

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ADVANCED MICRO DEVICES, INC.,
Petitioner

v.

REALTEK SEMICONDUCTOR CORPORATION,
Patent Owner

CASE: IPR2023-00789
U.S. PATENT NO. 7,936,245

PATENT OWNER'S PRELIMINARY RESPONSE

TABLE OF CONTENTS

I.	INTRODUCTION	- 1 -
II.	SUMMARY	- 3 -
III.	OVERVIEW OF THE '245 PATENT	- 5 -
A.	Problem Addressed by the '245 Patent	- 7 -
B.	Challenged Claims	- 8 -
C.	Fundamental Differences Between Inductors and Transformers- 10 -	
D.	Person Having Ordinary Skill in the Art.....	- 14 -
IV.	CLAIM CONSTRUCTION	- 14 -
V.	THE PETITION DOES NOT ESTABLISH A REASONABLE LIKELIHOOD THAT THE CHALLENGED CLAIMS WOULD HAVE BEEN OBVIOUS BASED ON <i>HO-HSIANG</i> ..	- 21 -
A.	Obviousness Standard	- 21 -
B.	<i>Ho-Hsiang</i> Does Not Render the Challenged Claims Obvious ..	- 22 -
1.	<i>Ho-Hsiang</i> Fails to Disclose Material Limitations of the Challenged Claims.....	- 22 -
a.	Analogous Art Test.....	- 22 -
b.	<i>Ho-Hsiang</i> is specifically directed to transformers and not reasonably pertinent to the problem addressed by the '245 Patent.....	- 24 -
2.	<i>Ho-Hsiang</i> Does Not Disclose a “Spiral Inductor”, which is a Material Limitation of the Challenged Claims	- 31 -

3.	<i>Ho-Hsiang</i> Does Not Disclose the Construction of “Shunt Windings” from the Metal Layers of a “Crossover Region” of the Challenged Claims	- 33 -
4.	Petitioner Provides No Motivation to Modify <i>Ho-Hsiang</i> to Achieve the Invention of the Challenged Claims	- 36 -
VI.	THE PETITION DOES NOT ESTABLISH A REASONABLE LIKELIHOOD THAT THE CHALLENGED CLAIMS WOULD HAVE BEEN OBVIOUS BASED ON <i>CHRISTENSEN</i>	- 37 -
A.	<i>Christensen</i> Does Not Render the Challenged Claims Obvious.-	37 -
1.	<i>Christensen</i> Fails to Disclose Material Limitations of the Challenged Claims.....	- 37 -
2.	Petitioner Misrepresents the <i>Christensen</i> Disclosure.....	- 39 -
3.	<i>Christensen</i> Does Not Disclose a “Spiral Inductor,” which is a Material Limitation of the Challenged Claims	- 45 -
4.	<i>Christensen</i> Does Not Disclose the Construction of “Shunt Windings” from Metal Layers of a “Crossover Region” of the Challenged Claims	- 46 -
5.	Petitioner Provides No Motivation to Modify <i>Christensen</i> to Achieve the Invention of the Challenged Claims	- 48 -
VII.	THE PETITION DOES NOT ESTABLISH A REASONABLE LIKELIHOOD THAT THE CHALLENGED CLAIMS WOULD HAVE BEEN OBVIOUS BASED ON <i>YANG</i>	- 48 -
A.	Summary of <i>Yang</i>	- 48 -

B.	<i>Yang</i> Does Not Disclose Material Limitations of the Challenged Claims.....	- 49 -
1.	<i>Yang</i> Does Not Disclose a “Sixth Segment” or a “Crossover Region” as Required by the Challenged Claims	- 49 -
2.	<i>Yang</i> Does Not Disclose the Construction of “Shunt Windings” from Metal Layers from a “Crossover Region” of the Challenged Claims	- 54 -
3.	Petitioner Provides No Motivation to Modify <i>Yang</i> to Achieve the Invention of the Challenged Claims .	- 56 -
VIII.	CONCLUSION.....	- 57 -

TABLE OF AUTHORITIES

	Page(s)
Cases	
<i>Applied Materials, Inc. v. Advanced Semiconductor Materials Am., Inc.</i> , 98 F.3d 1563 (Fed. Cir. 1996)	19
<i>Arendi S.A.R.L. v. Apple Inc.</i> , 832 F.3d 1355 (Fed. Cir. 2016)	22
<i>Arris Int’l PLC v. Sony Corp.</i> , IPR2016-00828, Paper 10 (PTAB Oct. 7, 2016).....	30
<i>In re Baxter Int’l, Inc.</i> , 678 F.3d 1357 (Fed. Cir. 2012)	21
<i>In re Bigio</i> , 381 F.3d 1320 (Fed. Cir. 2004)	23
<i>C.W. Zumbiel Co. v. Kappos</i> , 702 F.3d 1371 (Fed. Cir. 2012)	16
<i>Catalina Market. Intern. v. Coolsavings.com</i> , 289 F.3d 801 (Fed. Cir. 2002)	18
<i>Chemours Co. FC, LLC v. Daikin Indus., Ltd.</i> , 4 F.4th 1370 (Fed. Cir. 2021)	23
<i>Circuit Check Inc. v. QXQ Inc.</i> , 795 F.3d 1331 (Fed. Cir. 2015)	3, 23
<i>In re Clay</i> , 966 F.2d 656 (Fed. Cir. 1992)	24, 26
<i>Corning Glass Works v. Sumitomo Electric U.S.A., Inc.</i> , 868 F.2d 1251 (Fed. Cir. 1989)	18
<i>Deere & Co. v. Bush Hog, LLC</i> , 703 F.3d 1349 (Fed. Cir. 2012)	16, 20

<i>Donner Tech., LLC v. Pro Stage Gear, LLC</i> , 979 F.3d 1353 (Fed. Cir. 2020)	23
<i>Eli Lilly & Co. v. Actavis Elizabeth LLC</i> , 435 F. App'x 917 (Fed. Cir. 2011)	54
<i>Endo Pharms Sol'ns, Inc. v. Custopharm Inc.</i> , 894 F.3d 1374 (Fed. Cir. 2018)	57
<i>In re Geisler</i> , 116 F.3d 1465 (Fed. Cir. 1997)	42
<i>General Electric Co. v. Nintendo Co.</i> , 179 F.3d 1350 (Fed. Cir. 1999)	18
<i>Himpp v. Hear-Wear Techs., LLC</i> , 751 F.3d 1362 (Fed. Cir. 2014)	56
<i>In re ICON Health & Fitness, Inc.</i> , 496 F.3d 1374 (Fed. Cir. 2007)	22
<i>Johns Manville Corp. v. Knauf Insulation, Inc.</i> , IPR2018-00827, Paper 9 (PTAB Oct. 16, 2018)	22
<i>Magnum Oil Tools Int'l, Ltd.</i> , 829 F.3d 1364 (Fed. Cir. 2016)	21
<i>PAR Pharm., Inc. v. TWI Pharms., Inc.</i> , 773 F.3d 1186 (Fed. Cir. 2014)	53
<i>In re Pearson</i> , 494 F.2d 1399 (CCPA 1974)	42
<i>PersonalWeb Techs. LLC v. Int'l Bus. Mach. Corp.</i> , No. 16-cv-01266-EJD, 2017 WL 2180980 (N.D. Cal. May 18, 2017)	17, 31
<i>Phillips v. AWH Corp.</i> , 415 F.3d 1303 (Fed. Cir. 2005) (en banc)	14
<i>Poly-America, L.P. v. GSE Lining Technology, Inc.</i> , 383 F.3d 1303 (Fed. Cir. 2004)	18

<i>Proveris Scientific Corp. v. Innovasystems, Inc.</i> , 739 F.3d 1367 (Fed. Cir. 2014)	20
<i>Rowe v. Dror</i> , 112 F.3d 473 (Fed. Cir. 1997)	19
<i>SEVEN Networks, LLC v. Apple Inc.</i> , No. 2:19-CV-115-JRG, 2020 WL1536152 (E.D. Tex. Mar. 31, 2020)	17
<i>Starhome GmbH v. AT&T Mobility LLC</i> , 743 F.3d 849 (Fed. Cir. 2014)	14
<i>Super Interconnect Techs. LLC v. Huawei Device Co.</i> , No. 2:18-CV-462-JRG, 2020 WL 60145 (E.D. Tex. Jan. 6, 2020)	17, 31
<i>Therasense, Inc. v. Becton, Dickinson & Co.</i> , 593 F.3d 1325 (Fed. Cir. 2010)	22
<i>TomTom, Inc. v. Adolph</i> , 790 F.3d 1315 (Fed. Cir. 2015)	16, 17
<i>Unwired Planet, LLC v. Google Inc.</i> , 841 F.3d 995 (Fed. Cir. 2016)	23
<i>In re Wesslau</i> , 353 F.2d 238 (C.C.P.A. 1965)	54
<i>Whirlpool Corp. v. TST Water, LLC</i> , No. 2:15- CV-1528-JRG, 2016 WL 3959811 (E.D. Tex. Jul. 22, 2016)	16
Statutes	
35 U.S.C. § 103	3, 21
35 U.S.C. § 314(a)	3
Other Authorities	
37 C.F.R. § 42.107(a).....	1

IPR2023-00789
U.S. Patent No. 7,936,245
Patent Owner Preliminary Response

37 C.F.R. § 42.108(c).....	3
77 Fed. Reg. 48,756 (Aug. 14, 2012)	3
77 Fed. Reg. 48,764 (Aug. 14, 2012)	3

EXHIBIT LISTING

Exhibit No.	Description
2001	<i>In the Matter of Certain Integrated Circuits, Components thereof, and Products Containing the Same</i> , Inv. No. 337-TA-1350, Order No. 21: Construing Terms of the Asserted Patents (July 25, 2023)
2002	Dae-Hee Weon <i>et al.</i> , <i>High Performance 3-D Helical RF Transformers</i> , IEEE MTT-S Microwave Symposium digest. IEEE MTT-S International Microwave Symposium, Jun. 2007, pp. 1897–1900.

I. INTRODUCTION

Patent Owner, Realtek Semiconductor Corporation, (“Realtek”), respectfully submits this Patent Owner Preliminary Response (POPR) pursuant to 37 C.F.R. § 42.107(a) to the IPR petition (“Petition”) filed by Advanced Micro Devices, Inc. (“AMD” or “Petitioner”) for certain claims of U.S. Patent 7,936,245 (“the ’245 Patent”, Ex.1001). The “Challenged Claims” are 1–5, 8 and 9 of the ’245 Patent.

AMD seeks review of the Challenged Claims of the ’245 Patent, which relate to a stacked structure of a spiral inductor. The Petition includes the following three grounds with respect to the Challenged Claims of the ’245 Patent:

- Ground 1: Claims 1, 2, 5, 8 and 9 are obvious based on *Ho-Hsiang*;
- Ground 2: Claims 1, 2, 8 and 9 are obvious based on *Christensen*; and
- Ground 3: Claims 1–4, 8 and 9 are obvious based on *Yang*.

In all three Grounds, AMD fails to identify a single credible reference that discloses every claim element of the Challenged Claims. AMD thus fails to demonstrate obviousness by a preponderance of the evidence and cannot prevail.

The fact that AMD turns to transformer art in Ground 1 and Ground 2 is telling. Both Ground 1 and Ground 2 are specifically directed to transformers references and not reasonably pertinent to the technical problem identified and addressed in the ’245 Patent. In an order dated July 25, 2023, in the concurrently

pending ITC investigation involving these same parties and this same patent, Administrative Law Judge Cameron Elliot construed “[a] structure of a spiral inductor” in claim 1 of the ’245 Patent as limiting. *See In the Matter of Certain Integrated Circuits, Components thereof, and Products Containing the Same*, Inv. No. 337-TA-1350, Order No. 21: Construing Terms of the Asserted Patents, at 13-16 (July 25, 2023) (Ex.2001). As the Order correctly held, because (a) the “spiral inductor” of the preamble provides an antecedent basis for the Challenged Claims, and (b) the “spiral inductor” is critical to the claimed inventions, the preamble is a material limitation of the Challenged Claims. The asserted art for Grounds 1 and 2 fails to disclose this material limitation, and a person of ordinary skill in the art (POSITA) would not have considered the teachings of the asserted art of Grounds 1 and 2 to achieve the objective of designing a stacked spiral inductor to optimize quality factor. The asserted art for Ground 3 is directed to an inductor but fails to disclose multiple material limitations of the claims (so much so that AMD is resigned to shameless annotate the art to add such limitations to the disclosure).

For Grounds 1, 2 and 3, AMD’s obviousness case requires multiple supplements and modifications to the asserted art that simply are not taught or suggested in these references themselves or otherwise supported by record evidence. That is, the Petition relies on art that fails to disclose material limitations of the

Challenged Claims.

Accordingly, AMD's petition fails to establish a reasonable likelihood of prevailing on any Challenged Claims under 35 U.S.C. § 314(a), and the Board should decline to institute *inter partes* review.

II. SUMMARY

AMD has not established a reasonable likelihood of prevailing as to any Challenged Claims. *See* 35 U.S.C. § 314(a); 37 C.F.R. § 42.108(c). AMD asserts three grounds of unpatentability under 35 U.S.C. § 103, all of which rely on single reference obviousness. As this Board has recognized, an IPR petition should be denied where, for example, “[t]he prior art lacks a material limitation in all of the independent claims.” Office Patent Trial Practice Guide, 77 Fed. Reg. 48,756, 48,764 (Aug. 14, 2012). The Board should do the same here.

For Ground 1, AMD relies on *Ho-Hsiang* for the alleged teaching of a “spiral inductor.” However, *Ho-Hsiang* is directed to on-chip transformer balun (balanced to unbalanced transformer) structures that are fundamentally different from stacked spiral inductors and fails to disclose several material limitations of the Challenged Claims. *See* MPEP § 2141.01(a) (9th ed. Rev. 7.2015, Nov. 2015) (explaining that, to rely on a reference for purposes of 35 U.S.C. § 103, the reference must be analogous art); *see also Circuit Check Inc. v. QXQ Inc.*, 795 F.3d 1331, 1335 (Fed.

Cir. 2015) (explaining that “a reference is only reasonably pertinent when it ‘logically would have commended itself to an inventor’s attention in considering his problem’”). A POSITA simply would not consider the teachings of the transformer arts to achieve the objective of designing a stacked spiral inductor to optimize quality factor. Even if *Ho-Hsiang* is considered, *Ho-Hsiang* fails to disclose or suggest at least a “structure of spiral inductor” or the construction of “shunt windings” from the metal layers of a “crossover region” in a stacked spiral inductor as required by all of the Challenged Claims.

For Ground 2, AMD relies on *Christensen* for the alleged teaching of a “spiral inductor.” However, *Christensen* is directed to planar transformers that are fundamentally different from stacked spiral inductors and fails to disclose several material limitations of the Challenged Claims. A POSITA simply would not consider the teachings of the transformer arts to achieve the objective of designing a stacked spiral inductor to optimize quality factor. Even if *Christensen* is considered, *Christensen* fails to disclose or suggest at least a “structure of a spiral inductor” or the construction of “shunt windings” from the metal layers of a “crossover region” in a stacked spiral inductor as required by all of the Challenged Claims.

For Ground 3, AMD relies on *Yang* for the alleged teaching of a “spiral

inductor.” However, *Yang* fails to disclose several material limitations of the Challenged Claims, including, but not limited to, a “sixth segment,” a “crossover region,” and the construction of “shunt windings” from metal layers of a “crossover region” as required by all of the Challenged Claims. Moreover, AMD argues these limitations are inherent in *Yang*, but provides no basis for such inherency, much less any motivation to modify the disclosure of *Yang* to achieve the claimed invention of the ’245 Patent.

In an attempt to backfill these deficiencies in the asserted art, Petitioner relies on expert testimony as a substitute for a teaching of the prior art, but the Trial Practice Guide precludes those attempts. *See* Patent Trial and Appeal Board Consolidated Trial Practice Guide November 2019 (PTAB November 2019) at 36 (“[E]xpert testimony ... is not a substitute for disclosure in a prior art reference itself.”).

For at least the reasons set forth above and further detailed below, AMD has not met its burden of demonstrating a reasonable likelihood of prevailing with respect to any of the Challenged Claims of the ’245 Patent. Accordingly, Realtek respectfully requests that the Board deny the Petition and not institute review.

III. OVERVIEW OF THE ’245 PATENT

The ’245 Patent describes and claims a stacked structure of a spiral inductor

with a stated objective of reducing the footprint of an inductor while optimizing quality factor. The '245 Patent is titled *Stacked Structure of a Spiral Inductor*, and was duly and legally issued on May 3, 2011. The '245 Patent issued from U.S. Patent Application Serial No. 12/773,024 ("the '024 Application"), filed May 4, 2010, and claims priority to a Taiwanese patent application, Taiwanese Application No. 98116543, filed on May 19, 2009, which issued as TW I385680B1 on February 11, 2013, before Taiwan Intellectual Property Office. The '024 Application received no Office Actions or other communications from the United States Patent and Trademark Office until the Notice of Allowance issued on December 29, 2010.

Ex.1002. The examiner's statement of reasons for allowance explained:

The prior art of record do not teach or suggest, in the claimed combination thereof, a structure of a spiral inductor, comprising: a first metal layer, including a first segment; a second segment; and a third segment, connected to the first segment, wherein a layout direction of the third segment is different from a layout direction of the first segment and a layout direction of the second segment; a second metal layer, being positioned under the first metal layer, the second metal layer including a fourth segment; a fifth segment; and a sixth segment, connected to the fifth segment, wherein a layout direction of the sixth segment is different from a layout direction of the fourth segment and a layout direction of the fifth segment; a first set of vias, for connecting the first segment with the fourth segment; and a second set of vias, for

connecting the second segment with the fifth segment; wherein the first segment, the fourth segment and the first set of vias construct a first shunt winding; the second segment, the fifth segment and the second set of vias construct a second shunt winding; and the third segment and the sixth segment construct a crossover region.

Id. at 11. The '245 Patent has two independent claims and 18 dependent claims. The '245 Patent expires on May 4, 2030. Realtek is the owner, by valid assignment, of the entire right, title, and interest in and to the '245 Patent.

A. Problem Addressed by the '245 Patent

Integrated inductors have been widely used in high-frequency integrated circuits which usually adopt silicon-based substrate structures. Ex.1001, 1:12–20. Substrate loss and metal loss of these integrated inductors will affect their quality factor, and metal loss is the main cause that most immediately affects the inductor properties. *Id.* The '245 Patent points out that prior art inductor designs either suffer from an *enlarged chip area* in an effort to reduce series resistance of the inductor or *difficulty to optimize the inductor quality factor* due to the fact that different metal layers are used for crossover regions and windings of the inductor. *See id.* at 1:21–41 (emphasis added).

The '245 Patent solved these prior art problems through the claimed innovative stacked structure that “is capable of optimizing a quality factor of the

inductor by making use of metal layers of the crossover region as shunt windings. As a result, parasitic resistors of the spiral inductor won't be restricted by a conductivity of the crossover region, a number of the vias, and resistance of the vias." *Id.* at 6:1–7. The claimed stacked structure of the spiral inductor of the '245 Patent provided a unique crossover region in that the crossover region was formed from the metal layers that comprise the shunt windings. *Id.* at Figs. 5 and 6; 6:8–36. As discussed below, none of the prior art references teaches, discloses or suggests the combination of features recited in the Challenged Claims of the '245 Patent.

B. Challenged Claims

Claim 1 recites:

A structure of a spiral inductor, comprising:
a first metal layer, comprising:
a first segment;
a second segment; and
a third segment, connected to the first segment, wherein a layout direction of the third segment is different from a layout direction of the first segment and a layout direction of the second segment;
a second metal layer, being positioned under the first metal layer,
the second metal layer comprising:
a fourth segment;
a fifth segment; and

a sixth segment, connected to the fifth segment, wherein a layout direction of the sixth segment is different from a layout direction of the fourth segment and a layout direction of the fifth segment;

*a first set of vias, for connecting the first segment with the fourth segment;
and*

a second set of vias, for connecting the second segment with the fifth segment;

wherein the first segment, the fourth segment and the first set of vias construct a first shunt winding; the second segment, the fifth segment and the second set of vias construct a second shunt winding; and the third segment and the sixth segment construct a crossover region.

Claim 1 recites a stacked structure for a spiral inductor, and claims 2–5, 8, and 9 all directly depend from claim 1.

Claim 2 recites “wherein the third segment is positioned between the first segment and the second segment; and the sixth segment is positioned between the fourth segment and the fifth segment.”

Claim 3 recites “wherein a first thickness of the first metal layer is greater than a second thickness of the second metal layer.”

Claim 4 recites “wherein the spiral inductor further comprises a third metal layer being positioned under the second metal layer, a structure of the third metal

layer is the same as a structure of the second metal layer, and the first thickness of the first metal layer is greater than a third thickness of the third metal layer.”

Claim 5 recites “wherein a first thickness of the first metal layer is equal to a second thickness of the second metal layer.”

Claim 8 recites “wherein the spiral inductor is a symmetric spiral inductor.”

Claim 9 recites “wherein a shape of the first shunt winding and the second shunt winding is substantially a rectangle, an octagon, or a circle.”

C. Fundamental Differences Between Inductors and Transformers

An inductor (electrical symbol L) is generally a passive two-terminal electrical component for storing electrical energy in the form of magnetic energy. Ex.1008, 4. The property by which an inductor stores energy in a magnetic field is known as inductance. *Id.* An inductor typically consists of an insulated wire wound into a coil. *Id.* Inductors serve to oppose changes in current flow. *Id.* at 4, 10. When an electric current is applied from a power source, an inductor stores it using a magnetic field. *Id.* at 4. When the current flow changes, the magnetic field induces a voltage that opposes the current change. *Id.* at 10.

The quality factor Q is an important figure of merit for an inductor at high frequencies. Ex.1009, 16; Ex.1011, 2. For an inductor, only the energy stored in the

magnetic field is of interest, and Q is defined as the ratio of maximum energy stored in the inductor to the energy dissipated per cycle:

$$Q = 2\pi \times \frac{\text{energy stored}}{\text{energy dissipated per cycle}}$$

Ex.1009, 16; Ex.1010, 50. Q describes how good an inductor can work as an energy-storage element. Ex.1009, 16. Ideally, an inductor should work as a pure energy-storage element (Q approaches infinity), while in reality parasitic resistance (dissipation) and capacitance of the inductor reduces Q . *Id.* at 16–17; Ex.1011, 5. This is because the parasitic resistance dissipates stored energy and parasitic capacitance reduces inductance. Ex.1009, 16–18. From a design perspective, Q is directly related to the series resistance R_s of the equivalent circuit of an inductor. *Id.* at 28. Metal resistivity gives rise to the series resistance R_s , and it is always desirable to reduce the resistance in order to improve Q . *Id.* at 16; Ex.1017, 41:21–22.

A high Q generally results in a narrow bandwidth (a narrow range of frequencies) of an RF inductor, which is important if the inductor is to be used as part of an LC tank (oscillator) circuit or in narrow bandpass applications. Ex.1010, 97.

Transformers are electrical devices used to transfer energy between two or more circuits, and a basic transformer consists of two magnetically coupled coils. Ex.2002, 1. AC in one (called the “primary”) creates a changing magnetic field

which induces a current in the second coil (the “secondary”). *Id.* Coupling coefficient (k) is a direct measure of the magnitude of magnetic coupling between the two coils of a transformer and is one of the most important parameters to evaluate the performance of the transformer. *Id.*

RF transformers are generally used as broadband devices (*i.e.*, low Q) with an operating bandwidth beyond a narrow set of frequencies and widely used as impedance matching devices (matching impedances of a source and a load to achieve maximum power transfer and minimum loss). Ex.1010, 97.

Petitioner misleadingly suggests that inductors and transformers are the same or interchangeable. Although transformers and inductors may have superficial similarities, the two are different in several fundamental ways including applications, design, and construction as demonstrated by the art cited by Petitioner’s expert declarant.

At the outset, an inductor stores energy as a magnetic field; a transformer does not. Ex.1008, 4. A transformer transfers power directly from one circuit to another without storing it in a magnetic field, an inductor does not. Ex.2002, 1. Transformers provide efficient transfer of power; inductors are meant to store energy; these are fundamentally different objectives, and a POSITA would readily appreciate that transformers and inductors are not in the same field of endeavor. *Id.*

From an RFIC design perspective, for an inductor, because only the energy stored in the magnetic field is of interest, achieving a higher Q value while maintaining a compact layout has become the prevailing design objective. *Id.* After all, Q describes how good an inductor works as an energy-storage element. Ex.1009, 16. The higher the Q , the narrower the bandwidth of the inductor, which is often required in many applications (*e.g.*, bandpass filters). Ex.1010, 97; Ex.1016, 6.

By contrast, transformers function by using magnetic coupling between primary and secondary windings to transfer electrical energy from the primary winding to the secondary winding. Ex.2002, 1. As discussed above, RF transformers are generally used as impedance matching devices and it is highly desirable to design an RF transformer to have a wide operating bandwidth. Ex.1010, 97. While the performance of an inductor with regard to its losses can be well described by its quality factor Q , there is no such simple figure of merit for transformers. Ex.2002, 1. The magnetic coupling coefficient between two windings is one of the most important parameters for transformer performance. *Id.*

Further, with respect to construction, an inductor typically consists of an insulated wire wound into a coil, while a transformer typically consists of a primary winding energized by a power source and at least one secondary winding connected to a load. Ex.1008, 4; Ex.1010, 97. Because of these well-known fundamental

differences between transformers and inductors, including fundamentally different design objectives, the transformer arts are not reasonably pertinent, and in fact would be counterproductive, to designing a spiral inductor to reduce the layout area and optimize Q , which was the stated objective of the '245 Patent. Ex.1001, 1:21–41.

D. Person Having Ordinary Skill in the Art

A person of ordinary skill in the art of this technology at the time of the invention would have had at least a bachelor's degree in electrical engineering or an equivalent field and at least 3–4 years of professional experience in the field of integrated circuit design. Someone with additional education but less professional experience may qualify as a POSITA, such as someone with a master's degree in electrical engineering and 1–2 years of professional experience in the field of integrated circuit design or someone with a Ph.D. in electrical engineering.

IV. CLAIM CONSTRUCTION

The Challenged Claims of the '245 Patent are construed according to the standard applied by district courts as set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–17 (Fed. Cir. 2005) (en banc). Under that standard, the words of a claim are generally given their ordinary and customary meaning, which is the meaning the term would have to a person of ordinary skill at the time of the invention, in the context of the entire patent including the specification. *Id.* at 1312–13. There is “a

‘heavy presumption’ that a claim term carries its ordinary and customary meaning.”
Starhome GmbH v. AT&T Mobility LLC, 743 F.3d 849, 857 (Fed. Cir. 2014).

In the Petition, AMD improperly attempts to read out the preamble of the Challenged Claims. The preamble, which recites “a structure of a spiral inductor,” appears in all of the Challenged Claims of the ’245 Patent. The preamble is limiting because: (1) it provides antecedent basis for the claims, and (2) it recites an important structural limitation - “a spiral inductor” - that the ’245 Patent identifies as critical to the invention.

In an order dated July 25, 2023, in the concurrently pending ITC investigation involving these same parties and this same patent, Administrative Law Judge Cameron Elliot construed “[a] structure of a spiral inductor” in claim 1 of the ’245 Patent as limiting. Ex.2001, 13–16. Administrative Law Judge Elliot reasoned, “The body of the claim does not recite a structurally complete invention.... So there is nothing in claim 1, apart from the preamble, to inform the public as to which field of art this collection of metal ‘segments’ and ‘layers’ pertains, or its utility. ‘Spiral inductor,’ as found in the preamble, is therefore necessary to give life, meaning, and vitality to this claim.” *Id.* at 15. Administrative Law Judge Elliot further reasoned, “That the body of claim 8 also recites ‘spiral inductor’ further shows the preamble

is limiting for antecedent basis reasons.” *Id.* The Board should similarly find the preamble limiting here.

The Federal Circuit has long held that “the preamble constitutes a limitation when the claim(s) depend on it for antecedent basis.” *C.W. Zumbiel Co. v. Kappos*, 702 F.3d 1371, 1385 (Fed. Cir. 2012). “This is also true where a preamble in an independent claim ‘provide[s] antecedent basis for a term in a dependent claim.’” *Whirlpool Corp. v. TST Water, LLC*, No. 2:15- CV-1528-JRG, 2016 WL 3959811, at *7 (E.D. Tex. Jul. 22, 2016) (citing *Pacing Techs., LLC v. Garmin Int’l, Inc.*, 778 F.3d 1021, 1024 (Fed. Cir. 2015)); *see also Deere & Co. v. Bush Hog, LLC*, 703 F.3d 1349, 1357–58 (Fed. Cir. 2012) (holding that the term “rotary cutter deck,” in the preamble, was limiting where it provided antecedent basis to the term “said deck” in a dependent claim). A preamble is not limiting if the body of the claim defines a structurally complete invention, and the preamble only states the invention’s purpose or intended use. *See TomTom, Inc. v. Adolph*, 790 F.3d 1315, 1323 (Fed. Cir. 2015) (citations omitted). A preamble can be limiting if it recites essential structure or steps, or is necessary to give life, meaning, or vitality to the claim. *See id.* (citations omitted).

The preamble of the Challenged Claims is limiting because the body of independent claim 1 of the ’245 Patent does not recite a structurally complete

invention. Claim 1 recites generic limitations such as first, second, third, *etc.* “segment[s]” connected to each other in certain “metal layer[s],” “layout direction[s],” and “shunt winding.” Ex.1001, claim 1. The body of claim 1 does not specify whether it is part of a spiral inductor, a generator, a transformer, or some other structure. Nothing in claim 1, apart from the preamble, informs the public as to which field of art this collection of metal “segments” and “layers” pertains, or its utility. “Spiral inductor,” as found in the preamble, is therefore necessary to give life, meaning, and vitality to this claim. *TomTom*, 790 F.3d at 1323.

Further, the substantive portion of the preamble—which recites a “spiral inductor”—provides antecedent basis for the dependent claims, including dependent claim 8, which is one of the Challenged Claims here.

In particular, claim 1 recites, in the preamble, “[a] structure of a spiral inductor, comprising:” That is the only reference to the spiral inductor in claim 1. Claim 8 further limits the “spiral inductor” of claim 1 by reciting “[t]he structure of the spiral inductor of claim 1, wherein the spiral inductor is a symmetric spiral inductor.” Ex.1001, claim 8. Because claim 8 relies on a limitation found only in the preamble of claim 1, the preamble is limiting. *See Super Interconnect Techs. LLC v. Huawei Device Co.*, No. 2:18-CV-462-JRG, 2020 WL 60145, at *10–13 (E.D. Tex. Jan. 6, 2020) (finding preamble limiting where it provided antecedent

basis for dependent claim); *SEVEN Networks, LLC v. Apple Inc.*, No. 2:19-CV-115-JRG, 2020 WL1536152, at *33 (E.D. Tex. Mar. 31, 2020) (same); *PersonalWeb Techs. LLC v. Int’l Bus. Mach. Corp.*, No. 16-cv-01266-EJD, 2017 WL 2180980, *13–14 (N.D. Cal. May 18, 2017) (finding recitation of “hardware” in the preamble was a structural limitation because it provided antecedent basis for a structural limitation in the dependent claims). Accordingly, the preamble is a material limitation of the Challenged Claims.

The preamble is limiting for a second, independent reason. The specification of the ’245 Patent repeatedly identifies the spiral inductor, recited in the preamble, as the “invention.” In such circumstances, the preamble is limiting. As the Federal Circuit has explained, “when reciting additional structure . . . underscored as important by the specification, the preamble may operate as a claim limitation.” *Catalina Market. Intern. v. Coolsavings.com*, 289 F.3d 801, 808 (Fed. Cir. 2002); *see also Corning Glass Works v. Sumitomo Electric U.S.A., Inc.*, 868 F.2d 1251, 1257 (Fed. Cir. 1989) (limiting claim scope to the “optical waveguides” recited in the preamble, rather than all optical fibers, because the specification identified optical waveguides as the invention); *General Electric Co. v. Nintendo Co.*, 179 F.3d 1350, 1361–62 (Fed. Cir. 1999) (limiting claim scope to the “raster scanned display device” recited in the preamble, rather than all display systems, because the

specification explained that the invention was an innovative way of displaying binary data on a “raster scan display device”); *Poly-America, L.P. v. GSE Lining Technology, Inc.*, 383 F.3d 1303 (Fed. Cir. 2004) (finding the preamble limiting where the preamble (i) recited “blown-film”; (ii) that term appeared in the Title, the Summary of the Invention, and all of the claims; and (iii) it repeatedly was used to describe preferred embodiments); *Rowe v. Dror*, 112 F.3d 473, 479–80 (Fed. Cir. 1997); *Applied Materials, Inc. v. Advanced Semiconductor Materials Am., Inc.*, 98 F.3d 1563, 1573 (Fed. Cir. 1996).

Here, the specification leaves no doubt that a spiral inductor with specific structural features is the invention. The specification, at least four times, identifies the spiral inductor as “the present invention.” Ex.1001, 1:7–8 (“The present invention relates to a stacked structure of a spiral inductor[.]”); *id.* at 1:45–47 (“It is one of the objectives of the present invention to provide a stacked structure of a spiral inductor to solve the above-mentioned problems.”); *id.* at 1:7–10 (“The present invention relates to a stacked structure of a spiral inductor, and more particularly, to a stacked structure for improving quality factor by making use of metal layers of a crossover region as shunt windings.”); *id.* at 6:1–5 (“As can be known from the embodiments above, the stacked structure of the spiral inductor disclosed in the present invention is capable of optimizing a quality factor of the

inductor by making use of metal layers of the crossover region as shunt windings.”). Under the Federal Circuit cases discussed above, these statements, standing alone, establish that the preamble is limiting. *See also Proveris Scientific Corp. v. Innovasystems, Inc.*, 739 F.3d 1367, 1373–74 (Fed. Cir. 2014) (finding the preamble limiting when it recites a particular structure or steps that are highlighted as important by the specification, such as finding the preamble phrase as part of the disclosure of the “present invention”).

The Federal Circuit also has held that the preamble is limiting when the Title, Abstract, Field of Invention, and Summary of the Invention all describe the language of the preamble as the invention. *See, e.g., Deere*, 703 F.3d at 1357–58. The ’245 Patent’s specification at least refers to the “spiral inductor” as the invention in each of the following sections:

- Title: “STACKED STRUCTURE OF A SPIRAL INDUCTOR”
- Abstract: “A stacked structure of a spiral inductor includes a . . .”
- Field of the Invention: “The present invention relates to a stacked structure of a spiral inductor . . .”
- Summary of the Invention: “It is one of the objectives of the present invention to provide a stacked structure of a spiral inductor to solve the above-mentioned problems.”

Ex.1001, Title, Abstract, 1:7–8, 1:45–47, 2:2–3, 2:21–22, 3:7–12, 5:54–57, 6:1–7; *see also id.* at 2:4–6, 2:29–3:3, 9:14–16; 9:20–21, 9:24–26. In addition, every

drawing expressly describes the spiral inductor. *Id.* at 2:29–3:3. Indeed, the specification explains that all drawings (Figs. 1–14) are directed to spiral inductors. In particular, it states that those drawings are directed to “symmetric spiral inductors (as is referenced by the embodiments shown in FIG. 1–FIG. 8)” and “non-symmetric spiral inductors (as is referenced by the embodiments shown in FIG. 9 - FIG. 14).” *Id.* at 3:7–12. As these passages make clear, the ’245 Patent is directed to solving a problem specific to spiral inductors—increasing the Q factor of the inductor by using the metal layers of the crossover region as shunt windings.

Because (a) the “spiral inductor” of the preamble provides an antecedent basis for the Challenged Claims, and (b) the “spiral inductor” is critical to the claimed inventions, the preamble is a material limitation of the Challenged Claims.

V. THE PETITION DOES NOT ESTABLISH A REASONABLE LIKELIHOOD THAT THE CHALLENGED CLAIMS WOULD HAVE BEEN OBVIOUS BASED ON *HO-HSIANG*

A. Obviousness Standard

The ultimate determination of obviousness under 35 U.S.C. § 103 is a question of law based on underlying factual findings. *In re Baxter Int’l, Inc.*, 678 F.3d 1357, 1362 (Fed. Cir. 2012) (citing *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1996)). “To satisfy its burden of proving obviousness, a petitioner cannot employ merely conclusory statements. The petitioner must instead articulate specific reasoning, based on evidence of record, to support the legal conclusion of obviousness.”

Magnum Oil Tools Int’l, Ltd., 829 F.3d 1364, 1380–81 (Fed. Cir. 2016). “[A] patent can be obvious in light of a single prior art reference if it would have been obvious to modify that reference to arrive at the patented invention.” *Arendi S.A.R.L. v. Apple Inc.*, 832 F.3d 1355, 1361 (Fed. Cir. 2016); *see Therasense, Inc. v. Becton, Dickinson & Co.*, 593 F.3d 1325, 1336–37 (Fed. Cir. 2010) (affirming an invalidity judgment where claims were held obvious over a single reference). However, Courts have repeatedly warned that references to “common sense” - whether to supply a motivation to combine or a limitation missing from the prior art references specified - cannot be used as a wholesale substitute for reasoned analysis and evidentiary support, especially when the missing limitation play a major role in the subject matter claimed.” *Arendi S.A.R.L.*, 832 F.3d at 1361–62.

B. *Ho-Hsiang* Does Not Render the Challenged Claims Obvious

1. *Ho-Hsiang* Fails to Disclose Material Limitations of the Challenged Claims

a. Analogous Art Test

“Whether a reference is analogous art is an issue of fact.” *In re ICON Health & Fitness, Inc.*, 496 F.3d 1374, 1378 (Fed. Cir. 2007). “Analogous art is merely a threshold inquiry as to whether a reference can be considered in an obviousness analysis.” *Johns Manville Corp. v. Knauf Insulation, Inc.*, IPR2018-00827, Paper 9 at 13–14 (PTAB Oct. 16, 2018). A reference is analogous art to the claimed

invention if: (1) the reference is from the same field of endeavor as the claimed invention (even if it addresses a different problem); or (2) the reference is reasonably pertinent to the problem faced by the inventor (even if it is not in the same field of endeavor as the claimed invention). *In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004).

In evaluating whether a reference is analogous, Courts have consistently held that a patent challenger must compare the reference to the particular problems and purpose to which the challenged patent relates. *Donner Tech., LLC v. Pro Stage Gear, LLC*, 979 F.3d 1353, 1359 (Fed. Cir. 2020) (examining whether reference is “reasonably pertinent to one or more of the particular problems to which the [challenged] patent relates”); *Unwired Planet, LLC v. Google Inc.*, 841 F.3d 995, 1001 (Fed. Cir. 2016) (“If a reference disclosure and the claimed invention have a same purpose, the reference relates to the same problem.”); *Bigio*, 381 F.3d at 1325 (examining whether prior art is “reasonably pertinent to the particular problem with which the inventor is involved”). This conclusion is reinforced by the purpose of the analogous art test, which is to examine whether a reference can be considered as prior art to the challenged patent in the first place. *Chemours Co. FC, LLC v. Daikin Indus., Ltd.*, 4 F.4th 1370, 1376 (Fed. Cir. 2021) (analogous art test defines “scope of the relevant prior art”); *Cir. Check Inc. v. QXQ Inc.*, 795 F.3d 1331, 1335 (Fed.

Cir. 2015) (“To be considered within the prior art for purposes of the obviousness analysis, a reference must be analogous.”)

Importantly, the analogous art analysis must be carried out from the vantage point of a POSITA who is considering turning to the teachings of references outside her field of endeavor. *See Clay*, 966 F.2d at 660 (concluding that a reference was not reasonably pertinent where a POSITA “would not reasonably have expected to solve the [relevant] problem . . . by considering” that reference).

b. *Ho-Hsiang* is specifically directed to transformers and not reasonably pertinent to the problem addressed by the '245 Patent

Ho-Hsiang generally relates to “transformers and balanced-to-unbalanced (BALUN) devices. More specifically, the disclosed system and method relate to on-chip symmetrical transformers and BALUN devices.” Ex.1005, 1:6–9.

A balun is a transformer configured to convert between a balanced signal and an unbalanced signal. Baluns share performance parameters with RF transformers.

As discussed above, fundamental differences exist between inductors and transformers, more specifically, RF balun transformers. Transformers provide efficient transfer of power. Ex.2002, 1. Inductors are meant to store energy. Ex.1008, 4. These are fundamentally different objectives that impact the design profile and approach to these different electronic devices. From an RFIC design

perspective, for an inductor, because only the energy stored in the magnetic field is of interest, achieving higher Q value while maintaining a compact layout has become the prevailing design objective. Ex.1009, 16–17. After all, Q describes how good an inductor works as an energy-storage element. *Id.* The higher the Q , the narrower the bandwidth of the inductor. Ex.1010, 97; Ex.1016, 6. By contrast, RF transformers are generally used as impedance matching devices and it is highly desirable to design an RF balun transformer to have a wide operating bandwidth. Ex.1010, 97. A POSITA would readily appreciate that transformers and inductors are not in the same field of endeavor. As such, *Ho-Hsiang* is directed to a different field of endeavor than the claimed stacked spiral inductor structure of the '245 Patent.

Moreover, *Ho-Hsiang* is not reasonably pertinent to the problem solved by the '245 Patent. The Federal Circuit explains this second inquiry into whether the proposed prior art reference is “reasonably pertinent” as follows:

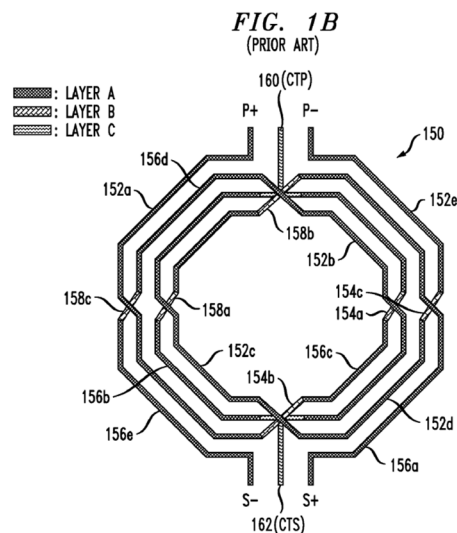
A reference is reasonably pertinent if, even though it may be in a different field from that of the inventor's endeavor, it is one which, because of the matter with which it deals, logically would have commended itself to an inventor's attention in considering his problem. Thus, the purposes of both the invention and the prior art are important in determining whether the reference is reasonably pertinent to the problem the invention attempts to solve. If a reference disclosure has

the same purpose as the claimed invention, the reference relates to the same problem, and that fact supports use of that reference in an obviousness rejection. An inventor may well have been motivated to consider the reference when making his invention. If it is directed to a different purpose, the inventor would accordingly have had less motivation or occasion to consider it.

In re Clay, 966 F.2d 656, 659 (Fed. Cir. 1992). This prong requires considering the purpose of the '245 Patent and comparing the purpose with that of *Ho-Hsiang*.

As discussed above, the '245 Patent identifies a prior art problem associated with integrated inductors in high-frequency ICs with silicon-based substrates, and substrate loss and metal loss affect the quality factor of these integrated inductors. Ex.1001, 1:12–20. More specifically, “metal loss is the main cause that most immediately affects the inductor properties.” *Id.* Among other things, the '245 Patent provides “a stacked structure of a spiral inductor, and more particularly, to a stacked structure for improving quality factor by making use of metal layers of a crossover region as shunt windings.” *Id.* at 1:7–10. That is, the claimed inductor structure of the '245 Patent reduces the footprint of the inductor, reduces the series resistance, improves the Q factor, and results in an overall reduction in power consumption. *Id.* at 1:45–47.

By contrast, *Ho-Hsiang* identifies a problem in the prior art, as shown in Fig. 1B (reproduced below), “the center taps 160 and 162 are connected at the inner-most portion of the BALUN 150 and extend to the outer-most portion. *This center tap location is an undesirable location as it may result in high current density on the center taps 160, 162, which may have a detrimental affect on the reliability of the circuit due to electromigration.* For example, the reliability of a transceiver circuit as illustrated in FIG. 12 would be detrimentally affected if a BALUN 150, as illustrated in FIG. 1B, were implemented as the BALUN in FIG. 12 as the location of the center tap 160, *e.g.*, CTP in FIG. 12, would have a high current density. Additionally, if the BALUN illustrated in FIG. 12 included a center tap on the secondary winding (CTS) as shown in FIG. 1B, *e.g.*, center tap 162 in FIG. 1B, the reliability of the transceiver circuit would be reduced.” Ex.1005, 1:59–2:6 (emphasis added).



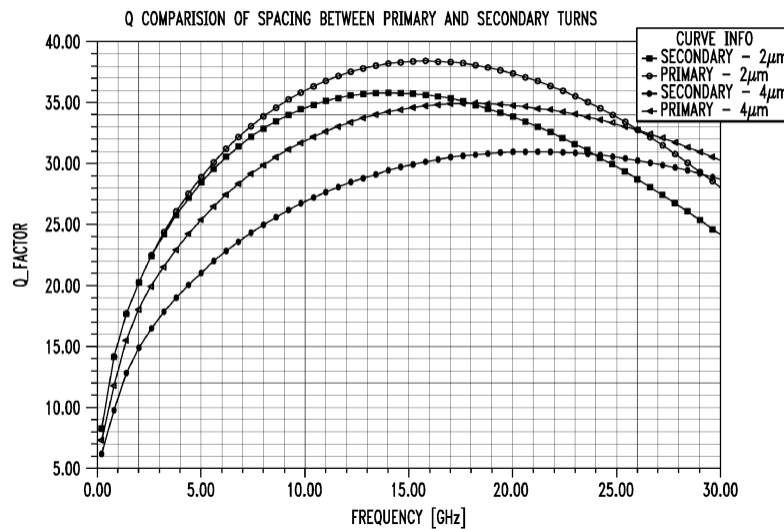
The gist of *Ho-Hsiang* is to provide a transformer balun structure that “advantageously enables current to flow from the inside of the device to the outside of the device thereby reducing the current density at the center of the device and reducing the likelihood of electromigration.” Ex.1003, 6:¶3. *Ho-Hsiang* has nothing to do with the problem identified and addressed in the '245 Patent, because *Ho-Hsiang* is certainly not concerned with designing an inductor structure for reducing the footprint of the inductor, reducing the series resistance of the inductor, and improving the Q factor of the inductor.

In fact, even broadly framing the problem(s) to be solved regardless of the fundamental differences between inductors and transformers, *Ho-Hsiang* is irrelevant with respect to “optimizing Q ” of the disclosed balun transformer. This is because *Ho-Hsiang* already presents a workable solution to improve the Q s of both the primary and secondary windings by increasing the thickness of the metal layers on which both windings are formed:

The Q-factor of a transformer or BALUN improves as the thickness of the metal layer on which the windings are formed is increased. FIG. 10 is a graph showing both the Q-factor versus frequency and the inductance versus frequency for primary and secondary windings made using metal layers having different thickness in a transformer having a 2:2 turn ratio. The thin metal layer plot was created with metal layers having a thickness of 1 micron, and the thick

metal layer plot was created with metal layers having thickness of microns. As shown in FIG. 10, the Q-factor is higher for the thick metal layers than for thin metal layers for all frequencies.

FIG. 10



Ex.1005, 3:36–46, Fig. 10. A POSITA would not have recognized the disclosures of two windings of a balun transformer in *Ho-Hsiang* as reasonably addressing the problem of reducing the footprint and series resistance of an inductor while improving its Q factor.

In other words, a POSITA seeking to solve the problem addressed by the '245 Patent would not have even considered the teachings of the balun transformer of *Ho-Hsiang*. Furthermore, a POSITA would not arrive at the claimed inductor structure of the '245 Patent by following the teachings disclosed in *Ho-Hsiang*, which explicitly teaches increasing the thickness of the metal layers on which both the primary and secondary windings of a balun transformer are formed to improve Q .

See, e.g., Arris Int'l PLC v. Sony Corp., IPR2016-00828, Paper 10 at 15–16 (PTAB Oct. 7, 2016) (denying institution and rejecting petitioner's obviousness rationale that "fails to acknowledge that [the primary prior art reference] already provides a different solution to the problem identified by Petitioner In other words, [the primary prior art reference] already addresses the alleged problem/need that Petitioner asserts would provide a motivating reason to seek a solution").

Ho-Hsiang would actually be counterproductive to "optimizing Q " and addressing the problem identified in the '245 Patent. As shown above in Fig. 10, *Ho-Hsiang* tries to achieve a high-coupling and broadband balun transformer (up to 30 GHz in terms of operating frequencies). Quality factor Q of a circuit relates the maximum or peak energy stored in the circuit (the reactance) to the energy dissipated (the resistance) during each cycle of oscillation meaning that it is a ratio of its self-resonant frequency to bandwidth (BW): $Q = \text{self-resonance frequency } (f_{\text{res}}) / \text{BW}$. Ex.1016, 6. The broader the bandwidth of a broadband transformer, the lower the circuit Q . Ex.1017, 8:66–9:9. This is precisely the opposite goal of the POSITA seeking to improve integrated inductors, and one of skill would not look to *Ho-Hsiang* for teaching higher- Q structures because *Ho-Hsiang* is directed to a different field of endeavor and in fact teaches away from such structures.

Because a POSITA would not have found the balun transformer of *Ho-Hsiang*, or the teachings of *Ho-Hsiang* as a whole, reasonably pertinent to the particular problem identified and addressed in the '245 Patent, *Ho-Hsiang* cannot form the basis of an obviousness finding.

2. *Ho-Hsiang* Does Not Disclose a “Spiral Inductor”, which is a Material Limitation of the Challenged Claims

Ho-Hsiang fails to disclose material limitations of the Challenged Claims. As discussed above, independent claim 1 of the '245 Patent specifically recites, “[a] structure of a spiral inductor, comprising:” Dependent claim 8 further limits the “spiral inductor” of claim 1 by reciting “[t]he structure of the spiral inductor of claim 1, wherein the spiral inductor is a symmetric spiral inductor.” Ex.1001, cls. 1 and 8. Because the preamble is a material limitation of the Challenged Claims and claim 8 relies on a limitation found only in the preamble of claim 1, the preamble is limiting. See *Super Interconnect Techs. LLC*, No. 2:18-CV-462-JRG, 2020 WL 60145, at *10–13 (E.D. Tex. Jan. 6, 2020); *PersonalWeb Techs. LLC*, No. 16-cv-01266-EJD, 2017 WL 2180980, *13–14 (N.D. Cal. May 18, 2017).

Ho-Hsiang does not disclose or teach a spiral inductor, but rather specifically discloses and teaches a transformer BALUN structure:

- Title: “ON-CHIP TRANSFORMER BALUN STRUCTURES”

- Field of the Invention: “The disclosed system and method relate to transformers and balanced-to-unbalanced (BALUN) devices. More specifically, the disclosed system and method relate to on-chip symmetrical transformers and BALUN devices.”
- Fig. 2A and its corresponding descriptions: “FIG. 2A is a top view of a transformer having a 2:2 turn ratio in accordance with the present disclosure.”
- Fig. 2B and its corresponding descriptions “FIG. 2B illustrates the first metal layer pattern of the transformer illustrated in FIG. 2A.”
- Fig. 2C and its corresponding descriptions: “FIG. 2C illustrates the second metal layer pattern of the transformer illustrated in FIG. 2A.”
- Fig. 2D and its corresponding descriptions: “FIG. 2D is a cross-sectional view of the transformer illustrated in FIG. 2A.”
- Fig. 7 and its corresponding descriptions: “FIG. 7 is a top view of a transformer with both inductors having non-integer number of turns and non-parallel ports in accordance with the present disclosure.”
- Fig. 9A and its corresponding descriptions: “FIG. 9A is a top view of a transformer having a 2:2 turn ratio in accordance with the present disclosure.”
- Fig. 9B and its corresponding descriptions: “FIG. 9B is an isometric cross-sectional view of the transformer shown in FIG. 9A.”
- Fig. 9C and its corresponding descriptions: “FIG. 9C is a cross-sectional view of the transformer illustrated in FIG. 9A.”
- Fig. 11 and its corresponding descriptions: “FIG. 11 is a block diagram of a transceiver in which a BALUN or transformer may be implemented.”

At least because the preamble of the Challenged Claims should be afforded patentable weight and *Ho-Hsiang* specifically teaches a transformer BALUN structure and not a spiral inductor, *Ho-Hsiang* fails to disclose material limitations of the Challenged Claims, and the Petition fails to establish a reasonable likelihood that the Challenged Claims would have been obvious over *Ho-Hsiang*.

3. *Ho-Hsiang* Does Not Disclose the Construction of “Shunt Windings” from the Metal Layers of a “Crossover Region” of the Challenged Claims

Moreover, *Ho-Hsiang* is entirely silent with respect to “wherein the first segment, the fourth segment and the first set of vias construct a first shunt winding; the second segment, the fifth segment and the second set of vias construct a second shunt winding; and the third segment and the sixth segment construct a crossover region” as recited in independent claim 1 (and each of the Challenged Claims) of the ’245 Patent, the subject matter the USPTO acknowledged as a basis of novelty for the claimed invention. Ex.1002, 11 (“The following is an examiner’s statement of reasons for allowance: The prior art of record do not teach or suggest, in the claimed combination thereof, a structure of a spiral inductor, comprising: ... wherein the first segment, the fourth segment and the first set of vias construct a first shunt winding; the second segment, the fifth segment and the second set of vias construct a second

shunt winding; and the third segment and the sixth segment construct a crossover region.”).

As disclosed in the '245 Patent, “the stacked structure of the spiral inductor disclosed in the present invention is capable of optimizing a quality factor of the inductor by making use of metal layers of the crossover region as shunt windings. As a result, parasitic resistors of the spiral inductor won’t be restricted by a conductivity of the crossover region, a number of the vias, and resistance of the vias.” Ex.1001, 6:1–7. As such, the claimed inductor segments, sets of vias, and shunt windings arranged at a specific location from metal layers of a crossover region of a stacked spiral inductor of the '245 Patent impart patentability to the claims of the '245 Patent.

The Petition requires adopting the unreasonable position that any teaching of two metal layers connected with vias would render obvious the above-noted combination of features of the Challenged Claims regardless of whether a spiral inductor is disclosed. Petition, 53–54. This position is manifestly incorrect, at least because Petitioner merely plucks the claimed subject matter out of context and picks and chooses among superficial similarities in isolated disclosures in *Ho-Hsiang* to deprecate the Challenged Claims.

Relying upon an annotated Fig. 9B of *Ho-Hsiang* supplemented with alleged winding segments and shunt windings, Petitioner simply attempts to reconstruct the claimed invention with hindsight, using the claimed subject matter as a template and selecting elements from the references to fill the gaps. Notably, Petitioner fails to point to any language from the disclosure of *Ho-Hsiang* describing the construction of “shunt windings” or a “crossover region” as required by the Challenged Claims. Petitioner fails to do so because *Ho-Hsiang* discloses nothing about the construction of shunt windings from segments adjacent to a crossover region in a stacked spiral inductor.

Instead, Petitioner reads into *Ho-Hsiang* multiple teachings that are simply not there. Petitioner repeatedly leans on the conclusory statement that “A POSITA would have understood/recognized” to suggest what Petitioner wants it to suggest. *Id.* Rather than articulate a clear argument, Petitioner tries to shoehorn in fundamentally flawed characterizations of *Ho-Hsiang* by having its expert cite to them in a declaration. *Id.* In other words, Petitioner essentially acknowledges that its own art does not disclose or suggest the limitations of the ’245 Patent. In an attempt to backfill these deficiencies, Petitioner relies on expert testimony as a substitute for a teaching of the prior art, but the Trial Practice Guide precludes those attempts. *See* Patent Trial and Appeal Board Consolidated Trial Practice Guide

November 2019 (PTAB November 2019) at 36 (“[E]xpert testimony...is not a substitute for disclosure in a prior art reference itself.”).

Petitioner improperly stretches the teachings of *Ho-Hsiang* to fill in the gaps of the missing material limitations of the Challenged Claims. A POSITA would not have found the Challenged Claims to be obvious based on *Ho-Hsiang* given its failure to disclose “a structure of a spiral inductor” and “shunt windings” arranged at a specific location from metal layers of a “crossover region” of a stacked “spiral inductor.” Accordingly, the Petition fails to establish a reasonable likelihood that the Challenged Claims would have been obvious over *Ho-Hsiang*.

4. Petitioner Provides No Motivation to Modify *Ho-Hsiang* to Achieve the Invention of the Challenged Claims

In addition, Petitioner has provided no motivation to utilize the teachings of *Ho-Hsiang* to develop the structure of a spiral inductor as claimed in the '245 Patent. *Ho-Hsiang* discloses on-chip transformer BALUN structures (*i.e.*, power transfer devices) and is directed to a different field of endeavor with fundamentally different design objectives that teaches away from the claimed stacked spiral inductor (*i.e.*, inductive energy storage elements) of the '245 Patent. Further, the balun transformer described and claimed in *Ho-Hsiang* would not be instructive to a POSITA seeking to reduce the footprint of an RF inductor while optimizing its Q factor. In other words, *Ho-Hsiang* is not reasonably pertinent to the particular problem identified

and addressed in the '245 Patent, and a POSITA would not be motivated to utilize its non-analogous teachings to achieve the inductor design objectives of the '245 Patent.

VI. THE PETITION DOES NOT ESTABLISH A REASONABLE LIKELIHOOD THAT THE CHALLENGED CLAIMS WOULD HAVE BEEN OBVIOUS BASED ON *CHRISTENSEN*

A. *Christensen* Does Not Render the Challenged Claims Obvious

1. *Christensen* Fails to Disclose Material Limitations of the Challenged Claims

Christensen is directed to transformers, specifically planar transformers. Ex.1006, Abstract. As discussed above, fundamental differences exist between inductors and transformers, more specifically, planar transformers. For an RF inductor, because only the energy stored in the magnetic field is of interest, achieving higher Q value while maintaining a compact layout has become the prevailing design objective. Ex.1009, 16–17. The higher the Q , the narrower the bandwidth of the inductor. Ex.1010, 97; Ex.1016, 6. Transformers, on the other hand, provide efficient transfer of power and it is highly desirable to design an RF transformer to have a wide operating bandwidth. Ex.1010, 97.

The spiral interleaved RF transformer in *Christensen* places two planar coils in an interleaved manner with one coil in between the other in order to increase the coupling coefficient of the two windings of the transformer. Ex.1006, Fig. 1.

Accordingly, a POSITA would readily appreciate that transformers and inductors are not in the same field of endeavor. As such, *Christensen* is directed to a different field of endeavor than the claimed stacked spiral inductor structure of the '245 Patent.

Moreover, *Christensen* is not reasonably pertinent to the problem solved by the '245 Patent, namely, a stacked structure of a spiral inductor with reduced footprint and higher Q . Ex.1001, 1:7–47. By contrast, *Christensen* identifies that known on-chip transformers employing a symmetrical layout of the primary and secondary windings or symmetrical inductors are undesirably lossy and suffer from difficulties in matching the electrical properties of primary and secondary windings. Ex.1006, 1: 9–28. *Christensen* goes on to state that, “It is the object of the present invention to provide an improved *substantially planar transformer* suitable for use in integrated circuits.” *Id.* at 1: 31–33.

Christensen is devoid of any teachings related to “ Q ” or “optimizing Q ,” let alone “optimizing Q of an inductor” while reducing the footprint of the inductor. To put it bluntly, *Christensen* has nothing to do with the problems identified and addressed in the '245 Patent. Moreover, *Christensen* would be counterproductive to reducing the footprint on an inductor because it explicitly teaches a planar transformer composed of intermingled windings with a footprint that would occupy

roughly twice the chip area of the stacked inductor structure of the Challenged Claims of the '245 Patent.

Because a POSITA would not have found the substantially planar transformer of *Christensen*, or the teachings of *Christensen* as a whole, reasonably pertinent to the particular problems identified and addressed in the '245 Patent, *Christensen* cannot form the basis of an obviousness finding.

2. Petitioner Misrepresents the *Christensen* Disclosure

The Petition misrepresents the *Christensen* disclosure. *Christensen* does not disclose or suggest several material elements of the Challenged Claims.

Christensen generally discloses an on-chip planar transformer made from two intertwined inductors: a primary winding and a secondary winding. Ex.1006, 2:53–55. “The primary winding 3 spirals in from the first terminal 5 and then out to the second terminal 6. The secondary winding 4 spirals in from the third terminal 7 and then out to the fourth terminal 8 in a similar manner.” *Id.* at Figs. 2 and 3 (both reproduced below) and 2:65–3:2. There are 6 crossover areas identified in *Christensen*’s Fig. 1, namely, primary winding 3’s self-crossing 9b, secondary winding 4’s self-crossing 9d, and 4 crossings of both primary and secondary windings 9a, 9e, 9f, and 9c. The Petition characterizes *Christensen*’s Fig. 1 as showing two inductors 3, 4 and indicates that the pink inductor (*i.e.*, a primary

winding 3 of planar transformer 1, as disclosed in *Christensen*) will be used for applying against the Challenged Claims of the '245 Patent. Petition, 69; Ex.1006, Figs. 1-3.

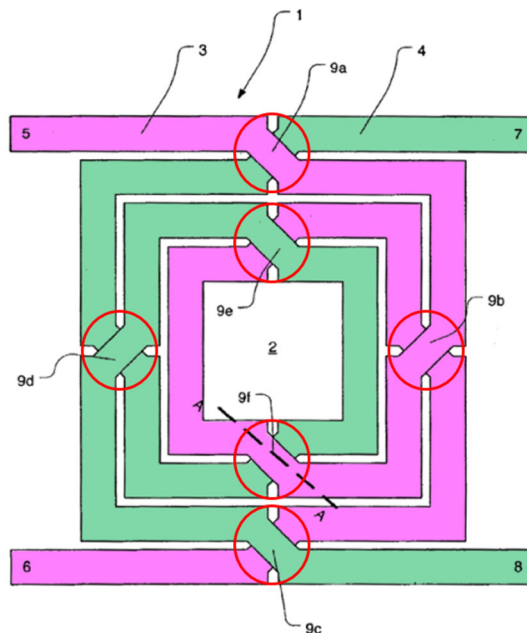
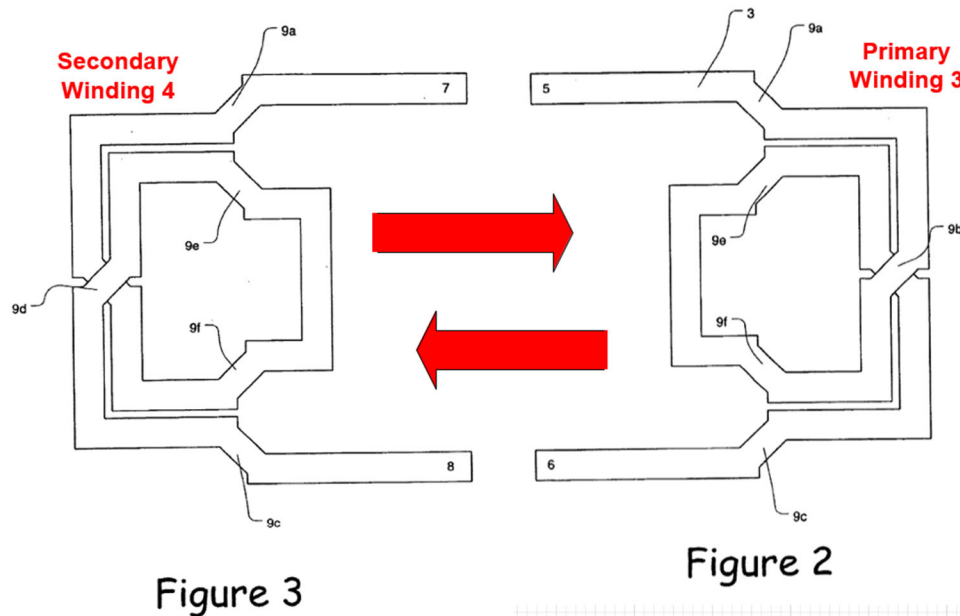
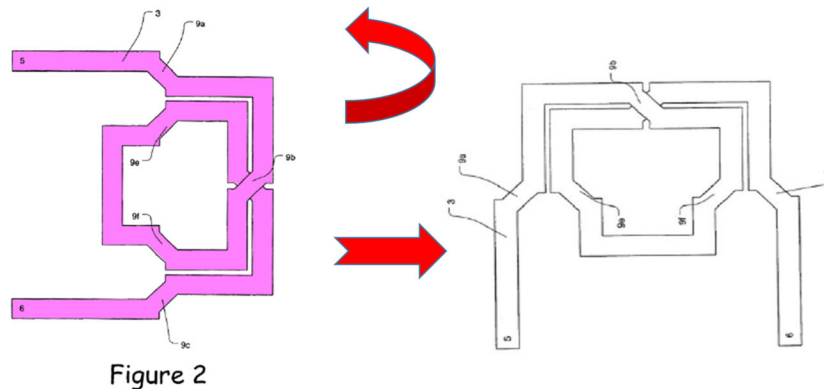


Figure 1

For illustration, Petition turns *Christensen's* Fig. 2 90° counter-clockwise (reproduced below) to focus on the crossover area 9b. It is noted that the crossover area 9b in *Christensen's* Fig. 2 depicts the primary winding 3's self-crossing and has been used by Petitioner for mapping to the crossover area 9f of both primary and secondary windings 3, 4, as shown in Figs. 4, 5, and 6(a). Petition, 71 (emphasis added).



Christensen, Fig. 2 (EX-1006) (annotated)

Specifically, Petitioner repeatedly forces an erroneous reading and understanding of *Christensen's* Fig. 5 in an effort to map structural features of specific winding portions of the primary winding to a crossover area of two planar intermingled windings (*i.e.*, the primary winding 3 and secondary winding 4) of a planar transformer. Petition, 71-82.

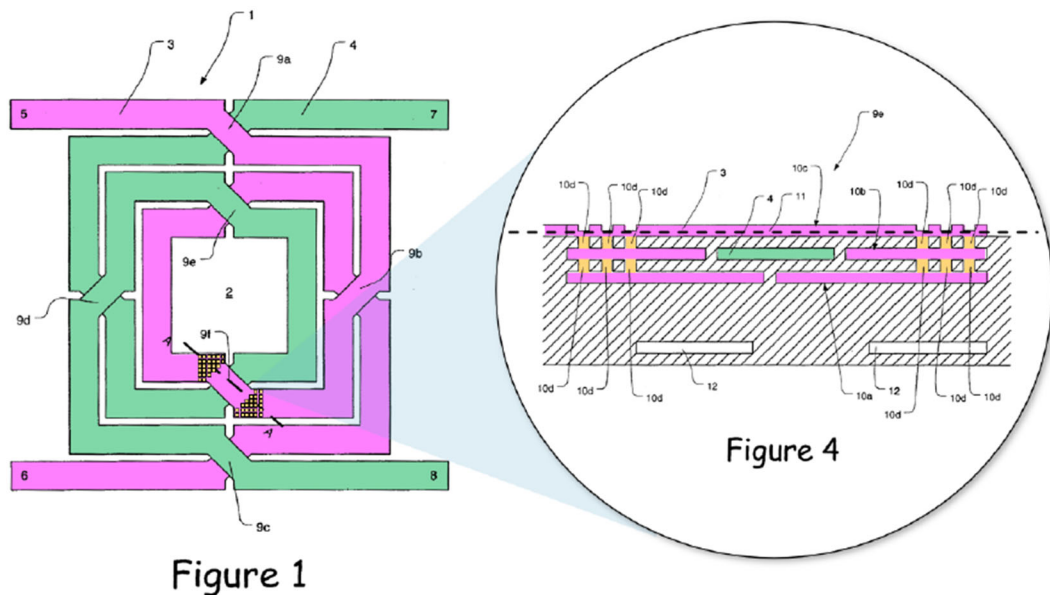
Nothing in *Christensen* supports Petitioner's contention that "[w]hile the labels in Figures 4, 5, and 6 refer to crossover 9f, a POSITA would have understood

this to be exemplary and that the disclosed structure of Figures 4, 5, and 6 applies to the other crossovers as well.” Petition, 85. Petitioner’s assertion amounts to nothing more than attorney arguments unsupported by evidence and, thus, is entitled to little, if any, weight. *In re Geisler*, 116 F.3d 1465, 1470 (Fed. Cir. 1997); *see also In re Pearson*, 494 F.2d 1399, 1405 (CCPA 1974) (An attorney’s arguments in a brief cannot take the place of evidence.).

Furthermore, as discussed above, *Christensen* solves the problem of matching the electrical properties of primary and secondary windings of a planar transformer. Ex.1006, 4:60–63 (“As a general rule, the crossings should be positioned so as to assist in balancing the electrical properties of the windings.”). A POSITA would have understood that *Christensen* necessarily requires two planar windings for an operable transformer and is focused on the structural and electrical symmetry between the two windings, especially in the layout area where the primary and secondary windings cross each other. *Id.* at 3:43–61. *Christensen* is entirely silent and irrelevant with respect to applying a multi-layer transformer structure as shown in Figs. 4, 5, and 6, to the design of a single stacked spiral inductor of the ’245 Patent.

Next, Petitioner conveniently switches to the crossover area 9f of primary winding 3 and secondary winding 4 (excerpt reproduced below) to support the position that multiple portions of both windings are bonded by arrays of vias.

Petition, 84. Once again, Petitioner improperly conflates the crossover area of two intermingled planar windings (*i.e.*, primary winding 3 and secondary winding 4) that are necessarily required by a transformer to a single stacked inductor structure claimed in the '245 Patent. *Id.*



Petitioner improperly expands the teaching of its deficient art by taking *Christensen's* explicit teaching (*i.e.*, a layout technique of two windings of a transformer) out of context to fill in the gaps of the missing elements of the Challenged Claims of the '245 Patent. The Petition requires adopting the unreasonable position that any teaching of two windings that crossover, even if simply in a planar configuration, with vias would render obvious the above-noted combination of features of the Challenged Claims regardless of whether a spiral

inductor is disclosed. This position is manifestly incorrect, at least because Petitioner merely plucks the claimed subject matter out of context and picks and chooses among isolated disclosures in *Christensen* to deprecate the claimed inventions. Relying upon annotated Figs. 1 and 4 of *Christensen* to which a POSITA would not have looked in addressing the technical problem in the '245 Patent, Petitioner simply attempts to reconstruct the claimed invention with hindsight, using the claimed subject matter as a template and selecting elements from the references to fill in the gaps.

Notably, Petitioner fails to point to any language from the disclosure of *Christensen* describing any of the material limitations required by the Challenged Claims. Petitioner fails to do so because *Christensen* discloses nothing about the construction of a stacked spiral inductor. Instead, Petitioner reads into *Christensen* multiple teachings that are simply not there. Petitioner repeatedly leans on the conclusory statement that “A POSITA would have understood/recognized” to suggest what Petitioner wants it to suggest. Petition, 53–54. Rather than articulate a clear argument, Petitioner tries to shoehorn in fundamentally flawed characterizations of *Christensen* by having its expert cite to them in a declaration. *Id.* In other words, Petitioner essentially acknowledges that its own art does not disclose or suggest the limitations of the '245 Patent. Petitioner improperly stretches

the teachings of its deficient art to fill in the gaps of the missing elements. Simply put, a POSITA would not have found the Challenged Claims to be obvious based on *Christensen*.

3. *Christensen* Does Not Disclose a “Spiral Inductor,” which is a Material Limitation of the Challenged Claims

Similar to the deficiencies pointed out in *Ho-Hsiang*, *Christensen* does not disclose or suggest a spiral inductor, but rather specifically discloses and teaches planar transformers:

- Title: “PLANAR TRANSFORMERS”
- Abstract: “In a planar transformer, at least a portion of each of the windings are intermingled in an intermingled portion. Within the intermingled portion, each full turn of each winding is effected by one self-crossing and two crossings of each other winding having turns in said intermingled portion. The windings may be formed in the conductor layers of an integrated circuit.”
- Field of the Invention: “The present invention relates to transformer structures suitable for integrated circuits.”
- Figs. 1, 2, 3, 4, 5, 6(a), 6(c), 7, 8, 9, 10, and 11 and their corresponding descriptions.
- Detailed Description of the Preferred Embodiments.
- All of the issued Claims 1–15 are explicitly directed to “a substantially planar transformer.”

At least because the preamble of the Challenged Claims should be afforded patentable weight and *Christensen* specifically teaches a substantially planar transformer, not a stacked spiral inductor, *Christensen* fails to disclose material limitations of the Challenged Claims, and the Petition fails to establish a reasonable likelihood that the Challenged Claims would have been obvious over *Christensen*.

4. *Christensen* Does Not Disclose the Construction of “Shunt Windings” from Metal Layers of a “Crossover Region” of the Challenged Claims

Petitioner argues that *Christensen*’s Figs. 5 and 6(a) disclose “A structure of a spiral inductor, comprising: ... wherein the first segment, the fourth segment and the first set of vias construct a first shunt winding; the second segment, the fifth segment and the second set of vias construct a second shunt winding; and the third segment and the sixth segment construct a crossover region.” as recited in independent claim 1 (and each of the Challenged Claims) of the ’245 Patent. Petition, 90-94.

As noted above, *Christensen* is entirely silent with respect to the claimed segments of a single stacked inductor, a first and second sets of vias connecting segments of the single stacked inductor, and shunt windings constructed and arranged at a specific location from the metal layers of the crossover region of the single stacked inductor of the ’245 Patent. Petitioner merely plucks the claimed

subject matter out of context and picks and chooses among isolated disclosures regarding a crossover area of two intermingled primary windings of a planar transformer in *Christensen* to deprecate the claimed inventions.

Notably, Petitioner maps structural features of specific winding portions of a primary winding inductor (as shown in Fig. 2) to a multi-layer crossover area of two windings (*i.e.*, the primary winding 3 and secondary winding 4, as shown in Fig. 6(a)) of a planar transformer. Petition, 91. Petitioner essentially acknowledges that *Christensen* does not disclose or suggest the limitations of the '245 Patent. In an attempt to backfill these deficiencies, Petitioner merely relies on expert testimony as a substitute for a teaching of the prior art, but the Trial Practice Guide precludes those attempts. *See* Patent Trial and Appeal Board Consolidated Trial Practice Guide November 2019 (PTAB November 2019) at 36 (“[E]xpert testimony...is not a substitute for disclosure in a prior art reference itself.”).

Petitioner improperly stretches the teachings of its deficient art to fill in the gaps of the missing material limitations of the Challenged Claims. A POSITA would not have found the Challenged Claims to be obvious based on *Christensen* given its failure to disclose these material limitations. Accordingly, the Petition fails to establish a reasonable likelihood that the Challenged Claims would have been obvious over the non-analogous art that is *Christensen*.

5. Petitioner Provides No Motivation to Modify *Christensen* to Achieve the Invention of the Challenged Claims

In addition, Petitioner has provided no motivation to utilize the teachings of *Christensen* to develop the structure of a spiral inductor as claimed in the '245 Patent. *Christensen* discloses a planar transformer structure and is directed to a different field of endeavor with fundamentally different design objectives. Further, as discussed above, the planar transformer described and claimed in *Christensen* would not be instructive to a POSITA seeking to reduce the footprint of an inductor while optimizing its Q factor. In other words, *Christensen* is not reasonably pertinent to the particular problem identified and addressed in the '245 Patent, and a POSITA would not be motivated to utilize its non-analogous teachings to achieve the inductor design objectives of the '245 Patent.

VII. THE PETITION DOES NOT ESTABLISH A REASONABLE LIKELIHOOD THAT THE CHALLENGED CLAIMS WOULD HAVE BEEN OBVIOUS BASED ON *YANG*

A. Summary of *Yang*

Yang generally discloses a differential inductor with multi-turn windings. Ex.1007, Abstract, ¶ [0018]. *Yang* includes only two drawings (both reproduced below). Fig. 1 shows a top view of an exemplary differential inductor 10 with multi-turn windings, and Fig. 2 is a sectional perspective view taken along line I-I' of Fig. 1. *Id.* at Figs. 1 and 2.

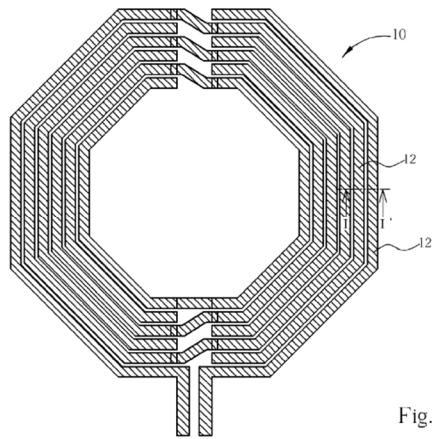


Fig. 1

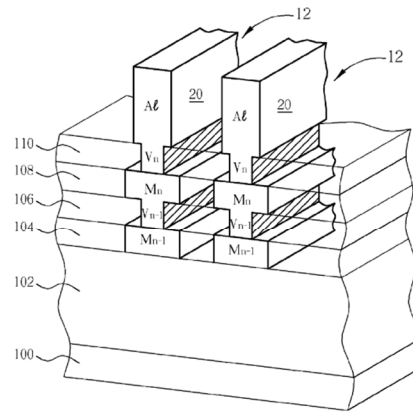


Fig. 2

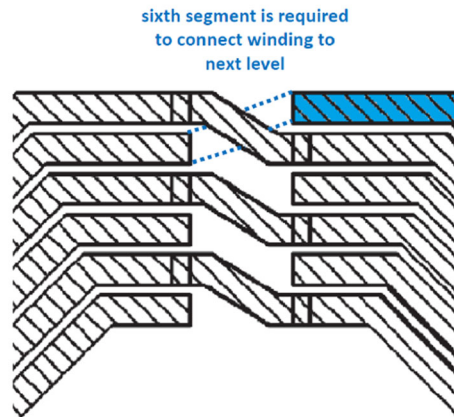
B. Yang Does Not Disclose Material Limitations of the Challenged Claims

1. Yang Does Not Disclose a “Sixth Segment” or a “Crossover Region” as Required by the Challenged Claims

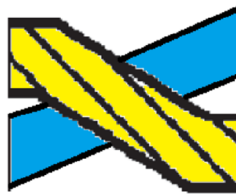
Contrary to the arguments on pages 113–17 and 127–29 of the Petition, *Yang* is silent with respect to at least “a second metal layer, being positioned under the first metal layer, the second metal layer comprising: ... *a sixth segment*, connected to the fifth segment, *wherein a layout direction of the sixth segment is different from a layout direction of the fourth segment and a layout direction of the fifth segment*, ... and *the third segment and the sixth segment construct a crossover region*,” as recited in independent claim 1 of the ’245 Patent.

Notably, Petitioner improperly annotates *Yang*’s Fig. 1 to represent a “second metal layer” that is not illustrated in *Yang*, but also to add the missing “sixth

segment” of the “second metal layer” to the lone top view image of the inductor disclosed in *Yang* (both reproduced below). Petition, 114–15.



Yang, Fig. 1 (partial) (EX-1007) (annotated)



Yang, Fig. 1 (portion, modified) (EX-1007) (annotated)

The claimed “sixth segment” and “crossover region” simply do not exist in *Yang*. Specifically, the Challenged Claims require “a second metal layer ... comprising: ... a sixth segment, connected to the fifth segment.” Petitioner fails to point to any language from the disclosure of *Yang* to teach or suggest the claimed “sixth segment.” *Yang* makes no mention of a sixth segment. *Yang* does not illustrate a sixth segment. *Yang* does not even illustrate a second metal layer. Instead, Petitioner is forced to recycle *Yang* Fig. 1 to illustrate a purported second

metal layer, and then Petitioner is forced to annotate the figure to add a “sixth segment” to suggest *Yang* discloses what Petitioner wants it to disclose.

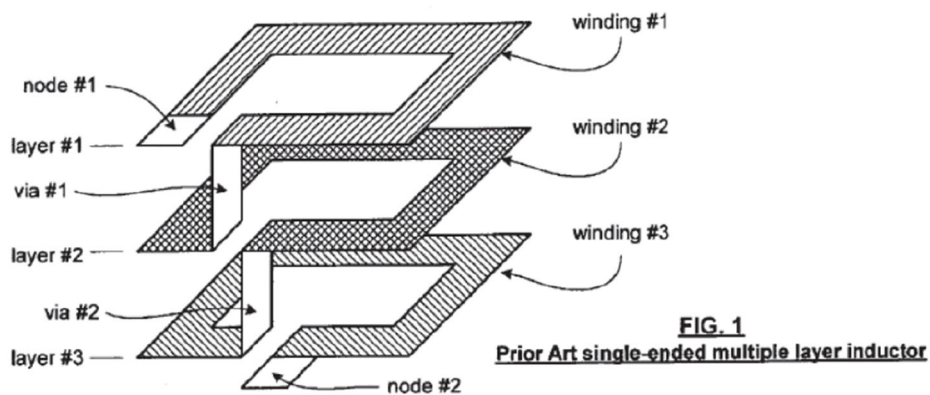
The Challenged Claims also require that “a layout direction of the sixth segment is different from a layout direction of the fourth segment and a layout direction of the fifth segment.” Because *Yang* does not teach or disclose a second metal layer having a sixth segment, *Yang* also fails to teach or disclose such a sixth segment having a layout direction different from the layout direction of the fourth and fifth segments.

Furthermore, the Challenged Claims require a structure of a spiral inductor, wherein “the third segment [of a first metal layer] and the sixth segment [of a second metal layer] construct a crossover region.” Because *Yang* does not teach or disclose a second metal layer with a sixth segment, *Yang* also fails to teach or disclose a structure of a spiral inductor wherein the third segment [of a first metal layer] and the sixth segment [of a second metal layer] construct a crossover region.

Petitioner annotates the illustration of *Yang* to add this material limitation and baselessly contends that “without a crossover connected to the fifth segment, the winding would not connect to the next loop and would simply be an open metal line. ... A POSITA would therefore have understood that in *Yang*, the second layer crossover ... would be directly under the top layer crossover ... Further, a POSITA

would have understood that symmetrical inductors have crossovers which are also symmetrical, *i.e.*, the two windings that form the crossover are equal in size, shape, and location, just mirror opposites of each other. ... a POSITA would have expected *Yang* to also have a symmetric crossover pattern.” Petition, 114–17.

This is simply untrue. This material limitation of the Challenged Claims is not “inherently” disclosed in *Yang*. Contrary to the misleading inherency argument of the Petition, a sixth segment would not be necessary to the disclosed structure in *Yang* because there are many ways to connect different parts of a winding. For example, *Yang* discloses that “[t]he invention is also applicable to single-ended type inductors.” Ex.1007, ¶ [0019]. The Petition on page 16 shows a prior art single-ended multiple layer inductor (reproduced below) where a number of vertical vias (*i.e.*, vertical vias #1, #2, and #3) are implemented to connect three winding layers of a multi-layer inductor.



Kvriazidou, Fig. 1 (EX-1013)

Petitioner's own examples demonstrate that a "sixth segment" and "crossover region" are not necessarily required for connecting the different metal layers in *Yang*, because different segments of windings can be connected via alternative methods proffered by Petitioner.

Additionally, nothing in *Yang* supports Petitioner's position that *Yang* discloses a symmetrical inductor. Nor does *Yang* disclose that a symmetrical inductor must possess the "crossover region" of the Challenged Claims to be operable as Petitioner baselessly suggests.

"A party must ... meet a high standard in order to rely on inherency to establish the existence of a claim limitation in the prior art in an obviousness analysis - the limitation at issue necessarily must be present, or the natural result of the combination of elements explicitly disclosed by the prior art." *PAR Pharm., Inc. v. TWI Pharms., Inc.*, 773 F.3d 1186, 1195–96 (Fed. Cir. 2014). The claimed "sixth segment" and "crossover region" constructed from the claimed "sixth segment" are not present in *Yang*, nor is this subject matter a natural result of the combination of elements explicitly disclosed in *Yang*. The only rationale for the proposed modification to the *Yang* disclosure (adding the "sixth segment" to *Yang*'s Fig. 1) is to target the Challenged Claims. This is classic hindsight predicated on improper picking and choosing and taking editorial liberties with the isolated disclosures in

Yang to deprecate the Challenged Claims. *See In re Wesslau*, 353 F.2d 238, 241 (C.C.P.A. 1965); *accord Eli Lilly & Co. v. Actavis Elizabeth LLC*, 435 F. App'x 917, 920-21 (Fed. Cir. 2011).

Once again, Petitioner reads into *Yang* multiple material limitations that are simply not there. In an attempt to backfill these deficiencies, Petitioner relies on expert testimony as a substitute for a teaching of the prior art, but the Trial Practice Guide precludes those attempts. *See Patent Trial and Appeal Board Consolidated Trial Practice Guide November 2019 (PTAB November 2019)* at 36 (“[E]xpert testimony... is not a substitute for disclosure in a prior art reference itself.”). In other words, Petitioner essentially acknowledges that its own art does not disclose or suggest the limitations of the '245 Patent. Nonetheless, Petitioner stretches the teachings of its deficient art to fill in the gaps of the missing material limitations. A POSITA would not have found the Challenged Claims to be obvious based on *Yang* given its failure to disclose these material limitations of the Challenged Claims, and the Petition fails to establish a reasonable likelihood that the Challenged Claims would have been obvious over the non-analogous art that is *Yang*.

2. *Yang* Does Not Disclose the Construction of “Shunt Windings” from Metal Layers from a “Crossover Region” of the Challenged Claims

Yang is entirely silent with respect to “wherein the first segment, the fourth segment and the first set of vias construct *a first shunt winding*; the second segment, the fifth segment and the second set of vias construct *a second shunt winding*,” as recited in independent claim 1 of the ’245 Patent. (Emphasis added.) *Yang* simply makes no mention of any “shunt windings.”

Petitioner fails to point to any language from *Yang*’s disclosure describing the construction of “shunt windings” from metal layers of a “crossover region” as required by the Challenged Claims. Rather, Petitioner has its expert support the unreasonable position that any teaching of two metal layers connected with vias would render obvious the above-noted combination of features of independent claim 1 of the ’245 Patent in a declaration. Petition, 124-27. Petitioner merely reads into *Yang* material limitations that are simply not there. *Id.* *Yang* does not disclose or suggest the construction of “shunt windings” from metal layers of a “crossover region” as required by the Challenged Claims, and Petitioner improperly stretches the teachings of *Yang* to fill in the gaps of these missing material limitations.

Yang fails to disclose several material limitations of the Challenged Claims, and the Petition fails to establish a reasonable likelihood that the Challenged Claims would have been obvious over *Yang*.

3. Petitioner Provides No Motivation to Modify *Yang* to Achieve the Invention of the Challenged Claims

As discussed above, Petitioner admits that both the claimed “sixth segment” and “crossover region” are entirely missing from *Yang* but annotates *Yang*’s Fig. 1 to supply the missing limitations by having its expert cite to them in a declaration. Petition, 114–17, 127–28. Nothing in *Yang* or elsewhere would suggest or motivate a POSITA to add the claimed “sixth segment” to the “second metal layer” to construct a “crossover region,” as required by the Challenged Claims.

A POSITA would not have been motivated to add those limitations based on *Yang* or any of the secondary references cited in the background section of the Petition, individually or in combination with one another, to arrive at the claimed invention. Petitioner only offers a conclusory assertion from a third party about general knowledge in the art without evidence on the record, particularly where the claimed “sixth segment” and “crossover region” are important structural limitations that are not “evidently and indisputably within the common knowledge of those skilled in the art.” *Himpp v. Hear-Wear Techs., LLC*, 751 F.3d 1362, 1365–66 (Fed. Cir. 2014). Petitioner attempts to rely on expert testimony as a substitute for a teaching of the prior art, but the Trial Practice Guide precludes those attempts. *See* Patent Trial and Appeal Board Consolidated Trial Practice Guide November 2019

(PTAB November 2019) at 36 (“[E]xpert testimony...is not a substitute for disclosure in a prior art reference itself.”).

Yang does not disclose the claimed “sixth segment,” let alone the claimed “crossover region” or any “shunt windings” and nothing in the Petition suggests why a POSITA would have been motivated to modify *Yang* to include such features. As such, *Yang* does not render obvious any claimed aspects related to the “sixth segment” and “crossover region” or the “shunt windings” of the Challenged Claims. *See Endo Pharms Sol’ns, Inc. v. Custopharm Inc.*, 894 F.3d 1374, 1379–81 (Fed. Cir. 2018) (holding that patents were not invalid for obviousness where the prior art did not disclose some of the claim limitations and rejecting challenger’s assertion that one of the limitations was inherently disclosed in the prior art).

A POSITA would not have found the Challenged Claims to be obvious based on *Yang* given its failure to disclose these material limitations of the Challenged Claims, and the Petition fails to establish a reasonable likelihood that the Challenged Claims would have been obvious over *Yang*.

VIII. CONCLUSION

For the reasons set forth above, Petitioner is unlikely to prevail on any of the asserted invalidity grounds in the Petition. Therefore, the Board should not institute any of the asserted grounds in the Petition.

Dated: July 28, 2023

Respectfully submitted,

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CERTIFICATION UNDER 37 C.F.R. § 42.24(d)

Under the provisions of 37 C.F.R. § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Patent Owner's Preliminary Response totals 12,204 words, which is less than the 14,000 words allowed under 37 C.F.R. § 42.24(b)(1).

Dated: July 28, 2023

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CERTIFICATE OF SERVICE

I hereby certify that on July 28, 2023, I caused a true and correct copy of the foregoing to be served on the following counsel for Petitioner by electronic mail to the following email address:

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