EXHIBIT A

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571-272-7822

Paper 44
Date: November 17, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TCL INDUSTRIES HOLDINGS CO., LTD. and LG ELECTRONICS INC.,
Petitioners,[1]

v.

PARKERVISION, INC.,
Patent Owner.

IPR2021-00985[2]
Patent 7,292,835 B2

Before MICHAEL R. ZECHER, BART A. GERSTENBLITH, and IFTIKHAR AHMED, *Administrative Patent Judges*.

GERSTENBLITH, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

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[1] The caption is updated to remove Petitioner Hisense Co., Ltd. ("Hisense") because Hisense is no longer a party to this proceeding. *See* Paper 43 (Termination due to Settlement After Institution of Trial Only as to Hisense Co., Ltd.). The parties shall use this caption (without this footnote) going forward.

[2] LG Electronics Inc., who filed a petition in IPR2022-00246, is joined as petitioner in this proceeding.

I. INTRODUCTION

A. Background

TCL Industries Holdings Co., Ltd. ("TCL"); Hisense; and ZyXEL Communications Corp. ("ZyXEL") filed a Petition (Paper 1, "Pet.") requesting institution of *inter partes* review of claims 1, 12–15, and 17–20 ("the Challenged Claims") of U.S. Patent No. 7,292,835 B2 (Ex. 1001, "the '835 patent"). ParkerVision, Inc. ("Patent Owner") filed a Preliminary Response (Paper 9). ZyXEL and Patent Owner reached a settlement and this proceeding was terminated only as to ZyXEL. Paper 13. TCL and Hisense remained as petitioners in the proceeding. Applying the standard set forth in 35 U.S.C. § 314(a), we instituted an *inter partes* review as to all claims and grounds set forth in the Petition. Paper 14 ("Inst. Dec.").

After institution, LG Electronics Inc. ("LG") filed a petition in IPR2022-00246 (challenging the same claims of the '835 patent on the same grounds), and a motion for joinder (seeking to join this proceeding as a petitioner). *LG Elecs. Inc. v. ParkerVision, Inc.*, IPR2022-00246 (PTAB Dec. 17, 2021), Papers 2 (petition), 3 (motion for joinder). We granted institution in IPR2022-00246 and granted LG's motion for joinder. *Id.* at Paper 10 (PTAB Apr. 12, 2022); IPR2021-00985, Paper 21. Recently, Hisense and Patent Owner reached a settlement and this proceeding was terminated only as to Hisense. Paper 43. Accordingly, we refer to TCL and LG, collectively, as "Petitioners."

Also following institution, Patent Owner filed a Patent Owner Response (Paper 17, "PO Resp."), Petitioners filed a Reply to Patent Owner's Response (Paper 25, "Pet. Reply"), and Patent Owner filed a Sur-reply (Paper 31, "PO Sur-reply"). Additionally, we granted Petitioners'

Motion for Routine and/or Additional Discovery (Paper 18), ordering the production of Patent Owner's Final Infringement Contentions. Paper 23 (Order), 8. And, we denied Patent Owner's Motion to Strike portions of Petitioners' Reply (Paper 26), finding that the "Reply does not raise new issues, is not accompanied by belatedly presented evidence, and does not otherwise exceed the proper scope of [a] reply brief as set forth in 37 C.F.R. § 42.23(b)." Paper 30 (Order), 13. An oral hearing was held on September 8, 2022, and the transcript is of record. Paper 39 ("Tr.").[3]

We have jurisdiction pursuant to 35 U.S.C. § 6. This Decision is a Final Written Decision under 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73 as to the patentability of the Challenged Claims. Petitioners bear the burden of proving unpatentability of the Challenged Claims. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). To prevail, Petitioners must prove unpatentability by a preponderance of the evidence. *See* 35 U.S.C. § 316(e) (2018); 37 C.F.R. § 42.1(d) (2020). Having reviewed the arguments and the supporting evidence, we determine that Petitioners have shown, by a preponderance of the evidence, that claims 1, 12–15, and 17–20 of the '835 patent are unpatentable.

B. Related Proceedings

The parties identify the following as related matters: *ParkerVision, Inc. v. TCL Industries Holdings Co., Ltd. et al.*, No. 6:20-cv-00945 (W.D. Tex.); *ParkerVision, Inc. v. Hisense Co., Ltd. et al.*, No. 6:20-cv-00870 (W.D. Tex.); *ParkerVision, Inc. v. ZyXEL Communications Corp.*, No. 6:20-

[3] Because of a substantial overlap in issues presented, the transcript includes oral argument from related case IPR2021-00990, although this proceeding and IPR2021-00990 are not consolidated or joined.

cv-01010 (W.D. Tex.)[4]; and *ParkerVision, Inc. v. LG Electronics Inc.*, No. 6:21-cv-00520 (W.D. Tex.). Pet. 13–14; Paper 6 (Petitioner's Updated Mandatory Notice), 1; Paper 8 (Patent Owner's Mandatory Notices), 1. Petitioners also identify *ParkerVision, Inc. v. Buffalo Inc.*, No. 6:20-cv-01009 (W.D. Tex.), as a related matter involving the '835 patent. Pet. 14. In joined case IPR2022-00246, Petitioner LG also identifies *ParkerVision, Inc. v. TCL Technology Group Corp.*, No. 5:20-cv-01030 (C.D. Cal.). *LG Elecs.*, IPR2022-00246, Paper 2 at 13. Additionally, Petitioners challenge several claims of U.S. Patent No. 7,110,444 B1, owned by Patent Owner, in IPR2021-00990. Pet. 14; Paper 8, 1.[5]

C. Real Parties in Interest

Petitioners identify TCL;TCL Electronics Holdings Ltd.; Shenzhen TCL New Technology Co., Ltd.; TCL King Electrical Appliances (Huizhou) Co., Ltd.; TCL Moka Int'l Ltd.; TCL Moka Manufacturing S.A. DE C.V.; TCL Technology Group Corp.; TTE Technology, Inc.; LG; and LG Electronics U.S.A., Inc. as real parties in interest. Pet. 13; *LG*, IPR2022-00246, Paper 2 at 12. Patent Owner identifies ParkerVision, Inc. as the sole real party in interest. Paper 8, 1; *LG*, IPR2022-00246, Paper 8 (Patent Owner's Mandatory Notices), 1.

[4] After the parties' briefing, the district court granted a joint motion to dismiss with prejudice and the case is now closed. *See* Ex. 3001 (Docket Entry 25, Order dated Sept. 27, 2001).
[5] Patent Owner identifies the instant proceeding—IPR2021-00985—as a related matter, but we understand Patent Owner to refer to IPR2021-00990. *See* Paper 8, 1.

D. The Asserted Grounds of Unpatentability and Declaration Evidence

Petitioners challenge the patentability of claims 1, 12–15, and 17–20 of the '835 patent on the following grounds:

Claim(s) Challenged	35 U.S.C. §[6]	Reference(s)/Basis
1, 12, 15, 17	103(a)	Hulkko,[7] Gibson[8]
1, 12, 15, 17	103(a)	Hulkko, Gibson, Goldberg,[9] Thacker,[10] ITU-T J.83b,[11] AAPA[12]
1, 12–15, 17–20	103(a)	Gibson, Schiltz[13]
1, 12–15, 17–20	103(a)	Gibson, Schiltz, Goldberg, Thacker, ITU-T J.83b, AAPA

Pet. 17. In the Petition, Petitioners first set forth the grounds as though there are two: Hulkko and Gibson, and Gibson and Schiltz. *Id.* Petitioners, however, explain that "if the Board finds that the preamble of claim 1 is limiting—and thus requires a 'cable modem'—then Petitioners submit that the [C]hallenged [C]laims are obvious for the reasons above and further in

[6] The Leahy-Smith America Invents Act ("AIA") included revisions to 35 U.S.C. § 103 that became effective on March 16, 2013. Because the '835 patent has an effective filing date before March 16, 2013, we apply the pre-AIA version of the statutory basis for unpatentability.
[7] U.S. Patent No. 5,734,683, issued Mar. 31, 1998 (Ex. 1004, "Hulkko").
[8] U.S. Patent No. 4,682,117, issued July 21, 1987 (Ex. 1005, "Gibson").
[9] L. Goldberg, "MCNS/DOCSIS MAC Clears a Path for the Cable-Modem Invasion," *Electronic Design*; Dec. 1, 1997; 45, 27; Materials Science & Engineering Collection pg. 69 (Ex. 1007, "Goldberg").
[10] U.S. Patent No. 6,011,548, issued Jan. 4, 2000 (Ex. 1008, "Thacker").
[11] ITU-T J.83 Recommendation (Apr. 1997) (Ex. 1009, "ITU-T J.83b"). Petitioners include the letter "b" in references to this exhibit although the title does not include the letter "b." *See, e.g.*, Pet. 17, 42. For consistency, we refer to the exhibit in the same manner as Petitioners by including the letter "b."

view of publications (*e.g.*, Goldberg and Thacker) describing the then-existing cable modem standards (ITU-T J.83b and DOCSIS) and/or AAPA." *Id.* Accordingly, the chart above includes the alternative grounds set forth in the Petition. Inst. Dec. 4.

Additionally, Petitioners support their challenge with a Declaration of Matthew B. Shoemake, Ph.D. (Ex. 1002) and a Declaration of Brenda Ray (Ex. 1010). Patent Owner supports its arguments with a Declaration of Dr. Michael Steer. (Ex. 2038). Petitioners cross-examined Dr. Steer and a transcript of that deposition is of record. Ex. 1016.

E. The '835 Patent

The '835 patent is directed to frequency translation and applications thereof, including cable modem applications. Ex. 1001, code (57). The applications include, but are not limited to, "frequency down-conversion, frequency up-conversion, enhanced signal reception, unified down-conversion and filtering, and combinations" thereof. *Id.*

In particular, with respect to the Challenged Claims, the '835 patent teaches a "[Quadrature Amplitude Modulation ("QAM")] modulation mode

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[12] Applicant admitted prior art ("AAPA") refers to the '835 patent, at column 40, lines 17–35, which states, *inter alia*, that "[t]he cable modem receivers, transmitters, and transceivers of the present invention may be implemented using a variety of well[-]known devices" and lists several examples. *See* Pet. 11. "A patentee's admissions regarding the scope and content of the prior art under § 103 can be used, for example, to (1) supply missing claim limitations that were generally known in the art prior to the invention . . . or the effective filing date of the claimed invention . . . ." USPTO Memorandum, Updated Guidance on the Treatment of Statements of the Applicant in the Challenged Patent in Inter Partes Reviews Under § 311 (issued June 9, 2022), at 4, *available at* https://go.usa.gov/xSbGF.

[13] U.S. Patent No. 5,339,459, issued Aug. 16, 1994 (Ex. 1006, "Schiltz").

receiver" that "down-convert[s] and demodulates an input signal that is modulated according to QAM . . . modulation techniques." *See* Ex. 1001, 42:43–49. Figure 54B is reproduced below:

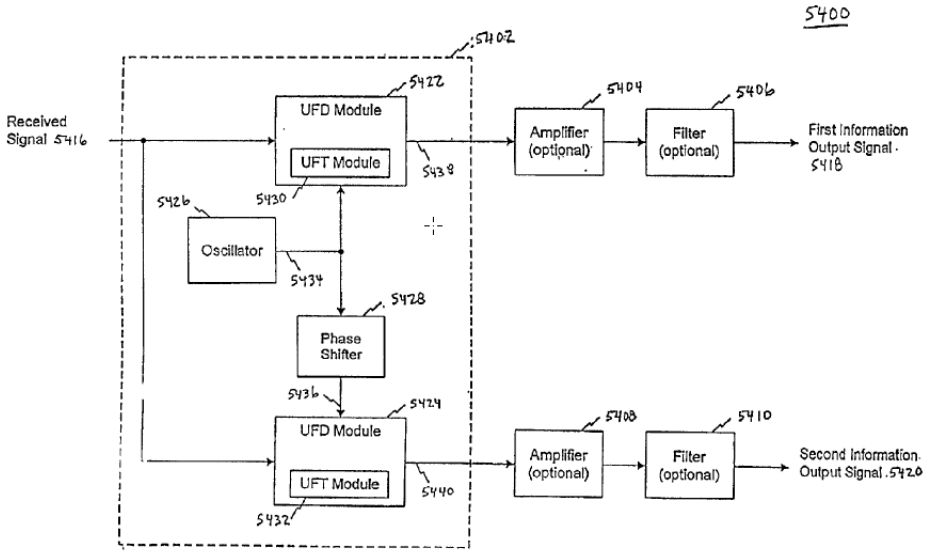


FIG. 54B

Figure 54B is an exemplary block diagram of QAM modulation receiver 5402. *Id.* at 4:42–44, 42:45–47.

The '835 patent explains that QAM modulation mode receiver 5402 "may be used to directly down-convert and demodulate a received [radio frequency ("RF")] input signal to two baseband information signals, or may down-convert and demodulate a received signal that is at an intermediate frequency to two baseband information signals." Ex. 1001, 42:49–54. QAM modulation mode receiver 5402 comprises oscillator 5426, first universal frequency down-conversion ("UFD") module 5422, second UFD module 5454, first universal frequency translation ("UFT") module 5430, second UFT module 5432, and phase shifter 5428. *Id.* at 42:63–67.

The '835 patent further explains that

> [o]scillator 5426 provides an oscillating signal used by both first UFD module 5422 and second UFD module 5424 via phase shifter 5428. Oscillator 5426 generates an "I" oscillating signal 5434.
>
> "I" oscillating signal 5434 is input to first UFD module 5422. First UFD module 5422 comprises at least one UFT module 5430. In an embodiment, first UFD module 5422 is structured similarly to UFD module 5300 of FIG. 53, with oscillator 5426 substituting for oscillator 5304, and "I" oscillating signal 5434 substituting for oscillating signal 5316. First UFD module 5422 receives received signal 5416. Received signal 5416 comprises two information signals modulated with an RF carrier signal according to either QAM or QPSK modulation techniques. First UFD module 5422 frequency down-converts and demodulates received signal 5416 to down-converted "I" signal 5438 according to "I" oscillating signal 5434. Down-converted "I" signal 5438 may be an information signal with two possible states or voltage levels (QPSK), or with more than two possible states or voltage levels (QAM).
>
> Phase shifter 5428 receives "I" oscillating signal 5434, and outputs "Q" oscillating signal 5436, which is a replica of "I" oscillating signal 5434 shifted preferably by 90°. Second UFD module 5424 inputs "Q" oscillating signal 5436. Second UFD module 5424 comprises at least one UFT module 5432. In an embodiment, second UFD module 5424 is structured similarly to UFD module 5300 of FIG. 53, with "Q" oscillating signal 5436 substituting for oscillating signal 5316. Second UFD module 5424 frequency down-converts and demodulates received signal 5416 to down-converted "Q" signal 5440 according to "Q" oscillating signal 5436. Down-converted "Q" signal 5440 may be an information signal with two possible states or voltage levels (QPSK), or with more than two possible states or voltage levels (QAM).
>
> Down-converted "I" signal 5438 is optionally amplified by first optional amplifier 5404 and optionally filtered by first

optional filter 5406, and a first information output signal 5418 is output.

Down-converted "Q" signal 5440 is optionally amplified by second optional amplifier 5408 and optionally filtered by second optional filter 5410, and a second information output signal 5420 is output.

Ex. 1001, 43:1–42.

Figures 20A and 20A-1 are reproduced below:

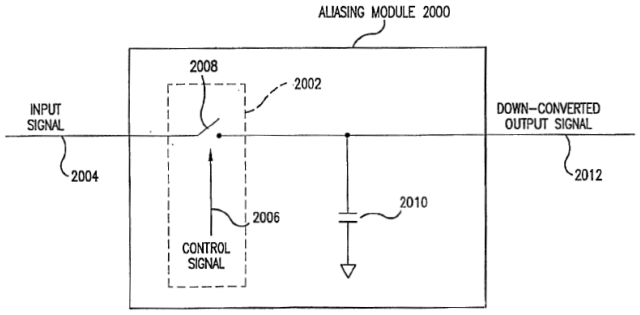


FIG. 20A

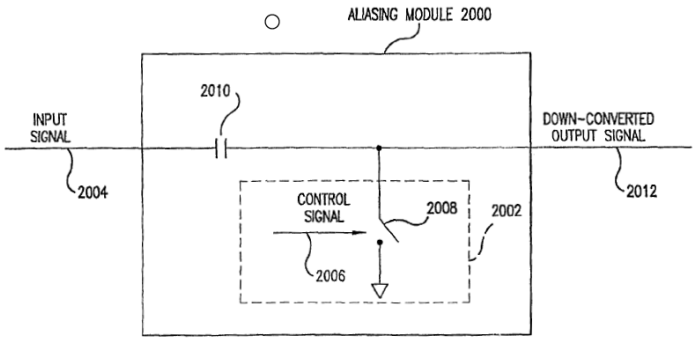


FIG. 20A-1

Figures 20A and 20A-1 are exemplary aliasing modules. Ex. 1001, 3:21–22.

The '835 patent explains that Figures 20A and 20A-1 illustrate "aliasing module 2000 for down-conversion using a [UFT] module 2002 which down-converts an [electromagnetic ("EM")] input signal 2004." Ex. 1001, 6:66–7:2. The '835 patent further provides that

> [i]n particular embodiments, aliasing module 2000 includes a switch 2008 and a capacitor 2010. The electronic alignment of the circuit components is flexible. That is, in one implementation, switch 2008 is in series with input signal 2004 and capacitor 2010 is shunted to ground (although it may be other than ground in configurations such as differential mode). In a second implementation (see FIG. 20A-1), capacitor 2010 is in series with input signal 2004 and switch 2008 is shunted to ground (although it may be other than ground in configurations such as differential mode). Aliasing module 2000 with UFT module 2002 can be easily tailored to down-convert a wide variety of electromagnetic signals using aliasing frequencies that are well below the frequencies of EM input signal 2004.

Id. at 7:2–14.

The '835 patent states that "[t]he down-conversion of an EM signal by aliasing the EM signal at an aliasing rate is fully described in . . . U.S. Pat[ent] No. 6,061,551 [('the '551 patent')], the full disclosure of which is incorporated herein by reference." Ex. 1001, 6:56–61. And, the '835 patent further states that "[a]dditional details pertaining to UFD module 5300 are contained in" the '551 patent.[14] *Id.* at 42:37–42.

F. Illustrative Claim

Claim 1, the sole independent claim challenged in this proceeding, is illustrative of the claimed subject matter and is reproduced below with Petitioners' bracketing added for reference:

> 1. [1pre] A cable modem for down-converting an electromagnetic signal having complex modulations, comprising:
>
> [1A] an oscillator to generate an in-phase oscillating signal;

[14] The '551 patent is Exhibit 2027 in this proceeding.

> [1B] a phase shifter to receive said in-phase oscillating signal and to create a quadrature-phase oscillating signal;
>
> [1C] a first frequency down-conversion module to receive the electromagnetic signal and said in-phase oscillating signal;
>
> [1D] a second frequency down-conversion module to receive the electromagnetic signal and said quadrature-phase oscillating signal; wherein
>
> [1E] said first frequency down-conversion module further comprises a first frequency translation module [1F] and a first storage module, [1G] wherein said first frequency translation module samples the electromagnetic signal at a rate that is a function of said in-phase oscillating signal, thereby creating a first sampled signal; and
>
> [1H] said second frequency down-conversion module further comprises a second frequency translation module [1I] and a second storage module, [1J] wherein said second frequency translation module samples the electromagnetic signal at a rate that is a function of said quadrature-phase oscillating signal, thereby creating a second sampled signal.

Ex. 1001, 51:5–29.

G. Level of Ordinary Skill in the Art

Petitioners, supported by Dr. Shoemake's testimony, propose that a person of ordinary skill in the art at the time of the invention would have had "at least a bachelor's degree in electrical engineering or a related subject, and two or more years of experience in communication system design, signal processing and/or analog and RF circuit design." Pet. 50 (citing Ex. 1002 ¶¶ 31–36). Petitioners explain that "[l]ess work experience may be compensated by a higher level of education, such as a master's degree." *Id.* (citing Ex. 1002 ¶¶ 31–36).

In the Institution Decision, we noted that Patent Owner had not expressed a position on the level of ordinary skill in the art in the Preliminary Response, and, based on the preliminary record, we adopted Petitioners' unopposed position, finding it consistent with the level of ordinary skill in the art reflected by the '835 patent and the prior art of record. Inst. Dec. 10–11 (citing *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001); *In re GPAC Inc*., 57 F.3d 1573, 1579 (Fed. Cir. 1995); *In re Oelrich*, 579 F.2d 86, 91 (CCPA 1978)).

In the Patent Owner Response, Patent Owner, supported by Dr. Steer's testimony, proposes that a person of ordinary skill in the art at the time of the invention would have had

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

PO Resp. 4 (citing Ex. 2038 ¶ 24). Neither Patent Owner nor Dr. Steer explains why their proposal materially differs from that proposed by Petitioners.

Patent Owner's option (a) is substantially the same as Petitioners' proposal—both require a bachelor's degree in the same or a related subject and two additional years of related work experience. Patent Owner's option (b) adds an additional option based on work experience in lieu of a formal degree.

Neither party contends that the difference in their proposals affects the outcome of this proceeding and we do not find that it does. Nonetheless, on

the full record before us, we find that our identification of the level of ordinary skill in art in the Institution Decision as well as Patent Owner's option (b) are supported by the prior art of record, the '835 patent, and the opinion of Dr. Steer. Accordingly, we modify our preliminary finding to include option (b) from Patent Owner's proposal. Thus, we find that one of ordinary skill in the art would have had at least a bachelor's degree in electrical engineering or a related subject and two or more years of experience in the field of RF circuit design, or at least five years of work experience and training in the design and development of RF circuits and/or systems. We also find that less work experience may be compensated by a higher level of education, such as a master's degree.

II. CLAIM CONSTRUCTION

In this *inter partes* review, claims are construed using the same claim construction standard that would be used to construe the claims in a civil action under 35 U.S.C. § 282(b). *See* 37 C.F.R. § 42.100(b) (2020). The claim construction standard includes construing claims in accordance with the ordinary and customary meaning of such claims, as would have been understood by one of ordinary skill in the art at the time of the invention. *See id.*; *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–14 (Fed. Cir. 2005) (en banc). In construing claims in accordance with their ordinary and customary meaning, we take into account the specification and prosecution history. *Phillips*, 415 F.3d at 1315–17.

If the specification "reveal[s] a special definition given to a claim term by the patentee that differs from the meaning it would otherwise possess[,] . . . the inventor's lexicography governs." *Phillips*, 415 F.3d at 1316 (citing *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366

(Fed. Cir. 2002)). Another exception to the general rule that claims are given their ordinary and customary meaning is "when the patentee disavows the full scope of a claim term either in the specification or during prosecution." *Uship Intellectual Props., LLC v. United States*, 714 F.3d 1311, 1313 (Fed. Cir. 2013) (quoting *Thorner v. Sony Computer Entm't Am., LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012)).

Additionally, only terms that are in controversy need to be construed, and these need be construed only to the extent necessary to resolve the controversy. *See Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (holding that "only those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy"); *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (citing *Vivid Techs.* in the context of an *inter partes* review).

A. "storage module"

In the Institution Decision, we did not construe any claim terms expressly because none of the terms were in dispute. Inst. Dec. 10 (citation omitted). In the briefing following institution, Patent Owner proposed a construction for the term "storage module," *see, e.g.*, PO Resp. 46–50, and it became clear that the parties dispute the meaning of the term. Additionally, because many of Patent Owner's arguments hinge on the meaning of this term, its proper construction is important to address the issues presented in this proceeding. Further, the parties' arguments rely, almost exclusively, on disclosures in the '551 patent, incorporated by reference into the '835 patent. *Id.* at 49–50; Pet. Reply 7–9.

In the final written decision in IPR2020-01265 (Ex. 2037), we construed the term "storage element," relying on its use in the '551 patent. Because "storage module" is synonymous with "storage element," our prior construction of "storage element" is relevant to our consideration of "storage module." In IPR2020-01265, after considering the parties' extensive arguments as well as prior constructions in related district court litigation, we construed "storage element" to mean "an element of a system that stores non-negligible amounts of energy from an input EM signal." Ex. 2037, 41. Critical to that determination was the finding that the patentees acted as their own lexicographers by defining the systems to which "storage modules" *refer to*. Specifically, we explained that the '551 patent expressly states "[s]torage modules and storage capacitances, on the other hand, *refer to* systems that store non-negligible amounts of energy from an input EM signal." *Id.* at 36 (emphasis added) (citing '551 patent,[15] 66:59–67). Additionally, we also explained that in a prior proceeding challenging claims of the '551 patent before the Board—IPR2014-00948—Patent Owner represented that the '551 patent "*provides an explicit definition*" and "*explicitly defines a storage module*." *Id.* at 39 (citing Ex. 1032[16], 21). We found that "Patent Owner's acknowledgement that the '551 patent provides an explicit definition of 'storage module' directly supports our determination that the patentees acted as lexicographers." *Id.* at 40.

[15] In IPR2020-01265, the '551 patent was Exhibit 2007.
[16] Exhibit 1032 from IPR2020-01265 is Patent Owner's Preliminary Response (Paper 7) from IPR2014-00948, which was not filed as an exhibit in this proceeding.

In this proceeding, in addition to raising substantially the same arguments addressed in IPR2020-01265, Patent Owner submitted a Claim Construction Order and Memorandum in Support Thereof from *ParkerVision, Inc. v. LG Electronics, Inc.*, No. 6:21-cv-00520-ADA (W.D. Tex. June 21, 2022) (Doc. 55) (Ex. 2039), and a Special Master's Report and Recommendation Regarding Claim Construction from *ParkerVision, Inc. v. Hisense Co.*, No. 6:20-cv-00870-ADA (W.D. Tex. Aug. 29, 2022) (Doc. 72) (Ex. 2042).[17] Each of these claim construction decisions construes "storage module" to mean "a module of an energy transfer system that stores non-negligible amounts of energy from an input electromagnetic signal." Ex. 2042, 33; *see* Ex. 2039, 16 (district court declining to modify its previous construction of "storage module," which was limited to an "energy transfer system"). In so determining, each of the district court's decisions finds that the patentees did not act as their own lexicographers. *See* Ex. 2039, 19; Ex. 2042, 32. Patent Owner advocates that we adopt the same construction here. PO Resp. 47–50.

Petitioners assert that "[u]nder any reasonable construction of the term, a capacitor constitutes a 'storage module.'" Pet. Reply 6 (citing Ex. 1002 ¶¶ 118–119). Petitioners rely on claim 4 of the '835 patent, which depends indirectly from claim 1 and recites that "said first storage

[17] Patent Owner also submitted the same Special Master's Report and Recommendation Regarding Claim Construction from *ParkerVision, Inc. v. TCL Industries Holdings Co.*, No. 6:20-cv-00945-ADA (W.D. Tex. Aug. 29, 2022) (Doc. 68) (Ex. 2041).

[module[18]] ***is a first capacitor***." *Id.* at 6 n.2. Nonetheless, "Petitioners do not object to adoption of the Board's construction for 'storage module' from IPR2020-01265 here." *Id.* at 7.

We have reviewed and considered the district court's construction (which limits "storage module" to an "energy transfer system"), but we are not persuaded that our construction from IPR2020-01265 should be altered. We expressly adopt and incorporate by reference our analysis from IPR2020-01265 and do not repeat it in full here. We do, however, take this opportunity to provide additional reasoning in support of our prior determination based on the arguments and evidence presented in this proceeding.

The '551 patent provides the following, which formed the focal point of Patent Owner's argument in IPR2014-00948 and which we found provides a lexicographic definition of "storage module"/"storage element" in IPR2020-01265:

> The terms storage module and storage capacitance, *as used herein*, are distinguishable from the terms holding module and holding capacitance, respectively. Holding modules and holding capacitances, as used above, identify systems that store negligible amounts of energy from an under-sampled input EM signal with the intent of "holding" a voltage value. Storage modules and storage capacitances, on the other hand, *refer to* systems that store non-negligible amounts of energy from an input EM signal.

[18] Although claim 1 recites a "first storage module" and a "second storage module," dependent claim 3 refers to "said first storage device" and "said second storage device," thus resulting in claim 4 referring to "said storage device" instead of "said storage module." Ex. 1001, claims 1, 3, 4. Because "storage device" is not recited in claim 1 (or claim 3), we understand that claim 4 refers to the first and second storage modules recited in claim 1.

Ex. 2027, 66:59–67 (emphases added); *see* Ex. 2037, 39–40 (discussing Patent Owner's prior arguments to construe "storage module" in IPR2014-00948). When defining certain terms in a section titled "General Terminology," the '551 patent repeatedly uses the phrase "when used herein" in combination with the phrase "refer(s) to." *See, e.g.*, *id.* at 13:56–15:27 (mentioning a term followed by "when used herein," followed by "refers to," followed by a definition). For example, the '551 patent states, "[t]he term digital signal, when used herein, refers to a signal that changes between discrete states, as contrasted to a signal that is continuous." *Id.* at 15:7–9. As shown, the '551 patent defines "digital signal" by stating "when used herein" followed by "refers to." And, the same sentence also provides a comparison between "digital signal" and a signal that is continuous. Even though the passage describing "storage module" is not listed under the "General Terminology" section of the '551 patent, the passage provides the same indications that the patentees clearly and unambiguously intended to define the term "storage module" by stating "as used herein" and "refer to"—hallmarks that the patentees were providing a lexicographic definition of the term. *Vasudevan Software, Inc. v. MicroStrategy, Inc.*, 782 F.3d 671, 679 (Fed. Cir. 2015) ("An applicant's use of the phrase 'refers to' generally indicates an intention to define a term.") (citing *In re Imes*, 778 F.3d 1250, 1252–53 (Fed. Cir. 2015); *Microsoft Corp. v. Int'l Trade Comm'n*, 731 F.3d 1354, 1360 (Fed. Cir. 2013); *Linear Tech. Corp. v. Int'l Trade Comm'n*, 566 F.3d 1049, 1054 (Fed. Cir. 2009)). Additionally, as with the term "digital signal," the above-passage provides a comparison between "storage module" and "holding module" and uses the definitions of the terms to compare and contrast them.

"To act as its own lexicographer, a patentee must 'clearly set forth a definition of the disputed claim term' other than its plain and ordinary meaning." *Thorner v. Sony Computer Entm't Am. LLC*, 669 F.3d 1362, 1366 (Fed. Cir. 2012) (citing *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002)). "It is not enough for a patentee to simply disclose a single embodiment or use a word in the same manner in all embodiments, the patentee must 'clearly express an intent' to redefine the term." *Id.* (citing *Helmsderfer v. Bobrick Wasroom Equip., Inc.*, 527 F.3d 1379, 1381 (Fed. Cir. 2008); *Kara Tech. Inc. v. Stamps.com*, 582 F.3d 1341, 1347–48 (Fed. Cir. 2009)). That is precisely what the patentees did in the above-passage. Specifically, we find that they clearly set forth a definition that is different than the plain and ordinary meaning and, in so doing, clearly expressed an intent to redefine the term. That the patentees intended to redefine the term "storage module" is clearly expressed by the use of "as used herein"[19] and "refers to" in the above-passage and is consistent with the patentees' use of these same phrases when defining other terminology in the '551 patent, as discussed above.

We also do not agree with Patent Owner's argument that this passage in the '551 patent does not provide a lexicographic definition for at least two reasons. First, in arguing the construction of "cable modem," discussed further below, Patent Owner points to the following from the '835 patent specification: "Cable Modems *refer to* modems that communicate across ordinary cable TV [television] network cables" (Ex. 1001, 36:19–20 (emphasis added)); and Patent Owner argues that "we just used *the same*

[19] There is no substantive difference between the phrase "when used herein" and "as used herein."

definition that was in the spec. . . . We just took *the same exact definition from the spec*" (Tr. 83:16–20 (emphases added)). In other words, Patent Owner's acknowledgement that the '835 patent provides a definition of the term "cable modem" undermines Patent Owner's argument that the patentees did not define "storage module" even though the patentees used *the same phrase* "refer(s) to."

Second, Patent Owner has absolutely no (even remotely) colorable explanation as to why it repeatedly argued, in IPR2014-00948, that the '551 patent "*provides an explicit definition*" and "*explicitly defines a storage module*." *See* Ex. 2037, 39–40 (discussing Patent Owner's prior arguments to construe "storage module" in IPR2014-00948). The only plausible explanation is that Patent Owner has simply changed positions to suit its current litigation strategy. But, that is not how claim construction works. There either *is* a lexicographic definition or there *is not*, regardless of the claim construction standard applied (i.e., whether applying the broadest reasonable interpretation or the same claim construction standard for construing claims in a civil action under 35 U.S.C. § 282(b)). In IPR2014-00948, Patent Owner argued that there was a lexicographic definition and emphasized the same exact statements in the above-passage from the '551 patent. That passage has not changed and provides definitive confirmation of the patentees' intent to provide a lexicographic definition of "storage module" for the reasons discussed above.[20]

[20] None of the district court claim construction decisions address Patent Owner's representations, in IPR2014-00948, that the '551 patent explicitly defines "storage module." *See generally* Exs. 2039, 2042.

In its Sur-reply, Patent Owner argues that the above-passage from the '551 patent "is comparative, *not* definitional." PO Sur-reply 4. We agree that it is comparative, but it is *also definitional*. These are not mutually exclusive concepts. And, the above-discussion reflects that the '551 patent defines other terms by providing a definition *and* comparing that definition to definitions of other terms.

Accordingly, for the reasons explained in detail in the Board's final written decision in IPR2020-01265 and as further explained above, we find that the patentees clearly and unmistakably set forth a definition of "storage module" in the incorporated '551 patent, and, therefore, we construe "storage module" to mean "a module of a system that stores non-negligible amounts of energy from an input EM signal."

B. "cable modem"

Petitioners identify "cable modem," as recited in the preamble of claim 1, as a term for potential construction. Pet. 31–32. Petitioners contend,

> if the preamble is limiting and if the Board finds it necessary to construe "cable modem" to resolve this IPR, the Board should find that any modem that can be used to down-convert modulated signals from a TV network is a "cable modem," regardless of whether the modem is wired or wireless, and regardless of whether it complies with any cable data standard.

Id. (citing Ex. 1002 ¶ 113).

Patent Owner contends that the "specification specifically states that a 'cable modem' 'refers to [a] modem[] that communicate[s] across ordinary cable TV network cables.'" PO Resp. 51 (alterations by Patent Owner) (quoting Ex. 1001, 36:19–20). Patent Owner asserts that "[t]he specification distinguishes a cable modem from a data modem, which communicates

across telephone lines." *Id.* (citing Ex. 1001, Figs. 45A, 45B, 36:20–25, 36:61–63). Thus, Patent Owner argues that "what makes a modem a 'cable' modem relates to the type of physical transmission line/cabling over which data is ultimately transmitted." *Id.* Patent Owner contends that Petitioners' construction "focuses on the type of network (TV network) over which data is transmitted," which "is inconsistent with the specification." *Id.* (citing Pet. 32). Nonetheless, despite "cable modem" appearing in the preamble of claim 1, Patent Owner does not provide any argument or analysis of whether the preamble is, in fact, limiting. *See generally* PO Resp.; *see also* PO Sur-reply.

In their Reply, Petitioners contend that "cable modem" is not limiting because it "is non-essential and does not give life or meaning to the structurally complete body of claim 1." Pet. Reply 14. Petitioners assert that, in related litigation, Patent Owner did not contend that the term was limiting and took the litigation position that certain WiFi chips in TVs are "cable modems" "even though Wi-Fi chips obviously have no physical transmission line or cabling." *Id.* (citing Ex. 2002 ¶ 112; Ex. 2001 ¶ 90).

Petitioners assert the following:

> The portion of the preamble that includes the phrase "[a] cable modem" does not provide antecedent basis for any later term in claim 1. Nor does cable modem provide any "essential structure," as the remainder of the claim recites a structurally complete invention, and the term "cable modem" does not give life, meaning, and vitality to the claim. . . . More specifically, if "cable modem" was deleted from the preamble or replaced with a generic word like "device," the body of the claims would still define a structurally complete apparatus that down-converts by using an oscillator, a phase shifter, a first frequency down-conversion module, and a second frequency down-conversion module. . . . Indeed, the '835 specification describes the

> combination of these components as a stand-alone device ("Receiver 5400"), which is "applicable to any of the applications described in any of the sections" in the specification. Ex. 1001 at 48:11-20, 42:43-43:57, Figures 52, 54B; Pet. at 26.

Pet. Reply 15. Additionally, Petitioners contend that "cable modem" states an intended use because it is "just one of the many 'exemplary applications' that can use the purported invention." *Id.* at 16 (citing Ex. 1001, 5:11–59, 21:55–22:7, 23:20–24:2, 48:11–20, 48:34–39, 49:6–12, 49:38–42, 50:1–5, 50:13–23). And, the '835 patent states that "[t]hese applications and embodiments are *not intended to limit the invention*." *Id.* (alteration by Petitioners) (quoting Ex. 1001, 50:14–15) (citing Ex. 1001, 23:55–24:2, 50:13–25). Petitioners further note that the district court, in the litigation between Patent Owner and LG, found that "cable modem" recited in the preamble of claim 1 was not limiting. *Id.* (citing Ex. 1021 (Court's Preliminary Constructions)[21]).

Petitioners argue that, "[i]f the Board finds that 'cable modem' is limiting, a cable modem in the limited context of the '835 patent can be used to communicate with a cable TV network using a cable or wirelessly." Pet. Reply 16 (citing Ex. 1001, 36:19–25, 36:50–56, 37:24–30, Fig. 45B). Petitioners note that "the invention 'is not limited to' the DOCSIS standard, as it can be used with 'additional standards' (*e.g.*, ITU-T J.83b) and can also be used in 'non-standard configurations.'" *Id.* at 16–17 (citing Ex. 1001, 38:28–34). Thus, Petitioners assert that, if the preamble is limiting, we

[21] The district court's final claim construction was filed after Petitioners' Reply, but maintains the court's preliminary finding that "cable modem" is not limiting. Ex. 2039 (Claim Construction Order and Memorandum in Support Thereof) (Doc. 55), 24.

should find that "any device that can be used to down-convert modulated signals from a TV network is a 'cable modem' in the context of the '835 patent whether the device has a cable or is wireless, and regardless of whether it complies with any standard." *Id.* at 17 (citing Ex. 1002 ¶ 113).

Patent Owner does not address whether "cable modem" is limiting or its construction in the Sur-reply. *See generally* PO Sur-reply.

"Generally . . . the preamble does not limit the claims." *Am. Med. Sys., Inc. v. Biolitec, Inc.*, 618 F.3d 1354, 1358 (Fed. Cir. 2010). A term in the preamble is a limitation only if it "recites essential structure or steps, or if it is 'necessary to give life, meaning, and vitality' to the claim." *TomTom, Inc. v. Adolph*, 790 F.3d 1315, 1323 (Fed. Cir. 2015).

We agree with Petitioners that "cable modem," as recited in the preamble of claim 1, is not limiting. In particular, "cable modem" does not provide antecedent basis for any term subsequently recited in claim 1, it does not provide any essential structure because the body of the claim recites a structurally complete invention, and "cable modem" is not necessary to give life, meaning, and vitality to the claim. Further, Patent Owner fails to raise any arguments on these issues to the contrary. Accordingly, for each of these reasons, we find that "cable modem" is not limiting.

Because "cable modem" is not limiting, we need not construe it expressly to resolve the present dispute between the parties.[22] *See Nidec Motor Corp.*, 868 F.3d at 1017 (recognizing that only those terms in controversy need be construed and only to the extent necessary to resolve the controversy).

C. "frequency translation module"

Petitioners present "frequency translation module" for construction, but it appears that Petitioners do so because of the possibility that 35 U.S.C. §112, ¶ 6 may apply. *See* Pet. 32 ("To the extent it is argued or determined that 35 U.S.C. § 112(6) applies . . . ."); *see* 37 C.F.R. § 42.104(b)(3) ("Where the claim to be construed contains a means-plus-function or step-plus-function limitation . . . , the construction of the claim must identify the specific portions of the specification that describe the structure, material, or acts corresponding to each claimed function.").

Patent Owner contends that 35 U.S.C. § 112, ¶ 6 does not apply. PO Resp. 51–52. Petitioners do not address the construction of "frequency translation module" in their Reply (*see generally* Pet. Reply) and Patent Owner does not address the issue in its Sur-reply (*see generally* PO Sur-reply).

[22] During oral argument, Patent Owner raised a new argument, not previously raised in its briefing, that because dependent claim 17 recites "cable modem" in the body of the claim, the construction of the term was still relevant and necessary to resolve Petitioners' challenges to that claim. *See* Tr. 79:21–80:15. As explained further herein, we find that Patent Owner waived any argument specifically directed to dependent claim 17 and its recitation of "cable modem" by not raising that argument in its Patent Owner Response. *See* Paper 15 (Scheduling Order), 8 ("Patent Owner is cautioned that any arguments not raised in the response may be deemed waived.").

On the full record, it is not clear whether the parties actually dispute the construction of "frequency translation module," but that is inapposite because none of the parties' arguments nor the outcome of this proceeding hinge on the construction of this term. Accordingly, we need not construe it expressly to resolve the present dispute between the parties. *See Nidec Motor Corp.*, 868 F.3d at 1017.

III. ANALYSIS

A. Legal Standards – Obviousness

The U.S. Supreme Court set forth the framework for applying the statutory language of 35 U.S.C. § 103 in *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 17–18 (1966):

> Under § 103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background, the obviousness or nonobviousness of the subject matter is determined. Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented.

The Supreme Court explained in *KSR International Co. v. Teleflex Inc.* that

> [o]ften, it will be necessary for a court to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue. To facilitate review, this analysis should be made explicit.

550 U.S. 398, 418 (2007) (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) ("[R]ejections on obviousness grounds cannot be sustained by mere

conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.")).

"Whether an ordinarily skilled artisan would have been motivated to modify the teachings of a reference is a question of fact." *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1327 (Fed. Cir. 2016) (citations omitted). "[W]here a party argues a skilled artisan would have been motivated to combine references, it must show the artisan 'would have had a reasonable expectation of success from doing so.'" *Arctic Cat Inc. v. Bombardier Recreational Prods. Inc.*, 876 F.3d 1350, 1360–61 (Fed. Cir. 2017) (quoting *In re Cyclobenzaprine Hydrochloride Extended-Release Capsule Patent Litig.*, 676 F.3d 1063, 1068–69 (Fed. Cir. 2012)).

B. Obviousness over Hulkko and Gibson, and Alternatively Hulkko, Gibson, Goldberg, Thacker, ITU-T J.83b, and/or AAPA

Petitioners assert the combination of Hulkko and Gibson, and alternatively the combination of Hulkko, Gibson, Goldberg, Thacker, ITU-T J.83b, and/or AAPA, would have rendered the subject matter of claims 1, 12, 15, and 17 obvious to one of ordinary skill in the art at the time of the invention.[23] Pet. 43–46 (discussing motivation to combine Hulkko and Gibson), 47–50 (discussing motivation to "use the modem[] of Hulkko modified with Gibson" as "cable modems" in view of Goldberg, Thacker,

[23] Petitioners refer to Goldberg and Thacker together as "the DOCSIS References." Pet. 52.

ITU-T J.83b, and/or AAPA), 50–67 (discussing the application of the art to the claims).[24]

1. Level of Ordinary Skill in the Art

The level of ordinary skill in the art is set forth above. *See supra* § I.G.

2. Scope and Content of the Prior Art

a. Hulkko

Hulkko is directed to demodulation of an intermediate frequency signal by a sigma-delta converter. Ex. 1004, code (54). More particularly, Hulkko teaches "a receiver for receiving a modulated carrier signal comprising, a sigma-delta signal converter having at least one adder included in a feedback loop, characteri[z]ed in that the arrangement comprises a time discrete sampling means for down converting the modulated carrier signal prior to the feedback loop." *Id.* at 2:31–37. Figure 2 is reproduced below:

[24] As discussed *infra* (*see* § III.B.3.a.i), we do not address Petitioners' alternative challenge based on Hulkko, Gibson, Goldberg, Thacker, ITU-T J.83b, and/or AAPA because we do not find that the recitation of "cable modem" in the preamble of claim 1 is limiting. *See* Pet. 17 (presenting this alternative ground "if the Board finds that the preamble of claim 1 is limiting—and thus requires a 'cable modem'"); *see also SAS Inst. v. Iancu*, 138 S. Ct. 1348, 1359 (2018) (holding that a petitioner "is entitled to a final written decision addressing all of the claims it has challenged"); *Boston Sci. Scimed, Inc. v. Cook Grp. Inc.*, 809 F. App'x 984, 990 (Fed. Cir. 2020) (nonprecedential) (stating that the "Board need not address issues that are not necessary to the resolution of the proceeding," such as "alternative arguments with respect to claims [the Board] found unpatentable on other grounds").

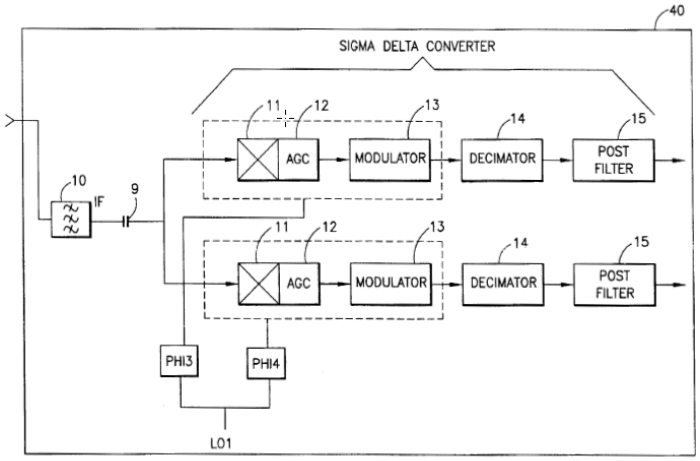


FIG.2

Figure 2 is a block diagram of a sigma-delta converter included in a receive arrangement. Ex. 1004, 3:33–35.

Hulkko explains the following regarding Figure 2:

> The receive arrangement of an embodiment of the invention is illustrated in FIG. 2 using a sigma-delta analog-digital converter with a large dynamic input range in which a mixer 11 is implemented using switched capacitor switching elements 30–39 illustrated in FIG. 4. The receive arrangement of this embodiment receives radio signals for a radio telephone 40. The switched capacitor switching elements providing the mixing function of the mixer 11 are driven by a square wave local oscillator signal (LO1) at (or near) the frequency of the [intermediate frequency ("IF")] signal. Both the mixer and the local oscillator signal are digital. Switched capacitor switching elements are also provided to implement an automatic gain controller (AGC) 12 providing an automatic gain control function for the circuit. The receive arrangement includes a bandpass filter 10, and each branch further includes a modulator 13 that converts signals from analog signals to digital signals, a decimator 14 and a post filter 15 which perform the same functions as the correspondingly named portions of the prior art receive arrangement illustrated in FIG. 1. The prefiltering of the signal (after modulation) can be designed to freely correspond to the design demands of the respective circuit and the dc-deviation of the sigma-delta

converter can be corrected using the internal, digital correction of deviations.

The phase and frequency details for the local oscillator signals provided to the respective branches are as follows:

PHI3=+45°

PHI4=-45°

LO1=IF

A base-frequency output signal is obtained from the modulator after the decimator and the low-pass filter which can be processed to retrieve the modulating information. Because the signal entering the sigma-delta converter arrangement is an IF signal, only a short time-constant capacitor 9 is necessary for preventing dc signals from transferring to the sigma-delta converter. This means that the device can be powered up and down more quickly and as less power is required to power up, short term power downs are practical making the arrangement more power efficient than conventional receive arrangements.

Ex. 1004, 3:48–4:20.

Further referring to Figure 2, Hulkko states that

the inventive idea is realized in the circuit arrangement of this embodiment of the invention in accordance with which switched capacitor switching elements present in the input stage of a sigma-delta converter are used to implement the mixer 11 which directly demodulates the IF-signal into a base-frequency signal; in other words, the IF-signal and its multiples are folded on the base frequency.

Id. at 5:39–46.

Hulkko's Figure 4 is reproduced below:

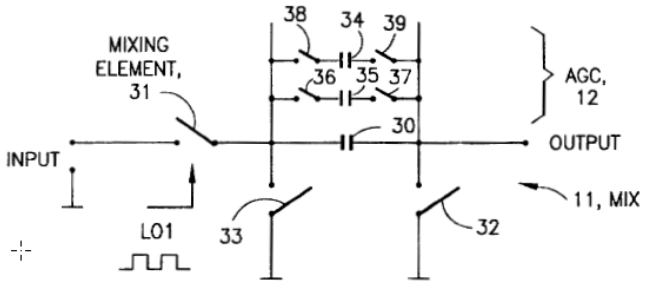


FIG.4

Figure 4 is a schematic representation of a switched capacitor switching element suitable for implementing the mixing and automatic gain control functions of the sigma-delta converter of Figure 2. Ex. 1004, 3:41–44.

Hulkko explains that Figure 4 "shows the input stage of the receive arrangement . . . of FIG. 2 showing switched capacitor switching elements of the mixer 11 and the AGC 12 in greater detail." Ex. 1004, 4:61–64. Hulkko discloses that

> [a] first capacitor 30 is used to sample end [sic] hold the incoming signal. First switches 31, 32 are closed to provide a sample to the first capacitor 30. Once the input signal has been sampled, a third switch 33 is closed to transfer the charge on the first capacitor 30 to the output. Second and third (and possibly further) capacitors 34, 35 are provided in parallel with the first capacitor 30. These are each controllably connected to the input and output through a pair of switches 36, 37; 38, 39. By closing the appropriate switches and adding parallel capacitance from one or more of the second and third capacitors 34, 35 the signal transfer ratio can be changed. The switches are under the control of an external cpu and can be used to replace automatic gain control steps of the circuit as a whole. In this way amplification steps can be included in the sigma-delta modulator by altering the ratios of the input capacitances.

Id. at 4:64–5:12. Hulkko further explains that "mixer 11 can be considered as a sample and a hold circuit that samples the input signal in synchronization with the oscillator and directs the samples to the output as a signal which remains constant for the period of the sampling interval." *Id.* at 5:13–17.

b. Gibson

Gibson is directed to "a data receiver including quadrature mixers having outputs coupled by signal paths to a coherent data de-modulator, wherein correction of carrier phase errors is effected after the outputs from the mixers have been pass filtered." Ex. 1005, 1:35–40. Figure 1 is reproduced below:

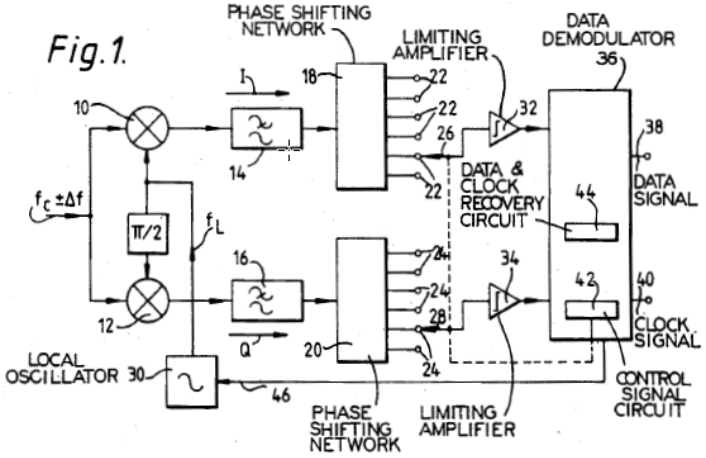


Figure 1 is a block schematic circuit of a data receiver. Ex. 1005, 2:44–46.

Regarding Figure 1, Gibson explains that

> a signal, which may be a frequency modulated, differentially encoded input signal $f_c \pm \Delta f$ is applied to quadrature mixers 10, 12 to which a frequency f_L, substantially equal to carrier frequency f_c, is applied from a local oscillator 30. The outputs of the mixers 10, 12 are filtered in low pass filters 14, 16 which will pass the modulation frequency Δf. In an alternative arrangement, not shown, the low pass filters 14, 16 may be omitted and the low pass filtering is done in the mixers 10, 12.

> Thus in the in-phase channel I the signal is $+\Delta f$ or $-\Delta f$ and in the quadrature channel Q the signal is $+\Delta f - \pi/2$ or $-\Delta f - \pi/2$. By the way of example, f_c may be 900 MHz and the deviation frequency Δf would be a quarter of the bit rate, e.g. for a bit rate of 16 Kb/s Δf is 4 kHz.

Ex. 1005, 2:56–3:2.

c. Goldberg

Goldberg is an article directed to the introduction of "the BCM3220 multimedia cable networking systems/Data-Over-Cable-Service Interface Specification (MCNS/DOCSIS) compliant media-access controller (MAC) chip." Ex. 1007, 4. Goldberg describes the DOCSIS, explaining that it "is designed to employ one or more unused video channels within the 54-to-860-MHz cable broadcast spectrum to transmit IP-based data across hybrid fiber coaxial networks." *Id.* at 4–5. Goldberg states that "[d]epending on the bit rate selected by the operator, the shared downstream channel uses either 64- or 256-point quadrature-amplitude modulation (QAM)." *Id.* at 5. Figures 1 and 2 of Goldberg, although not reproduced herein, show Broadcom's BCM3220 MAC chip and illustrate use of Broadcom's BCM3116 QAM receiver and the BCM3037 QPSK/16-QAM modulator. *Id.* Goldberg predicts that "Broadcom's first silicon implementation of the DOCSIS standard will surely give rise to a first generation of low-cost, interoperable cable modems." *Id.* at 8.

d. Thacker

Thacker is directed to "broadband multimedia data distribution systems, and more particularly, to [an] apparatus for integrating satellite broadband data distributed over a cable TV network with legacy corporate local area networks." Ex. 1008, 1:7–11. Thacker explains that "the Institute

of Electronic and Electrical Engineering's (IEEE) 802.14 Cable TV Media Access Control and Physical Protocol Working Group" developed the IEEE 802.14 standard, which "supports the International Telecommunications Union's (ITU) J.83 Annex A, B and C standards for 64/256 QAM modulation." *Id.* at 1:22–24, 1:52–54.

e. ITU-T J.83b

The International Telecommunication Union, Telecommunication Standardization Sector, describes the J.83b standard for "[d]igital multi-programme systems for television, sound and data services for cable distribution," including QAM television. *See* Ex. 1009, 1, 5 (indicating that Annex B describes the 64- and 256-QAM specifications).

f. AAPA

As AAPA, Petitioners rely on a portion of the '835 patent that describes several well-known devices for implementing the cable modem receivers, transmitters, and transceivers. In particular, Petitioners rely upon the following disclosure:

> The cable modem receivers, transmitters, and transceivers of the present invention may be implemented using a variety of well[-]known devices. In embodiments, these receivers, transmitters, and/or transceivers may be implemented by a BCM3415 CMOS Digital Cable Tuner, a BCM3125 QAM-Link™ Universal Set-Top Box Transmission Solution, a BCM3120-Set-Top Box Transceiver, a BCM3116-QAMLink™ 64/256-QAM ITU-B Receiver, a BCM3118B-QAMLink™ 64/256-QAM DVB/DAVIC Receiver, a BCM3115-QAMLink™ 64/256-QAM Dual-Channel Receiver, a BCM3037-QAMLink™ QPSK/16-QAM Burst Modulator, a BCM3033-QAMLink™ Universal Modulator, a BCM3137-QAMLink™ QPSK/16-QAM Burst Demodulator, a BCM3360 QAMLink™ Single-Chip MCNS/DOCSIS Cable Modem, a

> BCM93310 DOCSIS External Cable Modem, a BCM93310i DOCSIS Internal PCI Cable Modem, and/or a BCM3300-QAMLink™ Single-Chip MCNS/DOCSIS Cable Modem, manufactured by Broadcom™ Corporation.

Ex. 1001, 40:17–35.

3. Differences Between the Prior Art and the Claims; Motivation to Modify

a. Claim 1

i. Element [1pre]

Element [1pre] recites "[a] cable modem for down-converting an electromagnetic signal having complex modulations, comprising." Ex. 1001, 51:5–6. Petitioners assert that "Hulkko discloses a modem for down-converting an electromagnetic signal having complex modulations." Pet. 51 (citing Ex. 1004, Fig. 2, 2:38–40). Petitioners contend that,

> [t]o the extent that the preamble is limiting and the electromagnetic signal must have "complex modulations," Hulkko discloses complex modulations because the invention works with "QAM" modulation and "an I/Q modulated signal," all of which were complex modulation formats within the general knowledge of a [person of ordinary skill in the art] at the time.

Id. at 51–52 (citing Ex. 1001, 2:1–3, 6:35–45; Ex. 1002 ¶¶ 146–149). Additionally, Petitioners argue that, "to the extent that 'cable modem' is limiting, it would have been obvious to use the modem of Hulkko (as modified by Gibson, discussed below) as a cable modem, in view of the DOCSIS References (Thacker, Goldberg), ITU-T J.83b, and AAPA." *Id.* (citing Pet. § VIII.G.3; Ex. 1002 ¶ 150).

Patent Owner's argument directed to element [1pre] focuses on the recitation of "a cable modem" in the preamble of claim 1. PO Resp. 69–71. In particular, Patent Owner asserts that Hulkko, as modified by Gibson, does

not "disclose/teach/suggest 'a cable modem.'" *Id.* at 69–70. Additionally, Patent Owner asserts that it would not have been obvious to use the modem of Hulkko, modified by Gibson, as a cable modem even considering the additional references provided by Petitioners. *Id.* at 70–71.

First, because we determine that the term "cable modem" recited in the preamble of claim 1 is not limiting, *see supra* § II.B, we need not address Patent Owner's arguments directed to that term. Second, Patent Owner does not assert that the other language recited in the preamble of claim 1 is limiting or that Hulkko fails to teach the additional recitations (i.e., "down-converting an electromagnetic signal having complex modulations"). We need not determine whether the other language in the preamble of claim 1 is limiting because we agree with Petitioners that Hulkko teaches "down-converting an electromagnetic signal having complex modulations" for the reasons argued by Petitioners, which are uncontested and which we adopt as our own findings.

Additionally, we need not address Petitioners' alternative challenge based on Hulkko, Gibson, Goldberg, Thacker, ITU-T J.83b, and/or AAPA because we do not find that the recitation of "cable modem" in the preamble of claim 1 is limiting. *See* Pet. 17 (presenting this alternative ground "if the Board finds that the preamble of claim 1 is limiting—and thus requires a 'cable modem'"); *see also SAS*, 138 S. Ct. at 1359 (holding that a petitioner "is entitled to a final written decision addressing all of the claims it has challenged"); *Boston Sci. Scimed*, 809 F. App'x at 990 (stating that the "Board need not address issues that are not necessary to the resolution of the proceeding," such as "alternative arguments with respect to claims [the Board] found unpatentable on other grounds").

ii. Element [1A]

Element [1A] recites "an oscillator to generate an in-phase oscillating signal." Ex. 1001, 51:7. Petitioners contend that "Hulkko discloses an oscillator (Fig. 2, 'LO1') to generate an in-phase signal." Pet. 52 (citing Ex. 1002 ¶ 151; Ex. 1004, Fig. 2, 3:54–57). Petitioners provide the following annotated version of Hulkko's Figure 2:

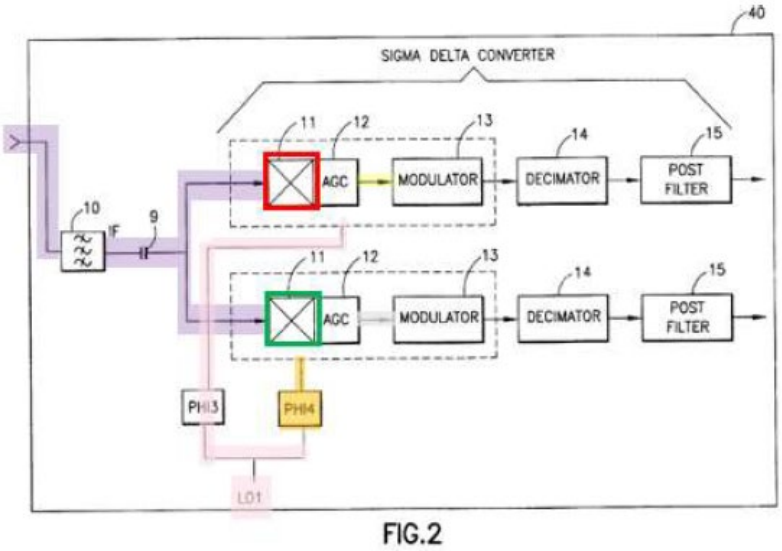


FIG.2

Pet. 53. Petitioners annotated Hulkko's Figure 2, "a block diagram of a sigma-delta converter included in a receive arrangement" (Ex. 1004, 3:33–35), to highlight the electromagnetic signal purple, one mixer 11 red, the other mixer 11 green, the in-phase oscillating signal (output of PHI3) pink, the quadrature-phase oscillating signal (travelling through PHI4) orange, a first sampled signal yellow, and a second sampled signal gray. *Id.* at 52. Petitioners contend that the in-phase oscillating signal "has a phase that is 90 degrees offset from the quadrature-phase oscillating signal." *Id.*

Patent Owner does not challenge Petitioners' analysis of element [1A]. *See generally* PO Resp.

We find Petitioners' arguments persuasive as to element [1A] and supported sufficiently on the complete record before us, and, therefore, we adopt them as our own findings. Accordingly, for the reasons explained by Petitioners, we find that Hulkko teaches element [1A].

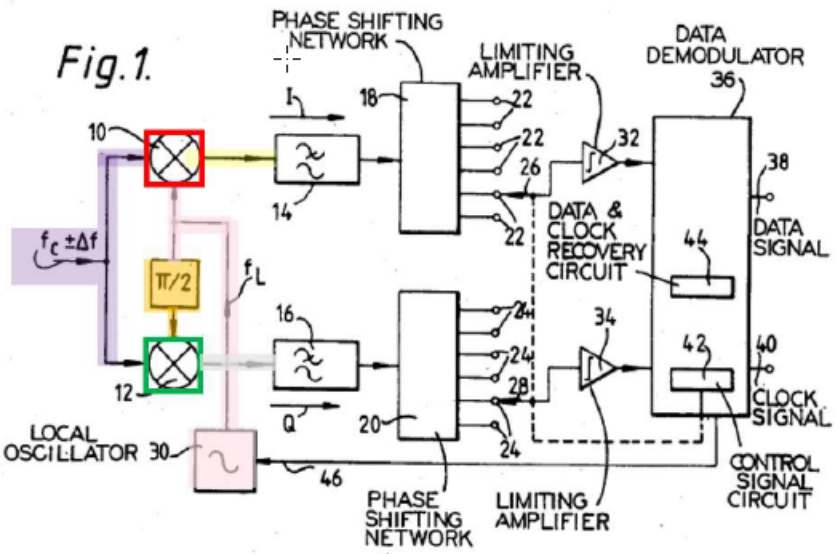
iii. Element [1B]

Element [1B] recites "a phase shifter to receive said in-phase oscillating signal and to create a quadrature-phase oscillating signal." Ex. 1001, 51:8–9. Relying on the same annotated version of Hulkko's Figure 2 reproduced above, Petitioners contend that Hulkko teaches a "phase shifter ('PHI4') to receive said in-phase oscillating signal (pink) and to create a quadrature-phase oscillating signal (orange signal output from 'PHI4')." Pet. 53. Petitioners assert that "[t]he quadrature-phase oscillating signal is 90 degrees out of phase with the in-phase oscillating signal" (*id.* at 54 (citing Ex. 1004, 3:48–4:9)), and that "the in-phase signal (through PHI3) and the quadrature-phase signal (through PHI4) can be used for demodulating an I/Q modulated signal" (*id.* (citing Ex. 1004, 6:35–45; Ex. 1002 ¶¶ 152–153)).

Petitioners also present an alternative position as to element [1B]:

> To the extent it is argued or determined that Hulkko fails to disclose Element [1B], it would have been obvious to modify the arrangement of Hulkko's PHI3 and PHI4 by eliminating PHI3 and replacing PHI4 with a 90 degree phase-shifter, such that the first mixer 11 (red) uses the signal from the local oscillator directly as the in-phase oscillating signal, and the 90 degree phase-shifter outputs a quadrature-phase oscillating signal to the second mixer 11 (green) as taught by Gibson.

Pet. 55. Petitioners provide the following annotated version of Gibson's Figure 1:



Id. Petitioners annotated Gibson's Figure 1, a block schematic circuit of a data receiver (Ex. 1005, 2:44–46), *inter alia*, to show a first mixer in a red box, a second mixer in a green box, an in-phase oscillating signal (pink), a phase shifter (orange), and a quadrature-phase oscillating signal (orange signal from phase shifter π/2 output to green mixer 12). *Id.* (citing Ex. 1002 ¶¶ 154–155).

Petitioners assert that, although Hulkko "discloses that the oscillating signal supplied to first mixer 11 (through 'PHI3') is 90 degrees out of phase with the oscillating signal supplied to second mixer 12 (through 'PHI4'). . . . [,] Hulkko does not describe the mechanism used to shift these signals 90 degrees out of phase from each other." Pet. 44 (citations omitted). Petitioners contend that "Gibson shows that . . . it was conventional at the time of Hulkko to use a phase shifter to supply a quadrature-phase oscillating signal." *Id.* And, Petitioners assert that Hulkko and Gibson "show that a [person of ordinary skill in the art] would have recognized the benefits of using a phase shifter as taught by Gibson, in that

the receiver could be used to demodulate an I/Q modulated signal such as a QAM modulated signal." *Id.*

Additionally, Petitioners contend that "combining Hulkko with Gibson would have yielded only expected, predictable results." Pet. 45. In particular, Petitioners assert,

> [j]ust as Hulkko teaches forming two control signals that are 90 degrees out of phase with each other by shifting a local oscillator signal by +45 degrees (Ex. 1004 at Fig. 2 "PHI3") and –45 degrees (Fig. 2 "PHI4"), respectively (*see id.* at 4:5–9), Gibson teaches forming two control signal[s] that are 90 degrees out of phase with each other by using a simpler structure—*i.e.*, a single, 90 degree phase shifter (Ex. 1005 at Fig. 1 "π/2").

Pet. 45. Petitioners argue that the combination proposed would have been "a combination of prior art elements according to known methods to yield predictable results" because one of ordinary skill in the art "would have understood how to implement a phase shifter (as taught by Gibson) in the context of Hulkko" and the combination would have been "obvious to try—a choice of one type of phase shifting device from a finite number of identified, predictable solutions, with a reasonable expectation of success." *Id.* (citing Ex. 1002 ¶ 136; *KSR*, 550 U.S. at 416–17; *Leapfrog Enters., Inc. v. Fisher-Price, Inc.*, 458 F.3d 1157, 1162 (Fed. Cir. 2007)).

Patent Owner's Response does not challenge Petitioners' first alternative relying on Hulkko alone as teaching element [1B]. *See generally* PO Resp. We find Petitioners' arguments that Hulkko alone teaches element [1B] persuasive and supported sufficiently on the complete record before us, and, therefore, we adopt them as our own findings. Accordingly, for the reasons explained by Petitioners, we find that Hulkko alone teaches element [1B].

We address Petitioners' second alternative based on Hulkko and Gibson primarily because Petitioners rely on the combined teachings of these references when addressing at least dependent claim 15 (*see* Pet. 65–66 (relying on Gibson)), thus requiring a determination as to whether one of ordinary skill in the art would have been motivated to combine the teachings of Hulkko and Gibson. As to this alternative, Patent Owner contests whether one of ordinary skill in the art would have been motivated to combine Gibson with Hulkko. PO Resp. 81–82. Specifically, Patent Owner asserts that one of ordinary skill in the art "would not be motivated to combine Gibson with Hulkko . . . because they are directed to *fundamentally different* and competing technologies; Gibson discloses a quadrature (non-sampling) mixer, whereas Hulkko . . . disclose[s] down-conversion by sampling." *Id.* at 81 (citing Ex. 2038 ¶ 381). Patent Owner contends, "[s]ince Gibson/Hulkko disclose different types of systems, a [person of ordinary skill in the art] would not look to Gibson for components to use in Hulkko." *Id.* at 82 (citing Ex. 2038 ¶¶ 387–388).[25]

In their Reply, Petitioners contend (1) the circuits of Hulkko and Gibson are nearly identical and both are nearly identical to Figure 54B of the '835 patent (Pet. Reply 27 (citing Pet. 1–7, 35–39)); (2) "Hulkko expressly encourages use of its switched capacitors *as a mixer* to perform down-conversion—the exact same function of the mixers disclosed in Gibson" (*id.* (citing Ex. 1004, 5:39–49)); and (3) the Petition sets forth several reasons for

[25] Patent Owner's argument regarding motivation to combine is primarily directed to Petitioners' challenge based on the combination of Gibson and Schiltz. *See* PO Resp. 81–82 (five paragraphs directed to Gibson and Schiltz as compared to one paragraph (particularly, one sentence) directed to Hulkko and Gibson, excluding the introduction and conclusion paragraphs).

combining Hulkko with Gibson providing ample evidence supporting Petitioners' argument that one of ordinary skill in the art would have been motivated to combine Hulkko with Gibson as proposed by Petitioners (*id.* at 27–28 (citing Pet. 43–46)).

In its Sur-reply, Patent Owner contends that Gibson discloses a non-sampling mixer, not a sampling system and that one of ordinary skill in the art "would not substitute a circuit that is specifically configured to operate in one way (sampling) (Hulkko) with a circuit that is configured to operate in a completely different manner (non-sampling mixing) (Gibson)." PO Sur-reply 17–18.[26]

Based on the full record, we find Petitioners' motivation to combine argument regarding the second alternative persuasive. In particular, the distinction Patent Owner seeks to draw between Hulkko and Gibson generally, does not undermine Petitioners' argument and evidence that the particular structures proposed for combination are substantially similar, operate in a similar manner, and would have been expected, by one of ordinary skill in the art, to function predictably and with a reasonable expectation of success, once combined. Notably, we find particularly persuasive Hulkko's teaching to use its switched capacitors as a mixer to perform down-conversion, which is the same function as Gibson's mixers. *See* Ex. 1004, 5:39–49 ("switched capacitor switching elements . . . are used to implement the mixer 11 which directly demodulates the IF-signal into a base-frequency signal"). Accordingly, we find that the combination of Hulkko and Gibson teaches element [1B] and that one of ordinary skill in the

[26] Patent Owner's other arguments are directed to Petitioners' challenge based on Gibson and Schiltz.

art would have been motivated to combine the teachings of these two references as proposed by Petitioners with a reasonable expectation of success.

iv. Element [1C]

Element [1C] recites "a first frequency down-conversion module to receive the electromagnetic signal and said in-phase oscillating signal." Ex. 1001, 51:10–12. Relying on the same annotated version of Hulkko's Figure 2, reproduced above in our discussion of element [1A], Petitioners contend that "Hulkko discloses a first frequency down-conversion module (red mixer 11) to receive the electromagnetic signal (purple) and said in-phase oscillating signal (pink)." Pet. 56. In particular, Petitioners assert that "[m]ixer 11 down-converts the received electromagnetic signal to baseband or an intermediate frequency." *Id.* (citing Ex. 1004, 5:12–6:34, claim 1; Ex. 1002 ¶¶ 156–157).

Patent Owner does not challenge Petitioners' analysis of element [1C]. *See generally* PO Resp.

We find Petitioners' arguments persuasive as to element [1C] and supported sufficiently on the complete record before us, and, therefore, we adopt them as our own findings. Accordingly, for the reasons explained by Petitioners, we find that Hulkko teaches element [1C].

v. Element [1D]

Element [1D] recites "a second frequency down-conversion module to receive the electromagnetic signal and said quadrature-phase oscillating signal." Ex. 1001, 51:14–16. Relying on the same annotated version of Hulkko's Figure 2, reproduced above in our discussion of element [1A], Petitioners contend that "Hulkko discloses a second frequency down-

conversion module (green mixer 11) to receive the electromagnetic signal (purple) and said quadrature-phase oscillating signal (orange)." Pet. 57. Petitioners explain that

> [t]he second frequency down-conversion module of Hulkko (green mixer 11) is structurally identical to its first frequency down-conversion module (red mixer 11) discussed above with respect to Element [1C], the only difference being that the first down-conversion module receives the in-phase oscillating signal (pink) while the second down-conversion module receives the quadrature-phase oscillating signal (orange).

Id. at 57–58. Petitioners assert that, "[l]ike the first down-conversion module, the second down-conversion module (green mixer 11) down-converts the received electromagnetic signal to baseband or an intermediate frequency." *Id.* (citing Ex. 1004, 5:12–6:34, 5:34–37, claim 1; Ex. 1002 ¶¶ 158–159).

Patent Owner does not challenge Petitioners' analysis of element [1D]. *See generally* PO Resp.

We find Petitioners' arguments persuasive as to element [1D] and supported sufficiently on the complete record before us, and, therefore, we adopt them as our own findings. Accordingly, for the reasons explained by Petitioners, we find that Hulkko teaches element [1D].

vi. Element [1E]

Element [1E] recites "wherein said first frequency down-conversion module further comprises a first frequency translation module." Ex. 1001, 51:17–18. Relying on an annotated version of Hulkko's Figure 4, reproduced below, Petitioners contend that "Hulkko discloses that the first frequency down-conversion module (red mixer 11) comprises a first frequency translation module (blue switch 31)." Pet. 58.

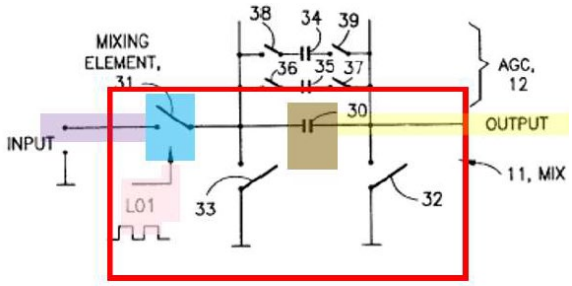


FIG.4

Id. at 59. Petitioners annotated Hulkko's Figure 4, "a schematic representation of a switched capacitor switching element suitable for implementing the mixing and automatic gain control functions" of the sigma-delta converter of Figure 2 (Ex. 1004, 3:41–44), to include a red box identifying mixer 11 and to highlight the input electromagnetic signal purple, switch 31 blue, in-phase oscillating signal pink, capacitor 30 brown, and a first sampled signal yellow. Petitioners provide the following quotation from Hulkko:

> It is preferable to use the first switch 31 of the switched capacitor switching element as the mixing element. In this case, signal bands around the multiples of the frequency of the local oscillator signal LO1 are folded onto the base frequency. The local oscillator base frequency or its subharmonics can therefore be used to down convert the carrier signal to the base-band or a frequency approaching the base-band.

Pet. 59 (quoting Ex. 1004, 5:30–37) (citing Ex. 1004, 4:61–6:34, claims 2, 3; Ex. 1002 ¶¶ 160–161).

Patent Owner does not challenge Petitioners' analysis of element [1E]. *See generally* PO Resp.

We find Petitioners' arguments persuasive as to element [1E] and supported sufficiently on the complete record before us, and, therefore, we adopt them as our own findings. Accordingly, for the reasons explained by Petitioners, we find that Hulkko teaches element [1E].

vii. Element [1F]

Element [1F] recites "and a first storage module." Ex. 1001, 51:18–19. Petitioners contend "the '835 patent at Figs. 20A and 20A-1 provide two examples of frequency down-conversion modules wherein a capacitor is used as the constituent storage module." Pet. 60. Relying on the annotated version of Hulkko's Figure 4 reproduced above in our discussion of element [1E], Petitioners assert that Hulkko "likewise uses a capacitor (brown capacitor 30) as the storage module of the claimed frequency down-conversion module." *Id.* (citing Ex. 1004, 4:64–65, claim 3; Ex. 1002 ¶¶ 162–163).

Patent Owner contends that Hulkko's capacitor 30 is not a "storage module." PO Resp. 60. Patent Owner asserts that "[t]he Board and District Court agree that a 'storage' element/module '*stores non-negligible* amounts from an input electromagnetic signal.' The Petition fails to set forth any argument/theory that the capacitor in Hulkko does so and, thus, the Petition fails." *Id.* at 61.

Patent Owner raises at least two related arguments directed to element [1F]. First, Patent Owner asserts that Hulkko's capacitor 30 is a sample-and-hold capacitor and thus Hulkko is "a sample-and-hold (voltage sampling) system." PO Resp. 61. As an alleged voltage sampling system, Patent Owner contends that capacitor 30 is a *holding* element, not a *storage* element. *Id.*; *see id.* at 62 (alleging that Hulkko's system "seeks to (1) accurately represent the voltage of the input signal, and (2) take readings of voltage in a capacitor in order to recreate a baseband signal" and that "to accurately read voltage, the Hulkko capacitor only *holds* <u>*negligible*</u> amounts of energy (near *zero*)" by using a high impedance load); *see id.* at 67–68

(arguing that "storage module" should be limited to an energy transfer system). This argument primarily is based on Patent Owner's claim construction of "storage module," which seeks to limit the term to "energy transfer systems."

Second, Patent Owner argues that Hulkko's capacitor 30 is not a "storage module" because it does not store *non-negligible* amounts of energy; rather, according to Patent Owner, capacitor 30 holds *negligible* amounts of energy. PO Resp. 62 (citing Ex. 2038 ¶ 313). Relying on Dr. Steer's declaration testimony, Patent Owner contends that "one way to determine energy storage is to perform calculations based on a time constant." *Id.* at 63 (citing Ex. 2038 ¶ 313). Patent Owner walks through three steps of calculations, spanning five pages of its Patent Owner Response (*see id.* at 63–67), and, relying on those calculations, asserts that "[o]nly **0.5%** of the energy available is held on a Hulkko capacitor" and that one of ordinary skill in the art would "understand that **0.5%** is a *negligible* (nearly zero) amount of energy" *id.* at 67 (citing Ex. 2038 ¶¶ 329–330).

In their Reply, Petitioners respond to both of Patent Owner's arguments. First, Petitioners assert that the Board should reject Patent Owner's attempt to read "*energy transfer system*" into the construction of "storage module." Pet. Reply 1. For the reasons explained above, we do not agree with Patent Owner's attempt to limit "storage module" to "energy transfer systems." *See supra* § II.A. Rather, we determine that "storage module" means "a module of a system that stores non-negligible amounts of energy from an input EM signal." *See id.*

Second, Petitioners assert that Patent Owner "offers no principled reason for imposing" its mathematically "complex, three-step calculation

that compares the 'total available energy' to the 'energy in a capacitor.'" Pet. Reply 2 (citing PO Resp. 62–67). Petitioners contend that Patent Owner's "newfound 'mathematical' construction-of-a-construction . . . contradicts its prior positions." *Id.* Petitioners point to prior testimony regarding the meaning of a "non-negligible" amount of energy by named-inventor David Sorrells from litigation between Patent Owner and Qualcomm, Inc. ("Qualcomm"). *Id.* (citing, *inter alia*, *ParkerVision, Inc. v. Qualcomm Inc.*, 621 F. App'x 1009, 1018 (Fed. Cir. 2015)).

In particular, Petitioners contend that

> Mr. Sorrells "explained at trial that transferring a non-negligible amount of energy into the storage capacitor means 'that you have to transfer enough energy *to overcome the noise in the system* to be able to meet your specifications.'" 621 F. App'x at 1019 (emphasis added). Mr. Sorrels also testified that when a product functions according to its specifications, this "is proof that a 'non-negligible' amount of energy is transferred to the storage element in those products." 621 F. App'x at 1019. "Mr. Sorrells' testimony thus establishes that to determine whether or not energy in amounts distinguishable from noise has been transferred from the carrier signal, one may look to whether the down-converting circuit functions in practice. If a circuit successfully down-converts, *that is proof* that enough energy has been transferred to overcome the noise in the system." *Id.* (emphasis added).

Pet. Reply 2–3. Petitioners assert that, "[h]ere, [Hulkko] indisputably discloses a capacitor within a circuit that 'successfully down-converts' a signal, and 'that is proof' that the capacitor stores non-negligible energy under [Patent Owner's] original position." *Id.* at 3 (citing *ParkerVision*, 621 F. App'x at 1019). Petitioners argue that "as its original construction was adopted by the courts, [Patent Owner] is collaterally estopped from advancing an entirely new 'mathematical' construction to try and create

patentability." *Id.* And, Petitioners assert that, "if the Board deems it necessary to provide a substituent construction of 'non-negligible' from its construction of 'storage module,' it should hold that when a device employs a capacitor in order to 'successfully down-convert' a signal, then 'that is proof' that the capacitor stores non-negligible energy." *Id.* at 11 (citing *ParkerVision*, 621 F. App'x at 1019).[27]

Turning to the relevant disclosures in Hulkko, Petitioners contend that Hulkko's frequency translation modules "perform down conversion by sampling the input signal using a switched capacitor—which accumulates (*i.e.*, integrates) charge (hence, energy)—exactly like the alleged invention of the '835 patent." Pet. Reply 20. Petitioners contend that

> "mixer 11 can be considered as a sample and a hold circuit that samples the input signal in synchronization with the oscillator and directs the samples to the output as a signal which remains constant for the period of the sampling interval." Ex. 1004 at 5:13-17. A "first capacitor 30 is used to sample [a]nd ***hold*** the incoming signal. . . . . Once the input signal has been sampled, a third switch 33 is closed to ***transfer the charge on the first capacitor 30*** to the output." *Id.* at 4:61-5:12 (emphasis added). Thus, the first capacitor 30 in Hulkko serves to store or "hold" non-negligible energy that has been sampled from the input EM signal, and then transfers that energy or "charge on the first capacitor" when the third switch is closed.

Pet. Reply 20–21. Petitioners assert that "[t]he '***switched capacitor switching elements*** . . . are used to implement the mixer 11 which ***directly demodulates the IF-signal into a base-frequency signal***." *Id.* at 21

[27] Petitioners also assert that Dr. Steer "failed to consider crucial materials in arriving at his opinion here, as he did not review Mr. Sorrell[s'] prior testimony regarding the meaning of 'non-negligible,' nor did he consider the Federal Circuit and District Court opinions relying on that testimony." Pet. Reply 11 n.6 (citing Ex. 1016, 55:25–56:14, 60:5–67:20, 72:11–74:5).

(emphasis by Petitioners) (citing Ex. 1004, 5:39–48; Ex. 1002 ¶¶ 120–123; Pet. 5–7, 35–37, 60). Thus, according to Petitioners, "because Hulkko's capacitors successfully demodulate the signal 'into a base-frequency signal' (*i.e.*, successfully perform down-conversion), '***that is proof***' that the capacitors store non-negligible energy under [Patent Owner's] prior litigation position." *Id.* (emphasis by Petitioners) (citing *ParkerVision*, 621 F. App'x at 1019).

Additionally, Petitioners argue that, "even under [Patent Owner's] and Dr. Steer's flawed mathematical construction of 'non-negligible,' the capacitors in Hulkko constitute 'storage modules.'" Pet. Reply 21. Petitioners point to dependent claim 42 of the '551 patent, arguing that the claim "instructs that 'one tenth of one percent of the energy' is 'non-negligible,'" which means that "even under Dr. Steer's spurious mathematical construction[,] the capacitors in Hulkko constitute 'storage modules'" because 0.5% of the energy is greater than 0.1% of the energy. *Id.* (citing Ex. 2027, claims 41, 42; Ex. 1016, 137:3–138:21).

In its Sur-reply, Patent Owner challenges Petitioners' reliance on Mr. Sorrells' testimony, contending that "instead of providing expert rebuttal, Petitioners chose to rely on out-of-context testimony by one inventor of the '835 patent and *attorney* interpretation of the cited references in view of that testimony." PO Sur-reply 1. Patent Owner asserts that it is not seeking to *require* a complex, three-step mathematical calculation to define non-negligible. *Id.* at 7. Rather, according to Patent Owner "whether mathematical calculations are used depends on the prior art's disclosure and, even then, does not require a specific calculation." *Id.* at 7 n.8. Patent Owner points to its arguments in the Patent Owner Response that the

calculations show "one way" to determine energy storage. *Id.* In other words, Patent Owner suggests that there may be *other* ways to demonstrate non-negligible energy storage. *See id.* But, Patent Owner asserts that "'[n]on-negligible' is a relative term and must be demonstrated in some manner," which Petitioners fail to do. *Id.* at 7–8.

Patent Owner contends that Petitioners' argument based on Mr. Sorrells' prior testimony is flawed because (1) "it is a concept and just attorney argument"; (2) the concept is solely based on extrinsic evidence—testimony by one inventor years after the '835 patent issued; and (3) Petitioners ignore key portions of Mr. Sorrells' testimony. PO Sur-reply 8. Patent Owner walks through Mr. Sorrells' testimony, contending that Petitioners' argument fails to accurately reflect both his actual testimony and how the testimony was applied by the Federal Circuit in its prior decision. *Id.* at 9–14. Patent Owner asserts that the "two key take-aways" from the Federal Circuit's decision are "(1) Mr. Sorrells's position is *one way* (not the only way) of determining non-negligible amounts of energy, and (2) whether a circuit 'successfully' down-converts depends on whether it meets cellular/wireless specifications." *Id.* at 12.

Patent Owner's primary argument in response to Petitioners' reliance on Mr. Sorrells' testimony is that Petitioners do not address whether the prior art references meet cellular/wireless specifications.[28] PO Sur-reply 13–

[28] Patent Owner also contends that Mr. Sorrells' testimony is directed to "transferring" energy to a capacitor whereas the claims here pertain to "storing" energy in a capacitor. PO Sur-reply 13. Nonetheless, Patent Owner does not argue that this difference results in any distinction in terms of our consideration of the primary question before us—whether the prior art teaches a "storage module."

14. Patent Owner contends that, "if Petitioners are going to follow the Federal Circuit's decision, simply showing the prior art down-converts a signal is not enough. Petitioners must show that the prior art 'successfully' down-converts a signal. To do so, Petitioners must identify cellular/wireless specifications and demonstrate that the prior art meet those specifications." *Id.* at 13. Patent Owner asserts that Petitioners "ignore the requirement of 'successfully' down-converting because they cannot prove it." *Id.* Specifically, Patent Owner argues that "there is no concept of cellular/wireless specifications to be met in those references, there is no evidence that such specifications were met, and there is no expert testimony otherwise. There is simply no evidence for Petitioners to meet their burden." *Id.* at 13–14. By not relying on a reply declaration, Patent Owner contends that Petitioners are left only with attorney argument and that Hulkko and Schiltz perform down-conversion. *Id.* at 14. But, according to Patent Owner, performing down-conversion alone, "says nothing about how [Hulkko's and Schiltz's] systems work and does not meet Mr. Sorrells's standard." *Id.* Further, Patent Owner argues that Petitioners' position is "illogical" because voltage sampling systems also perform down-conversion, but they use capacitors that hold negligible amounts of energy. Thus, it cannot follow that merely because down-conversion occurs, that means Hulkko's and Schiltz's capacitors store a non-negligible amount of energy. *Id.*

As reflected above, element [1F] recites "a first storage module." Ex. 1001, 51:18–19. As also reflected above, the parties dispute the proper construction of "storage module" and also dispute the meaning of the construction. In other words, there are multiple levels of complexity

regarding the dispute between the parties pertaining to this limitation. For the reasons discussed above, we construe "storage module" to mean "a module of a system that stores non-negligible amounts of energy from an input EM signal." *See supra* § II.A. That determination resolves the first level of the parties' dispute because we do not construe "storage module" as limited to an energy transfer system.

The second level of the parties' dispute, to which the discussion above is primarily directed, is the meaning of "non-negligible amounts of energy." On this point, although Patent Owner presents a multi-step series of calculations, Patent Owner expressly states that determining whether an amount of energy is a non-negligible amount of energy "does not require a specific calculation" (PO Sur-reply 7 n.8) and that its calculations are but "*one way*" to approach the question (*id.*). Additionally, Patent Owner acknowledges that Mr. Sorrells' testimony also provides "*one way*" of determining a non-negligible amount of energy. *Id.* at 12. Yet, as discussed in several instances at the oral hearing, Patent Owner cannot or would not identify any specific amount that indicates when a negligible amount of energy becomes a non-negligible amount of energy. *See, e.g.*, Tr. 73:15–18, 77:18–79:11. Patent Owner's arguments give the impression that a non-negligible amount of energy is a moving target because Patent Owner is the only party that can tell when an amount is negligible or non-negligible, a non-negligible amount is relative, and it depends on the circuit in question at any given time.

Fortunately, the Federal Circuit already has addressed essentially the same question. In *ParkerVision, Inc. v. Qualcomm Inc.*, the Federal Circuit addressed claims of several patents, including the '551 patent—the precise

patent on which the parties rely to explain the meaning and application of "storage module." *ParkerVision*, 621 F. Appx. at 1011 (identifying four patents at issue). Claim 23 of the '551 patent, which the Federal Circuit identified as a representative claim, is directed to an apparatus for down-converting a carrier signal to a lower frequency signal, comprising, *inter alia*, "a storage module" and recites "wherein said storage module receives non-negligible amounts of energy transferred from a carrier signal." *Id.* As part of its cross-appeal, Qualcomm argued that claim 23, and others, should have been held invalid by the district court. *See id.* at 1017–18. One of the arguments raised by Patent Owner, similar to the one here, was that the prior art at issue did not disclose transferring non-negligible amounts of energy from a carrier signal to a storage capacitor. *See id.* at 1018 ("First, Weisskopf[29] does not disclose transferring 'non-negligible amounts of energy' from the carrier signal to the storage capacitor.").

In addressing that argument by Patent Owner, the Federal Circuit explained, "[t]he asserted claims all require transferring 'non-negligible amounts of energy' from the carrier signal to a store device, such as the storage capacitor in Weisskopf." *ParkerVision*, 621 F. Appx. at 1018. The Federal Circuit explained that "[t]he district court construed 'non-negligible amounts of energy' to mean 'energy in amounts that are distinguishable from noise.'" *Id.* And, the Federal Circuit noted that the "construction is not disputed on appeal." *Id.* Here, neither party has provided any sufficient reason why we should construe "non-negligible amounts of energy"

[29] P.A. Weisskopf, "Subharmonic Sampling of Signal Processing Requirements," Microwave Journal, May 1992, 239–47. The same article is Exhibit 1023 in IPR2014-00948.

differently than the Federal Circuit in *ParkerVision*. Accordingly, because this specific issue of what amounts to "non-negligible amounts of energy" was already decided by the Federal Circuit, we construe this term to mean "energy in amounts that are distinguishable from noise."[30]

The next logical question the Federal Circuit faced in *ParkerVision* was how to determine if energy in amounts that are distinguishable from noise is transferred from the carrier signal to the storage device. *ParkerVision*, 621 F. Appx. 1018–19. The Federal Circuit relied on Mr. Sorrells' testimony to answer this specific question. The Federal Circuit stated:

> Mr. Sorrells explained at trial that transferring a non-negligible amount of energy into the storage capacitor means "that you have to transfer enough energy to overcome the noise in the system to be able to meet your specifications." He further testified that the fact that the accused Qualcomm products meet "all of the cellular/cellphone specifications" is proof that a "non-negligible" amount of energy is transferred to the storage element in those products.
>
> Mr. Sorrells' testimony thus establishes that to determine whether or not energy in amounts distinguishable from noise has been transferred from the carrier signal, one may look to

[30] The intrinsic record does not define "non-negligible amounts of energy," but the '551 patent does state, when referring to an energy transfer signal, that it includes "a train of pulses having non-negligible apertures *that tend away from zero*." Ex. 2027, 66:36–39 (emphasis added); *see also* Ex. 1001, 10:31–32 ("In another embodiment, the pulses of control signal 2006 have non-negligible apertures that tend away from zero."). Even if we applied a meaning of non-negligible as tending away from zero, that construction would not assist in resolving the parties' dispute because neither party can explain where to draw the line between negligible and non-negligible amounts of energy simply based on that meaning. Thus, the Federal Circuit's decision provides a better basis from which to understand the meaning of non-negligible in this context.

> whether the down-converting circuit functions in practice. If a circuit successfully down-converts, that is proof that enough energy has been transferred to overcome the noise in the system.

Id. at 1019.[31]

Having decided how to determine whether energy in amounts distinguishable from noise has been transferred to a storage module, the Federal Circuit turned to testimony provided by Qualcomm's expert, who the Federal Circuit found "testified, without contradiction, that the Weisskopf system is designed to maximize the amount of energy transferred from the carrier signal." *ParkerVision*, 621 F. Appx. at 1019. The Federal Circuit concluded that "[t]he fact that Weisskopf transfers as much energy as possible from the carrier signal, resulting in a commercially viable down-converting system is proof that the system successfully distinguishes the transferred energy from noise." *Id.*

Applying the discussion above, we first recognize that, although claim 1 does not expressly recite transferring energy from the carrier signal to the storage device, the construction we adopt for "storage module" is "a module of a system that stores non-negligible amounts of energy from an input EM signal." Thus, the language we consider is substantially similar to the language at issue in *ParkerVision*. In both circumstances, energy *from* a signal is stored at a storage module/device. And, neither party raises any specific reason why the Federal Circuit's analysis would not apply equally

[31] Mr. Sorrells' testimony was directed to the issue of infringement (hence the discussion of "the accused Qualcomm products"). *ParkerVision*, 621 Fed. Appx. at 1012 ("To prove infringement, ParkerVision called . . . David Sorrells, one of the inventors.").

here.[32] Accordingly, Patent Owner's argument that the Federal Circuit "refers to *transferring* energy to a capacitor to *overcome noise* whereas Petitioners refer to *storing* energy in a capacitor" is a distinction without a difference. *See* PO Sur-reply 13.

Second, we disagree with Patent Owner's strained reading of the Federal Circuit's decision and with Patent Owner's argument that places far too much emphasis on what Patent Owner contends the Federal Circuit meant by "successfully" down-converting. Patent Owner asserts that to show Hulkko successfully down-converts, in accordance with the Federal Circuit's decision, Petitioners were required to "identify cellular/wireless specifications and demonstrate that the prior art meet[s] those specifications." PO Sur-reply 13. We disagree because the Federal Circuit's decision fails to support Patent Owner's argument. In particular, when considering whether Weisskopf satisfied this aspect of the claims at issue in that case, the Federal Circuit did not identify or rely on evidence regarding cellular or wireless specifications.[33] Rather, the Federal Circuit noted that Weisskopf transfers as much energy as possible resulting in a "commercially

[32] In fact, Patent Owner acknowledges that "Mr. Sorrells's position is *one way* (not the only way) of determining non-negligible amounts of energy." PO Sur-reply 12.

[33] Patent Owner focuses primarily on the Federal Circuit's discussion of Mr. Sorrells' testimony regarding Qualcomm's accused products as opposed to considering how the Federal Circuit specifically *applies that testimony* to determining whether Weisskopf (an anticipatory reference) satisfies the test for infringement set forth by Mr. Sorrells. We also note that, in *ParkerVision*, despite Mr. Sorrells' testimony, Patent Owner contended that Weisskopf failed to disclose transferring non-negligible amounts of energy, a position the Federal Circuit found "[n]o reasonable jury could have concluded . . . ." *See ParkerVision*, 621 F. Appx. at 1019.

viable down-converting system" and that was "proof that the system successfully distinguishes the transferred energy from noise." *ParkerVision*, 621 F. Appx. at 1019. The Federal Circuit's discussion does not identify how the court determined that Weisskopf's system was commercially viable. But, Weisskopf is an article, not an issued patent, such as Hulkko.[34] And, Hulkko expressly states that "[e]mbodiments of the invention can be utilized advantageously in, for example, radio telephones." Ex. 1004, 3:23–34; *see id.* at 4:21–24 (discussing radio telephone 40), 6:46–52 (discussing use of a circuit arrangement as "especially significant for radio telephones"); *see also* Tr. 101:2–8 (addressing Hulkko's identification of commercial uses). Accordingly, because Hulkko is a patent that is presumed to be enabled such that it operates in a manner that successfully down-converts and does so in a commercially viable system that can be used for radio telephones, we find that constitutes sufficient evidence that Hulkko's capacitor 30 is a "storage module" as that term is used in the context of the '835 patent. In other words, Hulkko's capacitor 30 is "a module of a system that stores non-negligible amounts of energy [i.e., energy in amounts that are distinguishable from noise] from an input EM signal."[35] Thus, we find that Petitioners have shown that Hulkko teaches element [1F].

[34] As an issued patent, Hulkko is presumed to be enabled. *See, e.g.*, *Cephalon v. Watson Pharms., Inc.*, 707 F.3d 1330, 1337 (Fed. Cir. 2013) (recognizing that an issued patent is presumed to be enabled).
[35] In light of our determination, we need not also address the parties' arguments regarding dependent claim 42 of the '551 patent and whether 0.1% is a non-negligible amount of energy.

viii. Element [1G]

Element [1G] recites "wherein said first frequency translation module samples the electromagnetic signal at a rate that is a function of said in-phase oscillating signal, thereby creating a first sampled signal." Ex. 1001, 51:19–22. Relying on the same annotated version of Hulkko's Figure 2, reproduced above in our discussion of element [1A], Petitioners contend that

> Hulkko discloses that the first frequency down-conversion module (red mixer 11 in Figure 2, comprising blue switch 31 and brown capacitor 30 as shown in [Petitioners' annotated version of Hulkko's] Figure 4[, reproduced above in our discussion of element [1E]]) samples the electromagnetic signal (purple) at a rate that is a function of said in-phase oscillating signal (pink), thereby creating a first sampled signal (yellow, labelled "output" in Figure 4).

Pet. 61. To further support its argument, Petitioners provide the following quotation from Hulkko:

> It is preferable to use the first switch 31 of the switched capacitor switching element as the mixing element. In this case, signal bands around the multiples of the frequency of the local oscillator signal LO1 are folded onto the base frequency. The local oscillator base frequency or its subharmonics can therefore be used to down convert the carrier signal to the base-band or a frequency approaching the base-band.

Id. at 62 (quoting Ex. 1004, 5:30–37) (citing Ex. 1004, 4:61–6:34, claims 2, 3; Ex. 1002 ¶¶ 164–165).

Patent Owner does not challenge Petitioners' analysis of element [1G]. *See generally* PO Resp.

We find Petitioners' arguments persuasive as to element [1G] and supported sufficiently on the complete record before us, and, therefore, we adopt them as our own findings. Accordingly, for the reasons explained by Petitioners, we find that Hulkko teaches element [1G].

ix. Element [1H]

Element [1H] recites "said second frequency down-conversion module further comprises a second frequency translation module." Ex. 1001, 51:23–24. Referring to their arguments directed to element [1E], Petitioners reiterate that "Hulkko discloses using a first frequency translation module comprising a switch 31 that is controlled by a control signal." Pet. 63. Referring to the previously reproduced annotated versions of Hulkko's Figures 2 and 4, Petitioners contend that "[t]he second frequency down-conversion module is in lower mixer 11 (green) in Hulkko's Figure 2 and is structurally identical to the first frequency down-conversion module (shown in Figure 4) discussed above." *Id.* Petitioners explain that "the control signal that controls switch 31 in the second[] frequency down[-]conversion module (lower mixer 11, green in Figure 2) is the quadrature-phase oscillating signal coming from PHI4 in Figure 2 (orange)." *Id.* (citing Ex. 1002 ¶¶ 166–167).

Patent Owner does not challenge Petitioners' analysis of element [1H]. *See generally* PO Resp.

We find Petitioners' arguments persuasive as to element [1H] and supported sufficiently on the complete record before us, and, therefore, we adopt them as our own findings. Accordingly, for the reasons explained by Petitioners, we find that Hulkko teaches element [1H].

x. Element [1I]

Element [1I] recites "and a second storage module." Ex. 1001, 51:24–25. Relying on the same annotated figures of Hulkko, Petitioners contend that "[t]he second storage module (in lower mixer 11 in Figure 2) is the same as the first storage module (in upper mixer 11) discussed above with

respect to Element [1F], each comprising a respective capacitor 30, as shown in Figure 4." Pet. 63 (citing Ex. 1002 ¶ 168).

We have addressed Patent Owner's arguments directed to whether Hulkko discloses a "storage module" in the context of our consideration of element [1F] ("a first storage module") and that same discussion and analysis apply equally here. Accordingly, for the same reasons explained in the context of our consideration of element [1F], we find that Petitioners have shown that Hulkko teaches element [1I].

xi. Element [1J]

Element [1J] recites "wherein said second frequency translation module samples the electromagnetic signal at a rate that is a function of said quadrature-phase oscillating signal, thereby creating a second sampled signal." Ex. 1001, 51:25–29. Relying on the same annotated figures of Hulkko, Petitioners assert that

> Hulkko discloses that the second frequency down-conversion module (green mixer 11 in Figure 2, comprising switch 31 and capacitor 30 as shown in Figure 4) samples the electromagnetic signal (purple) at a rate that is a function of said quadrature-phase oscillating signal (orange signal from "PHI4"), thereby creating a second sampled signal (gray in Figure 2 . . . , labelled "output" in Figure 4).

Pet. 64 (citing Ex. 1004, 5:30–37, 4:61–6:34, claims 2, 3; Ex. 1002 ¶¶ 169–170).

Patent Owner does not challenge Petitioners' analysis of element [1J]. *See generally* PO Resp.

We find Petitioners' arguments persuasive as to element [1J] and supported sufficiently on the complete record before us, and, therefore, we

adopt them as our own findings. Accordingly, for the reasons explained by Petitioners, we find that Hulkko teaches element [1J].

xii. Summary as to Claim 1

For the reasons discussed above, we find that Petitioners have established on the complete record before us that the combination of Hulkko and Gibson teaches the subject matter of claim 1 and that one of ordinary skill in the art would have been motivated to combine the teachings of these two references as proposed by Petitioners with a reasonable expectation of success in so doing.

b. Dependent Claims 12, 15, and 17

Claims 12, 15, and 17 depend, directly or indirectly, from claim 1. Petitioners set forth argument with supporting evidence as to how the combination of Hulkko and Gibson teaches each element of claims 12, 15, and 17. Pet. 65–67. Patent Owner does not challenge Petitioners' analysis of claims 12, 15, and 17 in the Patent Owner Response.[36] *See generally* PO Resp.

We find Petitioners' arguments supported sufficiently on the complete record before us, and, therefore, we adopt them as our own findings. Accordingly, for the reasons explained by Petitioners, we find that the combination of Hulkko and Gibson teaches the subject matter of claims 12, 15, and 17 and that one of ordinary skill in the art would have been

[36] As noted above, Patent Owner raised a new argument, directed to dependent claim 17's recitation of "cable modem," during the oral argument, which we find waived because it was not raised in the Patent Owner Response. *See* Paper 15 (Scheduling Order), 8 ("Patent Owner is cautioned that any arguments not raised in the response may be deemed waived.").

motivated to combine the teachings of these two references as proposed by Petitioners with a reasonable expectation of success.

4. Objective Indicia of Nonobviousness

Patent Owner contends that, "[i]n the late 1990s through March 2000, there was a long-felt need for a solution for direct down-conversion." PO Resp. 21. Patent Owner asserts that "[t]he industry was looking to voltage sampling and mixing using nonlinear or time-varying elements to solve the direct down-conversion problem. But these solutions had their own problems (e.g., too much noise) and were never widely implemented commercially (if at all)." *Id.* (citing Ex. 2038 ¶¶ 277–280).

Patent Owner contends that "[u]sing energy sampling at the time was counter-intuitive and against the thinking of the industry, which was looking to replicate the voltage of the RF signal and use that voltage to derive a baseband signal. Energy sampling did not accurately replicate the voltage of an RF signal." PO Resp. 21. Patent Owner asserts that

> [e]nergy sampling had a number of unexpected results: an energy sampling downconverter (1) enables selection of just one channel from a band, (2) uses enough of the available RF energy so that the desired baseband signal stands out from the noise which, in turn, improves RF receiver performance, lowers power consumption, allows for reduction/elimination of expensive/bulky external components, and (3) is surprisingly linear (at the time of the invention, the common understanding was that competing mixing technologies were nonlinear).

Id. at 22 (citing Ex. 2038 ¶¶ 282–286). Patent Owner argues that "[u]nknown at this time by industry and academia was that, by using an energy transfer system, RF receivers could be built smaller, cheaper and with improved performance." *Id.* Patent Owner contends that Qualcomm recognized the significance of Patent Owner's energy transfer system "as set

forth in the challenged claims" and subsequently Qualcomm and others in the industry "transitioned away from superheterodyne receivers and mixer technology and began to use the energy transfer system set forth in the challenged claims." *Id.* (citing Ex. 2038 ¶ 287).

In its discussion of Hulkko, Patent Owner contends that it would not have been obvious to one of ordinary skill in the art "to replace the voltage sampling configuration of Hulkko with an energy sampling configuration." PO Resp. 68. And, Patent Owner contends that "secondary considerations of non-obviousness demonstrate that, at the time of the invention, (1) such a dramatic modification of Hulkko was not envisioned by a [person of ordinary skill in the art] and (2) the challenged claims are not obvious in view of Hulkko." *Id.* Patent Owner contends that "[o]ne would have to use hindsight to modify Hulkko to use a *low* impedance load and *energy* sampling to get to the claimed invention." *Id.* (citing Ex. 2038 ¶ 334).

Objective indicia of nonobviousness are "only relevant to the obviousness inquiry 'if there is a nexus between the claimed invention and the [objective indicia of nonobviousness].'" *In re Affinity Labs of Tex., LLC*, 856 F.3d 883, 901 (Fed. Cir. 2017) (quoting *Ormco Corp. v. Align Tech., Inc.*, 463 F.3d 1299, 1312 (Fed. Cir. 2006)). For objective indicia of nonobviousness to be accorded substantial weight, their proponent must establish a nexus between the evidence and the merits of the claimed invention. *ClassCo, Inc., v. Apple, Inc.*, 838 F.3d 1214, 1220 (Fed. Cir. 2016). "[T]here is no nexus unless the evidence presented is 'reasonably commensurate with the scope of the claims.'" *Id.* (quoting *Rambus Inc. v. Rea*, 731 F.3d 1248, 1257 (Fed. Cir. 2013)).

A patentee is entitled to a presumption of nexus "when the patentee shows that the asserted objective evidence is tied to a specific product and that product 'embodies the claimed features, and is coextensive with them.'" *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019) (quoting *Polaris Indus., Inc. v. Arctic Cat, Inc.*, 882 F.3d 1056, 1072 (Fed. Cir. 2018) (quoting *Brown & Williamson Tobacco Corp. v. Philip Morris Inc.*, 229 F.3d 1120, 1130 (Fed. Cir. 2000))); *Lectrosonics, Inc. v. Zaxcom, Inc.*, IPR2018-01129, Paper 33, 32 (PTAB Jan. 24, 2020) (precedential, designated Apr. 14, 2020). On the other hand, a patentee is not entitled to a presumption of nexus if the patented invention is only a component of a commercially successful machine or process. *Fox Factory*, 944 F.3d at 1373 (reaffirming the importance of the "coextensiveness" requirement).

"[T]he purpose of the coextensiveness requirement is to ensure that nexus is only presumed when the product tied to the evidence of secondary considerations '*is* the invention disclosed and claimed.'" *Fox Factory*, 944 F.3d at 1374 (quoting *Demaco Corp. v. F. Von Langsdorff Licensing Ltd.*, 851 F.2d 1387, 1392 (Fed. Cir. 1988)). "[T]he degree of correspondence between a product and a patent claim falls along a spectrum. At one end of the spectrum lies perfect or near perfect correspondence. At the other end lies no or very little correspondence." *Id.* "A patent claim is not coextensive with a product that includes a 'critical' unclaimed feature that is claimed by a different patent and that materially impacts the product's functionality." *Id.* at 1375.

However, "[a] finding that a presumption of nexus is inappropriate does not end the inquiry into secondary considerations." *Fox Factory*, 944 F.3d at 1375. "To the contrary, the patent owner is still afforded an

opportunity to prove nexus by showing that the evidence of secondary considerations is the 'direct result of the unique characteristics of the claimed invention.'" *Id.* at 1373–74 (quoting *In re Huang*, 100 F.3d 135, 140 (Fed. Cir. 1996)). "Where the offered secondary consideration actually results from something other than what is both claimed and *novel* in the claim, there is no nexus to the merits of the claimed invention," meaning that "there must be a nexus to some aspect of the claim not already in the prior art." *In re Kao*, 639 F.3d 1057, 1068–69 (Fed. Cir. 2011) (emphasis in original). On the other hand, there is no requirement that "objective evidence must be tied exclusively to claim elements that are not disclosed in a particular prior art reference in order for that evidence to carry substantial weight." *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1331 (Fed. Cir. 2016). A patent owner may show, for example, "that it is the claimed combination as a whole that serves as a nexus for the objective evidence; proof of nexus is not limited to only when objective evidence is tied to the supposedly 'new' feature(s)." *Id.* at 1330.

Ultimately, the fact finder must weigh the objective indicia evidence presented in the context of whether the claimed invention, as a whole, would have been obvious to a skilled artisan. *WBIP*, 829 F.3d at 1331–32. Once the patentee has presented a prima facie case of nexus, the burden of coming forward with evidence in rebuttal shifts to the challenger "to adduce evidence to show that the commercial success was due to extraneous factors other than the patented invention." *Demaco*, 851 F.2d at 1393.

Here, we first note that Patent Owner's arguments as to objective indicia appear to be responding to a position not asserted by Petitioners—to replace the voltage sampling configuration of Hulkko with an energy

sampling configuration. *See* PO Resp. 68. Petitioners do not propose to modify Hulkko as Patent Owner contends. *See, e.g.*, Pet. 43–46. And, as discussed above, we decline to construe "storage module" as limited to an "energy transfer system." *See supra* § II.A. Thus, in large part, Patent Owner's arguments as to nonobviousness do not respond to Petitioners' arguments and evidence discussed above.

Nonetheless, even assuming that all or some of Patent Owner's arguments and Dr. Steer's testimony are directed to the combination proposed by Petitioners, Patent Owner's evidence of nonobviousness remains insufficient to "be accorded substantial weight" because Patent Owner fails to "establish a nexus between the evidence and the merits of the claimed invention." *ClassCo*, 838 F.3d at 1220. In particular, neither Patent Owner nor Dr. Steer makes any attempt to establish nexus with the elements recited in any specific challenged claim based on a presumption of co-extensiveness or otherwise. Rather, Patent Owner and Dr. Steer only tie the discussion to energy transfer systems or energy sampling *in general*, which is based on Patent Owner's proposed claim construction that we do not adopt, and make no attempt to tie their discussion to the specific language of any of the Challenged Claims. *See* Ex. 2038 ¶¶ 277–288 (referring generally to "energy sampling as set forth in the challenged claims"). Thus, we find that Patent Owner fails to establish that a presumption of nexus is warranted and similarly fails to establish nexus absent the presumption. Accordingly, for the reasons above, Patent Owner has not satisfied its burden to establish nexus. *See WMS Gaming Inc. v. Int'l Game Tech.*, 184 F.3d 1339, 1359 (Fed. Cir. 1999) (patent owner "bears the burden of showing that a nexus exists").

Nonetheless, in spite of the above failures, we consider Patent Owner's weak evidence of nonobviousness in our weighing of the *Graham* factors below.

5. Weighing the Graham Factors

"Once all relevant facts are found, the ultimate legal determination [of obviousness] involves the weighing of the fact findings to conclude whether the claimed combination would have been obvious to an ordinary artisan." *Arctic Cat*, 876 F.3d at 1361. On balance, considering the complete record before us and for the reasons explained above, the evidence of obviousness is very strong and the evidence of nonobviousness, which includes Patent Owner's objective evidence of nonobviousness, is very weak. As a result of that balancing, we determine that Petitioners have established by a preponderance of the evidence that the combination of Hulkko and Gibson would have rendered the subject matter of claims 1, 12, 15, and 17 obvious to one of ordinary skill in the art at the time of the invention.

C. Obviousness over Gibson and Schiltz, and Alternatively Gibson, Schiltz, Goldberg, Thacker, ITU-T J.83b, and/or AAPA

Petitioners assert the combination of Gibson and Schiltz, and alternatively the combination of Goldberg, Thacker, ITU-T J.83b, and/or AAPA, would have rendered the subject matter of claims 1, 12–15, and 17–20 obvious to one of ordinary skill in the art at the time of the invention.[37]

[37] Although the heading on page 67 of the Petition omits dependent claim 17 (*see* Pet. 67 (listing claims 1, 12–15, and 18–20)), Petitioners' argument under these challenges include claim 17 (*see id.* at 83 (discussing claim 17)) and claim 17 is listed in Petitioners' identification of the obviousness ground based on the combination of Gibson and Schiltz under the section titled "Grounds for Challenge" (*see id.* at 17).

Pet. 46–47 (discussing motivation to combine Gibson and Schiltz), 47–50 (discussing motivation to "use the modem[] of . . . Gibson modified with Schiltz" as a "cable modem[]" in view of Goldberg, Thacker, ITU-T J.83b, and/or AAPA), 67–85 (discussing the application of the art to the claims).[38]

1. Level of Ordinary Skill in the Art

The level of ordinary skill in the art at the time of the invention is discussed above. *See supra* § I.G.

2. Scope and Content of the Prior Art

a. Gibson, Goldberg, Thacker, ITU-T J.83b, and AAPA

The scope and content of Gibson, Goldberg, Thacker, ITU-T J.83b, and AAPA are described above. *See supra* §§ III.B.2.b–f.

b. Schiltz

Schiltz is directed to high speed electronic circuits and, more specifically, "to a high speed sample and hold circuit and to radios which use such a circuit as a mixer." Ex. 1006, 1:7–10. Figure 1 is reproduced below:

[38] As discussed *infra* (*see* § III.C.3.a.i), we do not address Petitioners' alternative challenge based on Gibson, Schiltz, Goldberg, Thacker, ITU-T J.83b, and/or AAPA because we do not find that the recitation of "cable modem" in the preamble is limiting. *See* Pet. 17 (presenting this alternative ground "if the Board finds that the preamble of claim 1 is limiting—and thus requires a 'cable modem'"); *see also SAS*, 138 S. Ct. at 1359 (holding that a petitioner "is entitled to a final written decision addressing all of the claims it has challenged"); *Boston Sci. Scimed*, 809 F. App'x at 990 (stating that the "Board need not address issues that are not necessary to the resolution of the proceeding," such as "alternative arguments with respect to claims [the Board] found unpatentable on other grounds").

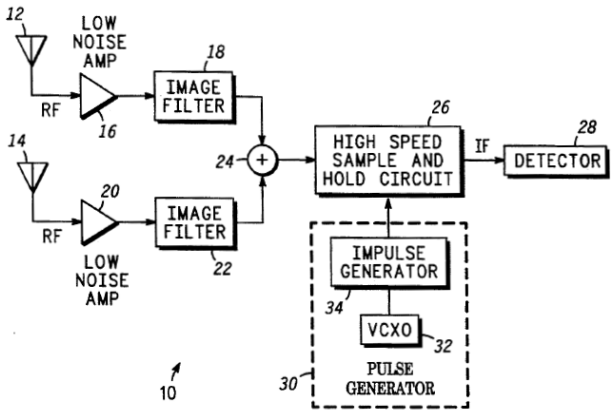


FIG. 1

Figure 1 shows a block diagram of radio 10. Ex. 1006, 3:4, 2:56–58.

Schiltz explains that radio 10 converts one or more RF signals into an IF signal and then into a baseband signal. *Id.* at 3:4–6. "Sample and hold circuit 26 operates as a downconverter in radio 10," by "convert[ing] a high frequency RF signal into an IF signal in a single operation." *Id.* at 4:29–32. Schiltz discloses that sample and hold circuit 26 "samples the RF signal while the pulses supplied by pulse generator 30 (see FIG. 1) are active and holds the samples while the pulses are inactive." *Id.* at 6:3–6.

Figure 5 is reproduced below:

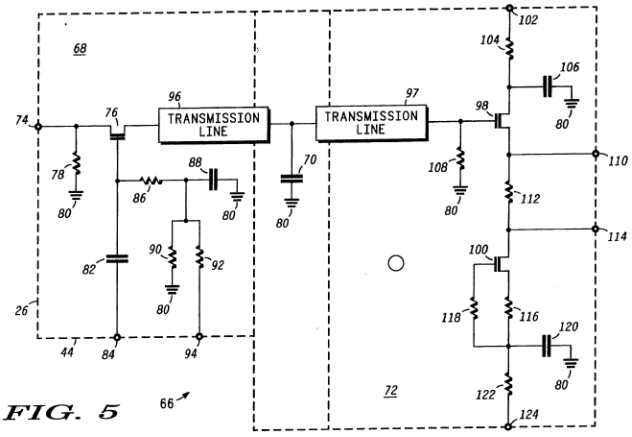


FIG. 5

Figure 5 shows a schematic diagram of a sample and hold circuit. Ex. 1006, 2:67–68.

Schiltz explains that Figure 5 "shows a schematic diagram of one embodiment of sample and hold circuit 26 that achieves a wide bandwidth and is suitable for use in radio 10." *Id.* at 7:39–42. Schiltz states that, "[i]n order to achieve a wide bandwidth, sample and hold circuit 26 is preferably implemented as an integrated circuit," meaning "substantially all components needed by sample and hold circuit 26 reside within a single integrated circuit (IC) 66." *Id.* at 7:46–50. Schiltz further provides that IC 66

> includes a sampling switch 68, a hold capacitor 70, and a buffer amplifier 72. Sampling switch 68 includes a contact 74 of IC 66, which serves as the sampling input. In other words, an RF signal is applied to sample and hold circuit 26 at contact 74. Contact 74 couples to a source of a field effect transistor (FET) 76. FET 76 performs the above-discussed sampling of the RF signal. A matching resistor 78, preferably around fifty ohms, couples between contact 74 and a ground terminal 80, which is adapted to receive a common potential. Matching resistor 78 provides for the termination of fifty ohm transmission lines, which are commonly used to transmit high frequency RF signals.
>
> A gate of FET 76 couples through a DC blocking capacitor 82 to a contact 84 of IC 66. Contact 84 serves as the control input for sample and hold circuit 26. In other words, the stream of sampling pulses is applied to sample and hold circuit 26 at contact 84. The gate of FET 76 also couples to a first node of a matching resistor 86, which preferably exhibits around fifty ohms for termination of fifty ohm transmission lines. An AC shorting capacitor 88 and a biasing resistor 90 each couple between a second node of matching resistor 86 and ground terminal 80. A biasing resistor 92 couples between the second node of matching resistor 86 and a contact 94 of IC 66. When a negative potential, around – 4 Vdc for example, is applied at contact 94 biasing resistors 90 and 92, bias the gate of FET 76 through matching resistor 86. Capacitor 88 provides an AC ground to the second node of matching resistor 86.

> A drain of FET 76 serves as the output of sample switch 68. The schematic diagram of FIG. 5 shows a transmission line 96, which couples sample switch 68 to a first node of hold capacitor 70. The schematic diagram of FIG. 5 also shows a transmission line 97, which couples the first node of hold capacitor 70 and sample switch 68 to an input of buffer amplifier 72. A second node of hold capacitor 70 couples to ground terminal 80.

Id. at 7:58–8:29.

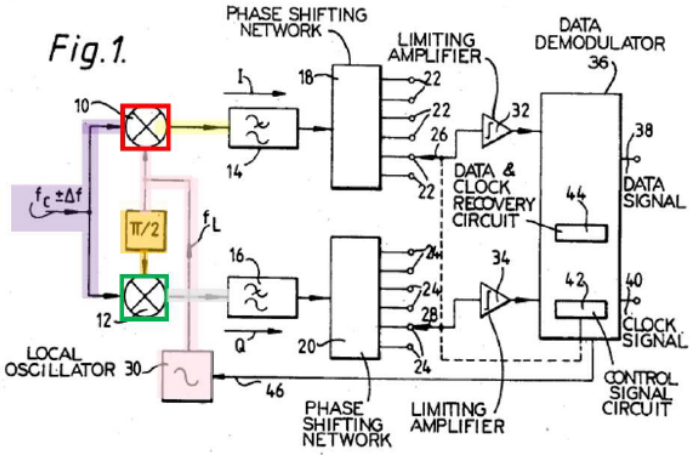
Schiltz states that it provides "an improved radio which uses a sample and hold circuit in various mixing applications, such as down conversion and oscillation signal generation circuits." Ex. 1006, 10:15–18. Schiltz explains that "[d]ue to the accurate high frequency operation, a high bandwidth results when the sample and hold circuit is used as a mixer." *Id.* at 10:29–31. Schiltz further states that "those skilled in the art will appreciate that radio and other architectures other than those described herein may utilize a sample and hold circuit as a mixer." *Id.* at 10:40–43.

3. Differences Between the Prior Art and the Claims; Motivation to Modify

a. Claim 1

i. Element [1pre]

Element [1pre] recites "[a] cable modem for down-converting an electromagnetic signal having complex modulations, comprising." Ex. 1001, 51:5–6. Petitioners assert that "Gibson discloses a modem for down-converting an electromagnetic signal having complex modulations." Pet. 67 (citing Ex. 1005, Fig. 1). Petitioners' annotated version of Gibson's Figure 1 is reproduced below.



Id. at 68. Petitioners annotated Gibson's Figure 1 to highlight the input electromagnetic signal purple, mixer 10 red, mixer 12 green, the in-phase oscillating signal pink, the quadrature-phase oscillating signal orange, the signal following mixer 10 yellow, and the signal following mixer 12 gray. *Id.* Petitioners assert that Gibson's "modem down-converts the modulated carrier signal, for example from a 900 MHz signal to a 4 kHz signal. *Id.* (citing Ex. 1005, 2:55–3:21).

> Petitioners contend that,
>
> [t]o the extent that the preamble is limiting and the electromagnetic signal must have "complex modulations," Gibson discloses that . . . the invention works with I/Q modulation, which were complex modulation formats within the general knowledge of a [person of ordinary skill in the art] at the time.

Pet. 68 (citing Ex. 1005,[39] Fig. 1, 2:55–3:21; Ex. 1002 ¶¶ 178–182). Additionally, Petitioners argue that, "to the extent that the preamble is limiting and requires a 'cable modem,' it would have been obvious to use the modem of Gibson (as modified by Schiltz, discussed below) as a cable

[39] Petitioners cite to Exhibit 1001, but we understand the citation was intended for Gibson, which is Exhibit 1005.

modem, in view of Thacker, Goldberg, ITU-T J.83b, and/or AAPA." *Id.* (citing Pet. § VIII.G.3).

Patent Owner's argument directed to element [1pre] focuses on the recitation of "a cable modem" in the preamble of claim 1. PO Resp. 79. Patent Owner relies on the same arguments it raised regarding the obviousness ground based on the combination of Hulkko and Gibson. *Id.* ("The same arguments regarding this element in connection to Hulkko (as modified by Gibson) apply equally to Gibson (as modified by Schiltz)."). In the context of that obviousness ground, Patent Owner asserts that Hulkko, as modified by Gibson, does not "disclose/teach/suggest 'a cable modem.'" *Id.* at 69–70. Additionally, Patent Owner asserts that it would not have been obvious to use the modem of Hulkko, modified by Gibson, as a cable modem even considering the additional references provided by Petitioners.[40] *Id.* at 70–71.

First, because we determine that the term "cable modem" recited in the preamble of claim 1 is not limiting, *see supra* § II.B, we need not address Patent Owner's arguments directed to that term. Second, Patent Owner does not assert that the other language recited in the preamble of claim 1 is limiting or that Gibson fails to teach the additional recitations (i.e., "down-converting an electromagnetic signal having complex modulations"). We need not determine whether the other language of the preamble of claim 1 is limiting because we agree with Petitioners that Gibson teaches "down-converting an electromagnetic signal having complex modulations" for the

[40] As applied to this obviousness ground, we understand Patent Owner's argument to be that it would not have been obvious to use Gibson, as modified by Schiltz, as a cable modem.

reasons argued by Petitioners, which are uncontested and which we adopt as our own findings.

Additionally, we need not address Petitioners' alternative challenge based on Gibson, Schiltz, Goldberg, Thacker, ITU-T J.83b, and/or AAPA because we do not find that the recitation of "cable modem" in the preamble of claim 1 is limiting. *See* Pet. 17 (presenting this alternative ground "if the Board finds that the preamble of claim 1 is limiting—and thus requires a 'cable modem'"); *see also SAS*, 138 S. Ct. at 1359 (holding that a petitioner "is entitled to a final written decision addressing all of the claims it has challenged"); *Boston Sci. Scimed*, 809 F. App'x at 990 (stating that the "Board need not address issues that are not necessary to the resolution of the proceeding," such as "alternative arguments with respect to claims [the Board] found unpatentable on other grounds").

ii. Element [1A]

Element [1A] recites "an oscillator to generate an in-phase oscillating signal." Ex. 1001, 51:7. Petitioners contend that "Gibson discloses an oscillator (30) to generate an in-phase oscillating signal (f_L)," which Petitioners identify in the annotated version of Gibson's Figure 1 (reproduced above) in pink. Pet. 69 (citing Ex. 1005, Fig. 1, 2:56–3:2; Ex. 1002 ¶¶ 183–184).

Patent Owner does not challenge Petitioners' analysis of element [1A]. *See generally* PO Resp.

We find Petitioners' arguments persuasive as to element [1A] and supported sufficiently on the complete record before us, and, therefore, we adopt them as our own findings. Accordingly, for the reasons explained by Petitioners, we find that Gibson teaches element [1A].

iii. Element [1B]

Element [1B] recites "a phase shifter to receive said in-phase oscillating signal and to create a quadrature-phase oscillating signal." Ex. 1001, 51:8–9. Relying on the same annotated version of Gibson's Figure 1 reproduced above, Petitioners contend that "Gibson discloses a phase shifter ($\pi/2$) to receive said in phase oscillating signal (pink, f_L) and to create a quadrature-phase oscillating signal (orange signal output from '$\pi/2$' to green mixer 12)." Pet. 69–70 (citing Ex. 1005, Fig. 1, 2:56–3:2; Ex. 1002 ¶¶ 185–186).

Patent Owner does not challenge Petitioners' analysis of element [1B]. *See generally* PO Resp.

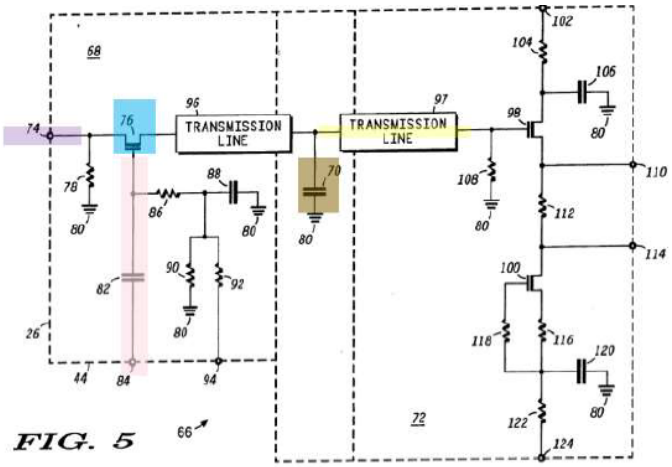
We find Petitioners' arguments persuasive as to element [1B] and supported sufficiently on the complete record before us, and, therefore, we adopt them as our own findings. Accordingly, for the reasons explained by Petitioners, we find that Gibson teaches element [1B].

iv. Element [1C]

Element [1C] recites "a first frequency down-conversion module to receive the electromagnetic signal and said in-phase oscillating signal." Ex. 1001, 51:10–12. Relying on the same annotated version of Gibson's Figure 1, reproduced above, Petitioners contend that "Gibson discloses a first frequency down-conversion module (mixer 10, red) to receive the electromagnetic signal (purple 'f_C +/- Δf') and said in-phase oscillating signal (pink, f_L)." Pet. 70–71 (citing Ex. 1005, Fig. 1).

Petitioners also present an alternative argument "[t]o the extent it is argued or determined that Gibson does not disclose Element [1C]." Pet. 71. In particular, Petitioners assert that "Schiltz discloses a frequency down-

conversion module, specifically, a 'high speed sample and hold circuit' used 'as a mixer.'" *Id.* (citing Ex. 1006, 1:5–10, 3:45–65, 4:29–32, 6:3–10, 7:58–60). Relying on an annotated version of Schiltz's Figure 5, reproduced below, Petitioners contend that "Schiltz's sample and hold circuit (26) shown in Figure 5 (. . . [which] includes the 'impulse generator' of Figure 1) discloses a mixer having a sampling switch 68 (comprising a field effect transistor 76, blue) and a 'hold capacitor' 70 (brown)." *Id.* at 71–72 (footnote omitted) (citing Ex. 1006, Fig. 5).



Id. at 72. Petitioners annotated Schiltz's Figure 5 to color input electromagnetic signal purple, field effect transistor 76 blue, control oscillating signal pink, hold capacitor 70 brown, and sampled signal yellow. *Id.* Petitioners assert that "[t]he input electromagnetic signal (purple) enters at contact 74, which serves as the sampling input and couples to a source of field effect transistor 76 (blue)." *Id.* (citing Ex. 1006, 7:58–8:48). Petitioners contend that "[c]ontact 84 serves as the input for a control oscillating signal (pink) for the sample and hold circuit 26, and couples to a gate of field effect transistor 76." *Id.* (citing Ex. 1006, Fig. 1, 4:8–13). Petitioners assert that "[f]ield effect transistor 76 operates as a switch and samples the incoming signal." *Id.* at 73 (citing Ex. 1006, 7:58–8:48).

Petitioners further contend that "[a] drain of FET 76 is coupled to 'a first node of hold capacitor 70' and serves as the output of the sample and hold switch 68, which outputs a sampled signal (yellow)." *Id.* (citing Ex. 1006, 7:58–8:48; Ex. 1002 ¶¶ 187–190).

Petitioners refer to their argument as to why one of ordinary skill in the art would have been motivated to combine the teachings of Gibson and Schiltz (*see* Pet. 73 ("Motivations to combine the references are set forth above in [Petition] Section VIII.G.2.")), which we discuss here because this is the first element of claim 1 that relies on the combined teachings of the references. In particular, Petitioners assert that one of ordinary skill in the art would have been motivated to use "Schiltz's sample and hold circuit (Ex. 1006, Figs. 1 and 5 at circuit 26) as the mixer in each of the two branches of Gibson's receiver (Ex. 1005, Fig. 2 at mixers 10 and 12)." *Id.* at 46. Petitioners explain that Gibson discloses using two mixers, but "does not describe the precise inner workings of its mixers." *Id.* Schiltz, according to Petitioners, "expressly teaches one of ordinary skill to use its 'sample and hold circuit ***as a mixer***' for down-conversion (like the mixers in Gibson)." *Id.* (citing Ex. 1006, 1:5–10, 10:15–22; Ex. 1002 ¶¶ 137–138). Petitioners contend that one of ordinary skill in the art "would have recognized the benefits of using the sample and hold circuit as taught in Schiltz for each of the mixers disclosed by Gibson," in part because "Schiltz encourages the use of a sample and hold circuit" by stating that "'the sample and hold circuit may be accurately operated at high frequencies' and 'may be applied to virtually any frequency RF and IF signals.'" *Id.* at 47 (citing Ex. 1006, 10:15–48; Ex. 1002 ¶ 139).

Further, Petitioners contend that "combining Gibson with Schiltz would have yielded only expected, predictable results." Pet. 47. In particular, Petitioners explain that

> [e]ach combination would have been (1) a combination of prior art elements according to known methods to yield predictable results, since a [person of ordinary skill in the art] would have understood how to implement a sample and hold mixer (as taught by Schiltz) in the context of Gibson; and (2) obvious to try—a choice of one type of mixer from a finite number of identified, predictable solutions, with a reasonable expectation of success.

Id. (citing *KSR*, 550 U.S. at 416–17, 421; *Leapfrog*, 485 F.3d at 1162; Ex. 1002 ¶ 140).

Patent Owner does not challenge Petitioners' first alternative argument relying on Gibson alone as teaching element [1C]. *See generally* PO Resp. We find Petitioners' first alternative argument persuasive and supported sufficiently on the complete record before us, and, therefore, we adopt them as our own findings. Accordingly, for the reasons explained by Petitioners, we find that Gibson teaches element [1C].

Regarding Petitioners' second alternative argument relying on the combination of Gibson and Schiltz, Patent Owner challenges Petitioners' argument that one of ordinary skill in the art would have been motivated to combine the teachings of these two references as proposed by Petitioners. PO Resp. 81–82. Similar to its arguments in response to Petitioners' combination of Hulkko and Gibson, Patent Owner contends that one of ordinary skill in the art "would not be motivated to combine Gibson with . . . Schiltz because they are directed to *fundamentally different* and competing technologies; Gibson discloses a quadrature (non-sampling) mixer, whereas . . . Schiltz disclose[s] down-conversion by sampling." *Id.* at 81 (citing

Ex. 2038 ¶ 381). Patent Owner asserts that "Schiltz discloses a *sample-and-hold* (*voltage* sampling) circuit" and that its operation "is fundamentally different than the operation of a *non-sampling* mixer/mixing system." *Id.* In particular, Patent Owner contends that "[w]hereas a mixer forms a down-converted signal by mixing two signals (e.g., an RF signal and an LO sinusoid) together, a voltage sampling system uses a switch to sample the input signal and recover a down-converted signal." *Id.* (citing Ex. 2038 ¶ 383).

Patent Owner argues that, "[b]ecause the systems described in Gibson, on the one hand, and Schiltz, on the other hand, are incompatible, a [person of ordinary skill in the art] would not look to the teachings of Schiltz to alter the circuit of Gibson and vice versa." PO Resp. 82. Rather, Patent Owner contends that "[s]uch modifications would require considerable research/development/experimentation that would not yield expected/predictable results." *Id.* (citing Ex. 2038 ¶ 385). And, Patent Owner argues that one of ordinary skill in the art "would understand that replacing the quadrature mixer in Gibson with the sample-and-hold circuit of Schiltz would fundamentally change the intent and design of Gibson." *Id.* (citing Ex. 2038 ¶ 386).

In their Reply, Petitioners assert that "Schiltz expressly encourages use of its 'sample and hold circuit ***as a mixer***' for down-conversion—the same function as the mixers disclosed in Gibson." Pet. Reply 28 (citing Ex. 1006, 1:5–10, 10:15–22). Petitioners contend that "Schiltz encourages the use of its sampling mixer because it 'may be accurately operated at high frequencies' and 'may be applied virtually to any frequency RF and IF signals.'" *Id.* (citing Ex. 1006, 10:15–48; Pet. 46–47).

In its Sur-reply, Patent Owner contends that its argument "go[es] to the incompatibility of different types of mixers," whereas Petitioners focus on the function performed (i.e., down-conversion). PO Sur-reply 18 (citing Pet. Reply 28). Patent Owner contends

> Schiltz discloses a sample-and-hold (voltage sampling) circuit. The operation of a sample and hold/voltage sampling system is fundamentally different than the operation of a non-sampling mixer/mixing system. Whereas a mixer forms a downconverted signal by mixing two signal (e.g., an RF signal and an LO sinusoid) together, a voltage sampling system uses a switch to sample the input signal and recover a down-converted signal.

Id. at 18–19 (citing Ex. 2038 ¶ 383). Patent Owner, thus, asserts that one of ordinary skill in the art "would understand that replacing the quadrature mixer in Gibson with the sample-and-hold circuit of Schiltz would fundamentally change the intent and design of Gibson." *Id.* at 19 (citing Ex. 2038 ¶ 386).

Based on the full record, we find Petitioners' motivation to combine argument persuasive. In particular, the distinction Patent Owner seeks to draw between Gibson and Schiltz, does not undermine Petitioners' argument and evidence that the particular structures proposed for combination are substantially similar, operate in a similar manner, and would have been expected, by one of ordinary skill in the art, to function predictably and with a reasonable expectation of success once combined. Notably, we find particularly persuasive Schiltz's express disclosure *encouraging* the use of its circuit as a mixer. Ex. 1006, 1:7–10 ("The present invention relates generally to high speed electronic circuits. More specifically, the present invention relates to a high speed sample and hold circuit and to radios *which use such a circuit as a mixer*." (emphasis added)); *see id.* at 10:15–18

("[T]he present invention provides an improved radio *which uses a sample and hold circuit in various mixing applications, such as down conversion* and oscillation signal generation circuits." (emphasis added)); *see also id.* at 10:40–43 ("For example, those skilled in the art will appreciate that radio and other architectures other than those described herein *may utilize a sample and hold circuit as a mixer*. In addition, those skilled in the art will understand that *the present invention may be applied to virtually any frequency RF and IF signals*." (emphases added)). Patent Owner's arguments to the contrary appear akin to arguing bodily incorporation, which is not the proper standard by which to determine whether one of ordinary skill in the art would have been motivated to modify Gibson in light of Schiltz. *See, e.g.*, *In re Keller*, 642 F.2d 413, 425 (CCPA 1981) ("it is not necessary that a device shown in one reference can be physically inserted into the device shown in the other").

Accordingly, we find that the combination of Gibson and Schiltz teaches element [1C] and that one of ordinary skill in the art would have been motivated to combine the teachings of these two references as proposed by Petitioners with a reasonable expectation of success.

v. Element [1D]

Element [1D] recites "a second frequency down-conversion module to receive the electromagnetic signal and said quadrature-phase oscillating signal." Ex. 1001, 51:14–16. Relying on the same annotated version of Gibson's Figure 1, reproduced above in our discussion of element [1pre], Petitioners contend that "Gibson discloses a second frequency down-conversion module (mixer 12, green) to receive the electromagnetic signal (purple) and said quadrature-phase oscillating signal (orange)." Pet. 73.

Alternatively, Petitioners assert that

> [t]o the extent it is argued or determined that Gibson does not disclose Element [1D], it would have been obvious to use the frequency down-conversion module of Schiltz in place of the second mixer of Gibson in the same manner and for the same reasons as discussed previously for Gibson's first mixer with respect to Element [1C].

Pet. 74 (citing Ex. 1002 ¶¶ 191–192).

Patent Owner does not challenge Petitioners' first alternative argument relying on Gibson alone as teaching element [1D]. *See generally* PO Resp. We find Petitioners' arguments persuasive and supported sufficiently on the complete record before us, and, therefore, we adopt them as our own findings. Accordingly, for the reasons explained by Petitioners, we find that Gibson teaches element [1D].

Patent Owner's arguments directed to Petitioners' second alternative argument, relying on the combination of Gibson and Schiltz, are directed to whether one of ordinary skill in the art would have been motivated to combine the teachings of these two reference as proposed by Petitioners and are addressed above in our discussion of the combination in element [1C]. For the same reasons explained in our discussion of element [1C] and based on Petitioners' argument and evidence directed to element [1D], we find that the combination of Gibson and Schiltz teaches element [1D] and that one of ordinary skill in the art would have been motivated to combine the teachings of these two references as proposed by Petitioners with a reasonable expectation of success.

vi. Element [1E]

Element [1E] recites "wherein said first frequency down-conversion module further comprises a first frequency translation module." Ex. 1001,

51:17–18. Petitioners contend the "Gibson discloses a first mixer 10 but does not expressly disclose that it has a switch (if a 'frequency translation module' requires one)." Pet. 74. Relying on the same annotated version of Schiltz's Figure 5 reproduced above, Petitioners assert that, "[a]s discussed above with respect to Elements [1C] and [1D], Schiltz discloses a mixer comprising a switch (FET 76, blue) coupled to a storage module (capacitor 70, brown)." *Id.* at 74–75. Petitioners contend "[i]t would have been obvious to use the mixer of Schiltz for each of the mixers (10, 12) in Gibson for the reasons discussed above with respect to Elements [1C] and [1D]." *Id.* at 75 (citing Ex. 1002 ¶¶ 193–194).

Patent Owner's arguments directed to element [1E] are based on whether one of ordinary skill in the art would have been motivated to combine the teachings of Gibson and Schiltz as proposed by Petitioners and are addressed above in our discussion of the combination in element [1C].[41] For the same reasons explained in our discussion of element [1C] and based on Petitioners' argument and evidence directed to element [1E], we find that the combination of Gibson and Schiltz teaches element [1E] and that one of ordinary skill in the art would have been motivated to combine the teachings of these two references as proposed by Petitioners with a reasonable expectation of success.

[41] Patent Owner does not assert that claim 1 requires a "switch," but does contest Petitioners' arguments regarding a switch in the context of dependent claim 18 (*see* PO Resp. 81), which we address below. *See infra* § III.C.3.c (addressing claims 18–20).

vii. Element [1F]

Element [1F] recites "and a first storage module." Ex. 1001, 51:18–19. Petitioners contend that "Gibson does not expressly disclose that first mixer 10 has a storage module (*e.g.*, capacitor)." Pet. 75. Petitioners assert that, "[a]s discussed above with respect to Elements [1C], [1D], and [1E], Schiltz discloses a mixer comprising a switched capacitor, and it would have been obvious to use a mixer in the modem of Gibson for the reasons discussed above with respect to Elements [1C] and [1D]." *Id.* (citing Ex. 1002 ¶ 195).

Patent Owner contends that Schiltz's sample-and-hold capacitor 70 is not a "storage module." PO Resp. 71–79. Patent Owner raises three arguments in support of its position. First, Patent Owner asserts that "Schiltz discloses using the smallest capacitor possible. In particular, Schiltz states that the capacitance of the capacitor 70 'needs to be *as small as possible* so that acquisition time may be as fast as possible and bandwidth extended as far as possible.'" *Id.* at 72 (quoting Ex. 1006, 8:31–34).

Second, Patent Owner contends that Schiltz is a sample-and-hold system and not an energy transfer system. PO Resp. 73 (citing Ex. 1006, 9:13–17; Ex. 2038 ¶¶ 356–357); *see id.* at 77–78 (arguing that Schiltz is a voltage sampling system and noting that Schiltz uses sample and hold terminology). Patent Owner asserts that, "[a]s a sample-and-hold system, a [person of ordinary skill in the art] understands that Schiltz seeks to (1) accurately represent the voltage of the input signal, and (2) take readings of voltage in a capacitor in order to recreate a baseband signal." *Id.* at 73. And, Patent Owner argues that Schiltz holds the voltage on the capacitor using a high impedance load (e.g., around 1,000,000 ohms). *Id.*

Third, Patent Owner contends that it can demonstrate mathematically that Schiltz's capacitor only holds negligible amounts of energy from an input electromagnetic signal. PO Resp. 73–76. Patent Owner asserts that, "given Schiltz's configuration as well as Schiltz's component values and voltage source information, one way to determine energy storage is to perform calculations based on [a] ratio of available RF input power to IF output power." *Id.* at 74. Patent Owner provides several pages of calculations, which result in Patent Owner's contention that "[t]he maximum energy held on the hold capacitor 70 in Fig. 5 is **0.002%** of the energy available in an RF cycle." *Id.* at 76. Thus, Patent Owner contends one of ordinary skill in the art "understands that the capacitor 70 in Schiltz only stores a *negligible* amount of energy." *Id.* (citing Ex. 2059[42] ¶¶ 358–366).

> Relying on Schiltz, Petitioners contend in their Reply that
>
> [f]ield effect transistor 76 operates as a switch and samples the incoming signal. . . . The drain of field effect transistor 76 is coupled to "hold capacitor 70," resulting in sufficient non-negligible energy being transferred from the input EM signal and stored on the capacitor 70 in order to "hold" the sampled signal.

Pet. Reply 23 (citing Ex. 1006, 7:58–8:48; Ex. 1002 ¶¶ 127–128, Pet. 10–11, 39–41, 75). Additionally, relying on Mr. Sorrells' testimony (discussed in detail above with respect to the obviousness ground based on the combination of Hulkko and Gibson), Petitioners assert that "capacitor 70—which accumulates (*i.e.*, integrates) charge/energy—successfully performs down-conversion. . . . [and] [t]his constitutes additional '***proof***' . . . that the

[42] Although Patent Owner cites Exhibit 2059, we understand Patent Owner to have intended to cite to Exhibit 2038 (Dr. Steer's Declaration) as there is no Exhibit 2059 in the record.

capacitor stores non-negligible energy and represents a 'storage module' within the meaning of the claims." *Id.* (citing *ParkerVision*, 621 F. App'x at 1019). Petitioners also contend that Schiltz's capacitor 70 "has a capacitance 'significantly larger' than the 'parasitic capacitance.'" *Id.* at 24 n.9.

Patent Owner's Sur-reply presents essentially the same arguments that Patent Owner raised in response to the obviousness ground based on the combination of Hulkko and Gibson. PO Sur-reply 2–17. In particular, Patent Owner (1) construes "storage module" as limited to an energy transfer system (PO Sur-reply 2–7), (2) contends that Petitioners have not shown that Schiltz's capacitor stores non-negligible amounts of energy (*id.* at 7–9), (3) characterizes Mr. Sorrells' testimony as requiring that a product meet cellular/wireless specifications in order to be considered to "successfully" down-convert (*id.* at 9–13), (4) argues that Petitioners have not shown that Schiltz's system successfully down-converts because "there is no evidence that such specifications were met, and there is no expert testimony otherwise" (*id.* at 13–14), and (5) asserts that Dr. Steer's unrebutted testimony and mathematical calculations do not contradict Mr. Sorrells' testimony because there may be more than one way in which to determine whether there is non-negligible amounts of energy (*id.* at 14–17).

In our discussion of element [1F] in the obviousness ground based on the combination of Hulkko and Gibson, we address the same arguments by Patent Owner, which discussion we refer to and incorporate here because it is equally applicable to both grounds. In terms of considering Schiltz,

which, like Hulkko, is an issued patent,[43] we find that Petitioners have established that Schiltz functions in practice and successfully down-converts. In particular, Schiltz is directed, *inter alia*, to radios that use a high speed sample and hold circuit as a mixer. Ex. 1006, 1:7–10; *see id.* at 2:24–27 ("The above and other advantages of the present invention are carried out in one form by an improved radio having a receiver capable of receiving a wideband RF signal."), 4:29–30 ("Sample and hold circuit 26 operates as a downconverter in radio 10."); *see also* Tr. 101:9–11 (addressing Schiltz's commercial use). Accordingly, because Schiltz is a patent that is presumed to be enabled such that it operates in a manner that successfully down-converts and does so in a commercially viable system that can be used for radios, we find that constitutes sufficient evidence that Schiltz's capacitor 70 is a "storage module" as that term is used in the context of the '835 patent. In other words, Schiltz's capacitor 70 is "a module of a system that stores non-negligible amounts of energy [i.e., energy in amounts that are distinguishable from noise] from an input EM signal." Thus, we find that Petitioners have shown that Schiltz teaches element [1F].

viii. Element [1G]

Element [1G] recites "wherein said first frequency translation module samples the electromagnetic signal at a rate that is a function of said in-phase oscillating signal, thereby creating a first sampled signal." Ex. 1001, 51:19–22. Relying on the same annotated version of Gibson's Figure 1,

[43] As an issued patent, Schiltz is presumed to be enabled. *See, e.g.*, *Cephalon*, 707 F.3d at 1337 (recognizing that an issued patent is presumed to be enabled).

reproduced above in our discussion of element [1pre], Petitioners contend that "Gibson discloses that the first frequency down-conversion module (mixer 10) mixes the electromagnetic signal (purple) with the in-phase oscillating signal (pink)," but "does not expressly disclose sampling." Pet. 76. Petitioners assert that, "[a]s discussed above with respect to Elements [1C], [1D], [1E], and [1F], Schiltz discloses a mixer module comprising a pulse generator and a switched capacitor acting as a 'sample and hold circuit.'" *Id.* Relying on Figure 1 of Schiltz and the same annotated version of Schiltz's Figure 5 reproduced above, Petitioners argue that "mixer module uses an input oscillating signal (pink, such as the one shown as an input to mixer 10 in Figure 1 of Gibson) to generate a stream of oscillating sampling pulses in order to control FET switch 76 which, in conjunction with 'hold capacitor 70,' samples the incoming RF signal (purple) to create a first sampled signal (yellow)." *Id.* at 76–77 (footnote and emphasis omitted). Petitioners assert that "[i]t would have been obvious to use the sampling mixer of Schiltz in place of the mixers (10, 12) in Gibson, for the reasons discussed previously in Section VIII.F.2" of the Petition. *Id.* at 77 (citing Ex. 1002 ¶¶ 196–198).

Patent Owner argues that "Gibson does not perform sampling" and "discloses a *fundamentally different and competing* technology to . . . sampling." PO Resp. 79–80 (citing Ex. 2038 ¶ 377).

Based on the full record, we do not agree with Patent Owner's argument because it amounts to an individual attack on Gibson. It is well-settled that "non-obviousness [cannot be established] by attacking references individually," when, as here, the asserted ground of obviousness is based upon the combined teachings of Gibson and Schiltz. *In re Keller*, 642 F.2d

413, 426 (CCPA 1981). Instead, the test is what the combined teachings of these references would have taught or suggested to one of ordinary skill in the art. *In re Young*, 927 F.2d 588, 591 (Fed. Cir. 1991). As discussed above, Petitioners do not rely on Gibson for sampling. Rather, Petitioners rely on the combination of Gibson and Schiltz. *See, e.g.*, Pet. 76–77. Thus, Patent Owner's contention—that Gibson does not perform sampling—does not respond to Petitioners' proposed combination.

Additionally, Patent Owner's arguments directed to whether one of ordinary skill in the art would have been motivated to combine the teachings of Gibson and Schiltz as proposed by Petitioners and are addressed above in our discussion of the combination in element [1C]. For the same reasons explained in our discussion of element [1C], we disagree with Patent Owner's arguments that one of ordinary skill in the art would not have been motivated to combine the teachings of Gibson and Schiltz as proposed by Petitioners. On the complete record before us, we find that Petitioners have established that the combination of Gibson and Schiltz teaches element [1G] and that one of ordinary skill in the art would have been motivated to combine the teachings of these two references as proposed by Petitioners with a reasonable expectation of success.

ix. Element [1H]

Element [1H] recites "said second frequency down-conversion module further comprises a second frequency translation module." Ex. 1001, 51:23–24. Petitioners assert that "[t]he first and second mixers of Gibson (10, 12) are structurally identical, and it would have been obvious to use the sample and hold mixer of Schiltz as a mixer in Gibson for the reasons discussed previously in element [1E]." Pet. 78. Relying on the

same annotated version of Schiltz's Figure 5, Petitioners contend that "the mixer of Schiltz has a frequency translation module, i.e., a switch (FET 76, blue), that is in turn coupled to a capacitor (70, brown), which down-converts the incoming RF signal (purple) to create a second sampled signal (gray)." *Id.* (citing Ex. 1002 ¶ 199).

Patent Owner's arguments directed to element [1H] are based on whether one of ordinary skill in the art would have been motivated to combine the teachings of Gibson and Schiltz as proposed by Petitioners[44] and are addressed above in our discussion of the combination in element [1C]. Patent Owner does not contest, however, that the combination of Gibson and Schiltz teaches element [1H]. For the same reasons explained in our discussion of element [1C], we find that one of ordinary skill in the art would have been motivated to combine the teachings of Gibson and Schiltz as proposed by Petitioners with a reasonable expectation of success, and based on the arguments and evidence provided by Petitioners, we find that this combination teaches element [1H].

x. Element [1I]

Element [1I] recites "and a second storage module." Ex. 1001, 51:24–25. Petitioners contend that, "[a]s discussed above, the mixer of Schiltz includes a storage module (capacitor 70)." Pet. 79 (citing Ex. 1002 ¶ 200).

We have addressed Patent Owner's arguments directed to whether Schiltz discloses a "storage module" in the context of our consideration of

[44] As addressed in our discussion of element [1E], Patent Owner does not assert that claim 1 requires a "switch," but does contest Petitioners' arguments regarding a switch in the context of dependent claim 18 (*see* PO Resp. 81), which we address below. *See infra* § III.C.3.c (addressing claims 18–20).

element [1F] ("a first storage module") and that discussion and analysis apply equally here. Accordingly, for the same reasons explained in the context of our consideration of element [1F], we find that Petitioners have shown that Schiltz teaches element [1I].

xi. Element [1J]

Element [1J] recites "wherein said second frequency translation module samples the electromagnetic signal at a rate that is a function of said quadrature-phase oscillating signal, thereby creating a second sampled signal." Ex. 1001, 51:25–29. Relying on the same annotated version of Gibson's Figure 1 reproduced above, Petitioners contend that "Gibson discloses that the second frequency down-conversion module (mixer 12) samples the electromagnetic signal (purple) at a rate that is a function of the quadrature-phase oscillating signal (orange)." Pet. 79. Petitioners assert that, "[a]s discussed with respect to Element [1G], Schiltz discloses a mixer comprising a switched capacitor acting as a 'sample and hold circuit.'" *Id.* Petitioners rely on the following annotated version of Schiltz's Figure 5.

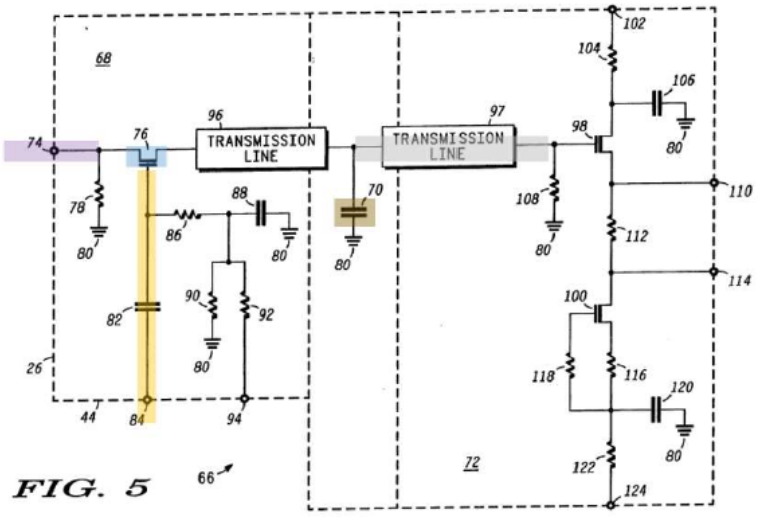


FIG. 5

Id. at 80. Petitioners annotated Schiltz's Figure 5 to highlight input electromagnetic signal purple, input for a control oscillating signal orange,

FET 76 blue, hold capacitor 70 brown, and sampled signal gray. *Id.* Petitioners contend that, "[a]s seen in Figure 5 of Schiltz, that mixer uses an oscillating signal (orange, such as the quadrature-phase one shown as an input to mixer 12 in Figure 1 of Gibson) in order to control FET switch 76 which, in conjunction with 'hold capacitor 70,' samples the incoming RF signal (purple) to create a sampled signal (gray)." *Id.* at 79–80 (emphasis omitted). Petitioners argue that "[i]t would have been obvious to use the sampling mixer of Schiltz in place of the mixers (10, 12) in Gibson, for the reasons discussed previously in Section VIII.G.2" of the Petition. *Id.* at 80 (citing Ex. 1002 ¶¶ 201–203).

To the extent Patent Owner's arguments are directed to element [1J], for example, whether one of ordinary skill in the art would have been motivated to combine the teachings of Gibson and Schiltz, they are addressed above in our discussion of element [1C]. For the same reasons explained above, and based on the arguments and evidence presented by Petitioners, we find that the combination of Gibson and Schiltz teaches element [1J] and that one of ordinary skill in the art would have been motivated to combine the teachings of these two references as proposed by Petitioners with a reasonable expectation of success.

xii. Summary as to Claim 1

For the reasons discussed above, we find that Petitioners have established on the complete record before us that the combination of Gibson and Schiltz teaches each of the elements of claim 1 and that one of ordinary skill in the art would have been motivated to combine the teachings of these two references as proposed by Petitioners with a reasonable expectation of success in so doing.

b. Dependent Claims 12–15 and 17

Claims 12–15 and 17 depend, directly or indirectly, from claim 1. Ex. 1001, 51:60–52:19. Petitioners set forth argument with supporting evidence as to how the combination of Gibson and Schiltz teaches each element of these claims. Pet. 80–83. Patent Owner does not challenge Petitioners' analysis of claims 12–15 and 17. *See generally* PO Resp.

We find Petitioners' arguments supported sufficiently on the complete record before us, and, therefore, we adopt them as our own findings. Accordingly, for the reasons explained by Petitioners, we find that the combination of Gibson and Schiltz teaches the elements of claims 12–15 and 17 and that one of ordinary skill in the art would have been motivated to combine the teachings of these two references as proposed by Petitioners with a reasonable expectation of success.

c. Dependent Claims 18–20[45]

Claim 18 depends from claim 1 and claims 19 and 20 depend, directly or indirectly, from claim 18. Ex. 1001, 51:20–51. Claim 18 recites:

> 18. The cable modem of claim 1, wherein said first frequency translation module comprises a first *switch* coupled to said first storage module, and said second frequency translation module comprises a second *switch* coupled to said second storage module, and
>
> wherein said first frequency down-conversion module further comprises a first control signal generator coupled to said first switch and coupled to receive said in-phase oscillating signal, and said second frequency down-conversion module further comprises a second control signal generator coupled to

[45] We group these claims together because Patent Owner raises a separate argument directed to dependent claim 18 that applies to claims 19 and 20 because of their dependency from claim 18.

> said second switch and coupled to receive said quadrature-phase oscillating signal.

Ex. 1001, 52:20–33 (emphases added).

Petitioners rely on their discussion of claim 1 for most of the elements of claim 18. *See* Pet. 83 ("As to the first modules, *see* Elements [1C], [1E], [1F], and [1G], *supra*. As to the second modules, *see* Elements [1D], [1H], [1I], and [1J], *supra*."). Petitioners assert that

> [a]s discussed above, the first and second frequency down-conversion modules in Gibson are structurally identical, the only difference being that the in-phase oscillating signal i[s] used to generate the sampling pulses that control the switch in the first module, while the quadrature-phase oscillating signal is used to generate the sampling pulses that control the second switch.

Id. at 84 (citing Ex. 1004, Fig. 1, 2:56–67). Petitioners contend "Schiltz discloses using a control signal generator (Fig. 1, 'impulse generator' 34 coupled through node 84 in Fig. 5) that is coupled to the respective switch (FET 76) and coupled to receive the respective oscillating control signal." *Id.* at 84–85 (referring to Petitioners' discussion of Element [1C]) (internal footnote omitted) (citing Ex. 1006, 4:8–13; Ex. 1002 ¶¶ 211–212).

In a section with the heading "Gibson does not disclose 'sampling' or a 'switch' (claim 1, 18)" (PO Resp. 79 (bold omitted)), Patent Owner first argues that Gibson does not disclose sampling. *Id.* at 79–80. We addressed this argument above, explaining that Petitioners rely on Schiltz for sampling, not Gibson. *See supra* § III.C.3.a.viii (element [1G]); *see also* Pet. 76 (relying on Schiltz for sampling as part of element [1G]), 79 (relying on Schiltz for sampling as part of element [1J]).

Second, Patent Owner contends that dependent "[c]laim 18 recites a first and second 'switch.' As discussed in Section VIII, non-sampling

mixers use FETs as time-varying *resistors*, not as *switches*." PO Resp. 81 (citing Ex. 2038 ¶ 380). In Section VIII of the Patent Owner Response, Patent Owner asserts that "[a] FET is a type of transistor that can amplify, oscillate, *or* switch the flow of current between two terminals by varying the current or voltage at a third terminal. In other words, a FET can behave and be used in *different* ways." *Id.* at 23 (citing Ex. 2038 ¶ 195); *see also id.* at 23–27 (discussing different uses of FETs). Even assuming Patent Owner is correct, the argument does not detract from Petitioners' position because Petitioners rely on the operation of FET 76 from Schiltz as teaching the recited switch (*see, e.g.*, Pet. 79–80 (referring to Schiltz's FET 76)), and Patent Owner does not contend that Schiltz is a non-sampling mixer (instead, Patent Owner contends that Gibson is a non-sampling mixer).

We find Petitioners' arguments supported sufficiently on the complete record before us, and, therefore, we adopt them as our own findings. Accordingly, for the reasons explained by Petitioners and as explained further above, we find that the combination of Gibson and Schiltz teaches the subject matter of claims 18–20 and that one of ordinary skill in the art would have been motivated to combine the teachings of these two references as proposed Petitioners with a reasonable expectation of success.

4. Objective Indicia of Nonobviousness

Patent Owner relies on the same arguments and evidence regarding objective indicia of nonobviousness that we addressed above, in the context of considering the obviousness ground based on the combination of Hulkko and Gibson. *See* PO Resp. 21–22 (addressing objective indicia generally), 78 (addressing the combination of Gibson and Schiltz). Our discussion, analysis, and findings from the obviousness ground based on the

combination of Hulkko and Gibson apply equally here. *See supra* § III.B.4 (finding that Patent Owner fails to establish that a presumption of nexus is warranted and similarly fails to establish nexus absent the presumption). As stated above, we consider Patent Owner's weak evidence of nonobviousness in our weighing of the *Graham* factors below.

5. Weighing the Graham Factors

"Once all relevant facts are found, the ultimate legal determination [of obviousness] involves the weighing of the fact findings to conclude whether the claimed combination would have been obvious to an ordinary artisan." *Arctic Cat*, 876 F.3d at 1361. On balance, considering the complete record before us and for the reasons explained above, the evidence of obviousness is very strong and the evidence of nonobviousness, which includes Patent Owner's objective evidence of nonobviousness, is very weak. As a result of that balancing, we determine that Petitioners have established by a preponderance of the evidence that the combination of Gibson and Schiltz would have rendered the subject matter of claims 1, 12–15, and 17–20 obvious to one of ordinary skill in the art at the time of the invention.

IV. SUMMARY[46]

For the reasons discussed above, Petitioners have demonstrated, by a preponderance of the evidence, that claims 1, 12–15, and 17–20 of the '835 patent are unpatentable.

Our conclusions regarding the Challenged Claims are summarized below:

Claims Challenged	35 U.S.C. §	Reference(s) /Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1, 12, 15, 17	103(a)	Hulkko, Gibson	1, 12, 15, 17	
1, 12, 15, 17	103(a)[47]	Hulkko, Gibson, Goldberg, Thacker, ITU-T J.83b, AAPA		
1, 12–15, 17–20	103(a)	Gibson, Schiltz	1, 12–15, 17–20	

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

[47] For the reasons explained above, we do not reach this alternative ground because we do not find that "cable modem" (recited in the preamble of claim 1) is limiting. *See supra* § III.B.3.a.i (element [1pre]).

Claims Challenged	35 U.S.C. §	Reference(s) /Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1, 12–15, 17–20	103(a)[48]	Gibson, Schiltz Goldberg, Thacker, ITU-T J.83b, AAPA		
Overall Outcome			1, 12–15, 17–20	

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1, 12–15, and 17–20 of U.S. Patent No. 7,292,835 B2 are determined to be unpatentable; and

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

[48] For the reasons explained above, we do not reach this alternative ground because we do not find that "cable modem" (recited in the preamble of claim 1) is limiting. *See supra* § III.C.3.a.i (element [1pre]).

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