

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SEMICONDUCTOR COMPONENTS INDUSTRIES, LLC
(d/b/a ON SEMICONDUCTOR),
Petitioner,

v.

POWER INTEGRATIONS, INC.,
Patent Owner.

Case IPR2018-00165
Patent 6,414,471 B1

Before THOMAS L. GIANNETTI, BRIAN J. McNAMARA, and
LYNNE E. PETTIGREW, *Administrative Patent Judges*.

GIANNETTI, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

Semiconductor Components Industries, LLC, d/b/a ON Semiconductor (“Petitioner”) filed a Petition (Paper 1, “Pet.”) seeking *inter partes* review of claims 1–3, 5, 6, 19–21, 23, and 24 of U.S. Patent No. 6,414,471 B1 (Ex. 1001, “the ’471 patent”) pursuant to 35 U.S.C. §§ 311–319. Power Integrations, Inc. (“Patent Owner”) filed a Patent Owner Preliminary Response (Paper 6, “Prelim. Resp.”).

We determined that there was a reasonable likelihood that the Petitioner would prevail with respect to at least one of the claims challenged in the Petition. 35 U.S.C. § 314(a). We therefore granted the Petition and instituted *inter partes* review for claims 1–3, 5, 6, 19–21, 23, and 24. Paper 7 (“Institution Dec.”).

Following institution, Patent Owner filed a Response to the Petition (Paper 9, “PO Resp.”), Petitioner filed a Reply (Paper 24, “Pet. Reply”)¹, and Patent Owner filed a Sur-reply (Paper 29, “PO Sur-reply”).

An Oral Hearing was held on February 13, 2019.² The Hearing Transcript (“Hearing Tr.”) is included in the record as Paper 35.

Having considered the evidence of record, and for the reasons set forth below, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 1–3, 5, 6, 19–21, 23, and 24 of the ’471 patent are unpatentable.

¹ Petitioner’s Reply (Paper 24) was filed under seal. A public (redacted) version was filed as Paper 23. Our citations in this Decision are to Paper 24.

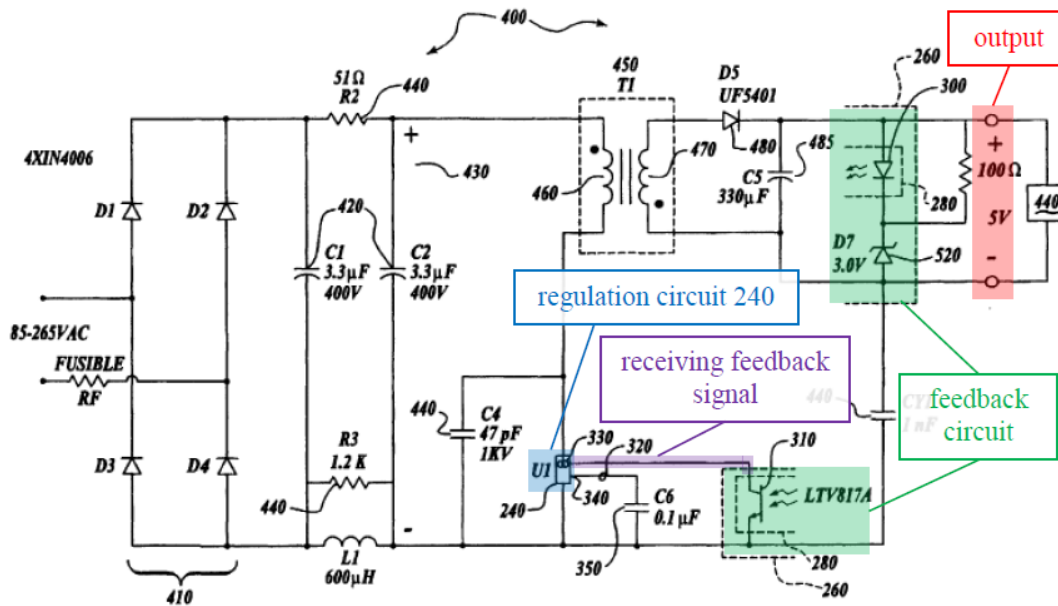
² The hearing was consolidated with IPR2018-00166. The transcript caption page incorrectly states the hearing date as February 22, 2019.

II. BACKGROUND

A. The '471 Patent (Ex. 1001)

The '471 patent is titled “Off-Line Converter with Digital Control.” The patent is directed to regulation of power supplies. Ex. 1001, 1:14–16. Accurate regulation of power supplies is important in many areas. For instance, in sensitive electronic devices such as computers and televisions, maintaining a constant power supply is important for the operation of the computer or television. *Id.* at 1:18–22. Power supplies are regulated by keeping either a current or voltage delivered to a load within a specified range. *Id.* at 1:26–27.

The subject matter of the '471 patent is illustrated by Figure 3, which is reproduced here from the Petition with annotations provided by Petitioner:



Pet. 13. Figure 3 of the '471 patent (annotated) is a circuit diagram of a DC-DC power supply. Ex. 1001, 3:39–40. The operation of the circuit will now be described with reference to the figure.

1. Feedback Circuit

The power supply makes use of a feedback circuit to regulate the output voltage and keep it constant within a range. Ex. 1001, 4:36–38. Feedback circuit 260 includes optocoupler 280, phototransistor 310, and Zener diode 290.³ *Id.* at 4:38–39. The output of feedback circuit 260 is coupled to feedback terminal 320 of regulator circuit 240, as shown in Figure 3, *supra*. *Id.* at 5:29–31. As described in the patent, “the output of feedback circuit 260 is utilized to enable or disable operation of the regulation circuit 240.” *Id.* at 4:30–32.

Feedback circuit 260 will trigger when the second DC voltage 220 is above a threshold level that is a combination of the voltage drop across light emitting diode 300 of optocoupler 280 (preferably one volt) and the reverse break down voltage of Zener diode 290. *Id.* at 4:39–44. Upon triggering, feedback circuit 260 will activate phototransistor 310 of optocoupler 280. *Id.* at 4:45–46. The activation of phototransistor 310 causes a current to flow into feedback terminal 320. The current input into feedback terminal 320 is utilized to disable regulation circuit 240. *Id.* at 4:46–49.

2. Operation

In operation, an AC voltage is input to bridge rectifier 410, which provides a rectified signal to power supply capacitor 420. This provides input DC voltage 430 to primary winding 460 of transformer 450. *Id.* at 5:38–40. Regulation circuit 240, which preferably operates at a constant frequency and about constant duty cycle at a given input DC voltage, allows current to flow through the primary winding during its on state of each

³ In Figure 3, the Zener diode is labeled with reference numeral 520.

switching cycle and acts as an open circuit when in its off state. *Id.* at 5:41–45. When current flows through the primary winding, the transformer stores energy. When no current is flowing through the primary winding, any energy stored in the transformer is delivered to secondary winding 470. *Id.* at 5:45–49. Secondary winding 470 then provides the energy to capacitor 485, which delivers power to load 490.⁴ *Id.* at 5:49–50.

The voltage across the load will vary depending on the amount of energy stored in the transformer in each switching cycle, which in turn depends on the length of time current is flowing through primary winding 460 in each switching cycle. This cycle is constant at a given input DC voltage 430. Regulation circuit 240 thus allows the voltage delivered to the load to be maintained at a constant level. *Id.* at 5:51–59.

3. Threshold Levels

As described above, the sum of the voltage drop across the optocoupler and the reverse break down voltage of the Zener diode is approximately equal to a desired threshold level. When the voltage across the load reaches the threshold level, current begins to flow through the optocoupler and Zener diode that, in turn, is used to disable regulation circuit 240. *Id.* at 5:60–66.

When the regulation circuit is disabled, an open circuit condition is created in primary winding 460 and transformer 450 does not store energy. The energy stored in the transformer from the last cycle of regulation circuit 240 is then delivered to the secondary winding, which in turn supplies power to the load 490. Once the remaining energy in transformer 450 is delivered

⁴ The load shown at the output terminals of Figure 3, *supra*, is mislabeled 440.

to the load, the voltage of the load will decrease. *Id.* at 6:8–16. When the voltage at the load decreases below the threshold level, current ceases to flow through the optocoupler and regulation circuit 240 resumes operation. *Id.* at 6:15–18.

B. Illustrative Claims

Of the claims challenged, claims 1 and 19 are independent. Claims 1 and 19 are reproduced here:

1. A circuit for regulating the level at a power converter output, the circuit comprising:

an input for receiving a feedback signal, the feedback signal having a first feedback state that represents a level that is above a threshold level and a second feedback state that represents a level that is below the threshold level;

an oscillator that provides a duty cycle signal that cycles between two states; and

a switch including a first terminal, a second terminal and a control terminal, said switch being operable to couple or decouple the first terminal and the second terminal in response to a control signal received at the control terminal, the control signal being responsive to the duty cycle signal and to a change between the first and second feedback states.

19. A method of regulating the level at a power converter output, said power converter having a power converter input and the power converter output, said method comprising:

receiving a feedback signal, the feedback signal having a first feedback state that represents a level at the power converter output that is above a threshold level and a second feedback state that represents a level at the power converter output that is below the threshold level;

providing a duty cycle signal that cycles between two states; and

in response to the duty cycle signal and to a change between the first and second feedback states, enabling or

disabling the flow of energy from the power converter input to the power converter output.

C. Real Parties-in-Interest

Petitioner identifies the following real parties-in-interest: (i) ON Semiconductor Corporation, (ii) Semiconductor Components Industries, LLC, doing business as ON Semiconductor, (iii) Fairchild Semiconductor International, Inc., (iv) Fairchild Semiconductor Corporation, (v) Fairchild (Taiwan) Corporation, and (vi) System-General Corporation. Pet. 1. Patent Owner identifies itself as the only real party-in-interest. Paper 3, 2.

D. Related Matters

The parties identify a pending lawsuit involving the '471 patent: *Power Integrations, Inc. v. ON Semiconductor Corp., et al.*, No. 5:16-cv-06371-BLF (N.D. Cal.). Pet. 1; Paper 3, 2. In addition, the parties identify several petitions for *inter partes* review filed by Petitioner seeking review of patents held by Patent Owner, including IPR2018-00166, involving U.S. Patent 6,297,623. The '471 patent is a continuation of that patent. Pet. 2; Paper 3, 2–3.

E. References and Other Evidence

Petitioner relies on the following patent references:

Barbehenn	US 5,914,865	June 22, 1999	Ex. 1004
Krupka	US 4,413,224	Nov. 1, 1983	Ex. 1007

Petitioner also relies on Grebene, a 1984 textbook titled “*Bipolar and MOS Analog Integrated Circuit Design*.” Ex. 1005.

In addition, both parties rely on declaration testimony. Petitioner relies on testimony from technical experts Dr. Vijay Madiseti (Ex. 1002, “Madiseti Decl.”) and Dr. Douglas Holberg (Ex. 1033, “Holberg Decl.”).

Patent Owner relies on expert testimony from William Bohannon (Ex. 2022, “Bohannon Decl.”).

Petitioner relies also on testimony from Balu Balakrishnan, Patent Owner’s President and CEO, and one of the co-inventors named in the ’471 patent (Ex. 2002, “Balakrishnan Decl.”). In addition, Patent Owner relies on testimony from David Kung, another of its employees (Ex. 2021, “Kung Decl.”).

The record also includes deposition transcripts for several of these witnesses.⁵ In addition, the parties have submitted testimony and other materials from parallel district court litigation.

F. Grounds Asserted

The Petition challenges the patentability of certain ’471 patent claims on the following grounds (Pet. 11, 20, 30, 40, 54):

References	Basis	Challenged Claims
Barbehenn	102(b)	19
Barbehenn and Grebene	103(a)	20, 23, and 24
Barbehenn and Grebene	103(a)	1, 2, 5, and 6
Barbehenn	103(a)	1–3 and 19–21
Krupka	103(a)	1–3 and 19–21

III. ANALYSIS OF CHALLENGES

A. Level of Ordinary Skill

We assess obviousness in view of the understanding of a person of ordinary skill in the art at the time of the invention. *Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966). Dr. Madisetti testifies that a person of ordinary

⁵ Ex. 1040 (“Bohannon I Dep.” taken Nov. 27, 2018); Ex. 1041 (“Bohannon II Dep.” taken Nov. 28, 2018); Ex. 1042 (“Kung Dep.”); Ex. 1043 (“Balakrishnan Dep.”).

skill in the art “would be a person having a B.S. in Electrical Engineering or a related field with at least two years of experience in designing power electronics, or having an M.S. in Electrical Engineering or a related field.”

Madisetti Decl. ¶ 25. Mr. Bohannon provides a similar formulation:

In my opinion, at the time of invention of the ’471 patent, people of ordinary skill in the art of developing and implementing switching regulators and their control circuits were people with at least a B.S. degree, or its equivalent, in electrical engineering or physics and approximately two years of practical experience working with switching regulators and analog/mixed signal circuit design, or an equivalent combination of academic study and work experience.

Bohannon Decl. ¶ 35.

We do not discern that our analysis of the evidence in light the parties’ arguments would change depending on the level of ordinary skill in the art. On this record, therefore, we accept Dr. Madisetti’s definition, which we also determine to be consistent with the level of skill reflected in the asserted prior art references. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (the prior art itself can reflect the appropriate level of ordinary skill in the art).

B. Claim Construction

The parties inform us that the ’471 patent expired on February 27, 2018. *See* Pet. 10; Prelim. Resp. 8. For claims of an expired patent, the Board’s claim construction analysis is similar to that of a district court. *See In re Rambus Inc.*, 694 F.3d 42, 46 (Fed. Cir. 2012). In this context, claim terms “are generally given their ordinary and customary meaning” as understood by a person of ordinary skill in the art in question at the time of the invention. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc). “In determining the meaning of the disputed claim

limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17). Extrinsic evidence is “less significant than the intrinsic record in determining ‘the legally operative meaning of claim language.’” *Phillips*, 415 F.3d at 1317.

Petitioner states that the challenged claims “should each be construed according [to] the principles set forth in *Phillips*,” but does not propose any constructions. Pet. 10–11. Patent Owner’s Preliminary Response, on the other hand, proposed one construction. Prelim. Resp. 8–11. Patent Owner construed the phrase “a second feedback state that represents a level that is below the threshold level” in claim 1 (and corresponding language in claim 19)⁶ as follows: “a state in which no feedback information is present at the feedback signal input.” *Id.* at 9. Patent Owner equated this state to “no current flowing” at the feedback signal input:

The meaning of “a second feedback state that represents a level [at the power converter output] that is below the threshold level” is clear in light of the specification, which describes a single embodiment for implementing the feedback signal and corresponding regulation, namely one in which *no feedback information is present (e.g., no current is flowing)* at the feedback signal input when the power converter output is at a level below the threshold level.

Id. at 10 (citing *Phillips*, 415 F.3d at 1315) (emphasis added). Because this

⁶ In claim 19, *supra*, the corresponding element reads: “a second feedback state that represents a level *at the power converter* that is below the threshold level.” (Emphasis added.) The parties’ arguments do not focus on this distinction.

construction is important to our analysis, we discuss it here in some detail.

In our Institution Decision, we did not adopt this proposed construction. Institution Dec. 11. We remarked that Patent Owner’s construction violated a “bedrock principle,” as it was not consistent with the language of the claims. *Id.* at 9 (citing *Phillips*, 415 F.3d at 1312). Nowhere do the claims refer to “feedback information,” much less require that “no feedback information be present at the feedback signal input.” Instead, the claims refer to a “feedback signal,” as in the following recitation from claim 1 (emphasis added):

an input for receiving a *feedback signal*, the *feedback signal* having a first feedback state that represents a level that is above a threshold level and a second feedback state that represents a level that is below the threshold level

We observed also that Patent Owner’s argument glossed over the differences in claim language. *Id.* Thus, for example, Patent Owner argued:

[T]he Specification “repeatedly, consistently, and exclusively” describes that the absence of *feedback information* (*e.g.*, no current flowing) at the feedback signal input represents a feedback state (*i.e.*, the claimed “second feedback state”) in which a level at the power converter output is below the threshold level.

Prelim. Resp. 11 (emphasis added). We found this argument to be misleading because the ’471 patent specification, like the ’471 patent claims, does not use the term “feedback information.” Institution Dec. 10. Instead, the specification, like the claims, refers to a “feedback signal.” *See, e.g.*, Ex. 1001, 2:50–53 (“When a feedback signal is above a threshold the regulator circuit is disabled and when the feedback signal is below said threshold level the regulator circuit is enabled.”).

We concluded that Patent Owner’s claim construction argument failed for a second reason: it was inconsistent with (and in fact contradicted by) the ’471 patent specification. Institution Dec. 10–11. We determined that the ’471 patent specification explicitly states that “other feedback circuits” can be used “without departing from the spirit and scope of the present invention.” *Id.* at 10 (citing Ex. 1001, 6:42–44). In this context, we referred to an example presented in the specification of a “voltage mode” alternative to the current mode operation cited by Patent Owner: “Either current or voltage mode regulation may be utilized by the present invention without departing from the spirit and scope of the present invention.” *Id.* (citing Ex. 1001, 6:35–37). In this discussion of alternatives, there is no reference to “zero current” or, for that matter, “zero voltage.” The only requirement is that “a signal indicative of the power supplied to the load is supplied to the feedback terminal 320 of the regulator circuit 240.” *Id.* at 6:38–40.

Patent Owner’s Response takes a new approach for construing this phrase. PO Resp. 11–14. Patent Owner now contends that “the proper construction of this phrase under the *Phillips* standard would be ‘a feedback signal having two discrete feedback states,’ with the term ‘discrete’ meaning ‘[having] a finite or countable set of values; *not continuous*.’” *Id.* at 11 (alterations and emphasis in original). Patent Owner elaborates: “Based on this construction, the claimed feedback signal includes digital signals and excludes analog signals, which do not have ‘a finite or countable’ set of states but, rather, are continuous.” *Id.* (citing Bohannon Decl. ¶ 37). Patent Owner argues that this construction “is consistent with the language of the claims under the *Phillips* standard.” *Id.* Specifically, Patent Owner points to the language in the claims calling for the feedback signal to have a “first

feedback state” and a “second feedback state.” *Id.* Relying on testimony from Mr. Bohannon, Patent Owner argues these “are two discrete feedback states.” *Id.* (citing Bohannon Decl. ¶ 38).

Petitioner responds that Patent Owner’s new construction “merely repackages” its rejected initial claim construction “in different terms.” Pet. Reply 1. We agree that this new claim construction argument by Patent Owner is fundamentally the same as and no more persuasive than the one we rejected prior to institution.

To interpret the claim language, we first look at the claims themselves. *Phillips*, 415 F.3d at 1312. The claims make no reference to “discrete” feedback states that would “exclude[] analog signals.” The claims describe the two feedback states as “represent[ing] a level that is above a threshold level” and “represent[ing] a level that is below a threshold level.” While the claims do specify what the “states” represent, they do not describe how those states are represented, i.e., what type of signal is used to represent the two states.

Nor does the ’471 patent specification support the construction proposed by Patent Owner. In explaining how the claimed “feedback signal” is presented in the specification, Patent Owner reverts to its “zero current” argument, discussed *supra*. PO Resp. 12. As in the Preliminary Response, Patent Owner relies on the embodiment, discussed *supra*, in which the current input into feedback terminal 320 is utilized to disable regulation circuit 240. *See* Ex. 1001, 4:46–49. Patent Owner argues:

Thus, the feedback signal is a digital feedback signal having two discrete states (e.g., presence or absence of current in the current embodiment), namely, (i) a first state in which “[t]he *current input* into feedback terminal [] is utilized to disable regulation

circuit,” and (ii) a second state in which the regulation circuit is enabled when “*no current flows* into the feedback terminal.”

PO Resp. 12–13 (alterations and emphasis original).

For reasons discussed *supra*, we are no more persuaded by this “zero current” argument now than we were at the institution stage. While the claims must be read in view of the specification, “limitations from the specification are not to be read into the claims.” *Teleflex, Inc. v. Ficoso N. Am. Corp.*, 299 F.3d 1313, 1326 (Fed. Cir. 2002) (citations omitted). Even when the specification describes only a single embodiment, the claims of the patent will not be read restrictively, unless the patentee has demonstrated a clear intention to limit the claim scope using words or expressions of manifest exclusion or restriction. *Liebel-Flarsheim Co. v. Medrad, Inc.*, 358 F.3d 898, 906 (Fed. Cir. 2004) (citing *Teleflex*, 299 F.3d at 1327). As noted *supra*, here, the ’471 patent describes alternative embodiments with no requirement of “zero current” or “zero voltage.”

We find that Mr. Bohannon’s testimony on this issue (Bohannon Decl. ¶¶ 37–47), which tracks closely the language of Patent Owner’s Response, is contrary to the above principles of proper claim construction, and we therefore do not find it convincing. Likewise, we do not find persuasive Patent Owner’s dictionary reference contrasting “discrete moments” with “a continuous flow.” Ex. 2023, 3. As discussed earlier, neither the claims nor the specification uses the term “discrete.” Thus, a dictionary definition for “discrete” does not shed light on the claim construction issue before us here.

Nor are we persuaded by Patent Owner’s reliance on the reference in the specification to “a ‘digital’ on and off for the power supply.” Ex. 1001, 6:45–48. From the context in which it appears, we agree with Petitioner that this generalized description applies to the power supply as a whole, not the

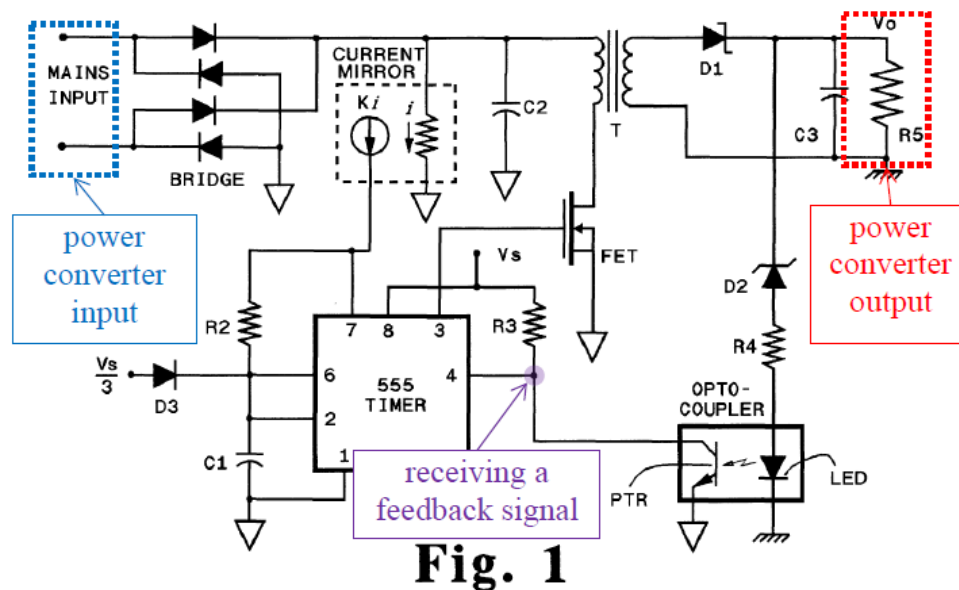
feedback signal specifically.⁷ Pet. Sur-reply 1. We are more persuaded by Petitioner’s argument that the feedback signal in the ’471 patent, i.e., the signal present at feedback terminal 320, is not limited to two discrete values, but instead occupies a range of values above and below the threshold. Pet. Reply 2–3 (discussing Fig. 6 of the ’471 patent). We are not persuaded by Patent Owner’s attempt to distinguish the feedback signal in the ’471 patent from prior art feedback signals (e.g., Barbehenn) on the ground that the signal in the ’471 patent is “digital.” See, e.g., Hearing Tr. 66:5–21. We see little material difference, if any, between the two feedback signals (’471 patent and Barbehenn) as they both meet the “threshold” requirements of the claims. We address this argument further in connection with our discussion of Patent Owner’s contentions regarding the prior art, *infra*.

C. Prior Art

1. Barbehenn (Ex. 1004)

Barbehenn is a patent titled “Simplified AC-DC Switching Converter with Output Isolation.” Barbehenn describes the operation of such a converter using a “bang-bang” control: “This means that the applied power is either furnished at maximum rate to the load filter, or it is turned off altogether.” Ex. 1004, 1:61–64. Figure 1 of Barbehenn, as annotated by Petitioner, follows:

⁷ “Advantages associated with the power supplies depicted in FIGS. 2 and 3 include a ‘digital’ on and off for the power supply making the regulation of the power supply extremely fast.” Ex. 1001, 6:45–48.

**Fig. 1**

Pet. 14. Figure 1 of Barbehenn is a circuit diagram of an AC-DC converter. Ex. 1004, 2:38–39. As shown in Figure 1, Barbehenn’s feedback loop includes Zener diode D2, resistor R4, and an optocoupler including an LED and phototransistor PTR. *Id.* at 3:29–32. Barbehenn’s output voltage threshold level is set by “the sum of the Zener voltage of diode D2 and the turn-on voltage of the light emitting diode LED in the OPTO-COUPLER.” *Id.* at 3:58–61.

The converter in Barbehenn alternates between two states by using an inhibit connection to an oscillator supplying the switching signal. *Id.* at 1:65–67. The optocoupler is used to generate the inhibit signal such that a small variation in the load will turn the oscillator on or off. The oscillator is implemented with a standard 555 timer, configured as a free-running oscillator. *Id.* at 1:67–2:4. A voltage applied to the inhibit line of the timer causes the oscillator to switch states. *Id.* at 2:4–7.

The operation of the circuit is described as follows. When the level of the output voltage (V_o) exceeds the output voltage threshold, the LED in the

optocoupler conducts and “causes the adjacent photo-transistor PTR to begin conduction.” *Id.* at 3:60–63. When the photo-transistor current flows through resistor R3, the voltage at reset pin 4 is lowered and the oscillation of the 555 timer is inhibited. *Id.* at 3:63–67. Petitioner contends the current level of the optocoupler or the resulting low voltage at pin 4 represents a first feedback state. Pet. 14.

When the level of the output voltage falls below the output threshold, the photo-transistor current ceases conduction through resistor R3, the voltage at reset pin 4 returns high, and the duty cycle signal provided at pin 3 of the 555 timer resumes oscillating. Ex. 1004, 3:67– 4:4. Petitioner contends the current level of the optocoupler or the resulting high voltage at pin 4 represents a second feedback state. Pet. 15.

2. Grebene (Ex. 1005)

Grebene is a textbook titled “Bipolar and MOS Analog Integrated Circuit Design.” Grebene shows the internal circuitry of the industry standard 555 timer used in Barbehenn.

3. Krupka (Ex. 1007)

Krupka is a patent titled “Micropower System.” The patent describes a “DC/DC conversion system providing a stabilized voltage output at a predetermined voltage higher than that of the energy source.” Ex. 1007, Abstract. A voltage reference and comparator determines whether the output voltage is above or below a threshold and outputs a control signal. *Id.* at Fig. 1, 3:5–10. An AND gate uses the control signal to enable or disable pulses from a pulse generator to a switching device to control the output voltage. *Id.* at 1:10–21.

E. Patent Owner's Challenge to Barbehenn's Status as Prior Art

Patent Owner asserts that Barbehenn does not qualify as prior art because the invention of the '471 patent was conceived by the inventors prior to Barbehenn's filing date of October 23, 1997, and the inventors exercised reasonable diligence in reducing the invention to practice. PO Resp. 14–23.

1. Applicable Law — Joint Inventorship

To antedate a reference, a patentee must establish that it invented the subject matter recited in the patent claims before the reference's effective date as prior art. Prior invention can be established by showing “either an earlier reduction to practice, or an earlier conception followed by a diligent reduction to practice.” *Purdue Pharma L.P. v. Boehringer Ingelheim GmbH*, 237 F.3d 1359, 1365 (Fed. Cir. 2001). A patent owner bears the burden to establish the facts necessary to overcome the reference's filing date. *In re Magnum Oil Tools Int'l, Ltd.*, 829 F.3d 1364, 1375–1376 (Fed. Cir. 2016).

“Conception is the touchstone of inventorship.” *Acromed Corp. v. Sofamor Danek Grp., Inc.*, 253 F.3d 1371, 1379 (Fed. Cir. 2001) (quoting *Burroughs Wellcome Co. v. Barr Labs., Inc.*, 40 F.3d 1223, 1227 (Fed. Cir. 1994); accord *Fina Oil & Chem. Co. v. Ewen*, 123 F.3d 1466, 1473 (Fed. Cir. 1997)). To prove conception, a patent owner is required to show “formation in the mind of the inventor, of a definite and permanent idea of the complete and operative invention, as it is hereafter to be applied in practice.” *Dawson v. Dawson*, 710 F.3d 1347, 1352 (Fed. Cir. 2013) (internal citations and quotations omitted).

In the case of a joint invention, each joint inventor must contribute to

the invention's conception. *See, e.g., Eli Lilly & Co. v. Aradigm Corp.*, 376 F.3d 1352, 1358–59 (Fed. Cir. 2004); *Ethicon, Inc., v. U.S. Surgical Corp.*, 135 F.3d 1456, 1460–61 (Fed. Cir. 1998); *Fina Oil*, 123 F.3d at 1473 (“[T]o be a joint inventor, an individual must make a contribution to the conception of the claimed invention that is not insignificant in quality, when that contribution is measured against the dimension of the full invention.”). He or she need not “make the same type or amount of contribution” to the invention nor contribute to every claim – a contribution to one claim is enough. *Ethicon*, 135 F.3d at 1460 (quoting 35 U.S.C. § 116).

To establish joint inventorship, there must be “some quantum of collaboration.” *Kimberly-Clark Corp. v. Procter & Gamble Distrib. Co.*, 973 F.2d 911, 917 (Fed. Cir. 1992) (“[T]here must be some element of joint behavior, such as collaboration or working under common direction, one inventor seeing a relevant report and building upon it or hearing another's suggestion at a meeting.”); *see also Eli Lilly*, 376 F.3d at 1359 (referring to the inventors having “some open line of communication during or in temporal proximity to their inventive efforts”).

In proving conception, “an inventor's testimony, standing alone, is insufficient.” *Price v. Symsek*, 988 F.2d 1187, 1194 (Fed. Cir. 1993). “[S]ome form of corroboration must be shown.” *Id.* Proof of conception must be by “corroborating evidence which shows that the inventor disclosed to others his ‘completed thought expressed in such clear terms as to enable those skilled in the art’ to make the invention.” *Coleman v. Dines*, 754 F.2d 353, 359 (Fed. Cir. 1985) (citing *Field v. Knowles*, 183 F.2d 593, 601 (CCPA 1950)); *see also Mahurkar v. C.R. Bard, Inc.*, 79 F.3d 1572, 1577 (Fed. Cir. 1996) (corroboration requirement “arose out of a concern that

inventors testifying in patent infringement cases would be tempted to remember facts favorable to their case by the lure of protecting their patent or defeating another's patent").

The sufficiency of corroboration is determined according to a "rule of reason" analysis, in which "an evaluation of all pertinent evidence must be made so that a sound determination of the credibility of the inventor's story may be reached." *Singh v. Brake*, 317 F.3d 1334, 1341 (Fed. Cir. 2003) (quoting *Price*, 988 F.2d at 1195). This, however, does not dispense with the requirement that some independent evidence provide corroboration. *Coleman*, 754 F.2d at 360. The requirement of "independent" corroboration requires evidence other than the inventor's testimony. *In re NTP, Inc.*, 654 F.3d 1279, 1291–92 (Fed. Cir. 2011).

2. Patent Owner's Contentions

Patent Owner asserts that the three inventors named in the '471 patent, Balakrishnan, Djenguerian, and Lund, jointly conceived of the claimed invention at least by October 9, 1997, and diligently reduced it to practice by filing U.S. Application No. 09/032,520 ("the '520 application"). PO Resp. 14–16. The '520 application is a grandparent to the application for the '471 patent and shares the same specification and figures. *Id.*

To establish the joint conception date of October 9, 1997, Patent Owner relies on several allegedly contemporaneous documents and declaration testimony from two employee fact witnesses: Balu Balakrishnan, one of the co-inventors listed on the '471 patent and Patent Owner's President and CEO (Ex. 2002, "Balakrishnan Decl."); and David Kung, Patent Owner's Director of Design Engineering (Ex. 2021, "Kung Decl."). Petitioner cross-examined both witnesses and submitted the transcripts as

exhibits. Exs. 1042 (“Kung Dep.”), 1043 (“Balakrishnan Dep.”). One of these documents is a schematic circuit diagram dated October 9, 1997. Ex. 2003.

Balakrishnan testifies that “[n]o later than October 9, 1997, Alex Djenguerian, Leif Lund, and I *collectively conceived* of the regulator circuits and methods claimed in the PI On/Off Control Patents.” Balakrishnan Decl. ¶ 10 (emphasis added). He further testifies that he “was responsible for conceiving of the overall concept of the On/Off control as well as preparing preliminary circuit designs for implementing” the “power supply architecture.” *Id.* ¶ 9. Referring to Exhibit 2003, Balakrishnan describes the document as “[a] schematic of a circuit used to provide a proof of concept for the operation of the inventive ON/OFF control regulator circuit, in the context of a switching power supply.” *Id.* ¶ 10.

Balakrishnan’s declaration is directed to claims 1 and 19 of the ’471 patent. *Id.* ¶ 11. He testifies that Exhibit 2003 “shows each element of at least claims 1 and 19 of the ’471 Patent.” *Id.* To establish conception, he compares Exhibit 2003 to claims 1 and 19. *Id.* at ¶¶ 12–15. He does not provide analysis for any other claim of the ’471 patent.

Exhibit 2003 bears a date of October 9, 1997, and contains various handwritten annotations, but does not indicate an author or mention any of the alleged joint inventors. Balakrishnan testifies on cross-examination that this schematic was not one he prepared, but was instead an “implementation” by an applications engineer, Derek Kroes. Ex. 1043, 69:7–70:5. Balakrishnan claims that Kroes implemented the circuit, based on guidance Balakrishnan and Djenguerian provided about how the circuit should work. *Id.* at 70:6–71:13.

Kung testifies that he was at the time Director of Design Engineering reporting to Balakrishnan. Kung Decl. ¶ 7. Both Djenguerian and Lund were design engineers reporting to Kung. *Id.* Kung testifies he “was aware of the underlying invention of PI’s On/Off Control Patents from the very beginning” and “recall[s] discussing with Mr. Balakrishnan his original ideas for the On/Off control scheme.” *Id.* ¶ 12. Kung further testifies that Balakrishnan worked with Kroes “to put together a power supply circuit as proof of concept” and “instructed Mr. Kroes on how to build a ‘breadboard’ design that would embody the concept of On/Off control that Mr. Balakrishnan had come up with.” *Id.* ¶ 13.

Kung describes the Exhibit 2003 schematic as “a version of the breadboard circuit built at Mr. Balakrishnan’s direction,” and testifies that “it shows a circuit using discrete components that operates according to what [he] understand[s] is disclosed in PI’s On/Off control patents.” *Id.* ¶ 14. Kung explains that Kroes, Djenguerian, and Lund were all engineers that reported to him in his group. *Id.* ¶¶ 7, 13. Djenguerian and Lund worked closely with Balakrishnan and “developed schematics for an integrated circuit chip that would implement the new On/Off control invention” after the concept was proven. *Id.* ¶ 15.

Balakrishnan testifies that he and his colleagues “worked to implement the inventive regulator circuit” and revised the design of the regulator circuit “[b]etween October 9, 1997 and October 23, 1997.” Balakrishnan Decl. ¶ 19 (citing Ex. 2004). Exhibit 2004, a second schematic, bears a date of October 23, 1998, but like Exhibit 2003, does not indicate an author or mention the inventors. Balakrishnan further testifies that he and his colleagues “continued to work on testing the performance of

the regulator circuit” between October 23, 1997, and October 28, 1997, and “conducted a series of tests of the performance of the prototype regulator circuit and recorded the performance on an oscilloscope” on October 28, 1997. *Id.* ¶ 20 (citing Ex. 2005). Exhibit 2005, the test results from October 28, 1997, contains various handwritten annotations, but does not indicate an author or mention the alleged joint inventors.

Patent Owner contends that Balakrishnan and the other two inventors “jointly conceived of the regulator circuit disclosed and claimed in the ’471 patent by no later than October 9, 1997.” PO Resp. 16. Patent Owner contends that Exhibit 2003 “establishes *the inventors* had a ‘definite and permanent’ grasp of the invention at least as of [October 9, 1997].” PO Resp. 16–17 (emphasis added). In addition, Patent Owner submits various other schematics (Ex. 2006; Ex. 2009; Ex. 2010; Ex. 2014), test results and simulations (Ex. 2006; Ex. 2009; Ex. 2010; Ex. 2013; Ex. 2014), presentations (Ex. 2007; Ex. 2011; Ex. 2015; Ex. 2018), status reports, meeting minutes, and agendas (Ex. 2008; Ex. 2012). Patent Owner contends that these exhibits demonstrate that the inventors exercised reasonable diligence in reducing the invention to practice. *Id.* at 19–23.

3. *Petitioner’s Contentions*

Petitioner disputes Patent Owner’s claimed conception date and argues that Barbehenn is not antedated by Patent Owner’s alleged prior invention. Pet. Reply 4–10. Petitioner argues that in a previous district court litigation, Patent Owner alleged an October 28, 1997, conception date for the ’471 patent, which differs from Patent Owner’s contention here of an October 9, 1997, joint conception date by 19 days. *Id.* at 10 (citing Ex. 1014, 9).

Petitioner further argues that Patent Owner's October 9, 1997, conception date lacks proper evidentiary support. Among other reasons, Petitioner contends there is no corroboration for the claim that Djenguerian or Lund contributed to the joint conception by the asserted date of October 9, 1997. *Id.* at 4. Petitioner explains that "[t]he earliest date on any document referencing [Djenguerian or Lund] is December 1997. See Ex. 2018, 11 (December 22, 1997 (Djenguerian)) and 15 (December 19, 1997 (Lund))." *Id.* at 6. Relying on Kung's testimony, Petitioner contends that the printed date on the Exhibit 2003 schematic (October 9, 1997) may have been the date the engineer first started drawing the schematic, not the date the engineer completed the schematic. *Id.* at 7 (citing Kung Dep. 51:4–24).

Petitioner contends that the "earliest possible date any functioning idea became definite and permanent was October 28, 1997," which is "consistent with PO's original assertion in District Court." *Id.* at 10. Petitioner contends that because this date falls after the filing date of Barbehenn, on October 23, 1997, Barbehenn is prior art to all challenged claims. *Id.*

4. Analysis

We have considered all of the arguments and evidence set forth by the parties on this issue. For the reasons explained below, we determine that Patent Owner has failed to carry its burden of proving that the alleged joint conception date for the invention claimed in the '471 patent antedates Barbehenn.

At the oral hearing, Patent Owner's counsel confirmed that the alleged conception on October 9, 1997, was joint. Hearing Tr. 40:17–41:1. As discussed above, Patent Owner attempts to prove prior joint conception and

reasonable diligence in reducing the claimed invention to practice by relying on testimony from two interested witnesses, Balakrishnan and Kung. Patent Owner does not provide testimony from any of the others allegedly involved in the conception and reduction to practice of the invention; there is no testimony from either of the other joint inventors, Djenguerian and Lund, or from Kroes, the engineer who prepared the schematic of October 9, 1997.

Patent Owner tries to corroborate Balakrishnan's and Kung's testimony on joint conception with several documents, but these do not sufficiently prove that the invention was jointly conceived by the inventors as of the asserted date of October 9, 1997. The main document relied upon by Patent Owner is the schematic identified as Exhibit 2003. Patent Owner argues that this schematic shows that the claimed invention was "jointly conceived" by October 9, 1997. PO Resp. 16–17.

While this document bears the asserted date, it has no information to corroborate the involvement of any of the alleged joint inventors in its preparation. *Id.* Moreover, we are persuaded by Petitioner's argument that based on Kung's testimony, there is lack of certainty that the October 9, 1997, date represents the date the schematic was completed as opposed to the date it was started. *See* Pet. Reply 7. This lack of certainty is heightened by the statement of Patent Owner's counsel at the oral hearing that the October 9, 1997, schematic was part of a multipage document that bears a different date (October 28) on the cover page. Hearing Tr. 49:21–24. In light of this evidence, we find that the October 9, 1997, date on the schematic is not a reliable indicator of when the circuit design was completed.

Balakrishnan testifies that he worked with Djenguerian and Lund to

conceive of the invention, but none of the joint inventors' names appear on the alleged conception document. Balakrishnan Decl. ¶ 10. In fact, both Balakrishnan and Kung testify that Kroes was responsible for creating the October 9 schematic, not any of the joint inventors. Balakrishnan Dep. 71:4–8; Kung Dep. 52:8–20.

Balakrishnan confirms that Kroes implemented the circuit, but says it was based on guidance he and Djenguerian provided about how the circuit should work. Balakrishnan Dep. 71:7–13. But there is no evidence to corroborate this statement by Balakrishnan. “[A]n alleged co-inventor must supply evidence to corroborate his testimony.” *Ethicon, Inc.*, 135 F.3d at 1461 (citing *Price*, 988 F.2d at 1194).

Patent Owner provides no explanation as to why it did not provide testimony from Djenguerian, Lund, or Kroes. Presumably, they were available to testify. According to Kung, Djenguerian is still employed by Patent Owner. Kung Dep. 100:4–6. Lund is retired from the company, and Kroes left sometime after the year 2000. *Id.* at 99:18–100:24.

Similar to the earlier-dated Exhibit 2003, Exhibit 2004 is a schematic that includes a date, but lacks any information to corroborate the identities of the inventors. As noted, Exhibit 2004 bears a date of October 23, 1997. However, there is no documentary proof that either Djenguerian or Lund played a role in the conception of the circuit shown in Exhibit 2004. As pointed out by Petitioner, neither Djenguerian's name nor Lund's name appears on any of the documents submitted to corroborate Patent Owner's conception story until December 1997. Pet. Reply 6.

Djenguerian and Lund also are mentioned in Kung's weekly reports, but the earliest date on a report submitted in this proceeding is January 9,

1998 — several months after Patent Owner’s purported conception date. Balakrishnan Decl. ¶ 25. Balakrishnan and Kung both testified that the earlier reports were lost due to a storage error and could not be found. *Id.* ¶ 25 n.2; Kung Decl. ¶ 10. Thus, there is no mention of Djenguerian and Lund in a contemporaneous document that would corroborate a joint conception date of October 9, 1997.

By a preponderance of the evidence, based upon the foregoing, we find that Patent Owner has not shown that Djenguerian or Lund began participating in the development program before December 1997, the earliest date their names appear on a document. We do not credit Balakrishnan’s uncorroborated testimony that he, Djenguerian, and Lund, conceived of the claimed invention “collectively” as of October 9, 1997. Balakrishnan Decl. ¶ 6. While there is some evidence that Balakrishnan was working on the project as of that date, there is no credible evidence that either Djenguerian or Lund was involved, and certainly no credible evidence that they made an inventive contribution as of that date. Without corroborated evidence of their involvement and contribution, Patent Owner’s claim of a joint conception on October 9, 1997 fails. *See Kimberly-Clark Corp.*, 973 F.2d at 917; *Eli Lilly*, 376 F.3d at 1359.

Patent Owner responds that it “is not required to demonstrate that the inventors ‘jointly conceived’ of the invention by October 9, 1997.” PO Sur-reply 1. Patent Owner attempts to distinguish the cases relied on by Petitioner: *Ethicon, Inc. v. U.S. Surgical Corp.* 135 F.3d 1456, 1460 (Fed. Cir. 1998) and *Apator Miitors ApS v. Kamstrup A/S*, 887 F.3d 1293, 1295–96 (Fed. Cir. 2018). Patent Owner argues that neither *Ethicon* nor *Apator Miitors* “require corroborating evidence of joint conception to swear behind

a reference.” PO Sur-reply 1–2. In support of this position, Patent Owner cites the Board’s non-precedential panel decision in *LG Electronics, Inc. v. ATI Technologies ULC*, IPR2015-00325, slip op. at 16 (PTAB April 14, 2016) (Paper 62). According to Patent Owner’s account of the case:

The patent in *LG* named three inventors. A declaration of one of the three inventors along with a specification he authored was provided as corroborating that “the named inventors conceived the claimed subject matter no later than [the critical date].” *Id.* The Board found patent owner “has demonstrated ... that the named inventors ... conceived the claimed system ... prior to the U.S. filing dates of [the prior art references].” *Id.*, 16–17.

PO Sur-reply 2 (citing *LG Electronics*, slip op. at 16 (emphasis and alterations in original)). Patent Owner also responds that the corroborating evidence as a whole supports prior conception and that the “[e]valuation of all pertinent evidence shows Mr. Balakrishnan ‘had the idea’ before Barbehenn’s October 23, 1997, filing date. *Burroughs Wellcome Co. v. Barr Labs., Inc.*, 40 F.3d 1223, 1228 (Fed. Cir. 1994)). That is all that is required [for conception].” PO Sur-reply 2–3.

We are not persuaded by Patent Owner’s reliance on the panel decision in *LG Electronics*, or its argument based on the “evidence as a whole.” *LG Electronics* is not precedential authority, and therefore does not bind this panel. But even if it were, that decision would be distinguishable on its facts. In that proceeding, the sufficiency of the corroborating documents showing conception was not disputed by the parties. The panel’s analysis, therefore, focused on actual reduction to practice. *LG Electronics*, slip op. at 16. This is confirmed by the decision itself, where the panel commented: “LG does not dispute the sufficiency of the R400 Sequencer Specification for showing conception.” *Id.* Here, in contrast, Petitioner

disputes the sufficiency of Patent Owner's conception evidence, and Patent Owner has not argued or provided evidence to show that the inventors actually reduced the invention to practice before Barbehenn's filing date.

Patent Owner alleges here that a joint conception of the invention of claims 1 and 19 occurred by October 9, 1997. *See supra*. Contrary to Patent Owner's argument based on *LG Electronics*, we determine that Patent Owner's alleged joint conception requires corroborated evidence that the joint inventors (not just Balakrishnan) contributed to that conception. *See, e.g., Eli Lilly*, 376 F.3d at 1358–1359; *Ethicon*, 135 F.3d at 1460–1461; *Fina Oil*, 123 F.3d at 1473.

Patent Owner's argument that Balakrishnan's testimony alone is sufficient is contradicted by Patent Owner's assertion that Balakrishnan and the two other inventors "jointly conceived of the regulator circuit disclosed and claimed in the '471 patent by no later than October 9, 1997." PO Resp. 16. Moreover, it is contrary to such cases as *Woodland Trust v. Flowertree Nursery, Inc.*, 148 F.3d 1368, 1371 (Fed. Cir. 1998) ("Throughout the history of the determination of patent rights, oral testimony by an alleged inventor asserting priority over a patentee's rights is regarded with skepticism, and as a result, such inventor testimony must be supported by some type of corroborating evidence.") (internal quotes omitted).

After considering all pertinent evidence, and under the rule of reason, we find that Patent Owner has failed to sufficiently corroborate its contention that the inventors jointly conceived of the claimed invention by October 9, 1997. Thus, as to claims 1 and 19, the only claims analyzed by Patent Owner, we find that the evidence of joint conception is insufficiently corroborated.

As to the other challenged claims (claims 2, 3, 5, 6, 20, 21, 23, and 24) not addressed by Balakrishnan, Patent Owner presents no evidence of a conception prior to the filing date of the '471 patent. In view of this determination that there is insufficient proof of conception on the dates alleged by Patent Owner, we need not reach the issue of reasonable diligence, as both an earlier date of conception and reasonable diligence are required to antedate a prior art reference. We, therefore, do not rely on Patent Owner's proofs of diligence. Thus, we find that Patent Owner has failed to antedate Barbehenn, and we will, therefore, consider Petitioner's challenges applying Barbehenn.

D. Challenges Based on Barbehenn Alone or Barbehenn and Grebene

1. Anticipation (Claim 19)

Petitioner challenges claim 19 as anticipated by Barbehenn. Pet. 11. Petitioner provides a detailed element-by-element analysis of claim 19 in relation to Barbehenn at pages 11–22 of the Petition. Petitioner also provides supporting testimony from its expert, Dr. Madisetti. Madisetti Decl. ¶¶ 46–59. We have considered Petitioner's analysis and Patent Owner's contentions, as discussed *infra*.

For example, Petitioner identifies the “first feedback state” recited in claim 19 with the operation of the 555 timer in Barbehenn:

When the level of the output voltage (Vo) exceeds the output threshold, the LED in the optocoupler conducts and “causes the adjacent photo-transistor PTR to begin conduction.” . . . When the photo-transistor current flows through resistor R3, the voltage at reset pin 4 is lowered and the oscillation of the 555 timer is inhibited. Accordingly, the current level of the

optocoupler or the resulting low voltage at pin 4 represents the first feedback state.

Pet. 14–15. Likewise, Petitioner identifies the “second feedback state” recited in the claim 19 with the operation of 555 timer:

[W]hen the level of the output voltage falls below the output threshold, the photo-transistor current ceases conduction through resistor R3, the voltage at reset pin 4 returns high, and the duty cycle signal provided at pin 3 of the 555 timer resumes oscillating. . . . Accordingly, the current level of the optocoupler or the resulting high voltage at pin 4 represents the second feedback state.

Pet. 15 (citations omitted).

Patent Owner responds that Barbehenn (with or without Grebene) fails to disclose “the feedback signal having a first feedback state . . . and a second feedback state.” PO Resp. 23–30. Patent Owner explains:

As explained above, the correct interpretation of the phrase “the feedback signal having a first feedback state . . . and a second feedback state...” is “the feedback signal having *two discrete feedback states*,” with “*discrete*” meaning “*non-continuous*.”

Id. at 24 (emphasis added). Patent Owner’s argument continues: “Nowhere does Barbehenn disclose a feedback signal having two discrete feedback states (i.e., presence or absence of current or voltage). Rather, Barbehenn uses an analog voltage signal having a continuous range of voltage values at the reset pin as the feedback signal to control oscillation of the 555 timer.” *Id.* at 24–25.

We are not persuaded by this argument, as it relies on a claim construction that we have not adopted. *See supra*. Moreover, it relies on comparing Barbehenn’s power converter with the disclosure in the ’471 patent specification, not the claims. *See, e.g.*, PO Resp. 25 (“Operation of the ’471 patent’s power converter is fundamentally different from that of

Barbehenn's AC-DC converter.”).

We find that the feedback loop in Barbehenn, as described by Petitioner, meets the limitation of claim 19⁸ calling for a “feedback signal having a first feedback state that represents a level at the power converter output that is above a threshold level and a second feedback state that represents a level at the power converter output that is below the threshold level.” We find that the disclosure in Barbehenn of the operation of Zener diode D2, resistor R4, and the optocoupler provides a feedback signal having first and second feedback states as called for in claim 19. As noted, we are not persuaded by Patent Owner's argument that the feedback loop in the '417 patent is digital and therefore distinguishable from Barbehenn. *See supra*. For the reasons stated, we do not construe the claims as requiring “discrete” states for the feedback signal or limiting the claims to digital feedback signals.

Patent Owner does not challenge other aspects of Petitioner's anticipation ground directed to claim 19. As to those additional uncontested limitations, we adopt Petitioner's analysis set forth in the Petition at pages 11–20 of the Petition. In view of the foregoing, and having considered Petitioner's element-by-element analysis and evidence regarding claim 19 in relation to Barbehenn set forth in the Petition and Patent Owner's Response, we determine that Petitioner has demonstrated by a preponderance of the evidence that claim 19 is anticipated by Barbehenn.

2. *Obviousness – Barbehenn and Grebene (Claims 1, 2, 5, 6)*

Petitioner challenges claims 1, 2, 5, and 6 as obvious in light of the

⁸ Claim 1 recites a similar limitation. *See infra*.

combination of Barbehenn and Grebene. Pet. 30–40. Petitioner contends it would have been obvious to combine Barbehenn and Grebene. *Id.* at 30 (citing *KSR Int’l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1741–42 (2007)). Patent Owner does not challenge this assertion.

Dr. Madisetti describes Grebene as a textbook aimed at the practicing engineer in the field of solid-state electronics. Madisetti Decl. ¶ 62 (quoting Ex. 1005, 4). He testifies Grebene would be suitable for a senior or graduate level university course. *Id.* (quoting Ex. 1005, 5). We credit Dr. Madisetti’s testimony on this issue. Upon reviewing the evidence of record, we find that a person of ordinary skill would have looked to the Grebene textbook on analog integrated circuit design for further information concerning the “industry standard” 555 timer used in Barbehenn’s power converter, including the internal block diagrams and circuit schematics that show an internal duty cycle. Pet. 30.

Petitioner provides an obviousness analysis of claims 1, 2, 5, and 6 at pages 31–40 of the Petition. Patent Owner’s response focuses on claim 1. Patent Owner does not provide a separate analysis for claims 2, 5, or 6.⁹ We therefore focus our discussion here on claim 1.

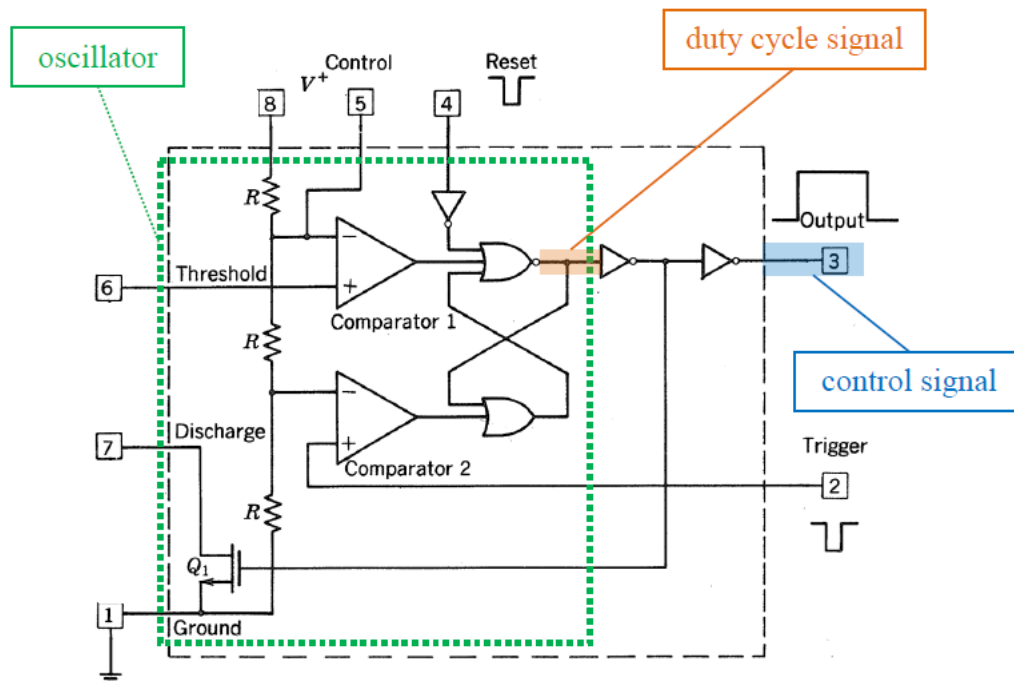
Petitioner’s detailed element-by-element analysis of claim 1 in relation to Barbehenn and Grebene appears at pages 31–37 of the Petition. Petitioner also provides supporting testimony from its expert, Dr. Madisetti. Madisetti Decl. ¶¶ 75–82. For example, Petitioner relies again on Barbehenn to provide disclosure of the “first feedback state” and “second

⁹ Patent Owner combines its response to these claims with its response to Petitioner’s challenge to claims 20, 23, and 24. PO Resp. 23. See discussion of claims 20, 23, and 24, *infra*.

feedback state” recited in claim 1. Pet. 31–32. For support, Petitioner refers back to its discussions of the two feedback states in connection with its anticipation challenge to claim 19 based on Barbehenn. *Id.* Petitioner relies also upon Grebene for the disclosure of the oscillator in claim 1. *Id.* at 33.

Patent Owner’s response, at least in part, is the same as for the anticipation challenge to claim 19 based on Barbehenn alone, namely, that the feedback signal in Barbehenn does not have a “first state” and a “second state” as described in the claims. PO Resp. 23–30. As discussed previously, this argument fails because it is based on a claim construction that we did not adopt, i.e., a construction requiring that there be “a feedback signal having two discrete feedback states,” with the term “discrete” meaning “[having] a finite or countable set of values; not continuous.” *See supra.* As discussed *supra*, for the same reasons given with respect to claim 19, we find that the disclosure in Barbehenn of the operation of Zener diode D2, resistor R4, and the optocoupler provides a feedback signal having first and second feedback states as called for in claim 1.

Patent Owner disputes this obviousness ground on a second basis. Patent Owner contends that Barbehenn and Grebene fail to disclose “the control signal being responsive to the duty cycle signal” as required by claim 1. PO Resp. 31–38. In Petitioner’s analysis, the “control signal” results from twice inverting the “duty cycle signal” provided by the oscillator. Pet. 33. Petitioner illustrates this in the following annotated figure from Grebene, showing the control signal and duty cycle signal:



Pet. 33. The annotated Grebene figure 11.48(a) above shows the internal circuitry of the 555 timer. Madisetti Decl. ¶ 78. As shown here, the oscillator provides a duty cycle signal that is inverted twice to provide a control signal at pin 3. *Id.*

Patent Owner contends that “[b]ecause claim 1 requires that the control signal is ‘responsive to the duty cycle signal,’” Petitioner’s contention that the claimed control signal is the same signal as the claimed duty cycle signal “would render the claim limitation ‘the control signal being responsive to the duty cycle signal’ superfluous.” PO Resp. 35.

We are not persuaded by this argument. We find that Petitioner has demonstrated that the control signal at pin 3 of the 555 timer in Barbehenn is responsive both to the duty cycle signal provided by the oscillator and the change between the first and second feedback states. Pet. 34–37. To illustrate this, Dr. Madisetti presents the following annotated Figure 1 from Barbehenn:



Madisetti Decl. ¶ 79. Figure 1 of Barbehenn (annotated) shows an AC-DC power converter. Ex. 1004, 2:38–39. Petitioner has labeled the control terminal, control signal, input receiving the feedback signal, and first and second terminals of the FET switch. When the FET is conductive in response to the control signal, the switch couples the first and second terminals; when the FET is nonconductive in response to the control signal, the switch decouples the first and second terminals. Madisetti Decl. ¶ 79.

We find, as Dr. Madisetti explains, that Barbehenn discloses a control signal responsive to the duty cycle signal. Madisetti Decl. ¶ 80. As shown above, the duty cycle is provided by the oscillator within the 555 timer that is routed through two inverters and then output as a control signal at pin 3 of the 555 timer. *Id.*; see Grebene Fig. 11.48(a) *supra*.

We further find, as Dr. Madisetti explains, that the control signal is also responsive to the change between the first and second feedback states. Madisetti Decl. ¶ 81. Referring to Figure 1 of Barbehenn, *supra*, Dr. Madisetti describes the response of the control signal to the first feedback

state:

When the level of the output voltage (Vo) exceeds a desired value (i.e., a feedback signal with the first feedback state), the LED in the optocoupler conducts and “causes the adjacent phototransistor PTR to begin conduction.” . . . The photo-transistor current flows through resistor R3, which decreases the voltage at the input for receiving the feedback signal that is coupled to reset pin 4. . . . Thus, the low voltage at reset pin 4 inhibits the oscillation of the 555 timer and stops the duty cycle signal, and the control signal is held low.

Madisetti Decl. ¶ 81. Dr. Madisetti explains the response of the control signal to the second feedback state:

When the level of the output voltage falls below the desired value (i.e., a feedback signal with the second feedback state), the photo-transistor ceases conduction altogether. . . . Thus, the voltage at reset pin 4 returns high, the 555 timer and the duty cycle signal resume oscillation, the duty cycle signal resumes oscillation, and the control signal provides a “high frequency square wave” to the FET.

Id. We agree with this analysis and find that this element of claim 1 is met by Barbehenn.

Patent Owner responds by comparing Barbehenn to the operation of the circuit shown in Figure 6 of the '471 patent. PO Resp. 31–35.

According to Patent Owner, in the '471 patent “there necessarily must be occasions where the control signal and the duty cycle signal have different logic states.” *Id.* at 32. In contrast, according to Patent Owner, the two signals in Grebene relied on by Petitioner “must always have the same logic state, regardless of the state of the alleged feedback signal.” *Id.* at 33.

Patent Owner’s argument fails to convince us. First, it compares the disclosure of Barbehenn and Grebene to an embodiment of the '471 patent,

not the claims.¹⁰ The claims do not require that the two signals (control and duty cycle) have different states. Moreover, this argument does not effectively address Petitioner’s argument that the duty cycle signal is itself dependent on the change in states from the first state to the second state, as demonstrated by Dr. Madisetti’s testimony. As Petitioner asserts, Patent Owner “concedes that Barbehenn/Grebene’s control signal is responsive to the duty cycle signal . . . , but ignores the Petition’s explanation that the duty cycle signal is itself dependent on a change between the first and second feedback states.” Pet. Reply 15.

Moreover, Patent Owner does not persuade us that because the two signals may have the same state, they are the same signal, or that this would “render the claim limitation superfluous.” PO Resp. 35. As a further demonstration that neither signal is “superfluous,” the duty cycle signal in Grebene’s Figure 11.48(a) is inverted to provide a signal to trigger transistor Q1 before again being inverted again to produce the control signal at pin 3.

Having considered Petitioner’s argument and evidence regarding claim 1 in relation to Barbehenn and Grebene and Patent Owner’s response, we determine that, for the reasons given above, Petitioner has demonstrated by a preponderance of the evidence that each element of claim 1 is taught or suggested by Barbehenn and Grebene.

As noted, Patent Owner does not provide a separate analysis for claims 2, 5, or 6. These claims depend from claim 1 and recite various details of the claimed circuit. Petitioner challenges them as obvious over Barbehenn and Grebene. Pet. 20–30. Petitioner’s element-by-element

¹⁰ Petitioner points out that in another ’471 patent embodiment (Fig. 14) the duty cycle and control signals have the same state. Pet. Reply 15–16.

analysis of these claims in relation to Barbehenn and Grebene appears at pages 37–40 of the Petition.

We have already discussed Petitioner’s analysis and Patent Owner’s arguments in connection with claim 1, from which these claims depend. *See supra*. We agree with and adopt Petitioner’s analysis of the additional features. Pet. 37–40. For example, claim 2 recites: “The circuit of claim 1 wherein the control signal responds substantially instantaneously to a change between the first and second feedback states.” We find that this limitation is met by Barbehenn and Grebene when “a control signal (i.e., output at pin 3 of the 555 timer that is received at the control terminal of the FET) that responds substantially instantaneously (i.e., in Barbehenn’s ‘bang-bang’ control loop with ‘very little filtering’) to a change between the first and second feedback states (e.g., pin 4 of the 555 timer going high or low).” *Id.* at 39.

Claim 5 recites: “The circuit of claim 1 wherein the circuit is operable to respond to a change from the second feedback state to the first feedback state to halt the cycling of the duty cycle signal.” Claim 6 recites: “The circuit of claim 5 wherein the circuit is operable to respond to a change from the first feedback state to the second feedback state to substantially instantaneously restart the cycling of the duty cycle signal.” As Petitioner explains, we find that “the combination of Barbehenn and Grebene discloses halting the cycling of the duty cycle signal in response to a change from the second feedback state to the first and restarting the cycling of the duty cycle signal substantially instantaneously in response to a change from the first feedback state to the second.” *Id.*

As further support for our findings, we refer to the analysis of

dependent claims 20, 23, and 24, which recite similar limitations. *See infra*.

For the reasons given, we find that Petitioner has demonstrated by a preponderance of the evidence that Barbehenn and Grebene, in combination, meet the limitations of these dependent claims.

3. *Obviousness – Barbehenn and Grebene (Claims 20, 23, 24)*

Claims 20, 23, and 24 depend from claim 19 and recite various details of the claimed method. Petitioner challenges them as obvious over Barbehenn and Grebene. Pet. 20–30. Petitioner’s element-by-element analysis of these claims appears at pages 23–30 of the Petition. Petitioner relies on Barbehenn for the features discussed *supra* in connection with claim 19. Petitioner relies on Grebene for details concerning the operation of the 555 timer. *Id.* at 28–29.

Patent Owner does not separately address these challenges, and combines its response with its discussion of the challenges to claims 1, 2, 5, and 6 as obvious over Barbehenn and Grebene. PO Resp. 23. We have considered Patent Owner’s arguments in connection with the preceding analysis of that challenge to claims 2, 5, and 6. We agree with and adopt Petitioner’s analysis of the additional features of claims 20, 23, and 24. For example, claim 20 recites: “The method of claim 19 wherein the flow of energy from the power converter input to the power converter output circuit is enabled or disabled substantially instantaneously after a change between the first and second feedback states.” We find that this limitation is met in Barbehenn when “the flow of energy is enabled when the duty cycle signal output from the 555 timer oscillates and disabled when the duty cycle signal stops cycling (i.e., the 555 timer oscillator is inhibited).” Pet. 23. The architecture disclosed in Barbehenn requires very little filtering and thus

provides a power converter output that is enabled or disabled substantially instantaneously after a change between the first and second feedback states. *Id.* at 24; Madisetti Decl. ¶¶ 67–72.

Claim 23 recites: “The method of claim 19 wherein, in response to a change from the second feedback state to the first feedback state, the cycling of the duty cycle signal is halted.” Claim 24 recites: “The method of claim 23 wherein, substantially instantaneously in response to a change from the first feedback state to the second feedback state, the cycling of the duty cycle signal is restarted.” We find that when Barbehenn’s feedback signal changes from the second to the first feedback state, oscillation of the 555 timer is stopped and the duty cycle stops cycling; when the feedback signal changes from the second to the first feedback state, the duty cycle signal resumes “nearly instantaneously” as the 555 timer oscillator resumes. Pet. 29–30; Madisetti Decl. ¶ 73.

For the reasons given, we find that Petitioner has demonstrated by a preponderance of the evidence that Barbehenn and Grebene, in combination, meet the limitations of these dependent claims.

4. Obviousness – Barbehenn Alone (Claims 1–3 and 19–21)

Petitioner also challenges claims 1–3 and 19–21 as obvious over Barbehenn alone. Pet. 40. Petitioner provides an analysis of those claims in relation to Barbehenn at pages 40–53 of the Petition. We will focus our discussion here on claim 1. However, the same analysis applies to claim 19.

This ground is based on what Petitioner calls an “additional embodiment” in Barbehenn. Pet. 40–41. In this embodiment, Barbehenn suggests that “instead of using an oscillator’s inhibit control line to control oscillation, a logic gate connected to the optoisolator and the oscillator could

effectively create the desired bursts of waveform from a continuously running oscillator.” Ex. 1004, 5:33–37. There is no further explanation or discussion of this “additional embodiment” in Barbehenn.

Petitioner’s argument relies on the testimony of its expert, Dr. Madisetti, and his modifications of Barbehenn’s Figure 1 to show the logic gate referred to in Barbehenn. Pet. 41; Madisetti Decl. ¶¶ 88–89. Dr. Madisetti testifies that a person of ordinary skill “would understand” the logic gate referred to in Barbehenn would be an AND gate. *Id.* ¶ 89. As explained by Dr. Madisetti, those modifications would involve:

[T]he output of the optocoupler is coupled to an input of the logic gate instead of the inhibit control line (i.e., reset pin 4) of the 555 timer. . . . And instead of being coupled directly to the FET, pin 3 is coupled to another input of the logic gate.

Madisetti Decl. ¶ 88 (citations omitted).¹¹ Patent Owner responds that Petitioner “has failed to provide an articulated reasoning with some rational underpinning to justify the legal conclusion of obviousness.” PO Resp. 39 (citing *KSR*, 550 U.S. at 418).

We agree with Patent Owner that Petitioner has not provided sufficient evidence of a motivation to have made these proposed modifications to Barbehenn. Petitioner’s argument amounts to a showing that Barbehenn could have been modified to use an AND gate. The law does not give weight to this type of modification as evidence of obviousness. Showing that a reference “could” have been modified does not demonstrate a motivation or rationale for making the modification or combination. See

¹¹ An additional modification suggested by Dr. Madisetti involves pin 4 of the 555 timer, which would be “tied high” to provide a continuously running oscillator. Madisetti Decl. ¶ 88 n.4.

Belden Inc. v. Berk-Tek LLC, 805 F.3d 1064, 1073 (Fed. Cir. 2015) (“[O]bviousness concerns whether a skilled artisan not only *could have made* but *would have been motivated to make* the combinations or modifications of prior art to arrive at the claimed invention.”); *Fresenius USA, Inc. v. Baxter Int’l, Inc.*, 582 F.3d 1288, 1299, 1301 (Fed. Cir. 2009).

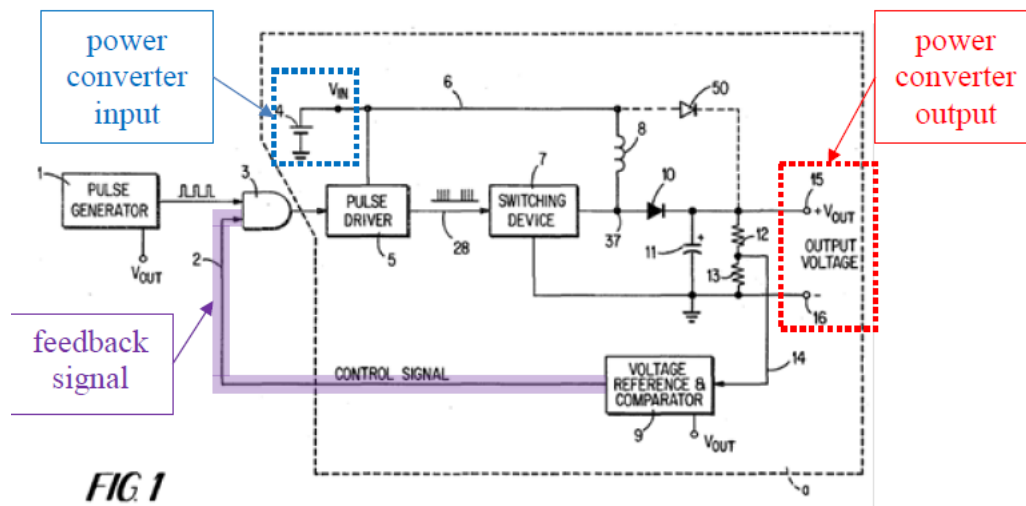
We find this testimony from Dr. Madisetti to be speculative. We, therefore, do not find that Petitioner has demonstrated by a preponderance of the evidence that these claims would have been obvious over Barbehenn alone.

E. Challenges Based on Krupka (Claims 1–3, 19–21)

Petitioner challenges claims 1–3 and 19–21 as obvious in light of Krupka. Pet. 54–74. Our discussion will focus on claim 19. However, the same analysis applies to claim 1.

Petitioner provides a detailed element-by-element analysis of claim 19 in relation to Krupka at pages 54–64 of the Petition. Petitioner also provides supporting testimony from Dr. Madisetti. Madisetti Decl. ¶¶ 102–111. We have also considered Patent Owner’s contentions as discussed *infra*.

For example, Petitioner identifies the “first feedback state” and “second feedback state” recited in the claims in the operation of Krupka’s switching device as shown in the following Figure 1 from Krupka (annotated by Petitioner):



Pet. 56. Figure 1 of Krupka (annotated) is a block diagram of a power converter providing a control signal. Ex. 1007, 2:30–31. According to Petitioner, signal 2 is a feedback signal that provides first and second feedback states representing the voltage level at the power converter output. Pet. 56–57. The output of voltage detection circuit 9 is logic one (i.e., the second feedback state) if the sample of the power converter output is below a threshold level. *Id.* at 56. Logic zero (i.e., the first feedback state) represents that the sample is at or above the threshold. *Id.* at 57; Madisetti Decl. ¶ 105.

Patent Owner contends “Petitioner never explains why Krupka’s ‘control signal 2’ can be properly mapped to the claimed ‘feedback signal.’” PO Resp. 44. Patent Owner contends “Petitioner’s mapping is erroneous.” *Id.* at 45. We assume that by referring to “mapping,” Patent Owner is contesting Petitioner’s identification of signal 2 output by voltage comparator 9 in the Krupka with the feedback signal in the claims. We find that Petitioner’s annotations to Krupka’s Figure 1, reproduced *supra*, and the

accompanying explanation sufficiently identify the claimed feedback signal in Krupka.

Moreover, we are not persuaded by Patent Owner's argument that Petitioner's "mapping" is erroneous. Patent Owner bases its argument on a simplified diagram of a feedback circuit from a textbook.¹² PO Resp. 45 (citing Ex. 2001). This diagram of a simplified feedback circuit identifies the system output as the feedback signal. *Id.* Referring to the diagram, Patent Owner identifies the "divided down output voltage 14" in Krupka's Figure 1, *supra*, and not the output of voltage reference and comparator 9, as the feedback signal. *Id.* at 45–46.

Patent Owner's argument is not consistent with the '471 patent specification, where the feedback signal is the output of the optocoupler. *See* discussion of Fig. 3, *supra*. According to Balakrishnan, in the TINYSwitch commercial embodiment of the patent, the optocoupler, in combination with resistor R13 "is acting like a voltage comparator." Balakrishnan Dep. 107:11–16. Similarly, Patent Owner's analysis of the TINYSwitch identifies the optocoupler output as a feedback signal: "The output of the optocoupler is coupled to the feedback input of the TINYSwitch." PO Resp. 53. We find, therefore, that just as in the '471 patent, in Krupka the feedback signal in the claims is the output of the voltage comparator 9 which compares the output voltage to a threshold and provides a feedback signal that controls the regulator circuit.

Next, having identified signal 14 in Krupka as the feedback signal in the claims, Patent Owner repeats its argument based on its claim

¹² Ex. 2001, Kevin Warwick, "An Introduction to Controlled Systems," World Scientific (1996).

construction requiring a feedback signal with “two discrete states.” *Id.* at 47–48. As discussed *supra*, this argument is based on a claim construction we do not adopt and is therefore not persuasive. Furthermore, for the reasons just stated, we do not agree with Patent Owner’s identification in Krupka of the feedback signal as “simply a scaled-down version of the analog voltage at the power converter output.” *Id.* at 48. As discussed *supra*, we find that the control signal in Krupka meets the requirements of the claims for a feedback signal as that term is used in the ’471 patent.

Finally, Patent Owner challenges Petitioner’s rationale for combining the various elements of Krupka. *Id.* at 49–50. Other than those discussed above, Patent Owner does not identify which teachings are lacking in Krupka. We find Petitioner has demonstrated that Krupka discloses all the elements of claims 1 and 19 to a person of ordinary skill. For example, Petitioner’s expert, Dr. Madisetti, testifies that “[t]he output of voltage detection circuit 9 is logic one (i.e., the second feedback state) if the sample is below the threshold level. . . . Krupka also discloses that logic zero (i.e., the first feedback state) represents that the sample is at the threshold. . . . In addition, in my opinion, a [person of ordinary skill] would have understood that control signal 2 is also logic zero when the sample is above the threshold level.” Madisetti Decl. ¶ 105 (citations omitted). We find this unchallenged testimony persuasive.

Patent Owner does not separately address the dependent claims in this challenge. Petitioner’s element-by-element analysis of those claims appears at pages 64–67 (claims 20 and 21) and 72–73 (claims 2 and 3) of the Petition. We agree with and adopt Petitioner’s analysis of these dependent claims. As to claim 20, we find that Krupka discloses enabling or disabling

the flow of energy between the power converter input and output in response to a change between the first and second feedback states. Voltage detector 9 outputs digital control signal 2 by comparing the sample of the output voltage (V_{OUT}) to a predetermined voltage (i.e., a threshold). See Figure 1 of Krupka, *supra*; Madisetti Decl. ¶ 112. We further find that in Krupka, the flow of energy is enabled or disabled immediately after a change between the first and second feedback states. *Id.* at ¶ 112. Similarly, as to claim 21, we find that this claim limitation is met because the output of AND gate 3 can change at any point in a cycle of the duty cycle signal to enable or disable the flow of energy. *Id.* at ¶ 113.

Petitioner's analysis of claims 2 and 3 in relation to Krupka follows the analysis of claims 20 and 21, which contain similar limitations. Pet. 72–73. We agree with and adopt that analysis and for the reasons stated there we find that Krupka meets the limitations of those claims. Madisetti Decl. ¶ 118.

F. Objective Indicia

Patent Owner contends “extensive objective indicia of non-obviousness” support the patentability of the '471 patent. PO Resp. 50. Patent Owner contends its TINYSwitch products embody the invention of the '471 patent. *Id.* at 55. Patent Owner argues “before the invention claimed in the '471 patent and embodied in TINYSwitch existed, there was a long-felt need for an effective solution to energy waste in power converters and, in particular, in low-power power converters.” *Id.* at 56. Patent Owner cites a number of articles in technical publications allegedly supporting this assertion. *Id.* at 56–59. Patent Owner also alleges industry praise: “TINYSwitch was recognized for its novel design and praised by others

knowledgeable about the technology in the power supply industry.” *Id.* at 59–63. Patent Owner alleges that TINYSwitch was “received with skepticism and achieved unexpected results.” *Id.* at 63–64. Finally, Patent Owner alleges TINYSwitch was a commercial success. *Id.* at 62–66. We consider these assertions, in turn.

1. TINYSwitch Embodies the ’471 Patent

We are persuaded by Patent Owner’s analysis at pages 51–56 of its Response and the supporting testimony by Balakrishnan that claims 1 and 19 of the ’471 patent are embodied by the TINYSwitch. Balakrishnan Decl. ¶¶ 43–46. As Petitioner points out, however, Patent Owner’s analysis is directed only to the original product, TINYSwitch-I. *See infra*.

2. Long-felt Need

We agree with Petitioner that the articles relied on by Patent Owner, at best, establish a generic need for reducing waste in power converters but are not specific enough to the invention of the ’471 patent. Pet. Reply 18. As the Federal Circuit held in *Perfect Web Technologies, Inc. v. InfoUSA, Inc.*, 587 F.3d 1324, 1332–33 (Fed. Cir. 2009):

Perfect Web provided no evidence to explain how long this need was felt, or when the problem first arose. . . . Nor does the evidence show that the ’400 patent met any such “need.” [Perfect Web’s expert] made the bare assertion that the patent provided “improved efficiency,” . . . but cited no supporting data to show, for example, that the invention actually reduced marketing costs, time, or the number of consumers who opt out. “Moreover, as we have often held, evidence of secondary considerations does not always overcome a strong prima facie showing of obviousness.” *Asyst Techs., Inc. v. Emtrak, Inc.*, 544 F.3d 1310, 1316 (Fed.Cir.2008) (affirming judgment as a matter of law of obviousness).

Patent Owner has failed to provide the type of evidence required by *Perfect*

Web and other authorities. For example, Patent Owner has failed to identify or provide evidence of a specific long-felt need in the industry, or show that the claimed invention satisfied that need when others had failed. *Id.* at 18–19.

We also credit Petitioner’s analysis of the articles cited by Patent Owner, demonstrating that much of the content was provided by Patent Owner itself. Pet. Reply 18–19 (citing Exs. 2016, 2017). For example, on cross-examination, Balakrishnan admitted that Patent Owner was the source of many of the quotes from the articles cited in his declaration as evidence of long-felt need. Balakrishnan Dep. 180:16–201:18.

In sum, for these reasons, we give this factor minimal weight as objective evidence of non-obviousness.

3. Industry Praise

We agree with Petitioner that the alleged evidence of industry praise offered by Patent Owner (Exs. 2016–2017) amounts to self-praise. Pet. Reply 19–20. Patent Owner submits a compendium of articles titled “TinySwitch Press Coverage 1998-1999.” Ex. 2016. Three of the articles were authored by Patent Owner’s director of marketing, Shyam Dujari. Ex. 2016, 13–18, 25–29, 35–38. Others directly quote Patent Owner’s employees or attribute claims to Patent Owner itself. *Id.* at 6–7, 30–32, 43–44, 62, 68, 78, 79–80, 81, 83, 85–88. Still others rely heavily on text provided by Patent Owner. See Pet. Reply 20 (comparing Ex. 1037, 42, 57 to Ex. 1016, 25–29, 42).¹³ At his deposition, Balakrishnan confirmed that

¹³ We find persuasive Petitioner’s Exhibit 1037, an “abridged, annotated version” of Exhibit 2016, highlighting, in yellow, articles written by Shyam Dujari; in green, quotes from Patent Owner or its employees; in pink, from

Patent Owner was the source for much of the information appearing in these exhibits quoted in his declaration. Pet. Reply 21–22 (citing Balakrishnan Dep 161:9–167:20).

We give this factor minimal weight as objective evidence of non-obviousness. We are not convinced by Patent Owner’s Sur-reply argument that “[a]ny articles or portions thereof” that were written by Patent Owner “were still independently reviewed” by the editors of the publication. PO Sur-reply 4. Patent Owner provides no proof of this. Nor are we convinced that “[t]hese technical and business journals would not publish inaccurate or false information.” *Id.* Noting in the record supports this assertion. For the reasons given we give this factor minimal weight as evidence of non-obviousness.

4. Skepticism and Unexpected Results

Patent Owner contends the TINYSwitch product was met with “quite a bit of skepticism.” PO Resp. 63 (citing Balakrishnan Decl. ¶ 59). As Petitioner points out, Balakrishnan does not identify any skeptical customers or provide any further evidence or other information to support this statement. Pet. Reply 22. Nor does he identify any differences in the result obtained by using TINYSwitch that were unexpected. *Id.* at 22–23. Given Balakrishnan’s position as President and CEO of Patent Owner and co-inventor of the ’471 patent, and the lack of supporting detail, we give his testimony on this issue little weight.

We therefore give this factor minimal weight as evidence of non-obviousness.

TINYSwitch data sheets; in blue, from TINYSwitch press releases; and in orange, text that appears in multiple articles. Pet. Reply 20 n.8.

5. *Commercial Success*

As evidence of commercial success, Patent Owner points to: (1) the integration of TINYSwitch into products of Nokia and Iomega “within months” of the formal product announcement; (2) predictions by analysts that cellphone makers and other appliance companies “were likely to use TINYSwitch;” and (3) predictions that Patent Owner’s stock “would double over the next six months and annual sales would increase to \$80 million after TINYSwitch’s release.” PO Resp. 65. In support of these assertions, Patent Owner relies on brief, conclusory testimony from Balakrishnan (Balakrishnan Decl. ¶ 62), and on Exhibit 2016, the collection of articles discussed *supra*. *Id.* For reasons discussed *supra*, we give limited weight to these articles, many of which were written by Patent Owner’s employees or based on information obtained from Patent Owner, and to Balakrishnan’s testimony, due to his position as a co-inventor and CEO of Patent Owner.

Patent Owner relies also on sales figures from its 2005 Annual Report and testimony from Balakrishnan regarding sales. PO Resp. 65 (citing Ex. 2020; Balakrishnan Decl. ¶ 63). According to Patent Owner, the report shows that “by 2003, TINYSwitch family products accounted for 51% of the company’s revenue from product sales.” *Id.* Balakrishnan testifies that since 1998, Patent Owner has sold over 4.3 billion units of TINYSwitch products. Balakrishnan Decl. ¶ 63.

As Patent Owner points out, a nexus between commercial success and a patent is presumed where, as here, there is proof that the products practice the patent. PO Resp. 66 (citing *J.T. Eaton & Co., Inc. v. Atl. Paste & Glue Co.*, 106 F.3d 1563, 1571 (Fed. Cir. 1997)). Petitioner responds that the nexus established by Patent Owner relates only to the product analyzed by

Balakrishnan, i.e., the original TINYSwitch-I. Pet. Reply 23.¹⁴

We agree that the presumption of nexus should apply only to TINYSwitch-I, for the reason stated by Petitioner. In further support of limiting the nexus, Petitioner points out also that the other TINYSwitch products (with the sole exception of TINYSwitch-I) incorporated a feature (“frequency jitter”) that Balakrishnan has testified in district court is important to the success of those products. Ex. 1044, 6:4–15. We find that this testimony reinforces our decision that the presumption of nexus should be limited to TINYSwitch-I. Pet. Reply 23.

As Petitioner points out, however, Patent Owner has not introduced any sales figures specific to the TINYSwitch-I product. *Id.* at 23–24. Patent Owner’s Annual Report for 1999 (Ex. 2019), the year after TINYSwitch-I was introduced, does not break out sales figures that separate that product from others being sold by Patent Owner. Balakrishnan Dep. 202:4–17. Similarly, the financial data in Patent Owner’s 10-K report for 2005 (Ex. 2020) includes two TINYSwitch products (I and II). *Id.* at 203:18–204:25. Other than these annual reports, Balakrishnan provides no underlying data to support his testimony on TINYSwitch sales (Balakrishnan Decl. ¶ 62), and thus, his testimony does not differentiate between TINYSwitch-I sales and sales of other products of his company. Balakrishnan Dep. 205:2–205:8.

For the foregoing reasons, after considering the secondary considerations of non-obviousness and according them appropriate weight along with all of the *Graham* factors, we agree with the Petitioner that the

¹⁴ Balakrishnan analyzed the schematic appearing at page 5 of Exhibit 2016. Balakrishnan Decl. ¶ 42. He testified that this represents the original TINYSwitch-I product. Balakrishnan Dep. 141:4–17.

invention of claims 1–3, 5, 6, 19–21, 23, and 24 would have been obvious.

IV. SUMMARY

We find that Petitioner has demonstrated by a preponderance of the evidence that:

1. Claim 19 of the '471 patent is anticipated by Barbehenn;
2. Claims 20, 23, and 24 would have been obvious over Barbehenn and Grebene;
3. Claims 1, 2, 5, and 6 would have been obvious over Barbehenn and Grebene; and
4. Claims 1–3 and 19–21 would have been obvious over Krupka.

We find that Petitioner has not demonstrated by a preponderance of the evidence that claims 1–3 and 19–21 would have been obvious over Barbehenn alone.

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1–3, 5, 6, 19–21, 23, and 24 of the '471 patent are not patentable; and

FURTHER ORDERED that, because this is a Final Written Decision, 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.

IPR2018-00165
Patent 6,414,471 B1

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