

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

FANTASIA TRADING LLC D/B/A ANKERDIRECT,
Petitioner,

v.

COGNIPOWER, LLC,
Patent Owner.

IPR2021-00071
Patent RE47,713 E

Before KEVIN F. TURNER, JEFFREY S. SMITH, and JOHN R. KENNY,
Administrative Patent Judges.

KENNY, *Administrative Patent Judge.*

DECISION
Final Written Decision
Determining No Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

Fantasia Trading LLC D/B/A AnkerDirect (“Petitioner”) filed a Petition to institute an *inter partes* review of claims 18, 19–23, 25, 30, 31, 34–36, 41–43, 45, and 48–51 (the “challenged claims”) of U.S. Patent No. RE47,713 E (Ex. 1001, the “’713 patent,” “challenged patent”) pursuant to 35 U.S.C. § 311 *et seq.* Paper 3 (“Pet.”), 1. CogniPower LLC (“Patent Owner”) filed a Preliminary Response. Paper 13 (“Prelim. Resp.”).

On May 12, 2021, we instituted an *inter partes* review of all challenged claims. Paper 21 (“Institution Decision” or “Inst. Dec.”). Patent Owner filed a Patent Owner Response (Paper 31, “PO Resp.”). Petitioner filed a Reply (Paper 37, “Pet. Reply”), and Patent Owner filed a Sur-reply (Paper 39, “PO Sur-reply”). A transcript of an oral hearing held on February 11, 2022 (Paper 49, “Tr.”) has been entered into the record.

We have jurisdiction under 35 U.S.C. § 6. For the reasons discussed below, we determine that Petitioner has not shown, by a preponderance of the evidence, that claims 18, 19–23, 25, 30, 31, 34–36, 41–43, 45, and 48–51 are unpatentable.

A. Related Matters

The parties identify the following related district court litigation: *CogniPower LLC v. Fantasia Trading, LLC D/B/A AnkerDirect*, C.A. No. 19-cv-02293 (D. Del.). Pet. 13; Paper 5, 2.

Patent Owner identifies the following related IPRs: IPR2021-00072 and -00073, which both challenge the ’713 patent, and IPR2021-00067, -00068, -00069, and -00070, which all challenge U.S. Patent No. RE47,031 E, of which the ’713 patent is a continuation. Paper 5, 2–4; Ex. 1001, code (63).

B. Challenged Patent

The '713 patent relates to “switched-mode power converters” and discloses “a switched-mode power converter with regulation demand pulses sent across a galvanic isolation barrier.” Ex. 1001, code (57), 1:33–35.

Figure 1 of the '713 patent is shown below:

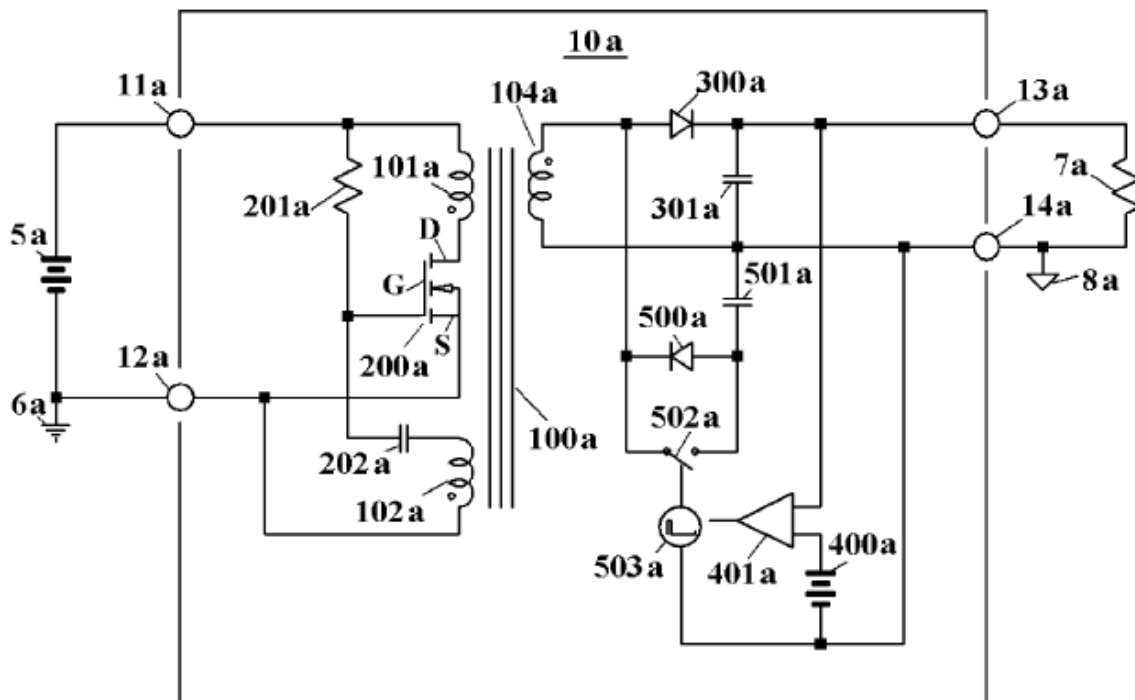


Fig. 1

Figure 1 is a schematic diagram of a power converter (10a). Ex. 1001, 2:34–35. “Terminals 11a and 12a constitute a power input port that places source 5a in circuit with primary winding 101a of transformer 100a and with communicating switch 200a.” *Id.* at 2:37–41. “[S]witch 200a is a MOSFET having a source S, a gate G, and a drain D.” *Id.* at 2:41–43. “Transformer 100a also comprises a regeneration winding 102a which is referenced to source S of MOSFET 200a, is connected through a capacitor 202a to gate G of MOSFET 200a, and is poled to provide regenerative feedback to gate G of

MOSFET 200a.” *Id.* at 2:43–47. “MOSFET 200a, transformer 100a, capacitor 202a, and resistor 201a form an input-side blocking oscillator which acts as a driver circuit toggling ON and OFF MOSFET 200a.” *Id.* at 2:50–53. “Transformer 100a also comprises a secondary winding 104a which may be connected to a floating common terminal 14a.” *Id.* at 2:54–56. “[D]iode 300a and a capacitor 301a form a rectifier circuit to rectify and filter voltage pulses from winding 104a to supply power through a power output port comprising terminals 13a and 14a to an external load represented by resistor 7a connected in circuit therewith, one end of which may be referred to a floating common 8a.” *Id.* at 2:56–61. “The power input port 11a/12a and the power output port 13a/14a may be galvanically isolated from each other.” *Id.* at 2:61–63.

“Flyback pulses of transformer 100a occur when MOSFET 200a ceases conduction, i.e., turns OFF.” Ex. 1001, 2:64–65. “Winding 104a is poled to cause diode 300a to rectify only these flyback pulses.” *Id.* at 2:65–67. “Forward pulses, of opposite polarity to the flyback pulses, occur while MOSFET 200a is ON.” *Id.* at 3:1–2. “Another diode 500a, poled to rectify forward pulses, and another capacitor 501a form an auxiliary rectifier circuit to rectify and filter forward pulses from winding 104a, and to store energy for triggering the input-side blocking oscillator formed by MOSFET 200a.” *Id.* at 3:2–6.

“This magnetically-coupled blocking oscillator may be triggered through any transformer winding magnetically coupled thereto.” Ex. 1001, 3:15–17. “Therefore, just as MOSFET 200a may be turned ON through winding 102a, it may as easily be triggered through winding 104a.” *Id.* at 3:17–19. “To trigger thusly, diode 500a is briefly short-circuited by a switch

502a which is driven by a demand pulse generator 503a to source a pulse of energy from capacitor 501a into transformer 100a.” *Id.* at 3:19–22.

“[T]ransformer 100a is used during the conduction of MOSFET 200a as a forward converter supplying the auxiliary rectifier circuit, and during the flyback of transformer 100a as a flyback converter supplying power to the power output port.” Ex. 1001, 3:54–58. “Once the flyback pulse has reset the inductance of transformer 100a, i.e., has depleted energy from its magnetic field, transformer 100a is free, until the next ON time of MOSFET 200a, to be used as a magnetically coupled isolator to convey trigger information between its windings.” *Id.* at 3:61–66. “[T]he information thus conveyed is a pulse from pulse generator 503a which, responsive to the output of comparator 401a, indicates the need for another energy-bearing cycle, and moreover retriggers the blocking oscillator to provide that energy-bearing cycle.” *Id.* at 3:66–4:4.

“This converter may be fitted with a reference voltage 400a and a comparison circuit 401a.” Ex. 1001, 4:8–9. “When the voltage at terminal 13a falls below the comparison voltage, comparison circuit 401a causes pulse generator circuit 503a to pulse, turning ON switch 502a, triggering an energy-bearing ON cycle of the blocking oscillator, and charging capacitor 301a.” *Id.* at 4:9–13. “As load 7a drains capacitor 301a, terminal 13a voltage repeatedly falls to the voltage of reference 400a, causing comparison circuit 401a to initiate energy-bearing ON cycles.” *Id.* at 4:13–16.

C. Challenged Claims

Petitioner challenges claims 18, 19–23, 25, 30–31, 34–36, 41–43, 45, and 48–51 of the '713 patent, of which claims 18 and 48 are independent.

Claim 18 reads:

18. An article of manufacture comprising a flyback converter, the flyback converter comprising:
- a primary side comprising an input port;
 - a secondary side comprising an output port, wherein the secondary side is galvanically isolated from the primary side; and
 - a power transformer configured to transfer input power received at the input port to provide output power at the output port, wherein:
 - the primary side further comprises a primary-side switch configured to selectively enable the input power at the input port to be transferred via the power transformer to the output power at the output port;
 - the secondary side further comprises a demand pulse generator that (i) determines when to turn on the primary-side switch based on output voltage or output current at the output port and (ii) generates corresponding demand pulses;
 - the primary side comprises a primary-side magnetically coupled conductor;
 - the secondary side comprises a secondary-side magnetically coupled conductor configured to be magnetically coupled to the primary-side magnetically coupled conductor to convey the demand pulses from the secondary side to the primary side;
 - the primary-side switch is turned on in response to the demand pulses conveyed from the secondary side to the primary side, wherein the determination of when to turn off the primary-side switch is originated on the primary side and not on the secondary side;

frequency with which the primary-side switch is turned on is adjusted by the demand pulses conveyed from the secondary side to the primary side to regulate the output voltage or the output current at the output port; and

the secondary side further comprises:

a first capacitor; and

a first rectifier poled to charge the first capacitor during forward power converter pulses of the flyback converter, wherein the demand pulses are generated using energy stored in the first capacitor.

Ex. 1001, 14:1–43.

D. Asserted Challenges to Patentability and Prior Art

Petitioner challenges the following claims based on the grounds in the table below.

Ground	Claims Challenged	35 U.S.C. §	References
1	18, 19–23, 25, 30, 31, 34–36, 41–43, 45, 48–51	103	Zhu ¹ and Mao ²
2	18, 19–23, 25, 30, 31, 35, 36, 41, 42, 45, 48–51	103	Szepesi ³ and Mao
3	18, 22, 23, 25, 30, 34, 41–43, 45, 48, 49, 51	103	Matsumoto ⁴ and Mao

Pet. 2.

¹ US 2011/0096573 A1, published Apr. 28, 2011 (Ex. 1005).

² US 6,466,461 B2, issued Oct. 15, 2002 (Ex. 1006).

³ US 5,498,995, issued Mar. 12, 1996 (Ex. 1007).

⁴ US 7,773,392 B2, issued Aug. 10, 2010 (Ex. 1010).

Petitioner submits a declaration from its expert, Mr. Bohannon (Ex. 1003, “Bohannon Original Declaration”) that accompanied the Petition, and a declaration from Mr. Bohannon (Ex. 1025, “Bohannon Reply Declaration”) that accompanied Petitioner’s Reply. Patent Owner submits a declaration (Ex. 2015, “Sandler Declaration”) from its expert, Mr. Sandler, that accompanied the Patent Owner Response.⁵

II. LEVEL OF SKILL AND CLAIM CONSTRUCTION

A. Level of Skill in the Art

To determine the level of an ordinarily skilled artisan, various factors may be considered, including the “type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.” *In re GPAC, Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (quotation omitted).

Mr. Bohannon testifies that an ordinarily skilled artisan would have had a “B.S. degree, or its equivalent, in electrical engineering or physics and approximately two years of practical experience working with switching regulators and analog/mixed signal circuit design, or an equivalent combination of academic study and work experience.” Ex. 1003 ¶ 43. Mr. Sandler uses the same definition for his analysis. Ex. 2015 ¶ 19.

We are persuaded that Messrs. Bohannon’s and Sandler’s description of the level of ordinary skill in the art is appropriate for the subject matter of the ’713 patent, and we adopt that description.

⁵ With its Preliminary Response, Patent Owner submitted the Declaration of Steven M. Sandler in Support of Preliminary Patent Owner Response (Ex. 2001). Prelim. Resp. vi.

B. Claim Construction

Patent Owner requests that we construe the term “regulate” in claims 18 and 48. PO Resp. 13. We determine that we do not need to expressly construe any claim term for this Decision.⁶ *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

III. ANALYSIS OF ASSERTED GROUNDS

“In an *inter partes* review . . . , the petitioner shall have the burden of proving a proposition of unpatentability by a preponderance of the evidence.” 35 U.S.C. § 316(e). “[T]he burden of proof is on the petitioner to prove unpatentable those issued claims that were actually challenged in the petition for review and for which the Board instituted review.” *Nike, Inc. v. Adidas AG*, 812 F.3d 1326, 1334 (Fed. Cir. 2016). To satisfy its burden of proving obviousness, a petitioner must articulate a reason why a person of ordinary skill in the art would have combined or modified prior art references. *In re NuVasive, Inc.*, 842 F.3d 1376, 1382 (Fed. Cir. 2016); *see also Metalcraft of Mayville, Inc. v. The Toro Co.*, 848 F.3d 1358, 1366 (Fed. Cir. 2017) (“In determining whether there would have been a motivation to combine prior art references to arrive at the claimed invention, it is insufficient to simply conclude the combination would have been obvious without identifying any reason why a person of skill in the art would have made the combination.”); *Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015) (“[O]bviousness concerns whether a skilled artisan not only could have made but would have been motivated to make the combinations or modifications of

⁶ We authorized the parties to file additional briefs regarding the meaning of the term “frequency” and appreciate the parties’ briefing of that issue. Papers 50–54. We have nevertheless determined that we do not need to construe that term for this Decision.

prior art to arrive at the claimed invention.”) (citing *InTouch Techs., Inc. v. VGO Commc'ns, Inc.*, 751 F.3d 1327, 1352 (Fed. Cir. 2014)). Further, it is Petitioner’s “burden to burden to demonstrate both ‘that a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so.’” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1381 (Fed. Cir. 2016) (quoting *Intelligent Bio-Sys., Inc. v. Illumina Cambridge, Ltd.*, 821 F.3d 1359, 1367-68 (Fed. Cir. 2016)).

As set forth below, we determine that Petitioner has not proven that an ordinarily skilled artisan would have been motivated to make any of the combinations set forth in its asserted grounds. Thus, Petitioner has not proven that any challenged claim would be unpatentable. *Magnum Oil*, 829 F.3d at 1381.

A. Ground 1: Asserted Obviousness over Zhu and Mao

Petitioner asserts that claims 18, 19–23, 25, 30–31, 34–36, 41–43, 45, and 48–51 would have been obvious over Zhu and Mao. Pet. 2.

1. Zhu

Zhu relates to “switching mode power supplies (SMPS).” Ex. 1005

¶ 3. Figure 3 of Zhu is shown below:

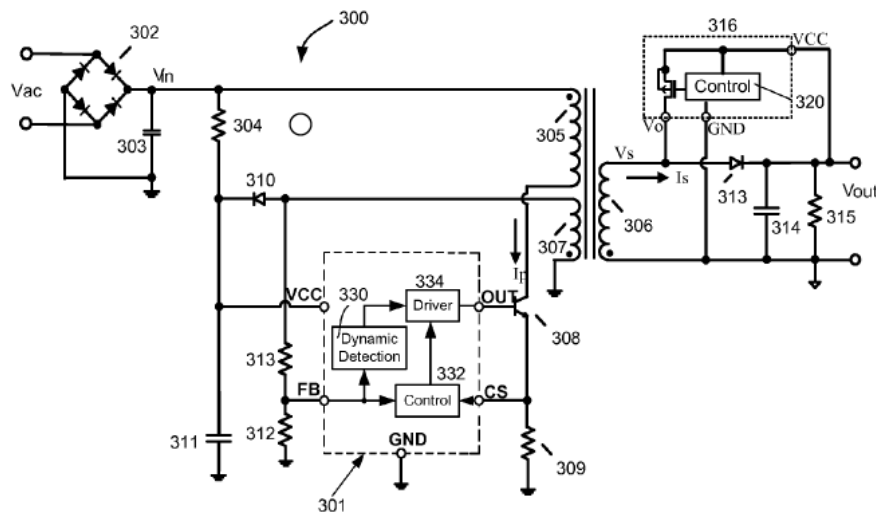


FIG. 3

Figure 3 above is “a simplified system schematic diagram of an SMPS having a rectifying diode located in the upper side of the secondary winding.”

Id. at ¶ 24. In particular, Figure 3 above “shows SMPS300 configured in a flyback converter topology.” *Id.* at ¶ 41.

“System 300 includes a primary winding 305 coupled in series to a power transistor 308, a secondary winding 306, and an auxiliary winding 307.” Ex. 1005 ¶ 41. “A primary side control circuit 301 receives a voltage signal through a FB input terminal and a current sense signal through a CS input terminal.” *Id.* “Control circuit 301 turns on and off power transistor 308 based on the voltage and/or current signals.” *Id.* “When power transistor 308 is turned on, a primary current I_p builds in primary winding 305, which stores energy.” *Id.* “The energy stored in primary winding 305 is transferred to secondary winding 306 during the turn-off time interval of

power transistor 308.” *Id.* “A rectifier element 313 and a smoothing capacitor 314 in secondary winding 306 converts a secondary voltage V_s into a DC system voltage V_{out} to supply to a load 315.” *Id.* “System output voltage V_{out} is monitored by a secondary side controller circuit 316.” *Id.* “The change information of output voltage V_{out} is sent by control circuit 316 in the secondary side, and received by control circuit 301 in the primary side.” *Id.*

“[S]econdary side control circuit 316 includes a control circuit 320 and a switch.” Ex. 1005 ¶ 42. “Control circuit 320 turns on the switch when system output voltage V_{out} is below a predetermined value.” *Id.*

2. *Mao*

Mao is directed to “circuits and techniques that improve the performance of circuitry that generates a dc bias voltage for use in the primary and/or secondary stages of a power converter, such as single-ended forward-converters, single-ended flyback converters, [and an] asymmetric half-bridge converter.” Ex. 1006, 1:11–15.

Figure 4A of Mao is shown below:

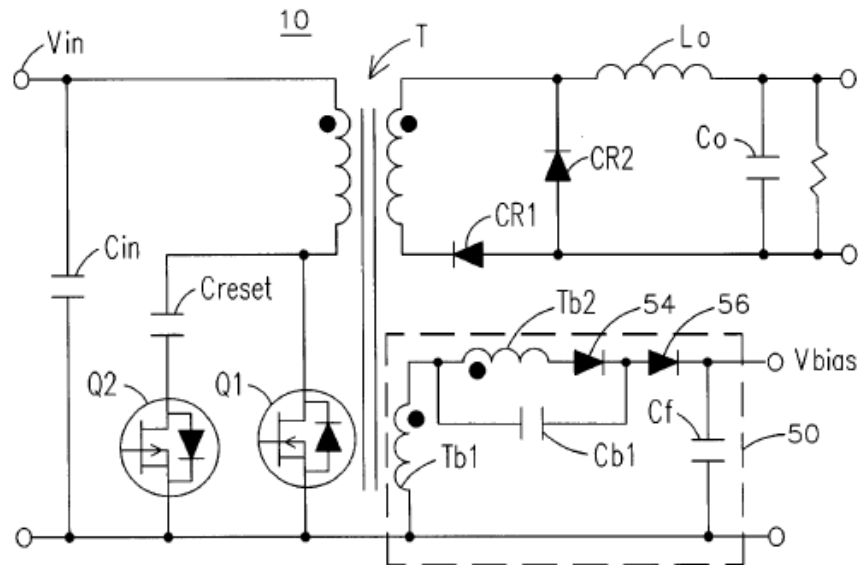


FIG. 4A

Figure 4A above illustrates “a bias circuit that . . . allows generating a bias voltage that is less sensitive to swings in the input voltage range as compared to [a prior art] biasing circuit.” Ex. 1006, 2:63–67. Bias circuit 50 includes bias windings $Tb1$ and $Tb2$, which are voltage sources, and are coupled with an isolating transformer T . *Id.* at 3:12–29. $Cb1$ is a voltage-holding capacitor and Cf is a filter capacitor that is coupled in parallel with the load to which bias circuit 50 delivers energy. *Id.*

Figure 9 of Mao is shown below:

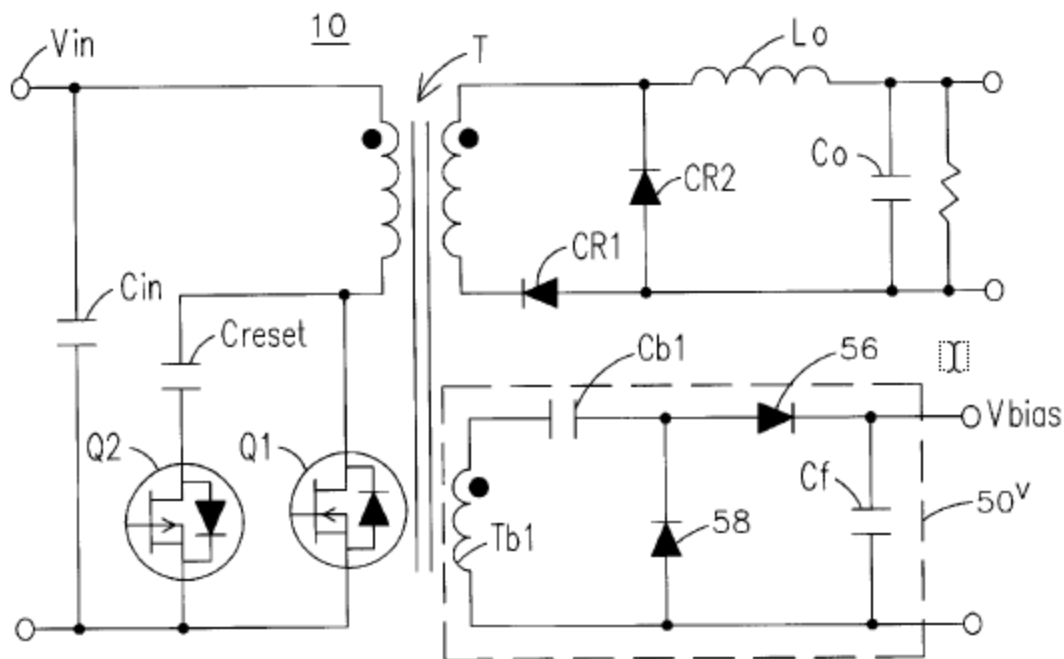


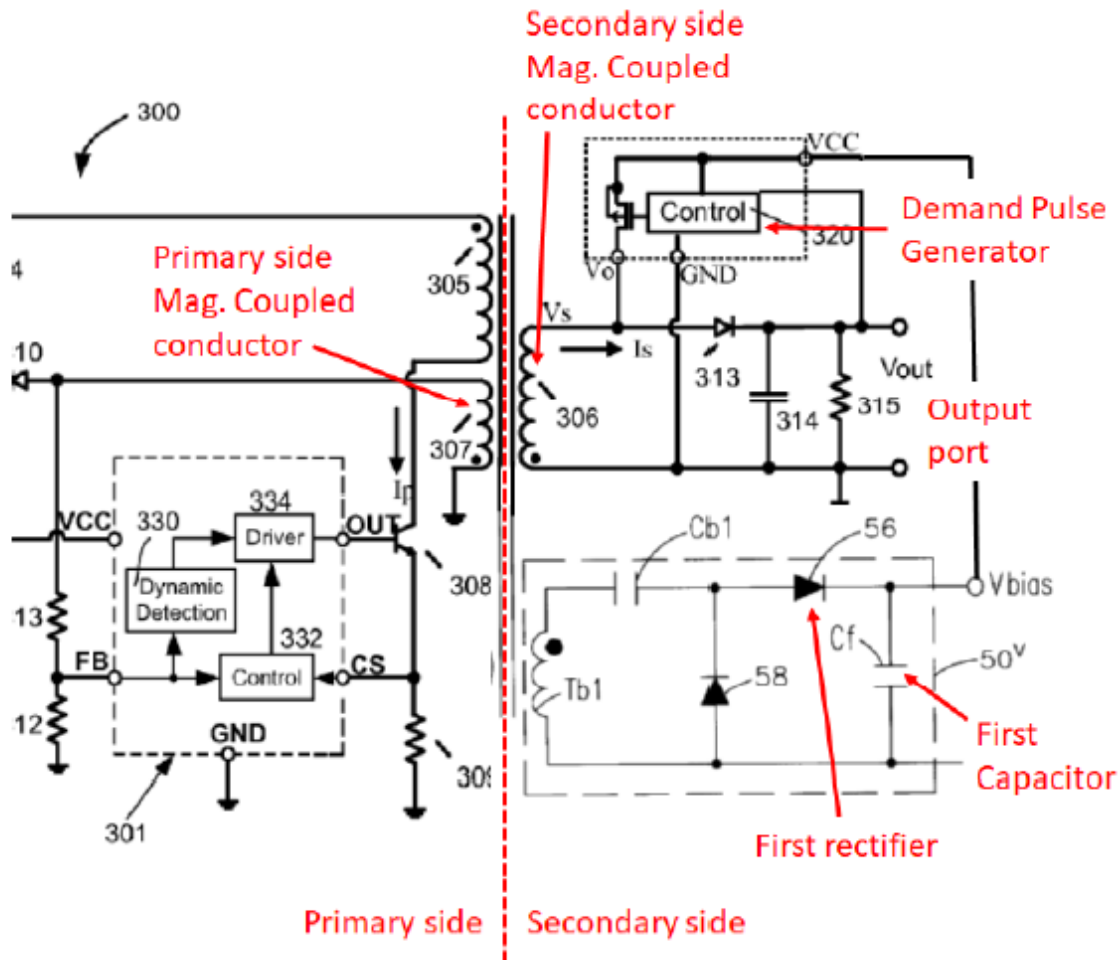
FIG. 9

Figure 9 above shows power converter 10 with circuit 50^V, diodes 56 and 58, capacitors C_{b1} and C_f , and bias winding $Tb1$. Mao has no express, textual description of this figure. Ex. 2015 ¶ 67.

3. Proposed Combination of Zhu and Mao

Petitioner argues that “[i]t would have been within the skill of [an ordinarily skilled artisan] to modify Zhu to add the improved bias circuit of Mao, either by providing an additional bias winding or by including the Mao circuit in the output stage itself.” Pet. 14 (citing Ex. 1003 ¶¶ 59–60).

Mr. Bonham provides the following annotated figure illustrating this combination:



Ex. 1003 ¶ 59. In the above figure, “the bias circuitry of FIG. 9 of Mao has been attached in place of the bias circuitry in Zhu, which merely powered the secondary controller using the output voltage.” *Id.* ¶ 60.

4. Motivations to Combine

Petitioner argues that an ordinarily skilled artisan would have been motivated to combine Zhu's and Mao's teachings to improve Zhu's bias circuit. Pet. 13. Petitioner provides four reasons why an ordinarily skilled artisan would be so motivated: (i) to avoid undesirable voltage fluctuations in

the power to Zhu's secondary controller, (ii) to enable Zhu to be more easily applied to power supplies operating at very low output voltages, (iii) to enable Zhu to be more easily applied to power supplies operating in a constant current mode, and (iv) to allow Zhu to be more easily applied to additional power supply topologies. *Id.* at 13–14. Patent Owner argues that none of these rationales would have motivated an ordinarily skilled artisan to combine Zhu's and Mao's teachings. PO Resp. 31.

We determine that Petitioner has not proven by a preponderance of the evidence that an ordinarily skilled artisan would have been motivated to combine Zhu's and Mao's teachings for any of the four proffered rationales. Below, we first summarize the parties' arguments regarding all four rationales because many arguments for the rationales overlap. Then, we address Petitioner's identification of Zhu's purported bias circuit. Then, we separately analyze each rationale.

a. Parties' Arguments

Petitioner argues that an ordinarily skilled artisan would have been motivated to improve Zhu's bias circuit based on Mao's teachings for the four rationales identified above. Pet. 13–14. Petitioner asserts that "Mao expressly teaches that a bias circuit, such as shown in Zhu, used to power its secondary controller can be vulnerable to undesirable fluctuations." *Id.* at 13 (citing Ex. 1006, 1:50–55). According to Petitioner, an ordinarily skilled artisan "would have also understood the Zhu bias circuit would be unable to accommodate very low output voltages, or be used in converters where a constant-current mode would cause the output voltage to drop to a level that was insufficient to reliably power Zhu's secondary circuits." *Id.* at 13–14

(citing Ex. 1003 ¶ 58). Petitioner asserts that this was a well-understood issue in the art. *Id.* at 14 (citing Ex. 1008, 3; Ex. 1003 ¶ 58).

According to Petitioner, “[t]herefore, [an ordinarily skilled artisan] would have been motivated to improve the Zhu bias circuit using the teachings of Mao to be able not only to improve the operation of the specific Zhu circuit, but also to allow the benefits of Zhu to be more easily applied to additional power supply topologies, to power supplies operating at low output voltages, and in power supplies with a constant output current mode.” Pet. 13–14 (citing Ex. 1003 ¶¶ 59–60). Further, according to Petitioner, “[i]t would have been within the skill of [an ordinarily skilled artisan] to modify Zhu to add the improved bias circuit of Mao, either by providing an additional bias winding or by including the Mao circuit in the output stage itself.” *Id.* at 14 (citing Ex. 1003 ¶¶ 59–60).

Patent Owner argues that Petitioner’s motivation to combine arguments rest on the faulty premise that Zhu has a bias circuit. PO Resp. 31. Patent Owner argues that Zhu does not show or discuss a bias circuit and neither Petitioner nor Mr. Bonham’s original declaration identify one. *Id.* at 31–32 (citing Ex. 2015 ¶ 146). Patent Owner further asserts that during cross examination Mr. Bohannon identified Zhu’s bias circuit as just a wire. *Id.* at 33 (citing Ex. 2016, 185:13–186:4). Patent Owner argues that a wire is not similar to Mao’s prior art bias circuit, which Mao described as having undesirable fluctuations. *Id.* at 35 (citing Ex. 2015 ¶¶ 147–150).

Further, Patent Owner argues that Petitioner has not provided any evidence that a wire would be vulnerable to voltage fluctuations, unable to accommodate very low output voltages, or unable to be used in a constant current mode. PO Resp. 36. Patent Owner also argues that the undesirable

fluctuations in Mao's prior art bias circuit 12 result from the fact that circuit has an unregulated bias voltage that varies as a function of input voltage. *Id.* at 37–38. Patent Owner argues that in contrast Zhu has a regulated output voltage that powers its secondary side circuitry without the need for a separate bias circuit. *Id.* at 39. Patent Owner also argues that Mao's improved bias circuits are unregulated and that there is no evidence that its unregulated bias voltages are any more stable than fully regulated power converter's output voltage. *Id.*

Patent Owner further argues that an ordinarily skilled artisan would not be motivated to modify Zhu to accommodate very low output voltages. PO Resp. 40. Patent Owner asserts that the teachings of the AN1283 Application Note are inapplicable to Zhu's circuit because Zhu's circuit does not use the TSM101 circuit. *Id.* at 41. Patent Owner also argues that an ordinarily skilled artisan would not have been motivated to modify Zhu's converter to accommodate very low voltage applications. *Id.* at 42–43 (citing Ex. 2015 ¶¶ 178–185). According to Patent Owner, Zhu has a flyback topology, which is generally known to be useful for generating high voltages. *Id.* at 43 (citing Ex. 2012, 11). Patent Owner argues that Zhu teaches that its converter is for applications requiring an output voltage of higher than 4.2V. *Id.* (citing Ex. 1005 ¶ 33). Further, Patent Owner asserts that using Zhu in a very-low-voltage application would eliminate the benefit available from Zhu's controller 320. *Id.* Patent Owner also argues that “Mao says nothing about its bias circuit achieving low voltage benefits, and, in fact, describes only relatively high bias voltage levels (i.e., 10V–22[V]).” *Id.* at 41.

Patent Owner argues that an ordinarily skilled artisan would not have been motivated to combine Zhu with Mao to operate in a constant current

mode. PO Resp. 45. Patent Owner argues that Petitioner presents no reasoning or support why an ordinarily skilled artisan would have been motivated to operate Zhu in a constant-current mode. *Id.*

Further, Patent Owner argues that Petitioner's additional power supply topologies rationale is unsupported. PO Resp. 46–47.

In its Reply, Petitioner argues that an ordinarily skilled artisan would have been motivated to incorporate Mao's bias circuit into Zhu's power converter to accommodate very low output voltages. Pet. Reply 16. Petitioner asserts that replacing Zhu's bias circuit with Mao's would improve Zhu's converter because the secondary voltage would not disappear with very low output voltages, allowing the converter to maintain regulation at such voltages. *Id.* at 17. Petitioner asserts that Mao's goal is to provide bias control techniques and circuits that improve the performance of bias circuitry even in converters that use the output voltage for bias. *Id.* Petitioner also argues that an ordinarily skilled artisan would have been motivated to use Mao's bias circuit to improve operation if an ordinarily skilled artisan used Zhu in a constant-current power supply. *Id.* at 18. Further, Petitioner argues that it would be easy to convert Zhu to regulating output current. *Id.* at 19. Petitioner also argues that Mao teaches an improved bias circuit that is independent of the particular secondary side output circuitry, and an ordinarily skilled artisan would add it to Zhu for that purpose. *Id.* at 20.

b. Zhu's Bias Circuit

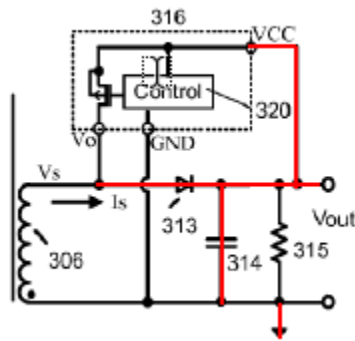
As mentioned, in the Petition, Petitioner's proffered motivations to combine Zhu and Mao concern improving the bias circuit shown in Zhu. Pet. 13 (“a bias circuit, such as shown in Zhu”). Petitioner argues that an ordinarily skilled artisan “would have been motivated to improve the Zhu

bias circuit using the teachings of Mao.” *Id.* Patent Owner notes that in the Petition, Petitioner never identifies Zhu’s bias circuit and Zhu itself does not refer to any of its circuits as a bias circuit. PO Resp. 31–32 (citing Ex. 2015 ¶ 146). As indicated above, Patent Owner argues that this lack of identification of Zhu’s bias circuit undermines Petitioner’s showing for a motivation to combine. *Id.* at 32–33.

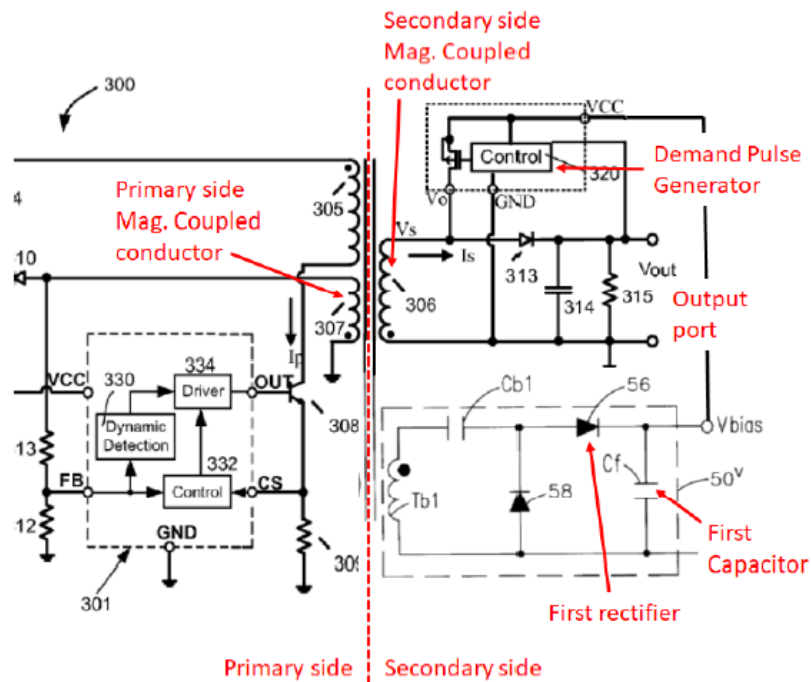
In our Institution Decision, we recognized that Petitioner failed to identify Zhu’s purported bias circuit. Inst. Dec. 30. Although we did not decline institution on that basis, we do agree with Patent Owner that, in the Petition, Petitioner should have identified the purported bias circuit in Zhu that an ordinarily skilled artisan would have been motivated to improve. Further, in our Institution Decision, we instructed Petitioner to identify Zhu’s purported bias circuit during the trial. *Id.* As set forth below, during trial, Mr. Bohannon, upon whose testimony Petitioner relies to prove a motivation to combine, gave inconsistent testimony regarding that bias circuit. That inconsistent testimony, coupled with Mr. Bohannon’s initial failure to identify Zhu’s bias circuit, diminishes the weight we accord to Mr. Bohannon’s testimony regarding motivations to combine.

As mentioned, the Petition does not identify the bias circuit in Zhu that it claims an ordinarily skilled artisan would have been motivated to improve. Pet. 13–14. In his original declaration, Mr. Bohannon also does not identify that bias circuit. Ex. 1003 ¶¶ 58–60. Zhu itself does not show or discuss any bias circuit. Ex. 2015 ¶ 146. Thus, Mr. Bohannon’s original testimony regarding motivations to combine lacks specificity: all four rationales set forth by Mr. Bohannon are directed to improving a bias circuit in Zhu, which Mr. Bohannon did not identify. Ex. 1003 ¶¶ 58–60; Pet. 13–14.

As discussed, in our Institution Decision, we instructed Petitioner to identify the bias circuit in Zhu that an ordinarily skilled artisan would have been motivated to improve. Inst. Dec. 30. During subsequent cross-examination, Mr. Bohannon was asked to identify that bias circuit and identified the wire in Figure 3 of Zhu from Vout up to VCC at controller 320 as Zhu's bias circuit. Ex. 2016, 186:4–6 (“The bias circuit was just a wire from Vout or trace out of circuit, probably a trace out of PCB going from Vout to 320.”). After Mr. Sandler testified that there was no evidence that a wire would have the problems that Mr. Bohannon identified Zhu's bias circuit as having (Ex. 2015 ¶ 153), Mr. Bohannon changed his identification of Zhu's bias circuit (Ex. 1025 ¶ 36), now identifying the elements highlighted in red in the annotated portion of Figure 3 of Zhu, reproduced below:



Ex. 1025 ¶ 36. The above annotated figure identifies diode 313, capacitor 314, and the wire extending from Vcc to Vout as Zhu's bias circuit. *Id.* This latter identification is not only inconsistent with Mr. Bohannon's cross examination testimony; it is also inconsistent with his original declaration testimony. In his original declaration, Mr. Bohannon illustrated the combination of Zhu and Mao as follows:



Ex. 1003 ¶ 59. Mr. Bohannon described this combined structure as showing “the bias circuitry of F[igure] 9 of Mao has been attached *in place of* the bias circuitry in Zhu, which merely powered the secondary controller using the output voltage.” *Id.* ¶ 60 (emphasis added). As can be seen from the above figure, diode 313 and capacitor 314 from Zhu Figure 2 were not replaced in this combined structure. Thus, Mr. Bohannon’s reply testimony that diode 313 and capacitor 314 are part of what he originally referred to as Zhu’s bias circuit is inconsistent with his original declaration testimony.

This inconsistent testimony, coupled with the initial failure by Mr. Bohannon to identify Zhu’s bias circuit, diminishes the weight we accord to Mr. Bohannon’s testimony regarding motivations to combine. The proper identification of Zhu’s bias circuit is not a minor issue: all four rationales for Petitioner’s motivation to combine are directed to improving Zhu’s bias circuit. Pet. 13. Further, although, over Patent Owner’s objections, we gave Petitioner the opportunity to identify the bias circuit in Zhu to be improved

during trial, we do not permit Petitioner and Mr. Bohannon to identify that bias circuit during cross examination and then completely change that identification, after Patent Owner argued the initial identification was flawed. A “petitioner may not submit new evidence or argument in reply that it could have presented earlier, e.g., to make out a prima facie case of unpatentability.” Patent Trial and Appeal Board Consolidated Trial Practice Guide (Nov. 2019) (“Consolidated Trial Practice Guide”), 73;⁷ *see also* *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369–70 (Fed. Cir. 2016) (holding that the Board did not err in refusing the reply brief as improper under 37 C.F.R. § 42.23(b) because petitioner relied on an entirely new rationale to explain why one of skill in the art would have combined the references at issue); 37 C.F.R. § 42.23(b); *Apple Inc. v. e-Watch, Inc.*, IPR2015-00412, Paper 50, 44 (PTAB May 6, 2016) (“‘Respond,’ in the context of 37 C.F.R. § 42.23(b), does not mean embark in a new direction with a new approach as compared to the position originally taken in the Petition. Accepting such belatedly presented new arguments would be unjust to the Patent Owner and we decline to do so.”).

To be clear, we do not hold the issues concerning Petitioner’s and Mr. Bohannon’s identification of the bias circuit in Zhu to be dispositive, but those issues do diminish the weight we accord Mr. Bohannon’s testimony regarding motivations to combine, which undermines Petitioner’s showing regarding those motivations.

c. Voltage Fluctuations

As mentioned, Petitioner argues that an ordinarily skilled artisan would have been motivated to combine Zhu’s and Mao’s teachings because “Mao

⁷ Available at www.uspto.gov/TrialPracticeGuideConsolidated.

expressly teaches that a bias circuit, such as shown in Zhu, used to power its secondary controller can be vulnerable to undesirable fluctuations.” Pet. 13. Petitioner argues that this teaching in Mao would have motivated an ordinarily skilled artisan to improve Zhu’s bias circuit using the teachings of Mao. *Id.* We determine that Petitioner has not proven that an ordinarily skilled artisan would have been so motivated.

First, Mr. Bohannon’s testimony, upon which Petitioner’s analysis for this rationale to combine relies, is unspecific and conclusory, and thus is entitled to little weight. Ex. 1003 ¶¶ 58–60. *Skky, Inc. v. MindGeek, s.a.r.l.*, 859 F.3d 1014, 1022 (Fed. Cir. 2017) (the Board is “not required to credit [a party’s] expert evidence simply because [the party] offered it”); *TQ Delta, LLC v. CISCO Sys., Inc.*, 942 F.3d 1352, 1359 (Fed. Cir. 2019) (“This court’s opinions have repeatedly recognized that conclusory expert testimony is inadequate to support an obviousness determination on substantial evidence review.”); *MobileMedia Ideas LLC v. Apple Inc.*, 780 F.3d 1159, 1172 (Fed. Cir. 2015); *Regents of Univ. of Min v. AGA Med. Corp.*, 717 F.3d 929, 941 (Fed. Cir. 2013); *Koito Mfg. Co. v. Turn-Key-Tech, LLC*, 381 F.3d 1142, 1152 (Fed. Cir. 2004); 37 C.F.R. § 42.22(a)(2) (“Each petition . . . must include . . . [a] full statement of the reasons for the relief requested including material facts.”). As discussed in Section III.A.4.b. above, Mr. Bohannon’s testimony regarding Zhu’s bias circuit was initially unspecific and subsequently contradictory. Further, as set forth below, Mr. Bohannon’s additional testimony for this rationale is conclusory and thus entitled to little weight.

In his original declaration, Mr. Bohannon testifies that a passage in Mao (Ex. 1006, 1:50–55) teaches that a secondary bias circuit such as the one

disclosed in Zhu can be disadvantageously vulnerable to output voltage fluctuations. Ex. 1003 ¶¶ 58–60. The cited passage reads “Although changing the polarity of the bias winding Tb may somewhat reduce the variation range of the voltage bias Vbias in some cases, the reduction is usually not significant, considering that both input voltage and output voltage can change in a typical dc-dc converter.” Ex. 1006, 1:50–55. This passage does not, on its face, teach that a secondary bias circuit, such as the one disclosed in Zhu, can be disadvantageously vulnerable to output voltage fluctuations. *Id.* And Mr. Bohannon does not explain why that passage teaches that the circuit disclosed in Zhu is vulnerable to such fluctuations. Ex. 1003 ¶¶ 58–60; Ex. 1025 ¶¶ 39–45.

Second, the record indicates Zhu’s circuit would not be vulnerable to the voltage fluctuations described in the cited passage in Mao. Ex. 2015 ¶¶ 154–162. The record further indicates that an ordinarily skilled artisan would not want to replace Zhu’s output voltage with Mao’s bias circuit to reduce such fluctuations because output voltage in Zhu is regulated, whereas the bias voltage of Mao is not. *Id.*

The cited passage in Mao (Ex. 1006, 1:50-55) is directed to power converter 10, which is shown in Figure 1, reproduced below:

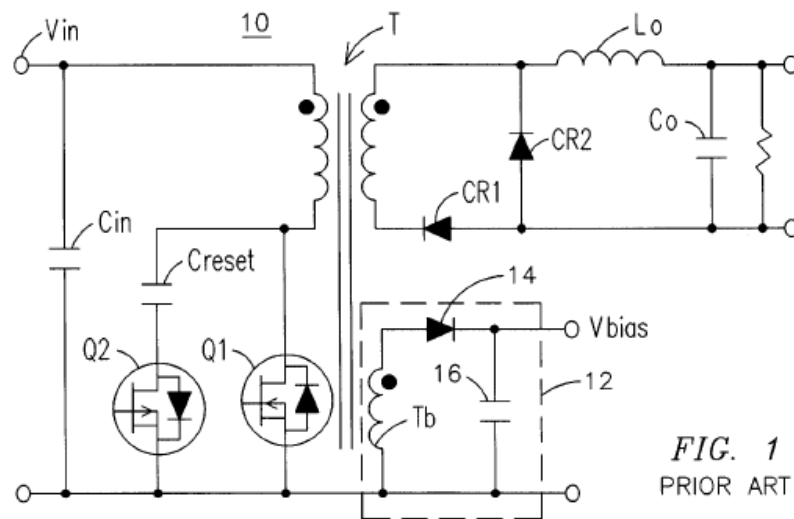


FIG. 1
 PRIOR ART

Ex. 1006, Fig. 1. “[Figure] 1 is a schematic diagram of a basic power converter used in one exemplary forward converter topology that uses biasing circuitry for generating a dc bias voltage that is susceptible to swings in the input voltage.” *Id.* at 2:47–50.

The bias voltage of power convertor 12 is unregulated and varies as a function of input voltage. Ex. 2015 ¶ 154; Ex. 2016, 118:21–24, 119:16–20, 133:9–13. Figure 2 of Mao, reproduced below, illustrates this variation (Ex. 2015 ¶ 155):

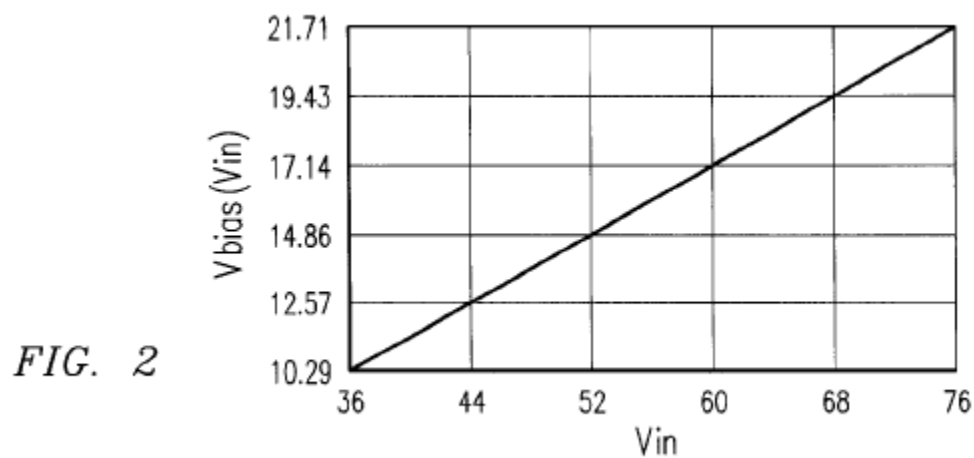


FIG. 2

Ex. 1006, Fig. 2. “[Figure] 2 is a plot illustrating exemplary voltage bias variation relative to the input voltage of the power converter [12] of [Figure] 1.” *Id.* at 2:51–53. As can be seen from Figure 2, the bias voltage “varies in proportion to the input voltage.” *Id.* at 1:38–42. Mao provides improved bias circuits that reduce the voltage level variation in a power circuit with an unregulated voltage bias, but even Mao’s improved bias circuits still have unregulated outputs. Ex. 2015 ¶¶ 154–155, 162; Ex. 1006, Figs. 4B–8B, 2:54–62 (“a bias voltage that is *less* sensitive to swings over the input voltage range” (emphasis added)), 3:15–29, 3:35–42.

In contrast, Zhu has a regulated voltage output. Ex. 1005 ¶ 36 (“output voltage V_{out} is regulated by a control block in controller 101.”); Ex. 2015 ¶ 157; Pet. 10 (Zhu’s “primary controller generates . . . a regulated output (V_{out}) on the secondary side to power a load.”). With Zhu’s regulated output voltage powering the bias to its secondary controller, Zhu does not have the voltage fluctuations described in Mao. Ex. 2015 ¶¶ 154–157. Mr. Sandler, in fact, testifies that the regulated output voltages of Zhu are constant over Zhu’s allowable input voltages. *Id.* ¶ 162. Mr. Sandler further testifies that Mao’s improved bias circuits are unregulated and thus an ordinarily skilled artisan would recognize that using Mao’s bias circuit 50V with Zhu would result in a less constant supply voltage because Mao’s bias voltage is unregulated. *Id.* Mr. Bohannon does not dispute Mr. Sandler’s testimony that the regulated output voltages of Zhu are constant over Zhu’s allowable input voltages and that using Mao’s bias circuit 50V with Zhu would result in a less constant supply voltage than without such a modification. Ex. 1025 ¶¶ 39–45. We credit Mr. Sandler’s undisputed testimony. Further, we agree with Mr. Sandler that, because the output voltages of Zhu are constant and

the use of Mao's bias circuit with Zhu would result in a less constant supply voltage, that an ordinarily skilled artisan would not have combined Zhu with Mao to reduce voltage fluctuations. Ex. 2015 ¶¶ 154–157, 160–162.

Third, in his Reply Declaration, Mr. Bohannon testifies that the following passage in Szepesi states that, even in a power supply with a regulated output, the supply voltage to the secondary-side controller can be vulnerable to output fluctuations under certain conditions: “In a short circuit condition the supply voltage to the secondary-side controller 22, V_{s2} gradually disappears due to the discharge of C2 by the chip.” Ex. 1007, 5:25–27 (cited in Ex. 1025 ¶ 39). It is unclear whether this testimony was meant to support Petitioner's Zhu-Mao combination—Szepesi is not an asserted reference for the Zhu-Mao ground (Ground 1). Ex. 1025 ¶ 39; Pet. Reply 16–17. Assuming this testimony is intended to support Ground 1, we find it unpersuasive.

First, Mr. Bohannon does not explain why a short circuit situation where a voltage gradually disappears would be considered a voltage fluctuation. Ex. 1025 ¶ 39. The cited passage in Szepesi does not describe this short circuit condition with the gradual disappearance of V_{s2} as a voltage fluctuation. Ex. 1007, 5:25–27. Mr. Bohannon merely argues that it is a voltage fluctuation without providing a reason why (Ex. 1025 ¶ 39), whereas a gradual decline in the output due to a short circuit would appear to be a decline, not a fluctuation. If Petitioner wanted to argue that an ordinarily skilled artisan would have been motivated to combine Zhu and Mao to address output issues with short circuits, Petitioner should have presented that rationale with its Petition. Consolidated Trial Practice Guide 73; 37 C.F.R. § 42.23(b). In any event, the gradual decline in output voltage

involving short circuits is not the voltage fluctuation that Mao warns about, upon which Petitioner relies. Ex. 1006, Fig. 2.

Second and equally important, Mr. Bohannon presents no persuasive reason why an ordinarily skilled artisan would expect that Mao's bias circuit would solve or ameliorate the short circuit output problem identified by Szepesi. Ex. 1025 ¶¶ 39–40. Mr. Bohannon merely testifies:

Replacing the primary reference's use of the output voltage as the source for its secondary bias with Mao's bias circuit would improve the converter because the supply voltage to the secondary-side controller would not disappear under these anticipated conditions, allowing the converter to maintain regulation even at very low output voltages. *Id.*; [Ex.] 1003, ¶ 143; *see also* [Ex.] 1008 (suggesting "[a] solution to provide a quasi constant supply voltage" to the controller").

Ex. 1025 ¶ 40. Mr. Bohannon, however, provides no analysis to support this testimony. He cites the AN1283 Application Note's disclosure that "[a] solution to provide a quasi constant supply voltage to the TSM101 is shown at Figure 4 [of the Application Note]: auxiliary winding is added at the secondary side of the transformer." Ex. 1008, 3 (cited by Ex. 1025 ¶ 40). Mr. Bohannon provides no analysis of why this referenced solution would be applicable to the proposed Zhu and Mao combination, which is not the circuit shown in Figure 4 of the Application Note. Ex. 1003 ¶¶ 58–59; Ex. 1025 ¶ 40.

In sum, we determine that Petitioner has not proven that an ordinarily skilled artisan would have combined Zhu's and Mao's teachings to avoid undesirable voltage fluctuations in the power to Zhu's secondary controller.

d. Constant Current Mode

As mentioned, Petitioner argues that an ordinarily skilled artisan would have been motivated to combine Zhu's and Mao's teachings to improve

Zhu's bias circuit so that it could be used in a constant current mode without causing the output voltage to drop to a level that was insufficient to reliably power Zhu's secondary circuits. Pet. 13–14 (citing Ex. 1003 ¶¶ 58–60, Ex. 1008, 3). We determine that Petitioner has not proven that an ordinarily skilled artisan would have been so motivated.

First, Mr. Bohannon's testimony, upon which Petitioner's analysis for this rationale to combine is based, is unspecific, inconsistent, and conclusory, and thus is entitled to little weight. Ex. 1003 ¶¶ 58–60; *see TQ Delta, LLC*, 942 F.3d at 1359. As discussed in Section III.A.4.b. above, Mr. Bohannon's testimony regarding Zhu's bias circuit was initially unspecific and subsequently contradictory. Further, Mr. Bohannon's additional declaration testimony for this rationale is conclusory. Mr. Bohannon cites the disclosure regarding the power supply for the TSM101 integrated circuit in the AN1283 Application Note, the pertinent part of which reads: "In applications requiring low voltage battery charge or when the charger is in current regulation mode, the output voltage can be too low to supply correctly the TSM101." Ex. 1008, 3 (cited by Ex. 1003 ¶ 58). Mr. Bohannon, however, provides no reason or analysis in his original declaration why this teaching is applicable to the proposed combination of Zhu and Mao. Ex. 1003 ¶¶ 58–60. Nor does Mr. Bohannon in his original declaration address how Zhu would be modified to operate in a constant current mode or why an ordinarily skilled artisan would seek to operate Zhu in a constant current mode. *Id.*; Ex. 2016, 254:13–18. In his Reply Declaration, Mr. Bohannon merely argues that a sense resistor could be added to the output circuit—without showing specifically the modification that he claims an ordinarily skilled artisan would have been motivated to make. Ex. 1025 ¶ 43.

Second, Mr. Bohannon provides no persuasive reason why an ordinarily skilled artisan would want to modify Zhu to operate in a constant current mode. Ex. 1003 ¶¶ 58–60. Zhu does not disclose operating in such a mode; Zhu provides regulated output voltage, not regulated current. Ex. 2015 ¶ 192. Zhu’s secondary controller is in fact designed to produce regulated output voltage—detecting when low voltage conditions at the output port during dynamic events to provide more energy to the secondary circuit. *Id.* ¶ 190.

In his Reply Declaration, Mr. Bohannon testifies that “[t]he motivation for using Mao’s bias circuit with [Zhu] is not to allow operation in a constant-current mode; it is to improve operation if [an ordinarily skilled artisan] used [Zhu] in a constant-current power supply.” Ex. 1025 ¶ 41 (emphasis omitted). Mr. Bohannon further testifies: “[Patent Owner] does not suggest that using Zhu’s circuit to regulate output current would be in any way difficult or beyond [an ordinarily skilled artisan’s] knowledge. In reality, Zhu’s circuit could easily be used to regulate output current by adding a sense resistor in the output circuit.” *Id.* ¶ 43. This testimony merely goes to whether an ordinarily skilled artisan *could* have modified Zhu’s circuit to regulate output current, not whether an ordinarily skilled artisan *would* have been motivated to do so.

In his Reply Declaration, Mr. Bohannon further testifies that: “Nor does Patent Owner dispute that [an ordinarily skilled artisan] would have known that a current regulation mode of operation is useful for certain power converter applications, e.g., to charge a battery and, therefore, would at the very least have been motivated to try using [Zhu] to provide [its] disclosed improvements (e.g., the better transient response of Zhu . . .) in a desirable

battery charger application.” Ex. 1025 ¶ 43. This testimony also misses the point. Patent Owner had no obligation to dispute an assertion that Petitioner did not make. And Mr. Bohannon should not wait for the Reply to assert that an ordinarily skilled artisan would have been motivated to modify Zhu because a current regulation mode is useful for power converter applications and Zhu has good transient response—and then rely on the fact that Patent Owner did not rebut this assertion in its Patent Owner Response.

Consolidated Trial Practice Guide 73; 37 C.F.R. § 42.23(b). If Petitioner wanted to rely on the motivation of using Zhu to charge a battery because of better transient responses, it needed to present that motivation with its Petition. *Intelligent Bio-Sys.*, 821 F.3d at 1369–70; 37 C.F.R. § 42.23(b).

This testimony by Mr. Bohannon regarding using Zhu in a current control mode to charge batteries due to Zhu’s better transient response is also conclusory. Mr. Bohannon merely states that Patent Owner does not dispute that the current regulation of mode is useful for certain power converter applications, such as charging a battery, and that an ordinarily skilled artisan would have been motivated to use such a mode with Zhu due to its better transient response without providing any analysis or evidence to support the assertion that an ordinarily skilled artisan would have been motivated to use Zhu’s circuit for charging a battery because of a better transient response. Ex. 1025 ¶ 43; *see TQ Delta*, 942 F.3d at 1359.

In sum, we determine that Petitioner has not proven that an ordinarily skilled artisan would have combined Zhu’s and Mao’s teachings so Zhu’s bias circuit could have been used or improved in a constant current regulation mode.

e. Accommodating Very Low Output Voltages

As mentioned, Petitioner argues that Zhu shows a bias circuit, that an ordinarily skilled artisan would have understood that Zhu's bias circuit would be unable to accommodate very low output voltages, and that, as a result, an ordinarily skilled artisan would have been motivated to improve Zhu's bias circuit to accommodate very low output voltages based on Mao's teachings. Pet. 13. We determine that Petitioner has not proven that an ordinarily skilled artisan would have been so motivated.

First, Mr. Bohannon's testimony on this issue, upon which Petitioner's analysis for this rationale to combine is based, is unspecific, inconsistent, and conclusory, and thus is entitled to little weight. Ex. 1003 ¶¶ 58–60 *see TQ Delta*, 942 F.3d at 1359. As discussed in Section III.A.4.b. above, Mr. Bohannon's testimony regarding Zhu's bias circuit was initially unspecific and subsequently contradictory. Further, Mr. Bohannon's additional testimony for this rationale is conclusory. For this rationale, Mr. Bohannon cites the disclosure regarding the power supply for the TSM101 integrated circuit in the AN1283 Application Note, the pertinent part of which reads: "In applications requiring low voltage battery charge or when the charger is in current regulation mode, the output voltage can be too low to supply correctly the TSM101." Ex. 1008, 3 (cited by Ex. 1003 ¶ 58). Although this disclosure indicates that applications that require "very low output voltages" may have particular concerns that need to be addressed, Mr. Bohannon does not explain why an ordinarily skilled artisan would have wanted to use Zhu's circuit or a modified version thereof for such "very low output voltages." Ex. 1003 ¶¶ 58–60. In his Reply Declaration, Mr. Bohannon further does not provide any evidence that an ordinarily

skilled artisan would want to use Zhu’s circuit for low voltage applications. Instead, Mr. Bohannon claims that his reference to accommodating very low output voltages concerned significant drops in output voltage under conditions, such as load transients or near short-circuit events:

[Patent Owner’s] criticisms related to “use in a low voltage application” again misapprehend my opinions on the [ordinarily skilled artisan]’s knowledge and motivations. It is not a question of [an ordinarily skilled artisan] intending to use Zhu (or Szepesi or Matsumoto) in an application having an intended “low” output voltage application (whatever [Patent Owner] intended to mean by “low” in this context). Rather, even in the applications expressly identified in the primary references (e.g., isolated, single ended flyback converters using two controllers), such power converters will sometimes experience significant drops in output voltage under expected conditions (e.g., load transients or near short-circuit events). It is in anticipation of such events that [an ordinarily skilled artisan] would seek to improve the primary references, not in order to use them in “low voltage” applications.

Ex. 1025 ¶ 40 n. 9. We do not interpret Mr. Bohannon’s original testimony as setting forth a motivation to combine Zhu and Mao to address load transients or near short-circuit events. Ex. 1003 ¶¶ 58–60. Mr. Bohannon’s original declaration and the Petition both expressly argued that the applicable motivation here was to *accommodate* very low output voltages—with the normal usage of the term *accommodate*, that means to deliberately produce such low voltages. Ex. 3003, 3. And it is too late to raise a new motivation to combine with the Reply. Consolidated Trial Practice Guide 73. Further, Mr. Bohannon has not set forth any persuasive evidence or analysis that modifying Zhu based on Mao would be expected to diminish drops in output voltage due to load transients or near-short circuit events. Ex. 1025 ¶ 40 n. 9.

In sum, Mr. Bohannon and Petitioner have not set forth persuasive evidence that an ordinarily skilled artisan would have been motivated to modify Zhu to accommodate very low voltages.⁸

Second, Mr. Sandler provides persuasive testimony that an ordinarily skilled artisan would not have been motivated to use Zhu's circuit or a modified version thereof "to accommodate very low output voltages." Ex. 2015 ¶¶ 163–186.⁹ Mr. Sandler testifies that Zhu has a flyback topology, which is generally known in the art to be "useful for generating *high* voltages," not low voltages. *Id.* ¶ 178 (quoting Ex. 2012, 11). The book *Switching Power Supply Design* supports this testimony, disclosing "the flyback topology is so useful generating high voltages." Ex. 2012, 11. Further, Mr. Bohannon has not provided any evidence that the flyback topology would be useful for low voltage applications. Ex. 1025 ¶¶ 39–45.

Mr. Sandler persuasively testifies that an ordinarily skilled artisan would not have wanted to use a power converter having secondary side circuitry requiring supply power and add a bias circuit when the prior art

⁸ In our Institution Decision, we held this proffered motivation to combine to be sufficient for Institution. Inst. Dec. 30. At that time, Patent Owner had not addressed the issue of whether an ordinarily skilled artisan would have been motivated to use Zhu's circuit for very low voltage applications. In any event, on a more complete record and with the preponderance of the evidence standard, we determine that Petitioner has not proven that an ordinarily skilled artisan would have been so motivated. *See TriVascular, Inc. v. Samuels*, 812 F.3d 1056, 1068 (Fed. Cir. 2016).

⁹ Mr. Bohannon suggests that there may be some ambiguity with Patent Owner's use of the term "low" output voltage. Ex. 1025 ¶ 40 n. 9. Petitioner and Mr. Bohannon, however, introduced the term "very low output voltages" when setting forth the involved rationale. Pet. 13; Ex. 1003 ¶ 58. Thus, an ambiguity in the term would undermine, not strengthen, Petitioner's showing.

circuit converter in Zhu can generate any desired low output. Ex. 2015 ¶ 178. Mr. Sandler testifies that it would be inefficient and expensive to add a secondary bias circuit to Zhu for this purpose when the prior art converter in Zhu can generate such outputs. *Id.* In his Reply Declaration, Mr. Bohannon does not dispute that the prior art circuit converter in Zhu can generate any desired low output without adding a secondary bias circuit. Ex. 1025 ¶¶ 39–40. Nor does Mr. Bohannon provide any persuasive reason why an ordinarily skilled artisan would choose to modify Zhu when Zhu’s prior art circuit could accommodate low voltage outputs without adding a secondary bias circuit. *Id.* We credit Mr. Sandler’s testimony that an ordinarily skilled artisan would not have wanted to do so. Ex. 2015 ¶ 178.

Mr. Sandler persuasively testifies that the benefits of Zhu’s secondary controller would be eliminated or significantly diminished by using Zhu’s circuit for very low output voltages. Ex. 2015 ¶¶ 179–182 (citing Ex. 1005 ¶¶ 37, 38, Fig. 2). In particular, Mr. Sandler testifies Zhu’s secondary circuit monitors the output voltage to determine when it drops below a specific level in which the primary side controller is triggered to provide more energy to the secondary circuit. *Id.* (citing Ex. 1005 ¶¶ 37, 38, Fig. 2). Mr. Sandler testifies that the benefits of this secondary circuit would diminish with low output voltages and fall to zero at very low output voltages. *Id.* (citing Ex. 1005 ¶¶ 37, 38, Fig. 2). We credit this testimony, which Mr. Bohannon does not dispute. Ex. 1005 ¶¶ 37, 38, Fig. 2; Ex. 1025 ¶¶ 39–45.

In sum, we determine that Petitioner has not proven that an ordinarily skilled artisan would have been motivated to combine Zhu’s and Mao’s teachings to accommodate very low output voltages.

f. Additional Topologies

As mentioned, Petitioner argues that an ordinarily skilled artisan would have been motivated to combine Mao's teachings with Zhu to allow Zhu to be more easily applied to additional power supply topologies. Pet. 13. The Petition cites nothing to support this assertion other than conclusory testimony by Mr. Bohannon, which reads: "[an ordinarily skilled artisan] would have been motivated to improve the bias circuit of Zhu using the teachings of Mao, to be able to not only improve the operation of the specific Zhu circuit, but also to allow the benefits of the Zhu circuit to be more easily applied to additional power supply topologies." Ex. 1003 ¶ 59.

Mr. Bohannon cites nothing to support that testimony. *Id.* In his original declaration, Mr. Bohannon further does not identify the additional power supply topologies he is referencing or provide any analysis of why combining Zhu with Mao would allow Zhu's circuit to be more easily applied to the unspecified additional power supply topologies. *Id.* Given the conclusory and unspecific nature of this testimony, we accord it little weight. *TQ Delta*, 942 F.3d at 1359.

In response to this testimony, Mr. Sandler notes that Mr. Bohannon in his original declaration does not explain whether the "additional power supply topologies" to which he refers are topologies that "accommodate very low output voltages" or operate in "a constant-current mode" or whether he is referring to other unnamed topologies. Ex. 2015 ¶ 195. Mr. Sandler testifies that "[t]o the extent that Mr. Bohannon is referring to additional different topologies, there is no indication as to what those topologies would be or why they would be desirable." *Id.* ¶ 196.

In his Reply Declaration, Mr. Bohannon identifies flyback, forward, and cuk converters as exemplary additional power supply topologies. Ex. 1025 ¶ 45. Mr. Bohannon cites Szepesi as identifying these topologies. *Id.* This identification is belated. Petitioner and Mr. Bohannon cannot wait for Mr. Sandler to complete his testimony before identifying the additional topologies that purportedly would have motivated an ordinarily skilled artisan to modify Zhu. Consolidated Trial Practice Guide 73; 37 C.F.R. § 42.23(b). The testimony setting forth these additional topologies is also conclusory. Mr. Bohannon merely declares that it would be beneficial to remove what he terms the dependent bias circuit of Zhu and replace it with Mao's circuit without explaining why that modification would purportedly be perceived as advantageous by an ordinarily skilled artisan for flyback, forward, and Cuk converters. Ex. 1025 ¶ 45; *see TQ Delta*, 942 F.3d at 1359.

We determine that Petitioner has not proven that an ordinarily skilled artisan would have been motivated to combine Zhu and Mao to allow Zhu to be more easily applied to additional topologies.

g. Summary

In sum, we determine that Petitioner has not proven that an ordinarily skilled artisan would have been motivated to modify Zhu based on Mao's teachings. Thus, Petitioner has not proven that any challenged claim would have been obvious over the combination of Zhu and Mao.

B. Ground 2: Asserted Obviousness over Szepesi and Mao

Petitioner asserts that claims 18, 19–23, 25, 30, 31, 35, 36, 41, 42, 45, and 48–51 would have been obvious over Szepesi and Mao. Pet. 2.

1. Szepesi

Szepesi is titled “Short Circuit Frequency Shift for Switching Regulators.” Ex. 1007, code (54). Szepesi discloses an isolated switched-mode power supply incorporating two control circuits, one on the primary side and one on the secondary side. *Id.* at 3:42-65, Figs. 1–2. Szepesi discloses a primary controller that generates a series of pulses to switch a power switch to start operation of the converter. *Id.* at 3:65–4:12. Szepesi further discloses a secondary controller that, once sufficient bias power has developed, takes over control and sends pulses from the output side, through a pulse transformer, to control the primary switch. *Id.* at 4:13-24.

Figure 2 of Szepesi is reproduced below:

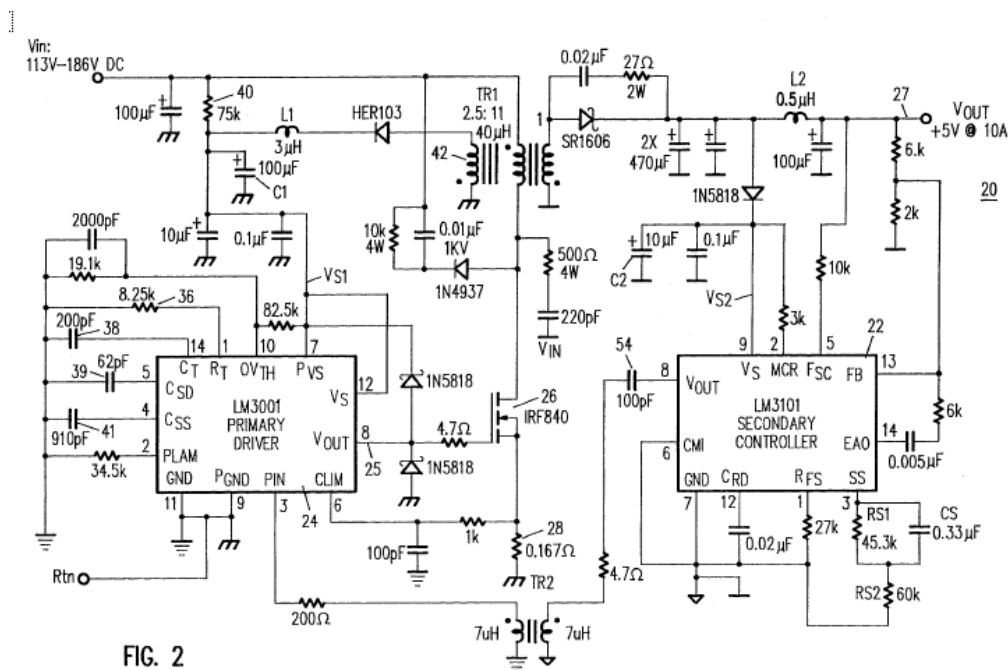


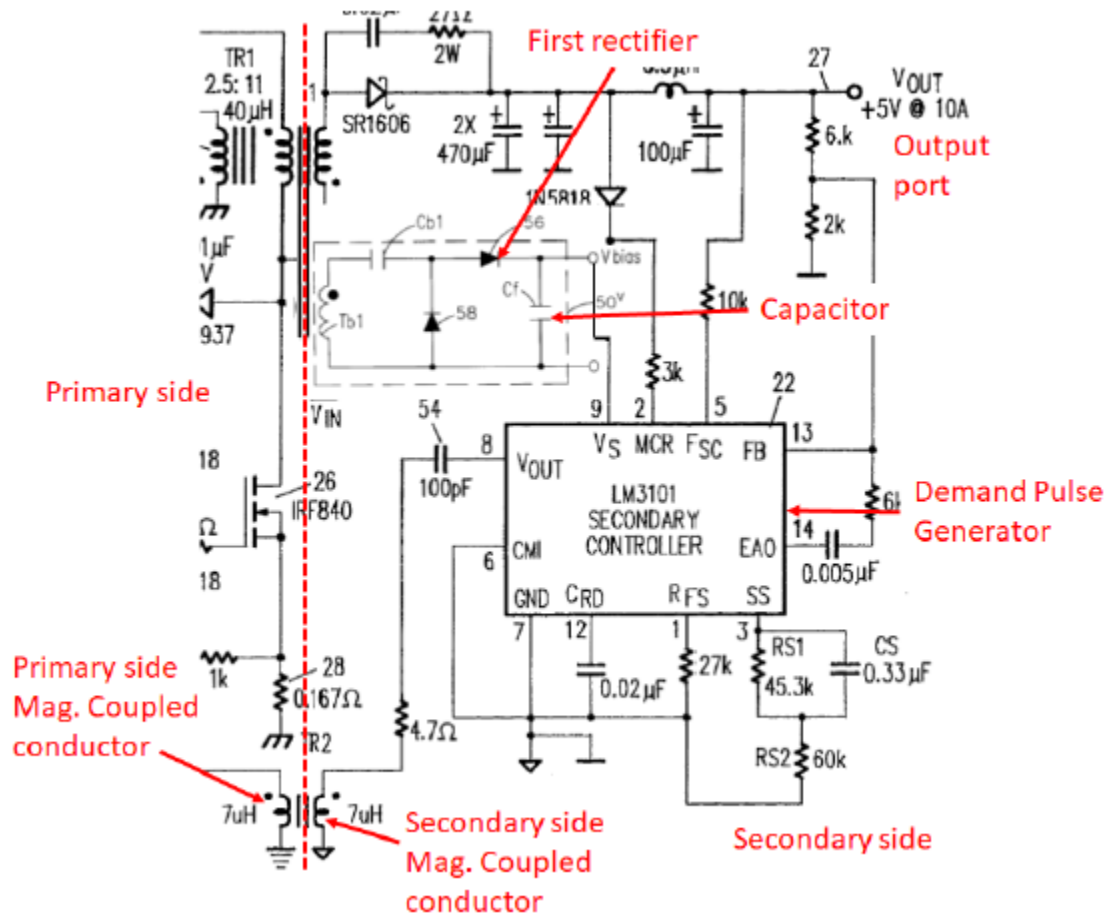
FIG. 2

Ex. 1007, Fig. 2. Figure 2 is a flyback voltage converter. *Id.* at 3:2–6.

2. Proposed Combination of Szepesi and Mao

Petitioner argues that “[i]t would have been within the skill of [an ordinarily skilled artisan] to modify Szepesi to add the improved bias circuit

of Mao, either by providing an additional bias winding or by including the Mao circuit in the output stage itself.” Pet. 29 (citing Ex. 1003 ¶¶ 144–145). Mr. Bonham provides the following annotated figure illustrating the proposed combination:



Ex. 1003 ¶ 144. In the above figure, “the bias circuitry of [Figure] 9 of Mao has been attached in place of the bias circuitry in Szepesi, which powers the secondary controller using diode IN5818 and capacitor C2 on the output voltage as shown in annotated Fig[ure] 2 above.” *Id.* ¶ 145.

3. Motivations to Combine

Petitioner presents the same four rationales for combining Szepesi and Mao as for Zhu and Mao. Pet. 13–14, 29. We determine that Petitioner has not proven by a preponderance of the evidence that an ordinarily skilled

artisan would have been motivated to combine Zhu and Mao's teachings for any of these four proffered rationales.

Below, we first summarize the parties' arguments regarding all four rationales because many of those arguments overlap. Then, we address Petitioner's identification of Szepesi's purported bias circuit. Then, we separately analyze each rationale.

a. Parties' Arguments

The parties present substantially the same arguments regarding motivations to combine Szepesi and Mao as for Zhu and Mao. In the Petition, Petitioner presents the same rationales and arguments for combining Szepesi and Mao as for Zhu and Mao. Pet. 13–14, 29. In the Patent Owner Response, Patent Owner responds to these arguments with essentially the same arguments it presents for Zhu and Mao. PO Resp. 30–47. Patent Owner does, however, present a few arguments that are specific to the Szepesi-Mao combination.

Patent Owner argues that, during cross examination, Mr. Bohannon identified diode 1N5818 and capacitor C2 as Szepesi's bias circuit. PO Resp. 34. Patent Owner argues that Petitioner has not shown that Szepesi's diode-capacitor combination is vulnerable to voltage fluctuations, unable to accommodate low output voltages, or unable to be used in a constant current mode. *Id.* at 36. Patent Owner further argues that Szepesi, like Zhu, has a regulated voltage output, whereas Mao does not. *Id.* at 38–39. Patent Owner asserts that Szepesi, like Zhu, is a flyback topology, which is generally known to be useful for generating high voltages. *Id.* at 43. Patent Owner also argues that an ordinarily skilled artisan would not select Szepesi's converter, which relies on secondary-side control, for very low voltage

applications. *Id.* at 44. According to Patent Owner, the logical choice for a very-low-voltage application would be a converter having primary-side regulation, such as the conventional SMPS of Zhu's Figure 1. *Id.* Patent Owner further asserts that an ordinarily skilled artisan would not go to the expense of adding a separate secondary-side bias circuit to Szepesi's already-expensive power converter when much-less-expensive solutions would provide the same low regulation voltage. *Id.*

Patent Owner also argues that Szepesi expressly discloses the ability to run in a constant current mode with no indication of any problems in doing so. PO Resp. 46. Patent Owner asserts that modification is therefore not necessary to operate Szepesi in a constant current mode. *Id.*

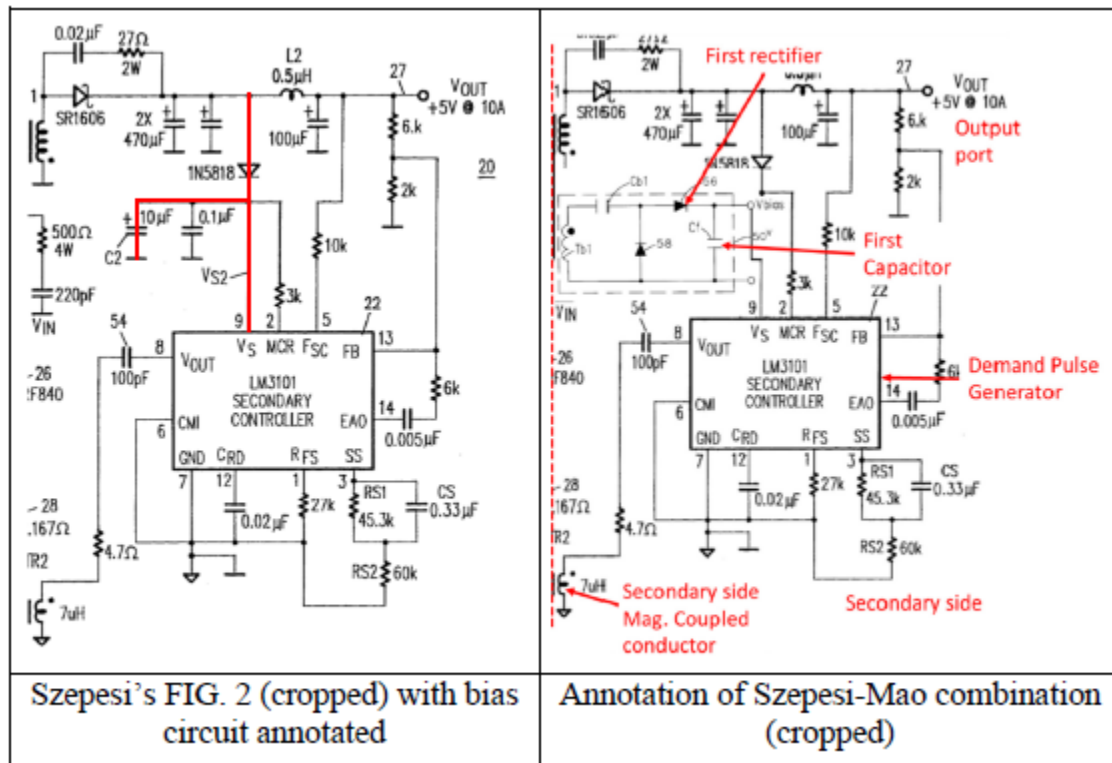
In its Reply, Petitioner presents essentially the same arguments regarding motivations to combine Szepesi and Mao as for Zhu and Mao. Pet. Reply 13–20. Petitioner does, however, present a few Szepesi-specific arguments. Petitioner argues that “Szepesi explicitly states that, even in a power supply with a regulated output, the supply to the secondary-side controller can be vulnerable to output fluctuations.” *Id.* at 16–17. Petitioner also argues that Szepesi does not disclose the ability to run in a constant current mode. *Id.* at 19. Petitioner asserts that Szepesi refers to current mode regulation to accomplish voltage regulation. *Id.* at 19–20. Petitioner also identifies diode 1N5818 and capacitor C2 as Szepesi's bias circuit. *Id.* at 15. Petitioner also argues that Szepesi suggests applying its two controller approach to different topologies. *Id.* at 20.

In the Sur-reply, Patent Owner argues that Szepesi teaches the drawbacks of using linear optocoupler feedback, like that used in the TSM101 integrated circuit. PO Sur-reply 26.

b. Szepesi's Bias Circuit

As mentioned, the Petition's proffered motivations to combine Szepesi and Mao concern the purported bias circuit shown in Szepesi. Pet. 29 ("a secondary bias circuit, such as shown in Szepesi."). Petitioner argues that an ordinarily skilled artisan "would have been motivated to improve the Szepesi bias circuit using the teachings of Mao." *Id.* As Patent Owner notes, in the Petition, Petitioner never identifies Szepesi's bias circuit, and, in his original declaration, Mr. Bohannon also does not identify Szepesi's bias circuit. PO Resp. 32; Pet. 29; Ex. 1003 ¶¶ 143–145. As indicated above, Patent Owner argues that this lack of identification of Szepesi's bias circuit undermines Petitioner's showing for a motivation to combine. *Id.*

In his Reply Declaration, Mr. Bohannon identifies Szepesi's bias circuit as capacitor C2 and diode IN5818 in Figure 2 of Szepesi bias. Ex. 1025 ¶ 37. Mr. Bohannon provides a side by side comparison of the secondary sides of Figure 2 of Szepesi and the Szepesi-Mao combination:



Ex. 1025 ¶ 37. In the above drawing, Mr. Bohannon identifies capacitor C2 and diode IN5818 in Figure 2 of Szepesi as Szepesi's bias circuit. *Id.*

This identification of Szepesi's bias circuit, however, is inconsistent with Mr. Bohannon's original declaration, in which Mr. Bohannon testifies that, in the Szepesi-Mao combination, the bias circuitry of Figure 9 of Mao has been attached in place of the bias circuitry in Szepesi. Ex. 1003 ¶ 145. In the annotated combination above, diode IN5818 is not replaced by Mao's bias circuitry. Diode IN5818 remains. Mr. Bohannon's failure to identify Szepesi's bias circuit with his original declaration and the lack of a subsequent identification that is consistent with his original declaration testimony cause us to discount Mr. Bohannon's testimony regarding motivations to combine Szepesi and Mao. The proper identification of Szepesi's bias circuit is not a minor issue: all four rationales for Petitioner's

motivation to combine are directed to improving Szepesi's bias circuit.
Pet. 29.

To be clear, as with Ground 1, we do not hold the issues concerning Petitioner's and Mr. Bohannon's identification of the bias circuit in Szepesi to be dispositive. These issues, however, diminish the weight we accord to Mr. Bohannon's testimony regarding a motivation to combine, which undermines Petitioner's showing.

c. Voltage Fluctuations

As mentioned, Petitioner argues that an ordinarily skilled artisan would have been motivated to combine Szepesi's and Mao's teachings because "Mao teaches that a secondary bias circuit, such as shown in Szepesi, used to power its secondary controller can be vulnerable to output voltage fluctuations." Pet. 29. Petitioner argues that this teaching in Mao would have motivated an ordinarily skilled artisan to improve the Szepesi bias circuit using the teachings of Mao. *Id.* We determine that Petitioner has not proven that an ordinarily skilled artisan would have been so motivated.

First, Mr. Bohannon's testimony, upon which Petitioner's analysis for this rationale to combine relies, is unspecific and conclusory, and thus is entitled to little weight. Ex. 1003 ¶¶ 143–145; *TQ Delta, LLC*, 942 F.3d at 1359; 37 C.F.R. § 42.22(a)(2). As discussed in Section III.B.3.b above, Mr. Bohannon's testimony regarding Szepesi's bias circuit was initially unspecific and subsequently contradictory. Further, as set forth below, Mr. Bohannon's additional testimony for this rationale is conclusory and thus entitled to little weight. *TQ Delta, LLC*, 942 F.3d at 1359.

In his original declaration, Mr. Bohannon testifies that passages in Mao and Szepesi teach that a secondary bias circuit such as the one disclosed in

Szepesi can be disadvantageously vulnerable to output voltage fluctuations and shorts. Ex. 1003 ¶¶ 143–145. Although the Petition itself does not discuss any motivation to combine Szepesi and Mao based on avoiding shorts (Pet. 29), we nevertheless address Mr. Bohannon’s testimony regarding shorts.

The cited passage in Mao reads: “Although changing the polarity of the bias winding Tb may somewhat reduce the variation range of the voltage bias Vbias in some cases, the reduction is usually not significant, considering that both input voltage and output voltage can change in a typical dc-dc converter.” Ex. 1006, 1:50–55 (cited by Ex. 1003 ¶ 143). The cited passage in Szepesi reads: “In a short circuit condition the supply voltage to the secondary-side controller 22, Vs2 gradually disappears due to the discharge of C2 by the chip.” Ex. 1007, 5:25–27 (cited by Ex. 1003 ¶ 143).

Mr. Bohannon testifies that, as a result of these disclosures, an ordinarily skilled artisan would have understood the bias circuit of Szepesi would be unable to accommodate shorts or very low output voltages. Ex. 1003 ¶ 143. Mr. Bohannon testifies that this was a well-understood issue in the art. *Id.* (citing Ex. 1008, 3). Mr. Bohannon further testifies that an ordinarily skilled artisan would have been motivated to improve the bias circuit of Szepesi using the teachings of Mao, to be able to not only improve the operation of the specific Szepesi circuit, but also to allow the benefits of the Szepesi circuit to be more easily applied to power supplies operating at lower output voltages. *Id.* ¶ 144.

Mr. Bohannon’s testimony regarding voltage fluctuations is conclusory. The cited passage in Mao does not, on its face, teach that a secondary bias circuit such as the one disclosed in Szepesi can be

disadvantageously vulnerable to output voltage fluctuations. *Id.* And Mr. Bohannon does not provide an explanation as to why that passage teaches that the circuit disclosed in Szepesi is vulnerable to such fluctuations. Ex. 1003 ¶¶ 143–145; Ex. 1025 ¶¶ 39–45. Further, Mr. Bohannon does not provide any analysis of why adding Mao’s bias circuit would improve the voltage fluctuations associated with Szepesi. Ex. 1003 ¶ 144.

Mr. Bohannon’s testimony regarding short circuits is also conclusory. Mr. Bohannon provides no analysis as to why Mao’s bias circuit would purportedly improve the short circuit issue identified by Szepesi. Ex. 1003 ¶ 144.

Second, the record indicates Szepesi’s circuit would not be vulnerable to the voltage fluctuations described in the cited passage in Mao. Ex. 2015 ¶¶ 154–162. The record further indicates that an ordinarily skilled artisan would not want to replace Szepesi’s output voltage with Mao’s bias circuit to reduce such fluctuations because output voltage in Szepesi is regulated, whereas the bias voltage of Mao is not. *Id.*

As set forth in Section III.A.4.c, the bias voltage of Mao is unregulated. In contrast, Szepesi has a regulated voltage output. Ex. 2015 ¶¶ 156, 158; Ex. 1007, 3:58–65. With its regulated output voltage powering the bias to its secondary controller, Szepesi does not have the voltage fluctuations described in Mao. Ex. 2015 ¶¶ 154–156, 158. In fact, Mr. Sandler testifies that the regulated output voltages of Szepesi are constant over its allowable input voltages. *Id.* ¶ 162. Mr. Sandler further testifies that Mao’s improved bias circuits are unregulated and thus an ordinarily skilled artisan would recognize that using Mao’s bias circuit 50V with Szepesi would result in a less constant supply voltage because Mao’s bias voltage is

unregulated. *Id.* Mr. Bohannon does not dispute Mr. Sandler’s testimony that the regulated output voltages of Szepesi are constant over its allowable input voltages and that using Mao’s bias circuit 50V with Szepesi would result in a less constant supply voltage than without such a modification. Ex. 1025 ¶¶ 39–45. We credit the undisputed testimony of Mr. Sandler. Further, we agree with Mr. Sandler that, because the output voltages of Szepesi are constant and the use of Mao’s bias circuit with Szepesi would result in a less constant supply voltage, that an ordinarily skilled artisan would not have combined Szepesi with Mao to reduce voltage fluctuations. Ex. 2015 ¶¶ 154–157, 162.

Third, in his Reply Declaration, Mr. Bohannon reiterates that the Szepesi explicitly states that, even in a power supply with a regulated output, the supply voltage to the secondary-side controller can be vulnerable to output fluctuations under certain conditions. Ex. 1025 ¶ 39. As with his original declaration, however, Mr. Bohannon presents no persuasive reason why an ordinarily skilled artisan would expect that Mao’s bias circuit would solve or ameliorate the short circuit output problem identified by Szepesi. Ex. 1025 ¶¶ 39–40. Mr. Bohannon merely testifies:

Replacing the primary reference’s use of the output voltage as the source for its secondary bias with Mao’s bias circuit would improve the converter because the supply voltage to the secondary-side controller would not disappear under these anticipated conditions, allowing the converter to maintain regulation even at very low output voltages. *Id.*; [Ex.] 1003, ¶ 143; see also [Ex.] 1008 (suggesting “[a] solution to provide a quasi constant supply voltage” to the controller”).

Ex. 1025 ¶ 40. Mr. Bohannon, however, provides no analysis to support this testimony. Although he cites the AN1283 Application Note’s disclosure that

“A solution to provide a quasi constant supply voltage to the TSM101 is shown at Figure 4 [of the Application Note]” (Ex. 1008, 3 (cited by Ex. 1025 ¶ 40)), Mr. Bohannon provides no analysis of why this solution would be applicable to the Szepesi and Mao combination he identified, which is not the circuit shown in Figure 4 of the Application Note. Ex. 1003 ¶¶ 143–144 ; Ex. 1025 ¶ 40.

In sum, we determine that Petitioner has not proven that an ordinarily skilled artisan would have combined Szepesi’s and Mao’s teachings in the power to Szepesi’s secondary controller to avoid undesirable voltage fluctuations or ameliorate short circuit situations.

d. Constant Current Mode

As mentioned, Petitioner argues that an ordinarily skilled artisan would have been motivated to combine Szepesi’s and Mao’s teachings to improve Szepesi’s bias circuit so it could be used in converters where a constant current mode would otherwise cause the output voltage to drop to a level that was insufficient to reliably power Szepesi’s secondary controller. Pet. 29 (citing Ex. 1003 ¶¶ 143–145, Ex. 1008, 3). We determine that Petitioner has not proven that an ordinarily skilled artisan would have been so motivated.

First, Mr. Bohannon’s testimony, upon which Petitioner’s analysis for this rationale to combine is based, is unspecific, inconsistent, and conclusory, and thus is entitled to little weight. Ex. 1003 ¶¶ 143–145; *see TQ Delta, LLC*, 942 F.3d at 1359. As discussed in Section III.B.3.b. above, Mr. Bohannon’s testimony regarding Szepesi’s bias circuit was initially unspecific and subsequently contradictory. Further, Mr. Bohannon’s additional declaration testimony for this rationale is conclusory. In his original declaration, Mr. Bohannon cites the disclosure regarding the power

supply for the TSM101 integrated circuit in the AN1283 Application Note, the pertinent part of which reads: “In applications requiring low voltage battery charge or when the charger is in current regulation mode, the output voltage can be too low to supply correctly the TSM101.” Ex. 1008, 3 (cited by Ex. 1003 ¶ 143). Mr. Bohannon, however, provides no reason or analysis in his original declaration why this teaching is applicable to the proposed combination of Szepesi and Mao. Ex. 1003 ¶¶ 144–145. Nor does Mr. Bohannon explain why Mao’s bias circuit would improve Szepesi’s operation in a current regulation mode. *Id.*

Second, Mr. Bohannon provides no persuasive reason why an ordinarily skilled artisan would want to modify Szepesi to operate in a constant current mode. Ex. 1003 ¶¶ 144–145. Mr. Sandler testifies that Szepesi discloses operating in a constant current mode. Ex. 2015 ¶ 193. Mr. Bohannon corrects that statement by Mr. Sandler, noting that Szepesi refers to using a current control mode to accomplish its voltage regulation and does not refer to current regulation. Ex. 1025 ¶ 44. We accept that correction by Mr. Bohannon. Ex. 1007, 5:7–10, 6:1–2. That, however, simply leaves the record without any explanation of why an ordinarily skilled artisan would have been motivated to use Szepesi to operate in a constant current mode, which Mr. Bohannon does not explain, and which is integral to a motivation to modify Szepesi to operate in such a mode. Ex. 1003 ¶¶ 144–145; Ex. 1025 ¶¶ 41–44.

In sum, we determine that Petitioner has not proven that an ordinarily skilled artisan would have combined Szepesi’s and Mao’s teachings so Szepesi’s bias circuit could be used in a constant current regulation mode.

e. Accommodating Very Low Output Voltages

As mentioned, Petitioner argues that Szepesi shows a bias circuit, that an ordinarily skilled artisan would have understood that Szepesi's bias circuit would be unable to accommodate very low output voltages, and that, as a result, an ordinarily skilled artisan would have been motivated to improve Szepesi's bias circuit to accommodate very low output voltages based on Mao's teachings. Pet. 29. We determine that Petitioner has not proven that an ordinarily skilled artisan would have been so motivated.

First, Mr. Bohannon's testimony on this issue, upon which Petitioner's analysis for this rationale to combine is based, is unspecific, inconsistent, and conclusory, and thus is entitled to little weight. Ex. 1003 ¶¶ 143–145; *see TQ Delta*, 942 F.3d at 1359. As discussed in Section III.B.3.b. above, Mr. Bohannon's testimony regarding Szepesi's bias circuit was initially unspecific and subsequently contradictory. Further, as set forth below, Mr. Bohannon's additional testimony for this rationale is conclusory.

For this rationale, Mr. Bohannon cites the disclosure regarding the power supply for the TSM101 integrated circuit in the AN1283 Application Note, the pertinent part of which reads: "In applications requiring low voltage battery charge or when the charger is in current regulation mode, the output voltage can be too low to supply correctly the TSM101." Ex. 1008, 3 (cited by Ex. 1003 ¶ 143). Although this disclosure indicates that applications that require "very low output voltages" may have particular concerns that need to be addressed, Mr. Bohannon does not explain why an ordinarily skilled artisan would want to use Szepesi's circuit or a modified version thereof for such "very low output voltages." Ex. 1003 ¶¶ 143–145. In his Reply Declaration, Mr. Bohannon further does not provide any evidence that an

ordinarily skilled artisan would want to use Szepesi's circuit for low voltage applications. Ex. 1025 ¶¶ 39–45. Instead, Mr. Bohannon claims that his reference to accommodating very low output voltages concerned significant drops in output voltage under conditions, such as load transients or near short-circuit events:

[Patent Owner's] criticisms related to “use in a low voltage application” again misapprehend my opinions on the [ordinarily skilled artisan]'s knowledge and motivations. It is not a question of [an ordinarily skilled artisan] intending to use Zhu (or Szepesi or Matsumoto) in an application having an intended “low” output voltage application (whatever [Patent Owner] intended to mean by “low” in this context). Rather, even in the applications expressly identified in the primary references (e.g., isolated, single ended flyback converters using two controllers), such power converters will sometimes experience significant drops in output voltage under expected conditions (e.g., load transients or near short-circuit events). It is in anticipation of such events that [an ordinarily skilled artisan] would seek to improve the primary references, not in order to use them in “low voltage” applications.

Ex. 1025 ¶ 40 n. 9. As discussed in Section III.B.3.c, Mr. Bohannon has not set forth any persuasive evidence or analysis showing that modifying Szepesi based on Mao would be expected to diminish drops in output voltage due to near-short circuit events. *See also* Ex. 1025 ¶ 40 n. 9. Mr. Bohannon has also not set forth any persuasive evidence or an analysis showing modifying Szepesi based on Mao would be expected to diminish drops in output voltage due to load transients. Ex. 1025 ¶ 40 n. 9. Mr. Bohannon also did not raise the issue of a purported motivation to modify Szepesi to accommodate load transients in his original testimony. Ex. 1003 ¶¶ 143–145.

In sum, Mr. Bohannon and Petitioner have not set forth persuasive evidence that an ordinarily skilled artisan would have been motivated to modify Szepesi to accommodate very low voltages.

Second, Mr. Sandler provides persuasive testimony that an ordinarily skilled artisan would not have been motivated to use Szepesi's circuit or a modified version thereof "to accommodate very low output voltages." Ex. 2015 ¶¶ 163–186. For one, Mr. Sandler testifies that Szepesi has a flyback topology, which is generally known in the art to be "useful for generating *high* voltages," not low voltages. *Id.* ¶ 178 (quoting Ex. 2012, 11). The Switching Power Supply Design book supports this testimony, disclosing "the flyback topology is so useful for generating high voltages." Ex. 2012, 11. And Mr. Bohannon has not provided any evidence that the flyback topology would be useful for low voltage applications.

Further, we credit Mr. Sandler's testimony that an ordinarily skilled artisan would not modify Szepesi's converter, which relies on secondary control, for very low voltage applications, due to the complexity and expense of that modification versus prior art options, such as the conventional SMPS in Figure 1 of Zhu. Ex. 2015 ¶¶ 182–183. We also credit Mr. Sandler's testimony that Szepesi is not designed for low voltage operations because it discloses an input voltage range between 113 and 186V and a regulated output voltage of 5V. *Id.* ¶ 183; Ex. 1007, Fig. 2.

In sum, we determine that Petitioner has not proven that an ordinarily skilled artisan would have combined Szepesi's and Mao's teachings to accommodate very low output voltages.

f. Additional Topologies

As mentioned, Petitioner argues that an ordinarily skilled artisan would have been motivated to combine Mao's teachings with Szepesi to allow Szepesi to be more easily applied to additional power supply topologies.

Pet. 29. The Petition cites nothing to support this assertion, other than conclusory testimony by Mr. Bohannon, which reads: "[an ordinarily skilled artisan] would have been motivated to improve the bias circuit of Szepesi using the teachings of Mao, to be able to not only improve the operation of the specific Szepesi circuit, but also to allow the benefits of the Szepesi circuit to be more easily applied to additional power supply topologies."

Ex. 1003 ¶ 144. Mr. Bohannon cites nothing to support that testimony. *Id.* In his original declaration, Mr. Bohannon also does not identify the additional power supply topologies he is referencing or provide any analysis of why combining Szepesi with Mao would allow Szepesi's circuit to be more easily applied to the unspecified additional power supply topologies. *Id.* Given the conclusory and unspecific nature of this testimony, we accord it little weight. *TQ Delta*, 942 F.3d at 1359.

In response to this testimony, Mr. Sandler notes that Mr. Bohannon in his original declaration does not explain whether the "additional power supply topologies" to which he refers are topologies that "accommodate very low output voltages" or operate in "a constant-current mode" or whether he is referring to other unnamed topologies. Ex. 2015 ¶ 195. Mr. Sandler testifies that to the extent that Mr. Bohannon is referring to additional different topologies, there is no indication as to what those topologies would be or why they would be desirable." *Id.* ¶ 196.

In his Reply Declaration, Mr. Bohannon identifies flyback, forward, and cuk converters as exemplary additional power supply topologies. Ex. 1025 ¶ 45. Mr. Bohannon cites Szepesi as noting these topologies. *Id.* This identification of these additional topologies is belated. Petitioner and Mr. Bohannon should not wait for Mr. Sandler to complete his testimony before identifying the topologies that purportedly would motivate an ordinarily skilled artisan to modify Szepesi. Consolidated Trial Practice Guide 73; 37 C.F.R. § 42.23(b). The testimony setting forth these additional topologies is also conclusory. Mr. Bohannon merely declares that it would be beneficial to remove what he terms the dependent bias circuit of Szepesi and replace it with Mao's circuit without explaining why that modification would purportedly be perceived as advantageous by an ordinarily skilled artisan for using with flyback, forward, and cuk converters. Ex. 1025 ¶ 45; *see TQ Delta*, 942 F.3d at 1359.

We determine that Petitioner has not proven that an ordinarily skilled artisan would have been motivated to combine Szepesi's and Mao's teachings to allow Szepesi to be applied to additional topologies.

g. Summary

In sum, we determine that Petitioner has not proven by a preponderance of the evidence that an ordinarily skilled artisan would have been motivated to combine Szepesi's and Mao's teachings. Thus, Petitioner has not proven that any challenged claim would have been obvious over the combination of Szepesi and Mao.

C. Ground 3: Asserted Obviousness over Matsumoto and Mao

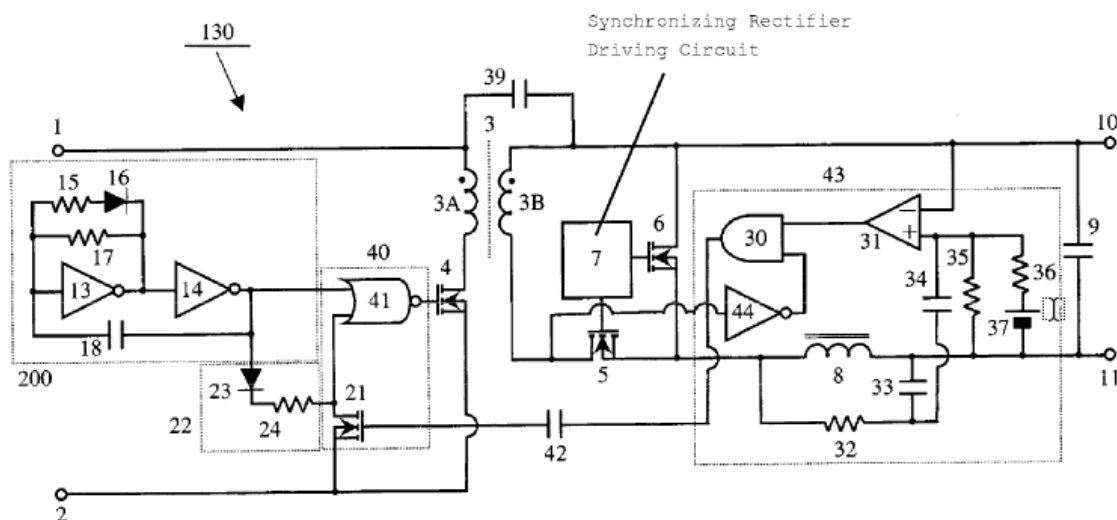
Petitioner asserts that claims 18, 22, 23, 25, 30, 34, 41–43, 45, 48, 49, and 51 would have been obvious over Matsumoto and Mao. Pet. 2.

1. Matsumoto

Matsumoto is titled “Isolated Switching Power Supply Apparatus.” Ex. 1010, code (54). Matsumoto “relates to an isolated switching power supply apparatus, and particularly to an isolated switching power supply apparatus in which a controlled variable can be transferred from the secondary side to the primary side and direct control can be performed without using a photocoupler, and further which has good transient reactivity.” *Id.* at 1:7–12.

Figure 4 of Matsumoto is shown below:

FIG. 4

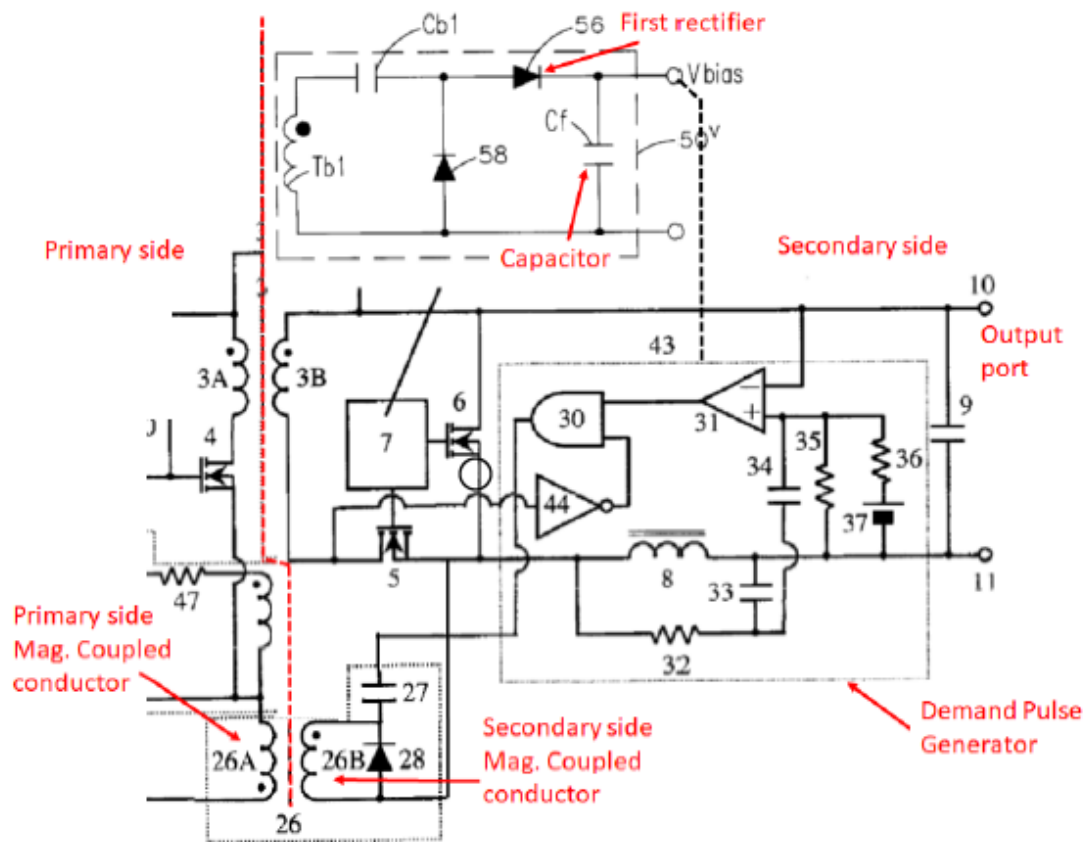


Ex. 1010, Fig. 4. Figure 4 is a circuit diagram of an isolated switching power supply apparatus. *Id.* at 6:22–24.

2. Proposed Combination of Matsumoto and Mao

Petitioner argues that “[i]t would have been within the skill of [an ordinarily skilled artisan] to modify Matsumoto to add the improved bias circuit of Mao, either by providing an additional bias winding or by including the Mao circuit in the output stage itself.” Pet. 43 (citing Ex. 1003 ¶¶ 222–

223). Mr. Bonham provides the following annotated figure illustrating this combination:



Ex. 1003 ¶ 222. In the above figure, “the bias circuitry of F[igure] 9 of Mao has been incorporated into Matsumoto to power the secondary control circuits.” *Id.* ¶ 223.

3. Motivations to Combine

The Petition presents the same rationales for combining Matsumoto and Mao as for combining Zhu and Mao and Szepesi and Mao, with the exception that Petitioner does not argue that Matsumoto discloses a bias circuit. Pet. 43. Petitioner instead argues that an ordinarily skilled artisan would have been motivated to improve a conventional bias circuit. *Id.* (“Mao

teaches that a conventional bias circuit has drawbacks [an ordinarily skilled artisan] would have understood such a bias circuit.”).

We determine that Petitioner has not proven by a preponderance of the evidence that an ordinarily skilled artisan would have been motivated to combine Matsumoto’s and Mao’s teachings for any of these four proffered rationales. Below, we first summarize the parties’ arguments regarding all four rationales because many of those arguments overlap. Then, we separately analyze each rationale.

a. Parties’ Arguments

The parties present substantially the same arguments regarding motivations to combine Matsumoto and Mao as for Szepesi and Mao and Zhu and Mao. The arguments that are common with other grounds are summarized in Sections II.A.4.a and II.B.3.a. The arguments that are unique with respect to Matsumoto and Mao are summarized below.

The Petition presents the same rationales and arguments for combining Matsumoto and Mao as for Szepesi and Mao and Zhu and Mao with the exception, noted above, that Petitioner does not argue that Matsumoto discloses a bias circuit. Pet. 13–14, 29, 43. In the Patent Owner Response, Patent Owner argues that Petitioner’s Matsumoto-Mao combination does not replace any wires or circuitry and thus Petitioner is not replacing any bias circuitry in Matsumoto with Mao’s circuitry. PO Resp. 37 n. 7. Patent Owner further argues that Matsumoto’s output voltage is regulated. *Id.* at 39. Patent Owner asserts that thus an ordinarily skilled artisan would not have been motivated to replace Matsumoto’s regulated output voltage with Mao’s unregulated bias circuit. *Id.* Patent Owner also argues that Matsumoto discloses a number of different types of converters, some of which would not

be selected for very-low-voltage applications for reasons similar to Szepesi, and some of which would have no problem operating in very low voltage applications. *Id.* at 44. Patent Owner also asserts that Matsumoto discloses constant current mode operation and thus modification would be not be needed to place Matsumoto in a constant current mode. *Id.* at 46.

In its Reply, Petitioner argues that it is implicit in Matsumoto's disclosure that its circuits take power from the output voltage in the conventional manner. Pet. Reply 15. Petitioner claims that Mao's bias circuit in its combination is used in place of circuitry that would power Matsumoto's secondary circuits from its output voltage. *Id.* at 15–16. Petitioner further argues that Szepesi's disclosure concerning short circuit conditions is applicable to Matsumoto. *Id.* at 16–17. Petitioner argues that Matsumoto discloses a modification that is similar to regulating current by adding a sense resistor. *Id.* at 19.

In the Sur-reply, Patent Owner argues that the AN1283 Application Note is inapplicable to Matsumoto because Matsumoto does not use an optocoupler for feedback. PO Sur-reply 26.

b. Voltage Fluctuations

As mentioned, Petitioner argues that an ordinarily skilled artisan would have been motivated to combine Matsumoto's and Mao's teachings because "Mao teaches that a conventional bias circuit has drawbacks" and an ordinarily skilled artisan "would have understood such a bias circuit would be vulnerable to voltage fluctuations." Pet. 43. Petitioner argues that this teaching in Mao would have motivated an ordinarily skilled artisan to improve the Matsumoto power converter using the teachings of Mao. *Id.*

We determine that Petitioner has not proven that an ordinarily skilled artisan would have been so motivated.

Mr. Bohannon's testimony, upon which Petitioner's analysis for this rationale to combine relies, is not persuasive. In his original declaration, Mr. Bohannon does not actually testify that an ordinarily skilled artisan would have added Mao's bias circuit to Matsumoto to avoid voltage fluctuations. Ex. 1003 ¶¶ 221–223. In his Reply Declaration, Mr. Bohannon references "voltage fluctuations" as a motivation for modifying the primary references for Petitioner's challenges. Ex. 2015 ¶ 39. In neither his original or reply declaration, however, does Mr. Bohannon make any assertions regarding voltage fluctuations that are specific to Matsumoto's circuit; instead he relies on the same testimony he set forth for Zhu's circuit. As set forth in Section III.A.4.c., that testimony is not persuasive. Further, as set forth in Section III.A.4.c., the contrary testimony by Mr. Sandler is persuasive.

In sum, we determine that Petitioner has not proven that an ordinarily skilled artisan would have combined Matsumoto's and Mao's teachings in the to avoid undesirable voltage fluctuations.

c. Constant Current Mode

As mentioned, Petitioner argues that an ordinarily skilled artisan would have been motivated to combine Matsumoto's and Mao's teachings to improve Matsumoto's circuit so that it could be used in a constant current mode without causing the output voltage to drop to a level that was insufficient to reliably power Matsumoto's secondary controller. Pet. 43 (citing Ex. 1003 ¶¶ 221–223, Ex. 1008, 3). We determine that Petitioner has not proven that an ordinarily skilled artisan would have been so motivated.

First, Mr. Bohannon's testimony, upon which Petitioner's analysis for this rationale to combine is based, is unspecific and conclusory, and thus is entitled to little weight. Ex. 1003 ¶¶ 221–223; *see TQ Delta, LLC*, 942 F.3d at 1359. In his original declaration, Mr. Bohannon cites the disclosure regarding the power supply for the TSM101 integrated circuit in the AN1283 Application Note, the pertinent part of which reads: "In applications requiring low voltage battery charge or when the charger is in current regulation mode, the output voltage can be too low to supply correctly the TSM101." Ex. 1008, 3 (cited by Ex. 1003 ¶ 221). Mr. Bohannon, however, provides no reason or analysis in his original declaration why this teaching is applicable to the proposed combination of Matsumoto and Mao. Ex. 1003 ¶¶ 221–223. Nor does Mr. Bohannon explain why Mao's bias circuit would improve operation in a current regulation mode. *Id.*

Second, Matsumoto discloses a constant-current mode of operation. Ex. 1010, 12:52–13:2; Ex. 2015 ¶¶ 193–194. Mr. Bohannon does not provide an analysis or persuasive explanation of how an ordinarily skilled artisan would expect Matsumoto's specific circuits and modes of operation for providing constant current to be improved by the addition of Mao's bias circuit. Ex. 1003 ¶¶ 221–223; Ex. 1025 ¶¶ 41–44. Instead, Mr. Bohannon merely testifies that "Matsumoto expressly suggests using its demand pulse regulation architecture in [a constant current] application, further evidencing the motivation of [an ordinarily skilled artisan] to apply Mao's improved bias circuit to improve the operation of Matsumoto's converter in that suggested application." Ex. 1025 ¶ 44. That testimony, however, is conclusory and thus entitled to little weight. *TQ Delta*, 942 F.3d at 1359.

We credit the contrary testimony of Mr. Sandler that an ordinarily skilled artisan would not have been motivated to combine Matsumoto's and Mao's teachings for a constant current mode operation, which we find to be supported by the record. Ex. 2015 ¶¶ 193–194; Ex. 1010, 12:52–13:2.

In sum, we determine that Petitioner has not proven that an ordinarily skilled artisan would have combined Matsumoto's and Mao's teachings so Matsumoto's circuit could be used in a constant current regulation mode.

d. Accommodating Very Low Output Voltages

As mentioned, Petitioner argues that an ordinarily skilled artisan would have understood that a conventional bias circuit for Matsumoto's circuit would be unable to accommodate very low output voltages, and that, as a result, an ordinarily skilled artisan would have been motivated to improve Matsumoto's circuit to accommodate very low output voltages based on Mao's teachings. Pet. 43. We determine that Petitioner has not proven that an ordinarily skilled artisan would have been so motivated.

First, Mr. Bohannon's testimony on this issue, upon which Petitioner's analysis for this rationale to combine is based, is unspecific and conclusory, and thus is entitled to little weight. Ex. 1003 ¶¶ 221–223; *see TQ Delta*, 942 F.3d at 1359. For this rationale, Mr. Bohannon cites the disclosure regarding the power supply for the TSM101 integrated circuit in the AN1283 Application Note, the pertinent part of which reads: "In applications requiring low voltage battery charge or when the charger is in current regulation mode, the output voltage can be too low to supply correctly the TSM101." Ex. 1008, 3 (cited by Ex. 1003 ¶ 221). Although this disclosure indicates that applications that require "very low output voltages" may have particular concerns that need to be addressed, Mr. Bohannon does not explain

why an ordinarily skilled artisan would want to use Matsumoto's circuit or a modified version thereof for such "very low output voltages." Ex. 1003 ¶¶ 221–223. In his Reply Declaration, Mr. Bohannon further does not explain why an ordinarily skilled artisan would want to use Matsumoto's circuit for such low voltage applications. Ex. 1025 ¶¶ 39–45. Instead, Mr. Bohannon claims that his reference to accommodating very low output voltages concerned significant drops in output voltage under conditions, such as load transients or near short-circuit events:

[Patent Owner's] criticisms related to "use in a low voltage application" again misapprehend my opinions on the [ordinarily skilled artisan]'s knowledge and motivations. It is not a question of [an ordinarily skilled artisan] intending to use Zhu (or Szepesi or Matsumoto) in an application having an intended "low" output voltage application (whatever [Patent Owner] intended to mean by "low" in this context). Rather, even in the applications expressly identified in the primary references (e.g., isolated, single ended flyback converters using two controllers), such power converters will sometimes experience significant drops in output voltage under expected conditions (e.g., load transients or near short-circuit events). It is in anticipation of such events that [an ordinarily skilled artisan] would seek to improve the primary references, not in order to use them in "low voltage" applications.

Ex. 1025 ¶ 40 n. 9. Mr. Bohannon, however, has not set forth any persuasive evidence or analysis showing that an ordinarily skilled artisan would have expected that modifying Matsumoto based on Mao would avoid or ameliorate drops in output voltage due to near-short circuit events. *Id.* Further, Mr. Bohannon has also not set forth any persuasive evidence or an analysis showing that an ordinarily skilled artisan would expect that modifying Matsumoto based on Mao would be expected to diminish drops in output voltage due to load transients. *Id.* In addition, Mr. Bohannon did not raise

the issue of a purported motivation to modify Matsumoto to accommodate load transients in his original testimony. Ex. 1003 ¶¶ 221–223; Consolidated Trial Practice Guide 73.

In sum, Mr. Bohannon and Petitioner have not set forth persuasive evidence that an ordinarily skilled artisan would have been motivated to modify Matsumoto to accommodate very low voltages.

Second, Mr. Sandler provides persuasive testimony that Matsumoto discloses different convertors and that an ordinarily skilled artisan would not be motivated to modify Matsumoto with Mao to accommodate very low voltages because the involved embodiments of Matsumoto (i) would not be used for low voltage applications due to the use of secondary side regulation or (ii) would have no problem operating in very low voltage applications. Ex. 2015 ¶¶ 185–186.

In sum, we determine that Petitioner has not proven that an ordinarily skilled artisan would have combined Matsumoto’s and Mao’s teachings to accommodate very low output voltages.

e. Additional Topologies

As mentioned, Petitioner argues that an ordinarily skilled artisan would have been motivated to combine Mao’s teachings with Matsumoto to allow Matsumoto to be more easily applied to additional power supply topologies. Pet. 43. The Petition cites nothing to support this assertion other than conclusory testimony by Mr. Bohannon, which reads: “[an ordinarily skilled artisan] would have been motivated to improve the bias circuit of Matsumoto using the teachings of Mao, to be able to not only improve the operation of the specific Matsumoto circuit, but also to allow the benefits of the Matsumoto circuit to be more easily applied to additional power supply

topologies.” Ex. 1003 ¶ 222. Mr. Bohannon cites nothing to support that testimony. *Id.* In his original declaration, Mr. Bohannon also does not identify the additional power supply topologies he is referencing or provide any analysis of why combining Matsumoto with Mao would allow Matsumoto’s circuit to be more easily applied to the unspecified additional power supply topologies. *Id.* Given the conclusory and unspecific nature of this testimony, we accord it little weight. *TQ Delta*, 942 F.3d at 1359.

In response to the above testimony, Mr. Sandler notes that Mr. Bohannon in his original declaration does not explain whether the “additional power supply topologies” to which he refers are topologies that “accommodate very low output voltages” or operate in “a constant-current mode” or whether he is referring to other unnamed topologies. Ex. 2015 ¶ 195. Mr. Sandler testifies that to the extent that Mr. Bohannon is referring to additional different topologies, there is no indication as to what those topologies would be or why they would be desirable.” *Id.* ¶ 196.

In his Reply Declaration, Mr. Bohannon identifies flyback, forward, and cuk converters as exemplary additional power supply topologies. Ex. 1025 ¶ 45. Mr. Bohannon cites Szepesi as noting these topologies. *Id.* This identification of these topologies, however, is belated. Petitioner and Mr. Bohannon should not wait for Mr. Sandler to complete his testimony before identifying the topologies that purportedly would motivate an ordinarily skilled artisan to modify Matsumoto. Consolidated Trial Practice Guide 73; 37 C.F.R. § 42.23(b). The testimony setting forth these additional topologies is also conclusory. Mr. Bohannon merely declares that it would be beneficial to replace Matsumoto’s source of secondary bias with Mao’s circuit without explaining why that modification would purportedly be

perceived as advantageous by an ordinarily skilled artisan for use with flyback, forward, and Cuk converters. Ex. 1025 ¶ 45; *see TQ Delta*, 942 F.3d at 1359.

We determine that Petitioner has not proven that an ordinarily skilled artisan would have been motivated to combine Matsumoto's and Mao's teachings to allow Matsumoto to be applied to additional topologies.

f. Summary

In sum, we determine that Petitioner has not proven by a preponderance of the evidence that an ordinarily skilled artisan would have been motivated to combine Matsumoto's and Mao's teachings. Thus, Petitioner has not proven that any challenged claim would have been obvious over the combination of Matsumoto and Mao.

IV. CONCLUSION

As set forth in the following table, Petitioner has not proven that any of the challenged claims are unpatentable:

Claims	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
18, 19–23, 25, 30, 31, 34–36, 41–43, 45, 48–51	103	Zhu, Mao		18, 19–23, 25, 30, 31, 34–36, 41–43, 45, 48–51
18, 19–23, 25, 30, 31, 35, 36, 41, 42, 45, 48–51	103	Szepesi, Mao		18, 19–23, 25, 30, 31, 35–36, 41, 42, 45, 48–51
18, 22, 23, 25, 30, 34, 41–43, 45, 48, 49, 51	103	Matsumoto, Mao		18, 22–23, 25, 30, 34, 41–43, 45, 48, 49, 51

Claims	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
Overall Outcome				18, 19–23, 25, 30, 31, 34–36, 41–43, 45, 48–51

V. ORDER

It is:

ORDERED that claims 18, 19–23, 25, 30, 31, 34–36, 41–43, 45, and 48–51 of the '713 patent have not been shown, by a preponderance of the evidence, to be unpatentable; and

FURTHER ORDERED that because this is a Final Written Decision, the parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

IPR2021-00071
Patent RE47,713 E

FOR PETITIONER:

Jennifer Huang
Kim Leung
Howard Pollock
FISH & RICHARDSON, P.C.
jjh@fr.com
leung@fr.com
pollack@fr.com

FOR PATENT OWNER:

Jonathan Lindsay
Hong Zhong
Jason Sheasby
IRELL AND MANELLA LLP
jlindsay@irell.com
hzhong@irell.com
jsheasby@irell.com