Trials@uspto.gov
571.272.7822

Paper 30
Date: January 14, 2020

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTEL CORPORATION,
Petitioner,

v.

QUALCOMM INCORPORATED,
Patent Owner.

IPR2018-01329
Patent 9,608,675 B2

Before MICHELLE N. WORMMEESTER, AMANDA F. WIEKER, and SCOTT B. HOWARD, *Administrative Patent Judges*.

WORMMEESTER, *Administrative Patent Judge*.

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

I. INTRODUCTION

Intel Corporation[1] ("Petitioner") filed a Petition (Paper 3, "Pet.") requesting an *inter partes* review of claims 28–30 of U.S. Patent No. 9,608,675 B2 (Ex. 1301, "the '675 patent"). Qualcomm Incorporated ("Patent Owner") filed a Preliminary Response. Paper 7 ("Prelim. Resp."). Pursuant to 35 U.S.C. § 314, we instituted an *inter partes* review of challenged claims 28–30 based on the sole ground presented in the Petition. Paper 8 ("Inst. Dec."). Patent Owner filed a Response (Paper 14, "PO Resp."), and Petitioner filed a Reply (Paper 16, "Pet. Reply"). Patent Owner then filed a Sur-reply. Paper 19 ("PO Sur-reply").

On October 9, 2019, we conducted an oral hearing. A copy of the transcript (Paper 29, "Tr.") is included in the record. With our authorization, the parties subsequently filed additional briefs on the meaning of certain claim language. Paper 27 ("PO Br."); Paper 28 ("Pet. Br.").

We have jurisdiction under 35 U.S.C. § 6(b). For the reasons that follow, we determine that Petitioner has shown by a preponderance of the evidence that claims 28–30 of the '675 patent are unpatentable. This final written decision is issued pursuant to 35 U.S.C. § 318(a).

II. BACKGROUND

A. Related Proceedings

Prior to institution, the parties identified various matters involving the '675 patent, including a federal district court case, an International Trade Commission ("ITC") investigation, as well as five other petitions for *inter*

[1] Intel Corporation identifies itself and Apple Inc. ("Apple") as real parties in interest. Paper 3, 1.

partes review. Pet. 1–2; Paper 4, 2. Since the entry of our Institution Decision, however, Patent Owner has asserted that "[t]he '675 patent is currently not involved in any litigation beyond the PTAB." PO Resp. 16. Petitioner has not stated otherwise.

B. The '675 Patent

The '675 patent describes power tracking for generating a power supply voltage for a circuit, such as an amplifier, that processes multiple transmit signals sent simultaneously. Ex. 1301, 1:8–10, 1:35–38. Figure 5, which is reproduced below, illustrates a transmit module with power tracking for all transmit signals according to the '675 patent. *Id.* at 1:65–67.

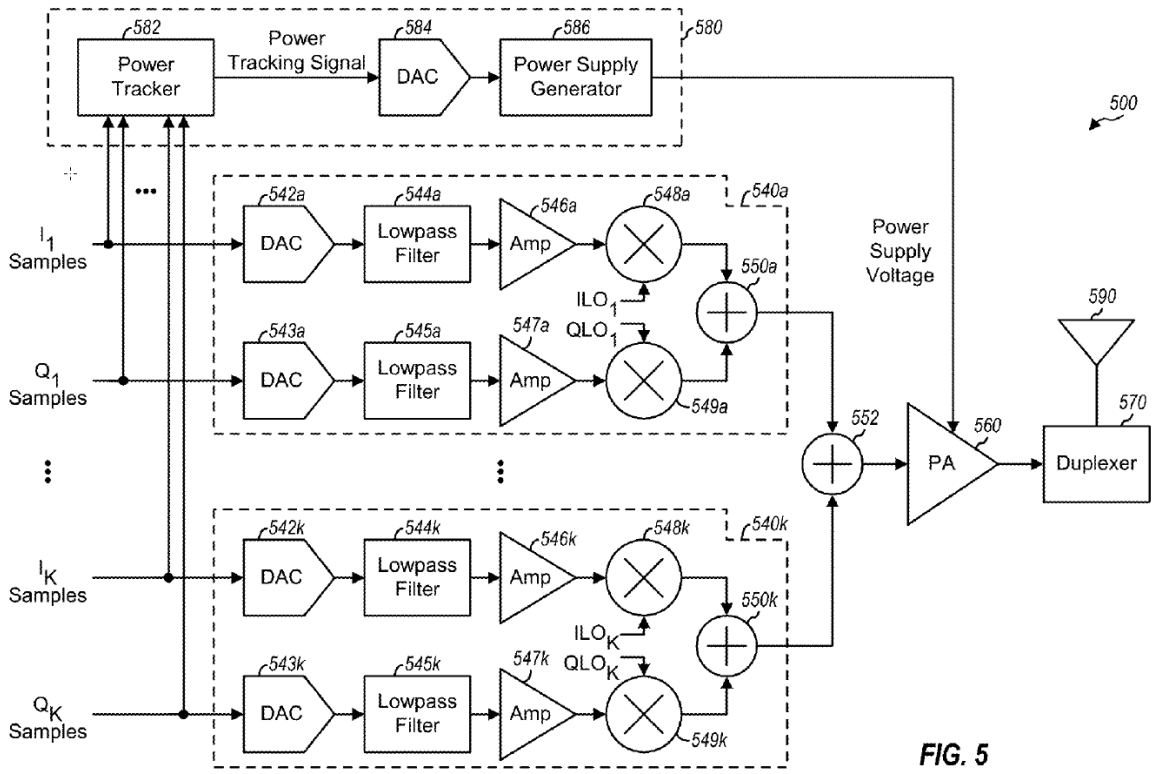


FIG. 5

In particular, Figure 5 shows transmit module 500, which includes K transmit circuits 540a to 540k that can simultaneously process K transmit signals, with each transmit circuit processing one transmit signal. *Id.* at 6:34–37. Transmit module 500 also includes summer 552, power amplifier ("PA") 560, duplexer 570, and power tracking supply generator (or voltage generator) 580. *Id.* at 6:37–39.

Inphase (I) and quadrature (Q) samples for a transmit signal are provided to both a transmit circuit and voltage generator 580. *Id.* at 6:42–44. For example, transmit circuit 540a receives I_1 and Q_1 samples for a first transmit signal and generates a first upconverted radio frequency ("RF") signal for the first transmit signal. *Id.* at 6:40–42. Within transmit circuit 540a, the I_1 and Q_1 samples are converted to I and Q analog signals by digital-to-analog converters (DACs) 542a and 543a. *Id.* at 6:44–46. The I and Q analog signals are then filtered by lowpass filters 544a and 545a, amplified by amplifiers 546a and 547a, upconverted from baseband to RF by mixers 548a and 549a, and summed by summer 550a to generate the first upconverted RF signal. *Id.* at 6:46–50.

The other transmit circuits operate similarly. *Id.* at 6:54–57. Summer 552 receives all upconverted RF signals from the transmit circuits, sums the upconverted RF signals, and provides a modulated RF signal to PA 560. *Id.* at 6:59–62.

Within voltage generator 580, power tracker 582 receives I_1 to I_K samples and Q_1 to Q_K samples for all transmit signals being sent simultaneously. *Id.* at 6:63–65. Power tracker 582 then computes a digital power tracking signal based on the I and Q samples for these transmit signals and provides the digital power tracking signal to DAC 584. *Id.* at

6:65–7:1, 8:6–32. DAC 584 converts the digital power tracking signal to analog and provides the analog power tracking signal to power supply generator 586. *Id.* at 7:1–4, Fig. 5. Power supply generator 586 generates a power supply voltage for PA 560. *Id.* at 7:6–8.

Once PA 560 receives both the modulated RF signal from summer 552 and the power supply voltage from power supply generator 586, PA 560 amplifies the modulated RF signal using the power supply voltage. *Id.* at 7:8–11. PA 560 then provides an output RF signal for all the transmit signals being sent simultaneously. *Id.* at 7:11–12. The output RF signal is routed through duplexer 570 and transmitted via antenna 590. *Id.* at 7:12–14.

C. Illustrative Claim

Petitioner challenges claims 28–30 of the ’675 patent. Claim 28 is independent and illustrative of the claims under challenge:

> 28. An apparatus comprising:
>
> means for determining a single power tracking signal based on a plurality of inphase (I) and quadrature (Q) components of a plurality of carrier aggregated transmit signals being sent simultaneously, wherein a power tracker receives the plurality of I and Q components corresponding to the plurality of carrier aggregated transmit signals and generates the single power tracking signal based on a combination of the plurality of I and Q components, wherein the plurality of carrier aggregated transmit signals comprise Orthogonal Frequency Division Multiplexing (OFDM) or Single Carrier Frequency Division Multiple Access (SC-FDMA) signals;
>
> means for generating a single power supply voltage based on the single power tracking signal; and

means for receiving the single power supply voltage and the plurality of carrier aggregated transmit signals being sent simultaneously and producing a single output radio frequency (RF) signal.

D. Asserted Ground of Unpatentability

Petitioner challenges claims 28–30 of the '675 patent on a single ground based on obviousness over 35 U.S.C. § 103. Pet. 24–79. We instituted *inter partes* review of that ground. Inst. Dec. 2, 33. The instituted ground is as follows.

Claims Challenged	35 U.S.C. §	References
28–30	103	Yu,[2] Wang,[3] Choi[4]

In support of its arguments, Petitioner relies on a declaration (Ex. 1303) as well as a reply declaration (Ex. 1331) of David Choi, Ph.D. Patent Owner submits with its Response a declaration of Tim Williams, Ph.D. (Ex. 2002). The transcripts of the depositions of Dr. Choi are entered in the record as Exhibits 2006 and 2007, and the transcript of the deposition of Dr. Williams is entered in the record as Exhibit 1330.

[2] Yu, EP 2442440 A1, published Apr. 18, 2012 (Ex. 1304).
[3] Wang et al., *Design of Wide-Bandwidth Envelope-Tracking Power Amplifiers for OFDM Applications*, 53 IEEE Transactions on Microwave Theory & Techniques 1244 (2005) (Ex. 1305).
[4] Jinsung Choi et al., *Envelope Tracking Power Amplifier Robust to Battery Depletion*, 2010 IEEE MTT-S Int'l Microwave Symposium Digest 1074 (2010) (Ex. 1308, at Ex. A).

III. ANALYSIS

A. Claim Construction

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); *Cuozzo Speed Techs. LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016) (upholding the use of the broadest reasonable interpretation standard).[5] 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).

As to claim elements recited in means-plus-function format, the Federal Circuit has stated: "Section 112, ¶ 6 recites a mandatory procedure for interpreting the meaning of a means- or step-plus-function claim element. These claim limitations 'shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.'" *Al-Site Corp. v. VSI Int'l, Inc.*, 174 F.3d 1308, 1320 (Fed. Cir. 1999); *see also In re Donaldson Co., Inc.*, 16 F.3d 1189, 1193–94 (Fed. Cir. 1994) (en banc) ("[P]aragraph six applies regardless of the context in which the interpretation of means-plus-function language arises, i.e.,

[5] 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) (codified at 37 C.F.R. § 42.100(b) (2019)). The Petition here was filed on July 3, 2018.

whether as part of a patentability determination in the PTO or as part of a validity or infringement determination in a court."). Accordingly, a means-plus-function limitation is construed by determining the claimed function and identifying the structure or materials disclosed in the specification that correspond to the means for performing that function. *See Kemco Sales, Inc. v. Control Papers Co., Inc.*, 208 F.3d 1352, 1360 (Fed. Cir. 2000). "Under this second step, structure disclosed in the specification is corresponding structure only if the specification or prosecution history clearly links or associates that structure to the function recited in the claim." *In re Aoyama*, 656 F.3d 1293, 1297 (Fed. Cir. 2011) (internal quotation omitted). Failure to disclose structure that performs the claimed function typically (e.g., in district court) renders the claim invalid for indefiniteness under 35 U.S.C. § 112 ¶ 2. *See Aristocrat Techs. Austl. Pty v. Int'l Game Tech.*, 521 F.3d 1328, 1331 (Fed. Cir. 2008).

Petitioner provides proposed interpretations of various terms recited in the challenged claims. Pet. 13–22; Pet. Reply 2–11; Pet. Br. 1–3. Patent Owner also provides proposed interpretations of various claim terms. PO Resp. 14–22; PO Sur-reply 2–11; PO Br. 1–3. In light of the parties' arguments and evidence, we address several claim terms. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (noting that "we need only construe 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. "power tracker"

This term appears in independent claim 28. The administrative law judge ("ALJ") in the related ITC investigation[6] construed "power tracker" to mean "component in a voltage generator that computes the power requirement." Ex. 1318, 18–20 (ITC order) (cited by Pet. 13). In construing that term, the ALJ applied the standard used in civil actions. *Id.* at 3–5 (citing *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005)). For purposes of this proceeding, the parties do not dispute the ALJ's construction. PO Resp. 17 ("Patent Owner agrees with the ITC's non-[means-plus-function] construction of 'power tracker' as a 'component in a voltage generator that computes the power requirement.'"); Pet. Reply 5–6, 8 ("The Board . . . should adopt the construction of 'power tracker' that both parties have agreed to—'component in a voltage generator that computes the power requirement.'"). On this record, we adopt the ALJ's construction.

Even though the parties do not dispute the ALJ's construction of "power tracker," they dispute whether Petitioner's approach in offering that construction in this proceeding complies with our rules. According to Petitioner, Apple (a real party in interest in this proceeding) argued in the related ITC investigation that the recited "power tracker" is a means-plus-function limitation lacking sufficient corresponding structure; but the ALJ nevertheless determined that term to be a structural limitation. Pet. 13 (citing Ex. 1318, 18–20), 14 n.4. Although Petitioner asserts that the challenged claims are invalid for indefiniteness under Apple's proposed

[6] Prior to institution, Petitioner indicated that Patent Owner had asserted the '675 patent against Apple in the ITC investigation but then withdrew the assertion. Pet. 1–2.

means-plus-function construction, Petitioner additionally asserts that its "Petition shows the invalidity of the challenged claims under the ALJ's construction," as "indefiniteness is not an issue that can be considered in an [*inter partes* review proceeding]." *Id.*

We recognize that Petitioner is offering a construction for "power tracker," namely, the ALJ's structural construction from the ITC investigation, under which it argues that the challenged claims are invalid as obvious, while at the same time expressing its belief that the challenged claims "also" are invalid for indefiniteness under a different construction, namely, Apple's proposed means-plus-function construction. *See id.* As we explained in our Institution Decision, this approach is acceptable. Inst. Dec. 12–13. In particular, we noted that a petitioner may "identify[] claim constructions it proposes as the basis for requesting review of the challenged claims," without "express[ing] its subjective agreement regarding correctness of its proffered claim constructions or . . . tak[ing] ownership of those constructions." *Id.* at 12; *Hologic, Inc. v. Enzo Life Scis., Inc.*, IPR2018-00019, Paper 21 at 5 (PTAB Nov. 28, 2018) (Decision Denying Request for Rehearing) (quoting *W. Digital Corp. v. SPEX Techs., Inc.* IPR2018-00084, Paper 14 at 11 (PTAB Apr. 25, 2018)). We also noted that in an *inter partes* review where the broadest reasonable interpretation applies, such as here, a petitioner may proffer a construction that the patent owner advocated in a different forum and may state that it disagrees that the construction is correct under the standard applied in the other forum but that it proposes the construction as the broadest reasonable interpretation of the term in question. Inst. Dec. 12; *Hologic*, Paper 21 at 5, 8. Additionally, in a broadest reasonable interpretation case, a petitioner may argue that a claim is

indefinite but still offer a construction for the claim. Inst. Dec. 12; *Hologic*, Paper 21 at 5, 7. If a petitioner is concerned that the Board may not adopt what it believes to be the proper claim construction, the petitioner may offer alternative constructions and demonstrate unpatentability under each construction. Inst. Dec. 12–13; *Hologic*, Paper 21 at 6.

In its Response, Patent Owner contends that "whether a claim term is means-plus-function (MPF) or not is the same regardless of the claim construction standard applied," and that the claim term "'power tracker' cannot be deemed MPF under *Phillips* but not MPF when BRI is applied." PO Resp. 17 (citing *Donaldson*, 16 F.3d at 1193). Pointing to Dr. Choi's deposition testimony, Patent Owner further asserts that "Petitioner's expert continues to take the position that 'power tracker' is a [means-plus-function] term in the present PTAB matter." *Id.* at 17–18 (citing Ex. 2006, 127:11–13). According to Patent Owner, "Petitioner must be held to that expert position." *Id.* at 18. Thus, Patent Owner contends, "[t]he Petition has failed [to] comply with the requirements of 37 C.F.R. §§ 42.104(b)(3)–(4)" because it "fails to present a case sufficient for the claim construction that Petitioner's expert continues to assert." *Id.*; *see also id.* ("Because the Petition fails to make the required case for the 'power tracker' that ***Petitioner's expert asserts*** is an MPF limitation, the claims are not unpatentable.").

Petitioner counters that "both parties have agreed to" the ALJ's construction in the ITC investigation and that "Patent Owner cites no authority for the proposition that a party 'must be held to' all opinions of its expert." Pet. Reply 6, 8. Petitioner adds that "nothing in *Donaldson* precludes [its] approach." Pet. Reply 7. In particular, Petitioner points out

that "the ALJ found that 'power tracker' is ***not*** a means-plus-function term, and [Petitioner] has proposed that same (non-MPF) construction here." *Id.* at 7–8. Petitioner further contends that "[i]f *Donaldson* mandates consistency between proceedings in the manner Patent Owner argues, that is all the more reason for the Board to adopt the ALJ's construction." *Id.* at 8.

According to Patent Owner, however, Petitioner "conduct[s] its unpatentability analysis under a claim construction with which it expressly disagrees," which is "improper" because "[t]he Board has repeatedly made clear that a petitioner must show 'how the construed claim is unpatentable' under 'a claim construction that it *consider[s] to be correct*.'" PO Sur-reply 5–6. As support, Patent Owner cites three Board decisions: *Hologic, Inc. v. Enzo Life Sciences, Inc.*, Paper 17 at 8–9 (PTAB Apr. 18, 2018); *Toyota Motor Corp. v. Blitzsafe Texas, LLC*, IPR2016-00422, Paper 12 at 26 (PTAB July 6, 2016); and *CareFusion Corp. v. Baxter International, Inc.*, IPR2016-01456, Paper 9 at 7 (PTAB Feb. 6, 2017). PO Sur-reply 6.

We disagree with Patent Owner's arguments. Petitioner indicates that the ALJ in the related ITC investigation determined that "power tracker" is a structural term, not a means-plus-function term, and that Petitioner therefore offers in this proceeding the ALJ's construction of that term. Pet. Reply 7–8. Petitioner's approach is reasonable. As noted above, our reviewing court has explained that whether a claim term is a means-plus-function term is the same regardless of the claim construction standard applied. *See Donaldson*, 16 F.3d at 1193 (holding that "paragraph six applies regardless of the context in which the interpretation of means-plus-function language arises, i.e., whether as part of a patentability determination in the PTO or as part of a validity or infringement determination in a court") (cited by PO Resp. 17).

Petitioner's approach also complies with 37 C.F.R. § 42.104(b)(3)–(4), which states, in pertinent part, that a petition must set forth:

> (3) How the challenged claim is to be construed. Where the claim to be construed contains a means-plus-function or step-plus-function limitation as permitted under 35 U.S.C. 112(f), the construction of the claim must identify the specific portions of the specification that describe the structure, material, or acts corresponding to each claimed function;
>
> (4) How the construed claim is unpatentable under the statutory grounds identified in paragraph (b)(2) of this section. The petition must specify where each element of the claim is found in the prior art patents or printed publications relied upon; . . . .

The plain language of 37 C.F.R. § 42.104(b)(3)–(4), as written, requires that a petition identify how the challenged claim is to be construed and how the construed claim is unpatentable, including where each element of the claim is found in the asserted prior art references. The plain language of 37 C.F.R. § 42.104(b)(3)–(4) does not prohibit a petitioner from submitting a construction adopted by a different tribunal in a related proceeding.

Our interpretation of 37 C.F.R. § 42.104(b)(3) is further supported by the rule's regulatory history. For example, in the discussion of this rule, the Patent Office states that the purpose of the petitioner's claim construction is to provide patent owners with notice as to the basis of the challenge to the claims:

> Section 42.104(b) requires that the petition identify the precise relief requested for the claims challenged. Specifically, the rule requires that the petition identify each claim being challenged, the specific grounds on which each claim is challenged, *how the claims are to be construed*, why the claims as construed are unpatentable under the identified grounds . . . .
>
> The rule provides an efficient means for identifying the legal and factual basis for satisfying the threshold for instituting *inter*

> *partes* review and *provides the patent owner with notice as to the basis for the challenge to the claims*.

Changes to Implement Inter Partes Review Proceedings, Post-Grant Review Proceedings, and Transitional Program for Covered Business Method Patents, 77 Fed. Reg. 48,679, 48,688 (Aug. 14, 2012) (codified at 37 C.F.R. pt. 42) (emphases added). The Office reiterates that purpose throughout its responses to public comment:

> *Comment 35*: Several comments recommended that the requirement for setting forth the claim construction of the challenged claims in the petition should be eliminated because, according to the comments, the requirement is burdensome and will create delays. Further, one comment suggested that claim construction should only be required to the extent necessary to establish the challenged claim is unpatentable. Other comments were in favor of the requirement.
>
> *Response*: The Office believes that the petitioner's claim construction requirement is not burdensome and will improve the efficiency of the proceeding. *In particular, the petitioner's claim construction will help to provide sufficient notice to the patent owner on the proposed grounds of unpatentability*, and assist the Board in analyzing to how a cited prior art reference meets the claim limitation(s). . . .
>
> *Comment 36*: A few comments suggested that the Office should adopt claim construction procedures similar to those in the district courts, as opposed to requiring the petitioner to submit a statement to identify how the challenged claim is to be construed.
>
> *Response*: The Office believes that the petitioner's claim construction requirement will improve the efficiency of the proceeding. As discussed previously, *the petitioner's claim construction will help to provide sufficient notice to patent owner on the proposed grounds of unpatentability*, and assist the Board in analyzing how a cited prior art meets the claim limitation.

Id. at 48,699–48,700 (emphases added). Additionally, in response to a comment from the public regarding alternative constructions, the Office states that the rule does not preclude providing alternative claim constructions in a petition:

> *Comment 40*: One comment expressed a concern as to restricting claim construction later in the proceeding and suggested that the rules should permit alternative claim construction in the petition, and revised claim construction later in the process.
>
> *Response*: *The rules do not preclude providing alternative claim constructions in a petition* or in later authorized filings.

Id. at 48,700 (emphasis added). In other words, the rule does not prohibit a petitioner from submitting a construction adopted by a different tribunal in a related proceeding, even where the petitioner argued for a different claim construction in the related proceeding. Petitioner is not required to advance a position that has been offered, and rejected, in another proceeding.

We note that Patent Owner relies on the Board decisions in *Hologic*, *Toyota*, and *CareFusion* to support its arguments. Patent Owner's reliance is misplaced, however, as the facts in those cases are distinguishable from the facts here. For example, in *Hologic*, the panel denied the petition because the petitioner stated in the petition that it was offering a construction with which it expressly disagreed. *Hologic*, Paper 17 at 8. By contrast, in this proceeding, Petitioner has not expressly disagreed with the claim construction offered in its Petition. To the contrary, Petitioner has expressly agreed with that construction by urging us to "adopt the construction of 'power tracker' that *both parties have agreed to*," namely, the ALJ's construction in the ITC investigation. *See* Pet. Reply 8 (emphasis added); *see also id.* at 5–6 ("As explained in the Petition, the Board should construe

'power tracker' as 'component in a voltage generator that computes the power requirement.' . . . In its Response, Patent Owner likewise agreed that the ALJ's construction was applicable."); *id.* at 6 (asserting that "Patent Owner cites no authority for the proposition that a party 'must be held to' all opinions of its expert," where the expert has expressed a different opinion not relied on by the party). The fact that Petitioner believes the challenged claims *also* are invalid for indefiniteness under Apple's proposed means-plus-function construction does not mean that Petitioner disagrees with the ALJ's construction or that it agrees with Apple's construction (which the ALJ has rejected). *See* Pet. 14 n.4. Nor does the fact that Dr. Choi believes "power tracker" is a means-plus-function term. *See* Ex. 2006, 127:11–13. Petitioner relies on Dr. Choi's opinions regarding how to "appl[y] the ALJ's construction to allow the Board to evaluate the claims against the cited prior art," not on his opinions as to the construction of "power tracker." Ex. 1303 ¶ 85 (cited by Pet. 14).[7]

Similar to the petitioner in *Hologic*, the petitioner in *Toyota* stated in its petition that it was offering constructions adopted by a district court with which it expressly disagreed. *Toyota*, Paper 12 at 26–27. Moreover, the panel indicated that it denied the petition partly because the petitioner did not identify the corresponding structure for a means-plus-function claim, which is required under 37 C.F.R. § 42.104(b)(3):

> [F]or the generating means, Petitioner does not offer its construction by identifying corresponding structure, material, or acts in the Specification. Instead, for the [generating] means,

[7] Although Petitioner cites paragraph 84 of Dr. Choi's declaration, we believe that Petitioner intended to cite paragraph 85, which corresponds to Dr. Choi's testimony regarding the term "power tracker."

> Petitioner asserts that there is no corresponding structure, material, or acts in the Specification of the '786 patent, and characterizes the means-plus-function element as indefinite.

Toyota, Paper 12 at 27; *see also id.* at 28 ("In any event, with regard to alleged obviousness of claims over prior art, Petitioner has not identified structure, material, and acts in the Specification of the '786 patent that correspond to the generating means of claim 92. Therefore, Petitioner has not accounted for how such unidentified structure, material, and acts would have been met by the prior art.").

The petitioner in *CareFusion* also stated in its petition that it was offering constructions with which it expressly disagreed, and the panel likewise indicated that it denied the petition partly because the petitioner did not sufficiently identify the corresponding structure for a means-plus-function claim:

> Petitioner has failed to identify the structure, material, or acts corresponding to the claimed function of generating user interface information either on the display areas (claim 1) or on the display (claims 11 and 24). Petitioner's assertion that the claim terms are indefinite does not excuse Petitioner's failure to provide the required claim construction.
>
> Petitioner's alternative argument that the corresponding structure is a generic microprocessor is also insufficient. Except for a narrow exception, the disclosure of a general purpose microprocessor as corresponding structure for a computer-implemented means-plus-function element is not sufficient—a corresponding algorithm must be disclosed. . . . Petitioner's alternative claim construction is insufficient for failure to identify a corresponding algorithm.

CareFusion, Paper 9 at 7, 9–10 (internal citation omitted); *see also id.* at 18 ("Relying on its erroneous claim construction, Petitioner identifies where [the asserted reference] discloses one or more processors. Petitioner's

erroneous claim constructions infect the anticipation and obviousness analyses of all of the challenged claims." (internal citations omitted)).

On the other hand, as discussed above, Petitioner here has offered a claim construction for "power tracker," and, in this proceeding, it has not expressly disagreed with that construction.

In view of the foregoing, we maintain our finding that Petitioner's approach in offering the ALJ's construction of "power tracker" in the related ITC investigation is acceptable under our rules. *See* Inst. Dec. 13 ("We find this approach to be acceptable under 37 C.F.R. § 42.104(b)(3).").

2. "plurality of carrier aggregated transmit signals"

This term appears in each of the challenged claims 28–30. Petitioner asserts that the ALJ in the related ITC investigation adopted Patent Owner's proposed interpretation of "plurality of carrier aggregated transmit signals," construing it to mean "signals for transmission on multiple carriers at the same time to increase the bandwidth for a user." Pet. 13; Ex. 1318, 14–17 (ITC order) (cited by Pet. 13). Petitioner "believes this construction is overbroad under *Phillips*," but "applies the ALJ's construction both as the broadest reasonable interpretation for purposes of analysis under Rule 42.100, and to show that the claims are invalid even under the Patent Owner's proposed construction." Pet. 13.

Patent Owner responds that the term "carrier aggregated transmit signals" instead means "signals from a single terminal utilizing multiple component carriers which provide extended transmission bandwidth for a user transmission from the single terminal." PO Resp. 16. As support, Patent Owner directs us to where the '675 patent teaches that "carrier

aggregation . . . is operation on multiple carriers." *Id.* at 14–15 (citing Ex. 1301, 2:63–64).[8] Patent Owner also asserts that Petitioner relies on extrinsic evidence, namely, Dahlman,[9] in its "background discussion" of carrier aggregation. *Id.* at 15. That background discussion does not provide details on carrier aggregation, instead directing us to the declaration testimony of Dr. Choi, which, in turn, relies on Dahlman. *See* Pet. 5–6 (citing Ex. 1303 ¶¶ 45–48 (citing Ex. 1306, 104)). According to Patent Owner, Petitioner, "via its citation to Dahlman, states that 'carrier aggregation' uses 'multiple component carriers' to extend 'transmission bandwidth' from a 'single terminal.'" PO Resp. 15–16 (quoting Ex. 1306, 104).[10]

In its Reply, Petitioner counters that Patent Owner's "new" construction "adds several limitations to the construction that the Patent Owner previously proposed and that the ALJ adopted: that the signals be 'from a single terminal,' that they use 'multiple component carriers,' and that they provide extended transmission bandwidth 'for a user transmission from the single terminal.'" Pet. Reply 3. Petitioner contends that "[a] construction that adds limitations to a construction advanced and adopted under the narrower *Phillips* standard cannot, by definition, be the broadest

[8] Patent Owner cites Exhibit 1001 when referring to the '675 patent in its papers. The '675 patent is entered in the record of this proceeding as Exhibit 1301. Thus, we cite Exhibit 1301 when referring to the '675 patent in this Decision.
[9] Erik Dahlman et al., 4G LTE / LTE-ADVANCED FOR MOBILE BROADBAND (Elsevier Ltd. 2011) (Ex. 1306).
[10] Patent Owner cites Exhibit 1006 when referring to Dahlman in its papers. Dahlman is entered in the record of this proceeding as Exhibit 1306. Thus, we cite Exhibit 1306 when referring to Dahlman in this Decision.

reasonable interpretation." *Id.* Petitioner also contends that Dahlman describes carrier aggregation in the context of "transmission to/from a single terminal," not just "from a single terminal." *Id.* at 4–5 (emphases omitted) (citing PO Resp. 15); *see also* Ex. 1306, 104 (cited by PO Resp. 15). Moreover, Petitioner notes, "in the ITC, Patent Owner stated expressly that the ['675] patent is 'agnostic' with respect to coverage of uplink versus downlink transmissions." Pet. Reply 4 (citing Ex. 1329, 143 (ITC hearing transcript)).

According to Patent Owner, it proposed a narrower construction of the claim term in response to Petitioner's characterization of the ITC construction as "overbroad." PO Sur-reply 2. Patent Owner asserts that "Petitioner cannot have it both ways: If the ITC construction is wrong, as Petitioner asserts, then it should not control the scope of the claim under the BRI." *Id.* at 2–3. With respect to Patent Owner's narrower construction, Patent Owner further asserts that "the added limitations about which Petitioner complains—'from a single terminal,' 'multiple component carriers,' and 'provid[ing] extended transmission bandwidth,'—come *verbatim* from the Petitioner's own evidence, Dahlman." *Id.* at 3 (internal citation omitted). Patent Owner also contends that "the natural read of the claims is that they are reciting carrier aggregated transmit signals that are transmitted *from* the mobile terminal" because "in the '675 patent, all examples are from the perspective of the wireless device 110 (*i.e.*, mobile terminal), and the claims are directed to transmitting, rather than receiving." *Id.* at 4 (internal citations omitted).

On the record before us, we determine that Patent Owner's proposed construction (i.e., "signals from a single terminal utilizing multiple

component carriers which provide extended transmission bandwidth for a user transmission from the single terminal") is overly narrow. The claims of the '675 patent recite "carrier aggregated transmit signals." The '675 patent explicitly defines "carrier aggregation" as "operation on multiple carriers," and it explicitly defines "[a] transmit signal" as "a signal comprising a transmission on one or more carriers, a transmission on one or more frequency channels, etc." Ex. 1301, 2:63–64, 3:60–62. Although Dahlman refers to *component* carriers in its discussion of carrier aggregation (*see* Ex. 1306, 104), we note that "a patentee can 'choose to be his or her own lexicographer by clearly setting forth an explicit definition for a claim term that could differ in scope from that which would be afforded by its ordinary meaning,'" *Jack Guttman, Inc. v. Kopykake Enters., Inc.*, 302 F.3d 1352, 1360 (Fed. Cir. 2002) (quoting *Rexnord Corp. v. Laitram Corp.*, 274 F.3d 1336, 1342 (Fed. Cir. 2001)). Our reviewing court has explained that "[t]he specification acts as a dictionary when it expressly defines terms used in the claims," and that such definition "[u]sually . . . is dispositive; it is the single best guide to the meaning of a disputed term." *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996). Here, the definitions provided in the '675 patent refer broadly to signals comprising transmissions on carriers; they do not support limiting "carrier aggregated transmit signals" to signals comprising transmissions on *component* carriers, as Patent Owner submits.

Further, Patent Owner's proposed construction improperly requires signals *from a single terminal*. Even if "all examples [in the '675 patent] are from the perspective of the wireless device 110 (*i.e.*, mobile terminal)," as Patent Owner argues, the specification "is not a substitute for, nor can it be

used to rewrite, the chosen claim language." *See* PO Sur-reply 4; *SuperGuide Corp. v. DirecTV Enters., Inc.*, 358 F.3d 870, 875 (Fed. Cir. 2004); *see also Liebel-Flarsheim Co. v. Medrad, Inc.*, 358 F.3d 898, 906 (Fed. Cir. 2004) (expressly rejecting "the contention that if a patent describes only a single embodiment, the claims of the patent must be construed as being limited to that embodiment"). We recognize that "understanding the claim language may be aided by the explanations contained in the written description," but "it is important not to import into a claim limitations that are not a part of the claim." *SuperGuide*, 358 F.3d at 875. Thus, "a particular embodiment appearing in the written description may not be read into a claim when the claim language is broader than the embodiment." *Id.*

In this case, the claim language itself recites nothing about signals from a single terminal. As our reviewing court has explained, "it is the *claims*, not the written description, which define the scope of the patent right." *Laitram Corp. v. NEC Corp.*, 163 F.3d 1342, 1347 (Fed. Cir. 1998). Although the '675 patent discloses examples and embodiments where the signals are from a single terminal, nowhere does the specification limit "carrier aggregated transmit signals" to those examples and embodiments. Our reviewing court has "cautioned against limiting the claimed invention to preferred embodiments or specific examples in the specification." *Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1346–47 (Fed. Cir. 2015) (quoting *Teleflex, Inc. v. Ficosa N. Am. Corp.*, 299 F.3d 1313, 1328 (Fed. Cir. 2002)). Indeed, the '675 patent states that its "disclosure is not intended to be limited to the examples and designs described." Ex. 1301, 14:21–25.

Moreover, with respect to carrier aggregation, the ’675 patent further teaches that wireless device 110 “may send and/or receive transmissions” on multiple carriers according to various combinations of bands and band groups, including three contiguous carriers in the same band, three non-contiguous carriers in the same band, three carriers in different bands in the same band group, and three carriers in different bands in different band groups. *Id.* at 3:1–35. This teaching is consistent with Dahlman’s discussion of carrier aggregation, where multiple carriers “are aggregated and jointly used for transmission *to/from* a single terminal.” *See* Ex. 1306, 104 (emphasis added) (cited by PO Resp. 15); Pet. Reply 4.

Patent Owner’s proposed construction also improperly requires providing extended transmission bandwidth for a user transmission from a single terminal. The claim language recites nothing about extended transmission bandwidth, let alone extended transmission bandwidth for a user transmission from a single terminal. Although the ’675 patent discloses an example where carrier aggregation provides such extended transmission bandwidth, nowhere does the specification limit “carrier aggregated transmit signals” to that example. *See* Ex. 1301, 2:65–67 (“Wireless device 110 *may* be configured with up to 5 carriers in one or two bands in LTE Release 11.” (emphasis added)). As discussed above, the ’675 patent states that its “disclosure is not intended to be limited to the examples and designs described.” *Id.* at 14:21–25.

Turning now to Petitioner’s proposed construction (i.e., “signals for transmission on multiple carriers at the same time to increase the bandwidth for a user”), we note its similar requirement of increasing the bandwidth for a user. Petitioner’s proposed construction is therefore also improper for the

same reasons as Patent Owner's proposed construction. In particular, the claim language recites nothing about increasing the bandwidth for a user, and nowhere does the specification limit "carrier aggregated transmit signals" to any disclosed example where carrier aggregation increases the bandwidth for a user. Moreover, during oral argument, Petitioner's counsel conceded that Petitioner "would have no objection to eliminating that ['']bandwidth for a user['] portion" because "that language itself does not come specifically from the specification." Tr. 10:22–11:17; *see id.* at 11:8–10 (Petitioner's counsel stating that "the idea of operation on multiple carriers *in our view* implies increasing bandwidth" (emphasis added)).

Additionally, we note that independent claim 28 of the '675 patent recites a "plurality of carrier aggregated transmit signals being sent simultaneously." Construing "plurality of carrier aggregated transmit signals" to mean, in part, "signals for transmission . . . at the same time" would render the claim language "being sent simultaneously" redundant and superfluous. *See Dig.-Vending Servs. Int'l, LLC v. Univ. of Phx., Inc.*, 672 F.3d 1270, 1275 (Fed. Cir. 2012) (noting "the importance of construing claim terms in light of the surrounding claim language, such that words in a claim are not rendered superfluous"); *cf.* Ex. 1318, 14 (ITC judge construing "a plurality of carrier aggregated transmit signals being sent simultaneously," not just "a plurality of carrier aggregated transmit signals"); Tr. 14:5–7 (Petitioner's counsel conceding that "if [we] were to construe the broader term, it would make that ['']at the same time['] inconsistency go away").

In view of the foregoing, we construe "plurality of carrier aggregated transmit signals" to mean "signals for transmission on multiple carriers."

Our construction is consistent with the '675 patent, which defines the term "carrier aggregation" as "operation on multiple carriers" and the term "[a] transmit signal" as "a signal comprising a transmission on one or more carriers, a transmission on one or more frequency channels, etc." *See* Ex. 1301, 2:63–64, 3:60–62. Our construction also encompasses, but is not limited to, Patent Owner's proposed construction (i.e., "signals from a single terminal utilizing multiple component carriers which provide extended transmission bandwidth for a user transmission from the single terminal").

3. "generates the single power tracking signal based on a combination of the plurality of I and Q components"

This term appears in claim 28. The parties' dispute as to the meaning of "generates the single power tracking signal based on a combination of the plurality of I and Q components" developed after institution as part of their respective analyses regarding whether the asserted references teach the recited power tracker. Following oral argument, we issued an order authorizing the parties to submit "further briefing on the meaning of the claim language 'generates the single power tracking signal based on a combination of the plurality of I and Q components.'" Paper 26, 2. Pursuant to our order, both parties filed briefs. *See* Pet. Br; PO Br.

In its brief, Petitioner argues that the claim term "generates the single power tracking signal based on a combination of the plurality of I and Q components" means "generates the single power tracking signal using a combination derived from the plurality of I and Q components." Pet. Br. 1. Petitioner asserts that the plain meaning of this claim term "requires only 'a'

combination—not any particular combination—involving the use of the I and Q components." *Id.*

By contrast, Patent Owner argues that "based on a combination of the plurality of I and Q components" means "based on the result of an addition operation of a plurality of inphase (I) component terms and a plurality of quadrature (Q) component terms," where "addition" refers to "the operation of combining numbers so as to obtain an equivalent simple quantity." PO Br. 1. According to Patent Owner, Petitioner's proposed construction equates "based on a combination of" with "based on," thereby "read[ing] out claim language added during prosecution." *Id.* To illustrate, Patent Owner points us to an amendment of claim 1, which is reproduced below. *Id.* at 1–2 (citing Ex. 1302, 189 (prosecution history file)).[11]

> 1. (Currently Amended) An apparatus comprising:
>
> a power tracker configured to determine a single power tracking signal based on a plurality of inphase (I) and quadrature (Q) components of a plurality of different transmit signals being sent simultaneously, wherein the power tracker receives the plurality of I and Q components corresponding to the plurality of different transmit signals and generates the single power tracking signal based on a combination of the plurality of I and Q components; ~~and~~
>
> a power supply generator configured to generate a single power supply voltage based on the single power tracking signal; and
>
> a power amplifier to receive the single power supply voltage and the plurality of different transmit signals being sent simultaneously and to produce a single output RF signal.

The amendment to claim 1 adds, *inter alia*, the requirement that the power tracker receives a plurality of I and Q components and generates the single

[11] Patent Owner cites Exhibit 1002 when referring to the prosecution history file for the '675 patent in its papers. The prosecution history file is entered in the record of this proceeding as Exhibit 1302. Thus, we cite Exhibit 1302 when referring to the prosecution history file in this Decision.

power tracking signal based on a combination of the plurality of I and Q components. Ex. 1302, 189 (prosecution history file). Claim 28 has the same requirement. Patent Owner contends that "[t]his amendment was made to differentiate prior art, where 'Kenington discloses multiple envelope trackers,' and 'Kenington's envelope tracker 162 receives only one I signal and one Q signal for envelope tracking[]. . . (*i.e.*, not a plurality of I and Q, as claimed).'" PO Br. 1–2 (citing Ex. 1302, 196, 221).

Patent Owner adds, "By amending, the applicant expressly disavowed implementations where there is no 'combination of the plurality of I and Q components.'" *Id.* at 2. Here, Patent Owner is referring specifically to Equation 2 of the '675 patent. Patent Owner asserts that the '675 patent "says that Eq. 2 can be implemented 'based on voltages of the plurality of transmit signals,' not a combination of I and Q components." *Id.* at 3. According to Patent Owner, "[b]ecause Eq. 2 can be implemented by combining voltage values, not all implementations of Eq. 2 have been shown to fall within the scope of claim 1." *Id.*

Petitioner counters that "[t]he claim language does not, as [Patent Owner] suggests, require combining I and Q components without any modification (*e.g.*, $I_1 + Q_1 + I_2 + Q_2$)." Pet. Br. 1. As support, Petitioner directs our attention to Equations 1 and 2 of the '675 patent, which are reproduced below. *Id.* (citing Ex. 1301, 8:6–27).

$$p(t)=\sqrt{K}\sqrt{I_1^2(t)+Q_1^2(t)+\ldots+I_K^2(t)+Q_K^2(t)}, \qquad \text{Eq (1)}$$

$$p(t)=\sqrt{I_1^2(t)+Q_1^2(t)}+\ldots+\sqrt{I_K^2(t)+Q_K^2(t)}. \qquad \text{Eq (2)}$$

In Equation 1, "the powers of all transmit signals are summed to obtain an overall power," and "[t]he digital power tracking signal [for period t] is then

obtained by taking the square root of the overall power." Ex. 1301, 8:10–21. In Equation 2, "the voltage of each transmit signal is first computed, and the voltages of all the transmit signals are then summed to obtain the digital power tracking signal." *Id.* at 8:25–32. Petitioner contends that "[b]oth equations satisfy the claim language, but neither combines the original, unmodified, I and Q components: rather, each equation squares the I and Q components before combining them." Pet. Br. 1–2.

Petitioner also directs our attention to claim 17 of the '675 patent, which depends from claim 1 and is reproduced below. *Id.* at 2.

> **17**. The apparatus of claim **1**, wherein the power tracker is configured to determine the single power tracking signal based on functions comprising:
>
> calculating $\sqrt{I_k^2(t)+Q_k^2(t)}$ corresponding to K inphase (I) and quadrature (Q) components to produce K voltages; and
>
> summing the K voltages.

Petitioner contends that claim 17 "requires determining the [single] power tracking signal [as recited in claim 1 by] using Equation 2," and that "the scope of the term at issue here (which is in every independent claim) must encompass Equation 2." *Id.*

As for Patent Owner's reliance on the prosecution history, Petitioner contends that "[n]othing in the amendment indicates a clear and unmistakable disavowal of Equation 2." *Id.* at 3 (citing *Core Wireless Licensing S.A.R.L. v. LG Elecs., Inc.*, 880 F.3d 1356, 1367 (Fed. Cir. 2018)). Petitioner asserts that "[t]he [disputed] term was added in an amendment that significantly altered several aspects of the claim, to overcome a rejection based on the Kenington reference," which the applicant argued "was distinguishable because it involved 'multiple envelope trackers' rather than

'a single power supply voltage derived from I and Q components of different transmit signals.'" *Id.* at 2–3 (citing Ex. 1302, 189–196). Additionally, Petitioner asserts that the "[a]pplicants described their invention ***broadly*** as generating a power supply voltage '***derived from I and Q components***.'" *Id.* at 3 (citing Ex. 1302, 196).

On this record, we find that Patent Owner's proposed construction improperly requires a power tracker that generates a single power tracking signal based on the result of an *addition operation* on a plurality of I and Q components. For instance, the claim language recites nothing about an addition operation. As for the written description, although it may disclose Equation 1 as an example where generating a single power tracking signal is based on the result of an addition operation on a plurality of I and Q components, as Patent Owner argues, nowhere does the written description limit the meaning of "based on a combination of" to that example. Indeed, the written description does not even use that phrase.

The prosecution history likewise says nothing about requiring an addition operation. *See generally* Ex. 1302. With respect to the cited amendment to claim 1 in particular, we note that the applicant argued that "Ken[]ington does not disclose a single power supply voltage derived from I and Q components of different transmit signals." *Id.* at 196. The term "derived from" by itself does not require an addition operation, and the applicant did not argue otherwise during prosecution.

Further, Patent Owner's contention that the amendment added the language "based on *a combination of*" to distinguish over Kenington is unavailing. Following the amendment, the Examiner explicitly disagreed with the applicant's arguments that "Kenington discloses multiple envelope

trackers driving different power supply for different transmit signals," and that "Kenington does not disclose a single power supply voltage derived from I and Q components of different transmit signals." *Id.* at 201. The Examiner continued to rely on Kenington, finding that it "teaches the power tracking signal *based on* I and Q." *Id.* at 203 (emphasis added); *see also id.* at 228–229 (Examiner stating in a subsequent advisory action that the applicant's request for reconsideration "does not overcome prior art of record," including Kenington). The applicant did not point to any distinctions between "based on" and "based on a combination of." *See generally id.* at 195–196 (Amendment & Response to Office Action, Nov. 12, 2014); *id.* at 221–223 (Amendment & Response to Office Action, Jan. 19, 2015). Notably, the Examiner stopped relying on Kenington only after the applicant amended claim 1 to recite "*carrier aggregated* transmit signals." *See id.* at 236–247 (Amendment & Response to Office Action under 37 C.F.R. § 1.116 and AFCP 2.0 Request, Mar. 6, 2015); *id.* at 266–280 (Office Action, July 2, 2015).

We turn now to Patent Owner's argument that the applicant expressly disavowed "implementations where there is no 'combination of the plurality of I and Q components,'" such as implementations of Equation 2 that combine voltage values. *See* PO Br. 2. Patent Owner contends in particular that "[b]ecause Eq. 2 can be implemented by combining voltage values, not all implementations of Eq. 2 have been shown to fall within the scope of claim 1." *Id.* at 3. We disagree. As Petitioner points out, claim 17, which depends from claim 1, "requires determining the power tracking signal using Equation 2." *See* Pet. Br. 2. Specifically, claim 17 recites, in part,

> the power tracker is configured to determine the single power tracking signal based on functions comprising:
>
> calculating $\sqrt{I_k{}^2(t) + Q_k{}^2(t)}$ corresponding to K inphase (I) and quadrature (Q) components to produce K voltages; and
>
> *summing the K voltages*.

(Emphasis added.) This claim language corresponds to the written description of Equation 2, which states,

> The quantity $\sqrt{I_k{}^2(t) + Q_k{}^2(t)}$ denotes the voltage of the k-th transmit signal in sample period t. In the design shown in equation (2), the voltage of each transmit signal is first computed, and the *voltages of all transmit signals are then summed* to obtain the digital power tracking signal.

Ex. 1301, 8:28–32 (emphasis added). Thus, the scope of claim 1 encompasses implementations of Equation 2 that combine *voltage* values, thereby undermining Patent Owner's disavowal argument. *See* PO Br. 3; *Poly-America, L.P. v. API Indus., Inc.*, 839 F.3d 1131, 1136 (Fed. Cir. 2016) ("[T]he standard for disavowal is exacting, requiring clear and unequivocal evidence that the claimed invention includes or does not include a particular feature.").

In view of the foregoing, we adopt Petitioner's proposed construction of the claim term "generates the single power tracking signal based on a combination of the plurality of I and Q components," namely, "generates the single power tracking signal using a combination derived from the plurality of I and Q components." *See* Pet. Br. 1. This construction encompasses implementations of both Equations 1 and 2 of the '675 patent, consistent with the written description's teaching that "*Equations (1) and (2)* are two exemplary designs of computing the digital power tracking signal based on the I and Q samples for all transmit signals being sent simultaneously."

Ex. 1301, 8:33–36 (emphasis added); *see also id.* at 8:47–50 ("In one design, the digital power tracking signal may be generated based on the I and Q samples for all transmit signals, without any filtering, e.g., as shown in *equation (1) or (2)*" (emphasis added).). This construction also is consistent with the prosecution history. For example, following its amendment to claim 1, which added the language "based on a combination of," the applicant indicated that the claim requires "a single power supply voltage *derived* from I and Q components of different transmit signals." *See* Ex. 1302, 196 (emphasis in italics added). Additionally, the applicant did not subsequently point to any distinctions between "based on" and "based on a combination of," even after the Examiner found that "Kenington teaches the power tracking signal *based on* I and Q." *Id.* at 203 (emphasis added).

4. "means for determining a single power tracking signal"

Claim 28 recites "means for determining a single power tracking signal based on a plurality of inphase (I) and quadrature (Q) components of a plurality of carrier aggregated transmit signals being sent simultaneously, wherein a power tracker receives the plurality of I and Q components corresponding to the plurality of carrier aggregated transmit signals and generates the single power tracking signal based on a combination of the plurality of I and Q components, where the plurality of carrier aggregated transmit signals comprise Orthogonal Frequency Division Multiplexing (OFDM) or Single Carrier Frequency Division Multiple Access (SC-FDMA) signals." The parties treat this claim limitation as a means-plus-function limitation. *See, e.g.*, Pet. 14–16; PO Resp. 18–20. We agree with this approach. *See Inventio AG v. ThyssenKrupp Elevator Americas Corp.*, 649

F.3d 1350, 1356 (Fed. Cir. 2011) ("The use of the term 'means' triggers a rebuttable presumption that § 112, ¶ 6 governs the construction of the claim term."); *see also Williamson*, 792 F.3d at 1349 (holding that "use of the word 'means' creates a presumption that § 112, ¶ 6 applies").

As noted above, construing a means-plus-function limitation involves determining the claimed function and identifying the structure or materials disclosed in the specification that correspond to the means for performing that function. *See Kemco*, 208 F.3d at 1360. Here, Petitioner contends that the claimed function is "determining a single power tracking signal based on a plurality of inphase (I) and quadrature (Q) components of a plurality of carrier aggregated transmit signals being sent simultaneously, wherein a power tracker receives the plurality of I and Q components corresponding to the plurality of carrier aggregated transmit signals and generates the single power tracking signal based on a combination of the plurality of I and Q components, wherein the plurality of carrier aggregated transmit signals comprise Orthogonal Frequency Division Multiplexing (OFDM) or Single Carrier Frequency Division Multiple Access (SC-FDMA) signals." Pet. 15. Petitioner further contends that the corresponding structure disclosed in the '675 patent is power tracker 582. *Id.* As support, Petitioner directs us to Figure 5 of the '675 patent, which is reproduced below. *Id.*

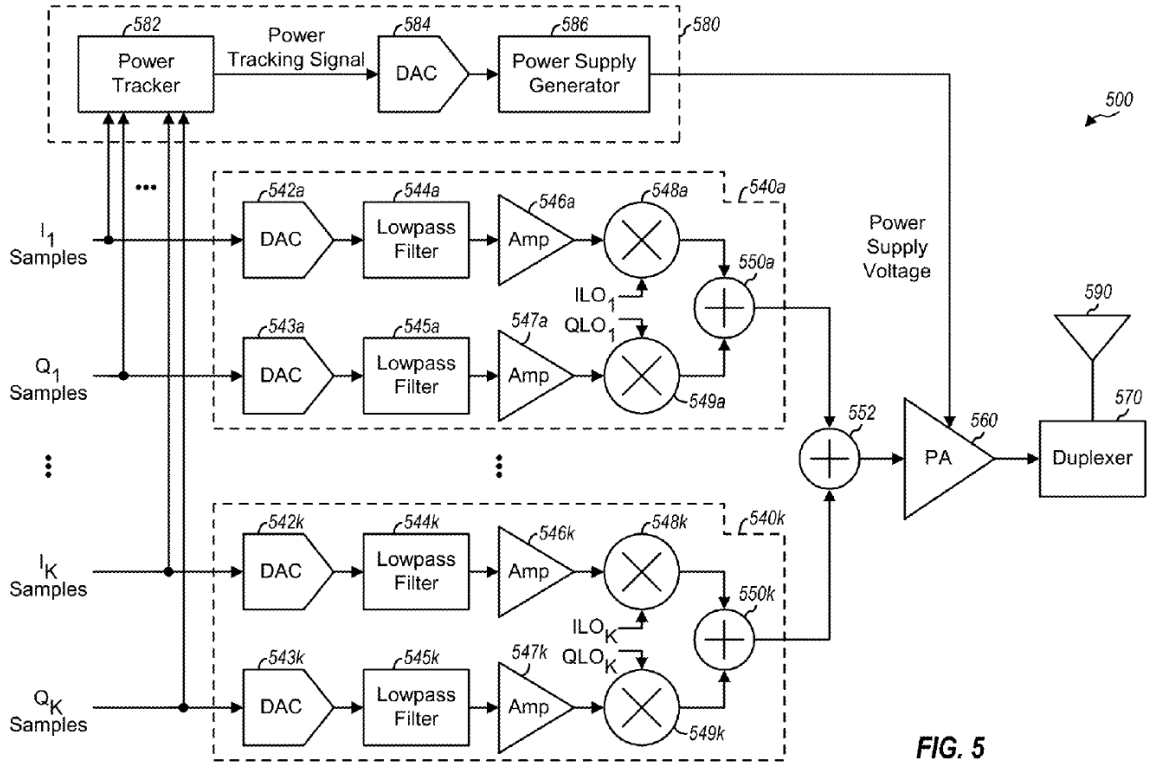


FIG. 5

Figure 5 of the ’675 patent illustrates a transmit module with power tracking for all transmit signals. Ex. 1301, 1:65–67. Petitioner notes that Figure 5 shows power tracker 582 “as a simple rectangle.” Pet. 15; *see also id.* at 18 (“[T]he patent does not provide any detail about the structure of power tracker 582.”). The ’675 patent teaches that power tracker 582 receives I and Q samples for multiple transmit signals and generates a power tracking signal based on the I and Q samples. Ex. 1301, 6:63–7:1 (“Power tracker 582 computes the overall power of all transmit signals based on the I and Q samples for these transmit signals and provides a digital power tracking signal to DAC 584.”) (cited by Pet. 15–16); *id.* at 8:6–8 (“Power tracker 582 may compute the digital power tracking signal based on the I and Q samples for all transmit signals in various manners.”) (cited by Pet. 15–16); *see also id.* at Fig. 5. The ’675 patent also teaches that the

transmit signals may comprise OFDM or SC-FDMA signals. *Id.* at 8:66–9:3 (cited by Pet. 16).

Patent Owner counters that "[t]he corresponding structure for a § 112 ¶ 6 claim for a computer-implemented function is the algorithm disclosed in the specification." PO Resp. 19 (quoting *Aristocrat*, 521 F.3d at 1333). In addition, Patent Owner asserts that "[t]he '675 patent discloses algorithms for determining its single power tracking signal," and points to Equations 1 and 2 of the '675 patent, which are reproduced below. *Id.* at 19–20 (citing Ex. 1301, 8:6–32).

$$p(t)=\sqrt{K}\cdot\sqrt{I_1^2(t)+Q_1^2(t)+\ldots+I_K^2(t)+Q_K^2(t)}, \qquad \text{Eq (1)}$$

$$p(t)=\sqrt{I_1^2(t)+Q_1^2(t)}+\ldots+\sqrt{I_K^2(t)+Q_K^2(t)}. \qquad \text{Eq (2)}$$

In Equation 1, "the powers of all transmit signals are summed to obtain an overall power," and "[t]he digital power tracking signal [for period t] is then obtained by taking the square root of the overall power." Ex. 1301, 8:10–21. In Equation 2, "the voltage of each transmit signal is first computed, and the voltages of all the transmit signals are then summed to obtain the digital power tracking signal." *Id.* at 8:25–32. Patent Owner contends that we "should incorporate the two . . . algorithms into the construction of claim 28's 'means for determining.'" PO Resp. 20.

In its Reply, Petitioner contends that "Patent Owner's argument is incorrect" because "the ***only*** component disclosed as performing the claimed function—power tracker 582—is never described as a computer or microprocessor." Pet. Reply 9. According to Petitioner, "nothing in the patent specification indicates that power tracker 582 is a computer or microprocessor, and Patent Owner provides ***no*** citation to any such

evidence." *Id.* at 8. Petitioner adds that power tracker 582 "has many possible implementations, including a standalone integrated circuit or set of integrated circuits." *Id.* at 9 (citing Ex. 1301, 13:41–50).

Patent Owner responds that "the generic hardware identified by Petitioner . . . does not actually perform the claimed function by itself, and rather, this generic hardware corresponds to the general purpose computer that the Federal Circuit has consistently found to be insufficient structure." PO Sur-reply 9 (citing *Aristocrat*, 521 F.3d at 1334). Patent Owner contends that "it is the *programming of the hardware to implement certain of the algorithms of column 8 of the '675 patent* that actually determines the single power tracking signal." *Id.* at 9–10 (citing Ex. 1301, 8:6–44). Patent Owner further contends that "[w]ithout implementing these algorithms, the generic hardware could not perform the function of determining a single power tracking signal." *Id.* at 10. Patent Owner concludes that "Petitioner's proposed construction is erroneous because it fails to include the algorithms disclosed in the specification that actually perform the recited function, and Petitioner fails to explain why these equations are not necessary for performing the recited function." *Id.*

We disagree with Patent Owner's arguments, which assume that the '675 patent's power tracker is a computer. As discussed above, we construe "power tracker" to mean "component in a voltage generator that computes the power requirement." *See supra* Part III.A.1. That is, a power tracker in the context of the '675 patent is a structural element. This interpretation is consistent with the intrinsic evidence. Although Figure 5 of the '675 patent may show power tracker 582 as a "simple rectangle," the specification of the '675 patent refers to the power tracker as "power tracking circuitry."

Ex. 1301, 8:42; *see also id.* at 13:32–35 ("The power tracker . . . may be implemented on an IC, an analog IC, an RFIC, a mixed-signal IC, an ASIC, a printed circuit board (PCB), an electronic device, etc."); Ex. 1318, 20 (ITC order stating that "power tracker" is a "structural term[] that refer[s] to [an] active circuitry component[]"). Our reviewing court has held that "the term 'circuit' connotes structure." *Power Integrations, Inc. v. Fairchild Semiconductor Int'l, Inc.*, 711 F.3d 1348, 1364 (Fed. Cir. 2013).

We note that the '675 patent specification states that "the functions described may be implemented in hardware, software, firmware, or any combination thereof." *See* Ex. 1301, 13:51–53. This statement, however, does not change the specification's description of the power tracker as circuitry. The power tracker is not a computer. *Cf. Sony Corp. v. Iancu*, 924 F.3d 1235, 1240 (Fed. Cir. 2019) ("On its face, the '676 patent refers to a computer-implementation of the reproducing means. The specification states that the 'reproducing means comprises a synthesizer 11 and a controller 13.' . . . If the controller of the reproducing means were implemented in hardware, we would expect the patent to describe or refer to the circuitry of the controller that would be required for a hardware controller to perform the claimed function. The '676 patent does not do so. Therefore, . . . we think that the reproducing means is necessarily construed as computer-implemented based on the specification."). Accordingly, contrary to Patent Owner's position, Petitioner need not identify an algorithm for the corresponding structure.

In view of the foregoing, we determine that the "means for determining a single power tracking signal" limitation is in means-plus-function format, and we adopt Petitioner's proposed construction of the

limitation. Specifically, we determine the claimed function to be "determining a single power tracking signal based on a plurality of inphase (I) and quadrature (Q) components of a plurality of carrier aggregated transmit signals being sent simultaneously, wherein a power tracker receives the plurality of I and Q components corresponding to the plurality of carrier aggregated transmit signals and generates the single power tracking signal based on a combination of the plurality of I and Q components, wherein the plurality of carrier aggregated transmit signals comprise Orthogonal Frequency Division Multiplexing (OFDM) or Single Carrier Frequency Division Multiple Access (SC-FDMA) signals." As for the corresponding structure, we identify the '675 patent's power tracker 582, which we find to be a circuit, not a computer. This is consistent with our construction of "power tracker" as a structural term. We note that neither party disputes our construction of "power tracker" for purposes of this proceeding. *See supra* Part III.A.1.

5. "means for generating a single power supply voltage"

Claim 28 recites "means for generating a single power supply voltage based on the single power tracking signal." The parties also treat this claim limitation as a means-plus-function limitation. *See, e.g.*, Pet. 16–17; PO Resp. 20–22. We agree with this approach. *See Inventio*, 649 F.3d at 1356.

Petitioner contends that the claimed function is "generating a single power supply voltage based on the single power tracking signal." Pet. 16. Petitioner further contends that power supply generator 586 is the corresponding structure disclosed in the '675 patent. *Id.* at 17. As support, Petitioner directs us to where the '675 patent teaches that "[t]he power

supply generator generates a power supply voltage based on the power tracking signal." *Id.* (citing Ex. 1301, 1:45–47, 7:6–8, 9:44–46).

In response, Patent Owner contends that Petitioner's proposed construction "is incorrect because it ignores certain components that the '675 [patent] describes as performing the function of generating [a] single power supply voltage *based on the single power tracking signal*." PO Resp. 21. Patent Owner asserts that "Figures 5 and 6 and their associated description in columns 6–8 [of the '675 patent] are clear in showing that the example single 'power tracking signal' is the output of power tracker 582 and the 'single power supply voltage' is the output of power supply generator 586." *Id.* Patent Owner further points out that "[b]etween those two signals is both *digital to analog converter 584* and the power supply generator 586." *Id.*; *see also* PO Sur-reply 10–11. According to Patent Owner, "[t]he construction of claim 28's 'means for generating' should be adjusted to incorporate digital to analog converter 584, which both Figures 5 and 6 illustrate as contributing to generating a single power supply voltage based on the single power tracking signal." PO Resp. 22.

Petitioner counters that "[t]he ***only*** component clearly linked to the claimed function of 'generating a single power supply voltage based on the single power tracking signal' is power supply generator 586." Pet. Reply 10 (citing Ex. 1301, 1:45–47, 7:6–8, 9:44–46). Petitioner further notes that "the ***only*** functions performed by the DAC 584 disclosed in the specification are 'convert[ing] the digital power tracking signal to analog' and 'provid[ing] an analog power tracking signal for all transmit signals.'" *Id.* at 11 (citing Ex. 1301, 7:1–8). According to Petitioner, "[t]he specification never describes the DAC as ***generating*** the power supply voltage, nor has the

Patent Owner cited any such disclosure." *Id.* Petitioner adds that the "means for generating a single power supply voltage" limitation "does not require the power supply voltage to be generated based on a digital signal, so DAC 584 is not a necessary part of the structure disclosed for generating the power supply voltage." *Id.* at 11 n.3.

We agree with Petitioner. As noted above, "structure disclosed in the specification is corresponding structure only if the specification or prosecution history clearly links or associates that structure to the function recited in the claim." *Aoyama*, 656 F.3d at 1297. The '675 patent teaches that "[t]he *power supply generator* generates a power supply voltage based on the power tracking signal." Ex. 1301, 1:45–47 (emphasis added); *see also id.* at 9:44–46 ("Power supply generator 586 may generate a power supply voltage for PA 560 based on a power tracking signal in various manners."). In particular,

> Power tracker 582 computes the overall power of all transmit signals based on the I and Q samples for these transmit signals and provides a digital power tracking signal to a DAC 584. DAC 584 converts the digital power tracking signal to analog and provides an analog power tracking signal for all transmit signals. . . . A power supply generator 586 receives the analog power tracking signal and generates a power supply voltage for PA 560.

Ex. 1301, 6:65–7:8. The only signal that DAC 584 generates is an analog power tracking signal. DAC 584 does not generate a power supply voltage. That both DAC 584 and power supply generator 586 are located between the digital power tracking signal and the power supply voltage does not mean both DAC 584 and power supply generator 586 generate the power supply voltage. The '675 patent teaches explicitly that DAC 584 generates an

analog power tracking signal based on the digital power tracking signal, and power supply generator 586 in turn generates a power supply voltage based on the analog power tracking signal. *See id.* at 1301, 6:65–7:8, Fig. 5.

In view of the foregoing, we determine that the "means for generating a single power supply voltage" limitation is in means-plus-function format, and we adopt Petitioner's proposed construction of the limitation. In particular, we determine that the claimed function is "generating a single power supply voltage based on the single power tracking signal." We further identify power supply generator 586 as the corresponding structure disclosed in the '675 patent.

B. Obviousness over Yu, Wang, and Choi

Petitioner asserts that claims 28–30 of the '675 patent would have been obvious over Yu, Wang, and Choi. Pet. 24–79. Patent Owner traverses this ground. PO Resp. 30–41, 45–47. For the reasons explained below, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 28–30 would have been obvious over Yu, Wang, and Choi.

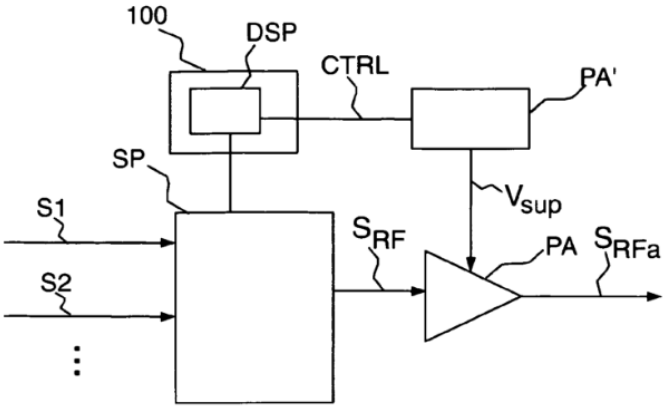
We start with an overview of the asserted references.

1. Yu

Yu states that its "inventive principle may be considered as an extension to the known principle of envelope-tracking amplifiers, which determine an envelope signal of the radio frequency signal to be amplified, and which control the voltage supply to the power amplifier depending on

said envelope signal." Ex. 1304 ¶ 8. Figure 1, which is reproduced below, illustrates a power amplifier system according to Yu. *Id.* ¶ 33.

Fig. 1



As Figure 1 shows, Yu's power amplifier system includes signal processing unit SP, control unit 100, and power amplifier PA. *Id.* ¶¶ 33, 37–38. Input signals S1 and S2 are forwarded to signal processing unit SP, which transforms the input signals into radio frequency signal S_{RF}. *Id.* ¶ 37. Power amplifier PA is configured to amplify radio frequency signal S_{RF}, which is fed to an input of power amplifier PA. *Id.* ¶ 33. Power amplifier PA comprises power amplifier supply voltage module PA'. *Id.* ¶ 35. Power amplifier supply voltage module PA' is configured to modify supply voltage Vsup, which is applied to power amplifier PA. *Id.*

Control unit 100 is used to control the operation of power amplifier PA and its supply voltage module PA'. *Id.* ¶ 38. Control unit 100 has digital signal processing means DSP, which derive control signal CTRL based on input signals S1 and S2. *Id.* According to Yu, by deriving control signal CTRL in this way, "an improved supply voltage control for the power amplifier PA as compared to conventional envelope tracking systems may

be obtained, especially in such cases, where more than one input signal S1, S2, . . . is to be processed to obtain said RF signal S_{RF}." *Id.* ¶ 39.

2. Wang

Wang describes an envelope-tracking power amplifier system. Ex. 1305, 1244 (Title, Abstract). In Wang, the input signal is a complex baseband signal whose amplitude is $A = (I^2 + Q^2)^{1/2}$, where I and Q are the real and imaginary parts of the complex baseband signal. *Id.* at 1245, Fig. 3.

3. Choi

Choi describes a supply modulator for envelope tracking. Ex. 1308, at Ex. A, at 1074. To illustrate, Figure 5 of Choi is reproduced below.

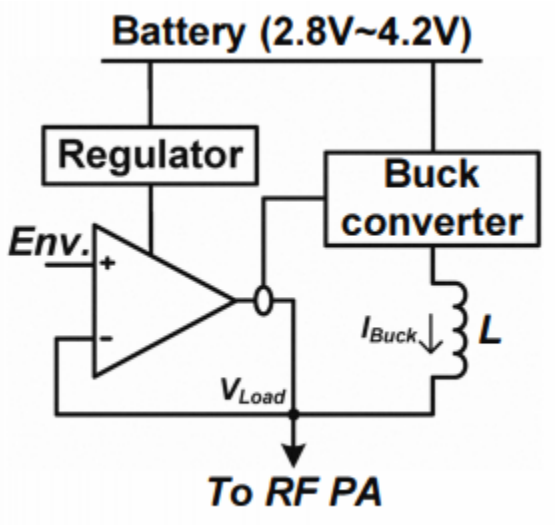


Fig. 5. Battery-to-5V boosting PA supply modulator.

Figure 5 of Choi shows the architecture of a power amplifier supply modulator that dynamically regulates a power amplifier. *Id.* The supply modulator employs a hybrid switching amplifier (HSA), which comprises the linear amplifier, regulator, and switching buck converter. *Id.* at 1074, Fig. 4. The linear amplifier receives an envelope signal designated as

"Env." *See id.* at Fig. 5. The regulator operates as an independent voltage source, and the buck converter operates as a dependent current source, supplying most of the current needed at the output. *Id.* at 1075. A current sensing unit detects the current flowing from the linear amplifier to the output and changes the state of the switching amplifier according to the sensed current. *Id.* An additional boost converter, whose input range is from 2.8 V to 4.2 V, is coupled to the supply of the linear amplifier, which regulates the load voltage. *Id.*

4. Independent Claim 28

Independent claim 28 recites an apparatus comprising "means for determining a single power tracking signal," "means for generating a single power supply voltage based on the single power tracking signal," and "means for receiving the single power supply voltage and the plurality of carrier aggregated transmit signals . . . and producing a single output radio frequency (RF) signal."

a. "means for determining a single power tracking signal"

Claim 28 recites "means for determining a single power tracking signal based on a plurality of inphase (I) and quadrature (Q) components of a plurality of carrier aggregated transmit signals being sent simultaneously, wherein a power tracker receives the plurality of I and Q components corresponding to the plurality of carrier aggregated transmit signals and generates the single power tracking signal based on a combination of the plurality of I and Q components, wherein the plurality of carrier aggregated transmit signals comprise Orthogonal Frequency Division Multiplexing

(OFDM) or Single Carrier Frequency Division Multiple Access (SC-FDMA) signals."

As discussed above in the Claim Construction section, we construe this limitation as a means-plus-function limitation. *See supra* Part III.A.4. The claimed function is "determining a single power tracking signal based on a plurality of inphase (I) and quadrature (Q) components of a plurality of carrier aggregated transmit signals being sent simultaneously, wherein a power tracker receives the plurality of I and Q components corresponding to the plurality of carrier aggregated transmit signals and generates the single power tracking signal based on a combination of the plurality of I and Q components, wherein the plurality of carrier aggregated transmit signals comprise Orthogonal Frequency Division Multiplexing (OFDM) or Single Carrier Frequency Division Multiple Access (SC-FDMA) signals." *Id.* The corresponding structure is the '675 patent's power tracker 582. *Id.*

We further construe "power tracker" to mean "component in a voltage generator that computes the power requirement." *See supra* Part III.A.1. In addition, we construe "plurality of carrier aggregated transmit signals" to mean "signals for transmission on multiple carriers." *See supra* Part III.A.2. Lastly, we construe "generates the single power tracking signal based on a combination of the plurality of I and Q components" to mean "generates the single power tracking signal using a combination derived from the plurality of I and Q components." *See supra* Part III.A.3.

For the "means for determining a single power tracking signal" limitation, Petitioner relies on both Yu and Wang. With respect to the claimed function, Petitioner identifies Yu's control unit 100 as a "power tracker," Yu's control signal CTRL as a "single power tracking signal," and

Yu's input signals S1 and S2 as "carrier aggregated transmit signals." Pet. 26, 28, 31. Petitioner asserts that control unit 100 is "in Yu's voltage generation circuitry." *Id.* at 25. To illustrate, Petitioner provides an annotated version of Figure 3 of Yu, which is reproduced below. *Id.* at 27.

Fig. 3

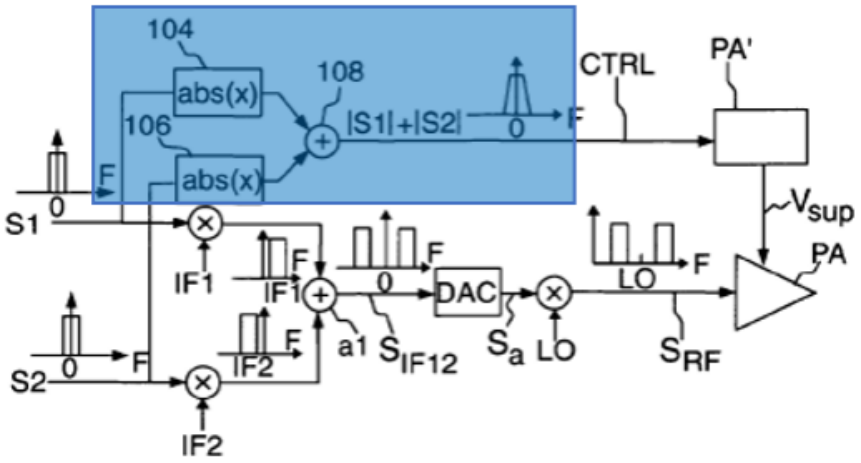


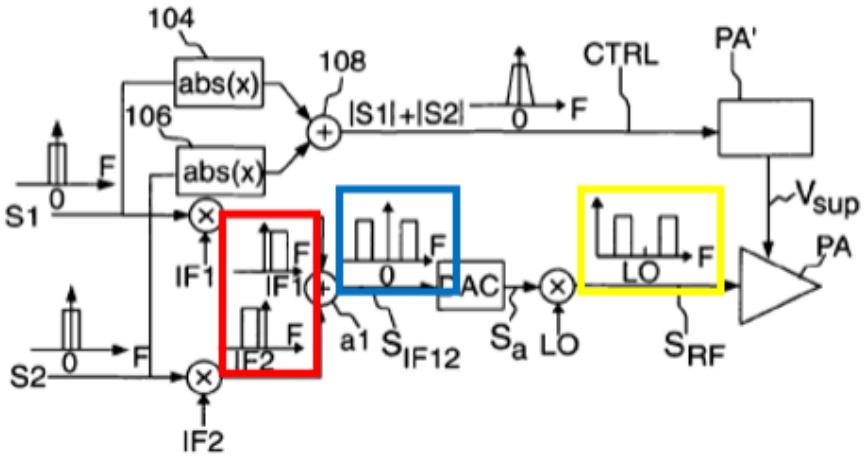
Figure 3 of Yu is a signal flow diagram. Ex. 1304 ¶¶ 32, 57. Petitioner directs us to where Yu teaches that control unit 100 may comprise function blocks 104 and 106 as well as adder 108. Pet. 26–27 (citing Ex. 1304 ¶ 66); *see also* Ex. 1304, Fig. 1 (control unit 100), Fig. 3 (blocks 104, 106 and adder 108). The annotated figure highlights Yu's blocks and adder in blue. *See* Pet. 27. Petitioner further directs us to where Yu teaches that blocks 104 and 106 receive input signals S1 and S2, respectively, and calculate the absolute values of those signals. *Id.* (citing Ex. 1304 ¶ 57).

Figure 3 of Yu shows that adder 108 combines the absolute values of input signals S1 and S2, and then outputs control signal CTRL. Ex. 1304, Fig. 3; *see also id.* ¶ 57 (cited by Pet. 27). Petitioner contends that "Yu's summing of the absolute values of the signals—(|S1| + |S2|)—is mathematically the same as the I/Q formula disclosed for determining the

power tracking signal in Equation 2 of the '675 patent." Pet. 37–38 (citing Ex. 1301, 8:23–29; Ex. 1303 ¶ 129). According to Petitioner, "the absolute value of an I/Q signal is equal to the magnitude of the signal, which is a proxy for the signal's power, and the sum of the two signals' magnitudes is a proxy for the power required to transmit the aggregated signals." *Id.* at 36–38 (footnote omitted) (citing Ex. 1303 ¶ 129). As discussed below in further detail, Petitioner contends that Yu's signals S1 and S2 include I and Q components, or, alternatively, that it would have been obvious to modify Yu in view of Wang to include signals with I and Q components. Petitioner further notes that Yu teaches using control signal CTRL for modifying supply voltage Vsup, which is applied to power amplifier PA. Pet. 28; Ex. 1304 ¶¶ 35, 37.

Regarding Yu's signals S1 and S2, Petitioner additionally directs us to where Yu teaches simultaneously processing the input signals. Pet. 31 (citing Ex. 1304 ¶ 15); *see also* Ex. 1304 ¶ 16 ("[B]oth input signals may simultaneously be processed by the digital signal processing means."). Petitioner also directs us to another annotated version of Figure 3 of Yu, which is reproduced below. Pet. 32.

Fig. 3



As discussed above, Figure 3 of Yu is a signal flow diagram. Ex. 1304 ¶¶ 32, 57. Petitioner asserts that signals S1 and S2 are upconverted to different intermediate frequencies, as shown in the red box. Pet. 32 (citing Ex. 1304 ¶ 48). Petitioner further asserts that the difference in frequencies is maintained when the signals are subsequently summed by adder a1, as shown in the blue box, and when they are upconverted again to different RF center frequencies, as shown in the yellow box. *Id.* Petitioner contends that the annotated portions of Figure 3 show that Yu's signals S1 and S2 are transmitted on multiple carriers at the same time. *Id.* at 31–32. Petitioner relies on the declaration testimony of Dr. Choi. *Id.* at 33 (citing Ex. 1303 ¶¶ 124–126).

Petitioner submits, however, "Yu does not expressly mention inphase (I) and quadrature (Q) components of the input signals, but a [person of ordinary skill in the art] would have understood that the input signals S1 and S2 are digital signals for wireless transmission and that each signal would have I and Q components." *Id.* at 34. Petitioner directs us to where Yu describes input signals S1 and S2 as digital baseband signals, and contends

that "at the time Yu was published, the standard practice for RF communication systems processing digital signals was to use I/Q components." *Id.* (citing Ex. 1304 ¶ 20); *see also* Ex. 1303 ¶ 128 (cited by Pet. 36).

Alternatively, Petitioner points to Wang for teaching the recited I and Q components. Pet. 38. According to Petitioner, even if Yu does not disclose I and Q signals, "it still would have been obvious to use Wang's I/Q signal processing with Yu's power tracker." *Id.* Petitioner directs us to where Wang teaches receiving a "complex baseband signal," which Petitioner asserts "is understood to comprise I and Q components." *Id.* at 38–39 (citing Ex. 1305, 1245, Fig. 3). Petitioner further draws our attention to Wang's teaching that "[t]he amplitude is $A = (I^2 + Q^2)^{1/2}$, where I and Q are the real and imaginary parts of the complex baseband signal." *Id.* at 39 (citing Ex. 1305, 1245). Petitioner contends that an ordinarily skilled artisan "would have been motivated to use Wang's I/Q signal processing in Yu" because "[i]f a [person of ordinary skill in the art] had any doubt about what type of signaling to use, she would have looked to Wang, a reference in the same field that provides those details." *Id.* at 40–41. In addition, Petitioner contends that "[c]omplex input signals (with I and Q components) improve immunity to transmit signal noise, and allow the use of advanced (higher order) modulation techniques such as quadrature phase-shift keying (QPSK), which doubles the data rate by increasing the number of bits per symbol that can be transmitted within the same bandwidth, compared with a method such as binary phase-shift keying (BPSK)." *Id.* at 41 (citing Ex. 1321, 308). Petitioner relies on the declaration testimony of Dr. Choi. *Id.* (citing Ex. 1303 ¶ 134).

Petitioner also points to Wang for teaching Orthogonal Frequency Division Multiplexing (OFDM) signals. *Id.* at 43 (citing Ex. 1305, 1244 (title), 1253). According to Petitioner, "Yu does not explicitly disclose which modulation technique to use for transmitting signals through the power amplifier," and an ordinarily skilled artisan "would have looked to Wang, a reference in the same field, to determine a modulation technique." *Id.* at 43. In addition, Petitioner contends that "OFDM had many advantages, including the ability to adapt to degraded channel conditions without complex equalization filters, and robustness against various forms of interference." *Id.* at 44–45 (citing Ex. 1322 ¶¶ 2–3). Petitioner relies on the declaration testimony of Dr. Choi. *Id.* (citing Ex. 1303 ¶ 140).

With respect to the corresponding structure, namely, the '675 patent's power tracker 582, Petitioner contends that "Yu's power tracker []as modified in view of Wang . . . is identical, or at a minimum, equivalent to the power tracker disclosed in the '675 patent." *Id.* at 46. According to Petitioner, "the power tracker in Yu . . . is a more detailed version of the power tracker disclosed in the '675 patent," but "[a]ny differences between the power tracker in the '675 patent and the power tracker in Yu would be insubstantial." *Id.* at 46–48. As support, Petitioner asserts that, "[a]s modified in view of Wang, Yu's power tracker operates in substantially the same way as the power tracker described in the '675 patent" because "it receives I/Q components for multiple transmit signals and generates a single power tracking signal based on a combination of the I/Q components." *Id.* at 48. Petitioner additionally asserts that "Yu's power tracker also achieves substantially the same result as the '675 patent structure," that is, "a single power tracking signal for multiple transmit signals that is provided to a

power supply generator for a PA." *Id.* Petitioner relies on the declaration testimony of Dr. Choi. *Id.* (citing Ex. 1303 ¶ 144).

Based on Petitioner's argument and evidence, we are persuaded that the proposed combination of Yu and Wang teaches the recited "means for determining a single power tracking signal" limitation in claim 28. With respect to the recited I and Q components in particular, we are persuaded that Yu's signals S1 and S2 would have been understood to include I and Q components. *See, e.g.*, Ex. 1303 ¶ 128. We also are persuaded that Petitioner's proffered reasoning for modifying Yu to include Wang's baseband signal (comprising an OFDM signal with I and Q components), namely, to provide a way to carry out Yu's signaling, 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 disputes certain aspects of Petitioner's analysis regarding the corresponding structure for this limitation as well as the recited "power tracker." *See* PO Resp. 30–41, 45–46. We address the parties' disputes in further detail below. *See infra* Parts III.B.6.a, III.B.6.c–e.

b. "means for generating a single power supply voltage"

Claim 28 further recites "means for generating a single power supply voltage based on the single power tracking signal." As discussed above, this limitation is a means-plus-function limitation, where the claimed function is "generating a single power supply voltage based on the single power tracking signal," and the corresponding structure is the '675 patent's power supply generator 586. *See supra* Part III.A.5.

Petitioner relies on Yu and Choi. With respect to the claimed function, Petitioner identifies Yu's supply voltage Vsup as a "single power supply voltage." Pet. 57–58. To illustrate, Petitioner provides an annotated version of Figure 3 of Yu, which is reproduced below. *Id.* at 49.

Fig. 3

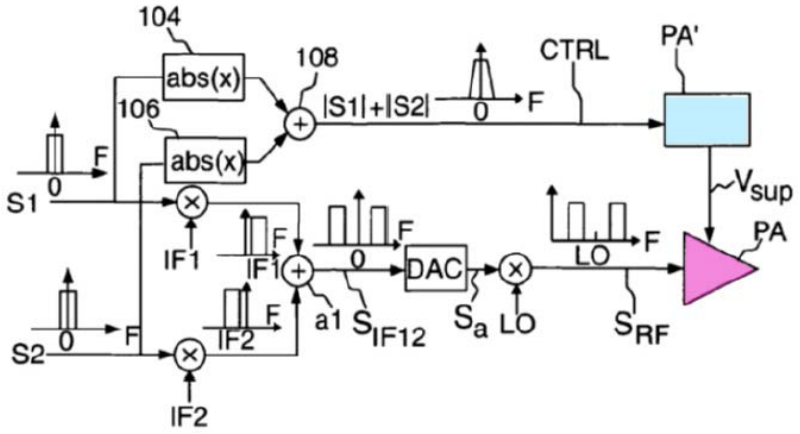


Figure 3 of Yu is a signal flow diagram. Ex. 1304 ¶¶ 32, 57. Petitioner directs us to where Yu teaches using control signal CTRL (which Petitioner identifies as the "single power tracking signal") to control the value of supply voltage Vsup via power amplifier supply voltage module PA'. Pet. 49 (citing Ex. 1304 ¶ 52); *see also* Ex. 1304, Fig. 3; *id.* ¶ 57 ("[T]he supply voltage Vsup for the power amplifier PA is again determined depending on said control signal CTRL.") (cited by Pet. 58). The annotated figure shows power amplifier supply voltage module PA' (shown with blue shading) receiving control signal CTRL and outputting supply voltage Vsup.

Petitioner asserts that "Yu does not disclose the internal structure of its power supply generator (PA'), but . . . it would have been obvious to implement Yu's power supply generator using the structure disclosed in Choi." Pet. 49. As support, Petitioner directs us to an annotated version of Figure 5 of Choi, which is reproduced below. *Id.* at 51.

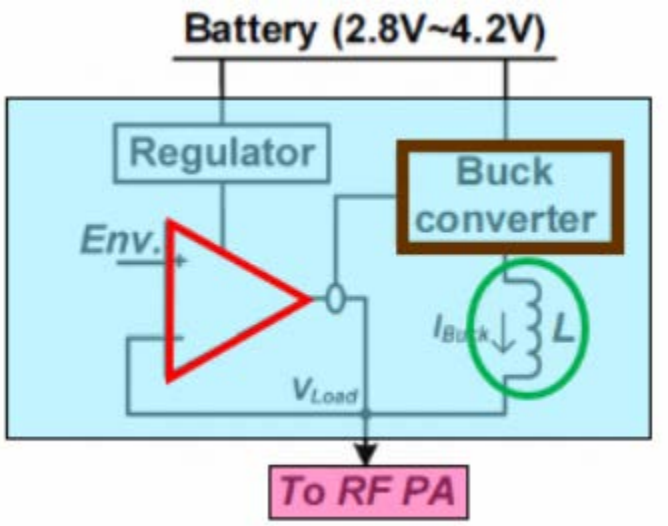


Fig. 5. Battery-to-5V boosting PA supply modulator.

Figure 5 of Choi shows the architecture of a power amplifier supply modulator, which employs a hybrid switching amplifier that dynamically regulates a power amplifier. Ex. 1308, at Ex. A, at 1074, Fig. 4. The hybrid switching amplifier includes a linear amplifier and buck converter. *Id.* at Figs. 4, 5 (cited by Pet. 50). Referring to its annotated figure, Petitioner indicates that the linear amplifier is outlined in red and the buck converter is outlined in brown. *Id.* at 50. Petitioner contends that "[t]he linear amplifier receives a power tracking signal Env and generates the power supply voltage V_{Load} for the power amplifier," which is highlighted in pink. *Id.* at 51. Petitioner further contends that "Choi discloses a specific implementation of a power supply generator that a [person of ordinary skill in the art] would have been motivated to use in a system such as Yu." *Id.* at 54. In addition, according to Petitioner, Choi's hybrid switching amplifier "is advantageously robust against battery depletion" and "can reduce waste of power and increase efficiency." *Id.* at 54–55. Petitioner relies on the declaration testimony of Dr. Choi. *Id.* (citing Ex. 1302 ¶¶ 152–153).

With respect to the corresponding structure, namely, the ’675 patent’s power supply generator 586, Petitioner directs us to an annotated version of Figure 8 of the ’675 patent, which is reproduced below. *Id.* at 56.

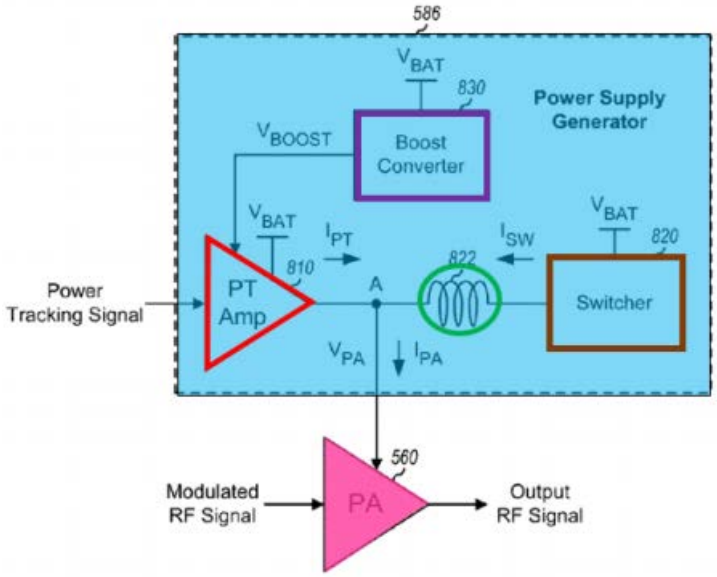
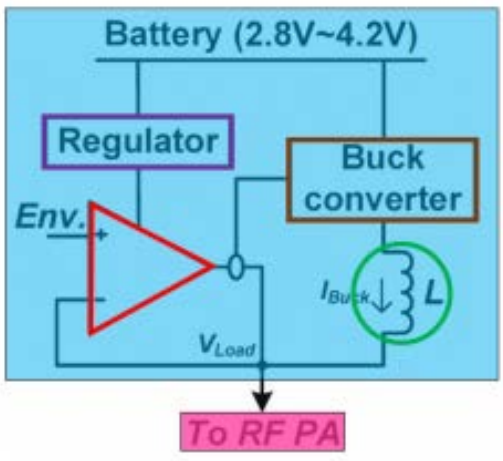


FIG. 8

Figure 8 of the ’675 patent shows the design of a power supply generator with power tracking. Ex. 1301, 2:3–4. Petitioner also directs us to an annotated version of Figure 5 of Choi, which is reproduced below.



As discussed above, Figure 5 of Choi shows the architecture of a power amplifier supply modulator that dynamically regulates a power amplifier.

Ex. 1308, at Ex. A, at 1074. Petitioner contends that "[t]he supply voltage generator (PA') in Yu (as modified in view of Choi) is identical, or at a minimum, equivalent to the power supply generator disclosed in the '675 patent." *Id.* at 57. According to Petitioner, "the power supply generators in Choi and in Figure 8 of the '675 patent are identical" because both include a power tracking amplifier (outlined in red), a boost converter (outlined in purple), a switcher (outlined in brown), an inductor (outlined in green), and a power amplifier (highlighted in pink). *Id.* at 57–59. Petitioner also contends that "[a]ny differences between the power supply generator in the '675 patent and the power supply generator in Yu (as modified by Choi) would be insubstantial," as they operate in substantially the same way by "us[ing] a linear amplifier that receives an envelope signal and works in conjunction with a switcher/buck converter to generate a supply voltage based on the envelope signal," and they achieve substantially the same result by "provid[ing] an envelope-tracking power supply for a PA." *Id.* at 59. Petitioner relies on the declaration testimony of Dr. Choi. *Id.* (citing Ex. 1303 ¶ 158).

Based on Petitioner's argument and evidence, we are persuaded that the proposed combination of Yu, Wang, and Choi teaches the recited "means for generating a single power supply voltage" limitation. We also are persuaded that Petitioner's proffered reasoning for further modifying the combination of Yu and Wang to include Choi's hybrid switching amplifier, namely, to provide implementation details for Yu's power amplifier supply voltage module PA', is sufficient to support the legal conclusion of obviousness. *See Kahn*, 441 F.3d at 988.

Patent Owner disputes certain aspects of Petitioner's analysis regarding the corresponding structure for this limitation. *See* PO Resp. 46–47. We address the parties' disputes in further detail below. *See infra* Part III.B.6.b.

c. "means for receiving the single power supply voltage and the plurality of carrier aggregated transmit signals . . . and producing a single output radio frequency (RF) signal"

Lastly, claim 28 recites "means for receiving the single power supply voltage and the plurality of carrier aggregated transmit signals being sent simultaneously and producing a single output radio frequency (RF) signal." Petitioner contends that this limitation is a means-plus-function limitation. Pet. 17–18. Petitioner identifies the claimed function as "receiving the single power supply voltage and the plurality of carrier aggregated transmit signals being sent simultaneously and producing a single output radio frequency (RF) signal." *Id.* at 17. Petitioner further identifies power amplifier 560 as the corresponding structure disclosed in the '675 patent. *Id.* at 18. As support, Petitioner directs us to where the '675 patent teaches that power amplifier 560 receives a power supply voltage from voltage generator 580, receives a modulated RF signal comprising the carrier aggregated transmit signals being sent simultaneously, and provides an output RF signal for all transmit signals being sent simultaneously. *Id.* (citing Ex. 1301, 6:59–62, 7:58–60, 7:62–64, Fig. 5).

For this limitation, Petitioner relies on Yu. With respect to the claimed function, Petitioner provides an annotated version of Figure 3 of Yu, which is reproduced below. *Id.* at 60.

Fig. 3

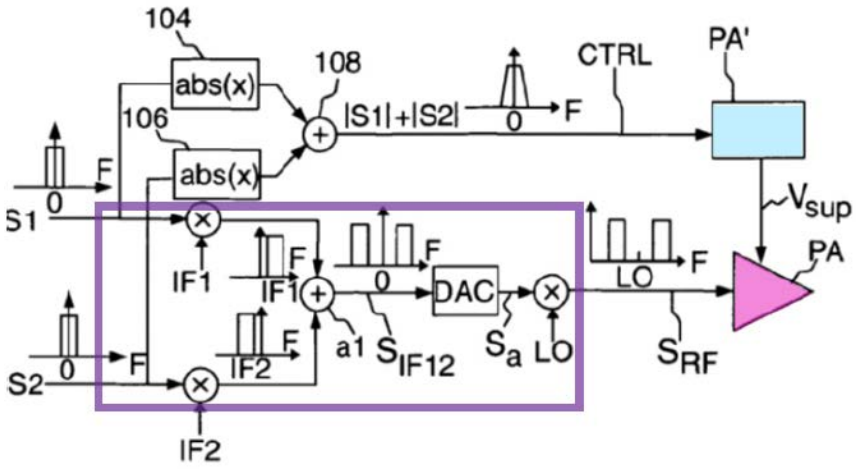
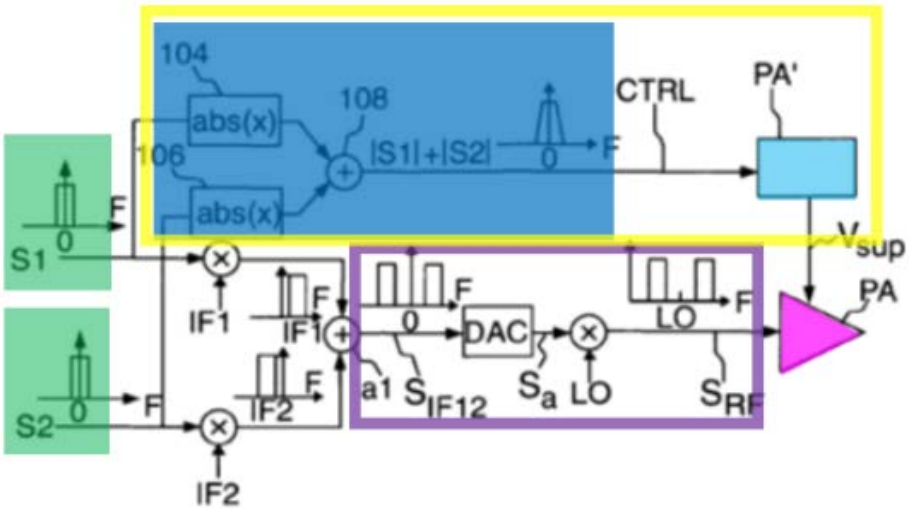


Figure 3 of Yu depicts a signal flow diagram. Ex. 1304 ¶¶ 32, 57. Referring to its annotated version of Figure 3, Petitioner contends that Yu teaches that power amplifier PA receives supply voltage Vsup (which Petitioner identifies as the "single power supply voltage") from power amplifier supply voltage module PA' (shown with blue shading). Pet. 59. The annotated figure shows power amplifier PA (shown with pink shading) receiving supply voltage Vsup.

Petitioner further contends that Yu's power amplifier PA also receives input signals S1 and S2 (which Petitioner identifies as the "plurality of carrier aggregated transmit signals"). *Id.* at 61. Referring still to its annotated version of Figure 3, Petitioner explains that Yu's input signals S1 and S2 are fed into signal processing unit SP, which is outlined in purple, and are output to power amplifier PA, which is shown in pink. *Id.* Petitioner also explains that "the output of the SP block (S_{RF} . . .) comprises the two input signals, at upconverted frequencies." *Id.* (citing Ex. 1304 ¶ 41). In addition, Petitioner directs us to where Yu teaches that, "at an output of the power amplifier PA, an amplified radio frequency signal S_{Rfa} is

obtained." *Id.* at 62 (citing Ex. 1304 ¶ 33); *see also* Ex. 1304, Fig. 1. We find that Yu's signal S_{Rfa} corresponds to the recited "single output radio frequency (RF) signal."

With respect to the corresponding structure, namely, the '675 patent's power amplifier 560, Petitioner directs us to an annotated version of Figure 3 of Yu, which is reproduced below. Pet. 63.



As discussed above, Figure 3 of Yu depicts a signal flow diagram. Ex. 1304 ¶¶ 32, 57. Petitioner also directs us to an annotated version of Figure 6 of the '675 patent, which is reproduced below. *Id.*

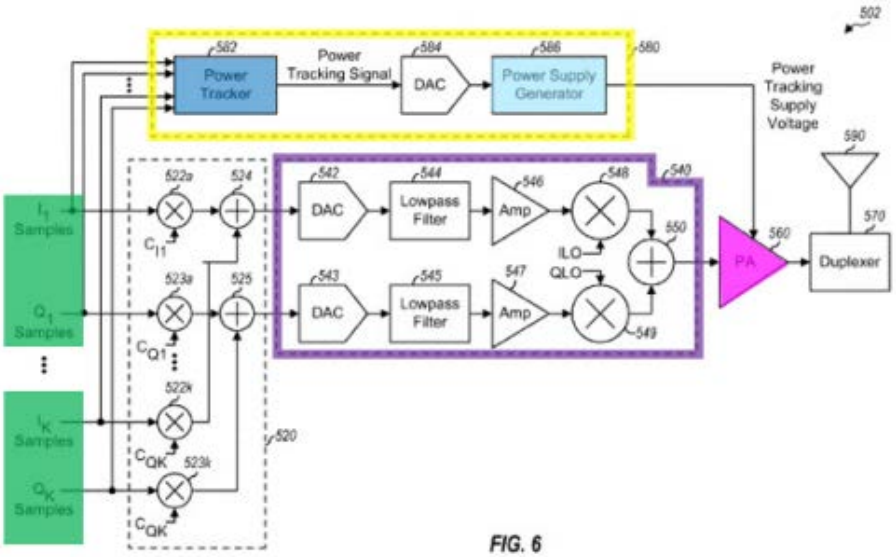


Figure 6 of the ’675 patent shows a design of a transmit module comprising a single power amplifier with power tracking for all transmit signals. Ex. 1301, 1:65–67. Relying on the declaration testimony of Dr. Choi, Petitioner contends that “[t]he power amplifier disclosed in Yu (highlighted . . . in pink) is identical to the power amplifier disclosed in the ’675 patent.” Pet. 62–63 (citing Ex. 1303 ¶ 163).

Based on Petitioner’s argument and evidence, we are persuaded that the proposed combination of Yu, Wang, and Choi teaches the recited “means for receiving the single power supply voltage and the plurality of carrier aggregated transmit signals being sent simultaneously and producing a single output radio frequency (RF) signal.” Patent Owner does not dispute Petitioner’s analysis for this limitation. *See generally* PO Resp.

5. Dependent Claims 29 and 30

Claim 29 depends from claim 28 and recites two additional limitations. In particular, claim 29 requires the means for determining the single power tracking signal discussed above (*see supra* Part III.A.B.4.a) to comprise “means for determining an overall power of the plurality of carrier aggregated transmit signals based on the I and Q components of the plurality of carrier aggregated transmit signals” as well as “means for determining the single power tracking signal based on the overall power of the plurality of carrier aggregated transmit signals.”

Petitioner treats both limitations in claim 29 as means-plus-function limitations. Pet. 18, 20. For the first limitation, Petitioner contends that the claimed function is “determining an overall power of the plurality of carrier

aggregated transmit signals based on the I and Q components of the plurality of carrier aggregated transmit signals," and that the corresponding structure is the '675 patent's power tracker 582. Pet. 18. As support, Petitioner directs us to where the '675 patent teaches that "power tracker 582 receives I_1 to I_K samples and Q_1 to Q_K samples for all transmit signals being sent simultaneously," and then "computes the overall power of all transmit signals based on the I and Q samples for these transmit signals." Ex. 1301, 6:63–67 (cited by Pet. 19). For the second limitation, Petitioner contends that the claimed function is "determining the single power tracking signal based on the overall power of the plurality of carrier aggregated transmit signals," and that the corresponding structure is the '675 patent's power tracker 582. Pet. 20. As support, Petitioner directs us to where the '675 patent teaches that "[p]ower tracker 582 computes the overall power of all transmit signals based on the I and Q samples for these transmit signals and provides a digital power tracking signal to a DAC 584." Ex. 1301, 6:65–7:1 (cited by Pet. 20).

Claim 30 also depends from claim 28 and recites two additional limitations. In particular, claim 30 requires the means for determining the single power tracking signal discussed above (*see supra* Part III.A.B.4.a) to comprise "means for determining a power of each transmit signal in the plurality of carrier aggregated transmit signals based on the I and Q components of each transmit signal" as well as "means for determining the single power tracking signal based on a sum of said power of each transmit signal of the plurality of carrier aggregated transmit signals."

Petitioner treats both limitations in claim 30 as means-plus-function limitations. Pet. 21–22. For the first limitation, Petitioner contends that the

claimed function is "determining a power of each transmit signal in the plurality of carrier aggregated transmit signals based on the I and Q components of each transmit signal," and that the corresponding structure is the '675 patent's power tracker 582. Pet. 21. As support, Petitioner directs us to where the '675 patent teaches that "power tracker 582 receives I_1 to I_K samples and Q_1 to Q_K samples for all transmit signals being sent simultaneously," and then "may determine the power of each transmit signal based on the I and Q components of that transmit signal." Ex. 1301, 6:63–65, 12:10–12 (cited by Pet. 21). For the second limitation, Petitioner contends that the claimed function is "determining the single power tracking signal based on a sum of said power of each transmit signal of the plurality of carrier aggregated transmit signals," and that the corresponding structure is the '675 patent's power tracker 582. Pet. 22. As support, Petitioner directs us to where the '675 patent teaches that its power tracker "may compute the digital power tracking signal based on the I and Q samples for all transmit signals in various manners." *Id.* (citing Ex. 1301, 8:6–8). For example, "[i]n the design shown in equation (1), the powers of all transmit signals are summed to obtain an overall power," and "[t]he digital power tracking signal is then obtained by taking the square root of the overall power." Ex. 1301, 8:17–21 (cited by Pet. 22).

We address claims 29 and 30 together. With respect to the claimed functions for the limitations recited in both claims, Petitioner directs us to where Yu teaches "evaluat[ing] said control signal CTRL as a sum of the absolute values of the input signals S1, S2," where "an absolute value abs(S1) of the first input signal S1 is obtained by the function block 104 and an absolute value abs(S2) of the second input signal S2 is obtained by the

function block 106 of Figure 3." Pet. 65 (quoting Ex. 1304 ¶ 57); *see also id.* at 73–74. Petitioner also directs us to where Yu teaches that "[t]he absolute values of the input signals S1, S2 are added by means of adder 108 to obtain said control signal CTRL." *Id.* at 65 (quoting Ex. 1304 ¶ 57); *see also id.* at 69–70. According to Petitioner, "each such absolute value (|S1|, |S2|) is a proxy for the power of a transmit signal," and the "sum [of the absolute values] is a proxy for the overall power of the plurality of carrier aggregated transmit signals." *Id.* at 65; *see also id.* at 73–74, 76–77. Petitioner adds that "Yu combined with Wang discloses that these calculations are based on the I and Q components of the plurality of carrier aggregated transmit signals." *Id.* at 65–66; *see also id.* at 73–74. Petitioner relies on the declaration testimony of Dr. Choi. *Id.* (citing Ex. 1303 ¶ 168).

We note that Petitioner reiterates that "Yu's summing of the absolute values of the signals . . . is the same as Equation 2 in '675 patent," where "the voltage of each transmit signal is first computed, and the voltages of all transmit signals are then summed to obtain the digital power tracking signal." Pet. 66–67 n.13; Ex. 1303 ¶ 169 (cited by Pet. 66–67); Ex. 1301, 8:29–32. Petitioner contends that, to the extent that Patent Owner disputes Petitioner's above analysis "because the absolute values [in Yu] are voltages (measured in volts) rather than powers (measured in watts), calculating a power (measured in watts, rather than volts) would have been obvious." Pet. 66; *see also id.* at 70, 74, 77. As support, Petitioner asserts that an ordinarily skilled artisan "would have understood that modifying Yu to determine the power tracking signal based on the magnitude squared ($I^2 + Q^2$) of each signal—instead of the absolute value ($\sqrt{I^2 + Q^2}$) of each signal—would have been a non-inventive, obvious alternative and a trivial

modification." *Id.* at 66. Petitioner also asserts that "[b]ecause power is directly proportional to the square of the voltage . . . a [person of ordinary skill in the art] would have understood that either of these mathematical methods would yield a functional, effectively similar metric for the generation of a power tracking signal." *Id.* (internal citation omitted). In addition, Petitioner notes that "the disclosures in the '675 patent require a voltage ultimately be used as the measure for the digital power tracking signal." *Id.* (citing Ex. 1301, 8:19–22 ("The digital power tracking signal is then obtained by taking the square root of the overall power. The scaling factor of $\sqrt{K}$ accounts for conversion between power and voltage.")). According to Petitioner, "[c]hoosing one mathematical form rather than the other would have been an obvious alternative among a limited number of ways to determine the power tracking signal, and would have been well within the competence and discretion of a [person of ordinary skill in the art]." *Id.* at 66–67. Petitioner relies on the declaration testimony of Dr. Choi. *Id.* (citing Ex. 1303 ¶ 169).

With respect to the corresponding structure for the limitations in claims 29 and 30, namely, the '675 patent's power tracker 582, Petitioner directs us to an annotated version of Figure 6 of the '675 patent, which is reproduced below. *Id.* at 68, 71, 75, 78.

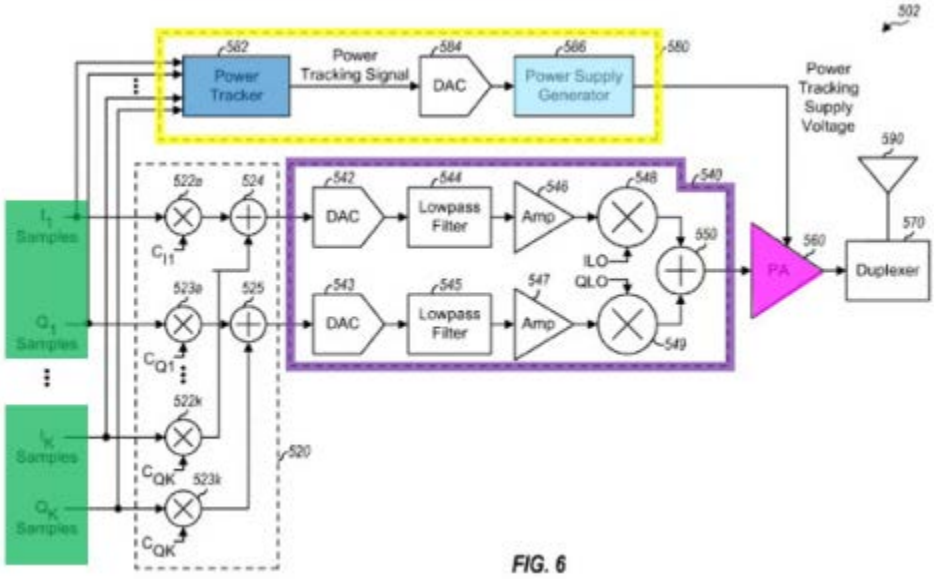


FIG. 6

Figure 6 of the ’675 patent shows a design of “a transmit module comprising a single power amplifier with power tracking for all transmit signals.” Ex. 1301, 1:65–67. Petitioner also directs us to an annotated version of Figure 3 of the ’675 patent, which is reproduced below. Pet. 68, 71, 75, 78.

Fig. 3

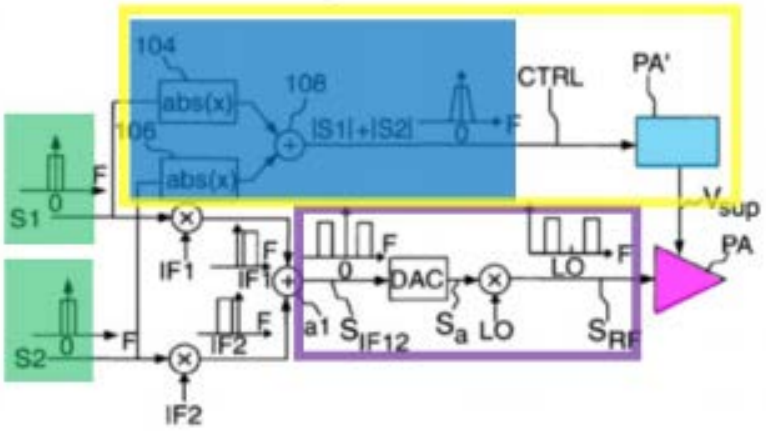


Figure 3 of Yu is a signal flow diagram. Ex. 1304 ¶¶ 32, 57. Petitioner contends that “[a]s modified by Wang, Yu’s power tracker—including specifically, function blocks 104 and 106 and summer 108 (in Figure 3)—is identical, or at a minimum, equivalent to the power tracker disclosed in the ’675 patent.” Pet. 67, 70, 74, 77. According to Petitioner, “the power

tracker in Yu . . . is a more detailed version of the power tracker disclosed in the '675 patent," and "[a]ny differences between the structures in the '675 patent and Yu (as modified by Wang) would be insubstantial." *Id.* at 67–68, 70–71, 74–75, 77–78. As support, Petitioner asserts that "Yu's power tracker operates in substantially the same way as the power tracker described in the '675 patent" because Yu's "function blocks 104 and 106 receive I and Q components for multiple transmit signals and calculate the absolute value of each signal ($\sqrt{I_k{}^2 + Q_k{}^2}$), and summer 108 sums these values." *Id.* at 69, 76, 78–79. Petitioner adds that "after summing absolute values of the input signals ($\sqrt{I_k{}^2 + Q_k{}^2}$), summer 108 also determines a single power tracking signal (CTRL) based on the same equation disclosed in Equation 2 in the '675 patent." *Id.* at 71–72 (citing Ex. 1301, 8:23–32); *see also id.* at 69 ("[T]his is substantially the same as the operations disclosed in Equation 2 in the '675 patent."); *id.* at 76, 79. In addition, Petitioner asserts that "Yu's power tracker also achieves substantially the same result as the '675 patent structure," that is, Yu's "function blocks 104 and 106 and summer 108 determine a measure that can be used to determine a single power tracking signal for supplying power to a PA." *Id.* at 69; *see also id.* at 72 ("[Yu's power tracker] determines a single power tracking signal that is sent to a power supply generator to control the voltage supplied to a PA."), 76, 79. Petitioner relies on the declaration testimony of Dr. Choi. *Id.* at 69 (citing Ex. 1303 ¶ 172), 72 (citing Ex. 1303 ¶ 177), 76 (citing Ex. 1303 ¶ 185), 79 (citing Ex. 1303 ¶ 191).

Based on Petitioner's argument and evidence, we are persuaded that the proposed combination of Yu, Wang, and Choi teaches the recited

limitations in claims 29 and 30. Patent Owner does not dispute Petitioner's analysis for these limitations. *See generally* PO Resp.

6. Patent Owner's Arguments

Patent Owner makes several arguments with respect to certain limitations recited in claim 28. As discussed above, claims 29 and 30 depend from claim 28. Accordingly, all the challenged claims in this proceeding require these disputed limitations. Patent Owner argues in particular that Yu, Wang, and Choi do not teach the corresponding structure for the recited "means for determining a single power tracking signal" limitation or the corresponding structure for the "means for generating a single power supply voltage" limitation. PO Resp. 45–47. Patent Owner also argues that Yu and Wang do not teach a power tracker that "generates the single power tracking signal *based on a combination of* the plurality of I and Q components" or a "plurality of *carrier aggregated* transmit signals." *Id.* at 30–37, 40–41. Lastly, Patent Owner argues that an ordinarily skilled artisan would not have been motivated to combine Yu and Wang to arrive at the claimed invention. *Id.* at 37–40. We address these arguments in turn.

a. "means for determining a single power tracking signal"

With respect to the corresponding structure for this limitation, Patent Owner argues that "the Petition's citation to Yu Figure 3 does not account for the '675 patent's column 8 algorithm determining the single power tracking signal based on the plurality of I and Q components in a single power tracker." PO Resp. 45–46. Patent Owner asserts that "the prior art must implement the same algorithm in the described structure (*i.e.*, a power

tracker)." *Id.* at 46. Patent Owner further asserts that "Yu's separate processing of S1 at 104 and S2 at 106 and their subsequent combination does not meet the '675 patent's Equation 2 algorithm that provides a 'single power tracking signal based on a combination of the plurality of I and Q components.'" *Id.* As support, Patent Owner submits that "S1's purported I and Q components are never in the same module as S2's," and that "Yu Figure 3 further does not provide the hardware consolidation benefit that the '675 patent provides." *Id.*

We disagree. Patent Owner's argument relies on Patent Owner's proposed construction of the "means for determining a single power tracking signal" limitation, which requires the corresponding structure to include the algorithms disclosed in the '675 patent specification (i.e., Equations 1 and 2). *See* PO Resp. 19–20. As discussed above, that construction is improper because it assumes that the '675 patent's power tracker is a computer. *See supra* Part III.A.4.

Under the proper construction of the "means for determining a single power tracking signal" limitation, the corresponding structure is the '675 patent's power tracker 582, which is a circuit that connotes structure, not a computer. *See id.* For the reasons given above, we find that Yu's functions blocks 104, 106 and adder 108 together correspond to the '675 patent's power tracker 582. *See supra* Part III.B.4.a.

Patent Owner's argument focuses on features that claim 28 does not require, namely, Equations 1 and 2 of the '675 patent. *See* PO Resp. 45–46. Accordingly, Patent Owner's argument does not undermine Petitioner's showing that the combination of Yu, Wang, and Choi teaches the recited "means for determining a single power tracking signal" limitation.

b. "means for generating a single power supply voltage"

With respect to the corresponding structure for this limitation, Patent Owner argues that "[a]t no point . . . does the Petition identify disclosure in either of Yu, Wang, or Choi that corresponds to [the '675 patent's] digital to analog converter 584." PO Resp. 47. This argument relies on Patent Owner's proposed construction of the "means for generating a single power supply voltage" limitation, which requires the corresponding structure to include the '675 patent's digital-to-analog converter 584. *See id.* at 21–22. As discussed above, that construction is improper because the '675 patent's digital-to-analog converter 584 does not perform the claimed function of "generating a single power supply voltage based on the single power tracking signal." *See supra* Part III.A.5.

Under the proper construction of the "means for generating a single power supply voltage" limitation, the corresponding structure is the '675 patent's power supply generator 586. *See id.* For the reasons given above, we find that Yu's power amplifier supply voltage module PA', as modified by Choi, corresponds to the '675 patent's power supply generator 586. *See supra* Part III.B.4.b.

Patent Owner's argument focuses on a feature that claim 28 does not require, namely, the '675 patent's digital-to-analog converter 584. *See* PO Resp. 46–47. Accordingly, Patent Owner's argument does not undermine Petitioner's showing that the combination of Yu, Wang, and Choi teaches the recited "means for generating a single power supply voltage" limitation.

c. "based on a combination of"

Patent Owner argues that Petitioner does not "identify any disclosure in Yu of a single power tracking signal being generated ***based on a combination of the plurality of I and Q components***." *Id.* at 33. Specifically, Patent Owner argues that Petitioner "wholly ignores the 'combination' portion of the claim language," which Patent Owner asserts "enables one of the primary benefits of the '675 patent: the reduction in circuit components and power consumption." *Id.* at 34–35 (citing Ex. 1301, 6:25–27). As support, Patent Owner states that "the alleged I and Q components of S1 are never in the same signal processing component as the purported I and Q components of S2." *Id.* at 36 (citing Ex. 2006, 78:11–14, 79:14–16 (deposition testimony of Dr. Choi)). Patent Owner also responds to Petitioner's comparison between Yu's summing of absolute values and Equation 2 of the '675 patent, stating further that "mathematical equivalence is insufficient." *Id.* According to Patent Owner, Petitioner "fails to explain how Yu's solution that requires disparate signal processing components 104, 106 does anything to achieve" the '675 patent's "hardware solution where a 'single PA with power tracking may be used to generate a single output RF signal for multiple transmit signals' that 'may reduce the number of circuit components, reduce power consumption, and provide other advantages.'" *Id.* at 36–37 (citing Ex. 1301, 6:20–27).

Petitioner counters that "Patent Owner's argument relies on the incorrect premise that Yu's power tracker consists of only signal processing components 104 and 106." Pet. Reply 14. Petitioner asserts that "the Petition makes clear[] Yu's power tracker also includes adder 108," which means "the power tracker . . . receives the input signals at blocks 104 and

106, and adder 108 then ***combines*** them to produce a single power tracking signal 'based on a combination of the plurality of I and Q components.'" *Id.* at 14–15 (citing Pet. 25–29). According to Petitioner, "[n]othing in the claims requires that these operations be performed in any particular way (e.g., that the input signals cannot be initially processed separately), or that the power tracker have a specific structure (e.g., that the power tracker must be a monolithic physical structure rather than include two envelope detectors)." *Id.* at 15; *see also id.* at 16 ("Patent Owner fails to identify any limitation ***in the claims*** that requires the power tracker to be implemented in a manner to reduce the number of circuits. Nor does the specification contain any such requirement; to the contrary, . . . the specification describes a method of receiving and processing signals ***separately*** before combining them into a single power tracking signal." (citing Ex. 1301, 8:23–32)).

Petitioner further reiterates that "Yu's processing of input signals also matches the processing disclosed in the '675 patent specification," referring to Equation 2. *Id.* at 15. Petitioner asserts that "Patent Owner's expert admitted that equation (2) describes the input signals being processed ***separately*** before they are summed to output the single power tracking signal—which is precisely the sequence that Yu discloses." *Id.* at 15–16 (citing Ex. 1330, 111:8–14 (deposition testimony of Dr. Williams)).

In response, Patent Owner contends that Petitioner's argument that Yu's adder 108 combines the input signals, thereby satisfying the disputed claim limitation, was not made in the Petition and should be rejected. PO Sur-reply 14. Patent Owner nevertheless also contends that "Petitioner's new reply argument is erroneous" because "the outputs of blocks 104 and 106 *are not* I and Q components but rather absolute values of the input

signals S1 and S2." *Id.*; *see also id.* at 15 ("Petitioner has not explained how [Yu]'s combining of the absolute values of the input signals S1 and S2—and *not* the I and Q components themselves—allegedly meets this claim language.").[12]

With respect to Equation 2 of the '675 patent, Patent Owner further contends that the equation "enabl[es] the computation of 'the digital power tracking signal *based on the I and Q samples,*'" but "the claims specifically require the power tracking signal to be generated '*based on a combination of . . . I and Q components*.'" *Id.* at 16 (citing Ex. 1301, 8:33–36). According to Patent Owner, "the 'combination' language was added during prosecution to narrow the scope of the claims," and "Petitioner's argument . . . ignores the 'combination' language." *Id.* (citing Ex. 1302, 188–196). Patent Owner asserts that "the claims were amended to explicitly recite that the power tracker is 'configured to determine a single power tracking signal based on a plurality of inphase (I) and quadrature (Q) components of a plurality of different transmit signals being sent simultaneously,'" which means the claims "require the power tracker to be implemented in a manner that reduces the number of circuit components and power consumption." *Id.* at 17 (citing Ex. 1302, 189–194).

We disagree with Patent Owner's argument, which relies on Patent Owner's proposed construction of "based on a combination of" (i.e., "based on the result of an addition operation"). *See* PO Br. 1. As discussed above, that construction improperly requires the recited power tracker to generate

[12] Patent Owner specifies "Chen," but we believe Patent Owner intended to specify "Yu," the asserted reference at issue.

the single power tracking signal based on the result of an *addition operation* on the plurality of I and Q components. *See supra* Part III.A.3.

The proper construction of "generates the single power tracking signal based on a combination of the plurality of I and Q components" is "generates the single power tracking signal using a combination derived from the plurality of I and Q components." *Id.* Under that construction, we find that the combination of Yu and Wang teaches a power tracker that generates the single power tracking signal based on a combination of the plurality of I and Q components, as recited in the claims. In particular, we find that Yu's control unit 100, which comprises blocks 104 and 106 as well as adder 108, corresponds to the recited power tracker, as Petitioner contends. *See* Pet. 25–27; Ex. 1304 ¶ 66 (cited by Pet. 26–27). To illustrate, Petitioner's annotated version of Figure 3 of Yu is reproduced below. Pet. 27.

Fig. 3

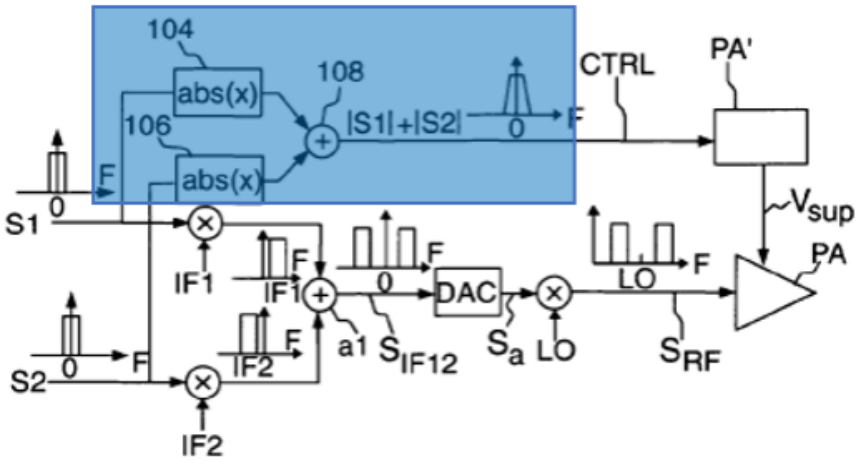


Figure 3 is a signal flow diagram. Ex. 1304 ¶¶ 32, 57. The annotated figure highlights Yu's blocks 104, 106 and adder 108 in blue. The blocks receive input signals S1 and S2, and then they calculate the absolute values of those

signals. *Id.* ¶ 57. The adder sums the absolute values of the input signals to obtain control signal CTRL, which the adder subsequently outputs. *Id.* As discussed above, we agree with Petitioner that Yu's control signal corresponds to the recited single power tracking signal. *See supra* Part III.B.4.a. We also agree that an ordinarily skilled artisan would have modified each of Yu's signals S1 and S2 to include Wang's baseband signal (comprising an OFDM signal with I and Q components) to provide a way to carry out Yu's signaling. *See id.* Accordingly, in view of Petitioner's proposed combination of Yu and Wang, we find that blocks 104, 106 and adder 108 together generate control signal CTRL using a combination derived from the plurality of I and Q components of the input signals, and therefore satisfy the recited power tracker limitation.

We note Patent Owner's contention that Petitioner "fails to explain how Yu's solution that requires disparate signal processing components 104, 106 does anything to achieve" the '675 patent's "hardware solution where a 'single PA with power tracking may be used to generate a single output RF signal for multiple transmit signals' that 'may reduce the number of circuit components, reduce power consumption, and provide other advantages.'" PO Resp. 36–37 (citing Ex. 1301, 6:20–27). This contention, however, does not undermine Petitioner's showing that the combination of Yu and Wang teaches the recited power tracker. The claims themselves do not limit the structure of the power tracker, let alone exclude what Patent Owner describes as "disparate signal processing components." Nor does the specification. Indeed, the specification refers specifically to "a single *PA*" (i.e., a single power amplifier), not a single power tracker, when stating that "an aspect of the present disclosure . . . . *may* reduce the number of circuit

components." Ex. 1301, 6:20–27 (emphases added). Moreover, contrary to Patent Owner's position, Yu does in fact teach a single power amplifier (i.e., power amplifier PA) that is used to generate a single output RF signal (i.e., amplified radio frequency signal S_{Rfa}) for multiple transmit signals (i.e., input signals S1 and S2). *See* Ex. 1304 ¶ 33, Figs. 1, 3; *see also supra* Part III.B.4.c.

Turning to Patent Owner's characterization of Petitioner's argument regarding Yu's adder 108 as a "new reply argument," we note Petitioner's identification in the Petition of Yu's adder 108 as part of the recited power tracker. *See* Pet. 26–27. Further, we note that Petitioner's argument responds directly to Patent Owner's contention that Petitioner does not address how the single power tracking signal is generated based on a *combination* of the plurality of I and Q components. *See* PO Resp. 34–36; Pet. Reply 14–15. As for Patent Owner's additional contention that the outputs of Yu's blocks 104, 106 are absolute values of input signals S1, S2, rather than the I and Q components themselves, we are not persuaded for the reasons given above. *See* PO Sur-reply 14–15. Namely, our construction of "generat[ing] the single power tracking signal based on a combination of the plurality of I and Q components" encompasses generating the control signal of Petitioner's proposed combination of Yu and Wang based on the sum of the absolute values of the input signals, which have I and Q components. Patent Owner's counsel conceded during oral argument that "what's coming out of blocks 104 and 106" are "envelope signals," which "are functions of I and Q components." Tr. 48:15–19. This is consistent with the specification of the '675 patent, which teaches generating a power tracking signal based on a sum of the *powers of the transmit signals* where the powers are

functions (e.g., $I_k{}^2(t) + Q_k{}^2(t)$) of the I and Q components of the transmit signals, or, alternatively, based on a sum of the *voltages of the transmit signals* where the voltages are functions (e.g., $\sqrt{I_k{}^2(t) + Q_k{}^2(t)}$) of the I and Q components of the transmit signals. Ex. 1301, 8:6–36. The specification does not require generating the power tracking signal based on a sum of the I and Q components themselves.

Lastly, Patent Owner's reliance on the prosecution history to support its contention that "the 'combination' language was added during prosecution to narrow the scope of the claims" also is unpersuasive. *See* PO Sur-reply 16. As discussed above in the Claim Construction section, following the addition of the "combination" language, the Examiner still found that the cited prior art reference "teaches the power tracking signal *based on* I and Q." *See* Ex. 1302, 203 (emphasis added). We note that the applicant did not point to any distinctions between "based on" and "based on a combination of" in response to the Examiner's finding. The prosecution history therefore does not support Patent Owner's contention.

d. "carrier aggregated"

Patent Owner argues that "neither Yu nor Wang discloses carrier aggregation under either party's construction of that term," both of which "require the increase [extension] of the bandwidth of a single user based on transmission across multiple carriers." PO Resp. 40. As support, Patent Owner asserts that "Yu's Figure 3 and Figure 4 embodiments describe base station technology that is processing signals provided by different users." *Id.* According to Patent Owner, "[p]rocessing signals from different users fails to disclose '*signals from a single terminal* utilizing multiple component

carriers *which provide extended transmission bandwidth for a user transmission* from the single terminal.'" *Id.* Patent Owner adds that "Wang does nothing to cure these deficiencies." *Id.*

We disagree with Patent Owner's argument, which relies on Patent Owner's proposed construction of "carrier aggregated transmit signals" (i.e., "signals from a single terminal utilizing multiple component carriers which provide extended transmission bandwidth for a user transmission from the single terminal"). *See* PO Resp. 16. As discussed above, that construction is overly narrow and improperly requires signals from a single terminal as well as providing extended transmission bandwidth for a user transmission from a single terminal. *See supra* Part III.A.2.

The proper construction of "plurality of carrier aggregated transmit signals" is "signals for transmission on multiple carriers." *Id.* Under that construction, we find that the combination of Yu and Wang teaches the recited "plurality of carrier aggregated transmit signals." In particular, as discussed above, we find that Yu's input signals S1 and S2, as modified by Wang, correspond to the recited "plurality of carrier aggregated transmit signals." *See supra* Part III.B.3.a. To illustrate, Petitioner's annotated version of Figure 3 of Yu is reproduced below. *See* Pet. 32.

Fig. 3

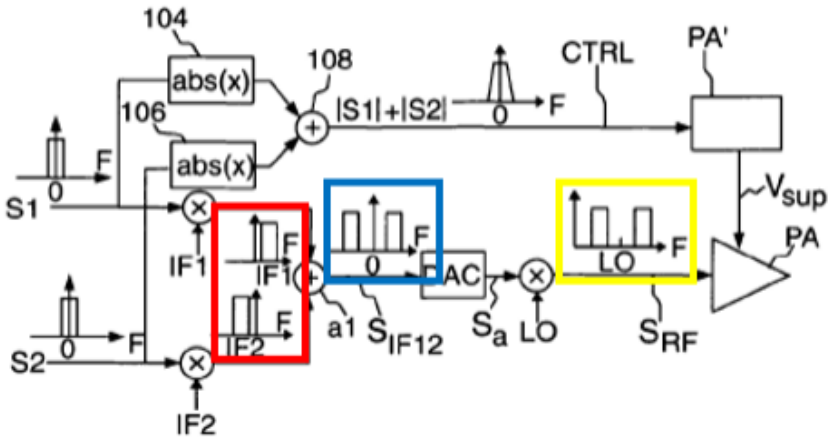


Figure 3 depicts a signal flow diagram. Ex. 1304 ¶¶ 32, 57. Petitioner asserts that signals S1 and S2 are upconverted to different intermediate frequencies, as shown in the red box. Pet. 32 (citing Ex. 1304 ¶ 48). Petitioner further asserts that the difference in frequencies is maintained when the signals are subsequently summed by adder a1, as shown in the blue box, and when they are upconverted again to different RF center frequencies, as shown in the yellow box. *Id.* Petitioner contends that the annotated portions of Figure 3 show that Yu's signals S1 and S2 are transmitted on multiple carriers at the same time. *Id.* at 31–33. Petitioner relies on the declaration testimony of Dr. Choi. *Id.* (citing Ex. 1303 ¶¶ 124–126).

Patent Owner's argument focuses on features that the claims do not require, namely, signals from a single terminal and providing extended transmission bandwidth for a user transmission from the single terminal. *See* PO Resp. 40. Accordingly, Patent Owner's argument does not undermine Petitioner's showing that the combination of Yu and Wang teaches the recited carrier aggregated transmit signals.

e. Motivation to Combine

Patent Owner argues that an ordinarily skilled artisan "would not be motivated to combine the Figure 3 and Figure 4 base station implementations of Yu with the single channel 802.11g WLAN technology described in Wang, where Petitioner's declarant testified that he is 'not aware of any cellular base stations in 2013 that use the IEEE 802.11g wireless LAN standards.'" PO Resp. 38–39. As support, Patent Owner asserts that "the OFDM disclosed in Wang is for a particular WLAN standard, namely IEEE 802.11g WiFi," and that "[t]he OFDMA used on the downlink in cellular base stations is far more challenging for envelope tracking than the OFDM used in 802.11g." *Id.* at 39. Patent Owner further notes that "[c]ellular OFDMA has both a larger bandwidth and a higher peak to average power ratio." *Id.* According to Patent Owner, "the Petition's motivation to combine is deficient" because "the Petition fails to provide any argument regarding why and how a [person of ordinary skill in the art] would combine teachings of a WiFi system into a cellular base station reference." *Id.* at 39–40.

In response, Petitioner contends that "Figures 3 and 4 from Yu are not 'base station implementations' that are inappropriate for mobile terminals." Pet. Reply 17. Petitioner asserts that "nothing in Yu suggests that Figures 3 and 4 cannot be applied to narrower frequency spacings typical in mobile terminals," and "[a]lthough Figures 3 and 4 are preferred embodiments for larger frequency spacings, they still would perform the invention of the '675 patent—the transmission of multiple signals simultaneously using a single power amplifier (PA) that receives a single power supply voltage from a single power tracking supply generator—even when the frequency

spacing is narrow." *Id.* at 17–18. Petitioner further asserts that "Yu's general description of its subject matter points to a broad scope of application that specifically includes mobile devices." *Id.* at 18 (citing Ex. 1304 ¶ 34).

Citing its discussion in the Petition regarding reasons for combining Yu and Wang, Petitioner also contends that "even if Figures 3 and 4 from Yu were 'base station implementations,' a [person of ordinary skill in the art] still would have been motivated to incorporate concepts from Wang (such as OFDM) into the systems disclosed by Yu." *Id.* at 18–19 (citing Pet. 43–45). Petitioner asserts that Patent Owner's argument is based on "the false premise that the Petition proposes incorporating the 802.11g WiFi standard into Yu." *Id.* at 18. According to Petitioner, the "Petition argues only that a [person of ordinary skill in the art] looking to implement and improve Yu would have been motivated to look to Wang and use basic RF concepts (e.g., OFDM modulation) that Wang discloses." *Id.* at 19. Petitioner states that its "Petition never suggested, and its argument does not depend upon, incorporating the IEEE 802.11g WiFi standard into Yu." *Id.*

Patent Owner counters that Petitioner's argument that Yu's Figures 3 and 4 can be applied to narrower frequency spacings typical in mobile terminals "is an improper new reply argument." PO Sur-reply 18. Patent Owner nevertheless contends that Petitioner's argument "is not an affirmative reason why the [person of ordinary skill in the art] would allegedly be motivated to modify the embodiments of these figures." *Id.* As support, Patent Owner asserts that "the only embodiments described with respect to these figures are for the wide frequency spacings expressly described in the reference." *Id.* at 19. Patent Owner further asserts that an

ordinarily skilled artisan "would recognize that the embodiment of Figure 2 is for narrower frequency spacings, whereas the embodiments of Figures 3 and 4 are not," and "Yu thus teaches that Figure 2 should be used for narrow frequency spacings and teaches away from using Figures 3 and 4 in such scenarios." *Id.* Patent Owner adds, "It was Petitioner's burden to articulate why and how the [person of ordinary skill in the art] would allegedly combine teachings of Wang's WiFi system with the cellular base station of Yu," and "[t]he Petition and supporting declaration fail to do this and do not address the disparity across operating environments of Yu and Wang at all." *Id.* at 20.

Based on the record before us, we disagree with Patent Owner. Patent Owner's focus on "the disparity across operating environments of Yu and Wang" disregards Wang's broader teaching of providing an OFDM signal with I and Q components as a way to carry out signaling. Ultimately, "[t]he test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference." *See In re Keller*, 642 F.2d 413, 425 (CCPA 1981). Instead, "the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art." *Id.* As Petitioner points out, Wang teaches a complex baseband signal comprising an OFDM signal with I and Q components. Pet. 38–39 (citing Ex. 1305, 1245, Fig. 3); *id.* at 43 (citing Ex. 1305, 1244 (title), 1253). Petitioner explains that "[c]omplex input signals (with I and Q components) improve immunity to transmit signal noise, and allow the use of advanced (higher order) modulation techniques such as quadrature phase-shift keying (QPSK), which doubles the data rate by increasing the number of bits per symbol that can be transmitted within

the same bandwidth, compared with a method such as binary phase-shift keying (BPSK)." *Id.* at 41 (citing Ex. 1321, 308). Petitioner also explains that "OFDM had many advantages, including the ability to adapt to degraded channel conditions without complex equalization filters, and robustness against various forms of interference." *Id.* at 44–45 (citing Ex. 1322 ¶¶ 2–3). According to Petitioner, it is for these reasons an ordinarily skilled artisan would have used Wang's baseband signal in Yu's system. Contrary to what Patent Owner argues, we find that these reasons provide sufficient rationale for why an ordinarily skilled artisan would have used Wang's baseband signal in Yu's system. Accordingly, we find that Patent Owner's argument does not undermine Petitioner's obviousness showing.

That "the OFDM disclosed in Wang is for a particular WLAN standard, namely IEEE 802.11g WiFi," as Patent Owner asserts, does not change our finding in this regard. *See* PO Resp. 39. We note that "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton," and, in modifying Yu's system to include Wang's signal, would have made any necessary additional modifications such that Yu's system could process appropriately Wang's signal. *See KSR*, 550 U.S. at 421.

Patent Owner does not dispute other aspects of Petitioner's analysis regarding challenged claims 28–30. *See generally* PO Resp.

In view of the foregoing, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 28–30 would have been obvious over Yu, Wang, and Choi.

IV. CONCLUSION[13]

In summary:

Claims	35 U.S.C. §	References	Claims Shown Unpatentable	Claims Not Shown Unpatentable
28–30	103	Yu, Wang, Choi	28–30	

V. ORDER

In consideration of the foregoing, it is hereby

ORDERED that claims 28–30 of the '675 patent are held *unpatentable*; and

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

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

PETITIONER:

David Cavanaugh
Richard Goldenberg
Theodoros Konstantakopoulos
Louis Tompros
WILMER CUTLER PICKERING HALE AND DORR LLP
david.cavanaugh@wilmerhale.com
richard.goldenberg@wilmerhale.com
theodoros.konstantakopoulos@wilmerhale.com
louis.tompros@wilmerhale.com

PATENT OWNER:

Matthew Johnson
Joseph Sauer
David Cochran
David Maiorana
Richard Graham
Joshua Nightingale
JONES DAY
mwjohnson@jonesday.com
jmsauer@jonesday.com
dcochran@jonesday.com
dmaiorana@jonesday.com
ragraham@jonesday.com
jrnightingale@jonesday.com