

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

DELTA ELECTRONICS, INC.

Petitioner

v.

VICOR CORPORATION

Patent Owner

IPR2024-00227
Patent No. 9,516,761

PATENT OWNER PRELIMINARY RESPONSE

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TABLE OF EXHIBITS

Exhibit No.	Description
2001	Declaration of Prof. Rivas-Davila
2002	Nadjahi, <i>et al.</i> , “A review of thermal management and innovative cooling strategies for data center”, <i>Sustainable Computing: Informatics and Systems</i> 19 14–28 (2018).
2003	Kheirabadi, <i>et al.</i> , “Cooling of server electronics: A design review of existing technology”, <i>Applied Thermal Engineering</i> 105, 622–638 (2016).
2004	Almoli, “Air Flow Management Inside Data Centers”, Doctoral Thesis, University of Leeds, (Feb. 2013), available at https://core.ac.uk/download/pdf/17187065.pdf
2005	Xu, <i>et al.</i> , “Extension of Air Cooling for High Power Processors”, 2004 Inter Society Conference on Thermal Phenomena, pp. 183-192 (2004).
2006	U.S. Pat. No. 7,361,844.
2007	Redline of BMR 2008 (Ex. 1026) over Ericsson BMR (Ex. 1007).
2008	Severns and Bloom, <i>Modern DC-To-DC Switch-Mode Power Converter Circuits</i> , Van Nostrand Reinhold Co., New York, 1985.
2009	Declaration of Steven B. Leeb, Ph.D. in Support of SynQor’s Motion for a Preliminary Injunction, from SynQor v. Ericsson, Inc., et al., Civil Action No. 2:11-cv-54-TJW-CE (E.D. Tex. Feb. 8, 2011).
2010	Intel, Power Supply Design Guide for Desktop Platform Form Vectors, Revision 1.31, April 2013, available at https://www.smpps.us/Power_Supply_Design_Guide_Desktop_Platform_Rev_1_31.pdf

2011	Intel, Voltage Regulator Module (VRM) and Enterprise Voltage Regulator-Down (EVRD) 10.0 Design Guidelines, July 2005, available at https://www.intel.com/content/dam/www/public/us/en/documents/design-guides/voltage-regulator-module-enterprise-voltage-regulator-down-10-0-guidelines.pdf
2012	U.S. Pat. No. 10,199,950.
2013-2029	Not submitted
2030	Declaration of Dr. Patrizio Vinciarelli
2031	Delta Non-isolated Bus Module Claim Charts
2032	SEALED: Vicor NBM2317 Claim Charts

Patent Owner Vicor Corporation (“Vicor”) hereby submits its preliminary response to the petition for *inter partes* review seeking to challenge U.S. Patent No. 9,516,761 to Vinciarelli, *et al.* (“the ’761 patent”).

The Petition should be denied for several reasons. The Petition asserts eight obviousness Grounds, but fails to address the requirement to show a reasonable expectation of success with respect to claim 1 (the only independent claim) in six of them. In the remaining two, the discussion of reasonable expectation of success is perfunctory, and only provided for a subset of the obviousness arguments. Furthermore, each Ground fails to teach or render obvious one or more limitations of claim 1, and the Petition fails to address known secondary considerations.

I. INTRODUCTION

A. Technical background

To aid in understanding the underlying technology, the attached declaration of Professor Rivas-Davila (Ex. 2001) reviews background concepts relevant to the ’950 patent in ¶¶23-51. Dr. Rivas-Davila is a Professor in the Electrical Engineering Department at Stanford University. (Ex. 2001, ¶4). He focuses his research on the design of power converters. (Ex. 2001, ¶3). Near the relevant timeframe, he was the Lead Power Electronics Engineer for General Electric’s Global Research Center. (Ex. 2001, ¶7).

B. Technology of the '761 patent

1. The Petition's argument

The Petition argues as follows:

“the purported innovation of the '761 Patent is the purely functional result that the power dissipated on the top and bottom sides of the power converter's printed circuit board (PCB) are roughly the same (specifically, within 150% of each other). This functional result was the natural outcome, however, of a conventional layout of power converter electrical components on a PCB, in particular a layout that was symmetrical on top and bottom.”

(Petition, p. 1). The petition thus sets the claims up as a simple, inherent result from a common package arrangement.

The petition is wrong. The claims of the '761 patent are neither the natural result of a common structure, nor was the structure common. (Ex. 2001, ¶59). Rather, the approach of the '761 patent is counterintuitive and advantageous, and later copied by Delta. (Ex. 2001, ¶59).

Claim 1 of the '761 patent requires a plurality of power semiconductor devices to be arranged into two sets, one set on the top of a printed circuit board (“PCB”), and one set on the bottom. Here, “power semiconductor devices” are usually MOSFETs (Metal Oxide Semiconductor Field Effect Transistors). (Ex. 2001, ¶60). These MOSFETs act as switches in the power converter. They are “power” MOSFETs because they are made much larger than logic level transistors found in

an integrated circuit, in order to increase their channel width and decrease their resistance. (Ex. 2001, ¶60). Lower resistance means lower heat losses due to resistive heating. (Ex. 2001, ¶60).

Having such power MOSFETs symmetrically arranged on the top and bottom of a circuit board is necessary, but not sufficient, to achieve balanced heat generation for MOSFETs on each side of the board, as required by claim limitation 1[e]. (Ex. 2001, ¶61). This is because heat generation depends on a number of variables, including the MOSFET's channel resistance and how the MOSFETs are used in the converter (how they are turned ON and OFF and how much current they carry). (Ex. 2001, ¶61).

To achieve balanced heat generation from MOSFETs on opposite sides of a converter's PCB, the *layout* and *operation* of the converter circuit need to be suitably engineered. (Ex. 2001, ¶62). And at the outset, the converter's circuit has to be *designed* in a way that makes it *possible* to partition companion MOSFETs, carrying similar currents, between the top and bottom surfaces of a PCB. (Ex. 2001, ¶62).

2. Datacenter thermal management

Balanced heat generation at the top and bottom of a PCB was not considered a desirable thing in the relevant timeframe. (Ex. 2001, ¶63). Converters of the type described in the '761 patent are used as on-board power converters for servers. (Ex. 2001, ¶63). That is, the converters are mounted on the same board as a server CPU,

and provide a portion of the power supply system to the CPU of the server. (Ex. 2001, ¶63). The servers are placed in racks in data centers, as shown in the following image:



Fig. 1. Data center in Nokia, Lannion.

(Ex. 2002, Fig. 1, p. 2)(Ex. 2001, ¶63). This image shows a series of vertically-shaped cabinets, each having a number of racks, like drawers. (Ex. 2001, ¶63).

In such data centers, thermal management is a significant issue. (Ex. 2001, ¶64). Data centers use approximately 2% of the U.S. electricity supply, and about 33% of that electricity is used by cooling systems external to the servers themselves. (Ex. 2002, p. 1)(Ex. 2001, ¶64). The cooling systems are necessary, because the servers and other electronic components in a data center generate a lot of heat as they operate. (Ex. 2001, ¶64). If the heat is not effectively removed, the servers can overheat (typically defined as semiconductor junction temperatures above 85 C),

causing damage to the equipment. (Ex. 2001, ¶64).

In the relevant timeframe, it was common for data centers to cool server racks by pushing cold air out of vents in the floor in front of servers. Fans within server housings would pull cold air in, pass it over components within the server to cool those components, and expel hot air out the rear side of the server, to be collected by the cooling system. (Ex. 2001, ¶65). An example illustration of this system is shown here:

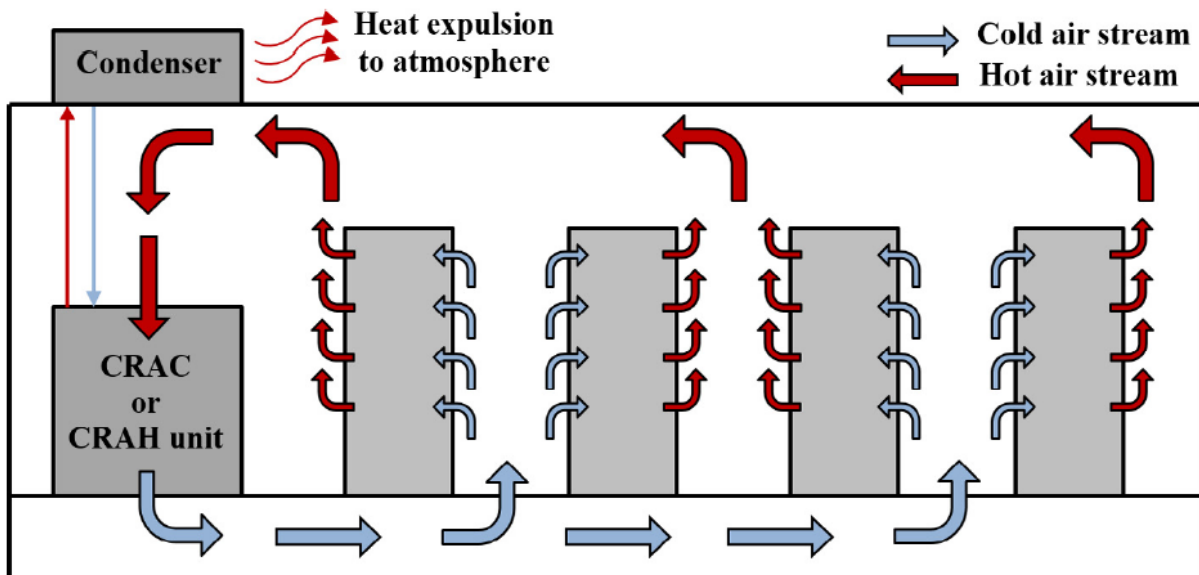


Fig. 4. Hot/cold aisle air cooling arrangement.

(Ex. 2003, Fig. 4, p. 5)(Ex. 2001, ¶65). As shown in the figure above, cold air enters the server rack space in specific aisles, called “cold aisles”, enters the front of the servers, and passes through to other aisles, called “hot aisles”. (Ex. 2001, ¶65).

The typical flow of air through a server (from cold aisle to hot aisle) is shown here:

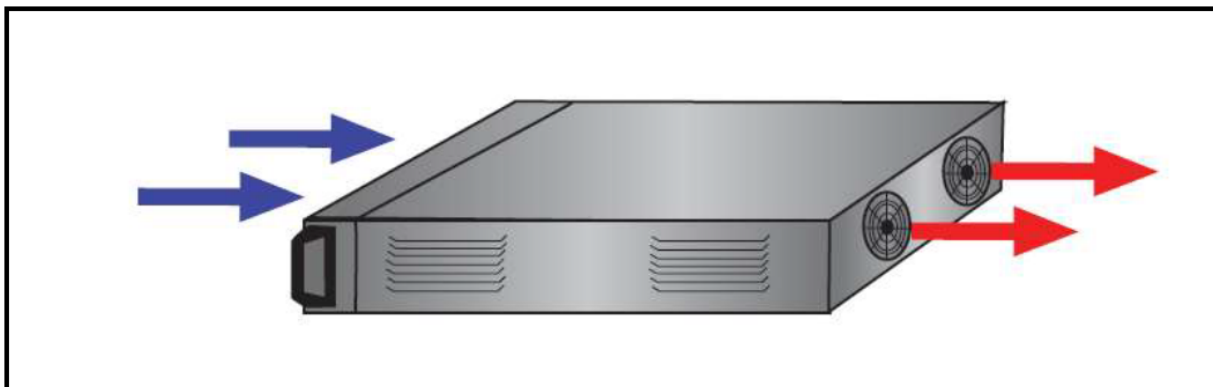


Figure 4.5 Location of the fan on the traditional server [32].

(Ex. 2004, Fig. 4.5, p. 98)(Ex. 2001, ¶66).

Air flowing through the server racks in this manner would flow over components on the main board, as illustrated here:

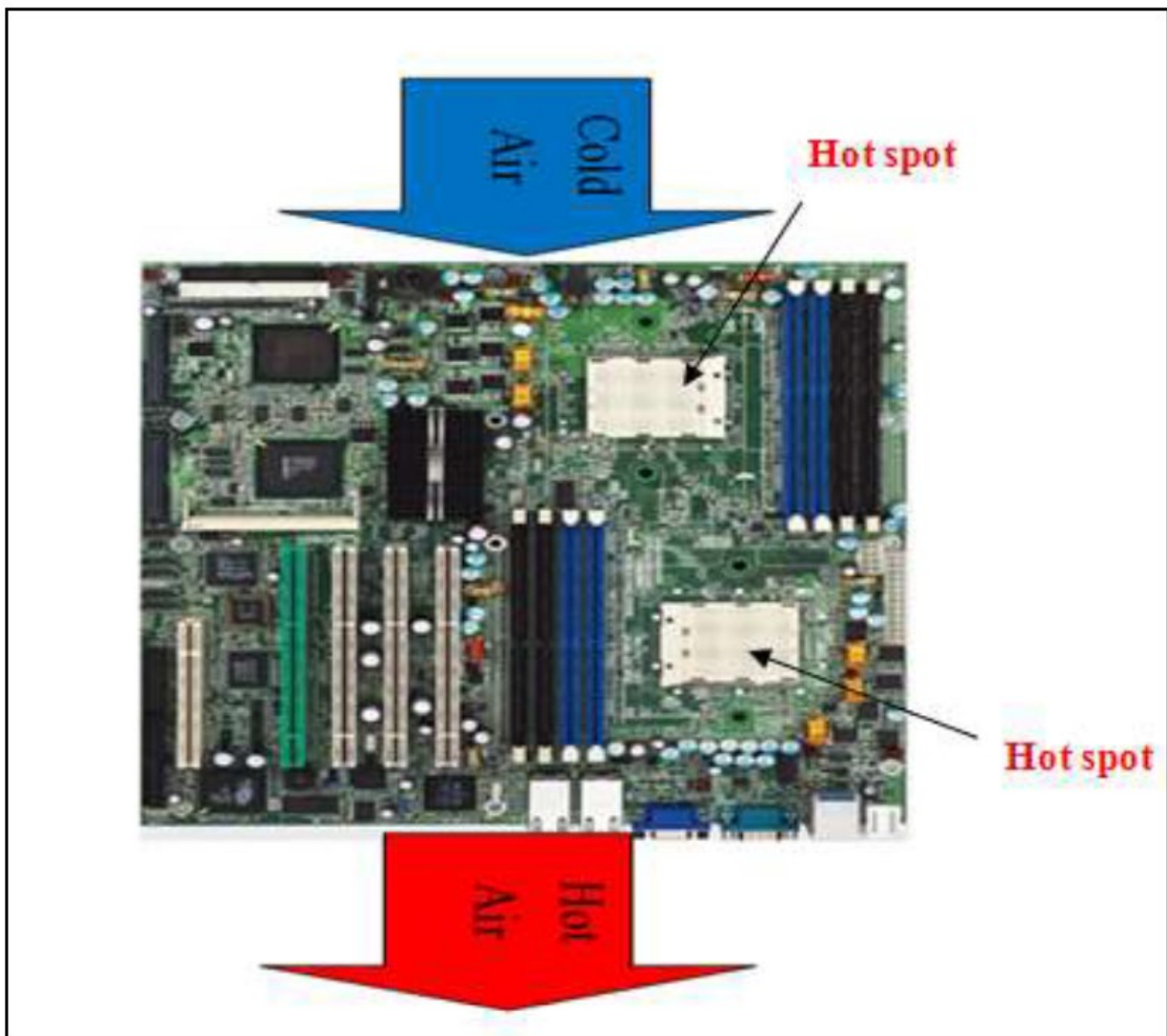


Figure 4.9 Thunder K8S Pro S882 server mother board [78].

(Ex. 2004, Fig. 4.9, p. 104)(Ex. 2001, ¶67). This internal arrangement of fan and airflow was typical for computer systems. (Ex. 2001, ¶67).

Because of this arrangement, components on the server motherboard were typically outfitted with a heat sink exposed to air flow. (Ex. 2001, ¶68). The heat sink was intended to facilitate heat extraction from the components on the top surface

of the PCB to the air flow:

“At the server level, all electronics are cooled through direct forced air convection with heat sink attachments required for high heat flux components [9]. Dedicated server fans drive cold aisle air through individual servers and release the heated exhaust air back into the facility through allocated hot aisles [11].”

(Ex. 2003, p. 4)(Ex. 2001, ¶68).

Heat sinks were typically attached to the top of power converters, because the converter’s bottom side was soldered to the server’s “motherboard”. (Ex. 2001, ¶69). This means that components on the bottom of the power converter’s PCB would have higher thermal resistance to the heat sink. (Ex. 2005, Fig. 2, Table I)(Ex. 2001, ¶69).

While limited heat extraction from components mounted to the bottom of the converter’s PCB is possible, thermal resistance between components mounted to the top side of the converter’s PCB and external cooling was typically far less than thermal resistance from components mounted on the bottom side of the converter’s PCB. (Ex. 2001, ¶70). Thus, it was considered advantageous to place components that generated considerable heat, such as MOSFETs, on the power converter’s top side, closest to the heat sink. (Ex. 2001, ¶70). As Vicor’s prior power-converter U.S. patent 7,361,844 (incorporated by reference into the ’761 patent at 1:42-47), entitled, “Power Converter Package and Thermal Management” stated:

“In applications where heat is primarily removed by forced airflow or by an external heat sink coupled to the top surface 35, **cooling of power dissipating components, such as MOSFET power switches 448, is enhanced by placing the devices on the top surface of the circuit board 442**, in close proximity to the large top surface 35.”

(Ex. 2006, 11:17-23)(Emphasis added)(*see also* 5:4-11, 12:13-17)(Ex. 2001, ¶70).

This was true even where measures were taken to increase thermal conductivity from the bottom side. (*e.g.* Ex. 2006, 11:44-48)(Ex. 2001, ¶70).

Thus, it was counterintuitive to place MOSFETs on the bottom surface of a power converter’s PCB, or to approximately balance the total heat generated by MOSFETs on opposite sides of the converter’s PCB. (Ex. 2001, ¶71). To the contrary, a PHOSITA would have sought to place MOSFETs on the top surface of the converter’s PCB.

3. The approach of the ’761 patent

Given this background, why did the ’761 patent seek to partition MOSFETs among the top and bottom sides of the converter’s PCB, and approximately equalize heat generation from these components?

Distributing MOSFETS symmetrically on opposite surfaces of a converter’s PCB with transformer windings embedded within the PCB’s inner layers enabled improved converter efficiency and reduced waste heat. (Ex. 2030, ¶¶29-31). Unexpectedly, these efficiency improvements provided a net positive trade-off for

higher thermal resistance, or the challenge of extracting heat from the bottom of the converter's package. (Ex. 2030, ¶¶29-31).

As the '761 patent explains,

“One benefit of sharing footprints allows the pair of components to share a common set of conductive vias used to electrically connect the components on the PCB surfaces to internal conductive layers, e.g. used to form the windings of the transformer. Because each via is used for both components in the pair, the total number of vias for making connections to the pair of components may be reduced (by as much as a factor of two) increasing the area of conductive layers useable for making connections and thus reducing resistance.”

(Ex. 1001, 24:25-34)(Ex. 2001, ¶72).

This benefit can be explained as follows: in power converters of the type used in the '761 patent, the top surface is packed with components. (Ex. 2001, ¶73). The inner layers of the power converters are primarily occupied by transformer windings, which need to be wide to handle high current levels. (Ex. 2001, ¶73). Switching MOSFETs need to be located near their respective winding terminals, and connected to those terminals by vias (electrical connections extending vertically through the PCB), in order to minimize the path through which current flows. (Ex. 2001, ¶73). By having MOSFETs placed in symmetrical positions on the top and bottom surfaces of the PCB, and having those MOSFETs share connections to transformer windings, companion MOSFET terminals can share vias, thus reducing the overall

number of vias. (Ex. 2001, ¶73). The area otherwise taken up by vias can thus be devoted to wider conductive pathways, reducing overall resistance. (Ex. 2001, ¶73).

4. The prior art

Delta argues that having power MOSFETs be located on the top and bottom of a PCB was a common layout practice, but its prior art tells a different story. No prior art discloses the concept, or the advantages, of the invention of the '761 or addresses the opportunity to balance heat generation. (Ex. 2001, ¶74). References that place MOSFETs on a top and bottom surface do so in unusual contexts (*e.g.* Wanes, on the top and bottom of a lead frame over a board and Spiazzi, on the top and bottom of a copper base plate) or place only a small subset of MOSFETs on the bottom side of a converter's PCB (Ericsson BMR and Takeshima) without balancing overall heat generation from power semiconductor devices mounted to the top and bottom surfaces of the converter's PCB. These references are also silent about the potential benefits of doing so. (Ex. 2001, ¶74).

Compare this to Delta's product

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

II. CLAIM CONSTRUCTION

A. Claim limitation 1[d]—“a power converter including...1[d] a plurality of power semiconductor devices, a first set of the power semiconductor devices being mounted on the top surface....a second set of the power semiconductor devices being mounted on the bottom surface”

Limitation 1[d] of claim 1 recites:

“a power converter including...1[d] a plurality of power semiconductor devices, a first set of the power semiconductor devices being mounted on the top surface and electrically connected to dissipate power at a level, P_t , during operation of the converter, a second set of the power semiconductor devices being mounted on the bottom surface and electrically connected to dissipate power at a level. P_b , during operation of the converter;”

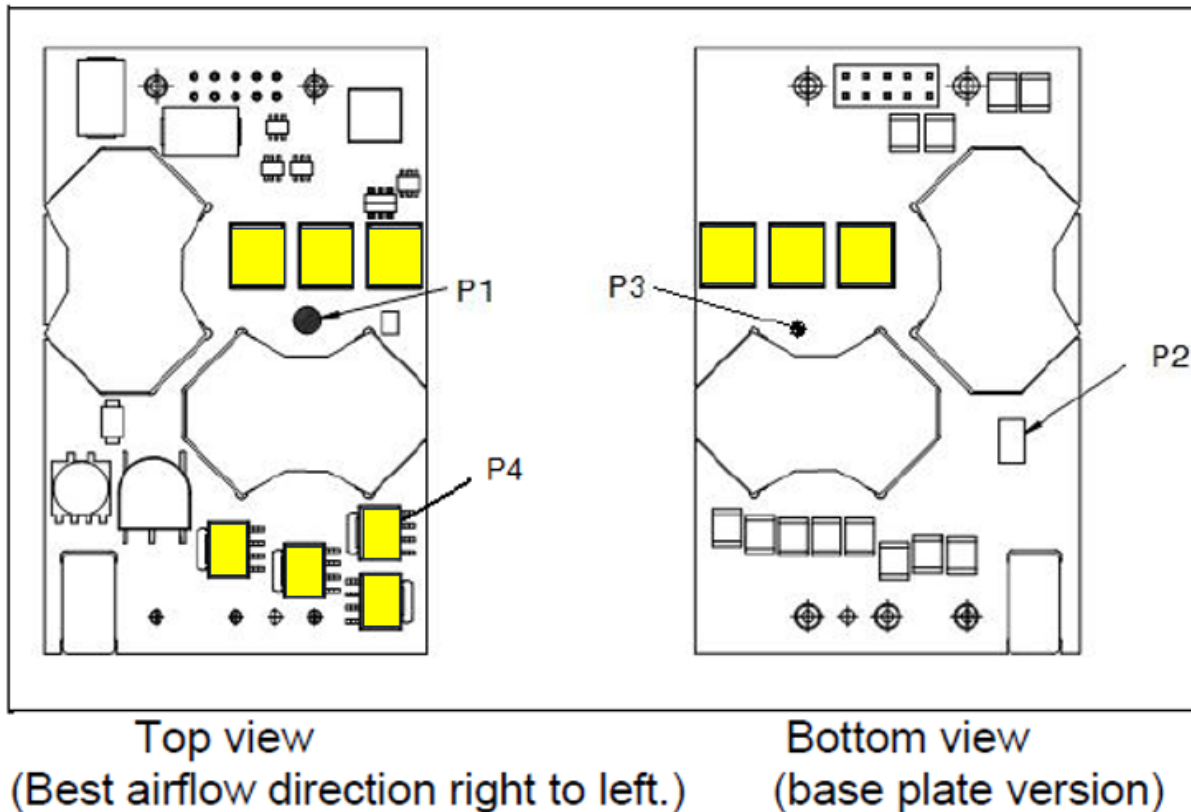
Claim limitation 1[d] is properly construed to require that “the first and second sets of the power semiconductor devices comprise the complete set of power semiconductor devices in the power converter.” (Ex. 2001, ¶79).

1. Relevance of the issue

This claim construction issue is relevant to Grounds I – III, VII, and VIII, and may be relevant to other Grounds, although it is at times difficult to understand exactly how the Petition proposes to combine references.

Taking Ground I as one of the clearer examples, the principal reference (“Ericsson-BMR”) has ten power semiconductor devices: seven on the top surface of the PCB, and three on its bottom surface. (Ex. 2001, ¶80). The ten power

semiconductor devices are shown in the following figures from page 24 of Ericsson BMR, which shows the top side (left) and bottom side (right), each power semiconductor device being highlighted in yellow:



(Ex 1007, p. 24)(Ex. 2001, ¶80). As the figures illustrate, there are seven power semiconductor devices on the top surface, and three on the bottom surface. (Ex. 2001, ¶80).

The presence of more than twice as many power semiconductor devices on the top surface of the PCB as on its bottom surface teaches away from claim limitation 1[e], which reads:

“the power semiconductor devices are distributed between the first

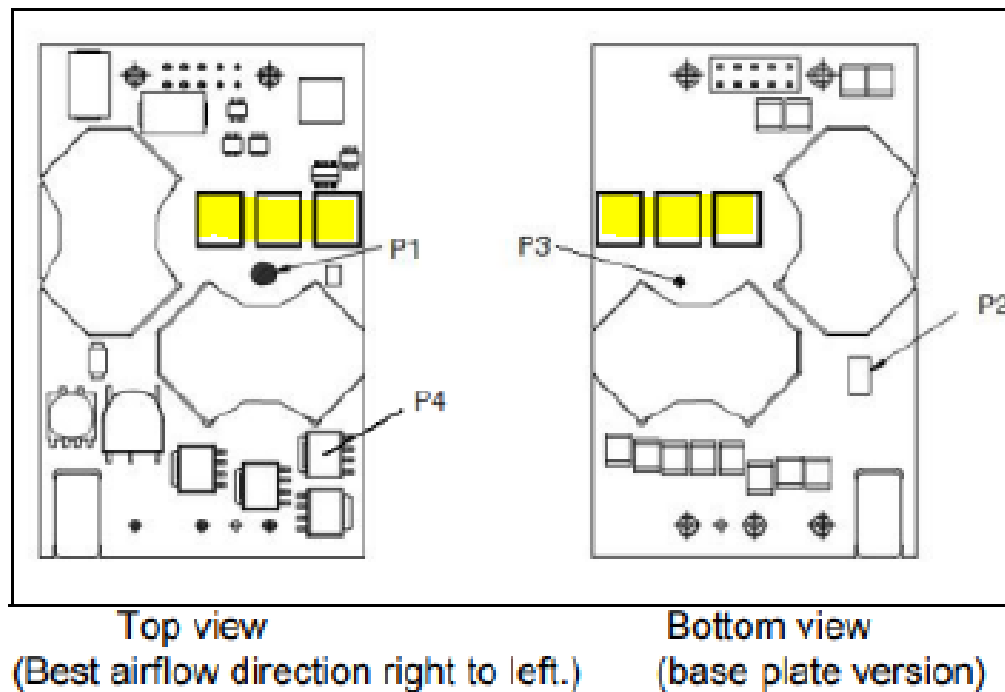
and second sets to distribute heat generation during operation of the converter such that each level P_t , P_b is less than 150% of the other level P_b , P_t .”

(Ex. 2001, ¶81). More specifically, the three MOSFETs at the bottom of the PCB do not give rise to nearly as much heat as the seven MOSFETs at the top of the PCB.

(Ex. 2001, ¶81).

The Petition disregards this issue by selectively including three of the seven MOSFETs in the “first set”, and ignoring the other four MOSFETs at the top.

(Petition, p. 10). The Petition’s selection of devices is shown here:



(Petition, p. 22).

The Petition then argues that the MOSFETs in the hand-picked first and

second sets meet limitation 1[e], because:

“As discussed in the previous element, **there are three *relevant power semiconductor devices on both the top and bottom*** of the PCB, which would dissipate power during operation of the power converter. A POSITA would have known, or at least found obvious, that the current and voltage (and thus, power) through the top three power semiconductor devices would be equal (or at least approximately equal) over time to the bottom three power semiconductor devices, for the following reason. See EX1002 ¶76.”

(Petition, p. 25)(Emphases added).

Thus, the claim construction question can be stated as follows: should the claim be construed to allow arbitrary *subsets* of power semiconductors for the first and second sets that happen to equalize heat generation for those subsets, *or* should the claim be construed to include heat generation from the full set of power semiconductor devices on top of the PCB and heat generation from the full set of power semiconductor devices on its bottom?

2. The Board should adopt the proposed construction

The claim construction requiring complete sets, instead of arbitrary subsets, is supported by two principal reasons, the **first** of which is that it preserves the specification’s meaning for claim limitation 1[e]. *See Bicon, Inc. v. Straumann Co.*, 441 F.3d 945, 951 (Fed. Cir. 2006)(“The second problem with Diro’s argument is that if the claim reads on any hypothetical abutment, limitations [e] and [h] are

rendered meaningless. If the claim limitations include only those elements of the claim that pertain to the structural features of the emergence cuff, as Diro contends, the requirement that ‘the distance between the first and second ends [of the emergence cuff must be] less than the height of the conical surface’ of the abutment would make no sense.”).

The relevant language of claim 1 begins with “a power converter including...1[d] a plurality of power semiconductor devices....”. The term “plurality”, of course, means “two or more”. *See Dayco Prods. v. Total Containment, Inc.*, 258 F.3d 1317, 1327–28 (Fed. Cir. 2001). This reflects the fact that different power converters may use different numbers of power semiconductor devices. However, in a converter with a multiplicity of power semiconductor devices, the claim cannot be interpreted to arbitrarily include, or exclude, any *subset* of these power semiconductor devices. (Ex. 2001, ¶¶85-87). *See, e.g., Apple Inc. v. Samsung Elecs. Co.*, 695 F.3d 1370, 1379 (Fed. Cir. 2013)(“Apple’s argument essentially urges us to hold that ‘plurality’ refers not to all but a subset of modules. As we pointed out, however, the district court has construed ‘plurality’ to mean ‘at least two,’ without any indication that the term refers to a hand-picked selection of a larger set. Nor do the parties seem to disagree with that construction, at least at this stage. Accordingly, despite the use of ‘comprising,’ claim 6 is not amenable to the addition of other modules that do not use different heuristic algorithms because

such addition would impermissibly wipe out the express limitation that requires every module to have a unique heuristic algorithm.”).

That this interpretation of the claims is proper is clear from the specification. (Ex. 2001, ¶85). The specification focuses on balancing the overall heat generation from all power MOSFETS (referred to in the following passage as “power FETs” or “power Field-Effect Transistors”) on the top and bottom surfaces of the PCB:

“In some examples, the FETs are arranged such that during operation, **the power FETs on the top surface dissipate power at a level that is comparable to the level of power dissipated by the power FETs on the bottom surface.** Also, the level of power dissipated by the power FETs in the upper input cell is comparable to the level of power dissipated by the power FETs in the lower input cell. For example, the level of power dissipated by the power FETs on one surface is less than 150% of the level of power dissipated by the power FETs on the other surface. The level of power dissipated by the power FETs in the upper cell is less than 150% of the level of power dissipated by the power FETs in the lower cell, and vice versa.”

(Ex. 1001, 25:11-24)(Emphasis added)(Ex. 2001, ¶85).

The '761 patent is thus clearly describing all of the power FETs on the top side of the PCB as one set, all of the power FETs on its bottom side as a second set, and comparing the heat generation of those two sets in their respective aggregates. (Ex. 2001, ¶86).

Importantly, there is *no embodiment* in the '761 patent that describes balancing the heat generation of *subsets* of power semiconductor devices on the top and bottom of the PCB. (Ex. 2001, ¶87). *See Raytheon Co. v. Sony Corp.*, 2017-1554, at *15 (Fed. Cir. Apr. 2, 2018)(non-precedential)(“The specification amply supports this reading. First, every embodiment described in the specification includes the second substrate.”); *Nystrom v. Trex Co.*, 374 F.3d 1105, 1121 (Fed. Cir. 2004); *Mformation Techs., Inc. v. Research in Motion Ltd.*, 764 F.3d 1392, 1399 (Fed. Cir. 2014); *Poly-America, L.P. v. API Indus., Inc.*, 839 F.3d 1131, 1137 (Fed. Cir. 2016).

It is clear why the '761 patent did not describe embodiments balancing heat generation of subsets of the power MOSFETs on opposite surfaces: claim limitation 1[e] would lose its import. *See Apple*, 695 F.3d at 1379. Specifically, Limitation 1[e] would be meaningless if construed to include subsets of the FETs, e.g. a subset of power semiconductor devices on the top that was hand-picked to nearly match the heat generated by an equally arbitrary subset of power semiconductor devices on the bottom of the PCB. This would empty claim limitation 1[e] of its meaning, and would be contrary to the specification. *See Apple*, 695 F.3d at 1379; *Harris Corp. v. Fed. Express Corp.*, 502 F. App'x 957, 12 (Fed. Cir. 2013)(non-precedential)(“Harris nonetheless argues that nothing in this language requires that ‘all’ of the data in the ground data link unit must be transmitted once the plane lands,

and accuses FedEx of importing the word ‘all’ into the claim in the absence of support for such an inclusion. We reject this argument for two reasons. First, although the claim does not expressly require that ‘all’ of the accumulated data must be transmitted, it similarly lacks any indication that some subset of the accumulated data should be transmitted, and if so what that subset should be. In the absence of such guidance, FedEx’s interpretation seems entirely reasonable.”); *Shire Development, LLC v. Watson Pharmaceuticals, Inc.*, 787 F.3d 1359, 1367-68 (Fed. Cir. 2015)(“Furthermore, under the district court’s construction...any arbitrarily selected volume in a single mixed matrix would satisfy the district court’s construction of ‘inner lipophilic matrix’ because that volume would necessarily contain ‘at least one lipophilic excipient’ and it would be ‘inside’ the surrounding volume. Similarly, under the district court’s construction, that same arbitrarily selected volume would constitute an ‘outer hydrophilic matrix’ because it would contain ‘at least one hydrophilic excipient’ and would be ‘outside’ the inner lipophilic matrix. The claims, however, require two matrices with a defined spatial relationship.”).

Second, [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

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[REDACTED]

[REDACTED] [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED] the Board should construe claim limitation

1[d] such that “a plurality of power semiconductor devices, a first set of the power semiconductor devices being mounted on the top surface and...a second set of the

power semiconductor devices being mounted on the bottom surface....the first and second sets including all power semiconductor devices of the power converter”.

III. THE PRIOR ART DOES NOT RENDER THE CLAIMS OBVIOUS

The Board should find that Delta’s petition does not demonstrate 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(a).

A. The Petition does not properly address the requirement of a reasonable expectation of success

All Grounds in the Petition fail to carry the Petitioner’s burden, because the Petition fails to explain why, and sometimes to even assert that, there would have been a reasonable expectation of success. For Grounds I-II, IV-VI, and VIII, the Petition fails completely to address a reasonable expectation of success with respect to the only independent claim, claim 1. Grounds III and VII mention a reasonable expectation of success for claim 1, but in each case the assertion is perfunctory, and only made for one of the two claim elements for which obviousness arguments are made. (Petition, pp. 42, 80). The failure of the Petition to address properly a basic requirement of an obviousness case is sufficient to find that Grounds I-VII do not meet the statutory standard for institution. *See Medtronic, Inc. v. Teleflex Innovations S.A.R.L.*, 70 F.4th 1331, 1345 (Fed. Cir. 2023)(“absence of a reasonable expectation of success defeats obviousness”); *Eli Lilly & Co. v. Teva Pharm. Int’l GmbH*, 8 F.4th 1331, 1348 (Fed. Cir. 2021)(“it was, at all times, Lilly’s [Petitioner’s]

burden to show that the claims would have been obvious, including that a skilled artisan would have had a reasonable expectation of success in achieving the claimed invention”); *Apotex Inc. v. Wyeth LLC*, IPR2014-00115, Paper 94, slip op. at 11 (Apr. 20, 2015)(“A party that petitions the Board for a determination of obviousness must show 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.’”)(citing *Procter & Gamble Co. v. Teva Pharms. USA, Inc.*, 566 F.3d 989, 994 (Fed. Cir. 2009)).

B. Ground I – (Ericsson BMR or BMR 2008) does not meet the Petitioner’s burden

Ground I (obviousness over Ericsson-BMR or BMR 2008) does not meet the Petitioner’s burden for several reasons.

1. Ground I does not comply with 35 U.S.C. §311 or does not meet basic requirements for an obviousness case

Ground I does not raise a reasonable likelihood of success because it is either non-statutory, or it does not meet the basic requirements for an obviousness case.

The Ground may be non-statutory because it likely relates to a product, not a printed publication. Petitions for *inter partes* reviews may be filed “only on the basis of prior art consisting of patents or printed publications.” 35 U.S.C. §311(b). While Delta puts forward a data sheet (Ex. 1007) that could qualify as a printed publication,

Delta does not rely entirely on this data sheet. Instead, the Petition maps the claims to various features in *different* documents, including Exhibits 1014 and 1018. (Petition, pp. 18, 21). Delta connects these Exhibits to “Ericsson-BMR” by repeatedly implying that they all refer to a single product, and arguing that the documents would allow a PHOSITA to recognize claimed features of that product. Here are some examples from the Petition:

- “layers can be seen in **additional documentation regarding the Ericsson-BMR module** [image omitted]. *See* EX1014.”(Petition, p. 17)(Emphasis added);
- “This understanding of a POSITA is confirmed by higher resolution photos of the **Ericsson-BMR unit** from the time [citing EX1014 (annotated); see also EX1018 at 6 (same disclosure).]” (Petition, pp. 19-20)(Emphasis added);
- “a POSITA would have expected that **Ericsson-BMR’s apparatus** includes a magnetic core structure....” (Petition, p. 19)(Emphasis added);
- “there is no other place in the **Ericsson-BMR module** for the windings to be....” (Petition, p. 21)(Emphasis added);
- “As Dr. Leeb explains, through analysis of the power converter circuit and layout, **visual inspection, and additional documentary evidence**, a POSITA would have known or at least found obvious....”(Petition, p. 21-

22)(Emphasis added);

- “...would allow a POSITA to **map the components** in the fundamental circuit diagram **to the real-world components on the Ericsson-BMR module** as follows:....”(Petition, p. 22)(Emphasis added).

This approach is deficient in several respects. First, as a factual matter, Delta’s apparent assumption about the documents is unwarranted. While Exhibits 1007, 1014, and 1018 each appear to be documents originating with Ericsson, and each appear to refer to “BMR453”, the documents are not contemporaneous: Ex. 1007 has an asserted publication date of July 2010, while Ex. 1014 is an image containing “2008”, and Ex. 1018 bears a copyright date of 2009. Delta provides no evidence that these documents relate to the same product variation (*e.g.* Ex. 1008 bears the number BMR45301000002) or the same release dates, such that each document is describing something with identical features. Indeed, the images of the bottom side of the product that are cited in each of Figs. 1014 and 1018 (p. 6) differ from the image on page 1 of Ex. 1007, suggesting that the products (even if they are in the same family) are not the same.

Second, Delta also makes no argument that it would be obvious to combine the features of these documents. This is likely because Delta is relying on BMR453 as a product (given the repeated references to it as such in the Petition, as noted above), and simply *assumes* that any product literature naturally describes the same

product. But if Delta is relying on an underlying product, then the Ground does not comply with 35 U.S.C. §311(b). If, on the other hand, Delta intended to argue that it would have been obvious to *combine* the various documents, then Delta needed to make that obviousness case, including a showing that Exhibits 1014 and 1018 are prior art printed publications, together with arguments to support a motivation to combine and a reasonable expectation of success. *See Apotex Inc. v. Wyeth LLC*, IPR2014-00115, Paper 94, slip op. at 11 (Apr. 20, 2015)(“A party that petitions the Board for a determination of obviousness must show 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.’”)(citing *Procter & Gamble Co. v. Teva Pharms. USA, Inc.*, 566 F.3d 989, 994 (Fed. Cir. 2009)).

Delta did not do so, and Ground I is therefore fatally deficient.

2. Ground I is not articulated with sufficient clarity

The obviousness case over Ericsson BMR does not meet the Petitioner’s burden to articulate the Petition’s theory clearly and with particularity. *See Netflix, Inc. v. DivX, LLC*, No. 2022-1203, at *8-9 (Fed. Cir. Oct. 25, 2023)(“Ultimately, it is the petitioner’s burden to present a clear argument.”); *Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369 (Fed. Cir. 2016)(“It is of the utmost importance that petitioners in the IPR proceedings adhere to the requirement

that the initial petition identify “with particularity” the “evidence that supports the grounds for the challenge to each claim.” 35 U.S.C. § 312(a)(3).”).

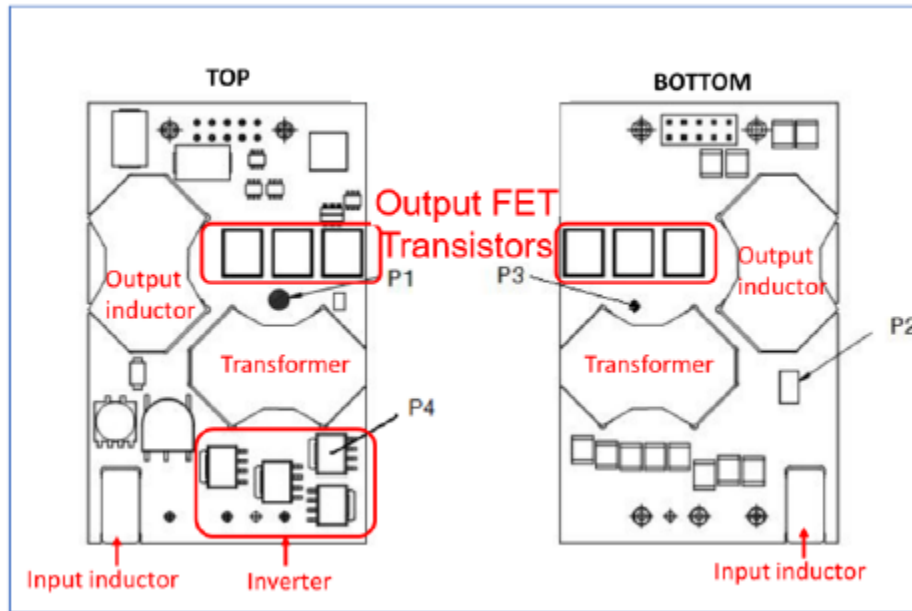
The Ground is unclear because it cites six different references (Exs. 1007, 1008, 1014, 1018, 1019, and 1020), never once explaining how the alleged principal reference might be modified with any of the prior art references. This creates a lack of clarity as to how the secondary references are being used. With respect to Exhibits 1014 and 1018, it appears that these references are being improperly asserted as evidence of an alleged prior-art product, as discussed in the previous section. With respect to Exhibits 1008, 1019, and 1020, these references are unrelated documents (a textbook and two non-Ericsson patents) that appear in the Petition’s arguments as “see, e.g.” or secondary citations about what a PHOSITA would have known about Ex. 1007. The Petition makes no argument to support a combination of these references, nor does it show how teachings from these references, in unrelated contexts, allow a PHOSITA to better understand Ex. 1007.

3. Ericsson BMR does not meet claim element 1[e]

As discussed above under §II, Limitation 1[d] should be construed such that the first set and second set include all power semiconductor devices in the power converter.

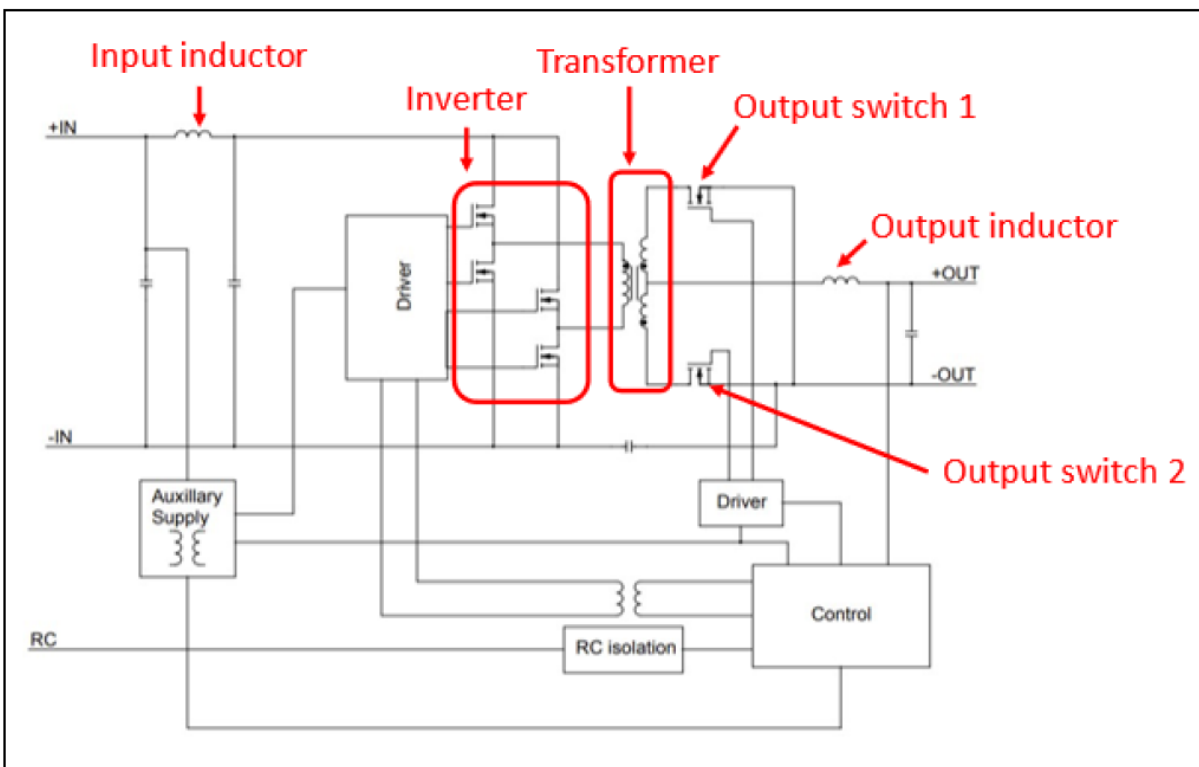
With a proper construction of claim limitation 1[d], the Ground does not render obvious claim limitation 1[e]. To the contrary, it teaches away from it.

Specifically, the Petition focuses only on a *subset* of power semiconductor devices, namely the output (secondary-side) MOSFETs, while ignoring *input* MOSFETs, shown in the box labeled “Inverter” in the lower left of the annotated diagram from page 24 of the Petition (annotations by Petitioner):



(Petition, p. 24)(annotations in Petition)(Ex. 2001, ¶92).

This inverter, as shown, has four “primary” or input MOSFETs. (Ex. 2001, ¶93). These MOSFETs can be seen in the circuit diagram from page 23 of the Petition, with red annotations by the Petitioner:



(Petition, p. 24)(Annotations in Petition)(Ex. 2001, ¶93). The four input MOSFETs of the inverter are shown with MOSFET symbols, e.g. . (Ex. 2001, ¶93)(Ex. 1007, p. 24)(lower left, Table referring to “primary MOSFET” P4). The four input MOSFETs can be seen on the top surface of the device in the Figure on page 1 of Ex. 1007, reproduced here with red arrows and a label added by Patent Owner:



(Ex. 1007, p. 1)(Ex. 2001, ¶93). These MOSFETs are power semiconductor devices. (Ex. 2001, ¶93).

By excluding input (primary) MOSFETs, the Petition’s argument fails to show that Ericsson BMR meets limitation 1[e]. (Ex. 2001, ¶94). The top of the PCB actually has *seven* MOSFETs (the three secondary MOSFETs and the four arbitrarily excluded primary MOSFETs), while the bottom has only three. (Ex. 2001, ¶94). A PHOSITA would not expect the seven MOSFETs on the top surface to generate approximately the same heat as the three on the bottom surface. (Ex. 2001, ¶94).

Although an analysis of heat generation requires knowledge of how the MOSFETs are driven—and Delta does not provide this information—we do know that primary switches process all of the converter’s power, as do secondary switches. (Ex. 2001, ¶95). That is, if the amount of power processed by the converter is “P”,

primary switches process power P , and secondary switches process power P . (Ex. 2001, ¶95). Assuming, as Delta appears to assert, that the three secondary MOSFETs on the top side of the device process the same power as the three secondary MOSFETs on the bottom side of the device (each processing $P/2$), then the MOSFETs on the top side of the device process $P+P/2$ (or $1.5 P$) and the MOSFETs on the bottom side of the device process $0.5 P$, or three times less power. (Ex. 2001, ¶95). Because the heat generation of power semiconductor devices relates to power processed, top-side MOSFETs process three times as much power, giving rise to a commensurately greater amount of heat. (Ex. 2001, ¶95).

Thus, the Petition does not meet its burden to show that Ericsson BMR teaches claim 1. (Ex. 2001, ¶96).

4. The alternative assertion over BMR-2008 also fails to meet the Petitioner's burden.

With respect to the alternate assertion of BMR-2008, the Petition only alleges that BMR-2008 meets the claim language in the same way as Ericsson BMR. In that sense, an assertion of obviousness over BMR-2008 would fail for the same reasons as the assertion of obviousness over Ericsson BMR.

Moreover, there appear to be significant differences between BMR-2008 and Ericsson BMR (*see* a redline of the two documents attached as Ex. 2007), and the Petition does not account for these. The Petition invites the Board to “Compare EX1007 at, e.g., 1, 2, 5, 24, 31 with EX1026 at, e.g., 1, 4, 15, 20”, but otherwise

provides no explanation of the differences in the documents, nor does the Petition explain the relationship between BMR 2008 (Ex. 1026) and Exhibits 1014 and 1018, used by the Petition in the claim mapping for Ground 1. This is insufficient for an assertion of obviousness. *See General Access Solutions, Ltd. v. Sprint Spectrum L.P.*, 811 F. App'x 654, 657 (Fed. Cir. 2020) (unpublished), explaining that the Board should not be forced to “play arch[a]eologist with the record.”

Ground I thus does not meet the Petitioner’s burden.

C. Ground II (Ericsson BMR or BMR 2008 and Spiazzi) does not meet the Petitioner’s burden

Ground II likewise fails to meet the Petitioner’s burden for multiple reasons.

1. Spiazzi does not change anything about Ericsson BMR or BMR-2008

The Petition does not propose that Ericsson BMR or BMR-2008 would be modified by Spiazzi, and thus Ground II fails for the same reasons as Ground I.

2. Spiazzi would not help a PHOSITA understand Ericsson BMR or BMR-2008

The Petition argues that Spiazzi would help a PHOSITA recognize that the way Spiazzi operates is the way Ericsson BMR would operate. (Petition, pp. 36-39). In particular, the Petition appears to argue that a PHOSITA would recognize that Ericsson BMR would achieve test results similar to those of Spiazzi. (Petition, pp. 38-39).

The Petition’s reasoning is incorrect. Spiazzi and Ericsson BMR are very

different circuits, with very different principles of operation. (Ex. 2001, ¶101). Spiazzi provides an academic model of converter heat, not a commercial converter like Ericsson's BMR. (Ex. 1011, p. 1, left column)(Petition, p. 87). Spiazzi is a high-frequency (1.8 MHz) resonant converter (Ex. 1011, p. 1, left column and title) while Ericsson BMR operates at a much lower (180 kHz) frequency (Ex. 1007, p. 7). (Ex. 2001, ¶101). This alone negates the Petition's argument that temperature test results would be the same for Spiazzi and Ericsson BMR. (Ex. 2001, ¶101). Resonant operation implies that the primary-side MOSFETs would be driven differently than in Ericsson BMR, and high frequency can impact power dissipation of power semiconductor devices.

Moreover, Spiazzi uses phase-shift regulation, while Petitioner does not define how Ericsson BMR provides regulation. (Ex. 1012, p. 1, Abstract)(*cited by* Ex. 1011, p. 1, left column)(Ex. 2001, ¶102). The method of regulation is relevant, because a different regulation method can cause primary- or secondary-side switches to switch differently, or with different duty cycles, thus increasing or decreasing the heat generation of certain MOSFETs. (Ex. 2001, ¶102).

Spiazzi also admits that its circuit is difficult to characterize thermally, because of the layout-dependent nature of the losses, stating:

“In this section we want to discuss the converter power losses distribution that will be used for the thermal simulation of the PCBs.

Due to the strong dependence on the layout, losses calculation is

just an exercise, without any correlation with the reality. **The only way is to measure them on the prototype**, which is usually not an easy task.”

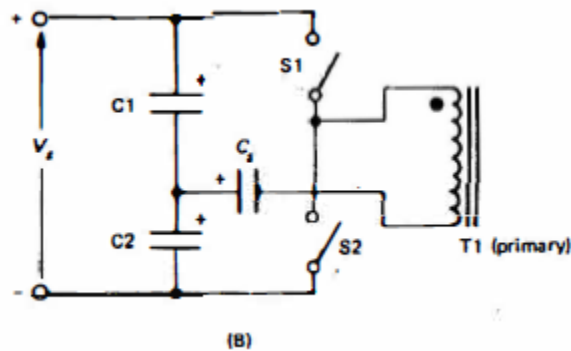
(Ex. 1011, p. 3, right column, bottom)(Emphasis added)(Ex. 2001, ¶103).

The Petition does not say why the operation of Spiazzi’s device is like that of Ericsson BMR, except to assert that Ericsson BMR has a full-bridge input circuit, while Spiazzi has a half-bridge input. (Petition, p. 38). Perhaps relying on the word “bridge” in both references, the Petition asserts (and Dr. Leeb states identically in ¶112) that “Spiazzi teaches a half-bridge converter, which, like Ericsson-BMR’s full-bridge converter, would have at least obviously applied balanced power cycles in order to avoid saturating the transformer.” (Petition, p. 38). No further explanation is provided.

This assertion, however, is factually false. (Ex. 2001, ¶105). As discussed in the textbooks submitted by Petition as Ex. 1008 at pp. 148-150, a transformer can saturate when its magnetizing current is not balanced in both directions, *i.e.*, when there is a DC component to the winding’s magnetizing current. (Ex. 2001, ¶105). Spiazzi’s half-bridge converter, however, connects two voltage-dividing input capacitors (C_A and C_B) in series with its transformer primary winding, as shown here:

insertion of a series capacitor (C_s) as shown in Fig. 4.20. **Notice that for the half-bridge version (Fig. 4.20B), the series DC-blocking capacitor function is accomplished inherently by the presence of the voltage-division capacitors, C_1 and C_2 .**”

(Ex. 2008, p. 116, Fig. 4.20B)(Ex. 2001, ¶106). Figure 4.20B of *Severns and Bloom*, referenced in the quote above, is shown here:



(Ex. 2008, p. 117, Fig. 4.20B)(Ex. 2001, ¶106). This circuit has voltage-divider capacitors C_1 and C_2 , just like the voltage-divider capacitors C_A and C_B of Spiazzi. (Ex. 2001, ¶106). Both sets of voltage-dividing capacitors block DC components of the current, and prevent saturation of the transformer core due to imbalance independently of the duty cycle of its power switches. (Ex. 2001, ¶106). Thus, Dr. Leeb’s assertion (Ex. 1003, ¶112) that Spiazzi “would have at least obviously applied balanced power cycles in order to avoid saturating the transformer” is false. (Ex. 2001, ¶106).

Dr. Leeb should have known this, because he testified in a prior case that a similar circuit would not saturate the transformer *merely because* it was a half-bridge

converter. The circuit about which Dr. Leeb testified is shown here:

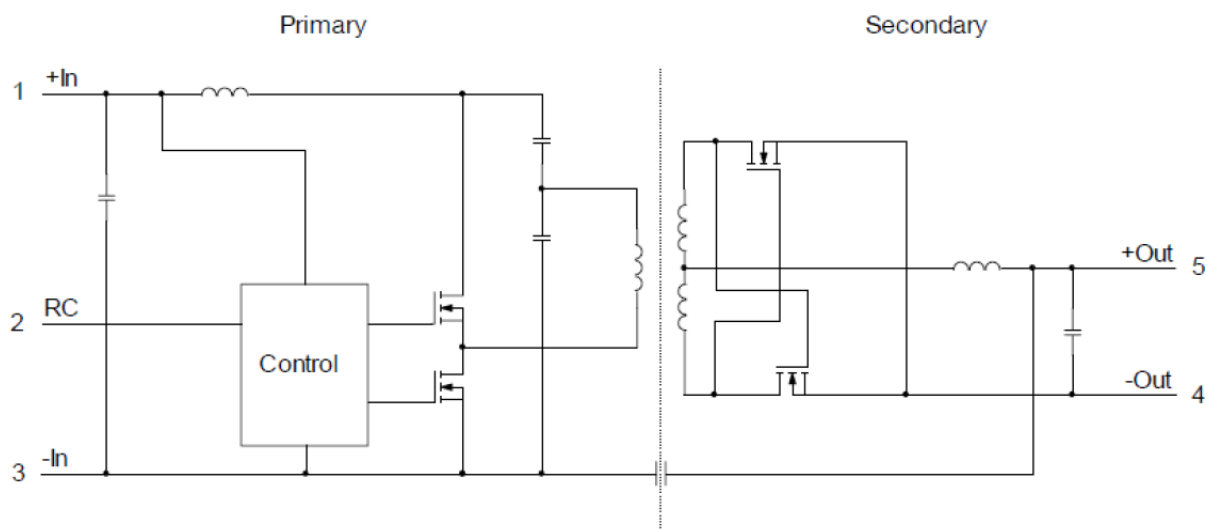


Exhibit I, PKM4303NF Datasheet at 4.

(Ex. 2009, ¶28, p. 14). This circuit, like the circuits of Spiazzi and *Severns and Bloom*, also uses a half-bridge topology with a transformer primary winding connected between two MOSFET switches and two voltage-dividing capacitors.

(Ex. 2001, ¶107). About this circuit, Dr. Leeb testified:

“The topology of the PKM4303NF, a half-bridge topology, is one that is configured not to drive the transformer into saturation.”

(Ex. 2009, ¶31, p. 18).

Dr. Leeb’s reasoning in the present case, that a PHOSITA would find it obvious to drive a half-bridge converter in a balanced way to avoid transformer saturation, is incorrect and clearly at odds with his prior testimony. (Ex. 2001, ¶108).

Dr. Leeb once knew that half-bridge topologies with input series capacitors are

driven with unbalanced duty cycle for good reason (for example, to regulate the output voltage) without risk of transformer saturation. (Ex. 2001, ¶108). Thus, the Petition's only attempt to connect the circuits of Ericsson-BMR with Spiazzi, by noting that Ericsson-BMR has a full-bridge topology and Spiazzi has a half-bridge topology, is misplaced. (Ex. 2001, ¶108).

Because of the different nature of the Spiazzi and Ericsson BMR circuits, the fact that Spiazzi teaches that losses from its circuit are highly layout-dependent, and the fact that the Petition's only argument to connect the two circuits is factually wrong, the Petition has not shown that a PHOSITA would have believed that testing on Spiazzi's converter would apply to Ericsson BMR. (Ex. 2001, ¶109).

3. Spiazzi does not teach limitation 1[e]

Nor does Spiazzi teach claim limitation 1[e]. First, Spiazzi, like Ericsson-BMR, places its input MOSFETs (HB1 and HB2) only on the top side of the device. (Ex. 1011, Fig. 5a)(Ex. 2001, ¶110). This unbalances heat generation of the power semiconductor devices. (Ex. 2001, ¶110). As Spiazzi's Table II indicates, the primary-side (input) MOSFETs on the top side dissipated about twice the power (1.02 W) of the secondary-side MOSFETs (0.44 W) on the top side. (Ex. 1011, p. 4, Table II)(Ex. 2001, ¶110). Table II is reproduced here, with highlighting added:

TABLE II. DISSIPATED POWER FOR THE MAIN HEATING COMPONENTS ESTIMATED FROM MEASUREMENTS

Component	Ref. name	I _{out} =30A Power [W]	I _{out} =40A Power [W]	I _{out} =50A Power [W]
Primary MOSFET 1	IRF7855	0.32	0.51	0.72
Primary MOSFET 2	IRF7855	0.32	0.51	0.72
Primary driver	LM5101A	1.0	1.0	1.0
Primary inductor	-	0.43	0.68	0.95
Transformer	-	0.9	1.5	2.1
Secondary inductor	-	0.18	0.32	0.5
Secondary traces	-	0.15	0.22	0.27
Secondary MOSFET 1	IRF7836	0.087	0.11	0.21
Secondary MOSFET 2	IRF7836	0.087	0.11	0.21
Secondary MOSFET 3	IRF7836	0.087	0.11	0.21
Secondary MOSFET 4	IRF7836	0.087	0.11	0.21
Secondary driver	IRF7319	1.0	1.0	1.0

(Ex. 1011, p. 4, Table II)(highlighting added)(Ex. 2001, ¶110).

Even assuming Delta is correct in its assertion that bottom-side *secondary* MOSFETs would dissipate the same power as top-side *secondary* MOSFETs, this would mean that top-side, including *primary*, MOSFETs would, in the aggregate, dissipate power at a rate of 1.46 W (0.51 + 0.51 + 0.11 + 0.11 + 0.11 + 0.11), whereas the bottom-side MOSFETs would dissipate power at only 0.44 W (0.11 + 0.11 + 0.11 + 0.11), or more than three times less. (1.46 / 0.44 = 3.31). (Ex. 2001, ¶111).

Delta argues that “Spiazzi further confirms that Ericsson-BMR’s full-bridge circuit would produce substantially similar results of power dissipation on both sides

of the Ericsson-BMR module”, referring in particular to Spiazzi’s statement that “[s]imilar results were obtained for the downward surfaces.” See EX1011 at 1999.” (Petition, p. 38)(emphasis in original).

Spiazzi’s statements about its temperature measurements do not indicate that Spiazzi meets claim limitation 1[e]. Spiazzi measured temperature on only one side of the board. (Ex. 1011, p. 7)(Ex. 2001, ¶113). Spiazzi’s statement that “[s]imilar results were obtained for the downward surfaces” cannot be referring to the *entire set* of Table III, because numerous components in Table III (such as primary MOSFETs 1 and 2, Primary driver, Primary inductor wound, Primary inductor core, and Transformer) are not found on the downward surface. (Ex. 2001, ¶113). Instead, Spiazzi is simply commenting on the primary purpose of the paper, which was to show approximate *agreement* between Spiazzi’s numerical model and measured values—regardless of what those measured values were. (Ex. 1011, p. 7, right column, p. 1, Abstract)(Ex. 2001, ¶113).

4. Spiazzi teaches away from the claims

Spiazzi also teaches away from the claims. (Ex. 2001, ¶114). Specifically, Spiazzi teaches that, if MOSFETs are placed on the bottom of a PCB, it is necessary to add a heat-dissipating layer between PCB fiberglass layers in order to remove heat. (Ex. 1011, p. 3, bridging left and right columns)(“Having power components on both sides of the PCB, the only way to remove the heat was to have a dissipating

layer in between the two component layers, that was also used as ground connection at secondary side.”)(Ex. 2001, ¶114).

This is consistent with the conventional wisdom to place MOSFETs on the top side of the PCB as discussed above in §I.B.2 (beginning on page 14), and teaches away from the claims by counseling a PHOSITA to (1) place MOSFETs on the top of the PCB or otherwise (2) use a thick copper baseplate (rather than a multi-layer PCB). (Ex. 2001, ¶115). Placing MOSFETs on the top of the device teaches away from limitations 1[d] and 1[e], whereas using a thick copper baseplate teaches away from limitations 1[b] and 1[c], because a copper baseplate would interfere with a transformer structure using PCB windings (and indeed, Spiazzi uses a separate, discrete transformer with windings outside of the PCB. (Petition, p. 86)(“Spiazzi’s windings are not formed by traces in one or more of the conductive layers in the PCB.”)(Ex. 1011, p. 2)(Ex. 2001, ¶115). *See In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994)(“A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant.”).

Ground II thus does not meet the Petitioner’s burden.

D. Ground III (Ericsson BMR and Wanes) does not meet the Petitioner’s burden

Ground III (Ericsson BMR and Wanes) does not meet the Petitioner’s burden

for several reasons.

1. Wanes does not remedy the deficiencies of Ericsson BMR or BMR-2008

First, Ground III does not remedy the deficiencies of Ground I, on which Ground III depends. Ground III newly applies Wanes in two ways against claim 1:

- under limitation 1[b], where it is alleged that “Wanes expressly teaches a plurality of conductive layers in the PCB, thus further supporting that a POSITA would have recognized and found obvious that Ericsson-BMR’s golden PCB layers comprised a plurality of conductive layers.” (Petition, p. 40); and
- under limitation 1[c], where it is alleged that “If Ericsson-BMR is found to have not taught, or at least rendered obvious, that the windings of the transformer are formed by traces in one or more of the conductive layers of the PCB, Wanes teaches this.” (Petition, pp. 41-42).

Ground III does not purport, however, to modify Ground I with respect to limitation 1[e], and thus does not overcome the deficiencies of Ground I.

2. Wanes teaches away from Ericsson BMR and BMR 2008

Moreover, Wanes teaches away from the combination with Ericsson BMR or Ericsson 2008. (Ex. 2001, ¶118). Wanes is an unusual converter design, the construction of which requires some background.

The Petition focuses on the embodiment of Fig. 9A and 9B, shown here:

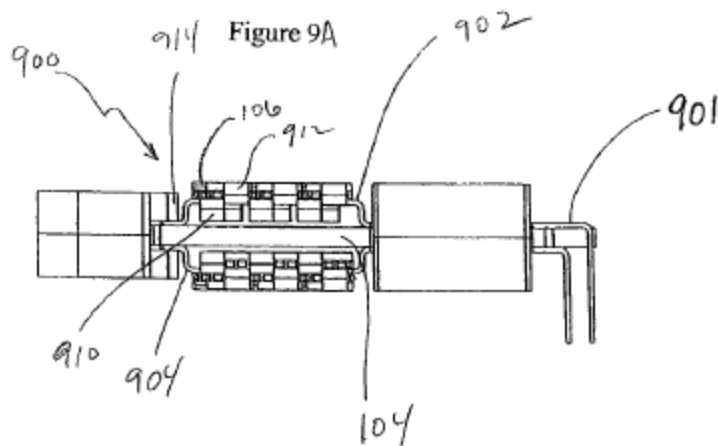
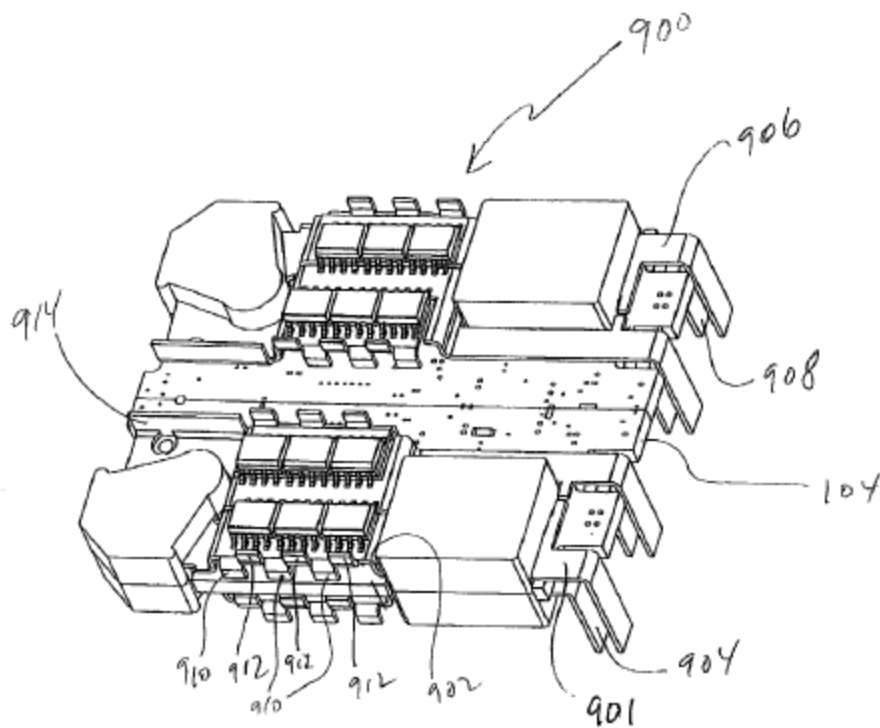


FIGURE 9B

(Ex. 1009, Fig. 9A, 9B)(Ex. 2001, ¶119). In Fig. 9A of Wanes, there is a circuit board 104. (Ex. 1009, 3:65)(Ex. 2001, ¶119). Mounted to that board are copper structures 902, as shown below, with added green coloring to show the PCB, and added copper coloring to show the copper structures 902:

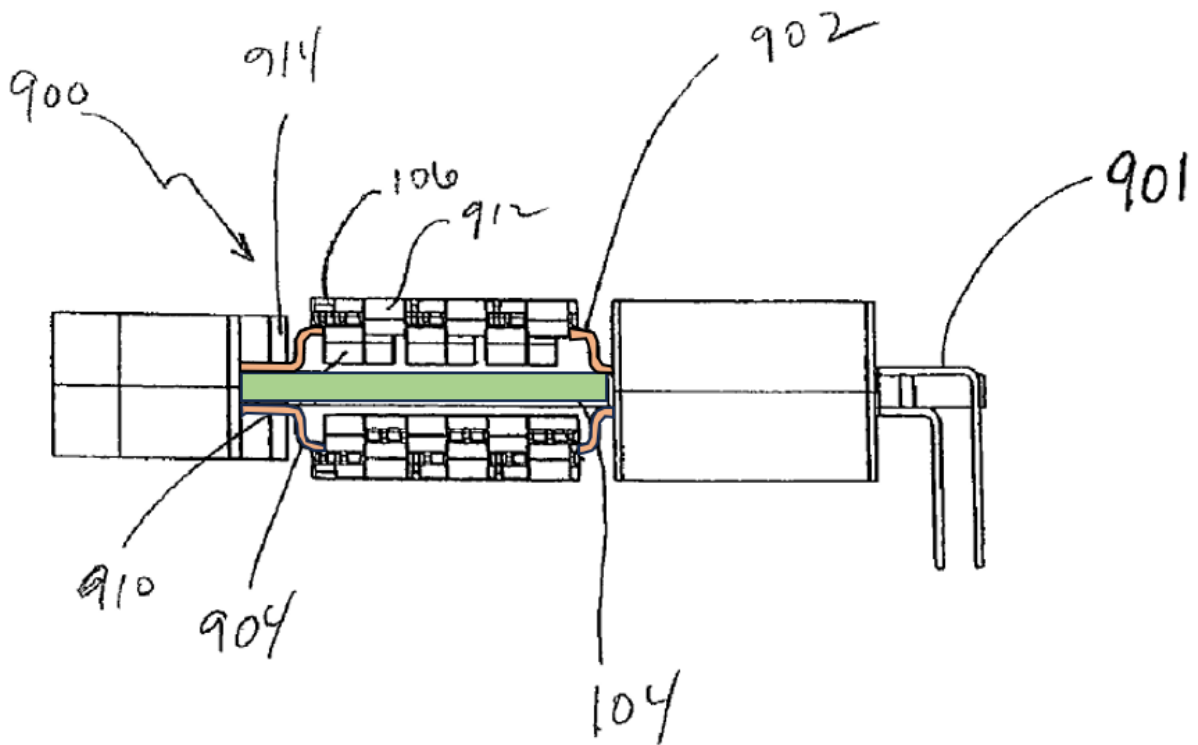


FIGURE 9B

(Ex. 1009, Fig. 9B, 11:4-36, 5:39-47)(Ex. 2001, ¶119).

The raised copper structures 902 serve to mount MOSFETs separate and apart from the circuit board. (Ex. 1009, 11:20-23, 7:37-40)(Ex. 2001, ¶120). The copper structures 902 also serve as a conductor that forms the secondary winding of the transformer. (Ex. 1009, 4:33-37, 5:39-60)(Ex. 2001, ¶120).

Wanes teaches that the copper structure 902 *should not be within* the PCB structure, for thermal management reasons:

“burying the thick copper layer within the PCB does not allow

effective dissipation of heat carried in the encapsulated copper layer, and will tend to reduce the number of substrate layers available for other design purposes.”

(Ex. 1009, 6:3-7)(Ex. 2001, ¶121).

Secondary windings in a converter providing N:1 voltage step-down carry N times more current than primary windings. (Ex. 2001, ¶122). Higher current in secondary windings leads to higher resistive losses, which are proportional to the *square* of the current. (Ex. 2001, ¶122). A PHOSITA would thus likely have understood Wanes to be teaching the use of a thick, *external* copper structure, or lead-frame, for the secondary winding because the secondary winding would give rise to high resistive losses. (Ex. 2001, ¶122).

Ericsson BMR and BMR 2008 are structurally different from Wanes. (Ex. 2001, ¶123). Nor does the Petition provide any argument that Ericsson BMR and BMR 2008 should be modified to include a raised copper structure, or lead-frame, that could serve to support a mounting surface for MOSFETs and provide a secondary transformer winding. (Ex. 2001, ¶123). Instead, according to the Petition, the windings of Ericsson BMR (and BMR 2008) are found within the PCB—exactly what Wanes teaches *not* to do. (Ex. 1009, 6:3-7)(Ex. 2001, ¶123).

Ground III thus does not meet the Petitioner’s burden.

E. Ground IV (Obviousness over Takeshima) does not meet the Petitioner's burden

Ground IV (Obviousness over Takeshima) does not meet the Petitioner's burden for several reasons.

1. There is no motivation to modify Takeshima to reach limitation 1[d]

First, there would have been no motivation to modify Takeshima to reach limitation 1[d]. (Ex. 2001, ¶126). This limitation reads:

“1[d] a plurality of power semiconductor devices, a first set of the power semiconductor devices being mounted on the top surface and electrically connected to dissipate power at a level, P_t , during operation of the converter, a second set of the power semiconductor devices being mounted on the bottom surface and electrically connected to dissipate power at a level, P_b , during operation of the converter;....”

To meet limitation 1[d], the Petition argues that a PHOSITA would have combined the Fig. 2 embodiment of Takeshima with the Fig. 14 embodiment, purportedly resulting in a Fig. 14 embodiment that has MOSFETs on the secondary side on the top and bottom of the PCB. (Petition, p. 56-58). With respect to motivation for this alteration of Takeshima's embodiments, the Petition argues:

“Takeshima teaches that ‘MOS field-effect transistors (hereafter abbreviated as ‘MOSFETs’) 8a and 8b’ are placed on the top and bottom of the PCB, as shown here in this annotated Figure 2: [Figure

omitted] Takeshima teaches that this layout could ‘advantage[ously]’ employ a ‘half-bridge’ converter circuit such as that shown in Figure 7, and further that ‘other converter circuits may be used.’ *See* EX1010 at 7:47-50, 14:44-59.”

(Petition, pp. 56-57).

There are several problems with this motivation. The first problem is that reference to a half-bridge or other converter topology says nothing about *where* its power semiconductor components should be located, and in particular, whether they should be placed on the top and/or bottom of a PCB. (Ex. 2001, ¶128). This is important because the circuit of Fig. 14 *already has a layout*, and it has *no MOSFETs on the bottom of the device*. (Ex. 2001, ¶128). Specifically, Fig. 14 belongs to the “third preferred embodiment” of Takeshima (Ex. 1010, 8:8-11), and the third preferred embodiment layout is shown in Fig. 15 (Ex. 10101, 8:12-18), with MOSFETs 8a-8d located on the *top* of the PCB:

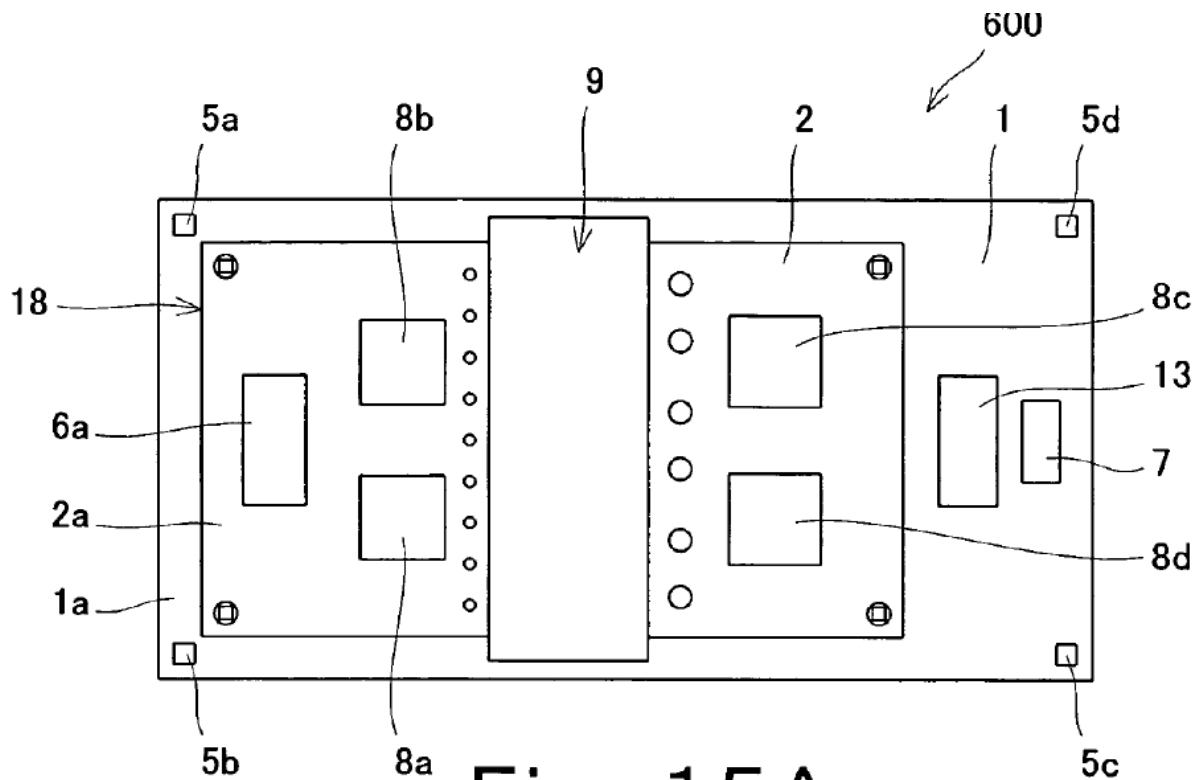


Fig. 15A

(Ex. 1010, Fig. 15A)(Ex. 2001, ¶128).

Thus, the Petition only provides a purported motivation (using a half-bridge primary-side topology) that does not address the main modification needed to combine the Fig. 2 and Fig. 14 embodiments: namely, splitting the MOSFETs shown on the top of the device in Fig. 15A into two sets, and placing these MOSFETs into overlapping positions on the top and bottom of the PCB. (Ex. 2001, ¶129).

Moreover, Takeshima explains with respect to another embodiment, that of Fig. 5, that Takeshima intentionally places topologically parallel MOSFETs together. (Ex. 1010, 12:53-64)(Ex. 2001, ¶130). This can have a variety of

advantages such as reducing wiring lengths and optimizing a layer of thick wiring for the high-current-carrying devices. (Ex. 1010, 12:53-64)(Ex. 2001, ¶130). It is also consistent with the known methodology of placing high-power-dissipating devices on the top surface of the PCB (*See* §I.B.2, beginning on page 14, above)(Ex. 2001, ¶130).

The Petition does not address the fact that Takeshima expressly places the MOSFETs of the third embodiment (including Fig. 14) on the same side of the board, nor the likely reasons for it, and thus fails to make a reasonable case for obviousness. (Ex. 2001, ¶131).

2. Takeshima does not disclose or render obvious limitation 1[e]

Takeshima also fails to disclose or render obvious limitation 1[e]. (Ex. 2001, ¶132). This limitation reads:

“1[e] wherein the power semiconductor devices are distributed between the first and second sets to distribute heat generation during operation of the converter such that each level Pt, Pb is less than 150% of the other level Pb, Pt.”

The Petition argues that “[a] POSITA would have known to operate Takeshima’s half-bridge converter with balanced power cycles on the top and bottom sides in order to avoid saturating the transformer” (Petition, p. 59), and that, with balanced power cycles on the primary side, “a POSITA would have expected” the MOSFETs to generate approximately equal heat. (Petition, p. 59).

First, the Petition is making an inherency-in-obviousness argument. That is, the PHOSITA first needs to rearrange Takeshima's converter to attempt to meet other elements of claim 1. From there, the Petition argues that the new, hypothetical rearrangement would have the inherent property of operating in accordance with limitation 1[e]. (Petition, p. 111). Note that this is not a case where a single reference teaches a claim limitation inherently, and then that reference is used in a combination. This is a case where Delta contends that a hypothetical circuit must first be constructed, and then, *only within that hypothetical circuit*, would an inherent property be found—whether the PHOSITA intended it or not. The Board should thus be cautious in applying inherency. *See Par Pharmaceutical, Inc. v. TWI Pharmaceuticals, Inc.*, 773 F.3d 1186, 1195 (Fed. Cir. 2014) (“We have, however, also explained that the use of inherency, a doctrine originally rooted in anticipation, must be carefully circumscribed in the context of obviousness.”).

The Petition's inherency argument is also wrong. (Ex. 2001, ¶134). Takeshima's half-bridge power converter (as shown in Fig. 14) has capacitors 6a and 6b in series with transformer primary winding 9a that preclude transformer saturation and enable it to operate with a variable, unbalanced duty cycle. (Ex. 2001, ¶134). Fig. 14 is reproduced here, with the voltage-dividing series capacitors outlined with added red-dashed boxes:

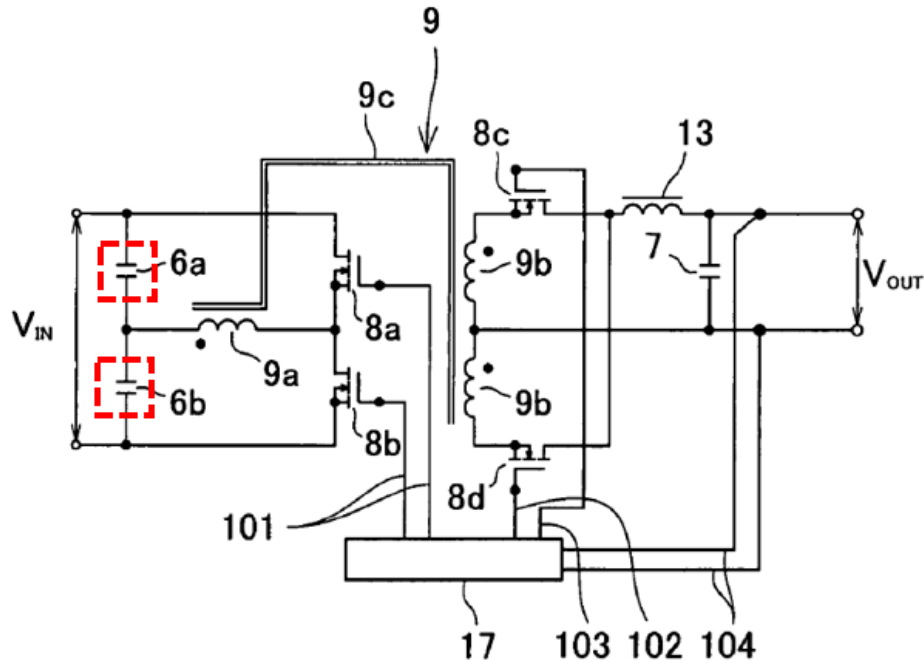


Fig. 14

(Ex. 1010, Fig. 14)(Ex. 2001, ¶134).

The topology of Takeshima's half-bridge embodiment connects the primary-side transformer winding 9a between the primary-side switches and the voltage-dividing capacitors 6a and 6b. (Ex. 2001, ¶135). As explained above in §III.C.2, beginning on page 39, this arrangement prevents transformer saturation, because the voltage-dividing capacitors block DC components of the transformer current. (Ex. 2001, ¶135)(Ex. 2008, p. 100, Fig. 4.20B). Notably, Delta's expert Dr. Leeb testified in a previous litigation that a half-bridge converter with an identical primary-side

configuration was “one that is configured not to drive the transformer into saturation.” (Ex. 2009, ¶31, p. 18)(Ex. 2001, ¶135).

For that reason, the Petition is incorrect that a PHOSITA would know to operate Takeshima with balanced power cycles to avoid saturating the transformer. (Ex. 2001, ¶136).

In fact, a PHOSITA would expect Takeshima’s MOSFETs, even if rearranged in the arbitrary manner discussed in the Petition, to have unbalanced heat generation. (Ex. 2001, ¶137). This is because Takeshima’s third embodiment (on which the Petition relies) is a regulating converter that uses PWM to operate both primary and secondary MOSFETs with a variable duty cycle to regulate the output voltage. (20:10-23). As Takeshima explains:

“The output voltage from both ends of the output smoothing capacitor 7 is constantly monitored by the control circuit 17, and the control circuit 17 controls the on-off ratio of the switching operation of the MOSFETs 8a and 8b by varying the turn-on signal in order to stabilize the output voltage. The turn-on signal is also applied to the gate terminals of the MOSFETs 8c and 8d with the same phase. Consequently, the MOSFETs 8c and 8d will perform a rectified operation in response to the turn-on signal (commonly called ‘synchronous rectification’). Since the control circuit 17 operates in the above-described manner, the direct current voltage that is output from the switching power supply device 100 is stabilized.”

(Ex. 1010, 20:10-23)(Ex. 2001, ¶137). The Petition fails to address PWM regulation. With such regulation, output MOSFETs operate with a variable duty cycle, in unbalanced fashion, in order to compensate for the variation in input voltage. (Ex. 2001, ¶137). In systems in which Takeshima's device could be expected to be used (powering personal computers, 1:9-29, 2:7-11), input voltages vary. (Ex. 2001, ¶137)(Ex. 2010, p. 14, Table 5)(Ex. 2011, p. 12, Fig. 3). That, in fact, is the reason that output regulation is needed in Takeshima's embodiment 3 device. (Ex. 2001, ¶137).

For these reasons, the Petition has not met its burden to demonstrate that a hypothetically-modified Takeshima would meet limitation 1[e], and Ground IV does not meet the Petitioner's burden.

F. Ground V (Takeshima and Spiazzi) does not meet the Petitioner's burden

Ground V (obviousness over Takeshima in view of Spiazzi) similarly does not meet the Petitioner's burden.

1. The Petition fails to articulate Ground V with sufficient clarity

Ground V does not meet the Petitioner's burden to articulate its theory clearly and with particularity, providing the basic components of a case for obviousness. *See Netflix, Inc. v. DivX, LLC*, No. 2022-1203, at *8-9 (Fed. Cir. Oct. 25, 2023)(“Ultimately, it is the petitioner's burden to present a clear argument.”); *Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369 (Fed.

Cir. 2016)(“It is of the utmost importance that petitioners in the IPR proceedings adhere to the requirement that the initial petition identify “with particularity” the “evidence that supports the grounds for the challenge to each claim.” 35 U.S.C. § 312(a)(3).”).

Ground V is fundamentally unclear. The Petition appears to contemplate some sort of modification of Takeshima with Spiazzi, arguing that “[a] POSITA would further have been motivated **to create this combination** because of the well-known benefits of addressing excess heat.” (Petition, p. 74)(Emphasis added). “This combination”, however, is never explained. The Petition has no description of any particular modification of Takeshima that might be undertaken with Spiazzi, leaving Vicor and the Board to guess at the Petition’s intent.

With respect to claim 1, the Petition only discusses Spiazzi under limitation 1[e], and states there only that “[i]n combining Takeshima with Spiazzi in Spiazzi’s environment, this result [limitation 1[e]] is confirmed, as explained below.” (Petition, p. 71). However, the Petition never explains what it means to “combin[e] Takeshima with Spiazzi in Spiazzi’s environment”. The Petition, for example, does not explain which features of Spiazzi would be used in Takeshima, nor does the Petition explain what Spiazzi’s “environment” might be. The Petition thus fails to meet the Petitioner’s burden. *See Medtronic, Inc. v. Teleflex Innovations S.A.R.L.*, 70 F.4th 1331, 1347 (Fed. Cir. 2023)(“The Board explained ‘[t]he extensive need to

modify Kontos' device in a way not suggested in the Petition supports [Teleflex's] argument that the proposed modifications are based on a hindsight desire to recreate the claimed invention, as opposed to a known need in the art for such a device.' *Id.* The Board did not err in discounting modifications not presented in Medtronic's petition as indicative of hindsight.'").

2. Spiazzi's method of operation is not relevant to Takeshima

To the extent the Petition is merely arguing that a PHOSITA would use statements in Spiazzi to *recognize* that Takeshima would meet limitation 1[e], the Petition is incorrect. Takeshima does not meet limitation 1[e], as discussed above in §III.E.2, and Spiazzi does not provide balanced operation, as discussed above in §III.C.3 (p. 43).

Moreover, Spiazzi and Takeshima are very different circuits, such that a PHOSITA would not think that test results from Spiazzi apply to Takeshima. (Ex. 2001, ¶141). In particular, Spiazzi is a phase-shift modulated circuit (Ex. 1012, p. 1, Abstract)(cited by Ex. 1011, p. 1, left column), while Takeshima is a pulse-width modulated circuit (Ex. 1010, 20:10-23). (Ex. 2001, ¶141). Spiazzi is regulating the output by shifting the phase between primary and secondary side MOSFETs, while Takeshima is regulating the output by changing the ON and OFF times of the primary and secondary side MOSFETs. (Ex. 2001, ¶141). There is thus no reason to think that Spiazzi's circuit would behave similarly to Takeshima's. (Ex. 2001,

¶141).

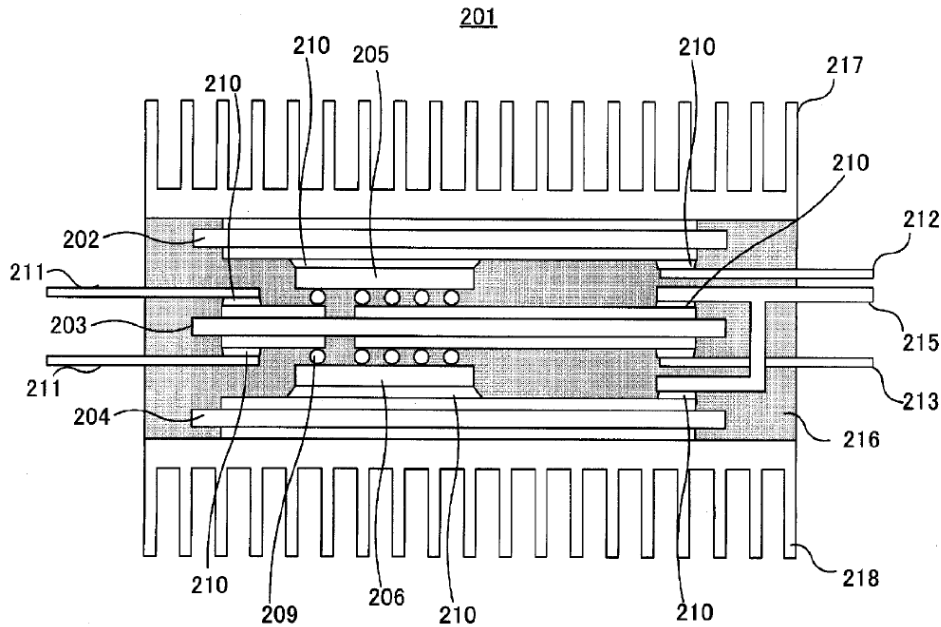
3. Spiazzi and Takeshima teach away from one another

To the extent some merger of the two circuits *is* contemplated by the Petition, Takeshima and Spiazzi teach away from one another. (Ex. 2001, ¶142). First, Takeshima teaches separating MOSFETs from control circuitry, in order to achieve a host of advantages. (Ex. 1010, 13:49-14:31)(Ex. 2001, ¶142). Spiazzi, however, places control circuitry on the same board surface as the MOSFETs (Figs. 5). (Ex. 2001, ¶142). Moreover, Spiazzi teaches that with components on both sides of the board, thermal management is difficult, and that it is best to use a thick copper baseplate between two PCBs, as in PCB 2. (Ex. 1011, p. 3, bridging left and right columns)(Ex. 2001, ¶142). This thick copper baseplate interferes with the formation of transformer windings within a PCB, and thus runs contrary to the allegation of the Petition (Petition, p. 56) that Takeshima contains transformer windings within the PCB conductive layers. (Ex. 2001, ¶142). It would thus not be obvious to combine the two references. *See Gurley*, 27 F.3d at 553.

4. The Kawanami reference

Finally, the Petition's reliance on the Kawanami reference (Ex. 1023) is misplaced. (Ex. 2001, ¶143). Kawanami is power converter designed for electric motor control applications. (Ex. 1023, ¶0002)(Ex. 2001, ¶143). Its structure is markedly different from that of both Spiazzi and Takeshima, having a semiconductor

package with multiple substrates, where each of several chips are mounted to their own substrates, and these substrates are stacked. This is shown in Fig. 1 of Kawanami, reproduced here:



(Ex. 1023, Fig. 1)(Ex. 2001, ¶143). In Fig. 1, elements 202 and 204 are insulated substrates (possibly a fiberglass reinforced epoxy laminate of a PCB), while elements 205 and 206 are semiconductor chips. (Ex. 1023, ¶¶0038-0039)(Ex. 2001, ¶143). The chips are further separated by an insulating element 203. (Ex. 1023, ¶0038)(Ex. 2001, ¶143). Kawanami also has heat sinks with radiating fins (217 and 218) on both sides of the device. (Ex. 1023, ¶¶0040, 0084-0085)(Ex. 2001, ¶143).

Given the differences in structure and area of application between Kawanami

on the one hand and Spiazzi and Takeshima¹ on the other hand, a PHOSITA would not take recommendations from Kawanami and believe them to be relevant to Spiazzi or Takeshima. In particular, while Kawanami is able, in its particular application field, to place heat sinks on both sides of the device, Spiazzi teaches that by having MOSFETs on opposite sides of PCBs, a copper baseplate is required to manage heat. (Ex. 1011, p. 3, bridging left and right columns)(Ex. 2001, ¶144).

Ground V thus does not meet the Petitioner's burden.

G. Ground VI (Takeshima and Wanes) does not meet the Petitioner's burden

Ground VI (obviousness over Takeshima in view of Wanes) similarly does not meet the Petitioner's burden.

Ground VI is not clear. The Petition provides no overview or explanation of what, if anything, is being modified in Takeshima. In the mapping for claim 1, the Petition merely refers back to Ground IV, except under limitation 1[e]. There, the Petition states only that “[i]n the asserted embodiment, Takeshima's module is in the environment of Wanes, thus confirming equal or at least approximately equal power dissipation and thus satisfying this element.” (Petition, pp. 77-78). But the Petition provides no evidence from Wanes that would indicate this, no explanation

¹ Both Spiazzi and Takeshima are directed to voltage regulators (VRs) to power CPUs. (Ex. 1011, p. 1, left column)(Ex. 1010, 1:9-25)(Ex. 2001, ¶144, n.1).

of what the “asserted embodiment” might be, nor any explanation of what is meant by “the environment of Wanes”. In fact, in the Petition’s entire analysis for claim 1 there is no citation to Wanes (Ex. 1009) *at all*. Other than citations to Dr. Leeb’s declaration and cross-references to Ground IV, the Petition only quotes *Spiazzi* (Ex. 1011) under limitation 1[e].

This leaves the manner in which Wanes is applied in Ground VI entirely a matter of speculation, and is insufficient to carry the Petitioner’s burden. Furthermore, because there is no apparent modification to Takeshima based on Wanes, the Ground adds nothing to the already-deficient Ground IV (or, if *Spiazzi* is being applied, Ground VI). (Ex. 2001, ¶148).

Ground VI thus does not meet the Petitioner’s burden.

H. Ground VII (Ericsson BMR or Ericsson 2008 and Takeshima) does not meet the Petitioner’s burden

Ground VII (obviousness over Ericsson BMR or Ericsson 2008 in view of Takeshima) does not meet the Petitioner’s burden.

The assertion against claim 1 in Ground VII is based on Ground I, because the claim mapping under each claim element refers back to the corresponding element of claim 1 under Ground I. Ground VII purports to alter the argumentation under Ground I as to claim 1 in only two ways, namely:

- under limitation 1[c], by arguing that a PHOSITA would have been motivated to form Ericsson-BMR’s transformer windings within a PCB

based on Takeshima (Petition, p. 80); and

- under limitation 1[d], by arguing that “Takeshima further confirms that Ericsson’s output FETS⁹ could have been those that are placed symmetrically and that it would have been an obvious design choice for the output FETs used as output switches by Ericsson-BMR”. (Petition, p. 81).

Ground VII thus does not address the deficiencies in Ground I discussed above in §III.A (pp. 27-37), Ground VII fails for the same reasons. (Ex. 2001, ¶152).

Even if it were urged under limitation 1[d] to *alter* Ericsson BMR or Ericsson 2008 in some way (and the Petition does not do so), it is clear from the discussion of the conventional wisdom in §I.B.2 above (beginning on page 14) as well as Takeshima’s own discussion of the placement of MOSFETs (*see* above, §§III.E.1-III.E.2, pages 51-58), that the decision to provide a layout of symmetrically-placed FETs was not a mere “design choice”, but had real technological implications. (Ex. 2001, ¶¶61-62, 70-74, 126-138). *See Cutsforth, Inc. v. Motivepower, Inc.*, 636 F. App’x 575, 7-8 (Fed. Cir. 2016)(“the Board found that the location of the spring is a design choice and is obvious. This statement alone is not enough to explain why the Board found claim 5 obvious. Merely stating that a particular placement of an element is a design choice does not make it obvious. The Board must offer a reason for why a person of ordinary skill in the art would have made the specific design

choice to locate the spring on the mounting block”).

Ground VII thus does not meet the Petitioner’s burden.

I. Ground VIII (Spiazzi and Wanes) does not meet the Petitioner’s burden

Ground VIII (obviousness over Spiazzi in view of Wanes) does not meet the Petitioner’s burden for several reasons.

1. The combination does not render obvious limitation 1[c]

First, the combination of Spiazzi and Wanes would not render obvious limitation 1[c], which requires “1[c] a magnetic core structure magnetically coupled to a winding formed by traces in one or more of the conductive layers in the PCB”. (Ex. 2001, ¶155).

The Petition proposes to modify Spiazzi with Wanes, arguing:

“Spiazzi’s windings are not formed by traces in one or more of the conductive layers in the PCB. However, Wanes does teach the layout approach of using the converter PCB to form windings....A POSITA would have been motivated to form Spiazzi’s windings in the manner described in Wanes for a number of reasons.”

(Petition, p. 86). The Petition then argues that forming transformer windings as PCB layers was well-known and space-efficient, and that Spiazzi would have moved toward that technique upon transition from a research product to a commercial device. (Petition, p. 87).

The principal issue with this reasoning is that Spiazzi does not provide a

multilayer circuit board that *could be* used for windings. (Ex. 2001, ¶157). Spiazzi has two variants, PCB1 and PCB2. (Ex. 1011, p. 3)(Ex. 2001, ¶157). Both of these structures have two layers PCBs that sandwich a middle copper plate that acts as a ground plane (in PCB1 the middle copper layer is 0.14 mm thick and in PCB2 it is 0.7 mm thick, p. 3). Spiazzi ultimately recommends PCB2. (Ex. 1011, p. 7)(Ex. 2001, ¶157). According to Spiazzi, the middle heat-conducting layer is *necessary* to remove heat when components are placed on the back side of the structure. Spiazzi explains:

“Having power components on both sides of the PCB, the only way to remove the heat was to have a dissipating layer in between the two component layers....”

(Ex. 1011, p. 3, bridging left and right columns)(Ex. 2001, ¶157).

A PHOSITA would not have expected to be able to construct transformer windings in Spiazzi’s structure, because windings would conflict with Spiazzi’s copper plate, which Spiazzi says is “the only way” to sufficiently remove heat. (Ex. 1011, p. 3, bridging left and right columns)(Ex. 2001, ¶158).

Notably, the Petition does not even assert that there would have been a reasonable expectation of success in modifying Spiazzi’s structure to accommodate a multi-layer PCB, without a thermally-conductive baseplate, that could use PCB conductive layers to form transformer windings. (Ex. 2001, ¶158).

2. The combination does not teach limitations 1[d] and 1[e]

The combination relies only on Spiazzi to meet limitations 1[d] and 1[e]. As discussed above in §§III.C.2 and III.C.3 (pp. 37-45), however, Spiazzi's input MOSFETs are entirely located on the top side of the device, and Spiazzi's own measurements indicate that MOSFETs on the top side would dissipate 3.31 times the power of MOSFETs on the bottom side. (Ex. 2001, ¶160)(Ex. 1011, p. 4, Table II). Furthermore, contrary to the Petition's assertion, Spiazzi's cryptic statement that "[s]imilar results were obtained for the downward surfaces" does not demonstrate that claim limitation 1[e] was met. (Ex. 2001, ¶1159).

The Petition's citation to Huber (Ex. 1012) is taken out of context. (Ex. 2001, ¶160). In the section in which the statement occurs, Huber, *et al.* are attempting to provide a simple mathematical characterization of the converter while at steady state. (Ex. 2001, ¶160). The statement that "the behavior of the circuit *is the same* as during the positive half cycle" means that, in general, the mathematical relationships in the simplified model do not need to be re-derived for the negative half cycle. (Ex. 2001, ¶160). At that stage in the article, however, Huber, *et al.* had not considered output regulation over changes in input voltage and output current. (Ex. 2001, ¶160). Output regulation in Huber's converter depends on a phase-shift between primary and secondary MOSFETs. (Ex. 2001, ¶160). The Petition fails to consider the effect of output regulation under operating conditions. (Ex. 2001, ¶160).

This failure is particularly egregious because the Petition seeks to rearrange Spiazzi, in an unspecified fashion, to incorporate embedded PCB transformer windings. (Ex. 2001, ¶161). Transformer windings tend to occupy large portions of a PCB, and Wanes further teaches to use an exposed, raised copper portion to form secondary windings. (Ex. 1009, 6:3-7)(Ex. 2001, ¶161). It is unclear how these teachings *could be* combined. The Petition’s contemplated design is not specified—but it needed to be. (Ex. 2001, ¶161). Spiazzi itself emphasizes that for its converter, stating “component placement and routing have a strong impact not only on parasitic components, but also on the overall converter efficiency, thus affecting the thermal management” (Ex. 1011, p. 1) and that “[d]ue to the strong dependence on the layout, losses calculation is just an exercise, without any correlation with the reality. The only way is to measure them on the prototype, which is usually not an easy task.” (Ex. 1011, p. 3)(Ex. 2001, ¶161).

Once a PHOSITA changes the Spiazzi layout, a PHOSITA would expect, based on Spiazzi’s own statements, to achieve fundamentally different heat generation results, which the Petition completely fails to address. (Ex. 2001, ¶162).

The Grounds in the Petition thus fail to carry the Petitioner’s burden.

A. Objective Evidence of Non-Obviousness

There are also strong objective indicia of non-obviousness, weighing against any finding of obviousness. *See Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530,

1538 (Fed. Cir. 1983)(“evidence of secondary considerations may often be the most probative and cogent evidence in the record.”).

Delta was on notice of this evidence, but failed to meaningfully address it in the Petition. (Ex. 2025, ¶¶27-33, 56-60, 73-79). The Petition should be denied for that reason alone. *See Robert Bosch Tool Corp. v. SD3 LLC*, IPR2016-01751 (PTAB Mar. 22, 2017)(Paper 15)(denying institution for failure to address objective indicia presented during an ITC proceeding); *Stryker Corp. v. KFX Medical, Inc.*, IPR2019-00817 (PTAB September 16, 2019)(Paper 10)(denying Institution under §314(a) in part for failure to address known secondary considerations from litigation); *Coalition for Affordable Drugs V LLC v. Hoffman–LaRoche, Inc.*, IPR2015–01792 (PTAB Mar. 11, 2016)(Paper 14)(denying institution for failure to address objective indicia considered by Examiner during original prosecution); *Merial Ltd. v. Virbac*, IPR2014–01279 (PTAB Jan. 22, 2015)(Paper 13)(denying institution for failure to address objective indicia considered by Examiner during original prosecution and noting “Merial was aware of the unexpected results showing which the Examiner found persuasive Merial should have addressed unexpected results in the first instance.”); *Omron Oilfield & Marine Inc. v. MD/TOTCO*, IPR2013–00265 (PTAB Oct. 31, 2013)(Paper 11)(denying institution for failure to address objective indicia successfully argued in a reexamination).

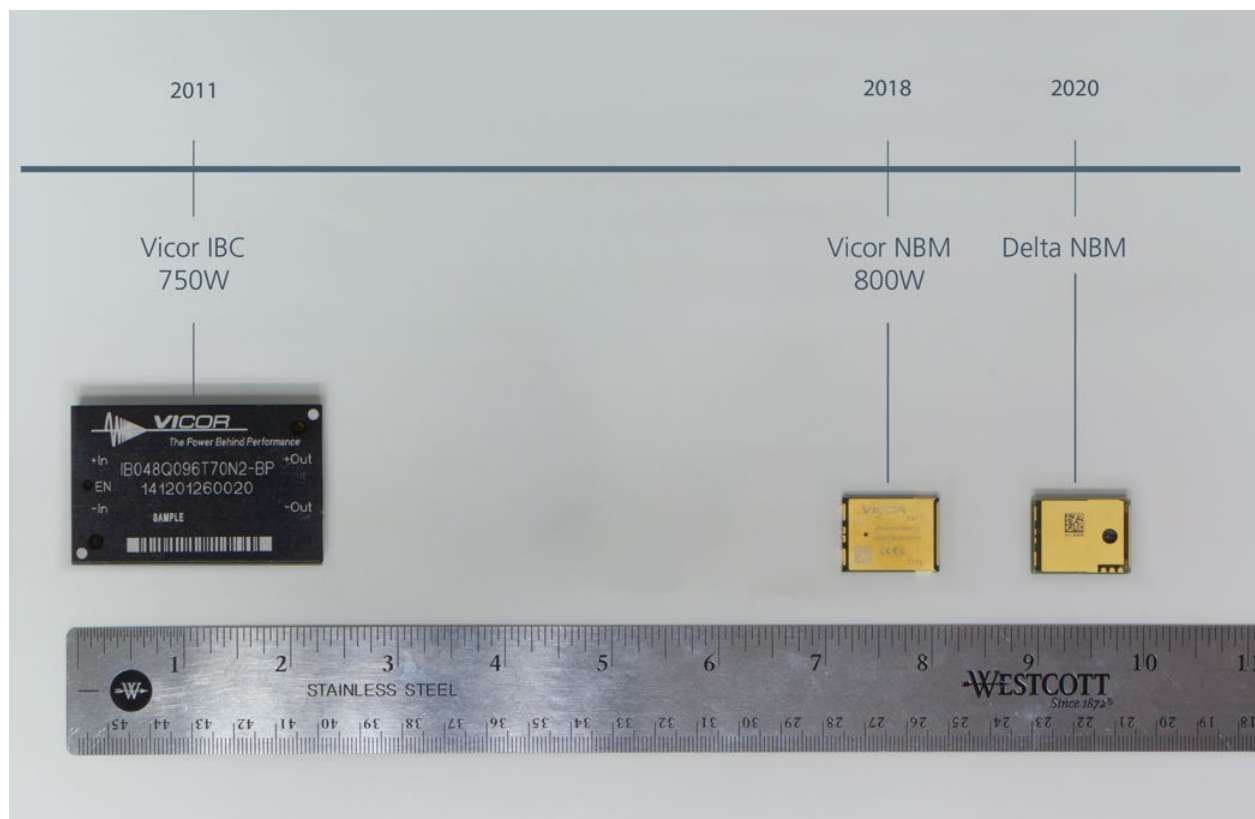
By laying out power MOSFETs on the top and bottom surfaces of the power

converter's PCB, with a converter topology that allowed heat generation from both surfaces to be approximately balanced, the inventors proceeded contrary to the conventional wisdom. (Ex. 2030, ¶¶29-31). This is objective evidence of non-obviousness, and is demonstrated in the '761 patent and its incorporated U.S. Pat. No. 7,361,844 (Ex. 2006). *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."); *Standard Oil Co. v. American Cyanamid Co.*, 774 F.2d 448, 454 (Fed. Cir. 1985)("A person of ordinary skill in the art is also presumed to be one who thinks along the line of conventional wisdom in the art...").

The claims of the '761 patent went contrary to the conventional wisdom because, as discussed above under §I.B.2, beginning on page 14, it was believed in the relevant timeframe that power semiconductor devices should be placed on the top surface of the converter's PCB, close to the heat sink. (Ex. 2030, ¶¶29-31). The '761 patent, however, departed from the prior-art by advancing the concept of a converter topology that enabled a top set and a bottom set of power semiconductor devices to be symmetrically placed and symmetrically driven to balance heat generation across opposite surfaces of a PCB with embedded transformer windings. (Ex. 2030, ¶¶29-31). This reduced winding interconnect losses, while improving converter efficiency and power density. (*Id.*). Placing MOSFETs symmetrically on the top and bottom surfaces of the PCB increased bus converter efficiency, because

MOSFETs of complementary cells could split current carried through common VIAs to transformer windings within the PCB. (Ex. 2030, ¶¶29-31).

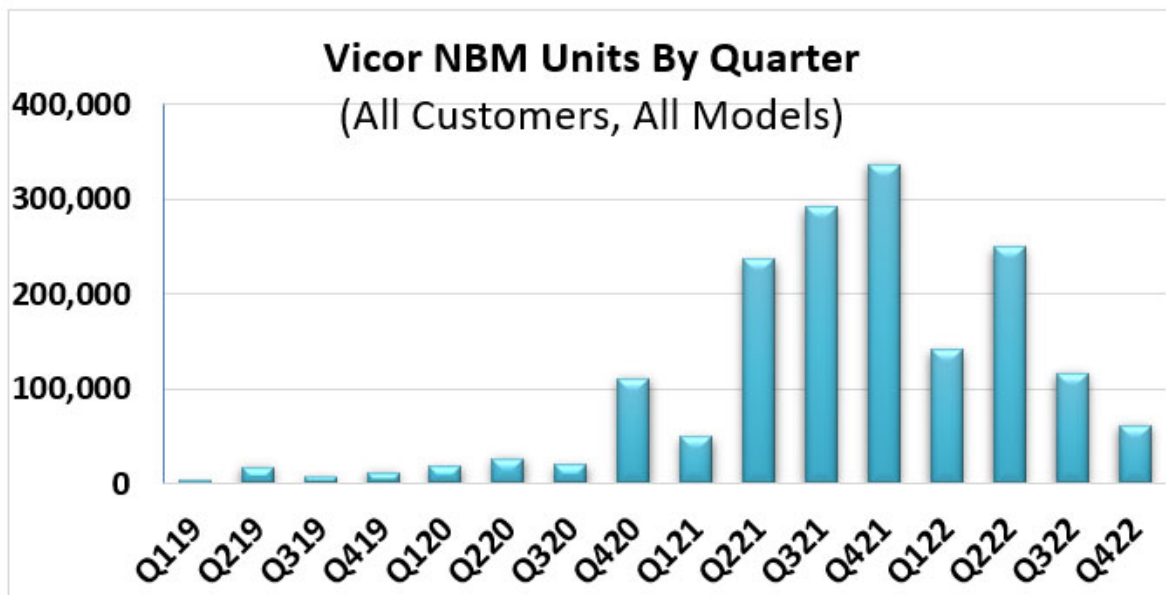
As the first-named inventor on the '761 patent, Dr. Patrizio Vinciarelli, explains, Vicor released its first Non-isolated Bus Modules (NBMs) incorporating the '761 patent in 2017. (Ex. 2030, ¶¶32-35). The products offered a ten-fold advantage in power density over Vicor's prior generation of products. (Ex. 2030, ¶¶32-35). The improvement in power density can be seen in the following image showing, to scale, the relative dimensions of Vicor's prior bus converter product (2011) on the left, Vicor's NBM 2317 (2018) in the middle, and on the right, a copycat product introduced by Delta in 2020, with added annotations at the top:



The 2011 converter shown on the left had a maximum power capacity of 750 W in a volume of 1.40 in³ (2.30 x 1.45 x 0.42in), for a power density of 535 W/in³. (Ex. 2030, ¶¶16-17). Such a converter would take up an area of 3.3 square inches on a mother board. (Ex. 2030, ¶17). Vicor's 2018 NBM2317, in contrast, processed 800 W within a volume of 0.12 in³ (0.90 x 0.68 x 0.20in), for a power density of about 6535 W / in³. (Ex. 2030, ¶¶32-35). The NBM2317 used the inventions of the '761 patent. (Ex. 2030, ¶35). In 2020, Petitioner Delta first released its copycat NBM with the same small footprint, which also used the inventions of the '761 patent. (Ex. 2030, ¶33).

Although Vicor initially encountered skepticism (for reasons including the non-isolated nature of Vicor's NBM) the dramatic power-density advantage of Vicor's NBM won customers over, resulting a surge in sales of Vicor's NBM 2317 product from a few thousand units in the fourth quarter of 2019 to over 300,000 in the third quarter of 2021. (Ex. 2030, ¶¶36-40). In 2021, a leading artificial intelligence ("AI") OEM licensed Vicor's patents and started paying royalties on NBMs sourced from third parties. (Ex. 2030, ¶¶36-40). *See Merck & Co. v. Teva Pharmaceuticals USA, Inc.*, 395 F.3d 1364, 1376 (Fed. Cir. 2005) ("Commercial success is relevant because the law presumes an idea would successfully have been brought to market sooner, in response to market forces, had the idea been obvious to persons skilled in the art.").

However, unlicensed sales of infringing products by third parties began in earnest in late 2021, and had a serious impact on sales of Vicor's NBM products, which had otherwise enjoyed an exponential growth curve:



(Ex. 2030, ¶¶36-40).

As Dr. Vinciarelli explains, the advantages of the invention, initial skepticism followed by commercial success of products embodying the invention, are tied to the step up in efficiency and power density gained by the invention—achieved contrary to the conventional wisdom. (Ex. 2030, ¶¶23-40). Higher power density was specifically enabled by placing MOSFETs of converter cells carrying current symmetrically at the top and bottom surfaces of the converter's PCB. (Ex. 2030, ¶¶29-31). Even though the individual contribution of the '761 patent is difficult to quantify, it contributed significantly. (Ex. 2030, ¶40).

In the present case, multiple lines of evidence independently confirm the non-obviousness of the invention. Before the invention, Vicor’s industry-leading bus converters had a power density 10 times lower than following the invention. The inventors proceeded contrary to the conventional wisdom. This change resulted in notable gains in efficiency and power density. (Ex. 2030, ¶¶29-31). The approach eventually resulted in significant commercial success—until copycat products appeared on the market. This indicates non-obviousness. *See Safety Car Heating Lighting v. General Elec*, 155 F.2d 937, 939 (2d Cir. 1946)(“In appraising an inventor's contribution to the art, as we have often said, the most reliable test is to look at the situation before and after it appears.”).

IV. CONCLUSION

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

Date: <u>February 29, 2024</u>	<u>/Matthew A. Smith/ (RN 49,003)</u> Matthew A. Smith SMITH BALUCH LLP 1100 Alma St., Ste 109 Menlo Park, CA (202) 669-6207 smith@smithbaluch.com <i>Counsel for Patent Owner</i>
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CERTIFICATE OF SERVICE

The undersigned hereby certifies that the foregoing patent owner preliminary response, together with all exhibits and other documents filed therewith, was served by electronic mail on February 29, 2024, on the petitioner's counsel of record at the United States Patent & Trademark Office having the following addresses:

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Date: February 29, 2024

/Matthew A. Smith/ (RN 49,003)

CERTIFICATE OF WORD COUNT

The undersigned hereby certifies that the foregoing patent owner preliminary response contains 13,346 words according to the word processing program used to prepare it.

Date: February 29, 2024

/Matthew A. Smith/ (RN 49,003)