

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VIVINT, INC.,
Petitioner,

v.

FRACTUS S.A.,
Patent Owner,

Patent No. 8,738,103 to Puente Baliarda et al.

Issue Date: May 27, 2014

Title: Multiple-Body-Configuration Multimedia and Smartphone Multifunction
Wireless Devices

Inter Partes Review No.: IPR2024-00087

DECLARATION OF DR. MANOS TENTZERIS

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I, Dr. Manos Tentzeris, declare as follows:

I. INTRODUCTION

1. I have been retained by Petitioner Vivint, Inc. (“Petitioner” or “Vivint”) to serve as an independent expert consultant in the *Inter Partes* review proceedings regarding U.S. Patent No. 8,738,103 (“the ’103 patent”) (Ex. 1001). I have been asked to consider the validity of claims 12 and 15 of the ’103 patent (the “Challenged Claims”). My opinions are set forth below.

2. I am being compensated at my normal rate of \$850/hour for all services rendered. My compensation is not dependent, in any way, on the nature of my findings, the content of my testimony, or the outcome of this proceeding or any other proceeding.

3. I have no other interest in this proceeding.

4. My analysis of the materials produced in this proceeding is ongoing and I will continue to review any new material that is provided. This declaration is indicative of only those opinions that I have formed to date. I reserve the right to amend, revise, and/or supplement my opinions stated herein based on any new information that may become available to me or my continuing analysis of the materials already provided.

II. QUALIFICATIONS

5. My qualifications for forming the opinions in this report are summarized here and explained in more detail in my Curriculum Vitae (“CV”), which is submitted as Appendix A attached hereto.

6. I am currently the Ken Byers Professor in the School of Electrical and Computer Engineering at the Georgia Institute of Technology. I received my Bachelor of Science degree in Electrical Engineering from the National Technical University of Athens in Greece in 1992. I received my Master’s degree and Ph.D from the University of Michigan at Ann Arbor in 1994 and 1998, respectively. A complete list of my academic positions, activities, and publications is set out in my CV, attached.

7. Between 1991 and 1992, I was a research assistant in the Microwave Lab at the National Technical University of Athens, Greece. From 1992 to 1998, I was a research assistant in the Radiation Laboratory at the University of Michigan, Ann Arbor. I became an assistant professor at the School of Electrical and Computer Engineering at Georgia Technical Institute in 1998, lasting until I became an Associate Professor in the same School in 2004. I then served as Associate Professor until my promotion to Professor in 2016, a title I have held since then. Also in 2016, I was appointed as the Ken Byers Professor in Flexible Electronics.

8. As described in my CV, I have more than 30 years of industry and academic experience. I have experience with antennas, fractal RF structures and

circuit design for these systems. As a professor of Electrical and Computer Engineering, I have taught courses relating to antenna and electromagnetic technologies. A complete list of my teaching positions, honors, and classes taught is set out in my CV. As a professor, I collaborated with over 130 Undergraduate, Masters and Doctoral students, as well as visiting students, post-doctoral fellows, and other researchers.

9. Throughout my career, I have received a variety of awards. I am a Fellow of IEEE, a member of the MTT-15 Committee, an Associate Member of European Microwave Association (EuMA), a Fellow of the Electromagnetics Academy, and a member of Commission D, URSI and of the Technical Chamber of Greece. In recognition of my world-leading achievements in the area of antennas and miniaturized/fractal RF structures, I served as an IEEE C-RFID (Committee on RFID technologies) Distinguished Lecturer from 2016-2022 and I served as an IEEE MTT Distinguished Microwave Lecturer (DML) from 2010-2012. I have won awards for my contributions in developing various technologies, including numerous multiband antenna topologies operating at different frequencies and integrated RF modules up to sub-THz frequencies. My achievements include the following:

- IEEE fellow — a distinction reserved for select IEEE members whose extraordinary accomplishments in any of the IEEE fields of interest are deemed fitting of this prestigious grade elevation. IEEE, About the IEEE Fellow Program, <http://www.ieee.org/membership/fellows/>.

- 2021 IEEE Antennas and Propagation Symposium (APS) Best Student Paper Award (co-authored)
- 2019 Humboldt Research Prize
- 2019 IEEE Antennas and Propagation (APS) Conference Co-Chair
- 2018 Intel IEEE ECTC 2018 Best Student Paper Award
- 2015-present IEEE CRFID Distinguished Lecturer
- 2010-2012 IEEE MTT-S Distinguished Microwave Lecturer
- 2017 Georgia Tech Outstanding Achievement in Research Program Development Award
- 2017 Archimedes IP Salon Gold Medal
- 2016 Bell Labs Prize Third Award
- 2015 IET Microwaves, Antennas and Propagation Premium Award
- 2014 Georgia Tech ECE Distinguished Faculty Achievement Award
- 2014 IEEE RFID-TA Best Student Paper Award
- 2013 IET Microwaves, Antennas and Propagation Premium Award
- 2012 Finland Distinguished Professor (Fi.Di.Pro.) Award
- 2012 Architecture Award of Excellence, Architecture World Summit
- 2010 IEEE Antennas and Propagation Society Piergiorgio L. E. Uslenghi Letters Prize Paper Award
- 2010 Georgia Tech Senior Faculty Outstanding Undergraduate Research

Mentor Award

- 2009 IEEE Transactions on Components and Packaging Technologies Best Paper Award
- 2009 IEEE Antennas and Propagation Symposium (APS) Second Best Student Paper Award
- 2009 E.T.S. Walton Award from Science Foundation Ireland
- 2007 IEEE Antennas and Propagation Symposium (APS) Best Student Paper Award
- 2007 IEEE International Microwave Symposium (IMS) Third Best Student Paper Award
- 2007 IEEE International Symposium on Antennas and Propagation (ISAP) Poster Presentation Award
- 2006 Asian-Pacific Microwave Conference (APMC) Award
- 2006 IEEE-MTT Outstanding Young Engineer Award
- 2004 IEEE Transactions on Advanced Packaging Commendable Paper Award
- 2003 NASA Godfrey “Art” Anzic Collaborative Distinguished Publication Award
- 2003 IBC International Educator of the Year Award
- 2003 IEEE-CPMT Outstanding Young Engineer Award
- 2002 International Conference on Microwave and Millimeter-Wave

Technology Best Paper Award (Beijing, China)

- 2002 Georgia Tech-ECE Outstanding Junior Faculty Award
- 2001 ACES Conference Best Student Paper Award
- 2000 NSF CAREER Award
- 1999 Technical Program Co-Chair of the 54th ARFTG Conference, Atlanta, GA
- 1997 Best Paper Award, International Hybrid Microelectronics and Packaging Society
- 1989 Papastavridios Greek Mathematics Excellence Fellowship
- 1988-1992 Greek Government Academic Excellence Fellowships

10. In Google scholar, there are over 27,810 citations to my work and my work has an h-index of 83. An h-index represents the number of papers with the same number of citations, meaning I have over 83 papers with 83 citations.

11. I have authored or contributed to over 30 books and 850 refereed journal and conference papers; spoke in over 140 presentations, many of which relate to antennas, antenna arrays, RFID systems, and other modes of wireless communication and electronics design. A complete list of my publications and conference presentations is included in my curriculum vitae.

12. I am a named inventor on 20 patents in the US and in Europe. In particular, I am a named inventor on patents relating to antenna design, RF systems,

and means of reducing signal interference in RF applications. A complete list of my patents and published applications is included in my curriculum vitae.

13. In addition to gaining expertise via my academic training, professional experiences, and research accomplishments described above, I have kept abreast of various sub-disciplines within the antennas space, by reading technical literature, attending and presenting at conferences, and attending and presenting at symposia. I have served as an editor for various journals and participated in the peer review process for various technical journals and conferences, and have reviewed manuscripts submitted by other scholars relating to antenna topologies. I have contributed further to the profession by chairing conference committees and planning conferences and panels. Furthermore, I have collaborated with or have communicated with many of the scholars and engineers in the field of antennas systems.

14. I am not an attorney and offer no legal opinions, but in the course of my work, I have had experience studying and analyzing patents and patent claims from the perspective of a POSITA.

III. SUMMARY OF OPINIONS AND MATERIALS CONSIDERED

15. All of the opinions contained in this declaration are based on the documents I have reviewed and my professional judgment, as well as my education, experience, and professional knowledge. I am not an attorney and I am not offering

any legal opinions in this declaration.

16. In forming my opinions expressed in this declaration, I relied on the '103 patent (Ex. 1001), the prosecution history of the '103 patent (Ex. 1007), the prior art references cited herein, and other exhibits I have cited in this declaration. Each of these documents is a type of document that an expert in my field would have reasonably relied upon when forming their opinion.

17. My opinions are additionally guided by my appreciation and understanding of how a POSITA would have understood the claims of the '### patent at the time of the alleged invention.

18. Based on my experience and expertise, it is my opinion that:

- Ground 1: Claims 12 and 15 of the '103 patent should be found unpatentable based on the understanding a POSITA would have of U.S. Patent No. 6,239,765 to Johnson *et al.* (“Johnson”) and U.S. Patent Application Publication No. 2007/0238483 to Boireau *et al.* (“Boireau”).
- Ground 2: Claims 12 and 15 of the '103 patent should be found unpatentable based on the understanding a POSITA would have of U.S. Patent Application Publication No. 2003/0189522 to Zeilinger (“Zeilinger”) and Boireau.

IV. LEVEL OF SKILL IN THE ART

19. I understand that patents are interpreted from the perspective of a hypothetical POSITA at the time of the alleged invention. I also understand that the priority date of the '103 Patent is alleged by the Patent Owner to be July 18, 2006 ("Priority Date"). As of this Priority Date, I was at least a person of ordinary skill in the art ("POSITA") of the '103 Patent, and I had personal knowledge of the technologies involved in the '103 Patent.

20. I also understand that various factors are considered in determining the level of ordinary skill in the art. I understand that the factors include types of problems encountered in the art, prior solutions to those problems, rapidity with which innovations are made, sophistication of technology at the time of the invention, and educational levels and experience of persons working in the field and capable of understanding the applicable scientific and engineering principles. I understand that in determining the level of ordinary skill in the art, not all factors may be present or one or more factors may predominate.

21. Additionally, I understand that the Patent Owner contends that, a POSITA relating to the technology of the '200 patent on or before the alleged invention would have had at least a "a bachelor's degree in electrical engineering, computer science, or a similar degree and at least four years of experience in applied electromagnetics with an emphasis on antennas." Alternatively, the person of ordinary skill in the art would have a master's degree in electrical engineering (or

similar discipline) and at least two years of similar experience. Ex. 1008.¹ At least as of the date of the Priority Date of the alleged invention, my education, experience, and professional knowledge qualify me to be a POSITA under the Patent Owner's definition for the '200 patent. I am qualified to provide opinions on what a POSITA would have known and understood at the time of the alleged invention (e.g., at least as of the Priority Date).

V. OVERVIEW OF U.S. PATENT NO. 8,738,103 (EX. 1001)

A. Description of the Specification

22. The '103 patent, titled "Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices," was filed on December 21, 2006 and issued on May 27, 2014. Ex. 1001, cover page. I understand that the '103 patent issued from United States Patent Application No. 11/614,429, and claims priority to European Patent No. 06117352, filed on July 18, 2006. *Id.*

23. I have used July 18, 2006 as the date of the alleged invention of the Challenged Claims for purposes of my analysis and opinions.

24. The '103 patent generally describes "A multifunction wireless device

¹ I adopt the Patent Owner's description of the level of skill in the art for the '200 patent for purposes of this declaration. I reserve the right to disagree with this description in the future, if called upon to specifically form an opinion on the matter.

having at least one of multimedia functionality and smartphone functionality, the multifunction wireless device including an upper body and a lower body, the upper body and the lower body being adapted to move relative to each other in at least one of a clamshell, a slide, and a twist manner. The multifunction wireless device further includes an antenna system disposed within at least one of the upper body and the lower body and having a shape with a level of complexity of an antenna contour defined by complexity factors F21 having a value of at least 1.05 and not greater than 1.80 and F32 having a value of at least 1.10 and not greater than 1.90.” *Id.*, Abstract.

25. The ’103 Patent is directed to “[a] multifunction wireless device” which “includes an antenna system.” *Id.*, Abstract. The ’103 Patent teaches that a “multifunction wireless device . . . advantageously comprises five functional blocks: display 11, processing module 12, memory module 13, communication module 14, and power management module 15.” *Id.* at 8:13-17. The specification then provides the following description: (1) the display can include “a touch screen with a size of at least half of the overall device, *Id.* at 9:13-14; (2) “[t]he processing module 12, that is the microprocessor or CPU,” *Id.* at 8:20-21; (3) the memory module is one of the blocks; (4) “[t]he antenna system [is] within the communication module 14,” *Id.* at 8:47; and (5) “[t]he MFWD 100 has a single source of energy and it is the power management module 15,” *Id.* at 8:26-28.

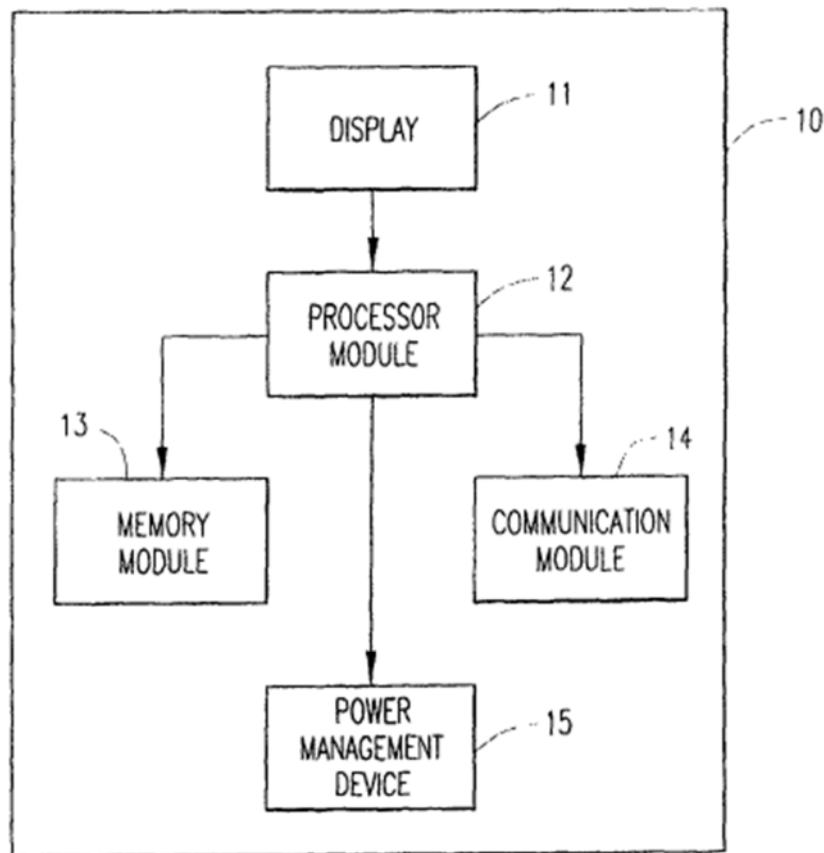


FIG. 1A

Id., at FIG. 1A.

26. The '103 Patent then describes the antenna system within the handheld multifunction wireless device. The antenna system includes a ground plane with a “ground plane rectangle . . . defined as being the minimum-sized rectangle that encompasses the ground plane of the antenna system included in the PCB of the MFWD 100 that comprises the feeding means responsible for the operation of the antenna system in its lowest frequency band. That is, the ground plane rectangle is a rectangle whose edges are tangent to at least one point of the ground plane.” *Id.* at

14:4-11.

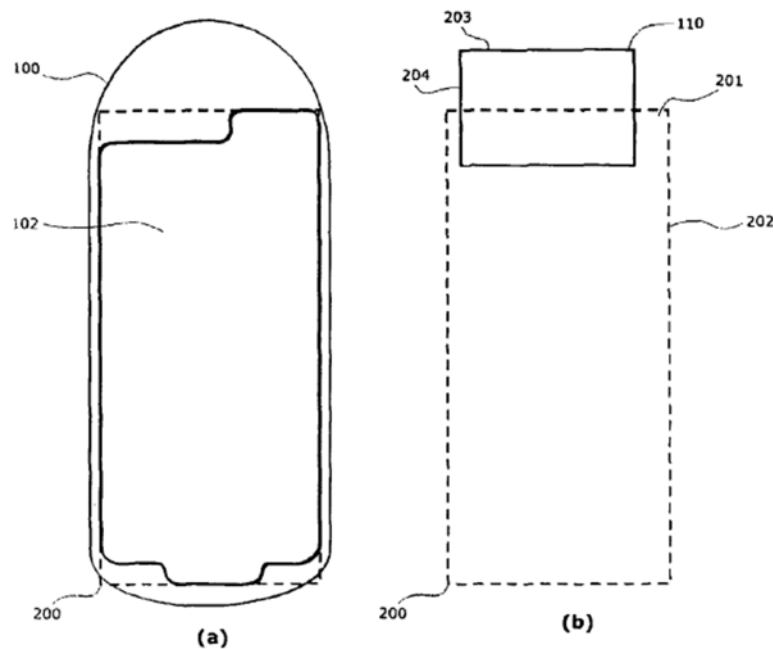


FIG. 2

27.

Id. at FIG. 2.

28. The antenna system of the '103 Patent “has a structure able to support different radiation modes so that the antenna system can operate with good performance and reduced size in the communication standards allocated in multiple frequency bands within at least three different regions of the electromagnetic spectrum.” *Id.* at 11:27-31. At least one of these regions incorporates “4G standards (for instance, bands within the frequency region 2-11 GHz and some of its sub-regions such as for instance 2-11 GHz, 3-10 GHz, 2.4-2.5 GHz and 5-6 GHz or some other bands).” *Id.* at 24:27-30. The antenna contour, “i.e., its peripheral both internally and externally, can comprise straight segments, curved segments or a

combination thereof.” *Id.* at 14:60-62. The ’103 Patent discloses that it is possible to require a minimum amount of segments in a contour and that “[p]ossible values for the minimum number of segments of a subset include 5, 6, 7, 8, 10, 12, 14, 16, 18, 20, 25, 30, 35, 40, 45 and 50.” *Id.* at 15:41-43.

29. The ’103 Patent further discloses “[a]n antenna box for the MFWD 100 is herein defined as being the minimum-sized parallelepiped of square or rectangular faces that completely encloses the antenna volume of space and wherein each one of the faces of the minimum-sized parallelepiped is tangent to at least one point of the volume. Moreover, each possible pair of faces of the minimum-size parallelepiped shares an edge forming an inner angle of 90°.” *Id.* at 11:3-12. Within the antenna box is an antenna rectangle “defined as being the orthogonal projection of the antenna box along the normal to the face with the largest area of the antenna box.” *Id.* at 13:55-58. The ’103 Patent also discloses that “in some examples the length of the antenna contour is larger than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 15, 20, 25, 30, 40 or more times the length of the diagonal of the antenna rectangle or less than any of those values.” *Id.* at 16:14-17.

B. Prosecution History of the ’103 patent (Ex. 1007)

30. The application from which the ’103 Patent issued (No. 11/614,429) was filed on December 21, 2006. During prosecution, the applicant filed 27 different Information Disclosure Statements (“IDS”) that identified hundreds of potential prior art references.

31. On August 16, 2010, the examiner issued a non-final office action that rejected original claims 1-3, 6-9, 11, 14, and 20 as being unpatentable over the combination of U.S. Patent No. 7,548,915 to Ramer *et al.* (“Ramer”) and U.S. Patent Application Publication No. 2004/0119644 to Baliarda *et al.* (“Baliarda”). Ex. 1007 at 162. Claims 12 and 13 were rejected as being unpatentable over a combination of Ramer, Baliarda, and U.S. Patent No. 7,183,983 to Ozden (“Ozden”). *Id.* at 174. Claims 16-19 were rejected as being unpatentable over the combination of Ramer, Baliarda, and U.S. Patent Application Publication No. 2002/0175211 to Dominquez *et al.* (“Dominquez”). *Id.* at 178. Claims 10 and 15 were rejected as being unpatentable over the combination of Ramer, Baliarda, and U.S. Patent Application No. 2007/0229383 to Koyanagi *et al.* (“Koyanagi”). *Id.* at 183. On February 11, 2011, Applicant responded and made no amendments nor cancelations to any of their claims. *Id.* at 147.

32. On March 7, 2011, the examiner issued a final rejection maintaining the original rejections based on the various combinations of Ramer, Baliarda, Ozden, Dominquez, and Koyanagi. *Id.* at 117-145. Applicant requested continued examination on March 21, 2011. *Id.* at 115. Examiner issued a final rejection on May 27, 2011. *Id.* at 87-114.

33. On November 23, 2011, applicant filed a request for continued examination and amended the independent claims 1, 16, 18, and 20. *Id.* at 70-85. Examiner issued a non-final rejection on March 19, 2013 which stated that claims 1-

3, 6-9, 11-14, and 20 were unpatentable over U.S. Patent No. 6,989,794 to Tran (“Tran”) in view of Ramer. *Id.* at 52. Claims 4-5 were rejected as being unpatentable over Tran in view of Ramer and Dominquez. *Id.* at 61. Claims 10 and 15 were rejected as being unpatentable over Tran in view of Ramer and Koyanagi. *Id.* at 62. Claim 16 was rejected as unpatentable over Tran in view of Dominquez. *Id.* at 64. Claim 17 was rejected as being unpatentable over Tran in view of Dominquez and Ramer. *Id.* at 66. Claims 18-19 were rejected as being unpatentable over U.S. Patent No. 6,476,769 to Lehtola (“Lehtola”) in view of Ramer and Dominquez. *Id.* at 67.

34. On July 17, 2013, Applicant canceled claims 1-20 and added claims 21-40. *Id.* at 35-48. Examiner responded that the amendment was non-responsive and withdrew new claims 21-40 from consideration as being directed to a non-elected invention. *Id.* at 32-34. Applicant responded on November 13, 2013, by amending claims 1-5 and 16-20, canceling claims 6-15, and adding claims 21-30. *Id.* at 10-30. A notice of allowance was issued on January 8, 2014. Ex. 1007 at 7-9.

VI. THE CHALLENGED CLAIMS OF THE '103 PATENT

35. I understand that claims 12 and 15 of the '103 patent are being challenged. Claims 12 and 15 of the '103 patent are reproduced below:

12. A handheld multifunction wireless device having at least one of multimedia functionality and smartphone functionality, the handheld multifunction wireless device comprising:
a touch screen;
a processing module;
a memory module;

a communication module;
a power management module;
an antenna system within the handheld multifunction wireless device and comprising:
a ground plane layer;
a first antenna element configured to simultaneously support radiation modes for first, second, and third frequency bands, the first frequency band being contained within a first frequency region of an electromagnetic spectrum, the second frequency band being contained within a second frequency region of the electromagnetic spectrum that is higher in frequency than the first frequency region, the third frequency band of operation being used by a 4 G communication standard, wherein a perimeter of the first antenna element defines a first antenna contour comprising at least thirty-five segments, the first antenna element defining an antenna box, an orthogonal projection of the antenna box along a normal to a face with a largest area of the antenna box defining an antenna rectangle, wherein a length of the first antenna contour is greater than four times a diagonal of the antenna rectangle; and
a second antenna element configured to operate in at least one frequency band used by a 4 G communication standard, wherein a perimeter of the second antenna element defines a second antenna contour comprising at least twenty segments.

15. The handheld multifunction wireless device according to claim 12, wherein the ground plane layer defines a ground plane rectangle, the projection of the antenna rectangle on the ground plane rectangle partially overlapping the ground plane rectangle.

VII. CLAIM CONSTRUCTION

36. I understand that when considering the meaning of claims subject to *inter partes* review, one must consider the claim language. I understand that claim terms are generally given their ordinary and customary meaning, as would be understood by one with ordinary skill in the art at the time of invention in the context of the specification, the prosecution history, and other claims. For my opinions in this declaration, I have been asked to consider the Challenged Claims under their

ordinary and customary meanings as understood by a POSITA at the time of the alleged invention. I have applied the above principles in forming my opinions provided in this declaration.

VIII. LEGAL PRINCIPLES

37. I am not an attorney and I have not been asked to express any legal opinions. Rather, in connection with the analysis presented in this declaration, I considered the following legal standards that counsel for Petitioner provided to me.

A. Burden of Proof

38. I understand that the Petitioner has the burden of proving the unpatentability of the patent claims by a preponderance of the evidence, which I understand as meaning more than 50% likely.

B. Anticipation

39. I understand that a claim is anticipated, and therefore not patentable, if each and every element of that claim is found in a single prior art reference. I further understand that, if a prior art reference does not explicitly disclose every element of a claim, the claim may still be anticipated and rendered invalid if the claim elements not explicitly disclosed are inherently disclosed. However, I understand that to inherently disclose an element, that element must be necessarily present in the prior art reference and that inherency cannot be established through mere probabilities or possibilities.

C. Obviousness

40. I understand that a claim is obvious, and therefore not patentable, if at the time of the invention, the subject matter of the claim as a whole would have been obvious to a person of ordinary skill in the art. I understand that a proper obviousness analysis must consider the following four factors: (1) the scope and content of the prior art; (2) the level of ordinary skill in the art; (3) the differences between the claimed subject matter and the prior art; and (4) any objective indicia of non-obviousness.

41. I understand that a reason to combine that merely describes the resulting combination without explaining the particular reason why one of ordinary skill would combine the elements of the prior art in order to form Patent Owner's claimed invention is merely conclusory and based on impermissible hindsight reasoning. It is not enough to simply show that the references disclose each element of a claim; it is also necessary to identify a reason that would have prompted a person of ordinary skill in the art to combine the elements in the manner set forth in the claim. I understand that a prima facie case of obviousness requires more than describing the results of the proposed combination. Rather, the Petitioner must articulate a reason for making the proposed combination in the first instance. I further understand that it is not enough to conclude that, once the proposed combination is made, the result is predictable; an obviousness finding requires that the Petitioner provide a reason, supported by a rational foundation, which explains why one of ordinary skill would

have chosen to make the particular combination in the first place.

42. I understand that, in analyzing the four obviousness considerations, a party challenging a patent must show that: (1) each and every limitation of the claimed subject matter was disclosed in the combination of prior art references; (2) a person of ordinary skill in the art would have been motivated to combine the teachings of the prior art references to achieve the claimed subject matter; and (3) there would have been a reasonable expectation that the combination of such teachings would achieve the claimed subject matter.

43. I understand that, in addition to its analysis of the teachings of the prior art, the fact finder must consider the patent owner's proffer of objective indicia of non-obviousness, including: (1) commercial success; (2) professional approval and praise by others; (3) expressions of disbelief and skepticism of those skilled in the art upon learning of the invention; (4) licenses showing industry respect and commercial acquiescence to the invention; (5) copying; (6) long felt but unresolved need, and failure of others to solve the problem, including the passage of time between publication of the prior art and the invention; and (7) unexpected results. In reviewing the file history of the '103 patent and the other information discussed in this declaration, I am not currently aware of any evidence supporting any of the above factors.

IX. OVERVIEW OF CITED REFERENCES

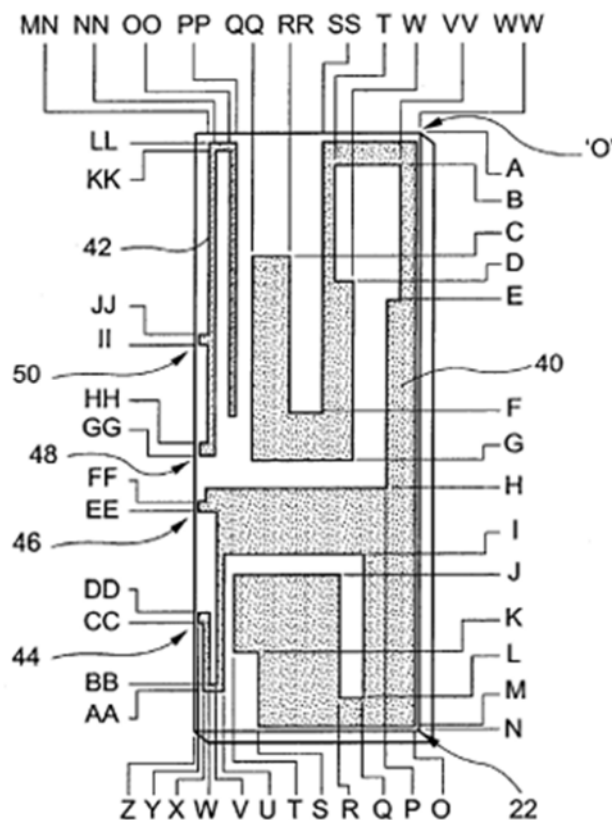
A. Johnson (Ex. 1003)

44. U.S. Patent No. 6,239,765 to Johnson *et al.* (Ex. 1003) (“Johnson”) filed on August 24, 1999, is prior art under at least 35 U.S.C. §§ 102(a). Johnson did not provide the basis for any particular examiner remarks during prosecution of the ’103 Patent.

45. Johnson is directed to “[a]n asymmetric dipole antenna assembly . . . provided for wireless communications devices.” Ex. 1003 at Abstract. Johnson “replaces the external wire antenna of a wireless communication device with a planar conformal element which is installed within the housing of a wireless device.” *Id.* at 2:5-9. This means that in Johnson, “an internal antenna . . . can easily fit inside the housing of a wireless transceiver such as a cellphone.” *Id.* at 2:21-22.

46. Johnson teaches an “antenna assembly of FIG. 9 [that] depicts a tri-band antenna assembly 20 functioning across a cellular band (880-960 MHz.), a PCS band (1710-1880 MHz.) and the BLUETOOTH™ band (2.4-2.5 GHz.).” *Id.* at 5:37-40.

FIG. 9



Id. at FIG. 9.

B. Boireau (Ex. 1004)

47. U.S. Patent Application Publication No. 2007/0238483 to Boireau *et al.* (Ex. 1004) (“Boireau”), filed April 5, 2006, published October 11, 2007, and is prior art under at least 35 U.S.C. §102(e). Boireau was not referenced during prosecution of the ’103 Patent.

48. Boireau is directed to “[a] mobile computing device [that] may comprise an antenna, a switch to couple to the antenna, and multiple transceivers to couple to

the switch.” Ex. 1004 at Abstract. Boireau discloses a “wireless device 100 may comprise a mobile computing device. A mobile computing device may include any computing device with a self-contained power source, such as a battery, for example.” *Id.* at ¶[0018]. Boireau further discloses that “mobile computing device 100 may be implemented as a combination handheld computer and mobile telephone, sometimes referred to as a smart phone.” *Id.* at ¶[0019]. The mobile computing device of Boireau may include a “display 138 [that] may be implemented as an additional I/O device, such as a touch screen, touch panel, touch screen panel, and so forth” *Id.* at ¶[0023].

49. Boireau teaches a “[p]rocessor 302 and transceiver module 304 [that] may communicate using various interface signals.” *Id.* at ¶[0052]. The mobile computing device of Boireau further includes “[m]emory 306 may be implemented using any machine-readable or computer-readable media capable of storing data, including both volatile and non-volatile memory.” *Id.* at ¶[0042].

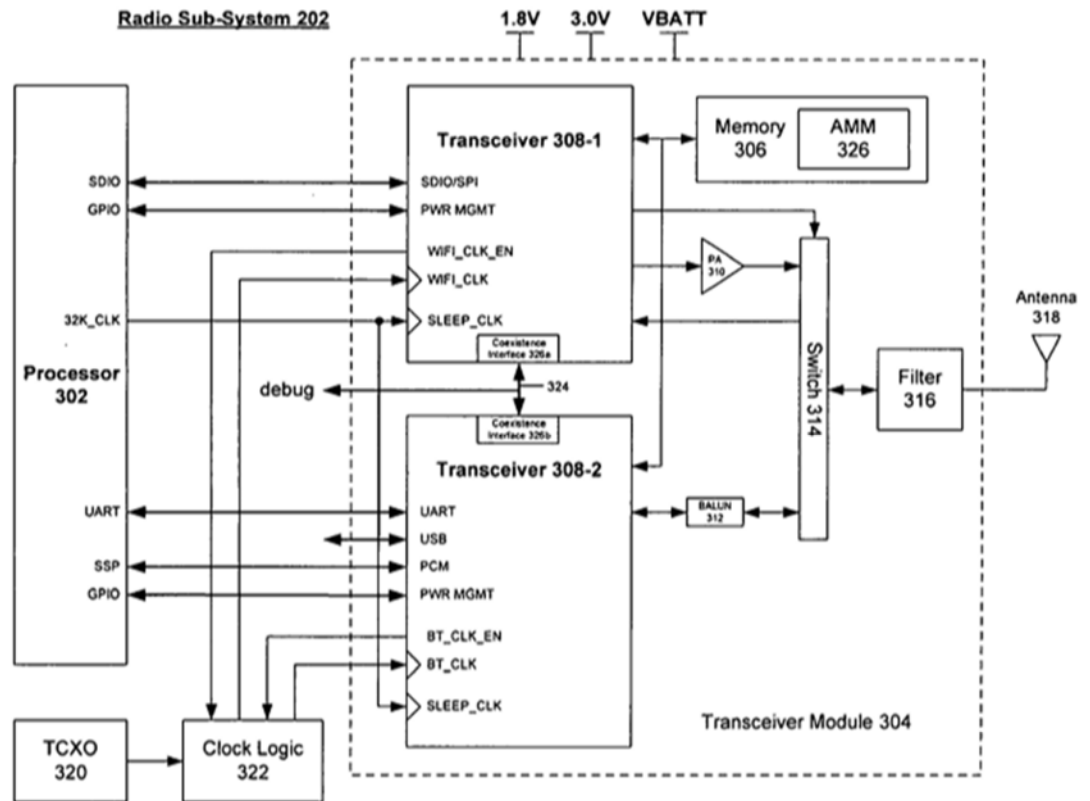


FIG. 3

50.

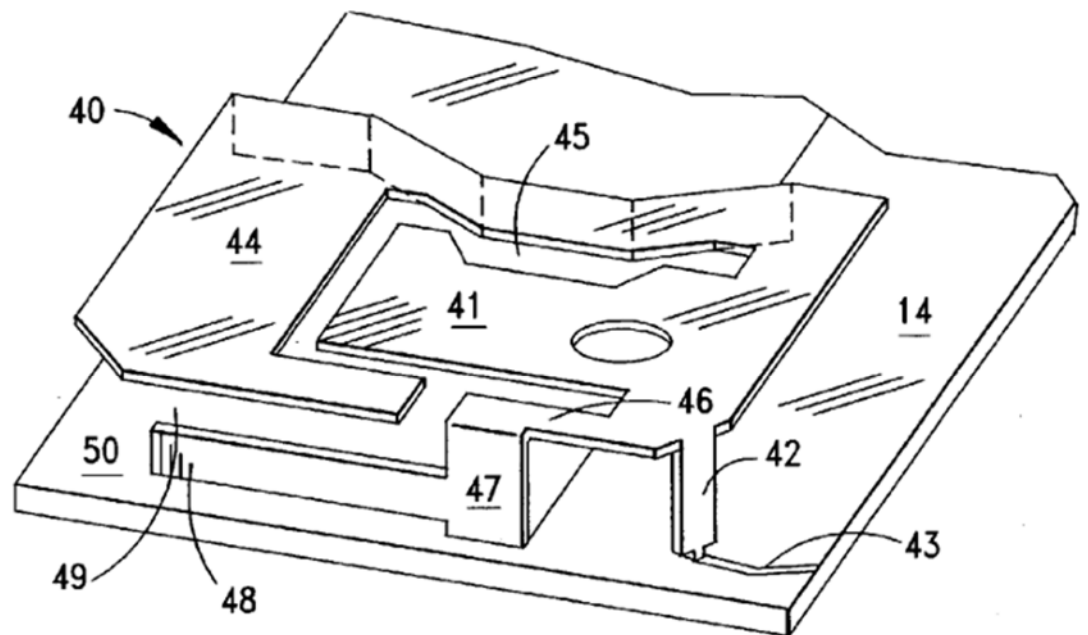
Id. at FIG. 3.

C. Zeilinger (Ex. 1005)

51. U.S. Patent Application Publication No. 2003/0189522 to Zeilinger (Ex. 1005 (“Zeilinger”) published October 9, 2003, and is prior art under at least 35 U.S.C. §102(a)-(b). Zeilinger was not referenced during prosecution of the ’103 Patent.

52. Zeilinger is directed to “[a] multiple frequency band antenna [that] is capable of operating in at least three distinct preselected frequency bands.” Ex. 1005, Abstract. It is an object of Zeilinger “to provide in one embodiment of the invention, a tri-band antenna for use with mobile telephones that is capable of operating in at least three distinct preselected frequency bands.” *Id.* at ¶[0011]. Zeilinger teaches an “antenna [that] will fit into the top portion of the internal cavity of the telephone housing 10.” *Id.* at ¶[0029].

FIG. 3



53.

Ex. 1005 at FIG. 3.

X. GROUND OF UNPATENTABILITY

54. As established below, all features of the Challenged Claims were well known in the prior art.

A. GROUND 1: JOHNSON AND BOIREAU

55. Claims 12 and 15 of the '103 Patent are unpatentable under 35 U.S.C. §103 as obvious over Johnson and Boireau.

1. Claim 12

- i) “A handheld multifunction wireless device having at least one of multimedia functionality and smartphone functionality, the handheld multifunction wireless device comprising:” (preamble)**

56. Claim 12 recites “a handheld multifunction wireless device having at least one of multimedia functionality and smartphone functionality, the handheld multifunction wireless device comprising.” Johnson teaches this for at least the following reasons.

57. Johnson explains that “[t]he present invention replaces the external wire antenna of a wireless communication device with a planar conformal element which is installed within the housing of a wireless device and closely-spaced to the printed circuit board and antenna feedpoint of the wireless device. Electrical connection to the wireless device’s main PWB may be achieved through automated production equipment, resulting in cost effective assembly and production. Electrical performance of the internal (embedded) antenna in wireless systems is nominally

equal to that of a conventional wire antenna.” Ex. 1003 at 2:5–14.

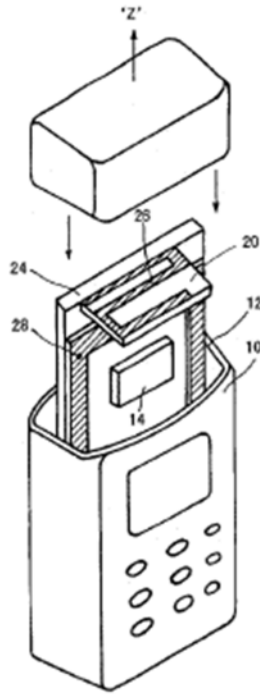
58. A POSITA would have recognized that the wireless communication device shown and described in Johnson can function as a handheld multifunction wireless device, such as a mobile phone.

59. Johnson explains that “[a]n asymmetric dipole antenna assembly is provided for wireless communications devices, and includes separate upper and lower conductor traces and a low impedance feedpoint at the junction of the conductor traces.” *Id.* at Abstract.

60. It is my opinion that the wireless device in Johnson includes both smartphone functionality and multimedia functionality.

61. Johnson further discloses “single or multiple frequency wireless communication devices, for instance devices operating over the GPS (1575 MHz), cellular telephone (824-890 MHz and 860-890 MHz), PCS device (1710-1880 MHz, 1750-1870 MHz, and 1850-1990 MHz), cordless telephone (902-928 MHz), or BLUETOOTH™ specification (2.4-2.5 GHz.) frequency ranges. *Id.* at 3:49-55.

62. The frequency ranges that are enabled by the antenna of Johnson allow the wireless communication device to perform multimedia and/or smartphone functionality for “known wireless communication devices,” which the ’103 patent admits included smartphones with multimedia capabilities. See *Id.* at 1:20-23; Ex. 1001 at 1:19-35.



Ex. 1003 at FIG. 1.

63. Thus, it is my opinion that a POSITA would find this disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole.

ii) “a touch screen;”

64. Claim 12 recites “a touch screen.” Boireau teaches this feature for at least the following reasons.

65. Boireau explains that a “[m]obile computing device 100 may comprise various input/output (I/O) devices. Such as an alphanumeric keyboard, alphanumeric keypad, numeric keys, keys, buttons, switches, rocker switches, multi-directional rocker switches, a microphone, an audio headset, a camera, a touch-sensitive display screen, a stylus, and so forth.” Ex. 1004 at ¶[0021].

66. A POSITA would have had reason to combine Johnson and Boireau

because both references had motivation to create a smaller antenna system while still enhancing wireless connectivity.

67. There would have had a reasonable expectation of success in combining Johnson and Boireau because Johnson and Boireau both involve antenna designs within wireless devices and therefore are analogous art directed to the same field of endeavor as the '103 Patent. Ex. 1003 at 1:13–30; Ex. 1004 at ¶[0001].

68. Like the '103 Patent, Johnson and Boireau are directed to the same problem of improving antenna geometry for small devices. Ex. 1003 at 1:13–30; Ex. 1004 at ¶[0001].

69. Thus, it would have been obvious to a POSITA to combine the teachings of Boireau with those of Johnson because the antennas of Johnson would have been obvious to use with any of a variety of mobile phones at the time, including those with a touch screen as disclosed by Boireau.

iii) “a processing module;”

70. Claim 12 recites “a processing module.” Johnson teaches this for at least the following reasons.

71. Johnson explains that “[t]he present invention replaces the external wire antenna of a wireless communication device with a planar conformal element which is installed within the housing of a wireless device and closely-spaced to the printed circuit board and antenna feedpoint of the wireless device. Electrical connection to the wireless device's main PWB may be achieved through automated production

equipment, resulting in cost effective assembly and production. Electrical performance of the internal (embedded) antenna in wireless systems is nominally equal to that of a conventional wire antenna.” Ex. 1003 at 2:6–14.

72. Johnson discloses “an antenna assembly for a wireless communication device, such as a cellular telephone.” *Id.* at 1:11-17. The ’103 patent defines the processing module to be “the microprocessor or CPU.” Ex. 1001 at 8:20-21.

73. It is my opinion that a POSITA would have understood that the cellular telephone of Johnson includes a processing module.

74. Additionally, Boireau describes “[h]ousing 102 may be used to encapsulate various internal components for mobile computing device 100, such as a processor, a memory, one or more transceivers, one or more printed circuit board (PCB), one or more antennas, a stylus, and so forth.” Ex. 1004 at ¶[0020].

75. Thus, it is my opinion that a POSITA would find this disclosed in the teachings of Johnson and/or Boireau and their incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

76. Additionally, for the same reasons as described above, a POSITA would have found it obvious to combine the teachings of Boireau with those of Johnson because it would be obvious to use the antennas of Johnson with any of a variety of mobile phones at the time, which included processors as disclosed by Boireau.

iv) “a memory module;”

77. Claim 12 recites “a memory module.” Johnson teaches this feature for at least the following reasons.

78. The ’103 patent does not describe the “memory module.” But, Johnson discloses this claim feature.

79. Johnson explains that “[t]he present invention replaces the external wire antenna of a wireless communication device with a planar conformal element which is installed within the housing of a wireless device and closely-spaced to the printed circuit board and antenna feedpoint of the wireless device. Electrical connection to the wireless device's main PWB may be achieved through automated production equipment, resulting in cost effective assembly and production. Electrical performance of the internal (embedded) antenna in wireless systems is nominally equal to that of a conventional wire antenna.” Ex. 1003 at 2:6–14.

80. Johnson discloses “an antenna assembly for a wireless communication device, such as a cellular telephone.” *Id.* at 1:11-17.

81. A POSITA would have understood a cellular telephone to include a memory module, including the cellular telephone disclosed in Johnson.

82. Additionally, Boireau explains “[h]ousing 102 may be used to encapsulate various internal components for mobile computing device 100, such as a processor, a memory, one or more transceivers, one or more printed circuit board (PCB), one or more antennas, a stylus, and so forth.” Ex. 1004 at ¶[0020].

83. Thus, it is my opinion that a POSITA would find this disclosed in the teaching of Johnson and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

84. Additionally, for the same reasons as described above, A POSITA would have found it obvious to combine the teachings of Boireau with those of Johnson it was obvious to use the antennas of Johnson with any of a variety of mobile phones at the time, which included memory as disclosed by Boireau.

v) “a communication module;”

85. Claim 12 recites “a communication module.” Johnson teaches this feature for at least the following reasons.

86. The ‘103 patent states that the communications module is, for example, an antenna. Ex. 1001 at 8:47.

87. Johnson explains “[a]n asymmetric dipole antenna assembly is provided for wireless communications devices, and includes separate upper and lower conductor traces and a low impedance feedpoint at the junction of the conductor traces.” Ex. 1003 at Abstract.

88. Johnson also explains that “[t]he present invention replaces the external wire antenna of a wireless communication device with a planar conformal element which is installed within the housing of a wireless device and closely-spaced to the printed circuit board and antenna feedpoint of the wireless device. Electrical connection to the wireless device's main PWB may be achieved through automated

production equipment, resulting in cost effective assembly and production. Electrical performance of the internal (embedded) antenna in wireless systems is nominally equal to that of a conventional wire antenna.” *Id.* at 2:6–14.

89. Johnson also discloses a transceiver 14. *Id.* at 2:50-54.

90. A POSITA would have understood that the purpose of a transceiver is to carry out wireless communications.

91. Thus, it is my opinion that a POSITA would have understood that Johnson’s disclosure of a wireless device, and an antenna and a transceiver includes a communication module to carry out wireless communication.

92. In addition, Johnson explains “an internal antenna that can easily fit inside the housing of a wireless transceiver such as a cellphone.” *Id.* at 2:21-22. A POSITA would have known that communication modules in a cellphone would include a wireless transceiver at the time.

93. Thus, it is my opinion that a POSITA would find this disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

vi) “a power management module;”

94. Claim 12 recites “a power management module.” Johnson teaches this feature for at least the following reasons.

95. The ’103 Patent describes the power management module as the “single source of energy” for the MFWD (wireless device). Ex. 1001 at 8:26-28.

96. Johnson teaches “[a]n asymmetric dipole antenna assembly is provided for wireless communications devices, and includes separate upper and lower conductor traces and a low impedance feedpoint at the junction of the conductor traces.” Ex. 1003 at Abstract.

97. Additionally, Boireau describes that “[m]obile computing device 100 also may comprise a rechargeable battery, such as a removable and rechargeable lithium ion battery, and an alternating current (AC) adapter.” Ex. 1004 at ¶[0022].

98. A POSITA would have understood that a battery as disclosed in Boireau would meet the “source of energy” description for a power management module as required by the ’103 Patent.

99. Thus, it is my opinion that a POSITA would find this disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

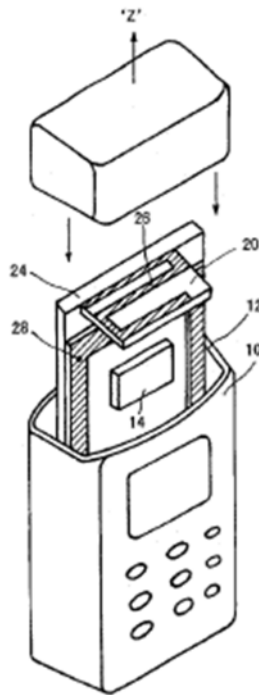
100. Additionally, for the same reasons as described above, a POSITA would have found it to be obvious to combine the teachings of Boireau with those of Johnson because they would have used the antennas of Johnson with any of a variety of mobile phones at the time, which included power management modules (e.g., batteries) as disclosed by Boireau.

vii) “an antenna system within the handheld multifunction wireless device and comprising:”

101. Claim 12 discloses “an antenna system within the handheld

multifunction wireless device and comprising.” Johnson teaches these features for at least the following reasons.

102. Johnson teaches “[a]n asymmetric dipole antenna assembly is provided for wireless communications devices, and includes separate upper and lower conductor traces and a low impedance feedpoint at the junction of the conductor traces.” Ex. 1003 at Abstract. Johnson also teaches “an internal antenna that can easily fit inside the housing of a wireless transceiver such as a cellphone.” Ex. 1003 at 2:21-22.



Ex. 1003 at FIG. 1.

103. A POSITA would have understood that, at the time of invention, a multifunction wireless device would include cellphones.

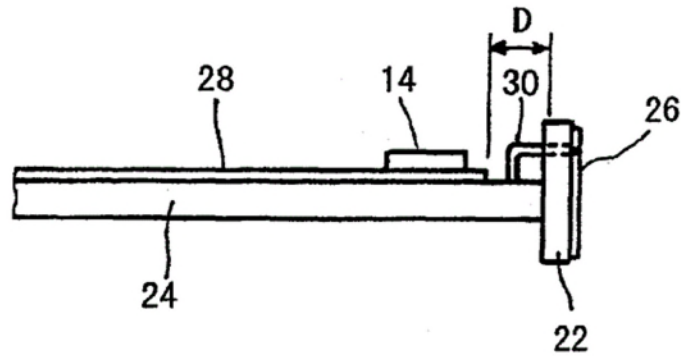
104. Johnson discloses an antenna system within a multifunction wireless device because the antenna fits inside the housing of the cellphone disclosed in Johnson.

105. Thus, it is my opinion that, a POSITA would have found this disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

viii) “a ground plane layer;”

106. Claim 12 recites “a ground plane layer.” Johnson teaches this feature for at least the following reasons.

107. Johnson explains that “[t]he present invention provides an antenna assembly including a first planar element having a conductive trace, and at least one conductive member disposed near the first element to jointly form an asymmetrical dipole antenna. The resonant frequency range of the dipole is primarily determined by the dimensions of the conductive trace on the first planar element, which may be selected to exhibit $\frac{1}{4}$ wave resonance. The elongate second element has a minimum electrical length dimension of $\frac{1}{4}$ wavelength at the lowest frequency of operation, and may consist solely of the ground traces of the printed wiring board(s) of a wireless transceiver such as a cellular telephone.” Ex. 1003 at 2:32–42.



Id. at FIG. 2.

108. Johnson explains that “[t]he conductor trace 26 is disposed upon a single major surface of the first planar element 22 and is operatively coupled to the transceiver electronics 14 of the second planar element 24 via a feedpoint 32. One end 34 of the conductive trace 26 is coupled to the second conductive trace 28 (the ground plane of the second planar element 24) via leads 36 or other electrical connection.” *Id.* at 4:55-62.

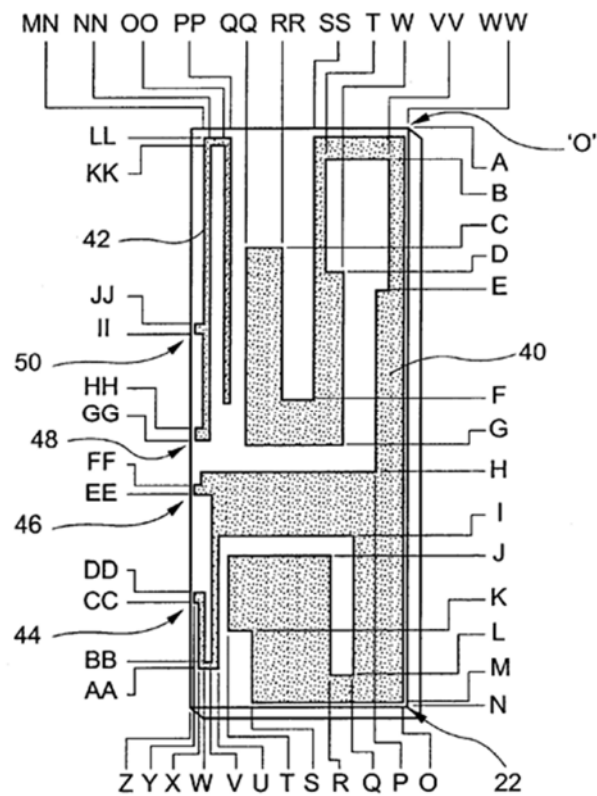
109. Thus, it is my opinion that a POSITA would find this disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole.

ix) “a first antenna element configured to simultaneously support radiation modes for first, second, and third frequency bands,”

110. Claim 12 recites “a first antenna element configured to simultaneously support radiation modes for first, second, and third frequency bands.” Johnson teaches these features, or renders them obvious, for at least the following reasons.

111. Johnson explains that “FIG. 9 illustrates a front elevational view of a tri-

band antenna assembly according to the present invention;” *Id.* at 3:33–34. Johnson also teaches that “FIG. 9 illustrates another embodiment of the present invention. The antenna assembly of FIG. 9 depicts a tri-band antenna assembly 20 functioning across a cellular band (880-960 MHz.), a PCS band (1710-1880 MHz.) and the BLUETOOTH™ band (2.4-2.5 GHz.). Cellular and PCS band operation is effected through first conductor trace 40. BLUETOOTH™ band operation is effected through conductor trace 42.” *Id.* at 5:35–42.



Id. at FIG 9.

112. Johnson also teaches “[r]eferring now to the drawings, wherein like numerals depict like parts throughout, preferred embodiments of an antenna assembly 20 according to the present invention are illustrated in FIGS. 1-12. The antenna assembly 20 may implemented within single or multiple frequency wireless communication devices, for instance devices operating over the GPS (1575 MHz), cellular telephone (824-890 MHz and 860---890 MHz), PCS device (1710-1880 MHz, 1750-1870 MHz, and 1850-1990 MHz), cordless telephone (902-928 MHz), or BLUETOOTH™ specification (2.4-2.5 GHz.) frequency ranges. Those skilled in the relevant arts may appreciate that principles of the present invention are equally applicable for antenna assemblies operating at alternative frequency ranges. In alternative embodiments, the dimensions of the antenna assembly 20 may be scaled in proportion to provide operation at other frequencies, including frequencies in the 800 MHz. to 3,000 MHz. range. Such modifications are considered within the scope of the applicant's claims.” Ex. 1003 at 3:45-62. In my opinion, a POSITA would consider scaling of the antenna assembly to include scaling of the antenna elements.

113. Thus, it is my opinion that Johnson teaches scaling a first antenna to provide functionality in at other frequency ranges such that a POSITA would have at least found it obvious to scale the antennas taught by Johnson to support first, second, and third radiation modes.

114. Thus, in my opinion, a POSITA would have found it obvious in light of Johnson’s teachings, to configure an antenna elements to simultaneously support

radiation modes for first, second, and third frequency bands.

x) “the first frequency band being contained within a first frequency region of an electromagnetic spectrum,”

115. Claim 12 recites “the first frequency band being contained within a first frequency region of an electromagnetic spectrum.” Johnson teaches this feature for at least the following reasons.

116. Johnson explains that “FIG. 9 illustrates another embodiment of the present invention. The antenna assembly of FIG. 9 depicts a tri-band antenna assembly 20 functioning across a cellular band (880-960 MHz.), a PCS band (1710-1880 MHz.) and the BLUETOOTH™ band (2.4-2.5 GHz.). Cellular and PCS band operation is effected through first conductor trace 40. BLUETOOTH™ band operation is effected through conductor trace 42.” *Id.* at 5:35–42.

117. Thus, it is my opinion that a POSITA would find this disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

xi) “the second frequency band being contained within a second frequency region of the electromagnetic spectrum that is higher in frequency than the first frequency region,”

118. Claim 12 recites “the second frequency band being contained within a second frequency region of the electromagnetic spectrum that is higher in frequency than the first frequency region.” Johnson teaches this feature for at least the following reasons.

119. Johnson explains that “FIG. 9 illustrates another embodiment of the present invention. The antenna assembly of FIG. 9 depicts a tri-band antenna assembly 20 functioning across a cellular band (880-960 MHz.), a PCS band (1710-1880 MHz.) and the BLUETOOTH™ band (2.4-2.5 GHz.). Cellular and PCS band operation is effected through first conductor trace 40. BLUETOOTH™ band operation is effected through conductor trace 42.” *Id.* at 5:35–42.

120. Thus, it is my opinion that a POSITA would find this disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

xii) “the third frequency band of operation being used by a 4 G communication standard,”

121. Claim 12 recites “the third frequency band of operation being used by a 4 G communication standard.” Johnson teaches this feature for at least the following reasons.

122. Johnson explains that “FIG. 9 illustrates another embodiment of the present invention. The antenna assembly of FIG. 9 depicts a tri-band antenna assembly 20 functioning across a cellular band (880-960 MHz.), a PCS band (1710-1880 MHz.) and the BLUETOOTH™ band (2.4-2.5 GHz.). Cellular and PCS band operation is effected through first conductor trace 40. BLUETOOTH™ band operation is effected through conductor trace 42.” *Id.* 5:35–42.

123. A POSITA would have recognized that Johnson’s antenna systems are

designed for use with what the '103 patent describes as falling within a 4G communication standard (as that term is described in the '130 patent). While I do not agree with this definition, a POSITA would have understood Johnson's disclosure of BLUETOOTH™ operating between 2.4-2.5 GHz to falls within the range described as a 4G communication standard by the '103 patent.

124. The '103 Patent includes “3G and other advanced services for instance HSDPA, WiBro, WiFi, WiMax, UWB or other high speed wireless standards,” as among those referred to by the '103 patent as “4G services” and “might require operation in additional frequency bands corresponding to said 4G standards (for instance, bands within the frequency region 2-11 GHz and some of its sub-regions such as for instance 2-11 GHz, 3-10 GHz, 2.4-2.5 GHz and 5-6 GHz or some other bands).” Ex. 1001, 24:22-30. The '103 patent further states that “4G” includes technologies such as 3G, WiFi, WiMax “or other high speed wireless standards.” *Id.* This definition by the '200 Patent is inconsistent with the traditional applications of the “4G” moniker, which does not include, for example, 3G or WiFi.

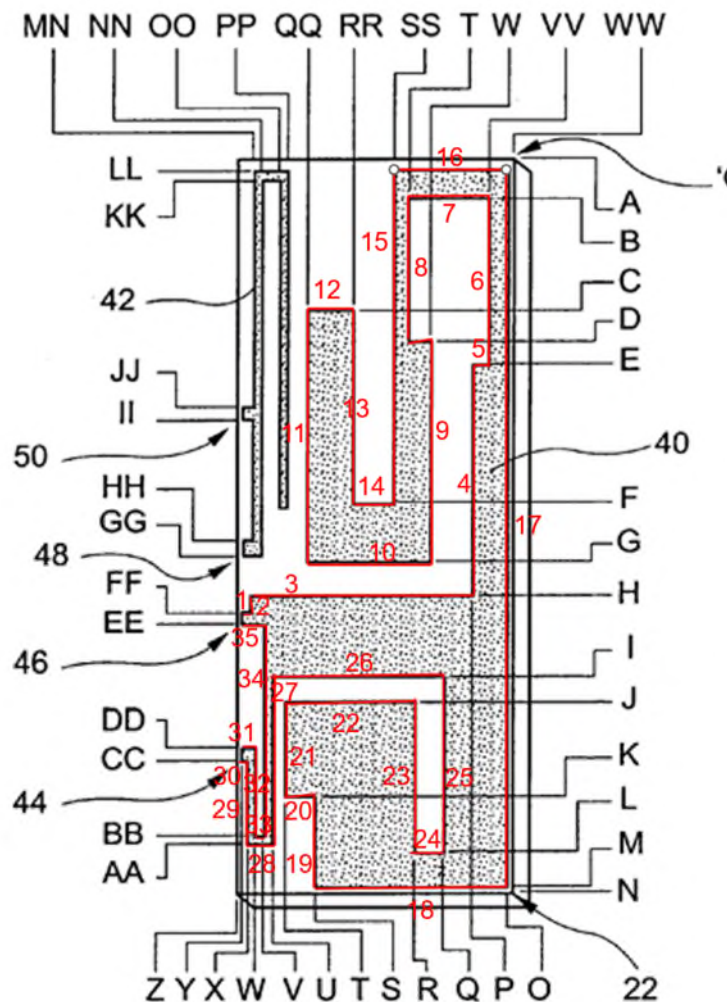
125. It is my opinion that the antennas taught by Johnson are configured to transmit and receive such high speed signals within the broad description of “4G” provided in the '103 patent. Ex. 1001 at 24:22-30.

126. Thus, it is my opinion that a POSITA would find this disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

- xiii) “wherein a perimeter of the first antenna element defines a first antenna contour comprising at least thirty-five segments,”

127. Claim 12 recites “wherein a perimeter of the first antenna element defines a first antenna contour comprising at least thirty-five segments.” Johnson teaches this feature for at least the following reasons.

128. The ’103 patent states that “[a]long the contour different segments can be identified e.g. by a corner between two segments, wherein the corner is given by a point on the contour where no unique tangent can be identified.” *Id.* at 15:4-7.

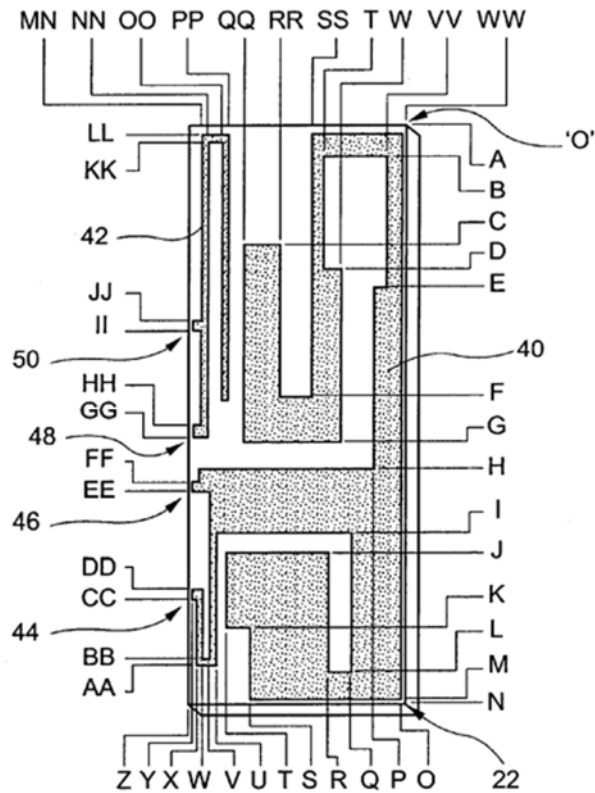


Ex. 1003 at FIG 9 (annotations added). The segments of the perimeter of the first antenna element are shown in red in the annotated figure above. Each red segment is added up for a total of at least thirty-five segments.

129. Thus, it is my opinion that a POSITA would find this disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

xiv) “the first antenna element defining an antenna box, an orthogonal projection of the antenna box along a normal to a face with a largest area of the antenna box defining an antenna rectangle,”

130. Claim 12 recites “the first antenna element defining an antenna box, an orthogonal projection of the antenna box along a normal to a face with a largest area of the antenna box defining an antenna rectangle.” Johnson teaches these features for at least the following reasons.



Ex. 1003 at FIG 9.

131. It is my opinion that the figure above shows a view of the antenna that by definition forms a planar antenna defining an antenna box and an antenna rectangle. The antenna rectangle being an orthogonal projection of the antenna box along a normal to a face with a largest area.

132. Thus, it is my opinion that a POSITA would find this disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

xv) “wherein a length of the first antenna contour is greater than four times a diagonal of the antenna rectangle; and”

133. Claim 12 recites “wherein a length of the first antenna contour is greater than four times a diagonal of the antenna rectangle.” Johnson teaches these features for at least the following reasons.

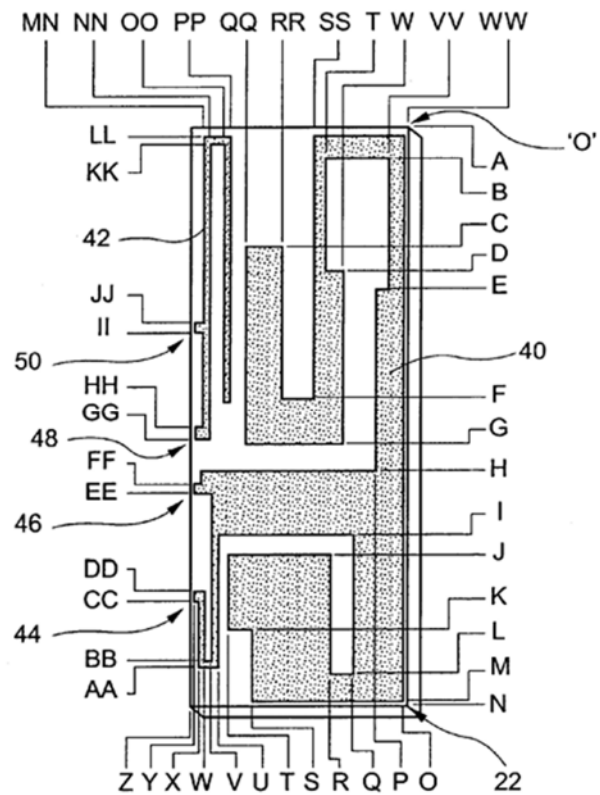
134. Dimensions for preferred embodiments of the antenna assembly of FIG. 10 of Johnson are included in Table 1. Horizontal and vertical dimensions are measured with respect to origin point ‘O’.

TABLE 1	
Position	Distance from Origin Point ‘O’ (Inches)
A	0.000
B	.075–1.905
C	.305–7.747
D	.365–9.271
E	.415–10.541
F	.703–17.856
G	.820–20.828
H	.885–22.479
I	1.048–26.619
J	1.080–27.432
K	1.300–33.020
L	1.415–35.941
M	1.485–37.719
N	1.500–38.100
O	.015–.381

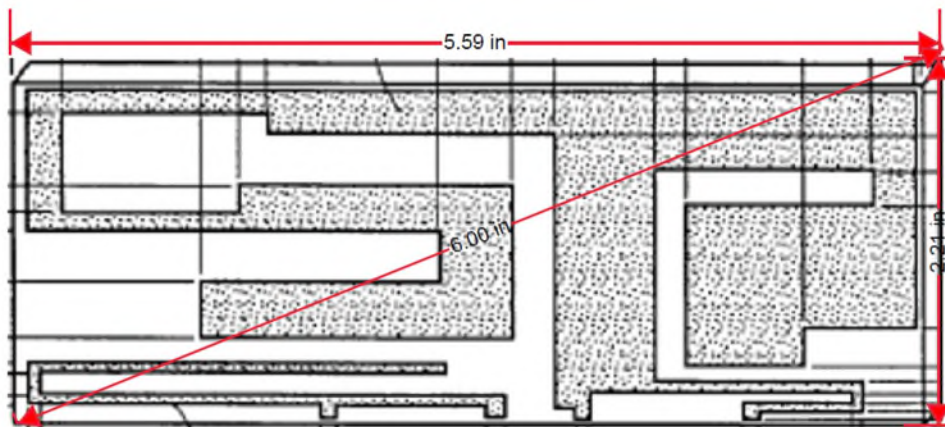
TABLE 1-continued

Position	Distance from Origin Point 'O' (Inches)
P	.105–2.667
Q	.151–3.835
R	.216–5.486
S	.422–10.719
T	.484–12.294
U	.529–13.437
V	.544–13.818
W	.559–14.199
X	.574–14.580
Y	.585–14.860
Z	.600–15.240
AA	1.400–35.560
BB	1.385–35.179
CC	1.227–31.166
DD	1.202–30.531
EE	.953–24.206
FF	.928–23.571
GG	.807–20.500
HH	.782–19.863
II	.532–13.513
JJ	.507–12.878
KK	.040–1.016
LL	.015–.381
MM	.560–14.224
NN	.545–13.843
OO	.515–13.081
PP	.500–12.700
QQ	.450–11.430
RR	.360–9.144
SS	.280–7.112
TT	.245–6.223
UU	.193–4.902
VV	.075–1.905
WW	0.000

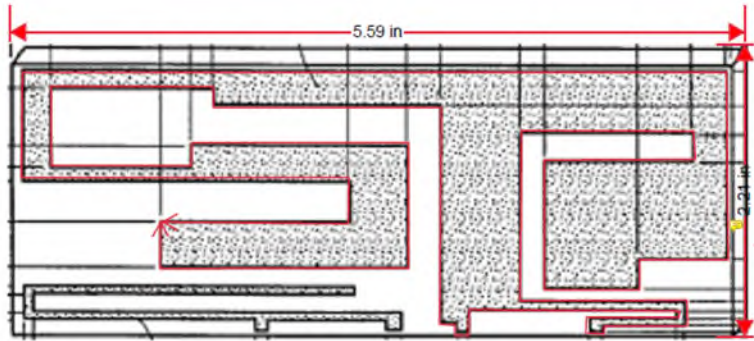
Ex. 1003 at 5:35–6:33.



Ex. 1003 at FIG. 9.



Ex. 1003 at FIG 9 (annotated showing a diagonal (D) of 6 such that four times D is 24).



Ex. 1003 at FIG 9 (cropped and annotated, showing a length of Contour 1 as 35.05).

135. 112. While I do not necessarily believe that the figures are intended to be to exact scale, the disclosure of Johnson makes clear that the length of the antenna contour is more than four times the diagonal of the antenna rectangle, using measurements of the figures with the measurement tools of PDF software. Thus, in my opinion, it would have been obvious to a POSITA, that Johnson discloses antennas with the length of the antenna contour as more than four times the diagonal of the antenna rectangle.

136. Thus, it is my opinion that a POSITA would find this disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole, or at least obvious in view of its teachings, or in combination with the state of the art at the time of the alleged invention.

xvi) “a second antenna element configured to operate in at least one frequency band used by a 4 G communication standard, wherein a perimeter of the second antenna element defines a second antenna contour comprising at least twenty segments.”

137. Claim 12 recites “a second antenna element configured to operate in at

least one frequency band used by a 4 G communication standard, wherein a perimeter of the second antenna element defines a second antenna contour comprising at least twenty segments.” Johnson teaches these features for at least the following reasons.

138. Johnson teaches “[r]eferring now to the drawings, wherein like numerals depict like parts throughout, preferred embodiments of an antenna assembly 20 according to the present invention are illustrated in FIGS. 1-12. The antenna assembly 20 may implemented within single or multiple frequency wireless communication devices, for instance devices operating over the GPS (1575 MHz), cellular telephone (824-890 MHz and 860---890 MHz), PCS device (1710-1880 MHz, 1750-1870 MHz, and 1850-1990 MHz), cordless telephone (902-928 MHz), or BLUETOOTH™ specification (2.4-2.5 GHz.) frequency ranges. Those skilled in the relevant arts may appreciate that principles of the present invention are equally applicable for antenna assemblies operating at alternative frequency ranges. In alternative embodiments, the dimensions of the antenna assembly 20 may be scaled in proportion to provide operation at other frequencies, including frequencies in the 800 MHz. to 3,000 MHz. range. Such modifications are considered within the scope of the applicant's claims.” Ex. 1003 at 3:45-62.

139. Thus, it is my opinion that Johnson teaches scaling a first antenna and adding a second antenna to provide functionality in at other frequency ranges in addition to the frequency ranges provided by the first antenna. Thus, in my opinion,

Johnson teaches, or at the very least, a person of skill in the art would have found it obvious in view of Johnson's teachings, to use multiple antennas, perhaps scaled, for use in wireless devices with the desired frequency responses.

140. Thus, it is my opinion that a POSITA would find this disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

2. Claim 15

i) "The handheld multifunction wireless device according to claim 12,"

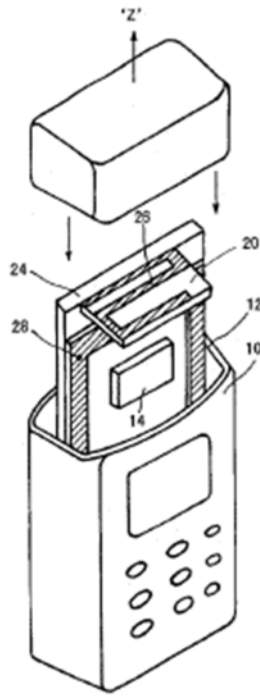
141. See Claim 12 above.

ii) "wherein the ground plane layer defines a ground plane rectangle, the projection of the antenna rectangle on the ground plane rectangle partially overlapping the ground plane rectangle."

142. Claim 15 recites "wherein the ground plane layer defines a ground plane rectangle, the projection of the antenna rectangle on the ground plane rectangle partially overlapping the ground plane rectangle." Johnson teaches these features for at least the following reasons.

143. Johnson teaches "the antenna assembly 20 includes first and second planar elements 22, 24 disposed in substantially perpendicular relationship. A first conductor trace 26 is disposed upon the first planar element 22, and a second conductor trace 28 is disposed upon the second planar element 24. The first conductor trace 26 is operatively coupled to the transceiver signal input/output

componentry 14 via connection 30.” Ex. 1003 at 4:7–17. “[T]he second conductor trace 28 is the printed ground plane circuit of the transceiver 14.” *Id.* at 4:24-25.



Id. at FIG. 1 (showing 28 “the ground plane circuit”).

144. As shown in Figs 2-4, it is my opinion that the antenna element may be placed in a variety of configurations with respect to the ground plane element, including those where the projection of the antenna rectangle form by the first element on the ground plane rectangle partially overlaps the ground plane rectangle.

145. For example, “[i]n FIG. 2, portions of the first planar element 22 are disposed relative both major surfaces of the second planar element 24 (a “T” shaped configuration), as opposed to FIG. 3, where the first planar element 22 extends from

one major surface of the second planar element 24 (an “L” shaped configuration). *Id.* at 4:41-46.

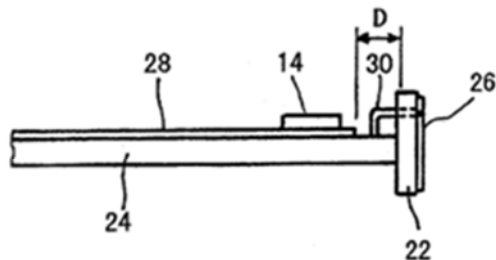


FIG. 2

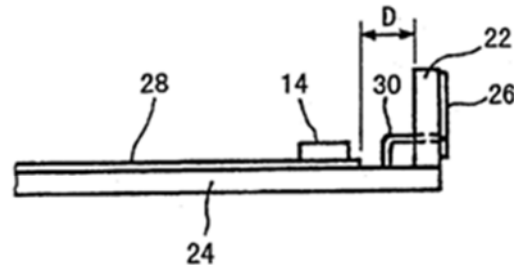


FIG. 3

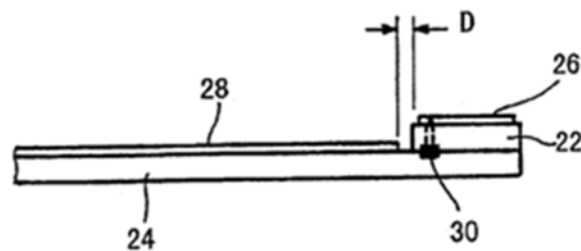


FIG. 4

146. Additionally, “FIG. 4 illustrates another embodiment of assembly 20 wherein the first and second planar elements 22, 24 are disposed in parallel orientation. The isolation distance D is approximately 1 millimeter (at 900 MHz.). The first conductive trace 26 may be operatively coupled to the transceiver 14 through known surface mount interconnections 30.” *Id.* at 4:47-53.

147. Thus, it is my opinion that a POSITA would find this disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

B. Ground 2:

148. Claims 12 and 15 of the '103 Patent are unpatentable under 35 U.S.C. §103 as obvious over Zeilinger in view of Boireau.

1. Claim 12

- i) **“A handheld multifunction wireless device having at least one of multimedia functionality and smartphone functionality, the handheld multifunction wireless device comprising:” (preamble)**

149. Claim 12 recites “a handheld multifunction wireless device having at least one of multimedia functionality and smartphone functionality, the handheld multifunction wireless device comprising.” Zeilinger teaches this for at least the following reasons.

150. It is my opinion that Zeilinger teaches use of its disclosed antennas in connection with wireless devices, including mobile phones known to have multimedia functionality or smartphone functionality.

151. For example, “FIG. 1 illustrates a mobile telephone housing 10 which is exemplary of the environment in which antennas of the present invention are used. As is known, the telephone housing 10 is formed from suitable plastic in the form of a hollow shell 11 having an internal cavity 12 surrounded by exterior sidewalls 13a, 13b. One or more printed circuit boards 14, 20 may be provided and supported within the cavity 12. Integrated circuits 15 in the form of chips 16 that power different aspects of the telephone may be supported on the circuit boards 14 and

terminated to various circuits thereon.” Ex. 1005 at ¶[0024].

152. It is my opinion that Boireau also discloses this.

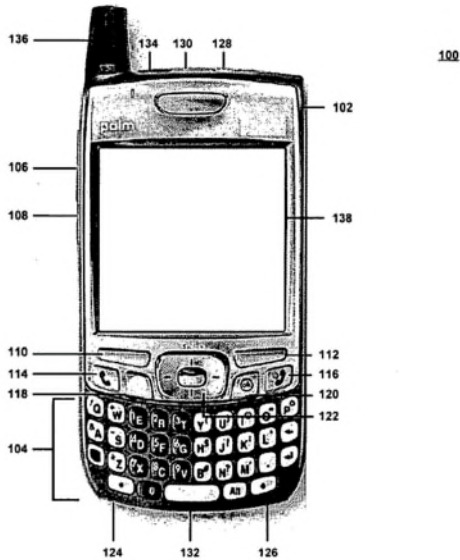
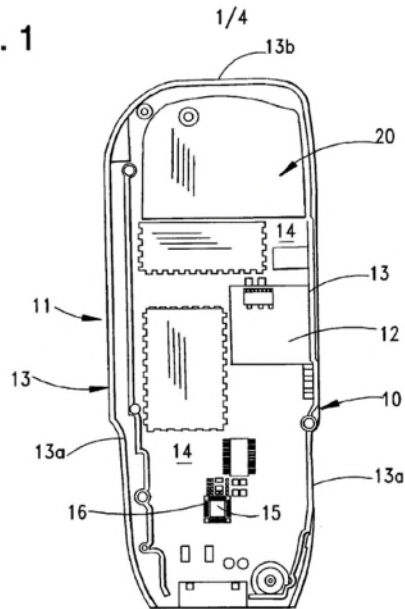


FIG. 1

Ex. 1004 at FIG. 1.

153. Boireau teaches that “FIG. 1 illustrates one embodiment of a wireless device 100. Wireless device 100 may comprise any device having a wireless transceiver arranged to communicate over one or more portions of a radio-frequency (RF) spectrum. In one embodiment, for example, wireless device 100 may comprise a mobile computing device.” Ex. 1004 at ¶[0018].

FIG. 1



Ex. 1005 at FIG. 1

154. A POSITA would have had reason to combine Zeilinger and Boireau because both references and the '103 Patent had motivation improve antenna geometry for small devices. Ex. 1005 at ¶[0002]; Ex. 1004 at ¶[0001].

155. There would have had a reasonable expectation of success in combining Zeilinger and Boireau because Zeilinger and Boireau both involve antenna designs within wireless devices and therefore are analogous art directed to the same field of endeavor as the '103 Patent.

156. Thus, it is my opinion that a POSITA would find this disclosed in the teachings of Zeilinger and Boireau and their incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

ii) “a touch screen;”

157. Claim 12 recites “a touch screen.” Boireau teaches this feature for at

least the following reasons.

158. As set forth above, Zeilinger teaches use of its disclosed antennas in connection with wireless devices, including mobile phones, which were known to have touch screens. Boireau additionally discloses this feature.

159. Boireau teaches that “[m]obile computing device 100 may comprise various input/output (I/O) devices. Such as an alphanumeric keyboard, alphanumeric keypad, numeric keys, keys, buttons, switches, rocker switches, multi-directional rocker switches, a microphone, an audio headset, a camera, a touch-sensitive display screen, a stylus, and so forth.” Ex. 1004 at ¶[0021]. Therefore, it is my opinion that Boireau discloses a touch screen.

160. A POSITA would have found it obvious to combine the teachings of Boireau with those of Zeilinger because it was obvious to use the antennas of Zeilinger with any of a variety of mobile phones at the time, including those with a touch screen as disclosed by Boireau.

iii) “a processing module;”

161. Claim 12 recites “a processing module.” Boireau teaches this feature for at least the following reasons.

162. As set forth above, it is my opinion that Zeilinger teaches use of its disclosed antennas in connection with wireless devices, including mobile phones, which were known to have processors. Boireau additionally discloses this feature.

163. Boireau teaches that “[h]ousing 102 may be used to encapsulate various

internal components for mobile computing device 100, such as a processor, a memory, one or more transceivers, one or more printed circuit board (PCB), one or more antennas, a stylus, and so forth.” Ex. 1004 at [0020].

164. The ’103 Patent defines a “processing module” as a “microprocessor or CPU.” Ex. 1001 at 8:21-22. Therefore, it is my opinion that Boireau’s “processor” is a processing module.

165. Thus, it is my opinion that a POSITA would find this disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

166. Additionally, for the same reasons as described above, it is my opinion that a POSITA would have found it obvious to combine the teachings of Boireau with those of Zeilinger because it was obvious to use the antennas of Zeilinger with any of a variety of mobile phones at the time, which included processors as disclosed by Boireau.

iv) “a memory module;”

167. Claim 12 recites “a memory module.” Zeilinger teaches this feature for at least the following reasons.

168. As set forth above, it is my opinion that Zeilinger teaches use of its disclosed antennas in connection with wireless devices, including mobile phones, which were known to have memory.

169. Additionally, Boireau teaches that “[h]ousing 102 may be used to

encapsulate various internal components for mobile computing device 100, such as a processor, a memory, one or more transceivers, one or more printed circuit board (PCB), one or more antennas, a stylus, and so forth.” Ex. 1004 at ¶[0020].

170. Thus, it is my opinion that a POSITA would have found this feature disclosed in the teaching of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

171. Additionally, for the same reasons as described above, a POSITA would have found it obvious to combine the teachings of Boireau with those of Zeilinger because it was obvious to use the antennas of Zeilinger with any of a variety of mobile phones at the time, which included memory as disclosed by Boireau.

v) “a communication module;”

172. Claim 12 recites “a communication module.” Zeilinger and Boireau teach this feature for at least the following reasons.

173. As set forth above, it is my opinion that Zeilinger teaches use of its disclosed antennas in connection with wireless devices, including mobile phones, which were known to have antennas for communication.

174. For example, Zeilinger teaches, “[w]ith the advent of digital signal transmission systems used in mobile telephones, other frequency bands are being utilized for communication. These bands are separated and are utilized for different communications application, for example, the go anywhere aspect of the PCS (“Personal Communication Services”) band, the GSM band that is widely used in

Europe and other bands. Each of these bands offers certain advantages and it is desirable to utilize mobile telephones that operate reliably within all such bands. Important to this operation are effective antennas.” Ex. 1005, ¶[1004].

175. Additionally, Boireau discloses this feature. Boireau teaches that “[h]ousing 102 may be used to encapsulate various internal components for mobile computing device 100, such as a processor, a memory, one or more transceivers, one or more printed circuit board (PCB), one or more antennas, a stylus, and so forth.” Ex. 1004 at ¶[0020]. Boireau also teaches a “transceiver module 304 [that] may include multiple transceivers and associated hardware and/or software components implemented in a single integrated package or module, such as on the same die, package or PCB. Transceiver module 304 may be implemented using a single chip, multiple chips, or a system on a chip (SoC) solution, as desired for a given set of performance and design constraints.” Ex. 1004 at ¶[0036].

176. It is my opinion that a POSITA would have understood that the “transceiver module” disclosed in Boireau would disclose the feature of a communication module.

177. Thus, it is my opinion that a POSITA would find this disclosed in the teachings of Zeilinger or Boireau and their incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

vi) “a power management module;”

178. Claim 12 recites “a power management module.” Boireau teaches this

feature for at least the following reasons.

179. The '103 Patent describes the power management module as the “single source of energy” for the MFWD (wireless device). Ex. 1001 at 8:26-28.

180. Thus, as set forth above, it is my opinion Zeilinger teaches use of its disclosed antennas in connection with wireless devices, including mobile phones, which were known to have energy sources for operation.

181. Additionally, Boireau discloses this feature. Boireau teaches that “[m]obile computing device 100 also may comprise a rechargeable battery, such as a removable and rechargeable lithium ion battery, and an alternating current (AC) adapter.” Ex. 1004 at ¶[0022].

182. It is my opinion that a battery as disclosed in Boireau would meet the “source of energy” description for a power management module.

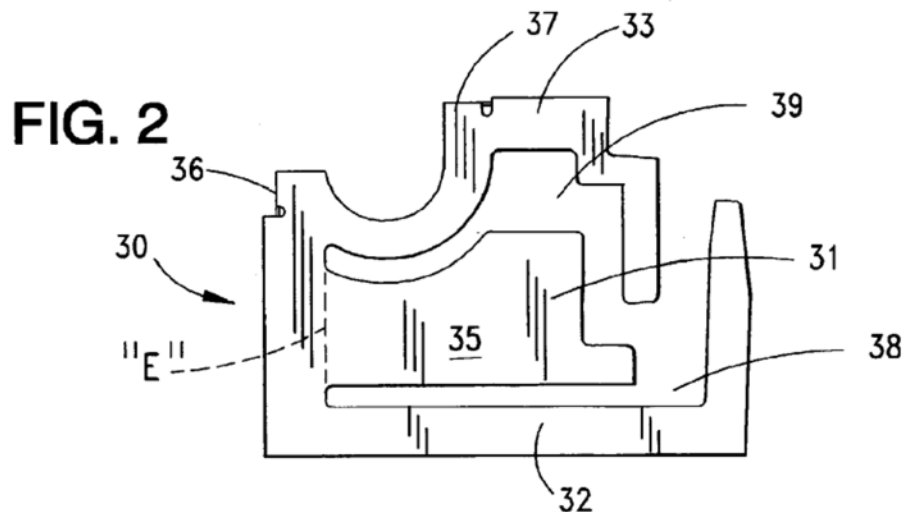
183. Thus, it is my opinion that a POSITA would find this disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

184. Additionally, for the same reasons as described above, it is my opinion that a POSITA would have found it obvious to combine the teachings of Boireau with those of Zeilinger because it was obvious to use the antennas of Zeilinger with any of a variety of mobile phones at the time, which included power management modules (e.g, batteries) as disclosed by Boireau.

vii) “an antenna system within the handheld multifunction wireless device and comprising:”

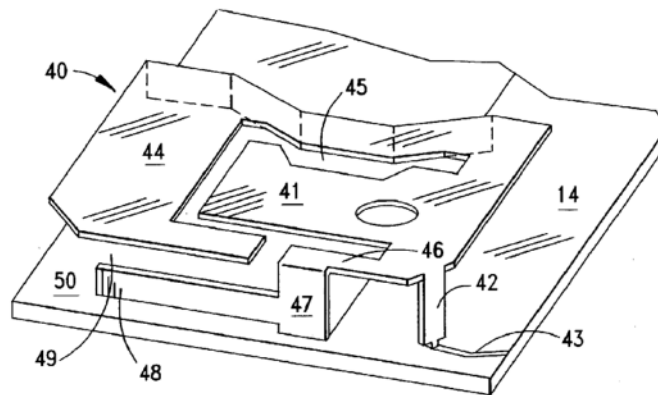
185. Claim 12 recites “an antenna system within the handheld multifunction wireless device and comprising.” Zeilinger teaches this feature for at least the following reasons.

186. It is my opinion that Zeilinger teaches use of its disclosed antennas in connection within wireless devices. For example, “FIG. 1 illustrates a mobile telephone housing 10 which is exemplary of the environment in which antennas of the present invention are used. As is known, the telephone housing 10 is formed from suitable plastic in the form of a hollow shell 11 having an internal cavity 12 surrounded by exterior sidewalls 13a, 13b. One or more printed circuit boards 14, 20 may be provided and supported within the cavity 12. Integrated circuits 15 in the form of chips 16 that power different aspects of the telephone may be supported on the circuit boards 14 and terminated to various circuits thereon.” Ex. 1005 at ¶[0024].



Ex. 1005 at FIG. 2.

FIG. 3



Ex. 1005 at FIG. 3.

187. It is my opinion that Boireau also discloses this feature.

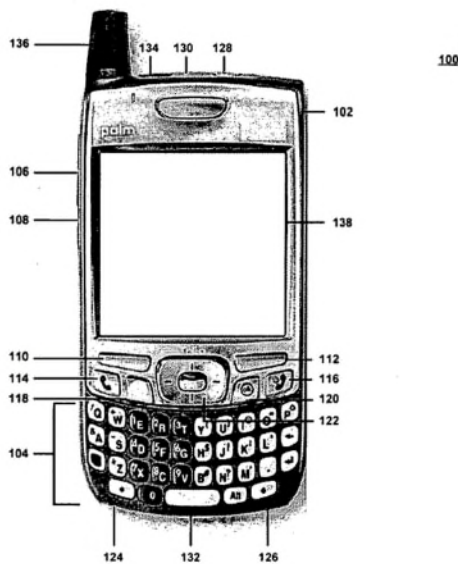


FIG. 1

Ex. 1004 at FIG. 1.

188. Boireau teaches that “[m]obile computing device 100 may comprise an antenna system including one or more antennas.” Ex. 1004 at ¶[0025].

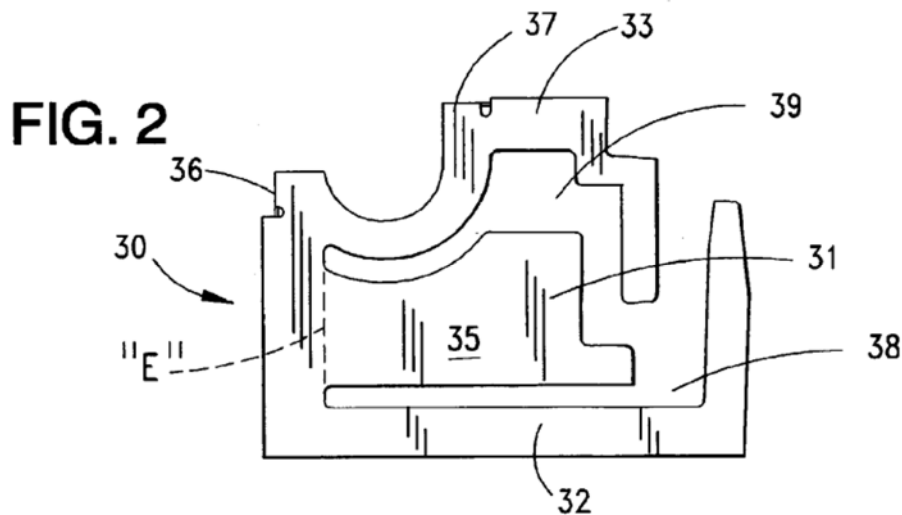
189. Boireau also teaches “antenna 318 may be implemented alone, or as part

of a broader antenna system (e.g., antenna 136) or antenna array for mobile computing device 100.” Ex. 1004 at ¶[0048].

190. It is my opinion that Boireau discloses an antenna system within the handheld multifunction wireless device and a POSITA would find this disclosed in the teachings of Zeilinger or Boireau and their incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

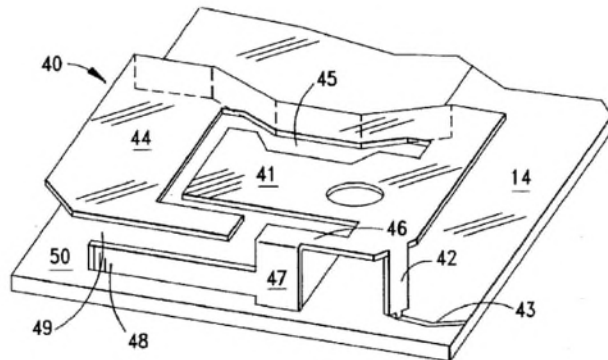
viii) “a ground plane layer;”

191. Claim 12 recites “a ground plane layer.” Zeilinger teaches this feature for at least the following reasons.



Ex. 1005 at FIG. 2.

FIG. 3



Ex. 1005 at FIG. 3.

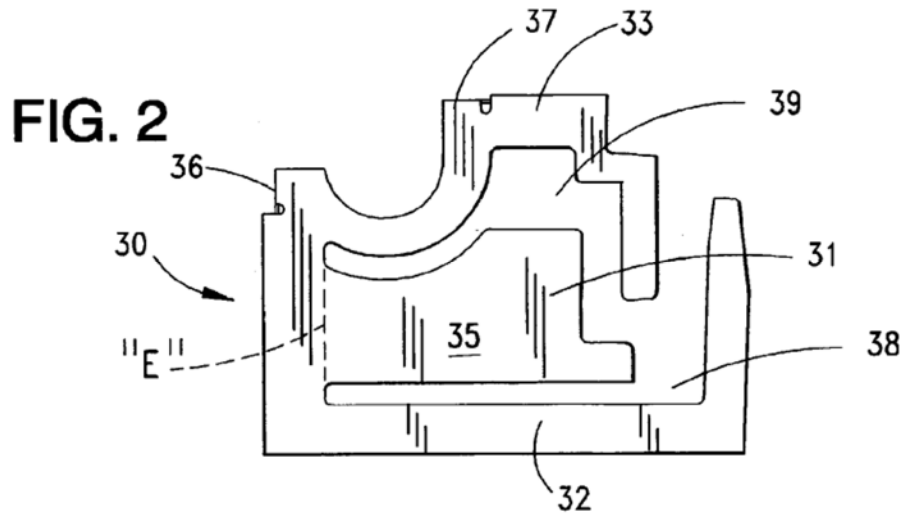
192. Zeilinger explains that “[a] second leg portion 37 is provided and it also is angled with respect to the radiating elements 31-33. This leg portion is electronically connected to a ground plane of the telephone 10, which can be a Separate component, or it can be formed on one of the circuit boards 14.” Ex. 1005, ¶[0028]. Also, “[i]n this instance, the third radiator communicates directly with the ground pin 47 and extends in a direction between the two radiating elements and a ground plane 50 that is either formed on the surface of the circuit board 14 or formed as a layer of the circuit board.” Ex. 1005 at ¶[0033].

193. Thus, it is my opinion that a POSITA would find this disclosed in the teachings of Zeilinger and its disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

ix) **“a first antenna element configured to simultaneously support radiation modes for first, second, and third frequency bands,”**

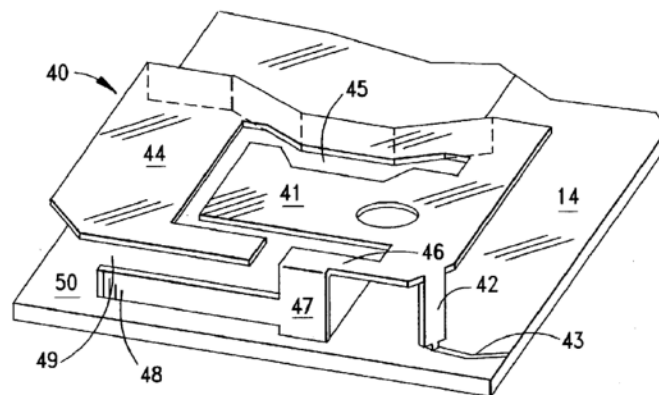
194. Claim 12 recites “a first antenna element configured to simultaneously

support radiation modes for first, second, and third frequency bands.” Zeilinger teaches this feature for at least the following reasons.



Ex. 1005 at FIG. 2.

FIG. 3



Ex. 1005 at FIG. 3.

195. Zeilinger teaches that “the radiating element 38 drives the PCS frequency band, while the second radiating element 32 drives the GSM900 frequency band. The third radiating element improves the bandwidth of the antenna by driving the PCN frequency band of the antenna.” Ex. 1005 at ¶[0029].

196. Thus, it is my opinion that a POSITA would find this disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole.

x) “the first frequency band being contained within a first frequency region of an electromagnetic spectrum,”

197. Claim 12 recites “the first frequency band being contained within a first frequency region of an electromagnetic spectrum.” Zeilinger teaches this feature for at least the following reasons.

198. Zeilinger discloses a “Tri-Band Antenna” and therefore, in my opinion, this feature.

199. For example, it is my opinion that the following description discloses a first frequency band being contained within a first frequency region of an electromagnetic spectrum, along with other frequency bands. Zeilinger teaches, “FIG. 5 is a VSWR plot of the operation of the antenna 30 of FIG. 2, but without the third radiating element 33 in place. In this instance, as evidenced by the “markers'1-5, it can be seen that two distinct operational frequency bands are defined, with the first band shown to the left of FIG. 5 and extending between markers 1 and 2 at frequencies of 880,000 MHz to 960,000 MHz, thereby covering the GSM900 band. The second operational frequency band in which the antenna operates is defined by markers 3 and 4 and can be seen, at the 6 dB level represented by the dark line D of FIG. 5, to cover the GSM 1800 band, from 1719 MHZ to about 1880 MHZ. This does not include the PCS or GSM 1900 MHZ bands.” Ex. 1005 at ¶[0030]. Further,

“FIG. 6 illustrates a VSWR plot of the antenna 30 of FIGS. 2 and 4, with the third radiating element 33 in place. Two peaks are shown on the plot and the second peak, “B”, shown to the right of FIG. 6) is wider than the second peak, “B”, to the right of FIG. 5. This is because the third radiating element causes a third peak, or spike close to the second one and the two radiating elements cooperatively combine to form a single, wider peak, or Spike. In FIG. 6, the first peak “A”, as defined by markers 1 and 2 provide an effective bandwidth from 880 to 960 MHz at 6 dB, while the second peak “B”, as defined by markers 3 and 5, provide an effective bandwidth from 1710 to 1990 MHz, thereby effectively encompassing both the GSM 1800 and 1900 bands (and the PCS band).” Ex. 1005 at ¶[0031].

200. Thus, it is my opinion that a POSITA would find this disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

xi) “the second frequency band being contained within a second frequency region of the electromagnetic spectrum that is higher in frequency than the first frequency region,”

201. Claim 12 recites “the second frequency band being contained within a second frequency region of the electromagnetic spectrum that is higher in frequency than the first frequency region.” Zeilinger teaches this feature for at least the following reasons.

202. As set forth above, in connection with the disclosures cited for the first

frequency band, Zeilinger discloses a “Tri-Band Antenna” and in my opinion this feature. Ex. 1005 at ¶¶[0030]-[0031].

203. Thus, in my opinion a POSITA would find this feature disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

xii) “the third frequency band of operation being used by a 4 G communication standard,”

204. Claim 12 recites “the third frequency band of operation being used by a 4 G communication standard.” Zeilinger teaches this feature for at least the following reasons.

205. As set forth above, in connection with the disclosures cited for the first frequency band, Zeilinger discloses a “Tri-Band Antenna” and in my opinion this feature. Ex. 1005 at ¶¶[0030]-[0031].

206. Additionally, Zeilinger discloses, “It is therefore a general object of the present invention to provide a low cost multiple band antenna having a small form factor and which is capable of operating in three distinct frequency bands so as to operate in GSM900 frequency band (from 880 to 960 Megahertz), the GSM1800 frequency band (from 1710-1889 Megahertz) and the PCT GSM 1900 frequency band (also referred to as the UMTS Band extending from 1900 to 2170 Megahertz).” Ex. 1005, ¶[0008].

207. The ’103 patent itself includes “3G and other advanced services for

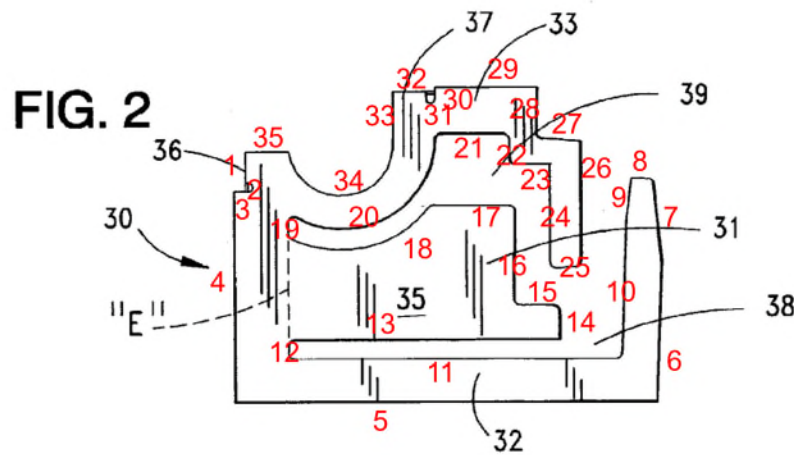
instance HSDPA, WiBro, WiFi, WiMax, UWB or other high speed wireless standards,” as among those referred to by the ’103 patent as “4G services” and “might require operation in additional frequency bands corresponding to said 4G standards (for instance, bands within the frequency region 2-11 GHz and some of its sub-regions such as for instance 2-11 GHz, 3-10 GHz, 2.4-2.5 GHz and 5-6 GHz or some other bands).” Ex. 1001, 24:22-30. The ’103 patent further states that “4G” includes technologies such as 3G, WiFi, WiMax “or other high speed wireless standards.” *Id.* This definition by the ’200 Patent is inconsistent with the traditional applications of the “4G” moniker, which does not include, for example, 3G or WiFi.

208. It is my opinion that the antennas taught by Zeilinger are configured to transmit and receive such high speed signals within the broad description of “4G” provided in the ’103 patent. Ex. 1001 at 24:22-30.

209. Thus, it is my opinion that a POSITA would find this feature disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

xiii) “wherein a perimeter of the first antenna element defines a first antenna contour comprising at least thirty-five segments,”

210. Claim 12 recites “wherein a perimeter of the first antenna element defines a first antenna contour comprising at least thirty-five segments.” Zeilinger teaches this feature for at least the following reasons.

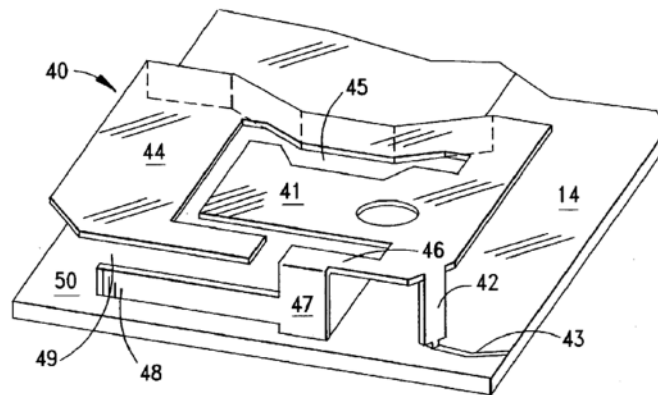


Ex. 1005 at FIG. 2 (annotated).

211. The '103 Patent discloses that “[a]long the contour different segments can be identified e.g. by a corner between two segments, wherein the corner is given by a point on the contour where no unique tangent can be identified. At the corners the contour has an angle. The segments next to a corner may be straight or curved or one straight and the other curved. Further, segments may be separated by a point where the curvature changes from left to right or from right to left. In a sine curve, for example such points are given where the curve intersects the horizontal axis (x-axis, abscissa, $\sin(x)=0$).” Ex. 1001 at 15:4-13.

212. Based on this definition, the first antenna contour as shown above in FIG. 2 has at least 35 segments. The contour shown in Figure 3 has even more segments.

FIG. 3

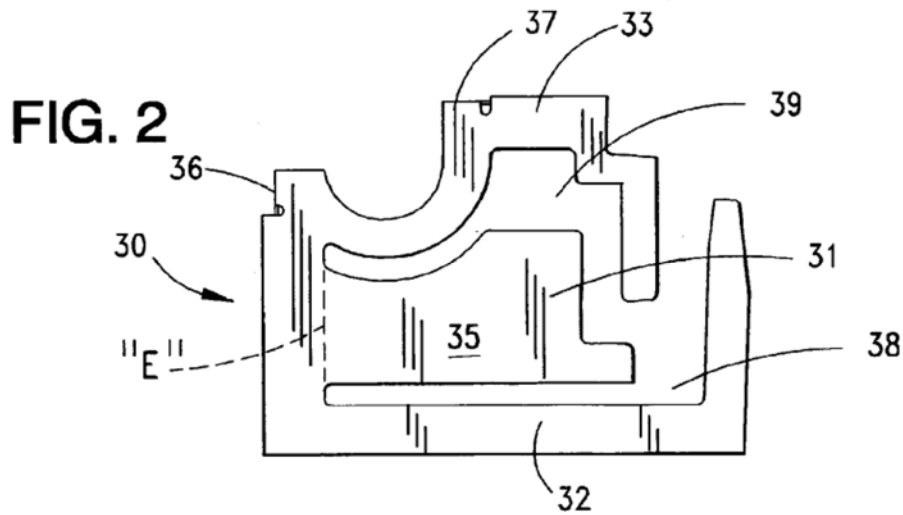


Ex. 1005 at FIG. 3.

213. Thus, it is my opinion that a POSITA would find this feature disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole.

xiv) **“the first antenna element defining an antenna box, an orthogonal projection of the antenna box along a normal to a face with a largest area of the antenna box defining an antenna rectangle,”**

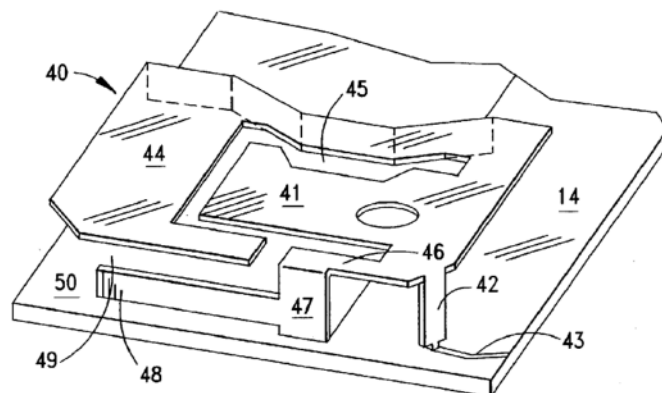
214. Claim 12 recites “the first antenna element defining an antenna box, an orthogonal projection of the antenna box along a normal to a face with a largest area of the antenna box defining an antenna rectangle.” Zeilinger teaches these features for at least the following reasons.



Ex. 1005 at FIG. 2.

215. In my opinion, Figure 2 shows a plan view of the antenna that by definition forms planar antenna defining an attend box and an antenna rectangle. It is also my opinion that the antenna rectangle being an orthogonal projection of the antenna box along a normal to a face with a largest area.

FIG. 3



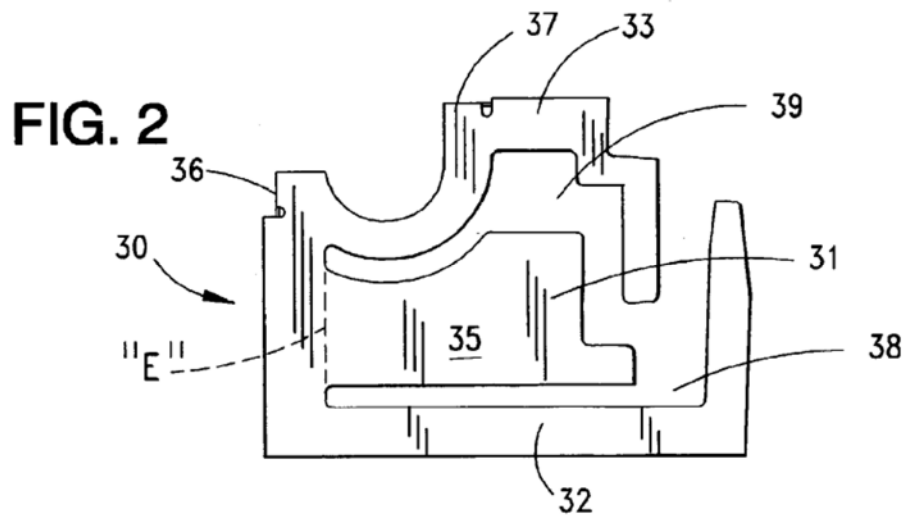
Ex. 1005 at FIG. 3.

216. Similarly, it is my opinion that Figure 3 shows a perspective view for which the top face is the largest area and defines an antenna box and antenna rectangle.

217. Thus, it is my opinion that a POSITA would find this feature disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

xv) **“wherein a length of the first antenna contour is greater than four times a diagonal of the antenna rectangle; and”**

218. Claim 12 recites “wherein a length of the first antenna contour is greater than four times a diagonal of the antenna rectangle.” Zeilinger teaches this feature for at least the following reasons.

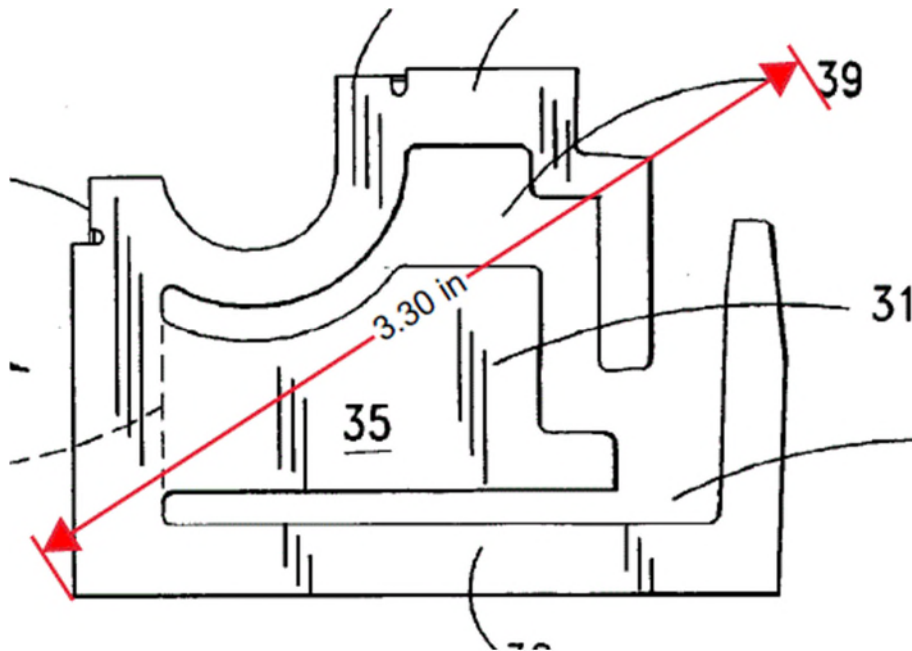


Ex. 1005 at FIG. 2.

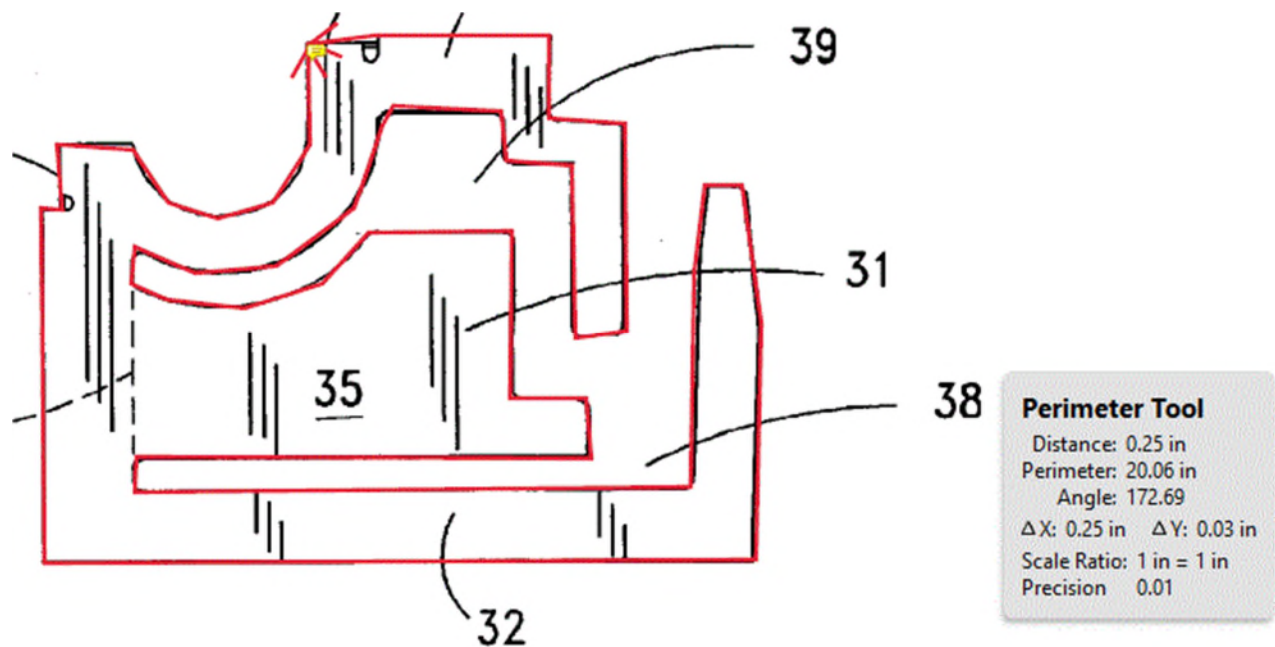
219. Again, while I do not necessarily believe that the figures are intended to be to exact scale, the disclosure of Zeilinger makes clear that length of the contour is

greater than four times the diagonal, and measurements of the figures using the measurement tools of PDF software, are at least useful to show that that length of the contour is greater than four times the diagonal. Thus, in my opinion, it would have been obvious to a POSITA, that Zeilinger discloses antennas with a length of the contour is greater than four times the diagonal.

220. Specifically, PDF measurement tools shows that measuring the lengths of the segments in the figures reveals that the perimeter is greater than 4X the diagonal of the antenna rectangle.



221. The diagonal of the antenna rectangle of FIG. 2. is approximately 3.30 inches (or units of length) such that four times the diagonal is 13.2 units of length.



222. The length of the contour of FIG. 2 is approximately 20 units of length using the same scale to measure the diagonal, which is more than four times the diagonal (13.2).

223. Similarly, assuming a similarly sized antenna rectangle and corresponding diagonal length for the contour in Figure 3, it is my opinion that the length of the contour in Figure 3 is almost certainly longer than that of Figure 2 and thus exceeds four times the diagonal as well.

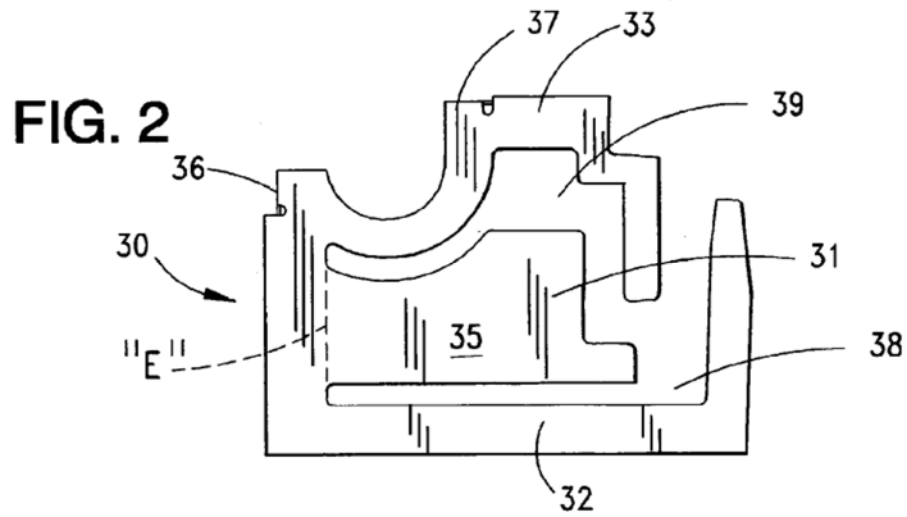
224. Thus, it is my opinion that a POSITA would find this feature disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or at least obvious in view of its teachings.

xvi) “a second antenna element configured to operate in at least one frequency band used by a 4 G communication standard, wherein a perimeter of the second antenna element defines a second antenna contour comprising at least twenty segments.”

225. Claim 12 recites “a second antenna element configured to operate in at least one frequency band used by a 4 G communication standard, wherein a perimeter of the second antenna element defines a second antenna contour comprising at least twenty segments.” Zeilinger teaches these features for at least the following reasons.

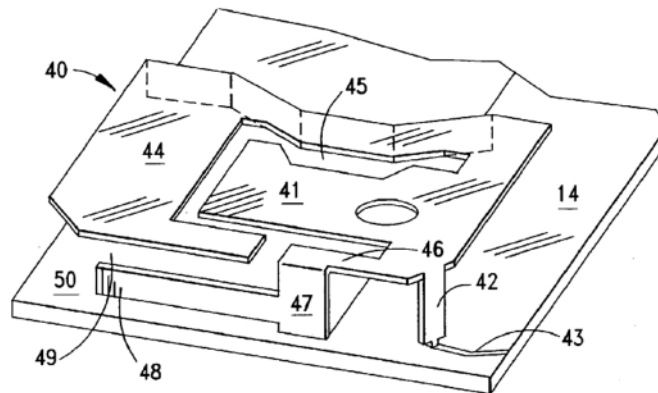
226. In my opinion, Zeilinger teaches use of its disclosed antennas in connection within wireless devices. For example, “FIG. 1 illustrates a mobile telephone housing 10 which is exemplary of the environment in which antennas of the present invention are used. As is known, the telephone housing 10 is formed from suitable plastic in the form of a hollow shell 11 having an internal cavity 12 surrounded by exterior sidewalls 13a, 13b. One or more printed circuit boards 14, 20 may be provided and supported within the cavity 12. Integrated circuits 15 in the form of chips 16 that power different aspects of the telephone may be supported on the circuit boards 14 and terminated to various circuits thereon.” Ex. 1005 at ¶[0024].

227. And Zeilinger discloses at least two antennas with contours of at least 20 segments and that operate in the disclosed frequency bands.



Ex. 1005 at FIG. 2.

FIG. 3



Ex. 1005 at FIG. 3.

228. Boireau also discloses this feature. For example, the following figures and accompanying written description disclose an antenna system within the handheld multifunction wireless device:

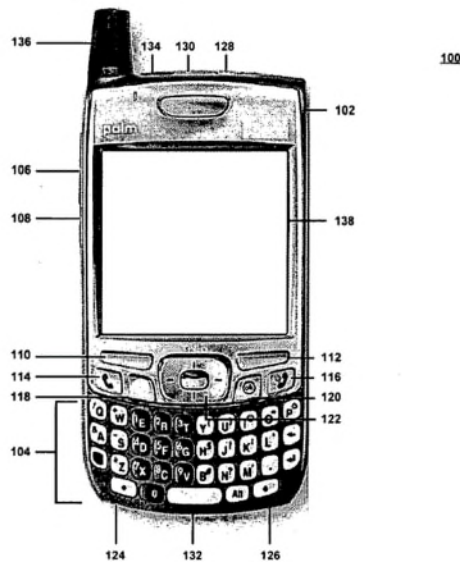


FIG. 1

Ex. 1004 at FIG. 1.

229. Boireau teaches that “[m]obile computing device 100 may comprise an antenna system including one or more antennas.” Ex. 1004 at ¶[0025]. Boireau also teaches “antenna 318 may be implemented alone, or as part of a broader antenna system (e.g., antenna 136) or antenna array for mobile computing device 100.” Ex. 1004 at ¶[0048].

230. Therefore, it is my opinion that a POSITA would have found it obvious to implement the antennas of Zeilinger alone, or as part of a broader antenna system or array for the mobile computing devices of Boireau.

231. Accordingly, in my opinion, a POSITA would find this feature disclosed in the teachings of Zeilinger or Boireau and their incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

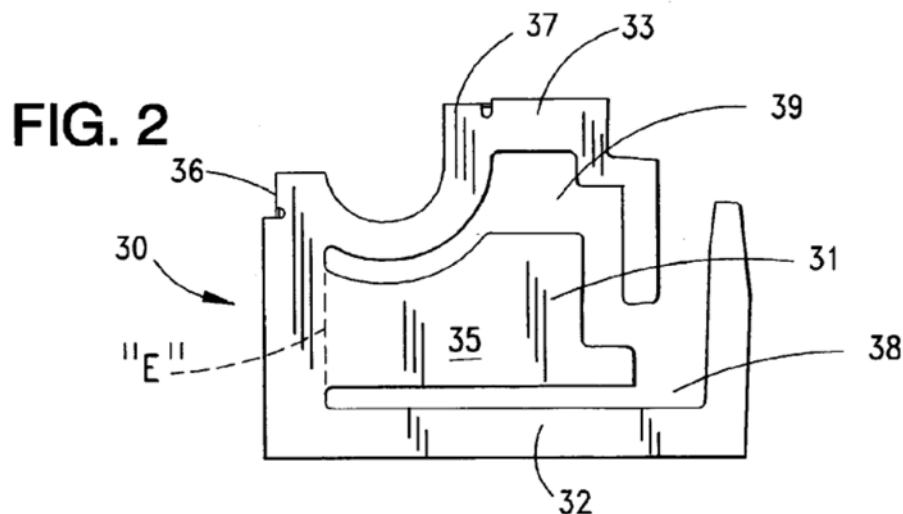
2. Claim 15

- i) **“The handheld multifunction wireless device according to claim 12,”**

See claim 12 above.

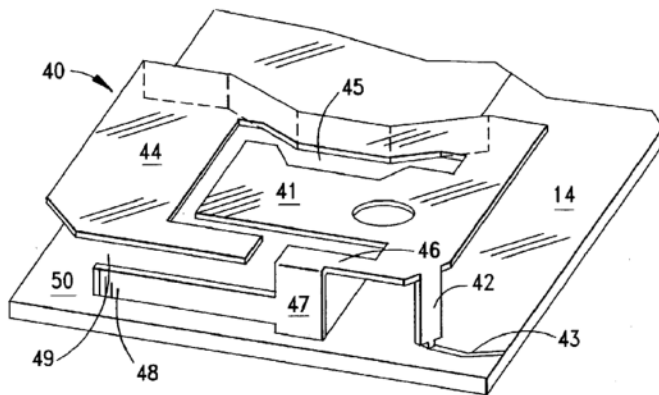
- ii) **“wherein the ground plane layer defines a ground plane rectangle, the projection of the antenna rectangle on the ground plane rectangle partially overlapping the ground plane rectangle.”**

232. Claim 15 recites “wherein the ground plane layer defines a ground plane rectangle, the projection of the antenna rectangle on the ground plane rectangle partially overlapping the ground plane rectangle.” Zeilinger teaches these features for at least the following reasons.



Ex. 1005 at FIG. 2.

FIG. 3



Ex. 1005 at FIG. 3.

233. Zeilinger explains that “[a] second leg portion 37 is provided and it also is angled with respect to the radiating elements 31-33. This leg portion is electronically connected to a ground plane of the telephone 10, which can be a separate component, or it can be formed on one of the circuit boards 14.” Ex. 1005, ¶[0028]. Also, “[i]n this instance, the third radiator communicates directly with the ground pin 47 and extends in a direction between the two radiating elements and a ground plane 50 that is either formed on the surface of the circuit board 14 or formed as a layer of the circuit board.” Ex. 1005 at ¶[0033].

234. According to the ’103 patent, “a ground plane rectangle is defined as being the minimum-sized rectangle that encompasses the ground plane of the antenna system...” Ex. 1001, col. 14, ln. 4-6.

235. Accordingly, it is my opinion that Figures 2-3 show an antenna with an

antenna rectangle that when projected on the ground plane at least partially overlaps the ground plane rectangle.

236. Thus, it is my opinion that a POSITA would find this feature disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

XI. CONCLUSION

I declare under penalty of perjury under the laws of the United States of America that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true.

Executed on: October 24, 2023

BY: /Emmanouil M. Tentzeris/

Dr. Manos Tentzeris

MANOS (EMMANOUIL) M. TENTZERIS
Ken Byers Professor
Georgia Institute of Technology,
School of Electrical and Computer Engineering
24 June 2023

I: EARNED DEGREES

- Ph.D., University of Michigan, Ann Arbor, 1998 (Graduate Advisor: Prof. Linda P.B.Katehi)
- M.Sc., University of Michigan, Ann Arbor, 1994
- B.S.E.E. (Diploma-“Summa Cum Laude”) National Technical University of Athens, GREECE, 1992

II: EMPLOYMENT HISTORY

- Ken Byers Professor in flexible electronics, School of Electrical and Computer Engineering, Georgia Tech, 2016-present
- Professor, School of Electrical and Computer Engineering, Georgia Tech, 2009-2016
- Humboldt Guest Professor, FAU, Nuremberg, GERMANY, 8/19-12/19.
- MediaTek Visiting Professor, NTU, Singapore, 1/18-12/18.
- Finland Distinguished Professor (Fi.Di.Pro.), TUT, 8/12-12/16
- Distinguished Visiting Professor, LAAS, Toulouse, 5/12-8/12
- Visiting Professor, GTRI-Ireland, Athlone, Ireland, 5/09-7/09
- Associate Professor, School of Electrical and Computer Engineering, Georgia Tech, 2004-2009
- Invited Professor, School of Electrical and Computer Engineering, Technical University of Munich, Germany, 5/02-8/02
- Assistant Professor, School of Electrical and Computer Engineering, Georgia Tech, 1998-2004
- Research Assistant, Radiation Laboratory, University of Michigan, Ann Arbor, MI, 1992-1998
- Research Assistant, Microwave Lab, National Technical University of Athens, Greece, 1991-1992

III: HONORS AND AWARDS

- IEEE Fellow
- IEEE MTT-S Distinguished Microwave Lecturer (2010-2012)
- Origami RF research was featured in a publication in the Proceedings of National Academy of Science (PNAS) in November 2018.
- Listed among the Top-25 Downloaded IEEE Sensor Papers in November 2013 and in December 2011.
- Listed among the 99th percentile of Scientific Reports with 109,000+ article accesses by 12/1/21.
- Listed among the 25 featured “Science@Microsoft” Technologies highlighting the most significant achievements of Microsoft Research over its 20 years of activities [<http://www.microsoft.com/en-us/researchconnections/science/stories/anti-counterfeit.aspx>]

- “5G as a Wireless Grid Technology” was listed among the Top 10 emerging technologies of 2021 published by Scientific American and The World Economic Forum [<https://www.scientificamerican.com/page/contributors-to-top-10-emerging-technologies-of-2021/>]
- 2023-2027 IEEE EPS Distinguished Lecturer
- 2023 IEEE Wireless Power Technology Conference & Expo (WPTCE) Second Best Contribution Award
- 2022 Georgia Tech Outstanding Doctoral Thesis Advisor Award
- 2021 IEEE Antennas and Propagation Symposium (APS) Best Student Paper Award
- 2019 Humboldt Research Prize
- 2016-2022 IEEE CRFID (RFID Council) Distinguished Lecturer
- 2018 IEEE ECTC Intel Best Student Paper Award
- 2018 ISAP Second Best Paper Award
- 2017 IMAPS Best Student Paper Award
- 2017 SRC TECHCON Best-in-Session Award
- 2017 Georgia Tech Outstanding Achievement in Research Program Development Award
- 2017 Archimedes IP Salon Gold Medal
- 2016 Bell Labs Prize Third Award
- 2016 GOMACTech Best Poster Paper Award
- 2016 Georgia Tech Capstone Design Expo Best Overall Project ECE, December 2016
- 2015 IET Microwaves, Antennas and Propagation Premium Award
- 2014 Georgia Tech ECE Distinguished Faculty Achievement Award
- 2014 IEEE RFID-TA Best Student Paper Award
- 2013 IET Microwaves, Antennas and Propagation Premium Award
- 2013 IEEE Wireless Power Transfer Conference (WPTC) Second Best Paper Award
- 2012 FiDiPro [Finland Distinguished Professor] Award from the Academy of Finland
- 2012 iCMG Architecture Award of Excellence
- Selected by NSF to represent US as a member of a team of 5 US prominent researchers, that participated in the US-Ireland R&D Partnership Telecommunications Workshop, hold in 11/2011 in Dublin, Ireland, and focusing on Millimeter-wave and sub-THz communication systems.
- Prof. Tentzeris’ research activity in electromagnetic energy scavenging has been highlighted in CBS, NSF Homepage, MSNBC, CNN, Yahoo, Discovery Channel, Boston Globe, IEEE The Institute and 500+ top High-Tech sites (e.g. engadget.com) as well as in numerous international newspapers (e.g. Asahi Shimbun, Vima, Kathimerini, ...) as one of the major technical inventions of 2011.
- Selected by SRC and NSF to be part of the 25-member US team to participate in the SRC/NSF/SFI Forum on Integrated Sensors for Cybersystems (FISC-2030) that took place in Ireland in 3/2012 aiming in identifying the critical ultra-low-power (low-frequency, UHF, RF and millimeter-wave) sensor technologies by 2030 and define global guidelines.

- Member of the first Outstanding U.S. Alumni Class of Alexander von Humboldt Foundation/German Research Foundation (DFG)
- 2011 International Workshop on Structural Health Monitoring Best Student Paper Award
- 2010 IEEE Antennas and Propagation Society Piergorgio L. E. Uslenghi Letters Prize Paper Award
- 2010 Georgia Tech Senior Faculty Outstanding Undergraduate Research Mentor Award
- 2010 World-Wide Distinguished Professor Award from the State Administration of Foreign Experts Affairs of China
- 2009 IEEE Transactions on Components and Packaging Technologies Best Paper Award
- 2009 IEEE Antennas and Propagation Symposium (APS) Second Best Student Paper Award
- 2009 E.T.S. Walton Award from Science Foundation Ireland (SFI)
- 2000 NSF CAREER Award
- 2008 IEEE International Microwave Symposium (IMS) Honorable Mention Student Paper Award.
- 2007 IEEE Antennas and Propagation Symposium (APS) Best Student Paper Award.
- 2007 IEEE International Microwave Symposium (IMS) Third Best Student Paper Award.
- 2007 IEEE International Symposium on Antennas and Propagation (ISAP) Poster Presentation Award.
- 2006 Asian-Pacific Microwave Conference (APMC) Award.
- 2006 IEEE Microwave Theory and Techniques (MTT) Society Outstanding Young Engineer Award.
- 2003 IEEE Components, Packaging and Materials' Technology (CPMT) Society Outstanding Young Engineer Award.
- 2004 IBA International Educator of the Year Award.
- 2004 IEEE Transactions on Advanced Packaging Commendable Paper Award.
- 2003 NASA Godfrey "Art" Anzic Collaborative Distinguished Publication Award.
- Best Paper Award by the International Symposium in Microwave and Millimeter-Wave Technology, Beijing, CHINA, August 2002.
- 2002 Outstanding Junior Faculty Award, School of ECE, Georgia Tech.
- Best Paper Award by the Advanced Computational Electromagnetics Society (ACES), ACES Conference, Monterey, CA, March 2001.
- • Listed at "Who-is-Who in America", Marquis Eds., 2002-2011 and at "Who-is-Who in the World", Marquis Eds., 2003-2011.
- Best Paper Award by the International Hybrid Microelectronics and Packaging Society, ISHM, Philadelphia, PA, October 1997.
- Greek Government Academic Excellence Fellowships, 1988-1992.
- Papastavridios Greek Mathematics Excellence Fellowship, 1989.

TEACHING

III.A : INDIVIDUAL STUDENT GUIDANCE

III.A.1. Research Personnel

1. R.Li, Research Scientist II, "Design and Optimization of Compact/Multiband Antennas for Broadband Wireless Applications (PCS, GSM,WLAN, LMDS, UWB, mm-wave)", Period of Collaboration: Summer 2001 – Fall 2011.

2. Y.Fang, Research Scientist, "Nanotechnology-Based Gas, Chemical and Biological Wireless Sensors", Period of Collaboration: 2014 – now.
3. Xiaoqiang Zhang, 'Railway applications of RFID's", Visiting Professor, Period of Collaboration: Spring 2010-Spring 2011
4. Min Jin, "Smart skin configurations", Visiting Professor, Period of Collaboration: Spring 2010-Spring 2011
5. D.Staiculescu, Research Engineer II, "Design and Optimization of SOP Multilayer Wireless Modules Using Statistical and Genetic Algorithms for Biosensing Applications", Period of Collaboration: Fall 2003 - 2009.
6. G.Jin, "Inkjet-Printed Wideband Baluns for Wearable RF Modules", Visiting Professor, Period of Collaboration: Summer 2011-Summer 2012.
7. Y.Kawahara, "RF Power Scavenging Modules for Internet of Things Applications", Visiting Professor, Period of Collaboration: Fall 2011-Fall 2013.
8. H.R.Ahn, "Broadband Couplers for Arbitrarily High Coupling Ratios", Visiting Scientist, Period of Collaboration: Summer 2015-Summer 2016.

III.A.2. Postdoctoral Fellows

1. N.Bushyager, "Application of Fluid-Dynamics Computational Techniques to the Design of Compact Wireless Modules", Period of Collaboration: Spring 2005 - Spring 2006.
2. C.You, "Hybrid Electromagnetic/Mechanical Modeling, Design and Optimization of Antenna Arrays on Composite Materials", Period of Collaboration: Fall 2005 - Fall 2007.
3. D.Anagnostou, "Design of Large Antenna Arrays on Flexible Organics for Space Applications", Period of Collaboration: Fall 2005 - Fall 2006.

III.A.3. Ph.D. Students

III.A.3.1. Graduated Ph.D. Students

1. N.Bushyager, "Novel Adaptive Time-Domain Techniques for the Analysis and Design of Complex RF and Wireless Structures", Period Advised: Fall 1999 - Fall 2004, GRADUATED: December 2004, Current Employer: Northrop-Grumman.
2. D.Thompson, "Novel Microwave Structures on Organic and Liquid Crystal Polymer (LCP) Substrates", (Main advisor; co-advisor: Prof. J.Papapolymerou), Period Advised: Fall 2002 – Spring 2006, GRADUATED: April 2006, Current Employer: Ansoft.
3. G.DeJean, "Multilayer Multiband Compact Antennas for Wireless/WLAN Applications", Period Advised: Fall 2001 - Fall 2006, GRADUATED: January 2007, Current Employer: Microsoft Research Center.
4. I.-K.Kim, "Design of Fractal-based Filters and Compact Endfire Antennas in Organic and Ceramic Multilayer Technologies", Period Advised: Spring 2004 - Spring 2006, GRADUATED: April 2006. (Yonsei University, KOREA, co-advisor: Prof. J.-G.Yook), Current Employer: Samsung. Dr.Kim spent significant amount of time (aggregate of 2 years) at GEDC covering the 80% of the design and all fabrication and experiments for his Ph.D. Thesis; the effort culminated in 2 Journal and 3 Conference Publications

5. J.H.Lee, "Hybrid EM and Circuit Optimization of RF Devices Built on Si, GaAs and Multilayer Ceramic (LTCC) and Organic Substrates", Period Advised: Fall 2001 - Fall 2006, GRADUATED: June 2007, Current Employer: Skyworks.
6. S.Nikolaou, "UWB Antennas and Integrated Modules on Silicon Substrates", (Main advisor; coadvisor: Prof. J.Papapolymerou), Period Advised: Fall 2003 - Summer 2007, GRADUATED: June 2007, Current Employer: Frederick University (Cyprus).
7. L.Martin, "Nanomagnetic Materials for Miniaturized UHF/VHF Antennas", (Main advisor; coadvisor: Prof. C.P.Wong), Period Advised: Fall 2003 - Spring 2008, GRADUATED: March 2008, Current Employer: Motorola.
8. Bo Pan, "Ultrawideband Antennas and Ultra-Low-Loss Transitions on Micromachined Silicon and Glass Substrates for Millimeter-Wave Applications", (Equal advising load with co-advisor: Prof. J.Papapolymerou), Period Advised: Fall 03 - Spring 2008, GRADUATED: Spring 2008, Current Employer: Wionics.
9. V.Palazzari, "Design of Novel Filters in LCP Multilayer Structures", Period Advised: Spring 2003 -Fall 2003, Ph.D.; GRADUATED: 11/2003 (University of Perugia, ITALY; Equal advising load with co-advisor: Prof. L.Roselli), Current Employer: W.I.S. (Italy) Dr. Palazzari spent the 11-month period from January-November 2003 in GEDC putting together the last 2 chapters of her PhD Thesis and performing most of the experimental work required for her PhD Thesis; Prof. Tentzeris started co-advising her during his trip to University of Perugia in September 2001; the effort culminated in 2 Journal and 2 Conference Publications.
10. Li Yang, "Inkjet-Printed Paper-Based RFID's", Period Advised: Fall 2005-Fall 2009, Ph.D., GRADUATED: 9/2009, Current Employer: Texas Instruments.
11. A.Rida, "Multiband and Wideband Antennas for Applications up to mmW", Period Advised: Fall 2006-Spring 2011, GRADUATED: 3/2011, Current Employer: Northrop Gruman.
12. T.Wu, "Integrated Antennas for Communication and Sensing Applications", Period Advised: Fall 2006-Spring 2011, GRADUATED: 4/2011, Current Employer: Direct TV
13. S.Kim, "Energy-Optimized Design Techniques for Wireless Communication and Ubiquitous Sensing Nodes", Period Advised: Fall 2009-Fall 2011, PhD Proposal: 1/2011, GRADUATED: 11/2011, Current Employer: Intel.
14. S.Beck, "An Interference-Cancellation Receiver for Multi-Band and Multi-Standard Wireless Communication Systems", Period Advised: Fall 2009-Summer 2011, PhD Proposal Exam: 9/2010, GRADUATED: 6/2011, Current Employer: Texas Instruments..
15. V.Lakafosis, "A hardware-Enabled Certificate of Authenticity System with Intrinsically High Entropy", Period Advised: Fall 2007 -Present, passed Preliminary Exam: Fall 2007, GRADUATED: Spring 2013, Current Employer: CISCO.
16. H.Lee, "Inkjet-printed RF Modules for Sensing and Communication Applications", period Advised: Fall 2009-Present, GRADUATED: Summer 2013, Current Employer: Southern Polytechnic State University (SPSU)
17. T.Thai, "Design and Development of Novel RF Sensors based on Far-Field and Near-Field Principles", Period Advised: Spring 2007-Present, passed Preliminary Exam: Fall 2008, PhD Proposal Exam: Spring 2013, GRADUATED: Fall 2013, Current Employer: GE Global Research *Microsoft Fellowship Recipient*

18. R.Vyas, "An Embedded Wireless Energy Harvesting Platform (E-WEHP) for Powering Sensors using Existing Ambient Wireless Signals", Period Advised: Fall 2006-Present, Passed Preliminary Exam: Fall 2007, Ph.D.Proposal: Spring 2013, GRADUATED: Spring 2014, Current Employer: University of Calgary, CANADA
19. J.Cooper, "A Novel Topology for Wireless Sensors Incorporating an Isotropic Radiator on an EBG Material", Period Advised: Summer 2010-Present, Passed Preliminary Exam: Spring 2011, Ph.D.Proposal: Summer 2013, Expected GRADUATED: Spring 2014, Current Employer: Curo Corporation **NSF Graduate Fellowship Recipient**
20. S.Kim, "Integrated Inkjet-Printed Sensors and Via-Enabled Structures for WSN and RFID-based Autonomous Wireless Sensor Platforms", Period Advised: Fall 2010-Present, Passed Preliminary Exam: Fall 2010, Ph.D.Proposal: Fall 2013, GRADUATED: Fall 2014, Current Employer: Qualcomm
21. A.Traill, "Inkjet-Printed Ground-Penetrating Radar Systems", Period Advised: Fall 2011-Present (LAAS-CNRS, France; Co-Advisor: Prof. H.Aubert), GRADUATED: Fall 2014.
22. B.Cook, "Vertical Integration of Inkjet-Printed RF Circuits and Systems", Period Advised: Spring 2012-Present, Ph.D.Proposal: Fall 2013, GRADUATED: Summer 2014, Current Employer: Texas Instruments-Kilby Labs
23. T.Le, "Inkjet-Printed Graphene/CNT-Based Ultrasensitive Wireless Gas Sensors", Period Advised: Spring 2012-Present, Passed Preliminary Exam: Fall 2013, GRADUATED: Fall 2016.
24. J.Bitto, "Energy Harvesting and Wireless Power Transfer Systems", Period Advised: Fall 2013 – Fall 2017, Passed Preliminary Exam: Spring 2014, Expected GRADUATED: Fall 2017, Current Employer: Texas Instruments-Kilby Labs.
25. J.Kimionis, "Software-Defined-Radio Readers for RFID Applications", Period Advised: Fall 2013-Fall 2017, GRADUATED: Fall 2017, Current Employer: Bell Labs.
26. W.Su, "Inkjet-Printed Microfluidic-Enabled Tunable RF Structures and Sensors", Period Advised: Fall 2013 – Spring 2018, Passed Preliminary Exam: Spring 2014, GRADUATED: Spring 2018, Current Employer: Google.
27. J.Hester, "Low-Cost Printed, Flexible and Energy Autonomous Van Atta and Carbon Nanotubes Based mm-Wave RFID Gas Sensors for Ultra-Long Range Ubiquitous IoT and 5G Implementations", Period Advised: Fall 2013 – Summer 2019, Passed Preliminary Exam: Spring 2015, GRADUATED: Summer 2019, Current Employer: Atheraxon (Founder).
28. A.Nauroze, "Origami-Inspired Tunable RF Structures", Period Advised: Fall 2014-Fall 2019, GRADUATED: Fall 2019, Current Employer: Amazon.
29. S.Alotaibi, "3D Printed Wireless Sensors for Strain and Stress Monitoring in Smart Skin Applications", Period Advised: Spring 2016-2020, GRADUATED: February 2020, Current Employer: Aramco.
30. S.Jeong, "Load-Reconfigurable Wireless Power Transfer Systems and Machine Learning Optimization", Period Advised: Fall 2014-2020, GRADUATED: April 2020, Current Employer: Qorvo.
31. Tong-Hong Lin, "Wearable Zero-Power Sensors and Microfluidics for 5G Applications", Period Advised: Spring 2016-2020, GRADUATED: September 2020, Current Employer: Apple.

32. B.Tehrani, "Additive Manufacturing Solutions for Application-specific Millimeter-Wave Wireless System Design and Packaging", Period Advised: Summer 2013-2020, GRADUATED: December 2020, Current Employer: Analog Devices.
33. R.Bahr, "3D-Printed RF Circuits", Period Advised: Spring 2015-2020, GRADUATED: December 2020, Current Employer: Dujud.
34. Xuanke He, "Additively Manufactured RF Components, Packaging, Modules and Flexible Modular Phased Arrays enabling widespread massively scalable mmWave/5G Applications", Period Advised: Spring 2017-2021, GRADUATED: July 2021, Current Employer: Skyworks.
35. E.M.Jung, "FM and UHF Energy Harvesting Systems", Period Advised: Fall 2018-2021, GRADUATED: December 2021, Current Employer: PowerCast.
36. A.Eid, "3D printed Novel Lenses, Energy Harvesters and Active Devices for IoT Applications", GRADUATED: December 2021, Current Employer: MIT-Media Lab.
37. A.Alreshaid, "MM-wave Reconfigurable Antenna Systems for 5G Applications", GRADUATED: January 2022, Current Employer: KFUPM (Assistant Professor)
38. Y.Cui, "Additively Manufactured Shape-changing RF Devices Enabled by Origami-inspired Structures", GRADUATED: August 2022, Current Employer: Apple.
39. A.Adeyeye, "Novel RFID Systems and Techniques for Localization, Positioning and Sensing Applications", GRADUATED: August 2022, Current Employer: Apple.
- *. H.Kim, "CMOS Radio-Frequency Power Amplifiers for Multi-Standard Wireless Communications", Period Advised: Spring 2010-Summer 2011, GRADUATED: 5/2011. [Academic Advisor]
- *. K.-H.Lee, "Design of Signal Integrity Enhancement Circuits", Period Advised: Summer 2010-Fall 2010, GRADUATED: 11/2010. [Academic Advisor]
- *. S.Woo, "Low Noise RF CMOS Receiver Integrated Circuits", Period Advised: Summer 2010-Fall 2010, GRADUATED: 10/2010. [Academic Advisor]
- *. J.Cha, "A CMOS Radio-Frequency Front-End for Multi-Standard Wireless Communications", Period Advised: Summer 2010, GRADUATED: 8/2010. [Academic Advisor]
- *. J.Choi, "Fully-Integrated DLL/PLL-Based CMOS Frequency Synthesizer for Wireless Systems", Period Advised: Summer 2010, GRADUATED: 7/2010. [Academic Advisor]
- *. H.-W.Kim, "CMOS RF Transmitter Front-End Module for High-Power Mobile Applications", Period Advised: Spring 2010-Present, PhD Proposal Exam: 8/2011, GRADUATED: Spring 2012 [Academic Advisor], Current Employer: RFMD

III.A.3.2. Current Ph.D. Students

1. C.Lynch, "Additively Manufactured Wireless Sensors for Smart Agriculture and Smart Biomonitoring Applications", Period Advised: Fall 2019-Present, Expected Graduation: Fall 2023.
2. K.Hu, "Additively Manufactured RF Structures for 5G and mmW Applications", Period Advised: Spring 2020-Present, Expected Graduation: Spring 2024.
3. G.S.V.Angulo, "Printed Wireless Sensors for Space and Gas Detection Applications", Period Advised: Fall 2021-Present, Expected Graduation: Fall 2025.

4. L.Smith, "Origami Reconfigurable Energy Harvesters", Period Advised: Fall 2021-Present, Expected Graduation: Fall 2025.
5. I.-T.Chen, "Wireless Power Transfer and Zero-Power RF Components for Reconfigurable Intelligent Surfaces", Period Advised: Fall 2021-Present, Expected Graduation: Fall 2025.
6. H.Al Jamal, "Self-Calibrated Tile-Based Antenna Arrays Using Computer Vision Techniques", Period Advised: Fall 2022-Present, Expected Graduation: Fall 2026.
7. M.Joshi, "Multiband flexible RF enhanced-accuracy localization systems", Period Advised: Fall 2022-Present, Expected Graduation: Fall 2026.
8. W.Callis, "Additively manufactured wireless bio/chemical sensors", Period Advised: Fall 2022-Present, Expected Graduation: Fall 2026.

III.A.4. M.Sc. Students

III.A.4.1. Graduated M.Sc. Students

1. B.McGarvey, "Efficient Numerical Coupling of FDTD and Solid-State Equations for 1D-circuits", Period Advised: Summer 2002 - Fall 2007, Graduation Date: Fall 2007, Current Employer: DoD-NSA.
2. S.Bassat, "Design and Optimization of RFID Compact Antennas", Period Advised: Fall 2003- Fall 2006, GRADUATED: Fall 06, Current Employer: Motorola.
3. N.Tavassolian, "UWB Antennas and Integrated Modules for Breast Cancer Detection Applications", Period Advised: Fall 2006-Summer 2007.
4. B.Kim, "Reconfigurable Multiband Antennas for mm-wave Applications", Period Advised: Summer 2005 - Fall 2006, Graduation Date: Fall 06 (Korea University, KOREA), Current Employer: Samsung.
5. L.Ward, "FDTD Modeling of the Crosstalk between Closely Spaced Microstrip Lines on Silicon Substrates", Period Advised: Summer 2000 - Winter 2000, Graduation Date: Winter 2000, Current Employer: Argon Labs.
6. E.Tsai, "Adaptive Modeling of Novel Micromachined Antennas on High-Resistivity Si Substrates", Period Advised: Spring 2001 - Fall 2002, Graduation Date: Fall 2002, Current Employer: Northrop-Grumman Corporation.
7. Y.Zhang, "Dual-Band Antenna Arrays for Conformal Space Applications", Period Advised: Fall 2007-Fall 2009 (UoLille/France; co-advisor: Prof.Pavlidis).
8. N. Chaisilwattana, "Novel UHF RFID Antennas for Automotive and Container Applications", Period Advised: Fall 2007-Fall 2009.
9. C.Kruesi, "3D Conformal Antennas for Supply-Chain and Inventory Tracking Applications", Period Advised: Fall 2007-Spring 2009.
10. J.Pan, "Compact RFID's on Metallic Structures", Period: Fall 2008-Fall 2009.
11. S.Mukala, "Wearable antennas integration with smart clothing", Period Advised: Fall 2009-Fall 2010.
12. A.Harrabi, "Novel RFID's for Agricultural Applications", Period Advised: Fall 2010-Fall 2011 (Faculty of Sciences in Tunis, Tunisia; co-advisor: Prof.Gharsallah)
13. Diapa Sanogo, "Broadband Harvesting Systems", Period Advised: Fall 2011
14. Guillaume Caillet, "RF Characterization of inkjet-printed CNT films and transmission lines", Thesis MSc Visiting Student from UoLille, FRANCE, Period Advised: Spring 2011-Fall 2011

15. Sebastien Mauzole, “Doubler implementations on ultralow-cost flexible materials for wireless crack detection”, Thesis MSc Visiting Student from UoLille, FRANCE, Period Advised: Spring 2011-Fall 2011
16. S.Palacios, “Inkjet Printed Smart Wireless Integrated Modules (SWIM)”, Period Advised: Fall 2012-Fall 2013
17. R.Herre, “Novel Inkjet printed Humidity Sensors”, Period Advised: Summer 2013-Fall 2013 (performed his MS Thesis Research as an Exchange Student from University of Erlangen-Nuremberg)
18. C.Saintsing, “Origami Foldable Structures for RF Sensing Applications”, Period Advised: Fall 2013-Fall 2014.

III.A.4.2 Visiting/Current M.Sc. Students

1. R.Bahr, "Inkjet Printed Wearable Motion Sensors", Period Advised: Summer 2014-Present
2. K.Nate, "3D Printed Origami Antennas", Period Advised: 2014-Present

III.A.5. M.Sc./Ph.D. Special Problems Students

1. N.Vasiloglou, “Fractal Antennas for WiFi Modules”, Period Advised: Summer 2003 - Summer 2004.
2. F.Caliskan, “MPI Parallelization of FEM Algorithms”, Period Advised: Spring 2001.
3. K.Madidmanana, “Survey of Carbon Nanotube Fabrication Techniques for Semiconductive and Metal Surfaces”, Period Advised: Fall 2006 - Summer 2007.
4. U.Onyewuchi, “Development of WiMax Miniaturized Antenna Arrays for Base Stations”, Advised: Fall 2006 - Spring 2007

III.A.6. Undergraduate UROP/Special Problems Students

1. B.McGarvey, “Numerical Modeling of Cascaded Transmission Line Interfaces through the Use of Bounce Diagrams”, Period Advised: Winter 1999 - Fall 1999, UROP, Graduation Date: Fall 1999.
2. M.Delwar, “Numerical Modeling of Wire Antennas Using FDTD”, Period: Winter 1999 – Spring 1999, UROP, Graduation Date: Summer 1999.
3. T.Owens, “Numerical Design of a Coupled-Line Planar Filter”, Period: Winter 1999, UROP, Graduation Date: N/A.
4. M.Rutledge, “Study of Crosstalk Effects in Planar Transmission Lines”, Period: Winter 1999, UROP, Graduation Date: N/A.
5. M.Fisher, “Numerical Design of Interdigitated Filters”, Period: Fall 1998 - Summer 1999, UROP, Graduation Date: Fall 1999.
6. L.Compton, “Planar Antennas Analysis Using FDTD”, Period: Fall 1998 -Winter 1999, Independent Research, Graduation Date: Spring 1999.
7. Q.Yasser, “Review of Commonly Used High-Frequency Packaging Geometries”, Period: Winter 1999, Special Topics, Graduation Date: Spring 1999.
8. D.Gauthier, “Review of Amplifier Topologies Used in Wireless Communication Systems”, Period: Winter 1999, Special Topics, Graduation Date: Spring 1999.
9. K.Browse, “Preliminary Models of Finite-Ground Coplanar Waveguides”, Period: Fall 1999, Special Topics, Graduation Date: Summer 2000.

10. A. Awa, "Estimation of Health Effects Caused by Radiation of Handheld Unit Antennas", Period: Fall 1999 - Summer 2000, Special Topics, Graduation Date: Summer 2000.
11. D.Feren, "Preliminary Design of a PCB for Monitoring the Beowulf Cluster", Period: Spring 2000 -Summer 2000, Special Topics.
12. R.Myers, "Benchmarking of a Beowulf Cluster Using LINUX with MPI/PVM Interfaces", Period: Fall 1999 - Fall 2000, Special Topics..
13. W.Frishe, "Development of GUIs for Commercial EM Simulators in Time-Domain", Period: Spring 1999 - Fall 2001, UROP.
14. R.Cicconetti, C.Pearson, B.Moudry and S.McCord, "Development of Monitoring and Geometry Acquisition Tools and Parallelization of ATHENA Adaptive EM Simulation Tool using a BEOWULF Cluster", Period: Summer 1999 - Fall 2001, Special Topics, Graduation Date: N/A.
15. S.Owens, "Gridding and Modeling of a Novel Wideband Vialess CPW-to-Mstrip Transition", Period: Fall 2001, Special Topics, Graduation Date: Spring 2002.
16. S.Bassat, "Design Rules for the Minimization of Crosstalk for Finite-Ground Microstrip Lines in Space Applications", Period: Spring 2002 - Fall 2003, Special Topics, Graduation Date: Fall 2003, **President's Undergraduate Research Award (PURA) recipient, School of ECE Undergraduate Research 2nd Place.**
17. S.Kulkarni, "Study of Nonsymmetrical Coplanar Waveguides that Are Embedded in Low-Resistivity Si Layers", Period: Spring 2002 - Spring 2003, Special Topics, Graduation Date: Spring 2003, **President's Undergraduate Research Award (PURA) recipient.**
18. J.Vickers, "Design and Modeling of LTCC Vertically-integrated Baluns in Microstrip and CPW Configurations", Period: Spring 2002 - Fall 2002, Special Topics, Graduation Date: Fall 2002.
19. T.Cervantes, "Code Optimization for RF-MEMS Numerical Hybrid Simulators", Period: Fall 2002 -Spring 2003, Special Topics, Graduation Date: Fall 2003.
20. G.Schumann, Anya Traille, C.Sanders, B.-C.Nguyen, "Setup of a new anechoic chamber up to 40 GHz/Modeling of Metamaterial-Based Circuits", Period: Fall 2003-Spring 2004, Special Topics.
21. G.Doney, "Fabrication of 3D Metamaterial Structures", Period: Spring 2005, Special Topics.
22. A.Rida, "Modeling of Micromachined Monopole Antennas", Period: Spring 2005-Summer 2006, Special Topics, **2006 IEEE MTT-S Undergraduate/Pre-graduate Scholarship Recipient.**
23. L.Nisonov, "Modeling and Design of Metamaterial/Loaded Transmission Lines", Period: Spring 2005, Special Topics.
24. Q.Xu, "Development of RFID Antennas for Embedded Tire Applications", Period: Spring 2005, Special Topics.
25. A.Sharpe, "60GHz Filters Using 3D resonators in LTCC Technologies", Period: Spring 2005, Special Topics.
26. E.Tsai, "60GHz Yagi-Uda Antennas and Integration with Nanostructures", Period: Summer 2005 -Fall 2005, Special Topics.
27. T.Ferrer, "HF and UHF RFID Characterization", Period: Fall 2005 - Fall 2006, Special Topics, **President's Undergraduate Research Award (PURA) recipient.**

28. F.Falcon, "RFID's for Container Tracking Applications", Period: Fall 2005 - Fall 2006, Special Topics.
29. M.Pichkhadze, "Authentication Algorithms for RFIDs", Period: Spring 2007, Special Topics.
30. D.Compston, "Modeling of Carbon-NanoTube Ultrasensitive Chemical Sensors", Period: Spring 2007-Fall 2007, Special Topics.
31. T.Thai, "Nanoengineering Thermal Solutions on Graphene", Period: Fall 2006-Fall 2007, Special Topics, **President's Undergraduate Research Award (PURA) recipient, 2007 Georgia Tech School of ECE Undergraduate Research Award recipient, 2007 IEEE MTT-S Undergraduate/Pre-graduate Scholarship recipient, 2007 SAIC Student Paper Award recipient.**
32. R.Moussounda, "Adhesives for Paper-Printed Electronics", Period: Spring 2008-Fall 2008, Special Topics.
33. J.Pan, "Compact RFID's on Metallic Structures", Period: Spring 2008, Special Topics.
34. N.Gorheski, "Automotive Passive RFID's with Enhanced Range", Period: Spring 2008, Special Topics.
35. S.Travis, "Miniaturized Wideband/Dual-Band UHF Antennas", Period: Fall 2007-Spring 2008, Special Topics.
36. J.Ratner, "Nanotechnology and Plasmonis RF Applications", Period: Fall 2008-Spring 2009, Special Topics
37. Dora Ahbe, "Miniaturized Antennas for Smart-Skin Sensing Applications", Period: Spring 2011-Summer 2011, **Diploma Visiting Student** from TU Karlsruhe, GERMANY
38. A.Amaya, "Inkjet-printed CNT-based Wireless Sensors", Period: Fall 2009-Summer 2010, ORS/Special Topics, **President's Undergraduate Research Award (PURA) recipient.**
39. S.Palacios, "Conformal Automotive Radars", Period: Fall 2009-Present, ORS/Special Topics, **President's Undergraduate Research Award (PURA) recipient, 2012 Georgia Tech School of ECE Undergraduate Research Award recipient, 2012 Georgia Tech College of Engineering Undergraduate Research Award recipient.**
40. S.Y.Lee, "Inkjet-printed Antennas for Power scavenging applications", Period: Summer 2011-Present.
41. W.J.Hwang, " Circuit design for doublers and scavenging modules", Period" Summer 2011-Present
42. R.Roca, "Inkjet-Printed CNT-based Gas Sensors", Period: Fall 2010-Present, GT-ORS, **IEEE MTT-S Undergraduate/Pre-Graduate Fellowship**
43. S.Elia, "Inkjet-Printed Integrated Wireless Sensor Modules", Period: Summer 2011-2012, GT-ORS Student.
44. J.T.Brock, "Zero-Power Wireless Sensors", Period: Fall 2011-2012.
45. S.Wilson, "Investigation of Chemical Mechanisms for the Ultrasensitive Gas Detection", Period: Summer 2011-2012, GT-ORS Student.
46. Aisha Jackson, "Sense for Cents", Period: 2015-Present, GT-ORS Student
47. Emily Pitts, "Sense for Cents", Period: 2015-Present, GT-ORS Student
48. Eric Rafalovsky, "Sense for Cents", Period: 2015-Present, GT-ORS Student
49. Hans Webster, "Sense for Cents", Period: 2015-Present, GT-ORS Student

III.B: OTHER TEACHING ACTIVITIES

1. Development of home pages for EE3310 [Electromagnetics II], ECE3065 [Electromagnetic Applications] (<http://www.ece.gatech.edu/~tentze/3065f08.html>), ECE4390 [Radar and Electromagnetic Sensing], ECE6261 [Numerical Methods for Electromagnetics] and ECE6380 [Numerical Methods for Electromagnetics] (<http://www.ece.gatech.edu/~tentze/6380f08.html>) Courses. Through the use of these home pages (Summer 1998-Fall 2010), undergraduate and graduate students can obtain previous homeworks and solutions, as well as important information concerning textbook typos and deadlines. Additional examples have been added in .pdf format and an easy-to-use Course Schedule is available.
2. Development of a Preliminary Graphical User Interface (GUI) for the full-wave FDTD modeling of Transmission Lines, Filters and Antennas. This CAD tool could be used as a means for a comprehensive demonstration and the visualization of high-frequency effect in the semester format Electromagnetics courses (ECE3025 [Electromagnetics], ECE3065 [Electromagnetic Applications]).
3. Development of a Beowulf Parallel-Processor Cluster with 8 dual nodes, that is currently extended to 24 dual nodes. This cluster could be used as a testbed for the demonstration of the principles of code parallelization for the simulations of complex wireless structures (ECE6380 [Numerical Techniques for Electromagnetics]).
4. Development of a new senior-level course on RFID Technologies (ECE4803A) in collaboration with Prof. Durgin. This proposal was approved from the Electromagnetics-TIG and School of ECE and the course has been already taught twice (Spring 2009, Spring 2010).

IV: SCHOLARLY ACCOMPLISHMENTS

IV.A: PUBLISHED BOOKS AND PARTS OF BOOKS

1. L.P.B.Katehi, J.F.Harvey and E.Tentzeris, "Time-Domain Analysis Using Multiresolution Expansions", Chapter in the book: Advances in Computational Electrodynamics, edited by A.Taflove, pp.111-162, Artech House, 1998.
2. E.M.Tentzeris, "Numerical Techniques in RF and Microwave Design", Section for the Book: The RF and Microwave Handbook, edited by M.Golio, pp.8.13-8.34, CRC Press, 2000.
3. J.Laskar, E.M.Tentzeris, J.Schutt-Aine and R.Tummala, "Fundamentals of RF Packaging", Chapter in the book: Fundamentals of Microsystems Packaging, edited by R.Tummala, pp.500-541, McGraw- Hill, 2001.
4. E.M.Tentzeris, "Full-Wave Methods for the Analysis, Modeling and Design of RF and Microwave Geometries", Section for the Book: The RF/Microwave Applications: Challenges and Solutions, edited by M.Golio, pp.18.1-18.32, CRC Press, June 2003.
5. E.M.Tentzeris and N.Bushyager, "Electromagnetics: Time-Domain Techniques," Chapter for the Book: Encyclopedia of RF and Microwave Engineering, edited by K.Chang, Wiley Eds., June 2004.
6. E.M.Tentzeris, K.Lim, S.Pinel and J.Laskar, "RF/Wireless Packaging," Chapter for the Book: Encyclopedia of RF and Microwave Engineering, edited by K.Chang, Wiley Eds., June 2004.
7. J.Goswami, E.M.Tentzeris and N.Bushyager, "Application of Wavelets to Electromagnetics," Chapter for the Book: Encyclopedia of RF and Microwave Engineering, edited by K.Chang, Wiley Eds., June 2004.

8. E.M.Tentzeris and R.L.Li, "Wideband Antennas on Silicon," Chapter for the Book: The Silicon Heterostructure Handbook, edited by J.D.Cressler, pp.1099-1118, Marcel-Dekker Eds., December 2005.
9. N.Bushyager and M.M.Tentzeris, "MRTD (MultiResolution Time-Domain) Method in Electromagnetics", Synthesis Lectures on Computational Electromagnetics, Morgan and Claypool Editions, November 2005.
10. E.M.Tentzeris, L.Yang, A.Rida and S.Basat "RFID: Beyond the Basics", Chapter for the Book: RFID Applied, edited by J.Banks, D.Hanny, M.Pachano and L.Thompson, pp.95-123, J.Wiley and Sons Eds., June 2007.
11. E.M.Tentzeris, L.Yang, A.Rida and S.Basat "RFID: Issues of Security and Privacy", Chapter for the Book: RFID Applied, edited by J.Banks, D.Hanny, M.Pachano and L.Thompson, pp.269-296, J.Wiley and Sons Eds., June 2007.
12. J.-H.Lee and M.M.Tentzeris, "Three-Dimensional Integration and Modeling: A Revolution in RF and Wireless Packaging", Synthesis Lectures on Computational Electromagnetics, Morgan and Claypool Editions, December 2007.
13. E.M.Tentzeris, "Numerical Techniques for the Analysis and Design of RF/Microwave Structures", Section for the Book: RF and Microwave Circuits, Measurements and Modeling, edited by M.Golio, pp.28.1-28.34, CRC Press, January 2008.
14. B.Pan, J.Papapolymerou and E.M.Tentzeris, "MEMS for Antennas", Chapter for the Book: Modern Antenna Handbook, edited by C.Balanis, pp.829-865, J.Wiley and Sons Eds., July 2008.
15. M.M.Tentzeris, B.Pan and R.L.Li, "Multiband Planar Wire Antennas", Chapter for the Book: Multiband Integrated Antennas for 4G Terminals, edited by D.Sanchez-Hernandez, pp.53-94, Artech House Eds., August 2008.
16. J.Papapolymerou, M.M.Tentzeris, J.Laskar and S.Bhattacharya, "Radio-Frequency System-on-Package (RF SOP)", Chapter for the Book: Introduction to System-On-Package (SOP): Miniaturization of the Entire System, edited by R.R.Tummala and M.Swaminathan, McGraw-Hill, August 2008.
17. S.Chakraborty, J.Laskar and E.M.Tentzeris, "Mixed-Signal Design and Packaging of RF and Wireless Microsystems", J.Wiley and Sons Eds., January 2009.
18. L.Yang, A.Rida and M.M.Tentzeris, "Design and Development of RFID's and RFID-enabled Sensors on Flexible Low-Cost Substrates", Synthesis Lectures on Computational Electromagnetics, Morgan and Claypool Editions, June 2009.
19. V.Lakafosis, R.Vyas and M.M.Tentzeris, "Enabling Localization Services in Single- and Multihop Wireless Networks", Chapter for the Book: Handbook on Smart Antennas for RFID Systems, edited by N. Karmakar, Wiley Eds., July 2010.
20. A.Rida, L.Yang and M.M.Tentzeris, "RFID-Enabled Sensor Design and Applications", Artech House Publishers, February 2010.
21. M.M.Tentzeris, L.Yang, A.Traill and A.Rida, " "Green" Inkjet-Printed Wireless Sensor Nodes on Low-Cost Paper, Liquid and Flexible Organic Substrates", Chapter for the Book: Electromagnetics and Network Theory and Their Microwave Technology Applications: A Tribute to Peter Russer, edited by S.Lindenmeier and R.Weigel, Springer Eds., July 2011.

22. V.Lakafosis, R.Vyas, C.Mariotti, T.Le and M.M.Tentzeris, "Integrating Tiny RFID and NFC Based Sensors With the Internet", Chapter for the Book: Green RFID Systems, Cambridge University Press, 2014.
23. M.M.Tentzeris, S.Kim, A.Traill, B.S.Cook and T.Le, "Materials for Substrates", Chapter for the Book: Green RFID Systems, Cambridge University Press, 2014.
24. M.M.Tentzeris, R.Vyas, W.Wei, Y.Kawahara, L.Yang, S.Georgakopoulos, V.Lakafosis, S.Kim, H.Lee, T.Le, S.Mukala and A.Traill, "Power Issues in Biomedical Telemetry", Chapter in Handbook of Biomedical Telemetry, edited by K.S.Nikita, Wiley-IEEE Press, August 2014.
25. M.M.Tentzeris, S.Kim, V.Lakafosis, H.Lee, T.Le, R.Vyas, S.Mukala and A.Traill, "Advanced Material-Based Sensing Structures", Chapter in Handbook of Biomedical Telemetry, edited by K.S.Nikita, Wiley-IEEE Press, August 2014.
26. B.S.Cook, B.Tehrani, J.R.Cooper, S.Kim and M.M.Tentzeris, "Inkjet Printing Technology for 2D/3D Flexible Electronic Systems", Chapter in Handbook of Flexible Organic Electronics, Materials, Manufacturing and Applications, edited by S.Logothetidis, Woodhead Publishing, December 2014.
27. S.Kim, B.Cook, J.Cooper and M.M.Tentzeris, "Inkjet-Printed Artificial Magnetic Conductor (AMC) Plane for Wearable Antennas", Chapter for the Book: Innovation in Wearable and Flexible Antennas, edited by H.Khaleel, WIT Press, 2015.
28. J.Kimionis, B.Tehrani, J.G.D.Hester, W.Su, J.Bito and M.M.Tentzeris, "Inkjet-Printed Wearable "Smart Skins" ", Chapter for the Book: Electromagnetics of Body-Area Networks: Antennas, Propagation and RF Systems, edited by D.Werner and Z.Jiang, Wiley Eds. 2015.
29. B.K.Tehrani, J.Hester, J.Bito, W.Su, R.Bahr, B.S.Cook and M.M.Tentzeris, "Advanced Antenna Fabrication Processes (MEMS/LTCC/LCP/Printing)", Chapter for the Book: Handbook of Antenna Technologies, edited by Z.N.Chen, D.Liu, H.Nakano, X.Qing and Th.Zwick, Springer Eds., 2016.
30. M.M.Tentzeris, A.Eid, T.-H.Lin, J.G.D.Hester, Y.Cui, A.Adeyeye, B.Tehrani and S.A.Nauroze, "Inkjet-/3D-/4D-Printed Nanotechnology-Enabled Radar, Sensing, and RFID Modules for Internet of Things, "Smart Skin," and "Zero Power" Medical Applications", Chapter for the Book: Antenna and Sensor Technologies in Modern Medical Applications, edited by Y.Rahmat-Samii and E.Topsakal, Wiley – IEEE Press, 2021.
31. A.Georgiadis, A.Collado and M.M.Tentzeris, "Energy Harvesting: Technologies, Systems and Challenges", Cambridge University Press, 2021.
32. Y.Cui, E.Min Jung, A.Adeyeye, C.Lynch, X.He and M.Tentzeris, "Additively Manufactured RF Devices for 5G, IoT, RFID, WSN and Smart City Applications", Chapter for the Book: "Nanotechnology for Electronics, Biosensors, Additive Manufacturing and Emerging Systems Application", edited by C.Broadbridge, F.C.Jain, H.Tang and M.Gherasimova, World Scientific Publishing Company, 2021.
33. Y.Cui, S.A.Nauroze and M.M.Tentzeris, "Origami-inspired 4D tunable RF and wireless structures and modules", Chapter for the Book: Smart Materials in Additive Manufacturing, Vol.2: 4D Printing mechanics, modeling and advanced engineering applications", edited by M.Bodaghi and A.Zolfagharian, Elsevier Press, 2022.

IV.B: REFEREED PUBLICATIONS [Google Scholar h-factor=80 / 26,648 citations]

IV.B.1. Refereed Journal Publications

1. G.Ponchak, E.Tentzeris and L.P.B.Katehi, "Characterization of Finite Ground Coplanar Waveguide with Narrow Ground Planes", Int. Journ. of Microcircuits and Electronic Packaging, Vol. 20, No. 2, pp. 167-173, Second Quarter, 1997.
2. G.Ponchak, E.Tentzeris and L.P.B.Katehi, "Characterization of the Coupling Between Adjacent Finite Ground Coplanar (FGC) Waveguides", Int. Journ. of Microcircuits and Electronic Packaging, Vol. 20, No. 4, pp. 587-592, Fourth Quarter, 1997.
3. T.P.Budka, E.Tentzeris, S.Waclawik, N.Dib, L.P.B.Katehi and G.M.Rebeiz, "Near-Field Mapping Above a Coupled-Line Filter and a MMIC", Microwave Journal, Vol.41, No.3, pp.94-106, March 1998.
4. E.Tentzeris, M.Krumpholz, N.Dib, J.-G.Yook and L.P.B.Katehi, "FDTD Characterization of Waveguide Probe Structures", IEEE Transactions on Microwave Theory and Techniques, Vol.46, No.10, pp.1452-1460, October 1998.
5. R.L.Robertson, E.Tentzeris and L.P.B.Katehi, "Modelling of Dielectric-Loaded Cavities using MRTD", Int. Journal of Numerical Modeling, Special Issue on Wavelets in Electromagnetics, Vol.11, pp.55-68, 1998.
6. E.Tentzeris, J.Harvey and L.P.B.Katehi, "Time Adaptive Time-Domain Techniques for the Design of Microwave Circuits", IEEE Microwave and Guided Wave Letters, Vol.9, No.3, pp.96-98, 1999.
7. E.Tentzeris, R.Robertson, J.Harvey and L.P.B.Katehi, "Stability and Dispersion Analysis of Battle-Lemarie Based MRTD Schemes", IEEE Transactions on Microwave Theory and Techniques, Vol.47, No.7, pp.1004-1013, July 1999.
8. E.Tentzeris, R.Robertson, J.Harvey and L.P.B.Katehi, "Application of the PML Absorber to MRTD Battle-Lemarie Schemes", IEEE Transactions on Antennas and Propagation, Vol.47, No.11, pp.1709-1715, November 1999.
9. D.Staciulescu, J.Laskar and E.M.Tentzeris, "Design Rule Development for Microwave Flip-Chip Applications", IEEE Transactions on Microwave Theory and Techniques, Vol.48, No.9, pp.1476-1481, September 2000.
10. A.Sutono, G.Cafaro, J.Laskar and M.Tentzeris, "Experimental modeling, repeatability investigation and optimization of microwave bond wire interconnects", IEEE Transactions on Advanced Packaging, Vol.24, No.2, pp.595-603, November 2001.
11. M.Tentzeris, "3G/4G Wireless Systems: Challenges of the Future" (in Greek), "Pyrforos" National Technical Review of National Technical University of Athens, Vol.12 (2001), No.4, pp.24-40, November 2001.
12. E.Tentzeris, A.Cangellaris, L.P.B.Katehi and J.Harvey "Multiresolution Time-Domain (MRTD) Adaptive Schemes Using Arbitrary Resolutions of Wavelets", IEEE Transactions on Microwave Theory and Techniques, Vol.50, No.2, pp.501-516, February 2002.
13. K.Lim, S.Pinel, M.Davis, A.Sutono, C.-H.Lee, D.Heo, A.Obateyinbo, J.Laskar, E.M.Tentzeris and R.Tummala, "RF-System-On-Package (SOP) for Wireless Communications", IEEE Microwave Magazine, Vol.3, No.1, pp.88-99, March 2002.
14. N.Bushyager, B.McGarvey and E.M.Tentzeris, "Introduction of an Adaptive Modeling Technique for the Simulation of RF Structures Requiring the Coupling of Maxwell's, Mechanical and Solid-State Equations", Applied Computational Electromagnetics Society Journal, Vol.17, No.1, pp.104-111, March 2002.

15. M.F.Davis, A.Sutono, S.-W.Yoon, S.Mandal, N.Bushyager, C.-H.Lee, L.Lim, S.Pinel, M.Maeng, A.Obatoyinbo, S.Chakraborty, J.Laskar, M.Tentzeris, T.Nonaka and R.R.Tummala, "Integrated RF Architectures in Fully-Organic SOP Technology", IEEE Transactions on Advanced Packaging, Vol.25, No.2, pp.136-142, May 2002.
16. R.Li, E.M.Tentzeris, J.Laskar, V.F.Fusco and R.Cahill, "Broadband Loop Antenna for DCS-1800/IMT-2000 Mobile Phone Handsets", IEEE Microwave and Wireless Components Letters, Vol.12, No.8, pp.305-307, August 2002.
17. G.Ponchak and E.M.Tentzeris, "Finite Ground Coplanar Waveguide (FGC) Low Loss, Low Coupling 90-Degree Crossover Junctions", IEEE Transactions on Advanced Packaging, Vol.25 No.3, pp.385-392, August 2002.
18. C.H.Lee, A.Sutono, S.Han, K.Lim, S.Pinel, J.Laskar and E.M.Tentzeris, "A Compact LTCC-based Ku-band Transmitter Module", IEEE Transactions of Advanced Packaging, Vol.25 No.3, pp.374-384, August 2002.
19. D.Staiculescu, J.Laskar and E.M.Tentzeris, "Design of Experiments Technique (DOE) for Microwave/Millimeter Wave Flip-Chip Optimization", International Journal of Numerical Modeling, Vol.16, pp.97-103, January 2003.
20. G.Zheng, J.Papapolymerou and M.M.Tentzeris, "Wideband Coplanar Waveguide RF Probe Pad to Microstrip Transitions without Via Holes", IEEE Microwave and Wireless Components Letters, pp.544-546, December 2003.
21. G.E.Ponchak, M.M.Tentzeris and J.Papapolymerou, "Coupling Between Microstrip Lines Embedded in Polyimide Layers for 3D-MMIC's on Si", IEE Proceedings, H Microwaves, Antennas, and Propagation, Vol. 150, No. 5, pp.344-350, October 2003.
22. K.Kawano, N.Miura, M.Kuroda and M.M.Tentzeris, "A Novel Numerical Approach for the Analysis of MEMS-Based Variable Capacitors with Moving Metallic Plates"-in Japanese, The IEICE Transaction on Electronics, Vol. J87-C, No.1, pp32-38, January 2004.
23. R.L.Li, G.DeJean, J.Laskar and M.M.Tentzeris, "Development and Analysis of a Folded Shorted-Patch Antenna with Reduced Size", IEEE Transactions on Antennas and Propagation, Vol.52, No.2, pp.555-562, February 2004.
24. R.L.Li, G.DeJean, J.Papapolymerou, J.Laskar and M.M.Tentzeris, "FDTD Analysis of Microstrip Patch Antennas and Arrays on High Dielectric-Constant Substrate Surrounded by a Soft-and-Hard Surface", IEEE Transactions on Magnetics, Vol.40, No.2, pp.1444-1447, March 2004.
25. M.Kuroda, N.Miura and M.M.Tentzeris, "A Novel Numerical Approach for the Analysis of 2D MEMS-Based Variable Capacitors Including the Effect of Arbitrary Motions", Applied Computational Electromagnetics (ACES) Society Journal, Vol.19, No.1b, pp.133-138, March 2004.
26. J.Papapolymerou, G.Ponchak, E.Dalton, A.Bacon and M.M.Tentzeris, "Crosstalk Between Finite Ground Coplanar Waveguides over Polyimide Layers for 3D-MMIC's on Si Substrates", IEEE Transactions on Microwave Theory and Techniques, Vol.52, No.4, pp.1292-1301, April 2004.
27. D.C.Thompson, O.Tantot, H.Jallageas, G.E.Ponchak, M.M.Tentzeris and J.Papapolymerou, "Characterization of Liquid Crystal Polymer (LCP) Material and Transmission Lines on LCP Substrates from 30-110 GHz", IEEE Transactions on Microwave Theory and Techniques, Vol.52, No.4, pp.1343-1352, April 2004.

28. M.M.Tentzeris, J.Laskar, J.Papapolymerou, D.Thompson, S.Pinel, R.L.Li, J.H.Lee, G.DeJean, S.Sarkar, R.Pratap, R.Bairavasubramanian and N.Papageorgiou, "RF SoP for Multi-band RF and Millimeter-wave Systems", *Advanced Packaging Magazine*, pp.15-16, April 2004.
29. N.Bushyager, E.Dalton and M.M.Tentzeris, "Modeling of Complex RF/Wireless Structures Using Computationally Optimized Time-Domain Techniques", *International Journal of Numerical Modeling*, Vol.17, No.3, pp.223-236, May 2004.
30. R.R.Tummala, M.Swaminathan, M.M.Tentzeris, J.Laskar, G.-K.Chang, S.Sitaraman, D.Keezer, D.Guidotti, Z.Huang, K.Lim, L.Wan, S.K.Bhattacharya, V.Sundaram, F.Liu and P.M.Raj, "The SOP for Miniaturized, Mixed-Signal Computing, Communication and Consumer Systems of the Next Decade", *IEEE Transactions on Advanced Packaging*, Vol.27 No.2, pp.250-267, May 2004.
31. M.M.Tentzeris, J.Laskar, J.Papapolymerou, S.Pinel, V.Palazzari, R.Li, G.DeJean, N.Papageorgiou, D.Thompson, R.Bairavasubramanian, S.Sarkar and J.-H.Lee, "3D Integrated RF and Millimeter-Wave Functions and Modules Using Liquid Crystal Polymer (LCP) System-on-Package Technology", *IEEE Transactions on Advanced Packaging*, Vol.27 No.2, pp.332-340, May 2004.
32. J.-H.Lee, N.Bushyager and M.M.Tentzeris, "Comparative Evaluation of DSP Techniques Coupled with EM Time-Domain Simulators for the Efficient Modeling and Design of Highly Resonant RF-MEMS Structures", *IEEE Microwave and Wireless Components Letters*, Vol.14, No.7, pp.361-363, July 2004.
33. R.L.Li, G.DeJean, K.Lim, M.M.Tentzeris and J.Laskar, "Design of Compact Stacked-Patch Antennas in LTCC Multilayer Packaging Modules for Wireless Applications", *IEEE Transactions on Advanced Packaging*, Vol.27, No.4, pp.581-589, November 2004.
34. R.L.Li, G.DeJean, J.Papapolymerou, J.Laskar and M.M.Tentzeris, "Radiation-Pattern Improvement of Patch Antennas on a Large-Size Substrate Using a Compact Soft Surface Structure and its Realization on LTCC Multilayer Technology", *IEEE Transactions on Antennas and Propagation*, Vol.53, No.1, pp.200-208, January 2005.
35. G.DeJean, R.Bairavasubramanian, D.Thompson, G.E.Ponchak, M.M.Tentzeris and J.Papapolymerou, "Liquid Crystal Polymer (LCP): A New Organic Material for the Development of Multilayer Dual Frequency/Dual Polarization Flexible Antenna Arrays", *IEEE Antennas and Wireless Propagation Letters*, Vol.4, No.1, pp.22-26, January 2005.
36. R.L.Li, D.Thompson, M.M.Tentzeris, J.Laskar and J.Papapolymerou, "Development of a Wideband Short Backfire Antenna Excited by an Unbalance-Fed H-Shaped Slot", *IEEE Transactions on Antennas and Propagation*, Vol.53, No.2, pp.662-671, February 2005.
37. G.E.Ponchak, J.Papapolymerou and M.M.Tentzeris, "Excitation of Coupled Slotline Mode in Finite-Ground CPW with Unequal Ground-Plane Widths", *IEEE Transactions on Microwave Theory and Techniques*, Vol.53, No.2, pp.713-717, February 2005.
38. V.Palazzari, S.Pinel, J.Laskar, L.Roselli and M.M.Tentzeris, "Asymmetrical Dual-Band WLAN Filter in Liquid Crystal Polymer System-on-Package Technology", *IEEE Microwave and Wireless Components Letters*, Vol.15, No.3, pp.165-167, March 2005.

39. G.E.Ponchak, E.Dalton, M.M.Tentzeris and J.Papapolymerou, "Coupling Between Microstrip Lines with Finite Width Ground Plane Embedded in Thin Film Circuits", IEEE Transactions on Advanced Packaging, Vol.28, No.2, pp.320-327, May 2005.
40. D.Staiculescu, N.Bushyager, A.Obatoyinbo, L.Martin and M.M.Tentzeris, "Design and Optimization of 3D Compact Stripline and Microstrip Bluetooth/WLAN Balun Architectures using the Design of Experiments Technique", IEEE Transactions on Antennas and Propagation, Vol.53, No.5, pp.1805-1812, May 2005.
41. J.-H.Lee, G.DeJean, S.Sarkar, S.Pinel, K.Lim, J.Papapolymerou, J.Laskar and M.M.Tentzeris, "Highly Integrated Millimeter-Wave Passive Components Using 3-D LTCC System-on-Package (SOP) Technology", IEEE Transactions on Microwave Theory and Techniques, Vol.53, No.6, pp.2220-2229, June 2005.
42. J.-H.Lee, L.Marcaccioli, G.DeJean, C.Lugo, S.Pinel, J.Papapolymerou, J.Laskar, R.Sorrentino and M.M.Tentzeris, "Advanced System-on-Package (SOP) Front-End Passive Solutions for RF and Millimeter-Wave Wireless Systems", European Microwave Association Magazine, Vol.1, No.2, pp.130-139, June 2005.
43. R.L.Li, D.Thompson, J.Papapolymerou, J.Laskar and M.M.Tentzeris, "A New Excitation Technique for Wideband Short Backfire Antennas", IEEE Transactions on Antennas and Propagation, Vol.53, No.7, pp.2313-2320, July 2005.
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IV.B.2. Selected Refereed Conference Publications

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- 299.H.Lee, G.Shaker, K.Naishadham and M.M.Tentzeris, "A Novel Highly-Sensitive Antenna-based "Smart Skin" Gas Sensor Utilizing Carbon Nanotubes and Inkjet Printing", Procs. Of the 2011 IEEE Antenna and Propagation Symposium, Spokane, WA, July 2011. **Best Student Paper Competition Honorable Mention APS 2011**

300. X.Quan, R.L.Li and M.M.Tentzeris, "A Novel Broadband Omni-Directional Circularly Polarized Antenna for Mobile Communications", Procs. Of the 2011 IEEE Antenna and Propagation Symposium, Spokane, WA, July 2011. **Best Student Paper Competition Honorable Mention APS 2011.**
301. T.Zhang, M.M.Tentzeris and R.L.Li, "A Dual-Frequency Broadband Antenna for Mobile Phone Applications", Procs. Of the 2011 IEEE Antenna and Propagation Symposium, Spokane, WA, July 2011.
302. A.Rida, S.Nikolaou and M.M.Tentzeris, "Design of Low-Cost Microstrip Antenna Arrays for mm-Wave Applications", Procs. Of the 2011 IEEE Antenna and Propagation Symposium, Spokane, WA, July 2011.
303. M.Marroncelli, D.Trinchero and M.M.Tentzeris, " Paper-Based Inkjet-Printed Text-Meandered UHF Resonant Antennas for RFID's", Procs. Of the 2011 URSI General Assembly, Istanbul, TURKEY, August 2011.
304. A.Traille and M.M.Tentzeris, "Liquid RF Antennas, Electronics and Sensors: A Modeling Challenge", Procs. Of the 2011 URSI General Assembly, Istanbul, TURKEY, August 2011. **National Academy of Engineering (NAE) Travel Grant Award.**
305. S.Beck, S.T.Kim, K.Lim, M.M.Tentzeris, "A Multi-Band WCDMA SAW-less Receiver with a Frequency Selective Feedback Loop", Procs. 54th International Midwest Symposium on Circuits and Systems (MWSCAS), Seoul, KOREA, August 2011..
306. A.Rida, V.Lakafosis, R.Vyas, M.M.Tentzeris and S.Nikolaou, "Review of Technologies for Low-Cost Integrated Sensors", Procs. 2011 IEEE International Conference on RFID Technologies and Applications (RFID-TA), pp.513-520, Barcelona, SPAIN, September 2011.
307. X.Yi, T.Wu, G.Lantz, J.Cooper, C.Cho, Y.Wang, M.M.Tentzeris and R.T.Leon, "Sensing Resolution and Measurement Range of a Passive Wireless Strain Sensor", Procs. 8th International Workshop on Structural Health Monitoring, Stanford, CA, September 2011. **Best Student Paper Award**
308. A.Traille, S.Bouaziz, H.Aubert, P.Pons and M.M.Tentzeris, "A Novel Wireless Passive Temperature Sensor Utilizing Microfluidic Principles in Millimeter-Wave Frequencies", Procs. IEEE Sensors 2011 Conference, pp.524-525, Limerick, IRELAND, October 2011.
309. V.Lakafosis, X.Yi, T.Le, E.Gebara, Y.Wang and M.M.Tentzeris, " Wireless Sensing with Smart Skins", Invited Paper to the IEEE Sensors 2011 Conference, pp.623-626, Limerick, IRELAND, October 2011.
310. T.T.Thai, H.Aubert, P.Pons, R.Plana and M.M.Tentzeris, "A Newly Developed Radio Frequency Wireless Passive Highly Sensitive Strain Transducer", Procs. IEEE Sensors 2011 Conference, pp.211-214, Limerick, IRELAND, October 2011.
311. A.Traille, S.Bouaziz, S.Pinon, P.Pons, H.Aubert, M.M.Tentzeris and A.Boukabache, "A Wireless Temperature Sensor Using Liquid Metal and Microfluidic Technologies", Procs. European Microwave Week 2011, Manchester, UK, October 2011.
312. G.Shaker, H.Lee, S.Safavi-Naeini and M.M.Tentzeris, "Printed Electronics for Next Generation Wireless Devices", Procs. 2011 Antennas and Propagation Conference (LAPC 2011), Loughborough, UK, November 2011.
313. F.Ciuppi, A.Georgiadis, S.Via, A.Collado, R.Vyas, M.M.Tentzeris and M.Bozzi, "A 927 MHz Solar Powered Active Antenna Oscillator Beacon Signal

- Generator”, Procs. 2012 IEEE Conference on Wireless Sensors and Sensor Networks (WiSNeT 2012), Santa Clara, CA, January 2012. **Best Student Paper Award Finalist**
314. Le, Taoran; Lakafosis, Vasileios; Lin, Ziyin; Wong, C. P.; Tentzeris, M. M.; , “Inkjet-printed graphene-based wireless gas sensor modules,” Procs. 2012 IEEE Electronic Components and Technology Conference (ECTC), pp.1003-1007, June 2012, San Diego, CA.
315. A.Georgiadis, A.Collado, S.Kim, H.Lee and M.M.Tentzeris, “UHF solar powered active oscillator antenna on low cost flexible substrate for wireless identification applications”, Procs. 2012 IEEE International Microwave Symposium, pp.1-3, June 2012, Montreal, CANADA.
316. H.Lee, S.Kim, D.De Donno and M.M.Tentzeris, “A novel “Universal” inkjet-printed EBG-backed flexible RFID for rugged on-body and metal mounted applications”, Procs. 2012 IEEE International Microwave Symposium, pp.1-3, June 2012, Montreal CANADA. **Best Student Paper Finalist**
317. R.Vyas, H.Nishimoto, M.M.Tentzeris, Y.Kawahara and T.Asami, “A battery-less, energy harvesting device for long range scavenging of wireless power from terrestrial TV broadcasts”, Procs. 2012 IEEE International Microwave Symposium, pp.1-3, June 2012, Montreal, CANADA. **Best Student Paper Finalist**
318. S.Kim, M.M.Tentzeris, G.Jin, S.Nikolaou, “Inkjet Printed Ultra Wideband Spiral Antenna Using Integrated Balun on Liquid Crystal Polymer (LCP)”, Procs. 2012 IEEE International Symposium on Antennas and Propagation, pp.1-2, July 2012, Chicago, IL.
319. H.Lee, F.Bush, M.M.Tentzeris and G.Shaker, “Inkjet-Printed Cylindrical EBG for Low-Cost Omnidirectional Antennas Using Split-Ring Resonators”, Procs. 2012 IEEE International Symposium on Antennas and Propagation, pp.1-2, July 2012, Chicago, IL.
320. H.Lee, M.M.Tentzeris and J.Geiger, “Flexible Spiral Antenna with Microstrip Tapered Infinite Balun for Wearable Applications”, Procs. 2012 IEEE International Symposium on Antennas and Propagation, pp.1-2, July 2012, Chicago, IL.
321. S.Kim, M.M.Tentzeris, S.Nikolaou, “Wearable Biomonitoring Monopole Antennas Using Inkjet Printed Electromagnetic Band gap Structures”, Procs. 2012 IEEE International Symposium on Antennas and Propagation, pp.1-2, July 2012, Chicago, IL.
322. S.Palacios, S.Kim, S.Elia, A.Rida, M.M.Tentzeris and S.Nikolaou, “Inkjet-Printed Planar Antenna for a Wireless Sensor on Paper Operating at WiFi Frequencies”, Procs. 2012 IEEE International Symposium on Antennas and Propagation, pp.1-2, July 2012, Chicago, IL.
323. D.DeDonno, L.Tarricone, V.Lakafosis and M.M.Tentzeris, “Multipacket Reception MAC Schemes for the RFID EPC Gen2 Protocol”, Procs. 2012 International Symposium on Wireless Communication Systems (ISWCS), pp.311-315, August 2012, Paris, FRANCE.

- 324.H.Lee, M.M.Tentzeris, Y.Kawahara and A.Georgiadis, ``Novel Inkjet-Printed Ferromagnetic-Based Solutions for Miniaturized Wireless Power Transfer (WPT) Inductors and Antennas'', Procs.2012 International Symposium on Antennas and Propagation (ISAP), pp.14-17, October 2012, JAPAN.
- 325.T.Le, V.Lakafosis, Z.Lin, M.M.Tentzeris and C.P.Wong, ``A Novel Graphene-Based Inkjet-Printed WISP-Enabled Gas Sensor'', Procs. 2012 European Microwave Conference, Amsterdam, NETHERLANDS, November 2012. **Listed among Best Conference Papers.**
- 326.R.Moro, M.Bozzi, S.Kim and M.M.Tentzeris, ``Substrate Integrated Waveguide Components in Paper-Based Inkjet-Printed Technologies'', Procs. 2012 European Microwave Conference, Amsterdam, NETHERLANDS, November 2012. **Listed among Best Conference Papers.**
- 327.R.Shigeta, T.Sasaki, D.M.Quan, Y.Kawahara, R.Vyas, M.Tentzeris and T.Asami, ``Ambient RF Energy Harvesting Sensor Node with Capacitor-Leakage-Aware Duty Cycle Control'', Procs. 2012 IEEE Sensors Conference, Taipei, TAIWAN, November 2012. **Second Best Paper Award Prize**
- 328.T.Le, T.Thai, V.Lakafosis, M.Tentzeris, Z.Lin, Y.Fang, K.Sandhage, C.P.Wong, ``Graphene-Enhanced Wireless Sensors'', Procs. 2012 IEEE Sensors Conference, pp.1-4, Taipei, TAIWAN, November 2012.
- 329.J.R.Cooper and M.M.Tentzeris, ``Novel ``Smart-Cube'' Wireless Sensors with Embedded Processing/Communication/Power Core for ``Smart Skin'' Applications'', Procs. 2012 IEEE Sensors Conference, pp.1-4, Taipei, TAIWAN, November 2012.
- 330.J.Virkki, J.Virtanen, L.Sydanheimo, L.Ukkonen and M.Tentzeris, ``Embedding Inkjet-Printed Antennas into Plywood Structures for Identification and Sensing'', Procs. 2012 IEEE International Conference on RFID Technologies and Applications (RFID-TA), pp.34-39, Nice, FRANCE, November 2012.
- 331.H.Aubert, F.Chebila, M.Jatlaoui, T.Thai, H.Hallil, A.Traille, S.Bouaziz, A.Rifai, P.Pons, P.Menini and M.Tentzeris, ``Wireless Sensing and Identification of Passive Electromagnetic Sensors based on Millimeter-Wave FMCW Radar'', Procs. 2012 IEEE International Conference on RFID Technologies and Applications (RFID-TA), pp.398-403, Nice, FRANCE, November 2012.
- 332.L.Aluigi, T.T.Thai, M.M.Tentzeris, L.Roselli, F.Alimenti, ``Heterogeneous Integration of Flexible Substrate Spiral Antennas and Silicon Chips by Magnetic Coupling'', Procs. 2012 Asia-Pacific Microwave Conference, pp.848-850, TAIWAN, December 2012.
- 333.C.Mariotti, V.Lakafosis, M.M.Tentzeris and L.Roselli, ``An IPv6-enabled Wireless Shoe-Mounted Platform for Health Monitoring'', Procs. 2013 IEEE Topical Conference on Wireless Sensors and Sensor Networks (WiSNet), pp.46-48, Austin, TX, January 2013. Invited Paper
- 334.L.Aluigi, T.T.Trang, M.M.Tentzeris, L.Roselli and F.Alimenti, ``Chip-to-Package Wireless Power Transfer and its Application to mm-Wave Antennas and Monolithic Radiometric Receivers'', Procs. 2013 IEEE Radio and Wireless Symposium (RWS), pp.202-204, Austin, TX, January 2013.
- 335.Y.Kawahara, W.Wei, Y.Narusue, R.Shigeta, T.Asami and M.M.Tentzeris, ``Virtualizing Power Cords by Wireless Power Transmission and Energy Harvesting'', Procs. 2013 IEEE Radio and Wireless Symposium (RWS), pp.37-39, Austin, TX, January 2013.

- 336.T.Bjorninen, J.Virkki, J.Virtanen, L.Sydanheimo, L.Ukkonen and M.M.Tentzeris, ``Inkjet-Printing and Performance Evaluation of UHF RFID Tag Antennas on Renewable Materials with Porous Surfaces", Procs. 2013 European Conference on Antennas and Propagation (EuCAP), pp.1721-1725, SWEDEN, March 2013.
- 337.H.Aubert, P.Pons and M.M.Tentzeris, ``Wireless Remote Sensing Based on Radar Cross Section Variability Measurement of Passive Electromagnetic Sensors", Procs. 2013 European Conference on Antennas and Propagation (EuCAP), pp.1714-1717, SWEDEN, March 2013.
- 338.S.Kim, R.Moro, M.Bozzi, S.Nikolaou and M.M.Tentzeris, ``Inkjet-Printed Wearable Microwave Components for Biomedical Applications", Procs. 2013 European Conference on Antennas and Propagation (EuCAP), pp.1714-1717, SWEDEN, March 2013.
- 339.O.Jonah, S.V.Georgakopoulos and M.M.Tentzeris, ``Wireless Power Transfer to Mobile Wearable Devices via Magnetic Resonance", Procs. 2013 IEEE Wireless and Microwave Technology Conference (WAMICON), pp.1714-1717, Orlando, FL, April 2013.
- 340.A.Vena, E.Moradi, K.Koski, A.A.Babar, L.Sydanheimo, L.Ukkonen and M.M.Tentzeris, ``Design and Realization of Stretchable Sewn Chipless RFID Tags and Sensors for Wearable Applications", Procs. 2013 IEEE International Conference on RFID, pp.176-183, Orlando, FL, pp.176-183, April 2013.
- 341.** O.Jonah, S.V.Georgakopoulos and M.M.Tentzeris, ``Orientation-Insensitive Power Transfer by Magnetic Resonance in Mobile Devices", Procs. 2013 IEEE Wireless Power Transfer Conference (WPTC), pp., Perugia, ITALY, May 2013.
Second Best Paper Award
- 342.T.Le, Z.Lin, C.P.Wong and M.M.Tentzeris, ``Novel Enhancement Techniques for Ultra-High-Performance Conformal Wireless Sensors and "Smart Skins" Utilizing Inkjet-Printed Graphene", Procs. 2013 IEEE Conference on Electronic Components and Technology (ECTC), pp.1640-1643, Las Vegas, NV, May 2013.
- 343.B.S.Cook, J.R.Cooper, S.Kim and M.M.Tentzeris, ``A Novel Inkjet-Printed Passive Microfluidic RFID-Based Sensing Platform", Procs. 2013 IEEE International Microwave Symposium (IMS), pp., Seattle, WA, June 2013.
- 344.S.Kim, B.Cook, J.Cooper, A.Traille, A.Georgiadis, H.Aubert and M.M.Tentzeris, ``A Novel Dual-Band Retrodirective Reflector Array on Paper Utilizing Substrate Integrated Waveguide (SIW) and Inkjet Printing Technologies for Chipless RFID Tag and Sensor Applications", Procs. 2013 IEEE International Microwave Symposium (IMS), pp., Seattle, WA, June 2013.
- 345.R.Vyas, B.Cook, Y.Kawahara and M.M.Tentzeris, ``A Self-sustaining Autonomous Wireless Sensor Beacon Powered from Long-Range Ambient RF Energy", Procs. 2013 IEEE International Microwave Symposium (IMS), pp., Seattle, WA, June 2013.
- 346.R.De Paolis, T.Le, F.Coccetti, G.Monti, L.Tarricone and M.M.Tentzeris, ``A Novel Circuit Model of Nanotechnology-Enabled Inkjet-Printed Gas Sensors Using Multi-Wall Carbon Nanotubes", Procs. 2013 IEEE International Microwave Symposium (IMS), pp., Seattle, WA, June 2013.
- 347.S.Kim, Y.Kawahara, A.Georgiadis, A.Collado and M.M.Tentzeris, ``Low-Cost Inkjet-Printed Fully Passive RFID Tags Using Metamaterial-inspired Antennas for Capacitive Sensing Applications", Procs. 2013 IEEE International Microwave Symposium (IMS), pp., Seattle, WA, June 2013.

348. A.Rifai, E.Debourg, S.Bouaziz, A.Traille, P.Pons, H.Aubert and M.M.Tentzeris, "Wireless Chipless Passive Microfluidic Temperature Sensor", Procs. 2013 International Conference on Transducers and Eurosensors, pp.1024-1027, Barcelona, SPAIN, June 2013.
349. W.Su, B.Cook, M.Tentzeris, C.Mariotti and L.Roselli, "A Novel Inkjet-Printed Microfluidic Tunable Coplanar Patch Antenna", Procs. 2014 IEEE Antennas and Propagation International Symposium (APS), pp.858-859, Memphis, TN, July 2014.
350. P.Pons, H.Aubert and M.Tentzeris, "Overview of electromagnetic transducers with radar interrogation for passive wireless sensors applications", Procs. 2014 20th International Conference on Microwaves, Radar, and Wireless Communication (MIKON), pp.1-3, Gdansk, POLAND, June 2014.
351. S.Yao, X.Liu, S.V.Georgakopoulos and M.M.Tentzeris, "A novel reconfigurable origami spring antenna", Procs. 2014 IEEE Antennas and Propagation International Symposium (APS), pp.374-375, Memphis, TN, July 2014.
352. A.Traille, S.Kim, A.Coustou, H.Aubert and M.M.Tentzeris, "A conformal/rollable monolithic miniaturized ultra-portable ground penetrating radar using additive and inkjet printing", Procs. 2014 IEEE MTT-S International Microwave Symposium (IMS), pp.1-4, Tampa Bay, FL, June 2014.
353. A.Traille, A.Coustou, H.Aubert, S.Kim, J.Kimionis, M.M.Tentzeris, A.Georgiadis, A.Collado, "Novel Inkjet Printed Modules for Sensing, Radar and Energy Harvesting Applications", Procs. 2014 44th European Microwave Conference (EuMC), pp.1-4, Paris, FRANCE, October 2014.
354. S.Jang, S.Kim and M.M.Tentzeris, "Low-cost flexible RFID tag for on-metal applications", Procs. 2014 IEEE Antennas and Propagation International Symposium (APS), pp.1298-1299, Memphis, TN, July 2014.
355. S.Yao, S.V.Georgakopoulos, B.Cook and M.M.Tentzeris, "A novel reconfigurable origami accordion antenna", Procs. 2014 IEEE MTT-S International Microwave Symposium (IMS), pp.1-4, Tampa Bay, FL, June 2014.
356. X.Liu, S.Yao, S.V.Georgakopoulos, B.S.Cook and M.M.Tentzeris, "Reconfigurable helical antenna based on an origami structure for wireless communication system", Procs. 2014 IEEE MTT-S International Microwave Symposium (IMS), pp.1-4, Tampa Bay, FL, June 2014.
357. C.Mariotti, L.Aluigi, T.T.Thai, F.Alimenti, L.Roselli and M.M.Tentzeris, "A fully inkjet-printed 3D transformer balun for conformal and rollable microwave applications", Procs. 2014 IEEE Antennas and Propagation International Symposium (APS), pp.330-331, Memphis, TN, July 2014.
358. S.Kim, H.Aubert and M.M.Tentzeris, "An inkjet-printed flexible broadband coupler in substrate integrated waveguide (SIW) technology for sensing, RFID and communication applications", Procs. 2014 IEEE MTT-S Microwave Symposium (IMS), pp.1-4, Tampa Bay, FL, June 2014.
359. D.Daerhan, O.Jonah, H.Hu, S.V.Georgakopoulos and M.M.Tentzeris, "Novel highly-efficient and misalignment insensitive wireless power transfer systems utilizing Strongly Coupled Magnetic Resonance principles", Procs. 2014 IEEE 64th Electronic Components and Technology Conference (ECTC), pp.759-762, Orlando, FL, May 2014.
360. S.Kim, T.Le, M.M.Tentzeris, A.Harrabi, A.Collado and A.Georgiadis, "An RFID-enabled inkjet-printed soil moisture sensor on paper for "smart" agricultural

- applications", Procs. 2014 IEEE Sensors Conference, pp.1507-1510, Valencia, SPAIN, November 2014.
- 361.J.Bito, B.Tehrani, B.Cook and M.Tentzeris, "Fully inkjet-printed multilayer microstrip patch antenna for Ku-band applications", Procs. 2014 IEEE Antennas and Propagation International Symposium (APS), pp.854-855, Memphis, TN, July 2014.
 - 362.R.J.Vyas, J.Bito, S.Kim and M.M.Tentzeris, "Harvesting wireless signals from two-way talk-radios to power smart meters and displays", Procs. 2014 IEEE MTT-S International Microwave Symposium (IMS), pp.1-4, Tampa Bay, FL, June 2014.
 - 363.H.Saghlatoon, L.Sydanheimo, L.Ukkonen and M.M.Tentzeris, "Optimized RF/microwave antennas and circuits on low-cost fibrous substrates using inkjet-printing technology", Procs. 2014 IEEE Antennas and Propagation International Symposium (APS), pp.322-323, Memphis, TN, July 2014.
 - 364.M.Yoo, S.Lim and M.Tentzeris, "Flexible inkjet-printed metamaterial paper absorber", Procs. 2014 IEEE Antennas and Propagation International Symposium (APS), pp.2060-2061, Memphis, TN, July 2014.
 - 365.J.Kimionis, M.M.Tentzeris and S.Nikolaou, "Inkjet-printed UHF RFID folded dipole antennas for remote sensing applications", Procs. 2014 IEEE Antennas and Propagation International Symposium (APS), pp.332-333, Memphis, TN, July 2014.
 - 366.A.Traille, A.Coustou, H.Aubert, S.Kim and M.M.Tentzeris, "A Technology for fully printable and rollable ground penetrating radar (GPR) systems", Procs. 2014 IEEE Antennas and Propagation International Symposium (APS), pp.334-335, Memphis, TN, July 2014.
 - 367.J.Kimionis, A.Georgiadis, S.Kim, A.Collado, K.Niotaki and M.M.Tentzeris, "An enhanced-range RFID tag using an ambient energy powered reflection amplifier", Procs. 2014 IEEE MTT-S International Microwave Symposium (IMS), pp.1-4, Tampa Bay, FL, June 2014.
 - 368.Y.-H.Di, X.-Y.Liu and M.M.Tentzeris, "A conformable dual-band antenna equipped with AMC for WBAN applications", Procs. 2014 3rd Asia-Pacific Conference on Antennas and Propagation (APCAP), pp.388-391, Harbin, CHINA, July 2014.
 - 369.X.Liu, S.Yao, S.V.Georgakopoulos and M.Tentzeris, "Origami Quadrifilar Helix Antenna in UHF band", Procs. 2014 IEEE Antennas and Propagation International Symposium (APS), pp.372-373, Memphis, TN, July 2014..
 - 370.J.Bito, S.Kim, M.Tentzeris and S.Nikolaou, "Ambient energy harvesting from 2-way talk-radio signals for "smart" meter and display applications", Procs. 2014 IEEE Antennas and Propagation International Symposium (APS), pp.1353-1354, Memphis, TN, July 2014.
 - 371.M.Hasani, A.Vena, L.Sydanheimo, L.Ukkonen and M.M.Tentzeris, "A novel RFID-enabled strain sensor using the double power measurement technique", Procs. 2014 IEEE MTT-S International Microwave Symposium (IMS), pp.1-4, Tampa Bay, FL, June 2014.
 - 372.B.Tehrani, B.Cook, J.Cooper and M.Tentzeris, "Inkjet printing of a wideband, high gain mm-Wave Vivaldi antenna on a flexible organic substrate", Procs. 2014 IEEE Antennas and Propagation International Symposium (APS), pp.320-321, Memphis, TN, July 2014.

- 373.Y.He, Z.Pan, J.Yang, G.Sun and M.M.Tentzeris, "Effect of feeder cable's phase tolerance on the first sidelobe level of base station antenna", Procs. 2014 International Wireless Communications and Mobile Computing Conference (IWCMC), pp.1022-1026, Nicosia, CYPRUS, August 2014.
- 374.R.Goncalves, J.Hester, N.Carvalho, P.Pinho and M.Tentzeris, "Passive sensors for food quality monitoring and counterfeiting", Procs. 2014 IEEE Sensors Conference, pp.1511-1514, Valencia, SPAIN, November 2014.
- 375.A.Vena, M.Tedjini, T.Bjorninen, L.Sydanheimo, L.Ukkonen and M.M.Tentzeris, "A novel inkjet-printed wireless chipless strain and crack sensor on flexible laminates", Procs. 2014 IEEE Antennas and Propagation International Symposium (APS), pp.1294-1295, Memphis, TN, July 2014.
- 376.S.-H.Zheng, X.-Y.Liu and M.M.Tentzeris, "A novel optically controlled reconfigurable antenna for cognitive radio systems", Procs. 2014 IEEE Antennas and Propagation International Symposium (APS), pp.1246-1247, Memphis, TN, July 2014.
- 377.B.K.Tehrani, J.Bito, B.S.Cook and M.M.Tentzeris, "Fully inkjet-printed multilayer microstrip and T-resonator structures for the RF characterization of printable materials and interconnects", Procs. 2014 IEEE MTT-S International Microwave Symposium (IMS), pp.1-4, Tampa Bay, FL, June 2014.
- 378.A.Vena, L.Sydanheimo, L.Ukkonen and M.M.Tentzeris, "A fully inkjet-printed chipless RFID gas and temperature sensor on paper", Procs. 2014 IEEE RFID Technology and Applications Conference (RFID-TA), pp.115-120, Tampere, FINLAND, September 2014.
- 379.S.Kim, M.M.Tentzeris and H.Aubert, "An inkjet-printed flexible broadband multilayer SIW coupler for antenna array systems", Procs. 2014 IEEE Antennas and Propagation International Symposium (APS), pp.324-325, Memphis, TN, July 2014.
- 380.B.S.Cook, C.Mariotti, J.R.Cooper, D.Revier, B.K.Tehrani, L.Aluigi, L.Roselli and M.M.Tentzeris, "Inkjet-printed, vertically-integrated, high-performance inductors and transformers on flexible LCP substrate", Procs.2014 IEEE MTT-S International Microwave Symposium (IMS), pp.1-4, Tampa Bay, FL, June 2014.
- 381.W.Su, C.Mariotti, B.S.Cook, S.Lim, L.Roselli and M.M.Tentzeris, "A metamaterial-inspired temperature stable inkjet-printed microfluidic-tunable bandstop filter", Procs. 2014 44th European Microwave Conference (EuMC), pp.9-12, Rome, ITALY, October 2014.
- 382.**J.Kimionis and M.M.Tentzeris, "RF tag front-end design for uncompromised communication and harvesting", Procs. 2014 IEEE RFID Technology and Applications Conference (RFID-TA), pp.109-114, Tampere, FINLAND, September 2014. **Best Student Paper Award**
- 383.S.Yao, X.Liu, S.V.Georgakopoulos and M.M.Tentzeris, "A novel tunable origami accordion antenna", Procs. 2014 IEEE Antennas and Propagation International Symposium (APS), pp.370-371, Memphis, TN, July 2014.
- 384.A.Traille, A.Georgiadis, A.Collado, Y.Kawahara, H.Aubert and M.M.Tentzeris, "Inkjet-printed "Zero-Power" wireless sensor and power management nodes for IoT and "Smart Skin" applications", Procs. 2014 XXXIth URSI General Assembly and Scientific Symposium (URSI GASS), pp.1-4, August 2014.
- 385.**K.Niotaki, S.Kim, F.Giuppi, A.Collado, A.Georgiadis and M.M.Tentzeris, "Optimized design of multiband and solar rectennas", Procs. 2014 IEEE Topical

- Conference on Wireless Sensors and Sensor Networks (WiSNet), pp.31-33, Newport Beach, CA, January 2014.
386. J.R.Cooper, B.S.Cook and M.M.Tentzeris, "The first hardware-based, anti-collision methodology for frequency doubling transceivers for RFID and wireless sensing applications", Procs. 2014 IEEE MTT-S International Microwave Symposium (IMS), pp.1-4, Tampa Bay, FL, June 2014.
 387. T.Le, Z.Lin, C.P.Wong and M.M.Tentzeris, "Enhanced-performance wireless conformal "smart skins" utilizing inkjet-printed carbon-nanostructures", Procs. 2014 IEEE 64th Electronic Components and Technology Conference (ECTC), pp.769-774, Orlando, FL, May 2014.
 388. J.Kimionis, M.M.Tentzeris, A.Georgiadis and A.Collado, "Inkjet-printed reflection amplifier for increased-range Backscatter radio", Procs. 2014 44th European Microwave Conference (EuMC), pp.5-8, Rome, ITALY, October 2014.
 389. M.M.Tentzeris, S.Kim, R.Vyas, A.Traille, P.Pons, H.Aubert, A.Georgiadis and A.Collado, "Inkjet-printed "Zero-Power" wireless sensor and power management nodes for IoT and "Smart Skin" applications", Procs. 2014 20th International Conference on Microwaves, Radar, and Wireless Communication (MIKON), pp.1-7, Gdansk, POLAND, June 2014.
 390. C.D.Saintsing, K.Yu, H.J.Qi and M.M.Tentzeris, "Planar Monopole Antennas on Substrates Fabricated Through an Additive Manufacturing Process", Proc. of the 2015 IEEE Radio and Wireless Symposium (RWS), pp.159-161, January 2015.
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- 488.S.Ghosh, M.M.Tentzeris and S.Lim, "[Lightweight 3D Printed Metamaterial for Electromagnetic Wave Absorption](#)". Proc. of the **2018 ISAP Symposium**, Busan, KOREA, October 2018, pp.
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- 537.K.Hu, X.He and M.M.Tentzeris, “Flexible and Scalable Additively Manufactured Antenna Array Tiles for Satellite and 5G Applications Using a Novel Rugged Microstrip-to-Microstrip Transition”, Procs. IEEE 2021 Antennas and Propagation Symposium, SINGAPORE, December 2021, pp.37-38.
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- 539.M.Holda, Y.Cui, A.Nauroze, M.Tentzeris and P.Dahmen, “Pop-Up Card Inspired 3D-Printed Corner Reflector Antenna – A Novel Deployable Antenna”, Procs. IEEE 2021 Antennas and Propagation Symposium, SINGAPORE, December 2021, pp.751-752.
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- 541.A.Alreshaid, Y.Cui, R.Bahr, M.M.Tentzeris and M.S.Sharawi, “A Millimeter Wave Tri-Polarized Patch Antenna with a Bandwidth-Enhancing Parasitic Element”, Procs. IEEE 2021 Antennas and Propagation Symposium, SINGAPORE, December 2021, pp.1051-1052.

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- 543.C.A.Lynch, A.O.Adeyeye, B.Tehrani and M.M.Tentzeris, "Flexible Passive Smart Skin Temperature Sensor for Remote Sensing in Structural Health Monitoring Applications", Procs. IEEE 2021 Antennas and Propagation Symposium, SINGAPORE, December 2021, pp.1123-1124.
- 544.A.Eid, J.Hester and M.M.Tentzeris, "Extending the Range of 5G Energy Transfer: Towards the Wireless Power Grid", Procs. 2022 16th European Conference on Antennas and Propagation (EuCAP), Madrid, SPAIN, March 2022.
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- 546.Y.Zhou, K.Hu, M.M.Tentzeris and S.K.Sitaraman, "Mechanical and Ka-Band Electrical Reliability Testing of Interconnects in 5G Wearable System-on-Package Designs Under Bending", Procs. of the 2022 IEEE 72nd Electronic Components and Technology Conference (ECTC), San Diego, CA, May 2022, pp.914-923.
- 547.S.D.Assimonis, V.Fusco and M.M.Tentzeris, "Efficient Circular Polarized Metamaterial RF Energy Harvester for Wi-Fi Applications", Procs.2022 International Workshop on Antenna Technology (iWAT), Dublin, IRELAND, May 2022, pp.150-152.
- 548.C.A.Lynch III, A.Adeyeye, A.Eid, J.Hester and M.M.Tentzeris, "Ultra-Long-Range Dual Rotman Lenses-Based Harmonic mmID's for 5G/mm-Wave IoT Applications", Procs. of the 2022 IEEE International Microwave Symposium (IMS), Denver, CO, June 2022.
- 549.A.Adeyeye, C.Lynch, J.Hester and M.M.Tentzeris, "A Machine Learning Enabled mmWave RFID for Rotational Sensing in Human Gesture Recognition and Motion Capture Applications", Procs. of the 2022 IEEE International Microwave Symposium (IMS), Denver, CO, June 2022.
- 550.K.Hu, G.Soto-Valle, Y.Cui and M.M.Tentzeris, "Flexible and Scalable Additively Manufactured Tile-Based Phased Arrays for Satellite Communication and 5G mmWave Applications", Procs. of the 2022 IEEE International Microwave Symposium (IMS), Denver, CO, June 2022.
- 551.R.Salvati, V.Palazzi, G.Cicioni, G.Simoncini, F.Alimenti, M.M.Tentzeris, P.Mezzanotte and L.Roselli, "Zero-Power Wireless Pressure Sensor based on Backscatter Harmonic Transponder in a WPT context", Proc. of the 2022 IEEE Wireless Power Week (WPW), Bordeaux, FRANCE, July 2022, pp.199-202.
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555. V.Palazzi, M.Tentzeris, F.Alimenti, P.Mezzanotte and L.Roselli, "A Novel Additively-Manufactured Pressure Transducer for Zero-Power Wireless Sensing", Proc. of the 2022 European Microwave Conference (EuMC), Milan, ITALY, September 2022, pp.68-71.
- 556.K.Hu, Y.Zhou, S.K.Sitaraman and M.M.Tentzeris, "Additively manufactured flexible material characterization and on-demand "smart" packaging topologies for 5G/mmwave wearable applications", Procs. of the 2023 IEEE 73rd Electronic Components and Technology Conference (ECTC), Orlando, FL, May 2023.
- 557.A.Eid, N.Rich, A.Hattori, I.-T.Chen, J.Hester and M.M.Tentzeris, "Deployable Origami Coils for Wireless UAV in-Flight Powering", Procs. of the 2023 IEEE Wireless Power Technologies Conference & Expo (WPTCE), San Diego, CA, June 2023. **[Second Best Contribution Award]**
- 558.L.Smith, C.Lynch, C.A.Kaylor, L.A.Campos, L.Cheng, S.Ralph and M.M.Tentzeris, "A Converged Optical and mm-Wave Dual-Band Multi-Beam Rotman Lens Antenna System Enabling Simplified Designs of 5G/mmW Base Stations and Network Densification", Procs. of the 2023 IEEE International Microwave Symposium (IMS), San Diego, CA, June 2023.
- 559.C.A.Lynch III, G.Soto-Valle, J.Hester and M.M.Tentzeris, "mmIDs Enter the 3rd Dimension: A Camera Inspired Broadbeam High-Gain Retrodirective Backscatter Tag", Procs. of the 2023 IEEE International Microwave Symposium (IMS), San Diego, CA, June 2023.
- 560.I.-T.Chen, C.A.Lynch III, A.Eid, J.G.D.Hester and M.M.Tentzeris, "Rotman-Lens-Based Reconfigurable Intelligent Surface mmID with Energy Harvesting Capability", Procs. of the 2023 IEEE International Microwave Symposium (IMS), San Diego, CA, June 2023.
- 561.K.Hu, T.Callis and M.M.Tentzeris, "Additively Manufactured Flexible On-Package Phased Antenna Arrays with Integrated Microfluidic Cooling Channels for 5G/mmWave System-on-Package Designs", Procs. of the 2023 IEEE International Microwave Symposium (IMS), San Diego, CA, June 2023.
- 562.M.Joshi, C.A.Lynch III, G.Soto-Valle, A.Adeyeye, R.Bahr and M.M.Tentzeris, "Machine Learning-Enhanced Gyro mmID-Sensor for Virtual Reality and Motion Tracking Applications", accepted for presentation to European Microwave Week (EuMW) 2023, Berlin, GERMANY, September 2023.

IV.C: OTHER PUBLICATIONS

1. E.Tentzeris, N.Dib, L.P.B.Katehi, J.Oswald and P.Siegel, "Modeling of Diode Mounting Structures Using the Finite Difference Time-Domain Method", Proc. of

- the 1994 International Union of Radio Science (URSI) Symposium, p.277, Seattle, WA, June 1994.
2. K.Goverdhanam, E.Tentzeris and L.P.B.Katehi, "Macromodeling of Circuit Components for High-Frequency Applications", Proc. of the 1995 URSI Symposium, p.361, Newport Beach, CA, June 1995.
 3. J.-G.Yook, E.Tentzeris and L.P.B.Katehi, "Parallelization of the Finite Difference Time-Domain Code on Shared Memory Machine", Proc. of the 1996 Progress in Electromagnetics Research Symposium (PIERS), p.85, Innsbruck, AUSTRIA, July 1996.
 4. G.E.Ponchak, E.Tentzeris and L.P.B.Katehi, "Finite Ground Coplanar (FGC) Waveguide: A Better Transmission Line", Proc. of the 1998 PIERS Symposium, p.86, Nantes, FRANCE, October 1998.
 5. E.M.Tentzeris, D.Staiculescu, N.G.Cafaro and J.Laskar, "Design and Optimization of Novel RF Packaging Structures Using Multiresolution and Statistical Schemes", Invited Paper in the 2000 PIERS Symposium, p.384, Boston, MA, July 2000.
 6. N.Bushyager, B.McGarvey and E.M.Tentzeris, "Modeling of Photonic Bandgap (PBG) Devices Using MRTD Adaptive Schemes", Invited Paper in the 2000 PIERS Symposium, p.58, Boston, MA, July 2000.
 7. D.Staiculescu, J.Laskar and E.M.Tentzeris, "Flip-Chip vs. Wirebond", Printed Circuit Design Magazine, pp.12-16, June 2002.
 8. M.M.Tentzeris, R.Vyas, V.Lakafosis, T.Le, A.Rida and S.Kim, "Conformal 2D/3D Wireless Modules Utilizing Inkjet Printing and Nanotechnology", ***Cover Story*** in the Microwave Magazine, February 2012.

IV.D: PRESENTATIONS (Selected)

1. Invited Presentation in the Workshop: "Multiresolution Techniques in Electromagnetics" in the 1998 IEEE AP-S Conference, Atlanta, GA, June 1998.
2. Invited Presentation in the Workshop: "Novel Full-Wave Techniques for HF Circuit Analysis" in the 1999 IEEE IMS (MTT-S) Conference, Anaheim, CA, June 1999.
3. Invited Presentation in the Workshop: "Time-Domain Techniques for Radiation Problems" in the 1999 AP-S Conference, Orlando, FL, July 1999.
4. Invited Presentation in the Short Course: "RF Packaging State-of-the-Art" in the 2000 NEPCONWest Conference, Anaheim, CA, March 2000.
5. Invited Presentations in the Workshops: "Novel Techniques for RF Packaging Design" in the 2000 IEEE-CPMT Conference, Las Vegas, NV, May 2000, 2001 IEEE-CPMT Conference, Orlando, FL, May 2001, 2002 IEEE-CPMT Conference, San Diego, CA, May 2002, 2003 IEEE-CPMT Conference, New Orleans, LA, May 2003 and 2004 IEEE-CPMT Conference, Las Vegas, NV, June 2004.
6. Invited Presentation in the Workshop: "Time-Domain Techniques for the Design of RF Circuits" in the 2000 IEEE IMS (MTT-S) Conference, Boston, MA, June 2000.
7. Invited Presentations at the National Technical University Athens, Greece in July 2000 ("Wavelets and Electromagnetics") and October 2001 ("RF Packaging: Challenges and Future").
8. Invited Presentation in the Workshop: "High-Density/Multilayer RF Interconnects" in the 2001 IEEE IMS (MTT-S) Conference, Phoenix, AZ, May 2001.

9. Invited Presentation at Tokyo University of Technology, Tokyo, Japan (“RF Packaging Solutions for Wireless Communication Systems”), August 2001.
10. Yamacraw Invited Speaker at Georgia Southern University (“Broadband Wireless Access Hardware”), October 2001.
11. Invited Presentation at Ferdinand-Braun Institut, Berlin, Germany, (“Multigridding Approaches for the Modeling and Optimization of Vertically Integrated RF Modules”), July 2002.
12. Invited Presentation at IMEC Research Center, Leuven, Belgium, (“Challenges in RF/Wireless Packaging”), July 2002.
13. Invited Presentation at Tsinghua University, Beijing, China, (“Novel Solutions for RF/Wireless Multilayer Transceivers”), August 2002.
14. Invited Presentation at the Technical University of Munich, Germany, April 2003.
15. Invited Presentation at University of Illinois, Urbana Champaign, IL, April 2003.
16. Invited Presentation in the Workshop: “Concurrent EM, Mechanical and Thermal Modeling of RF MEMS” in the 2003 IEEE IMS (MTT-S) Conference, Philadelphia, PA, June 2003.
17. Invited Presentation in the Workshop: “Active and Integrated Antennas” in the 2003 IEEE IMS (MTT-S) Conference, Philadelphia, PA, June 2003.
18. Invited Presentation at ASME INTERPACK 2003 Symposium, Maui, HI, July 2003.
19. Invited Presentation to the NEC Headquarters, Kansai, Japan, August 2003.
20. Invited Presentation to the National Semiconductor Headquarters, San Jose, CA, August 2003.
21. Invited Presentation to the Siemens Headquarters, Munich, Germany, (“RF/WiFi/mm-wave Modules: 3D Solutions and Materials”), August 2003.
22. Invited Presentation at the School of Physics, National University of Athens, Greece, (“RF/Wireless Integration: Challenges of the Future”), March 2004.
23. Invited Panelist at the 2004 TI System Hardware Design Symposium and Exhibition, Dallas, TX, May 2004.
24. Invited Presentation in the Workshop: “Active and Integrated Antennas” in the 2004 IEEE IMS (MTT-S) Conference, Fort Worth, TX, June 2004.
25. Invited Presentation at the Electrochemical Society Meeting in Honolulu, HI, October 2004.
26. Invited Presentations to National Semiconductor, Motorola, TI, Infineon, Siemens in 2005-2006.
27. Invited Presentation at UCLA WINMEC Conference, LA, CA, (“Fully Integrated and Packaged RFID’s for Health-Related Applications”), October 2006.
28. Invited Presentation at the University of Illinois, Urbana-Champaign, IL, (“3D RF Integration and Packaging Using Conformal Organics”), October 2006.
29. Invited Presentation to the 3M Research Headquarters, Minneapolis, MN, (“Paper-Printed RFID and Wireless Sensors”), November 2006.
30. Invited Presentation to the AAPA Port Operation, Safety and Information Technology Seminar, Jacksonville, FL, (“RFID and Wireless Modules: Challenges for Port-Authority Applications”), April 2007.
31. Invited Presentation at the Symposium in Honor of Prof. W.J.R.Hoefer, (“State-of-the-Art of RF/Wireless Packaging”), Technical University of Munich, GERMANY, May 2007.

32. Invited External PhD Committee “Challenging Member”/ Invited Presentation (“State-of-the-Art of RF/Wireless Paper-printed Electronics”), Mid-Sweden University, Sundsvall, SWEDEN, May 2007.
33. Invited Presentation in the Workshop: “RFID and Printed Electronics” in the 2007 IEEE IMS (MTT-S) Conference, Honolulu, HI, June 2007.
34. Invited Presentation at IEEE PIMRC2007, Athens, GREECE, (“RF Reconfigurable Fully-Packaged Modules for Telecom, Multimedia and Sensing Applications”), September 2007.
35. Invited Presentation at IEEE Eurasia RFID, Istanbul, TURKEY, (“Global Item Tracking Using RFID’s”), September 2007.
36. Invited Presentation at National Technical University of Athens, GREECE, (“Paper-Based RF Electronics”), December 2007.
37. Invited Presentation at Ain Shams University, Cairo, EGYPT, (“Flexible Wireless Sensors”), May 2008.
38. Invited Presentation at IEEE COMCAS Meeting, Tel Aviv, (“Paper-based Wearable Sensors”), May 2008.
39. Invited Presentation at Port of Savannah E-Tag Roundtable, Savannah, GA, (“RFID’s in a Globalized Port Environment”), June 2008.
40. Invited Presentation at MEMSWAVE Conference, Iraklion, GREECE, (“Paper: The Solution for Ubiquitous Wireless Sensors?”), July 2008.
41. Invited Presentation at LAAS 50th Anniversary Conference, Toulouse, FRANCE, (“Inkjet-Printed Electronics and Power Scavenging: The Path for Environmentally-Friendly Cognitive Intelligence”), October 2008.
42. Invited Presentation at IEEE ISAP Symposium, Taipei, Taiwan, (“Wearable Conformal Wireless Sensor Modules”), October 2008.
43. Invited Presentation at USNC/URSI 2009 Meeting, Boulder, CO, January 2009.
44. Invited Presentation at IEEE RAWCON 2009 Conference, San Diego, CA, January 2009.
45. Invited Presentation at the University of Perugia, Perugia, Italy, March 2009.
46. Invited Presentation at Pischello Research Center, Pischello, Italy, March 2009.
47. Invited Presentation at EU Commission, Brussels, Belgium, March 2009.
48. Invited Presentation at IEEE RFID 2009, Orlando, FL, April 2009.
49. Invited Presentation at National Semiconductors (NSC), Norcross, GA, May 2009.
50. Invited Presentation at Dublin Institute of Technology (DIT), Dublin, Ireland, June 2009.
51. Invited Presentation at Heriott-Watt University, Edinburgh, June 2009.
52. Invited Presentation at IEEE Geoscience and Remote Sensing Conference 2009 (IGARSS), Cape Town, July 2009.
53. Invited Presentation at University of Galway, Galway, Ireland, July 2009.
54. Invited Presentation at e-Democracy Conference 2009, Athens, Greece, September 2009.
55. Invited Presentation at COST IC803 Action Meeting, Athens, Greece, October 2009.
56. Invited Presentations at CSIRO/ICT Centre, Sydney, Australia; University of New South Wales, Sydney, Australia; Macquarie University/IEEE New South Wales Section, Sydney, Australia; Monash University, Melbourne, Australia, October 2009.

57. Invited Presentation at the IEEE Sensors 2009 Conference, Christchurch, New Zealand, October 2009.
58. Invited Presentations at National University of Singapore (N.U.S.) and at IEEE RFIT 2009, Singapore, Singapore, December 2009.
59. Invited Presentation at IEEE RAWCON 2010 Conference, New Orleans, LA, January 2010.
60. Invited Presentation at NEDO workshop, Hakone, Japan, February 2010.
61. Invited Presentations at the University of Brazilia, University of Sao Paulo, University of Campinas in Brazil, March 2010.
62. Invited Presentation at the University of Wisconsin, Madison, WI, April 2010.
63. Invited Presentation at GTRI-SEAL, Smyrna, GA, April 2010.
64. Invited Presentation at the IFC-SRC Workshop at M.I.T., Cambridge, MA, May 2010.
65. Plenary IEEE DML Presentation at the European Microwave Week 2011, Paris, FRANCE, October 2010.
66. Invited Presentation at the Asian Pacific Microwave Symposium 2011, Yokohama, JAPAN, December 2010.
67. Invited Presentation at the IEEE RWS Symposium 2011, January 2012.
68. Invited Presentation at the PIERS 2011, Marrakech, MOROCCO, March 2011.
69. Invited IEEE DML Presentation at the University of Valetta, MALTA, March 2011.
70. Invited Presentation at the European Antennas and Propagation Symposium (EuCAP 2011), April 2011.
71. Invited/Featured Presentation at the URSI General Assembly 2011, Istanbul, TURKEY, August 2011.
72. Invited Presentation at the 8th IDGA Military Antennas Conference, Washington, DC, September 2011.
73. **Plenary Talk** at the 2011 IEEE Conference on RFID and Technical Applications (RFID-TA), Barcelona, SPAIN, September 2011.
74. **Invited Presentation** at IEEE MTT Dallas Section, 2011.
75. Invited Presentation at the 2011 European Microwave Conference, Manchester, UK, October 2011.
76. Invited Presentation at the 2011 CLASTECH Conference, El Segundo, CA, October 2011.
77. Invited Presentation at the IEEE Sensors 2011, Athlone, IRELAND, October 2011.
78. Invited DML Presentation at Tyndall Institute, Cork, IRELAND, November 2011.
79. Invited Presentation at 2011 IDTEX Conference on Energy Harvesting and Wireless Sensor Networks, Boston, MA, November 2011.
80. Invited Presentation at the 2011 ST Energy Harvesting Council, Aix-en-Provence, FRANCE, December 2011.
81. Invited DML Talk at the 2011 IEEE International RF and Microwave Conference (RFM 2011), Seremban, MALAYSIA, December 2011.
82. Invited Presentation at the IEEE WiSNet Symposium 2012, Santa Clara, CA, January 2012.
83. **Keynote talk** at the International School on Internet of Things (IoT), Aveiro, PORTUGAL, January 2012.
84. Invited Presentation at the 2012 Winter Enrichment Program (WEP) 2012, Jeddah, Saudi Arabia, January 2012.
85. Invited Presentation at the NSF/SRC/SFI Joint meeting, IRELAND, March 2012.

86. **Keynote Prsensation** at the IEEE APEMC2012 Conference (“Millimeter-Wave and Nanotechnology: The path to “green” electronics?”), SINGAPORE, May 2012.
87. **Plenary Talk** at the 2012 Radio Conference, MAURITIUS, September 2012.
88. Invited DML Presentation at University of Alberta, Edmonton, CANADA, February 2013.
89. **Panelist** in the “Wireless Power” panel in IEEE Wireless Symposium, Beijing, CHINA, April 2013.
90. Invited Presentation at the 60th Anniversary NJUST Workshop on RF and Microwave/mmW Technologies and Applications, Nanjing, CHINA, September 2013.
91. **Plenary Talk** at the 2013 IEEE RFID-TA Conference, Malaysia, September 2013.
92. **Plenary Talk** at the 2013 PACO Conference, Gardanne/Aix-en-Provence, FRANCE, October 2013.
93. Invited presentation at IWS2014 Symposium, Xi'an, CHINA, March 2014.
94. Invited presentation at MIKON 2014 Conference, Gdansk, POLAND, June 2014.
95. Invited DML talks in Poland (Krakow, Gdansk, Warsaw), June 2014.
96. Invited DML Talks in Indonesia (Jakarta, Yogyakarta and Bali), September 2014.
97. Invited DML Talks in Peru (Lima, Arequipa, Chiclayo and Puno), March 2015.
98. Invited DML/CRFID-DL talk on Internet of Things, Alexandria, VA, March 2016.
99. Invited Presentation at University of Minnesota ECE Colloquium, March 2016.
Invited Presentation at the 2016 AFRL Workshop on RF Reconfigurable Electronics, Arlington, VA, May 2016.
100. Invited Talk at Physics Colloquium, Georgia Southern University, Statesboro, GA, August 2016.
101. Keynote University Speaker at Altair/Georgia Tech Symposium, November 2016.
102. Invited IEEE MTT-S Webinar Speaker on “3D Printed RF Circuits”, March 2017.
103. Invited Talks at NTU-MediaTek Workshops 2017 and 2018, SINGAPORE, January 2017 and January 2018.
104. Invited Talk at ICNC 2018 Conference, Maui, HI, March 2018.
105. Invited Talk at CMOC 2018 Symposium, Orange, CT, April 2018.
106. Invited Talk at MITRE Symposium on Additive Manufacturing of Antennas and EM Structures, McLean, VA, April 2018.
107. Invited talk at IEEE ETCMOS 2018 Conference, Whistler, CANADA, May 2018.
108. Invited Talk at 2018 TechConnect World Innovation Conference, Anaheim, CA, May 2018.
109. Invited Tutorial on Inkjet-Printed RFID-Enabled Wireless Sensors, Ottawa, CANADA, August 2018.
110. Invited SRC/GRC e-Workshop on Printed RF Elecgronics, October 2018.
111. Distinguished Guest Lecture at ARIA European School of Antennas 2018, Beirut, LEBANON, October 2018.
112. **Keynote Presentation** at the IEEE WiSEE Conference 2018, Huntsville, AL, December 2018.
113. Invited Talk at ICNC 2019 Conference, Honolulu, HI, March 2019.
114. Invited Talk at University of Hawaii, Honolulu, HI, March 2019.
115. Invited Talk at the University of Alabama, Tuscaloosa, AL, April 2019.
116. Invited Talk at the University of Southern California, LA, April 2019.
117. **Keynote Presentation** at the 7th International Symposium on Deformation Characteristics of Geomaterials (IS-Glasgow 2019), Glasgow, UK, June 2019.

118. Invited Talk at American University of Beirut, Beirut, LEBANON, September 2019.
119. Invited Talk at 2019 EMN Meeting on Flexible Electronics, Dubrovnik, CROATIA, October 2019.
120. Invited Talk at the Workshop “Get Started with Flexible Hybrid Electronics”, Fraunhofer EMFT, Munich, GERMANY, October 2019.
121. Invited Talk at European School of Antennas-ARIA, Nice, FRANCE, November 2019.
122. Invited Talk at Fraunhofer IHP, Frankfurt (Oder), GERMANY, December 2019.
123. Invited Talk at TEDxEmory 2020, February 2020.
124. Invited Talk at MIT Horizons Series 2020, June 2020.
125. Invited IEEE CRFID Distinguished Lecture, IEEE PES Kerala Chapter, INDIA, June 2020.
126. **Keynote Talk** at Mediterranean Microwave Symposium (MMS) 2020, MOROCCO, December 2020.
127. Invited Talk at Virtual Vertical and Topical IoT Summit at IEEE Radio and Wireless Week – RWW 2021, USA, January 2021.
128. **Keynote Talk** at 6th ICREGA 2021, UAE, February 2021.
129. Invited Talk at IEEE International Conference on Flexible Printable Sensors and Systems (FLEPS) 2021 Conference, June 2021.
130. Invited Presentation at 32nd Annual Electronics Packaging Symposium, Binghamton University, NY, USA, September 2021.
131. Invited Presentation at IRTG Energy Conversion System Series, FIU, GERMANY, September 2021.
132. Invited Presentation at Space Solar Power Workshop, IEEE WiSee 2021, USA, October 2021.
133. Invited Lecture at US Government Seminar on Smart Materials and Intelligent Systems (SMIS), The MITRE Corporation, October 2021.
134. **Keynote Speech**, International Emerging Technologies Competition (IETC) 2021, Universiti Teknologi PETRONAS, MALAYSIA, October 2021.
135. **Keynote Speaker**, SBMO/IEEE International Microwave and Optoelectronics Conference (IMOC 2021), BRAZIL, October 2021.
136. Invited Lecture at Korean Institute of Electromagnetic Engineering and Science (KIEES 2022) Tutorial on Backscattering Communication, KOREA, February 2022.
137. Invited Lecture at International Workshop on Antenna Technology 2022 (iWAT 2022), Dublin, IRELAND, May 2022.
138. **Plenary Speaker**, IEEE SpliTech International Conference on Smart and Sustainable Technologies 2022, Split and Bol, CROATIA, July 2022.
139. **Keynote Speaker**, International Workshop on Antenna Technologies in Shenzhen University (IWAT-SZU 2022), Shenzhen, PR China, July 2022.
140. **Plenary Speaker**, EMN Eurosensors 2022 Conference, Leuven, BELGIUM, September 2022.
141. Invited Talk at ICNC 2023 Conference, Honolulu, HI, February 2023.
142. **Keynote Speaker**, IEEE MTT-S Latin America Microwave Conference (LAMC-2023), San Jose, COSTA RICA, December 2023.

IV.E: OTHER SCHOLARLY ACCOMPLISHMENTS – PATENTS (more pending)

1. R.Li, E.M.Tentzeris and J.Laskar, "Multiband Broadband Planar Wire Antennas for Wireless Communication Handheld Terminals", US Patent 6,917,339.
2. M.G.Allen, Y.-K.Yoon, J.-W.Park, Y.-H.Joung, F.Cros, I.Papapolymeroy, E.M.Tentzeris and B.Pan, "Surface Micromachined Millimeter-Scale RF System and Method", US Patent 7,196,666.
3. E.Gebara, J.Laskar and E.M.Tentzeris, "Method and system for antenna interference cancellation", US Patent 7,366,244, US Patent 7,729,341 and EP Patent 1,687,929.
4. D.Thompson, G.Wang, N.D.Kingsley, I.Papapolymerou, E.M.Tentzeris, R.Bairavasubramanian, G.DeJean and R.L.Li, "Multilayer Electronic Component Systems and Methods of Manufacture", US Patent 7,834,808.
5. E.Gebara, A.J.Kim, J.Laskar, A.Stelliga and E.M.Tentzeris, "Method and System for Reducing Signal Interference", US Patent 7,522,883.
6. J.S.Lee, P.D.Schmalenberg, A.Rida, R.L.Li and E.M.Tentzeris, "Microwave Antenna", US Patent 8,325,092.
7. E.Gebara, A.J.Kim, J.Laskar, A.Stelliga and E.M.Tentzeris, "Reducing signal interference", US Patent 8,503,940.
8. J.S.Lee, P.D.Schmalenberg, A.Rida, R.L.Li and E.M.Tentzeris, "Antenna with tapered array", US Patent 8,743,016.
9. A.Rida, L.Yang, A.Margomenos and M.Tentzeris, "Three-dimensional array antenna on a substrate with enhanced backlobe suppression for mm-wave automotive applications", US Patent 8,786,496.
10. S.Georgakopoulos, E.Tentzeris and B.Cook, "Origami folded antennas", US Patent 9,214,722.
11. M.Tentzeris and B.Cook, « Additively deposited electronic components and methods for producing the same », US Patent 9,343,233.
12. S.Georgakopoulos and M.Tentzeris, « Misalignment Insensitive Wireless Power Transfer », US Patent 9,406,435
13. S.Georgakopoulos, M.Tentzeris and O.Jonah, « Multi-band and broadband wireless power transfer through embedded geometric configurations », US Patent 9,466,418
14. X.Yi, C.Cho, B.Cook, Y.Wang, M.Tentzeris and R.T.Leon, « Frequency doubling antenna sensor for wireless strain and crack sensing », US Patent 9,506,848.
15. H.Grigner, M.M.Tentzeris, M.Drissi, « Device for Protecting the Human Body and Equipment Against Electromagnetic Radiation », International Patent WO2018236202.
16. S.Georgakopoulos and M.Tentzeris, « Wireless power transfer through embedded geometric configurations », US Patent 9,799,443.
17. J.Hester and E.M.Tentzeris, « Inkjet Printed Flexible Van Atta Array Sensor », US Patent 10,511,100.
18. J. Bito and E.M.Tentzeris, « Hybrid Energy Harvesting Systems and Devices Incorporating the Same », US Patent 10,566,844.
19. N.Arora, G.D.Abowd, M.Gupta, D.Osorio, S.F.Shahmiri, T.E.Starner, Y.-C.Wang, Z.Wang, Z.L.Wang, S.L.Zhang, P.McAughan, Q.Xue, D.Bansal, R.Bahr and E.Tentzeris, « Thin and flexible self-powered vibration transducer employing triboelectric nanogeneration », US Patent 10,932,063.
20. A.Eid, J.G.D.Hester and M.Tentzeris, « High gain and large beamwidth rotman-lens-based and mm-wave energy harvester systems and associated methods », WIPO (PCT) W02020223486A1
21. J.G.D.Hester and E.M.Tentzeris, « System for Sensing Backscatter Tag Communications from Retrodirective Antenna Arrays », US Patent 11,474,233.

V: SERVICE

V.A. PROFESSIONAL CONTRIBUTIONS

V.A.1. Conference Leadership (Selected)

- Co-Chair in 2023 IEEE WPTCE Conference, San Diego, CA, June 2023.
- Multi-Society Panel Session Organizer and Chair in 2023 IEEE IMS Conference, San Diego, CA, June 2023.
- Co-Chair in 2019 IEEE Antennas and Propagation Conference (AP-S), Atlanta, GA, July 2019.
- ADCOM Member of IEEE CRFID, 2017-present.
- Panel Session Organizer and Chair in 2011 IEEE RFID-TA Conference, Barcelona, SPAIN, September 2011.
- Technical Program Chair in 2008 IEEE IMS hold in Atlanta, GA, June 2008.
- Technical Program Co-Chair in 2009 ACES Conference hold in Monterey, CA, March 2009.
- Interactive Forum Chair in 2009 IEEE APS Conference, Charleston, SC, May 2009.
- Panel Session Organizer in 2010 IEEE ECTC Conference, Las Vegas, NV, June 2010.
- Member of the Technical Program Committee (TPC) of the annual IEEE International Microwave Symposium (IEEE-IMS), June 2001-present.
- Member of the Technical Program Committee (TPC) of the annual IEEE Antennas and Propagation Symposium (IEEE-APS), January 2001-present.
- Member of the Technical Program Committee (TPC) of the annual IEEE Electronic Components and Technology Conference (IEEE-ECTC), June 2003-present.
- Member of the Technical Program Committee (TPC) of the annual IEEE Vehicular Technology Conference (IEEE-TC), September 2006-September 2009.
- Member of the Technical Program Committee (TPC) of the annual European Microwave Conference (EuMC), January 2008-present.
- Member of the International Advisory Committee of 2007 PIERS Conference held in Pisa, ITALY, March 2007.
- Member of the International Program Committee of annual IASTED International WOC Conference held in Banff, CANADA, June 2004-present.
- Member of the Technical Program Committee of 2007 IEEE Conference on Wireless Rural and Emergency Communications (WRECOM), Rome, ITALY, October 2007.
- Conference Chairman of 2005 IEEE CEM-TD held in Atlanta, GA, in September 2005.
- Member of the International Advisory Committee of 2007 IEEE CEM-TD Conference held in Perugia, ITALY, in October 2007.
- Technical Program Co-Chair in ARFTG Conference, Atlanta, GA, December 1999.
- Vice-Chair of the IEEE Components Packaging, and Manufacturing Technology Society (IEEE-CPMT) Technical Committee TC16 (RF Subcommittee), January 2000-2005.
- Chair: Numerous Special/Regular Sessions in IEEE IMS, RAWCON, APS, APMC and EuMW Conferences

- Organizer of 20+ Workshops/Short Courses in IEEE IMS, APS, EuMW, APMC, RWS.
- Founder and organizer of numerous panels and special sessions on mmID (millimeter-wave RFID's) and millimeter-wave automotive radars.

V.A.2. Other Conference Activities

- Member of the Student Paper Contest Committee, 2000 IEEE-IMS Conference, Boston, MA, June 2000.
- Member of the Student Paper Contest Committee, 2010 IEEE RFID-TA Conference, Guangzhou, CHINA, June 2010.
- Member of the Student Paper Contest Committee, 2011 IEEE RFID-TA Conference, Barcelona, SPAIN, September 2011.
- Member of the Student Paper Contest Committee, 2012 IEEE RWS Symposium, Santa Clara, CA, January 2012.
- Member of the Steering Committee and the Student Paper Contest Committee, 1998 IEEE-AP Conference, Atlanta, GA, June 1998.

V.A.3. Editorial/Reviewer Activity

- Member of the Editorial Board, Proceedings of IEEE, 2019-2022
- Guest Editor for the Special Issue of Proceedings of IEEE ("Energy Harvesting Systems") to be published in November 2014.
- Associate Editor for the IEEE Transactions on Microwave Theory and Techniques from June 2007-June 2009.
- Guest Editor for the Special Issue of IEEE Transactions on Microwave Theory and Techniques ("RFID Architectures") published in May 2009.
- Associate Editor for the ETRI Journal from May 2009-May 2010.
- Associate Editor at the ACES Society Newsletter from April 2001-April 2005.
- Associate Editor at the International Journal of Antennas and Propagation (IJAP) from 11/1/2006-11/1/2007.
- Guest Editor for the Special Issue on RFID's of the Proceedings of European Microwave Association published in December 2007.
- Guest Editor for the Special Issue of International Journal of Antennas and Propagation ("Conformal Antennas") to be published in December 2012.
- Guest Editor for International Journal of Numerical Modeling for 2006.
- Member of the NSF Proposal Reviewers' Panels of 5/30-5/31/00, 5/17-5/18/01, 4/15-4/16/02, 6/15-6/16/02, 12/15-12/16/03, 10/21-10/22/04, 5/15-5/16/06, 11/24-11/25/08, 6/7-6/8/10, 1/5-1/6/12, 3/13, 10/27-10/28/14, 10/25/16, 3/29-3/30/17, 2/20-2/21/18, 5/1-5/2/18, 10/23-10/24/18, 4/15-4/16/20
- Member of the Proposal Reviewers' Committee for NSERC (Canada), ISF (Israel), CRDF (U.S.A.), DFG (Germany), Singapore Research Foundation (Singapore), Hong Kong Research Committee (China), KAUST (Saudi Arabia), State of Indiana Research Committee (U.S.A.), State of S.Carolina Research Committee (U.S.A.), EPSRC (U.K.), ANR (France), Austrian Science Fund-FWF (Austria).
- *Reviewer:* IEEE Transactions on Microwave Theory and Techniques (54 papers, 1996-present), IEEE Transactions on Antennas and Propagation (36 papers, 1997-present), The International Journal of Microcircuits and Electronic Packaging (3 papers, 1998 present), IEEE Microwave and Guided Wave Letters/Microwave and Wireless Components Letters (39 papers, 1998-present), IEEE

Transactions on Electromagnetic Compatibility (8 papers, 2000-present), International Journal of Numerical Modeling (12 papers, 2000-present), International Journal of Electronics (2 papers, 2001-present), IEEE Transactions on Advanced Packaging (58 papers, 2002-present), Journal of the Optical Society of America (5 papers, 2000-present), IEEE Transactions on Components and Packaging (6 papers, 2002-present), IEEE Transactions on Signal Processing (3 papers, 2002-present), IEEE Electron Devices Letters (4 papers, 2003-present), IEEE Transactions on Electron Devices (2 papers, 2005-present), International Journal of RF and Microwave Computer-Aided Engineering (10 papers, 2003-present), IEEE/ASME Journal on MEMS (3 papers, 2004-present), SPIE OE Journal (2 paper, 2004-present), IEEE Transactions on Circuits and Systems I, (3 paper, 2004-present) ETRI Journal (10 papers, 2006-present), Radio Science Journal (5 papers, 2004-present), Measurement Science and Technology Journal (3 papers, 2007-present), IEEE Sensors Journal (2 papers, 2007-present), International Journal of Microwave Science and Technology (1 paper, 2007-present), IEEE Microwave Magazine (1 paper, 2007-present), IEEE/OSA Journal of Lightwave Technology (2 papers, 2007-present), IEEE Design and Test of Computers (2 papers, 2007-present), IEEE Antennas and Propagation Magazine (1 paper, 2007-present), Journal of Electronic Imaging (1 paper, 2007-present).

V.A.4. Professional Society Activity

- IEEE, Fellow, (MTT, AP, CPMT Societies), 2010-present.
- IEEE CRFID Committee/Council (IEEE Inter-Society Committee on RFID Technologies) Founding Member (2008) and Secretary-Treasurer since 2011.
- IEEE MTT TC-24 (RFID) Founder-Chair, 2009-present.
- IEEE MTT TC-25 (Nanotechnology) Founder-Member, 2010-present.
- IEEE MTT TC-26 (Wireless Power Transfer) Founding Member, 2011-present
- IEEE MTT Representative at the IEEE CRFID Committee, 2009-2015.
- URSI, Member (Commission D), 1999-present.
- PIERS, Fellow, 2007-present.
- IEEE MTT-15 Committee, Member, 2006-2008.
- IEEE CPMT TC-16 Committee, Member, 2002-present [Vice-Chair:2003].
- European Microwave Association (EuMA), Associate Member, 2005-present.
- Technical Chamber of Greece, Member, 1993-present.
- Chairman of the IEEE MTT/AP Atlanta Chapter from 1/1/02-12/31/02.
- Member of the Board Committee of the IEEE MTT/AP Atlanta Chapter from 1999-2002.

V.A.5. Professional Collaborations/Technical Advising

- Northrop, Rockwell-Collins, Raytheon, Motorola, Intel, IBM, Google, Lockheed, National Semiconductors, Kyocera, Asahi, NEDO, FHWA, Rogers, Siemens, Lucent, Hitachi, Intracom, Samsung-Techwin, ETRI, Manheim, Port of Savannah, Avery-Denison, 3M, Exceletron, Infineon, Dimatix, DELL, Microsoft Research Center, Toyota TEMA, NASA Glenn/Lewis Center, Qualcomm, Eaton Corporation, Samsung, Honeywell
 - University of Michigan, Ann Arbor, MI 9/92-5/98
- Graduate Research Assistant (GSRA) with the Radiation Laboratory.
- Jet Propulsion Laboratory (J.P.L.), Pasadena, CA 9/92-6/94

Collaborator on Optimization of Novel Waveguide Probes.

- National Technical University of Athens, GREECE 9/90-8/92

Research Assistant with the Microwaves Laboratory.

V.B. CAMPUS CONTRIBUTIONS

- Associate Director for RFID and Sensors Research at Georgia Electronic Design Center (GEDC), 8/1/05-12/09.
- Associate Director for RF Research at Georgia Tech Packaging Research Center (PRC), 8/1/03-8/1/05.
- Chair of ECE Electromagnetics Technical Interest Group, 2011-2012.
- Member of the ECE RPT Committee, Fall 2011.
- Active member of the Georgia Tech ORS Program, 9/2008-Present.
- Member of the ECE Graduate Recruitment Committee, 9/1/00-8/31/02.
- Leader of the Novel Integration Techniques Subthrust of the Broadband Hardware Access Thrust of the Yamacraw Initiative of the State of Georgia, 1/1/00-8/1/05.
- Member of the ECE Research Committee, 9/98-8/00, 9/02-5/2004.
- Member of the ECE Education / Research Technology Transfer Committee, 9/2004-5/2005.
- Member of the ECE Graduate Student Recruitment Committee, 9/2005-5/2006.
- Member of the ECE Undergraduate Committee, 9/2006-5/2009.
- Member of the ECE Undergraduate Curriculum Committee, 9/2009-5/2011.
- Head of the RF Alliance of Georgia Tech Packaging Research Center (PRC), 1/1/01-12/31/06.
- Member of Georgia Tech Broadband Institute (GTBI), 9/1/99-5/2004.
- Member of M.Sc. Thesis (21), Ph.D. Qualifying Exam (19), Ph.D. Thesis Proposal (62) and Ph.D. Thesis Defense (65) Committees

VI. EXPERT WITNESS/LITIGATION EXPERIENCE

- LG vs. NFCT IPR: 2014 [Fish & Richardson P.C.] / 2 patents (**all claims accepted by IPTO**)
- HTC vs. NFCT IPR: 2014-2015 [Perkins Coie LLP]; deposed on 4/30/15, 5/1/15, 9/30/15 and 11/19/15 / 2 patents (**all claims accepted by IPTO**)
- HID vs. Morphotrust: 2017-2018 [Finnegan]; deposed on 5/25/18 / 4 IPRs (**all claims accepted by IPTO**)
- DeCurtis vs Carnival Cruises: 2021 [Quinn Emmanuel]; deposed on 10/25/21
- 5 Additional IPR Cases
- References: Ai Bing (Perkins Coie), Miguel Bombach (Perkins Coie), Won Yoon (Fish & Richardson), David Seastrunk (Finnegan), Patrick Schmidt (Quinn Emmanuel)