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Paper 36
Date: March 31, 2026

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MEDIATEK INC.,
Petitioner,

v.

PARKERVISION, INC.,
Patent Owner.

IPR2025-00030
Patent 8,498,593 B2

Before MICHAEL R. ZECHER, BARRY L. GROSSMAN, and IFTIKHAR AHMED, *Administrative Patent Judges.*

GROSSMAN, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Not Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

MediaTek, Inc. petitioned for an *inter partes* review ("IPR") of claims 1–20 of U.S. Patent No. 8,498,593 B2 ("the '593 patent"). The Petition presented six distinct grounds based on various combinations of six references. We have jurisdiction to hear this *inter partes* review under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a). Petitioner has the burden of proving unpatentability by a preponderance of the evidence. 35 U.S.C. § 316(e).

Based on the findings and conclusions below, we determine that MediaTek has established, by a preponderance of the evidence, that challenged claims 1–20 would have been obvious to a person of ordinary skill in the relevant technology, and thus are unpatentable.

A. Background

MediaTek, Inc. ("Petitioner") filed a Petition (Paper 2, "Pet.") requesting an IPR of claims 1–20 (the "challenged claims") of the '593 patent. ParkerVision, Inc. ("Patent Owner") filed a Preliminary Response (Paper 8, "Prelim. Resp.").

We concluded that Petitioner satisfied the burden, under 35 U.S.C. § 314(a), to show that there was a reasonable likelihood that Petitioner would prevail with respect to at least one of the challenged claims. Accordingly, on behalf of the Director (37 C.F.R. § 42.4(a)), and in accordance with *SAS Inst., Inc. v. Iancu*, 138 S. Ct. 1348, 1353 (2018), we instituted an *inter partes* review of all the challenged claims, on all the asserted grounds. Paper 9 ("Dec. Inst.").

Patent Owner filed a Response. Paper 14 ("PO Resp."). Petitioner filed a Reply. Paper 21 ("Pet. Reply"). Patent Owner filed a Sur-reply. Paper 27 ("PO Sur-reply").

A hearing was held January 7, 2026. *See* Paper 35.

B. Real Parties-in-Interest

Petitioner identifies itself, MediaTek USA Inc., MTK Wireless Limited (UK), Gaintech Co. Limited, and MediaTek Investment Singapore Pte. Ltd. as the real parties-in-interest. Pet. 99.

Patent Owner identifies itself as the sole real party-in-interest. Paper 31, 1.

C. Related Matters

The parties indicate that the '593 patent is the subject of the following district court proceeding: *ParkerVision v. MediaTek, Inc.*, No. 6:23-cv-00732 (W.D. Tex. filed October 27, 2023). Pet. 100; Paper 31, 1.[1]

Patent Owner also states it "is not aware of any other judicial or administrative matter involving the '593 Patent that would affect, or be affected by, a decision in the requested IPR." Paper 31, 1.

D. The '593 patent

We make the following findings of fact concerning the '593 patent.

The '593 patent is titled "Switching Power Supply." Ex. 1001, According to Patent Owner's declarant, Dr. David Ricketts, "[s]witching converter power supplies convert electrical energy from one voltage level to

[1] This case is still pending and active. Based on the First Amended Case Schedule from the Court, entered March 28, 2025, fact discovery closes November 26, 2026, and jury selection and trial begin April 19, 2027. *See* Ex. 3002.

another using high frequency switching devices in combination with e.g., inductors or capacitors." Ex. 2001 ¶ 27. Essentially, these devices are used "to regulate the output voltage." *Id.* ¶ 28.

As disclosed in the '593 patent, the efficiency of a power supply directly affects the efficiency of the power amplification system using the power supply. Ex. 1001, 1:29–31. In mobile or portable battery powered wireless devices, the voltage and current requirements of the radio frequency (RF) transmitter used in the devices are largely determined by the power amplifier technology and system requirements. *Id.* at 1:31–35. Thus, the power supply efficiency not only affects the efficiency of the power modulation and amplification system, but also the efficiency of the mobile device using the power amplification system. *Id.* at 1:36–39.

According to the '593 patent, "[t]here is a need therefore for power supply architectures, design techniques, and operation modes that affect and/or optimize the overall system efficiency of the modulation and power amplification system." *Id.* at 1:40–43.

> As summarized in the Abstract, the disclosed power supply:
>
> can include a switching device [402, 406] and an aperture generator and control module [404]. The switching device can be configured to *down-convert* an input voltage and pass the *down-converted input voltage* to an output voltage node. The aperture generator and control module can be configured to control the switching device. In response to a power efficiency of the power supply exceeding a predetermined threshold, the aperture generator and control module can deactivate the switching device and pass the input voltage to the output voltage node.

Id. at code (57) (emphases and reference numerals added); Fig. 4.

A "step down" power supply also is referred to as a "buck" power supply. *Id.* at 6:36–37; Ex. 1003 ¶ 67 (Declaration testimony of Petitioner's declarant, Dr. Lawrence E. Larson stating "A DC-DC converter is known as either a buck (or down) converter or a boost (or up) converter. DC-DC converters may also be a combination of the two, known as a buck-boost converter."); Ex.2001 ¶¶ 29–33 (Declaration testimony of Dr. Ricketts describing a "[s]tep-down (buck) converter"). The purpose of these converters is to improve the efficiency by varying voltage in a circuit. Ex. 1012, 493 ("Efficiency of power amplifiers can be significantly improved by employing a DC-DC converter which varies the power supply voltage in accordance with the envelope of the input signal.").[2]

The '593 patent discloses and claims embodiments relating to a "power supply," a "method of controlling a power supply," and a "system" that "includes an electronic device and a power supply." *Id.* at 2:12–32; 11:15–12:57.

Figure 4 from the '593 patent, annotated by Petitioner (Pet. 8), is reproduced below.

[2] "Microwave Power Amplifiers with Digitally-Controlled Power Supply Voltage for High Efficiency and High Linearity," 2000 IEEE MTT-S Digest, Ex. 1012 ("Ranjan").

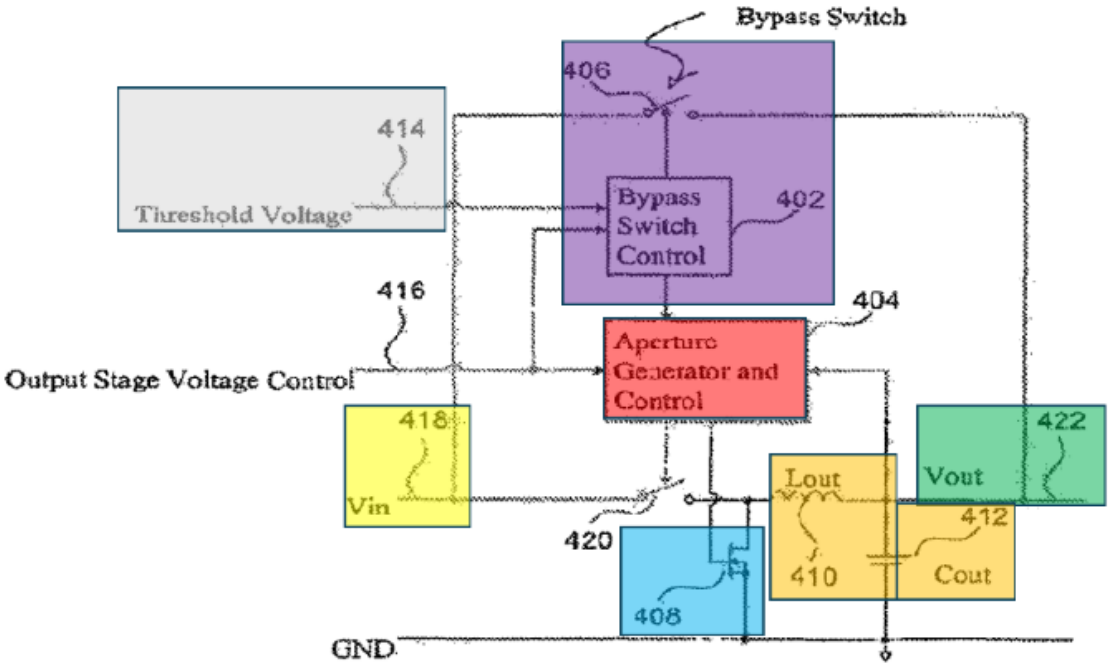

Figure 4 "illustrates an example step down switching power supply [reference numeral 400, not shown in the annotated Figure 4] having a bypass switch architecture." Ex. 1001, 3:5–6.

As shown in annotated Figure 4, a power supply receives three different inputs: (1) an "input voltage signal" V_{IN} 418 (yellow), (2) an "Output Stage Voltage Control signal" 416, and (3) a "Threshold Voltage signal" 414 (grey). *Id.* at 6:38–40. Input voltage signal V_{IN} 418 (yellow) typically is received from a battery and is set according to, among other requirements, the device using the power amplifier. *Id.* at 6:41–43.

"Output Stage Voltage Control signal 416"[3] is received from a control module configured to control the power supply voltage provided to the

[3] We have used the capitalization of terms from the '593 patent, which is somewhat inconsistent. For example, the term "input voltage signal" is not capitalized, but the term "Output Stage Voltage Control signal" is capitalized. *See, e.g.*, Ex. 1001, at 6:38–43.

output stage of the power amplifier. *Id.* at 6:46–48. In the embodiment illustrated in Figure 4, "Output Stage Voltage Control signal 416" controls an "Aperture Generator and Control module 404" (red) of power supply 400. The function of "Threshold Voltage 414" is to control "Bypass Switch Control module 402 of power supply 400." *Id.* at 6:54–55.

Control methods such as pulse-width modulation (PWM) or pulse-frequency modulation (PFM) are used to regulate the output voltage by adjusting the duty cycle or frequency of the switch. PO Resp. 2 (citing Ex. 2001 ¶ 28).

Power supply 400 operates in two modes: (1) normal mode and (2) bypass mode. Ex. 1001, 7:9–10.

In normal mode, input voltage signal V_{IN} 418 is received at input switch 420, which is controlled by "Aperture Generator and Control module" 404. *Id.* at 7:11–13. "Aperture Generator and Control module" 404 (red) is configured to control input switch 420, shown in Figure 4, to couple input Voltage signal V_{IN} 418 to the collector/drain of switching transistor 408 (blue). *Id*. at 7:14–16.

In bypass mode, V_{IN} 418 is directly coupled to the power supply output node, which provides power Supply output voltage V_{OUT} 422. *Id*. at 7:46–48. "Bypass Switch Control module" 402 (purple) receives "Threshold Voltage signal" 414 (grey) and "Output Stage Voltage Control signal" 416. *Id*. at 7:50–52. "Threshold Voltage signal" 414 determines at which value of the power supply output voltage power supply 400 switches to bypass mode. *Id*. at 7:52–54. "Output Stage Voltage Control signal" 416 includes information about the target power supply output voltage and thus

allows Bypass Switch Control module 402 (purple) to determine the value of the power supply output voltage. *Id*. at 7:54–58.

According to the '593 patent, the overall power supply efficiency can be improved by bypassing the power supply at a pre-determined threshold. Ex. 1001, 6:21–35; Ex. 2001 ¶ 50. Specifically, the '539 patent discloses that a "bypass switch control circuitry" can be used "to cause the bypass of the power supply circuitry when the pre-determined threshold is exceeded." Ex. 1001, 4:1–7; Ex. 2001 ¶¶ 50-51; Ex. 1003 ¶ 85 ("Bypass Switch Control module bypasses the power supply when the output power exceeds a determined threshold, thereby increasing the efficiency of the power supply. . . ." (citing Ex. 1001, 7:59–8:8)).

The circuit pathways for normal and bypass mode are shown in Figure 4 of the '593 patent, annotated by Petitioner (Pet. 10), as reproduced below.

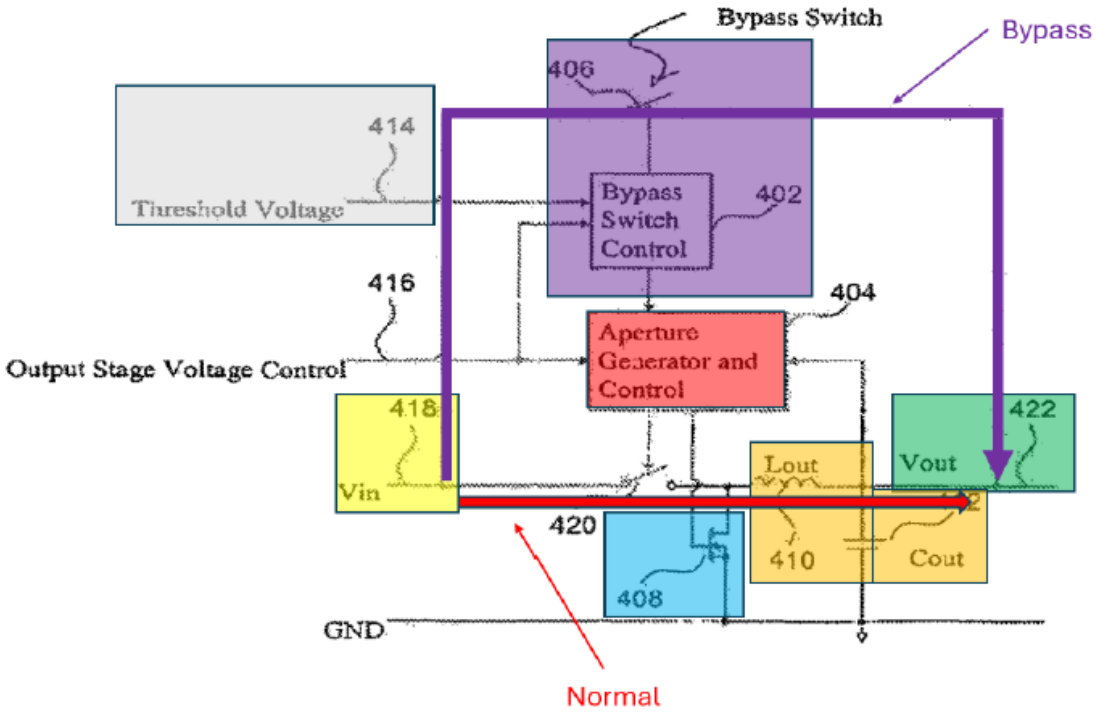

Figure 4, annotated by Petitioner, shows both the normal pathway (red) and bypass pathway (purple).

E. Illustrative Claim

Petitioner challenges claims 1–20. Claims 1, 9, and 15 are independent claims. Independent claim 1 is directed to a "power supply." Ex. 1001, 11:16–25. Independent claim 9 is directed to a "method for controlling a power supply." *Id.* at 11:54–12:4. Independent claim 15 is directed to a "system comprising an electronic device and a power supply." *Id.* at 12:24–38. Except for the inclusion of an "electronic device" coupled to the power supply in claim 15, claims 1 and 15 are identical.

Independent claim 1 is illustrative and is reproduced below with bracketed labels employed by Petitioner to facilitate analysis and discussion. *See, e.g.*, Pet. XV (Listing of Challenged Claims).

> 1[pre] A power supply comprising:
>
> 1[a] a switching device configured to down-convert an input voltage and pass the down-converted input voltage to an output voltage node; and
>
> 1[b1] an aperture generator and control module configured to control the switching device,
>
> 1[b2] wherein, in response to a power efficiency of the power supply exceeding a predetermined threshold, the aperture generator and control module deactivates the switching device and passes the input voltage to the output voltage node.

Ex. 1001, 11:16–25.

F. Prior Art and Asserted Grounds

Petitioner asserts that the challenged claims would have been obvious based on the following six grounds:

Claim(s) Challenged	35 U.S.C. §[4]	Reference(s)/Basis
1, 2, 5–7, 9, 11, 12, 15	103	Hau[5] and Yoshida[6]
3, 4, 8, 10, 13, 14, 17–20	103	Hau, Yoshida, and Sahu[7]
16	103	Hau, Yoshida, and Lejon[8]
1–5, 9–11, 15, 19, 20	103	Canyon[9] and Ranjan
6–8, 12–14	103	Canyon, Ranjan, and Hau
16–18	103	Canyon, Ranjan, and Lejon

Petitioner also relies on the Declaration testimony of Dr. Larson. *See* Exs. 1003, 1031.[10] Patent Owner relies on the Declaration testimony of Dr. Ricketts. *See* Ex. 2001.[11]

[4] The Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112-29, 125 Stat. 284, 296–07 (2011), took effect on September 16, 2011. The changes to 35 U.S.C. §§ 102 and 103 in the AIA do not apply to any patent application filed before March 16, 2013. Because the application for the patent at issue in this proceeding was filed before March 16, 2013, we refer to the pre-AIA version of the statute. Ex. 1001, codes (21), (22).
[5] U.S. Patent No. 7,427,897 B2, filed February 8, 2006, Ex. 1007 ("Hau").
6 U.S. Patent No. 7,061,213 B2, filed July 3, 2003, Ex. 1008 ("Yoshida").
[7] "A High-Efficiency Linear RF Power Amplifier With a Power-Tracking Dynamically Adaptive Buck-Boost Supply," IEEE Transactions on Microwave Theory and Techniques, Vol. 52, No. 1, January 2004, Ex. 1009, ("Sahu").
[8] WO 2007/084033 A1, filed January 23, 2006, Ex. 1013 ("Lejon").
[9] U.S. Patent No. 6,646,511, filed Nov. 12, 2002, Ex. 1011, ("Canyon").
[10] Dr. Larson's experience in industry and academia is summarized in his testimony and his Curriculum Vitae. Ex. 1003 ¶¶ 5–20; Ex. 1004. Exhibit 1031 is Dr. Larson's additional testimony in support of Petitioner's Reply. We recognize his unchallenged expertise and accept his opinion testimony under Fed. R. Evid. 702.
[11] Dr. Ricketts' experience in industry and academia is summarized in his testimony. Ex. 2001 ¶¶ 3–15. His testimony refers to a "curriculum vitae, which is attached as Appendix A hereto." *Id.* ¶ 14. There was, however, no

II. ANALYSIS

A. Legal Standards

Section 103 of the United States Code forbids issuance of a patent when "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when available, evidence such as commercial success, long felt but unsolved needs, failure of others, etc.[12] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966); *see KSR*, 550 U.S. at 407 ("While the sequence of these questions might be reordered in any particular case, the [*Graham*] factors continue to define the inquiry that controls."). The Court in *Graham* explained that these factual inquiries promote "uniformity and definiteness," for "[w]hat is obvious is not a question upon which there is likely to be uniformity of thought in every given factual context." 383 U.S. at 18.

The U.S. Supreme Court made clear that we apply "an expansive and flexible approach" to the question of obviousness. *KSR*, 550 U.S. at 415.

Appendix A, and no such "curriculum vitae" document attached to his Declaration, or otherwise of record in this proceeding. This did not detract from our ability to recognize his unchallenged expertise and accept his opinion testimony under Fed. R. Evid. 702.

[12] On the complete record, there is no reference to any objective evidence of non-obviousness.

Whether a patent claiming the combination of prior art elements would have been obvious is determined by whether the improvement is more than the predictable use of prior art elements according to their established functions. *Id.* at 417. To support this conclusion, however, it is not enough to show merely that the prior art includes separate references covering each separate limitation in a challenged claim. *Unigene Labs., Inc. v. Apotex, Inc.*, 655 F.3d 1352, 1360 (Fed. Cir. 2011). Rather, obviousness additionally requires that a person of ordinary skill at the time of the invention "would have selected and combined those prior art elements in the normal course of research and development to yield the claimed invention." *Id.*

In determining whether there would have been a rationale to combine prior art references to arrive at the claimed invention, it is insufficient to simply conclude the combination would have been obvious without identifying any reason *why* a person of skill in the art would have made the combination. *Metalcraft of Mayville, Inc. v. Toro Co.*, 848 F.3d 1358, 1366 (Fed. Cir. 2017).

Moreover, in determining the differences between the prior art and the claims, the question under 35 U.S.C. § 103 is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious. *Litton Indus. Prods., Inc. v. Solid State Sys. Corp.*, 755 F.2d 158, 164 (Fed. Cir. 1985) ("It is elementary that the claimed invention must be considered as a whole in deciding the question of obviousness."); *see also Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1537 (Fed. Cir. 1983) ("[T]he question under 35 U.S.C. § 103 is not whether the differences *themselves* would have been obvious. Consideration of differences, like each of the findings set forth in *Graham*, is but an aid in

reaching the ultimate determination of whether the claimed invention *as a whole* would have been obvious.").

As a factfinder, we also must be aware "of the distortion caused by hindsight bias and must be cautious of arguments reliant upon *ex post* reasoning." *KSR*, 550 U.S. at 421.

Applying these general obviousness principles, we consider the evidence and arguments presented by the parties.

B. Level of Ordinary Skill in the Art

The level of skill in the art is "a prism or lens" through which we view the prior art and the claimed invention. *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001). "This reference point prevents . . . factfinders from using their own insight or, worse yet, hindsight, to gauge obviousness." *Id.*

"The *Graham* analysis includes a factual determination of the level of ordinary skill in the art. Without that information, a . . . court cannot properly assess obviousness because the critical question is whether a claimed invention would have been obvious at the time it was made to one with ordinary skill in the art." *Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986); *see also Ruiz v. A.B. Chance*, 234 F.3d 654, 666 (Fed. Cir. 2000) ("The determination of the level of skill in the art is an integral part of the *Graham* analysis.").

Because claim terms generally are given their ordinary and customary meaning, as would have been understood by one of ordinary skill in the art in the context of the entire disclosure, the level of ordinary skill also an integral part of construing the claims, as discussed in the following section of this Decision.

Factors pertinent to a determination of the level of ordinary skill in the art include: (1) educational level of the inventor; (2) type of problems encountered in the art; (3) prior art solutions to those problems; (4) rapidity with which innovations are made; (5) sophistication of the technology; and (6) educational level of workers active in the field. *Env't Designs, Ltd. v. Union Oil Co.*, 713 F.2d 693, 696–697 (Fed. Cir. 1983) (citing *Orthopedic Equip. Co. v. All Orthopedic Appliances, Inc.*, 707 F.2d 1376, 1381–82 (Fed. Cir. 1983)). Not all such factors may be present in every case, and one or more of these or other factors may predominate in a particular case. *Id.* Moreover, these factors are not exhaustive but are merely a guide to determining the level of ordinary skill in the art. *Daiichi Sankyo Co. v. Apotex, Inc.*, 501 F.3d 1254, 1256 (Fed. Cir. 2007). In determining a level of ordinary skill, we also may look to the prior art, which may reflect an appropriate skill level. *Okajima*, 261 F.3d at 1355.

Relying on the testimony of Dr. Larson, Petitioner asserts that a person of ordinary skill in the art would have had:

> at least a bachelor's degree in electrical engineering or a related subject and two or more years of experience in the field of RF circuit design and/or power supplies for RF circuits, or at least five years of work experience and training in the design and development of RF circuits and/or power supplies for RF circuits. Less work experience may be compensated by a higher level of education, such as a master's degree.

Pet. 11 (citing Ex. 1003 ¶¶ 22–23).

Dr. Larson's Declaration testimony states he considered some of the pertinent factors listed above. Ex. 1003 ¶ 21. Dr. Larson testifies that, in his opinion, the level of ordinary skill is as stated by Petitioner. *Id.* ¶ 22.

Relying on the testimony of Dr. Ricketts, Patent Owner asserts that a person of ordinary skill in the art would have had:

> (a) a Bachelor of Science degree in electrical or computer engineering (or a related academic field), and at least two (2) additional years of work experience in the design and development of radio frequency circuits and/or systems, or (b) at least five (5) years of work experience and training in the design and development of radio frequency circuits and/or systems.

PO Resp. 1 (citing Ex. 2001, ¶¶ 24–26).

Dr. Ricketts states that in his opinion, the level of ordinary skill is as stated by Patent Owner. Ex. 2001 ¶ 25. This proposed level of skill is nearly identical to that proposed by Petitioner. Unlike Dr. Larson, however, Dr. Ricketts states his "opinion," without stating the facts, data, or factors that he considered in reaching his opinion. Accordingly, we give his testimony little probative weight. 37 C.F.R. § 42,65(a) ("Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight.").

For purposes of this Decision, based on the prior art, the sophistication of the disclosed technology in the '593 patent, and Dr. Larson's testimony, we adopt Petitioner's definition of the level of ordinary skill, which is that a person of ordinary skill in the art would have had:

> at least a bachelor's degree in electrical engineering or a related subject and two or more years of experience in the field of RF circuit design and/or power supplies for RF circuits, or at least five years of work experience and training in the design and development of RF circuits and/or power supplies for RF circuits. Less work experience may be compensated by a higher level of education, such as a master's degree.

Pet. 11 (citing Ex. 1003 ¶¶ 22–23).

We note, however, that our obviousness analysis would be the same under each party's definition of the level of ordinary skill in the art.

C. Claim Construction

Petitioner contends that the following two claim terms require construction: (1) "power efficiency," as used in the claim phrase "in response to a power efficiency of the power supply exceeding a predetermined threshold;" and (2) "aperture generator and control module." Pet. 11–16; Reply 2–8.

According to Petitioner, "power efficiency" (independent claims 1, 9, and 15) should be construed as "the output power of the power supply compared to its input power." Pet. 12 (citing Ex. 1003 ¶ 83). Petitioner also asserts that "[t]he broader phrase 'in response to a power efficiency of the power supply exceeding a predetermined threshold'. . . should also be construed to encompass *indirect measurements of power efficiency* such as output current or voltage, and should *not* be interpreted to require a *direct measurement of power efficiency*. *Id.* at 12 (emphases added) (citing Ex. 1003 ¶ 83. According to Petitioner, "[t]here is no disclosure in the '593 Patent specification where the circuitry directly calculates the power efficiency, much less determines whether to bypass the down-converter based on such a calculation." *Id.* at 13 (citing Ex. 1003 ¶ 85).

Petitioner also asserts that the claim term "aperture generator and control module" (independent claims 1 and 15) should *not* be construed as a means-plus-function term, governed by 35 U.S.C. § 112 ¶ 6 (*id.* at 13–14), but rather "refers to a known structure which controls the gain of a down-converting transistor by varying the width (aperture) of control pulses." (*id.* at 15; *see also id.* at 13–16 (providing an expanded discussion of the

construction of this phrase). Neither independent claim 9, nor any of the claims that depend from claim 9, use this phrase or a similar one. *See* Ex. 1001, 11:54–12:25.

Patent Owner's Response addresses only the proposed construction for the claim term "power efficiency." PO Resp. 13–19; Sur-Reply 1–9 ("The sole claim construction dispute in this IPR relates to the term 'power efficiency' *and the broader phrase* 'in response to the power efficiency of the power supply exceeding a predetermined threshold.'" (Sur-Reply 1 (emphasis added))). Patent Owner asserts that the term "power efficiency" "was well-known in the art and should be given its plain and ordinary meaning." PO Resp. 13. According to Patent Owner, "it was well-known that 'power efficiency' is a ratio of output power to input power, which could be expressed in percentage." *Id*. (citing Ex. 2001 ¶ 67).

Dr. Ricketts cited testimony is:

> a [person of ordinary skill in the art] would have understood that power efficiency is not merely a comparison of output and input power, as Dr. Larson suggests. [Ex. 1003 ¶ 83]. Rather, it is a ratio of output power to input power, which could be expressed in percentage by multiplying the ratio by 100."

Ex. 2001 ¶ 67 (citing Ex. 1001, 4:35–42, 50–56 (which provide specific examples of calculating a "power supply" or "system" efficiency). Dr. Ricketts' conclusion from the cited examples is that it is his "opinion that the plain and ordinary meaning of 'power efficiency' is *the ratio* of output power to input power." Ex. 2001 ¶ 68 (emphasis added).

Claims must be construed "only to the extent necessary to resolve the controversy." *AstraZeneca AB v. Mylan Pharms. Inc.*, 19 F.4th 1325, 1345 (Fed. Cir. 2021) (quoting *Vivid Techs., Inc. v. American Science & Eng'g,*

Inc., 200 F.3d 795, 803 (Fed. Cir. 1999); *see also Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) ("we need only construe terms 'that are in controversy, and only to the extent necessary to resolve the controversy.'").

There is a clear controversy between the parties over the scope and meaning of the claim term "power efficiency" and how "power" is measured or determined, which we address below. In general, this controversy is whether the claimed "power efficiency" must be measured directly as a "ratio" of output power to input power, as asserted by Patent Owner, or measured indirectly as a comparison of output power to input power, such as using voltage or current measurements, as advocated by Petitioner.

There is no dispute over the meaning of the claim term "aperture generator and control module," and thus we determine there is no need for a specific construction of this claim term.

1. Legal Standards

As stated in 37 C.F.R. § 42.100(b),

> In an *inter partes* review proceeding, a claim of a patent . . . shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b), including construing the claim in accordance with the *ordinary and customary* meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent. Any prior claim construction determination concerning a term of the claim in a civil action, or a proceeding before the International Trade Commission, that is timely made of record in the *inter partes* review proceeding will be considered.

37 C.F.R. § 42.100(b) (emphasis added). Under this standard, claim terms are generally given their "*ordinary and customary* meaning" as would have

been understood by a person of ordinary skill in the art at the time of the invention and in the context of the entire patent disclosure. *See Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–1313 (Fed. Cir. 2005) (en banc) (emphasis added) ("We have frequently stated that the words of a claim 'are generally given their ordinary and customary meaning.'" (citations omitted)).[13]

The "ordinary and customary meaning" is the generic, default label for all claim constructions, with only two exceptions – (1) when a patentee acts as a "lexicographer;" or (2) when a patentee disavows the full scope of a claim term. *Thorner v. Sony Comput. Entm't Am. LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012). As stated in *Thorner*,

> The words of a claim are generally given their *ordinary and customary meaning* as [would have been] understood by a person of ordinary skill in the art when read in the context of the specification and prosecution history. There are only two exceptions to this general rule: 1) when a patentee sets out a definition and acts as his own lexicographer, or 2) when the patentee disavows the full scope of a claim term either in the specification or during prosecution.

Thorner, 669 F.3d at 1365 (emphasis added; citations deleted).

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[13] We use the phrase "ordinary and customary meaning" because that is the phrase used in *Phillips*, as cited above, and in our applicable Rule 42.100(b). The parties use the phrase "plain and ordinary meaning" in asserting, opposing, or discussing their proposed claim constructions. Thus, the District Court also used the phrase "plain and ordinary" in its claim construction Order (*see* Ex. 1037). We too will refer to the phrase "plain and ordinary" in citing arguments by the parties or the District Court's analysis. While there may be nuanced differences between the two different phrases, which we need not discuss in this Decision, we use the two phrases interchangeably, as having the same meaning.

In the case before us, there is neither argument nor persuasive evidence by the parties that meets either of these two exceptions. Thus, we apply the generic, default label of the "ordinary and customary" meaning in construing the claims.

"[T]here is no magic formula or catechism for conducting claim construction." *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 801, 809 (Fed. Cir. 2021) (quoting *Phillips*, 415 F.3d at 1324). Fortunately, however, there is substantial judicial guidance.

Claim construction requires determining how a skilled artisan would understand a claim term "in the context of the entire patent, including the specification." *Grace Instrument Indus., LLC v. Chandler Instruments Co., LLC*, 57 F.4th 1001, 1008 (Fed. Cir. 2023) (quoting *Phillips*, 415 F.3d at 1313. "[C]laims must be read in view of the specification, of which they are a part." *Id.* ((citation omitted; quoting *Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 978 (Fed. Cir. 1995) (en banc)). The Specification is the "single best guide to the meaning of a disputed term." *Grace Instrument,* 57 F.4th at 1008 (quoting *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996). The Specification "is, thus, the primary basis for construing the claims." *Id.* (citation omitted). Although claim terms are interpreted in the context of the entire patent, it is improper to import limitations from the Specification into the claims. *Phillips*, 415 F.3d at 1323. Thus, we are careful not to cross that "fine line" that exists between properly construing a claim in light of the specification and improperly importing into the claim a limitation from the specification." *Comark Commc'ns., Inc. v. Harris Corp.*, 156 F.3d 1182, 1186 (Fed. Cir. 1998) ("We recognize that there is sometimes a fine line between reading a

claim in light of the specification, and reading a limitation into the claim from the specification.").

While certain terms may be at the center of the claim construction debate, the context of the surrounding words of the claim also must be considered in determining the ordinary and customary meaning of those terms. *ACTV, Inc. v. Walt Disney Co.*, 346 F.3d 1082, 1088 (Fed. Cir. 2003).

In construing the claims, we may also look to available "extrinsic evidence concerning relevant scientific principles, the meaning of technical terms, and the state of the art." *Phillips*, 415 F.3d at 1314 (quoting *Innova/Pure Water, Inc. v. Safari Water Filtration Sys., Inc.*, 381 F.3d 1111, 1116 (Fed. Cir. 2004)).

2. Power Efficiency

a) District Court Construction

Our rules require that "[a]ny prior claim construction determination concerning a term of the claim in a civil action, . . . that is timely made of record in the *inter partes* review proceeding will be considered." 37 C.F.R. § 42.100(b). Here, following briefing by the parties and a Markman hearing, the District Court in which a parallel case involving the '593 patent is pending (*see* Section I.C of this Decision) issued a Claim Construction Order and Memorandum determining that the term "power efficiency" should have its "plain and ordinary meaning." Ex. 1037, 31–36, 38. This was the meaning asserted by ParkerVision, Inc., the Plaintiff in the District Court proceeding, who is the Patent Owner in the proceeding before us. We considered the District Court's analysis. We reach the same conclusion as the District Court – the claim term "power efficiency" has its ordinary and

customary meaning. *See supra* fn 13. It is clear, however that the two parties have different views of what is the ordinary and customary meaning of this claim term. Accordingly, we also provide a specific determination of how a person of ordinary skill would have understood this claim term. *See Grace Instrument.*, 57 F.4th at 1008 (stating that claim construction involves "determining how a skilled artisan would understand a claim term in the context of the entire patent, including the specification."

To determine the correct construction of the claim term "power efficiency", we first turn to the intrinsic evidence. We start with the plain language of the claims.

b) Claims

Independent claims 1, 9, and 15 each include the identical phrase that contains the term "power efficiency." This phrase is "in response to a power efficiency of the power supply exceeding a predetermined threshold." *See* claim 1[b2] (Pet. xv); claim 9[c] (*id.*at xvii); claim 15[d2] (*id*. at xviii). We will cite representative independent claim 1 unless a specific citation to independent claims 9 or 15 is necessary. Thus, the independent claims *do not* include a specific structure, step, or other limitation that states how the "power efficiency" is determined or what it is. The independent claims state only that the "power efficiency" referred to in the claims is the power efficiency of the "power supply." Referring to claim 1, the "power supply" is the entirety of the claimed invention. *Id.* at 1[pre] (claiming "A power supply comprising . . .).

We also know from the independent claims that the function of the "power efficiency" determination is to "deactivate" (clause 1[b2]) a claimed "switching device" (clauses 1[a]; 1[b2]) when the "power efficiency"

exceeds "a predetermined threshold" (clause 1[b2]). Deactivating the switching device results in the input voltage flowing to an output voltage node without the input voltage being "down-converted." When deactivated, the circuit operates in its "normal" mode, not its "bypass" mode. Ex. 1001, 7:9–13, 46–49, 59–65.

Several dependent claims also refer to "power efficiency.

Dependent claim 3 refers to "*one or more power efficiency characteristics* of an electronic device coupled to the power supply" Ex. 1001, 11:30–35 (emphasis added). This suggests that there is "one or more" ways to determine, calculate, or measure power efficiency. In an embodiment, the threshold is defined in terms of output power, and the bypass switch is engaged or disengaged when the output power exceeds or falls below the threshold. Ex. 1001, 4:7–10. In another embodiment, the power supply is bypassed when the noise power on or near the output frequency (frequency of the output signal) exceeds a threshold. *Id.* at 4:10–13.

Dependent claim 5 refers to a "power efficiency associated with the down-converted input voltage." *Id.* at 11:39–42.

Dependent claim 10 refers to "a selected modulation scheme based on *one or more power efficiency characteristics* of an electronic device coupled to the power supply." *Id.* at 12:5–10 (emphasis added). Like claim 3, this

also suggests that there is "one or more" characteristics that can be used to determine, calculate, or measure power efficiency.

Dependent claim 11 refers to "providing an output current at a maximum power efficiency associated with the down-converted voltage." *Id.* at 12:11–13.

Dependent claim 19, like claim 10, refers to "a selected modulation scheme based on *one or more power efficiency characteristics* of an electronic device coupled to the power supply." *Id.* at 12:49–54 (emphasis added). Like claims 3 and 10, this also suggests that there is "one or more" characteristics that can be used to determine, calculate or measure power efficiency.

Based on the plain language of the claims, we determine that the term "power efficiency" has one or more characteristics, which suggests that there are one or more ways to determine, calculate, or measure power efficiency.

c) Specification

The Specification provides a considerable analysis of the claim term "power efficiency" and the related word "power."

Figure 1 illustrates exemplary plots of efficiency versus output *current*. Ex. 1001, 2: 63–65.

Figure 3 illustrates exemplary plots of power supply output *voltage* and power supply output *current* versus output power of an example multiple-input-single-output (MISO) amplifier. *Id.* at 3:1–4.

Figure 4 shows, in part, a step down switching power supply having a bypass switch architecture based on voltage inputs. *Id.* at 3:5–6, 6:36–40.

Figure 6 illustrates efficiency enhancement due to the use of a bypass switch architecture in a switching power supply based on voltage and current. *Id.* at 3:9–11, 9:20–24.

The Specification discloses that in one embodiment "the pre-determined threshold" stated in the claims "is defined in terms of output power, and the bypass switch is engaged or disengaged when the output power exceeds or falls below the threshold." Ex. 1001, 4:4–10. In another embodiment, the power supply is bypassed when the "noise power on or near the output frequency (frequency of the output signal) exceeds a threshold." *Id.* at 4:10–14. None of the claims, however, refer to "noise power."

The Specification also states that "[t]he power supply efficiency directly affects the efficiency of the entire power amplification system using the power supply." *Id.* at 4:24–26. The Specification then provides an example of the "power supply efficiency." This example refers to "the battery voltage (power supply input voltage"), "output voltage (power supply output voltage," and where the power supply drives a power amplifier that is "50% efficient." *Id.* at 4:35–39. Based on the specific voltages in this example, "the power supply current" is determined. *Id.* at 4:40–41. The example then refers to "plot 102 of FIG. 1," which is a plot of "Efficiency vs. Output Current." Using specific values of input and output voltages at various output currents, "a power supply efficiency" is determined. Thus, as stated in this example, and as asserted by Petitioner, the factors of current and voltage are used to determine "power supply efficiency."

Under the heading of "Power Supply Design Optimization for Enhanced System Efficiency" (*id.* at 4:57–58), the Specification states "one set of criteria that can be used to design both the power supply and the power amplifier for maximized system efficiency include the network characteristics and/or statistics." *Id.* at 5:1–3. This disclosure then suggests various criteria that affect power supply design and efficiency.

Under the heading "Power Supply Efficiency Optimization" (*id.* at 6:20), which appears to be more specifically directed to the claimed invention, the Specification states "system efficiency can be further increased by bypassing the power supply when the required output voltage (or the output power) exceeds a pre-determined threshold." Ex. 1001, 6:25–28. The Specification refers to Figure 4, and states that "[t]he function of Threshold Voltage 414 is to control a Bypass Switch Control module 402 of power supply 400." *Id.* at 6:54–55.

In summary, the Specification refers extensively and repeatedly to the factors of current and voltage in determining, calculating, or measuring whether the "power efficiency" of the power supply exceeds a predetermined threshold.

d) Extrinsic Evidence

The only extrinsic evidence asserted by the parties on the issue of claim construction is the Declaration testimony of Dr. Larson (Exs. 1003, 1031) and Dr. Ricketts (Ex. 2001), and the related cross-examination of their testimony (Ex. 1030 (cross-examination of Dr. Ricketts); Ex. 2003 (cross-examination of Dr. Larson)).

Both Dr. Larson and Dr. Ricketts provide testimony regarding the scope and meaning of the claim term "power efficiency" in the context of

the phrase "in response to a power efficiency of the power supply exceeding a predetermined threshold."

Dr. Larson testifies that in his opinion "power efficiency" in independent claims 1, 9, and 15 "should be construed as "the output power of the power supply compared to its input power." Ex. 1003 ¶ 83 (citing Ex. 1001, Fig. 1, 4:15–56).

Dr Larson explains his opinion is based on the disclosure in the '593 patent that the only description in the Specification of activating the bypass switch to "de-activat[e] the switching device and pass[] the input voltage to the output voltage node" relies on indirect measurements such as output voltage. *Id.* ¶ 85 (citations omitted).

Dr. Larson also testifies:

> the broader phrase 'in response to a power efficiency of the power supply exceeding a predetermined threshold' (in which case 'the aperture generator and control module deactivates the switching device and passes the input voltage to the output voltage node') should also be construed to encompass indirect measurements of power efficiency such as current or voltage, and should not be interpreted to require a direct measurement of power efficiency.

Id. ¶ 83 (citations omitted).

Petitioner criticizes Dr. Larson's proposed construction because he stated on cross-examination that the comparison of outpower and input power may have" multiple definitions." PO Sur-reply 1–2 (citing Ex. 2003, 12:22–13:11). Dr. Larson further explained, however, that:

> you could measure the input power, and if the power supply voltage is known, that would tell you something about the output power. So I guess there are many different ways of making that measurement, you know, and they all have their pros and cons. And that's part of what we do when we design these circuits.

Ex. 2003, 14:10–17.

Dr. Ricketts provides a slightly different opinion concerning the scope and meaning of the claim term "power efficiency." Dr. Ricketts testifies that in his opinion the term "[p]ower efficiency [as used in the '593 patent] is "a metric that measures the proportion of input power that is successfully converted into useful output power." Ex. 2001 ¶ 41. He further opines that the claim term "[p]ower efficiency" ŋ" is defined as "the ratio of output power P_{out} to input power P_{in}, generally expressed as a percentage, such as $ŋ=P_{out}/P_{in}\times100\%$." *Id.* ¶ 42. He further testifies that "[i]n the context of power converters, P_{in} is the electrical power drawn from the source, and P_{out} is the power delivered to the load. *Id.*

The parties and the experts argue extensively over their differences concerning the meaning of the term "power efficiency." We find little difference between Dr. Larson's opinion that the term "power efficiency," as used in the claims, "should be construed as 'the output power of the power supply *compared to* its input power'" (Ex. 1003 ¶ 83 (emphasis added)) and Dr. Ricketts testimony that the term "power efficiency," as used in the claims, "is defined as "the *ratio of* output power P_{out} to input power P_{in}, generally expressed as a percentage" (Ex. 2001 ¶ 42 (emphasis added)); *see also id.* ¶ 67 (stating that "a POSITA would have understood that power efficiency is *not merely a comparison* of output and input power, as Dr. Larson suggests. Rather, *it is a ratio* of output power to input power" (citation omitted)).

Dr. Ricketts "ratio" is nothing more than a mathematical "comparison" of output power to input power. Power is measured based on various factors. Indeed, Dr. Ricketts testifies that the "'593 patent discloses

how the threshold for engaging or disengaging the bypass switch can be set in terms of "output power or *output voltage that corresponds to an output power*." Ex. 2001 ¶ 51 (emphasis added). Dr. Ricketts also testifies that "[a]s was well-known by a [person of ordinary skill in the art], power is a function of (and is dependent on) voltage and current (i.e., P=IV). As such, power cannot be derived based on any one such quantity alone." *Id.* ¶ 70. Patent Owner makes this same argument, asserting that "'power efficiency' is a function of input and output power, which depends on both voltage ***and*** current." PO Resp. 30.

There is no dispute that the disclosed and claimed power efficiency threshold is "predetermined."

There also is no dispute that the supply circuit itself does *not* measure or determine "power efficiency." *See* Ex. 2001 ¶ 74 (testimony by Dr. Ricketts that "the claims do not require a calculation of power efficiency by the circuitry"); Ex. 1003 ¶ 85 (testimony by Dr. Larson that the '593 patent does not disclose that the circuit "directly calculates the power efficiency," such as by comparing input and output power; instead the "Bypass Switch Control module 402 of power supply 400 compares Threshold *Voltage* 414 to output *voltage* to determine whether power supply 400 should switch to bypass mode" (emphasis added) (citations omitted).

e) Claim Construction Conclusion

We recognize that "[t]he very nature of words would make a clear and unambiguous claim a rare occurrence." *Autogiro Co. of Am. v. United States*, 384 F.2d 391, 396 (Ct. Cl. 1967). Our reviewing Court, however, has provided a beacon, which we have followed, to guide us in determining

the proper construction when we encounter ambiguities or differing interpretations from the parties:

> Ultimately, the interpretation to be given a term can only be determined and confirmed with a full understanding of what the inventors actually invented and intended to envelop with the claim. The construction that stays true to the claim language and most naturally aligns with the patent's description of the invention will be, in the end, the correct construction.

Renishaw PLC v. Marposs Societa' per Azioni, 158 F.3d 1243, 1250 (Fed. Cir. 1998) (citations omitted).

Based on our review of the intrinsic and extrinsic evidence that bears on the construction of the claim term "power efficiency," we agree with Petitioner and its declarant, Dr. Larson, that a person of ordinary skill (i.e., a degreed engineer with two or more years of experience in the field of RF circuit design and/or power supplies for RF circuits) would have understood that to determine the power efficiency of a circuit, one would measure the components or characteristics of power, such as voltage and current, to determine the output power of the power supply *compared to* its input power.

Based on our construction of the claim term "power efficiency," we also note that the claims only require performing a bypass function when the efficiency threshold is exceeded. The claims *do not* require a power efficiency ratio to be measured or calculated. Thus, we decline Patent Owner's attempt to limit the claim term "power efficiency" to a ratio.

D. Grounds 1A–1C

Grounds 1A–1C each rely on Hau and Yoshida. Ground 1B adds Sahu, and Ground 1C adds Lejon. Collectively, Grounds 1A–1C include all of the challenged claims, which are claims 1–20.

In broad summary of these asserted grounds of unpatentability, Petitioner relies on Yoshida for the disclosure of a power supply with a switching DC-DC converter. Pet. 23–28. Petitioner relies on Hau for the disclosure of a bypass switch to bypass the DC-DC converter at a power efficiency threshold. *Id.* at 28–33. Petitioner relies on Sahu for the disclosure that the performance of the power supply should be optimized based on the most probable power output levels at which the device is likely to be operated. *Id.* at 45–49. Petitioner relies on Leon for the disclosure of a linear amplification using nonlinear components (LINC) to provide excellent efficiency over a vast range of output powers. *Id.* at 58–60.

1. Ground 1A – Hau and Yoshida
Claims 1, 2, 5–7, 9, 11, 12, 15

We make the following findings of fact regarding Hau and Yoshida.

a) Hau

Similar to the ’593 patent, Hau discloses power amplifiers used in battery powered mobile handsets. Ex. 1007, 1:7–11. More particularly, Hau discloses optimizing current use in such power amplifiers over a range of output power levels. *Id.* Hau recognizes that there is a constant need to reduce power consumption of the handset components in order to extend battery life. *Id.* at 1: 20–22. According to Hau, the RF power amplifier is one of the main current consuming parts within handsets. *Id.* at 1:23–24.

Hau also discloses, in general, the handset is required to transmit at a high output power level when it is farther away from a receiving base station in order to maintain a pre-determined signal strength at the base station for sufficient reception. *Id.* at 1:33–34. Hau also states that handsets transmit at maximum linear output power only for a small fraction of time, and most of

the transmission takes place at a considerably lower power levels. *Id.* at 1:52–55. Hou's disclosed device is directed to dynamically optimizing current consumption and linearity of a power amplifier at each power level without the need for any external control in order to provide automatic current optimization for performance improvement while also extending battery life. *Id.* at 2:36–40. To achieve this objective, Hau uses a two-stage power amplifier, where the bias voltage applied to the power amplifier varies dynamically with the output power. *Id.* at 2:45–48.

Figure 1 from Hau is reproduced below.

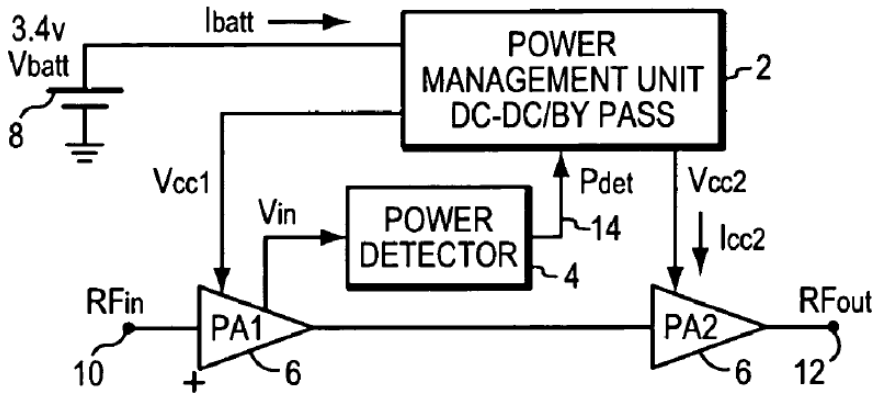


FIG. 1

Figure 1 from Hau is a is a circuit block diagram of a system employing Hau's disclosed invention. Ex. 1007, 3:49–50.

As shown in Figure 1, Hau's circuit includes power management unit 2, power detector 4, 3.4V battery 8, and two power amplifiers 6 labeled as PA1 and PA2. *Id.* at 4:7–10.

The circuit illustrated in Hau's Figure 1 is part of a handset that has been turned on and has received a new RF control signal from a base station. *Id.* at 4:10–12. In this status, RF_{in} signal 10 is changed to a level such that the circuit will deliver the optimum, pre-determined output power at the

RF_{out} signal 12 which corresponds to that particular RF_{in} signal level. *Id.* at 4:12–16. V_{in} is an RF signal sensed from the output of power amplifier PA1 that is input to power detector 4. *Id.* at 4:16–17.

Power detector 4 outputs a DC voltage P_{det} to a DC-to-DC converter in power management unit 2. *Id.* at 4:18–19. The DC-to-DC converter responds by providing optimum V_{cc1} and V_{cc2} to amplifiers PA1 and PA2, respectively. *Id.* at 4:19–21

Petitioner provides the following annotated Figure 6 from Hau (Pet. 17).

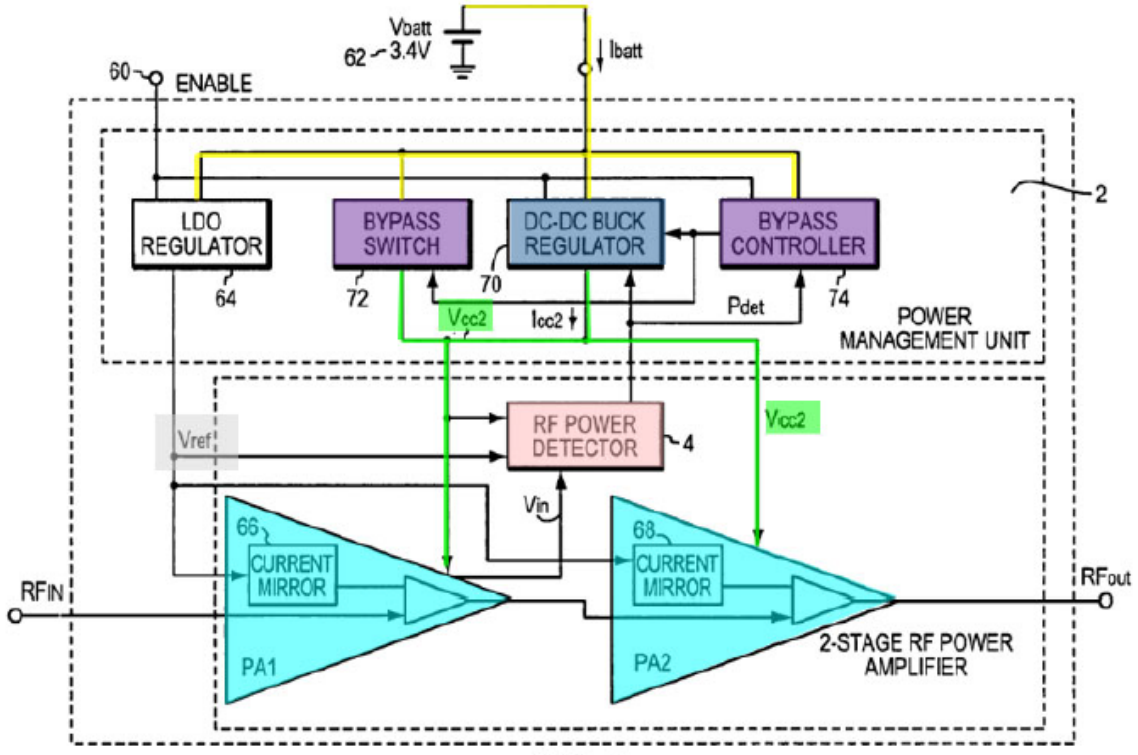


FIG. 6

Annotated Figure 6 from Hau is a more detailed circuit block diagram of the system disclosed in Figure 1. Ex. 1007, 3:59–60. Petitioner describes its annotated Figure 6 as showing a DC-DC buck regulator 70 (blue) that receives battery voltage V_{BATT} (yellow) and outputs voltage V_{cc2}

(green) to two power amplifiers, PA1/PA2 (aqua). Pet. 16 (citing Ex. 1007, 6:54–7:6). Bypass controller 74 (purple) receives a signal P_{det} from power detector 4 (pink) and, based on a comparison with a threshold, controls whether the DC-DC buck regulator should be bypassed via bypass switch 72 (purple). *Id.* (citing Ex. 1007, 6:54–7:6). P_{det} is proportional to V_{in} (citing 6:27–28) and V_{in} is an output from PA1, to which RF_{IN} is input. *Id.* (citing Ex. 1007 at 5:62–63).

In Hau's Figure 6, "[t]here is a comparison to a predetermined threshold in the bypass controller 74 where, if exceeded, the bypass switch 72 is activated and the DC-to-DC converter is deactivated." Ex. 1007, 6:63–66. The bypass controller generates a control signal as a function of RF power (yellow). *Id.* at 6:54–7:6. If the output power is greater than a predetermined value (aqua) the DC/DC regulator is turned off and the DC/DC regulator bypass switch is turned on (green). *Id*. at 6:54–7:6.

Petitioner also provides the following annotated Figure 10 from Hau (Pet. 18).

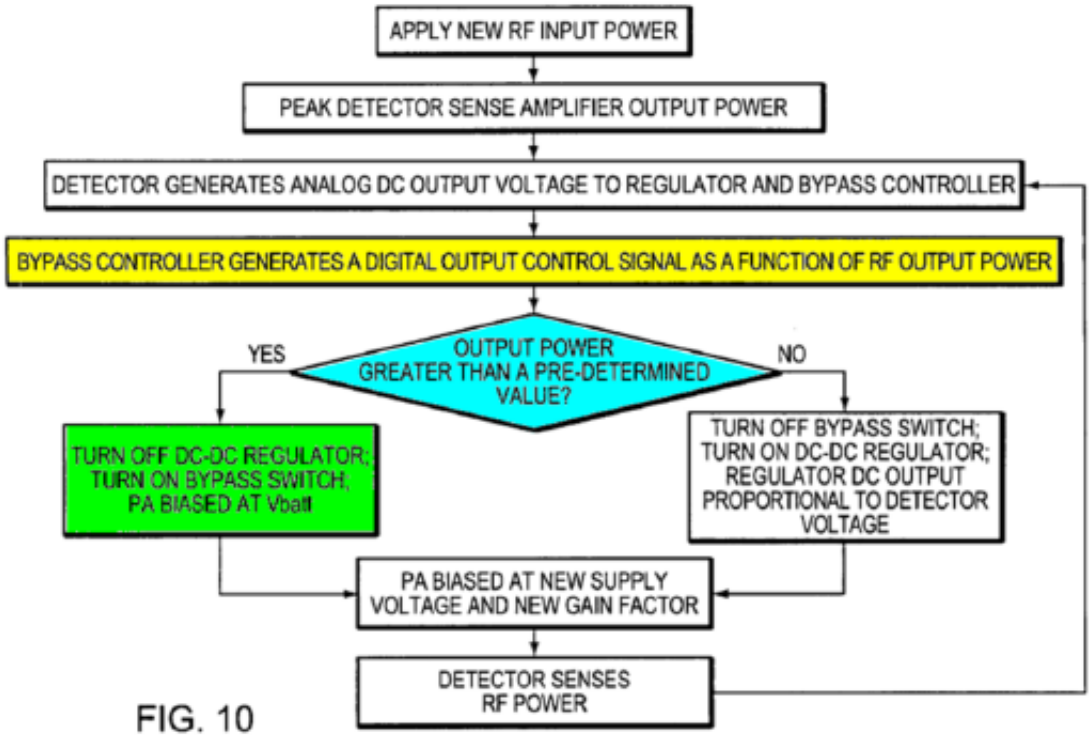


FIG. 10

Annotated Figure 10 from Hau is a flow chart of an embodiment disclosed in Hau. Ex. 1007, 4:1–2. As shown in Figure 10, Hau discloses that if the output power is greater than a pre-determined level (aqua), the DC-DC regulator is turned-off and the bypass switch is turned on (green). *See id.* 6:54–7:6.

b) Yoshida

As summarized in the Abstract of Yoshida, Yoshida discloses:

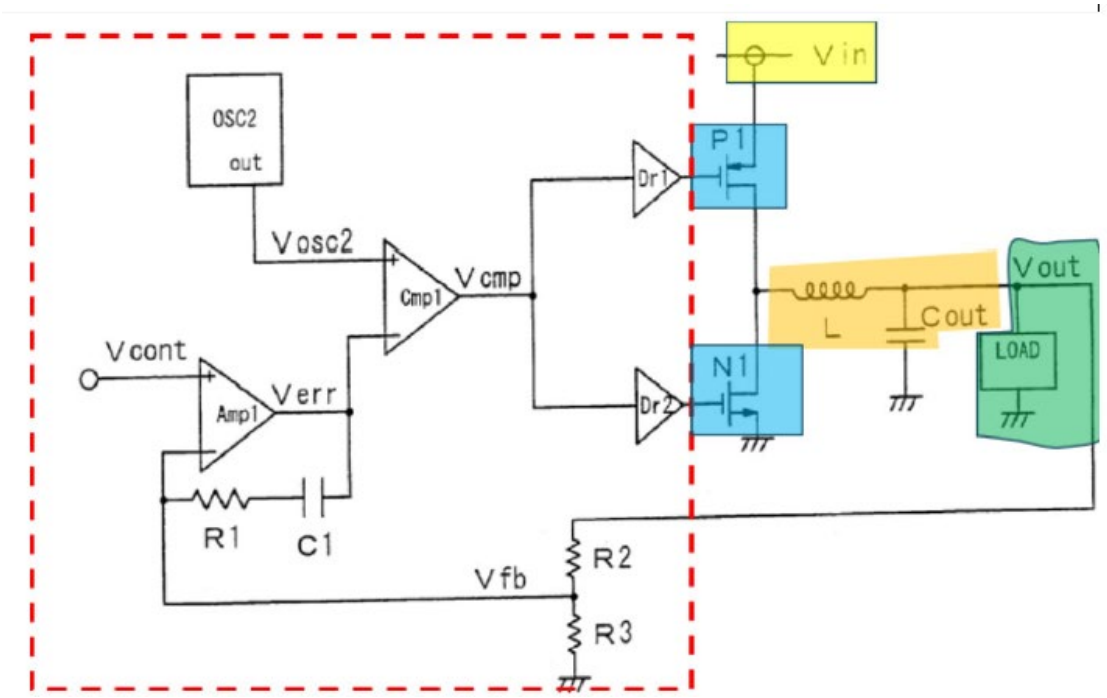
> A DC—DC converter switches a semiconductor switch device for converting a DC voltage to a certain level and supplies the converted DC voltage to a load. The DC—DC converter is configured to be able to switch between a first feedback control mode and a second feedback control mode. The DC—DC converter selects the second feedback control mode when a load current flowing through the load is below a predetermined value. The DC—DC converter selects the first feedback control mode

> when a level of the DC voltage supplied to the load changes irrespective of a value of the load current.

Ex. 1008, code (57).

Petitioner provides the following annotated Figure 29 from Yoshida.

Pet. 19.



Annotated Figure 29 is a block circuit diagram of a conventional step-down DC-DC converter with a pulse width modulation ("PWM") control mode. Ex. 1008, 8:35–36. Petitioner states that

> "[t]he circuitry on the left, highlighted in red, creates and controls the width pulses which turn the switches P1 and N1 (blue) on and off. Pet. 19 (citing Ex. 1003 ¶ 105). A comparator Cmp1 compares a triangular wave signal V_{OSC2} from an oscillator to a threshold voltage V_{ERR} (itself based on a control voltage V_{CONT} and a feedback signal V_{fb}) to generate pulses output at V_{CMP} of varying widths depending on the value of V_{ERR}.

Pet. 19 (citing Ex. 1008, 1:48–67, 2:12–19, Fig. 30).

Petitioner asserts a person of ordinary skill would have been motivated to combine Hau and Yoshida because "Yoshida explains the operation of a 'DC-DC buck regulator' as taught by Hau." Pet. 21 (citing Ex. 1003 ¶ 111). Petitioner also asserts "Hau explains that its amplifier circuit has a DC-DC buck regulator (i.e., converter) 70, but does not show or explain the details of its operation." *Id.* at 21–22 (citing Ex. 1007, 5:39–40). Hau merely states "DC to DC converter 70, in this example a 'buck' converter, whose design is known to those in the art." *Id.* at 22. Petitioner asserts Yoshida discloses examples of "buck converters" which down-convert a signal via pulse width modulation. *Id.*

c) Motivation to combine Hau and Yoshida

Petitioner asserts that based on the disclosures of Hau and Yoshida a person of ordinary skill, which is a person with a bachelor's degree in electrical engineering or a related subject and two or more years of experience in the field of RF circuit design and/or power supplies for RF circuits, "would have recognized that using a buck converter as taught by Yoshida for the unspecified buck converter taught by Hau would have been a simple combination of known elements according to known methods to yield predictable results." Pet. 23 (citing Ex. 1003 ¶¶ 111–112).

Petitioner also asserts that Hau discloses that "virtually any DC to DC converter design . . . could be advantageously used in embodiments with [Hau's disclosed] invention." *Id.* (citing Ex. 1007, 5:56–61). Petitioner concludes that "Hau therefore contains an explicit teaching, suggestion, or motivation to use a suitable DC-DC converter such as that taught by Yoshida." *Id.* (citing Ex. 1003 ¶ 113). As further evidence of a motivation to combine Hau and Yoshida, Petitioner asserts that "Yoshida's DC-DC

converter circuits take the same inputs and outputs (a DC input at a higher voltage, output at a lower voltage) as Hau. *Id*. (citing Ex. 1003 ¶ 113).

Patent Owner takes a different view of the evidence. Patent Owner asserts "Hau in view of Yoshida does not render obvious controlling the switching device "in response to a power efficiency of the power supply exceeding a predetermined threshold," as required by all challenged claims." PO Resp.28.

For each of the claims in Ground 1A, as well as the claims in all the other Grounds asserted by Petitioner, Petitioner provides a detailed, comprehensive clause-by-clause analysis of how the references relied on teach a recited claim element or limitation, and why it would have been obvious to combine each of the references relied on to establish that the claimed invention would have been obvious. *See* Pet. xv–xix (listing each clause in claims 1–20 with its associated label, *e.g.*, for claim 1, listing clauses 1[pre], 1[a], 1[b1], and 1[b2]). Patent Owner does *not* oppose or comment on most of the individual clauses or the rationale to combine the asserted references challenged in Ground 1A or the other asserted grounds of unpatentability. For these clauses we have considered Petitioner's arguments and evidence, determined that they establish a preponderance of the evidence on the issue for which they are asserted, and adopt them as our own findings and conclusions. Below, we discuss the parties' contentions as to claim limitations on which Patent Owner has provided argument.

d) Claims 1, 9, and 15

Independent claims 1, 9, and 15, each recite "in response to a power efficiency of the power supply exceeding a predetermined threshold." Ex. 1001, 11:21–23 (claim 1), 12:1–2 (claim 9), 12:34–36 (claim 15). Patent

Owner presents arguments only as to this limitation of the independent claims. PO Resp. 28–33. We address Patent Owner's arguments in context of limitation 1[b2] of independent claim 1.

(1) 1[b2] wherein, in response to a power efficiency of the power supply exceeding a predetermined threshold, the aperture generator and control module deactivates the switching device and passes the input voltage to the output voltage node

Claim 1 is representative of independent claims 9 and 15, which have essentially the same limitation. Ex. 1001, 11:16–25, 11:54–12:4, 12:26–38.

Petitioner asserts the second function of the aperture generator and control module, the "bypass" function, is taught by Hau. Pet. 29–33.

As shown in annotated Figure 6 of Hau (Pet. 29 and included in Section II.D.2 of this decision), Hau teaches a bypass controller 74 (purple) which receives a signal P_{det} from a power detector (pink) and activates a bypass switch 72 (purple) when the signal P_{det} exceeds a predetermined threshold (in response to a power efficiency of the power supply exceeding a predetermined threshold). *Id*. at 28 (citing Ex. 1007, 5:43–51, 6:57–7:20).

According to Petitioner Hau discloses that the strength of the signal P_{det}, the power output of the amplifier PA1, and the supply voltage V_{cc2} are all proportional. *Id.* at 29 (citing Ex. 1007, 6:22–44; Ex. 1003 ¶¶ 122–123. Petitioner concludes, therefore, that P_{det} is an indicator of the power output by the DC-DC buck regulator at V_{cc2}. *Id.* Petitioner also concludes that because input power is supplied to the DC-DC buck regulator from a fixed voltage, P_{det} is also an indicator of the power efficiency of the DC-DC buck regulator because higher power indicated at P_{det} indicates greater efficiency

relative to the fixed input power. Pet.29 (citing Ex. 1003 ¶ 123). Dr. Larson's testimony supports Petitioner's conclusions.

Petitioner also asserts:

> when P_{det} exceeds the predetermined threshold, Hau's bypass controller 74 activates bypass switch 72 and deactivates the DC-DC converter (which is a PWM switching device in the combination of Hau and Yoshida) (*deactivates the switching device*) to pass the input voltage directly to the output voltage V_{cc2} (*passes the input voltage to the output voltage node*).

Pet. 30 (citing Ex. 1007, 5:44-51, 6:61, 66; Ex. 1003 ¶¶ 125-126).

Here, Patent Owner disputes Petitioner's analysis and conclusions. PO Resp. 28–33. To the extent Patent Owner's arguments are based on its proposed construction of "power efficiency," we do not adopt that construction and, thus, we find those arguments unpersuasive. *See supra* Section II.C.

Patent Owner provides two reasons why it disagrees with Petitioner's assertions.

First, Patent Owner asserts that Petitioner "conflates RF [radio frequency] power and supply power." PO Resp. 29. According to Patent Owner, "Hau's P_{det} is generated based on an RF AC signal, which has no direct relation to the power efficiency of the DC power supply." *Id.* Patent Owner also asserts that "Hau's P_{det} is generated based on V_{in}, which "is ***an RF signal sensed from the output of the first power amplifier*** *PA1* that is input to the power detector 4." *Id.* (citing Ex. 1007, 4:16–17). Additionally, Patent Owner asserts that "[b]ased on V_{in} (an RF signal), "[t]he ***power detector 4 outputs a DC voltage Pdet*** to a DC to DC converter in the power management unit 2." *Id.* (citing Ex. 1007, 4:18–21). Patent Owner concludes that "RF power (upon which P_{det} is based) is not, and cannot be,

an indicator of power efficiency of the power supply." *Id.* According to Patent Owner, "[t]hey are distinct quantities (AC for RF power, DC for supply power) relating to separate circuit elements (power amplifier for RF power, power supply for supply power)." PO Resp. 29 (citing Ex. 2001 ¶ 110).

Dr. Ricketts testimony is that "RF power (upon which P_{det} is based) cannot be an indicator of power efficiency of the power supply because they are separate circuits relating to distinct quantities (AC and DC, respectively)." Ex. 2001 ¶ 110.

Second, Patent Owner asserts "Petitioner is mistaken that Hau's input power is fixed." PO Resp. 29 (citing Pet. 29 ("Because input power is . . . from a ***fixed voltage***, P_{det} is also an indicator of the power efficiency . . . because higher power indicated at P_{det} indicates greater efficiency ***relative to the fixed input power***.")

Patent Owner argues that "power efficiency" is a function of input and output power, which depends on both voltage ***and*** current. *Id.* at 30. According to Patent Owner, Hau's P_{det}, however, only determines the DC-DC buck regulator's output voltage V_{cc2}. *Id.* (citing Ex. 1007, 4:19-21). Patent Owner concludes that, "notwithstanding a fixed input *voltage*, Hau's P_{det} does not account for variation in input and output *current*, which respectively impacts input power and output power, and thus power efficiency as a whole." *Id.* (citing Ex. 2001 ¶ 111).

We determine that Dr. Larson provides a persuasive rebuttal to Patent Owner's assertions. In both his initial Declaration testimony (Ex. 1003), and in his Reply Declaration testimony (Ex. 1031), Dr. Larson provides persuasive evidence establishing the errors in Patent Owner's analysis.

In Dr. Larson's initial Declaration testimony, he explains that Hau discloses that the voltages V_{cc2}, V_{in}, and P_{det} are proportional. *See* Ex. 1003 ¶ 123 (citing Ex. 1007, 6:28–30). In his Reply Declaration, he expands his analysis and further discusses Hau's disclosure. *See* Ex. 1031 ¶¶ 40–51.

Dr. Larson testifies that Patent Owner's "arguments that P_{det} cannot be an indicator of power efficiency because it is based on an AC signal rather than a DC signal are also misplaced." Ex. 1031 ¶ 43. As correctly stated by Dr. Larson, "[t]he independent claims of the '593[p]atent say nothing about what type of signal is measured to indicate power efficiency." *Id.*

Moreover, Dr. Larson testifies,

> There is nothing even remotely unusual to a [person of ordinary skill in the art] about a DC signal being indicative of the strength of an AC signal or vice versa, and that is exactly what Hau teaches: P_{det} is proportional to V_{in}, which in turn is proportional to V_{cc2}. Additionally, the power supply and power amplifier are not "separate" because V_{cc2} provides the power for the power amplifier, whose power output is in turn related to V_{cc2}.

Id.

Patent Owner also argues that "Hau's P_{det} does not account for variation in input and output current, which respectively impacts input power and output power, and thus power efficiency as a whole." PO Resp. 30. Patent Owner does not identify any element or limitation in the challenged independent claims that requires input and output *current* to be considered. As Dr. Larson persuasively testifies "a requirement to account for variation in input *current* would read out every embodiment in the '593 [p]atent, which does not teach any circuit that measures the input *current* to the power supply." Ex. 1031 ¶ 44 (emphases added). We are therefore not persuaded by Patent Owner's interpretation of the disputed claim language

and thus do not find Petitioner's contentions to be deficient. Moreover, Dr. Larson testifies that even if the independent claims were construed to account for variations in input and output current, Hau discloses it. *Id.* ¶ 45. For example, Dr. Larson correctly points out that Hau's Figure 5 "shows a plot of input current (IBATT) against output power in dBm for both a fixed voltage Vcc2 and the optimum voltage provided by embodiments of Hau's invention." *Id.* (citing Ex. 1007, Fig. 5, 3:56–57, 4:66–5:22).

Based on the entirety of the record, we determine that Petitioner has proven by a preponderance of the evidence that Hau teaches this limitation recited in claim 1.

e) Claim 2

Patent Owner asserts Hau does not disclose nor suggest that "the aperture generator and control module is configured to deactivate the switching device based on a load *current* at the output *voltage* node," as required by claim 2. PO Resp. 33 (emphases added) (citing Ex. 2001 ¶¶ 117–34); Ex. 1001, 11:26–29.

According to Patent Owner, Hau also "teaches away" from using load current as required by claim 2. *Id.* at 34–36.

Petitioner acknowledges that Hau does not expressly disclose the use of current, as claimed. Pet. 33 ("in Hau's preferred embodiment the bypass controller relies on a voltage measurement indicative of power to perform the bypass function (*deactivate the switching device*)). Petitioner notes, however, Hau's recognition that "the prior art related the output current to the output power from the (I) [current] (V) [voltage] power relationship." *Id.* (citing Ex. 1007, 6:40–44). Petitioner asserts that "Hau thus at least suggests using current measurements to perform the same switching function

(based on a load current at the output voltage node). *Id.* (citing Ex. 1003 ¶ 131). Petitioner concludes that "Hau thus at least suggests using current measurements to perform the same switching function (*based on a load current at the output voltage node*). *Id.* (citing Ex.1003 ¶ 131). We agree with Petitioner.

As the Supreme Court informs us, a "person of ordinary skill is also a person of ordinary creativity, not an automaton." *KSR*, 550 U.S. at 421. The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. *Id.* at 416. A conclusion of obviousness may be supported by a showing that the claims are directed to a process, machine, manufacture, or composition of matter "already known in the prior art that is altered by the mere substitution of one element for another known in the field, and such modification yields a predictable result. *KSR,* 550 U.S. at 416. This is the situation here.

As we explain above, the calculation of power involves two elements, current and voltage. *See supra* Section II.C. When considering obviousness of a combination of known elements, the operative question is "whether the improvement is more than the predictable use of prior-art elements according to their established functions." *Id*. Here we determine that it would have been obvious to a degreed engineer with two years of relevant experience to interchange current and voltage in circuits involving power calculations.

We also disagree with Patent Owner's "teaching away" argument. PO Resp. 34–36.

"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." *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994); *see also Centripetal Networks, LLC v. Palo Alto Networks, Inc*., 2024 WL 4635578, at *6 (Fed. Cir. Oct. 31, 2024 (citing *In re Gurley* and determining the Board applied the correct legal rule when it found that there is no teaching away because "[t]he evidence of record does not support a conclusion that an ordinarily skilled artisan . . . would have been *discouraged* from considering" the proposed modification)).

Patent Owner does not provide any persuasive evidence that Hau discourages the use of current to deactivate the switching device. Hau does not teach away from the claimed invention; it merely teaches toward a preferred arrangement. *See Intel Corp. v. Qualcomm Inc.*, 21 F.4th 784, 800 (Fed. Cir. 2021) ("[It is] not necessary to show that a combination is 'the best option, only that it be a suitable option.'").

Based on the entirety of the record, we determine that Petitioner has proven by a preponderance of the evidence that Hau teaches the limitation recited in claim 2.

f) Claims 5 and 11

Claim 5, dependent from claim 1, and claim 11, dependent from claim 9 claim, state the same limitation – a requirement that of "an output current at a maximum power efficiency associated with the down-converted input voltage." Ex. 1001, 11:39–42, 12:11–15. Claim 5 includes the additional requirement that the "the aperture generator and control module is configured to provide" this limitation. *Id.* at 11:39–40.

Patent Owner acknowledges that "Hau is directed towards dynamically optimizing current consumption . . . of a power amplifier." PO

Resp. 38. Patent Owner argues, however, that "the object of Hau is to minimize input current at each output power level of the power amplifier. Hau does not aim to minimize the output current at the load of the DC-DC convertor." *Id.*

Additionally, Patent Owner also argues:

> Petitioner's conclusory argument that Hau "provides the most ***efficient current consumption*** for each power output level' (Pet., 34 (quoting EX1007, 4:51-54 (emphasis added))) is not a sufficient explanation as to how Hau's teaching of minimizing input current discloses "output current at a maximum power efficiency associated with the down-converted input voltage," as required by claims 5 and 11.

Id. at 39–40.

Petitioner asserts Hau discloses that its circuit, including the DC-DC buck regulator (which includes the "aperture generator and control module" [in claim 5] and "switching device," when implemented using PWM control circuitry as taught by Yoshida), provides a DC voltage that is a measure of the optimum output power. Pet. 34 (citing Ex. 1007, Figs. 2–5, 8, 9, 3:30 [sic 20]–28), 4:12–16, 4:66–5:22, 6:15–21, 6:34–37, claim 1). According to Petitioner, this optimum output power "provides the most efficient current consumption for each power output level." *Id.* (citing Ex. 1007, 4:51–54).

Dr. Larson's testimony supports Petitioner's arguments. Dr. Larson also testifies that a person of ordinary skill in the art "would also have recognized that Hau's circuit would provide an output current." Ex. 1003 ¶ 133. Dr. Larson states "Hau teaches that the output *voltage* V_{CC2} supplies *current* to amplifiers PA1 and PA2." *Id.* (citing Ex. 1007, 6:22–25 (emphasis added)). Based on the disclosures in Hau, Dr. Larson concludes that "Hau teaches that the DC-DC regulator (*aperture generator and control*

module) provides 'an output current at a maximum power efficiency associated with the down-converted input voltage.'" We find Dr. Larson's testimony credible on this issue.

Based on Hau's disclosure to maximize efficiencies in a circuit, supported by Dr. Larson's testimony, we determine that Petitioner has established by a preponderance of the evidence that claims 5 and 11 would have been obvious to a person of ordinary skill in the art based on Hau and Yoshida.

g) Claims 6, 7, and 12

Patent Owner argues claims 6–8 and 12–14 together. PO Resp. 40. We note, however, that only claims 6, 7, and 12 are challenged under Ground 1A. Our analysis below only focuses on these three claims.

Claims 7 depends from claim 6, which depends from claim 1, which recites a "power supply." Claim 12 depends from claim 9, which recites a "method of controlling a power supply." Patent Owner's arguments are based solely on claims 6 and 12. Claims 6 and 12 recite essentially identical subject matter. Claim 6, which is representative, states "the aperture generator and control module is configured to deactivate the switching device and pass the input voltage to the output voltage node based on a comparison of the down-converted input voltage to a threshold voltage." Ex. 1001, 11:43–47. Claim 6 is similar to claim 1 in that both claims require that "deactivation" is based on a comparison of the down-converted input voltage to a threshold voltage.

For convenient reference, the chart below compares claims 1 and 6, which is color-coded to show the substantial similarities between them.

CLAIM 1	CLAIM 6
1[pre] A power supply comprising:	The power supply of claim 1, based on a comparison of the down-converted input voltage to a threshold voltage.
1[a] a switching device configured to down-convert an input voltage and pass the down-converted input voltage to an output voltage node; and	
1[b1] an aperture generator and control module configured to control the switching device,	wherein the aperture generator and control module is configured to **deactivate** the switching device and **pass** the **input voltage to the output voltage node**
1[b2] wherein, in response to a power efficiency of the power supply exceeding a predetermined threshold, the aperture generator and control module **deactivates** the switching device and **passes** the input voltage to the output voltage node.	

Petitioner recognizes the similarities between claim 6 and clause 1[b2] in claim 1 and claim 6. Pet. 35. Petitioner repeats the substance of its claim 1 analysis, asserts that its analysis of unpatentability of claim 1, and particularly clause 1[b2], applies equally to claim 6.

Patent Owner repeats its argument for claim 1, which, as discussed above, we found unpersuasive. *See supra* Section II.D.1.d. Accordingly, we determine claims 6 and 12 are unpatentable.

Concerning claim 7, based on Petitioner's unchallenged arguments and evidence, which we adopt as our findings and conclusions, we determine

that a preponderance of the evidence establishes that claim 7 also is unpatentable. *See* Pet. 36.

h) Summary of Ground 1A

On the complete record, Petitioner has shown, by a preponderance of the evidence, that the combination of Hau and Yoshida would have rendered the subject matter of claims 1, 2, 5–7, 9, 11, 12, and 15 obvious to one of ordinary skill in the art at the time of the invention.

2. Ground 1B – Hau, Yoshida, Sahu
Claims 3, 4, 8, 10, 13, 14, 17–20

a) Sahu

We make the following findings of fact regarding Sahu (Ex. 1009).

Sahu is a paper, titled "A High-Efficiency Linear RF Power Amplifier With a Power-Tracking Dynamically Adaptive Buck-Boost Supply." Ex. 1009, 112.[14] The paper was published in IEEE Transactions on Microwave Theory and Techniques, Vol. 52, No. 1, January 2004. *Id.*

As stated in Sahu,

> With the explosive growth of RF portable devices and their increasing functional densities (e.g., voice, video, and data), efficient power-saving techniques are intrinsic in prolonging battery lifetime. Consequently, energy-efficient RF power amplifiers (PAs) are key components in mobile battery-operated systems [e.g., cellular phones, personal digital assistants (PDAs)] because they determine and dominate the total power consumption of their respective systems.

Id.

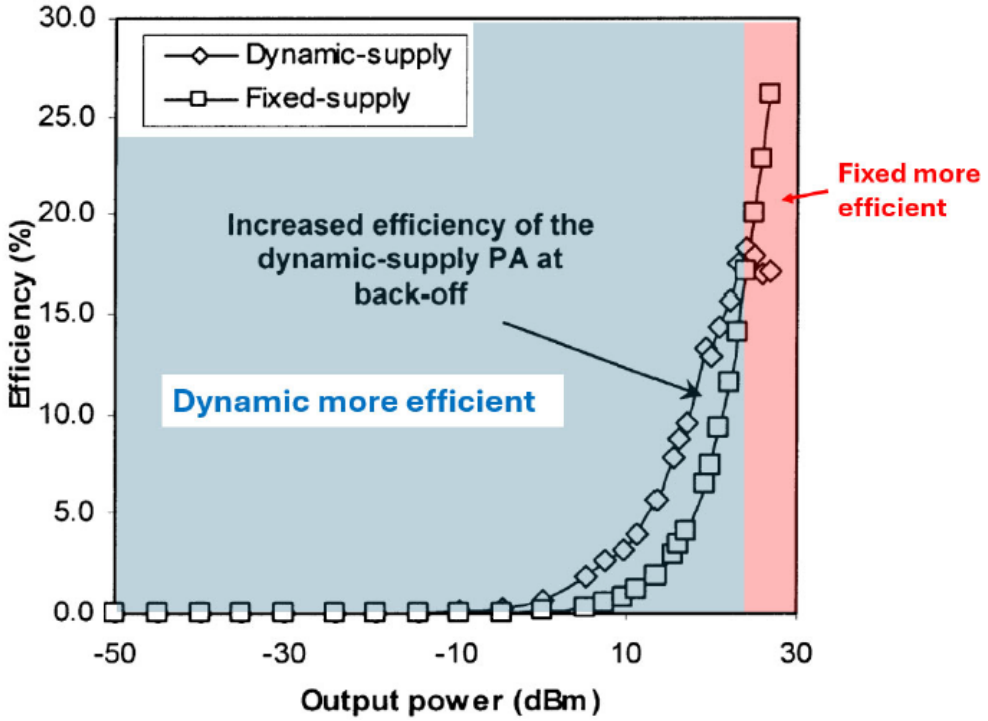
Sahu describes various types of dynamic power systems to provide an optimum amount of power for transmission requirements in a mobile

[14] We cite to the pages as numbered in the upper left corner (odd numbered pages) and upper right corner (even numbered pages).

environment, including buck, boost, and buck-boost power supplies. *Id.*, at 113–115. Sahu describes a preferred embodiment using a buck-boost conversion system. *Id.* at 116.

Sahu discloses that, although "the peak dc-to-RF efficiency of the [power amplifier] occurs at the peak output power, the [power amplifier] itself rarely operates at that power level. *Id.* at 113 (citing Figure 1). Sahu states, "[t]herefore], it is extremely important to calculate the average efficiency when considering the optimum [power amplifier] configuration." *Id.*

Sahu's Figure 8(a), annotated below by Petitioner with colorization and colored labels for fixed and dynamic efficiency (Pet. 42), compares the efficiency of a dynamic power supply power amplifier ("PA") to a fixed power supply over various power levels.



As shown clearly in Sahu's Figure 8(a), there is increased efficiency of the dynamic power supply PA at lower levels, but better performance from a fixed power supply at the highest power levels. Ex. 1009, 118–119.

Sahu discloses that "with the highly variable nature of the batteries used in portable applications, the buck-converter supplied systems cannot be operated at their peak performance when the required supply is higher than battery voltage." *Id.* at 115. According to Sahu, "dynamically changing the supply voltage and current as a function of power (termed as *power tracking*), which changes at a much slower rate compared to the envelope, is the best option for achieving higher light load efficiency and, consequently, increased battery life." *Id.* Thus, Sahu recognizes that a "dynamic power supply" with a variable power output, "is the best option" for higher light load efficiency and increased battery life. *Id.* Sahu also recognizes, however, that, as shown in Figure 8(a), a "fixed power supply," with direct battery output, will be more efficient at the high end of the power operating range.

b) Motivation to combine Sahu with Hau and Yoshida

Petitioner contends that a person of ordinary skill in the art "would have considered Sahu's teaching that the performance of the power supply should be optimized based on the most probable power output levels at which the device is likely to be operated as instructive for optimizing the performance of a power supply taught by Hau (as modified by Yoshida)." Pet. 43 (citing Ex. 1009, 113). Petitioner asserts that "both Hau and Sahu are directed to poer supplies which operate at less than peak power for the majority of the time based on the power requirements associated with mobile transmission." *Id.* (citing Ex. 1007, 1:33–61, 5:17–20; Ex. 1009, 113; Ex.

1003 ¶155). According to Petitioner, "a [person of ordinary skill in the art] would have considered Sahu's teaching that the performance of the power supply should be optimized based on the most probable power output levels at which the device is likely to be operated as instructive for optimizing the performance of a power supply taught by Hau (as modified by Yoshida)." *Id.* (citing Ex. 1009, 113; Ex. 1003 ¶ 155). Petitioner concludes that, when "[a]pplying Sahu's teachings[] to control the performance of a power supply based on its efficiency at the most probable power levels for a given modulation scheme, to the power supply of the Hau-Yoshida combination would have been a simple application of a known technique to a known device ready for improvement to yield predictable results." *Id.* (citing Ex. 1003 ¶ 156).

Patent Owner asserts there is no motivation to combine Sahu with Hau and Yoshida. PO Resp. 42–48.

Patent Owner argues that a skilled person "would not have been motivated to apply Sahu's teachings of controlling a power supply for increased PA efficiency in the backoff power region for two reasons," which are:

(1) "The Hau/Yoshida device already controls its power supply in the manner Sahu teaches would improve efficiency when operating in a CDMA system;" and

(2) "Hau teaches away from the specific implementation of Sahu's device. PO Resp. 45 (citing Ex. 2001 ¶ 161).

We disagree with Patent Owner's analysis and conclusion.

Petitioner asserts that there is no dispute that Sahu teaches to "calculate the average efficiency when considering the optimum PA

configuration." Pet. Reply 16 (citing Ex.1009, 113). Petitioner also asserts there is no dispute that "a fixed-supply power supply becomes more efficient than a 'dynamic-supply' power supply at a point that can be calculated for a particular system. *Id.* at 16–17 (citing Ex. 1009, Fig. 8a). Petitioner concludes that a person or ordinary skill would have understood from Sahu that the performance of such a power supply "can be optimized both (1) by designing the PA configuration to be most efficient at the power levels at which it is most likely to operate, and (2) setting the threshold for bypass operation to correspond to the point where a fixed supply becomes more efficient." *Id.* (citing Pet. 43–45; Ex. 1003 ¶¶ 154–156; Ex. 1031 ¶¶ 62–65. We agree with Petitioner.

Sahu discusses the various options available to a person of ordinary skill in designing a circuit for a power supply. Patent Owner recognizes that that Hau, Yoshida, and Sahu each involve the same technology (power amplifiers and switching converters in battery powered devices) and the same issues (battery and power efficiency). Each discloses its own preferred options of addressing common issues. These known options are available to a person of ordinary skill in the art, here a degreed engineer in a relevant technology with two years of relevant experience.

Patent Owner concedes that the "Hau/Yoshida device and Sahu's device are both dynamic supply systems that seek to improve efficiency in the 'backoff' region." PO Resp. 45 (citing Ex.1007, 1:33–61, 5:17–20; Ex.1009, 113; Pet.,43–44). Patent Owner also concedes that "both Sahu and Hau similarly controls the power supply output voltage based on the RF input signal." *Id.* at 46. Patent Owner further acknowledges that Sahu and

"Hau/Yoshida" use "a dynamic power supply for improved efficiency in the backoff power region." *Id*. (citing Ex. 2001 ¶ 163).

As stated above, in addressing the proposed combination of references in Ground 1A, a "person of ordinary skill is also a person of ordinary creativity, not an automaton." *KSR*, 550 U.S. at 421. The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. *Id.* at 416. A conclusion of obviousness may be supported by a showing that the claims are directed to a process, machine, manufacture, or composition of matter "already known in the prior art that is altered by the mere substitution of one element for another known in the field, and such modification yields a predictable result. *KSR,* 550 U.S. at 416. Once again, this is the situation here.

We also disagree with Patent Owner's "teaching away" argument. PO Resp. 34–36.

Patent Owner does not provide any persuasive evidence that Sahu *discourages* the proposed combination of Sahu with Hau and Yoshida. *In re Gurley*, 27 F.3d at 553; *Centripetal Networks*, 2024 WL 4635578, at *6 (the Board applied the correct legal rule when it found that there is no teaching away because "[t]he evidence of record does not support a conclusion that an ordinarily skilled artisan . . . would have been *discouraged* from considering" the proposed modification). Sahu does not teach away from the claimed invention; it merely teaches toward a preferred arrangement, and suggests additional options for achieving improved efficiency in specific circumstances. *See Intel*, 21 F.4th at 800.

c) Claims 3, 4, 10, and 19

Patent Owner argues claims 3, 4, 10, and 19, together. PO Resp. 48. Claim 3 is representative. Claim 3 requires that the "aperture generator and control module" is configured to control the "switching device" based on "a probable output power point of operation for a selected modulation scheme based on one or more power efficiency characteristics of an electronic device coupled to the power supply." Ex. 1001, 11:30–35.

Patent Owner asserts that Hau, Yoshida, and Sahu collectively, as combined as proposed by Petitioner, "do not render obvious" the requirement of claims 3, 4, 10, and 19. PO Resp. 48 (citing Ex. 2001, ¶¶ 169-72). Patent Owner also asserts that Sahu teaches that a dynamic-supply system is more efficient "when the PA is operating in the backoff power region, which is more likely than when the PA is operating at maximum power (at least for the CDMA standard)." *Id.* at 48 (citing Ex. 1009, 113).

We note that claim 3, however, does not require a system that operates at "maximum power." *See* Ex. 1001, 11:30–35. It merely requires that a circuit designer choose "a probable output power point of operation" for a selected modulation scheme based on one or more power efficiency characteristics." *Id.*

Petitioner asserts Sahu discloses "to optimize the output of the PA based on the probability of operating at a given power output for a selected modulation scheme. Pet. 45 (citing Ex. 1009 ¶ 113). According to Petitioner, because the power levels in Sahu are obtained by control of a "switching device" (i.e., a buck-boost converter that relies on switched transistors, a person of ordinary skill "would have understood that the

control circuitry accordingly controls the switching device to obtain optimal efficiency for probable power levels." Pet. 46 (citing Ex. 1009, 116–117, § IV(B); Ex. 1003 ¶¶ 157–159). Petitioner also asserts it would have been obvious to a person of ordinary skill "to apply Sahu's teachings of optimizing efficiency based on most probable power levels for a given modulation scheme" to the Hau/Yoshida system. *Id.* at 47 (citing Ex. 1003 ¶ 160).

The requirements of representative claim 3 are broad and generic. Petitioner refers to them as "notably vague." Pet. 47 ("[t]he specification of the '593 Patent itself is notably vague about the additional element added by [claim 3]"). Our jurisdiction in an IPR proceeding does not extend to issues under 35 U.S.C. § 112, which concerns the specificity requirements for claims and the Specification. *See* 35 U.S.C. § 311(b) (limiting an IPR proceeding to "only on a ground that could be raised under section 102 or 103 and only on the basis of prior art consisting of patents or printed publications").

Whether "vague" or not, we agree with Petitioner that Sahu adds more options for a person of ordinary skill to consider in achieving a specific objective. Thus, we determine it would have been obvious to a person of ordinary skill to modify the Hau/Yoshida system with an "aperture generator and control module" configured to control the "switching device" based on "a probable output power point" of for a selected modulation scheme, as suggested by Sahu.

Accordingly, we determine that Petitioner has established by a preponderance of the evidence that claims 3, 4, 10, and 19 would have been

obvious to a person of ordinary skill in the art based on Hau, Yoshida, and Sahu.

d) Claims 8 and 13.

Patent Owner argues claims 8 and 13 together. PO Resp. 50. Claim 8 is representative. Claim 8 requires that "the threshold voltage is programmed based on a communication waveform efficiency, battery life associated with an electronic device coupled to the power supply, or a combination thereof." Ex. 1001, 11:50–53.

Petitioner relies on Sahu for the disclosure that for a given system operating with a given modulation scheme, a dynamic power supply (i.e., provided by a down-converter) "is more efficient for most of the range of output power, but that a fixed supply is more efficient for the highest output power," as shown in Figure 8(a) of Sahu (reproduced above, as annotated by Petitioner). Pet. 49–50.

According to Petitioner, it would have been obvious to a person of ordinary skill "to set Hau's predetermined threshold to correspond to the point at which a fixed power supply (e.g., the bypass pathway of Hau) becomes more efficient than the down-converted power supply, as taught by Sahu." Pet. 50–51 (citing Ex. 1007, 6:63–66; Ex. 1003 ¶¶ 166–167). Petitioner also asserts a person of ordinary skill "would have recognized that Sahu's efficiency graph shows performance for a particular modulation scheme", and that the resulting efficiency of the system using that modulation scheme "correlates with the efficiency of the communication waveform in that scheme (*based on a communication waveform efficiency*)." *Id.* at 51 (citing Ex. 1003 ¶ 168). Petitioner concludes that a person of ordinary skill "would have understood and found it obvious that basing the

predetermined threshold of Hau on the point where a fixed power supply becomes more efficient as taught by Sahu is programming the threshold voltage based on a communication waveform efficiency." *Id.* at 51 (citing Ex. 1003 ¶ 168). We find Petitioner's contentions persuasive.

Patent Owner asserts it is "hindsight" to rely on Sahu. PO Resp. 51 (a person of ordinary skill "would not have equated Sahu's fixed-supply system with Hau's bypass pathway without the benefit of hindsight"). According to Patent Owner, "Petitioner used the disclosures in the '593 patent as a road map for reasons to combine Sahu and Hau/Yoshida." *Id.* (citing Ex. 2001, ¶¶ 174–75).

Patent Owner also asserts a person of ordinary skill "would have recognized that Figure 8(a) of Sahu "relates to specific devices that were tested in Sahu." *Id.* at 50.

We find these assertions unpersuasive. We have discussed above the substantial relationship to similar technology in Hau, Yoshida, and Sahu. They each are directed to solving the efficiency problem in the same technology as in the '593 patent. The references inform a person of ordinary skill of viable options for achieving their common goal. Choosing among known viable options is not hindsight. It is ordinary skill. Accordingly, we determine that Petitioner has proved by a preponderance of the evidence that claims 8 and 13 would have been obvious in view of Hau, Yoshida, and Sahu.

e) Claims 14, 17, 18, and 20

Ground 1B includes claims 3, 4, 8, 10, 13, 14, 17–20. Patent owner presents argument only as to claims 3, 4, 8, 10, 13 and 19, as discussed in the preceding sections of this Decision. Patent Owner has not addressed

separately claims 14, 17, 18, and 20. Thus, there is no contrary evidence rebutting Petitioner's assertions for these claims.

We have reviewed Petitioner's arguments and evidence challenging claims 14, 17, 18, and 20. Pet. 51–53 (citing Ex. 1003 ¶¶ 171–175). We have also reviewed Dr. Larson's cited testimony in support of Petitioner's asserted unpatentability of claims 14, 17, 18, and 20. Petitioner also explains why a person of ordinary skill would have been motivated to combine the cited references, citing annotated figures from the cited references, specific disclosures from the references, and supporting testimony from Dr. Larson. *Id.* at 43–45.

Based on our review of the evidence and arguments, we determine that Petitioner has established by a preponderance of the evidence that the cited references disclose all the limitations of claims 14, 17, 18, and 20, and that Petitioner has established why it would have been obvious to a person of ordinary skill to combine the references, as proposed, with a reasonable expectation of success, for the reasons advocated by Petitioner on these claims. *See* Pet. 51–53 (citing to applicable sections of Ex. 1003).

3. Ground 1C: Hau, Yoshida, and Lejon
Claim 16

Claim 16 is the sole claim at issue in Ground 1C. It depends from independent claim 15, which is directed to "a system" having an "electronic device" and "a power supply coupled to the electronic device." Ex. 1001, 12:26–38. Claim 16 adds the additional limitation that "the electronic device comprises a multiple-input-single-output (MISO) amplifier." *Id.* at 12:39–40.

The Specification states:

> According to embodiments of the present invention, the efficiency of all types of amplifiers, including, but not limited to, MISO amplifiers can be improved over various output power levels by designing a variable voltage switching power supply based on system criteria, such as, but not limited to, network statistics and/or typical operating conditions.

Id. at 3:49–54. The Specification also states that "[e]mbodiments for enhancing system efficiency can be used with traditional power amplifiers, vector power amplifiers, and multiple-input-single-output (MISO) power amplifiers." *Id.* at 3:62–64.

The Specification also acknowledges that switching power supplies can be designed to operate in predetermined output voltage and current ranges that result in increased efficiency of the power supply and consequently in increased system efficiency in system using "traditional power amplifiers (PAs) and/or multiple-input-single-output (MISO) amplifiers." *Id.* at 4:61–67.

a) Lejon

Lejon "relates to a linear amplification using nonlinear components (LINC) out-phasing amplifier system, and improving the characteristics of such systems." Ex. 1013, 1:4–7. For purposes of the issue before us, however, the issue is whether Lejon discloses the use of a MISO electronic device, as required for claim 16. The simple answer is clearly yes, Lejon discloses a MISO electronic device.

Figures 9 and 10 from Lejon, both annotated by Dr. Larson to identify the multiple inputs and single output, disclose two different electronic devices that use a MISO system, are reproduced below.

Figure 9 is a current load amplifier with two inputs at ports 210 and 220, which connect to the gates of transistors 230 and 240, and the single output is output load 290. Ex. 1003 ¶¶ 182, 184; Pet. 54–56.

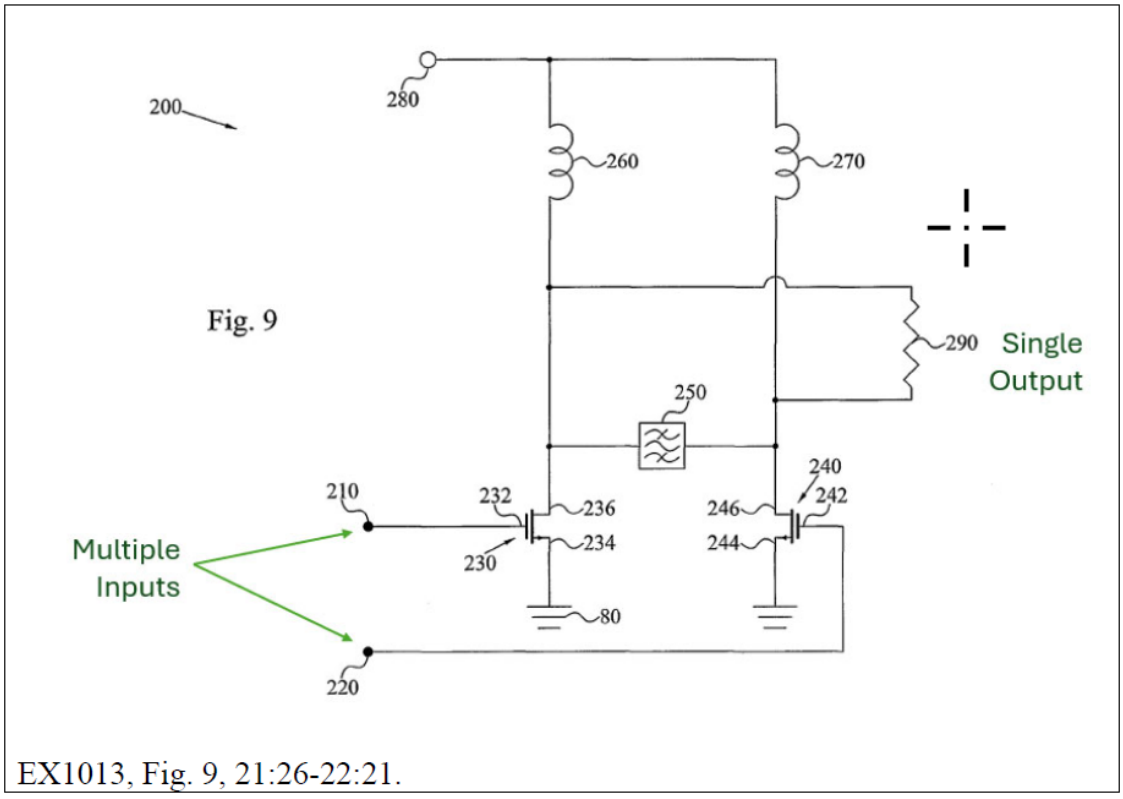
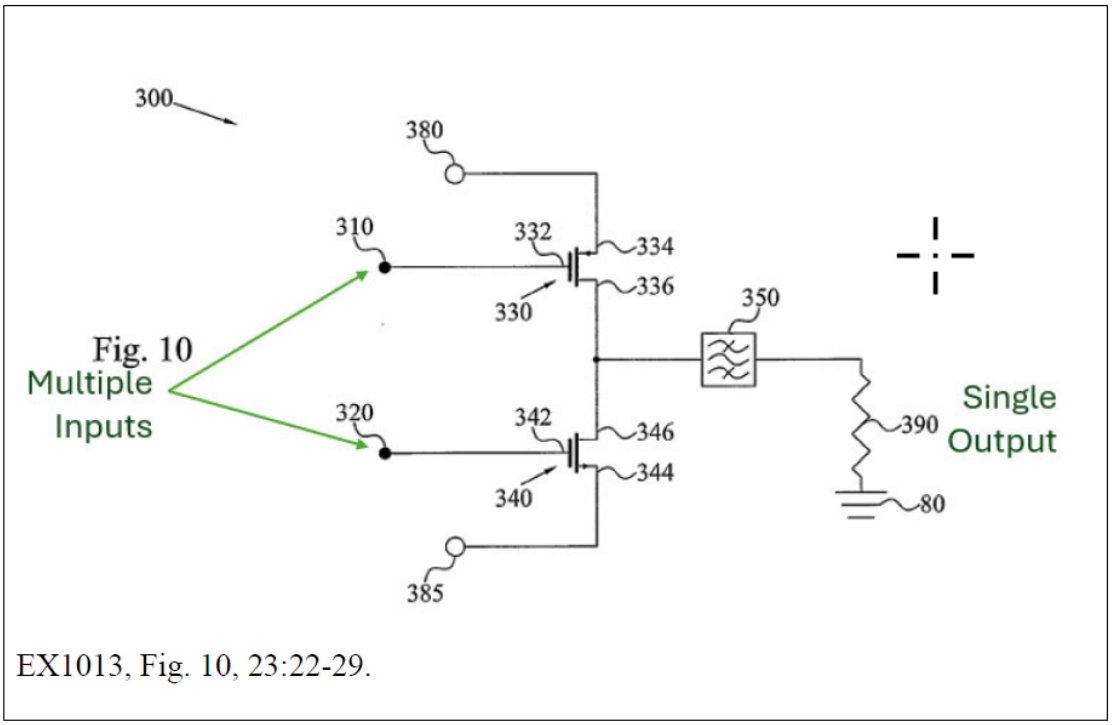


Fig. 9

EX1013, Fig. 9, 21:26-22:21.

Figure 10 (next page) is a voltage load amplifier with two inputs at ports 310 and 320, which connect to the gates of transistors 330 and 340, and the single output is output load 390. Ex. 1003 ¶¶ 183, 184; Pet. 54–56.



EX1013, Fig. 10, 23:22-29.

b) Motivation to Combine

Petitioner asserts Lejon discloses a power amplifier (*the electronic device*) that has multiple inputs and a single output (*a multiple-input-single-output (MISO) amplifier*). Pet. 56–57; Ex. 1003 ¶ 184.

Petitioner asserts that Lejon addresses concerns with power consumption, as does Hau. Pet. 56 (citing Ex. 1013, 1:27–2:5; Ex. 1003 ¶ 179). Petitioner also asserts that Lejon, like Hau and Yoshida, operate at varying output power levels, which are controlled by varying the bias voltage provided to the amplifiers. *Id.* at 57 (citing Ex. 1013, 2:7–2 [sic, 7–12], 2:27–29; Ex. 1003 ¶ 180). Thus, a person of ordinary skill would seek to combine use the Hau/Yoshida combination in similar electronic devices, like the Lejon MISO electrical device, with a reasonable expectation that it would be successful. *Id.*

Patent Owner asserts Lejon does *not* disclose a MISO circuit. PO Resp. 52–53. According to Patent Owner, "Lejon receives a single input (which ***are*** split into two phasor components) and provides a single output." *Id.* at 53 (emphasis added). We find it telling that Patent Owner uses a plural verb form to describe the allegedly "single" input. Patent Owner concludes that "such LINC amplifiers do not constitute MISO amplifier as required by claim 16." *Id.* (citing Ex. 2001, ¶ 180).

Dr. Larson's rebuttal testimony clarifies more specifically Petitioner's position. Dr. Larson testifies:

> As an initial matter, the plain language of the claim does not say anything about the source of the signals being amplified. If an amplifier has two or more inputs and a single output, that amplifier is a "MISO" amplifier regardless of how the inputs were generated. In the case of Lejon, I explained in my original declaration that it contains two figures which each show amplifiers with multiple inputs (210, 220 in Fig. 9; 310, 320 in Fig. 10) and a single output (load 290 in Fig. 9, 390 in Fig. 10). Nothing in the plain language of the claim, nor in the specification (*e.g.* Fig. 8 or the description at 9:66-10:22 of the '593 Patent), suggests any reason to exclude multiple inputs because they are phasors of the same original signal.

Ex. 1031 ¶ 74. Indeed, Dr. Larson suggests that his understanding as stated above is common practice, citing prior patents. *Id.* ¶ 75; Reply 20. We credit Dr. Larson's testimony because it is consistent with the proper scope of the claim and the disclosures of the prior art.

In view of the above, we determine that Petitioner has proved by a preponderance of the evidence that claim 16 would have been obvious in view of Hau, Yoshida, and Lejon.

E. Grounds 2A–2C

We have found all of the challenged claims unpatentable in Grounds 1A–1C. Grounds 2A–2C are essentially redundant and duplicative of Grounds 1A–1C. Grounds 2A–2C rely on similar references raising the same issues as in Grounds 1A–1C. Pet. 60–97. Petitioner contends that the combination of Canyon and Ranjan renders claim 1–5, 9–11, 15, 19, and 20 unpatentable. *Id.* at 60–83. Petitioner contends that the combination of Canyon, Ranjan, and Hau renders claims 6–8 and 12–14 obvious. *Id.* at 83–90. Petitioner further contends that the combination of Canyon, Ranjan, and Lejon renders claim 16–18 obvious. *Id.* at 91–97.

For each of the Grounds 2A–2C, Petitioner provides a detailed, comprehensive clause-by-clause analysis of how the references relied on disclose a recited claim element or limitation, and why it would have been obvious to combine each of the references relied on to establish that the claimed invention would have been obvious. *Id.* at 60–97.

Patent Owner does *not* oppose or comment on most of the individual clauses challenged in Grounds 2A–2C. For Ground 2A, Patent Owner argues that there is no motivation to combine Canyon with Ranjan and that the asserted combination does not teach controlling the switching device "in response to a power efficiency of the power supply exceeding a predetermined threshold." PO Resp. 53–64. As to dependent claims 3–4, 10, and 19, Patent Owner contends Ranjan does not disclose controlling the switching device "based on a probable output power point of operation for a selected modulation scheme based on one or more power efficiency characteristics of an electronic device coupled to the power supply." *Id.* at 65–66. For Ground 2B, Patent Owner contends that Hau does not disclose

"deactivating the switching device and passing the input voltage to the output voltage node based on a comparison of the down-converted voltage to a threshold voltage," as required by claims 6–8 and 12–14. *Id.* at 65–66. Patent Owner also contends that the asserted combination does not teach "programming the threshold voltage based on a communication waveform efficiency, battery life associated with an electronic device coupled to the power supply, or a combination thereof," as required by claims 8 and 13. *Id.* at 67–68. Lastly, Patent Owner argues, as with Ground 1C, that Lejon does not disclose or suggest a MISO amplifier. *Id.* at 68.

We have considered Patent Owner's arguments and do not find them persuasive. Most of these arguments are similar to the ones presented for Grounds 1A–1C and address similar disclosures in the prior art. For Grounds 2A–2C, we determine that Petitioner's arguments and evidence establish a preponderance of the evidence on the issue for which they are asserted, and adopt them as our own findings and conclusions. Pet. 60–97; Pet. Reply 20–30.

Accordingly, we determine that Petitioner has shown by a preponderance of the evidence, that claims 1–20 would have been obvious in view of the various combinations of Canyon, Ranjan, Hau, and Lejon, asserted in Petitioner's Grounds 2A–2C.

III. CONCLUSION[15]

Based on the evidence and analysis above, we determine that Petitioner has established that all challenged claims, are not patentable based on Grounds 1A–1C.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that, that Petitioner has shown by a preponderance of the evidence that claims 1–20 are unpatentable;

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

[15] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

V. SUMMARY TABLE

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1, 2, 5–7, 9, 11, 12, 15	103	Hau, Yoshida	1, 2, 5–7, 9, 11, 12, 15	
3, 4, 8, 10, 13, 14, 17–20	103	Hau, Yoshida, Sahu	3, 4, 8, 10, 13, 14, 17–20	
16	103	Hau, Yoshida, Lejon	16	
1–5, 9–11, 15, 19, 20	103	Canyon, Ranjan	1–5, 9–11, 15, 19, 20	
6–8, 12–14	103	Canyon, Ranjan, Hau	6–8, 12–14	
16–18	103	Canyon, Ranjan, Lejon	16–18	
Overall Outcome			1–20	

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