

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

NXP USA, INC.,
Petitioner,

v.

IMPINJ, INC.,
Patent Owner.

IPR2020-00556
Patent 9,031,504 B1

Before BRIAN J. McNAMARA, ROBERT J. WEINSCHENK, and
KEVIN C. TROCK, *Administrative Patent Judges*.

TROCK, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Granting-in-Part and Denying-in-Part
Patent Owner's Motion to Amend
35 U.S.C. § 318(a)

I. INTRODUCTION

We have authority to hear this *inter partes* review under 35 U.S.C. § 6. This Final Written Decision issues pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons discussed herein, Patent Owner’s Non-Contingent Motion to Amend is granted-in-part as to the cancellation of claims 1, 2, 4, 7–10, 13–15, 17–19, and 21 (the “challenged claims”) of U.S. Patent No. 9,031,504 B1 (Ex. 1002, “the ’504 patent”), and denied-in-part as to proposed substitute claims 22–35 (the “substitute claims”).

A. Procedural History

NXP USA, Inc. (“Petitioner”) filed a Petition for *inter partes* review of claims 1, 2, 4, 7–10, 13–15, 17–19, and 21. Paper 1 (“Pet.” or “Petition”). Impinj, Inc. (“Patent Owner”) filed a Preliminary Response, Paper 10 (“Prelim. Resp.”). We instituted *inter partes* review of all challenged claims on the grounds presented in the Petition. Paper 15 (“Institution Decision” or “Dec.”).

After institution, Patent Owner filed a Non-Contingent Motion to Amend, cancelling all the challenged claims and proposing substitute claims 22–35. Paper 25 (“Mot. to Amend.”). Petitioner thereafter filed an Opposition to the Motion to Amend. Paper 30 (“Pet. Opp.”). We then issued Preliminary Guidance to Patent Owner’s Non-Contingent Motion to Amend. Paper 31 (“Prelim. Guid.”). Patent Owner filed a Reply in support of the Non-Contingent Motion to Amend. Paper 32 (“PO Reply”). With our authorization, Petitioner filed a Supplemental Opposition to Patent Owner’s Non-Contingent Motion to Amend. Paper 38 (“Pet. Supp. Opp.”). Patent Owner filed a Response to Petitioner’s Supplemental Opposition. Paper 41 (“PO Resp. to Supp. Opp.”). Petitioner filed a Sur-Reply to Patent Owner’s

Reply in support of the Non-Contingent Motion to Amend. Paper 42 (“Pet. Sur-Reply”).

An oral hearing was held on May 18, 2021. A transcript of the hearing is included in the record. Paper 51 (“Tr.”).

Subsequent to the hearing, Patent Owner filed, with our authorization, a Revised Non-Contingent Motion to Amend. Paper 49 (“Rev. Mot. to Amend.”). Petitioner filed a response to Patent Owner’s Revised Non-Contingent Motion to Amend. Paper 50 (“Pet. Resp. to Rev. Mot. to Amend.”).

B. Related Proceedings

According to the parties, the ’504 patent is the subject of the following action: *Impinj, Inc. v. NXP USA, Inc.*, No. 4:19-cv-03161-YGR (N.D. Cal.) filed June 6, 2019. Pet. 60; Paper 4, 2–3. The parties acknowledge that Petitioner has filed another petition (IPR2020-00554) challenging the ’504 patent. Paper 4, 3; *see* Pet. 61. The parties also identify IPR petitions Petitioner has filed against other family members of the ’504 patent. Paper 4, 3–4; Pet. 61. The following table identifies these *inter partes* review case numbers and their respective patent numbers:

Case No.	U.S. Patent No.
IPR2020-00514	9,471,816 (“the ’816 patent”)
IPR2020-00516	9,633,302 (“the ’302 patent”)
IPR2020-00519	8,115,597 (“the ’597 patent”)
IPR2020-00543	9,495,631 (“the ’631 patent”)
IPR2020-00544	8,344,857 (“the ’857 patent”)
IPR2020-00552	8,600,298 (“the ’298 patent”)
IPR2020-00553	the ’298 patent
IPR2020-00554	9,031,504 (“the ’504 patent”)
IPR2020-00589	10,002,266 (“the ’266 patent”)

See Paper 4, 3–4.

C. The '504 Patent (Ex. 1002)

The '504 patent relates to Radio Frequency Identification (“RFID”) systems that use a RFID reader to interrogate a RFID tag attached to an object. Ex. 1002, 1:19–22, 1:30–31. In a RFID system, a RFID reader may transmit an interrogating RF wave. *Id.* at 1:31–32, 4:40–41, Fig. 1. A RFID tag in the vicinity may sense the RF wave and respond by transmitting back another RF wave that the RFID reader may then sense and interpret. *Id.* at 1:32–34, 4:41–44, Fig. 1. The '504 patent recognizes, however, that an interrogating RF wave may experience distortion due to interference caused by, for example, other RF signals sent from nearby mobile devices. *Id.* at 1:55–61. As a result, when the RFID tag circuit converts the received RF wave into a received signal, that signal may also be distorted. *Id.* at 1:62–64. “The distorted signal may cause false bits to be detected by the RFID tag, which in turn can result in the RFID tag not being able to detect the interrogating RF wave reliably, or parse its commands.” *Id.* at 1:64–67. For example, the RFID tag circuit may include a demodulator that receives the distorted RF input signal and converts it to a digital output signal that also includes distortion. *Id.* at 8:18–23, Fig. 7 (item 742). Due to the distortion, the digital output signal may include an artifact feature that is received and interpreted by a processor such that the processor may not respond exactly as intended. *Id.* at 8:28–33, Fig. 7 (item 744).

To address this problem, the '504 patent describes an interference rejection filtering circuit (“IRF”) for filtering a received RF signal to remove any artifact features from the signal and generating a filtered output that does not include artifact features. *Id.* at 1:14–16, 10:14, 10:16–19. Figure 9 of the '504 patent is reproduced below.

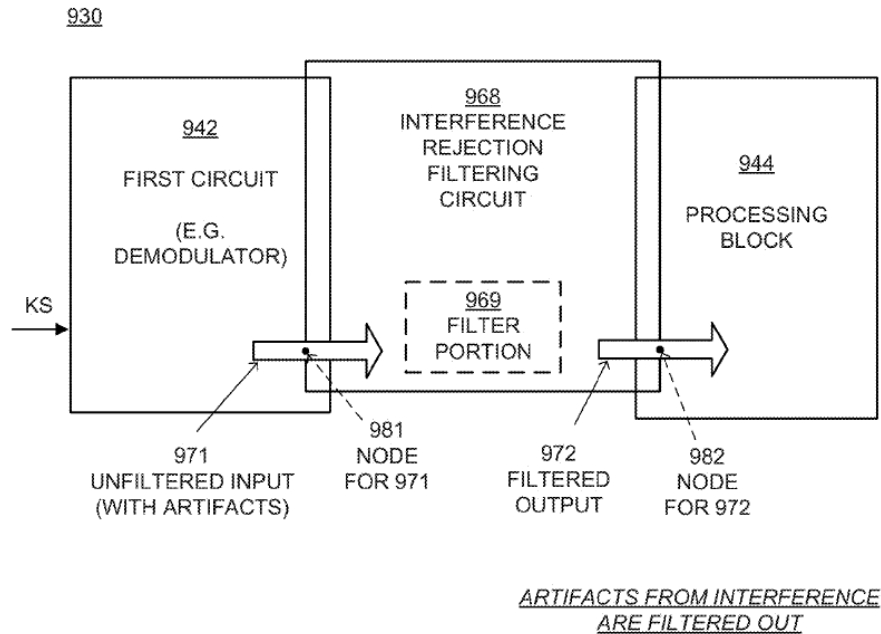


FIGURE 9

Figure 9, above, depicts a partial block diagram of a RFID tag circuit including a first circuit (e.g., demodulator) 942, an IRF 968 with a filter portion 969, and a processor 944 for generating filtered output 972 from unfiltered input 971. *Id.* at 9:54–58. Filter portion 969 may identify features of unfiltered input 971 and apply them to a first criterion related to time duration to determine whether the feature is an artifact arising from a distortion due to interference. *Id.* at 10:43–47, 11:6–10. Features that meet the first criterion may be detected as artifact features and may be removed from filtered output 972, whereas features that do not meet the first criterion may be deemed legitimate and included in filtered output 972. *Id.* at 10:45–51.

Responsive to received periodic samples such as a clock signal CLK, a counter may count an artifact number for the time duration of an identified feature while the identified feature is taking place. *Id.* at 11:22–26, Fig. 10. The first criterion may be met if the artifact number is less than a low

number, which corresponds to a low threshold time. *Id.* at 11:21–29, *see also id.* at 13:11–14.

Figure 12A of the '504 patent is reproduced below.

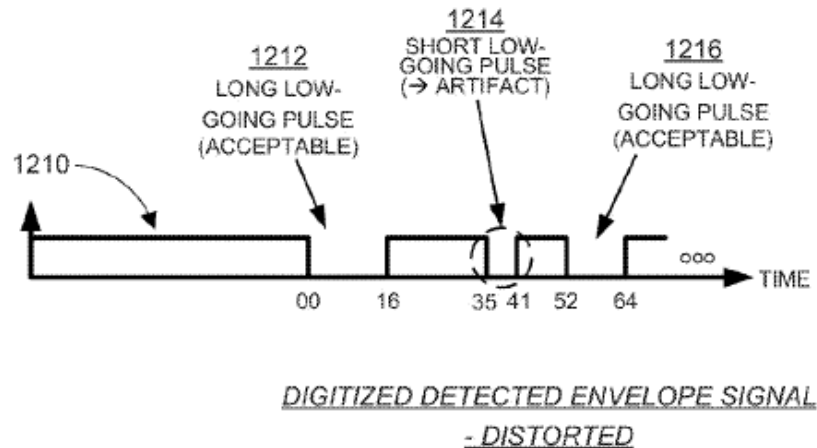


FIGURE 12A

Figure 12A, above, depicts how an unfiltered digital signal input 1210 can be rendered over time. *Id.* at 12:24–25. Signal 1210 is digital—meaning that it has two extreme values (high and low) as well as transitions between them. *Id.* at 12:26–27. In signal 1210, low going pulses 1212, 1214, and 1216 can be identified by their respective transitions from high-to-low and then low-to-high. *Id.* at 12:40–41. According to the figure, pulses 1212 and 1216 meet a low time duration threshold and, thus, are retained, whereas pulse 1214 does not meet the threshold and, thus, is detected as an artifact and rejected. *Id.* at 12:41–44.

Figure 12B of the '504 patent is reproduced below.

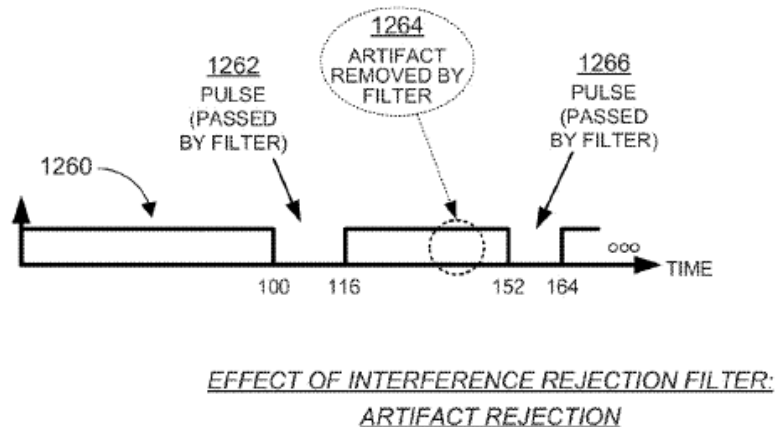


FIGURE 12B

Figure 12B, above, depicts a filtered output generated as a reconstructed signal 1260 from the unfiltered input of Figure 12A. *Id.* at 12:48–49. As noted by comment 1264, there is no pulse corresponding to pulse 1214 of signal 1260 because the artifact feature associated with that pulse has been rejected. *Id.* at 12:55–58.

IRF 968 of the '504 patent's RFID tag circuit can also reject features of duration longer than a high threshold time. *Id.* at 14:23–30, 14:42–52. Figure 14B of the '504 patent is reproduced below.

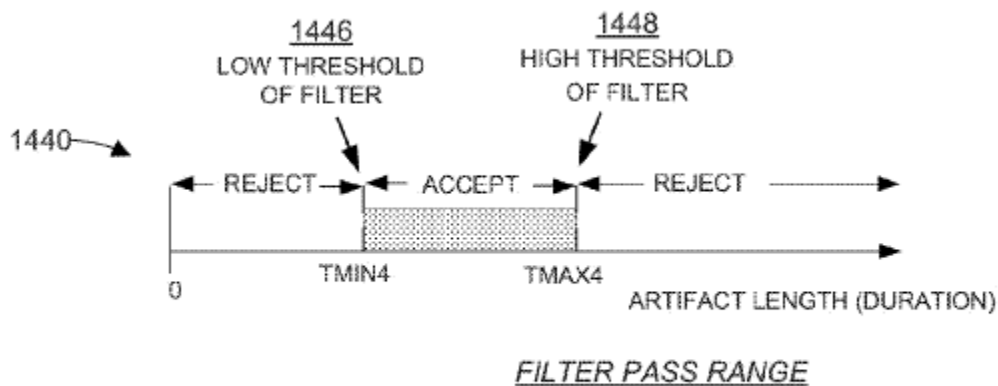


FIGURE 14B

Figure 14B, above, “is a diagram showing another possible characteristic 1440 of IRF 968.” *Id.* at 14:42–43.

The filter with characteristic 1440 is configured to accept features within a preset range between a low threshold time 1446, which occurs at a time TMIN4, and a high threshold time 1448, which occurs at a time TMAX4 Any features with duration less than TMIN4 or more than TMAX4 are rejected as artifact features. As such, characteristic 1440 enables rejection of both short features as well as features that are too long.

Id. at 14:43–52.

Also according to the ’504 patent, the time duration threshold may be adjusted based on information associated with a RF input signal, such as a preamble, a received packet, a filtered output signal, a data rate, or an expected next packet. *See, e.g., id.* at 10:53–55, 14:60–61, 15:15–27, 16:60–61, 17:13–18, 17:37–39, 18:1–14, 18:42–44, Figs. 15, 20, 22, 23B.

D. Cancelled Claims 1, 2, 4, 7–10, 13–15, 17–19, and 21

Our rules provide for cancellation of challenged claims. *See* 37 C.F.R. § 42.121(a)(3) (2019) (“A motion to amend may cancel a challenged claim”). Patent Owner’s Non-Contingent Motion to Amend requests cancellation of all the challenged claims: 1, 2, 4, 7–10, 13–15, 17–19, and 21.¹ Paper 25, 5; Paper 49, 5. Patent Owner’s counsel also confirmed at the oral hearing that it intended to cancel all of the challenged claims. Paper 51, 5:19–6:9. Petitioner does not oppose Patent Owner’s request. Therefore, we

¹ In a non-contingent motion to amend, “the Board provides a final decision on the patentability of substitute claims in place of determining the patentability of corresponding original claims.” Notice Regarding a New Pilot Program Concerning Motion To Amend Practice and Procedures in Trial Proceedings Under the America Invents Act Before the Patent Trial and Appeal Board, 84 Fed. Reg. 9497, 9505 (Mar. 15, 2019).

grant Patent Owner's non-contingent request to cancel claims 1, 2, 4, 7–10, 13–15, 17–19, and 21 of the '504 patent.

E. Proposed Substitute Claims 22–35

Proposed substitute claims 22, 30, and 33 are independent, with proposed substitute claims 23–26 depending from claim 22, proposed substitute claims 27–28 depending from claim 26, proposed substitute claim 29 depending from claim 27, proposed substitute claims 31–32 depending from claim 30, and proposed substitute claims 34–35 depending from claim 33. Proposed substitute claims 22 and 30 recite a method for a Radio Frequency Identification (RFID) tag circuit, and proposed substitute claim 33 recites a Radio Frequency Identification (RFID) tag circuit. Claim 22 is proposed as a substitute for cancelled claim 1 and is set out below, showing added language underlined and deleted language struck out.

[22-pre] A method for a Radio Frequency Identification (RFID) tag circuit comprising:

[22-a] receiving a modulated wireless RF input signal; deriving a first digital output signal responsive to the modulated wireless RF input signal, wherein the first digital output signal comprises a sequence of digital pulses;

[22-b1] filtering the first digital output signal with an interference rejection circuit of the tag circuit to derive a second digital output signal by: receiving the first digital output signal;

[22-b2] generating artifact numbers by counting time durations of the digital pulses;

[22-b3] setting a filter pass range to detect a delimiter, detecting the delimiter

[22-b4] detecting an expected next packet after the delimiter

[22-b5, b6] adjusting the filter pass range based on an aspect of the expected next packet, wherein deriving a the second digital output signal comprises responsive to the first digital output signal at an interference rejection circuit of a RFID tag circuit

~~by substantially removing~~ retaining digital pulses with artifact numbers ~~less than a first low number~~ within the pass range ~~while substantially retaining and removing~~ digital pulses with artifact numbers ~~greater~~ less than the ~~first low number~~ pass range, wherein the ~~first low number corresponds to a first time duration threshold.~~

Paper 25, App. A (bracketed designations added).

F. Evidence

Petitioner relies upon the following evidence to challenge the patentability of the proposed substitute claims:

- (1) U.S. Patent Application Publication No. US 2006/0244598 A1, published November 2, 2006 (“Hyde ’598”) (Ex. 1005);
- (2) U.S. Patent Application Publication No. US 2002/0152044 A1, published October 17, 2002 (“Shanks”) (Ex. 1006);
- (3) U.S. Patent No. 3,997,798, issued December 14, 1976 (“Breimesser”) (Ex. 1007);
- (4) U.S. Patent No. 4,779,077, issued October 18, 1988 (“Lichtblau”) (Ex. 1008);
- (5) EPC™ Radio-Frequency Identity Protocols Class-1 Generation-2 UHF RFID Protocol for Communications at 860 Mhz – 960 Mhz Version 1.0.9, EPCglobal, Inc. (January 2005) (“Gen2”) (Ex. 1015);
- (6) First Declaration of Dr. Travis Blalock, dated February 10, 2020 (Ex. 1003); and
- (7) Second Declaration of Dr. Travis Blalock, dated February 2, 2021 (Ex. 1020).

Patent Owner relies upon the following evidence in support of the patentability of the proposed substitute claims:

- (1) First Declaration of Dr. James Kenney, dated May 20, 2020

(Ex. 2001); and

(2) Second Declaration of Dr. James Kenney, dated March 16, 2021 (Ex. 2009).

G. Asserted Grounds of Unpatentability

Petitioner challenges the patentability of the proposed substitute claims on the following grounds:

Claims Challenged	35 U.S.C. §	References
22–35	103(a)	Shanks, Breimesser, Lichtblau, Gen2
22–35	102(b)	Hyde '598 ²

II. ANALYSIS

A. Principles of Law

In an *inter partes* review, amended claims are not added to a patent as of right, but rather must be proposed as a part of a motion to amend.

35 U.S.C. § 316(d). The Board must assess the patentability of proposed substitute claims “without placing the burden of persuasion on the patent owner.” *Aqua Prods., Inc. v. Matal*, 872 F.3d 1290, 1328 (Fed. Cir. 2017) (en banc); *see also Lectrosonics, Inc. v. Zaxcom, Inc.*, IPR2018-001129,

² In its Supplemental Opposition to Patent Owner’s Non-Contingent Motion to Amend, Petitioner alleges Hyde ’598 anticipates substitute claims 22–35 because “Patent Owner relies on the ’177 Application, which published as Hyde ’598, for its disclosure of the subject matter it seeks to claim” and Hyde ’598 “is prior art to the . . . ’504 Patent.” Paper 38, 4; *see also id.* at 1–4. Hyde ’598 was part of the subject matter of a certificate of correction sought by Patent Owner for the ’504 patent. *See* Paper 41, 1–2. Patent Owner asks us to use our “discretion in not considering the new Hyde ’598 ground in the instant trial.” *Id.* at 1. As explained below, we need not reach the asserted ground based on Hyde ’598.

Paper 15 at 3–4 (PTAB Feb. 25, 2019) (precedential). Subsequent to the issuance of *Aqua Products*, the Federal Circuit issued a decision in *Bosch Automotive Service Solutions, LLC v. Matal*, 878 F.3d 1027 (Fed. Cir. 2017) (“*Bosch*”), as well as a follow-up Order amending that decision on rehearing. *See Bosch Auto. Serv. Sols., LLC v. Iancu*, No. 2015-1928 (Fed. Cir. Mar. 15, 2018) (Order on Petition for Panel Rehearing).

In accordance with *Aqua Products*, *Bosch*, and *Lectrosonics*, a patent owner does not bear the burden of persuasion to demonstrate the patentability of the substitute claims presented in the motion to amend. Rather, ordinarily, “the petitioner bears the burden of proving that the proposed amended claims are unpatentable by a preponderance of the evidence.” *Bosch*, 878 F.3d at 1040 (as amended on rehearing); *see Lectrosonics*, Paper 15 at 3–4. In determining whether a petitioner has proven unpatentability of the substitute claims, the Board focuses on “arguments and theories raised by the petitioner in its petition or opposition to the motion to amend.” *Nike, Inc. v. Adidas AG*, 955 F.3d 45, 51 (Fed. Cir. 2020).

Patent Owner’s proposed substitute claims, however, must meet the statutory requirements of 35 U.S.C. § 316(d) and the procedural requirements of 37 C.F.R. § 42.121. *Lectrosonics*, Paper 15 at 4–8. Accordingly, Patent Owner must demonstrate: (1) the amendment proposes a reasonable number of substitute claims; (2) the proposed claims are supported in the original disclosure (and any earlier filed disclosure for which the benefit of filing date is sought); (3) the amendment responds to a ground of unpatentability involved in the trial; and (4) the amendment does not seek to enlarge the scope of the claims of the patent or introduce new subject matter. *See* 35 U.S.C. § 316(d); 37 C.F.R. § 42.121.

A proposed substitute claim, however, is unpatentable under 35 U.S.C. § 102 if the claimed invention is anticipated by a disclosure that is available as prior art. “A claim is anticipated when ‘the four corners of a single, prior art document describe every element of the claimed invention, either expressly or inherently, such that a person of ordinary skill in the art could practice the invention without undue experimentation.’” *Spanston, Inc. v. Int’l Trade Comm’n*, 629 F.3d 1331, 1356 (Fed. Cir. 2010) (quoting *Advanced Display Sys., Inc. v. Kent State Univ.*, 212 F.3d 1272, 1282 (Fed. Cir. 2000)). The elements must be arranged as required by the claim, but this is not an *ipsissimis verbis* test, i.e., identity of terminology is not required. *In re Bond*, 910 F.2d 831 (Fed. Cir. 1990).

A proposed substitute claim may also be unpatentable under 35 U.S.C. § 103 if “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and, where presented, (4) objective evidence of nonobviousness, i.e., secondary considerations. *See Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 17–18 (1966).

The Supreme Court has made clear that we apply “an expansive and flexible approach” to the question of obviousness. *KSR*, 550 U.S. at 415. Whether a patent claiming the combination of prior art elements would have been obvious is determined by whether the improvement is more than the

predictable use of prior art elements according to their established functions. *Id.* at 417. Reaching this conclusion, however, requires more than a mere showing that the prior art includes separate references covering each separate limitation in a claim under examination. *Unigene Labs., Inc. v. Apotex, Inc.*, 655 F.3d 1352, 1360 (Fed. Cir. 2011). Rather, obviousness requires the additional showing that a person of ordinary skill at the time of the invention would have selected and combined those prior art elements in the normal course of research and development to yield the claimed invention. *Id.*

B. Level of Ordinary Skill

We review the grounds of unpatentability in view of the understanding of a person of ordinary skill in the art at the time of the invention. *Graham*, 383 U.S. at 17. In the Institution Decision, we generally adopted Petitioner's assessment of a person of ordinary skill in the art, as a person having a bachelor's degree in electrical engineering or computer engineering and two years of experience in the field of integrated circuit design or an equivalent combination of education, work, and/or experience. Paper 15, 9–10 (citing Pet. 11). In its Motion to Amend, Patent Owner accepts this assessment of a person of ordinary skill in the art for purposes of this proceeding. Paper 25, 17. We continue to apply that assessment here.

C. Claim Construction

In this proceeding, a claim shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b), including construing the claim in accordance with the ordinary and customary meaning of such claim as

understood by one of ordinary skill in the art and the prosecution history pertaining to the patent. 37 C.F.R. § 42.100 (2019). We therefore apply the claim construction standard as set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc).

Under *Phillips*, claim terms are generally given their ordinary and customary meaning as would have been understood by one with ordinary skill in the art in the context of the specification, the prosecution history, other claims, and even extrinsic evidence including expert and inventor testimony, dictionaries, and learned treatises, although extrinsic evidence is less significant than the intrinsic record. *Phillips*, 415 F.3d at 1312–17. Usually, the specification is dispositive, and it is the single best guide to the meaning of a disputed term. *Id.* at 1315.

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

In the Institution Decision, we determined that no claim term required express construction at that stage of the proceeding. Paper 15, 10–18. In its Motion to Amend, Patent Owner stated that it “does not believe that any of the limitations added to the substitute claims require construction and should instead be construed in accordance with their ordinary meaning.” Paper 25, 17. In its Opposition to the Motion to Amend, Petitioner does not propose any express claim construction. To the extent that the determination of the meaning of any claim term is necessary, we use its ordinary and customary meaning.

D. Statutory and Regulatory Requirements

As noted above, Patent Owner’s proposed substitute claims must meet the statutory requirements of 35 U.S.C. § 316(d) and the procedural requirements of 37 C.F.R. § 42.121.

1. Reasonable Number of Substitute Claims

A motion to amend must “propose a reasonable number of substitute claims.” 35 U.S.C. § 316(d)(1)(B); *see* 37 C.F.R. § 42.121(a)(3) (“A motion to amend may cancel a challenged claim or propose a reasonable number of substitute claims.”). Patent Owner proposes the same number of substitute claims as the original challenged claims that are cancelled, i.e., a one-to-one substitution for a total of fifteen substitute claims. Paper 25, 6–7. “There is a rebuttable presumption that a reasonable number of substitute claims per challenged claim is one (1) substitute claim.” *Lectrosonics*, Paper 15 at 4; *see* 37 C.F.R. § 42.121(a)(3). Petitioner does not argue otherwise. *See generally* Paper 30. Therefore, we determine that Patent Owner proposes a reasonable number of substitute claims.

2. Support in the Original Disclosure

A motion to amend may not present substitute claims that introduce new subject matter. 35 U.S.C. § 316(d); 37 C.F.R. § 41.121(a)(2)(ii). New matter is any addition to the claims without support in the original disclosure. *See TurboCare Div. of Demag Delaval Turbomach. v. Gen. Elec. Co.*, 264 F.3d 1111, 1118 (Fed. Cir. 2001) (“When [an] applicant adds a claim . . . the new claim[] . . . must find support in the original specification.”); *see also Lectrosonics*, Paper 15 at 7 (“the Board requires that a motion to amend set forth written description support in the originally filed disclosure of the subject patent for each proposed substitute claim”).

As noted, *supra*, subsequent to the hearing, Patent Owner filed, with our authorization, a Revised Non-Contingent Motion to Amend. Paper 49. The purpose of this filing was to allow Patent Owner the opportunity to revise its Motion to Amend to provide citation support to the originally filed disclosure for the '504 patent, which Patent Owner asserts was left out of the original motion because of its good-faith reliance on an inadvertently issued certificate of correction. *See* Paper 48, 3–5; Paper 49, 7–18. In its Response to Patent Owner's Revised Motion, Petitioner states that it “does not oppose Patent Owner's revised Motion to Amend to provide citations to Application No. 13/666,285 for its argument that the proposed substitute claims are supported by the written description.” Paper 50, 1 (citing Paper 49 at 7, n.3).

Patent Owner has identified written description support in the originally filed disclosure of the '504 patent for the new limitations added for the proposed substitute claims. *See* Paper 49, 7–18. We have reviewed Patent Owner's assertions of support in the original disclosure for the proposed substitute claims and determine that sufficient support exists.

3. Respond to a Ground of Unpatentability

“A motion to amend may be denied where . . . [t]he amendment does not respond to a ground of unpatentability involved in the trial.” 37 C.F.R. § 42.121(a)(2)(i). Patent Owner asserts that the proposed substitute claims are patentable over the combination of references that forms the basis of the obviousness ground on which we instituted trial. Paper 25, 14–15. In particular, Patent Owner asserts that “the amended claims recite filtering a digital signal in a manner not disclosed or taught by the prior art of record.” *Id.* at 14. Petitioner does not dispute that Patent Owner's amendment responds to a ground of unpatentability in this trial. *See generally* Paper 30.

We determine that the amended language in the proposed substitute claims is responsive to a ground of unpatentability involved in this trial.

4. Scope of the Claims

Patent Owner asserts that the substitute claims are each narrower than the corresponding original claim. Paper 25, 15–17. “For example,” Patent Owner argues, “substitute claim 22 recites a method for an RFID tag circuit that is narrower than that of the corresponding original claim 1, because it recites a method where the digital pulses are filtered in a more specific way than claim 1.” *Id.* at 15. “Specifically,” Patent Owner argues, “original claim 1 recites, in part, ‘generating artifact numbers’ and ‘deriving’ a digital output signal using the artifact numbers.” *Id.* “Claim 22 includes those limitations, but adds filtering by also ‘setting a filter pass range to detect a delimiter,’ ‘detecting the delimiter,’ ‘detecting an expected next packet after the delimiter,’ ‘adjusting the filter pass range based on an aspect of the expected next packet,’ and retaining and removing digital pulses based on the ‘pass range.’” *Id.*

Patent Owner argues “[n]one of these added limitations appear in or are otherwise required by original claim 1.” *Id.* “Thus,” Patent Owner argues, “substitute claim 22 recites a narrower, more specific way of filtering than original claim 1.” *Id.*

Patent Owner makes similar arguments with respect to the other proposed substitute claims. *See id.* at 15–17.

Petitioner does not argue otherwise. *See generally* Paper 30.

We, therefore, determine that the amendment does not seek to enlarge the scope of the claims of the patent.

E. Relevant Prior Art

1. Shanks (Ex. 1006)

Shanks is a U.S. Patent Application Publication that published on October 17, 2002, more than one year before the earliest priority date of the '504 patent. Ex. 1002, code (63); Ex. 1006, code (43). Petitioner asserts that Shanks is prior art under pre-AIA 35 U.S.C. § 102(a), (b), and (e). Pet. 13.

Shanks relates to an RFID architecture including readers for interrogating and powering tags at data rates, distances, and reliability levels greater than existing readers. Ex. 1006 ¶ 9.

Figure 10 of Shanks is reproduced below.

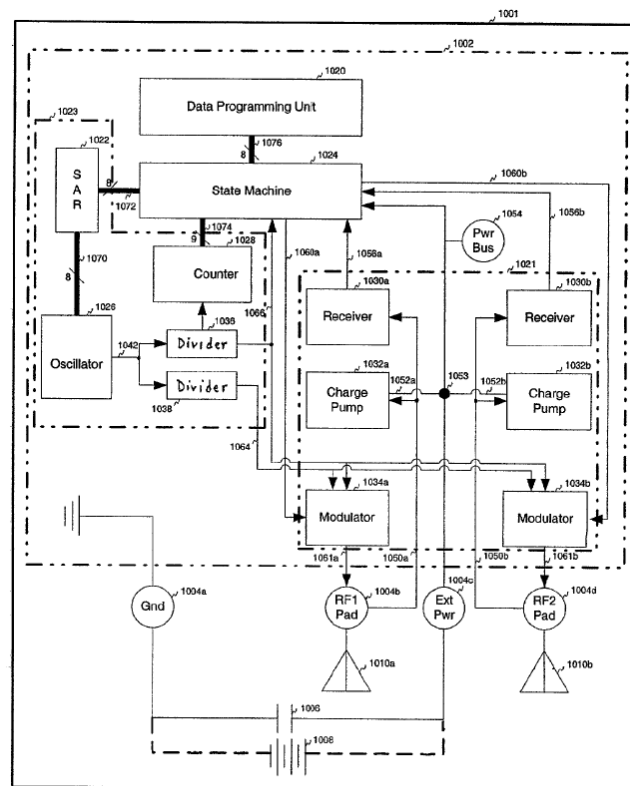


FIG. 10

Figure 10, shown above, depicts a block diagram of an RFID tag according to an embodiment of Shanks. *Id.* ¶¶ 25, 124. Tag 1002, which is

printed on substrate 1001, includes integrated circuit 1002, data programming unit 1020, state machine 1024, timing subsystem 1023, and RF interface portion 1021. *Id.* ¶ 142. RF interface portion 1021 “includes components that . . . demodulate RF signals into digital information symbols.” *Id.* ¶ 144.

Figure 30 of Shanks is reproduced below.

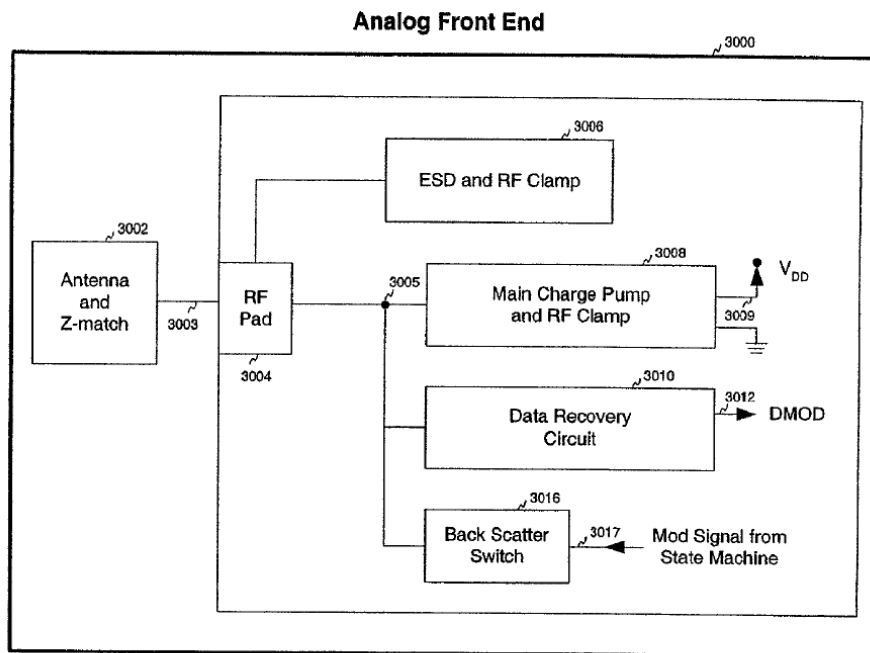


FIG. 30

Figure 30, shown above, depicts analog front-end 3000 of an exemplary RF tag. *Id.* ¶ 526. Analog front-end 3000 includes data recovery circuit 3010, which demodulates RF signal 3003 and generates a digital output signal labeled “DMOD” at output terminal 3012. *Id.* ¶ 527.

Figure 42 of Shanks is reproduced below.

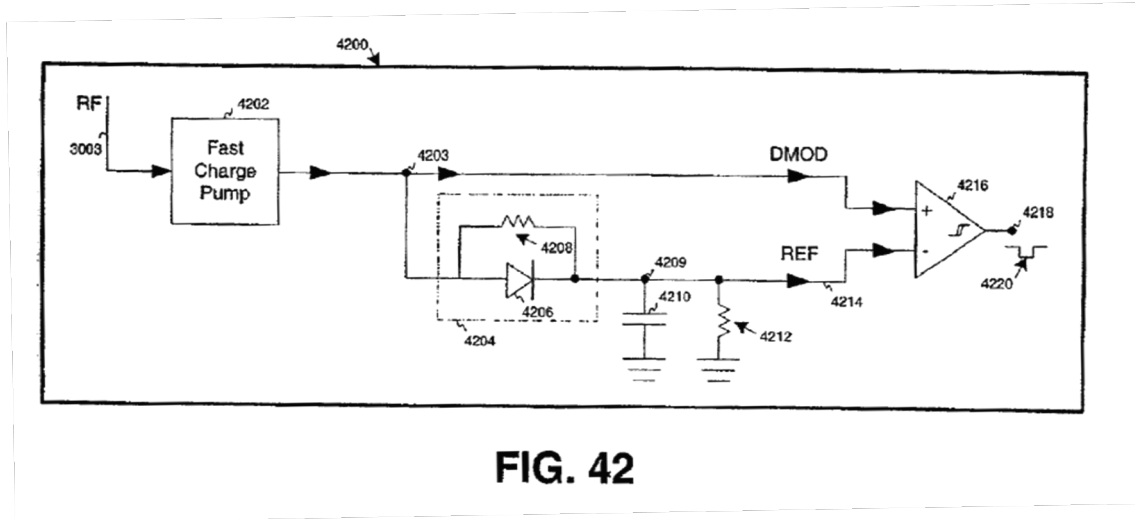


FIG. 42

Figure 42, shown above, depicts an exemplary data recovery circuit 4200 that is an embodiment of data recovery circuit 3010 of Figure 30. *Id.* ¶ 562. Data recovery circuit 4200 may include fast charge pump 4202 to demodulate RF signal 3003 and comparator 4216 to further process the demodulated output signal 4203 to generate digital output signal 4220. *Id.* ¶¶ 562–63.

In one embodiment of Shanks, the tag may receive, from a reader network, a modulated wireless RF input signal that conveys information in the form of one or more symbols for a particular duration of time. *Id.* ¶¶ 73, 74, 95, 96, 150.

Figures 3, 4, and 5 of Shanks are reproduced below.

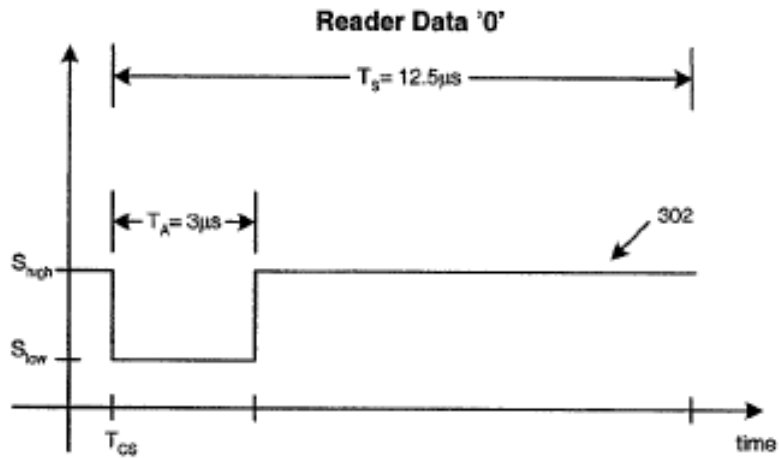


FIG. 3

Figure 3, above, shows that, when transmitting a symbol that represents a logical “0”, the reader network maintains its carrier signal amplitude at S_{low} for a duration of $T_A = 3$ microseconds. *Id.* ¶¶ 96, 99.

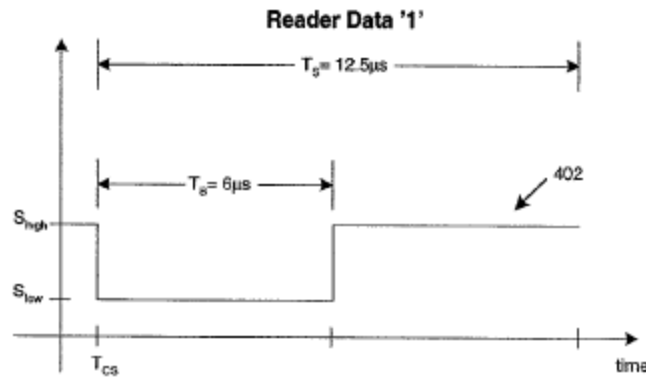


FIG. 4

Figure 4, above, shows that, when transmitting a symbol that represents a logical “1”, the reader network maintains its carrier signal amplitude at S_{low} for a duration of $T_A = 6$ microseconds. *Id.*

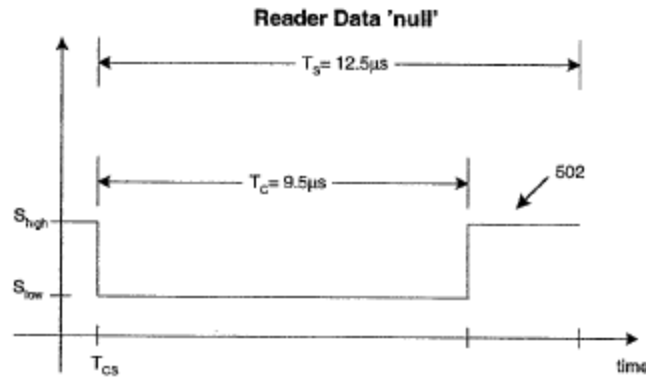


FIG. 5

Figure 5, above, shows that, when transmitting a symbol that represents a logical “NULL” symbol, the reader network maintains its carrier signal amplitude at S_{low} for a duration of $T_A = 9.5$ microseconds. *Id.* As shown in Figures 3 through 5, the reader network may transmit one symbol every 12.5 microseconds, which represents a “symbol exchange period.” *Id.* ¶ 97.

The duration of timing intervals that define these symbols may be set during a calibration routine in which the reader network transmits a series of pulse waveforms received by a tag. *Id.* ¶¶ 475, 477–78. The tag may use the received pulse waveforms to set boundaries for the timing intervals that define the symbols. *Id.* ¶ 475. The duration of a received calibration waveform may be measured as the duration of time passing between the falling edge and rising edge of its pulse. *Id.* ¶ 478.

Figure 26A is reproduced below.

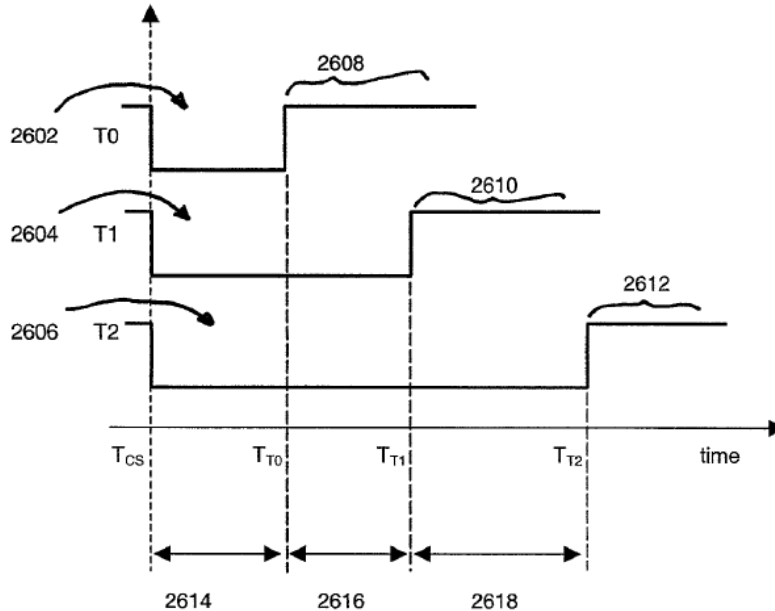


FIG. 26A

Figure 26A, above, shows calibration waveforms for three time periods: 2602 (the time between T_{CS} and T_{T0} , e.g., 4.5 milliseconds), 2604 (the time between T_{CS} and T_{T1} , e.g., 7.75 milliseconds), and 2606 (the time between T_{CS} and T_{T2} , e.g., 11.5 milliseconds). *Id.* ¶¶ 478–80. Figure 26B is reproduced below.

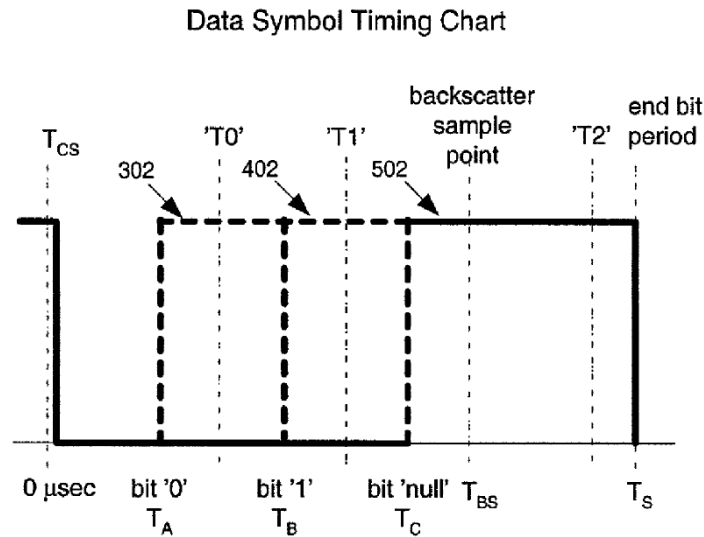


FIG. 26B

Figure 26B, above, shows that if the trailing rising edge of a data symbol pulse occurs between time T_{CS} and T_{T0} , the data symbol will be interpreted as a logical “0” value; if the trailing rising edge occurs between time T_{T0} and T_{T1} , the data symbol will be interpreted as a logical “1”; and if the trailing rising edge occurs between time T_{T1} and T_{T2} , the data symbol will be interpreted as a logical “NULL” value. *Id.* ¶¶ 479–480. T_{T2} may be set to a longer time period to allow the reader network to decrease transmitted data rates such that noise immunity may be improved.

2. Breimesser (Ex. 1007)

Breimesser is a U.S. Patent that issued on December 14, 1976, more than one year before the earliest priority date of the '504 patent. Ex. 1002, code (63); Ex. 1007, code (45). Petitioner asserts that Breimesser is prior art under pre-AIA 35 U.S.C. § 102(a), (b), and (e). Pet. 13.

Breimesser relates to a circuit arrangement for gating out pulses and pulse gaps whose duration is shorter than a given test period. Ex. 1007, 1:9–12.

Figure 1 of Breimesser is reproduced below.

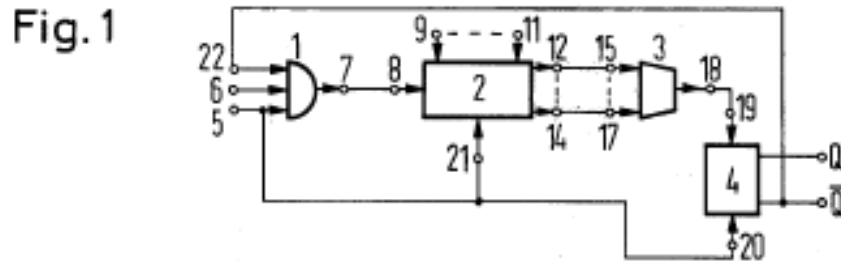


Figure 1, above, shows a circuit arrangement for gating out pulses according to an embodiment of Breimesser. *Id.* at 4:52–53. “If pulse gaps are to be gated out it is also possible to use this circuit arrangement if the input signal is inverted” by “preced[ing] the gate 1 by an inverter whose output is connected to the first input 5.” *Id.* at 4:53–57; *see also id.* at 5:62–6:16, Fig. 3. According to Figure 1, output 7 of gate 1 is connected to counter input 8 of counter 2. *Id.* at 3:3–4. From counter 2, parallel outputs 12 and 14 are connected to inputs 15 and 17 of decoder 3. *Id.* at 3:4–6. Output 18 of decoder 3 is connected to first input 19 of binary storage circuit 4. *Id.* at 3:6–8. First input 5 of gate 1 is connected to setting input 21 of counter 2 and to second input 20 of the binary storage circuit 4. *Id.* at 3:8–10.

Figure 2 of Breimesser is reproduced below.

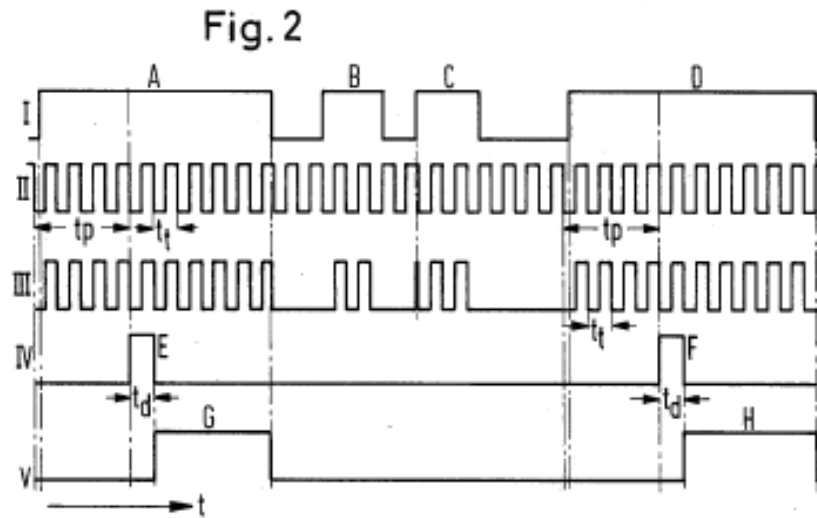


Figure 2 of Breimesser, above, shows a mode of operation of the circuit arrangement shown above in Figure 1 of Breimesser.

“The digital pulse sequence I is fed to the first input 5 of the gate 1,” which may be an AND gate or a NAND gate. *Id.* at 3:15–16, 3:26–28. “A counter pulse sequence II is connected to the second input 6 of the gate,” with a pulse train length of counter pulses assumed to be t_t . *Id.* at 3:21–23. Output Q inverse of the binary storage element 4 is connected to the third input 22 of gate 1. *Id.* at 4:67–5:1.

“The gate 1 in the circuit . . . is only open for the counter pulses when and for as long as an input pulse is present at the input 5.” *Id.* at 3:23–27. “If then an input pulse appears at the input 5 of the gate, . . . the pulse sequence III composed of individual groups of counter pulses appears at the output 7 of the gate.” *Id.* at 3:28–31. “These counter pulses pass to the counter input 8 and the counter 2,” which counts the counter pulses “from a given initial value m with the first pulse of each pulse group, and continues to count for the maximum until the pulse at the input 5 is at an end.” *Id.* at 3:35–41. “The decoder 3 establishe[s] the individual states of the counter

and when a predetermined value n is reached in the counter, it emits a pulse at the output 18. *Id.* at 3:46–49. “The pulses E and F of the pulse sequence IV represent the pulses from the output of the decoder.” *Id.* at 3:51–53. “[P]ulses only appear at the output 18 of the decoder if the input pulse is longer than the test period t_p .” *Id.* at 3:55–58.

The pulse from the output 18 of the decoder sets the output Q of the binary storage element via the input 19 to 1. This state continues until the storage element is reset via the input 20. . . . [T]he output pulse sequence V with the pulses G and H arises at the output Q of the storage element. As will be seen from this sequence, pulses occur only if the input pulse is longer than the test period t_p . The front edges of the pulses G and H are displaced by the time $t_p + t_d$ and shortened in comparison to the input pulses A and D in the sequence I. *Id.* at 3:63–4:7.

“The values m and n , and the pulse train length t_t of the counter pulses determine the test period t_p in accordance with $t_p = (m - n) \cdot t_t$.” *Id.* at 3:49–51. “The test period may be freely programmed and can be varied within wide limits.” *Id.* at 2:40–41. “In FIG. 2, $t_p = 4 \cdot t_t$ was selected by way of example.” *Id.* at 3:53–54.

“The above described circuit arrangements can be used for gating out interference signals of shorter duration than the useful signal.” *Id.* at 7:47–49.

3. *Lichtblau* (Ex. 1008)

Lichtblau is a U.S. Patent that issued on October 18, 1988, more than one year before the earliest priority date of the '298 patent. Ex. 1002, code (63); Ex. 1008, code (45). Petitioner asserts that *Lichtblau* is prior art under pre-AIA 35 U.S.C. § 102(a), (b), and (e). Pet. 13.

Lichtblau “is directed to the field of noise rejection circuitry, and more particularly, to a continuously armed, highly reliable, pulse train processor especially for magnetic strip and resonant tag signal detection.”

Ex. 1008, 1:6–10. Figure 1 of Lichtblau is reproduced below.

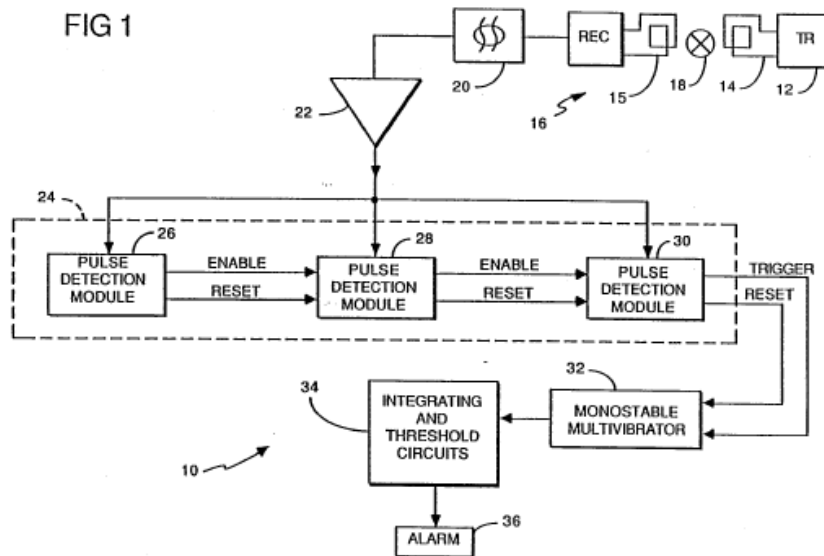


Figure 1, above, shows a continuously armed, high reliability pulse train processor in an exemplary magnetic and resonant interrogation system receiver application according to one embodiment. *Id.* at 2:34–38.

Lichtblau describes a circuit whose antenna 15 receives a “radio frequency signal” that is “demodulated by the receiver 16, filtered in a band-pass filter 20 to remove noise, and amplified in amplifier 22. Thereafter the signal is fed in parallel into the pulse train processor 24.” *Id.* at 2:56–3:4. The pulse train processor may include three pulse processing modules, each of which includes a “minimum and maximum pulse width detector pair[] . . . selected to conform to the expected duration time . . . of the corresponding . . . pulses of the expected pulse train.” *Id.* at 4:34–36, 4:65–5:6, Fig. 2. “Only the correct polarity sequence of pulses above a preselected threshold that exist within carefully defined time durational windows are passed through by the

pulse train processor, while all other pulse signals kinds and types are rejected thereby as undesirable noise.” *Id.* at 5:6–11. Thus, Lichtblau describes “a pulse train processor that is responsive to both the minimum duration and to the maximum duration of each of the several pulses.” *Id.* at 2:3–9.

4. *Gen2 (Ex. 1015)*³

The article, EPC™ Radio-Frequency Identity Protocols Class-1 Generation-2 UHF RFID Protocol for Communications at 860 MHz – 960 MHz Version 1.0.9, published by EPC Global, Inc., is a specification for RFID air interface. The specification defines the base class (Class-1) of four RFID Tag classes. Ex. 1015, App. A, 8. The Gen2 system comprises “Interrogators, also known as Readers, and Tags.” *Id.* at 1, 9. “An Interrogator transmits information to a Tag by modulating an RF signal.” *Id.* at 9. The information is pulse-interval encoded (PIE), whereby pulses of energy are transmitted for different intervals of time (i.e., symbols) to communicate information that is interpreted by the tag as either a binary 0 or a binary 1. Ex. 1020 ¶ 351.

In Gen2, the duration (pulse-interval) of the encoded symbols is specified by a “Tari” reference time interval where 1 Tari is equivalent to the duration of a data-0 symbol. Ex. 1015 § 6.3.1.2.3, Fig. 6.1; *see* Ex. 1020 ¶ 355. Data-1 symbols are transmitted using pulses between 1.5 to 2.0 Tari.

³ Exhibit 1015 includes an Affidavit of Elizabeth Rosenberg, averring to certain facts Petitioner uses to establish the public availability of the Gen2 reference as prior art to the ’504 patent. *See* Ex. 1015, 1–2; Paper 30, 2–3. Patent Owner does not challenge the public availability of Gen2, or its status as prior art to the ’504 patent. *See* Paper 51, 31:1–11. Based on the evidence of record, we determine that Petitioner has established the public availability of the Gen2 reference as prior art to the ’504 patent.

Ex. 1015 § 6.3.1.2.3, Fig. 6.1. Tari values of 6.25μs, 12.5μs, or 25μs are preferred for reader to tag (“R=>T”) communications. *Id.* at Tables 6.5, 6.6.

Gen 2 specifies an “inventory” process that is used for identifying tags. Ex. 1015 § 6.3.2.6; Ex. 1020 ¶ 356. To initiate the R=>T signaling for “an inventory round,” readers transmit a “preamble or a framesync.”

Ex. 1015 § 6.3.1.2.8, Fig. 6.4. Both the preamble and the frame-sync include a fixed-length start delimiter, a data-0 symbol, and an R=>T calibration (RTcal) symbol. *Id.* The data-0 symbol that follows the delimiter is used to specify the length of a data-0 symbol for the R=>T communications. *Id.* The RTcal symbol specifies the combined length of a data-0 symbol and a data-1 symbol. *Id.* A tag interprets subsequent symbols that are shorter than duration of RTcal / 2 as data-0 symbols, and symbols longer than RTcal / 2 as data-1 symbols, except that symbols longer than four times RTcal are “bad data.” *Id.*; Ex. 1020 ¶ 356.

F. Obviousness Based on Shanks, Breimesser, Lichtblau, and Gen2

Petitioner asserts proposed substitute claims 22–35 are unpatentable as obvious under 35 U.S.C. § 103 over the combined teachings of Shanks, Breimesser, Lichtblau, and Gen2. *See* Paper 30, 5–25. The parties principally rely on their arguments directed to independent claim 22. *See* Paper 30, 22–23; Paper 32, 1. We address any arguments specifically directed to independent claims 30 and 33 separately.

1. Proposed Substitute Independent Claim 22

[22-pre] A method for a Radio Frequency Identification (RFID) tag circuit comprising [not amended]

Proposed substitute claim 22 recites the same preamble as claim 1. *See* Paper 25, App. A; Ex. 1002, 21:37–38. Petitioner asserts that “Shanks discloses an *RFID tag circuit*.” Paper 30, 5–6 (citing Pet. § VI.A.1(a) (claim

[1-preamble]); Ex. 1020 ¶ 400). The cited section of the Petition states that “[a]s shown in FIG. 10, integrated circuit 1002 includes a data programming unit 1020, a state machine 1024, a timing subsystem 1023, and an RF interface portion 1021.” Pet. 24 (citing Ex. 1006 ¶ 142).

Figure 10 of Shanks is shown below.

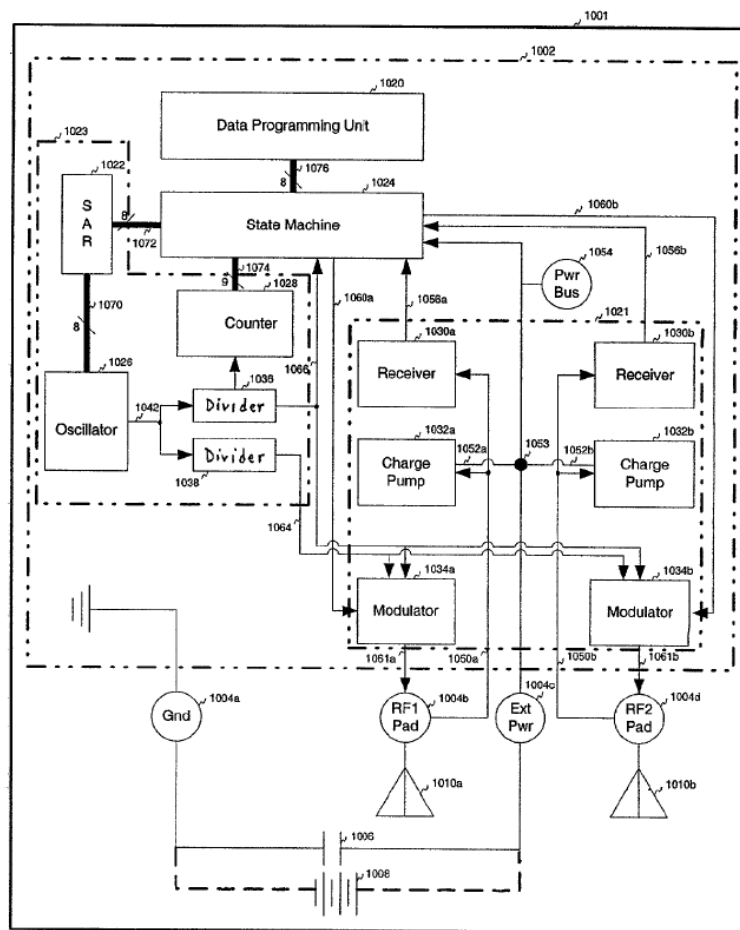


FIG. 10

Shanks Figure 10, shown above, is a block diagram of a RFID tag showing integrated circuit 1002. Ex. 1006 ¶ 124, Fig. 10.

Petitioner also asserts that “Gen2 discloses ‘operating procedures’ for an *RFID tag circuit*, and ‘the signaling layer of the communication link’ between a reader and the tag circuit.” Paper 30, 6 (citing Ex. 1015, 10).

Patent Owner does not contest Petitioner's evidence that Shanks teaches a RFID tag circuit and Gen2 teaches operating procedures for a RFID tag circuit. *See* Paper 32, 1–12. Petitioner's arguments are supported by the cited evidence. Based on the evidence of record, we are persuaded that Petitioner has demonstrated that the combined teachings of Shanks and Gen2 amount to a “method for a Radio Frequency Identification (RFID) tag circuit” as recited in the preamble of proposed substitute claim 22.

[22-a] receiving a modulated wireless RF input signal; deriving a first digital output signal responsive to the modulated wireless RF input signal, wherein the first digital output signal comprises a sequence of digital pulses [not amended]

Petitioner asserts that Shanks teaches this limitation because “Shanks discloses demodulating an RF input signal that is received from an RF reader, and deriving a first digital output signal comprising a sequence of digital pulses.” Paper 30, 6 (citing Pet. § VI.A.1(b) (claim [1-a]); Ex. 1020 ¶ 401). Petitioner also argues that “[t]his limitation is also disclosed by Figure 7 of the '177 Application, which the applicant admitted was prior art.” Paper 30, 6 (citing Ex. 1010, 11).

Petitioner further argues that “Gen2 also discloses tags that ‘*receive a modulated wireless RF input signal from an RFID reader.*’” Paper 30, 6 (citing Ex. 1015 §§ 6.3.1.1, 6.3.1.2). Petitioner explains that “Gen2 tags demodulate the received wireless RF input signal, which uses a pulse-interval encoding (PIE) format, to *derive a first digital output signal that comprises a sequence of digital pulses.*” Paper 30, 6 (citing Ex. 1015 §§ 6.3.1.2.2, 6.3.1.2.3, Fig. 6.1 (illustrating digital pulses); Ex. 1020 ¶ 402).

Patent Owner does not contest Petitioner's evidence that Shanks and Gen2 teach the recited demodulator. *See* Paper 32, 1–12.

Petitioner's arguments are supported by the cited evidence. Petitioner's declarant, Dr. Blalock, provides credible testimonial evidence that Shanks' RF interface portion 1021, as shown in Shanks' Figure 10, amounts to a demodulator configured for receiving a modulated wireless RF input signal from an RFID reader and derives an output signal comprising a sequence of digital pulses, aspects of which are illustrated in Shanks' Figures 30 and 42. *See* Ex. 1003 ¶¶ 282–285. Dr. Blalock also provides credible evidence that the Gen2 tags demodulate a received wireless RF signal using a pulse-interval encoding format (PIE). *See* Ex. 1020 ¶¶ 401–402.

Based on the evidence of record, we are persuaded that Petitioner has demonstrated that Shanks and Gen 2 teach the recited limitation.

[22-b1] filtering the first digital output signal with an interference rejection circuit of the tag circuit to derive a second digital output signal by: receiving the first digital output signal

Petitioner asserts that the combination of Shanks, Breimesser, and Lichtblau teaches this limitation. Paper 30, 6–7. Petitioner first asserts that “the combination of Shanks in view of Breimesser discloses *an interference rejection circuit* configured to receive *the first digital output signal*.” *Id.* (citing Pet. § VI.A.1(d) (claim [1-c(i)]); Ex. 1020 ¶ 403). Petitioner argues that “Breimesser's circuit would have been configured by *setting* a test period *tp*, a *filter pass range*, that ‘can be arbitrarily varied’ to *filter the first digital output signal* in order to *derive a second digital output signal*.” Paper 30, 7 (citing Pet. § VI.A.1(d) (claim [1-c(i)]); Ex. 1007, 1:48–53; Ex. 1020 ¶ 403). Petitioner argues that a person of ordinary skill in the art “would have been motivated to form this combination to address a specific need in Shanks to filter digital pulses in order to improve the performance of

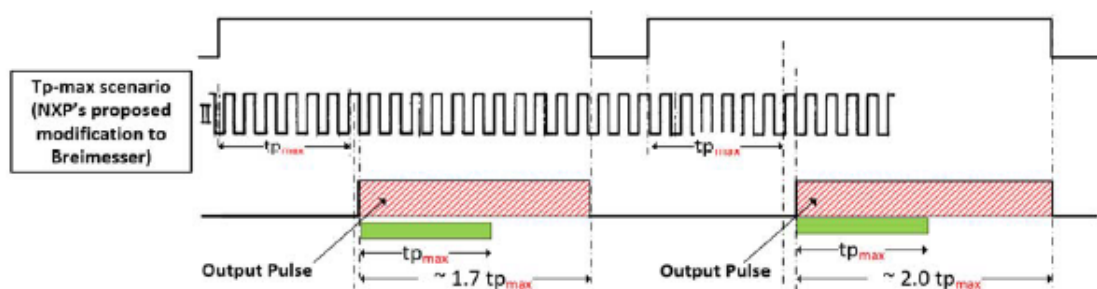
the digital circuitry by preventing noise pulses from being interpreted as valid data. Paper 30, 7 (citing Pet. § VI.A.1(d) (claim [1-c(i)]).

Petitioner next asserts that a person of ordinary skill in the art “would have been motivated to modify Breimesser’s circuit in view of Lichtblau to include both a first and second test period (e.g., tp_{min} and tp_{max}) to filter (remove) pulses shorter than the first test period (“a low threshold time”) and also to filter (remove) pulses longer than the second test period (“a high threshold time”). Paper 30, 7 (citing Pet. § VI.B; Ex. 1020 ¶ 404).

Patent Owner asserts that Petitioner’s proposed modification to Breimesser’s circuit sets the wrong pass range. See Paper 32, 4–6. Patent Owner argues that:

“modify[ing] Breimesser’s circuit to include both a first and second test period (e.g., tp_{min} and tp_{max}),” as NXP alleges (Paper 30, 7), would not have produced a pass range “to filter (remove) pulses longer than the second test period.” *Id.* In fact, implementing a second test period, tp_{max} , using Breimesser’s circuit would have resulted in ***retaining pulses that were longer than tp_{max}*** . This is shown in the illustrative diagram below, where setting NXP’s second test period, tp_{max} would result in pulses larger than tp_{max} ($\sim 1.7 tp_{max}$ and $\sim 2.0 tp_{max}$ in the examples shown) to pass through, as opposed to passing those pulses that were in the range between tp_{min} and tp_{max} . Ex. 2009, ¶¶ 27-31.

Paper 32, 5–6 (alteration in original). Patent Owner’s illustration of Petitioner’s proposed pass range is shown below.



Paper 32, 6. According to Patent Owner, the illustration above shows output pulses from Petitioner's proposed modification to Breimesser's circuit allowing pulses longer than *tp-max* to pass through. *Id.*

Petitioner points out, however, and we agree, that Patent Owner's argument fails to consider Lichtblau's contribution to Petitioner's proposed combination. *See* Paper 42, 6–8.⁴ Petitioner argues that Lichtblau teaches filtering pulses shorter than *tp-min* and longer than *tp-max*. *Id.* at 6 (citing Paper 30, 7). Petitioner explains, and we agree, that Lichtblau teaches “a pulse train processor 24 that includes ‘minimum and maximum pulse width detector(s),’ corresponding to a low threshold (e.g., *tp-min*) and a high threshold (e.g., *tp-max*), that ‘are selected to conform to the expected duration time’ of the expected pulses.” Paper 42, 6–7 (citing Pet. 53; Ex 1008, 5:1–6; Ex. 1003 ¶ 325). Petitioner argues that a person of ordinary skill in the art “would have been motivated to modify Breimesser's interference rejection circuit based on the teachings of Lichtblau to include a first and second test period (e.g., *tp-min* and *tp-max*), thus providing a *filter pass range* to filter pulses shorter than the first test period and pulses longer than the second test period.” Paper 42, 7 (citing Paper 30, 7; Pet. § VI.B); Ex. 1003 ¶¶ 320–323; Ex. 1020 ¶¶ 383–385, 404). Patent Owner's failure to consider the contribution of Lichtblau to Petitioner's proposed combination undermines Patent Owner's argument on this point.

Petitioner's arguments are supported by the cited evidence. Petitioner's declarant, Dr. Blalock, provides credible testimonial evidence that Breimesser's circuit arrangement, in combination with Shanks and

⁴ Petitioner also asserts that Patent Owner's argument is only relevant to proposed substitute dependent claims 26, 30, and 33, because “only these claims recite filtering pulses longer than the pass range.” Paper 42, 6.

Lichtblau, can be used for gating out digital pulses or digital pulse gaps and amounts to the recited interference rejection circuit. *See* Ex. 1003 ¶ 289; Ex. 1020 ¶¶ 403–404.

Based on the evidence of record, we are persuaded that Petitioner has demonstrated that the proposed combination of prior art teaches the recited claim limitation. We consider the evidence and arguments with respect to the rationale to combine the prior art, *infra*.

[22-b2] generating artifact numbers by counting time durations of the digital pulses [not amended]

Petitioner asserts that the combination of Shanks and Breimesser teaches this limitation because “Breimesser[’s] *counter* 2 would have been configured for *generating* a count (*artifact numbers*) *by counting* counter pulses that reflect *time durations of the digital pulses*.” Paper 30, 7 (citing Pet. § VI.A.1(c) (claim [1-b]); Ex. 1020 ¶ 405). Patent Owner does not contest Petitioner’s evidence that the combination of Shanks and Breimesser teaches this limitation. *See* Paper 32, 1–12.

Dr. Blalock points out that “Shanks discloses a tag that ‘uses oscillator 1026 to serve as a system time reference for internal digital functions’” and that “[c]ounter 1028 ‘counts the number of cycles of master clock signal 1062 that occur during a cycle of input signal 2100.’” Ex. 1003 ¶ 286 (citing Ex. 1006 ¶¶ 358, 377; Fig. 10). Dr. Blalock also points out that Breimesser similarly “discloses counter 2 for counting a pulse sequence.” Ex. 1003 ¶ 287 (citing Ex. 1007, 3:35–41).

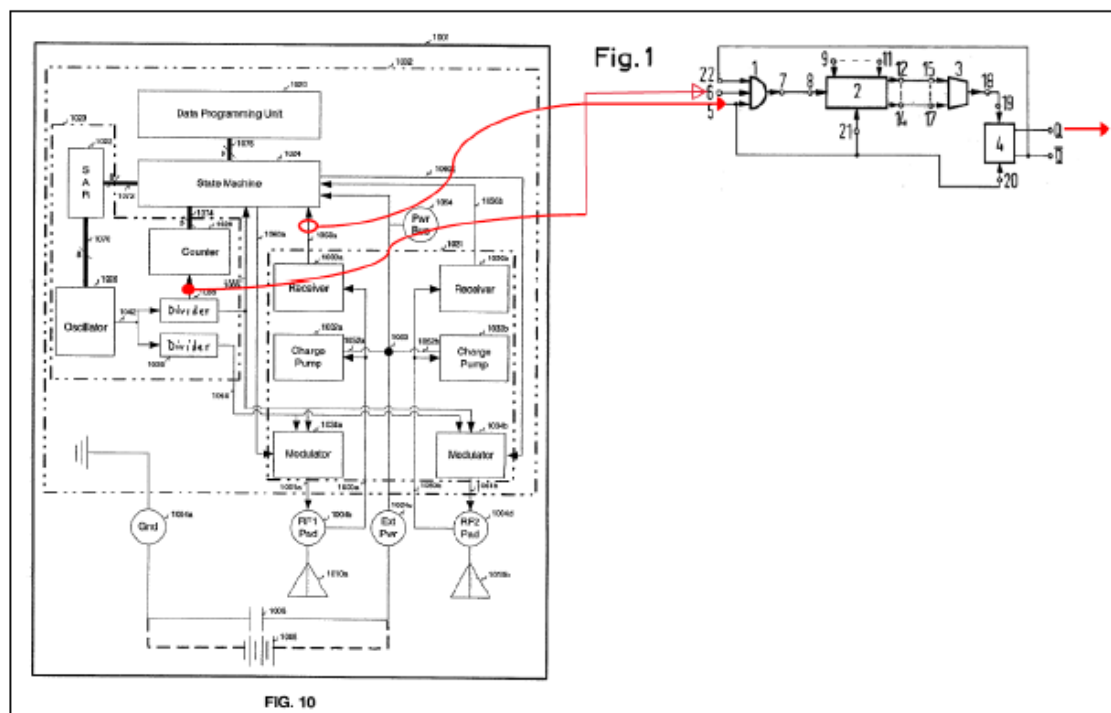
Dr. Blalock testifies persuasively that a person of ordinary skill in the art:

would have understood that Breimesser’s counter 2 would count, similar to the operation of Shanks counter 1028, the time durations of the digital pulses using a clock signal derived from

Shanks' oscillator 1026. In combination, a POSITA would have configured, for example, input 5 of the circuit of Breimesser to receive the first digital output signal disclosed by Shanks. . . . Thus, in combination, Breimesser counter 2 would have been configured for *generating* a count (*artifact numbers*), for example at parallel outputs 12 to 14, *by counting* counter pulses that reflect *time durations of the digital pulses*.

Ex. 1003 ¶ 288.

Petitioner provides an annotated illustration depicting the combination of Breimesser's interference rejection circuit with Shanks' RFID tag circuit, shown below. Ex. 1003, 136.



The illustration shown above is a block diagram depicting Petitioner's combination of Breimesser's interference rejection circuit, shown on the right as Figure 1, with Shanks' RFID tag circuit, shown on the left as Figure 10.

Based on the evidence of record, we are persuaded that Petitioner has demonstrated that the proposed combination of prior art teaches the recited

claim limitation. We consider the evidence and arguments with respect to the rationale to combine the prior art, *infra*.

[22-b3] setting a filter pass range to detect a delimiter, detecting the delimiter

Petitioner asserts that the combination of Shanks, Breimesser, Lichtblau, and Gen2 teaches this limitation. Paper 30, 7–8. Petitioner argues that “Shanks discloses that a signal of a specified length serves as a master reset event to cause a tag to enter a mode to calibrate the duration of each data symbol, which establishes the communication data rate for transmitting information to the tag.” *Id.* at 8 (citing Ex. 1006 ¶¶ 166, 172, 483–486, Fig. 27; Ex. 1020 ¶ 406). Petitioner argues that “to establish the R=>T data rate in a Gen2 system, at ‘the start of an inventory round’ tags receive a preamble or a frame-sync that includes a fixed-length start delimiter, a data-0 symbol, and an R=>T calibration (RTcal) symbol.” *Id.* (citing Ex. 1015 § 6.3.1.2.8, Fig. 6.4; Ex. 1020 ¶ 406). Petitioner also argues that “[t]he pulse duration of a Gen2 fixed-length start delimiter is ‘12.5µs +/- 5%.’” *Id.* (citing Ex. 2015, § 6.3.1.2.8, Fig. 6.4). Petitioner further argues that it would have been obvious for a person of ordinary skill in the art in view of Gen2

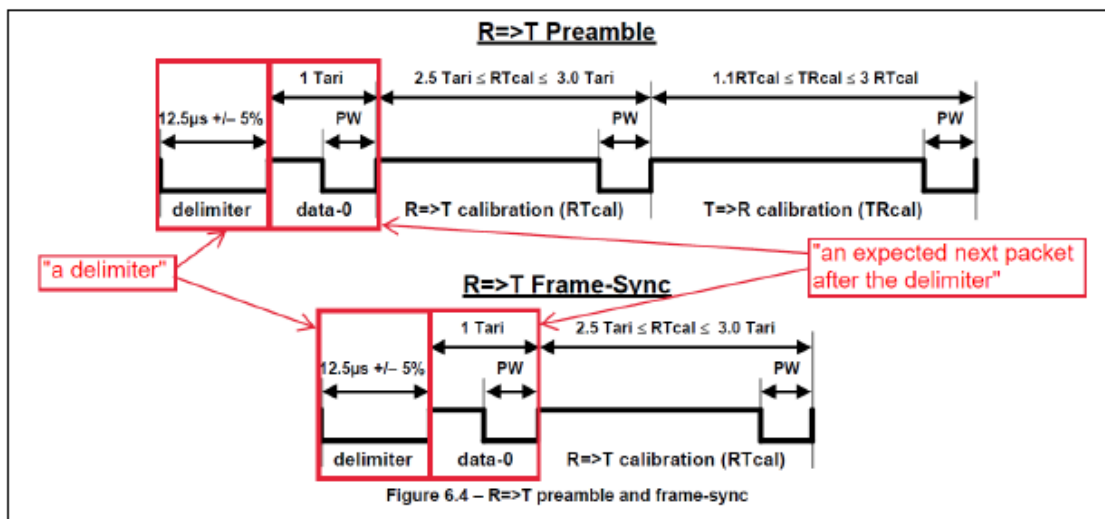
to configure Breimesser’s circuit in combination with Lichtblau to filter the first digital output signal *to detect a Gen2 delimiter* by *setting* the first and second test period to, for example, 11.875µs and 13.125µs, *a filter pass range*, to detect a delimiter having a “12.5µs +/- 5%” pulse duration,[] and then *detecting the delimiter*.

Paper 30, 8 (citing Ex. 1015 § 6.3.1.2.8, Fig. 6.4; Ex. 1020 ¶ 406).

Patent Owner asserts that Petitioner’s proposed initial pass range would have failed to detect the majority of Gen2 Tari values and associated pulses. Paper 32, 8–10. Patent Owner argues that “[s]uch a modification

would have detected the delimiter, but would have rendered a large range of Gen2 Tari values undetectable.” *Id.* at 9. Patent Owner concedes, however, that Petitioner’s proposed modification “would have detected the delimiter.” *Id.*

Petitioner’s arguments are supported by the cited evidence. Dr. Blalock explains how a person of ordinary skill in the art would have configured Breimesser’s circuit in combination with Lichtblau to filter the first digital output signal to detect a Gen2 delimiter. *See* Ex. 1020 ¶ 406. Petitioner provides an annotated illustration of Gen2’s Figure 6.4 below.



Petitioner’s annotated illustration of Gen2’s Figure 6.4, shown above, depicts a R=>T preamble and frame-sync, indicating the portions of the signal relating to the recited limitation. *Id.* at 33.

Based on the evidence of record, we are persuaded that Petitioner has demonstrated that the proposed combination of prior art teaches the recited claim limitation. We consider the evidence and arguments with respect to the rationale to combine the prior art, *infra*.

[22-b4] detecting an expected next packet after the delimiter

For this limitation, Petitioner argues that:

[a]fter receiving the delimiter, Gen2 tags must detect a data-0 symbol, an expected next packet. Ex. 1015, § 6.3.1.2.8, Fig. 6.4; Ex. 1020 ¶ 407. That data-0 symbol is then followed by an RTcal symbol that is “equal to the length of a data-0 symbol plus the length of a data-1 symbol.” *Id.* These waveforms calibrate the tag to interpret subsequent symbols as either data-0 (i.e., shorter than $RTcal / 2$) or data-1 (i.e., longer than $RTcal / 2$). Ex. 1015, § 6.3.1.2.8, Fig. 6.4; Ex. 1020 ¶ 407. Gen2’s data-0 and RTcal waveforms that are received after the delimiter are analogous to Shanks’ data calibration waveforms that are received after a master reset event. Ex. 1006 ¶¶ 477–78, Fig. 26A; Ex. 1020 ¶ 407; Pet. § V.A.

Paper 30, 9.

Patent Owner argues that “[s]uch a proposed modification, however, while would have detected the delimiter, it would have rendered a large range of Gen2 Tari values undetectable.” Paper 32, 9. Patent Owner argues that “[t]he initial pass range of $12.5\mu s (\pm 5\%)$, at best, would have allowed only a small percentage of Tari values to be detected, but would not have detected the great majority of possible Tari values that are specified in Gen2.” *Id.* (citing Ex. 2009 ¶¶ 38–46). Patent Owner also argues that Petitioner’s proposed combination “would also fail to detect any of Gen2’s Tari values in practical implementations of the system.” Paper 32, 9–10 (citing Ex. 2009 ¶¶ 43–46).

Petitioner asserts that Patent Owner’s argument is misplaced, “because [the] claim elements . . . do not recite ‘setting a filter pass range to detect a delimiter’ *and then maintaining that same pass range* for ‘detecting an expected next packet after the delimiter.’” Paper 42, 8–9 (emphasis added). Petitioner points out that “claim 22 is silent as to whether a *different*

filter pass range may be set in the purported sequence of operations after ‘detecting the delimiter’ and before ‘detecting an expected next packet.’” *Id.* at 9. “Indeed,” Petitioner notes, “none of the proposed claims recite maintaining the same pass range to detect both a delimiter and an expected next packet.” *Id.* Petitioner argues that Patent Owner “did not bother to analyze the operation of the prior art combination after the filter pass range had been readjusted in this manner, and did not dispute that altering the filter pass range would change the range of pulse widths (Tari values) detected.” *Id.* (citing Ex. 1021, 62:24–63:18, 59:5–24).⁵

We agree with Petitioner. Claim 22 does not require that the pass range used to detect a delimiter must also be the same pass range used to detect an expected next packet after the delimiter. Nothing in claim 22 precludes adjustment of the pass range. Patent Owner’s argument assumes incorrectly that the pass range used to detect a delimiter must necessarily be the same pass range used to detect an expected next packet. Claim 22 has no such restriction and a person of ordinary skill in the art would understand that there are valid reasons to adjust the pass range. Indeed, as Dr. Blalock explains:

it would have been obvious that the first and second test periods, *the filter pass range*, must be readjusted to *detect a command*, such as a Query command, that included valid data-0 symbols based on pulses as short as 6.25µs or as long as 25µs. Ex. 1015, § 6.3.2.10.2.1 (identifying Query command with a four bit code “1000”). Accordingly, based on the Tari value of the data-0 symbol that was received after the delimiter, *an aspect of the expected next packet*, it would have been obvious to *adjust* the

⁵ Petitioner also points out that claim 27 “recites the very operational sequence that [Patent Owner] complains is required for claim 22: ‘after detecting the delimiter, adjust the filter pass range for detecting the expected next packet.’” Paper 42, 9.

first and second test periods, *the filter pass range, for detecting a Gen2 Query command.*

Ex. 1020 ¶ 411.

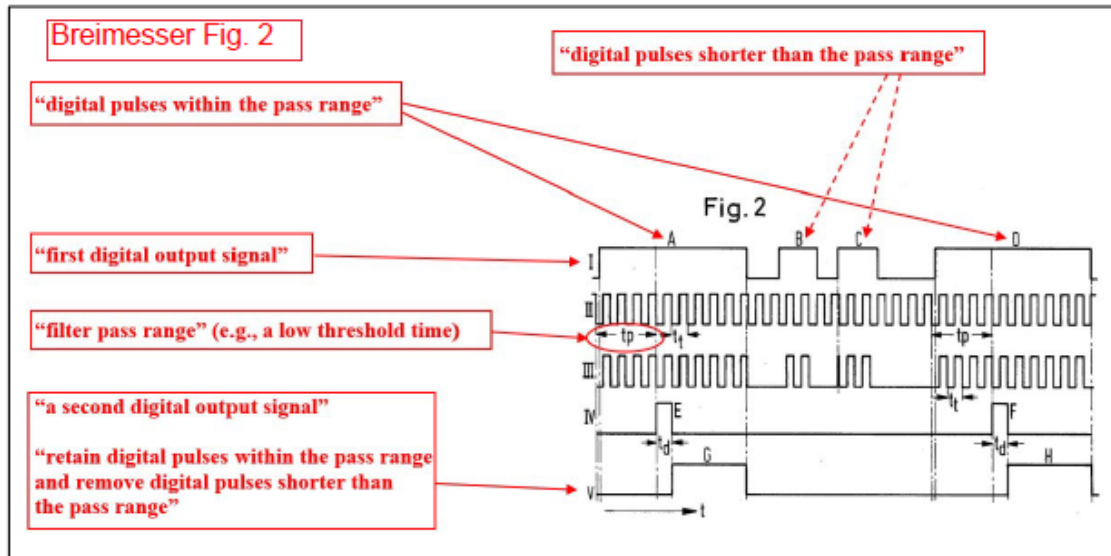
We are persuaded that Petitioner has demonstrated that the proposed combination of prior art teaches the recited claim limitation. We consider the evidence and arguments with respect to the rationale to combine the prior art, *infra*.

[22-b5, b6] adjusting the filter pass range based on an aspect of the expected next packet, wherein deriving a the second digital output signal comprises responsive to the first digital output signal at an interference rejection circuit of a RFID tag circuit by substantially removing retaining digital pulses with artifact numbers less than a first low number within the pass range while substantially retaining and removing digital pulses with artifact numbers greater less than the first low number pass range, wherein the first low number corresponds to a first time duration threshold.

Petitioner asserts that the combination of Shanks and Breimesser teaches this limitation. Paper 30, 9–12. Petitioner argues that the combination would “filter interference pulses shorter than the calibrated value for the shortest valid signal (e.g., bit ‘0’) to prevent the misidentification of a noise pulse as a valid data bit.” *Id.* at 9 (citing Pet. § VI.A.1(d) (claim [1-c(i)]); Ex. 1020 ¶ 408). Specifically, Petitioner argues, a person of ordinary skill in the art “would have *adjusted* Breimesser’s test period *tp*, *the filter pass range*, based on the duration of data symbols used with a particular data rate.” *Id.* at 9–10 (citing Pet. § VI.A.1(d, e) (claim [1-c(i, ii)]); Ex. 1020 ¶ 408). As a result, Petitioner argues interference pulses shorter than the test period would not

be interpreted as a logical “0.” *Id.* at 10 (citing Pet. § VI.A.1(d, e) (claim [1-b(i, ii)]); Ex. 1020 ¶ 408).

Petitioner provides an annotated version of Breimesser’s Figure 2, shown below.



Breimesser’s Figure 2, annotated by Petitioner and shown above, depicts a series of digital pulse sequences, I–V, over time *t*. Paper 30, 10. According to Breimesser, Figure 2 shows the mode of operation of Breimesser’s circuit arrangement depicted in Breimesser Figure 1.⁶ Ex. 1007, 3:11–31; Fig. 1. Petitioner’s annotations of Breimesser’s Figure 2 relate the digital pulse sequences to the recited claim limitations.

Petitioner also argues that for tags implemented in compliance with the Gen2 specification, it would have been similarly obvious to filter such

⁶ In Figure 2, according to Breimesser, sequence I shows a series of digital input pulses, A–D, fed to a first input of gate 1. Ex. 1007, 3:11–31; Fig. 1. Sequence II shows a series of counter pulses fed to a second input of the gate. *Id.* Sequence III shows individual groups of output counter pulses that pass through the gate when an input pulse, A–D, is present. *Id.* Sequence IV shows decoder output pulses E, F and sequence V shows storage element output pulses G, H. *Id.* at 3:51–53, 4:1–3.

interference pulses. Paper 30, 10 (citing Ex. 1020 ¶ 409). According to Petitioner, Gen2 specifies that the duration of a data-0 symbol is 1 Tari value. Paper 30, 10 (citing Ex. 1015 §§ 6.3.1.2.3, 6.3.1.2.8, Figs. 6.1, 6.4; Ex. 1020 ¶ 409). “The duration of a RTcal symbol,” Petitioner explains, “which is ‘equal to the length of a data-0 symbol plus the length of a data-1 symbol,’ is between 2.5 and 3.0 Tari.” Paper 30, 10 (citing Ex. 1015 §§ 6.3.1.2.3, 6.3.1.2.8, Figs. 6.1, 6.4; Ex. 1020 ¶ 409). Petitioner also explains that Gen2 provides for R=>T communications at a data rate based on Tari values between 6.25µs and 25µs. Paper 30, 10–11 (citing Ex. 1015 § 6.3.1.2.4, Table 6.5. Ex. 1020 ¶ 409).

“To inventory a tag population,” Petitioner argues, “the Gen2 command set includes a ‘Query’ command that ‘initiates an inventory round and decides which Tags participate in the round (where “inventory round” is defined as the period between successive Query commands).”” Paper 30, 11 (citing Ex. 1015 §§ 6.3.2.8, 6.3.2.10.2.1; Ex. 1020 ¶ 410). Petitioner points out that “Gen2 commands, such as the Query command, ‘begin with either a preamble or a frame-sync.”” Paper 30, 11 (citing Ex. 1015 § 6.3.2.10; Ex. 1020 ¶ 410).

Petitioner argues that:

[a]fter detecting the Gen2 delimiter where the first and second test period of Breimesser’s circuit had been set to, for example, 11.875µs and 13.125µs as explained above, it would have been obvious that the first and second test periods, *the filter pass range*, must be readjusted to *detect a command*, such as a Query command, that included valid data-0 symbols based on pulses as short as 6.25µs or as long as 25µs. Ex. 1015, § 6.3.2.10.2.1 (identifying Query command with a four bit code “1000”); Ex. 1020 ¶ 411. Furthermore, Breimesser teaches filtering both high and low portions of pulses, such as pulse-encoded data-0 symbols. Ex. 1007 2:13-15, 6:63-66, Figs. 3-4; Ex. 1020 ¶ 412.

Accordingly, based on the Tari value of the data-0 symbol that was received after the delimiter, *an aspect of the expected next packet*, it would have been obvious to *adjust* the first and second test periods, *the filter pass range, for detecting a Gen2 Query command* in order for Breimesser's circuit to *retain digital pulses within the pass range and remove digital pulses shorter than the pass range*.

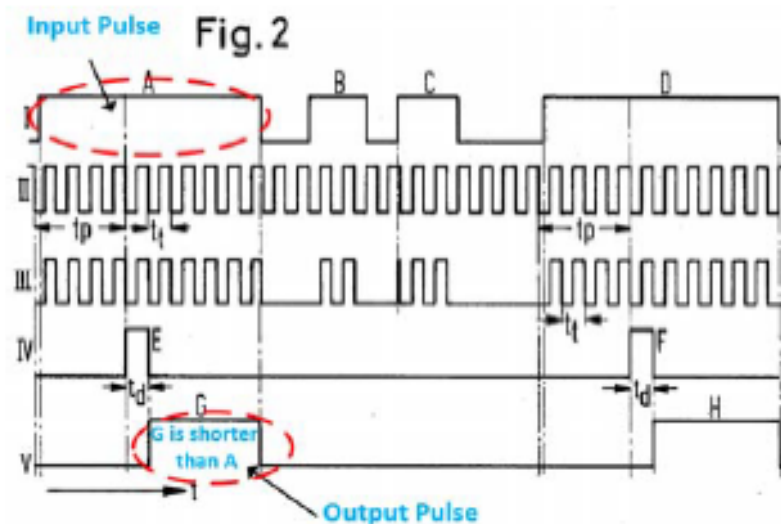
Paper 30, 11–12 (citing Ex. 1020 ¶ 411).

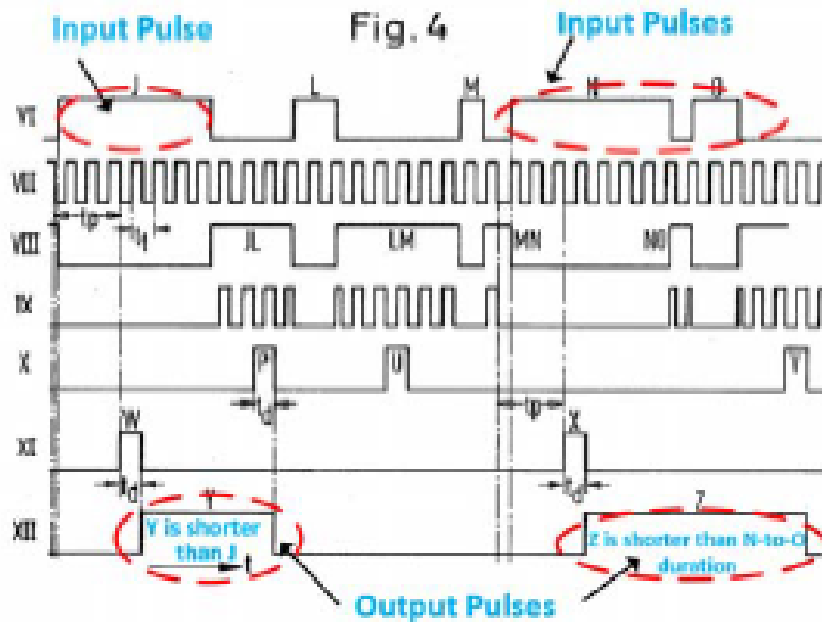
Patent Owner argues that Breimesser's circuit does not retain digital pulses within the pass range because it shortens, lengthens and shifts the digital pulses. Paper 32, 1–4. Patent Owner argues that:

[a] closer analysis of Breimesser reveals that neither Fig. 2, nor Fig. 4, describes retaining digital pulses within the pass range. Fig. 2, at best, produces a shortened output pulse if the input pulse exceeds the test period, t_p . Fig. 4 also shows pulses that are shortened even if an intervening gap is removed, and notably both figures illustrate output pulses (bottom rows V, XII in annotated Figs. 2 and 4) that are always shifted in time compared to the input signal.

Id. at 2.

Patent Owner provides annotated versions of Breimesser's Figures 2 and 4, set out below.





Breimesser's Figures 2 and 4, annotated by Patent Owner as shown above, depict Breimesser's digital pulse sequences I–V (Fig. 2) and digital pulse sequences VI–XII (Fig. 4).

Patent Owner argues that:

[u]nlike claim 1, the amended claims simply recite “*to [sic] retaining digital pulses within the pass range*” - without qualifications regarding *substantially* removing or retaining the pulses. Accordingly, the plain language of the claim (as corroborated by the detailed description (e.g., ‘504 Patent; Figs. 12A-D; Ex. 2001, ¶¶ 50-52) requires digital pulses within the pass range to be retained. Ex. 2009, ¶¶ 9-15. Breimesser does not retain digital pulses within the pass range, but rather produces shortened and shifted-in-time pulses.

Paper 32, 3. Patent Owner also argues that Petitioner “has failed to address Breimesser’s express statement that despite any such modifications, the pulse ‘exhibits an inaccuracy of a maximum of one pulse train length t_t .’” *Id.* at 4.

In reply, Petitioner argues that Patent Owner improperly equates the recited claim language “retaining digital pulses” with “retaining *the exact length of any* digital pulse.” Paper 42, 2. Petitioner argues that “[u]nder [Patent Owner’s] reasoning, a circuit that ‘shortens, lengthens and shifts the digital pulses’ does not ‘retain digital pulses,’” and “there can be no ‘inaccuracy’ in the length of the retained digital pulse—not even less than a clock cycle.” *Id.* (citing Paper 32, 1, 3–4). Petitioner further argues that Patent Owner “does not identify sufficient evidence to import an absolute ‘no inaccuracy’ limitation into the claims,” because Figures 12 A–D cited by Patent Owner are only “‘example[s],’ in which pulse transitions are aligned with ‘clock cycles.’” *Id.* at 2–3 (citing Ex. 1002, 12:22–23, 12:27–30, 12:65–67 (alteration in original)).

Petitioner argues that the “specification refers to ‘substantially retaining digital pulses’ (Ex. 1002, 20:48–49, 20:56, 21:12, 21:15–16), but there is no mention of retaining digital pulses, let alone retaining pulses that transition during a clock cycle.” Paper 42, 3. Petitioner further argues that “under PO’s interpretation of ‘retains,’ the proposed claims are indefinite because they ‘fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention.’” *Id.* at 4 (citing *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 901 (2014)). “If ‘retains *the exact length of any* digital pulse’ were the intended scope,” Petitioner argues, Patent Owner “simply could have proposed claims explicitly reciting that meaning rather than asking the Board to read limitations into the claims.” *Id.* at 3.

Petitioner also asserts that Patent Owner’s argument “that retained pulses cannot be shifted-in-time is not supported by the ’504 patent specification.” Paper 42, 4. Petitioner argues that “Figures 12A-B illustrate retained pulses that are shifted ‘along a time axis’ ‘with intercepts [of signal

1260] occurring *later in time* than corresponding intercepts of signal 1210.””
Id. (citing Ex. 1002, 12:50–52). Petitioner asserts that Patent Owner’s
expert “agrees ‘the patent teaches that the output signal occurs later in time
than the input signal.’” Paper 42, 4 (citing Ex. 1021, 38:8–11).

Petitioner also argues that “even if ‘retain digital pulses’ means that
output pulses cannot be shortened, Breimesser expressly teaches
embodiments that avoid shortened pulses.” Paper 42, 4. Petitioner asserts
that “Breimesser recognized ‘the pulses of the output signal are shortened’
by the circuit in Figure 1 and explained that ‘[t]his shortening can easily be
cancelled by addition or subtraction.’” *Id.* at 4–5 (citing Ex. 1007, 5:56–60;
see also id. at 4:5–21 (“The displacement and shortening ... *may be*
avoided.”); Paper 30, 6–7 (citing Pet. §VI.A.1(d)). “In other words,”
Petitioner argues, “Breimesser provides a circuit modification to precisely
maintain pulse widths.” Paper 42, 5 (citing Ex. 1003 ¶ 182).

Petitioner further argues that Patent Owner:

fails to acknowledge the teachings of Breimesser’s Figure 3
circuit, which produces an output pulse that is not necessarily
shortened and, even if it were, is accurate within two clock
cycles. Ex. 1007, 7:1-20, Fig. 4 (illustrating output pulse Z and
corresponding input pulse group N to O); Ex. 1021, 51:14-22
(Breimesser “doesn’t say that the embodiment of Figure 3 always
shortens the output.”). [Patent Owner] deceptively represents
that pulse Z is “shorter” (Reply, 2), but [Patent Owner’s] expert
admitted on cross-examination that he simply “*assumed*” output
pulse Z was shorter, even “though there’s no real indication in
Figure 4 if it is, *in fact*, shorter or longer.” Ex. 1021, 52:3-12; *id.*
at 49:6-50:14 (PO’s expert conceded that he did not, and could
not, “count the CLK pulses from N to O and compare that to the
CLK pulses for pulse Z.”)

Paper 42, 5.

Petitioner also points out that:

Breimesser explains that pulse length inaccuracy arises “due to the position of the front edge of the input pulse in relation to the triggering edge of the first counter pulse,” and can be reduced by increasing the clock frequency (i.e., selecting a smaller *tt*). Ex. 1007, 4:12-19; *see also* Ex 1021, 33:13-24 (describing inaccuracy where pulse “transitions occurred in the middle of a CLK cycle”). Thus Breimesser teaches that the magnitude of any inaccuracy can be reduced to the extent necessary as a matter of design.

Paper 42, 5.

We disagree with Patent Owner’s arguments that we summarized above. Implicit in Patent Owner’s arguments is that the proposed claim language, “retaining digital pulses,” must mean that any such digital pulses cannot be altered in any way, such as by shortening, time-shifting, or creating any type of inaccuracy. Such an interpretation is not warranted and would require us to improperly read into the proposed claim language a limitation that is not expressly set out in the claim, or clearly supported by the specification. “Though understanding the claim language may be aided by the explanations contained in the written description, it is important not to import into a claim limitations that are not a part of the claim.” *SuperGuide Corp. v. DirecTV Enters., Inc.*, 358 F.3d 870, 875 (Fed. Cir. 2004).

The proposed claim language reads “adjusting the filter pass range based on an aspect of the expected next packet, wherein deriving the second digital output signal comprises retaining digital pulses with artifact numbers within the pass range and removing digital pulses with artifact numbers less than the pass range.” The proposed claim language does not require “retaining *unaltered* digital pulses” or “retaining *the exact length of any* digital pulses.” Neither does the proposed claim language expressly prohibit

retaining digital pulses that have been shortened, lengthened, time-shifted, or having an inaccuracy.

The '504 Specification does not define “retaining digital pulses” to mean excluding digital pulses that have been shortened, lengthened, time-shifted, or having an inaccuracy. Rather, the '504 Specification describes an interference rejection circuit that “substantially remov[es] digital pulses shorter than a first time duration threshold while substantially retaining digital pulses longer than the first time duration threshold.” Ex. 1002, 20:47–49; *see id.* at 21:10–17. Indeed, even Figures 12A–D cited by Patent Owner to support its argument are just examples in which pulse transitions are aligned with clock cycles. *See id.* at 12:22–23, 12:27–30, 12:65–67.

As Petitioner points out, Patent Owner could have, but did not, propose substitute claim language that recited “retaining *the exact length of any* digital pulses,” or perhaps “retaining *unaltered* digital pulses” or even “retaining digital pulses *that have not been shortened, lengthened, time-shifted, or having an inaccuracy.*”

To the extent that Breimesser’s circuit shortens output pulses, Breimesser also teaches embodiments that avoid shortened pulses. As Petitioner points out, “Breimesser recognized ‘the pulses of the output signal are shortened’ by the circuit in Figure 1 and explained that ‘[t]his shortening can easily be cancelled by addition or subtraction.’” *See* Ex. 1007, 5:56–60; *see also id.* at 4:5–21. In other words, Breimesser provides a circuit modification to maintain pulse widths. Ex. 1003 ¶ 297.

As for any inaccuracy in Breimesser’s circuit, Breimesser explains that pulse length inaccuracy arises “due to the position of the front edge of the input pulse in relation to the triggering edge of the first counter pulse,” and can be reduced by increasing the clock frequency. *See* Ex. 1007, 4:12–

19. Petitioner points out, and we agree, “in cases where the input pulse and the counter pulse are aligned, such as in Figure 12A of the patent, this clocking inaccuracy would not result.” *See* Paper 42, 5.

We are persuaded that Petitioner has demonstrated that the proposed combination of prior art teaches the recited claim limitation. We consider the evidence and arguments with respect to the rationale to combine the prior art, *infra*.

2. *Rationale to Combine the Prior Art*

Petitioner asserts that a person of ordinary skill in the art would have been motivated to combine the teachings of Shanks, Breimesser, Lichtblau, and Gen 2, such that the proposed substitute claims would have been obvious at the time of the claimed invention. *See* Paper 30, 12–16. Petitioner argues that Shanks and Gen2 teach similar RFID systems such that it would have been obvious to a person of ordinary skill in the art to modify Shanks’ pulse-interval encoded signaling system for use in Gen2 systems. *See id.* at 12–14 (citing Ex. 1020 ¶ 419).

Petitioner acknowledges that Gen2 describes a protocol for communication, “but does not define any particular circuitry or structure for implementing a Gen-2 compliant tag.” Paper 30, 13 (citing Ex. 1020 ¶ 419). Petitioner points out that Shanks provides circuitry to demodulate a wireless RF input signal from an RFID reader, as well as clocking and counter circuitry, that could be readily adapted for use in constructing a Gen-2 compliant tag. *Id.* (citing Ex. 1020 ¶¶ 419–420).

Petitioner also argues that a person of ordinary skill in the art “would have known that interference causing spurious digital output pulses could be filtered in order to remove pulses that did not conform to certain minimum or maximum expected pulse durations.” Paper 30, 13–14 (citing Ex. 1003

¶ 169); *see* Ex. 1003 ¶ 290. Petitioner argues that such filtering was known for decades prior to the alleged invention. Paper 30, 14 (citing Ex. 1003 ¶¶ 62–63). Petitioner points to Breimesser, which “teaches a circuit that ‘can be used for gating out interference signals of shorter duration than the useful signal.’” Paper 30, 14 (citing Ex. 1007, 7:47–49, 7:63–8:15); *see also* Ex. 1013, 1:6–11 (“The present invention relates to filters for removing short noise pulses from digital signals. . . . Noise in a digital transmission may introduce extra pulses . . .”).

Petitioner also argues that a person of ordinary skill in the art would have looked to existing solutions that could be combined with Shanks, such as Breimesser, to filter pulses arising from interference in a Gen-2 system and to overcome the known limitations in Shanks’ data recovery circuit. Paper 30, 14 (citing Ex. 1020 ¶¶ 421–422). Petitioner points out that Breimesser teaches a circuit for filtering pulses that do not conform to a minimum expected pulse duration. Paper 30, 14. Petitioner also argues that a person of ordinary skill in the art “would be motivated to combine Breimesser’s interference rejection circuit with Shanks,” such that “interference pulses shorter than the calibrated value for the Gen2 data-0 symbol (e.g., bit ‘0’) would be filtered so that they would not be processed as invalid data.” *Id.*

Petitioner argues that “combining the circuits disclosed in Shanks and Breimesser is a straightforward modification.” *Id.* (citing Ex. 1003 ¶ 171). Petitioner points out that Shanks, Breimesser, and Gen2 all “disclose the use of timing pulse widths for calibration.” Paper 30, 14 (citing Ex. 1020 ¶ 423). Petitioner argues a person of ordinary skill in the art “would have understood that this concept could be expanded to use timing to distinguish

valid pulses from interference pulses.” Paper 30, 14–15 (citing Ex. 1020 ¶ 423).

Petitioner also argues that “whereas Breimesser’s circuit is configured to reject only pulses that do not conform to a minimum duration (i.e, test period *tp*), Lichtblau’s ‘pulse train processor . . . is responsive to both the minimum duration and to the maximum duration of each of the several pulses.’” Paper 30, 15 (citing Ex. 1008, 2:3–9; Ex. 1003 ¶ 223); *see* Ex. 1003 ¶ 320. “And Gen2,” Petitioner argues, “provides an explicit motivation for this combination by specifying, for example, that symbols longer than 4 times *RTcal* are not data-1 symbols, but instead are invalid data.” Paper 30, 15 (citing Ex. 1015 § 6.3.1.2.8; Ex. 1020 ¶ 424). “To filter longer pulses arising from interference that exceed a maximum duration in a Gen2 system,” Petitioner argues, a person of ordinary skill in the art “would have looked to the teaching of Lichtblau for use in the combination with Shanks and Breimesser.” Paper 30, 15 (citing Ex. 1020 ¶ 424).

“In particular,” Petitioner argues, a person of ordinary skill in the art “would have been motivated to modify Breimesser’s interference rejection circuit to include both a first and second test period (e.g., *tp-min* and *tp-max*) to filter pulses shorter than the first test period [] and also to filter pulses longer than the second test period.” Paper 30, 15 (citing Ex. 1003 ¶¶ 225, 425); Ex. 1020 ¶ 385. “To the extent modifications would have been needed to the combination of Shanks and Breimesser to accommodate a second test period to filter pulses that exceed a maximum duration,” Petitioner argues, “such modifications would have been within the level of ordinary skill in the art at the time of the alleged invention.” Paper 30, 15; Ex. 1020 ¶ 425.

Petitioner argues that the “combination of these aspects of Shanks, Breimesser, Lichtblau, and Gen2 represents the use of known techniques

(i.e., filtering digital pulses that do not conform to a minimum expected pulse duration as Breimesser teaches and to a maximum expected pulse duration as Lichtblau teaches) to address a specific need in Shanks to filter digital pulses in order to improve the performance of the digital circuitry by preventing noise pulses from being interpreted as valid data in a Gen2 system.” Paper 30, 16 (citing Ex. 1020 ¶ 426).

Petitioner also argues that the “proposed combination also amounts to combining prior art elements according to conventional methods (adding circuitry to further filter digital pulses) to yield obvious, predictable and beneficial results from processing a received wireless communication signal, such as a Gen2 R=>T signal, to eliminate noise pulses that do not conform to a specified minimum and maximum pulse duration.” Paper 30, 16 (citing Ex. 1020 ¶ 427).

Petitioner further argues a person of ordinary skill in the art “would have looked to combine Shanks and Gen2 with Breimesser’s circuit arrangement, including modifications to include a maximum expected pulse duration as Lichtblau teaches, with a reasonable expectation of success.” Paper 30, 16 (citing Ex. 1020 ¶ 428). A person of ordinary skill in the art, Petitioner argues, “would have recognized that combining the teachings of these references would yield improved performance in cases where the Gen2 tag circuit is subjected to noise pulses not filtered by Shanks’ data recovery circuit.” Paper 30, 16 (citing Ex. 1020 ¶ 428).

Patent Owner argues that a person of ordinary skill in the art “at the time of the invention in mid-2000’s, reading Breimesser’s disclosure from the mid-1970s, would not have been motivated to use Breimesser’s circuit with inferior pulse-shortening and pulse shifting characteristics to tackle the noisy, power-starved and dynamic RFID environment, and yet undertake

unspecified modifications to Breimesser’s circuit.” Paper 32, 4 (citing Ex. 2009 ¶¶ 32–37).

Patent Owner also argues that a person of ordinary skill in the art “would not have been motivated, and would not have found it obvious, to combine Gen2 with three other references with a reasonable expectation of success because such a system could not have been used to verify interrogator compliance as required by Gen2.” Paper 32, 11 (citing Ex. 2009 ¶¶ 47–49).

Patent Owner further argues that a person of ordinary skill in the art “would have had no reason to change the pass range” as Petitioner proposes, because:

the initial pass range was already successfully used to detect the “expected next packet” (and the associated pulse width (PW)). This detection would have provided the needed information (data rate and other characteristics) regarding all subsequent Data-0 symbols in the subsequent command. Ex. 2009, ¶¶ 50-52. Therefore, there would **NOT** have been a need to change the pass range to detect subsequent Data-0 symbols associated with the following command, and [Petitioner’s] assertion that the pass range must be readjusted is an attempt to fill a gap in the proposed combination with an arbitrary operation that lacks logical sense.

Paper 32, 10–11.

We disagree with Patent Owner. With respect to Patent Owner’s argument concerning the use of Breimesser’s circuit in an RFID environment, Dr. Blalock first explains that “Shanks’ analog front-end includes a data recovery circuit to demodulate a wireless RF input signal from an RFID reader.” Ex. 1003 ¶ 165; *see id.* ¶ 290. “Since the Shanks demodulator is designed to demodulate signals from a range of frequencies of interest for its particular application(s),” Dr. Blalock explains, “any

interfering signals within the same range of frequencies will also be processed by the demodulator.” *Id.* ¶ 167. Dr. Blalock testifies that a person of ordinary skill in the art “would have understood that such a circuit would allow RF interference to pass through the detector and comparator.” *Id.*

¶ 168. Dr. Blalock also testifies that “[a]t the time of the alleged invention, a [person of ordinary skill in the art] would have known that interference that resulted in spurious digital output pulses could be further filtered in order to remove pulses that did not conform to certain minimum or maximum expected pulse durations.” *Id.* ¶ 169.

Dr. Blalock further testifies that in order to “filter pulses arising from interference and also to overcome the known limitations in Shanks data recovery circuit (susceptibility to interference), a [person of ordinary skill in the art] would have looked to [] existing solutions that could be combined with Shanks, such as Breimesser, which discloses a circuit for filtering pulses that do not conform to an expected pulse duration. *Id.* ¶ 170. “The combination of these two circuits,” Dr. Blalock testifies, “represent the use of known techniques (Breimesser’s pulse filtering circuit) to address a specific need in Shanks to further filter digital pulses to improve the performance of the digital circuitry.” *Id.*

We find Dr. Blalock’s testimony persuasive, explaining why a person of ordinary skill in the art at the time of the invention would have looked to Breimesser’s known filtering circuit to improve Shanks’ RFID data recovery circuit in order to filter out undesirable RF interference.

Patent Owner’s argument with respect to Gen2 compliance is misplaced. The question is not whether “such a system could not have been used to verify interrogator compliance as required by Gen2,” but rather, “whether there is something in the prior art as a whole to suggest the

desirability, and thus the obviousness, of making the combination.” *In re Fulton*, 391 F.3d 1195, 1200 (Fed. Cir. 2004). Moreover, “[t]here is no requirement that one of ordinary skill have a reasonable expectation of success in developing” a system that could be used to verify interrogator compliance as required by Gen2, as Patent Owner argues.⁷ *Allergan, Inc. v. Sandoz Inc.*, 726 F.3d 1286, 1292 (Fed. Cir. 2013). “Rather, the person of ordinary skill need only have a reasonable expectation of success of developing the claimed invention.” *Id.*

Here, Dr. Blalock explains that a person of ordinary skill in the art “would have referred to Gen2 in developing RFID tags, because Gen2 was an industry standard that had been ‘designed to work globally and be approved as an international standard by the International Organization for Standardization (ISO).’” Ex. 1020 ¶ 415; *see* Ex. 1016, 1. Dr. Blalock explains that “[l]ike Shanks, Gen2 discloses an RFID system where reader to tag information is pulse-interval encoded.” Ex. 1020 ¶ 416. Also like Shanks, Dr. Blalock explains, “Gen2 discloses an RFID system, in which passive tags backscatter modulate information to a reader,” and “discloses tags that store information in memory, such as an identification number, that can be retrieved by a reader.” *Id.* ¶ 418.

“Given these similarities,” Dr. Blalock testifies persuasively that: it would have been obvious to [a person of ordinary skill in the art] to modify Shanks pulse-interval encoded signaling system for use in Gen2 systems. Gen2 describes a protocol for communication, but does not define any particular circuitry or structure for implementing a Gen-2 compliant tag. Shanks

⁷ Petitioner also points out that Gen2 “section 6.3.1.2.4 describes requirements for an RFID *interrogator*, which is not within the scope of the claims. Instead, the claims recite an RFID *tag circuit*.” Paper 42, 11 (citing Ex. 1015, 23).

provides circuitry to demodulate a wireless RF input signal from an RFID reader, as well as for example, clocking and counter circuitry, that could be readily adapted for use in constructing a Gen2 compliant tag.

Id. ¶ 419.

Dr. Blalock further testifies that:

[u]tilizing both Shanks and Gen2 is simply an example of how design work is typically done. Gen2 is essentially a design specification stating the functional requirements of a Reader-Tag wireless communication protocol. Given the Gen2 specification that has timing requirements, it is suggestive of hardware for timing and pulse validation. Rather than start from scratch, it is typical to look for existing similar designs that could be adapted to meet the needs of a specification. Shanks describes circuitry to implement a similar wireless protocol so combining Shanks with Gen2 is a natural design approach for [a person of ordinary skill in the art].

Id. ¶ 420.

As for Patent Owner’s argument that a person of ordinary skill in the art “would have had no reason to change the pass range,” Petitioner persuasively argues that it would have been obvious to readjust the filter pass range after receiving the expected next packet because “Gen2 specifies that the preamble and frame-sync may include a data-0 symbol as short as 6.25µsec or as long as 25µsec. The duration of this data-0 symbol (Tari) calibrates the tag to interpret subsequent symbols as either data-0 or data-1,” making it “obvious to adjust the filter pass range based on this calibrated duration.” Paper 42, 10 (citing Paper 30, 9–12, 19; Ex. 1020 ¶¶ 407–411, 434).

We find that Petitioner has shown by a preponderance of the evidence that one of ordinary skill in the art at the time of the invention would have

had reason to combine the teachings of the prior art in the manner described by Petitioner.

3. Conclusion as to Proposed Substitute Independent Claim 22

Based upon consideration of the entire record, we are persuaded by Petitioner's arguments and evidence and determine that Petitioner has demonstrated by a preponderance of the evidence that proposed substitute independent claim 22 is unpatentable under 35 U.S.C. § 103(a) as obvious over the combined teachings of the prior art.

4. Proposed Substitute Independent Claims 30 and 33

As noted, *supra*, the parties, in general, do not argue proposed substitute independent claims 30 and 33 separately, relying instead on their arguments directed to independent claim 22. *See* Paper 30, 22–23; Ex. 1020 ¶ 439; Paper 32, 1. Petitioner, however, does argue the *adjusting the filter pass range based on an aspect of the expected next packet* limitation of claim 30 and claim 33 separately. *See* Paper 30, 23–25.

The proposed limitation in claim 30 reads:

[30-b5, b6]: adjusting the filter pass range based on an aspect of the expected next packet, wherein deriving a the second digital output signal responsive to the first digital output signal at an interference rejection circuit of a RFID tag circuit by comprises substantially removing retaining digital pulses with artifact numbers greater than a first high number within the pass range while substantially retaining and removing digital pulses with artifact numbers lower greater than the first high number, wherein the first high number corresponds to a first time duration threshold pass range.

Paper 25, App. A. The proposed limitations in claim 33 (33-c4, c5) recite substantially the same limitations. *Id.* Accordingly, Petitioner asserts claim

33 would have been obvious for the same reasons claim 30 would have been obvious. Paper 30, 25 (citing Ex. 1020 ¶ 445).

For this limitation, Petitioner largely reiterates its arguments for the equivalent limitation in claim 22 (22-b5, b6). Paper 30, 23–25 (citing Ex. 1020 ¶¶ 440–445); *see* § II.F.1 (claim 22-b5, b6), *supra*. For example, Petitioner argues a person of ordinary skill in the art “would have been motivated to combine Shanks and Breimesser to filter interference pulses shorter than the calibrated value for the shortest valid signal (e.g., bit ‘0’) to prevent the misidentification of a noise pulse as a valid data bit.” Paper 30, 23 (citing Pet. § VI.A.1(d) (claim [1-c(i)]); Ex. 1020 ¶ 440). Petitioner argues a person of ordinary skill in the art “would have adjusted Breimesser’s test period *tp*, the filter pass range, based on the duration of data symbols used with a particular data rate.” *Id.* (citing Pet. § VI.A.1(d, e) (claim [1-c(i, ii)]); Ex. 1020 ¶ 440). “As a result,” Petitioner concludes, “interference pulses shorter than the test period, that is *pulses with artifact numbers less than the pass range*, would not be interpreted as a logical ‘0.’” *Id.* (citing Pet. § VI.A.1(d, e) (claim [1-c(i, ii)]); Ex. 1020 ¶ 440).

Patent Owner does not specifically address Petitioner’s argument with respect to this limitation. *See generally* Paper 32.

Petitioner’s argument is supported by the cited evidence. We are persuaded that Petitioner has demonstrated that the proposed combination of prior art teaches the recited claim limitation.

Based upon consideration of the entire record, and for the reasons discussed, *supra*, with respect to proposed substitute independent claim 22, we are persuaded by Petitioner’s arguments and evidence and determine that Petitioner has demonstrated by a preponderance of the evidence that

proposed substitute independent claims 30 and 33 are unpatentable under 35 U.S.C. § 103(a) as obvious over the combined teachings of the prior art.

5. Proposed Substitute Dependent Claims 23–29, 31–32, 34–35

As noted above, Petitioner asserts that proposed substitute dependent claims 23–29, 31–32, and 34–35 (*see* Paper 25, App. A) are unpatentable as obvious over the combined teachings of Shanks, Breimesser, Lichtblau, and Gen2. Paper 30, 17–25.

Petitioner provides evidence and argument showing that the combination of Shanks, Breimesser, Lichtblau, and Gen2 teaches the limitations of these proposed substitute dependent claims. *Id.* Petitioner also provides evidence and argument that one of ordinary skill in the art would have combined the teachings of the prior art in the manner described. *Id.*

Patent Owner does not specifically address Petitioner’s arguments with respect to the dependent claims. Paper 32, 12.

We have considered the evidence and arguments with respect to proposed substitute dependent claims 23–29, 31–32, and 34–35. We are persuaded that Petitioner has demonstrated that the combined teachings of the prior art meet the recited limitations of these claims and that one of ordinary skill in the art would have been motivated to combine the prior art in the manner described.

Based upon consideration of the entire record, we are persuaded that Petitioner has demonstrated by a preponderance of the evidence that proposed substitute dependent claims 23–29, 31–32, and 34–35 are unpatentable under 35 U.S.C. § 103(a) as obvious over the combined teachings of the prior art.

G. Anticipation Based on Hyde '598

Petitioner asserts proposed substitute claims 22–35 are unpatentable as anticipated under 35 U.S.C. § 102(b) by Hyde '598. Because Petitioner has already shown that all of the proposed substitute claims are unpatentable as discussed *supra*, we do not reach this additional asserted ground. *See Beloit Corp. v. Valmet Oy*, 742 F.2d 1421, 1423 (Fed. Cir. 1984) (“The Commission . . . is at perfect liberty to reach a ‘no violation’ determination on a single dispositive issue.”); *Boston Sci. Scimed, Inc. v. Cook Grp. Inc.*, 809 F. App’x 984, 990 (Fed. Cir. 2020) (recognizing that “[t]he Board has the discretion to decline to decide additional instituted grounds once the petitioner has prevailed on all its challenged claims”).

III. CONCLUSION

For the foregoing reasons, we cancel claims 1, 2, 4, 7–10, 13–15, 17–19, and 21 of the '504 patent, and we deny Patent Owner's motion to amend the '504 patent to add proposed substitute claims 22–35. In summary:

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatenable
1–2, 4, 7, 13	103(a)	Shanks, Breimesser ⁸		
8–10, 14–15, 17–19, 21	103(a)	Shanks, Breimesser, Lichtblau ⁹		
Overall Outcome				

Motion to Amend Outcome	Claims
Original Claims Cancelled by Amendment	1, 2, 4, 7–10, 13–15, 17–19, 21
Substitute Claims Proposed in the Amendment	22–35
Substitute Claims: Motion to Amend Granted	
Substitute Claims: Motion to Amend Denied	22–35
Substitute Claims: Not Reached	

⁸ We do not reach this asserted ground. *See* Section I.D.

⁹ We do not reach this asserted ground. *See* Section I.D.

IV. ORDER

Accordingly, it is

ORDERED that Patent Owner's Motion to Amend is *granted-in-part* as to its non-contingent request to cancel claims 1, 2, 4, 7–10, 13–15, 17–19, and 21; and

FURTHER ORDERED that Patent Owner's Motion to Amend is *denied-in-part* as to substitute claims 22–35.

This is a final 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.

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