

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTEL CORPORATION,
Petitioner

v.

Telefonaktiebolaget L M Ericsson
Patent Owner.

IPR2024-00728

U.S. Patent 7,151,430

PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE

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EXHIBIT LIST

Petitioner's Exhibits

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1001	U.S. Patent 7,151,430 to Mattsson
1002	File History for U.S. Patent 7,151,430
1003	Declaration of Dr. Manos Tentzeris in Support of Petition
1004	CV of Dr. Manos Tentzeris
1005	U.S. Patent Publication 2003/0063034 to Taniguchi, et al (“Taniguchi”)
1006	U.S. Patent 6,373,447 to Rostoker, et al (“Rostoker”)
1007	PCT Publication WO 98/05048 to Midya, et al (“Midya”)
1008	U.S. Patent Publication 2005/0077992 to Raghavan, et al (“Raghavan”)
1009	U.S. Patent Publication 2001/0030591 to Gardner (“Gardner”)
1010	“Signal Integrity Issues and Printed Circuit Board Design,” to Brooks (“Brooks”)
1011	Declaration of June Ann Munford
1012	“RFID Handbook: Fundamentals and Applications in Contactless Smart Cards and Identification” to Finkenzeller (Wiley, Second Edition)
1013	“Principles of Physics,” to Serway, 2nd Edition (“Serway”)
1014	“Fundamentals of Applied Electromagnetics” to Ulaby (“Ulaby”)
1015	Certified Translation of Excerpts from prosecution of JP2007526642
1016	Excerpts from the EP prosecution of EP3567614

Exhibit	Reference
1017	PCT Publication WO 2004/012213 to Einzinger (“Einzinger-US”)
1018	U.S. Patent 6,708,880 to Acher, et al (“US-Acher”)
1019	ITC-337-TA-1376 Claim Construction Order
1020	ITC-337-TA-1300 Claim Construction Order
1021	U.S. Patent 6,533,189 to Gaul (“Gaul”)
1022	U.S. Patent 5,345,231 to Koo (“Koo”)
1023	U.S. Patent 6,137,447 to Saitoh, et al (“Saitoh”)
1024	U.S. Patent 6,320,491 to Gevorgian, et al (“Gevorgian”)
1025	U.S. Patent 7,088,964 to O (“O”)
1026	U.S. Patent Publication 2002/0044058 to Heinrich, et al (“Heinrich”)
1027	U.S. Patent 6,970,088 to Kovach (“Kovach”)
1028	U.S. Patent 4,724,427 to Carroll (“Carroll”)
1029	U.S. Patent 7,057,514 to Mickle (“Mickle”)
1030	“A Comprehensive Explanation On the High Quality Characteristics of Symmetrical Octagonal Spiral Inductor” to Ooi, et al (“Ooi”)
1031	“Design and Analysis of Symmetric Dual-Layer Spiral Inductors for RF Integrated Circuits” to Lee, et al (“Lee”)
1032	“A Q-Factor Enhancement Technique for MMIC Inductors” to Danesh, et al (“Danesh”)
1033	PCT Publication WO 99/49513 to Zhou, et al. (“Zhou”)
1034	U.S. Patent 5,583,474 to Mizoguchi (“Mizoguchi”)

Exhibit	Reference
1035	Reserved
1036	“A Single-Chip 900-MHz Spread-Spectrum Wireless Transceiver in 1-up CMOS – Part 1: Architecture and Transmitter Design” by Ahmadsreza Rofougaran, et al. , IEEE Journal of Solid-State Circuits, Vol. 33, No. 4 (April 1998)
1037	“A Single-Chip CMOS Transceiver for DCS-1800 Wireless Communication” by Michiel Steyaert, et al. ISSCC98, Session 3, Transceiver and Power Amplifiers (1998)
1038	“A 1.8-GHz Low-Phase-Noise CMOS VCO Using Optimized Hollow Spiral Inductors” by Craninckx, et al. (“Craninckx”)
1039	“Low-Phase-Noise LC Quadrature VCO Using Coupled Tank Resonators in a Ring Structure” by ElSayed, et al. (“ElSayed”)
1040	“A CMOS Frequency Synthesizer with an Injection-Locked Frequency Divider for a 5-GHz Wireless LAN Receiver” to Rategh, et al. (“Rategh”)
1041	“Illustrated Dictionary of Electronics” to Gibilisco, Eighth Edition
1042	“Class Definition for Class 343 Communications: Radio Wave Antennas,” U.S. Patent & Trademark Office (2001), https://web.archive.org/web/20011123183942/http://www.uspto.gov/web/patents/classification/uspc343/defs343.htm
1043	Supplemental Declaration of Dr. Manos Tentzeris
1044	Deposition Transcript of Dr. Paul Prucnal
1045	“Antenna Theory” by Constantine Balanis (2 nd Ed. 1997)
1046	U.S. Patent 5,070,317 to Bhagat (“Bhagat”)
1047	“Advanced Silicon IC Interconnect Technology and Design: Present Trends and RF Wireless Implications” by Ronald J. Gutmann, IEEE Transactions on Microwave Theory and Techniques, Vol. 47, No. 6 (June 1999)

Exhibit	Reference
1048	“Interconnect Technology and Design Implications for Future ASIC and System-on-a-Chip (SOC) Implementations” by Ronald J. Gutmann et al., 10 th Annual IEEE/SEMI Advanced Semiconductor Manufacturing Conference, ASMC 99 Proceedings (Cat. No.99CH36295) (1999)
1049	“Core Design and System-on-a-Chip Integration” by Ann Marie Rincon, et al., IEEE Design and Test of Computers (October-December 1997)
1050	WO 03/015110 to Tiemeijer (“Tiemeijer”)
1051	Prucnal Ex. 1, ITC-337-TA-1300, CXM-0035, Declaration of Paul R. Prucnal, Ph.D. in Support of Complainant’s Claim Construction Brief
1052	U.S. Patent Publication 2003/0186674 to Keeney (“Keeney”)

Patent Owner's Exhibits

Exhibit	Reference
2001	Statutory Disclaimer of claims 20 & 21 of U.S. Patent 7,151,430
2002	Declaration of Dr. Paul Prucnal In Support of Patent Owner Preliminary Response
2003	US 6,512,422 Dufour
2004	US 6,664,606 Estes
2005	US 6,891,444 Jacobson
2006	US 6,894,598 Heima
2007	WO 2003/084295 Bhailis
2008	US 6,194,987 Zhou
2009	Supplemental Declaration of Dr. Paul Prucnal, Ph.D.
2010	Dr. Tentzeris Deposition Transcript

I. Introduction.

Patent Owner Response (“POR”) fails to rebut the Petition’s compelling showing of unpatentability. First, PO’s arbitrary distinction between art related to printed circuit boards (“PCBs”) and integrated circuits (“ICs”) is contrary to the Institution Decision (“ID”) and Petitioner’s evidence of motivation to combine. Second, PO’s arguments about Taniguchi’s inductors/antennas combined coupling to tags are irrelevant to the reduced electromagnetic (“EM”) coupling between Taniguchi’s two antennas. Third, the Petition established, and PO’s expert conceded, the fundamental physics is the same for inductors and for loop antennas. Finally, PO improperly focuses on alleged shortcomings of individual references without addressing Petitioner’s combinations.

II. Claim 11 Preamble Is Not Limiting.

Petitioner contends at least the portion of claim 11’s preamble reciting “*on a semiconductor die*” is not limiting. Outside of the preamble, “*semiconductor die*” does not appear in claim 11, or its dependent claims, and thus does not provide antecedent basis for any limitations. PO’s argument that the entire preamble is limiting where only a portion provides antecedent basis for the “*first inductor*” is inconsistent with Federal Circuit precedent. *TomTom, Inc. v. Adolph*, 790 F.3d 1315, 1323 (Fed. Cir. 2015).

“*Semiconductor die*” is **not** limiting because it “does not recite essential structure or steps, or give necessary life, meaning, and vitality to the claim.” *TomTom*, 790 F.3d at 1323. “*Semiconductor die*” merely describes a purpose or intended use. The claim body recites complete structure without “*semiconductor die*.” *Id.*; *Catalina Mktg. Int’l, Inc. v. Coolsavings.com, Inc.*, 289 F.3d 801, 809 (Fed. Cir. 2002); *Arctic Cat Inc. v. GEP Power Prods., Inc.*, 919 F.3d 1320, 1329 (Fed. Cir. 2019). Unlike the preamble in *Bio-Rad Labs, Inc. v. 10X Genomics Inc.*, 967 F.3d 1353 (Fed. Cir. 2020) (*see* POR, 10), “on a semiconductor die” is easily parsed from the preamble without impacting the understandability or grammatical completeness of claim 11 and its dependent claims. *See, e.g., PACT XPP Schweiz AG v. Intel Corp.*, No. 1:19-CV-01006-JDW, 2020 WL 5821723, at *4 (D. Del. Sept. 30, 2020).

PO wrongly argues “*semiconductor die*” is a fundamental characteristic of the recited method and therefore limiting. (POR, 7-8.) As the Board found, “[e]ven though portions of the ’430 patent refer to semiconductor die or chip applications (*e.g.*, Ex. 1001, 1:27–61), neither the specification nor the claims are limited to such specific applications.” (ID, 17; *see also infra* §III.)

PO’s case law is distinguishable. In *Fought*, the entire preamble (“a travel trailer”) was limiting where it provided antecedent basis for a limitation reciting “the travel trailer.” *In re Fought*, 941 F.3d 1175, 1177, 1179 (Fed. Cir. 2019);

POR, 7. “*Semiconductor die*” does not modify or describe “*a first inductor*,” the portion of the preamble that provides an antecedent basis for the claim’s body, and thus is not a structural limitation.

Unlike the preamble in *Deere*, “*semiconductor die*” is not “necessary to understand the subject matter encompassed by the claim.” (POR 7.) In *Deere*, the preamble’s recitation of “rotary cutter deck” provided antecedent basis for “said deck” recited in the claim body, and was necessary to understand a structural limitation requiring “a box section having torsional stiffness”—“sufficient stiffness to withstand the torsional loads imposed by the operation of a rotary cutter.” *Deere & Co. v. Bush Hog, LLC*, 703 F.3d 1349, 1357-58 (Fed. Cir. 2012). By contrast, the ’430 patent specification’s broad descriptions of the purported invention, and claim 1’s recitation of similar limitations without a “*semiconductor die*,” confirm claim 11 is not limited to “*a semiconductor die*.” This is particularly true where claim 11 is directed to an apparatus and must, therefore, be structurally complete as recited. (*See infra* §III.)

In *Invitrogen*, the Court found the preamble phrase “improved competence” limiting because the applicant amended the claims to add this phrase to distinguish the prior art. *Invitrogen Corp. v. Biocrest Mfg., L.P.*, 327 F.3d 1364, 1370 (Fed. Cir. 2003). Here, Applicant did not amend the claims to add “*semiconductor die*” or rely on this phrase to distinguish prior art. Instead, Applicant broadened claim

11 by removing “said semiconductor substrate” from the claim’s body in rewriting original claim 11 as new claim 26 (issued claim 11). (INTEL-1002, 23, 72.)

PO argues a POSITA would conclude claim 11’s preamble is limiting because of the absence of a dependent method claim mirroring dependent claim 2. (POR, 10-11.) PO cites no authority supporting a conclusion that all apparatus claims must have corresponding method claims. And contrary to PO’s incorrect argument (POR, 11), none of claim 11’s dependent claims recite “*semiconductor die*.”

Petitioner’s position is also consistent with the construction from a previous ITC case, where the ALJ determined the preamble is limiting only to the extent it provides an antecedent basis for the “first inductor.” (INTEL-1019, 2-3.) PO failed to address this holding.

III. The Field of Endeavor is “Inductor Design.”

The ID correctly determined that the field of endeavor is “inductor design.” (ID, 17.) PO’s proposed additional limitation of “inductor design *for semiconductor*” is not supported. (POR, 13 (emphasis added).) To the contrary, PO’s cited passages describe specific, non-limiting embodiments and simulations. (See POR, 13, citing ’430 patent, 2:13-17 (referring to semiconductor die “in another aspect” of invention); 2:19-20 (same); 3:14-15 (method “may also be used ... on-chip”); 5:45-48 (describing exemplary simulations).) The full scope of the invention is not

so limited. (*See* ID, 17.)

PO ignores the specification's teaching that its techniques are broadly applicable. For example, the specification states "various embodiments of the invention provide an inductor design and method of implementing the same where mutual electromagnetic coupling is reduced" with no mention of semiconductor dies or chips. ('430 patent, 3:4-6; *see also id.*, 3:36-40 ("[A] person having ordinary skill in the art will appreciate that the inductor design and method *may be used to reduce coupling between two functional blocks of any type* so long as each contains one or more inductors."); 3:4-16 ("The inductor design and method *may also be used* to reduce the coupling between an inductor and another on-chip or external structure"); 5:32-39 (describing additional "more complex inductor designs").) Further, only two of the twenty-one issued claims even recite "*semiconductor die*"—dependent claim 2 and, only in a non-limiting manner in the preamble, claim 11. (*Id.*, cl. 2, 11; *infra* §11.)

PO attempts to bolster its field of endeavor argument by proposing a new definition of a POSITA to require, as an alternative to a master's degree, "a minimum of two years of experience designing integrated radiofrequency circuits *and* inductors for semiconductors." (POR, 4-5 (emphasis added).) PO argues this is consistent with Petitioner's expert's articulation. (*Id.*, 5.) However, this argument

is *inconsistent* with Dr. Tentzeris's proposal of experience designing "integrated circuits *or inductors*." (INTEL-1003, ¶58; INTEL-1043, ¶¶55-57.)

IV. Taniguchi and Rostoker are Analogous Art.

PO uses its newly proposed field of endeavor to argue Taniguchi and Rostoker are not analogous because (1) Taniguchi and Rostoker are directed to antennas, which PO alleges are not inductors (POR, 18-19, 22, 28, 48, 50-53); and (2) Taniguchi does not relate to an inductor layout on a semiconductor die (POR, 28). PO's first argument is wrong (*see below*) and the second is irrelevant (*see* §§III, V.A).

PO's myopic focus on the '430 patent and asserted prior art references' terminology, without regard to the substance of their disclosures, is misplaced. As explained in the Petition and Dr. Tentzeris's Declarations, Taniguchi and Rostoker's loop antennas are inductors. (Petition, 6-11; INTEL-1003, ¶¶85-93; INTEL-1043, ¶38-43; *see also* INTEL-1042, 1, 13-14 (USPTO Class 336 covers "inductor structure[s] ... which may be used as loop antennas" and classifying structures in Class 336 "[i]f the disclosure is a loop antenna, but the claims recite merely an inductor device," or in Class 343, Communications: Radio Wave Antennas, if what is claimed is "an antenna by name only.")) Loop antennas and inductors are both current-carrying loops formed of conducting material. (INTEL-1003, ¶¶23, 28, 85; INTEL-1043, ¶¶38, 41; *see also* INTEL-1001, 4:9-14.) Thus, the electromagnetic

fields produced by loop antennas and inductors of the same shape and carrying the same current are the same. (INTEL-1003, ¶25; INTEL-1043, ¶¶38, 41.) Even PO’s expert conceded—consistent with Petitioner’s evidence—that there is no meaningful difference between an inductor and a loop antenna in terms of their underlying physical principles. (INTEL-1044, 110:13-16; INTEL-1043, ¶41, 43; EX2010, 12:8-13:12, 14:24-15:3, 31:24-42:4, 32:15-19, 35:23-36:9, 37:12-18; INTEL-1045, 203, 214 (“[a] small loop ... is equivalent to an infinitesimal magnetic dipole” and “is primarily inductive”)) As the ID noted, the ’430 patent’s inductors are structurally similar to Taniguchi’s eight-shaped antennas and the ’430 patent explains how the characteristics of the electromagnetic field arise due to the equal and opposite current flow in the inductor’s loops. (ID, 18; INTEL-1001, 4:5–32.) In fact, Dr. Prucnal at times referred to Taniguchi’s antennas as “inductors” (INTEL-1044, 65:7-13) and the ’430 patent’s inductors as “antennas” (INTEL-1044, 108:12-15).

In arguing Taniguchi is not analogous, PO improperly focuses on Taniguchi’s disclosures related to coupling between antennas and *tags* used in retail anti-theft systems. (POR, 28.) Taniguchi’s tags are irrelevant; Petitioner maps only the two antennas of Taniguchi’s identification apparatus to the two inductors of the challenged claims. (Petition, 30-43; INTEL-1044, 139:13-18.) PO admits Taniguchi discloses reduced electromagnetic coupling between the two antennas/inductors of the identification apparatus. (*See* POR, 33 (“antennas 1 and 2 [are] in close

proximity without EM coupling with each other”).) And Taniguchi teaches alternative applications with smaller form factors, such as an “electronic coupon ticket system.” (Petition, 56-57; INTEL-1005, ¶¶1-2, INTEL-1003, ¶203.)

Contrary to PO’s assertion, Rostoker does not “distinguish[] ‘antennas’ from ‘inductors.’” (POR, 48.) While Rostoker uses both terms, as explained above and in the Petition, a loop antenna is an inductor, but not all inductors are antennas and not all antennas are loop antennas. (Petition, 11; INTEL-1003, ¶93; INTEL-1042, 13-14.). Nor does the application of Taniguchi’s and Rostoker’s antennas to non-contact identification systems change the fact that the fundamental physics of loop antennas and inductors are the same, or obviate their relevance as analogous art.

PO further argues Taniguchi is not reasonably pertinent because it is directed to “the problem of too little mutual magnetic coupling between” large antennas. (POR, 28.) PO ignores Taniguchi’s disclosures, that like the ‘430 patent, address the problem of efficient circuit design. (Petition 56, 3-4, 31-36, 42-43; INTEL-1003, ¶¶69-73, 138-166 (reduced EM field of Taniguchi’s antenna/inductor 1 allows closer placement to antenna/inductor 2), 203; INTEL-1001, 1:26-28 (describing advances driving the need to place inductors closer to other circuit components, 1:29-40 (explaining efficient circuit design hampered because circuitry producing EM fields cannot be placed in close proximity due to mutual coupling); *see also id.* Abstract, 3:4-18, 1:66-2:2, 3:36-40, 7:19-63, Table 2 (addressing problem of

efficient placement of inductors in a circuit by reducing EM field generated by an inductor which in turn reduces EM coupling with other components); INTEL-1005, ¶¶1, 16, 49-50, 55, 73) and Taniguchi’s goal of “mak[ing] a data communication apparatus which is *small-sized*, lightweight and high in performance.” (Petition, 56; INTEL-1005, ¶¶22, 86, 95.)

Rostoker is also pertinent to efficient circuit design by recognizing the need to integrate antennas/inductors with other circuitry. (Petition, 56; INTEL-1006, 1:10-15, Abstract, 3:55-57.) Thus, Taniguchi and Rostoker are reasonably pertinent because “the matter with which [they] deal[]” would have logically “commended [them] to an inventor’s attention in considering his [or her] problem.” *In re ICON Health & Fitness, Inc.*, 496 F.3d 1374, 1379-1380 (Fed. Cir. 2007). Even Applicant deemed PCB references relevant by disclosing several during prosecution. (*Infra*, §V.A.)

V. PO Does not Overcome Petitioner’s Unpatentability Showing.

A. A POSITA Would Recognize the Applicability of PCB Teachings to ICs and IC Teachings to PCBs.

As of the ’430 patent’s priority date, inductors for use in both PCB and IC applications were well known. (INTEL-1043, ¶¶49-54.) In either application, the fundamental physics governing the electromagnetic fields produced by inductors is the same. (*Id.*, ¶51.) Techniques for miniaturization of electronic components, including inductors, were also well-known, and spiral and loop inductors were scaled

for use in ICs before the priority date. (*Id.*, ¶¶45-47; EX2010, 10:23-11:17; INTEL-1046, 4:3-25 (describing miniaturized inductors for use on semiconductors); Petition, 56-57, 60 (citing references disclosing coils on chips).)

PO's expert states, without support, that Taniguchi and Midya are not applicable to inductors on ICs because inductors on PCBs are "orders of magnitude larger." (*See* POR, 2-3, 26, 46-47, 55, 57; EX2002, ¶¶22, 89.) Regarding Brooks, PO argues a POSITA "would have been motivated to follow the CMOS layout rules" in designing a semiconductor chip rather than the PCB teachings from Brooks. (POR, 26, 69; EX2009, ¶36.) PO again cites no support for this statement and does not even explain what the CMOS layout rules are or how they meaningfully differ from PCB design. *Id.* These conclusory statements should not be credited. *TQ Delta, LLC v. Cisco Sys., Inc.*, 942 F.3d 1352, 1358–59 (Fed. Cir. 2019).

These statements are also incorrect—at the time of alleged invention, a POSITA would have recognized the applicability of PCB design principles to IC design. (INTEL-1043, ¶¶43-47, 49-54; INTEL-1047, 670 ("anticipated IC design environment is similar to the PCB design environment"); INTEL-1048, 164 (noting "parallel between leading-edge PCB design and IC design"); INTEL-1049, 28 (noting methods "[s]uccessfully used in the world of printed circuit board design" applicable to SOC design). Further, while Midya includes embodiments directed to inductors on PCBs, Midya states that these embodiments are "illustrative and not

restrictive.” (INTEL-1007, 22:14-16.) In fact, Midya’s claims 1-4 do not recite a PCB. (INTEL-1007, claims 1-10.)

It is also irrelevant that neither Taniguchi nor Midya states its teachings are applicable to ICs, or that Rostoker and Raghavan do not state their teachings apply equally to PCBs. (*See* POR, 2-3, 31, 46-47, 55-57, 65.) A reference need not explicitly disclose all potential applications for its teachings for a POSITA to appreciate its relevance to those applications. *See KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 402, (2007) (“It is common sense that familiar items may have obvious uses beyond their primary purposes...”); *see also Intel Corp. v. Qualcomm Inc.*, 2022 WL 880681, at *4 (Fed. Cir. Mar. 24, 2022) (nonprecedential) (holding Board’s requirement that both references in obviousness combination teach “carrier aggregation” was error).

PO’s argument that PCB inductor and IC inductor teachings are not applicable to each other is at odds with its argument that Taniguchi is less material than other references cited during prosecution. (POR, 18-19.) Petitioner disagrees Taniguchi is less material; however, several of the allegedly more material references cited by Applicant during prosecution are directed to inductors for PCBs. (*See, e.g.*, EX2007; INTEL-1052; INTEL-1007.)

Petitioner established the relevance of the teachings from Taniguchi, Midya, and Brooks and motivation to combine in the Petition; PO has failed to rebut this

showing. (Petition, 6-11, 54-60, 65-74, 105-06; INTEL-1003, ¶¶201-10, 239-47, 323-27, 336-39.)

B. A POSITA Would Have Been Motivated to Modify Taniguchi.

Petitioner established a POSITA would have understood Taniguchi's antennas to be inductors that generate magnetic fields when current flows through them. (Petition, 6-11; *supra* §IV.) Contrary to PO's assertion, Taniguchi does not teach away from the invention of the '430 patent. (POR, 30-31.) A reference does not teach away if it does not "criticize, discredit, or otherwise discourage" investigation into the invention claimed. *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004).

To the extent PO argues Taniguchi teaches away because Taniguchi's antennas promote rather than reduce electromagnetic coupling between the antennas and tags (POR, 29-30, 36-37), this is irrelevant because Petitioner relies only on Taniguchi's teachings as to its two antennas/inductors, not the tags. (Petition, 5-22.) Furthermore, PO's expert admitted that the coupling that is allegedly promoted is *not* between inductor/antenna 1 and the tags, but rather between inductor/antenna 2 and the tags or the combined inductor/antenna 1 and 2 and the tags. (INTEL-1044, 69:14-70:8 (admitting tag 211 does not couple with figure-8 antenna), 72:22-73:9 (same), 96:7-97:5 (same).) Indeed, PO admits there is reduced electromagnetic coupling between Taniguchi's inductor/antenna 1 and inductor/antenna 2. (POR, 33; EX2002, ¶51.) This is what the challenged claims require.

PO further argues Taniguchi is inapplicable because Taniguchi requires concentrically positioned antennas. (POR, 31-35.) PO's argument is based on an erroneous construction of "*predetermined distance*." (POR, 32, 33.)

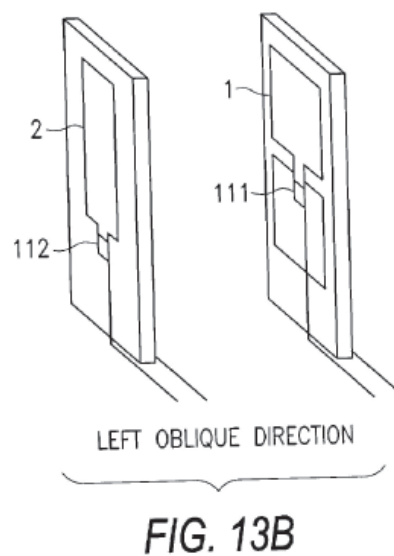
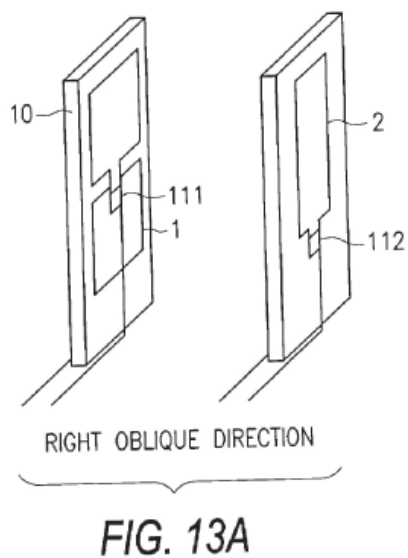
To the extent the Board entertains PO's idiosyncratic definition of "*predetermined distance*" despite PO's failure to request construction of this term (*see* POR 5-12), PO's citations do not support this construction. (POR, 32.) Each citation references simulations performed on layouts involving inductors at various center-to-center distances. None define or even mention the term "*predetermined distance*," or purport to mandate that the claimed inductors must be arranged in a particular manner. (*See* INTEL-1001, Figs. 6, 8, 12 and 6:60-61, 7:20-21, 9:3-5.) PO attempts to improperly limit the claims' scope to a preferred embodiment.

The claims require only that the inductors are positioned at some predetermined distance at which there is reduced mutual electromagnetic coupling. (*See, e.g.,* INTEL-1001, claim 1.) PO has identified no lexicography, disclaimer, or disavowal that would justify requiring the inductors to be laterally displaced from one another. *Cont'l Cirs. LLC v. Intel Corp.*, 915 F.3d 788, 797 (Fed. Cir. 2019). Further, a POSITA would not understand the claims to be so limited. (INTEL-1043, ¶¶58-59.) Thus, PO's arguments against motivation for the Taniguchi grounds are unavailing, where PO admits that Taniguchi discloses its layout results in reduced

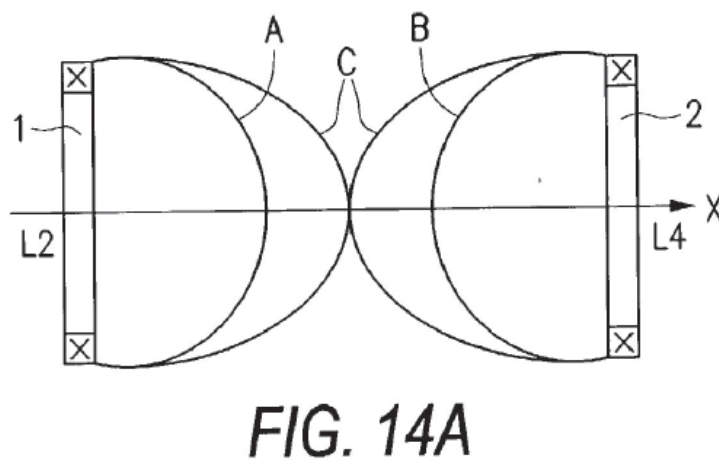
electromagnetic coupling between the two antennas/inductors, as required by the claims. (POR, 33.)

Relying exclusively on the supplemental Prucnal declaration, PO further argues a POSITA would not have looked to Taniguchi's concentric antennas because it would be difficult to make this arrangement work on a semiconductor chip. (POR, 36; EX2009, ¶¶48-50.) The Board should not credit PO's expert's conclusory statements. *TQ Delta*, 942 F.3d at 1358–59. And, as explained above, apart from dependent claim 2, the challenged claims are not limited to inductors/antennas on a semiconductor die. (*Supra* §II.) Furthermore, the use of planar concentric inductors on ICs was well known at the time of the invention. (INTEL-1043, ¶60; *see, e.g.*, INTEL-1006, 10:1-63, Fig. 7A; INTEL-1050, 1:4-10; 2:62-66.)

PO also erroneously argues “the fields from antennas 1 and 2 in the area between the two antenna gates” of Taniguchi, as allegedly shown in Figure 14A, “are sufficiently strong to communicate with the tags” to support its positions. (POR, 34.) However, this is a misstatement of how the antennas/inductors are arranged in the gates. As shown in Figures 13A & 13B, each gate includes a figure-8 antenna/inductor on the inside of the gate and a simple loop antenna/inductor on the outside of the gate. (INTEL-1005, ¶81; Figs. 13A, 13B.)



The magnetic field shown in Figure 14A is the **net** field produced by **both** antennas/inductors in **each** gate. (*Id.*, ¶83, Fig. 14A.) PO's expert admitted this at deposition. (INTEL-1044, 81:10-16.) And that net field effect is irrelevant to the challenged claims' requirement of a "first inductor having a reduced electromagnetic field," which Taniguchi teaches. (Petition, 14-18; INTEL-1005, ¶¶94-95.)



C. Taniguchi Renders Obvious Claims 1, 3-5, 7, 10-11, 13-15, 17, and 19.

1. Taniguchi discloses “reducing mutual electromagnetic coupling between a first inductor and a second inductor on a semiconductor die.” [11P]

Petitioner established Taniguchi discloses [11P]. (Petition, 31-35; INTEL-1003, ¶167.) As explained above, claim 11’s preamble is not limiting at least as to a semiconductor die. *Supra* §II. Nor does claim 11 require the first inductor and second inductor to be laterally displaced from one another. *Supra* §V.B. As PO acknowledges, Taniguchi’s “antenna 1 and 2 [are] in close proximity without EM coupling with each other.” (POR, 39.)

2. The “reduced far field” [1A1]/[1A2]/[11A1]/[11A2], and “reduced electromagnetic field” limitations [1B1]/[1B2]/[11B1]/[11B2]

PO argues that “*reduced far field*” should be construed consistent with the construction adopted in 337-ITC-1300, “(reduced/reduce) the electromagnetic field at a certain distance from the first inductor (where the second inductor is positioned).” (POR, 12.) Petitioner established the antennas in each of Taniguchi’s Figure 7, 8, and 9/10 embodiments result in a “reduced far field” and “reduced electromagnetic field” under both the ITC’s construction and to the extent described in the ’430 specification. (Petition, 14-18, 39-43; INTEL-1003, ¶¶83-84, 95, 97-100, 103-07; *see also Apple v. Valencell*, IPR2017-00315, Paper 45, 47-49 (PTAB May 31, 2018) (considering challenge to patentability even where claims found indefinite).)

As explained in the Petition, Taniguchi's antennas/inductors are "positioned at a predetermined distance from" each other. (Petition, 39-41.) PO argues Taniguchi's embodiments provide a magnetic field sufficient for mutual inductance coupling between the antenna and the tags, which are located "relatively far away" from the antenna. (POR, 42.) As explained in the Petition, Taniguchi's two antennas/inductors (in the Fig. 8 and 9/10 embodiments) are separated by a distance equal to the thickness of the insulation and thus are a predetermined distance apart. (Petition, 39-40.) In the Figure 7 embodiment, the sides of each antenna/inductor are separated by a specific distance. (Petition, 41.) Because the two loops of the eight-shaped antenna/inductor in each embodiment produce electromagnetic fields having opposite direction, the eight-shaped antenna/inductor has a reduced far field ***at the location of the second antenna/inductor***. (Petition, 14-17, 42; INTEL-1003, ¶¶100, 104; INTEL-1005, ¶¶55, 59, 94, 95.) Petitioner's expert performed simulations demonstrating the electromagnetic field produced by the eight-shaped antenna/inductor is constrained both laterally and vertically, such that the field strength decreases rapidly with increasing distance. (See ID, 19 (encouraging parties to develop record); INTEL-1043, ¶¶25-30). This is all the claims require under the ITC's construction, which PO advocated for, and is further consistent with how the '430 patent describes "*reduced far field*." (Petition, 5, 14-18.)

PO's expert suggests "far field" means a location at a distance from the inductor at which there are "uniformly symmetric field lines that cancel." (EX2009, ¶46.) Dr. Prucnal provides no support for such requirement. Dr. Prucnal further states "Taniguchi has no cancellation of the magnetic field whatsoever," but rather the currents are cancelled. (EX2009, ¶48.) This is incorrect. The flux lines of the magnetic field generated by the two loops of Taniguchi's eight-shaped antenna/inductor are equal and opposite in direction and therefore cancel, as shown in Dr. Tentzeris' simulations. (INTEL-1043, ¶¶24-25; Petition, 14-15; INTEL-1003, ¶¶116, 121-22, 139; INTEL-1005, ¶¶48, 63, 64, Fig. 4; *see also* Petition, 64 (discussing Saitoh's eight-shaped antenna.) Further, this is inconsistent with Dr. Prucnal's testimony in prior litigation that, "if current is flowing in opposite directions in two different conductors, the magnetic fields from the conductors will also be in opposite directions and tend to cancel each other out at locations away from those two conductors." (INTEL-1051, ¶64; *see also* INTEL-1001, 4:14-17.)

3. The "closely spaced" limitations [1A.3]/[11A.3]

Petitioner established the terminals of Taniguchi's Figures 7-8, and 9/10 embodiments are "closely spaced" relative to the width of the conductors, consistent with the '430 patent's disclosure. (Ppetition, 25-30; INTEL-1003, ¶¶126, 133.) Petitioner also met its burden to demonstrate the magnetic field contributions from the

terminals of Taniguchi's Figures 7-8, and 9/10 embodiments are minimized. (Petition, 28-30; INTEL-1003, ¶¶127, 134.) PO has not rebutted this showing.

PO argues the terminals in Taniguchi's one-meter long antennas are "not closely spaced relative to the semiconductor chip described in the '430 Patent." (POR at 43; EX2002, ¶64.) First, this comparison is irrelevant—claims 1 and 11 do not include limitations directed to a semiconductor chip. INTEL-1001, cls. 1, 11; *supra* §II. Second, this is the wrong comparison, and is inconsistent with PO's arguments in prior litigation. Dr. Prucnal previously opined that "mutual electromagnetic coupling between the two inductors is reduced *as long as the spacing between the terminals is close enough that magnetic field contributions from each of the two terminals tend to cancel each other out in the vicinity of the second inductor.*" (INTEL-1051, ¶64.) In other words, the terminals need to be "closely spaced" with respect to the rest of the circuit. The ALJ in 337-TA-1300 agreed and adopted PO's proposed construction of this term, explaining the relevant comparison is whether the terminals are closely spaced "relative to the proportions and locations of other claim elements." (INTEL-1020, 13.) Taniguchi's terminals are closely spaced relative to the proportions of other claim elements (e.g., the width of the inductor loop). (Petition, 27; INTEL-1003, ¶131.)

PO further argues Taniguchi's Figure 8B embodiment does not teach that placing the feeding points near each other minimizes the magnetic field

contributions from the terminals, but only that it is favorable for wiring. (POR 43; EX2002, ¶65.) But an explicit disclosure of the effect of closely-spaced terminals is not required; Brooks (INTEL-1010) confirms a POSITA's understanding that having terminals spaced closely together (including more closely than the inductor loop width)—as in Taniguchi's embodiments—minimizes magnetic field contributions from the terminals relative to when the terminals are placed farther apart. (Petition 28-29; INTEL-1003, ¶¶127-131, 134; INTEL-1010, 156-57.) PO does not dispute Brooks' disclosures or that they evidence a POSITA's understanding. (POR, 43-44; *see also* INTEL-1044, 132:7-12.)

4. The “predetermined distance” limitations [1B.1]/[11B.1]

Petitioner established Taniguchi's antenna/inductor 2 is positioned at a predetermined distance from antenna 1. (Petition, 39-41; INTEL-1003, ¶¶153, 158, 163.) PO's arguments about center distance are incorrect for the reasons explained in §V.B above.

D. Taniguchi-Rostoker Combination

Contrary to PO's argument (POR, 46), Petitioner explained claims 13-15, 17, and 19 are rendered obvious by the Taniguchi-Rostoker combination for the same reasons rendered obvious by Taniguchi, as explained in Ground 1. (Petition, 62.) Petitioner explained why the Taniguchi-Rostoker combination renders claim 18 obvious. (Petition, 63-65.)

1. A POSITA Would Have Been Motivated to Combine Taniguchi and Rostoker

As explained above and in the Petition, Taniguchi's and Rostoker's antennas are inductors. (Petition, 6-11; *supra* §IV.) In addition, a POSITA designing inductors for ICs would have sought out art relating to inductor design regardless of whether implemented on PCBs or ICs. (*Supra*, §V.A; INTEL-1043, ¶¶49-54.) Petitioner established, and PO has not effectively rebutted, that Taniguchi and Rostoker are analogous art and a POSITA would have been motivated to integrate Taniguchi's antennas/inductors onto Rostoker's chip. (Petition, 54-62.)

PO repeats its arguments as to Taniguchi individually from Ground 1 and further argues Rostoker individually teaches away for reasons related to Rostoker's antenna. (POR, 47-48; Ex. 2009, ¶¶25-26, 53-56.) But Petitioner's combination uses Taniguchi's antennas on Rostoker's chip, so PO's arguments are irrelevant to the Taniguchi-Rostoker combination. (Petition, 60-62.) Similarly, PO argues Rostoker does not teach a first and second inductor on a single semiconductor die because Rostoker is directed to antennas. (POR, 52-53.) As explained above and in the Petition, Rostoker's loop antennas are inductors. (Petition, 11; INTEL-1003, ¶¶85-93; *supra* §V.A; INTEL-1006, Abstract, 8:64-9:42, 10:9-46.) PO acknowledges Rostoker's antennas are integrated on a chip. (POR, 53.) Moreover, PO's attempt to distinguish Rostoker's antennas from inductors because Rostoker also refers to inductors (*see* POR 48, 52-53) is misguided (*see supra* §IV), where

Rostoker teaches that inductors may also be integrated on a chip. (INTEL-1006, 4:21-22.) At bottom, PO's arguments improperly focusing on the references individually and failing to address the presented Taniguchi-Rostoker combination should not be credited. *See Enzo Life Scis., Inc. v. Becton, Dickinson & Co.*, 780 F. App'x 903, 910 (Fed. Cir. 2019) (citing *In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986)).

PO's arguments that Saitoh does not provide motivation to combine similarly fail. Saitoh's antenna is an inductor for the same reasons explained above and in the Petition. (*Supra* §IV.) Saitoh discloses an eight-shaped inductor, like Taniguchi, and teaches cancellation of mutual magnetic fields between the transmitting and receiving antennas by setting the "coil parameters," including by increasing the number of turns in the loop. (Petition, 64; INTEL-1003, ¶¶225-28; INTEL-1023, 7:57-65, 6:27-31, 11:1-20.) Indeed, PO admits "Saitoh indicates the number of turns of a loop coil of a transmitting antenna is one of many factors that may influence magnetic field intensity" (POR 52); that admitted teaching demonstrates motivation to use multiple turns in an 8-shaped inductor.

PO argues a POSITA would not have had a reasonable expectation of success in using an eight-shaped inductor in a semiconductor chip because the prior art Petitioner relies on only taught spiral or O-shaped inductors on semiconductor chips. (POR, 49; EX2002, ¶78.) But PO does not explain why an eight-shaped

inductor presents any special challenge for integrating onto a chip. Further, Rostoker describes fabricating antennas of various configurations—including loop antennas—on a chip using well-known processes, demonstrating it was well-known in the art how to fabricate antennas/inductors on a single chip; Taniguchi supplies the teaching of using eight-shaped antennas/inductors. (Petition 59-60; INTEL-1006, Abstract, 4:11-14, 9:19-21, 10:61-63; INTEL-1005, ¶¶72-73, 77.)

E. Midya-Raghavan Combination

Midya and Raghavan are analogous art. As explained above, a POSITA designing inductors for ICs would have sought out art related to inductor design, regardless of whether such designs were implemented on PCBs or ICs and thus would have been motivated to combine the teachings of Midya and Raghavan. (*Supra*, §V.A; INTEL-1043, ¶¶64-65.)

PO argues a POSITA would not have been motivated to combine Midya and Raghavan based on the disclosures of the individual references rather than the combination. (POR, 56-57.) Similarly, PO argues the combination does not render the claims of the '430 patent obvious because the references individually do not disclose certain limitations. (POR, 55-64.) This improper focus on the individual references rather than the combination should not be credited. *See Enzo Life Scis.*, 780 F. App'x at 910; *see also* ID, 23).

As to claims 1 and 11, PO's only substantive argument directed to the Midya-Raghavan combination is that inserting four of Raghavan's inductors into Midya's layout "would not repair the asymmetry produced by the interconnections required to connect the four inductors." (POR, 59; EX2009, ¶57.) But the '430 patent claims do not require perfect symmetry, just "substantial" symmetry. *See, e.g.*, cls. 1, 11.) This alleged asymmetry does not materially impact the reduced far field achieved using the four-loop inductor layout of the Midya-Raghavan combination at least because the interconnects themselves have equal and opposite current, such that the magnetic fields produced by those interconnections will cancel. (INTEL-1049, ¶65.) PO has not attempted to explain how or why the additional interconnections impact the far field and merely parrots the conclusory statements from its expert. (POR, 59; EX2009, ¶57.) These conclusory statements should be given little weight.

F. Gardner Grounds

Gardner is used in combination with Midya and Raghavan in Ground 4 and additionally with Brooks in Ground 8. (Petition, 101-04.) As explained above, a POSITA designing inductors for ICs would have sought out art related to inductor design, regardless of whether implemented on PCBs or ICs and thus would have been motivated to combine the teachings of Gardner with those of Midya, Raghavan, and Brooks. (*Supra*, §V.A; INTEL-1043, ¶¶49-54, 66-67.)

Gardner does not teach away. PO argues because Gardner’s terminals are perpendicular to each other, they cannot cancel each other’s electromagnetic fields. (POR, 66; Ex. 2009, ¶58.) This is irrelevant—the Petition does not rely on the shape or design of Gardner’s inductors, but rather Gardner’s teachings that inductors can be integrated on an IC. (Petition, 101-02.) A POSITA would have understood Gardner’s teachings to apply to inductors generally. (INTEL-1043, ¶67; INTEL-1009, ¶[0003].) PO again improperly focuses on the individual references instead of the combination. *See Enzo Life Scis.*, 780 F. App’x at 910.

G. Brooks Grounds

Grounds 5-8 include Brooks in combination with the Grounds 1-4 art. As explained in the Petition, Brooks explicitly discloses the “closely spaced” and “minimizing magnetic field contributions from the terminals” limitations of claims 1 and 11. (Petition, 104-06.) Brooks teaches the basic principle that when two wires carry a signal and return current (like the terminals of the ’430 patent inductor layouts), the currents are equal and opposite and the magnetic fields produced by those current carrying wires will be equal and opposite. (INTEL-1003, ¶¶127.) Brooks teaches that when the wires are “very close together, their EMI radiations would completely cancel and would not be measurable.” (*Id.*, ¶128; INTEL-1010, 157.)

PO criticizes Dr. Tentzeris for allegedly not providing any “testing or methodology to show that the terminals in Taniguchi are close enough to [sic] that the

magnetic fields are minimized or cancelled.” (POR, 68; Ex. 2009, ¶59.) But this is irrelevant as for these Grounds, Petitioner explicitly relies on Brooks to provide the closely spaced limitation. (Petition, 104-06.) Furthermore, Dr. Tentzeris explained how to identify the direction and relative magnitudes of the magnetic fields produced by the current flowing in each terminal. (INTEL-1003, ¶¶127-28, 335.) Dr. Tentzeris further explained that summing those contributions results in approximately zero net magnetic field. (*Id.*)

PO relies on a single paragraph in the supplemental Prucnal declaration, which itself has no supporting citations and merely notes that “Brooks has no applicability to ICs.” (EX-2009, ¶60.) As explained above, a POSITA designing inductors for ICs would have sought out art related to inductor design, regardless of whether implemented on PCBs or ICs and thus would have been motivated to combine Brooks with Taniguchi. (*Supra*, §V.A; INTEL-1043, ¶¶49-54.)

PO further argues “there are problems with noise, capacitance, and complexity of conductive traces, such as capacitive crosstalk between the interconnect lines.” (POR at 26, 51, 68-69.) This statement in the POR merely parrots PO’s expert’s conclusory statement. *TQ Delta*, 942 F.3d at 1358–59. Dr. Prucnal does not explain what the alleged “problems” are or why the potential for noise or capacitive crosstalk would dissuade a POSITA from combining the teachings of Taniguchi and Brooks. (EX2002, ¶82.) In fact, the portion of Brooks Dr. Prucnal relies on

refers to conductive traces that are not connected and carry different signals (EX2002, ¶82, 111; INTEL-1010, 222); this is not applicable to Taniguchi's terminals, which are connected (i.e. part of the same wire or conductive trace) and therefore carry the same signal. (INTEL-1043, ¶68-70.)

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CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24(d), the undersigned certifies that this Reply to Patent Owner's Response complies with the type-volume limits of 37 C.F.R. § 42.24(c)(1) because it contains 5,593 words according to the word-processing system used to prepare this Reply, excluding words in the Table of Contents, Table of Authorities, List of Exhibits, and Certificate of Service. This word count was prepared using Microsoft Word.

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The undersigned hereby certifies that on April 15, 2024, a copy of the foregoing Reply to Patent Owner's Preliminary Response was served via email on the following attorneys for the Patent Owner:

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