

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 IPR2023-00788
U.S. PATENT NO. 9,590,582

PETITIONER'S REPLY BRIEF

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PETITIONER'S EXHIBIT LIST

Exhibit No.	Description
1001	U.S. Patent No. 9,950,582
1002	File History of U.S. Patent No. 9,590,582
1003	Declaration of Dr. Paul Prucnal
1004	Curriculum Vitae of Dr. Paul Prucnal
1005	J. Gonzalez et al., <i>A 56-GHz LC-Tank VCO With 17% Tuning Range in 65-nm Bulk CMOS for Wireless HDMI</i> , IEEE Transactions on Microwave Theory and Techniques, Vol. 58, Issue 5 (May 2010), available at https://ieeexplore.ieee.org/document/5438827
1006	Matthew Muh, Master of Science thesis entitled <i>Design of a FinFET static frequency divider and a millimeter-wave CMOS push-push VCO</i> , Department of Electrical Engineering and Computer Sciences at the University of California at Berkeley (2005), available at https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=7337593a3bdb909b1f7d53da1c3202a61401fac7
1007	A. Niknejad et al., <i>mm-Wave Silicon Technology 60 GHz and Beyond</i> (Springer Science + Business Media 2008) (excerpts)

Exhibit No.	Description
1008	S. Biswal, <i>Basic Electronics Volume I</i> (Atlantic Publishers 2001) (excerpts)
1009	A. Niknejad & R. Meyer, <i>Design, Simulation and Applications of Inductors and Transformers for Si RF ICs</i> (Springer Science+Business Media 2000) (excerpts)
1010	A. Niknejad, <i>Electromagnetics for High-Speed Analog and Digital Communication Circuits</i> (Cambridge Univ. Press 2007) (excerpts)
1011	Joachim N. Burghartz, <i>Spiral Inductors on Silicon – Status and Trends (Invited Article)</i> , International Journal of RF and Microwave Computer-Aided Engineering, V. 8, No. 6, 422-432 (Nov. 1998), available at https://onlinelibrary.wiley.com/doi/abs/10.1002/%28SICI%291099-047X%28199811%298%3A6%3C422%3A%3AAID-MMCE3%3E3.0.CO%3B2-K
1012	O.H. Murphy et al., <i>Design of Multiple-Metal Stacked Inductors Incorporating an Extended Physical Model</i> , IEEE Transactions on Microwave Theory and Techniques, Vol. 53, No. 6, 2063-2072 (June 2005), available at https://ieeexplore.ieee.org/document/1440724

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1013	U.S. Patent No. 6,885,275 filed on Jan. 28, 2000, titled “Multi-track Integrated Spiral Inductor” to James Chang (“Chang”)
1014	U.S. Patent Application Pub. No. US 2008/0074229 published on Mar. 27, 2008 by Shahriar Moinian et al. (“Moinian”)
1015	Bryant Derand Williamson, Masters Thesis entitled <i>A 2.4 GHz LC-VCO Using On-Chip Inductors and Accumulation- Mode Varactors in a CMOS 0.18 μm Process</i>, University of Tennessee – Knoxville, Aug. 2005, available at https://trace.tennessee.edu/utk_gradthes/2537/ Axel Dominique Berny, PhD Dissertation entitled <i>Analysis and Design of Wideband LC VCOs</i>, Electrical Engineering and Computer Sciences, University Of California, Berkeley, Spring 2006, available at https://www2.eecs.berkeley.edu/Pubs/TechRpts/2006/EECS-2006-50.pdf
1016	Axel Dominique Berny, PhD Dissertation entitled <i>Analysis and Design of Wideband LC VCOs</i>, Electrical Engineering and Computer Sciences, University Of California, Berkeley, Spring 2006, available at https://www2.eecs.berkeley.edu/Pubs/TechRpts/2006/EECS-2006-50.pdf

Exhibit No.	Description
1017	A. Kral et al., <i>RF-CMOS Oscillators with Switched Tuning</i> , IEEE Custom Integrated Circuits Conference, May 14, 1998 available at https://ieeexplore.ieee.org/document/695039
1018	Fei Yuan, <i>CMOS Active Inductors and Transformers Principle, Implementation, and Applications</i> , (Springer Science+Business Media, LLC 2008) ISBN 978-0-387-76477-1, available at https://link.springer.com/book/10.1007/978-0-387-76479-5
1019	Thomas H. Lee et al., <i>RF Passive IC Components</i> in book entitled <i>Circuits and Filters Handbook</i> , 2d Ed. (CRC Press LLC 2003), available at http://www.kelm.ftn.uns.ac.rs/literatura/ekui/Circuits_and_Filters_Handbook_CH10.pdf
1020	Agilent Technologies, <i>Overview on interdigital capacitor design</i> , 2001, available at https://www.keysight.com/us/en/assets/7018-08093/technical-overviews-archived/5989-8912.pdf
1021	Sang Wook Park, PhD Dissertation entitled <i>Oscillator Architectures And Enhanced Frequency Synthesizer</i> , Texas A&M University (Dec. 2009) (“Park”), available at https://core.ac.uk/download/pdf/13643134.pdf

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1022	Changhua Cao et al., <i>Millimeter-Wave Voltage-Controlled Oscillators in 0.13-um CMOS Technology</i> , IEEE Journal of Solid-State Circuits, Vol. 41, Issue 6 (June 2006) (“Cao”), available at https://ieeexplore.ieee.org/document/1637594
1023	Yue Wu et al., <i>A Temperature Stabilized CMOS VCO for Zero-IF Cellular CDMA Receivers</i> , Digest of Technical Papers, 2005 Symposium on VLSI Circuits, June 16-18, 2005 (“Wu”), available at https://ieeexplore.ieee.org/document/1469413
1024	Dorra Mellouli et al., <i>Design and Implementation of A 6-GHz Array of Four Differential VCOs Coupled Through a Resistive Network</i> , Analog Integrated Circuits and Signal Processing, Vol. 76, pp. 179-193 (2013) (“Mellouli”), available at https://link.springer.com/article/10.1007/s10470-013-0099-6#citeas
1025	Xiao Shimao et al., <i>A novel 2.95–3.65 GHz CMOS LC-VCO using tuning curve compensation</i> , Journal of Semiconductors, Vol. 30, No. 10, 105001 (Oct. 2009) (“Xiao”), available at https://iopscience.iop.org/article/10.1088/1674-4926/30/10/105001/pdf

Exhibit No.	Description
1026	Mohammad Nariman et al., <i>A Switched-Capacitor mm-Wave VCO in 65 nm Digital CMOS</i>, 2010 IEEE Radio Frequency Integrated Circuits Symposium, May 23-25, 2010, pp. 157-160 (“Nariman”), available at https://ieeexplore.ieee.org/document/5477323
1027	Neric H. W. Fong, PhD Dissertation entitled <i>Low-Voltage Radio-Frequency CMOS Integrated Circuits in Silicon-On-Insulator</i>, Department of Electronics, Carleton University, Ottawa, Canada (May 23, 2002) (“Fong”), available at https://curve.carleton.ca/system/files/etd/63d93fb2-a8cc-4f63-865e-fba751da4fa1/etd_pdf/02a5d5d8788c5ea3b03555a6557ea59c/fong-lowvoltagefrequencycmosintegratedcircuits.pdf
1028	Babak Soltanian et al., <i>An Ultra Compact Differentially Tuned 6 GHz CMOS LC VCO with Dynamic Common-Mode Feedback</i>, IEEE 2006 Custom Integrated Circuits Conference, Sept. 10-13, 2006 (“Soltanian”), available at https://ieeexplore.ieee.org/document/4115046

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1029	V. Macaitis et al., <i>Design of a 4.48-5.89 GHz LC-VCO in nm RF CMOS Technology</i> , Elektronika IR Elektrotechnika, Vol. 20, No. 2, 44-47 (Feb. 5, 2014) (“Macaitis”), available at https://eejournal.ktu.lt/index.php/elt/article/view/6383
1030	Judith Maget, <i>Varactors and Inductors for Integrated RF Circuits in Standard MOS Technologies</i> , Institute of Electronics at the University of Bundeswehr (2002) (“Maget”), available at http://athene-forschung.unibw.de/doc/85282/85282.pdf .
1031	Paolo Lucchi, PhD Dissertation entitled <i>Frequency generation for mm-Wave and satellite applications</i> , University of Bordeaux (Feb. 2012) (“Lucchi”), available at https://www.theses.fr/2012BOR14479.pdf
1032	U.S. Patent Publication No. 2009/0322447 (“Daley”)
1033	U.S. Patent No. 9,270,247 (“Jing”)
1034	Realtek Infringement Chart for U.S. Patent No. 9,950,582
1035	Printout from www.m-w.com (Merriam-Webster Online Dictionary) (“substantial”)
1036	Declaration of Sylvia D. Hall-Ellis, Ph.D.

Exhibit No.	Description
1037	Curriculum Vitae of Sylvia D. Hall-Ellis, Ph.D
1038	Website Printout Regarding Gonzalez (EX-1005) accessed at: https://ieeexplore.ieee.org/abstract/document/5135585/figures#figures
1039	Website Printout Regarding IEEE Transactions on Microwave Theory and Techniques, accessed at: https://ieeexplore.ieee.org/abstract/document/5135585/figures#figures
1040	Order Denying Realtek’s Motion for Summary Determination (Public Version), <i>Certain Integrated Circuits, Components Thereof, and Products Containing the Same</i> , Inv. No. 337-TA-1350 (Sept. 7, 2023)
1041	Declaration of Joseph C. Masullo in support of <i>Pro Hac Vice</i> Admission
1042	Declaration of Robert T. Vlasits III in support of <i>Pro Hac Vice</i> Admission
1043 New	Supplemental Declaration of Sylvia D. Hall-Ellis, Ph.D.
1044 New	B. Raj et al., <i>Analytical Modeling of Nanoscale Double Gate FinFET Device</i> , Journal on Intelligent Electronic Systems, Vol. 1, No. 1 (Nov. 2007)

Exhibit No.	Description
1045 New	F. Nesamani et al., <i>Performance Improvement of FinFET using Nitride Spacer</i> , International Journal of Engineering Trends and Technology, Vol. 4, Issue 3 (2013)
1046 New	C. Nilges, <i>The Online Computer Library Center's Open WorldCat Program</i> , Library Trends, Vol. 54, No. 3 (Winter 2006)
1047 New	April 2, 2024 Affidavit from Internet Archive Records Request Processor Nathaniel E. Frank-White
1048 New	Initial Determination on Violation of Section 337 and Recommended Determination on Remedy and Bond, <i>Certain Integrated Circuits, Components Thereof, and Products Containing the Same</i> , Inv. No. 337-TA-1350 (Jan. 19, 2024) (public version)
1049 New	Portions of Transcript from October 16-20, 2023, Trial in <i>Certain Integrated Circuits, Components Thereof, and Products Containing the Same</i> , Inv. No. 337-TA-1350 (portions from public hearing)
1050 New	Supplemental Declaration of Dr. Paul Prucnal
1051 New	Transcript of April 19, 2024 Deposition of Dr. Joshua Phinney

TABLE OF ABBREVIATIONS

AMD or Petitioner	Petitioner Advanced Micro Devices, Inc.
Realtek or PO	Patent Owner Realtek Semiconductor Corporation
582 patent	U.S. Patent No. 9,590,582 (EX-1001)
ID	Institution Decision, Paper 12
Pet.	Petition for Inter Partes Review, Paper 2
POR	Patent Owner Response, Paper 21
POSITA	Person of Ordinary Skill in the Art
Emphasis	All emphasis added herein except if noted otherwise
Citations	All citations are to the PDF page number unless noted otherwise

I. INTRODUCTION

The evidence presented in the Petition confirms that the 582 patent challenged claims are invalid. The arguments and evidence in the POR do not change that conclusion, as explained herein.

II. IDENTIFICATION OF HOW THE CLAIMS ARE UNPATENTABLE

A. GROUND 1: Gonzalez

1. The 582 patent Teaches that a MOS Capacitor has Electrode Segments

PO's core argument against Gonzalez is that Gonzalez discloses MOS varactors, and "[b]ecause of their structure, these varactors are not, and cannot be, the capacitor component described and claimed in the '582 Patent. Specifically, these varactors, as *MOS capacitors, do not have electrode segments.*" POR, 26; EX-1051.31:6-15. Not so. The "'582 Patent itself discloses MOS capacitors (e.g., capacitor component 150' in its Fig. 12)" that have electrode segments. Pet., 66; EX-1001 [12:11-23]; EX-1003, ¶165. In figure 12, "the capacitor component 150'—which is a 'MOS capacitor'—includes finger-shaped electrode segments 155, 156, 157, 158, just like Gonzalez's finger-shaped electrode segments." *Id.*

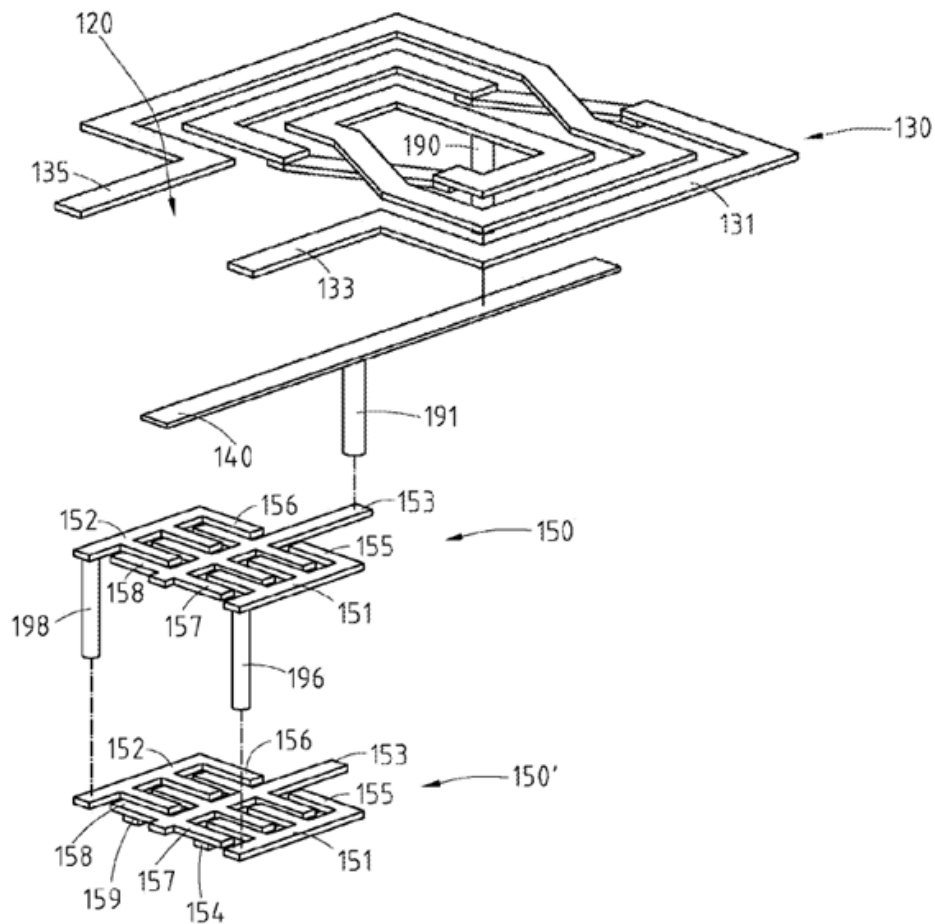


FIG. 12

EX-1001, Fig. 12.

PO fails to address MOS capacitor 150', let alone demonstrate whether/how it differs from Gonzalez's MOS capacitors. This is because it cannot do so. PO's expert Dr. Phinney agreed that, just like capacitor component 150, the MOS capacitor 150' includes a "finger capacitor" with electrode segments 155, 156, 157, 158. EX-1051.123:6-124:21.

PO's argument that "silicon-based" MOS capacitors cannot include metal electrode segments also contradicts the 528 patent. POR, 26, 31. In MOS capacitor

150', segments 155-158 are interdigitated metals. EX-1001, Fig. 12, [5:45-47] ("the electrode segments 155, 156, 157, and 158 are all formed by patterning the second metal layer."); EX-1051.125:23-25 (Dr. Phinney agreeing "those electrode segments are metal"). The 582 patent identifies 155-158 as "electrode segments," contradicting Dr. Phinney's assertion that "the capacitance of [MOS] varactors comes from electric fields created substantially vertically between transistor gates and the doped substrate beneath, *not from electric fields extending laterally between interdigitated metals.*" EX-2003, ¶98. Moreover, the 582 patent identifies additional structures below the segments 155-158 as "semiconductor segment 154/159," not electrode segments. EX-1001, [12:16-20]; EX-1050, ¶¶4-9.

2. Gonzalez Discloses the Claimed "Electrode Segments"

Gonzalez's yellow fingers meet the claimed electrode segments. As Dr. Prucnal explains, Gonzalez's yellow fingers share many similarities with the 582 patent's electrode segments 155-158 (MOS capacitor 150').

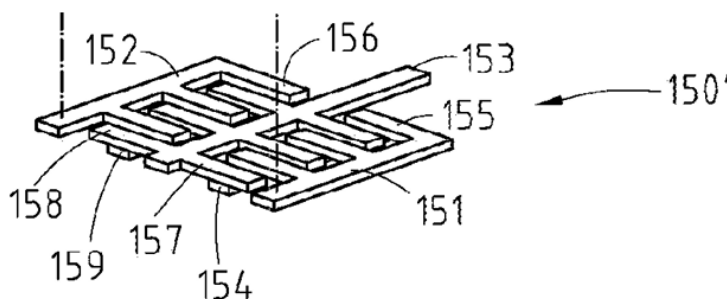
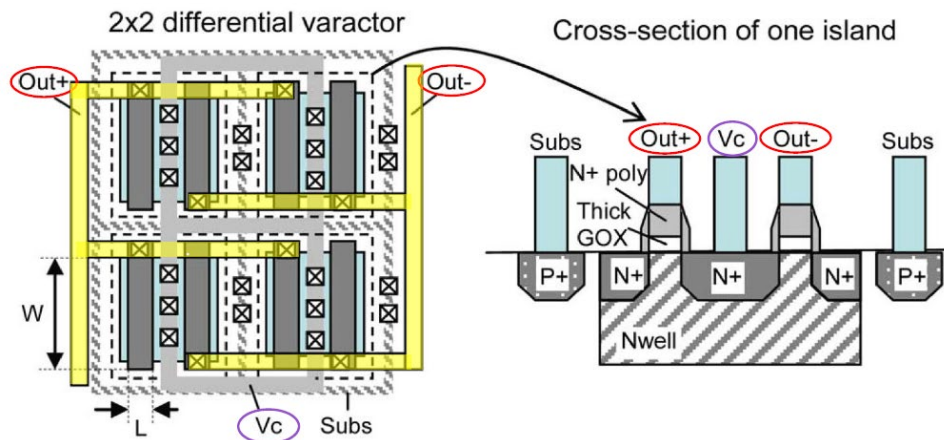


FIG. 12

582 Patent, Fig. 12 (partial) (EX-1001)

Pet., 67.



EX-1003, ¶166.

Exemplary similarities are listed below (see EX-1050, ¶11):

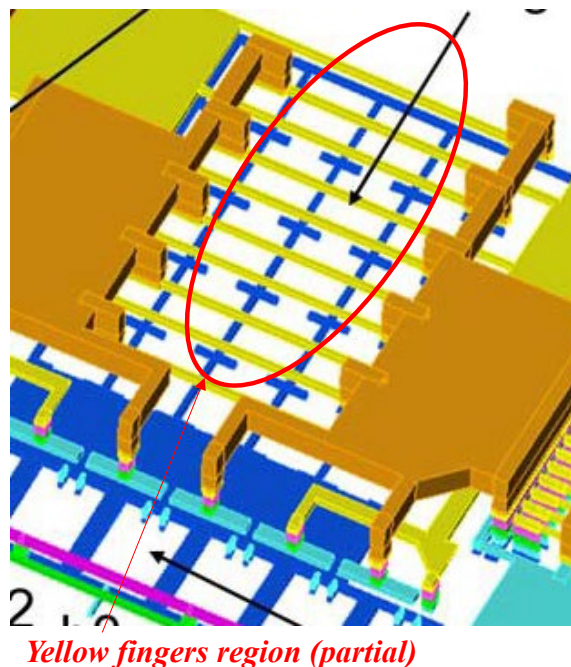
- Both are metal wires.
- Both are part of a MOS capacitor.
- Both reside above, and extend approximately perpendicular to, underlying semiconductor segments.
- Both form a comb structure capacitor.
- Both serve as gate electrodes (or parts thereof) that deliver voltage to the underlying semiconductor segments.

a. Gonzalez's Yellow Fingers are Part of its MOS Capacitor

Gonzalez's fine-tuning MOS varactor includes the yellow fingers as electrode segments. Fig. 5 describes a "varactor structure" including the F-shaped finger structures. EX-1003, ¶¶162-166. PO nonetheless argues that Gonzalez's

yellow fingers in Fig. 8 cannot correspond to the F-shaped fingers in Fig. 5 because the yellow fingers in Fig. 8 “sit at least five metal layers” above silicon, while the F-shaped fingers are “at most two metal layers above the silicon.” POR, 30-34. PO is wrong.

In Gonzalez’s Fig. 8, the additional via metal layers do not extend into the region under the yellow fingers, as illustrated below. EX-1050, ¶13. Fig. 8’s yellow fingers connect directly down to the N+ poly gates. *Id.*, ¶14. This explains why the same fingers are shown in Fig. 5 as F-shaped fingers directly above the N+ poly gates, consistent with Fig. 12 of the 582 patent. Indeed, viewing Gonzalez’s overall disclosures, a POSITA would have readily concluded that Fig. 8’s yellow fingers correspond to the F-shaped fingers in Fig. 5 to supply Out+ and Out- voltages to underlying N+ poly gates. *Id.*



EX-1005, Fig. 8.

Further, Gonzalez's Fig. 5 shows a "2x2 differential varactor," which includes 4 "basic cells." EX-1005.6; EX-1051.81:7-12. The F-shaped fingers reside within the 2x2 differential varactor to deliver voltages to each basic cell. Since the overall varactor maps to the claimed "capacitor component," the fingers are part of that "capacitor component." EX-1050, ¶15.

b. PO's "Design Rules" Argument Fails

PO argues that connecting the Fig. 8 yellow fingers to underlying semiconductor structures "would be at odds with the design rules of Gonzalez, limiting it to 6 metal layers." POR, 32. PO misreads Gonzalez. The design rules apply to Fig. 9, which permits six metal layers. EX-1005.8 ("[T]he choices of width and height are also constrained by the technology design rules. Fig. 9 illustrates the realization of a microstrip line using the top metal level (M6) as a conducting strip and the two bottom metal levels (M1 M2) as ground plane.") But Fig. 9 and Fig. 8 use completely different EM modeling approaches. Fig. 9 relates to modeling transmission lines (TLs). *Id.*, .7 ("The TL used in this study is illustrated in Fig. 9.") And this TL modeling is "*an alternative modeling approach*" compared to the modeling approach used in Fig. 8, which is concerned with optimizing the layout of the VCO core. *Id.* Gonzalez confirms that Fig. 8's modeling approach, i.e., "the previous approach," "is suitable for fixed layout

structures,” but does not work where “the length of the TLs has to be adjusted.”

EX-1005.7. As Dr. Phinney agrees, the design rules of Fig. 9 do not apply to the VCO core structure shown in Fig. 8. EX-1050, ¶¶16-17; EX-1051.80:18-81:6 (“Q: Is it reasonable that the design rules actually refer to the illustration of the transmission line in Figure 9, but . . . the rules don’t apply to Figure 8? A: I think it’s reasonable....”).

Further, the bottom half of Fig. 8 has at least seven metal layers (without adding any layer from elsewhere). POR, 39; EX-1051.65:22-66:1. Thus, had the design rules of six metal layers applied, Fig. 8 would violate such design rules, which would prevent Fig. 8’s VCO core structure from being simulated and tested. But Gonzalez discloses successful simulation and testing results, EX-1005.7-10, which confirm that Fig. 8’s VCO satisfied its design rules. Indeed, Gonzalez’s Fig. 12 confirms that the TLs are not about Fig. 8’s VCO core, and that they are outside the VCO core. EX-1050, ¶18.

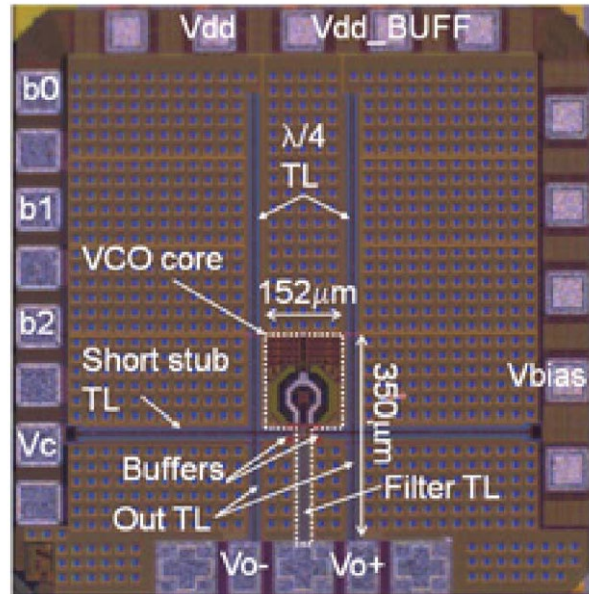


Fig. 12. VCO die micrograph.

EX-1005, Fig. 12.

c. Even if Not Part of any MOS Capacitor, Gonzalez’s Yellow Fingers Still Meet the Claimed Electrode Segments

Even accepting PO’s incorrect argument that the yellow fingers are outside of the fine-tuning varactor, the yellow fingers still meet the claimed electrode segments because they still provide a “comb structure” that induces a “static capacitance.” EX-2003, ¶102. Dr. Phinney agreed that “after reviewing the ’582 patent and the asserted claims, [] a POSITA would conclude that the *claims at issue are purely structural and do not include any functional requirements.*” EX-1049.1273:21-24. Therefore, the yellow fingers are structurally “electrode segments” meeting the claim limitation.

The 582 patent discloses multiple stacked capacitor components in an LC circuit. For example, Fig. 12 includes a capacitor component 150 (finger capacitor) and another capacitor component 150' (MOS capacitor). Claim 1 requires only “a capacitor component.” EX-1001, cl. 1. Similarly, even if not part of Gonzalez’s MOS varactor, the yellow finger capacitor would constitute “a capacitor component” just like capacitor component 150 in the patent’s Fig. 12. EX-1050, ¶20.

PO and Dr. Phinney nonetheless now assert the yellow fingers only generate “incidental capacitance” (POR, 27), and Dr. Phinney testified that the “electrode segments” must “*function* as a designed capacitor” to meet the claim (EX-1051.14:23-15:19). This reverse in position should be rejected. EX-1049.1273:21-24.

Even accepting Dr. Phinney’s inconsistent “functional” requirement, the yellow fingers still “function” as electrode segments by inducing “static capacitance.” PO and Dr. Phinney argue that Gonzalez aims to minimize this capacitance because “it seeks to minimize the differential current path”. EX-2003, ¶107; POR, 32-33. This argument is both unsupported by Gonzalez¹ and irrelevant.

¹ Gonzalez does not teach minimizing the “differential current path length” by minimizing the capacitance induced by the yellow fingers. EX-2003, ¶107; POR,

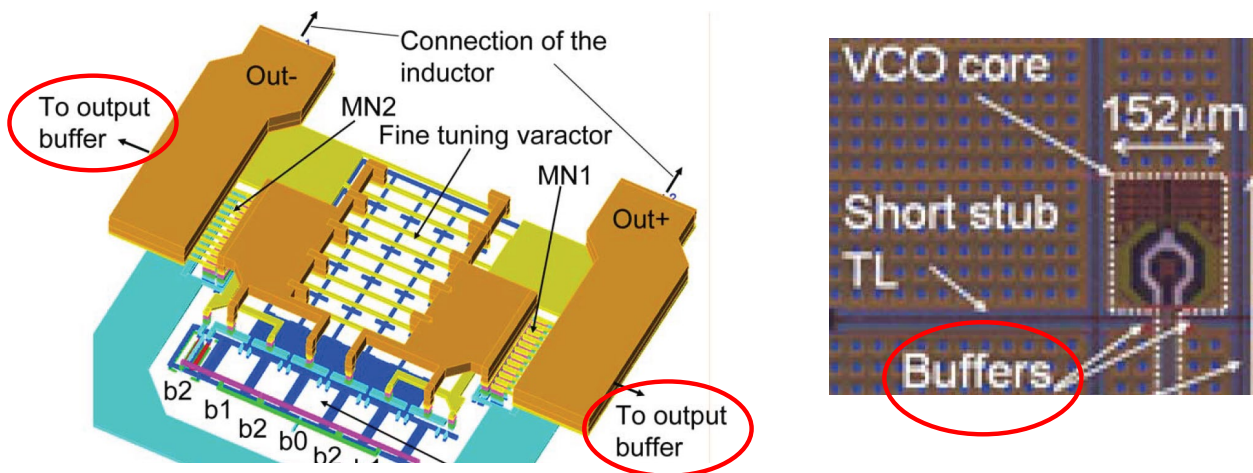
The claims do not require “substantial” or minimal capacitance, as Dr. Phinney agrees. POR, 32; EX-1051.40:9-13; EX-1050, ¶21. The capacitance in Muh is “static” and therefore known, and a POSITA would have taken it into consideration when designing Fig. 8’s LC circuit. EX-1050, ¶22; EX-1051.37:10-39:2, 43:9-23, 44:14-24. Therefore, even with PO’s improper functional requirement, the yellow fingers still meet the claimed “electrode segments.”

Notably, PO’s Fig. 2 annotation is unsupported by its expert and thus merely unsubstantiated attorney argument. Its suggestion that the yellow wires correspond only to the “crossover structure” to convey electric charges (POR, 32) ignores the fact that the same yellow wires serve multiple purposes/functions. As Dr. Phinney agrees, even the 582 patent’s electrode segments also convey electric charges. EX-1051.22:1-21. Indeed, a POSITA would have appreciated the genius of Gonzalez’s design is to use the same yellow wires to serve as gate electrodes of the fine-tuning varactor and to convey electric charges to the underlying poly gates, among other things. EX-1050, ¶23.

32-33. Instead, the differential current path length is minimized by placing N⁺ poly gates in a differential varactor, as shown in Fig. 5. See EX-1005.6; EX-1050, ¶21 (footnote); EX-1051.46:9-17, 48:1-6.

3. Gonzalez's Capacitor Component is not Substantially Overlapped with its Coil-Conductor Segment

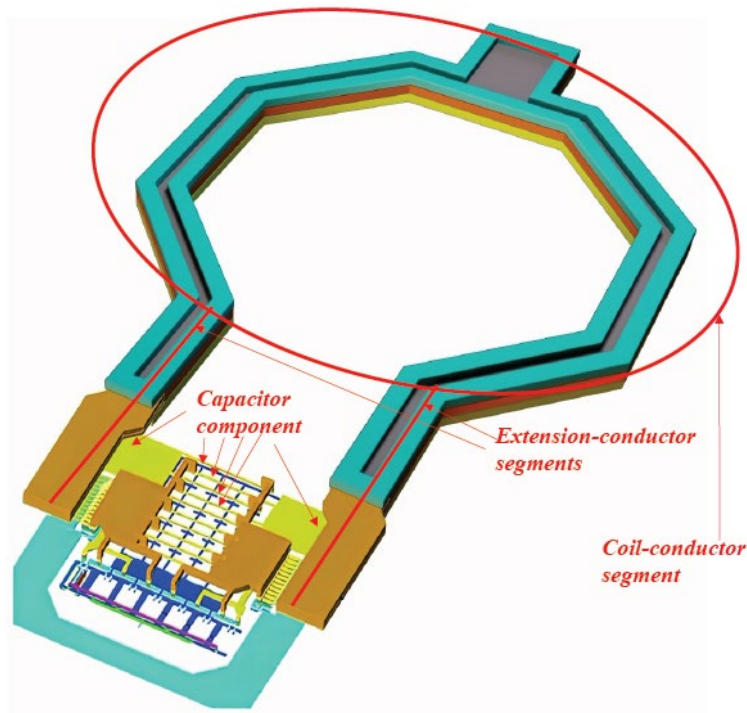
Gonzalez's Fig. 8 shows its fine-tuning varactor is positioned between two output buffers, and Gonzalez's Fig. 12 shows the same buffers (indicated by two white arrows) are located at the extension-conductor segments of the inductor, not at the inductor coil. The relative positioning of the VCO's physical structures is further corroborated by Gonzalez's Fig. 2. EX-1050, ¶¶24-26.



EX-1005, partial Figs. 8, 12.

Further, the top half of Fig. 8 shows an “inductor layout,” and the bottom half contains “connection of *the* [same] inductor.” EX-1005.8. A POSITA would have understood the term “connection” here refers to the extension-conductor segments of the inductor component. EX-1050, ¶27. Further, the brown and yellow metal layers appear in both halves of Fig. 8. *Id.* PO again uses the “design rules” to attack this the combination, but as discussed above, the design rules do not even apply to Fig. 8. *See* Section II.A.2.b *supra*.

As Dr. Prucnal explains, viewing Gonzalez’s disclosures, it would have been obvious for a POSITA to combine the top and bottom portions of Fig. 8 in a manner that meets the claim, e.g., as illustrated below. EX-1003, ¶150-152; EX-1050, ¶¶24-28.



EX-1003, ¶152.

Moreover, a POSITA need not use “the ’582 Patent as a roadmap to piece together the disclosures of Gonzalez,” as PO alleges. POR, 40. It was well known to design an LC circuit where a capacitor component is offset from (not substantially overlapped with) the coil-conductor segment of the inductor, and aligned with the extension-conductor segments. EX-1003, ¶88. Such a spatial relationship had known benefits. *Id.*, ¶89. Indeed, the ALJ in the parallel ITC trial

found that the prior art chip Qualcomm RBR1000 invalidates claim 1. *See* Section II.B.4.a *infra*. Therefore, it would have been obvious for a POSITA to combine the top and bottom portions of Fig. 8 to meet claim 1. EX-1050, ¶¶29-30.

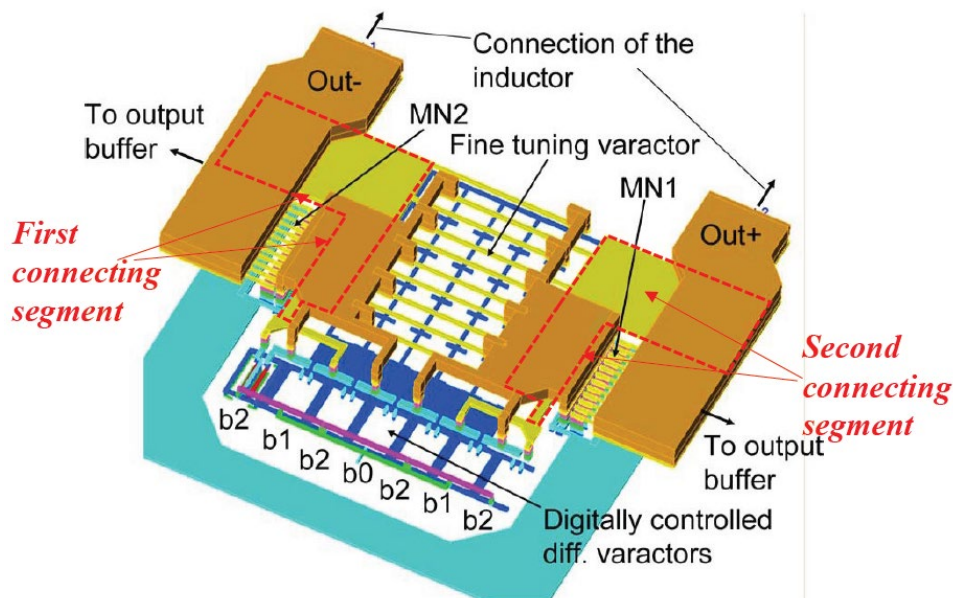
4. Gonzalez Discloses the Claimed “Connecting Segments”

PO concedes that Gonzalez discloses “connecting segments” in its yellow metal but argues that these segments do not extend corresponding to the two extension-conductor segments in a same direction, allegedly because the exact shape of the yellow metal is hidden under the brown metal. POR, 41-43.²

PO’s premise—that a POSITA must know the exact shape of the yellow metal under the brown metal to render claim 1 obvious—is wrong. All Petitioner needs to show is that Gonzalez’s yellow metal would *include* “connecting

² PO also argues that Gonzalez’s “connecting segments” are not “respectively overlapped with the two extension-conductor segments in a vertical direction.” POR, 41, 43; EX-2003, ¶¶128-130. But this is a conclusory argument without substantive rebuttal to the Petition’s analysis. Pet., 61-62. Regardless, this argument fails because Gonzalez’s Fig. 8 shows the “connecting segments” in its yellow metal overlap with (sit directly below) the brown metal which is the “connection of the inductor” (i.e., extension-conductor segments). EX-1003, ¶¶157-159; EX-1050, ¶34.

segments” with the right positioning and extending direction that meet claim 1. Petitioner and Dr. Prucnal provided multiple examples of “connecting segments” with different shapes that meet claim 1, and PO completely fails to rebut at least the below example. Pet., 60-61; EX-1003, ¶¶155-157. Therefore, the following example of “connecting segments” extends in the right direction and meets claim 1. End of story.

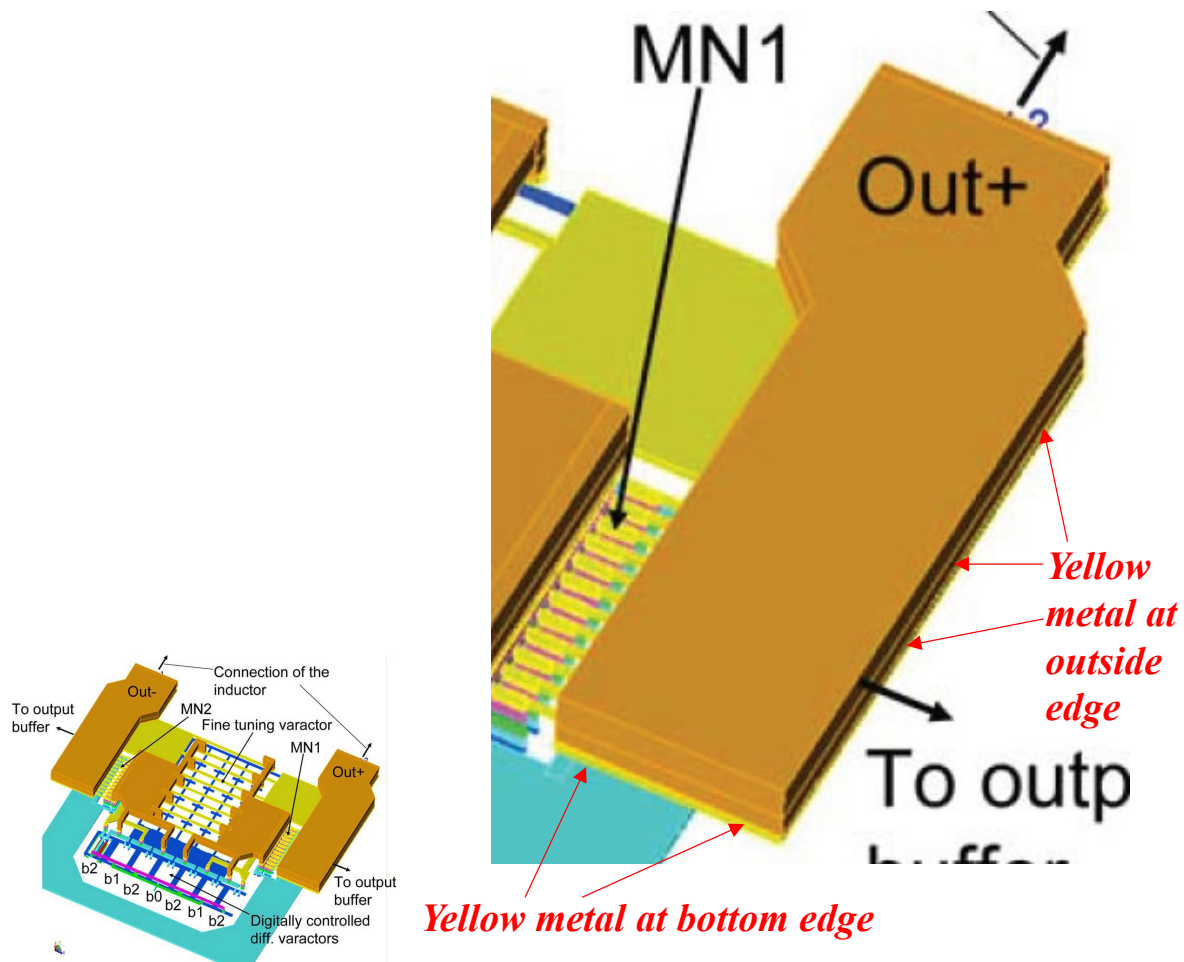


Pet., 60.

Further, even in the example PO disputed, a POSITA would have understood based on their knowledge and understanding when reviewing Gonzalez that Gonzalez’s yellow metal layer would **include** “connecting segments” with certain shapes. EX-1050, ¶31.

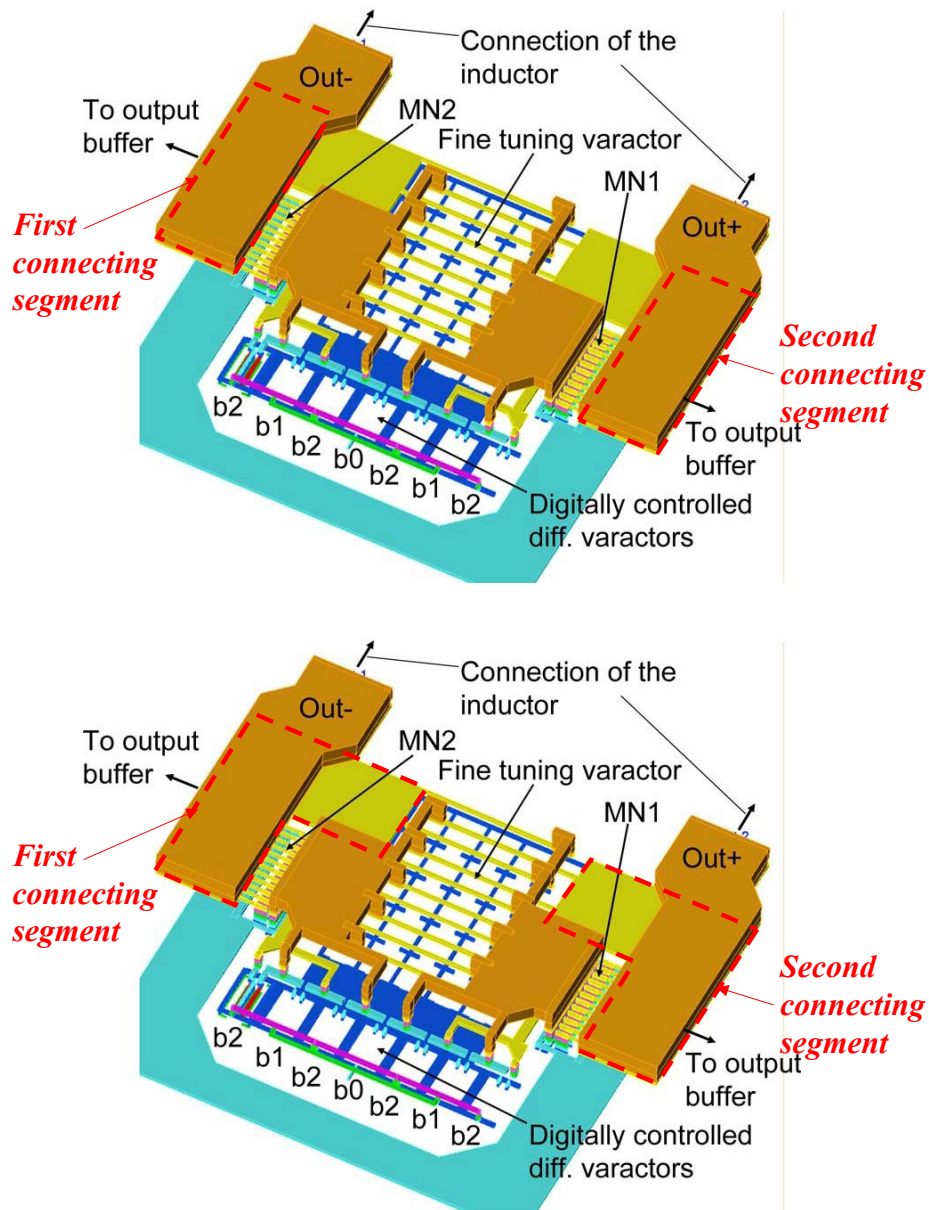
Moreover, based on PO's infringement allegations at the ITC, a rectangular shape would extend in the claimed direction. Specifically, PO alleged that an L-shaped connecting segment in Petitioner's products meets the limitation. Just like a rectangle, an L-shape extends in multiple directions without a primary direction. Further, PO relied on one leg of the L-shape and contended that constituted the claimed "connecting segment." EX-1050, ¶32. A portion of the yellow metal in Gonzalez that extends in the same direction as the extension-conductor segment thus meets the claimed "connecting segment" under PO's position.

Furthermore, both experts agree that, when zooming-in on Fig. 8 of Gonzalez, the yellow metal extends to the bottom edge and outside edge of the brown metal, as illustrated below. EX-1051.69:16-18; EX-1050, ¶33.



EX-1005, Fig. 8 (with zoom-in view)

As a result, a POSITA would have understood that the yellow metal layer includes connecting segments shaped as shown below. EX-1050, ¶34. And a POSITA would have recognized either example of the “connecting segments” would meet claim 1’s limitations. EX-1003, ¶¶155-160.



EX-1005, Fig. 8.

5. Gonzalez Discloses Claims 2 and 3

The 582 patent discloses multi-layer capacitors, where one layer constitutes a capacitor component. EX-1001.12:28-36; EX-1050, ¶36; EX-1051.12:19-24.

Gonzalez's fine-tuning MOS varactor is a multi-layer capacitor. Fig. 5 shows that each varactor includes at least a metal layer connected to a voltage

terminal Out+ or Out- (F-shaped fingers), a poly gate layer under the metal, a gate oxide (GOX) layer under the poly gate layer, and a bulk silicon layer. EX-1005, Fig. 5; EX-1050, ¶37. The layer including F-shaped fingers alone, or with the poly gate layer, constitutes a capacitor component. *Id.* Therefore, the electronic component can be the transistor structure of the bulk silicon layer. The insulation layer is/includes the GOX layer. This meets claim 2. *Id.*, ¶38.

Moreover, this transistor structure is both a “transistor component” and a “capacitor component” and meets claim 3. The 582 patent discloses “transistor capacitors” and “MOS capacitors,” both of which would encompass the bulk silicon structure shown in Fig. 5 of Gonzalez. EX-1050, ¶39; EX-1001 [4:29-33], [7:34-35], [12:11-20].

B. GROUND 2: Muh+Niknejad Invalidates the Challenged Claims

1. Muh is Prior Art

Muh qualifies as prior art. PO does not dispute that: (1) MARC is the library standard for uniquely identifying references; (2) a MARC-identified reference may be searched for using the Online Computer Library Center (OCLC) in any MARC-compatible library (which is almost every major library in the world); and (3) the

Berkeley Library created the MARC record for Muh on July 8, 2005, which was indexed by title and author. EX-1036, ¶¶25-30, 74-77; EX-1043, ¶¶19-26, 29, 47.³

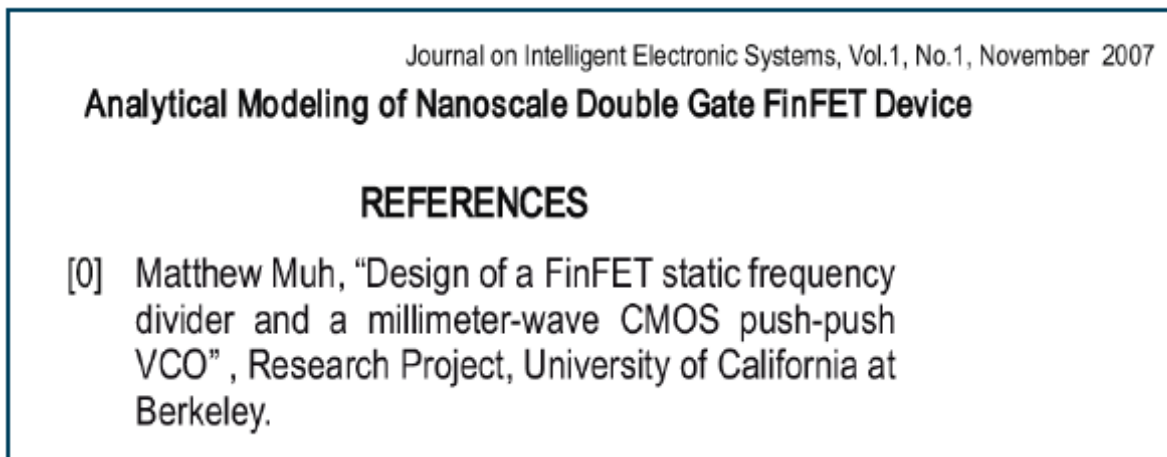
The Federal Circuit has held that a thesis found in a *single* library was prior art when the thesis was indexed and discoverable in the library’s general stacks. *In re Hall*, 781 F.2d 897, 898-99 (Fed. Cir. 1986). Muh was also indexed (by at least name and title) and, using the MARC standard, OCLC, and the user-friendly WorldCat interface software, was discoverable in *thousands* of libraries around the world. Muh was therefore *more* accessible than the thesis in *Hall*, and as such qualifies as prior art. EX-1043, ¶¶19-26, 29.

PO nonetheless argues that a POSITA would be unfamiliar with MARC records or how to use them. POR, 52-53. But the relevant question is whether a POSITA could access Muh using “reasonable diligence.” *Telefonaktiebolaget LM Ericsson v. TCL Corp.*, 941 F.3d 1341, 1346 (Fed. Cir. 2019). A POSITA would have understood how to conduct library research and would have known to ask librarians for assistance in searching MARC records. EX-1043, ¶¶12-16, 29. Such reasonable diligence—which could be conducted from nearly any library in the

³ The Board in the ID raised questions concerning Dr. Hall-Ellis’s original declaration (EX-1036). ID, fn. 5. Dr. Hall-Ellis addresses those questions in her supplemental declaration. EX-1043, ¶¶31-32.

world— would have led a POSITA to Muh much more easily than the *Hall* thesis, located in a single library. *Id.*, ¶¶ 35-39.⁴

Objective evidence confirms Muh’s accessibility to the interested public. Muh is cited in two journal papers (both published before the 582 filing date), showing that not only was Muh accessible, it was accessed by the interested public:



EX-1044.

⁴ *In re Cronyn*, 890 F.2d 1158, 1161 (Fed. Cir. 1989) is off-point because there the thesis was “indexed” on a card kept in a shoebox at the library. MARC records in contrast were discoverable at libraries around the world.

Performance Improvement of FinFET using Nitride Spacer

I. Flavia Princess Nesamani^{#1}, Geethanjali Raveendran^{*2}, Dr.V. Lakshmi Prabha^{#3}

REFERENCES

- [16] Matthew Muh, “Design of a FinFET static frequency divider and a millimeter-wave CMOS push-push VCO”.

EX-1045.

These journal papers were publicly available before April 16, 2014. EX-1043, ¶¶49-53. As such, they provided a POSITA with a “roadmap” to Muh. *Blue Calypso, LLC v. Groupon, Inc.*, 815 F.3d 1331, 1350 (Fed. Cir. 2016) (holding that a “published article with an express citation to the potentially invalidating reference would ... provide the necessary guidance” to the reference). Here, EX-1044 and EX-1045 provide a POSITA a research aid for finding Muh.⁵

Further, a POSITA before May 2014 also could have found Muh using Google Scholar and keywords such as the author’s name, “VCO,” “oscillator,” or

⁵ The Federal Circuit cited *Cornell Univ. v. Hewlett-Packard Co.*, 2008 U.S. Dist. LEXIS 39343, *21-22 (N.D.N.Y. May 14, 2008). The Court identified a journal article citing a thesis as “a ‘research aid,’ guiding [POSITAs]” to the thesis.

others. EX-1043, ¶¶43-47; EX-2002 [82:1-84:20]. Google Scholar had incorporated all MARC-identified references into its database by 2006, which therefore included Muh. EX-1043, ¶47; EX-1046.012. This confirms Muh’s accessibility to a POSITA prior to 2014.

Additionally, a POSITA exercising reasonable diligence prior to April 2014 would have been able to access Muh from the Berkeley Library webpage. EX-1047 contains Internet Archive evidence showing that the Berkeley library provided public access to its theses, which were searchable by name, title, or keyword. EX-1043, ¶¶35-39. Thus, a POSITA would have had access to, and been able to find, Muh through the Berkeley Library also. *Id.*

2. Construction of “Extension-Conductor Segments”

PO’s claim construction argument (POR, 12-23) is a transparent attempt to avoid Muh+Niknejad and should be rejected.

The claimed inductor has “two extension-conductor segments... coupled to two ends of the coil-conductor segment respectively.”

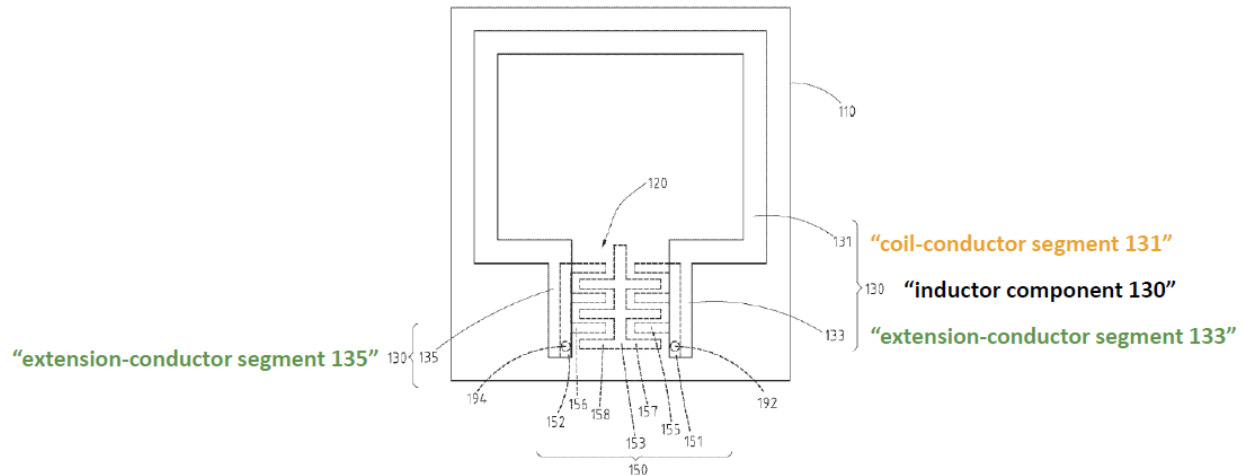


FIG. 5

EX-1001 [3:22-27]. PO's construction limits where the extension-conductor segments "couple" to the coil-conductor segment—only at the red lines:

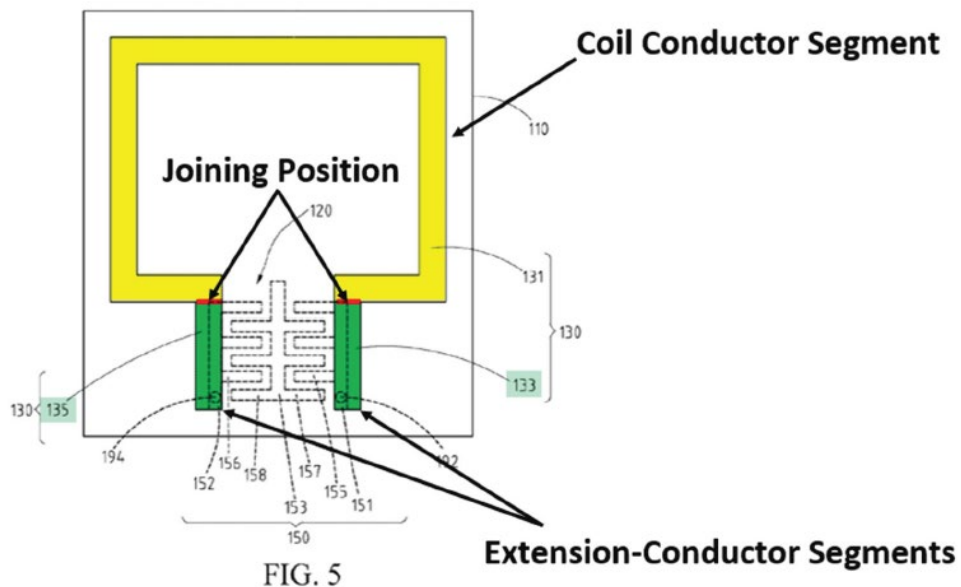


FIG. 5

POR, 13. Thus, under PO's construction, the extension-conductor segments are limited to the green segments below the red lines. The specification, however, confirms that the claims are broader and cover embodiments with longer extension-conductor segments:

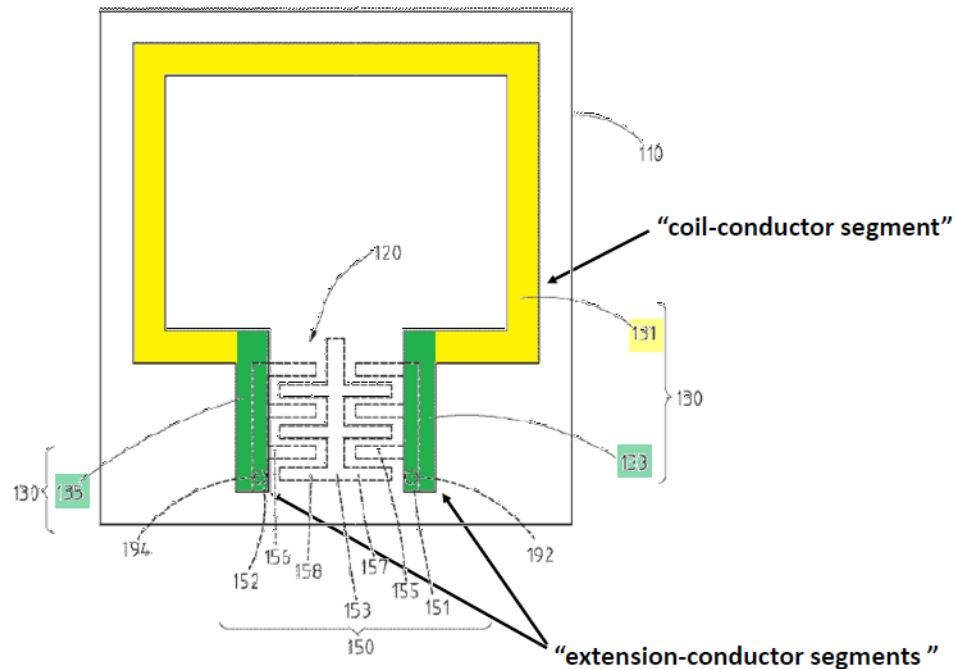
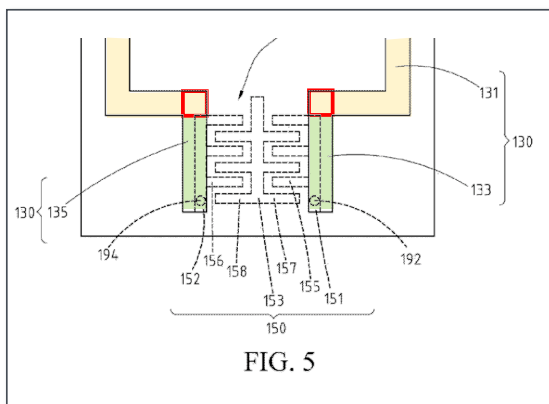
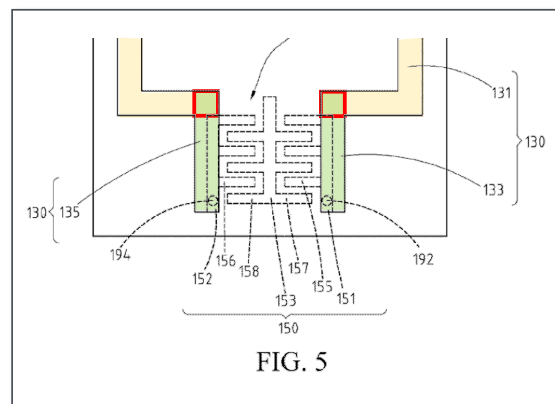


FIG. 5

The dispute is visually represented below—are the claims limited to version A, where the extension-conductor segments exclude the portion in the red boxes, or do the claims also cover version B, where the extension-conductor segments include the portion in the red boxes?



Version A



Version B

extension-conductor segment 133 [and] 135.” *Id.* If the specification limited the red boxes to only being part of the coil-conductor segment, then the specification would have said that the connecting segments “overlap with” both the extension-conductor segments and the coil-conductor segment. That it does not confirms that version B is also fairly covered by the claims.

Fig. 6 shows an embodiment where the “first region 120” is defined by the “two extension conductor segments” 133/135, as Dr. Phinney agrees. EX-1001, [8:47-50]; EX-1051.28:9-13.

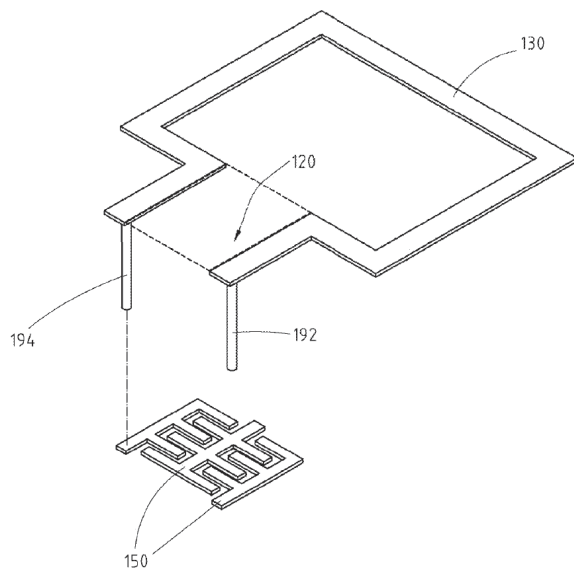


FIG. 6

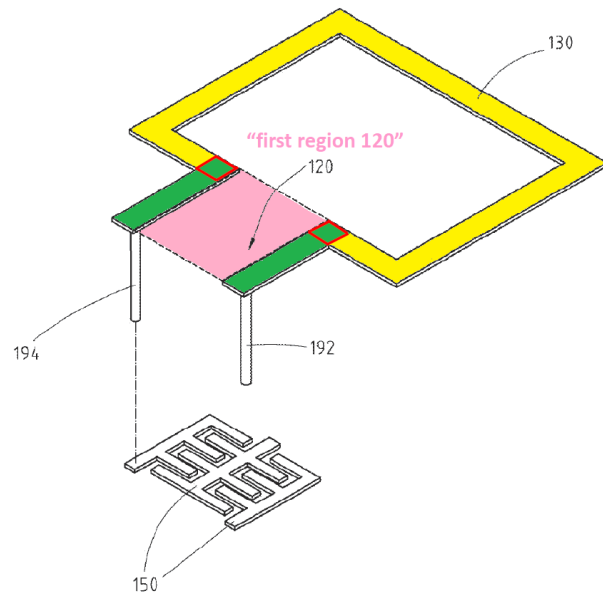


FIG. 6

EX-1001, FIG. 6 (and annotated)

The first region 120 (in pink, right) is demarcated by dotted lines. EX-1001, [4:9-11]. If the extension-conductor segments did *not* include the portions in the red boxes, then the first region would have been identified as follows:

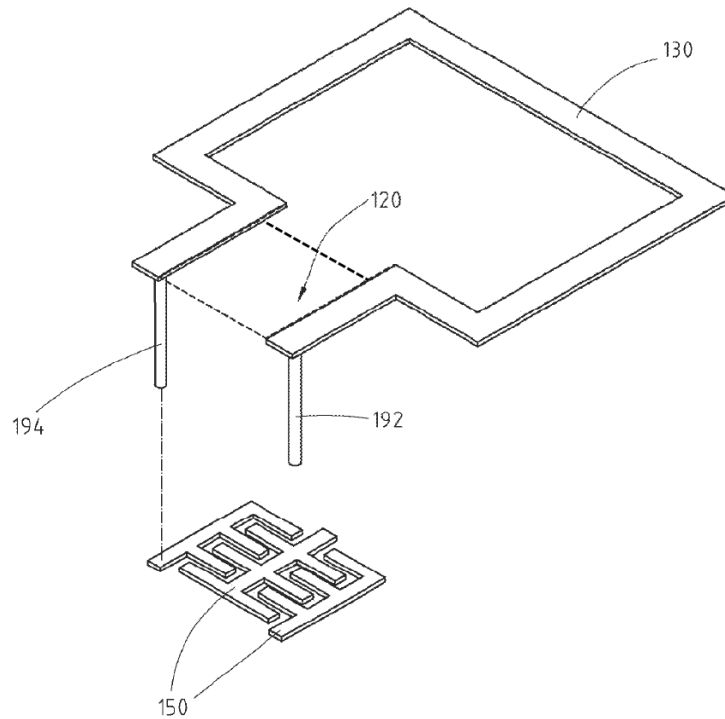
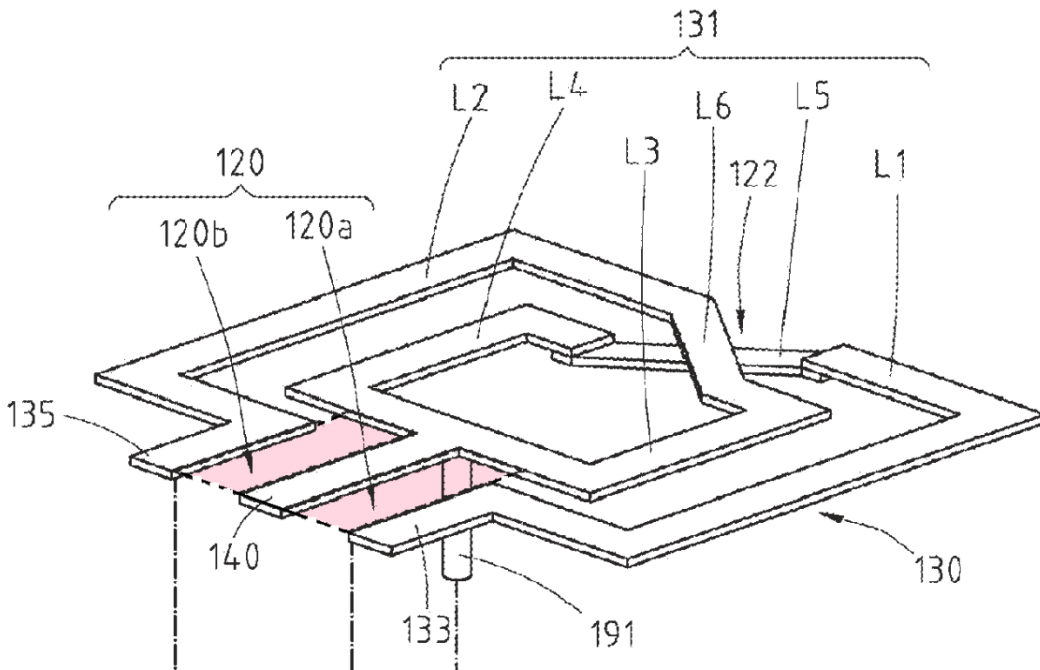


FIG. 6

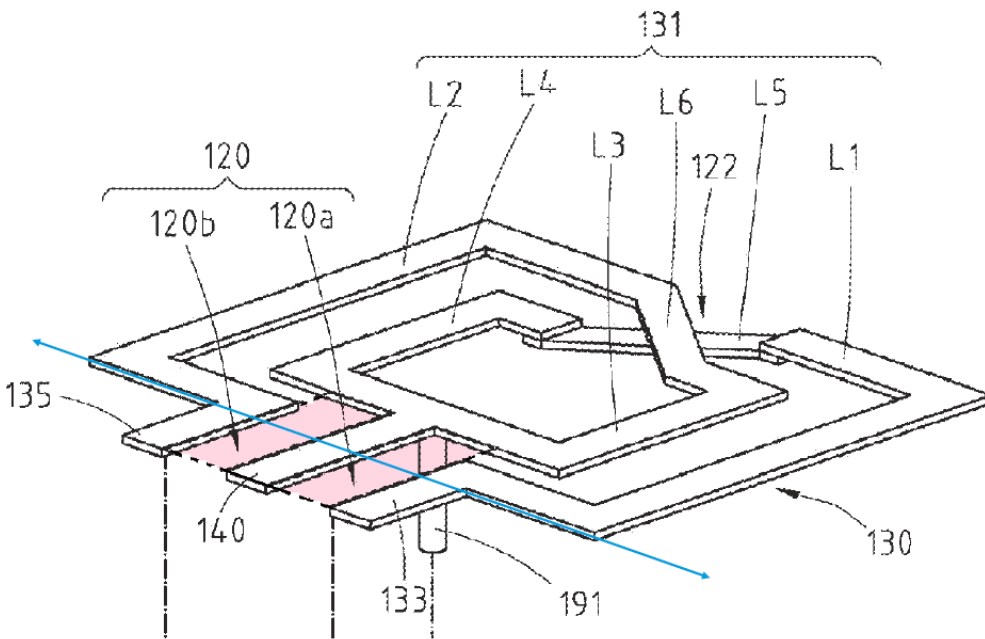
EX-1001, FIG. 6 (modified)

That it was not shows that the specification teaches that the location where the extension-conductor segments “couple to” the coil-conductor segment was flexible and not limited in the manner PO proposes.

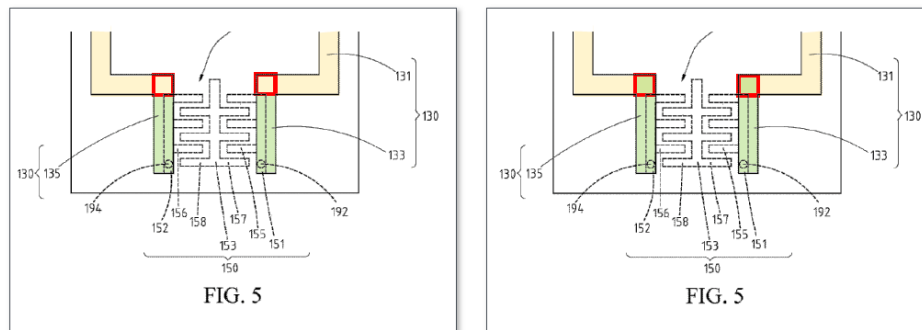
Fig. 9 shows an embodiment where the first region 120 (pink) is defined by the “two extension-conductor segments 133 and 135 and the coil-conductor segment 131.” EX-1001, [8:50-53]:



EX-1001, [Fig. 9 (partial)] [8:47-53] (annotated). PO's construction is inconsistent with Fig. 9, as it would end the first region at the blue line below:



PO's construction should therefore be rejected. The claims cover multiple embodiments, including having the extension-conductor segments (green) extend as shown in both versions A and B:



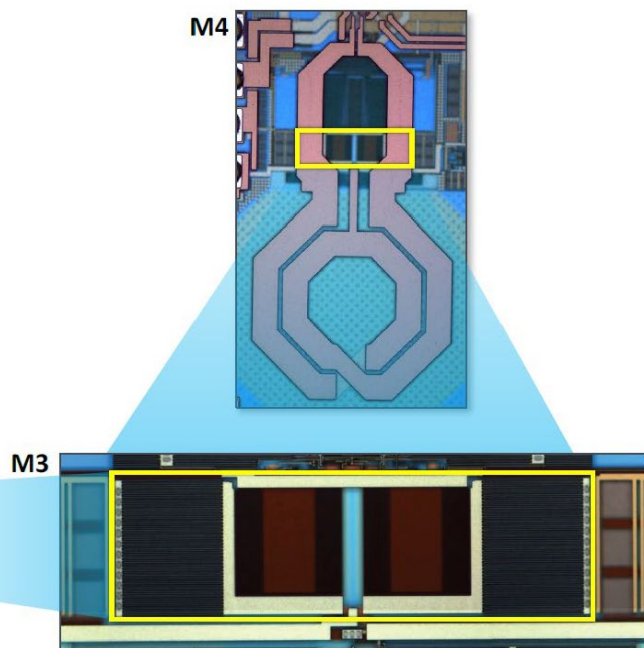
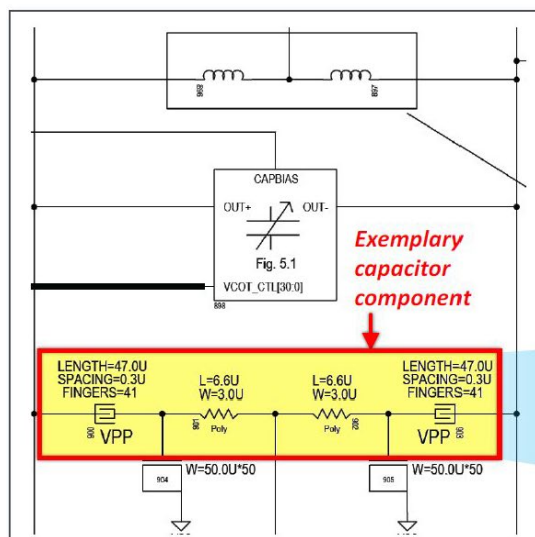
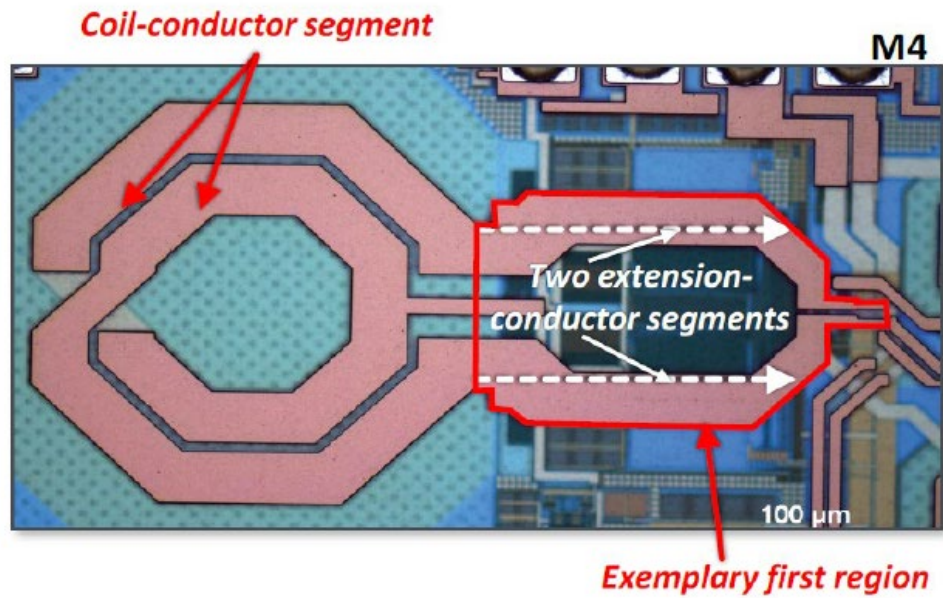
3. Construction of “Coil-Conductor Segment”

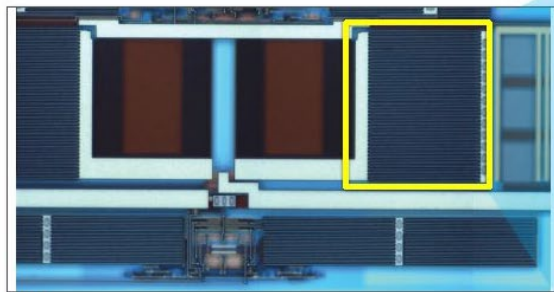
PO's construction of "coil-conductor segment" excludes version B above and should be rejected. If this term requires construction, it is "the induction part" of the inductor. EX-1001, [3:24-25].

4. Realtek's Arguments are Without Merit

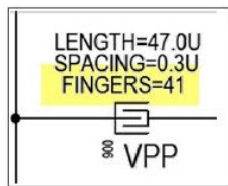
a. There Was Motivation to Combine as Claimed

PO's argument is premised on a falsehood. Specifically, PO's representation that "no other reference," POR, 51, discloses the orientation of the capacitor component in the way claimed is false. The ALJ in the parallel ITC proceedings found that the prior art Qualcomm RBR1000 (publicly available several years before the 582 filing date) disclosed the same arrangement and anticipated the claims. EX-1048.204-207, .211-219:

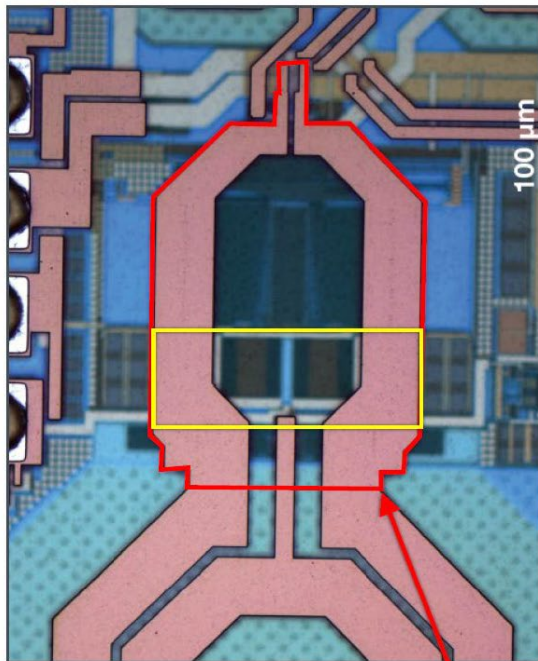
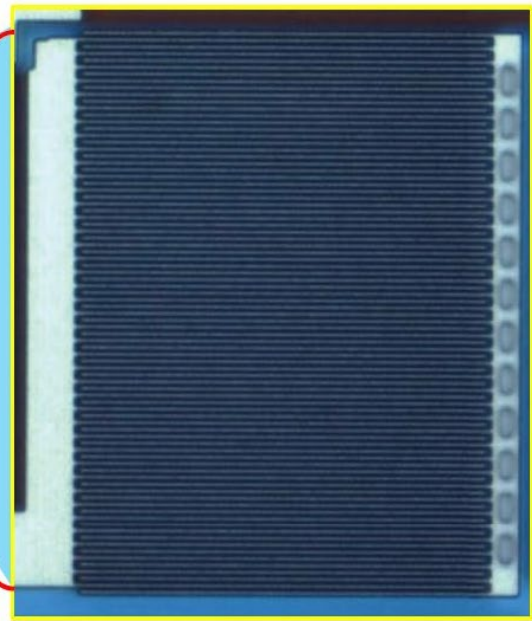




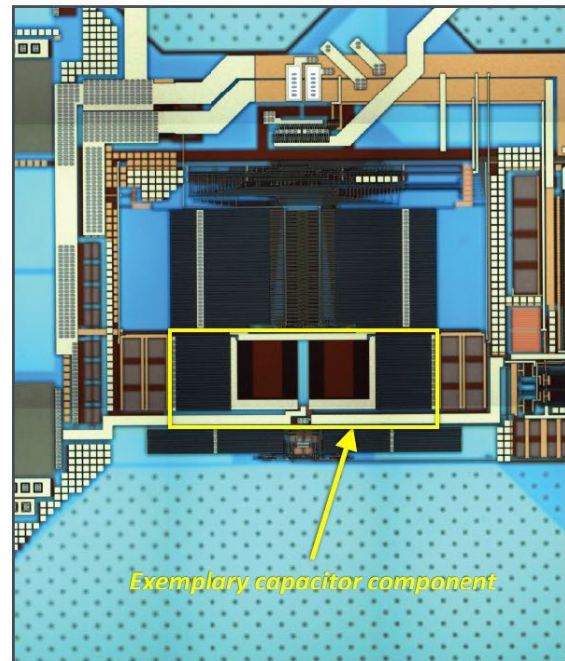
M3



*41 fingers
coupled to one
side of VPP*

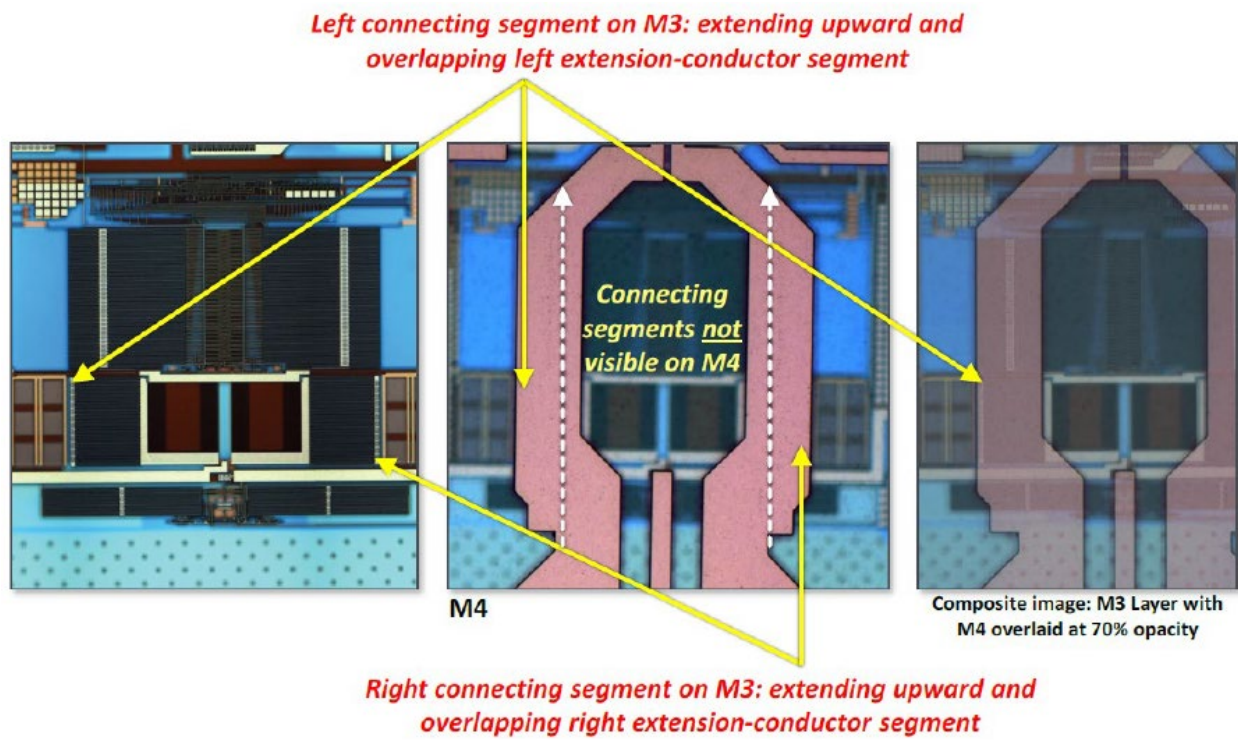
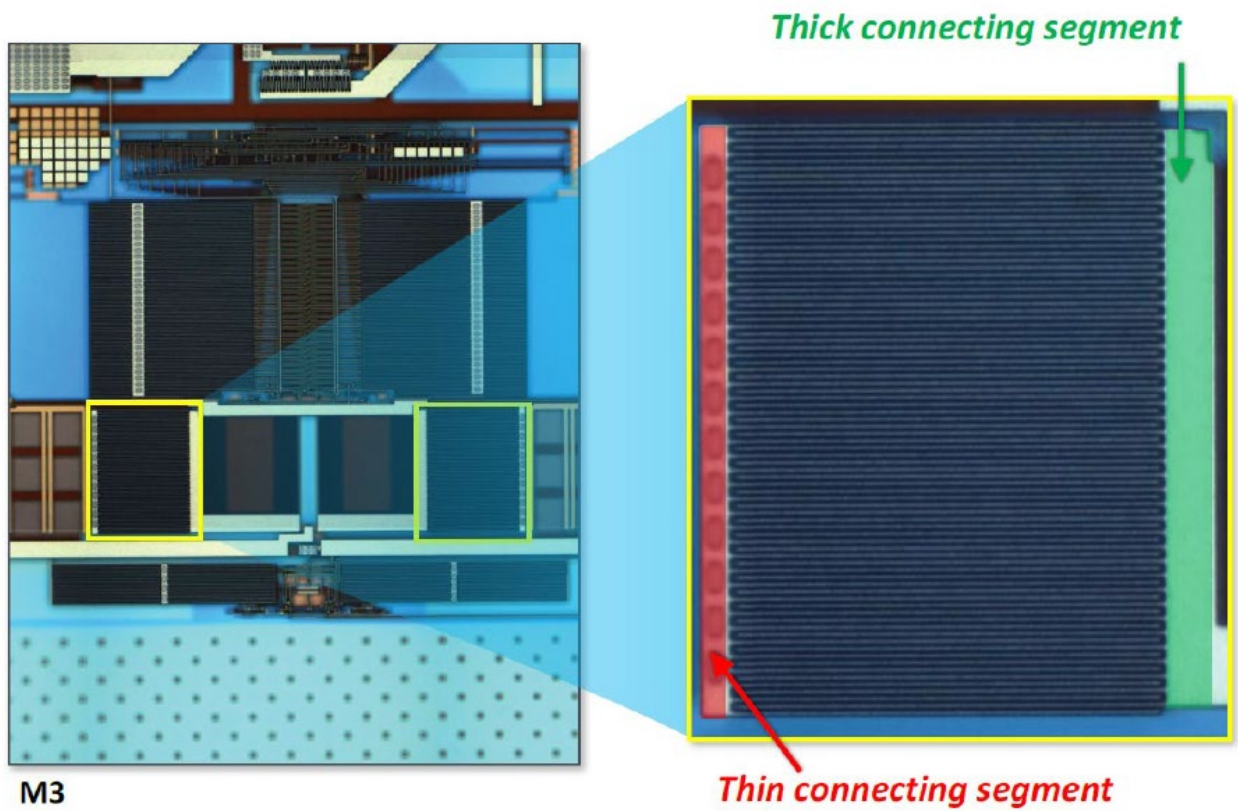


M4 *Exemplary first region*



M3

Exemplary capacitor component



EX-1048.213-219; *id.*, .223 (“[A]ll limitations of claim 1 are met in the Qualcomm RBR1000 and claim 1 is invalid as anticipated....”). PO’s expert conceded at trial that the RBR1000 capacitor is oriented in the way claimed in the 582 patent. *See* EX-1049.1270:6-1271:22.⁶

Moreover, Daley (EX-1032), discussed during prosecution, also refutes Realtek’s claim. Daley discloses an “LC tank or resonator” [0046] where the capacitor 16 has “conductive bars” 26, 28 and “electrodes” 30 connected to conductive bar 26 and electrodes 32 connected to conductive bar 28. *Id.* [0024]-[0025] (disclosing that “electrodes 30 project laterally as spaced-apart, substantially parallel fingers” from conductive bar 26 and the same for electrodes 32 from conductive bar 28).

⁶ The Federal Circuit has confirmed that the Board may rely on evidence other than printed publications and patents, not as part of the asserted grounds, but for its “proper supporting role,” including the level of skill and knowledge in the art. *Yeda Research Dev. Co. v. Mylan Pharms. Inc.*, 906 F.3d 1031, 1041 (Fed. Cir. 2018).

See EX-1032, [0034] (“the on-chip capacitor 16 and the on-chip inductor 20 are ... in approximate vertical alignment...”). The Examiner during prosecution confirmed this understanding of Daley. EX-1002.057-62. Other prior art references also demonstrate the claimed orientation was well known. EX-1003, ¶88.

With that background, PO’s arguments crumble. PO argues that Niknejad teaches that “to decrease finger resistance” which “increases the Q factor,” a POSITA should use “a large number of short fingers in parallel.” POR, 55-57. From this, PO concludes that a POSITA would understand this to mean that the finger capacitor should be arranged with the connecting segments perpendicular to (not parallel with) the inductor’s extension-conductor segment. *Id.* Niknejad, however, is silent regarding how to orient a finger capacitor in a LC circuit. Instead, PO argues that **Jing** (not Niknejad) allegedly shows a large number of short fingers and the connecting segments do not extend in the claimed direction.

Also disproving PO’s arguments is Daley, which shows many fingers and having connecting segments extending in the claimed direction. See pp. 33-34 *supra*. Likewise, the RBR1000 had a large number (41) of fingers in the capacitor with connecting segments extending in the claimed direction. EX-1048.215-219. Thus, the prior art only confirms that a POSITA would have understood that there were two options for orienting the finger capacitor, and both were obvious. EX-1049.1268:16-1270:5.

PO proposes a combination of Muh and Niknejad that does not read onto the claims based on its argument “[t]he two references only teach the use of a larger number of shorter fingers.” POR, 58-60; EX-2003, ¶165. Wrong. Niknejad teaches the capacitor having either many short fingers or fewer long fingers, and explains that there were known pros and cons to both designs—the former provides smaller finger resistance and inductance but larger lead parasitics, the latter provides the opposite tradeoff. EX-1007.028. And ultimately, as Niknejad teaches, the “tradeoff and optimum geometry are dependent on the overall capacitor size.” EX-1007.028; EX-1050, ¶46-47; EX-1051.99:1-14.

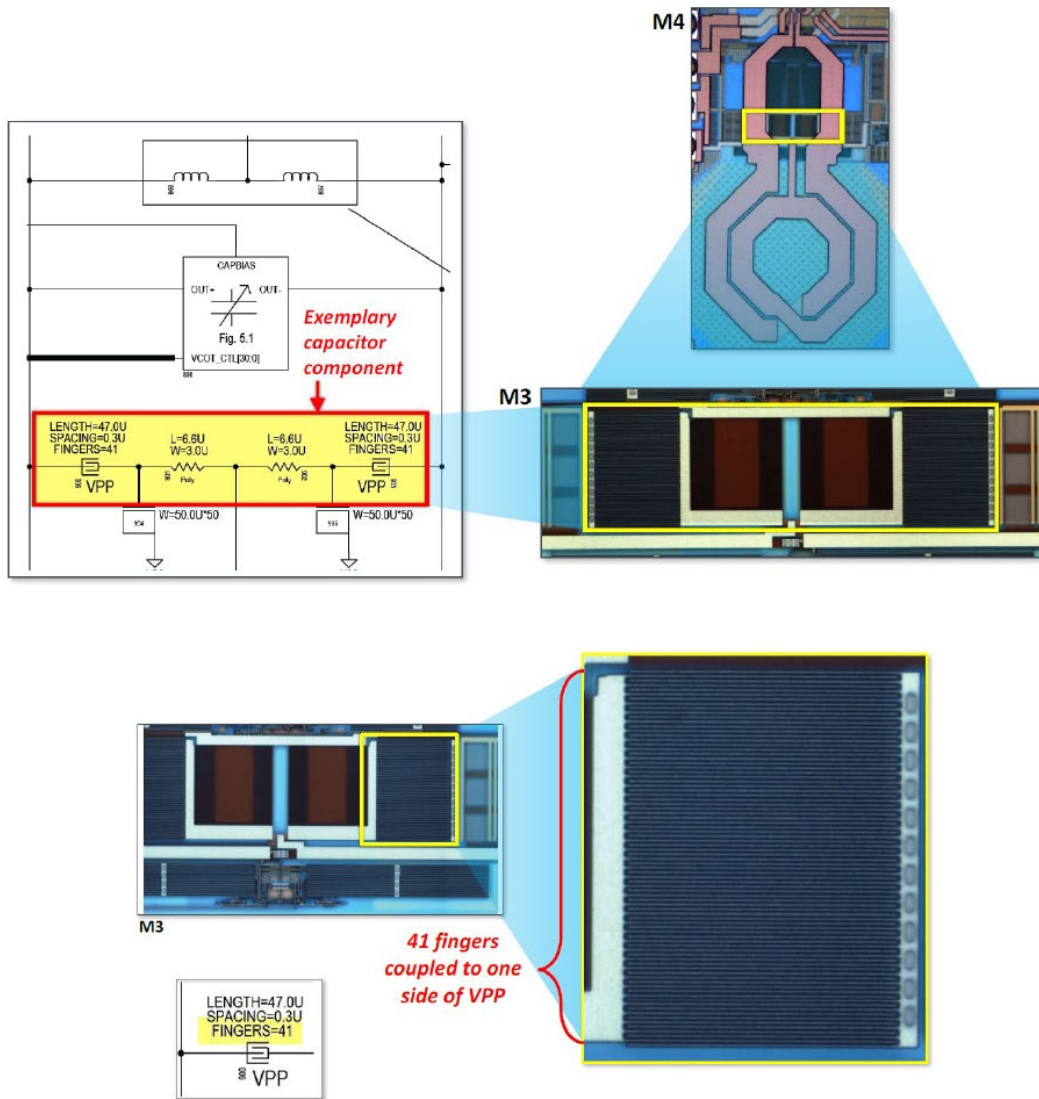
Contrary to PO’s allegations, Dr. Prucnal did not testify that the first design was superior. PO, 57. Rather, consistent with Niknejad, he testified that the ultimate capacitor design “would have to be done within the design constraints of the LC circuit to achieve the capacitance that is required.” EX-2004.1134:15-1135:22. This provides a POSITA the flexibility to design and orient the capacitor in the manner that achieves the goals of the LC circuit. EX-1003, ¶¶236, 239-241, 243 (explaining that the “capacitance increases as the width of the gaps [between the fingers] are decreased”). As Dr. Prucnal explains, although PO argues using many short fingers “increases the Q factor” in Muh’s LC (POR, 57), Muh actually discloses its Q factor is unrelated to the finger capacitor design. EX-1050, ¶¶40-43.

Using few longer fingers reduces parasitics, which is the 582 patent’s goal. EX-1050, ¶43; EX-1001.12:51-54, 99:16-6.

Indeed, even if Niknejad taught a preference for a specific orientation of a finger capacitor in a LC circuit—which he does not—stating a preference does not negate obviousness. *In re Mouttet*, 686 F.3d 1322, 1334 (Fed. Cir. 2012) (“This court has further explained that just because better alternatives exist in the prior art does not mean that an inferior combination is inapt for obviousness purposes.”); *Bayer Pharma AG v. Watson Labs. Inc.*, 874 F.3d 1316, 1327 (Fed. Cir. 2017) (“When there are only two possible formulations and both are known in the art at the time, the fact that there may be reasons a skilled artisan would prefer one over the other does not amount to a teaching away from the lesser preferred but still workable option.”).

Further, PO’s argument that arranging the capacitor as Petitioner proposes would require the capacitor to have “fewer and longer fingers” is contradicted by the record. As the ALJ found, the RBR1000 had many (41) fingers:⁷

⁷ By comparison, Jing’s Fig. 1 shows 14 fingers and Fig. 4 shows 16 fingers. EX-1033.



EX-1048.215. And the capacitor connecting segments are overlapped in the same direction as the extension-conductor segments as claimed. EX-1048.218-219.

Indeed, the arrangement as Petitioner proposes can fit a larger number of fingers because the fingers can extend further away from the inductor coil. In contrast, it is more difficult for the arrangement PO proposes to fit a larger number of fingers because that would result in a larger gap between the two extension-

conductor segments, which would affect LC performance. EX-1050, ¶50. Further, This orientation would “disrupt bilateral symmetry” in the LC circuit, according to Dr. Phinney. *Id.*, ¶51; EX-1051.50:4-11, 118:14-119:1.

Ultimately, RBR1000 and the references identified by the Examiner (Daley and Jing) prove Petitioner’s point—there are only two ways to orient the capacitor. One way, as shown by Daley and RBR1000, has the capacitor connecting segments aligned in same direction as the inductor extension-conductor segments (i.e., in parallel with). The second way, as shown by Jing (*see* POR at 56) arranges the connecting segments perpendicular to the extension-conductor segments. PO’s expert admitted that these were the only two ways to orient the capacitor. EX-1049.1268:16-1270:5. Both ways were obvious to a POSITA. EX-1003, ¶¶237-241. When there are a limited number of known options, each are obvious. *Uber Techs, Inc. v. X One, Inc.*, 957 F.3d 1334, 1340 (Fed. Cir. 2020) (holding that a POSITA would have “two predictable choices for when to perform plotting, providing them with a simple design choice as to whether to plot server-side or terminal-side.... § 103 bars the patentability of such obvious variations”); *KSR Int’l Co. v. Teleflex, Inc.*, 550 U.S. 398, 417 (2007) (holding that if a POSITA “can implement a predictable variation, § 103 likely bars its patentability”); *Wal-Mart Inc. v. Current Lighting Solutions*, IPR2022-00569, Paper 52 at 72-73 (PTAB Sept. 15, 2023) (holding that “there are two ways to connect devices to a common power

source—in parallel and in series” and finding claims to series connection obvious).⁸

b. The Capacitor is “Not Substantially Overlapped”

PO’s arguments that the Muh/Niknejad combination does not meet the claimed requirement that the capacitor is “not substantially overlapped” with the inductor coil-conductor segments are meritless.

PO argues that Muh and Niknejad disclose the “same structure” and as such there is no motivation to combine them in the manner claimed. POR, 51. Wrong. The Niknejad figure PO identifies teaches that the capacitor comprises “MIM capacitors.” EX-1007.026. Muh discloses that his test chip used instead an “interdigitated finger capacitor.” EX-1006.057. Niknejad, in turn, teaches that finger capacitors are “MOM” *not* “MIM” capacitors:

⁸ Dr. Prucnal explained why a POSITA would have been motivated to orient the capacitor with the connecting segments vertically aligned with the extension-conductor segments. EX-1003, ¶¶239-240.

3.1.3.1 Coupling Capacitors

“Finger” (comb) capacitors, sometimes referred to as “MOM” (metal-oxide-metal) capacitors, can be easily fabricated in any modern CMOS process due to the abundance and high packing density of the metal layers. Finger capacitors are composed of a large number of parallel fingers connected to either port of the device as shown in Fig. 3.11. Each finger consists of all available metal layers stacked on top of each other in order to decrease its resistance which increasing both its quality factor and the self-resonance frequency. The metal layers are connected together through the maximum number of vias possible in order to take advantage of the additional via-to-via capacitance.

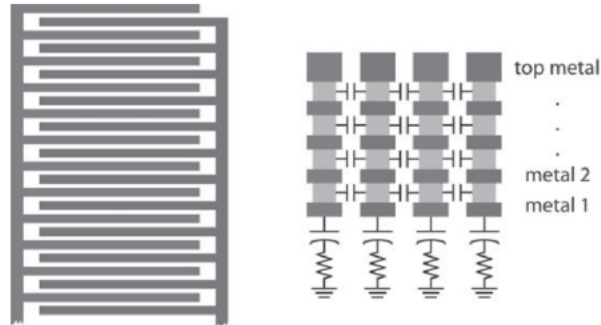
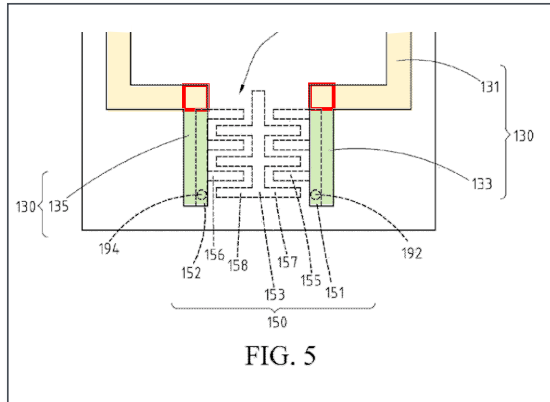


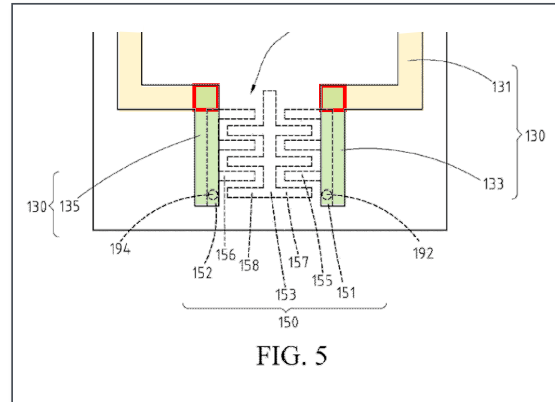
Fig. 3.11 Layout geometry of a “finger” or “comb” capacitor structure.

EX-1007.027 (annotated). The issue then is whether a POSITA would have found it obvious to arrange a MOM finger capacitor in Muh’s circuit in the way claimed, not a MIM capacitor. The evidence shows they would. EX-1003, ¶¶199, 224-226, 235-241, 249-252.

Second, PO’s argument that the Muh/Niknejad combination would not result in a capacitor “not substantially overlapped” with the inductor’s coil-conductor segment depends on PO’s improper claim construction (*see* Section II.B.2-3) which ignores specification embodiments showing that the claims cover version B:

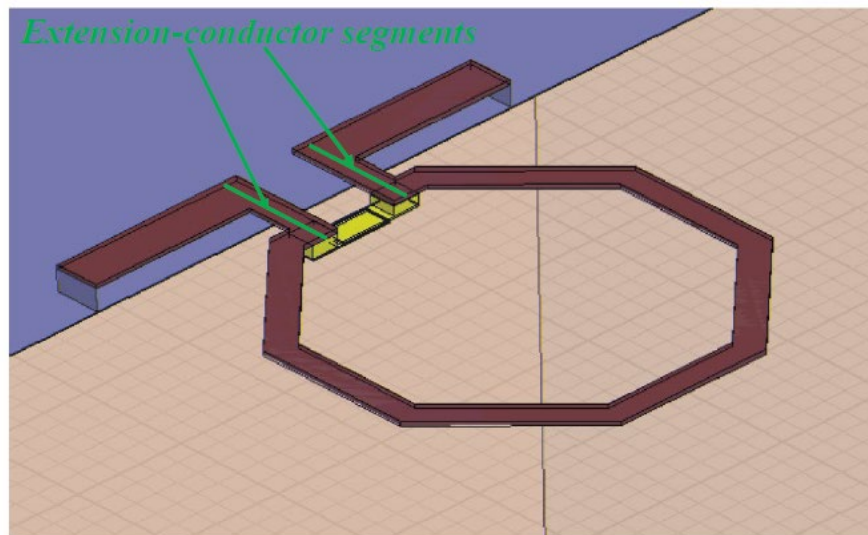


Version A



Version B

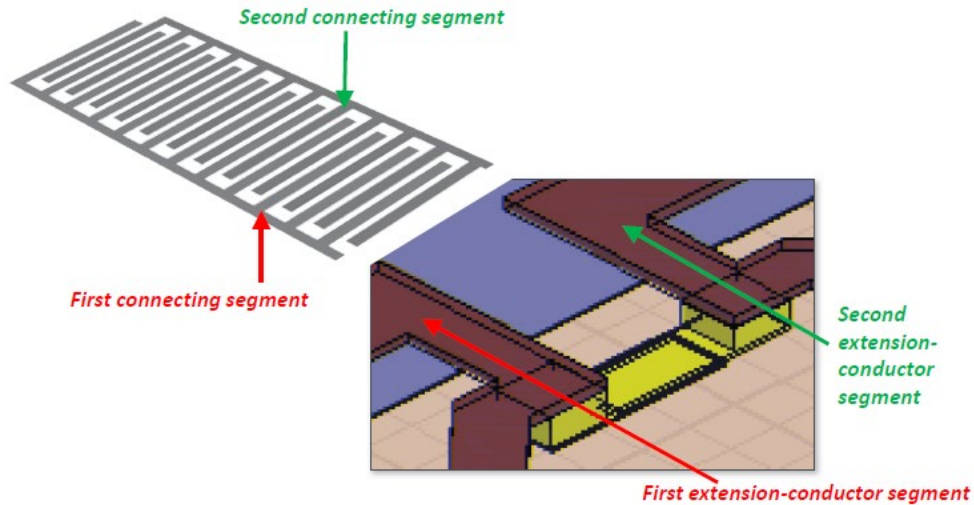
In Version B, the portions in red boxes are part of the extension-conductor segments, not the coil-conductor segment. Thus, in Muh's pictured embodiment, the coil-conductor segment does not overlap the yellow capacitor:



EX-1006.058 (annotated); *see* EX-1003, ¶¶228-234.

Moreover, the claim requires only that the capacitor is “not *substantially* overlapped” with the coil-conductor segment. When Niknejad’s finger capacitor is substituted in Muh, the capacitor is not substantially overlapped with the coil-

conductor segment, as a POSITA would understand that most of the capacitor would extend outward and away from the coil-conductor segment:



EX-1050, ¶49; EX-1003, ¶¶235-236. This is confirmed by the 582 patent, which shows embodiments where the capacitor partially extends into the coil-conductor segment, but is still “not substantially overlapped” therewith:

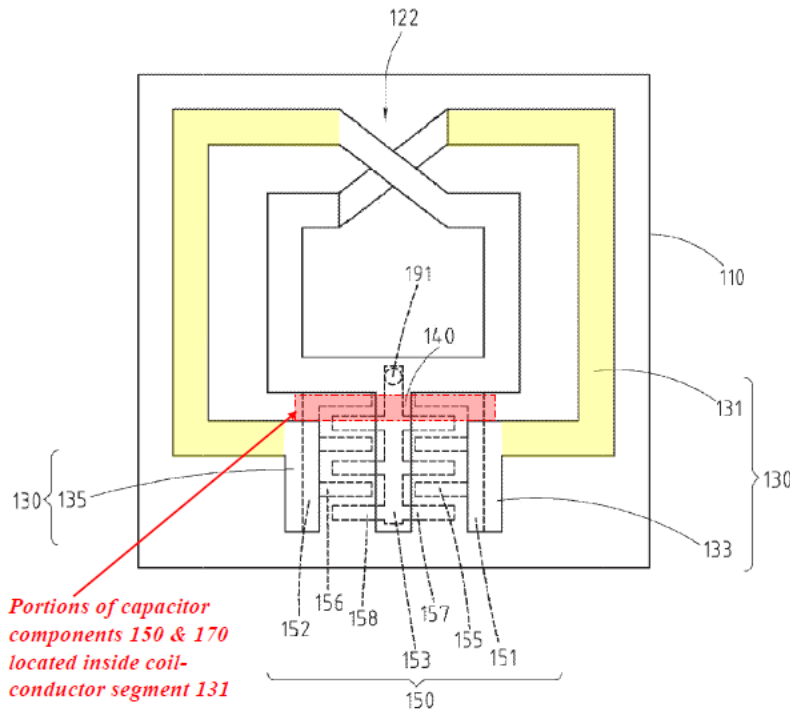


FIG. 8

EX-1001, Fig. 8 (annotated); EX-1003, ¶234; EX-1035.

PO's argument therefore fails. First, it is based on an erroneous claim construction. Second, even under that wrong construction, it fails to address the fact that the 582 patent shows how a finger capacitor (like in the Muh/Niknejad combination) would not be substantially overlapped by the coil-conductor segment.

c. There is No Hindsight Bias

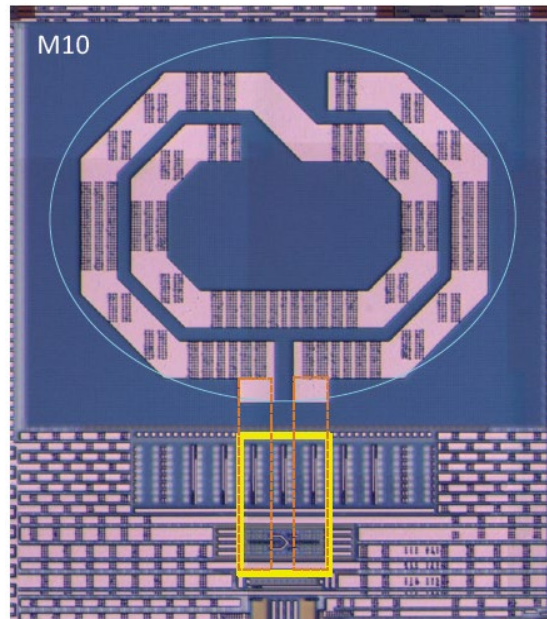
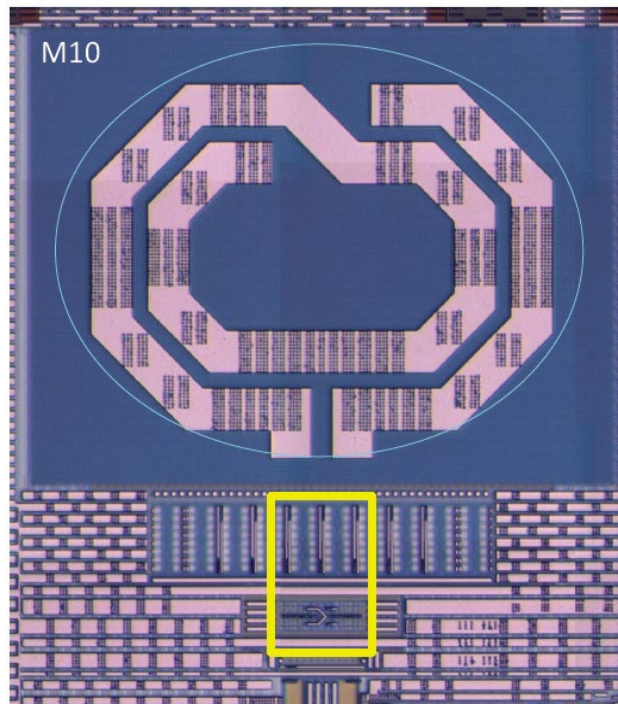
PO's hindsight bias arguments fail, at least because they are grounded in a disproven theory—that what the 582 patent claims was “unknown” in the art. RBR1000 proves that wrong, and Daley also demonstrates that aligning the capacitor connecting segments in the same direction as the extension-conductor

segments was not new. EX-1051.119:21-120:1. There is therefore no hindsight bias in Petitioner’s Muh/Niknejad combination—the prior art proves it was known. Dr. Prucnal confirmed that aligning the Niknejad capacitor in the way claimed was the “simplest and most reliable design choice” and explained why. EX-1003, ¶240; EX-1050, ¶¶44-45, 48; EX-2004.1082:10-22; *Uber*, 957 F.3d at 1340 (Fed. Cir. 2020) (holding that a “simple design choice” between two options “bars the patentability of such obvious variations”).

d. Claim 4 is Invalid

Claim 4 requires that the first region is “defined between the two extension-conductor segments.” Realtek itself interpreted claim 1 and claim 4 the same for infringement:

A first region, marked by a yellow box below, is defined by the two extension-conductor segments and the coil-conductor segment



The first region (yellow block) is defined between the two extension-conductor segments (shown with the green lines and dashed orange boxes, respectively, in the images above).

EX-1003, ¶¶260-261; EX-1034.013, .022. Realtek cannot take inconsistent positions now. *CommScope Techs. v. Dali Wireless*, 10 F.4th 1289, 1299 (Fed. Cir. 2021) (holding that a patentee cannot interpret a claim one way for infringement and another way to avoid invalidity). And Dr. Prucnal showed that the Muh/Niknejad combination meets claim 4 even if the first region is between the segments. The capacitor component is still “arranged corresponding to the first region” as the claims require. EX-1003, ¶¶225, 250-261.

III. CONCLUSION

Petitioner respectfully requests that the Board cancel all challenged claims.

Date: May 3, 2024

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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 5,461 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.

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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:

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