

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTEL CORPORATION,
Petitioner,

v.

QUALCOMM INCORPORATED,
Patent Owner.

Case IPR2019-00047
Patent 9,154,356 B2

Before DANIEL N. FISHMAN, MICHELLE N. WORMMEESTER, and
AARON W. MOORE, *Administrative Patent Judges*.

WORMMEESTER, *Administrative Patent Judge*.

DECISION
Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

Intel Corporation¹ (“Petitioner”) filed a Petition (Paper 3, “Pet.”) requesting *inter partes* review of claims 1, 7, 8, 10, 11, 17, and 18 of U.S. Patent No. 9,154,356 B2 (Ex. 1001, “the ’356 patent”). Qualcomm Incorporated (“Patent Owner”) filed a Preliminary Response (Paper 7, “Prelim. Resp.”). We have jurisdiction under 35 U.S.C. § 314 and 37 C.F.R. § 42.4(a). Under 35 U.S.C. § 314(a), an *inter partes* review may not be instituted “unless . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” For the reasons that follow, we institute an *inter partes* review as to all the challenged claims of the ’356 patent and all the grounds presented.

II. BACKGROUND

A. Related Proceedings

The parties identify a district court case in the Southern District of California in which Patent Owner asserted the ’356 patent against Apple: *Qualcomm Incorporated v. Apple Incorporated*, No. 3:17-cv-02398 (S.D. Cal.). Pet. 1; Paper 4, 1. The parties also identify an International Trade Commission (“ITC”) investigation in which Patent Owner has asserted the ’356 patent against Apple. Pet. 1; Paper 4, 1. In addition, the parties identify four other petitions for *inter partes* review involving the ’356 patent that Petitioner has filed. Pet. 1; Paper 4, 1. According to Petitioner’s Updated Mandatory Notices in a related *inter partes* review proceeding, the district court case has been dismissed and the parties have moved to

¹ Intel Corporation identifies itself and Apple Inc. (“Apple”) as real parties in interest. Paper 3, 1.

terminate the ITC investigation. *Intel Corp. v. Qualcomm Inc.*,
Case IPR2019-00128, slip op. at 1 (PTAB May 24, 2019) (Paper 8).

B. The '356 Patent

The '356 patent describes low noise amplifiers. Ex. 1001, 1:15–16.
Figure 6A, which is reproduced below, illustrates an example of a low noise
amplifier according to the '356 patent. *Id.* at 1:54–55.

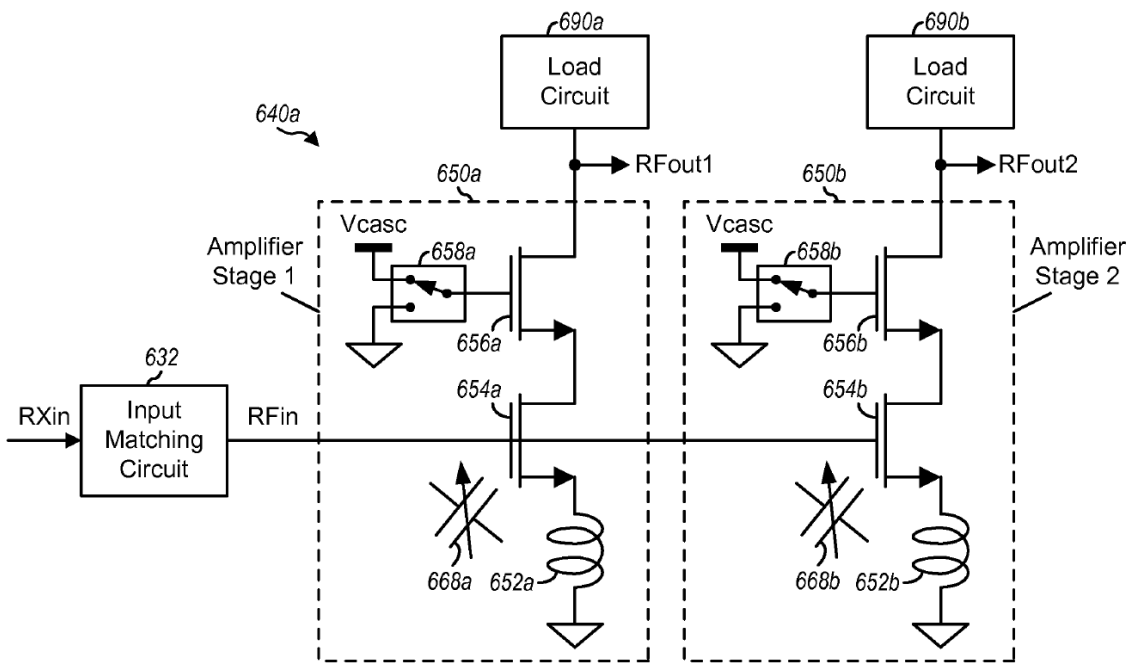


FIG. 6A

In particular, Figure 6A shows carrier aggregation low noise amplifier 640a, which has two amplifier stages 650a and 650b. *Id.* at 7:44–49. Amplifier stage 650a includes source degeneration inductor 652a, gain transistor 654a, cascode transistor 656a, and switch 658a. *Id.* at 7:58–8:4. Similarly, amplifier stage 650b includes source degeneration inductor 652b, gain transistor 654b, cascode transistor 656b, and switch 658b. *Id.* at 8:4–9. Both amplifier stages 650a and 650b are coupled to common input matching circuit 632 and to respective load circuits 690a and 690b. *Id.* at 7:47–49.

In operation, matching circuit 632 receives receiver input signal RXin, performs input matching for low noise amplifier 640a, and provides input RF signal RFin to low noise amplifier 640a. *Id.* at 7:49–52. Input RF signal RFin may include transmissions on one set of carriers or transmissions on two sets of carriers in the same band, with each set including one or more carriers. *Id.* at 7:55–57, 8:16–18, 8:30–32. An RF signal with transmissions on multiple sets of carriers is called a carrier aggregated RF signal. *Id.* at 8:16–18.

Low noise amplifier 640a operates in either a non-carrier aggregation (non-CA) mode or a carrier aggregation (CA) mode, depending on the type of input RF signal it receives. *Id.* at 8:24–32, 8:36–44. In the non-CA mode, low noise amplifier 640a receives transmissions on one set of carriers and provides one output RF signal to one load circuit. *Id.* at 8:30–32. Only one amplifier stage is enabled, while the other amplifier stage is disabled. *Id.* at 8:46–47. To illustrate, Figure 6C is reproduced below.

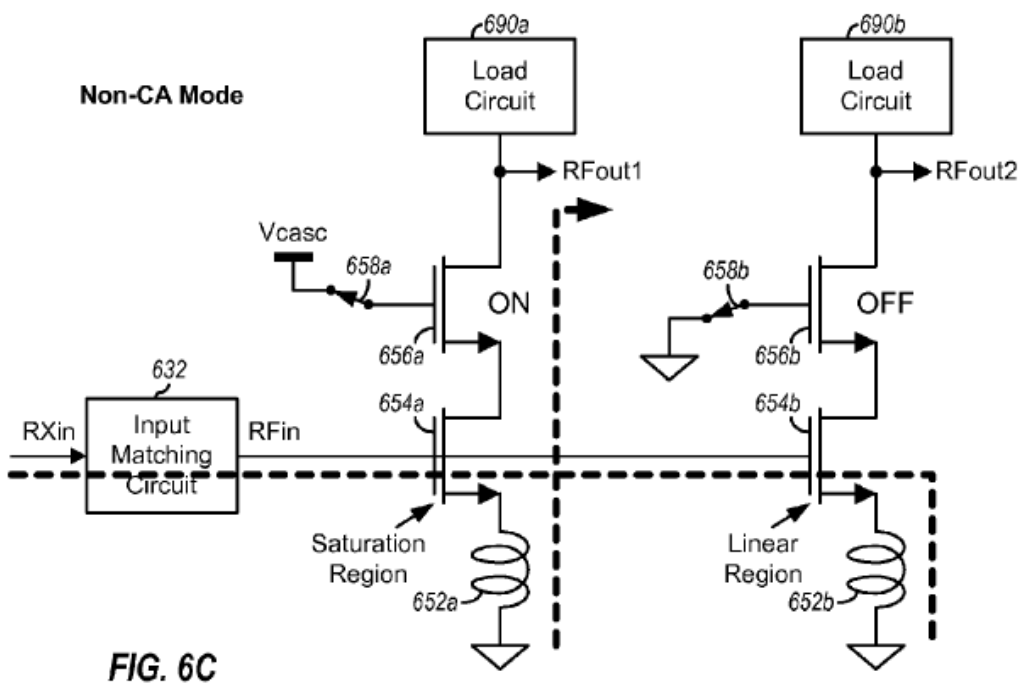


Figure 6C shows low noise amplifier 640a operating in the non-CA mode. *Id.* at 8:45–46. Amplifier stage 650a is enabled by connecting the gate of cascode transistor 656a to the V_{casc} voltage via switch 658a, and amplifier stage 650b is disabled by shorting the gate of cascode transistor 656b to circuit ground via switch 658b. *Id.* at 8:47–52. Amplifier stage 650a amplifies the input RF signal and provides an output RF signal to load circuit 690a. *Id.* at 8:52–54.

In the CA mode, low noise amplifier 640a receives transmissions on two sets of carriers and provides two output RF signals to two load circuits, one output RF signal for each set of carriers. *Id.* at 8:32–35. Both amplifier stages are enabled. *Id.* at 8:37–38. To illustrate, Figure 6B is reproduced below.

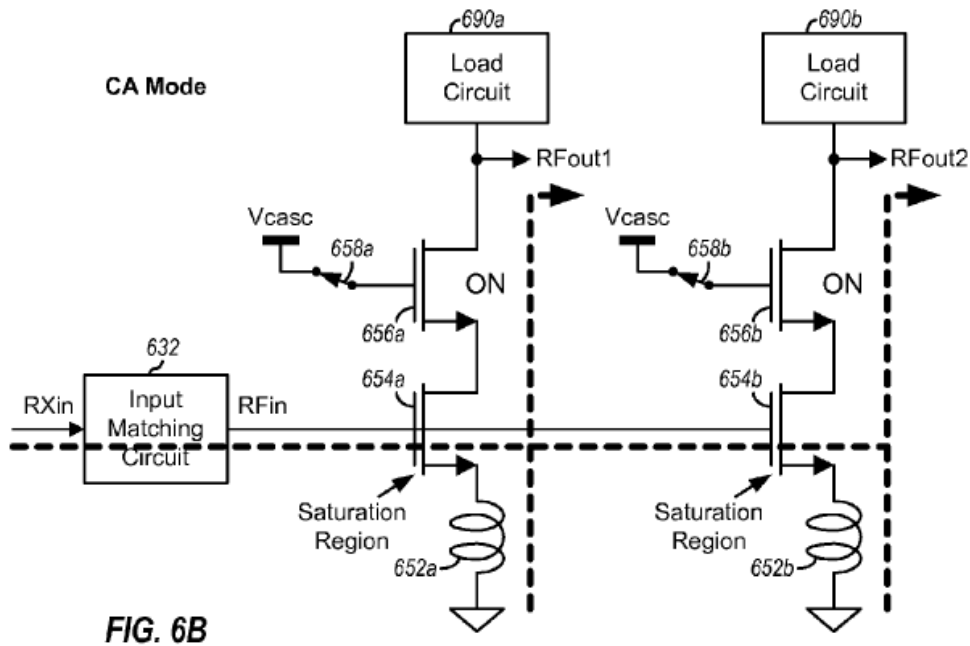


Figure 6B shows low noise amplifier 640a operating in the CA mode. *Id.* at 8:36–37. Amplifier stages 650a and 650b are enabled by connecting the gate of cascode transistor 656a to the V_{casc} voltage via switch 658a and

coupling the gate of cascode transistor 656b to the V_{casc} voltage via switch 658b. *Id.* at 8:37–40. The carrier aggregated RF signal splits at the input of low noise amplifier 640a, and then amplifier stages 650a and 650b amplify the carrier aggregated RF signal and provide two output RF signals to two separate downconverters in load circuits 690a and 690b. *Id.* at 8:21–28. Specifically, amplifier stage 650a amplifies the input RF signal and provides the first output RF signal to load circuit 690a. *Id.* at 8:41–42. Similarly, amplifier stage 650b amplifies the input RF signal and provides the second output RF signal to load circuit 690b. *Id.* at 8:42–44.

C. Illustrative Claim

Petitioner challenges claims 1, 7, 8, 10, 11, 17, and 18 of the '356 patent. Claims 1 and 17 are independent. Claim 1 is illustrative of the claims under challenge:

1. An apparatus comprising:
 - a first amplifier stage configured to be independently enabled or disabled, the first amplifier stage further configured to receive and amplify an input radio frequency (RF) signal and provide a first output RF signal to a first load circuit when the first amplifier stage is enabled, the input RF signal employing carrier aggregation comprising transmissions sent on multiple carriers at different frequencies to a wireless device, the first output RF signal including at least a first carrier of the multiple carriers; and
 - a second amplifier stage configured to be independently enabled or disabled, the second amplifier stage further configured to receive and amplify the input RF signal and provide a second output RF signal to a second load circuit when the second amplifier stage is enabled, the second output RF signal including at least a second carrier of the multiple carriers different than the first carrier.

D. Asserted Grounds of Unpatentability

Petitioner challenges claims 1, 7, 8, 10, 11, 17, and 18 of the '356 patent on the following grounds. Pet. 44–82.

Reference(s)	Basis	Claim(s) Challenged
Uehara ²	§ 102	1, 11, 17, and 18
Uehara and Perumana ³	§ 103	7 and 8
Uehara and Youssef ⁴	§ 103	10
Uehara and the Feasibility Study ⁵	§ 103	1, 11, 17, and 18
Uehara, the Feasibility Study, and Perumana	§ 103	7 and 8
Uehara, the Feasibility Study, and Youssef	§ 103	10

In support of its arguments, Petitioner relies on a Declaration of Patrick Fay, Ph.D. (Ex. 1002). *See id.*

III. DISCUSSION

A. Discretion Under § 314(a): Multiple Petitions

Patent Owner requests that we exercise our discretion under 35 U.S.C. § 314(a) to deny institution of an *inter partes* review in light of Petitioner's multiple filings. Prelim. Resp. 16–19; *see Cuozzo Speed Techs. LLC v. Lee*,

² U.S. Publ'n No. 2011/0217945 A1 (published Sept. 8, 2011) (Ex. 1003).

³ Bevin G. Perumana et al., *Resistive-Feedback CMOS Low-Noise Amplifiers for Multiband Applications*, 56 IEEE TRANSACTIONS ON MICROWAVE THEORY & TECHNIQUES 1218 (2008) (Ex. 1008).

⁴ Ahmed Youssef et al., *Digitally-Controlled RF Passive Attenuator in 65 nm CMOS for Mobile TV Tuner ICs*, 2010 IEEE INT'L SYMP. ON CIRCUITS & SYS. 1999 (Ex. 1009).

⁵ 3d Generation P'Ship Project, *Technical Specification Group Radio Access Network; Feasibility Study for Further Advancements for E-UTRA (LTE-Advanced) (Release 9) (3GPP TR 36.912 V9.1.0)* (Dec. 2009) (Ex. 1004, "the Feasibility Study").

136 S. Ct. 2131, 2140 (2016) (“[T]he agency’s decision to deny a petition is a matter committed to the Patent Office’s discretion.”); *Harmonic Inc. v. Avid Tech, Inc.*, 815 F.3d 1356, 1367 (Fed. Cir. 2016) (“[T]he PTO is permitted, but never compelled, to institute an IPR proceeding.”). For the reasons explained below, we do not exercise our discretion to deny institution.

Patent Owner contends that “Petitioner challenges overlapping claims with redundant references and arguments across three petitions.” Prelim. Resp. 16. As support, Patent Owner asserts that Petitioner relies primarily on Uehara in the instant Petition, on Lee⁶ in a second petition, and on a combination of Jeon⁷ and Xiong⁸ in a third petition. *Id.* at 16–17. Patent Owner further asserts that, “in separate petitions, Petitioner alleges that Uehara and Lee each anticipate claims 1, 11, 17, and 18” but “has provided no indication that Uehara is somehow more relevant or provides different disclosure than the primary references in the other petitions.” *Id.* at 18. According to Patent Owner, “[t]he fact that both references are relied upon to anticipate the claims evidences that the anticipatory grounds present substantially the same argument applied in the same way – that Uehara and Lee each allegedly teach all of the limitations of claims 1, 11, 17, and 18.” *Id.* (citing *Conopco, Inc. v. Proctor & Gamble Co.*, Case IPR2014-00628, slip op. at 9 (PTAB Oct. 2014) (Paper 21)). In addition, Patent Owner asserts that “the petitions all rely on the Feasibility Study as a back-up to the

⁶ U.S. Publ’n No. 2012/0056681 A1 (published Mar. 8, 2012).

⁷ Sanggeun Jeon et al., *A Scalable 6-to-18 GHz Concurrent Dual-Band Quad-Beam Phased-Array Receiver in CMOS*, 43 IEEE J. SOLID-STATE CIRCUITS 2660 (Dec. 2008).

⁸ U.S. Publ’n No. 2010/0237947 A1 (published Sept. 23, 2010).

primary references,” and that the combinations of the Feasibility Study and those references “are cumulative to one another.” *Id.* at 19. As to the remaining grounds across the petitions, Patent Owner characterizes them as “involv[ing] insignificant secondary references that are relied on for the same duplicative arguments already made.” *Id.* (citing *TomTom, Inc. v. Blackbird Tech, LLC*, Case IPR2017-02025, slip op. at 7 (PTAB Mar. 12, 2018) (Paper 7)).

We disagree with Patent Owner. In *Conopco*, a prior Board decision that Patent Owner cites, the panel “recognize[d] that the prior art disclosures relied upon in the two petitions are not identical,” but it nevertheless was persuaded that “both petitions appl[ied] the prior art references to support substantially the same arguments” based on “the information presented.” *Conopco*, slip op. at 8–9. In the instant case, however, the limited evidence available on this record does not show that the prior art disclosures support substantially the same arguments. Patent Owner asserts that Uehara and Lee “are relied upon to anticipate the claims” and that various secondary references are “insignificant” and relied on for “duplicative arguments.” Prelim. Resp. 18. Patent Owner additionally asserts that combinations based on the Feasibility Study are “cumulative to one another.” *Id.* at 19.

Notwithstanding, Patent Owner acknowledges that Petitioner relies on Uehara as an anticipatory reference for claims 1, 11, 17, and 18 of the ’356 patent in the instant Petition, while relying on Lee as an anticipatory reference for claims 1, 7, 8, 11, 17, and 18 in a second petition. *See id.* at 16–17. The instant Petition additionally challenges claims 7 and 8 based on a combination of Uehara and Perumana. *See id.* at 16. That Petitioner does not apply Uehara and Lee as anticipatory references to the same set of

claims implies that the disclosures in those references are different and do not necessarily support substantially the same arguments. The situation here is not like the one in *TomTom*, another prior Board decision that Patent Owner cites, where the petitioner relied on different prior art disclosures across two petitions for the same set of claims. *See TomTom*, slip op. at 14–15.

Patent Owner also acknowledges that Petitioner relies on a combination of Jeon and Xiong for claims 1, 17, and 18 in a third petition. *See* Prelim. Resp. 17. The third petition does not challenge claim 11 at all. *Id.* As with Uehara and Lee, Petitioner applies Uehara and the combination of Jeon and Xiong to different sets of claims. In addition, neither Jeon nor Xiong is applied as an anticipatory reference. These facts imply that the disclosures in Uehara, Jeon, and Xiong are different and do not necessarily support substantially the same arguments.

Accordingly, on this record, we find no persuasive reason to deny institution based on Petitioner’s multiple filings.

B. Discretion Under § 325(d): Prior Art Previously Considered

Patent Owner further requests that we exercise our discretion under 35 U.S.C. § 325(d) to deny institution because (1) all six grounds presented in the Petition rely on a reference considered during prosecution, namely, Uehara; (2) another reference on which the Petition relies, the Feasibility Study, is cumulative to a disclosure considered during prosecution; and (3) the remaining asserted references, Perumana and Youssef, are insignificant and redundant in view of disclosures presented to the Patent Office during prosecution. Prelim. Resp. 9–16; *see Cuozzo*, 136 S. Ct. at

2140; *Harmonic*, 815 F.3d at 1367. For the reasons explained below, we do not exercise our discretion to deny institution.

Under 35 U.S.C. § 325(d), we have discretion to deny a petition when the same or substantially the same prior art or arguments were presented previously in another proceeding before the Office. Although a petitioner may have sound reasons for raising art or arguments similar to those previously considered by the Office, the Board weighs petitioners' desires to be heard against the interests of patent owners who seek to avoid harassment. *See* H.R. Rep. No. 112–98, pt. 1, at 48 (2011) (explaining that post-grant review proceedings “are not to be used as tools for harassment or a means to prevent market entry through repeated litigation and administrative attacks on the validity of a patent,” and that “[d]oing so would frustrate the purpose of the section as providing quick and cost effective alternatives to litigation”).

In the instant proceeding, Petitioner relies on Uehara for teaching all the recited elements of claims 1, 11, 17, and 18. Pet. 44–67. Under an alternative theory, Petitioner additionally relies on the Feasibility Study for its teaching of an input radio frequency signal employing carrier aggregation. *Id.* at 77–80. Petitioner further relies on Perumana for teaching the recited elements of claims 7 and 8, and on Youssef for teaching the recited elements of claim 10. *Id.* at 68–76.

Patent Owner contends that the prosecution history for the '356 patent indicates that the Examiner considered Uehara. Prelim. Resp. 9–11. As support, Patent Owner points out that Uehara is listed on the face of the '356 patent. *Id.* at 10; *see* Ex. 1001, at [56]. Patent Owner also directs us to an information disclosure statement that lists Uehara as a reference and

includes the Examiner’s signature. Prelim. Resp. 10 (citing Ex. 2004); *see also* Ex. 2004, 9.⁹ The bottom of each page of the signed information disclosure statement reads, “ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /KCT/.” *See* Ex. 2004. Uehara is not lined through. *See id.* at 9. According to Patent Owner, “[t]hat is enough to show that the Office previously considered Uehara for purposes of Section 325(d).” Prelim. Resp. 10 (citing *R.J. Reynolds Vapor Co. v. Fontem Holdings 1 B.V.*, Case IPR2018-00626, slip op. at 21 (PTAB Sept. 27, 2018) (Paper 7));¹⁰ *Clim-A-Tech Ind., Inc. v. William A. Ebert*, IPR2017-01863, slip op. at 18–19 (PTAB Feb. 12, 2018) (Paper 13)).

In addition, Patent Owner directs us to where another signed information disclosure statement lists an international search report and written opinion for a related international application, and contends that these listed papers “provide[] a detailed description of how Uehara allegedly reads on the claims.” *Id.* at 10–11 (citing Ex. 2005; Ex. 2006); *see also* Ex. 2005, 5 (listing of the search report and written opinion); Ex. 2006, 7 (written opinion providing “[r]easoned statement with regard to novelty”); *compare* Ex. 2005, 1 (identifying attorney docket number for ’356 patent application), *with* Ex. 2006, 1 (identifying same docket number for international application). The search report designates Uehara as an “X”

⁹ For Exhibit 2004, our citations correspond to Patent Owner’s numbering of pages.

¹⁰ Patent Owner cites *R.J. Reynolds Vapor Co. v. Fontem Holdings 1 B.V.*, Case IPR2017-00626, slip op. at 12 (PTAB Sept. 27, 2018) (Paper 7), but the language relied on appears at *R.J. Reynolds Vapor Co. v. Fontem Holdings 1 B.V.*, Case IPR2018-00626, slip op. at 21 (PTAB Sept. 27, 2018) (Paper 7).

reference, meaning that Uehara is “of particular relevance” and “the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone.” Ex. 2006, 3.

Based on the record before us, we are not persuaded that it is appropriate to exercise our discretion to deny institution. As Patent Owner acknowledges, the Examiner did not rely on Uehara to reject claims in the application for the '356 patent. Prelim. Resp. 13 (“[T]he Office did not issue a rejection over Uehara.”). The fact that Uehara was not the basis of rejection weighs strongly against exercising our discretion to deny institution under 35 U.S.C. § 325(d). *See Becton, Dickinson & Co. v. B. Braun Melsungen AG*, Case IPR2017-01586, slip op. at 17 (PTAB Dec. 15, 2017) (Paper 8) (informative) (considering six nonexclusive factors in evaluating whether to exercise discretion under 35 U.S.C. § 325(d), including “the extent to which the asserted art was evaluated during examination, including whether the prior art was the basis for rejection”); *Kayak Software Corp. v. Int’l Bus. Machs. Corp.*, Case CBM2016-00075, slip op. at 11 (PTAB Dec. 15, 2016) (Paper 16) (informative) (“There could be situations where, for example, the prosecution is not as exhaustive, where there are clear errors in the original prosecution, *or where the prior art at issue was only cursorily considered* that can weigh against exercising the discretion.” (emphasis added)).

Although the international search report and written opinion identify Uehara as an “X” reference and provide a “[r]easoned statement with regard to novelty,” the papers by themselves do not demonstrate the extent to which the Examiner considered the reference. Nor do the papers demonstrate that

the Examiner considered the various combinations of Uehara, the Feasibility Study, Perumana, and Youssef as relied on in the Petition.

Moreover, we note that the Examiner singled out the claim limitations “a first amplifier stage configured to be independently enabled or disabled” and “a second amplifier stage configured to be independently enabled or disabled” as “reasons for allowance” for the ’356 patent. Ex. 1022, 4–5. The “[r]easoned statement with regard to novelty” in the written opinion for the related international application does not address these limitations. *See* Ex. 2006, 7.

Lastly, neither of the prior Board decisions cited by Patent Owner (*see* Prelim. Resp. 10) presents a situation where the panel denied institution based solely on the fact that the asserted prior art was listed in an information disclosure statement. For instance, the panel in *R.J. Reynolds* additionally denied institution because it was not persuaded that the petitioner had shown a reasonable likelihood of prevailing on the sole ground presented in the petition. *See R.J. Reynolds*, slip op. at 18, 21 (“After due consideration of the record before [us] and for the foregoing reasons, we deny the Petition.”). Similarly, the panel in *Clim-A-Tech* additionally denied institution because it was not persuaded that the petitioner had shown a reasonable likelihood of prevailing on the grounds presented in the petition. *Clim-A-Tech*, slip op. at 18, 19 (“[T]he Board exercises its discretion under 35 U.S.C. § 325(d) as an additional basis to decline to institute.”), 22, 25–26, 30–31. By contrast, for the reasons explained below, we are persuaded that Petitioner in this proceeding has demonstrated a reasonable likelihood that it will prevail on the asserted grounds presented in the Petition. *See infra* Sections III.D–III.G.

In view of the foregoing, we decline to exercise our discretion under 35 U.S.C. § 325(d) to deny institution. Because Uehara is relied on for all six grounds presented in the Petition, we need not address whether the other asserted references are cumulative to prior art previously considered by the Office.

C. Claim Interpretation

The claim construction standard applicable to this *inter partes* review proceeding is the broadest reasonable interpretation in light of the patent specification. *See* 37 C.F.R. § 42.100(b) (2018);¹¹ *Cuozzo*, 136 S. Ct. at 2144–46 (upholding the use of the broadest reasonable interpretation standard). Under this standard, claim terms generally are given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *See In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007).

Petitioner provides a proposed interpretation of the claim term “carrier aggregation.” Pet. 30–34. Patent Owner responds that “no terms must be construed at this stage of the proceeding” and that “the Board should deny institution under any claim construction it adopts.” Prelim. Resp. 8. For

¹¹ The revised claim construction standard for interpreting claims in *inter partes* review proceedings as set forth in the final rule published October 11, 2018, does not apply to this proceeding because the new “rule is effective on November 13, 2018 and applies to all IPR, PGR and CBM petitions filed on or after the effective date.” *Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board*, 83 Fed. Reg. 51,340 (Oct. 11, 2018) (to be codified at 37 C.F.R. pt. 42). This Petition was filed on November 8, 2018.

purposes of this Decision, we conclude that no claim term requires express interpretation at this time to resolve any controversy in this proceeding.

D. Anticipation by Uehara

Petitioner asserts that Uehara anticipates claims 1, 11, 17, and 18 of the '356 patent. Pet. 44–67. For the reasons explained below, we are persuaded that Petitioner has demonstrated a reasonable likelihood of prevailing on this asserted ground.

1. Uehara

Uehara describes dual carrier amplifier circuits. Ex. 1003 ¶¶ 2, 4–7. Figure 3, which is reproduced below, illustrates an example of an amplifier circuit according to Uehara. *Id.* ¶ 47.

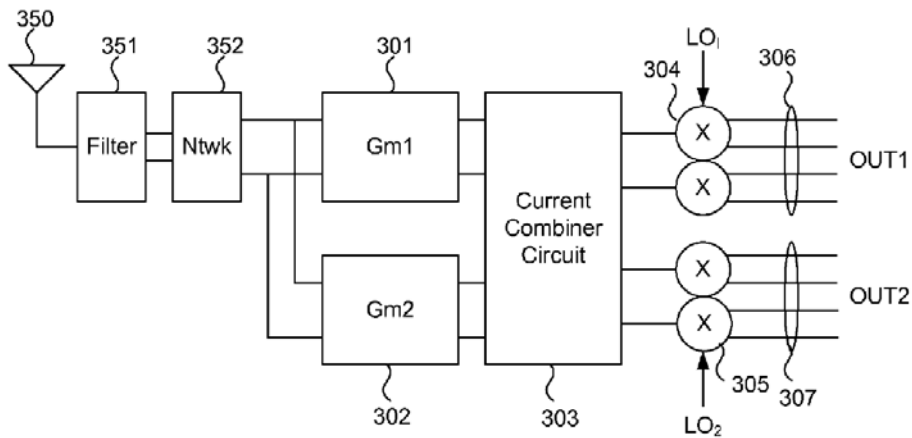


Fig. 3

Specifically, Figure 3 shows a low noise amplifier (LNA) that includes antenna 350, filter 351, matching network 352, two transconductance stages 301 and 302, current combiner circuit 303, as well as mixers 304 and 305. *Id.* In operation, antenna 350 receives a radio frequency (RF) signal with two channels encoded around two different carrier frequencies. *Id.*

The dual carrier signal is amplified by transconductance stages 301 and 302 and coupled to mixers 304 and 305 on two different output paths 306 (“OUT1”) and 307 (“OUT2”) by current combiner circuit 303. *Id.*

Figure 2A is reproduced below to help explain how transconductance stages 301 and 302 and current combiner circuit 303 operate. *Id.* ¶ 34 (describing an LNA shown in Figure 2A); *see also id.* ¶ 47 (stating that the LNA shown in Figure 3 “includes two transconductance stages 301 and 302 and a current combiner circuit 303 that operate as described above”).

200A

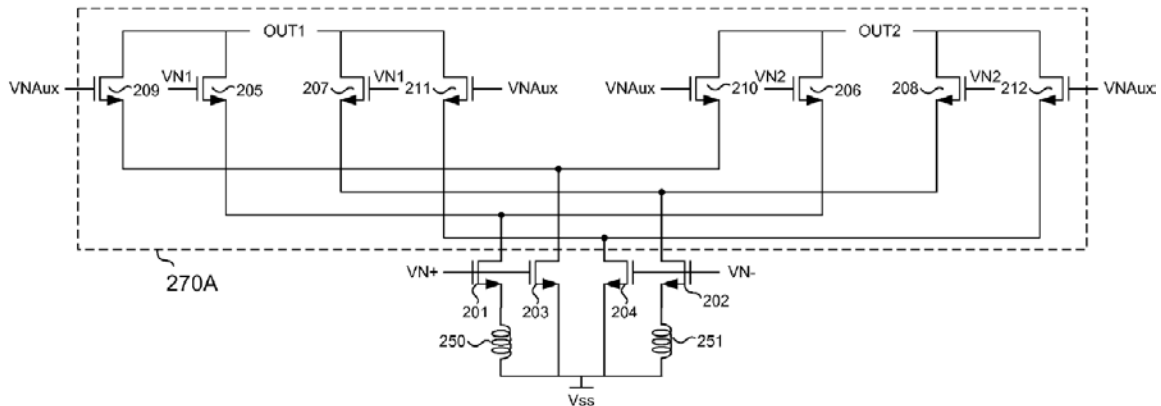


Fig. 2A

Figure 2A shows amplifier circuit 200A, which is an LNA including input transistors 201–204 that act as parallel transconductance stages. *Id.* ¶ 34. Transistors 201 and 202 make up a first transconductance stage, receiving a differential signal with first and second components VN+ and VN- and then converting the components to corresponding currents for output. *Id.* Transistors 203 and 204 make up a second transconductance stage, similarly receiving first and second components VN+ and VN- and then converting the components to corresponding currents for output. *Id.* ¶ 35.

The currents are received by current combiner circuit 270A, which is implemented with selectively enabled cascode transistors 205–212 to selectively couple currents from the transconductance stage transistors to either or both of output paths OUT1 and OUT2. *Id.* ¶ 36. For example, with respect to the first transconductance stage, cascode transistors 205 and 207 may be turned on to couple current from transistors 201 and 202 to output path OUT1, or they may be turned off to decouple the current from output path OUT1. *Id.* Likewise, cascode transistors 206 and 208 may be selectively turned on or off to couple the current from transistors 201 and 202 to output path OUT2 or to decouple the current from transistors 201 and 202 from output path OUT2. *Id.* Similarly, with respect to the second transconductance stage, cascode transistors 209–212 may be turned on or off to couple or decouple current from transistors 203 and 204 with output paths OUT1 and OUT2. *Id.* ¶ 38.

2. Analysis

Independent claim 1 recites “a first amplifier stage configured to be independently enabled or disabled” and “configured to receive and amplify an input radio frequency (RF) signal and provide a first output RF signal to a first load circuit when the first amplifier stage is enabled.” For this limitation, Petitioner provides an annotated version of Figure 3 of Uehara, which is reproduced below. Pet. 47.

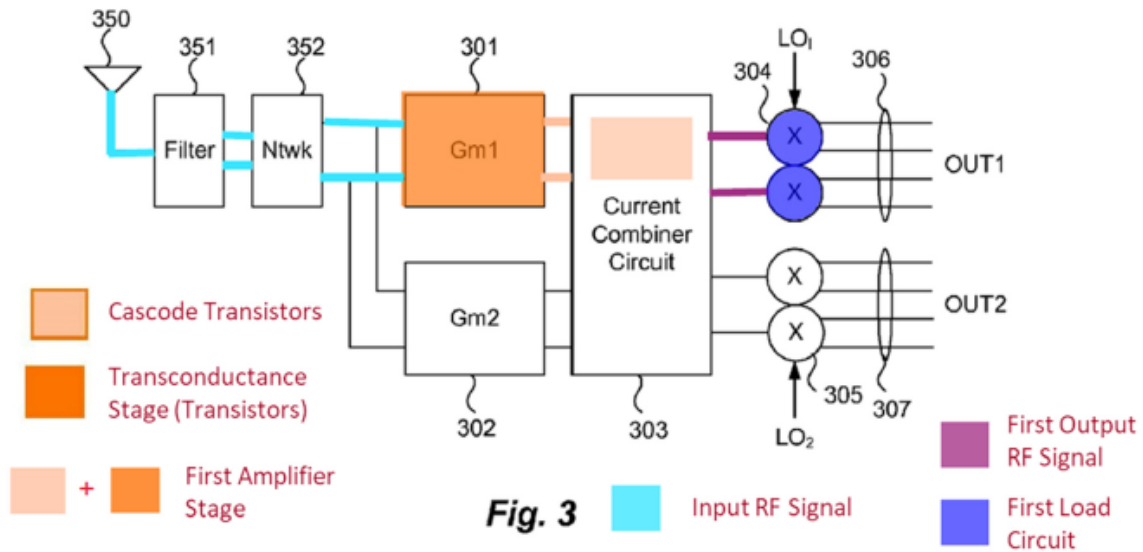


Fig. 3

Figure 3 of Uehara, as annotated by Petitioner, shows a low noise amplifier that includes antenna 350, transconductance stages 301 and 302, current combiner circuit 303, and mixers 304 and 305. Ex. 1003 ¶ 47. Petitioner also provides an annotated version of Figure 2A of Uehara, which is reproduced below. Pet. 49.

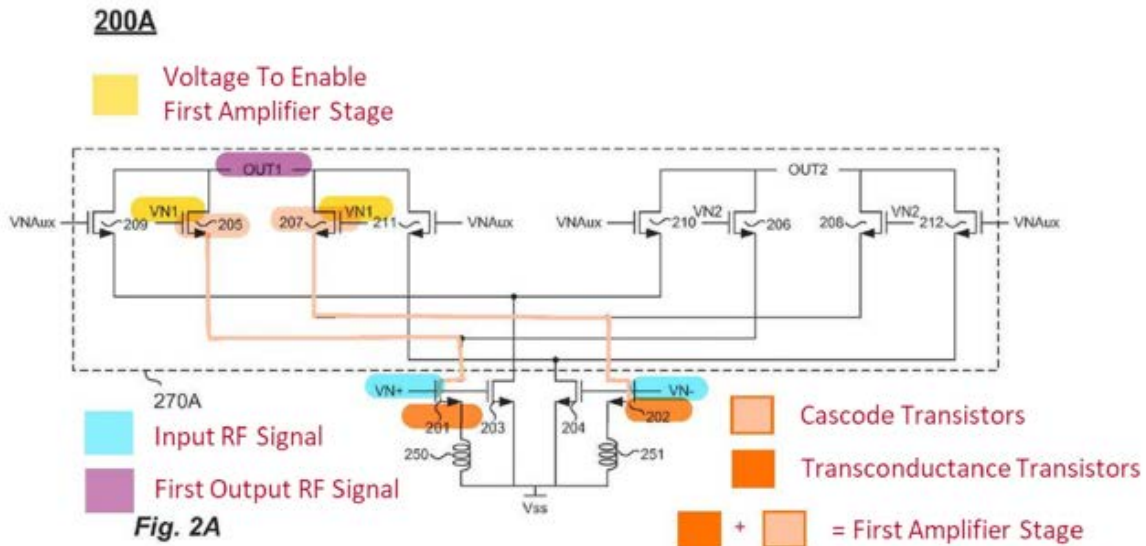


Fig. 2A

Figure 2A of Uehara, as annotated by Petitioner, shows amplifier circuit 200A, which is a low noise amplifier that includes input transistors 201–204 and cascode transistors 205–212. Ex. 1003 ¶¶ 34, 36.

Petitioner contends that “Figure 2A is a detailed diagram of the [transconductance] stages and current combiner circuit of Figure 3.” Pet. 47. As support, Petitioner points us to Uehara’s teaching that Figure 3 illustrates “a low noise amplifier (LNA) includ[ing] two transconductance stages 301 and 302 and a current combiner circuit 303 that operate as described above,” where Uehara describes Figure 2A prior to discussing Figure 3. *Id.* (citing Ex. 1003 ¶ 47); *accord id.* at 37.

Petitioner identifies Uehara’s transconductance stage 301 together with current combiner circuit 303 as a “first amplifier stage.” *Id.* at 48. According to Petitioner, transconductance stage 301 (highlighted in dark orange in Figure 3) corresponds to input transistors 201 and 202 (highlighted in dark orange in Figure 2A), while current combiner circuit 303 (whose upper portion is highlighted in light orange in Figure 3) corresponds to cascode transistors 205 and 207 (highlighted in light orange in Figure 2A). Pet. 45, 47–48 (citing Ex. 1003 ¶¶ 36, 47). Petitioner further identifies Uehara’s mixer 304 (highlighted in dark blue in Figure 3) as a “first load circuit.” *Id.* at 48.

In addition, Petitioner directs us to Uehara’s teaching that “[c]ascode transistors 205 and 207 may be selectively turned on or off . . . thereby coupling or decoupling current from transistors 201 and 202 from output path OUT1.” *Id.* at 50 (quoting Ex. 1003 ¶ 36); *accord id.* at 46. According to Petitioner, “when current flows through the cascode and transconductance transistors, the amplifier stage is enabled.” Pet. 46.

Petitioner also directs us to where Uehara teaches that antenna 350 in Figure 3 receives an RF signal that is amplified by transconductance stage 301 (i.e., “first amplifier stage”) and then provided to mixer 304 (i.e.,

“first load circuit”) on output path OUT1. *Id.* at 47–48 (citing Ex. 1003 ¶ 47). Petitioner identifies Uehara’s RF signal as an “input radio frequency (RF) signal,” and contends that Uehara’s RF signal (highlighted in light blue in Figure 3) corresponds to Uehara’s differential signal with first and second components VN+ and VN– (highlighted in light blue in Figure 2). *Id.* at 47–49 (citing Ex. 1003 ¶¶ 34, 47). Petitioner relies on Uehara’s teaching that “[i]n one embodiment, the signal is a differential RF voltage signal.” *Id.* at 49 (citing Ex. 1003 ¶ 19). Petitioner additionally identifies the signal (highlighted in purple in Figures 2A and 3) provided to mixer 304 on output path OUT1 as a “first output RF signal.” *Id.* at 48–49; *see also id.* at 49 (“Figure 3 shows that output path OUT1 includes mixer 304. . . . Thus, [in Figure 2] transistors 201 and 202 work together with transistors 205 and 207 . . . to route the amplified first output RF signal along output path OUT1 to the first load circuit (e.g., mixer 304).”).

Based on the record before us, we are persuaded that Petitioner has sufficiently shown for purposes of this Decision that Uehara discloses the recited “first amplifier stage.”

Claim 1 further recites that “the input RF signal employ[s] carrier aggregation comprising transmissions sent on multiple carriers at different frequencies to a wireless device.” Regarding this limitation, Petitioner directs us to where Uehara teaches using its low noise amplifier in a wireless receiver. Pet. 50 (citing Ex. 1003 ¶¶ 7, 47). Petitioner also directs us to where Uehara teaches that its low noise amplifier may process an RF signal that “include[s] two channels encoded around two different carrier frequencies (i.e., dual carriers).” *Id.* at 51 (citing Ex. 1003 ¶ 47). For dual carrier signals, Uehara further teaches coupling currents from both

transconductance stages to the two output paths. Ex. 1003 ¶ 50 (cited by Pet. 51); *see also id.* ¶ 47 (explaining that “[m]ixer 304 may receive the dual carrier signal and a local oscillator signal having a frequency equal to the one of the two carriers in the RF signal” and “mixer 305 may receive the dual carrier signal and another local oscillator signal having another frequency equal to the other of the two carriers in the RF signal”), Fig. 3.

Petitioner contends that “Uehara’s use of two channels provides greater bandwidth than one channel,” and that “[n]on-redundant data present in the transmissions sent over the ‘two channels encoded around two different carrier frequencies’ increases the data rate . . . because the device is receiving more data per unit of time.” Pet. 51–52 (internal citation omitted). Petitioner relies on the declaration testimony of Dr. Fay. *Id.* (citing Ex. 1002 ¶¶ 89–90).

Based on the record before us, we are persuaded that Petitioner has sufficiently shown for purposes of this Decision that Uehara discloses the recited “input RF signal.”

Claim 1 further recites that “the first output RF signal includ[es] at least a first carrier of the multiple carriers.” For this limitation, Petitioner directs us to where Uehara teaches that “[m]ixer 304 may receive the dual carrier signal and a local oscillator signal having a frequency equal to the one of the two carriers in the RF signal” and then “down convert[] one of the channels of the RF signal to baseband.” Pet. 53 (citing Ex. 1003 ¶ 47).

Based on the record before us, we are persuaded that Petitioner has sufficiently shown for purposes of this Decision that Uehara discloses the recited “first output RF signal.”

Claim 1 further recites “a second amplifier stage configured to be independently enabled or disabled” and “configured to receive and amplify the input RF signal and provide a second output RF signal to a second load circuit when the second amplifier stage is enabled.” For this limitation, Petitioner provides another annotated version of Figure 3 of Uehara, which is reproduced below. Pet. 56.

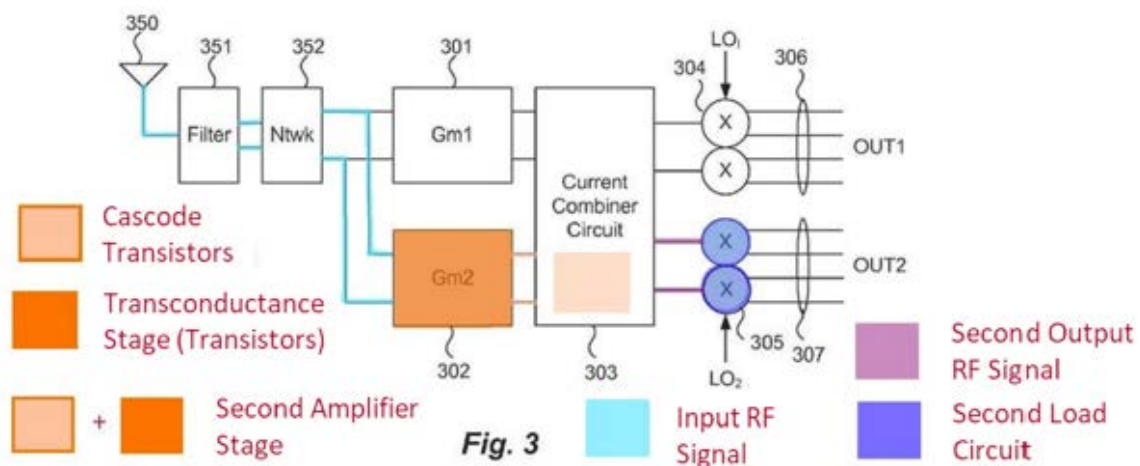


Figure 3 of Uehara, as annotated by Petitioner, shows a low noise amplifier including antenna 350, transconductance stages 301 and 302, current combiner circuit 303, and mixers 304 and 305. Ex. 1003 ¶ 47. Petitioner also provides another annotated version of Figure 2A of Uehara, which is reproduced below. Pet. 58.

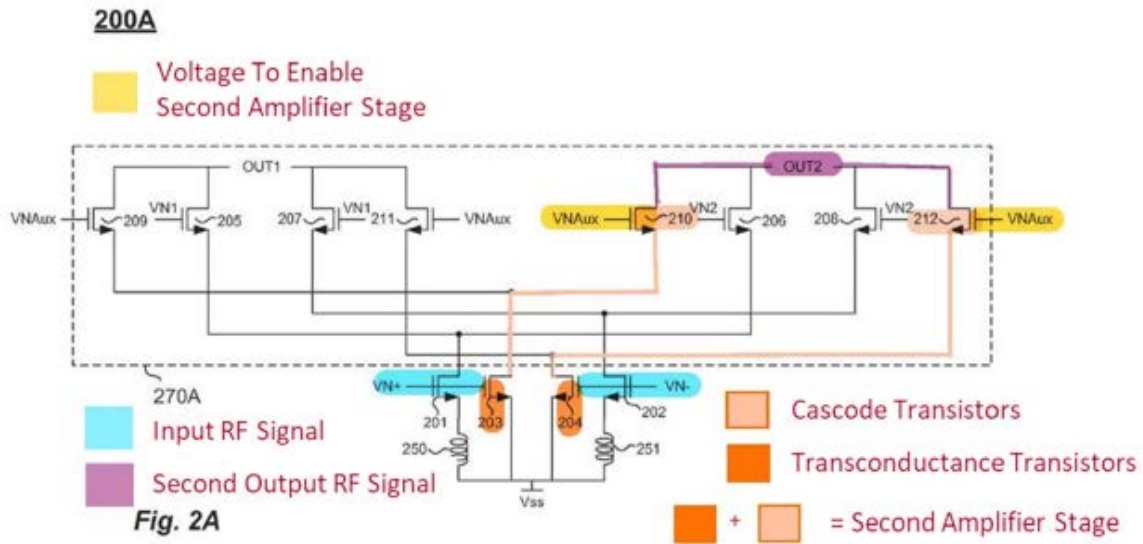


Figure 2A of Uehara, as annotated by Petitioner, shows amplifier circuit 200A, which is a low noise amplifier including input transistors 201–204 and cascode transistors 205–212. Ex. 1003 ¶¶ 34, 36. As discussed above, Petitioner contends that “Figure 2A is a detailed diagram of the [transconductance] stages and current combiner circuit of Figure 3.” Pet. 47.

Petitioner identifies Uehara’s transconductance stage 302 together with current combiner circuit 303 as a “second amplifier stage,” and Uehara’s mixer 305 as a “second load circuit.” *Id.* at 56. According to Petitioner, transconductance stage 302 (highlighted in dark orange in Figure 3) corresponds to input transistors 203 and 204 (highlighted in dark orange in Figure 2A), while current combiner circuit 303 (whose lower portion is highlighted in light orange in Figure 3) corresponds to cascode transistors 210 and 212 (highlighted in light orange in Figure 2A). *Id.* at 56, 58–59 (citing Ex. 1003 ¶¶ 36, 47).

Petitioner further directs us to Uehara’s teaching that “[c]ascode transistors 209–212 may be selectively turned on or off . . . thereby coupling or decoupling current from transistors 203 and 204 with output path OUT1

and output path OUT2.” *Id.* at 58 (quoting Ex. 1003 ¶ 38). According to Petitioner, “when current flows through the cascode and transconductance transistors, the amplifier stage is enabled.” *Id.* at 46.

Petitioner also directs us to where Uehara teaches that antenna 350 in Figure 3 receives an RF signal (i.e., “input RF signal”) that is amplified by transconductance stage 302 (i.e., “second amplifier stage”) and then provided to mixer 305 (i.e., “second load circuit”) on output path OUT2. *Id.* at 57 (citing Ex. 1003 ¶ 47). As discussed previously, Petitioner identifies Uehara’s RF signal (highlighted in light blue in Figures 2A and 3) as the “input RF signal.” *Id.* at 47–49; *accord id.* at 56–58. Petitioner additionally identifies the signal (highlighted in purple in Figures 2A and 3) provided to mixer 305 (highlighted in dark blue in Figure 3) on output path OUT2 as a “second output RF signal.” *Id.* at 56; *see also id.* at 59 (“As shown in Figure 3, output path OUT2 includes mixer 305. Thus, [in Figure 2] transistors 210 and 212 route the amplified second output RF signal from transistors 203 and 204 along output path OUT2 and provide it to the second load circuit (mixer 305).”).

Based on the record before us, we are persuaded that Petitioner has sufficiently shown for purposes of this Decision that Uehara discloses the recited “second amplifier stage.”

Lastly, claim 1 recites that “the second output RF signal includ[es] at least a second carrier of the multiple carriers different than the first carrier.” As discussed above, Uehara teaches that “[m]ixer 304 may receive the dual carrier signal and a local oscillator signal having a frequency equal to one of the two carriers in the RF signal” and then “down convert[] one of the channels of the RF signal to baseband.” Ex. 1003 ¶ 47 (cited by Pet. 53).

Petitioner directs us to where Uehara further teaches that “mixer 305 may receive the dual carrier signal and another local oscillator signal having another frequency equal to the other of the two carriers in the RF signal” and then “down convert[] the other channel of the RF signal to baseband.” Pet. 59–60 (citing Ex. 1003 ¶ 47). Again, the signals provided to the mixers correspond to the recited output RF signals, respectively. Based on the record before us, we are persuaded that Petitioner has sufficiently shown for purposes of this Decision that Uehara discloses the recited “second output RF signal.”

Patent Owner does not respond to Petitioner’s arguments regarding claim 1. *See generally* Prelim. Resp. In view of the foregoing, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion that Uehara anticipates claim 1. Having reviewed Petitioner’s arguments asserting that Uehara anticipates claims 11, 17, and 18 (*see* Pet. 60–67), we also determine that Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion as to these dependent claims. We note that Patent Owner does not respond to Petitioner’s arguments regarding claims 11, 17, and 18. *See generally* Prelim. Resp.

E. Obviousness over Uehara and Perumana

Petitioner asserts that claims 7 and 8 of the ’356 patent would have been obvious over Uehara and Perumana. Pet. 68–71. For the reasons explained below, we are persuaded that Petitioner has demonstrated a reasonable likelihood of prevailing on this asserted ground.

We discussed Uehara above. *See supra* Section III.D.1.

1. Perumana

Perumana describes resistive-feedback low noise amplifiers. Ex. 1008, 1218 (Abstract). Figure 3(a), which is reproduced below, illustrates a resistive-feedback amplifier according to Perumana.

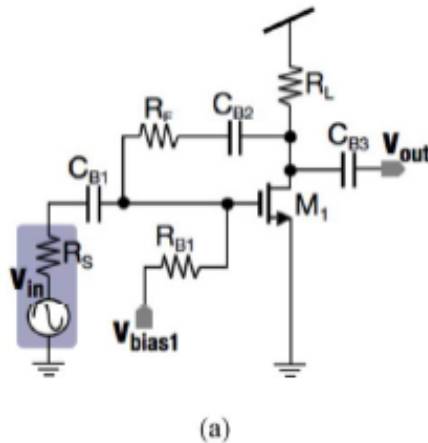


Fig. 3. Simplified schematic and small-signal model of a shunt-shunt feedback amplifier.

Figure 3 shows a resistive-feedback amplifier including input transconductance device M_1 , load resistance R_L , resistor R_F , source resistance R_S , and direct current blocking capacitors C_{B1} , C_{B2} , and C_{B3} . *Id.* at 1219. Input transconductance device M_1 may be a single transistor or a cascode pair. *Id.* Load resistance R_L includes the output resistance of the input transconductance stage. *Id.* Resistor R_F implements the shunt–shunt feedback. *Id.*

According to Perumana, using resistive-feedback low noise amplifiers “can potentially reduce the cost of the wireless front-end implementation.” *Id.* at 1218. Additionally, such amplifiers “achieve high gain and reasonably low NF.” *Id.* at 1218–1219.

2. Analysis

Claim 7 depends from claim 1 and recites “a feedback circuit coupled between an output and an input of at least one of the first and second amplifier stages.” Claim 8, which depends from claim 7, further recites that “the feedback circuit compris[es] a resistor, or a capacitor, or both a resistor and a capacitor.” For these limitations, Petitioner relies on Perumana.

In particular, Petitioner provides an annotated version of Figure 3(a) of Perumana, which is reproduced below.

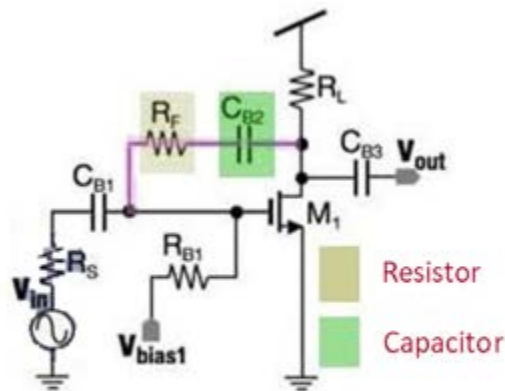


Figure 3(a)

Figure 3(a) of Perumana, as annotated by Petitioner, shows a resistive-feedback amplifier, where M_1 represents the input transconductance device, which may be a single transistor or a cascode pair, R_F is a resistor implementing the shunt–shunt feedback, and C_{B1} , C_{B2} , and C_{B3} are direct current blocking capacitors. Ex. 1008, 1219. Petitioner identifies Perumana’s resistor R_F and capacitor C_{B2} as a “feedback circuit.” Pet. 71. According to Petitioner, “[t]he feedback circuit lies in between V_{in} , the input R_F signal, and R_L , which ‘represents the load resistance including the output resistance of the input transconductance stage.’” *Id.* at 68–69 (citing Ex. 1008, 1219). Petitioner contends that “Perumana thus illustrates a

feedback circuit coupled between the output and the input of the amplifier M1.” *Id.* at 69 (citing Ex. 1002 ¶ 117). Petitioner further contends that an ordinarily skilled artisan “would have been motivated to add the feedback circuit of Perumana to the amplifier stages of Uehara” to “‘significantly reduce the cost of the wireless front-end implementation’ and provide[] ‘high gain and reasonably low NF [noise figure].’” *Id.* (quoting Ex. 1008, 1218–1219).

On the record before us, we are persuaded that Petitioner has sufficiently shown for purposes of this Decision that Uehara teaches the recited “feedback circuit” in both claims 7 and 8. We also are persuaded that Petitioner’s proffered reasoning for modifying the low noise amplifier of Uehara to include the feedback circuit of Perumana, namely, to reduce implementation costs and to provide high gain and low noise figure, is sufficient to support the legal conclusion of obviousness. *See In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (“[T]here must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.”).

Patent Owner does not respond to Petitioner’s arguments regarding claims 7 and 8. *See generally* Prelim. Resp. In view of the foregoing, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion that these claims would have been obvious over Uehara and Perumana.

F. Obviousness over Uehara and Youssef

Petitioner asserts that claim 10 of the ’356 patent would have been obvious over Uehara and Youssef. Pet. 71–76. For the reasons explained

below, we are persuaded that Petitioner has demonstrated a reasonable likelihood of prevailing on this asserted ground.

We discussed Uehara above. *See supra* Section III.D.1.

1. Youssef

Youssef describes an attenuator suitable for mobile TV applications. Ex. 1009, 1999. Figure 1(b), which is reproduced below, illustrates an attenuator according to Youssef.

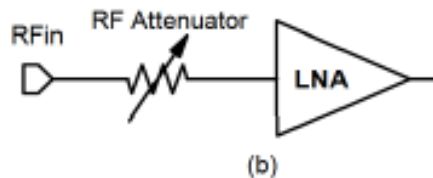


Figure 1. RF gain control through a) a variable gain LNA or through b) RF programmable passive attenuator.

In particular, Figure 1(b) shows a programmable passive attenuator that is used to control the RF gain. *Id.* The attenuator is “capable of preventing a receiver from clipping at large input signal levels.” *Id.*

2. Analysis

Claim 10 depends from claim 1 and recites “an attenuation circuit coupled to the first and second amplifier stages and configured to receive the input RF signal.” For this limitation, Petitioner relies on Youssef. In particular, Petitioner directs us to the RF attenuator in Figure 1(b) of Youssef, which is reproduced above. Pet. 72 (citing Ex. 1009, Fig. 1(b)). As Figure 1(b) shows, the RF attenuator receives signal RFin and is coupled to an LNA. Petitioner identifies Youssef’s signal RFin as an “input RF signal” and Youssef’s LNA as an “amplifier stage.” *Id.*

Petitioner contends that an ordinarily skilled artisan “would have been motivated to couple the first and second amplifier stages of the LNA of Uehara to the attenuation circuit of Youssef to prevent signal clipping and to suppress interfering signals.” *Id.* at 74 (citing Ex. 1009, 1999). Relying on the declaration testimony of Dr. Fay, Petitioner also contends that an ordinarily skilled artisan “would have been motivated to couple the attenuation circuit of Youssef to the first and second amplifier stages of Uehara to improve dynamic range and linearity.” *Id.* at 74–75 (citing Ex. 1002 ¶ 130). Petitioner further explains that using a common attenuation circuit “would have provided the benefits of reducing the circuit cost and complexity relative to adding separate attenuation circuits to each amplifier stage.” *Id.* at 76 (citing Ex. 1002 ¶ 130 n.24).

Based on the record before us, we are persuaded that Petitioner has sufficiently shown for purposes of this Decision that Youssef teaches an “attenuation circuit.” We also are persuaded that Petitioner’s proffered reasoning for modifying Uehara’s low noise amplifier to include Youssef’s RF attenuator, namely, to prevent clipping at large input signal levels as well as to improve dynamic range and linearity, is sufficient to support the legal conclusion of obviousness. *See Kahn*, 441 F.3d at 988.

Patent Owner does not respond to Petitioner’s arguments regarding claim 10. *See generally* Prelim. Resp. In view of the foregoing, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion that claim 10 would have been obvious over Uehara and Youssef.

G. Grounds Based on the Feasibility Study

Petitioner asserts that claims 1, 11, 17, and 18 of the '356 patent would have been obvious over Uehara and the Feasibility Study. Pet. 77–80. Petitioner also asserts that claims 7 and 8 would have been obvious over Uehara, the Feasibility Study, and Perumana. *Id.* at 80–81. In addition, Petitioner asserts that claim 10 would have been obvious over Uehara, the Feasibility Study, and Youssef. *Id.* at 81–82. For the reasons explained below, we are persuaded that Petitioner has demonstrated a reasonable likelihood of prevailing on these asserted grounds.

We discussed Uehara, Perumana, and Youssef above. *See supra* Sections III.D.1., III.E.1, III.F.1.

1. The Feasibility Study

The Feasibility Study is a 3GPP (Third Generation Partnership Project) technical report that considers technology components for the evolution of E-UTRA (Evolved Universal Mobile Telecommunications System Terrestrial Radio Access). Ex. 1004, 6–8. E-UTRA also refers to LTE-Advanced (Long Term Evolution). *See id.* at 8 (“E-UTRA (LTE-Advanced)”).

2. Analysis

As discussed above with respect to anticipation by Uehara, Petitioner relies on Uehara for teaching every limitation recited in claim 1, including an “input RF signal employing carrier aggregation.” Under an alternative theory, Petitioner relies additionally on the Feasibility Study.

In particular, Petitioner contends that, “[t]o the extent the Patent Owner argues that Uehara fails to teach an input RF signal employing carrier aggregation, . . . the Feasibility Study also discloses this element.” Pet. 77; *accord id.* at 80–81. As support, Petitioner directs us to where the Feasibility Study teaches that “LTE-Advanced extends LTE release 8 with support for *Carrier Aggregation*, where two or more *component carriers* (CC) are aggregated in order to support wider transmission bandwidths up to 100MHz and for spectrum aggregation.” *Id.* (citing Ex. 1004, 22). Petitioner also directs us to where the Feasibility Study teaches that “[i]t is possible to configure a [mobile device] to aggregate a different number of component carriers originating from the same [base station] and of possibly different bandwidths in the [uplink] and the [downlink].” *Id.* at 77–78 (citing Ex. 1004, 9). Petitioner contends that an ordinarily skilled artisan “would have been motivated to use the carrier-aggregated input RF signal of the Feasibility Study with the receiver front-end architecture of Uehara,” and that combining these references would have “require[d] nothing more than substitution of the ‘dual or multi-carrier signals’ of Uehara for the ‘Carrier Aggregation’ signals described in the Feasibility Study.” *Id.* at 78–79; *see also id.* at 80–81 (“[T]he receiver architecture of Uehara can remain the same when combined with the Feasibility Study. Thus, it would have been obvious to a POSITA to have modified the first and/or second amplifier stage(s) of Uehara in view of the Feasibility Study with the feedback circuit of Perumana for the same reasons that a POSITA would have modified Uehara alone”); *id.* at 82 (“[T]he receiver architecture of Uehara can remain the same when combined with the Feasibility Study. Thus, it would have been obvious to a POSITA to have coupled the first and second

amplifier stages of the LNA of Uehara in view of the Feasibility Study to the attenuation circuit of Youssef for the same reasons that a POSITA would have done so to Uehara alone”). Petitioner relies on the declaration testimony of Dr. Fay. *Id.* at 78–79 (citing Ex. 1002 ¶¶ 134–135).

Based on the record before us, we are persuaded that Petitioner has sufficiently shown for purposes of this Decision that the Feasibility Study teaches an “input RF signal employing carrier aggregation.” We also are persuaded that Petitioner’s proffered reasoning for modifying Uehara’s low noise amplifier to process the carrier aggregation signals described in the Feasibility Study, namely, to achieve wider transmission bandwidths and spectrum aggregation, is sufficient to support the legal conclusion of obviousness. *See Kahn*, 441 F.3d at 988.

Patent Owner does not respond to Petitioner’s arguments in this regard. *See generally* Prelim. Resp. For the remaining limitations recited in claim 1 as well as the limitations recited in claims 11, 17, and 18, Petitioner relies on its arguments with respect to anticipation by Uehara. Pet. 79. For the remaining limitations recited in claims 7 and 8, Petitioner relies on its arguments with respect to obviousness over Uehara and Perumana. *Id.* at 80. Lastly, for the remaining limitations recited in claim 10, Petitioner relies on its arguments with respect to obviousness over Uehara and Youssef. *Id.* at 82. As discussed above, we are persuaded by Petitioner’s arguments. *See supra* Sections III.D–III.F. Accordingly, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion that claims 1, 11, 17, and 18 would have been obvious over Uehara and the Feasibility Study, its assertion that claims 7 and 8 would have been obvious over Uehara, the Feasibility Study, and Perumana, as well as its assertion

that claim 10 would have been obvious over Uehara, the Feasibility Study, and Youssef.

IV. CONCLUSION

For the foregoing reasons, we are persuaded that Petitioner has demonstrated a reasonable likelihood that it will prevail in showing that claims 1, 7, 8, 10, 11, 17, and 18 of the '356 patent are unpatentable. We have not made a final determination, however, with respect to the patentability of these claims.

V. ORDER

For the reasons given, it is

ORDERED that *inter partes* review is instituted as to all the challenged claims of the '356 patent, namely, claims 1, 7, 8, 11, 17, and 18, based on all the grounds presented in the Petition:

- A. Anticipation under 35 U.S.C. § 102 of claims 1, 11, 17, and 18 by Uehara;
- B. Obviousness under 35 U.S.C. § 103 of claims 7 and 8 over Uehara and Perumana;
- C. Obviousness under 35 U.S.C. § 103 of claim 10 over Uehara and Youssef;
- D. Obviousness under 35 U.S.C. § 103 of claims 1, 11, 17, and 18 over Uehara and the Feasibility Study;
- E. Obviousness under 35 U.S.C. § 103 of claims 7 and 8 over Uehara, the Feasibility Study, and Perumana; and

F. Obviousness under 35 U.S.C. § 103 of claim 10 over Uehara, the Feasibility Study, and Youssef;

FURTHER ORDERED that no other grounds of unpatentability are authorized for an *inter partes* review as to any claim of the '356 patent; and

FURTHER ORDERED that, pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial; the trial will commence on the entry date of this Decision.

IPR2019-00047
Patent 9,154,356 B2

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