

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INFINEON TECHNOLOGIES AG,
Petitioner,

v.

FEINICS AMATECH TEORANTA,¹
Patent Owner.

IPR2022-00650
Patent 9,633,304 B2

Before STACEY G. WHITE, BRIAN D. RANGE, and
JULIET MITCHELL DIRBA, *Administrative Patent Judges*.

RANGE, *Administrative Patent Judge*.

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

¹ Patent Owner is AmaTech Group Limited. Patent Owner's Mandatory Notice, Paper 5, 1.

I. INTRODUCTION

Infineon Technologies AG (“Petitioner”) filed a Petition requesting *inter partes* review of claims 1–3, 5–8, 11–14, and 16 (“the challenged claims”) of U.S. Patent No. 9,633,304 B2 (Ex. 1001, “the ’304 patent”). Paper 2 (“Pet.”). We instituted *inter partes* review of the challenged claims on all asserted grounds. Paper 12 (“Dec.”). After institution, Patent Owner filed a Patent Owner Response (Paper 15, “PO Resp.”), Petitioner filed a Reply (Paper 16, “Pet. Reply”), and Patent Owner filed a Sur-Reply (Paper 19, “Sur-Reply”). An oral hearing was held on June 22, 2023, and a transcript of the hearing is included in the record (Paper 30, “Tr.”).

We have jurisdiction under 35 U.S.C. § 6. This decision is issued pursuant to 35 U.S.C. § 318(a). For the reasons that follow, we determine that Petitioner has shown, by a preponderance of the evidence, that claims 1–3, 5–8, 11–14, and 16 of the ’304 patent are unpatentable.

II. BACKGROUND

A. Related Matters

The parties indicate that the ’304 patent is the subject of the following district court proceedings: *Smart Packaging Solutions SA v. CPI Card Group Inc.*, No. 1:21-cv-00556 (D. Del. 2021), and *Smart Packaging Solutions SA v. Perfect Plastic Printing Corp.*, No. 1:21-cv-00557 (D. Del. 2021). Pet. xvi; Paper 5, 2. Patent Owner further indicates that patents related to the ’304 patent are at issue in IPR proceedings in IPR2022-00235, *Infineon Technologies AG v. Feinics AmaTech Teoranta* (filed November 24, 2021) (U.S. Pat. No. 9,195,932 B2) and IPR2022-00417, *Infineon Technologies AG v. AmaTech Group Ltd.* (filed January 10, 2022) (U.S. Pat. No. 9,033,250 B2). Paper 5, 3. We also note that in IPR2022-00951, petition

filed April 29, 2022, Petitioner challenges claims of related U.S. Patent No. 9,165,240 B2.

B. The '304 patent

The '304 patent is titled “Booster Antenna Configurations and Methods.” Ex. 1001, code (54). Generally, the '304 patent describes a booster antenna for a smart card. *Id.* at code (57). We reproduce Figures 1 and 1A of the '304 patent below.

FIG. 1

Dual Interface (DI) Smart Card, and Readers

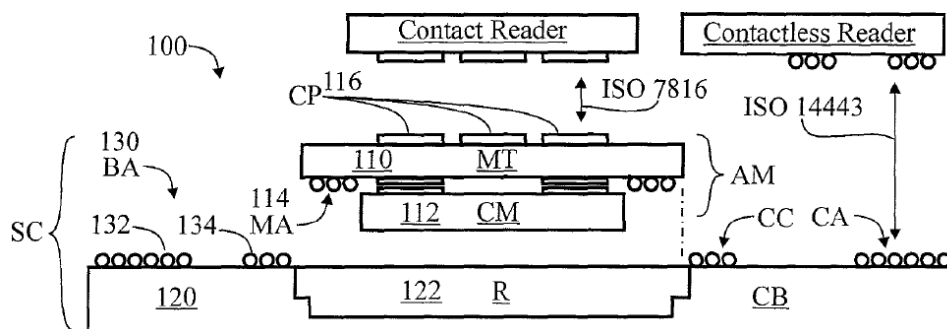


FIG. 1A

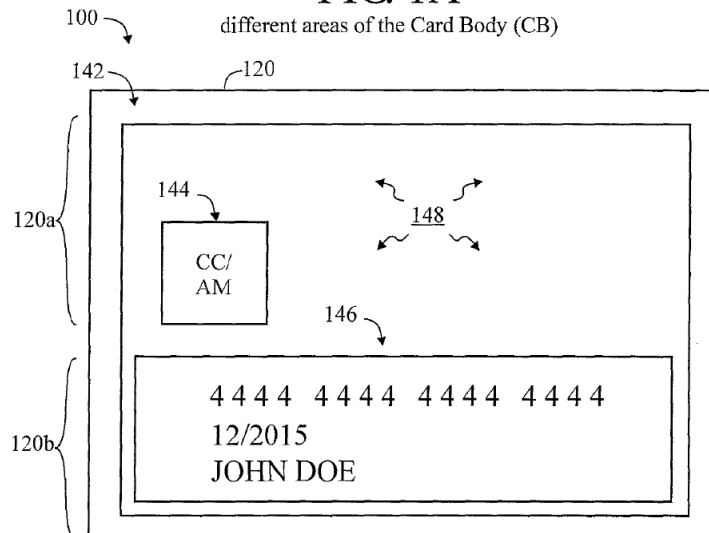


Figure 1 is a cross-section of a dual-interface smart card and reader and Figure 1A is the top view of a smart card's card body (CB). *Id.* at 7:35–38. A smart card may comprise card body (CB) (120) that has coupling area (144) in the location of antenna module (AM), and booster antenna (BA) (130). *Id.* at 1:63–2:1, 10:10–28. Antenna module (AM) may comprise a module tape (MT) or an RFID (radio frequency identification) chip or chip module. *Id.* at 1:65–2:4, 10:12–18. Booster antenna (BA) (130) may comprise various antenna components, such as card antenna (CA) (132) for coupling with an external contactless reader, and coupling coil (CC) (134) for coupling with module antenna (MA) (114) of antenna module (AM). *Id.* at 2:4–8, 10:23–27.

We reproduce '304 patent Figure 4B below.

FIG. 4B

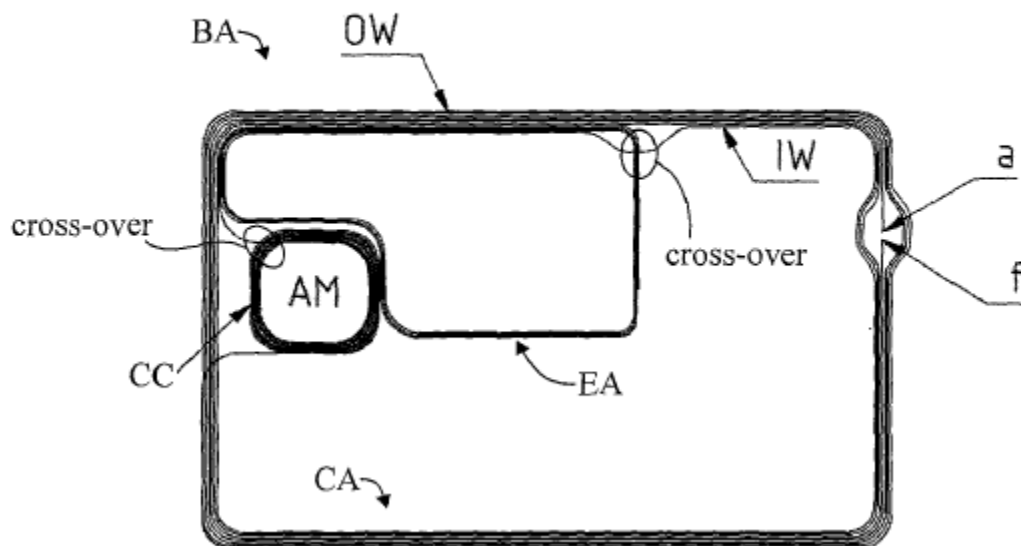


Figure 4B illustrates an embodiment of a booster antenna (BA) with card antenna (CA), a coupler antenna (CC), and an extension antenna (EA). *Id.* at 7:52–54. The booster antenna BA may be formed from “one, continuous”

wire laid in a pattern to form several coils that the '304 patent characterizes as the card antenna CA, coupler antenna CC, and extension antenna EA. *Id.* at 18:9–14. The coupler antenna CC may encircle or nearly encircle the antenna module AM for inductively coupling. *Id.* at 16:66–17:5. The extension antenna may serve to “increase the inductivity of the booster antenna BA while reducing its resonance frequency.” *Id.* at 17:52–60.

The '304 patent describes a prior art reference, “U.S. Patent No. 8,130,166 (Assa Abloy, 2012)” as disclosing a “coupling device for transponder and smart card with such device.” *Id.* at 3:38–40. Petitioner explains that the “Assa Abloy” reference is the patent that issued from the application that Petitioner refers to as Ayala-362. Pet. 6; *see also* Ex. 1012 (the “Assa Abloy” patent); Ex. 1006 (the Ayala-362 patent application). The '304 patent explains that this prior art device had a small spiral and large spiral where “the small spiral shows a larger pitch than the ones of the large spirals.” Ex. 1001, 3:40–49. The '304 patent explains that Assa Abloy teaches choosing the pitches of spirals as follows:

The pitches of the large spirals are chosen such as that the interturn stray capacitances is important and that the large spirals have mainly a capacitive behavior. And the pitch of the small spiral is chosen such as that the interturn stray capacitances are negligible, and that the small spiral has mainly an inductive behavior.

Id. at 3:49–54; *see also id.* at 26:7–22 (distinguishing Assa Abloy); Ex. 1006, code (57) (Ayala-362 abstract providing a similar explanation).

The '304 patent teaches that at least one of its components “may have a pitch which is different than one or more of the other components.” Ex. 1001, code (57). Figure 6A (not reproduced here) states that “pitch increases across width of card body (CB).” *Id.* at Fig. 6A. The '304 patent

also explains that its device's features may include "windings (turns) of CA, CC or EA having different pitches/spacings." *Id.* at 5:27–28. In the paragraph we reproduce below, the '304 patent explains how it uses the word "pitch" and explains that pitch may vary during manufacturing:

As used herein, "pitch" may refer to the average distance, center-to-center (c-c), between adjacent turns of a wire for a winding (OW, IW) or the coupler coil (CC), as it is being laid. (Or, by analogy, to the center-to-center distance between adjacent conductive tracks made by additive or subtractive processes). It should be understood that during manufacturing (including as a result of subsequent manufacturing steps such as laminating), the pitch of the wire may vary or change somewhat, such as +/-5%, or more. And, when going around a corner, such as in a rectangular spiral, the pitch may be somewhat indeterminate. It should also be understood that the pitch of the windings (OW, IW) or coupler coil (CC) may be advertently altered (typically increased) locally, such as at the free ends "a" and "f", to accommodate manufacturing processes (such as starting and ending embedding the wire) and the like. "Pitch" may refer to the initial (during laying) or final (after laminating) distance (c-c) between adjacent turns of a winding.

Id. at 13:1–18. The '304 patent explains that "pitch can be selected in order to vary the capacitance of the extension antenna (EA) and hence tune the resonance frequency of the booster antenna (BA)." *Id.* at 20:40–46.

C. Illustrative Claim

Petitioner challenges claims 1–3, 5–8, 11–14, and 16. Pet. 1. Claim 1 is the only independent claim, and we reproduce claim 1 below.

1. Booster [A]ntenna (BA) comprising the following components:
 - a card antenna (CA) component;
 - a coupler coil (CC) component; and
 - an extension antenna (EA) component;

characterized in that:

at least one of the components has a pitch which is
different than one or more of the other components.

Ex. 1001, 48:39–46.

D. Asserted Grounds of Unpatentability

Petitioner, supported by the declaration of Dr. Daniel van der Weide (Ex. 1003), asserts the following four² grounds of unpatentability (Pet. 2):³

Claims Challenged	35 U.S.C. §	References/Basis
1–3, 5–8, 12–14, 16	103	Takeda-322, ⁴ Ayala-362 ⁵
1–3, 5–8, 11–14, 16	103	Murayama ⁶ , Ayala-362
1–3, 5–8, 11–14, 16	102	Ayala-362
6–8, 11, 16	103	Ayala-362

² Petitioner lists three grounds in its Petition. Pet. 2. Petitioner, however, argues under its third ground, that “Ayala-362 anticipates claims 1-3, 5, and 12-14, and anticipates and/or renders obvious claims 6-8, 11, and 16.” Pet. 77. We, therefore, interpret Petitioner’s third ground as including two separate grounds, one in which Petitioner contends that claims 1-3, 5-8, 11-14, and 16 are anticipated by Ayala-362 and another, in which Petitioner contends that claims 6-8, 11, and 16 are obvious over Ayala-362.

³ The relevant sections of the Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112–29, took effect on March 16, 2013. The application that issued as the ’304 patent was filed after this date, but claims priority to applications filed before March 16, 2013. *See* Ex. 1001, codes (22), (60), (63). For the purposes of this Decision, we need not determine whether pre- or post-AIA statutes apply. Moreover, our analysis would be the same under either version of these statutes. *See* Pet. 52–54 (arguing that Murayama is prior art whether or not pre-AIA law applies).

⁴ JP 4016322 B2, published November 21, 2003, Ex. 1005 (“Takeda-322”).

⁵ US 2009/0152362 A1, published June 18, 2009, Ex. 1006 (“Ayala-362”).

⁶ WO 2011/122162, published October 6, 2011, Ex. 1007 (“Murayama”).

Patent Owner's Response is supported by the declaration of Dr. William Eisenstadt. Ex. 2003; *see also* Ex. 2022 (Dr. Eisenstadt declaration from prior IPR2022-00235); Ex. 2023 (same).

III. ANALYSIS

A. *Patent Owner's Motion to Submit Supplemental Information*

Patent Owner's Sur-Reply cites two proposed exhibits that would be new to the record. The proposed exhibits are Petitioner's expert declaration from IPR2022-00417 (Proposed Exhibit 2028⁷) and the transcript from consolidated oral arguments in IPR2022-00235 and -00417 (Proposed Exhibit 2029). Sur-Reply 13, 23. The Board authorized Patent Owner to file a motion to submit these exhibits as supplemental information pursuant to 37 C.F.R. § 42.123(b). Ex. 2030. The Board instructed Patent Owner that, "[i]f the Board denies the motion, it will disregard any quotes from or citations to the proposed supplemental information that may be found in Patent Owner's Sur-reply." *Id.* at 1. Patent Owner filed a timely motion ("Mot. to Supp."), and Petitioner filed a timely opposition (Paper 23, "Opp. to Mot. to Supp.").

Patent Owner argues that Petitioner stated in the Petition that an "EA" (extension antenna) is "disposed in available card space" and that, in reply, "Petitioner stressed that 'available card space' is the 'remaining (or residual area.)'" Mot. to Supp. 1 (citing Pet. 4–5; Reply 3; Ex. 1055 ¶ 13 (Dr. van der Weide declaration in support of Reply)). Patent Owner quotes the following from the Reply: "Petitioner explained that an 'additional coil, disposed in

⁷ Patent Owner requests, in particular, consideration of paragraphs 38, 40, 123, and 124 of Proposed Exhibit 2028. Paper 20, Motion to Supplement ("Mot. to Supp."), 3.

available card space... ’ ... is an EA.... Petition, 4–5; ’304 patent,... 11:4–13 (‘... may be disposed in remaining (or residual) area...’).” Mot. to Supp. 1 (quoting Reply 3) (emphasis original to Reply; ellipses original to the Motion to Supplement). For further context we reproduce the relevant portion of the Reply verbatim:

Petitioner did not propose an outer-boundary construction because none was required. Petition, 9. Instead, Petitioner explained that an additional coil, disposed in available card space, that contributes to the booster antenna’s inductance”—as in all the grounds—is an EA pursuant to the ’304 patent’s description. Petition, 4-5; ’304 patent, 5:60-62 (the “(EA) contributes to the inductance of the booster antenna (BA), and may be in the form of a coil...”), 11:4-13 (“...may be disposed in remaining (or residual) area...”). AmaTech characterizes this as “Petitioner’s construction.” POR, 23-34, 29-30.

Reply 3 (emphases and alterations original).

Patent Owner further argues that Petitioner’s witness, Dr. van der Weide, introduced a new theory during reply deposition by responding to the question “Assuming there were no conductors disposed on the card shown in Figure 3B, where is the available card space?” with the answer “It would comprise the entirety of the card.” Mot. 2 (quoting Ex. 2027, 137:1–10). Patent Owner thus seeks to introduce Exhibit 2028 which Patent Owner characterizes as Dr. van der Weide testifying that “the EA cannot be disposed in the coupling area.” *Id.* Patent Owner also seeks to introduce Exhibit 2029 which Patent Owner characterizes as Petitioner’s counsel also endorsing the “new theory” that “each of Takeda-322’s coils L1 are both a CC [coupler coil] and an EA [extension antenna].” *Id.* at 5; *see also* Sur-Reply 23 n. 10 (referencing argument of Petitioner’s counsel during oral arguments for IPR2022-00235 and -00417). The purpose of these exhibits is to support a Patent Owner argument that, at least according to Petitioner,

L₁-top is a CC (coupler coil) and therefore, is in a “coupling area” which is not “available card space” such that L₁-top cannot also be an extension antenna (because Petitioner argued that an extension antenna must reside in “available card space”). Sur-Reply 23–24.

To succeed, a motion to submit supplemental information pursuant to 37 C.F.R. § 42.123(b) must meet two requirements. First, the motion must show why the supplemental information reasonably could not have been obtained earlier. 37 C.F.R. § 42.123(b). Second, the motion must show that consideration of the supplemental information would be in the interest of justice. *Id.* As we explain below, Patent Owner’s motion fails to meet either requirement.

We first address Exhibit 2028 and the first requirement of 37 C.F.R. § 42.123(b). Patent Owner “obtained” Exhibit 2028 as of at least January 10, 2022 when IPR2022-00417 was filed. *See* IPR2022-00417, Ex. 1003 (van der Weide declaration). If something about that declaration is important, Patent Owner must adequately explain why it did not address Exhibit 2028 as part of its December 6, 2022, Response to Petition (filed nearly eleven months after obtaining the exhibit in question). *See* Opp. to Mot. to Supp. 2; *see also* Paper 12, 1 (institution decision cautioning that “[a]ny arguments not raised by Patent Owner in a timely-filed response may be deemed waived”); Paper 13, 9 (scheduling order stating “Patent Owner is cautioned that any arguments not raised in the response may be deemed waived”).

Patent Owner’s timeliness argument appears to be that Exhibit 2028 was not relevant until the Sur-Reply due to a chain of causal connections arising from Petitioner’s Reply. Patent Owner’s chain necessitates that (1) Petitioner first stressed that “available card space” is the “remaining (or

residual area)” on Reply thus (2) causing Patent Owner to question Dr. van der Weide about “remaining card space” in a reply deposition thus (3) causing Dr. van der Weide to testify as, according to Patent Owner, a “new theory” that available card space is “anywhere on the card body” thus (4) necessitating Patent Owner to introduce Exhibit 2028 as rebuttal evidence wherein Dr. van der Weide supposedly said the EA cannot be disposed in the coupling area. Mot. 1–3.

But Patent Owner’s causal chain fails at every link. As to the first link, Patent Owner relies on Petitioner quoting the ’304 patent at 11:4–13. The Petition, however, cited precisely the same portion of the ’304 patent for precisely the same premise—that the EA must be disposed in available card space. Pet. 4–5 (“The EA component is an additional coil, disposed in available card space, that contributes to the BA’s inductance. [Ex. 1001], 11:4–13, 27:63–28:5.”). Dr. van der Weide did the same in his first declaration for this matter. Ex. 1003 ¶ 34 (citing Ex. 1001, 11:4–13 to support that “the extension antenna component is an additional coil, disposed in available card space, which contributes to the booster antenna’s inductance”). Thus, Patent Owner’s explanation fails to identify anything new in the Reply.

As to the second link, Patent Owner could have deposed Dr. van der Weide about available card space and his citation of 11:4–13 of the ’304 patent prior to filing the Reply. If Patent Owner would have done so, there would have been no need to introduce new evidence in Sur-Reply.

As to the third link, Dr. van der Weide did not introduce a “new theory” that available card space is “anywhere on the card body.” Rather, Dr. van der Weide testified that the “available card space” would be “the

entirety of the card” if we assume “there were no conductors disposed on the card shown in Figure 3B.” Ex. 2027, 137:1–10. Rather than being a “new theory,” this testimony is unremarkable. If a card has nothing on it, the entirety of the card is “available card space.” Neither party seems to dispute this proposition, and we are not persuaded that this proposition is somehow a “new theory” of Petitioner’s case.

As to the fourth link, if Patent Owner wanted to argue that an extension antenna cannot be in a coupling area or, alternatively, that Petitioner was taking the position that an extension antenna cannot be in a coupling area, Patent Owner could have made such an argument in the Patent Owner Response. The import of such an argument, if any, is to address the merits of Petitioner’s argument made in the Petition. Because Patent Owner fails to adequately explain why Patent Owner could not have introduced and addressed Exhibit 2028 in the Patent Owner Response, Patent Owner does not meet the first requirement of 37 C.F.R. § 42.123(b).

Moreover, the fourth link also fails because we do not agree that Exhibit 2028 evidences that Dr. van der Weide took the position that there was some general “area” where the extension antenna cannot be located. Rather, in Exhibit 2028, Dr. van der Weide states that the extension antenna is located in a “‘remaining’ area” which is “separate from” “the ‘coupling area (*where the coupler coil is formed*).” Ex. 2028 ¶ 124 (emphasis added). This testimony is best understood as Dr. van der Weide merely stating that the extension antenna cannot be in the precise same location as the coupler coil. This is an unremarkable proposition considering that the extension antenna and coupler coil are not the same and considering that two physical objects cannot occupy one location in space. The proposition is consistent

with Dr. van der Weide's testimony indicating that available card space is space where another structure is not present. Because Patent Owner's causal links to justify a late filing fail, Patent Owner's timeliness argument is unpersuasive.

As to the interest of justice requirement of 37 C.F.R. § 42.123(b), it would not be in the interest of justice to permit Patent Owner to use Exhibit 2028 to change positions for the first time in Sur-Reply. *See* Opp. to Mot. to Supp. 1–2. In the Patent Owner Response, Patent Owner and its witness, Dr. Eisenstadt, took the position that Petitioner's requirement that the EA be located in "available card space" was "meaningless" because "any coil could only be located in available card space." PO Resp. 32; Ex. 2003 ¶ 84. Indeed, this appears to *still* be Patent Owner's position. Tr. 50:10–18 (Patent Owner's counsel confirming that Patent Owner's witness testimony is consistent with "available card space" being meaningless). But in Sur-Reply, Patent Owner argues for the first time that the Petition fails because the Takeda-322 EA is not in "available card space" according to Petitioner's "construction" of "available card space." Sur-Reply 23–24. Because Patent Owner could have raised such an argument earlier (as explained above) and because Petitioner would have no meaningful opportunity to rebut a new argument raised in Sur-Reply, it is not in the interest of justice to permit Exhibit 2028 as supplemental information pursuant to 37 C.F.R. § 42.123(b).

Patent Owner also argues that "it is in interests of justice to consider an expert's contradictory testimony from a related, co-pending [*inter partes* review] when evaluating the scope of an identical claim term (EA) as applied to identical prior art (Takeda-322)." Mot. to Supp. 5. Although we

agree that contradictory testimony from a different proceeding could be very relevant, this reasoning does not justify entry of Exhibit 2028. As we explain above, Exhibit 2028 does not contradict Dr. van der Weide's testimony (Ex. 2027, 137:1–10) in this proceeding.

With respect to Exhibit 2029, Patent Owner seeks to introduce the argument of Petitioner's counsel in a different IPR wherein Petitioner asserted that Takeda-322's L_1 may function as both a CC and an EA. Patent Owner's argument for needing this exhibit is unpersuasive. Patent Owner explicitly argued in the Patent Owner Response that Takeda-322's L_1 coil cannot be an extension antenna because it serves as a coupler coil. PO Resp. 55–56. So, prior to the Reply, Patent Owner already understood that Petitioner was taking the position that one coil could be the claimed extension antenna and could *also* serve as an unclaimed coupler coil (while nonetheless being a physically distinct component than the claimed coupler coil). *See also* Pet. 28 (taking the position that the upper L_1 (in pink) is an extension antenna for chip CP_1 despite L_1 also coupling chip CP_2 to booster coil L_2 (thus also acting as a coupler coil)). The interests of justice do not support the inclusion of Exhibit 2029 as a new exhibit because Petitioner's counsel's position at oral argument is the same as that in the Petition.

We, thus, deny Patent Owner's motion with respect to Exhibit 2028 pursuant to both requirements of 37 C.F.R. § 42.123(b) and deny Patent Owner's motion with respect to Exhibit 2029 pursuant to the 37 C.F.R. § 42.123(b) interests of justice requirement.

We further note that, even if we were to allow Exhibit 2028 and Exhibit 2029 as evidence, doing so would not change the outcome of our decision. In particular, neither exhibit adds persuasive evidentiary support to

the notion that a coil cannot serve as an extension antenna as to one chip while also serving as a coupler coil as to a different chip or that Takeda's top L_1 is not an extension antenna because it is not in "available card space." We discuss these issues further at Section III.H.4.b, *infra*.

B. Patent Owner's Objections to Petitioner's Demonstrative Slides

Patent Owner objects to a number of Petitioner's demonstratives for oral argument because, for example, the demonstratives constitute evidence that Petitioner did not reference or discuss in a prior paper. *See, e.g.*, Paper 29 *passim*.

We have considered the objections. Demonstratives for oral argument, however, are not evidence. Paper 24, 2 (Order Setting Oral Argument); *see also* Consolidated Trial Practice Guide 84, *available at* <https://www.uspto.gov/TrialPracticeGuideConsolidated> ("Demonstrative exhibits used at the final hearing are aids to oral argument and not evidence."). We do not rely on demonstratives as evidence in our decision making; instead, we rely solely on the arguments properly presented in the parties' briefs and the evidence of record. Because demonstratives do not affect our decision making, Patent Owner's objections to the demonstratives likewise do not affect our decision making. We dismiss Patent Owner's objections as moot.

C. Anticipation: Legal Standard

"[A] claim is anticipated 'if each and every limitation is found expressly or inherently in a single prior art reference.'" *King Pharm., Inc. v. Eon Labs., Inc.*, 616 F.3d 1267, 1274 (Fed. Cir. 2010) (quoting *Celeritas Techs., Ltd. v. Rockwell Int'l Corp.*, 150 F.3d 1354, 1360 (Fed. Cir. 1998)). Anticipation is a question of fact, *In re Gleave*, 560 F.3d 1331, 1334–35

(Fed. Cir. 2009), assessed from the perspective of one of ordinary skill in the art, *see Dayco Prods., Inc. v. Total Containment, Inc.*, 329 F.3d 1358, 1368 (Fed. Cir. 2003) (“the dispositive question regarding anticipation [i]s whether one skilled in the art would reasonably understand or infer from the [prior art reference’s] teaching that every claim element was disclosed in that single reference” (alteration in original) (quotation omitted)).

D. Obviousness: Legal Standard

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter 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 ordinary skill in the art; and (4) when in evidence, objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).⁸

E. Level of Ordinary Skill in the Art

In order to determine whether an invention would have been obvious at the time the application was filed, we consider the level of ordinary skill in the pertinent art at critical time. *Graham*, 383 U.S. at 17. The resolution of this question can be important because it allows us to “maintain[] objectivity in the obviousness inquiry.” *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714,

⁸ Here, the parties do not direct us to objective evidence of nonobviousness.

718 (Fed. Cir. 1991). The Federal Circuit has identified a non-exhaustive list of factors to be considered in defining the level of skill in the art including: “(1) the educational level of the inventor; (2) type of problems encountered in the art; (3) prior art solutions to those problems; (4) rapidity with which innovations are made; (5) sophistication of the technology; and (6) educational level of active workers in the field.” *Best Med. Int’l, Inc. v. Elekta Inc.*, 46 F.4th 1346, 1353 (Fed. Cir. 2022) (quotation omitted). Generally, it is easier to establish obviousness under a higher level of ordinary skill in the art. *Innovention Toys, LLC v. MGA Entm’t, Inc.*, 637 F.3d 1314, 1323 (Fed. Cir. 2011) (“A less sophisticated level of skill generally favors a determination of nonobviousness . . . while a higher level of skill favors the reverse.”).

Petitioner asserts that a person having ordinary skill in the art “would have had a Bachelor’s degree in electrical engineering or a similar field, and 1–2 years of experience researching and developing RFID antennas; additional educational background could substitute for professional experience and vice versa.” Pet. 8 (citing Ex. 1003 ¶¶ 22–26).

Patent Owner argues that Petitioner’s definition of the level of ordinary skill in the art is too broad because the field of RFID is “incredibly wide,” with important differentiation criteria including the operating frequency of the reader, the physical coupling method, and the range of the system. PO Resp. 22 (citing Ex. 2003 ¶¶ 20–28; Ex. 2005, 11, 22). According to Patent Owner, the smart cards of the ’304 patent operate on relatively low frequencies, require antennas that perform inductive coupling, and are technologically distinct from antennas for microwave RFID devices. *Id.* at 22–23 (citing Ex. 2003 ¶¶ 24–26). Thus, Patent Owner asserts that a

person having ordinary skill in the art “would have had a Bachelor’s degree in electrical engineering or a similar field, and 1–2 years of experience researching and developing antennas for RFID devices that are used for inductive coupling; additional educational background could substitute for professional experience and *vice versa*.” *Id.* at 23 (citing Ex. 2003 ¶ 26) (emphasis original).

The parties are in general agreement as to the level of education (undergraduate degree in electrical engineering or equivalent) and the number of years of experience working with RFID devices (1–2 years), but differ as to the exact nature of that experience (developing antennas used in RFID devices versus developing antennas used in RFID devices for inductive coupling). The specification of the ’304 patent describes its technical field as relating to a smart card that may comprise an RFID (radio frequency identification) chip with antenna components for operating in contactless modes. Ex. 1001, 1:37–54. The specification discusses both inductive and capacitive coupling. *See, e.g., id.* at 3:14–39. Patent Owner submitted into the record a text titled RFID Handbook, which details different frequencies and types of coupling that may be used by various RFID systems. *See* Ex. 2005, 22–23. Although this text differentiates between “inductively or capacitively coupled system[s] and microwave system[s] or backscatter system[s]” (*id.* at 23 (emphasis omitted)), its description of each of these types of RFID devices indicates that an ordinary artisan would have had experience with RFID devices generally. *Id.* Thus, we are not persuaded that the level of ordinary skill should be confined to developing antenna for RFID devices that are used for inductive coupling. For the purposes of this Decision, we adopt Petitioner’s definition of the

level of ordinary skill in the art as “a Bachelor’s degree in electrical engineering or a similar field, and 1–2 years of experience researching and developing antennas used in RFID applications.” Pet. 7.⁹

F. Dr. van der Weide’s Testimony

Patent Owner argues that we should not give substantial weight to the testimony of Petitioner’s declarant, Dr. van der Weide, for several reasons. PO Resp. 45–51. Patent Owner first argues that Dr. van der Weide lacks relevant experience to provide opinions through the lens of a person having ordinary skill in the art. *Id.* at 45–46 (citing Ex. 2003 ¶ 96). According to Patent Owner, Dr. van der Weide “has experience with RFID that operates at microwave frequencies,” but “identifies no experience with relevant inductive RFID systems at lower frequencies (*e.g.*, frequencies such as 13.56MHz and 8.2MHz).” *Id.* at 45. This argument is based on Patent Owner’s articulation of the level of ordinary skill in the art, which we have not adopted. Moreover, Petitioner presents evidence that Dr. van der Weide’s experience exceeds even Patent Owner’s articulation of the level of ordinary skill in the art. Pet. Reply 25–27 (citations omitted). Dr. van der Weide’s education and experience are sufficient to allow us to grant his testimony our full consideration. *See* Ex. 1003 ¶¶ 2–7; Ex. 1004 (van der Weide *curriculum vitae*).

Patent Owner also argues that Dr. van der Weide’s testimony “runs counter to fundamental principles of inductive coupling RFID technology.” PO Resp. 46–47 (formatting omitted). Patent Owner bases this argument on

⁹ We further note that our final determination, on the merits, would be the same even under Patent Owner’s definition of the level of ordinary skill in the art.

Dr. van der Weide failing to immediately know (and testify) that Takeda-322's L_2 inductance is much larger than L_1 . *Id.* Patent Owner further argues that this alleged failure "is directly relevant to his mistaken opinion that Takeda-322 discloses an 'extension antenna component.'" *Id.* at 47. Patent Owner further criticizes Dr. van der Weide's deposition testimony in various regards. *Id.* at 48–51; Sur-Reply 20–22. Petitioner argues that Dr. van der Weide's deposition testimony represents careful answers to irrelevant hypotheticals. Pet. Reply 27–28.

Patent Owner does not seek to exclude Dr. van der Weide's testimony. When considering credibility and weight of evidence below, we consider Dr. van der Weide's testimony as a whole as well as all other evidence of record.

G. Claim Construction

In an *inter partes* review proceeding, a patent 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). 37 C.F.R. § 42.100(b) (as amended Oct. 11, 2018). Our rule adopts the same claim construction standard used by Article III federal courts, which follow *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc), and its progeny. In applying this standard, claim terms are generally given their ordinary and customary meaning, as would be understood by a person of ordinary skill in the art, at the time of the invention and in the context of the entire patent disclosure. *Phillips*, 415 F.3d at 1312–13. "In determining the meaning of the disputed claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence." *DePuy Spine, Inc. v. Medtronic Sofamor*

Danek, Inc., 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17).

Petitioner asserts that “[n]o claim term requires an exact outer boundary construction, because the prior art meets the claim terms under any reasonable interpretation.” Pet. 9. Patent Owner proposes constructions for the claim terms “booster antenna,” “card antenna component,” “coupler coil component,” and “extension antenna component.” PO Resp. 23–44. According to Patent Owner, Petitioner also has proposed its own constructions for these terms, despite stating that no claim term requires construction. *Id.* at 24.

We address “booster antenna” and “extension antenna component” below. It is unnecessary to construe “card antenna component” or “coupler coil component” in this Decision because none of the parties’ disputes turn on the meaning of either term. *See, e.g., Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017). It is also unnecessary to construe any other claim terms because our analysis with respect to other claim terms is based on plain and ordinary meaning. *Id.*

1. Booster antenna

Patent Owner defines a “booster antenna” as “an antenna tuned to a single resonance frequency that enables a chip to communicate with an external reader.” PO Resp. 24. According to Patent Owner, Petitioner implicitly defines a “booster antenna” as “a conductive element that enables an IC chip to communicate with an external reader.” *Id.*

Patent Owner directs us to multiple citations in the ’304 patent specification that indicate a resonance frequency for the antenna. PO Resp. 25–26; *see, e.g.,* Ex. 1001, 17:54 (“[booster antenna’s] resonance

frequency”), 18:60–61 (“desired resonance of 13.56 MHz”). Patent Owner further argues that “[n]owhere does the ’304 patent disclose a card antenna tuned to multiple resonance frequencies.” PO Resp. 26 (citing Ex. 2003 ¶¶ 73–74). Patent Owner contends that Petitioner’s allegedly implicit construction “over-broadly covers non-disclosed antennas that might be tuned to multiple frequencies.” *Id.* Dr. Eisenstadt supports Patent Owner’s position by opining that Petitioner’s construction is correct, but incomplete “in that it leaves open the unavailable possibility of the booster antenna being tuned to more than a single resonance frequency.” Ex. 2003 ¶ 71.

We are not persuaded that Patent Owner’s proposed construction is correct. We note that none of the claims recite specific frequencies or frequency ranges, and no claims prohibit the booster antenna from resonating at multiple frequencies. Ex. 1001, 48:39–50:20. While claim 14 recites “the extension antenna (EA) component lowers the resonance frequency of the booster antenna BA to a desired resonance” and claim 15 recites “the pitch of the individual turns of the extension antenna (EA) are adjusted to match the booster antenna (BA) resonance frequency,” neither claim indicates that the booster antenna must always resonate at only a single frequency. *Id.* at 50:3–7.

Further, the examples in the specification describe the frequency with permissive language, indicating that an antenna may have a resonance frequency. *See, e.g.*, Ex. 1001, 32:26–30 (“**may** have a self-resonance frequency of approximately 75 MHz”) (emphasis added), 32:30–36 (structures “**may** reduce the resonance frequency to a more desirable range of approximately 13~17 MHz”) (emphasis added), 40:17–18 (“the booster antenna (BA) **may** have a resonance frequency at or below 13.56 MHz”)

(emphasis added). The specification, however, does not indicate that the antenna is limited to operating on only one frequency. The specification notes that “[w]hile the invention(s) has/have been described with respect to a limited number of embodiments, these should not be construed as limitations on the scope of the invention(s), but rather as examples of some of the embodiments.” *Id.* at 48:29–36; *see also id.* at 7:5:39–7:14 (noting that embodiments are examples); 8:59–61 (embodiments “should be construed as illustrative rather than limiting”), 7:17–20 (figures illustrate “non-limiting examples”). Moreover, the Federal Circuit has noted that “[e]mbodiments in the specification—even if there is only one embodiment—cannot limit the scope of the claims absent the patentee’s ‘words or expressions of manifest exclusion or restriction.’” *Apple Inc. v. Wi-LAN Inc.*, 25 F.4th 960, 967 (Fed. Cir. 2022) (citing *Hill-Rom Servs., Inc. v. Stryker Corp.*, 755 F.3d 1367, 1372 (Fed. Cir. 2014)). We see no such manifest exclusion or restriction in the ’304 patent specification. Rather, while the specification explains that frequency may be adjusted, the specification never states the booster antenna must be tuned to only one frequency or that subcomponents cannot be tuned to a different frequency. Reply 15–16; Ex. 1055 ¶¶ 63–67.¹⁰

Thus, we decline Patent Owner’s request to limit the claims to the described single-frequency embodiments. *See Phillips*, 415 F.3d at 1323. We need not provide further express construction of this claim language to resolve the issues before us.

¹⁰ Patent Owner also argues that the booster antenna (BA) must be on the card with the chip. Sur-Reply 20. We do not address this issue because this issue does not affect the unpatentability issues before us. *Nidec Motor Corp.*, 868 F.3d at 1017.

2. Extension antenna component

Patent Owner argues that the “extension antenna component” (as independent claim 1 recites) should be construed as “a component connected to at least one of the card antenna component or the coupler coil component, and which enhances coupling between the module antenna and the booster antenna.” PO Resp. 30. According to Patent Owner, Petitioner construes the term to mean “an additional coil, disposed in available card space, that contributes to the booster antenna’s inductance.” *Id.*; *see* Pet. 4–5 (citing Ex. 1001, 11:4–13, 27:63–28:5). Petitioner does not propose an “exact outer boundary” construction for “extension antenna” but argues that the extension antenna should contribute to the inductance of the booster antenna. *See, e.g.*, Pet. 4–5, 9, 28–29.¹¹

Claim language

We begin our assessment of the parties’ arguments by examining the language of the only independent claim at issue, claim 1. Claim 1 recites “an extension antenna (EA) component.” Ex. 1001, 48:43. Claim 1 provides little context for the meaning of “extension antenna.” Claim 1 recites different structures separately and, from this, a person of ordinary skill in the art would understand that the extension antenna cannot be precisely the same structure within the card body as other recited elements such as the card body, the card antenna, the antenna module, and the coupler coil. *Id.* at 48:39–46; *see also* PO Resp. 11, 39–44 (arguing that extension antenna is

¹¹ Patent Owner argues that Petitioner fails to properly offer a construction for extension antenna. *See, e.g.*, Sur-Reply 2. Petitioner took the position that “ordinary and customary” meaning applies. Pet. 9. Petitioner’s position is sufficient to comply with 37 C.F.R. § 42.104(b)(3).

distinct from coupler coil and card antenna); Pet. Reply 2 (agreeing that the claimed coupler coil and extension antenna should not be conflated or construed identically). A person of ordinary skill in the art would also understand that the extension antenna functions as an “antenna” that extends the functioning of the device (for example by contributing to the inductance of the booster antenna). *See, e.g.*, Ex. 1001, code (57) (abstract referring to “extension antenna (EA) component contributing to the inductance of the booster antenna (BA)”).

Patent Owner appears to argue that, because the extension antenna and coupler coil are separate recitations, they must also have entirely non-identical functions. PO Resp. 39–44. We disagree. Claim 1, and thereby all of the challenged claims, is an apparatus claim directed to physical structure. Thus, different claim terms have different meanings and refer to distinct structure of the claimed apparatus. There is no requirement, however, that different claim recitations in an apparatus claim necessarily perform entirely separate functions. Also, there is no requirement that different claim terms require that each separate structure within the apparatus necessarily has physical differences. *See Applied Med. Res. Corp. v. U.S. Surgical Corp.*, 448 F.3d 1324, 1333 n.3 (Fed. Cir. 2006) (“[T]he use of two terms . . . connote[s] different meanings, not that they necessarily refer to two different structures.” (emphasis omitted)); Pet. Reply 4.

The ’304 patent specification

We next consider the ’304 patent’s written description. The written description indicates that the extension antenna contributes to the inductance of the booster antenna. For example, the abstract refers to “an extension antenna (EA) contributing to the inductance of the booster antenna (BA).”

Ex. 1001, code (57) (abstract); *see also id.* at 5:60–62 (“[t]he extension antenna (EA) contributes to the inductance of the booster antenna (BA)”), 28:2–5 (“In the present invention, the antenna extension EA . . . contributes to the inductance of the booster antenna BA.”).

Patent Owner appears to argue that merely “negligible” contributions of inductance to the booster antenna should not be sufficient for a structure to be an extension antenna. PO Resp. 32–33. The ’304 patent describes a “dummy turn” with “the winding direction of the two conductor tracts being opposite with respect to one another so that the dummy turn does not supply any or a negligible contribution to the inductance of the booster antenna structure.” Ex. 1001, 26:43–49. In contrast, the extension antenna is described as contributing to inductance of the booster antenna. *See id.* at 5:60–62. Thus, the written description supports that the extension antenna’s contribution to the booster antenna is non-negligible.

Beyond contributing to booster antenna inductance, however, the written description refers to structure the extension antenna *may* employ. *See, e.g.*, Pet. Reply 7–9 (arguing that nothing in the specification requires that the extension antenna enhance coupling between the module antenna and booster antenna). For example, the extension antenna *may* be a “true coil” having at least one cross-over. Ex. 1001, 5:7–8; *see also id.* at 5:60–62 (“extension antenna (EA) . . . may be in the form of a coil comprising at least one cross-over.”). It “may be disposed adjacent at least 90° of the coupler coil (CC).” *Id.* at 5:31–35. It *may* be connected to the coupler coil on one end and, on the other end, be connected to the card antenna or be unconnected. *Id.* at 5:64–67. The coupler coil and extension antenna *may* be formed as one continuous embedded coil. *Id.* at 16:41–46. The extension

antenna *may* be formed of a spiral of wire embedded in the card body and *may* be formed of a spiral of wire contiguous with the card antenna CA and coupler coil CC. *Id.* at 17:9–16; *see also id.* at 18:48–53 (explaining that in the example corresponding to Figure 4D, the “extension antenna has one end which is an extension of the coupler coil CC”). The extension antenna *may* be formed with varying pitches. *Id.* at 20:40–44.

Patent Owner argues that the ’304 patent specification defines the extension antenna as being connected to the card antenna and/or coupler coil. PO Resp. 12–15. Patent Owner supports this argument by explaining that the ’304 patent references provisional application U.S. 61/697,825 (“the ’825 provisional”) and that the ’825 provisional “further emphasizes what the word ‘extension’ means in the context of the term ‘extension antenna.’” *Id.* at 12 (citing Ex. 1001, 16:30–40; Ex. 2007, 330). The quoted portion of the ’825 provisional, however, addresses only one embodiment (Figure 5H) and does not define “extension” or “extension antenna component.”

Moreover, the ’304 patent specification indicates that the extension antenna component does not have to be connected with the card antenna or the coupler coil. In particular, the ’304 patent specification states that the extension antenna¹² “may be either (i) connected with one or both of the card antenna CA and coupler coil CC or (ii) not connected with either of the card antenna and coupler coil CC.” Ex. 1001, 11:8–13. The meaning of this sentence is clear. Pursuant to romanette (i), the extension antenna could be connected with only the card antenna (“connected with one ... of”), the

¹² This passage refers to the “antenna extension EA.” Ex. 1001, 11:8–14. Patent Owner explains that “antenna extension” is synonymous with “extension antenna component” in the ’304 patent. PO Resp. 11.

extension antenna could be connected with only the coupler coil (“connected with one ... of”), or the extension antenna could be connected with both the card antenna and the coupler coil (“connected with ... both”). Romanette (ii) spells out the only remaining option: the extension antenna could be not connected with either.¹³ This understanding of the specification is consistent with the specification later stating that the extension antenna “may have at least one free end” and, thereby, suggesting the extension antenna could have two free ends (and thus be unconnected).¹⁴ *Id.* at 47:50–54; *see also* Reply 19. Thus, contrary to Patent Owner’s claim construction proposal, the ’304 patent specification is explicit that the extension antenna does not have to be connected to the card antenna or the coupler coil.

Patent Owner argues that other parts of the ’304 patent specification show a connected extension antenna (PO Resp. 34–36), but these other parts of the specification are figures or descriptions of embodiments. *See, e.g.*, Ex. 1001, 7:52–57 (explaining that Figures 4A–4I are “illustrating embodiments”). Patent Owner, however, identifies nothing in the ’304 patent indicating that the extension antenna component must, definitionally, be connected to the card antenna component or the coupler coil component.

¹³ Patent Owner’s argument to the contrary (PO Resp. 33–36) is unpersuasive for the reasons we explain here. We agree with Petitioner that Patent Owner’s argument would render option (ii) superfluous. Reply 19.

¹⁴ Patent Owner argues that Petitioner waived any argument regarding this citation by not explaining it in the Reply. Sur-Reply 6. We disagree. The Reply properly cites Ex. 1001, 47:50–54 as evidence to support Petitioner’s reading of Ex. 1001, 11:8–13 and to rebut Patent Owner’s argument in the Patent Owner Response that a connection is required.

Patent Owner also argues that the '304 patent does not explain how an unconnected extension antenna would operate and that the claims should be construed to maintain enablement and validity. PO Resp. 37–38. Patent Owner, however, does not present persuasive evidence that a person of ordinary skill in the art would be unable to make or use, without undue experimentation, an embodiment of the invention with an unconnected extension antenna component from disclosures in the '304 patent coupled with information known in the art. *See* Ex. 2003 ¶ 90 (Patent Owner's witness, Dr. Eisenstadt stating that “[a person of ordinary skill in the art (POSA)] would not know how to make a smart card booster antenna with an unconnected extension antenna from reading the '304 patent” without addressing background knowledge of the person of ordinary skill in the art or the amount of experimentation that would be required); *see also, e.g., United States v. Telectronics, Inc.*, 857 F.2d 778, 785 (Fed. Cir. 1988) (“The test of enablement is whether one reasonably skilled in the art could make or use the invention from the disclosures in the patent coupled with information known in the art without undue experimentation.”).

Patent Owner also argues that the extension antenna component must be connected to the card antenna component or the coupler coil component if the word “extension” is given proper weight. PO Resp. 36–37. As explained above, however, the extension antenna component contributes to the inductance of the booster antenna. The extension antenna component, thus, *extends* the functionality of the booster antenna even if unconnected. Moreover, the word “extension” serves to differentiate the extension antenna component from other recited components. A physical connection to the

card antenna component or coupler coil component is not necessary for the word “extension” to have meaning.

Patent Owner also argues that the ’304 patent does not disclose an extension antenna component on the opposite side of the card body. PO Resp. 38–39. Nothing in the ’304 patent, however, definitionally requires the extension antenna component to be on a particular side of the card body.

In addition to addressing structural options, the written description addresses functions the extension antenna *may* perform. For example, in one particular example (corresponding to Figure 4B), the extension antenna *may* “increase the inductivity of the booster antenna BA while reducing its resonance frequency.” Ex. 1001, 17:52–54. Also, in *some* of the designs the ’304 patent describes, the extension antenna may lower the resonance frequency of the booster antenna and may regulate or concentrate the electromagnetic field when in close proximity to the external contactless reader. *Id.* at 18:54–19:3.

Elsewhere, the ’304 patent similarly states that the extension antenna “may enhance the overall coupling between the booster antenna BA and the module antenna MA, and/or the booster antenna BA and the antenna of an external reader.” *Id.* at 19:14–20 (emphasis added). The “or” in the preceding quote indicates that the extension antenna may have only one of the two indicated functions but does not have to perform both functions. In other words, this passage is important because it indicates that the extension antenna does not *necessarily* enhance the overall coupling between the booster antenna and the module antenna.

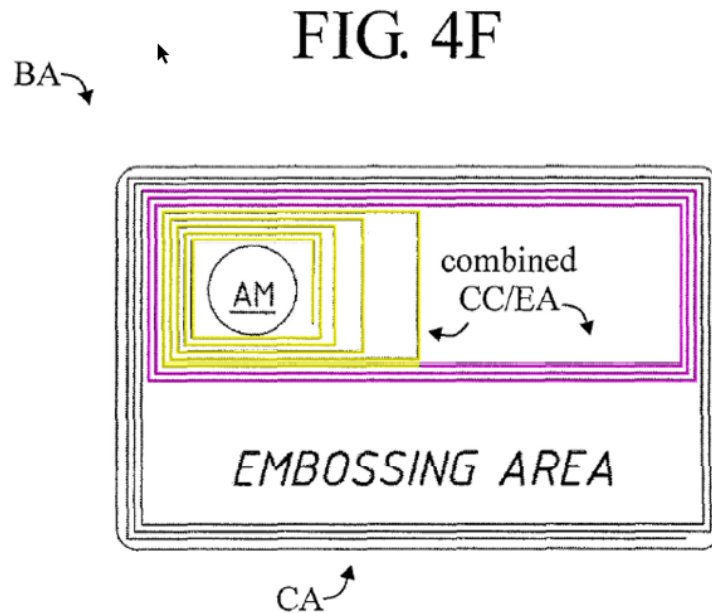
Patent Owner cites *Ethicon, Inc. v. United States Surgical Corp.*, 937 F. Supp. 1015, 1030 (D. Conn. 1996), for the proposition that the permissive

language nonetheless informs the meaning of the extension antenna component. Sur-Reply 5. The Federal Circuit, however, has approved of Board cases in which we have held that the use of permissive language is indicative of optional language. *See, e.g., In re Johnston*, 435 F.3d 1381, 1384 (Fed. Cir. 2006) (“additional content did not narrow the scope of the claim because these limitations are stated in the permissive form ‘may’”). *Ethicon* is also distinguishable for two reasons. First, the *Ethicon* court assessed a means plus function claim and determined that the specification described certain networks that were structure corresponding to the recited function pursuant to 35 U.S.C. § 112, ¶ 6. *Ethicon*, 937 F. Supp. at 1030. The use of the word “may” in the specification did not prevent the specification’s structure from limiting claim scope in this § 112, ¶ 6 context especially because the specification used “may” to also set forth required elements. *Id.* Here, in contrast, claims 1 and 18 do not invoke § 112, ¶ 6; there is, thus, no invocation of means plus function language that would provide a statutory reason to limit claim scope to the specification’s structure.

Ethicon also is distinguishable because the ’304 patent’s specification omits “may” when describing the extension antenna’s function of contributing to the inductance of the booster antenna. *See, e.g.,* Ex. 1001, code (57) (abstract describing this function without use of “may”); 5:60–62 (“The extension antenna (EA) contributes to the inductance of the booster antenna (BA).”). In contrast, the specification uses “may” or “can” when describing the extension antenna’s effect on coupling between the booster antenna and module antenna. *See, e.g.,* Ex. 1001, 19:14–20, 21:20–23. The ’304 patent specification, therefore, indicates that contributing to inductance

of the booster antenna is a required function of the extension antenna whereas improving coupling between the booster antenna and module antenna is a powerful, but optional, feature.

Petitioner argues that the '304 patent specification says “the *same coil* may be both an EA component *and* a CC component.” Pet. 29–30 (Ex. 1001, 20:8–22, Fig. 4F; Ex. 1003 ¶¶ 119–120). Patent Owner disagrees. PO Resp. 39–44 (citing Ex. 2003 ¶¶ 92–95). Patent Owner reproduces and colorizes Figure 4F of the '304 patent, and we provide that reproduction below.



PO Resp. 41–42. Figure 4F is a “diagram illustrating [an] embodiment[] of a booster antenna (BA) with card antenna CA, a coupler antenna (CC), and an extension antenna (EA).” Ex. 1001, 7:55–57. Patent Owner colorizes the figure by coloring smaller size rectangular windings near the antenna module with yellow and colorizing larger rectangular windings farther from the antenna module with violet.

Figure 4F illustrates that, in this embodiment, the extension antenna and coupler coil are combined to form one large coil. We agree with

Petitioner that deciding where to switch from yellow (coupler coil component) to violet (extension antenna component) in the figure is arbitrary. Pet. Reply 7–9; Ex. 1055 ¶¶ 20–24 (Petitioner’s witness, Dr. van der Weide, opining that the annotation is arbitrary). Patent Owner’s witness agrees that the line could subjectively be moved some amount. Ex. 1050, 143:10–20 (Patent Owner’s witness, Dr. Eisenstadt, indicating that the line could subjectively move). Moreover, Patent Owner’s witness indicates that at least a portion of the coupler coil could perform functions of either component. Ex. 1050, 144:18–146:16; *see also* Ex. 1055 ¶¶ 20–24 (Dr. van der Weide providing consistent testimony). Figure 4F and the specification’s discussion of that figure as a whole suggest that the line between extension antenna and coupler coil may be blurred such that portions of a combined coil may perform functions of both the extension antenna and coupler coil. Ex. 1001, 20:8–15 (“In this [Figure 4F] example, the coupler coil CC and extension antenna EA are essentially combined with one another.”).

Patent Owner argues that Figure 4F is irrelevant because it “is not within the scope of the claims.” Sur-Reply 14 (citing Ex. 2027, 118:14–16 (Petitioner’s witness, Dr. van der Weide, testifying “[i]t is not my opinion that Figure 4F meets claim one in view of the file history.”)). We disagree. The “*entire* patent, including the specification,” is relevant to determining the meaning of claim terms. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313 (Fed. Cir. 2005) (en banc) (emphasis added). Absent evidence to the contrary, a claim term should be understood to have the same meaning throughout the patent. *Cf. Rexnord Corp. v. Laitram Corp.*, 274 F.3d 1336, 1342 (Fed. Cir. 2001) (“[A] claim term should be construed consistently with its appearance in other places in the same claim or in other claims of

the same patent.”). Patent Owner does not suggest that the term “extension antenna component” should exclude consideration of the specification’s Figure 4F discussion, and we do not discern anything in the ’304 patent that would support this suggestion.

To summarize our analysis of the ’304 patent specification, the specification indicates that the extension antenna contributes to the inductance of the booster antenna. Ex. 1001, code (57) (abstract). The specification also indicates, contrary to Patent Owner’s present position, that the extension antenna may, but does not necessarily, enhance coupling between the booster antenna and the module antenna.

Prosecution history

Prosecution history may also impact claim construction. Here, the prosecution history does little to illuminate the meaning of “extension antenna component” except to further confirm the extension antenna is distinct from the card antenna and coupler coil. Patent Owner argues that many related patents and provisional patent applications disclose the extension antenna as connected to the card antenna or coupler coil. PO Resp. 12, 12–19. Patent Owner does not, however, identify any express or implied definition of “extension antenna component” that would flow to the ’304 patent or outweigh the ’304 patent specification’s statement that an extension antenna need not be connected to the card antenna or coupler coil.

Similarly, Patent Owner also argues that “[a]ncestral applications and patents further emphasize how the extension antenna improves coupling between the module antenna and the booster antenna.” *Id.* at 21. Like passages of the ’304 patent, these ancestral applications and patents either refer to this functionality as optional by using the word “may” or describe a

particular embodiment. Ex. 2015, 16:37–40 (’250 patent) (“The extension antenna... may enhance overall coupling between the booster antenna BA and the module antenna....”); Ex. 2011, 53 (“The extension antennas [*sic*]... may enhance the overall coupling between the booster antenna (BA) and the module antenna (MA)....”) (’089 provisional application); Ex. 2010, 25 (“The extension antennas EA may be disposed in other than the coupling area, but nevertheless may enhance the overall coupling between the booster antenna BA and the module antenna MA....”) (’354 provisional application). Rather than supporting Patent Owner’s position that an extension antenna must, by definition, enhance coupling between the module antenna and the booster antenna, these passages support that this functionality is optional.

Extrinsic evidence

Finally, we consider extrinsic evidence. Neither party uses extrinsic evidence to argue what known or ordinary meaning “extension antenna component” might have to a person having ordinary skill in the art, in this context. To the contrary, both parties appear to agree that “extension antenna” was not a known term. *See, e.g.*, Sur-Reply 1 (Patent Owner acknowledges that “EA” [extension antenna component] “was not known”).

Patent Owner’s witness, Dr. Eisenstadt, testifies that the extension antenna “necessarily enhances coupling between the booster antenna and the module antenna.” Ex. 2003 ¶ 68; *see also* Sur-Reply 22–23. But this evidence, at most, only addresses functions that an extension antenna, in view of Patent Owner’s patent disclosures, would perform. The evidence does not establish known or ordinary meaning of the words “extension antenna” to a person having ordinary skill in the art.

In view of all of the evidence presented above, we construe the “extension antenna component” to mean “an additional coil, disposed in available card space, that non-negligibly contributes to the booster antenna’s inductance.” This construction is consistent with the specification which consistently describes the function of the extension antenna as contributing to booster antenna inductance without using the word “may.” The “non-negligible” requirement distinguishes from dummy circuits or other circuits that do not meaningfully perform this function. This construction is also consistent with the specification’s acknowledgment that an extension antenna need not be connected to the card antenna or coupler coil. Moreover, this construction is consistent with Petitioner’s arguments and Patent Owner’s response to those arguments and is not a new construction. Further construction of extension antenna component is unnecessary to resolve the matter before us. *Nidec Motor Corp.*, 868 F.3d at 1017.

H. Obviousness Analysis

1. Overview of Takeda-322

Takeda-322 describes “a contactless IC card.” Ex. 1005 ¶ 1. As described in Takeda-322, an IC card “can, by being provided with a booster coil that operates as an external antenna shared by a plurality of IC chips, provide an increased information transmission distance and have its included functions easily expanded.” *Id.* ¶ 5. Takeda-322’s “booster coil is formed, as a two-dimensional spiral of a plurality of turns.” *Id.* ¶ 6. The booster coil operates as an external antenna that boosts signals by providing increased transmission distance to facilitate communication with an external reader/writer. *Id.* ¶¶ 5, 12.

We reproduce Takeda-322’s Figure 3 below.

[FIG. 3]

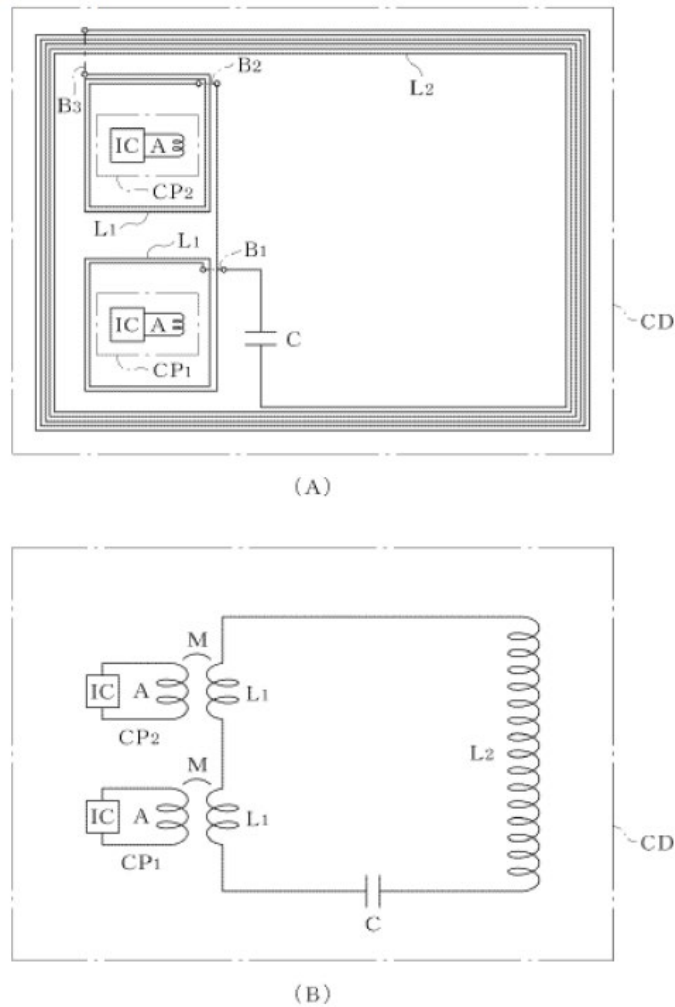


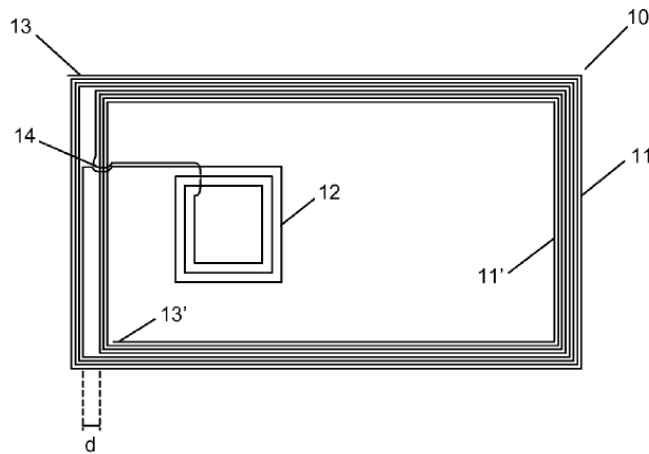
Figure 3 depicts (A) a schematic plan view of the card substrate CD and (B) a circuit diagram of card substrate CD. *Id.* ¶ 29. Takeda-322’s “card substrate CD is formed in a thin card shape by an insulating material such as a paper material or a synthetic-resin material.” *Id.* ¶ 22. Booster coil L2 extends around the card substrate and is used to “perform data communication with the external reader/writer.” *Id.* at Fig 3(A), ¶¶ 12, 29–30. IC chips CP1, CP2 each can use booster coil L2 as a shared external antenna and individually perform data communication with the external reader/writer to realize different functions of different applications. *Id.* ¶ 27.

Takeda-322 describes a multi-wire implementation with exciting coils L1, L1 for the IC chips CP1, CP2 inductively coupling the IC chips to booster coil L2. *Id.* ¶¶ 6, 14, 29. The reference also describes a single wire implementation in which the coils “may be formed on the card substrate CD using one wire member having an insulating coating.” *Id.* ¶ 33. Exciting coils L1 “act as a secondary coil for the antenna of the IC chip and exhibit a signal-amplifying action according to a ratio of the number of turns had by each.” *Id.* ¶ 14. CP1 is disposed inside of exciting coil L1 such that the antenna of the IC chip is inductively coupled to the exciting coil with sufficient closeness. *Id.* ¶¶ 14, 25, 29. “M,” shown on Figure 3(B), indicates the inductive coupling between antenna A of CP1 and exciting coil L1 and the inductive coupling between antenna A of CP2 and booster coil L2 due to the enclosed portion G. *Id.* ¶ 25.

2. Overview of Ayala-362

Ayala-362 is the publication application that ultimately resulted in the Assa Abloy reference that the '304 patent discusses. Ex. 1001, 3:38–63, 11:32–34, 26:7–23, 27:66–28:2; Ex. 1006, code (10); Ex. 1012, code (65). Ayala-362 teaches a “coupling device” for a non-contact smart card. Ex. 1006, code (54), ¶¶ 1, 5. The device has a “small spiral for inductive coupling with [a] transponder device” and “large spiral[s] for inductive coupling with [a] reader device.” *Id.* at code (57), ¶ 24. Ayala-362's Figure 5 illustrates its device, and we reproduce Figure 5 below.

Fig.5



Id. at Fig. 5. Ayala-362 Figure 5 shows a coupling device according to one of the reference’s embodiments. *Id.* ¶ 35. Large spirals, 11 and 11', surround the device’s edge. *Id.* ¶ 52. The small spiral, 12, is located within the large spirals. *Id.* ¶ 51. Ayala-362 teaches that its system’s performance may be improved by adding a spiral resonator in a second layer having “the same geometry and dimensions as the external large spiral 11.” *Id.* ¶ 54.

The small spiral and large spirals have different pitches. *Id.* at code (57). Ayala-362 explains how to adjust the pitches of its large and small spirals as follows:

The pitches of the large spirals are chosen such as that the interturn stray capacitances is important and that the large spirals have mainly a capacitive behavior. And the pitch of the small spiral is chosen such as that the interturn stray capacitances are negligible, and that the small spiral has mainly an inductive behavior.

Id. at code (57); *see also id.* ¶¶ 25–26 (providing a similar explanation of how “pitches ... are chosen”).

Ayala-362 defines pitch as “mean distance between the turns of a spiral.” *Id.* ¶ 18. Petitioner refers to this distance as “interturn gap distance” or “IGD.” Pet. 5. Ayala-362 also explains that design and manufacturing

constraints do not permit a perfectly constant interturn distance. Ex. 1006 ¶ 19. Ayala-362 thus states that “the definition of pitch herein has to be understood as the mean interturn distance of the whole spiral (weighted on the length of the spiral).” *Id.*

3. Overview of Murayama

Murayama is titled “Composite Antenna and Composite Wireless Communications Device.” Ex. 1007, code (54). Murayama’s compound antenna is composed of a first antenna that functions in a first frequency band (e.g., 8.2 MHz) and a second antenna that functions in a second frequency band (e.g., 13.56 MHz). When the second antenna is operating, the first antenna “functions as a radiating element (boost antenna) of the second antenna in the second frequency band, thereby improving gain.” *Id.* ¶ 8. Figure 1 of Murayama is reproduced below.

[FIG. 1]

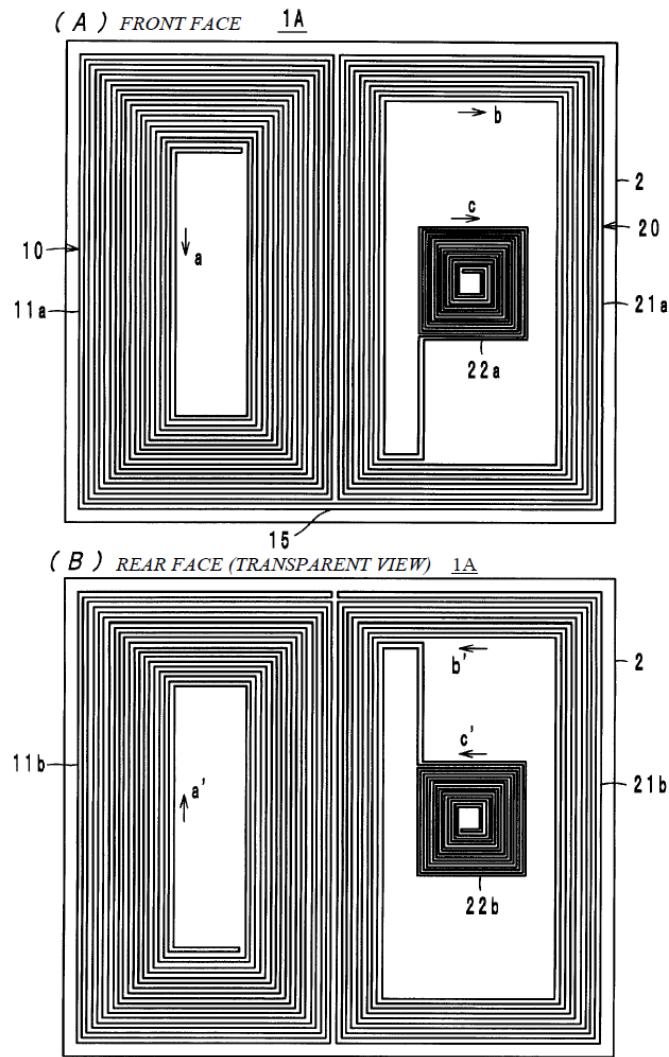


Figure 1 of Murayama, above, depicts a compound antenna “with (A) being a front face view, and (B) being a transparent view.” *Id.* ¶ 11. Compound antenna 1A is composed of insulating substrate 2, first antenna 10, and second antenna 20. *Id.* ¶ 13. First antenna 10 is composed of first and second coiled electrodes 11a, 11b formed opposing each other on a first main face (front) and a second main face (rear) of insulating substrate 2. *Id.* ¶ 14. Second antenna 20 is composed of first and second coiled electrodes 21a, 21b formed opposing each other on the front and rear faces of insulating

substrate 2 and first and second coupling parts 22a, 22b that are looped in spiral patterns in the center. *Id.* ¶ 15.

4. Unpatentability over Takeda-322 and Ayala-362

Petitioner asserts that claims 1–3, 5–8, 12–14, and 16 are unpatentable under 35 U.S.C. § 103(a) as obvious over Takeda-322 and Ayala-362, citing the declaration of Dr. Daniel van der Weide for support. Pet. 9–73 (citing Ex. 1003). Below, we first address Petitioner’s proposed obviousness modifications of Takeda-322. We then address independent claim 1. Finally, we address the dependent claims collectively.

a. Obvious modifications of Takeda-322

Petitioner contends that it would have been obvious to implement Takeda-322 by having its inner coils have a larger pitch than the booster coil, as disclosed in Ayala-362. Pet. 16–17. Petitioner provides several reasons why an ordinary artisan would have been motivated to implement Takeda-322 in this manner, and Petitioner refers to the result as “the Takeda-322/Ayala-362 smart card.” *Id.* at 17–21.

Petitioner’s argument is persuasive and supported by a preponderance of the evidence. Takeda-322 does not explain how to space adjacent turns of its spiral booster and exciting coils. Ex. 1003 ¶ 75. As explained above, however, Ayala-362 explains how this spacing or pitch should be adjusted in order to optimize inductive coupling, resonant frequencies, and communication. Pet. 17; Ex. 1003 ¶¶ 76–77; Ex. 1006, code (57), ¶¶ 25–26. Ayala-362 also specifically describes providing a larger pitch to the inner coil and a smaller pitch to the outer coil. Ex. 1006 ¶¶ 48–49, Fig. 3. It has long been held that “where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges

by routine experimentation.” *In re Aller*, 220 F.2d 454, 456 (CCPA 1955); *see also In re Boesch*, 617 F.2d 272, 276 (CCPA 1980) (“[D]iscovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art.”). The preponderance of the evidence thus supports that a person of ordinary skill in the art would have known to (and been motivated to) choose a pitch for Takeda-322’s various coils such that Takeda-322’s inner, exciting coil has a larger pitch than the outer, booster coil, as Ayala-362 suggests. The preponderance of the evidence of record also supports that such an implementation would have had a reasonable expectation of success. Pet. 19 (providing citations to evidence providing support); Ex. 1003 ¶ 85. As such, the preponderance of the evidence establishes that a person of ordinary skill in the art would have reached the Takeda-322/Ayala-362 smart card. Patent Owner does not dispute this aspect of Petitioner’s contentions.

b. Independent Claim 1

Petitioner asserts that claim 1 is unpatentable as obvious over Takeda-322 and Ayala-362. Pet. 22. The preamble of claim 1 recites a “Booster antenna (BA) comprising the following components.” Ex. 1001, 48:39–40. Petitioner argues that the Takeda-322/Ayala-362 smart card includes a multi-coil antenna which is a booster antenna. Pet. 22–23. Petitioner’s argument is persuasive and supported by a preponderance of the evidence. Takeda-322 teaches, for example, a booster coil that “operates as an external antenna” and “increase[s] information transmission distance.” Ex. 1005 ¶¶ 5, 12, Fig. 3. Takeda-322 also teaches, for example, a smaller coupler coil. *Id.* at Fig. 3. Takeda-322 thus teaches a booster antenna within the parlance of claim 1. Ex. 1001, 2:48–55 (describing booster antenna).

Claim 1 next recites “a card antenna (CA) component.” Ex. 1001, 48:41. Petitioner argues that the booster coil L2 of Takeda-322/Ayala-362 is a card antenna. Pet. 24–25. Petitioner’s argument is persuasive and supported by a preponderance of the evidence. As explained above, Takeda-322 teaches that its booster coil operates as an external antenna. Ex. 1005 ¶¶ 5, 12, Fig. 3. Takeda-322 teaches that its booster-coil has “a maximum opening area in the effective area of the card substrate” to “realize sufficiently high transmission and reception sensitivity.” *Id.* ¶ 12; *see also id.* ¶¶ 29–30, Figs. 3(a), 3(b).

Claim 1 next recites “a coupler coil (CC) component.” Ex. 1001, 48:42. Petitioner argues that the lower inner coil (including at least lower “exciting coil L₁”) of Takeda-322/Ayala-362 is a coupler coil. Pet. 25–27. Petitioner’s argument is persuasive and supported by a preponderance of the evidence. The ’304 patent states that the coupler coil component may be a “relatively small” component “for coupling with the ... antenna” of an antenna module. Ex. 1001, 2:4–8, 51–55. The ’304 patent further states that the coupler coil “may comprise a loop” encircling “a coupling area on the card body ... associated with the antenna module.” *Id.* 4:61–67, 40:11–12. The lower inner coil that Takeda-322 illustrates at, for example, Figure 3(A) meets this description of a coupler coil. Ex. 1005, Fig. 3(a), ¶ 5. Takeda-322 Figure 3(B) further illustrates antenna A being electromagnetically coupled with lower exciting coil L1. *Id.* at Fig. 3(B), ¶ 25; Ex. 1003 ¶ 108.

Claim 1 next recites an “extension antenna (EA) component.” Ex. 1001, 48:43. Petitioner argues that the Takeda-322/Ayala-362 smart card includes a third coil (the upper inner coil of Takeda-322’s Figure 3(a)) that is an extension antenna component. Pet. 28–33. Petitioner’s argument is

persuasive and supported by a preponderance of the evidence. The '304 patent refers to extension antenna EA as a component that may comprise “several turns (or traces) of wire (or other conductive material)” and may be connected or not connected with the card antenna or coupler coil or both. Ex. 1001, 11:4–13, 27:63–28:5. The upper inner coil that Petitioner identifies meets these criteria for an extension antenna. Moreover, the identified structure may function as an extension antenna in the same manner as the '304 patent's EA component. Ex. 1003 ¶¶ 117–118.

As we explain above, we construe “extension antenna” as “an additional coil, disposed in available card space, that non-negligibly contributes to the booster antenna's inductance.” Petitioner argues that Takeda-322's second inner coil (as Petitioner identifies in dark pink, Pet. 28, 49) “contributes to the [BA]'s inductance.” Pet. 28–29. To support this argument, Petitioner compares disclosures of the '304 patent and Takeda-322. *Id.* at 29 (citing Ex. 1001, 11:4–13, 27:63–28:5, 18:26–31, 18:48–53; Ex. 1005 ¶¶ 14, 15, 29, 30, Fig. 3(A), Fig. 4(B); Ex. 1002 ¶¶ 113–114). Takeda-322 states, for example, that “[t]he booster coil and exciting coil formed as two-dimensional spirals can each realize a necessary inductance.” Ex. 1005 ¶ 15. The identified extension antenna is connected to both the coupler coil and the card antenna. *Id.* at Fig. 3(A); *see also* Pet. 29 (citing, for example, Ex. 1003 ¶¶ 113–115). Petitioner also provides figures demonstrating that the identified extension antenna is located in available card space. Pet. 28. We, thus, agree with Petitioner that the preponderance of

the evidence supports that Takeda-322's second inner coil meets our construction of extension antenna.¹⁵

Patent Owner presents several arguments why Takeda-322 “does not disclose an extension antenna.” PO Resp. 55 (emphasis removed). First, Patent Owner argues that Takeda-322's “alleged extension component is actually an alleged coupler coil component” and that different claim terms are “presumed to have different meanings.” *Id.* This argument is unpersuasive for two reasons. First, Petitioner identifies distinct aspects of Takeda-322 as mapping to claim 1's coupler coil component and extension coil component. Pet. 26 (identifying lower L₁ as a coupler coil component by using a yellow highlight), 28 (identifying upper L₁ as an extension antenna component using a pink highlight). Second, as we explain above (*see* § III.G.2), the '304 patent does not forbid the extension antenna from also performing other functions. The preponderance of the evidence supports that the upper inner coil (pink) acts as an EA component “for communications between the IC chip CP₁ and an external reader/writer.”

¹⁵ We further note that the second inner coil that Petitioner identifies has, in relevant respects, the same structure and function as the extension antenna of the '304 patent. *Compare* Ex. 1001, 11:8–13 (explaining that the extension antenna EA may be “connected with one or both of the card antenna CA and coupler coil CC”), 18:26–31 (explaining that extension antenna EA may be a continuation of card antenna CA and may have several turns of wire) *with* Ex. 1005 ¶¶ 14 (explaining that antenna turns add to signal-amplifying action), 15 (explaining that booster coil spirals may achieve necessary inductance), 29 (explaining that exciting coils may be connected in series with the booster coils), 30 (providing similar teaching), Fig. 3; *see also* Ex. 1003 ¶¶ 111–114 (Petitioner's witness, Dr. van der Weide, explaining how characteristics of Takeda-322's coil and the '304 patent's coil are “comparable”). As a result, the second inner coil would qualify as an “extension antenna” under any reasonable construction of that term.

Pet. 29 (citing Ex. 1003 ¶¶ 117–118). We agree with Petitioner that it is immaterial that this upper inner coil also couples IC chip CP₂ to booster coil L₂. *Id.* (citing Ex. 1003 ¶¶ 119–120). As Petitioner notes, the '304 patent specification states that the same coil may be both an extension antenna component and a coupler coil component. Ex. 1001, 20:8–22 (describing embodiment in which “the coupler coil CC and extension antenna EA are essentially combined with one another”).

Second, Patent Owner also argues that Petitioner has not shown that Takeda-322's coil L₁-top non-negligibly contributes to inductance of the alleged booster antenna. PO Resp. 56–57. As explained above, we disagree. *See* Ex. 1005 ¶¶ 14–15 (explaining that exciting coils realize a necessary inductance). The Petition establishes by a preponderance of the evidence that the second inner coil meets this requirement. Importantly when considering the preponderance of the evidence, Patent Owner presents no evidence that contradicts Petitioner's showing that the second coil improves inductance of the booster antenna. *See* Pet. 29 (citing Ex. 1005 ¶¶ 15, 29–30; Ex. 1003 ¶¶ 116–117); Pet. Reply 11 (citing Ex. 1055 ¶ 43 (reply declaration of Dr. van der Weide)).

Third, Patent Owner argues that Petitioner has not shown that the alleged extension antenna enhances coupling between the module antenna and the booster antenna. PO Resp. 57. Patent Owner's argument is unpersuasive because, as we explain above, we do not construe the term “extension antenna component” as requiring this particular enhanced coupling. *See* § III.G.2.

Fourth, Patent Owner argues that the L₁-top is not an extension antenna because it is not disposed in “available card space.” Sur-Reply 23–

24. As a threshold matter, we reject Patent Owner’s argument because it comes for the first time in Sur-Reply—procedurally too late. *See* Paper 12, 1 (institution decision warning Patent Owner that arguments not raised in a response may be waived); Consolidated Trial Practice Guide 94, *available at* <https://www.uspto.gov/TrialPracticeGuideConsolidated> (“Patent Owner is cautioned that any arguments for patentability not raised in the response may be deemed waived.”). Patent Owner does not provide adequate explanation for why this argument could not have been raised previously. As we explain in Section III.A, *supra*, Patent Owner’s position regarding timeliness of Patent Owner’s “available card space argument” argument is unpersuasive for many reasons including, for example, the original Petition stating that the EA must be in “available card space.” Pet. 4–5.

Patent Owner’s argument is also unpersuasive on the merits. Petitioner provides figures demonstrating that the identified extension antenna component is located in available card space. Pet. 28. And, as we address above, the fact that L_1 -top may also couple IC chip CP_2 to booster coil L_2 does not affect whether or not L_1 -top is an extension antenna component relative to IC chip CP_1 . Likewise, this second functionality does not affect whether or not L_1 -top is in available card space. Moreover, Patent Owner and Patent Owner’s witness, Dr. Eisenstadt, agree that “any coil could only be located in available card space.” Resp. 32; Ex. 2003 ¶ 84; *see also* Opp. to Mot. to Supp. 3 (Petitioner stating that “both parties ***agreed*** that Takeda-322’s coil identified as an EA was in available space”). Dr. Eisenstadt’s testimony is credible in this regard because Patent Owner does not persuasively identify any language in the ’304 patent that would limit “extension antenna component” by narrowing the meaning of available

card space. In sum, the preponderance of the evidence establishes that Takeda-322 teaches the recited extension antenna component.

Claim 1 next recites that the booster antenna is “characterized in that: at least one of the components has a pitch which is different than one or more of the other components.” Ex. 1001, 48:44–46. Petitioner argues that the outer card antenna and the inner coupler coil of Takeda-322/Ayala-362 have different pitches and that this is the case whether (1) pitch encompasses pitch when measured by interturn gap distance or (2) pitch is measured only by center-to-center distance. Pet. 33–39. Based on the complete record adduced during trial, we find Petitioner’s assertion to be persuasive and supported by evidence.

As we explain above, Ayala establishes that pitch (which Ayala describes as interturn gap distance or “mean distance between the turns of a spiral”) is a result effective variable. Ex. 1006, code (57), ¶¶ 18–19, 25–26. A person of skill in the art would have been motivated to select interturn gap distance of the Takeda-322 device such that the inner coupler coil has a larger pitch than the outer coil in order to achieve the benefits Ayala teaches. Pet. 17; *see also* Ex. 1006 ¶¶ 25–26, 48–49. An ordinary artisan would also be motivated to select different pitches for these coils if, as would have been obvious, a single diameter was used for wires of each of the Takeda-322 coils. Pet. 19–21; *see also* Ex. 1003 ¶¶ 87–92 (Petitioner’s witness explaining why it would have been obvious to use wires with a specific wire diameter and citing evidence to support this point); Ex. 1026 ¶¶ 7–8 (suggesting use of a single diameter of wire for a smart card); Ex. 1014 ¶ 285 (supporting desirability of single size of wire). Moreover, given that Ayala suggests adjusting interturn gap distance, a person of skill in the art

would have designed its layout accordingly rather than attempting to achieve a perfectly uniform center-to-center distance; such design would result in different center-to-center distances. Pet. 16–18.

Petitioner has shown by a preponderance of the evidence that a person of ordinary skill in the art would have been motivated to combine Takeda-322 and Ayala-362, and that the combination teaches or reasonably suggests all of the elements of claim 1 in the manner claim 1 recites. Thus, we are persuaded that Petitioner has established by a preponderance of the evidence that Takeda-322 and Ayala-362 render claim 1 obvious.

c. *Dependent Claims 2, 3, 5–8, 12–14, and 16*

Petitioner accounts for the limitations recited in claims 2, 3, 5–8, 12–14, and 16. Pet. 16–21, 39–51. Petitioner provides detailed explanations as to how the combined teachings of Takeda-322 and Ayala-362 disclose, teach, or suggest the limitations of these claims and why it would have been obvious to combine those teachings with a reasonable expectation of success, citing Dr. van der Weide’s testimony for support. *Id.* (citing Ex. 1003).

We are persuaded that Petitioner has demonstrated that all of the limitations recited in claims 2, 3, 5–8, 12–14, and 16 would have been obvious over Takeda-322 in view of Ayala-362. Patent Owner provides no arguments regarding these claims outside of the arguments discussed in regards to independent claim 1. *See generally* PO Resp. Having reviewed Petitioner’s arguments and supporting evidence, we are persuaded that Petitioner has established by a preponderance of the evidence that claims 2, 3, 5–8, 12–14, and 16 are unpatentable under § 103(a) over Takeda-322 and Ayala-362.

5. *Unpatentability over Murayama and Ayala-362*

Petitioner asserts that claims 1–3, 5–8, 11–14, and 16 are unpatentable under 35 U.S.C. § 103(a) as obvious over Murayama and Ayala-362, citing the declaration of Dr. Daniel van der Weide for support. Pet. 52–73 (citing Ex. 1003). Below, we first address Murayama’s status as prior art. We then address Petitioner’s proposed obviousness modifications of Murayama. We then address independent claim 1. Finally, we address dependent claims collectively.

a. Prior art status of Murayama

Murayama was published October 6, 2011. Ex. 1007, code (43). The ’304 patent claims priority to more than thirty U.S. Patent applications. Ex. 1001, codes (60), (63). The priority chain includes eight applications that predate the publication of Murayama with two of those applications predating the publication of Murayama by more than a year. *See id.* (listing provisional application No. 61/373,269, filed on Aug. 12, 2010 and provisional application No. 61/384,219, filed on Sep. 17, 2010). Petitioner argues that Murayama’s October 6, 2011, publication date “establish[es] Murayama as prior art absent a showing by Patent Owner that the Challenged Claims are entitled to an earlier effective filing date.” Pet. 53 (citing *Nat. Alternatives Int’l v. Iancu*, 904 F.3d 1375, 1380 (Fed. Cir. 2018)).

The Federal Circuit has held that in an *inter partes* review there are two distinct burdens of proof: the burden of persuasion and the burden of production. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (citing *Tech. Licensing Corp. v. Videotek, Inc.*, 545 F.3d 1316, 1326–27 (Fed. Cir. 2008)). Petitioner bears the ultimate

burden of persuasion regarding unpatentability, which never shifts to Patent Owner. *Id.* at 1379. *Dynamic Drinkware*, however, also establishes that Petitioner has the initial burden of production to show a reference is prior art. *Id.* Once Petitioner's burden of production is satisfied, the burden of production then shifts to Patent Owner to refute Petitioner's argument by either showing the prior art does not actually render the claims unpatentable or does not qualify as prior art. *Id.* at 1380. The burden of production then shifts back to Petitioner to respond to Patent Owner's argument. *Id.*

We find that Petitioner has met its initial burden of production and as such, the burden shifted to Patent Owner to assert evidence regarding the prior art status of Murayama. Patent Owner, however, did not provide such argument or evidence. *See* PO Resp. *passim*. Thus, we are persuaded that Petitioner has established the prior art status of Murayama. *See Dynamic Drinkware*, 800 F.3d at 1379–80. The burden of persuasion still rests with Petitioner and thus, we must analyze Murayama and the related arguments and evidence to determine whether Petitioner's challenge prevails.

b. Obvious modifications of Murayama

Like Takeda-322, Murayama does not explain the spacing for adjacent turns of its various coils. Pet. 57; Ex. 1003 ¶ 212. As we explain above, Ayala-362 explains that spacing or pitch should be adjusted to optimize inductive coupling, resonant frequencies, and communication. Pet. 17; Ex. 1003 ¶¶ 76–77; Ex. 1006, code (57), ¶¶ 25–26. *See* Section III.H.4.a, *supra*. The preponderance of the evidence thus supports that a person of ordinary skill in the art would have known to choose a pitch for Murayama's various coils as Ayala-362 suggests. The preponderance of the evidence also supports that such an implementation would have had a reasonable

expectation of success. Pet. 58–59 (providing citations to evidence providing support); Ex. 1003 ¶ 218. As such, the preponderance of the evidence adequately establishes that a person of ordinary skill in the art would have reached the “Murayama/Ayala-362” smart card as Petitioner describes it. Pet. 60–61. Patent Owner does not rebut this position.

c. Independent Claim 1

Petitioner asserts that claim 1 is unpatentable as obvious over Murayama and Ayala-362. Pet. 52. The preamble of claim 1 recites a “Booster antenna (BA) comprising the following components.” Ex. 1001, 48:39–40. Petitioner argues that Murayama’s “compound antenna 1A” is a booster antenna. Pet. 61. Petitioner’s argument is persuasive and supported by a preponderance of the evidence. Murayama teaches, for example, that its compound antenna boosts the range for a wireless IC chip to facilitate communication with an RFID read-writer. Ex. 1007 ¶¶ 9, 17, 26–27; Ex. 1003 ¶¶ 227–228. Takeda-322 thus teaches a booster antenna within the parlance of claim 1. Ex. 1001, 2:48–55 (describing booster antenna).

Patent Owner argues that Murayama does not disclose a booster antenna because a booster antenna should be construed as “an antenna tuned to a single resonance frequency that enables a chip to communicate with an external reader.” PO Resp. 63. We disagree.

Murayama discloses a composite antenna with first antenna (10) that resonates in a first frequency band, and second antenna (20) that resonates in a second frequency band higher than the first frequency band. Ex. 1007, code (57). As noted above, however, we did not adopt Patent Owner’s proposed construction which would have limited booster antenna to a single frequency. *See* § III.G.1.

Moreover, even if Patent Owner’s claim construction were correct, we would still find that Murayama teaches the claimed booster antenna. Murayama states that the antennas “can be used as a single antenna even in a first frequency band.” Ex. 1007, code (57). These antennas are “electrically connected” and “the coupling of the wireless communication element 30 to the second antenna 20 results in the compound antenna 1A being configured as a wireless communication device (wireless IC tag) that communicates with a reader-writer of an RFID system.” *Id.* ¶¶ 16, 27.

Petitioner argues that “Murayama’s BA [booster antenna] is its compound antenna (coils 21a/21/b, 22a/22b, and 11a/11b) which is only tuned to one frequency—the 13.56 MHz RFID frequency—to enable the IC chip to communicate with a reader.” Reply 16. Dr. van der Weide persuasively supports Petitioner’s position by opining that the Petition identifies “Murayama’s compound antenna (implemented in Murayama/Ayala-362) as a booster antenna that operates at 13.56 MHz to communicate with an RFID reader—because that is precisely what it is.” Ex. 1055 ¶¶ 68–69. Murayama explains that currently RFID communication and anti-theft tags operate on different frequencies because anti-theft tags use electromagnetic fields to communicate over comparatively long ranges while RFID uses magnetic fields to communicate over relatively short ranges. Ex. 1007 ¶ 3. Prior systems, therefore, had to use two separate communication devices for inventory management and loss prevention. *Id.* Murayama’s solution was to create a compound antenna that allowed the first antenna to provide anti-theft communication and a second antenna that provided RFID communication. *Id.* ¶¶ 6–8. When the second antenna (RFID) is in use, the first antenna “functions as a radiating element (boost

antenna) of the second antenna in the second frequency band, thereby improving gain.” *Id.* ¶ 8. We are persuaded that this discloses the recited booster antenna, both under our construction and under Patent Owner’s proposed construction.

Claim 1 next recites “a card antenna (CA) component.” Ex. 1001, 48:41. Petitioner argues that Murayama’s interconnected electrodes 21a, 11a meet the claimed card antenna component. Pet. 62. Petitioner’s argument is persuasive and supported by a preponderance of the evidence. Murayama Figure 1, for example, illustrates that electrodes 21a, 11a meet the specification’s description of a card antenna component: a “single wire (or conductive trace) having two ends, arranged in a ... rectangular spiral pattern, and disposed in the peripheral area ... of the card body.” Ex. 1001, 11:29–32; *see also* Ex. 1003 ¶¶ 231–233.

Patent Owner argues that Petitioner does not demonstrate that Murayama teaches a card antenna component because a card antenna component must be a component of a booster antenna and because a booster antenna must be tuned to a single resonance frequency. PO Resp. 65. As explained above, we disagree with Patent Owner’s construction of booster antenna as requiring tuning to a single resonance frequency, and we also disagree with Patent Owner as to whether, even under Patent Owner’s construction, Murayama discloses such a booster antenna. Patent Owner’s argument is, thus, unpersuasive.

Claim 1 next recites “a coupler coil (CC) component.” Ex. 1001, 48:42. Petitioner argues that Murayama’s coupling part 22a meets the claimed coupler coil component. Pet. 63. Petitioner’s argument is persuasive and supported by a preponderance of the evidence. The ’304 patent states

that the coupler coil component may be a “relatively small” component “for coupling with the ... antenna” of an antenna module. Ex. 1001, 2:4–8, 51–55. The ’304 patent further states that the coupler coil “may comprise a loop” encircling “a coupling area on the card body ... associated with the antenna module.” *Id.* 4:61–67, 40:11–12. Murayama’s coupling part 22a is a relatively small coil compared to Murayama’s other BA components. Ex. 1007 ¶ 15, Fig. 1; Ex. 1002 ¶¶ 240–241. Murayama’s antenna module “is disposed over the first coupling part 22a” to enabling coupling between part 22a and the IC chip’s antenna. Ex. 1007 ¶¶ 17, 21, 24–25, 31–32; Ex. 1002 ¶¶ 242–243.

Claim 1 next recites an “extension antenna (EA) component.” Ex. 1001, 48:43. Petitioner argues that Murayama’s electrode 11b meets the claimed extension antenna component. Pet. 65. Petitioner’s argument is persuasive and supported by a preponderance of the evidence. As we explain above, we construe the “extension antenna component” as “an additional coil, disposed in available card space, that non-negligibly contributes to the booster antenna’s inductance.” *See* Section III.G.2, *supra*.

Petitioner argues that Murayama’s electrode 11b (as Petitioner identifies in dark pink, Pet. 65) “contributes to the BA’s inductance.” Pet. 66–67. Petitioner’s position is supported by a preponderance of the evidence. Murayama states, for example, that “antenna 10 forms a resonant circuit through the inductance of the first and second coiled electrodes 11a, 11b” which may be formed with additional turns to “raise ... inductance value” and “increase communication range.” Ex. 1007 ¶¶ 22–23; *see also id.* ¶ 26; Ex. 1002 ¶¶ 250–251. The preponderance of the evidence also supports

that electrode 11b is positioned in available card space. Pet. 65 (reproducing Figure 1A which illustrates electrode 11b located in available card space).

Patent Owner argues that electrode 11b is not an “extension antenna component” because it is “disconnected from the alleged card antenna and coupler coil components.” PO Resp. 62. This argument is unpersuasive because claim 1 does not recite that the extension antenna component must be connected to the card antenna or coupler coil component. Moreover, as we explain in Section III.G.2, *supra*, we do not construe “extension antenna component” as requiring such a connection. *See also* Ex. 1001, 11:8–13 (indicating that the extension antenna need not be connected to the card antenna or coupler coil); Reply 19–20.

Patent Owner also argues that Petitioner has not shown that Murayama’s electrode 11b provides non-negligible inductive contribution to the booster antenna. PO Resp. 62–63. This argument is also unpersuasive. As we explain above, the Petition cites both Murayama and the declaration of Dr. van der Weide, and these citations provide evidence that electrode 11b provides non-negligible inductive contribution to the booster antenna. Pet. 66–67; *see also* Reply 24–25; Ex. 1055 ¶¶ 98–99. Patent Owner does not identify any evidence to the contrary. *See* PO Resp. *passim*. In sum, the preponderance of the evidence supports that Murayama discloses an extension antenna component as the Petition alleges.

Claim 1 next recites that the booster antenna is “characterized in that: at least one of the components has a pitch which is different than one or more of the other components.” Ex. 1001, 48:44–46. Petitioner argues that the different components of Muraya/Ayala-362 have different pitches. Pet. 69. Petitioner’s argument is persuasive and supported by the preponderance

of the evidence. Ex. 1007, Fig. 1A; Ex. 1002 ¶¶ 254–256. Patent Owner does not dispute Petitioner’s position. *See* PO Resp. *passim*.

d. *Dependent Claims 2, 3, 5–8, 11–14, and 16*

Petitioner accounts for the limitations recited in claims 2, 3, 5–8, 11–14, and 16. Pet. 69–73. Petitioner provides detailed explanations as to how the combined teachings of Murayama and Ayala-362 disclose, teach, or suggest the limitations of these claims and why it would have been obvious to combine those teachings with a reasonable expectation of success, citing Dr. van der Weide’s testimony for support. *Id.* (citing Ex. 1003).

We are persuaded that Petitioner has demonstrated that all of the limitations recited in claims 2, 3, 5–8, 11–14, and 16 would have been obvious over Murayama in view of Ayala-362. Patent Owner provides no arguments regarding these claims outside of the arguments discussed in regards to independent claim 1. *See generally* PO Resp. Having reviewed Petitioner’s arguments and supporting evidence, we are persuaded that Petitioner has established by a preponderance of the evidence that claims 2, 3, 5–8, 11–14, and 16 are unpatentable under § 103(a) over Murayama and Ayala-362.

6. *Unpatentability over Ayala-362*

Petitioner asserts that claims 1–3, 5–8, 11–14, and 16 are unpatentable under 35 U.S.C. § 102 as anticipated by Ayala-362 and claims 6–8, 11, and 16 are unpatentable under 35 U.S.C. § 103 as obvious over Ayala-362, citing the declaration of Dr. Daniel van der Weide for support. Pet. 74–88 (citing Ex. 1003). We first address independent claim 1. We next address dependent claims collectively.

a. Independent Claim 1

Petitioner asserts that claim 1 is unpatentable under 35 U.S.C. § 102 over Ayala-362. Pet. 77.¹⁶ As we address above, Ayala-362 relates to a smart card multi-coil antenna. Pet. 16, 77; Ex. 1006, Fig. 5, code (57), ¶¶ 5–7, 43. Ayala-362 explains that spacing or pitch should be adjusted to optimize inductive coupling, resonant frequencies, and communication. Pet. 17; Ex. 1003 ¶¶ 76–77; Ex. 1006, code (57), ¶¶ 25–26.

The preamble of claim 1 recites a “Booster antenna (BA) comprising the following components.” Ex. 1001, 48:39–40. Petitioner argues that the Ayala-362 smart card is a transponder device with “booster antenna component” spirals that form a booster antenna. Pet. 77. Petitioner’s argument is persuasive and supported by a preponderance of the evidence. Ayala-362 teaches, for example, a transponder device with an IC chip for communicating with an RFID reader. Ex. 1006, ¶¶ 43, 46, 54; Ex. 1003 ¶¶ 296–300.

Claim 1 next recites “a card antenna (CA) component.” Ex. 1001, 48:41. Petitioner argues that the large spirals 11 and 11' of Ayala-362 are a card antenna component. Pet. 78–79. Petitioner’s argument is persuasive and supported by a preponderance of the evidence. Ayala-362 teaches, for example, that 11 and 11' meet the '304 patent’s description of a card antenna component because they are formed of a “single wire (or conductive trace) ... disposed in the peripheral area ... of the card body.” Ex. 1001, 11:29–36; Ex. 1006, Fig. 5, ¶¶ 23–25, 27, 52, 54, 65; Ex. 1003 ¶¶ 301–302.

¹⁶ We understand that Petitioner relies only on anticipation for claim 1. Pet. 77 (“Ayala-362 anticipates claims 1–3, 5, and 12–14, and anticipates and/or renders obvious claims 6–8, 11, and 16.”).

Claim 1 next recites “a coupler coil (CC) component.” Ex. 1001, 48:42. Petitioner argues that Ayala-362’s small spiral 12 is a coupler coil component. Pet. 79. Petitioner’s argument is persuasive and supported by a preponderance of the evidence. For example, Ayala’s small spiral 12 matches the ’304 patent’s description of a coupler coil component as a “relatively small” component “for coupling with the ... antenna.” Ex. 1001, 2:4–8, 2:51–55; Ex. 1006, Fig. 5, ¶¶ 24–25, 37–38, 43–44, 49, 66; Ex. 1003, ¶¶ 303–305.

Claim 1 next recites an “extension antenna (EA) component.” Ex. 1001, 48:43. Petitioner argues that Ayala-362’s spiral resonator is an extension antenna component. Pet. 80–81. Petitioner’s argument is persuasive and supported by a preponderance of the evidence. The ’304 patent refers to extension antenna EA as a component that may comprise “several turns (or traces) of wire (or other conductive material)” and may be connected or not connected with the card antenna or coupler coil or both. Ex. 1001, 11:4–13, 27:63–28:5. Ayala-362’s spiral resonator has this characteristic. Ex. 1006, Fig. 5, ¶¶ 54; Ex. 1003 ¶¶ 306–309; *see also* Ex. 1001, 23:13–26 (disclosing components “on two separate layers which may then be laminated together”).

As we explain above, we construe “extension antenna” as “an additional coil, disposed in available card space, that non-negligibly contributes to the booster antenna’s inductance.” Petitioner reproduces and colorizes Ayala-362 Figure 5 in a manner that demonstrates that the spiral resonator, highlighted in pink, is disposed in available card space. Pet. 80–81 (reproducing Ex. 1006, Fig. 5). Petitioner also presents evidence that supports that the spiral resonator non-negligibly contributes to the booster

antenna's inductance. *See* Ex. 1003 ¶¶ 308–309 (*cited in* Pet. 82); Ex. 1029 (prior art referenced by Ayala-362 discusses an antenna with a spiral “resonator” that “amplifies the electrical signals passing through it” and because the resonator is “dispos[ed] ... in the form of turns[,] generates an inductive behavior”). Petitioner's position is supported by a preponderance of the evidence. Patent Owner presents no evidence to the contrary. *See* Sur-Reply 25.

Patent Owner argues that the resonator cannot be an extension antenna component because the resonator is unconnected with the alleged card antenna component (large spirals 11, 11') or the alleged coupler coil component (small spiral 12). PO Resp. 68. We, however, declined to construe extension antenna component as requiring a connection to the card antenna component or the coupler coil component. *See* Section III.G.2., *supra*. Patent Owner's argument is thus unpersuasive.

Patent Owner also argues that Petitioner has not shown that Ayala-362's extension antenna enhances coupling. Sur-Reply 26–27. Patent Owner forfeited this argument by raising it for the first time in sur-reply. *See* PO Resp. 66–68 (not raising this argument with respect to the Ayala-362 ground); *see also* Paper 12, 1 (institution decision warning Patent Owner that arguments not raised in a response may be waived); Consolidated Trial Practice Guide 94, *available at* <https://www.uspto.gov/TrialPracticeGuideConsolidated> (“Patent Owner is cautioned that any arguments for patentability not raised in the response may be deemed waived.”). Also, this argument is not persuasive on the merits. Petitioner supports, with a preponderance of the evidence, that the spiral resonator

non-negligibly contributes to the booster antenna's inductance for the reasons we explain above.

Claim 1 next recites that the booster antenna is “characterized in that: at least one of the components has a pitch which is different than one or more of the other components.” Ex. 1001, 48:44–46. Petitioner argues Ayala-362 teaches components of different pitches regardless of how pitch is measured. Pet. 83. For the reasons we discuss above, Petitioner's argument is persuasive and supported by a preponderance of the evidence. For example, Ayala teaches that pitch of the large spiral is chosen so it has a largely capacitive behavior and pitch of the small spiral is chosen to have a mainly inductive behavior. Ex. 1006, code (57), ¶¶ 25–26. Along these lines, Figure 5 depicts the smaller spiral 12 having a larger pitch than smaller spirals 11 and 11'. *Id.* at Fig. 5. Ayala-362 states that “the small spiral shows a larger pitch than the ones of the large spirals.” *Id.* at code (57); *see also id.* ¶¶ 24 (providing same text), 37 (describing “large spiral 11 with a small pitch” and “smaller spiral 12 ... with a larger pitch”).

Petitioner has shown by a preponderance of the evidence that each and every limitation of claim 1 is found expressly within Ayala-362 in the manner claim 1 recites. Thus, we are persuaded that Petitioner has established by a preponderance of the evidence that Ayala-362 anticipates claim 1.

b. Dependent Claims 2–3, 5–8, 11–14, and 16

Petitioner accounts for the limitations recited in claims 2–3, 5–8, 11–14, and 16. Pet. 83–76. Petitioner provides detailed explanations as to how Ayala-362 teaches (or reasonably suggests, with respect to claims 6–8, 11,

and 16) the limitations of these claims, citing Dr. van der Weide's testimony for support. *Id.* (citing Ex. 1003).

We note that Petitioner alleges that Ayala-362 anticipates claims 2, 3, 5, and 12–14 and anticipates and/or renders obvious claims 6–8, 11, and 16. Pet. 77. With regard to claim 7, however, Petitioner only argues obviousness. Pet. 85. We, thus, do not determine that Petitioner has established that Ayala-362 anticipates claim 7.

We are persuaded that Petitioner has demonstrated that all of claims 2–3, 5–8, 11–14, and 16 would have been anticipated by and/or obvious in view of Ayala-362. Patent Owner provides no arguments regarding these claims outside of the arguments discussed in regards to independent claim 1. *See generally* PO Resp. Having reviewed Petitioner's arguments and supporting evidence, we are persuaded that Petitioner has established by a preponderance of the evidence that claims 2, 3, 5, 6, 8, 11–14, and 16 are unpatentable under § 102 over Ayala-362, and that claims 6–8, 11, and 16 are unpatentable under § 103(a) over Ayala-362.

IV. CONCLUSION

Based on the evidence presented with the Petition, the evidence introduced during the trial, and the parties' respective arguments, Petitioner has shown by a preponderance of the evidence that claims 1–3, 5–8, 11–14, and 16 of U.S. Patent No. 9,633,304 B2 are unpatentable.¹⁷

¹⁷ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg.

In summary:

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
1–3, 5–8, 12–14, 16	103	Takeda-322, Ayala- 362	1–3, 5–8, 12– 14, 16	
1–3, 5–8, 11–14, 16	103	Murayama, Ayala- 362	1–3, 5–8, 11– 14, 16	
1–3, 5–8, 11–14, 16	102	Ayala-362	1–3, 5, 6, 8, 11– 14, 16	7
6–8, 11, 16	103	Ayala-362	6–8, 11, 16	

V. ORDER

For the foregoing reasons, it is

ORDERED that Petitioner establishes by a preponderance of the evidence that claims 1–3, 5–8, 11–14, and 16 of U.S. Patent No. 9,633,304 B2 are unpatentable;

FURTHER ORDERED that Patent Owner’s Motion to Submit Supplemental Information is *denied*;

FURTHER ORDERED that Patent Owner’s Objections to Petitioner’s Demonstratives are *dismissed as moot*; and

FURTHER ORDERED that, because this is a Final Written Decision, the 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.

16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

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