Trials@uspto.gov
571-272-7822

Entered: January 29, 2018

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

KINGSTON TECHNOLOGY COMPANY, INC.,
Petitioner,

v.

POLARIS INNOVATIONS LTD.,
Patent Owner.

Case IPR2016-01621
Patent 6,438,057 B2

Before SALLY C. MEDLEY, JEAN R. HOMERE, and KEN B. BARRETT, *Administrative Patent Judges*.

HOMERE, *Administrative Patent Judge*.

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

I. INTRODUCTION

In this *inter partes* review, instituted pursuant to 35 U.S.C. § 314, Kingston Technology Company, Inc. ("Petitioner") challenges claims 1–17 ("the challenged claims") of U.S. Patent No. 6,438,057 B1 (Ex. 1001, "the '057 patent"), owned by Polaris Innovations Ltd. ("Patent Owner").[1] We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is entered pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons discussed below, Petitioner has shown by a preponderance of the evidence that the challenged claims are unpatentable.

A. Procedural History

Petitioner filed a Petition requesting an *inter partes* review of claims 1–17 of the '057 patent. Paper 2 ("Pet."). Patent Owner filed a Preliminary Response. Paper 7 ("Prelim. Resp."). On February 15, 2017, we instituted *inter partes* review of claims 1, 3, 5–9, 12, 13, and 16 of the '057 patent under 35 U.S.C. § 103(a) as being unpatentable over the combination of Atkinson,[2] and Broadwater.[3] Paper 8 ("Inst. Dec."), 17. Further, we instituted *inter partes* review of claims 2, 4, 10, 11, 14, 15, and 17 of the '057 patent under 35 U.S.C. § 103(a) as being unpatentable over the combination of Atkinson, Broadwater, and Miller.[4] *Id.* at 20.

Thereafter, Patent Owner filed a Patent Owner Response (Paper 18, "PO Resp."), to which Petitioner filed a Reply (Paper 21, "Reply").

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[1]Patent Owner identifies Polaris Innovations Ltd., Wi-LAN Inc., and Quarterhill Inc. as real parties-in-interest. Paper 4, 2; Paper 20, 2.
[2] U.S. Patent No. 6,134,167, issued Oct. 17, 2000 (Ex. 1010) ("Atkinson").
[3] U.S. Patent No. 4,970,497, issued Nov. 13, 1990 (Ex. 1006) ("Broadwater").
[4] U.S. Patent No. 3,812,717, issued May 28, 1974 (Ex. 1015) ("Miller").

Pursuant to an Order (Paper 22), Patent Owner filed a listing of alleged statements and evidence in connection with Petitioner's Reply that Patent Owner considered to be beyond the proper scope of a reply. Paper 23. Petitioner filed a response to Patent Owner's listing. Paper 24.

We held a consolidated hearing on November 14, 2017, for this case and related Cases IPR2016-01622 and IPR2016-01623, and a transcript of the hearing is included in the record. Paper 32 ("Tr.").

B. Related Proceedings

The parties state that the '057 patent is the subject of a pending lawsuit in the Central District of California Southern Division that includes assertions against Petitioner. Pet. 2; Paper 4 (Patent Owner's Mandatory Notice), 1; Ex. 1002.

C. The '057 patent (Ex. 1001)

The '057 patent is directed to a method and system for refreshing the contents of a dynamic random access memory (DRAM) array. Ex. 1001, 1:5–7. In particular, the temperature of the DRAM array is utilized to adjust a refresh rate at which the contents of the DRAM array are updated. *Id.* at 1:7–10. Figure 3 of the '057 patent is reproduced below:

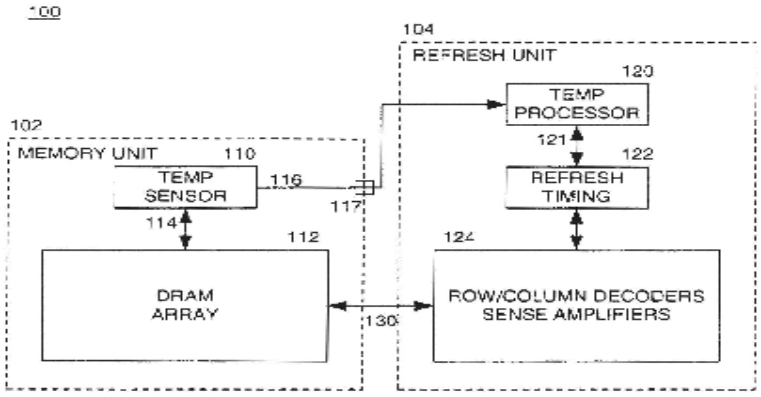

FIG. 3

Figure 3 illustrates system 100 for storing data in DRAM array 112. *Id.* at 4:11–12. In particular, Figure 3 depicts memory unit 102 containing temperature sensor 110 coupled to DRAM array 112, wherein memory unit 102 is connected to refresh unit 104 containing temperature processor 120 coupled to refresh timing 122 and row/column decoders sense amplifiers 124. *Id.* at 4:12–30. According to the '057 patent, "the DRAM array 112 may be implemented on a semiconductor chip and the temperature sensor 110 may be thermally coupled to the same semiconductor chip or to an intermediate member that is in thermal communication with the semiconductor chip." *Id.* at 4:22–26.

More specifically, in system 100 illustrated in Figure 3, upon receiving signal 116 from temperature sensor 110 indicating a temperature sensed from DRAM array 112, refresh unit 104 produces refresh signal 130 to refresh DRAM array 112 at a rate that varies in response to received temperature signal 116. *Id.* at 4:30–32. Preferably, DRAM array 112 is refreshed at a rate that decreases as the temperature of DRAM array 112 decreases. Conversely, DRAM array 112 is refreshed at a rate that increases

as the temperature of DRAM array 112 increases. *Id.* at 4:33–37. Further, according to the '057 patent, "the temperature sensor 110 and the DRAM array 112 are preferably disposed in a semiconductor package where the package includes at least one connection pin 117 operable to provide the signal on line 116 to external circuitry, such as the refresh unit 104." *Id.* at 4:49–53. "[T]he temperature sensor 110 preferably includes at least one diode 140 having a forward voltage drop that varies as a function of the temperature of the DRAM array 112." *Id.* at 5:17–20.

D. Illustrative Claim

Of the instituted claims, claims 1, 13, and 16 are independent. Claims 2–12 depend from independent claim 1. Claims 14 and 15 depend from independent claim 13. Claim 17 depends from independent claim 16. Independent claim is illustrative of the challenged claims, and is reproduced below:

> 1. An apparatus, comprising:
>
> a semiconductor package including at least one connection pin;
>
> at least one dynamic random access memory (DRAM) array disposed within the package; and
>
> at least one temperature sensor in thermal communication with the DRAM array, operable to produce a signal indicative of a temperature of the DRAM array, and coupled to the at least one connection pin such that the signal may be provided to external circuitry,
>
> wherein the DRAM array is refreshed at a rate that decreases as the temperature of the DRAM array decreases and that increases as the temperature of the DRAM array increases.

Ex. 1001, 5:60–6:7.

II. ANALYSIS

A. Claim Construction

The Board interprets claims of an unexpired patent using the broadest reasonable construction in light of the specification of the patent in which they appear. *See* 37 C.F.R. § 42.100(b); *see Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2142–46 (2016). Under the broadest reasonable construction standard, claim terms are given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007).

In our Decision on Institution, we found no material dispute between the parties as to claim construction in the present proceeding. Inst. Dec. 7.

Patent Owner contends that because Petitioner has not provided in the Petition how each of the challenged claims is to be construed, but instead advises the Board that the claims are to be construed according to their plain and ordinary meaning, Petitioner has failed to demonstrate a scope of the claimed invention that permits the Board to apply the asserted references to the claims. PO Resp. 13–14. Further, Patent Owner contends Petitioner previously argued in the companion district court litigation that the claim terms "refresh unit" and "refresh timing unit" in claims 6–11 are means plus function recitations with no corresponding structures in the Specification; that the cited claim terms are indefinite and cannot be construed. *Id.* at 16–17. According to Patent Owner, Petitioner cannot now request the Board to construe those claim terms as anything other than means plus function recitations. *Id.* at 17–18. Patent Owner, therefore, submits that Petitioner has failed to meet its burden to demonstrate, with reasonable certainty, the

scope of the claims to which the Board is to apply the alleged prior art. *Id.* at 18.

These arguments are not persuasive. Petitioner was not required to make explicit claim constructions for each term of each claim. "It may be sufficient for a party to provide a simple statement that the claim terms are to be given their broadest reasonable interpretation, as understood by one of ordinary skill in the art and consistent with the disclosure." Office Patent Trial Practice Guide, 77 Fed. Reg. 48,756, 48,764 (Aug. 14, 2012). For this reason, we disagree with Patent Owner's contention that Petitioner's statement that the claim terms be given their plain and ordinary meaning is insufficient. We also are not persuaded by Patent Owner's argument that Petitioner's position regarding its proposed claim constructions in the District Court for dependent claims 6–11 and prior allegation of indefiniteness of the cited claim terms in the district court proceeding "is a failure to meet its burden of proof." PO Resp. 18. We disagree that Petitioner's alleged inconsistent claim construction positions are fatal to Petitioner. Moreover, we decline Patent Owner's invitation to consider on the merits Petitioner's arguments made in the related District Court proceeding. PO Resp. 18. Here, neither party proffers an explicit construction of, or otherwise disputes the meaning of, any of the claim terms. We determine that it is not necessary to provide any express interpretation of the claim terms. Only terms that are in controversy need to be construed, and then only to the extent necessary to resolve the controversy. *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

B. Level of Ordinary skill in the Art

Both Petitioner's Declarant, Dr. Vivek Subramanian, and Patent Owner's Declarant, Dr. Joseph Bernstein, contend that a person having ordinary skill in the art at the time of the invention would have had (1) a Master's degree in Electrical Engineering, and (2) two to five years of experience working in the field of semiconductor design. Ex. 1005 ¶ 17, Ex. 2008 ¶ 25.

This definition is consistent with the level of ordinary skill reflected in the prior art references of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (the prior art itself may reflect an appropriate level of skill in the art). ; *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995); *In re Oelrich*, 579 F.2d 86, 91 (CCPA 1978). For purposes of this decision, we adopt the undisputed definition of the person of ordinary skill in the art, as set forth above.

C. The Parties' Post-Institution Arguments

In our Decision on Institution, we concluded that the arguments and evidence advanced by Petitioner demonstrated a reasonable likelihood that claims 1, 3, 5–9, 12, 13, and 16 of the '057 patent are unpatentable under 35 U.S.C. § 103(a) over the combination of Atkinson and Broadwater. Inst. Dec. 17. Further, we concluded that the arguments and evidence advanced by Petitioner demonstrated a reasonable likelihood that claims 2, 4, 10, 11, 14, 15, and 17 of the '057 patent under 35 U.S.C. § 103(a) are unpatentable over the combination of Atkinson, Broadwater, and Miller. *Id.* at 20. We must now determine whether Petitioner has established by a preponderance of the evidence that the specified claims are unpatentable over the cited prior art. 35 U.S.C. § 316(e).

With a complete record before us, we note that we have reviewed arguments and evidence advanced by Petitioner to support its unpatentability contentions where Patent Owner chose not to address certain limitations in its Patent Owner Response. In this regard, the record now contains persuasive, unrebutted arguments and evidence presented by Petitioner regarding the manner in which the asserted prior art teaches corresponding limitations of the claims against which that prior art is asserted. Based on the preponderance of the evidence before us, we conclude that the prior art identified by Petitioner teaches or suggests all uncontested limitations of the reviewed claims. The limitations of claim 1 and the limitations in the other challenged claims that Patent Owner contests in the Patent Owner Response are addressed below.

D. Obviousness over the Combination of Atkinson and Broadwater

Petitioner contends that claims 1, 3, 5–9, 12, 13, and 16 of the '057 patent are unpatentable under 35 U.S.C. § 103(a) over the combination of Atkinson and Broadwater. Pet. 12–32.

1. Principles of Law

A claim is unpatentable under § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) when in evidence, objective indicia of non-obviousness

(i.e., secondary considerations). *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). We analyze this asserted ground based on obviousness with the principles identified above in mind.

2. Atkinson Overview

Atkinson describes a technique for reducing the consumption of electric power in the main computer memory. Ex. 1010, 1:16–20. In particular, Atkinson discloses a refresh logic device that generates a memory refresh signal having a rate, which varies proportionally with the sensed temperature of the computer memory. *Id.* at 5:61–66, 7:41–44.

Figure 8 of Atkinson is reproduced below.

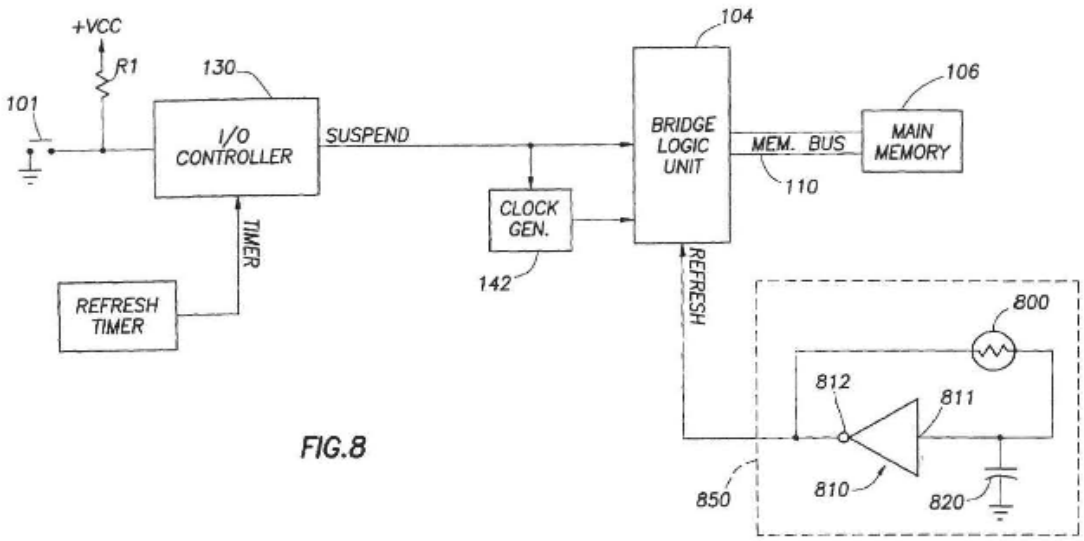

FIG.8

As illustrated in Figure 8 of Atkinson, refresh generator 850 includes thermistor 800, the temperature of which drops upon sensing a decreased temperature of main memory 106 to thereby produce a decrease of the rate of the refresh signal. *Id.* at 22:39–65. "Accordingly, the temperature of thermistor 800 represents the temperature of memory storage logic 930, and the refresh frequency decreases approximately in proportion to the decrease

in the temperature of memory storage logic 930." *Id.* at 24:11–17. Conversely, when the temperature of thermistor 800 increases upon sensing an increased temperature of main memory 106, refresh generator 850 increases the rate of the refresh signal. *Id.* at 7:41–44, 21:38–39. Atkinson also discloses an alternative embodiment in which refresh generator 950, including thermistor 800, is integrated in main memory 906. *Id.* at 23:37–40, 24:11–13, 24:22–23, Fig. 9.

Atkinson further discloses that that main memory 906 is an alternative embodiment of main memory 106 that preferably comprises DRAM circuitry (*id.* at 23:32–34), but may also be other types of DRAM, such as synchronous DRAM (SDRAM), extended data output DRAM (EDO RAM), and Rambus RAM. *Id.* at 3:38–46, 9:1–5. Main memory 106 is connected to bus 110 to exchange signals therewith. *Id.* at 12:4–7.

3. Broadwater Overview

Broadwater relates to a technique for sensing and reducing the effects of thermal stress on packaged semiconductor chips. Ex. 1006, 1:6–8, Abstract. Figure 1 of Broadwater is reproduced below:

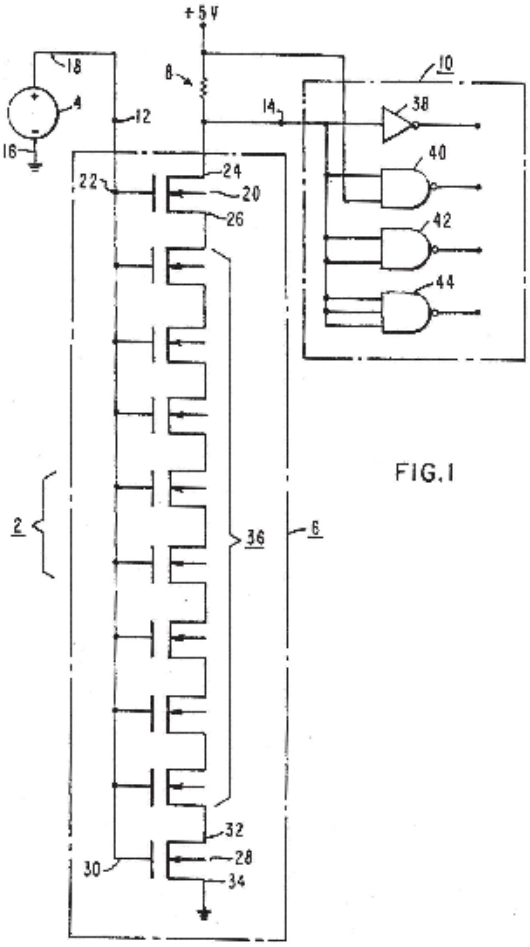

FIG. 1

As depicted in Figure 1 above, Broadwater describes a chip package having thermal stress sensing circuit 6 with input 12 and output 14. *Id.* at 3:35–37, 4:31–35. The voltage at output 14 varies as a function of input voltage and temperature. *Id.* at 4:39–41, Fig. 2. Output 14 can be routed to gate array 10, as shown, or can be provided to an external pin of the chip package. *Id.* at 4:31–53.

4. Petitioner's Positions

Petitioner asserts that the combination of Atkinson and Broadwater discloses the elements of claims 1, 3, 5–9, 12, 13, and 16. Pet. 12–32. We begin our analysis with claim 1. We have reviewed the Petition, Patent Owner Response, and Petitioner's Reply, as well as the relevant evidence

discussed in those papers and other record papers. We are persuaded that the record sufficiently establishes Petitioner's contentions for claims 1, 3, 5–9, 12, 13, and 16[5].

The preamble of claim 1 recites "an apparatus comprising." Ex. 1001, 5:61. Petitioner contends that Atkinson's description of an apparatus containing a main memory with a temperature sensor discloses the preamble of claim 1. Pet. 12.

Claim 1 next recites "a semiconductor package including at least one connection pin." Ex. 1001, 5:62–63. Petitioner contends that Atkinson's description of main memory 106 including any suitable type of memory such as DRAM or any of the special types of DRAM devices (e.g., SDRAM, EDO DRAM, Rambus DRAM) discloses the "semiconductor package" because "[o]ne of ordinary skill in the art would know that SDRAM and Rambus DRAM are packaged semiconductor chips." Pet. 13 (citing Ex. 1005 ¶ 41; Ex. 1007, 524; Ex. 1010, 4:31–35, 8:65–9:5). Further, Petitioner asserts that Atkinson's description of main memory 106's connection to bus 110 discloses the "connection pin" because one of ordinary skill would appreciate that "[a]s the main memory is composed of packaged memory chips that receive a variety of memory bus signals," its "connections to the memory bus 110 would necessarily require at least one connection pin or it would be obvious to have one." *Id.* at 13–14 (citing Ex. 1010, 12:4–7,

[5] We acknowledge Patent Owner's argument that "Dr. Subramanian's opinions on the ultimate question of obviousness are entitled to no weight" because he is not an attorney. PO Response 28–30. We arrive at the ultimate conclusion regarding obviousness independently and without adopting any purported "lay opinions" on the ultimate issue, *id.* at 28–29.

23:32–37, 12:8–12; Ex. 1005 ¶ 42). We are persuaded by Petitioner's showing and find that Atkinson's main memory 106 teaches a packaged semiconductor chip including at least one connection pin.

Claim 1 also recites "at least one dynamic random access memory (DRAM) array disposed within the package." Ex. 1001, 5:64–65. Petitioner asserts that Atkinson's description of a "computer system where the main memory 106 includes an array of memory devices such as DRAM" discloses the "package" having disposed therein the DRAM array. Pet. 14 (citing Ex. 1010, Figs. 1, 4A, 5, 7–9, 5:57–62, 8:37–9:15; Ex. 1005 ¶ 43). We are persuaded by Petitioner's showing and find that Atkinson's description of the main memory packaged in the semiconductor chip teaches a dynamic random access memory.

Claim 1 further recites "at least one temperature sensor in thermal communication with the DRAM array, operable to produce a signal indicative of a temperature of the DRAM array." Ex. 1001, 5:66–6:1. Petitioner asserts Atkinson's description of refresh generator 850, including thermistor 800 that directly senses the temperature of the DRAM, discloses "the temperature sensor . . . in thermal communication with the DRAM array." Pet. 14–16 (citing Ex. 1010, 22:52–62, 22:39–67, 23:32–37, 24:1–26, Fig. 8; Ex. 1005 ¶¶ 44, 45). Further, Petitioner asserts Atkinson describes an alternate embodiment wherein a "voltage controlled oscillator [(VCO)] combined with a temperature sensor could replace the refresh generator," such that "***the temperature sensor couples to main memory 106***, providing a voltage to the VCO ***that represents the main memory temperature***." *Id.* at 16 (citing Ex. 1010, 23:5–19). The refresh signal produced by the VCO varies with the temperature of the memory device as

sensed by the temperature sensor. *Id.* at 16–17 (citing Ex. 1010, 6:46–62, 7:46–48). We are persuaded by Petitioner's showing and find that Atkinson's description of the refresh generator, and alternatively the voltage controlled oscillator combined with the temperature sensor, teaches a sensor coupled to the DRAM array to indicate the temperature of the DRAM array.

Claim 1 also recites "coupled to the at least one connection pin such that the signal may be provided to external circuitry." Ex. 1001, 6:2–3. Petitioner asserts that Atkinson describes an on-chip embodiment wherein a temperature sensor coupled directly to main memory 106 provides a voltage to the VCO that represents the main memory temperature. Pet. 17 (citing Ex. 1010, 23:15–17, Fig. 8; Ex. 1005 ¶ 47). According to Petitioner, while the on-chip embodiment described by Atkinson does not disclose providing the temperature signal to an external circuit, such a modification would have been obvious to one of ordinary skill in the art, particularly in view of Broadwater's disclosure of an external pin of a chip package (e.g., DRAM memory chip) for outputting a signal indicative of the chip's temperature. *Id.* (citing Ex. 1005 ¶¶ 47–49); *id.* at 30 (citing Ex. 1006, 4:31–33, 4:49–53; Ex. 1005 ¶¶ 83–84).

Further, Petitioner asserts that the ordinarily skilled artisan would have been motivated to combine the cited disclosures of Atkinson and Broadwater because Broadwater's disclosure of adding an external pin to an existing chip package (e.g., Atkinson's DRAM) would help reduce the effects of thermal stress on the DRAM. *Id.* at 31 (citing Ex. 1006, 1:14–29; Ex. 1005 ¶ 85). Additionally, Petitioner concludes that the ordinarily skilled artisan would have recognized that the proposed combination would help maximize power saving during the self-refresh timing sequence. *Id.* (citing

Ex 1005 ¶ 86). We are persuaded that a person having ordinary skill in the art would have found it obvious to combine the teachings of Atkinson and Broadwater because we agree that transmitting the sensed temperature of the DRAM to an external circuit via an external pin would have been recognized by a person having ordinary skill in the art as resulting in a more efficient system that maximizes power saving by reducing thermal stress on the packaged semiconductor chip.

Claim 1 also recites "wherein the DRAM array is refreshed at a rate that decreases as the temperature of the DRAM array decreases and that increases as the temperature of the DRAM array increases." Ex. 1001, 6:4–7. Petitioner asserts Atkinson describes a refresh logic that reduces the rate of the refresh signal in response to receiving a signal from the temperature sensor indicating a drop in the main memory temperature. Pet. 19 (citing Ex. 1010, 13:13–15, 22:2–7). Conversely, the refresh logic increases the rate of the refresh signal in response to receiving a signal indicating an increase in the temperature of the main memory. *Id.* (citing Ex. 1010, 7:41–44; Ex. 1005 ¶¶ 50–51). According to Petitioner, the refresh frequency increases or decreases in proportion to the increase or decrease in the temperature of the DRAM as a way to achieve the greatest power savings. *Id.* (citing Ex. 1010, 20:53–56, 24:3–17, Fig. 6; Ex. 1005 ¶ 51). We are persuaded by Petitioner's showing and find that Atkinson's description of the refresh logic teaches a mechanism for providing to the DRAM an increased or decreased refresh rate in proportion with the sensed temperature of the DRAM.

Independent claims 13 and 16 are similar to claim 1. Petitioner has made a showing with respect to claims 13 and 16 similar to its showing with

respect to claim 1. *See, e.g.*, Pet. 26–28. To the extent that claims 13 and 16 are different from claim 1, Petitioner has accounted for such differences. We also have reviewed Petitioner's showing with respect to dependent claims 3, 5–9, and 12. *Id.* at 21, 23–26. Notwithstanding Patent Owner's arguments, which we have considered and which we address below, we are persuaded by Petitioner's showing, which we adopt as our own findings and conclusions, as set forth above, that claims 1, 3, 5–9, 12, 13, and 16 are unpatentable as obvious over the combination of Atkinson and Broadwater.

5. Patent Owner's Assertions Concerning the References

Patent Owner argues that the challenged claims would not have been obvious over the combination of Atkinson and Broadwater for the following reasons: (a) "Petitioner does not demonstrate a proper motivation to modify Atkinson to add Broadwater's 'connection pin' to provide a temperature indicative signal to 'external circuitry,'" as recited in challenged claims 1–17 (PO Resp. 32–53 (emphasis omitted)); (b) "Petitioner has failed to show it was obvious to modify Atkinson to add the 'diode' limitations," as recited in dependent claims 2, 4, 10, 11, 14, and 15 (*id.* at 19–27, 53–57 (emphasis omitted)); and (c) "Petitioner has failed to point out where the 'refresh unit' . . . and 'refresh timing unit' . . . limitations are found," as recited in dependent claims 6–11, and 7–11 respectively (*id.* at 57–60). We address each argument in turn.[6]

[6] Patent Owner lists several portions of Petitioner's Reply and evidence as being allegedly beyond the scope of what can be considered appropriate for a reply. *See* Paper 23. We have considered Patent Owner's listing, but disagree that the cited portions of Petitioner's Reply and reply evidence are

a. The Allegation that Petitioner Does Not Demonstrate a Proper Reason to Modify Atkinson to Add Broadwater's "Connection Pin" to Provide a Temperature Indicative Signal to "External Circuitry" (claims 1–17)

Independent claim 1 recites, in relevant part, "at least one connection pin such that the signal may be provided to external circuitry." Independent claim 13 recites, in relevant part, "at least one connection pin operable to provide the signal to external circuitry." Independent claim 16 recites, in relevant part, "outputting a signal indicative of the temperature of the DRAM array to external circuitry." Patent Owner presents four sub-arguments: (i) "The teachings of Atkinson and Broadwater discourage the combination" (PO Resp. 37–42 (emphasis omitted)); (ii) "Even if Atkinson and Broadwater were not contrary to the Patent's teaching, there is no reason to combine them to make the specific invention claimed" (*id.* at 42–47 (emphasis omitted)); (iii) "The proposed Atkinson-Broadwater combination would require extensive modifications of Atkinson to practice the claims" (*id.* at 48–50 (emphasis omitted)); and (iv) "Petitioner and its declarant wave aside the references' disclosures and rely on generalities and offhand

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beyond the scope of what is appropriate for a reply. Replies are a vehicle for responding to arguments raised in a corresponding patent owner response. Petitioner's arguments and evidence that Patent Owner objects to (*id.* at 1) are not beyond the proper scope of a reply because we find that they fairly respond to Patent Owner's arguments raised in Patent Owner's Response. *See Idemitsu Kosan Co., Ltd. v. SFC Co. Ltd.*, 870 F.3d 1376, 1381 (Fed. Cir. 2017) ("This back-and-forth shows that what Idemitsu characterizes as an argument raised 'too late' is simply the by-product of one party necessarily getting the last word. If anything, Idemitsu is the party that first raised this issue, by arguing—at least implicitly—that Arakane teaches away from non-energy-gap combinations. SFC simply countered, as it was entitled to do.").

comments in each reference" (*id.* at 50–53 (emphasis omitted)). We address each in turn.

i. Whether the teachings of Atkinson and Broadwater Discourage the Combination.

Patent Owner argues that "[t]here is no motivation to couple Atkinson's onboard sensor to a connection pin such that the temperature indicative signal may be provided to external circuitry, because in Atkinson all external circuitry, particularly any that might affect the DRAM refresh rate, is expressly turned off." PO Resp. 37 (citing Ex. 1010, 4:54–59, 6:6–10, 11:4–16). Specifically, Patent Owner argues that every embodiment disclosed in Atkinson is focused on performing the refresh operation during system sleep with all external logic/circuitry outside of the DRAM module off. *Id.* According to Patent Owner, modifying Atkinson's onboard module in its sleep state (during which the rate of temperature decreases to control the DRAM refresh rate) to operate with an external circuitry in active state, would go against the thrust of Atkinson. *Id.* (citing Ex. 2008 ¶ 60). Patent Owner stresses that Atkinson's "on-chip" embodiment with the temperature sensor in thermal communication with the array was designed to be self-contained to include the temperature sensing refresh generator within main memory 906. *Id.* at 38 (citing Ex. 1010, 24:22– 23, 24:23–27; Ex. 2008 ¶ 61). Further, Patent Owner argues that the "on-chip" embodiment does not include a connection pin to provide a signal indicative of the DRAM temperature to an external circuit because, in response to the temperature, it generates internally a refresh pulse, which does not provide meaningful data based on the temperature sensor by a pin to an external circuitry. *Id.* (citing Ex. 1010, Fig. 8, 22:38–23:1). Furthermore, Patent Owner argues that adding components to Atkinson's "on-chip" embodiment with its on-board

components would have increased the price, size, and complexity of the unit. *Id.* at 39 (citing Bernstein ¶ 63). Additionally, Patent Owner argues that Broadwater is not related to memory, DRAM or refresh, and offers no tradeoffs or incentives for additional on-board circuitry or pins for which the solution is to reduce or cutoff circuit activity (as opposed to increasing circuit activity). *Id.* at 39–40 (citing Ex. 1006, 5:18–32). According to Patent Owner, Broadwater is concerned with combatting thermal stress from operating temperatures during operation. *Id.* at 40 (citing Ex. 1006, 1:30–51, 4:66–5:1). In Patent Owner's words, "while Atkinson is on, Broadwater is off, and vice versa." *Id.* (citing Ex. 2008 ¶¶ 63–66). Patent Owner argues that Atkinson and Broadwater are directed to very different applications. In particular, Atkinson is directed to making power use more efficient in laptops during system sleep, whereas Broadwater is directed to protecting mission critical circuitry in high speed aircraft. *Id.* (citing Ex. 1010, 3:6–28; Ex. 1006, 1:25–31).

Moreover, Patent Owner argues that although both Atkinson and Broadwater are focused on power efficiency, they do so by reducing circuit activity, whereas the '057 patent reduces waste of energy by increasing circuit activity. *Id.* at 40–41. That is, Atkinson prevents waste of energy by dropping circuit activity from a default level when the temperature drops, and Broadwater prevents waste of energy by dropping circuit activity from a default level when the temperature increases. *Id.* at 41 (citing Ex. 1010, 13:11–18; Ex. 1005, 5:18–27). In contrast, Patent Owner stresses that the '057 patent prevents waste of energy and failure by increasing circuit activity from a default level when the temperature increases. *Id.* (citing Ex. 1001, 3:55–66; Ex. 2008 ¶¶ 69–70). Therefore, Patent Owner submits that

both Atkinson and Broadwater disclose cutting the temperature of the circuits, whereas the ’057 patent teaches increasing the circuitry temperature most when it is at its hottest. *Id.* (citing Ex. 1006, 5:18–27; Ex. 1010, 13:11–18;, Ex. 1001, 2:34–36, 3:55–58; Ex. 2008 ¶ 71).

A further difference argued by Patent Owner is that Atkinson is active when the external circuit is not operational, whereas the ’057 is active when the external circuit is operational. *Id.* (citing Ex. 1010, 3:6–28; Ex. 1001, 2:1–2, 2:64–67; Ex. 2008 ¶ 72). Likewise, Patent Owner argues that Broadwater teaches shutting down part of the circuit, whereas the ’057 “patent teaches keeping its DRAM active and working, since shutting down any portion would amount to a total data loss of that portion.” *Id.* (citing Ex. 1006, 1:25–45; Ex. 1001, 1:51–59; Ex. 2008 ¶ 73).

Petitioner counters that Atkinson and Broadwater are directed to the same field of endeavor. Reply 2 (citing Ex. 1018, 38:3–6). According to Petitioner, chiefly among the ample reasons why a person of ordinary skill in the art would add Broadwater’s functionality of reducing thermal stress in chips to Atkinson’s circuitry is to prevent the DRAM in Atkinson from “blowing up” thereby furthering Atkinson’s purpose of ensuring reliable operation of the chip. *Id.* at 2–3. Petitioner contends that because nothing in the claims requires the external pin to be used as part of the refresh process, there is no basis in the claims to support Patent Owner’s argument that a temperature pin cannot be added to Atkinson’s system, which performs the refresh process in a sleep mode. *Id.* at 3–4, 8. In particular, Petitioner argues because Atkinson’s chip is still functioning even when it is in sleep mode, it is still subject to overheating. *Id.* at 4. Therefore, Petitioner submits that the ordinarily-skilled artisan would have good reason to add the

overheat protection of Broadwater to Atkinson's circuitry during periods of sleep mode and in the wake state because the external pin is not limited to a particular state. *Id.*

We agree with Petitioner. First, we agree with Petitioner that Atkinson and Broadwater are within the same field of endeavor because both references are generally within the field of integrated circuits. Reply 2. In particular, the references relate to optimizing the performance of integrated circuits by preventing the overheating thereof thereby enhancing reliability, temperature, and power consumption of integrated circuits. Further, Patent Owner's arguments regarding Atkinson are not commensurate in scope with the claim language. Patent Owner has not provided any basis in the claims to support the argument that Atkinson's system cannot be modified as proposed to add an external connection pin to complement the refresh process. The claim recitation "one connection pin such that the signal may be provided to external circuitry" implies that the external pin may be used as a vehicle for indicating the temperature of the DRAM to the external circuitry. However, as persuasively argued by Petitioner, the cited claim limitation does not restrict the use of the external pin/circuit to a particular state. Nor does it tie the external pin to the refresh process triggered in response to being informed of the DRAM temperature. As correctly noted by Petitioner, so long as Atkinson's DRAM is subject to disrupted operation due to possible overheating (in the sleeping mode or wake state) and includes a temperature sensor that outputs the sensed temperature of the DRAM, its proposed combination with Broadwater would be proper because Broadwater's thermal stress reduction technique would help cool down the chip notwithstanding that the systems of Atkinson and Broadwater operate at

different states. *Id.* at 4–5, 10. Accordingly, we agree with Petitioner that the teachings of Atkinson and Broadwater do not discourage the proposed combination.

ii. Whether Even If Atkinson and Broadwater Were Not Contrary to The Patent's Teaching, There Is No Reason to Combine Them to Make the Specific Invention Claimed.

Patent Owner argues that there is no reason to modify Atkinson to provide signals indicative of the onboard array temperature from the DRAM array to an external circuitry using Broadwater's external pin. PO Resp. 42 (citing Ex. 2008 ¶ 75). According to Patent Owner, adding an external pin to an existing DRAM is a very expensive and complex endeavor that counters the intended operation of Atkinson's self-refresh chip. *Id.* Patent Owner contends that because Atkinson's system performs an internal refresh operation in the sleep mode, the additional expense and complexity associated with adding an external pin would not be justified. *Id.* at 43–44. Moreover, Patent Owner contends that adding a forward biased diode as the temperature sensor would further increase the energy drain "sleep" mode. *Id.* at 44 (citing Ex. 2008 ¶¶ 78–79). Additionally, Patent Owner argues that neither Atkinson nor Broadwater discloses any teachings pertaining to external control of DRAM timing to facilitate efficient, deterministic control of the DRAM in sync with the rest of the activity of the system. *Id.* at 45–46 (citing Ex. 2008 ¶ 82).

These arguments are not persuasive. As correctly noted by Petitioner, because the claims do not recite any limitation regarding external control of DRAM timing, Patent Owner's arguments are misplaced and are not commensurate with the scope of the claims. Reply 8. Further, we agree with Petitioner that adding a pin to Atkinson's chip for the purpose of

communicating the sensed temperature of the DRAM to the external circuit, as taught by Broadwater, was well within the purview of the ordinarily-skilled artisan. *Id.* at 6–7, 9–10. As acknowledged by Patent Owner, Broadwater's disclosed technique pertains to a refresh circuit producing a refresh signal to reduce thermal stress in an integrated circuit (e.g., Atkinson's DRAM) in response to receiving from an external pin a signal indicating thermal distress in the chip. PO Resp. 36 (citing Ex. 1006, 2:31–38). Thus, we agree with Petitioner that because Broadwater's teachings pertain to relieving any type of chips from thermal distress, the ordinarily-skilled artisan would have been apprised that such a communication of the sensed temperature of the DRAM to the external circuitry via the external pin is a suitable addition to complement Atkinson's refreshing circuit in relieving the DRAM from possible overheating. Pet. 31 (citing Ex. 1005 ¶¶ 85, 86); Reply 7–8. Accordingly, we agree with Petitioner that there are sufficient reasons to combine the teachings of Atkinson and Broadwater to yield the specific invention claimed. Reply 3–4.

iii. Whether the Proposed Atkinson-Broadwater Combination Would Require Extensive Modifications of Atkinson to Practice the Claims.

Patent Owner asserts that "a combination of Atkinson and Broadwater to practice the claims would require extensive modifications." PO Resp. 48. Specifically, Patent Owner argues that the proposed modification of Atkinson to add a connection pin would be extensive. *Id.* In particular, Patent Owner argues that such modification would require (1) selecting Atkinson's non-preferred embodiment with an on-chip temperature sensor in direct communication with the DRAM; (2) removing the temperature-sensing refresh generator from main memory so as to justify providing the

signal to external circuitry; (3) adding a connection pin to the on-chip DRAM module; (4) generating a signal indicative of temperature that may be provided over the pin; (5) having the external circuitry in active mode while its energy saving system is working (not in sleep mode); (6) adding logic permitting DRAM to be refreshed at higher than default operation rate in high temperature situations; and (7) replacing temperature sensor with forward-biased diode. *Id.* at 48–50 (citing Ex. 2008 ¶¶ 85–91).

These arguments are not persuasive. We agree with Petitioner that none of these arguments has any basis in the claims. Reply 9. Further, we do not find any support on this record that Petitioner's proposed combination of Atkinson and Broadwater would require the cited modifications above, as alleged by Patent Owner in reliance upon Dr. Bernstein's Declaration. The alleged modifications are incorrectly premised upon the substitution of Atkinson's onboard refresh unit with Broadwater's external refresh unit. Instead, the modification proposed by Petitioner contemplates adding a pin to Atkinson's on-board circuit to communicate the sensed temperature of the DRAM to the external circuit. Pet. 17 (citing Ex. 1005 ¶¶ 47–49); *id.* at 30 (citing Ex. 1006, 4:31–33, 4:49–53; Ex. 1005 ¶¶ 83–84). Consequently, the resulting Atkinson-Broadwater system would offer the dual benefit of maximizing power saving during self-refresh timing sequence, as well as reducing thermal stress on the DRAM. *Id.* at 31 (citing Ex. 1006, 1:14–29; Ex. 1005 ¶¶ 85–86). Therefore, we agree with Petitioner that none of these arguments changes the conclusion that the proposed modification of Atkinson with Broadwater would reinforce Atkinson's onboard refresh unit thereby allowing Atkinson's system to combat both thermal distress and preserve energy consumption. Reply 2–3 (citing Ex. 1018, 38:3–6, 40:5–15,

20–25). Furthermore, we agree with Petitioner that because the laptop disclosed in Atkinson is vulnerable to overheating even in sleep mode, it could benefit from Broadwater's external refresh unit, which is designed to relieve such circuit from thermal distress irrespective that the latter external unit operates in the active mode. *Id.* at 10. Moreover, we agree with Petitioner because Atkinson discloses a system configured to increase or decrease the DRAM refresh rate proportionally with the sensed temperature of the DRAM, a person of ordinary skill in the art (POSITA) would have been motivated to supplement Atkinson's circuitry with Broadwater's external refreshing circuit as a way to keep the DRAM operating at all times. *Id.* at 10–11. On this record, we are not persuaded that the proposed Atkinson-Broadwater combination would require extensive modifications of Atkinson to practice the claims.

iv. Whether Petitioner and Its Declarant Wave Aside the References' Disclosures and Rely on Generalities and Offhand Comments in Each Reference

Patent Owner alleges that both Petitioner and its declarant rely on virtual irrelevancies, instead of main teachings from the references, in an attempt to show a motivation to combine the references. PO Resp. 51. In particular, Patent Owner offers the following examples of alleged generic Petitioner's statements: "it is desirable for the computer or external circuitry to be aware of the temperature for thermal management reasons," "to 'monitor and track the memory temperature for diagnostic purposes,'" "to enable throttling of power to reduce heat." *Id.* According to Patent Owner, such statements are conclusory and "would apply to anything that uses temperature as an input." *Id.* Further, Patent Owner argues that "Petitioner's declarant, at deposition, ignored or waved away most of the

disclosures of both references in order to dwell on minute offhand comments in both references that he argued lend purported support to the combination." *Id.* at 52. In particular, Patent Owner argues that Petitioner's declarant, Dr. Subramanian, "dwelled [at his deposition] on Broadwater's asides" such as concepts that might be useful at low temperatures (*id.* (citing Ex. 2009, 147:24–148:21, 160:16–165:2)); whereas "Broadwater is directed to alleviating thermal stress from overheating circuitry by selectively shutting off parts of the overheated circuitry to reduce its temperature." *Id.* (citing Ex. 1006 1:14–45, 3:48–64, 5:35–45). Likewise, Patent Owner argues that "Atkinson is wholly directed to DRAM low-temperature self-refresh in non-operation;" whereas declarant's deposition "dwelled" on the comment that in Atkinson "'the refresh rate may be varied according to temperature during normal computer operation.'" *Id.* at 52–53 (citing Ex. 1010, 6:5–8; Ex. 2009, 175:12–176:10, 182:14–24). Patent Owner, therefore, submits that none of these off-hand comments corresponds to any explicit embodiments or substantial teachings in the references about how the completed applications might be accomplished. *Id.* at 53 (citing Ex. 2008 ¶¶ 95–98).

These arguments are not persuasive. We agree with Petitioner that the asserted motivation statements are not generalities, but pertain to reasons why a POSITA would have combined the teachings of Atkinson with Broadwater's. Reply 12. In particular, we agree with Petitioner that, as taught in Broadwater, thermal stress reduction during the operation of integrated chips has been recognized in the semiconductor art as a significant problem to be addressed. *Id.* (citing Pet. 30; Ex. 1006, 1:14–22). Likewise, we agree with Petitioner that even Patent Owner's expert

acknowledges the benefit of preventing ICs from "blowing up." *Id.* at 13 (citing Ex. 1018, 40:12–15, 141:7–12).

On the record before us, we are persuaded that there is adequate motivation to modify Atkinson's sensor to add Broadwater's connection pin so as to provide a signal indicative of the DRAM sensed temperature to an external circuitry for the purpose of reducing thermal stress in Atkinson's integrated circuit.

For the foregoing reasons, we are persuaded that Petitioner has established, by a preponderance of the evidence, that claims 1, 3, 5–9, 12, 13, and 16 of the '057 patent are unpatentable under 35 U.S.C. § 103(a) over the combination of Atkinson and Broadwater.

b. The Allegation That "Petitioner Has Failed to Show it Was Obvious to Modify Atkinson to Add the 'Diode' Limitations" (claims 2, 4, 10, 11, 14, 15, and 17)

Dependent claims 2, 4, 10, 11, 14, 15, and 17 recite, in relevant part, "wherein the at least one temperature sensor includes at least one diode having a forward voltage drop that varies as a function of the temperature of the DRAM array, and the signal corresponds to the forward voltage drop of the at least one diode." Ex. 1001, 6:8–12.

1. Petitioner's Positions

Petitioner contends claims 2, 4, 10, 11, 14, 15, and 17 are unpatentable under 35 U.S.C. § 103(a) as being unpatentable over the combination of Atkinson, Broadwater, and Miller.[7] Pet. 20–21, 22, 25, 27,

[7] Although Miller is omitted from the Petition's summary of asserted grounds, it was nevertheless relied upon in Petitioner's analysis of claims 2, 4, 10, 11, 14, 15, and 17. *See, e.g.*, Pet. 20. We, therefore, in the Decision

28, 29–30. Relying on the declaration of Dr. Subramanian, Petitioner explains how the proposed combination of references discloses all of the claim limitations. *Id.* (citing Ex. 1005). In particular, Petitioner asserts that, although the '057 patent includes a diode as a known temperature sensor, it also discloses other known temperature sensors (e.g., thermocouples, thermistors, or any other device that provides an output signal varying as a function of temperature). Pet. 20 (citing Ex. 1001, 2:42–45). Petitioner further asserts that Atkinson similarly discloses the use of such known temperature sensors (e.g., thermocouple or temperature sensing integrated circuit). *Id.* (citing Ex. 1010, 22:21–24; Ex. 1005 ¶¶ 52, 53). Petitioner then contends that, at the time of the invention, measuring a forward voltage drop across a semiconductor diode to thereby read the temperature, as described in Miller, was a well-known use of such a type of temperature sensor. Pet. 20 (citing Ex. 1015, Abstract). Petitioner concludes it would have been obvious to one of ordinary skill in the art to select a diode as a well-known type of temperature sensor for reading the temperature of Atkinson's DRAM. *Id.* at 21 (citing Ex. 1010, 24:63–65; 1005 ¶ 53). We are persuaded by Petitioner's showing and find that Miller's description of a diode as a temperature sensor would complement the Atkinson-Broadwater combination to teach using the diode to sense the temperature of the DRAM, which is communicated to an external circuitry via an external pin.

Likewise, claim 4 depends directly from claim 1, and recites

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on Institution treated Petitioner's analysis of claims 2, 4, 10, 11, 14, 15, and 17 based upon Atkinson, Broadwater, and Miller as a separate ground of unpatentability. Inst. Dec. 5.

> wherein the at least one temperature sensor includes a diode having a forward voltage drop that varies as a function of the temperature of the DRAM array; the at least one connection pin includes a first pin coupled to an anode of the diode and a second pin coupled to a cathode of the diode; and the signal corresponds to a potential voltage between the first and second pins.

Ex. 1001, 6:17–23. Petitioner explains, with supporting evidence, that at the time of the invention, "given that the claim merely recites 'first pin' and 'second pin,' the diode temperature sensor would necessarily be connected to a first pin and a second pin if it were operational." Pet. 22 (citing Ex. 1005 ¶ 56). Petitioner further explains that "in such a diode configuration, the signal between the first pin and the second pin would necessarily be the forward voltage drop of the diode, which claim 4 defines as the signal." *Id.* Petitioner concludes that it would have been obvious to one of ordinary skill in the art at the time of the invention to "modify Atkinson to use a diode configuration as recited in claim 4 (which is essentially the same as the obvious variant in claim 2)." *Id.* We are persuaded by Petitioner's showing and find that Miller's diode coupled to the pins in Atkinson's DRAM teaches a forward biased diode connected to the connection pins.

We also have reviewed the Petition with respect to dependent claims 10, 11, 14, 15, and 17, and determine that Petitioner has accounted sufficiently for the recited limitations. Pet. 25, 27, 28.

2. Patent Owner's Assertions Regarding the References

Patent Owner makes two principal arguments: (i) Miller was not part of any of the combinations expressly raised by the Petition (PO Resp. 19–28), and that (ii) Petitioner fails to show it was obvious to modify Atkinson

to add the diode limitations. *Id.* at 53–57. We address each argument in turn.

i. The Allegation that Miller was not Part of Any Combination Expressly Raised in the Petition

Patent Owner argues that Petitioner did not expressly raise Miller as part of any of the combinations argued in the Petition. PO Resp. 54. In particular, Patent Owner argues that the Petition's "Summary of Grounds of Rejection" lists Atkinson and Broadwater as a possible combination, but never mentions Miller. *Id.* at 20. According to Patent Owner, while the Petition recognizes that the Atkinson-Broadwater combination is silent about the forward biased diode, it asserts that the ordinarily-skilled artisan would have known that forward biased diodes were well-known in the art for sensing temperature, and then lists Miller as an example of such common use of forward biased diode. *Id.* According to Patent Owner, such a reference to Miller in the Petition is not tantamount to including Miller as part of the Atkinson-Broadwater combination. *Id.* at 21. Patent Owner argues that the Board, *sua sponte*, redrafted the ground of unpatentability proposed by Petitioner to yield the Atkinson, Broadwater, and Miller combination as a separate and new ground in the Institution Decision thereby converting Miller from background art to a reference in the combination. *Id.* at 19, 21–22. Consequently, Patent Owner submits that by instituting on the new ground combination, the Board has caused the following:

(1) Deprived Patent Owner of its due process right to file a preliminary response as to the new ground (PO Resp. 23–24);

(2) Violated the Board's regulations whereby the Petition must identify the challenge along with the specific ground (*id.* at 24–25);

(3) Contradicted without reason Petitioner's choice of making Miller background art, as opposed to making Miller part of the combination (*id.* at 25);

(4) Prejudiced Patent Owner by forcing it to consider and address the issue in its Patent Owner's Response (*id.* at 26); and

(5) Contravened the Administrative Procedure Act's requirement to maintain an impartial stance by weighing on Petitioner's side of the controversy (*id.* at 26–28).

In response, Petitioner argues that Miller is introduced in Ground 1 of the Petition to teach using a diode detecting temperature in an integrated circuit. Reply 15 (citing Pet. 19–20). According to Petitioner, because Ground 2 builds off Ground 1, the Board properly interpreted Petitioner's intent to make Ground 2 additive to Ground 1, and therefore to include Miller, and that the heading or title within the Petition does not alter the underlying content of the Petition. *Id.* at 14–15.

We agree with Petitioner. As noted in the Institution Decision, Petitioner's discussion of Miller within the content of the Petition as a way to bolster the Atkinson-Broadwater combination is tantamount to the Atkinson-Broadwater-Miller combination. Inst. Dec. 5; Pet. 20–21. Patent Owner was apprised of the Petitioner's reliance on Miller in the Petition, and Patent Owner availed itself of the opportunity to provide arguments addressing Miller in the Patent Owner Response (*see* PO Resp. 53–57). Accordingly, we are not persuaded that the combination of Atkinson, Broadwater, and Miller was not raised in the Petition.

ii. The Allegation that There is No Motivation to Combine Miller with Atkinson

Patent Owner argues that because Miller does not discuss memory, DRAM, or DRAM refresh, substituting Miller's forward-voltage-drop diode for Atkinson's thermistor would not have been obvious to the ordinarily-skilled artisan. PO Resp. 54. According to Patent Owner, neither the Petitioner nor its declarant identifies a rationale supporting the proposed substitution of Atkinson's temperature sensors for Miller's diode. *Id.* at 55. Patent Owner further argues that merely indicating Miller's diode could be selected over the alternatives listed in Atkinson does not identify a rationale for the proposed substitution. *Id.* (citing Ex. 2008 ¶¶ 99–101). Furthermore, Patent Owner argues that because the claimed diode voltage sensor only works with the diode forward biased, the steady state current flowing through a voltage drop for sensing the temperature through the forward-biased diode would increase the steady state power during the sleep mode. *Id.* Accordingly, Patent Owner submits that a diode would increase the sleep mode current drain, and would thereby violate Atkinson's desired reduction in energy consumption. *Id.* Additionally, Patent Owner argues that even if Miller were used as merely background information as intended by Petitioner, the Petition still fails to show that it would have been obvious to replace a generally known diode in place of Atkinson's thermistor because the limitation in question is not "'unusually' insignificant" and the technology "'particularly straightforward.'" *Id.* at 56. Patent Owner, therefore, submits that because the diode limitations are important structural limitations in the claim, replacing Atkinson's thermistor with Miller's generally known diode would change the operation of the device and necessitates modification of Atkinson's refresh generator. *Id.* at 57.

Petitioner counters that because diodes have been used for sensing temperature in integrated circuits since the 1970s, POSITA would have known that the proposed substitution is reasonable as conceded by Patent Owner's expert. Reply 13–14 (citing Ex. 1010, 22:21–26; Ex. 2009, 209:12–17; Ex. 1015; Ex. 1018, 188:19–25), 18–19. In particular, Petitioner argues that Broadwater's express teaching of using a diode to detect temperature (Ex. 1006, 3:55–58), taken in combination with Patent Owner's admission that a thermocouple is much like a forward biased diode (Ex. 1018, 180:6–10) supports the proposed combination. *Id.* at 14. Further, Petitioner submits that "[o]ne of ordinary skill in the art would be motivated to send the signal indicative of memory temperature to an external connection pin, at least to enable its use in a cooling regime, such as the one set forth in Miller." Pet. 18. Additionally, Petitioner submits "[t]hose of ordinary skill at the time of the filing of the '057 [p]atent would know that one example of the finite alternate types of integrated circuits for detecting temperature was a diode having a forward voltage drop that varies as a function of temperature." *Id.* at 20.

We agree with Petitioner. As correctly argued by Petitioner, Patent Owner does not dispute that, at the time of the invention, using a diode for sensing the temperature of an integrated device was well-known in the art. Therefore, we agree with Petitioner that although Miller is not related to a memory type circuit, the forward-biased diode disclosed in Miller is directed to sensing integrated circuits as a whole including memory integrated circuits such as the DRAM disclosed in Atkinson. Reply 15–17. Further, as correctly noted by Petitioner, Atkinson, in fact, suggests using alternative temperature sensing devices not particularly listed for sensing the

temperature of the DRAM. Pet. 20 (citing 1010, 22:21–24). Furthermore, we do not agree with Patent Owner that Petitioner has not provided sufficient motivation for substituting Miller's forward biased diode with Atkinson's thermistor. As noted above, Petitioner expressly asserts that the ordinarily-skilled artisan would have made the proposed substitution to enable the use of Atkinson's DRAM in a "cooling regime," as well as "to enable throttling of power to reduce heat as well as to monitor and track the memory temperature for diagnostic purposes." Pet. 18. Moreover, as discussed above, irrespective of differing modes of Atkinson's DRAM, Broadwater's external circuit or Miller's forward biased diode, the overall combination of the cited references would predictably result in reducing thermal stress in the DRAM, upon being notified that the DRAM is overheating, thereby reducing the overall power consumption of the circuit. In other words, Petitioner's proposed combination of the cited teachings of Atkinson, Broadwater, and Miller is no more than a simple arrangement of old elements with each performing the same function it had been known to perform, yielding no more than one would expect from such an arrangement. *KSR Int'l Co. v. Teleflex Inc*., 550 U.S. 398, 416 (2007). The ordinarily-skilled artisan, being "a person of ordinary creativity, not an automaton," would be able to fit the teachings of the cited references together like pieces of a puzzle to predictably result in an external circuit that provides a proportional cooling signal to a DRAM circuit upon receiving a signal from a forward biased diode indicating a sensed temperature of the DRAM. *Id.* at 420–21. We are not persuaded that the Petitioner's proffered combination would have been "uniquely challenging or difficult for one of ordinary skill in the art"; we agree with the Petitioner that the proposed modification

would have been within the purview of the ordinarily skilled artisan. *Leapfrog Enters., Inc. v. Fisher-Price, Inc*., 485 F.3d 1157, 1162 (Fed. Cir. 2007) (citing *KSR*, 550 U.S. at 418).

Petitioner has sufficiently shown that it would have been obvious to use the diode described in Miller to read and measure the temperature of Atkinson's DRAM. Pet. 20–21. On the record before us, we are persuaded that Petitioner has provided an articulated reasoning with some rational underpinning sufficient to support the legal conclusion of obviousness based on Atkinson, Broadwater, and Miller. *See KSR*, 550 U.S. at 418.

For the foregoing reasons, we are persuaded that Petitioner has established, by a preponderance of the evidence, that claims 2, 4, 10, 11, 14, 15, and 17 of the '057 patent are unpatentable under 35 U.S.C. § 103(a) over the combination of Atkinson, Broadwater, and Miller.

c. The Allegation that Petitioner Has Failed to Point Out Where the "Refresh Unit" (Claims 6–11) and the "Refresh Timing Unit" (Claims 7–11) Limitations Are Found.

Dependent claims 6–11 recite, in relevant part, "a refresh unit operable to refresh the DRAM array at a rate that varies in response to the signal." Ex. 1001, 6:28–30. Further, dependent claims 7–11 recite a "refresh timing unit is operable to decrease the rate at which the DRAM array is refreshed as the signal indicates that the temperature of the DRAM array decreases." *Id.* at 6:36–39.

1. Petitioner's Positions

Petitioner asserts Atkinson describes a temperature sensing refresh generator that senses the main memory temperature to issue a refresh frequency that increases or decreases in proportion with the sensed temperature. Pet. 23 (citing Ex. 1010, 24:15–23; Ex. 1005 ¶ 58). Further,

Petitioner asserts that Atkinson discloses an alternative embodiment with a voltage controller oscillator (VCO) combined with a temperature sensor, whereupon the VCO receives from the sensor a sensed temperature signal of the main memory, the VCO, produces in response a proportional refresh signal to refresh the main memory. *Id.* (citing Ex. 1010, 23:8–10, 23:17–20). We are persuaded by Petitioner's showing and find that Atkinson's description of the refresh generator teaches a refresh unit for providing to the DRAM an increased or decreased refresh rate in proportion with the sensed temperature of the DRAM. Likewise, we are persuaded that Atkinson's description of the VCO teaches a refresh timing unit to decrease the rate at which the DRAM array is refreshed as the signal indicates the temperature of the DRAM decreases.

2. Patent Owner's Assertions Regarding the References

As to the terms "refresh unit" and "refresh timing unit" recited in claims 6–11, Patent Owner argues the following:

(i) Petitioner fails to show that Atkinson teaches "'a refresh unit operable to refresh the DRAM array at a rate that varies in response to the signal'" (PO Resp. 58–59), and that

(ii) Petitioner fails to show Atkinson teaches "'a refresh timing unit operable to establish the rate at which the DRAM array is refreshed in response to the signal.'" *Id.* at 59–60.

We address each argument in turn.

i. The Allegation that Petitioner Fails to Show that Atkinson Teaches "a Refresh Unit Operable to Refresh the DRAM Array at a Rate that Varies in Response to the Signal"

Patent Owner argues that the statement in Atkinson relied upon by Petitioner teaches, at most, that the rate and the temperature are linked, but not that the rate "'varies in response to the signal.'" PO Resp. 58 (quoting Ex. 101, 24:15–23). According to Petitioner, the signal described in the statement is not equivalent to the signal recited in claim 6 because the signal described in Atkinson relates to a periodic voltage pulse produced by Atkinson's generator, whereas the claimed signal relates to a signal produced by the temperature sensor. *Id.* at 58–59. Accordingly, Patent Owner submits that Atkinson does not teach the required limitation of a signal indicative of the temperature of the DRAM array. *Id.* at 59.

This argument is not persuasive for the same reasons previously noted in our institution Decision. In particular, we noted the following:

> The antecedent basis for "the signal" is in claim 1, where Petitioner relies upon Atkinson's teaching of the refresh generator output, which is indicative of the temperature of the DRAM as measured by thermistor 800. Pet. 14–17 (discussing embodiments described in Figures 8 and 9 of Atkinson). In connection with the embodiment of Figure 8, Atkinson teaches explicitly that "[t]he frequency of the refresh signal in this embodiment continuously reduces as temperature decreases, rather than in discrete steps as in prior embodiments. Thus, refresh generator 850 provides a refresh signal that closely follows the temperature/frequency response of curve 600 or any other desired temperature/frequency response curve." Ex. 1010, 22:62–23:1. As a result, we agree with and are persuaded by Petitioner's contentions that Atkinson teaches refreshing the DRAM array at a rate that varies in response to the signal, as claim 6 requires, and not merely in response to the temperature of the DRAM array, as Patent Owner suggests.

Inst. Dec. 15–16.

We, therefore, reiterate our agreement with Petitioner that because Atkinson's refresh unit generates the refresh signal in response to receiving the DRAM temperature signal such that the generated refresh signal track the temperature signal proportionally, the generated refresh signal teaches the temperature signal. Reply 19–20.

On this record, Petitioner has shown by a preponderance of the evidence that Atkinson teaches "a refresh unit operable to refresh the DRAM array at a rate that varies in response to the signal."

ii. The Allegation that Petitioner Fails to Show Atkinson Teaches "'a Refresh Timing Unit Operable to Establish the Rate at Which the DRAM Array is Refreshed in Response to the Signal'"

Patent Owner argues Petitioner does not show that Atkinson's VCO is operable to establish the rate at which the DRAM array is refreshed in response to the sensed temperature signal. PO Resp. 59–60. According to Patent Owner, Atkinson's VCO merely 'produces a periodic waveform having a frequency that changes in response to changes in the input voltage. *Id.* at 60 (quoting Ex.1010, 23:5–9).

This argument is not persuasive. We agree with Petitioner that because Atkinson's VCO "'produces the refresh signal at the proper frequency'" in response to receiving a signal indicative of the temperature, the generated refresh signal sets the frequency to refresh the DRAM. Reply 21.

On this record, Petitioner has shown by a preponderance of the evidence that Atkinson teaches "'a refresh timing unit operable to establish the rate at which the DRAM array is refreshed in response to the signal.'"

d. Weight to be Given to Dr. Subramanian's Declaration

Patent Owner argues that no weight should be given to Dr. Subramanian's declaration because the declarant is not an attorney, he applied an incorrect legal test, and he is thereby not suited to provide opinions on the legal question of obviousness. PO Resp. 28–29. In support of this argument, Patent Owner directs attention to portions of Dr. Subramanian's deposition where he allegedly testified that background knowledge (including common sense) of an ordinary artisan can be routinely added to a combination to teach a missing limitation, even if the missing

limitation "'went to the heart of the invention.'" *Id.* at 29. According to Patent Owner, because the legal test allegedly applied by Dr. Subramanian was previously rejected by the Board's reviewing court in *Arendi S.A.R.L. v. Apple Inc.*, 832 F.3d 1355, 1361–65 (Fed. Cir. 2016) (2), the Board should disregard Dr. Subramanian's opinions on the ultimate question of obviousness. *Id.* at 29–30. Further, Patent Owner argues that Petitioner's declaration should be given little to no weight because the declaration allegedly parrots Petitioner's attorney's arguments. *Id.* at 30–31. According to Patent Owner, Petitioner's declaration section VII-B, for example, is exactly the same as Petition's section VII-B. *Id.* (citing Pet. 29–32; Ex. 1005, 28–30).

We have reviewed the arguments provided by Patent Owner and determine such arguments are insufficient to have Dr. Subramanian's declaration disregarded in its entirety. Rather, it is within our discretion to assign the appropriate weight to be accorded evidence. *See* 37 C.F.R. § 42.65(a); *see also, e.g.*, *Yorkey v. Diab*, 601 F.3d 1279, 1284 (Fed. Cir. 2010) (holding the Board has discretion to give more weight to one item of evidence over another "unless no reasonable trier of fact could have done so"); *In re Am. Acad. of Sci. Tech Ctr.*, 367 F.3d 1359, 1368 (Fed. Cir. 2004) ("[T]he Board is entitled to weigh the declarations and conclude that the lack of factual corroboration warrants discounting the opinions expressed in the declarations."); *Velander v. Garner*, 348 F.3d 1359, 1371 (Fed. Cir. 2003) ("In giving more weight to prior publications than to subsequent conclusory statements by experts, the Board acted well within [its] discretion."). Based on the record before us, we are not persuaded that we should give the entirety of Dr. Subramanian's declaration no weight. We reiterate

nonetheless that we reached the ultimate conclusion of obviousness in this Decision based on the totality of the record before us, and without adopting any purported "lay opinions".[8]

e. Summary

For the foregoing reasons, we are persuaded that Petitioner has established, by a preponderance of the evidence the following:

(1) Claims 1, 3, 5–9, 12, 13, and 16 of the '057 patent are unpatentable under 35 U.S.C. § 103(a) over the combination of Atkinson and Broadwater;

(2) Claims 2, 4, 10, 11, 14, 15, and 17 of the '057 patent are unpatentable under 35 U.S.C. § 103(a) over the combination of Atkinson, Broadwater, and Miller.

III. CONCLUSION

Petitioner has demonstrated, by a preponderance of the evidence, that: (1) Claims 1, 3, 5–9, 12, 13, and 16 of the '057 patent are unpatentable under 35 U.S.C. § 103(a) over the combination of Atkinson and Broadwater; (2) Claims 2, 4, 10, 11, 14, 15, and 17 of the '057 patent are unpatentable under 35 U.S.C. § 103(a) over the combination of Atkinson, Broadwater, and Miller.

[8] See supra note 5.

IV. ORDER

Accordingly, it is

ORDERED that claims 1–17 of the ’057 patent are determined to be *unpatentable*;

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.

For PETITIONER:

David Hoffman
FISH & RICHARDSON P.C.
hoffman@fr.com
IPR37307-0007IP1@fr.com

Martha Hopkins
LAW OFFICES OF S.J. CHRISTINE YANG
mhopkins@sjckawpc.com
IPR@sjclawpc.com

For PATENT OWNER:

Kenneth Weatherwax
Nathan Lowenstein
Parham Hendifar
LOWENSTEIN & WEATHERWAX LLP
weatherwax@lowensteinweatherwax.com
lowenstein@lowensteinweatherwax.com
hendifar@lowensteinweatherwax.com