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

PETITIONER'S REPLY BRIEF

TABLE OF CONTENTS

PETITIONER'S EXHIBIT LIST iii

TABLE OF ABBREVIATIONS vii

I. INTRODUCTION 1

II. PROCEDURAL HISTORY 3

III. INDUCTORS AND TRANSFORMERS 4

A. Realtek's Discussion Regarding Differences between Inductors and Transformers 4

B. Transformers are Analogous Art 6

C. Obviousness of the Patent's Stated Purpose 10

IV. IDENTIFICATION OF HOW THE CLAIMS ARE UNPATENTABLE 12

A. GROUND 1: *Ho-Hsiang* 12

1. Preamble: a structure of a spiral inductor, comprising. 12

2. *Ho-Hsiang* does not Teach Away from the Claimed Inductor Structure 15

3. No modification to the Transformer of *Ho-Hsiang* is Necessary to Invalidate 17

4. Because No Modification to the Transformer of *Ho-Hsiang* is Necessary to Invalidate, it would Clearly Still Work for its Intended Purpose 22

B. GROUND 2: *Christensen* Invalidates the Challenged Claims 23

1. Realtek's Redundant Arguments Regarding Transformer Art 24

C. GROUND 3: *Yang* Invalidates the Challenged Claims 25

V. CONCLUSION 29

PETITIONER'S EXHIBIT LIST

Exhibit No.	Description
1001	U.S. Patent No. 7,936,245
1002	File History of U.S. Patent No. 7,936,245
1003	Declaration of Dr. Paul R. Prucnal ("Initial Declaration")
1004	*Curriculum Vitae* of Dr. Paul R. Prucnal
1005	U.S. Patent No. 7,821,372 to Ho-Hsiang
1006	U.S. Patent No. 6,794,977 to Christensen
1007	U.S. Patent Application Publication No. 2009/0002114 A1 to Yang et al.
1008	Sadasiva Biswal, Basic Electronics Volume I, 45, (2001)
1009	A. Niknejad, Design, Simulation and Applications of Inductors and Transformers for Si RF ICs, Second Printing. (2002)
1010	A. Niknejad, Electromagnetics for High-Speed Analog and Digital Communication Circuits, (2008)
1011	J. Burghartz, *Spiral Inductors on Silicon – Status and Trends (Invited Article)*, International Journal of RF and Microwave Computer-Aided Engineering, V. 8, No. 6, 422-432 (Nov. 1998)

Exhibit No.	Description
1012	O.H. Murphy et al., *Design of Multiple-Metal Stacked Inductors Incorporating an Extended Physical Model*, IEEE Transactions on Microwave Theory and Techniques, Vol. 53, No. 6, 2063-2072 (June 2005)
1013	U.S. Patent No. 6,759,937 to Kyriazidou
1014	U.S. Patent No. 6,967,555 to Kao
1015	U.S. Patent No. 8,325,001 to Huang
1016	I. Bahl, Lumped Elements for RF and Microwave Cicuits, Artech House (2003)
1017	U.S. Patent No. 6,885,275 to Chang
1018	U.S. Patent Application Publication No. US 2008/0074229 A1 to Moinian
1019	Reserved
1020	*Webster's New World College Dictionary,* Fourth Edition, 2009 (excerpt)
1021	*Encyclopedia of Electronics,* 2d (McGraw-Hill 1990) (excerpt)
1022	Realtek Exhibit 30 to Complaint, ITC Inv. No. 337-TA-1350

Exhibit No.	Description
1023	7,936,245 Priority Application and Feb. 24, 2023 Transperfect Certified Translation
1024	D. Brooks, *Differential Signals Rules to Live By*, Printed Circuit Design, CMP Media Publication (Oct. 2001)
1025	M. Soyuer, Multilevel monolithic inductors in silicon technology, Electronics Letters Vol. 31 No. 5 (1995)
1026	Website Printout from the Internet Archive for the Biswal Book (EX-1008)
1027	Website Printout from the Internet Archive for the Bahl Book (EX-1016)
1028	Website Printout from the Internet Archive for the Brook Paper (EX-1024)
1029	Burghartz, *On the Design of RF Spiral Inductors on Silicon (Invited Paper)*, IEEE Transactions on Electron Devices, V. 50, No. 3 (Mar. 2003)
1030	R. Lutz, M*odeling and Analysis of Multilevel Spiral Inductors for RFICS*, IEEE MTT-S Int'l Microwave Symposium Digest V. 1 (Jun. 1999)

Exhibit No.	Description
1031	Declaration of Sylvia D. Hall-Ellis, Ph.D.
1032	Curriculum Vitae of Sylvia D. Hall-Ellis, Ph.D.
1033	Declaration of Joseph C. Masullo ISO PHV Admission
1034	Declaration of Robert T. Vlasis ISO PHV Admission
1035 **New**	January 19, 2024 Initial Determination on Violation of Section 337 and Recommended Determination on Remedy and Bond (Public Version)
1036 **New**	U.S. Patent No. 7,656,264 to Hsu
1037 **New**	April 18, 2024 Deposition Transcript of Dr. Joshua Phinney, Ph.D.
1038 **New**	PTO Classification Definitions – Class 336 Inductor Devices https://www.uspto.gov/web/patents/classification/uspc336/defs336.pdf
1039 **New**	Reply Declaration of Dr. Paul R. Prucnal ("Reply Declaration")

TABLE OF ABBREVIATIONS

AMD or Petitioner	Petitioner Advanced Micro Devices, Inc.
Realtek or PO	Patent Owner Realtek Semiconductor Corporation
245 patent	U.S. Patent No. 7,936,245 (EX-1001)
ID	Institution Decision, Paper 9
Pet.	Petition for Inter Partes Review, Paper 22
POR	Patent Owner Response, Paper 19
POSITA	Person of Ordinary Skill in the Art
ITC Investigation	ITC Investigation No. 337-TA-1350
PTO	United States Patent and Trademark Office
Emphasis	All emphasis added herein except if noted otherwise
Cites	All cites are to the PDF page number unless noted otherwise

I. INTRODUCTION

The challenged claims are invalid based on the following grounds, and PO's arguments to the contrary are meritless.

- Ground 1: Claims 1, 2, 5, 8 and 9 are obvious based on U.S. Patent No. 7,821,372 ("*Ho-Hsiang*") (Ex. 1005).
- Ground 2: Claims 1, 2, 8 and 9 are obvious based on US Patent No. 6,794,977 ("*Christensen*") (Ex. 1006).
- Ground 3: Claims 1–4, 8 and 9 are obvious based on U.S. Patent App. Pub. No. 2009/0002114 ("*Yang*") (Ex. 1007).

Every challenged claim relates solely to the ***structure***, and ***not*** the functionality, of an inductor. Conversely, PO's arguments focus almost exclusively on alleged functional differences between transformers and inductors. Those arguments are flawed both legally and from a technical perspective.

***Ho-Hsiang and Christensen*:** A POSITA interested in building an inductor would have looked to references disclosing transformers because a transformer is simply two or more inductors. EX-1039, ¶¶11-15, 25-34. As such, transformers are unquestionably from the same field of endeavor as inductors. *In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004); EX-1039, ¶¶19-22. One need look no further than the PTO's art classification system in place at the time the 245 patent was prosecuted, which included both inductors and transformers in "CLASS 336,

INDUCTOR DEVICES." *See, e.g.*, EX-1038.001, .007; EX-1039, ¶¶37-39. Tellingly, the 245 patent itself discusses transformers (EX-1039, ¶19) while the *Ho-Hsiang* and *Christensen* references discuss inductors (EX-1039, ¶¶35-36, 52-53).

Indeed, PO's expert admitted that inductors and transformers have many of the same design considerations, e.g., substrate loss, metal loss, and quality factor. EX-1039, ¶29; EX-1037, 66:2-10. And there is no hindsight bias here, as PO contends, because AMD does not rely on any necessary modifications to *Ho-Hsiang* or *Christensen* or resort to combining references. Instead, the challenged claims are invalidated by the ***unmodified inductor structures*** disclosed in the *Ho-Hsiang* and *Christensen* references. *See, e.g.*, EX-1039, ¶¶40, 51.

***Yang*:** *Yang* teaches a symmetric spiral inductor. PO's sole dispute boils down to *Yang* not explicitly depicting a sixth segment at the crossover region. However, it is not disputed that (though not explicitly shown) a connection must be present in the *Yang* inductor. EX-1039, ¶59. Neither Realtek nor its expert annotated the *Yang* inductor to depict what such a connection would look like, were it not the way that Petitioner and Dr. Prucnal proposed. Thus, Dr. Prucnal's analysis, explaining in detail why a POSITA would have found it obvious for the sixth segment crossover to exist in the manner Dr. Prucnal described, is not rebutted by any evidence to the contrary. EX-1039, ¶60-63.

In sum, the challenged claims of the 245 patent disclose nothing more than basic elements of inductor design and are unpatentable based on the grounds discussed herein.

II. PROCEDURAL HISTORY

In the parallel ITC Investigation, claims 1, 2, and 8 were at issue. EX-1035.031. There, three pieces of prior art were substantively and individually considered. Two were physical integrated circuit products (Qualcomm RFR6122 and Marvell 88W8686) and the third was *Christensen*. The Administrative Law Judge ("ALJ") found that all claims at issue were invalid based on the RFR6122 alone (EX-1035.064-.066), the 88W8686 alone (EX-1035.075-.077), and *Christensen* alone (EX-1035.085-.086). At the ITC trial, Realtek and Dr. Phinney made the same flawed arguments as they do here, arguing that inductors found in transformer prior art do not invalidate. EX-1039, ¶¶9-15. The ALJ soundly rejected those arguments. *See, e.g.*, EX-1035.073-75 (Finding Realtek's opposition "entirely unpersuasive").

For instance, Realtek argued that "[t]he evidence is clear that the intended use of Marvell is as a transformer and in order to use it as an inductor, as suggested by Dr. Prucnal, it would need to be modified." EX-1035.073. In rejecting that argument, the ALJ found that "Realtek completely avoid[ed] discussing [the] body of evidence and testimony assembled by AMD ***establishing that transformers***

consist of two inductors." *Id*. Realtek has taken the same approach here, avoiding the inconvenient but well-established fact that a transformer consists of two inductors. EX-1039, ¶13.

III. INDUCTORS AND TRANSFORMERS

A. Realtek's Discussion Regarding Differences between Inductors and Transformers

As in the ITC Investigation, Realtek's arguments here are heavily focused on what it refers to as the "fundamental differences between inductors and transformers." *See*, POR, 16-20. This argument is misguided. As Dr. Prucnal has explained, a common application for inductors is in transformers, which are widely used in RF circuits. EX-1039, ¶16. Indeed, a transformer's primary behavior derives from the phenomenon of mutual induction. EX-1039, ¶17. A basic schematic representation of a transformer includes two inductors. EX-1039, ¶18.

Notably, the POR is particularly focused on the functionality and coupling of transformers and inductors. *See, e.g.*, POR, 18-20. However, the functionality of inductors is ***not claimed*** in the 245 patent. Regardless, both inductors and transformers share many of the same functional and design considerations, e.g., substrate loss, metal loss, and quality factor. EX-1039, ¶¶23, 28-33. The POR contends that "[k]ey design goals for transformers include symmetry and coupling." POR, 17. Realtek's expert argues that "[w]hen transformer windings are intermingled to improve coupling, each winding includes structural

modifications ***particular to its use as transformer windings***. These structural modifications to the windings of a transformer run counter to the goals of inductor design because the modifications do not optimize Q." EX-2003, ¶62 (emphasis retained). However, as Dr. Prucnal explains, transformers and inductors share similar design considerations. EX-1039, ¶¶28-30. And a POSITA would have understood that the mere fact that windings may be intermingled or take into account coupling does not mean that all other design considerations are ignored. EX-1039, ¶30. A POSITA would have recognized that a chip layout must account for many competing design considerations, not merely one in isolation. EX-1039, ¶¶30, 45.

Moreover, PO's argument that "a POSITA would understand individual inductors must be substantially modified in a manner deleterious to their function as inductors, in order to be used as one of the windings in a transformer" is belied by the evidence its own expert has presented. POR, 20. For instance, the Mohan reference (EX-2003) depicts numerous symmetric transformers with symmetric (square-shaped) inductor structures, as shown below.

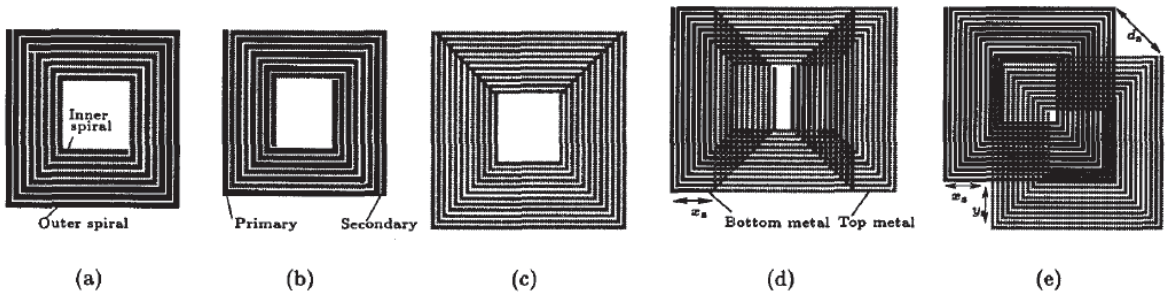


Figure 1: On-chip transformer realizations. (a)Tapped, (b)interleaved, (c)stacked with top spiral overlapping the bottom one, (d)stacked with top and bottom spirals laterally shifted, (e)stacked with top and bottom spirals diagonally shifted.

EX-2007.03; *see also*, EX-1039, ¶¶30-33. Thus, PO's blanket assertion that inductors must be substantially modified when utilized in transformers is incorrect. And fundamentally, PO does not contest that even an inductor allegedly modified to comprise part of a transformer still has a "structure" of an inductor, and therefore may invalidate the 245 patent claims if the specific structural limitations are found in that inductor—as is the case with the *Ho-Hsiang* and *Christensen* inductors.

B. Transformers are Analogous Art

Transformers and inductors are in the same field of endeavor. *In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004); EX-1039, ¶¶19-22. Numerous courts have explicitly held that transformers are comprised of inductors. *ICM Controls Corp. v. Honeywell Int'l, Inc*., 256 F. Supp. 3d 173, 180 (N.D.N.Y. 2017); *Hochstein v. Microsoft Corp.,* No. 04-73071, 2009 WL 6372589, at *3 (E.D. Mich. Dec. 14, 2009); *Superior Elec. Co. v. Raytheon Co.*, 360 F. Supp. 960, 961–62 (D.N.H.

1972). The 245 patent itself, as well as the prior art, confirms that transformers are analogous art. EX-1001, [1:12-20], EX-1006, [1:9-25]; EX-1039, ¶19.

The PTO also confirms that transformers are analogous art to inductors. At the time it was filed and prosecuted, the 245 patent belonged to class 336. EX-1001, [cover page, lines 52, 58 (identifying class 336)]. Class 336 is titled "Inductor Devices" and there was no separate "transformer class." *See, e.g.*, EX-1038.07; EX-1039, ¶¶37-39. Instead, in defining "inductor," the PTO stated that "transformers … ***are included within*** the definition of 'inductor'" and defines "transformer" as including "an ***inductor***." EX-1038.07. Realtek's expert disagrees with the PTO, arguing that the PTO's classification is "not in line with the way these words are used in education for a person of ordinary skill;" but tellingly, he offers not a single piece of evidence to support this misguided assertion. EX-1037, 107:11-21; EX-1039, ¶¶37-39. As such, his testimony is entitled to little to no weight. *Xerox Corp. v. Bytemark Inc.*, IPR 2022-00624, Paper 9 at 15 (PTAB August 24, 2022) (designated precedential on Director Review, Paper No. 12 (Feb. 10, 2023)) ("[The expert] does not cite to any additional supporting evidence or provide any technical reasoning to support his statement. Thus, the cited declaration testimony is conclusory and unsupported, adds little to the conclusory assertion for which it is offered to support, and is entitled to little weight. See 37 C.F.R. § 42.65(a)."). In contrast, AMD and Dr. Prucnal have presented numerous

scientific references supporting their contentions. *See, e.g.*, EX-1039, ¶¶13-15; EX-1003, ¶¶53-57.

The prosecution history also confirms that transformer art is analogous art and a POSITA would have looked to references describing transformers as relevant to the pending claims. Indeed, during prosecution of the 245 patent, both the Examiner and Applicant considered transformer art. EX-1039, ¶¶20-22; *see also*, EX-1002.016 (Information Disclosure Statement by Applicant citing "Design, Simulation and Applications of ***Inductors and Transformers*** for SI RF ICS.") (below).

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99**)		
	Application Number	12773024
	Filing Date	2010-05-04
	First Named Inventor	Kai-Yi Huang
	Art Unit	2811
	Examiner Name	N/A
	Attorney Docket Number	REAP0577USA

	1							
NON-PATENT LITERATURE DOCUMENTS								
Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.						
/TN/	1	DESIGN,SIMULATION AND APPLICATIONS OF INDUCTORS AND TRANSFORMERS FOR SI RF ICS, ALI M. NIKNEJAD AND ROBERT G. MEYER, 2000, P.22-24,Kluwer Academic Publishers, Distributors for North, Central and South America. no date						
EXAMINER SIGNATURE								
Examiner Signature		/Tuyen Nguyen/				Date Considered		12/20/2010
*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.								

See also, EX-1002.013 (Notice of References Cited, citing U.S. Patent No 7,656,264 to Hsu, titled "High Coupling Factor ***Transformer*** and Manufacturing Method Thereof") (below).

Notice of References Cited	Application/Control No. 12/773,024	Applicant(s)/Patent Under Reexamination HUANG ET AL.	
	Examiner TUYEN T. NGUYEN	Art Unit 2832	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-4,816,784	03-1989	Rabjohn, Gordon G.	333/24R
*	B	US-7,656,264	02-2010	Hsu et al.	336/223
*	C	US-7,525,407	04-2009	Lee et al.	336/200
*	D	US-7,721,414	05-2010	Sia et al.	29/602.1
*	E	US-6,426,267	07-2002	Liou, Ping	438/319
*	F	US-6,355,535	03-2002	Liou, Ping	438/381
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

See, EX-1036.01 (below).

(12) **United States Patent**
Hsu et al.

(10) **Patent No.: US 7,656,264 B2**
(45) **Date of Patent: Feb. 2, 2010**

(54) **HIGH COUPLING FACTOR TRANSFORMER AND MANUFACTURING METHOD THEREOF**

Solid-State Circuit, vol. 52, No. 7, p. 1410-1414, Jul. 2005.
Alireza Zolfaghari et al. "Stacked Inductors and Transformers in CMOS Technology" published in Journal of Solid-State Circuit, vol. 36, No. 4, p. 620-628, Apr. 2001.

Tellingly, the Hsu transformer patent reference shares the same 336 classification as the 245 patent and lists a publication titled "Stacked ***Inductors and Transformers*** in CMOS Technology" on its face (above). EX-1036.001. Moreover, it is "understandable" to Realtek's expert that the cited Hsu prior art is

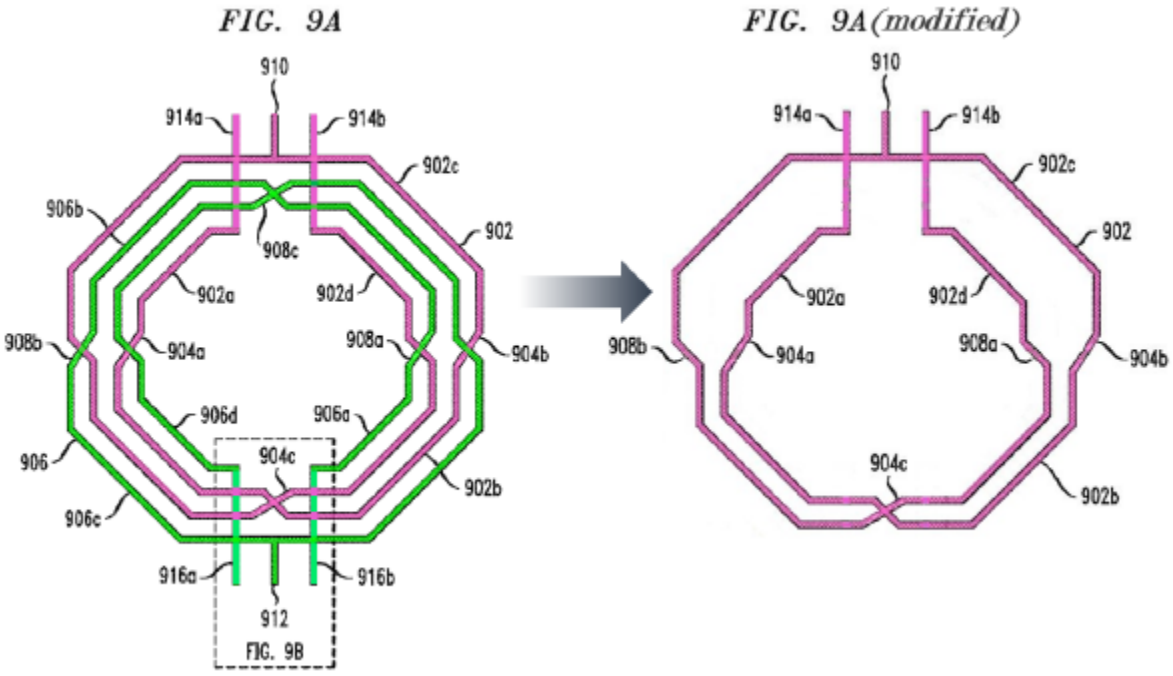
in fact a ***transformer which includes two inductors***. EX-1037, 90:17-93:15, e.g., at 92:25-93:7.

Indeed, the 245 patent itself discusses transformers (EX-1039, ¶19) while the *Ho-Hsiang* and *Christensen* references discuss inductors (EX-1039, ¶¶35-36, 52-53). Because a transformer comprises two or more inductor structures, a POSITA would have naturally looked to references disclosing transformers and transformer structures when looking to design a new type of inductor structure. EX-1039, ¶20. Transformers are therefore "from the same field of endeavor" as inductors. *Bigio*, 381 F.3d at 1325. Accordingly, transformer art is analogous art to the 245 patent and may be considered in an obviousness analysis.

C. Obviousness of the Patent's Stated Purpose

Realtek argues that "[i]n appropriate circumstances, a single prior art reference can render a claim obvious. However, there must be a showing of a suggestion or motivation to **modify the teachings** of that reference to the claimed invention in order to support the obviousness conclusion." POR, 22 (citing *SIBIA Neurosciences*); *see also*, POR, 28. This argument is misplaced. As Dr. Prucnal explains, because a transformer is simply two inductors his analysis ***does not require any modification*** to the structural components he relies on to demonstrate invalidity with respect to the inductors found in the *Ho-Hsiang* and *Christensen* transformers. EX-1039, ¶¶40, 51. For instance, the inductor structure on the right

(below) is depicted in isolation not because the structure of *Ho-Hsiang* needs to be modified from a chip-design perspective to invalidate the challenged claims, but instead solely for illustrative purposes to show each claim limitation more clearly.



EX-2003, ¶70; EX-1039, ¶40; EX-1003, ¶124.

Hence, AMD's analysis concerning *Ho-Hsiang* and *Christensen* is distinguishable from those in the case law Realtek presents in its briefing. For instance, Realtek asserts *In re Fritch* for the proposition that it is impermissible to pick and choose among section 103 references and that the "same inquiry must be carried out in the context of a purported [] motivation to modify a reference." POR, 22 (citing *Fritch*, 972 F.2d 1260, 1266 (Fed. Cir. 1992)). However, in that case, the Federal Circuit clarified that "[i]t is impermissible to use the claimed invention as an instruction manual or 'template' ***to piece together the teachings*** of

the prior art so that the claimed invention is rendered obvious… [i.e.], [o]ne cannot use hindsight reconstruction ***to pick and choose among isolated disclosures in the prior art*** to deprecate the claimed invention." *Id*. (internal citations omitted). This holding is inapposite to Dr. Prucnal's analysis which focuses on a ***single*** inductor structure as embodied in a ***single*** figure[1] for each of *Ho-Hsiang* and *Christensen*. EX-1039, ¶¶40, 51; *see also*, EX-1003, ¶¶122-124, 200-202. Dr. Prucnal did not pick and choose embodiments or modify the structure of these inductors in any way. *See, e.g.*, EX-1039, ¶43.

IV. IDENTIFICATION OF HOW THE CLAIMS ARE UNPATENTABLE

A. GROUND 1: *Ho-Hsiang*

AMD has presented more than a preponderance of evidence to show that Claims 1, 2, 5, 8 and 9 are obvious based on *Ho-Hsiang*. In response, Realtek and its expert only dispute the preamble limitation of claim 1. EX-2003, ¶¶67-94; EX-1039, ¶35; EX-1037, 13:3-20:15.

1. Preamble: a structure of a spiral inductor, comprising.

The transformer structure of *Ho-Hsiang* includes a structure of a spiral ***inductor***. This is clear from the plain text of *Ho-Hsiang*. While Realtek

---

[1] Dr. Prucnal analyzes additional figures as well, but they are merely different views ***of the same structure***.

emphasizes that the transformer structure of *Ho-Hsiang* includes windings (POR, 23-24), *Ho-Hsiang* clearly uses the terms "winding" and inductor" interchangeably. EX-1039, ¶35; EX-1005, [4:40-46] ("[b]oth the ***primary winding 302*** and the secondary winding 306 have a center tap 310, 312 connected to the outermost portion of the BALUN 306. For example, ***primary inductor 302*** has a center tap 310 connected to winding segment 302c located at the outer portion of the BALUN300…"). Realtek's expert provides no principled explanation for why the transformers of *Ho-Hsiang* do not include inductors when the reference explicitly refers to the transformer windings as inductors. *See*, EX-1037, 57:1-58:10. Indeed, though Dr. Phinney suggests that "every book on magnetics or power electronics that [he's] ever seen" refers to transformer components as "windings" and not "inductors," neither he nor Realtek has presented a single piece of evidence for this proposition. EX-1039, ¶¶26-27; *see Xerox v. Bytemark*, *supra*. Regardless, this assertion is plainly false. Beyond the myriad evidence AMD and Dr. Prucnal presented which specifically define a transformer as including multiple inductors (*see*, e.g., EX-1003, ¶¶53-57, 67), the evidence ***Realtek and Dr. Phinney assert*** also confirms that transformers include multiple inductors (as depicted below).

The tapped transformer (Fig. 1.a) is best suited for three-port applications. It permits a variety of tapping ratios to be realized. This transformer relies only on lateral magnetic coupling. All windings can be implemented with the top metal layer, thereby minimizing port-to-substrate capacitances. Since the two inductors occupy separate regions, the self-inductance is maximized while the port-to-port capacitance is minimized. Unfortunately, this spatial separation also leads to low mutual coupling ($k \approx 0.3 - 0.5$).

...

separation will reduce k by less than 5%. One can also trade off reduced coupling for reduced capacitance by displacing the centers of the stacked inductors (Fig. 1.d,1.e).

EX-2007.01.

On chip transformers in RF circuits are typically implemented using two planar spiral inductors that are interweaved together. There are

EX-2002.02.

Lastly, Realtek's own expert has testified that two inductors can create a transformer. EX-1035.074-075 (Q. And do you agree that ***you can put that inductor together with another inductor and create a transformer? A. You could do that***."); *see also*, EX-1039, ¶¶31-33. Thus, *Ho-Hsiang* clearly discloses a structure of a spiral inductor.

2. *Ho-Hsiang* does not Teach Away from the Claimed Inductor Structure

Realtek asserts that *Ho-Hsiang* teaches away from the claimed inductor structure because it discloses transformers. Realtek argues that certain design motivations differ between inductors and transformers. POR, 25. It argues, "structural design choices of the spiral inductors of the Challenged Claims [include] reducing footprint and series resistance while optimizing Q." *Id*. However, as Dr. Prucnal explains, transformers and inductors have ***similar*** design considerations. EX-1039, ¶¶28-33.

Indeed, as the 245 patent confirms, and Dr. Phinney admits, substrate loss, metal loss, and Q-factor are all design considerations for both inductors ***and*** transformers. EX-1039, ¶29; EX-1001, [1:12-20]; EX-1037, 66:2-10, 63:8-19 ("substrate loss and metal loss can affect both types of structures [i.e., inductors and transformers]."). And like transformers, inductors are also often designed to be symmetric. EX-1039, ¶30 (citing EX-1001, Figs. 2, 5, 6, 10, and 11; EX-1007, Fig. 1.). Indeed, the Mohan reference cited by Realtek includes transformer structures which appear symmetric while the inductors that form the transformer structures ***also*** appear symmetric. EX-1039, ¶30 (citing EX-2007.03). Moreover, Realtek's analysis misses the fact that there are many design considerations when designing both transformers and inductors to fit a chip's layout, not just the symmetry of one structure. EX-1039, ¶30.

Realtek additionally argues that *Ho-Hsiang* teaches away because it presents "a workable solution to improve the Q of planar transformers by ***increasing the thickness of the metal layers***." POR, 26. Citing Dr. Phinney, Realtek articulates that this teaching is directed to planar transformers but not inductors and *Ho-Hsiang*'s teaching of "thicker" layers is "counterintuitive" and teaches away from the objective of the 245 patent "to design a stacked inductor with a reduced footprint…" POR, 27.

Realtek's argument is particularly perplexing as the 245 patent teaches the ***exact same thing***. EX-1039, ¶¶41-42. As shown below, claims 13-15 of the 245 Patent clearly also teach the additional technique of increasing the thickness of metal layers.

> **13**. The structure of the spiral inductor of claim **10**, wherein a first thickness of the first metal layer is greater than a second thickness of the second metal layer.
>
> **14**. The structure of the spiral inductor of claim **13**, wherein the spiral inductor further comprises a third metal layer; a structure of the third metal layer is the same as a structure of the second metal layer; both the third metal layer and the second metal layer are positioned above or under the first metal layer; and the first thickness of the first metal layer is greater than a third thickness of the third metal layer.
>
> **15**. The structure of the spiral inductor of claim **10**, wherein a first thickness of the first metal layer is equal to a second thickness of the second metal layer.

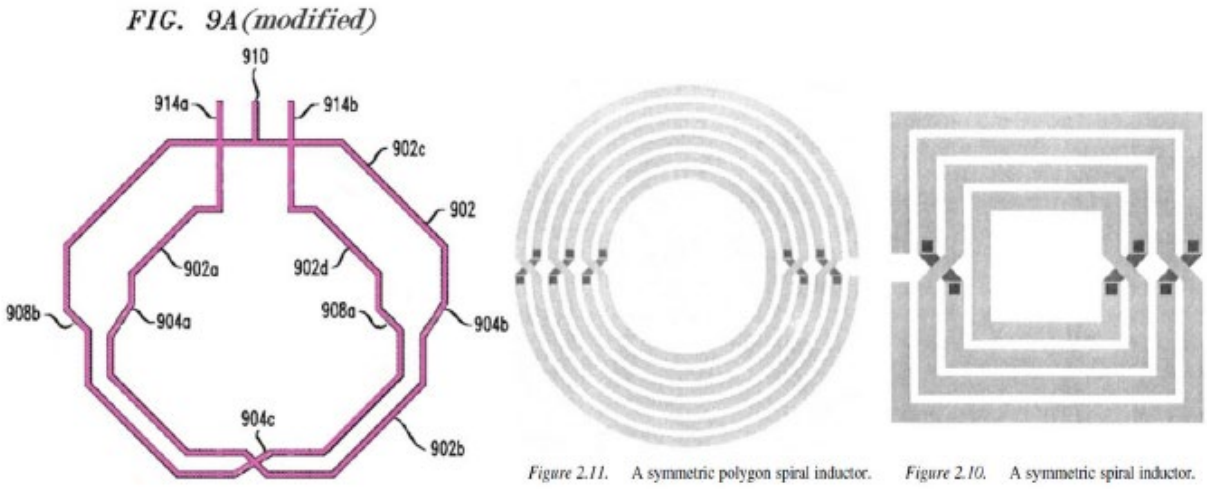
EX-1001, claims 13-15. As Dr. Prucnal explains, this demonstrates that the 245 patent contemplates scenarios in which the first and second metal layers would be

of greater thickness than underlying layers such as the third metal layer. EX-1039, ¶42. In sum, transformers have many of the same design considerations as inductors and do not teach away from inductors.

3. No modification to the Transformer of *Ho-Hsiang* is Necessary to Invalidate

Realtek argues that "Petitioner modifies one of *Ho-Hsiang*'s planar transformers (disclosed in Fig. 9A) by isolating the primary winding 902." POR, 29. But as Dr. Prucnal explains, this is not a "modification" of the inductor but instead is simply for illustrative purposes. EX-1039, ¶¶40, 43. Regardless, Realtek contends that AMD "fails to acknowledge the design characteristics of planar transformers that affect the structural features of the individual windings themselves—many of which undermine the stated goals of the '245 Patent, i.e., designing an inductor with reduced footprint, lower resistance, and optimized Q." POR, 29. But as discussed *supra*, inductors and transformers have many of the same design goals. EX-1039, ¶¶23, 28-33. This is reflected in the 245 patent itself and not disputed by Realtek's expert. EX-1001, [1:12-20]; EX-1037, 66:2-10, 63:8-19.

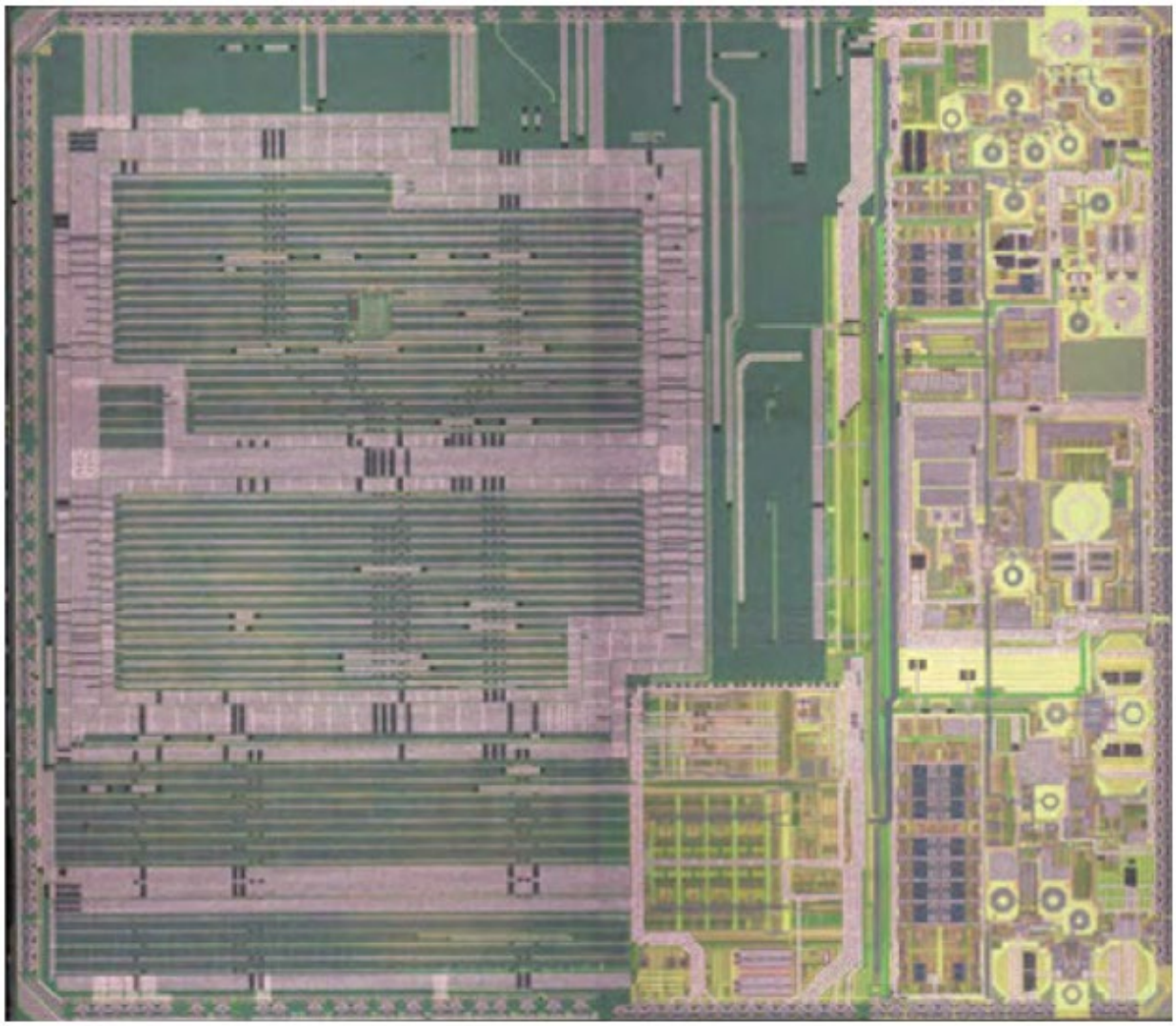
Realtek insists, however, that because *Ho-Hsiang* discloses transformers, certain "undesirable structural features are readily apparent in the isolated windings as illustrated and annotated by Petitioner" as shown below.



POR, 30 (internal citations omitted). Notably, Realtek's expert admits that ***none*** of the above inductor structures have perfect symmetry and that the *Ho-Hsiang* inductor (like the others) includes mirror symmetry. EX-1037, 75:13-77:18.

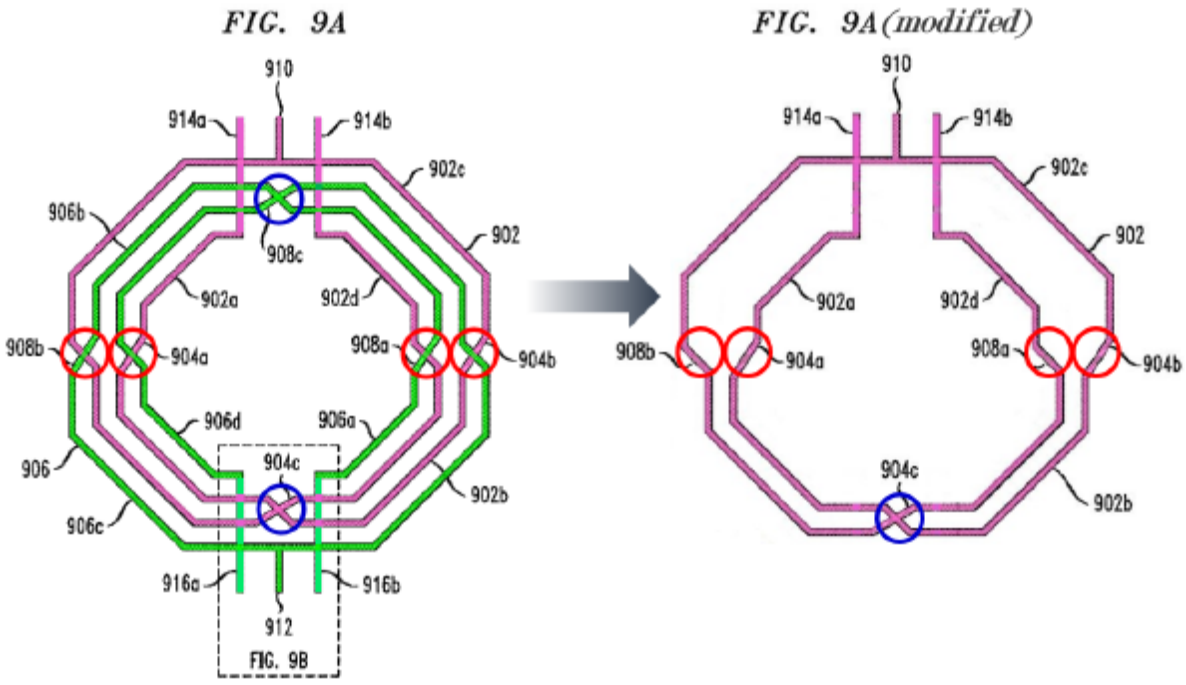
Realtek goes on to argue that *Ho-Hsiang*'s Fig. 9 inductor (above) "reveals a structure with a somewhat unusual, meandering geometry as compared to the geometry of inductors disclosed in the prior art, which are typically more compact and uniform." POR, 30. But Realtek and its expert's focus on "irregular geometry" (EX-2003, ¶¶80, 82-83, 90), "unnecessary gaps" e.g., at the crossings (EX-2003, ¶¶81-82), and "underutilized metal layers" (¶¶85-88) is both irrelevant (because the claims do not exclude such structures) and ignores practical design constraints in IC chips. EX-1039, ¶45. As Dr. Prucnal explains, a POSITA would have understood there to be many design considerations which may impact the circuit footprint, beyond merely creating a perfectly symmetric inductor structure

in isolation. EX-1039, ¶45. As shown below, a typical IC chip has many meandering components that must all fit together.



EX-1039, ¶45 (citing EX-1035.056).

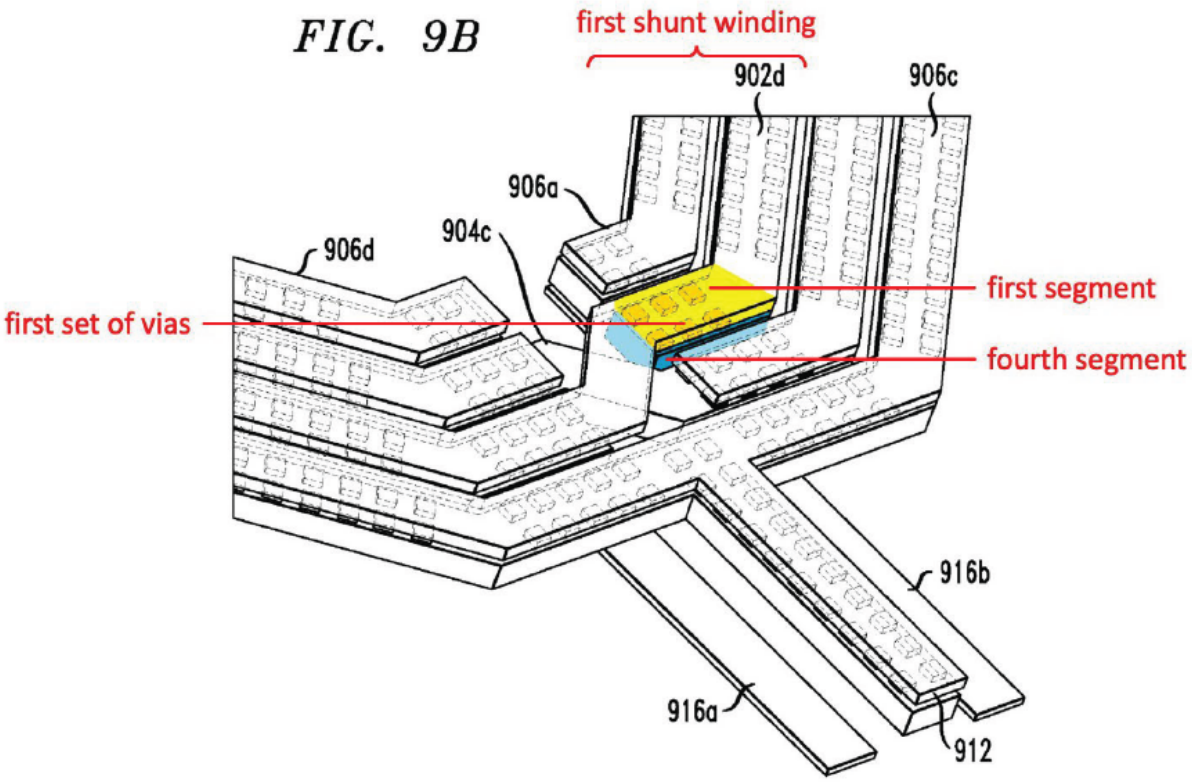
Indeed, perfect symmetry is hard to attain (nor is it required by the 245 patent claims). EX-1039, ¶46. Realtek's focus on gaps (e.g., at the red circles below) and its impact on symmetry and spacing is misplaced.



POR, 31-33. As Dr. Prucnal explains, and as Realtek's expert admits, the presence of crossovers in ***any form*** will cause some level of asymmetry. *See*, EX-1039, ¶47; EX-1037, 75:5-76:6 ("A: So this is – it's a little bit nuanced because ***wherever there's a crossing, there's never perfect symmetry***"); *id*, 72:22-73:10. This is likely why perfect symmetry is not required by the 245 patent claims, which themselves require crossovers. And Dr. Phinney admits *Ho-Hsiang*'s inductor is symmetric within the meaning of the 245 patent. *See*, EX-1039, ¶47; *see also*, EX-1003, ¶¶124-125.

Though neither Realtek nor its expert argue that the *Ho-Hsiang* reference does not satisfy the "shunt limitations" of the claims, Realtek states that "due to the intermingling necessary for a planar transformer, the individual windings, in

addition to their irregular geometry, contain numerous breaks or gaps in the metal layers that prohibit shunting at those locations, which undermines the stated objective of the inventors of the '245 Patent." POR, 33. But this argument is undermined by Realtek's own expert, who testified that a "shunt winding" in accordance with the purported invention can be a straight line without tracing the current throughout the winding of the device. EX-1037, 26:6-27:15, 33:17-34:22. For instance, the below portion of *Ho-Hsiang* forms a "shunt winding" consistent with Realtek's interpretation.



EX-1003, ¶166; *see also*, e.g., *id.*, ¶¶163-165, 167. The parallel shunting must have gaps at the crossovers regardless of whether they are irregularly shaped as

Realtek contends. EX-1037, 80:3-13 ("Q: And when you shunt two metal layers together [] vias can aid in that, correct? A: Yeah … ***they would be there to create the shunt paths, vias***. Q: But you can't have vias at every single portion of the two metal layers when there's crossings, correct? A: ***I would expect a crossing to not include vias*** between all layers because part of the idea of a crossing is that you move past another wire without touching it."). Thus, Realtek's focus on additional crossover segments in *Ho-Hsiang* and how they prohibit shunting at certain locations is simply a distraction. Crossovers ***in general*** cause gaps in shunting, yet are still explicitly claimed in claim 1 of the 245 patent.

Realtek makes additional arguments regarding the functionality of transformers versus inductors and how underutilized portions of the *Ho-Hsiang* inductor would make it a "poorly functioning inductor" that does not have a "small footprint" and does not "achieve low resistance" or "optimize Q." POR, 33-36. Suffice to say, none of these functional or design elements, such as optimizing Q, are claimed. EX-1039, ¶¶48-49; EX-1037, 25:12-17, 75:6-12.

4. Because No Modification to the Transformer of *Ho-Hsiang* is Necessary to Invalidate, it would Clearly Still Work for its Intended Purpose

Realtek's entire discussion related to the "standalone inductor" of *Ho-Hsiang* is a distraction. The case law Realtek cites is distinguishable from how *Ho-Hsiang* invalidates. *In re Gordon* discusses a situation in which an "apparatus

[is] turned upside down [leaving it] inoperable for its intended purpose." POR, 37 (internal citations omitted). Realtek claims *Ho-Hsiang*'s inductor is similar because it "would be inoperable as a balun transformer, which is the intended purpose of the transformer structure taught and disclosed in *Ho-Hsiang*." POR, 37. This argument is based on the false premise that AMD argues the *Ho-Hsiang* transformer should be modified in any way (e.g., turning it upside down), when in fact, as both sides agree, AMD simply asserts an ***unaltered structure*** within another structure. EX-1035.074-075; EX-1037, 48:20-49:10; EX-1039, ¶¶13-14, 24, 26, 31-32, 36, 49. The inductor of *Ho-Hsiang* need not be removed, be placed in an unintended position, or rely on gravity to invalidate. EX-1039, ¶¶40, 43, 51; EX-1037, 73:22-74:25. Lastly, Realtek's argument that the isolated inductor of *Ho-Hsiang* would not work as a transformer is both obvious and irrelevant. It would indisputably function as an ***inductor***, and it serves its intended function as part of a transformer as well.

In sum, the Petition establishes by a preponderance of the evidence that claims 1, 2, 5, 8 and 9 are obvious based on *Ho-Hsiang*.

B. GROUND 2: *Christensen* Invalidates the Challenged Claims

AMD has presented more than a preponderance of evidence to show that Claims 1, 2, 8 and 9 are obvious based on *Christensen*. In response, Realtek and

its expert only appear to dispute the preamble limitation of claim 1. EX-2003, ¶¶95-120; EX-1039, ¶50; EX-1037, 134:4-140:16.

While Realtek argues that "Figs. 4-6 [of *Christensen*] are specific to the inter-winding crossing at 9f," it does not point to a specific limitation that is not satisfied. POR, 50. Dr. Prucnal contends Fig. 6(a) is representative of all the crossovers in *Christensen* and thus, the "via" and "shunt winding" limitations are satisfied. EX-1039, ¶¶54-57. Fig. 6(a). Despite previously arguing that certain "structural features" are not disclosed at certain crossovers (EX-2003, ¶112), Realtek's expert now admits that he would expect vias to be located at ***all*** the crossover regions, including crossover region (9b) which Dr. Prucnal analyzed. EX-1039, ¶55; EX-1037, 153:24-155:3 (Q: Okay. Got it. So you would expect there to be vias generally where – in the region where you have those blue circles? A: Yeah… ***Q: Okay. And so that would apply to the blue circle on the right side*** in the Figure 1 modified, correct? ***You would expect there to be vias over there?*** THE WITNESS: ***Yeah, I think that's – that's right***…).

1. Realtek's Redundant Arguments Regarding Transformer Art

Realtek's arguments regarding the transformer of *Christensen* teaching away from the claimed inductor structure (POR, 40-43), the lack of motivation to modify or rely on an isolated inductor (POR, 43-51), and the *Christensen* transformer not working for its intended purpose (POR, 51-53), are redundant of the arguments it

made regarding the *Ho-Hsiang* transformer. These arguments fail for the same reasons discussed *supra*. EX-1039, ¶¶51-53; *see also*, e.g., EX-1003, ¶¶192-194, 200-203. Notably, Realtek made similar arguments at the ITC which were rejected by the ALJ, who invalidated all claims asserted in that investigation (claims 1, 2, and 8) based on *Christensen*. EX-1039, ¶¶, 14-15, 53.

In sum, the Petition establishes by a preponderance of the evidence that claims 1, 2, 8 and 9 are obvious based on *Christensen*.

C. GROUND 3: *Yang* Invalidates the Challenged Claims

AMD has presented more than a preponderance of evidence to show that Claims 1–4, 8 and 9 are obvious based on *Yang*. In response, Realtek and its expert dispute the lack of a "sixth segment" and limitations of claim 1 relying on that segment. EX-2003, ¶¶95-120; EX-1039, ¶58; EX-1037, 155:8-13, 162:9-163:20, 184:8-187:17.

It is not disputed that *Yang* discloses an inductor. EX-1039, ¶59. The dispute is focused on the crossover region of *Yang*. In particular, Fig. 1, which depicts the inductor structure of *Yang*, appears to be an incomplete drawing that is missing a portion of the crossover. EX-1003, ¶¶293-299.

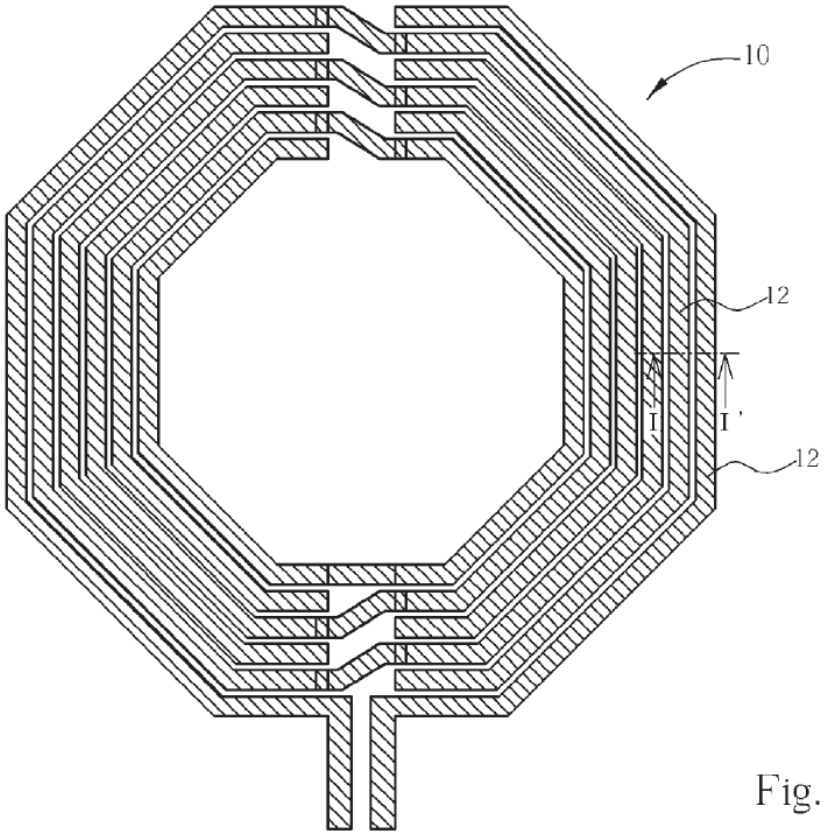


Fig. 1

[EX-1007, Fig. 1]

It is also not disputed that a connection is missing in the Figure because *Yang* discloses an inductor (EX-1007, [0019]) and without an additional connection (not shown in Fig. 1), it would not function. *See*, EX-1037, 158:9-18 ("Q: Right. There's something missing clearly, right, that it would need to be an inductor? A: I'd say that's right…"); EX-1039, ¶59.

The dispute is focused on the structure of the missing connection. Dr. Prucnal explains how a POSITA would have expected such a connection to be formed, i.e., as shown in the marked up figured below.

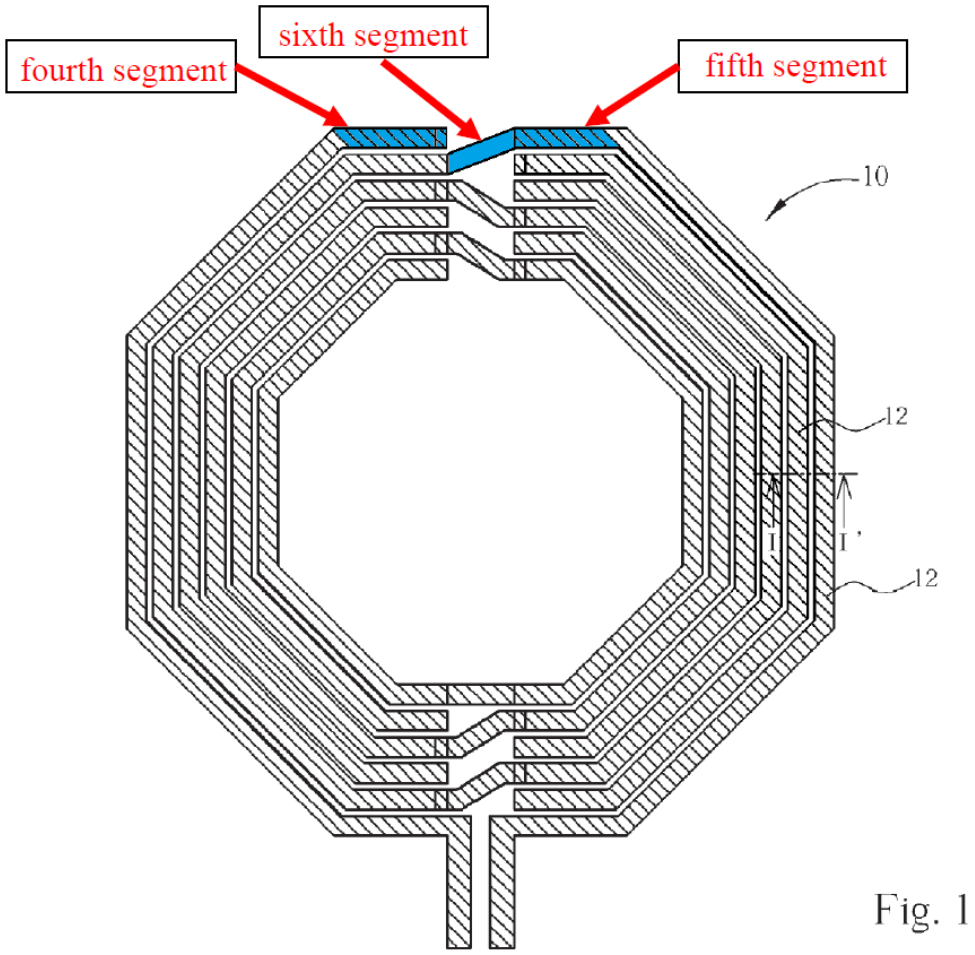
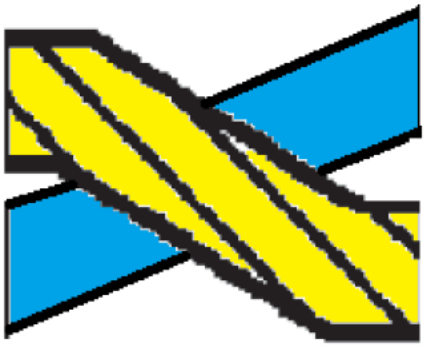


Fig. 1

EX-1039, ¶60 (citing EX-1007, [Fig. 1] (third segment crossover portion removed, sixth segment added)).



EX-1039, ¶60 (citing EX-1007, [Fig. 1] (partial figure with emphasis added)).

As Dr. Prucnal explains, there is no dispute that the *Yang* inductor is generally symmetric. EX-1039, ¶59; EX-1037, 155:8-157:11. A POSITA would have understood that there is no possible implementation that would be as symmetrical as forming a crossover as depicted above. EX-1039, ¶60. As Dr. Prucnal explains, "[w]ithout the blue crossover connected to the fifth segment, the winding ***would not connect to the next loop***. This problem would also occur on the following loop and so on. And as shown below, implementing a crossover in this manner would maintain near perfect symmetry and as a basic manner of design structure, it would be the simplest and most logical way to maintain electrical conductivity." EX-1039, ¶61. A POSITA would have understood this as the "standard way a crossover is formed." EX-1039, ¶¶61-62.

Realtek's expert agrees that the *Yang* inductor is largely symmetrical. EX-1037, 155:8-157:11. Moreover, a POSITA would have understood that using a symmetric crossover that forms a near-perfect X would be the most logical way to maintain electrical conductivity in an otherwise completely symmetric octagonal inductor structure. *See, e.g.*, EX-1039, ¶63, EX-1037, 196:17-198:24 ("A: Yeah. You'd like the two halves of the inductor to be as electrically identical as possible, hence you'd make them as symmetric as you could...").

Realtek's expert maintains that "a POSITA would simply use what was currently taught in the prior art, the use of an underpass on a separate metal layer to

close the circuit" to maintain the electrical connection. EX-2003, ¶128. However, as Dr. Prucnal explains, "[i]t is hard to visualize how the underpass would be formed in *Yang*, because Dr. Phinney does not mark up the image of *Yang* to show where the underpass would form. And, a POSITA would have understood that there is no possible implementation that would be as symmetrical as forming a crossover as [] depicted [above]" with respect to Fig. 1. EX-1039, ¶60.

In sum, the Petition establishes by a preponderance of the evidence that claims 1-4, 8 and 9 are obvious based on *Yang*.

V. CONCLUSION

Petitioner respectfully requests that the Board cancel all challenged claims.

Date: May 3, 2024

Respectfully submitted,

/s/ Brian E. Ferguson

Brian E. Ferguson (lead counsel)
Reg. No. 36,801
Joseph C. Masullo (backup counsel)
(pro hac vice)
Robert T. Vlasis III (backup counsel)
(pro hac vice)
Winston & Strawn LLC
1901 L Street, N.W.
Washington, D.C. 20036
T: 202-282-5200
beferguson@winston.com
jmasullo@winston.com
rvlasis@winston.com

Chaoxuan Charles Liu (backup counsel)
Reg. No. 76,616

Winston & Strawn LLP
2121 North Pearl Street, Ste. 900
Dallas, TX 75201
T: 214-453-6500
ccliu@winston.com

Louis L. Campbell (backup counsel)
Reg. No. 59,963
Winston & Strawn LLP
255 Shoreline Drive, Ste. 520
Redwood City, CA 94065
T: 650-858-6500
llcampbell@winston.com

AMD-IPR@winston.com

Attorneys for Petitioner Advanced Micro Devices, Inc.

CERTIFICATE OF COMPLIANCE

The undersigned certifies that this Reply complies with the word-count limitations of 37 C.F.R. § 42.24(a)(1)(ii). This Reply contains 4,732 words as calculated by the Word Count feature of Microsoft Word, the word processing program used to create it.

The undersigned further certifies that this Reply complies with the typeface requirements of 37 C.F.R. § 42.6(a)(2)(ii) and typestyle requirements of 37 C.F.R. § 42.6(a)(2)(iii). This Reply has been prepared in a proportionally spaced typeface using Microsoft Word in Times New Roman 14-point font.

Dated: May 3, 2024

Respectfully submitted,

/s/ Brian E. Ferguson

Brian E. Ferguson (lead counsel)
Reg. No. 36,801
Winston & Strawn LLC
1901 L Street, N.W.
Washington, D.C. 20036
T: 202-282-5276
beferguson@winston.com
AMD-IPR@winston.com

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.205 and § 42.6(e), the undersigned certifies that on May 3, 2023, a complete and entire copy of this Reply Brief and all new supporting exhibits were served on Patent Owner's counsel of record as follows:

Jason.Engel.PTAB@klgates.com

Jay.chiu@klgates.com

Erik.halverson@klgates.com

sbaik@whitehat.legal

/s/ Brian E. Ferguson

Brian E. Ferguson (lead counsel)
Reg. No. 36,801
Winston & Strawn LLC
1901 L Street, N.W.
Washington, D.C. 20036
T: 202-282-5276
beferguson@winston.com
AMD-IPR@winston.com