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Paper No. 8
Entered: January 15, 2019

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTEL CORPORATION,
Petitioner,

v.

QUALCOMM INCORPORATED,
Patent Owner.

Case IPR2018-01330
Patent 9,608,675 B2

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

WORMMEESTER, *Administrative Patent Judge*.

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

I. INTRODUCTION

Intel Corporation[1] ("Petitioner") filed a Petition (Paper 3, "Pet.") requesting *inter partes* review of claims 28–30 of U.S. Patent No. 9,608,675 B2 (Ex. 1401, "the '675 patent"). Qualcomm Incorporated ("Patent Owner") filed a Preliminary Response (Paper 7, "Prelim. Resp."). We have jurisdiction under 35 U.S.C. § 314 and 37 C.F.R. § 42.4(a). Under 35 U.S.C. § 314(a), an *inter partes* review may not be instituted "unless . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." For the reasons that follow, we institute an *inter partes* review as to all the challenged claims of the '675 patent based on the sole ground presented.

II. BACKGROUND

A. Related Proceedings

The parties identify a district court case in the Southern District of California in which Patent Owner has asserted the '675 patent against Apple. Pet. 2; Paper 4, 2. The parties also identify five other petitions for *inter partes* review involving the '675 patent that Petitioner has filed. Pet. 2; Paper 4, 2. In addition, Petitioner identifies an International Trade Commission ("ITC") investigation in which Patent Owner asserted the '675 patent against Apple, but has since withdrawn that assertion. Pet. 1–2.

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

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. 1401, 1:8–10, 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.

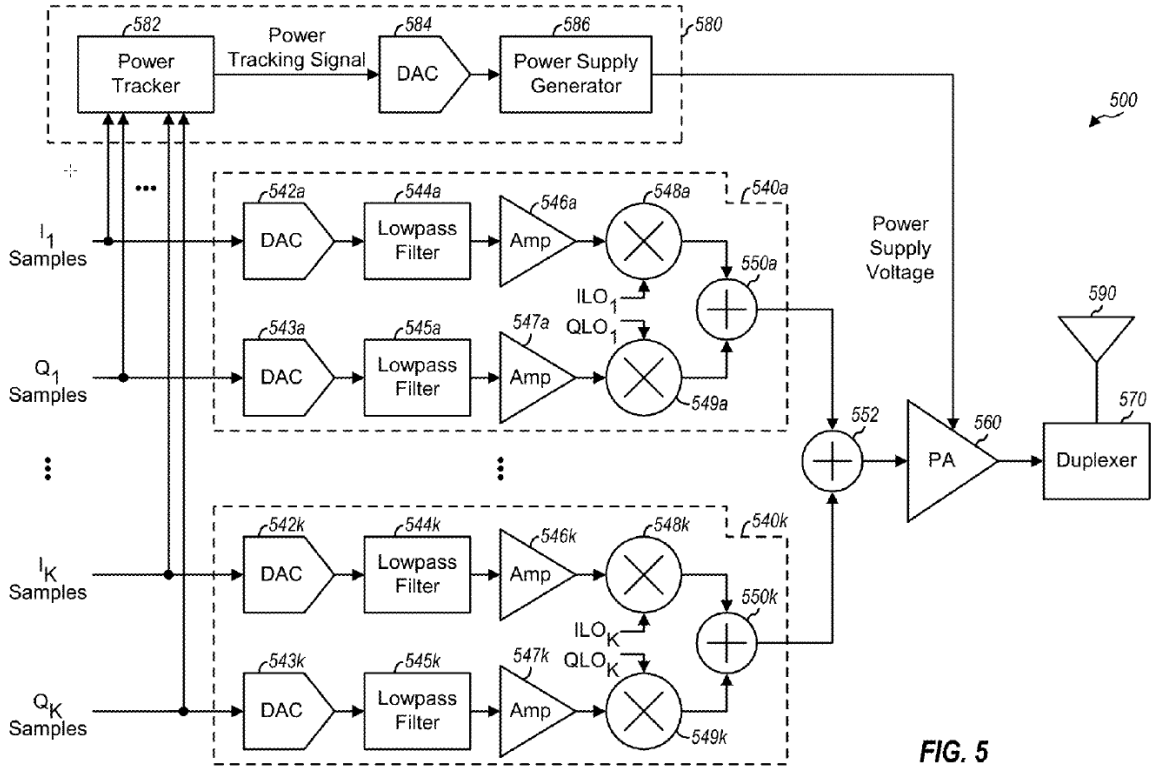


FIG. 5

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 the 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 computes the overall power of all the transmit signals based on the I and Q samples and provides a digital power tracking signal to DAC 584. *Id.* at 6:65–7:1. DAC 584 converts the digital power tracking signal to analog and provides an analog power tracking signal for all the transmit signals to power supply generator 586. *Id.* at 7:1–4, Fig. 5. Power supply generator 586 then 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 one ground only: obviousness under 35 U.S.C. § 103 over Chen,[2] Wang,[3] and Choi.[4] Pet. 22–75. In support of its arguments, Petitioner relies on a Declaration of David Choi, Ph.D. (Exhibit 1403). *See id.*

III. DISCUSSION

A. Multiple Petitions

Patent Owner contends that we should exercise our discretion under 35 U.S.C. § 314(a) to deny institution of an *inter partes* review because Petitioner attempts to "sidestep" the Supreme Court's mandate in *SAS Institute, Inc. v. Iancu*, 138 S. Ct. 1348 (2018), by filing six petitions against the same patent. Prelim. Resp. 13–16. In *SAS*, the Supreme Court held that a decision to institute under 35 U.S.C. § 314 may not institute on fewer than all claims challenged in the petition. 138 S. Ct. at 1358. Patent Owner asserts that the Board, however, has "cautioned that the presence of weak grounds in a petition could result in a complete denial of institution even if other unpatentability allegations met the threshold for institution." Prelim. Resp. 14. As such, Patent Owner further asserts that Petitioner "has divided

[2] W. Chen et al., *Hybrid Envelope Tracking for Efficiency Enhancement in Concurrent Dual-Band PAs*, 54 Microwave & Optical Tech. Letters 662 (2012) (Ex. 1412, "Chen").
[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. 1405, "Wang").
[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. 1408, at Ex. A, "Choi").

its challenges to the '675 patent claims that would normally fit into one or two petitions (*i.e.*, two grounds challenging 31 claims) across *six* petitions, hoping to increase its odds of institution." *Id.* at 14–15. Patent Owner additionally asserts that "Petitioner provides no explanation for its convoluted filing strategy and why it requires 84,000 words (6 * 14,000) to make its case that 31 claims of the '675 patent are unpatentable based on two grounds." *Id.* at 16 (citing *Alere Inc. v. Rembrandt Diagnostics, LP*, Case IPR2017-01130, slip op. at 10 (PTAB Sept. 28, 2017) (Paper 10)); *see also id.* at 19 ("The rules state that a petition may contain no more than 14,000 words. . . . [T]he petition states that it contains 12,812 words."). According to Patent Owner, "such tactics unnecessarily multiply the amount of material that the Board and patent owner must traverse to assess the patentability of the '675 patent claims." *Id.* at 15.

We disagree with Patent Owner. There is nothing inherently improper with filing multiple petitions at the same time to avoid issues associated with the word limit. Petitioner's practice as described by Patent Owner is expressly permitted by the Board, which previously has provided guidance that petitioners should consider filing multiple petitions if concerned with exceeding word limits. *See* Rules of Practice for Trials Before the Patent Trial and Appeal Board and Judicial Review of Patent Trial and Appeal Board Decisions, 77 Fed. Reg. 48,612, 48,635 (Aug. 14, 2012) ("Where a petitioner can demonstrate how a waiver of the page limit is in the interests of justice, a motion to waive the page limit should be considered. Alternatively, the filing of multiple petitions directed to subsets of related claims should be considered."). On this record, we find no reason to deny institution based on Petitioner's multiple filings.

B. Word Limit

Patent Owner also contends that we should deny the Petition for violating our rules on word limits and incorporation by reference. Prelim. Resp. 19–21. Noting that "a petition may contain no more than 14,000 words," Patent Owner asserts that "the [instant] petition states that it contains 12,812 words," "[b]ut that total does not count the three full sections that the petition incorporates by reference from other documents." *Id.* at 19. In particular, Patent Owner asserts that the Petition incorporates by reference 4,094 words, including "the description of the technology," "the overview of the '675 patent," and "the description of the '675 patent's prosecution history" from Dr. Choi's declaration in this case and the petition in IPR2018-01326. *Id.* at 19–20 (citing Pet. 6–8). Patent Owner characterizes these instances of incorporation by reference as "improper" and "especially egregious" for "bring[ing] the petition length significantly beyond the 14,000 word limit." *Id.* at 20 (citing 37 C.F.R. §§ 42.6(a)(3), 42.24(a)(1)(i)).

This Decision does not rely on the portions of Dr. Choi's declaration and the petition in IPR2018-01326 that Patent Owner alleges are incorporated by reference improperly. Nevertheless, we disagree with Patent Owner. As Patent Owner acknowledges, our rules specify that "[a]rguments must not be incorporated by reference from one document into another document," and that "combined documents are not permitted." Prelim. Resp. 20; 37 C.F.R. § 42.6(a)(3). Patent Owner does not allege or show that the instant Petition incorporates *arguments* by reference from another document. Mere descriptions or overviews of technologies, patents, and patent prosecution histories do not constitute arguments. Nor does

Patent Owner allege or show that Petitioner has combined the instant Petition with another document. Accordingly, based on the record before us, we find that Petitioner has not violated our rules regarding word limits or incorporation by reference in this case.

C. Claim Interpretation

The claim construction standard applicable to this *inter partes* review proceeding is the broadest reasonable interpretation in light of the patent specification. *See* 37 C.F.R. § 42.100(b) (2017); *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

[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) (to be codified at 37 C.F.R. pt. 42).

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) ("[P]aragraph 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."). 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. Aus. Pty Ltd. v. Int'l Game Tech.*, 521 F.3d 1328, 1331 (Fed. Cir. 2008).

Petitioner provides proposed interpretations of various claim terms, including claim terms that it contends are means-plus-function limitations. Pet. 11–21. Patent Owner responds that "procedural defects in the petition warrant its denial," and "[t]hose defects can be ascertained without particular construction of any terms of the '675 patent." Prelim. Resp. 13. In light of the parties' arguments and evidence, we provide further discussion of the claim term "power tracker."

1. Satisfying 37 C.F.R. § 42.104(b)(3)

Petitioner indicates that Apple (a real party in interest in this proceeding) has argued in a related ITC investigation that the recited "power tracker" is a means-plus-function limitation lacking sufficient corresponding structure. Pet. 12 n.3. Although Petitioner asserts that the challenged claims are invalid for indefiniteness under Apple's proposed means-plus-function construction, Petitioner directs us to the construction of "power tracker" determined by the Administrative Law Judge ("ALJ") in the ITC investigation: "component in a voltage generator that computes the power requirement." *Id.* at 12 (citing Ex. 1418, 18–20), 12 n.3. According to Petitioner, 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.*

In response, Patent Owner contends that we should deny the Petition because our "rules 'require a petition to identify, not only how the challenged claim is to be construed but also how the construed claim is unpatentable' under 'a claim construction that it consider[s] to be correct.'" Prelim. Resp. 18 (quoting *Hologic, Inc. v. Enzo Life Sciences, Inc.*, Case IPR2018-00019, slip op. at 8–9 (PTAB Apr. 18, 2018) (Paper 17)); *see* 37 C.F.R. § 42.104(b)(3) (a petitioner must identify "[h]ow the challenged claim is to be construed"). According to Patent Owner, "[i]n this case, petitioner believes that the term 'power tracker' is a means-plus-function term," but "advocates a different claim construction (*i.e.*, a non-[means-plus-function] claim construction)." Prelim. Resp. 18. Patent Owner also contends that, "[d]espite believing that 'power tracker' should be construed as a [means-plus-function] term, petitioner did not comply with 37 C.F.R.

§ 42.104(b)(3)[,] thereby providing another basis for denial of the petition." *Id.* at 19; *see* 37 C.F.R. § 42.104(b)(3) ("Where the claim to be construed contains a means-plus-function or step-plus-function limitation . . . , the [petitioner's] construction of the claim must identify the specific portions of the specification that describe the structure, material, or acts corresponding to each claimed function.").

We disagree with Patent Owner. A petitioner may satisfy 37 C.F.R. § 42.104(b)(3) "by identifying 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." *Hologic, Inc. v. Enzo Life Sciences, Inc.*, Case IPR2018-00019, slip op. at 5 (PTAB Nov. 28, 2018) (Paper 21)[6] (quoting *Western Digital Corp. v. SPEX Techs., Inc.*, Case IPR2018-00084, slip op. at 11 (PTAB Apr. 25, 2018) (Paper 14)). In an *inter partes* review where the broadest reasonable interpretation applies, 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. *Id.* 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. *Id.* at 5, 7. If a petitioner is concerned that the Board may not adopt what it believes to be the proper claim

[6] This decision denied the motion for rehearing of the *Hologic* decision cited by Patent Owner.

construction, the petitioner may offer alternative constructions and demonstrate unpatentability under each construction. *Id.* at 6.

As discussed above, we apply the broadest reasonable interpretation in this proceeding. By contrast, the ALJ in the related ITC investigation applied the *Phillips* standard. Ex. 1418, 3–5 (ITC claim construction order); *see also* Pet. 12 ("The ALJ's construction was based on the *Phillips* standard."). Here, Petitioner offers a construction for the claim term "power tracker," namely, the ALJ's construction in the ITC investigation, and expresses its belief that the challenged claims of the '675 patent are "also" invalid for indefiniteness under Apple's proposed means-plus-function construction of the term. Pet. 12, 12 n.3. We find this approach to be acceptable under 37 C.F.R. § 42.104(b)(3). This is not a situation like that presented in *Hologic*, where the *Phillips* standard was being applied and the petitioner offered constructions with which it expressly disagreed. *See Hologic*, slip op. at 7 (Paper 21).

2. Request for Proposed Constructions of "power tracker"

As discussed above, Patent Owner does not address the construction of "power tracker." At this stage of the proceeding, we have not reached a final decision regarding whether "power tracker" is a means-plus-function limitation under section 112, sixth paragraph, which requires identification of sufficient structure, material, or acts in the specification. *See In re Donaldson Co.*, 16 F.3d 1189, 1193 (Fed. Cir. 1994) (en banc). We are able to analyze Petitioner's asserted prior art ground for purposes of this Decision, however, without making such a determination. For purposes of this Decision, we adopt the ALJ's construction in the ITC investigation and

construe "power tracker" to mean "component in a voltage generator that computes the power requirement." *See* Ex. 1418, 20. The preliminary evidence in favor of this construction passes the threshold sufficient to institute an *inter partes* review.

The parties are directed to address specifically in their subsequent briefing in this proceeding whether the recited "power tracker" invokes 35 U.S.C. § 112 ¶ 6. If it does invoke 35 U.S.C. § 112 ¶ 6, the parties are directed to identify the corresponding structure from the specification of the '675 patent. *See* 37 C.F.R. 42.104(b)(3). If not, the parties are directed to explain their reasoning and address the construction of the term under the broadest reasonable interpretation standard.

D. Obviousness over Chen, Wang, and Choi

Petitioner asserts that claims 28–30 of the '675 patent would have been obvious over Chen, Wang, and Choi. Pet. 22–75. For the reasons explained below, we are persuaded that Petitioner has demonstrated a reasonable likelihood of prevailing on this asserted ground.

1. Chen

Chen is a paper that proposes a hybrid envelope tracking scheme. Ex. 1412, 662. Figure 1 of Chen, which is reproduced below, illustrates the proposed scheme. *Id.*

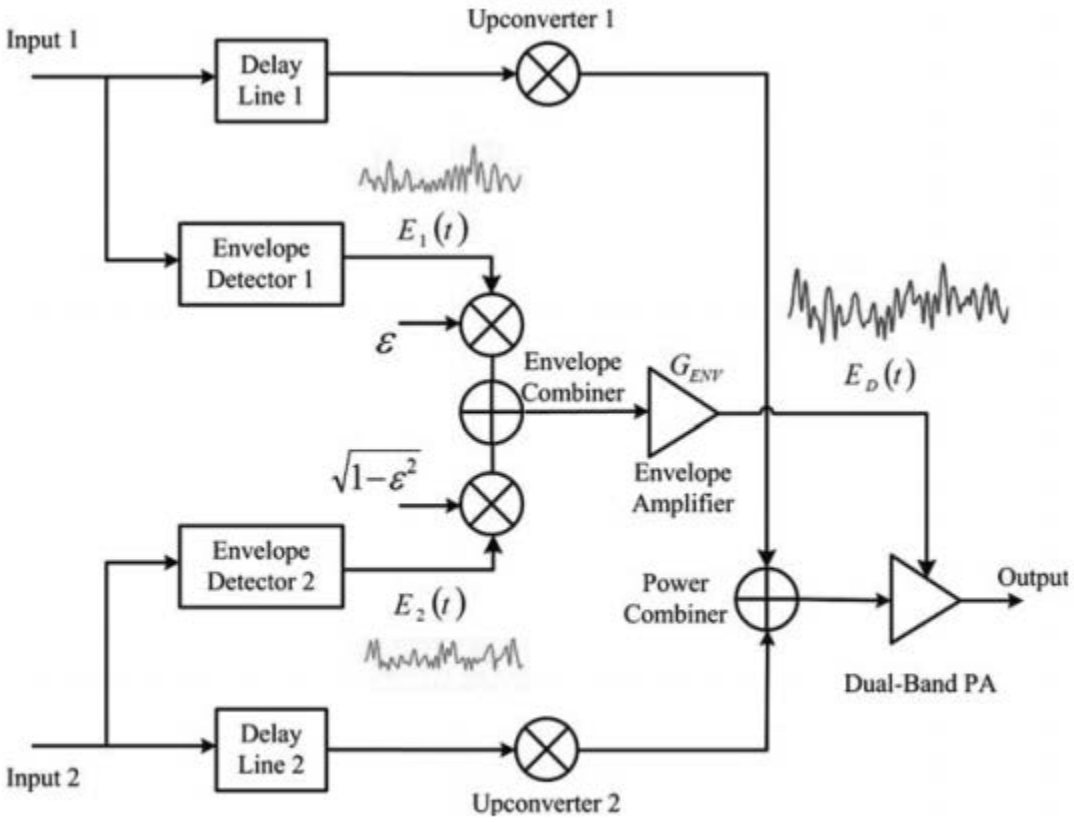


Figure 1 Proposed hybrid ET scheme for concurrent dual-band PAs.

In particular, Figure 1 of Chen shows the proposed hybrid envelope tracking architecture for concurrent dual-band power amplifiers. *Id.* Input signals 1 and 2 are provided at different frequencies (*id.* at 662), and each signal follows two paths (*see id.*, Fig. 1). Along one path, input signals 1 and 2 are fed separately to respective envelope detectors 1 and 2, where the envelopes of the signals are detected. *Id.* at 662, Fig. 1. The signals are then weighted using power weighting factor Ɛ. *Id.* Next, the signals are added together by the envelope combiner and injected into the envelope amplifier. *Id.* The output of the envelope amplifier is used to modulate the supply voltage of the target dual-band power amplifier (PA). *Id.* at 662. Chen indicates that

$E_1(t)$ and $E_2(t)$ represent the signal envelopes in dual bands, and $E_D(t)$ represents the final modulated supply of the power amplifier. *Id.*

Along the other path, Figure 1 of Chen shows input signals 1 and 2 also being fed separately to respective delay lines 1 and 2. *See id.*, Fig. 1. The signals are then upconverted by upconverters 1 and 2 and added together by the power combiner. *See id.* The power combiner outputs a signal that is provided to the dual-band PA. *See id.*

After receiving signals from both the envelope amplifier and the power combiner, the dual-band PA generates an output signal. *See id.*

2. Wang

Wang describes an envelope-tracking power amplifier system. Ex. 1405, 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. 1408, at Ex. A, at 1074. Figure 5 of Choi, which is reproduced below, illustrates such supply modulator.

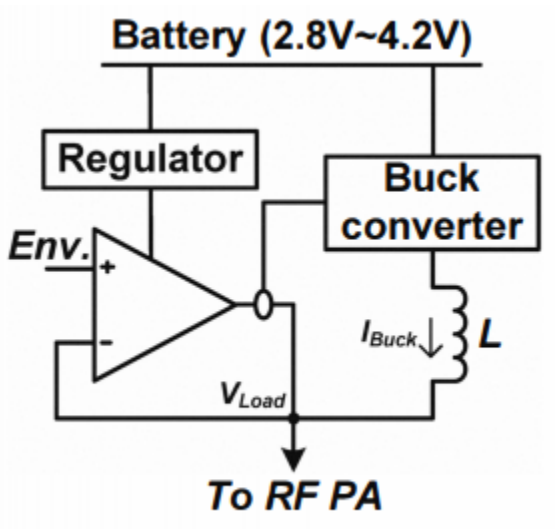


Fig. 5. Battery-to-5V boosting PA supply modulator.

In particular, 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. Analysis

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

Independent 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 Interpretation section, we construe "power tracker" to mean "component in a voltage generator that computes the power requirement."

According to Petitioner, the recited "means for determining a single power tracking signal" limitation is a means-plus-function limitation. Pet. 13–15. Petitioner identifies the claimed function as "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.* at 13–14. Petitioner

further identifies power tracker 582 as the corresponding structure disclosed in the ’675 patent. *Id.* at 14. As support, Petitioner directs us to Figure 5 of the ’675 patent, which is reproduced below. *Id.*

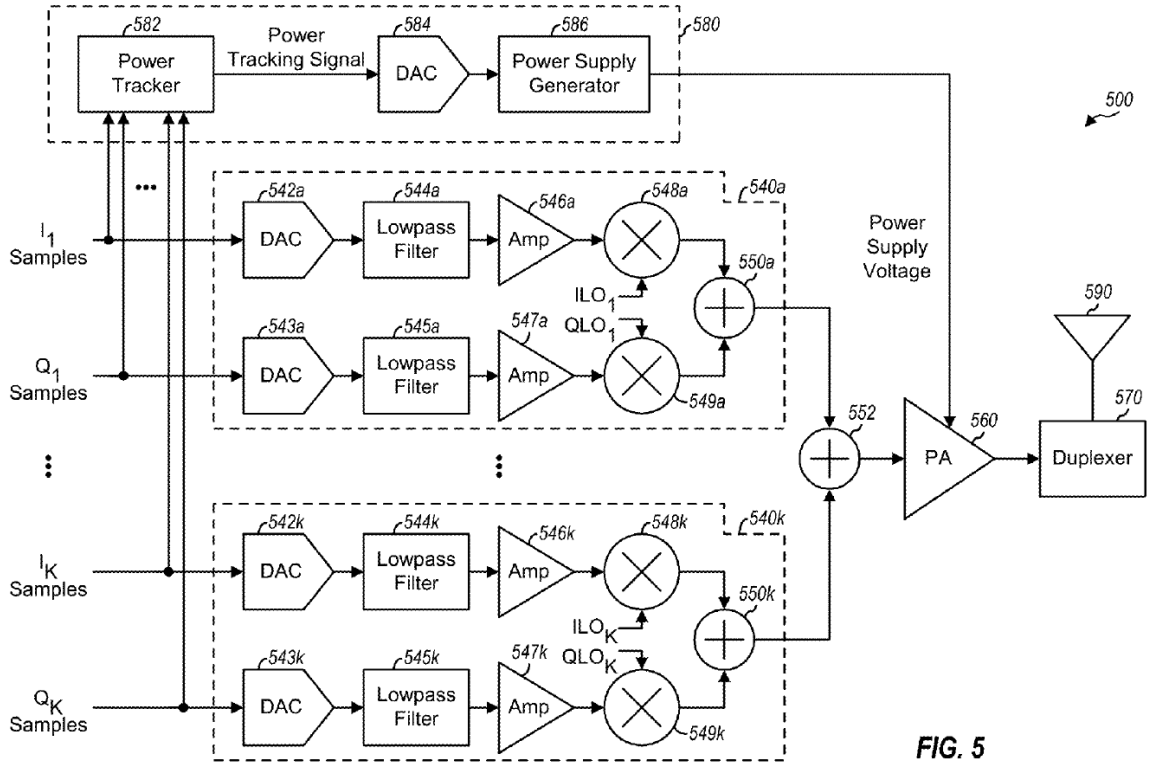
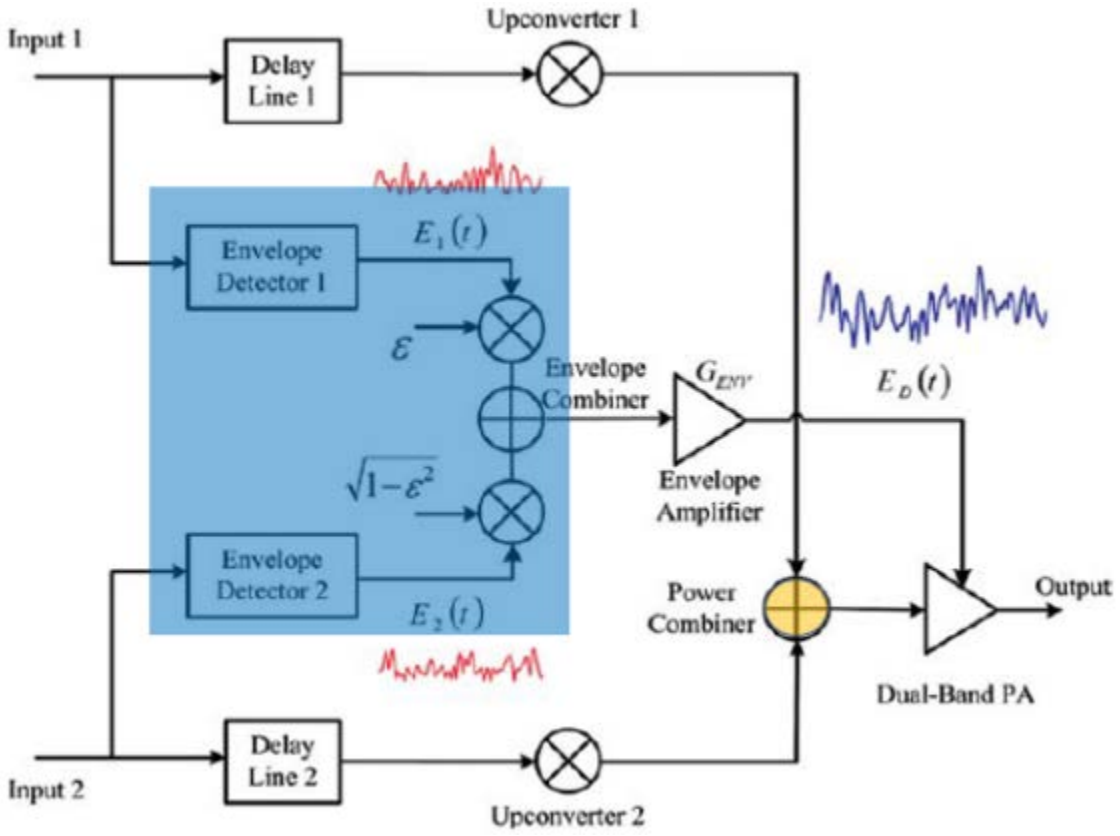


FIG. 5

Figure 5 of the ’675 patent illustrates a transmit module with power tracking for all transmit signals. Ex. 1401, 1:65–67. As Figure 5 shows, power tracker 582 receives I and Q samples for multiple transmit signals and generates a power tracking signal. *Id.* at Fig. 5; *see also* Pet. 14 (citing Ex. 1401, 6:63–7:1, 8:6–8). Petitioner also directs us to where the ’675 patent teaches that the transmit signals may comprise OFDM or SC-FDMA signals. Pet. 14–15 (citing Ex. 1401, 8:66–9:3).

For the recited “means for determining a single power tracking signal” limitation, Petitioner relies on both Chen and Wang. With respect to the

claimed function, Petitioner identifies Chen's envelope detectors 1 and 2 together with Chen's envelope combiner as comprising a "power tracker." Pet. 25. Petitioner also identifies the output of Chen's envelope combiner as a "single power tracking signal." *Id.* at 28. In addition, Petitioner identifies Chen's input signals 1 and 2 as "carrier aggregated transmit signals." *Id.* at 29–30. To illustrate, Petitioner provides an annotated version of Figure 1 of Chen, which is reproduced below. *Id.* at 25.



As discussed above, Figure 1 of Chen illustrates the architecture for a hybrid envelope tracking scheme. Ex. 1412, 662. Chen's envelope detectors 1 and 2 as well as Chen's envelope combiner are highlighted in blue. Petitioner asserts that these components are in a voltage generator for the dual-

band PA, and directs us to where Chen teaches that "$E_D(t)$ is the final modulated supply of the PA." *Id.* at 25 (citing Ex. 1412, 662); *see also* Ex. 1412, Fig. 3 (showing envelope waveforms E(t) measured in voltages). Petitioner also directs us to where Chen teaches that the envelopes of input signals 1 and 2 are detected by envelope detectors 1 and 2, weighted using power weighting factor Ɛ, and then combined by the envelope combiner. *Id.* at 25–26 (citing Ex. 1412, 662). The envelope combiner outputs a signal that is fed to the envelope amplifier, which generates $E_D(t)$. Ex. 1412, 662. Petitioner further directs us to where Chen teaches that the detected envelope signals are represented by $E_1(t)$ and $E_2(t)$. Pet. 26 (citing Ex. 1412, 662). According to Petitioner, these envelope signals "are proxies for the power of each input signal," and the envelope combiner's output signal "is a proxy for the combined power of the two input signals." *Id.* at 26, 28; *see also id.* at 22 ("[T]he use of a 'power weighting factor' to weight the envelope signals . . . confirms that the output of the Envelope Combiner represents the power requirement.") (citing Ex. 1403 ¶ 122).

With respect to Chen's input signals 1 and 2, Petitioner additionally directs us to where Chen describes the signals as "two single carrier wideband code division multiple access signals," which operate at different frequencies. Pet. 30 (citing Ex. 1412, 663). Petitioner contends that this teaching indicates that the signals "are from different (multiple) carriers," and that "aggregating multiple signals on different frequencies increases the bandwidth for a user, allowing more information to be transmitted per unit of time." *Id.* Petitioner relies on the declaration testimony of Dr. Choi. *Id.* (citing Ex. 1403 ¶ 124).

Petitioner submits, however, "Chen does not expressly mention I and Q components of the input signals, but [an ordinarily skilled artisan] would have understood that Input 1 and Input 2 are digital signals that each would have such I and Q components." Pet. 31. Petitioner directs us again to where Chen describes its input signals as wideband code division multiple access ("WCDMA") signals, and asserts that "WCDMA is the dominant third-generation (UMTS) cellular technology and uses Quadrature Phase Shift Keying (QPSK) modulation." *Id.* at 31–32 (citing Ex. 1412, 663; Ex. 1406, 19, 205, 389). Relying on the declaration testimony of Dr. Choi, Petitioner contends that an ordinarily skilled artisan "would have known that QPSK modulation uses signals that have I and Q components." *Id.* at 32 (citing Ex. 1403 ¶ 126).

Alternatively, Petitioner points to Wang for teaching the recited I and Q components. *Id.* at 32. According to Petitioner, even if Chen does not disclose I and Q signals, "it would have been obvious to use Wang's I/Q signal processing in Chen." *Id.* Petitioner directs us to where Wang teaches receiving a "complex baseband signal," which Petitioner asserts "is generally understood to comprise I and Q components." *Id.* at 32–33 (citing Ex. 1405, Fig. 3; Ex. 1403 ¶ 127). 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 33 (citing Ex. 1405, 1245). Petitioner contends that an ordinarily skilled artisan "would have been motivated to use Wang's I/Q signal processing in Chen to efficiently process and transmit the RF signals in Chen's system." *Id.* at 36. Petitioner asserts that "[c]omplex input signals (with I and Q components) allow the use of advanced 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 37 (citing Ex. 1421, 308).

Petitioner also points to Wang for expressly teaching Orthogonal Frequency Division Multiplexing (OFDM) signals. *Id.* at 41 (citing Ex. 1405, 1244 (title), 1253). According to Petitioner, an ordinarily skilled artisan "would have looked to Wang, a reference in the same field, to determine a modulation technique for Chen." *Id.* at 42. 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 42–43 (citing Ex. 1422 ¶¶ 2–3). Petitioner relies on the declaration testimony of Dr. Choi. *Id.* (citing Ex. 1403 ¶ 138).

With respect to the corresponding structure, namely, the '675 patent's power tracker 582, Petitioner contends that "Chen'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." Pet. 45. According to Petitioner, "the power tracker in Chen . . . is a more detailed version of the power tracker disclosed in the '675 patent," but "[a]ny differences between the structures in the '675 patent and Chen (as modified by Wang) would be insubstantial." *Id.* at 45–46. As support, Petitioner asserts that, "[a]s modified by Wang, Chen's power tracker operates in substantially the same way as the power tracker described in the '675 patent" because it "receives I and Q components for multiple transmit signals, sums them to determine a single power tracking signal based on those I/Q components, and generates a

single power tracking signal." *Id.* at 46. Petitioner additionally asserts that "Chen's power tracker also achieves substantially the same result" as the power tracker in the '675 patent," that is, "a single power tracking signal for multiple transmit signals that is provided to a power supply generator for a PA." *Id.* at 46–47. Petitioner relies on the declaration testimony of Dr. Choi. *Id.* (citing Ex. 1403 ¶ 144).

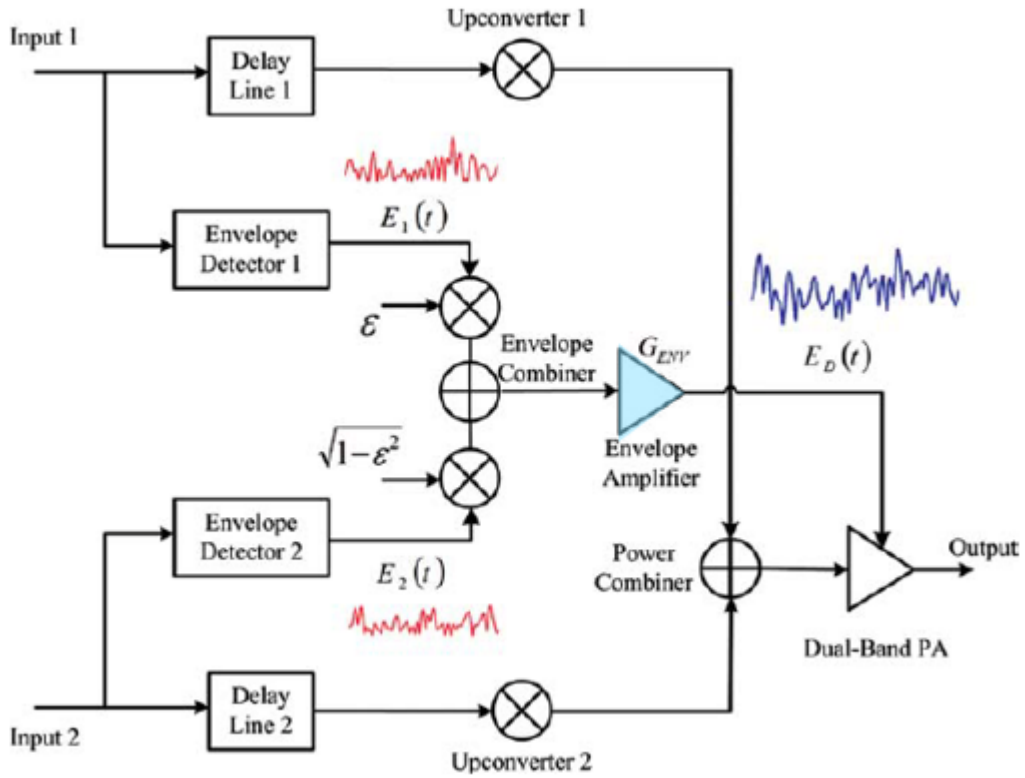
Based on the record before us, at this stage of the proceeding, we are persuaded that Petitioner has established sufficiently for purposes of this Decision that the combination of Chen and Wang teaches the recited "means for determining a single power tracking signal" limitation. We also are persuaded that Petitioner's proffered reasoning for modifying Chen to include Wang's baseband signal (comprising an OFDM signal with I and Q components) 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."). Namely, we are persuaded that modifying Chen to include Wang's baseband signal would have provided a way to carry out Chen's signaling. *See* Pet. 37 ("Complex input signals (with I and Q components) allow the use of advanced modulation techniques such as quadrature phase-shift keying (QPSK)."); *id.* at 42 (an ordinarily skilled artisan "would have looked to Wang, a reference in the same field, to determine a modulation technique for Chen").

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." Petitioner contends that

this limitation is a means-plus-function limitation. Pet. 15–16. Petitioner identifies the claimed function as "generating a single power supply voltage based on the single power tracking signal." *Id.* at 15. Petitioner further identifies power supply generator 586 as the corresponding structure disclosed in the '675 patent. *Id.* 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.* at 16 (citing Ex. 1401, 1:45–47, 7:6–8, 9:44–46).

For this limitation, Petitioner relies on Chen and Choi. With respect to the claimed function, Petitioner identifies Chen's supply $E_D(t)$ as a "single power supply voltage." Pet. 48. To illustrate, Petitioner provides an annotated version of Figure 1 of Chen, which is reproduced below. *Id.*



As discussed above, Figure 1 of Chen shows the architecture for a hybrid envelope tracking scheme. Ex. 1412, 662. Petitioner directs us to where

Chen teaches that "[t]he envelopes of the input signals at different frequencies are detected separately . . . and then added together in time domain and injected into the envelope amplifier, finally, the output of the envelope amplifier is used to modulate the supply voltage of the target dual-band PA." Pet. 48 (citing Ex. 1412, 662). The annotated figure shows Chen's envelope amplifier with light blue shading receiving the envelope combiner's output signal (which Petitioner identifies as the "single power tracking signal") and generating supply $E_D(t)$.

Petitioner asserts that "Chen does not disclose the internal structure of its power supply generator (Envelope Amplifier), but . . . it would have been obvious to implement Chen's power supply generator using the structure disclosed in Choi." Pet. 49. As support, Petitioner provides an annotated version of Figure 5 of Choi, which is reproduced below. *Id.* at 50.

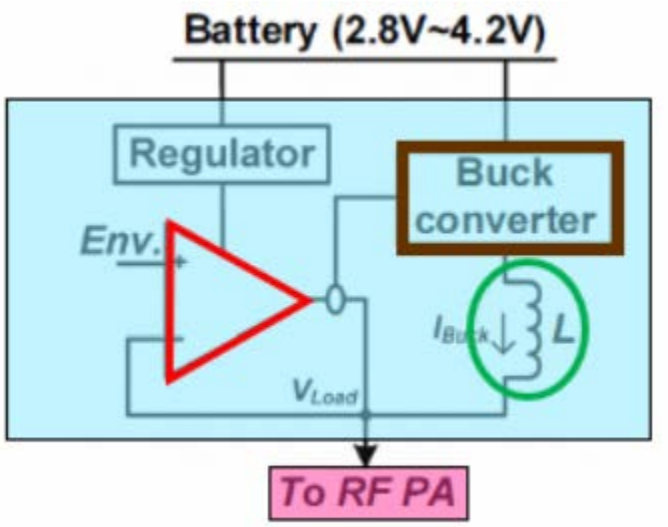


Fig. 5. Battery-to-5V boosting PA supply modulator.

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. 1408, 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. Pet. 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 shown with pink shading. *Id.* at 51. Petitioner further contends that "Choi discloses an 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 Chen." *Id.* 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 52. Petitioner relies on the declaration testimony of Dr. Choi. *Id.* at 52–53 (citing Ex. 1402 ¶¶ 153–155).

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 54.

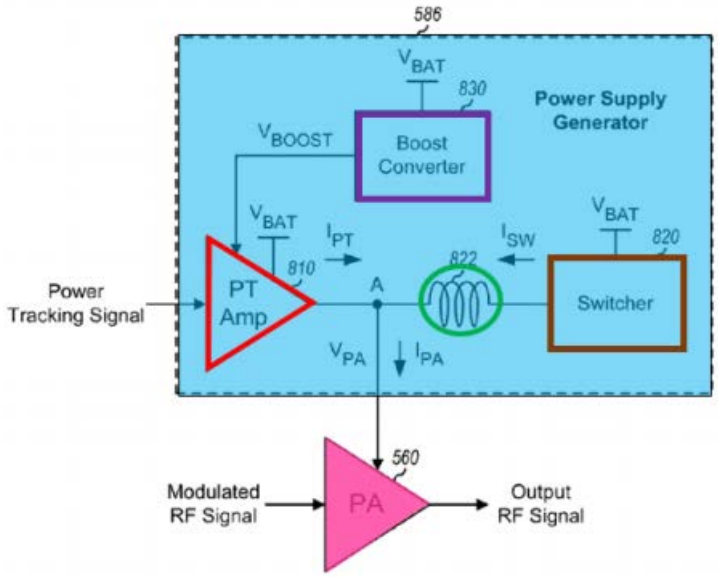
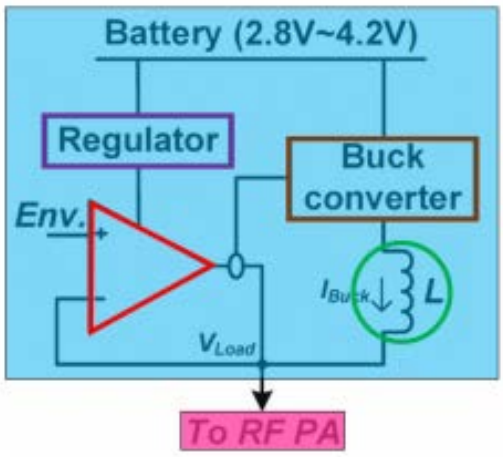


FIG. 8

Figure 8 of the ’675 patent shows the design of a power supply generator with power tracking. Ex. 1401, 2:3–4. Petitioner also directs us to an annotated version of Figure 5 of Choi, which is reproduced below. Pet. 55.



As discussed above, Figure 5 of Choi shows the architecture of a power amplifier supply modulator that dynamically regulates a power amplifier. Ex. 1408, at Ex. A, at 1074. Petitioner contends that “Choi’s hybrid switching amplifier (substituted for Chen’s Envelope Amplifier in the combination of Chen and Choi) is identical, or at a minimum, equivalent to

the power supply generator disclosed in the '675 patent." *Id.* at 55. 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 or linear amplifier (outlined in red), a boost converter (outlined in purple), a switcher (outlined in brown), an inductor (outlined in green), and a power amplifier (shown with pink shading). *Id.* at 55–56. Petitioner also contends that "[a]ny differences between the power supply generator in the '675 patent and the power supply generator in Chen (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 56. Petitioner relies on the declaration testimony of Dr. Choi. *Id.* (citing Ex. 1403 ¶ 159).

Based on the record before us, at this stage of the proceeding, we are persuaded that Petitioner has established sufficiently for purposes of this Decision that the combination of Chen, 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 Chen and Wang to include Choi's hybrid switching amplifier, namely, to provide implementation details for Chen's envelope amplifier, is sufficient to support the legal conclusion of obviousness. *See Kahn*, 441 F.3d at 988.

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. 16–17. 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 16. Petitioner further identifies power amplifier 560 as the corresponding structure disclosed in the '675 patent. *Id.* 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.* at 16–17 (citing Ex. 1401, 6:59–62, 7:58–60, 7:62–64, Fig. 5).

For this limitation, Petitioner relies on Chen. With respect to the claimed function, Petitioner provides an annotated version of Figure 1 of Chen, which is reproduced below. *Id.* at 58.

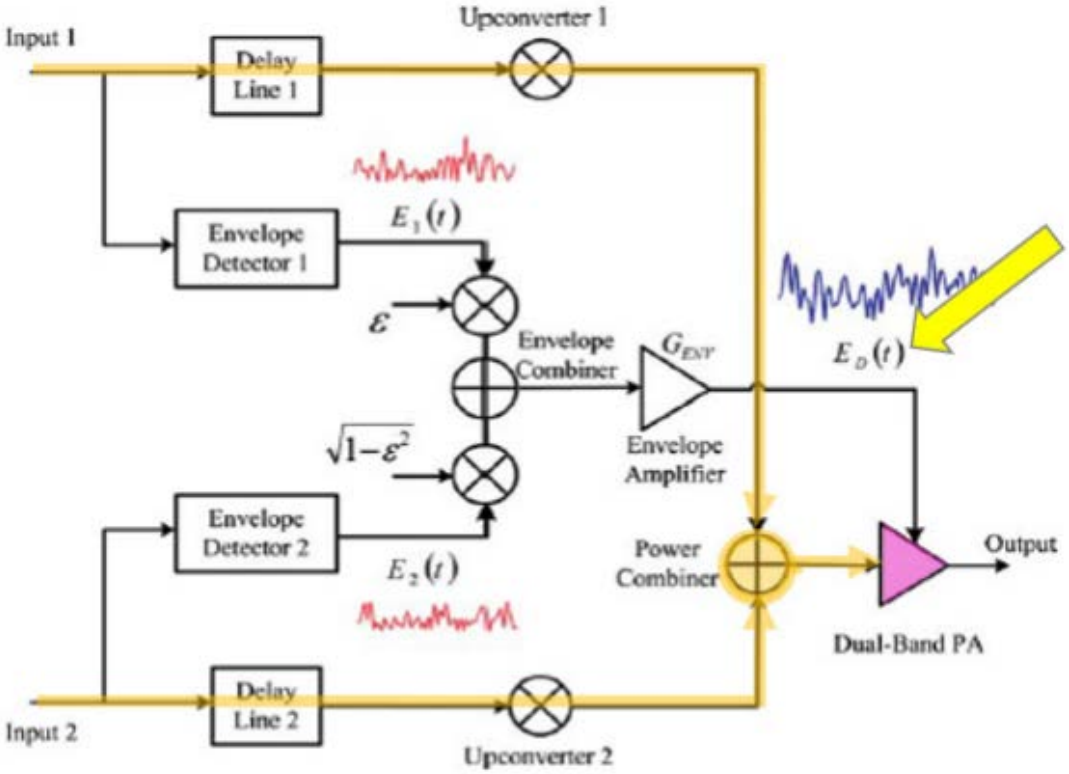
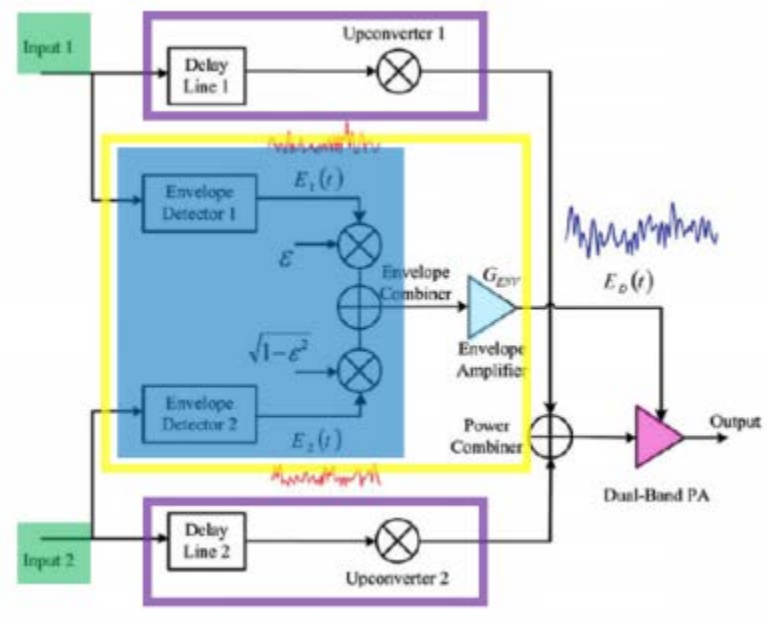


Figure 1 of Chen shows the architecture for a hybrid envelope tracking scheme. Ex. 1412, 662. Referring to its annotated Figure 1 of Chen, Petitioner contends that "the [dual-band] PA (highlighted in pink) receives the single power supply voltage $E_D(t)$ from the Envelope Amplifier, indicated at the yellow arrow." Pet. 57. Petitioner further contends that Chen's "[dual-band] PA also receives the plurality of carrier aggregated transmit signals (inputs 1 and 2) after they have been upconverted (by Upconverters 1 and 2 (mixers)) and summed (by the Power Combiner), as indicated . . . in gold, and produces a single output radio frequency signal such that the transmit signals are sent simultaneously." *Id.* We find that the signal generated by Chen's dual-band PA 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 another annotated version of Figure 1 of Chen, which is reproduced below. Pet. 59.



As discussed above, Figure 1 of Chen shows the architecture for a hybrid envelope tracking scheme. Ex. 1412, 662. Petitioner also directs us to an annotated version of Figure 6 of the ’675 patent, which is reproduced below. Pet. 60.

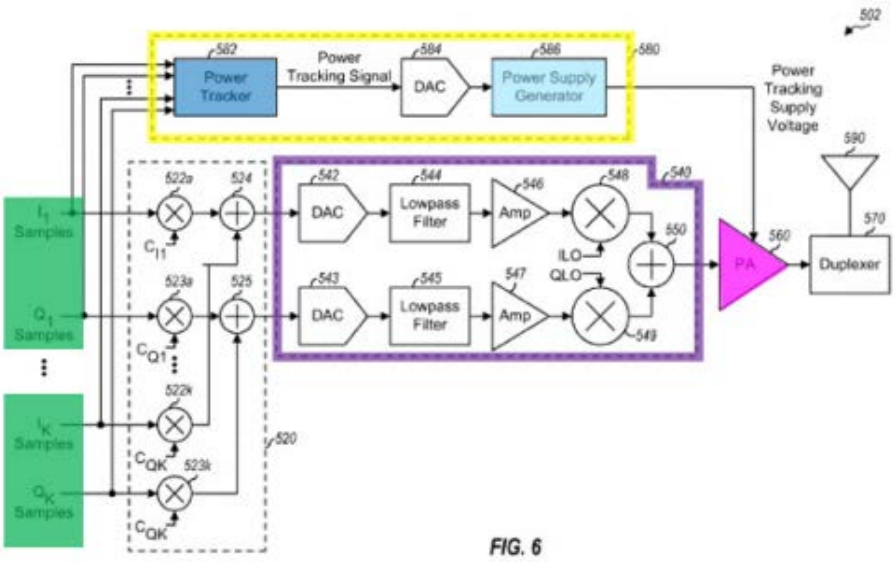


FIG. 6

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. 1401, 1:65–67. Relying on the declaration testimony of Dr. Choi, Petitioner contends that “[t]he power amplifier disclosed in Chen (highlighted . . . in pink) is identical to the power amplifier disclosed in the ’675 patent.” Pet. 59–60 (citing Ex. 1403 ¶ 163).

Based on the record before us, at this stage of the proceeding, we are persuaded that Petitioner has established sufficiently for purposes of this Decision that the combination of Chen, 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 respond to Petitioner’s arguments regarding claim 28. *See generally* Prelim. Resp. In view of the foregoing, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion that independent claim 28 would have been obvious over Chen, Wang, and Choi. Having reviewed Petitioner’s arguments asserting that dependent claims 29 and 30 would have been ovious over Chen, Wang, and Choi (*see* Pet. 60–75), we also determine that Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion as to these claims. Patent Owner does not respond to Petitioner’s arguments regarding claims 29 and 30. *See generally* Prelim. Resp.

IV. CONCLUSION

For the foregoing reasons, we are persuaded that Petitioner has demonstrated a reasonable likelihood that it will prevail in showing that

claims 28–30 of the ’675 patent are unpatentable. We have not made a final determination, however, with respect to the patentability of these claims.

V. ORDER

For the reasons given, it is

ORDERED that *inter partes* review is instituted as to all challenged claims of the ’675 patent, namely, claims 28–30, based on the sole asserted ground: obviousness under 35 U.S.C. § 103 of claims 28–30 over Chen, Wang, and Choi;

FURTHER ORDERED that no other grounds of unpatentability are authorized for an *inter partes* review as to any claim of the ’675 patent; and

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

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