

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.

Patent 10,333,405
Filing Date: May 2, 2018
Issue Date: June 25, 2019
Title: SYSTEMS AND METHODS FOR ENHANCED EFFICIENCY
AUXILLARY POWER SUPPLY MODULE

Inter Partes Review No.: IPR2023-01133

**PETITION FOR *INTER PARTES* REVIEW
UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 42.100 *et seq.***

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PETITIONER’S EXHIBIT LIST

Exhibit	Description
Ex.1001	U.S. Patent No. 10,333,405
Ex.1002	Certified English Translation of DE3725476 (Mieth)
Ex.1003	U.S. Patent No. 6,246,592 (Balogh)
Ex.1004	U.S. Patent Publication No. 2005/105224 (Nishi)
Ex.1005	U.S. Patent No. 6,798,177 (Liu)
Ex.1006	File wrapper of U.S. Patent No. 10,333,405
Ex.1007	Declaration of Dr. Doug Holberg
Ex.1008	German Language DE3725476 (Mieth)
Ex.1009	Allen, Philip E., and Douglas R. Holberg. “CMOS Analog Circuit Design” (2002) (“CMOS”)
Ex.1010	Solibro GmbH Data Sheet, CIGS THIN FILM SOLAR MODULE SL2 (“Solibro”)
Ex.1011	MITSUBISHI ELECTRIC Data Sheet, PHOTOVOLTAIC MODULE (“ME”)
Ex.1012	US Patent Publication No. 2007/0001653 (Xu)
Ex.1013	U.S. Patent Publication No. 2006/0207192 (Durham)
Ex.1014	Arias et al., “A Modular PV Regulator Based on Microcontroller with Maximum Power Point Tracking,” IEEE, IAS 2004
Ex.1015	U.S. Patent No. 4,617,529 (Suzuki)

Note Regarding Page Citations

For exhibits that include suitable page numbers as originally published, Petitioner's citations are to those original page numbers and not to the page numbers added for compliance with 37 C.F.R. § 42.63(d)(2)(ii).

Petition for *Inter Partes* Review

SMA Solar Technology America, LLC ("Petitioner") petitions for *inter partes* review of claims 1-13 of U.S. Patent No. 10,333,405 ("the '405 patent") (Ex. 1001).

I. MANDATORY NOTICES PURSUANT TO 37 C.F.R. § 42.8(A)(1), 37 C.F.R. § 42.8(b)(1)&(2):

A. Real Parties in Interest, § 42.8(b)(1)

The real party-in-interest is Petitioner SMA Solar Technology America, LLC. No unnamed entity is funding, controlling, or directing this Petition, or otherwise has had an opportunity to control or direct this Petition or Petitioner's participation in any resulting IPR.

B. Related Matters, § 42.8(b)(2)

Petitioner is not aware of any disclaimers, reexamination certificates or other petitions for *inter partes* review for the '405 Patent. The '405 patent is the subject of a civil action: *Tigo Energy Inc. v. SMA Solar Technology America LLC*, 22-915-VAC (D. Del.).

No references relied upon herein for disclosing elements of the issued claims were cited during prosecution of the '405 patent. It is noted that one reference, Ex. 1012, U.S. Patent Publication No. 2007/0001653 (Xu), that was cited during prosecution of the '405 patent, is not being relied upon herein for teaching any element of the issued claims, but rather is relied upon solely as evidence of the general knowledge of a PHOSITA prior to the priority date of the '405 patent. No arguments presented in this Petition were raised during prosecution of the '405 patent.

A petition for *Inter Partes* Review, IPR2023-00879 was filed on April 24, 2023, for U.S. Patent No. 9,584,021, which is the great-grandparent of the '405 patent.

37 C.F.R. § 42.8(b)(3)&(4):

C. Lead & Back-Up Counsel and Service Information

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II. COMPLIANCE WITH THE REQUIREMENTS FOR A PETITION FOR INTER PARTES REVIEW

A. Payment of Fees

The undersigned authorizes the charge of any required fees to Deposit Account No. 50-1733.

B. Grounds for Standing

The present petition is being filed within one year of service of a complaint against SMA Solar Technology America LLC, a wholly owned subsidiary of SMA Solar Technology AG in *Tigo Energy Inc. v. SMA Solar Technology America LLC*, 22-915-VAC (D. Del.).

Petitioner certifies that the '405 patent is available for review and that Petitioner is not barred or estopped from requesting review challenging claims 1-13.

III. OVERVIEW OF THE '405 PATENT

A. Brief Description

The '405 patent is directed to a power supply for use in a solar electric production system. Ex.1001,1:50-51;Ex.1007,¶63. Figure 4 shows a power supply having a first stage 401 and a second stage 402, where the first stage 401 receives an input voltage from a photovoltaic ("PV") panel and outputs a first voltage at a first output. The second stage 402 is connected to the first stage 401 and in one example comprises a second power converter. Ex.1001,1:51-56;Ex.1007,¶63. The second stage 402 operates in two states: (1) a first, deactivated state, and (2) a second, enabled state. In the second state the second stage 402 generates a second voltage at a second output using the first voltage to supply a micro-controller with a voltage. Ex.1001,8:41-48;Ex.1007,¶63.

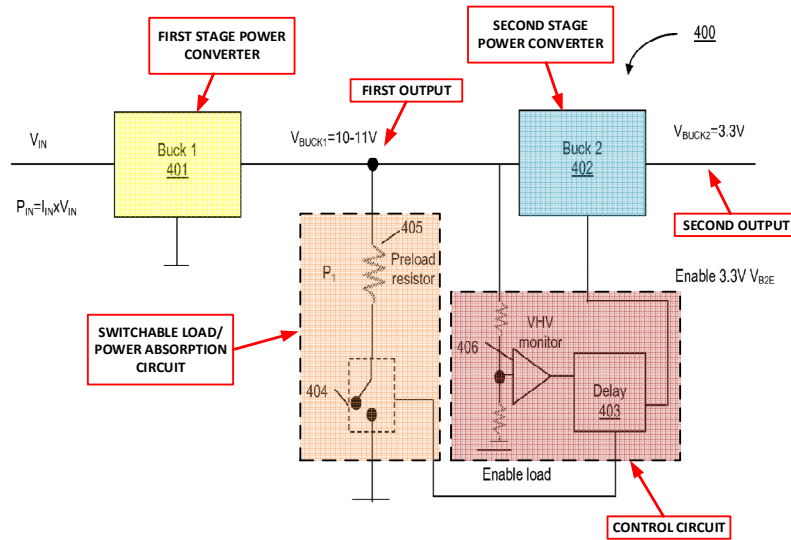
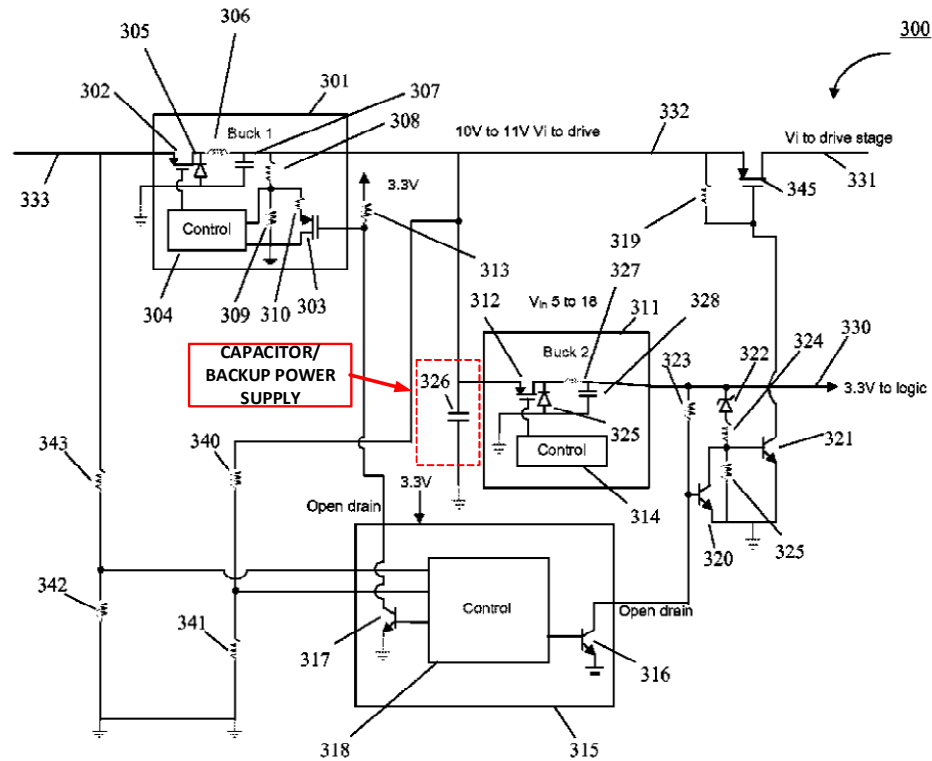


Figure 4

The power supply includes a control circuit (406, 403) to prevent false start problems when the solar panel is providing insufficient power. Ex.1001,8:19-22;Ex.1007,¶64. The control circuit, in the first state, connects a preload resistor 405 to the first output by closing a switch 404 via a first control signal to emulate the load of the second stage 402 on the first stage output prior to activating the second stage 402 via a second control signal. Ex.1001,8:22-23,8:35-37;Ex.1007,¶64. If the first stage output voltage exceeds a threshold, the control circuit, in the second state, disconnects the preload resistor 405 by opening the switch 404 via the first control signal. Ex.1001,8:41-45;Ex.1007,¶64. The control circuit employs a delay 403 to delay the second control signal with respect to the first control signal to ensure the second stage operation remains disabled until after the switch 404 is opened, thus providing a “break before make condition,” wherein

the switch 404 opens before the second stage 402 is enabled. Ex.1001,8:40-48;Ex.1007,¶64.

In another embodiment (Figure 3 of Ex.1001), a capacitor 326 is connected to the input of the second stage 311/402. Ex.1001,9:32-34;Ex.1007,¶65.



Ex.1001,Figure3

Capacitor 326 is employed as a backup power supply to keep the second stage 311/402 running longer than the first stage 401. Thus, in the first state, the capacitor 326 is charged and absorbs power, and when the first stage 401 is inoperative/unstable, the capacitor provides charge to keep the second stage 402

working to provide the second voltage at the second output. Ex.1001,4:60-66;Ex.1007,¶66.

B. Relevant Prosecution History

The '405 patent was filed as App. No. 15/969,607 ('607 application) on May 2, 2018, as a continuation of App. No. 15/392,960 (issued as Patent No. 8,966,848), filed on December 28, 2016, as a continuation of App. No. 14/822,227 (issued as Patent No. 9,584,021), filed on August 10, 2015, as a continuation of App. No. 12/787,205 (issued as Patent No. 9,143,036), filed on May 25, 2010, claiming priority to U.S. App. No. 61/275,734, filed on September 2, 2009, and U.S. App. No. 61/336,743, filed on January 26, 2010. Ex.1001,P.1;Ex.1006,88-90,101-108). At least 61/275,734, and arguably 61/336,743, does not provide support under 35 U.S.C. §112, first paragraph, for the claimed subject matter. While Petitioner does not rely on prior art published in the time period between the priority dates and the non-provisional filing date of May 25, 2010 of the great-grandparent application, Petitioner reserves the right to challenge the priority date of the claimed subject matter of the '405 Patent.

A first substantive Office Action was issued in the '607 application on October 18, 2018. In the non-final Office Action, claims 1-3 and 10-12 were rejected under 35 U.S.C. § 103(a) as being obvious in view of U.S. Patent Publication No. 2007/0001653 (Xu) in view of U.S. Patent No. 5,565,761

(Hwang). Claim 4 was rejected under 35 U.S.C. § 103(a) as being obvious over Xu in view of Hwang and U.S. Patent Publication No. 2007/0278861 (Lou), and claims 19-20 were rejected under 35 U.S.C. § 103(a) as being obvious over Xu in view of Hwang and U.S. Patent Publication No. 2008/0179949 (Besser). Claims 5-9 and 13-18 were held to contain allowable subject matter, but were objected to for depending upon a rejected independent claim. (Ex.1006,70-79).

A response to the non-final Office Action was filed by the applicant on January 3, 2019. In the response, allowable claims 5 and 13 were amended into independent form, claims 1, 3-4, 10-11 and 19-20 were cancelled, and the other rejected depending claims were amended to depend upon amended independent claims 5 and 13, respectively. (Ex.1006,43-48). The allowable subject matter of claim 5 deemed to distinguish over the cited art of record was: “wherein the control circuit is configured to signal the switchable load to be in a first state of consuming the first output during the time period and to be in a second state of not consuming the first output after the time period.” The allowable subject matter of claim 13 deemed to distinguish the claim over the cited art of record was: “consuming, by a switchable load in a power absorption circuit, a portion of the first output from the first stage power converter during the time period.” (Ex.1006).

A Notice of Allowance was issued on February 19, 2019, wherein pending claims 2, 5-9 and 12-18 were deemed allowed. (Ex. 1006,10-18). The '405 patent issued on June 25, 2019, wherein independent claims 5 and 13 were renumbered as independent claims 1 and 7, respectively. (Ex.1006,2).

C. Earliest Priority Date for the Claims

The earliest alleged priority date for the '405 patent claims is the filing date of the U.S. provisional application—the earlier one filed September 2, 2009. Each reference discussed herein in the grounds for rejection predates this date and constitutes available prior art under 35 U.S.C. § 311(b).

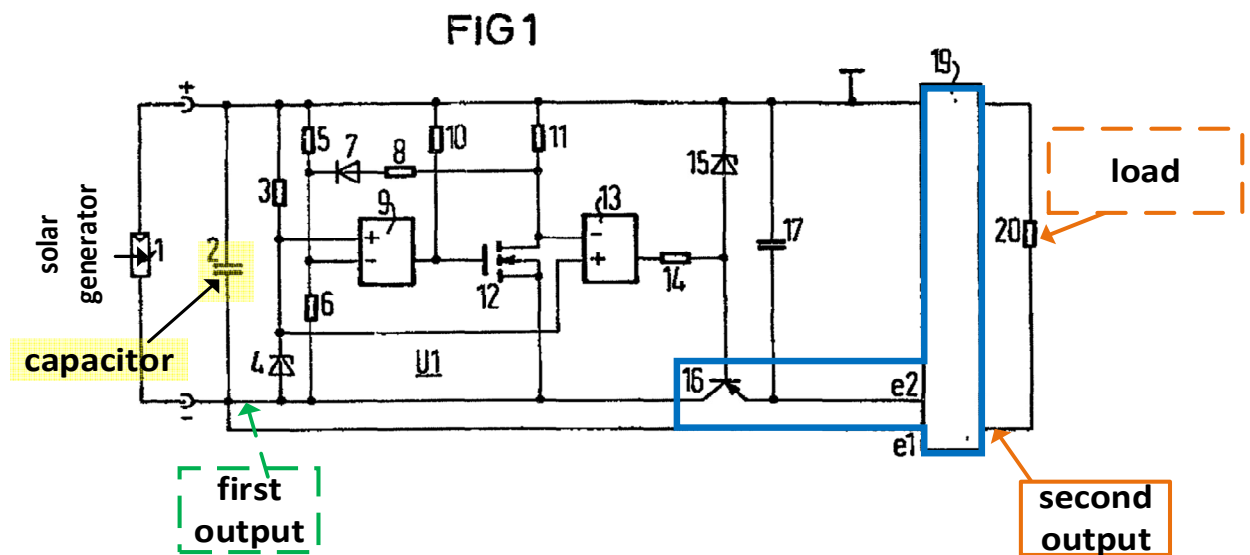
IV. OVERVIEW OF PRIOR ART

A. DE3725476 (Mieth)(Ex.1002)

Mieth discloses a circuit and method that supplies power to an electrical load such as a micro-controller 20 from a solar generator 1. Ex.1002,8:8-9. For energy sources that vary in performance, such as a solar converter (due to time of day/weather conditions), the circuit operates in two different states, depending on the power provided by the energy source at the solar generator 1. Ex.1002,1:23-28; 5:22-27. In a first state, at lower source voltages, a preliminary load 11 is switched “in” to the circuit, while a downstream auxiliary power supply circuit (*e.g.*, power supply apparatus 19) is disabled. In a second state, at higher source voltages, the preliminary load 11 is switched “out” of the circuit, and the power

from the solar generator 1 is connected to the auxiliary power supply circuit . *Id.* 1:28-34; claim 1, 2:10-34.

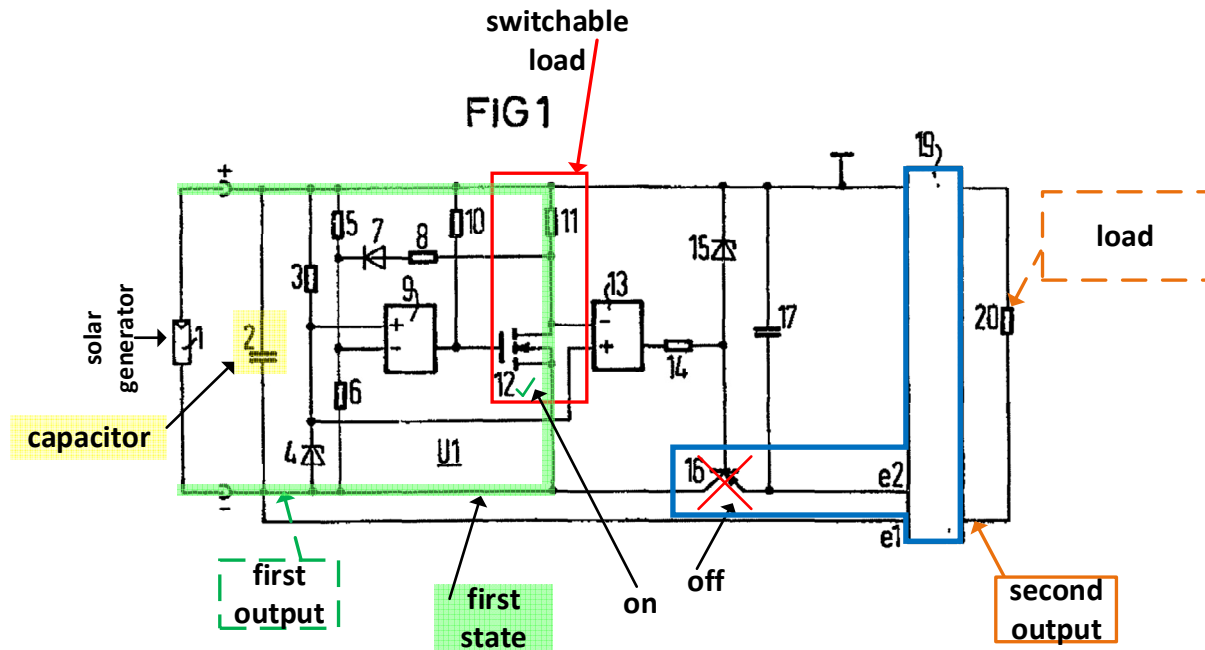
Fig.1(annotated A) shows the solar generator 1 as an input source that provides a direct current to a first stage capacitor 2 that provides a first voltage at a first output in response to the direct current input.



Ex.1002, Fig.1(annotated A)

The circuit includes a first comparator 9, and a second comparator 13 that operate to generate the first and second states. In the first state, at low voltages at the first output, the first comparator 9 “trips” and switches “in” the preliminary load 11, while the second comparator 13 is not tripped, resulting in the auxiliary power supply 19 being disabled. *Id.* 1:23-34;6:14-23;9:15-32, Ex.1007, ¶¶75-76.

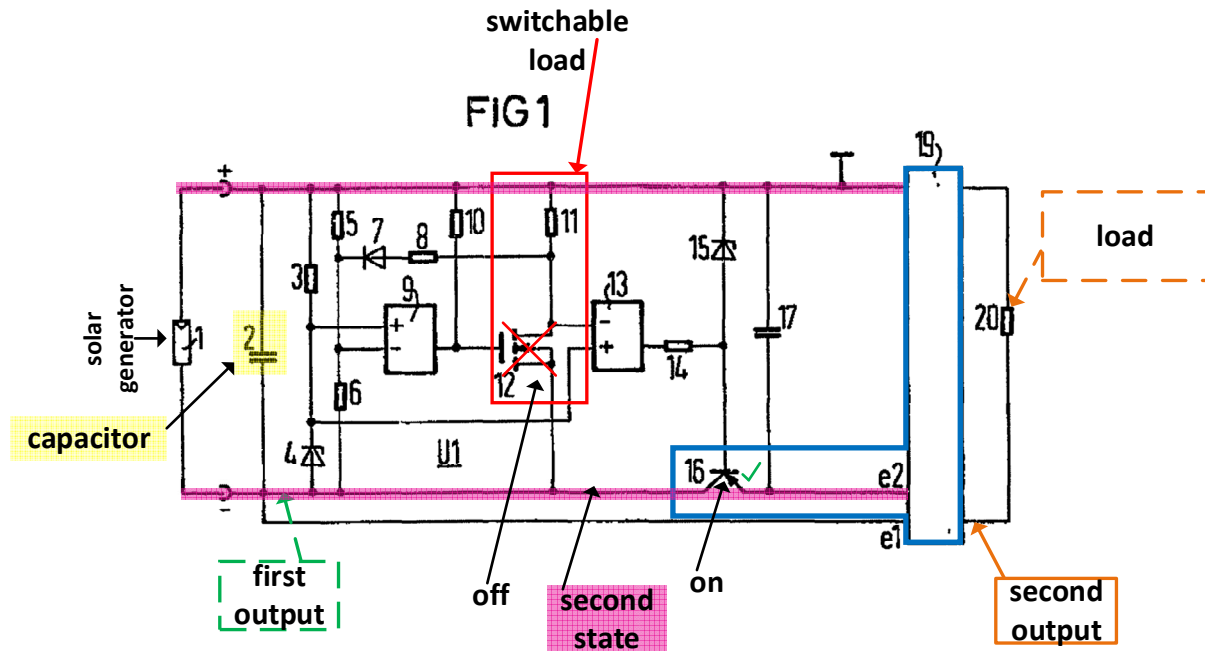
Fig.1(annotated B) highlights the first state at low input voltages; the first comparator 9 is “high” and the preliminary load 11 (*i.e.*, resistor 11) is switched “in” due to transistor 12 being “on.”



Ex.1002, Fig.1(annotated B)

Further, in the first state, the second comparator 13 output is “high”, causing pnp bipolar transistor 16 to be “off,” and power supply apparatus 19 to be disabled. *Id.* 12:21-30, Ex.1007, ¶¶78-79.

Fig.1(annotated C) illustrates the second state when the power provided by the solar generator 1 provides high first voltages at the first output. With higher input voltages, the representative voltage at the first comparator 9 exceeds a reference voltage, causing the first comparator 9 output to transition “low” and turn off transistor 12 (*i.e.*, “switching out” the switchable load/resistor 11).



Ex.1002, Fig.1(annotated C)

With transistor 12 off, the negative input of the second comparator 13 is pulled high, causing the second comparator 13 output to go “low”, thus turning on the pnp bipolar transistor 16. With transistor 16 conducting, the first output is passed to the e2 input of auxiliary power converter 19, enabling such circuitry, which provides the second output to load 20. *Id.*, Ex.1007, ¶¶78-79. Auxiliary power converter 19 is also connected to the solar generator 1 via an input e1.

Ex.1002,8:29-35. Mieth does not discuss the function of input e1, a person having ordinary skill in the art (PHOSITA) understands that input e1 may provide additional functionality to the circuit of Mieth that is extraneous to the detailed description. Ex.1007, ¶79.

Mieth discloses a “break before make” operation between the first and second states. An exit from the first state (when preliminary load 11 is “switched in”) is concluded before the second state (when auxiliary power converter 19 is enabled) is initiated. This “break before make” operability is facilitated by the cascaded first and second comparators 9 and 13. When the first voltage at the first output exceeds the reference voltage, the first comparator 9 output goes “low” to turn off transistor 12. Only after transistor 12 stops conducting does the second comparator 13 output transition from “high” to “low” to activate bipolar transistor 16. Ex.1007,¶80. Thus, a delay is built into the cascaded comparator arrangement to ensure that the first control signal that disables preliminary load 11 always occurs before the second control signal that enables power supply apparatus 19. Thus, Mieth teaches a delay between the first and second control signals. Ex.1007,¶80.

B. U.S. Patent No. 6,246,592 (Balogh)(Ex.1003)

Balogh is a United States patent that issued on June 12, 2001. Balogh discloses that cascaded power converter arrangements that include two or more power converters are well known. Ex.1003,1:21-22;Ex.1007,¶87. Balogh further discloses that cascaded converters are commonly used to provide large input to output voltage conversion ratios. *Id.*1:25-28. Solar power applications often employ high voltages where cascaded power converter systems having large input

to output voltage conversion ratios are advantageous. Ex.1007,¶¶87-88;
Ex.1010;Ex.1011.

Balogh discloses multiple cascaded buck converter arrangements in prior art Figs.1B-1D, respectively. One is illustrated in Fig.1D shown below.

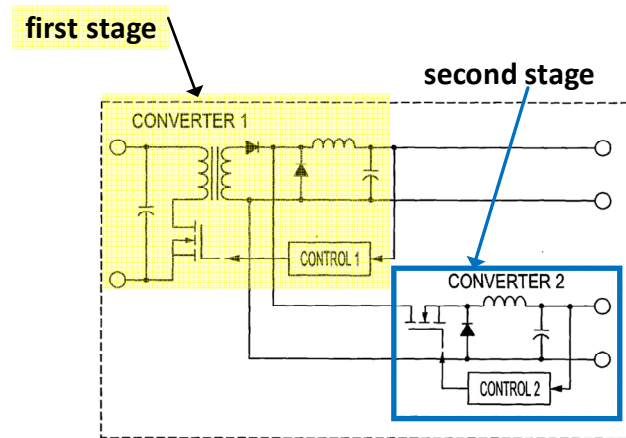


FIG. 1D
PRIOR ART

In Fig.1D, an isolated DC-DC converter (converter 1) feeds a post regulator circuit (converter 2) to form first and second step-down converter stages, respectively.

The first converter is a transformer-coupled input power converter that steps down the input voltage to an intermediate voltage. Ex.1003,1:61-66,3:8-13. The second converter is a buck power converter. Ex.1003,1:62-63.

C. U.S. Patent No. 6,798,177 (Liu)(Ex.1005)

Liu is a United States patent that issued on September 28, 2004.

Liu discloses a multi-stage converter circuit that employs a storage capacitor in-between, and in parallel with, two cascaded converter stages. The multi-stage

converter circuit includes an input stage 50, a storage or reservoir capacitor 58, and an output stage 60 that connects to a power amplifier (“PA”) 68 as a load.

Ex.1005, Fig. 5, 4:25-28; Ex.1007, ¶¶91.

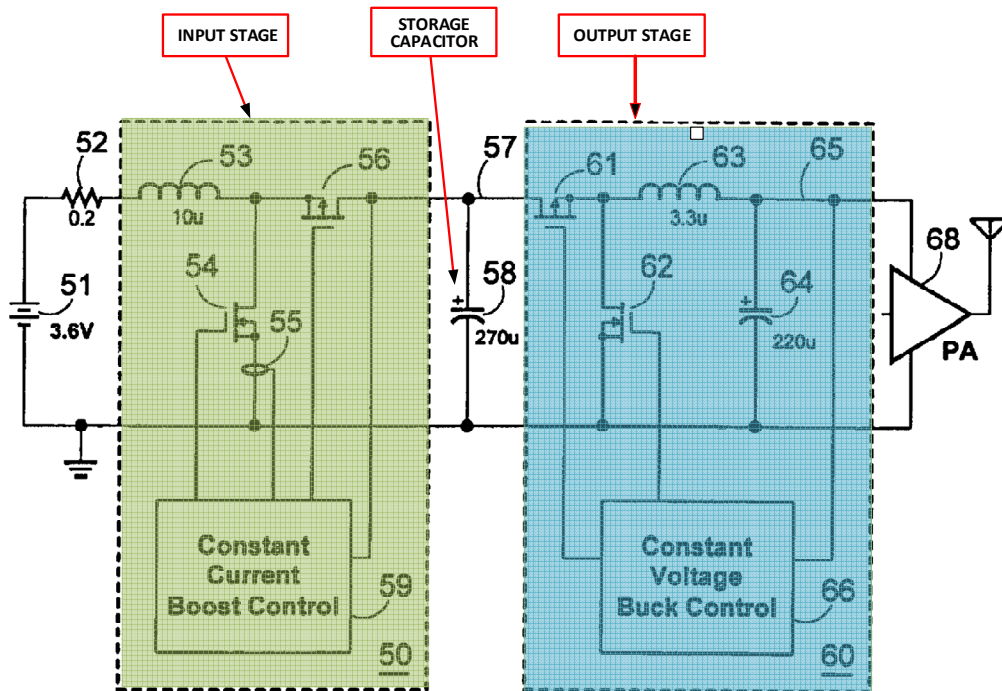


FIG. 5

The input stage 50 charges the storage capacitor 58 and increases the voltage across the capacitor. The output stage 60 down-converts the voltage on reservoir capacitor 58 to an output voltage, for example, 3.4V, needed by the PA 68, which the output stage 60 regulates. The storage/reservoir capacitor 58 supplies energy to PA 68, such that if input stage 50 ceases operating, the output stage continues powering PA 68 for some further time period. *Id.*, 4:36-50; Ex.1007, ¶¶91-92.

V. SUMMARY OF ARGUMENT

The '405 patent claims an apparatus and method for supplying power. The prior art herein is replete with auxiliary power supply circuitry that teaches the features of the apparatus and the steps of the method. Mieth teaches all the elements of the '405 patent's independent claims and most dependent claims. For independent and dependent claim elements arguably not taught by Mieth, Balogh teaches first stage power converter features and cascaded first and second stage power converters such as step-down power converters, and Liu discloses a capacitor as an auxiliary power supply between cascaded power converters. Adding these features to Mieth's auxiliary power supply system would have been obvious, and yields the alleged invention claimed in the '405 patent.

In sum, as demonstrated by a preponderance of the evidence herein, including the Declaration of Dr. Doug Holberg (Ex.1007), the '405 patent claims are unpatentable as being anticipated and/or obvious in view of the cited prior art.

VI. IDENTIFICATION OF CHALLENGE PURSUANT TO 37 C.F.R.

§ 42.104(B) AND STATEMENT OF THE RELIEF REQUESTED

A. Claims for Which Review is Requested and Grounds on Which Challenge is Based

Petitioner requests review on the following grounds under 35 U.S.C. §§ 102 and 103.

Ground	Prior Art	Claims Challenged
A	Mieth	1-2, 4-9 and 11-13
B	Mieth in view Balogh	1-2, 4-9 and 11-13
C	Mieth in view of Liu, or Mieth-Balogh in view of Liu	3, 10

B. How Claims Are to Be Construed and Level of Skill

1. How Claims Are to Be Construed

A claim subject to *inter partes* review shall be given its ordinary and customary meaning to a PHOSITA, consistent with the prosecution history, as it would be given in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b). All claim terms should be construed according to their ordinary and customary meaning at the time of invention to a PHOSITA. *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). Ex.1007,¶34.

No prosecution history exists that addresses the construction of the claim language at issue. Ex.1006.

Therefore, based on the ordinary and customary meaning of the terms, common usage in the art, and a consistent usage of the terms in the detailed description of the '405 patent, the terms “first stage power converter” and “second stage power converter,” as they are not defined in the detailed description, mean “one or more circuit components” that operate alone or together to provide the specified function set forth in the claim.

2. Level of Skill

A PHOSITA 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. Ex.1007,¶¶30-31.

VII. SPECIFIC GROUNDS FOR UNPATENTABILITY

A. Ground A: Anticipation of claims 1-2, 4-9 and 11-13 over Mieth

1. Independent Claim 1

With reference to the claim listing appendix, Mieth discloses elements [1A]-[1H], as set forth below.

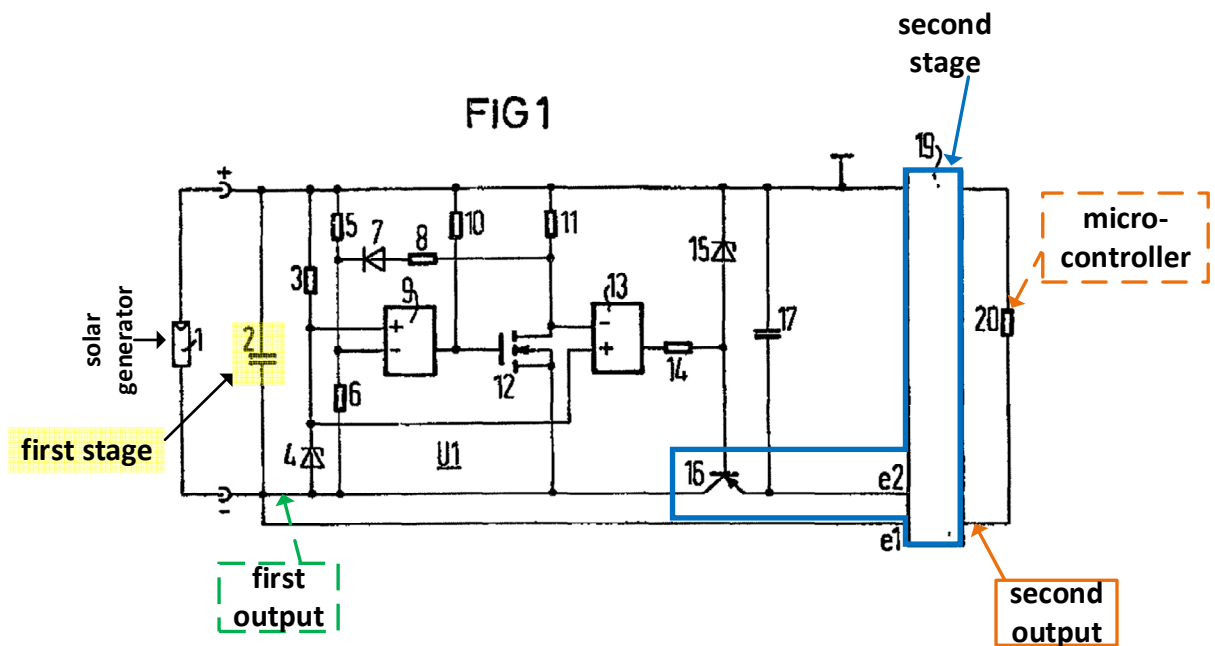
i. [1A]: “An apparatus, comprising:”

Mieth (Ex.1002) discloses a circuit that supplies power to an electrical load from a solar generator. Ex.1002 (Mieth),8:8-9. A PHOSITA understands that a

“circuit” is a species of the genus term “apparatus.” Ex.1007,¶96. Thus, Mieth teaches [1A].

ii. [1B]: “a micro-controller;”

Mieth discloses a circuit as shown below in Fig.1(annotated-1B). Mieth discloses a capacitor 2 (yellow) in parallel with a solar generator 1, and a power supply apparatus 19 connected to a bipolar transistor 16 (blue). Ex.1002,9:5-9,11:14-16;Ex.1007,¶97. The capacitor 2 receives direct current from the solar generator 1, and provides a first output.



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

The power supply apparatus 19 of Mieth is a DC-DC voltage converter or a charging converter and outputs a voltage and current to power a load 20, as shown in Fig.1(annotated-1B). Ex.1007,¶98. A PHOSITA understands that the load 20 is

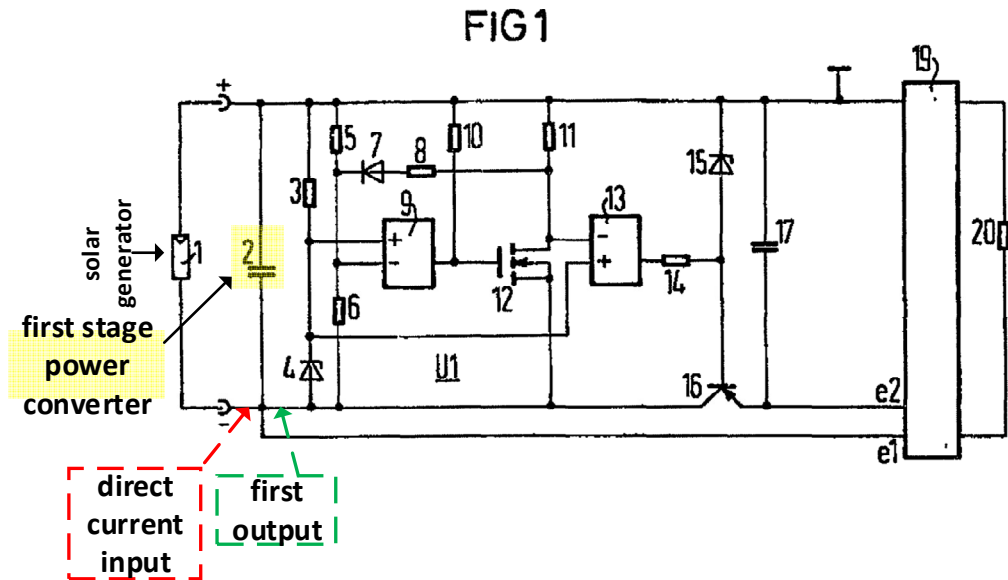
a generic term, and can be or include a micro-controller.

Ex.1007,¶98;Ex.1014,1180,Fig.5. As such, the load 20 is analogous to the claimed *micro-controller* (dashed-orange).

Thus, Mieth teaches [1B]. Ex.1007,¶99.

iii. [1C]: “a first stage power converter to generate a first output from a direct current input;”

A PHOSITA understands that absent an explicit definition of the term in the detailed description (wherein none is provided in the ‘405 patent), a first stage power converter is one or more circuit elements that perform the recited function set forth in the claim. Ex.1007,¶100. As such, the solar generator 1 of Mieth supplies a *direct current input* (dashed-red) to the capacitor 2, and the supplied current charges the capacitor, resulting in a voltage, i.e., a first output, to form across the capacitor at its output. As specified in the claim feature at issue, the first stage power converter merely generates a first output from a direct current input. The capacitor 2 performs that recited function, and thus constitutes a first stage power converter, as shown in Fig. 1 (annotated-1C.1) below. The first stage power converter of Mieth is a parallel capacitor 2 which converts the direct current input into a *first output* (dashed-green) as shown. Ex.1007,¶100.

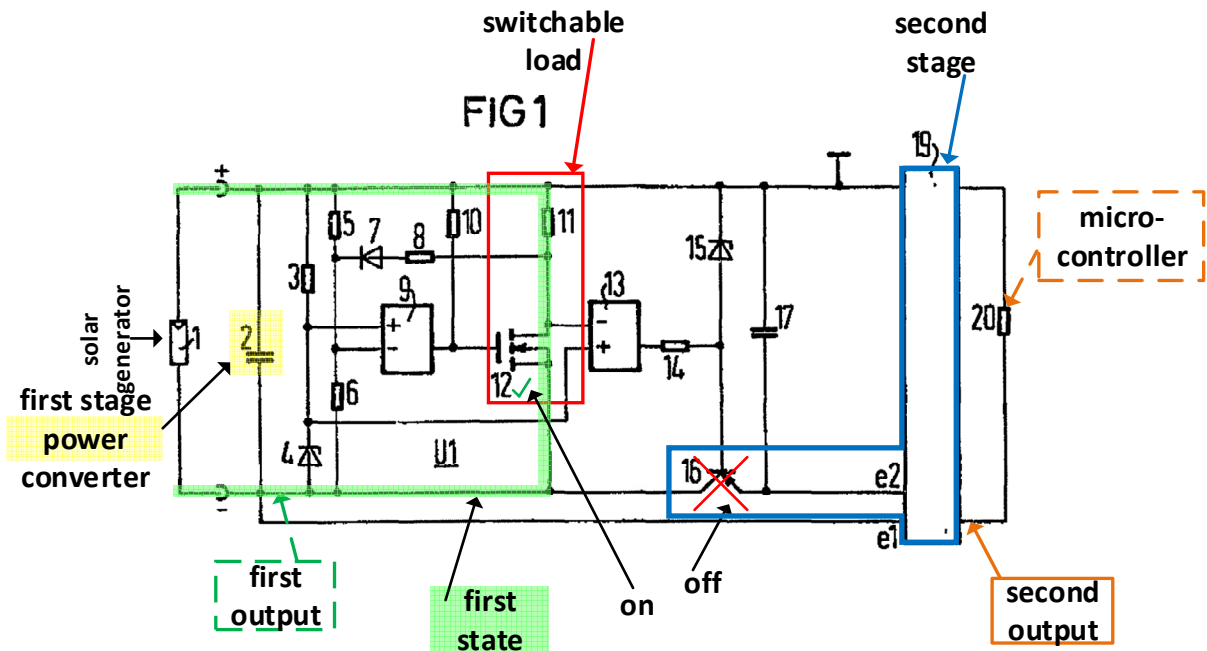


Ex.1002, Fig.1 (annotated-1C.1)

Thus, Mieth discloses [1C].

iv. [1D]: “a switchable load powered by the first output;”

Mieth discloses that the first output (dashed-green) of capacitor 2 is connected to a series connection of a field-effect transistor 12 and a preliminary load 11 as shown in Fig.1(annotated-1D). Ex.1002,10:5-14;Ex.1007,¶102.



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

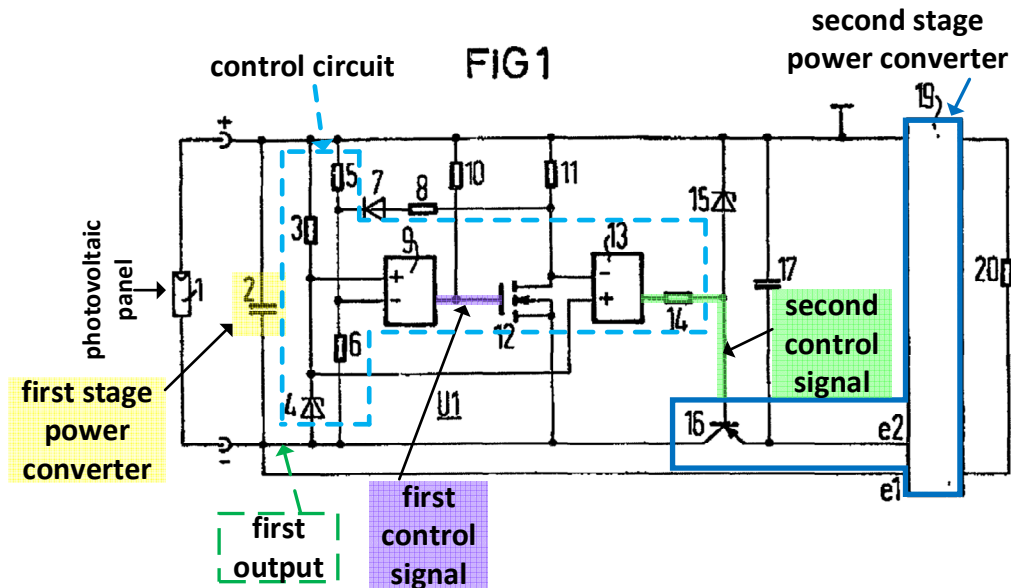
The field-effect transistor 12, which operates as a switch, and the preliminary load 11 in combination are analogous to the claimed *switchable load* (red).

Ex.1007,¶103. Mieth discloses that when voltages at the first output are below a predefined minimum value (in magnitude) for reliable operation of the power supply apparatus 19, the field-effect transistor 12 is “on”, and operates as a closed switch where the preliminary/switchable load 11 is connected to the solar generator 1 by the first output. Ex.1002,9:15-23;Ex.1007,¶103. As shown in Fig.1(annotated-1D), a first state (highlighted-green) illustrates that the switchable load is powered by the first output from the capacitor 2 (i.e., field-effect transistor 12 is “on” or in a conducting state). Ex.1007,¶103. As such, Mieth is analogous to *a switchable load powered by the first output*. Ex.1007,¶103.

Thus, Mieth teaches [1D].

v. [1E]: “a control circuit powered by the first output; and”

Mieth discloses a first comparator 9 that turns the transistor 12 “on” or “off” as shown in Fig.1(annotated-[1E]). Ex.1002,9:34-10-14;Ex.1007,¶105.



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

First comparator 9 compares a reference voltage from a reference voltage generator to a representative voltage from a voltage divider. Ex.1002,9:34-10:3;Ex.1007,¶106. The reference voltage generator is defined by the Zener diode 4 and the resistor 3. *Id.* The voltage divider is defined by the resistors 5 and 6 and the representative voltage is representative (e.g., a scaled-down version) of the first output (dashed-green) of capacitor 2 (first stage power converter-yellow). *Id.* First comparator 9 compares the representative voltage to the reference voltage to determine if the representative voltage exceeds a threshold (in magnitude) defined

by the reference voltage, and outputs a first control signal (highlighted-purple) to transistor 12 based on the comparison. Ex.1002,12:12-26,Ex.1007,¶106.

A PHOSITA understands that at least the circuitry (dashed-blue) that controls transistor 12, which includes first comparator 9, voltage divider 5, 6 and reference voltage generator 3, 4 constitutes a control circuit. Further, as illustrated, such circuitry are powered by the first output from the capacitor 2, and therefore the circuitry is analogous to the claimed **a control circuit powered by the first output**. Ex.1002,9:34-10:3,Ex.1007,¶107.

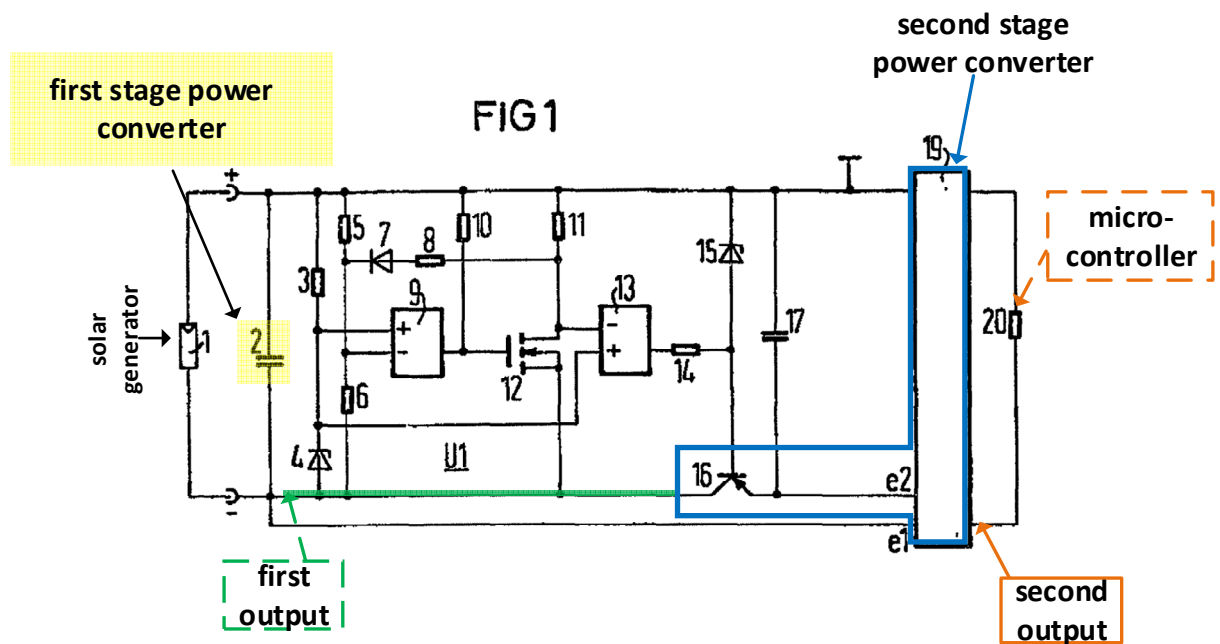
Thus, Mieth teaches [1E].

- vi. [1F]: “a second stage power converter connected to the first stage power converter and configured to convert the first output to a second output;”

In Mieth, a power supply apparatus 19 connected to a bipolar transistor 16 (second stage-blue) together constitutes a **second stage power converter connected (green)** to capacitor 2 that forms the first output (dashed-green), as illustrated below in Fig.1(annotated-1F). As stated above in §VII A,1,iii,element [1C], the capacitor 2 is a first stage power converter. The first stage power converter is connected to the second stage power converter (teal), as shown in Fig. 1(annotated-1F). Ex.1007, 109.

Still referring to the figure below, the power supply apparatus 19 **is powered** by way of auxiliary voltage input e2 which is coupled to the first output when the

bipolar transistor 16 is conducting. Ex.1002,8:29-35;Ex.1007,¶110. According to Mieth, 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.* Thus the power supply apparatus 19 is a power converter, and as a power converter, power supply apparatus 19 receives the first output and ***converts the first output to a second output*** (orange) as shown in Fig.1(annotated-1F). Ex.1007,¶110. As shown, the second output is provided by the second stage power converter 16/19 to the load 20, and a PHOSITA understands that a load in a circuit can be or include a micro-controller (dashed-orange). Ex.1007,¶110;Ex.1014,1180,Fig.5.



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

Therefore the bipolar transistor 16/power supply apparatus 19 combination is analogous to ***a second stage power converter connected to the first stage power***

converter and configured to convert the first output to a second output.

Ex.1007,¶111.

Thus, Mieth teaches [1F].

- vii. **[1G]: “wherein the control circuit is configured to block the second stage power converter from powering the micro-controller using the second output in a time period that is after the control circuit is powered by the first output and before a predefined condition is met in the control circuit; and”**

According to element [1G], the control circuit functions to block the second stage power converter from powering the micro-controller using the second output in a time period. Further, element [1G] requires the time period in which such control occurs to be bounded by two constraints: (1) after the control circuit is powered by the first output, and (2) before a predefined condition is met in the control circuit. As will be appreciated below, Mieth discloses such a control circuit.

As discussed briefly in §IV.A and §VII.A.1.v, the control circuit of Mieth is configured to place the power supply circuitry into two different states: (1) a first state associated with “low” first output voltages, where the switchable load is connected and the second output is not powered, and (2) a second state associated with “high” first output voltages, where the switchable load is disconnected, and power from the first output connects to the second power converter which, in

generator 3, 4 (**highlighted-teal-outlined-red**) connected to a positive terminal of the first comparator 9 to a representative voltage from the voltage divider 5, 6 (**highlighted-teal-outlined-green**) connected to a negative terminal of the first comparator 9. Ex.1002,9:34-10:3;Ex.1007,¶116. The first comparator 9 compares the representative voltage provided by the voltage divider 5, 6 to the reference voltage to determine if the representative voltage exceeds a threshold defined by the reference voltage. Ex.1002,12:12-26,Ex.1007,¶____.

In the first state, the representative voltage is less than the reference voltage in magnitude (i.e., a “low” voltage condition at the first output), and the control circuit of Mieth powers the preliminary load 11 and field-effect transistor 12 by the first output. Ex.1002,12:12-19;Ex.1007,¶116. The first state of Mieth concurrently disables the second output of the power supply apparatus 19 to the load 20 (i.e., the micro-controller) by turning the bipolar transistor 16 “off,” which is the same as the claimed ***the control circuit is configured to block the second stage power amplifier from powering the micro-controller using the second output.*** *Id.* More particularly, when transistor 12 is conducting and powering the switchable load 11 in the first state, the input node to the second comparator 13 is pulled low, below that of the reference voltage supplied to the other input of the second comparator 13, causing the second comparator output to go “high,” which ensures that the pnp bipolar transistor 16 is turned “off,” as shown. Ex.1007,¶117.

With transistor 16 “off,” the second stage power converter 19 is blocked from powering the micro-controller 20.

The time period the circuit of Mieth is in the first state is the same as the claimed *time period* and the predefined minimum value of Mieth is the same as the claimed *predefined condition*. Ex.1002,9:15-26;Ex.1007,¶118. The circuit of Mieth is in the first state for the time period after the control circuit is being powered by the first output (*i.e.*, the first output is providing power to the first comparator 9 and the second comparator 13, as well as the voltage monitoring circuit 5, 6, and the reference voltage generator circuit 3, 4). The time period in question is also before the predefined condition is met, because once the representative voltage representative of the first output exceeds the predefined minimum value in magnitude, the output of the first comparator 9 goes low, causing the field-effect transistor 12 is shut “off,” which discontinues the first state. Thus, the *control circuit blocks the second stage power converter 19 from powering the micro-controller using the second output in a time period after the control circuit is powered by the first output and before the predefined condition is met*. Ex.1007,¶118.

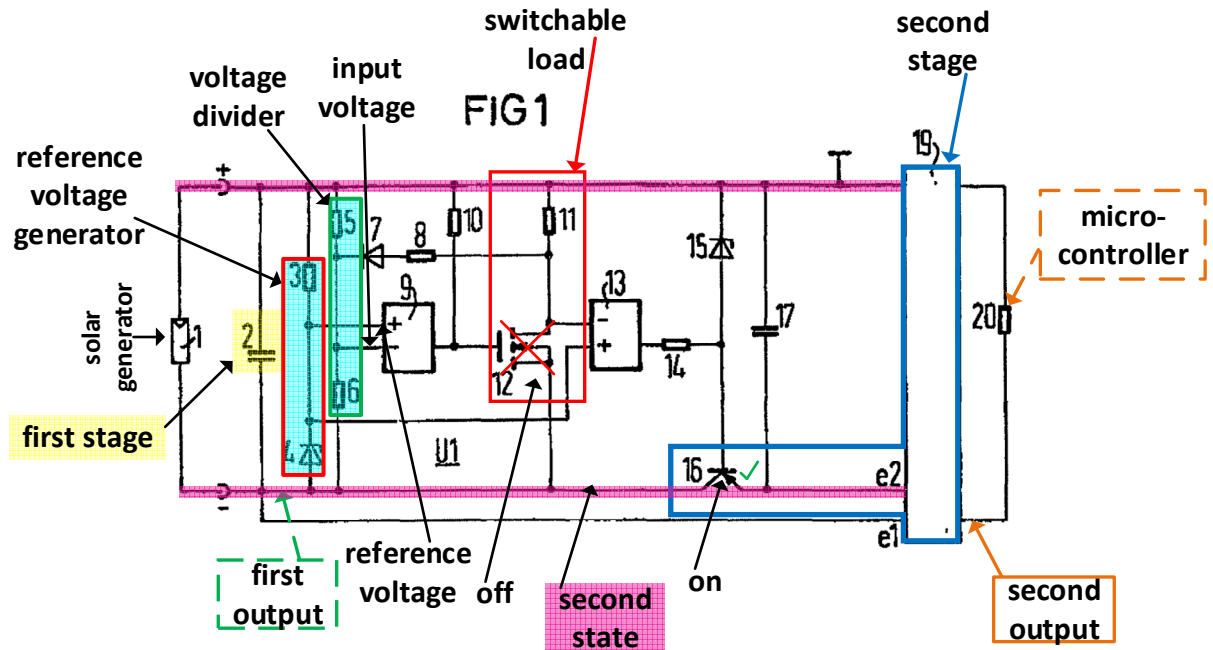
Thus, Mieth teaches [1G].

- viii. [1H]: “wherein the control circuit is configured to signal the switchable load to be in a first state of consuming the first output during the time period and to be in a second state of not consuming the first output after the time period.”

As discussed above in accordance with §IV.A, §VII.A.1.vi., element [1F] and §VII.A.1.vii.. element [1G], in the first state associated with relatively low voltages at the first output, the preliminary load 11 and the field-effect transistor 12 (i.e., switchable load-**red**) are powered by the first output of capacitor 2 (i.e., first stage power converter-**highlighted-yellow**), *resulting in current conducting through the preliminary/switchable load 11 and thus consuming the first output.* (See §IV.A, Fig.1(annotated C and Fig.1(annotated-1G)). Thus, in the first state, the control circuit is analogous to the first portion of claim feature [1H] *wherein the control circuit is configured to signal the switchable load to be in a first state of consuming the first output during the time period.* (Ex.1001, claim 1).

Mieth further discloses that when voltages from the solar generator 1 (as represented at the negative terminal of first comparator 9) are above a predefined minimum value (as represented at the positive terminal of first comparator 9)(i.e., relatively “high” first output voltages), the control circuit transitions the circuit to the second state, wherein in the second state the auxiliary voltage input e2 of the power supply apparatus 19 is connected to the first output of the solar generator 1. Ex.1002,9:23-26. As shown in Fig.1(annotated-1H) below, when the predefined minimum value is satisfied, the circuit of Mieth operates in the second state

(highlighted-pink) where the bipolar transistor 16 is “on” or conducting, causing the first output (dashed-green) of capacitor 2 to be connected to e2, thereby powering the power supply apparatus 19. Ex.1002,10:16-29;Ex.1007,¶¶120-121.



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

Furthermore, in the second state, the field-effect transistor 12 is “off” or non-conducting, thereby “disconnecting” the preliminary load 11 from the first output. *Id.* As discussed in §VII.A.1.vii., the first comparator 9 compares a reference voltage from a reference voltage generator (highlighted-teal-outlined-red) to the representative voltage from the voltage divider (highlighted-teal-outlined-green) to determine if the representative voltage exceeds the threshold defined by the reference voltage. Ex.1002,12:12-26,Ex.1007,¶122. While in the first state, when the first output of capacitor 2 rises in magnitude and the

representative voltage across voltage divider 5, 6 rises above the threshold (i.e., “predefined minimum value” as quoted by Mieth), the “time period” of the first state ends, and the control circuit disconnects the preliminary load 11 from the first output by configuring the field-effect transistor 12 to an “off” state, which results in the preliminary load 11 (i.e., the switchable load) not consuming the first output in the second state. Thus, the control circuit of Mieth teaches the second portion of claim element [1H] *and to be in a second state of not consuming the first output after the time period.* *Id.* Ex.1001, claim 1;Ex.1007,¶¶122-123.

Thus, Mieth discloses element [1H].

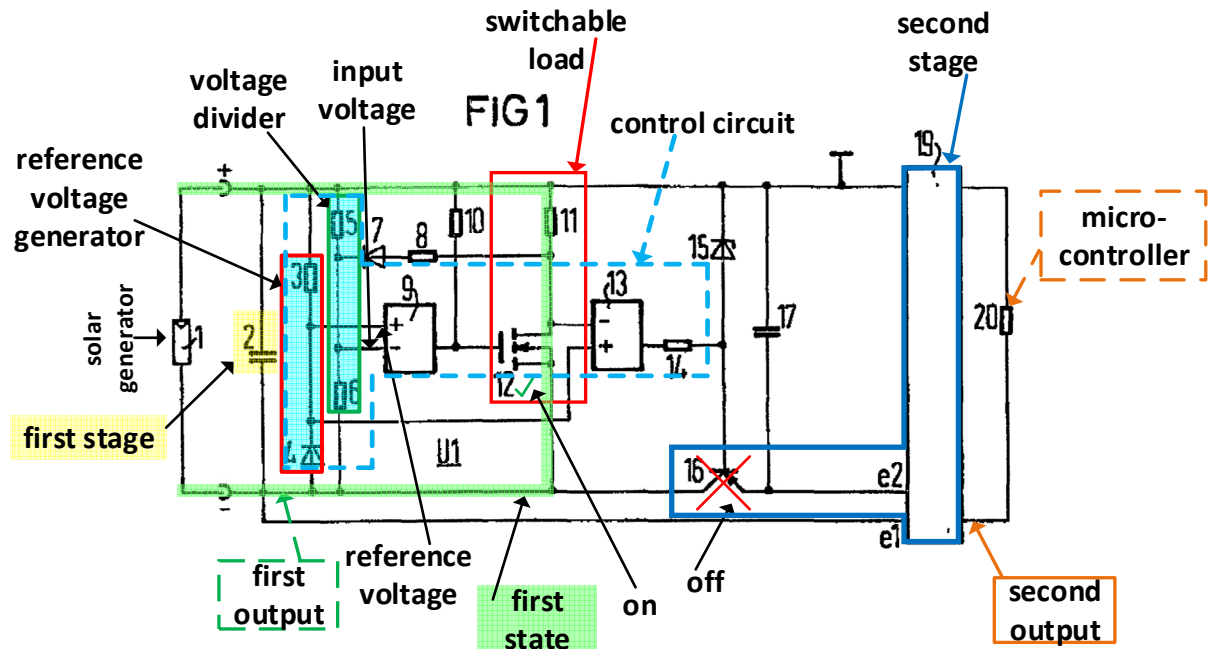
As Mieth discloses each and every element [1A]-[1H], Mieth anticipates claim 1. Ex.1007,¶124.

2. Dependent Claim 2

Claim 1 is disclosed by Mieth. *Supra*, §VII.A.1. Claim 2 depends from claim 1 and requires, “wherein the predefined condition includes a voltage of the first output reaching a threshold.” Ex.1001, claim 2.

As discussed in detail in §VII.A.1.vii, and as shown below in Fig.1(annotated-Claim-2), Mieth discloses that the predefined condition that is monitored to determine an end of the first state, and an initiation of the second state is a value of the first output and its corresponding representative voltage reaching a threshold.

For the first state, bipolar transistor 16 is non-conducting, and the power supply apparatus 19 (i.e., second stage-blue) is disabled, or “blocked” from supplying the load 20 (i.e., micro-controller-dashed-orange) with the second output (orange), see Fig.1(annotated-Claim-2).



Ex.1002, Fig.1(annotated-Claim-2)

While in the first state, transistor 12 is turned “on” by the first comparator 9, thereby loading the first output with the preliminary load 11 (controlled through the field-effect transistor 12 when conducting, *i.e.*, the first state – analogous to the switchable load-red). Ex.1002, 9:15-32,10:5-14;Ex.1007,¶¶127-128. In the first state, the first comparator 9 compares the reference voltage (which operates as a *threshold*) from the reference voltage generator (highlighted-teal-outlined-red) connected to a positive terminal of the first comparator 9 to the representative

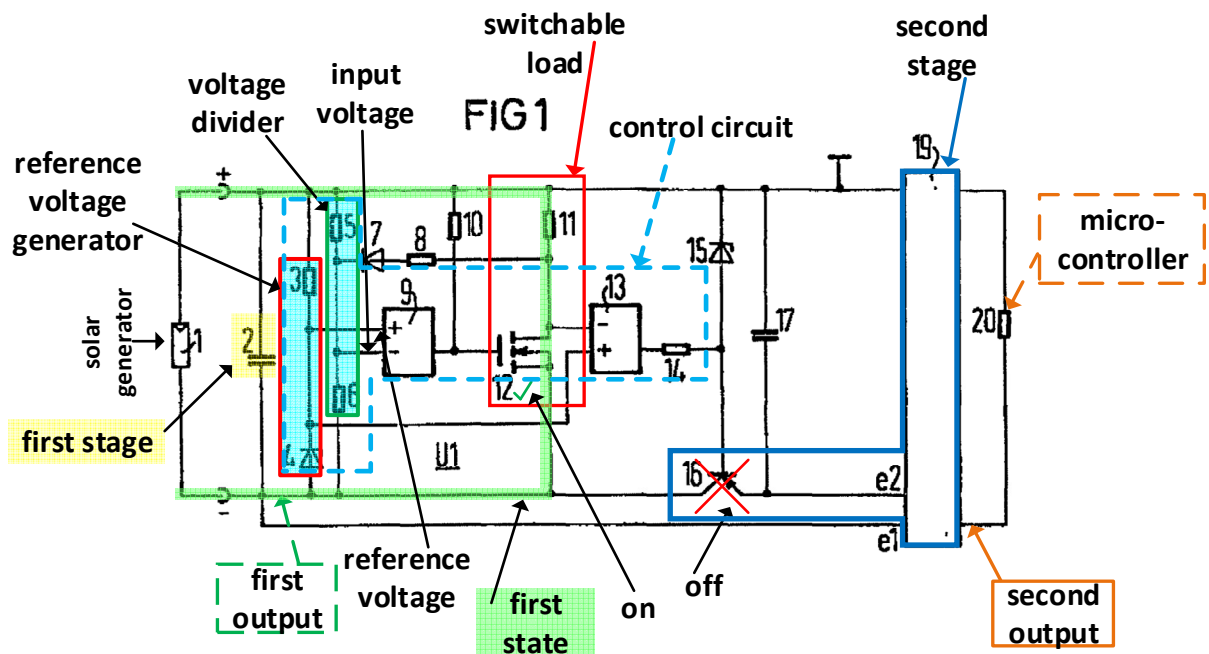
voltage from the voltage divider (highlighted-teal-outlined-green) connected to a negative terminal of the first comparator 9. Ex.1002,9:34-10:3;Ex.1007,¶128. The first comparator 9 compares the representative voltage provided by the voltage divider 5, 6 to the reference voltage ***threshold*** to determine if the representative voltage exceeds ***the threshold*** defined by the reference voltage. Ex.1002,12:12-26,Ex.1007,¶128.

In the first state, the representative voltage is less than the reference voltage in magnitude (i.e., a “low” voltage condition at the first output being below a threshold value), and the circuit of Mieth powers the preliminary load 11 and field-effect transistor 12 by the first output. Ex.1002,12:12-19;Ex.1007,¶129. Thus, the control circuit that involves the first comparator 9 operation with the voltage divider 5, 6 and the reference voltage generator 3, 4 operates to scale down the voltage of the first output via the voltage divider 5,6 and compares the scaled down, “representative” voltage to a scaled down reference value (i.e., scaled down threshold with respect to the first output), is analogous to the claim feature ***wherein the predefined condition includes a voltage of the first output reaching a threshold***. Ex.1007,¶129.

Thus, Mieth discloses claim 2.

3. Dependent Claim 4

Claim 1 is disclosed by Mieth. *Supra*, §VII.A.1. Claim 4 depends from claim 1 and requires [4A], “wherein the switchable load comprises: a resistive device.” Ex.1001, claim 4. As shown below in Fig.1(annotated-Claim-4.1) of Mieth, preliminary load 11 (highlighted-orange) can be a resistor. Ex.1002,12:14-20 (“preliminary load formed by the resistor 11”);Ex.1007,¶131. Since the preliminary load 11 can be a resistor, and a resistor is a resistive device, preliminary load 11 of Mieth is analogous to element [4A] ***the switchable load comprises: a resistive device.*** Ex.1007,¶131.



Ex.1002, Fig.1(annotated-Claim-4.1)

Claim 4 further requires [4B], *inter alia*, “a switching device connected to the resistive device.” Ex.1001, claim 4. As shown in Fig.1(annotated-Claim-4.1),

the field-effect transistor 12 (highlighted-teal) is connected to the preliminary load

11. *Supra*, §VII.A.1.v. Mieth describes the field-effect transistor 12 as a first electronic switch, and thus a PHOSITA would understand that the field-effect transistor 12 is a switching device. Ex.1002,10:5-14;Ex.1007,¶132. As such, the field-effect transistor 12 connected to resistor 11 is analogous to a first portion of element [4B], the *switching device connected to the resistive device*.

Ex.1007,¶132.

Feature [4B] further recites, “wherein the switching device is turned on in the first state to connect the resistive device to the first output and turned off in the second state to disconnect the resistive device from the first output.” As discussed above in §IV.A and §VII.A.1.v, the control circuit of Mieth is configured to operate in two different states: (1) a first state associated with “low” first output voltages, where the switchable load is connected to and consumes the first output, and the second output is not powered, and (2) a second state associated with “high” first output voltages, where the switchable load is disconnected, and power from the first output connects to the second power converter which, in response, powers the micro-controller via the second output. Ex.1007,¶133.

As stated above in VII.A.1.vii, element[1G], in the first state, for “low” first output voltages, transistor 12 is turned “on” by the first comparator 9 and loads the first output with the preliminary load 11 (analogous to the switchable load-red).

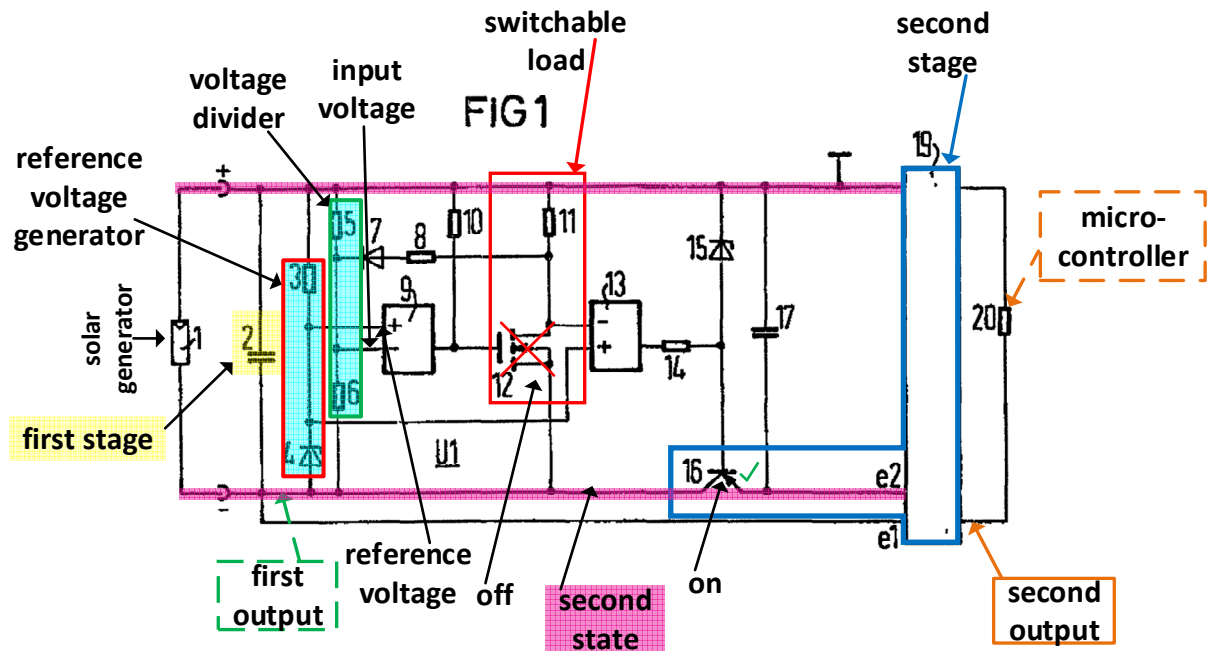
Ex.1002, 9:15-32,10:5-14. In the first state, the first comparator 9 compares the reference voltage at the positive terminal of the first comparator 9 to the representative voltage at the negative terminal of the first comparator 9.

Ex.1002,9:34-10:3;Ex.1007,¶134.

In the first state, the representative voltage is less than the reference voltage in magnitude (i.e., a “low” voltage condition at the first output), and the first comparator 9 turns on the transistor 12 and powers the preliminary load 11 and field-effect transistor 12 by the first output. Ex.1002,12:12-19;Ex.1007,¶135.

Thus, the control circuit and transistor 12 are analogous to the claim recitation *wherein the switching device is turned on in the first state to connect the resistive device to the first output*, which is a further portion of feature [4B }.

Mieth further discloses that when voltages from the solar generator 1 (as represented at the negative terminal of first comparator 9) are above a predefined minimum value (i.e., relatively “high” first output voltages), the control circuit transitions the circuit to the second state, wherein the auxiliary voltage input e2 of the power supply apparatus 19 is connected to the first output of the solar generator 1. Ex.1002,9:23-26. As shown in Fig.1(annotated-Claim-4.2) below, when the predefined minimum value is exceeded, the circuit of Mieth operates in the second state (highlighted-pink) where the the first output (dashed-green) is connected to e2 to power the power supply apparatus 19. Ex.1002,10:16-29;Ex.1007,¶136.



Ex.1002, Fig.1(annotated-Claim-4.2)

Furthermore, in the second state, the field-effect transistor 12 is “off” or non-conducting, thereby disconnecting the preliminary load 11 from the first output. *Id.* As discussed in §VII.A.1.vii., the first comparator 9 compares the reference voltage to the representative voltage to determine if the representative voltage exceeds a threshold defined by the reference voltage. Ex.1002,12:12-26,Ex.1007,¶137. While in the first state, when the first output rises in magnitude and the representative voltage exceeds the threshold (i.e., “predefined minimum value” as quoted by Mieth), the “time period” of the first state ends, and the control circuit disconnects the preliminary load 11 from the first output by configuring the field-effect transistor 12 to an “off” state, which results in the preliminary load 11 (i.e., the switchable load) not consuming the first output in the second state. Thus,

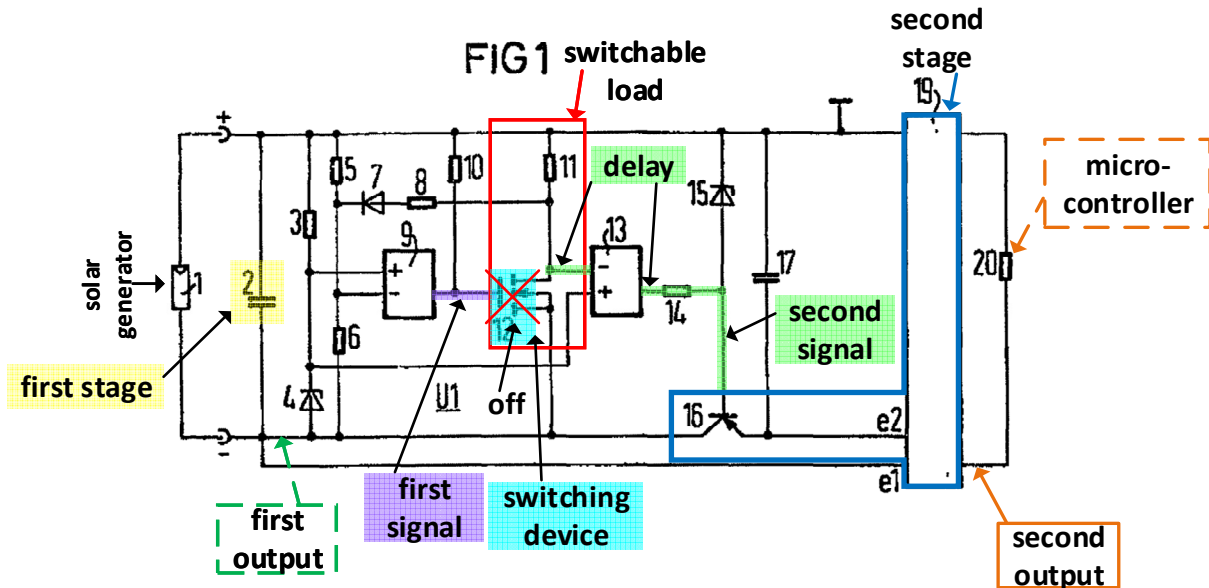
the control circuit of Mieth teaches the remaining claim feature of element [4B] *wherein the switching device is... turned off in the second state to disconnect the resistive device from the first output. Id. Ex.1007,¶137.*

Thus, Mieth discloses claim 4.

4. Dependent Claim 5

Claim 1 is disclosed by Mieth. *Supra*,§VII.A.1. Claim 5 depends from claim 1 and requires “wherein the control circuit delays a first signal instructing the switching device to change from the first state to the second state to generate a second delayed signal that instructs the second stage power converter to change from not powering the micro-controller to powering the micro-controller.”

In the first state, the output of the first comparator 9 (e.g., the claimed first signal, **highlighted-purple**), which controls the field-effect transistor 12 (switching device, **highlighted-teal**), is “high,” turning transistor 12 “on.” Ex.1002,12:21-30;Ex.1007,¶140;Ex.1002,Fig.1(annotated-Claim-4,1).



Ex.1002, Fig.1(annotated-Claim-5)

When the first output reaches a high voltage, the output of the first comparator 9 turns the transistor 12 “off” (i.e., when the output voltage at the first output reaches the desired level, the representative voltage at the comparator input exceeds the predefined minimum value). Ex.1002,10:16-29,12:21-30;Ex.1007,¶141. The circuit of Mieth that generates *the first signal* (i.e., the output of the first comparator 9 that feeds the gate of the transistor 12) is *analogous to the first portion of claim 5*.

Mieth discloses delaying the first signal from the first comparator 9 to generate a second signal at the output of the second comparator 13 to enable the second stage power converter to power the load 20. Ex.1007,¶142. Mieth discloses that the field-effect transistor 12 and the second comparator 13 *delays the first signal from the first comparator 9 to generate a second signal* (highlighted-green)

that turns on the bipolar transistor 16. More particularly, the second comparator 13 outputs the second signal based on an output from the field-effect transistor 12, where the output from the field-effect transistor 12 (i.e., the drain terminal thereof) is itself based on the first signal. *Id.* As such, the state of the second signal is dictated by the state of the first signal, and ***the transition of the second signal to activate bipolar transistor 16 is delayed with respect to the transition of the first signal by the propagation delays of the transistor 12 and the second comparator 13*** which is analogous to the claimed ***delaying the first signal***. Ex.1007,¶142. The second comparator 13 generates the second signal based on the first signal which is analogous to the claimed ***to generate a second signal***, and the second signal controls the bipolar transistor 16 which operates as a switch to selectively pass the first output to the second stage power converter 19 at the e2 terminal.

Ex.1002, Fig.1(annotated-Claim-5). Upon the second stage power converter 19 being powered by the first output via bipolar transistor 16 at e2, the second stage power converter 19 provides the second output that powers the load 20, which is the micro-controller. This circuit functionality is analogous to the last part of claim 5, wherein the ***control circuit is configured to generate the second delayed signal that instructs the second stage power converter to change from not powering the micro-controller to powering the micro-controller***. Ex.1007,¶142.

Furthermore, while not required by the claim language nor described as necessary in the detailed description of the '405 Patent, if it is contended that the *delaying the first signal* should be defined by a specific delay circuitry rather than the intrinsic switching and delay characteristics of comparator 13 and switch 12, a PHOSITA would have known to interpose one or more buffer circuits or delay elements between the second comparator output and the base of bipolar transistor 16 to define a larger delay period. Further, or in the alternative, a PHOSITA would have known to add a capacitor (optionally with a series resistor) parallel to resistor 11 according to customary practices in the art at the time of filing.

Ex.1007,¶143;Ex.1015,3:53-63,Fig.3.

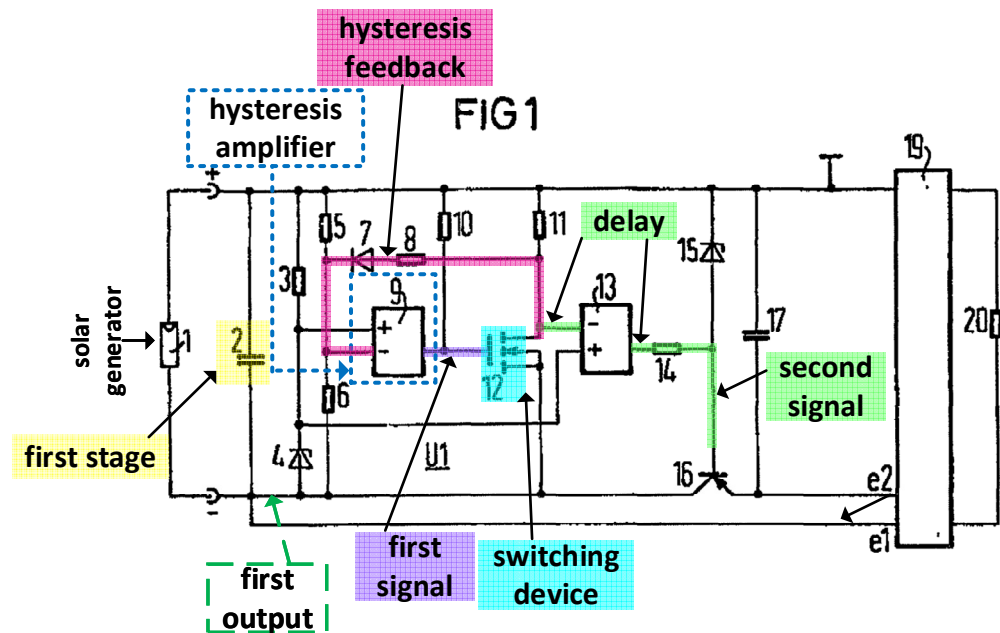
Thus, Mieth teaches all the features of claim 5.

5. Dependent Claim 6

Claim 6 depends upon claim 5, and feature [6A] recites hysteresis, namely, “wherein the control circuit comprises: a hysteresis amplifier coupled to the first output to generate the first signal....” A PHOSITA understands hysteresis is a positive feedback loop between the output of a device and an input of a device, such as an amplifier or comparator, to mitigate instability in switched signals.

Ex.1007,¶¶ 57-60, 81-86 and 145. A PHOSITA would further understand that an amplifier can be configured as a comparator, and thus the first comparator 9 can be an amplifier. Ex.1007,¶145.

As shown in Fig.1(annotated-[6A,B]) below, Mieth discloses a capacitor 2 (highlighted-yellow) that outputs a first output (dashed-green) analogous to the claimed first output, and the first comparator 9 (dashed-blue) that is analogous to the claimed hysteresis amplifier that outputs a first signal (highlighted-purple) analogous to the claimed first signal that teach [6A] as discussed further below.



Ex.1002, Fig.1(annotated-[6A,B])

The first comparator 9 is configured with hysteresis where the hysteresis feedback path (highlighted-pink) from the output of the switching device (field-effect transistor 12) is connected to the negative input node of the first comparator 9 through resistor 8 and diode 7. Ex.1002,9:34-38;Ex.1007,¶147. Furthermore, Mieth recites that “[h]ysteresis is achieved by means of the resistor 8.” Ex.1002,12:26-27. Specifically, when the switch 12 is off, the series circuit

comprising resistors, 8, 11 and diode 7 are in parallel with resistor 5 forming a voltage divider with resistor 6. When the switch 12 is on, diode 7 is off and no current flows through resistor 8 leaving only resistors 5 and 6 to form the voltage divider. In this way the first comparator 9 and associated circuitry exhibit hysteretic behavior. Ex.1007,¶147. Since the first comparator 9 can be an amplifier with a positive feedback loop, the first comparator 9 is the same as the claimed *hysteresis amplifier*. Ex.1007,¶147. The first output of the capacitor 2 is represented at the negative input node of the first comparator 9 through a voltage divider defined by resistors 5 and 6 in addition to resistors 8 and 11 and diode 7 when comparator 9 output is low, and the first comparator 9 outputs the first signal, which is analogous to the claimed *hysteresis amplifier coupled to the the first output to generate the first signal*. Ex.1002,9:34-38;Ex.1007,¶147.

Thus, Mieth teaches [6A].

Claim 6 further requires [6B], “a delay circuit coupled to the first signal to generate the second delayed signal.” Fig.1(annotated-[6A,B]) further illustrates the field-effect transistor 12 (switching device, highlighted-teal) and the second comparator 13 that delays the first signal (highlighted-purple) from first comparator 9 to generate a second signal (highlighted-green). Ex.1002,Fig.1,11:4-12;Ex.1007,¶149.

The delay circuit operates when the first signal goes low, causing transistor 12 to turn “off,” and pulling the drain terminal thereof high due to no current conducting through resistor 11. With the drain terminal connected to the negative input terminal of the second comparator 13, the drain terminal going high causes the output of the second comparator 13 to go low (i.e., the second signal), which activates the bipolar transistor 16. *The propagation delays from the first signal through the transistor 12 and the second comparator 13 constitute a delay circuit that delays the second signal with respect to the first signal. That is, when the first signal goes low, the second signal goes low thereafter by a delay time period dictated by the transistor 12 and the second comparator 13.* Ex.1007,¶150-151.

Since, the field-effect transistor 12 and the second comparator 13 are coupled together and delay the first signal to generate the second signal at the output of the second comparator 13, the field-effect transistor 12 and the second comparator 13 are analogous to the claimed *delay circuit coupled to the first signal to generate the second delayed signal*. However, if it is argued that the *delay* circuit should be defined by further specific circuitry rather than the intrinsic switching characteristics of second comparator 13 and switch 12, delay elements discussed in accordance with claim 5 in §VII.A.5 can be implemented.

Ex.1007,¶151.

Thus, Mieth teaches [6B].

6. Independent Claim 7

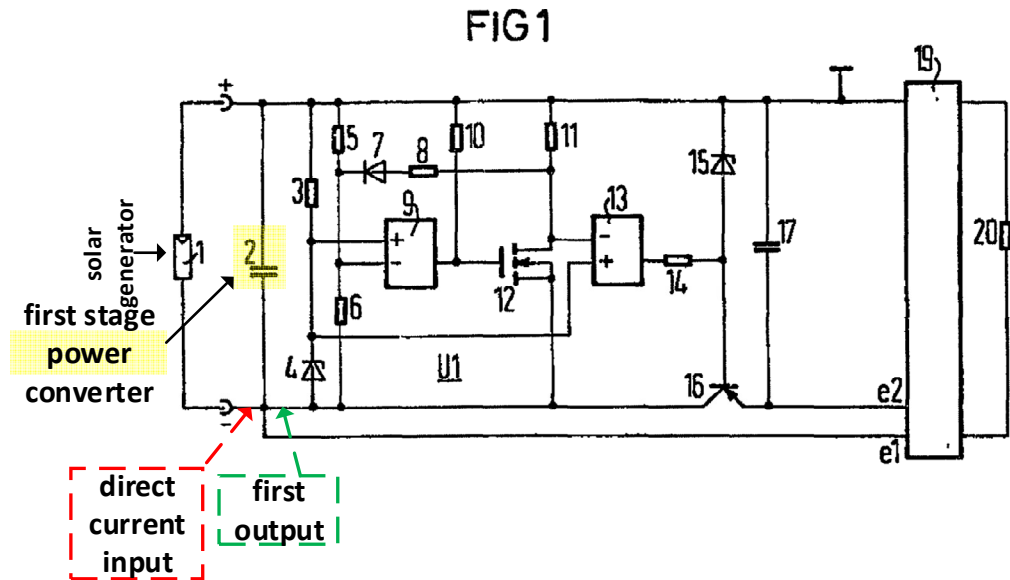
Claim 7 is an independent claim, and is directed toward a method of supplying power. With reference to the claim listing appendix, Mieth discloses elements [7A]-[7H], as provided below.

i. [7A]: “A method to supply power, the method comprising:”

Mieth (Ex.1002) discloses a circuit that supplies power to an electrical load from a solar generator. Ex.1002 (Mieth),8:8-9. A PHOSITA would understand that when the circuit of Mieth supplies power to the electrical load, the circuit is performing a method to supply power to the electrical load. Ex.1007,¶96. Thus, Mieth teaches [7A].

ii. [7B]: “generating, by a first stage power converter, a first output from a direct current input;”

A PHOSITA understands that solar generators generate a direct current. Ex.1007,¶155;Ex.1013, ¶21. As such, the solar generator 1 of Mieth supplies a *direct current input* (dashed-red) to the capacitor 2 that is analogous to a first stage power converter as shown in Fig. 1 (annotated-7B) below. The ‘405 Patent does not define what is a first stage power converter, but instead merely recites its function in claim 7; namely to generate a first output from a direct current input. The first stage power converter of Mieth is a parallel capacitor 2 that performs the recited method function in that it converts power associated with the direct current input into a *first output* (dashed-green) as shown. Ex.1007,¶¶155-157.

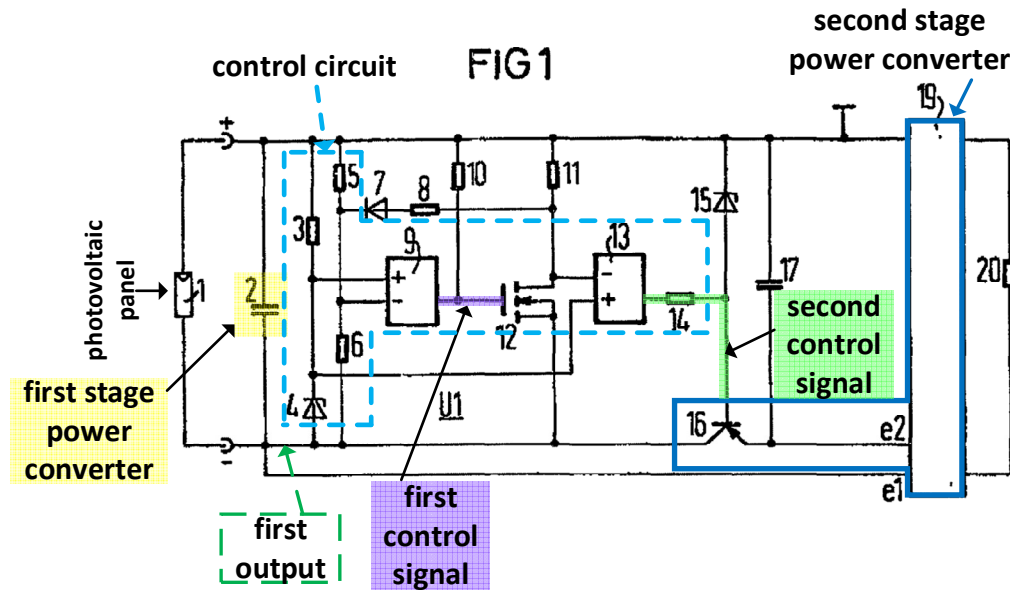


Ex.1002, Fig.1(annotated-7B)

Thus, Mieth discloses [7B].

iii. [7C]: “powering a control circuit using the first output;”

Mieth discloses, *inter alia*, a first comparator 9 that turns the transistor 12 “on” or “off” as shown in Fig.1(annotated-[7C]). Ex.1002,9:34-10-14;Ex.1007,¶157.



Ex.1002, Fig.1 (annotated-[7C])

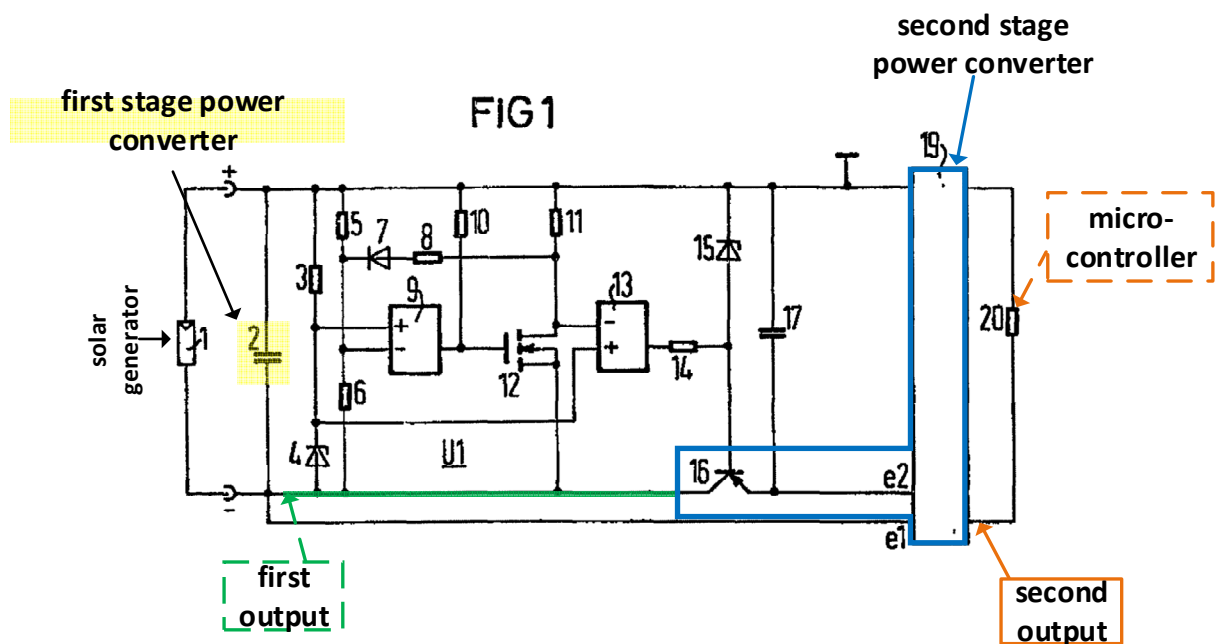
First comparator 9 compares the reference voltage from the reference voltage generator 3,4 to a representative voltage from the voltage divider 5,6. Ex.1002,9:34-10:3;Ex.1007,¶158. First comparator 9 compares the representative voltage to the reference voltage to determine if the representative voltage exceeds a threshold (in magnitude) defined by the reference voltage, and outputs a first control signal (highlighted-purple) to transistor 12 based on the comparison. Ex.1002,12:12-26,Ex.1007,¶158.

A PHOSITA understands that the circuitry (dashed-blue) that controls transistor 12, which includes first comparator 9, voltage divider 5,6 and reference input generator 3,4 are coupled electrically to the first output, and thus are powered by the first output from the capacitor 2, is analogous to the claimed *powering a control circuit using the first output*. Ex.1002,9:34-10:3,Ex.1007,¶159.

Thus, Mieth teaches [7C].

- iv. [7D]: “generating, by a second stage power converter connected to the first stage power converter, a second output from the first output from the first stage power converter;”

In Mieth, a power supply apparatus 19 connected to a bipolar transistor 16 (second stage-blue) together constitutes a *second stage power converter connected* (green) to a capacitor 2 that forms the first stage power converter and generates the first output (dashed-green), as illustrated below in Fig.1(annotated-7D). Thus, *Mieth discloses a first stage power converter connected* (green) *to a second stage power converter*, as shown in Fig. 1(annotated-7D). (Ex.1007,¶161).



Ex.1002, Fig.1(annotated-7D)

Still referring to the figure above, the power supply apparatus 19 *is powered* by way of auxiliary voltage input e2 which is associated with the first output when

the bipolar transistor 16 is conducting (**green**)(Fig.1(annotated-7D). Ex.1002,8:29-35;Ex.1007,¶162. According to Mieth, the power supply apparatus 19 is a DC-DC voltage converter or a charging converter and outputs a voltage and current to power the micro-controller load 20. *Id.* As a power converter, power supply apparatus 19 receives the first output and ***converts the first output to a second output*** (**orange**) as shown in Fig.1(annotated-7D). Ex.1007,¶162. As shown, the second output is provided by the second stage power converter 16/19 to the load/microcontroller (**dashed-orange**). Ex.1007,¶162;Ex.1014,1180,Fig.5.

Thus, Mieth teaches [7D].

- v. **[7E]: “blocking, by the control circuit during a time period that is after the control circuit is powered by the first output and before a predefined condition is met in the control circuit, the second output from the second stage power converter from powering a micro-controller;”**

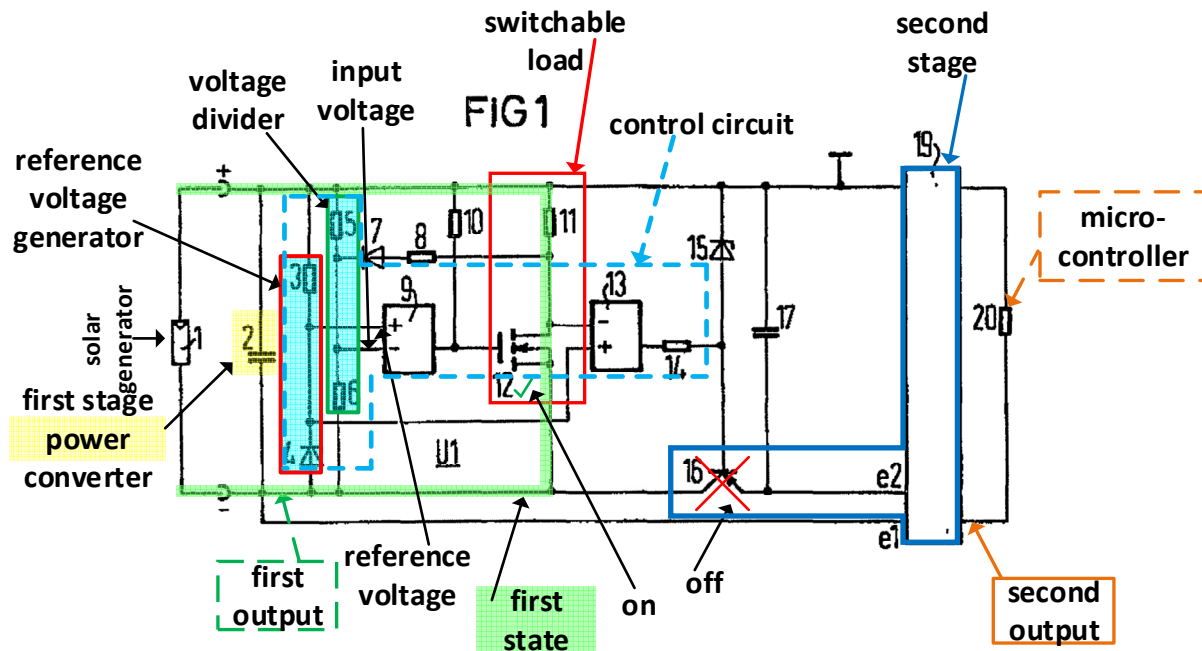
According to element [7E], the control circuit functions to block the second stage power converter from powering the micro-controller using the second output in a time period. Further, element [7E] requires the time period in which such control occurs to be bounded by two constraints: (1) after the control circuit is powered by the first output, and (2) before a predefined condition is met in the control circuit. Mieth discloses such functionality in the control circuit for at least the reasons set forth above in §VII.A.1.vii.

Therefore the function of the control circuit is analogous to *blocking, by the control circuit during a time period that is after the control circuit is powered by the first output and before a predefined condition is met in the control circuit, the second output from the second stage power converter from powering a micro-controller.* Ex.1007,¶¶164-165.

Thus, Mieth teaches [7E].

- vi. [7F]: “**consuming, by a switchable load in a power absorption circuit, a portion of the first output from the first stage power converter during the time period;**”

As discussed above in accordance with §IV.A, §VII.A.1.vi., element [1F], and §VII.A.1.vii.. element [1G] (that define and disclose the “time period”), in the first state associated with relatively low voltages at the first output, the preliminary, switchable load 11 and the field-effect transistor 12 (i.e., switchable load-red) are powered by the first output of capacitor 2 (i.e., first stage power converter-highlighted-yellow). (See §I V.A, Fig.1(annotated 7F)). In this condition, with the transistor 12 conducting, the switchable load 11 operates as part of a power absorption circuit to consume at least a part of the first output. Ex.1002,18:19-19:3;19:9-14, Ex.1007,¶167.



Ex.1002, Fig.1(annotated-7F)

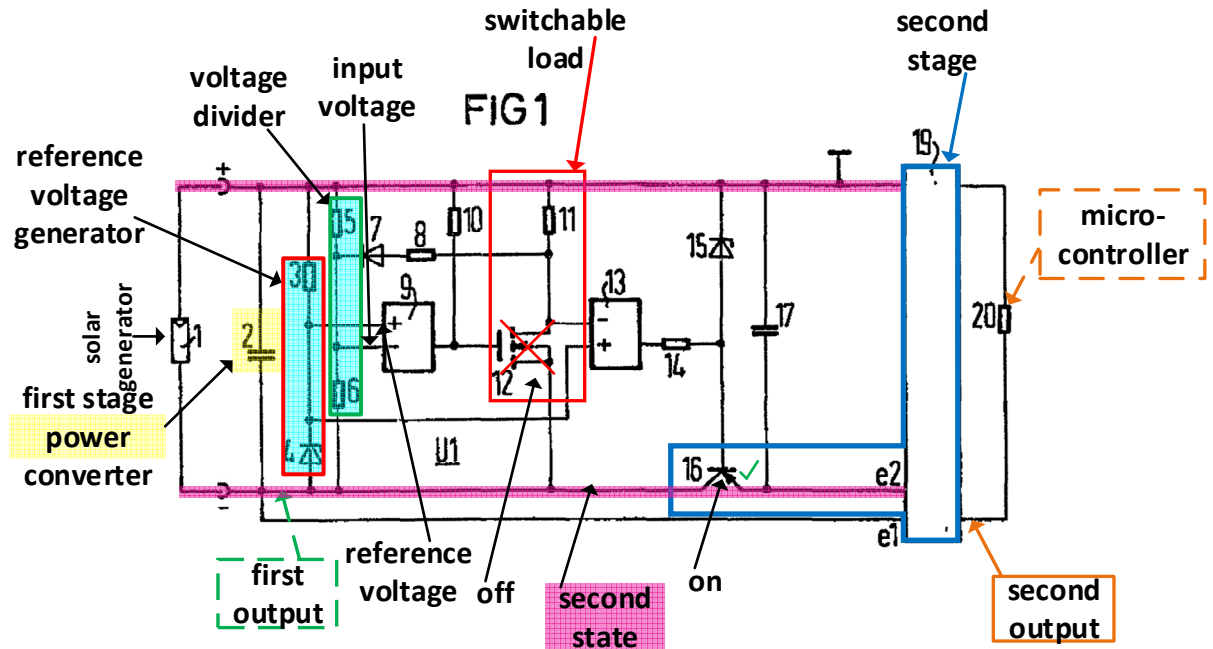
Thus, in the first state, the control circuit and switchable load functions are analogous to the claim feature *consuming, by a switchable load in a power absorption circuit, a portion of the first output from the first stage power converter during the time period*. (Ex.1001, claim 1).

Thus, Mieth teaches feature [7F].

- vii. **[7G]: “powering the micro-controller using the second output from the second stage power converter after the time period; and”**

Mieth further discloses that when voltages from the solar generator 1 reflected at the first output (as represented at the negative terminal of first comparator 9) are above a predefined minimum value (as represented at the positive terminal of first comparator 9)(*i.e.*, the “predefined condition” is met at

relatively “high” first output voltages) the control circuit transitions the circuit to the second state. In the second state the auxiliary voltage input e2 of the power supply apparatus 19 is connected to the first output of the first stage power converter 2. Ex.1002,9:23-26; Ex.1007,¶170. As shown in Fig.1(annotated-1H) below, when the predefined condition is satisfied, the circuit of Mieth operates in the second state (highlighted-pink) where transistor 12 is shut off. As the output of the first comparator goes low, the second comparator 13 trips, resulting in the second comparator 13 output going low. With the output of the second comparator 13 (the second signal) going low, the bipolar transistor 16 turns “on,” causing the first output (dashed-green) of capacitor 2 to be connected to e2, thereby powering the power supply apparatus 19. Ex.1002,10:16-29;Ex.1007,¶170. With the power supply apparatus 19 powered during the second state (which is after the time period), the second stage power converter is operational and provides the second output to power the load 20, which may be a micro-controller. Ex.1002,17:19-18:3, Ex.1007,¶170;Ex.1014,1180,Fig.5.



Ex.1002, Fig.1(annotated-7G)

Therefore the function of the control circuit is analogous to *powering the micro-controller using the second output from the second stage power converter after the time period.*

- viii. [7H]: “stopping, by the control circuit and after the time period, the switchable load from consuming the first output from the first stage power converter.”

In the first state, the first comparator 9 outputs a high value, resulting in transistor 12 being “on”, and the switchable load 11 consuming the first output. Ex.1002,12:12-26,Ex.1007,¶172. While in the first state, when the first output of capacitor 2 rises in magnitude and the representative voltage at voltage divider 5,6 is above the threshold (i.e., “predefined minimum value” as quoted by Mieth), the “time period” of the first state ends, and the control circuit disconnects the

preliminary load 11 from the first output due to the output of the first comparator 9 going low, thus configuring the field-effect transistor 12 to an “off” state, which results in the preliminary load 11 (i.e., the switchable load) not consuming the first output in the second state. Ex.1007,¶172. In this way, the control circuit function is analogous to *stopping, by the control circuit and after the time period, the switchable load from consuming the first output from the first stage power converter.*

Thus, Mieth teaches claim element [7H].

7. Dependent Claim 8

Claim 7 is taught by Mieth. *Supra*,§VII.A.6.i-viii. Claim 8 depends from claim 7 and requires, “wherein the predefined condition includes a voltage of the first output reaching a threshold.” Ex.1001, claim 8.

The feature of claim 8 is the same as claim 2. As discussed in detail in §VII.A.2, Mieth discloses this feature. Ex.1007,¶¶174-176.

Thus, Mieth discloses the method feature of claim 8 for at least the same reasons.

8. Dependent Claim 9

Claim 7 is taught by Mieth. *Supra*,§VII.A.6.i-viii. Claim 9 depends from claim 7 and element [9A] requires, “signaling, by the control circuit, the switchable load to be in a first state of consuming the portion of the first output during the

time period,” and element [9B] requires, “signaling, by the control circuit, the switchable load to be in a second state of not consuming the first output from the first stage power converter after the time period.” Ex.1001, claim [9A]-[9B]. As set forth in ,§VII.A.1.viii, for element [1H]. Mieth discloses each of features [9A]-[9B] for at least the same reasons. Ex.1007,¶¶177-178.

Thus, Mieth discloses features [9A] and [9B].

9. Dependent Claim 11

Claim 9 is taught by Mieth. *Supra*,§VII.A.8. Claim 11 depends from claim 9 and element [11A] requires, “wherein the switchable load includes a resistive device, and a switching device connected to the resistive device,” element [11B] requires “turning on the switching device to place the switchable load in the first state in which the resistive device is connected to the first output,” and element [11C] requires “turn[ing] off the switching device to place the switchable load in the second state in which the resistive device is disconnected from the first output.” Ex.1001, claim [11A]-[11C]. As set forth in ,§VII.A.3, for elements [4A]-[4B], Mieth discloses each of features [11A]-[11C] for at least the same reasons. Ex.1007,¶¶179-180.

Thus, Mieth discloses features [11A], [11B] and [11C].

10. Dependent Claim 12

Claim 9 is taught by Mieth. *Supra*, §VII.A.8. Claim 12 depends from claim 9 and element [12A] requires, “delaying, by the control circuit, a first signal instructing the switching device to change from the first state to the second state,” and element [12B] recites, “generating, via the delaying, a second delayed signal that instructs the second stage power converter to change from not powering the micro-controller to powering the micro-controller.” Ex.1001, claim [12A]. As set forth in ,§VII.A.4, for elements [5A]-[5C], Mieth discloses each of features [12A]-[12B] for at least the same reasons. Ex.1007,¶¶181-182.

Thus, Mieth discloses features [12A] and [12B].

11. Dependent Claim 13

Claim 12 is taught by Mieth. *Supra*, §VII.A.10. Claim 13 depends from claim 12 and requires, “generating the first signal using a hysteresis amplifier coupled to the first output.” Ex.1001, claim 13. As set forth in ,§VII.A.5, for element [6A], Mieth discloses the feature of claim 13 for at least the same reasons. Ex.1007,¶¶183-184.

Thus, Mieth discloses claim 13.

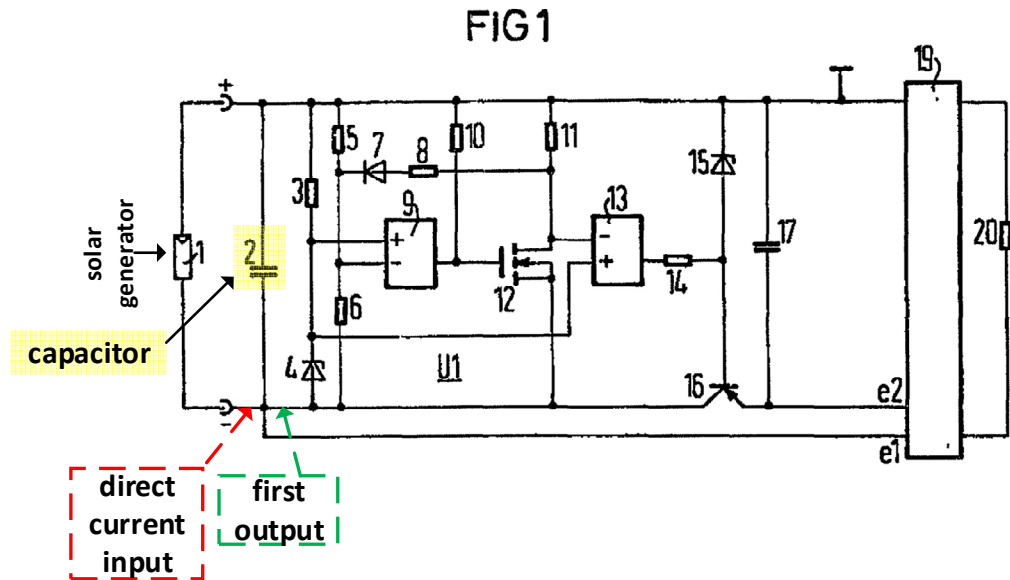
B. Ground B: Obviousness of claims 1-2, 4-9 and 11-13 over Mieth in view of Balogh

1. Independent Claim 1

With reference to the claim listing appendix, Mieth is believed to disclose all the elements of claims 1-2, 4-9 and 11-13. To the extent it is argued that Mieth does not teach the first stage power converter (e.g., elements [1C] and [7B]), Balogh discloses a first stage power converter as set forth in elements [1C] and [7B]. Further, as explained below, a PHOSITA would have been motivated to combine together Mieth and Balogh to arrive at the alleged invention of claims 1-2, 4-9 and 11-13.

i. [1C]: “a first stage power converter to generate a first output from a direct current input;”

A PHOSITA understands that solar generators generate a direct current. Ex.1007,¶186;Ex.1013,¶21. As such, the solar generator 1 of Mieth supplies a *direct current input* (dashed-red) to the capacitor 2 as shown in Fig. 1 (annotated-1C.1) below, and generates a first output. Ex.1007,¶186.



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

Balogh discloses cascaded converter arrangements (*e.g.*, Ex.1003(Balogh),Figs.1B-1D), and states that cascaded arrangements using first and second buck converters are employed in circuit applications that require large input/output conversion ratios. Ex.1003,1:21-27. It is known to a PHOSITA that photovoltaic panels or modules can realize high input voltages, and such high input voltages need large input/output conversion ratios to step down the input voltage. Ex.1003,1:21-27,Ex.1007,¶187. Even a single photovoltaic module can see a voltage as high as 80V, which may necessitate a large input/output conversion ratio. Ex.1007,¶187;Ex.1010;Ex.1011. Balogh teaches in Fig 1D a cascaded converter arrangement using *a first stage transformer-coupled input power converter that steps down an input voltage to an intermediate voltage*, followed by a second stage buck output power converter that further steps down the

intermediate voltage to a final voltage. Ex.1003,1:62-66. Thus, Balogh clearly discloses *a first stage power converter*, as recited in element [1C] and shown in Fig.1D(annotated-1C.2) below.

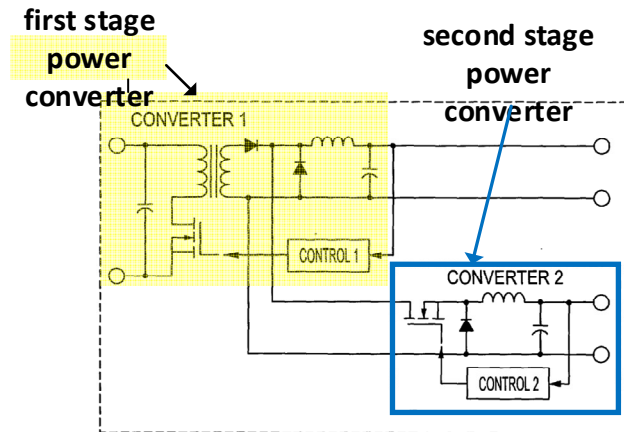


FIG. 1D
PRIOR ART

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

Mieth states that applications having photovoltaic energy sources or wind energy sources often provide varying levels of input voltage that can create difficulties when serving as an input to a power converter. Ex.1002,5:22-38. Mieth further teaches the use of a switchable load in situations where an input voltage to a power converter varies, such as the voltage from a photovoltaic system that will vary depending upon the time of day, or weather conditions. Ex.1002,5:22-38; Ex.1007,¶188.

A PHOSITA is motivated to combine the cascaded power converter architecture of Balogh with Mieth. Balogh discloses the first stage power

converter to replace the capacitor 2 of Mieth and generate two, cascaded power converters with the switchable load feature of Mieth for DC applications with high input voltages. Ex.1007,¶189. Mieth is directed towards solar generators that generate up to 36 volts. Ex.1002,12:21-26. Balogh discloses higher DC voltages relative to Mieth, for example, 48V with large step-down ratios, for example, 48V to 1.5V. Ex.1003,10:45-52. In other prior art examples, solar panel modules can have 80V output voltages requiring large step-down ratios. Ex.1010;Ex.1011; Ex.1007,¶189. As such, a PHOSITA would have known and been motivated to combine the cascaded power converter architecture of Balogh with Mieth for high DC applications (e.g., 48V or 80V solar panel modules) to realize an appropriate intermediate voltage for the second stage power converter 16/19 of Mieth. Ex.1007,¶189.

The combination of Mieth-Balogh involves combining known prior-art elements (Mieth's switchable load and step-down converter and Balogh's cascaded step down converter architecture) according to known methods to yield predictable results, i.e., a cascaded step-down power converter having a switchable load at the second power converter input that is selectively employed based on the output voltage of the first stage step-down power converter. A PHOSITA would have had the skills, knowledge, and motivation to carry out the combination. Ex.1007,¶190. A PHOSITA would have reasonably expected success in combining Mieth and

Balogh as no significant modifications are required to implement. *Id.* A PHOSITA would have 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. Ex.1007,¶190. As understood by a PHOSITA, there are no undue technical hurdles to applying Mieth with Balogh or vice-versa, as such a combination would have been a simple modification to Mieth's system, readily accomplished by a PHOSITA. Ex.1007,¶190. Accordingly, Mieth in combination with Balogh is proper and teaches element [1C]. *Id.*

Specifically, while the capacitor 2 discussed in §VII.A.1.ii-§VII.A.1.iv. (see Fig. 1(annotated-1D.1) above) provides the recited function of the first stage power converter as recited in the claims, and the bipolar transistor 16/power supply apparatus 19 is analogous to the claimed second stage power converter, Balogh discloses a cascaded converter arrangement having an isolated DC-DC converter in its first stage that is explicitly set forth as a first stage power converter. Ex.1003,10:45-52;Ex.1007,¶191.

Balogh's isolated DC-DC converter (analogous to the first stage power converter-yellow) and post regulator circuit are cascaded step-down converters and are shown in Fig.1D(annotated-1C.2). Ex.1003,2:61-64;Ex.1007,¶192.

Based on Balogh, a PHOSITA would understand that cascaded converters are commonly used to provide input to output power conversion that is not optimally implemented in a single converter. Ex.1003,1:25-28.Ex.1007,¶193. Thus, the purpose of the first stage power converter and the second stage power converter was previously described by Balogh, that is, to provide input-to-output power conversion that is not optimally implemented in a single converter, for example, in high DC voltage applications. Ex.1003,10:45-52. The claimed first stage power converter of Balogh can replace the capacitor 2 of Mieth to provide a first output to be consumed by the switchable load or to power the second stage power converter, and the claimed second stage power converter uses the first output from the first stage to power the micro-controller, which is not optimally implemented by a single converter (e.g. the first stage power converter or the second stage power converter alone). Ex.1007,¶193. As such, a PHOSITA, at the time of filing, would know that the capacitor 2 of Mieth could be replaced by the first stage power converter of Balogh, and combined with the power supply apparatus 19 of Mieth to form a cascaded converter architecture as disclosed by Balogh. Ex.1007,¶193.

In addition, it is well known in the art that improved efficiency can be achieved by cascading buck power converters when there is a large ratio of input to output voltage as described in Patent application: US 2007/0001653 (hereafter

“Xu”). Ex. 1012. Xu states: “The present invention provides a two-stage power delivery system that employs cascaded buck stages. For high input-to-output voltage ratios, each cascaded buck stage has a more suitable (i.e., larger) duty cycle that results in a much lower total power loss than in a single-stage buck.” Ex. 1012, ¶6; Ex.1007,¶194.

In addition, Xu reflects further general knowledge of a PHOSITA that cascaded converters advantageously improve circuit efficiency. Ex. 1012. Xu states that in some applications where there is a lower input-to-output voltage ratio, for example, like in Mieth, the first stage power converter can be configured with a duty cycle of one so that it operates as a well-known L-C filter for the subsequent second stage, thereby being substantially similar to Mieth’s capacitor 2 input stage. For at least these reasons, it would have been obvious for a PHOSITA to combine Balogh with Mieth in view of the general knowledge of a PHOSITA, as shown by the teaching of Xu, where large output/input ratios are more efficient when implemented with cascaded buck converters. Ex.1007,¶195.

Thus, Xu provides a teaching that a PHOSITA would readily consider a cascaded converter arrangement in various solar applications, such as the application taught in Mieth. As such, a PHOSITA, at the time of filing, would know that the capacitor 2 of Mieth could be replaced readily by the first stage power converter of Balogh, and combined with the power supply apparatus 19 of

Mieth to form a cascaded converter architecture as disclosed by Balogh.

Ex.1007,¶196.

Thus, Balogh discloses [1C] in combination with Mieth.

ii. Features [1A]-[1H] are disclosed by Mieth-Balogh

As discussed in §VII.A.1 Mieth discloses claim 1. As discussed in §VII.B.1.i, Mieth in combination with Balogh discloses feature [1C], thus Mieth-Balogh also teaches all the elements [1A]-[1H] of claim 1. Additionally, for the same reasons, Mieth-Balogh teaches all of claims 2, and 4-6.

2. Independent Claim 7

i. [7B]: “generating, by a first stage power converter, a first output from a direct current input”

Feature [7B] is essentially the same as feature [1C]. For at least the same reasons set forth above in, §VII.B.1.i, Balogh in combination with Mieth discloses element [7B]. Ex.1007,¶¶197-198.

ii. Features [7A]-[7H] are disclosed by Mieth-Balogh

As discussed in §VII.A.6 Mieth discloses claim 7. As discussed in §VII.B.2.i, Mieth in combination with Balogh discloses feature [7B], thus Mieth-Balogh also teaches all the elements [7A]-[7H] of claim 7. Additionally, for the same reasons, Mieth-Balogh teaches all of claims 8-9 and 11-13. Ex.1007,¶198.

C. Ground C: Obviousness of claims 3 and 10 in view of Mieth and Liu, or over Mieth-Balogh and further in view of Liu

1. Dependent Claim 3

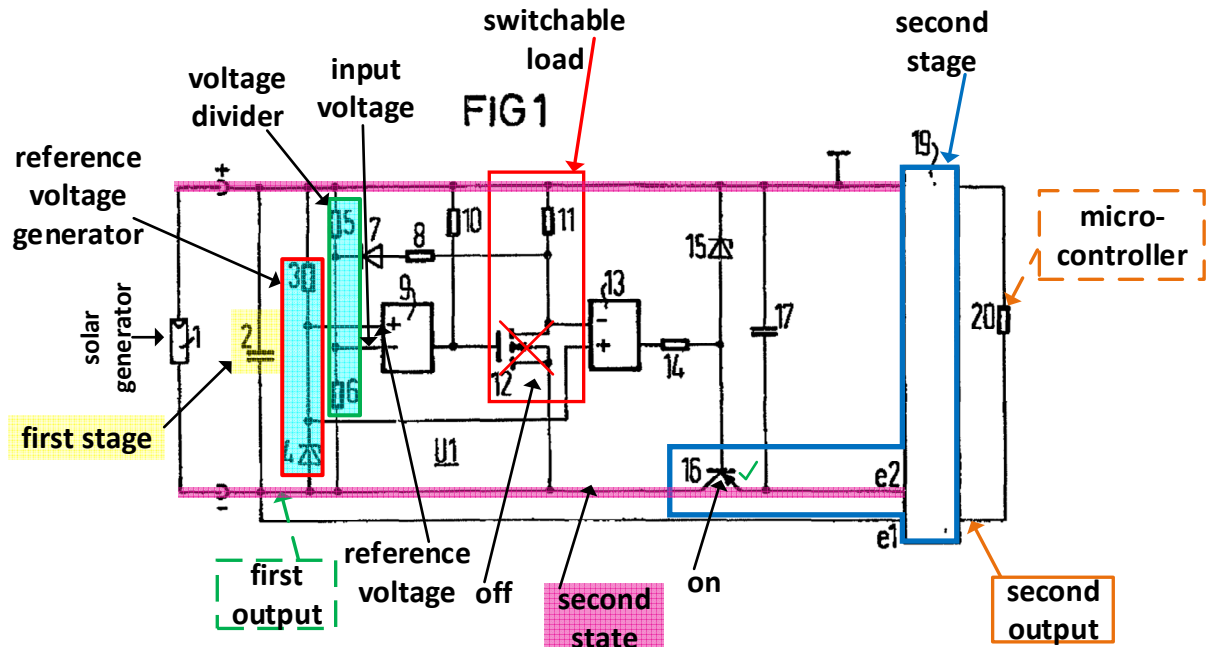
Claim 1 is taught by Mieth alone, or by a combination of Mieth-Balogh.

Supra, §VII.A.1.i-viii. Claim 3 depends from claim 1 and requires, “wherein, when the switchable load is in the second state, the voltage above the threshold is sufficient to power the second stage power converter to operate the micro-controller for at least a predetermined period of time during which the direct current input to the first stage power converter has diminishing power.”

Fig.1(annotated-Claim-3) below illustrates Mieth in the second state. As taught in Mieth, when voltages from the solar generator 1 (as represented at the negative terminal of first comparator 9) are above a predefined minimum value (as represented at the positive terminal of first comparator 9)(i.e., relatively “high” first output voltages), the control circuit transitions the circuit to the second state, wherein the auxiliary voltage input e2 of the power supply apparatus 19 is connected to the first output of the solar generator 1. Ex.1002,9:23-26; Ex.1007,¶199. As shown in Fig.1(annotated-Claim-3) below, when the predefined minimum value is satisfied (i.e., the voltage associated with the first output exceeds the claimed threshold), the circuit of Mieth operates in the second state (highlighted-pink) where the the field-effect transistor 12 is “off” or non-

conducting, thereby disconnecting the preliminary load 11 from the first output.

Id. Ex.1007,¶199.



Ex.1002, Fig.1(annotated-Claim-3)

As discussed in §VII.A.1.vii., the first comparator 9 compares the reference voltage from the reference voltage generator (**highlighted-teal-outlined-red**) to the representative voltage from the voltage divider (**highlighted-teal-outlined-green**) to determine if the representative voltage exceeds a threshold defined by the reference voltage. Thus, according to Mieth, *the design of the reference voltage generator dictates the magnitude of the threshold that triggers the exit from the first state and entry into the second state.* Ex.1002,12:12-26,Ex.1007,¶200.

As shown above, upon the control circuit of Mieth causing the circuitry to exit the first state and enter the second state, the first output is large enough that the

threshold defined by the reference voltage generator is exceeded, and the first output is passed to the e2 terminal of the second stage power converter 19.

More particularly, when the voltage representative of the first output exceeds the threshold, the transistor 12 is shut “off,” pulling its output node (connected to the negative input terminal of the second comparator 13) high due to the resistor 11. This causes the output of the second comparator 13 to go low, thus turning bipolar transistor 16 “on,” and passing the first output to the e2 terminal to power the second stage power converter 19, which, in turn provides the second output to the micro-controller 20. Ex.1007, ¶¶201-202.

Claim 3 requires that when the direct current input to the first stage power converter has diminishing power, the threshold is sufficient for the second stage power converter to operate the micro-controller for at least a predetermined period of time. Ex.1001, claim 3. The ‘405 patent does not define or provide any context for what constitutes the predetermined period of time for the claim feature. In the second state, when the direct current input to the first stage power converter has diminishing power, the first output will begin to decrease. As the second stage power converter has a range of input voltages at which it may operate effectively to provide the second output to the micro-controller 20, Mieth’s control circuit is operable to allow the second stage power converter 19 to operate the micro-controller 20 for a predetermined period of time despite a decreasing first output

voltage, as no minimum time period is set forth by the claim, nor provided as an example in the detailed description of the '405 patent. Ex.1007,¶203. Thus, Mieth discloses this feature.

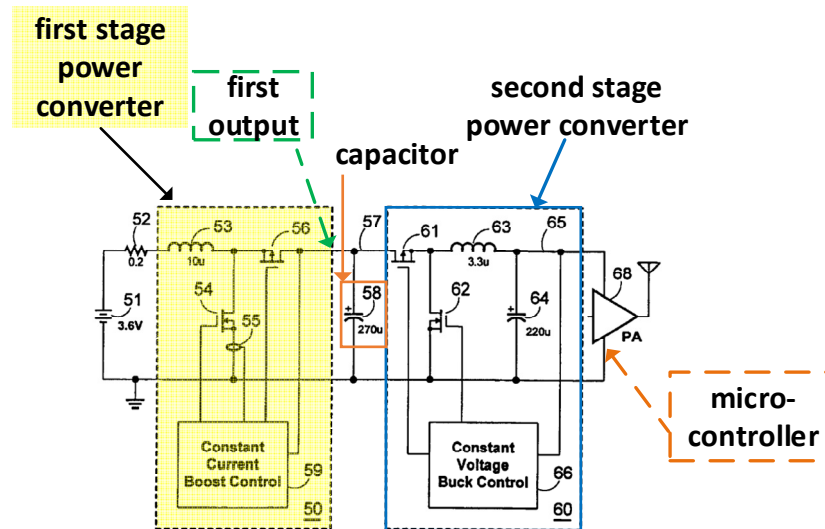
If Mieth standing alone is not deemed to provide adequate support for the feature of claim 3, Liu discloses use of a reservoir capacitor 58 between first and second stage power converters, so that if the first stage power converter is inoperable or otherwise deficient, the capacitor provides auxiliary power to the second stage power converter to power the micro-controller for the predetermined period of time. Ex.1005, 4:25-50Ex.1007,¶204.

Mieth discloses transistor 12 connected to preliminary load/resistor 11 to form a power absorption circuit coupled to the first output, as, during the first state, power from the first output is at least partially consumed by the preliminary load/resistor 11. Ex.1002, 9:15-32,10:5-14,18:19-19:3,19:9-14,23:15-19;Ex.1007,¶295. Mieth does not disclose that preliminary load/resistor 11 includes a capacitor. However, Liu (Ex.1005) discloses a capacitor as a power absorption circuit coupled to the first output and feeding a second stage power converter, and a PHOSITA is motivated to combine Mieth and Liu for at least the following reasons.

As shown in Fig.5(annotated-Claim-3), Liu discloses cascaded DC voltage converters with an input stage (or first stage power converter) 50 separated from an

output stage (or a second stage power converter) 60 by a reservoir capacitor 58.

Ex.1005,4:25-35;Ex.1007,¶206.



Ex.1005, Fig.5(annotated-Claim-3)

The first stage power converter 50 converts the voltage from battery 51 to charge reservoir capacitor 58, and second stage power converter 60 down converts the voltage of reservoir capacitor 58 to power a power amplifier (“PA”) 68.

Ex.1005,4:36-43;Ex.1007,¶207. Since first stage power converter 50 (highlighted-yellow) converts an input voltage to an output voltage, input stage 50 is analogous to the claimed first stage power converter of claim 1, and the output (dashed-green) of first stage power converter 50 is analogous to the claimed *first output* of claim 3. Ex.1007,¶207. Since the reservoir capacitor 58 (orange) is charged from the first output of the first stage power converter 50, reservoir capacitor 58 absorbs the first output of the first stage power converter 50, and as the capacitor 58 charges, in

combination with Mieth, the voltage at the voltage divider eventually exceeds the “predefined condition” which causes the control circuit of Mieth to transition from the first state (lower first output voltages) to the second state (higher first output voltages). Ex.1007,¶207.

Claim 3 further requires “the voltage above the threshold is sufficient to power the second stage power converter to operate the micro-controller for a predetermined period of time during which the direct current input to the first stage power converter has diminishing power.”

Liu teaches that reservoir capacitor 58 provides most of the energy to PA 68 through output stage 60 for a period of time when battery 51 cannot supply power to the PA 68. Ex.1005,1:8-12,4:43-51;Ex.1007,¶¶208-209. A PHOSITA understands that capacitor 58 provides power to the PA 68 for a predetermined period of time by sizing the capacitor appropriately. Ex.1007,¶209. Furthermore, while Liu shows PA 68 powered by reservoir capacitor 58 through the second stage power converter 60, a PHOSITA understands that reservoir capacitor 58 and output stage 60 could power another load (as opposed to the PA 68) such as the claimed *micro-controller*. *Id.* Thus, capacitor 58 that can provide power to the PA 68 for a period of time is analogous to the claimed *voltage above the threshold is sufficient to power the second stage power converter to operate the micro-controller for at least a predetermined period of time during which the direct*

current input to the first stage power converter has diminishing power.

Ex.1007,¶209.

Liu discloses cascaded power converters with a capacitor that provides power to a load through a second power converter for a period of time without incoming power from a first power converter. Ex.1005,4:36-43;Ex.1007,¶210.

Mieth teaches use of a power absorption circuit when an input voltage to a power converter varies, such as the voltage from a photovoltaic system that varies depending upon time of day, or weather conditions. Ex.1002,5:22-

38,Ex.1007,¶210. Mieth in view of Balogh disconnects the switchable load between first stage and second stage power converters when the input voltage to the first stage power converter meets a stable criteria according to a voltage threshold. *Id.* A PHOSITA is motivated to combine the capacitor of Liu with the power absorption circuit (i.e., the switchable load 11/12) of Mieth, as the capacitor provides a more stable power source to Mieth's load (i.e., the micro-controller) 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. *Id.* Ex.1007,¶211.

A PHOSITA is motivated to employ known means in the art, as taught in Liu, to modify the circuit of Mieth (e.g., Fig. 1(annotated-Claim-3) such that when Mieth is in the second state and the monitored voltage connected to first

comparator 9 falls below the predefined minimum value (i.e., the “predefined threshold”) according to the first output, the capacitor of Liu powers load 20 (i.e., micro-controller) through power supply apparatus 19 (i.e., the second stage power converter) for a predetermined period of time, *which is analogous to claim 3*.

Ex.1007, ¶¶210-211. Therefore, 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. *Id.*

The combination of Mieth-Liu involves combining known prior art elements (replacing/combining Mieth’s resistive load between converters with Liu’s capacitive load between converters) according to known methods to yield predictable results, a cascaded power converter having a capacitive load at the second power converter input. A PHOSITA has the skills, knowledge, and motivation to carry out the combination. Ex.1007,¶212. A PHOSITA would reasonably expect success in combining Mieth and Liu, and there is no undue technical hurdles in combining Mieth with Liu, as the combination is a simple modification to Mieth’s system. *Id.*

If it is argued that Mieth does not teach a first stage power converter, Mieth may be combined with Balog to provide such feature, as set forth in §VII.B.1.i. Further, Liu may be combined with a combination of Mieth-Balogh for at least the reasons above in §VII.C.1. Ex.1007,¶213.

Thus, Mieth-Liu, or alternatively Mieth-Balogh-Liu disclose claim 3.

2. Dependent Claim 10

Claim 9 is taught by Mieth alone, or by a combination of Mieth and Balogh. Claim 10 depends from claim 9 and requires, “wherein, when the switchable load is in the second state, the voltage above the threshold is sufficient to power the second stage power converter to operate the micro-controller for at least a predetermined period of time during which the direct current input to the first stage power converter has diminishing power.” This claim language is identical to the claim language of claim 3. It is submitted that claim 10 is taught by a combination of Mieth and Liu, or alternatively by a combination of Mieth, Balogh and Liu for at least the same reasons articulated above for claim 3. Ex.1007,¶¶215-216.

Thus, Mieth-Liu, or alternatively Mieth-Balogh-Liu disclose claim 10.

D. CONCLUSION

Inter partes review of claims 1-13 should be instituted and the claims cancelled.

Respectfully submitted,

June 27, 2023

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CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(a)(1)(i), I certify that this paper includes 12,774 words. In accordance with 37 C.F.R. § 42.24(a)(1), this word count does not include a count of the words in a table of contents, a table of authorities, mandatory notices under § 42.8, a certificate of service or word count, or appendix of exhibits or claim listing. Furthermore, in accordance with 37 C.F.R. § 42.24(d), this word count is the word count of the word-processing system used to prepare the paper.

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.105, I hereby certify that I caused a true and correct copy of the Petition for *Inter Partes* Review in connection with U.S. Patent No. 10,333,405 and supporting evidence to be served via FedEx Priority Overnight on June 27, 2023, on the following:

Firm Name and Address here

Respectfully submitted,

June 27, 2023

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CLAIM LISTING APPENDIX

U.S. Patent No. 10,333,405 - Avrutsky	
Claim Element Designation	Claim Element
Claim 1	
[1A]	An apparatus, comprising:
[1B]	a micro-controller;
[1C]	a first stage power converter to generate a first output from a direct current input;
[1D]	a switchable load powered by the first output;
[1E]	a control circuit powered by the first output; and
[1F]	a second stage power converter connected to the first stage power converter and configured to convert the first output to a second output;
[1G]	wherein the control circuit is configured to block the second stage power converter from powering the micro-controller using the second output in a time period that is after the control circuit is powered by the first output and before a predefined condition is met in the control circuit; and
[1H]	wherein the control circuit is configured to signal the switchable load to be in a first state of consuming the first output during the time period and to be in a second state of not consuming the first output after the time period.
Claim 2	
The apparatus of claim 1, wherein the predefined condition includes a voltage of the first output reaching a threshold.	
Claim 3: The apparatus of claim 1, wherein, when the switchable load is in the second state, the voltage above the threshold is sufficient to power the second stage power converter to operate the micro-controller for at least a predetermined period of time during which the direct current input to the first stage power converter has diminishing power.	
Claim 4	
[4A]	The apparatus of claim 1, wherein the switchable load comprises: a resistive device; and
[4B]	a switching device connected to the resistive device, wherein the switching device is turned on in the first state to connect the

	resistive device to the first output and turned off in the second state to disconnect the resistive device from the first output.
Claim 5: The apparatus of claim 1, wherein the control circuit delays a first signal instructing the switching device to change from the first state to the second state to generate a second delayed signal that instructs the second stage power converter to change from not powering the micro-controller to powering the micro-controller.	
Claim 6:	
[6A]	The apparatus of claim 5, wherein the control circuit comprises: a hysteresis amplifier coupled to the first output to generate the first signal; and
[6B]	a delay circuit coupled to the first signal to generate the second delayed signal.
Claim 7:	
[7A]	A method to supply power, the method comprising:
[7B]	generating, by a first stage power converter, a first output from a direct current input;
[7C]	powering a control circuit using the first output;
[7D]	generating, by a second stage power converter connected to the first stage power converter, a second output from the first output from the first stage power converter;
[7E]	blocking, by the control circuit during a time period that is after the control circuit is powered by the first output and before a predefined condition is met in the control circuit, the second output from the second stage power converter from powering a micro-controller;
[7F]	consuming, by a switchable load in a power absorption circuit, a portion of the first output from the first stage power converter during the time period;
[7G]	powering the micro-controller using the second output from the second stage power converter after the time period; and
[7H]	stopping, by the control circuit and after the time period, the switchable load from consuming the first output from the first stage power converter.
Claim 8: The method of claim 7, wherein the predefined condition includes a voltage of the first output reaching a threshold.	
Claim 9:	
[9A]	The method of claim 7, further comprising: signaling, by the control circuit, the switchable load to be in a first state of

	consuming the portion of the first output during the time period; and
[9B]	signaling, by the control circuit, the switchable load to be in a second state of not consuming the first output from the first stage power converter after the time period.
Claim 10: The method of claim 9, wherein, when the switchable load is in the second state, the voltage above the threshold is sufficient to power the second stage power converter to operate the micro-controller for at least a predetermined period of time during which the direct current input to the first stage power converter has diminishing power.	
Claim 11:	
[11A]	The method of claim 9, wherein the switchable load includes a resistive device, and a switching device connected to the resistive device; wherein the method further includes:
[11B]	turning on the switching device to place the switchable load in the first state in which the resistive device is connected to the first output; and
[11C]	turned off the switching device to place the switchable load in the second state in which the resistive device is disconnected from the first output.
Claim 12	
[12A]	The method of claim 9, further comprising: delaying, by the control circuit, a first signal instructing the switching device to change from the first state to the second state; and
[12B]	generating, via the delaying, a second delayed signal that instructs the second stage power converter to change from not powering the micro-controller to powering the micro-controller.
Claim 13: The method of claim 12, further comprising: generating the first signal using a hysteresis amplifier coupled to the first output.	