

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SMA SOLAR TECHNOLOGY AMERICA, LLC,
Petitioner,

v.

TIGO ENERGY, INC.,
Patent Owner.

IPR2023-00879
Patent 9,584,021 B2

Before KRISTINA M. KALAN, ELIZABETH M. ROESEL, and
JULIA HEANEY, *Administrative Patent Judges*.

KALAN, *Administrative Patent Judge*.

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

SMA Solar Technology America, LLC (“Petitioner”) filed a Petition requesting *inter partes* review of claims 1–20 of U.S. Patent No. 9,584,021 B2 (Ex. 1001, “the ’021 patent”). Paper 1 (“Pet.”). Tigo Energy, Inc. (“Patent Owner”) did not file a Preliminary Response.

To institute *inter partes* review, we must determine that the information presented in the Petition shows “there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” 35 U.S.C. § 314(a) (2018). Upon considering the Petition and the evidence of record, we determine that Petitioner has shown a reasonable likelihood that it would prevail in showing the unpatentability of at least one of the claims challenged in the Petition. Accordingly, we institute *inter partes* review of all claims and all grounds asserted in the Petition.

A. *Related Proceedings*

The parties identify the following district court litigation as a related matter: *Tigo Energy Inc. v. SMA Solar Technology America LLC*, 22-915-VAC (D. Del.). Pet. 4; Paper 5, 1 (Patent Owner’s Mandatory Notices).

B. *Real Party-in-Interest*

Petitioner states that the “real party-in-interest is Petitioner SMA Solar Technology America, LLC.” Pet. 4. Patent Owner “identifies Tigo Energy, Inc. as the real party-in-interest.” Paper 5, 2.

C. *The ’021 Patent (Ex. 1001)*

The ’021 patent is titled “Systems and Methods for Enhanced Efficiency Auxiliary Power Supply Module.” Ex. 1001, code (54). The ’021 patent relates to “enhancing the efficiency for auxiliary power supply modules used in photovoltaic systems.” *Id.* at 1:22–25. The ’021

patent explains the need to provide higher voltages for components within a photovoltaic system, e.g., 10 V to 12 V, for “driving the metal-oxide-semiconductor field-effect transistors (MOSFET) or similar devices or switches,” as compared to 3.3 V for the main supply of the control circuit. *Id.* at 1:29–42.

According to the '021 patent, “driving the gate of the MOSFET relative to the source with a lower voltage value (low V_{GS} values on the gate-to-source voltage axis []) may yield energy savings for the associated voltage drive at, for example, saving roughly twice the amount of energy compared to using high-voltage values.” *Id.* at 3:22–28. “This power savings allows a photovoltaic system to achieve great reduction in housekeeping energy supply, by using an ‘adaptive’ gate drive that adapts power consumption based on the amount of gate driving voltage provided.” *Id.* at 3:35–39.

Figure 4 of the '021 patent is reproduced below.

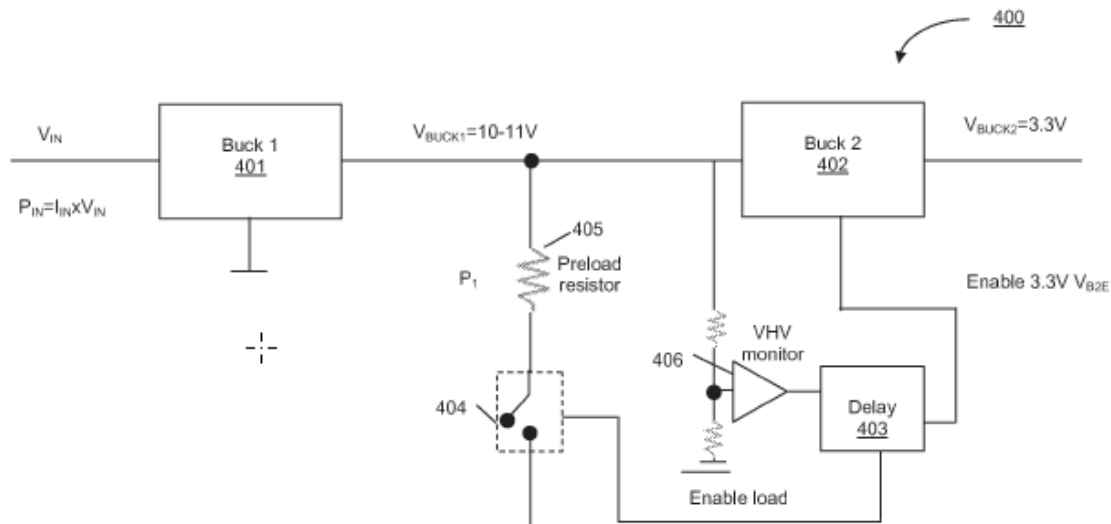


Figure 4

Figure 4 of the '021 patent is a schematic description of a circuit practicing a system and method. *Id.* at 2:24–25. As shown in Figure 4, circuit 400 includes buck converter 401 connected to buck converter 402. *Id.* at 8:17–23. A buck converter is a type of step-down converter. *See id.* at 4:51–54. Circuit 400 also includes preload resistor 405, switch 404, delay circuit 403, and amplifier 406 (very high voltage [VHV] monitor). *Id.* at 8:22–26, 33–48, 64–67.

In use, circuit 400 receives voltage (V_{IN}) at buck converter 401 which outputs first voltage V_{BUCK1} . *See id.* at 8:49–52. V_{BUCK1} powers preload resistor 405 by turning on switch 404 controlled by delay circuit 403. *Id.* at 8:33–40. Delay circuit 403 simultaneously suppresses buck converter 402. *Id.* at 8:40–41. If housekeeping voltage V_{BUCK1} is above a predefined threshold for the full delay period of delay circuit 403, delay circuit 403 turns off switch 404 to provide power to buck converter 402. *Id.* at 8:41–45. Buck converter 402 then outputs second voltage output V_{BUCK2} to its load, such as a control circuit or microcontroller. *Id.* at 8:30–32, 8:45–48.

D. Challenged Claims

Claims 1, 10 and 18 are independent. Claim 1 is reproduced below.

1. [1A] A method to supply power, the method comprising:
 - [1B] providing a power supply having a first stage and a second stage,
 - [1C] wherein the first stage converts power from a direct current input into a first output, and
 - [1D] the second stage powered by the first output has a second output for a micro-controller;
- [1E] connecting the first output of the first stage to a switchable load to consume at least a portion of the first output while disabling the second stage in supplying the second output to the micro-controller;
- [1F] determining whether the first output from the first stage powering the switchable load is above a threshold during

a time period in which the second output to the micro-controller is disabled; and
[1G] in response to a determination that the first output from the first stage powering the switchable load is above the threshold during the time period in which the second output to the micro-controller is disabled, disconnecting the switchable load from the first output of the first stage; and instructing the second stage to enable the second output to the micro-controller using power from the first output of the first stage.

Ex. 1001, 11:2–25 (bracketed designations added by Petitioner).

E. Asserted Grounds of Unpatentability

Petitioner asserts the following grounds of unpatentability:

Claims Challenged	35 U.S.C. § ¹	Reference(s)
1–7, 9	102	Mieth ²
1–12, 15–18, 20 ³	103	Mieth, Balogh ⁴
13, 14	103	Mieth, Balogh, Nishi ⁵
19	103	Mieth, Balogh, Liu ⁶

¹ The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (“AIA”), amended 35 U.S.C. §§ 102 and 103. Because the ’021 patent has an effective filing date before the effective date of the applicable AIA amendments, we refer to the pre-AIA version of §§ 102 and 103.

² DE 37 25 476 A1, published February 9, 1989 (Ex. 1008). The certified translation is Ex. 1002. An incorrect copy of Ex. 1002 was filed with the Petition; with agreement of the parties, the incorrect copy was expunged and Petitioner filed the correct copy of Ex. 1002 on October 19, 2023. Ex. 3001.

³ Although Petitioner identifies only claims 1, 8, 10–12, 15–18, 20 in its “Identification of Challenge” table (Pet. 20), Petitioner ultimately includes claims 2–7 and 9 in this Ground as well, stating: “Additionally, claims 2-7 and 9 are obvious in view of Mieth-Balogh for the reasons set forth in §VII.B.1. and §VII.B.2.-§VII.B.8.” See Pet. 55. Accordingly, we understand Petitioner’s second Ground is an obviousness challenge to claims 1–12, 15–18, and 20 based on Mieth and Balogh.

⁴ US 6,246,592 B1, issued June 12, 2001 (Ex. 1003).

⁵ US 2005/0105224 A1, published May 19, 2005 (Ex. 1004).

⁶ US 6,798,177 B1, issued September 28, 2004 (Ex. 1005).

Petitioner relies on the declaration of Douglas Holberg, Ph.D. in support of its arguments. Ex. 1007.

II. ANALYSIS

A. Claim Construction

We apply the claim construction standard articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005). 37 C.F.R. § 42.100(b) (2023). Under *Phillips*, claim terms are afforded “their ordinary and customary meaning.” *Phillips*, 415 F.3d at 1312. The “ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention.” *Id.* at 1313. Only terms that are in controversy need to be construed, and then only to the extent necessary to resolve the controversy. *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

Petitioner proposes that the term “stage” means “‘one or more circuit components’ that operate alone or together to provide a specified function set forth in the claim.” Pet. 21–22 (citing Ex. 1007 ¶¶ 99–100). Patent Owner does not propose any claim construction.

In our view, we can determine the reasonable likelihood of proving unpatentability of the challenged claims without making an express construction of any term at this time. We determine that, for purposes of this Decision, no term requires express construction. *See, e.g., Vivid Techs.*, 200 F.3d at 803.

B. Level of Ordinary Skill in the Art

For the purpose of this Decision, we accept Petitioner’s undisputed contention that a person of ordinary skill in the art “would have had a bachelor’s degree in electrical engineering, or a similar discipline and at least two years of design experience with circuit design.” Pet. 22 (citing Ex. 1007 ¶ 30); *see* Ex. 1007 ¶ 31. The level of ordinary skill in the art is further demonstrated by the prior art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

C. Principles of Law

To establish anticipation under 35 U.S.C. § 102, each and every element in a claim, arranged as recited in the claim, must be found in a single prior art reference. *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008). Each element of the challenged claim must be found, either expressly or inherently, in the single prior art reference. *Verdegaal Bros., Inc. v. Union Oil Co. of Cal.*, 814 F.2d 628, 631 (Fed. Cir. 1987). Although the elements must be arranged or combined in the same way as in the claim, “the reference need not satisfy an *ipsissimis verbis* test,” i.e., identity of terminology is not required. *In re Gleave*, 560 F.3d 1331, 1334 (Fed. Cir. 2009). Thus, the dispositive question is whether one skilled in the art would have reasonably understood or inferred from a prior art reference that every claim element is disclosed in that reference. *Eli Lilly & Co. v. L.A. Biomedical Research Inst.*, 849 F.3d 1073, 1074–1075 (Fed. Cir. 2017).

A claim is unpatentable under 35 U.S.C. § 103 if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said

subject matter pertains. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) if in evidence, objective evidence of nonobviousness.⁷ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). A decision on the ground of obviousness must include “articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006). The obviousness analysis “should be made explicit” and it “can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does.” *KSR*, 550 U.S. at 418.

D. Asserted Anticipation based on Mieth (Ground 1)

Petitioner argues that Mieth anticipates claims 1–7 and 9. Pet. 23–50.

*1. Mieth (Ex. 1002)*⁸

Mieth is a German patent application titled “Circuit arrangement for supplying power to an electrical load from an electrical energy source with fluctuating performance.” Ex. 1002, code (54). A solar generator may serve as the energy source with fluctuating performance. *Id.* at 4:29–32. Figure 1 is reproduced below:

⁷ Neither party presents any objective evidence of nonobviousness as to any of the challenged claims.

⁸ We rely on the certified English translation of Mieth (Ex. 1002).

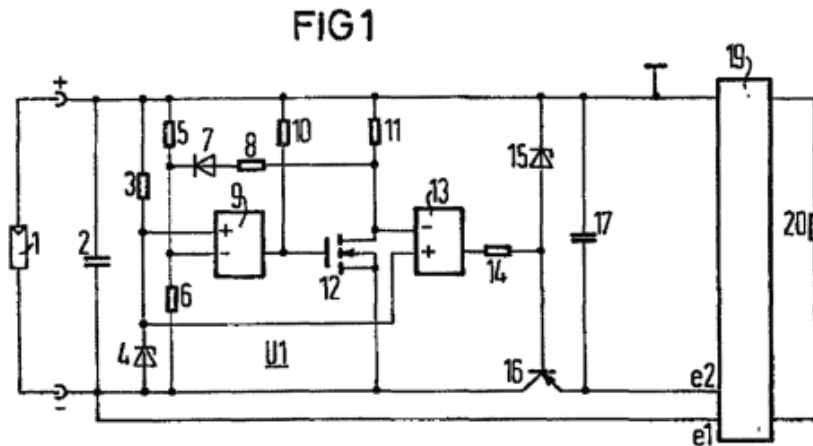


Figure 1 of Mieth is a “circuit arrangement having a starter circuit and auxiliary power supply for a charging converter without electrical isolation.” *Id.* at 8:11–12. Figure 1 shows a circuit arrangement for supplying power from solar generator 1 to electrical load 20 through power supply 19, which is a DC-DC voltage converter or charging converter. *Id.* at 8:20–35. Power supply apparatus 19 is connected to solar generator 1 by way of voltage input e1 and auxiliary voltage input e2, and outputs to electrical load 20. *Id.*

The circuit arrangement includes solar generator 1 situated in parallel with capacitor 2. *Id.* at 9:5–6. Switching apparatus U1 is connected to the parallel connection of solar generator 1 and capacitor 2, and “serves to connect either the preliminary load 11 or the auxiliary voltage input e2 of the power supply apparatus 19 to the solar generator 1 depending on the particular voltage of the solar generator 1.” *Id.* at 9:7–13.

Switching apparatus U1 includes comparator 9 connected by way of its positive input to a reference voltage generator and by way of its negative input to the tap of a voltage divider. *Id.* at 9:34–37. Zener diode 4 serves as the reference voltage generator and connects to solar generator 1 via resistor 3. *Id.* at 9:37–10:3. The output of comparator 9 is connected to field-effect transistor 12. *Id.* at 10:5–14. Field-effect transistor 12 forms a

first electronic switch in switching apparatus U1. *Id.* Switching apparatus U1 includes a feedback branch “arranged between the connection point of the field effect transistor 12 and the preliminary load 11 on one side and [] at the negative input of the comparator 9 on the other side.” *Id.* at 10:22–25.

Switching apparatus U1 further includes bipolar transistor 16 that serves as a second electronic switch. *Id.* at 10:31–32. “The transistor 16 is connected by way of its collector to the negative pole of the solar generator 1 and is routed by way of its emitter to the auxiliary voltage input e2 of the power supply apparatus 19.” *Id.* at 10:33–36. “The emitter-collector path of the transistor 16 forms the switching path of the second electronic switch of the switching apparatus.” *Id.* at 11:1–4.

In use, switching apparatus U1, depending on the voltage of solar generator 1, connects solar generator 1 to either preliminary load 11 or power supply apparatus 19. *Id.* at 9:9–13. If the voltage is below a predefined minimum value, switching apparatus U1 connects solar generator 1 to preliminary load 11. *Id.* at 9:15–32. If the voltage is above the predefined minimum value, switching apparatus U1 connects solar generator 1 to power supply apparatus 19. *Id.* Comparator 9 compares the voltage of solar generator 1 with reference voltage at Zener diode 4. *Id.* at 12:13–19. “If the generator voltage is too small, the field-effect transistor 12 serving as a circuit breaker has low resistance and the increased preliminary load formed by the resistor 11 is in effect. The bipolar transistor 16 is off here.” *Id.* “If the generator voltage rises above the predefined threshold voltage,” which can be 20 V in the case of a 36 V solar generator, “the transistor 12 is turned off and the transistor 16 is connected up and delivers auxiliary energy for the power supply apparatus 19 formed by a charging converter.” *Id.* at 12:21–26.

2. *Petitioner's Arguments*

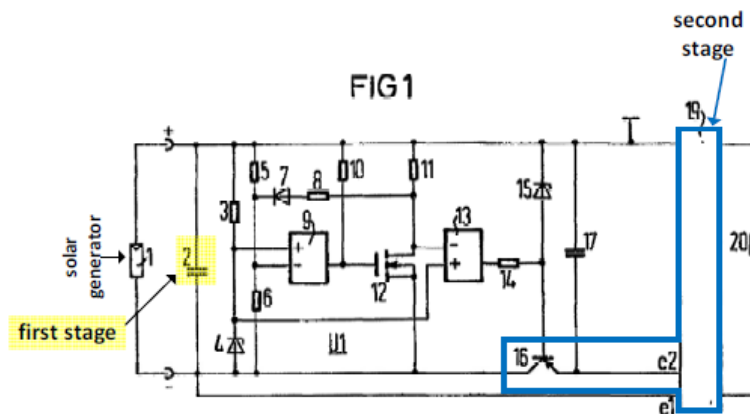
Petitioner argues that Mieth discloses every element of claim 1, as set forth in more detail below.

a) [1A] A method to supply power, the method comprising:

Petitioner argues that Mieth discloses a circuit that supplies power to an electrical load from a solar generator. Pet. 23 (citing Ex. 1002, 8:8–9; Ex. 1007 ¶¶ 96).

b) [1B] providing a power supply having a first stage and a second stage,

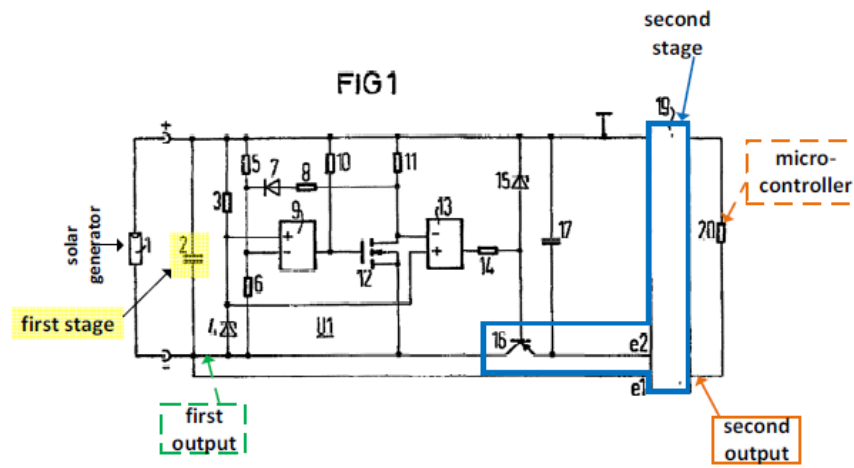
Petitioner argues that Mieth discloses capacitor 2 in parallel with solar generator 1, that is “analogous” to the first stage. Pet. 23–24 (citing Ex. 1002, 9:5–9, 11:14–16, Fig. 1; Ex. 1007 ¶¶ 97–100). Petitioner argues that Mieth discloses power supply 19 connected to bipolar transistor 16 that is “analogous” to the second stage. *Id.* Petitioner’s annotated Mieth Figure 1 is reproduced below.



Ex.1002, Fig.1(annotated-1B)

Petitioner’s annotated Figure 1B highlights in yellow a first stage including capacitor 2, and outlines in blue a second stage including bipolar transistor 16 and power supply 19. *See id.* at 24.

Ex. 1014, 1180, Fig. 5). Petitioner’s annotated version of Mieth’s Figure 1 is reproduced below.



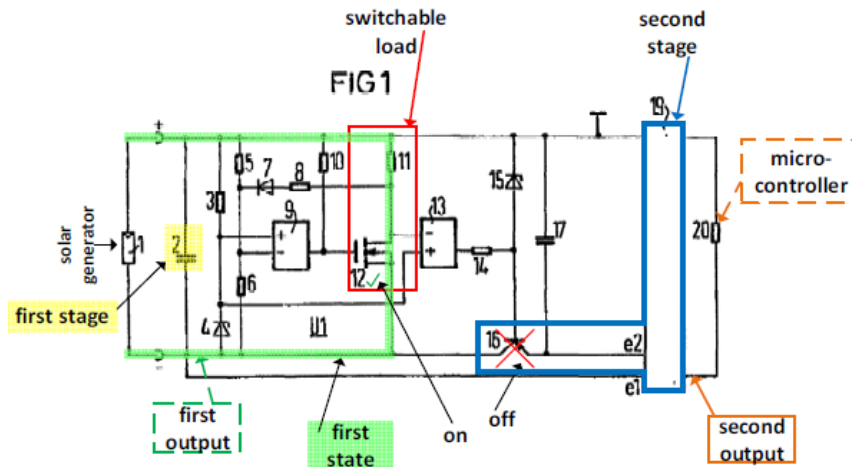
Ex.1002, Fig.1(annotated-1D.1)

Petitioner’s annotated Figure 1D.1 identifies a second output (orange box) from power supply 19 to load 20, labeled as a microcontroller (dashed orange). *Id.* at 26.

- e) [1E] connecting the first output of the first stage to a switchable load to consume at least a portion of the first output while disabling the second stage in supplying the second output to the micro-controller;

Petitioner argues that Mieth discloses field-effect transistor 12, which operates as a switch, connected to preliminary load 11. Pet. 26–27 (citing Ex. 1002, 10:5–14, 9:15–23, Fig. 1; Ex. 1007 ¶¶ 106–107). Petitioner argues that field-effect transistor 12 and preliminary load 11 “in combination are analogous to the claimed **switchable load**.” *Id.* Petitioner argues that Mieth discloses field-effect transistor 12 operates as a closed switch when voltages at the first output are below a predefined minimum value, thus connecting preliminary load 11 to solar generator 1. *Id.* Because “the preliminary load 11 is connected to the first output, during this state, the preliminary load 11 **consumes at least a portion of the first output**.” *Id.* at

27 (citing Ex. 1007 ¶ 107). Petitioner further argues that “in the first state, bipolar transistor 16 is ‘off’ or in a non-conducting state” so that “power supply apparatus 19 is *disabled in supplying the second output to the micro-controller.*” *Id.* at 28 (citing Ex. 1002, 9:9–13, 9:23–32, Fig. 1; Ex. 1007 ¶ 108). Petitioner’s annotated version of Mieth’s Figure 1 is reproduced below.



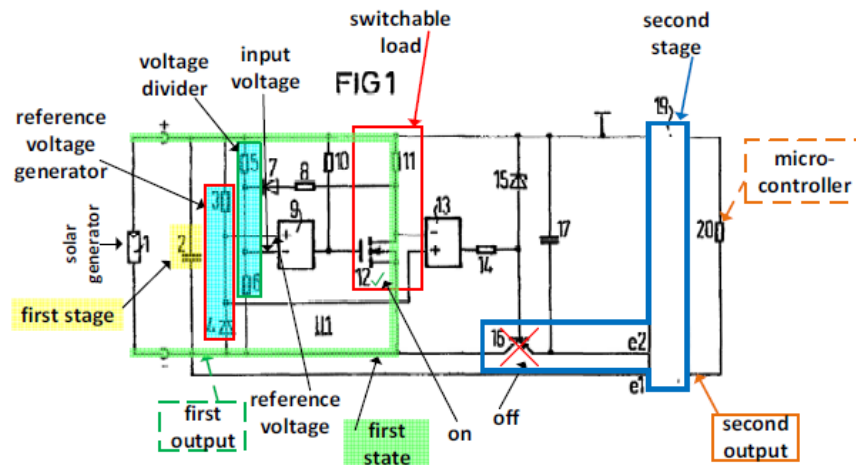
Ex.1002, Fig.1(annotated-1E)

Petitioner’s annotated Figure 1E identifies a first state (highlighted green) in which a switchable load (red box encompassing preliminary load 11 and field-effect transistor 12) is powered by the first output from capacitor 2. *Id.* at 27–28.

- f) [1F] determining whether the first output from the first stage powering the switchable load is above a threshold during a time period in which the second output to the micro-controller is disabled; and

Petitioner argues that Mieth discloses that in the first state, “first comparator 9 compares the representative voltage provided by the voltage divider 5, 6 to the reference voltage to determine if the monitored voltage exceeds a threshold related to the reference voltage.” Pet. 29–30 (citing Ex. 1002, 9:15–32, 10:5–14, 9:34–10:3, 12:12–26, Fig. 1; Ex. 1007 ¶ 111).

Petitioner argues that the “first state of Mieth concurrently disables the second output of the power supply apparatus 19 to the load 20 by turning the bipolar transistor 16 ‘off,’ which is the same as the claimed *the second output to the micro-controller is disabled.*” *Id.* at 30 (citing Ex. 1002, 12:12–19; Ex. 1007 ¶ 112). Petitioner’s annotated version of Mieth’s Figure 1 is reproduced below.



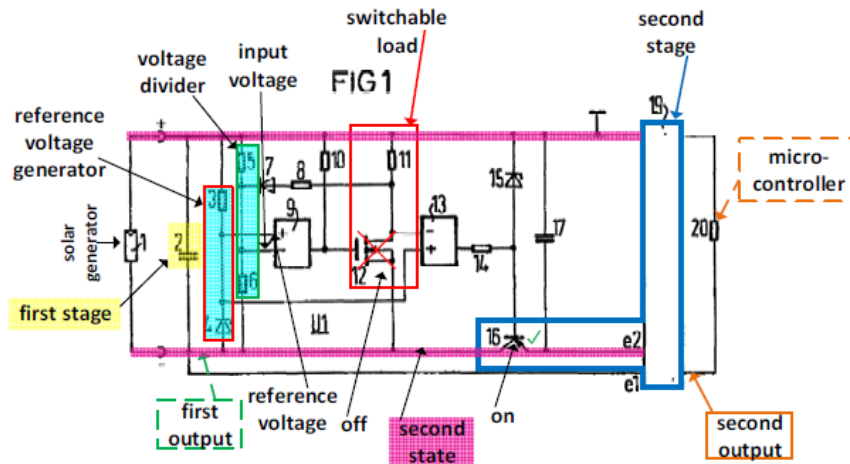
Ex.1002, Fig.1(annotated-1F)

Petitioner’s annotated Figure 1F identifies a reference voltage generator (highlighted teal and outlined with a red box) encompassing resistor 3 and Zener diode 4. *Id.* at 29. The figure further identifies a voltage divider (highlighted teal) encompassing resistors 5 and 6. *Id.*

- g) [1G] in response to a determination that the first output from the first stage powering the switchable load is above the threshold during the time period in which the second output to the micro-controller is disabled, disconnecting the switchable load from the first output of the first stage; and instructing the second stage to enable the second output to the micro-controller using power from the first output of the first stage.

Petitioner argues that Mieth discloses “when the first output of capacitor 2 rises and the representative voltage across voltage divider 5, 6 is above the value (i.e., ‘predefined minimum value’ . . .), the circuit

disconnects the preliminary load 11 from the first output by configuring the field-effect transistor 12 to an ‘off’ state.” Pet. 32 (citing Ex. 1002, 12:12–26; Ex. 1007 ¶ 115). Petitioner argues that Mieth discloses that “bipolar transistor 16 that connects the power supply apparatus 19 to the first output” results in “the second output of the power supply apparatus 19 powering the load 20.” *Id.* at 33 (citing Ex. 1007 ¶ 116). Petitioner’s annotated version of Mieth’s Figure 1 is reproduced below.



Ex.1002, Fig.1(annotated-1G)

Petitioner’s annotated Figure 1G identifies a second state (highlighted pink) in which bipolar transistor 16 is “on” and first output (dashed green) is connected to power supply apparatus 19 via e2. *Id.* at 31–32.

3. Analysis

We have considered the arguments and evidence presented by Petitioner, which currently stand unrebutted, and are persuaded that Petitioner has demonstrated a reasonable likelihood that independent claim 1 is anticipated by Mieth. We also have considered Petitioner’s arguments and evidence as to dependent claims 2–7 and 9, and are persuaded that Petitioner has demonstrated a reasonable likelihood that it would prevail as to those claims as well. For the foregoing reasons, Petitioner has established

a reasonable likelihood of prevailing in showing anticipation of claims 1–7 and 9 over Mieth.

E. Asserted Obviousness based on Mieth and Balogh (Ground 2)

Petitioner argues that claims 1–12, 15–18, and 20 would have been obvious in view of Mieth and Balogh.⁹ Pet. 50–78.

1. Balogh (Ex. 1003)

Balogh is titled “Unique Power Supply Architecture with Cascaded Converters for Large Input-to-Output Step-Down Ratio.” Ex. 1003, code (54). Balogh relates to cascaded power converters where a first converter converts an input voltage to an intermediate voltage and a second converter converts the intermediate voltage to a regulated output voltage. *Id.* at code (57).

Balogh discloses a “conventional cascaded arrangement,” in which “a first buck converter is followed by a second buck converter.” *Id.* at 1:29–30. “A buck converter is characterized by its voltage step-down ratio wherein the output voltage is lower than the input voltage to thereby produce a higher average output current.” *Id.* at 1:30–33.

Figure 1D of Balogh is reproduced below.

⁹ The heading set forth in the Petition states that the legal basis of this challenge is “Anticipation/obviousness.” Pet. 50. This ambiguity does not provide a precise statement of the relief requested, as required by our rules. 37 C.F.R. § 42.104(b). Because this challenge is based on a combination of the references (*see* Pet. 50–78), we analyze it as an obviousness challenge.

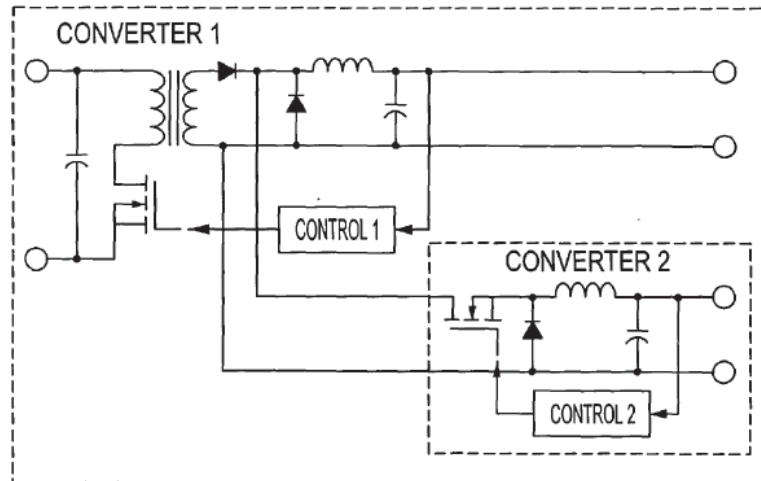


FIG. 1D
PRIOR ART

Figure 1D “shows an isolated DC/DC converter followed by a post regulator circuit for obtaining an independently regulated auxiliary output voltage.”

Id. at 2:61–64.

2. *Petitioner’s Arguments*

Mieth discloses a photovoltaic system, which, according to Petitioner, was known by those of skill in the art as an energy source that provides “varying levels of input voltage.” Pet. 51–52 (citing Ex. 1002, 5:22–38). Petitioner argues that “Balogh discloses a cascaded converter arrangement having an isolated DC-DC converter followed by a post regulator circuit that reads on the claimed **first and second stages**, respectively.” *Id.* at 53 (citing Ex. 1003, 10:42–52; Ex. 1007 ¶ 158). Petitioner argues that Balogh describes the purpose of the first and second stages “is to provide input and output power conversion that is not optimally implemented in a single converter, for example, in high DC voltage applications.” *Id.* at 54 (citing Ex. 1003, 10:45–52). Petitioner asserts that one of ordinary skill in the art would have been “motivated to combine the cascaded power converter architecture of Balogh with the switchable load feature of Mieth for DC

applications with high input voltages.” *Id.* at 52 (citing Ex. 1007 ¶¶ 153–156). Petitioner argues that the combination Mieth and Balogh would have yielded “predictable results, a cascaded step down power converter having a switchable load at the second power converter input that is selectively employed based on the state of the first stage step down power converter.” *Id.* at 52–53. Petitioner additionally argues that one of ordinary skill in the art would have “reasonably expected success in combining Mieth and Balogh” and “appreciated the benefit of adapting the high DC voltage stepped down to an intermediate voltage of Balogh to situations with a variable input voltage to a power converter as shown in Mieth.” *Id.* at 52–53 (citing Ex. 1007 ¶ 157). “As such, a PHOSITA, at the time of filing, would know that the capacitor 2 and the power supply apparatus 19 of Mieth could be the cascaded converters as disclosed by Balogh.” *See id.* at 54–55 (citing Ex. 1007 ¶ 160).

3. *Analysis*

We have considered the arguments and evidence presented by Petitioner, which currently stand unrebutted, and are persuaded that Petitioner has demonstrated a reasonable likelihood that independent claims 1, 10, and 18 would have been obvious based on the combination of Mieth and Balogh. We also have considered Petitioner’s arguments and evidence as to dependent claims 2–9, 11, 12, 15–17, and 20, and are persuaded that Petitioner has demonstrated a reasonable likelihood that it would prevail as to those claims. For the foregoing reasons, Petitioner has established a reasonable likelihood of prevailing in showing obviousness of claims 1–12, 15–18, and 20 over Mieth and Balogh.

*F. Asserted Obviousness based on Mieth, Balogh, and Nishi
(Ground 3)*

Petitioner argues that claims 13 and 14 would have been obvious in view of Mieth, Balogh, and Nishi. Pet. 78–83.

1. Nishi (Ex. 1004)

Nishi is titled “Inverter Apparatus Connected to a Plurality of Direct Current Power Sources and Dispersed-Power-Source System Having Inverter Apparatus Linked to Commercial Power System to Operate.” Ex. 1004, code (54). Nishi relates to an inverter apparatus including plurality of converters each receiving a direct current power from respective plurality of solar cell arrays having different output voltage ranges. *Id.* at code (57). Figure 2 of Nishi is reproduced below.

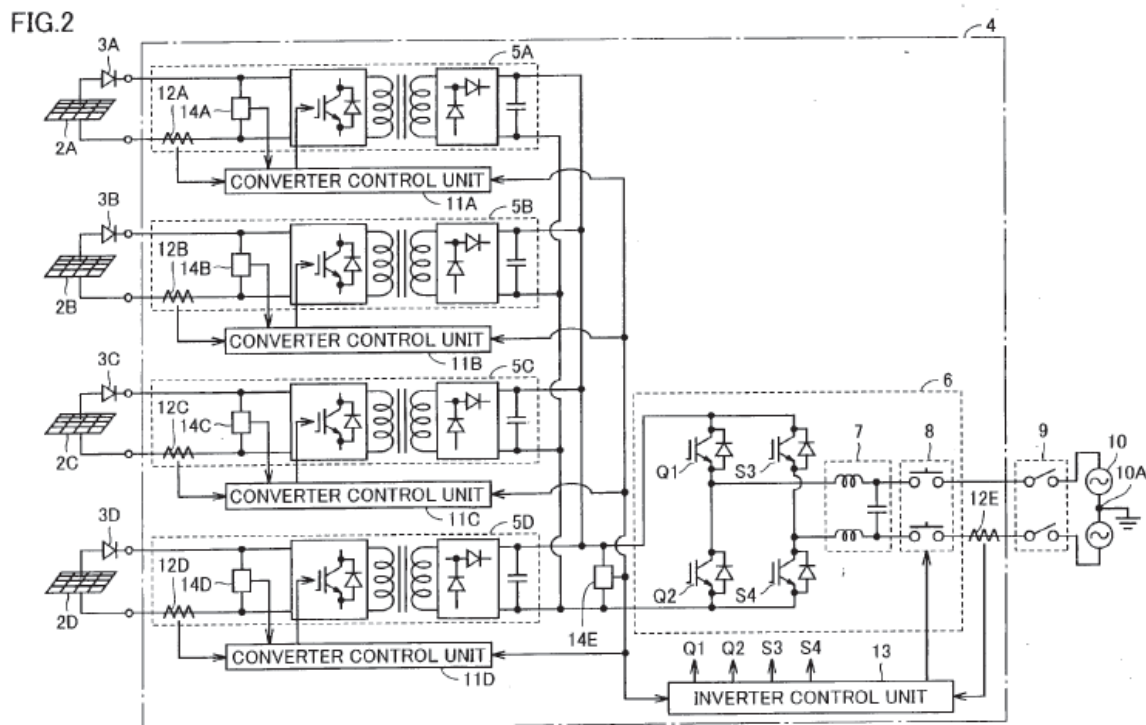


Figure 2 shows inverter apparatus 4 including converters 5A–5D, solar cell arrays 2A–2D, and diodes 3A–3D. *Id.* ¶¶ 60, 70. “Each of converters 5A–5D is a DC-DC converter formed of a switching element, a high-frequency

transformer, a rectifier diode, and an output capacitor.” *Id.* ¶ 71. Each switching element turns on/off based on control signals provided by converter control units 11A–11D. *Id.* For example, converter control unit 11A “receives detection values of an input voltage and an output voltage of converter 5A from voltage sensors 14A, 14E, respectively, and receives detection value of an input current of converter 5A from current sensor 12A.” *Id.* ¶ 73. Inverter apparatus 4 also includes inverter 6 controlled by inverter control unit 13. *Id.* ¶¶ 70, 88. “Inverter control unit 13 receives a detection value of an input voltage of inverter 6 from voltage sensor 14E, and receives a detection value of an output current of inverter 6 from current sensor 12E.” *Id.* ¶ 88. Nishi’s Figure 7 is reproduced below.

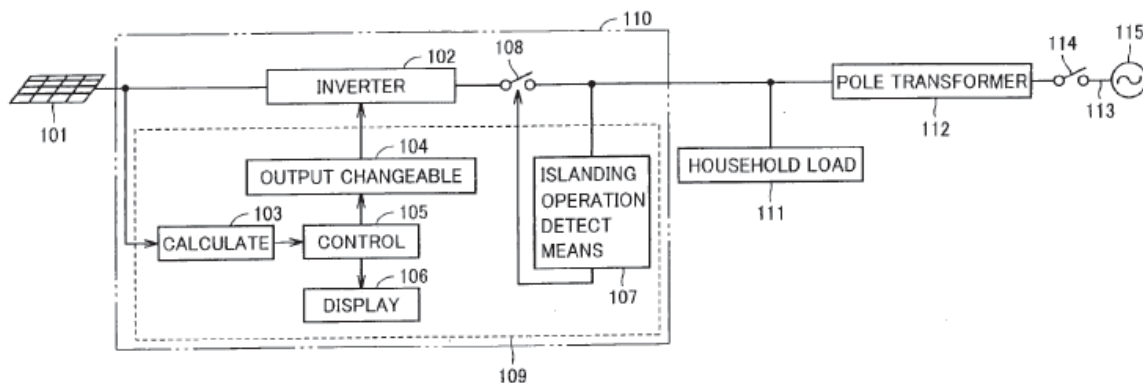


Figure 7 illustrates a home photovoltaic power generation system including solar cell array 101 and inverter apparatus 110. *Id.* ¶ 8. Inverter apparatus 110 includes inverter circuit 102, breaker 108, and microcomputer 109. *Id.* “Microcomputer 109 is formed of calculate means 103, output changeable means 104, control means 105, display means 106, and islanding operation detect means 107.” *Id.*

2. *Petitioner's Arguments*

Regarding claim 13 (“wherein the micro-controller is configured to maximize power generated by the power source”), Petitioner relies on Mieth and Balogh for the limitations of parent claim 12 and argues that Nishi “discloses a microcomputer 109 that controls input voltage so that output power from a solar cell array is maximized, which is analogous to the features of claim 13.” Pet. 78–79 (citing Ex. 1004 ¶¶ 8, 98; Ex. 1007 ¶ 283). Petitioner argues that one of ordinary skill in the art “would understand that the solar cell arrays 2A-2D” of Nishi “generate power and thus the solar cell arrays 2A-2D are analogous to the claimed **power source** and further analogous to the solar generator 1 of Mieth,” and the “power generated . . . by the solar cell arrays 2A-2D is analogous to the claimed **power generated by the power source**.” *Id.* at 80–81 (citing Ex. 1007 ¶ 285). According to Petitioner, it was well known to one of ordinary skill in the art “that solar systems that include solar panels and loads with inverters benefit from maximum power point tracking to maximize the power generated from a solar array” and, thus, it would have been obvious “to combine the reliable startup circuit of Mieth with the maximum power point tracking configuration of Nishi.” *Id.* at 82–83 (citing Ex. 1007 ¶ 288 (“As a simple substitution of elements, a reasonable expectation of success exists, and no undue technical hurdles are needed to be overcome.”)). Regarding claim 14 (“wherein the power source comprises a photovoltaic panel; the first stage power converter comprises a first step-down converter; and the second stage power converter comprises a second step-down converter”), Petitioner argues that Nishi discloses the photovoltaic panel with solar cell arrays 2A-2D, and relies on its claim 8 arguments for the remaining limitations. *Id.* at 83 (citing Ex. 1007 ¶¶ 291–293).

3. Analysis

We have considered the arguments and evidence presented by Petitioner, which currently stand unrebutted, and are persuaded by Petitioner's arguments and evidence supporting this ground. On this record, Petitioner has established a reasonable likelihood of prevailing in showing the obviousness of claims 13 and 14 in view of Mieth, Balogh, and Nishi.

G. Asserted Obviousness based on Mieth, Balogh, and Liu (Ground 4)

Petitioner argues that claim 19 would have been obvious in view of Mieth, Balogh, and Liu. Pet. 83–88.

1. Liu (Ex. 1005)

Liu is titled “Boost-Buck Cascade Converter for Pulsating Loads.” Ex. 1005, code (54). Liu relates to a cascaded power converter capable of storing energy in a reservoir capacitor and insulating pulsating load currents from a primary energy source. *Id.* at 1:8–12.

Figure 5 of Liu is reproduced below.

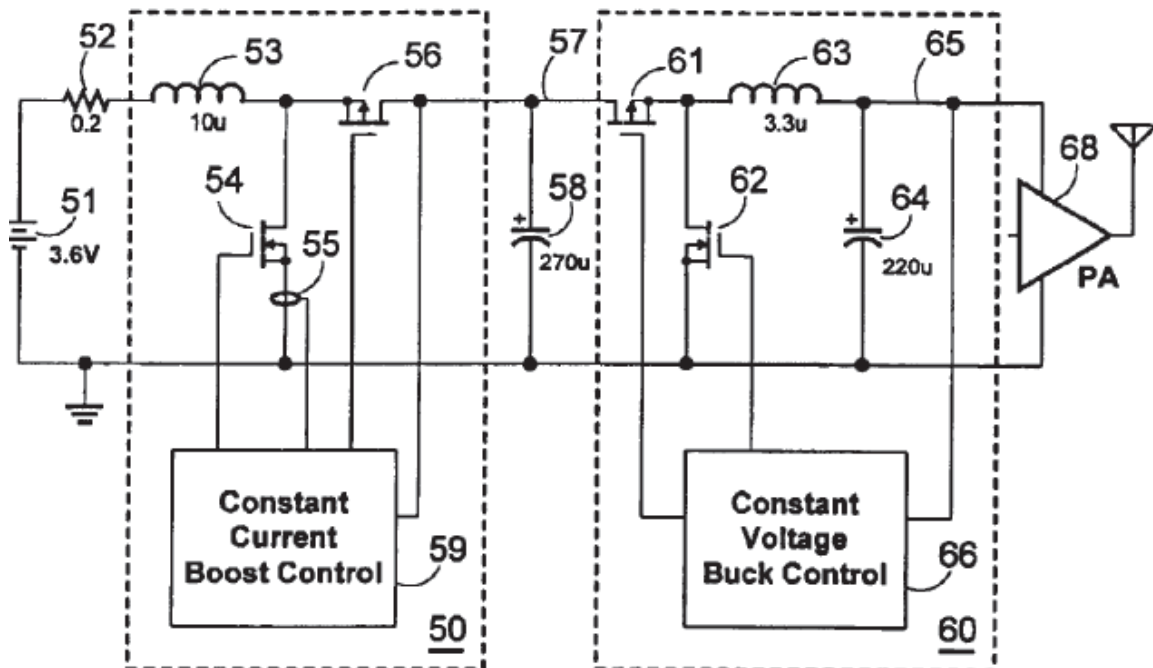


Figure 5 illustrates a circuit diagram including a boost converter input stage followed by a small reservoir capacitor and a buck converter output stage. *Id.* at 4:5–7. More specifically, Figure 5 illustrates input stage 50 connected to output stage 60 by reservoir capacitor 58. *Id.* at 4:25–28. Input stage 50 includes input inductor 53, first and second switches 54, 56, current sense circuit 55, and first control circuit 59. *Id.* at 4:28–30. The output stage includes third and fourth switches 61, 62, output inductor 63, output capacitor 64, and second control circuit 66. *Id.* at 4:30–32.

2. *Petitioner's Arguments*

Petitioner relies on the combination of Mieth and Balogh for independent claim 18 and argues that the additional limitations of dependent claim 19 (“wherein the power absorption circuit includes a capacitor coupled to the first output” and “the threshold allows the capacitor to power the second stage to operate the micro-controller for a predetermined period of time even without the output of the first stage”) is obvious over Mieth’s disclosure of transistor 12 connected to preliminary load 11, and Liu’s disclosure of capacitor 58 as a power absorption circuit coupled to the first output and provide power to PA 68 for a period of time. Pet. 83, 86 (citing Ex. 1007 ¶¶ 295–296, 300). According to Petitioner, one of ordinary skill in the art would have been motivated to combine the “capacitor of Liu with the power absorption circuit of Mieth, as the capacitor provides a more stable power source to Mieth’s load for a predetermined time period when the power absorption circuit is disconnected from the circuit or voltage from the photovoltaic system is varying due to dynamic conditions,” and “both Mieth and Liu provide an express motivation to combine together to improve a cascaded power converter system by including a capacitor in the power

absorption circuit” with a reasonable expectation of success. *Id.* at 86–87 (citing Ex. 1007 ¶¶ 301–303).

3. *Analysis*

We have considered the arguments and evidence presented by Petitioner, which currently stand unrebutted, and are persuaded by Petitioner’s arguments and evidence supporting this ground. On this record, Petitioner has established a reasonable likelihood of prevailing in showing the obviousness of claim 19 in view of Mieth, Balogh, and Liu.

III. CONCLUSION

We have considered the Petition and the evidence relied upon by the Petitioner and, for the foregoing reasons, we are persuaded that Petitioner has established a reasonable likelihood of prevailing in challenging claims 1–20 of the ’021 patent. This is not a final decision as to the construction of any claim term or the patentability of claims 1–20. Our final decision will be based on the full record developed during trial.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that *inter partes* review of all challenged claims of the ’021 patent is instituted with respect to all grounds set forth in the Petition; and

FURTHER ORDERED that pursuant to 35 U.S.C. § 314(a), *inter partes* review of the ’021 patent is hereby instituted commencing on the entry date of this Decision, and pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial.

IPR2023-00879
Patent 9,584,021 B2

FOR PETITIONER:

Thomas Eschweiler
Nathanael Smith
James Potashnik
Ningjiao Zhang
ESCHWEILER & POTASHNIK LLC
docketing@eschweilerlaw.com
njsmith@epiplaw.com
jpotashnik@eschweilerlaw.com
nzhang@epiplaw.com

Philip Marsh
ARNOLD & PORTER KAYE SCHOLER LLP
philip.marsh@apks.com

FOR PATENT OWNER:

Heath Briggs
Leif Olson
GREENBERG TRAURIG, LLP
briggsh@gtlaw.com
olsonl@gtlaw.com