Demonstratives of Patent Owner Greenthread, LLC

Monolithic Power Systems, Inc. v. Greenthread, LLC

IPR2024-00468 (8,421,195)
IPR2024-00469 (9,190,502)
IPR2024-00470 (11,121,222)
IPR2024-00550 (10,510,842)
IPR2024-00551 (10,734,481)
IPR2024-00552 (11,121,222)
IPR2024-00553 (11,316,014)

PTAB Oral Hearing: September 10, 2025

PUBLIC VERSION

Overview of Issues

1. Petitioner has presented zero "actual evidence" that the Petitions are timely.
2. The Claims require "movement of carriers" from the "surface layer" or "active region."
3. The '195 and '502 Claims require "movement of minority carriers" from the "surface layer."
4. Kawagoe does not disclose "movement of [minority] carriers" from the "surface layer."
5. Onoda/Nishizawa does not disclose "movement of [minority] carriers" from the "surface layer."
6. Petitioner has the burden to identify electric fields that would "aid carrier movement."
7. Petitioner's expert confirmed that carriers in the "surface layer" are affected by numerous other fields and forces.
8. Petitioner's expert confirmed "movement of carriers" depends on the sum of all fields in the "surface layer."
9. Petitioner's expert did not analyze any of the fields or force magnitudes in the "surface layer."
10. Petitioner's prosecution-related arguments are incorrect.
11. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

Overview of Issues

1. **Petitioner has presented zero "actual evidence" that the Petitions are timely.**
2. The Claims require "movement of carriers" from the "surface layer" or "active region."
3. The '195 and '502 Claims require "movement of minority carriers" from the "surface layer."
4. Kawagoe does not disclose "movement of [minority] carriers" from the "surface layer."
5. Onoda/Nishizawa does not disclose "movement of [minority] carriers" from the "surface layer."
6. Petitioner has the burden to identify electric fields that would "aid carrier movement."
7. Petitioner's expert confirmed that carriers in the "surface layer" are affected by numerous other fields and forces.
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9. Petitioner's expert did not analyze any of the fields or force magnitudes in the "surface layer."
10. Petitioner's prosecution-related arguments are incorrect.
11. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

1. The Petitions Are Time-Barred

- Petitioner knew of its burden under *Worlds* (and some of the evidence against it) since February 2024.

Counsel,

Petitioner in the above-captioned matters has the burden of identifying all real parties in interest (RPIs) in the petitions and demonstrating that the petitions are not time barred. *Samsung Electronics Co. Ltd. v. Netlist Inc.*, IPR2022-00615, Paper 40 (Director Vidal Feb. 3, 2023) (quoting *Worlds Inc. v. Bungie, Inc.*, 903 F.3d 1237, 1242 Fed. Cir. 2018); 35 U.S.C. § 322(a). The petitions should be withdrawn because they do not to meet these requirements.

More than one year before the filing of these petitions, Intel and [redacted] were served with complaints alleging infringement of Greenthread's patents at issue. [redacted] was served with a complaint alleging infringement of the '195 patent more than one year ago. As the attached documents indicate, petitioner is a supplier to at least Intel and [redacted] Therefore, petitioner may be operating, in part, under Greenthread's licenses to Intel, [redacted] Accordingly, petitioner is in privity with at least one of Intel, [redacted] (or they are RPIs) and the petitions are time barred.

Ex. 2013 (Feb. 5, 2024) Email Correspondence

Feb. 3, 2024

IPR2024-{00468, 00469, 00470} Petitions

Feb. 5, 2024

Worlds Email Correspondence

Mar. 18, 2024

IPR2024-{00550, 00551, 00552, 00553} Petitions

1. The Petitions Are Time-Barred

- Petitioner <u>always</u> bears the burden of proving its Petitions are not time-barred.

> **[1, 2]** We largely concur with the burden framework used in *Atlanta Gas Light*. As explained below, we agree that the IPR petitioner bears the burden of persuasion to demonstrate that its petitions are not time-barred under § 315(b) based on a complaint served on a real party in interest more than a year earlier. We also agree that an IPR petitioner's initial identification of the real parties in interest should be accepted unless and until disputed by a patent owner. And although we disagree with treating this initial acceptance as a "rebuttable presumption" that formally shifts a burden of production to the patent owner, we agree 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.

Worlds Inc. v. Bungie, Inc., 903 F.3d 1237, 1242 (Fed. Cir. 2018)

1. The Petitions Are Time-Barred

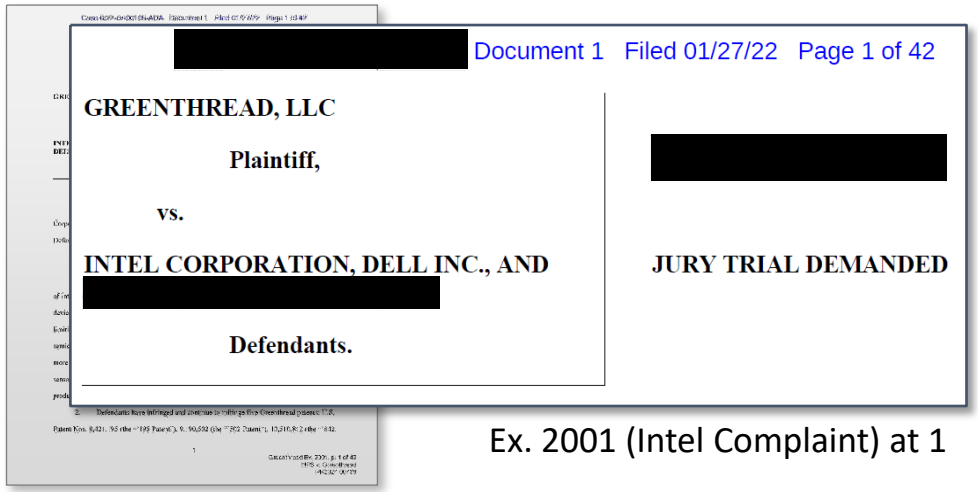
- *Worlds* makes clear that it is a low bar to dispute privity.

[7] The next question then becomes: what must a patent owner do to sufficiently raise the issue? In *Atlanta Gas Light*, the Board viewed the "presumption" created by the IPR petitioner's initial identification of the real parties in interest as shifting the burden of production to the patent owner. From this, the Board explained that, where "a patent owner provides *sufficient rebuttal evidence that reasonably brings into question the accuracy of a petitioner's identification of the real parties in interest*, the burden remains with the petitioner to establish that it has complied with the statutory requirement to identify all the real parties in interest." *Atlanta Gas Light*, Paper 88 at 8 (emphasis added). As explained above, we disagree with the use of a presumption in this context. We agree, however, that a patent owner must produce *some* evidence that tends to show that a particular third party should be named a real party in interest.[8] A mere assertion that a third party is an unnamed real party in interest, without any support for that assertion, is insufficient to put the issue into dispute.

Worlds Inc. v. Bungie, Inc., 903 F.3d 1237, 1244 (Fed. Cir. 2018)

1. The Petitions Are Time-Barred

- These Petitions were filed more than one year after the Intel [redacted] complaints.


[redacted] Document 1 Filed 01/27/22 Page 1 of 42

GREENTHREAD, LLC

Plaintiff,

vs.

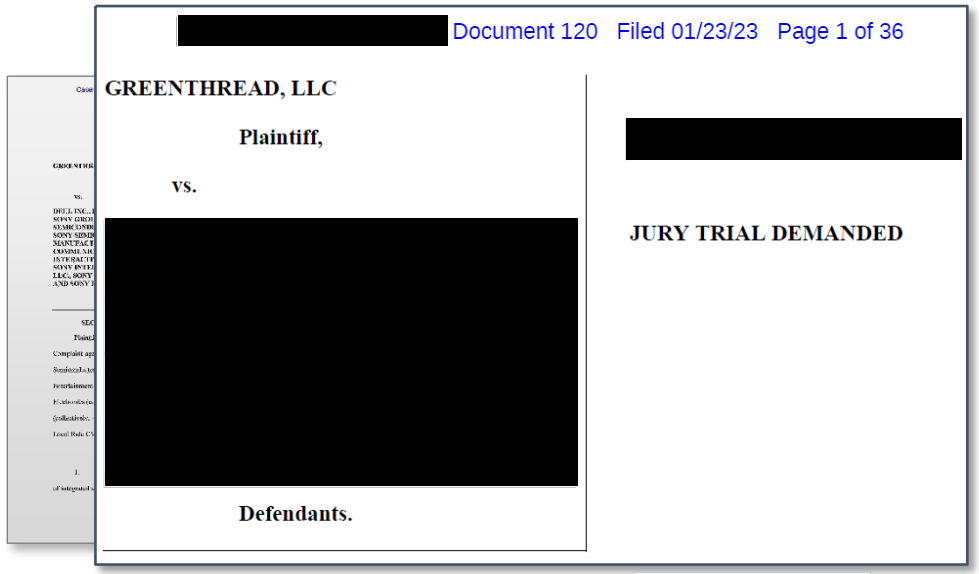
INTEL CORPORATION, DELL INC., AND [redacted]

Defendants.

[redacted]

JURY TRIAL DEMANDED

Ex. 2001 (Intel Complaint) at 1


[redacted] Document 120 Filed 01/23/23 Page 1 of 36

GREENTHREAD, LLC

Plaintiff,

vs.

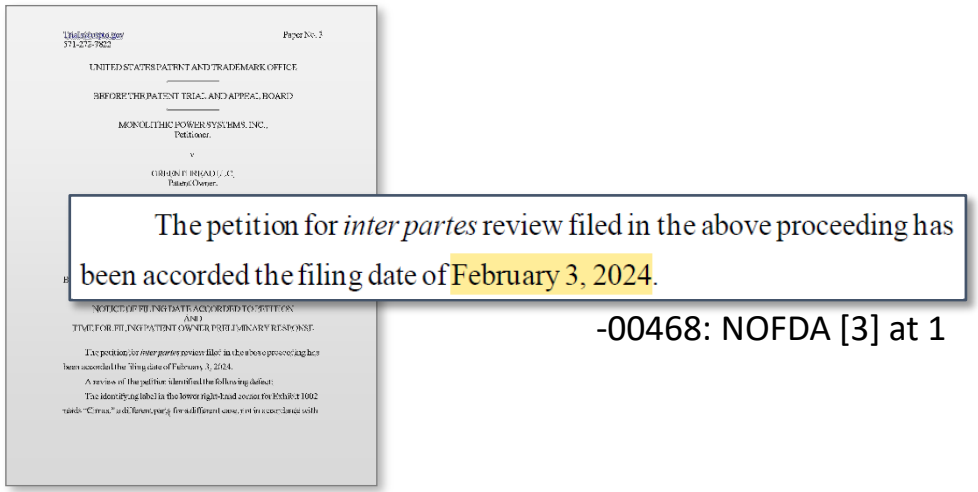
[redacted]

Defendants.

[redacted]

JURY TRIAL DEMANDED

Ex. 2009 ([redacted]) at 1


Paper No. 3

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MONOLITHIC POWER SYSTEMS, INC.,
Petitioner,

v.

GREENTHREAD, LLC,
Patent Owner.

NOTICE OF FILING DATE ACCORDED TO PETITION AND TIME FOR FILING PATENT OWNER PRELIMINARY RESPONSE

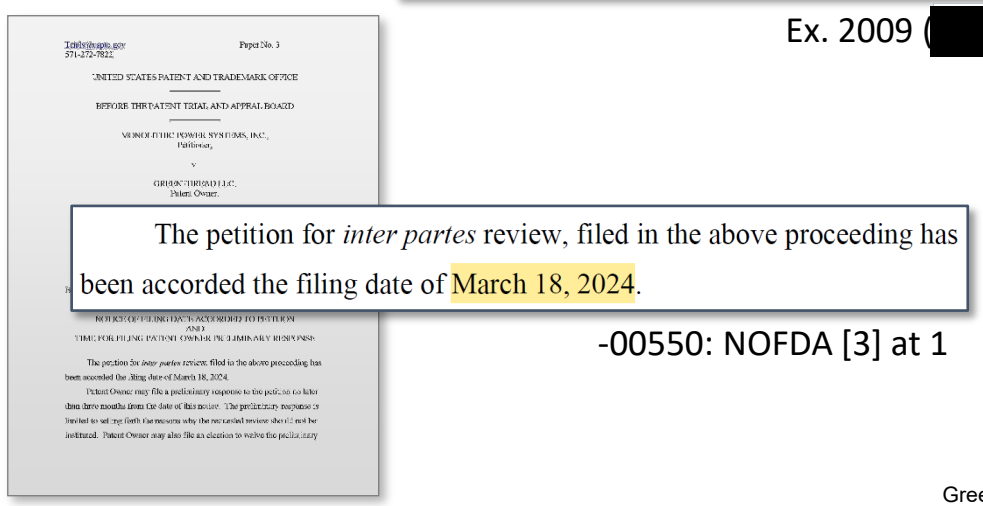
The petition for *inter partes* review filed in the above proceeding has been accorded the filing date of February 3, 2024.

A review of the petition identified the following defect:

The identifying label in the lower right-hand corner for Exhibit 1002 reads "Citrix," a different party for a different case, not in accordance with

The petition for *inter partes* review filed in the above proceeding has been accorded the filing date of February 3, 2024.

-00468: NOFDA [3] at 1


Paper No. 3

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MONOLITHIC POWER SYSTEMS, INC.,
Petitioner,

v.

GREENTHREAD LLC,
Patent Owner.

NOTICE OF FILING DATE ACCORDED TO PETITION AND TIME FOR FILING PATENT OWNER PRELIMINARY RESPONSE

The petition for *inter partes* review, filed in the above proceeding has been accorded the filing date of March 18, 2024.

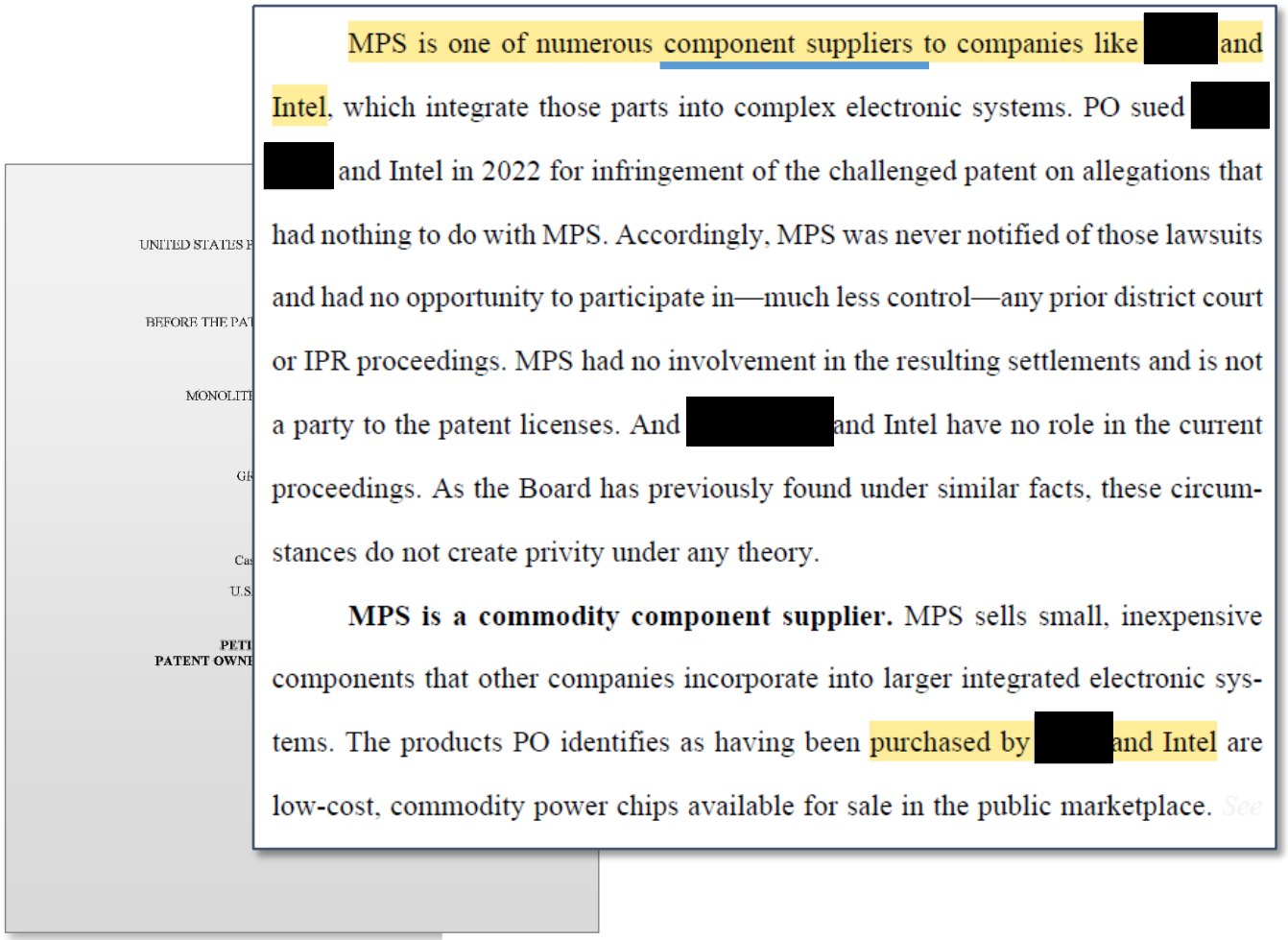
Patent Owner may file a preliminary response to the petition no later than three months from the date of this notice. The preliminary response is limited to setting forth the reasons why the requested review should not be instituted. Patent Owner may also file an election to waive the preliminary

The petition for *inter partes* review, filed in the above proceeding has been accorded the filing date of March 18, 2024.

-00550: NOFDA [3] at 1

1. The Petitions Are Time-Barred

- Petitioner admits it supplies components to Intel and [redacted].



MPS is one of numerous component suppliers to companies like [redacted] and Intel, which integrate those parts into complex electronic systems. PO sued [redacted] and Intel in 2022 for infringement of the challenged patent on allegations that had nothing to do with MPS. Accordingly, MPS was never notified of those lawsuits and had no opportunity to participate in—much less control—any prior district court or IPR proceedings. MPS had no involvement in the resulting settlements and is not a party to the patent licenses. And [redacted] and Intel have no role in the current proceedings. As the Board has previously found under similar facts, these circumstances do not create privity under any theory.

MPS is a commodity component supplier. MPS sells small, inexpensive components that other companies incorporate into larger integrated electronic systems. The products PO identifies as having been purchased by [redacted] and Intel are low-cost, commodity power chips available for sale in the public marketplace. *See*

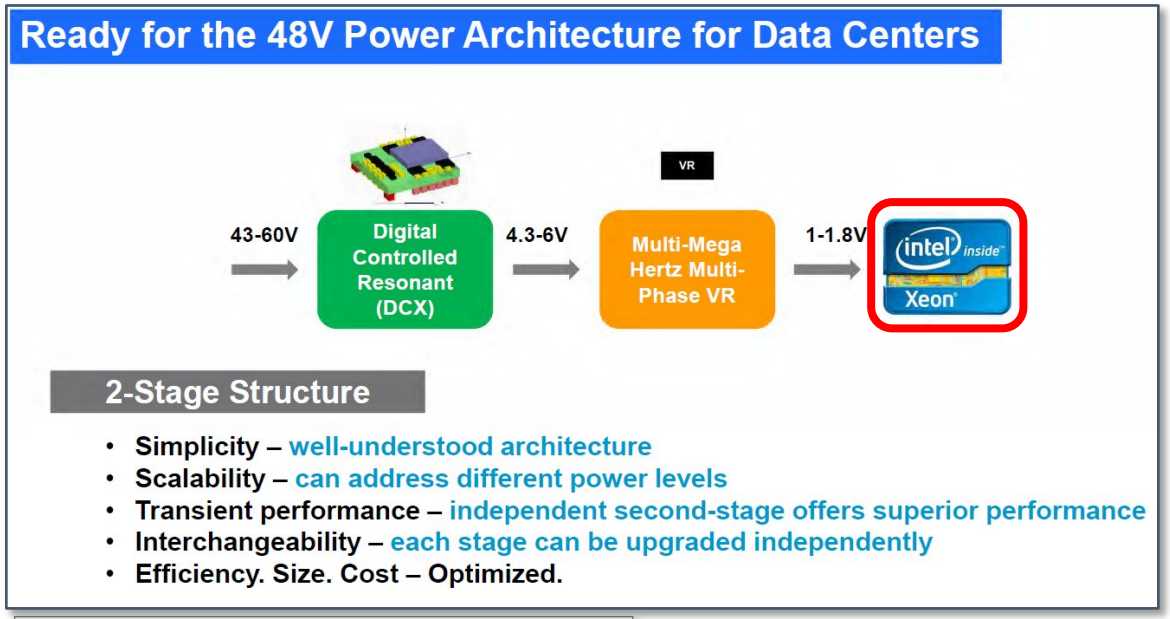
MPS's sales to [redacted] and Intel do not give rise to privity. The Federal Circuit and the Board have consistently found that the type of supplier-customer relationship here does not create the type of "substantive legal relationship" that establishes privity. *WesternGeco LLC v. ION Geophysical Corp.*, 889 F.3d 1308, 1321–22 (Fed. Cir. 2018); *see Wi-Fi One, LLC v. Broadcom Corp.*, 887 F.3d 1329, 1340–41 (Fed. Cir. 2018); *Samsung Elecs. Co. v. Netlist*, Inc., IPR2022-00615, Paper 62 at 14–15 (PTAB June 30, 2023). MPS sells commodity chips to [redacted] and Intel. This is nothing like PO's cited supplier-customer cases, POPR at 26–27, which involved indemnification relationships, exclusive supply arrangements, and the petitioners' prior assertions of RPI status in other proceedings. *See Ventex Co., Ltd. v. Columbia*

-00550: Pet. Prelim. Reply [17] at 5-7

-00550: PO Resp. [32] at 47, 53; PO Sur-Reply [45] at 4-5, 8-9

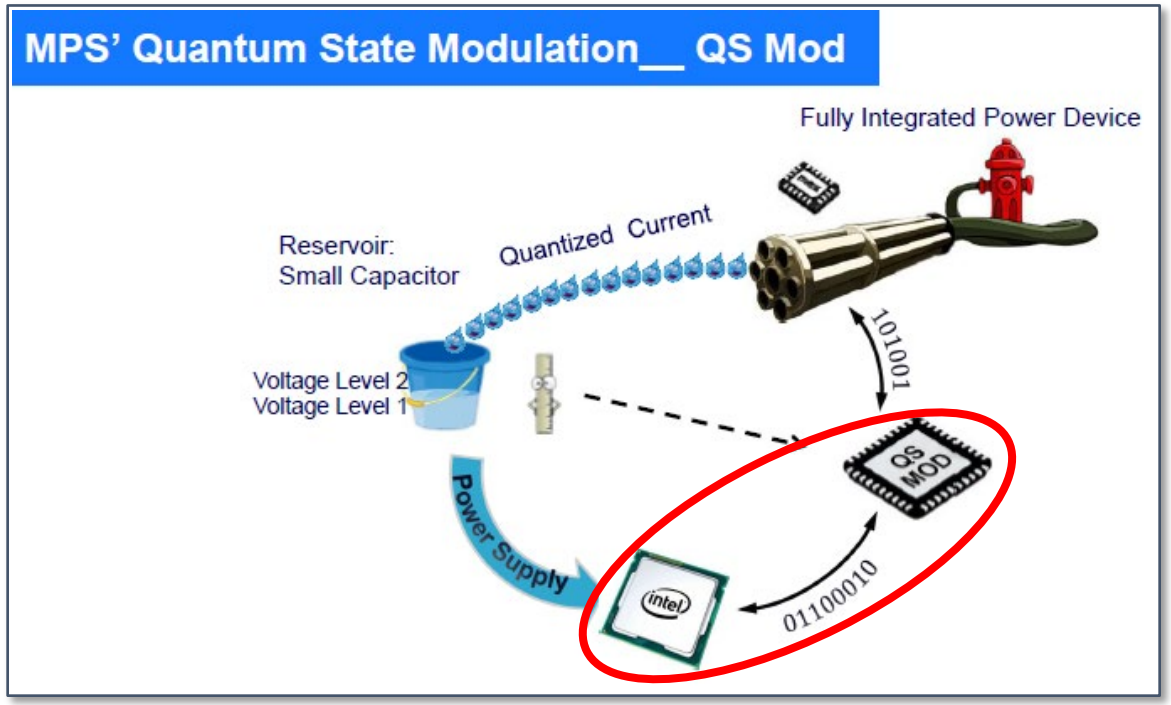
1. The Petitions Are Time-Barred

- PO has "presented more than enough evidence to sufficiently put this issue into dispute."



Ex. 2017 at 18





Ex. 2017 at 9

- **MPS First Server Core Power Solution Successfully Powered Intel Grantley Platform in June 2014.**

Ex. 2017 (MPS Presentation) at 5

1. The Petitions Are Time-Barred

- PO has "presented more than enough evidence to sufficiently put this issue into dispute."



Quinn Bolton -- *Needham & Company, LLC – Analyst*

Kevin Garrigan -- *Rosenblatt Securities Inc. – Analyst*

Genevieve Cunningham:

Welcome everyone to the MPS second quarter 2021 earnings webinar. Please note that this webinar is being recorded and will be archived for one year on our investor relations page at www.monolithicpower.com. My name is Genevieve Cunningham and I will be the moderator for this webinar. Joining me today are Michael Hsing, CEO and founder of MPS and Bernie Blegen, VP and CFO. During this webinar, we will discuss our Q2 2021 financial results and guidance for Q3 2021 followed by Q&A session. Analysts, you are currently muted. If you wish to ask a question during the Q&A session, please click on the participants icon on the menu bar and then click the raise hand button.

In the course of today's webinar, we will make forward-looking statements and projections that involve risk and uncertainty, which could cause results to differ materially from management's current views and expectations. Please refer to the safe harbor statement contained in the earnings release published today. Risks, uncertainties, and other factors that could cause actual results to differ are identified in the safe harbor statements contained in the Q2 earnings release and in our SEC filings, including our form 10K filed on March 1st, 2021, and our form 10Q filed on May 10th, 2021, which are accessible through our website, www.monolithicpower.com. MPS assumes no obligation to update the information provided on today's call.

We will be discussing gross margin, operating expense, R&D and SG&A expense, operating income interest and other income, net income and earnings on both a GAAP and a non-GAAP basis. These non-GAAP financial measures are not prepared in accordance with GAAP and should not be considered as a

MPS_EarningsCall_Q2_2021 (Completed 07/28/21)
Transcript by Rev.com

Page 1 of 13

Greenthread Ex 2018, p. 1 of 13
MPS v. Greenthread
IPR2024-00550

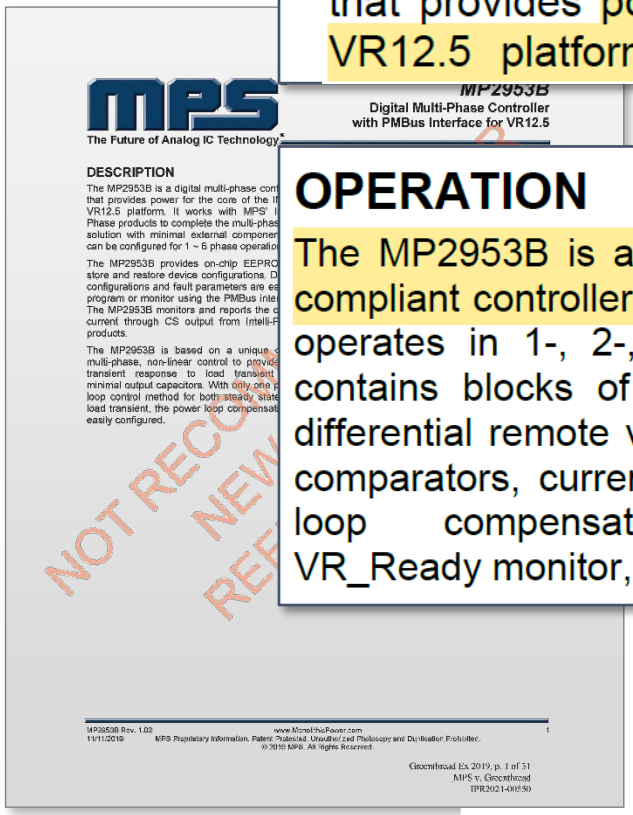
Bernie Blegen:

And then as far as server, we've been fairly consistent in articulating our strategy as far as being able to grow our market position with each succeeding next generation, particularly Intel and AMD products. Not limited to that though, but also in 48 volts and with GPUs. So it really expresses the point that we're ratcheting up in share gains within the Intel family, but also branching out into these other opportunities.

Ex. 2018 (MPS Q2 2021 Earnings Call) at 5

1. The Petitions Are Time-Barred

- PO has "presented more than enough evidence to sufficiently put this issue into dispute."


MP2953B
Digital Multi-Phase Controller
with PMBus Interface for VR12.5

The Future of Analog IC Technology

DESCRIPTION

DESCRIPTION

The MP2953B is a digital multi-phase controller that provides power for the core of the INTEL VR12.5 platform. It works with MPS' Intelli-

FEATURES

- 6-Phase Digital PWM Controller
- Intel's VR12.5 Compliant
- PMBus Compliant

OPERATION

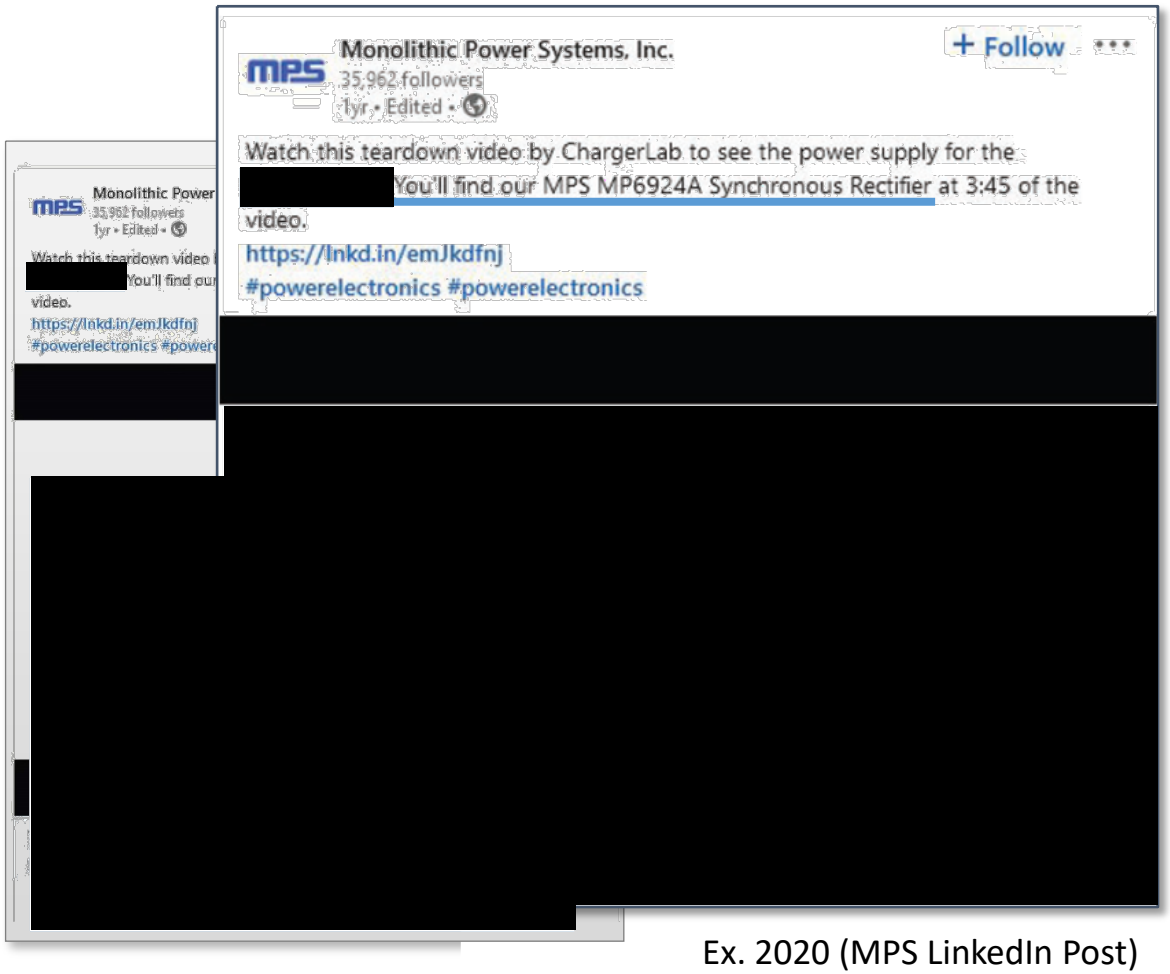
The MP2953B is a digital multi-phase VR12.5 compliant controller for Intel microprocessors. It operates in 1-, 2-, 3-, 4-, 5-, or 6-phase. It contains blocks of precision DAC and ADC, differential remote voltage sense amplifier, fast comparators, current sense amplifiers, internal loop compensation, load-line setting, VR_Ready monitor, temperature monitor, PMBus interface, SVID interface, and EEPROM for custom configuration.

Fault protection features include under-voltage lockout (Vin-UVLO), over-current protection (OCP), over-voltage protection (OVP), under-voltage protection (UVP), over-temperature protection (OTP), and reverse-voltage protection (RVP).

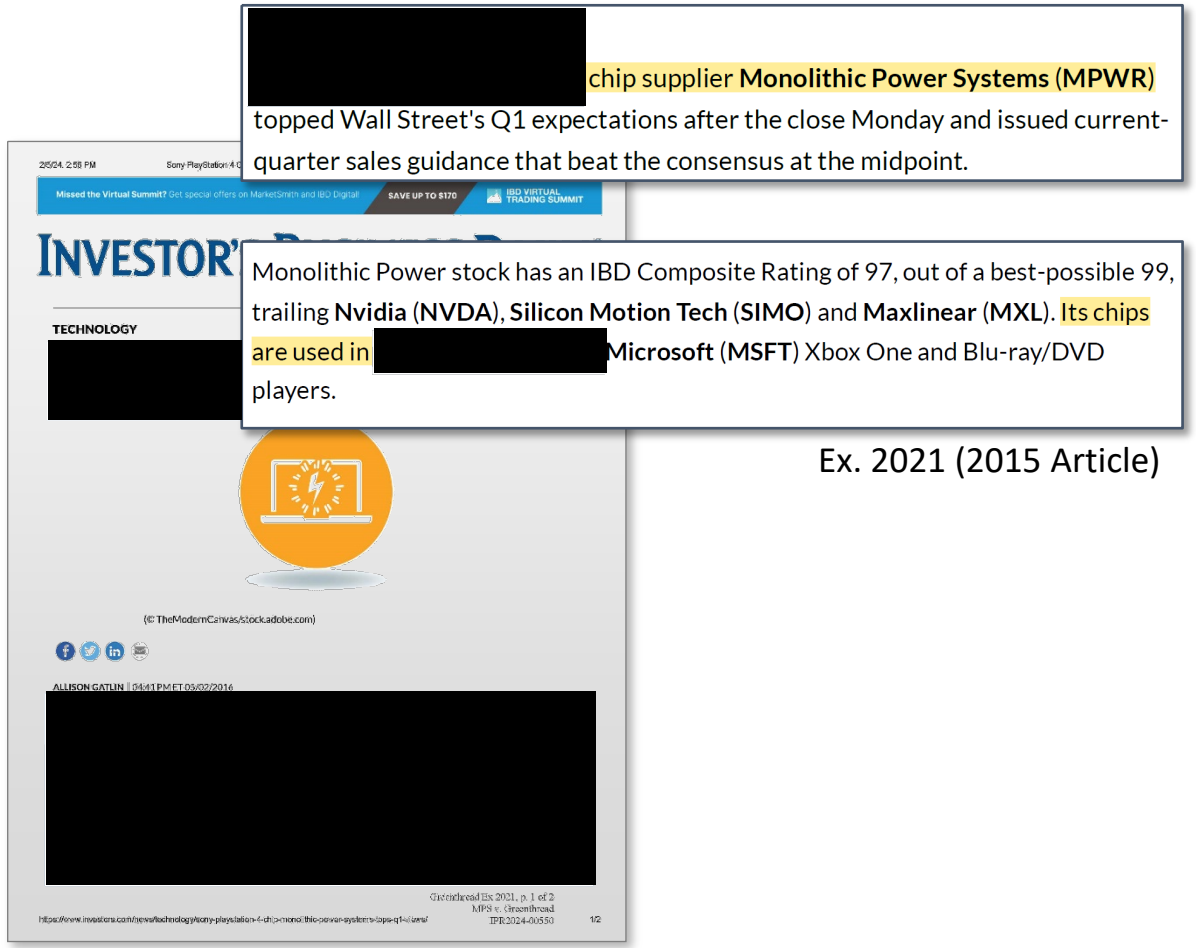
Ex. 2019 (MPS Controller Data Sheet) at 1, 14

1. The Petitions Are Time-Barred

- PO has "presented more than enough evidence to sufficiently put this issue into dispute."



Ex. 2020 (MPS LinkedIn Post)



Ex. 2021 (2015 Article)

1. The Petitions Are Time-Barred

- PO has "presented more than enough evidence to sufficiently put this issue into dispute."



Customers, Sales and Marketing

We have sales offices in China, India, Japan, Singapore, South Korea, Taiwan, the United States and throughout Europe. Our products typically require a highly technical sales and applications engineering effort where we assist our customers in the design and use of our products in their application. We maintain a staff of applications engineers who work directly with our customers' engineers in the development of their systems' electronics containing our products.

ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934

For the fiscal year ended December 31, 2023

Commission file number: 000-51026

Monolithic Power Systems, Inc.

Delaware — 77-0466759

5808 Lake Washington Blvd. NE, Kirkland, Washington 98033

(425) 296 5956

Common Stock, par value $0.001 per share. — MPWR — The NASDAQ Global Select

Securities registered pursuant to Section 12(g) of the Act: None

Greenthread Ex. 2022, p. 1 of 79
MPS v. Greenthread
IPR2024-00550

Ex. 2022 (MPS 2023 SEC 10-K) at 6

<u>Our products typically require a highly technical sales and applications engineering effort</u> where we assist our customers in the design and use of our products in their applications. We maintain a staff of **<u>applications engineers who work directly with customers' engineers</u>** in the development of their systems' electronics containing our products.

Greenthread Ex. 2088, p. 13 of 149
MPS v. Greenthread

1. The Petitions Are Time-Barred

- Petitioner was licensed to make components for Intel's and [redacted] products.

EXECUTION COPY

PATENT LICENSE AG

This PATENT LICENSE AGREEMENT (th
between Greenthread, LLC, a Texas limited liability c
at 7424 Mason Dells Drive, Dallas, TX 75230-324
Delaware corporation with a principal place of busines
San Francisco, CA 94111 ("RPX"), on the date when
Licensor and RPX (the "Effective Date"). Each of RPX
are referenced as the "Parties".

WHEREAS, Licensor is the sole and exclusive
United States and throughout the world, the Patents (as

WHEREAS, RPX desires to acquire from Lic
including the right to grant to RPX Licensees (as defi
and duration as the Patent License, provided that the p
as described herein are met;

WHEREAS, Licensor is willing to grant to RI
grant to RPX Licensees a sublicense of the same scope
that the preconditions to the granting of such rights as

NOW, THEREFORE, in consideration of the
RPX and Licensor agree as follows:

Definitions

As used herein, the following terms shall have

"Affiliate(s)" of an Entity shall mean any and a
long as the Control exists, that are Controlled, directly

"Agreement" shall have the meaning ascribed

"Bankruptcy Code" shall have the meaning asc

"Claims" shall mean any and all claims, counterclaims, third-part
claims, indemnity claims, demands, actions, liabilities, damages, losses, c
other claims of every kind and nature in law or equity, whether arisin
international or other law, which arise from or relate to in any way the
(currently or in the future) or were asserted in, could have been asserted
the same transactions or occurrences as those claims that are (currently o
asserted in any Licensor Litigations with respect to the Patents, whether s
or contingent, in tort, contract or otherwise, direct or indirect, presen
unknown.

"Combined Licensed Product and Service" shall mean any p
combination or use, whether by an RPX Licensee, an RPX Licensee Affil

PROTECTIVE ORDER MATERIAL/ATTORNEYS' EYES ONLY

Confidential Outside Attorneys Eyes Only - Produced Under Local Rule 26.2

(c) The sublicense (and release) granted in accordance with Section 1.2(a) and Section 4.3 to any Entity under the Patent License shall be deemed to be a further sublicense (and release) to that Entity's Affiliates ("RPX Licensee Affiliates"), and such RPX Licensees' and RPX Licensee Affiliates' direct and indirect customers, have-made vendors, developers, distributors, dealers, suppliers, manufacturers, original equipment manufacturers (OEMs), original design manufacturers (ODMs), system integrators, other contractors, licensees, and users (including end users) solely to the extent such third parties make, have made, use, purchase, provide, host, sell, lease, distribute, supply, export, import, offer for sale, or otherwise exploit or dispose of any Licensed Product and Service and/or Combined Licensed Product and Service (each, a "Covered Third Party"). Each RPX Licensee shall have the right, consistent with this Section 1.2(c), to grant specific non-sublicensable, non-assignable sublicenses to its Covered Third Parties with respect to such RPX Licensee's or its Affiliates' Licensed Products and Services and/or Combined Licensed Product and Service.

INITIAL LICENSEES

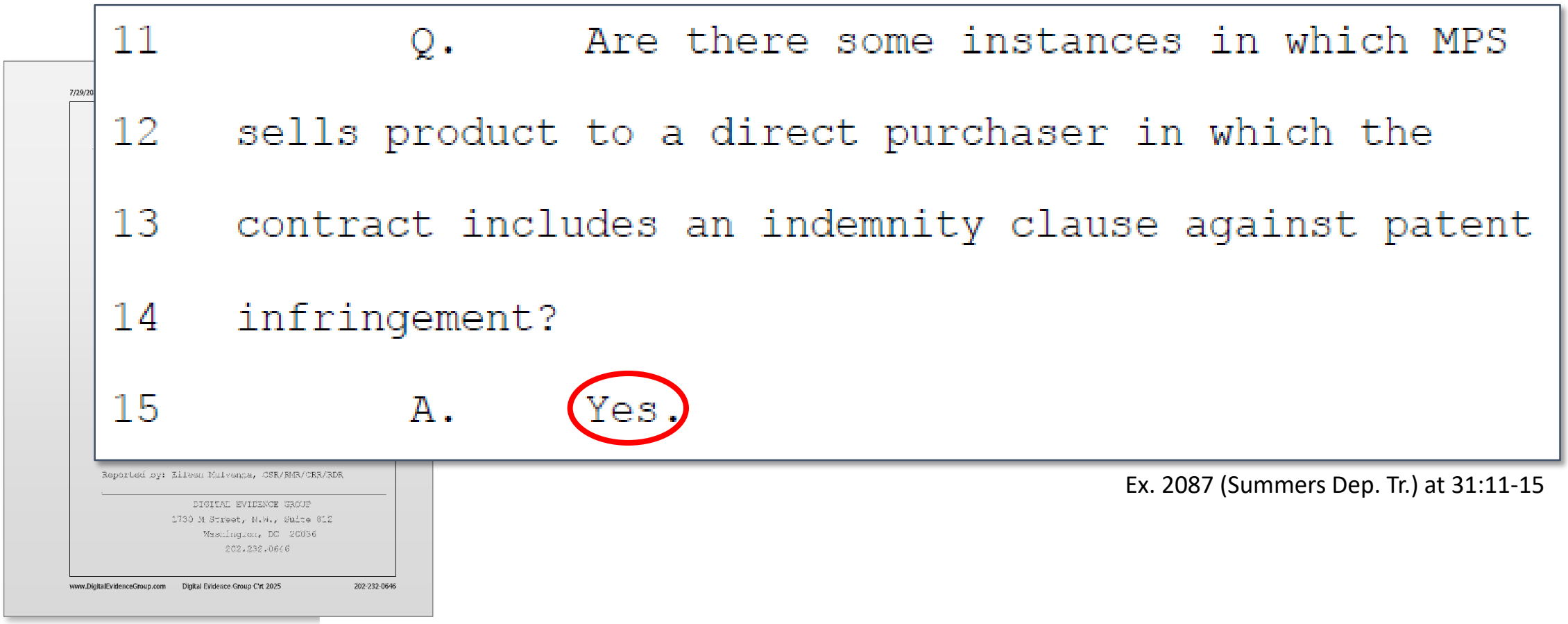
Intel Corporation

[redacted]

Ex. 2011 (Confidential Agreement) at 5, 16

1. The Petitions Are Time-Barred

- Ms. Summers confirmed that Petitioner's sales contracts sometimes include indemnification clauses.



11 Q. Are there some instances in which MPS
12 sells product to a direct purchaser in which the
13 contract includes an indemnity clause against patent
14 infringement?
15 A. Yes.

Reported by: Eileen Mulvenna, CSR/RMR/CRR/RDR
DIGITAL EVIDENCE GROUP
1730 M Street, N.W., Suite 812
Washington, DC 20036
202.232.0646
www.DigitalEvidenceGroup.com Digital Evidence Group C'rt 2025 202-232-0646

Ex. 2087 (Summers Dep. Tr.) at 31:11-15

1. The Petitions Are Time-Barred

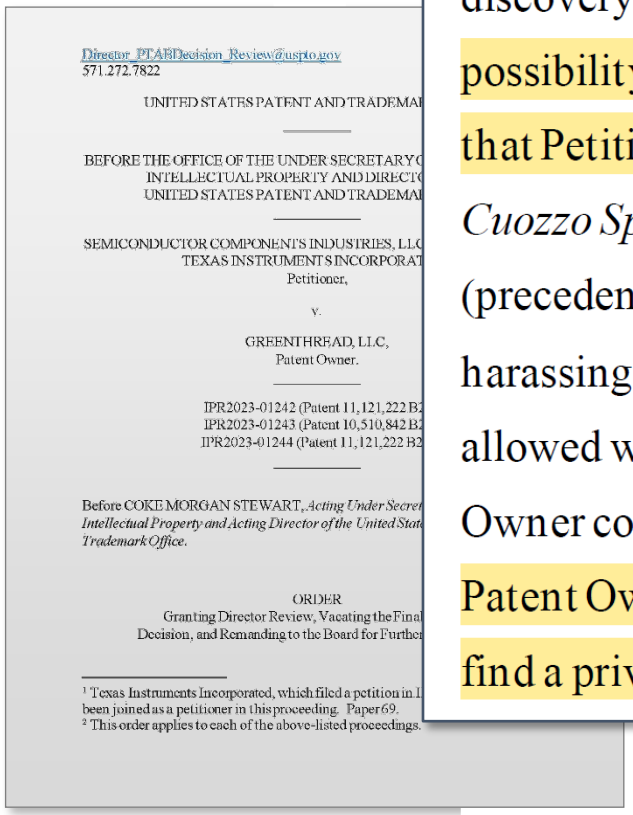
- Since PO produced "some evidence" to put the RPI issue "into dispute," the Board can "no longer merely rely upon" Petitioner's RPI assertions.

> [10] Under the framework we have outlined above, the Board was entitled to rely, at least initially, on Bungie's list of all real parties in interest, which raised no time-bar issues under the facts presented. Here, however, Worlds presented evidence sufficient to put Bungie's identification of itself as the sole real party in interest into dispute. Thus, in this circumstance, the Board could no longer merely rely upon Bungie's initial identification of the real parties in interest. Instead, the Board was required to make any factual determinations necessary to evaluate whether Bungie had satisfied its burden to demonstrate that its petition was not time-barred based on the complaints served upon Activision, the alleged real party in interest.

Worlds Inc. v. Bungie, Inc., 903 F.3d 1237, 1245-46 (Fed. Cir. 2018)

1. The Petitions Are Time-Barred

- Director Stewart ordered discovery that would "yield useful information on the privity issue."


Director_PTABDecision_Review@uspto.gov
571.272.7822

UNITED STATES PATENT AND TRADEMAR

BEFORE THE OFFICE OF THE UNDER SECRETARY
INTELLECTUAL PROPERTY AND DIRECT
UNITED STATES PATENT AND TRADEMAR

SEMICONDUCTOR COMPONENTS INDUSTRIES, LL
TEXAS INSTRUMENTS INCORPORAT
Petitioner,

v.

GREENTHREAD, LLC,
Patent Owner.

IPR2023-01242 (Patent 11,121,222 B2
IPR2023-01243 (Patent 10,510,842 B2
IPR2023-01244 (Patent 11,121,222 B2

Before COKE MORGAN STEWART, *Acting Under Secret*
Intellectual Property and Acting Director of the United Stat
Trademark Office.

ORDER
Granting Director Review, Vacating the Final
Decision, and Remanding to the Board for Further

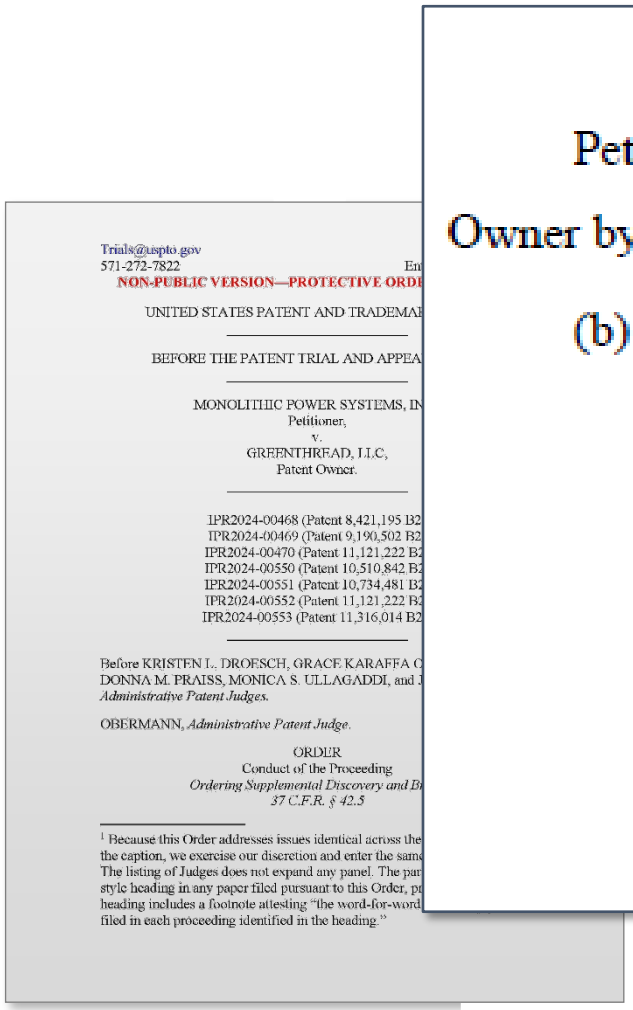
[1] Texas Instruments Incorporated, which filed a petition in I
been joined as a petitioner in this proceeding. Paper 69.
[2] This order applies to each of the above-listed proceedings.

I agree with Patent Owner that the Board abused its discretion in denying the discovery motions. In the motions, Patent Owner raised more than a mere possibility that discovery would yield useful information on the privity issue given that Petitioner was a supplier of a time-barred party, Intel. *Garmin Int'l, Inc. v. Cuozzo Speed Techs. LLC*, IPR2012-00001, Paper 26 at 6 (PTAB Mar. 5, 2013) (precedential). While Patent Owner's requested discovery was broad, it was not harassing or abusive. Under these circumstances, the Board either should have allowed whatever narrower discovery was appropriate or made it clear that Patent Owner could amend or resubmit its discovery motions. Instead, the Board denied Patent Owner's motions and then cited the absence of evidence as a basis not to find a privity relationship.

IPR2023-01242, 43, 44: Director Review Decision [94] at 3

1. The Petitions Are Time-Barred

- The Board ordered Petitioner produce documents "sufficient" to disprove Intel's RPI status.


Trials@uspto.gov
571-272-7822
NON-PUBLIC VERSION—PROTECTIVE ORDE
UNITED STATES PATENT AND TRADEMA
BEFORE THE PATENT TRIAL AND APPEA
MONOLITHIC POWER SYSTEMS, IN
Petitioner,
v.
GREENTHREAD, LLC,
Patent Owner.
IPR2024-00468 (Patent 8,421,195 B2
IPR2024-00469 (Patent 9,190,502 B2
IPR2024-00470 (Patent 11,121,222 B2
IPR2024-00550 (Patent 10,510,842 B2
IPR2024-00551 (Patent 10,734,481 B2
IPR2024-00552 (Patent 11,121,222 B2
IPR2024-00553 (Patent 11,316,014 B2
Before KRISTEN L. DROESCH, GRACE KARAFFA C
DONNA M. PRAISS, MONICA S. ULLAGADDI, and
Administrative Patent Judges.
OBERMANN, *Administrative Patent Judge.*
ORDER
Conduct of the Proceeding
Ordering Supplemental Discovery and B
37 C.F.R. § 42.5
[1] Because this Order addresses issues identical across the
the caption, we exercise our discretion and enter the same
The listing of Judges does not expand any panel. The par
style heading in any paper filed pursuant to this Order, p
heading includes a footnote attesting "the word-for-word
filed in each proceeding identified in the heading."

1. Scope and Timing of Supplemental Discovery

Petitioner is instructed to provide the following discovery to Patent Owner by July 11, 2025:

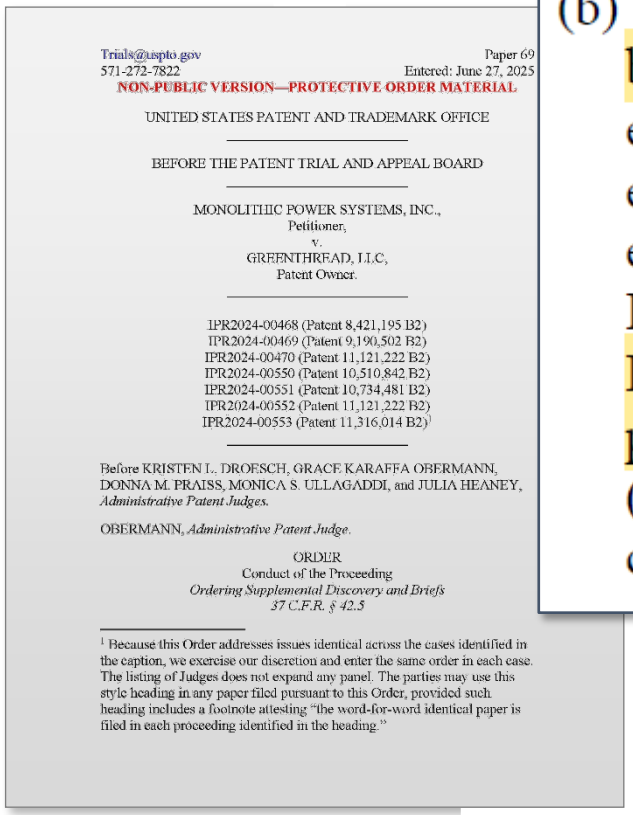
(b) Documents sufficient to show the asserted privity relationship between Petitioner and Intel, including any new declaration(s) that establish that no documents responsive to Subsection (a) above exist, as well as any documents and new declaration(s) that establish (1) the time by which Petitioner became aware of the Intel litigation referenced in the Director's Decision; (2) whether Petitioner was the supplier of any product, or component of a product, accused of infringement in the Intel litigation; and (3) whether Petitioner was in a position to control, or actually controlled, Intel's defense of that litigation.

-00468: Disc. Order [69] at 6-7

-00550: PO Supp. Brief [63] at 3-4, 13; PO Supp. Reply [67] at 12

1. The Petitions Are Time-Barred

- The Board ordered Petitioner to investigate whether it was a **supplier** of any **component** of an IAP.



Trials@uspto.gov
571-272-7822

Paper 69
Entered: June 27, 2025

NON-PUBLIC VERSION—PROTECTIVE ORDER MATERIAL

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MONOLITHIC POWER SYSTEMS, INC.,
Petitioner,
v.
GREENTHREAD, LLC,
Patent Owner.

IPR2024-00468 (Patent 8,421,195 B2)
IPR2024-00469 (Patent 9,190,502 B2)
IPR2024-00470 (Patent 11,121,222 B2)
IPR2024-00550 (Patent 10,510,842 B2)
IPR2024-00551 (Patent 10,734,481 B2)
IPR2024-00552 (Patent 11,121,222 B2)
IPR2024-00553 (Patent 11,316,014 B2)[1]

Before KRISTEN L. DROESCH, GRACE KARAFFA OBERMANN, DONNA M. PRAISS, MONICA S. ULLAGADDI, and JULIA HEANEY, *Administrative Patent Judges.*

OBERMANN, *Administrative Patent Judge.*

ORDER
Conduct of the Proceeding
Ordering Supplemental Discovery and Briefs
37 C.F.R. § 42.5

[1] Because this Order addresses issues identical across the cases identified in the caption, we exercise our discretion and enter the same order in each case. The listing of Judges does not expand any panel. The parties may use this style heading in any paper filed pursuant to this Order, provided such heading includes a footnote attesting "the word-for-word identical paper is filed in each proceeding identified in the heading."

(b) Documents sufficient to show the asserted privity relationship between Petitioner and Intel, including any new declaration(s) that establish that no documents responsive to Subsection (a) above exist, as well as any documents and new declaration(s) that establish (1) the time by which Petitioner became aware of the Intel litigation referenced in the Director's Decision; (2) whether Petitioner was the supplier of any product, or component of a product, accused of infringement in the Intel litigation; and (3) whether Petitioner was in a position to control, or actually controlled, Intel's defense of that litigation.

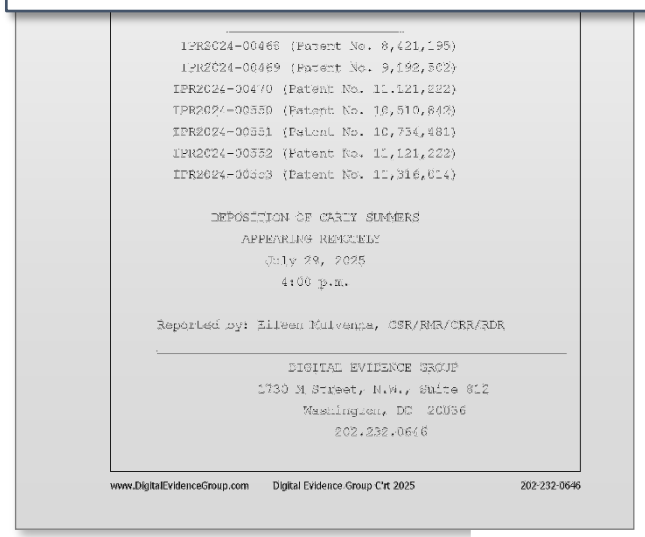
-00468: Disc. Order [69] at 7

-00550: PO Supp. Brief [63] at 3-4, 6-10; PO Supp. Reply [67] at 6-9

1. The Petitions Are Time-Barred

- Ms. Summers did not investigate whether Petitioner was a **supplier** of any **component** of an IAP.

4 Q. And as part of preparing this
5 declaration, did you conduct an investigation so
6 that you could provide responses in this
7 declaration?
8 A. Yes.


IPR2024-00468 (Patent No. 8,421,195)
IPR2024-00469 (Patent No. 9,192,302)
IPR2024-00470 (Patent No. 11,121,222)
IPR2024-00550 (Patent No. 10,510,642)
IPR2024-00551 (Patent No. 10,734,481)
IPR2024-00552 (Patent No. 11,121,222)
IPR2024-00553 (Patent No. 11,316,014)

DEPOSITION OF CASEY SUMMERS
APPEARING REMOTELY
July 29, 2025
4:00 p.m.

Reported by: Eileen Mulvenna, CSR/RMR/CRR/RDR

DIGITAL EVIDENCE GROUP
1730 M Street, N.W., Suite 812
Washington, DC 20036
202.232.0646

www.DigitalEvidenceGroup.com Digital Evidence Group C'rt 2025 202-232-0646

9 Q. And what did you do as part of that
10 investigation?
11 A. So as part of that investigation,
12 there were two areas of inquiry that the PTAB
13 requested. One was to search for certain types of
14 agreements. The other was to confirm when we had
15 knowledge -- both me as well as the company had
16 knowledge of the under- -- prior Intel lawsuit. So
17 I undertook those -- those two investigations.

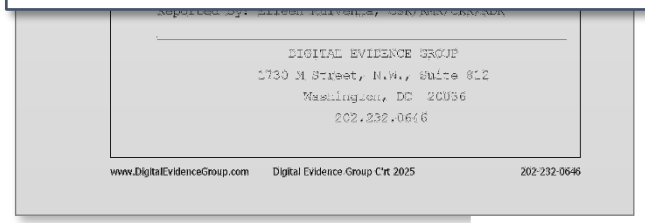
-00468: Ex. 2087 (Summers Dep. Tr.) at 12:4-17

-00550: PO Supp. Brief [63] at 5

1. The Petitions Are Time-Barred

- Ms. Summers did not investigate whether Petitioner was a **supplier** of any **component** of an IAP.

18 Q. About how long did you spend searching
19 for agreements between Monolithic Power Systems and
20 Intel?
21 A. Maybe -- probably, I would say, about
22 an hour and a half.
1 Q. How long did you spend investigating
2 Monolithic Power Systems' knowledge of the Intel
3 litigation?
4 A. Around the same. So I spent about
5 half of a day total.



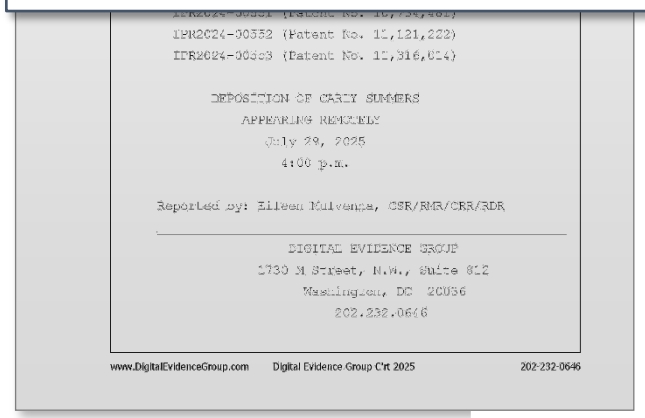
6 Q. And did you spend time reviewing the
7 products listed in Exhibit 2005 as part of your
8 investigation?
9 A. Yes.
10 Q. About how long did you spend
11 investigating the products listed in Exhibit 2005?
12 A. I reviewed the list, as requested by
13 the PTAB.
14 Q. And how long did you spend in that
15 process?
16 A. Maybe 20 minutes, 30 minutes.

-00468: Ex. 2087 (Summers Dep. Tr.) at 12:18-13:16

1. The Petitions Are Time-Barred

- Ms. Summers only investigated direct sales of the IAPs to Intel.

20 Q. What did you do to confirm your
21 statement that petitioner did not sell to Intel or
22 supply Intel with any of the Intel accused products?
1 A. I guess the main confirmation of that
2 statement was to confirm that I did not have record
3 of any sales agreements with Intel for those
4 products.


IPR2024-00352 (Patent No. 11,121,222)
IPR2024-00353 (Patent No. 11,316,814)

DEPOSITION OF CASEY SUMMERS
APPEARING REMOTELY
July 29, 2025
4:00 p.m.

Reported by: Eileen Mulvenna, CSR/RMR/CRR/RDR

DIGITAL EVIDENCE GROUP
1730 M Street, N.W., Suite 812
Washington, DC 20036
202.232.0646

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-00468: Ex. 2087 (Summers Dep. Tr.) at 15:20-16:4

15 Q. And what did you do to confirm that
16 there were no direct sales between MPS and Intel?
17 A. Again, I checked our records to
18 confirm whether I had sales agreements in place with
19 Intel, to confirm whether they were a direct
20 customer, and found none.

-00468: Ex. 2087 at 16:15-20

15 Q. Did you do any further investigation
16 beyond examining whether there were any sales
17 agreements between MPS and Intel?
18 A. No.

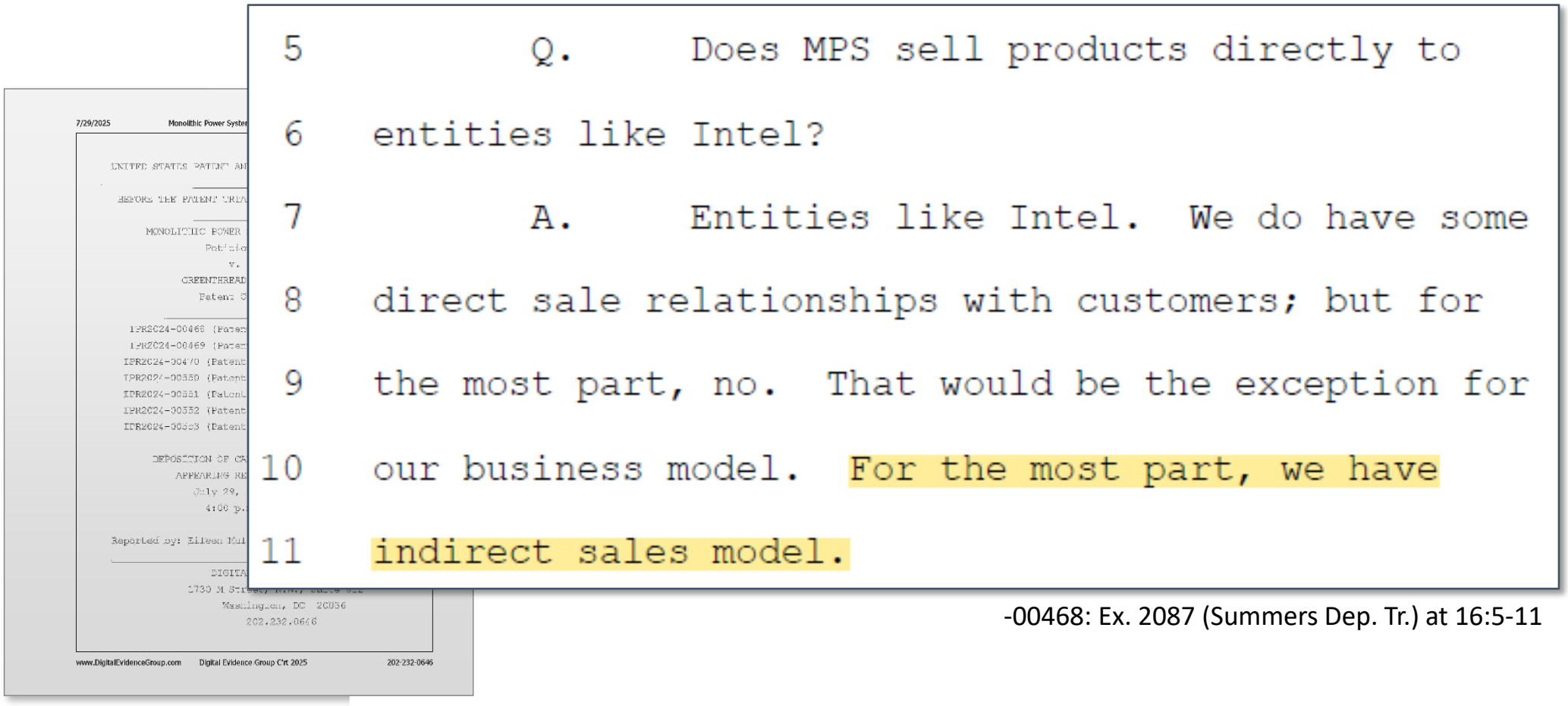
-00468: Ex. 2087 at 18:15-18

-00550: PO Supp. Brief [63] at 5-7; PO Supp. Reply [67] at 7-8

PUBLIC VERSION
DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

1. The Petitions Are Time-Barred

- Ms. Summers did not investigate “indirect sales” to Intel.



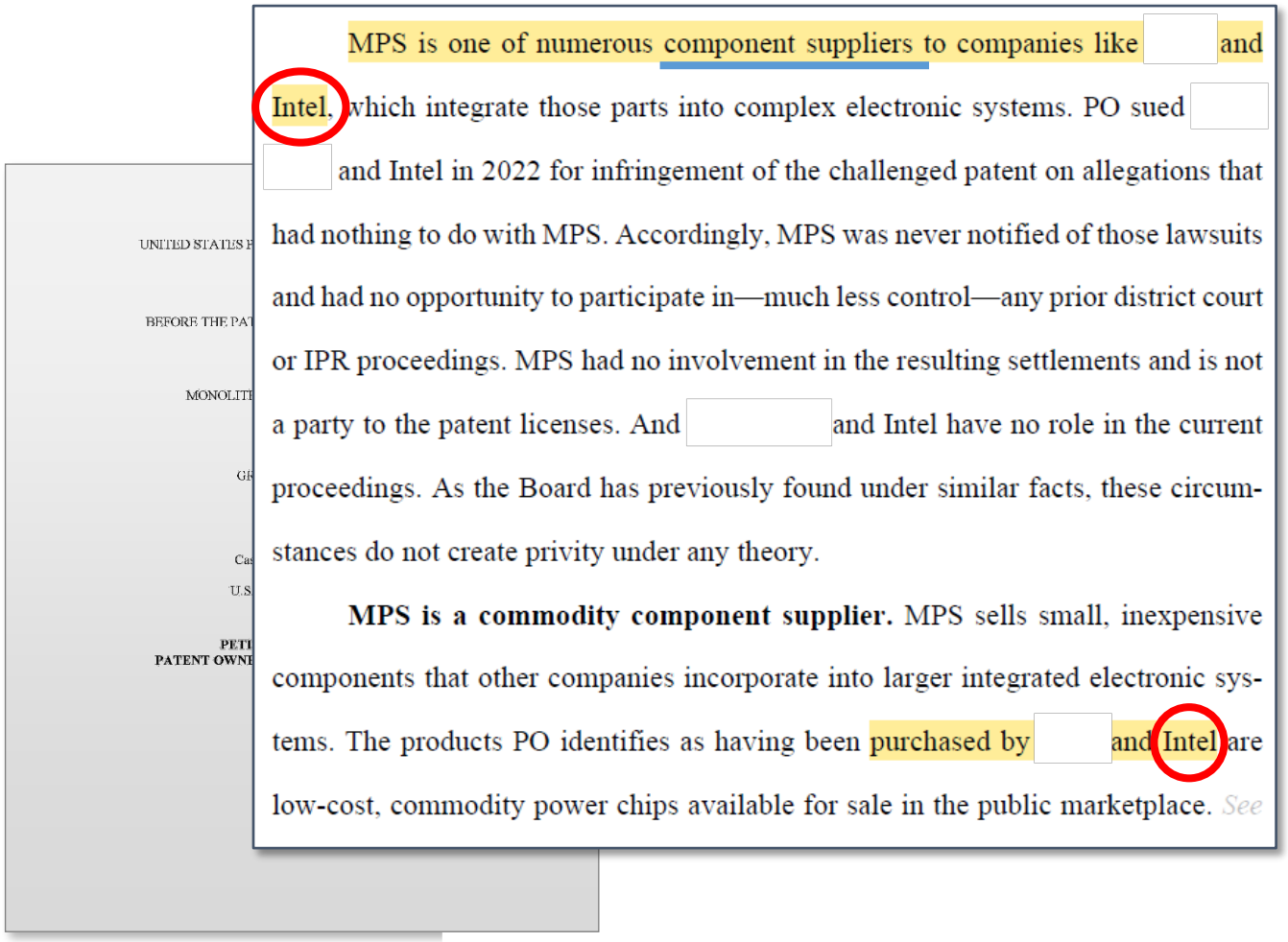
5 Q. Does MPS sell products directly to
6 entities like Intel?
7 A. Entities like Intel. We do have some
8 direct sale relationships with customers; but for
9 the most part, no. That would be the exception for
10 our business model. For the most part, we have
11 indirect sales model.

-00468: Ex. 2087 (Summers Dep. Tr.) at 16:5-11

-00550: PO Supp. Brief [63] at 7

1. The Petitions Are Time-Barred

- Petitioner admits it supplies chips and other components to Intel.



MPS is one of numerous component suppliers to companies like [redacted] and Intel, which integrate those parts into complex electronic systems. PO sued [redacted] and Intel in 2022 for infringement of the challenged patent on allegations that had nothing to do with MPS. Accordingly, MPS was never notified of those lawsuits and had no opportunity to participate in—much less control—any prior district court or IPR proceedings. MPS had no involvement in the resulting settlements and is not a party to the patent licenses. And [redacted] and Intel have no role in the current proceedings. As the Board has previously found under similar facts, these circumstances do not create privity under any theory.

MPS is a commodity component supplier. MPS sells small, inexpensive components that other companies incorporate into larger integrated electronic systems. The products PO identifies as having been purchased by [redacted] and Intel are low-cost, commodity power chips available for sale in the public marketplace. *See*

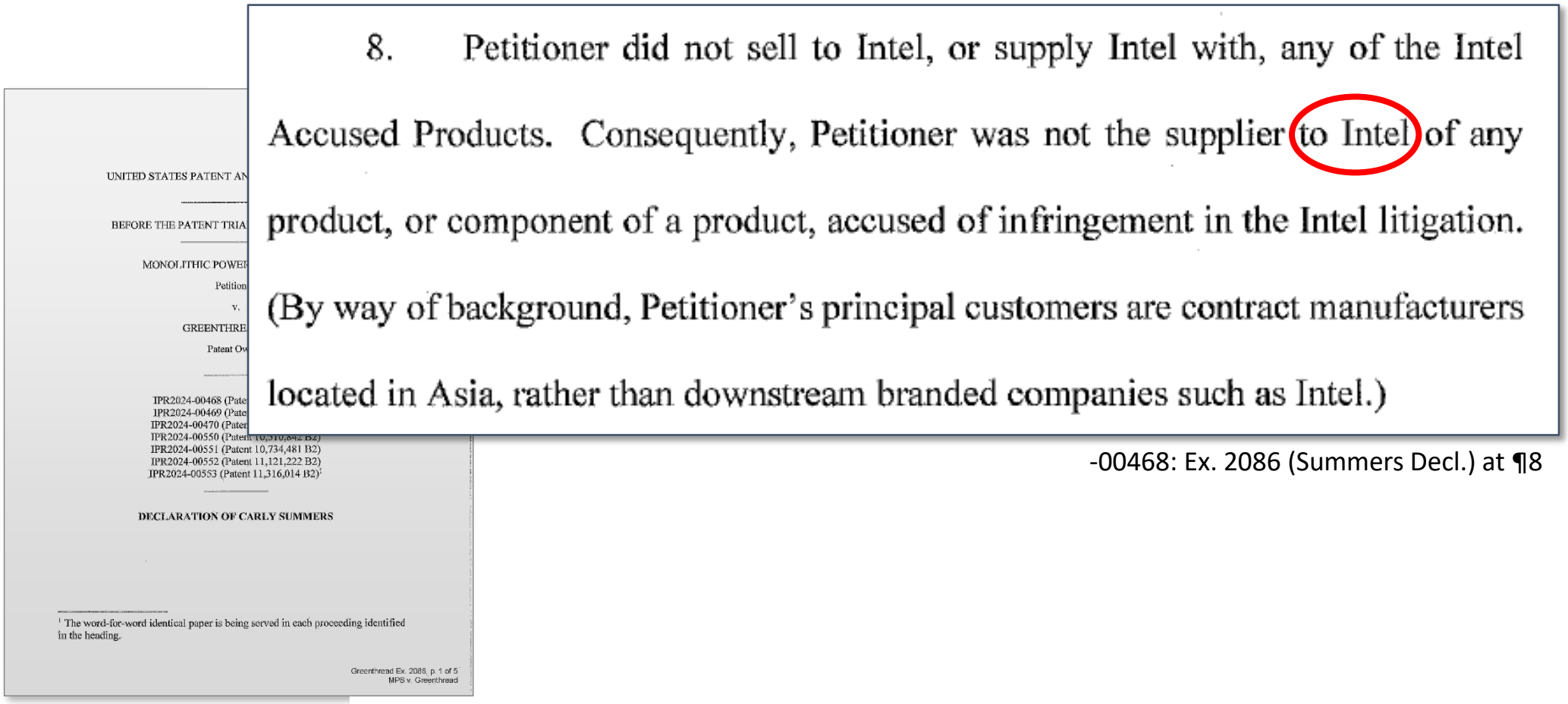
MPS's sales to [redacted] and Intel do not give rise to privity. The Federal Circuit and the Board have consistently found that the type of supplier-customer relationship here does not create the type of "substantive legal relationship" that establishes privity. *WesternGeco LLC v. ION Geophysical Corp.*, 889 F.3d 1308, 1321–22 (Fed. Cir. 2018); *see Wi-Fi One, LLC v. Broadcom Corp.*, 887 F.3d 1329, 1340–41 (Fed. Cir. 2018); *Samsung Elecs. Co. v. Netlist, Inc.*, IPR2022-00615, Paper 62 at 14–15 (PTAB June 30, 2023). MPS sells commodity chips to [redacted] and Intel. This is nothing like PO's cited supplier-customer cases, POPR at 26–27, which involved indemnification relationships, exclusive supply arrangements, and the petitioners' prior assertions of RPI status in other proceedings. *See Ventex Co., Ltd. v. Columbia*

-00550: Pet. Prelim. Reply [17] at 5-7

-00550: PO Resp. [32] at 47, 53; PO Sur-Reply [45] at 4-5, 8-9

1. The Petitions Are Time-Barred

- Petitioner does not deny that it <u>indirectly</u> supplies <u>components</u> of the IAPs.



UNITED STATES PATENT AN

BEFORE THE PATENT TRIA

MONOLITHIC POWE
Petition
v.
GREENTHRE
Patent Ow

IPR2024-00468 (Pate
IPR2024-00469 (Pate
IPR2024-00470 (Pater
IPR2024-00550 (Patent 10,510,842 B2)
IPR2024-00551 (Patent 10,734,481 B2)
IPR2024-00552 (Patent 11,121,222 B2)
IPR2024-00553 (Patent 11,316,014 B2)[1]

DECLARATION OF CARLY SUMMERS

[1] The word-for-word identical paper is being served in each proceeding identified in the heading.

Greenthread Ex. 2086, p. 1 of 5
MPS v. Greenthread

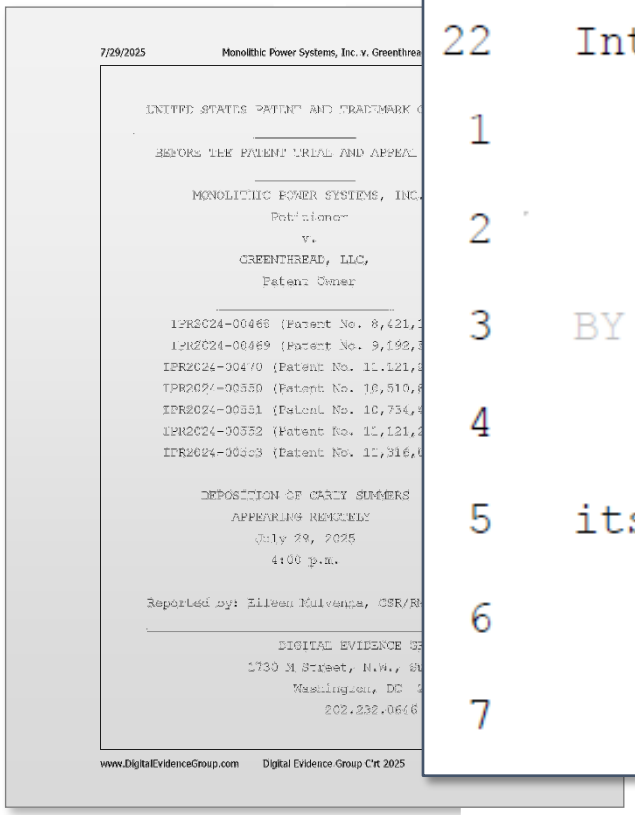
8. Petitioner did not sell to Intel, or supply Intel with, any of the Intel Accused Products. Consequently, Petitioner was not the supplier to Intel of any product, or component of a product, accused of infringement in the Intel litigation. (By way of background, Petitioner's principal customers are contract manufacturers located in Asia, rather than downstream branded companies such as Intel.)

-00468: Ex. 2086 (Summers Decl.) at ¶8

-00550: PO Supp. Brief [63] at 6-7; PO Supp. Reply [67] at 3

1. The Petitions Are Time-Barred

- Ms. Summers did not investigate whether Petitioner was a **supplier** of any **component** of an IAP.



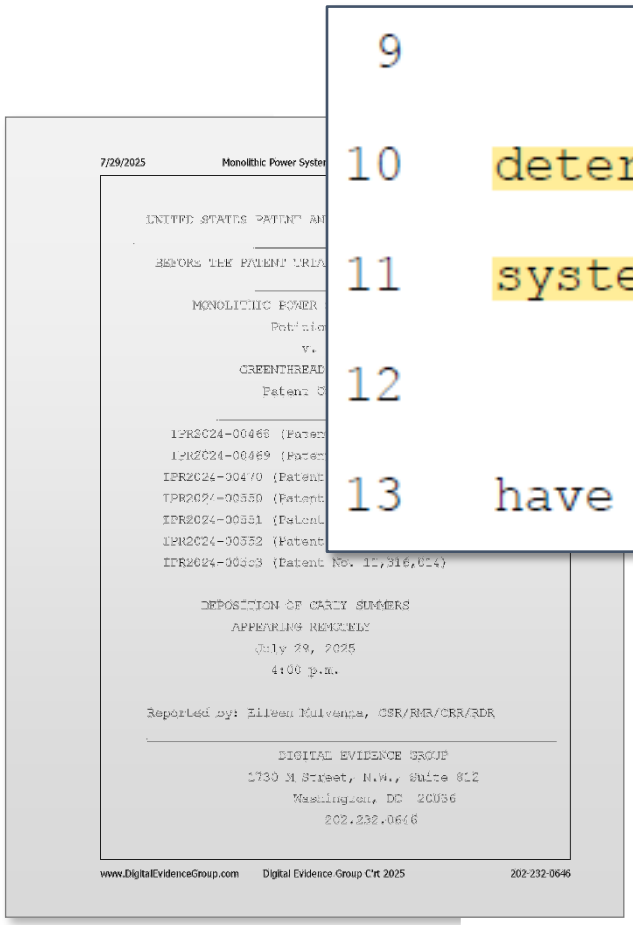
21 Q. Does MPS sell products indirectly to
22 Intel?
1 MR. ESTERHAY: Objection, vague.
2 THE WITNESS: I don't know.
3 BY MR. HEJNY:
4 Q. Does Intel use MPS or MPS products in
5 its systems?
6 MR. ESTERHAY: Objection, vague.
7 THE WITNESS: Maybe.

-00468: Ex. 2087 (Summers Dep. Tr.) at 16:21-17:7

-00550: PO Supp. Brief [63] at 7-8

1. The Petitions Are Time-Barred

- Ms. Summers did not investigate whether Petitioner was a **supplier** of any **component** of an IAP.



9 Q. Did you do any investigation to
10 determine which MPS products are used in Intel
11 systems?
12 A. The premise assumes they do. I don't
13 have knowledge of that. So no, I did not.

-00468: Ex. 2087 (Summers Dep. Tr.) at 17:9-13

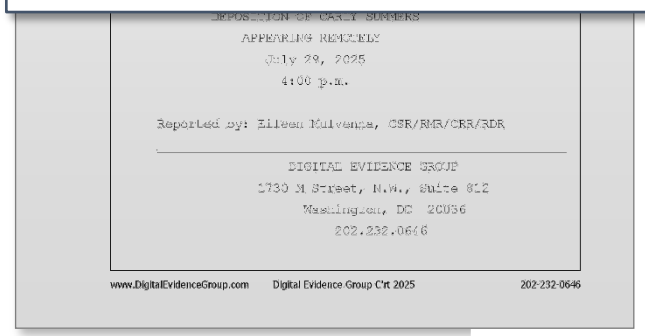
-00550: PO Supp. Brief [63] at 8; PO Supp. Reply [67] at 7

1. The Petitions Are Time-Barred

- Ms. Summers did not investigate whether Petitioner was a **supplier** of any **component** of an IAP.

What did you do to determine that no MPS product or MPS component is used in the Intel processors listed in Exhibit 2005?

A. The statement says petitioner was not the supplier to Intel of any product. I wouldn't have knowledge or the ability to confirm whether our product was used, but we were not the supplier to Intel of any of the accused products, certainly.


DEPOSITION OF CARLY SUMMERS
APPEARING REMOTELY
July 29, 2025
4:00 p.m.
Reported by: Eileen Mulvenna, CSR/RMR/CRR/RDR
DIGITAL EVIDENCE GROUP
1730 M Street, N.W., Suite 812
Washington, DC 20036
202.232.0646
www.DigitalEvidenceGroup.com Digital Evidence Group C'rt 2025 202-232-0646

Q. Did you do any investigation to determine whether any MPS products or components are used in the Intel accused products?

A. Yes. As I mentioned, I confirmed that there were no sales agreements between MPS and Intel. And there were none.

Q. Did you do any further investigation beyond examining whether there were any sales agreements between MPS and Intel?

A. No.

-00468: Ex. 2087 (Summers Dep. Tr.) at 18:1-18

-00550: PO Supp. Brief [63] at 8; PO Supp. Reply [67] at 7-8

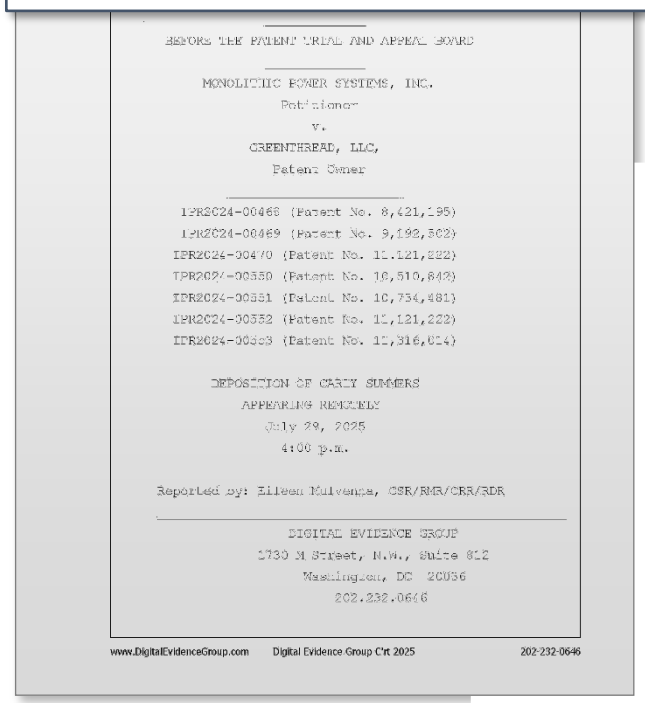
PUBLIC VERSION

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

1. The Petitions Are Time-Barred

- Ms. Summers did not investigate whether Petitioner was a **supplier** of any **component** of an IAP.

8 Q. Do any MPS subsidiaries or affiliates
9 sell products indirectly to Intel?
10 A. I don't know.



BEFORE THE PATENT TRIAL AND APPEAL BOARD

MONOLITHIC POWER SYSTEMS, INC.
Petitioner
v.
GREENTHREAD, LLC,
Patent Owner

IPR2024-00468 (Patent No. 8,421,195)
IPR2024-00469 (Patent No. 9,192,302)
IPR2024-00470 (Patent No. 11,121,222)
IPR2024-00550 (Patent No. 10,510,842)
IPR2024-00551 (Patent No. 10,734,481)
IPR2024-00552 (Patent No. 11,121,222)
IPR2024-00553 (Patent No. 11,316,014)

DEPOSITION OF CARLY SUMMERS
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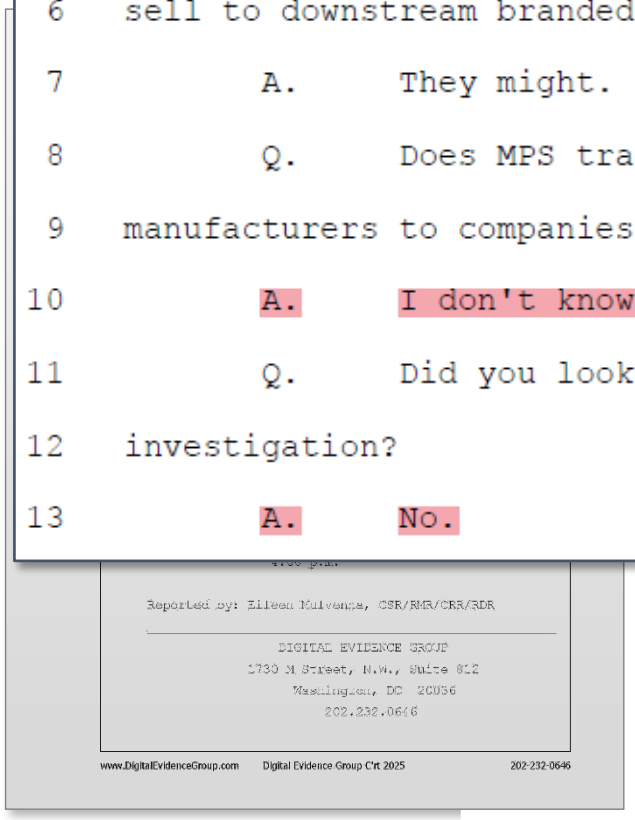
11 Q. Do MPS subsidiaries or affiliates also
12 use contract manufacturers when manufacturing MPS
13 parts?
14 A. Yes.
15 Q. Are those the same contract
16 manufacturers that we discussed before, or are they
17 different?
18 A. The same, to my knowledge.

-00468: Ex. 2087 (Summers Dep. Tr.) at 29:8-18

1. The Petitions Are Time-Barred

- Ms. Summers did not investigate whether Petitioner was a **supplier** of any **component** of an IAP.

5 Q. So the contract manufacturer would
6 sell to downstream branded companies such as Intel?
7 A. They might.
8 Q. Does MPS track sales from contract
9 manufacturers to companies like Intel?
10 A. I don't know.
11 Q. Did you look into that as part of your
12 investigation?
13 A. No.



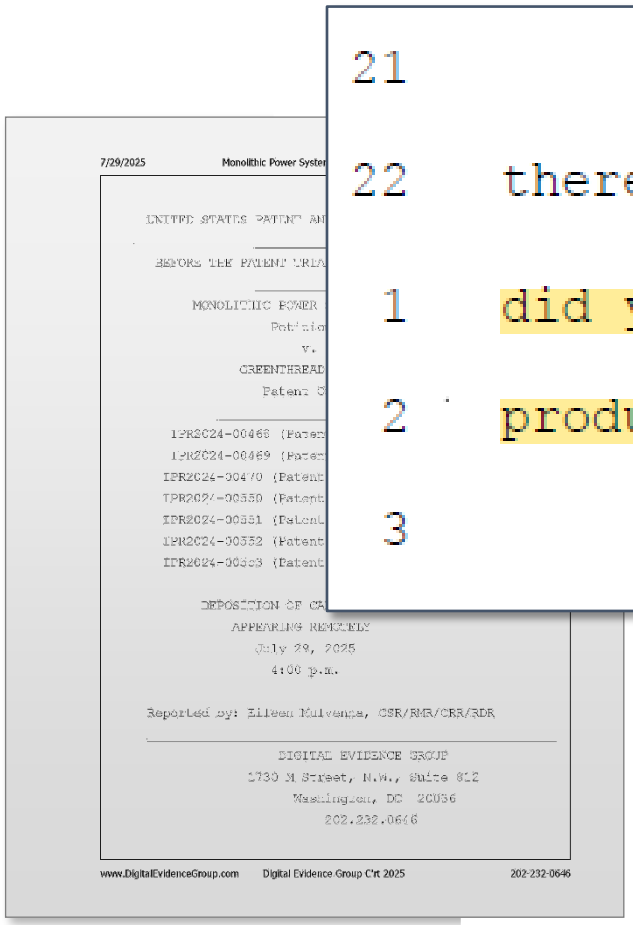
-00468: Ex. 2087 (Summers Dep. Tr.) at 22:5-13

6 Q. Did you do anything to investigate
7 sales from any of those contract manufacturers to
8 other entities, including Intel?
9 A. No.

-00468: Ex. 2087 at 23:6-9

1. The Petitions Are Time-Barred

- Ms. Summers did not investigate whether Petitioner was a **supplier** of any **component** of an IAP.



21 Q. So outside of researching whether
22 there were sales agreements between MPS and Intel,
1 did you do any investigation at all as to how MPS
2 products are integrated with Intel processors?
3 A. No.

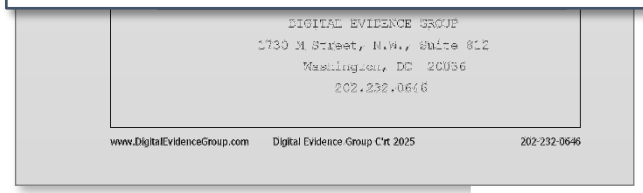
-00468: Ex. 2087 (Summers Dep. Tr.) at 23:21-24:3

-00550: PO Supp. Brief [63] at 9

1. The Petitions Are Time-Barred

- Ms. Summers did not investigate whether Petitioner was a **supplier** of any **component** of an IAP.

Q. Do you know whether the Intel Core i5-12400F processor includes any components designed or manufactured by Monolithic Power Systems?
MR. ESTERHAY: Objection, vague.
THE WITNESS: No, I don't know.
BY MR. HEJNY:
Q. And would your answer be the same for the rest of the processors listed on pages 5 through 7 of Exhibit 2005?
A. Yes.



Q. Did you contact Intel and ask them if any of these processors listed in Exhibit 2005 include any components or elements designed or manufactured by MPS?
A. No.
Q. Have you ever seen a parts list for any of these processors?
A. No.
Q. Do you know if anyone in-house at MPS has a parts list for any of these processors?
A. I don't know.

-00468: Ex. 2087 (Summers Dep. Tr.) at 25:15-26:13

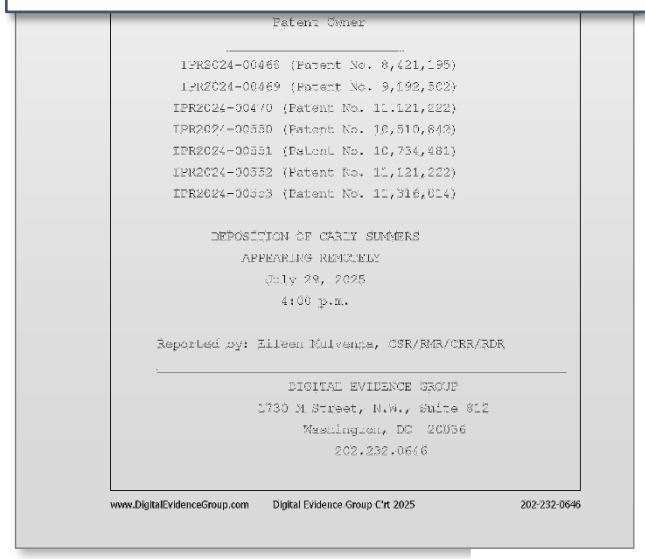
-00550: PO Supp. Brief [63] at 9, 12; PO Supp. Reply [67] at 8

1. The Petitions Are Time-Barred

- Ms. Summers never contacted Intel or MPS employees who communicate with Intel.

Q. Did you contact Intel and ask them if any of these processors listed in Exhibit 2005 include any components or elements designed or manufactured by MPS?

A. No.


Patent Owner

IPR2024-00468 (Patent No. 8,421,195)
IPR2024-00469 (Patent No. 9,192,302)
IPR2024-00470 (Patent No. 11,121,222)
IPR2024-00550 (Patent No. 10,510,642)
IPR2024-00551 (Patent No. 10,734,481)
IPR2024-00552 (Patent No. 11,121,222)
IPR2024-00553 (Patent No. 11,316,014)

DEPOSITION OF CARLY SUMMERS
APPEARING REMOTELY
July 29, 2025
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-00468: Ex. 2087 (Summers Dep. Tr.) at 26:3-7

Q. Did you contact Intel and ask them if there were any MPS parts in the products listed on pages 5 through 7 of Exhibit 2005?

A. No.

Q. Did you, in your capacity as in-house counsel, communicate with Intel?

A. I have not.

Q. Are there engineers at MPS that communicate with Intel?

MR. ESTERHAY: Objection, calls for speculation.

THE WITNESS: I don't know.

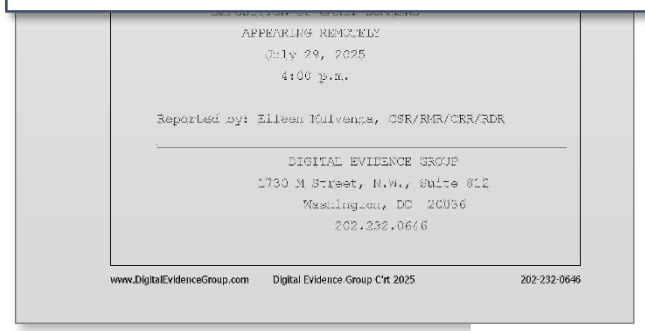
-00468: Ex. 2087 at 18:19-19:8

-00550: PO Supp. Brief [63] at 9, 12; PO Supp. Reply [67] at 8

1. The Petitions Are Time-Barred

- Ms. Summers never contacted Intel or MPS employees who communicate with Intel.

10 Q. Did you contact anyone in sales or
11 engineering at MPS and ask them, "Do we provide any
12 components that are used in certain Intel
13 processors, such as the ones listed on pages 5
14 through 7 of Exhibit 2005"?
15 A. No. By "provide," I guess, what do
16 you mean? I confirmed that MPS does not sell
17 products to Intel.


APPEARING REMOTELY
July 29, 2025
4:00 p.m.

Reported by: Eileen Mulvenna, CSR/RMR/CRR/RDR

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1730 M Street, N.W., Suite 812
Washington, DC 20036
202.232.0646

www.DigitalEvidenceGroup.com Digital Evidence Group C'rt 2025 202-232-0646

18 Q. Do you know whether or not MPS
19 components are included in Intel devices?
20 A. No.
21 Q. Did you reach out to anyone in sales
22 or engineering at MPS to find out whether or not MPS
1 components are included in Intel devices?
2 A. No.

-00468: Ex. 2087 (Summers Dep. Tr.) at 19:10-20:2

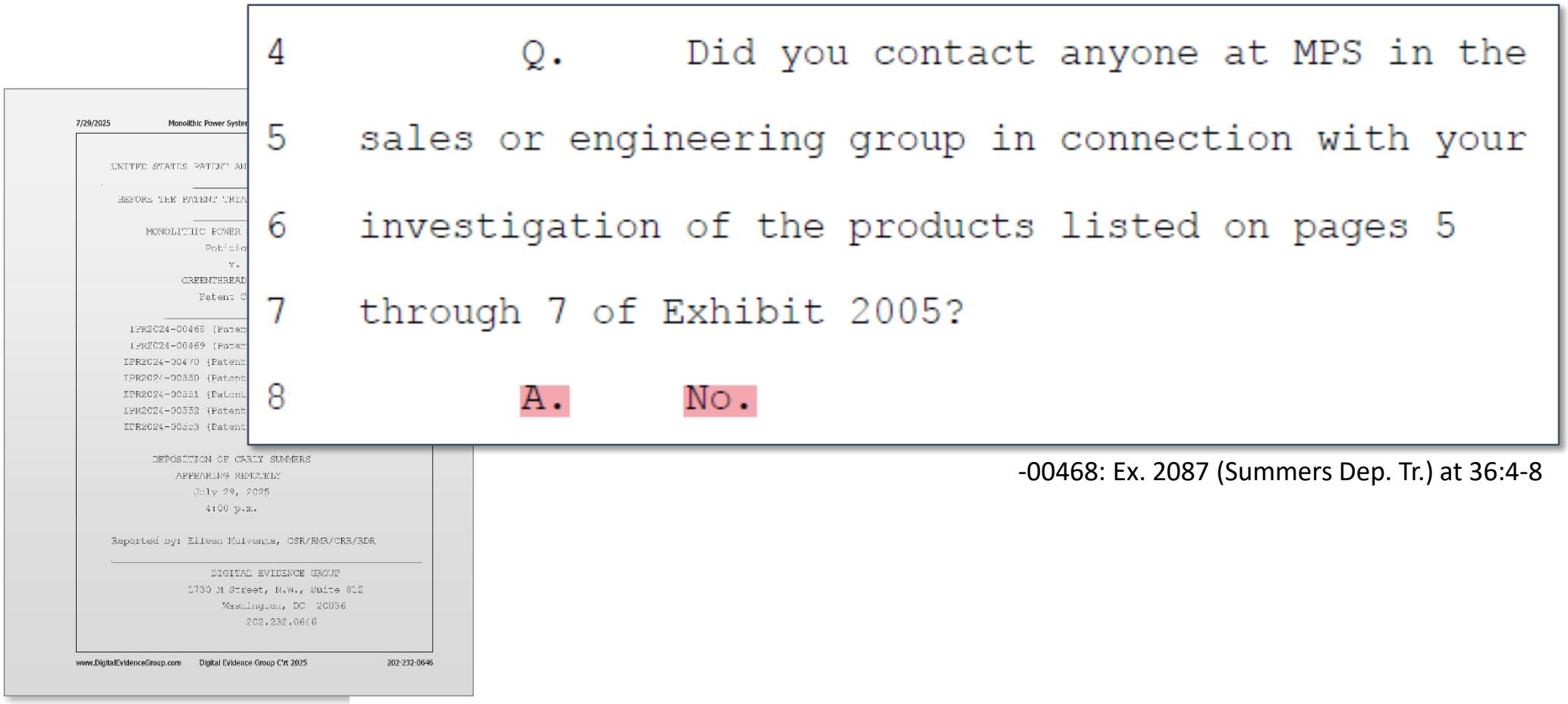
-00550: PO Supp. Brief [63] at 9, 12; PO Supp. Reply [67] at 8

PUBLIC VERSION

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

1. The Petitions Are Time-Barred

- Ms. Summers never contacted Intel or MPS employees who communicate with Intel.



7/29/2025 Monolithic Power Syster

UNITED STATES PATENT AN

BEFORE THE PATENT TRIA

MONOLITHIC POWER

Petitio

v.

GREENTHREAD

Patent

IPR2024-00468 (Paten

IPR2024-00469 (Paten

IPR2024-00470 (Patent

IPR2024-00550 (Patent

IPR2024-00551 (Patent

IPR2024-00552 (Patent

IPR2024-00553 (Patent

DEPOSITION OF CARLY SUMMERS

APPEARING REMOTELY

July 29, 2025

4:00 p.m.

Reported by: Eileen Mulvenna, CSR/RMR/CRR/RDR

DIGITAL EVIDENCE GROUP

1730 M Street, N.W., Suite 812

Washington, DC 20036

202.232.0646

www.DigitalEvidenceGroup.com Digital Evidence Group C'rt 2025 202-232-0646

4 Q. Did you contact anyone at MPS in the
5 sales or engineering group in connection with your
6 investigation of the products listed on pages 5
7 through 7 of Exhibit 2005?
8 A. No.

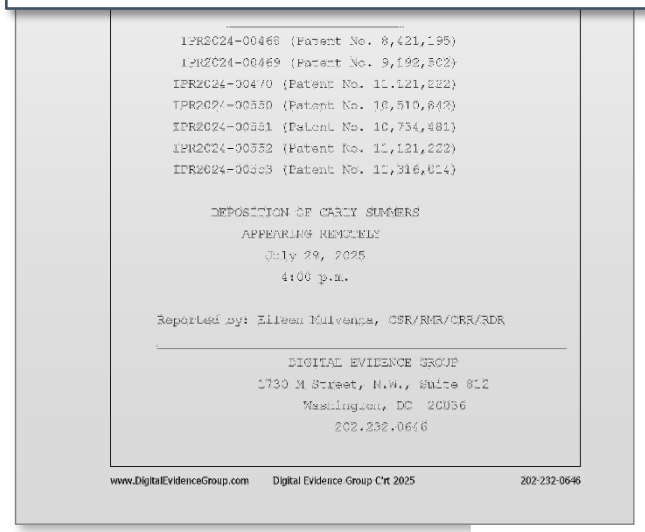
-00468: Ex. 2087 (Summers Dep. Tr.) at 36:4-8

-00550: PO Supp. Brief [63] at 12

1. The Petitions Are Time-Barred

- Ms. Summers did not even know who at MPS to ask about its relationship with Intel.

4 Q. Are there engineers at MPS that
5 communicate with Intel?
6 MR. ESTERHAY: Objection, calls for
7 speculation.
8 THE WITNESS: I don't know.


IPR2024-00468 (Patent No. 8,421,195)
IPR2024-00469 (Patent No. 9,192,302)
IPR2024-00470 (Patent No. 11,121,222)
IPR2024-00550 (Patent No. 10,510,642)
IPR2024-00551 (Patent No. 10,734,481)
IPR2024-00552 (Patent No. 11,121,222)
IPR2024-00553 (Patent No. 11,316,014)

DEPOSITION OF CARLY SUMMERS
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www.DigitalEvidenceGroup.com Digital Evidence Group C'rt 2025 202-232-0646

-00468: Ex. 2087 (Summers Dep. Tr.) at 19:4-8

8 Q. Have you ever seen a parts list for
9 any of these processors?
10 A. No.
11 Q. Do you know if anyone in-house at MPS
12 has a parts list for any of these processors?
13 A. I don't know.

-00468: Ex. 2087 (Summers Dep. Tr.) at 26:8-13

-00550: PO Supp. Brief [63] at 9, 12; PO Supp. Reply [67] at 8

1. The Petitions Are Time-Barred

- Ms. Summers did not even know who at MPS to ask about its relationship with Intel.

Q. Does MPS work with Intel to ensure that its products are compatible with the Intel processors?

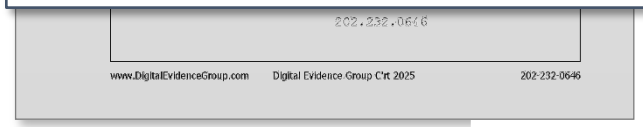
MR. ESTERHAY: Objection, vague.

THE WITNESS: Not that I know of.

BY MR. HEJNY:

Q. Is there someone at MPS that would know the answer to that question?

A. I don't know. The question doesn't clarify whether this relates to the accused parts or any parts. So I'm not sure. I don't know.



MPS manufactures parts to be used in conjunction with Intel processors; right?

MR. ESTERHAY: Objection, vague.

THE WITNESS: I don't know.

BY MR. HEJNY:

Q. Did you ask that question of anyone at MPS when you were preparing your declaration?

A. No.

-00468: Ex. 2087 (Summers Dep. Tr.) at 27:2-22

-00550: PO Supp. Brief [63] at 12-13

Overview of Issues

1. **Petitioner has presented zero "actual evidence" that the Petitions are timely.**
2. **The Claims require "movement of carriers" from the "surface layer" or "active region."**
3. The '195 and '502 Claims require "movement of minority carriers" from the "surface layer."
4. Kawagoe does not disclose "movement of [minority] carriers" from the "surface layer."
5. Onoda/Nishizawa does not disclose "movement of [minority] carriers" from the "surface layer."
6. Petitioner has the burden to identify electric fields that would "aid carrier movement."
7. Petitioner's expert confirmed that carriers in the "surface layer" are affected by numerous other fields and forces.
8. Petitioner's expert confirmed "movement of carriers" depends on the sum of all fields in the "surface layer."
9. Petitioner's expert did not analyze any of the fields or force magnitudes in the "surface layer."
10. Petitioner's prosecution-related arguments are incorrect.
11. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

2. Movement of Carriers from the Surface Layer

- All of the Challenged Claims require "movement of carriers" from the "active region" or "surface layer."

US 8,421,195

1. A CMOS Semiconductor device comprising:
a surface layer;
a substrate;
an active region including a source and a drain, disposed on one surface of said surface layer;
a single drift layer disposed between the other surface of said surface layer and said substrate, said drift layer having a graded concentration of dopants extending between said surface layer and said substrate, said drift layer further having a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate; and
at least one well region disposed in said single drift layer, said well region having a graded concentration of dopants and a second static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.

-00468: Ex. 1001 ('195 pat.) at 4:13-29

US 9,190,502

7. A semiconductor device comprising:
a surface layer;
a substrate;
an active region including a source and a drain, disposed on one surface of said surface layer;
a single drift layer disposed between the other surface of said surface layer and said substrate, said drift layer having a graded concentration of dopants generating a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate; and
at least one well region disposed in said single drift layer, said well region having a graded concentration of dopants generating a second static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.

-00469: Ex. 1001 ('502 pat.) at 4:52-67

US 11,121,222

44. A CMOS Semiconductor device comprising:
a surface layer;
a substrate;
an active region including a source and a drain, disposed on one surface of the surface layer;
a single drift layer disposed between the other surface of the surface layer and the substrate, the drift layer having a graded concentration of dopants extending between the surface layer and the substrate, the drift layer further having a first static unidirectional electric drift field to aid the movement of carriers from the surface layer to an area of the substrate where there are no active regions; and
at least one well region disposed in the single drift layer, the well region having a graded concentration of dopants and a second static unidirectional electric drift field to aid the movement of carriers from the surface layer to the area of the substrate where there are no active regions.

-00470: Ex. 1001 ('222 pat.) at 8:21-39

2. Movement of Carriers from the Surface Layer

- All of the Challenged Claims require "movement of carriers" from the "active region" or "surface layer."

US 10,510,842

1. A semiconductor device, comprising:
a substrate of a first doping type at a first doping level having first and second surfaces;
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;
a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;
transistors formed in at least one of the first active region or second active region; and
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.

-00550: Ex. 1001 ('842 pat.) at 4:45-60

US 10,734,481

1. A semiconductor device, comprising:
a substrate of a first doping type at a first doping level having first and second surfaces;
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;
a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;
transistors formed in at least one of the first active region or second active region;
at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first surface to the second surface of the substrate; and
at least one well region adjacent to the first or second active region containing at least one graded dopant region, the graded dopant region to aid carrier movement from the first surface to the second surface of the substrate.

-00551: Ex. 1001 ('481 pat.) at 4:50-5:3

US 11,121,222

1. A VLSI semiconductor device, comprising:
a substrate of a first doping type at a first doping level having a surface;
a first active region disposed adjacent the surface with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed;
a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;
transistors formed in at least one of the first active region or second active region;
at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first and second active regions towards an area of the substrate where there are no active regions; and
at least one well region adjacent to the first or second active region containing at least one graded dopant region, the graded dopant region to aid carrier movement from the surface towards the area of the substrate where there are no active regions, wherein at least some of the transistors form digital logic of the VLSI semiconductor device.

-00552: Ex. 1001 ('222 pat.) at 4:38-62

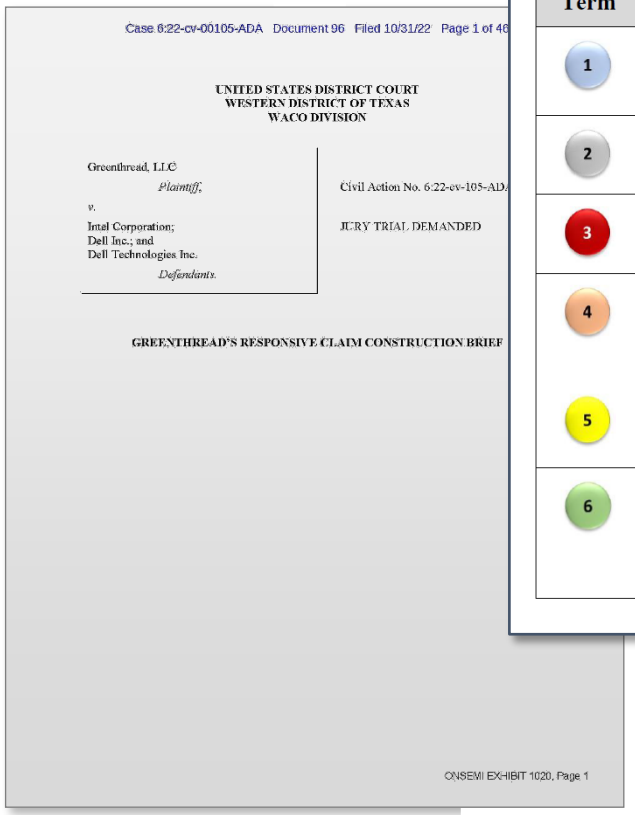
US 11,316,014

1. An electronic system, the system comprising:
at least one semiconductor device, the at least one semiconductor device including:
a substrate of a first doping type at a first doping level having a surface;
a first active region disposed adjacent the surface with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed;
a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;
transistors formed in at least one of the first active region or second active region;
at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first and second active regions towards an area of the substrate where there are no active regions; and
at least one well region adjacent to the first or second active region containing at least one graded dopant region, the graded dopant region to aid carrier movement from the surface towards the area of the substrate where there are no active regions, wherein at least some of the transistors form digital logic of the semiconductor device.

-00553: Ex. 1001 ('014 pat.) at 4:49-5:7

2. Movement of Carriers from the Surface Layer

- The "active region" is located in the "surface layer."


Case 6:22-cv-00105-ADA Document 96 Filed 10/31/22 Page 1 of 46

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF TEXAS
WACO DIVISION

Greenthread, LLC
Plaintiff;
v.
Intel Corporation;
Dell Inc.; and
Dell Technologies Inc.
Defendants.

Civil Action No. 6:22-cv-105-ADA

JURY TRIAL DEMANDED

GREENTHREAD'S RESPONSIVE CLAIM CONSTRUCTION BRIEF

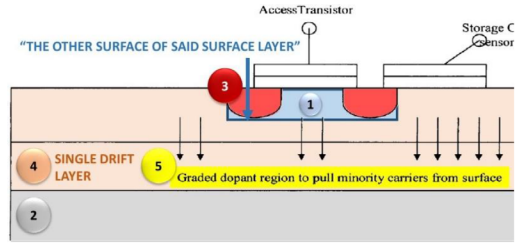
ONSEMI EXHIBIT 1020, Page 1

EXEMPLARY CLAIMS 195:1 & 842:1

Term	U.S. Patent No. 8,421,195, Claim 1 (195:1)
1	A CMOS Semiconductor device comprising: a surface layer;
2	a substrate;
3	an active region including a source and a drain, disposed on one surface of said surface layer;
4 5	a single drift layer disposed between the other surface of said surface layer and said substrate, said drift layer having a graded concentration of dopants extending between said surface layer and said substrate, said drift layer further having a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate; and
6	at least one well region disposed in said single drift layer, said well region having a graded concentration of dopants and a second static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.

Ex. 1030 (Claim Constr. Brief) at 6

Ex. 1, ¶30. The "active region" is a doped region where a transistor can be formed. *Id.*, ¶31; Ex. 2, 1:61-63; 2:18-23; 3:1-3, 30-33. Next, the claim specifies there is a single drift layer disposed between "the other surface of said surface layer" and the substrate. The single drift layer has a graded concentration of dopants. Ex. 1, ¶32.



The graded dopants create an electric field that aids the movement of minority carriers (holes in the example shown in Fig. 5B) from the surface layer to the substrate. Ex. 1, ¶¶32-33; Ex. 2, 3:17-

Ex. 1030 at 16

2. Movement of Carriers from the Surface Layer

- The Petitions acknowledge that the "active region" is located in the "surface layer."

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MONOLITHIC POWER SYSTEMS, INC.,

Petitioner,

v.

GREENTHREAD LLC,

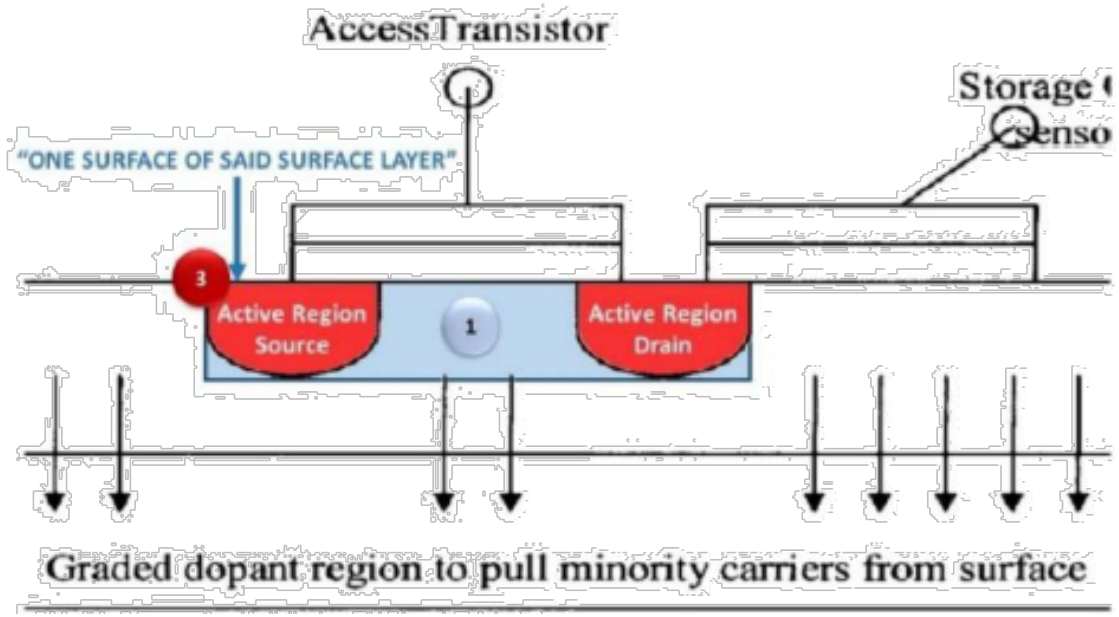
Patent Owner.

U.S. PATENT NO. 8,421,195
PTAB Case No. IPR2024-00468

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 8,421,195 UNDER 35 U.S.C. §312 AND 37 C.F.R. §42.104

165387608.1

Patent Owner further annotated FIG. 5(b) of the '195 Patent to depict this orientation, where the active region source and drains were disposed on the surface of the surface layer (similar to Onoda's FIG. 3). (Ex. 1003 at ¶¶ 63-64.)



-00468: Petition [1] at 25-26

2. Movement of Carriers from the Surface Layer

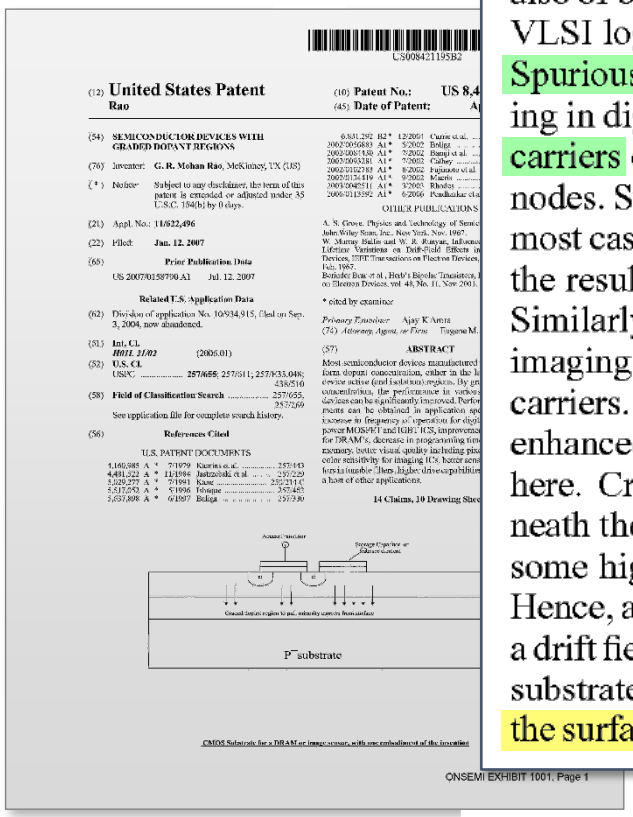
- The Challenged Claims must be construed to properly reflect the purpose of the invention.

> The specification further supports this construction. We have explained that a patent's express purpose of the invention "informs the proper construction of claim terms." *Kaken Pharm. Co. v. Iancu*, 952 F.3d 1346, 1352 (Fed. Cir. 2020). Here, an expressed purpose of the invention is minimizing metadata.[5] *See, e.g., id.* at col. 1 ll. 10–12, col. 4 ll. 7–10. To achieve this goal, the specification explains that "[t]he present invention constructs a logical volume by using a disk partition as a volume construction unit so the present invention can minimize the size of metadata." *Id.* at col.

Sequoia Tech., LLC v. Dell, Inc.,
66 F.4th 1317, 1326 (Fed. Cir. 2023)

2. Movement of Carriers from the Surface Layer

- The specification explains that "spurious minority carriers" interfere with the "active circuitry at the surface."



(12) **United States Patent**
Rao

(10) Patent No.: US 8,4
(45) Date of Patent:

(54) SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS

(76) Inventor: G. R. Mohan Rao, McKinney, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 11/622,496

(22) Filed: Jan. 12, 2007

(65) Prior Publication Data

US 2007/0158790 A1 Jul. 12, 2007

Related U.S. Application Data

(62) Division of application No. 10/934,915, filed on Sep. 3, 2004, now abandoned.

(51) Int. Cl.
H01L 21/02 (2006.01)

(52) U.S. Cl.
USPC 257/655; 257/511; 257/933; 438/510

(58) Field of Classification Search 257/655, 257/699
See application file for complete search history.

(56) References Cited

U.S. PATENT DOCUMENTS

OTHER PUBLICATIONS

ABSTRACT

14 Claims, 10 Drawing Sheets

P⁻ substrate

ONSEMI EXHIBIT 1001, Page 1

As illustrated in FIGS. **5**(*a*), **5**(*b*), **5**(*c*), donor gradient is also of benefit to very large scale integrated circuits (VLSI)–VLSI logic, DRAM, nonvolatile memory like NAND flash. Spurious minority carriers can be generated by clock switching in digital VLSI logic and memory IC'S. These unwanted carriers can discharge dynamically-held 'actively held high' nodes. Statically held nodes (with V_{cc}) can not be affected, in most cases. Degradation of refresh time in DRAM's is one of the results, because the capacitor holds charge dynamically. Similarly, degradation of CMOS digital images, in digital imaging IC's is another result of the havoc caused by minority carriers. Pixel and color resolution can be significantly enhanced in imaging IC's with the embodiments described here. Creating 'Sub Terrain' recombination centers underneath the wells (gold doping, platinum doping) as is done in some high-voltage diodes is not practical for VLSI circuits. Hence, a novel technique has been described here by creating a drift field to sweep these unwanted minority carriers into the substrate as quickly as possible, from the active circuitry at the surface. In a preferred embodiment, the subterrain n-layer

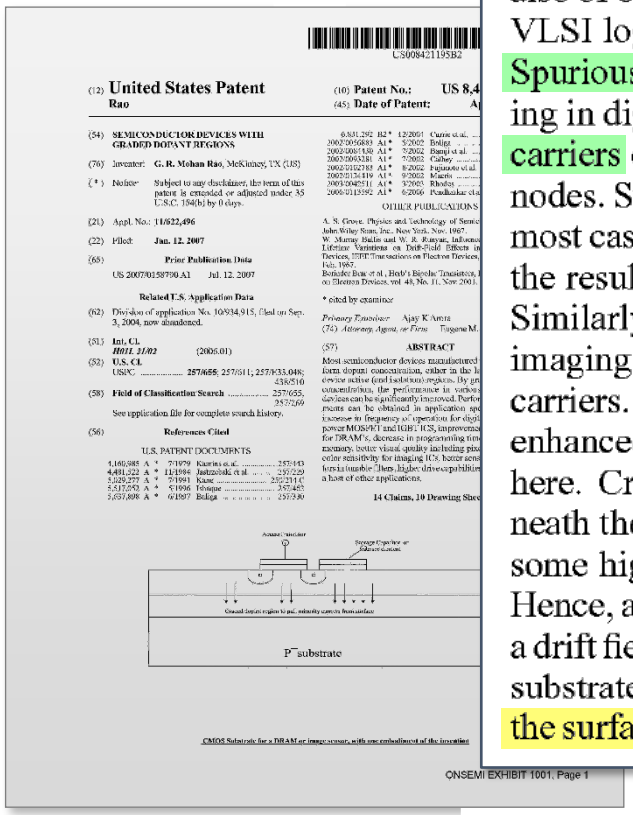
-00468: Ex. 1001 ('195 pat.) at 3:14-33

the surface. In a preferred embodiment, the subterrain n-layer has a graded donor concentration to sweep the minority carriers deep into the substrate. One or more of such layers can also be implemented through wafer to wafer bonding or similar "transfer" mechanisms. This n-layer can be a deeply-implanted layer. It can also be an epitaxial layer. The n-well and p-well also can be graded or retrograded in dopants, as desired, to sweep those carriers away from the surface as well.

-00468: Ex. 1001 at 3:33-40

2. Movement of Carriers from the Surface Layer

- The specification discloses using a "drift field" to "sweep these unwanted minority carriers from the active circuitry at the surface into the substrate."



(12) **United States Patent**
Rao

(10) **Patent No.: US 8,4**
(45) **Date of Patent:**

(54) **SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS**

(76) Inventor: **G. R. Mohan Rao**, McKinney, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **11/622,496**

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(65) **Prior Publication Data**

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(51) **Int. Cl.**
H01L 21/02 (2006.01)

(52) **U.S. Cl.**
USPC **257/655**; 257/511; 257/933,048; 438/510

(58) **Field of Classification Search** 257/655, 257/699
See application file for complete search history.

(56) **References Cited**

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W. Murray Bullis and W. R. Runyan, Infineon Lifetime Variations on Drift-Field Effects in Devices, IEEE Transactions on Electron Devices, Feb. 1967.
Bonafide Bias et al., Hoh's Bipolar Transistors, IEEE Transactions on Electron Devices, vol 48, No. 11, Nov 2001.

* cited by examiner

Primary Examiner — Ajay K Arora
(74) *Attorney, Agent, or Firm* — Eugene M...

(57) **ABSTRACT**

Most semiconductor devices manufactured form dopant concentration, either in the h... device active (and isolation) regions. By gr... concentration, the performance in various... devices can be significantly improved. Perfor... ments can be obtained in application sp... increase in frequency of operation for digit... power MOS/BCT and IGBT ICS, improvemen... for DRAM's, decrease in programming tim... memory, better visual quality including pix... color sensitivity for imaging ICS, better sens... for ultraviolet, blue. Higher drive capabilities... a host of other applications.

14 Claims, 10 Drawing Shee...

CMOS Substrate for a DRAM or image sensor, with one embodiment of the invention

ONSEMI EXHIBIT 1001, Page 1

As illustrated in FIGS. **5**(*a*), **5**(*b*), **5**(*c*), donor gradient is also of benefit to very large scale integrated circuits (VLSI)–VLSI logic, DRAM, nonvolatile memory like NAND flash. Spurious minority carriers can be generated by clock switching in digital VLSI logic and memory IC'S. These unwanted carriers can discharge dynamically-held 'actively held high' nodes. Statically held nodes (with V_{cc}) can not be affected, in most cases. Degradation of refresh time in DRAM's is one of the results, because the capacitor holds charge dynamically. Similarly, degradation of CMOS digital images, in digital imaging IC's is another result of the havoc caused by minority carriers. Pixel and color resolution can be significantly enhanced in imaging IC's with the embodiments described here. Creating 'Sub Terrain' recombination centers underneath the wells (gold doping, platinum doping) as is done in some high-voltage diodes is not practical for VLSI circuits. Hence, a novel technique has been described here by creating a drift field to sweep these unwanted minority carriers into the substrate as quickly as possible, from the active circuitry at the surface. In a preferred embodiment, the subterrain n-layer

-00468: Ex. 1001 ('195 pat.) at 3:14-33

the surface. In a preferred embodiment, the subterrain n-layer has a graded donor concentration to sweep the minority carriers deep into the substrate. One or more of such layers can also be implemented through wafer to wafer bonding or similar "transfer" mechanisms. This n-layer can be a deeply-implanted layer. It can also be an epitaxial layer. The n-well and p-well also can be graded or retrograded in dopants, as desired, to sweep those carriers away from the surface as well.

-00468: Ex. 1001 at 3:33-40

2. Movement of Carriers from the Surface Layer

- Fig. 5B shows how an electric field moves minority carriers (positively-charged “holes”) from the active region at the surface.
- The positively-charged holes move in the same direction as the electric field.



US008421195B2

(12) **United States Patent**
Rao

(10) **Patent No.: US 8,421,195 B2**
(45) **Date of Patent: Apr. 16, 2013**

(54) **SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS**

(76) Inventor: **G. R. Mohan Rao**, McKinney, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(22) Filed: **Jan. 12, 2007**

(65) **Prior Publication Data**

US 2007/0158700 A1 Jul. 12, 2007

Related U.S. Application Data

(62) Division of application No. 10/934,915, filed on Sep. 3, 2004, now abandoned.

(51) **Int. Cl.**
H01L 21/02 (2006.01)

(52) **U.S. Cl.**
USPC **257/655**; 257/611; 257/933; 438/516

(58) **Field of Classification Search** 257/655, 257/69
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

OTHER PUBLICATIONS

A. S. Grove, Physics and Technology of Semiconductor Devices, John Wiley Sons, Inc., New York, Nov. 1967.
W. Murray Bullis and W. R. Runyan, Influence of Mobility and Lifetime Variations on Drift-Field Effects in Silicon-Junction Devices, IEEE Transactions on Electron Devices, vol. ED-14, No. 5, Feb. 1967.
Bonder Bae et al., Hoh's Bipolar Transistors, IEEE Transactions on Electron Devices, vol 48, No. 11, Nov 2001.

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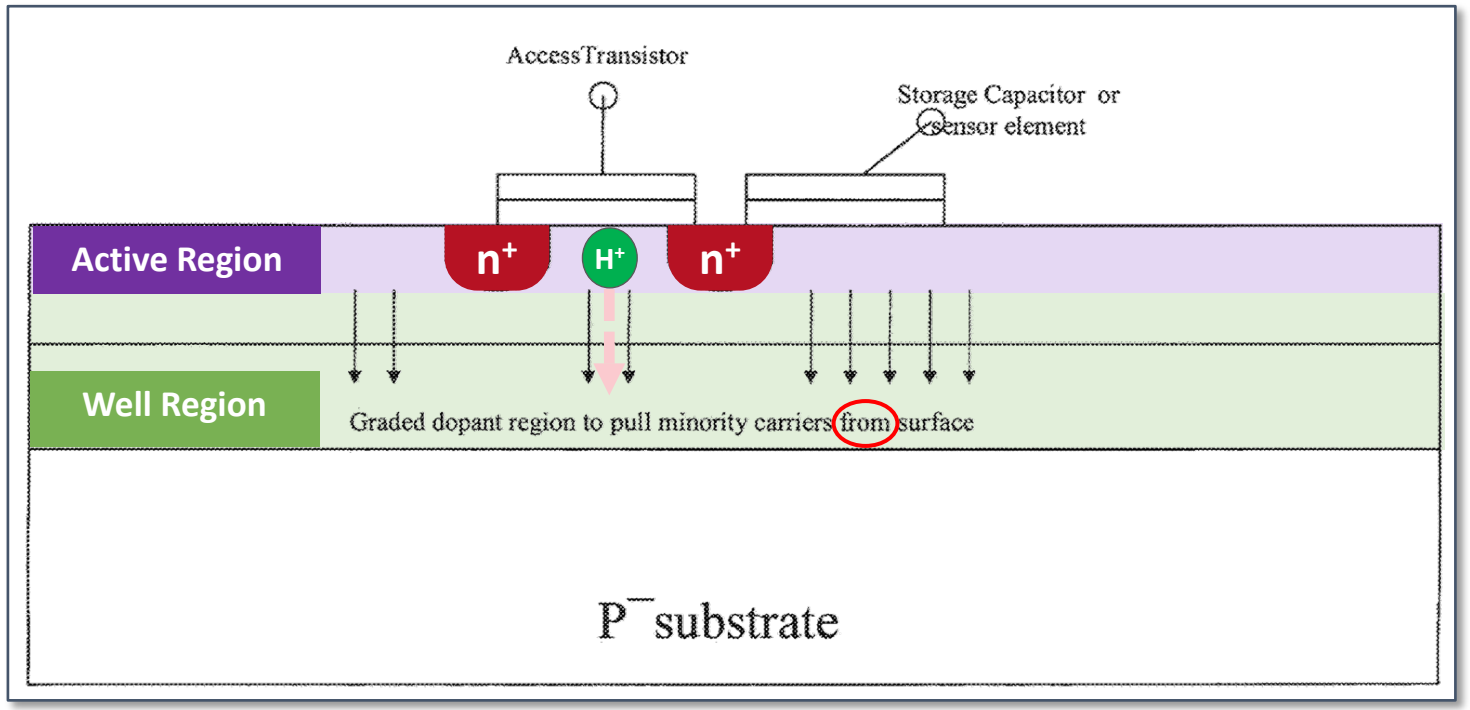
Primary Examiner — Ajay K Arora
(74) *Attorney, Agent, or Firm* — Eugene M. Cummings, P.C.

(57) **ABSTRACT**

Most semiconductor devices manufactured today, have uniform dopant concentration, either in the lateral or vertical device active (and isolation) regions. By grading the dopant concentration, the performance in various semiconductor devices can be significantly improved. Performance improvements can be obtained in application specific areas like increase in frequency of operation for digital logic, various power MOS/IGT and IGBT ICS, improvement in refresh time for DRAM's, decrease in programming time for nonvolatile memory, better visual quality including pixel resolution and color sensitivity for imaging ICS, better sensitivity for various humble fibers, higher driver capabilities for IGBT's, and a host of other applications.

14 Claims, 10 Drawing Sheets

CMOS Substrate for a DRAM or image sensor, with one embodiment of the invention



-00468: Ex. 1001 (’195 pat.) at Fig. 5B

2. Movement of Carriers from the Surface Layer

- The Challenged Claims do not impermissibly mix apparatus and method limitations.

US 8,421,195

1. A CMOS Semiconductor device comprising:
a surface layer;
a substrate;
an active region including a source and a drain, disposed on one surface of said surface layer;
a single drift layer disposed between the other surface of said surface layer and said substrate, said drift layer having a graded concentration of dopants extending between said surface layer and said substrate, said drift layer further having a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate; and
at least one well region disposed in said single drift layer, said well region having a graded concentration of dopants and a second static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.

-00468: Ex. 1001 ('195 pat.) at 4:13-29

US 9,190,502

7. A semiconductor device comprising:
a surface layer;
a substrate;
an active region including a source and a drain, disposed on one surface of said surface layer;
a single drift layer disposed between the other surface of said surface layer and said substrate, said drift layer having a graded concentration of dopants generating a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate; and
at least one well region disposed in said single drift layer, said well region having a graded concentration of dopants generating a second static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.

-00469: Ex. 1001 ('502 pat.) at 4:52-67

US 11,121,222

44. A CMOS Semiconductor device comprising:
a surface layer;
a substrate;
an active region including a source and a drain, disposed on one surface of the surface layer;
a single drift layer disposed between the other surface of the surface layer and the substrate, the drift layer having a graded concentration of dopants extending between the surface layer and the substrate, the drift layer further having a first static unidirectional electric drift field to aid the movement of carriers from the surface layer to an area of the substrate where there are no active regions; and
at least one well region disposed in the single drift layer, the well region having a graded concentration of dopants and a second static unidirectional electric drift field to aid the movement of carriers from the surface layer to the area of the substrate where there are no active regions.

-00470: Ex. 1001 ('222 pat.) at 8:21-39

2. Movement of Carriers from the Surface Layer

- The Challenged Claims do not impermissibly mix apparatus and method limitations.

US 10,510,842

1. A semiconductor device, comprising:
a substrate of a first doping type at a first doping level having first and second surfaces;
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;
a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;
transistors formed in at least one of the first active region or second active region; and
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.

-00550: Ex. 1001 ('842 pat.) at 4:45-60

US 10,734,481

1. A semiconductor device, comprising:
a substrate of a first doping type at a first doping level having first and second surfaces;
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;
a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;
transistors formed in at least one of the first active region or second active region;
at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first surface to the second surface of the substrate; and
at least one well region adjacent to the first or second active region containing at least one graded dopant region, the graded dopant region to aid carrier movement from the first surface to the second surface of the substrate.

-00551: Ex. 1001 ('481 pat.) at 4:50-5:3

US 11,121,222

1. A VLSI semiconductor device, comprising:
a substrate of a first doping type at a first doping level having a surface;
a first active region disposed adjacent the surface with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed;
a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;
transistors formed in at least one of the first active region or second active region;
at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first and second active regions towards an area of the substrate where there are no active regions; and
at least one well region adjacent to the first or second active region containing at least one graded dopant region, the graded dopant region to aid carrier movement from the surface towards the area of the substrate where there are no active regions, wherein at least some of the transistors form digital logic of the VLSI semiconductor device.

-00552: Ex. 1001 ('222 pat.) at 4:38-62

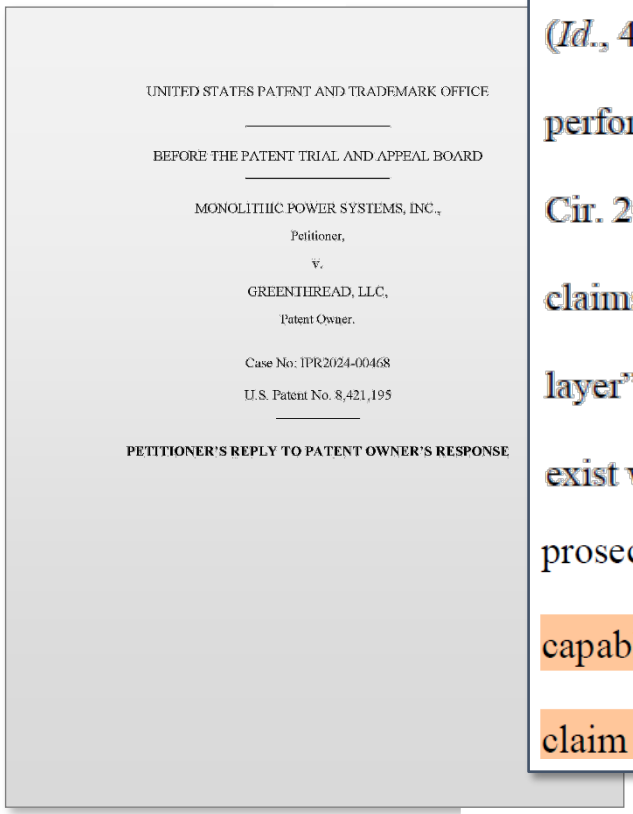
US 11,316,014

1. An electronic system, the system comprising:
at least one semiconductor device, the at least one semiconductor device including:
a substrate of a first doping type at a first doping level having a surface;
a first active region disposed adjacent the surface with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed;
a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;
transistors formed in at least one of the first active region or second active region;
at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first and second active regions towards an area of the substrate where there are no active regions; and
at least one well region adjacent to the first or second active region containing at least one graded dopant region, the graded dopant region to aid carrier movement from the surface towards the area of the substrate where there are no active regions, wherein at least some of the transistors form digital logic of the semiconductor device.

-00553: Ex. 1001 ('014 pat.) at 4:49-5:7

2. Movement of Carriers from the Surface Layer

- Petitioner argues that, under *ParkerVision*, Greenthread's "restrictions are unsupported."



UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MONOLITHIC POWER SYSTEMS, INC.,
Petitioner,
v.
GREENTHREAD, LLC,
Patent Owner.

Case No: IPR2024-00468
U.S. Patent No. 8,421,195

PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE

PO's position is not supported by the claims. The claims recite a device (EX1001, 4:13) that has a "drift layer having a graded concentration of dopants." (*Id.*, 4:19-23.) They describe a device's *structure*, not a method and active performance. *ParkerVision, Inc. v. Qualcomm Inc.*, 903 F.3d 1354, 1361 (Fed. Cir. 2018) (device claims "cover what a device *is*, not what a device *does*"). The claims, moreover, merely require that the claimed "electric field" form the "drift layer" "aid the movement," not that the field overcome all other forces that may exist within a theoretical device—none of which are identified the specification or prosecution history. *ParkerVision,* 903 F.3d at 1361 (a device may be "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.") PO's restrictions are unsupported.

-00468: Pet. Reply [42] at 2-3

-00468: PO Sur-Reply [47] at 4

2. Movement of Carriers from the Surface Layer

- *ParkerVision* is not controlling law here—*INVT* is.



(Fed. Cir. 2002)); *see also* *ParkerVision, Inc.*, 903 F.3d at 1361 (articulating a distinction between configuration-type and capability-type claims).

Possibly the most straightforward example of this is the common distinction between method claims and apparatus claims. *See, e.g.*, *Finjan*, 626 F.3d at 1203–

Cir. 2009))). *Cf.* *ParkerVision, Inc.*, 903 F.3d at 1363 (similarly differentiating apparatus claims and method claims in the patent invalidity context).

However, differences exist between apparatus claims as well, depending on the claim language. We have construed some apparatus claims to require an infringing device to actually perform and operate according to the functional terms recited in the claim. The intervenors cite two such cases, *Cross Medical* and *Ball Aerosol*. *See* Intervenors' Br. 64, 67–68. We have construed other apparatus claims to require only capability, such as in *Finjan* and *Silicon Graphics*.

INVT SPE LLC v. Int'l Trade Comm'n, 46 F.4th 1361, 1371-72 (Fed. Cir. 2022)

2. Movement of Carriers from the Surface Layer

- Treatment of the claim "depend[s] on the claim language," not the apparatus-or-method inquiry.

(Fed. Cir. 2002)); *see also* *ParkerVision, Inc.*, 903 F.3d at 1361 (articulating a distinction between configuration-type and capability-type claims).

Possibly the most straightforward example of this is the common distinction between method claims and apparatus claims. *See, e.g., Finjan*, 626 F.3d at 1203–

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INVT SPE LLC v. Int'l Trade Comm'n, 46 F.4th 1361, 1371-72 (Fed. Cir. 2022)

2. Movement of Carriers from the Surface Layer

- Mechanical apparatus claims are "configuration-type" claims that require "actual operation."

> *Ball Aerosol* and *Cross Medical* both involve mechanical apparatus claims. According to these two cases, intervenors argue, the '439 claims should be construed to require actual operation of the functions recited in limitations [d] and [e] in order for there to be infringement. Intervenors'

> In both of those cases, actual operation of arranging elements in a particular way was required because of the claim language. Neither case involved claim language resembling the language in INVT's claims. Intervenors emphasize that the

INVT SPE LLC v. Int'l Trade Comm'n, 46 F.4th 1361, 1372 (Fed. Cir. 2022)

2. Movement of Carriers from the Surface Layer

- The Challenged Claims recite specific structural limitations that require movement from the "surface layer."

US 8,421,195

1. A CMOS Semiconductor device comprising:
a surface layer;
a substrate;
an active region including a source and a drain, disposed on one surface of said surface layer;
a single drift layer disposed between the other surface of said surface layer and said substrate, said drift layer having a graded concentration of dopants extending between said surface layer and said substrate, said drift layer further having a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate; and
at least one well region disposed in said single drift layer, said well region having a graded concentration of dopants and a second static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.

-00468: Ex. 1001 ('195 pat.) at 4:13-29

US 9,190,502

7. A semiconductor device comprising:
a surface layer;
a substrate;
an active region including a source and a drain, disposed on one surface of said surface layer;
a single drift layer disposed between the other surface of said surface layer and said substrate, said drift layer having a graded concentration of dopants generating a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate; and
at least one well region disposed in said single drift layer, said well region having a graded concentration of dopants generating a second static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.

-00469: Ex. 1001 ('502 pat.) at 4:52-67

US 11,121,222

44. A CMOS Semiconductor device comprising:
a surface layer;
a substrate;
an active region including a source and a drain, disposed on one surface of the surface layer;
a single drift layer disposed between the other surface of the surface layer and the substrate, the drift layer having a graded concentration of dopants extending between the surface layer and the substrate, the drift layer further having a first static unidirectional electric drift field to aid the movement of carriers from the surface layer to an area of the substrate where there are no active regions; and
at least one well region disposed in the single drift layer, the well region having a graded concentration of dopants and a second static unidirectional electric drift field to aid the movement of carriers from the surface layer to the area of the substrate where there are no active regions.

-00470: Ex. 1001 ('222 pat.) at 8:21-39

2. Movement of Carriers from the Surface Layer

- The Challenged Claims recite specific structural limitations that require movement from the "surface layer."

US 10,510,842

1. A semiconductor device, comprising:
a substrate of a first doping type at a first doping level having first and second surfaces;
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;
a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;
transistors formed in at least one of the first active region or second active region; and
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.

-00550: Ex. 1001 ('842 pat.) at 4:45-60

US 10,734,481

1. A semiconductor device, comprising:
a substrate of a first doping type at a first doping level having first and second surfaces;
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;
a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;
transistors formed in at least one of the first active region or second active region;
at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first surface to the second surface of the substrate; and
at least one well region adjacent to the first or second active region containing at least one graded dopant region, the graded dopant region to aid carrier movement from the first surface to the second surface of the substrate.

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US 11,121,222

1. A VLSI semiconductor device, comprising:
a substrate of a first doping type at a first doping level having a surface;
a first active region disposed adjacent the surface with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed;
a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;
transistors formed in at least one of the first active region or second active region;
at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first and second active regions towards an area of the substrate where there are no active regions; and
at least one well region adjacent to the first or second active region containing at least one graded dopant region, the graded dopant region to aid carrier movement from the surface towards the area of the substrate where there are no active regions, wherein at least some of the transistors form digital logic of the VLSI semiconductor device.

-00552: Ex. 1001 ('222 pat.) at 4:38-62

US 11,316,014

1. An electronic system, the system comprising:
at least one semiconductor device, the at least one semiconductor device including:
a substrate of a first doping type at a first doping level having a surface;
a first active region disposed adjacent the surface with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed;
a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;
transistors formed in at least one of the first active region or second active region;
at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first and second active regions towards an area of the substrate where there are no active regions; and
at least one well region adjacent to the first or second active region containing at least one graded dopant region, the graded dopant region to aid carrier movement from the surface towards the area of the substrate where there are no active regions, wherein at least some of the transistors form digital logic of the semiconductor device.

-00553: Ex. 1001 ('014 pat.) at 4:49-5:7

2. Movement of Carriers from the Surface Layer

- There is no "different structure" that can "perform the claimed function."



> Here, the apparatus claims are most similar to those in *Ericsson* and are fundamentally dissimilar to those in *Ball Aerosol*. The '940 patent's apparatus claims are drawn to "[a]n apparatus *for frequency upconversion*" (claim 4) or "[a]n apparatus *for communicating*" (claim 22), all of which comprise "a switch module *to receive*" an oscillating signal and a bias signal, wherein the oscillating signal "*causes* said switch module *to gate* said bias signal and thereby *generate* a periodic signal having a plurality of harmonics." '940 patent, col. 67, ll. 25–33 (emphases added); *id.* col. 69, ll. 19–32 (emphases added). Accordingly, just as D-Link's products only required a component that was reasonably capable of "arranging information for transmission . . . which identifies a type of payload information . . .," *Ericsson*, 773 F.3d at 1217, Nozawa's circuit requires only an oscillating signal that is reasonably capable of gating the bias signal in a manner that generates a periodic signal having a plurality of harmonics. And, unlike in *Ball Aerosol*, the claims here recite no structural limitations that would preclude a prior art reference that discloses a different structure from performing the claimed function.

ParkerVision, Inc. v. Qualcomm Inc., 903 F.3d 1354, 1362 (Fed. Cir. 2018)

2. Movement of Carriers from the Surface Layer

- Greenthread's claim language requires "actual operation" and "actual performance" of the claimed limitation in order to be found obvious.

> In both of those cases, actual operation of arranging elements in a particular way was required because of the claim language. Neither case involved claim language resembling the language in INVT's claims. Intervenors emphasize that the

INVT SPE LLC v. Int'l Trade Comm'n, 46 F.4th 1361, 1372 (Fed. Cir. 2022)

Overview of Issues

1. **Petitioner has presented zero "actual evidence" that the Petitions are timely.**
2. **The Claims require "movement of carriers" from the "surface layer" or "active region."**
3. **The '195 and '502 Claims require "movement of minority carriers" from the "surface layer."**
4. Kawagoe does not disclose "movement of [minority] carriers" from the "surface layer."
5. Onoda/Nishizawa does not disclose "movement of [minority] carriers" from the "surface layer."
6. Petitioner has the burden to identify electric fields that would "aid carrier movement."
7. Petitioner's expert confirmed that carriers in the "surface layer" are affected by numerous other fields and forces.
8. Petitioner's expert confirmed "movement of carriers" depends on the sum of all fields in the "surface layer."
9. Petitioner's expert did not analyze any of the fields or force magnitudes in the "surface layer."
10. Petitioner's prosecution-related arguments are incorrect.
11. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

3. Movement of Minority Carriers from the Surface Layer

- The ’195 and ’502 claims require “movement of minority carriers.”

US 8,421,195

1. A CMOS Semiconductor device comprising:
a surface layer;
a substrate;
an active region including a source and a drain, disposed on one surface of said surface layer;
a single drift layer disposed between the other surface of said surface layer and said substrate, said drift layer having a graded concentration of dopants extending between said surface layer and said substrate, said drift layer further having a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate; and
at least one well region disposed in said single drift layer, said well region having a graded concentration of dopants and a second static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.

-00468: Ex. 1001 (’195 pat.) at 4:13-29

US 9,190,502

7. A semiconductor device comprising:
a surface layer;
a substrate;
an active region including a source and a drain, disposed on one surface of said surface layer;
a single drift layer disposed between the other surface of said surface layer and said substrate, said drift layer having a graded concentration of dopants generating a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate; and
at least one well region disposed in said single drift layer, said well region having a graded concentration of dopants generating a second static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.

-00469: Ex. 1001 (’502 pat.) at 4:52-67

3. Movement of Minority Carriers from the Surface Layer

- The Challenged Claims ***must*** be considered in light of the specification.

¶¶ 1,2. The claims are directed to the invention that is described in the specification; they do not have meaning removed from the context from which they arose. Thus the claims are construed to state the legal scope of each patented invention, on examination of the language of the claims, the description in the specification, and the prosecution history. *See Renishaw PLC v. Marposs Societa' per Azioni*, 158 F.3d 1243, 1250, 48 USPQ2d 1117, 1122 (Fed. Cir.1998) ("[T]he interpretation to be given a term can only be determined and confirmed with a full understanding of what the inventors actually invented and intended to envelop with the claim."). Although

Netword LLC v. Centraal Corp.,
242 F.3d 1347, 1352 (Fed. Cir. 2001)

[1–3] "If the intrinsic record fully governs the proper construction of a term, we review the [b]oard's claim construction *de novo*." *Wasica Fin. GmbH v. Cont'l Auto. Sys., Inc.*, 853 F.3d 1272, 1278 (Fed. Cir. 2017). During reexamination, "the PTO must give claims their broadest reasonable construction consistent with the specification." *In re ICON Health & Fitness, Inc.*, 496 F.3d 1374, 1379 (Fed. Cir. 2007). Even under the broadest reasonable construction rubric, however, the board must always "consider the claims in light of the specification and teachings in the underlying patent." *In re CSB-Sys. Int'l, Inc.*, 832 F.3d 1335, 1341 (Fed. Cir. 2016) (citations and internal quotation marks omitted). And there is no reason why this construction could not coincide with that of a court in litigation.

In re Power Integrations,
884 F.3d 1370, 1375 (Fed. Cir. 2018)

Courts must exercise caution lest dictionary definitions, usually the least controversial source of extrinsic evidence, be converted into technical terms of art having legal, not linguistic, significance. The best source for understanding a technical term is the specification from which it arose, informed, as needed, by the prosecution history. The evolution of restrictions in the claims, in the course of examination in the PTO, reveals how those closest to the patenting process—the inventor and the patent examiner—viewed the subject matter. *See Hoechst Celanese Corp. v. BP Chemicals Ltd.*, 78 F.3d 1575, 1578, 38 USPQ2d 1126, 1129 (Fed.Cir. 1996) ("A technical term used in a patent document is interpreted as having the meaning that it would be given by persons experienced in the field of the invention, unless it is apparent from the patent and the prosecution history that the inventor used the term with a different meaning.") When the specification explains and defines a term used in the claims, without ambiguity or incompleteness, there is no need to search further for the meaning of the term.

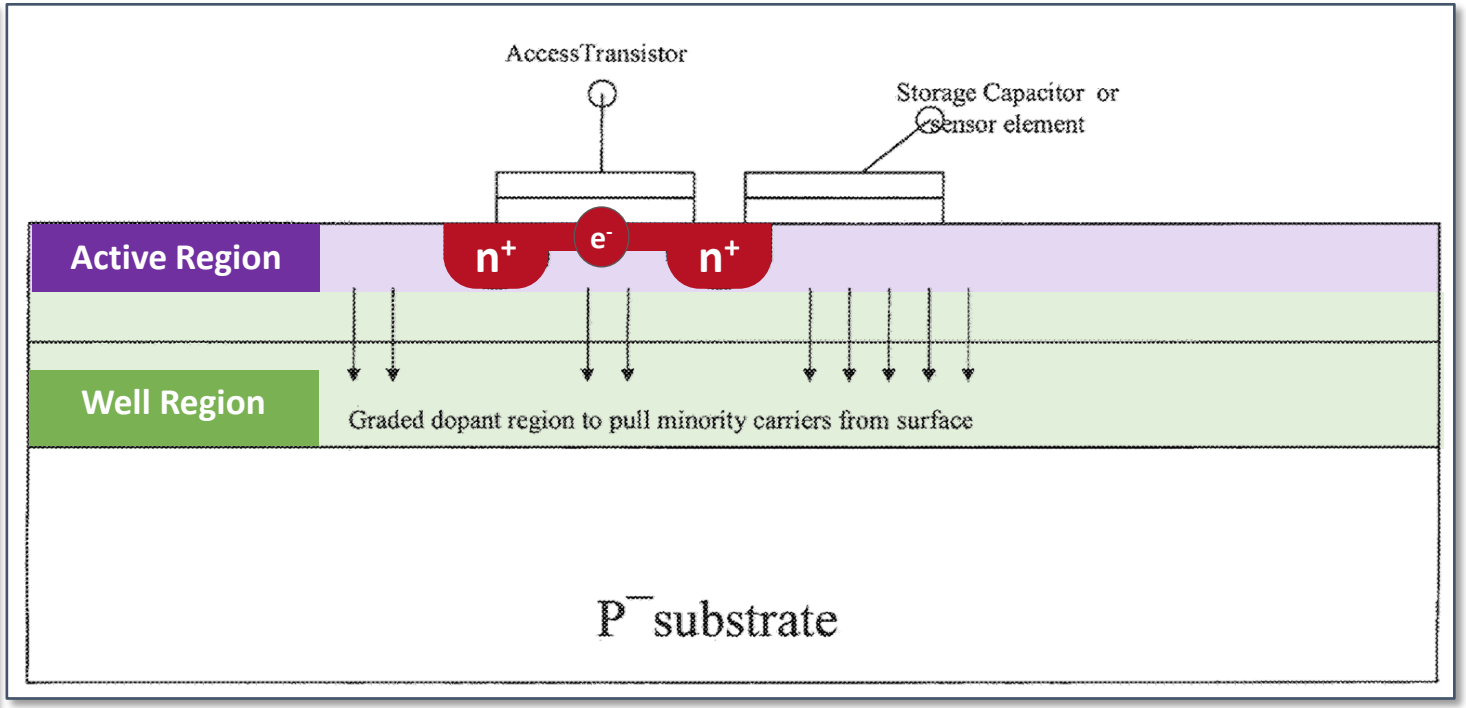
Multiform Desiccants, Inc. v. Medzam, Ltd., 133 F.3d 1473, 1478 (Fed. Cir. 1998)

3. Movement of Minority Carriers from the Surface Layer

- The specification explains the "majority carriers" are the majority carrier in the MOSFET channel.

Bipolar Junction transistors (BJT) are minority carrier devices as the principle device conduction mechanism. However, majority carriers also a small yet finite role in modulating the conductivity in BJTs. Consequently, both carriers (electrons and holes) play a role in the switching performance of BJTs. The maximum frequency of operation in BJTs is limited by the base transit time as well as the quick recombination of the majority carriers when the device is switched off (prior to beginning the next cycle). The dominant carrier mechanism in BJTs is carrier diffusion. Carrier drift current component is fairly small, especially in uniformly doped base BJTs. Efforts 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. However, most semiconductor devices, including various power MOSFETs (traditional, DMOS, lateral, vertical and a host of other configurations), IGBT's (Insulated Gated Base Transistors), still use a uniformly doped drift epitaxial region in the base. FIG. **1** shows the relative doping concentration versus distance in a BJT. FIG. **2** shows the uniformly doped epi region' in a IGBT. In contrast to BJTs, MOS devices are majority carrier devices for conduction. The conduction is channel dominated. The channel can be a surface in one plane in planar devices. The surface can also be on the sidewalls in a vertical device. Other

-00468: Ex. 1001 ('195 pat.) at 1:23-46



-00468: Ex. 1001 at Fig. 5B

[4] Because the channel is formed by electrons with a **n**egative charge, the MOSFET is referred to as an **n**-channel MOSFET, and the "minority carriers" are holes.

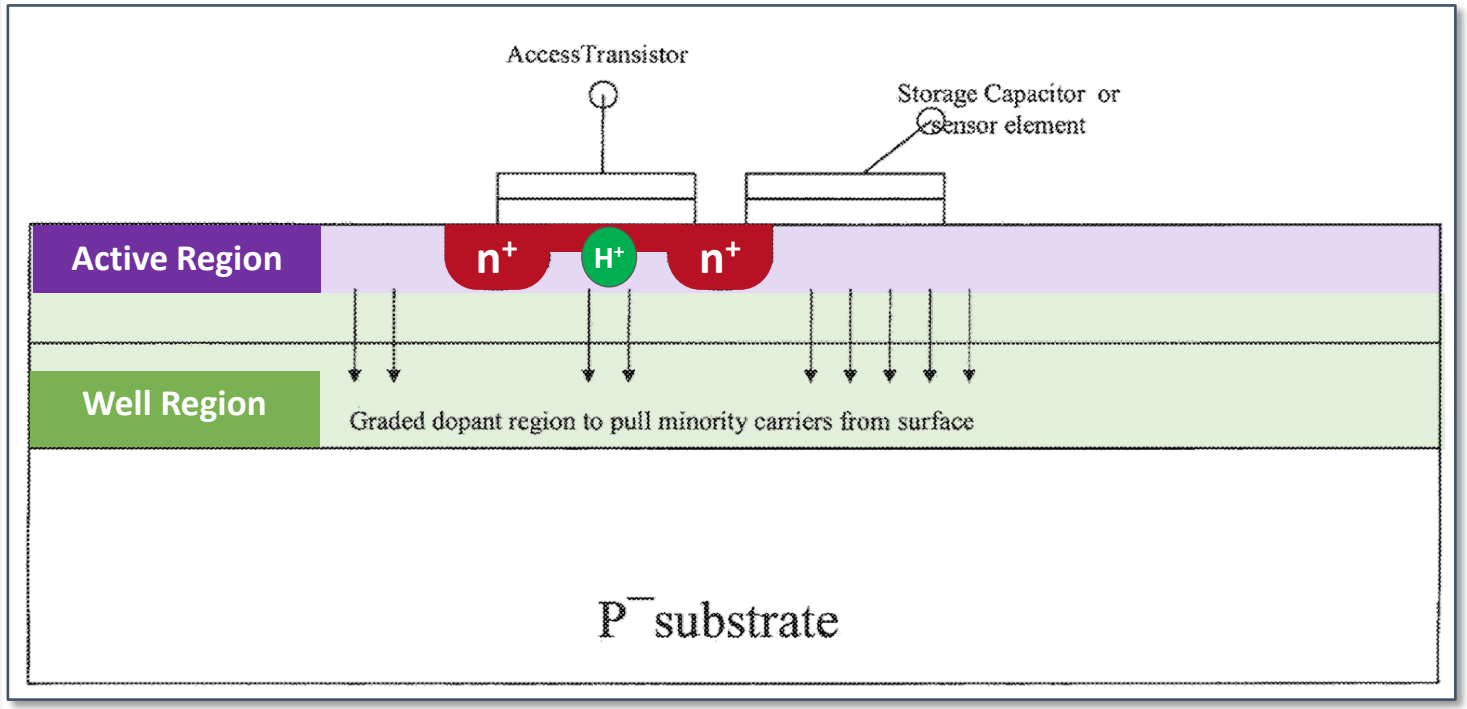
-00468: Ex. 2057 (Glew Decl.) at ¶36, n. 3

3. Movement of Minority Carriers from the Surface Layer

- The "spurious minority carriers" interfere with the "active circuitry at the surface."

As illustrated in FIGS. **5**(*a*), **5**(*b*), **5**(*c*), donor gradient is also of benefit to very large scale integrated circuits (VLSI)–VLSI logic, DRAM, nonvolatile memory like NAND flash. Spurious minority carriers can be generated by clock switching in digital VLSI logic and memory IC'S. These unwanted carriers can discharge dynamically-held 'actively held high' nodes. Statically held nodes (with V_{cc}) can not be affected, in most cases. Degradation of refresh time in DRAM's is one of the results, because the capacitor holds charge dynamically. Similarly, degradation of CMOS digital images, in digital imaging IC's is another result of the havoc caused by minority carriers. Pixel and color resolution can be significantly enhanced in imaging IC's with the embodiments described here. Creating 'Sub Terrain' recombination centers underneath the wells (gold doping, platinum doping) as is done in some high-voltage diodes is not practical for VLSI circuits. Hence, a novel technique has been described here by creating a drift field to sweep these unwanted minority carriers into the substrate as quickly as possible, from the active circuitry at the surface. In a preferred embodiment, the subterrain n-layer has a graded donor concentration to sweep the minority carriers deep into the substrate. One or more of such layers can also be implemented through wafer to wafer bonding or similar "transfer" mechanisms. This n-layer can be a deeply-implanted layer. It can also be an epitaxial layer. The n-well and p-well also can be graded or retrograded in dopants, as desired, to sweep those carriers away from the surface as well.

-00468: Ex. 1001 ('195 pat.) at 3:14-40



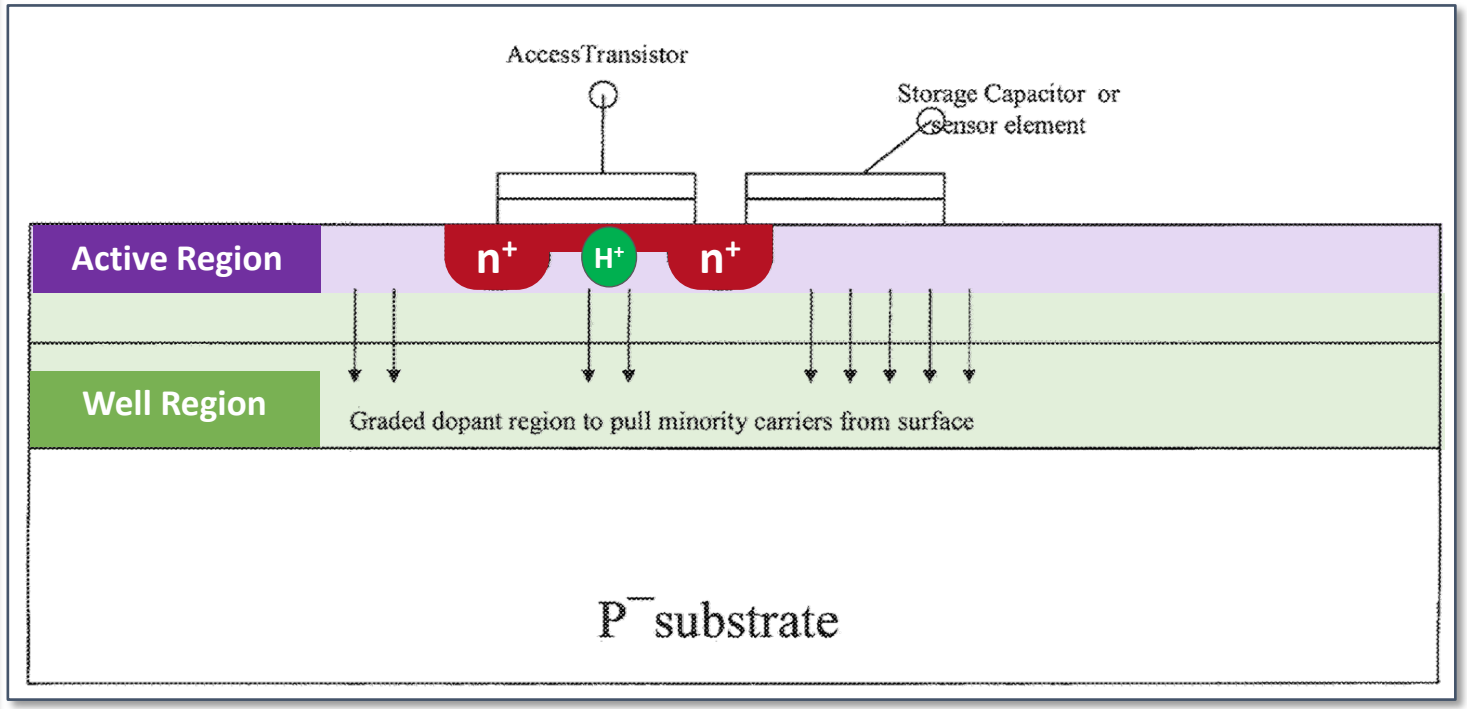
-00468: Ex. 1001 at Fig. 5B

3. Movement of Minority Carriers from the Surface Layer

- The "minority carriers" interfere with the MOSFET's channel.

As illustrated in FIGS. **5**(*a*), **5**(*b*), **5**(*c*), donor gradient is also of benefit to very large scale integrated circuits (VLSI)– VLSI logic, DRAM, nonvolatile memory like NAND flash. Spurious minority carriers can be generated by clock switching in digital VLSI logic and memory IC'S. These unwanted carriers can discharge dynamically-held 'actively held high' nodes. Statically held nodes (with V_{cc}) can not be affected, in most cases. Degradation of refresh time in DRAM's is one of the results, because the capacitor holds charge dynamically. Similarly, degradation of CMOS digital images, in digital imaging IC's is another result of the havoc caused by minority carriers. Pixel and color resolution can be significantly enhanced in imaging IC's with the embodiments described here. Creating 'Sub Terrain' recombination centers underneath the wells (gold doping, platinum doping) as is done in some high-voltage diodes is not practical for VLSI circuits. Hence, a novel technique has been described here by creating a drift field to sweep these unwanted minority carriers into the substrate as quickly as possible, from the active circuitry at the surface. In a preferred embodiment, the subterrain n-layer has a graded donor concentration to sweep the minority carriers deep into the substrate. One or more of such layers can also be implemented through wafer to wafer bonding or similar "transfer" mechanisms. This n-layer can be a deeply-implanted layer. It can also be an epitaxial layer. The n-well and p-well also can be graded or retrograded in dopants, as desired, to sweep those carriers away from the surface as well.

-00468: Ex. 1001 ('195 pat.) at 3:14-40



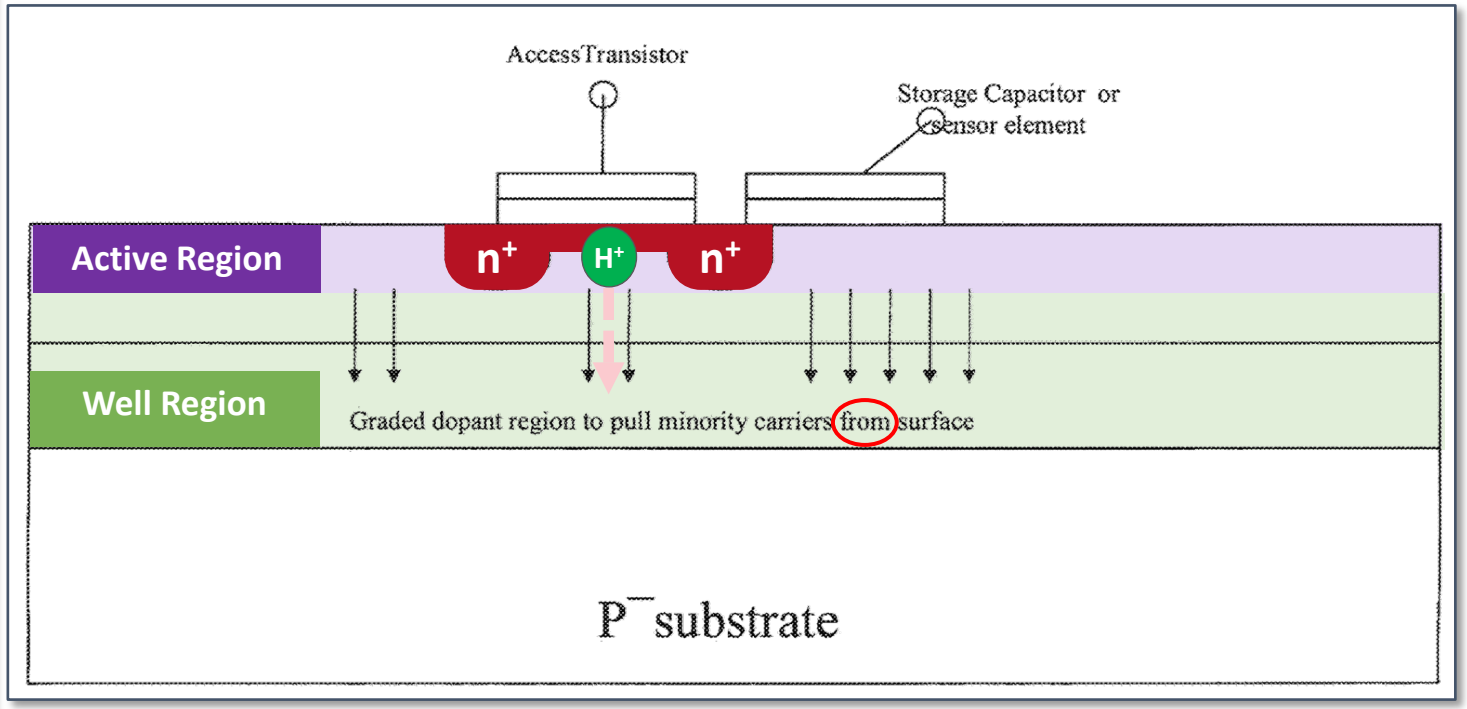
-00468: Ex. 1001 at Fig. 5B

3. Movement of Minority Carriers from the Surface Layer

- A "drift field" with a "graded dopant region" sweeps the minority carriers from the surface.

As illustrated in FIGS. **5**(*a*), **5**(*b*), **5**(*c*), donor gradient is also of benefit to very large scale integrated circuits (VLSI)–VLSI logic, DRAM, nonvolatile memory like NAND flash. Spurious minority carriers can be generated by clock switching in digital VLSI logic and memory IC'S. These unwanted carriers can discharge dynamically-held 'actively held high' nodes. Statically held nodes (with V_{cc}) can not be affected, in most cases. Degradation of refresh time in DRAM's is one of the results, because the capacitor holds charge dynamically. Similarly, degradation of CMOS digital images, in digital imaging IC's is another result of the havoc caused by minority carriers. Pixel and color resolution can be significantly enhanced in imaging IC's with the embodiments described here. Creating 'Sub Terrain' recombination centers underneath the wells (gold doping, platinum doping) as is done in some high-voltage diodes is not practical for VLSI circuits. Hence, a novel technique has been described here by creating a drift field to sweep these unwanted minority carriers into the substrate as quickly as possible, from the active circuitry at the surface. In a preferred embodiment, the subterrain n-layer has a graded donor concentration to sweep the minority carriers deep into the substrate. One or more of such layers can also be implemented through wafer to wafer bonding or similar "transfer" mechanisms. This n-layer can be a deeply-implanted layer. It can also be an epitaxial layer. The n-well and p-well also can be graded or retrograded in dopants, as desired, to sweep those carriers away from the surface as well.

-00468: Ex. 1001 ('195 pat.) at 3:14-40



-00468: Ex. 1001 at Fig. 5B

3. Movement of Minority Carriers from the Surface Layer

- Dr. Glew explained that in Fig. 5B, the "minority carriers" are holes.

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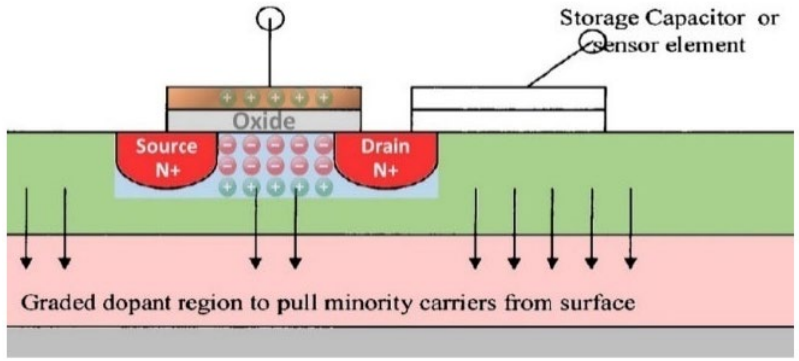
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Greenthread Ex. 2057, p. 1 of 46
MPS v. Greenthread

36. When a positive voltage is applied to the gate, an electric field forms in the oxide. This positive electric field repels the "positive" holes downwards, while the negative electrons (red circles) are attracted to move into the blue surface layer. When enough electrons have accumulated in the surface layer below the oxide, they form a conductive channel (as annotated in Figure 5B below) of electrons between the source and the drain, and current can begin to flow through the transistor.



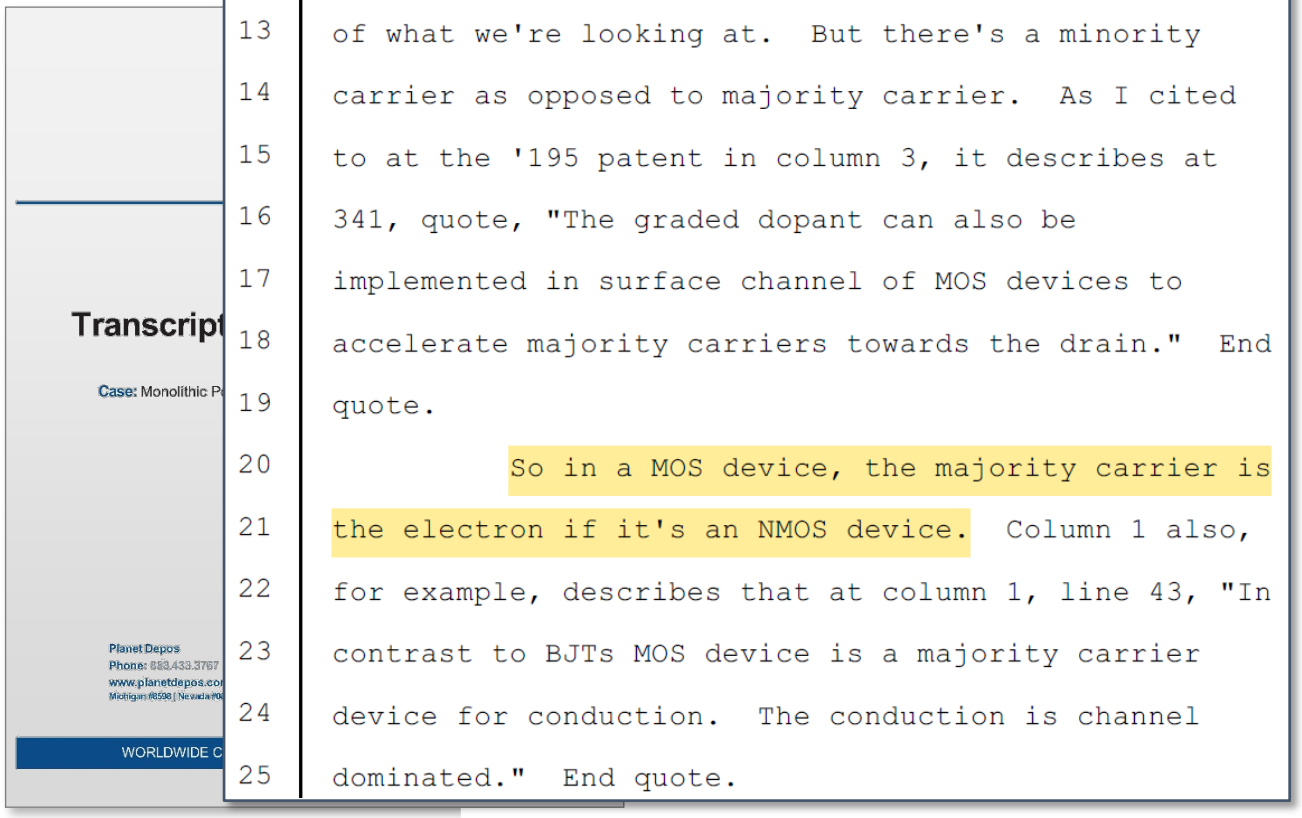
Ex. 1001, FIG. 5B (annotated).[3] In order to turn the transistor "off," the positive voltage is removed from the gate and the channel disappears as the holes return to the surface layer.

[3] Because the channel is formed by electrons with a **n**egative charge, the MOSFET is referred to as an **n**-channel MOSFET, and the "minority carriers" are holes.

-00468: Ex. 2057 (Glew Decl.) at ¶36, n. 3

3. Movement of Minority Carriers from the Surface Layer

- Dr. Glew confirmed the same when cross-examined by Petitioner's counsel.



Q. I guess while we're on it, what's a minority carrier?

A. Well, you know, it depends on the context of what we're looking at. But there's a minority carrier as opposed to majority carrier. As I cited to at the '195 patent in column 3, it describes at 341, quote, "The graded dopant can also be implemented in surface channel of MOS devices to accelerate majority carriers towards the drain." End quote.

So in a MOS device, the majority carrier is the electron if it's an NMOS device. Column 1 also, for example, describes that at column 1, line 43, "In contrast to BJTs MOS device is a majority carrier device for conduction. The conduction is channel dominated." End quote.

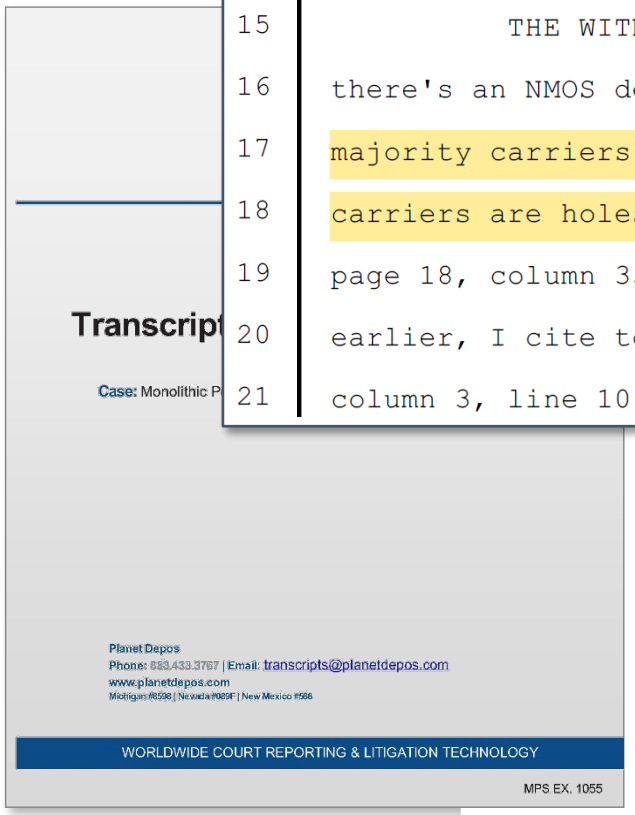
So basically in a MOS device, the majority carrier in an NMOS device would be electrons. Electrons flow from an N-type source to an N-type drain.

Minority carriers would be the holes. So when one applies voltage to the great which sits on top of the channel, one inverts the layers so that holes are -- a positive voltage pushes holes away from the surface and attracts electrons to the surface. That way, there is a connection between the source and drain which have electrons, and now the channel has electrons, and the channels are that majority carrier -- excuse me, the electrons in that channel are the majority carrier, and the P -- the holes represented by the symbol P are pushed away, and those are the minority carriers.

Ex. 1055 (Glew Dep. Tr.) at 38:10-39:16

3. Movement of Minority Carriers from the Surface Layer

- Dr. Glew confirmed the same when cross-examined by Petitioner's counsel.



12 Q. In the well 6P, is a minority carrier an
13 electron or a hole?
14 MR. WHITEHURST: Object to form.
15 THE WITNESS: In the minority carrier 6P,
16 there's an NMOS device, and so in the NMOS device the
17 majority carriers are the electrons, the minority
18 carriers are holes. As I wrote in my declaration on
19 page 18, column 35, I believe we reviewed this
20 earlier, I cite to Exhibit 1001, the '195 patent, at
21 column 3, line 10.

Ex. 1055 (Glew Dep. Tr.) at 126:12-21

15 Q. Is that an electron or a hole which is the
16 minority carrier?
17 A. For NMOS, the minority carrier is P. For
18 PMOS, a minority carrier would be N.

Ex. 1055 at 133:15-18

6 Q. I'll ask again because that doesn't
7 actually answer. Are the minority carriers of P-type
8 electron or hole?
9 MR. WHITEHURST: Object to form.
10 THE WITNESS: A hole or P-type minority
11 carrier is a minority carrier in an NMOS device, an
12 NMOS transistor. On the other hand, an electron or
13 N-type carrier would be the minority in a PMOS
14 device.

Ex. 1055 at 136:6-14

3. Movement of Minority Carriers from the Surface Layer

- Dr. Glew confirmed the same when cross-examined by Petitioner's counsel.

Q. Okay. In a device that has an N doped drain and an N doped source in a P doped well, are the minority carriers electrons or holes?

A. In an NMOS device with an N-type source and drain in a P-well, the majority carriers in an NMOS device are electrons. The minority carriers are holes.

Ex. 1055 at 138:22-139:3

Q. Do you have an opinion what the spurious minority carriers would be in Figure 5B?

A. Figure 5B is an NMOS device. So it would store and pass electrons to spurious minority carriers -- would be holes, or P.

Ex. 1055 (Glew Dep. Tr.) at 152:23-153:2

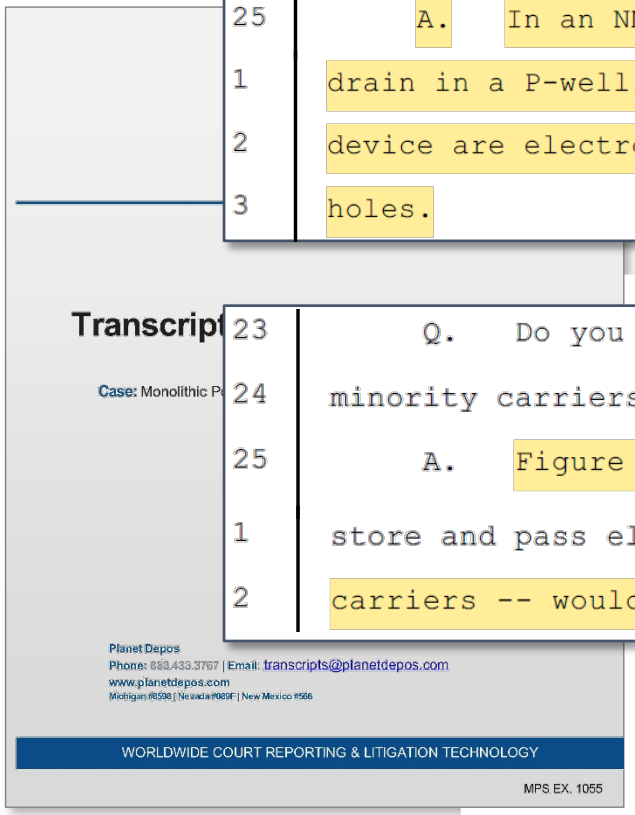
Q. Do you have an opinion whether the majority carriers -- before I ask that question, can you go back and look at Figure 5B where you identified an NMOS transistor in a P-well?

A. Yes.

Q. Can you explain what the majority carrier would be?

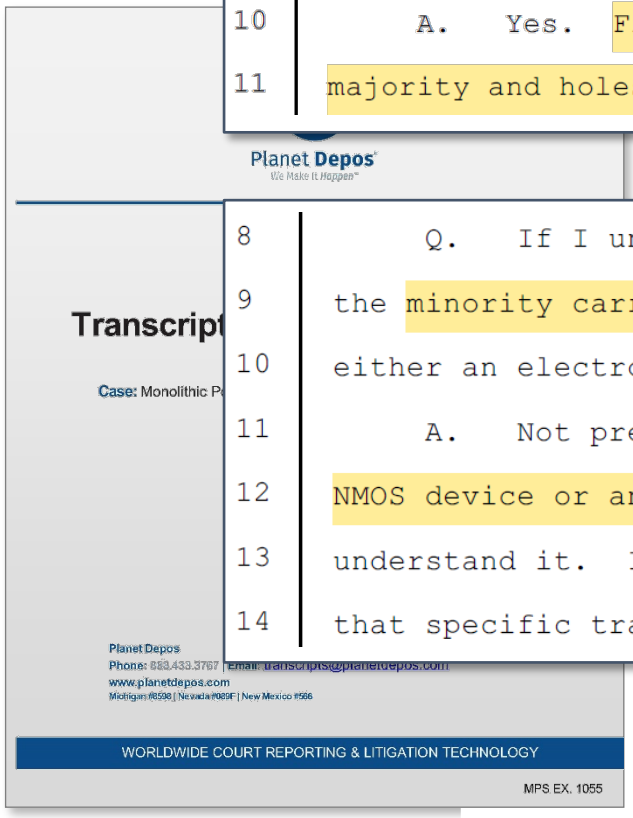
A. Yes. This is an NMOS transistor shown because the source and drain are labelled N and T. So an NMOS transistor requires electrons to connect the N-type source and drain. So electrons are the majority carrier N-type and the minority carriers are holes or P-type.

Ex. 1055 at 154:25-155:12



3. Movement of Minority Carriers from the Surface Layer

- Dr. Glew confirmed the same when cross-examined by Petitioner's counsel.



7 Q. And I believe you testified previously that
8 these unwanted minority carriers would be holes in
9 Figure 5B?
10 A. Yes. Figure 5B is NMOS, so electrons are
11 majority and holes are minority carriers.

Ex. 1055 at 157:7-11

8 Q. If I understand your testimony correctly,
9 the minority carrier as claimed in claim 1 can be
10 either an electron or a hole?
11 A. Not precisely. It can be a hole for an
12 NMOS device or an electron for a PMOS device, as I
13 understand it. It must be the minority carrier for
14 that specific transistor in the CMOS structure.

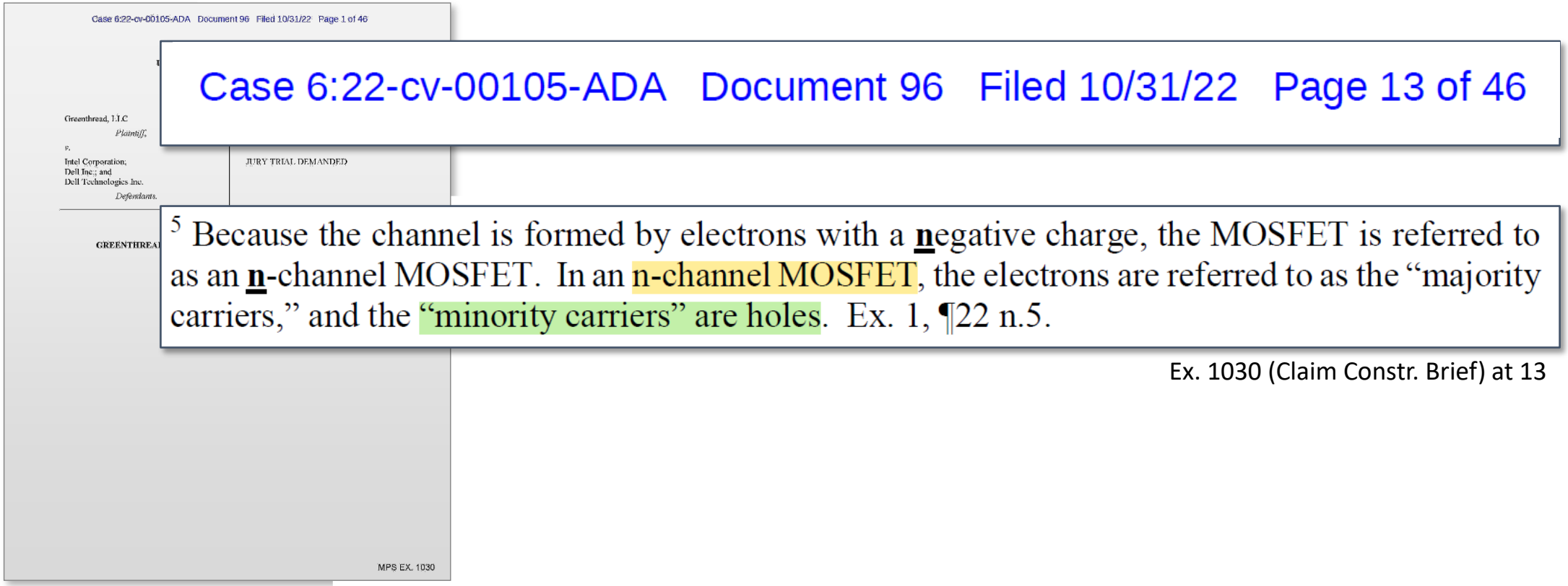
Ex. 1055 (Glew Dep. Tr.) at 188:8-14

13 Q. So just like we saw in Figure 5B of the
14 patent, Figure 11 of ONODA is showing a dopant
15 profile for an NMOS transistor in a P-well?
16 A. That is my understanding, yes.
17 Q. And for an NMOS transistor, the majority
18 carrier would be an electron?
19 A. Yes, that is correct. NMOS has a majority
20 of electrons as the carriers.
21 Q. And what is the minority carrier?
22 A. The minority carrier for an NMOS is a hole.

Ex. 1055 at 176:13-22

3. Movement of Minority Carriers from the Surface Layer

- Petitioner was aware of Greenthread's position when it filed its Petitions in February and March 2024 and cited Greenthread's prior claim construction briefing.



Ex. 1030 (Claim Constr. Brief) at 13

3. Movement of Minority Carriers from the Surface Layer

- Dr. Campbell (Petitioner's expert) relies on the doping type within a region to define the "minority carrier."

C. Overview of the Technical Concepts

32. My analysis will primarily rely on prior art patents Onoda, Nishizawa, and Kawagoe to show that the '195, '502, and '222 patents are invalid. All three prior art patents deal with the same technical challenge as the patents being challenged: how to protect electronic circuits from impacts of high energy photons such as x-rays or high energy particles such as alpha particles. When a high-energy collision takes place in a semiconductor, it creates a very large number of negatively charged electrons and positively charged holes. Of particular interest are the minority carriers such as electrons in a p-type region. If enough of these electrons

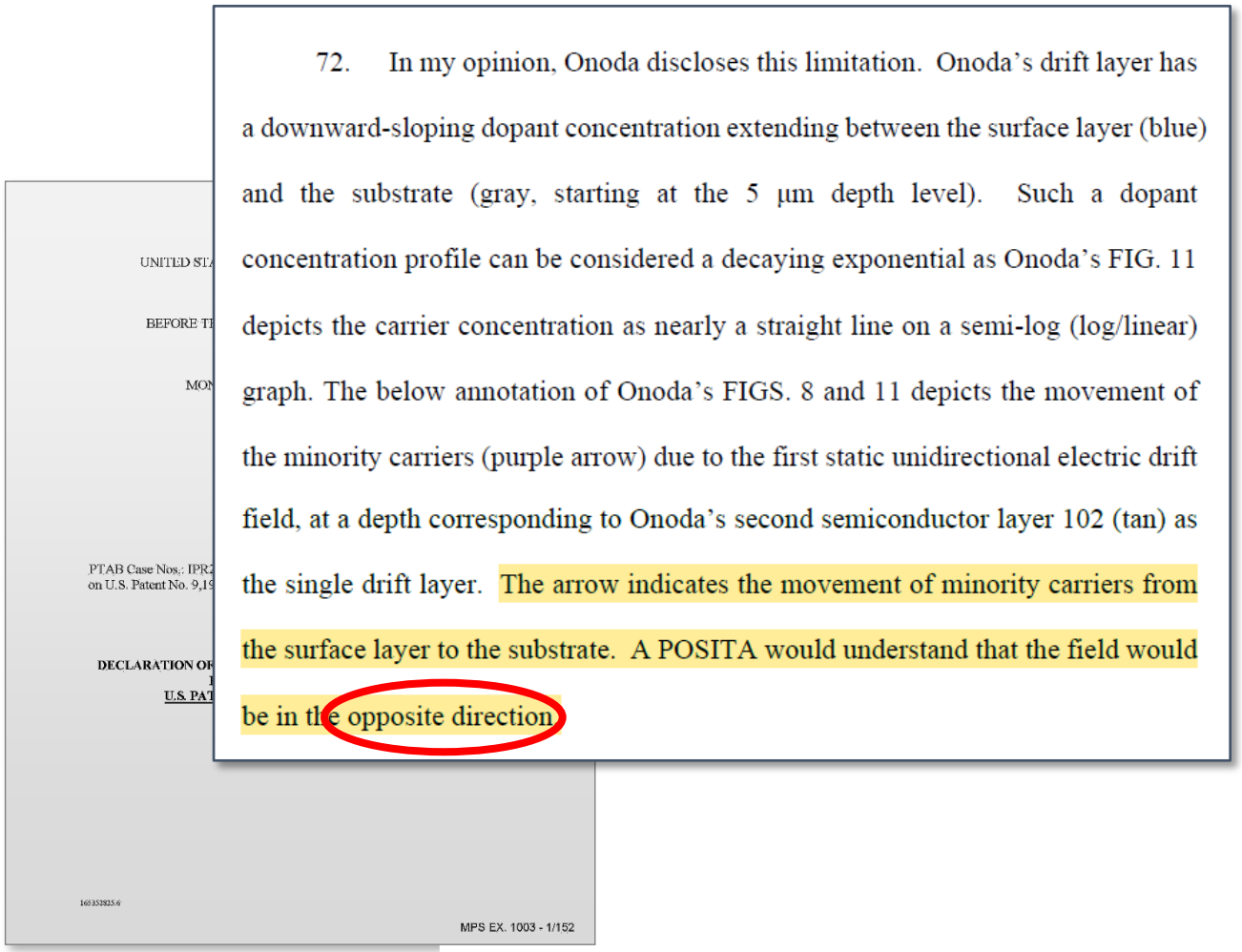
are collected by the circuitry on the surface of the semiconductor, they can introduce faults in the circuit. As will be discussed, these charged species move in response to an electric field, and so an electric field that is properly constructed will push the minority carriers away from the surface, making their collection much less probable. I will also point out that an electric field caused by a doping profile can improve the performance of photosensing devices (Patents from Jastrzebski and from Kamins) by drifting minority carriers into the substrate.

-00468: Ex. 1003 (Campbell Decl.) at ¶32

charged electrons and positively charged holes. Of particular interest are the minority carriers such as electrons in a p-type region. If enough of these electrons

3. Movement of Minority Carriers from the Surface Layer

- Ground I: Dr. Campbell views electrons as "minority carriers."



72. In my opinion, Onoda discloses this limitation. Onoda's drift layer has a downward-sloping dopant concentration extending between the surface layer (blue) and the substrate (gray, starting at the 5 μm depth level). Such a dopant concentration profile can be considered a decaying exponential as Onoda's FIG. 11 depicts the carrier concentration as nearly a straight line on a semi-log (log/linear) graph. The below annotation of Onoda's FIGS. 8 and 11 depicts the movement of the minority carriers (purple arrow) due to the first static unidirectional electric drift field, at a depth corresponding to Onoda's second semiconductor layer 102 (tan) as the single drift layer. The arrow indicates the movement of minority carriers from the surface layer to the substrate. A POSITA would understand that the field would be in the opposite direction.

79. The well region 105a, like the "single drift layer" 102, has a dopant profile that has a downward sloping gradient. (Onoda at [0052].) The well region 105a has the claimed second static unidirectional electric drift field. The pink arrow depicts the direction of minority carrier movement (where the field would be depicted in the opposite direction) to aid the movement of minority carriers from the surface layer to said substrate.

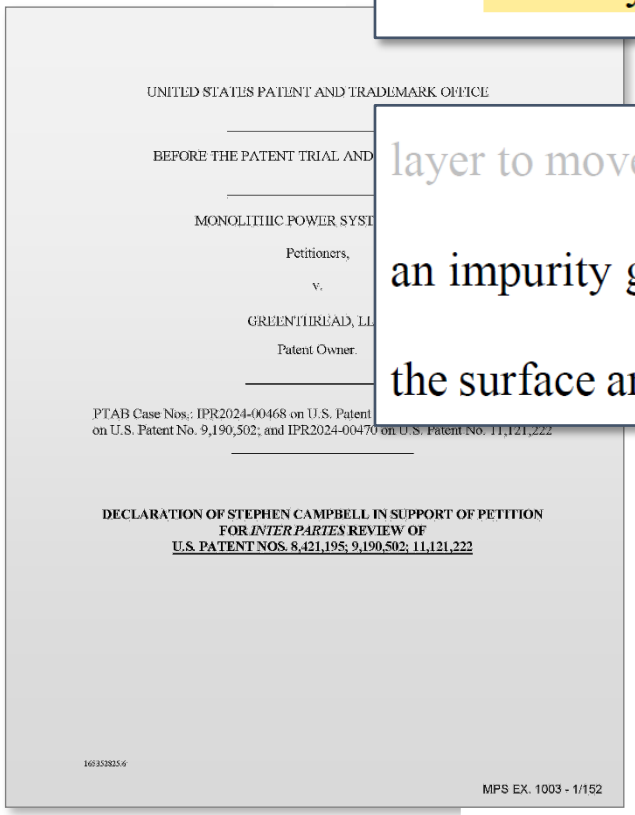
-00468: Ex. 1003 (Campbell Decl.) at ¶¶72, 79

3. Movement of Minority Carriers from the Surface Layer

- Ground II: Dr. Campbell views electrons as "minority carriers."

89. Onoda and Nishizawa both disclose CMOS devices and are concerned with minority carriers (electrons) moving into the functioning circuitry. Specifically,

layer to move the minority carriers to the substrate. Nishizawa at 18:10-19:53. Such an impurity gradient will keep the electrons from being captured by the circuitry at the surface and impairing the circuit. (*Id.* at 18:42-50.) FIG. 16 in Nishizawa depicts


UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND

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Petitioners,

v.

GREENTHREAD, LL

Patent Owner.

PTAB Case Nos.: IPR2024-00468 on U.S. Patent
on U.S. Patent No. 9,190,502; and IPR2024-00470 on U.S. Patent No. 11,121,222

DECLARATION OF STEPHEN CAMPBELL IN SUPPORT OF PETITION
FOR *INTER PARTES* REVIEW OF
U.S. PATENT NOS. 8,421,195; 9,190,502; 11,121,222

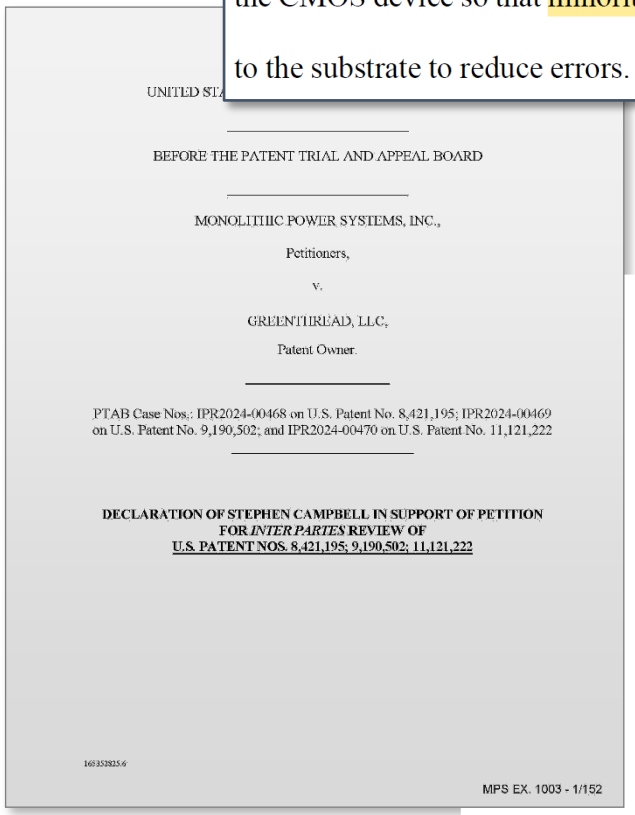
MPS EX. 1003 - 1/152

-00468: Ex. 1003 (Campbell Decl.) at ¶¶89, 96

3. Movement of Minority Carriers from the Surface Layer

- Ground III: Dr. Campbell views electrons as "minority carriers."

transistors for the CMOS device. This single drift layer in Kawagoe is at the surface of the semiconductor device (*see, e.g.*, Kawagoe at 15:62-16:15) and is formed into the CMOS device so that minority carriers (*e.g.*, electrons in the p-well) are attracted to the substrate to reduce errors. (*Id.* at 16:7-11.) The single drift layer in Kawagoe



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BEFORE THE PATENT TRIAL AND APPEAL BOARD

MONOLITHIC POWER SYSTEMS, INC.,

Petitioners,

v.

GREENTHREAD, LLC,

Patent Owner.

PTAB Case Nos.: IPR2024-00468 on U.S. Patent No. 8,421,195; IPR2024-00469 on U.S. Patent No. 9,190,502; and IPR2024-00470 on U.S. Patent No. 11,121,222

DECLARATION OF STEPHEN CAMPBELL IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NOS. 8,421,195; 9,190,502; 11,121,222

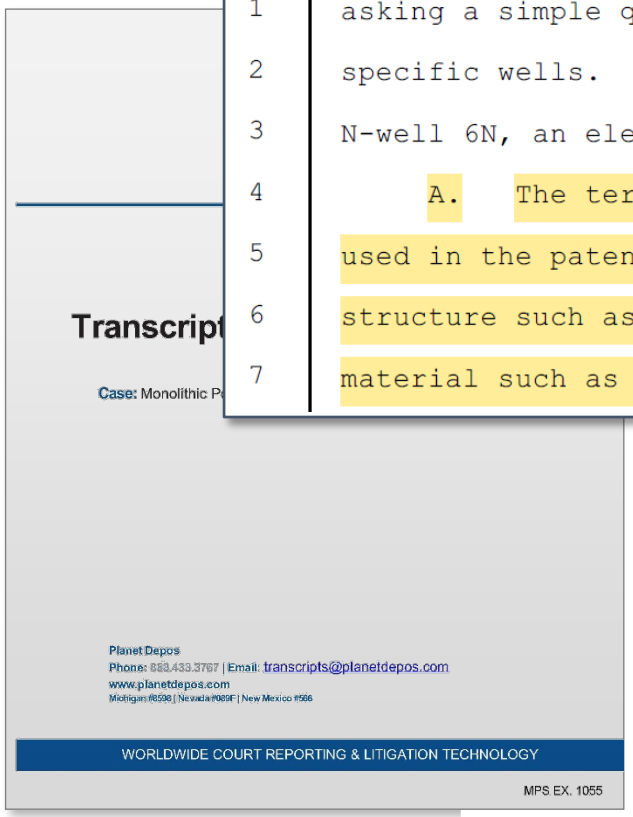
MPS EX. 1003 - 1/152

-00468: Ex. 1003 (Campbell Decl.) at ¶¶111, 117

117. Kawagoe teaches a single drift layer with a graded dopant profile. This graded dopant profile results in "electrons … [being] attracted to the substrate body 2S by that concentration gradient." (Kawagoe at 16:7-11.) A POSITA would understand that electrons are minority carriers in the p-well, and that the electrons are attracted to the substrate due to a static unidirectional electric drift field. A POSITA would understand the field to be static because it is created by doping impurities that are fixed during device fabrication, as depicted in Kawagoe (*see, e.g.*, Kawagoe at 15:26-36, FIGS. 20-21). There are electric fields in separate regions due to the graded doping concentrations, *e.g.*, those depicted by pink and purple arrows in annotated FIG. 17 below, where the pink field would have been understood to be the the first static unidirectional electric drift field. The arrow orientation and direction are depicting the drift of minority carriers (electrons) in the p-well and a POSITA would understand that the electric field would exist in the opposite direction.

3. Movement of Minority Carriers from the Surface Layer

- Dr. Campbell's understanding of "minority carrier" is inconsistent with how the term is used in the patents.



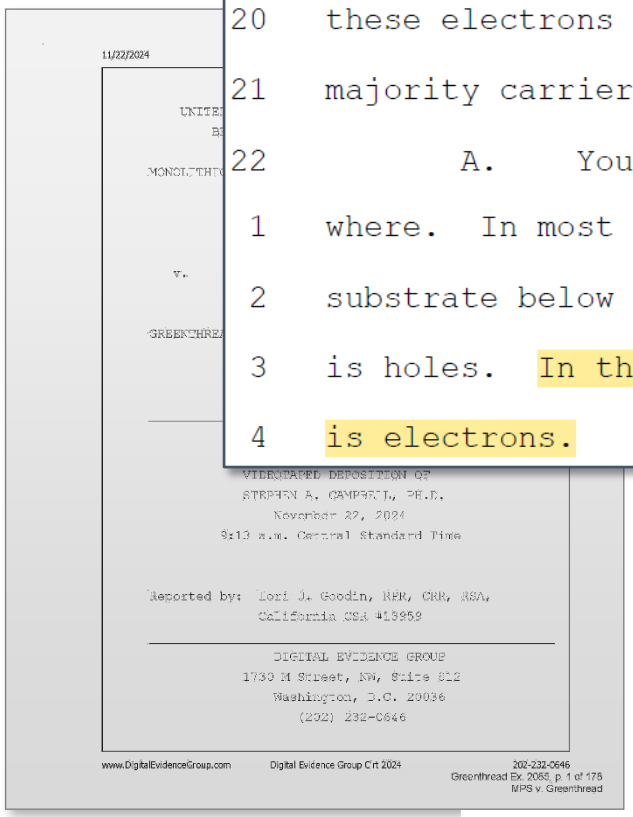
25 Q. I'm asking about Kawagoe, though, and I'm
1 asking a simple question. It's A or B in those
2 specific wells. Figure 16 is a minority carrier in
3 N-well 6N, an electron or a hole?
4 A. The term majority or minority character as
5 used in the patents in suit relates to an electronic
6 structure such as a transistor, not to a chunk of raw
7 material such as a well.

Ex. 1055 (Glew Dep. Tr.)
at 129:25-130:7 (left); 139:4-22 (right)

4 Q. Okay. And taking your answer to Figure 16
5 of Kawagoe, the minority carriers of the well 6N,
6 according to your testimony, are electrons; correct?
7 A. A well doesn't have a minority/majority. A
8 transistor has a minority/majority carrier. It
9 carries from the source to the drain. So you're
10 asking me about a PMOS device, P source drain in an
11 N-well; is that correct?
12 Q. I'm asking specifically about the N
13 material 6N of Kawagoe's Figure 16 which the P doped
14 source and P doped drain are implanted thereon. What
15 would the minority carrier be there?
16 MR. WHITEHURST: Object to form.
17 THE WITNESS: As I've stated previously,
18 the term, concept of carrier has meaning in a context
19 of a transistor or device. The current is carried
20 from the source to the drain. The PMOS device with a
21 P source in a P drain has holes as the majority
22 carrier and electrons as the minority

3. Movement of Minority Carriers from the Surface Layer

- Dr. Campbell recognized that what constitutes a "minority carrier" changes when one looks at the channel itself.


11/22/2024

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v.
GREENTHREA

VIDEOTAPED DEPOSITION OF
STEPHEN A. CAMPBELL, PH.D.
November 22, 2024
9:13 a.m. Central Standard Time

Reported by: Lori J. Goodin, RPR, CRR, RSA,
California CSR #13959

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Greenthread Ex. 2085, p. 1 of 175
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19 Q. So, in an NMOS device, when you have
20 these electrons carrying the charge, what is the
21 majority carrier?
22 A. You have to qualify that by saying
1 where. In most of the device -- sorry. In the
2 substrate below the channel, the majority carrier
3 is holes. In the channel, the majority carrier
4 is electrons.

Ex. 2085 (Campbell Dep. Tr.) at 80:19-81:4

16 Q. And when you form an N-channel, what
17 is the majority carrier in the channel?
18 A. For an NMOS device, it would be
19 electrons.
20 Q. Okay. So, if we are talking about
21 turning this transistor on and it forms an
22 N-channel, the majority carrier in the N-channel
1 is an electron, correct?
2 A. Correct.
3 Q. What is the minority carrier in the
4 N-channel?
5 A. Holes.

Ex. 2085 at 98:16-99:5

3. Movement of Minority Carriers from the Surface Layer

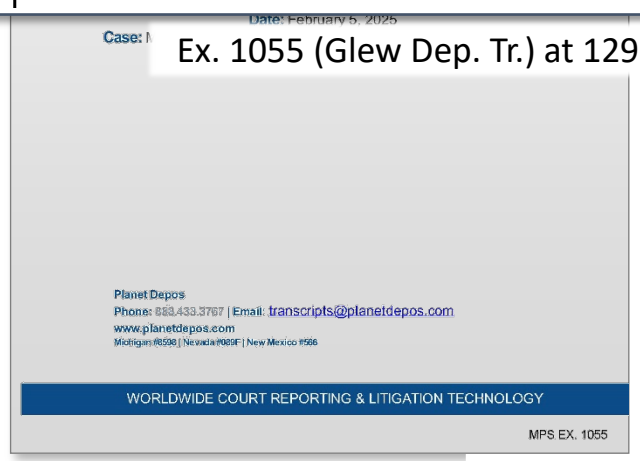
- In an NMOS device, electrons are the majority carriers and holes are the minority carriers.

So in the NMOS device shown in the P-well, NMOS devices are formed in P-wells, the majority carrier from NMOS device is an electron.

Q. So you're stating that the minority carrier in the P-well 6P of Figure 16 is a hole; correct?

A. What I'm saying is the minority carrier in the NMOS device would be considered P. The majority carrier in the NMOS device in the P-well is an electron.

Ex. 1055 (Glew Dep. Tr.) at 129:10-18



Q. And let me ask that more simply. In the P-type material, P-well 6P in Figure 16, is the minority carrier an electron or a hole?

MR. WHITEHURST: Object to form.

THE WITNESS: The question makes no sense because there is no carrier unless there's device. Where would this electron be carrying something? You know, to carry it has to go from A to B. There's nowhere for an electron to carry in this. The term carrier as it's used in the '195 patent is very clearly associated with a specific device type, and with the NMOS device type shown in that figure, the majority carrier in the language used in the '195 patent is an electron.

Ex. 1055 at 127:24-128:12

Q. Does it matter whether the transistor is on or off?

A. No. The majority carrier for an NMOS transistor is always an electron. Transistors are meant to turn on and off. That's a normal part of their operation.

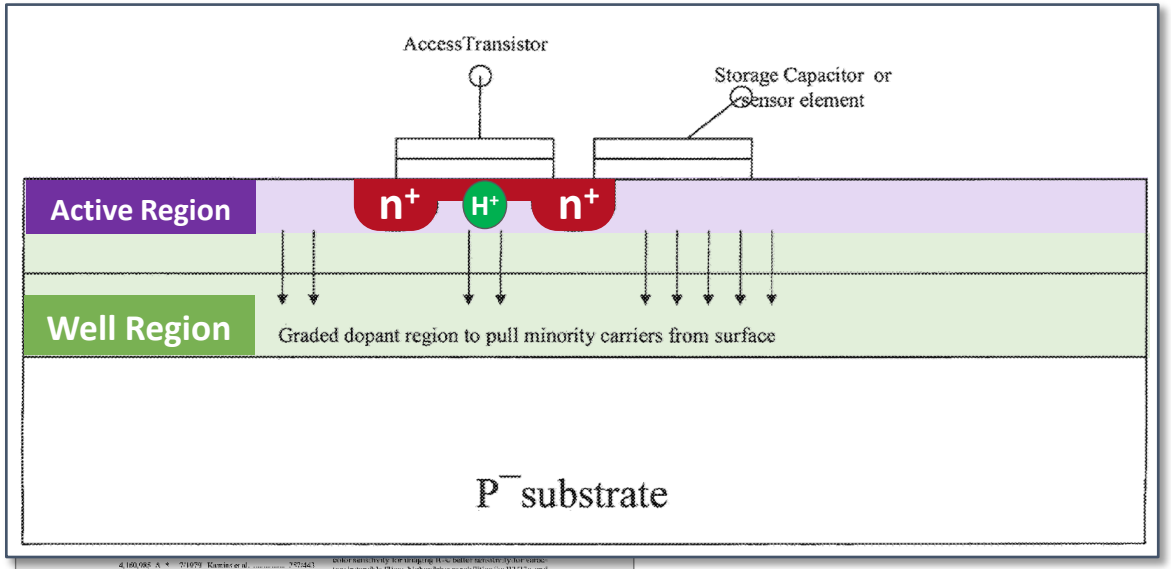
Q. So a majority carrier -- strike that. So for the NMOS transistor shown in Figure 5B, the majority carrier is an electron regardless of whether the transistor is on or off?

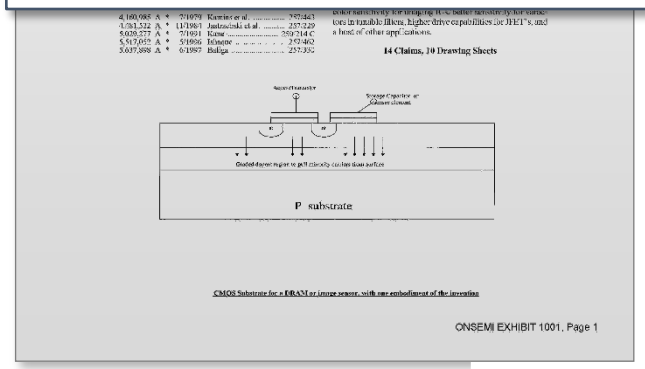
A. Yes. The majority carrier is always an electron for NMOS transistor, regardless of its state. It is channel dominated. And the only way to get an electrical signal from the source to the drain is to use electrons. The source is filled with electrons, the drain is filled with electrons, and the only way to connect the two is with electrons. It never changes.

Ex. 1055 at 160:2-19

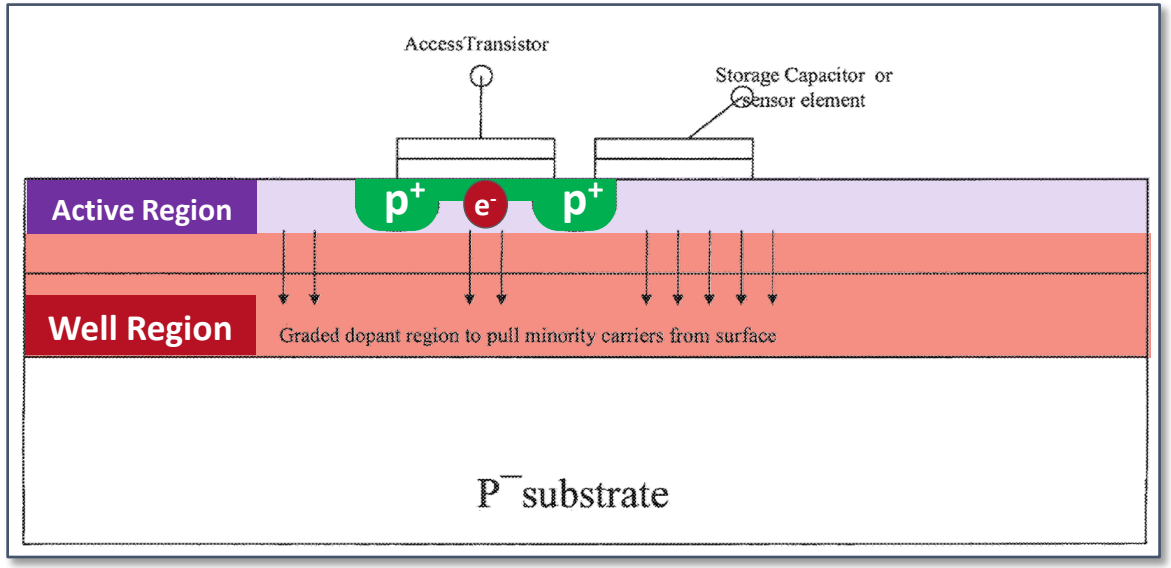
3. Movement of Minority Carriers from the Surface Layer

- In an NMOS transistor, the "majority carrier" is an electron, and the "minority carrier" is a hole.
- In an PMOS transistor, the "majority carrier" is a hole, and the "minority carrier" is an electron.





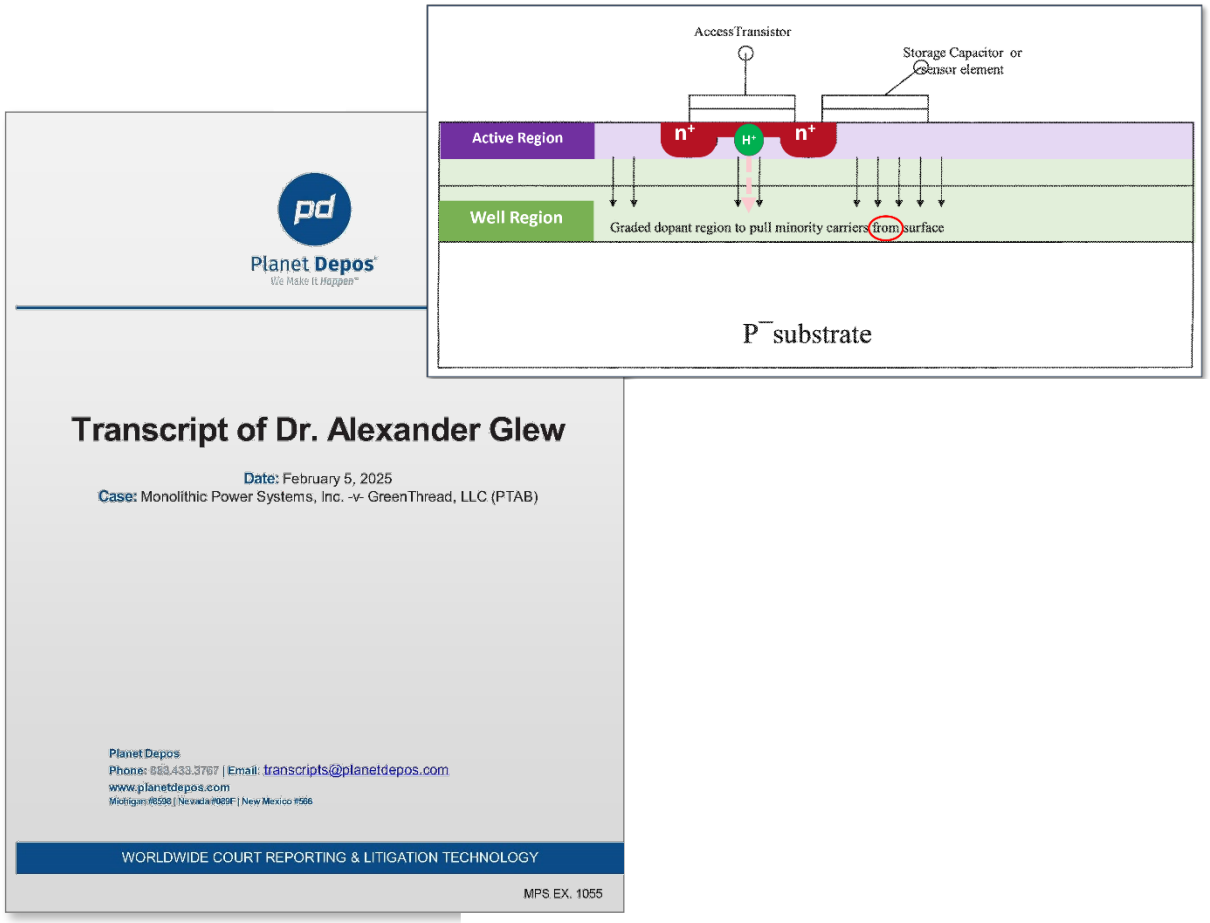
-00468: Ex. 1001 ('195 pat.) at Fig. 5B



-00468: Ex. 1001 at Fig. 5B

3. Movement of Minority Carriers from the Surface Layer

- Dr. Glew explained how the only "carrier" that Fig. 5B's electric field can move from the "surface layer" is a positively-charged hole.



Q. Now what effect, if any, would the electric field shown in Figure 5B have on an electron?

A. Figure 5B shows an electric field pointed downward. So it would pull holes downward and push electrons upward in the opposite direction. The electric field acts in opposite direction on carriers of opposite polarity. Thanks to Ben Franklin, electrons go in the opposite direction of the electric field.

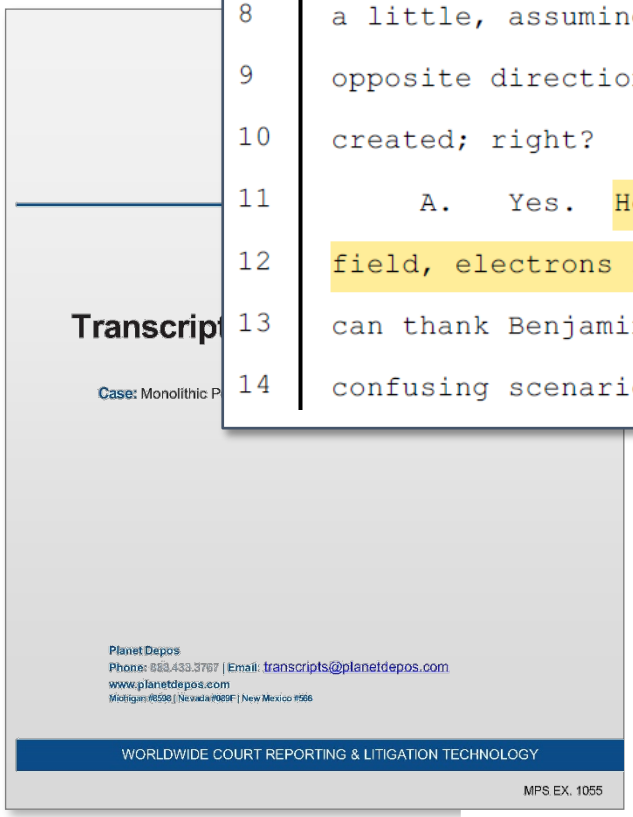
Q. Looking at Figure 5B, would the electric field in Figure 5B be capable of pulling electrons from the surface?

A. No. The electric field at 5B is pointed downwards. It only would pull holes downward. It would push electrons upwards. It could not pull electrons downward.

Ex. 1055 (Glew Dep. Tr.) at 159:6-21

3. Movement of Minority Carriers from the Surface Layer

- Dr. Glew explained how the only "carrier" that Fig. 5B's electric field can move from the "surface layer" is a positively-charged hole.



7 Q. Just to -- well, strike that. To slow down
8 a little, assuming electrons will flow in the
9 opposite direction of the electric field current
10 created; right?
11 A. Yes. Holes flow in the direction of the
12 field, electrons flow in the opposite direction. We
13 can thank Benjamin Franklin for creating this
14 confusing scenario.

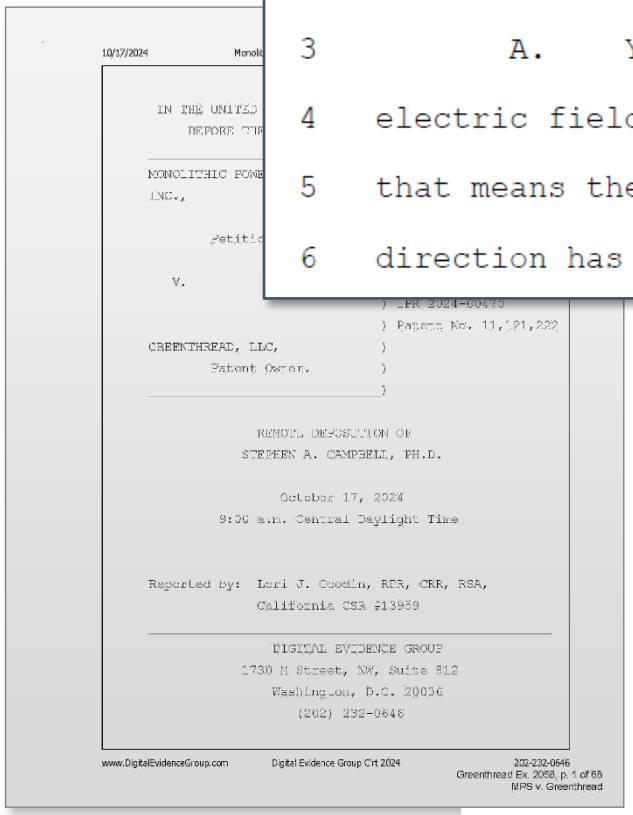
Ex. 1055 (Glew Dep. Tr.) at 70:7-14

25 and technology and semiconductor devices. An
1 electric field acts on everything in its area. Where
2 the field exists, it acts on charged particles, and
3 it acts on all charged particles of a certain
4 polarity in the same way. It will act on particles
5 of opposite polarity in the opposite direction.

Ex. 1055 at 74:25-75:5

3. Movement of Minority Carriers from the Surface Layer

- Dr. Campbell agrees that the downward-facing electric field can only move holes.


10/17/2024 Monolithic

IN THE UNITED
BEFORE THE

MONOLITHIC POWER
INC.,

Petitioner,

v.

GREENTHREAD, LLC,
Patent Owner.

IPR 2024-00470
Patent No. 11,721,222

REMOTE DEPOSITION OF
STEPHEN A. CAMPBELL, PH.D.

October 17, 2024
9:00 a.m. Central Daylight Time

Reported by: Lori J. Coodin, RDR, CRR, RSA,
California CSR #13959

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Greenthread Ex. 2058, p. 1 of 65
MPS v. Greenthread

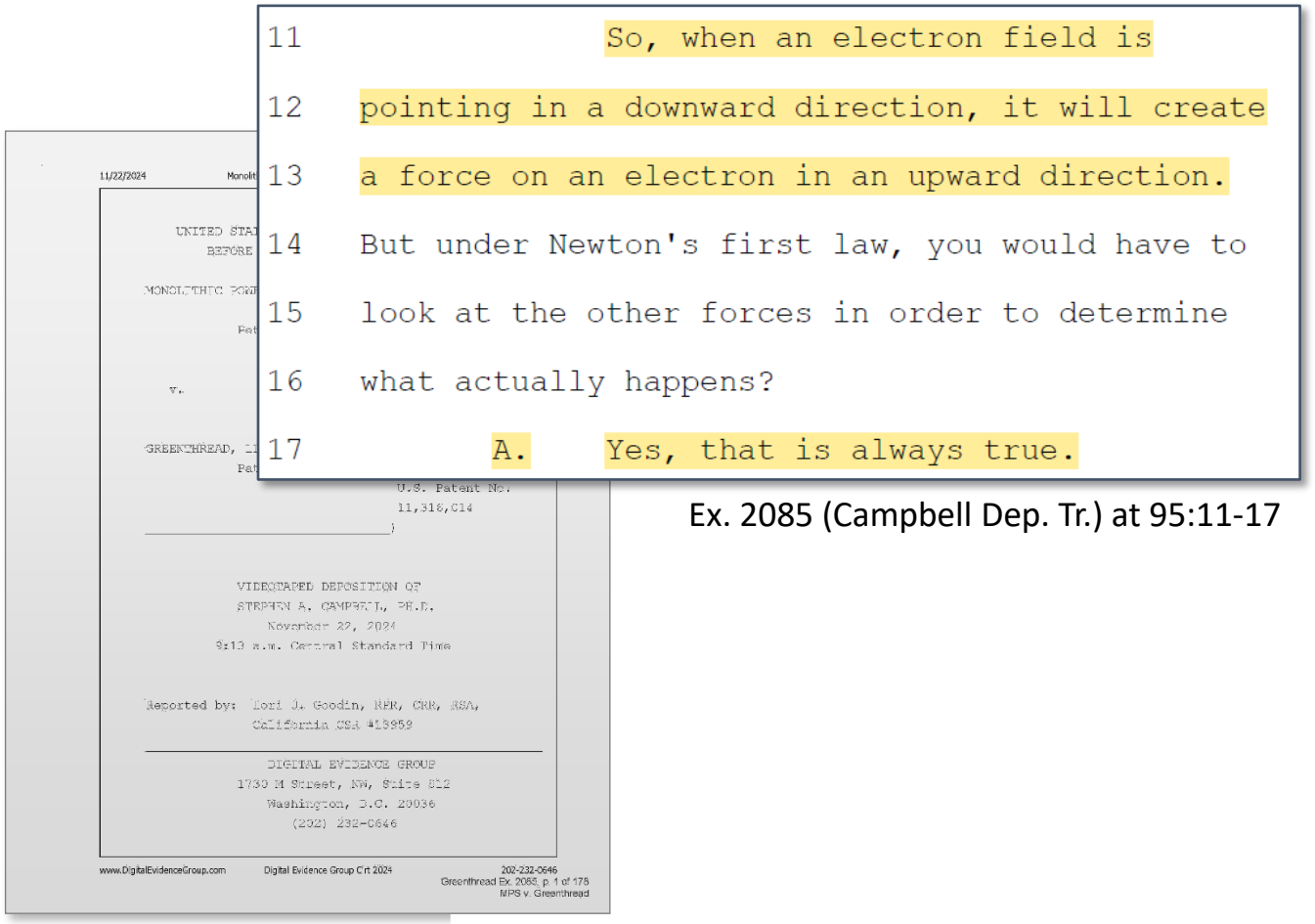
1	Q. What did you mean by
2	"properly constructed"?
3	A. You would have to construct an
4	electric field that moves the carriers away, and
5	that means the electric field has to be, the
6	direction has to be correct.

7	If you're moving poles, then you
8	have to have the electric field that points
9	downward.
10	If you're moving electrons, the
11	electric field has to be pointing upward and you
12	have to have a sufficient electric field
13	intensity to prevent most of the carriers from
14	being collected by the drain.

Ex. 2058 (Campbell Dep. Tr.) at 34:1-14

3. Movement of Minority Carriers from the Surface Layer

- Dr. Campbell agrees that the downward-facing electric field can only move holes.



VIDEOTAPED DEPOSITION OF
STEPHEN A. CAMPBELL, PH.D.
November 22, 2024
9:13 a.m. Central Standard Time

Reported by: Lori J. Goodin, RPR, CRR, RSA,
California CSR #13959

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Greenthread Ex. 2085, p. 1 of 175
MPS v. Greenthread

11 So, when an electron field is
12 pointing in a downward direction, it will create
13 a force on an electron in an upward direction.
14 But under Newton's first law, you would have to
15 look at the other forces in order to determine
16 what actually happens?
17 A. Yes, that is always true.

Ex. 2085 (Campbell Dep. Tr.) at 95:11-17

12 Q. Okay. Just so the record is clear,
13 the electric field shown in Figure 5B would cause
14 holes to move in a downward direction and
15 electrons move in an upward direction, right?
16 A. Yes.
17 Q. And why is that?
18 A. Because holes are positively charged
19 and electrons are negatively charged.

Ex. 2085 at 109:12-19

3. Movement of Minority Carriers from the Surface Layer

- If the "minority carrier" in an NMOS transistor were an electron, it would exclude the specification's preferred embodiment.

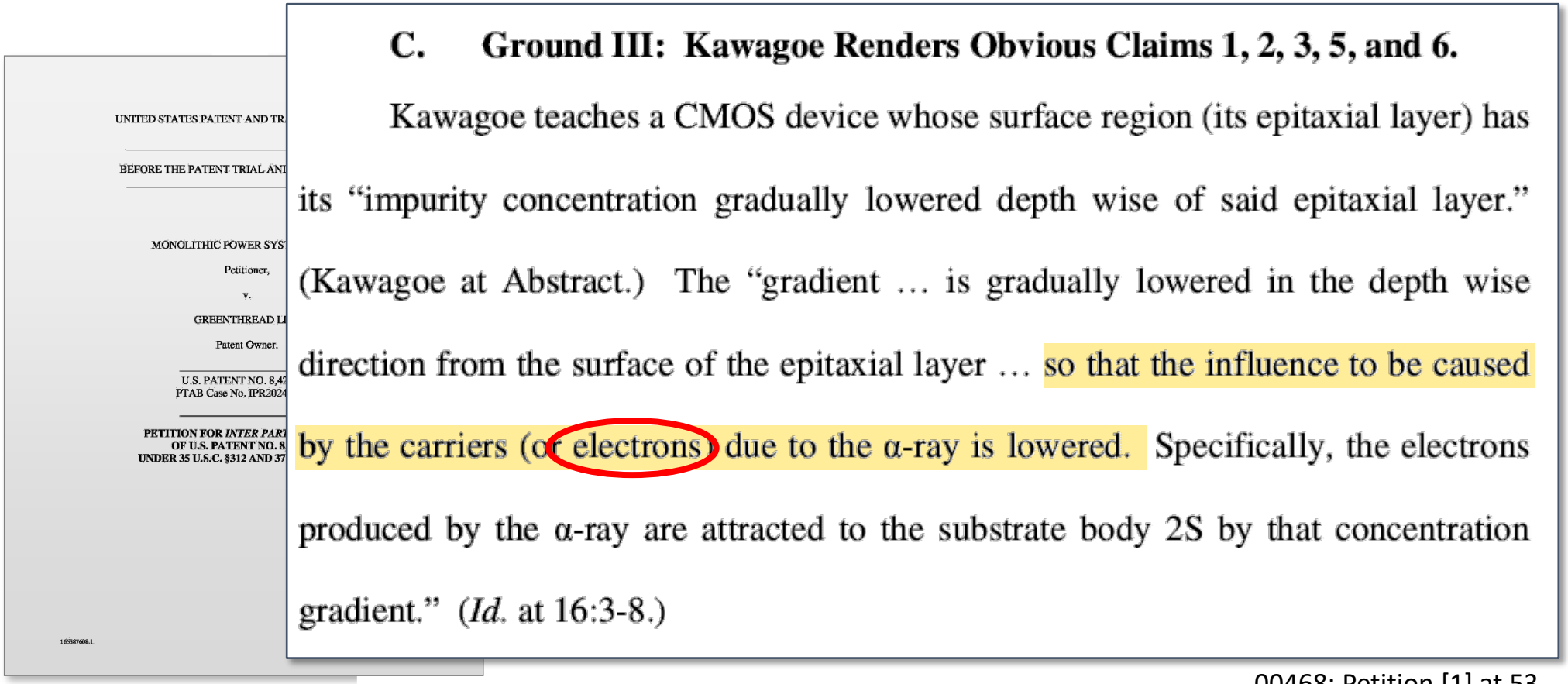


[17] Moreover, Defendants' expert admitted that construing the claims such that "employ[ing] the common technique of grounding the system" would cause the converter to be considered non-isolated would prevent the claims from encompassing the preferred embodiment. J.A. at 45070–71. A claim construction that "excludes the preferred embodiment is rarely, if ever, correct and would require highly persuasive evidentiary support." *Adams Respiratory Therapeutics, Inc. v. Perrigo Co.*, 616 F.3d 1283, 1290 (Fed.Cir.2010). In this case, the specification, including the claims, supports a reading that encompasses the preferred embodiment.

SynQor, Inc. v. Artesyn Techs., Inc.,
709 F.3d 1365, 1378-79 (Fed. Cir. 2013)

3. Movement of Minority Carriers from the Surface Layer

- Kawagoe's graded concentration is only concerned with ***electrons***.
- But the Petition says nothing about Kawagoe's effect on "minority carriers" (*i.e.*, holes).



UNITED STATES PATENT AND TR

BEFORE THE PATENT TRIAL AN

MONOLITHIC POWER SYS

Petitioner,

v.

GREENTHREAD LI

Patent Owner.

U.S. PATENT NO. 8,42
PTAB Case No. IPR2024

PETITION FOR *INTER PAR*
OF U.S. PATENT NO. 8
UNDER 35 U.S.C. §312 AND 37

16538760

C. Ground III: Kawagoe Renders Obvious Claims 1, 2, 3, 5, and 6.

Kawagoe teaches a CMOS device whose surface region (its epitaxial layer) has its "impurity concentration gradually lowered depth wise of said epitaxial layer." (Kawagoe at Abstract.) The "gradient … is gradually lowered in the depth wise direction from the surface of the epitaxial layer … so that the influence to be caused by the carriers (or electrons) due to the α-ray is lowered. Specifically, the electrons produced by the α-ray are attracted to the substrate body 2S by that concentration gradient." (*Id.* at 16:3-8.)

-00468: Petition [1] at 53

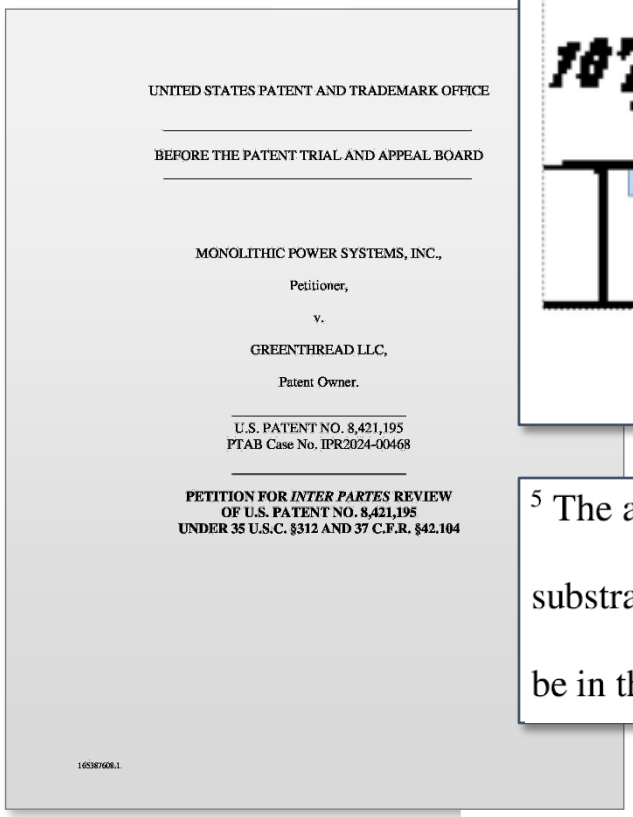
-00468: PO Resp. [35] at 22-24; PO Sur-Reply [47] at 17-18

PUBLIC VERSION

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

3. Movement of Minority Carriers from the Surface Layer

- Petitioner relies on Onoda's NMOS transistor whose "minority carrier" is holes.
- The Petition says nothing about Onoda's effect on holes but instead discusses ***electrons***.



UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MONOLITHIC POWER SYSTEMS, INC.,

Petitioner,

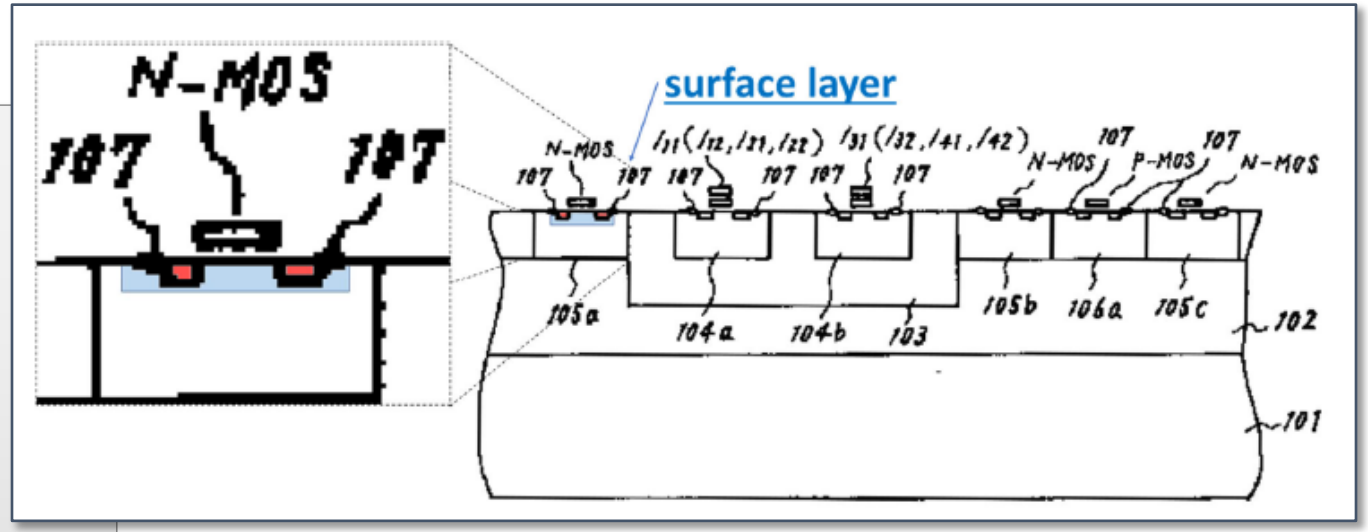
v.

GREENTHREAD LLC,

Patent Owner.

U.S. PATENT NO. 8,421,195
PTAB Case No. IPR2024-00468

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 8,421,195 UNDER 35 U.S.C. §312 AND 37 C.F.R. §42.104



[5] The arrow indicates the movement of minority carriers from the surface layer to the substrate. (Ex. 1003 at ¶¶ 72-74). A POSITA would understand that the field would be in the opposite direction. (*Id.*)

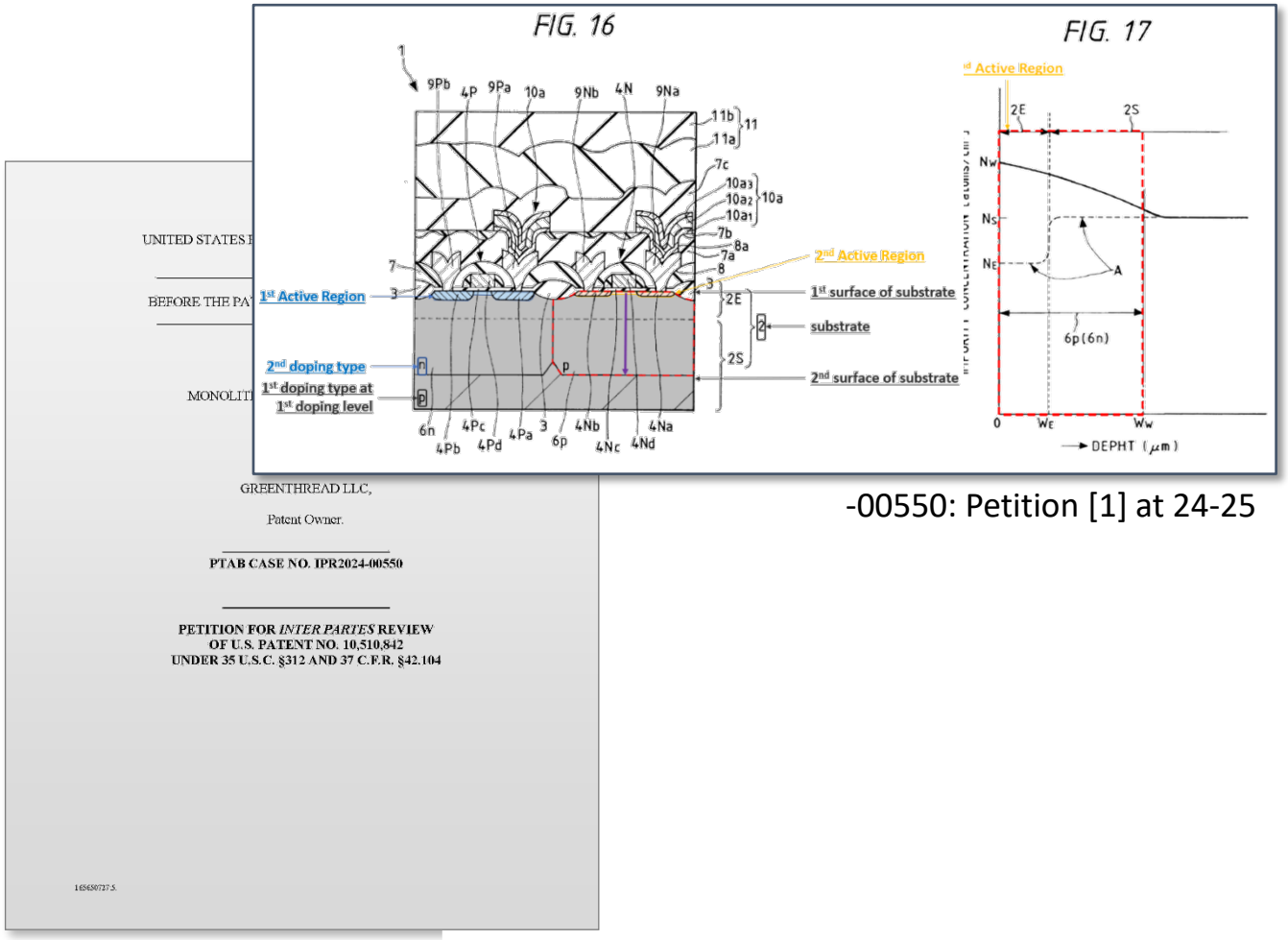
-00468: Petition [1] at 21, 32 n.5

Overview of Issues

1. **Petitioner has presented zero "actual evidence" that the Petitions are timely.**
2. **The Claims require "movement of carriers" from the "surface layer" or "active region."**
3. **The '195 and '502 Claims require "movement of minority carriers" from the "surface layer."**
4. **Kawagoe does not disclose "movement of [minority] carriers" from the "surface layer."**
5. Onoda/Nishizawa does not disclose "movement of [minority] carriers" from the "surface layer."
6. Petitioner has the burden to identify electric fields that would "aid carrier movement."
7. Petitioner's expert confirmed that carriers in the "surface layer" are affected by numerous other fields and forces.
8. Petitioner's expert confirmed "movement of carriers" depends on the sum of all fields in the "surface layer."
9. Petitioner's expert did not analyze any of the fields or force magnitudes in the "surface layer."
10. Petitioner's prosecution-related arguments are incorrect.
11. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

4. Kawagoe Does Not Move Carriers from the "Surface Layer"

- Kawagoe does not mention moving carriers from the "surface layer."



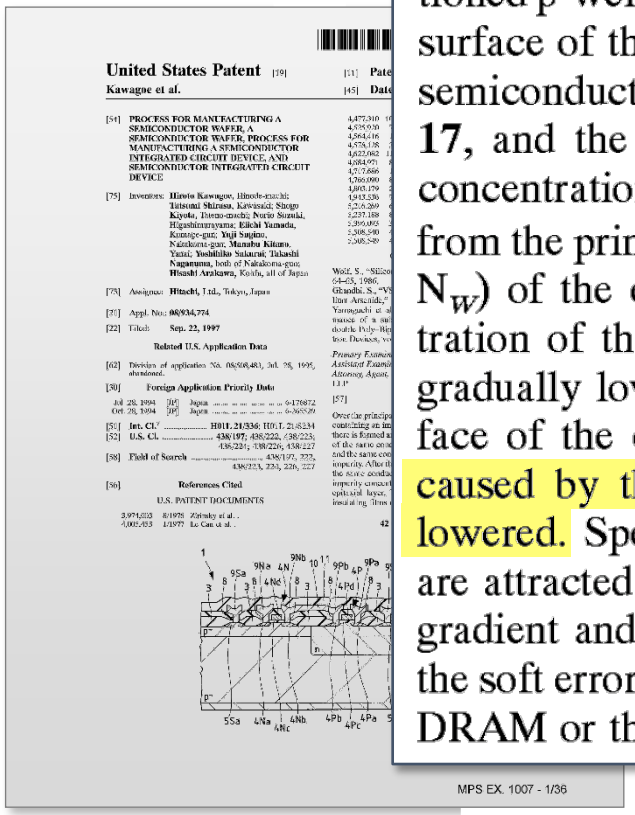
-00550: Petition [1] at 24-25

Kawagoe's dopant gradient in the p-well 6p is designed to aid carrier movement of electrons from the top surface of the substrate 2 to attract electrons to the substrate body 2S. (Kawagoe at 15:62-16:40.) Kawagoe states that "the impurity concentration of the p-well 6p is given such a gradient that it is gradually lowered in the depthwise direction from the surface of the epitaxial layer 2E, so that the influence to be caused by the carriers (or electrons) due to the α-ray is lowered. Specifically, the electrons produced by the α-ray are attracted to the substrate body 2S by that concentration gradient and prevented from entering the p-well 6p so that the soft errors can be reduced in case the MIS memory of the DRAM or the like is formed in the p-well 6p." (Kawagoe at 16:2-11.) Kawagoe's graded concentration at the active regions (and into the wells) thusly meets the claimed "to aid carrier movement from the first surface to the second surface of the substrate."

-00550: Petition [1] at 25-26

4. Kawagoe Does Not Move Carriers from the "Surface Layer"

- Kawagoe does not mention moving an electron from the "surface layer."

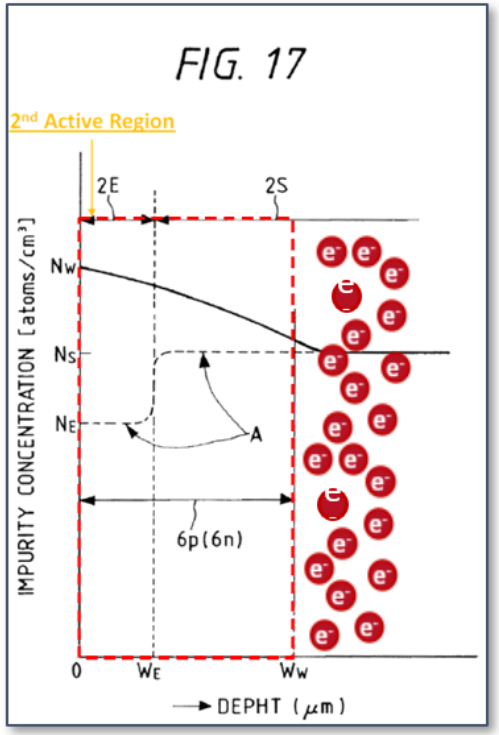

United States Patent [19]
Kawagoe et al.

PROCESS FOR MANUFACTURING A SEMICONDUCTOR WAFER, A SEMICONDUCTOR WAFER, PROCESS FOR MANUFACTURING A SEMICONDUCTOR INTEGRATED CIRCUIT DEVICE, AND SEMICONDUCTOR INTEGRATED CIRCUIT DEVICE

MPS EX. 1007 - 1/36

Incidentally, in the present embodiment 4, the aforementioned p-well **6***p* and n-well **6***n* are formed to extend from the surface of the epitaxial layer **2**E to the upper portion of the semiconductor substrate body **2**S, as shown in FIGS. **16** and **17**, and the p-well **6***p* and n-well **6***n* have their impurity concentrations gradually lowered in the depthwise direction from the principal surface (having an impurity concentration N_W) of the epitaxial layer **2**E. Thus, the impurity concentration of the p-well **6***p* is given such a gradient that it is gradually lowered in the depthwise direction from the surface of the epitaxial layer **2**E, so that the influence to be caused by the carriers (or electrons) due to the α-ray is lowered. Specifically, the electrons produced by the α-ray are attracted to the substrate body **2**S by that concentration gradient and prevented from entering the p-well **6***p* so that the soft errors can be reduced in case the MIS memory of the DRAM or the like is formed in the p-well **6***p*. The impurity

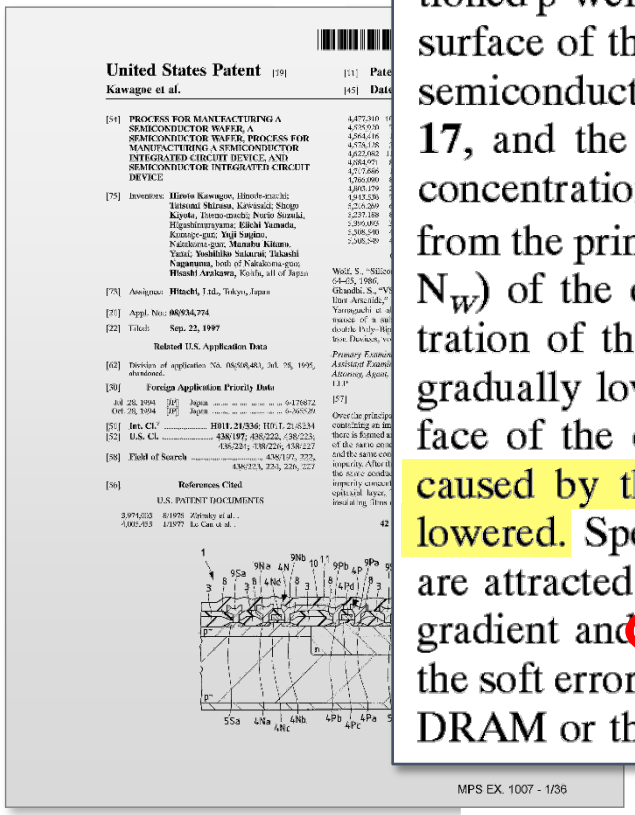
Ex. 1007 (Kawagoe) at 15:62-16:11



-00468: Petition [1] at 24 (annotations added)

4. Kawagoe Does Not Move Carriers from the "Surface Layer"

- Kawagoe expressly says it "prevents" the electrons from "entering the p-well 6p."


United States Patent [19]
Kawagoe et al.

[54] PROCESS FOR MANUFACTURING A SEMICONDUCTOR WAFER, A SEMICONDUCTOR WAFER, PROCESS FOR MANUFACTURING A SEMICONDUCTOR INTEGRATED CIRCUIT DEVICE, AND SEMICONDUCTOR INTEGRATED CIRCUIT DEVICE

[75] Inventors: Hiroto Kawagoe, Hitoshi-machi; Tetsumi Shirasu, Kawasaki; Shogo Kiyota, Ibaraki-machi; Norio Suzuki, Higashimurayama; Eiichi Yamada, Kunitachi; Yuji Sugino, Kokubunji-gun; Manabu Kitano, Yatsushiro; Yoshihiko Sakurai; Takashi Nagamura, both of Nakakoma-gun; Hisashi Arakawa, Kofu, all of Japan

[73] Assignee: Hitachi, Ltd., Tokyo, Japan

[21] Appl. No.: 08/934,774

[22] Filed: Sep. 22, 1997

Related U.S. Application Data

[62] Division of application No. 08/508,483, Jul. 28, 1995, abandoned.

[30] Foreign Application Priority Data

Jul 28, 1994 [JP] Japan 6-176972
Oct 28, 1994 [JP] Japan 6-265729

[51] Int. Cl.[6] H01L 21/8234
[52] U.S. Cl. 438/197; 438/222, 438/223; 438/224; 438/226, 438/227
[58] Field of Search 438/197, 222, 223, 226, 227

[56] References Cited

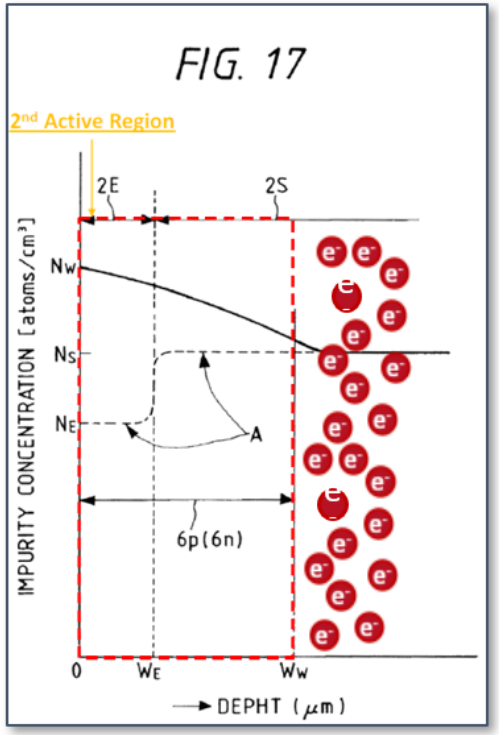
U.S. PATENT DOCUMENTS

3,971,033 8/1976 Zolnsky et al. .
4,005,453 1/1977 Le Can et al. .

MPS EX. 1007 - 1/36

Incidentally, in the present embodiment 4, the aforementioned p-well **6***p* and n-well **6***n* are formed to extend from the surface of the epitaxial layer **2**E to the upper portion of the semiconductor substrate body **2**S, as shown in FIGS. **16** and **17**, and the p-well **6***p* and n-well **6***n* have their impurity concentrations gradually lowered in the depthwise direction from the principal surface (having an impurity concentration N_W) of the epitaxial layer **2**E. Thus, the impurity concentration of the p-well **6***p* is given such a gradient that it is gradually lowered in the depthwise direction from the surface of the epitaxial layer **2**E, so that the influence to be caused by the carriers (or electrons) due to the α-ray is lowered. Specifically, the electrons produced by the α-ray are attracted to the substrate body **2**S by that concentration gradient and prevented from entering the p-well **6***p* so that the soft errors can be reduced in case the MIS memory of the DRAM or the like is formed in the p-well **6***p*. The impurity

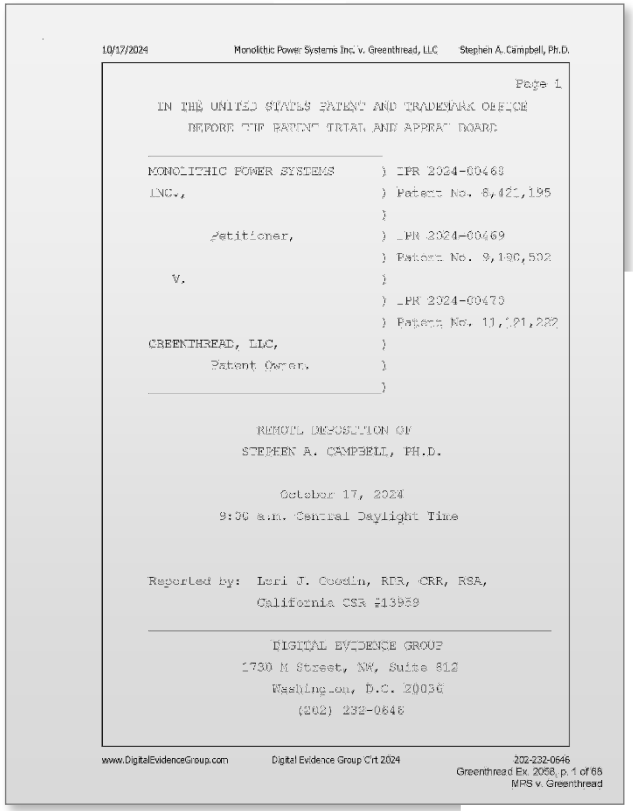
Ex. 1007 (Kawagoe) at 15:62-16:11



-00468: Petition [1] at 24 (annotations added)

4. Kawagoe Does Not Move Carriers from the "Surface Layer"

- Dr. Campbell admits that the carriers (i.e., "electrons produced by the α-ray") are created in the substrate below the wells.



10/17/2024 Monolithic Power Systems Inc. v. Greenthread, LLC Stephen A. Campbell, Ph.D.

Page 1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD

MONOLITHIC POWER SYSTEMS INC., Petitioner, v. GREENTHREAD, LLC, Patent Owner.

IPR 2024-00468 Patent No. 8,421,195
IPR 2024-00469 Patent No. 9,190,502
IPR 2024-00470 Patent No. 11,721,222

REMOTE DEPOSITION OF
STEPHEN A. CAMPBELL, PH.D.

October 17, 2024
9:00 a.m. Central Daylight Time

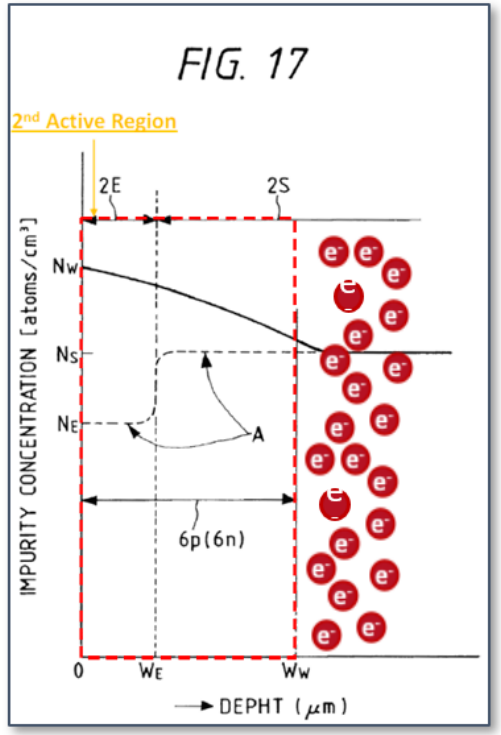
Reported by: Lori J. Coodin, RDR, CRR, RSA, California CSR #13959

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Greenthread Ex. 2058, p. 1 of 65
MPS v. Greenthread

8	Q. And the focus of Kawagoe and
9	Nishizawa and Onoda, was to solve that problem
10	and block the carriers from coming up into the
11	substrate, or into the transistor?
12	A. I would put it just slightly
13	differently. They are not saying that they are
14	totally blocking all of the carriers. They are
15	reducing the carrier flow to an acceptable level.
16	Q. Okay. But they are reducing the
17	carrier flow in an upwards direction?
18	A. Yes, that's correct.
19	Q. Upwards from the substrate?
20	A. Yes, that's correct.

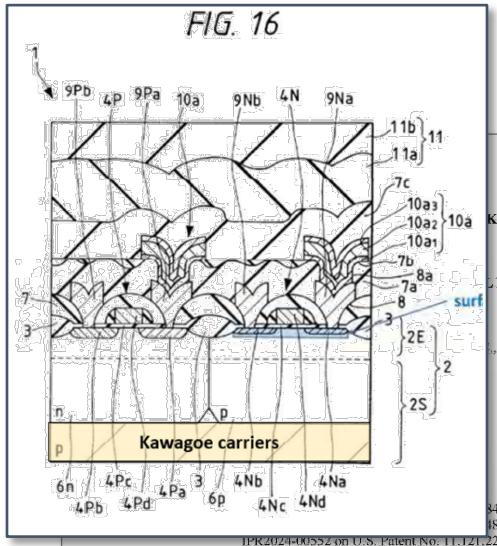
Ex. 2058 (Campbell Dep. Tr.) at 43:8-20



-00468: Petition [1] at 24 (annotations added)

4. Kawagoe Does Not Move Carriers from the "Surface Layer"

- Dr. Glew confirms that Kawagoe is <u>not</u> concerned with carriers in the "surface layer."



IPR2024-00552 on U.S. Patent No. 11,121,222
IPR2024-00553 on U.S. Patent No. 11,316,014

DECLARATION OF ALEXANDER D. GLEW

Greenthread Ex. 2057, p. 1 of 45
MPS v. Greenthread

But while Kawagoe does disclose a "concentration gradient," Dr. Campbell misses the context of Kawagoe. In general, there are three possibilities: a reference disclosing a dopant concentration gradient in a semiconductor device could a) teach that the concentration gradient aids carrier movement; b) teach that the concentration gradient impedes carrier movement; or c) be silent as to the concentration gradient aiding or impeding carrier movement. Kawagoe teaches using a concentration gradient to *impede* carrier movement. Kawagoe is concerned with naturally occurring α-rays striking a semiconductor device and generating free electrons in the substrate.[5] Kawagoe's free electrons can disrupt the operation of the device during a "single event upset" ("SEU"). Dr. Campbell fails to appreciate that Kawagoe teaches a "concentration gradient" to "*prevent*[] [the SEU-generated carriers] from entering the p-well." Ex. 1007, 16:7-11. Below, I reproduce the portion of

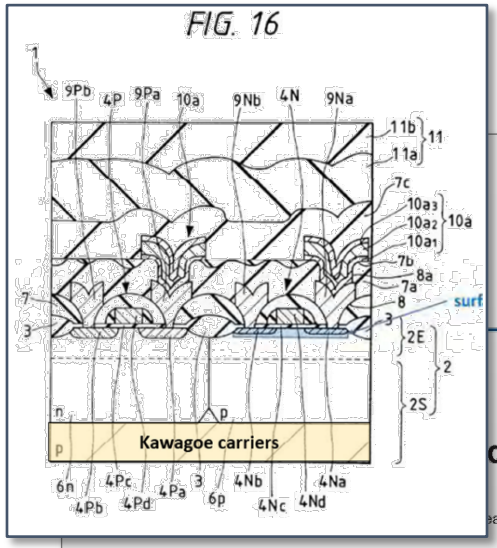
-00550: Ex. 2057 (Glew Decl.) at ¶62

Pet., 56 (annotated). Kawagoe does not address carriers in the surface / active region, and as the annotated image above shows, does not "aid carrier movement" to the substrate / second surface / area of the substrate where there are no active regions, because Kawagoe's carriers are nowhere near what the Petition identifies as the "surface" or first/second "active regions." Recall that the dopant gradient keeps the alpha particle-generated electrons (SEU) from entering the well. Since the well starts at the surface / active region and extends down to the depth 2WE, the generated electrons must originate in the substrate below the wells, in the area highlighted in yellow.

-00550: Ex. 2057 at ¶66

4. Kawagoe Does Not Move Carriers from the "Surface Layer"

- Dr. Glew confirms that Kawagoe is <u>not</u> concerned with carriers in the "surface layer."



der Glew

ead, LLC (PTAB)

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WORLDWIDE COURT REPORTING & LITIGATION TECHNOLOGY

MPS EX. 10

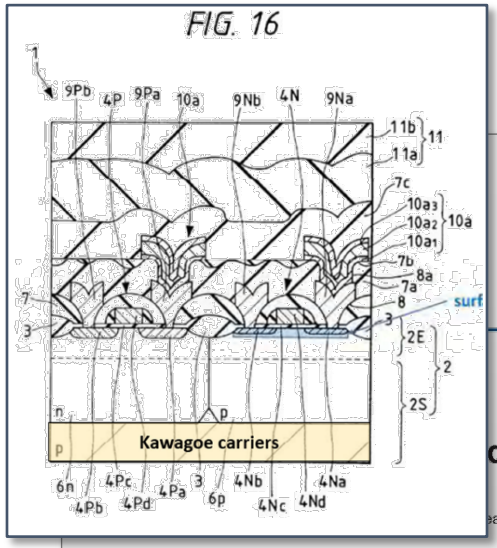
Q. And it states, "The electrons produced by the alpha ray are attracted to the substrate body 2S by that concentration gradient." The state -- and then it continues, and. The statement that says, "Attracted to the substrate body 2S, as a POSITA in 2004," how would you understand -- what would you understand attracted to mean?

A. Well, it describes electrons that are below the P-well. They don't want them entering the P-well. So electrons below the P-well are acted upon by a field so that they stay in substrate.

Ex. 1055 (Glew Dep. Tr.) at 112:10-20

4. Kawagoe Does Not Move Carriers from the "Surface Layer"

- Dr. Glew confirms that Kawagoe is <u>not</u> concerned with carriers in the "surface layer."



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WORLDWIDE COURT REPORTING & LITIGATION TECHNOLOGY

MPS EX. 1055

Q. Does Kawagoe say that electrons generated near the surface can be disregarded?

MR. WHITEHURST: Object to form.

THE WITNESS: Well, Kawagoe says that it keeps electrons from entering through the P-well. So it never mentions that it's dealing with alpha particle generated electrons above the P-well. It just says that it's stopping them from entering through the P-well. So it's consistent with that.

Ex. 1055 (Glew Dep. Tr.) at 117:4-12

Q. Does Kawagoe's concentration gradient have any effect on -- any force effect on electrons in the device?

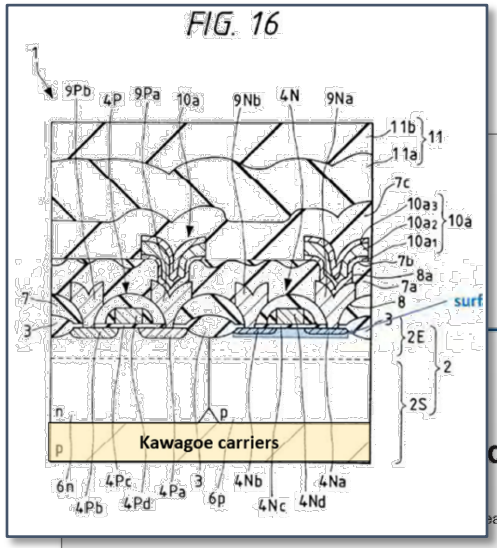
MR. WHITEHURST: Object to form.

THE WITNESS: As I recently spoke, Kawagoe at column 16, starting at the top, describes that there's a concentration gradient and this concentration precludes electrons from entering the P-well. So it does have that effect. That is, the electrons generated by the alpha rays or alpha particles.

Ex. 1055 at 120:20-121:5

4. Kawagoe Does Not Move Carriers from the "Surface Layer"

- Dr. Glew did <u>not</u> admit that Kawagoe pushes electrons downward from the surface.



der Glew

ead, LLC (PTAB)

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WORLDWIDE COURT REPORTING & LITIGATION TECHNOLOGY

MPS EX. 1055

Q. Looking at Kawagoe's Figure 17, which depicts the concentration gradient, and comparing it to Figure 16, looking at Figure 16, at the point between 2E and 2S which is indicated by the dashed line, what would the concentration gradient impart? A downward force on an electron or an upward force on an electron?

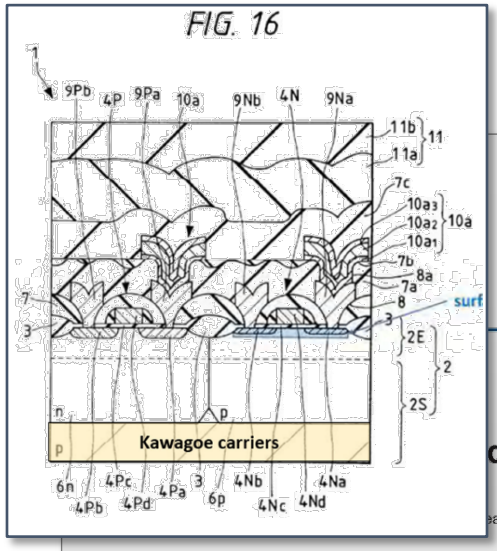
THE WITNESS: The concentration or impurity concentration gradient shown in Figure 17 is decreasing to the right. Therefore, the field would point to the left. So holes would experience a potential force in the left direction, or upward, and electrons would be pushed potentially in the opposite direction to the right or downward. This is an effect in isolation.

Whether there was actually any motion or net effect would depend upon other forces acting upon the electron also.

Ex. 1055 (Glew Dep. Tr.) at 122:14-123:7

4. Kawagoe Does Not Move Carriers from the "Surface Layer"

- Dr. Glew did <u>not</u> admit that Kawagoe pushes electrons downward from the surface.



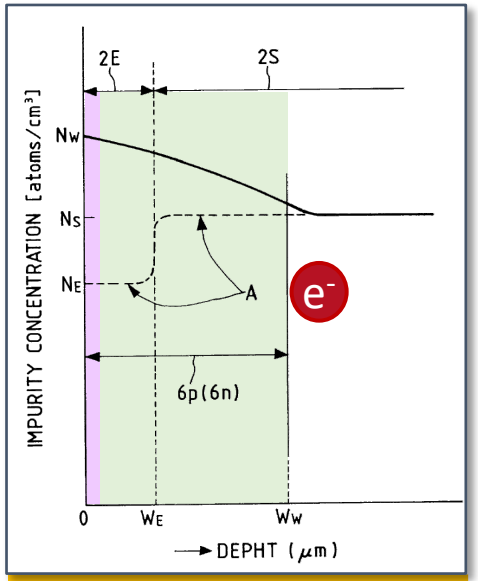
Q. And assuming that an alpha particle does generate an electron in Figure 16's P-well region 6P, are you able to answer me today whether that electron would be attracted upwards, downwards, or locked in place?

THE WITNESS: What I can't do is identify the net sum of forces acting upon that electron in the P-well. The patent is specific and clear that below the P-well there's sufficient forces to keep the electron from entering the P-well. It doesn't make that same claim or assertion in the P-well or active area. As I cited to on page 39 of my report, from column 16, line 7 on, "Those electrons are precluded from entering the P-well, those generated by the alpha ray or alpha particle."

Ex. 1055 (Glew Dep. Tr.) at 120:4-19

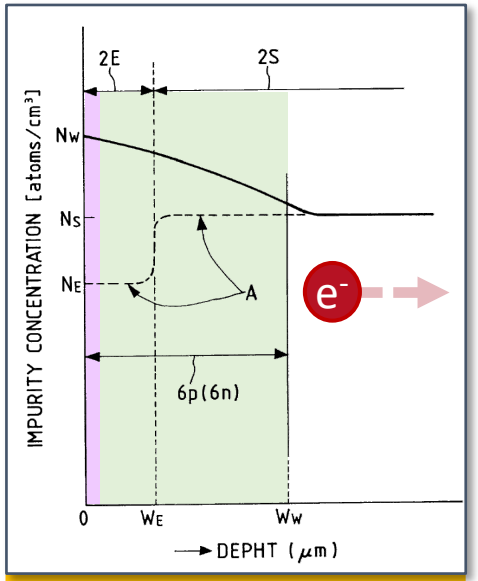
4. Kawagoe Does Not Move Carriers from the "Surface Layer"

- Kawagoe does <u>not</u> disclose "aiding carrier movement" <u>from</u> the surface <u>to</u> the substrate.



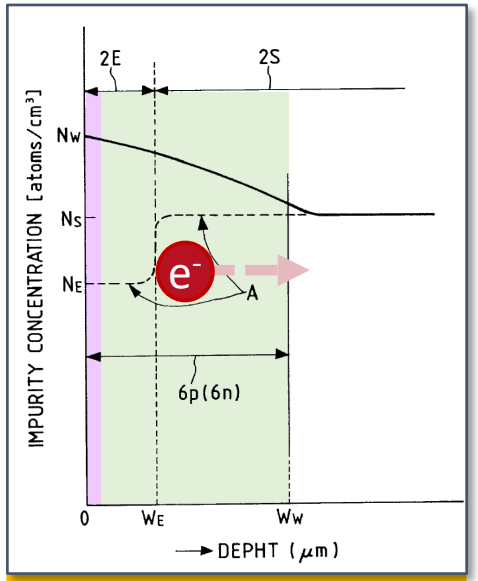
Scenario 1

SEU electron stays in substrate and never enters p-well



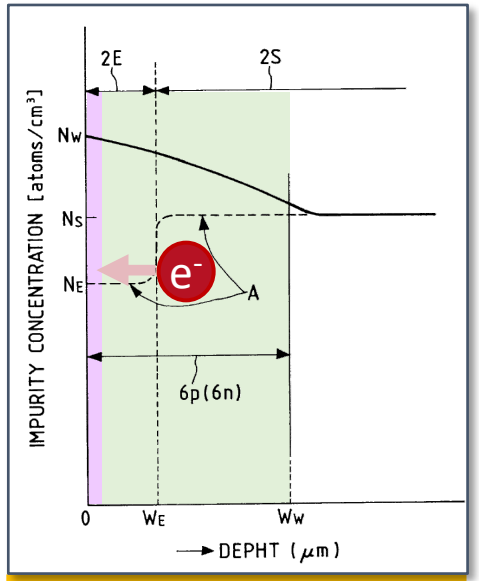
Scenario 2

SEU electron moves deeper into substrate



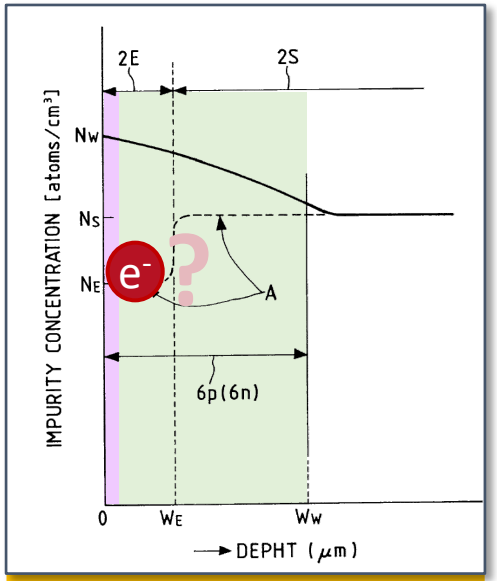
Scenario 3

SEU electron theoretically enters p-well contrary to Kawagoe specification



Scenario 4

SEU electron theoretically enters p-well contrary to Kawagoe specification

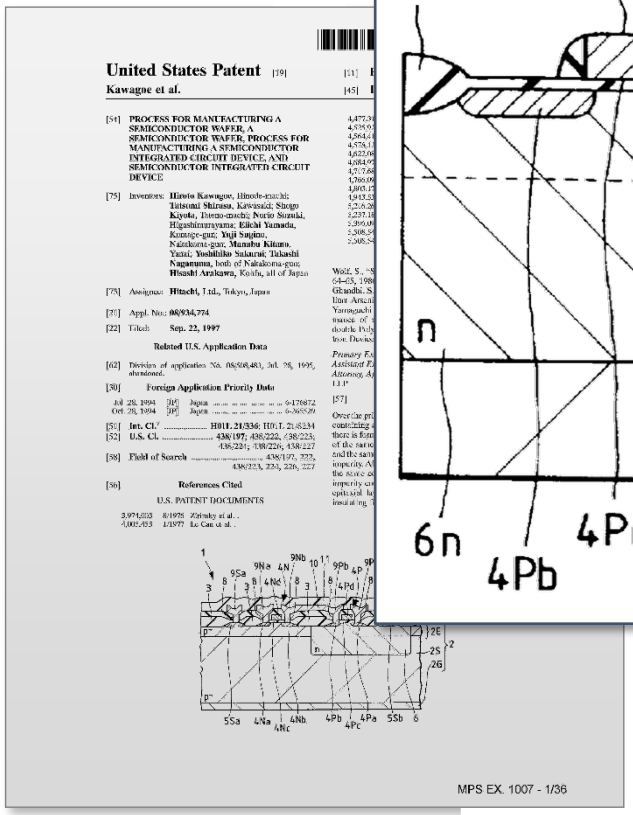


Scenario 5

SEU electrons are not in the active region

4. Kawagoe Does Not Move Carriers from the "Surface Layer"

- Kawagoe does <u>not</u> disclose "aiding carrier movement" <u>from</u> the surface <u>to</u> the substrate.


United States Patent [19]
Kawagoe et al.

[54] PROCESS FOR MANUFACTURING A SEMICONDUCTOR WAFER, A SEMICONDUCTOR WAFER, PROCESS FOR MANUFACTURING A SEMICONDUCTOR INTEGRATED CIRCUIT DEVICE, AND SEMICONDUCTOR INTEGRATED CIRCUIT DEVICE

[75] Inventors: Hiroto Kawagoe, Hitoshi-machi; Tatsumi Shirasa, Kawasaki; Shogo Kyoda, Ibaraki-machi; Norio Suzuki, Higashimurayama; Eiichi Yamada, Kunitachi; Yuji Sugino, Kokubunji-gun; Manabu Kitano, Yatsushiro-gun; Yoshihiko Sakurai; Takashi Nagamuma, both of Nakakoma-gun; Hisashi Arakawa, Kofu, all of Japan

[73] Assignee: Hitachi, Ltd., Tokyo, Japan

[21] Appl. No.: 08/934,774

[22] Filed: Sep. 22, 1997

Related U.S. Application Data

[62] Division of application No. 08/508,483, Jul. 28, 1995, abandoned.

[30] Foreign Application Priority Data

Jul 28, 1994 [JP] Japan 6-176872
Oct 28, 1994 [JP] Japan 6-265729

[51] Int. Cl.[6] H01L 21/336; H01L 21/8234

[52] U.S. Cl. 438/197; 438/222; 438/223; 438/224; 438/226; 438/227

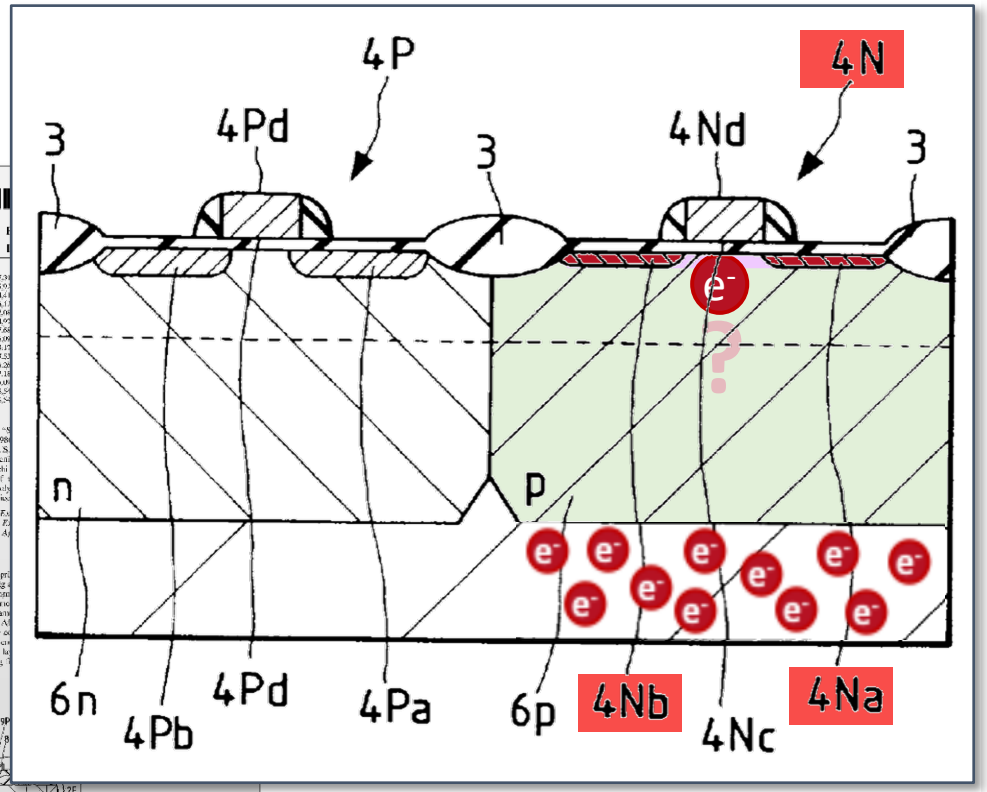
[58] Field of Search 438/197, 222, 223, 226, 227

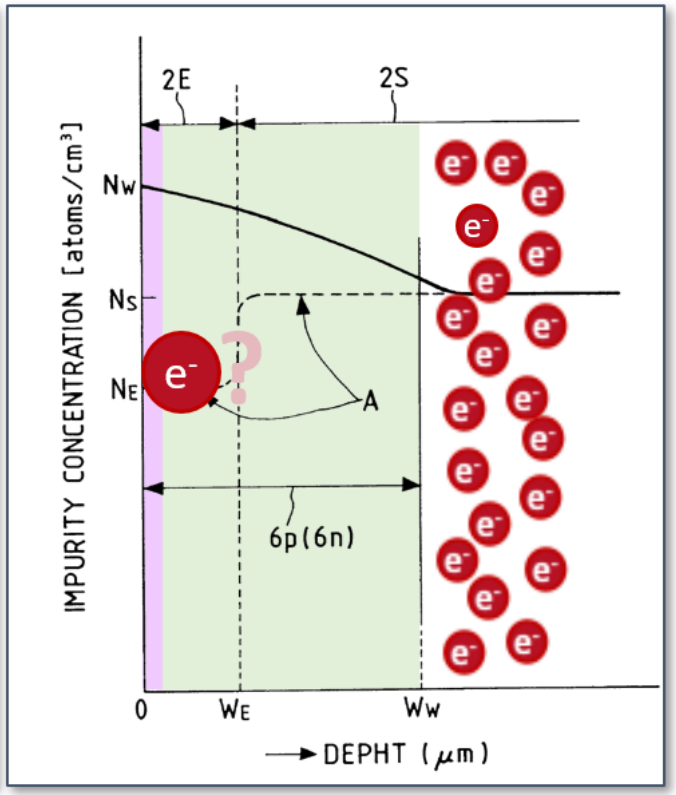
[56] References Cited

U.S. PATENT DOCUMENTS

3,971,033 8/1976 Zolnsky et al. .
4,005,453 1/1977 Le Can et al. .

MPS EX. 1007 - 1/36





Scenario 5

SEU electrons are not in the active region

4. Kawagoe Does Not Move Carriers from the "Surface Layer"

- Kawagoe does <u>not</u> disclose "aiding carrier movement" <u>from</u> the surface <u>to</u> the substrate.

PROTECTIVE ORDER MATERIA

UNITED STATES PATENT AND TRADEMA

BEFORE THE PATENT TRIAL AND APPE

MONOLITHIC POWER SYSTEMS, IN
Petitioner,

v.

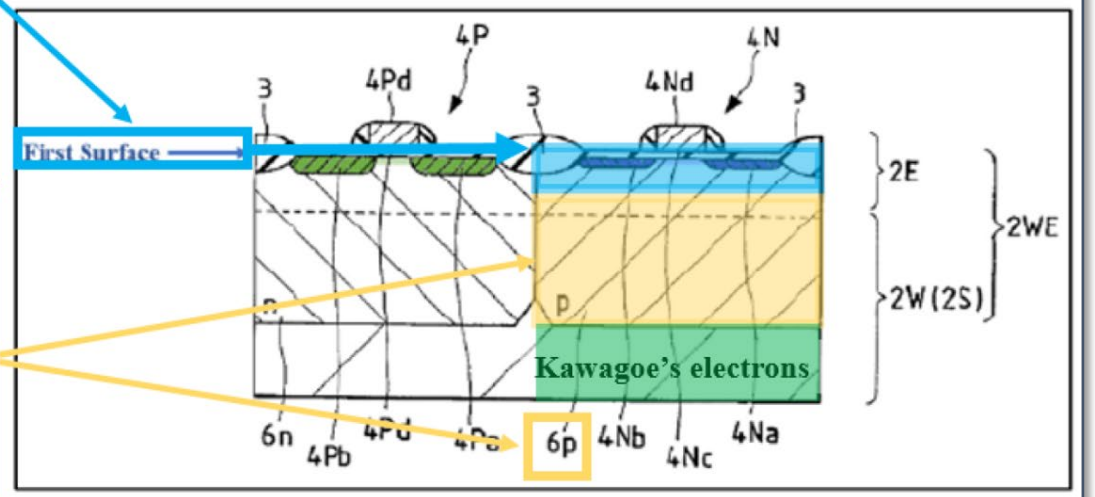
GREENTHREAD, LLC,
Patent Owner.

Case IPR2024-00550
U.S. Patent 10,510,842

PATENT OWNER'S RESPONSE

"probability of [electrons] … extremely low" and can be "disregarded."
Nishizawa, 19:21-34; 20:19-22

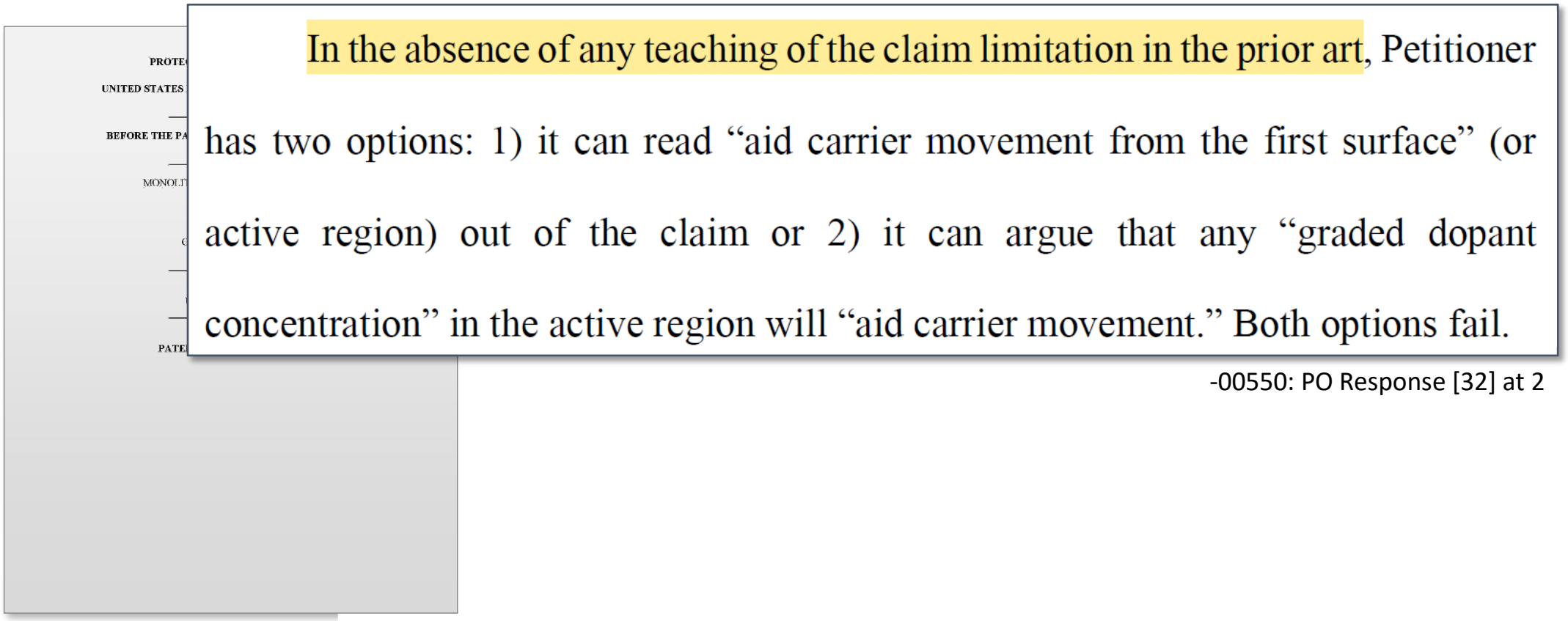
electrons "<u>prevented from entering</u> the p-well 6p"
Ex. 1007 at 16:7-11 .



-00550: PO Response [32] at 25

4. Kawagoe Does Not Move Carriers from the "Surface Layer"

- Because Kawagoe does not expressly teach moving carriers from the "surface layer," Petitioner had the burden to identify an electric field that would move carriers from the "surface layer."



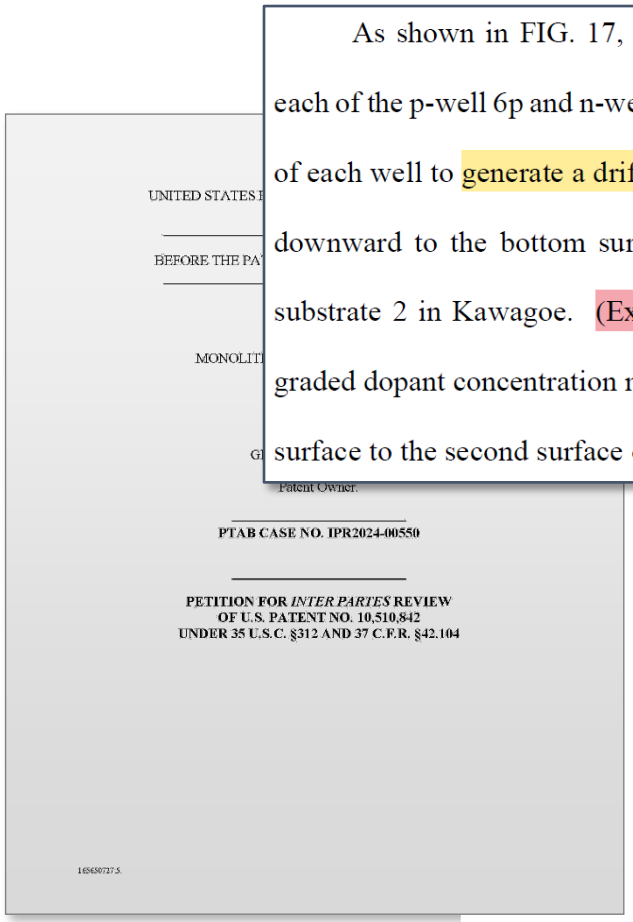
In the absence of any teaching of the claim limitation in the prior art, Petitioner has two options: 1) it can read "aid carrier movement from the first surface" (or active region) out of the claim or 2) it can argue that any "graded dopant concentration" in the active region will "aid carrier movement." Both options fail.

-00550: PO Response [32] at 2

Greenthread Ex. 2088, p. 98 of 149
MPS v. Greenthread

4. Kawagoe Does Not Move Carriers from the "Surface Layer"

- Petitioner did not identify an electric field, much less an electric field starting at the surface layer.
- Petitioner's only mention of "field" for Kawagoe is conclusory.


UNITED STATES P

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Patent Owner.

PTAB CASE NO. IPR2024-00550

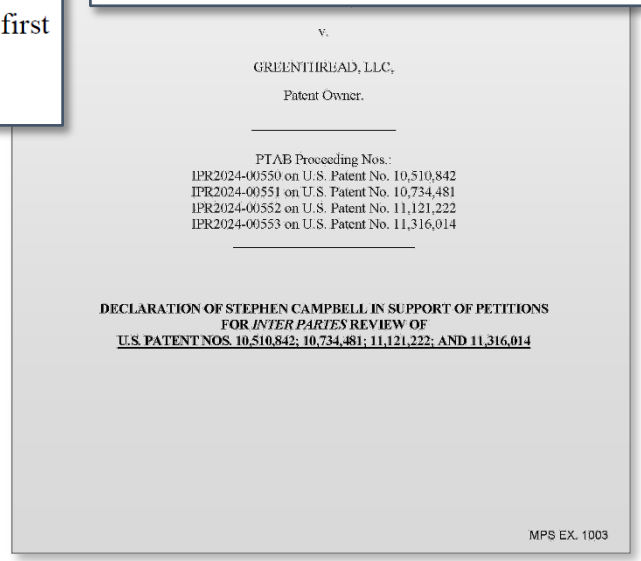
PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 10,510,842
UNDER 35 U.S.C. §312 AND 37 C.F.R. §42.104

165650737.5

As shown in FIG. 17, Kawagoe's downward graded dopant concentration for each of the p-well 6p and n-well 6n is present from the top surface to the bottom surface of each well to generate a drift electric field to move their respective minority carriers downward to the bottom surface of each well, which the is second surface of the substrate 2 in Kawagoe. (Ex. 1003, ¶¶173-178.) Therefore, Kawagoe's downward graded dopant concentration meets the claimed "to aid carrier movement from the first surface to the second surface of the substrate."

-00550: Petition [1] at 25

15:26-36, 17:11-21; *see also id.* at 1:59-2:5, 2:20-23, 15:62-16:15.) The gradient of this graded dopant concentration is represented by a portion of the purple arrow which is also the direction of the electron carrier movement caused by a drift electric field associated with the graded dopant concentration in the second active region which is at the top of the p-well 6p. Notably, Kawagoe specifically teaches that "the


v.

GREENTHREAD, LLC,

Patent Owner.

PTAB Proceeding Nos.:
IPR2024-00550 on U.S. Patent No. 10,510,842
IPR2024-00551 on U.S. Patent No. 10,734,481
IPR2024-00552 on U.S. Patent No. 11,121,222
IPR2024-00553 on U.S. Patent No. 11,316,014

DECLARATION OF STEPHEN CAMPBELL IN SUPPORT OF PETITIONS
FOR *INTER PARTES* REVIEW OF
U.S. PATENT NOS. 10,510,842; 10,734,481; 11,121,222; AND 11,316,014

MPS EX. 1003

-00468: Ex. 1003
(Campbell Decl.) at ¶77

-00550: PO Resp. [32] at 3; PO Sur-Reply [45] at 17, 19-20

PUBLIC VERSION

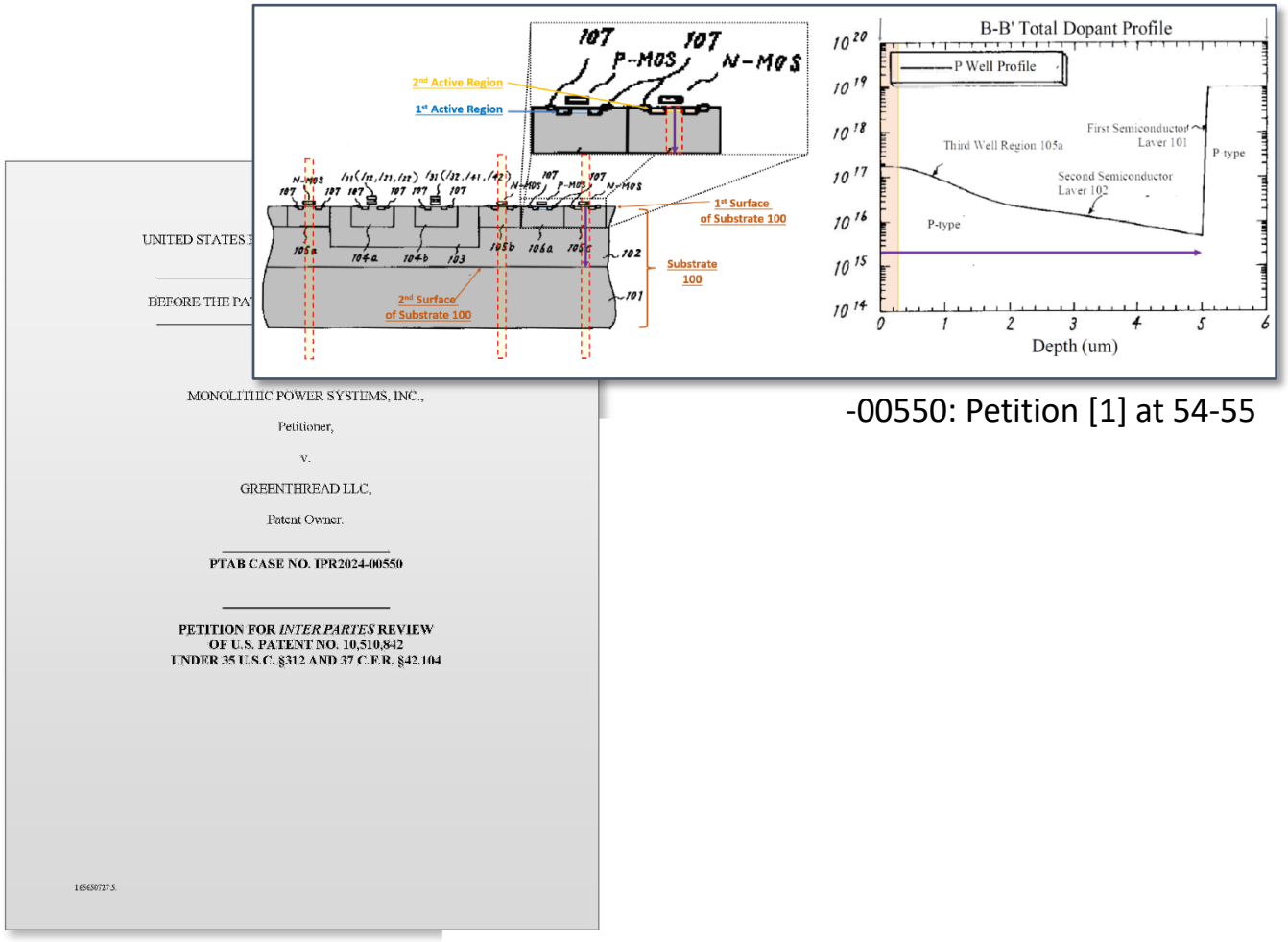
DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Overview of Issues

1. **Petitioner has presented zero "actual evidence" that the Petitions are timely.**
2. **The Claims require "movement of carriers" from the "surface layer" or "active region."**
3. **The '195 and '502 Claims require "movement of minority carriers" from the "surface layer."**
4. **Kawagoe does not disclose "movement of [minority] carriers" from the "surface layer."**
5. **Onoda/Nishizawa does not disclose "movement of [minority] carriers" from the "surface layer."**
6. Petitioner has the burden to identify electric fields that would "aid carrier movement."
7. Petitioner's expert confirmed that carriers in the "surface layer" are affected by numerous other fields and forces.
8. Petitioner's expert confirmed "movement of carriers" depends on the sum of all fields in the "surface layer."
9. Petitioner's expert did not analyze any of the fields or force magnitudes in the "surface layer."
10. Petitioner's prosecution-related arguments are incorrect.
11. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

5. Onoda Does Not Move Carriers from the "Surface Layer"

- Onoda does not mention moving carriers from the "surface layer."



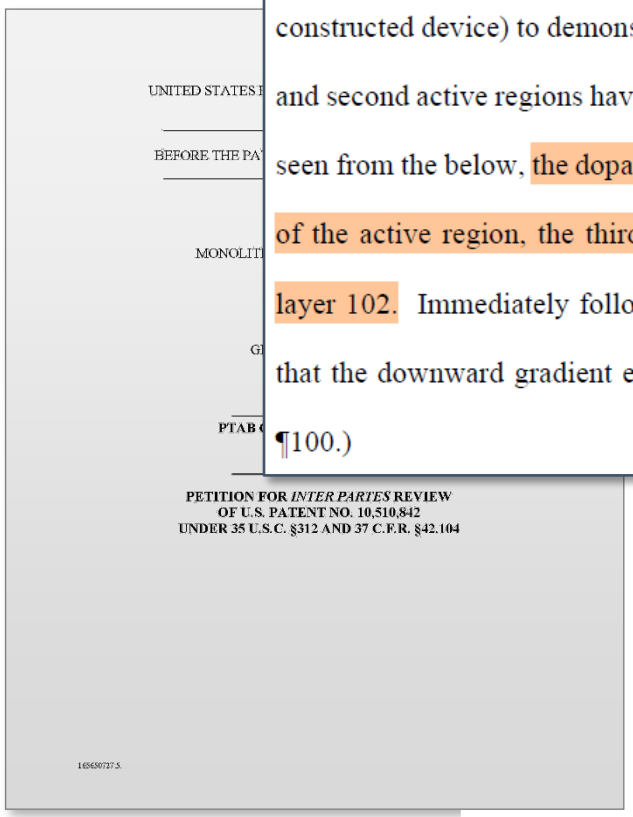
-00550: Petition [1] at 54-55

> The fact that a graded concentration aids the movement of carriers was a well-known property of semiconductor devices long before September 2004. (Ex. 1003, ¶103, 46-58.) Indeed, Patent Owner admitted that to be the case in prosecution, where Patent Owner, citing prior art, stated that "the graded dopant concentration itself creates a 'built-in' electrical field" and this "built-in" electric field "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." (Ex. 1003, ¶¶47, 103.). The net effect of the graded dopant concentration is to cause carriers (e.g., electrons) to move from the top surface of the substrate 100 to the bottom surface of the layer 102, which is towards the second surface of the substrate 100. (Ex. 1003, ¶104.)

-00550: Petition [1] at 52-53

5. Onoda Does Not Move Carriers from the "Surface Layer"

- Onoda's dopant profile is <u>not</u> graded in the "surface layer" to aid carrier movement.



Shown below is the graded concentration profile of FIGS. 8 and 11 (which depict intermediate processing steps) annotated on top of FIG. 3 (which is the final constructed device) to demonstrate that the "at least a portion of at least one of the first and second active regions having at least one graded dopant concentration." As can be seen from the below, the dopant profile is downward graded going through the channel of the active region, the third well regions 105a/b/c, and the second semiconductor layer 102. Immediately following annotated FIG. 3, is annotated FIG. 11, depicting that the downward gradient exists in the active region's (tan) channel. (Ex. 1003 at ¶100.)

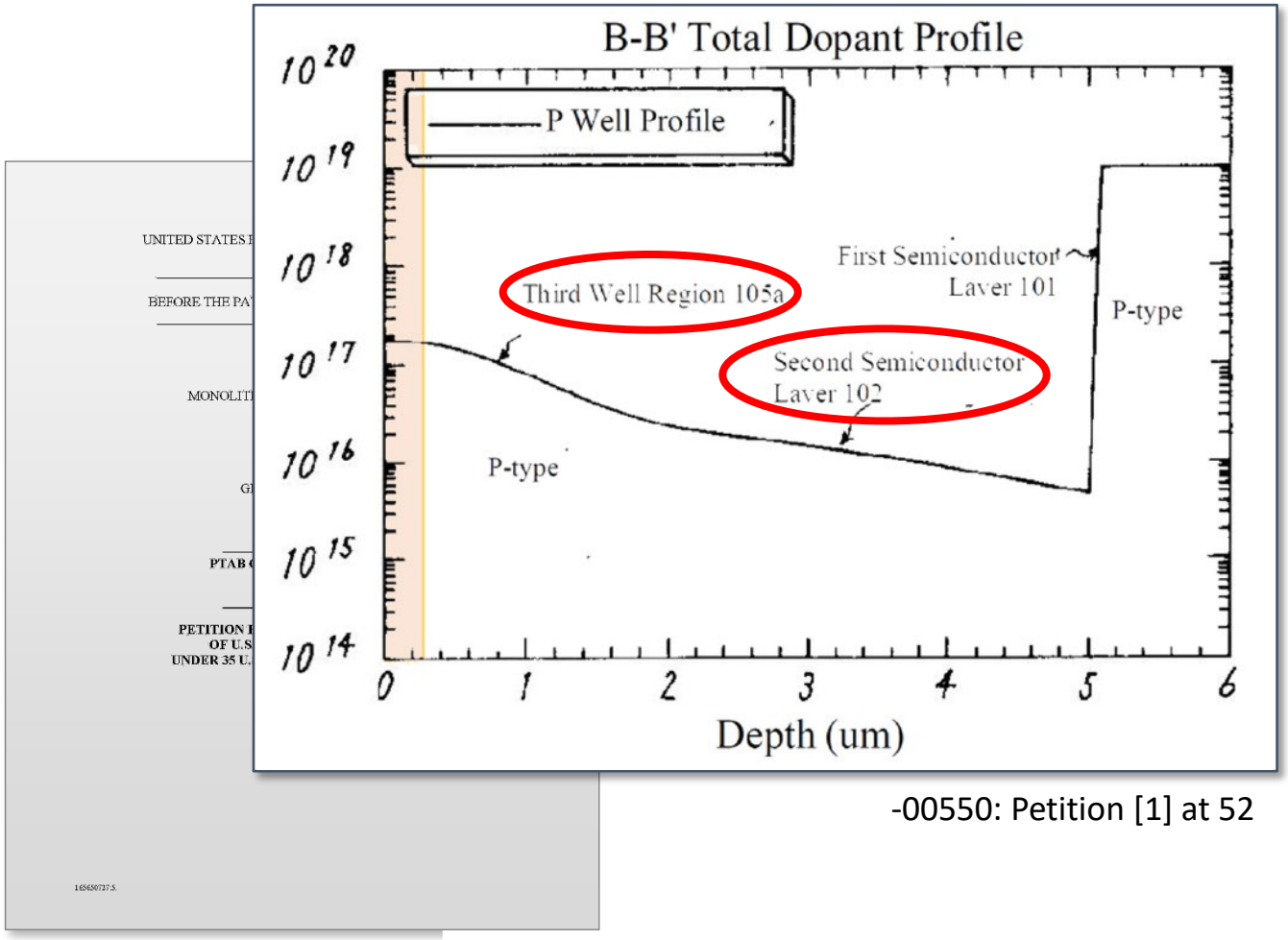
-00550: Petition [1] at 51

Onoda's FIG. 11 depicts the graded dopant profile across the p-type well regions 105a, 105b, 105c, which constitutes the "at least one graded dopant concentration" of the "at least a portion of at least one of the first and second active regions." FIG. 11 is a cross sectional slice (B-B) through the device depicted in FIG. 8, which is the same embodiment as FIG. 3. (*See, e.g.*, Onoda at [0041]-[0045]). As can be seen from the below, the dopant concentration decreases as a function of depth through the third well region 105a (p-type) and the second semiconductor layer 102 (p-type). Then, at the point where the slice reaches the semiconductor layer 101, the dopant concentration increases. (*Id.* at [0052].). Moreover, a POSITA would have understood that third well regions 105b and 105c would have the same dopant profile as region 105a, because the composition of all three regions are identical. (Ex. 1003 at ¶¶98-100.) FIGS. 8 and 11 are shown annotated below.

-00550: Petition [1] at 49-50

5. Onoda Does Not Move Carriers from the "Surface Layer"

- Onoda's dopant profile is graded <u>below</u> the "surface layer."



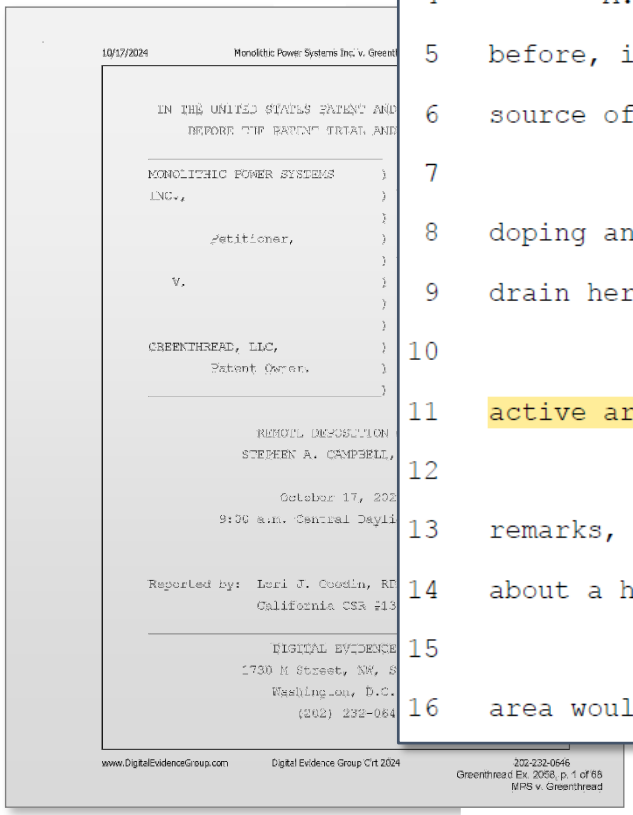
-00550: Petition [1] at 52

Onoda's FIG. 11 depicts the graded dopant profile across the p-type well regions 105a, 105b, 105c, which constitutes the "at least one graded dopant concentration" of the "at least a portion of at least one of the first and second active regions." FIG. 11 is a cross sectional slice (B-B) through the device depicted in FIG. 8, which is the same embodiment as FIG. 3. (*See, e.g.*, Onoda at [0041]-[0045]). As can be seen from the below, the dopant concentration decreases as a function of depth through the third well region 105a (p-type) and the second semiconductor layer 102 (p-type). Then, at the point where the slice reaches the semiconductor layer 101, the dopant concentration increases. (*Id.* at [0052].). Moreover, a POSITA would have understood that third well regions 105b and 105c would have the same dopant profile as region 105a, because the composition of all three regions are identical. (Ex. 1003 at ¶¶98-100.) FIGS. 8 and 11 are shown annotated below.

-00550: Petition [1] at 49

5. Onoda Does Not Move Carriers from the "Surface Layer"

- Onoda is silent as to where the "active region" or "surface layer" begins and ends.



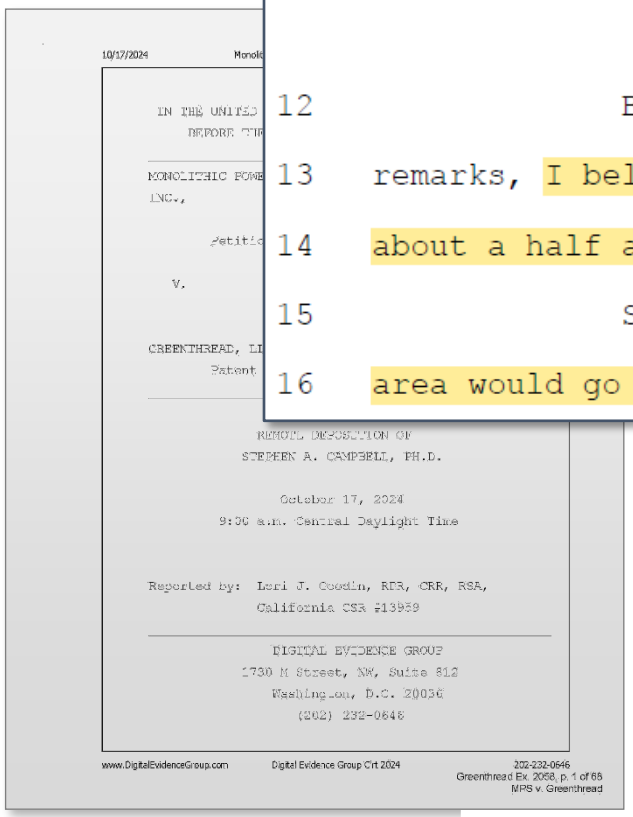
2 Q. Dr. Campbell, can you tell me where
3 the active region would be on this graph?
4 A. The active region, as I mentioned
5 before, is coincident with the depth of the
6 source of drain.
7 This profile is showing the channel
8 doping and below. So, we don't see the source or
9 drain here.
10 So, I can't say exactly where the
11 active area would end.
12 But consistent with my previous
13 remarks, I believe the source drain depth was
14 about a half a micron.
15 So, with that, assertion, the active
16 area would go from 0 to 0.5 on this spot.

17 Q. Okay. But you can't be sure because
18 you are not sure of the depth of source and
19 drain?
20 A. That is correct.

Ex. 2058 (Campbell Dep. Tr.) at 52:2-20

5. Onoda Does Not Move Carriers from the "Surface Layer"

- Onoda's dopant profile does not begin to angle downward until <u>below</u> the "active region."



2 Q. Dr. Campbell, can you tell me where
3 the active region would be on this graph?
* * *
12 But consistent with my previous
13 remarks, I believe the source drain depth was
14 about a half a micron.
15 So, with that, assertion, the active
16 area would go from 0 to 0.5 on this spot.

Ex. 2058 (Campbell Dep. Tr.) at 52:2-16

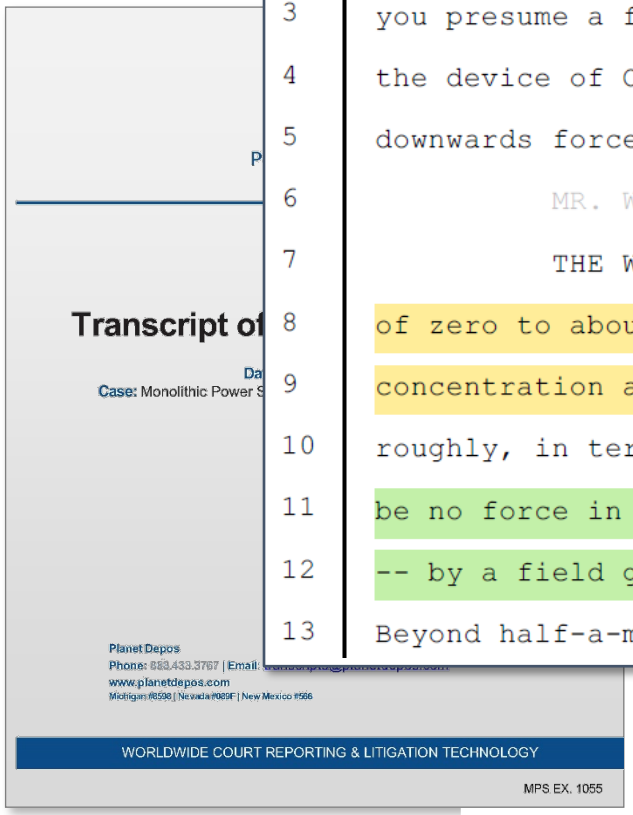
22 Q. How would you describe this gradient?
23 A. The dopant file is shown on an X scale of
24 zero to six micrometers, UN or UM. The initial
25 portion on the left side approximately half a micron
1 appears to be flat. I don't see a downward slope.
2 Subsequent to the first half micron, it does slope
3 downward. Then, beyond five microns, the dopant
4 profile.



Ex. 1055 (Glew Dep. Tr.) at 91:22-92:4

5. Onoda Does Not Move Carriers from the "Surface Layer"

- Onoda's dopant profile does not exert a downward force in the "active region."



Q. I misspoke. Let me just re-ask. In the vertical direction, looking at Figure 11, how would you presume a force to be applied onto an electron in the device of ONODA? Would it be upwards force, downwards force, or net canceled? So zero force.

MR. WHITEHURST: Object to form.

THE WITNESS: To begin with, in the region of zero to about half-a-micron in Figure 11, the concentration appears to be flat or constant, roughly, in terms of concentration. So there would be no force in the first half-micron exerted by this -- by a field generated by this dopant profile. Beyond half-a-micron, the concentration decreases.

Ex. 1055 (Glew Dep. Tr.) at 94:1-13

Q. Looking at Figure 11, is it possible to tell whether Figure 11 is capable of aiding the movement of holes from the surface layer to the substrate?

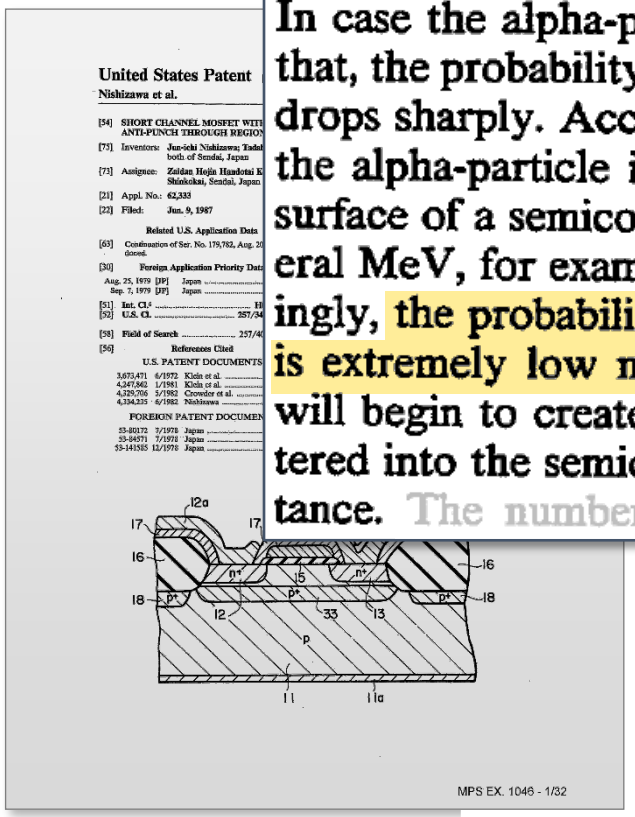
MR. BOMBACH: Objection. Leading.

THE WITNESS: Because the dopant profile is flat, it does not generate an electric field near the surface. It is flat near the surface. Thus, it cannot move holes or electrons or any charged carrier.

Ex. 1055 at 178:9-18

5. Onoda Does Not Move Carriers from the "Surface Layer"

- Nishizawa does not address carriers at the surface; these can be "disregarded."



into, for example, silicon. As shown in FIG. 33, when the alpha-particle gains an energy ϵ_3 of about 360 keV, it creates electron-hole pairs with highest probability. In case the alpha-particle gains an energy higher than that, the probability of generation of electron-hole pairs drops sharply. 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 create electron-hole pairs after it has entered into the semiconductor substrate to a certain distance. The number of electron-hole pairs which are

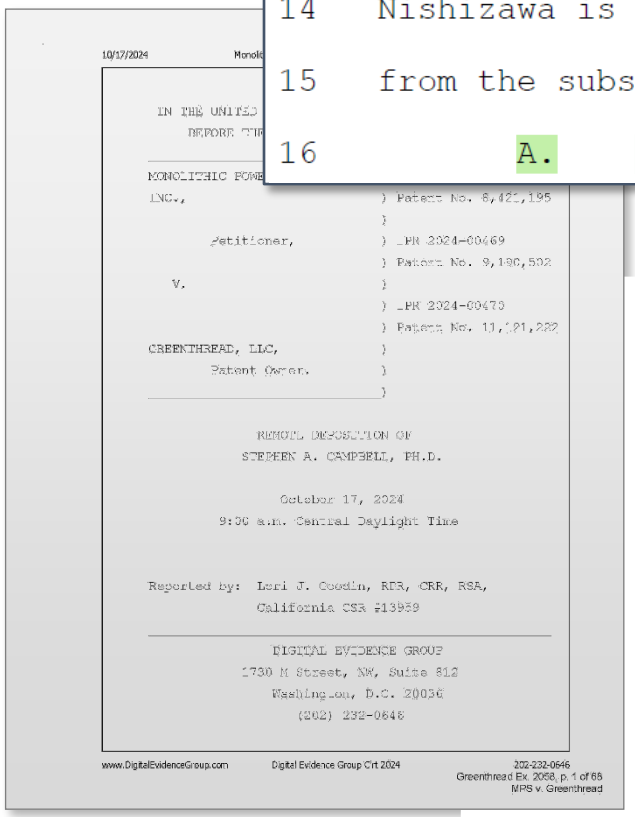
Ex. 1046 (Nishizawa) at 19:21-34

electrons is 1.9×10^6. That is, the 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. 1046 at 20:19-11

5. Onoda Does Not Move Carriers from the "Surface Layer"

- Dr. Campbell explained that Nishizawa does not teach moving carriers <u>downward</u> from the "surface layer."



13 Q. So, the electrons are coming,
14 Nishizawa is concerned with electrons coming up
15 from the substrate?
16 A. That is correct.

Ex. 2058 (Campbell Dep. Tr.) at 31:13-16

8 Q. And the focus of Kawagoe and
9 Nishizawa and Onoda, was to solve that problem
10 and block the carriers from coming up into the
11 substrate, or into the transistor?
12 A. I would put it just slightly
13 differently. They are not saying that they are
14 totally blocking all of the carriers. They are
15 reducing the carrier flow to an acceptable level.
16 Q. Okay. But they are reducing the
17 carrier flow in an upwards direction?
18 A. Yes, that's correct.
19 Q. Upwards from the substrate?
20 A. Yes, that's correct.

Ex. 2058 at 43:8-20

Greenthread Ex. 2058, p. 106 of 149
MPS v. Greenthread

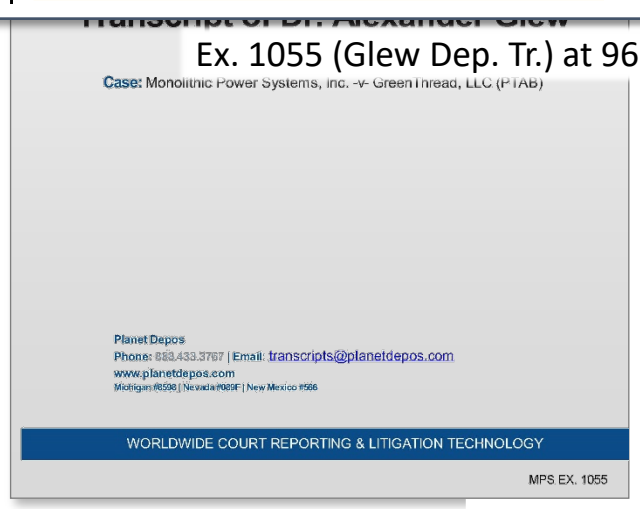
5. Onoda Does Not Move Carriers from the "Surface Layer"

- Dr. Glew confirmed that Nishizawa does not teach moving carriers <u>downward</u> from the "surface layer."

Q. What PN junction of Nishizawa are you specifically referring to in paragraph 60?

A. In that I'm rebutting Dr. Campbell, I might need to look at Dr. Campbell's declaration to put better light on this. In general -- I'll give this one more minute. Nishizawa is generally concerned with, among other things, spurious electrons generated by events, external events, and has created a shield of sorts underneath the transistor.

Ex. 1055 (Glew Dep. Tr.) at 96:13-21



A. And to the extent that the whole purpose of that feature 33A in Figure 35 is to keep electrons from entering the transistor region and interfering with the operation of NMOS device shown in 35, it is a barrier to electrons entering from the substrate upward. If it were to pull electrons down from the operating transistor that would be, as I described previously, deleterious to the functioning of an NMOS device, robbing it of the majority of its electron carriers, which are required for operation. So either it would render it non-functional if it pulled them down, or degrade the speed or performance of the NMOS device.

Ex. 1055 at 98:2-14

Q. I'll ask this more simply. Looking at Nishizawa column 18, lines 35 through 54, are you able to tell me whether an electron generated by an alpha particle hitting region 33A goes up, down, or is fixed in place?

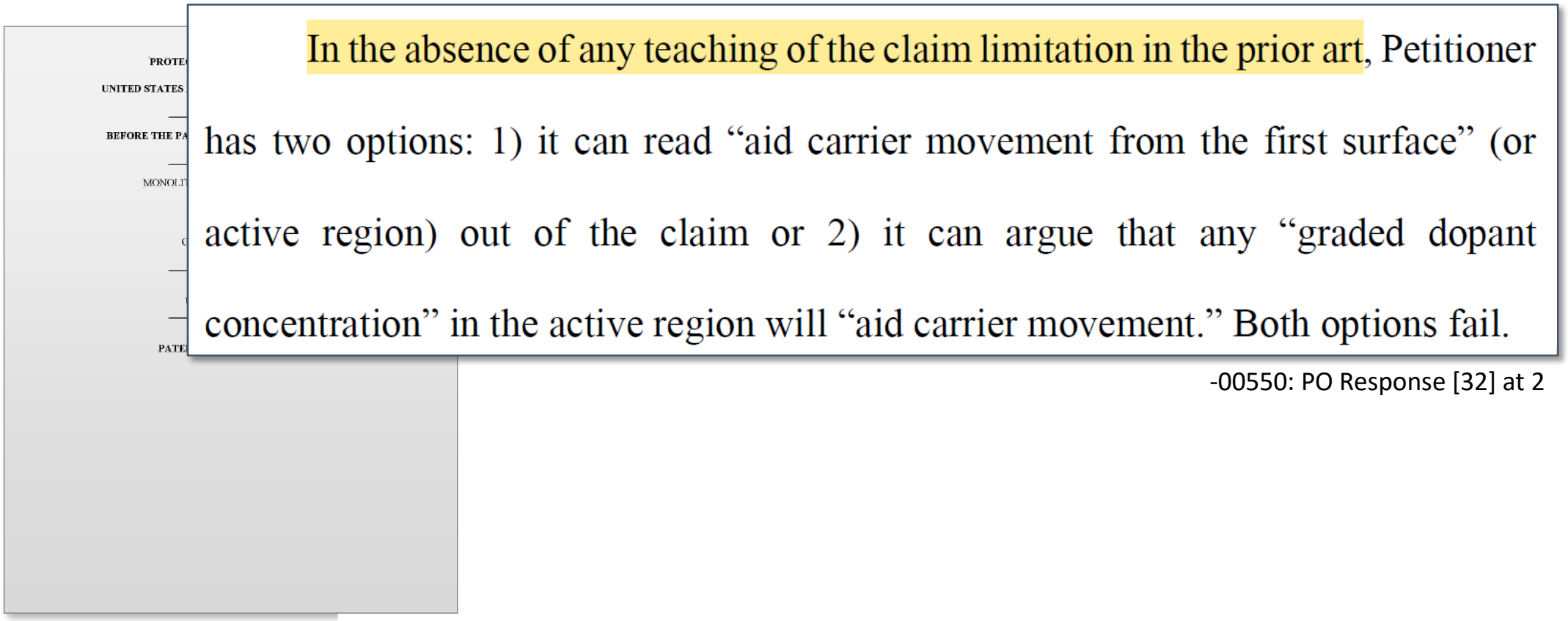
MR. WHITEHURST: Object to form.

THE WITNESS: Column 18 at the paragraph beginning at line 35 describes that the electron that enters region 33A is stopped from entering source drain region 13. So to some extent, it is hindered from vertical entry into the region 13.

Ex. 1055 at 106:8-18

5. Onoda Does Not Move Carriers from the "Surface Layer"

- Because Onoda (and Nishizawa) do not expressly teach moving carriers from the "surface layer," Petitioner had the burden to identify an electric field that would move carriers from the "surface layer."

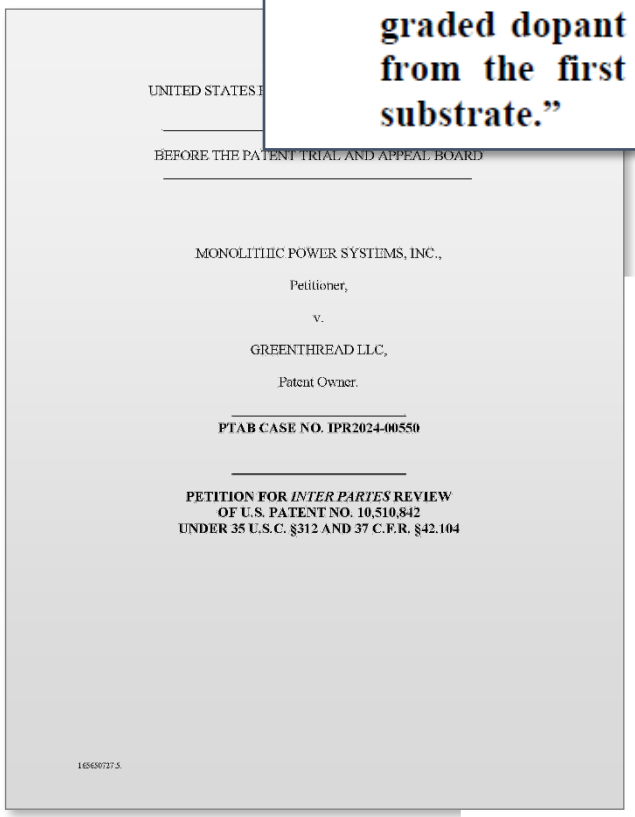


In the absence of any teaching of the claim limitation in the prior art, Petitioner has two options: 1) it can read "aid carrier movement from the first surface" (or active region) out of the claim or 2) it can argue that any "graded dopant concentration" in the active region will "aid carrier movement." Both options fail.

-00550: PO Response [32] at 2

5. Onoda Does Not Move Carriers from the "Surface Layer"

- Petitioner did <u>not</u> identify an electric field, much less an electric field starting at the surface layer.
- Petitioner's only mention of "field" related to its erroneous prosecution history arguments.



UNITED STATES P

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MONOLITHIC POWER SYSTEMS, INC.,

Petitioner,

v.

GREENTHREAD LLC,

Patent Owner.

PTAB CASE NO. IPR2024-00550

PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 10,510,842
UNDER 35 U.S.C. §312 AND 37 C.F.R. §42.104

165630737.5

f. Element [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."

-00550: Petition [1] at 23, 49

The fact that a graded concentration aids the movement of carriers was a well-known property of semiconductor devices long before September 2004. (Ex. 1003, ¶103, 46-58.) Indeed, Patent Owner admitted that to be the case in prosecution, where Patent Owner, citing prior art, stated that "the graded dopant concentration itself creates a 'built-in' electrical field" and this "built-in" electric field "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." (Ex. 1003, ¶¶47, 103.). The net effect of the graded dopant concentration is to cause carriers (e.g., electrons) to move from the top surface of the substrate 100 to the bottom surface of the layer 102, which is towards the second surface of the substrate 100. (Ex. 1003, ¶104.)

-00550: Petition [1] at 52-53

-00550: PO Resp. [32] at 28-29; PO Sur-Reply [45] at 23-25

PUBLIC VERSION

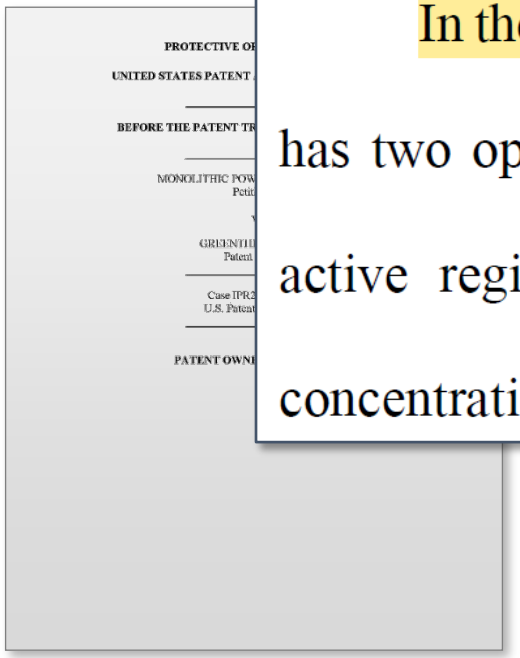
DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Overview of Issues

1. **Petitioner has presented zero "actual evidence" that the Petitions are timely.**
2. **The Claims require "movement of carriers" from the "surface layer" or "active region."**
3. **The '195 and '502 Claims require "movement of minority carriers" from the "surface layer."**
4. **Kawagoe does not disclose "movement of [minority] carriers" from the "surface layer."**
5. **Onoda/Nishizawa does not disclose "movement of [minority] carriers" from the "surface layer."**
6. **Petitioner has the burden to identify electric fields that would "aid carrier movement."**
7. Petitioner's expert confirmed that carriers in the "surface layer" are affected by numerous other fields and forces.
8. Petitioner's expert confirmed "movement of carriers" depends on the sum of all fields in the "surface layer."
9. Petitioner's expert did not analyze any of the fields or force magnitudes in the "surface layer."
10. Petitioner's prosecution-related arguments are incorrect.
11. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

6.Petitioner Has the Burden to Analyze the Electric Fields

- Because the Prior Art does not expressly teach moving carriers (or minority carriers) from the "surface layer," Petitioner has the burden to:
  - identify an electric field that is in the correct location (*i.e.*, starts in the "surface layer")
  - identify an electric field that points in the correct direction
  - analyze the other fields in the "surface layer"



In the absence of any teaching of the claim limitation in the prior art, Petitioner has two options: 1) it can read "aid carrier movement from the first surface" (or active region) out of the claim or 2) it can argue that any "graded dopant concentration" in the active region will "aid carrier movement." Both options fail.

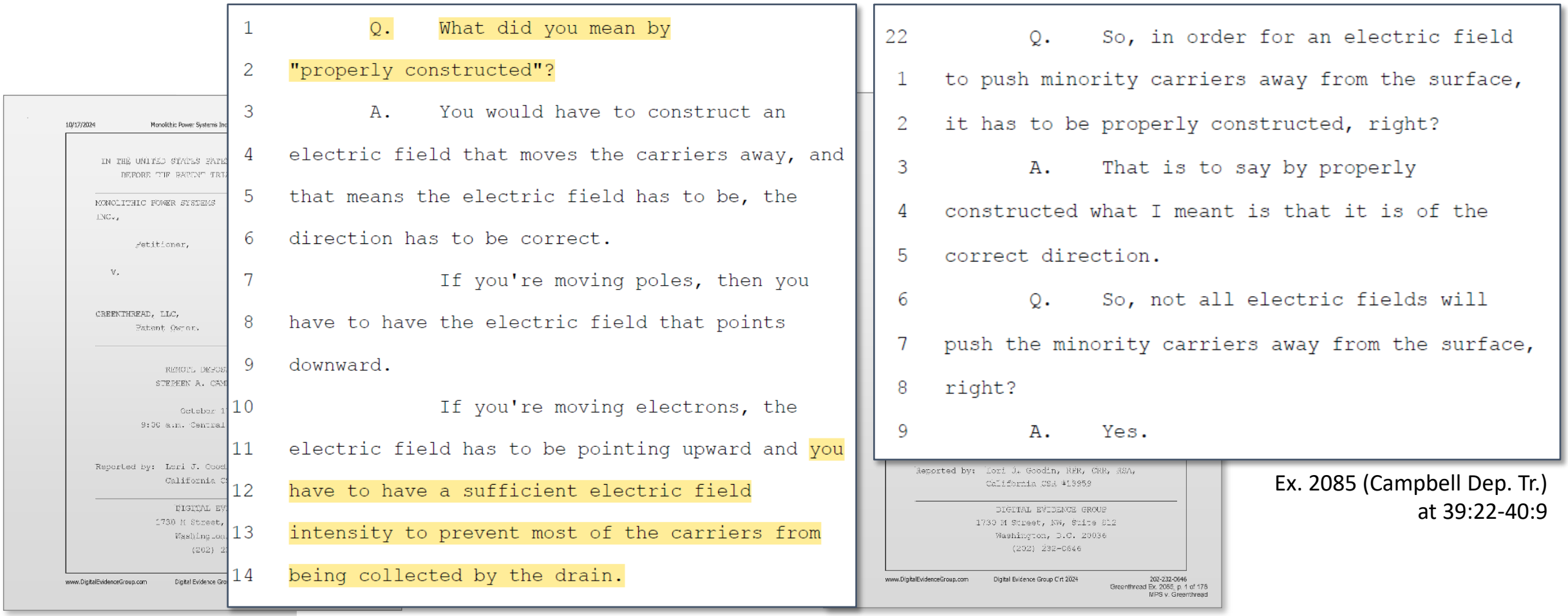
-00550: PO Response [32] at 2

Overview of Issues

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7. Carriers in the Surface Layer are Affected by Numerous Fields

- Dr. Campbell testified that only a "properly constructed" electric field would actually move carriers.



Q. What did you mean by "properly constructed"?

A. You would have to construct an electric field that moves the carriers away, and that means the electric field has to be, the direction has to be correct.

If you're moving poles, then you have to have the electric field that points downward.

If you're moving electrons, the electric field has to be pointing upward and you have to have a sufficient electric field intensity to prevent most of the carriers from being collected by the drain.

Ex. 2058 (Campbell Dep. Tr.) at 34:1-14

Q. So, in order for an electric field to push minority carriers away from the surface, it has to be properly constructed, right?

A. That is to say by properly constructed what I meant is that it is of the correct direction.

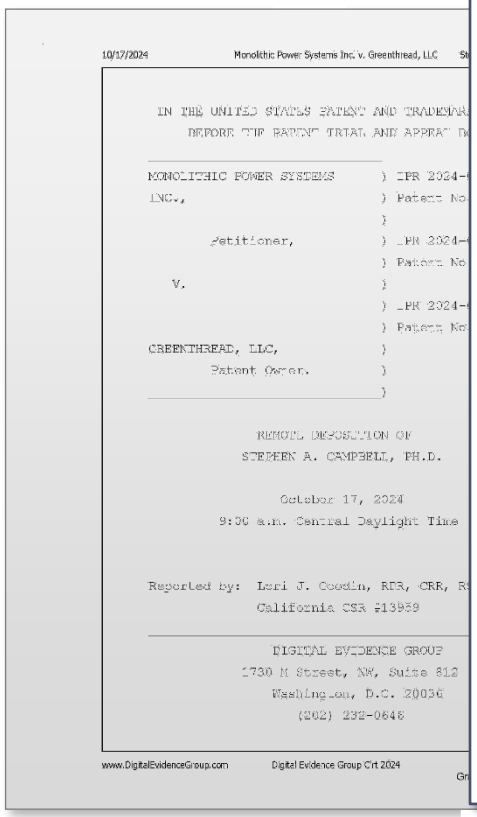
Q. So, not all electric fields will push the minority carriers away from the surface, right?

A. Yes.

Ex. 2085 (Campbell Dep. Tr.) at 39:22-40:9

7. Carriers in the Surface Layer are Affected by Numerous Fields

- Dr. Campbell testified that temperature affects carrier motion.


10/17/2024 Monolithic Power Systems Inc. v. Greenthread, LLC

IN THE UNITED STATES PATENT AND TRADEMAR
BEFORE THE PATENT TRIAL AND APPEAL B

MONOLITHIC POWER SYSTEMS INC., Petitioner, v. GREENTHREAD, LLC, Patent Owner.

REMOTE DEPOSITION OF STEPHEN A. CAMPBELL, PH.D.

October 17, 2024
9:00 a.m. Central Daylight Time

Reported by: Lori J. Coodin, RDR, CRR, R
California CSR #13959

DIGITAL EVIDENCE GROUP
1730 M Street, NW, Suite 812
Washington, D.C. 20036
(202) 232-0646

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15 Q. Okay. Can, does temperature affect
16 the carrier motion?
17 A. In general? Yes. General, the
18 mobility of carriers decreases as the temperature
19 increases.
20 The number of minority carriers, you
21 know, this is not excess minority carriers, this
22 is just the number of minority carriers in an
1 undisturbed sector, increases with temperature.
2 And since the fusion coefficient is
3 proportional to the mobility, as the temperature
4 goes up, both mobility and the diffusion
5 coefficient goes down.

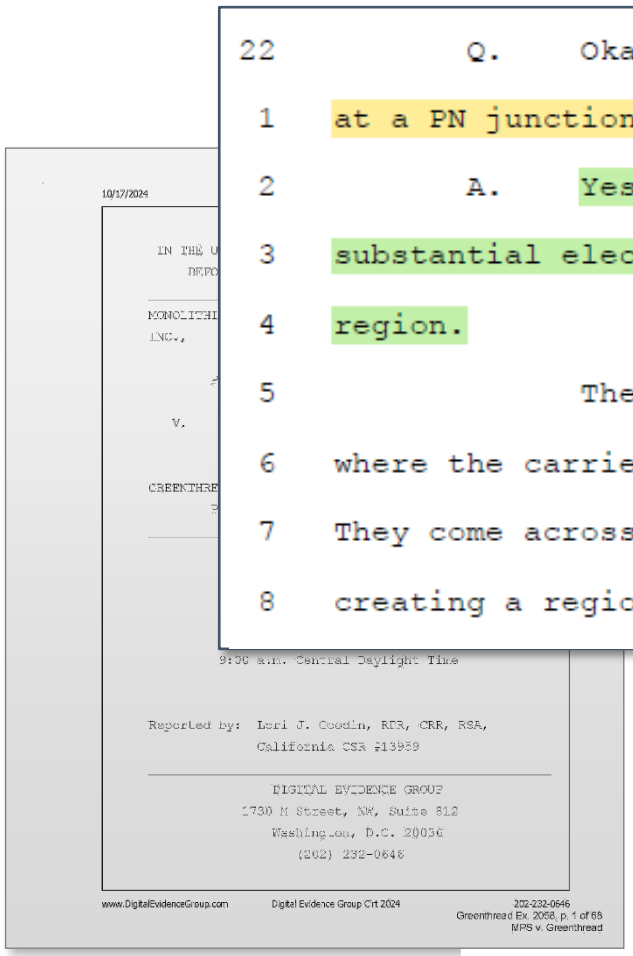
Ex. 2058 (Campbell Dep. Tr.) at 34:15-35:5

5 Q. Can you think of any situation where
6 you might want to use a different doping profile
7 for a higher temperature range?
8 A. Yes. It is certainly possible.
9 Q. Why is it possible that you would
10 want to use a different doping profile for a
11 higher temperature range?
12 A. The higher temperature range
13 introduces the higher concentration of minority
14 carriers nowhere near what you get with an
15 alpha-particle strike but still more than you
16 would have in a lower temperature.
17 You would also change the threshold
18 voltage, and you want to make sure that over that
19 temperature range, the threshold voltage stays
20 within the range specified.

Ex. 2085 (Campbell Dep. Tr.) at 115:5-20

7. Carriers in the Surface Layer are Affected by Numerous Fields

- Dr. Campbell testified that P-N junction capacitance affects carrier motion.



22 Q. Okay. Does the capacitance created
1 at a PN junction affect carrier motion?
2 A. Yes. It creates a fairly
3 substantial electric field in the depletion
4 region.
5 There's a region near the junction
6 where the carriers are, annihilate each other.
7 They come across the boundary and recombine them
8 creating a region where there are a few carriers.

9 This is called the depletion region.
10 And you're left with positive and
11 negatively-charged ions on the two sides of the
12 junction.
13 And, that creates a capacitance.
14 Thus, and that also creates an electric field.
15 Q. And, is that electric field that's
16 on top of the electric field created by the
17 dopant ingredients?
18 A. Yes. The electric field -- yes.
19 I'll just say yes.

Ex. 2058 (Campbell Dep. Tr.) at 35:22-36:19

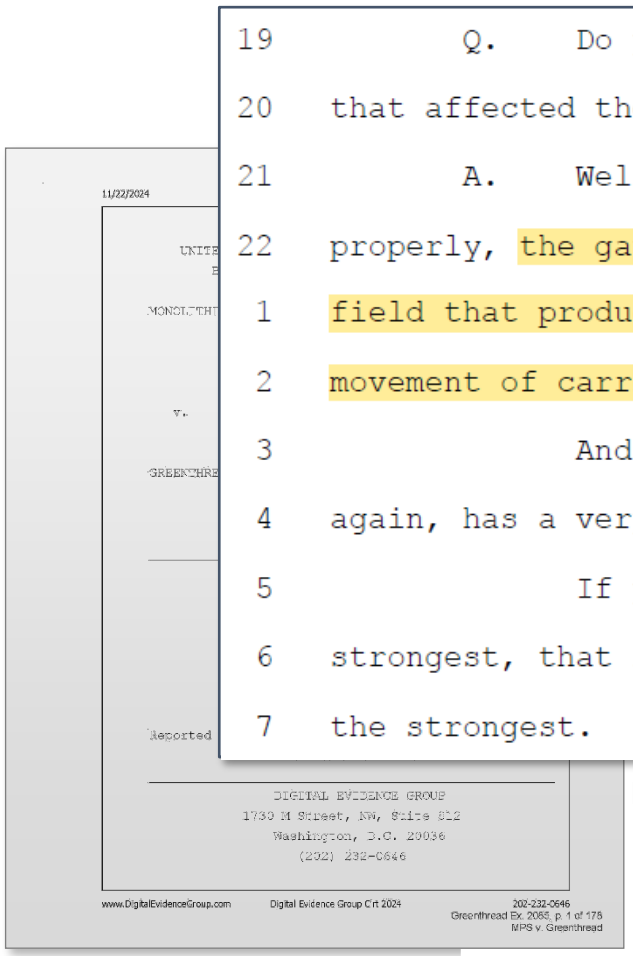
-00550: PO Resp. [32] at 3, 12, 17, 20, 25, 27, 30; PO Sur-Reply [45] at 18

PUBLIC VERSION

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

7. Carriers in the Surface Layer are Affected by Numerous Fields

- Dr. Campbell testified that electric fields produced by the gate oxide affects carrier motion.



19 Q. Do you recall some of the forces
20 that affected the semiconductor devices the most?
21 A. Well, if the device is operating
22 properly, the gate electrode produces an electric
1 field that produces a very strong effect on the
2 movement of carriers.
3 And, the voltage on the drain,
4 again, has a very strong effect.
5 If you are asking what is the
6 strongest, that is the strongest -- those two are
7 the strongest.

Ex. 2085 (Campbell Dep. Tr.) at 50:19-51:7

22 When you were working on these
1 MOSFETs, what forces affected the minority
2 carriers?
3 A. The obvious one was the one that is
4 being discussed in these patents, the existence
5 of an inherent electric field due to a doping
6 gradient.
7 That is not as strong -- excuse me.
8 That is not as strong of a force as the electric
9 field created by the gate.

Ex. 2085 at 52:22-53:9

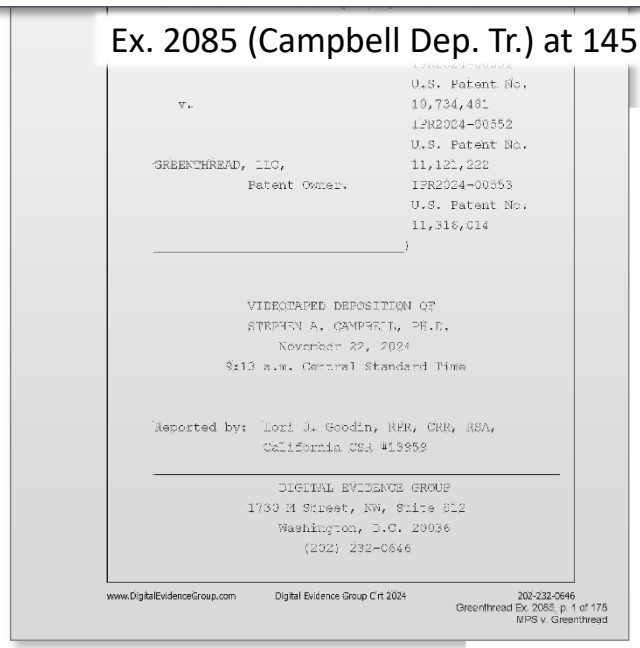
7. Carriers in the Surface Layer are Affected by Numerous Fields

- Dr. Campbell testified that different semiconductor materials have "different resistances" which affect carrier motion.

So, different semiconductors have different resistances; is that right?

A. Different resistances -- if they have the same doping concentration, they would have different resistances.

Ex. 2085 (Campbell Dep. Tr.) at 145:18-22



v.

U.S. Patent No. 10,734,481
IPR2024-00552
U.S. Patent No. 11,121,222
IPR2024-00553
U.S. Patent No. 11,316,014

GREENTHREAD, LLC,
Patent Owner.

VIDEOTAPED DEPOSITION OF
STEPHEN A. CAMPBELL, PH.D.
November 22, 2024
9:13 a.m. Central Standard Time

Reported by: Lori J. Goodin, RPR, CRR, RSA, California CSR #13959

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Greenthread Ex. 2085, p. 1 of 176
MPS v. Greenthread

Q. So, it sounds like you could have the same amount of dopants, but those dopants will have a different effect in different semiconductors.

Is that what you are saying?

A. Yes, that is correct.

Q. And why would the same amount of dopants have a different effect in different semiconductors?

A. Because the different semiconductors have different mobilities. The carriers are effectively lighter or heavier.

So, you have more of them, but they are more sluggish in one material compared to another.

Ex. 2085 at 146:21-147:13

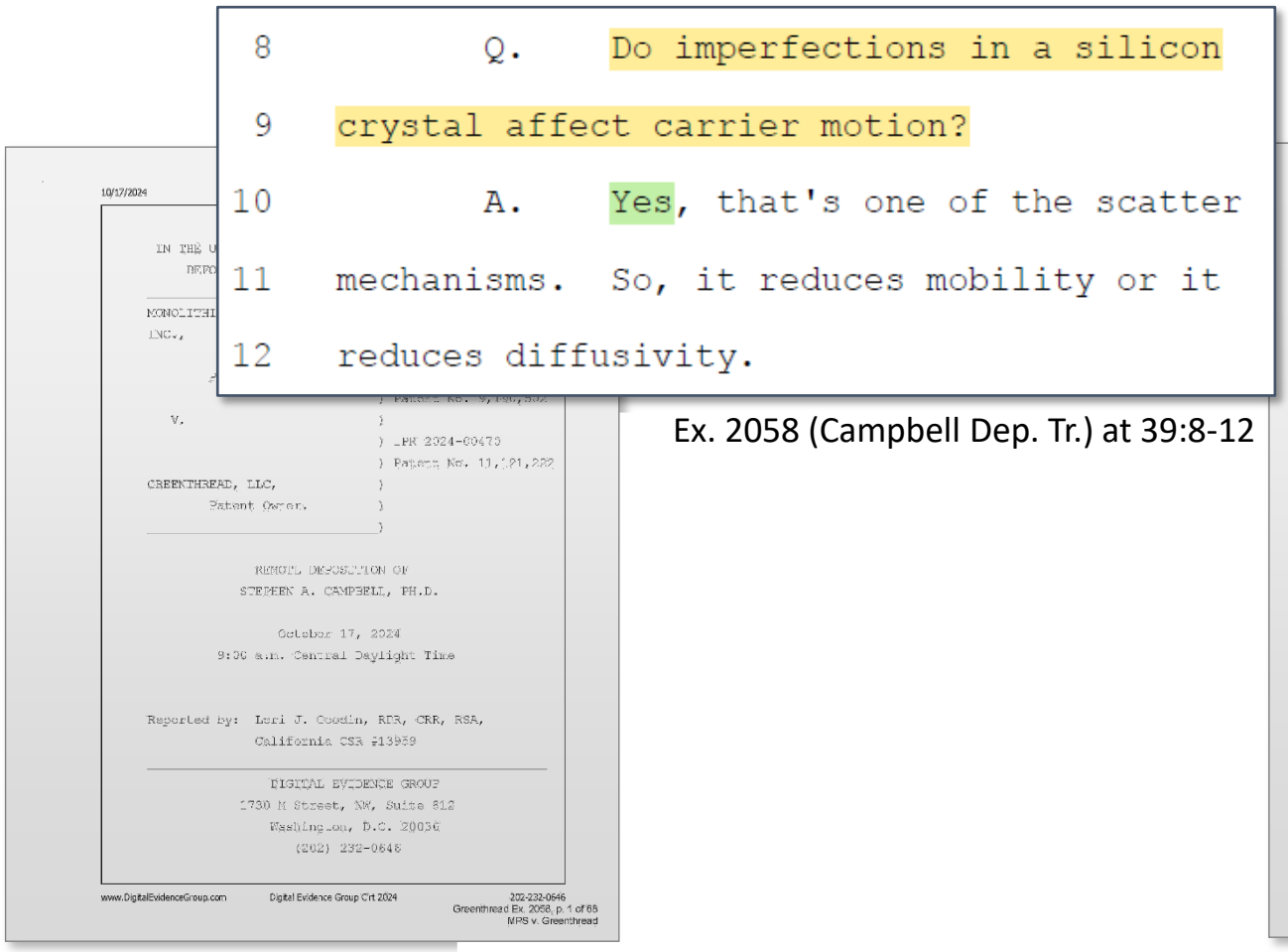
Q. But if we were talking about silicon where it is more sluggish, if you are trying to get a carrier to move, do you have to put more force on it?

A. Right. To get it to move to the same velocity, you would need a larger electric field which is more force.

Ex. 2085 at 145:18-22

7. Carriers in the Surface Layer are Affected by Numerous Fields

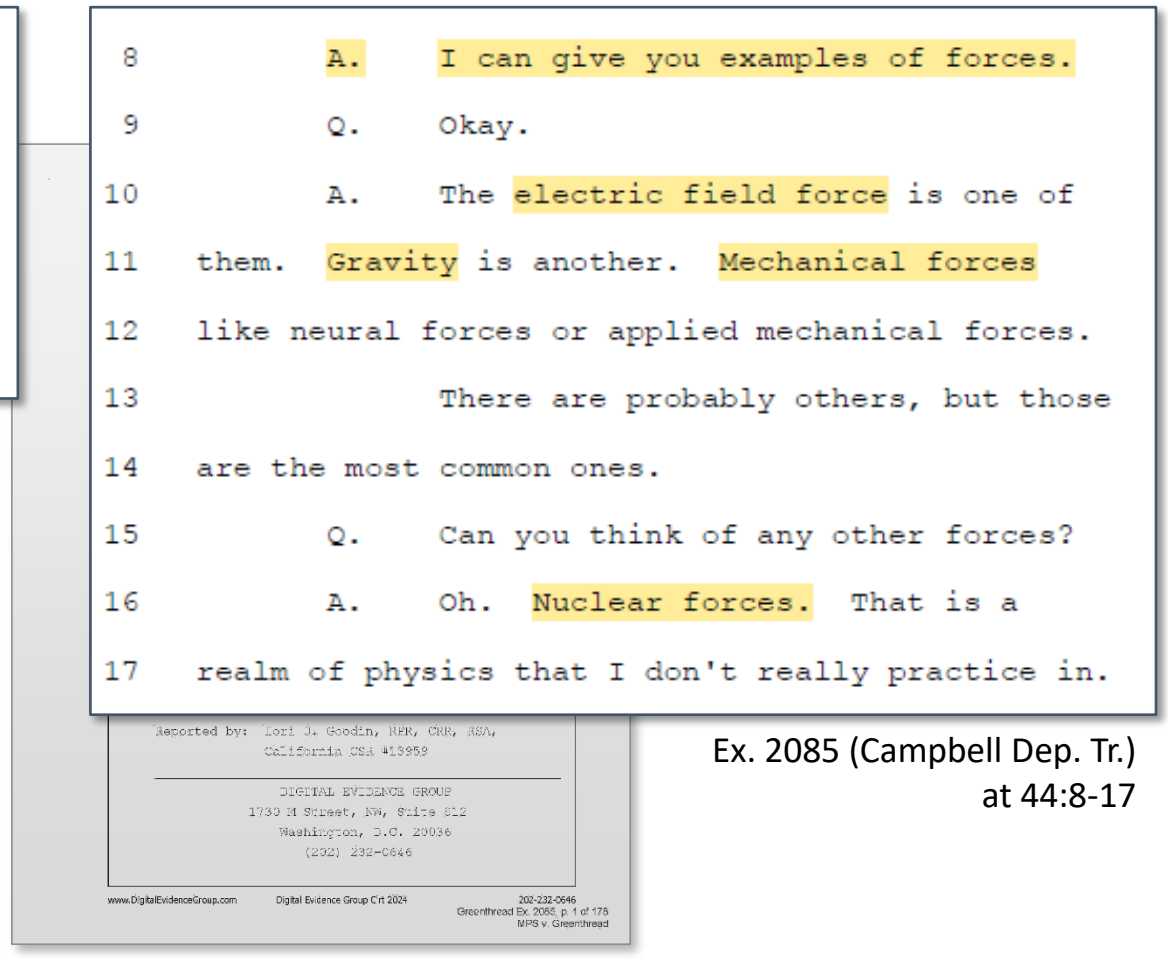
- Dr. Campbell testified to other forces and fields that affect carrier motion.



Q. Do imperfections in a silicon crystal affect carrier motion?

A. Yes, that's one of the scatter mechanisms. So, it reduces mobility or it reduces diffusivity.

Ex. 2058 (Campbell Dep. Tr.) at 39:8-12



A. I can give you examples of forces.

Q. Okay.

A. The electric field force is one of them. Gravity is another. Mechanical forces like neural forces or applied mechanical forces. There are probably others, but those are the most common ones.

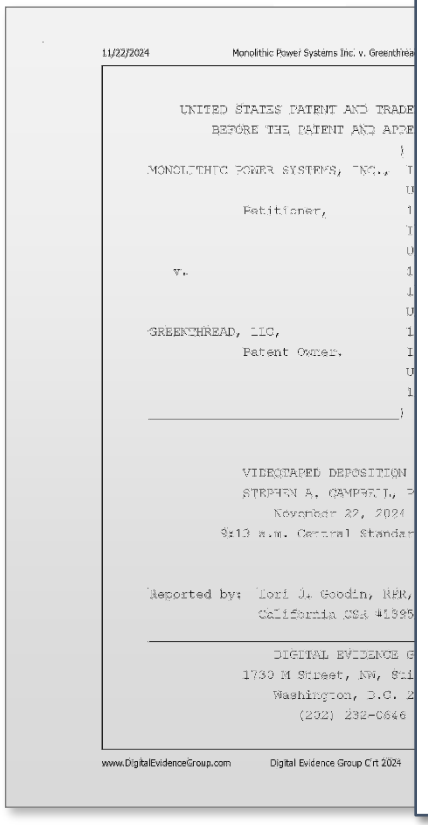
Q. Can you think of any other forces?

A. Oh. Nuclear forces. That is a realm of physics that I don't really practice in.

Ex. 2085 (Campbell Dep. Tr.) at 44:8-17

7. Carriers in the Surface Layer are Affected by Numerous Fields

- Dr. Campbell testified to other forces and fields that affect carrier motion.


11/22/2024 Monolithic Power Systems Inc. v. Greenthrea

UNITED STATES PATENT AND TRADE
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California CSR #1395

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12 And so, when I say other forces in
13 regard to minority carrier transport, one has to
14 deal with, well, with the energy associated with
15 thermal motion, if you will. That is the motion
16 on -- well -- okay.
17 All right. So, we have electric
18 fields, one of which might be an inherent field
19 due to a doping gradient. Another might be due
20 to some applied voltage on devices.
21 And then, as I mentioned, you can
22 have mechanical forces. And mechanical forces
1 that are of interest in this application would be
2 collisions between minority carriers and other
3 minority carriers, or minority carriers and
4 phonons. Phonons are the vibration of the atoms
5 in the crystal lattice.

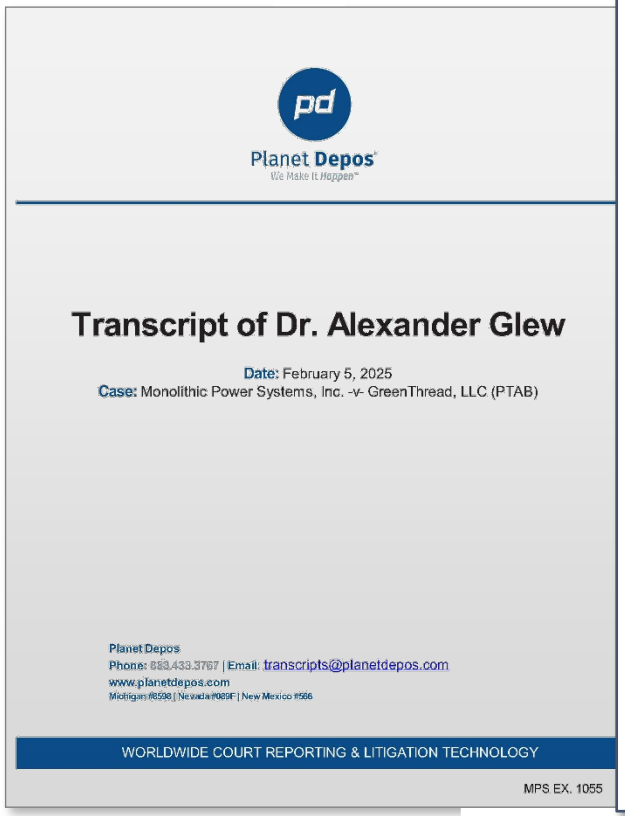
Ex. 2085 (Campbell Dep. Tr.) at 45:12-46:5

20 What would -- when you were
21 designing MOSFETs, what would affect the movement
22 of the carriers?
1 A. The electric fields, temperatures --
2 temperature, sorry. If there were magnetic
3 fields around, we don't usually design for that,
4 but if there were, that would affect it.
5 If there light exposure -- again,
6 usually these things are packaged, and so there
7 is no light. But, if you are not encapsulating
8 them, then that is something to be aware of.
9 I may be missing a few things, but
10 that is what I can think of at the top of my
11 head.

Ex. 2085 at 139:20-140:11

7. Carriers in the Surface Layer are Affected by Numerous Fields

- Dr. Glew confirmed that carrier motion depends on whatever other forces are present.



create a field that affects -- strike that. Would a graded concentration of dopants create an electric field that exerts a force onto a minority carrier?

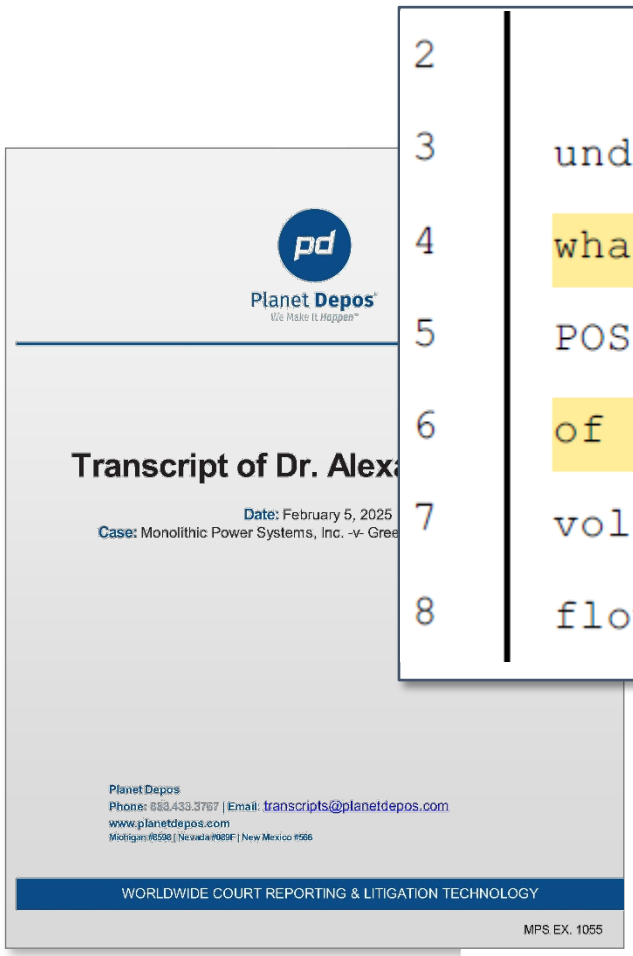
THE WITNESS: The graded concentration gradient of dopants of the opposite type of the carrier may actually just recombine with the opposite carrier. So there may not be any opposite carriers left. If the dopant gradient is of the same type of the carrier, then it would produce a field proportional to the gradient. However, that field may not be sufficient to actually exert a force on the carrier that resulted in motion.

Whether or not there was motion due to one specific force depends upon the other forces that exist in the semiconductor device. There may be

Ex. 1055 (Glew Dep. Tr.) at 65:22-66:16

7. Carriers in the Surface Layer are Affected by Numerous Fields

- Dr. Glew confirmed that the resistance of the silicon affects carrier motion.

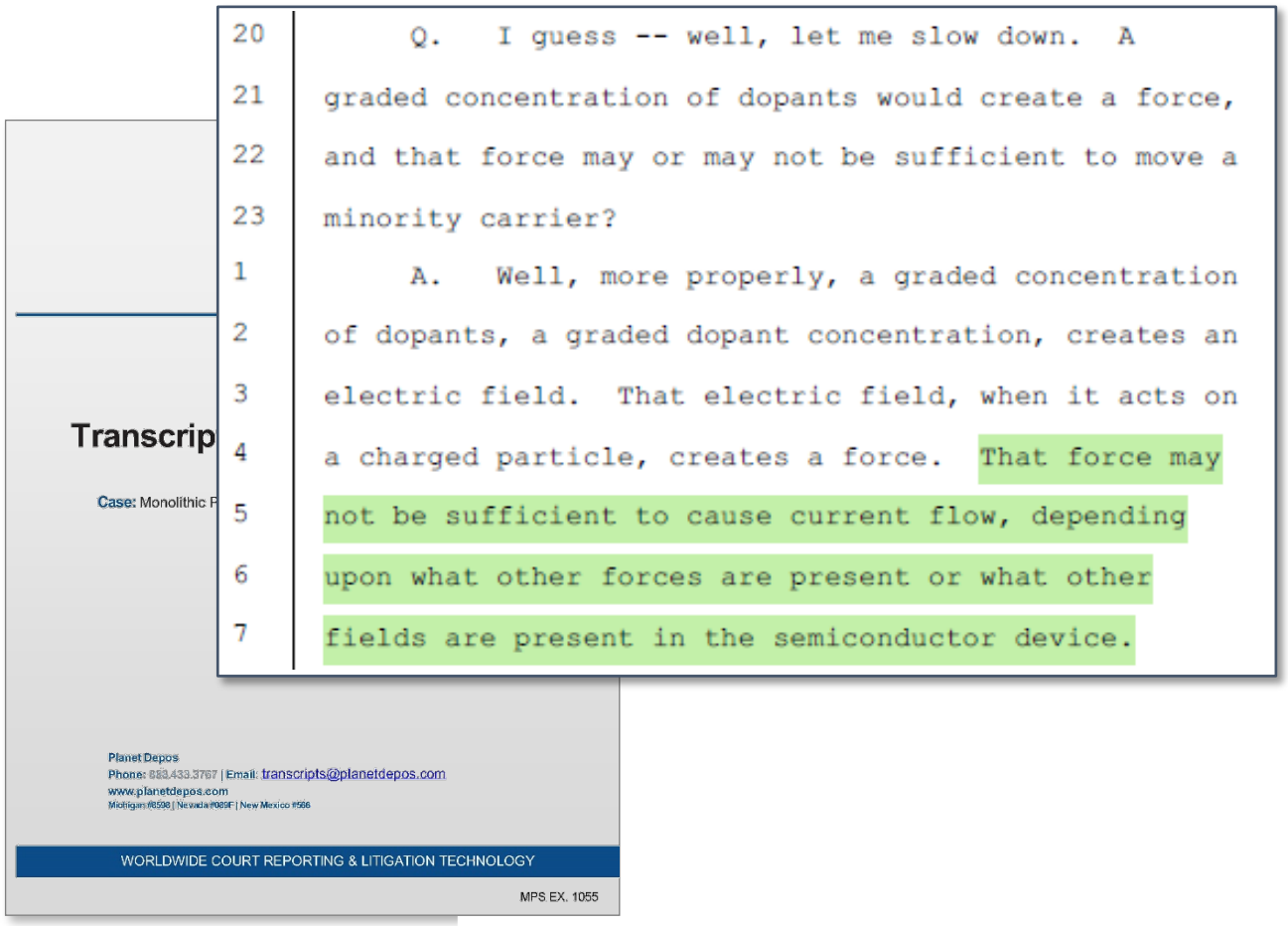


THE WITNESS: I think POSITA would understand that one would need to account for whatever forces existed. That's something that POSITA would do. For example, knowing the resistance of the silicon, one could try to determine the voltage potential necessary to speed up the electron flow to accommodate a higher cutoff frequency.

Ex. 1055 (Glew Dep. Tr.) at 60:2-8

7. Carriers in the Surface Layer are Affected by Numerous Fields

- Dr. Glew confirmed many of the other forces that Dr. Campbell testified about concerning carrier motion.



Transcrip

Case: Monolithic P

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MPS EX. 1055

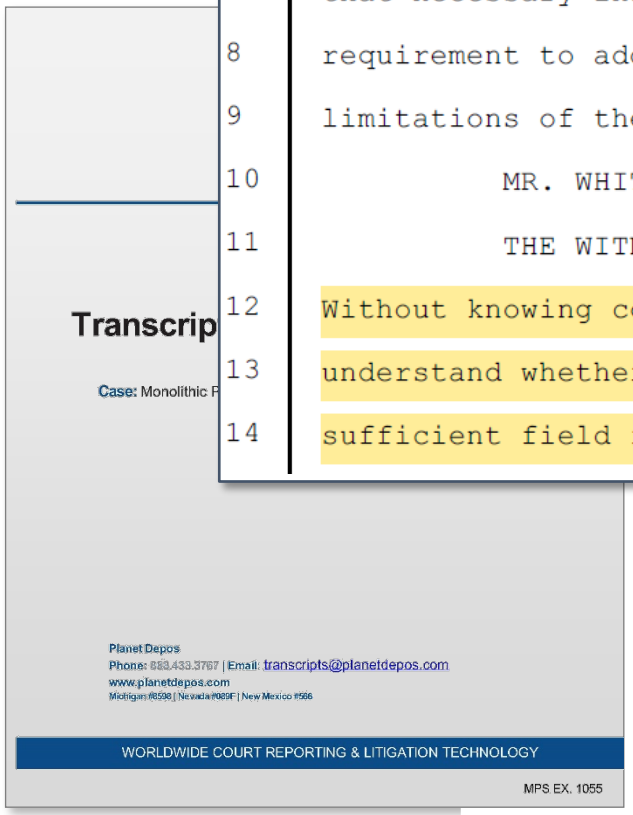
20 Q. I guess -- well, let me slow down. A
21 graded concentration of dopants would create a force,
22 and that force may or may not be sufficient to move a
23 minority carrier?
1 A. Well, more properly, a graded concentration
2 of dopants, a graded dopant concentration, creates an
3 electric field. That electric field, when it acts on
4 a charged particle, creates a force. That force may
5 not be sufficient to cause current flow, depending
6 upon what other forces are present or what other
7 fields are present in the semiconductor device.

8 These forces and fields, we've recited
9 before. Examples are imperfections such as crystal
10 dislocations, impurities, temperature. Stress is
11 also a force. So forth and so on. Junctions create
12 pretty high forces also in their capacitance.
13 Junction is a rather abrupt change in concentration
14 in gradient of dopants or of carriers. So that has a
15 very large effect.

Ex. 1055 (Glew Dep. Tr.) at 66:20-67:15

7. Carriers in the Surface Layer are Affected by Numerous Fields

- Dr. Glew confirmed that—in the context of Onoda—it is impossible to determine carrier motion "without knowing all the forces."



Q. Do you believe that ONODA's disclosure of that necessary information that you referenced is a requirement to address the aid the carrier movement limitations of the '195, '502, and '222 patents?

MR. WHITEHURST: Object to form.

THE WITNESS: I would say generally, yes. Without knowing counteracting forces, one can't understand whether or not there is going to be sufficient field force to motivate current flow.

Ex. 1055 (Glew Dep. Tr.) at 91:6-14

Q. The downward sloping portion, are you able to discern the impact that the force generated by that slope would have on an electron in the ONODA device?

MR. WHITEHURST: Object to form.

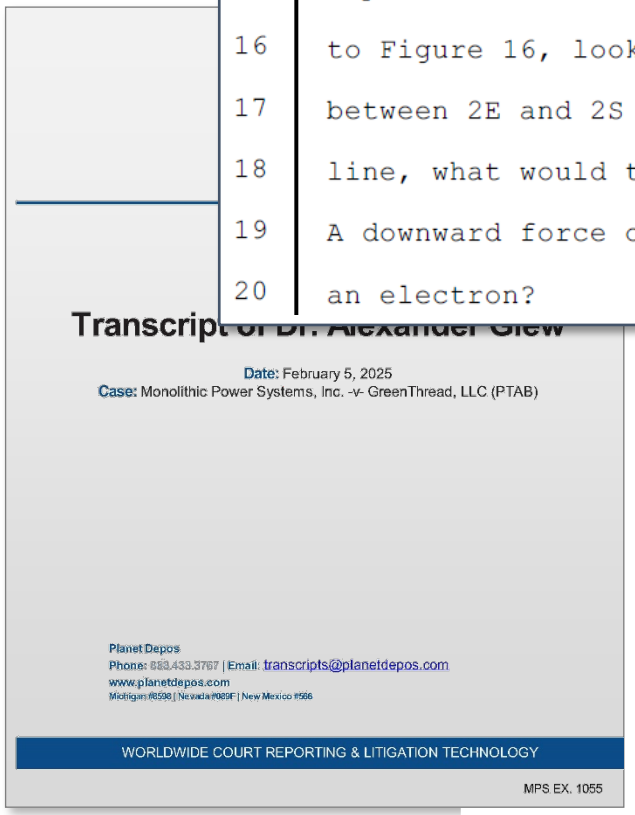
THE WITNESS: One can't determine the net effect without knowing all of the forces. This is one potential, one force, but any other counteracting or aiding forces that act in the same direction would have to be accounted for also in order to understand if there was any motion due to this or in this direction.

Ex. 1055 at 92:5-16

7. Carriers in the Surface Layer are Affected by Numerous Fields

- Dr. Glew confirmed that—in the context of Kawagoe—any "potential force" from a dopant profile "would depend upon other forces."

14 Q. Looking at Kawagoe's Figure 17, which
15 depicts the concentration gradient, and comparing it
16 to Figure 16, looking at Figure 16, at the point
17 between 2E and 2S which is indicated by the dashed
18 line, what would the concentration gradient impart?
19 A downward force on an electron or an upward force on
20 an electron?


Transcript of Dr. Alexander Glew

Date: February 5, 2025
Case: Monolithic Power Systems, Inc. -v- GreenThread, LLC (PTAB)

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WORLDWIDE COURT REPORTING & LITIGATION TECHNOLOGY

MPS EX. 1055

22 THE WITNESS: The concentration or impurity
23 concentration gradient shown in Figure 17 is
24 decreasing to the right. Therefore, the field would
25 point to the left. So holes would experience a
1 potential force in the left direction, or upward, and
2 electrons would be pushed potentially in the opposite
3 direction to the right or downward. This is an
4 effect in isolation.
5 Whether there was actually any motion or
6 net effect would depend upon other forces acting upon
7 the electron also.

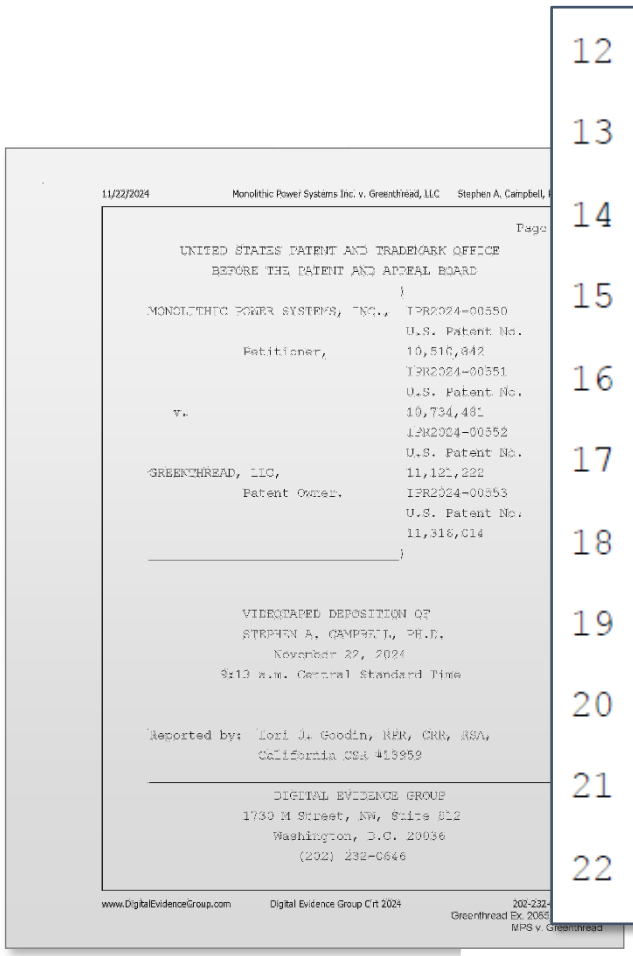
Ex. 1055 (Glew Dep. Tr.) at 122:14-123:7

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9. Petitioner's expert did not analyze any of the fields or force magnitudes in the "surface layer."
10. Petitioner's prosecution-related arguments are incorrect.
11. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

8. Movement of Carriers Depends on the Net Field

- Dr. Campbell testified that "movement … is dependent on the sum of all forces."

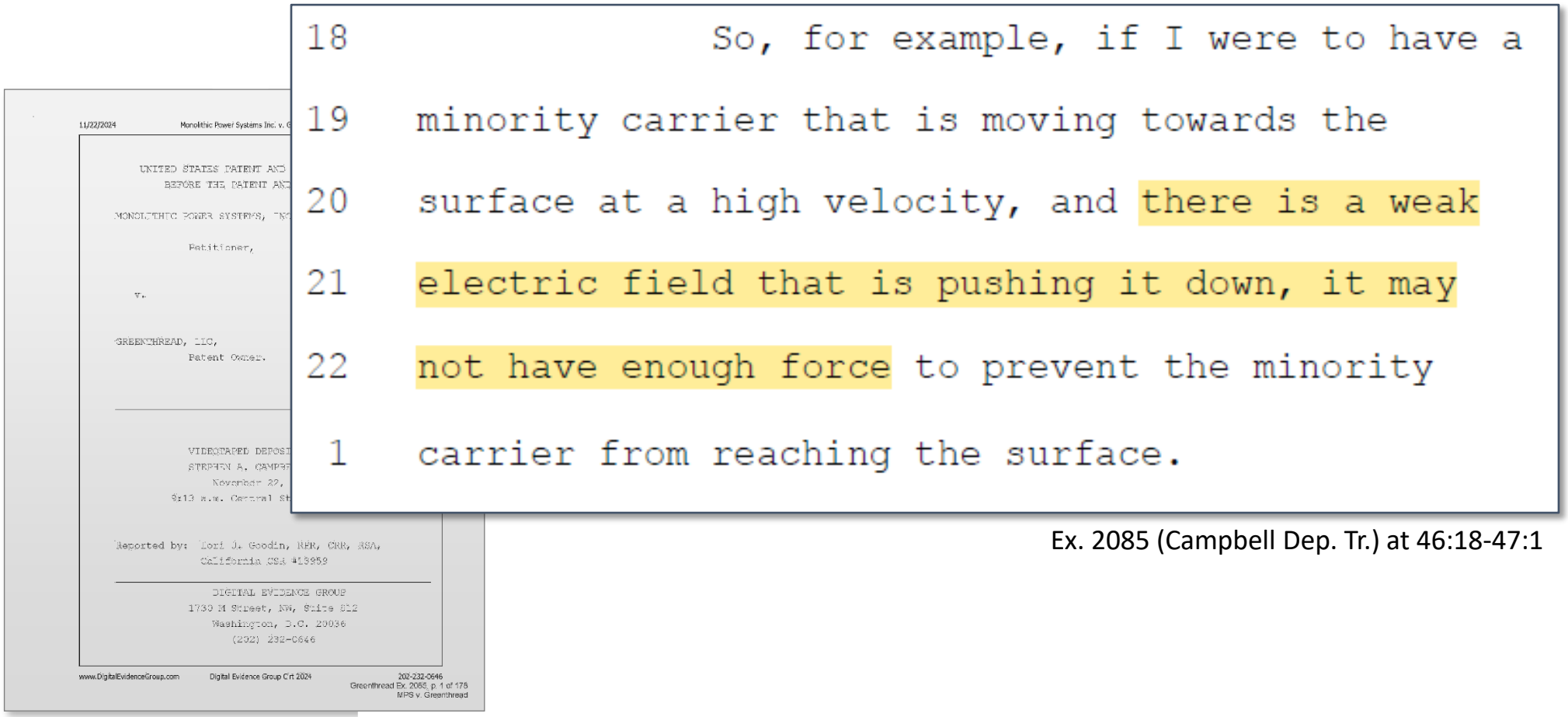


12 The electric field will provide a
13 force that would tend to move them in one
14 direction or the other.
15 There may be other forces acting
16 upon the carriers, and you have to add all of the
17 forces.
18 Q. Why do you have to add all of the
19 forces?
20 A. Newton's first law. You have -- the
21 movement of an object is dependent on the sum of
22 all forces on that object.

Ex. 2085 (Campbell Dep. Tr.) at 42:12-22

8. Movement of Carriers Depends on the Net Field

- The net force/field is important because the generated electric field “may not have enough force” to overcome the other forces/fields present.



11/22/2024 Monolithic Power Systems Inc. v. G

UNITED STATES PATENT AND
BEFORE THE PATENT AN

MONOLITHIC POWER SYSTEMS, IN

Petitioner,

v.

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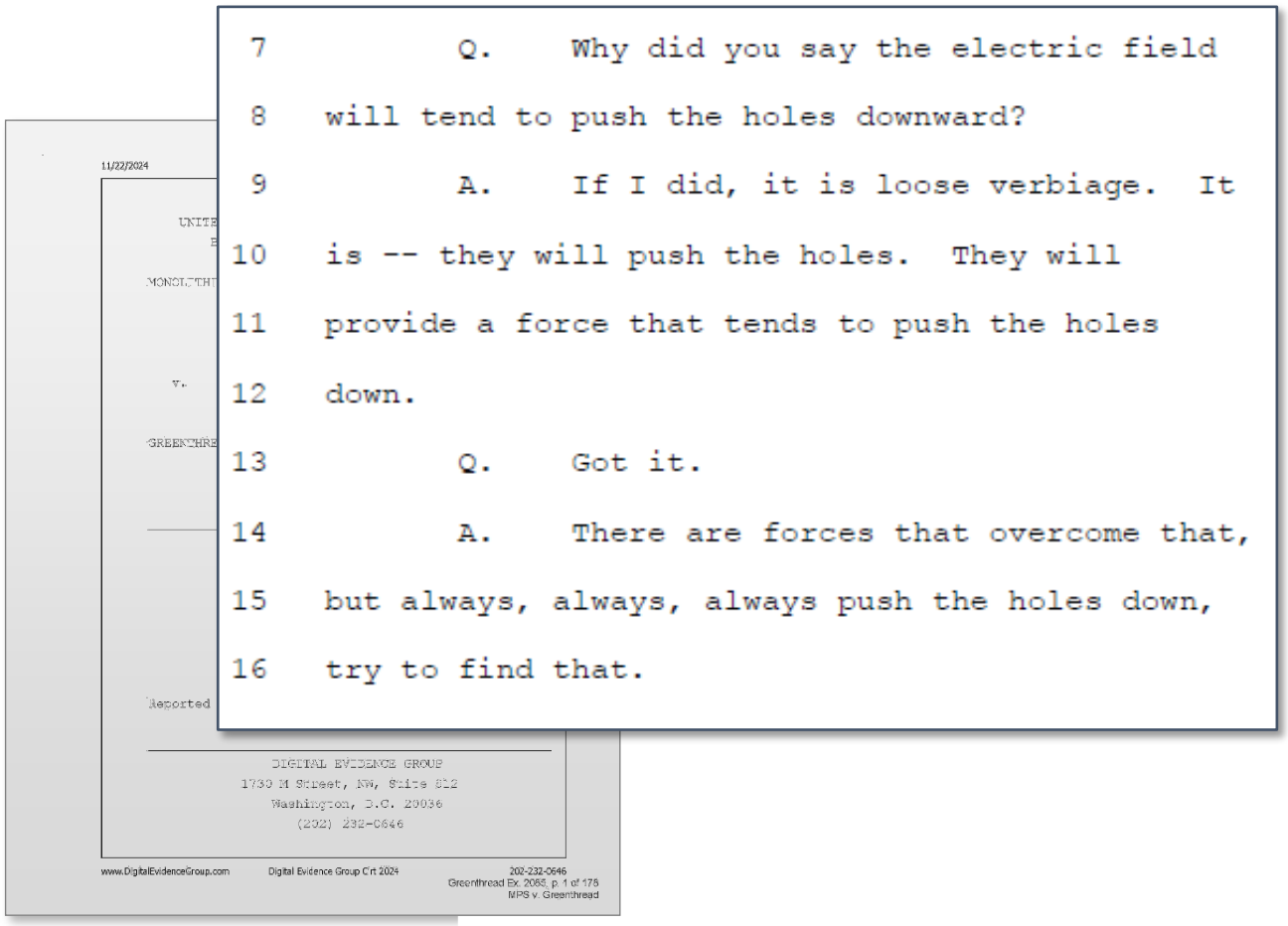
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Greenthread Ex. 2085, p. 1 of 176
MPS v. Greenthread

18 So, for example, if I were to have a
19 minority carrier that is moving towards the
20 surface at a high velocity, and there is a weak
21 electric field that is pushing it down, it may
22 not have enough force to prevent the minority
1 carrier from reaching the surface.

Ex. 2085 (Campbell Dep. Tr.) at 46:18-47:1

8. Movement of Carriers Depends on the Net Field

- Dr. Campbell testified that "whether the hole actually goes downward" depends on the "other forces."



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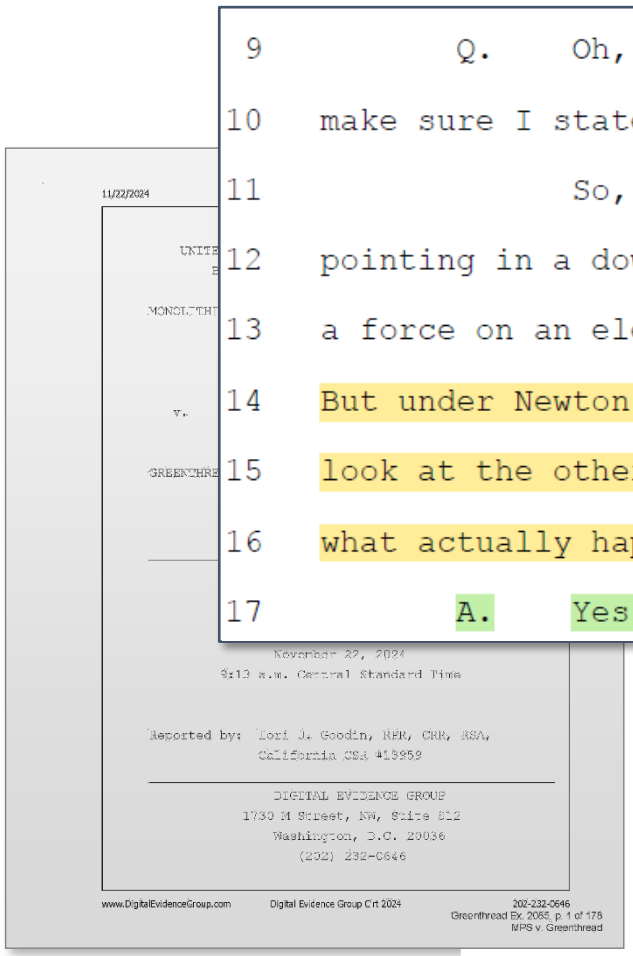
7 Q. Why did you say the electric field
8 will tend to push the holes downward?
9 A. If I did, it is loose verbiage. It
10 is -- they will push the holes. They will
11 provide a force that tends to push the holes
12 down.
13 Q. Got it.
14 A. There are forces that overcome that,
15 but always, always, always push the holes down,
16 try to find that.

17 Q. So, I think I understand what you
18 are saying.
19 The electric field will try to push
20 holes downward, but you have to look at the other
21 forces to determine whether the hole actually
22 goes downward?
1 A. Yes.

Ex. 2085 (Campbell Dep. Tr.) at 93:7-94:1

8. Movement of Carriers Depends on the Net Field

- Dr. Campbell testified that "what determines movement" is the "net effect of the forces."



9 Q. Oh, I understand now. So, let me
10 make sure I state that correctly.
11 So, when an electron field is
12 pointing in a downward direction, it will create
13 a force on an electron in an upward direction.
14 But under Newton's first law, you would have to
15 look at the other forces in order to determine
16 what actually happens?
17 A. Yes, that is always true.

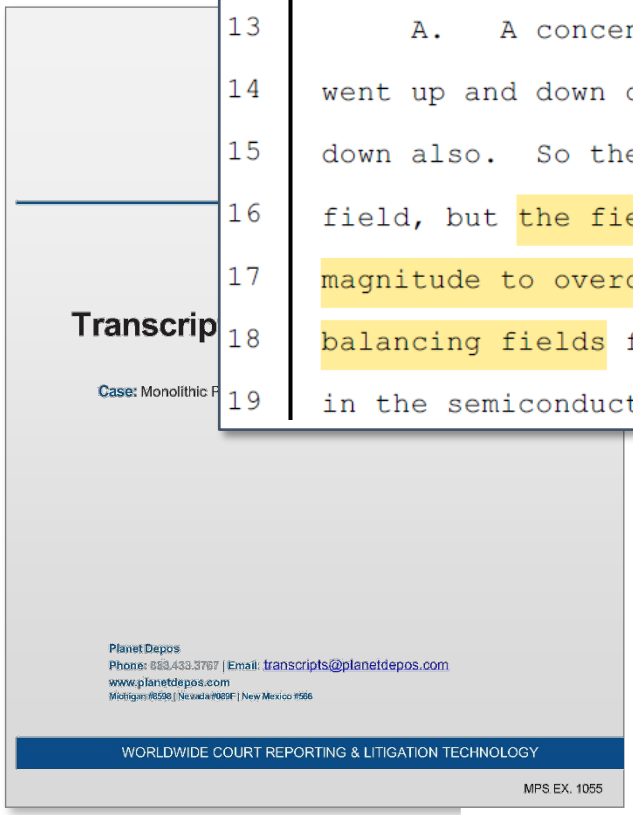
Ex. 2085 (Campbell Dep. Tr.) at 95:9-17

15 Q. And why is it important to look at
16 the net effect of the forces?
17 A. Because that is what determines the
18 movement, in this case, of the minority carriers.

Ex. 2085 at 154:15-18

8. Movement of Carriers Depends on the Net Field

- Dr. Glew confirmed that the "net sum of the forces determines whether there is motion."



Q. Would -- parsing that. A field would be generated; correct?

A. A concentration gradient of dopants that went up and down could create fields that went up and down also. So there might be not any effective field, but the field would have to be of sufficient magnitude to overcome countervailing or counter balancing fields from other structures and materials in the semiconductor device.

Ex. 1055 (Glew Decl. Tr.) at 65:11-19

create a field that affects -- strike that. Would a graded concentration of dopants create an electric field that exerts a force onto a minority carrier?

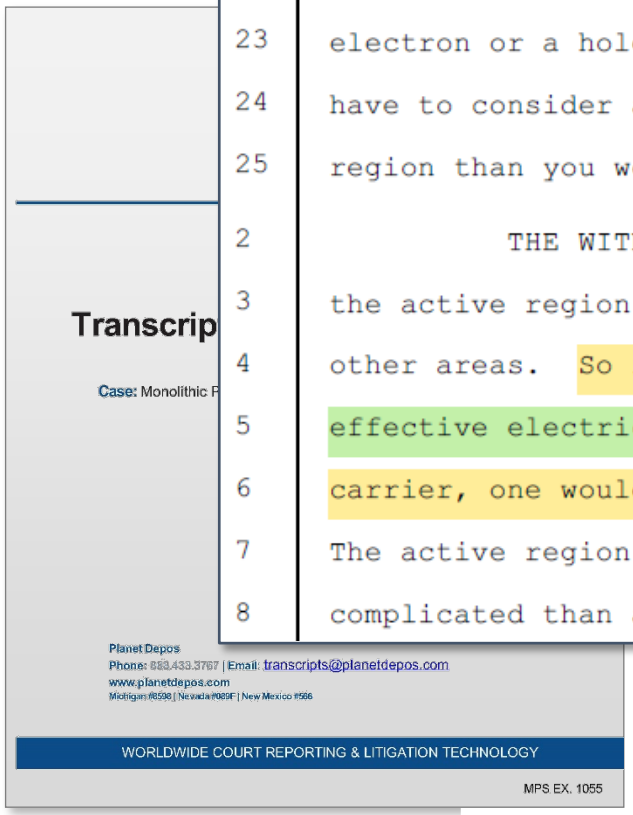
* * *

Whether or not there was motion due to one specific force depends upon the other forces that exist in the semiconductor device. There may be greater forces that exert force in the opposite direction. Forces need to be added up or summed, and the net sum of the forces determines whether there is motion and in what direction that motion occurs.

Ex. 1055 at 65:22-66:16

8. Movement of Carriers Depends on the Net Field

- Dr. Glew confirmed that the net force is needed to determine whether the references' dopant profiles actually would move carriers.



21 In Figure 11 of ONODA, if you were trying to
22 determine whether Figure 11 is capable of moving an
23 electron or a hole from the active region, would you
24 have to consider additional factors for the active
25 region than you would for other parts of the well?

2 THE WITNESS: Similar to my last answer,
3 the active region is different than the substrate or
4 other areas. So in order to determine the net
5 effective electrical and other forces on a charged
6 carrier, one would need to know those other effects.
7 The active region is very complicated, much more
8 complicated than anywhere else on a transistor.

Ex. 1055 (Glew Decl. Tr.) at 181:21-182:8

12 Q. Same question for Kawagoe. If you were
13 trying to determine whether Figure 17 is capable of
14 moving an electron or a hole from the active region,
15 would you have to consider additional factors for the
16 active region that you would not have to consider for
17 other parts of the well?
18 MR. BOMBACH: Objection. Leading.
19 THE WITNESS: The answer I would give for
20 Figure 17 of Kawagoe would be similar to the previous
21 answers I just gave. In order to know whether there
22 was an effect in the active region, one would have to
23 know the net of all the electrical and other forces
24 acting on a charged carrier to determine if there was
25 motion.

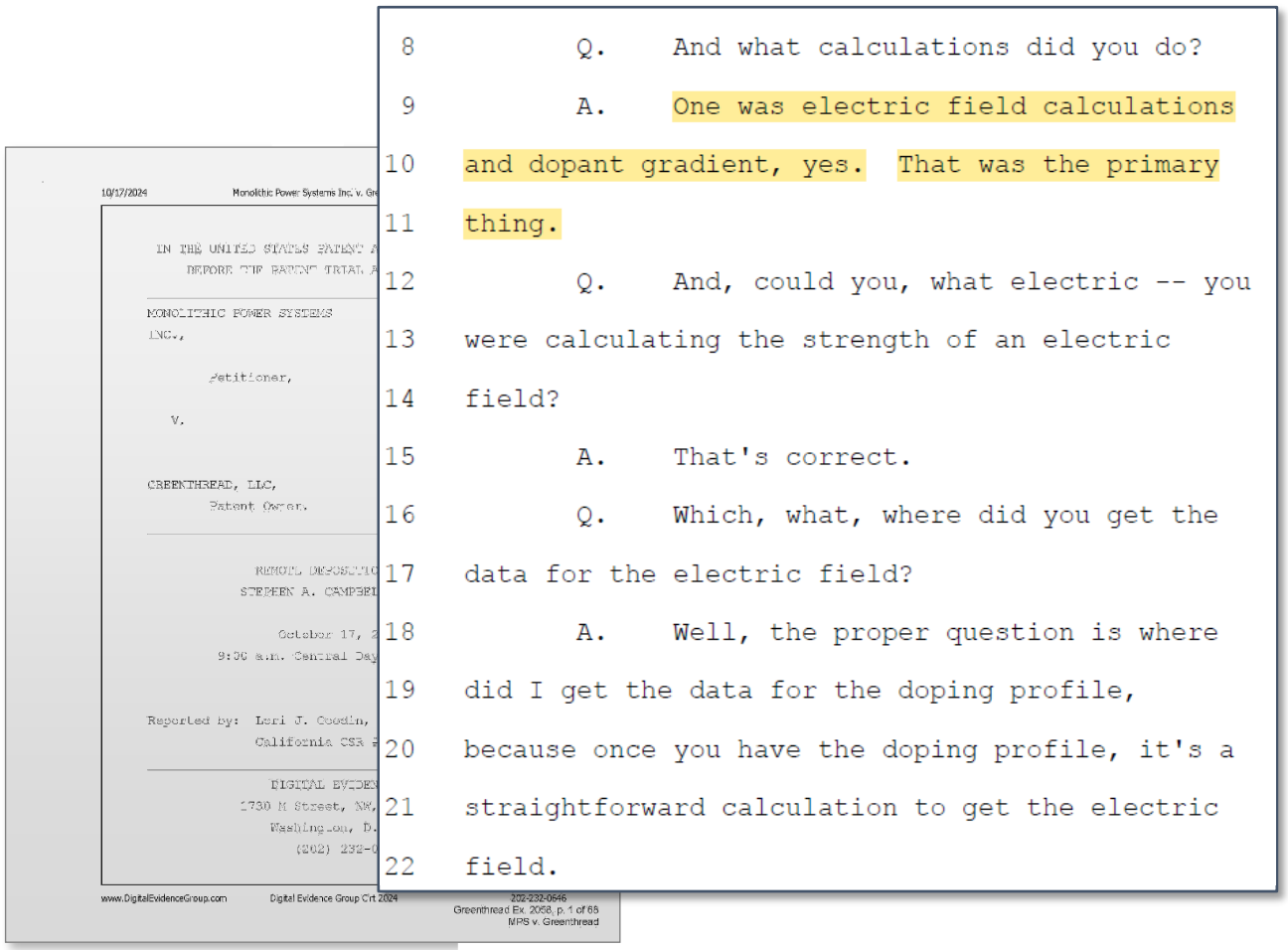
Ex. 1055 at 182:12-25

Overview of Issues

1. **Petitioner has presented zero "actual evidence" that the Petitions are timely.**
2. **The Claims require "movement of carriers" from the "surface layer" or "active region."**
3. **The '195 and '502 Claims require "movement of minority carriers" from the "surface layer."**
4. **Kawagoe does not disclose "movement of [minority] carriers" from the "surface layer."**
5. **Onoda/Nishizawa does not disclose "movement of [minority] carriers" from the "surface layer."**
6. **Petitioner has the burden to identify electric fields that would "aid carrier movement."**
7. **Petitioner's expert confirmed that carriers in the "surface layer" are affected by numerous other fields and forces.**
8. **Petitioner's expert confirmed "movement of carriers" depends on the sum of all fields in the "surface layer."**
9. **Petitioner's expert did not analyze any of the fields or force magnitudes in the "surface layer."**
10. Petitioner's prosecution-related arguments are incorrect.
11. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

9. Dr. Campbell Did Not Perform the Required Analysis

- Dr. Campbell admits that he did not calculate any electric field for the asserted references.



10/17/2024 Monolithic Power Systems Inc. v. Gr

IN THE UNITED STATES PATENT A
BEFORE THE PATENT TRIAL A

MONOLITHIC POWER SYSTEMS INC.,

Petitioner,

v.

GREENTHREAD, LLC,
Patent Owner.

REMOTE DEPOSITIO
STEPHEN A. CAMPBEL

October 17, 2
9:00 a.m. Central Day

Reported by: Lori J. Coodin,
California CSR #

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Greenthread Ex. 2058, p. 1 of 65
MPS v. Greenthread

8 Q. And what calculations did you do?
9 A. One was electric field calculations
10 and dopant gradient, yes. That was the primary
11 thing.
12 Q. And, could you, what electric -- you
13 were calculating the strength of an electric
14 field?
15 A. That's correct.
16 Q. Which, what, where did you get the
17 data for the electric field?
18 A. Well, the proper question is where
19 did I get the data for the doping profile,
20 because once you have the doping profile, it's a
21 straightforward calculation to get the electric
22 field.

1 I just assumed that a reasonable
2 doping profile -- yeah, I will just put a period
3 at that point.
4 It was a reasonable doping profile
5 for the types of technology that are under
6 discussion here.
7 Q. Okay. So, you didn't calculate the
8 electric field for any of the prior art cited in
9 your declaration?
10 A. That's correct.

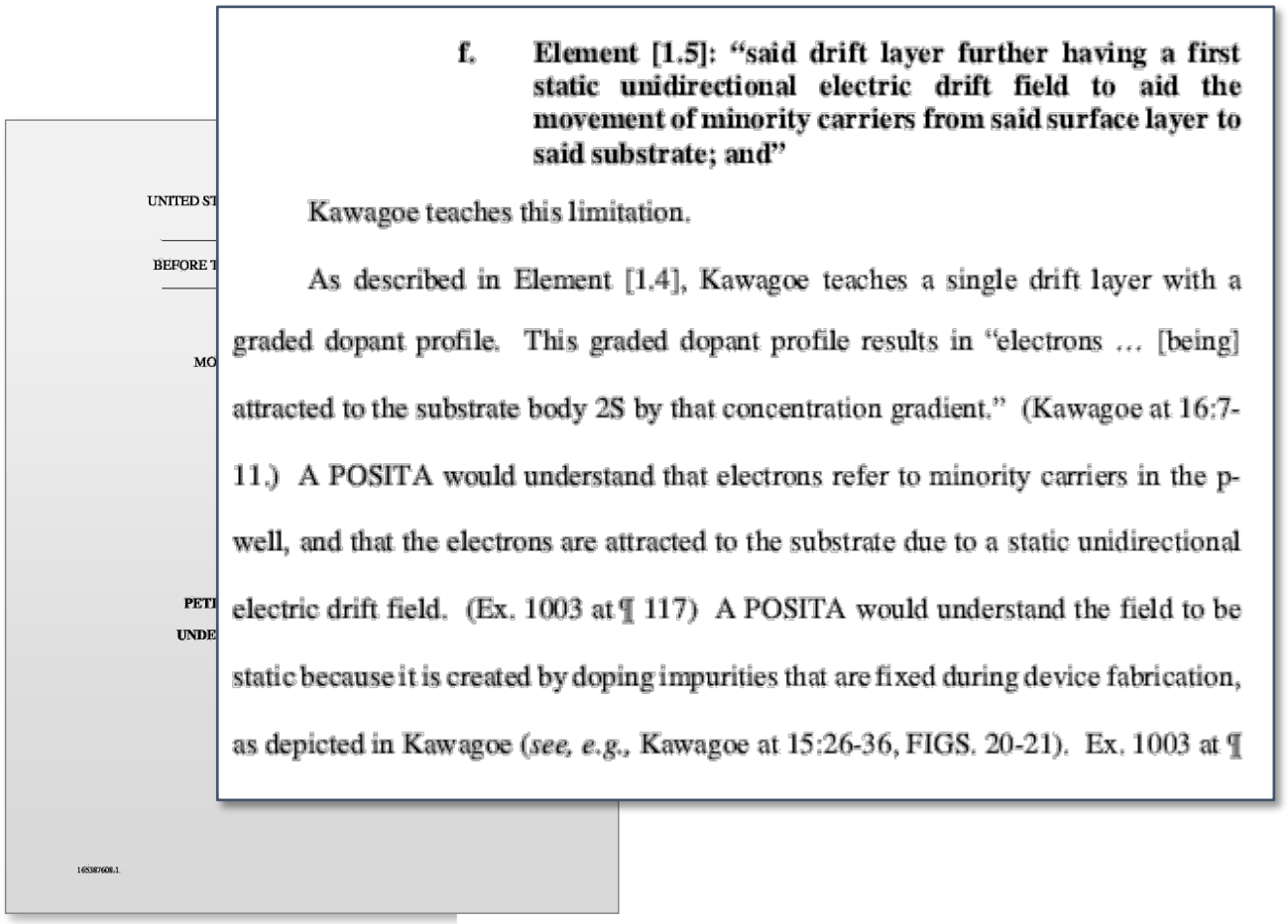
Ex. 2058 (Campbell Dep. Tr.) at 19:8-20:10

Overview of Issues

1. **Petitioner has presented zero "actual evidence" that the Petitions are timely.**
2. **The Claims require "movement of carriers" from the "surface layer" or "active region."**
3. **The '195 and '502 Claims require "movement of minority carriers" from the "surface layer."**
4. **Kawagoe does not disclose "movement of [minority] carriers" from the "surface layer."**
5. **Onoda/Nishizawa does not disclose "movement of [minority] carriers" from the "surface layer."**
6. **Petitioner has the burden to identify electric fields that would "aid carrier movement."**
7. **Petitioner's expert confirmed that carriers in the "surface layer" are affected by numerous other fields and forces.**
8. **Petitioner's expert confirmed "movement of carriers" depends on the sum of all fields in the "surface layer."**
9. **Petitioner's expert did not analyze any of the fields or force magnitudes in the "surface layer."**
10. **Petitioner's prosecution-related arguments are incorrect.**
11. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

10. Petitioner's Prosecution-Related Arguments are Incorrect

- Petitioner relies entirely on a misreading of the prosecution history to make up for Kawagoe's lack of express disclosure "aiding carrier movement" from the surface.



f. Element [1.5]: "said drift layer further having a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate; and"

Kawagoe teaches this limitation.

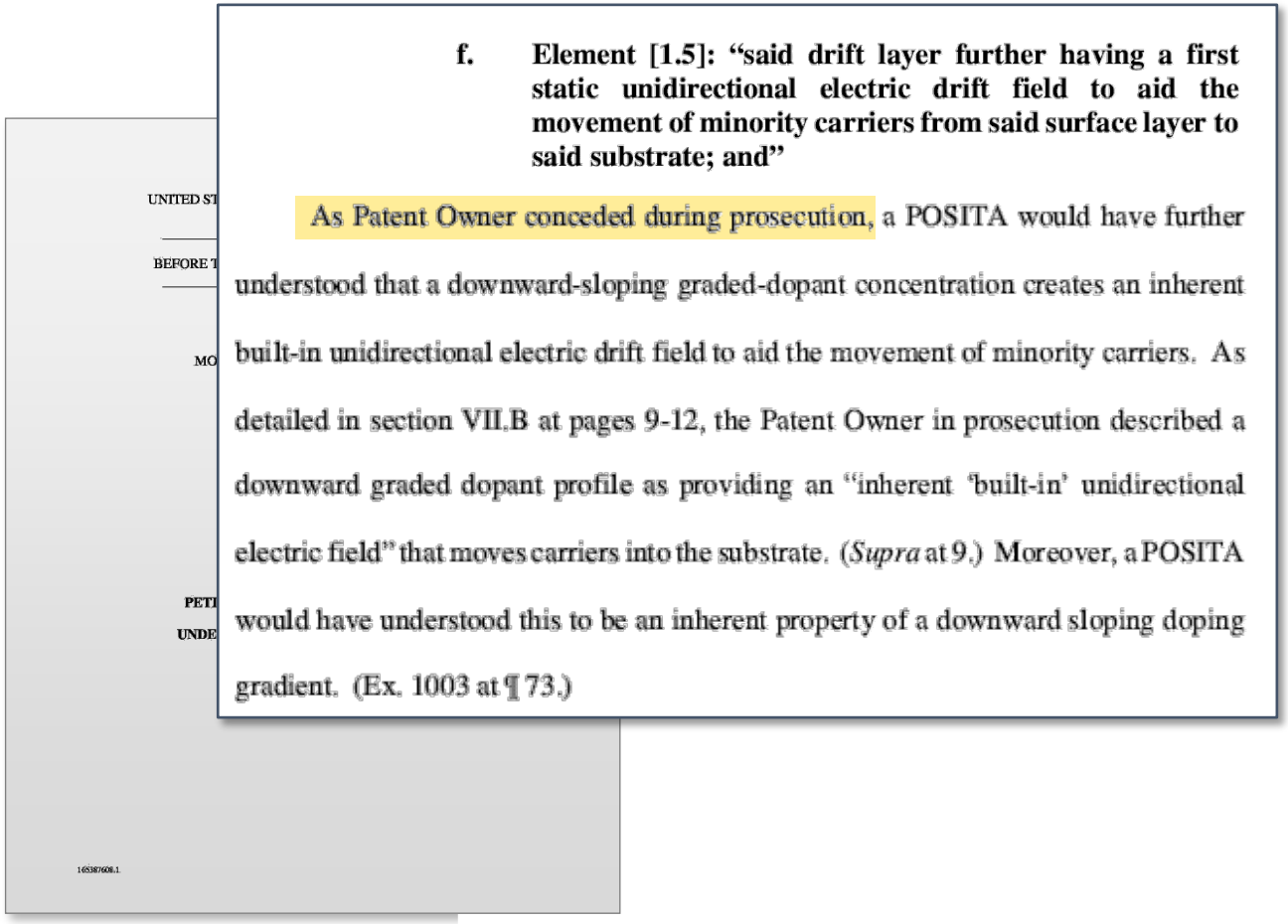
As described in Element [1.4], Kawagoe teaches a single drift layer with a graded dopant profile. This graded dopant profile results in "electrons … [being] attracted to the substrate body 2S by that concentration gradient." (Kawagoe at 16:7-11.) A POSITA would understand that electrons refer to minority carriers in the p-well, and that the electrons are attracted to the substrate due to a static unidirectional electric drift field. (Ex. 1003 at ¶ 117) A POSITA would understand the field to be static because it is created by doping impurities that are fixed during device fabrication, as depicted in Kawagoe (*see, e.g.*, Kawagoe at 15:26-36, FIGS. 20-21). Ex. 1003 at ¶

117. This was, moreover, recognized by Patent Owner as a property of a graded dopant profile in the specification of the '195 Patent and during prosecution. (Ex. 1003 at ¶ 36.) There are electric fields in separate regions due to the graded doping concentrations, *e.g.*, those depicted by pink and purple arrows in annotated FIG. 17 below, where the pink field satisfies the first static unidirectional electric drift field.[14] (Ex. 1003 at ¶ 118.).

-00468: Petition [1] at 70-71

10. Petitioner's Prosecution-Related Arguments are Incorrect

- Petitioner relies entirely on a misreading of the prosecution history to make up for Onoda's lack of express disclosure "aiding carrier movement" from the surface.



f. Element [1.5]: "said drift layer further having a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate; and"

As Patent Owner conceded during prosecution, a POSITA would have further understood that a downward-sloping graded-dopant concentration creates an inherent built-in unidirectional electric drift field to aid the movement of minority carriers. As detailed in section VII.B at pages 9-12, the Patent Owner in prosecution described a downward graded dopant profile as providing an "inherent 'built-in' unidirectional electric field" that moves carriers into the substrate. (*Supra* at 9.) Moreover, a POSITA would have understood this to be an inherent property of a downward sloping doping gradient. (Ex. 1003 at ¶ 73.)

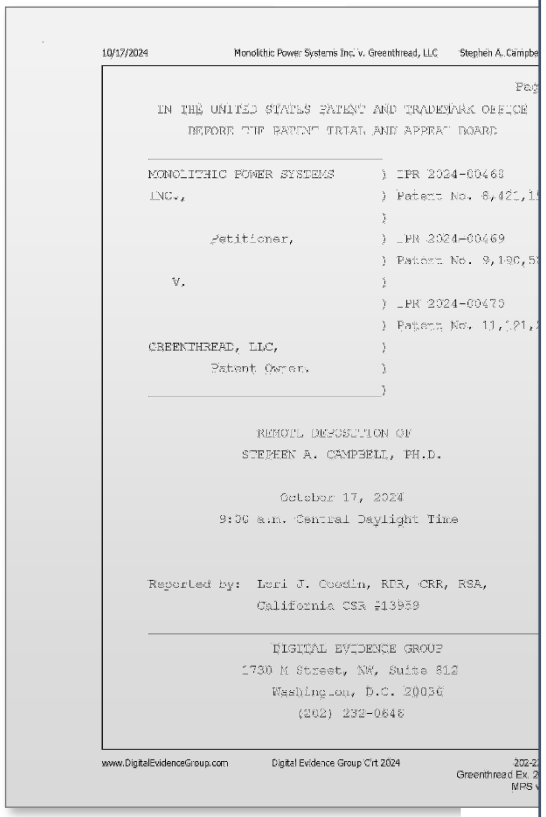
Furthermore, the static unidirectional electric drift field would have been understood to be static. (*Id.* at 74.) As discussed in [1.4], the dopant profile is created through ion implantation and thermal diffusion techniques and is thusly set once the device has been fabricated. (Onoda at [0047]-[0050]; *see also* Ex. 1003 at ¶¶ 66-71, 74.) In other words, this would have understood to be static to a POSITA. (Ex. 1003 at ¶ 74.) Patent Owner also described "static" similarly during prosecution, stating that a semiconductor device with a fabricated dopant profile provides a static unidirectional electric field. (Ex. 1002 at 318 (citing Ex. 1009), 333.) Consequently, a POSITA would have understood Onoda's downward sloping gradient to provide a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate. (Ex. 1003 at ¶¶ 72-74.)

-00468: Petition [1] at 32-34

-00468: PO Resp. [35] at 14-16; PO Sur-Reply [47] at 15

10. Petitioner's Prosecution-Related Arguments are Incorrect

- Dr. Campbell admitted that he was not familiar with the prosecution history, despite relying upon it in his declarations.


10/17/2024 Monolithic Power Systems Inc. v. Greenthread, LLC Stephen A. Campbe

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD

MONOLITHIC POWER SYSTEMS INC., Petitioner, v. GREENTHREAD, LLC, Patent Owner.

IPR 2024-00468 Patent No. 8,421,1
IPR 2024-00469 Patent No. 9,190,5
IPR 2024-00470 Patent No. 11,121,

REMOTE DEPOSITION OF
STEPHEN A. CAMPBELL, PH.D.

October 17, 2024
9:00 a.m. Central Daylight Time

Reported by: Lori J. Coodin, RDR, CRR, RSA, California CSR #13959

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Greenthread Ex. 2
MPS v

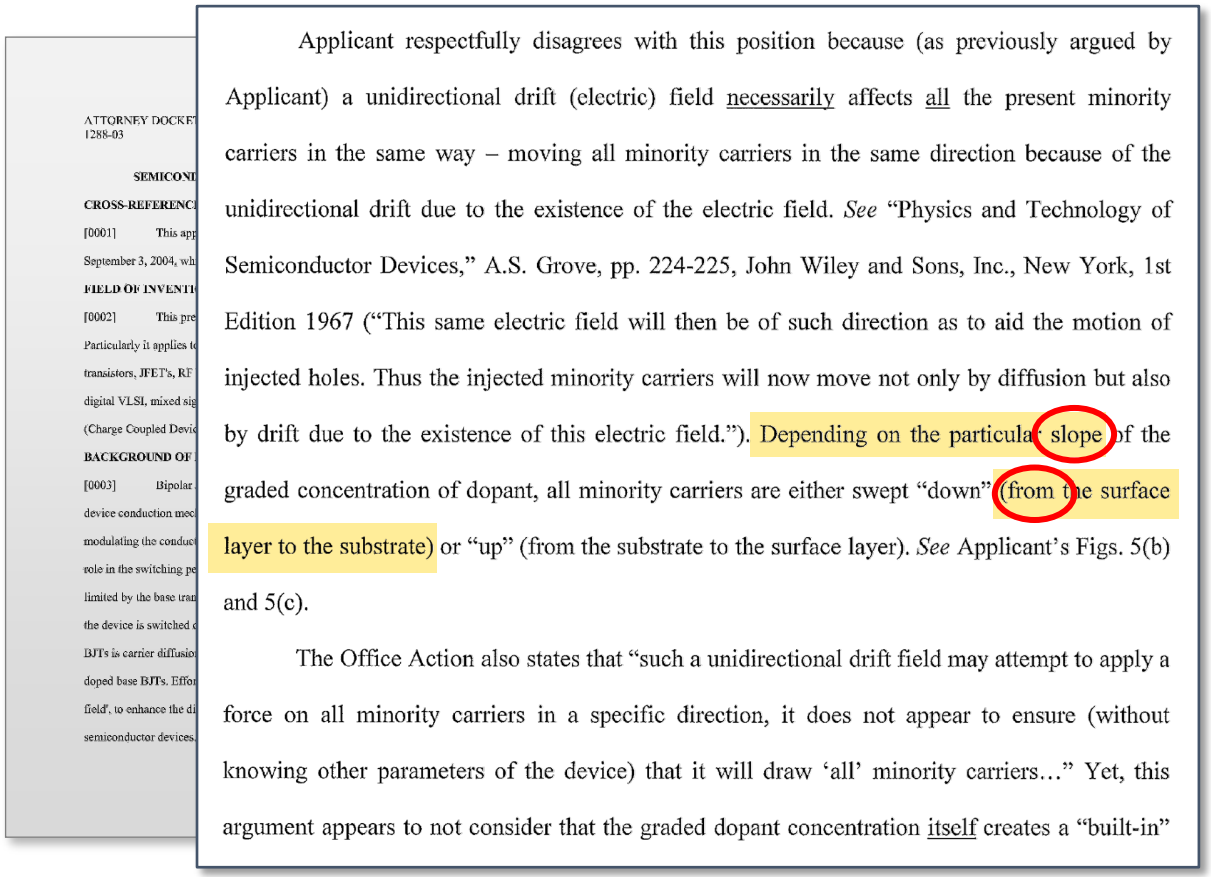
```
 4        Q.    Dr. Campbell, when you were
 5  preparing your declaration, did you read the
 6  whole file history of the Greenthread patents?
 7        A.    Of course I read the patents.  The
 8  file history I don't recall reading that.  I may
 9  have.
10              But it was close to a year ago and I
11  don't recall.
12        Q.    Okay.  Do you understand what I am
13  referring to when I say "file history"?
14        A.    It would be best if you were to
15  explain it to me.
16        Q.    Okay.  So the, I'm referring to the
17  back and forth between the patent examiner and
18  the inventor or patent owner during patent
19  prosecution.
20        A.    Yes.  I remember getting that
21  document.  I glanced at it, but that wasn't my
22  objective or my job.
```

```
 1              My job was to read the patents and
 2  provide the technical comments.
 3        Q.    Okay.  So, when you read the, your
 4  declaration refers to various statements by the
 5  patent owner during patent prosecution, do you
 6  recall that?
 7        A.    I do recall that, yes.
 8        Q.    Did you look at the other parts of
 9  the prosecution history or just the excerpts that
10  are in your report?
11        A.    Just the excerpts in the report.
```

Ex. 2058 (Campbell Dep. Tr.) at 49:4-50:11

10. Petitioner's Prosecution-Related Arguments are Incorrect

- Greenthread did not say: all "graded dopant concentrations" will move carriers from the "surface layer."
- Greenthread said: the electric field must move the carriers from the surface layer.



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

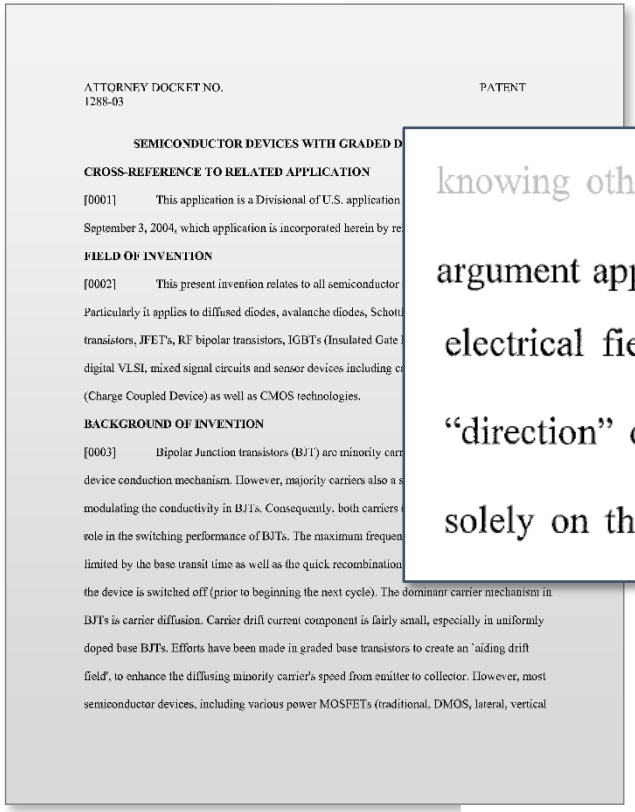
The Office Action also states that "such a unidirectional drift field may attempt to apply a force on all minority carriers in a specific direction, it does not appear to ensure (without knowing other parameters of the device) that it will draw 'all' minority carriers…" Yet, this argument appears to not consider that the graded dopant concentration itself creates a "built-in"

electrical field that forces the movement of carriers into a particular direction, whereby the "direction" of the electrical field and the resulting direction of the carrier movement depends solely on the slope of the graded concentration of dopant. With regard to the existence of a "built-in" electric field created by a graded dopant density, *see*, e.g., Jastrzebski (US 4,481,522) col. 5, lines 11-13 (cited in Office Action). Applicant respectfully submits that 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.

Ex. 1002 ('195 Prosecution History) at 289-290

10. Petitioner's Prosecution-Related Arguments are Incorrect

- Greenthread did not say: all "graded dopant concentrations" will move carriers from the "surface layer."
- Greenthread said: the electric field must move the carriers from the surface layer.



ATTORNEY DOCKET NO.
1288-03

PATENT

SEMICONDUCTOR DEVICES WITH GRADED D

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is a Divisional of U.S. application

September 3, 2004, which application is incorporated herein by re

FIELD OF INVENTION

[0002] This present invention relates to all semiconductor

Particularly it applies to diffused diodes, avalanche diodes, Schott

transistors, JFET's, RF bipolar transistors, IGBTs (Insulated Gate

digital VLSI, mixed signal circuits and sensor devices including c

(Charge Coupled Device) as well as CMOS technologies.

BACKGROUND OF INVENTION

[0003] Bipolar Junction transistors (BJT) are minority carr

device conduction mechanism. However, majority carriers also a s

modulating the conductivity in BJTs. Consequently, both carriers

role in the switching performance of BJTs. The maximum frequen

limited by the base transit time as well as the quick recombinatio

the device is switched off (prior to beginning the next cycle). The dominant carrier mechanism in

BJTs is carrier diffusion. Carrier drift current component is fairly small, especially in uniformly

doped base BJTs. Efforts 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. However, most

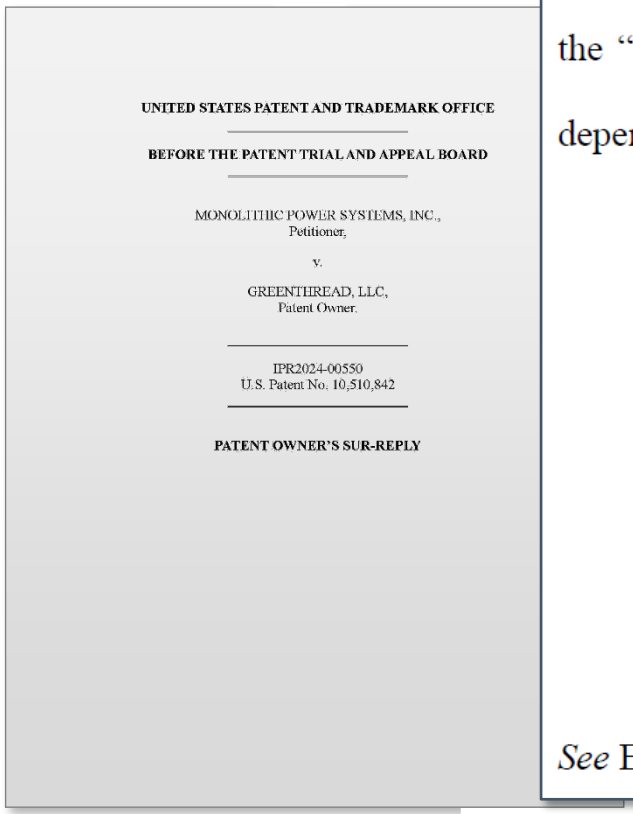
semiconductor devices, including various power MOSFETs (traditional, DMOS, lateral, vertical

knowing other parameters of the device) that it will draw 'all' minority carriers…" Yet, this argument appears to not consider that the graded dopant concentration itself creates a "built-in" electrical field that forces the movement of carriers into a particular direction, whereby the "direction" of the electrical field and the resulting direction of the carrier movement depends solely on the slope of the graded concentration of dopant. With regard to the existence of a

Ex. 1002 ('195 Prosecution History) at 289-290

10. Petitioner's Prosecution-Related Arguments are Incorrect

- Dr. Glew has explained that whether the resulting direction of carrier movement is "up" or "down"—if there is movement at all—depends on a number of factors.



UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MONOLITHIC POWER SYSTEMS, INC.,
Petitioner,

v.

GREENTHREAD, LLC,
Patent Owner.

IPR2024-00550
U.S. Patent No. 10,510,842

PATENT OWNER'S SUR-REPLY

carrier movement, depends on the *slope* of the "graded concentration." *Id.* Whether the "resulting direction" is "up" or "down" (or whether the carrier moves at all) depends on a number of factors including:

(1) Whether the dopants are n-type or p-type;

(2) Whether the dopants are increasing or decreasing;

(3) Whether the carrier is a hole or an electron;

(4) Whether the electric field generates a force that is sufficient to overcome the resistance of the semiconductor;

(5) Whether the resulting force is in the same direction or the opposite direction of another force; and

(6) Whether the force is greater than or less than the other forces.

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

-00468: PO Sur-Reply [47] at 10

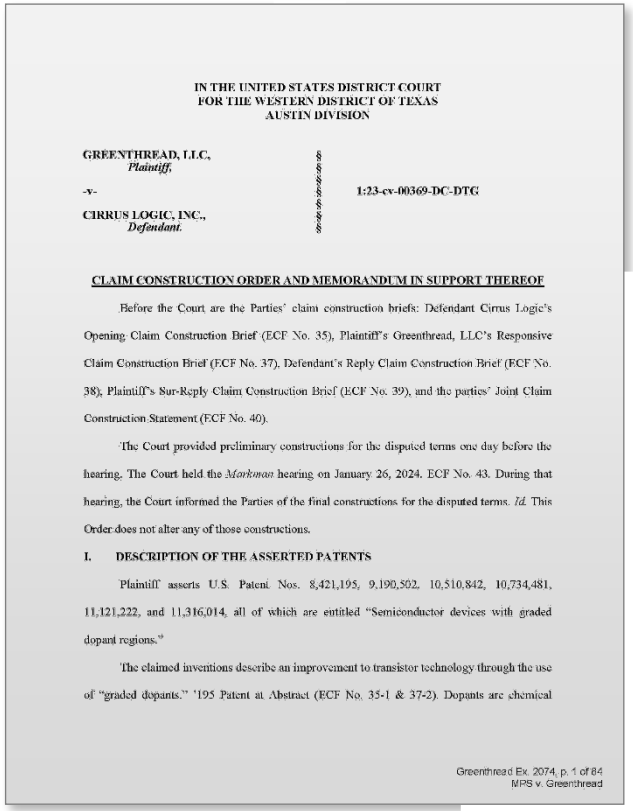
-00468: PO Resp. [35] at 5, 8-9, 10-11, 24-25; PO Sur-Reply [47] at 10

PUBLIC VERSION

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

10. Petitioner's Prosecution-Related Arguments are Incorrect

- WDTX ruled that a graded concentration does not necessarily "aid carrier movement."
- The dopants must be "sufficiently graded" in order to "aid movement."



IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
AUSTIN DIVISION

GREENTHREAD, LLC,
Plaintiff,
-v-
CIRRUS LOGIC, INC.,
Defendant.

1:23-cv-00369-DC-DTG

CLAIM CONSTRUCTION ORDER AND MEMORANDUM IN SUPPORT THEREOF

Before the Court are the Parties' claim construction briefs: Defendant Cirrus Logic's Opening Claim Construction Brief (ECF No. 35), Plaintiff's Greenthread, LLC's Responsive Claim Construction Brief (ECF No. 37), Defendant's Reply Claim Construction Brief (ECF No. 38), Plaintiff's Sur-Reply Claim Construction Brief (ECF No. 39), and the parties' Joint Claim Construction Statement (ECF No. 40).

The Court provided preliminary constructions for the disputed terms one day before the hearing. The Court held the *Markman* hearing on January 26, 2024. ECF No. 43. During that hearing, the Court informed the Parties of the final constructions for the disputed terms. *Id.* This Order does not alter any of those constructions.

I. DESCRIPTION OF THE ASSERTED PATENTS

Plaintiff asserts U.S. Patent Nos. 8,421,195, 9,190,502, 10,510,842, 10,734,481, 11,121,222, and 11,316,014, all of which are entitled "Semiconductor devices with graded dopant regions."

The claimed inventions describe an improvement to transistor technology through the use of "graded dopants." '195 Patent at Abstract (ECF No. 35-1 & 37-2). Dopants are chemical

Greenthread Ex. 2074, p. 1 of 84
MPS v. Greenthread

Second, the claim language provides some guidance as to the scope of this term. More specifically, the claim language describes that the graded concentration of dopants creates an electric field. *See, e.g.*, '195 Patent, Claim 1, Limitation [d] ("said drift layer having a graded concentration of dopants … said drift layer further having a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate"). The Court concludes that a person of skill would understand that the graded concentration has to be sufficiently graded to result in a "static unidirectional electric drift field to aid the movement of minority carriers." This establishes a minimum graded concentration of dopants, *i.e.*, a graded concentration of dopants that is below this minimum will not aid in the movement of minority carriers and thus is not a graded concentration.

Ex. 2074 (WDTX Order) at 39-40

10. Petitioner's Prosecution-Related Arguments are Incorrect

- EDTX already rejected Petitioner's prosecution history argument.

'195 Patent File Wrapper April 17, 2012 Response Pursuant to 37 CFR 1.114 Amendment E at 6–7, Dkt. No. 50-12 at 59–60. Taken in context, that the direction of the electrical field and the carrier movement "depends solely on the slope of the graded concentration of dopant" does not mandate that the slope must be only increasing or only decreasing to maintain a unidirectional drift field. For example, the slope has both a direction and a magnitude and Defendant suggests that the direction of the drift electric field depends solely on ***the direction*** of the slope of the graded concentration of dopant. This is not justified by the prosecution history statements that Defendant cites. In fact, the *Grove* reference cited by the patentee in the above-quoted statement includes Figure 7.13 (reproduced and annotated below) which depicts a dopant concentration that both increases and decreases in the "graded base region" that provides an "electric field . . . of such direction as to aid the motion of injected holes." A.S. Grove, *Physics and Technology of Semiconductor Devices* 224–25 (1967), Dkt. No. 50-13 at 22–23. In other words, the patentee cited

[1] Citations to the parties' filings are to the filing's number in the docket (Dkt. No.) and pin cites are to the page numbers assigned through ECF.

1

Greenthread Ex. 2075, p. 1 of 32
MPS v. Greenthread

Ex. 2075 (EDTX Order) at 15

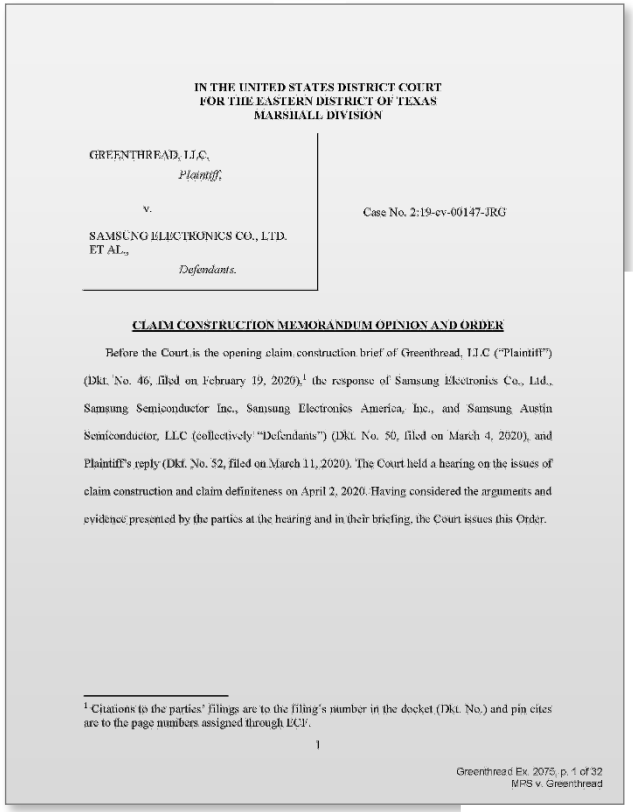
Applicant respectfully disagrees with this position because (as previously argued by Applicant) a unidirectional drift (electric) field necessarily affects all the present minority carriers in the same way – moving all minority carriers in the same direction because of the unidirectional drift due to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

semiconductor devices, including various power MOSFETs (traditional, DMOS, lateral, vertical

Ex. 1002 ('195 Prosecution History) at 289

10. Petitioner's Prosecution-Related Arguments are Incorrect

- EDTX ruled that carrier movement depends on the direction and magnitude of the slope.



IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

GREENTHREAD, LLC,
Plaintiff,

v.

SAMSUNG ELECTRONICS CO., LTD. ET AL.,
Defendants.

Case No. 2:19-cv-00147-JRG

CLAIM CONSTRUCTION MEMORANDUM OPINION AND ORDER

Before the Court is the opening claim construction brief of Greenthread, LLC ("Plaintiff") (Dkt. No. 46, filed on February 19, 2020),[1] the response of Samsung Electronics Co., Ltd., Samsung Semiconductor Inc., Samsung Electronics America, Inc., and Samsung Austin Semiconductor, LLC (collectively "Defendants") (Dkt. No. 50, filed on March 4, 2020), and Plaintiff's reply (Dkt. No. 52, filed on March 11, 2020). The Court held a hearing on the issues of claim construction and claim definiteness on April 2, 2020. Having considered the arguments and evidence presented by the parties at the hearing and in their briefing, the Court issues this Order.

[1] Citations to the parties' filings are to the filing's number in the docket (Dkt. No.) and pin cites are to the page numbers assigned through ECF.

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'195 Patent File Wrapper April 17, 2012 Response Pursuant to 37 CFR 1.114 Amendment E at 6–7, Dkt. No. 50-12 at 59–60. Taken in context, that the direction of the electrical field and the carrier movement "depends solely on the slope of the graded concentration of dopant" does not mandate that the slope must be only increasing or only decreasing to maintain a unidirectional drift field. For example, the slope has both a direction and a magnitude and Defendant suggests that the direction of the drift electric field depends solely on ***the direction*** of the slope of the graded concentration of dopant. This is not justified by the prosecution history statements that Defendant cites. In fact, the *Grove* reference cited by the patentee in the above-quoted statement includes Figure 7.13 (reproduced and annotated below) which depicts a dopant concentration that both increases and decreases in the "graded base region" that provides an "electric field . . . of such direction as to aid the motion of injected holes." A.S. Grove, *Physics and Technology of Semiconductor Devices* 224–25 (1967), Dkt. No. 50-13 at 22–23. In other words, the patentee cited

Ex. 2075 (EDTX Order) at 15

Overview of Issues

1. Petitioner has presented zero "actual evidence" that the Petitions are timely.
2. The Claims require "movement of carriers" from the "surface layer" or "active region."
3. The '195 and '502 Claims require "movement of minority carriers" from the "surface layer."
4. Kawagoe does not disclose "movement of [minority] carriers" from the "surface layer."
5. Onoda/Nishizawa does not disclose "movement of [minority] carriers" from the "surface layer."
6. Petitioner has the burden to identify electric fields that would "aid carrier movement."
7. Petitioner's expert confirmed that carriers in the "surface layer" are affected by numerous other fields and forces.
8. Petitioner's expert confirmed "movement of carriers" depends on the sum of all fields in the "surface layer."
9. Petitioner's expert did not analyze any of the fields or force magnitudes in the "surface layer."
10. Petitioner's prosecution-related arguments are incorrect.
11. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

12. Objective Indicia of Non-Obviousness

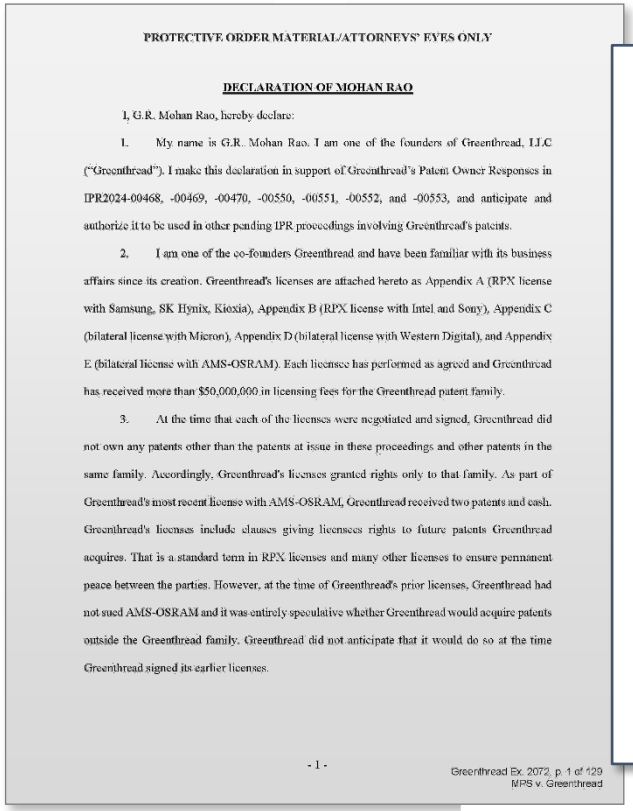
(Fed.Cir.1983). Objective evidence of non-obviousness is an important component of the obviousness inquiry because "evidence of secondary considerations may often be the most probative and cogent evidence in the record. It may often establish that an invention appearing to have been obvious in light of the prior art was not." *Id.* This objective evidence must be "considered as part of all the evidence, not just when the decisionmaker remains in doubt after reviewing the art." *Id.* at 1538–39. Thus, in

We conclude that Transocean presented sufficient evidence for the jury to find that Transocean's licensing supports nonobviousness. From Transocean's testimony regarding the value of the licenses relative to litigation costs and regarding licenses with companies under no apparent threat of litigation, a reasonable jury could have found that the licenses reflect the value of the claimed invention and are not solely attributable to litigation. As a result, the district court erred by holding that the jury lacked substantial evidence to support its finding regarding licensing.

Transocean Offshore Deepwater Drilling, Inc. v. Maersk Drilling USA, Inc., 699 F.3d 1340, 1349, 1353 (Fed. Cir. 2012)

12. Objective Indicia of Non-Obviousness

- Two semiconductor companies took licenses without any threat of litigation.
- There is no evidence that these companies took a license to save litigation costs.
- The license was for the entire patent family related to graded dopant concentrations.



PROTECTIVE ORDER MATERIAL/ATTORNEYS' EYES ONLY

DECLARATION OF MOHAN RAO

I, G.R. Mohan Rao, hereby declare:

1. My name is G.R. Mohan Rao. I am one of the founders of Greenthread, LLC ("Greenthread"). I make this declaration in support of Greenthread's Patent Owner Responses in IPR2024-00468, -00469, -00470, -00550, -00551, -00552, and -00553, and anticipate and authorize it to be used in other pending IPR proceedings involving Greenthread's patents.

2. I am one of the co-founders Greenthread and have been familiar with its business affairs since its creation. Greenthread's licenses are attached hereto as Appendix A (RPX license with Samsung, SK Hynix, Kioxia), Appendix B (RPX license with Intel and Sony), Appendix C (bilateral license with Micron), Appendix D (bilateral license with Western Digital), and Appendix E (bilateral license with AMS-OSRAM). Each licensee has performed as agreed and Greenthread has received more than $50,000,000 in licensing fees for the Greenthread patent family.

3. At the time that each of the licenses were negotiated and signed, Greenthread did not own any patents other than the patents at issue in these proceedings and other patents in the same family. Accordingly, Greenthread's licenses granted rights only to that family. As part of Greenthread's most recent license with AMS-OSRAM, Greenthread received two patents and cash. Greenthread's licenses include clauses giving licensees rights to future patents Greenthread acquires. That is a standard term in RPX licenses and many other licenses to ensure permanent peace between the parties. However, at the time of Greenthread's prior licenses, Greenthread had not sued AMS-OSRAM and it was entirely speculative whether Greenthread would acquire patents outside the Greenthread family. Greenthread did not anticipate that it would do so at the time Greenthread signed its earlier licenses.

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4. Greenthread has never threatened litigation—implicitly, explicitly, or otherwise—against [redacted] or any of their affiliates.

5. In 2020, after Greenthread sued [redacted] for infringing Greenthread's patents, RPX Corp. ("RPX") approached Greenthread to negotiate a license on behalf of some of its members, including [redacted] and [redacted]. Greenthread and RPX negotiated a license to RPX (Appendix A) which gave RPX the right to sublicense those companies to the Greenthread family of patents and which I understand RPX did in fact grant to them.

Ex. 2072 (Dr. Rao Decl.) at 2

-00550: PO Resp. [32] at 32-34; PO Sur-Reply [45] at 25

PUBLIC VERSION

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

12. Objective Indicia of Non-Obviousness

- Intel, Micron, Western Digital, and other companies also licensed the patents.

EXHIBIT E

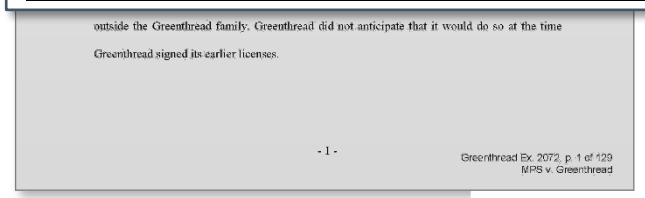
LICENSEE NULLITY PROCEEDINGS AND LICENSOR LITIGATIONS

Greenthread, LLC v. Intel Corporation, 22-cv-02001-JR (D. Or.)

[redacted]

Intel Corp. v. Greenthread LLC, IPR2023-00260
Intel Corp. v. Greenthread LLC, IPR2023-00308
Intel Corp. v. Greenthread LLC, IPR2023-00386
Intel Corp. v. Greenthread LLC, IPR2023-00420
Intel Corp. v. Greenthread LLC, IPR2023-00541
Intel Corp. v. Greenthread LLC, IPR2023-00548
Intel Corp. v. Greenthread LLC, IPR2023-00552

[redacted]


outside the Greenthread family. Greenthread did not anticipate that it would do so at the time Greenthread signed its earlier licenses.

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Ex. 2072 (Dr. Rao Decl.) at 55

EXHIBIT D – LITIGATION

Greenthread, LLC v. Micron Technology, Inc. et al., 23-cv-00333 (D. Del.)

EXHIBIT D – LITIGATION

Greenthread, LLC v. Western Digital Corporation et al., 1:23-cv-00326-RGA (D. Del.)

GREENTHREAD-AMS-OSRAM SETTLEMENT

EXHIBIT D – LITIGATION and IPRs

Greenthread, LLC v. OSRAM GmbH et al., 2:23-cv-00179-JRG (E.D. Tex.)

IPR2024-00001, IPR2024-00016, IPR2024-00017, IPR2024-00018, IPR2024-00019, IPR2024-00020, IPR2024-00021 and all other proceedings challenging the validity of a Licensed Patent.

Ex. 2072 at 81, 101, 122