

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VICOR CORPORATION,

Petitioner,

v.

DELTA ELECTRONICS, INC.,

Patent Owner.

PTAB Case No. IPR2024-00704

U.S. Patent No. 8,711,580

PATENT OWNER'S PRELIMINARY RESPONSE

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EXHIBIT LIST

Exhibit No.	Description
2001	Declaration of Dr. Joshua Phinney
2002	Petition for <i>Inter Partes</i> Review in IPR2024-00704
2003	B. Yang et al., <i>Over Current Protection Methods for LLC Resonant Converter</i> (Conference Paper, Eighteenth Annual IEEE Applied Power Electronics Conference and Exposition, Feb. 2003) (“Yang IEEE”)
2004	U.S. Pub. No. 2007/0008745 to Joshi, et al.

I. INTRODUCTION

Patent Owner Delta Electronics Incorporated (“Delta” or “Patent Owner”) hereby submits its preliminary response to the petition for *inter partes* review (“IPR”) against U.S. Patent No. 8,711,580 to Zhang, *et al.* (“the ’580 Patent”).

The petition should be denied for several reasons.

First, as an initial matter, Petitioner formulates its entire Petition on what it perceives to be Patent Owner’s construction. This construction is Petitioner’s own construct, and the whole of the Petition (and its expert’s analysis) uses the perceived construction. Here, Patent Owner repudiates Petitioner’s construction and offers the correct construction. Specifically, Petitioner argues that Patent Owner states that the claims do not require feedback between a buck converter and a resonant converter; this is incorrect. As a consequence, the Petition is fatally flawed.

Second, Petitioner recycles art (Hwang) that is cumulative to art in prosecution (Joshi) to teach critical limitations of the ’580 Patent directed to PWM modulation for overcurrent protection. Namely, Hwang teaches stopping PWM modulation when there is an overcurrent situation; it further teaches voltage regulation using PWM under normal conditions. Joshi (which Patent Owner amended the claims to overcome in prosecution) teaches the same exact thing. The Petition should thusly be denied under 35 U.S.C. § 325(d).

Ground 1 fails. Petitioner presents a challenge that provides no feedback

between a resonant converter and a buck converter. In fact, its combination uses an internal setting of the buck converter to satisfy determining an overcurrent in a separate component (the resonant converter). This is far afield from the claims. Moreover, Petitioner's motivation to arrive at the claims is pure hindsight. Petitioner argues that a POSITA would have been motivated, looking at Hwang, to add overcurrent protection via PWM modulation. This, however, is not what Hwang teaches; it teaches turning off the circuits if there is an overcurrent situation. If there were any motivation, a POSITA would have added the overcurrent shutoff switch (which is not what is claimed).

Ground 2 fails for the same reasons as number two. It again relies on the teachings of Hwang, but is rife with hindsight bias. Petitioner takes non-overcurrent protection teachings of Hwang and add it to the White Paper, all the while ignoring Hwang's actual overcurrent protection teachings.

II. THE '580 PATENT

On April 29, 2014, the U.S. Patent and Trademark Office issued U.S. Patent No. 8,711,580 ("the '580 Patent"), titled "Resonant Conversion System with Over Current Protection Processes," listing Jinfa Zhang, Lei Cai, Jiaojun Sun, and Guodong Yin as the inventors, from a patent application filed on May 20, 2011. The '580 Patent claims priority from China Patent Application, No. 201010187409.0, filed on May 28, 2010.

The '580 patent is directed towards providing over-current protection for system that provides DC-DC conversion having both a buck converter and a resonant converter:

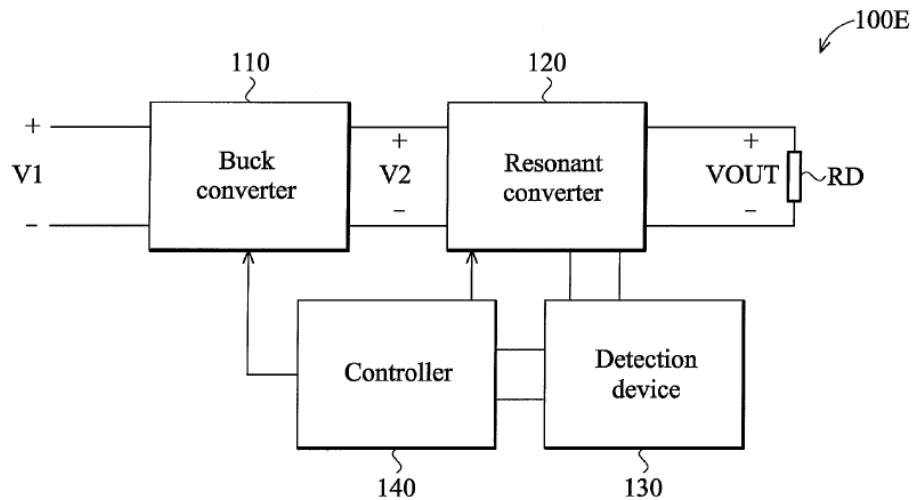


FIG. 7

(VICOR-1001, FIG. 7.) First, during over-current protection, the output voltage of buck converter—which is applied to input of resonant converter—is controlled, based on a signal corresponding to the output current of the resonant converter. (DELTA-2001, ¶38.) Second, if the restriction on the output current is in the first predetermined current, then the current-limit value is equivalent to the over-current point. (*Id.*) Therefore, the duty cycle of the system is reduced to a target, in a short time. (*Id.*) Finally, if the restriction on the output current is in the higher, second predetermined current, then the current-limit value is greater than over-current point. (*Id.*) Thus, gradually reducing the duty cycle to a target. (*Id.*)

III. CLAIM CONSTRUCTION

When construing claims, the Board applies the principles set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–17 (Fed. Cir. 2005) (en banc). Under the standard, the words of a claim are generally given their plain and ordinary meaning, which is the meaning the term would have to a POSITA at the time of the invention, in the context of the entire patent including the specification. *Phillips*, 415 F.3d at 1312–13.

Patent Owner presents the following constructions which are the plain and ordinary meaning a POSITA accords them. In contrast, Petitioner presents its own interpretation of what it perceives Patent Owner’s construction to be, and proclaims that they should govern. Claim construction, however, begins with intrinsic evidence and what Petitioner perceives Patent Owner’s construction to be in a parallel litigation is, at best, extrinsic evidence. Nonetheless, Petitioner’s perception does not apply the plain and ordinary meaning standard and is incorrect (and should be wholly rejected). (*Id.* at ¶¶ 39, 40.)

Petitioner’s interpretation of the claims is fatally flawed. It removes any feedback mechanism between the buck converter and the resonant converter, which is plainly required by the claims. The feedback is captured in the language, *e.g.*, “first controller, decreasing a duty cycle of a switching device of the buck converter ... when the resonant converter generates the over-current” and “when an output

current exceeds a predetermined current, the first controller determines that the resonant converter generates the overcurrent.” (VICOR-1001, 11:22-23.)

Petitioner’s attempt to read-out the feedback mechanism entirely from claims that plainly require it should be wholly rejected.

Patent Owner provides the below constructions for the sake of completeness.

A. Terms to be construed under the *Phillips* standard

- (i) “[when]/[that] the resonant converter generates [the] / [an] over-current” (Claims 1, 10, 11, 13, and 17)**

This term refers to a condition that occurs when resonant converter itself generates an over-current; the proper construction is accordingly that the “when” is tied to the system detecting the resonant converter’s over-current condition.

(DELTA-2001, ¶ 41.)

This construction is supported in the language and, moreover, supported in the specification. The plain language requires “when” and refers to a specific condition “an over-current.” (*Id.*, ¶ 42.) The specification repeats this understanding, stating “when the output current I_o of the resonant converter 120 exceeds the predetermined current I_{o2} .” (*Id.*)

Petitioner’s construction is incorrect because it removes this requirement entirely. Petitioner states that this—and a swath of other terms—are met “when the output voltage of a PRM (or other buck converter) provides the input voltage to a VTM (or other resonant converter that provides an output current proportional to

the input current), and the PRM (or other buck converter) detects that its output current has reached a set current limit.” (*Id.*, ¶ 43.) However, Petitioner’s construction removes the condition of the resonant converter generating an overcurrent, and replaces it with the requirement that the resonant converter have “an output current proportional to the input current.” (*Id.*) Petitioner takes out any requirement of feedback that is plainly necessary in the claims of the ’580 Patent. Petitioner’s construction is wrong, and “these terms should be construed such that the “when” is tied to detecting the resonant converter’s over-current condition,” therefore, Petitioner’s incorrect construction should be rejected. (*Id.*, ¶ 44.)

(ii) “the first controller determines that the resonant converter generates the over-current” (claim 1, claim 10)

This term refers to the controller itself determining that the resonant converter has generated the over-current; the proper construction is accordingly that the first controller is part of determining the resonant converter’s over-current condition. (*Id.*, ¶ 45.)

This construction is supported in the language and, moreover, supported in the specification. The plain language requires “first controller” and “determines” and refers to a specific condition “an over-current.” (*Id.*) The specification repeats this understanding, stating “the controller 140 controls the buck converter 110 to decrease the output power or the output voltage of the buck converter 110 when

the resonant converter 120 generates an over-current . . . , such that the input voltage of the resonant converter 120 is restricted for performing over-current protection process.” (VICOR-1001, 4:45–51.).

Petitioner’s construction is incorrect because it removes this requirement. Instead, Petitioner equates a buck converter with a PRM since the “PRM determines that a current limit threshold is reached.” (DELTA-2002, p. 29.) However, this amounts to the buck converter determining its own overcurrent, and not a controller determining an over-current of the resonant converter. (DELTA-2001, ¶ 47.) The proper construction of this term requires that the first controller performs part of determining the resonant converter’s over-current condition. (*Id.* at ¶ 48.) Therefore, Petitioner’s incorrect construction should be rejected.

(iii) “when determining that the resonant converter has generated an over-current” (claim 10)

This term refers to when the controller determines that the resonant converter itself has generated the over-current; the proper construction is accordingly that the “when” is tied to determining the resonant converter’s over-current condition.

This construction is supported in the language and, moreover, supported in the specification. The plain language requires “when” and refers to recognizing a specific condition (“an over-current”). (*Id.* at ¶ 50.) The specification repeats this understanding, stating “the controller 140 can determine that the resonant conversion system is over-loaded” and “control[] the buck converter to decrease the input

voltage received by the resonant converter for performing the over-current protection.” (VICOR-1001, 2:30–34, 5:50–51, 6:48–49.) Petitioner’s construction with respect to this term essentially reads out the “when.” (DELTA-2001, ¶ 51.) Therefore, Petitioner’s incorrect construction, with respect to this term, should be rejected.

(iv) “determining whether the resonant converter generates an over-current” (claim 13)

This term refers to a method of determining whether the resonant converter generate an over-current based on a detection result; the proper construction is accordingly that the “whether” is tied to determining the resonant converter’s over-current condition.

This construction is supported in the language and moreover, supported in the specification. The plain language requires “whether” and refers to a specific condition, “an over-current.” (*Id.* at ¶ 53.) The specification repeats this understanding, stating that “whether the resonant converter generates an over-current is determined according to the first detection result” by coupling the detection device “to the resonant converter 120 to detect a signal corresponding to the output current of the resonant converter 120 and then provide the detection result to the controller 140,” which controls the output voltage of the buck converter, thus *restricting* the input of the resonant converter. (VICOR-1001, 2:38–40, 4:44–60, 10:17–19.)

Petitioner's construction is incorrect. Not only does Petitioner misinterpret Patent Owner's alleged "Apparent Construction," it attempts to represent the construction as if it determines whether there is over-current at the VTM by first "detecting a signal corresponding to an output current of the PRM" and using this detection result "to determine whether a PRM current-limit is reached." (DELTA-2001, ¶ 54.) This construction diverges from the Patent Owner's construction and completes an analysis that is irrelevant to the construction of the claim, therefore, Petitioner's construction should be rejected. (*Id.*)

(v) "it is determined that the resonant converter generates the over-current" (claim 13)

This term refers to when it is determined that the resonant converter itself has generated the over-current; the proper construction is accordingly that the "it" is tied to the resonant converter's over-current situation.

This construction is supported in the language and, moreover, supported in the specification. The plain language recites "it is determined" and refers to a specific condition of the over-current being generated. (*Id.*, ¶ 56.) The specification repeats this understanding, stating that "when the output current I_o of the resonant converter 120 exceeds the predetermined current I_{o2} , the controller can determine that the resonant converter 120 generates the over-current." (VICOR-1001, 9:36–39.) Here, once it is determined that the resonant converter generates the over-current, the output current of the resonant converter is restricted because the

controller has restricted the input voltage of the resonant converter by controlling the output voltage of the PRM. (*Id.* at 4:45–51, 9:36–39.)

Petitioner’s construction continues to be incorrect. Petitioner reasons that this claim limitation is met “when the output voltage of a PRM (or other buck converter) provides the input voltage to a VTM (or other resonant converter that provides an output current proportional to the input current), and the PRM (or other buck converter) detects that its output current has reached a set current limit.” (DELTA-2002, p. 10.) However, Petition’s construction ignores the condition for determining that the resonant converter generates an overcurrent, and replaces it with the requirement that detecting an overcurrent in a buck converter can automatically attributed to the resonant converter. (*Id.* at p. 9.) Therefore, Petitioner’s incorrect construction should be rejected. (DELTA-2001, ¶ 57.)

(vi) “determining whether the resonant converter generates over-current” (claim 17)

As discussed above in §III.A.(iv), this term refers to a method of determining whether the resonant converter generate an over-current based on a detection result. As discussed above, this construction is supported in the language and by the specification. However, as in §III.A.(iv), Petitioner’s construction is incorrect. In its Petition, Petitioner does not bother to provide analysis. Instead, it states that this limitation is met “when the output voltage of a PRM (or other buck converter) provides the input voltage to a VTM (or other resonant converter that provides an

output current proportional to the input current), and the PRM (or other buck converter) detects that its output current has reached a set current limit.” (DELTA-2002, p. 10.) This fails to meet the claim condition of determining whether the resonant converter has generated over-current. That is, the Petition’s construction reads out the active action of “determining whether” and effectively only points to an instance of “over-current” that it finds. (DELTA-2001, ¶59.)

Further, Petitioner does not offer an analysis of this limitation and refers the reader to its “discussion for claim [3],” which is a dependent system claim. (*Id.* at p. 44]). Petitioner has inappropriately equated a system claim, which claims the detection device, with an independent method claim, that claims the actual determining step. Because Petitioner’s construction improperly removes the requirement of “whether” in order to determine if the resonant converter generates an over-current, its construction should be rejected.

B. Petitioner’s failure to apply the correct construction standard or present proper construction warrants denial

Beyond basing its Petition on a whole swath of incorrect constructions, Petitioner does not even purport to present claim interpretation under the proper construction standard. The whole of its Petition depends on its apparent view of Patent Owner’s construction (which as noted above, is an incorrect straw-man). Nowhere in the Petition (or Dr. Baker’s declaration) is there any recognition of the proper *Phillips* standard or a proper articulation regarding construction.

Petitioner is required to identify how certain claim terms should be construed (37 C.F.R. § 42.405) and it must apply the plain and ordinary meaning of the terms as understood by a POSITA. *Phillips*, 415 F.3d 1303, 1313; *Samsung Elecs. Co., Ltd. v. Mojo Mobility Inc.*, 2024 WL 457731 at *8 (P.T.A.B. Feb. 6, 2024); *see also* 83 Fed. Reg. 51,340 (Oct. 11, 2018) (describing changes to the claim construction standard for interpreting claims in trial proceedings before the patent trial and appeal board). Petitioner and Dr. Baker do not identify the proper standard and, instead, they ***purposefully do not apply and avoid*** the plain and ordinary meaning.

Petitioner's failure is seen in its claim construction articulations and in Dr. Baker's declaration. Nowhere in the claim construction section. (DELTA-2002, pp. 6-10.) does Petitioner identify the plain and ordinary meaning it is applying (or whether that standard is being applied at all). Instead, it applies its own self-serving understanding of a Patent Owner interpretations. (*Id.* at p. 10.)

The same is true, and even more pronounced, with the declaration of Petitioner's expert (Dr. Baker). Dr Baker unequivocally does not apply the plain and ordinary meaning standard and instead states he was "asked to apply the construction apparently used by the Patent Owner in its infringement allegations in co-pending litigation. (VICOR-1003, ¶49.) He continues that his construction analysis is based on what he was told by Petitioner, stating that "I am informed that Exhibit VICOR-1005 provides those infringement allegations" and yet he provides

no analysis regarding those contentions or whether Petitioner’s representation of Patent Owner’s interpretations is correct (or not). (*See generally id.* at ¶¶ 49-54.) Instead, he concludes again “I have been asked to apply Patent Owners’ Apparent Construction” and repeats Petitioner’s statements. (*Id.* at ¶ 54.) Dr. Baker applies these constructions throughout his declaration. (*See, e.g., id.* at ¶¶ 49-54, 100, 102, 104.)

However, those constructions that Petitioner proposes as Patent Owner’s constructions are wrong, and Patent Owner wholly rejects Petitioner’s premise. As a result, Petitioner asks the Board to analyze its Petition under a facially incorrect claim construction standard (and incorrect constructions under an incorrect premise). This goes against PTAB practice and warrants denial. *Intervet, Inc. v. Boehringer Ingelheim Vetmedica, Inc.*, IPR2018-01788, Paper 9, at 14-15 (P.T.A.B. Apr. 16, 2019). Petitioner is the master of its challenge and should not be given a claim construction re-write. Typically, when Petitioner fails to construe the challenged in its Petition, but states that “all the claim terms recited in [the patent] should be given their plain and ordinary meaning” the Board finds this to be satisfactory. *MED-EL Electromedizinische Gerate Ges.M.B.H. v. Adv. Bionis AG*, 2022 WL1025014 at *7 (P.T.A.B. Mar. 31, 2022). And, even if there is any deficiency in the Petition, so long as the deficiency is not fatal to Petitioner’s arguments, then the Board will not be persuaded to deny the Petition. *Par Pharm., Inc. v. Horizon Therapeutics, Inc.*,

IPR2015-01127, Paper 13, at 11 n. 4 (P.T.A.B. Nov. 5, 2015). But the situation in the instant Petition is markedly different than the case of mere clerical omission or the general application of the correct standards.

Here, Petitioner wholly fails to satisfy any of the rules and considerations outlined by PTAB that would allow a trial of its petition. *Intervet, Inc.*, IPR2018-01788, Paper 9, at 14-15. First, beyond Petitioner failing to propose its own construction of the challenged claims, Petitioner (and its expert) declares that it is following the apparent construction of Patent Owner and not the plain and ordinary meaning. Petitioner (and its expert) then apply analysis under that construction. Second, through its Preliminary Response, Patent Owner addresses and disputes all of Petitioner's contentions on claim construction grounds and provides analysis under the correct interpretation. The Petition is thusly fatally defective and cannot merely be cured via the benefit of the doubt.

Finally, while reliance upon another parties' construction can be proper; jettisoning the plain and ordinary meaning entirely is not. The Board has recognized that a Petitioner's reliance on the Patent Owner's construction "in related District Court litigation . . . suffices to identify [the] claim constructions [the] Petitioner is adopting for purposes of the [IPR] in compliance with [37 C.F.R. §104(b)(3)]." *Western Digit. Corp. v. SPEX Techs., Inc.*, IPR2018-00084, Paper 14, at 11 (P.T.A.B. Apr. 25, 2018). However, in *Western Digital*, the board accepted the

Petitioner's adoption because in addition to identifying claim construction, the Petitioner had also identified "corresponding structure[s] when appropriate, and . . . has not expressly disagreed with [the Patent Owner's] proffered constructions." *Id.* And, it applied the plain and ordinary and customary meaning. *Id.* at *2. Here, this is not the case; Petitioner's position (and Dr. Baker's opinions) are based on Patent Owner's apparent construction, and no inquiry is made into what a POSITA would understand to be the plain and ordinary meaning of any claim term as dictated by *Philips*.

Due to these fatal defects, the Petition fails to present a reasonable likelihood of success. *Intervet, Inc.*, IPR2018-01788, Paper 9, at 14-15.

C. Petitioner's reliance on an "apparent construction" and purported district court positions is incorrect

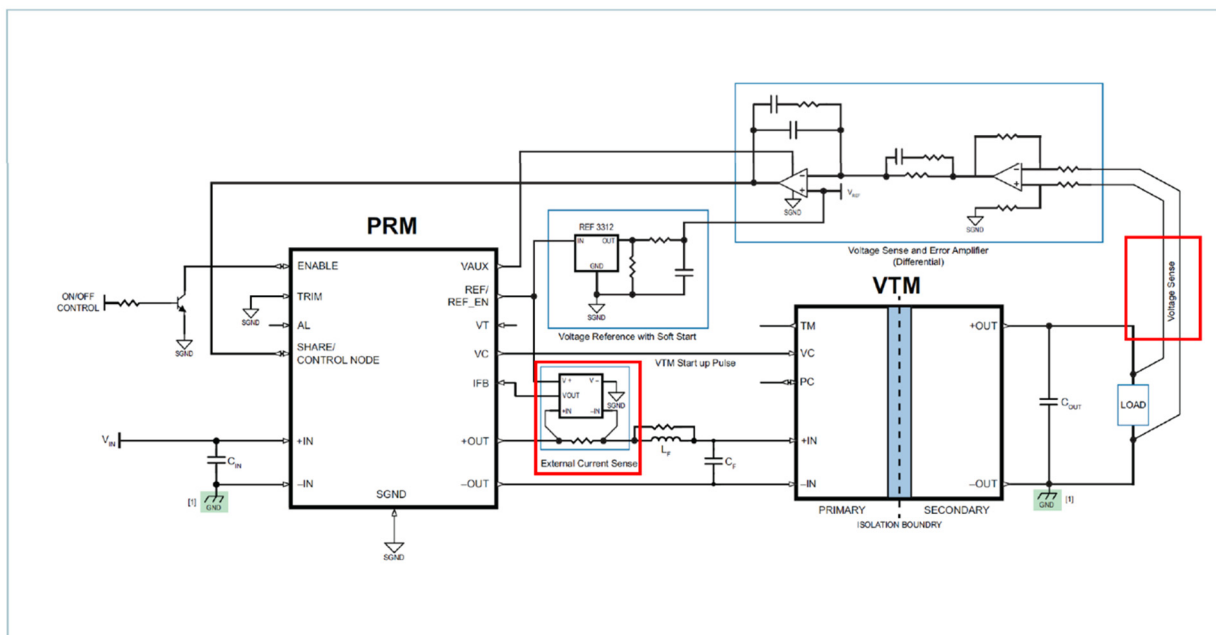
The Petition promotes the fiction that Petitioner is presenting the same exact prior art that Patent Owner is accusing of as infringing. This is incorrect; Patent Owner is accusing Petitioner's products that have feedback for current control of infringing the '580 Patent. Petitioner's product references (VTM/PRM documents) lack that feedback control.

Petitioner, moreover, bases the whole of its analysis on an "apparent construction" of Patent Owner that it self-servingly deciphers from an initial complaint claim chart. (DELTA-2002, pp. 9, 10 (citing VICOR-1005).)

Petitioner's articulation of what this claim chart states is incorrect. The chart was

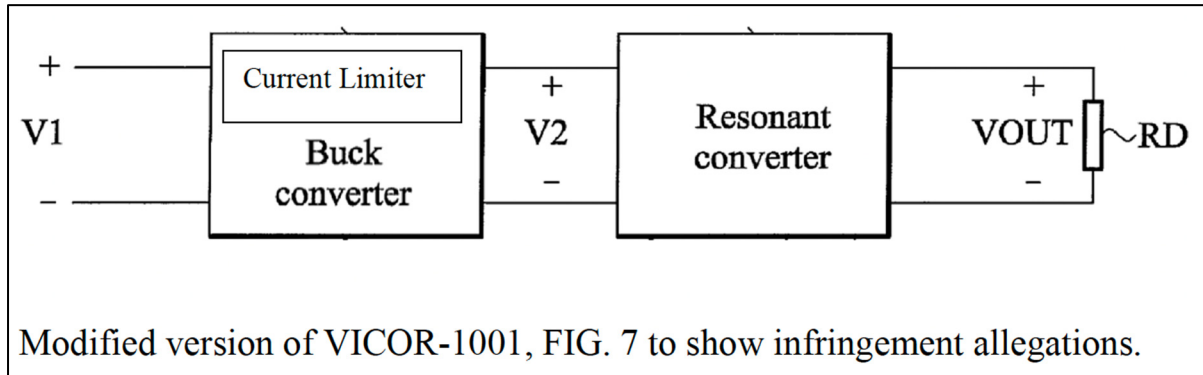
presented to show that the challenged limitations existed on “information and belief” (VICOR-1005, p. 6) due to the early nature of the case where Patent Owner did not have access to source/code schematics, and where all the functionality of the feedback mechanisms could not fully be deciphered from the public record.

Patent Owner’s articulations of the many modes demonstrating feedback signaling from the resonant converter indicated that there is over-current protection in the accused products. A few feedback signals of the accused products are annotated in red below from page 8 of VICOR-1005. As can be seen from the below, there is feedback from Petitioner’s products that were accused of infringement in the district court, and the chart demonstrated a basis to assert infringement:



(VICOR-1005, p. 8.)

Petitioner’s attempt to conflate the infringement and invalidity analysis is most evident in its own modified figures. Petitioner shamelessly makes a modified representation of Patent Owner’s charts, which are nothing but a self-serving graphic that bears no resemblance to the actual infringement allegations. An excerpt from page 13 of the Petition is provided below. As can be seen from the below, the feedback aspect has been removed from Petitioner’s representation (and analysis) entirely when it is plainly present in their accused products.



(DELTA-2002, p. 13.)

Nonetheless, whether Petitioner’s products practice the claims (or not) is far afield of the instant proceeding. As described above, Petitioner’s analysis of the “apparent construction” is flatly incorrect, does not represent Patent Owner’s constructions, and the Petition should be denied outright for failing to apply the proper claim construction standards and purposefully applying an incorrect standard, as already ruled by this Board. *Intervet, Inc.*, IPR2018-01788, at *6.

IV. PETITIONER RECYCLES CUMULATIVE ART FROM PROSECUTION WARRANTING DENIAL UNDER 35 U.S.C. § 325(D)

The Petition suffers from another fatal flaw: it re-uses prior art that is cumulative to prior art overcome during prosecution for the same exact limitation (over-current protection), warranting denial under 35 U.S.C. § 325(d). Namely, the Petition relies on Hwang (U.S. Pat. No. 6,674,272) to teach limiting the duty cycle during an overcurrent protection limitation of [1c]. *See* DELTA-2002 at 28,29 (Ground 1) and 55 (Ground 2). Hwang, however, is substantively similar to U.S. Pub. No. 2007/0008745 (“Joshi”) which was subject to a rejection in prosecution.

When there is an overcurrent condition, both Hwang and Joshi shut off PWM modulation instead of “controlling voltage” as required by limitation [1b] and “decreasing a duty cycle” as required by limitation [1c]. Moreover, each reference teaches voltage regulation via PWM in normal operation in addition to and separate from its over-current protection circuitry. Petitioner merely performs a combinatorial switcheroo by stating a POSITA would desire over-current protection from Hwang (but then Petitioner adds embodiments from Hwang’s voltage regulator or soft-start circuitry *not* Hwang’s over-current protection circuitry). In total, Hwang is cumulative to Joshi which applicant overcame in amendment. Petitioner’s attempt to re-use prior art should be rejected under 35 U.S.C. § 325(d). *Advanced Bionics, LLC v. MED-EL Electromedizinische Gerate Gmbh*, IPR2019-01469, Paper 6, at 8 (P.T.A.B. Feb. 13, 2020).

Provided below is a brief description of Hwang, Joshi, and the pertinent rejection, their similarities, and supportive caselaw on denying the Petition.

A. Hwang teaches over-current protection by shutting off PWM and voltage regulation via PWM

Hwang turns off the system (i.e., shuts off PWM modulation) in an over-current condition. (DELTA-2001, ¶ 62.)

Figure 1, reproduced below, illustrates Hwang's control circuitry (blue) that controls switches (red).

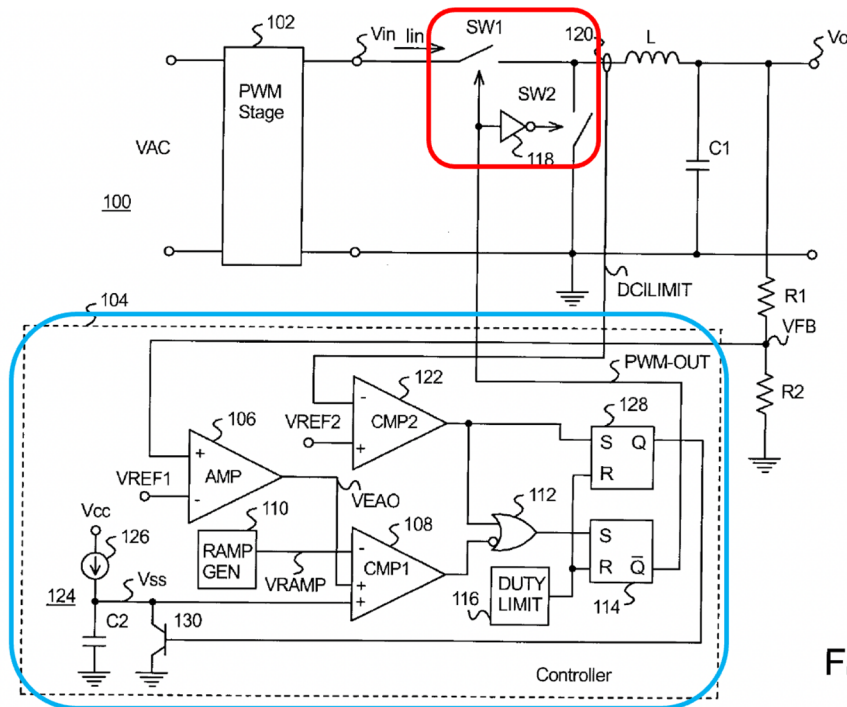


Fig. 1

(VICOR-1007, FIG. 1). Hwang turns off the buck converter's switch (SW1) when there is an over-current. (DELTA-2001, ¶ 64.) Hwang's overcurrent protection circuit operates by detecting a voltage signal (DCILIMIT) that is representative of the sensed current via current sensor 120 (green, below) and, when DCILIMIT is too

high, comparator 122 blocks the transfer of power from the source by turning off SW1 (red). (VICOR-1007, 4:7-24 (“current sensor 120 forms a voltage signal DCILIMIT that is representative of the sensed current ... [where] the output of the comparator may open the switch SW in the even that a current sensing signal DCILIMIT exceeds a predetermined threshold”).)

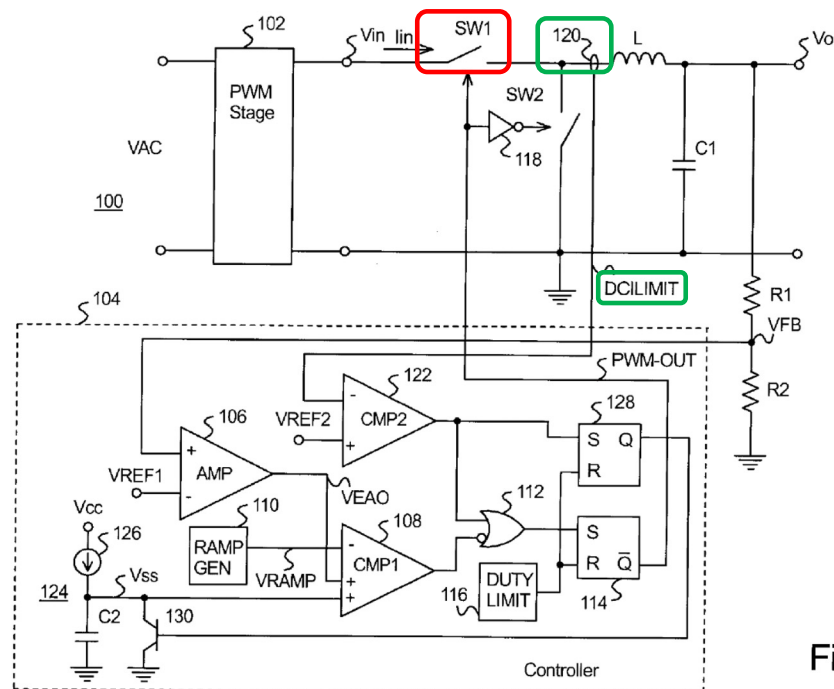


Fig. 1

Comparator 122 opens SW1 when there is an over-current as follows. (DELTA-2001, ¶ 65.) Hwang's current sensor 120 senses output current of the converter. (VICOR-1007, 3:51–4:7). DCILIMIT is coupled to an input of a comparator 122 (yellow, below), where the second input receives a reference voltage, VREF2 (purple), representative of a maximum desired current level. (*Id.* at 4:7–14.). When DCILIMIT exceeds the reference voltage VREF2, the output of comparator 122 is coupled to an input of a logic OR gate 112 (pink) to set SR Flip

flop 114 (orange). (DELTA-2001, ¶65.) SR flip flop 114 turns off switch SW1 (red) via Q-bar (i.e., a “0”) which further results in SW2 (also red) being closed and grounding the left terminal of output inductor L through SW2. (*Id.*) As such, whenever there is an overcurrent comparator 122 opens SW1 and couples the output L-C1 network to ground.

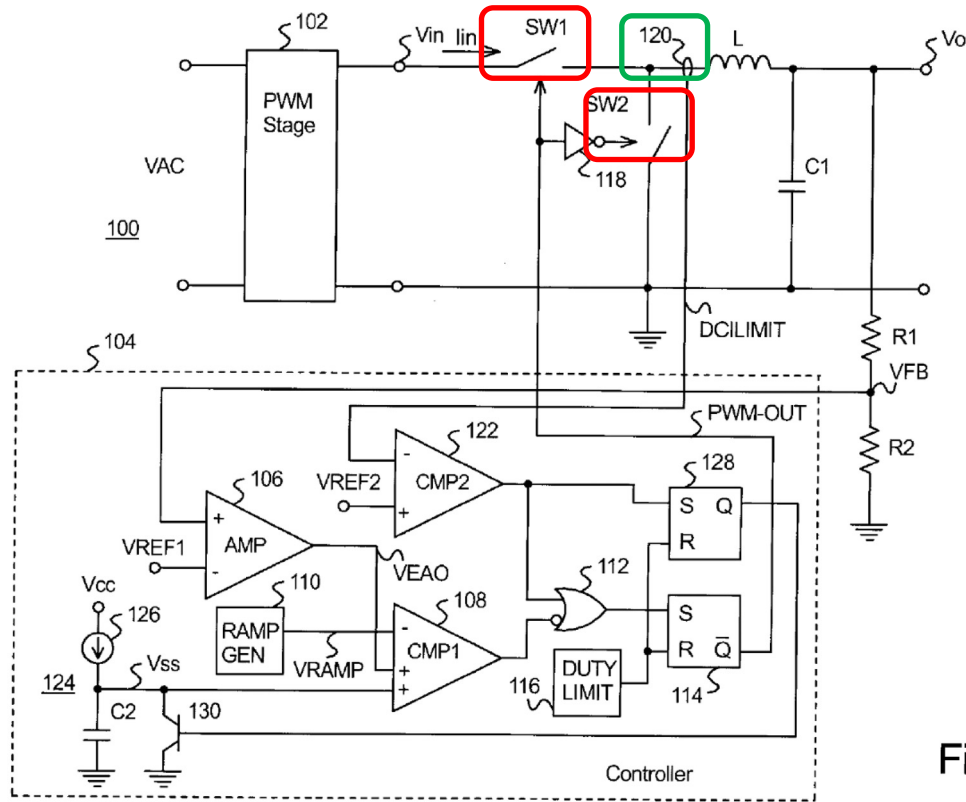


Fig. 1

From here, other parts of the circuit that control switch SW1 enter a soft start condition. (*Id.* at ¶66.) Comparator 108 (green, below) also controls setting flip-flop 114 (orange). (*Id.*) Comparator 108 receives 3 signals, V_{EAO} on its + terminal, V_{ss} on its other + terminal, and ramp gen 110 on its – terminal. (*Id.*) Capacitor C2 will discharge through a switch 130, then after some time C2 will recharge causing duty

cycle to gradually increase as V_{ss} increases. (VICOR-1007, 4:43-5:5]). This is the same condition (starting from zero volts across $C2$) that prevails when the Hwang's buck converter is first powered on from a $V_{cc} = 0$ Volt state. (DELTA-2001, ¶66.)

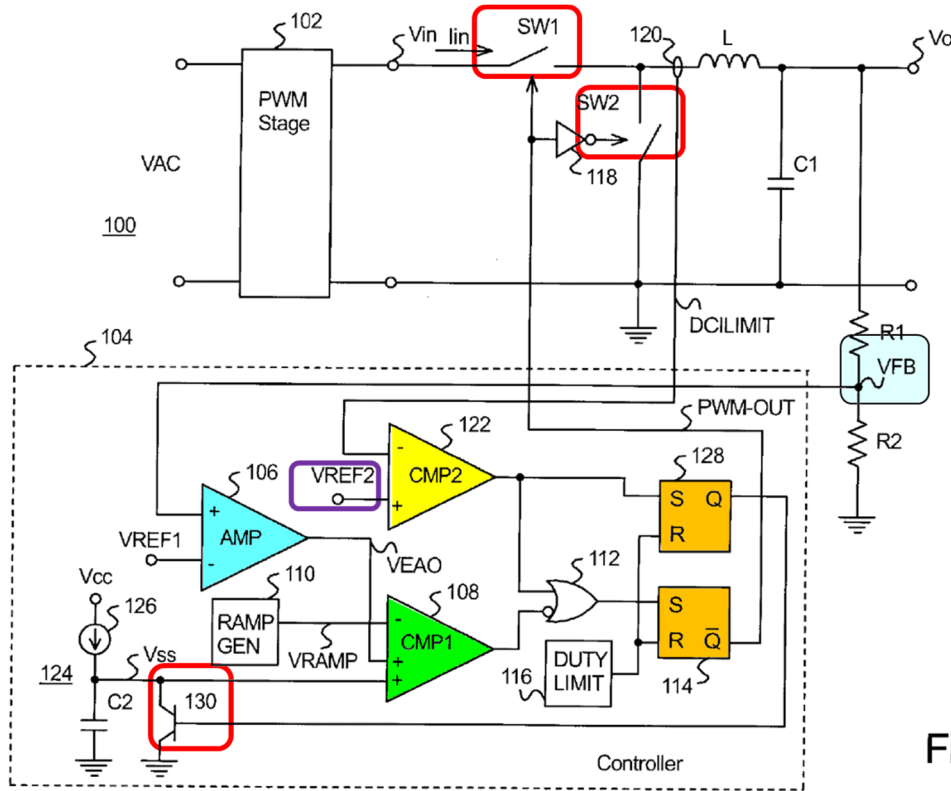


Fig. 1

Under normal operating conditions, Hwang has a voltage regulator. (DELTA-2001, ¶67.) Comparator 108 (green) compares VFB (aqua) amplified via amp 106 (also aqua) that is representative of V_o in order to adjust the duty cycle to provide voltage regulation. (VICOR-1007, 4:19-24.) This standard mechanism for voltage regulation, however, is separate from over-current protection using CMP2 (yellow). (DELTA-2001, ¶67.)

B. The Joshi reference and the Examiner's rejection

Joshi is substantively similar to Hwang, as both provide voltage regulation under normal conditions, but also an over-current protection shut-down mechanism when there is an over-current.

The Examiner twice rejected the '580 Patent over Joshi in a non-final and final rejection. (VICOR-1002, pp. 38, 58 (stating Joshi teaches a “buck converter that feed its output to resonant converter with both converters having overcurrent or overload protection” and citing to the embodiment of FIG. 9).)

In response to the rejections, applicant acknowledged that Joshi taught both voltage regulation and over-current protection. Applicant argued (with applicant's own emphasis, with Patent Owner emphasis to the voltage regulation discussion in yellow and over-current discussion in aqua) that:

Joshi recites, in paragraph [0076], “The power supply controller (or the DSP) 930 provides the necessary PWM gate drive signals to buck converter 910. The output and input voltage of the buck converter 910 and the current flowing through the buck converter power elements are measured using necessary circuits and are sampled by the DSP 930 periodically. These sampled values are used by the algorithm running on the DSP 930 to adjust the PWM duty cycle continuously. **In case of a fault resulting in excessive voltage at the output of the buck converter 910 or excessive current through the switching elements in the buck converter 910, the protection interrupt, a signal input to the DPS 930, causes the PWM signals to be turned off.**” (*Id.* at 50, 51.)

It is apparent that applicant acknowledged the voltage regulation using

PWM and over-current protection mechanisms using PWM shut-off in Joshi.

(DELTA-2001, ¶ 70.) Applicant argued that the over-current protection mechanisms of Joshi were substantively different from the claims because Joshi shuts down the PWM when there is an overcurrent situation. (VICOR-1002, pp. 38, 58.) Applicant emphasized this argument that shutting down the PWM in the case of an over-current is not what is claimed (with applicant’s own emphasis):

“...The inverter overload and protection circuits 943 can shutdown the PWM signals in case of a fault.”

Obviously, Joshi discloses that when the resonant inverter 915 generates an over-current, the power supply controller 930 turns off the PWM signals of the buck converter 910 rather than controls the buck converter to decrease the input voltage received by the resonant converter. In addition, the power supply controller 930 turns off the PWM signals of the buck converter 910 when an overcurrent is generated by the buck converter 910 rather than the resonant inverter 915. Hence, Joshi does not teach or suggest the claimed features that “when the **resonant converter** generates an over-current, the **buck converter** further decreases the input voltage received by the resonant converter.”

(*Id.* at 51.)

Applicant repeated the substance of these arguments in a subsequent rejection. (*Id.* at 28-29.) Thereafter, the application was allowed.

Importantly, pertinent teachings of Joshi were presented to the Examiner that Joshi taught both: (1) voltage regulation via PWM modulation; and (2) overcurrent protection via disabling the PWM signals. (DELTA-2001, ¶ 72.) This is the same

exact teachings Petitioner presents with Hwang for the same limitations. (*Id.*)

C. Both Hwang and Joshi are Substantially the Same Art

Hwang and Joshi are substantively similar in both voltage regulation under normal conditions, but also an over-current protection shut-down mechanism when there is an over-current. (*Id.* at ¶ 73.) It is these common teachings that are raised in the Petition. (*Id.*) Thus, by being substantively similar in regard to the pertinent teachings subject to the instant petition (and subject to rejection in examination), Hwang and Joshi are wholly cumulative.

Like Hwang, Joshi also provides over-current protection that shuts down the PWM. As illustrated in Figure 9 of Joshi, when the supply voltage is outside of an acceptable range, a fail signal will be transmitted informing the processors of the system to shutdown the PWM signals. (DELTA-2004, ¶¶ [0073], [0078].) Similarly, in Hwang, the comparator 122 turns off the switching circuit when DCILIMIT reaches a certain threshold. (DELTA-2001, ¶ 74.) Hwang was described in more detail in §IV.A.. As a result, both Hwang and Joshi teach substantively identical over-current protection techniques. (DELTA-2001, ¶ 74.)

Like Hwang, Joshi also provides voltage regulation via PWM modulation based on a feedback signal. (*Id.* at ¶ 75.) Joshi provides voltage regulation of its buck converter via PWM. (DELTA-2004, ¶¶ [0037], [0038] (“The output voltage of the buck converter is regulated by power supply controller 130 in accordance with

present values or dynamically based on output 140. [0038] In one embodiment, power supply controller 130 controls buck converter 110 with PWM signals, e.g., by regulating the duty cycle of the PWM signal.”.) Hwang similarly provides voltage regulation via PWM modulation. (VICOR-1007, 4:15-24.) As a result, both Hwang and Joshi teach substantively identical voltage regulation techniques. Thus, Hwang and Joshi are substantively identical in their relevant teachings, which have already been considered by the Examiner. (DELTA-2001, ¶ 76.)

D. The Board Should Deny Institution Under 35 U.S.C. § 325(d)

Patent Owner overcame Joshi in prosecution, and Hwang is cumulative to it. Therefore, the Board should use its discretion to deny this petition for recycling already examined art under 35 U.S.C. §§ 314(a) and 325(d).

Institution of an IPR is discretionary and under 35 U.S.C. § 325(d) the board is given *express* discretion to deny a petition when “the same or *substantially the same* prior art or arguments previously were presented to the Office.” 35 U.S.C. § 325(d). *See also NHK Spring Co., Ltd. v. Intri-Plex Technologies, Inc.*, No. IPR2018-00752, Paper 8, at 11 (P.T.A.B. Sep. 12, 2018). In 2020, the Board established a precedential two-prong framework for determining whether it should use its discretion to deny institution of an IPR petition under § 325(d). *Advanced Bionics, LLC*, IPR2019-01469, Paper 6, at 8. The Board determines “(1) whether the same or substantially the same art previously was presented to the [Patent] Office or whether

the same or substantially the same arguments previously were presented to the Office; and (2) if either condition of first part of the framework is satisfied, whether the [IPR] petitioner has demonstrated that the Office erred in a manner material to the patentability of challenged claims.” *Id.* The Board will generally exercise its discretion not to institute an IPR “[i]f a condition in the first part of the framework is satisfied and the petitioner fails to make a showing of material error.” *Id.* at 9. In *Advanced Bionics*, the Board reasoned that “[i]f reasonable minds can disagree regarding the purported treatment of the art or arguments, it cannot be said that the Office erred in a manner material to patentability.” *Id.* Further, under the *Advanced Bionics* two-prong test, if, in the first prong, the Board determines that “the same or *substantially the same* art” was previously presented to the Patent Office during prosecution, then there is no need to reach whether “the same or substantially the same arguments” were previously presented.¹

As described in the preceding sections, both Hwang and Joshi are identical in their teachings for both over-current protection and voltage regulation. Applicant overcame Joshi because its over-current protection mechanism is different than what was claimed. (*See generally* VICOR-1002, pp. 28-29, 51.)

¹ In the past this was considered under the old test formulated in *Becton, Dickinson & Co. v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8 (Dec. 15, 2017)

The Petition relies on Hwang for this very element, and adds other references to teach generic limitations. (*See, e.g.,* DELTA-2002, pp.15-25.). As such the Petition should be denied.

V. GROUNDS 1-2 DO NOT PROVIDE A REASONABLE LIKELIHOOD OF UNPATENTABILITY

Petitioner has failed to show a reasonable likelihood of unpatentability for any challenged claim because the Petition does not demonstrate that: (i) the claim requirements of determining a resonant converter's over-current and, in response, controlling the buck converter, and (ii) a motivation for a POSITA to combine the cited references. (DELTA-2001, ¶ 77.)

For the limitations, Petitioner relies on a buck converter's current limit setting via an external resistor. This does not meet the claims which require feedback between the resonant converter and the buck converter to determine the resonant converter's overcurrent. (*Id.* at ¶ 78.)

For motivations to combine, Dr. Baker's arguments are based on hindsight, using the infringement contentions (and hence the '580 Patent itself) as a roadmap for combining the prior art. (*Id.* at ¶ 79.) This point is explained in greater detail below, with reference to overcurrent protection schemes within the resonant converter itself, which were known in the prior art. (VICOR-1001, 1:49-2:14.) Furthermore, the Petitioner does not consider that Hwang teaches shutting down PWM modulator (as in Joshi) when there is an overcurrent condition. (DELTA-

2001, ¶ 79.) Petitioner’s combinations do not consider that a POSITA even if they were motivated to implement over-current protection in a preceding regulation stage would have applied over-current protection exactly as taught by Hwang, i.e., by shutting down PWM modulation. (*Id.*) Dr. Baker’s opinion that a POSITA would be motivated to implement over-current protection for a resonant converter in a preceding regulation stage is erroneous, and in any event the proposed combination is cumulative of Joshi and already addressed during prosecution. (*Id.*) Also, neither Dr. Baker nor any of the references cited in Petitioner’s grounds explain how to adapt Hwang’s single-switch PWM control to the four-switch, zero-voltage-switching (ZVS) topology that Petitioner relies on for Grounds 1 and 2. (*Id.*)

A. Ground 1 Fails to Present a Reasonable Likelihood

Ground 1 fails for several reasons.

First, Petitioner relies on a buck converter’s current setting (settable via an external resistor) to allege that the combination of the PRM Datasheet + Hwang is practiced. (*See, e.g.*, DELTA-2002, p. 27 (for [1b] arguing that the buck converter performs an overcurrent protection process via the “PRM [that] has a preset, maximum current limit set point”), 28 (for [1c] arguing that the “PRM enforces a current limit based on its own output current, where that current limit is pre-set or externally-adjustable”), 29 (for [1d] arguing that “the PRM determines when the output current reaches a pre-programmed current limit ... [when] ‘[t]he PRM has a

preset, maximum current limit set point.’’). Setting a current limit of a buck converter via an external resistor is not the same operation as determining an overcurrent condition of a resonant converter as required by [1b], [1c], and [1d] (and substantially equivalent claims 10, 13, and 17 ([10b], [10c], [10d], [13b], [13c], [13d], [17b], [17c], [17d])).)

Second, Petitioner’s analysis on these same limitations relies on its own perception of Patent Owner’s construction. Petitioner’s position relies solely on a buck converter’s control of its own current. The claims, however, require that there be a feedback loop between the buck converter and the resonant converter, where an overcurrent of the resonant converter is detected. Because Petitioner’s construction is incorrect, [1b], [1c], [1d] (and substantially equivalent claims 10, 13, and 17 ([10b], [10c], [10d], [13b], [13c], [13d], [17b], [17c], [17d])) are not taught.

Third, Petitioner’s motivation to combine fails. Petitioner argues that a POSITA would have combined certain embodiments of Hwang’s normal operation voltage regulating mode to the PRM datasheet to provide over-current protection. A POSITA would not have done this; Hwang provides specific teachings for over-current protection that teaches turning off PWM modulation.

These are described in more detail below.

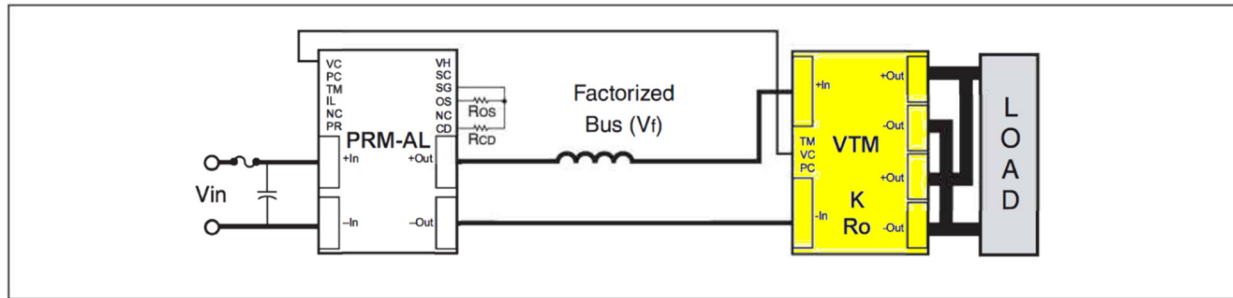
1. Ground 1 fails on claim 1 ([1c], and [1d]) and 10, 13, and 17 ([10c], [10d], [13c], [13d], [17c], [17d]) due to Petitioner's identification under "Patent Owner's Construction"

Ground 1 fails because Petitioner presents its analysis under the wrong construction. (DELTA-2001, ¶ 80.) Petitioner's ground 1 and, namely, its challenge using the prior art on limitations 1[c] and 1[d] were made "Under Patent Owner's Construction." (DELTA-2002, pp. 28, 29.) Substantively similar challenges were made against claims 10/13/17 ([10c], [10d], [13c], [13d], [17c], [17d]). (*Id.* at 37, 38, 40-42.)

As described in the claim construction (§III.A.(i), beginning on page 5), Petitioner's articulation of Patent Owner's construction is incorrect (and Petitioner proffers incorrect constructions). The proper construction for limitation 1[c] ("when the resonant converter generates the over-current") is that "when" is tied to the resonant converter's over-current situation itself. (DELTA-2001, ¶ 82.)

Petitioner's Ground 1 does not show this. Instead, Petitioner's ground 1 demonstrates that the PRM (i.e., the identified buck converter) itself limits its own current. DELTA-2002, p. 28 (arguing that "PRM enforces a current limit based on its own output current"). There is no feedback mechanism relating to current anywhere found on the VTM (i.e., the identified resonant converter, annotated yellow below). The signal VC—which is the only feedback mechanism from the resonant converter—describes "a wake up signal" and also for the VTM to inform

the PRM of a voltage drop. (VICOR-1006, p. 2.) A “voltage drop” is not an overcurrent; the voltage drop is informing the PRM of additional losses incurred by the output impedance of the VTM in normal operation, so that the PRM can compensate its output accordingly.



Limitation [1d] is further not met. (DELTA-2001, ¶ 84.) The proper construction for limitation 1[d] (“the first controller determines that the resonant converter generates the over-current”) is that the first controller is part of determining the resonant converter’s over-current situation. (*Id.*) As described above, a POSITA would not understand that anything determines the identified resonant converter’s (VTM) over-current. (*Id.*) As such both limitations 1[c] and 1[d] are not met. Substantively similar challenges were made against claims 10/13/17 ([10c], [10d], [13c], [13d], [17c], [17d]). (DELTA-2002, pp. 37,38, 40-42.)

Therefore, Ground 1 fails to present a reasonable likelihood of success (DELTA-2001, ¶ 86.)

2. Ground 1 fails on claim 1 ([1b], [1c], and [1d]) and 10, 13, and 17 ([10b], [10c], [10d], [13b], [13c], [13d], [17b], [17c], [17d]) due to Petitioner's identification of a buck converter's current limit

Limitations [1b], [1c], [1d], [10b], [10c], [10d], [13b], [13c], [13d], [17b], [17c], [17d] in claims 1, 10, 13, and 17 require that a buck converter determines a resonant converter's over-current and that the buck converter controls its output voltage in response. (DELTA-2001, ¶87.) The Petition does not meet these limitations because it relies on a buck converter's current limit (which is internally set and may be adjusted via a resistor). (*Id.*) This settable limit on a buck converter does not suggest a POSITA the resonant converter feedback limitations of the claims. (*Id.*)

Detecting a resonant converter's overcurrent and decreasing a buck converter's duty cycle in response is required by the claims. (*Id.* at ¶ 88.) Let us first focus on claim 1. Claim 1 requires: [1b] controlling the input voltage for performing an overcurrent protection process; [1c] decreasing a buck converter's duty cycle when the resonant converter generates an overcurrent; and [1d] determining a resonant converter's overcurrent and restrict its output current. (*Id.*) This feedback mechanism between buck and resonant converter is absent from the Petition. (*Id.*)

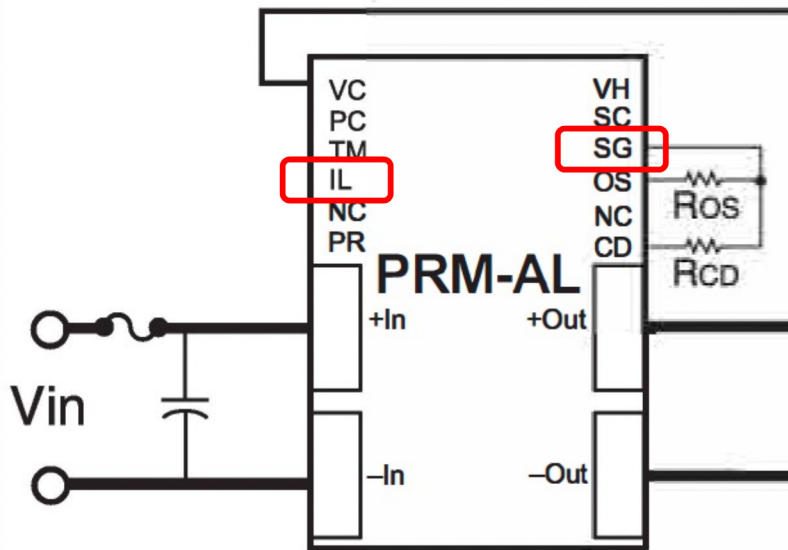
Petitioner relies on a buck converter's current limit (settable via an external resistor) to meet [1b], [1c], and [1d]. (*Id.* at ¶ 89.) To meet [1b], Petitioner argues

that the PRM is the claimed buck converter and that “the PRM provides the input voltage ... to the VTM and performs an over-current protection process.”

(DELTA-2002, p. 27.) Petitioner argues that the buck converter performs its overcurrent protection via the “PRM[’s] preset, maximum, current limit set point.”

(*Id.*) Petitioner continues this argument in [1c] and [1d]. (DELTA-2002, pp. 28, 29 (arguing that the “current limit is pre-set or externally-adjustable”).)

Moreover, and more fatally, Petitioner continues this argument in [1c] and [1d] that are explicit that the over-current process is related to the resonant converter (and not the buck converter). (*Id.* (arguing that the “current limit is pre-set or externally-adjustable”).) A POSITA would understand that the external resistor setting for the buck converter is not related to the resonant converter’s over-current, but for the intermediate voltage bus (called the “factorized bus”) and specific to the buck converter. (DELTA-2001, ¶ 90.) Page 8 of VICOR-1006 (the PRM datasheet) refers to a setting of “IL - Current Limit Adjust” referring to page 10, which states that “[t]he current limit can be lowered by placing an external resistor between the IL and SG ports (see figure 18 for resistor values).” (*Id.*) As can be seen below, the buck converter’s current limit is set by connecting an external resistor to it.



(VICOR-1006, FIG. 16.)

A POSITA would understand that this “IL - current limit” is not [1b] controlling the input voltage for performing an overcurrent protection process for the resonant converter; [1c] decreasing a buck converter’s duty cycle when the resonant converter generates an overcurrent; or [1d] determining a resonant converter’s overcurrent and restrict its output current. (DELTA-2001, ¶ 91.)

Additionally, Petitioner’s reliance on Hwang does not cure this deficiency. (*Id.* at ¶ 92.) Petitioner relies on Hwang’s duty-cycle limiter, and does not modify its combination to not rely on the identified current-control resistor or current limit of the PRM. Petitioner relies on Hwang solely for its PWM technique. (*Id.*) Namely, Petitioner states that the PRM datasheet “does not disclose how the PRM performs the current limit” and that Hwang teaches “current limit by reducing the

duty cycle of the PRM.” (DELTA-2002, pp. 27, 29, 30.) Whether the buck converter’s duty cycle is adjusted based on a settable resistor connected to the buck converter is immaterial to [1b] controlling the input voltage for performing an overcurrent protection process; [1c] decreasing a buck converter’s duty cycle when the resonant converter generates an overcurrent; and [1d] determining a resonant converter’s overcurrent and restrict its output current. (*Id.*) Further, Hwang teaches that the buck converter shuts off PWM modulation and is out of control when there is an over-current. (*Id.*) This is not equivalent to limitation [1b] controlling voltage for performing an overcurrent protection process, limitation [1c] decreasing a buck converter’s duty cycle when the resonant converter generates an overcurrent, and limitation [1d] determining a resonant converter’s overcurrent and restrict its output current. (*Id.*) Therefore, none of these limitations are met because a POSITA would understand that a buck converter’s external resistor setting a current limit is not for detecting a resonant converter’s overcurrent. (*Id.*) Further, the other independent claims have similar limitations. Claim 10’s limitations of [10b], [10c], and [10d] are substantively similar and Petitioner provides refer-backs to their claim 1 counterparts. (DELTA-2002, pp. 37, 38.) Claim 13 and 17’s parallel limitations ([13b], [13c], [13d], [17b], [17c], [17d]) are similarly referred-back to by Petitioner. (*Id.* at 40-42.)

Further, the PRM Datasheet does not disclose how the PRM performs the current limit admitted by the Petitioner. (DELTA-2001, ¶ 93.) Even though the PRM will restrict its output current when triggering the current limit, PRM only restricts its output current within the preset value like described in the Petition. (*Id.*) A POSITA cannot obtain whether the output current of the PRM can be kept in a predetermined current required by, for example, limitation [1d]. (*Id.*) On the contrary, the Petition combines Hwang's over-current protection, but Hwang teaches the output current of the buck will reduce to zero or is out of control when there is an over-current, instead of restricting the output current in a predetermined current. (*Id.*) So the PRM datasheet does not disclose whether the output current of the PRM is restricted in the first predetermined current or in a second predetermined current. (*Id.*) Thus, the Petition does not meet its burden to show that Ground 1 teaches limitations [1d], [10d], [13d], and [17d] in claims 1, 10, 13, and 17.

Therefore, Ground 1 fails at least the aforementioned reasons.

The other independent claims have similar limitations. Claim 10's limitations of [10b], [10c], and [10d] are substantively similar and Petitioner provides refer-backs to their claim 1 counterparts. (DELTA-2002, pp. 37, 38.) Claim 13 and 17's parallel limitations ([13b], [13c], [13d], [17b], [17c], [17d]) are similarly referred-back to by Petitioner. (*Id.* at 40-42.)

Ground 1 thusly fails.

3. Ground 1 fails to present a motivation to combine to arrive at the claims because Hwang teaches a circuit shut-off PWM when there is an overcurrent

As described in the preceding sections, Ground 1 fails to teach limitations. Ground 1 further fails because there is no motivation presented to arrive at the claims.

A POSITA would not have combined the PRM Datasheet with Hwang / Vicor White Paper / Electronic Design Article. (DELTA-2001, ¶ 95.) This is because a POSITA would not have been motivated to add over-current protection for the resonant converter to the PRM itself, and also would not have been motivated to do so in the manner described by the Petition (i.e., restricting the input voltage of the resonant converter to restrict the output current of the resonant converter). (*Id.*) Moreover, Hwang teaches over-current protection by shutting off the PWM signal. (*Id.*) Because of the lack of motivation, the Petition arriving at the '580 Patent limitations in hindsight, using the infringement contentions (and hence the '580 Patent itself) as a roadmap for combining the prior art. In proposing the combination of references in Ground 1, Petitioner and Dr. Baker have not addressed the liminal question of what would motivate a POSITA to dispense with the then-known methods for overcurrent protection that were internal to the resonant converter itself, namely:

- changing the switching frequency of the resonant converter (VICOR-1001, 1:49-60);
- modulating the on-time of the resonant-converter switches (*Id.* 1:61-2:4); or
- clamping the resonant voltage (*Id.* 2:5-14, and Fig. 2, showing a diode clamp on the resonant capacitor)

All of these methods ultimately hamper the optimization of the resonant converter for efficiency. (DELTA-2001, ¶ 96.) For instance, increasing the switching frequency of the resonant converter increases switching loss. (*Id.*) Switch losses are also increased when the resonant-converter switches are pulse-width modulated, thus disrupting the zero-voltage switching conditions in the resonant converter. (*Id.*) Similarly, the effect of clamping the resonant-converter voltage varies depending on the (variable) value of V_{in} , which further restricts the resonant-converter design (*Id.*)

The '580 Patent takes a substantially different pre-regulation approach, which does not merely shut down the preceding stage of power conversion in the event of an overcurrent (as exemplified by Joshi). (*Id.*, ¶ 97.) Based on the disclosure of the '580 Patent, a POSITA would recognize that the resonant converter may now be optimized for efficiency; its design is not hampered by different types of modulation and/or protection:

The invention also provides a method for the over-current protection by efficiently restricting the resonant current or the output current of the resonant converter when the resonant conversion system is over-loaded, short-circuited

or at startup.

(*Id.*) The claims include determining whether the resonant converter generates the over-current based on detection of its operation, and “decreasing an input voltage of the resonant converter for performing the over-current protection process when the resonant converter generates the over-current.” (*Id.*)

Dr. Baker has not accounted for what POSITA would ascertain regarding overcurrent protection from the references. (*Id.* at ¶ 98.) This is especially relevant since details of internal protection in PRM/VTM system are not described in PRM Datasheet, White Paper, or Electronic Design Article. For instance, the White Paper does describe the rationale for steady-state operation, including the improvements to efficiency by converting power in two stages, and moving to a higher-voltage intermediate bus (called the “factorized bus”). (VICOR-1008, pp. 1, 2.) However, PRM Datasheet, White Paper, and Electronic Design Article (1) don’t mention overcurrent or how it is handled; (2) only provide internal topological details of the VTM that are “simplified” (*Id.* at 2.); and (3) even mention that the VTM can be used in standalone operation, presumably without any benefits from the preceding PRM. (*Id.* at 4.)

For the sake of discussion, even if a POSITA sought to add over-current protection from Hwang into a PRM, they would have added its over-current protection circuitry as disclosed in Hwang. (DELTA-2001, ¶ 99.) However,

Hwang's over-current protection circuitry shuts down the PWM modulation by opening SW1 when there is an over-current. (*Id.*) This PWM shutdown is cumulative of Joshi, but also what Petitioner alleges would result from the incorporation of Hwang. (*Id.*) Figure 1, reproduced below, illustrates Hwang's control circuitry (blue) that controls switches (red).

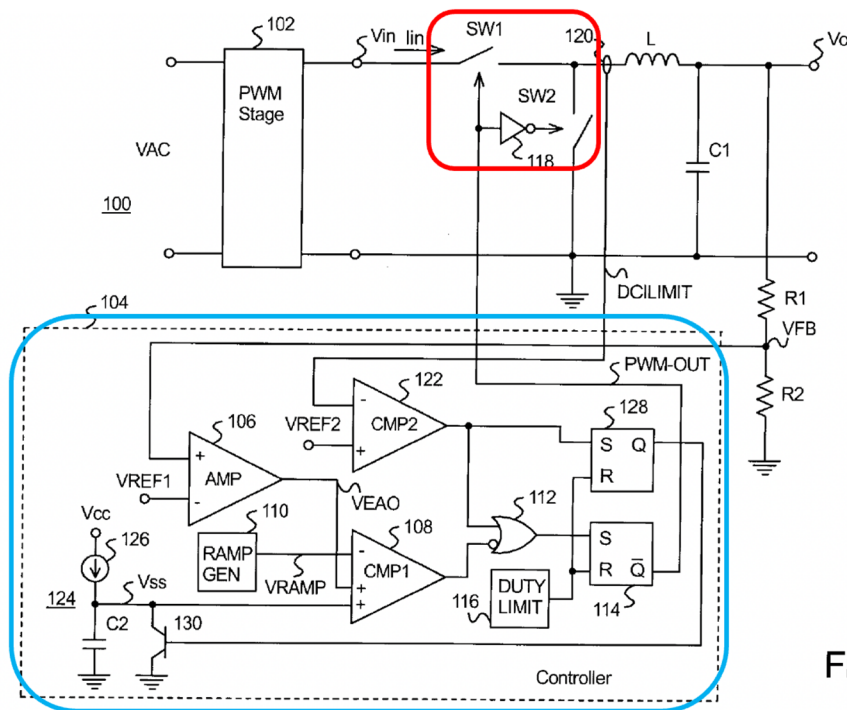
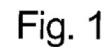


Fig. 1

(VICOR-1007, FIG. 1.) Hwang shuts off PWM modulation (i.e., turns off the buck converter's switch (SW1) when there is an over-current. This circuit operates by detecting a voltage signal (DCILIMIT) that is representative of the sensed current via current sensor 120 (green, below) and, when DCLIMIT is too high, comparator 122 blocks the transfer of power from the source by turning off SW1 (red). (VICOR-1007, 4:7-24 ("current sensor 120 forms a voltage signal DCILIMIT that is



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SW2 (also red) being closed and grounding the left terminal of output inductor L through SW2 (*Id.* at 2:15-22; 3:28-32.) As such, whenever there is an overcurrent comparator 122 opens SW1 and couples the output L-C1 network to ground.

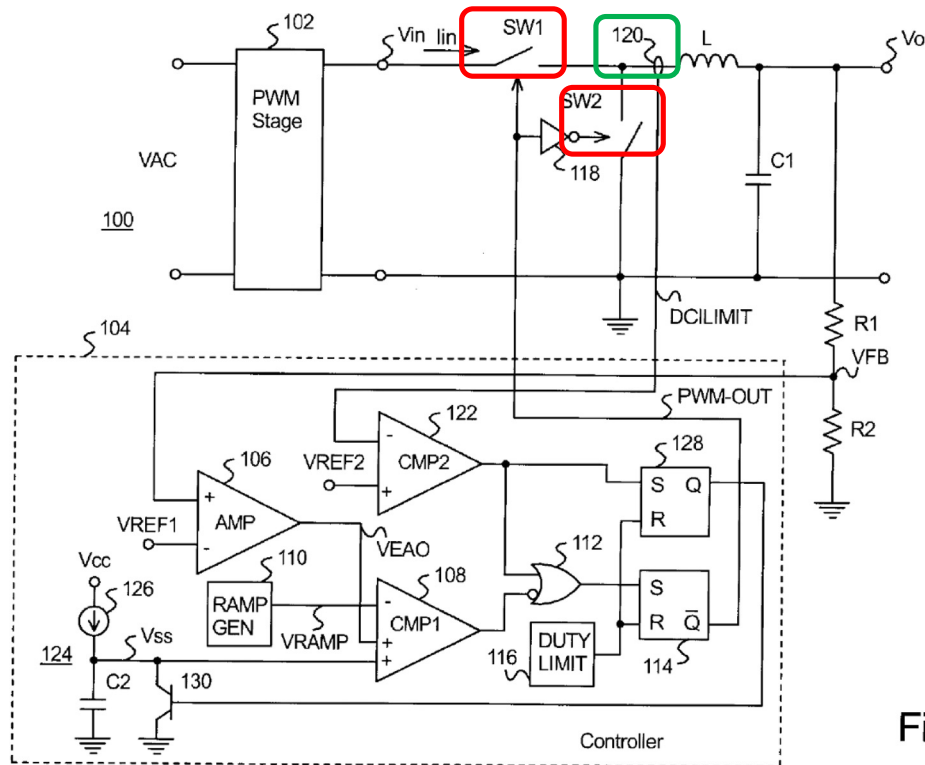


Fig. 1

A POSITA—if they would have been motivated to add over-protection from Hwang—would have added Hwang’s shut-down as it is the conventional method. (DELTA-2001, ¶ 102.) Moreover, Hwang’s circuits described above represent the common existing approaches to overcurrent protection. (*Id.*) A POSITA would not have been motivated to add an entirely different type of functionality. As such, there is an absence of motivation to reach the mechanism actually recited in the claims based on the presented prior art. (*Id.*) Petitioner only arrives there via hindsight bias. Therefore, Petitioner’s claims should be rejected.

4. Ground 1 fails to present a motivation to combine to arrive at the claims because Hwang's PWM circuit would not have been provided for overcurrent protection

As described in the preceding sections, Ground 1 fails to teach limitations and, moreover, fails to provide motivation to arrive at the claims. Ground 1 further fails because a POSITA would not have been motivated to provide Hwang's PWM modulated circuit for over-current protection due to complications in doing so (and due to Hwang's direction to use a shut-down for overcurrent protection). (*Id.* at ¶ 103.) Petitioner equates Hwang's disclosure of pulse width modulation with over-current protection using a resonant converter, but that is not accurate. (*Id.*) Over-current protection and voltage regulation are different concepts in the field, and Petitioner's analysis seems to confuse the two. (*Id.*) Further, the Petition also does not consider the difficulties in using a voltage regulator to provide over-current protection. The implementation of effective over-current protection in resonant converters is crucial. For a power converter with a traditional pulse-width modulation (PWM), during an over-load or short circuit condition, the duty cycle can be reduced to limit the current. (DELTA-2003, p. 1.) In a resonant converter, because the impedance of the resonant tank is small during normal operation, the current can reach to a very high level in a very short time. (DELTA-2001, ¶ 105.) Accordingly, simply providing voltage regulation via a PWM as a mechanism to prevent an overcurrent condition when a resonant tank is used will not prevent the

current from reaching a very high level in a very short time. (*Id.*) This could result in damaging the load; therefore, a POSITA would not have simply looked to PWM pre-regulation to prevent over-current. (*Id.*)

However, using a resonant tank (as required by the claims) complicates the issue of simply using regulation. (*Id.* at ¶ 106.) The regulator itself can no longer directly affect the output because of the interceding resonant tank, whose current can spike. (*Id.*) As a result, regulation itself was seen as insufficient to prevent over-current with a resonant tank. (*Id.*) A POSITA would not have merely provided PWM pre-regulation for overcurrent protection, especially when the art teaches providing a shut-down circuit and other methods directed to the resonant converter itself. (*Id.*)

Petitioner argues that “a skilled artisan would have had a reasonable expectation of success in combining the teachings of the PRM in the PRM Datasheet with a current limiter as taught by Hwang in which the duty cycle of the switching regulator is reduced if excessive current it detected.” (DELTA-2002, p. 25.) Petitioner provides separate arguments for this motivation on pages 23–25 of its Petition. However, Petitioner’s reasoning is inaccurate or generic. First, Petitioner states that “the PRM Datasheet stat[ing] the PRM is a “buck-boost regulator” and Hwang specifically teaching a current limit approach for a[] . . . “buck” topology.” (DELTA-2002, pp. 23, 24.) Petitioner here is identifying that both references discuss buck regulators. (DELTA-2001, ¶ 108.) However, a POSITA would need more than a common

mention of buck regulators to be motivated combine the references to arrive at the claims. (*Id.*) Second, even with the introduction of Hwang, it would not have been obvious to take a regulating buck-boost converter and implement an over-current protection feature via PWM when the Hwang reference teaches a shut-down of the PWM signals. (*Id.* at ¶ 109.) This mechanism results in the same condition (starting from zero volts across C2) that prevails when the Hwang's buck converter is first powered on from a $V_{cc} = 0$ Volt state. (*Id.*)

Third, Petitioner continues to mischaracterize the technology. Petitioner alleges that a POSITA would recognize that a combination of the PRM Datasheet and Hwang combines prior art elements according to known methods to yield predictable results. (DELTA-2002, p. 24.) Hwang describes regulating the output voltage and limiting the current via shutdown when there is excessive output current. (DELTA-2001, ¶ 110.) As discussed, voltage regulation is not synonymous to over-current protection, thus a POSITA would not be motivated to implement an over-current protection feature by combining the PRM Datasheet and Hwang. (*Id.*) Moreover, neither Dr. Baker nor any of the references cited in Petitioner's grounds explain how to adapt Hwang's single-switch PWM control to the four-switch, zero-voltage-switching (ZVS) PRM topology that Petitioner relies on for Ground 1. (*Id.*)

Therefore, a POSITA would not have a reasonable expectation of success in combining the teaching of the PRM in the PRM Datasheet with the current limiter

taught by Hwang. (*Id.* at ¶¶ 110, 111.)

B. Ground 2 Fails to Present a Reasonable Likelihood of Success

Ground 2 is based on a subset of references considered in Ground 1. In Ground 1, Petitioner included “if necessary, the White Paper,” and in Ground 2, the White Paper is now affirmatively combined with Hwang. Again, the Petitioner and Dr. Baker rely on the infringement contentions (and hence the ’580 Patent itself) as a roadmap for combining the prior art, without considering that a POSITA would ascertain regarding overcurrent protection from the references. (*Id.* at ¶ 112.) This problem is compounded in Ground 2, since details of internal protection in VTM/PRM are scantily described within the ambit of the White Paper alone, compared to the PRM Data Sheet and Electronic Design Article. (*Id.*) As explained below, Ground 2 does not show the limitation of “decreasing a duty cycle of a switching device of the buck converter to decrease the input voltage received by the resonant converter, when the resonant converter generates the over-current.” (*Id.*) Additionally, there are errors repeated here from Ground 1. For example, Ground 2 continues the reliance on Hwang’s particular method of “resetting” PWM (as at start-up) to provide overcurrent protection. (*Id.*) Ground 2 continues to present a generic and inaccurate motivation to combine. (*Id.*) Therefore, Ground 2 fails to show the unpatentability of the challenged claims.

1. Ground 2: Petitioner fails to provide an over-current protection mechanism

Petitioner relies on Hwang to gap-fill the over-current protection mechanism. Hwang’s voltage regulation teachings, however, do not do so. (DELTA-2002, p. 54 (stating that Hwang decreases a duty cycle while citing in part to Hwang’s voltage regulation embodiments of 1:32-50, 3:51-57, 4:7-17, 4:43-5:20). *See also* (VICOR-1003, ¶155 (citing the same and stating that “duty cycle limiter controls the output voltage of the buck converter in the combination”).) To the extent that these refer to Hwang’s over-current protection mechanism, these arguments have already been addressed in Ground 1. (DELTA-2001, ¶ 113.) To the extent that they rely on the duty-cycle limiter 116, this element orchestrates the PWM cycle as part of a conventional voltage controller. (*Id.*) For instance,

When the flip-flop 114 is reset by the **duty-cycle limiter 116**, the switch SW1 is closed and the switch SW2 is opened. In addition, the ramp signal VRAMP, being synchronized with the periodic clock signal from the duty-cycle limiter 116, is reset to its initial value from which it begins to rise. [...] Then, when the level of the ramp signal VRAMP exceeds the level of the error signal VEO, the switch control signal VSC transitions to a logic low voltage. As a result, the flip-flop **114** is set and the switch SW1 is opened and the switch SW2 is closed. The switch SW1 remains open and the switch SW2 remains closed until the flip-flop **114** is *once again reset by the duty-cycle limiter 116*.

(VICOR-1007, 3:38-50 (emphasis added).)

From these disclosures, a POSITA would understand that the duty-cycle limiter 116 starts a PWM cycle by (a) closing, not opening, switch SW1; and (b) resetting VRAMP, which rises to match the output of the error amplifier and modulate the trailing edge of the PWM pulse. (DELTA-2001, ¶ 114.) A POSITA would also recognize that in Hwang's figures, duty-cycle limiter 116 is only connected to flip-flops 114/128 to provide this switch-turn on function (not a switch turn off) and initiate a PWM cycle. (*Id.*) The figures do not show another connection for duty-cycle limiter 116 where it is even capable of responding to overcurrent. A POSITA would thus understand that duty-cycle limiter 116 is part of a conventional PWM technique for voltage control, and not for over-current protection, which Petitioner seems to conflate. Moreover, as described for Ground 1, Hwang's voltage regulation techniques do not "decrease a duty cycle ... when the resonant converter generates the over-current." (*Id.*) Instead, Hwang's over-current protection circuits shut down the PWM modulation, as described in more detail in §VIII.A.3. Ground 2 fails to teach this limitation.

The limitations of the other independent claims (10, 13, and 17; [10c], [13c], [17c]) are substantially similar to [10c] and Petitioner relies on the same teachings of Hwang. (*Id.* at ¶115.) However, these limitations are not taught for the same reasons. (*Id.*)

Therefore, Ground 2 fails for at least the aforementioned reason.

2. Ground 2 fails to present a motivation to combine to arrive at the claims because Hwang teaches a circuit shut-down when there is an overcurrent

Petitioner's Ground 2 suffers from the same deficiency of Ground 1.

Namely, the prior art combination is based on a POSITA allegedly looking to “Hwang for its teaching of an over-current protection technique.” (DELTA-2002, p. 49.) However, Hwang teaches a technique of shutting down the PWM when an over-current condition occurs. This does not reach the claims, as discussed throughout herein, and a POSITA would not have been motivated to provide Hwang's PWM circuit for overcurrent protection. (DELTA-2001, ¶ 118.) Therefore, a POSITA would not form the prior art combination of Ground 2 for the same reasons discussed with Ground 1.

3. Ground 2: Petitioner fails to present a motivation to combine

Petitioner's reasonings are not compelling since they are not only generic, but also recycled portions of Petitioner's obviousness arguments from Ground I. (*Id.* at ¶ 120.) Thus, Petitioner's combination fails because Petitioner does not provide a compelling rationale to combine.

For Petitioner's *First* argument, it argues that a POSITA would have been concerned with excessive currents caused by faulty loads or shorts, and would have placed an over-current protection circuit in the system. (DELTA-2002, p. 50.)

However, overcurrent protection methods were already known for both buck converters and resonant converters, and a POSITA understood this type of protection to be wholly conventional. (DELTA-2001, ¶ 121.) A POSITA would have addressed over-current in the resonant converter by applying known techniques at the resonant converter (VICOR-1001, 1:49-2:14), which is discussed in relation to Ground 1. (*Id.*) A POSITA would understand that resonant tank (as required by the claims) complicates the issue of simply using pre-regulation for overcurrent protection. (*Id.*) The regulator itself can no longer directly affect the output because of the interceding resonant tank, whose current can spike. (*Id.*) As a result, regulation itself was seen as insufficient to prevent over-current with a resonant tank. (*Id.*) A POSITA would not have merely provided PWM pre-regulation for overcurrent protection, especially when the art teaches providing a shut-down circuit and other methods directed to the resonant converter itself. (*Id.*)

For Petitioner's ***Second*** argument, it argues that both references provide buck converters falls short. (DELTA-2002, pp. 50, 51.) A POSITA would need more reason to combine two references beyond a common mention of buck converter. In power electronics, it is not the case that any technology can be automatically combined with the same topology, since it is crucial to understand how that topology is controlled. (DELTA-2001, ¶122.) Certain claim limitations not being met here in this case is demonstrative of that. Indeed, as a POSITA would not have been

motivated to provide Hwang's PWM modulation techniques as an overcurrent protection technique for at least the reasons herein. (*Id.*)

For Petitioner's **Third** argument, it argues that a POSITA would need to decide where to place the feedback loop. (DELTA-2002, p. 51.) Specifically, the Petition states that a POSITA would need to decide between providing protection at the PRM, at the VTM, or both the PRM and VTM. (*Id.*) As described with respect to the first argument, above, there is no specific motivation to place the feedback loop on the resonant converter and rely on some form of pre-regulation for overcurrent protection. (DELTA-2001, ¶123.) Here, Petitioner argues that a POSITA would add Hwang's voltage regulation techniques because of a strong desire to provide current protection. However, this is incorrect because if a POSITA had such a strong desire, they would have dispensed with known techniques directed to the resonant converter, or added Hwang's over-current protection shut-off techniques. (*Id.*)

For Petitioner's **Fourth** argument, it argues that the art teaches known techniques. (DELTA-2002, pp. 50, 51.) However, known technique for overcurrent protection is a circuit-shut-off, as taught by Hwang, in addition to known methods directed to the resonant converter itself, which is discussed in relation to Ground 1. (VICOR-1001, 1:49-2:14.) A POSITA would have added that common technique, not re-regulation with PWM modulation. Moreover, neither Dr. Baker nor any of the

references cited in Petitioner’s grounds explain how to adapt Hwang’s single-switch PWM control to the four-switch, zero-voltage-switching (ZVS) PRM topology that is disclosed in the White Paper.

For Petitioner’s *Fifth* argument, it argues for “soft start.” (DELTA-2002, p. 52.) The Petition states that “soft start” is a type of overcurrent protection. However, this is incorrect. Soft-start is a feedforward method to gradually increase the duty cycle to a point where a the PWM-controlled converter can enter regulation. (DELTA-2001, ¶125.) It does so at start-up, whether or not the resonant converter generates the over-current based on detection of its operation. (*Id.*) Nonetheless, a POSITA would not view the existence of “soft start” in the White Paper and immediately be motivated to add the specific feedback loop for overcurrent protection using PWM modulation as in the claims. (*Id.*)

VI. PETITIONER FAILS TO IDENTIFY ITS GROUNDS WITH PARTICULARITY AND FAILS TO IDENTIFY THE PROPER CONSTRUCTION

Grounds 1 and 2 should be denied because Petitioner failed to identify its grounds with particularity and failed to provide analysis under the plain and ordinary meaning.

Petitioner has the “burden of proving a proposition of unpatentability by a preponderance of evidence” and this burden never shifts to the Patent Owner. 35 U.S.C. § 316); *see also FanDuel, Inc. v. Interactive Games LLC*, 966 F.3d 1334,

1341 (Fed. Cir. 2020). Petitioner must identify “with particularity, each claim challenged, the grounds on which the challenge to each claim is based, and the evidence that supports the grounds for the challenge to each claim.” 35 U.S.C. § 312(a)(3). Petitioner is moreover required to identify “[h]ow the challenged claim is to be construed.” 37 CFR § 42.104(b)(3). Petitioner has failed with respect to both particularity and construction, which warrants denial.

Petitioner’s Grounds contain an amalgamation of references viewed *not* via the plain and ordinary meaning to a POSITA (but instead via a perceived construction). Ground 1 contains 4 references, and Petitioner uses them “if necessary” for various limitations. Petition at 4. This is an improper formulation of grounds warranting denial. *Adaptics Ltd. v. Perfect Co.*, IPR2018-01596, Paper 20 (P.T.A.B. March 6, 2019) (Informative) (denying institution on linking optional reference combinations as lacking particularity). The Petition argues a modification of PRM Datasheet with Hwang and if necessary, the Vicor White Paper and/or Electronic Design Article yet fails to provide motivation and reasonable expectation of success to combine all of these references together. *See Apotex Inc. v. Wyeth LLC*, IPR2014-00115, Paper 94, at 11 (Apr. 20, 2015). For instance, Petitioner appears to present:

- 1[pre], Petitioner relies on a combination of the PRM Datasheet and the Vicor White Paper or the Electronic Design Article.

- 1[a], Petitioner relies on a combination of the PRM Datasheet and the Vicor White Paper and/or the Electronic Design Article.
- 1[b], Petitioner relies on a combination of the PRM Datasheet and Hwang.
- 1[c], Petitioner relies on a combination of the PRM Datasheet and Hwang, under Patent Owner’s claim construction.
- 1[d], Petitioner relies on a combination of the PRM Datasheet and the Vicor White Paper, under Patent Owner’s claim construction.

Compounding this problem, the Petition’s combinatorial analysis was based on its expert’s (Dr. Baker) application of a Petitioner-perceived construction, not the actual plain and ordinary meaning. (VICOR-1003, ¶54 (stating he was “asked [by Petitioner] to apply [the] Patent Owner’s Apparent Construction, in which the following claim limitations are met when (1) the output voltage of a PRM (or other buck converter) provides the input voltage to a VTM (or other resonant converter that provides an output current proportional to the input current), and (2) the PRM (or other buck converter) detects that its output current has reached a set current limit.”).) As an effect, none of Petitioner’s expert’s analysis of the large batch of references was through the lens of a POSITA on the plain and ordinary meaning.

Beyond Ground 1, this problem is compounded in Ground 2 because Petitioner’s expert’s analysis of the motivation to combine is via the faulty construction. (*See generally* §III.).

Petitioner failed to properly analysis Grounds 1 and 2 with particularity and under the plain and ordinary meaning. As a consequence, the petition should be denied.

VII. THE BOARD SHOULD EXERCISE ITS DISCRETION TO DENY

The Board should use its discretion to deny the Petition under 35 U.S.C. § 314(a). “The Director’s discretion is informed by 35 U.S.C. §§ 316(b) and 326(b), which require the Director to ‘consider the effect of any such regulation [under this section] on the economy, the integrity of the patent system, the efficient administration of the Office, and the ability of the Office to timely complete proceedings instituted under this chapter.’” (Trial Practice Guide Update, 10 at 9; see also Office Patent Trial Practice Guide, August 2018 Update, 83 Fed. Reg. 39,989 (Aug. 13, 2018).)

Ground 1 is, in effect, multiple grounds in one and is procedurally and technologically flawed at a fundamental level. Ground 1 plainly lacks critical elements and applies the wrong construction and does so in a confusing combination of 4 references provided as optional and in the alternative. This presents a waste of Board resources, and the Board should use its discretion to deny even if the Board finds Ground 2 worthy of review. *Adaptics Ltd. v. Perfect Co.*, IPR2018-01596, pg. 17 Paper 20 (P.T.A.B. March 6, 2019) (Informative) (denying institution when numerous other grounds were baseless and presented a

waste of resources).

VIII. OBJECTIVE EVIDENCE OF NON-OBVIOUSNESS

Both of Petitioner's Grounds 1 and 2 are obviousness grounds. There is, however, a strong objective indicia of non-obviousness, which weighs against any finding of obviousness. *See Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1538 (Fed. Cir. 1983)("[E]vidence of secondary considerations may often be the most probative and cogent evidence in the record.").

By providing for a resonant converter with over-current protection, the inventors of the '580 patent went against the conventional wisdom. (DELTA-2001, ¶ 126.) This is objective evidence of non-obviousness. *See Arkie Lures, Inc. v. Gene Larew Tackle*, 119 F.3d 953, 958 (Fed. Cir. 1997) ("[C]onventional wisdom that a combination should not be made is evidence of unobviousness.").

The claims of the '580 patent went contrary to the conventional wisdom in the field by providing for a resonant converter with over-current protection using a pre-regulation approach. (DELTA-2001, ¶ 126.) This is a secondary consideration that weighs against the obviousness asserted in Grounds 1 and 2.

The claims of the '580 patent went contrary to the conventional wisdom because, it was believed in the relevant timeframe that preventing the current from exceeding its predetermined threshold involved control changes within the resonant converter itself, namely:

- changing the switching frequency of the resonant converter (VICOR-1001, 1:49-60);
- modulating the on-time of the resonant-converter switches (*Id.* 1:61-2:4); or
- clamping the resonant voltage (*Id.* 2:5-14, and Fig. 2, showing a diode clamp on the resonant capacitor).

All of these methods ultimately hamper the optimization of the resonant converter for efficiency. (DELTA-2001, ¶ 127.) For instance, increasing the switching frequency of the resonant converter increases switching loss (*Id.*). Switch losses are also increased when the resonant-converter switches are pulse-width modulated, thus disrupting the zero-voltage switching conditions in the resonant converter (*Id.*). Similarly, the effect of clamping the resonant-converter voltage varies depending on the (variable) value of V_{in} , which further restricts the resonant-converter design (*Id.*).

The '580 Patent takes a substantially different pre-regulation approach, one which does not merely shut down the preceding stage of power conversion in the event of an overcurrent (as exemplified by Joshi). (*Id.* at ¶128.) Based on the disclosure of the '580 Patent, a POSITA would recognize that the resonant converter may now be optimized for efficiency; its design is not hampered by different types of modulation and/or protection:

The invention also provides a method for the over-current protection by efficiently restricting the resonant current or

the output current of the resonant converter when the resonant conversion system is over-loaded, short-circuited or at startup.

(VICOR-1007, 10:1-5.) The claim system and method include determining whether the resonant converter generates the over-current based on detection of its operation, and “decreasing an input voltage of the resonant converter for performing the over-current protection process when the resonant converter generates the over-current.” (*Id.* 10:15-22.)

Petitioner’s arguments that these features would have been obvious to a POSITA are based on hindsight, using the infringement contentions (and hence the ’580 Patent itself) as a roadmap for combining the prior art. (DELTA-2001, ¶129.) Dr. Baker hasn’t accounted for what POSITA would ascertain regarding overcurrent protection from the references; especially since details of internal protection in PRM/VTM system are not described in PRM Datasheet, White Paper, and Electronic Design Article. (*Id.*) For instance, the White Paper does describe the rationale for steady-state operation, including the improvements to efficiency by converting power in two stages, and moving to a higher-voltage intermediate bus (called the “factorized bus”). (*Id.*) However, PRM Datasheet, White Paper, and Electronic Design Article do not mention overcurrent or how it is handled, and these disclosures wouldn’t motivate a POSITA to dispense with the then-known methods for overcurrent protection, namely (1) control changes within the resonant converter

itself; or (2) shutting down the preceding stage of power conversion in the event of an overcurrent (as exemplified by Joshi and Hwang). (*Id.*)

Therefore, the '580 Patent claims recite solutions that go against the conventional wisdom in the field, which suggests their non-obviousness.

IX. CONCLUSION

Petitioner respectfully requests that the Board exercise its discretion to decline institution.

Dated: July 10, 2024

Respectfully submitted,



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CERTIFICATE OF WORD COUNT UNDER 37 CFR § 42.24(d)

Under 37 C.F.R. § 42.24(d), the undersigned certifies that the word count for this Patent Owner's Preliminary Response to the Petition for *inter partes* review totals 12,388 excluding the parts exempted by 37 C.F.R. § 42.24(a). The word count was made using the built-in word count function in the Microsoft® Word software used to prepare this document.

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6(e), I certify that I caused to be served a true and correct copy of the foregoing: PATENT OWNER'S PRELIMINARY RESPONSE and accompanying exhibits by email to the electronic service addresses for Petitioner on the date indicated below:

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