

SMA Solar Technology America, LLC
v.
TIGO Energy, Inc.

IPR2023-00879 (US 9,584,021)

PATENT OWNER'S DEMONSTRATIVE EXHIBIT

Tigo Energy and '021 Patent



- California Company
- Designs and manufactures electronics for solar systems

- The '021 patent addresses a significant problem in the industry:
 - “[U]nreliability of the power source during the early morning [or] late evening hours, when faint blue light allows the panel to generate a high voltage, but presents barely enough current to properly operate...[creating] a ‘false start’ in which the voltages appear to be there, but as soon as the controller becomes active there is a drop or brown out or power outage, leading to the undesirable occurrence of unstable or even meta-stable modes, which may occur more frequently for small processors.”
- Three Independent Claims:
 - 1, 10 and 18
 - All require a “micro-controller”

POR at 3, 10

Invalidity Grounds

Ground	Prior Art	Claims Challenged
A	Mieth	1-7, 9
B	Mieth in view Balogh	1, 8, 10-12, 15-18, 20
C	Mieth in view of Balogh and Nishi	13-14
D	Mieth in view of Balogh and Liu	19

Pet. at 20

Disputed Issues

- Dispositive Issue: Does Mieth expressly or inherently disclose a “micro-controller?”
- Other Issues:
 - Is Mieth’s “capacitor 2” a power converter?
 - Are Petitioner’s Mieth+Balogh arguments logical/supported?

Related Patents, IPRs and Denials

- IPR2023-01175:
 - U.S. Patent No. 9,966,848 (same family as the '021 patent)
 - Institution denied because Mieth fails to expressly or inherently disclose a micro-controller as required by all claims (Paper 12)
 - Rehearing denied (Paper 14)
- IPR2023-01133:
 - U.S. Patent No. 10,333,405 (same family as the '021 patent)
 - Institution denied because Mieth fails to expressly or inherently disclose a micro-controller as required by all claims (Paper 10)
 - Rehearing denied (Paper 13)

POR at 6
POSR at 9-10

Mieth Does Not Disclose a Micro-Controller

All claims require a “micro-controller”

1. A method to supply power, the method comprising: providing a power supply having a first stage and a second stage, wherein the first stage converts power from a direct current input into a first output, and the second stage powered by the first output has a second output for a micro-controller; 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; 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 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.

10. A system to supply power, the system comprising: a power source to provide a direct current input; a first stage power converter configured to convert the direct current input into a first output; a second stage power converter configured to be powered by the first output to generate a second output; a micro-controller powered by the second output; a switchable load; and a control circuit powered by the first output and configured to connect the first output to the switchable load to consume at least a portion of the first output while disabling the second stage power converter in supplying the second output to the micro-controller;

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18. A system to supply power, the system comprising: a photovoltaic panel to provide a direct current input; a first stage power converter connected to the photovoltaic panel to generate a first output from the direct current input; a second stage power converter connected to convert the first output to a second output; a micro-controller; a power absorption circuit; and a control circuit coupled with the first stage power converter and the second stage power converter, the control circuit powered by the first output to control the second stage power converter, wherein when the second stage power converter is disabled in providing the second output to the micro-controller, the control circuit monitors a voltage of the first output powering the power absorption circuit and signals the second stage power converter to continue disabling the providing of the second output to the

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POR at 10

Ground A: Petitioner relies on anticipation

VII. SPECIFIC GROUNDS FOR UNPATENTABILITY

A. Ground A: Anticipation of claims 1-7, and 9 in view of Mieth

Pet. at 23, 25-26

iv. [1D]: “and the second stage powered by the first output has a second output for a micro-controller;”

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Ex.1007,¶104. A PHOSITA would understand that a load in a circuit can be or include a micro-controller, as such the load 20 is analogous to the claimed *micro-controller* (dashed-orange). Ex.1007,¶105;Ex.1014,1180,Fig.5.

Ground B: No change to micro-controller argument

B. Ground B: Anticipation/obviousness of claims 1, 8, 10-12, 15-18, and 20 in view of Mieth and Balogh

Pet. at 50, 60, 71

1. Independent Claim 1 features [1B]-[1D]

Independent claim 1 features [1B]-[1D] are taught by Mieth as discussed in

§VII.A.1.ii-§VII.A.1.iv.

v. [10E]: “a micro-controller powered by the second output; a switchable load; and”

[10E] is analogous to the micro-controller of [1D] and the switchable load of

[1E], and thus Mieth-Balogh disclose [10E] for at least the same reasons Mieth

discloses [1D],[1E] as described in §VII.A.1.iv

Ex.1007,¶¶177-181;Ex.1014,1180,Fig.5.

v. [18E]: “a micro-controller”

[18E] is analogous to the micro-controller of [1D]. Thus, Mieth or Mieth-

Balogh disclose [18E] for at least the same reasons Mieth discloses [1D] described

in §VII.A.1.iv. Ex.1007,¶¶247-250;Ex.1014,1180,Fig.5.

Ground B rationale proves no argument change

Pet. at 50-52
POR 17

Independent claim 1 features [1B]-[1D] are taught by Mieth as discussed in §VII.A.1.ii-§VII.A.1.iv. As discussed previously, Mieth teaches the first stage. However, Balogh (Ex.1003) also discloses a first stage, and a PHOSITA would have been motivated to do so for the following reasons.

A PHOSITA is motivated to combine the cascaded power converter architecture of Balogh with the switchable load feature of Mieth for DC applications with high input voltages. Ex.1007, ¶¶153-156. Mieth is directed

The combination of Mieth and Balogh merely involves combining known prior-art elements (Mieth's switchable load and Balogh's cascaded step down converter architecture) according to known methods to yield predictable results, a

Reply confirms no change for Ground B

In arguing that the combination of Mieth and Balough results in the combination not teaching the control circuit, PO mischaracterizes the combination. Paper 18, pp. 33-35. The Petition does not seek to replace all the elements of Mieth in front of the power converter 19 with Mieth, but instead asserts that a PHOSITA would be motivated to replace the capacitor with the first stage power converter of Balough. Paper 1, p. 51 (stating, “Balogh (Ex.1003) also discloses a first stage, and a PHOSITA would have been motivated to combine Balogh.”)

Reply at 20-21

Thus, as asserted in the Petition, replacing the capacitor 2 of Mieth with the first power converter (converter 1) of Balough establishes a cascaded power converter architecture that keeps all the teachings of Mieth regarding the switchable load, including the control circuitry thereof, and thus renders obvious the claims of Ground B.

Grounds C-D: Challenge to dependent claims only

Pet. at 20

Ground	Prior Art	Claims Challenged
A	Mieth	1-7, 9
B	Mieth in view Balogh	1, 8, 10-12, 15-18, 20
C	Mieth in view of Balogh and Nishi	13-14
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Anticipation Standard

To prevail on a showing of anticipation for any claim, Petitioner must show that Mieth expressly or inherently discloses every element of at least one of the independent claims. *Verdegaal Bros. v. Union Oil Co. of Cal.*, 814 F.2d 628, 631 (1981); *Finisar Corp. v. DirecTV Group, Inc.*, 523 F.3d 1323, 1334 (Fed. Cir. 2008); *Spansion, Inc. v. Int’l Trade Comm’n*, 629 F.3d 1331, 1356 (Fed. Cir. 2010). Petitioner cannot meet this standard, because Mieth’s “load 20” does not expressly or inherently disclose a micro-controller.

POR at 12

Undisputed: no express disclosure

- Petition:

- “The power supply apparatus 19 is a DC-DC voltage converter or a charging converter and outputs a voltage and current to power a load 20. *Id.* ... *A PHOSITA would understand that a load in a circuit can be or include a micro-controller, as such the load 20 is analogous to* the claimed micro-controller (dashed-orange).

Pet. at 25-26

- Reply:

- “*Load 20 of Mieth constitutes a genus* that encompasses the micro-controller as a species. ...”

Reply at 5

A micro-controller is not inherent

Ex.1007,¶104. A PHOSITA would understand that a load in a circuit **can be or include** a micro-controller, as such the load 20 is **analogous to** the claimed *micro-controller* (**dashed-orange**). Ex.1007,¶105;Ex.1014,1180,Fig.5.

Pet. at 5

“Petitioner must show that ‘the missing descriptive matter is necessarily present in the thing described in the reference.... Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.’”

POR at 15

Patent Owner's incorrect new theories

- “The term ‘load’ at issue is a well-defined term of art that permits a PHOSITA to readily envisage each species therein, in particular, the claimed micro-controller as a species of that genus.”
[Reply at 6](#)
- [A] PHOSITA would reasonably understand or infer from Mieth that a micro-controller is disclosed therein, as required by Eli Lilly/L.A. Biomedical.”
[Reply at 8](#)

“Load” is not a limited class

- Patent Owner: “A load is any circuit, device or apparatus that, when connected to a source of electrical energy, consumes electrical energy.... In other words, a load is a device that consumes electrical energy in the form of a current and transforms it into other forms of energy like heat, light, work, etc.”

Reply at 7

“Even a lay person would recognize that this definition of load captures an immeasurable number of things. Petitioner’s own statements thus show that Mieth’s load cannot meet the genus/species law Petitioner seeks to apply.”

POSR at 7

Board agreed in related IPRs

anticipate a species within that genus. *Eli Lilly*, 471 F.3d at 1376. Here, Petitioner argues that Mieth's load 20 is a generic disclosure of devices that consume electrical power. Req. 14. Petitioner has not shown that Mieth's load is a "definite and limited class" or contains a "very limited number" of class members. Rather, the class of things that consume electrical power is not necessarily definite and is not limited in scope.

POSR at 10, citing Rehearing
Denials in IPR2023-01175;
IPR2023-001133

Petitioner's Expert Confirms

anything that consumes electrical power is a “load.” Dr. Holberg’s prior testimony shows that a “load” is not the type of genus contemplated in *Zenith*: capacitors (Ex-2005-Holberg-Dep. at 51:21-24), resistors (*id.* at 38:20-39:13), diodes (*id.* at 39:23-40:8), Zener diodes (*id.* at 40:22-24), inductors (*id.* at 40:25-41:4), and transistors (*id.* at 41:5-9), light bulbs, long wires, and switches (*id.* at 41:10-42:8) are all components that dissipate power, and thus are also “loads” according to Petitioner’s definition. Mieth’s “load” cannot possibly disclose anything resembling a “defined and limited” class—as the Board previously noted in the related proceedings, “the class of things that consume electrical power is not necessarily definite and is not limited in scope.” IPR2023-01133, Paper 13 at 7; *see* IPR2023-01175 at 7 (same).

POSR at 8

“Reasonably Infer.” Petitioner’s case law proves it cannot carry its burden

- Petitioner cites: *Eli Lilly and Co. v. L.A. Biomedical Res.*, 849 F.3d 1073 (Fed. Cir. 2017)
- *L.A. Biomedical* claim limitation:
 - “wherein the PDE-5 inhibitor is administered at a dosage up to 1.5 mg/kg/day for not less than 45 days”
- PTAB: *No anticipation* based on Whitaker reference
 - Whitaker’s title insufficient:
 - “Daily Treatment for Erectile Dysfunction Using a PDE5 Inhibitor”
 - Whitaker’s “chronic administration” insufficient:
 - “regular administration for an extended period, preferably daily for three or more days, and still more preferably daily as long as the patient suffers from erectile dysfunction (in the absence of therapy)”
 - Whitaker’s studies insufficient:
 - Subjects who took a PDE5 inhibitor ‘greater than 70% of the time’ over the course of either 8 or 12 weeks did not constitute a disclosure of daily dosing

Federal Circuit Affirmed the PTAB

Lilly's argument boils down to saying that Whitaker's definition of 'chronic administration' anticipates daily administration for 45 days or more because a [POSITA] would understand that erectile dysfunction...can last longer than 45 days. As the Board stated, however, that "at best, is an obviousness argument."

- *L.A. Biomedical*, 849 F.3d at 1075.

Whitaker may 'suggest' long-term daily treatment by noting the beneficial effects of daily treatment..., but that is not enough. To anticipate, a reference must do more than 'suggest' the claimed subject matter.

- *L.A. Biomedical*, 849 F.3d at 1076.

POSR at 11-12

No anticipation: even more definitive here

- “Unlike in L.A. Biomedical, where the prior art may have reasonably suggested the “for not less than 45 days” limitation, here Mieth’s “load” does not suggest **any** particular item, let alone a microcontroller....”

POSR 12

Petitioner inverts the analysis

- Petitioner: Mieth anticipates because the '021 patent's micro-controller operates as a load Reply at 9
 - Incorrect analysis
- Correct Analysis: does Mieth expressly or inherently disclose a micro-controller?
 - No.
 - “The possibility that a microcontroller—like virtually every other circuit element—consumes power does not mean Mieth’s “load” discloses a microcontroller.” POSR at 13

Petitioner's improper obviousness arguments

- Petition, Ground B: no change to micro-controller arguments POR at 11
- Petitioner's Reply—entirely new argument/theory: it would have been obvious to use a micro-controller in Mieth Reply at 12-18
- Improper new invalidity theory/argument routinely rejected by the Board and the Federal Circuit
 - *Yita LLC v. MacNeil IP LLC*, 69 F.4th 1356, 1366-67 (Fed. Cir. 2023)

POSR at 3

Reliance on Exhibit 1014

- “Ex-1014 is cited three times in the Petition, each time without explanation or analysis, in support of Petitioner’s one-sentence argument about Mieth’s “load” being analogous to a microcontroller. (Petition at 26, 60, 71.) As the Board previously explained, the lack of argument or explanation in the Petition regarding Ex-1014 means Petitioner is raising a new argument.”

POSR at 13

Mieth's Capacitor 2 Is Not a Power Converter

All claims require a first stage “power converter”

1. A method to supply power, the method comprising: providing a power supply having a first stage and a second stage, wherein the first stage converts power from a direct current input into a first output, and the second stage powered by the first output has a second output for a micro-controller; 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; 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 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.

10. A system to supply power, the system comprising: a power source to provide a direct current input; a first stage power converter configured to convert the direct current input into a first output; a second stage power converter configured to be powered by the first output to generate a second output; a micro-controller powered by the second output; a switchable load; and a control circuit powered by the first output and configured to connect the first output to the switchable load to consume at least a portion of the first output while disabling the second stage power converter in supplying the second output to the micro-controller;

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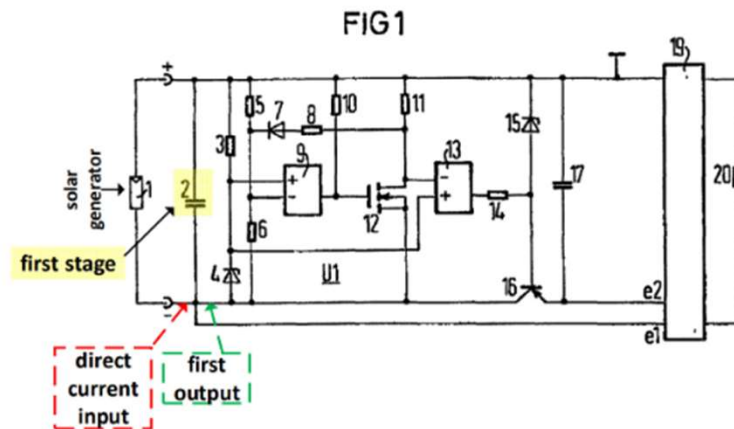
18. A system to supply power, the system comprising: a photovoltaic panel to provide a direct current input; a first stage power converter connected to the photovoltaic panel to generate a first output from the direct current input; a second stage power converter connected to convert the first output to a second output; a micro-controller; a power absorption circuit; and a control circuit coupled with the first stage power converter and the second stage power converter, the control circuit powered by the first output to control the second stage power converter, wherein when the second stage power converter is disabled in providing the second output to the micro-controller, the control circuit monitors a voltage of the first output powering the power absorption circuit and signals the second stage power converter to continue disabling the providing of the second output to the

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POR at 19

All Grounds: Petitioner argues “capacitor 2”

“The first stage of Mieth is a parallel capacitor 2 which a PHOSITA would understand converts power associated with the direct current input into a first output (dashed-green).



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

POR at 21-22

Mieth's "Capacitor 2" $\neq$ "Power Converter"

- Specification confirms:
 - Defines “buck converters” separately from “capacitors”
 - Capacitors “store energy” in context of '021 patent
- Petitioner's expert's testimony confirms
 - Agrees a capacitor does not step-up or step-down power
 - Agrees capacitors ideally do not dissipate power
 - Merely argued Mieth's *capacitor 2* is “analogous to” a power converter
- Use of Balogh for Ground 2 confirms

POR at 22-27

Mieth's "Capacitor 2" ≠ "Power Converter"

- Claim language confirms

Independent Claim 18	Dependent Claim 19
[18A] 18. A system to supply power, the system comprising: ... [18C] a <u>first stage power converter</u> connected to the photovoltaic panel to generate a <u>first output</u> from the direct current input; [18D] a <u>second stage power converter</u> connected to convert the first output to a second output; ... [18F] a power absorption circuit....	[19A] The system of claim 18, wherein the power absorption circuit includes a <u>capacitor</u> coupled to the <u>first output</u>; [19B] and the threshold <u>allows the capacitor to power the second stage</u> to operate the micro-controller for a predetermined period of time <u>even without the output of the first stage</u>.

POR at 30-32

District Court Constructions

Term	Agreed Construction
“Power supply...converts power”	A power electronics circuit that converts one type or level of a voltage or current waveform to another
“Power converter”	A power electronics circuit that converts one type or level of a voltage or current waveform to another

POR at 28-30

Petitioner's Mieth+Balogh Arguments

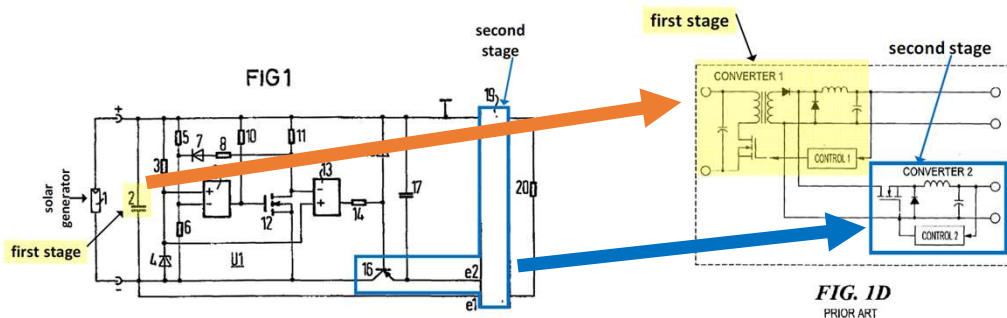
Petitioner's Proposal

- Ground B:
 - Limitations 1A, 1E-1G: Mieth alone
 - Limitations 1B-1D: Mieth+Balogh

Pet. 50-55
POR at 28-30

1. A method to supply power, the method comprising:
providing a power supply having a first stage and a second stage, wherein the first stage converts power from a direct current input into a first output, and the second stage powered by the first output has a second output for a micro-controller;
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;
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
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.

Ground B replaces Mieth's elements with Balogh's cascaded converters



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

Ex.1003, Fig.1D(annotated-1D.2)

Pet. at 24 (Mieth, FIG. 1)
(Ground A – Mieth only)

Pet. at 54 (Balogh, FIG. 1D)
(Ground B – Mieth + Balogh)

Pet. at 54

Specifically, while the capacitor 2 discussed in §VII.A.1.ii-§VII.A.1.iv. (see Fig. 1(annotated-1D.1) above) is analogous to the claimed first stage, and the bipolar transistor 16/power supply apparatus 19 is analogous to the claimed second stage, 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. Ex.1003,10:45-52;Ex.1007,¶158.

Ground B never addresses limitations 1E-1G

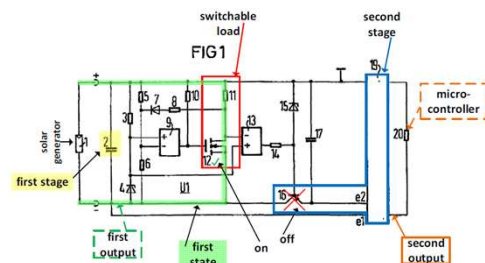
B.	Ground B: Anticipation/obviousness of claims 1, 8, 10-12, 15-18, and 20 in view of Mieth and Balogh.....	50
1.	Independent Claim 1 features [1B]-[1D]	50
2.	Dependent Claim 8.....	55
3.	Independent Claim 10.....	56
4.	Dependent Claim 11.....	62
5.	Dependent Claim 12.....	64
6.	Dependent Claim 15.....	67
7.	Dependent Claim 16.....	69
8.	Dependent Claim 17.....	69
9.	Independent Claim 18.....	69
10.	Dependent Claim 20.....	77

POR at 35-38

Ground A, Limitations 1E-1G

- v. [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;”

Mieth discloses that the first output (dashed-green) of capacitor 2 is connected to a field-effect transistor 12 that is connected to a preliminary load 11 as shown in Fig.1(annotated-1E). Ex.1002.10:5-14;Ex.1007.¶106.

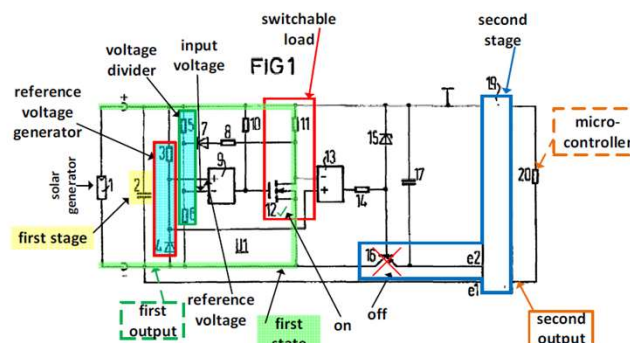


Ex.1002, Fig.1(annotated-1E)

Pet. at 26-27

- vi. [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”

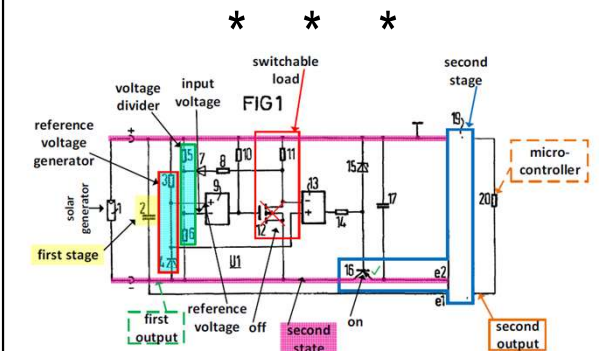
As discussed in §VII.A.1.v., when the circuit of Mieth is configured for the first state, bipolar transistor 16 is non-conducting, and the power supply apparatus 19 (i.e., second stage-blue) is disabled from supplying the load 20 (i.e., micro-controller-dashed-orange) with the second output (orange), see Fig.1(annotated-1F).



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

Pet. at 28-29

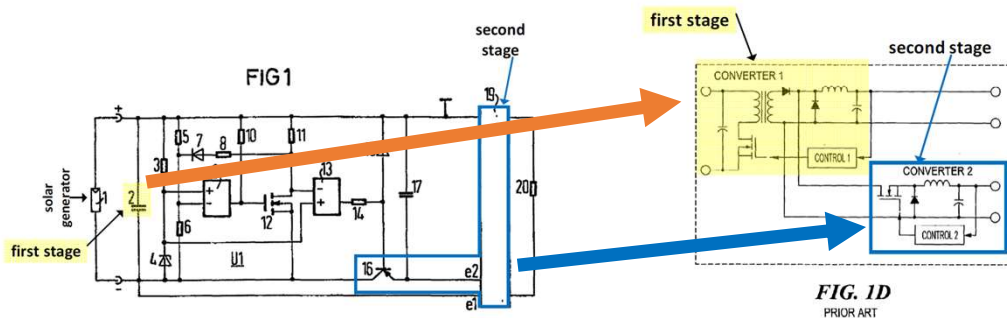
- vii. [1G]: “in response to a determination that the first output from the first stage powering the switchable load is above the threshold during the time period in which the second output to the micro-controller is disabled, disconnecting the switchable load from the first output of the first stage; 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.1002, Fig.1(annotated-1G)

Pet. at 31-33

How does Petitioner's Mieth+Balogh proposal function?



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

Pet. at 24 (Mieth, FIG. 1)
(Ground A – Mieth only)

Ex. 1003, Fig. 1D(annotated-1D.2)

Pet. at 54 (Balogh, FIG. 1D)
(Ground B – Mieth + Balogh)

arguments are illogical in the context of Grounds B-D. Specifically, Balogh's cascaded power converters are controlled differently than Mieth's "capacitor 2" (the alleged "first stage") and "bipolar transistor 16"/"power supply 19" (the alleged "second stage"). Dr. Holberg confirmed that the cascaded buck converters he relied on from Balogh's FIG. 1D each have their own independent control circuits and would likely be controlled by pulse-width modulation. (Ex-2005-Holberg-Dep. at 58:17-59:2, 53:11-54:1.) As such, the circuitry for controlling Balogh's converters would need to be different than the circuitry used in Mieth. Thus, the elements in Mieth that Petitioner identifies in Ground A as meeting steps 1E-1G would not work in the proposed Mieth-Balogh combination.⁸ Since Petitioner did not provide any argument or discussion as to how the combination would meet steps 1E-1G of the claim, Petitioner cannot show that claim 1 or any of its dependents are obvious. In

POR at 36

IPR2023-00879

U.S. Patent No. 9,584,021

§ 42.6(e)—CERTIFICATION OF SERVICE

In accordance with § 42.6(e)(1), the undersigned certifies that on the 5th day of August, 2024, the above **PATENT OWNER'S DEMONSTRATIVE EXHIBIT** was served, via electronic mail upon the following counsel for Petitioner,

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Dated: August 5, 2024

/ Heath J. Briggs /

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