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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GEOTAB INC. AND GEOTAB USA, INC.,
Petitioners,

v.

FRACTUS, S.A.
Patent Owner.

Case No. IPR2025-00928
Patent No. 8,456,365

PETITION FOR *INTER PARTES* REVIEW
UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 42.1 et seq

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EXHIBIT LIST

Exhibit	Description
1001	U.S. Patent No. 8,456,365
1002	Prosecution History of U.S. Patent No. 8,456,365
1003	Declaration of David M. Pozar, Ph.D.
1004	Curriculum Vitae of David M. Pozar, Ph.D.
1005	U.S. Patent No. 6,184,833 (“Tran”)
1006	Teng, P. L., & Wong, K. L., “Planar monopole folded into a compact structure for very-low-profile multiband mobile-phone antenna.” <i>Microwave and Optical Technology Letters</i> , vol. 33, no. 1, 2002, pp. 22-25 (“Teng”)
1007	Plaintiff’s Disclosure of Asserted Claims and Infringement Contentions Against Geotab Pursuant to Local Patent Rules 3-1 and 3-2, <i>Fractus, S.A. v. Geotab Inc.</i> , No. 2:24-cv-01008 (E.D. Tex.), served March 12, 2025
1008	D.I. 75, Fractus’s Opening Claim Construction Brief, <i>Fractus, S.A. v. ADT LLC</i> , No. 2:22-cv-00412 (E.D. Tex. Nov. 16, 2023)
1009	D.I. 75-1, Exhibit 1 to D.I. 75, Fractus’s Opening Claim Construction Brief, <i>Fractus, S.A. v. ADT LLC</i> , No. 2:22-cv-00412 (E.D. Tex. Nov. 16, 2023)
1010	D.I. 92, Joint Claim Construction Chart, <i>Fractus, S.A. v. ADT LLC</i> , No. 2:22-cv-00412 (E.D. Tex. Jan. 4, 2024)
1011	D.I. 115, Claim Construction Order, <i>Fractus, S.A. v. ADT LLC</i> , No. 2:22-cv-00412 (E.D. Tex. Feb. 25, 2024) (Payne, M.J.)
1012	D.I. 127, Order, <i>Fractus, S.A. v. ADT LLC</i> , No. 2:22-cv-00412 (E.D. Tex. Mar. 15, 2024) (Gilstrap, D.J.)
1013	D.I. 82, Defendants ADT LLC and Vivint, Inc.’s Responsive Claim Construction Brief, <i>Fractus, S.A. v. ADT LLC</i> , No. 2:22-cv-00412 (E.D. Tex. Dec. 14, 2023)
1014	U.S. Patent Application Publication No. 2004/0135729 A1 (“Talvitie”)
1015	U.S. Patent Application Publication No. 2004/0052272 A1 (“Frank”)
1016	U.S. Patent No. 6,008,774 (“Wu”)
1017	U.S. Patent No. 6,005,519 (“Burns”)
1018	U.S. Patent Application Publication No. 2002/0011953 A1 (“Reece”)
1019	U.S. Patent No. 6,956,530 B2 (“Kadambi”)
1020	U.S. Patent No. 6,665,927 B1 (“Dow”)
1021	International PCT Publication No. WO 02/087294 A1 (“Chua”)
1022	U.S. Patent Application Publication No. 2003/0156065 A1 (“Jo”)

Exhibit	Description
1023	U.S. Patent No. 6,218,989 (“Schneider”)
1024	U.S. Patent No. 7,245,196 (“Baliarda”)
1025	U.S. Patent No. 5,596,401 (“Kusuzawa”)
1026	U.S. Patent Application Publication No. 2003/0092420 A1 (“Sugimoto”)
1027	U.S. Patent Application Publication No. 2002/0158806 A1 (“Caimi”)
1028	U.S. Patent Application Publication No. 2004/0051672 A1 (“Nevermann”)
1029	U.S. Patent No. 6,459,413 B1 (“Tseng”)
1030	U.S. Patent Application Publication No. 2003/0006936 A1 (“Aoyama”)
1031	Pey-Ling Teng et al., “PIFA with a Bent, Meandered Radiating Arm for GSM/DCS Dual-Band Operation.” <i>IEEE Antennas and Propagation Society International Symposium. Digest. Held in conjunction with: USNC/CNC/URSI North American Radio Sci. Meeting (Cat. No.03CH37450)</i> , Columbus, OH, USA, vol. 3, 2003, pp. 107-110, doi: 10.1109/APS.2003.1219801.
1032	Chiu, C., Teng, P., & Wong, K., “Shorted, folded planar monopole antenna for dual-band mobile phone.” <i>Electronics Letters</i> , vol. 39, no. 18, 2003, pp. 1301-1302.
1033	U.S. Patent No. 6,233,464 B1 (“Chmaytelli”)
1034	U.S. Patent No. 8,456,365 Claim Limitation Comparison Chart
1035	U.S. Patent Application Publication No. 2004/0150561 A1 (“Tillery”)
1036	Declaration of James L. Mullins, Ph.D.
1037	Curriculum Vitae of James L. Mullins, Ph.D.
1038	Pages from R. Graf, <i>Modern Dictionary of Electronics</i> (Newnes: 7th ed. 1999)
1039	Pages from S. Gilbilisco, ed., <i>The Illustrated Dictionary of Electronics</i> (McGraw-Hill: 8th ed. 2001)
1040	Pages from Pozar, <i>Microwave Engineering</i> (3rd ed. 2005)
1041	U.S. Patent Application Publication No. 2001/0011964 A1 (“Sadler”)
1042	U.S. Patent Application Publication No. 2003/0124982 A1 (“Saari”)

MANDATORY NOTICES

A. Real Party-In-Interest – §42.8(b)(1)

Geotab Inc. and Geotab USA, Inc. are the real parties-in-interest.

B. Related Matters – §42.8(b)(2)

A decision in this proceeding could affect or be affected by the following:

1. United States Patent & Trademark Office

U.S. Patent No. 8,456,365 (“the ’365 patent”) issued from Application No. 12/228,487, filed August 13, 2008, which is a continuation of U.S. Patent Application No. 10/584,442, filed July 18, 2006, which is a National Stage Entry of International PCT Application No. PCT/EP2005/000880, filed January 28, 2005 (now U.S. Patent No. 7,423,592), which claims priority from Provisional Application No. 60/540,450, filed January 30, 2004.

The following application is a continuation of U.S. Patent Application No. 12/228,487, which issued as U.S. Patent No. 8,456,365:

- U.S. Patent Application No. 13/874,914 filed May 1, 2013 (abandoned).

2. United States Patent Trial and Appeal Board

There are currently no other proceedings pending before the Board on the ’365 patent or a related patent.

3. U.S. District Court for the Eastern District of Texas

The '365 patent is currently asserted in: *Fractus, S.A. v. Geotab Inc.*, No. 2:24-cv-01008 (E.D. Tex.) (“Texas Litigation”); and *Fractus, S.A. v. Verizon Connect Inc. et al.*, No. 2:24-cv-01009 (E.D. Tex.) (the “Verizon Litigation”).

The '365 patent was previously asserted in: *Fractus, S.A. v. ADT LLC*, No. 2:22-cv-00412 (E.D. Tex.) (“ADT Litigation”), which was dismissed with prejudice on October 4, 2024 (D.I. 253).

C. Counsel and Service Information - §§42.8(b)(3) and (4)

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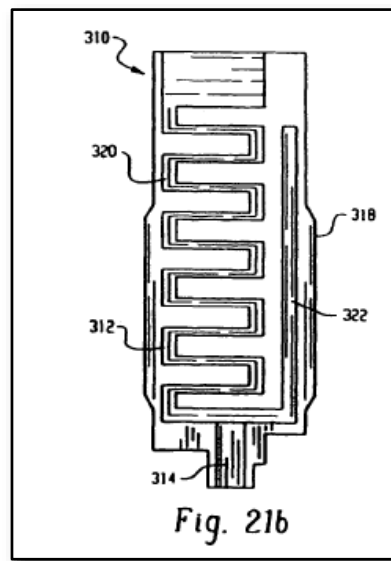
A power of attorney is submitted with the Petition. Counsel for Petitioners consents to service of all documents via electronic mail.

Geotab Inc. and Geotab USA, Inc. (“Petitioners” or “Geotab”) request *inter partes* review and cancellation of claims 1-42 and 44-45 (“Challenged Claims”) of U.S. Patent No. 8,456,365 (EX1001, “the ’365 patent”).

I. INTRODUCTION¹

The ’365 patent concerns multi-band antennas for cellphones. It describes physically compact antennas having several bends that nonetheless comprise traces long enough to support frequencies for conventional cellular communication.

Figure 21b’s conductor 320 is exemplary.

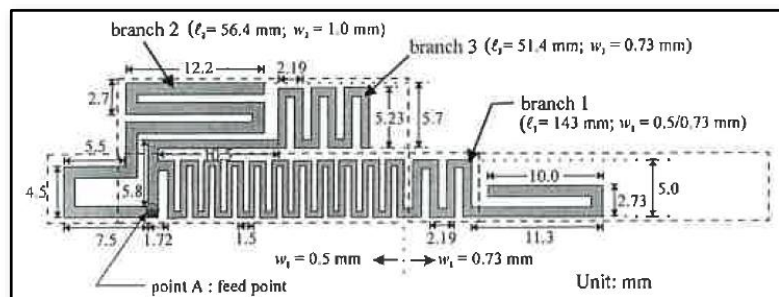
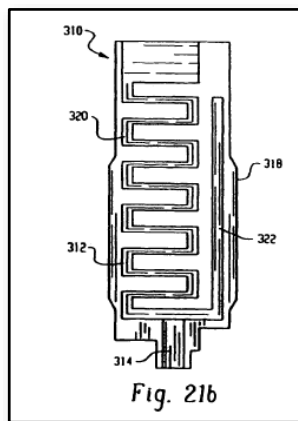


The patent received minimal examination. While on its face the patent identifies **1,063 references**, the Examiner ***never used or discussed any of them*** in a claim rejection and allowed the claims with no meaningful explanation. Indeed,

¹ Emphasis added throughout unless noted otherwise.

the record shows that the Patent Owner provided the Examiner with no guidance to identify the most material prior art from among more than a thousand references, let alone any guidance to properly evaluate it.

The Challenged Claims each recite a “*mobile communication device*” comprising conventional components—a housing, a printed circuit board, communication electronics—with a multi-band antenna meeting particular shape, dimensions, and placement requirements. The ’365 patent’s purportedly inventive antennas were well-known. Teng described the claimed multi-band antenna (right below) before Patent Owner’s alleged invention.



Tran describes a cellphone. **Ground 1** shows that Tran, using Teng’s antenna, renders obvious every Challenged Claim. Accordingly, the Board should institute IPR and cancel the Challenged Claims.

II. STANDING CERTIFICATION

The ’365 patent is available for IPR. Petitioners are neither barred nor estopped from requesting IPR of the ’365 Patent. 37 C.F.R. §42.104(a).

III. UNPATENTABILITY GROUND

The Petition demonstrates that Tran in view of Teng would have rendered renders claims 1-42 and 44-45 unpatentable as obvious under pre-AIA §103.

In litigation, Patent Owner (“Fractus”) alleged that claims 1-2, 4-8, 12-13, 31-32, 35-37, and 41 were conceived December 5, 2003. EX1007, 1-3. Even if every Challenged Claim was conceived by December 5, 2003 and entitled to the earliest-alleged priority date (January 30, 2004) on the face of the ’365 patent,² Tran and Teng are prior art under these pre-AIA §102 sub-sections:

Reference	Priority Date	Basis
Tran (EX1005)	2001-02-06	§§102(a)-(b), (e)
Teng (EX1006)	2002-04-12	§§102(a)-(b)

Teng was included in *Microwave and Optical Technology Letters* volume 33, number 1, dated April 5, 2002, published by Wiley, an established publisher. EX1006, 1; EX1036, ¶¶35-49; *VidStream LLC v. Twitter, Inc.*, 981 F.3d 1060, 1065 (Fed. Cir. 2020) (“When there is an established publisher there is a presumption of public accessibility as of the publication date.”). Teng is pre-AIA §102(b) prior art because it published before January 30, 2003. EX1036, ¶¶50-72.

² Petitioners do not concede that either is true.

IV. '365 PATENT

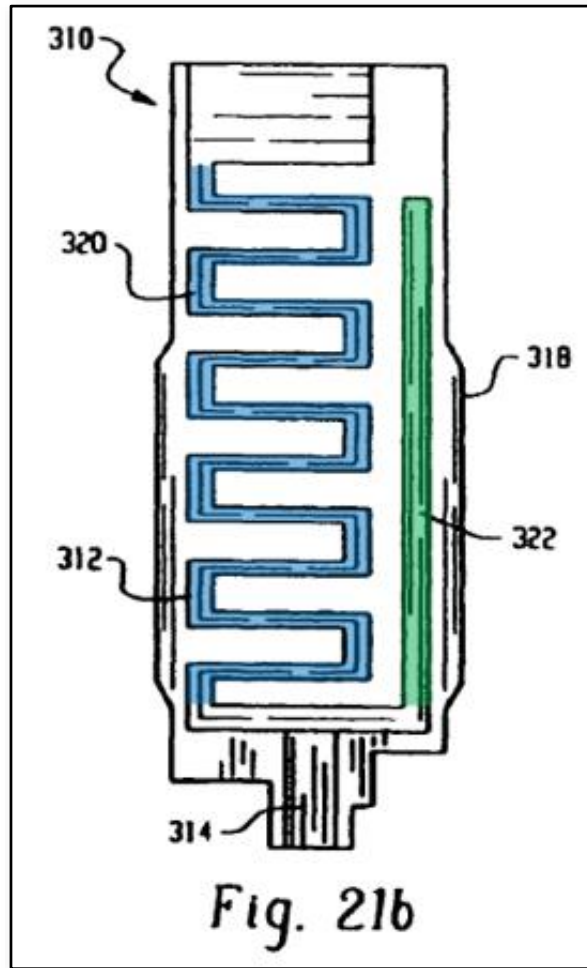
A. Embodiments

The '365 patent concerns “multi-band monopole antennas... for use in mobile communications devices” (e.g., “cellular telephones” or personal digital assistants (PDAs)). EX1001, 1:17-22. The patent says “inverted-F” antennas—antennas shaped like a capital “F”—“performed adequately” as “internally-mounted antenna[s],” but were “typically bandwidth-limited” because they experienced “problematic amounts of electromagnetic interference.” EX1001, 1:34-39.

Every Challenged Claim requires an antenna arm with “*a grid-dimension curve*”—a term having no ordinary meaning in the art. *See* Appendix A (Claim List); EX1003, Decl. of David M. Pozar, Ph.D. (“Pozar”), ¶46.

The patent says, “the term grid dimension... describe[s] a curve geometry having a grid dimension that is greater than one (1),” which is calculated using a formula discussed *infra* §V.B.2. EX1001, 7:16-18. “The larger the grid dimension, the higher the degree of miniaturization that may be achieved” because grid dimension measures antenna compactness. EX1001, 7:18-21. But as the '365 patent admits, Fractus did not invent antennas that the specification describes as “space-filling or grid dimension” because such antennas were already “known” to experience “reduce[d]” “interference.” EX1001, 1:39-44.

Figure 21b (annotated below) shows an antenna with a “grid dimension section 320 [blue] and a linear section 322 [green]” both connected to a “feeding port 314” for coupling to conventional communication circuitry like a transmitter/receiver. EX1001, 8:52-64.



The '365 patent says its multi-band antennas are useful for mobile communications devices having conventional components, like a housing and circuit board for mounting the electronics and ground plane layer. EX1001, 5:35-48.

B. POSA

Petitioners adopt Fractus's definition of a person having ordinary skill in the art ("POSA") from the ADT Litigation:

[A] person with at least 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.

EX1009, 8-9, ¶32; Pozar, ¶¶36-44.

C. Prosecution History

The Examiner rejected application-claims 1-15 for double patenting over the parent. EX1002, 182-185. Fractus then added application-claims 16-60 (which issued as claims 1-45). EX1002, 265-276. The Examiner thereafter allowed those claims with no meaningful explanation. EX1002, 391-392. Other than double patenting the prosecution history, in short, contains no rejections or substantive discussion of the examined claims.

D. Challenged Claims

The '365 patent has 45 claims, all reciting a "mobile communication device." Appendix A provides a claim list. Claims 1, 15, and 31 are independent.

Claim 1's device comprises four components: (1) a housing [1A]; (2) a printed circuit board ("PCB") [1B] comprising a ground plane [1C] and having

(3) “communication circuitry” [1E]; and (4) a “multi-band antenna” [1G]. Other limitations concern the antenna design—having a “common conductor” and two “radiating arms” [1I], disposed on “planes” [1K]—and electrical connection to other components through a “feeding point” on the PCB [1D] and “feeding port” on the antenna [1J]. Claim 1 requires that a radiating arm be “at least partially shaped according to a grid-dimension curve” [1L] (*infra* §V.B).

Claim 15 adds that the second radiating arm is also “at least partially shaped according to a grid-dimension curve” [15I]. Claim 31 adds that the radiating arms are “arranged on two or more sides” of a “dielectric mounting structure” [31J]. Dependent claims recite further detail on the antenna shape, dimensions, layout, placement, or numerical limits on “grid dimension.”

V. CLAIM INTERPRETATION

Claim terms are construed under the standard used in civil actions under 35 U.S.C. §282(b), in accordance with the ordinary and customary meaning as understood by POSAs and the patent’s prosecution history. 37 C.F.R. §42.100(b).

In Fractus’s ADT Litigation, the court construed “*a common conductor*” and the parties stipulated to “*grid-dimension curve*.”

A. “*a common conductor*” (claims 1-14, 25-30, 37-44)

In the ADT Litigation, the court construed this term to mean “a conductor common to two or more radiating arms.” EX1011, 13-14; EX1012. The prior art meets that construction or any other reasonable construction.

B. “*grid-dimension curve*” (all claims)

Every claim recites a “*grid-dimension curve*” (“*GDC*”). Fractus offered the below *GDC* construction in the ADT Litigation. EX1008, 27-30 (native page numbering). ADT agreed to Fractus’s construction (EX1013, 34), and the court did not separately construe it (EX1011, 29-30).

Fractus’s construction is wrong. However, the Board need not resolve this dispute because, as demonstrated below, the Ground 1 combination Tran+Teng meets both Fractus’s *GDC* construction and the correct construction.

1. Fractus’s *GDC* construction

In the ADT Litigation, Fractus construed “*grid-dimension curve*” as:

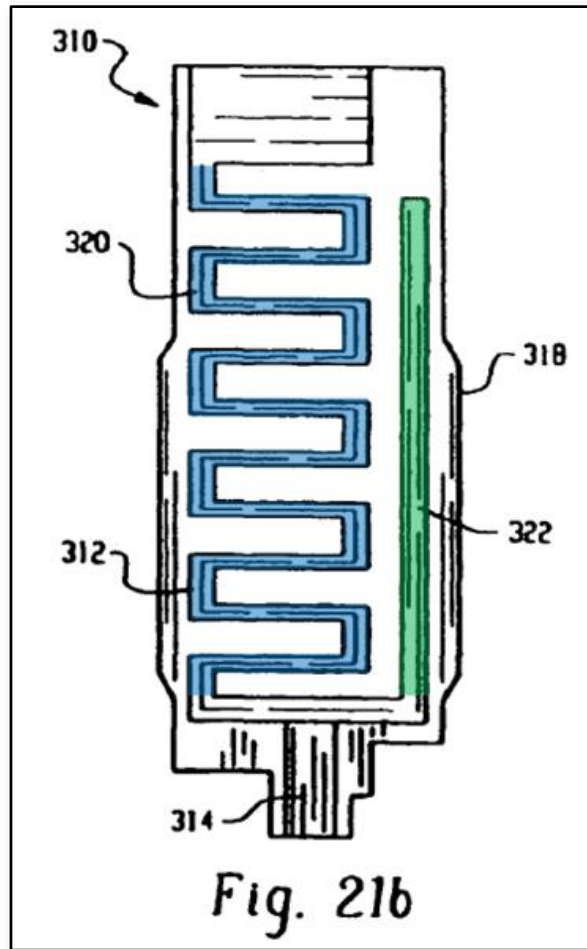
[1] A curve which is not self-similar, [2] which possesses a geometry having a grid dimension that is greater than one (1), and, [3] if the curve has any periodicity, the period is defined by a non-periodic curve that includes at least ten connected segments in which no two adjacent and connected segments define a longer straight segment.

EX1008, 27. That construction is incorrect. Pozar, ¶61. Part [1]’s requirement that the curve cannot be “self-similar” is unsupported by the ’365 patent

specification. Part [3]’s requirement of “at least ten segments” is described by the specification as a “character[istic]” of a “space-filling curve,” not of a grid-dimension curve, which “**may**... meet the requirements of a space-filling curve” but need not. EX1001, 3:10-13, 7:22-24. Claim differentiation also refutes Fractus’s construction because Part [3] improperly renders limitation [20F] superfluous. *See* Appendix A (Claim List).

2. Petitioners’ construction

The patent says Figure 21b (highlighted below) has a “**grid dimension section 320** [blue] and a linear section 322 [green].” EX1001, 8:61-64.



The '365 patent says, “the term *grid dimension curve* is used to describe a **curve geometry having a grid dimension that is greater than one (1)**” (EX1001, 7:16-18) and that “[t]he grid dimension of a curve may be calculated as follows” (bracketing added):

[1] A first grid having square cells of length L1 is positioned over the geometry of the curve, such that the grid completely covers the curve. **[1a]** The number of cells (N1) in the first grid **[1b]** that enclose at least a portion of the curve **[1c]** are counted. **[2]** Next, **a second grid having square cells of length L2** is similarly positioned to completely cover the geometry of the curve, and **[2a]** the number of cells (N2) in

the second grid [2b] that enclose at least a portion of the curve [2c] are counted. [3] In addition, the first and second grids should be positioned within a minimum rectangular area enclosing the curve, such that no entire row or column on the perimeter of one of the grids fails to enclose at least a portion of the curve. [4] **The first grid should include at least twenty-five cells,** and [5] **the second grid should include four times the number of cells as the first grid.** Thus, **the length (L2) of each square cell in the second grid should be one-half the length (L1) of each square cell in the first grid.** [6] The grid dimension (D_g) may then be calculated with the following equation:

$$D_g = -\frac{\log(N2) - \log(N1)}{\log(L2) - \log(L1)}$$

EX1001, 6:59-7:15; Pozar, ¶63.

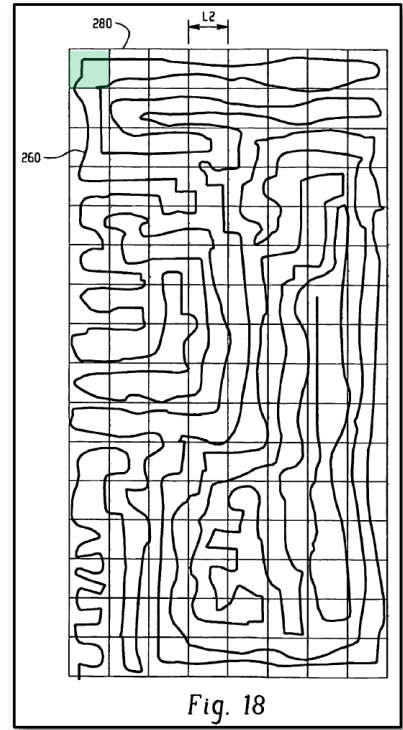
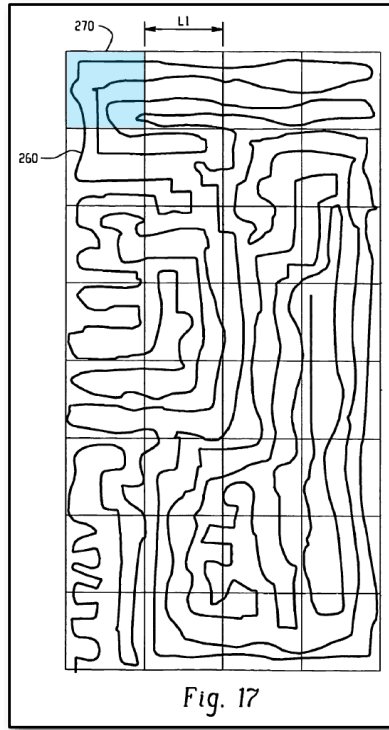
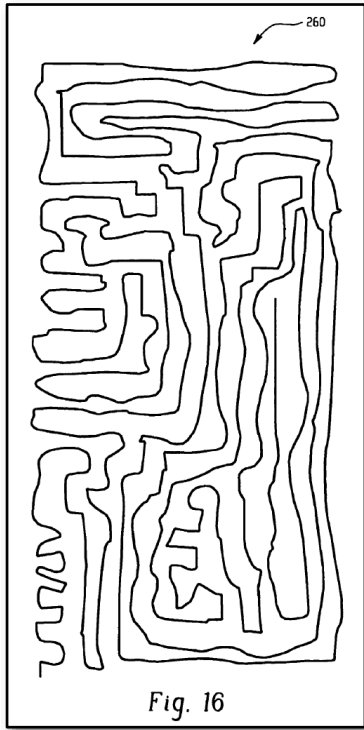
Using Figure 16's curve (below left), the patent describes:

a first grid (Figure 17, highlighted below-middle): with $N1$ ="thirty-two (32) square cells" of length $L1$ (one square highlighted blue below-middle); and

a second grid (Figure 18, highlighted below-right): with $N2$ ="one hundred twenty-eight (128) square cells" of length $L2$, such that $L1$ is "twice the length [of] $L2$ " (i.e., $L1 = 2 \times L2$)³ (one square highlighted green below-right).

³ The '365 patent at 7:34-36 and 7:45-49 has an obvious typo: $L1$ equaling "twice

EX1001, 7:26-49; Pozar, ¶64.



For convenience, a grid’s total number of square cells is labelled N_{Total} . For Figure 17 showing a first grid, $N1_{\text{Total}}=32$ and for Figure 18 showing a second grid, $N2_{\text{Total}}=128$.

Using the grids in Figures 17-18, grid-dimension (D_g) for Figure 16’s curve is:

$$D_g = - \left(\frac{\log(N2) - \log(N1)}{\log(L2) - \log(L1)} \right) = - \left(\frac{\log(128) - \log(32)}{\log(L2) - \log(2 \times L2)} \right)$$

the length [] $L2$ ”—and $L2$ being “one-half the length ($L1$)” (EX1001, 7:7-9)—means $L1=2 \times L2$, **not** “ $L2=2 \times L1$.” Pozar, ¶64 n.1.

$$= -\left(\frac{\log(4)}{\log(1/2)}\right) = -\left(\frac{2 \log(2)}{(-1) \log(2)}\right) = 2.$$

EX1001, 7:27-59. Pozar, ¶65.

In view of the foregoing, “*grid dimension curve*” means “a curve geometry **having a grid dimension that is greater than one (1)**” (EX1001, 7:16-18), where “grid dimension” can be calculated using

$$D_g = -\frac{\log(N2) - \log(N1)}{\log(L2) - \log(L1)}$$

(from EX1001, 7:11-15), where L1, L2 and N1, N2 meet the requirements labelled [1]-[6] above (from EX1001, 6:59-7:10).⁴ Pozar, ¶66.

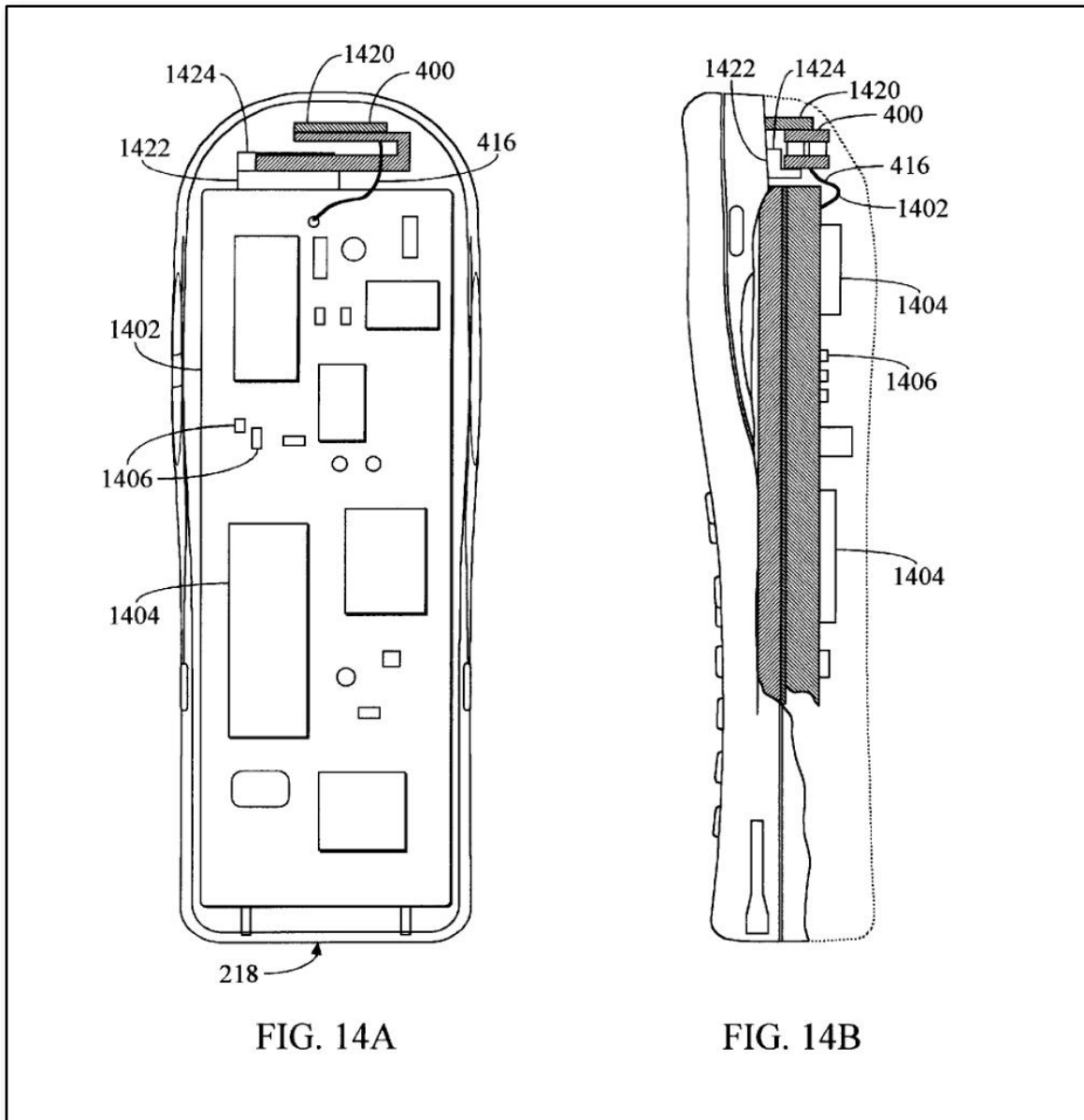
⁴ Petitioners may argue in district court that “grid-dimension curve” is indefinite for reasons that are not placed at issue by the invalidity analysis for Ground 1. *PLR Worldwide Sales Ltd. v. Flip Phone Games, Inc.*, IPR2024-00209, Paper 9, 39 (May 10, 2024) (“even if full scope of” term “is indefinite because the specification does not provide a sufficient boundary... that does not prevent us from making a determination that a teaching is well within that boundary”).

VI. GROUND 1: TRAN+TENG RENDERS OBVIOUS CLAIMS 1-42 AND 44-45

A. Tran (EX1005)

Tran discloses “internal antennas for wireless devices” like “mobile cellular” “phones” for communication over “multiple frequency” bands. Tran, Abstract, 1:9-58. Tran’s antennas are dual-band antennas supporting a “cellular frequency band” from 825-960 MHz and “the PCS frequency band” from 1.85-1.99 GHz. Tran, Figs. 10-11, 12:56-67, 13:15-18.

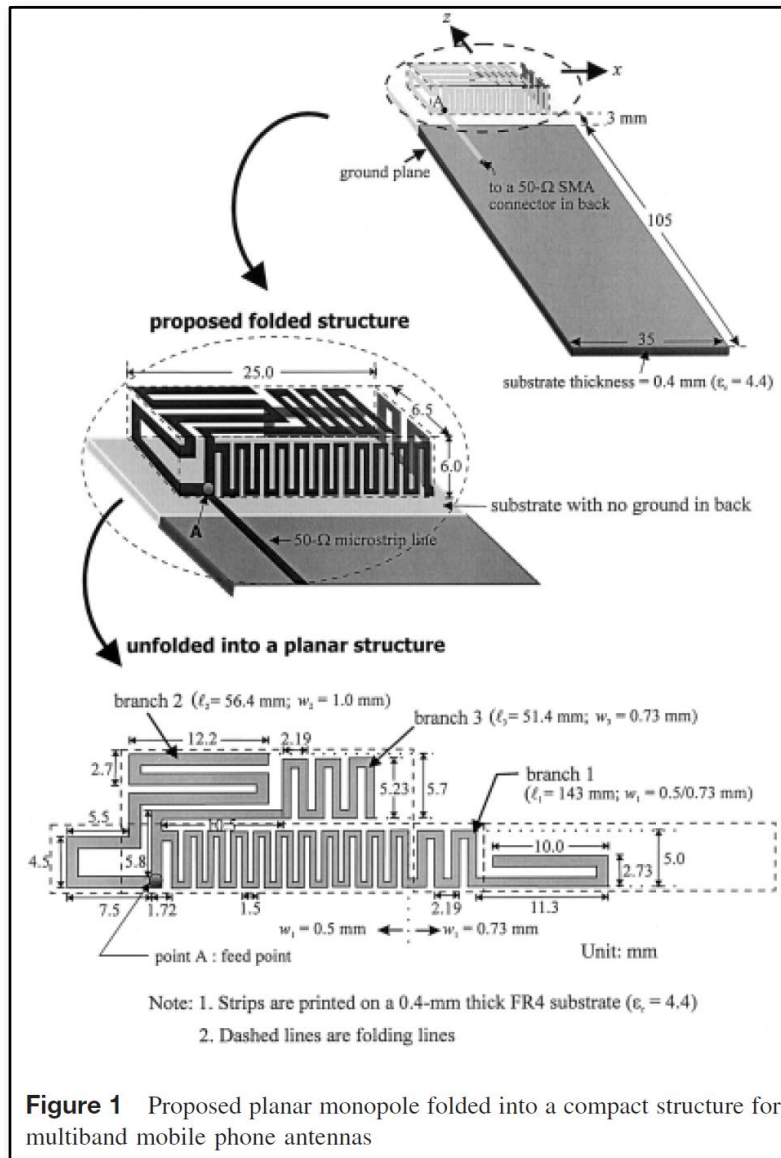
Tran’s Figures 14A-14B (below) “illustrate” “cutaway section views” of antenna 400 “within” a mobile phone. Tran, 13:28-30. The mobile phone has components like “integrated circuits or chips 1404” “for performing the various functions needed or desired” (like a “transceiver”), and those components are supported by a printed circuit board (PCB), and all are arranged “inside of housing 102.” Tran, 13:28-57.



B. Teng (EX1006)

Teng discloses “a novel very-low-profile” antenna “consisting of three branch strips” “folded into a rectangular-box-like compact structure for applications in multi-band mobile phones” that support communication over three,

conventional mobile-phone frequency bands: GSM, DCS, and PCS. Teng, Fig. 1 (below), 23.



Each branch “generat[es] a resonant mode” for a respective frequency band (e.g., Branch 1 resonates around “900 MHz for GSM operation”). Teng, 23; Pozar, ¶¶69-70. Teng’s “proposed antenna is mounted on the top portion of an FR4 substrate... which can be considered as the circuit board of a practical mobile

handset.” Teng, 24. Teng mounts its antenna on a substrate, “which can be considered as the circuit board of a practical mobile handset,” over a portion of the “substrate with no ground in back.” Teng, 24, Fig. 1.

C. Tran+Teng Combination

POSAs considering the teachings of Tran and Teng together had reasons to implement a multi-band cellular telephone having, *inter alia*, a PCB, ground plane, antenna, and the telephone’s communication circuitry inside the device’s housing of the type disclosed by Tran, but using Teng’s compact, low-profile multiband-antenna design.

First, POSAs would have recognized that Teng’s “very-low-profile” “compact structure”—which “achieve[s] a much-reduced antenna height” of “6.5 mm” (Teng, 23)—would have furthered Tran’s desire for “small” multi-band antennas (Tran, 1:24-37) that could be integrated into a mobile phone’s housing to avoid the need for an external antenna that could be easily damaged and would “catch[] on objects” (Tran, 1:59-65). Pozar, ¶¶71-72. Teng’s compact antenna ($6.5 \times 6 \times 25 \text{ mm}^3$, Teng, 25) is substantially smaller than Tran’s internal antenna ($4.9 \times 0.4 \times 0.3 \text{ inches}^3 \cong 124 \times 10 \times 8 \text{ mm}^3$, Tran, 12:23-41). Thus, Teng’s antenna would have beneficially supported even further reduction in the mobile phone’s device size (and/or integration of additional circuitry to perform additional functionality) because, as Tran recognizes, “the size of the antenna can

play an important role in decreasing the size of the device” and “device aesthetics and manufacturing costs.” Tran, 1:33-37; Pozar, ¶73.

Second, Teng teaches the desirability of using Teng’s antenna in “multiband mobile phones.” Teng, 25. Thus, POSAs would have been motivated to identify a suitable mobile-device housing and related components to further Teng’s desire to design an antenna for use in “a practical mobile handset.” Teng, 24; Pozar, ¶74.

Third, Tran’s antenna operated on GSM850 and PCS1900 bands. Tran, FIG. 10, 12:23-27, 12:56-67. Teng’s antenna supported **two** bands in addition to PCS1900: a “GSM band (890-960 MHz)” and the “DCS band (1710-1880 MHz)”. Teng, 24. POSAs would have recognized the benefit of adding to Tran’s phone the capability of operating on additional frequency bands. Pozar, ¶75 (citing corroborating EX1014, [0002]-[0003] (“demand for... mobile stations [e.g., phones] supporting several wireless systems is also on the increase”)).

Moreover, the GSM850 (824-894 MHz) and PCS1900 (1850-1990 MHz) bands supported by Tran’s antenna were used in North America, whereas GSM900 (890-960 MHz) and DCS1800 (1710-1880 MHz) supported by Teng’s antenna were used in Europe. See EX1015, [0002]. POSAs had reasons to use Teng’s antenna in Tran’s device to produce a phone that could be used in (and sold for) Europe (and also work in North America on PCS1900). Pozar, ¶76.

Fourth, Tran in view of Teng is nothing more than combining prior art elements (Teng's antenna with Tran's mobile device) according to known techniques for integrating mobile-phone antennas and circuitry inside the device's housing, to yield the predictable result of a mobile-phone device with an internal antenna capable of transmitting over three frequency bands. Pozar, ¶77; *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417-18 (2007).

A POSA would have implemented Tran in view of Teng by mounting Teng's multiband folded antenna onto the mobile device's PCB because Tran discloses mounting its multiband antenna to the PCB along with the mobile device's communication circuitry and enclosing all within the housing of the mobile-communications device (Tran, 5:46-59) and Teng similarly teaches mounting its antenna to a substrate "which can be considered as the circuit board of a practical mobile handset" (Teng, 24). Pozar, ¶78.

Based on Teng, the portion of the PCB below the antenna would not comprise a portion of the ground plane layer. A POSA would have implemented the mobile device's communications circuitry (e.g., a transceiver) as discussed in Tran to support communications over the three frequency bands supported by Teng's antenna (GSM, PCS, DCS) which was well within a POSA's capability. Teng, 23; Pozar, ¶79 (citing corroborating EX1015, [0007]-[0008] (disclosing as background information a prior art "handset [that] can operate in three modes:

GSM 900, GSM 1800, or WCDMA” and “supports GSM in four frequency bands”)).

A mobile device implemented as described above is hereafter referred to as “Tran+Teng.” A POSA would have reasonably expected success in implementing Tran+Teng because doing so was well within a POSA’s capabilities. Pozar, ¶80. As discussed above, Teng’s antenna is “compact,” smaller than Tran’s, and intended for use in a “practical mobile handset” (Teng, 24), while Tran discloses a mobile phone that already includes an internal antenna and communications circuitry mounted on a PCB and within the mobile’s device’s housing. Pozar, ¶80 (citing EX1015, [0007]-[0008]).

D. Tran+Teng Meets Claims 1-42, 44-45

1. Claim 1

a. Preamble [1PRE]

1PRE	<i>A mobile communication device, comprising</i>
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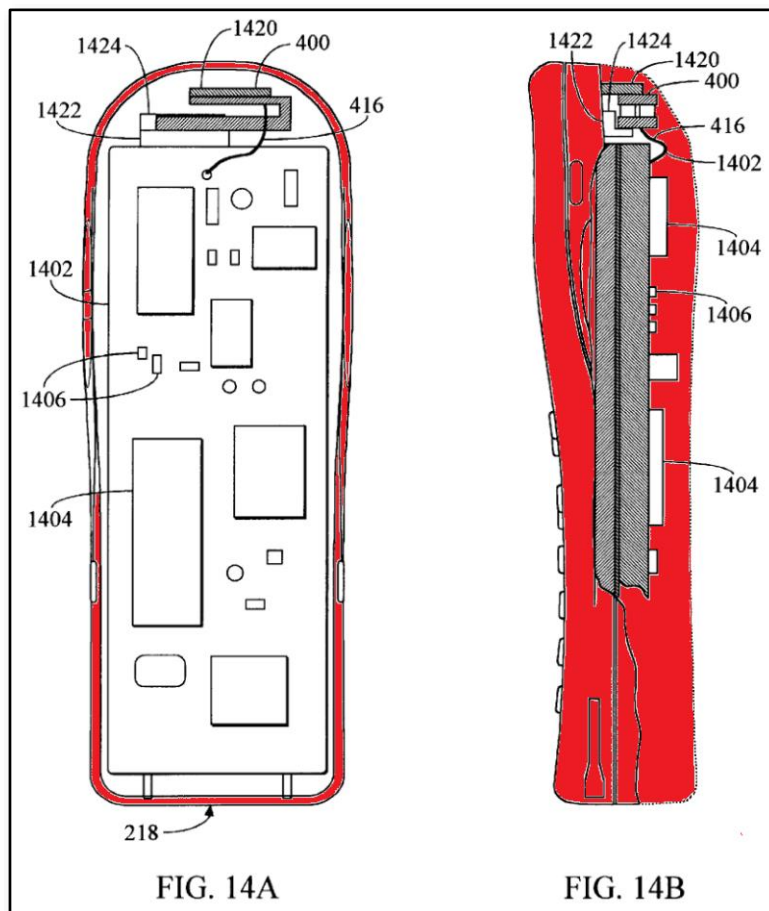
Tran+Teng is a mobile cellular phone as taught by Tran and suggested by Teng. *Supra* §VI.C (Tran+Teng combination); Tran, 13:28-42, Figs. 14A-14B; Teng, 22 and 24-25 (“proposed antenna” for use in “a practical **mobile** handset”).

A mobile cellular phone is an example *mobile device* identified in the ’365 patent (EX1001, 1:18-21) and meets the plain meaning of *a mobile communication device* (see EX1011, 12).

b. Limitation [1A]

1A	<i>a device housing;</i>
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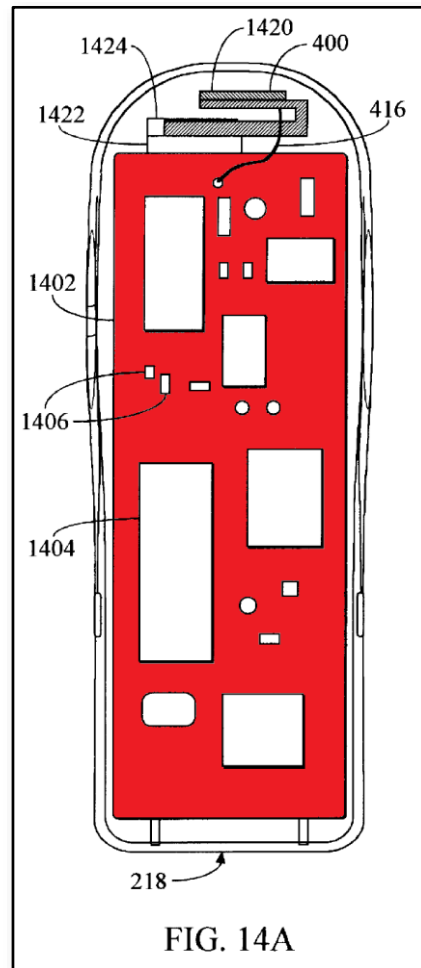
Tran+Teng’s mobile phone is a device and comprises Tran’s housing (red) which is a *device housing* that houses other components of the phone like the antenna, PCB, and communication circuitry. *Supra* §VI.C; Tran, Figs. 14A-14B (highlighted below), Figs. 1A-1B (housing 102), 13:28-30 (“FIGS. 14A and 14B” show Tran’s “invention mounted within the phone of FIG. 1”); Pozar, ¶¶82-83.



c. Limitation [1B]

1B	<i>a printed circuit board</i>
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Tran+Teng comprises Tran's "***printed circuit board***" 1402 (red). *Supra* §VI.C; Tran, Figure 14A (highlighted below), 13:43-47; Pozar, ¶84.



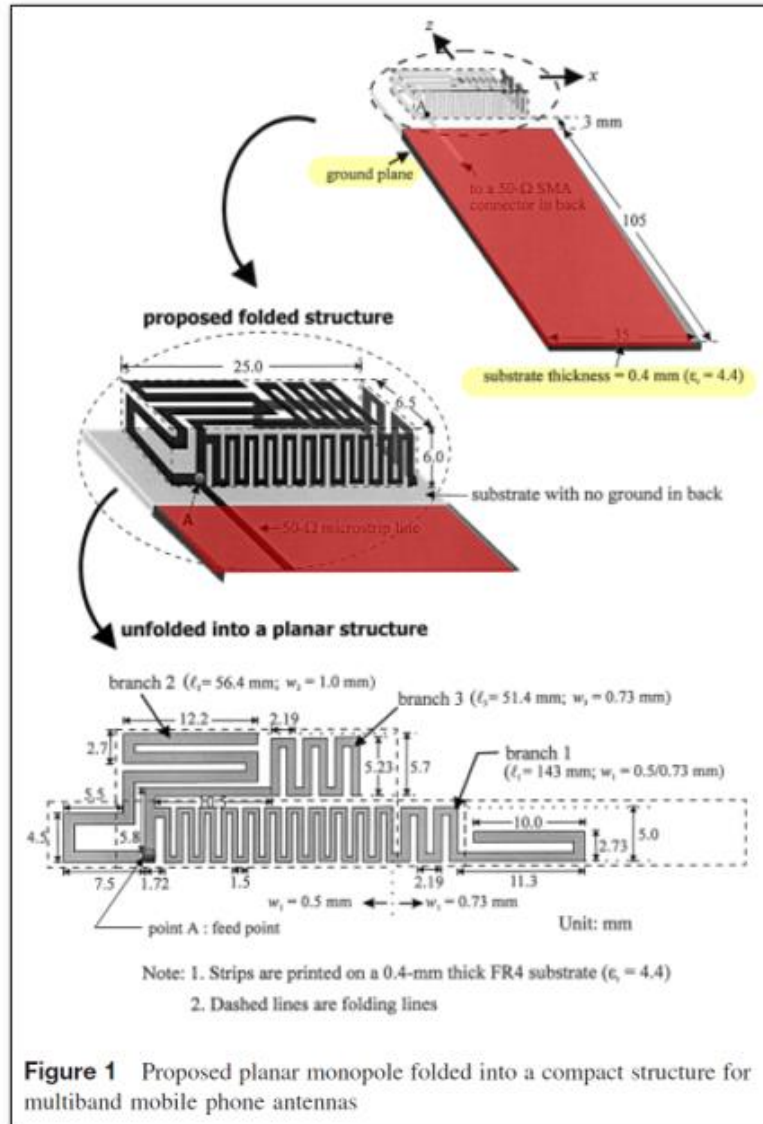
d. Limitation [1C]

1C	<i>the [PCB] comprising: a ground plane layer</i>
----	---

Tran+Teng's PCB comprises *a ground plane layer* as was well-known for PCBs and taught by Tran and Teng. Tran, 13:43-57 (PCB comprises "dielectric material layer 1412 disposed next to **metallic conductor layer 1414** disposed next to dielectric material layer 1416 supporting or disposed next to **metallic conductor layer 1418**" wherein "either layer 1414 or 1418 **could form a ground layer or ground plane** for board 1402, as would be known in the art."); Teng, 24 (antenna is for mounting on "circuit board of a practical mobile handset" made with a "ground plane in back"); EX1041 ("Sadler"), [0012] ("ground plane" is "typically the [PCB] of the phone"), [0015] ("The antenna may use the printed circuit board of the mobile terminal as the ground plane."), [0043] ("In conventional cellular telephones, the printed circuit board 106 acts as a ground plane for numerous electrical components positioned within the housing 100, and especially those components positioned on the printed circuit board 106."); Pozar, ¶¶85-86.

It was well-known to POSAs that a PCB ground plane's placement relative to the antenna impacts antenna performance. E.g., Sadler, [0004] (antenna placement relative to ground plane affects antenna resonance), [0046] (describing parasitic tuning from antenna placement over ground plane), [0049] (similar); Pozar, ¶¶87-89 (citing corroborating EX1030, [0069]-[0071] (disclosing that a “grounding electrode [] formed on the entire bottom surface” of a “surface-mounted antenna” will cause the antenna to “lose[] omni-directionality because of capacitance coupling to the radiation electrode”)), [0097], [0117]; EX1027, [0061]-[0063])).

Because Tran+Teng uses Teng's antenna to achieve the results Teng describes, and because Teng says “the top portion” of its substrate “has **no ground plane in back**” and the “antenna **should be placed... away from**” the substrate “portion with a ground plane in back” (Teng, 24), POSAs would have implemented Tran+Teng in the manner Teng discloses so that no portion of the *ground plane layer* is underneath the antenna, as shown in Teng Figure 1 (highlighted below). Pozar, ¶90.

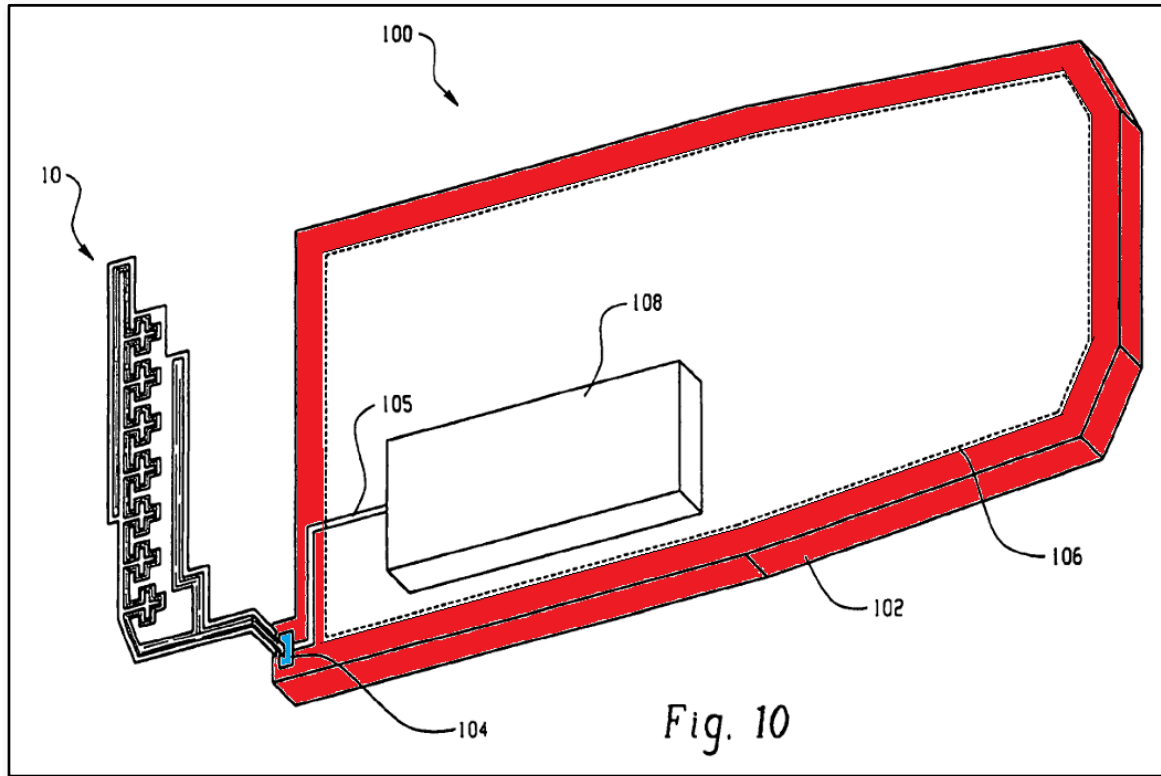


e. Limitation [1D]

1D	[PCB comprising] a feeding point;
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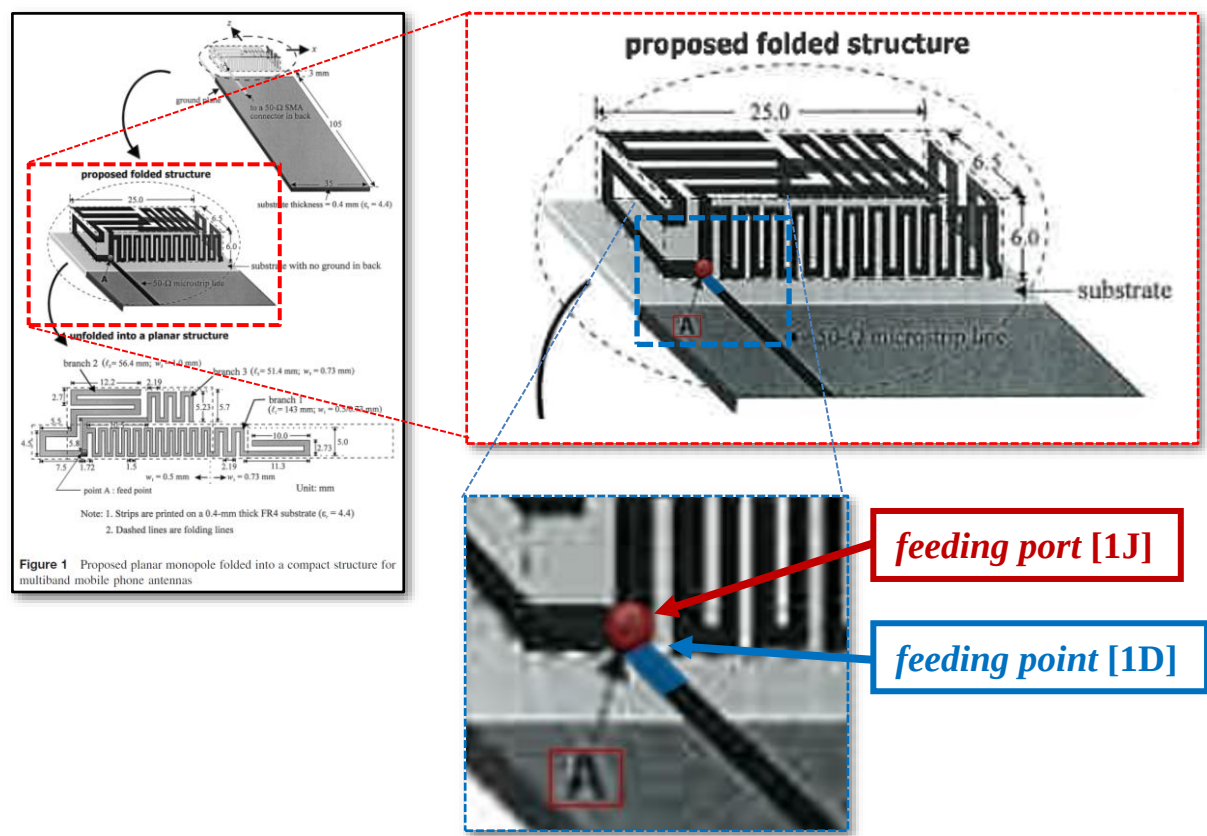
The '365 patent's "circuit board 102 [red] includes a feeding point 104 [blue]" coupling communication circuitry 108 to antenna 10. EX1001, 4:49-62, Figs. 1, 10 (highlighted below). Feeding point 104 may be "a metallic bonding pad" coupled to "circuit traces 105." EX1001, 4:55-58. Thus, the *feeding point* is

a conventional conductive element on the PCB for coupling the communication circuitry to the antenna (*infra* §VI.D.1.g ([1F])). Pozar, ¶91.



Tran+Teng's PCB comprises a feeding point to provide a pathway for RF signals between Tran+Teng's antenna assembly and its communications circuitry (discussed *infra* §VI.D.1.j ([1I])), as illustrated in Teng. Pozar, ¶92. For example, Teng's Figure 1 (annotated detail below) illustrates that Teng's "antenna can [] be easily **fed at Point A** with the use of a 50-Ω microstrip line printed **on** the FR4 substrate." Teng, 24. While Teng labels point A on the antenna element a "feed point," in Limitation [1D]'s terminology the point **on the substrate** where Point A

couples to the microstrip is Teng’s PCB’s *feeding point*. Pozar, ¶92. (As explained *infra* §VI.D.1.k ([1J]), Point A is a “*feeding port*.”)

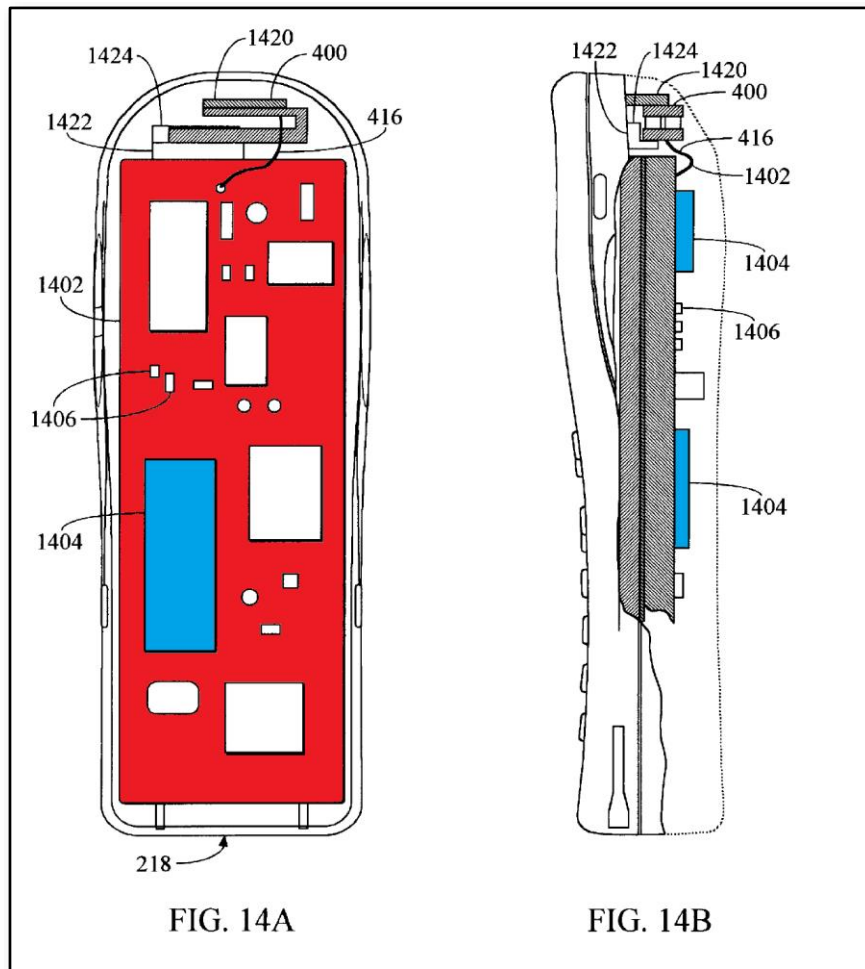


f. Limitation [1E]

1E	<i>a communication circuitry, the communication circuitry being mounted on the printed circuit board;</i>
----	---

Tran+Teng’s PCB (red) has “integrated circuits or chips 1404” (blue) “supported [*i.e., mounted*] on” the *PCB*, as shown in Tran Figures 14A-14B (highlighted below), “for performing the various functions needed or desired.” Tran, 13:28-37. The Tran+Teng phone’s mobile-phone-service functionality is implemented via “a signal unit (not shown), such as a transceiver... or radio

circuitry” (i.e., *communication circuitry*) to process signals transmitted/received on Tran+Teng’s frequency bands (*supra* §VI.C). Tran, 8:41-55; Pozar, ¶93. POSAs would have implemented Tran’s signal unit transceiver functionality using one or more chips 1404 that Tran explains are “for performing the various functions needed or desired.” Tran, 13:28-37; Pozer, ¶94.

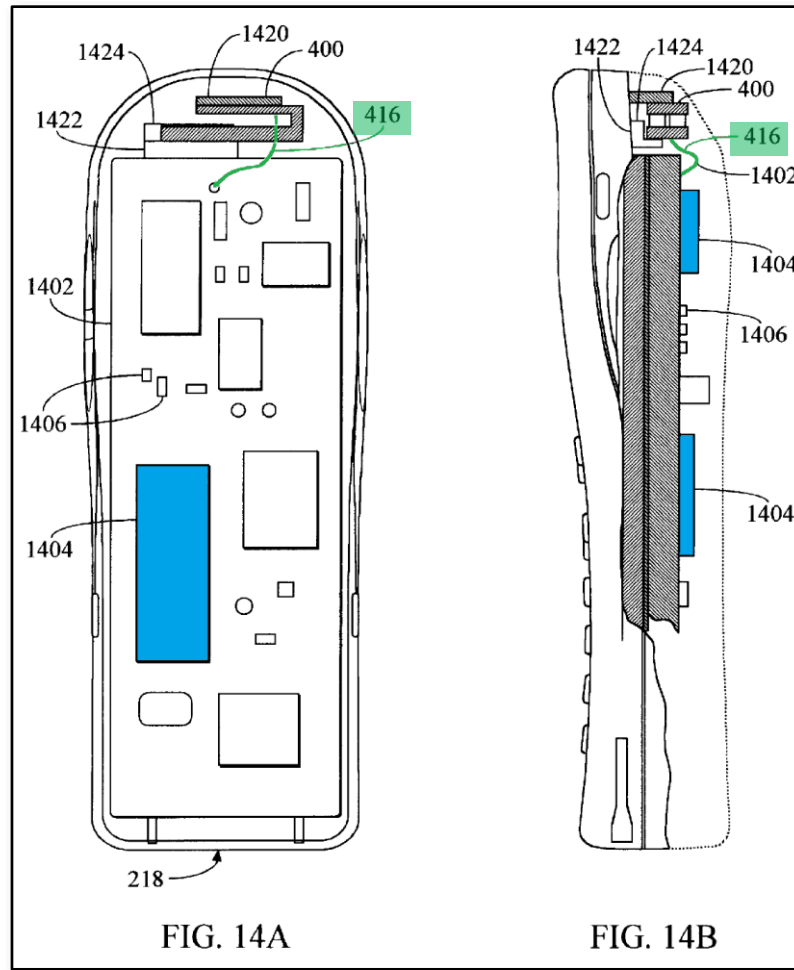


g. Limitation [1F]

1F	<i>wherein the communication circuitry is coupled to the feeding point and to the ground plane layer;</i>
----	---

Tran+Teng's *communication circuitry is coupled to the antenna's feeding point*, as discussed by Tran and Teng. Pozar, ¶95.

Tran+Teng implements a mobile phone as shown in Tran's Figure 14A-14B (highlighted below), which has a coaxial feed 416 that, as in Tran's Figure 4 embodiment, couples the antenna to "a signal unit... such as a transceiver." Tran, 8:37-43. In Tran's Figures 14A-14B, the transceiver(s) coupled to the antenna are implemented in integrated circuit(s) 1404 (blue) mounted on the PCB as discussed *supra* §VI.D.1.f ([1E]). Thus, the PCB has a feeding point that is coupled to the coaxial feed 416 (green) to feed signals to the antenna. Pozar, ¶96.



Teng's PCB also has a *feeding point*, highlighted blue in Figure 1 below. *Supra* §VI.D.1.e ([1D]). In Teng, the microstrip line (blue) on the PCB that drives the feeding point connects to test circuitry (Teng, 24-25), but in Tran+Teng this would represent a PCB trace to the communications circuitry. Pozar, ¶97 (citing corroborating EX1017, 1:27-29 (background: "A power-driven transmitter and/or receiver network (i.e., transceiver) is generally coupled to the microstrip antenna via feed point and feed line.")).

In implementing Tran+Teng, it would have been a design choice whether to connect the PCB's feeding point to the antenna via a coaxial wire as in Tran or via a solder or other bond between the antenna and the feeding point as discussed in Teng, and POSAs had reason to choose Teng's approach to avoid a bulkier coaxial wire. Pozar, ¶98.

Figure 1 Proposed planar monopole folded into a compact structure for multiband mobile phone antennas

within the housing 100, and especially those components positioned on the printed circuit board 106.”), claim 20 (“A mobile communications terminal comprising: a) a radio communications circuit; b) ***a ground plane operatively coupled to said radio communications circuit...***”); Pozar, ¶99 (citing additionally corroborating EX1020, 4:5-8; EX1021, 1:12-2:2).

h. **Limitation [1G]**

1G	<i>a multi-band antenna capable of operating at multiple frequency bands, the multi-band antenna including an antenna element;</i>
----	--

Tran+Teng uses Teng’s monopole “GSM/DCS/PCS multiband mobile-phone antenna” for which “the obtained impedance bandwidths cover the required bandwidths of the GSM band (890-960 MHz), the DCS band (1710-1880 MHz), and the PCS band (1850-1990 MHz).” Teng, 22 (Abstract), 24 (“From the obtained results in Figure 3 [annotated below], the lower band has a bandwidth (1:2.5 VSWR) of 889-960 MHz, covering the required GSM band. For the upper band, a bandwidth of 1704-2008 MHz is obtained, which covers the required DCS and PCS bandwidths.”); Pozar, ¶100. The antenna is thus “*capable of operating at multiple frequency bands*” meeting [1G]. Pozar, ¶100.

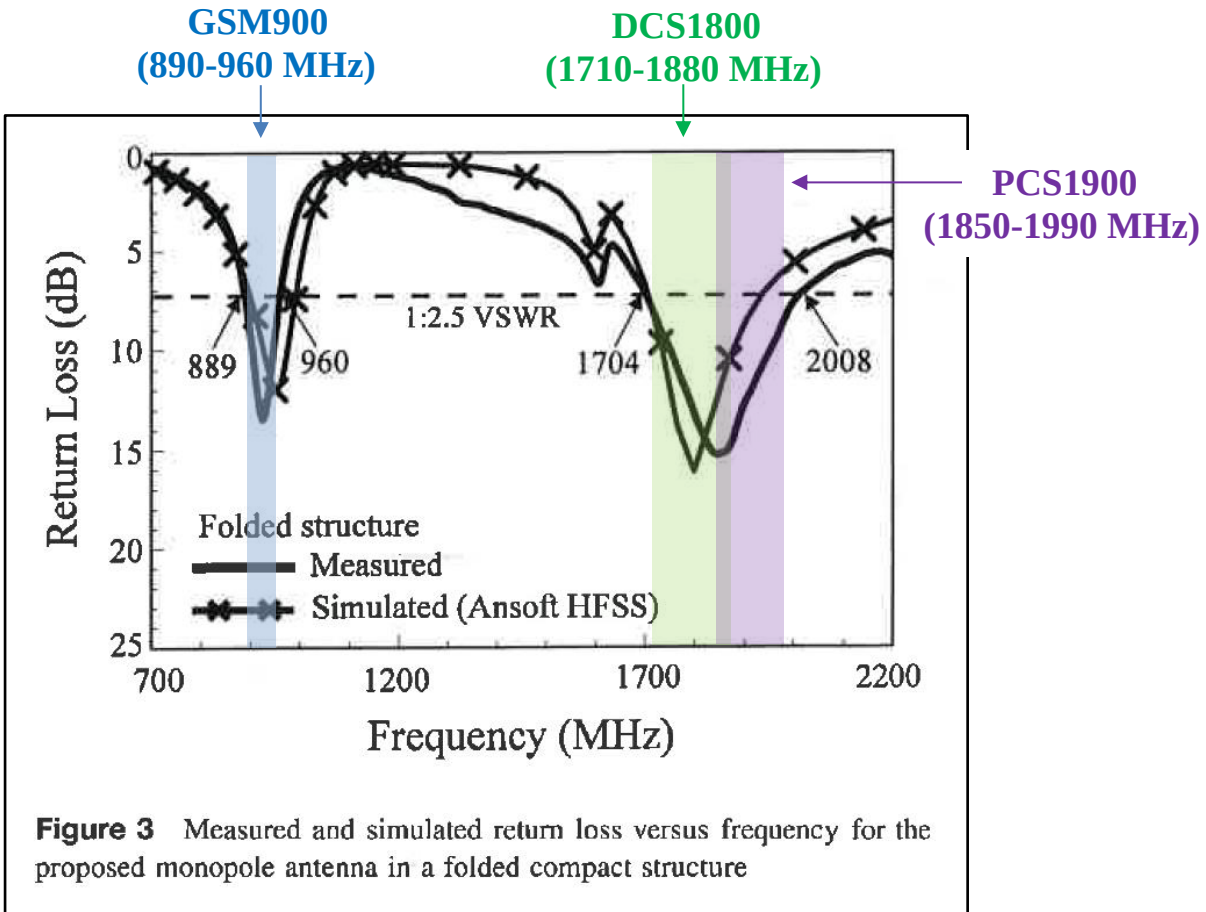


Figure 1 (annotated below) illustrates that Teng's antenna has an *antenna element* shown in planar-structure (blue) and folded-structure (red) form, which further meets Limitation [1I] as shown *infra* §VI.D.1.j. Pozar, ¶101.

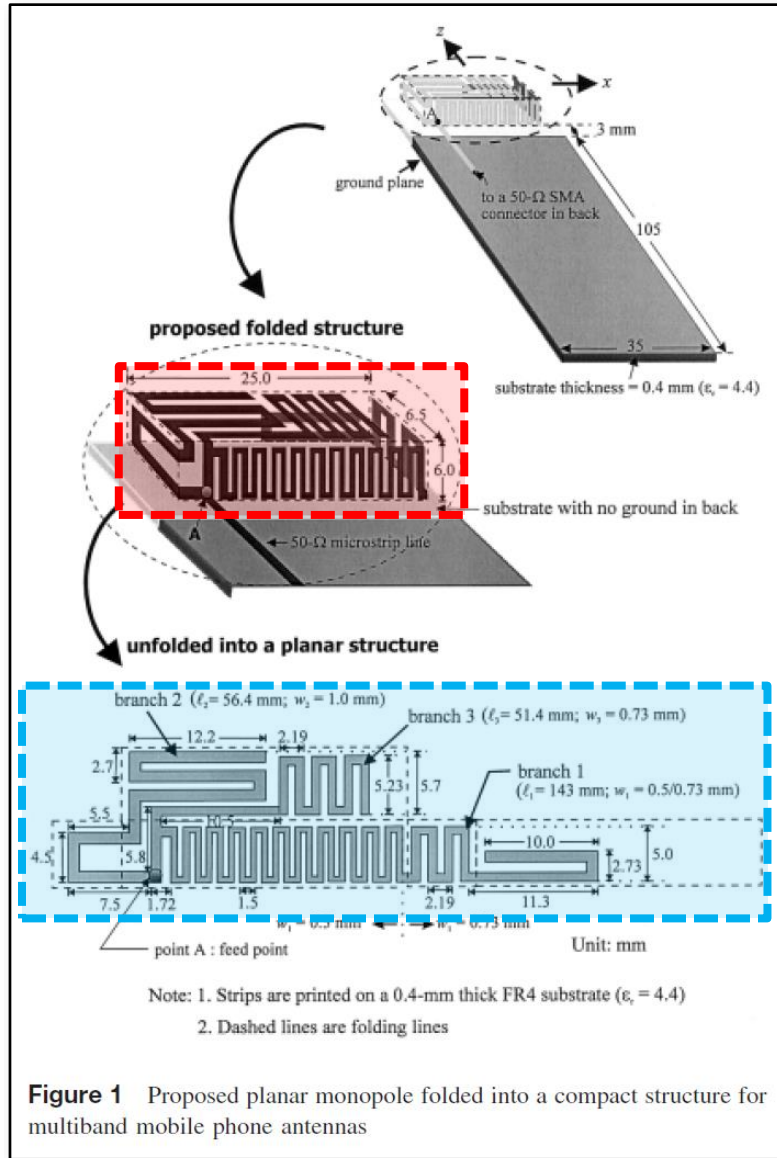


Figure 1 Proposed planar monopole folded into a compact structure for multiband mobile phone antennas

i. Limitation [1H]

1H	wherein the antenna element operates in cooperation with the ground plane layer;
----	--

The '365 patent does not explain how an *antenna element operates in cooperation with the ground plane layer* and, instead, relies on a POSA's background knowledge. Pozar, ¶102.

Teng’s antenna has three branches “designed to operate as quarter-wavelength structures.” Teng, 22 (Abstract). POSAs knew quarter-wavelength antennas *operate in cooperation with the ground plane layer* to exhibit electromagnetic-radiation properties comparable to corresponding half-wavelength dipole antennas and provide a signal-return path and ground reference for communication circuitry coupled to the antenna. Pozar, ¶¶102-103 (citing corroborating EX1022, [0005] (in a “quarter-wavelength monopole antenna... [t]he physical antenna length is a quarter-wavelength, but when placed above a ground plane the antenna performance resembles that of a half-wavelength dipole”); EX1018, [0003] (“To complete the antenna structure, the dielectric substrate is covered with metal on one side, (the *ground plane*).... [T]he substrate fulfills an electrical function by concentrating electromagnetic fields and preventing unwanted radiation in the associated circuits.”); EX1019, 2:6-16 (“[T]he ground plane element also functions as a ground potential for the radio-device’s communication circuitry.”)).

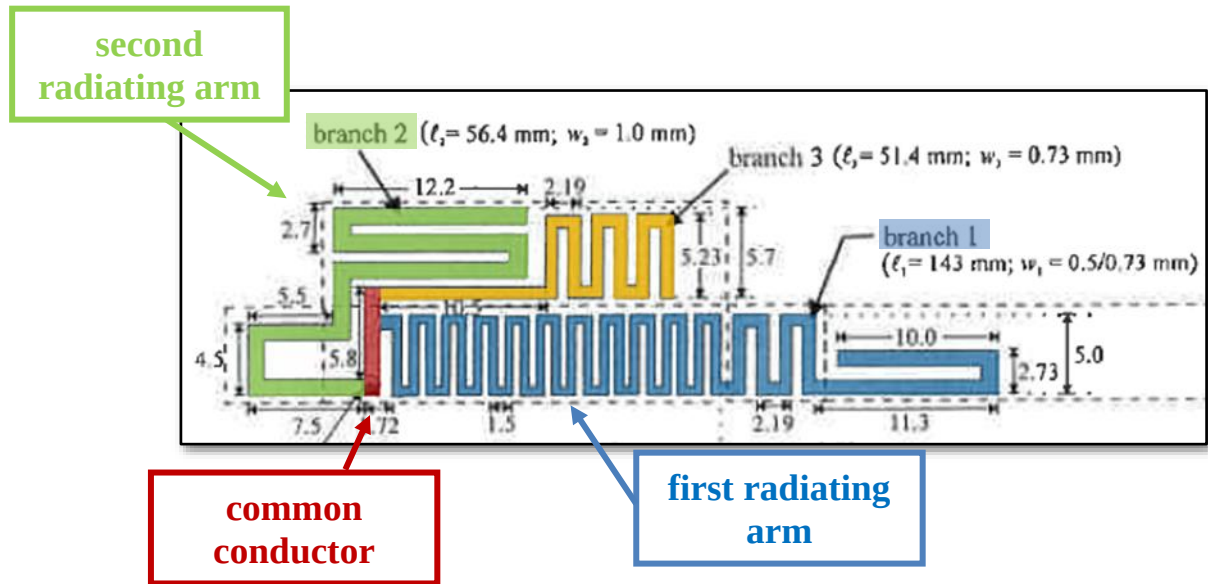
j. Limitation [1I]

1I	<i>the antenna element comprising: a common conductor; a first radiating arm connected to the common conductor; a second radiating arm connected to the common conductor;</i>
----	---

Tran+Teng uses Teng’s antenna element, which is “printed on a thin FR4 substrate” and formed from a *conducting* material that radiates/resonates RF

energy. Teng, 23 (discussing electromagnetic “coupling effect between two adjacent or meandered sections” of the antenna element, which corroborates that it is formed of conductive material); Pozar, ¶104 (citing corroborating EX1014, [0005]). Using *conducting* material was also the obvious and conventional way to print antennas onto a substrate. Pozar, ¶105 (citing additionally corroborating EX1017, 1:11-18, 4:12-24; EX1022, [0006]); *see also* Tran, 11:35-39 (Tran’s antenna can be “constructed by etching or depositing a **metallic** [*conductive*] strip on two sides of a dielectric substrate”)).

Teng’s *antenna element* has three branches highlighted blue, green, and orange in Teng’s Figure 1 (annotated detail below), with each branch strip originating from a common, conductive trunk highlighted red, which is *a common conductor*. Teng, 23-24 (disclosing that RF signals to/from the branches are “fed at Point A”); Pozar, ¶106. Each branch is designed to *radiate* over a respective frequency band and is thus a *radiating arm*. Teng, 23; Pozar, ¶107. Teng’s Figure 1 (annotated detail below) illustrates branch 1 (*first radiating arm*, blue) *connected to the common conductor* (red) and branch 2 is a *second radiating arm* (green) *connected to the common conductor* (red). Teng, 23-24, Fig. 1; Pozar, ¶107.

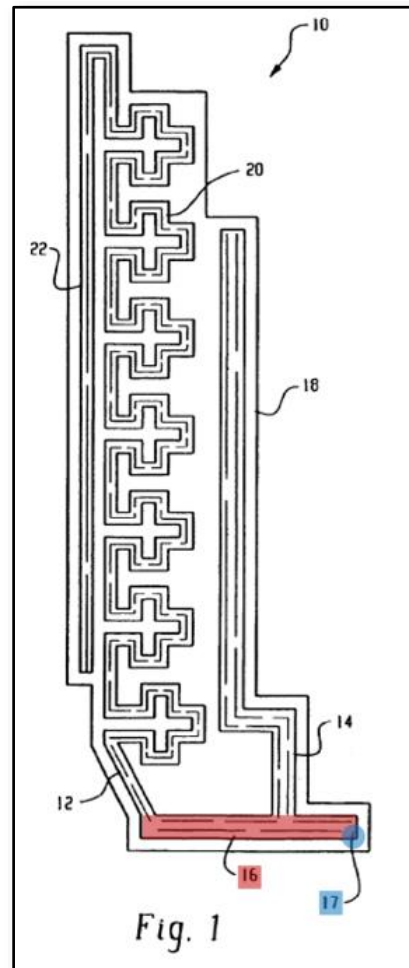


The red-highlighted portion of Teng's antenna element above is a *common conductor* because it is common to multiple radiating arms (e.g., branches 1 to 3) and conducts signal between each branch and feed point A. *Supra* §V.A (claim construction); Pozar, ¶108.

k. Limitation [1J]

1J	<i>wherein the common conductor includes a feeding port, the feeding port being coupled to the feeding point;</i>
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The '365 patent says Figure 1 shows two radiating arms 12, 14 “coupled to a feeding port 17 [blue] through a common conductor 16 [red].” EX1001, 2:54-59, Fig. 1 (annotated).

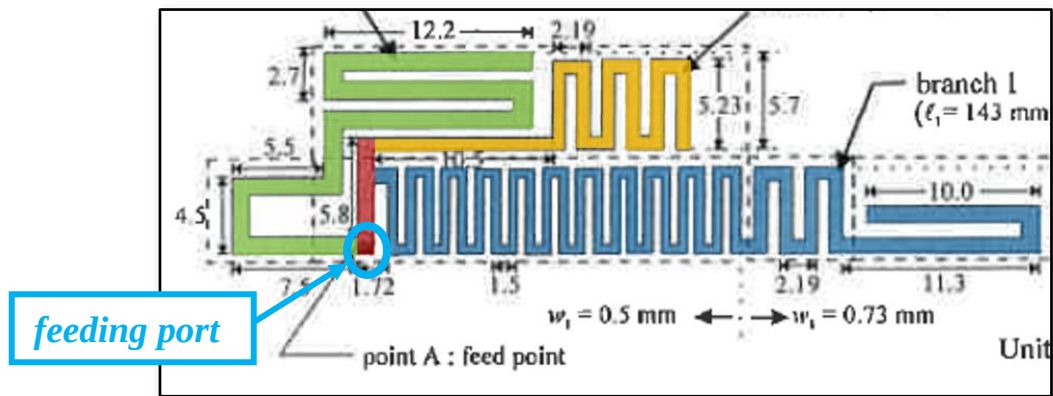
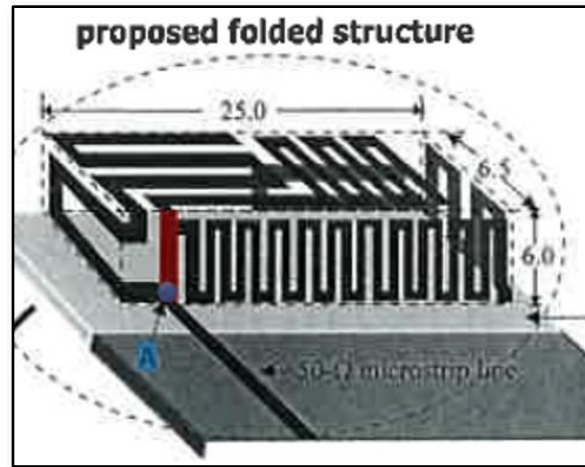


“[F]eeding port 17 of the antenna 10 may... be coupled to the feeding point 104... by bonding the feeding port 17 directly to the feeding point 104.” EX1001, 5:18-23. Thus, the claimed feeding port is met by a portion of the common conductor coupled (e.g., bonded) to the PCB’s feeding point. Pozar, ¶¶109-110.

Additionally, “feed port” was known in the art to “refer[] to the point of electrical contact between the conducting antenna elements and signal processing

electronics.” EX1023, 5:38-41; Pozar, ¶111. An example “feed port” included “a metallized hole through the ground plane[], the dielectric substrate[], and the conducting antenna element.” EX1023, 5:41-50; Pozar, ¶111.

Teng’s Figure 1 (annotated detail below) shows the *common conductor* (red) includes a “point A: feed point.” Teng, 23. While Teng calls this a “feed point” (Teng, Fig. 1), in Limitation [1J]’s terminology this portion of Teng’s common conductor element is the “*feeding port*” because it is “the point through which RF signals are fed into and from the antenna” from the adjacent “*feeding point*” on PCB (*supra* §VI.D.1.e ([1D])). Pozar, ¶112; Teng, 24 (“The proposed antenna can then be easily fed at Point A with the use of a 50-Ω microstripline[.]”).

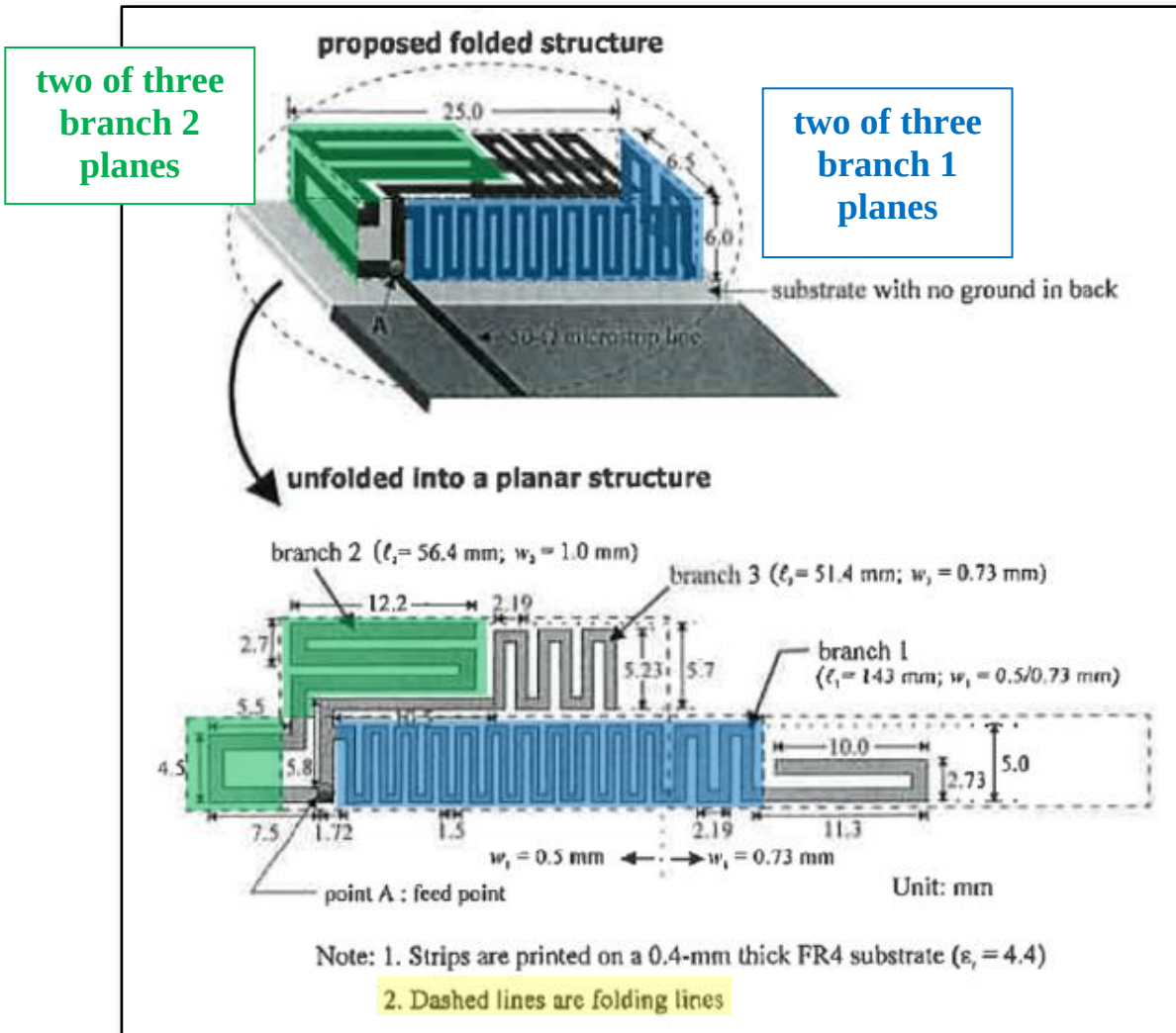


Thus, Teng's feed point A is the *common conductor's feeding port* because it is the point of electrical contact between the antenna's conductor and the communications circuitry. Pozar, ¶113; EX1023, 5:38-41. In Tran+Teng, Teng's *feeding port* (feed point A) is *coupled to Tran+Teng's PCB's feeding point* (*supra* §VI.D.1.d) to transmit/receive wireless signals to/from the communications circuitry. Pozar, ¶113.

I. Limitation [1K]

1K	<i>wherein at least a portion of the first radiating arm and at least a portion of the second radiating arm are arranged on different planes;</i>
----	---

Teng's *antenna element* is “folded into a rectangular-box-like compact structure” in which *at least a portion of* Branch 1 (blue: *the first radiating arm, supra* §VI.D.1.j, [1I]) and *at least a portion of* Branch 2 (green: *the second radiating arm, id.*) are *arranged on different planes* of the rectangular-box-like structure, as illustrated in Teng's Figure 1 (annotated detail below). Teng, 23; Pozar, ¶114.

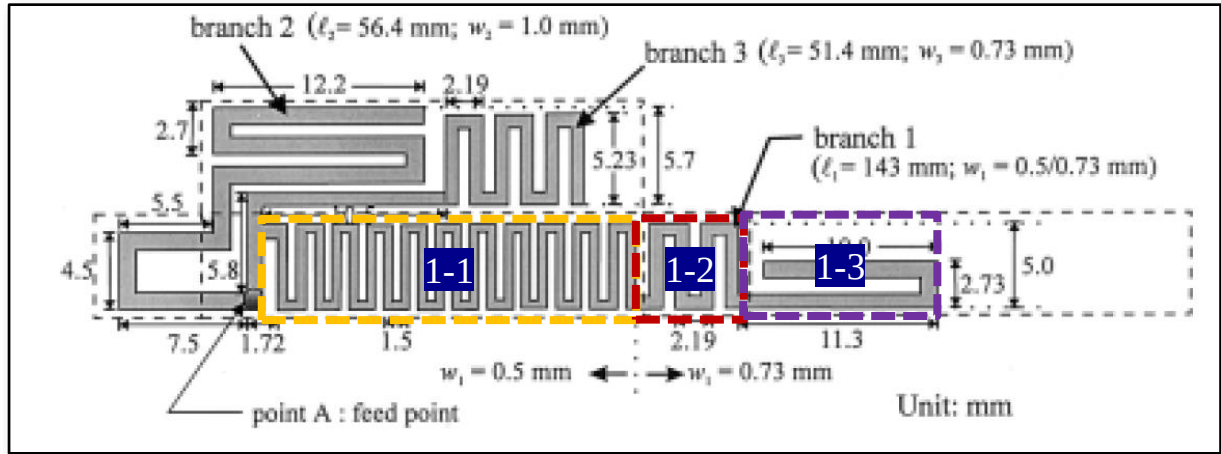


m. Limitation [1L]

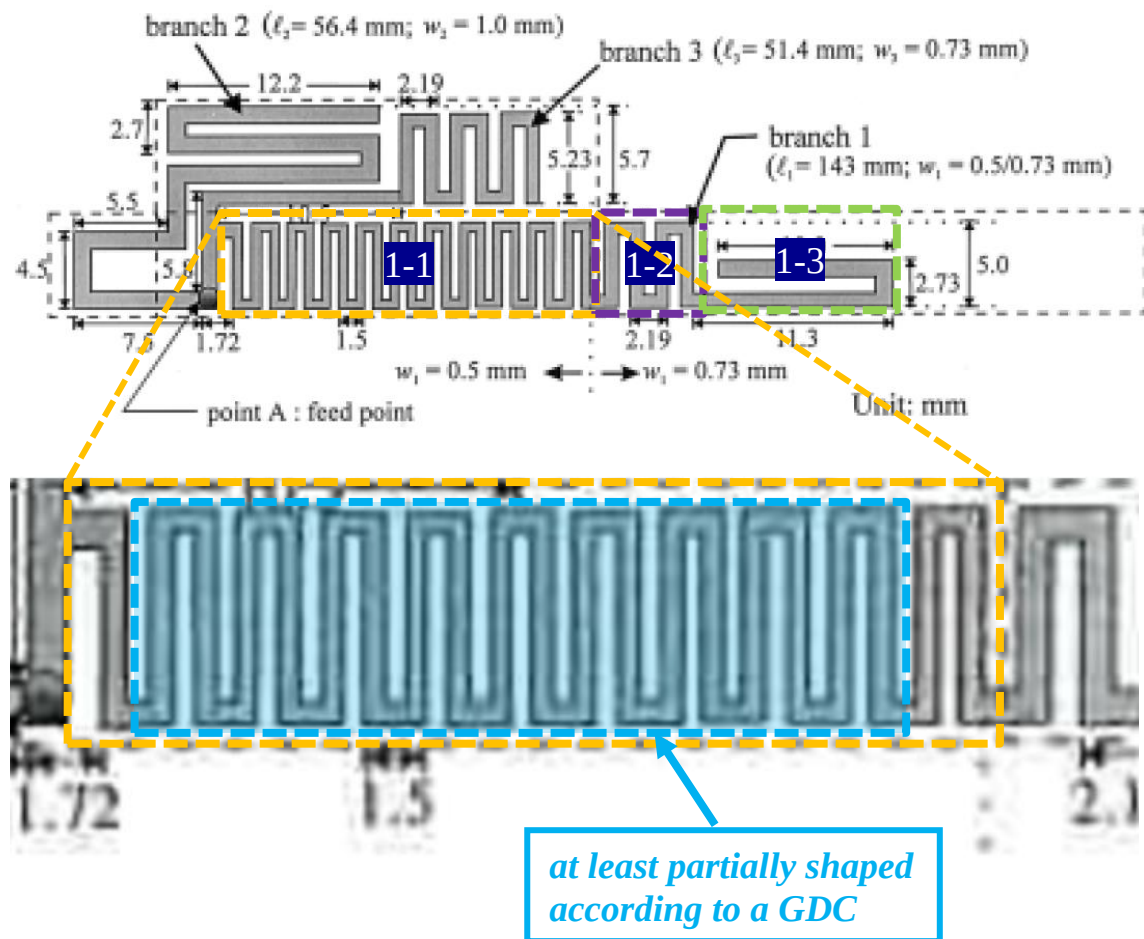
1L	wherein the first radiating arm is at least partially shaped according to a grid-dimension curve; and
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The first radiating arm portion need only be at least partially, not entirely, shaped according to a grid-dimension curve. See *supra* §V.B (constructions of “grid-dimension curve”). Here, Teng’s Branch 1 (first radiating arm) has portions (1-1, 1-2, and 1-3) that, when Branch 1 is folded, lie on three different planes.

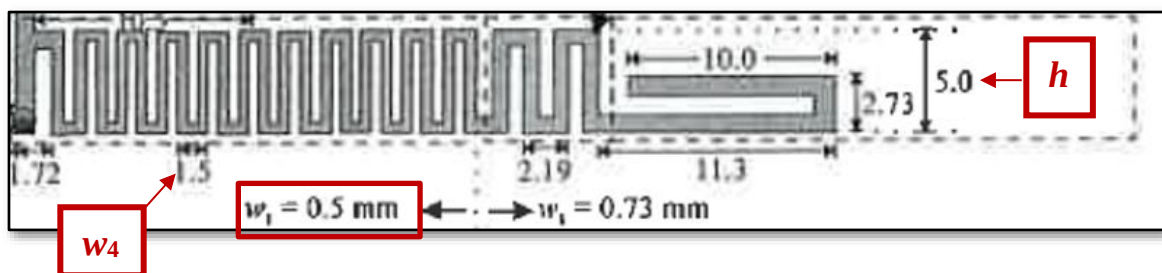
Teng, Fig. 1 (annotated below).



In the portion of section 1-1 shaded blue below (hereinafter, “GDC portion” or “First GDC portion”), Branch 1 (*first radiating arm*) is “*at least partially shaped according to a grid-dimension curve*” meeting limitation [1L], as discussed *infra* §§VI.D.1.m.i-ii. Pozar, ¶¶115-116.



Teng's Figure 1 (annotated detail above) reports dimensions for Branch 1-1, as shown in Petitioners' Figure P-1 below. The strip has a width $w_1 = 0.5$ mm, the meandering pattern has a height $h = 5.0$ mm, and the width $w_4 = 1.5$ mm. Teng, 23.

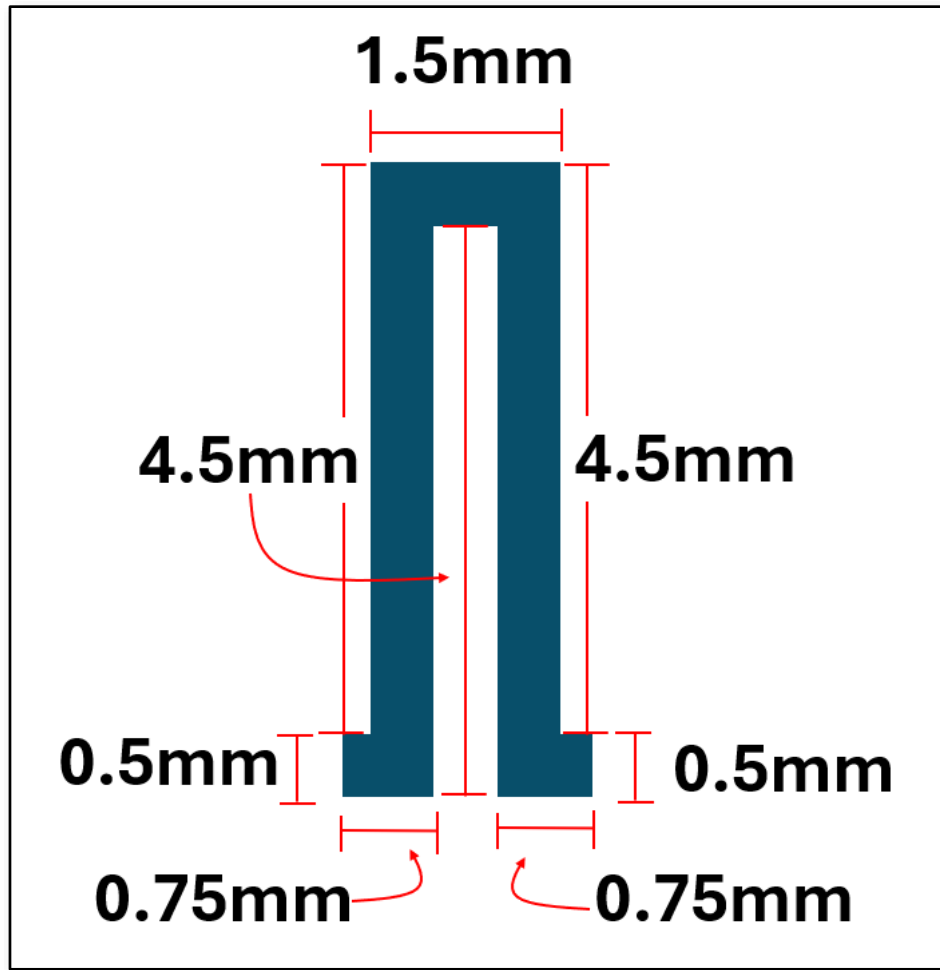


Based on Teng's Figure 1 and that Teng discloses only these dimensions, POSAs would have understood that the GDC portion's pattern is repeating and symmetrical so that top and bottom horizontal segments have the same 1.5 mm width and thus the spacing between horizontal segments is uniform. Pozar, ¶¶117-118. Even if that uniformity were not expressly taught by Teng, that would have been the obvious way to implement what Teng discloses because it would have made it easier to layout, simulate, and modify Teng's design, and because a lack of uniformity would have led to increased radiation losses. Pozar, ¶119 (citing corroborating EX1027, [0054]; EX1030, [0095]).



Petitioners' Figure P-1

Given that Teng's meandering pattern is uniform, other dimensions can be calculated, as shown in Petitioners' Figure P-2 below. Figure P-1 above shows the GDC portion formed by repeating the unit meander shape identified in Figure P-2 (below) nine times. Pozar, ¶120.

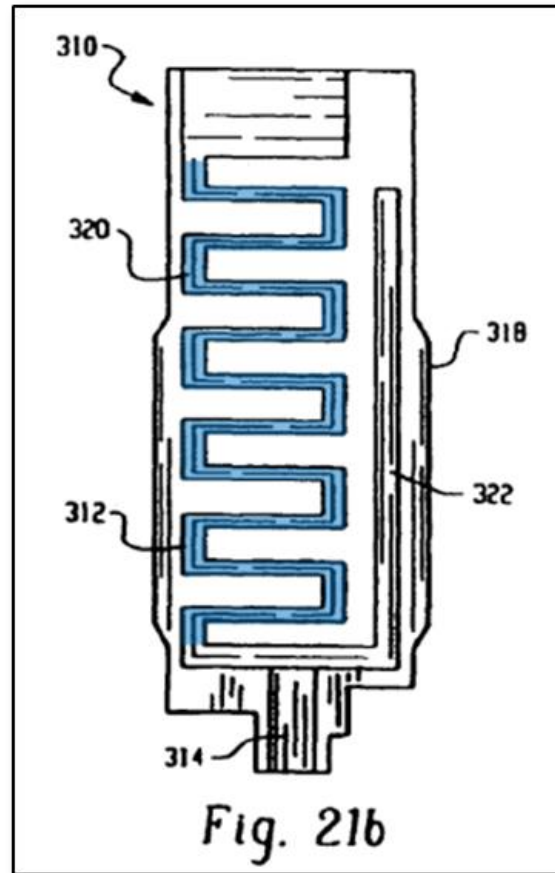


Petitioners' Figure P-2(a)



Petitioners' Figure P-2(b)

As demonstrated below, the GDC portion meets each party’s construction of *grid-dimension curve* and also meets the patent’s depiction of “grid dimension section 320.” *Infra* §§VI.D.1.m.i-ii; EX1001, Fig. 21b (annotated below), 8:61-64.



i. Petitioners’ construction of *grid-dimension curve*

Petitioners’ construction requires the grid-dimension of the grid-dimension portion to be greater than 1, using this formula:

$$D_g = -\frac{\log(N2) - \log(N1)}{\log(L2) - \log(L1)}$$

where (using the labeling for the specification’s “grid dimension” discussion *supra* §V.B.2):

(1)-(2): L1, L2 are the edge lengths of the square cells that form respective rectangular grids that “completely cover[] the curve”;

(1a)-(1c), (2a)-(2c): N1, N2 are the respective “number of cells” in each grid “that enclose at least a portion of the curve”;

(3): both grids are “positioned within a minimum rectangular area” “such that no entire row or column on the perimeter” of a grid “fails to enclose at least a portion of the curve”;

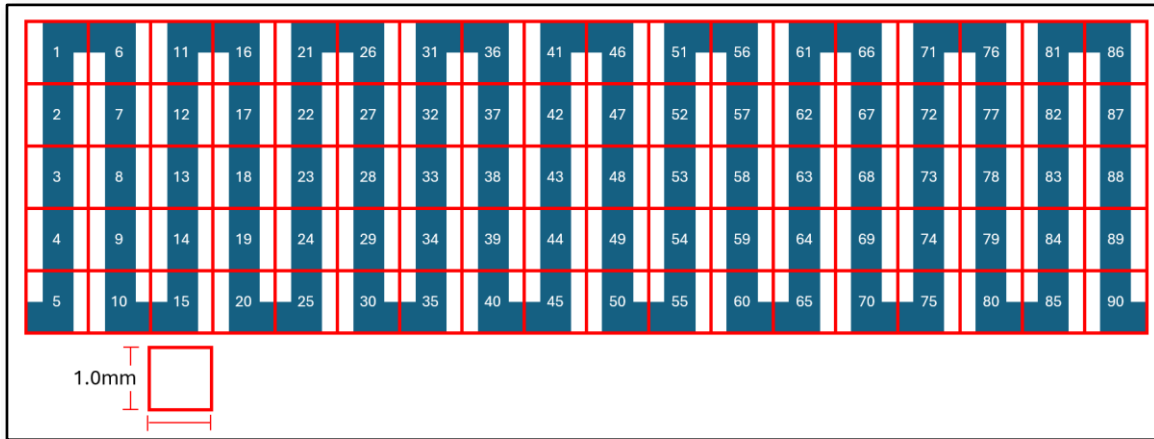
(4): N1_{Total} is at least 25;

(5): N2_{Total} should be four times N1_{Total}; and

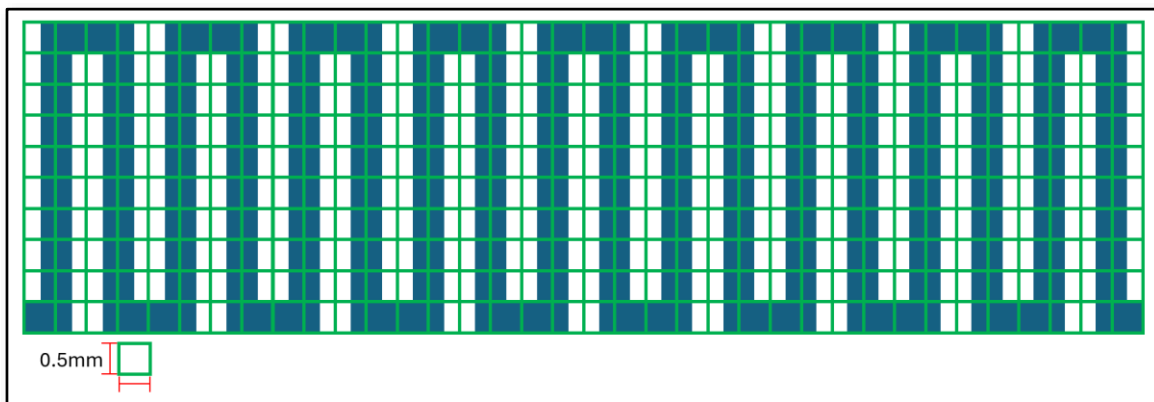
(6): L2 “should be one-half” of L1.

Supra §V.B.2; EX1001, 6:59-7:15; Pozar, ¶123.

Applying this construction results in a first rectangular grid (red) below comprising 5 rows and 18 columns, enclosing the GDC portion with 90 square cells (numbered for convenience) of edge length $L1 = 1.0mm$:



A second rectangular grid (green) below encloses the GDC portion with 360 square cells of edge length $L2 = 0.5mm$ (*i. e.*, $L2 = 1/2 \times L1$):



As shown above, in each grid ***all cells*** “enclose ***at least a portion***” of the GDC portion. EX1001, 6:63-7:1. Thus, every cell is counted so $N1 = 90$, $N2 = 360$, and the grid-dimension value is greater than 1, as shown below:

$$\begin{aligned}
D_g &= -\left(\frac{\log(N2) - \log(N1)}{\log(L2) - \log(L1)}\right) = -\left(\frac{\log(360) - \log(90)}{\log(0.5) - \log(2 \times 0.5)}\right) \\
&= -\left(\frac{\log(360/90)}{\log(1/2)}\right) = -\left(\frac{\log(4)}{\log(1/2)}\right) = -\left(\frac{2 \log(2)}{(-1) \log(2)}\right) = 2.0.
\end{aligned}$$

Pozar, ¶¶124-126.

The additional requirements in Petitioners’ construction (*supra* §V.B.2) are also met.

First, $N1_{Total} = 90$, which is “at least twenty-five cells,” and $N2_{Total} = 360$, which is “four times the number of cells as the first grid.” *Supra* §V.B.2 (citing EX1001, 7:5-7).

Second, “the length (L2) of each square cell in the second grid” (0.5mm) is “one-half” the length (L1) (1.0mm) of each square cell in the first grid. *Supra* §V.B.2 (citing EX1001, 7:7-9).

Third, grids 1 (red) and 2 (green) are “positioned within a minimum rectangular area enclosing the curve, such that no entire row or column on the perimeter of” either grid “fails to enclose at least a portion of the curve.” *Supra* §V.B.2 (citing EX1001, 7:1-5); Pozar, ¶¶127-130.

Thus, the GDC portion of Teng’s Branch 1 (*first radiating arm*) meets Petitioners’ construction of a *grid-dimension curve*. Pozar, ¶131.

ii. Fractus's construction of *grid-dimension curve*

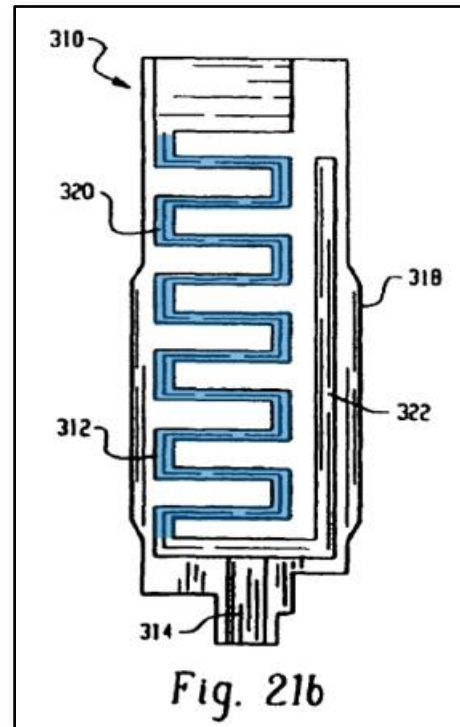
In addition to requiring a “grid dimension that is greater than one,” Fractus's construction has two additional requirements that are met by the GDC portion, as demonstrated below. *See supra* §V.B.1 (quoting EX1008, 27).

“A curve which is not self-similar”: Fractus's claim-construction briefing does not explain what “self-similar” means or how this negative limitation is met. Another Fractus-assigned patent says “self-similarity” means “each part of the geometrical object is a replica of the whole object at a different scale” (e.g., a “fractal curve”). EX1024, 2:12-14. Under that definition, the GDC portion is “**not** self-similar” because the repeating part (Petitioners' Figure P-2(a) above) is not a replica of the entire pattern (Petitioners' Figure P-1 above). Pozar, ¶¶132-133. Moreover, the GDC portion (below-left) is shaped like the '365 patent's example “**grid dimension section 320**” in Figure 21b (blue-highlighted, below-right), reinforcing that if a grid-dimension curve cannot be self-similar, then the GDC portion and the '365 patent's section 320 are “not self-similar” in the same way. EX1001, 8:61-64. Pozar, ¶134.

Teng GDC portion



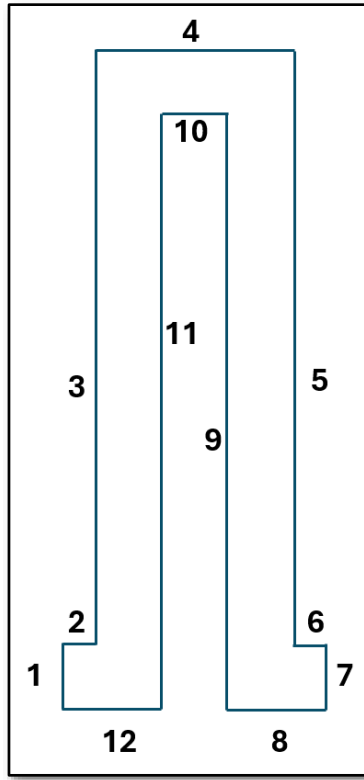
'365 patent "grid dimension section 320"



“If the curve has any periodicity, the period is defined by a non-periodic curve that includes at least ten connected segments in which no two adjacent and connected segments define a longer straight segment” (*supra* §V.B.1 (quoting EX1008, 27)): Teng’s GDC portion *has a periodicity with a period defined by the non-periodic curve* highlighted in alternating colors below:



Fractus’s proposed construction recites the specification’s description of segments in a “space filling curve” (EX1001, 3:10-13) such that a “segment” is a straight portion along the outer perimeter of the curve. As shown below, the non-periodic unit curve of the GDC portion (alternating colors above) includes twelve (“at least ten”) connected segments—numbered below clockwise around the perimeter of the unit curve—in which no two adjacent and connected segments define a longer straight segment because adjacent connected segments form right angles. Pozar, ¶¶135-136.



Thus, the GDC portion meets Fractus’s construction of *grid-dimension curve*. Pozar, ¶137.

n. Limitation [1M]

1M	<i>wherein the printed circuit board, the communication circuitry, and the multi-band antenna are arranged inside the device housing.</i>
----	---

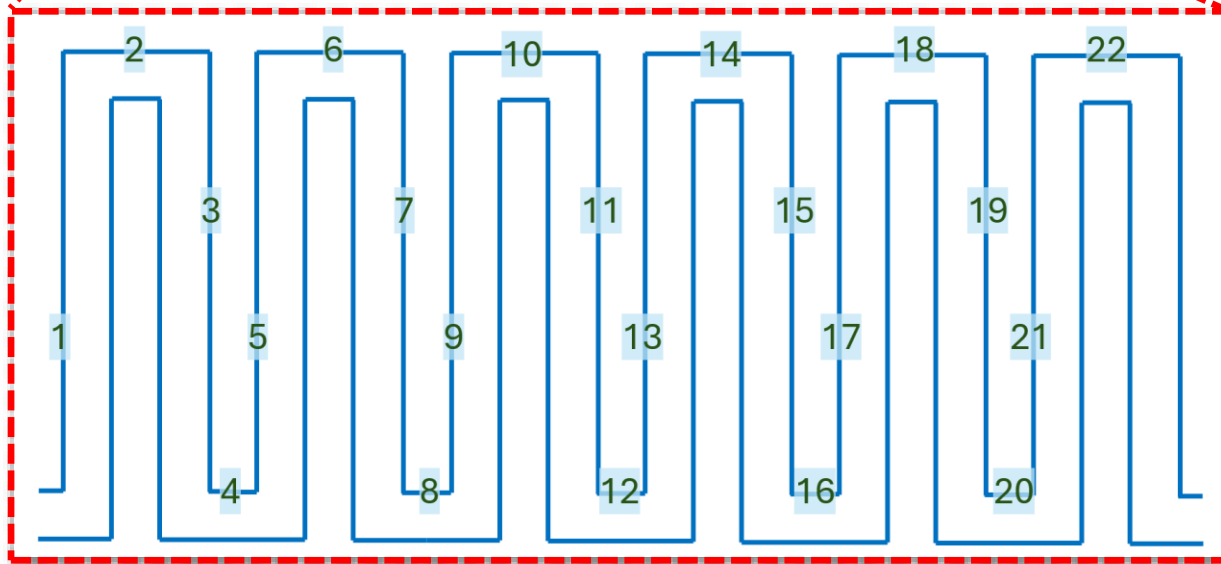
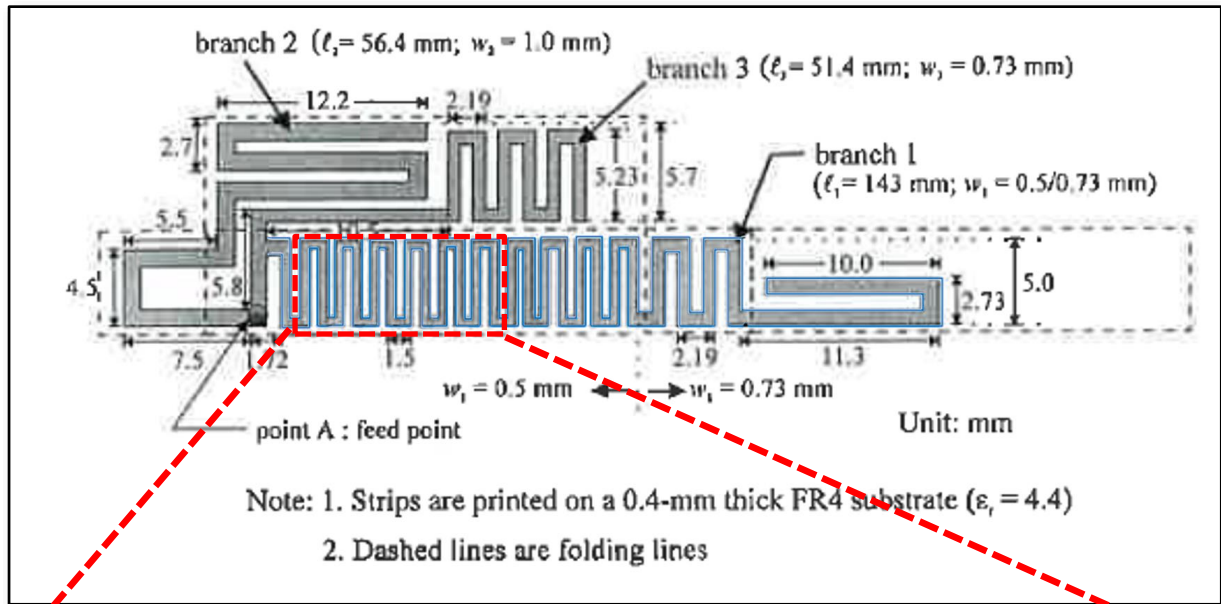
Tran+Teng’s “*printed circuit board*,” “*multi-band antenna*,” and “*integrated circuits or chips*” implementing the *communication circuitry* are all *arranged inside the device housing*, similar to Tran’s Figures 14A-14B. *Supra* §VI.C (Tran+Teng combination); Tran, 13:28-14:13. Pozar, ¶138.

2. Claim 2

a. Limitation [2A]

2A	[Claim 1's device] <i>wherein the first radiating arm comprises a first plurality of segments;</i>
----	--

Tran+Teng's Branch 1 (*first radiating arm*) *comprises a first plurality of segments* outlined in blue in the first image below, for which the second image numbers 22 exemplary segments. *See supra* §VI.D.1.j ([11]); Pozar, ¶139.



b. Limitation [2B]

2B	wherein each segment of the first plurality of segments is smaller than 1/10 of a lowest operating free-space wavelength of the multi-band antenna;
----	---

Tran+Teng uses Teng's antenna, which is capable of *operating* over three frequency bands: "GSM (890–960 MHz), DCS (1710–1880 MHz), and PCS

(1850–1990 MHz).” Teng, 23; *supra* §VI.D.1.h ([1G]). An *operating free-space wavelength* (λ , in mm) of an antenna is determined from an operating frequency, as follows:

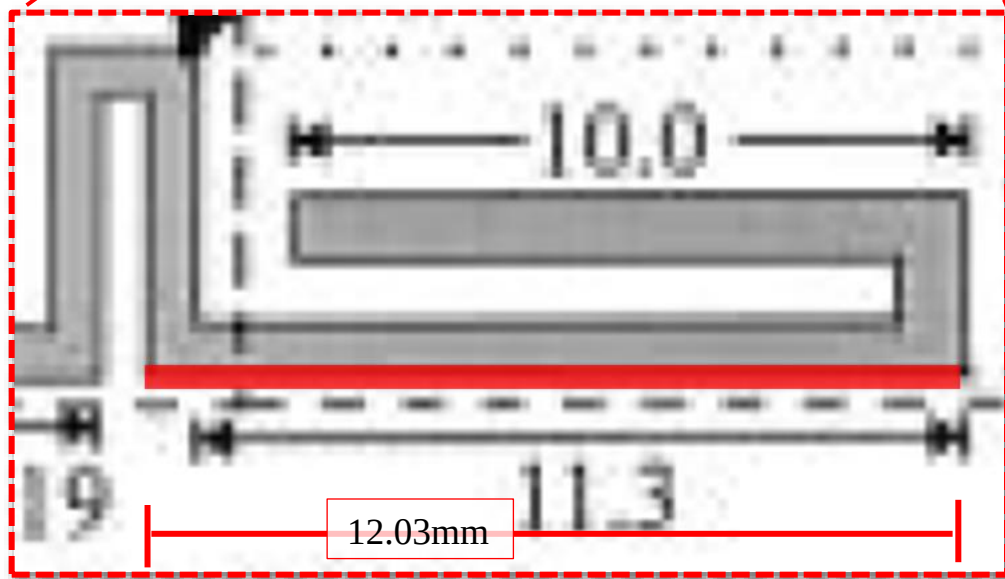
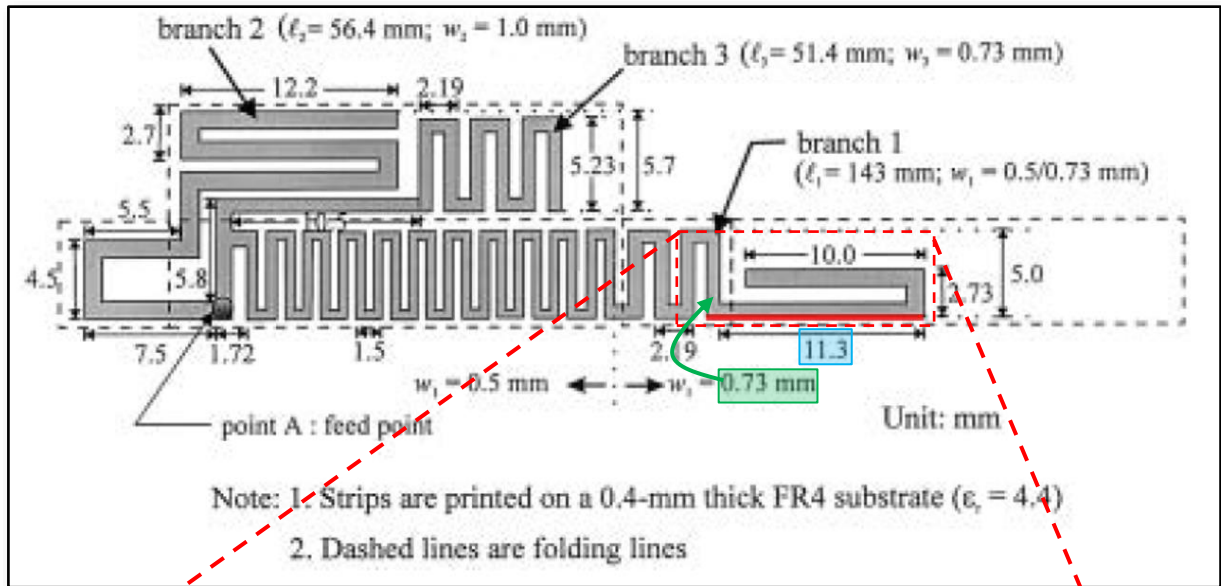
$$\lambda = \frac{c}{f},$$

where c = speed of light ($\approx 3 \times 10^{11}$ mm/sec), and f = frequency (Hz). Pozar, ¶140 (citing corroborating EX1040, 15-16; EX1025, 6:26-29). Thus, 1/10 of the free-space wavelengths of Tran+Teng’s antenna for each frequency band is:

Band	Frequency (MHz)	Wavelength (mm)	1/10 Wavelength (mm)
GSM	890–960	313–337	31.3–33.7
DCS	1710–1880	160–175	16.0–17.5
PCS	1850–1990	151–162	15.1–16.2

The “*lowest operating free-space wavelength*” is thus 15.1mm. Pozar, ¶141.

The **longest** segment among *the first plurality of segments* is 12.03mm (highlighted red below): the 11.3mm dimension that Teng’s Figure 1 provides (highlighted blue) **plus** 0.73mm for the portion of the segment that is as long as the 0.73mm strip width (highlighted green). Teng, 23, Fig. 1. Pozar, ¶142.

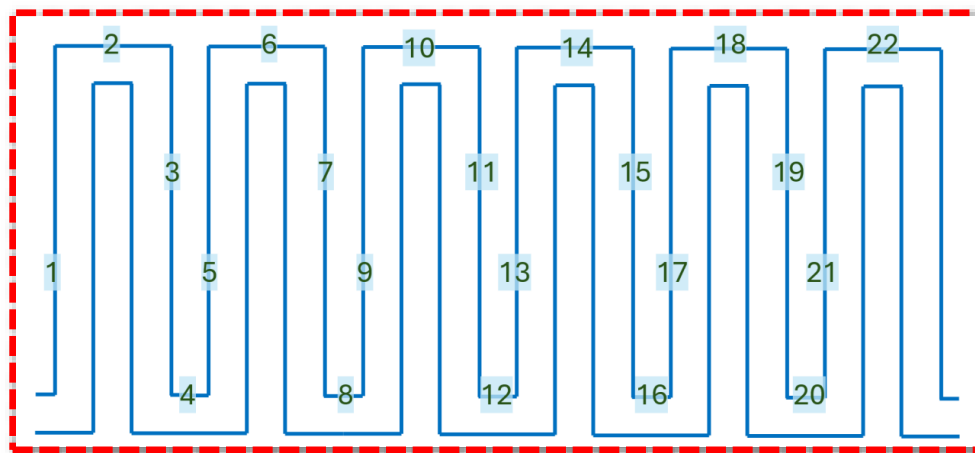
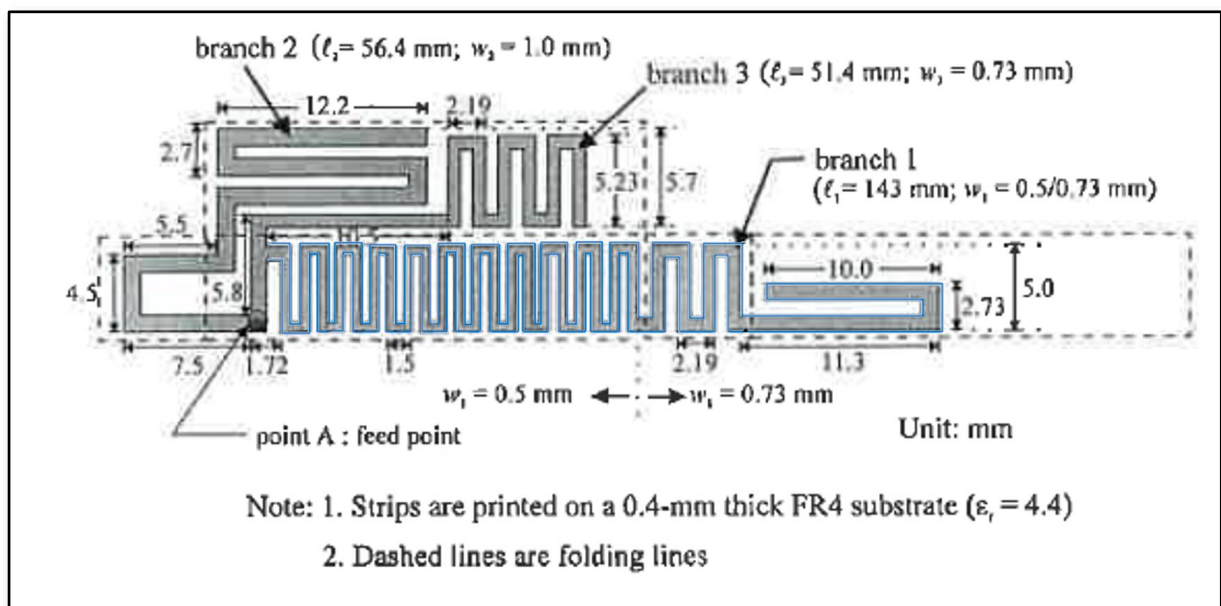


Thus, the **longest segment** (and each of the other segments) in *the first plurality of segments* (12.03 mm) is *smaller than* 15.1 mm, which is *1/10 of a lowest operating free-space wavelength of Tran+Teng's multi-band antenna*.
 Pozar, ¶143.

c. Limitation [2C]

2C	wherein the segments are spatially arranged such that each pair of adjacent segments forms a corner; and
----	--

In Tran+Teng's first plurality of segments (blue below), the segments are spatially arranged such that each pair of adjacent segments forms a 90-degree corner. Teng, Fig. 1 (annotated below); Pozar, ¶144.



d. Limitation [2D]

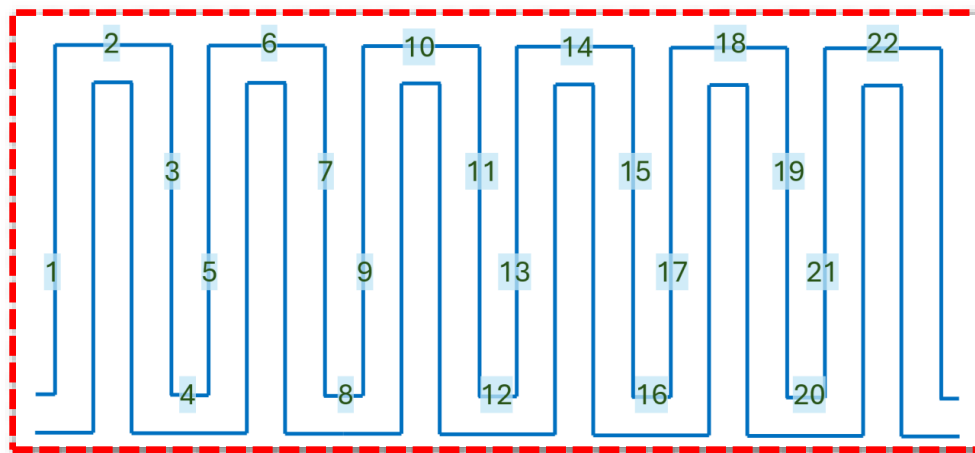
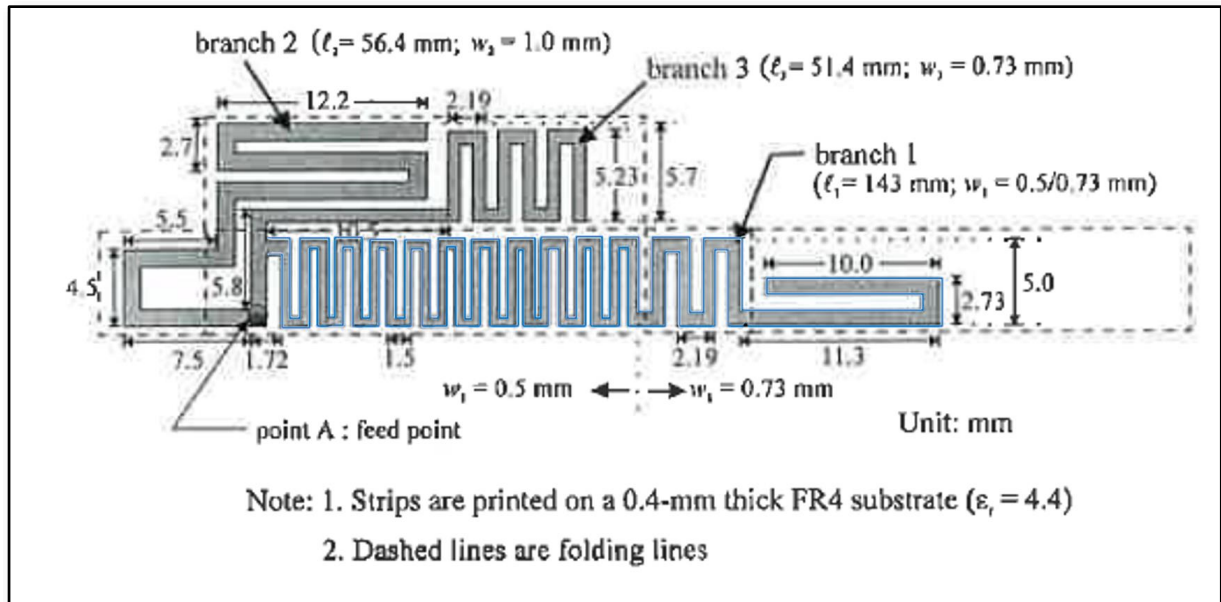
2D	<i>wherein no two adjacent and connected segments form another longer straight segment; and</i>
----	---

As shown *supra* §VI.D.2.c ([2C]), *no two adjacent and connected segments form another longer straight segment* (i.e., there is no 180-degree angle between adjacent segments) because each pair of adjacent segments form a 90-degree corner. Teng, Fig. 1; Pozar, ¶145.

e. Limitation [2E]

2E	<i>wherein none of said segments intersect with another segment other than to form a closed loop.</i>
----	---

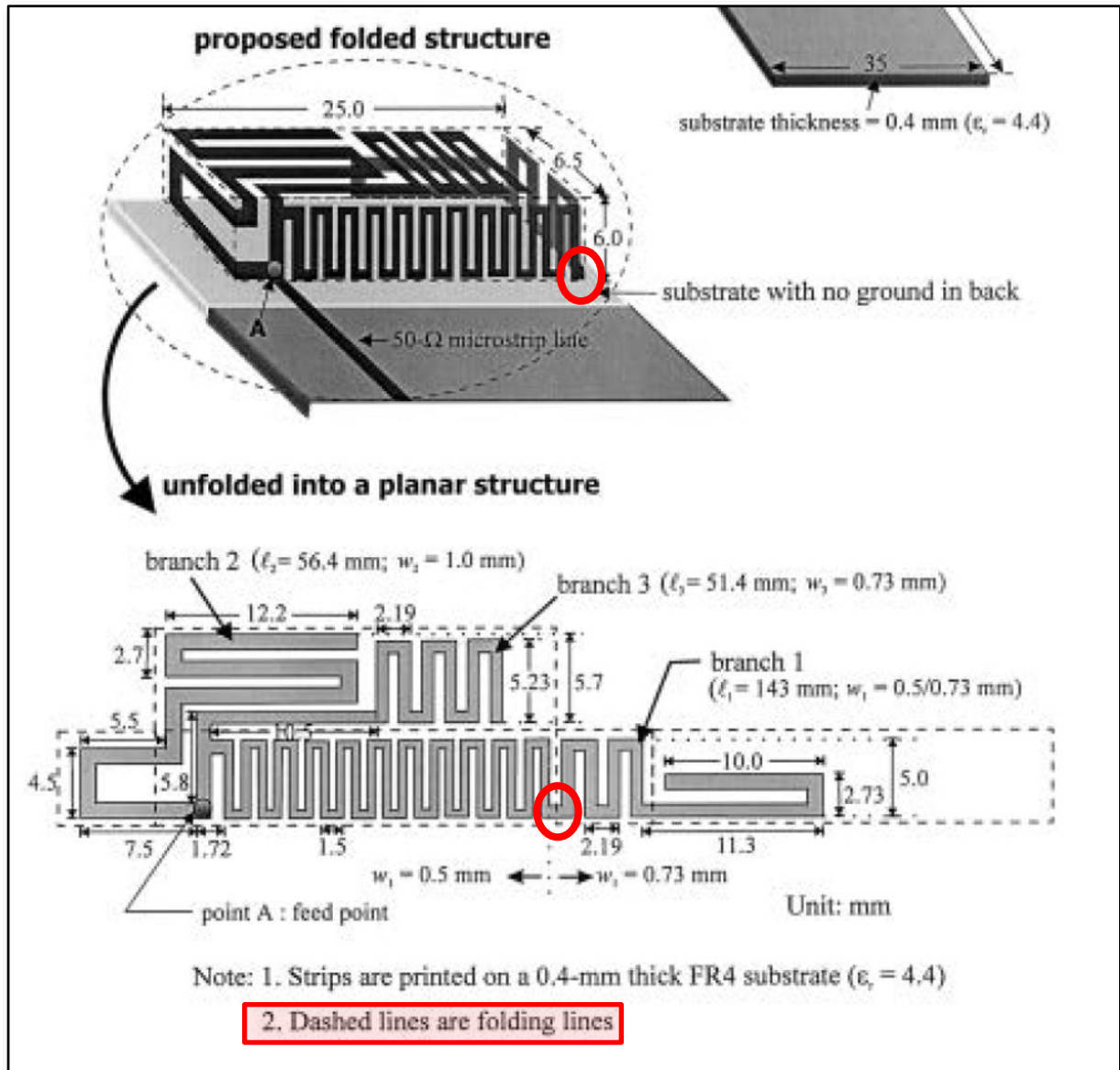
In the GDC portion *none of said segments intersect with another segment other than to form a closed loop* because each adjacent segment forms a 90-degree corner (as discussed *supra* §VI.D.2.c, [2C]), as shown by the blue-outlined segments of *the first plurality of segments* in Teng’s annotated Figure 1 below. Pozar, ¶146.



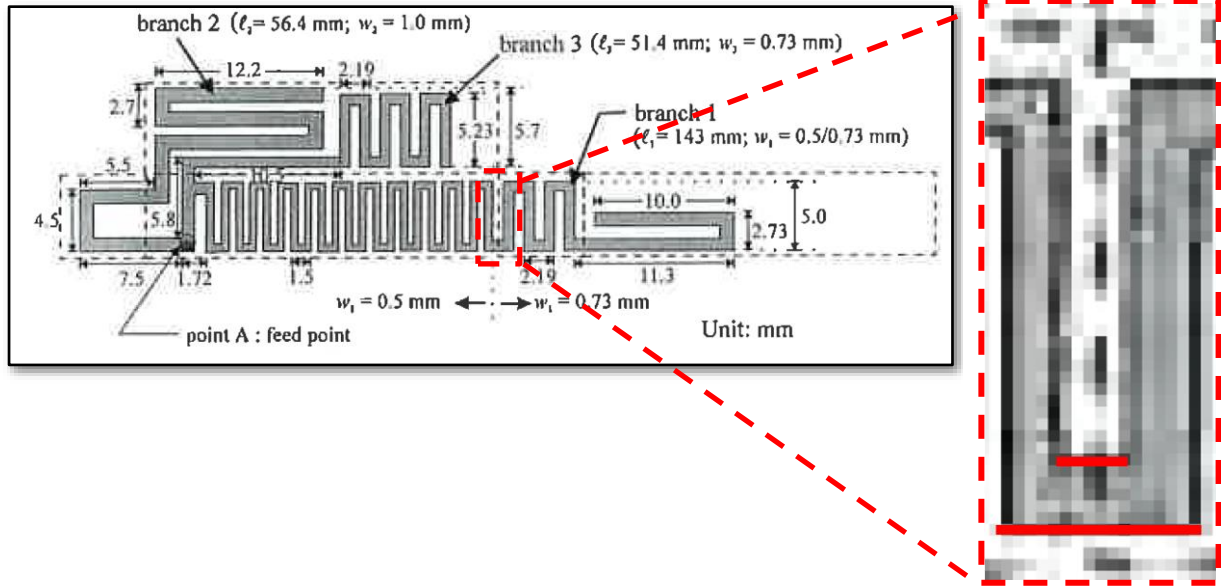
3. Claim 3

3	[claim 2's device], wherein the first plurality of segments comprises at least one curved segment.
---	--

Tran+Teng's Branch 1 has segments in the circle below that are bisected by the dashed "folding lines" shown in Teng's Figure 1 (excerpted and annotated below), which identify where the antenna is folded to achieve its "folded structure" so that different portions of the antenna lie in different planes. Pozar, ¶147.



POSAs understood that Teng teaches that the two segments (red-highlighted below-right) bisected by the folding line are *curved* when a real-world antenna is in its folded structure, rather than have perfect 90° angle fold. Pozar, ¶148.

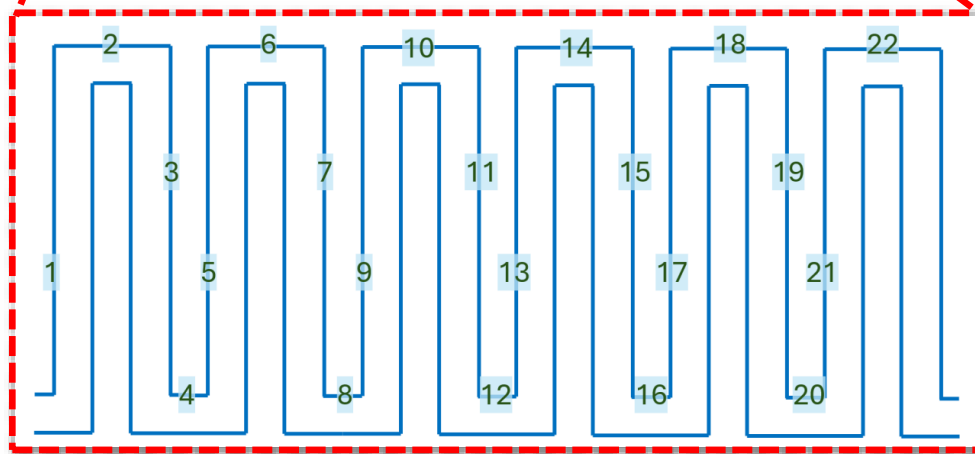
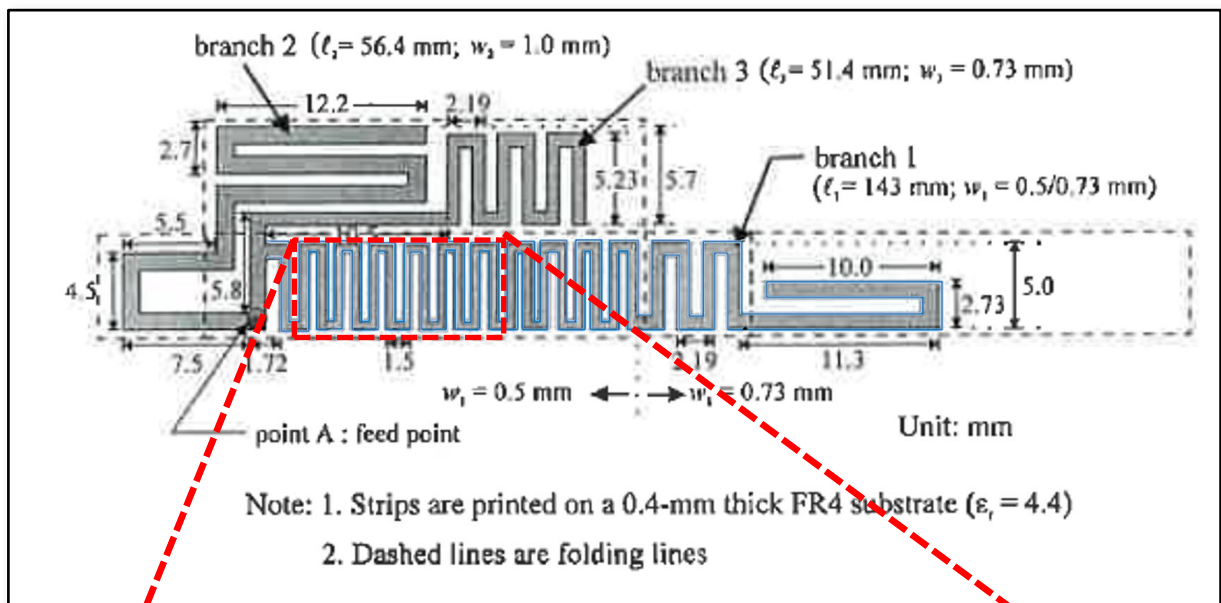


And if Teng were considered to not expressly teach this, that would have been the conventional and obvious way to implement the folded antenna structure Teng describes. As a wealth of corroborating evidence shows, *curving* the segments where the Tran+Teng antenna is folded would beneficially reduce the risk of fracturing at corner and reduce “reflections and attendant losses” in RF energy if the antenna were to be bent at a sharp 90° angle. EX1022, [0056]; Pozar, ¶149 (citing additionally corroborating EX1026, [0069]; EX1027, Fig. 9, [0057]; EX1028, Fig. 2, [0019]; EX1029, 4:46-59, Fig. 7f; EX1030, Figs. 11(a)-11(b), [0095]).

4. Claim 4

4	[Claim 2's device], wherein the first plurality of segments comprises at least ten segments
---	---

As discussed *supra* (§VI.D.2.a [2A]), Tran+Teng Branch 1 comprises the *first plurality of segments*, which comprises at least ten segments (more than the 22 segments annotated below). Pozar, ¶150.

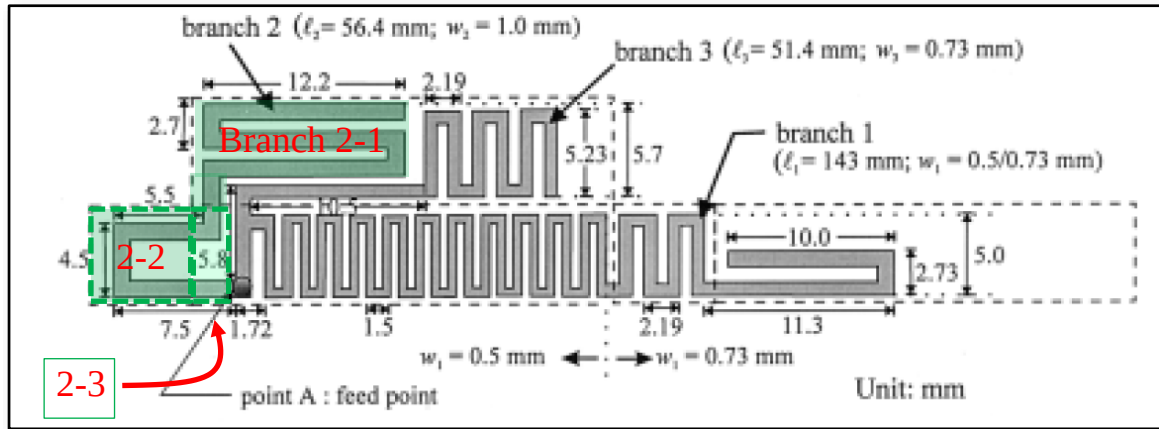


5. Claim 5

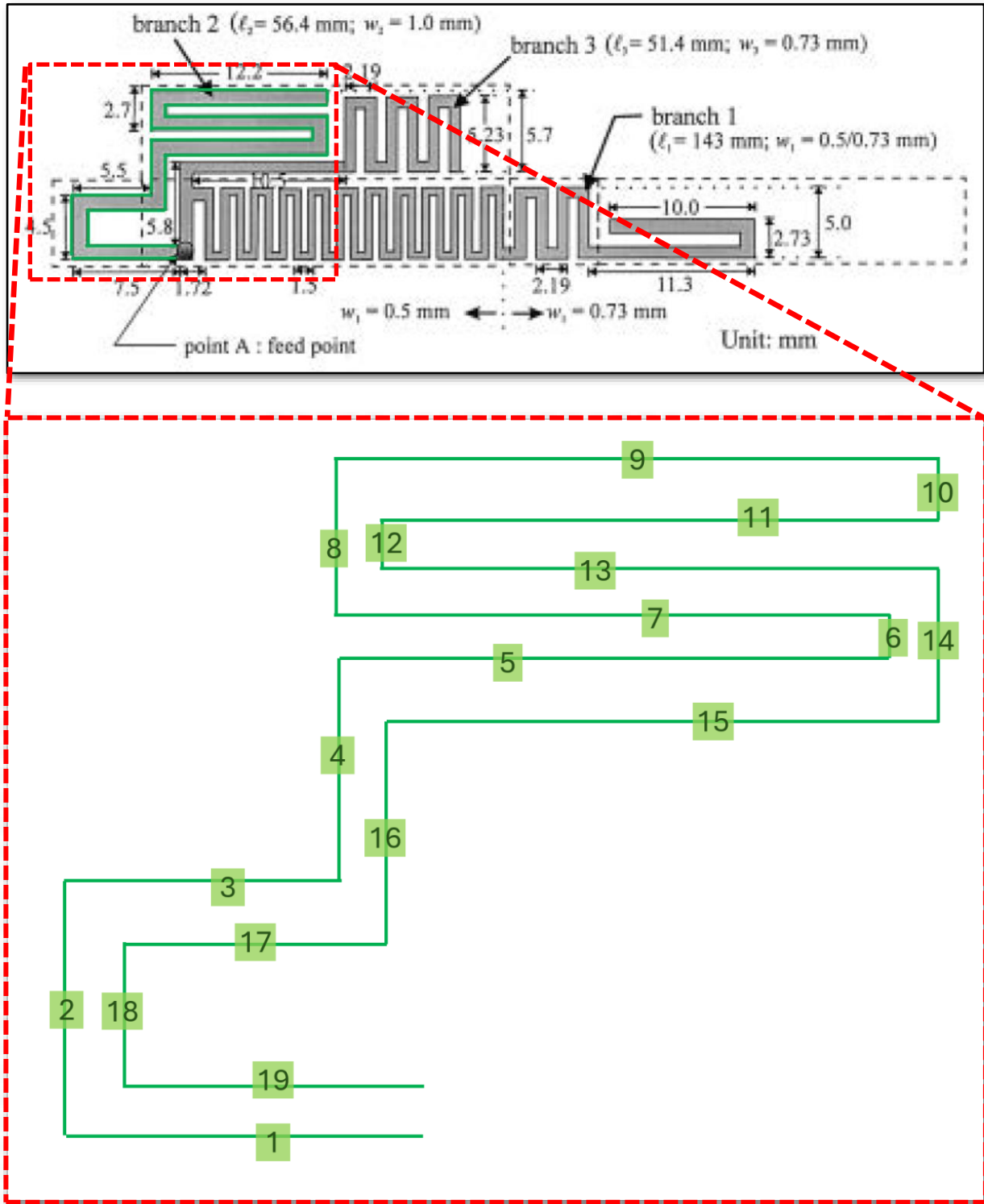
a. Limitation [5A]

5A	[Claim 2's device], wherein the second radiating arm comprises a second plurality of segments;
----	--

Tran+Teng's antenna Branch 2 (second radiating arm, *supra* §VI.D.1.j ([1I]) has three sections, separated by dashed fold lines, labelled Branch 2-1 through 2-3 in Teng's Figure 1 annotated below.



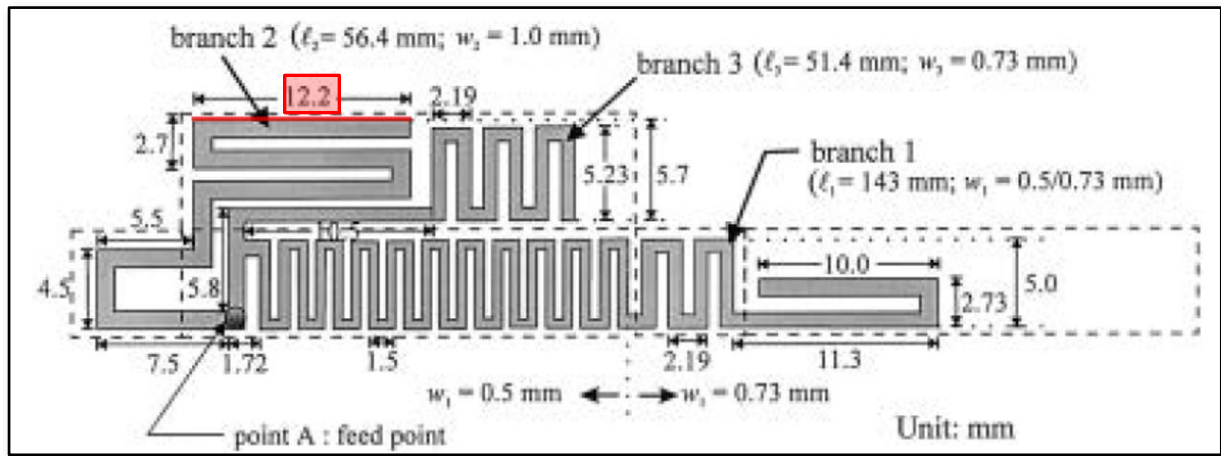
Branch 2 comprises a second plurality of segments (19 segments numbered in the second image below). Pozar, ¶152.



b. Limitation [5B]

5B	<i>wherein each segment of the second plurality of segments is smaller than 1/10 of a lowest operating free-space wavelength of the multi-band antenna;</i>
----	---

A 1/10 of a lowest operating free-space wavelength of Tran+Teng's multi-band antenna is 15.1mm. See *supra* §VI.D.2.b ([2B]). As shown in Teng's Figure 1 (annotated below), Tran+Teng Branch 2's longest segment (red) is 12.2mm. Pozar, ¶153.



Thus, Branch 2's longest segment (and therefore each of the segments) in the *second plurality of segments* is smaller than 1/10 of a lowest operating free-space wavelength of Teng's multi-band antenna (15.1mm). Pozar, ¶154.

c. Limitation [5C]

5C	<i>wherein the segments are spatially arranged such that each pair of adjacent segments forms a corner; and</i>
----	---

As shown above (§VI.D.5.a, [5A]), Branch 2's second plurality of *segments are spatially arranged such that each pair of adjacent segments forms a 90-degree corner*. Pozar, ¶155.

d. Limitation [5D]

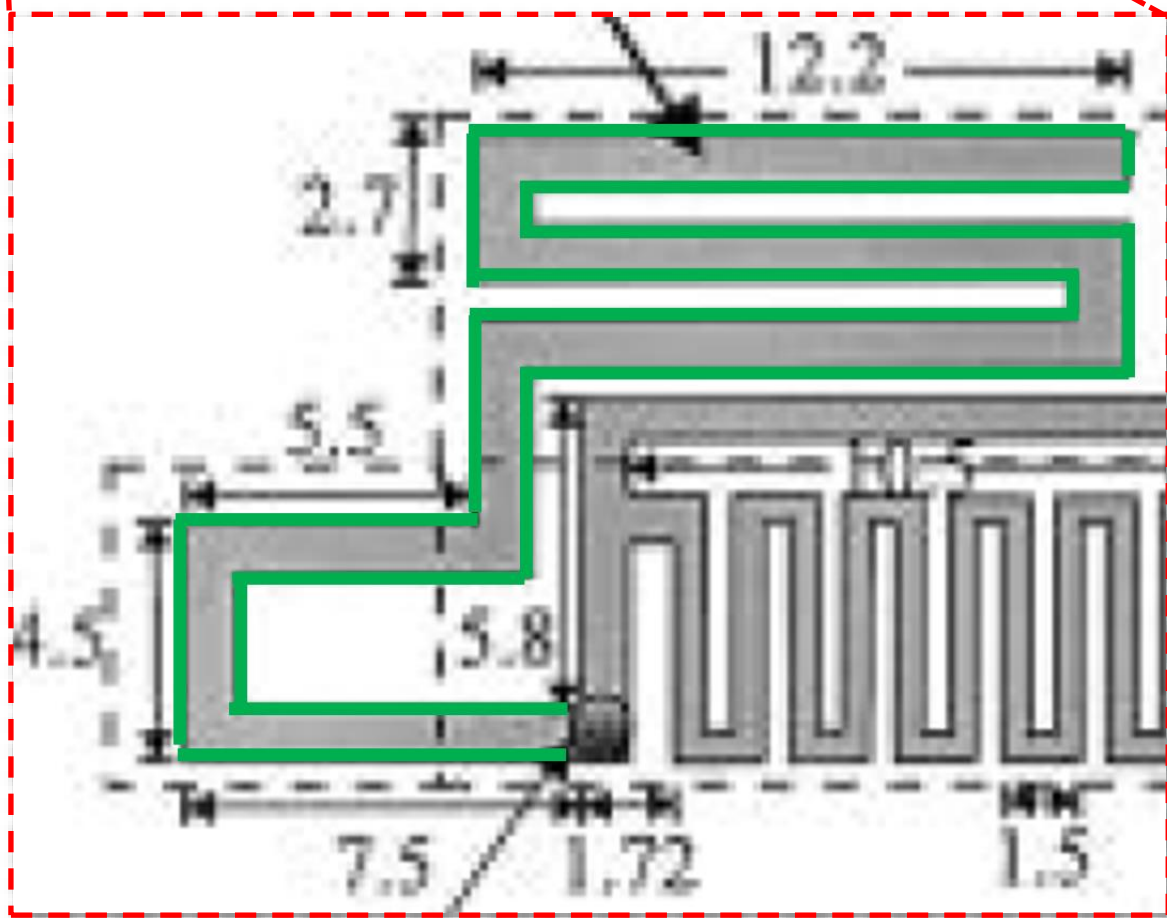
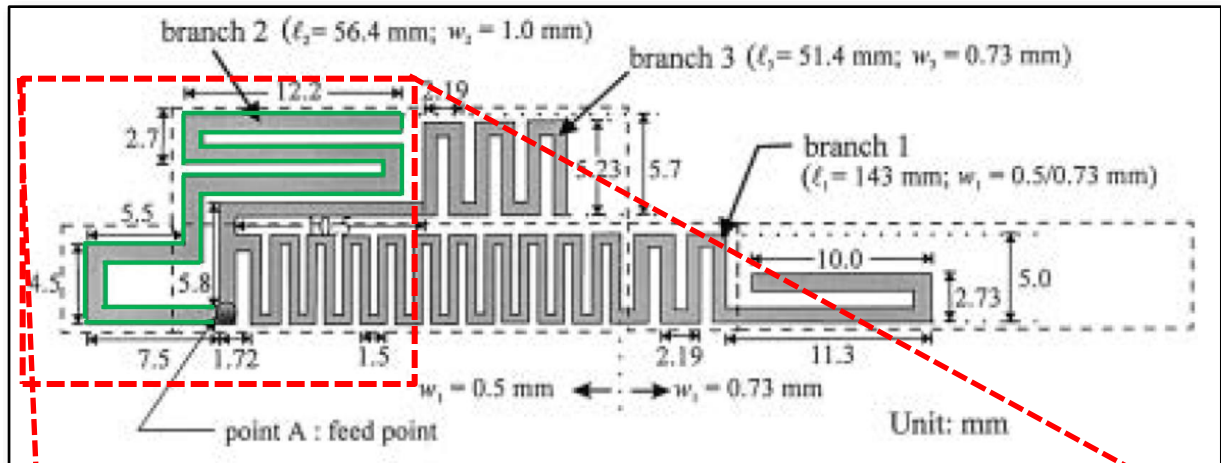
5D	<i>wherein no two adjacent and connected segments form another longer straight segment; and</i>
----	---

As illustrated above (§VI.D.5.a, [5A]), *no two adjacent and connected segments form another longer straight segment* (i.e., there is no 180-degree angle between adjacent segments) because each pair of adjacent segments forms a 90-degree corner (*supra* §VI.D.5.c, [5C]). Pozar, ¶156.

e. Limitation [5E]

5E	<i>wherein none of said segments intersect with another segment other than to form a closed loop.</i>
----	---

None of said segments intersect with another segment other than to form a closed loop because each adjacent segment forms a 90-degree corner (as discussed *supra* §VI.D.5.c, [5C]), as shown by the green-outlined segments that comprise *the second plurality of segments* in Teng's annotated Figure 1 below. Pozar, ¶157.



6. Claim 6

6	[Claim 5's device], wherein the first plurality of segments comprises more segments than the second plurality of segments
---	---

The first plurality of segments comprises more than 22 segments (*supra* §VI.D.4, claim 4), which is more segments than the (19) second plurality of segments (*supra* §VI.D.5.a, [5A]). Pozar, ¶158.

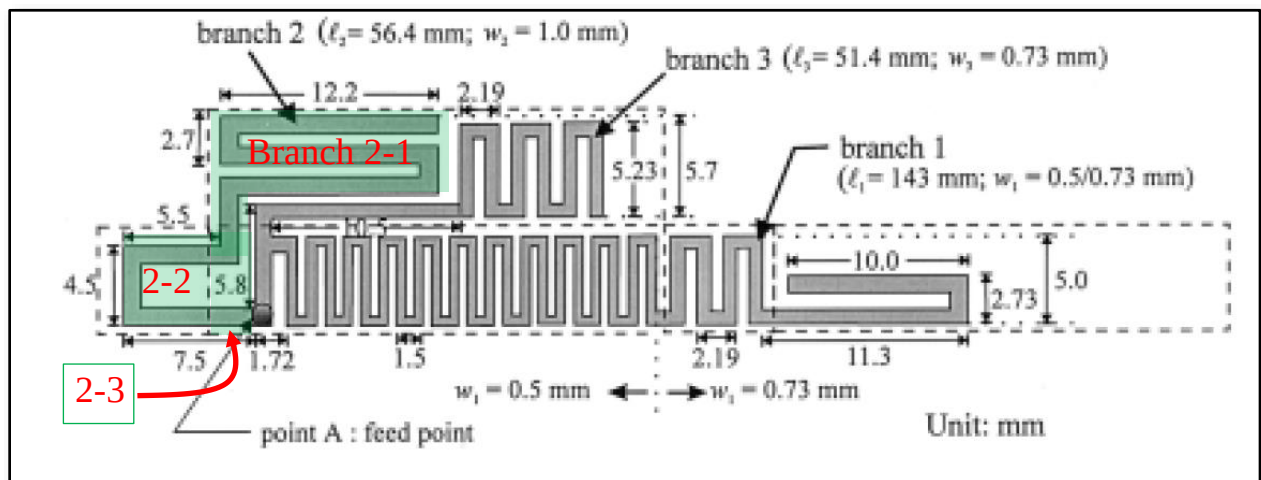
7. Claims 7-8

Tran+Teng's Branch 1-1's (grid-dimension curve) has a grid dimension of 2 (*supra* §VI.D.1.m, [1L]), which is larger than 1.3 (claim 7) and 1.5 (claim 8). Pozar, ¶159.

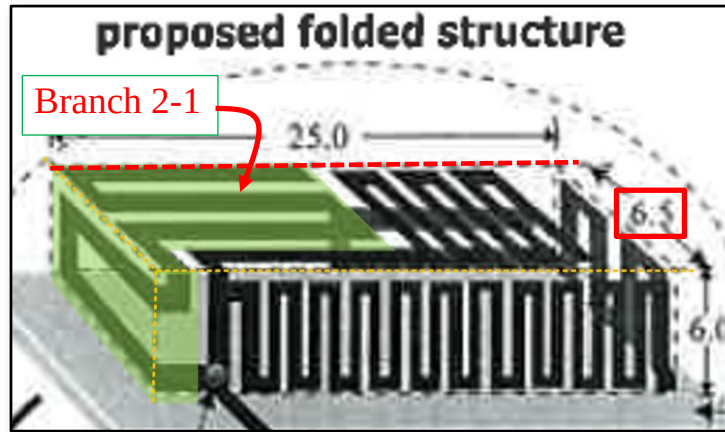
8. Claim 9

9	[Claim 1's device], wherein the second radiating arm is at least partially shaped according to a second grid-dimension curve
---	--

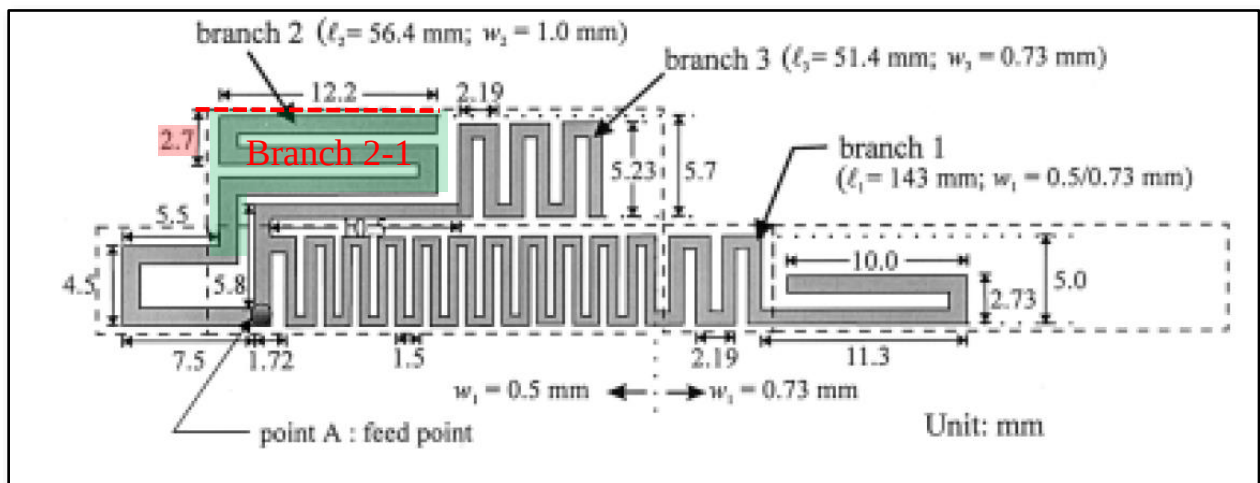
As discussed above (§VI.D.5.a, [5A]), Tran+Teng's Branch 2 has three sections 2-1, 2-2, and 2-3, as highlighted below:



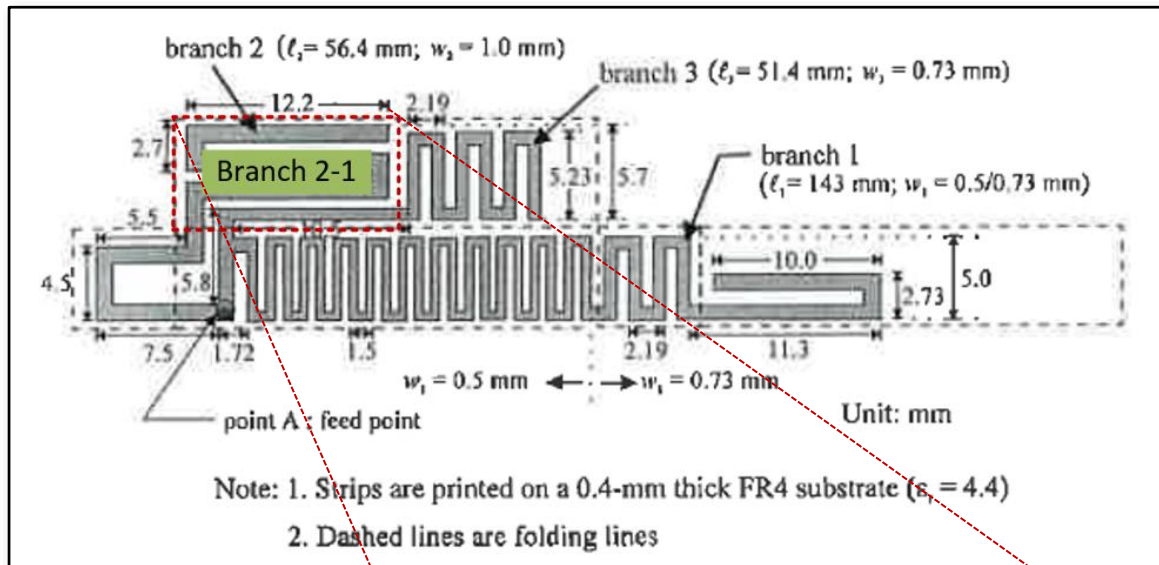
The image above from Teng Figure 1 provides the dimensions for portions of Teng's antenna trace, whereas the image below from Teng Figure 1 (annotated detail) provides dimensions for the surfaces of the rectangular folded mounting structure. Pozar, ¶161.



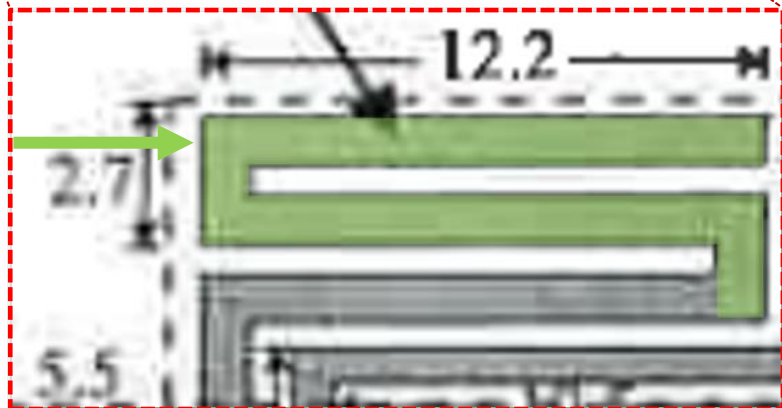
As shown above, Branch 2-1 extends to the lateral edge of the top-surface (red-dashed line) having a 6.5 mm width. Thus, the top-arrow for the 2.7 mm dimension in Teng Figure 1 (red-box below) coincides with the upper lateral edge of Branch 2-1 (red-dashed line). Pozar, ¶162.



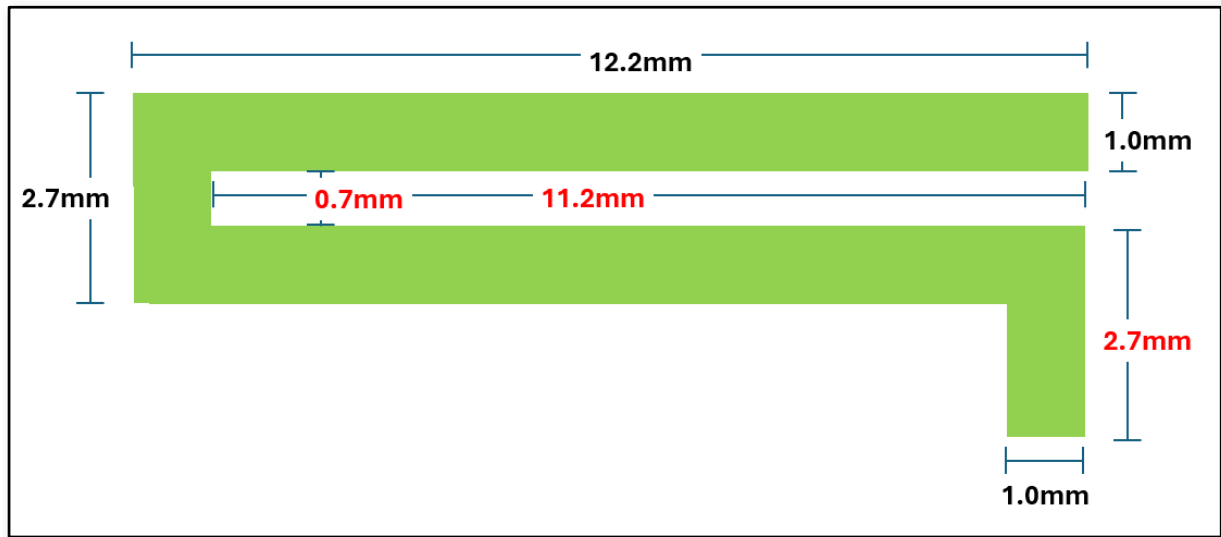
The portion of Branch 2-1 shaded green below (“Second GDC portion”), meets each party’s construction of *grid-dimension curve*. *Supra* §V.B; Pozar, ¶163.



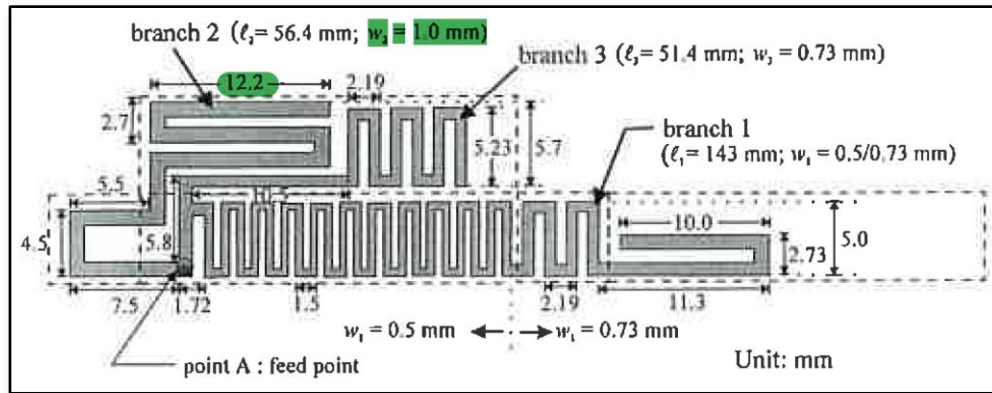
Second GDC portion



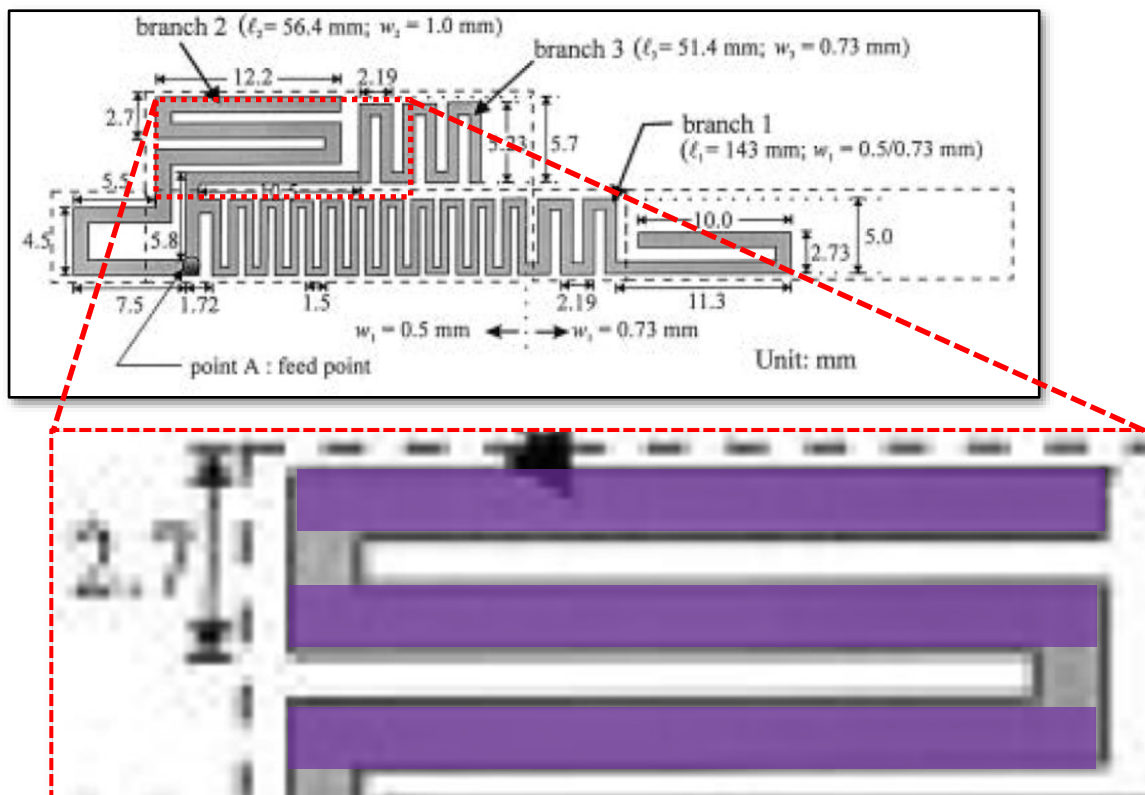
The Second GDC portion's segments below have black dimensions, recited in Teng Figure 1, and red dimensions calculated from Teng's Figure 1, as discussed below.



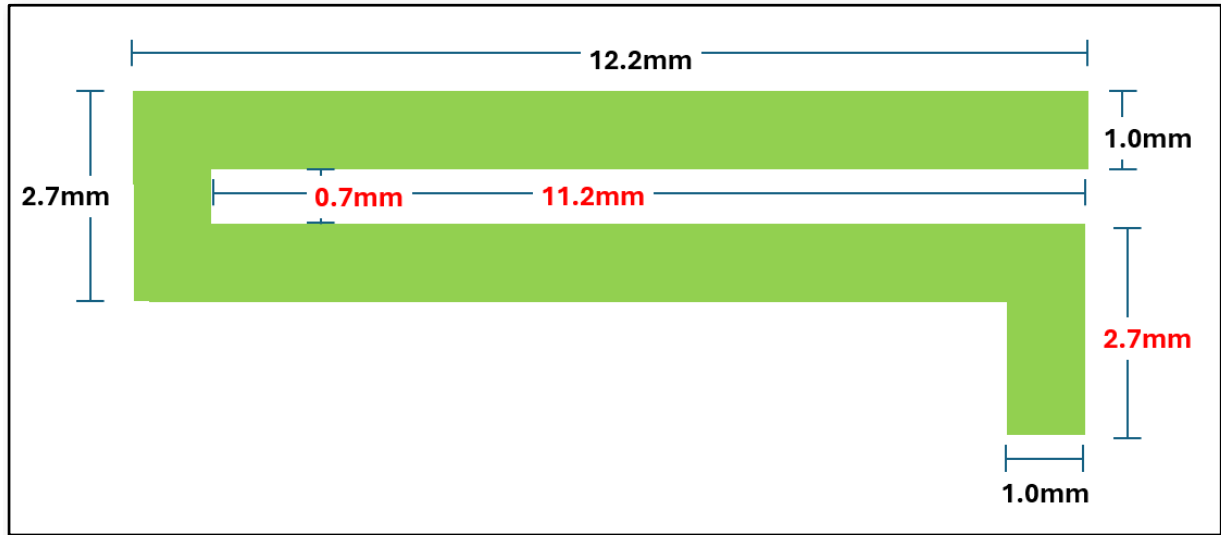
The 0.7 mm dimension for the gap between the above-two horizontal strips is calculated by subtracting two 1.0 mm widths of the antenna trace (e.g., 2.0 mm) from the left-hand 2.7 mm dimension. The 11.2 mm horizontal dimension in the gap is calculated by subtracting a 1.0 mm wide antenna trace on one right-hand side of the horizontal gap from the 12.2 mm dimension Teng discloses in Figure 1 (highlighted detail below). Pozar, ¶¶164-165.



The red 2.7 mm dimension is calculated based on a POSA's understanding that the gap between the three horizontal strips highlighted purple below is the same 0.7 mm dimension calculated above and that Branch 2-1 extends to the lateral edge of the top surface, as discussed above. Pozar, ¶166.



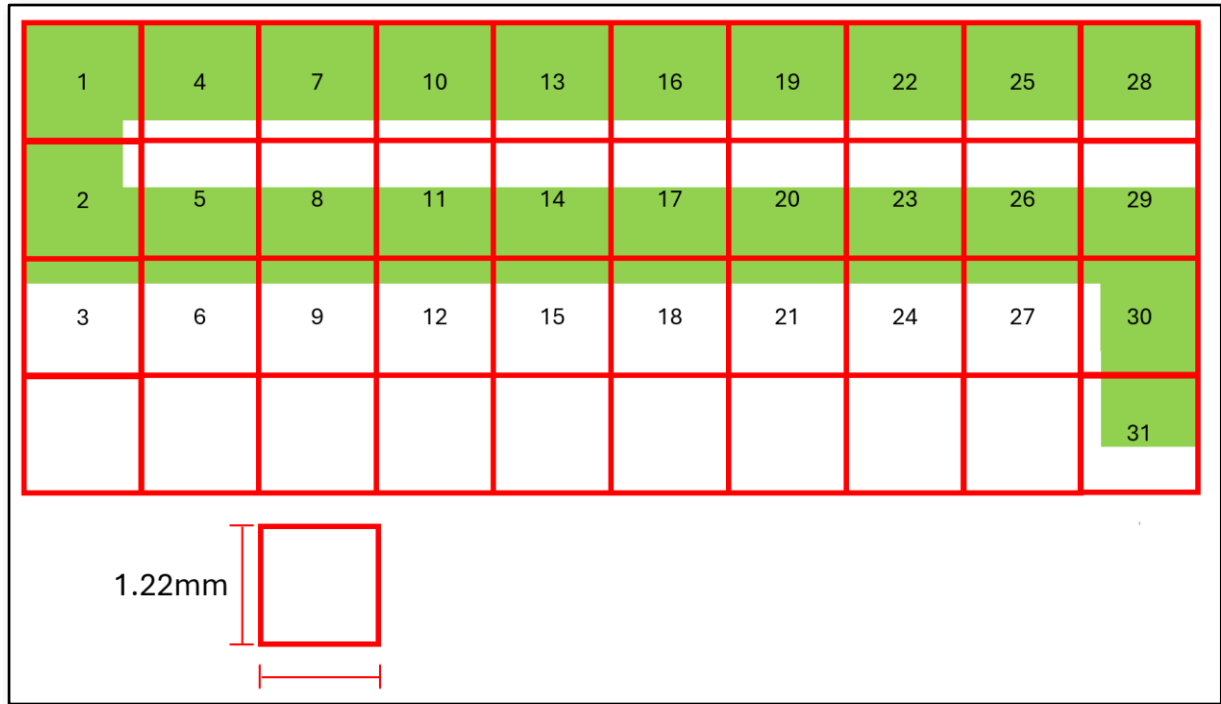
Based on the dimensions of Branch 2-1's segments discussed above, the dimensions of the Second GDC portion within a 4.4 mm x 12.2 mm area are below. Pozar, ¶167.



i. Petitioners' construction of *grid-dimension curve*

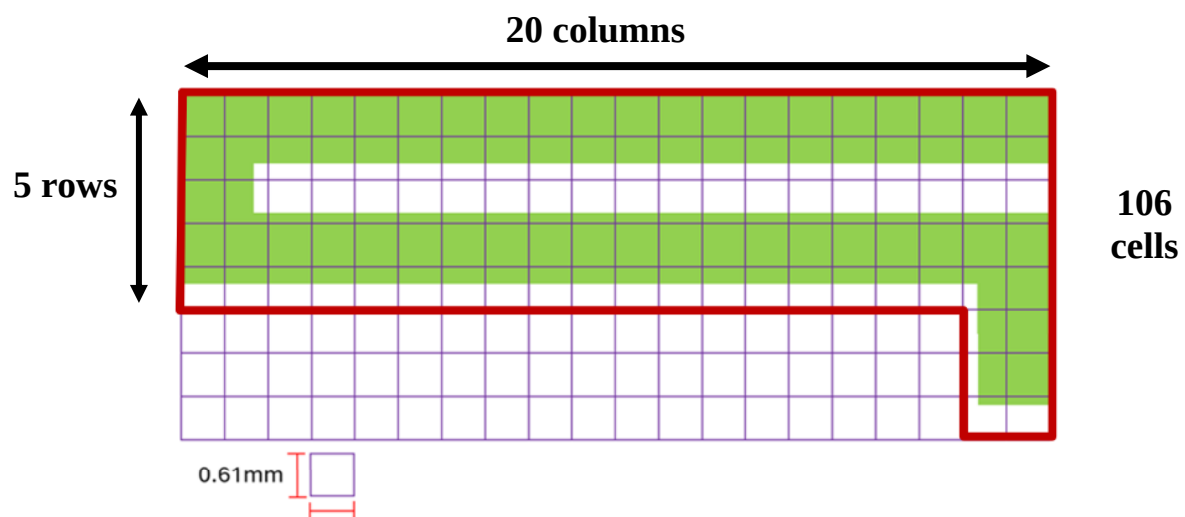
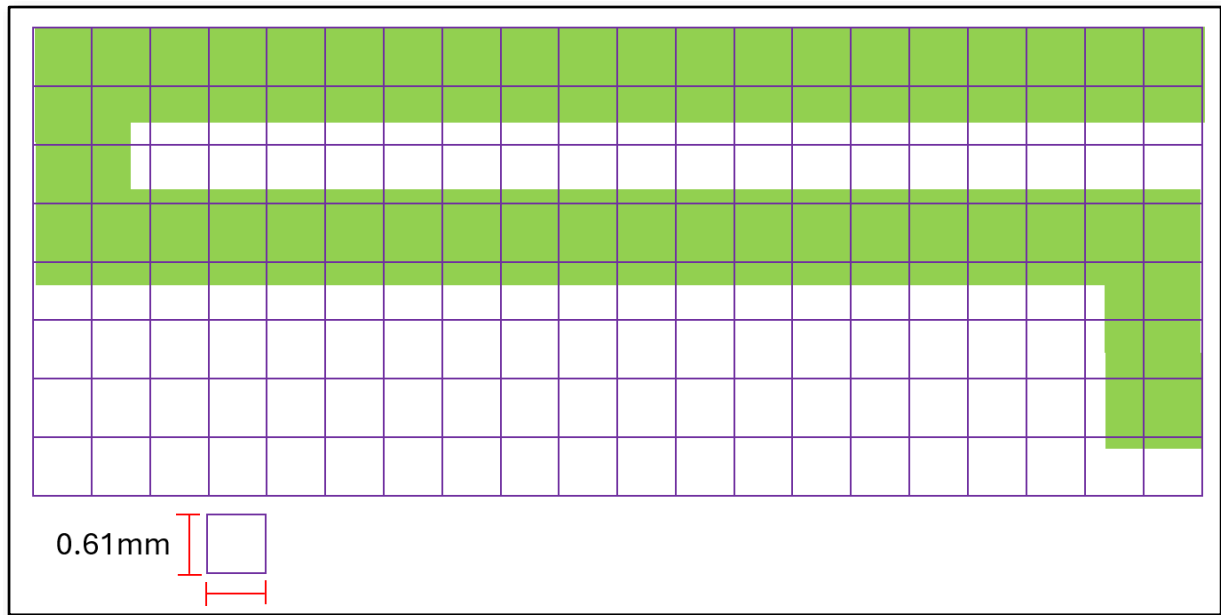
Below, the Second GDC portion is enclosed with $N1_{Total} = 40$ square cells (four rows by ten columns) with edge length $L1 = 1.22 \text{ mm}$, where 31 cells

(numbered below) contain at least a portion of the curve (i.e., $N1 = 31$). Pozar, ¶168.



Below, the Second GDC portion is enclosed with $N2_{Total} = 160$ square cells of length $L2 = 0.61 \text{ mm}$ (i.e., $L2 = 1/2 (L1)$) where 106 cells (100 cells in

the top 5 rows and 20 columns, and 6 cells at the bottom right) enclose at least a portion of the curve (i.e., $N2 = 106$). Pozar, ¶169.



The Second GDC portion grid-dimension value (*see supra* §V.B.2) is greater than 1:

$$\begin{aligned} D_g &= -\left(\frac{\log(N2) - \log(N1)}{\log(L2) - \log(L1)}\right) = -\left(\frac{\log(106) - \log(31)}{\log(0.61) - \log(2 \times 0.61)}\right) \\ &= -\left(\frac{\log(106/31)}{\log(1/2)}\right) = -\left(\frac{0.534}{-0.301}\right) \approx 1.77. \end{aligned}$$

Pozar, ¶170.

The additional requirements in Petitioners’ construction (*supra* §V.B.2) are also met.

First, $N1_{Total} = 40$, which is “at least twenty-five cells,” and $N2_{Total} = 160$, which is “four times the number of cells as the first grid.” *Supra* §V.B.2.

Second, “the length (L2) of each square cell in the second grid” (0.61 mm) is “one-half” the length (L1) (1.22 mm) of each square cell in the first grid. *Supra* §V.B.2.

Third, grids 1 (red) and 2 (purple) above are “positioned within a minimum rectangular area enclosing the curve, such that no entire row or column on the perimeter of” either “grid[] fails to enclose at least a portion of the curve.” *Supra* §V.B.2. Pozar, ¶¶171-174.

Thus, the Second GDC portion (within Tran+Teng’s *second radiating arm*), meets Petitioners’ construction of a *grid-dimension curve*. Pozar, ¶175.

ii. Fractus's construction of *grid-dimension curve*

The Second GDC portion of Tran+Teng's Branch 2-1 meets the requirements of Fractus's construction, as demonstrated below. *Supra* §V.B.1 (quoting EX1008, 27).

Fractus's “*not self-similar*” limitation: Under a description of “self-similar” Fractus provided in an alternative patent (*see supra* §VI.D.1.m.ii, [1L] (citing EX1024, 2:12-14)), Tran+Teng's Second GDC portion (comprised in Branch 2-1) is **not** self-similar because there is no part of the Second GDC portion that is a replica of the **entirety** thereof (e.g., it is not fractal-like). Pozar, ¶¶176-177. *Compare also* Tran+Teng's Second GDC portion with EX1001, FIG. 21b, 8:61-64 (“**grid dimension section 320**”).

Fractus's “*If the curve has any periodicity...*” limitation: Tran+Teng's Second GDC portion *has no periodicity*. Pozar, ¶178.

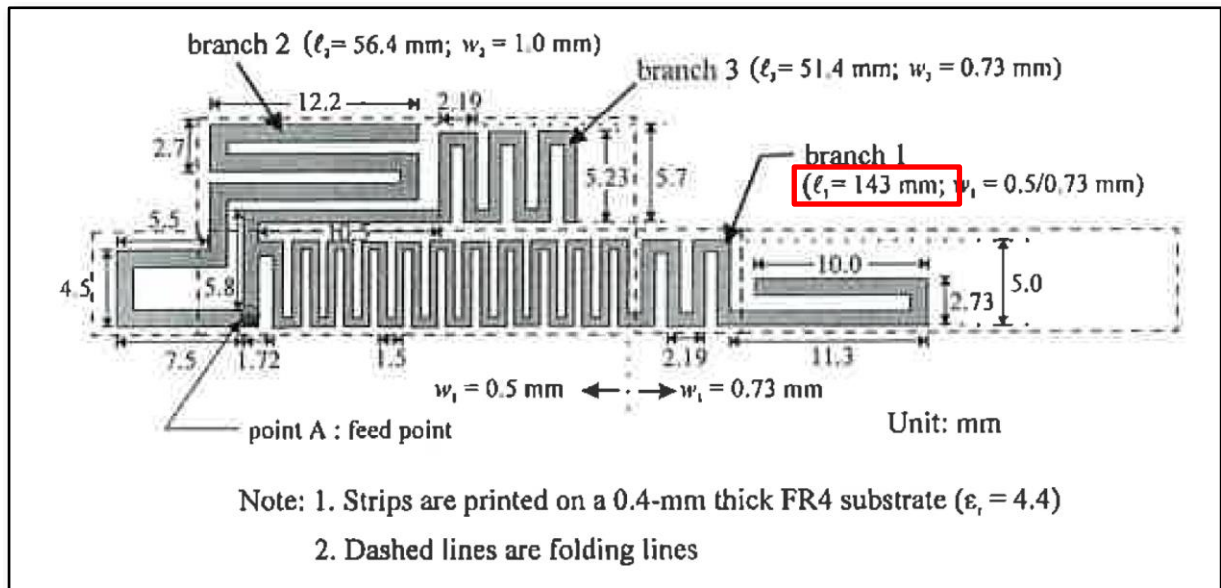
Thus, Tran+Teng's Branch 2, which comprises the Second GDC portion, meets Fractus's construction of *grid-dimension curve*. Pozar, ¶179.

9. Claim 10

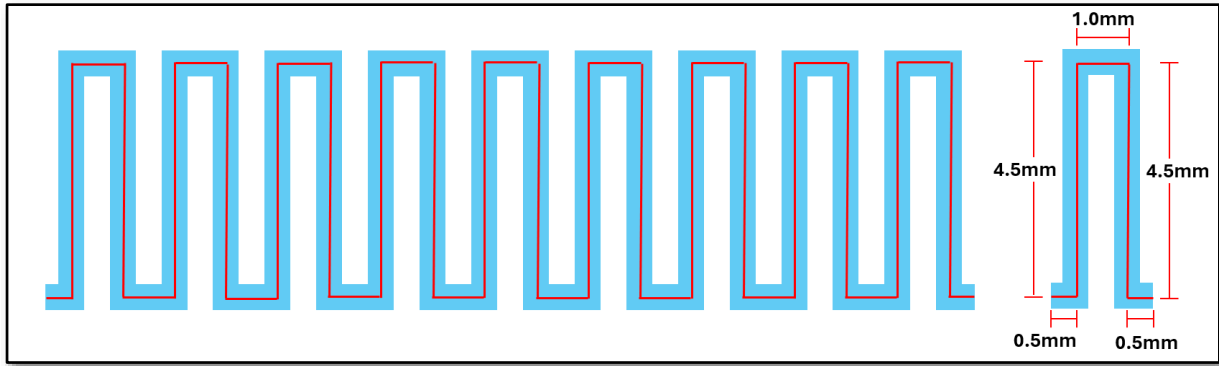
10	[Claim 9's device], wherein the grid-dimension curve and the second grid-dimension curve have different lengths.
----	--

The only “length” the '365 patent specification describes for Figure 1's “radiating arms 12, 14” is “the total conductor **length**.” EX1001, 3:35-46.

Teng says Branch 1’s “strip **length** (ℓ_1)... is 143 mm.” Teng, 23. POSAs understood that Teng’s strip length is the same as the ’365 patent’s “total conductor length” and is the total linear length of a line (red) running through the center of a branch. Pozar, ¶180.



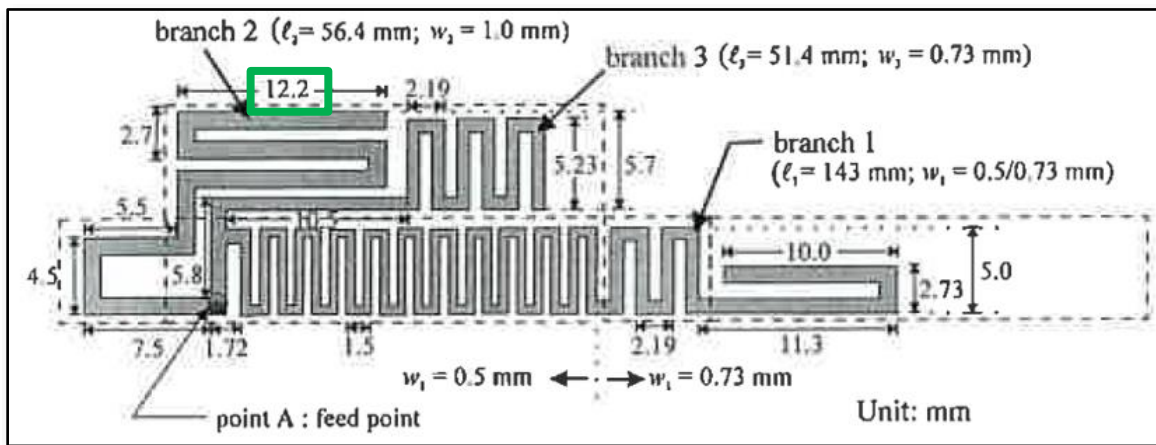
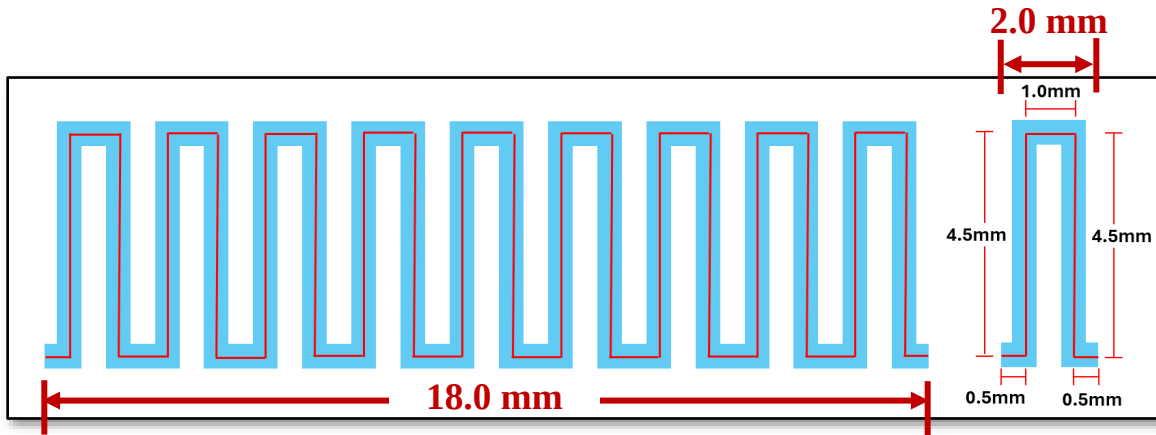
As discussed above (§VI.D.1.m ([1L])), Tran+Teng’s Branch 1-1 is at least partially shaped according to a *grid-dimension curve*, with a portion shaped according to a grid-dimension curve (below-left) that is comprised of a unit cell (below right) repeated nine times. As shown in Petitioners’ Figure P-3 below, a line through the center of one unit cell has two 0.5mm portions, two 4.5mm portions, and one 1.0mm portion. Thus, a line through the center of the unit cell has a total length of 11.0mm, and the total length of Branch 1-1’s grid-dimension portion is $9 \times 11.0\text{mm} = 99.0\text{mm}$. Pozar, ¶181.



Petitioners' Figure P-3

Teng says Branch 2's "strip *length* (ℓ_2) is 56.4 mm." Teng, 23. As discussed above, *the second grid-dimension curve* is a portion of Tran+Teng's Branch 2. Thus, *the second grid-dimension curve's* strip length is necessarily less than 56.4 mm and therefore is *different from the grid-dimension curve's* strip length calculated above (99.0 mm). Pozar, ¶182. Thus, Tran+Teng's antenna element meets claim 10.

If claim 10's "*length*" were considered to be the lateral distance from one edge of a curve to the other, then the GDC portion lateral length is $9 \times 2.0 = 18.0$ mm, which is different from the 12.2 mm lateral distance for Branch 2-1. *Supra* §VI.D.1.m ([1L]); Teng, Fig. 1 (annotated detail below). Pozar, ¶183.



10. Claim 11

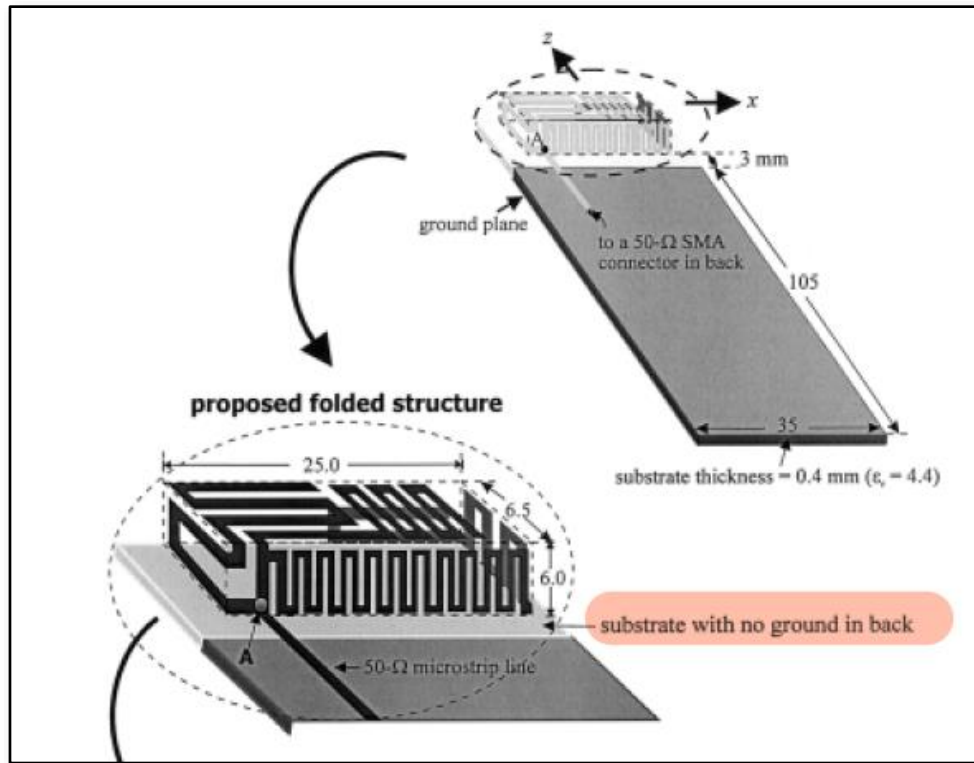
11	[Claim 9's device], wherein the grid-dimension curve and the second grid-dimension curve have different grid dimensions.
----	--

The first GDC portion grid dimension (*grid-dimension curve... grid dimension*) is 2 (*supra* §VI.D.1.m.i), which is *different* from the *second grid-dimension curve's grid dimension* (≈ 1.77 , *supra* §VI.D.8.i). Pozar, ¶184.

11. Claim 12

12	[Claim 1's device], wherein an orthogonal projection of a footprint of the antenna element on a plane of the printed circuit board overlaps the ground plane layer in less than 50% of an area of said footprint
----	--

Tran+Teng's *antenna element* is mounted to the portion of the PCB "substrate with **no ground** in back," as taught by Teng. *Supra* §VI.C (combination), §VI.D.1.d ([1C]); Teng, Figure 1 (annotated below), 24 ("FR4 substrate...can be considered as the circuit board of a practical mobile handset"). Thus, *an orthogonal projection of a footprint of the antenna element on a plane of the PCB* has **zero overlap** with the ground plane and thus *overlaps the ground plane layer in less than 50% of an area of said footprint*. Pozar, ¶185. That mapping is consistent with the '365 patent's discussion of Figure 10, which allegedly shows "50% or less of the projection of the antenna footprint on the plane of the circuit board 102" because "antenna 10 is **laterally offset from an edge of the circuit board 102**, such that" "the projection of the antenna footprint on the plane of the circuit board 102 **does not intersect any** of the metal[l]ization of the ground plane 106." EX1001, 4:63-5:9. Pozar, ¶186.



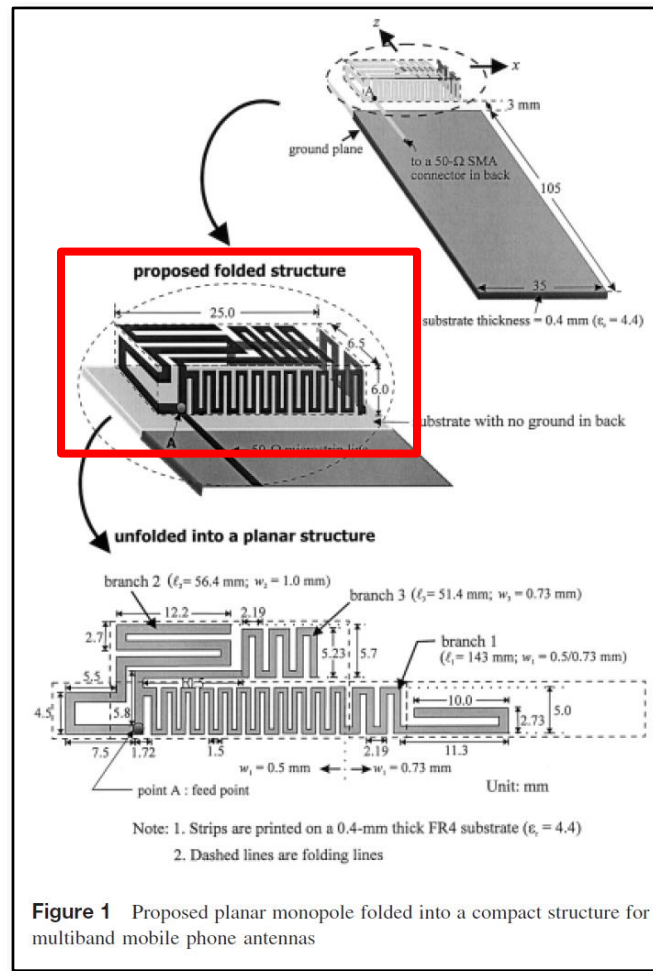
12. Claim 13

a. Limitation [13A]

13A	[Claim 1's device], comprising: a dielectric mounting structure having a plurality of surfaces;
-----	---

In Tran+Teng's mobile communications device (*supra* §§VI.C-VI.D.1.a), the antenna branches are “printed on a thin (0.4 mm) FR4 substrate,” which is a *dielectric* substrate, as taught by Teng. Teng, 23, Fig. 1; EX1001, 8:39-41 (disclosing that “[s]uitable antenna substrate materials... include... FR4”). Pozar, ¶187 (citing corroborating EX1042, [0035] (“**FR4 dielectric** substrate material”)); *see also supra* §§VI.D.1.d-f ([1C]-[1E]) (discussing Tran+Teng's PCB).

In manufacturing the mobile communications device, the FR4 substrate with the antenna printed thereon is “folded into a compact structure like a rectangular box” (Teng, 23) as shown in Teng Figure 1 (annotated below), and the compact structure (the dielectric with the antenna mounted thereon) is then mounted to Tran+Teng mobile device’s PCB. *Supra* §VI.B; Pozar, ¶188.



In the manufactured mobile communications device, the FR4 dielectric material folded into a “rectangular box” is a *dielectric mounting structure having a plurality of surfaces* because the rectangular dielectric structure has at least five

surfaces having portions of the antenna element mounted thereon. Teng, 23, Figure 1; Pozar, ¶189.

Furthermore, it would have also been obvious to include an additional mounting structure to support Tran+Teng's antenna. For example, Teng's authors elsewhere describe similar, folded-planar antennas where the folded dielectric substrate is "attached to and supported by a foam base." EX1031, 108; EX1032, 1. A POSA had reasons to use such a dielectric foam base in Tran+Teng to beneficially provide additional rigidity to Tran+Teng's antenna with a reasonable expectation of success, based (in part) on EX1031's similar antenna structure being mounted to a foam base. Pozar, ¶¶190-191 (citing corroborating EX1035, [0053]-[0054]).

Moreover, Tran's "dual strip antenna" has two strips "spaced apart from each other by a dielectric material or substrate, such as air or a foam... known for such uses." Tran, 7:63-8:6. For example, Tran uses "Rohacell foam ($\epsilon_r=1.05$ [relative permittivity])... to manufacture [Tran's] dielectric substrate." Tran, 13:9-14. The relative permittivity of Rohacell's foam is only 5% different from air's relative permittivity ($\epsilon_r=1.00$), and thus POSAs would have reasonably expected success in using a foam mounting structure with Teng's antenna. Pozar, ¶192 (citing corroborating EX1035, [0053]-[0054]). A rectangular dielectric foam base to support the "rectangular box" formed by the folded FR4 substrate with the

antenna printed thereon (Teng, 23 and Figure 1) is also a dielectric mounting structure having a plurality of surfaces that meets [13A]. Pozar, ¶193.

b. Limitation [13B]

13B	<i>wherein at least a portion of the first radiating arm is arranged on a first surface of said plurality of surfaces; and wherein at least a portion of the second radiating arm is arranged on a second surface of said plurality of surfaces, the second surface being different from the first surface.</i>
-----	---

When the *dielectric mounting structure* is mapped to the FR4 substrate folded into a rectangular box (*supra* §VI.D.12.a, [13A]), *at least a portion of* Tran+Teng’s Branch 1 (*first radiating arm, supra* §VI.D.1.j ([1I])) *is arranged on a first surface* (supporting the blue trace below) *of said plurality of surfaces* of the *dielectric mounting structure* (rectangular box of FR4 substrate), and *at least a portion of* Branch 2 (*second radiating arm, supra* §VI.D.1.j ([1I])) *is arranged on a second (different) surface of said plurality of surfaces* (supporting the green trace below) of the *dielectric mounting structure* (rectangular box of FR4 substrate), as shown in Teng’s Figure 1 (highlighted below). Pozar, ¶194.

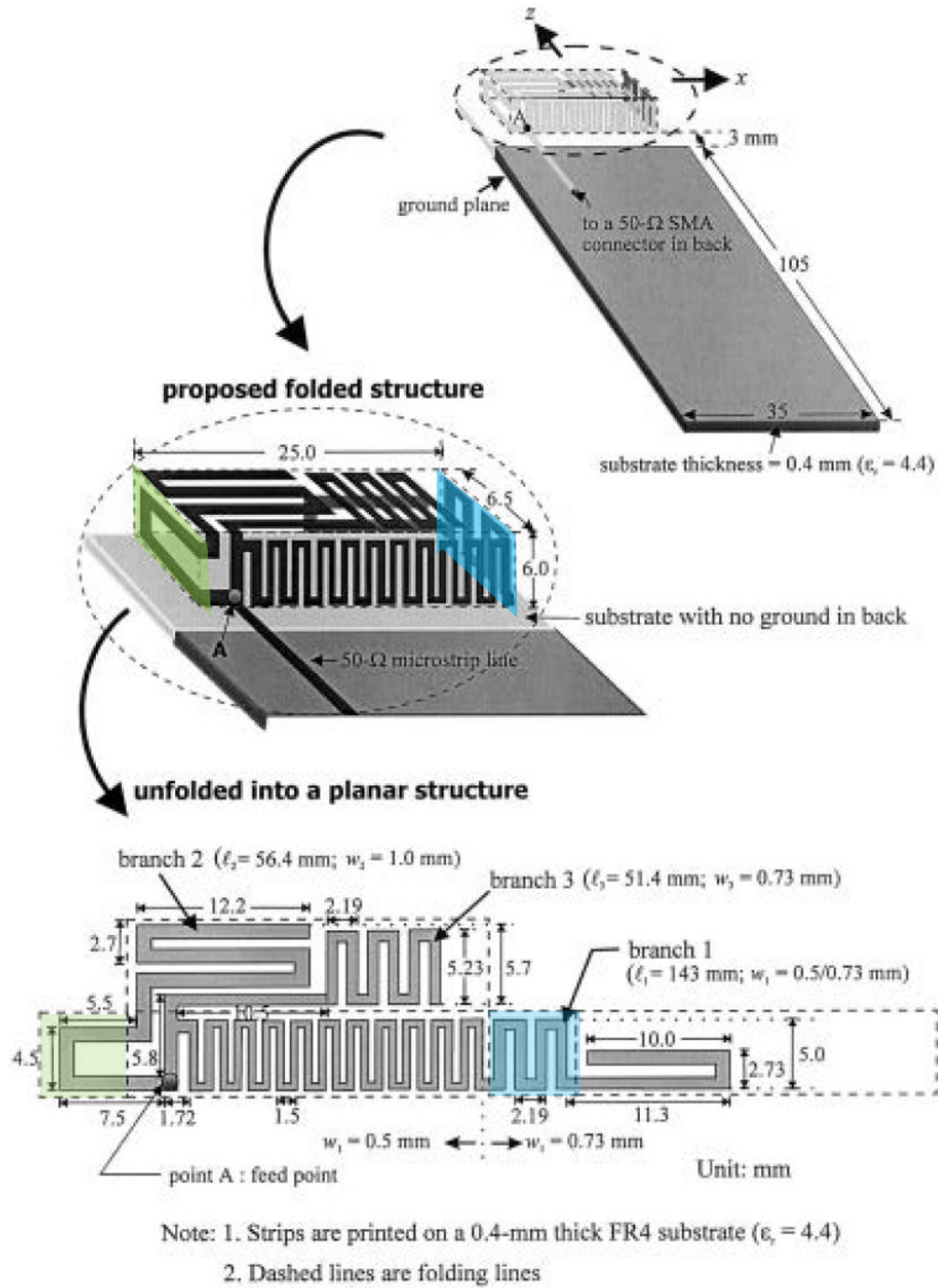


Figure 1 Proposed planar monopole folded into a compact structure for multiband mobile phone antennas

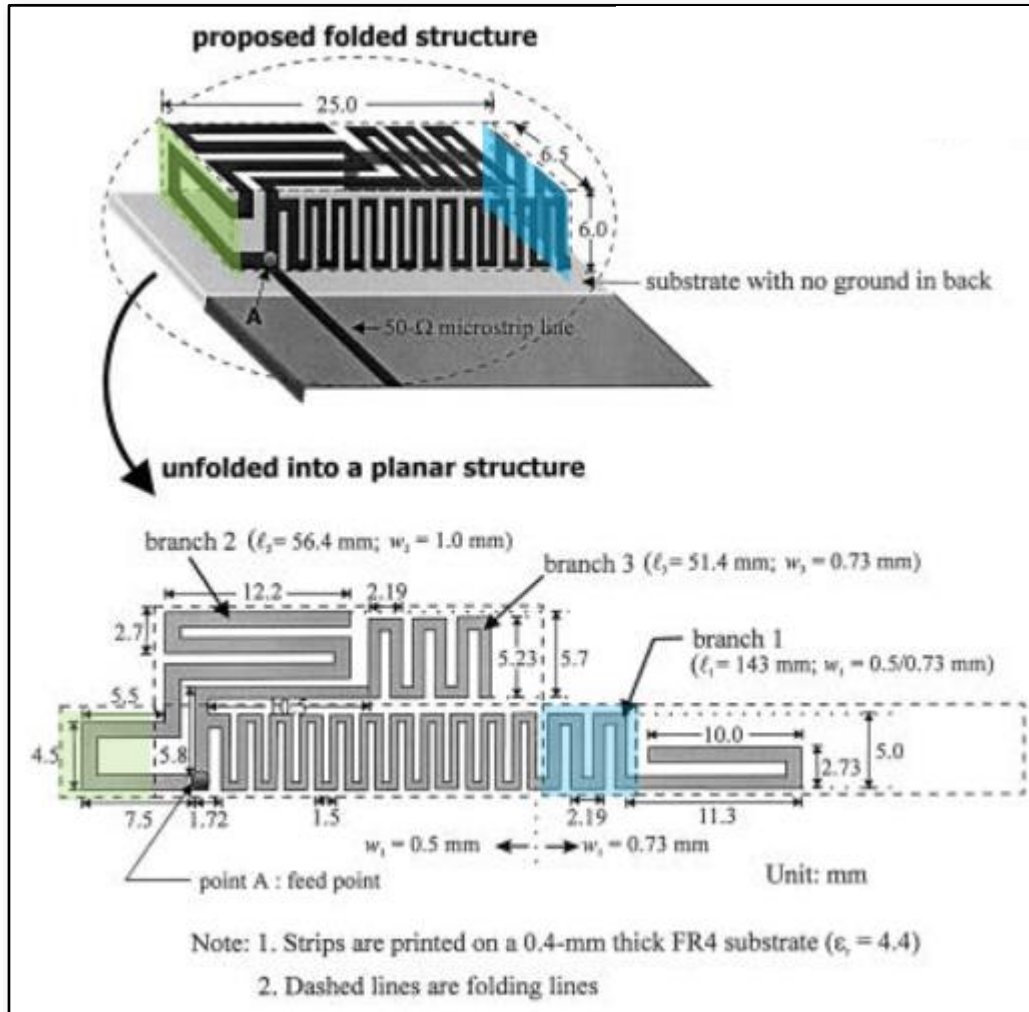
When the *dielectric mounting structure* is mapped to a rectangular dielectric foam base that supports the “rectangular box” formed by the folded FR4 substrate with the antenna printed thereon (*supra* §VI.D.12.a, [13A]), *at least a portion of* Tran+Teng’s Branch 1 (*first radiating arm*) is *arranged on a first surface of said plurality of surfaces* of the *dielectric mounting structure* (a surface of the dielectric foam base supporting the blue-highlighted surface above), and *at least a portion of* Branch 2 (*second radiating arm*), *supra* §VI.D.1.j ([11])) is *arranged on a second (different) surface of said plurality of surfaces* of the *dielectric mounting structure* (a surface of the dielectric foam base supporting the green-highlighted surface above), based on Teng’s Figure 1 (highlighted above). Pozar, ¶195. “*Arranged on*” one of the surfaces of the *dielectric mounting structure* does not require that the at least a portion of the radiating arm be in direct contact with the surface of the *dielectric mounting structure* and, therefore, the portions of the antenna arranged on different surfaces of the rectangular box are “arranged on” the corresponding surface of the rectangular foam base. Pozar, ¶196.

13. Claim 14

14	[Claim 13’s device], <i>wherein the first surface and the second surface are opposite surfaces of the dielectric mounting structure.</i>
----	--

As shown below, *the first surface (green) and the second surface (blue) are opposite surfaces of the dielectric mounting structure* because they are opposite

surfaces of the folded rectangular-box structure. Teng, Fig. 1 (annotated detail below).



14. Claim 15

Claim 15 is an independent claim that has many limitations that are identical, or substantially similar, to limitations in claim 1. Below, Petitioners rely on the showing for claim 1 to meet the identical or substantially similar limitations and then addresses any limitations of claim 15 that are not in claims 1-14.

a. Limitations [15PRE]-[15I], [15L]

Tran+Teng meets the following limitations of claim 15 for the same reasons

Tran+Teng meets the corresponding limitations below. EX1034, 1-2; Pozar, ¶199.

Limitation	Corresponding limitation	Discussion (<i>supra</i>)
[15PRE]	[1PRE]	§VI.D.1.a
[15A]	[1A]	§VI.D.1.b
[15B]	[1B]	§VI.D.1.c
[15C]	[1C]	§VI.D.1.d
[15D]	[1D]	§VI.D.1.e
[15E]	[1E]	§VI.D.1.f
[15F]	[1F]	§VI.D.1.g
[15G]	[1G]	§VI.D.1.h
[15H]	[1H]	§VI.D.1.i
[15I]	[1I], [1L]	§§VI.D.1.j ([1I]), VI.D.1.m ([1L])
[15L]	[1M]	§VI.D.1.n

In [15I], the “*first conductor*” is Teng’s Branch 1 (the “*first radiating arm*” in Limitation [1I] *supra* §VI.D.1.j), while the “*grid-dimension section*” is the GDC portion of Teng’s Branch 1 described *supra* §VI.D.1.m ([1L]). *See also infra* §VI.D.14.c.i ([15J]) (discussing the *conducting* material in Tran+Teng’s radiating arms). Pozar, ¶200.

b. Limitation [15H]

15H	<i>wherein the antenna element is coupled to the feeding point and operates in cooperation with the ground plane layer;</i>
-----	---

Tran+Teng meets [15H] because the *feeding point* provides a pathway (e.g., *is coupled*) for RF signals between Tran+Teng’s antenna assembly (comprising the *antenna element*) and its communications circuitry (discussed *infra* §VI.D.1.j

([1I])), as illustrated in Teng Figure 1. *Supra* §§VI.D.1.e ([1D]), VI.D.14.a ([15D]). Tran+Teng meets the remaining limitations in [15H] for the reasons it meets [1H] *supra* §VI.D.1.i. Pozar, ¶201.

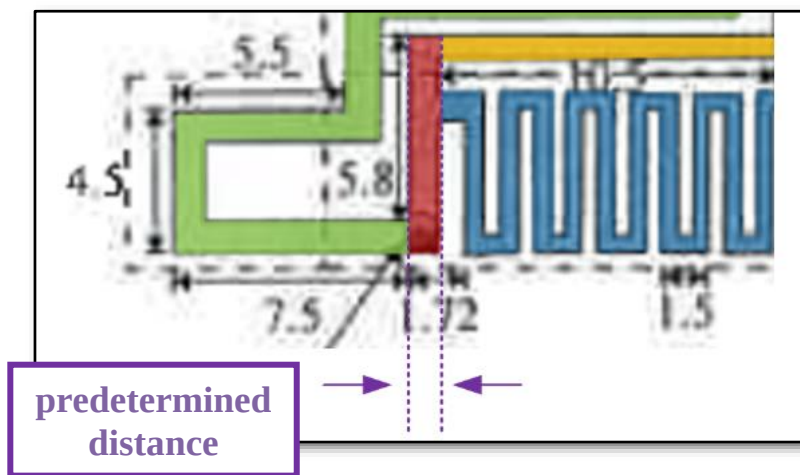
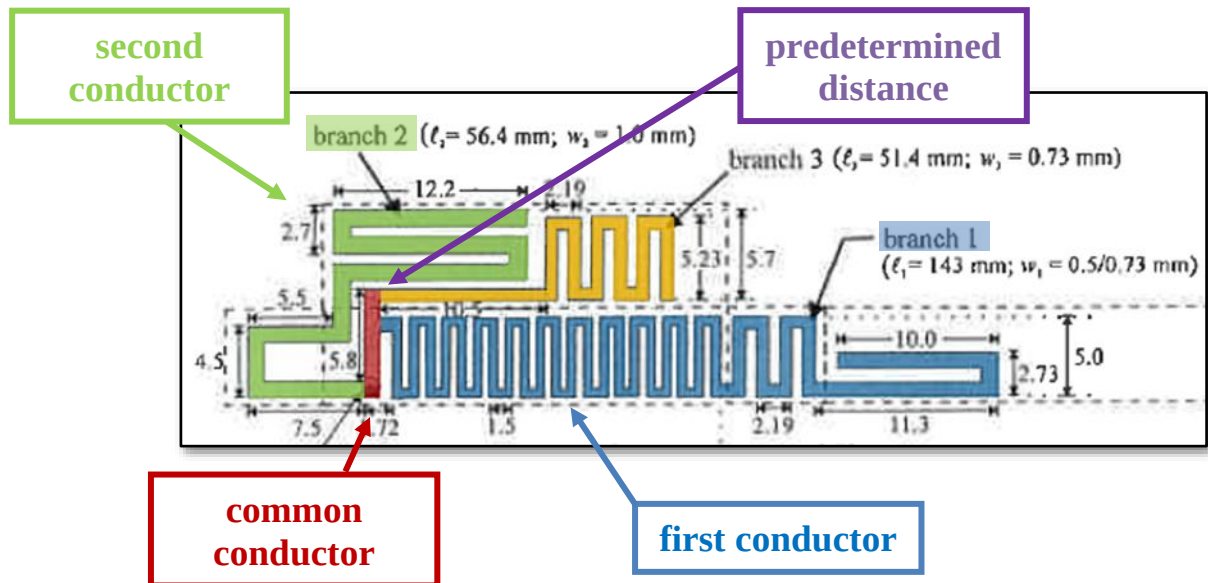
c. Limitation [15J]

15J	<i>a second conductor arranged at a predetermined distance from the first conductor and electromagnetically coupled to the first conductor,</i>
-----	---

i. *predetermined distance*

Tran+Teng’s first and second radiating arms are *first* and *second* conductors, respectively, because Teng discloses (or at least suggests and renders obvious) “print[ing]” the antenna branches as *conducting* material (e.g., metal). *Supra* §VI.D.1.j ([1I]) (citing Teng, 23; Tran, 11:35-39 (forming antenna using a “**metallic** [*conductive*] strip” of material)); EX1017, 4:12-24; EX1022, [0006]). Pozar, ¶202.

Tran+Teng’s *second conductor* (green) is *arranged at a predetermined distance from Branch 1* (blue: *first conductor comprising a first radiating arm*), defined by the width of the common conductor strip and the points where the *first and second conductors* connect to the common conductor, as shown in Teng’s Figure 1 (annotated below). Pozar, ¶203.



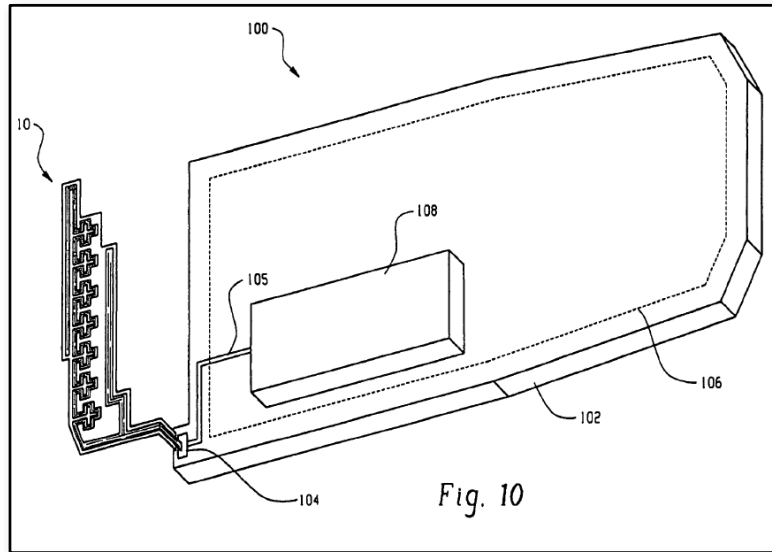
ii. *electromagnetic coupling*

The '365 patent refers to positioning antenna 10 and feeding point 104 in Figure 10 to reduce “*electromagnetic coupling* from the ground plane 106.”

EX1001, 4:63-64, 5:10-13. POSAs understood that electromagnetic coupling

means an interaction between circuit components through electromagnetic fields.

EX1038, 242; EX1039, 240, 362; Pozar, ¶204.

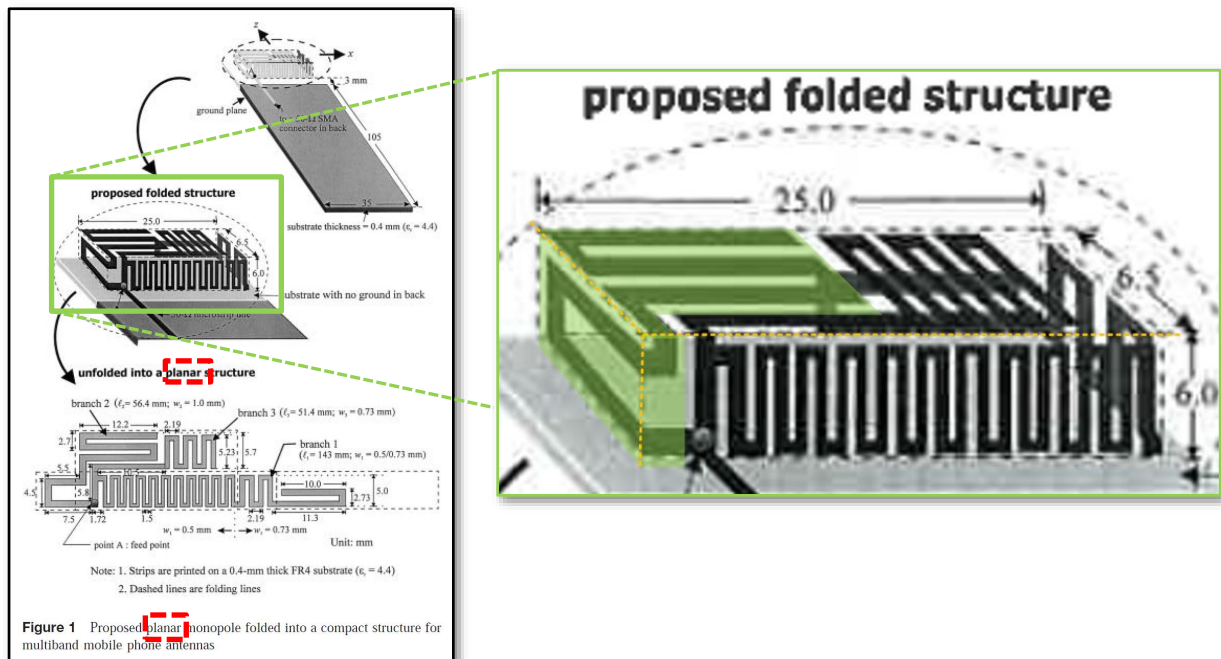


As discussed above, Tran+Teng’s Branch 1 and Branch 2 are *first and second conductors*, respectively. In a manufactured mobile device that feeds RF signals into Tran+Teng’s antenna branches, POSAs understood that Branch 1 and Branch 2 are *electromagnetically coupled* because, as Teng discloses, there will be a “***coupling*** effect between two adjacent or nearby meandered sections”—including between Teng’s Branch 1 and Branch 2. Teng, 23; Pozar, ¶205. POSAs understood that Teng’s *coupling* between proximate meandered sections is a type of *electromagnetic coupling*, meeting [15J]. Pozar, ¶205 (citing corroborating EX1022, [0040]-[0041]; EX1038, 242; EX1039, 240, 362).

d. Limitation [15K]

15K	<i>the second conductor comprising a planar section; and</i>
-----	--

Tran+Teng's Branch 2 (the *second conductor*) comprises multiple *planar* sections (highlighted green below-right) because Branch 2 is first formed on a “*planar* structure” substrate, and then that substrate is folded into a rectangular structure, which results in each section of Branch 2 being located entirely on one *plane* of the rectangular, folded structure. Teng, Fig. 1 (annotated detail below); Pozar, ¶206.



15. Claim 16

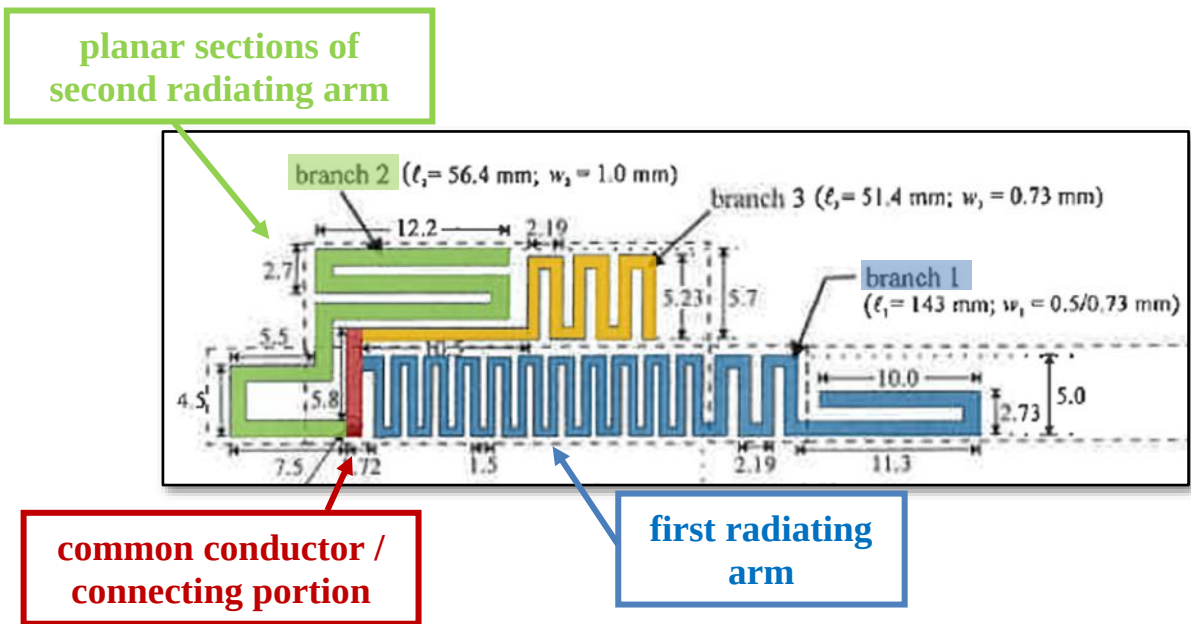
16	[Claim 15's device], wherein the first conductor and the second conductor are electrically connected.
----	---

Tran+Teng's Branch 1 and Branch 2 are the *first and second conductors* both *connected to the common conductor* that feeds RF (electrical) signals to the branches as explained *supra* §VI.D.1.j ([1I]). That connection is an *electrical connection* because the branches and common conductor are all formed from one piece of conducting metal material. Pozar, ¶207.

16. Claim 17

17	[Claim 16's device], wherein the antenna element comprises a connecting portion that connects the first radiating arm and the planar section.
----	---

The '365 patent's written description does not use the term "*connecting portion*." The closest written description is (at most) the patent's disclosure of a "conducting portion." See, e.g., EX1001, 4:4-30 (disclosing that "FIGS. 3-9" illustrate "a common conductor 52 coupled to a first radiating arm 54 and a second radiating arm 56," which is illustrated as a planar, linear conductor). As discussed *supra* §VI.D.1.j ([1I]), Tran+Teng has a *common conductor* (red) as shown in Teng's Figure 1 (annotated detail below). Pozar, ¶208.



Tran+Teng’s common conductor (red) *connects* Branch 1 (blue, *first radiating arm*) to Branch 2 (green, *planar sections*). *Supra* §VI.D.14.c ([15J]). Thus, Tran+Teng’s common conductor also meets claim 17’s *connecting portion that connects the first radiating arm* (blue) *and each planar section* in Branch 2 (green). Pozar, ¶209.

17. Claim 18

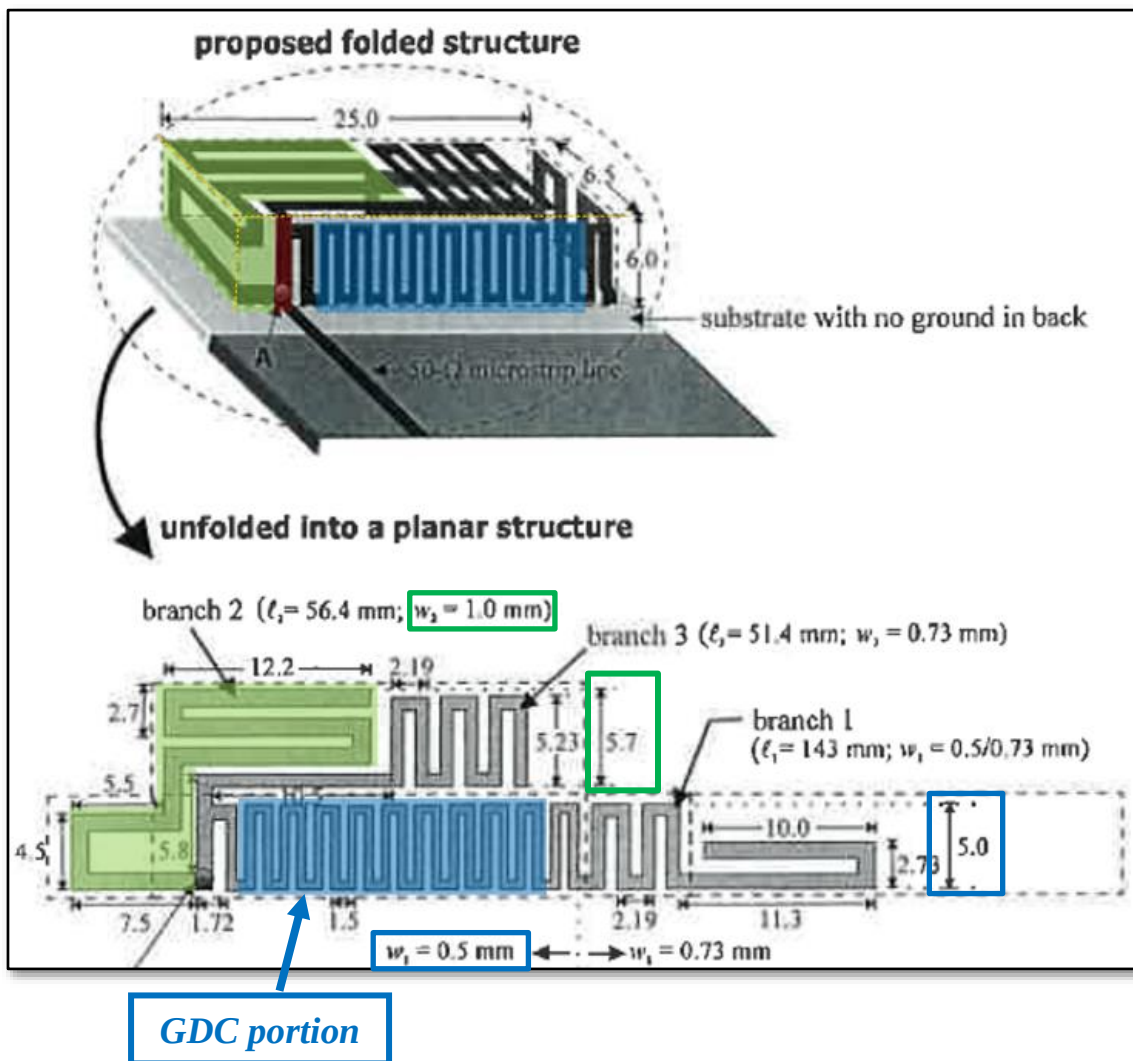
18	[Claim 17’s device], wherein a width of the grid-dimension section is smaller than a width of the planar section.
----	---

In the claims “a width” is the antenna element width. *E.g.*, claim 40 (“second radiating arm has a *uniform width*”); *accord* EX1001, 9:59-61 (antenna “conductor plates... can be decreased in width”); Pozar, ¶210.

In the Branch 1 GDC portion (“First GDC portion,” blue below; *see supra* §VI.D.1.m ([1L])) the 0.5mm antenna element width *is smaller than* the 1.0mm

antenna element width in Branch 2 (comprising the planar section). Teng, Fig. 1 (detail annotated below). Pozar, ¶210.

Alternatively, the First GDC portion height (e.g., a width) is 5.0mm, which is less than the 5.7mm top planar section height (e.g., a width). *Id.* Pozar, ¶211.



18. Claims 19-21, 23, 25, 27

Claims 19-21, 23, 25 and 27 add limitations substantially similar to limitations that have already been addressed. Tran+Teng meets the additional

limitations for the reasons it meets the corresponding limitations below. EX1034, 3-5; Pozar, ¶212.

Limitation	Corresponding limitation	Discussion (<i>supra</i>)
19	7	§VI.D.7
[20A]	4	§VI.D.4
[20B]	[2B]	§VI.D.2.b
[20C]	[2D]	§VI.D.2.d
[20D]	[2E]	§VI.D.2.e
[20E]	[2C]	§VI.D.2.c
[20F]	[1L]	§VI.D.1.m.ii
21	13	§VI.D.12
23	14	§VI.D.13
25	[1I]	§VI.D.1.j
27	9	§VI.D.8

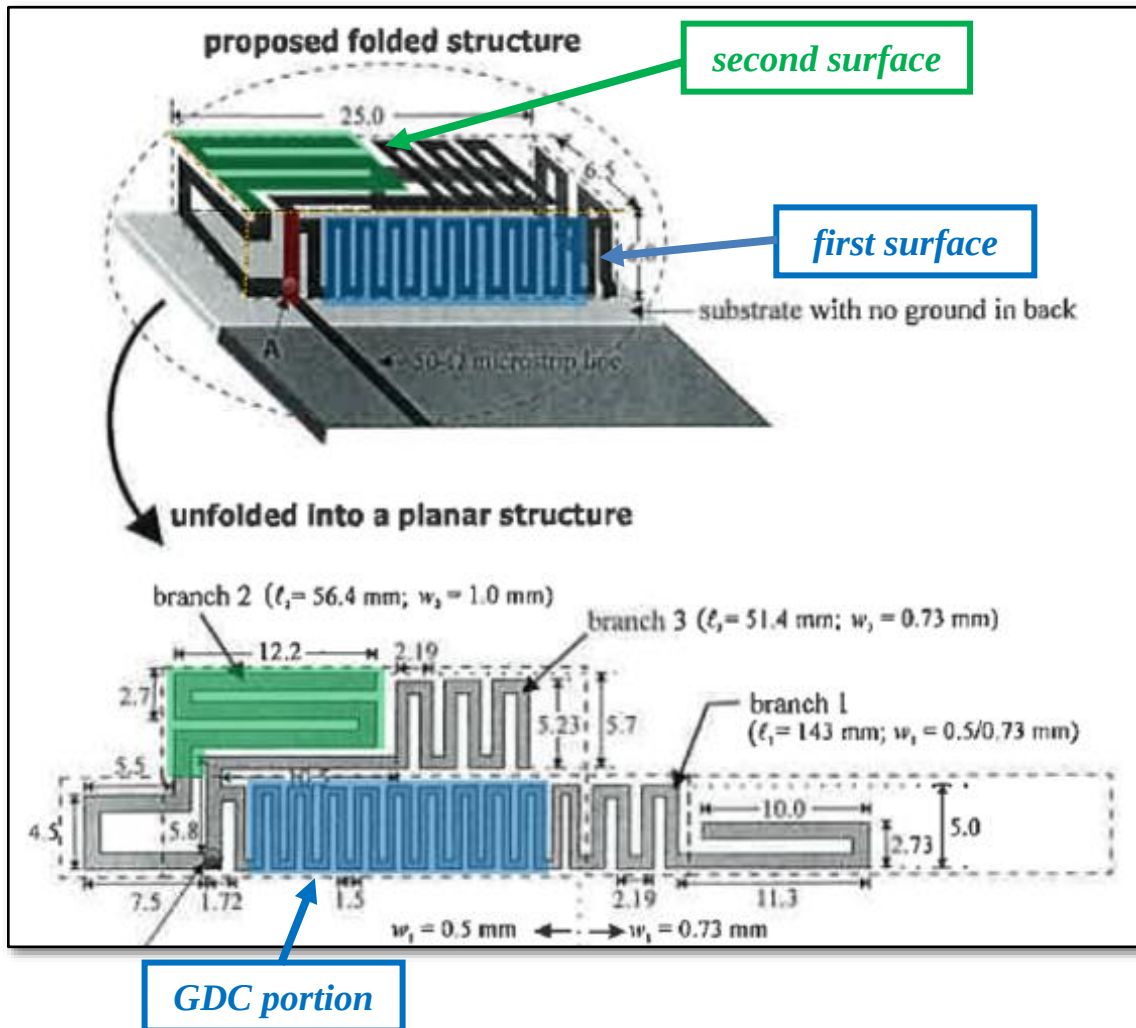
Limitation [20F] recites language that Fractus incorporates in its *grid-dimension curve* construction and Tran+Teng meets it for the reasons it meets Fractus’s construction *supra* §VI.D.1.m.ii ([1L]) and because the grid-dimension curve’s periodic portion *is periodic along a fixed straight direction*—e.g., the front surface of Tran+Teng’s rectangular mounting structure, as shown in Teng’s Figure 1. Pozar, ¶213.

19. Claim 22

22	[Claim 21’s device], <i>wherein the grid-dimension section is arranged on the first surface; and wherein the planar section is arranged on the second surface.</i>
----	--

Tran+Teng meets claim 22 under an alternative *first/second surface* mapping wherein Branch 1’s First GDC portion (*grid-dimension section*; blue

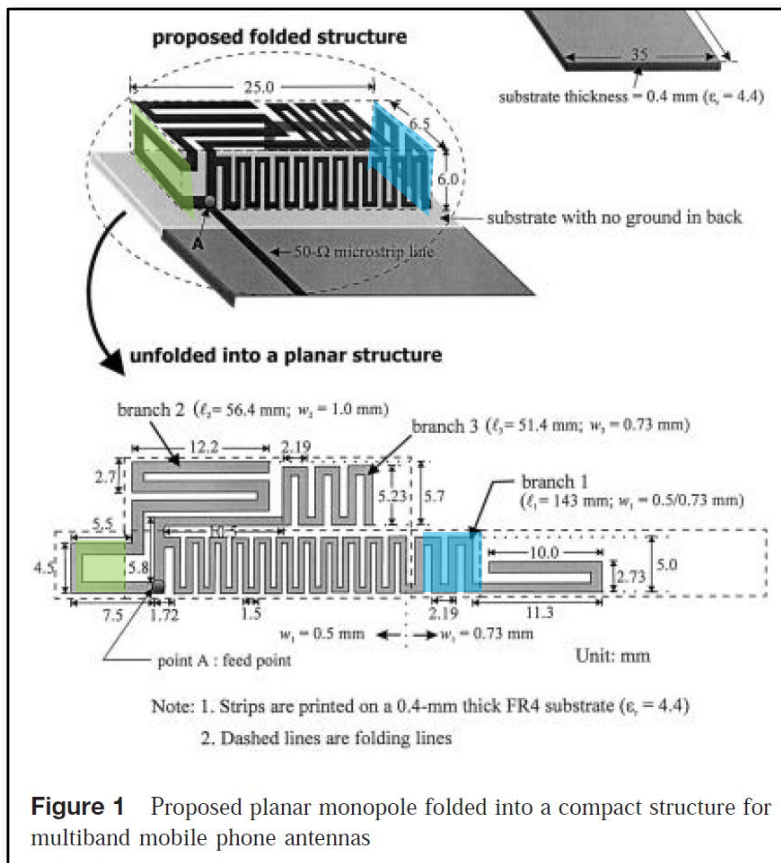
below) is disposed on a first surface while Branch 2-1 (*planar section*; green below) is disposed on a second surface. *Supra* §VI.D.12 (claim 13), §VI.D.14.d ([15K]); Teng, Fig. 1 (annotated detail below); Pozar, ¶214.



20. Claim 24

24	[Claim 21's device], wherein the first surface and the second surface are substantially parallel.
----	---

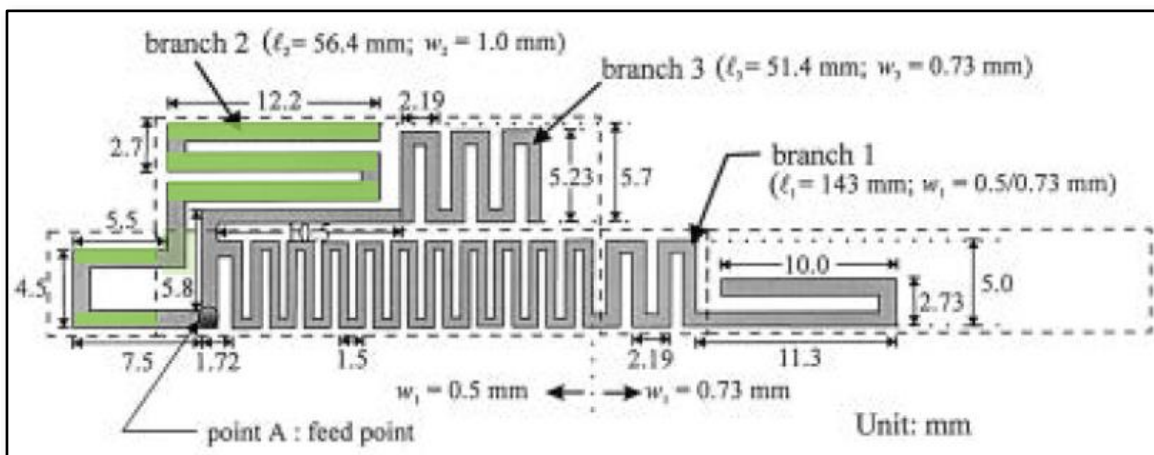
Claim 24 depends from claim 21 that uses the mapping in claim 13 wherein the *first* (blue) and *second* (green) surfaces are *substantially parallel* because they form opposite sides of a rectangular box. *Supra* §VI.D.12 (claim 13); Teng, Fig. 1; Pozar, ¶215.



21. Claim 26

26	[Claim 25's device], wherein the second radiating arm comprises a substantially straight section.
----	---

Tran+Teng's Branch 2 (second radiating arm, §§VI.D.1.j ([1I]), VI.D.14.c.i ([15J])) comprises several substantially straight sections highlighted green in Teng's Figure 1 below. As shown below, each of Branch 2's sections is formed from several substantially straight lengths of the conducting strip, which reinforces that each of Branch 2's sections is a substantially straight section. Pozar, ¶216.

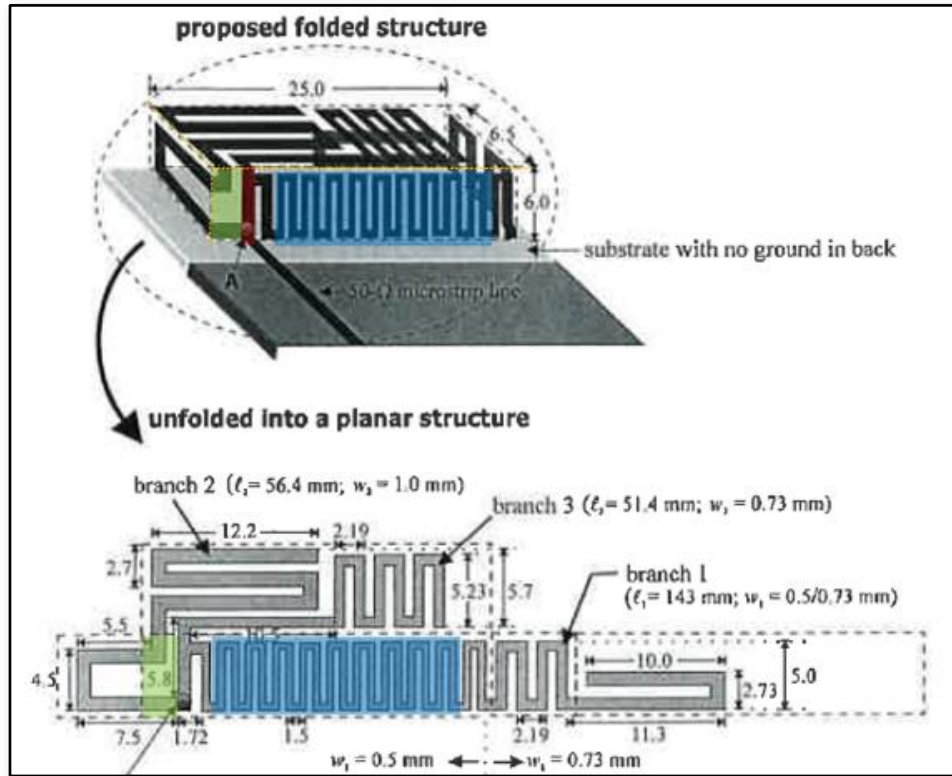


22. Claim 28

28	[Claim 25's device], wherein the second radiating arm and the grid-dimension section of the first radiating arm lie on a common surface.
----	--

In Tran+Teng, a portion (green) of Branch 2 (second radiating arm, *supra* §VI.D.14.c.i [15J]) and Branch 1-1 (blue) (grid-dimension section of the first radiating arm, *supra* §VI.D.1.m [1L]) lie on a common surface (foreground

surface of the rectangular box), as shown in Teng's Figure 1 (annotated detail below). Pozar, ¶217.

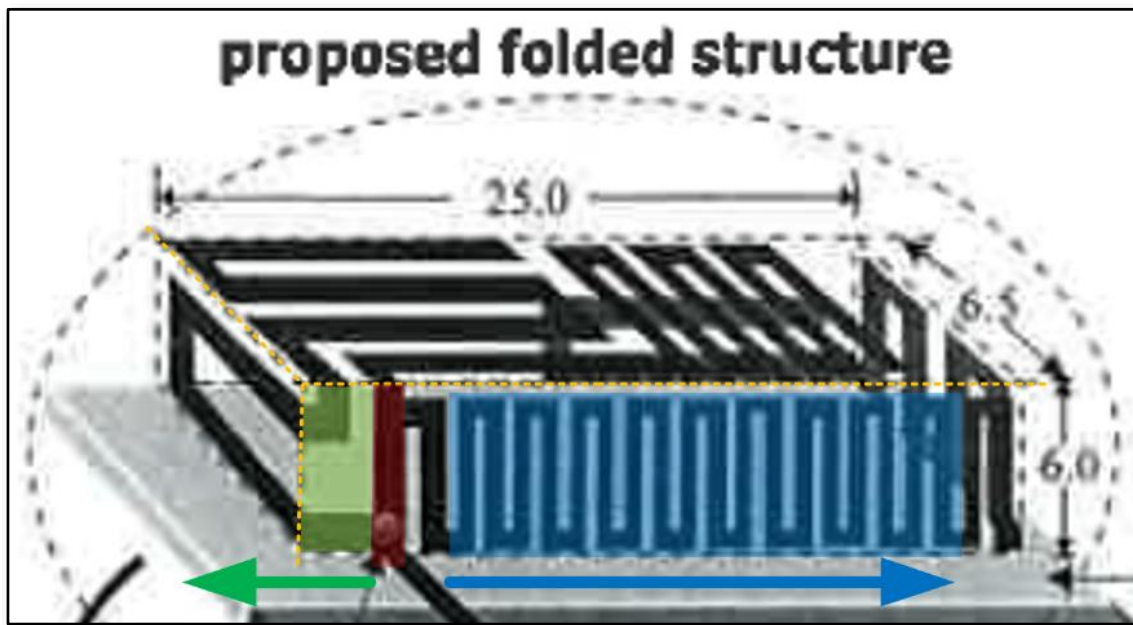


23. Claim 29

29	[Claim 15's device], wherein the grid-dimension section of the first radiating arm extends away from the common conductor along a first direction; and wherein the second radiating arm extends away from the common conductor along a second direction, the second direction being substantially parallel to the first direction.
----	--

Tran+Teng's grid-dimension section of the first radiating arm (blue) extends away from the common conductor (red) along a first direction (blue arrow) and the second radiating arm (green) extends along a second direction (green arrow) that

is *substantially parallel to the first direction*, as shown in Teng’s Figure 1 (annotated detail below). Pozar, ¶218.

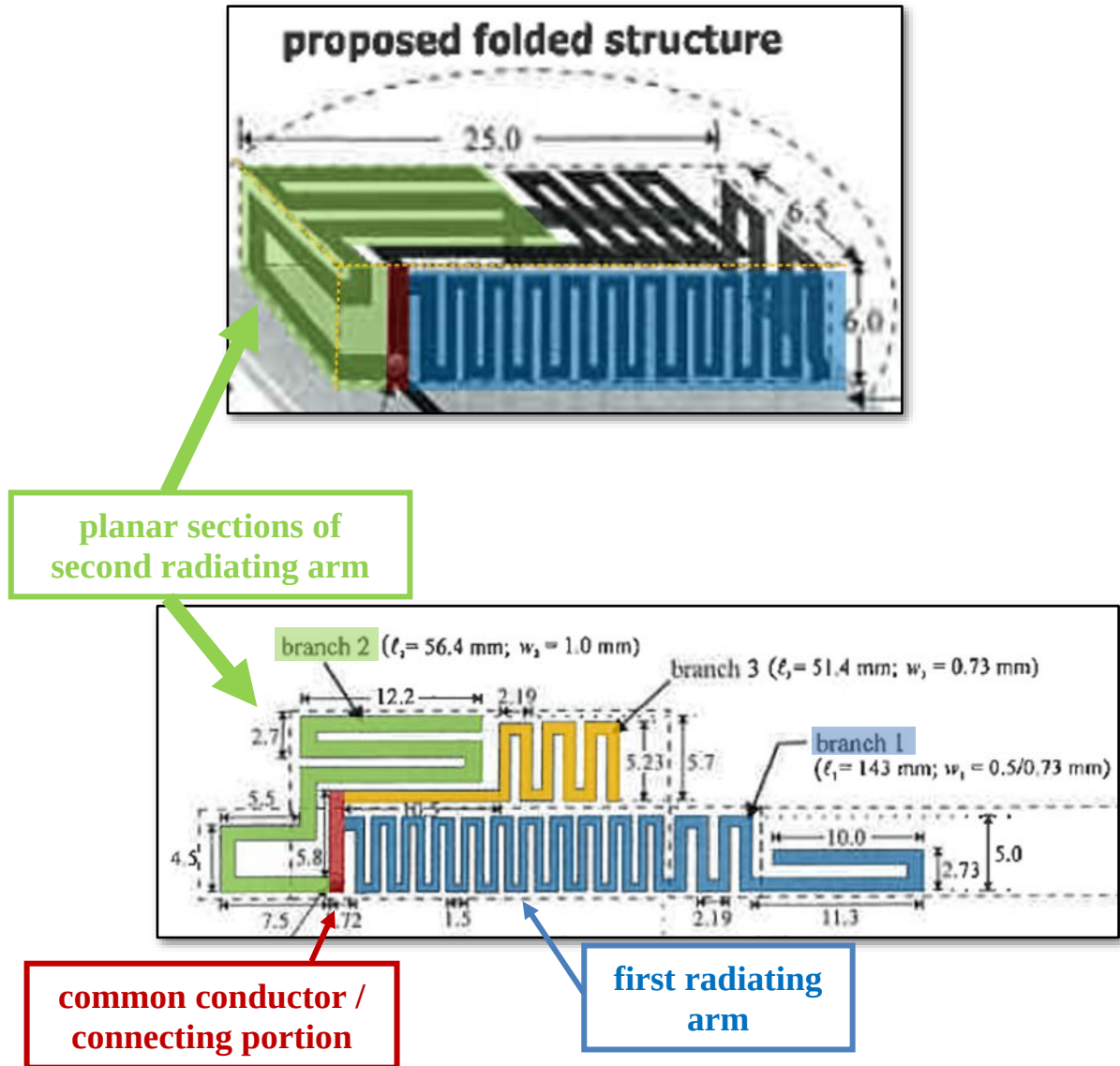


24. Claim 30

a. Limitation [30A]

30A	[Claim 29’s device] wherein the antenna element comprises a connecting portion that connects the grid-dimension section and the planar section; and
-----	---

As discussed *supra* §VI.D.16 (claim 17), Tran+Teng’s *antenna element* comprises a *connecting portion* (red below) comprising the same portion of the antenna element that meets the *common conductor* discussed above for limitation [1J] (*supra* §VI.D.1.k).



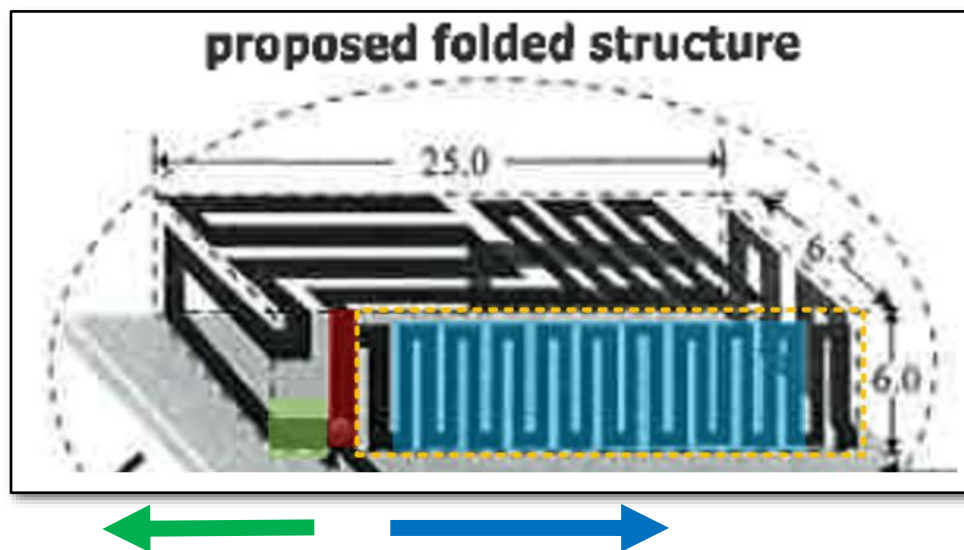
Tran+Teng's *first radiating arm* (blue above) comprises the GDC portion (*grid-dimension section*; *supra* §VI.D.1.m ([1L])), and Tran+Teng's *second radiating arm* (green above) comprises the *planar section* (*supra* §VI.D.14.d ([15K])). Thus, Tran+Teng's *connecting portion* connects the *grid-dimension section* and *planar section* in the same way the common conductor is connected to

the first and second radiating arms, as discussed *supra* §VI.D.1.k ([1J]). Pozar, ¶¶219-220.

b. Limitation [30B]

30B	<i>wherein the planar section extends away from the connection portion along a direction substantially opposite to the first direction.</i>
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As shown below in Teng's Figure 1 (annotated below), one of Tran+Teng's *planar section* (green below) extends away from the *connection portion* (red) along the direction indicated by the green arrow, which is *substantially opposite to the first direction* (blue arrow, discussed *supra* §VI.D.23, claim 29). Pozar, ¶221.



25. Claim 31

Claim 31 is an independent claim that has many limitations that are identical or substantially similar to limitations in claim 1. Below, Petitioners rely on the showing for claims 1 and 13 to meet the identical or substantially similar

limitations and then address any limitations of claim 31 that are not in claims 31-45.

a. Limitations [31PRE]-[31I], [31M]

Tran+Teng meets the following limitations of claim 31 for the same reasons
Tran+Teng meets the same limitations in claim 1 as identified below. EX1034, 6-8; Pozar, ¶223.

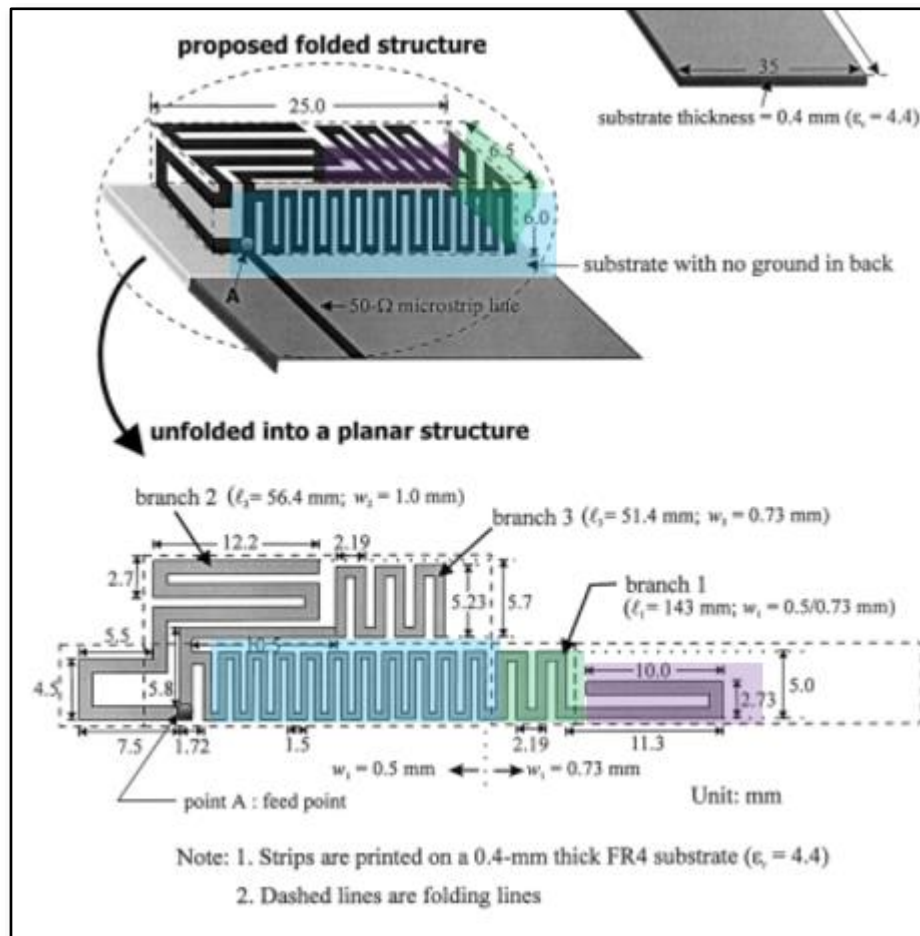
Limitation	Corresponding limitation	Discussion (<i>supra</i>)
[31PRE]	[1PRE]	§VI.D.1.a
[31A]	[1A]	§VI.D.1.b
[31B]	[1B]	§VI.D.1.c
[31C]	[1C]	§VI.D.1.d
[31D]	[1D]	§VI.D.1.e
[31E]	[1E]	§VI.D.1.f
[31F]	[1F]	§VI.D.1.g
[31G]	[1G]	§VI.D.1.h
[31H]	[13A]	§VI.D.12.a
[31I]	[1G]-[1J]	§§VI.D.1.h ([1G])- VI.D.1.k ([1J])
[31M]	[1M]	§VI.D.1.n

b. Limitations [31J]

31J	<i>wherein the antenna element comprises a first radiating arm arranged on two or more surfaces of the plurality of surfaces of the dielectric mounting structure;</i>
-----	--

Tran+Teng's antenna element comprises Branch 1 (*first radiating arm*) arranged on multiple surfaces of the rectangular structure as discussed *supra* §§VI.D.1.j ([1I]), VI.D.1.l ([1K]).

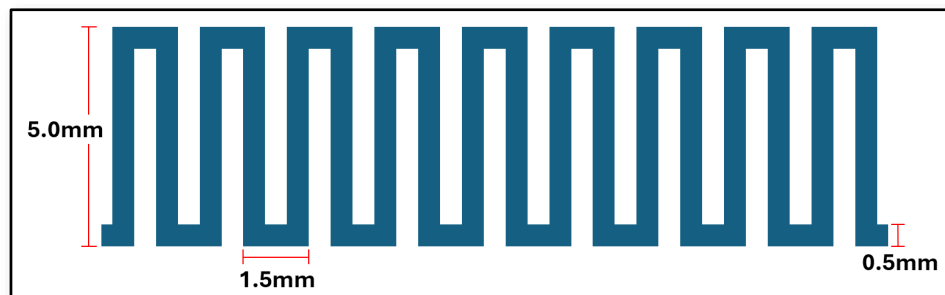
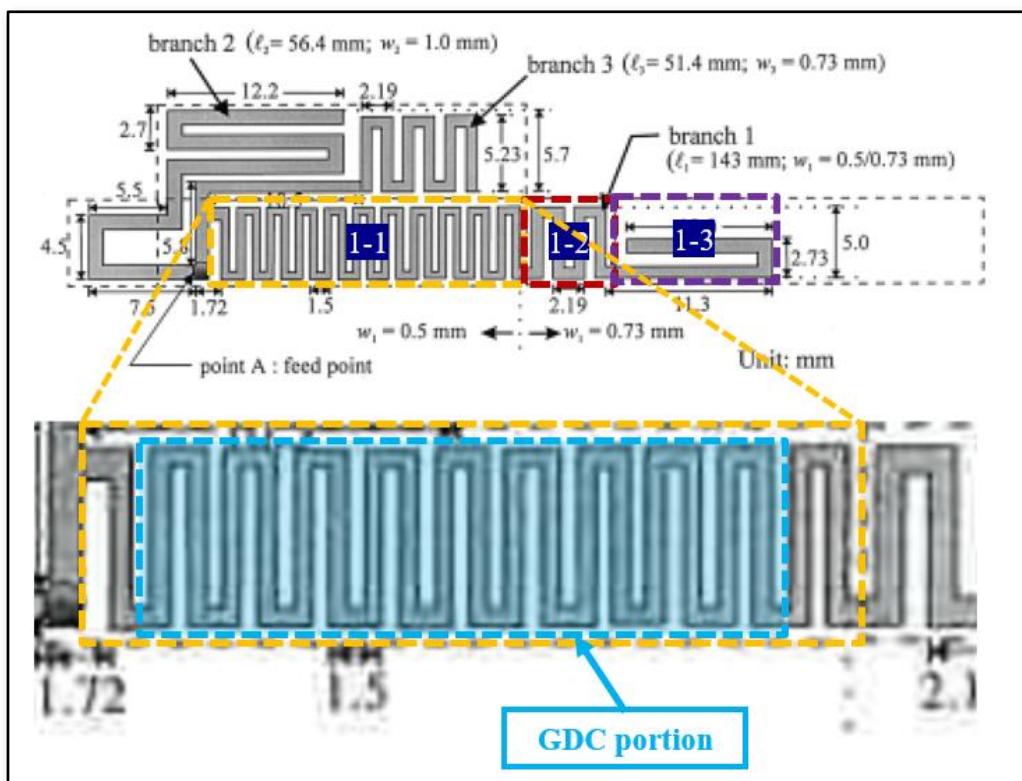
Teng's Figure 1 (annotated below) shows that in the rectangular ("folded") structure used in Tran+Teng's mobile device, Branch 1 (*first radiating arm*) is arranged on two or more surfaces of the plurality of surfaces of the dielectric mounting structure because Branch 1 is arranged on the front (blue), right (green) and back (purple) surfaces of the rectangular structure in Figure 1. Pozar, ¶¶224-225.



c. Limitation [31K]

31K	<i>the first radiating arm comprising: a first section shaped according to a grid-dimension curve;</i>
-----	--

Tran+Teng's *first radiating arm* (Branch 1) comprises a GDC portion (*first section*) that is *shaped according to a grid-dimension curve* as explained *supra* §VI.D.1.m ([1L]) and shown below.

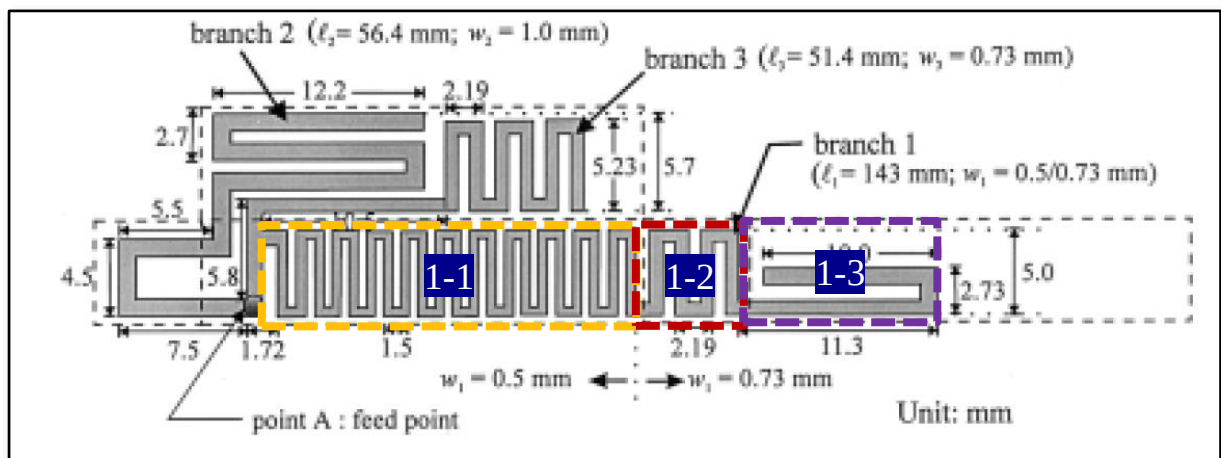


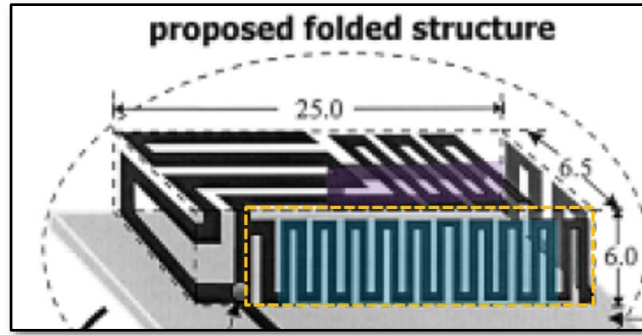
d. Limitation [31L]

31L	<i>[the first radiating arm comprising:] a second section connected to the grid-dimension section, the second section having a width different from a width of the first section; and</i>
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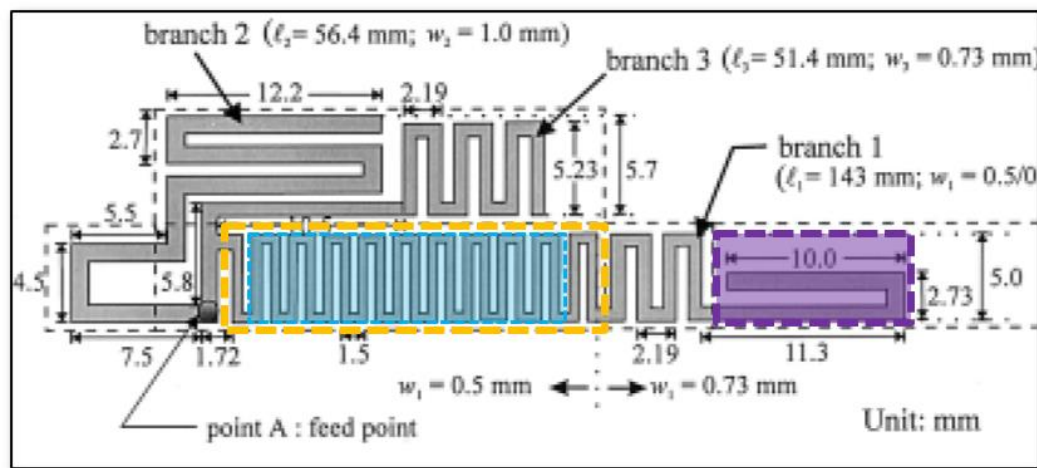
There is no precise antecedent for “the grid-dimension section” in claim 31, but there is a “first section shaped according to a grid-dimension curve” (Limitation [31L]) so Limitation [31M]’s reference to “the grid-dimension section” refers to the “first section shaped according to a grid-dimension curve” (e.g., GDC portion) in Limitation [31L].

Tran+Teng’s Branch 1 (*first radiating arm*) comprises a portion labelled 1-3 below (*second section*), bounded by a fold line and representing the portion of Branch 1 disposed on the rear of the rectangular box. *Supra* §VI.D.1.m ([1L]); Teng, Fig. 1 (annotated detail below), 23-24.





Branch 1-3 (*second section*, purple below) physically and electrically connects to the GDC portion of Branch 1-1 (*first section*, blue below). *Supra* §VI.D.25.c ([31K]); Teng, Fig. 1 (annotated detail below). Pozar, ¶¶227-229.



The '365 patent makes a single reference to “width” in referring to “conductor plates/parasitic plane reflectors of antennas” (EX1001, 9:58-64) but never explains what “width” refers to.

Table 1 summarizes GDC portion (*first section*) parameters—with 0.5mm width, 5.0mm height, and 18.0mm lateral extent (9 repetitions of a 2.0mm cell)—

that **differ in every dimension** from Branch 1-3 (*second section*) parameters.

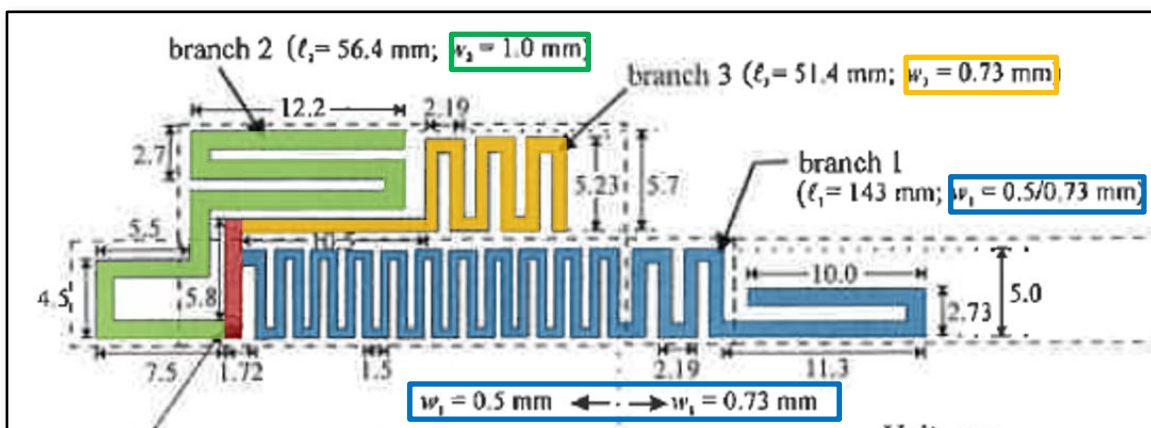
Supra §VI.D.1.m ([1L]); Teng, Fig. 1; Pozar, ¶231.

Table 1

Section	trace width (mm)	height (mm)	lateral extent (mm)
GDC portion	0.5	5.0	18.0
Branch 1-3	0.73	2.73	<11.3

Thus, **no matter which parameter** is deemed a “width” the GDC portion (*first section*) value **is different** from a Branch 1-3 (*second section*) value, meeting [31L]. Pozar, ¶¶230-232.

Regardless, when describing branches (as recited in [31L]) Teng uses “width” as the strip width (e.g., Teng’s w_1 , w_2 , w_3) for each segment printed on the substrate to form the branch meandering patterns. Teng, Fig. 1 (annotated detail below), 23; Pozar, ¶233.



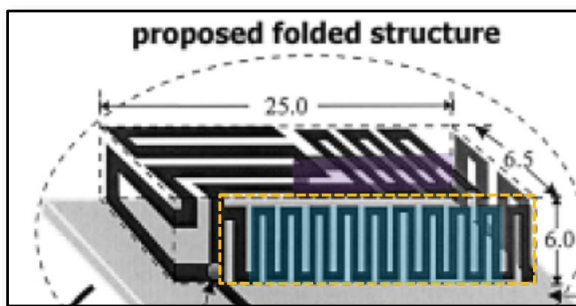
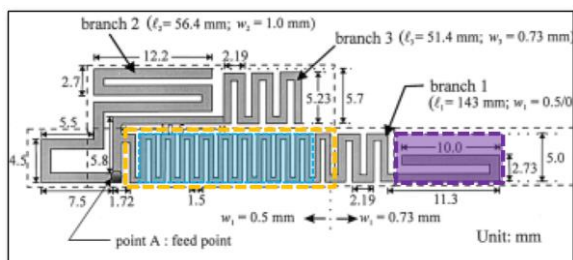
Given that the '365 patent does not redefine the term “width” to give it any other meaning, the term “width” should be given its plain meaning as used in the prior art so Teng’s explicit reference to a “strip width” meets the claimed *first*

radiating arm “width,” and thus meets [31L], as demonstrated in the “trace width” column in Table 1 above. Pozar, ¶234.

26. Claim 32

32	[Claim 31’s device], wherein the first section is arranged on a first surface of said plurality of surfaces; and wherein the second section is arranged on a second surface of said plurality of surfaces, the second surface being different from the first surface.
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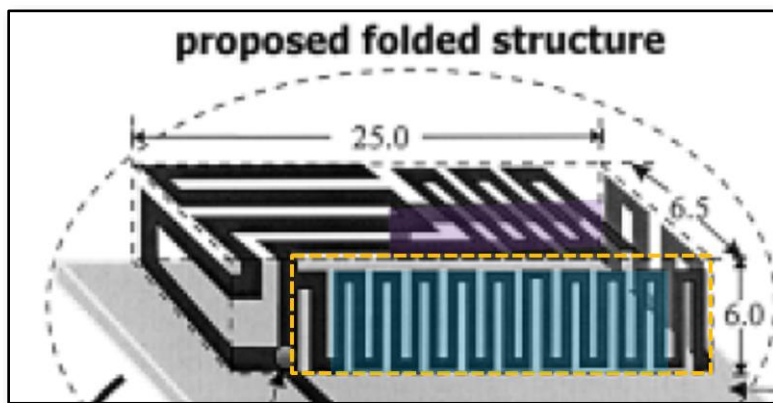
Tran+Teng’s first section (blue) is arranged on a first surface and second section (purple) is arranged on a second (different) surface (the rear-facing surface of the rectangular dielectric mounting structure), as shown in Teng’s Figure 1 (annotated detail below), wherein the rectangular box encloses the dielectric as explained *supra* §VI.D.12.a ([13.A]). Pozar, ¶235. Each branch is printed on FR4 (dielectric mounting structure) comprising a surface, and in the alternative, a POSA would have mounted the folded structure on a foam core. *Supra* §VI.D.12.a ([13A]).



27. Claim 33

33	[Claim 32's device], wherein the <i>first surface</i> and the <i>second surface</i> are <i>opposite surfaces</i> of the <i>dielectric mounting structure</i> .
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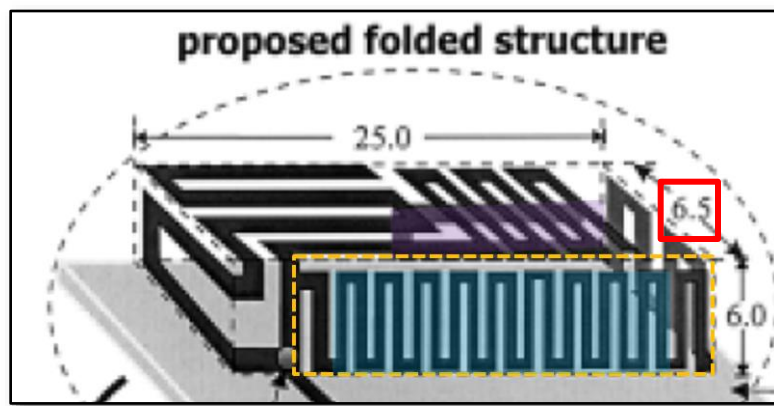
As shown *supra* §VI.D.26 (claim 32), the GDC portion (*first section*, blue) and Branch 1-3 (*second section*, purple) are disposed on a *first/second surface*, respectively, that are *opposite surfaces* of Tran+Teng's rectangular box. As explained *supra* §§VI.D.12.a ([13A]), VI.D.25.a ([31H]), the box (folded FR4 or the foam core) is a *dielectric mounting structure*. Pozar, ¶236.



28. Claim 34

34	[Claim 33's device], wherein the first surface and the second surface are substantially parallel surfaces spaced by a predetermined distance.
----	---

As shown *supra* §VI.D.26 (claim 32), Tran+Teng's first and second surfaces are substantially parallel because they are opposing sides of a rectangular box, and are spaced apart by a predetermined distance (the 6.5mm length rectangular dielectric mounting structure sides). Pozar, ¶237.



29. Claim 35

35	[Claim 31's device], wherein the first section extends along a first direction and the second section extends along a second direction, the second direction being different from the first direction.
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The '365 patent describes antenna sections as “extend[ing]” “from” or “towards” **a common reference point**, i.e., the “common conductor” to which radiating arms are connected. EX1001, 3:1-10.

Claims 29-30 recite language—similar to claim 35—that the first radiating arm **extends along a first direction**, the second radiating arm **extends along a**

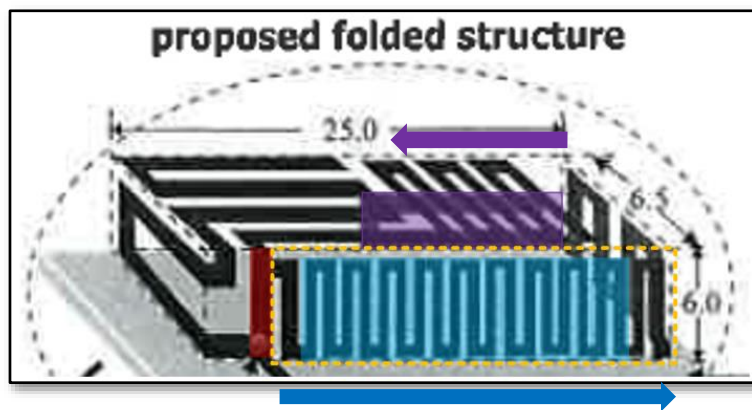
second direction and a section extends along a direction opposite to the first direction, and—like the specification—claims 29-30 identify a common conductor as a frame of reference for determining what direction an antenna section extends.

Claim 36 depends from claim 35 and recites “*the second direction is substantially opposite to the first direction.*” So pursuant to claim 35, the first and second directions are “*different*” and pursuant to claim 36 the first and second directions can be “*substantially opposite.*”

But neither claim 35 nor claim 36 identify any frame of reference to determine ***which direction*** an antenna segment extends—e.g., for two straight segments between points A and B, whether each segment extends (1) from A to B; (2) from B to A; or (3) each in a mutually opposite direction. Nothing in claims 35-36 determines which “*direction*” such a section can be considered to extend.

In view of the foregoing, it is appropriate in interpreting claim 35 (and claim 36 that depends therefrom) to choose a frame of reference for the antenna sections and then apply that frame of reference consistently to the first and second sections to determine whether they extend in “*different*” (claim 35) and “*opposite*” (claim 36) directions. In mapping claims 35-36 to Tran+Teng below, Petitioners choose the common conductor to which radiating arms are connected because that is the frame of reference described in the specification (EX1001, 3:1-10) and recited in other claims (claims 29-30). Pozar, ¶¶238-242.

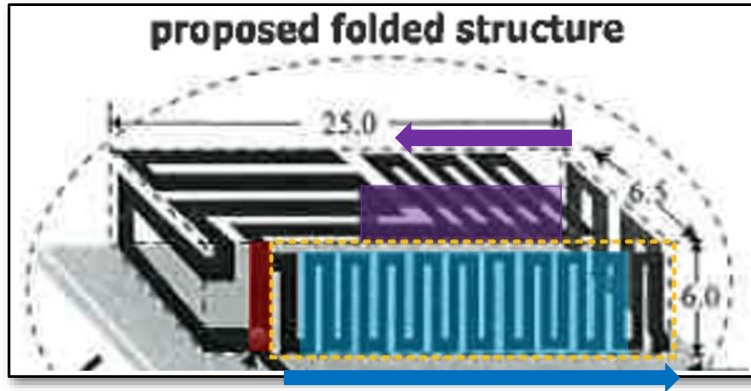
The common conductor in Tran+Teng's antenna is highlighted red in Teng Figure 1 annotated below. In the folded monopole Tran+Teng's *first section* (blue GDC portion) *extends along a first direction* (blue arrow) **away from** the common conductor (red) *and the second section* (purple) *extends along a second (different) direction* (purple arrow) **towards** the common conductor, as shown in Teng's Figure 1 (annotated below). That meets claim 35. Pozar, ¶243.



30. Claim 36

36	[Claim 35's device], wherein the second direction is substantially opposite to the first direction.
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Tran+Teng's *second direction* (purple arrow) is *substantially opposite to the first direction* (blue arrow) when both are considered relative to the common conductor, as shown in Teng's Figure 1 (annotated below). *Supra* §VI.D.29 (claim 35); Pozar, ¶244.



31. Claim 37

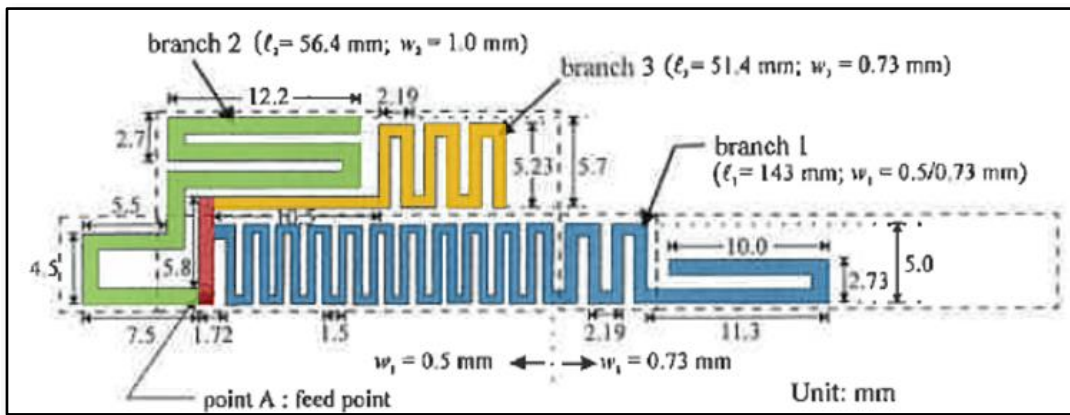
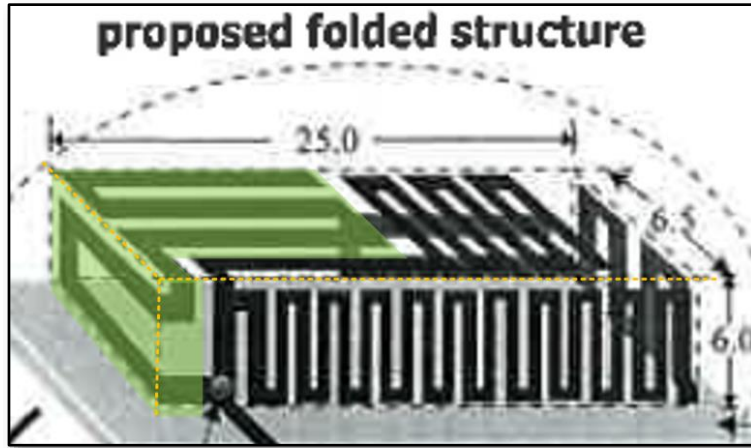
a. Limitation [37A]

Claim 37 depends from claim 31. Tran+Teng meets the additional limitations in [37A] for the reasons it meets Limitation [1I]. *Supra* §VI.D.1.j ([1I]); Teng, Fig. 1, 23; Pozar, ¶245.

b. Limitation [37B]

37B	<i>wherein the second radiating arm is arranged on at least one surface of the plurality of surfaces of the dielectric mounting structure.</i>
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Tran+Teng's Branch 2 (*second radiating arm*; green below) is arranged on three (*at least one*) surface[s] of the plurality of surfaces of the dielectric mounting structure – the foreground face of the rectangular structure, the left-hand side of the rectangular structure, and the top surface of the rectangular structure in Figure 1. *Supra* §VI.D.12.b ([13B]); Teng, Fig. 1 (annotated detail below); Pozar, ¶246.

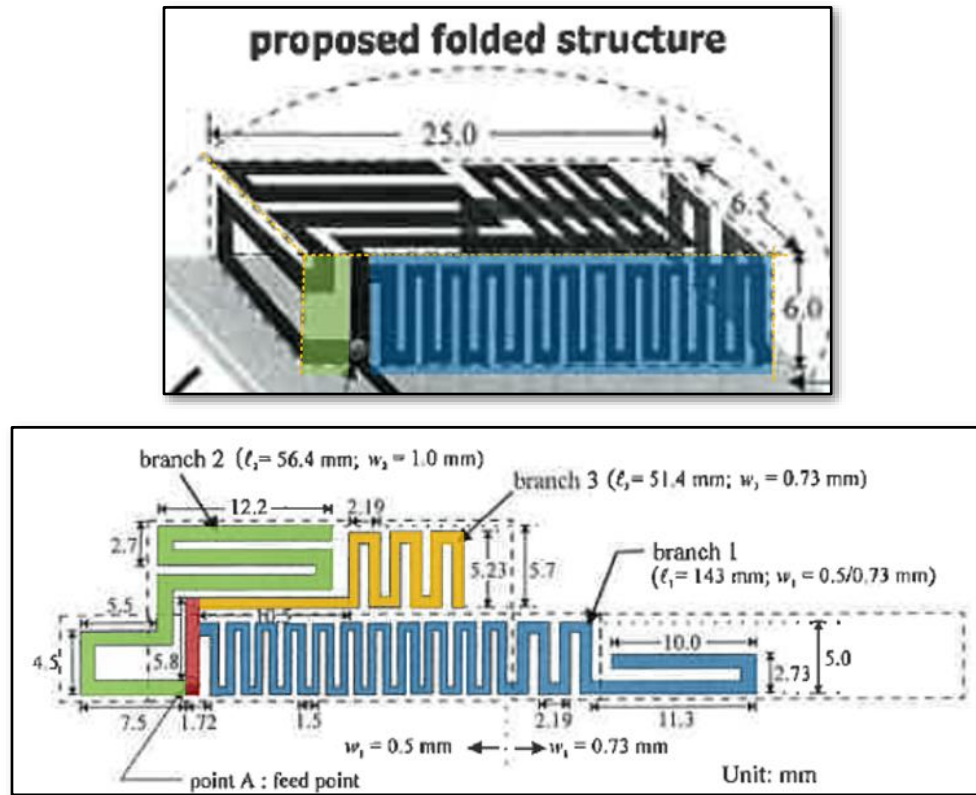


32. Claim 38

Claim 38 depends from claim 37 and recites “*wherein said at least one surface is one of the two or more surfaces on which the first radiating arm is arranged,*” where claim 37’s *at least on surface on which the second radiating arm is arranged* is the antecedent for “*said at least one surface.*”

Tran+Teng meets claim 38 because Branch 2 (*second radiating arm*) is disposed on the foreground face of the rectangular box enclosing the dielectric mounting structure, where a portion of Branch 1 (*first radiating arm*) is also

“arranged.” *Supra* §VI.D.31 (claim 37); Teng, Fig. 1 (annotated detail below); Pozar, ¶¶247-248.



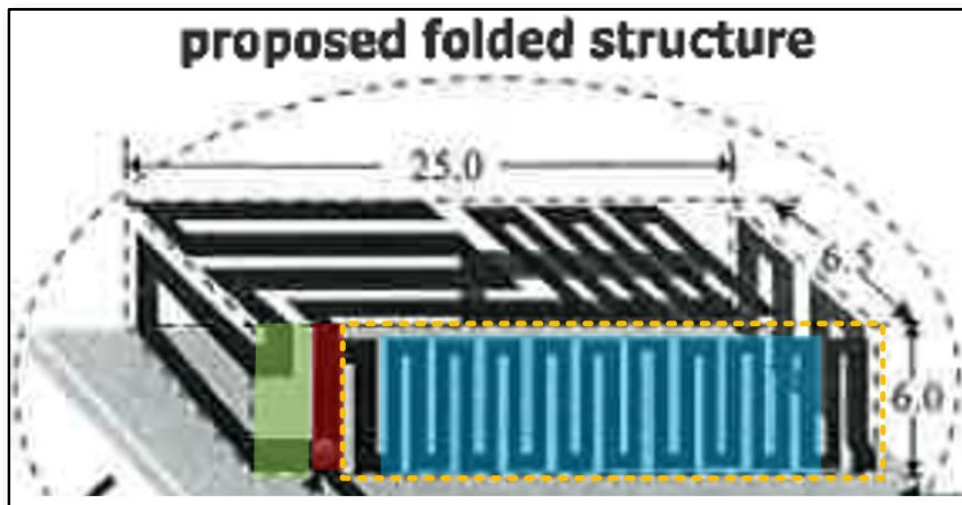
33. Claim 39

Claim 39 depends from claim 38 and recites “*wherein the first section of the first radiating arm is arranged on said at least one surface, so that said first section and the second radiating arm are on a common surface of the plurality of surfaces of the dielectric mounting structure.*”

The *first section* of Tran+Teng’s *first radiating arm* is Branch 1’s GDC portion (blue below), *supra* §VI.D.25 (claim 31), while Branch 2 (green below) is the *second radiating arm*, *supra* §VI.D.32 (claim 38), and both are “arranged” on

the same foreground surface of the rectangular dielectric mounting structure.

Teng, Fig. 1 (annotated detail below); Pozar, ¶¶249-250.



34. Claim 40

Claim 40 depends from claim 37 and recites “*wherein the second radiating arm has a uniform width.*” Tran+Teng’s Branch 2 (*second radiating arm*) has a *uniform width* of 1.0mm. Teng, Fig. 1, 23-24; *supra* §VI.D.25.d ([31L], discussing “width”); Pozar, ¶251.

35. Claims 41-42

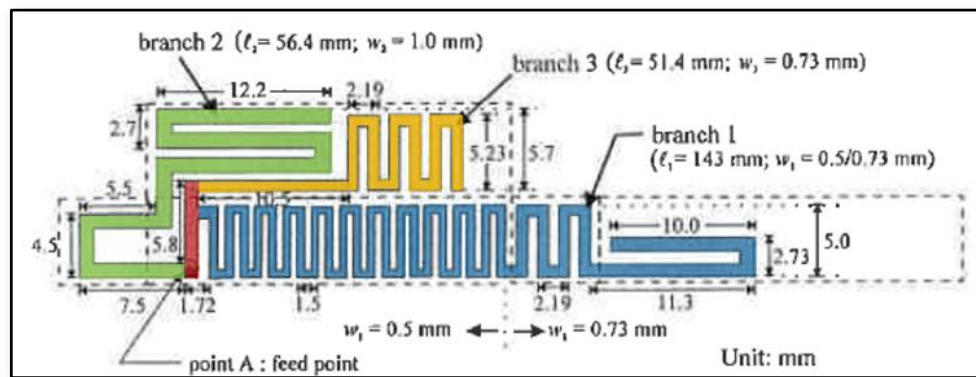
Tran+Teng meets the additional limitations in claims 41-42 for the reasons it meets the corresponding limitations below. EX1034, 9; Pozar, ¶252.

Limitation	Corresponding limitation	Discussion (<i>supra</i>)
41	12	§0
42	[5A]	§VI.D.5.a

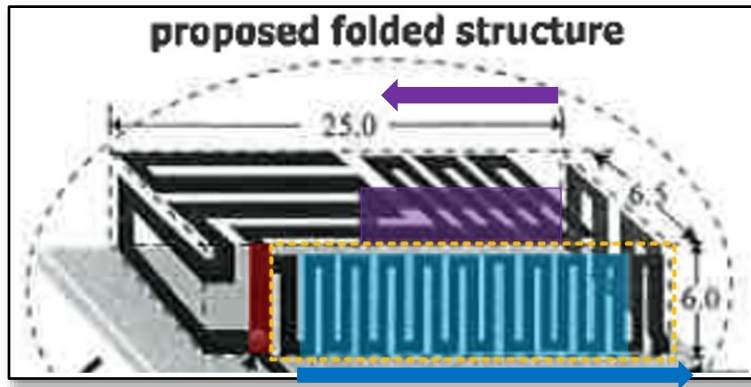
36. Claim 44

44	<i>The mobile communication device according to claim 37,</i> <i>wherein the first section of the first radiating arm is connected to the common conductor and extends away from the common conductor along a first direction;</i> <i>wherein the second section of the first radiating arm is connected to the first section and extends along a second direction; and</i> <i>wherein the second radiating arm extends away from the common conductor along a direction substantially opposite to the second direction.</i>
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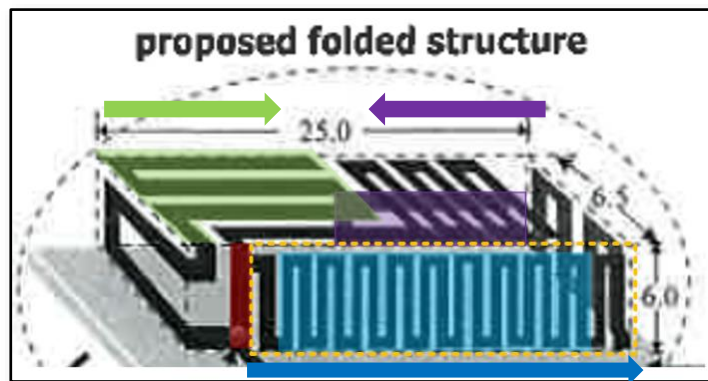
Tran+Teng's first radiating arm (blue) and second radiating arm (green) are connected to the common conductor (red). *Supra* §§VI.D.31.a ([37A]), VI.D.1.j ([1I]); Teng, Fig. 1 (annotated detail below).



As explained *supra* §VI.D.29 (claim 35), the *first section* of the *first radiating arm* (blue below) *extends* along the *direction* indicated by the blue arrow, which is *away from the common conductor along a first direction* and the *second section* of the *first radiating arm* (purple below) *extends* along a *second direction* indicated by the purple arrow.



As also shown below, the *second section is connected to the first section* because they are both part of the same conducting strip that comprises Tran+Teng's Branch 1 (*first radiating arm*), and the portion of Tran+Teng's Branch 2 (*second radiating arm*) highlighted green below *extends away from the common conductor along a direction* indicated by the green arrow, which is *substantially opposite to the second direction* (purple arrow). Thus, Tran+Teng meets claim 44. Pozar, ¶¶253-255.



37. Claim 45

45	[Claim 31’s device], wherein the mobile communication device operates as one of a personal digital assistant and a cellular telephone.
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As discussed *supra* §§VI.C-V.D.1.a, Tran+Teng’s device operates as a “**mobile cellular... phone[]**.” Tran, 1:23-28; *see also* Teng, 22-23. By the early 2000s, it was also conventional and beneficial to have one device that operated both as a cellular telephone and *personal digital assistant*, to offer PDA functionality (e.g., email and calendar applications) along with voice calls. Pozar, ¶256 (citing corroboration EX1033, 1:14-31; Tran, 14:54-60 (implementing its antenna in “a portable computer, data terminal,... or the like”).

VII. *SOTERA*

Petitioners stipulate that if IPR is instituted on this Petition they will not pursue in the Texas Litigation any ground raised or that reasonably could have been raised in IPR. *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12, 18-19 (Dec. 1, 2020) (precedential as to §II.A).

VIII. DISCRETIONARY DENIAL IS UNWARRANTED

There is no basis for discretionary denial. Petitioners rely on the Director’s March 26, 2025 Memorandum concerning Interim Processes for PTAB Workload

Management⁵ and the Board’s guidance concerning “the new interim processes relating to institution in AIA proceedings”⁶ wherein “the Director... will determine whether discretionary denial of institution is appropriate” in separate briefing filed after a Notice of Filing Date Accorded.

Petitioners reserve the right to respond to any Patent Owner discretionary denial arguments in opposition briefing under the March 26, 2025 Interim Process.

⁵ Available at <https://www.uspto.gov/sites/default/files/documents/InterimProcesses-PTABWorkloadMgmt-20250326.pdf> (visited April 30, 2025).

⁶ FAQ, available at <https://www.uspto.gov/patents/ptab/faqs/interim-processes-workload-management> (visited April 30, 2025); USPTO Boardside Chat (Apr. 17, 2025), available at <https://www.uspto.gov/about-us/events/learn-about-new-interim-processes-relating-institution-aia-proceedings> (visited April 30, 2025).

IX. CONCLUSION

The Petition demonstrates a reasonable likelihood that at least one Challenged Claim is not patentable. Accordingly, the Board should institute IPR and cancel claims 1-42 and 44-45.

Respectfully submitted,
Geotab Inc. and Geotab USA, Inc.

Dated: April 30, 2025

By: /Adam R. Wichman/
Adam R. Wichman, Reg. #43,988
WOLF, GREENFIELD & SACKS, P.C.

APPENDIX A: U.S. PATENT NO. 8,456,365 CLAIM LIST

Ref	Limitation
[1PRE]	A mobile communication device, comprising:
[1A]	a device housing;
[1B]	a printed circuit board,
[1C]	the printed circuit board comprising: a ground plane layer;
[1D]	a feeding point;
[1E]	a communication circuitry, the communication circuitry being mounted on the printed circuit board;
[1F]	wherein the communication circuitry is coupled to the feeding point and to the ground plane layer;
[1G]	a multi-band antenna capable of operating at multiple frequency bands, the multi-band antenna including an antenna element;
[1H]	wherein the antenna element operates in cooperation with the ground plane layer;
[1I]	the antenna element comprising: a common conductor; a first radiating arm connected to the common conductor; a second radiating arm connected to the common conductor;
[1J]	wherein the common conductor includes a feeding port, the feeding port being coupled to the feeding point;
[1K]	wherein at least a portion of the first radiating arm and at least a portion of the second radiating arm are arranged on different planes;
[1L]	wherein the first radiating arm is at least partially shaped according to a grid-dimension curve; and
[1M]	wherein the printed circuit board, the communication circuitry, and the multi-band antenna are arranged inside the device housing.
[2A]	The mobile communication device according to claim 1, wherein the first radiating arm comprises a first plurality of segments;
[2B]	wherein each segment of the first plurality of segments is smaller than 1/10 of a lowest operating free-space wavelength of the multi-band antenna;

Ref	Limitation
[2C]	wherein the segments are spatially arranged such that each pair of adjacent segments forms a corner; and
[2D]	wherein no two adjacent and connected segments form another longer straight segment; and
[2E]	wherein none of said segments intersect with another segment other than to form a closed loop.
3	The mobile communication device according to claim 2, wherein the first plurality of segments comprises at least one curved segment.
4	The mobile communication device according to claim 2, wherein the first plurality of segments comprises at least ten segments.
[5A]	The mobile communication device according to claim 2, wherein the second radiating arm comprises a second plurality of segments;
[5B]	wherein each segment of the second plurality of segments is smaller than 1/10 of a lowest operating free-space wavelength of the multi-band antenna;
[5C]	wherein the segments are spatially arranged such that each pair of adjacent segments forms a corner; and
[5D]	wherein no two adjacent and connected segments form another longer straight segment; and
[5E]	wherein none of said segments intersect with another segment other than to form a closed loop.
6	The mobile communication device according to claim 5, wherein the first plurality of segments comprises more segments than the second plurality of segments.
7	The mobile communication device according to claim 1, wherein the grid-dimension curve has a grid dimension larger than 1.3.
8	The mobile communication device according to claim 1, wherein the grid-dimension curve has a grid dimension larger than 1.5.
9	The mobile communication device according to claim 1, wherein the second radiating arm is at least partially shaped according to a second grid-dimension curve.

Ref	Limitation
10	The mobile communication device according to claim 9, wherein the grid-dimension curve and the second grid-dimension curve have different lengths.
11	The mobile communication device according to claim 9, wherein the grid-dimension curve and the second grid-dimension curve have different grid dimensions.
12	The mobile communication device according to claim 1, wherein an orthogonal projection of a footprint of the antenna element on a plane of the printed circuit board overlaps the ground plane layer in less than 50% of an area of said footprint.
[13A]	The mobile communication device according to claim 1, comprising: a dielectric mounting structure having a plurality of surfaces;
[13B]	wherein at least a portion of the first radiating arm is arranged on a first surface of said plurality of surfaces; and wherein at least a portion of the second radiating arm is arranged on a second surface of said plurality of surfaces, the second surface being different from the first surface.
14	The mobile communication device according to claim 13, wherein the first surface and the second surface are opposite surfaces of the dielectric mounting structure.
[15PRE]	A mobile communication device, comprising:
[15A]	a device housing;
[15B]	a printed circuit board,
[15C]	the printed circuit board comprising: a ground plane layer;
[15D]	a feeding point;
[15E]	a communication circuitry, the communication circuitry being mounted on the printed circuit board;
[15F]	wherein the communication circuitry is coupled to the feeding point and to the ground plane layer;
[15G]	a multi-band antenna capable of operating at multiple frequency bands, the multi-band antenna including an antenna element;
[15H]	wherein the antenna element is coupled to the feeding point and operates in cooperation with the ground plane layer;

Ref	Limitation
[15I]	the antenna element comprising: a first conductor, the first conductor comprising a first radiating arm having a grid-dimension section shaped according to a grid-dimension curve;
[15J]	a second conductor arranged at a predetermined distance from the first conductor and electromagnetically coupled to the first conductor,
[15K]	the second conductor comprising a planar section; and
[15L]	wherein the printed circuit board, the communication circuitry, and the multi-band antenna are arranged inside the device housing.
16	The mobile communication device according to claim 15, wherein the first conductor and the second conductor are electrically connected.
17	The mobile communication device according to claim 16, wherein the antenna element comprises a connecting portion that connects the first radiating arm and the planar section.
18	The mobile communication device according to claim 17, wherein a width of the grid-dimension section is smaller than a width of the planar section.
19	The mobile communication device according to claim 15, wherein the grid-dimension curve features a grid dimension larger than 1.3.
[20A]	The mobile communication device according to claim 15, wherein the grid-dimension curve comprises at least ten connected segments;
[20B]	wherein said segments are each smaller than 1/10 of a lowest operating free-space wavelength of the multi-band antenna;
[20C]	wherein the segments are spatially arranged such that no two adjacent and connected segments form another longer straight segment;
[20D]	wherein none of said segments intersect with another segment other than to form a closed loop;
[20E]	wherein each pair of adjacent segments forms a corner; and
[20F]	wherein any portion of the grid-dimension curve that is periodic along a fixed straight direction of space is defined by a non-periodic curve that includes at least ten connected segments in which no two adjacent and connected segments define a straight longer segment.

Ref	Limitation
21	The mobile communication device according to claim 15, wherein the multi-band antenna comprises: a dielectric mounting structure having a plurality of surfaces; wherein at least a portion of the first radiating arm is arranged on a first surface of said plurality of surfaces; and wherein at least a portion of the second conductor is arranged on a second surface of said plurality of surfaces, the second surface being different from the first surface.
22	The mobile communication device according to claim 21, wherein the grid-dimension section is arranged on the first surface; and wherein the planar section is arranged on the second surface.
23	The mobile communication device according to claim 21, wherein the first surface and the second surface are two opposite surfaces of the dielectric mounting structure.
24	The mobile communication device according to claim 21, wherein the first surface and the second surface are substantially parallel.
25	The mobile communication device according to claim 15, wherein the antenna element further comprises: a common conductor; a second radiating arm connected to the common conductor; and wherein the first radiating arm is connected to the common conductor.
26	The mobile communication device according to claim 25, wherein the second radiating arm comprises a substantially straight section.
27	The mobile communication device according to claim 25, wherein the second radiating arm comprises a second grid-dimension section, the second grid-dimension section being shaped according to a second grid-dimension curve.
28	The mobile communication device according to claim 25, wherein the second radiating arm and the grid-dimension section of the first radiating arm lie on a common surface.
29	The mobile communication device according to claim 25, wherein the grid-dimension section of the first radiating arm extends away from the common conductor along a first direction; and wherein the second radiating arm extends away from the common conductor along a second direction, the second direction being substantially parallel to the first direction.

Ref	Limitation
[30A]	The mobile communication device according to claim 29, wherein the antenna element comprises a connecting portion that connects the grid-dimension section and the planar section; and
[30B]	wherein the planar section extends away from the connection portion along a direction substantially opposite to the first direction.
[31PRE]	A mobile communication device, comprising:
[31A]	a device housing;
[31B]	a printed circuit board,
[31C]	the printed circuit board comprising: a ground plane layer;
[31D]	a feeding point;
[31E]	a communication circuitry, the communication circuitry being mounted on the printed circuit board;
[31F]	wherein the communication circuitry is coupled to the feeding point and to the ground plane layer;
[31G]	a multi-band antenna capable of operating at multiple frequency bands, the multi-band antenna including:
[31H]	a dielectric mounting structure having a plurality of surfaces;
[31I]	an antenna element, the antenna element being coupled to the feeding point and operating in cooperation with the ground plane layer;
[31J]	wherein the antenna element comprises a first radiating arm arranged on two or more surfaces of the plurality of surfaces of the dielectric mounting structure;
[31K]	the first radiating arm comprising: a first section shaped according to a grid-dimension curve;
[31L]	a second section connected to the grid-dimension section, the second section having a width different from a width of the first section; and
[31M]	wherein the printed circuit board, the communication circuitry, and the multi-band antenna are arranged inside the device housing.

Ref	Limitation
32	The mobile communication device according to claim 31, wherein the first section is arranged on a first surface of said plurality of surfaces; and wherein the second section is arranged on a second surface of said plurality of surfaces, the second surface being different from the first surface.
33	The mobile communication device according to claim 32, wherein the first surface and the second surface are opposite surfaces of the dielectric mounting structure.
34	The mobile communication device according to claim 33, wherein the first surface and the second surface are substantially parallel surfaces spaced by a predetermined distance.
35	The mobile communication device according to claim 31, wherein the first section extends along a first direction and the second section extends along a second direction, the second direction being different from the first direction.
36	The mobile communication device according to claim 35, wherein the second direction is substantially opposite to the first direction.
[37A]	The mobile communication device according to claim 31, wherein the antenna element further comprises: a common conductor; a second radiating arm; wherein each of the first radiating arm and the second radiating arm is connected to the common conductor; and
[37B]	wherein the second radiating arm is arranged on at least one surface of the plurality of surfaces of the dielectric mounting structure.
38	The mobile communication device according to claim 37, wherein said at least one surface is one of the two or more surfaces on which the first radiating arm is arranged.
39	The mobile communication device according to claim 38, wherein the first section of the first radiating arm is arranged on said at least one surface, so that said first section and the second radiating arm are on a common surface of the plurality of surfaces of the dielectric mounting structure.
40	The mobile communication device according to claim 37, wherein the second radiating arm has a uniform width.

Ref	Limitation
41	The mobile communication device according to claim 31, wherein an orthogonal projection of a footprint of the antenna element on a plane of the printed circuit board overlaps the ground plane layer in less than 50% of an area of said footprint.
42	The mobile communication device according to claim 37, wherein the second radiating arm comprises a plurality of segments.
43	The mobile communication device according to claim 37, wherein the second radiating arm is shaped according to a second grid-dimension curve.
44	The mobile communication device according to claim 37, wherein the first section of the first radiating arm is connected to the common conductor and extends away from the common conductor along a first direction; wherein the second section of the first radiating arm is connected to the first section and extends along a second direction; and wherein the second radiating arm extends away from the common conductor along a direction substantially opposite to the second direction.
45	The mobile communication device according to claim 31, wherein the mobile communication device operates as one of a personal digital assistant and a cellular telephone.

CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24, the undersigned certifies that the foregoing Petition for *Inter Partes* Review contains 13,482 words excluding a table of contents, a table of authorities, Mandatory Notices under § 42.8, a certificate of service or word count, or appendix of exhibits or claim listing. Petitioners have relied on the word count feature of the word processing system used to create this paper in making this certification.

Date: April 30, 2025

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CERTIFICATE OF SERVICE UNDER 37 C.F.R. § 42.6 (E)(4)

I certify that on April 30, 2025, a copy of the foregoing document, including any exhibits or appendices filed therewith, is being served via *Overnight FedEx* at the following correspondence address of record for the patent:

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