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571-272-7822

Paper: 8
Entered: May 17, 2024

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

DELTA ELECTRONICS, INC.,
Petitioner,

v.

VICOR CORPORATION,
Patent Owner.

IPR2024-00134
Patent 10,199,950 B2

Before GEORGIANNA W. BRADEN, KARA L. SZPONDOWSKI, and SEAN P. O'HANLON, *Administrative Patent Judges.*

BRADEN, *Administrative Patent Judge*.

DECISION
Denying Institution of *Inter Partes* Review
35 U.S.C. § 314
Granting Patent Owner's Motion to Seal and
Entry of Stipulated Protective Order
37 C.F.R. §§ 42.5, 42.14, 42.54

I. INTRODUCTION

Delta Electronics, Inc. ("Petitioner") filed a Petition requesting an *inter partes* review of claims 1, 2, 5–10, 13–17, 19, and 21–40 (the "challenged claims") of U.S. Patent No. 10,199,950 B2 (Ex. 1001, "the '950 patent"). Paper 1 ("Pet."). Vicor Corporation ("Patent Owner") filed a Preliminary Response. Paper 6 ("Prelim. Resp."). With its Preliminary Response, Patent Owner provided evidence (Ex. 2028) that it filed with the Office a statutory disclaimer of claims 22, 24, 39, and 40 of the '950 patent pursuant to 37 C.F.R. § 1.321(a). Prelim. Resp. 7 n.1 (citing Ex. 2028). Patent Owner also filed a Motion to Seal Exhibit 2032. Paper 7 ("Motion" or "Mot.").

We have authority to determine whether to institute an *inter partes* review under 35 U.S.C. § 314 and 37 C.F.R. § 42.4. An *inter partes* review may not be instituted unless it is determined that "the information presented in the petition filed under section 311 and any response filed under section 313 shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." 35 U.S.C. § 314; *see also* 37 C.F.R § 42.4(a) (2022) ("The Board institutes the trial on behalf of the Director."). The reasonable likelihood standard is "a higher standard than mere notice pleading," but "lower than the 'preponderance' standard to prevail in a final written decision." *Hulu, LLC v. Sound View Innovations, LLC*, IPR2018-01039, Paper 29 at 13 (PTAB Dec. 20, 2019) (precedential).

For the reasons provided below and based on the record before us, we determine Petitioner has not demonstrated a reasonable likelihood that it would prevail in showing the unpatentability of at least one of the

challenged claims. Accordingly, we decline to institute *inter partes* review on any of the alleged grounds of unpatentability.

II. BACKGROUND

A. Real Parties in Interest

Petitioner identifies Delta Electronics, Inc.; Delta Electronics (Americas), Ltd.; Delta Electronics (USA), Inc.; Cyntec Co., Ltd.; Delta Electronics (Thailand) Public Company Limited; and DET Logistics (USA) Corporation as real parties in interest. Pet. 106. In addition, Petitioner states that the following entities are not real parties in interest, but Petitioner is disclosing them for purposes of transparency: Hon Hai Precision Industry Co. Ltd., Foxconn Industrial Internet Co. Ltd., FII USA Inc., Ingrasys Technology Inc., Ingrasys Technology USA Inc., Quanta Computer, Inc., Quanta Computer USA Inc., Quanta Cloud Technology, Inc., Quanta Cloud Technology USA, LLC, and QCH, Inc. *Id.* at 106 n.3.

Patent Owner only identifies itself as a real party in interest. Paper 5 (Patent Owner's Mandatory Notices), 1.

B. Related Proceedings

The parties identify the following cases involving the '950 patent: (1) *Certain Power Converter Modules and Computing Systems Containing the Same*; Inv. No. 337-TA-3688, and (2) *Vicor Corporation v. Delta Electronics, Inc. et al.*, 2-23-cv-00323 (E.D. Tex.). Pet. 107; Paper 5, 1.

C. The '950 Patent (Ex. 1001)

The '950 patent is titled "Power Distribution Architecture with Series-Connected Bus Converter," and issued on February 5, 2019. Ex. 1001, codes (45), (54).

1. Written Description

The '950 patent relates to an "apparatus for power conversion" and for distribution of power in electrical systems such as computer and telecommunications systems where the "power converter is adapted to convert power from the input circuit to the output circuit at a substantially fixed voltage transformation ratio $K_{DC} = V_{OUT}/V_{IN}$ at an output current, wherein V_{IN} is an input voltage and V_{OUT} is an output voltage." Ex. 1001, code (57), 1:7–9. More specifically, in one embodiment, the '950 patent relates to an apparatus with an intermediate bus architecture ("IBA") power distribution system for a telecommunications system with a power source for providing a DC source voltage plus a circuit board with a bus converter and regulators. *Id.* at 2:43–56. According to the '950 patent, the bus converter includes (1) an input circuit with a primary transformer winding, and (2) an output circuit with a secondary transformer winding, such that the primary and secondary transformer windings are galvanically connected in series so the bus converter provides power to a power distribution bus that is not galvanically isolated from the source. *Id.*

One embodiment of the '950 patent is shown in Figure 2, which is reproduced below:

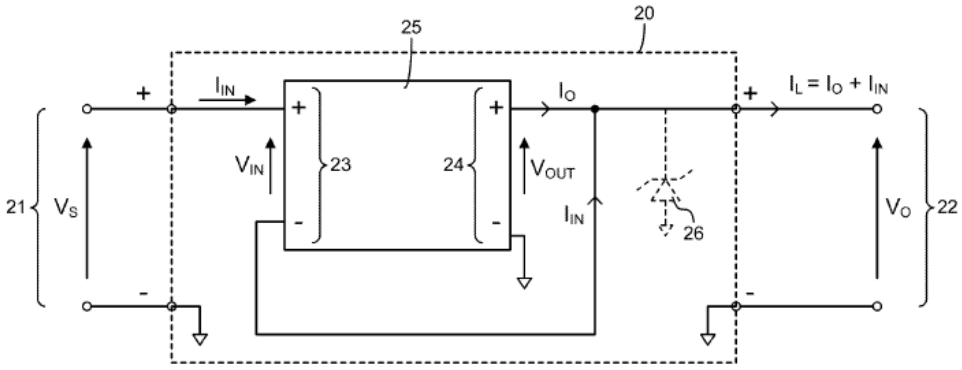


FIG. 2

Id. at Fig. 2. Figure 2 is a diagram depicting a "functional block diagram of a series connected DC Transformer." *Id.* at 3:1–3. According to the '950 patent, power conversion system 20 includes input 21 for receiving power from a source at a source voltage, V_S, output 22 for delivering power to a load at an output voltage, V_O, that is less than V_S, and DC Transformer 25. *Id.* at 4:34–41. The '950 patent discloses that DC Transformer 25 may be implemented preferably using Sine-Amplitude Converter ("SAC") topologies and timing architectures. *Id.* at 4:41–49.

The '950 patent further discloses that DC Transformer 25 converts power received from its input 23 (distinguished from input 21 of bus converter 20) at an input voltage, V_{IN}, for delivery to its output 24 at an output voltage, V_{OUT}, using an essentially fixed voltage gain or voltage transformation ratio. *Id.* at 4:51–56. The voltage gain or voltage transformation ratio of a system is defined by the '950 patent as the ratio of its output voltage to its input voltage at a specified current such as an output current. *Id.* at 4:58–60.

Another embodiment of the '950 patent is shown in Figure 3, which is reproduced below:

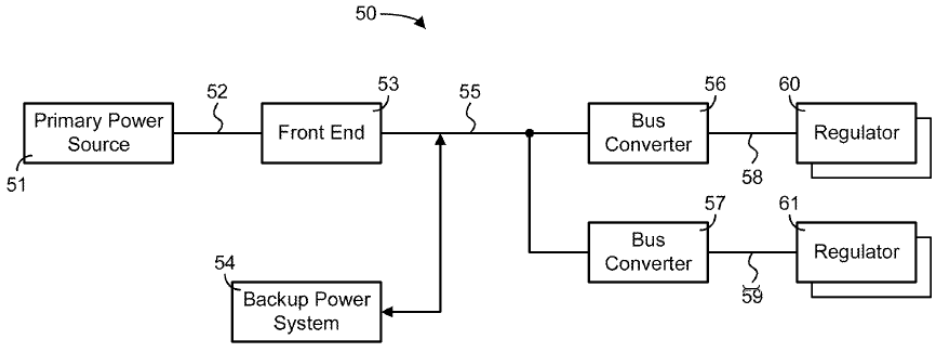


FIG. 3

Id. at Fig. 3. Figure 3 is "a schematic diagram of a new power distribution architecture." *Id.* at 3:4–6. According to the '950 patent, power distribution system 50 has primary power source 51 delivering power via connection 52 to front-end power-processing unit 53, which converts power from power source 51 delivering power at a relatively high but safe DC voltage to power distribution bus 55. *Id.* at 3:24–32. The '950 patent discloses that one or more bus converters 56, 57 may be connected to power distribution bus 55 downstream from front end 53 in order to convert power received from the relatively high voltage power distribution bus 55 for delivery to a respective lower voltage bus. *Id.* at 3:44–49.

The '950 patent further discloses that bus converters 56 and 57 respectively supply power to buses 58 and 59 at voltages at or near the requisite load voltages, and that are lower than the voltage of the power distribution bus 55, providing step-down voltage transformation. *Id.* at 3:49–53. According to the '950 patent, bus converters 56, 57 are generally separated by a distance from their respective regulators 60, 61, and may each, in turn, provide power via its respective bus 58, 59 to a plurality of regulators, preferably at or near the point of load, such as point-of-load switching voltage regulators 60, 61. *Id.* at 3:53–55, 4:14–17. The '950 patent explains that regulators 60, 61 may supply power to respective loads, which can be a variety of devices, including integrated circuits and electromechanical devices (such as storage and cooling devices). *Id.* at 4:25–28.

The '950 patent discloses that bus converters 56, 57 do not provide galvanic isolation between their respective output busses 58, 59 and the power distribution bus 55. *Id.* at 4:29–32.

Additional embodiments of the '950 patent are shown in Figures 4 and 5, which are reproduced below:

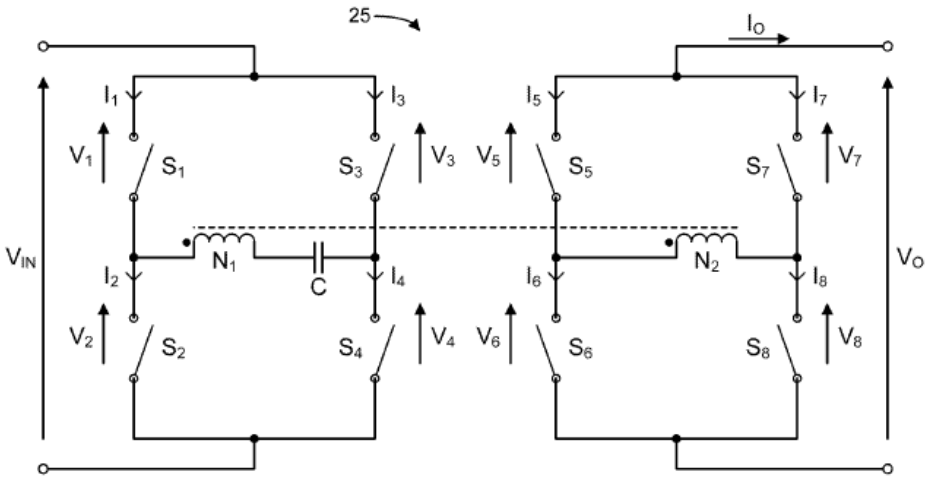


FIG. 4

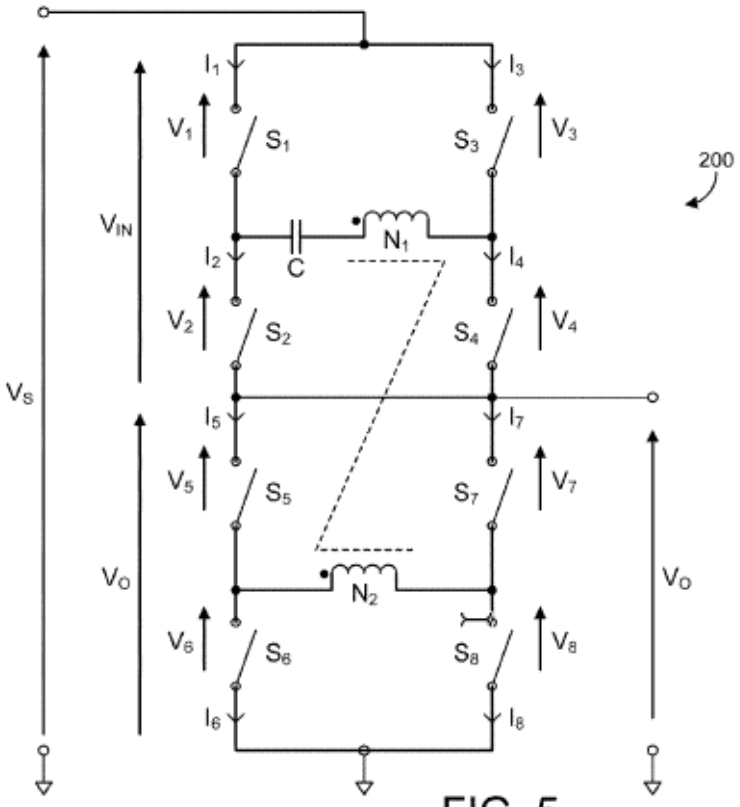


FIG. 5

In Figure 4, the '950 patent discloses that DC Transformer 25 (from Figure 2) may use an isolated SAC topology and timing architecture with (1) a full-

bridge input circuit including switches S1, S2, S3, and S4 connected to drive the circuit including capacitor C and the input winding, having N1 turns, with the input voltage V_{IN} (*id.* at 5:25–30), and (2) a full-bridge output circuit, including switches S5, S6, S7, and SS, connected to rectify the voltage impressed across the output winding, having N2 turns, and delivering the output voltage, V_O (*id.* at 5:30–34).

By way of comparison, the '950 patent further discloses in Figure 5 that "series-connected SAC 200 uses the same full-bridge input circuit topology, including switches S1, S2, S3, and S4, driving the resonant circuit including capacitor C and the input winding, having N1 turns, with the input voltage V_{IN}." *Id.* at 5:37–42. "SAC 200 also uses the same full-bridge output topology, including switches S5, S6, S7, and S8, connected to rectify the voltage impressed across the output winding, having N2 turns, and delivering the output voltage, V_O." *Id.* at 5:42–45.

The '950 patent specifically discloses that "[c]onnecting the input and output of the DC Transformer 25 in series eliminates galvanic isolation between the input and output of the series-connected bus converter 20, which is counterintuitive." *Id.* at 6:10–13. According to the '950 patent, however, "when used in the architecture of FIG. 3, isolation is deployed at an intermediate stage where the isolation may be superfluous." *Id.* at 6:13–15. Therefore, the architecture shown in the Figure 3 embodiment "trades isolation at this stage for efficiency gain and reduced component stress." *Id.* at 6:15–17.

2. Illustrative Claim

As noted previously, Petitioner challenges claims 1, 2, 5–10, 13–17, 19, and 21–40 of the '950 patent, of which claims 1, 9, 16, 22, 29, 31, 32,

and 33 are independent. Pet. 2; Ex. 1001, 10:24–17:27. Patent Owner has disclaimed claims 22, 24, 39, and 40. Prelim. Resp. 7 n.1 (citing Ex. 2028). Claim 1 is illustrative of the challenged subject matter and is reproduced below.

1. An apparatus comprising:
   a power distribution system comprising a source for providing power at a DC source voltage Vs;
   a bus converter comprising an input circuit and an output circuit, the bus converter being adapted to convert power from the input circuit to the output circuit at a substantially fixed voltage transformation ratio, K_{DC}, at an output current, wherein an input voltage V_{IN} is applied to the input circuit and an output voltage V_{OUT} is produced by the output of the bus converter, and wherein the substantially fixed voltage transformation ratio can be represented as $K_{DC}=V_{OUT}/V_{IN}$;
   a power distribution bus connected to distribute power from the output circuit of the bus converter at the output voltage V_{OUT}; and
   a plurality of regulators, wherein each regulator comprises a regulator input connected to the power distribution bus to receive power from the output circuit of the bus converter and a regulator output connected to supply power to a respective load, the plurality of regulators each being separated by a distance from the bus converter;
   wherein the input circuit of the bus converter and at least a portion of the output circuit of the bus converter are galvanically connected in series across the source such that an absolute value of the input voltage V_{IN} applied to the input circuit is approximately equal to the absolute value of the DC source voltage V_S minus a number N times the absolute value of the output voltage V_{OUT}, where N is at least 1;
   wherein the bus converter comprises an inductive component and one or more power switches in the input circuit, the output circuit, or both; and
   wherein a current flowing in the inductive component charges and discharges capacitances in the bus converter reducing a

voltage across said one or more switches prior to turning ON said one or more switches.

Ex. 1001, 10:24–60.

D. Asserted Challenges to Patentability and Evidence of Record

Petitioner challenges the patentability of claims 1, 2, 5–10, 13–17, 19, and 21–40 of the '950 patent based on the following reference or combination of references:

Claims Challenged	35 U.S.C. §	Reference(s)/Basis
1, 5–7, 9, 13–16, 19, 21–40	103[1]	Huang[2]
5, 13, 21, 25–27, 34	103	Huang, Vinciarelli[3]
1, 5–7, 14–16, 19, 21–40	103	Huang, Lee[4]
5, 13, 21, 25–27, 34	103	Huang, Vinciarelli, Lee
1, 2, 6–10, 14–17, 19, 22-33, 35–37, 39, 40	103	Liu[5]
1, 2, 6–8, 10, 14–17, 19, 22–33, 35–37, 39, 40	103	Liu, Lee

In support of its patentability challenge, Petitioner relies on, *inter alia*, the Declaration of Douglas Charles Hopkins, Ph.D. ("Dr. Hopkins"). Ex. 1003. In support of its Preliminary Response, Patent Owner relies on, *inter alia*,

[1] The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) ("AIA"), included revisions to 35 U.S.C. § 103 that became effective as of March 16, 2013. The application for the '950 patent was filed after March 16, 2013. Ex. 1001, code (22). Accordingly, for purposes of institution, we apply the AIA version of 35 U.S.C. § 103.
[2] Daocheng Huang et al., "Novel Non-isolated LLC Resonant Converters" IEEE (March 9, 2012) ("Huang," Ex. 1005).
[3] US Patent 9,166,481 B1, issued Oct. 20, 2015; filed Mar. 14, 2013 ("Vinciarelli," Ex. 1007)
[4] Fred C. Lee, et al., "Design Challenges for Distributed Power Systems," Asian Power Elect. J. Vol. 1 (1), Aug. 2007 ("Lee," Ex. 1008).
[5] US Patent 7,307,857 B1, issued Dec. 11, 2007; filed Aug. 16, 2006 ("Liu," Ex. 1006).

the Declaration of Juan Rivas-Davila, Ph.D. ("Dr. Rivas-Davila," Ex. 2001) and the Declaration of Patrizio Vinciarelli, Ph.D. ("Dr. Vinciarelli," Ex. 2030).

III. PRELIMINARY MATTERS

A. Effect of Statutory Disclaimer

Patent Owner provided, with its Preliminary Response, evidence that it filed with the Office a statutory disclaimer of claims 22, 24, 39, and 40 of the challenged patent pursuant to 35 U.S.C. § 253(a) and 37 C.F.R. § 1.321(a). Ex. 2028, 1; *see* Prelim. Resp. 7 n.1. The disclaimer of a claim "shall . . . be considered as part of the original patent." 35 U.S.C. § 253(a). The language "considered as part of the original patent" means that a patent subject to a disclaimer under § 253(a) "is treated as though the disclaimed claims never existed." *Vectra Fitness, Inc. v. TNWK Corp.*, 162 F.3d 1379, 1383 (Fed. Cir. 1998) ("This court has interpreted the term 'considered as part of the original patent' in section 253 to mean that the patent is treated as though the disclaimed claims never existed.") (citing *Altoona Publix Theatres v. Am. Tri-Ergon Corp.*, 294 U.S. 477, 492 (1935)); *Guinn v. Kopf*, 96 F.3d 1419, 1422 (Fed. Cir. 1996) (holding that the Board's interference jurisdiction under 35 U.S.C. § 291 required "the existence of an interference, and a claim that 'never existed' [due to a statutory disclaimer] cannot form the basis for an interference"); *Facebook, Inc. v. Skky, LLC*, CBM2016-00091, Paper 12 at 8 (PTAB Sept. 28, 2017) (precedential as to § II.B.2) ("The Federal Circuit has held consistently that claims disclaimed under § 253(a) should be treated as though they never existed."). Thus, even though claims of the challenged patent existed at the time the Petition here

was filed, we must now treat the challenged patent as if it had never included those claims.

Accordingly, no *inter partes* review will be instituted for disclaimed claims 22, 24, 39, and 40 of the '950 patent. *See* 37 C.F.R. § 42.107(e) ("No *inter partes* review will be instituted based on disclaimed claims."). Nevertheless, our analysis continues because not all of the claims challenged in the Petition have been disclaimed by Patent Owner.

B. Claim Construction

A claim "shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. [§] 282(b)." 37 C.F.R. § 42.100(b). Under that standard, the "words of a claim 'are generally given their ordinary and customary meaning.'" *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312 (Fed. Cir. 2005) (en banc).

Petitioner asserts that "all terms should be given their plain and ordinary meaning. Pet. 14 (citing 37 C.F.R. § 42.104(b)(3)).

Patent Owner does not assert any construction for the challenged claim limitations. *See generally* Prelim. Resp.

Based on our review of the record, we do not construe any limitations or terms of the challenged claims because construction is needed only for those terms "that are in controversy, and only to the extent necessary to resolve the controversy" and we do not discern any such controversy. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

C. Principles of Law Regarding Obviousness

A claim is unpatentable under 35 U.S.C. § 103 if "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) where in evidence, objective evidence of non-obviousness.[6] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). A patent claim "is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." *KSR*, 550 U.S. at 418.

An obviousness determination based on a combination of references requires finding "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.'" *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1367–68 (Fed. Cir. 2016) (citation omitted); *see KSR*, 550 U.S. at 418. Furthermore, an assertion of obviousness "cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." *KSR*, 550 U.S. at 418; *In re NuVasive, Inc.*, 842

[6] Patent Owner presents arguments for objective indicia of non-obviousness. Prelim. Resp. 71–77. Because we determine that the Petition is deficient for other reasons as set forth herein, we do not address these arguments.

F.3d 1376, 1383 (Fed. Cir. 2016) (a finding of a motivation to combine "must be supported by a 'reasoned explanation'" (citation omitted)).

"In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable." *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3)); *see also Intelligent Bio-Sys.*, 821 F.3d at 1369. This burden of persuasion never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review). Therefore, to prevail in an *inter partes* review, Petitioner must explain how the proposed combination of prior art would have rendered the challenged claims unpatentable. At this preliminary stage, we determine whether the information presented in the Petition shows there is a reasonable likelihood that Petitioner would prevail in establishing that at least one of the challenged claims would have been obvious over the proposed combinations of prior art.

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

D. Level of Ordinary Skill in the Art

In determining the level of ordinary skill in the art, 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 marks omitted). Furthermore, the prior art itself can reflect the

appropriate level of ordinary skill in the art. *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

Here, Petitioner asserts a person of ordinary skill in the art at the time of the '950 patent would have had "at least a Master's degree in electrical engineering and two or more years of work experience relating to power electronics and the design of switching power converters, with more experience potentially substituting for education or vice versa." Pet. 7 (citing Ex. 1003 ¶ 29; Ex. 1009 ¶¶ 35–38; Ex. 1010, 80).

Patent Owner does not assert a different level of skill in the art at the time of the alleged invention at this time. *See generally* Prelim. Resp. Additionally, Dr. Rivas-Davila applies Petitioner's definition in his declaration. Ex. 2001 ¶ 64.

For the purposes of this Decision, we adopt Petitioner's level of ordinary skill in the art because it appears consistent with (1) the problems addressed in the '950 Patent and (2) the level of ordinary skill in the art reflected by the prior art of record. *See Okajima*, 261 F.3d at 1355.

E. Overview of Asserted Prior Art of Record

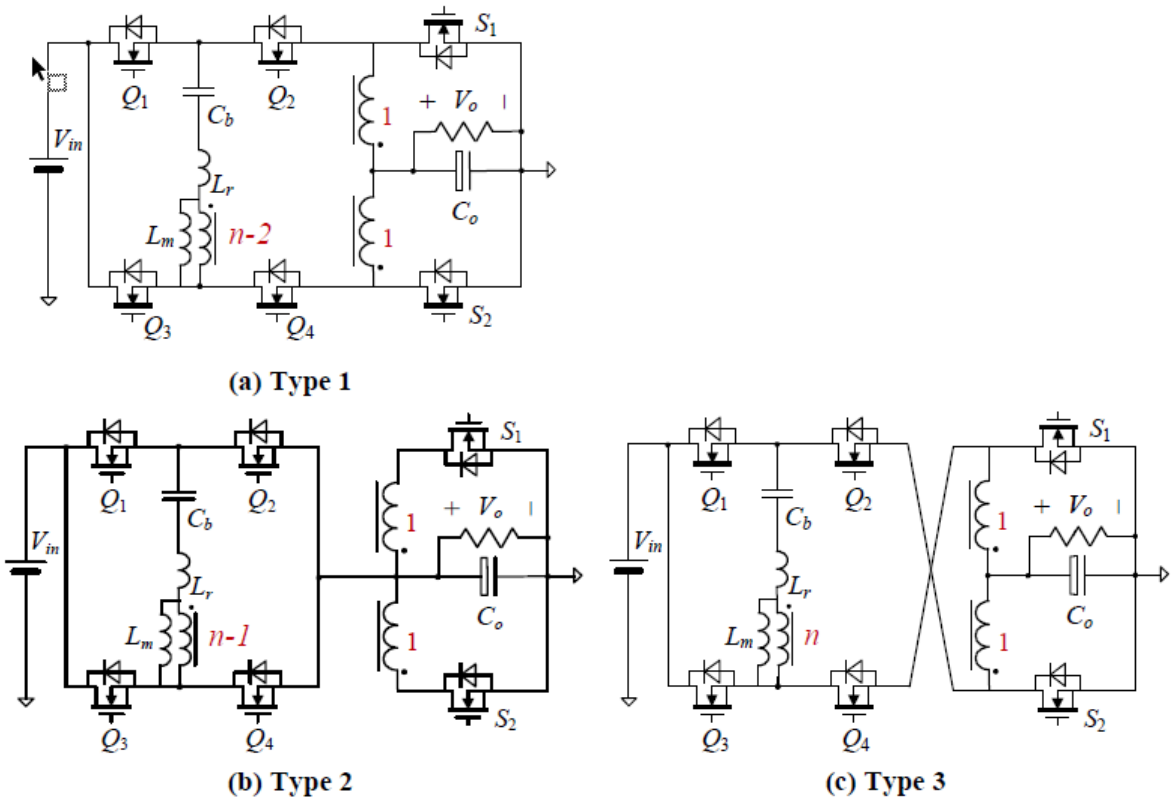
1. Huang (Ex. 1005)

Huang is a conference paper titled "Novel Non-Isolated LLC Resonant Converters" by Daocheng Huang, Xinke Wu, and Fred C. Lee. Ex. 1005, 1373[7]; *see* Ex. 1009 ¶ 39. Petitioner asserts that Huang was publicly available as of March 9, 2012. Pet. 7 (citing Ex. 1009 ¶¶ 39–45, 48). Patent Owner does not dispute the asserted date of availability. *See generally* Prelim. Resp.

[7] The parties are inconsistent in their citations. Therefore, we cite to the original pagination rather than the exhibit pagination added by Petitioner.

Huang relates to non-isolated LLC resonant converters that can achieve zero voltage switching, reduce the number of turns in the transformer, and reduce the current through the secondary transformer winding. Ex. 1005, 1373. According to Huang, most LLC resonant converters are isolated by a transformer. *Id.* But, as Huang explains, in PWM ("pulse width modulation") converters, a non-isolated structure has shown benefits for low conduction loss and driven loss. *Id.* Therefore, Huang applies the same non-isolated structure to resonant converters. *Id.*

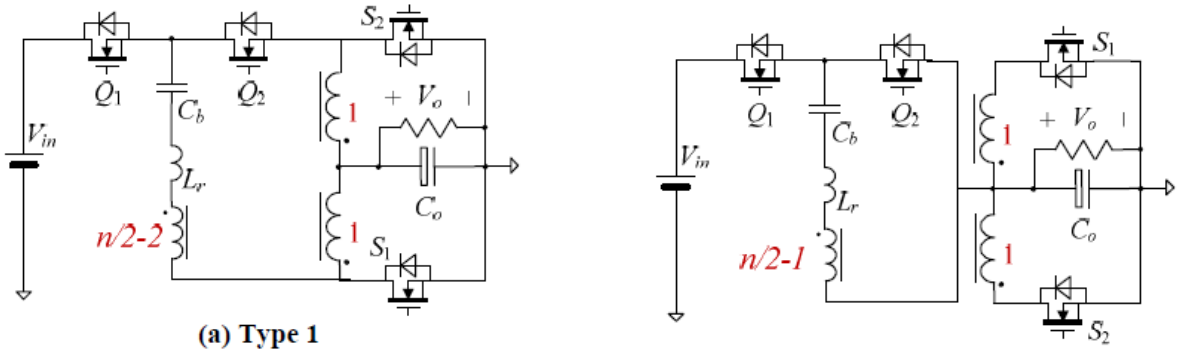
One embodiment of Huang teaches full bridge topologies as shown in Figures 1 (a), (b), and (c), reproduced below.



Figures 1 (a), (b), and (c) are circuit diagrams illustrating full bridge topologies for LLC Resonant Converters. Huang discloses simulated

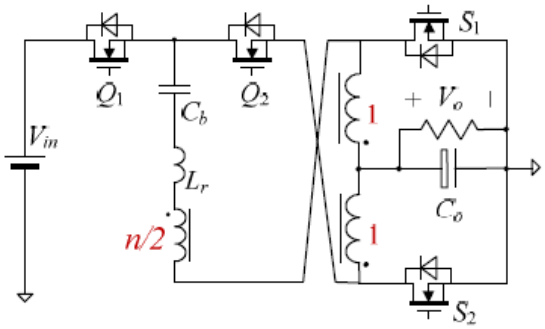
waveforms for each topography, which Huang uses to show savings of driving loss. *Id.* at 1374.

Another embodiment of Huang teaches non-isolated resonant converters in halfbridge topologies as shown in Figures 12 (a), (b), and (c), reproduced below.



(a) Type 1

(b) Type 2



(c) Type 3

Figures 12 (a), (b), and (c), reproduced above, are circuit diagrams illustrating halfbridge topologies for LLC Resonant Converters.

Huang states that "[d]uring the switching circle, the voltage across resonant tank is always *Vin/2-2Vo*, thus, the turns ratio of transformer equals *(Vin/2-2Vo)/Vo*" and "[t]he winding numbers is decreased" while "[t]he size and loss of transformer are effectively reduced." *Id.* at 1377. Huang further states, in discussing the half bridge topology of Figure 12(c), that "[d]ue to the unsymmetrical non-isolated structure, *isec1* and *isec2*, *is2* and *is1* are very different," and "[d]uring the switching circle, the average voltage across resonant tank is *Vin/2*, thus, the turns ratio of transformer equals

(Vin/2)/Vo." *Id.* at 1378. Figures 14(a) and 14(b) of Huang depict equivalent circuits for the operation of Huang's Figure 12(b) converter at two different time intervals. *Id.* During t_1 to t_2, the current is delivered from the source to the resonant tank and the transformer (Q1 is closed/on and Q2 is open/off). *Id.*

2. Vinciarelli (Ex. 1007)

Vinciarelli is a U.S. Patent, issued October 20, 2015, titled "Digital Control of Resonant Power Converters." Ex. 1007, codes (12), (45), (54). Vinciarelli relates to "apparatus and methods for digital control of resonant power converters, more particularly the invention relates to digital control of resonant zero-current and zero-voltage switching resonant power converters." *Id.* at 1:6–9. Vinciarelli cites to U.S. Patent No. 6,984,965 (which also lists Vinciarelli as an inventor and is assigned to the same entity) for the disclosure of a power converter, called a Sine-Amplitude Converter ("SAC"). *Id.* at 1:14–20. A block diagram of a half-bridge SAC 10 is shown in Vinciarelli's Figure 1, which is reproduced below.

Fig. 1

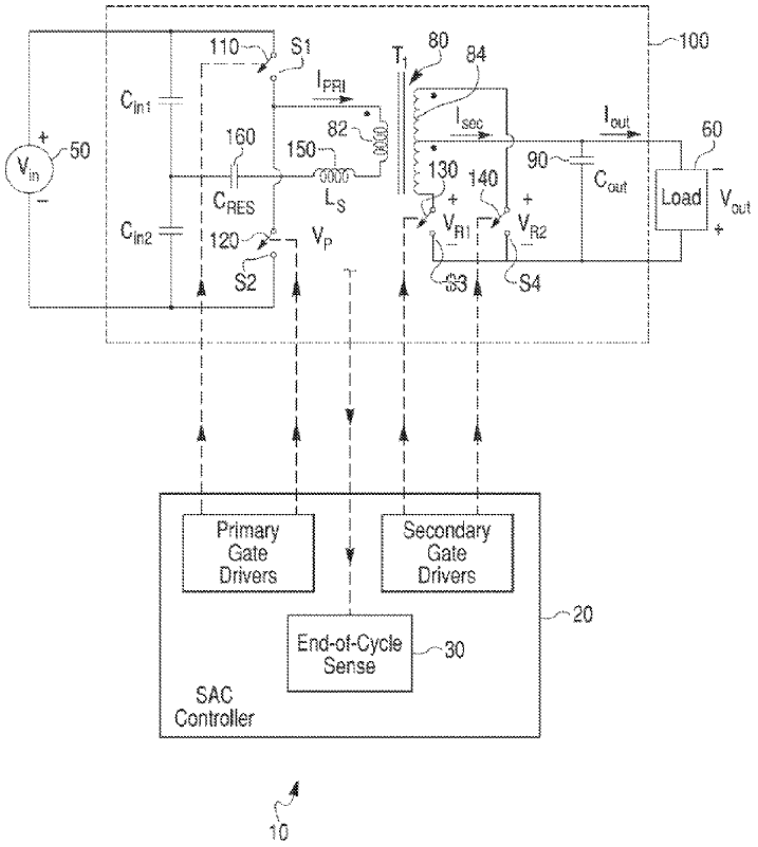


Figure 1, above, is a block diagram of a prior art SAC converter. *Id.* at 3:61. Vinciarelli teaches that "[t]he SAC comprises SAC power conversion circuitry 100 (shown connected to power source 50 and load 60) and SAC controller 20, which controls the turning ON and OFF of switches within the power conversion circuitry 100." *Id.* at 1:20–25.

One embodiment of Vinciarelli discloses a digital controller to replace the controller from its SAC shown in Figure 1. *Id.* at 4:29–5:9. The new digital controller is shown in Figure 2, reproduced below.

Fig. 2

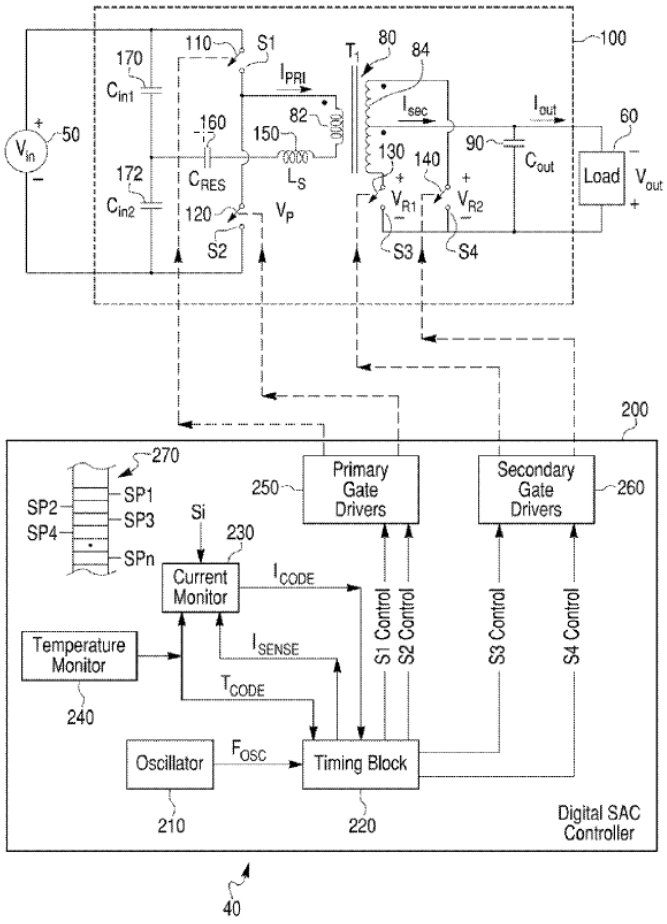


Figure 2, above, is a block diagram of a SAC converter with a digital controller. *Id.* at 3:61–63. According to Vinciarelli, digital SAC controller ("DSC") 200, as shown in Figure 2 above, includes "oscillator 210 for generating a series of timing pulses at a frequency, F_{osc}; a timing block 220 for generating one or more control signals or event outputs; and current monitoring circuitry 230." *Id.* at 4:50–54. DSC 200 "may also include temperature monitoring circuitry 240, primary gate drivers 250, secondary gate drivers 260, and storage memory 270 for storing set-point values and other parameters." *Id.* at 4:55–58. "The beginning and end of a converter operating cycle, the beginning and end of each power transfer interval, and the points during each operating cycle at which switches are turned ON and

OFF may be controlled by the DSC 200 based upon pre-defined timing parameters." *Id.* at 4:61–65.

Vinciarelli further describes "a method of synchronously operating a power converter in a series of converter operating cycles," which "includes providing an oscillator for generating clock signals at an oscillator frequency and generating timing control signals for each of a plurality of events based upon the clock signals in a standard converter operating cycle having a standard operating period and frequency." *Id.* at 2:26–32. According to Vinciarelli, "[t]he timing and control signals may turn a primary switch ON and OFF at times when essentially zero voltage is impressed across and essentially zero resonant current is flowing in the primary switch and turn a secondary switch ON and OFF at times when essentially zero current is flowing in and essentially zero voltage is impressed across the secondary switch." *Id.* at 2:33–41. Vinciarelli explains that although resonant power converters with zero-current and zero voltage switching capabilities were known in the art at the time of invention, they "required that circuit conditions be monitored in order to determine the proper time at which to turn switches ON and OFF." *Id.* at 1:13–2:7, Fig. 1.

3. Lee (Ex. 1008)

Lee is a journal article, published in August 2007, titled "Design Challenges for Distributed Power Systems." Ex. 1008, 1.[8] Lee discloses that:

> The 48V input DC/DC for high-end server and telecom applications requires higher voltage devices on the primary side and a transformer for isolation. To get fast dynamic response and

[8] We cite to the original pagination rather than the exhibit pagination added by Petitioner.

> regulation performance, the PWM type power conversion is preferred, whereas the efficiency and switching frequency is limited by the presence of the leakage inductances of the transformer. In order to achieve acceptable efficiency, lower switching frequencies, around 200~300 KHz, are normally adopted. Thus the size of the transformer and its passive components are bulky and the transient responses are slow.

Id. at 9–10. Therefore, according to Lee, "[t]o leverage the 48V isolated DC/DC with standard high frequency non-isolated POL converter techniques, a superior two-stage approach was proposed." *Id.* at 10. Such an approach is shown in Lee's Figure 31, reproduced below.

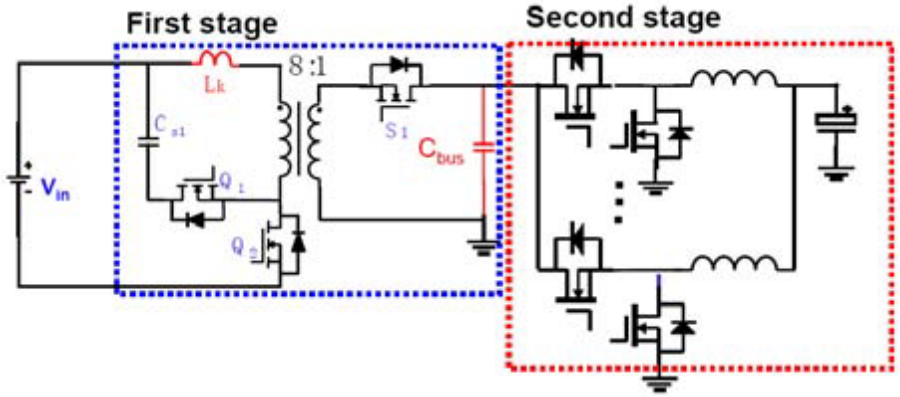


Figure 31, above, is a circuit diagram illustrating a two-stage solution.

Lee discloses that the first stage uses "a simple inductorless DC/DC transformer operating at 1MHz switching frequency by adopting the resonant switching to minimize switching losses. The second stage employs the multiphase buck capable of operating at multi-Mega Hertz, taking advantage of the already established infrastructure for low-voltage POL converters." *Id.* Lee explains that "[t]his architecture has been quickly adopted by the industry and used in the current products." *Id.*

Lee further discusses the uses of Intermediate Bus Architecture (IBA) and Bus Converters where:

> With the proliferation of low-voltage, high-current microprocessors/DSPs and high-voltage analog devices on a single circuit board, the number of different voltages encountered has mushroomed. All these voltages share a common ground so that it is unnecessary to use an isolated transformer for each of these loads, respectively.

Id. at 11. Due to this, Lee explains that "the two-stage concept aforementioned was extended to the sub-system level, as shown in Fig. 33" reproduced below. *Id.*

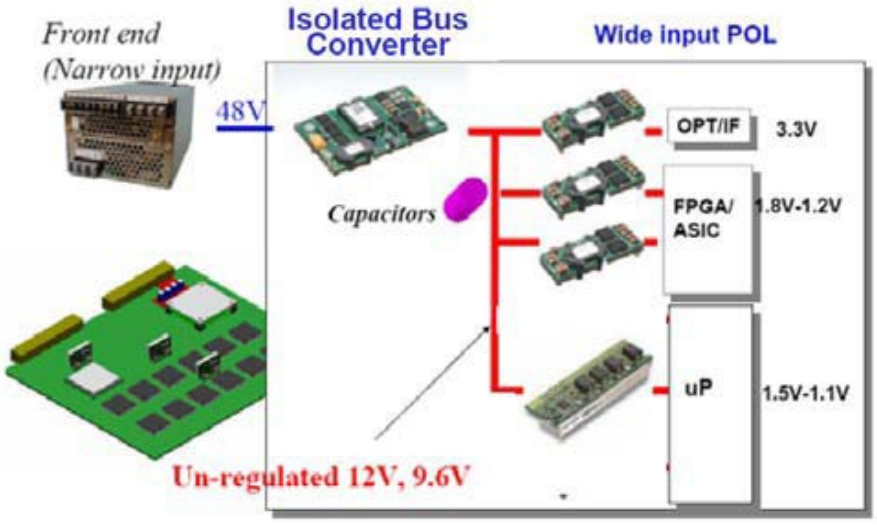


Figure 33 of Lee is a graphic of a two-stage IBA. *Id.* Lee discloses that, as shown in Figure 33 above, "an isolated bus converter steps down the 48V to an intermediate bus voltage to feed all the non-isolated point-of-load converters (POL) in the same board." *Id.* at 11. According to Lee, "[t]his concept has been adopted by industry and is becoming a mainstream for high-end server and telecommunication applications, because it is more cost-effective, more flexible in terms of system structure." *Id.*

Lee then proposes a non-isolated intermediate bus architecture, as shown in Fig. 43, reproduced below. *Id.* at 12, Fig. 43.

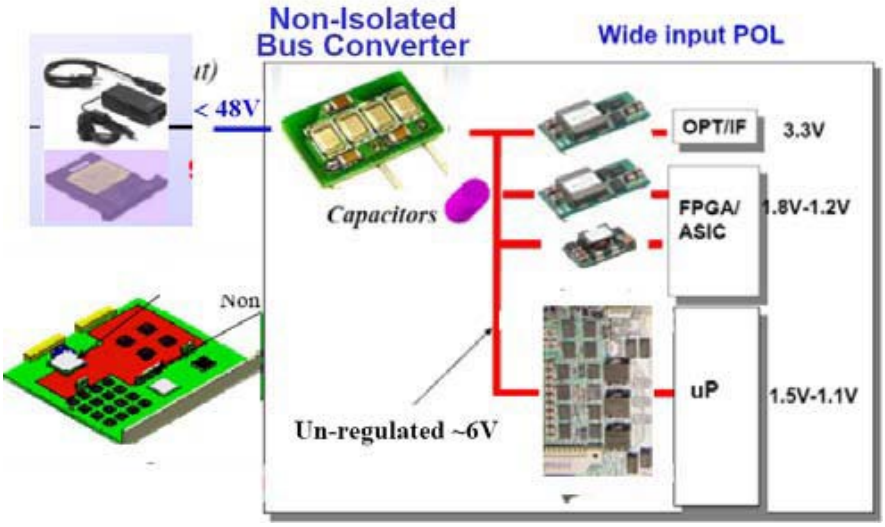
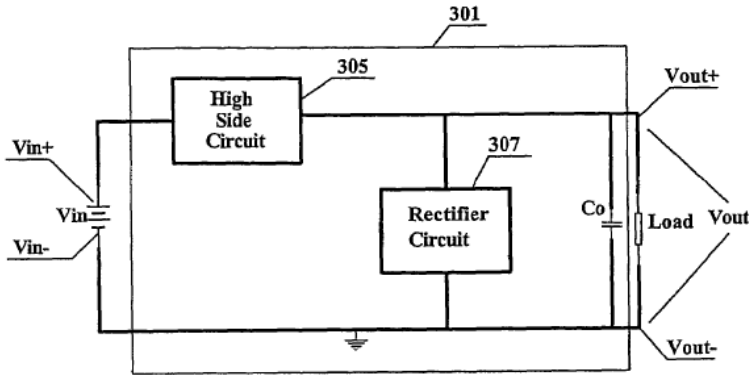


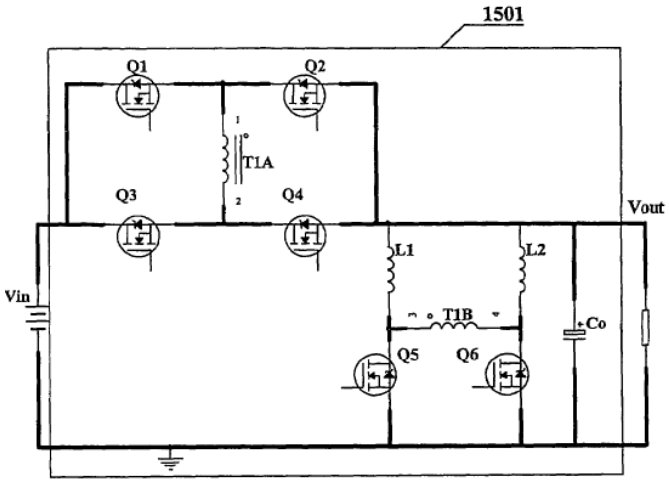
Figure 43 of Lee is a graphic of a proposed non-isolated two-stage IBA. *Id.* Lee states "[b]y extending this two-stage approach into system level, the non-isolated IBA structure is proposed . . . ., in which the voltage divider is used as the nonisolated bus converter. This architecture has been investigated for the laptop." *Id.*

4. Liu (Ex. 1006)

Liu is a U.S. Patent, issued December 11, 2007, titled "Non-Isolated DC-DC Converters With Direct Primary To Load Current." Ex. 1006, codes (12), (45), (54). Liu discloses two high-level converter topologies, one shown in Figure 3, reproduced below:

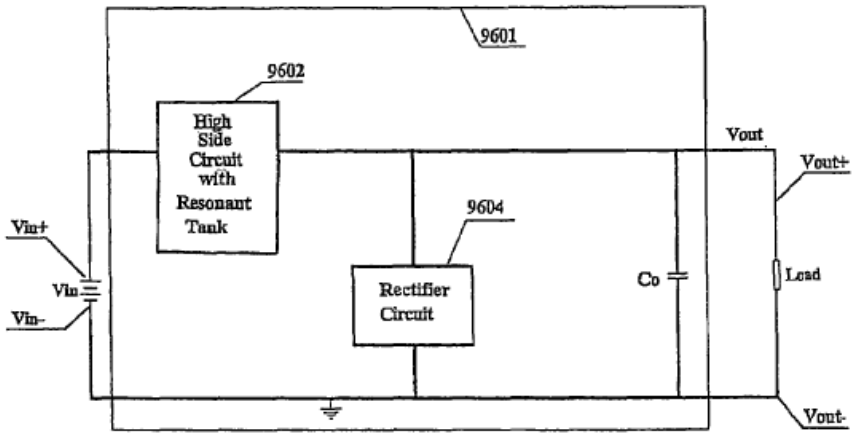


Liu's Figure 3 is a circuit diagram illustrating a high-side circuit, rectifier circuit, and output capacitor. Ex. 1006, Fig. 3. One embodiment of Liu's first topology is shown in Figure 15, reproduced below:

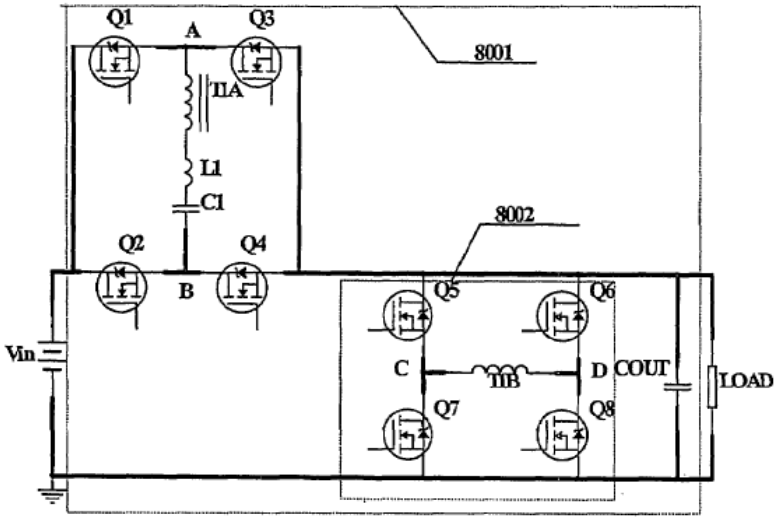


Liu's Figure 15 is a circuit diagram illustrating a full-bridge high-side circuit with primary switches that control the flow of current through the transformer primary winding and a half-bridge rectifier circuit with two switches controlling the flow of current through the transformer secondary winding and two inductors L1 and L2. Ex. 1006, Fig. 15, 16:16–18:16.

The second topology disclosed in Liu is shown in Figure 68A, reproduced below:



Liu's Figure 68A is a circuit diagram that is similar to Figure 3 except the high-side circuit includes a resonant tank. One embodiment of Liu's second topology is shown in Figure 80, reproduced below:



Liu's Figure 80 is a circuit diagram illustrating a full-bridge high-side circuit with four primary switches that control the flow of current through an LLC series resonant tank including the transformer primary winding T1A, inductor L1, and capacitor C1. *Id.* at 32:53–33:7. Liu teaches that a full-bridge rectifier circuit with four primary switches can control the flow of current through the transformer secondary winding T1B. *Id.*

IV. ANALYSIS

A. Alleged Obviousness of Claims 1, 5–7, 9, 13–16, 19, and 21–40 in view of Huang

Petitioner contends claims 1, 5–7, 9, 13–16, 19, and 21–40 would have been obvious to a person of ordinary skill in the art in view of the teachings of Huang. Pet. 16–45. Patent Owner disputes Petitioner's contentions for two specific limitations, as well as Petitioner's proffered reasons to apply the prior art to an Intermediate Bus Architecture. Prelim. Resp. 21–48. We

only address those limitations disputed by Patent Owner.[9] For the reasons discussed below, we are not persuaded Petitioner has established a reasonable likelihood of success on this challenge.

1. Analysis of Independent Claim 1

a) "a bus converter comprising an input circuit and an output circuit, the bus converter being adapted to convert power from the input circuit to the output circuit at a substantially fixed voltage transformation ratio, K_{DC}, at an output current, wherein an input voltage V_{IN} is applied to the input circuit and an output voltage V_{OUT} is produced by the output of the bus converter, and wherein the substantially fixed voltage transformation ratio can be represented as $K_{DC}=V_{OUT}/V_{IN}$"

Petitioner contends this limitation is met because Huang's component parts would be equivalent to a bus converter and would be useful in an Intermediate Bus Architecture. Pet. 17 (citing Ex. 1001, 1:13–35). Specifically, Petitioner notes that the IBA includes a bus converter, which includes a DC transformer to provide voltage transformation. *Id.* Therefore, according to Petitioner, a person of ordinary skill in the art at the critical time would have known (1) a bus converter is or contains a power converter, (2) Huang discloses a DC-DC converter, and (3) where the input and output of the converter both need to be DC, to use a DC-DC converter such as Huang's as the bus converter or part of the bus converter because the input

[9] In this Decision, we focus on two specific limitations of the '950 patent, as these limitations are dispositive for purposes of this Decision for all challenges presented by Petitioner. Petitioner has provided contentions for the remaining limitations, and in some cases, Patent Owner has provided additional arguments regarding Petitioner's contentions. Because we determine that Petitioner has not sufficiently established that the asserted references teach the disputed limitations in all challenges, we do not address or take any position on these additional contentions and arguments.

to the converter is DC and the electronics downstream from the converter also use DC. *Id.* (citing Ex. 1005, Fig. 12(b); Ex. 1003 ¶¶ 63–64).

Petitioner then contends that because a person of ordinary skill in the art at the time of the invention already knew about IBA, Huang would have been "an attractive option to a [person of ordinary skill in the art (POSITA)] seeking a high efficiency converter." *Id.* (citing Ex. 1003 ¶ 65). According to Petitioner, this would have been particularly beneficial because the power conversion in Huang "is performed at a substantially fixed voltage transformation ratio that can be represented as $K_{DC}=V_{OUT}/V_{IN}$." *Id.* at 19. Petitioner relies on the testimony of Dr. Hopkins to support its position. *See id.* at 18–20 (citing Ex. 1003 ¶¶ 68–71).

Dr. Hopkins testifies that "[i]n LLC converters, the impedance of the resonant tank is zero when the switching frequency is at the resonant frequency." Ex. 1003 ¶ 68. According to Dr. Hopkins, "[b]ecause the impedance of the resonant tank is zero, the voltage gain is fixed for all load conditions when the switching frequency is at the resonant frequency because the impedance is not interfering with the voltage." *Id.* Dr. Hopkins then concludes that "the transformation ratio (which is the voltage gain, as noted by the '950 Patent, Ex. 1001, 4:57–60), is fixed and only affected by the transformer turns ratio when the switching frequency is at the resonant frequency." *Id.* "The transformer turns ratio is physically fixed in the circuit and, therefore, the transformation ratio is likewise fixed." Ex. 1003 ¶ 68.

Dr. Hopkins further testifies that the "power conversion performed by Huang's Figure 12(b) converter is performed at a substantially fixed voltage transformation ratio that can be represented as $K_{DC} = \frac{V_{OUT}}{V_{IN}}$ [and] can also be

demonstrated mathematically." *Id.* ¶ 69. According to Dr. Hopkins, "the converter shown in Figure 12(b) of Huang is adapted to convert power from the input circuit to the output circuit at the fixed voltage transformation ratio, $\frac{1}{2K_t+1} = K_{DC}$, where K_t is the transformer turns ratio $\frac{(V_{IN}/2)-V_O}{V_O}$." *Id.* ¶ 71. Dr. Hopkins then concludes that "[b]ecause the transformer turns ratio is physically fixed for a circuit, and the transformation ratio is dependent upon the transformer turns ratio, the transformation ratio is therefore likewise fixed." *Id.*

Dr. Hopkins, however, does not provide any citation to the prior art, other evidence of record, or the '950 patent to support this testimony, nor does he provide any further explanation as to how or why the impedance of a resonant tank would always be zero such that the voltage gain would be fixed. Therefore, the cited declaration testimony is "conclusory, adds little to the conclusory assertion for which it is offered to support, and is entitled to little weight." *Xerox Corp. v. Bytemark, Inc.*, IPR2022-00624, Paper 9 at 15 (PTAB August 24, 2022) (precedential); *see also* 37 C.F.R. § 42.65(a) ("Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight."); *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 . . . ."); *Upjohn Co. v. Mova Pharm. Corp.*, 225 F.3d 1306, 1311 (Fed. Cir. 2000) ("Lack of factual support for expert opinion to factual determinations, however, may render the testimony of little probative value in a validity determination.") (quoting *Ashland Oil, Inc. v. Delta Resins & Refractories, Inc.*, 776 F.2d 281, 294

(Fed. Cir. 1985); *MobileMedia Ideas LLC v. Apple Inc.*, 780 F.3d 1159, 1172 (Fed. Cir. 2015)).

Patent Owner disagrees with Petitioner's arguments and contends Huang does not meet the limitation of "adapted to convert power from the input circuit to the output circuit at a substantially fixed voltage transformation ratio, K_{DC} . . . wherein the substantially fixed voltage transformation ratio can be represented as $K_{DC}=V_{OUT}/V_{IN}$." Prelim. Resp. 25 (citing Ex. 2001 ¶ 66).

Patent Owner specifically argues that Huang is a regulating converter, which produces an unvarying output voltage from a varying input voltage. Prelim. Resp. 25–26 (citing Ex. 1005, 1; Ex. 2001 ¶ 67). Therefore, according to Petitioner, it is "*by design*, [that] the ratio V_{OUT}/V_{IN} in Huang's converter varies, because V_{IN} varies while V_{OUT} remains fixed." *Id.* at 25 (citing Ex. 2001 ¶ 66). Patent Owner provides persuasive explanation and evidence demonstrating the behavior of regulated converters and showing that Huang's regulated converter is adapted to hold output voltage fixed even as input voltage changes. *Id.* at 26–34 (citing Ex. 2001 ¶¶ 67–79; Ex. 2002, 1; Ex. 2003, 3; Ex. 2004, 1; Ex. 2006, 2; Ex. 2007, 2; Ex. 2008, 1; Ex. 2009 6, n3; Ex. 2011, 1:60–65; Ex. 2012, 2, 8, 10, 12, 15; Ex. 2013, 3, 5, 7; Ex. 2014, 1, 19; Ex. 2015, 2; Ex. 2016, 1; Ex. 2017, 4; Ex. 2021, 152, 155–156, 167, § 7.1.9.2; Ex. 2026, 1; Ex. 1005, 1; Ex. 1006, 1:38–64). Thus, Patent Owner concludes that Huang's converter is not "adapted to convert power from the input circuit to the output circuit at a substantially fixed voltage transformation ratio," K_{DC} and does not meet the challenged claim limitation. *Id.* at 34.

Patent Owner then takes issue with Petitioner's math as well as some of the underlying assumptions Petitioner made when performing its calculations. Prelim. Resp. 35–36 (citing Ex. 2001 ¶¶ 80–81). Specifically, Patent Owner argues that Petitioner was incorrect in making the assertation that "[p]reliminarily, Huang discloses that the switching frequency of its converter may be at the resonant frequency." *Id.* at 35 (citing Pet. 19; Ex. 1005, 1378). Rather, according to Patent Owner, the cited page of Huang states: "It is the same as type 1, the node voltage V_a is in phase with i_{s1} and i_{s2} when switching frequency is at or above resonant frequency." *Id.* (citing Ex. 1005, 7, left column, bottom; Ex. 2001 ¶ 81). Patent Owner asserts that statement "is not an invitation to make Huang's converter a fixed frequency device, but rather a reminder that the observed behavior . . . happens when the converter's variable frequency operation happens to veer into the range of frequencies above the resonant frequency." *Id.* at 35–36 (citing Ex. 2001 ¶ 81).

Patent Owner further asserts Petitioner's conclusion is false because "the changing frequency of the Huang converter allows it to change its voltage transformation ratio to counteract changes in input voltage and output load." Prelim. Resp. 36 (citing Ex. 2001 ¶ 82). According to Patent Owner, Petitioner's calculations "are nothing more than a formalization of the Petitioner's error, because they begin with the [incorrect] assumption that the voltage transformation ratio is simply equal to the transformer turns ratio," which "[i]t is not." *Id.* (citing Pet. 19; Ex. 2001 ¶ 82).

Patent Owner finally contends it would not have been obvious to a person of ordinary skill in the art to use Huang's regulated LLC converter as a bus converter in an IBA for at least three reasons. Prelim. Resp. 37. First,

according to Patent Owner, Huang's converter is non-isolated (Ex. 1005, 1), and bus converters were commonly believed to require isolation. Prelim. Resp. 37–43 (citing Ex. 2001 ¶¶ 87–88; Ex 2017, 1; Ex. 2006, 1–2; Ex. 2002, 1; Ex. 2018, 1). Patent Owner argues that "[b]ecause Huang's converters are non-isolating, a [POSITA] would have needed some specific motivation to use them in a role (that of the 'bus converter' in IBA) thought to require an isolating converter." *Id.* at 43 (citing Ex. 2001 ¶ 93). Patent Owner then concludes that the Petition fails to provide such motivation to use a non-isolated converter in a role that was thought to require an isolated converter. *Id.* at 44 (citing Ex. 2001 ¶ 94). Therefore, according to Patent Owner, it would be inappropriate to use Huang's non-isolated converter as an IBA bus converter.

Second, Patent Owner contends that a person of ordinary skill at the time of the invention would not have looked to Huang's teachings of a regulating converter (which is tightly regulated for use with microprocessors) for a replacement of an IBA bus converter (which does not need to regulate its output voltage) because downstream Point of Load "POL" converters provide regulation. Prelim. Resp. 45–46 (citing Ex. 2001 ¶ 95; Ex. 2002, 1; Ex. 2003, 3; Ex. 2004, 1; Ex. 2007, 2; Ex. 2008, 1).

Lastly, Patent Owner contends there is no rationale for Huang's regulated converter to change roles from POL to a bus converter in an IBA application as postulated by Petitioner. Prelim. Resp. 46–48 (citing Ex. 1005, 1; Ex. 2001 ¶ 97). Patent Owner argues Bus converters and POLs perform fundamentally different functions, have different requirements, and are not interchangeable. *Id.* at 47–48 (citing Ex. 2017, 4, Fig. 4; Ex. 2001 ¶¶ 97–100; Ex. 2007, 1, 4).

We agree with Patent Owner. Specifically, we are persuaded by Patent Owner's arguments that Huang's converter is a tightly regulated, non-isolated LLC resonant converter, which is designed to be either a voltage regulator (VR) or a point-of-load (POL) voltage regulator. *See* Ex. 1005, 1; Ex. 2006, 2; Ex. 2007, 2; Ex. 2008, 1; Prelim. Resp. 25–35. As seen in Huang's Figure 12b, the two inductors ("L") and the one capacitor ("C") are used to provide regulation. *See* Ex. 2011, 1:60–65; Ex. 2012, 2; Ex. 2013, 3; Ex. 2014, 19; Ex. 2001 ¶¶ 71–72. We are persuaded by Dr. Rivas-Davila, who explains that:

> [t]hese so-called "fixed ratio" converters have certain applications, but often the "load" (or the device attached to the output of the converter, which uses its output voltage) will require a precise voltage, like 1.00 V. This is especially true for microprocessors and other integrated circuits. In order to provide a precise and non-varying output voltage, many power converters will employ "regulation". With regulation, the power converter in some way monitors the level of the output voltage. When the output voltage goes too high or too low, feedback into the power converter circuitry will change some aspect of the converter's operation to counteract the deviation in output voltage.

Ex. 2001 ¶ 49.

Dr. Rivas-Davila further testifies that:

> [b]ecause regulating converters hold their output voltage constant while the input voltage varies, the voltage transformation ratio V_{OUT}/V_{IN} is not fixed, but rather varies (because only V_{OUT} is fixed while V_{IN} varies).

Ex. 2001 ¶ 50. This testimony is consistent with evidence of record, the disclosures in the cited prior art, and the specification of the '950 patent itself. *See* Ex. 1005, 1; Ex. 1006, 1:38-64; Ex. 2002, 1; Ex. 2003, 3; Ex. 2006, 2; Ex. 2007, 2; Ex. 2008, 1; Ex. 2011, 1:60-65; Ex. 2012, 2; Ex. 2013,

3; Ex. 2015, 2; Ex. 2017, 4; Ex. 2021, 152, 155; 167. Accordingly, the record supports that in regulated converters, such as the ones in Huang, the output voltage (V_{OUT}) stays the same while the input voltage (V_{IN}) changes; therefore, the ratio of V_{OUT}/V_{IN} (the claimed "voltage transformation ratio") also changes, and is not "substantially fixed" as required by the challenged claims.

We also agree with Patent Owner that Petitioner fails to meet its burden to shown why a person of ordinary skill in the art at the time of the invention would use Huang's non-isolated, regulated converter as an isolated bus converter in an IBA.[10] Specifically, Petitioner's two arguments (*see* Pet. 17) that (1) both Huang and an IBA bus converter use DC voltages, and (2) Huang's converter "increases efficiency" are insufficient, and fail to demonstrate with particularity how or why an ordinarily skilled artisan would exchange an IBA's isolated bus converter for Huang's non-isolated, regulated POL converter or that they would have a reasonable expectation of success in doing so.

A determination of obviousness cannot be reached where the record lacks explanation as to *how* or *why* a reference would be modified to produce the claimed invention. *NuVasive*, 842 F.3d at 1382–86 (holding that an obviousness determination cannot be reached where there is no "articulat[ion of] a *reason why* a [person having ordinary skill in the art] would combine" and "modify" the prior art teachings). The Supreme Court

[10] We agree with Patent Owner that Petitioner's position is not entirely clear – i.e., whether or not Petitioner is proposing to modify Huang to be used as a bus converter. Prelim. Resp. 24–25.

has explained that it is essential, in an obviousness analysis, to provide a reason for combining and/or modifying the teachings of prior art references:

> [A] patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art. Although common sense directs one to look with care at a patent application that claims as innovation the combination of two known devices according to their established functions, it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does. This is so because inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known.

KSR, 550 U.S. at 418–19. Relatedly, our reviewing court explained that "obviousness concerns whether a skilled artisan not only *could have made* but *would have been motivated to make* the combinations or modifications of prior art to arrive at the claimed invention." *Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015). Accordingly, the Federal Circuit has elsewhere stated, "[w]ithout any explanation as to how or why the references would be combined to arrive at the claimed invention, we are left with only hindsight bias that *KSR* warns against" and "we cannot allow hindsight bias to be the thread that stitches together prior art patches into something that is the claimed invention." *Metalcraft of Mayville, Inc., v. The Toro Co.*, 848 F.3d 1358, 1367 (Fed. Cir. 2017).

Petitioner's analysis is conclusory, non-specific, and "fail[s] to provide any meaningful explanation for why one of ordinary skill in the art would be motivated to" modify Huang at the time of this invention. *InTouch Techs., Inc. v. VGO Communications, Inc.*, 751 F.3d 1327, 1353–1354 (Fed. Cir. 2014). Indeed, we fail to see any *reason* provided by Petitioner or Dr.

Hopkins as to why a person of ordinary skill in the art would be motivated to modify or exchange Huang's regulated LLC resonant converter to be the bus converter recited in challenged claim 1. Thus, Petitioner's arguments fall short of "some articulated reasoning with some rationale underpinning to support the legal conclusion of obviousness." *KSR*, 550 U.S. at 418.

Accordingly, for purposes of this Decision, we are not satisfied Petitioner has shown that Huang would have rendered this limitation obvious to a person of ordinary skill in the art at the critical time. Specifically, we are not satisfied that Huang's non-isolated, regulated converter would have been used as an isolated bus converter in an IBA or that it had a substantially fixed voltage transformation ratio. *See, e.g.*, Ex. 1005, 1; Ex. 2002, 1; Ex. 2003, 3; Ex. 2004, 1; Ex. 2006, 2; Ex. 2007, 2; Ex. 2008, 1; Ex. 2011, 1:60–65; Ex. 2012, 2; Ex. 2013, 3; Ex. 2014, 19.

b) *"a plurality of regulators, wherein each regulator comprises a regulator input connected to the power distribution bus to receive power from the output circuit of the bus converter and a regulator output connected to supply power to a respective load, the plurality of regulators each being separated by a distance from the bus converter"*

Petitioner contends that "the '950 Patent explains that the use of IBA, wherein a bus converter supplies power to one or more down-stream regulators, was known at the time of invention." Pet. 21 (citing Ex. 1001, 1:13–35, Fig. 1). According to Petitioner, "in this configuration, the input of the regulators is attached to a power distribution bus to which the output of the bus converter is also attached, such that the regulators are receiving power from the output of the bus converter," and then the regulators would "provide regulated power/voltage to their respective loads." *Id.* Petitioner then argues that, therefore, a person of ordinary skill in the art at the time of

the invention "would have further known that regulators would be separated by a distance from the bus converter." *Id.* (citing Ex. 1003 ¶ 73).

Patent Owner disputes that Huang teaches this limitation of the challenged claims for the same reasons discussed above regarding the lack of interchangeability of Huang's regulated LLC resonant converter as a bus converter in an IBA. Prelim. Resp. 37; *see supra*, Section IV.A.1.a.

We agree with Patent Owner that Petitioner fails to meet its burden to show that this claim limitation would have been obvious in view of Huang.[11] Specifically, as discussed previously, we find that Huang's converter is a tightly regulated, non-isolated LLC resonant converter, which is designed to be either a voltage regulator (VR) or a point-of-load (POL) voltage regulator. *See* Ex. 1005, 1; Ex. 2006, 2; Ex. 2007, 2; Ex. 2008, 1. Moreover, Petitioner's citations to the challenged patent itself, without explanation or connection to Huang (the asserted reference), do not satisfy Petitioner's burden "to show *with particularity* why the patent it challenges is unpatentable." *Harmonic*, 815 F.3d at 1363 (emphasis added).

Accordingly, for purposes of institution, Petitioner has provided insufficient evidence demonstrating that a person of ordinary skill in the art would have found it obvious to use Huang's regulated, non-isolated LLC resonant converter as both a bus converter and as a plurality of down-stream regulators that would be separated by a distance from each other.

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[11] Again, we agree with Patent Owner that Petitioner's argument is not entirely clear. Prelim. Resp. 37. Petitioner's argument for this limitation does not discuss Huang at all, but solely cites to disclosure in the '950 patent. Pet. 21. We understand Petitioner's argument to be related to the argument discussed above in Section IV.1.a. in that Petitioner proposes to, in some manner, use Huang's converter as the recited "bus converter," which was known at the time of invention.

c) Conclusion Regarding Claim 1

Having analyzed Petitioner's arguments and supporting evidence in this present record, we determine Petitioner has not established adequately for purposes of this Decision that Huang teaches or suggests all of the limitations of independent claim 1. Accordingly, we determine Petitioner has not demonstrated a reasonable likelihood that Petitioner would prevail in showing that claim 1 would have been rendered obvious to a person of ordinary skill in the art at the critical time by the teachings of Huang.

2. Analysis of Claims 5–7, 9, 13–16, 19, and 21–40

Independent claims 9, 16, 29, 31, 32, and 33 each recite "a substantially fixed voltage transformation ratio" "wherein the substantially fixed voltage transformation can be represented as $K_{DC}=V_{OUT}/V_{IN}$," which is recited in independent claim 1. *See* Ex. 1001, 10:30–35, 11:44–49, 12:52–57, 14:59–64, 15:28–33, 15:64–16:2, 16:27–33. Independent claims 16, 22, 29, 31, and 32 each recite "a plurality of regulators" each being "separated by a distance from the bus converter," which also is recited in independent claim 1. *Id.* at 10:39–45, 12:61–67, 14:1–7, 15:1–7, 15:37–43, 16:6–12. All dependent claims depend directly or indirectly from independent claims 1, 9, 16, 22, 29, 31, 32, or 33, and therefore, require the same ability for a "substantially fixed voltage transformation ratio" and/or "a plurality of regulators."

Having reviewed Petitioner's arguments and supporting evidence in this present record, including the arguments summarized above for claim 1, we determine Petitioner has not established adequately for purposes of this Decision that Huang teaches or suggests the limitations of claims 5–7, 9, 13–16, 19, 21, 23, 25–38 for the same reasons Petitioner did not meet its burden

regarding claim 1. Accordingly, we determine Petitioner has not demonstrated a reasonable likelihood of prevailing in showing that these claims would have been rendered obvious to a person of ordinary skill in the art at the critical time by the teachings of Huang.

B. Alleged Obviousness of Claims 5, 13, 21, 25–27, and 34 in view of Huang and Vinciarelli

Petitioner contends dependent claims 5, 13, 21, 25–27, and 34 would have been obvious to person of ordinary skill in the art in view of the combined teachings of Huang and Vinciarelli. Pet. 45–49 (citing Ex. 1003 ¶¶ 167–172). Petitioner relies on Vinciarelli's disclosures for a (1) resonant circuit including its transformer and (2) "method of synchronously operating a power converter in a series of converter operating cycles" to control the timing of power transfer and energy recycling intervals. *Id.* at 47 (citing Ex. 1007, 1:32–36, 4:29–45, 6:21–24, 12–59, claim 1).

Petitioner further contends it would have been obvious to an ordinarily skilled artisan to modify Huang's resonant converter with Vinciarelli's digital control circuitry for at least three reasons. Pet. 45–47. First, according to Petitioner, power converters were known already in the art so it would have been obvious to try a digital controller with Huang's converter. *Id.* at 45–46. Second, a digital controller would have improved the energy efficiency of Huang's converter. *Id.* at 46. Third, it would have been "mere substitution" to use Vinciarelli's digital control circuitry with Huang's resonant converters to obtain predictable results (the efficient control of the resonant converter). *Id.* (citing Ex. 1003 ¶ 170).

Patent Owner does not specifically dispute Petitioner's contentions regarding this challenge. *See* Prelim. Resp. 48–49. Nonetheless, the burden

remains on Petitioner to demonstrate unpatentability. *See Dynamic Drinkware*, 800 F.3d at 1378.

Petitioner's citations to and reliance on Vinciarelli do not remedy the deficiencies of Huang, and therefore, the combined teachings do not teach or suggest "a bus converter . . . adapted to convert power . . . at a substantially fixed voltage transformation ratio, K_{DC}, . . . wherein the substantially fixed voltage transformation ratio can be represented as $K_{DC} = V_{OUT}/V_{IN}$" or a "plurality of regulators each being separated by a distance from the bus converter" as required by the independent challenged claims. As discussed previously, we find insufficient evidence demonstrating that a person of ordinary skill in the art would have found it obvious to use Huang's regulated, non-isolated LLC resonant converter as both a bus converter and as a plurality of down-stream regulators that would be separated by a distance from each other.

Accordingly, for the reasons discussed above, we are not persuaded that Petitioner has established a reasonable likelihood of prevailing on this challenge.

C. Alleged Obviousness of Claims 1, 5–7, 13–16, 19, 21, 23, and 25–38 in view of either Huang, Vinciarelli, and Lee, or Huang and Lee

Petitioner contends independent claims 1, 16, 29, and 31–33 and dependent claims 5–7, 13–15, 19, 21, 23, 25–28, 30, and 34–38 would have been obvious to a person of ordinary skill in the art in view of the combined teachings of Huang, Vinciarelli, and Lee or in view of Huang and Lee. Pet. 49–62 (citing Ex. 1003 ¶¶ 182–200). Petitioner relies on Lee's disclosure of a non-isolated intermediate bus architecture with a non-isolated bus converter designed to minimize switching losses and body diode losses at high switching frequencies and increase circuit efficiency. *Id.* at 50

(citing Ex. 1005, 11–12, Fig. 43). Petitioner also relies on Lee's usage of a "voltage divider" DC-DC converter that "can achieve high power density and 'ultra-high efficiency in the whole load range with capability to handle over load conditions' as the non-isolated bus converter in Lee's architecture." *Id.* (citing Ex. 1005, 12).

Petitioner further contends it would have been obvious to an ordinarily skilled artisan to use Huang's resonant converters, as is or as modified by Vinciarelli, in Lee's IBA in place of Lee's "voltage divider" for several reasons. Pet. 51–53 (citing Ex. 1003 ¶ 184). First, according to Petitioner, an ordinarily skilled artisan would have understood that the "non-isolated bus converter" in Lee's IBA is simply "a power converting circuit that could take many forms, including the DC-DC converter disclosed by Huang." *Id.* at 51. Then Petitioner argues that, because "Huang contemplates the use of its converters in point-of-load (POL) and voltage regulator applications where high power density and high efficiency are desired," it would have been obvious "to try Huang's high power density and high efficiency converters as the non-isolated bus converter in place of Lee's DC-DC 'voltage divider.'" *Id.* (citing Ex. 1005, 1373). Petitioner specifically argues that "there were limited options for non-isolated converters, and Huang's non-isolated LLC resonant converters were specifically designed for the same purpose as Lee's voltage divider, namely, increasing overall circuit efficiency." *Id.* (*comparing* Ex. 1005, 1373, 1378–79, *with* Ex. 1008, 12; Ex. 1003 ¶ 185). Petitioner also argues that a person of ordinary skill in the art at the critical time would have wanted to enhance the efficiency of both Lee and Huang by "improving existing converter design to reduce switching and transformer losses." *Id.* at 52 (citing

Ex. 1005, 1373; Ex. 1008, 11–12). According to Petitioner, using Huang's resonant converters in Lee's IBA "would have involved mere substitution of one known element (Lee's 'voltage divider' as the non-isolated bus converter shown in Figure 43) for another (Huang's non-isolated LLC resonant converters as the nonisolated bus converter) to obtain predictable results (more efficient power conversion)." *Id.* (citing Ex. 1003 ¶ 187).

Patent Owner disputes Petitioner's contentions regarding these challenges. Prelim. Resp. 49–54 (citing Ex. 2001 ¶¶ 102–110). Specifically, Patent Owner argues a person of ordinary skill in the art would not have used Huang's converter in Lee's system because Lee does not use a magnet, Huang is less efficient than Lee, and their converter "species" are different so an ordinarily skilled artisan would not have found them to be known or natural substitutes for one another. *Id.*

Regardless of Patent Owner's arguments as to the combination, Petitioner's citations to and reliance on Lee do not remedy the deficiencies of Huang as previously discussed, and therefore, the combined teachings do not teach or suggest "a bus converter . . . adapted to convert power . . . at a substantially fixed voltage transformation ratio, K_{DC}, . . . wherein the substantially fixed voltage transformation ratio can be represented as $K_{DC} = V_{OUT}/V_{IN}$" as required by all the independent claims. *See* Prelim. Resp. 49. Additionally, Patent Owner notes that the Petition does not "seek to alter anything about the operation of the Huang converter" and only relies on Lee "as teaching the possibility of 'a non-isolated intermediate bus architecture.'" *Id.* (citing Pet. 49–52).

Accordingly, for the reasons discussed previously, we are not persuaded that Petitioner has established a reasonable likelihood of success on this challenge.

D. Alleged Obviousness of Claims 1, 2, 6–10, 14–17, 19, 23, 25–33, and 35–37 in view of Liu

Petitioner contends claims 1, 2, 6–10, 14–17, 19, 23, 25–33, and 35–37 would have been obvious to person of ordinary skill in the art in view of the teachings of Liu. Pet. 63–90 (citing Ex. 1003 ¶¶ 243–296). Petitioner argues Liu discloses a DC-DC converter that could be used as a bus converter in an IBA. *Id.* at 65 (citing Ex. 1006, 36:20–33, Figs. 3, 15, 68A, 80; Ex. 1003 ¶ 246). According to Petitioner, "Liu's converters increase efficiency by, for example, achieving zero voltage switching" and therefore, it would "be an attractive option to a POSITA." *Id.* (citing Ex. 1006, 36:20–33; Ex. 1003 ¶ 247).

Petitioner then contends that in Liu's DC Converter, the "power conversion is performed at a substantially fixed voltage transformation ratio that can be represented as $K_{DC}=V_{OUT}/V_{IN}$." Pet. 67. Petitioner states that "[i]n the circuits of Figures 15 and 80, the voltage transformation ratio is $K_{DC} = \frac{V_{out}}{V_{in}-V_{out}}$." *Id.* (citing Ex. 1003 ¶ 250). Petitioner argues that "the values of V_{OUT} and V_{IN} can be represented in terms of the transformer turns ratio." *Id.* (citing Ex. 1006, 17:5–15, 18:36–46; Ex. 1003 ¶ 151). Petitioner then derives K_{DC} based on transformer turn ratio and total duty cycle, such as with a duty cycle of 50%, "which Liu describes as desirable because it optimizes performance of the converter." *Id.* at 68 (citing Ex. 1006, 17:5–15). Based on Petitioner's calculations, Liu's voltage transformation ratio

becomes $K_{DC} = \frac{0.5*N}{2} K_{DC} = \frac{0.5*N}{2}$, which Petitioner simplifies to $K_{DC} = \frac{N}{4}$. *Id.* Therefore, Petitioner concludes K_{DC} is fixed. *Id.*

Patent Owner disputes Petitioner's contentions, pointing out that Liu discloses a regulating converter where V_{OUT} is held constant while V_{IN} changes. Prelim. Resp. 55–56 (citing Ex. 2001 ¶¶ 114–117; Ex. 1006, 1:15–17, 1:37–46, 1:56–64, 13:3–6, 14:65–67; Ex. 2021, 152, 155–156; Ex. 2015, 2). Patent Owner relies on the testimony of Dr. Rivas-Davila to support its position and to explain in detail why and how Petitioner's math is incorrect. *Id.* at 62–66 (citing Ex. 2001 ¶¶ 113–135).

We agree with Patent Owner that Petitioner has not sufficiently shown that Liu teaches a "substantially fixed voltage transformation ratio." *See* Prelim. Resp. 55–66. Specifically, we are persuaded that Liu's converter is a tightly regulated, non-isolated DC converter, which is designed to be a voltage regulator (VR). *See* Ex. 1006, 32:53–33:7, Figs. 10–18, 80; Ex. 2006, 2; Ex. 2007, 2; Ex. 2008, 1; Ex. 2001 ¶ 125. As seen in Liu's Figure 80, for example, the inductor ("L1") and the capacitor ("C1") are used to provide regulation. *See* Ex. 2011, 1:60–65; Ex. 2012, 2; Ex. 2013, 3; Ex. 2014, 19. Liu specifically discloses that V_{OUT}=D*V_{IN} where V_{OUT} is the output voltage, V_{IN} is the input voltage, and D is the duty cycle. Ex. 1006, 2:4–6; Ex. 2001 ¶¶ 123–124. Liu defines the duty cycle as D is T_{ON}/T_S where T_{ON} is the time period during which the top switch Q1 is conducting and T_S is the switching period of Q1. *Id.* at 2:9–10. As explained by Liu, the duty cycle is not fixed and will change based on several variables, specifically it will change as the pulse width is modulated. *Id.* at 2:11–60, 17:14–15, 18:40–42; Ex. 2001 ¶ 129. Dr. Rivas-Davila explains that Liu's converter is not fixed at a duty cycle, but rather

> the duty cycle is changing as the input voltage and load conditions change. Liu does not suggest to use a fixed 50% duty cycle in the portion of the specification cited by Delta, but rather states that "[w]hen the duty cycle is *around* 0.5, the performance of the converter is optimized." (Ex. 1006, 17:14–15).

See Ex. 2001 ¶ 129. Thus, in regulated converters, such as the ones in Liu, the output voltage (V_{OUT}) stays the same while the input voltage (V_{IN}) changes; therefore, the ratio of V_{OUT}/V_{IN} (the claimed "voltage transformation ratio") also changes, and is not "substantially fixed" as required by the challenged claims.

Additionally, we have reviewed Dr. Hopkins' testimony, upon which Petitioner's analysis is based. We find the testimony to be mostly unsupported by the record, inconsistent with the disclosure of Liu, and/or conclusory. *See* Ex. 1003 ¶¶ 246–253. For example, regarding the last limitation reciting "wherein a current flowing in the inductive component charges and discharges capacitances in the bus converter reducing a voltage across said one or more switches prior to turning ON said one or more switches" Dr. Hopkins testifies this action is met by Liu's Fig. 15, which uses "phase-shift PWM control." *Id.* ¶ 263. Liu indicates, however, that phase-shift PWM is a control method used to regulate the output voltage. *See* Ex. 1006, 7:46–49) ("phase shift control to **regulate** output voltage), 30:38–45, 31:27–41). Thus, Dr. Hopkins' testimony is entitled to little weight. *See TQ Delta*, 942 F.3d at 1359.

Additionally, Dr. Hopkins provides insufficient persuasive reasoning why an ordinarily skilled artisan would have wanted to modify Liu to operate as a regulated converter with a fixed voltage transformation ratio. *See* Ex. 1003 ¶¶ 246–253. As explained above, Liu does not disclose operating with such a fixed ratio. Therefore, given the inconsistent,

conclusory, and unsupported nature of this testimony, we accord it little weight. *TQ Delta*, 942 F.3d at 1359.

We also agree with Patent Owner that Petitioner fails to meet its burden to shown why a person of ordinary skill in the art at the time of the invention would use Liu's regulated DC converter as an isolated bus converter in an IBA. Prelim. Resp. 66–69. Specifically, Petitioner's two arguments (*see* Pet. 65) that (1) both Liu and an IBA bus converter use DC voltages, and (2) Liu's converter "increases efficiency" are insufficient, and fail to demonstrate with particularity how or why an ordinarily skilled artisan would exchange an IBA's isolated bus converter for Liu's regulated DC converter or that they would have a reasonable expectation of success in doing so for the same reasons as discussed above in the Huang challenge (Section IV.A.1.a).

Accordingly, for the reasons discussed previously, we are not persuaded that Petitioner has established a reasonable likelihood of prevailing on this challenge.

E. Alleged Obviousness of Claims 1, 2, 6–8, 10, 14–17, 19, 23, 25–33, and 35–37, in view of Liu and Lee

Petitioner contends claims 1, 2, 6–8, 10, 14–17, 19, 23, 25–33, and 35–37 would have been obvious to a person of ordinary skill in the art in view of the combined teachings of Liu and Lee. Pet. 90–103 (citing Ex. 1003 ¶¶ 329–348). Petitioner relies on Lee to show a "voltage divider" DC-DC converter that "can achieve high power density and 'ultra-high efficiency in the whole load range with capability to handle over load conditions' as the non-isolated bus converter in Lee's architecture." *Id.* at 91 (citing Ex. 1008, 12, Fig. 43). According to Petitioner, "[i]t would have been obvious to a POSITA to use the DC-DC converters disclosed in

Liu in the intermediate bus architecture disclosed in Lee." *Id.* at 91–92 (citing Ex. 1003 ¶ 331).

Petitioner argues that Lee's converter is a non-isolated, unregulated bus converter. *Id.* at 94 (citing Ex. 1004, Fig. 43; Ex. 1003 ¶ 337). Petitioner further argues that "[w]hen Liu's non-isolated converter is substituted into Lee's architecture as the bus converter, the transformation ratio (V_{OUT}/V_S) is therefore fixed" "[b]ecause for Liu's converters $V_{IN}=V_S-V_{OUT}$, V_{OUT}/V_{IN} is necessarily also fixed as it depends on other fixed values." *Id.*

Patent Owner disputes Petitioner's contentions regarding this challenge for similar reasons as set forth in the Huang/Lee ground discussed above. Prelim. Resp. 70–71.

Regardless of Patent Owner's arguments as to the combination, we find that Petitioner's citations to and reliance on Lee do not remedy the deficiencies of Liu as discussed above, and therefore, the combined teachings do not teach or suggest "a bus converter . . . adapted to convert power . . . at a substantially fixed voltage transformation ratio, K_{DC}, . . . wherein the substantially fixed voltage transformation ratio can be represented as $K_{DC} = V_{OUT}/V_{IN}$" as required by all the independent claims.

Accordingly, for the reasons discussed previously, we are not persuaded that Petitioner has established a reasonable likelihood of prevailing on this challenge.

V. MOTION TO SEAL

In connection with the filing of its Preliminary Response, Patent Owner filed a Motion to Seal Exhibit 2032 (Paper 7, "Motion"). As part of the Motion, Patent Owner also requests entry of the Stipulated Protective

Order, which is attached as Exhibit A to the Motion.[12] Motion 4. Patent Owner contends the motion is unopposed and that good cause exists to seal Exhibit 2032. *Id.* at 1, 5–6. Exhibit 2032 includes claim charts from a parallel district court litigation and compares "highly-sensitive information regarding the structure and operation of certain [of Patent Owner's] products" to challenged claim limitations. *Id.* at 2; Ex. 2032. According to Patent Owner, this information is not publicly available and is held as confidential information by the parties to which Patent Owner will be harmed if the information is released publicly. Motion 2–3.

"There is a strong public policy for making all information filed in a quasi-judicial administrative proceeding open to the public." *Garmin Int'l v. Cuozzo Speed Techs., LLC*, IPR2012–00001, Paper 34 at 1–2 (PTAB Mar. 14, 2013). The standard for granting a motion to seal is "good cause." 37 C.F.R. § 42.54. That standard includes showing that the information addressed in the motion to seal is truly confidential, and that such confidentiality outweighs the strong public interest in having the record open to the public. *See Garmin*, Paper 34 at 2–3. The moving party bears the burden of showing that the relief requested should be granted, and establishing that the information sought to be sealed is confidential information. 37 C.F.R. § 42.20(c).

In reviewing the documents and information that Patent Owner seeks to seal, we observe, as Patent Owner asserts, that the document contains sensitive technical information regarding Patent Owner's products. Therefore, after having considered Patent Owner's arguments and the

[12] Patent Owner also submitted as Exhibit B a redline indicating how the Stipulated Protective Order deviates from the Default Protective Order.

evidence, we determine that Patent Owner has established good cause for sealing Exhibit 2032, which is not cited or relied upon in this Decision. Patent Owner's Motion to Seal, therefore, is granted.

We have also considered Patent Owner's request for entry of the Stipulated Protective Order, which has been agreed to by the Parties. As shown in Exhibit B to the Motion, the proposed changes to the Board's Default Protective Order are minimal, adding an "Outside Attorneys' Eyes Only" level of designation that restricts certain materials to Outside Counsel, Experts, Office Staff, and Support Personnel. Motion 4, Exhibit B. These changes appear to be justified under the circumstances, for the reasons stated by Patent Owner. Motion 4–5. The Stipulated Protective Order is, therefore, entered, and will control access to confidential materials in this proceeding absent a further order from the Board modifying such access.

We remind the parties that confidential information that is subject to a protective order ordinarily becomes public forty-five days after denial of a petition to institute. *See* Patent Trial and Appeal Board Consolidated Trial Practice Guide (November 2019) 21–22. There is an expectation that information will be made public where the existence of the information is referred to in a decision to grant or deny a request to institute a review. *Id.* at 22. A party seeking to maintain the confidentiality of information, however, may file a motion to expunge the information from the record prior to the information becoming public. *Id.*; 37 C.F.R. § 42.56.

VI. CONCLUSION

After consideration of the Petition, the Preliminary Response, and the evidence of record, we are not persuaded that Petitioner has demonstrated a reasonable likelihood of prevailing in showing that any of claims 1, 2, 5–10,

13–17, 19, 21, 23, and 25–38 of the '950 Patent are unpatentable on any asserted ground. On this record, we decline to institute *inter partes* review of claims 1, 2, 5–10, 13–17, 19, 21, 23, and 25–38 of the '950 Patent.

VII. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that an *inter partes* is not instituted;

FURTHER ORDERED that Patent Owner's Motion to Seal (Paper 7) is granted and Exhibit 2032 is maintained under seal; and

FURTHER ORDERED that the Stipulated Protective Order (Paper 8, Exhibit A) is entered.

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