

[REDACTED]

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TEXAS INSTRUMENTS INC. and
NXP USA, INC.,
Petitioner,

v.

PARKERVISION, INC.
Patent Owner.

IPR2024-00936¹
Patent 9,118,528 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)
Denying Petitioner's Motion to Exclude and
Dismissing in Part and Denying in Part
Patent Owner's Motion to Exclude
37 C.F.R. § 42.64(c)

¹ NXP USA, Inc., who filed a petition in IPR2024-01068, is joined as petitioner in this proceeding.

I. INTRODUCTION

A. Background

Texas Instruments Inc. (“Petitioner”) filed a Petition (Paper 2, “Pet.”) requesting institution of *inter partes* review (“IPR”) of claims 1–5, 8, 9, 11–23, 26, 27, and 29–36² (“the Challenged Claims”) of U.S. Patent No. 9,118,528 B2 (Ex. 1001, “the ’528 patent”). ParkerVision, Inc. (“Patent Owner”) filed a Preliminary Response (Paper 6, “Prelim. Resp.”). Applying the standard set forth in 35 U.S.C. § 314(a), we instituted an IPR as to the Challenged Claims on all grounds set forth in the Petition. Paper 9 (“Inst. Dec.”).

After institution, Patent Owner filed a Patent Owner Response (Paper 21,³ “PO Resp.”), Petitioner filed a Reply (Paper 31,⁴ “Pet. Reply”), and Patent Owner filed a Sur-reply (Paper 39,⁵ “Sur-reply”).⁶ Additionally, Patent Owner filed a Motion to Exclude Evidence (Paper 46,⁷ “PO MTE”),

² In the Institution Decision, we explained that “[f]rom the context of the analysis and discussion in the Petition, we understand Petitioner to challenge claim 29 and not claim 28 even though, in several places, the Petition either incorrectly includes claim 28 or omits claim 29.” Paper 9 (“Inst. Dec.”), 2 n.1. Counsel generally agreed at the oral argument that claim 29, and not claim 28, was challenged in the Petition. Paper 68 (“Tr.”), 172:5–173:17.

³ A public version of Patent Owner’s Response is of record as Paper 22.

⁴ A public version of Petitioner’s Reply is of record as Paper 57.

⁵ A public version of Patent Owner’s Sur-reply is of record as Paper 44.

⁶ As reflected in Paper 67, we granted in part and dismissed in part Patent Owner’s Motions to Seal, granted Petitioner’s Motions to Seal, and Granted Patent Owner’s Motion for Entry of a Protective Order.

⁷ A public version of Patent Owner’s Motion is of record as Paper 73.

Petitioner filed an Opposition to Patent Owner’s Motion (Paper 47,⁸ “Pet. Opp.”), and Patent Owner filed a Reply in support of its Motion (Paper 53,⁹ “PO MTE Reply”). Petitioner also filed a Motion to Exclude Evidence (Paper 45,¹⁰ Pet. MTE), Patent Owner filed an Opposition to Petitioner’s Motion (Paper 48,¹¹ “PO Opp.”), and Petitioner filed a Reply in support of its Motion (Paper 55,¹² “Pet. MTE Reply”). An oral hearing was held on September 10, 2025, and the transcript is of record. Paper 68, “Tr.”¹³

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. Petitioner bears the burden of proving unpatentability of the Challenged Claims. *Dynamic Drinkware*,

⁸ Petitioner timely filed its Opposition as Paper 47 without including the confidential header required by the Protective Order and then refiled the Opposition as Paper 51, including the header. To avoid confusion (because the Opposition includes information subject to the Protective Order) and for clarity of the record, we exercise our authority under 37 C.F.R. § 42.7(a) to expunge Paper 47. A public version of Petitioner’s Opposition is of record as Paper 71.

⁹ A public version of Patent Owner’s Reply is of record as Paper 57.

¹⁰ Petitioner timely filed its Motion as Paper 45 without including the confidential header required by the Protective Order and then refiled the Motion as Paper 50, including the header. To avoid confusion (because the Motion includes information subject to the Protective Order) and for clarity of the record, we exercise our authority under 37 C.F.R. § 42.7(a) to expunge Paper 45. A public version of Petitioner’s Motion is of record as Paper 70.

¹¹ A public version of Patent Owner’s Opposition is of record as Paper 74.

¹² A public version of Petitioner’s Reply in support of its Motion is of record as Paper 72.

¹³ A public version of the transcript is of record as Paper 76.

LLC v. Nat'l Graphics, Inc., 800 F.3d 1375, 1378 (Fed. Cir. 2015). To prevail, Petitioner must prove unpatentability by a preponderance of the evidence. *See* 35 U.S.C. § 316(e) (2018); 37 C.F.R. § 42.1(d) (2021). Having reviewed the arguments and the supporting evidence, we determine that Petitioner has shown, by a preponderance of the evidence, that the Challenged Claims of the '528 patent are unpatentable. Additionally, for the reasons explained below, we *deny* Petitioner's Motion to Exclude, and we *dismiss in part and deny in part* Patent Owner's Motion to Exclude.

B. Related Proceedings

Petitioner identifies the following litigation involving the '528 patent: *ParkerVision, Inc. v. Texas Instruments Inc.*, No. 6:23-cv-00384 (W.D. Tex.) ("Western District of Texas Litigation"); *ParkerVision, Inc. v. NXP Semiconductors NV*, No. 6:23-cv-00389 (W.D. Tex.); *ParkerVision, Inc. v. Realtek Semiconductor Corp.*, 6:23-cv-00374 (W.D. Tex.); *ParkerVision, Inc. v. MediaTek, Inc.*, No. 6:23-cv-00375 (W.D. Tex.); *ParkerVision, Inc. v. LG Electronics, Inc.*, 6:21-cv-00520 (W.D. Tex.); *ParkerVision, Inc. v. Buffalo Inc.*, 6:20-cv-01009 (W.D. Tex.); *ParkerVision, Inc. v. ZyXEL Communications Corp.*, 6:20-cv-01010 (W.D. Tex.); *ParkerVision, Inc. v. TCL Industries Holdings Co.*, 6:20-cv-00945 (W.D. Tex.); *ParkerVision, Inc. v. Hisense Co.*, 6:20-cv-00870 (W.D. Tex.); *ParkerVision, Inc. v. TCL Technology Group Corp.*, 5:20-cv-01030 (C.D. Cal.); *ParkerVision, Inc. v. Intel Corp.*, 6:20-cv-00108 (W.D. Tex.); *ParkerVision, Inc. v. LG Electronics, Inc.*, 2:17-cv-05359 (D.N.J.); *RF Capable Integrated Circuits and Products Containing the Same*, 337-TA-982 (USITC); and *ParkerVision, Inc. v. Apple Inc.*, 3:15-cv-01477 (M.D. Fla.). Pet. 97. Patent

Owner identifies the first four cases listed above as being “current[.]”

Paper 7 (Patent Owner’s Updated Mandatory Notices), 2.

Additionally, in response to an Order (Paper 77) requiring the parties to indicate the relevancy of several decisions in related cases identified by Patent Owner, Patent Owner filed an Identification of Decision in Related Matters (Paper 78), which identifies nine decisions from eight of the cases listed above.

C. Real Parties in Interest

Petitioner Texas Instruments Inc. identifies itself as a real party in interest. Pet. 96. Petitioner NXP USA, Inc. identifies itself, NXP Semiconductors N.V., NXP B.V., and Freescale Semiconductors Holdings V, Inc. as real parties in interest. IPR2024-01068, Paper 2 (Petition), 98. Patent Owner identifies ParkerVision, Inc. as a real party in interest. Paper 7, 1.

D. The Asserted Grounds of Unpatentability and Declaration Evidence

Petitioner challenges the patentability of claims 1–5, 8, 9, 11–23, 26, 27, and 29–36 of the ’528 patent on the following four grounds:

Claim(s) Challenged	35 U.S.C. § ¹⁴	Reference(s)/Basis
1, 5, 8, 9, 11–19, 23, 26, 27, 29–36	103(a)	Tayloe, ¹⁵ TI Datasheet, ¹⁶ Macnally ¹⁷

¹⁴ The Leahy-Smith America Invents Act (“AIA”) includes revisions to 35 U.S.C. § 103 that became effective on March 16, 2013. Although Petitioner contests whether the ’528 patent is entitled to its full priority claim (*see* Pet. 1–2 (noting that the priority claim includes continuation-in-part applications)), Petitioner assumes the ’528 patent is entitled to its full priority claim for purposes of determining whether the asserted references qualify as prior art. Because Petitioner does not present its challenge to the ’528 patent’s priority for our consideration, we assume for purposes of this Decision that the ’528 patent is entitled to its full priority claim and, therefore, we apply the pre-AIA version of the statutory basis for unpatentability. *See* Ex. 1001, code (60) (claiming priority to October 21, 1998).

¹⁵ U.S. Patent No. 6,230,000 B1, issued May 8, 2001 (Ex. 1004, “Tayloe”).

¹⁶ Texas Instruments, *SN74CBT3253 Dual 1-of-4 FET Multiplexer/Demultiplexer*, 1–23 (2004) (Ex. 1005, “TI Datasheet”).

¹⁷ U.S. Patent No. 7,065,327 B1, issued June 20, 2006 (Ex. 1021, “Macnally”). Petitioner contends that “Macnally is entitled to its provisional filing date, because Macnally and the Macnally-Provisional [Ex. 1022] share virtually identical figures and similar descriptions of those figures.” Pet. 21. Petitioner asserts that, although the Macnally-Provisional omits some of disclosure of Macnally—the priority paragraph, summary of the claims, some overview paragraphs, the abstract, and the claims—“columns 5–8, the core of [Macnally’s] description, is nearly identical to the provisional.” *Id.* Thus, Petitioner contends “[t]he corresponding disclosures in the Macnally-Provisional support[] at least one claim of Macnally (the patent).” *Id.* at 21–22 (citing Ex. 1003 ¶¶ 112–114). Patent Owner does not contest Petitioner’s assertions regarding the effective filing date of Macnally. *See generally* PO Resp. Since Patent Owner does not contest Petitioner’s assertions regarding Macnally’s effective filing date, we do not include citations to Exhibit 1022 to simplify the record.

Claim(s) Challenged	35 U.S.C. § ¹⁴	Reference(s)/Basis
2–4, 20–22	103(a)	Tayloe, TI Datasheet, Macnally Cahn ¹⁸
1, 5, 8, 9, 11–19, 23, 26, 27, 29–36 ¹⁹	103(a)	Razavi, ²⁰ Macnally
2–4, 20–22	103(a)	Razavi, Macnally, Cahn

Pet. 1.

Additionally, Petitioner supports its challenge with a (first) Declaration of Ian Galton, Ph.D. (Ex. 1003), a Declaration of June Ann Munford (Ex. 1014), a Declaration of Rickea McLeod (Ex. 1015), a Declaration of Maureen M. Honeycutt (Ex. 1018), a (corrected) Second Declaration of Dr. Ian Galton (Ex. 1066²¹), a Supplemental Declaration of

¹⁸ C. Cahn, *Combined Digital Phase and Amplitude Modulation Communication Systems*, 1960 IEEE/IRE Transactions on Communications Systems, Vol. 8, Issue 3 (Sept.), 150–55 (Ex. 1007, “Cahn”).

¹⁹ For the reasons discussed above, we identify claim 29 and not claim 28 in this ground.

²⁰ B. Razavi, *A 900-MHz CMOS Direct Conversion Receiver*, 1997 Symposium on VLSI Circuits Digest of Technical Papers, 113–14 (Ex. 1017, “Razavi”).

²¹ Petitioner first filed a Second Declaration of Dr. Ian Galton on June 27, 2025, and one day later filed a corrected Second Declaration using the same exhibit number (Ex. 1066) without indicating in the document itself that the declaration was corrected (the “corrected” indication exists solely in the “Document name” listed in our docketing system and was provided by Petitioner when filing the document). To clarify the record, we exercise our authority under 37 C.F.R. § 42.7(a) and expunge the first filed Exhibit 1066 that was replaced with the corrected version. To avoid confusion, after this introduction, we do not refer to Dr. Galton’s Second Declaration as “corrected” since that indication is not identified in the declaration itself.

Dr. James Dickens (Ex. 1067²²), and a second Declaration of June Munford (Ex. 1069). Patent Owner supports its arguments with a Declaration of David Sorrells (Ex. 2016²³), a Declaration of Dr. David Ricketts (Ex. 2024), and a Declaration of Taylor Lepore (Ex. 2041). Additionally, Petitioner filed deposition transcripts of Dr. Ricketts (Ex. 1065 (taken June 13, 2025)) and Mr. Sorrells (Ex. 1068 (taken May 23, 2025)), and Patent Owner filed deposition transcripts of Dr. Galton (Exs. 2034 (taken Mar. 12, 2025), 2042 (taken July 16, 2025)) and Dr. Dickens (Ex. 2043²⁴ (taken July 18, 2025)).

E. The '528 Patent

The '528 patent is directed to “methods, systems, and apparatuses, and combinations and sub-combinations thereof, for down-converting an electromagnetic (EM) signal.” Ex. 1001, code (57). More particularly, the '528 patent “relates to down-conversion of EM signals to intermediate frequency signals, to direct down-conversion of EM modulated carrier signals to demodulated baseband signals, and to conversion of [frequency modulation ('FM')] signals to non-FM signals.” *Id.* at 1:65–2:2. And, the '528 patent teaches under-sampling and transferring energy at aliasing rates. *Id.* at 2:2–4.

²² Although titled as a “Supplemental Declaration,” Exhibit 1067 is the only declaration provided by Dr. Dickens.

²³ Exhibit 2016 was first filed on April 4, 2025, and a “corrected” exhibit was filed the same day. To clarify the record, we exercise our authority under 37 C.F.R. § 42.7(a) and expunge the originally filed Exhibit 2016 that was replaced with the corrected version.

²⁴ Exhibit 2043 was first filed on July 25, 2025, and a “corrected” version was filed on August 1, 2025. To clarify the record, we exercise our authority under 37 C.F.R. § 42.7(a) and expunge the originally filed Exhibit 2043 that was replaced with the corrected version.

As pertains to the Challenged Claims, the '528 patent describes “I/Q modulation receiver 19700 [that] receives, down-converts, and demodulates a I/Q modulated [radio frequency ('RF')] input signal 19782 to an I baseband output signal 19784, and a Q baseband output signal 19786.”

Ex. 1001, 176:47–51. The '528 patent explains that

I/Q modulation receiver 19700 comprises a first Processing module 19702, a first optional filter 19704, a second Processing module 19706, a second optional filter 19708, a third Processing module 19710, a third optional filter 19712, a forth Processing module 19714, a fourth filter 19716, an optional [low noise amplifier] 19718, a first differential amplifier 19720, a second differential amplifier 19722, and an antenna 19772.

Id. at 176:40–46.

Figure 197 is reproduced below.

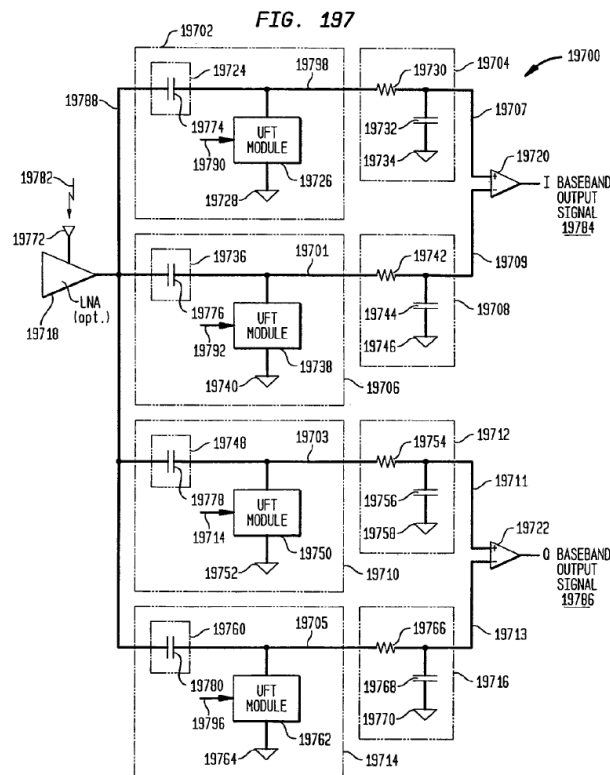


Figure 197 “illustrates an exemplary I/Q modulation receiver.” Ex. 1001, 12:24–25.

The '528 patent explains that “First Processing module 19702 down-converts the I-phase signal portion of amplified input I/Q signal 19788 according to an I control signal 19790.” *Id.* at 176:62–64. “[F]irst Processing module 19702 comprises a first storage module 19724, a first [universal frequency translator (‘UFT’)] module 19726” and “a switch contained within first UFT module 19726 [that] opens and closes as a function of I control signal 19790.” *Id.* at 176:66–177:3. The '528 patent teaches that, “[a]s a result of the opening and closing of this switch . . . a down-converted signal, referred to as I output signal 19798, results.” *Id.* at 177:3–7.

According to the '528 patent, “[s]econd Processing module 19706 down-converts the inverted I-phase signal portion of amplified input I/Q signal 19788 according to an inverted I control signal 19792.” Ex. 1001, 177:32–36. I output signal 19798 is filtered and first filter 19704 outputs filtered I output signal 19707. *Id.* at 177:16–30. Inverted I output signal 19701 is filtered and second filter 19708 outputs filtered inverted I output signal 19709. *Id.* at 177:55–178:2.

Continuing to describe Figure 197, the '528 patent explains that “[f]irst differential amplifier 19720 receives filtered I output signal 19707 . . . and receives filtered inverted I output signal 19709” to “output[] I baseband output signal 19784.” Ex. 1001, 178:3–8. Similarly, third processing module 19710 and fourth processing module 19714 also operate on amplified input I/Q signal 19788 and produce, respectively, Q output signal 19703 and inverted Q output signal 19705, which are filtered and provided to “[s]econd differential amplifier 19722.” *Id.* at 178:26–179:22, 179:34–40.

Figure 110A is reproduced below.

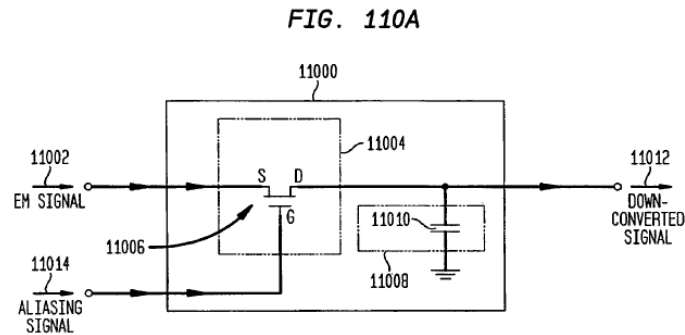


Figure 110A illustrates “aliasing module 11000 [as] a single [field effect transistor (‘FET’)] configuration.” Ex. 1001, 9:43–44. In one embodiment, the ’528 patent teaches that “UFT module 11004 is implemented as a n-channel FET 11006, and storage module 11008 is implemented as a capacitor 11010.” *Id.* at 108:30–33.

F. Illustrative Claim

Claim 1, the sole independent claim challenged in this proceeding, is reproduced below with Petitioner’s bracketing added for reference:

1. 1[a] A system for frequency down-converting a modulated carrier signal to a baseband signal, comprising:
 - 1[b] a first switch coupled to a first control signal which comprises a sampling aperture with a specified frequency, wherein the first switch is on and a portion of energy that is distinguishable from noise is transferred from the modulated carrier signal as an output of said first switch during the sampling aperture of the first control signal;
 - 1[c] a first energy storage element that stores the transferred energy from the modulated carrier signal and outputs a down-converted in-phase baseband signal portion of said modulated carrier signal;
 - 1[d] a second switch coupled to a second control signal which comprises a sampling aperture with a specified frequency, wherein the second switch is on and a portion of energy that is distinguishable from noise is transferred from the

modulated carrier signal as an output of said second switch during the sampling aperture of the second control signal;

1[e] a second energy storage element that stores the transferred energy from the modulated carrier signal and outputs a down-converted inverted in-phase baseband signal portion of said modulated carrier signal;

1[f] wherein the portions of transferred energy from each of the first and second switch are integrated over time to accumulate said portions of transferred energy from which said down-converted in-phase baseband signal portion and said down-converted inverted in-phase baseband signal portion are derived; and

1[g] a first differential amplifier circuit that combines said down-converted in-phase baseband signal portion with said down-converted inverted in-phase baseband signal portion and outputs a first channel down-converted differential in-phase baseband signal.

Ex. 1001, 192:32–65; *see* Pet. v (indicating Petitioner’s bracketing).

II. 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.” (alteration in original))).

“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). “[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. Level of Ordinary Skill in the Art

Petitioner, supported by Dr. Galton’s testimony, proposes 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 the field of EM circuit design.” Pet. 6

(citing Ex. 1003 ¶¶ 68–71). Petitioner further proposes that “[l]ess work experience may be compensated by a higher level of education, such as a master’s degree.” *Id.*

Patent Owner did not take a position in the Preliminary Response as to the level of ordinary skill in the art. *See generally* Prelim. Resp. And, at the preliminary stage, we adopted Petitioner’s uncontested, proposed level of ordinary skill in the art, which we found consistent with the level of ordinary skill in the art reflected by the ’528 patent and the prior art of record. Inst. Dec. 13 (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 its Response, Patent Owner contends that one of ordinary skill in the art “would have

- (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/development of radio frequency circuits and/or systems, or (b) at least five (5) years of work experience and training in the design/development of radio frequency circuits and/or systems.

PO Resp. 3 (citing Ex. 2024 ¶ 30). Neither Patent Owner nor Dr. Ricketts explains why their proposal differs from that proposed by Petitioner. In its Reply, Petitioner does not specifically respond to Patent Owner’s definition of the level of ordinary skill in the art. *See generally* Pet. Reply.

Patent Owner’s option (a) is substantially the same as Petitioner’s 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 differences in proposals

affect the outcome of this proceeding, and we do not find that they do. 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 '528 patent, and the opinions of Drs. Galton and Ricketts. 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 at least a bachelor's degree in electrical engineering or a related subject and two or more years of experience in the field of electromagnetic (EM) circuit design, or at least five years of work experience and training in the design and development of EM²⁵ 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.²⁶

C. Claim Construction

In this IPR, 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*

²⁵ We use EM here instead of "radio frequency" for consistency with the experience noted previously, but our analysis herein would not change whether the experience were in EM circuits and/or systems or RF circuits and/or systems.

²⁶ The level of ordinary skill in the art is the same as that which we adopt in the Final Written Decision in related case IPR2024-00935.

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 Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’”) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

1. “energy storage element”

Petitioner contends that the claims should be construed according to their plain and ordinary meaning, with one exception. Pet. 3. Specifically, Petitioner asserts “storage element” and “energy storage element” are recited “interchangeably” in the claims and should each be construed to mean “**an**

element of a system that stores non-negligible amounts of energy from an input EM signal,” as previously “determined by the Board and affirmed by the [U.S. Court of Appeals for the] Federal Circuit.” *Id.* (citing *ParkerVision, Inc. v. Vidal*, 88 F.4th 969, 976 (Fed. Cir. 2023) (holding that “ParkerVision acted as its own lexicographer to define the term ‘storage element’” and “the Board’s construction of ‘storage element’ [(quoted above)] correctly tracks the lexicography provided by [ParkerVision]”) (citing U.S. Patent No. 6,061,551 A (“the ’551 patent”), 66:55–67)).

Petitioner contends that, like U.S. Patent No. 7,110,444 (“the ’441 patent”) that was at issue in *ParkerVision v. Vidal*, the ’528 patent also incorporates the ’551 patent by reference. Pet. 4 (citing Ex. 1001, 1:30–34). And Petitioner notes that the ’528 patent “includes an identical disclosure to that deemed dispositive from the incorporated by reference ’551 patent.” *Id.* (citing Ex. 1001, 73:9–22 (which Petitioner contends defines “storage module”)). Further, Petitioner asserts “[n]o intrinsic evidence demands a different construction” because, even though claim 1 recites “system,” “energy,” and “transfer,” it does so “in isolation” and “does not recite ‘energy transfer system,’ let alone restrict the claimed ‘storage element’ to any energy transfer system.” *Id.* at 5 (also contending the file history of the ’528 patent does not support a different construction). Petitioner further contends “the proposed combinations teach the claimed ‘storage element’ or ‘energy storage element,’ even including the alleged condition of ‘low impedance load’ that purportedly ‘goes to the heart of what makes an element, a “storage” element.’” *Id.*

Patent Owner did not take a position on claim construction in the Preliminary Response (*see generally* Prelim. Resp.) and, on the preliminary

record at that time, we agreed with Petitioner that “storage element” and “energy storage element” “are used interchangeably in the claims and should be construed consistently with our prior construction of ‘storage element,’” which, we noted, was affirmed by the Federal Circuit to mean “an element of a system that stores non-negligible amounts of energy from an input EM signal.” Inst. Dec. 15.

In its Response, Patent Owner contends that “energy storage element” would have been understood by one of ordinary skill in the art to be “an element used in an energy transfer system.” PO Resp. 53. Patent Owner asserts that, unlike the claims at issue in the prior case involving the ’441 patent, the claims at issue here “recite transferring energy and other claim language that are specific (directed) to an energy transfer system.” *Id.* (pointing to the following phrases recited in claim 1: “a portion of energy that is distinguishable from noise is transferred from the modulated carrier signal,” “energy storage element that *stores the transferred energy* . . . ,” “the *portions of transferred energy* . . . are *integrated over time to accumulate said portions of transferred energy* from which [the down-converted signals portions] are derived.” (alteration, omissions, and emphasis in original)).

Additionally, Patent Owner contends that the construction of “storage element” already includes “non-negligible amounts of energy” and, thus, one of ordinary skill in the art would understand that “energy storage element” must be something more than just an element that stores energy; otherwise, the term “energy” in “energy storage element” would be meaningless. PO Resp. 53.

Further, Patent Owner contends that “[a]n ‘*energy* storage element’ is a use [sic] to denote a component of an energy transfer system. A ‘holding’ element refers to a component of a voltage sampling system.” PO Resp. 53; *see id.* at 54–56 (referring to Figures 82B, 29G, and 78B and distinguishing “holding” module from “storage” module). Thus, Patent Owner contends that “energy storage element” should be construed as “an element of an energy transfer system that stores non-negligible amounts of energy from an input EM signal.” *Id.* at 56.

In its Reply, Petitioner reiterates that the ’528 patent uses the terms “storage element” and “energy storage element” interchangeably and that through its construction, Patent Owner seeks to shoehorn in a requirement that an energy transfer system must have a low impedance load. Pet. Reply 20–21. Petitioner contends that Patent Owner ignores that the ’528 patent uses “storage element” and “energy storage element” interchangeably, that, of these two terms, the only term defined in the Specification is “storage element,” and that the express definition of “storage element” includes the term “energy” because that is what is stored by a “storage element.” *Id.* at 21. Petitioner also asserts that Patent Owner’s argument—that “energy storage element” must mean something different than “storage element” because the word “energy” would otherwise be redundant with the meaning of “storage element,” which includes the term “energy”—makes no sense because the same logic would dictate that the term “storage” in “energy storage element” is rendered redundant because a “storage element” *stores* non-negligible amounts of energy. *Id.*

Additionally, Petitioner contends that Patent Owner’s construction “is also wrong for reading into the claims an entire unrecited system,” a

contention Petitioner asserts the Board previously rejected in IPR2020-01265. Pet. Reply 21 (citing *Intel Corp. v. ParkerVision, Inc.*, IPR2020-01265, Paper 44 at 32–38, *aff'd*, *ParkerVision, Inv. v. Vidal*, 88 F.4th 969, 976 (Fed. Cir. 2023)). Petitioner asserts that the claims here are similar to those in IPR2020-01265 because in neither instance do the claims recite an energy transfer system when mentioning the terms “system,” “energy,” and “transfer” in isolation. *Id.* at 21–22.

Further, Petitioner notes that Patent Owner’s construction improperly seeks to read into the claims a requirement for a low impedance load when the Specification implies that an energy transfer system can drive loads that are not low impedance. Pet. Reply 22 (citing Ex. 1001, 73:65–74:1); *id.* (also contending that energy transfer is achieved independent of the load (citing Ex. 1066 ¶ 9)).

Although not required, Patent Owner does not address the construction of “energy storage element” in its Sur-reply. *See generally* PO Sur-reply.

We agree with Petitioner that “energy storage element” should be construed consistently with “storage element.” *Cf. SightSound Techs., LLC v. Apple Inc.*, 809 F.3d 1307, 1316 (Fed. Cir. 2015) (explaining that, “[w]here multiple patents ‘derive from the same parent application and share many common terms, we must interpret the claims consistently across all asserted patents’” (quoting *NTP, Inc. v. Rsch. In Motion, Ltd.*, 418 F.3d 1282, 1293 (Fed. Cir. 2005))). Although the terms are different because the word “energy” appears expressly in one and not the other, and we might otherwise construe different terms differently, there are several reasons why we do not do so here. First, as argued by Petitioner and uncontested by

Patent Owner, the claims use the terms interchangeably. *See* Pet. 3–4; Pet. Reply 21; *see generally* PO Resp.

Second, Patent Owner does not argue, and we do not determine, that the Specification provides an explicit definition for “energy storage element.” Thus, under usual circumstances, the plain and ordinary meaning would apply. Nonetheless, we recognize that the Specification does provide an explicit definition of “storage element,” as we previously addressed in IPR2020-01265 (based on a related patent with the same definition) and which the Federal Circuit affirmed on appeal. *See* Ex. 1001, 1:10–34 (incorporating by reference several applications and patents, including the ’551 patent, which explicitly defines “storage element”).

Third, we disagree with each of Patent Owner’s arguments as to why “energy storage element” should be construed differently. Specifically, Patent Owner starts by asserting that the claims here recite *other terms* that Patent Owner insists are specific to an energy transfer system. PO Resp. 53. If that is the case, and if those terms then distinguish the prior art from the Challenged Claims, Patent Owner can argue that those terms are not met by the prior art. We do not agree with reading an entire energy transfer system into one term because *other* terms in the same claim allegedly invoke that system. Additionally, we disagree that the term “energy,” in “energy storage element,” is somehow rendered redundant by adopting the same meaning as “storage element.” Specifically, the meaning of “storage element” includes the word “energy” because (a) that is how the term is defined in the Specification and (b) that is what is stored by the element. And the *amount* of energy stored (negligible versus non-negligible) is exactly what the Specification uses to distinguish “[h]olding modules and holding

capacitances” from “storage modules and storage capacitances.” *See* Ex. 1001, 73:14–22 (defining the terms).

Accordingly, for each of the reasons noted above, we decline to read into the term “energy storage element” an entire energy transfer system; rather, we construe the term to mean “an element of a system that stores non-negligible amounts of energy from an input EM signal.”²⁷

2. “*sampling aperture*” and “*switch*”

For completeness, we note that, in the Patent Owner Response, Patent Owner states that “[t]he parties agree that ‘sampling aperture’ means ‘a period of time during which the switch is in its closed (i.e., on) state’” and that the Board previously construed “switch” to mean “an electronic device for opening and closing a circuit.” PO Resp. 52 (citing Ex. 2007; *Intel Corp. v. ParkerVision, Inc.*, IPR2021-00346, Paper 33 at 25–26 (PTAB July 20, 2022), *aff’d*, *ParkerVision, Inc. v. Vidal*, No. 2022-2173, slip op. at 2 (Fed. Cir. 2024)). Neither of these terms appear to be in dispute. Thus, we do not express any further opinion on the meaning of these terms. *Realtime Data*, 912 F.3d at 1375.

D. Ground 1A: Obviousness over Tayloe, TI Datasheet, and Macnally

Petitioner asserts that the combination of Tayloe, TI Datasheet, and Macnally would have rendered the subject matter of claims 1, 5, 8, 9, 11–19, 23, 26, 27, and 29–36 obvious to one of ordinary skill in the art at the time

²⁷ This is the same construction of “energy storage element” recommended by the Special Master in the Western District of Texas and adopted by the district court. *See* Ex. 1042, 49 (Special Master’s Report and Recommendation Regarding Claim Construction); Ex. 2053 (Order Adopting Report and Recommendation of Special Master).

of the invention. Pet. 10–60. Petitioner first discusses the scope and content of the prior art, then asserts one of ordinary skill in the art would have been motivated to combine the teachings of the references with a reasonable expectation of success, and lastly contends that the combined teachings of the references meet each element of the claims. *See id.* at 10–22 (discussing the scope and content of the prior art), 22–30 (discussing motivation to combine Tayloe, TI Datasheet, and Macnally and reasonable expectation of success), 30–60 (discussing the application of the prior art to the claims).

Patent Owner contends that Tayloe and Macnally are not prior art to claims 1, 3, 5, 8, 9, and 11–18 of the '528 patent. PO Resp. 76. Additionally, Patent Owner asserts that the Tayloe/TI Datasheet/Macnally combination fails to teach several elements of the claims, that there is a lack of motivation of combine, that Tayloe and Macnally are not compatible, and that there is no reasonable expectation of success in combining Tayloe, TI Datasheet, and Macnally into an integrated circuit. *Id.* at 77–98.

We first address whether Tayloe and Macnally are prior art to claims 1, 3, 5, 8, 9, and 11–18 and then we address whether Petitioner has established that the combination of Tayloe, TI Datasheet, and Macnally would have rendered the subject matter of claims 1, 5, 8, 9, 11–19, 23, 26, 27, and 29–36 obvious to one of ordinary skill in the art.

1. Whether Tayloe and Macnally are Prior Art to Claims 1, 3, 5, 8, 9, and 11–18 of the '528 Patent

The application that issued as Tayloe was filed on October 15, 1998, and issued on May 8, 2001. Ex. 1004, codes (22), (45). The priority provisional application leading to the application that issued as Macnally was filed on September 10, 1998, and Macnally issued on June 20, 2006.

Ex. 1021, codes (60), (45). Petitioner contends that Tayloe and Macnally are prior art under pre-AIA 35 U.S.C. § 102(e). Pet. 2. The '528 patent was filed on February 4, 2014, and states that it is related to a series of earlier patent applications, the earliest of which was U.S. Patent Application No. 09/176,022, filed on October 21, 1998 (now the '551 patent). Ex. 1001, codes (22), (60). Patent Owner contends that “[c]laims 1, 3, 5, 8–9, 11–18 of the '528 patent were conceived at least as early as January 20, 1998[,] and diligently reduced to practice by no later than April 29, 1998.” PO Resp. 23.

The Federal Circuit has explained the following:

In considering whether or not a reference qualifies as prior art under pre-AIA 35 U.S.C. § 102(e), we must consider whether or not “the invention was described in . . . a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent.” A patent owner may antedate an asserted prior art patent by showing conception of the claimed invention prior to the critical date and either actual reduction to practice prior to the critical date or “reasonably continuous diligence” in reducing the invention to practice until its effective filing date.

Medtronic, Inc. v. Teleflex Innovations S.À.R.L., 68 F.4th 1298, 1302–03 (Fed. Cir. 2023) (alteration in original) (citing *ATI Techs. v. Iancu*, 920 F.3d 1362, 1369 (Fed. Cir. 2019); *Tyco Healthcare Grp. v. Ethicon Endo-Surgery, Inc.*, 774 F.3d 968, 975 (Fed. Cir. 2014)). Additionally, “[i]nventor declarations submitted to antedate a reference must be corroborated, and corroboration is governed by a ‘rule of reason’ standard.” *Id.* at 1303 (citing *Perfect Surgical Techs., Inc. v. Olympus Am., Inc.*, 841 F.3d 1004, 1007–09 (Fed. Cir. 2016)). “To establish actual reduction to practice before the critical date, it must have been shown that ‘(1) [the inventors] constructed an embodiment or performed a process that met all the limitations of the

[claimed invention]; and (2) [the inventors] determined that the invention would work for its intended purpose.” *Id.* (alterations in original) (citing *Cooper v. Goldfarb*, 154 F.3d 1321, 1327 (Fed. Cir. 1998)).

Additionally, in the specific context before us, “the petitioner bears the ultimate burden of persuasion on invalidity, which never shifts to the patent owner,” but “when a patent owner attempts to antedate an asserted prior art reference, the patent owner takes on a temporary burden of production.” *Medtronic*, 68 F.4th at 1303 (citing *Dynamic Drinkware*, 800 F.3d at 1378). But “[o]nce that burden is met, the burden shifts back to the petitioner.” *Id.* (citing *Dynamic Drinkware*, 800 F.3d at 1379).

As noted above, Patent Owner contends that “[c]laims 1, 3, 5, 8–9, [and] 11–18 of the ’528 patent were conceived at least as early as January 20, 1998[,] and diligently reduced to practice by no later than April 29, 1998.” PO Resp. 23. Since Patent Owner’s alleged date of reduction to practice (April 29, 1998) is prior to Tayloe’s October 15, 1998, filing date and Macnally’s provisional application’s September 10, 1998, filing date, Patent Owner does not need to establish “reasonably continuous diligence in reducing the invention to practice.” *Medtronic*, 68 F.4th at 1302–03. Additionally, as explained further below, Patent Owner does not argue that it constructively reduced the claims to practice. Thus, we assess the parties’ evidence and arguments to determine whether Patent Owner has shown that it “conce[ived] of the claimed invention prior to the critical date and . . . actual[ly] reduc[ed] [the invention] to practice prior to the critical date.” *Id.*

Patent Owner contends that the subject matter of claims 1, 3, 5, 8, 9, and 11–18 was conceived and reduced to practice as its “Eddie chip” and

that the Eddie chip and circuit board practice each and every element of the claims. PO Resp. 27 (citing Exs. 2015, 2036). Patent Owner relies on the testimony of Mr. Sorrells (Ex. 2016), who is one of the named inventors listed on the '528 patent as well as Patent Owner's current Senior Technical Strategist. *See id.* at 24–27; Ex. 2016 ¶ 2. Patent Owner points to the following testimony of Mr. Sorrells:

- A file named “[REDACTED]” shows the Eddie chip layout and was last modified on March 6, 1997. PO Resp. 24 (citing Ex. 2016 ¶¶ 7–10; Ex. 2012).
- The Eddie chip used sampling mixers and performed energy sampling. *Id.* (citing Ex. 2016 ¶ 5).
- The Eddie chip implemented [REDACTED]
[REDACTED]
[REDACTED]. *Id.* (citing Ex. 2016 ¶ 5).
- A file named “[REDACTED]” is a schematic of a circuit board and was last modified on February 26, 1998. *Id.* at 25 (citing Ex. 2016 ¶¶ 13–15; Ex. 2011).
- “[REDACTED]” was Patent Owner's Eddie chip layout and it was fabricated by TriQuint. *Id.* (citing Ex. 2016 ¶¶ 7, 8, 17, 18; Ex. 2027).
- The Eddie chip layout shown in file “[REDACTED]” was mounted on the circuit board shown in file “[REDACTED]” and tested/evaluated. *Id.* at 25–26 (citing Ex. 2016 ¶¶ 19–20).
- Patent Owner issued press releases related to testing and evaluation of the Eddie chip in December 1997 and March 1998. *Id.* at 26 (citing Exs. 2019, 2020).

- The Eddie chip mounted on the circuit board was provided to Boeing for testing and Boeing produced a report pursuant to an agreement. *Id.* (citing Ex. 2016 ¶¶ 21–25; Ex. 2010).
- Testing and pictures from the Boeing test are shown in Exhibit 2022. *Id.* (citing Ex. 2016 ¶ 22).
- The testing and evaluation showed that the combined Eddie chip and circuit board worked for its intended purpose of down-converting an RF signal. *Id.* (citing Ex. 2016 ¶¶ 21, 24).
- There is correspondence between the connections on the Eddie chip layout and the connections of the schematics on the circuit board. *Id.* (citing Ex. 2016 ¶ 26).
- Those working on the Eddie chip and circuit board worked continuously through the time it was tested/evaluated, as demonstrated by a list of files reflecting continuous work. *Id.* at 27 (citing Ex. 2016 ¶¶ 28–30).

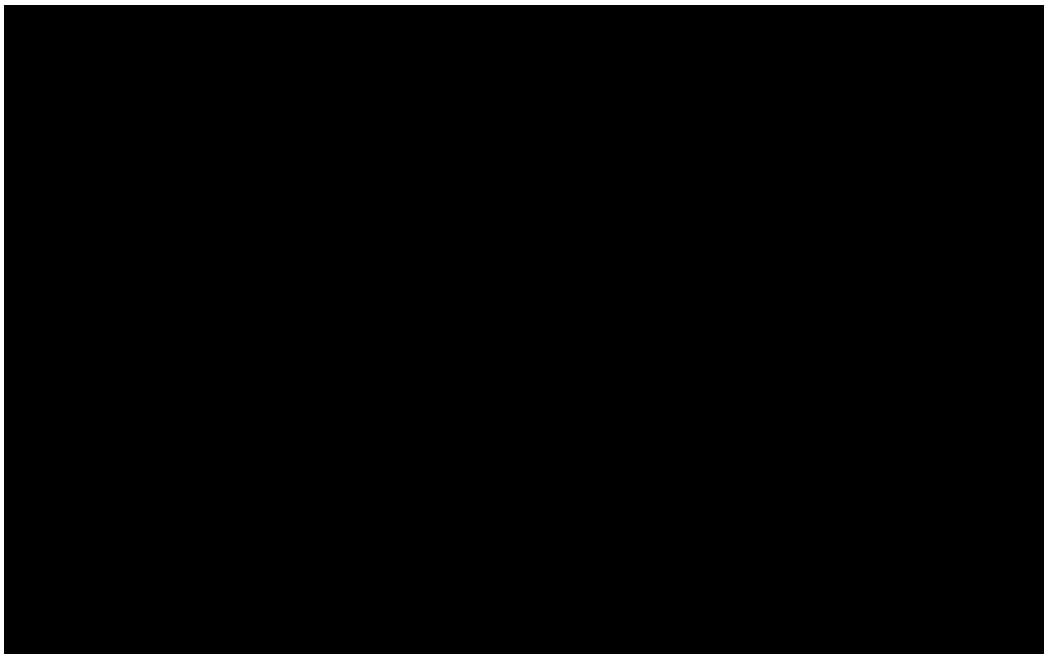
Additionally, Patent Owner points to a claim chart, provided by Dr. Ricketts, allegedly demonstrating where each and every element of claims 1, 3, 5, 8, 9, and 11–18 are embodied in the Eddie chip and circuit board. PO Resp. 27–51 (citing Exs. 2015, 2036).

In its Reply, Petitioner contends that Patent Owner fails to show conception and actual reduction to practice by April 29, 1998 (Patent Owner’s asserted reduction to practice date). Pet. Reply 2. Petitioner asserts that Patent Owner “relies on circuit schematics, metadata, and the testing of the ‘Eddie’ chip. But even assuming that Eddie is relevant to the claims (it is not), the evidence surrounding Eddie and the proffered circuit schematics and testing is incomplete and uncorroborated.” *Id.*

First, Petitioner notes that Patent Owner contends the circuit schematic of Exhibit 2012 is the Eddie integrated circuit (“IC”) layout, but “[t]he schematic is not labeled ‘Eddie.’” Pet. Reply 2 (citing PO Resp. 26). Petitioner points to a label on the schematic that states “[REDACTED]” noting that it does not mention “Eddie” or “[REDACTED].” *Id.* at 3. Petitioner asserts that Patent Owner “cites only inventor Sorrells’s declaration to show that [Exhibit 2012] is the ‘Eddie’ chip, but without corroboration.” *Id.* (citing PO Resp. 26–27). Petitioner argues that Patent Owner’s evidence “does not link the [Exhibit 2012] filename, [REDACTED],’ to the Eddie chip.” *Id.* Petitioner notes that Patent Owner points to Mr. Sorrells’ discussion of metadata for the [REDACTED] file, “but the metadata does not link the filename to its contents, to Eddie, or to the claims,” and “[n]othing shows the relevance of other files in Sorrells[’] declaration ‘[REDACTED],’ and ‘[REDACTED].’” *Id.* Petitioner provides the following annotated versions of screenshots (showing metadata) provided in paragraph 9 of Mr. Sorrells’ declaration, intended to show discrepancies between the file names and dates:



EX2016, ¶9 (annotated)



EX2016, ¶9 (annotated)

Pet. Reply 4. Mr. Sorrells testified that the screenshots above are from the Relativity database. Ex. 2016 ¶ 9. Petitioner annotated the screenshots to indicate “different file name,” “no linkage to ‘Eddie’ & two different file names,” and “different timestamps” with arrows pointing to each. Pet. Reply 4.

Second, Petitioner contends that Patent Owner does not establish that the circuit schematic of Exhibit 2011 shows possession of the claims because “the only evidence linking [Exhibit 2011] to ‘Eddie’ is

uncorroborated inventor testimony.” Pet. Reply 5 (citing PO Resp. 26–27, 34 (citing Ex. 2016); Ex. 2016 ¶¶ 13–15). Additionally, Petitioner asserts that “no identifying features from the circuit schematic labeled ‘TM PV 97 1’ in [Exhibit 2012], beyond the pins, appear on [Exhibit 2011].” *Id.* And, Petitioner observes that “Eddie” does not appear anywhere in Exhibit 2011, including its filename. *Id.* at 5–6 (citing Ex. 2011).

Third, Petitioner contends that the file “rcvr-amp2.sch” “has a different date-stamp in [Exhibit 2011] (1/20/1998) than it does in [Patent Owner’s] listing of files showing diligence ([Exhibit 2029], showing 2/26/1998), calling into question the accuracy of its file-keeping and Sorrells[’] testimony.” Pet. Reply 6.

Fourth, Petitioner contends that Patent Owner relies only on Mr. Sorrells’ testimony for evidence that the Eddie chip implemented [REDACTED]. Pet. Reply 6 (citing PO Resp. 26–27, 37, 47, 62; Ex. 2015, 18, 27). Petitioner asserts that, “[w]ithout corroborating [REDACTED], [Patent Owner] cannot show the Eddie chip’s operation.” *Id.*

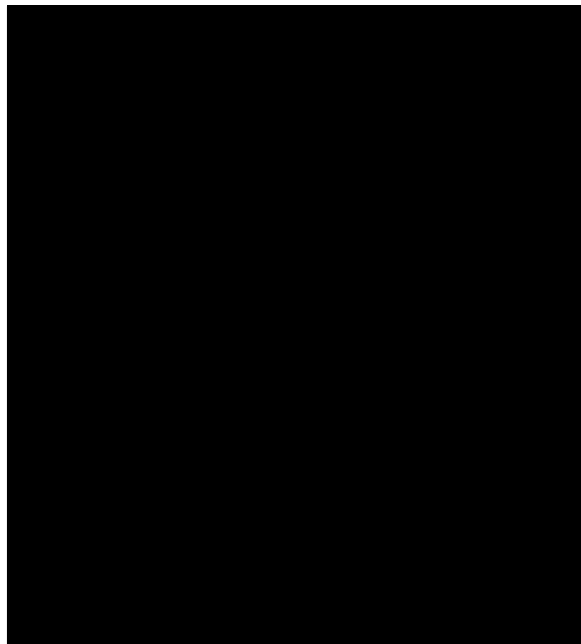
Fifth, Petitioner asserts that “[t]he Boeing Documents ([Exhibits 2010, 2021, 2022]) fail to corroborate Sorrells.” Pet. Reply 7. Specifically, Petitioner contends that the Boeing documents “do not show a schematic of the circuit that was tested or reference a filename, referring only to the ‘Eddie,’” and do not identify a duty cycle. *Id.* (citing Ex. 2010, 5).

Thus, Petitioner asserts that critical evidence Patent Owner relied on “is incomplete, inconsistent, and shown solely through inventor testimony,” which is insufficient because, “[u]nder the rule of reason, the ‘evidence of corroboration must not depend solely on the inventor.’” Pet. Reply 8 (citing

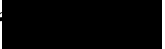
PO Resp. 26–29 (citing Ex. 2016 ¶¶ 13–15); *Apator Mitors ApS v. Kamstrup A/S*, 887 F.3d 1293, 1295 (Fed. Cir. 2018)).

Sixth, Petitioner asserts that Patent Owner’s evidence does not demonstrate performance of claims 1, 3, 5, 8, 9, and 11–18. Pet. Reply 7–16. Petitioner contends that Patent Owner’s schematics fail to establish performance of at least three elements of claim 1 and an additional element of claim 8. We discuss each.

The first allegedly missing element of claim 1 identified by Petitioner is “a first switch coupled to a first control signal” and “a second switch coupled to a second control signal,” as recited in elements 1[b] and 1[d]. Pet. Reply 7. Petitioner asserts that Patent Owner’s schematic shows switches controlled by a single control signal. *Id.* Petitioner provides the following annotated version of a figure from Exhibit 1015:

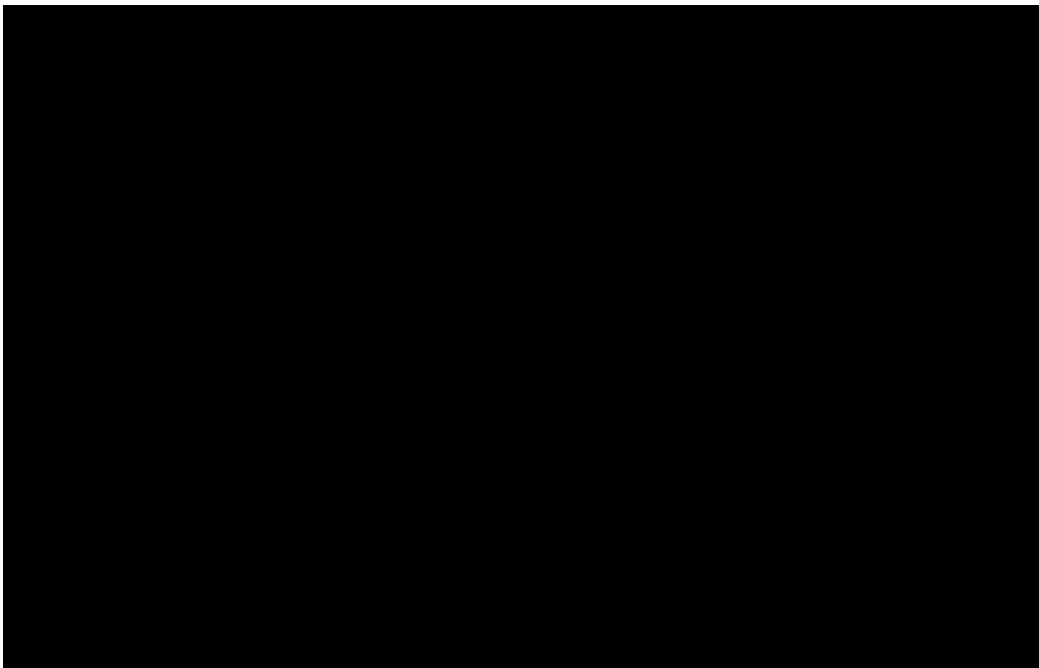


EX1015, 5 (partial, annotated); TI-1067, ¶13

Pet. Reply 8. Petitioner annotated Exhibit 1015 to include notations of “ have a common gate node” and “single signal from control

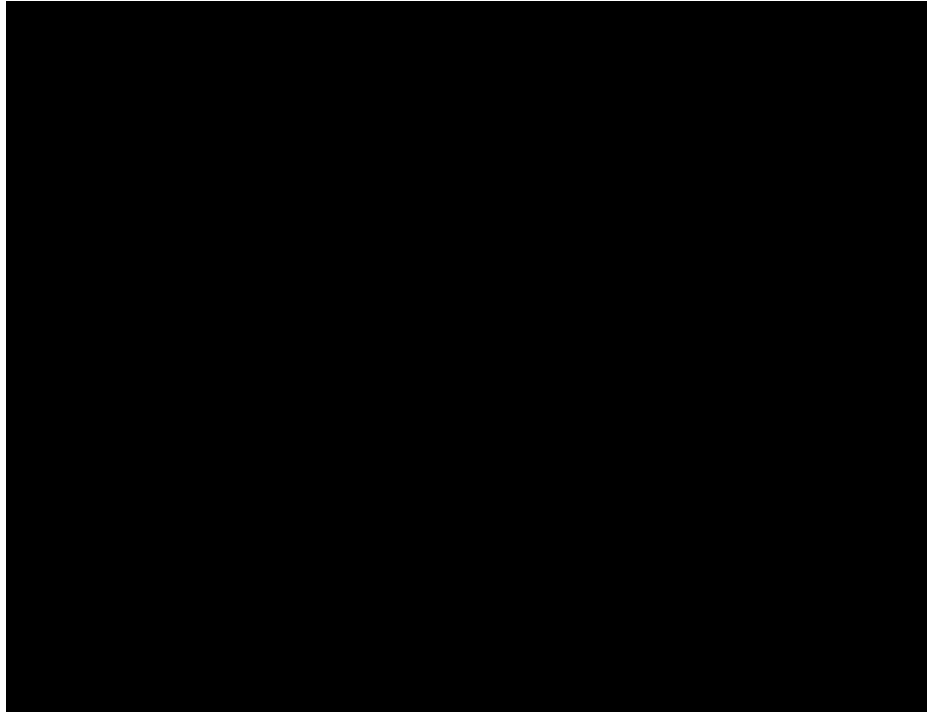
signal generator.” *Id.* Petitioner explains that “[t]he schematic shows that 1) the gates to all transistors [REDACTED] are connected together (green); and 2) transistors [REDACTED] share a common control signal (red). Thus, the common control signal will switch all transistors [REDACTED] concurrently.” *Id.* (citing Ex. 1067 ¶¶ 14–15). Petitioner contends that “the asserted second switch is not coupled to a second control signal—there is only one control signal for all switches [REDACTED].” *Id.* (citing Ex. 1067 ¶¶ 14–15). Additionally, Petitioner points to Dr. Ricketts’ testimony, asserting that Dr. Ricketts testified that “the mixer only has one switch.” *Id.* at 8–9 (citing Ex. 1065, 78:6–12).

Petitioner contends that a second deficiency is that the asserted energy storage devices would not have worked. Pet. Reply 9–12. Petitioner reproduces two schematics from Exhibit 2011, annotated by Dr. Ricketts, that we reproduce below.



Pet. 9. The schematic above, from Exhibit 2011, was annotated to identify a “first energy storage device” in green and also includes a green box around

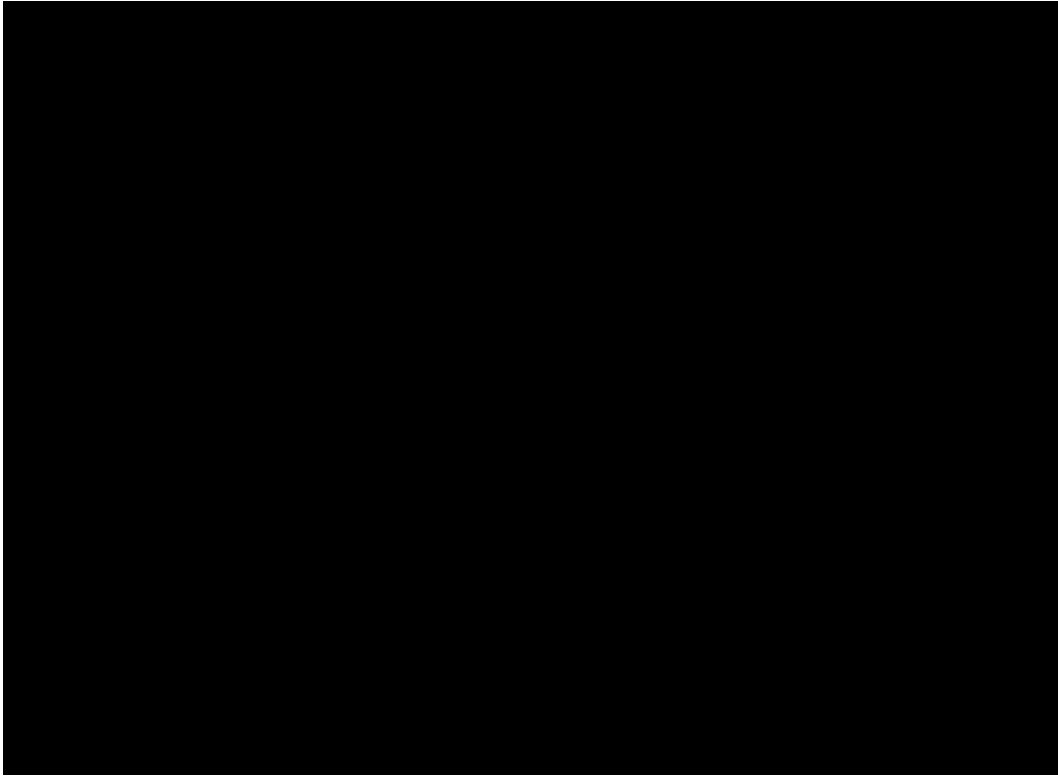
what Dr. Ricketts identifies as a first energy storage element and a yellow box around what Dr. Ricketts identifies as transistor [REDACTED] *Id.*; see PO Resp. 36.



Pet. 10. The schematic above, from Exhibit 2011, was annotated to identify a “second energy storage device” in green and also includes a green box around what Dr. Ricketts identifies as a second energy storage element and a yellow box around what Dr. Ricketts identifies as [REDACTED]. *Id.*; see PO Resp. 42.

Petitioner contends that “[t]hese ‘storage elements’ would not have stored non-negligible amounts of energy, nor would the circuits have even worked for the claimed ‘down-converting a modulated carrier signal’ to generate ‘a down-converted . . . baseband signal,’ as claimed.” Pet. Reply 10 (citing Ex. 1001, claim 1; Ex. 1067 ¶¶ 16–20). Petitioner contends that the schematic reproduced below (from Exhibit 2011) shows values for

the input signal frequency (915 MHz) and capacitors [REDACTED] (0.1 μ F – 20%).” *Id.*

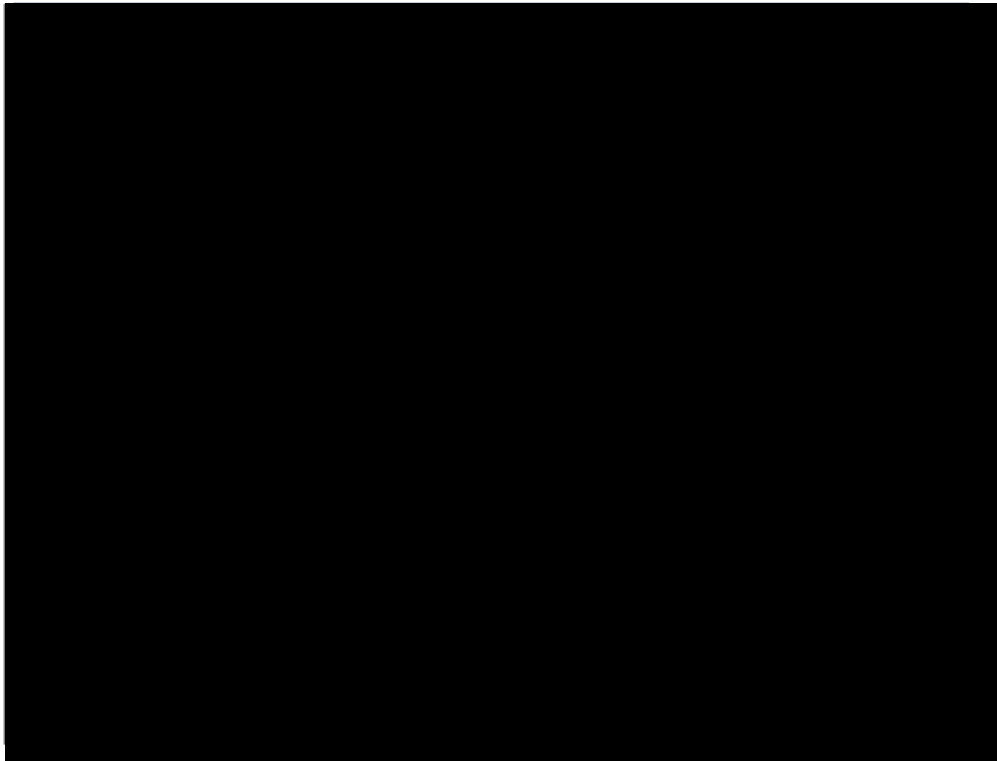


Pet. Reply 11. The schematic shown above, from Exhibit 2011, includes red boxes around capacitors [REDACTED], as well as additional text in red stating [REDACTED] in two locations pointing to [REDACTED], respectively, and a purple box around the indication of 915 MHz with additional text in purple stating “915 MHz input signal.” *Id.*

Petitioner contends that “[c]apacitors [REDACTED] are coupled to ground. At 915 MHz, a 0.1 μ F capacitor exhibits an impedance of 0.0017 Ω . The outputs of the dashed boxed circuits are coupled to the inputs of the mixer ([REDACTED]), which exhibit a significantly larger input impedance than [REDACTED].” Pet. Reply 11 (footnote omitted) (citing Ex. 1067 ¶¶ 16–20). Petitioner asserts that signals into [REDACTED]

“would take the path of least resistance and flow to ground through [REDACTED] [REDACTED] respectively.” *Id.* at 11–12. According to Petitioner, “[t]he input signals, therefore, are not affected by switching in the mixer, the capacitors [REDACTED] do not accumulate or discharge energy based on the switching, and no down-conversion to baseband occurs.” *Id.* at 12 (citing Ex. 1067 ¶¶ 19–22). Petitioner contends that Patent Owner has not asserted, nor provided analysis suggesting, that the circuits operate at a different input signal frequency. *Id.* Thus, Petitioner contends that Patent Owner has not shown actual reduction to practice. *Id.*

Petitioner contends that a third deficiency is that Patent Owner provides no evidence of “a first differential amplifier circuit” for “combining,” as recited in element 1[g]. Pet. Reply 12. Petitioner asserts that Patent Owner argues the claimed “combining” occurs because “both down-converted signals share a common VDD (+5V) (blue circle) and ground (orange circles),” shown below in a schematic from Exhibit 2011. *Id.* (citing Ex. 2015, 30). Petitioner asserts that, “[e]ven assuming down-conversion takes place in the proffered circuits (it does not), that signals share a common VDD and ground does not mean (or even suggest) that they are combined.” *Id.* (citing Ex. 1067 ¶¶ 23–24). Petitioner contends that one of ordinary skill in the art would have understood that the meaning of “combining” includes “merging two or more signals into one output signal,” but as shown in the annotated version of Exhibit 2011, below, “the signals are never combined.” *Id.* (citing Ex. 1067 ¶¶ 23–24). Rather, “[t]he signals are directed to two different circuits and remain separated.” *Id.*



Pet. Reply 13. Petitioner adds annotations of red boxes and a statement that “ParkerVision’s schematic & annotation show that the signals remain separated” to the version of Exhibit 2011 annotated by Dr. Ricketts. *See id.*; *see also* PO Resp. 46.²⁸

Additionally, Petitioner contends that Patent Owner failed to show a differential baseband signal, as required by element 1[g] because “the measured spectrum from a spectrum analyzer . . . does not reveal whether

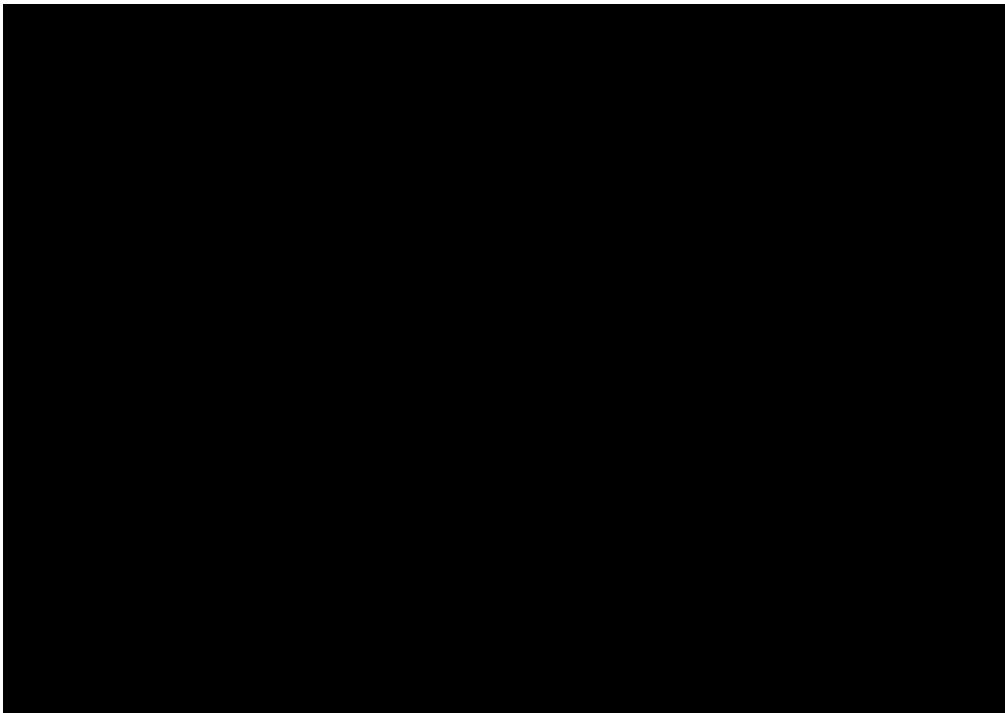
²⁸ Explaining his annotations to Exhibit 2011, Dr. Ricketts states that “[t]he Eddie IC includes a first differential amplifier circuit (red box) that combines the down-converted in-phase baseband signal portion (bottom green arrow) with the down-converted inverted in-phase baseband signal portion (top green arrow) and outputs a first channel down-converted differential in-phase baseband signal (purple arrows). The combining occurs because amplifiers (red box) share a common VDD (+5V) (blue circle) and ground (orange circles).” PO Resp. 46 (discussing element 1[g]).

[the] underlying signal is a *differential* signal.” Pet. Reply 13 (citing Ex. 2010, 7; Ex. 1067 ¶¶ 28–31).

Petitioner contends that a fourth deficiency, which only applies to claim 8, is that there is no evidence of “energy . . . is transferred to the respective storage element when the switch is on” and “the transferred energy is discharged . . . when the switching device is off,” as recited in claim 8. Pet. Reply 14. Petitioner asserts that, as discussed above, “at 915 MHz, no charge is stored in any of [REDACTED], regardless of the switching position,” but “[a]ssuming, *arguendo*, that charge were stored in one of the capacitors, such charge would have been accumulated when the switches were open and discharged when the switches were closed,” which is the “opposite of claim 8.” *Id.* at 14–15²⁹ (footnote omitted) (citing Ex. 1067 ¶¶ 21–22).

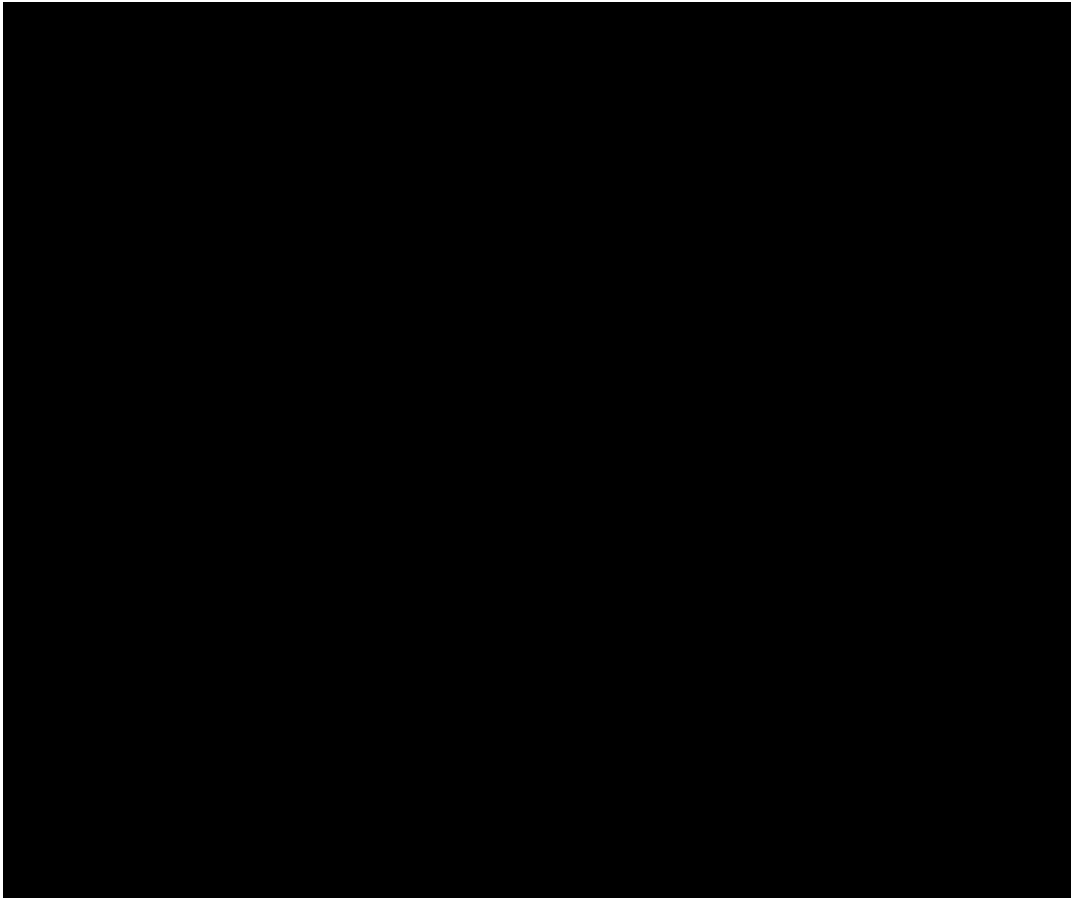
Petitioner provides the following figure, “FIG. Dickens1,” contending that, if the circuit works, “when [REDACTED] are closed, nodes [REDACTED] are connected together because of the common control signal.” Pet. Reply 15.

²⁹ Petitioner also notes that Patent Owner “does not specify which capacitor is part of the asserted energy storage device or which circuit component constitutes a low-impedance load to which energy is transferred.” Pet. Reply 15 n.4.



Pet. Reply 15. Dr. Dickens' figure shows blue, green, and red annotations, and includes text stating "Common control = All switches [REDACTED] ON at the same time = Nodes [REDACTED] short" and "[REDACTED] discharge." *Id.* Petitioner asserts that "[t]he charge on capacitors [REDACTED] is equalized when switch [REDACTED] is closed (ON)." *Id.* at 16 (citing Ex. 1067 ¶¶ 21–22).

Petitioner asserts that, "[w]hen [REDACTED] are open (OFF), the RF input at [REDACTED] would provide charge to capacitor [REDACTED] and the RF input at [REDACTED] would provide charge to capacitor [REDACTED]." Pet. Reply 16 (citing Ex. 1067 ¶¶ 21–22). According to Petitioner, "[i]n that hypothetical, capacitors [REDACTED] would accumulate differential charge when switches [REDACTED] is [sic] open (OFF)," as shown in "FIG. Dickens2" reproduced below. *Id.*



Pet. Reply 16. Dr. Dickens' figure shows blue and red annotations, and includes text in blue pointing to [REDACTED] stating "[REDACTED] would be allowed to accumulate charge when switches are open (OFF)," and text in blue pointing to [REDACTED], stating "[REDACTED] would be allowed to accumulate charge when switches are open (OFF)," and text at the bottom of the figure stating (in part, in red), "Common Control = All switches [REDACTED] OFF at the same time = Capacitors [REDACTED] accumulate." *Id.*

Sixth, Petitioner contends that the critical evidence on which Patent Owner relies to antedate Tayloe and Macnally is inventor testimony provided by Mr. Sorrells, but that testimony is inadequate because it is insufficiently corroborated by independent evidence. Pet. Reply 18–20. Petitioner provides the following examples.

As a first example of insufficient corroboration, Petitioner contends that “the only evidence of the pad layout necessary to understand the Eddie chip is Sorrells’s, which is also uncorroborated. The GDSII [Graphic Data System II] tape-out of the Eddie chip lacks these labels.” Pet. Reply 19 (citing Ex. 2015, 5). Thus, Petitioner asserts that, “at least for the GDSII tape-out, no evidence corroborates that the mixer, differential amplifier, or other circuits are relevant to the claims or even worked.” *Id.*

As a second example that Petitioner contends lacks sufficient corroboration, Petitioner asserts that “all of the circuit schematics ([Exs. 2011, 2012]), filenames ([Exs. 2011, 2029]), and file properties ([Ex. 2016]) are explained only by Sorrells.” Pet. Reply 19. Petitioner notes that “[m]oreover, while these files are ostensibly [Patent Owner’s] business records, the contents, metadata, and dates are only asserted by Sorrells.” *Id.*

As a third example of insufficient corroboration, Petitioner asserts that “[t]he Boeing Documents are likewise incomplete” because, “[f]or example, they do not describe the circuit that was tested, provide schematics of the tested circuit, or mention the terms ‘switch,’ ‘energy storage element, and ‘differential output.’” Pet. Reply 19. Rather, “[t]he only evidence linking the Boeing Documents to the Eddie chip is Sorrells’s declaration.” *Id.* Thus, Petitioner contends that “the Boeing Documents are inconclusive, at best” and “the Sorrells declaration by itself cannot corroborate the assertion that the Boeing Documents prove conception and reduction-to-practice of the swear-behind claims.” *Id.*

As a fourth example of insufficient corroboration, Petitioner asserts that Patent Owner cannot rely on Dr. Ricketts’ testimony as providing corroboration because Dr. Ricketts’ “conclusions rely entirely on the

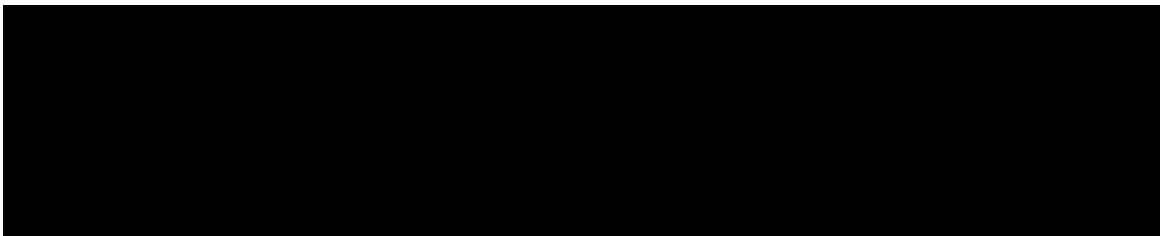
Sorrells declaration” and “take[], on blind faith, Sorrells’s testimony as authentic and accurate.” Pet. Reply 19–20. Petitioner explains that the weaknesses identified above similarly apply to Dr. Ricketts’ claim chart (Ex. 2015) “because it merely repeats the information provided only by Sorrells.” *Id.* at 20. Thus, Petitioner asserts that Dr. Ricketts’ testimony “cannot show that the inventors reduced any claim to practice prior to Tayloe or Macnally.” *Id.*

In its Sur-reply, Patent Owner first asserts that Petitioner’s Reply violates 37 C.F.R. §§ 42.6(a)(3) and 42.22(a)(2) because the Reply “improperly attempts to circumvent the word limits by incorporating arguments by reference from its expert declarations,” and “fails to cite to the expert declarations with the specificity required” by the rules governing an IPR. PO Sur-reply 1. Patent Owner contends that it is “unfairly prejudiced” and “requests that the Board decline to consider arguments/analysis/expert testimony and supporting exhibits not specifically discussed in the Reply.” *Id.* at 1–2.

We address this argument now by first noting that Patent Owner did not request any relief from the Board prior to filing its Sur-reply, such as requesting additional pages or requesting that a portion of the Reply be stricken from the record. Second, to the extent we find Petitioner improperly incorporated by reference a position solely set forth in one of its expert declarations or supporting exhibits, we note that below and do not consider the issue beyond the arguments made by Petitioner and evidentiary support directly cited by Petitioner in its Reply. We do not intend, however, by this statement that we have, in fact, identified any such instances by Petitioner.

In its Sur-reply, Patent Owner next asserts that Petitioner’s experts take inconsistent positions—“Dickens takes a narrow view of the claims to dispute conception/reduction, while Galton takes a broader view to argue invalidity.” PO Sur-reply 2. Patent Owner provides the following examples of the alleged inconsistencies.

First, Patent Owner contends that, similar to Dr. Galton’s testimony regarding the combinations of Razavi/Macnally³⁰ and Tayloe/Macnally, Dr. Ricketts opines that the Eddie device has a differential amplifier circuit that receives two inputs and outputs two signals, each of which is a combination of both inputs. PO Sur-reply 4 (citing Ex. 2024 ¶ 172; Ex. 2015, 35). Patent Owner asserts that, “[a]s [Dr.] Galton makes clear, in a differential amplifier with differential outputs, there are *two* outputs, and *each* output signal is a *combination* of *both* inputs.” *Id.* at 5 (citing Ex. 1003 ¶¶ 168–169, 245–246; Ex. 1066 ¶¶ 44–45). Additionally, Patent Owner contends that Dr. Dickens “never disputes that the Eddie device includes a differential amplifier,” and Patent Owner provides an enlarged portion of Exhibit 2015 highlighted to identify that the file name includes the phrase “WITH AMPLIFIER.” *Id.* at 6.



PO Sur-reply 6. Thus, Patent Owner asserts that Dr. Ricketts’ testimony regarding the Eddie device is similar to Dr. Galton’s testimony regarding

³⁰ Razavi is relied on by Petitioner in Grounds 3 and 4.

Macnally's amplifier and, therefore, we should not credit Dr. Dickens' testimony regarding this aspect of the Eddie device.

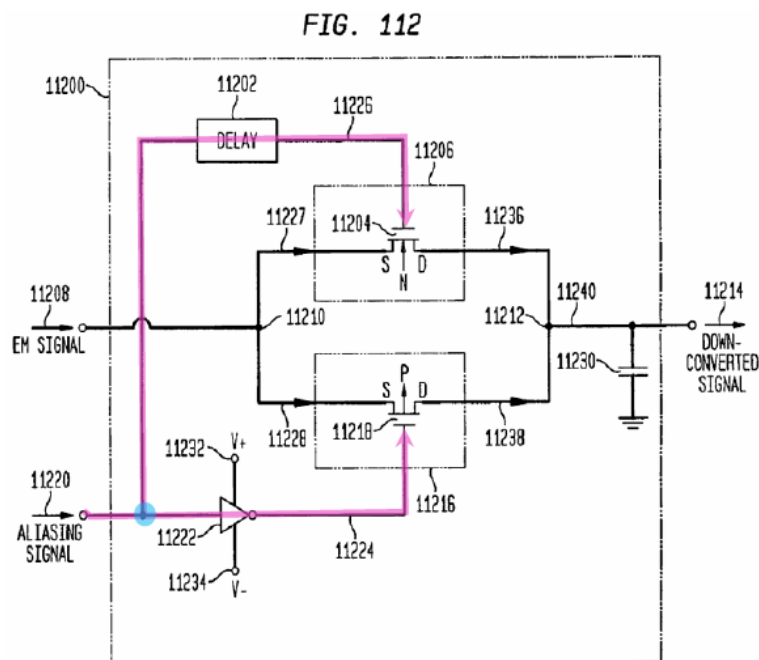
Second, Patent Owner contends that Dr. Galton "identifies a shared control signal received at the gates of transistors as separate control signals" in Razavi (i.e., a single control signal V_{LO} that is common to transistors M5/M6) "as being the first and second control signals." PO Sur-reply 7–8. Patent Owner contends that Dr. Ricketts' analysis of the Eddie device is consistent with Dr. Galton's analysis of Razavi because Dr. Ricketts similarly identifies first and second control signals, where each is derived from a common LO signal, and each is routed to a respective gate. *Id.* (citing Ex. 2015, 14, 24).

Patent Owner asserts that, in contrast, Dr. Dickens contends that the Eddie chip has only a single control signal because "transistors [REDACTED] share a common gate node . . . and also share the same common control signal."³¹ PO Sur-reply 9 (omission in original) (quoting Ex. 1067 ¶¶ 13–14). Patent Owner contends that "[n]othing in the claim language, however, excludes this. The claims only require that a first switch be coupled to a 'first control signal' and a second switch be coupled to a 'second control signal.'" *Id.* at 10. According to Patent Owner, "[w]hile the control signals in Eddie may share a common node or be derived from a common LO signal, they are routed separately to different switches. That is, each switch

³¹ Patent Owner asserts that the one "switch" Dr. Ricketts identified in Eddie is actually "several transistors" and that "each transistor meets the PTAB's construction of 'switch' as opening and closing a circuit." PO Sur-reply 9 n.2 (citing Ex. 2015, 15, 25). Patent Owner also contends that Dr. Dickens recognizes that the mixer in Exhibit 2015 "illustrates *multiple* switches." *Id.* (citing Ex. 1067 ¶¶ 4, 13).

has a respective signal line (or branch) and, thus, is ‘coupled to’ its own control signal which turns it on/off, satisfying the claim language.” *Id.*

Additionally, Patent Owner contends that Figure 112 of the ’528 patent, reproduced below with Patent Owner’s annotations, is consistent with Eddie’s configuration because this figure “illustrates transistors having two control signals [pink] sharing a common node [blue] and common LO signal.” PO Sur-reply 10.



PO Sur-reply 11. Figure 112 of the ’528 patent “illustrates aliasing module 11200 with a complementary [(field effect transistor)] FET configuration.” Ex. 1001, 9:48–49. Patent Owner asserts that the ’528 patent “discloses that there are ‘two complementary aliasing signals 11224, 11226 [] generated from [one] aliasing signal 11220 to control the sampling by FETs 11218, 11204, respectively.’” PO Sur-reply 11 (alterations in original) (citing Ex. 1001, 109:60–63, Figs. 114–115).

Patent Owner next addresses what it refers to as “Petitioner’s other arguments regarding the Eddie device,” asserting that they are “also flawed.” PO Sur-reply 11. Turning to these arguments, Patent Owner first contends that Petitioner’s position that Eddie would not have worked to store non-negligible amounts of energy “is directly at odds with the Board’s present and with Petitioner’s expert’s admissions.” *Id.* (citing Pet. Reply 10–12). In particular, Patent Owner contends that the Board previously held that, if a circuit “operates in a manner that successfully down-converts and does so in a commercially viable system,” this is sufficient evidence that a capacitor stores non-negligible amounts of energy. *Id.* at 12 (citing *TCL Holdings Co. v. ParkerVision, Inc.*, IPR2021-00985, Paper 44 at 58 (PTAB Nov. 17, 2022)). Patent Owner contends that the Eddie device meets this standard because Dr. Dickens “*admits* that (1) the Eddie device successfully down-converts, and (2) testing showed the Eddie device performed at a ‘level that could be used for a [] consumer wireless device in [the] 1998 to 2000 time frame.’” *Id.* (alterations in original) (quoting Ex. 2043, 54:2–8) (citing Ex. 2043, 70:7–16, 55:1–59:18, 63:8–65:2). Thus, Patent Owner asserts that “the capacitors in the Eddie device necessarily store non-negligible amounts of energy.” *Id.*

Additionally, Patent Owner contends that Dr. Dickens’ “analysis is flawed because it ignores the actual testing configuration used by Boeing.” PO Sur-reply 12–13. Patent Owner provides the followed annotated version of one of the Eddie schematics.



PO Sur-reply 13. Patent Owner contends that Dr. Dickens opined that “input signals entering the Eddie chip at [REDACTED] (blue arrows, PO annotated) would flow to capacitors [REDACTED] and immediately be dumped to ground (thrown away).” *Id.* (citing Ex. 2043, 21:22–22:9). Patent Owner asserts that “[t]his means that all other circuitry in the Eddie device would be useless.” *Id.* (citing Ex. 2043, 22:14–21). Patent Owner contends that Dr. Dickens’ “sole basis for this claim is the component values shown on the schematic.” *Id.* (citing Pet. Reply 10–11 (citing Ex. 1067 ¶¶ 16–22); Ex. 2043, 21:44–22:13).

Patent Owner asserts, “[c]ritically, [Dr.] Dickens admitted in deposition that he did not do anything to reconcile the testing configuration specified by Boeing (matching ports to 50-ohm for appropriate frequencies) and the values he used in his analysis.” PO Sur-reply 13 (citing Ex. 2043, 51:12–52:1). Patent Owner argues that “[Dr.] Dickens was aware of the [REDACTED] notation in the schematic—an important qualifier

indicating that the component values shown may not have been used in the tested circuit” (*id.* (citing Ex. 2043, 50:19–22)), and “he admitted that the Boeing test results show [REDACTED] could not have had the values he used in his calculation” for Exhibit 2011 (*id.* (citing Ex. 2043, 25:18–28, 30:16–22, 32:17–22, 36:3–12, 47:10–48:14 (discussing Exs. 2010, 2044))).

Additionally, Patent Owner contends that, even though Dr. Dickens “calculates the input impedance of capacitors [REDACTED],” he “baldly asserts—without analysis/support—that mixer inputs (SP1, SP2) ‘exhibit a significantly larger impedance than capacitors [REDACTED].’” PO Sur-reply 14 (citing Ex. 1067 ¶ 17). Patent Owner argues that Dr. Dickens “fails to specify/explain/calculate any *actual* impedance values of the mixer input impedance.” *Id.* Patent Owner asserts that “[t]he fact that the Boeing report shows successful down-conversion under commercial performance standards, however, demonstrates that Dickens made incorrect *assumptions* when performing his analysis. Petitioner’s assertion that Eddie does not work at all is unsupported and contrary to objective evidence.” *Id.* Similarly, Patent Owner contends Dr. Dickens admitted that the Boeing report demonstrates successful down-conversion from 914.95 MHz to 4.95 MHz and, thus, establishes that the input signal was affected by repetitively opening/closing a mixer switch. *Id.* at 14–15 (citing Ex. 2010, 7–8, 11; Ex. 2043, 54:2–8; PO Resp. 17, 32–33, 35–36).

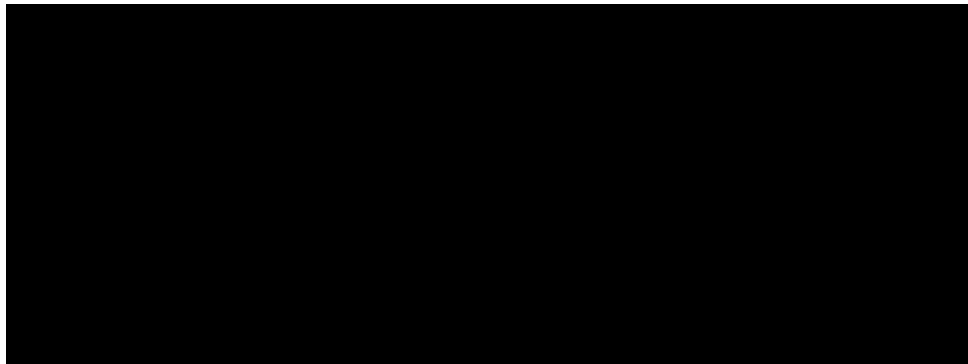
Further, pertaining to claim 8, Patent Owner contests Petitioner’s argument that the “charging/discharging behavior of Eddie’s storage elements is opposite to how it is claimed” because, although Dr. Dickens points to capacitors C63/C64, those are not the relevant capacitors. PO Sur-reply 15. Instead, Dr. Ricketts points to capacitors [REDACTED]

██████████. *Id.* (citing Pet. Reply 14–16). Thus, Patent Owner asserts that Dr. Dickens provides “no analysis of these capacitors, nor rebut[s] that their charging/discharging behavior satisfies the claim limitation.” *Id.*

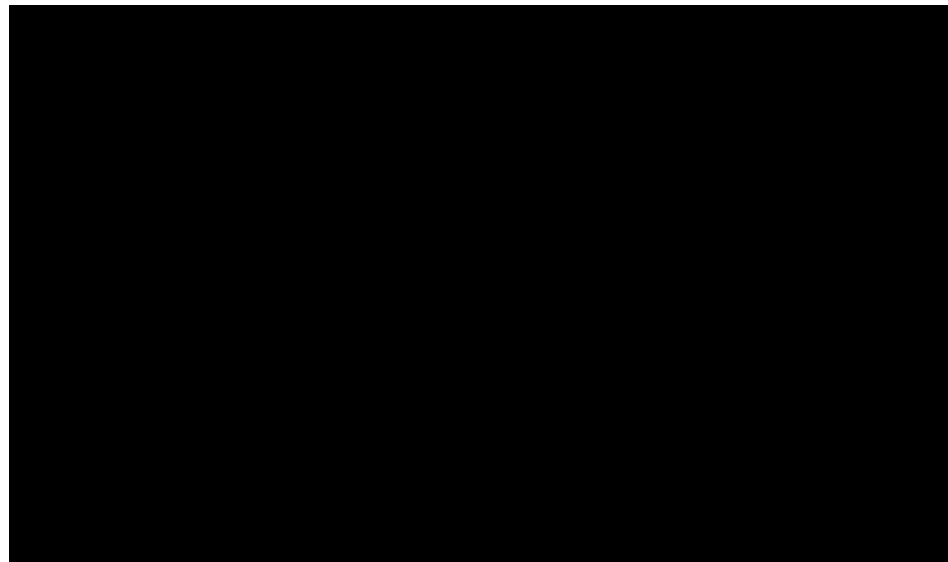
Patent Owner next addresses Petitioner’s arguments as to whether there is sufficient corroboration relating to conception and reduction to practice/diligence. PO Sur-reply 15. Patent Owner contends that Mr. Sorrells cites numerous contemporary documents to support every aspect of his invention story and that the evidence he relies on is sufficient to corroborate his story. *Id.* (citing Ex. 2016). Patent Owner similarly asserts that it is not impermissible for Mr. Sorrells to authenticate the documents on which he relies for corroboration because he is the person who was responsible for, and had personal knowledge of, these documents. *Id.* at 15 n.4.

Turning first to conception, Patent Owner contends that Petitioner’s attacks on Mr. Sorrells’ credibility are meritless. First, Patent Owner disagrees with Petitioner’s argument that nothing ties the layout/schematics files to Patent Owner’s Eddie device. PO Sur-reply 16 (citing Pet. Reply 2–5). Patent Owner points to Mr. Sorrells’ testimony that all the files relate to Eddie and that 95 percent of his time from 1997 to 1998 was spent developing the patented technology embodied in Eddie. *Id.* (citing Ex. 1068, 12:13–13:18, 19:9–20:6). Patent Owner asserts that Mr. Sorrells’ testimony “is corroborated by contemporaneous 1997/1998 press releases and a 1998 Boeing report, which confirm that ‘Eddie’ was the focus of [Patent Owner’s] work at that time.” *Id.* (citing PO Resp. 24–26 (citing Exs. 2016, 2010, 2019, 2020)).

Additionally, Patent Owner contends that “[f]urther corroboration appears on the schematic (Ex.-2011) itself, which specifies an input configuration with ‘matching network’ and precise input frequency of 915MHz.” PO Sur-reply 17. Patent Owner contends “this is the *same* setup described in the Boeing report, which indisputably pertains to *Eddie*.” *Id.* Patent Owner provides the following annotated versions of Exhibits 2011 and 2010 for comparison.

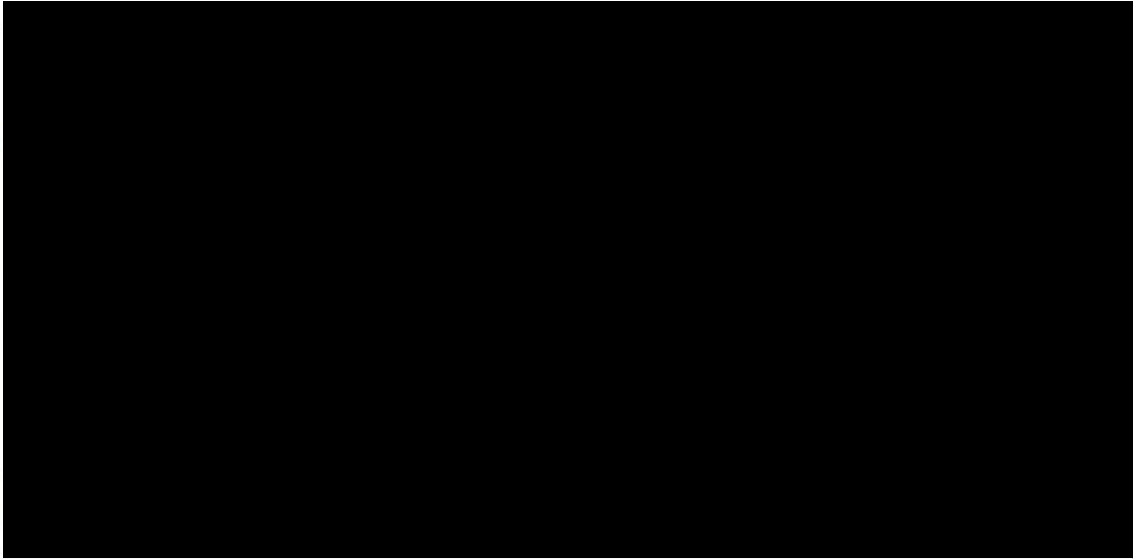


PO Sur-reply 17 (annotating Ex. 2011 with blue highlighting).



PO Sur-reply 17–18 (annotating Ex. 2010 with blue highlighting) (citing Ex. 2043, 52:17–20). Patent Owner thus contends that “evidence beyond Sorrells’s testimony directly connects the schematic to the Eddie device.

The layout file (Ex.-2012), in turn, is directly tied to the schematic.” *Id.* at 18. Additionally, Patent Owner points to the connection labels in the layout (shown on the left, below) as matching those in the schematic (shown on the right, below). *Id.*



PO Sur-reply 18.

Second, Patent Owner asserts that, although the label in the layout (shown in purple, above) is not the filename, the label ([REDACTED]) “is nearly identical to the layout’s file name ‘ [REDACTED] .’” PO Sur-reply 19 (citing Pet. Reply 3).

Third, Patent Owner contends that, even “[t]hough *different* versions of *some* files have different timestamps or names (which is expected because they are *different* versions), all files have dates that predate Tayloe and Macnally by *many months*.” PO Sur-reply 19 (citing Pet. Reply 4, 6).

Fourth, Patent Owner argues that, although Petitioner asserts that Mr. Sorrells failed to corroborate that the Eddie device uses a 50% duty cycle LO,” Petitioner “does not explain how this is even relevant to conception/reduction.” PO Sur-reply 19 (citing Pet. Reply 6). Patent

Owner, however, asserts that Mr. Sorrells' testimony is corroborated "by the layout (Ex.-2012), which shows the actual circuitry used to generate the LO signals, and by [Dr.] Ricketts's analysis of that circuitry." *Id.* (citing Ex. 2015, 5, 13–14, 23–25). Additionally, Patent Owner points to the Boeing report, asserting that it states that [REDACTED] [REDACTED] "independently corroborating Sorrells's statement that the Eddie chip operates at a sub-harmonic LO frequency." *Id.* (citing Ex. 2010, 1, 7, 11). Patent Owner also contends that the '551 patent (from which the '528 patent claims priority) discloses that apertures of the energy transfer signal (i.e., LO signal) can be " $\frac{1}{2}$ " (i.e., 50%) of the input signal. *Id.* (citing Ex. 2006, 69:27–38, 83:43–47, 104:60–105:7).

Lastly, Patent Owner responds to Petitioner's argument that Mr. Sorrells fails to show what schematic Boeing tested. PO Sur-reply 20 (citing Pet. Reply 7). Patent Owner contends that "Petitioner has not presented any evidence that there was anything other than the Eddie device (shown in the layout/schematic) that [Patent Owner] was working on in 1997/1998 and provided to Boeing." *Id.* Additionally, Patent Owner contends that Mr. Sorrells testified that "(1) the device Boeing tested is the configuration shown in the schematic/layout files, and (2) the schematics/layout files at that time were for that Eddie device." *Id.* (citing Ex. 2016 ¶¶ 20–22). And Patent Owner asserts that Mr. Sorrells' testimony "is corroborated not only by contemporaneous press releases but, as discussed above, by the specific configuration noted in the schematic that matches the setup described in the Boeing report." *Id.*

Turning to actual reduction to practice, Patent Owner contends that Petitioner's arguments are "belied by the Boeing report and [Dr.] Dickens

admission that, when tested, the Eddie device performed down-conversion.” PO Sur-reply 20 (citing Ex. 2043, 54:2–8; PO Resp. 26; Ex. 2016 ¶¶ 20–24). Patent Owner contends that “[a]ll of this is corroborated with press releases, [Patent Owner’s] contract with Boeing/Triquant, the Boeing report, notes from Boeing, and as shown above, the Eddie device schematic and Boeing report both showing the same setup.” *Id.*

Based on the circumstances presented here, we need not address constructive reduction to practice or diligence. Specifically, Patent Owner does not rely on constructive reduction to practice to antedate Tayloe and Macnally in its Patent Owner Response. *See generally* PO Resp. Rather, Patent Owner relies on actual reduction to practice occurring prior to the effective dates of Tayloe and Macnally. We find by not raising constructive reduction to practice in its Patent Owner Response, Patent Owner has waived that issue. *See* Paper 10 (Scheduling Order), 9 (“Patent Owner is cautioned that any arguments not raised in the response may be deemed waived.”). Additionally, since the date of Patent Owner’s alleged actual reduction to practice precedes Tayloe and Macnally and since constructive reduction to practice is not before us, we need not consider whether Patent Owner has established reasonable diligence. Therefore, we do not address Petitioner’s position as to constructive reduction to practice and diligence in its Reply (Pet. Reply 17–18 (noting that Patent Owner has not asserted constructive reduction to practice)) or Patent Owner’s response to these arguments in its Sur-reply (PO Sur-reply 20–23 (discussing constructive reduction to practice and diligence)).

Turning to conception and actual reduction to practice, Patent Owner’s evidence as to each relies primarily on the testimony of

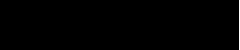
Mr. Sorrells. *See* PO Resp. 23–27 (citing Ex. 2016). Patent Owner also relies on the testimony of Dr. Ricketts to map the Eddie chip and circuit board to the elements of claims 1, 3, 5, 8, 9, and 11–18, but Dr. Ricketts’ testimony ultimately relies on evidence provided by Mr. Sorrells. *See id.* at 27–51. That evidence provided by Mr. Sorrells suffers from a significant failure of proof as to corroboration that fundamentally undermines Patent Owner’s attempt to establish conception and actual reduction to practice. Specifically, there is a lack of evidence that corroborates Mr. Sorrells’ testimony that the schematics alleged to be the Eddie chip and circuit board are actually the chip and circuit board tested by Boeing. The testing materials from Boeing (Exs. 2010, 2022) do not include any circuit schematics, especially those that Mr. Sorrells identifies from the Relativity database. Additionally, the Boeing materials do not refer to any specific, identifiable designation from the schematics, file names, or metadata to corroborate that Boeing actually tested the same chip and circuit board. Nor do the schematics identified by Mr. Sorrells use the term “Eddie.” Although we recognize that not every individual aspect of conception and reduction to practice needs to be corroborated, and that the “corroborative evidence simply needs to be sufficient to support the credibility of the inventors’ story” (*see Medtronic*, 68 F.4th at 1306), Patent Owner’s evidence fails the “rule of reason” test because it lacks key corroborative evidence on this critical connection.

Perhaps, more importantly, we find the facts presented here similar to those presented in *Apator*. In *Apator*, the Federal Circuit noted that “[t]he evidence proffered by [the inventor] is stuck in a catch-22 of corroboration: Apator attempts to corroborate [the inventor’s] testimony with the emails

and the drawings, but the emails and drawings can only provide that corroboration with help from [the inventor’s] testimony.” *Apator*, 887 F.3d at 1296; *see id.* at 1297 (“It would be strange indeed to say that [an inventor], who filed the . . . affidavit that needs corroborating, can by his own testimony provide that corroboration.” (quoting *In re NTP*, 654 F.3d 1279, 1292 (Fed. Cir. 2011) (alteration and omission in original))). That is precisely the situation Patent Owner presents with Mr. Sorrells (a named inventor of the ’528 patent) who seeks to provide critical testimony connecting the alleged Eddie schematics with the Boeing testing documents that Patent Owner then seeks to use to corroborate Mr. Sorrells’ testimony as to conception and reduction to practice.

Additionally, we find inconsistencies in Mr. Sorrells’ testimony and evidence that raise further questions about conception and actual reduction to practice. Mr. Sorrells points to data from the Relativity database that he asserts identifies when a file named “[REDACTED]n” was last modified, but at least one of the files identified has a different name—“[REDACTED]”—even though it also shows a “[m]odified” date of “1997-03-06.” *See* Ex. 2016 ¶ 9. Patent Owner acknowledges that “*different versions of some files have different timestamps or names,*” but contends that all of the files have dates that predate Tayloe and Macnally. PO Sur-reply 19. Although it is true that the dates of the files predate Tayloe and Macnally, that fact alone does not remedy the inconsistencies in Patent Owner’s evidence. Rather, we find that the inconsistencies in the file names and dates suggest that there are multiple potential versions of the schematics and the inconsistencies support Petitioner’s argument that there is a lack of corroborating evidence as to which schematic Boeing tested.

Patent Owner's reliance on 1997/1998 press releases and the 1998 Boeing report as evidencing that Eddie was the focus of ParkerVision's work at the time similarly fail to provide the missing evidence of corroboration connecting the schematics to the Boeing test results. So too does the 915 MHz input noted in the Boeing report and schematic. PO Sur-reply 17 (citing Ex. 2010, 1, 5, 7; Ex. 2011; Ex. 2043, 52:17–20). The same is true of the connection labels in the layout and schematic. *Id.* at 18. Although the connection labels provide some degree of consistency between the layout and schematic, Patent Owner's evidence establishes that multiple versions of files and schematics were prepared during the relevant time period and none of the evidence sufficiently corroborates Mr. Sorrells' testimony connecting the specific schematics to the Eddie chip and circuit board actually tested by Boeing because it is unclear exactly which circuit and components Boeing tested.

Additionally, Patent Owner's evidence of actual reduction to practice is lacking in that it is not tied sufficiently to the schematics provided by Mr. Sorrells. Patent Owner was required to produce evidence sufficient to demonstrate that the Eddie chip and circuit board tested by Boeing (1) is the chip and circuit board shown in the schematics from the Relativity database and (2) actually practiced the claims. Although the Boeing test results indicate that the chip and circuit board Boeing tested worked for down-conversion (*see, e.g.*, Ex. 2010), Patent Owner acknowledges that “component values shown [in the schematic] may not have been used in the tested circuit.” PO Sur-reply 13–14 (pointing to the “” notation in the schematic). Patent Owner offers this argument in rebuttal of Dr. Dickens' testimony showing that the schematic allegedly representing

the Eddie chip did not practice the claims. *Id.* Contrary to Patent Owner’s attempt to assert that the “[REDACTED]D” notation helps its argument to show actual reduction to practice, that indication and Patent Owner’s argument in rebuttal reinforces our findings above that Mr. Sorrells’ testimony lacks sufficient evidence corroborating that the schematics were embodied in the Eddie chip and circuit board tested by Boeing because it is unclear exactly which circuit and components Boeing tested.

As set forth above, we have considered Patent Owner’s evidence and argument, and Petitioner’s evidence and argument, and we have provided our analysis detailing specific issues with Patent Owner’s evidence that render Mr. Sorrells’ testimony insufficiently corroborated under the rule of reason.³² Accordingly, we find that Patent Owner has not satisfied its burden of production to show conception and actual reduction to practice necessary to antedate Tayloe and Macnally. *See, e.g., Apator*, 887 F.3d at 1297 (“a patentee bears the burden of establishing that its claimed invention is entitled to an earlier priority date than an asserted prior art reference”

³² We do not address other arguments raised by Petitioner because we find the lack of corroboration dispositive.

(quoting *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1275–76 (Fed. Cir. 2016)).³³

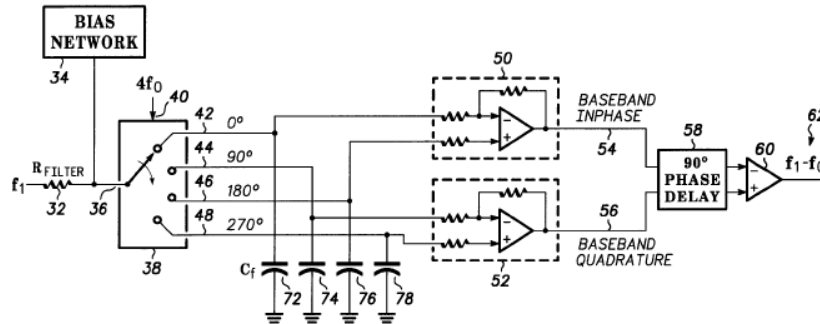
We now address the specific grounds set forth in the Petition challenging the claims.

2. *Scope and Content of the Prior Art*

a. *Tayloe (Ex. 1004)*

Tayloe is directed to “a direct conversion receiver” and its method of “convert[ing] signal of interest directly to baseband (or near zero hertz) from a radio frequency (RF) or intermediate frequency (IF).” Ex. 1004, 1:10–13. Figure 3 is reproduced below:

³³ We note that, as discussed further below, Petitioner filed a Motion to Exclude several of the exhibits proffered by Mr. Sorrells in support of conception and actual reduction to practice based on hearsay and lack of authenticity. *See, e.g.*, Pet. MTE 5–11. Patent Owner opposes Petitioner’s challenge, in part, by relying on Mr. Sorrells’ testimony, which Patent Owner asserts he provides, in this instance, as a corporate witness since Mr. Sorrells was Patent Owner’s Chief Technology Officer. *See, e.g.*, PO Opp. 6. The parties have a fundamental disagreement regarding whether a named inventor can provide testimony on behalf of a corporation (Patent Owner) to authenticate documents that are then sought to provide corroborating evidence in support of that same inventor’s testimony as an individual fact witness. For the purpose of assessing Patent Owner’s evidence under the rule of reason, we need not determine whether Patent Owner’s approach is permissible because, even assuming it is, we find that Patent Owner has not satisfied its burden of production to show conception and actual reduction to practice necessary to antedate Tayloe and Macnally under the rule of reason.



30 FIG. 3

Figure 3 is a block schematic circuit of a direct conversion receiver. *Id.* at 1:51–52.

Regarding Figure 3, Tayloe explains that

an RF or IF signal f_1 is received at resistor 32. Resistor 32, as is more fully discussed below, forms a filter when taken in combination with capacitors 72–78. After passing through resistor 32, the input signal is received by commutating switch 38 at input 36. Commutating switch 38 switches input 36 to outputs 42, 44, 46, and 48. The rate at which commutating switch 38 operates is controlled by a signal present at control input 40. In the preferred embodiment as shown in FIG. 3, the control signal input to control input 40 is substantially equal to four times the local oscillator frequency that would exist in a simple direct conversion receiver. As a result, input 36 is switched to each of the four outputs substantially once during each period of the input signal f_1 .

In a preferred embodiment, commutating switch 38 remains closed at each of the four outputs for substantially 90 degrees at the frequency of the input signal. In alternate embodiments, commutating switch 38 remains closed at each of the four outputs for less than 90 degrees.

During the time that commutating switch 38 connects input 36 to output 42, charge builds up on capacitor 72. Likewise, during the time commutating switch 38 connects input 36 to output 44, charge builds up on capacitor 74. The

same principle holds true for capacitors 76 and 78 when commutating switch 38 connects input 36 to outputs 46 and 48 respectively. As commutating switch 38 cycles through the four outputs, capacitors 72-78 charge to voltage values substantially equal to the average value of the input signal during their respective quadrants. Each of the capacitors functions as a separate integrator, each integrating a separate quarter wave of the input signal. . . .

Output 42 represents the average value of the input signal during the first quarter wave of the period, and is termed the 0 degree output. Output 44 represents the average value of the input signal during the second quarter wave of the period, and is termed the 90 degree output. Output 46 represents the average value of the input signal during the third quarter wave of the period, and is termed the 180 degree output. Output 48 represents the average value of the input signal during the fourth quarter wave of the period, and is termed the 270 degree output.

The outputs of commutating switch 38 are input to summing amplifiers 50 and 52. Summing amplifier 50 differentially sums the 0 degree output and the 180 degree output, thereby producing baseband in-phase signal 54. Summing amplifier 52 differentially sums the 90 degree output and the 270 degree output, thereby producing baseband quadrature signal 56. Baseband in-phase signal 54 and baseband quadrature signal 56 are input to phase delay 58 which shifts the phase of baseband quadrature signal 56 by 90 degrees relative to baseband in-phase signal 54. The resulting signals are then summed by summing amplifier 60 to produce the signal of interest 62.

Ex. 1004, 2:13–67.

Taylor explains that commutating switch 38 is “controlled by a signal present at control input 40,” which causes the switch to couple the RF input signal f_1 to one of four outputs 42, 44, 46, and 48 so that the RF input

signal f_1 is sampled four times during a full cycle, as shown in Figure 4, reproduced below. Ex. 1004, 2:17–20, 3:40–48.

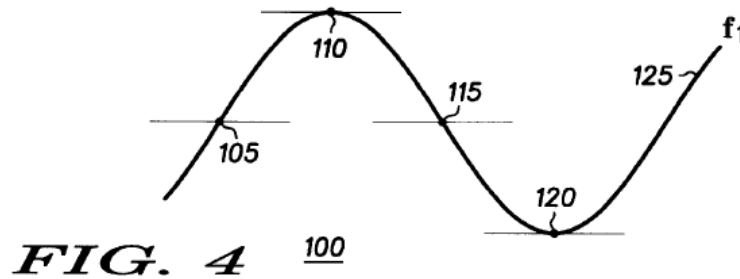


Figure 4 “shows a waveform” in accordance with a preferred embodiment of Tayloe. *Id.* at 1:53–54. Tayloe indicates that “[p]oint 105 represents the voltage to which capacitor 72 (FIG. 3) charges,” “point 110 represents the voltage to which capacitor 74 charges, point 115 represents the voltage to which capacitor 76 charges, and point 120 represents the voltage to which capacitor 78 charges.” *Id.* at 3:41–48.

As shown in Figure 6, reproduced below, Tayloe also discloses “an alternate embodiment in which each integrating capacitor has its own resistor.” Ex. 1004, 4:48–49.

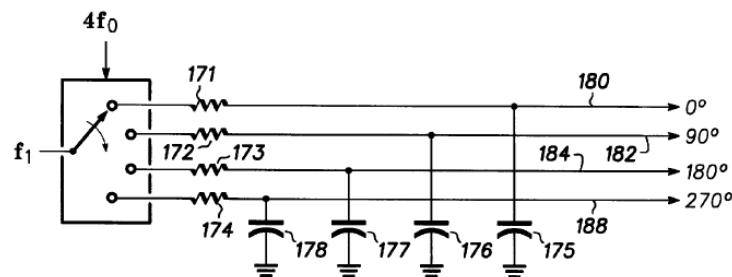


Figure 6 “shows a product detector in accordance with an alternate embodiment” of Tayloe. *Id.* at 1:58–59. Tayloe explains that “0 degree output 180 has a voltage controlled by the combination of capacitor 175 and resistor 171” and “180 degree output 184 has a voltage controlled by the combination of capacitor 177 and resistor 173.” *Id.* at 4:49–57 (similarly

describing 90 degree output 182 and 270 degree output 188 in relation to the combination of their capacitors and resistors).

Taylor teaches implementing “direct conversion receiver 30 (FIG. 3) utilizing an analog multiplexer and a digital counter as shown in FIG. 7,” reproduced below. Ex. 1004, 5:33–37.

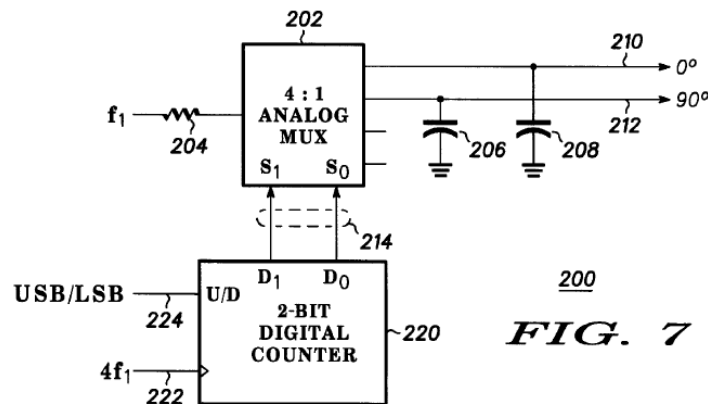


Figure 7 “shows a product detector” in accordance with one of Taylor’s embodiments. *Id.* at 1:60–61. Taylor discloses that “[t]he analog multiplexer is a Texas Instruments SN74BCT3253D.”³⁴ *Id.* at 5:36–37.

b. TI Datasheet (Ex. 1005)

TI Datasheet describes the SN74CBT3253 multiplexer/demultiplexer, “a dual 1-of-4 high-speed TTL-compatible FET multiplexer/demultiplexer.” Ex. 1005, 1. A demultiplexer may be used to receive one input signal and route it to several output lines. Ex. 1003 ¶ 105.

³⁴ Petitioner explains that the “BCT” in Taylor’s reference to the TI Datasheet is a typographical error and should instead be read as “CBT.” Pet. 17–18 n.5. Patent Owner does not contest Petitioner’s characterization. *See generally* PO Resp.

c. Macnally (Ex. 1021)

Macnally generally relates to “[a] single-chip CMOS [complementary metal-oxide semiconductor] direct conversion transceiver [that] includes an RF circuit, a transmitter having a synthesizer, a receiver having a baseband filter, and a demodulator.” Ex. 1021, code (57). Figure 1 of Macnally, reproduced below, illustrates a block diagram of the single-chip CMOS transceiver according to one embodiment. *Id.* at 2:20–21.

FIG. 1

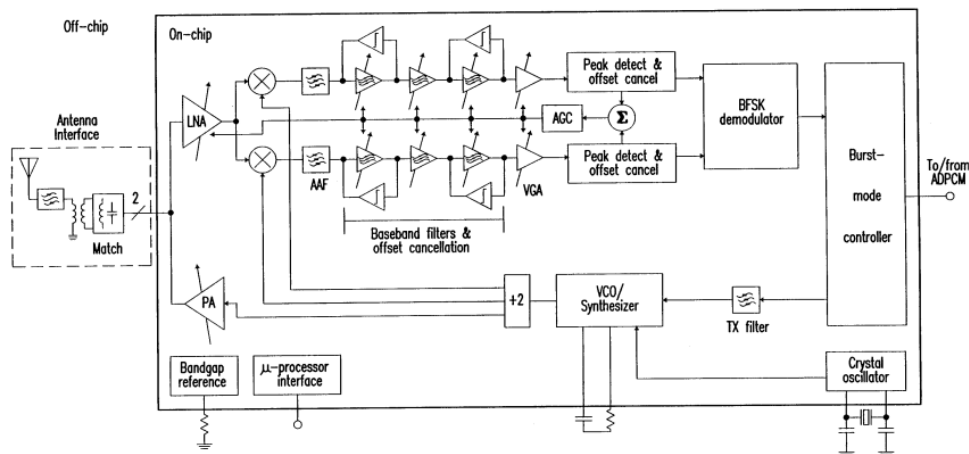


Figure 1 illustrates a fully-integrated transceiver 100 that includes, among other things, RF circuits 102 and 104, synthesizer 106, baseband filters 108, demodulator 110, and digital signal processing. *Id.* at 5:7–11.

Figure 3 of Macnally, reproduced below, illustrates a circuit diagram of the mixer and antialias filter according to one embodiment. Ex. 1021, 2:24–25.

FIG. 3

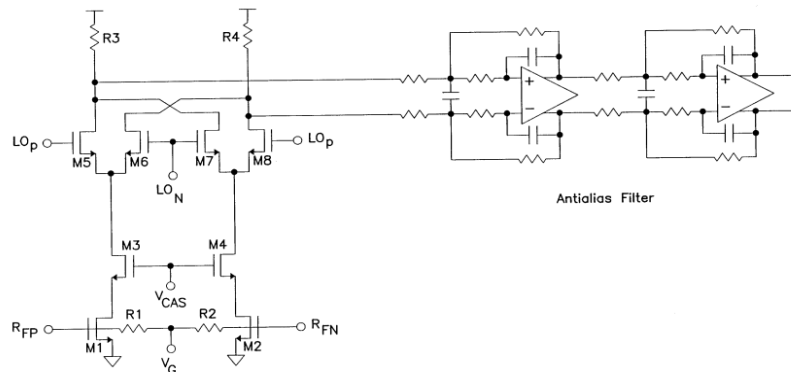


Figure 3 illustrates mixer 142 and antialias filter 144. *Id.* at 7:7–8.

Macnally discloses that “[t]he output of the mixer 142 is fed to a four–pole Butterworth antialias filter 144” formed by “[t]wo biquad stages.” *Id.* at 7:14–17.

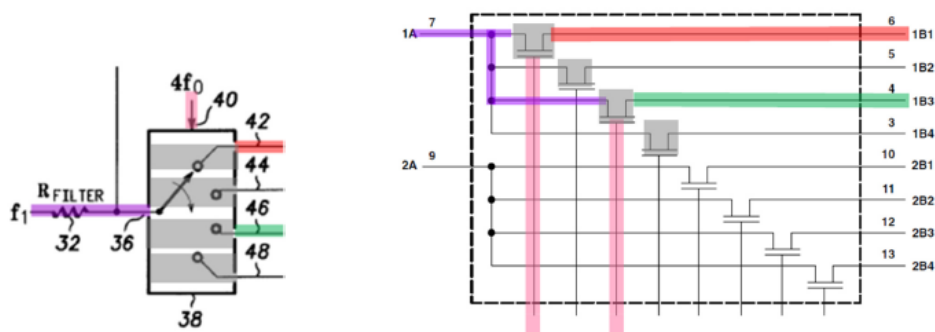
3. *The Combination: Motivation to Combine and Reasonable Expectation of Success*

Petitioner asserts Tayloe discloses “a direct conversion receiver using a commutating switch to ‘sample an RF waveform four times per period at the RF frequency’ in which ‘[t]he samples are integrated over time to produce an average voltage of 0 degrees, 90 degrees, 180 degrees and 270 degrees’ across the 360-degree full cycle.” Pet. 22 (alteration in original) (quoting Ex. 1004, code (57)) (citing Ex. 1004, 2:13–67 (referring to “one embodiment using separate capacitors 72, 74, 76, and 78), Figs. 3, 4). Petitioner contends Tayloe “discloses ‘an alternative embodiment in which each integrating capacitor has its own resistor.’” *Id.* (quoting Ex. 1004, 4:48–57) (citing Ex. 1004, Fig. 6). Petitioner further asserts Tayloe discloses implementing commutating switch 38 using the multiplexer/demultiplexer disclosed by TI Datasheet. *Id.* (citing Ex. 1004, 5:33–37, 5:1–16, Fig. 7). Additionally, Petitioner contends “Macnally

discloses examples of using antialiasing filters in an integrated transceiver device.” *Id.* at 23 (citing Ex. 1021, Fig. 3, 1:44–46, 7:7–29).

Petitioner proposes several modifications based on combining the teachings of Tayloe, TI Datasheet, and Macnally, and asserts that one of ordinary skill in the art would have been prompted to combine the teachings as proposed with a reasonable expectation of success. Pet. 22–30. As described below, Petitioner proposes combining Tayloe with TI Datasheet, then describes modifying Tayloe according to one of the alternate embodiments disclosed therein, and then describes modifying the Tayloe/TI Datasheet combination in light of Macnally. *Id.*

First, Petitioner contends that one of ordinary skill in the art would have been motivated “to combine Tayloe and the TI Datasheet, using any four of the multiplexer switches (gray) from the multiplexer to implement Tayloe’s commutating switch 38.” Pet. 23. Petitioner annotates Tayloe’s Figure 3 and the multiplexer/demultiplexer of TI Datasheet, as shown below.



TI-1004, Fig 3 (switch 38)

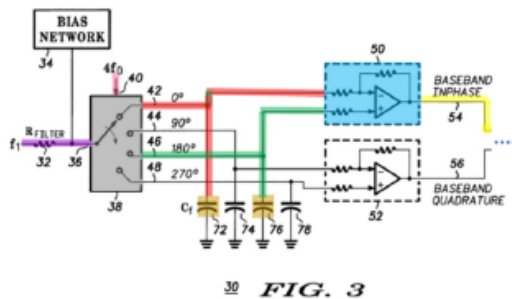
TI-1005, 1 (multiplexer/demultiplexer)

Pet. 24. Petitioner highlights Tayloe's switch 38 as shown in Figure 3 (left) and the multiplexer/demultiplexer of TI Datasheet (right) using the same colors to indicate the correspondence between switch 38 and the multiplexer/demultiplexer, and explains how using the multiplexer/demultiplexer instead of Tayloe's switch 38 would have been a

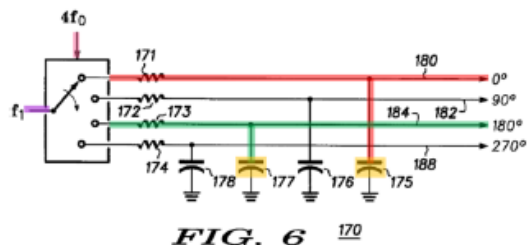
“simple substitution of one known element for another.” Pet. 24–25 (citing *KSR*, 550 U.S. at 401); *see id.* at 24 (asserting one of ordinary skill in the art would have been “motivated to use the multiplexer of the TI Datasheet to implement Tayloe’s commutating switch 38 at least because Tayloe expressly teaches using an analog multiplexer, and the multiplexer of TI’s Datasheet is a suitable analog multiplexer capable of performing the needed switching with the requisite number of channels” (citing Ex. 1003 ¶ 134)).

Petitioner contends one of ordinary skill in the art “would have a reasonable expectation of success at combining Tayloe with TI Datasheet because the combination would have yielded predictable results (e.g., ‘low on-state resistance of the switch [which] allows connections to be made with minimal propagation delay’).” Pet. 25 (alteration in original) (citing Ex. 1005, 1; Ex. 1003 ¶ 136).

Second, Petitioner contends one of ordinary skill in the art “would have found it obvious to apply the separate integrator example” from Tayloe’s Figure 6 to the receiver depicted in Tayloe’s Figure 3, as shown below. Pet. 25.



TI-1004, Fig. 3



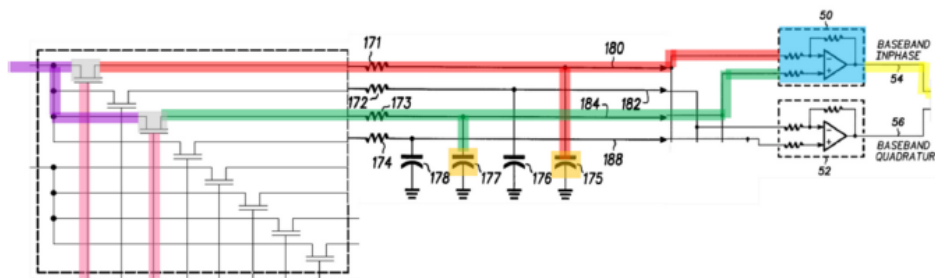
TI-1004, Fig. 6

Pet. 25. Tayloe’s Figure 3 “shows a direct conversion receiver” and Tayloe’s Figure 6 “shows a product detector.” Ex. 1004, 1:51, 1:58.

Petitioner annotates with highlighting the similar components of Tayloe's Figures 3 and 6. *Id.* Petitioner asserts that the figures reproduced below show how it proposes to combine (1) Figures 3 and 6 of Tayloe and (2) Figures 3 and 6 of Tayloe with TI Datasheet. *Id.* at 26.



Combined Teachings of TI-1004



Combination System (using switch of TI-1005)

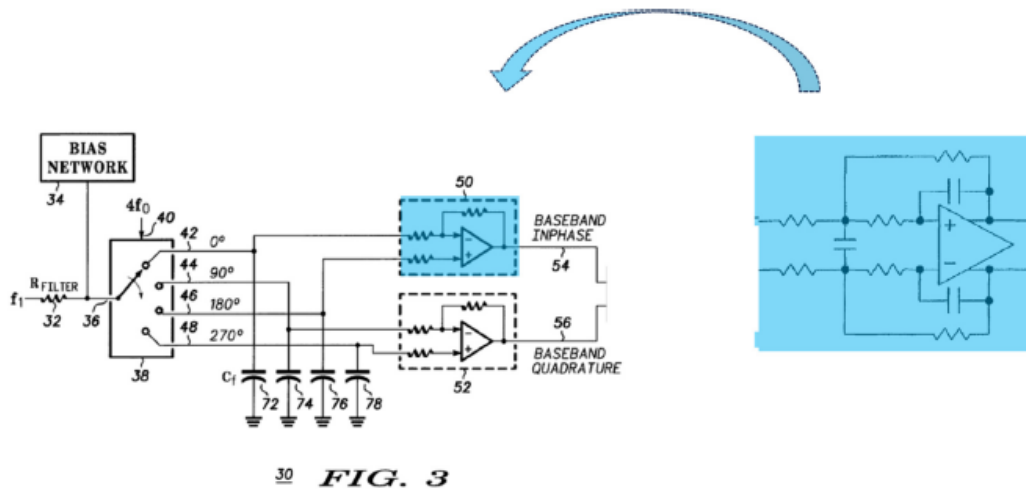
Pet. 26. The first figure shown above includes Tayloe's Figure 6 in place of a portion of Tayloe's Figure 3, specifically where each integrating capacitor has its own resistor. *Id.* The second figure shown above substitutes TI Datasheet's multiplexer switches for Tayloe's switch 38. *Id.* Each figure includes highlighting to identify the corresponding portions of each figure. *Id.*

Petitioner contends that one of ordinary skill in the art "would have been motivated to combine Figure 6 with Figure 3 of Tayloe at least because Tayloe specifically describes Figure 6 as 'an alternate embodiment in which each integrating capacitor has its own resistor.'" Pet. 26 (quoting Ex. 1004, 4:46–49). Petitioner asserts, "[a]s 'an alternate embodiment' relative to the

embodiment where capacitors 72–78 share a resistor 32, i.e., Figure 3, a [person of ordinary skill in the art] would have understood the ‘alternate embodiment’ as replacing a portion of Figure 3.” *Id.* In further explanation of Petitioner’s proposed combination of Figures 3 and 6 in Tayloe, Petitioner asserts that, “[w]hile the ‘alternate embodiment’ performs a similar function of the portion of Figure 3, it alone does not produce a baseband signal.” *Id.* Therefore, Petitioner contends one of ordinary skill in the art “seeking to generate a baseband signal with the ‘alternate embodiment’ would have found it obvious to replace the existing arrangement of capacitors in Figure 3 using the alternate arrangement where ‘each integrating capacitor has its own resistor,’ as depicted in Figure 6.” *Id.* at 26–27.

Petitioner contends one of ordinary skill in the art “would have a reasonable expectation of success in combining Figures 3 and 6 of Tayloe because the replacement is no more than ‘a simple substitution of one known element for another’ to obtain predictable results (i.e., ‘each integrating capacitor has its own resist[o]r’).” Pet. 27 (citing Ex. 1003 ¶¶ 135–139).

Third, Petitioner contends it would have been obvious to one of ordinary skill in the art “to implement each of Tayloe’s differential amplifier circuits (light blue) ([Ex.] 1004, Fig. 3) as a fully differential operational amplifier configuration (light blue), as taught in Macnally ([Ex.] 1021 . . . , Fig. 3).” Pet. 27. To illustrate Petitioner’s combination, Petitioner provides the annotated figures reproduced below.



TI-1004, Fig. 3 (left)

TI-1021/TI-1022, Fig. 3 (right)

Pet. 27. To demonstrate this combination, Petitioner reverts back to unmodified Figure 3 of Tayloe (left) to show where Macnally's differential operational amplifier configuration (right) would be substituted into Tayloe. *Id.* Petitioner illustrates this substitution by coloring the respective portions of the figures in light blue and adding a light blue arrow showing the substitution. *Id.*

Petitioner contends one of ordinary skill in the art would have been motivated “to adapt Tayloe’s system as a single-chip (i.e., integrated circuit known as IC) to meet relentless market demand for improved product size/performance, and decreased unit cost.” Pet. 28 (citing Ex. 1003 ¶¶ 140–142 (citing Ex. 1021, 5:5–7)). Petitioner asserts one of ordinary skill in the art would have been “inspired by several known advantages of using fully differential amplifiers and Macnally’s topology for baseband processing on an IC.” *Id.*

First, Petitioner asserts “fully differential amplifiers operate on complementary signal components such that interference which equally

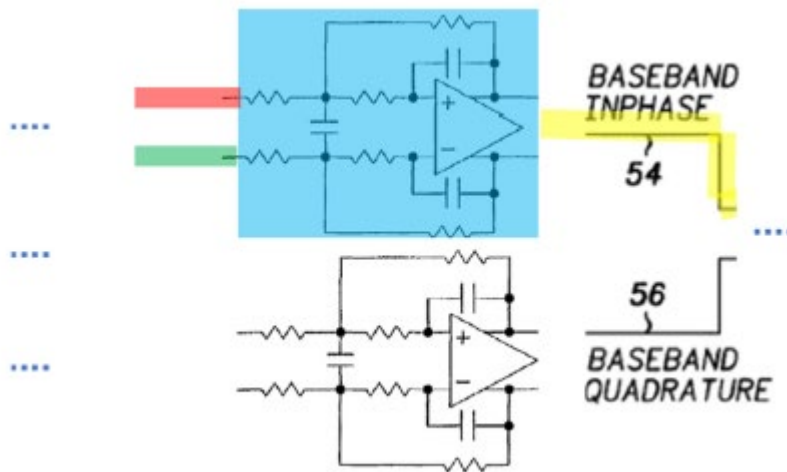
corrupts both complementary signal components can be cancelled by taking the difference between the two complementary signal components.” Pet. 28. Petitioner asserts “[t]his known feature can minimize even order harmonic distortion, thus improving the linearity of amplifier output.” *Id.* (citing Ex. 1003 ¶ 141).

Second, Petitioner contends “each fully differential amplifier is laid out symmetrically on an integrated circuit (IC) to provide ‘a fully differential analog signal path [that] minimizes supply and substrate noise coupling [e.g., interference coupling from the substrate, power supply lines, and ground lines].” Pet. 28 (alterations in original) (citing Ex. 1021, 6:64–65³⁵; Ex. 1003 ¶ 141 (citing Ex. 1027, 1389)).

Third, Petitioner asserts that, “among available design options for fully differential amplifiers, Macnally’s configuration employs the Rauch biquad topology that can achieve a given power output with lower power input and reduced noise and distortion.” Pet. 28 (citing Ex. 1003 ¶ 141 (citing Ex. 1027, 1388, Fig. 12)).

Petitioner provides the following figure, which shows part of the combined system focused on the circuits from Macnally.

³⁵ Petitioner cites column 6, lines 64–65, of Macnally, but we understand Petitioner to have intended to cite column 5 as opposed to column 6 given the discussion in Macnally in those locations.



Pet. 29. Petitioner’s figure shows the combination with Macnally’s differential operational amplifier configuration substituted into Tayloe’s Figure 3, using the same color highlighting from the previous iterations of Petitioner’s combined figures reproduced above. *Id.*

Relying on Dr. Galton’s testimony, Petitioner asserts that “the differential output of Macnally’s configuration is characteristic of on-chip baseband signals for subsequent on-chip processing, also in differential format.” Pet. 29 (citing Ex. 1003 ¶ 142). Petitioner contends that one of ordinary skill in the art would have understood “the subsequent on-chip components would likewise be differential as in Macnally, *e.g.*, differential inputs/outputs for I and for Q in any subsequent circuit paths, phase shifters, amplifiers, and other components, eventually summing each differential pair with a summing amplifier, like Tayloe’s amplifier 60.” *Id.* (citing Ex. 1003 ¶ 142). And Petitioner asserts “the implementation would have been a simple substitution of one known element (fully differential amplifier circuit of Macnally) for another (summing amplifier circuit of Tayloe) to obtain predictable results (*e.g.*, improved linearity and reduced power consumption

for on-chip performance), and hence would have had a reasonable expectation of success.” *Id.* at 29–30 (citing Ex. 1003 ¶¶ 141–143).

Patent Owner raises several arguments in response to Petitioner’s proposed combination of Tayloe, TI Datasheet, and Macnally. As discussed further below, Patent Owner contends that the combination fails to teach several elements of the claims. PO Resp. 77 (asserting that the combination does not teach (1) an “‘energy storage element’ that stores transferred energy and outputs a baseband signal portion, (2) deriving a baseband signal portion from accumulated transferred energy, or (3) outputting a differential baseband signal” as well as “transferred energy being discharged when a switch is OFF”). We address each of these arguments below in our discussion of the claims.

The bulk of Patent Owner’s argument in response to this challenge, however, is directed to whether one of ordinary skill in the art would have been motivated to combine the teachings of Tayloe, TI Datasheet, and Macnally as proposed by Petitioner with a reasonable expectation of success. PO Resp. 77–98. We address these arguments before we discuss the elements of the claims.

Patent Owner contends that Petitioner’s proposed combination is based on hindsight and uses the claims “as a roadmap to reconstruct a completely new circuit,” “without analyzing how each substitution would affect circuit functionality.” PO Resp. 80. As discussed above, because Petitioner provides a sufficient reason for each of the modifications proposed, we do not agree that Petitioner’s proposed combination is based on improper hindsight reconstruction.

*a. Whether Tayloe Teaches Away from Combining
Figure 6 and TI Datasheet*

Patent Owner contends that it would not have been obvious to use Tayloe’s Figure 6 in combination with the TI Datasheet multiplexer because “Tayloe only discloses using the TI Datasheet multiplexer in the context of Figures 3 and 7.” PO Resp. 80. Patent Owner contends that Tayloe does not disclose or suggest using a multiplexer with Figure 6 and Petitioner’s combination “ignores critical distinctions among embodiments.” *Id.* at 80–81.

Patent Owner asserts that the configuration of Tayloe’s Figure 6 is different than that of Tayloe’s Figures 3 and 7, and, because of those differences, Tayloe specifically chose not to use TI Datasheet’s multiplexer with Figure 6. PO Resp. 81. Patent Owner contends that, unlike Figure 6, Figures 3 and 7 “use a *shared* resistor configuration — a *single* resistor and individual capacitors” whereas Figure 6 “uses a *per-path* resistor configuration — four separate resistors, one for each capacitor.” *Id.* Patent Owner asserts that the “multiplexer-based implementation is expressly tied to the shared-resistor configuration in Figures 3 and 7,” and Tayloe never teaches “combining the multiplexer with the more complex and component-heavy configuration of Figure 6.” *Id.*

Patent Owner asserts that Petitioner’s use of Tayloe’s Figure 6, “undermines the very design tradeoffs Petitioner claims would motivate” one of ordinary skill in the art to make the combination in the first place. PO Resp. 81 (citing Ex. 2024 ¶ 299). In particular, Patent Owner contends that if one of ordinary skill were “considering ‘size, packaging advantages, and low unit cost’ . . . of an integrated circuit (IC), then the simpler architecture of Figure 3—which uses fewer components, reduces layout complexity, and

minimizes die area and power consumption—would be preferred to Figure 6’s per-path resistor structure—which introduces greater component count, routing complexity, and cost.” *Id.* at 81–80 (citing Ex. 2024 ¶ 300).

Patent Owner also asserts Tayloe’s Figure 6 “introduces substantial practical complications” in an “IC context,” particularly regarding matching. PO Resp. 82 (citing Ex. 2024 ¶ 301). Patent Owner points to potential difficulties in achieving matching and a potential need for larger resistors, which it argues run counter to Petitioner’s motivation of simplicity and reducing costs. *Id.*

Additionally, Patent Owner contends that using Tayloe’s Figure 6 instead of Tayloe’s Figure 3 with TI Datasheet’s multiplexer is not a simple substitution because using four separate resistors after the switch, as shown in Figure 6, introduces complexities that do not exist in the Figure 3 design, which uses a single resistor before the switch. PO Resp. 82. Such a change, according to Patent Owner, results in “meaningful consequences for signal timing, die layout, and implementation in silicon,” and Petitioner fails to provide evidence that one of ordinary skill in the art would “willingly introduce these complexities counter to Petitioner’s own rationale.” *Id.* at 82–83 (citing Ex. 2024 ¶¶ 302–303).

In its Reply, Petitioner first contends that Patent Owner’s assertion that Petitioner used the invention as a roadmap to construct a new circuit is incorrect because Tayloe expressly discloses using the TI Datasheet multiplexer/demultiplexer as the switch in Figure 3 and also expressly discloses Figure 6 as an “alternate embodiment” for the resistor-capacitor network in Figure 3. Pet. Reply 25 (citing Ex. 1004, 4:46–49; Pet. 22–30 (citing Ex. 1003 ¶¶ 130–143)).

Turning to Patent Owner’s argument regarding Tayloe’s Figure 6 and teaching away, Petitioner contends that Figure 6 “does not teach away because it does not contradict [Petitioner’s] motivation to combine with Macnally.” Pet. Reply 26. In particular, Petitioner asserts that, “[i]n the combination, the fully-differential amplifier (like Macnally’s) generally reduces area and power consumption relative to those of a comparable single-ended amplifier (like Tayloe’s).” *Id.* (citing Ex. 1066 ¶ 89). Petitioner asserts that the “signal swing” of a fully differential amplifier is approximately double that of a single-ended amplifier and, therefore, “it can handle four times more noise power than a single-ended amplifier for the same signal-to-noise ratio,” which “allows reducing the size of the fully-differential amplifier and its bias current while achieving the same signal-to-noise ratio.” *Id.* (citing Ex. 1066 ¶ 89).

Additionally, Petitioner contends that “[m]atching resistors during IC fabrication was routine, as evidenced by prior art demonstrating on-chip resistors matched to a fraction of a percent of accuracy,” and “[w]hen combining Tayloe and TI-Datasheet, using matched resistors would be just part of the ‘standard CMOS and BiCMOS processes.’” Pet. Reply 26 (citing Ex. 1058, 935–39; Ex. 1003 ¶ 141).

Further, Petitioner contends that “obviousness ‘does not require that motivation lead to the best option, only that it be a suitable option from which the prior art did not teach away.’” Pet. Reply 27 (quoting *Par Pharm., Inc. v. TWi Pharm., Inc.*, 773 F.3d 1186, 1197–98 (Fed. Cir. 2014); *Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1381 (Fed. Cir. 2003)). And Petitioner asserts that Patent Owner only relied on Dr. Ricketts’ testimony in support of its teaching away position, but

Dr. Ricketts’ testimony is conclusory and unsupported. *Id.* (citing Ex. 2024 ¶¶ 300–303; *Xerox Corp. v. Bytemark, Inc.*, IPR2022-00624, Paper 9 (PTAB Aug. 24, 2022)).

In its Sur-reply, Patent Owner contends that Tayloe “never suggests this combination” of Figure 6 and TI Datasheet; rather, Tayloe only discloses combining TI Datasheet with Figures 3 or 7. PO Sur-reply 30 (citing PO Resp. 80–81). Patent Owner asserts that Petitioner’s citation of Tayloe “merely identifies Figure 6 as its own *separate* embodiment.” *Id.* (citing Pet. Reply 25 (citing Ex. 1004, 4:46–49)).

Based on the complete record, we disagree with Patent Owner’s argument that Tayloe teaches away from using Figure 6 with TI Datasheet’s multiplexer. “A reference may be said to teach away when a person of ordinary skill, upon reading the reference . . . would be led in a direction divergent from the path that was taken by the applicant.” *In re Haruna*, 249 F.3d 1327, 1335 (Fed. Cir. 2001) (quoting *Tec Air, Inc. v. Denso Mfg. Mich. Inc.*, 192 F.3d 1353, 1360 (Fed. Cir. 1999)); *see In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004) (holding that, to teach away, the prior art must “criticize, discredit, or otherwise discourage the solution claimed”).

Patent Owner does not assert that anything in Tayloe would have discouraged or led one of ordinary skill in the art away from combining Figure 6 with TI Datasheet. *See* PO Resp. 80–83 (asserting that the combination is not expressly disclosed and that it introduces complexities that run counter to Petitioner’s motivation, but not that Tayloe discourages or would have led one of ordinary skill in the art away from the combination). Tayloe explains that Figure 3 “shows a direct conversion receiver in accordance with a preferred embodiment of the present

invention.” Ex. 1004, 2:6–8. Tayloe states that, in Figure 3, “[t]he combination of resistor 32, commutating switch 38, and capacitors 72–78 form a portion of a preferred embodiment of a product detector” and that “[t]his product detector is referred to herein as a ‘Tayloe Product Detector.’” *Id.* at 3:1–4. In describing Figure 6, Tayloe explicitly states that Figure 6 “shows a product detector in accordance with an alternate embodiment of the present invention. Product detector 170 shows an alternate embodiment where each integrating capacitor has its own resistor.” *Id.* at 4:46–49; *see id.* at 5:1–2 (describing Figure 7 as a “product detector in accordance with an alternate embodiment of the present invention”). Thus, Tayloe expressly refers to Figure 6 as illustrating an alternate product detector as compared to the product detector of Figure 3, and we see nothing in Tayloe that would have discouraged or led one of ordinary skill in the art away from combining that embodiment (Figure 6) with TI Datasheet as Tayloe teaches for the Figure 3 embodiment (*see id.* at 5:32–37 (describing combining Figure 3 with the analog multiplexer of TI Datasheet)).

*b. Whether Tayloe Teaches Away from Creating
Petitioner’s Integrated Circuit*

Patent Owner contends that Tayloe provides no motivation for one of ordinary skill in the art “to develop an IC incorporating Tayloe’s product detector,” and that “Tayloe already discloses use of an integrated circuit—the TI Datasheet multiplexer.” PO Resp. 83. Even in light of those teachings, Patent Owner asserts that “Tayloe, however, never discloses/teaches/suggests integrating its product detector into the TI Datasheet IC or any other IC,” and one of ordinary skill in the art “would

not have been motivated to develop an entirely new integrated circuit around Tayloe’s product detector.” *Id.* (citing Ex. 2024 ¶ 305).

In contrast, Patent Owner asserts that “Tayloe specifically teaches away from implementing its product detector in an IC.” PO Resp. 83 (citing Ex. 2024 ¶ 306). Patent Owner contends that Petitioner’s proposed circuit includes Tayloe’s capacitors, but one of ordinary skill in the art would recognize that due to the size of Tayloe’s capacitors, they would not be suitable for integration and would instead be “off chip.” *Id.* at 83–84 (citing Ex. 2024 ¶ 306; Ex. 1004, 5:50–51). Patent Owner contends that Dr. Galton ignores this practical consideration, Tayloe provides no example/guidance of how to build a direct conversion receiver using the circuit of Figure 6, and that building such an IC “would require redesigning the circuit architecture, abandoning the TI multiplexer, and developing new switches components capable of operating orders of magnitude faster than those disclosed in Tayloe/TI Datasheet.” *Id.* at 84 (citing Ex. 2024 ¶¶ 307–308). Patent Owner contends that doing so “would require undue experimentation, well beyond routine skill in the art.” *Id.* (citing Ex. 2024 ¶ 308). Thus, Patent Owner asserts Tayloe “does not provide any motivation to create an IC using Tayloe/TI [D]atasheet” and “Tayloe teaches away from such a design” while “Petitioner’s proposal relies on hindsight and ignores real-world engineering constraints.” *Id.* at 85 (citing Ex. 2024 ¶ 309).

In Reply, Petitioner contends that Patent Owner’s argument amounts to an argument against bodily incorporation, but bodily incorporation is not required. Pet. Reply 27. Petitioner asserts that Tayloe expressly teaches that its invention is not limited to “the particular forms shown” and, therefore, “[u]sing different component values than Tayloe’s examples does not

‘depart from the spirit and scope of [Tayloe’s] invention.’” *Id.* (second alteration in original) (citing Ex. 1066 ¶¶ 58–63).

Additionally, Petitioner asserts that Patent Owner identified a common solution to the question of placing Tayloe’s capacitors on-chip, which is to place them off-chip. Pet. Reply 27–28 (citing Ex. PO Resp. 83–84; Ex. 2016; Ex. 1066 ¶¶ 62–63). Petitioner contends that the combination “does not preclude such off-chip capacitors.” *Id.* at 84 (citing Ex. 1066 ¶¶ 62–63).

Further, responding to Patent Owner’s argument that Tayloe could not handle higher frequency, Petitioner asserts that the claims do not recite any particular operating frequency, and Tayloe specifically targeted lower-frequency operation, which teaches the subject matter of the claims. Pet. Reply 28 (citing Ex. 1066 ¶¶ 58–61; Ex. 1004, 5:49–60³⁶).

In its Sur-reply, Patent Owner asserts that the only motivation Petitioner argued for combining Tayloe and Macnally is to “adapt Tayloe’s system as a *single*-chip.” PO Sur-reply 23 (citing Pet. 27–30; Ex. 1003 ¶¶ 140–142). Patent Owner contends that Petitioner fails to meet its own stated motivation. *Id.* at 24. In particular, Patent Owner asserts that “single-chip” means a single chip that contains all essential functionality and that Dr. Galton agreed. *Id.* (citing Ex. 2042, 50:11–16). Patent Owner asserts that Dr. Galton identified Tayloe’s “system” as including “all switches/resistors/capacitors of Tayloe” and each of those components

³⁶ Petitioner inadvertently cites Exhibit 1003, but we understand from the context and citation format that Petitioner intended to cite Tayloe (Ex. 1004).

would need to be combined on a single chip along with Macnally's filter. *Id.* at 24–25 (citing Ex. 1003 ¶ 140).

Patent Owner asserts that Dr. Ricketts explained that Petitioner's motivation to implement the combination on a single chip fails because Tayloe's capacitors would have to be off-chip. PO Sur-reply 25 (citing PO Resp. 83–84; Ex. 2024 ¶ 306; Ex. 2042, 41:19–22, 58:9–16). Patent Owner contends that, in its Reply, Petitioner changes positions and asserts that, even with Tayloe's capacitors off-chip, the Tayloe/Macnally combination would still be considered a single-chip IC. *Id.* (citing Pet. Reply 27–28 (citing Ex. 1055 ¶¶ 58–63)). Patent Owner asserts that “moving Tayloe's capacitors (essential components) off-chip defeats the entire purpose of the *single-chip* IC rationale” and Dr. Galton's new position renders his testimony not credible. *Id.* at 25–26.

Based on the complete record, we disagree with Patent Owner's arguments that Tayloe teaches away from creating an integrated circuit for two reasons. First, as with the previous discussion, Patent Owner does not identify anything in Tayloe that discourages or would otherwise lead one of ordinary skill in the art away from doing so and we do not discern anything in Tayloe that teaches away from creating an integrated circuit as proposed by Petitioner.

Second, we disagree with Patent Owner that Petitioner changed positions between the Petition and Reply regarding why one of ordinary skill in the art would have been motivated to combine the teachings of Tayloe and Macnally. Although, in the Petition, Petitioner referred to “adapt[ing] Tayloe's *system* as a single-chip (i.e., integrated circuit known as IC)” (Pet. 28 (emphasis added)), Dr. Galton, supported by evidence of record,

explains that one of ordinary skill in the art would have understood that, even a single-chip IC could have off-chip capacitors and still be known in the art as a single-chip IC. Specifically, as evidence of the general background knowledge in the art, Dr. Galton points to Exhibit 1059, which describes a “single-chip” (IC) receiver that Dr. Galton explains includes two off-chip capacitors. Ex. 1066 ¶ 63 (citing Ex. 1059). We also note that Macnally describes a “single-chip CMOS transceiver” and yet illustrates the chip as showing two off-chip capacitors. Ex. 1021, Fig. 1. Thus, we do not agree with Patent Owner that Petitioner changed positions or that placing Tayloe’s capacitors off-chip somehow lessens Petitioner’s motivation to combine, or the benefits achieved by the combination. *See* Pet. 28 (also describing “several known advantages of using fully differential amplifiers and Macnally’s topology for baseband processing on an IC”).

c. Whether Macnally and TI Datasheet are Incompatible

Patent Owner contends that Macnally and TI Datasheet are not compatible because one of ordinary skill in the art would not combine their teachings in an IC. PO Resp. 85. Patent Owner asserts that “Macnally is realized in IC technology, in part, because it operates at high frequencies . . . , which enables the use of physically smaller components, making it feasible for an IC.” *Id.* (citing Ex. 2024 ¶ 312). Patent Owner contends that the TI Datasheet multiplexer “cannot switch quickly enough to function at” Macnally’s high frequency of, e.g., 915 MHz. *Id.* (citing Ex. 2024 ¶ 313).

In its Reply, Petitioner responds by asserting that “neither the claims nor the combination require high-frequency operation,” and that “Macnally’s

mixer is not part of the proposed combination.” Pet. Reply 28 (citing Ex. 1066 ¶¶ 64–69; Pet. 20–21 (citing Ex. 2021, Fig. 3), 27–30).

In its Sur-reply, Patent Owner contends that Petitioner does not respond to its assertion that single chips can be realized by operating at higher frequencies, but that the switches in the TI Datasheet cannot operate at those same high frequencies. PO Sur-reply 31.

Based on the complete record, we disagree with Patent Owner’s arguments that Macnally and TI Datasheet are incompatible for three reasons. First, we agree with Petitioner’s position that the claims do not require a particular frequency. Second, Patent Owner’s argument is based on Dr. Ricketts’ testimony where he points specifically to Macnally’s operating frequency and opines that the switches taught in TI Datasheet would not be able to operate at those frequencies, but, as Petitioner explained, nothing in the combination or claims requires the combination to operate at those frequencies. Third, we also add that Dr. Ricketts’ testimony regarding operating at high frequencies is specific to Macnally and he does not opine that every integrated circuit must operate at high frequencies to be feasible or even that the claims require such operation. *See, e.g.*, Ex. 2024 ¶ 312 (explicitly discussing Macnally’s frequency and Macnally’s integrated circuit). Fourth, we disagree with Patent Owner’s argument, in its Sur-reply, that Petitioner did not address this issue; as noted above, Petitioner addressed it. *See* Pet. Reply 28.

d. Whether Macnally Teaches a Fundamentally Different Mixer than Tayloe

Patent Owner contends that Dr. Galton “ignores that his combination is replacing Macnally’s mixer with Tayloe/TI Datasheet,” and he “fails to

show any motivation for replacing Macnally's mixer, which achieves significant gain." PO Resp. 86 (citing Ex. 2024 ¶ 316). Patent Owner asserts that Macnally "discloses a high-performance mixer," whereas Tayloe "discloses a mixer with a -1dB conversion loss, which is 15 dB less gain (worse) than Macnally." *Id.* (citing Ex. 1021, 7:8–10; Ex. 1004, 1:65, 3:5–6, 3:9–11); *see id.* (asserting that "[t]he gain achieved in Macnally is not due to the biquad two-pole filter" (citing Ex. 2024 ¶ 317)).

Petitioner contends that Patent Owner's argument ignores the proposed combination, and that Patent Owner misinterprets Macnally because Macnally teaches that over half of its gain (measured in dB) comes from its biquad two-pole filters. Pet. Reply 28 (citing Ex. 1066 ¶¶ 70–75 (citing Ex. 1021, 7:7–20)).

Based on the complete record, we disagree with Patent Owner's argument that Macnally teaches a fundamentally different mixer than Taylor because it is not responsive to Petitioner's proposed combination and further because it is based on a misunderstanding of Macnally. We find Dr. Galton's rebuttal testimony on this issue persuasive. In particular, Dr. Galton explains that he did not opine on replacing Macnally's mixer with Tayloe; rather, he opined that one of ordinary skill in the art would be motivated to implement Tayloe as an IC and to use fully-differential amplifiers when implementing Tayloe as an IC. Ex. 1066 ¶ 72; *see* Pet. 28 (a person of ordinary skill in the art "would have been inspired by several known advantages of using fully differential amplifiers and Macnally's topology for baseband processing on an IC"). Additionally, Dr. Galton's testimony persuasively rebuts Dr. Ricketts' testimony regarding Macnally's teaching pertaining to gain due to the biquad two-pole filter because

Macnally expressly states that two biquad stages provide gain of 15.6 dB. Ex. 1066 ¶ 73 (further noting that the gain from the two-pole filters is greater than the 14.3 dB of gain from the mixer (citing Ex. 1021, 7:7–20)). .

e. Whether There is Motivation to Replace Tayloe's Amplifiers with Macnally's Filter

Patent Owner argues several reasons why one of ordinary skill in the art would not consider using a fully differential amplifier. PO Resp. 87. We address each of Patent Owner's arguments.

First, Patent Owner contends that “Tayloe specifically teaches using an amplifier with a single-ended output for a specific goal, namely ‘to increase gain.’” PO Resp. 87 (citing Ex. 1004, Abstract; Ex. 2024 ¶ 320). Patent Owner asserts that, because “Tayloe's amplifiers already accomplish the intended goal of providing gain,” one of ordinary skill in the art “would not have any reason to replace Tayloe's amplifiers with a different type of circuit” and “would not be motivated to look to Macnally's biquad two-pole filter to perform amplification.” *Id.* (citing Ex. 2024 ¶¶ 321–322). Additionally, Patent Owner contends that Tayloe “deliberately uses a single-ended output to increase gain” and Petitioner's “proposed substitution undermines Tayloe's intended functionality.” *Id.* at 88 (citing Ex. 2024 ¶ 323).

Petitioner contends that “Macnally's amplifier topology offers ‘advantages . . . for baseband processing on an IC’ over a single ended amplifier.” Pet. Reply 29 (citing Pet. 28; Ex. 1003 ¶ 34 (noting the differential signal)). Petitioner asserts that “this differential signal enables reducing the size of the fully-differential amplifier and its bias current while

achieving the same signal-to-noise ratio.” *Id.* (citing Pet. Reply § IV.A.2(a) (addressing motivation to combine)).

We disagree with Patent Owner that Petitioner’s proposed substitution undermines Tayloe’s intended functionality because Petitioner’s argument regarding the benefits of using a fully differential amplifier (such as Macnally’s) are supported on the record before us. *See* Ex. 1066 ¶ 89 *cited in* Pet. Reply 26.

Second, Patent Owner contends that “Macnally’s biquad two-pole filter acts as a low-pass (anti-alias) filter” that “removes aliased signals from the band of operation,” whereas Tayloe “already achieves low-pass filtering using RC time constants created by resistor and capacitors in Figure 3 or 6.” PO Resp. 88 (citing Ex. 1021, 7:17–19; Ex. 1003 ¶ 143; Ex. 2034, 56:5–57:16, 145:2–9; Ex. 1004, 2:14–15, 3:21–27; Ex. 2024 ¶ 324). Patent Owner asserts that Tayloe does not identify or discuss any need for additional filtering or anti-aliasing because Tayloe already performs “the function of an anti-aliasing filter—removing aliasing artifacts.” *Id.* Thus, Patent Owner contends one of ordinary skill in the art would not have been motivated “to look at filtering technology such as Macnally’s biquad two-pole filters to incorporate into Tayloe’s circuit,” nor would one have “look[ed] to replace an amplifier with a filter, regardless of whether that filter also happens to amplify a signal.” *Id.* (citing Ex. 2024 ¶ 325). Additionally, Patent Owner contends that Petitioner “simply provides no rationale for why an additional low-pass filter is needed when there is a low-pass filter that is already part of Tayloe’s product detector.” *Id.* at 89 (citing Ex. 2024 ¶ 326).

Petitioner responds by noting that Tayloe’s filtering is provided by an RC filter with a single pole, whereas Dr. Galton testifies that “more filtering is generally needed than that offered by a single pole filter.” Pet. Reply 29 (citing Ex. 1066 ¶¶ 81–83 (citing Exs. 1017 (Razavi), 1064).

We agree with Petitioner because we find Dr. Galton’s testimony credible on this point. He explains in detail why one of ordinary skill in the art would have understood that there are benefits to be gained by additional filtering, relying in part on Razavi as evidence of the general background knowledge in the art. Ex. 1066 ¶ 81 (citing Ex. 1017). We credit his testimony on this issue because it finds support in the record before us.

Third, Patent Owner contends that Petitioner “attempts to justify replacing Tayloe’s amplifiers with Macnally’s biquad two-pole filter by suggesting problems with Tayloe’s circuit,” “[b]ut Tayloe already addresses these purported problems.” PO Resp. 89 (citing Ex. 2024 ¶ 327). Patent Owner asserts that Tayloe’s amplifiers already “process complementary inputs and achieve the same results” as if Macnally’s filter were used. *Id.* Patent Owner, thus, contends that there is no “technical reason” one of ordinary skill in the art would look to Macnally for Petitioner’s alleged improvements. *Id.* (citing Ex. 2024 ¶ 328). Additionally, Patent Owner contends that “using Macnally’s biquad two-pole filter in Tayloe’s circuit would require more components (not fewer) than Tayloe’s existing amplifier design,” thereby contradicting Petitioner’s motivation to use a fewer number of operational amplifiers on an IC. *Id.* at 90 (citing Ex. 1003 ¶ 141; Pet. 28; Ex. 2024 ¶¶ 330–331); *see id.* at 91 (asserting that “[t]he circuits are not functionally equivalent, and the substitution would increase complexity without offering meaningful benefits” (citing Ex. 2024 ¶ 335)).

Petitioner replies by pointing to Dr. Galton’s testimony that, “while Tayloe’s amplifier processes complementary inputs, it provides a single-ended output, an asymmetric arrangement sensitive to interference from other parts of the system,” which is in contrast to “fully differential amplifiers (like Macnally’s) [that] are far less sensitive to that interference.” Pet. Reply 30 (citing Ex. 1003 ¶ 35).

Although we recognize that Patent Owner’s arguments identify some equivalencies between Tayloe and Macnally as well as potential drawbacks to Macnally’s biquad two-pole filter, we also recognize that Dr. Galton provides a reason with rational underpinning as to why one of ordinary skill in the art would have been motivated to perform the substitution. *See* Ex. 1066 ¶ 85 (referring to Ex. 1003 ¶¶ 34–35 (opining that most amplifiers in systems implemented on integrated circuits are fully differential because they offer significant benefits over their single-ended counterparts)). We find Dr. Galton’s testimony credible because it is supported on the record and offers a clear explanation as to the additional benefits of the substitution.

Fourth, Patent Owner contends that, in contrast to Petitioner’s stated benefit of “size, packaging advantages, and low unit cost,” substituting for Macnally’s biquad two-pole filter would “significantly increase (not decrease) the number of components needed to achieve the same result.” PO Resp. 91–92. In particular, Patent Owner contends that Tayloe’s “Figure 6 uses *more* resistors than [Tayloe’s] Figure 3 and Macnally’s filter requires many *more* components than Tayloe’s amplifier and additional subsequent components to process the differential signal.” *Id.* at 92 (citing Ex. 2024 ¶ 336).

In its Reply, Petitioner reiterates its argument that “mere count of components in an IC is less significant than the area/power consumption, both of which are improved in the combination” and that, “[i]n the combination, subsequent circuitry is likewise differential to enjoy similar benefits of Macnally’s fully-differential amplifier.” Pet. Reply 30 (citing Ex. 1066 ¶¶ 78–90 (citing Ex. 1060)). Relying on Dr. Galton’s testimony, Petitioner asserts that “the appearance of additional parts does not translate into increased area or power consumption.” *Id.* (citing Ex. 1066 ¶¶ 87–90).

In the Petition, Petitioner argued that one of ordinary skill in the art would have been motivated to modify Tayloe to meet relentless market demand for improved product size/performance and decreased unit cost. Pet. 28. Petitioner also provided three “known advantages” of using fully differential amplifiers and Macnally’s topology for baseband processing on an IC. *Id.* Patent Owner’s argument regarding additional components does not directly contradict Petitioner’s stated rationale because Petitioner explains that area and performance benefits outweigh the potential negatives of using more components to achieve those benefits. Dr. Galton’s testimony is convincing and supported on the record before us. *See* Ex. 1066 ¶¶ 85–90 (explaining the design considerations involved and why one of ordinary skill in the art would have been motivated to modify Tayloe as proposed even if additional components were needed). We credit Dr. Galton’s testimony because we find it more persuasive for these reasons.

Fifth, Patent Owner contends that Tayloe teaches that it is “a simple and inexpensive product detector” that includes “low conversion loss” and “substantial receiver performance gains” as benefits, which are the same reasons Petitioner alleges would motivate one of ordinary skill in the art to

incorporate Macnally's teachings. PO Resp. 92 (citing Ex. 1004, 1:65, 3:5–6, 3:9–11; Ex. 2024 ¶ 337). Additionally, Patent Owner contends that Tayloe and Macnally are fundamentally different systems because Tayloe is a sampling system whereas Macnally is not. *Id.*

Petitioner reiterates that there is a “relative scale of potential benefits” resulting from the combination and that Tayloe's existing benefits do not detract from the additional benefits that can be achieved through the combination. Pet. Reply 30–31.

We agree with Petitioner that we have already addressed this issue above and that Petitioner has shown, through the testimony of Dr. Galton, whose testimony is supported on the complete record before us, that there are additional, potential benefits to the combination that would have motivated one of ordinary skill in the art to modify Tayloe as proposed. We address Patent Owner's argument regarding allegedly different systems and sampling below because that argument is related to Patent Owner's argument regarding compatibility of the references' teachings.

f. Whether Tayloe and Macnally are Compatible

Patent Owner contends that Tayloe and Macnally are fundamentally incompatible circuits, and that the combination changes the fundamental nature of Tayloe. PO Resp. 92–93 (citing Ex. 2024 ¶ 339). Patent Owner contends that “Tayloe is a voltage sampling system and Tayloe's amplifiers operate as *high* impedance loads,” which ensure that “Tayloe's capacitors retain charge during the sampling cycle and establish a stable voltage.” *Id.* at 93 (citing PO Resp. § VIII.A (discussing Tayloe); Ex. 2024 ¶ 340). Patent Owner contends that Macnally's filter “presents a *low impedance* load” that “would draw current from Tayloe's capacitors during the sampling cycle,

altering voltage levels in the capacitors and preventing an accurate voltage reading,” thus “fundamentally alter[ing] the operation of Tayloe’s circuit.” *Id.* (citing Ex. 2024 ¶ 341). Patent Owner contends that “[t]he incompatibility between Tayloe’s amplifier and Macnally’s filter would dissuade, not encourage, a [person of ordinary skill in the art] from making Petitioner’s proposed substitution.” *Id.* at 94 (citing Ex. 2024 ¶ 343); *see also* PO Sur-reply 26–30.

Petitioner contests Patent Owner’s characterization of Tayloe’s summing amplifier boxes 50/52 as having high impedance loads. Pet. Reply 31 (citing Ex. 1066 ¶¶ 95–97; Pet. Reply § IV.A.1(a)(i)³⁷). In contrast, Petitioner contends that Tayloe’s summing amplifier boxes 50/52 have low impedance loads and that replacing them with “fully-differential amplifier circuits having comparable input impedances would not significantly alter the behavior of Tayloe’s circuit with respect to the 0° and 90° outputs of switch 38.” *Id.* Additionally, Petitioner asserts that, “[d]espite the 180° and 270° being optional, matching the 180° and 0° paths and matching the 270° and 90° paths (e.g., using Macnally’s fully differential amplifiers) would improve the system’s overall signal-to-noise ratio.” *Id.* (citing Ex. 1066 ¶ 97). Further, Petitioner contends that Patent Owner’s “assertion must also fail for characterizing Tayloe as a voltage sampling system” because Patent Owner “does not, and could not, reconcile the fact that two of Tayloe’s four capacitors are already coupled to low

³⁷ We understand Petitioner to refer to § IV.A.1 (Petitioner’s “application of prior art meets all claim limitations”), which presents Petitioner’s position regarding Tayloe and its load impedance.

impedance loads.” *Id.* (citing Ex. 1066 ¶ 96; Pet. Reply § III (discussing the meaning of “energy storage element”)).

Based on the complete record, we do not agree that the combination of Tayloe and Macnally’s fully differential amplifier are incompatible or that the modification proposed by Petitioner would fundamentally change Tayloe’s principle of operation such that one of ordinary skill in the art would not have been motivated to make the modification as proposed. First, we understand Patent Owner’s focus on the relative impedance load (high or low) to be based on its continued desire to read into the claims aspects of an “energy transfer system” that we have rejected as part of the meaning of “energy storage element.” *See supra* § II.C.1. In particular, Patent Owner’s arguments regarding alleged differences between impedance loads in voltage sampling as compared to energy transfer are directed to that issue. Second, we find Petitioner’s arguments and Dr. Galton’s testimony more persuasive regarding the operation of Tayloe’s circuit and the impedance involved. In particular, Dr. Galton’s testimony thoroughly explains the operation of Tayloe’s circuit, the considerations involved, and an explanation as to the benefit achieved by the combination that we find more credible than Dr. Ricketts’ testimony thereon. *See* Ex. 1066 ¶¶ 95–97.

g. Whether Petitioner has Established a Reasonable Expectation of Success in Achieving the Proposed Combination

Above, we set forth Petitioner’s position as to reasonable expectation of success for each of the modifications proposed. *See* Pet. 25–30. Patent Owner challenges whether one of ordinary skill in the art would have had a reasonable expectation of success in achieving the third aspect of Petitioner’s combination, combining Tayloe/TI Datasheet and Macnally into

an IC. PO Resp. 94–98; PO Sur-reply 32. Patent Owner contends that “[r]eplacing Tayloe’s amplifiers with Macnally’s [filters] requires fundamental restructuring of Tayloe’s circuit that will not produce predictable results or have a reasonable expectation of success.” PO Resp. 94.

Patent Owner raises three arguments. First, Patent Owner argues “[i]mplementing Macnally’s differential output in place of Tayloe’s single-ended output would require redesigning the rest of Tayloe’s signal chain to accommodate Macnally’s differential output configuration,” something even Petitioner acknowledges. PO Resp. 95 (citing Ex. 2024 ¶ 347; Pet. 29). Patent Owner contends that “[t]he changes would not lead to predictable results or a reasonable expectation of success” because the change would replace a “simple amplifier” with “a complicated circuit,” and such change would require substantial experimentation to determine “how (or whether) such a filter could function in Tayloe’s circuit.” *Id.* (citing Ex. 2024 ¶ 348).

Second, Patent Owner contends that the proposed replacement would “alter the fundamental operation of Tayloe’s circuit” because using Macnally’s “biquad two-pole filter with a differential output changes that configuration considerably” and “Tayloe’s amplifiers are *high impedance loads*.” PO Resp. 96–97. Patent Owner, thus, asserts that one of ordinary skill in the art “would therefore not be motivated to replace Tayloe’s amplifiers with Macnally’s filters.” *Id.* at 97 (citing Ex. 2024 ¶¶ 352–353).

Third, Patent Owner contends that Tayloe “already incorporates a low-pass filter and achieves low-pass filtering,” and “Petitioner never explains how adding a second filtering stage—or replacing Tayloe’s RC

filtering with Macnally's filters—would affect the circuit's frequency response.” PO Resp. 97–98 (citing Ex. 2024 ¶ 354).

In its Reply, Petitioner notes that Patent Owner's arguments were previously raised in Patent Owner's discussion of motivation including alleged incompatibility, altering Tayloe's operation, and the question of whether the changes benefit Tayloe when it already includes some filtering. Pet. Reply 31–32. Additionally, Petitioner reiterates that bodily incorporation is not required to show obviousness. *Id.*

In its Sur-reply, Patent Owner reiterates the same positions and accuses Petitioner of having no response. PO Sur-reply 32.

Based on the complete record, we find that Petitioner has shown that one of ordinary skill in the art would have had a reasonable expectation of success in undertaking each of Petitioner's modifications, including the modification challenged by Patent Owner here, combining Macnally with Tayloe and TI Datasheet. In particular, Petitioner, supported by Dr. Galton's testimony, explains that the modification involving Macnally is a relatively simple substitution of one known element for another and that the results would be predictable and success would have been reasonably expected. *See* Pet. 29–30 (citing Ex. 1003 ¶¶ 141–143). That does not mean that no experimentation would be necessary; rather, the experimentation would be well within the skill set of one of ordinary skill in the art and would have been reasonably expected to succeed as Dr. Galton's testimony supports. *Id.* Additionally, we agree with Petitioner that Patent Owner repackaged several of its lack-of-motivation arguments under the heading of reasonable expectation of success, which we have addressed above. For each of these reasons and those discussed above, we find that Petitioner has shown that

one of ordinary skill in the art would have had a reasonable expectation of success in achieving the combination proposed.

h. Patent Owner's Allegations of Misrepresentations and Omissions

In its Sur-reply, Patent Owner reiterates certain arguments discussed above and asserts that Petitioner misrepresents some issues while avoiding others. *See* PO Sur-reply 30–32. We have reviewed each of Patent Owner's seven arguments and we do not agree that they reflect either misrepresentations or omissions in Petitioner's position. We have discussed each of Patent Owner's assertions in the context in which they were raised in the Patent Owner Response, and we maintain the determinations reached on each as discussed above.

i. Summary as to Motivation to Combine and Reasonable Expectation of Success

For the reasons discussed above, we find that Petitioner has established that one of ordinary skill in the art would have had a reason with rational underpinning for modifying the references as proposed and would have had a reasonable expectation of success in so doing.

4. Claim 1

a. Element 1[a] (Preamble)

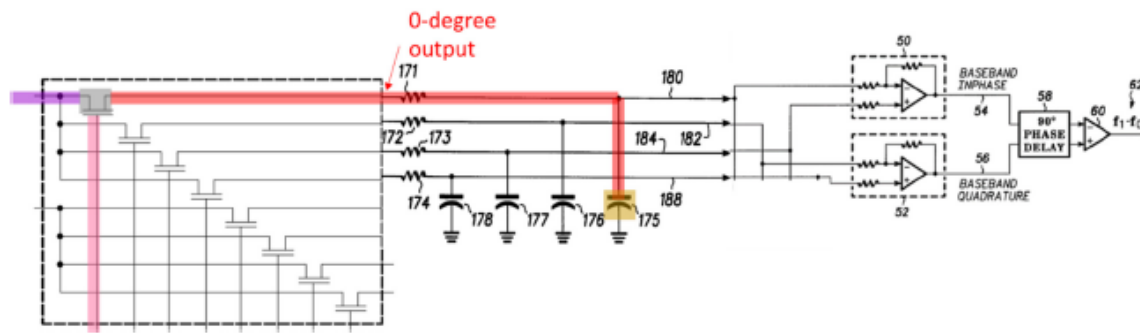
Element 1[a] recites “[a] system for frequency down-converting a modulated carrier signal to a baseband signal, comprising.” Ex. 1001, 192:32–33. Petitioner contends that, “[t]o the extent that [the] preamble is deemed limiting, the combination system (Tayloe's system using a multiplexor/demultiplexer design taught by TI-Datasheet) is a system for frequency down-converting a modulated carrier signal to a baseband signal.”

Pet. 30 (citing Ex. 1004, Figs. 3 (system diagram), 4–7, 1:5–6, 1:10–21, 2:6–8, 2:13–26, 2:46–55, 2:56–57, 3:58–4:45, 6:3–4, Abstract; Pet. § III.A.1–4). Petitioner explains that, “[i]n the combination, each of the capacitor arrangements depicted in Fig. 3 (capacitors 72 to 78 sharing resister 32) and Fig. 6 (capacitors 175 to 178 each has a pairing resister) separately satisfy this element. *Id.* (citing Ex. 1003 ¶¶ 144–146).

Patent Owner does not specifically contest Petitioner’s assertions regarding the preamble of claim 1. *See generally* PO Resp. Because we find that Petitioner has established that the combination teaches the preamble of claim 1, for the reasons explained by Petitioner, we need not determine whether it is limiting.

b. Element 1[b]

Element 1[b] recites “a first switch coupled to a first control signal which comprises a sampling aperture with a specified frequency, wherein the first switch is on and a portion of energy that is distinguishable from noise is transferred from the modulated carrier signal as an output of said first switch during the sampling aperture of the first control signal.” Ex. 1001, 192:34–39. Petitioner contends that, as shown in the annotated, combined figure below, “the combination system includes a **first switch** (gray) coupled to a **first control signal** (pink).” Pet. 30–31 (citing Ex. 1004, 2:5–26, Figs. 3, 6). Petitioner notes that, in the combined system, “commutating switch 38 is implemented as an analog multiplexer/demultiplexer 202, one example of which is the ‘Texas Instruments SN74[CBT]3253D’ multiplexer/demultiplexer.” *Id.* at 31 (alteration in original) (citing Ex. 1004, 5:33–37, Fig. 7; Ex. 1005, 2; Ex. 1003 ¶¶ 146–147).



Combination System (using multiplexor/demultiplexer of TI-1005)¹⁰

Pet. 31.³⁸ Petitioner explains the annotations to the combined system shown above as follows:

The *first control signal* (pink) has *a sampling aperture* (e.g., up to 90 degree at the frequency of the input signal f_1) *with a specified frequency* (e.g., the rate of toggling the first switch (gray)). TI-1004, 2:18–20 (switch controlled by control signal), 2:27–32 (“... [switch] remains closed at each of the four outputs *for substantially 90 degrees* at the frequency of the input signal”); TI-1003, ¶148.

The first switch (gray) is on and *a portion of energy* that is distinguishable from noise is transferred *from the modulated carrier signal* (i.e., RF input signal f_1 (purple)) *as an output* (i.e., the 0-degree output) of said first switch *during the sampling aperture* (e.g., up to 90 degrees at the frequency of the input signal f_1) of said first switch. TI-1004, 2:27–32 (“... [switch] remains closed at each of the four outputs for substantially 90 degrees at the frequency of the input signal”), 2:33–45 (“[when switch] connects input 36 to output 42 [the 0-degree output], charge builds up on capacitor 72 [corresponding to capacitor 175 in Fig. 6]”); TI-1003, ¶149.

³⁸ Petitioner’s footnote 10 in the description of the annotated, combined system, states that, “[a]lthough the integrator of FIG. 6 is depicted, the FIG. 3 embodiment also provides the relevant elements of claim 1.” Pet. 31 n.10.

Pet. 31–32 (alterations and omissions in original).

Additionally, Petitioner contends that

Tayloe makes clear the portion of energy is ***distinguishable from noise*** when “[o]utput 42 [the 0-degree output] represents the average value of the input signal during the first quarter wave of the period” for generating a baseband signal. TI-1004, 2:46–55, 5:1–16, Figs. 3–4, 6, 7; TI-1003, ¶150. The fact that the capacitor is charged to reflect the average value of the input signal during the first quarter wave, indicates that the portion of energy is distinguishable from noise. TI-1003, ¶150. Furthermore, Tayloe describes “information bearing signals . . . super imposed on f_1 ” converted to a baseband “signal of interest.” TI-1004, 3:62–4:8, 6:10–14. The portion of energy therefore reaches a threshold for the “signal of interest” to convey the “information.” TI-1003, ¶150.

Pet. 32 (alterations and omissions in original).

Further, Petitioner asserts that

if a system operates to down-convert an electromagnetic signal, as described by Tayloe, (TI-1004, 5:30–60 (experiment results), then sufficient ***energy distinguishable from noise is transferred*** by virtue of the down-conversion process. *ParkerVision, Inc. v. Qualcomm, Inc.*, 621 F. App’x 1009, 1019 (Fed. Cir. Jul[y] 31, 2015) (“ . . . 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 downconverts, that is proof that enough energy has been transferred to overcome the noise in the system.”). TI-1003, ¶¶146-51.

Pet. 33.

Patent Owner does not separately argue element 1[b]. *See generally* PO Resp. In light of Petitioner’s argument and evidence, which we find

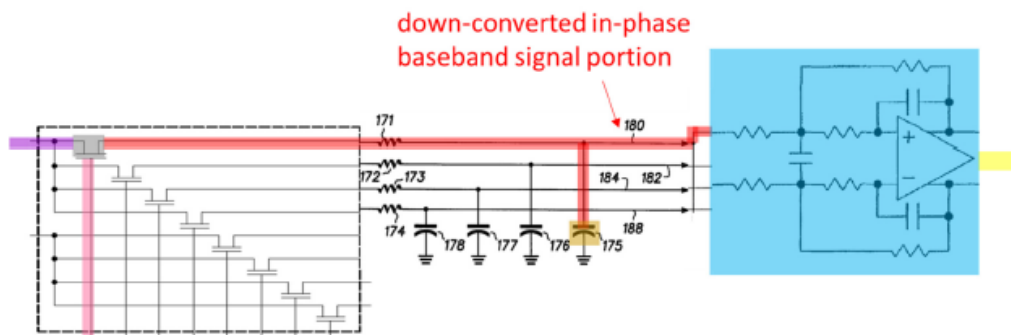
persuasive for the reasons provided by Petitioner as we explain above, we find that Petitioner has shown that the combination teaches element 1[b].

c. Element 1[c]

Element 1[c] recites “a first energy storage element that stores the transferred energy from the modulated carrier signal and outputs a down-converted in-phase baseband signal portion of said modulated carrier signal.” Ex. 1001, 192:40–43. Petitioner contends that, as shown in the annotated, combined figure below,

the combination system includes **a first energy storage element** (e.g., capacitor 175 (brown), or capacitor 72 of Fig. 3) that **stores** the transferred energy from the modulated carrier signal (purple) and **outputs a down-converted in-phase baseband signal portion** (red portion feeding into Macnally’s circuit (light blue)) of said modulated carrier signal (purple).

Pet. 33.



Combination System (using switch of TI-1005 and circuit of TI-1021/TI-1022)

Pet. 34. Petitioner explains the annotations to the combined system shown above as follows:

In the combination annotated above, “[d]uring the time [the first switch] connects input 36 [receiving input signal (purple)] to output 42 [0-degree output], charge builds up on capacitor 72 [corresponding to capacitor 175 in Fig. 6].” *Id.*, 2:33–45, 2:46–55 (“Output 42 [0-degree output] represents the average value

of the input signal during the first quarter wave of the period, and is termed the 0 degree output . . .”), 2:56–59 (“. . . producing baseband in-phase signal”), 4:49–51, 2:27–32, 2:13–18, Figs. 3, 4, 6. The average value results in down-conversion, and a [person of ordinary skill in the art] would have recognized that the 0-degree output is an in-phase signal. TI-1003, ¶ 153.

Id. (alterations and omissions, except for the last alteration, in original).

Additionally, Petitioner contends that “Tayloe specifically describes that ‘0 degree output [is] used to generate baseband in-phase . . . signal[],’ (Ex. 1004, 5:1–16), consistent with descriptions from the ’528 [p]atent.” Pet. 34 (alterations and omission in original) (citing Ex. 1001, Fig. 197 (first processing module 19702), 176:61–177:15; Ex. 1003 ¶ 154; Pet. § VI.C (technology background)).

Further, Petitioner asserts that,

[c]onsistent with Petitioner’s claim construction proposal *supra* § I.C.1, Tayloe’s capacitor 175 (brown) (or capacitor 72 of Fig. 3) “**stores non-negligible amounts of energy from an input EM signal,**” i.e., the RF input signal f_1 . TI-1003, ¶155. As observed by Dr. Galton, the differential amplifier circuit of Macnally provides **low impedance load** typically in the kilo ohm range, (TI-1003, §VI.D), which “goes to the heart of what makes an element, a ‘storage’ element,” as alleged by [Patent Owner]. IPR2020-01265, Paper 26 (PO Sur-reply), 13; Paper 18 (POR) at 46–50.

Pet. 35.

Patent Owner contends that the combination of Tayloe and TI Datasheet do not teach an “‘energy storage element’ that stores

transferred energy and outputs a baseband signal portion.” PO Resp. 77³⁹ (citing Ex. 2024 ¶¶ 279–284).

In its Reply, Petitioner contests Patent Owner’s assertion explaining that, in the Petition, Petitioner asserts that “Taylor’s capacitor is an ‘energy storage element’ because it ‘*stores non-negligible amounts of energy from an input EM signal*,’ i.e., the RF input signal f_1 .” Pet. Reply 23 (citing Pet. 3–5, 34–36 (citing Ex. 1004, 5:1–16⁴⁰; Ex. 1003 ¶¶ 153–158)). Petitioner asserts that Dr. Ricketts does not acknowledge that Taylor “indeed[] generates baseband signals using the stored energy.” *Id.* (citing Ex. 2024 ¶¶ 279–284, 213; Ex. 1004, 5:1–15). Petitioner also contends that Dr. Ricketts did not consider other sources of information, such as textbooks on the topic, that Petitioner contends indicate that “amplifier circuits, like Taylor’s, using a feedback resistor, have an impedance equal to its input resistor, which is low impedance.” *Id.* (citing Ex. 1066 ¶¶ 11–35 (citing Exs. 1046, 1055)). Additionally, Petitioner notes that, “as applied in the Taylor combination, Taylor’s capacitors are coupled to Macnally’s differential amplifier circuit which provides a low impedance load ‘in the kilo ohm range.’” *Id.* at 24 (citing Pet. 5, 36, 22–30; Ex. 1066 ¶¶ 36–40).

Based on the complete record, we disagree with Patent Owner’s argument because we find that Petitioner shows that Taylor teaches an

³⁹ Although Patent Owner raises extensive argument directed to motivation to combine and reasonable expectation of success, Patent Owner provides only limited argument directed to several elements of the claims in a single paragraph without elaboration. *See* PO Resp. 77; *see also id.* at 77–78 (arguing motivation to combine).

⁴⁰ Petitioner mistakenly cites to Exhibit 1001, but we understand from the Petition and context that Petitioner intended to cite Taylor (Ex. 1004).

“energy storage element” for the reasons explained by Petitioner, which are supported by Tayloe’s teaching and Dr. Galton’s testimony. *See, e.g.*, Ex. 1004, 5:1–16 (describing generating “baseband in-phase and quadrature signals”); Ex. 1003 ¶¶ 153–156 (Dr. Galton’s testimony regarding element (1c)).

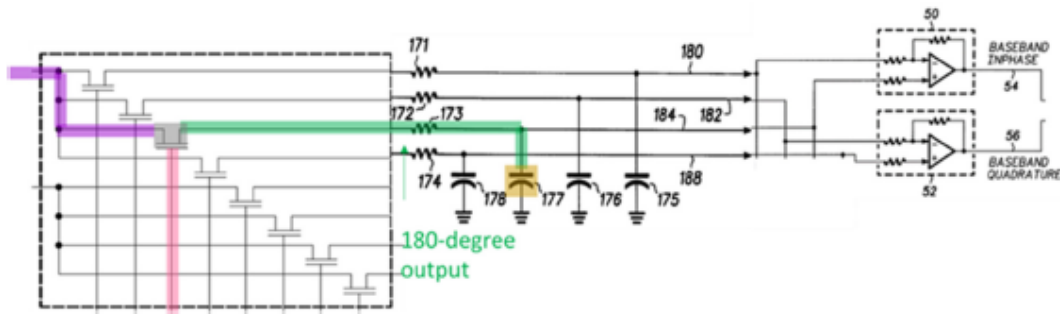
In light of Petitioner’s argument and evidence, which we find persuasive for the reasons provided by Petitioner as we explain above, we find that Petitioner has shown that the combination teaches element 1[c].

d. Element 1[d]

Element 1[d] recites “a second switch coupled to a second control signal which comprises a sampling aperture with a specified frequency, wherein the second switch is on and a portion of energy that is distinguishable from noise is transferred from the modulated carrier signal as an output of said second switch during the sampling aperture of the second control signal.” Ex. 1001, 192:44–50. Petitioner contends that, as shown in the annotated, combined figure below (and like its discussion of element 1[b]),

the combination system includes ***a second switch*** (gray) coupled to ***a second control signal*** (pink) which comprises ***a sampling aperture*** (e.g., up to 90 degrees at the frequency of the input signal f_1) ***with a specified frequency*** (e.g., the rate of toggling the second switch (gray)). TI-1004, 2:5–26 (“... input 36 is switched [by a control signal (pink)] to each of the four outputs”), 2:27–32, 5:1–16; Figs. 3, 6–7; TI-1005, 2; §III.A.4 (element 1[b]); TI-1003, ¶156.

Pet. 35.



Combination System (using switch of TI-1005)

Pet. 36. Petitioner explains the annotations to the combined system shown above as follows:

The second switch (gray) is on and **a portion of energy** that is distinguishable from noise is transferred **from the modulated carrier signal** (i.e., RF input signal f_1 (purple)) as an output (i.e., the 180-degree output) of said second switch **during the sampling aperture** (e.g., up to 90 degrees at the frequency of the input signal f_1) of the second control signal. TI-1004, 2:27–32 (switch (gray) “remains closed at each of the four outputs for substantially 90 degrees at the frequency of the input signal” or “for less than 90 degrees”), 2:33–45 (charge builds up on corresponding capacitor), 2:46–55 (“the 180 degree output [in Fig. 3]”), 4:53–55 (“180 degree output 184 [in Fig. 6]”), 5:1–16 (180-degree output “can be utilized as embodied in FIG. 3 to achieve greater gain”), Figs. 3–4, 6–7; TI-1003, ¶157. Tayloe describes “information bearing signals . . . super imposed on f_1 ” converted to a baseband “signal of interest.” TI-1004, 3:62–4:8, 6:10–14. The portion of energy therefore reaches a threshold for the “signal of interest” to convey the information.” TI-1003, ¶158.

Pet. 36 (omission and alterations in original).

Patent Owner does not separately argue element 1[d]. *See generally* PO Resp. To the extent Patent Owner’s previous arguments apply, we disagree with them for the reasons explained above. In light of Petitioner’s argument and evidence, which we find persuasive for the reasons provided

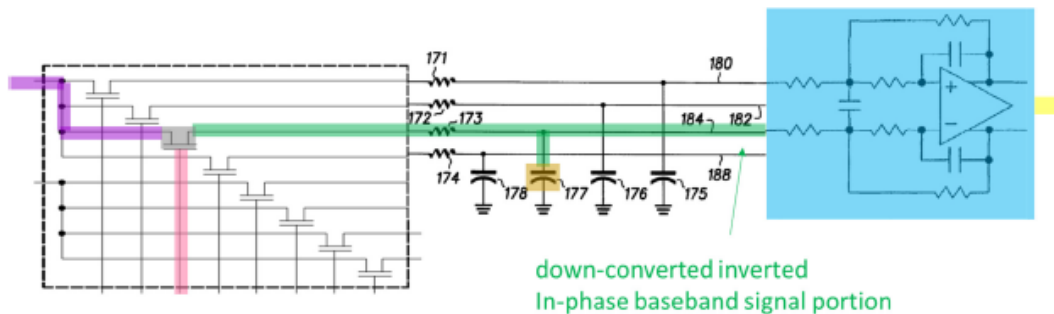
by Petitioner as we explain above, we find that Petitioner has shown that the combination teaches element 1[d].

e. Element 1[e]

Element 1[e] recites “a second energy storage element that stores the transferred energy from the modulated carrier signal and outputs a down-converted inverted in-phase baseband signal portion of said modulated carrier signal.” Ex. 1001, 192:51–54. Petitioner contends that, as shown in the annotated, combined figure below,

the combination system includes ***a second energy storage element*** (e.g., capacitor 177 (brown), or capacitor 76 of Fig. 3) that ***stores*** the transferred energy from the modulated carrier signal (purple) and ***outputs a down-converted inverted in-phase baseband signal portion*** (green portion feeding into Macnally’s circuit (light blue)) of said modulated carrier signal (purple).

Pet. 37.



Combination System (using switch of TI-1005 and circuit of TI-1021/TI-1022)

Pet. 37. Petitioner explains the annotations to the combined system shown above as follows:

In the combination system, the switch (gray) “remains closed at each of the four outputs for substantially 90 degrees at the frequency of the input signal.” TI-1004, 2:27–32, 2:13–18. As a result, charge builds up on capacitor (brown). *Id.* 2:33–45,

2:46–55 (“ . . . Output 46 [Fig. 3] represents the average value of the input signal during the third quarter wave of the period, and is termed the 180 degree output . . .”), 4:49–51 (“ . . . 180 degree output [Fig. 6] has a voltage controlled by the combination of capacitor and resistor 173 . . .”), Figs. 3–4, 6–7. A [person of ordinary skill in the art] would have recognized that the 180-degree output is an inverted signal. TI-1003, ¶¶159–60.

Id. (alterations and omissions except for the last alteration in original).

Additionally, Petitioner contends that “Tayloe explains that the 180-degree output ‘can be utilized as embodied in FIG. 3 to achieve greater gain’ because the 180-degree output is an inverted version of the 0-degree output, and hence the inverted in-phase baseband signal, as described by the ’528 Patent.” Pet. 38 (citing Ex. 1001, Fig. 197 (second processing module 19706), 177:31–54 (“[A] switch . . . opens and closes as a function of inverted I control signal As a result of the opening and closing of this switch . . . a down-converted signal, referred to as the inverted I output signal, results.”); Ex. 1003 ¶ 161 (providing further explanation)). And as noted above, Petitioner asserts that, consistent with its claim construction and similar to its discussion of element 1[c], “Tayloe’s capacitor 177 (brown) (or capacitor 74 of Fig. 3) ‘**stores non-negligible amounts of energy from an input EM signal,**’ i.e., the RF input signal V_{RF} .” *Id.* (citing Ex. 1003 ¶ 162 (noting low impedance load to Tayloe’s capacitor)).

Patent Owner does not separately argue element 1[e]. *See generally* PO Resp. To the extent Patent Owner’s previous arguments apply, we disagree with them for the reasons explained above. In light of Petitioner’s argument and evidence, which we find persuasive for the reasons provided

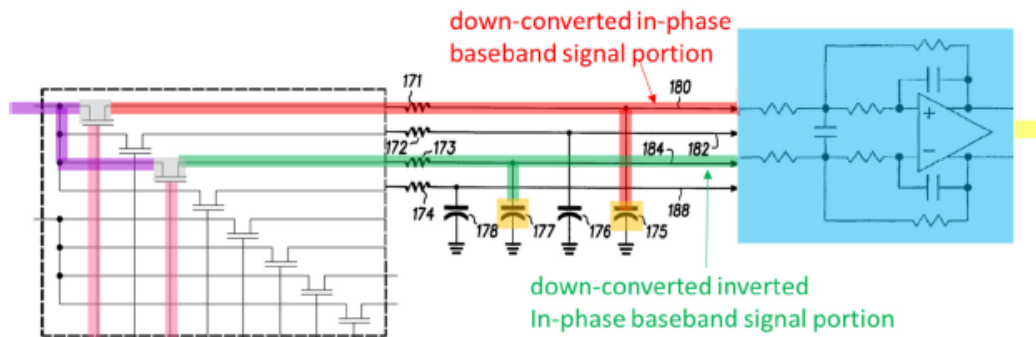
by Petitioner as we explain above, we find that Petitioner has shown that the combination teaches element 1[e].

f. Element 1[f]

Element 1[f] recites “wherein the portions of transferred energy from each of the first and second switch are integrated over time to accumulate said portions of transferred energy from which said down-converted in-phase baseband signal portion and said down-converted inverted in-phase baseband signal portion are derived; and.” Ex. 1001, 192:55–60. Petitioner contends that, as shown in the annotated, combined figure below,

in the combination system, ***the portions of transferred energy from each of the first and second switch are integrated over time to accumulate said portions of transferred energy from which said down-converted in-phase baseband signal portion (red portion feeding into Macnally’s circuit (light blue)) and said down-converted inverted in phase baseband signal portion (green portion feeding into Macnally’s circuit (light blue)) are derived.***

Pet. 38–39.



Combination System (using switch of TI-1005 and circuit of TI-1021/TI-1022)

Pet. 39. Petitioner explains the annotations to the combined system shown above as follows:

Taylor describes that each capacitor 175, 176, 177, and 178 (and the corresponding capacitors in FIG. 3) are

“integrating capacitors” where each has “its own resistor” so that “the combination of capacitor 175 and resistor 171” control the 0-degree output and “the combination of capacitor 177 and resistor 173” control the 180-degree output.” TI-1004, 3:54–4:4, 4:46–67 (“each [integrator] preferably integrates for substantially 90 degrees of the input signal.”), Abstract (“. . . *samples are integrated over time* to produce an average voltage at 0 degrees, 90 degrees, 180 degrees and 270 degrees . . .”). Moreover, Tayloe discloses similar integrator operation in the example of Figure 3 using capacitors 72 and 76 respectively for the 0-degree and 180-degree outputs. TI-1004, 2:33–55 (“Each of the capacitors [Fig. 3] functions as a separate integrator, each integrating a separate quarter wave of the input signal.”), Figs. 3–4, 6–7; TI-1003, ¶¶164–165.

Pet. 39 (alterations and omissions in original).

Patent Owner contends that the combination of Tayloe and TI Datasheet does not teach “deriving a baseband signal portion from accumulated transferred energy.” PO Resp. 77.

Petitioner disagrees and reiterates its argument that “Tayloe teaches deriving a baseband signal portion from the accumulated transferred energy because Tayloe teaches ‘producing [a] baseband in-phase signal’ from charge build-up on its capacitor.” Pet. Reply 24 (citing Pet. 33–35 (citing Ex. 1004, 2:56–59, 5:1–16; Ex. 1003 ¶¶ 164–165, 201–202)). Petitioner also contends that, in the combination, Tayloe’s capacitors also meet Patent Owner’s requirement of a low impedance load. *Id.* (citing Pet. 36; Ex. 1066 ¶¶ 41–43).

We disagree with Patent Owner’s argument for the same reasons explained by Petitioner, which we find supported on the complete record before us as cited by Petitioner. In light of Petitioner’s argument and evidence, which we find persuasive for the reasons provided by Petitioner as

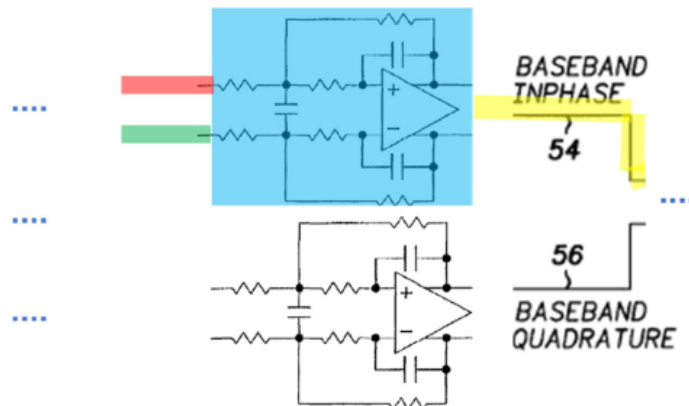
we explain above, we find that Petitioner has shown that the combination teaches element 1[f].

g. Element 1[g]

Element 1[g] recites “a first differential amplifier circuit that combines said down-converted in-phase baseband signal portion with said down-converted inverted in-phase baseband signal portion and outputs a first channel down-converted differential in-phase baseband signal.” Ex. 1001, 192:61–65. Petitioner contends that, as shown in the annotated, combined figure below,

the combination system includes *a first differential amplifier circuit* (light blue) that *combines said down-converted in-phase baseband signal portion* (red portion) *with said down-converted inverted in-phase baseband signal portion* (green portion) *and outputs a first channel down-converted differential in-phase baseband signal* (yellow).

Pet. 40.



Combined System (zoomed portions using circuit of TI-1021/TI-1022)

Pet. 40. Petitioner explains the annotations to the combined system shown above as follows: “Summing amplifier 50 [implemented using a fully differential amplifier circuit of Macnally] differentially sums the 0 degree

output 42 and the 180 degree output 46, thereby producing [first channel down-converted differential] baseband in-phase signal [as a differential output having two complementary components].” *Id.* (alterations in original) (quoting Ex. 1004, 2:56–67) (citing Ex. 1004, Abstract, Fig. 3; Ex. 1021, 5:64–67 (“fully-differential analog signal path”); Ex. 1003 ¶¶ 166–169 (details of fully differential amplifier for on)).

Patent Owner contends that the combination of Tayloe and TI Datasheet does not teach “outputting a differential baseband signal.” PO Resp. 77.

Petitioner responds by noting that Patent Owner fails to address the combination because it includes Macnally’s fully differential amplifier which provides a differential output having two complementary components. Pet. Reply 25 (citing Pet. 27–30, 38–40).

We agree with Petitioner for the reason provided by Petitioner and because Patent Owner’s argument does not address the addition of Macnally to the combination. In light of Petitioner’s argument and evidence, which we find persuasive for the reasons provided by Petitioner as we explain above, we find that Petitioner has shown that the combination teaches element 1[f].

5. *Summary as to Claim 1*

For the reasons discussed above, we find Petitioner has established that the combination of Tayloe, TI Datasheet, and Macnally teaches the subject matter of claim 1.

6. *Claims 5, 11–19, 23, and 29–36*

Petitioner sets forth a detailed argument with supporting evidence as to why the combination of Tayloe, TI Datasheet, and Macnally teaches each

element of dependent claims 5, 11–19, 23, and 29–36. Pet. 41, 43–54, 55–60. Patent Owner does not separately argue these dependent claims. *See generally* PO Resp. In light of Petitioner’s argument and evidence, which we find persuasive for the reasons provided by Petitioner, we adopt Petitioner’s arguments as though they were our own findings and we determine that Petitioner has shown that the combination teaches the subject matter of dependent claims 5, 11–19, 23, and 29–36.

7. Claims 8, 9, 26, and 27

Petitioner sets forth a detailed analysis and discussion of claims 8, 9, 26, and 27 with citations to supporting evidence showing how the combination of Tayloe, TI Datasheet, and Macnally teaches the subject matter of these claims. Pet. 41–42, 54–55.

Patent Owner contends that the combination “does not disclose/teach/suggest transferred energy being discharged when a switch is OFF.” PO Resp. 77 (citing Ex. 2024 ¶¶ 279–284).

Petitioner responds to Patent Owner’s argument by noting that “both Tayloe and Macnally present a low impedance load allowing the claimed energy transfer.” Pet. Reply 25 (citing Ex. 1066 ¶¶ 46–51 (opining that two of Tayloe’s capacitors experience a low impedance load and, after Macnally’s teaching is added, a low impedance load is provided to all four capacitors)).

Based on the complete record, we agree with Petitioner’s position as to the loads pertaining to Tayloe and in combination with Macnally. And we find Petitioner has established that the combination teaches the subject matter disputed by Patent Owner for the reasons explained by Petitioner. *See, e.g.*, Pet. 41–42 (discussing claim 8). In light of Petitioner’s argument

and evidence, which we find persuasive for the reasons provided by Petitioner, we adopt Petitioner’s arguments as though they were our own findings and we determine that Petitioner has shown that the combination teaches the subject matter of dependent claims 8, 9, 26, and 27.

8. Objective Indicia of Nonobviousness

In the record presently before us, neither Petitioner nor Patent Owner has presented any evidence of objective indicia of nonobviousness.

9. 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, the evidence of obviousness is strong, and Patent Owner has not presented objective evidence of nonobviousness. Accordingly, on balance, we determine that Petitioner has established by a preponderance of the evidence that the combination of Tayloe, TI Datasheet, and Macnally would have rendered the subject matter of claims 1, 5, 8, 9, 11–19, 23, 26, 27, and 29–36 of the ’528 patent obvious to one of ordinary skill in the art at the time of the invention.

E. Ground 1B: Obviousness over Tayloe, TI Datasheet, Macnally, and Cahn

1. Scope and Content of the Prior Art

a. Cahn (Ex. 1007)

Cahn is titled “Combined Digital Phase and Amplitude Modulation Communication Systems” and describes modulation techniques including amplitude modulation, phase modulation, and combined amplitude and

phase modulation. Ex. 1007, 150–51.⁴¹ Dr. Galton describes Cahn as a seminal paper on modulation techniques from the 1960s. Ex. 1003 ¶¶ 120–121.

2. *Claims 2–4 and 20–22*

Petitioner contends that the combination of Tayloe, TI Datasheet, Macnally, and Cahn would have rendered the subject matter of claims 2–4 and 20–22 obvious to one of ordinary skill in the art at the time of the invention. Pet. 60–61. Petitioner’s arguments are supported by evidence including the testimony of Dr. Galton. *See id.* (citing Ex. 1003 ¶¶ 217–218).

Patent Owner does not raise any argument specifically directed to Petitioner’s challenge to claims 2–4 and 20–22 aside from the argument discussed above. *See generally* PO Resp.

We have reviewed Petitioner’s argument and supporting evidence, and we find that Petitioner has established that the combination of Tayloe, TI Datasheet, Macnally, and Cahn teaches the subject matter of claims 2–4 and 20–22, and that one of ordinary skill in the art would have had a reason with rational underpinnings to combine the teachings of the references as proposed and would have had a reasonable expectation of success in doing so. For those reasons, we adopt Petitioner’s arguments as though they were our own findings. *See* Pet. 60–61.

3. *Objective Indicia of Nonobviousness*

As noted above, neither Petitioner nor Patent Owner has presented any evidence of objective indicia of nonobviousness.

⁴¹ Citations are to the native page numbers of the underlying document.

4. Weighing the Graham Factors

On balance, considering the complete record before us, the evidence of obviousness is strong, and Patent Owner has not presented objective evidence of nonobviousness. Accordingly, on balance, we determine that Petitioner has established by a preponderance of the evidence that the combination of Tayloe, TI Datasheet, Macnally, and Cahn would have rendered the subject matter of claims 2–4 and 20–22 of the '528 patent obvious to one of ordinary skill in the art at the time of the invention.

F. Ground 2A: Obviousness over Razavi and Macnally

Petitioner contends that the combination of Razavi and Macnally would have rendered the subject matter of claims 1, 5, 8, 9, 11–19, 23, 26, 27, and 29–36 obvious to one of ordinary skill in the art at the time of the invention. *Id.* at 62–94.

1. Scope and Content of the Prior Art

a. Razavi (Ex. 1017)

Razavi describes a 900 MHz CMOS direct conversion receiver (Ex. 1017, title),⁴² that includes a low-noise amplifier (LNA), quadrature mixers, a local oscillator, and baseband amplifiers (*id.* at 1:4–7). Figure 1, reproduced below, illustrates Razavi's receiver architecture.

⁴² Citations to Razavi are to the page numbers of Exhibit 1017 inserted by Petitioner in the middle portion of each page as opposed to the native page numbers of the underlying document.

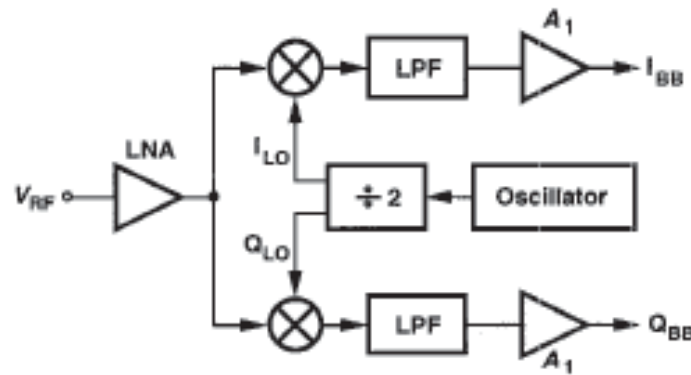


Fig. 1. Receiver architecture.

Razavi's Figure 1 shows the direct conversion receiver architecture, including "a low-noise amplifier (LNA), quadrature mixers, simple low-pass filters (LPFs), a local oscillator (LO), a divide-by-two circuit, and baseband amplifiers, A_1 ." *Id.* at 1:4–7.

Razavi's Figure 2 is reproduced below.

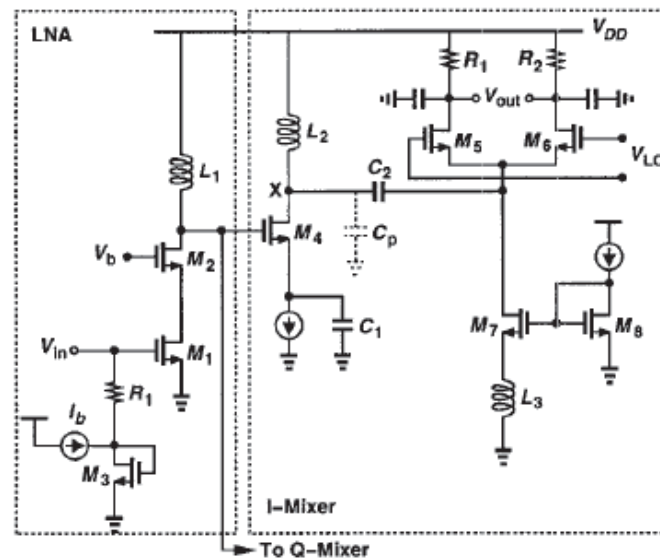


Fig. 2. LNA/mixer implementation.

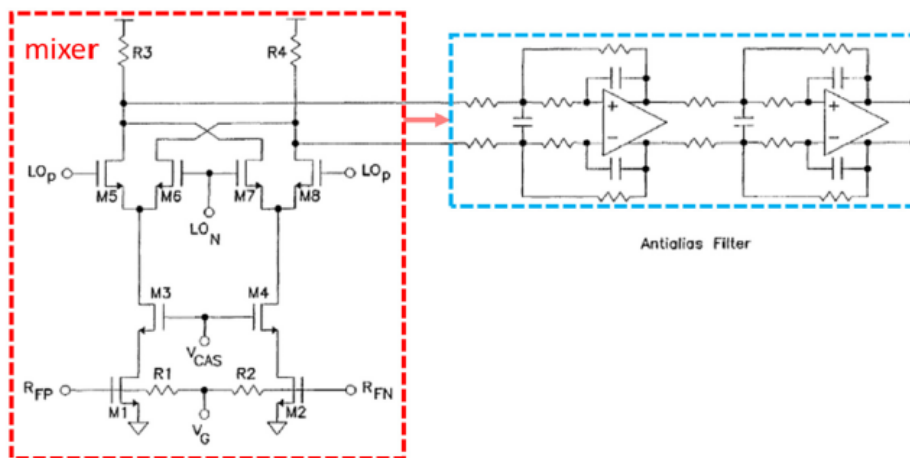
Razavi's Figure 2 "shows the implementation of the LNA and the quadrature mixers." Ex. 1017, 1:16-17. Razavi explains that "[t]he mixer employs a single-balanced topology consisting of an input transistor M_4 and a switching pair M_5 - M_6 ." *Id.* at 1:32–33.

2. Claim 1

a. *The Combination: Motivation to Combine and Reasonable Expectation of Success*

Petitioner contends that Macnally “discloses examples of using antialiasing filters in an integrated transceiver device.” Pet. 64 (citing Ex. 1021, Fig. 3, 1:10–12, 1:44–46, 7:7–8; Ex. 1003 ¶ 226). Petitioner provides the following annotated version of Macnally’s Figure 3:

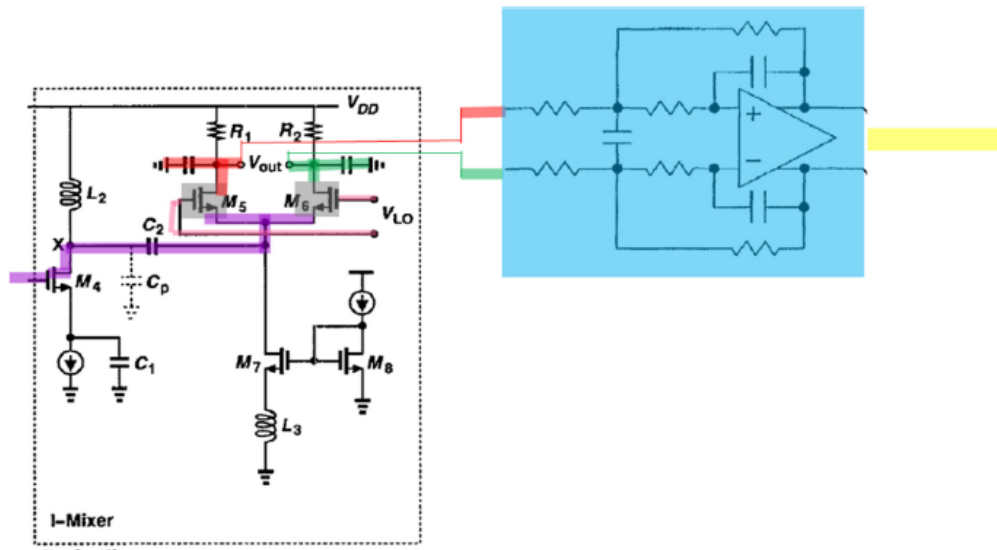
FIG. 3



TI-1021/TI-1022, Fig. 3 (annotated)

Pet. 65. Petitioner added a dashed, red box around what it identifies as a “mixer” (left) and a dashed, blue box around Macnally’s “Antialias Filter” (right). *Id.*

Petitioner contends one of ordinary skill in the art would have found it obvious to “incorporate Macnally’s fully differential amplifier circuits in Razavi’s receiver to process the down-converted signals,” as Petitioner shows in its combined and annotated figure below. Pet. 65 (citing Ex. 1017, Figs. 1, 2, 4, 5; Ex. 1021, Fig. 3).



Combination Receiver (using Macnally's circuit (light blue))

Pet. 65. Petitioner asserts the following as to why one of ordinary skill in the art would have been motivated to incorporate Macnally's fully differential amplifier circuits in Razavi's receiver to supply low-pass filtering. *Id.* (citing Ex. 1021, 1:35–50).

Acknowledging “output nodes of the mixer are loaded with on-chip capacitors to suppress high-frequency components,” Razavi states “channel-selection filtering is not included,” thus indicating the need for channel-selection filtering, which a [person of ordinary skill in the art] would understand as low-pass filtering because Razavi performs “direct conversion” to baseband. [Ex.] 1017, 113. Indeed, Razavi provides “three permutations in Fig. 4 [depicting high-level examples of] “a low-pass filter suppresses out-of-channel interferers,” (*id.*), albeit with no further details of filter design. As explained *supra* [Petition] § III.A.3 [describing Macnally], Macnally provides details of a fully differential amplifier circuit that performs low-pass filtering to process “mixer output.” [Ex.] 1021, 7:7–16, 7:17–20 (“anti-alias filter”), Fig. 1 A [person of ordinary skill in the art] would have recognized the benefits of applying the example circuit of Macnally to complement Razavi's receiver design and achieve both

amplification and “channel-selection filtering” at baseband.
[Ex.] 1017, 113; [Ex.] 1003 ¶¶ 227–228.

Pet. 66 (second alteration in original).

Additionally, Petitioner contends that one of ordinary skill in the art would have had a reasonable expectation of success in achieving the combination “because it would have been a combination of prior art elements according to known methods to yield predictable results (using Macnally’s fully differential amplifier circuit, a known low-pass filter, consistent with one design option disclosed by Razavi).” Pet. 66–67 (footnote omitted) (citing Ex. 1021, Fig. 3; Ex. 1017, Fig. 4(a); Ex. 1003 ¶ 229).

Patent Owner raises several arguments contesting Petitioner’s position regarding motivation to combine and reasonable expectation of success. PO Resp. 105–14. We address each of Patent Owner’s argument in turn.

First, Patent Owner contends that “Razavi does not simply identify a generic amplifier circuit or use a generic symbol for an op-amp. Instead, Razavi’s Figure 5 discloses a fully realized amplifier design (including the length and width of transistors) tailored to meet specific performance goals: to achieve ‘high gain,’ improve linearity, and reduce noise.” PO Resp. 105–06 (citing Ex. 1017, 113). Patent Owner asserts that “Petitioner inexplicitly removes Razavi’s carefully designed amplifier and replaces it with Macnally’s filter.” *Id.* at 106 (citing Ex. 2024 ¶ 385).

Petitioner responds that “Razavi’s existing features would not preclude further improvement” and that “Razavi indicates the need for additional low-pass filtering.” Pet. Reply 34–35 (citing Ex. 1066 ¶¶ 152–155; Ex. 1017, 113, Pet. 66; Ex. 1003 ¶¶ 227–228).

Based on the complete record, we credit Dr. Galton’s testimony that one of ordinary skill in the art would have appreciated that additional benefits could be achieved, including amplification and channel-selection filtering, by applying Macnally’s teaching to Razavi. *See* Ex. 1066 ¶ 155; Ex. 1003 ¶¶ 227–228; Ex. 1017, 113. Thus, we disagree with Patent Owner on its first point.

Second, Patent Owner contends that “Macnally’s biquad two-pole filter acts as a low-pass filter[]–anti-alias filter” and that an “anti-aliasing filter removes aliased signals from the band of operation.” PO Resp. 106. But, Patent Owner contends, Razavi already discloses on-chip RC low-pass filters and “makes no mention of the need for additional filtering or bandwidth narrowing beyond these RC filters at the mixer output.” *Id.* Additionally, Patent Owner contends that Razavi does not teach that its receiver lacks channel filtering altogether, and that Figures 4(b) and 4(c) “expressly show a channel-select filter block located *after* the amplifier of Figure 5.” *Id.* at 106–07 (citing Ex. 2024 ¶ 388). Thus, Patent Owner asserts that “Razavi intentionally places the channel-select filter downstream of the amplifier—not within it like Macnally.” *Id.* at 107. Therefore, Patent Owner contends one of ordinary skill in the art would have recognized “that inserting Macnally’s filter at the amplifier stage would contradict Razavi’s specific design intent.” *Id.* (citing Ex. 2024 ¶ 389).

Petitioner responds by asserting that Razavi’s mixer has a single-pole RC filter for lowpass filtering and turns to Dr. Galton’s testimony that “more filtering is generally needed than that offered by a single pole filter.” Pet. Reply 35 (citing Ex. 1066 ¶¶ 156–158). Petitioner also relies on its argument in response to Patent Owner’s first argument above that Razavi

suggests additional lowpass filtering. *Id.* (citing Pet. 66; Ex. 1017, 113, Fig. 4; Ex. 1003 ¶¶ 227–228).

Based on the complete record, we do not find the positions of the parties to be completely contradictory. Rather, we recognize that Petitioner sets forth a potential, recognizable benefit from the combination even if Razavi proposes an option to achieve a potentially similar benefit. Even if one of Razavi’s design options could potentially increase filtering, we remain of the view that Petitioner has sufficiently demonstrated that one of ordinary skill in the art would have been motivated to modify Razavi with Macnally for the reasons provided by Petitioner, which we find supported by Dr. Galton’s testimony, as cited above.

Third, Patent Owner asserts that the benefits proposed by Petitioner from Macnally’s filter are already addressed and achieved by Razavi. PO Resp. 107–08. In particular, Patent Owner contends that “[j]ust like Macnally, Razavi’s amplifier (Figure 5) uses differential inputs and differential outputs and operates on complementary signal components.” *Id.* at 107 (citing Ex. 2024 ¶ 390). Patent Owner also asserts that Razavi already “addresses noise, improving linearity, and distortion,” and, therefore, one of ordinary skill in the art “would not be motivated to look for a solution to these issues” and “would not think to look to Macnally’s biquad two-pole filter.” *Id.* at 107–08 (citing Ex. 2024 ¶ 391; Ex. 1017).

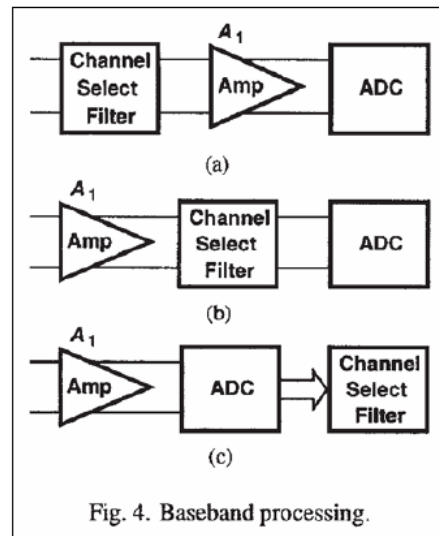
Additionally, Patent Owner contends that using “Macnally’s biquad two-pole filter” would “significantly increase the component count over Razavi’s amplifier” and, therefore, one of ordinary skill in the art would not have been motivated to make the combination since the benefits are already

achieved by Razavi and the number of components would not be reduced. PO Resp. 108–09 (citing Ex. 2024 ¶¶ 394–395).

In its Reply, Petitioner contends that “using a fully differential amplifier generally reduces area and power consumption, which matters more for IC implementation than component count.” Pet. Reply 35 (citing Ex. 1066 ¶ 159).

Based on the complete record, we recognize that certain modifications may have advantages and disadvantages, but that does not obviate Petitioner’s stated motivation to combine. *See Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006) (“[A] given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine.”). In this instance, we agree with Patent Owner’s undisputed evidence that the combination would increase the number of components, but we also find persuasive Petitioner’s argument that area and power consumption would be improved. In this instance, we find that even though there is an identified disadvantage in achieving the combination, the advantages noted by Petitioner would have provided one of ordinary skill in the art with sufficient motivation to have sought to combine the references as proposed because we find Dr. Galton’s testimony persuasive and credible. *See, e.g.*, Ex. 1066 ¶ 159.

Fourth, Patent Owner contends that Razavi teaches away from the proposed combination. PO Resp. 109. Patent Owner relies on Razavi’s Figure 4, which is reproduced below.



Razavi’s Figure 4 shows “three permutations” by which “[t]he downconverted signal can be further processed.” Ex. 1017, 113.

Patent Owner contends that Petitioner’s combination “aligns with the permutation in Figure 4(a),” which “Razavi specifically teaches against” because “the low-pass filter design entails severe noise-linearity-power tradeoffs” and Razavi specifies that its design “is intended for permutations in Figs. 4(b) and (c).” PO Resp. 109–10 (citing Ex. 2024 ¶¶ 396–403; Pet. 66–67; Ex. 1017, 113).

Petitioner contends that Razavi does not teach away from the permutation in Figure 4(a), Figures 4(a) to 4(c) illustrate combined amplification and lowpass filters, and “[w]hile each shows a distinct order for combining, all three are consistent with benefits of the proposed combination to ‘achieve both amplification and channel-selection filtering’ at baseband.” Pet. Reply 35 (citing Pet. 66). Petitioner asserts that it presented all three permutations as “high-level examples.” *Id.* (citing Pet. 66; Ex. 1066 ¶¶ 161–163).

Based on the complete record, we are not persuaded by Patent Owner's argument that Razavi teaches away from the proposed combination. To begin, we note that Dr. Galton testifies that the "Macnally anti-alias filter simultaneously performs amplification and filtering, so it does not fit the paradigm of either Figure 4(a) or Figure 4(b)." Ex. 1066 ¶ 162. In other words, his testimony reflects that the combination proposed by Petitioner does not neatly fit into either Figure 4(a) or 4(b). We agree. Thus, even if we were to determine (which we do not for the reasons below) that Razavi teaches away from the permutation shown in Figure 4(a), that finding would not detract from, nor would it undermine, Petitioner's argument that one of ordinary skill in the art would have been motivated to make the combination proposed.

Additionally, we do not agree with Patent Owner that Razavi would have led one of ordinary skill in the art away from the permutation shown in Figure 4(a). In discussing the permutations of Figures 4(a) and 4(b), Razavi identifies advantages and disadvantages of each. Referring to Figures 4(a) and 4(b), Razavi states:

In Fig. 4(a), a low-pass filter suppresses out-of-channel interferers, allowing A_I to be a nonlinear, high-gain amplifier and the analog-to-digital converter (ADC) to have a moderate dynamic range However, the low-pass filter design entails severe noise-linearity-power tradeoffs. The second permutation, shown in Figure 4(b), relaxes the LPF noise requirements while demanding a higher performance in the amplifier. The difficulty here is that the signals are still quite small and the interferers quite large. Thus, A_I must exhibit both low noise and high linearity.

Ex. 1017, 113. After this discussion, Razavi then states "[t]he present design is intended for permutations in Figs. 4(b) and (c)." *Id.* As reflected

in the block quote above, Razavi provides advantages and disadvantages of Figures 4(a) and 4(b). We disagree with Patent Owner's premise that a reference that identifies a potential disadvantage of a permutation, while also identifying a potential advantage, necessarily discourages one of ordinary skill in the art from pursuing that permutation to achieve the advantage. Regardless, we do not find that Petitioner's combination matches the exact permutation of Figure 4(a) for the reasons expressed by Dr. Galton. *See* Ex. 1066 ¶ 162.

Fifth, Patent Owner contends that Razavi and Macnally are not compatible. PO Resp. 111–12. Patent Owner contends that “Razavi’s amplifier operates as a *high impedance* load, which is critical to ensuring accurate baseband voltage representation,” but “Macnally’s filter presents a *low impedance* load,” and such a replacement would alter the operation of Razavi’s circuit and “defeat its intended design goals.” *Id.* at 111 (citing Ex. 2024 ¶¶ 405–407). Patent Owner asserts that “[t]he incompatibility between Razavi’s high impedance amplifier and Macnally’s low impedance biquad filter would therefore dissuade, not encourage, a [person of ordinary skill in the art] from making Petitioner’s proposed substitution.” *Id.* at 112 (citing Ex. 2024 ¶ 408).

Petitioner contests Patent Owner’s characterization of Razavi’s resistance as a high impedance load; rather, Petitioner asserts that Dr. Galton calculated the resistance of R1 and R2 in Razavi and determined that each is less than 1.25 kilo-ohm, which is low resistance according to Patent Owner’s prior argument. Pet. Reply 35–36 (citing Ex. 1066 ¶¶ 164–165; Pet. Reply § V.A.1; PO Resp. §§ VI.C, V.B (citing Ex. 1001, Fig. 82B)). Thus, Petitioner contends “coupling Razavi’s mixer to Macnally’s circuit would

not cause the alleged compatibility issue.” *Id.* at 36 (citing Ex. 1066 ¶¶ 164–165).

In its Sur-reply, Patent Owner contends that Dr. Galton acknowledges that gates of FETs have high resistance/impedance (PO Sur-reply 34 (citing Ex. 2034, 72:14–73:6, 85:1–7)) and, therefore, his testimony about the resistance of R1 and R2 in Razavi “has nothing to do with the connection to V_{out} .” *Id.* at 33–36. Thus, Patent Owner asserts that Petitioner “fails to demonstrate that using Macnally’s filter in place of Razavi’s amplifiers would not alter the behavior of Razavi’s circuit such that a [person of ordinary skill in the art] would be motivated to combine.” *Id.* at 36.

Based on the complete record, we do not agree with Patent Owner that compatibility issues between Razavi and Macnally would have precluded one of ordinary skill in the art from being motivated to combine their teachings as proposed by Petitioner. In particular, we do not agree with Patent Owner’s characterization of Dr. Galton’s deposition testimony discussing the resistance of the gates of a MOSFET. Dr. Galton specifically explained that his testimony regarding high resistance was “looking at it in isolation,” i.e., “out of the circuit.” Ex. 2034, 72:14–73:1. In other words, we do not read Dr. Galton’s deposition testimony as contradicting his declaration testimony regarding the resistance in Razavi’s circuit and, therefore, we do not agree that there is a compatibility problem between Razavi and Macnally such that one of ordinary skill in the art would not have been motivated to combine their teachings as proposed by Petitioner.

Sixth, under a heading stating that there is no reasonable expectation of success, Patent Owner contends “[r]eplacing Razavi’s amplifier with Macnally’s filter requires fundamental restructuring of Razavi’s receiver

architecture,” which would “fundamentally change Razavi’s circuit.” PO Resp. 112–14. Patent Owner bases its argument on two points already argued above: (1) that Razavi warns not to follow the permutation shown in Figure 4(a), and (2) that replacing Razavi’s amplifier with Macnally’s biquad two-pole filter would alter the fundamental operation of Razavi’s circuit. *Id.* Patent Owner contends that both issues would not lead to predictable results or a reasonable expectation of success. *Id.* at 112–13.

Petitioner notes that it previously responded to both of Patent Owner’s arguments in the context of motivation to combine. Pet. Reply 36 (citing Pet. Reply §§ IV.B.4(a)-(b), V.A.1; Ex. 1066 ¶¶ 166–169).

Based on the complete record, we agree with Petitioner that each of these arguments by Patent Owner was addressed above in the context of motivation to combine, and we do not find that either issue raised by Patent Owner would have caused one of ordinary skill in the art not to have a reasonable expectation of success for the reasons outlined by Petitioner and as we have set forth above. Thus, for the same reasons, we do not agree with Patent Owner.

Accordingly, for the reasons discussed above, we find that Petitioner has shown a reason with rational underpinnings as to why one of ordinary skill in the art would have been motivated to combine the teachings of Razavi and Macnally as proposed and would have had a reasonable expectation of success in achieving the combination.

b. Element 1[a] (Preamble)

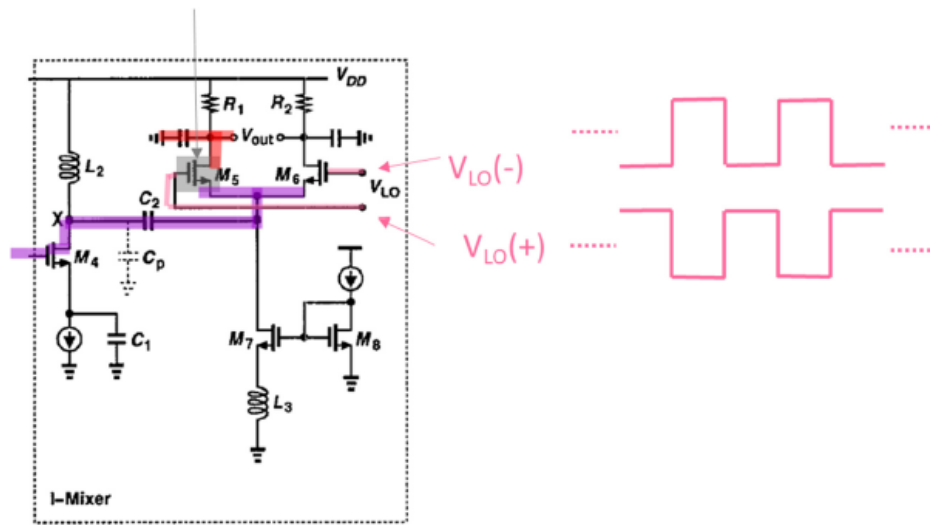
Element 1[a] recites “[a] system for frequency down-converting a modulated carrier signal to a baseband signal, comprising.” Ex. 1001, 192:32–33. Petitioner contends that, “[t]o the extent the preamble is deemed

limiting, the combination receiver (Razavi's receiver using Macnally's circuits) is a system for frequency down-converting a modulated carrier signal to a baseband signal." Pet. 67 (citing Ex. 1017, 113, Fig. 1; Ex. 1021, Figs. 1, 3; Ex. 1003 ¶ 230).

Patent Owner does not specifically contest Petitioner's assertions regarding the preamble of claim 1. *See generally* PO Resp. Because we find that Petitioner has established that the combination teaches the preamble, for the reasons discussed by Petitioner above, we need not determine whether it is limiting.

c. Element 1[b]

Element 1[b] recites "a first switch coupled to a first control signal which comprises a sampling aperture with a specified frequency, wherein the first switch is on and a portion of energy that is distinguishable from noise is transferred from the modulated carrier signal as an output of said first switch during the sampling aperture of the first control signal." Ex. 1001, 192:34–39. Petitioner contends that "the combination receiver includes a **first switch** M_5 (gray)) coupled to a **first control signal** ($V_{LO}(+)$ (pink)) which comprises a **sampling aperture** (the period when M_5 is CLOSED, which lasts approximately half the period of the oscillating frequency of V_{LO}) with a specified frequency (the oscillating frequency of V_{LO})." Pet. 67 (citing Ex. 1003 ¶ 231; Ex. 1017, 1). Petitioner provides the following annotated version of Razavi's Figure 2:



TI-1017, Fig. 2 (annotated)

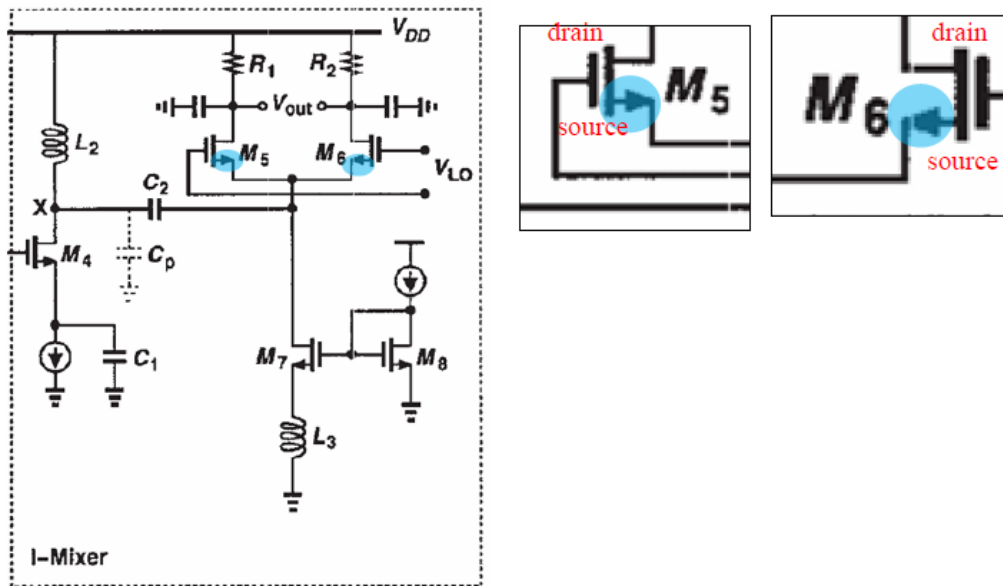
Pet. 68. Razavi's Figure 2 "shows the implementation of the LNA and the quadrature mixers." Ex. 1017, 1:16-17. Petitioner explains its annotations as follows,

[i]n the combination receiver, the first switch (M₅ (gray)) is on so that the drain terminal starts conducting and ***a portion of energy that is distinguishable from noise*** is transferred from the modulated carrier signal (V_{RF} (purple)) as an output of said first switch (V_{out} (red) above M₅ (gray)) during the sampling aperture of said first switch (when M₅ is ON), consistent with portions of the '528 Specification that allegedly lend support to the Challenged Claims.

Pet. 68 (citing Ex. 1001, Fig. 197, 176:66–177:16). Additionally, Petitioner contends “Razavi describes experimental results, further demonstrating sufficient energy distinguishable from noise is transferred via direct conversion.” *Id.* (citing Ex. 1017, Table 1; Pet. § III.A.5(1[b])) (explaining, in the context of Petitioner’s challenge based on Tayloe, TI Datasheet, and Macnally, how the Federal Circuit determined whether sufficient energy distinguishable from noise is transferred); Ex. 1003 ¶ 232).

Patent Owner contends that Razavi does not teach transferring energy from a modulated carrier signal as an output of a switch when the switch is ON. PO Resp. 98–103. Patent Owner asserts that one of ordinary skill in the art “understands that sampling, in this context, refers to reducing a continuous-time signal to a discrete-time signal” and that “Razavi does not sample.” *Id.* at 98 (citing Ex. 2030; Ex. 2024 ¶ 359; PO Resp. §§ III.B.9, IV.B, VI.B). Patent Owner contends that, contrary to Petitioner’s argument and Dr. Galton’s testimony, “[n]either M5 nor M6 . . . transfers energy from the modulated carrier signal as an output even if M5 or M6 is ON” and that “Dr. Galton’s explanation of how Razavi’s mixer works is incorrect.” *Id.* (citing Ex. 2024 ¶ 360). Patent Owner asserts that “Razavi’s mixer does not sample the RF input signal” because “[t]he RF input signal does not—and cannot—pass through transistors M5 or M6” and, therefore, “energy is never transferred as an output of M5 or M6 even if they are ON.” *Id.* at 98–99 (citing Ex. 2024 ¶ 361).

Patent Owner contends that “transistors M5 and M6 operate in saturation,” which means that “current can only flow through M5 to M6 in one direction—downward from the drain to the source.” PO Resp. 99. Patent Owner asserts that, “[b]ecause the RF input signal cannot propagate through M5 or M6, energy is not transferred to the output of M5 or M6 even if M5 or M6 are ON.” *Id.* (citing Ex. 2024 ¶ 362). Patent Owner provides the following annotated versions of Razavi’s Figure 2 to demonstrate its position. *Id.*



PO Resp. 99. Patent Owner annotated portions of Razavi's Figure 2 with blue highlighting and identified a "drain" and "source" for each of transistors M5 and M6. *Id.* Patent Owner explains that the n-channel metal oxide semiconductor (NMOS) symbols (expanded above right) for transistors M5 and M6 "depict arrows indicating the direction of current flow—from the drain to the source." *Id.* (citing Ex. 2024 ¶¶ 363–364). Patent Owner contends that, "[e]ven assuming, as Dr. Galton asserts, that transistors M5 and M6 are switches that open and close, this would not change the fact that no current from the RF input signal passes through M5 or M6 from the source to the drain." *Id.* at 100 (citing Ex. 2024 ¶ 365).

Patent Owner contends that one of ordinary skill in the art "understands that current flows from a higher potential to a lower potential" and that, as shown below in the annotated figure, "VDD is the highest potential in the circuit" and, "[c]onsequently, current flows downward from VDD, through resistors R1 and R2, transistors M5, M6, and M7, and ultimately to ground," even assuming "transistors M5 and M6 turn ON." PO Resp. 100 (citing Ex. 2034, 152:19–22, 164:13–21; Ex. 2024 ¶¶ 366–367).

Patent Owner provides the following two annotated versions of Razavi's Figure 2 showing what Patent Owner refers to as two scenarios. *See id.* at 101–02.

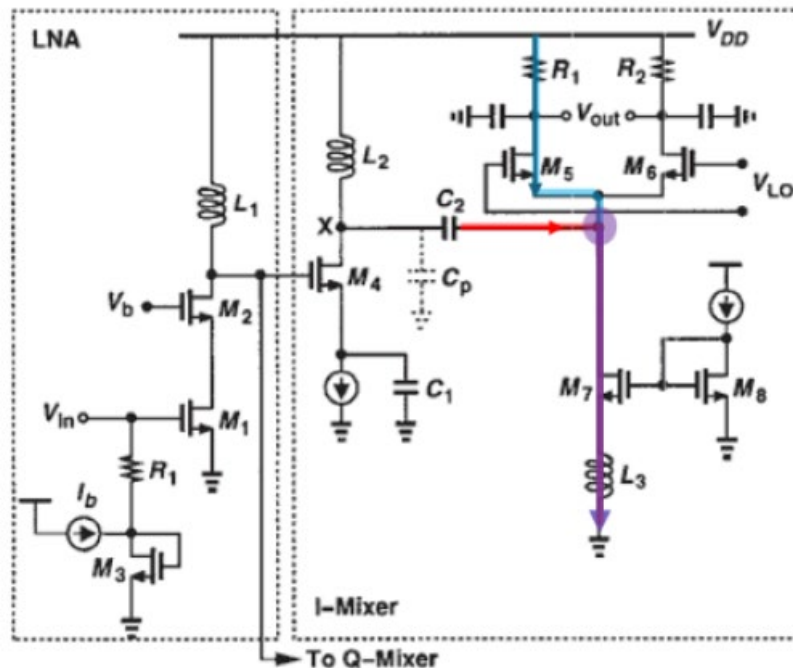


Fig. 2. LNA/mixer implementation.

PO Resp. 101. Patent Owner annotated Razavi's Figure 2 to illustrate what it refers to as a "first scenario" showing "the actual current flow." *Id.* at 100 (citing Ex. 2024 ¶ 369). As Patent Owner describes, "current from V_{DD} (blue arrow) flows downward through [resistor] R_1 and [transistor] M_5 to the common node (highlighted in purple). The RF input signal current (red arrow) flows from capacitor C_2 to the same common node (purple). These currents combine and flow through M_7 toward ground (purple arrow)." *Id.* at 101 (citing Ex. 2024 ¶ 370).

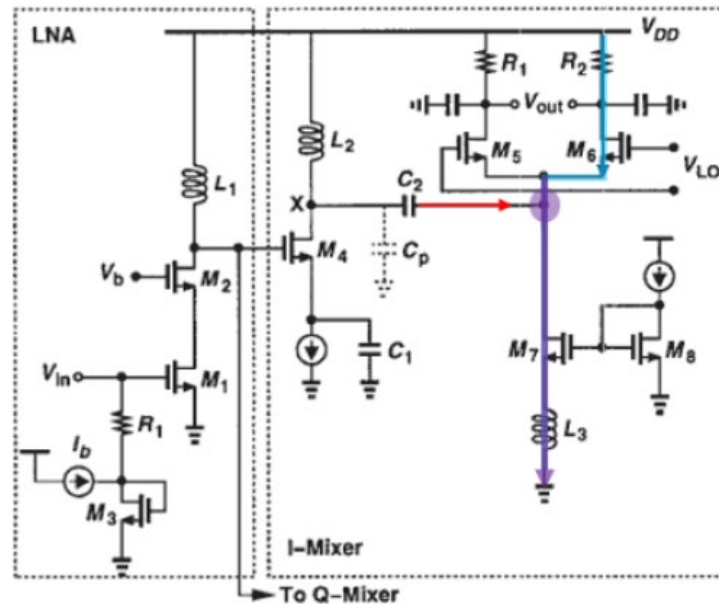


Fig. 2. LNA/mixer implementation.

PO Resp. 102. Patent Owner annotated Razavi's Figure 2 to illustrate what it refers to as a "second scenario" showing the "actual current flow." *Id.* As Patent Owner describes, "current from V_{DD} (blue arrow) flows downward through R_2 and M_6 to the common node (highlighted in purple). The RF input signal current (red arrow) flows from capacitor C_2 to the same common node (purple). These currents combine and flow through M_7 toward ground (purple arrow)." *Id.* (citing Ex. 2024 ¶ 371).

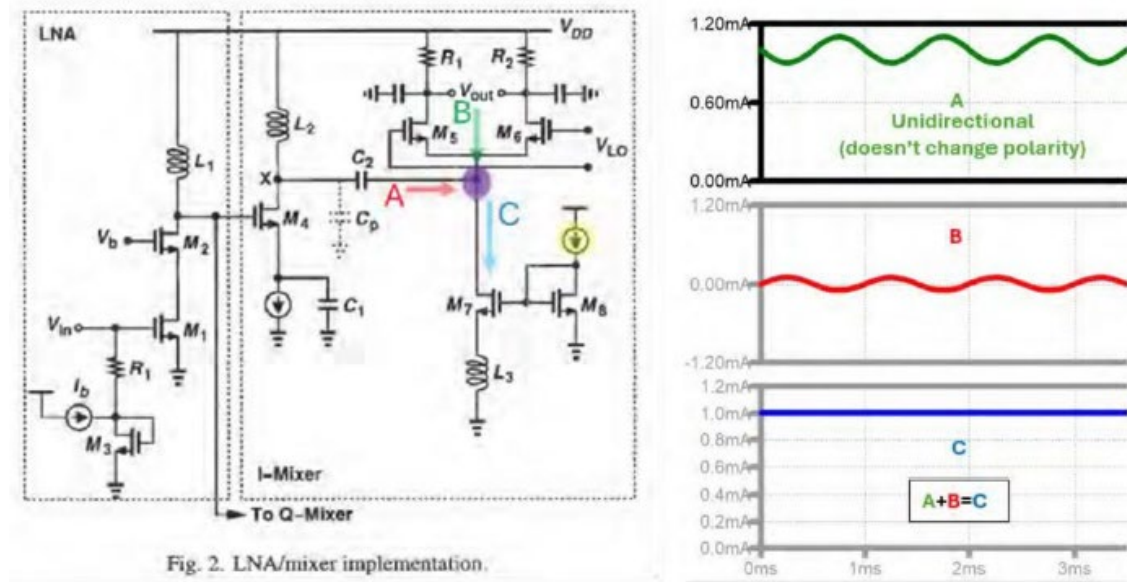
Patent Owner contends that, in each scenario, there is no sampling of the RF input signal. PO Resp. 102 (citing Ex. 2024 ¶ 372). Patent Owner asserts that, "[e]ven if transistors M_5 and M_6 open and close, this action only affects the amount of current flowing downward from V_{DD} ," "[t]he alleged opening and closing of M_5 and M_6 , does not affect the RF input signal in any way." *Id.* at 102–03 (citing Ex. 2024 ¶ 373).

Additionally, Patent Owner contests Dr. Galton's deposition testimony regarding distinguishing absolute or total current from V_{DD} and

“signal current” or “signal component.” PO Resp. 103. Patent Owner asserts that Dr. Galton’s distinction is incorrect because “[t]here is only one physical current in the circuit—the absolute current from VDD.” *Id.* Patent Owner contends that the “‘signal component’ Dr. Galton refers to is not an independent current that flows separately but merely describes how the RF input signal affects the current flow from VDD. The entire current, including any signal variations, flows downward. No portion of the RF input signal current moves upward.” *Id.* Thus, Patent Owner asserts that “no energy is transferred from the RF input signal as an output of M5 or M6.” *Id.* (citing Ex. 2024 ¶¶ 254–256, 374–375).

In its Reply, Petitioner contends that Patent Owner’s “description of Razavi ignores the laws of physics.” Pet. Reply 32 (citing Ex. 1066 ¶¶ 102–137). Petitioner asserts that “[t]he experts agree that, in Razavi’s Figure 2, electrons from the input signal flow through the transistors M_5 and M_6 toward the positive supply terminal V_{DD} .” *Id.* (citing Ex. 1066 ¶¶ 102–137; Ex. 1065, 12:1–14:25). Petitioner, thus, contends that Patent Owner’s assertion “is both misleading and erroneous.” *Id.* (citing PO Resp. 98–103, 70; Ex. 1066 ¶¶ 102–137, 144–148).

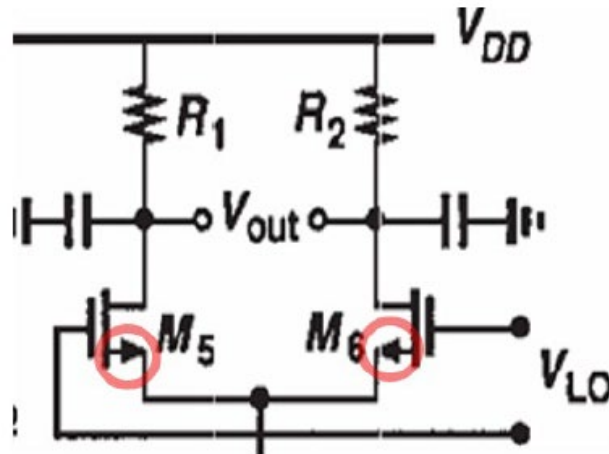
Petitioner asserts that Patent Owner’s “own annotation demonstrates transferring energy output from Razavi’s switch (i.e., M_5 and M_6).” Pet. Reply 32. As shown below, Petitioner relies on Patent Owner’s annotated version of Razavi’s Figure 2 (left) and Patent Owner’s current flow diagrams (right). *Id.* at 32–33 (citing PO Resp. 68–69).



Pet. Reply 33. The left is Razavi's Figure 2 with Patent Owner's annotations to show what are labeled as currents "A," "B," and "C." PO Resp. 68. The right is Patent Owner's waveform plot showing current asserted to represent "A," "B," and "C."⁴³ *Id.* at 69. Petitioner contends that Patent Owner argues that "'current A' representing 'the RF input signal flowing into the node' causes 'current B,' which is 'flowing from VDD to M7,' to oscillate so that the oscillation is reflected on Vout terminals." Pet. Reply 32–33 (citing PO Resp. 68–69). Petitioner asserts that Dr. Galton explains that "current B (annotated by [Dr.] Ricketts above-right) represents the signal component that oscillates (not unidirectional) which provides charging to the capacitors of Razavi." *Id.* at 33 (citing Ex. 1066 ¶¶ 138–139; Ex. 1003 ¶¶ 232, 248–249; Pet. 68, 71, 82–83, 84–85).

⁴³ Dr. Galton correctly observes in his Second Declaration that Patent Owner and Dr. Ricketts "mixed current A and current B in [the] annotation on the right-hand side," the red waveform should have been labeled A and the green waveform should have been labeled B. *See* Ex. 1066 ¶ 138 n.4.

In its Sur-reply, Patent Owner asserts that, “when transistors M_5 and M_6 in Razavi’s mixer are ON, energy is *not* transferred from the modulated carrier signal (RF input) upward through transistors M_5/M_6 (as an output) towards capacitors C_p/C_m .” PO Sur-reply 36 (citing PO Resp. 98–103). Patent Owner contends that, instead, as reproduced below, “current only flows downward from V_{DD} in the direction of the transistor arrows (red).” *Id.* Patent Owner reproduces the following annotated portion of Razavi’s Figure 2, previously produced in its Patent Owner Response.



PO Sur-reply 37. Patent Owner annotated a portion of Razavi’s Figure 2 to include red circles around the M_5 and M_6 transistor arrows. *Id.*

Patent Owner points to Razavi’s statement that transistors M_5 and M_6 “must remain in saturation,” arguing that Dr. Galton agreed that, in saturation, NMOS transistors “conduct current from drain to source—here, from V_{DD} downwards.” PO Sur-reply 37 (citing Ex. 1017, 1; Ex. 2042, 62:3–10, 63:8–20). Thus, Patent Owner contends “Razavi does not meet this claim element.” *Id.*

Patent Owner contends that Petitioner and Dr. Galton change positions by “reframing the issue in terms of electron flow rather than current flow,” which “underscores Petitioner’s lack of substantive rebuttal

and seeks to create confusion where none exists.” PO Sur-reply 37. Patent Owner contends that there are “two ways to look at current flow – conventional current and the flow of electrons. The two are opposites. For conventional current, charge flows from a higher to lower potential (V_{DD} to ground). Electron flow is the opposite.” *Id.* at 38 (footnote omitted) (citing Ex. 2042, 19:1–4; Pet. Reply 32). Patent Owner contends that the claims “must be looked at from the point of view of how the patent discusses the invention,” and Dr. Galton admits that the ’528 patent is written from the perspective of conventional current, including its description of charging and discharging storage elements (capacitors). *Id.* (citing Ex. 2042, 61:16–62:2, 59:21–60:9).⁴⁴ Patent Owner further asserts that the claims refer to transfer, storage, and output of energy and Dr. Galton admits that the fundamental electrical equations used to describe energy transfer (power) are expressed in terms of conventional current. *Id.* (citing Ex. 2024 ¶ 50; Ex. 2042, 21:19–24:5, 19:16–20:1). Patent Owner, thus, contends that “[t]his should end the inquiry.” *Id.* at 39.

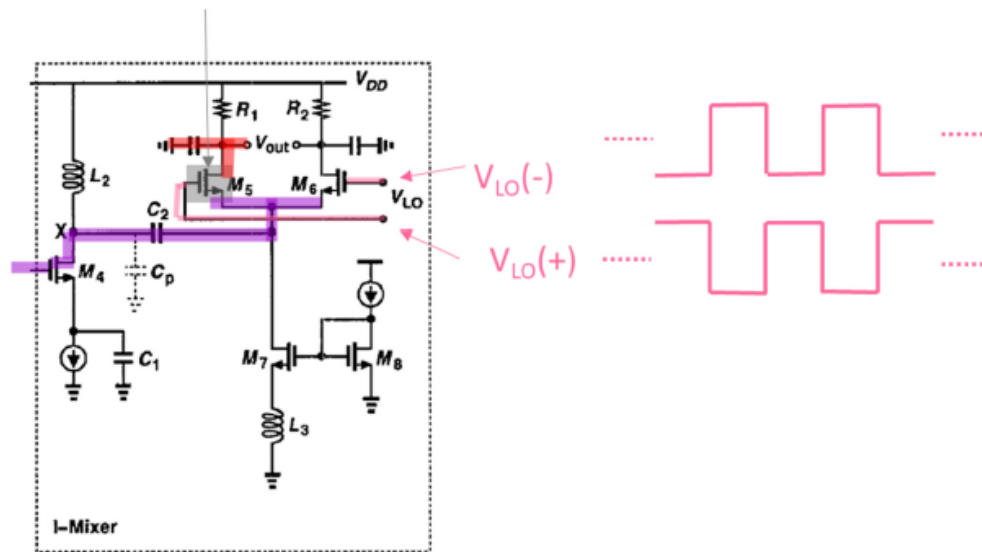
Patent Owner contends that Dr. Ricketts analyzes the claims and the prior art “using conventional current,” as Patent Owner asserts one of ordinary skill in the art would do, and Petitioner “offers no evidence that a [person of ordinary skill in the art] would rely on electron flow to interpret circuit operation other than Galton’s bald assertions/say-so.” PO Sur-reply 39. And Patent Owner asserts that the technical references on which Dr. Galton relies use standard, conventional current notation and analyze

⁴⁴ Patent Owner cites *Phillips* for the principle that “claims must be read in view of the specification, of which they are a part.” PO Sur-reply 38 (citing *Phillips*, 415 F.3d at 1315).

current flow. *Id.* at 39–40 (citing Ex. 1053, 13; Ex. 1046, 40). Thus, Patent Owner contends the claims “should be analyzed from the point of view of conventional current, not flow of electrons.” *Id.* at 41.

First, we begin our analysis by reiterating that element 1[b] recites “a first switch coupled to a first control signal which comprises a sampling aperture with a specified frequency, wherein the first switch is on and a portion of energy that is distinguishable from noise is transferred from the modulated carrier signal as an output of said first switch during the sampling aperture of the first control signal.” Ex. 1001, 192:34–39.

Second, we find that Petitioner has established that Razavi teaches element 1[b]. Specifically, Petitioner shows that Razavi’s Figure 2 and description teaches each and every limitation of element 1[b], as reflected in the figure reproduced below and explained by Petitioner.



TI-1017, Fig. 2 (annotated)

Pet. 68. We agree that Petitioner has established that

[i]n the combination receiver, the first switch (M_5 (gray)) is on so that the drain terminal starts conducting and ***a portion of energy that is distinguishable from noise*** is transferred from

the modulated carrier signal (V_{RF} (purple)) as an output of said first switch (V_{out} (red) above M_5 (gray)) during the sampling aperture of said first switch (when M_5 is ON), consistent with portions of the '528 Specification that allegedly lend support to the Challenged Claims.

Id. (citing Ex. 1001, Fig. 197, 176:66–177:16).

Third, as reflected above, central to the parties' dispute is the operation of the circuit shown in Razavi's Figure 2, and whether a portion of energy that is distinguishable from noise is transferred from the modulated carrier signal as an output of the first switch. That question is answered based on whether it is appropriate to consider the flow of electrons in the circuit (as Petitioner contends) or whether it is *only* appropriate to consider the conventional circuit nomenclature. In that regard, Patent Owner's argument pertaining to the directionality of the signal is central to whether Razavi samples an input signal. If we find that one of ordinary skill in the art would consider Razavi as proposed by Petitioner and Dr. Galton, that determination effectively resolves the issues raised by Patent Owner.

Reviewing the expert testimony presented in their respective declarations and deposition testimony, we find the testimony presented by Dr. Galton more credible than that presented by Dr. Ricketts. In particular, Dr. Galton's testimony from paragraphs 102–139 in his Second Declaration (Ex. 1066) is highly persuasive. There, Dr. Galton explains his opinion as to Razavi's operation as well as why Dr. Ricketts' opinion is incorrectly based on conventional current that does not accurately reflect how current moves through Razavi's circuit shown in Figure 2. Dr. Galton's testimony is both clear and convincing. He explains the history regarding conventional current and that it is based on the incorrect assumption that electricity moves

from positive to negative. *See, e.g.*, Ex. 1066 ¶ 106. And Dr. Galton persuasively explains that the electron flow is toward V_{DD} . *Id.* ¶ 105. Thus, we agree with Dr. Galton’s testimony that the actual current (i.e., actual electron flow) in the circuit flows from the source to the drain of each transistor M_5 and M_6 . *Id.* ¶ 107.

Fundamentally, the experts agree. Dr. Ricketts acknowledged during his deposition that “[b]y convention, current flows from – typically from a positive to a negative, and the electrons are actually traveling from the negative back up to the positive, by just how we have defined those things in the field.” Ex. 1065, 14:21–25. So, the question we resolve here is whether to interpret Razavi’s circuit shown in Figure 2 as operating incorrectly by sticking with conventional naming that is recognized by both experts and explained by Dr. Galton as not representing the actual current, i.e., the electron flow, or whether we interpret Razavi’s circuit shown in Figure 2 as it operates in the real world in terms of actual physics. *See* Ex. 1066 ¶ 130 (opining that Dr. Ricketts uses “a naming convention that defines current as flowing from high to low voltages for historical reasons, to reach an invalid conclusion”). We find that one of ordinary skill in the art would interpret Razavi in terms of how the current (i.e., electrons) actually flows as opposed to using a convention that is acknowledged to be opposite. In so doing, we also find particularly persuasive, Dr. Galton’s testimony in paragraph 129 that, in the circuit shown in Razavi’s Figure 2, “the RF input signal directly transfers energy to both the capacitors and the resistors.” Ex. 1066 ¶ 129 (further testifying that the capacitors perform integration, and the resistors are the loads, and, therefore, energy of the input signal is integrated and

transferred from the modulated carrier signal as an output of the switch during the sampling aperture of that switch).

We also find credible and persuasive Dr. Galton's testimony that Razavi's circuit shown in Figure 2 implements sampling and "does so in two places, one that uses M_5 as the switch and the capacitor above it as the storage element, and one that uses M_6 as the switch and the capacitor above it as the storage element." Ex. 1066 ¶ 125. And we agree with Dr. Galton's testimony that, because the sample rate is the LO frequency (i.e., 900 MHz), which is the same as the frequency of the EM signal, Razavi samples at an aliasing rate. *Id.*

Additionally, Dr. Galton's testimony regarding Figure 95 of the '528 patent calls into question Patent Owner's argument (based on Dr. Ricketts' opinion) that a circuit with a continuous input and a continuous output does not perform "sampling." Ex. 1066 ¶ 126. Dr. Galton provides persuasive testimony that the embodiment illustrated in Figure 95 has continuous input and continuous output time signals for the reasons he explains therein. *Id.*

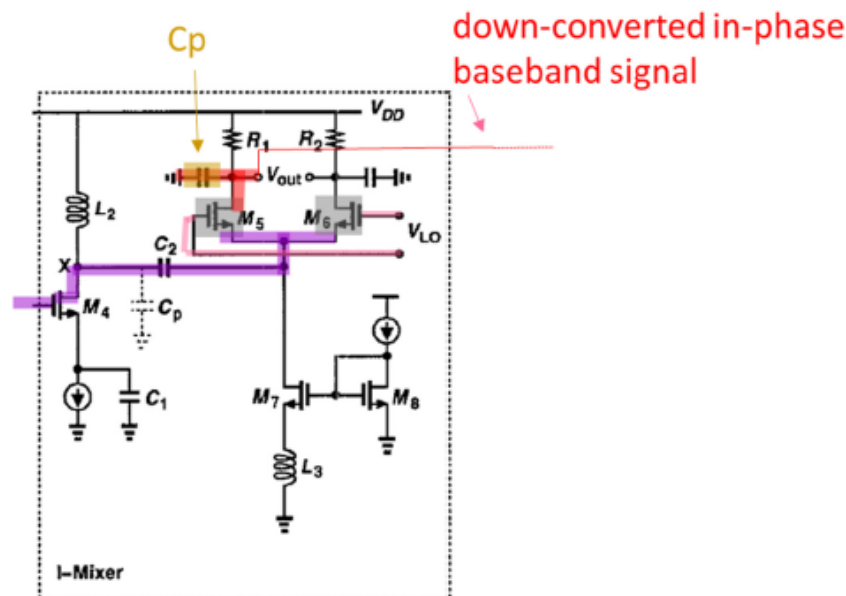
Further, we do not agree with Patent Owner's argument that, because the '528 patent describes the circuits therein using conventional current, that means one of ordinary skill in the art would not have interpreted Razavi's circuit shown in Figure 2 as Dr. Galton explains. In particular, both the '528 patent and Razavi use conventional current, which is to be expected because it is, in fact, "conventional," but as Dr. Galton explains, one of ordinary skill in the art would have understood that, in actuality, it is the flow of electrons that influences the transfer of energy from the input signal. Thus, we do not agree with Patent Owner's argument that Dr. Galton's

understanding of Razavi contradicts how one of ordinary skill in the art would have understood the '528 patent.

In light of the full record before us, we find Petitioner’s argument more strongly supported on the record and Dr. Galton’s testimony more credible for the reasons discussed above. Therefore, considering how the current – electrons – actually flows in Razavi, we agree with Petitioner that the combination teaches element 1[b].

d. Element 1[c]

Element 1[c] recites “a first energy storage element that stores the transferred energy from the modulated carrier signal and outputs a down-converted in-phase baseband signal portion of said modulated carrier signal.” Ex. 1001, 192:40–43. Petitioner provides the following annotated version of Razavi’s Figure 2.



TI-1017 (annotated)

Pet. 69. Explaining its annotations, Petitioner contends that “the combination receiver includes a ***first energy storage element*** (capacitor Cp (brown)) coupled to a ***first control signal*** (V_{LO} lower (pink)) and outputs a

down-converted in-phase baseband signal portion (red portion exiting in-phase (I) mixer) of said modulated carrier signal (V_{RF} (purple)). *Id.* Petitioner asserts that, “[a]s explained in [element] 1[b], when M_5 (gray) is on, the drain terminal starts conducting and the capacitor C_p (brown) stores the transferred energy and outputs a down-converted in-phase baseband portion (red portion) of V_{RF} (purple) in the same manner as described by the ’528 Patent.” *Id.* (citing Ex. 1001, Fig. 197 (first processing module 19702), 176:61–177:15; Ex. 1003 ¶¶ 233–234).

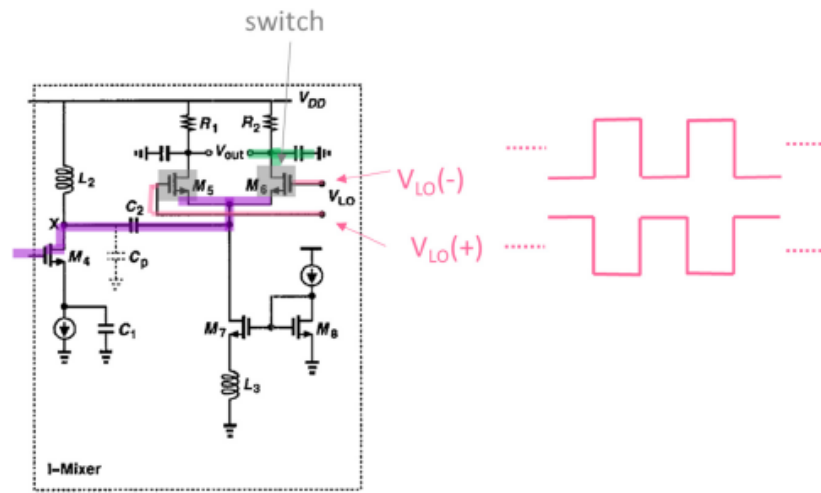
Petitioner contends that, consistent with its claim construction of “energy storage element,” “Razavi’s capacitor C_p (brown) ‘***stores non-negligible amounts of energy from an input EM signal***,’ *i.e.*, the RF input signal V_{RF} , to provide sufficient energy for outputting the down-converted signal.” Pet. 70. Relying on Dr. Galton’s testimony, Petitioner asserts that “the differential amplifier circuit of Macnally provides ***low impedance load*** typically in the kilo ohm range, ([Ex.] 1003, ¶235), which allegedly ‘goes to the heart of what makes an element, a “storage” element.’” Pet. 70 (citing IPR2020-01265, Paper 26 at 13 (PO Sur-reply)). Petitioner reiterates that Razavi’s results “further demonstrate sufficient energy distinguishable from noise.” *Id.* (citing Pet. § III.C.3(1[b]); Ex. 1017, Table 1; Pet. § III.A.5(1[b]); Ex. 1003 ¶ 232).

Relying on its interpretation of Razavi, discussed above in the context of element 1[b], Patent Owner contends that because “no current—and therefore no energy—from the RF input signal passes through M_5 or M_6 towards the capacitors C_p/C_m ,” “no energy from the RF input signal can ever make its way to the capacitors to be stored and accumulated/integrated.” PO Resp. 104.

Based on the complete record, we disagree with Patent Owner's argument because it is based on the same position regarding Razavi's Figure 2 that we discussed above in the context of element 1[b]. Rather, we find that Petitioner has established that Razavi teaches transferring energy of the RF input signal and that the transferred energy is stored and accumulated/integrated. *See* Pet. 71–73; *see also* Pet. Reply 33–34. Therefore, for the reasons provided by Petitioner and as we explain above, we find that Petitioner has shown that the combination teaches element 1[c].

e. Element 1[d]

Element 1[d] recites “a second switch coupled to a second control signal which comprises a sampling aperture with a specified frequency, wherein the second switch is on and a portion of energy that is distinguishable from noise is transferred from the modulated carrier signal as an output of said second switch during the sampling aperture of the second control signal.” Ex. 1001, 192:44–50. Petitioner contends “the combination receiver includes a ***second switch*** (M_6 (gray)) coupled to a ***second control signal*** (V_{LO} (-) (pink)) which comprises a sampling aperture (the period when M_6 is CLOSED, which lasts approximately half the period of the oscillating frequency of V_{LO}) with a specified frequency (the oscillating frequency of V_{LO}).” Pet. 70. Petitioner provides the following annotated version of Razavi's Figure 2.



TI-1017, Fig. 2 (annotated)

Pet. 71. Petitioner explains its annotations as follows,

[i]n the combination receiver, the second switch (M₆ (gray)) is on so that the drain terminal starts conducting and ***a portion of energy that is distinguishable from noise*** is transferred from the modulated carrier signal (V_{RF} (purple)) as an output of said [second]⁴⁵ switch (V_{out} (red) above M₆ (gray)) during the sampling aperture of said [second] switch (when M₆ is ON), consistent with portions of the '528 Specification that allegedly lend support to the Challenged Claims.

Id. (footnote added) (citing Ex. 1001, Fig. 197, 177:31–48; Ex. 1003 ¶ 237 (explaining that V_{out} terminals in Razavi are complementary)).

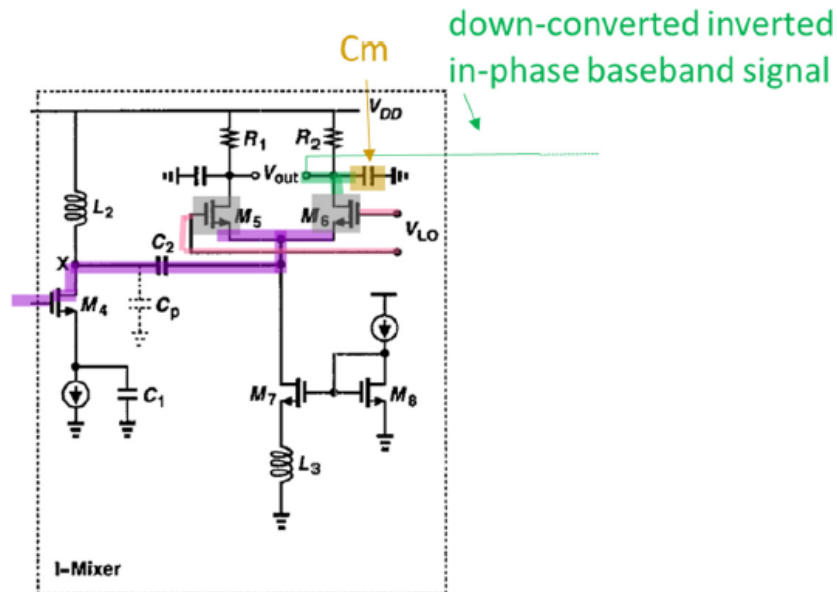
Patent Owner's argument regarding element 1[b] similarly applies to element 1[d]. See PO Resp. 98–103 (generally referring to both the first and second switch, elements 1[b] and 1[d], of claim 1). For the same reasons discussed in our consideration of the argument above, we disagree with Patent Owner's interpretation of Razavi. In light of Petitioner's argument

⁴⁵ From the context of Petitioner's arguments and previous identification, we understand that Petitioner intended to refer to its identified "second switch" (M₆) here and in the subsequent reference in the block quote above.

and evidence, which we find persuasive for the reasons provided by Petitioner as we explain above, we find that Petitioner has shown that the combination teaches element 1[d].

f. Element 1[e]

Element 1[e] recites “a second energy storage element that stores the transferred energy from the modulated carrier signal and outputs a down-converted inverted in-phase baseband signal portion of said modulated carrier signal.” Ex. 1001, 192:51–54. Petitioner provides the following annotated version of Razavi’s Figure 2:



TI-1017, Fig. 2 (annotated)

Pet. 72. Petitioner contends that the annotated Figure 2, above, shows the combination receiver “includes a **second energy storage element** (capacitor Cm (brown)) coupled to a **second control signal** (V_{LO} (-) (pink)) and outputs a **down-converted in-phase baseband signal portion** (green portion exiting in-phase (I) mixer) of said modulated carrier signal (V_{RF} (purple)).” *Id.* at 71–72. Petitioner asserts that, consistent with its claim

construction of “energy storage element,” “Razavi’s capacitor C_m (brown) ‘stores non-negligible amounts of energy from an input EM signal,’ i.e., the RF input signal V_{RF} , to provide sufficient energy for outputting the down-converted signal.” *Id.* at 72 (citing Ex. 1003 ¶¶ 239–240 (opining that Macnally’s circuit provides a low impedance load to capacitor C_m of Razavi)).

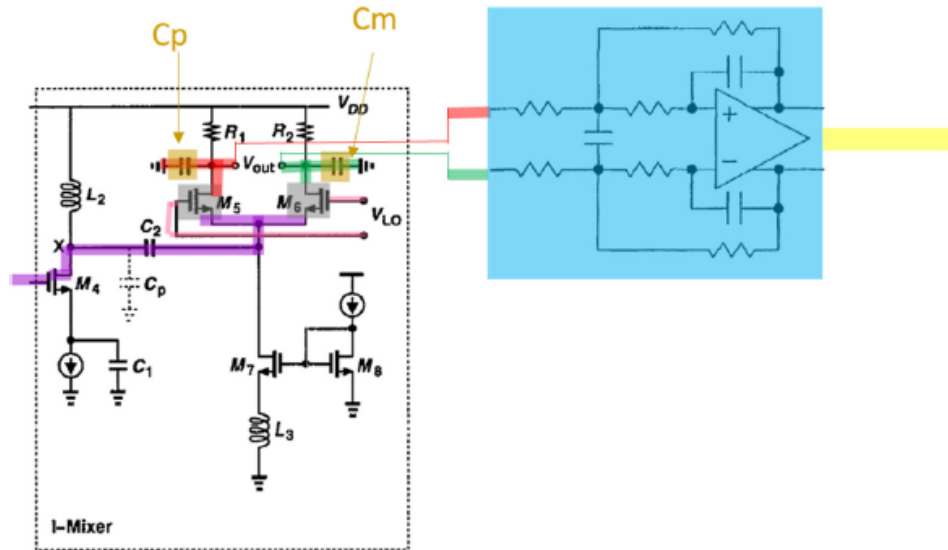
Additionally, Petitioner contends that, as explained in the context of its discussion of element 1[d] above, “when M6 (gray) is on, the drain terminal starts conducting and the second capacitor (brown) stores the transferred energy and outputs a down-converted inverted in-phase baseband portion (green portion) of VRF (purple) in the same manner as described by the ’528 Patent.” Pet. 72–73 (citing Ex. 1001, Fig. 197 (second processing module 19706), 177:31–54; Ex. 1003 ¶ 241).

Patent Owner’s argument regarding element 1[c] also applies to element 1[e]. *See* PO Resp. 104 (generally referring to storing and accumulating/integrating energy). For the same reasons discussed in our consideration of the argument above, we disagree with Patent Owner’s interpretation of Razavi. In light of Petitioner’s argument and evidence, which we find persuasive for the reasons provided by Petitioner as we explain above, we find that Petitioner has shown that the combination teaches element 1[e].

g. Element 1[f]

Element 1[f] recites “wherein the portions of transferred energy from each of the first and second switch are integrated over time to accumulate said portions of transferred energy from which said down-converted in-phase baseband signal portion and said down-converted inverted in-phase

baseband signal portion are derived; and.” Ex. 1001, 192:55–60. Petitioner provides the following annotated version of Razavi’s Figure 2 (left) with an annotated version of Macnally’s circuit (right).



Combination Receiver (using circuit of TI-1021/1022)

Pet. 73. Petitioner contends that, as explained in Petition § III.C.1–2 (describing Razavi and the proposed combination), and as shown in the annotated combination, above, in the combined system

*the portions of transferred energy from each of the first and second switch **are integrated** (e.g., on each respective capacitor (Cp/Cm (brown)) over time (when the coupled-to transistor switch is on) to accumulate said portions of transferred energy **from which said down-converted in-phase baseband signal portion** (red portion feeding into Macnally’s circuit) **and said down-converted inverted in-phase baseband signal portion** (green portion feeding into Macnally’s circuit) **are derived.***

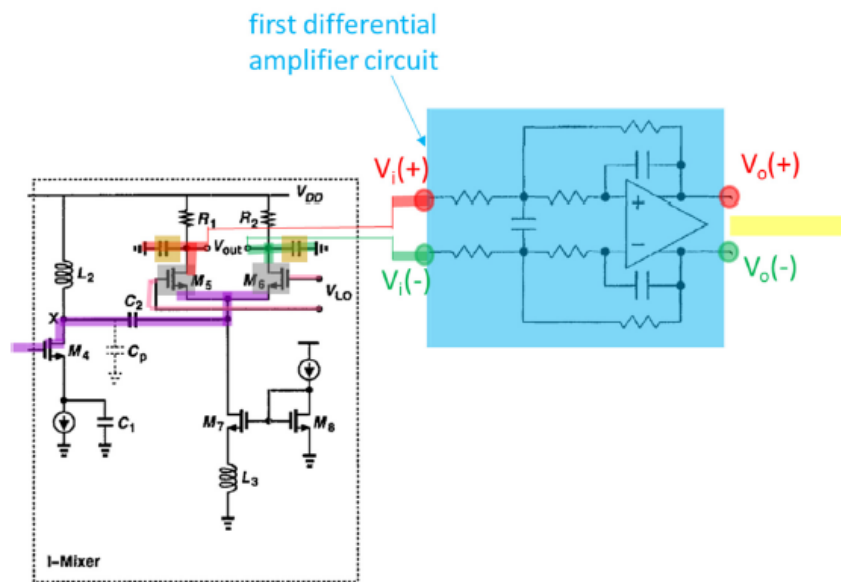
Id. (citing Ex. 1003 ¶¶ 242–242; Pet. § III.C.3 (Elements 1[c], 1[e])).

Patent Owner does not appear to separately argue element 1[f]. To the extent Patent Owner’s previous arguments apply, we disagree with them

for the reasons explained above. In light of Petitioner's argument and evidence, which we find persuasive for the reasons provided by Petitioner as we explain above, we find that Petitioner has shown that the combination teaches element 1[f].

h. Element 1[g]

Element 1[g] recites “a first differential amplifier circuit that combines said down-converted in-phase baseband signal portion with said down-converted inverted in-phase baseband signal portion and outputs a first channel down-converted differential in-phase baseband signal.” Ex. 1001, 192:61–65. Petitioner provides the following annotated version of Razavi's Figure 2 (left) with an annotated version of Macnally's circuit (right).



Combined Receiver (using circuit of TI-1021/1022)

Pet. 74. Petitioner contends that, as explained in Petition § III.C.1–2 (describing Razavi and the proposed combination), and as shown in the annotated combination, above, the combined receiver includes a “*first differential amplifier circuit*” (light blue) that *combines* said down-converted

in-phase baseband signal portion (red portion) with said down-converted inverted in-phase baseband signal portion (green portion) and outputs a first channel down-converted differential in-phase baseband signal (yellow portion).” *Id.* Petitioner asserts that

[t]he first differential amplifier circuit (light blue) combines the down-converted in-phase baseband signal portion (red portion) with the down-converted inverted in-phase baseband signal portion (green portion) because each of the two complementary signal components at the output (i.e., $V_o(+)$ and $V_o(-)$) is a result of both of the two complementary signal components at the input (i.e., $V_i(+)$ and $V_i(-)$).

Id. at 74–75 (citing Ex. 1003 ¶¶ 244–246 (opining that one of ordinary skill in the art would have understood that a single-ended amplifier was typically used to generate the output signal off-chip and would have found it obvious to use a single-ended amplifier, as needed)).

Patent Owner does not appear to separately argue element 1[g]. To the extent Patent Owner’s previous arguments apply, we disagree with them for the reasons explained above. In light of Petitioner’s argument and evidence, which we find persuasive for the reasons provided by Petitioner as we explain above, we find that Petitioner has shown that the combination teaches element 1[g].

3. Claims 5, 8, 9, 11–19, 23, 26, 27, and 29–36

Petitioner contends that the combination of Razavi and Macnally would have rendered the subject matter of dependent claims 5, 8, 9, 11–19, 23, 26, 27, and 29–36 obvious to one of ordinary skill in the art at the time of the invention. Pet. 75–94. Petitioner’s arguments are supported by evidence, including the testimony of Dr. Galton. *See id.* (citing Ex. 1003 ¶¶ 248–317).

Patent Owner does not raise additional argument directed to dependent claims 5, 9, 11–19, 23, 27, and 29–36. *See generally* PO Resp. As directed to dependent claims 8 and 26, Patent Owner contends that the combination does not teach transferring energy from the modulated carrier signal to the storage element when the switch is ON. PO Resp. 104–05. Patent Owner’s argument is essentially derived from the same position noted above, explaining “when M5 or M6 is ON, the respective capacitor is connected through to M7 and ultimately to ground,” in which case “current only flows down through M5 or M6 and into M7.” *Id.* at 105 (citing PO Resp. § IX.C.1–2). “Conversely, when M5 or M6 is OFF, the capacitor is disconnected from the signal path to ground and only connected to VDD through R1 or R2,” and “[w]hen either M5 or M6 is OFF, the respective capacitor is isolated from ground (via M7) and instead is connected only to VDD, allowing it to only charge from VDD.” *Id.* (citing Ex. 2024 ¶ 381). Additionally, Patent Owner asserts that Razavi’s capacitors do not receive any energy from the modulated carrier signal (RF input signal), rather they receive “current/energy” only from VDD. *Id.* “No current—and therefore no energy—flows from the RF input signal upward through M5 or M6 toward Cp or Cm.” *Id.* (citing PO Resp. § IV.C.1; Ex. 2024 ¶¶ 382–383).

In its Reply, Petitioner responds by pointing to its previous arguments regarding Razavi and reiterates that Patent Owner’s position would contradict an example provided in the ’528 patent. Pet. Reply 34 (citing Pet. Reply §§ IV.B.1–2; Ex. 1066 ¶¶ 149–152; Pet. 76 (citing Ex. 1003 ¶¶ 251–252), 87–88). Additionally, Petitioner points to Dr. Galton’s testimony explaining “that each side of V_{out} of Razavi (Figure 2) is represented as a bias and a signal component, and when a respective switch (e.g., M_5 or M_6)

is on, the corresponding signal component, resulting from the RF input signal, charges the corresponding capacitor connected to R_1 or R_2 .” *Id.* (citing Ex. 1066 ¶¶ 142–148).

For the reasons discussed above, we agree with Petitioner’s explanation as to how Razavi functions in terms of transferring energy from the modulated carrier signal, and we find Dr. Galton’s testimony credible and persuasive in its detail and supported explanation.

We have reviewed Petitioner’s argument and supporting evidence, and we find that Petitioner has established that the combination of Razavi and Macnally teaches the subject matter of claims 5, 8, 9, 11–19, 23, 26, 27, and 29–36, and that one of ordinary skill in the art would have had a reason with rational underpinnings to combine the teachings of the references as proposed and would have had a reasonable expectation of success in doing so. For those reasons, we adopt Petitioner’s arguments as though they were our own findings. *See* Pet. 75–94.

4. Objective Indicia of Nonobviousness

As noted above, neither Petitioner nor Patent Owner has presented any evidence of objective indicia of nonobviousness.

5. Weighing the Graham Factors

On balance, considering the complete record before us, the evidence of obviousness is strong, and Patent Owner has not presented objective evidence of nonobviousness. Accordingly, on balance, we determine that Petitioner has established by a preponderance of the evidence that the combination of Razavi and Macnally would have rendered the subject matter of claims 1, 5, 8, 9, 11–19, 23, 26, 27, and 29–36 of the ’528 patent obvious to one of ordinary skill in the art at the time of the invention.

G. Ground 2B: Obviousness over Razavi, Macnally, and Cahn

1. Claims 2–4 and 20–22

Petitioner contends that the combination of Razavi, Macnally, and Cahn would have rendered the subject matter of claims 2–4 and 20–22 obvious to one of ordinary skill in the art at the time of the invention. Pet. 94–95. Petitioner’s arguments are supported by evidence, including the testimony of Dr. Galton. *See id.* (citing Ex. 1003 ¶¶ 318–323).

Patent Owner does not raise any argument specifically directed to Petitioner’s challenge to claims 2–4 and 20–22 aside from the argument discussed above. *See generally* PO Resp.

We have reviewed Petitioner’s argument and supporting evidence, and we find that Petitioner has established that the combination of Razavi, Macnally, and Cahn teaches the subject matter of claims 2–4 and 20–22, and that one of ordinary skill in the art would have had a reason with rational underpinnings to combine the teachings of the references as proposed and would have had a reasonable expectation of success in doing so. For those reasons, we adopt Petitioner’s arguments as though they were our own findings. *See* Pet. 94–95.

2. Objective Indicia of Nonobviousness

As noted above, neither Petitioner nor Patent Owner has presented any evidence of objective indicia of nonobviousness.

3. Weighing the Graham Factors

On balance, considering the complete record before us, the evidence of obviousness is strong, and Patent Owner has not presented objective evidence of nonobviousness. Accordingly, on balance, we determine that Petitioner has established by a preponderance of the evidence that the

combination of Razavi, Macnally, and Cahn would have rendered the subject matter of claims 2–4 and 20–22 of the '528 patent obvious to one of ordinary skill in the art at the time of the invention.

H. Energy Transfer System

Patent Owner includes an additional section asserting that claim 1 “recites a first and second ‘energy storage element’” but “[n]either Tayloe nor Razavi disclose/teach/suggest an energy transfer system.” PO Resp. 114 (citing Ex. 2024 ¶ 416). Patent Owner contends “Tayloe is a voltage sampling system,” “Razavi does not perform sampling, and does not accumulate/discharge transferred energy from the input signal to a load,” and “by using an active mixer with high gain, Razavi is not transferring the RF input signal or its energy to the output of the mixer.” *Id.* at 114–15 (citing PO Resp. §§ VIII.A, VIII.C; Ex. 2024 ¶¶ 417–418).

In its Reply, Petitioner contends that “no energy transfer system is required” and each ground “provide[s] a low-impedance load to each (energy) storage element.” Pet. Reply 36 (citing Pet. Reply § III; Pet. § III).

Patent Owner’s arguments, although set forth in a distinct section of the Patent Owner Response, essentially reiterate positions that Patent Owner argued in previous sections of its Response and which we have addressed above, most particularly that “energy storage element” is not construed as requiring an entire “energy transfer system.” Accordingly, we disagree that an energy transfer system is required by claim 1.

III. MOTIONS TO EXCLUDE

A. Petitioner's Motion to Exclude

Following a timely objection (*see* Paper 23), Petitioner moves to exclude Exhibits 2010–2014, 2019–2022, 2027, and 2029, as well as portions of Exhibit 2016 (Sorrells' Declaration). Pet. MTE 1. Petitioner contends that each of the exhibits were filed in support of Patent Owner's argument that it conceived and actually reduced to practice the subject matter of claims 1, 3, 5, 8, 9, and 11–18 prior to the filing dates of Tayloe and Macnally. *Id.* Petitioner asserts that Exhibits 2010–2012, 2022, and 2029 are inadmissible hearsay; Exhibits 2010–2014, 2019, 2020, 2022, 2027, and 2029 lack authentication; Exhibits 2013, 2014, 2019, 2020, and 2022 are irrelevant, and that certain portions of Mr. Sorrells' declaration (e.g., Ex. 2016 ¶ 9) are irrelevant. *Id.* Petitioner organizes its Motion by objection, not by exhibit number. *See generally id.* For consistency and ease of discussion, we do the same below.

1. Hearsay

Petitioner contends that each of Exhibits 2010–2012, 2022, and 2029 are hearsay because Patent Owner offers them to prove the truth of the matter asserted—that Patent Owner had conceived and actually reduced to practice claims 1, 3, 5, 8, 9, and 11–18 of the '528 patent prior to the filing dates of Tayloe and Macnally. Pet. MTE 5. Petitioner asserts that these exhibits are inadmissible because Patent Owner has not provided testimony from a custodian or other qualified witness to show that the factors outlined in Federal Rule of Evidence ("FRE") 803(6)(A)–(C) are satisfied. *Id.* Therefore, Petitioner contends these exhibits should be excluded. *Id.* at 6.

Petitioner contends that Exhibits 2011 and 2012 are relied on by Mr. Sorrells for metadata from the Relativity database showing the last date certain files were modified and Exhibit 2029 is a list of files downloaded from the Relativity database with associated metadata, but Mr. Sorrells, the only witness Patent Owner offered to provide testimony regarding the exhibits, “is not a custodian or qualified witness to testify as to the storage or maintenance of files on the Relativity database” and he did not know where the database is stored or who maintains it. Pet. MTE 6–8. Petitioner asserts that Mr. Sorrells is not a custodian or another qualified witness to attest to the requirements of FRE 803(6)(A)–(C) and, since exhibits 2011, 2012, and 2029 are not entitled to the business records hearsay exception, they are inadmissible. *Id.* at 9. Alternatively, Petitioner contends that, even if the circuit schematics are admissible under a hearsay exception, the metadata, including the date and time stamps and file names, are inadmissible hearsay for the same reasons. *Id.*

For Exhibits 2010 and 2022 (referred to in the parties’ motion papers collectively as the “Boeing reports”), Petitioner contends that, again, the only testimony offered is that of Mr. Sorrells, but Mr. Sorrells was not a custodian or a qualified witness of the Boeing reports under FRE 803(6) and his declaration does not indicate that he was present for Boeing’s testing conducted on April 27, 1998, that resulted in “the Smith chart on page 15” of Exhibit 2010 (and Exhibit 2042⁴⁶) or February 23–27, 1998, the dates

⁴⁶ Petitioner contends that Exhibit 2042 should also be excluded pursuant to FRE 803(6), because it includes a portion of the Smith chart from Exhibit 2010, and also pursuant to FRE 106 for lack of completeness. Pet. MTE 10 n.2.

indicated on Exhibit 2022. Pet. MTE 9–10. Petitioner contends that, without evidence of first-hand knowledge regarding the testing, Mr. Sorrells is not a qualified witness to testify as to the details of the testing that occurred on those days, reflected on pages 3–39 of Exhibit 2022. *Id.* at 10. Thus, Petitioner asserts that pages 8–16 of Exhibit 2010 and pages 3–39 of Exhibit 2022 are inadmissible hearsay and should be excluded. *Id.* at 10–11.

In its Opposition, regarding Exhibits 2010–2014, 2019–2022, 2027, and 2029, Patent Owner contends that Mr. Sorrells was the former chief technology officer (CTO) and, therefore, was the “individual in charge of the research, development and design of the technology at issue” and “was fully qualified to testify that the documents are what they appear to be.” PO Opp. 3 (citing Ex. 2016 ¶¶ 2, 4). Patent Owner asserts that, in light of Mr. Sorrells’ declaration, “each of the challenged documents is self-authenticating under [FRE] 902(11) as certified domestic record[s] of a regularly conducted activity.” *Id.*

Additionally, Patent Owner contends that Exhibits 2010, 2019, and 2020 are “self-authenticating under [FRE] 902(7) by their ‘Trade Inscriptions’ because they have ‘[a]n inscription, sign, tag, or label purporting to have been affixed in the course of business and indicating origin, ownership, or control.’” PO Opp. 3 (citing Fed. R. Evid. 902(7); Ex. 2010, 2 (Boeing’s logo); Exs. 2019, 2020 (Patent Owner’s logo)).

Regarding Exhibits 2011 and 2012, Patent Owner contends that the metadata in each exhibit are not hearsay because they are machine generated and, therefore, they are not a “statement” by a person or declarant within the meaning of FRE 801. PO Opp. 4. Patent Owner also contends that the metadata is “useful for non-hearsay purposes—to corroborate the dates

shown in Exhibits 2011 and 2012 and Mr. Sorrells' testimony regarding creation of the same." *Id.* at 5.

Regarding Exhibits 2011–2014, Patent Owner asserts that the exhibits are admissible pursuant to FRE 803(6) based on Mr. Sorrells' testimony because he "is a qualified witness who is knowledgeable of [Patent Owner's] regular business practice of creating, maintaining, and retrieving technical documentations," including these exhibits. PO Opp. 6. Patent Owner contends that Mr. Sorrells' testimony establishes that

- (1) as [former] CTO, he was responsible for, and has personal knowledge of, the creation, maintenance, and retrieval of Exhibits 2011–2014; (2) Exhibits 2011–2014 [were] created at or around the time by individuals with knowledge of the designs set forth therein, as directed by Mr. Sorrells;
- (3) creation and maintenance of technical documents, including Exhibits 2011–2014, was a regular business practice of [Patent Owner].

Id. at 7. Patent Owner, thus, contends that Mr. Sorrells is a qualified witness, and his testimony shows that Exhibits 2011–2014 fall under the "'Records of a Regularly Conducted Activity' exception to hearsay under [FRE] 803(6)'" and "Petitioner's motion did not (and could not) allege any circumstance that indicates a lack of trustworthiness." *Id.*

Regarding Exhibits 2012 and 2014, Patent Owner contends that the exhibits are admissible under FRE 803(16) because they are ancient documents prepared before January 1, 1998. PO Opp. 7 (citing FRE 803(16)). Patent Owner asserts Exhibit 2012 was last modified March 6, 1997, and Exhibit 2014 was last modified August 21, 1997. *Id.* at 8. Thus, Patent Owner argues Exhibits 2012 and 2014 are not hearsay pursuant to FRE 803(16). *Id.*

Regarding Exhibits 2011–2014, Patent Owner contends that they also are admissible pursuant to FRE 807 because “they are supported by sufficient guarantees of trustworthiness and [are] more probative on conception and reduction to practice than any other evidence that can be offered.” PO Opp. 8. Patent Owner asserts that these exhibits are technical documents routinely and regularly created and maintained by technology companies such as Patent Owner, and Patent Owner contends Mr. Sorrells’ testimony corroborates and confirms their creation. *Id.* at 8–9.

Turning to Exhibits 2010 and 2022, Patent Owner notes that they are Boeing’s testing reports for the Eddie device, and they are admissible. PO Opp. 10. First, Patent Owner contends that Mr. Sorrells’ testimony establishes that each exhibit is admissible pursuant to FRE 803(6). *Id.* Patent Owner asserts that Mr. Sorrells is a qualified witness who is knowledgeable about Patent Owner’s “regular business practice of ordering and maintaining tests from independent testing company [sic] to evaluate performance of [Patent Owner’s] technology.” *Id.* at 10–11. Patent Owner asserts that Mr. Sorrells’ testimony establishes that Patent Owner and Boeing entered into an agreement for Boeing to conduct testing on the Eddie device to evaluate its performance, that Mr. Sorrells observed some of the testing, that technical documents, including Exhibits 2010 and 2022, were stored on computer hard drives in 1997 and 1998, and in 2011 or 2012 were submitted to Patent Owner’s IT department where full copies and images were made and uploaded to a Relativity database. *Id.* Thus, Patent Owner asserts that Mr. Sorrells’ testimony establishes that

- (1) as [former] CTO, he was responsible for, and has personal knowledge of, the creation, maintenance, and retrieval of Exhibits 2010 and 2022; (2) Exhibits 2010 and 2022 [were]

created at or around the time by individuals with knowledge of the results set forth therein; (3) the ordering and maintenance of independent testing reports, including Exhibits 2010 and 2022, was a regular business practice of [Patent Owner].

Id. at 11–12. Thus, Patent Owner contends Mr. Sorrells is a qualified witness and that his testimony establishes Exhibits 2010 and 2022 fall under the “‘Records of a Regularly Conducted Activity’ exception to hearsay under [FRE] 803(b).” *Id.* at 12. And Patent Owner contends that Petitioner’s Motion “did not (and could not) allege any circumstance that indicates a lack of trustworthiness.” *Id.*

Second, Patent Owner contends that Exhibits 2010 and 2022 are admissible pursuant to FRE 807 “because they are supported by sufficient guarantees of trustworthiness and [are] more probative on conception and reduction to practice than any other evidence that can be offered.” PO Opp. 12. Patent Owner asserts that these exhibits “were created more than 20 years ago,” “were created by an independent party—Boeing—with no interest in this IPR and the parallel district court proceedings,” Exhibit 2010 bears the logo of Boeing and was signed by Boeing personnel, Exhibit 2021 “evinces an agreement between [Patent Owner] and Boeing for the purpose of conduct[ing] the test, the result of which was reported in Exhibit 2010,” Exhibit 2022 “includes photographs and notes of the test, consistent with the content of Exhibit 2010,” and Mr. Sorrells was present and observed some of the testing. *Id.* at 12–13.

Third, Patent Owner contends Exhibits 2010 and 2022 “also serve[] non-hearsay purposes of: (1) showing that communication relating to testing of [Patent Owner’s] down conversion technology took place at the relevant time”; and “(2) corroborating the design layouts and schematics shown in

Exhibits 2011–2014, which corresponds with the content of Exhibits 2010 and 2022.” PO Opp. 13.

Turning to Exhibit 2029, Patent Owner asserts that this exhibit is “an excel spreadsheet export of search results generated by the Relativity database” and that the exhibit and the metadata therein “were machine generated” and, therefore, are not a “‘statement’ by a person/declarant within the meaning of [FRE] 801.” PO Opp. 14. Patent Owner contends that Exhibit 2029 is useful for what Patent Owner asserts are non-hearsay purposes, “to corroborate the dates shown in Exhibits 2011–2014 and Mr. Sorrells’ testimony regarding [Patent Owner’s] ‘continuous work . . . related to designing and developing the Eddie chip and circuit’” and, therefore, “Exhibit 2029 and the metadata therein are not hearsay.” *Id.* at 14–15.

In reply, Petitioner addresses Patent Owner’s arguments in terms of several groupings of exhibits. First, regarding Exhibits 2010–2012, 2022, and 2029, Petitioner asserts that Patent Owner has not established that Mr. Sorrells is a qualified witness pursuant to FRE 803(6)(A)–(C) because he does not know how the files got from Patent Owner into the Relativity database and that the Relativity database was not used by Patent Owner in the relevant time period of 1997–1999. Pet. MTE Reply 1–2. Petitioner contends that Mr. Sorrells is neither a custodian nor someone with knowledge of the Relativity database and, therefore, does not offer testimony as a qualified witness at the time the documents in question were created. *Id.* at 2. Rather, Petitioner contends that Patent Owner was required to produce some statement or affidavit from someone with knowledge of the Relativity database itself and, without such, the documents

lack authentication. *Id.* (citing *Standard Innovation Corp. v. Lelo, Inc.*, IPR2014-00148, Paper 41 at 11 (PTAB Apr. 23, 2015)).

Second, regarding Exhibits 2011 and 2012, Petitioner contests Patent Owner’s reliance on machine-generated metadata in these exhibits because Patent Owner seeks to offer the metadata “for the truth of the matter being asserted,” specifically, “the last modified date and timestamps,” but neither of the exhibits was properly authenticated by someone with “knowledge” of the Relativity database. Pet. MTE Reply 3.

Third, regarding Exhibits 2011–2014, Petitioner contests Patent Owner’s reliance on FRE 803(6) because the chain of custody of the exhibits requires a statement or affidavit from someone with “knowledge” of the Relativity database. Pet. MTE Reply 3.

Fourth, Petitioner contests Patent Owner’s reliance on FRE 803(16) (ancient documents) for Exhibits 2012 and 2014 because Patent Owner has not established the authenticity of the exhibits, a prerequisite to relying on the ancient document exception to the rule against hearsay. Pet. MTE Reply 3–4.

Fifth, Petitioner contests Patent Owner’s reliance on FRE 807 for Exhibits 2011–2014 because, as asserted above, Mr. Sorrells lacks personal knowledge of the Relativity database and, therefore, he cannot properly authenticate the documents. Pet. MTE Reply 4.

Sixth, Petitioner contests Patent Owner’s reliance on FREs 803(6) and 807 for Exhibits 2011 and 2022 because (a) Mr. Sorrells is not qualified under FRE 803(6), and (b) the chain of custody has not been established and Patent Owner seeks to offer the exhibits for the truth of the matter asserted, namely that Boeing tested a working circuit in April 1998, contrary to the

alleged non-hearsay purposes asserted by Patent Owner. Pet. MET Reply 4–5.

Seventh, Petitioner contests Patent Owner’s arguments directed to Exhibit 2029, asserting that the file listing was offered for the truth of the matter asserted (i.e., the date range) and that Mr. Sorrells cannot authenticate documents from the Relativity database. Pet. MTE Reply 5.

As a general matter, Petitioner, as the “moving party,” “has the burden of proof to establish that it is entitled to the requested relief.” 37 C.F.R.

§ 42.20. Here, we have serious concerns regarding the admissibility of the exhibits challenged by Petitioner. Specifically, Mr. Sorrells acknowledged that he does not have specific knowledge of the Relativity database, how the documents were added to the database, where the database is located, who maintains the database, and whether the metadata reflected in the database is current. Ex. 1068, 21:5–21, 22:8–13, 23:19–24:18; *see* Pet. MTE 8–9. In short, Mr. Sorrells is not a custodian or other qualified witness to attest to the authentication requirements that underly many of the hearsay exceptions on which Patent Owner seeks to rely to gain admissibility of these exhibits. Nor do we agree with Patent Owner’s argument that it seeks to rely on the information in these exhibits for a non-hearsay purpose. Rather, the information is directed specifically to the truth of the matter asserted, namely corroborating Mr. Sorrells’ statements regarding conception and reduction to practice. Even accepting that metadata and other computer-created information is not specifically hearsay, Patent Owner’s reliance on Mr. Sorrells’ testimony alone fails to offer proper authentication for the specific exhibit proffered. The same is true of the Boeing reports (Exhibits 2010 and 2022). Simply because Mr. Sorrells was present for

“some” of the testing, does not establish that he can authenticate the entirety of these reports prepared by a third party such as Boeing.

The lack of proper foundation for the admissibility of these exhibits is particularly concerning because of the purpose for which Patent Owner seeks to use them, namely providing corroboration for Mr. Sorrells’ testimony as to conception and reduction to practice. Even though we note below that the cases relied on by Petitioner do not speak to admissibility of evidence, we share Petitioner’s concerns that a patent owner’s reliance solely on an inventor’s testimony to establish authentication of exhibits that are then used to establish corroboration of that same inventor’s testimony appears circular and contrary, at least in-part, to the purpose of having independent corroborating evidence.

Thus, based purely on the arguments presented before us, we would find these exhibits inadmissible based on authenticity and hearsay grounds. Nonetheless, because we determine that, even with our consideration of the exhibits, Patent Owner fails to establish sufficient corroboration of conception and reduction to practice necessary to antedate Tayloe and Macnally, we decline to take the substantial step of granting Petitioner’s motion to exclude these exhibits. To the extent, however, that our reviewing court determines that we erred in some respect regarding our determination as to corroboration, the record shall reflect that it is our opinion that Petitioner sufficiently shows that the exhibits challenged herein constitute inadmissible hearsay and lack proper authentication based on the complete record before us. Thus, we *deny* Petitioner’s Motion challenging certain of the above-exhibits as inadmissible hearsay.

2. *Lack of Authentication*

Petitioner challenges Exhibits 2010–2014, 2019–2022, 2027, and 2029 pursuant to FRE 901 as lacking authentication or “identification of non-testimonial evidence as a precondition to their admissibility.”

Pet. MTE 11. Petitioner contends that Patent Owner cannot rely solely on Mr. Sorrells’ testimony because an inventor’s testimony “is insufficient to corroborate documents relied on for purposes of establishing conception or actual reduction to practice of a system as recited by claims 1, 3, 5, 8, 9, and 11–18 of the ’528 patent.” *Id.* (citing *Apator*, 887 F.3d at 1295).

In opposition, Patent Owner first asserts that Petitioner conflates admissibility with sufficiency of corroboration for conception and reduction to practice as there was no issue of admissibility of evidence in *Apator*, and Petitioner fails to cite any authority for the proposition that inventor testimony cannot be used for authentication as a matter of law. PO Opp. 2. Additionally, Patent Owner contends that Exhibits 2010–2014, 2019–2022, 2027 “have corroborative value that stand on their own, independent of Mr. Sorrells[’] testimony.” *Id.* at 2–3. And Patent Owner contends that Exhibit 2029 is authenticated by Mr. Sorrells’ testimony “that he (along with [Patent Owner’s] attorney) performed the search on the Relativity database, the result of which was exported to an excel spreadsheet and produced as Exhibit 2029.” *Id.* at 15. Patent Owner asserts that Mr. Sorrells “created the document and there is no better person to authenticate than him.” *Id.*

In reply, Petitioner contends that, “[h]ere, the only witness testimony offered to authenticate these exhibits is from the inventor himself. However, **‘inventor testimony alone, without more, is not considered credible** for the purposes of corroborating documentary evidence purporting to show

earlier conception/reduction-to-practice to antedate a prior art reference.” Pet. MTE Reply 1 (quoting *Chen v. Bouchard*, 347 F.3d 1299, 1309 (Fed. Cir. 2003)) (citing *Apator*, 887 F.3d at 1295–96). Petitioner asserts that Exhibits 2010–2014, 2019–2022, 2027, and 2029 can only corroborate inventor testimony with help from inventor testimony, presenting the same “catch-22” issue rejected by *Apator*. *Id.* (citing Pet. MTE 5–11; *Apator*, 887 F.3d at 1296). Thus, Petitioner contends these exhibits should be excluded as inadmissible pursuant to FRE 901. *Id.*

We disagree that Patent Owner has failed to authenticate the subject exhibits based on Petitioner’s citations to cases involving the standard for corroboration. Petitioner conflates two different issues—authentication pursuant to FRE 901 and the requirement of corroboration to show conception/actual reduction to practice. The caselaw cited by Petitioner, *Chen* and *Bouchard*, pertain to the latter, not the former, as Petitioner’s quotations and citations above reflect. Although not explicitly discussed, it appears that, in each case, the use of the term “evidence” reflects that the documents at issue were admitted into evidence. In neither case, however, was the Federal Circuit addressing the requirements for authentication pursuant to FRE 901. Nonetheless, several of the exhibits challenged here also are challenged as introducing inadmissible hearsay, which for some of the exhibits also implicates authenticity, and we have addressed those above. Accordingly, as pertains specifically to Petitioner’s allegations of lack of authenticity solely based on *Chen* and *Apator*, we *deny* this portion of Petitioner’s Motion.

3. *Relevancy*

Petitioner challenges Exhibits 2013 and 2014 and paragraph 9 of Exhibit 2016 as being irrelevant pursuant to FRE 402. Pet. MTE 11–13. Petitioner contends that Dr. Ricketts did not cite either of these exhibits in his claim chart regarding conception and actual reduction to practice and, therefore, these exhibits are irrelevant and should be excluded. *Id.* at 12.

Additionally, Petitioner contends that paragraph 9 of Exhibit 2016 should be excluded from Mr. Sorrells’ declaration because “[t]h[e] screenshot is irrelevant to the question of whether [Patent Owner] reduced claims 1, 3, 5, 8-9, [and] 11-18 of the ’528 patent to practice prior to the respective filing dates of Tayloe and Macnally based on the testing of the Eddie circuit.” Pet. MTE 13. Petitioner asserts that Mr. Sorrells “does not provide an explanation for what the . . . [named file] is, what it contains, or how it relates to the circuit shown in” a file with the different name. *Id.* Thus, Petitioner contends that the screenshot of the properties is irrelevant and should be excluded. *Id.*

In opposition, Patent Owner contends that Mr. Sorrells “relied upon Exhibits 2013–2014 to show design iterations of the circuit board for the

Eddie device, what was fabricated by TriQuint, and what was tested by Boeing.” PO Opp. 10.⁴⁷

Additionally, Patent Owner contends paragraph 9 of Exhibit 2016 “is at least probative [as] to the last modified date of a file with an almost identical name” to the file Patent Owner contends is the Eddie device. PO Opp. 15. Patent Owner asserts that we “should not exclude paragraph 9 . . . and should instead weigh the probative value of the evidence and testimony therein in view of the substantial similarity between the file names.” *Id.*

Petitioner contends that Patent Owner admits that the two file names are different and, thus, they are two different files. Pet. MTE Reply 5 (citing PO Opp. 15). Petitioner asserts that Patent Owner’s statement effectively acknowledges that the screenshot reproduced in paragraph 9 of Exhibit 2016 is irrelevant to the circuit schematics that allegedly reduced claims 1, 3, 5, 8, 9, and 11–18 to practice. *Id.*

FRE 401 provides that evidence is relevant if it “has any tendency to make a fact more or less probable than it would be without the evidence” and “the fact is of consequence in determining the action.” Courts routinely

⁴⁷ Patent Owner contends that Petitioner also challenges the relevancy of Exhibits 2019, 2020, and 2022 without providing an explanation as to why and cites to pages 11–12 of Petitioner’s Motion to Exclude. PO Opp. 9 n.2. Petitioner’s Motion includes Exhibits 2019, 2020, and 2022 in the heading asserting that certain exhibits are irrelevant, but Petitioner’s Motion does not specifically address these three exhibits, and we understand that the reference to these exhibits is likely a typographical error that carried over from Petitioner’s Motion to Exclude in related case IPR2024-00936, which does include a challenge to these exhibits on this basis. To the extent Petitioner’s Motion in the present proceeding can be construed as applying to these three exhibits, we deny this portion of Petitioner’s Motion.

characterize the relevance threshold as being “very low.” *See United States v. White*, 692 F.3d 235, 246 (2nd Cir. 2012) (quoting *United States v. Al-Moayad*, 545 F.3d 139, 176 (2nd Cir. 2008)). Under this standard, we find that Exhibits 2013 and 2014 are relevant at least for the purposes described by Patent Owner above, even though Dr. Ricketts does not cite to either exhibit in his claim chart.

On the separate issue of paragraph 9 of Exhibit 2016, we find that relevancy of the screenshot and hence the paragraph is tenuous at best, but that the better course of action is to decline to exclude the paragraph. Therefore, we *deny* this portion of Petitioner’s Motion.

For the reasons explained above, we *deny* Petitioner’s Motion to Exclude.

B. Patent Owner’s Motion to Exclude

Following a timely objection (*see* Paper 33), Patent Owner moves to exclude Exhibits 1047–1049, 1054, 1058–1061 and portions of Exhibits 1066, 1067, 2034, and 2042 relied on by Petitioner. PO MTE 1.

1. Exhibit 1047

Patent Owner contends that Exhibit 1047 should be excluded pursuant to FREs 401 and 402 “because it is not prior art and thus is irrelevant to the knowledge of a [person of ordinary skill in the art] at the relevant time of the invention.” PO MTE 1–2. Patent Owner also contends that Exhibit 1047 should be excluded pursuant to FRE 901 because “Petitioner produced no evidence to support a finding that it is what Petitioner claims it to be—description of an implementation of the Tayloe reference.” *Id.* at 2 (citing Pet. Reply 23).

In its Opposition, Petitioner contends that Exhibit 1047 is relevant rebuttal evidence and, even though it is not prior art, it can be relied on to indicate, among other things, (1) the level of ordinary skill in the art and (2) how one of ordinary skill in the art would have understood Tayloe's disclosure. Pet. Opp. 1–2. Petitioner contends that Dr. Galton relied on Exhibit 1047 in rebuttal to Dr. Ricketts' testimony regarding the size of Tayloe's resistors, and Petitioner contends that Patent Owner did not and cannot provide evidence that the general understanding of circuits has changed between the time of the '528 patent and the date of Exhibit 1047 such that Exhibit 1047 is not representative of a person of ordinary skill in the art's understanding of basic circuit concepts in the relevant time frame. *Id.* at 2–3.

Additionally, Petitioner proffered the testimony of Ms. Munford to authenticate Exhibit 1047 pursuant to FRE 901(b)(1). Pet. Opp. 3. And Petitioner contends that there is a large amount of circumstantial evidence that Exhibit 1047 was authored by the same named inventor of Tayloe. *Id.* at 3–4. Petitioner asserts, however, that whether or not the author of Exhibit 1047 is the same as the named inventor of Tayloe, “the article is relevant rebuttal evidence in at least that it discloses implementation details of circuits determined by Dr. Galton to be highly similar to those disclosed in the Tayloe” reference. *Id.* at 4. Thus, Petitioner contends Exhibit 1047 is admissible as rebuttal evidence to corroborate Dr. Galton's response to Dr. Ricketts' testimony. *Id.*

Patent Owner contends that Petitioner relies on Exhibit 1047 as an implementation of Tayloe even though the exhibit was published years later. PO MTE Reply 1–2. Patent Owner asserts that the potential prejudice of

Exhibit 1047 outweighs the probative value because it is unclear which (if any) portion of Exhibit 1047 was known before its publication. *Id.* at 3.

Dr. Galton (in Exhibit 1066) relies on Exhibit 1047 as supporting his opinion regarding the input resistance in Tayloe. *See, e.g.*, Ex. 1066 ¶¶ 22, 25, 27–29, 82, 99. These portions of Dr. Galton’s Second Declaration are generally directed to responding to Dr. Ricketts’ testimony regarding Tayloe. Dr. Galton’s testimony is supported by other evidence cited in his Second Declaration and, therefore, we need not rely on Exhibit 1047 or the specific portions of Exhibit 1066 in which the exhibit is discussed in order to determine that Petitioner has shown that the combination of Tayloe, TI Datasheet, and Macnally (and Cahn in Ground 1B) would have rendered the subject matter of claims 1–5, 8, 9, 11–23, 26, 27, and 29–36 obvious to one of ordinary skill in the art at the time of the invention. Accordingly, we *dismiss as moot* this portion of Patent Owner’s Motion.

2. *Exhibit 1054*

Patent Owner contends that Exhibit 1054 should be excluded pursuant to FREs 401 and 402 because “it is not prior art and thus is irrelevant to the knowledge of a [person of ordinary skill in the art] at the relevant time of the invention.” PO MTE 3–4. Patent Owner asserts that this exhibit is not relevant because its date, January 2019, comes many years (19–21 years) after the priority date of the ’528 patent. *Id.*

Petitioner contends, in similar response to that discussed above in the context of Exhibit 1047, that it is permissible to rely on non-prior art references, such as Exhibit 1054, to understand both the level of ordinary skill in the art and how one of ordinary skill would have understood a prior art disclosure. Pet. Opp. 5. In particular, Petitioner asserts that Exhibit 1054

is a review article cited by Dr. Galton to illustrate mixer operation and it is relevant because Razavi, one of the references on which Petitioner's challenge is based, teaches a system including a mixer. *Id.* Thus, Petitioner contends Exhibit 1054 is relevant as corroborating evidence to shed light on how one of ordinary skill in the art would have understood Razavi, and Patent Owner has not argued or proffered any evidence that the general understanding of circuits has changed such that Exhibit 1054 does not represent the understanding of one of ordinary skill in the art at the relevant time frame. *Id.* at 5–6.

In reply, Patent Owner raises a similar argument as the one it raised above regarding Exhibit 1047, namely that Exhibit 1054 comes too late in time to be relevant to the issues addressed in the proceeding. PO MTE Reply 3–4.

We do not rely on Exhibit 1054 in reaching our decision herein. Accordingly, we need not decide the propriety of Dr. Galton's reliance on Exhibit 1054. Thus, we *dismiss as moot* this portion of Patent Owner's Motion.

3. *Exhibit 1066*

Patent Owner contends that certain paragraphs of Dr. Galton's Second Declaration should be excluded because they are either based on Exhibits 1047 and 1054 or not relied on by Petitioner in its briefing. PO MTE 4–5. In particular, Patent Owner contends that paragraphs 22–25, 27, 28, and 30 of Exhibit 1066 rely on Exhibit 1047 and, therefore, they should be excluded pursuant to FREs 401, 402, 702, 703 and 802. *Id.* Patent Owner asserts that, in these paragraphs, Dr. Galton asserts that Exhibit 1047 was written by the named inventor of Tayloe and that the exhibit shows an

implementation of Tayloe. *Id.* Patent Owner contends that the Exhibit 1047 does not mention Tayloe and Dr. Galton has no personal knowledge as to the truthfulness of his assertions. *Id.*

Additionally, Patent Owner contends that paragraphs 52, 76–80, 91–94, 160, and 170–171 of Exhibit 1066 should be excluded pursuant to FREs 401 and 402 because Petitioner does not rely on any of those paragraphs of Dr. Galton’s Second Declaration. PO MTE 5.

In Opposition, Petitioner contends that paragraphs 22–25, 27, 28, and 30 of Exhibit 1066 are admissible for the same reasons Exhibit 1047 is admissible, as discussed above. Pet. Opp. 6–7. Additionally, Petitioner contends that paragraphs 52, 76, 77, and 160 “are transition paragraphs for context” and are relevant by providing context for adjacent paragraphs cited in Petitioner’s Reply, and paragraphs 78–80, 91–94, 170, and 171 support statements made in Petitioner’s Reply. *Id.* at 7–8.

Patent Owner reiterates, in its reply, that paragraphs 22–25, 27, 28, and 30 of Exhibit 1066 rely on Exhibit 1047 and these paragraphs should be excluded for the same reasons the exhibit should be excluded. PO MTE Reply 4. And Patent Owner maintains that Petitioner does not rely on paragraphs 52, 76–80, 91–94, 160, 170, and 171 of Exhibit 1066 and, therefore, they should be excluded as well. *Id.* at 1.

For the same reasons discussed above in our consideration of Patent Owner’s arguments directed to Exhibit 1047, we do not rely on the specific portions of the paragraphs of Dr. Galton’s Second Declaration that rely on Exhibit 1047 in order to reach the decision we reach here. Accordingly, we *dismiss as moot* this portion of Patent Owner’s Motion. As to paragraphs 52, 76–80, 91–94, 160, 170, and 171 of Exhibit 1066, we agree

with Petitioner that they are relevant for the reasons Petitioner provides above. Therefore, we *deny* the portion of Patent Owner’s Motion directed thereto.

4. *Exhibit 1067*

Patent Owner seeks to exclude paragraphs 16–20, 25–27, 32, and 33 of Exhibit 1067, Dr. Dickens’ Supplemental Declaration. PO MTE 6–7. In particular, Patent Owner seeks to exclude paragraphs 16–20 of Exhibit 1067, which Petitioner relies on in pages 10–12 of its Reply. *Id.* at 6. Patent Owner contends that, in those paragraphs, Dr. Dickens opines that “capacitors C67 and C68 create a shunt to ground for the 915 MHz input signal,” but that his opinion is based on his assertion that SP1 and SP2 “exhibit a significantly larger impedance than capacitors C67 and C68,” which he calculated based on frequency and capacitance values shown in Exhibit 2011. *Id.* Patent Owner, however, contends that Exhibit 2011 does not provide sufficient information from which to calculate the impedance of SP1 and SP2 and, therefore, Dr. Dickens “has no reliable basis to determine the impedance of SP1 and SP2, let alone comparing them to the impedance of C67 and C68.” *Id.* Thus, Patent Owner contends that Dr. Dickens’ opinions, reflected in paragraphs 16–20 of Exhibit 1067, are “not based on any reliable facts, data, or methodology,” and, thus, should be excluded pursuant to FREs 702 and 703. *Id.* at 6–7.

Additionally, Patent Owner asserts that paragraphs 25–27, 32, and 33 of Exhibit 1067 should be excluded pursuant to FREs 401 and 402 because Petitioner does not rely on those paragraphs in its briefing. PO MTE 7.

Petitioner contends that paragraphs 16–20 of Exhibit 1067 are supported by more than Exhibit 2011 because Dr. Dickens also based his

analysis on Exhibits 2010, 2012, 2013, 2015, 2016, 2022, and 2024. Pet. Opp. 8–9. Petitioner asserts that Dr. Dickens considered each of these exhibits, as well as Dr. Ricketts’ testimony, and that Dr. Dickens’ analysis is supported by reliable facts, data, or methodology. *Id.*

Additionally, Petitioner contends that paragraphs 25–27 of Exhibit 1067 provide context for adjacent paragraphs in Dr. Dickens’ Supplemental Declaration supporting statements made in Petitioner’s Reply. Pet. Opp. 10–11 (citing Pet. Reply 13–14). And Petitioner asserts that paragraphs 32 and 33 are attestation paragraphs. *Id.* at 11.

Patent Owner asserts, in reply, that Petitioner points to other evidence relied on by Dr. Dickens, in addition to Exhibit 2011, but that does not remedy Dr. Dickens’ reliance on Exhibit 2011. PO MTE Reply 4–5. Additionally, Patent Owner asserts that Petitioner does not contest that paragraphs 25–27 of Exhibit 1067 were not cited in Petitioner’s briefing. *Id.* at 1.

We disagree with Patent Owner’s challenge to these paragraphs of Dr. Dickens’ Supplemental Declaration (Ex. 1067). We determine that Patent Owner’s arguments go to the weight to be assigned to Dr. Dickens’ testimony as opposed to its admissibility. In particular, as Petitioner explains, Dr. Dickens relied on Exhibit 2011 in addition to other exhibits and evidence in deriving his opinion addressed at the paragraphs noted above. Additionally, the paragraphs not cited in Petitioner’s Reply provide some context for Dr. Dickens’ testimony, even though we do not rely on these paragraphs in reaching our decision here. Therefore, we *deny* this portion of Patent Owner’s Motion.

5. Exhibits 1048, 1049, 1059, 1061, and 1063

Patent Owner seeks to exclude Exhibits 1048, 1049, 1059, 1061, and 1063 for lack of relevancy pursuant to FREs 401 and 402 because neither Petitioner nor its experts cite or rely on any of these exhibits.⁴⁸ PO MTE 7.

Petitioner contends that these exhibits were cited in Dr. Galton's declarations or relied on by Dr. Galton in rendering his opinion. Pet. Opp. 11–12 (citing Ex. 1066 ¶¶ 57, 67, 90; Ex. 1003 ¶ 40).

In its reply to Petitioner's Opposition, Patent Owner contends that these exhibits were not cited in Petitioner's briefing and Petitioner's argument that they are relevant for context and background should be rejected. PO MTE Reply 1.

We decline to exclude these exhibits because we agree that several of the exhibits were relied on by Petitioner's experts and they provide underlying foundational knowledge on which the expert's opinions were based. That being said, we rely on the arguments raised by the parties in reaching our decision here. Accordingly, we *deny* this portion of Patent Owner's Motion.

6. Exhibits 2034 and 2042

Patent Owner contends that certain portions of the deposition transcripts of Dr. Galton (Exhibit 2034 (109:10–113:2, 179:21–182:19, and

⁴⁸ Patent Owner identifies the exhibits differently in this section. In the heading and first sentence, Patent Owner lists "Exhibits 1048–1049, 1059, 1061, and 1063." PO MTE 7. In the second sentence of that section, Patent Owner lists "Exhibits 1048–1049, 1058–1061, and 1063." *Id.* Thus, Patent Owner's second sentence adds Exhibits 1058 and 1060. Our discussion above equally applies to these exhibits as well assuming Patent Owner intended to include them in its Motion.

209:18–211:2) and Exhibit 2042 (36:8–37:5 and 87:4–88:14)) should be excluded because Dr. Galton provided answers that were non-responsive to the questions asked and irrelevant to any issues in this proceeding. PO MTE 7–10.

Petitioner contests Patent Owner’s characterization of Dr. Galton’s testimony and provides several examples of responsive answers. Pet. Opp. 12–15.

In reply, Patent Owner contends that the portions of Dr. Galton’s testimony identified by Petitioner do not respond to Patent Owner’s point that the answers were nonresponsive. PO MTE Reply 5.

We have the ability to discern for each deposition question and response whether Dr. Galton’s answer was sufficiently responsive to warrant our consideration. *See, e.g., Donnelly Garment Co. v. NLRB*, 123 F.2d 215, 224 (8th Cir. 1941) (“One who is capable of ruling accurately upon the admissibility of evidence is equally capable of sifting it accurately after it has been received.”). From our review of the challenged testimony, we do not determine that any of the responses were particularly off track based on the question or subject matter raised during the deposition to warrant exclusion. Therefore, we *deny* this portion of Patent Owner’s Motion.

Accordingly, for the reasons explained above, we *dismiss in part* as moot and *deny in part* Patent Owner’s Motion to Exclude Evidence.

IV. SUMMARY

For the reasons discussed above, Petitioner has demonstrated, by a preponderance of the evidence, that claims 1–5, 8, 9, 11–23, 26, 27, and 29–36 of the ’528 patent is unpatentable. Additionally, we *deny* Petitioner’s

Motion to Exclude Evidence, and we *dismiss in part and deny in part* Patent Owner's Motion to Exclude Evidence.

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, 5, 8, 9, 11–19, 23, 26, 27, 29–36	103(a)	Tayloe, TI Datasheet, Macnally	1, 5, 8, 9, 11–19, 23, 26, 27, 29–36	
2–4, 20–22	103(a)	Tayloe, TI Datasheet, Macnally, Cahn	2–4, 20–22	
1, 5, 8, 9, 11–19, 23, 26, 27, 29–36	103(a)	Razavi, Macnally	1, 5, 8, 9, 11–19, 23, 26, 27, 29–36	
2–4, 20–22	103(a)	Razavi, Macnally, Cahn	2–4, 20–22	
Overall Outcome			1–5, 8, 9, 11–23, 26, 27, 29–36	

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1–5, 8, 9, 11–23, 26, 27, and 29–36 of U.S. Patent No. 9,118,528 B2 are determined to be unpatentable;

FURTHER ORDERED that Petitioner's Motion to Exclude Evidence (Paper 45) is *denied*;

FURTHER ORDERED that Patent Owner's Motion to Exclude Evidence (Paper 46) is *dismissed in part and denied in part*; 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.

IPR2024-00936
Patent 9,118,528 B2

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