

Filed on behalf of Resmed Corp.

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

RESMED CORP.

Petitioner

v.

FRACTUS, S.A.,

Patent Owner.

Case No. IPR2026-00341

U.S. Patent No. 8,362,960

**Petition for *Inter Partes* Review of
U.S. Patent No. 8,362,960**

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1001	U.S. Patent No. 8,362,960 to Mumbru, et al. (“the ’960 Patent”)
1002	File History of U.S. Patent No. 8,362,960
1003	Declaration of Manos M. Tentzeris, Ph.D (“Tentzeris”)
1004	Curriculum Vitae of Manos M. Tentzeris, Ph.D
1005	U.S. Patent Pub. No. 2003/0193437 to Kangasvieri et al. (“Kangasvieri ”)
1006	U.S. Patent No. 6,195,048 to Chiba et al. (“Chiba”)
1007	U.S. Patent No. 6,909,402 to Vance (“Vance”)
1008	Karaboikis et al., “Compact Dual-Printed Inverted-F Antenna Diversity Systems for Portable Wireless Devices,” IEEE Antennas and Wireless Propagation Letters, Vol. 3 (2004)
1009	Inoue et al., “Pattern Calibration Free Antenna By Suppressing Mutual Coupling Between Elements,” Proceedings of ISAP’04, Sendai, Japan, 1A2-4 (2004)
1010	U.S. Patent No. 6,606,071 to Cheng (“Cheng”)
1011	U.S. Patent No. 6,424,300 to Stanford et al. (“Stanford ”)
1012	U.S. Patent No. 6,204,819 to Hayes et al.
1013	U.S. Patent No. 6,518,929 to Gilmore
1014	Canadian Patent No. CA 2312542 C to Gagnon

Exhibit No.	Description
1015	U.S. Patent No. 6,639,560 to Kadambi et al.
1016	U.S. Patent No. 7,109,923 to Ollikainen et al.
1017	Ciais et al., “Design of an Internal Quad-Band Antenna for Mobile Phones,” IEEE Microwave and Wireless Components Letters, Vol. 14, No. 2 (Apr. 2004), pp. 148–150
1018	“IBM Unveils First Biometric ThinkPad, Offering Security at Your Fingertips,” Phys.org (Oct. 4, 2004)
1019	Dialogue Flybook User’s Manual, Revision 1.02, Part No. DTC-FA33I-01-02 (2003)
1020	Wong et al., “Isolation between GSM/DCS and WLAN Antennas in a PDA Phone,” Microwave and Optical Technology Letters, Vol. 45, No. 4 (2005), pp. 347–352
1021	U.S. Patent Application Publication No. 2006/0082503 to Gaucher et al.
1022	U.S. Patent Application Publication No. 2004/0113848 to Gaucher et al.
1023	IEICE Proceedings Archive entry for Inoue et al., “Pattern Calibration Free Antenna by Suppressing Mutual Coupling Between Elements,” Proceedings of the 2004 International Symposium on Antennas and Propagation (ISAP 2004), Session 1A2-4, listing publication date Aug. 18, 2004, Online ISSN 2188-5079, and DOI: 10.34385/proc.12.1A2-4, available at https://www.ieice.org/publications/proceedings/summary.php?expandable=12&iconf=ISAP&session_num=1A2&number=1A2-4&year=2004 .

Exhibit No.	Description
1024	Google Scholar Citation Record for Yuki Inoue et al., “Pattern Calibration Free Antenna by Suppressing Mutual Coupling Between Elements”
1025	Georgakopoulos et al., “Coupling Modeling and Reduction Techniques of Cavity-Backed Slot Antennas: FDTD Versus Measurements,” IEEE Transactions on Electromagnetic Compatibility, Vol. 43, No. 3, Aug. 2001, pp. 261–272
1026	Sievenpiper et al., “High-Impedance Electromagnetic Surfaces with a Forbidden Frequency Band,” IEEE Transactions on Microwave Theory and Techniques, Vol. 47, No. 11, Nov. 1999, pp. 2059–2074.
1027	U.S. Patent No. 6,961,545 to Tehrani et al.
1028	Complaint, <i>Fractus, S.A., v. Resmed Corp.</i> , 3:25-cv-02680-LL-JLB (S.D. Cal.).
1029	Declaration of Dr. Ingrid Hsieh-Yee
1030	Yang et al., “Microstrip Antennas Integrated With Electromagnetic Band-Gap (EBG) Structures: A Low Mutual Coupling Design for Array Applications,” 51 IEEE Trans. Antennas & Propagation 2936 (2003).
1031	Constantine A. Balanis, <i>Antenna Theory: Analysis and Design</i> , (3d ed. 2005) (excerpt).

I. INTRODUCTION

Resmed Corp. (“Petitioner”) respectfully requests *inter partes* review of claims 1, 2, 3, 4, 5, 6, 7, 19, and 20 (“the challenged claims”) of U.S. Patent No. 8,362,960 (Ex. 1001, “the ’960 patent”) assigned to Fractus, S.A. (“Patent Owner” or “PO”). The Examiner allowed the ’960 patent after concluding the claimed orthogonal antenna layout was a dispositive feature of novelty. Unfortunately, as the prosecution record shows, this conclusion was reached after only a cursory search process that did not involve meaningful evaluation of the relevant prior art, and, therefore, overlooked that orthogonal antenna arrangements were already well known. Indeed, Figure 2 of the ’960 patent itself depicts a conventional two-antenna system with an orthogonal antenna arrangement that is clearly labeled “PRIOR ART.” Moreover, U.S. Patent Publication No. 2003/0193437 to Kangasvieri et al. (“Kangasvieri,” Ex. 1005), which was cited in an Information Disclosure Statement during prosecution, clearly disclose orthogonal antenna arrangements in a two-antenna system. Although Kangasvieri does not disclose the three frequency band limitation of the challenged claims, as the Examiner found, this limitation was already in the prior art. Indeed, implementing the first antenna of Kangasvieri to operate in at least three frequency bands would have been a straightforward combination of well-known technologies, such as Chiba’s multi-band PIFA, with predictable results and would have arisen from the known industry demand for

supporting multiple communication standards within limited space constraints. For the reasons below, the challenged claims should be found unpatentable and canceled.

II. MANDATORY NOTICES

A. Real Parties-in-Interest

Pursuant to 37 C.F.R. § 42.8(b)(1), Petitioner identifies the following as the real parties-in-interest: Resmed Corp.

Petitioner further identifies Resmed Inc. (the parent of Resmed Corp.) as a previously named defendant in the parallel litigation, which has now been dismissed. Petitioner makes this identification without conceding that Resmed Inc. is, in fact, a real party-in-interest.

B. Related Matters

U.S. Patent Office records indicate that the '960 patent is assigned to Fractus S.A., ("PO"), which is currently asserting the '960 patent in the following concurrent litigation filed on February 5, 2025: *Fractus, S.A. v. Resmed Inc. and Resmed Corp.*, 3:25-cv-02680-LL-JLB (S.D. Cal.).

U.S. Patent No. 11,031,677 is also asserted in the Parallel Litigation and is subject to the instituted IPR2025-01026 and its copycat IPR2026-00191.

C. Notice of Counsel and Service Information

Petitioner provides the following designation of counsel:

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Pursuant to 37 C.F.R. § 42.10(b), a Power of Attorney accompanies this petition. Petitioner consents to electronic service by e-mail.

D. Fee for *Inter Partes* Review

The Director is authorized to charge the fee specified by 37 C.F.R. § 42.15(a) to Deposit Account 50-2613.

III. GROUNDS FOR STANDING

Petitioner certifies pursuant to 37 C.F.R. § 42.104(a) that the '960 patent is available for *inter partes* review and that Petitioner is not barred or estopped from requesting an *inter partes* review challenging the patent claims on the grounds identified in this Petition.

IV. IDENTIFICATION OF CHALLENGES

Ground	Claims	Basis	References
1	1, 2, 3, 4, 19, and 20	§ 103	Kangasvieri (Ex. 1005) and Chiba (Ex. 1006)
2	5, 6	§ 103	Kangasvieri, Chiba, and Inoue (Ex. 1009)
3	7	§ 103	Kangasvieri, Chiba, and Vance (Ex. 1007)

The '960 patent issued from a continuation application of U.S. Patent Application No. 11/988,888, filed on September 30, 2008, which is a national-stage filing of International Patent Application No. PCT/EP2006/007050, filed on July 18, 2006. The PCT application claims priority to European Patent Application No. EP 05106694.2, filed on July 21, 2005, and U.S. Provisional Patent Application No. 60/702,205, filed on July 25, 2005. Ex. 1001, 1:8-22. For purposes of this proceeding only, Petitioner assumes, without conceding, that the earliest effective filing date of the '960 patent is July 21, 2005. Accordingly, pre-AIA law applies to the challenged claims.¹

¹ Regardless, even if pre-AIA law were deemed inapplicable, each reference relied upon in Grounds 1–3 qualifies as prior art under 35 U.S.C. § 102(a)(1) (AIA).

Kangasvieri was published on October 16, 2003. Ex. 1005, Cover. Chiba was issued on February 27, 2001. Ex. 1006, Cover. Thus, Kangasvieri and Chiba qualify as prior art at least under 35 U.S.C. § 102(b) (pre-AIA).

Vance was issued on June 21, 2005 from an application filed on June 11, 2003. Ex. 1007, Cover. Vance, therefore, qualifies as prior art at least under 35 U.S.C. §§ 102(a), (e) (pre-AIA). Ex. 1007, Cover.

Inoue was publicly available in August 2004. Ex. 1009; Ex.1029 ¶¶ 23-25. The paper was published as part of the Proceeding of the International Symposium on Antennas and Propagation (“ISAP 2004”), Session 1A2-4. Ex. 1009 at 17. The publication identifies an August 18, 2004 publication date and includes an ISBN. *Id.* at 1. In addition, the IEICE Proceedings website identifies the publication using an ISSN (2188-5079) and DOI: (10.34385/proc.12.1A2-4). Ex. 1023; Ex.1029 ¶¶ 9-12, 13-21 (public availability).

Dr. Hsieh-Yee further explains that records from the IEICE Proceedings website demonstrate that interested users could locate and access Inoue through the conference proceedings archive. Ex. 1029 ¶¶ 13-14, 21, 25, App’x C; Ex. 1023. Archived records from the IEICE website and ISAP 2004 conference registration webpages further demonstrate that conferences registrants were provided access to the proceedings and that the conference fee included a copy of the proceedings on CD-ROM. Ex. 1029 ¶¶ 14-21, 25, App’x D, App’x E.

In addition, citation records show that Inoue was cited by later publications as early as June and July 2005, further corroborating its dissemination to the relevant technical community. Ex. 1029 ¶ 22; App'x F-I; Ex. 1024.

Based on these records, Dr. Hsieh-Yee opines that Inoue “became available to registrants of the ISAP 2004 symposium in August 2004.” Ex. 1029 ¶ 25. Thus, Inoue qualifies as prior art under 35 U.S.C. § 102(a) (pre-AIA).

Further, no substantive consideration during the prosecution of the '960 patent was given to Kangasvieri, Chiba, Vance, or Inoue. Although Kangasvieri was cited in an Information Disclosure Statement, the Examiner did not apply it in any rejection or otherwise substantively analyze its teachings. *See* Ex. 1002 at 145 (Jan. 30, 2012 IDS Form), 603-606 (Feb. 22, 2012 Non-Final Rejection), 619-625 (Feb. 22, 2012 Non-Final Rejection), 648-650 (Sept. 24, 2012 Notice of Allowance). Chiba, Vance, and Inoue were not cited during the prosecution. *See* Ex. 1001, Cover (“References Cited”).

V. OVERVIEW OF THE '960 PATENT

A. '960 Patent

The '960 patent “relates to a handset and generally to any handheld device, which includes an antenna for receiving and transmitting electromagnetic wave signals.” Ex. 1001 at 1:26-28. The '960 patent acknowledges that such handheld devices were well known and depicts a known prior art handset in Figure 2, reproduced below. *Id.* at 3:5-7.

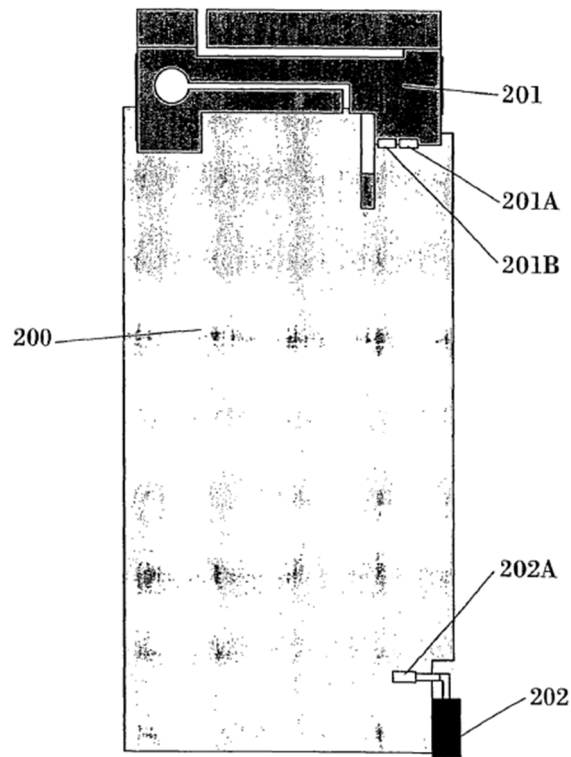


FIG. 2
(PRIOR ART)

Ex. 1001 at FIG. 2.

The prior art handset as depicted in Figure 2 includes “a first antenna (201), placed on the top part of the first PCB (200), that operates at the frequency bands for mobile communications, and a second antenna (202) placed on the bottom right corner of the PCB (200) that operates at the frequency bands of the wireless connectivity services.” Ex. 1001 at 3:22-27. The first antenna (201) is a multiband antenna with “a first resonance around 900 MHz to provide coverage for the GSM900 service, and a second resonance around 1900 MHz to provide service to the GSM1800 and GSM1900 services.” *Id.* at 3:42-47. The second antenna is a

single band antenna, “tuned in the 2500 MHz band.” *Id.* at 3:47-48. The ’960 patent further explains that the second antenna of the prior art handset, as depicted in Figure 2 above, “is a surface mount technology (SMT) component mounted on the PCB (200), although it could have been replaced by, for example, an antenna printed on the PCB (200).” *Id.* at 3:30-35.

Unlike the prior art handset of Figure 2, where the first antenna is configured to transmit and receive over two frequency bands, claim 1 of the ’960 patent recites that the first antenna is “configured to transmit and receive electromagnetic wave signals *in at least three frequency bands* used for mobile communication services.” *Compare* Ex. 1001 at cl. 1 *with id.* at 3:22-27 (emphasis added).

Unlike the prior art handset of Figure 2, the ’960 patent also discloses a handset embodiment, as depicted in Figure 4 below, where the second antenna is a “*slot antenna*” rather than an SMT antenna. Ex. 1001 at 14:52-59 (emphasis added); *see also id.* at 16:10-26.

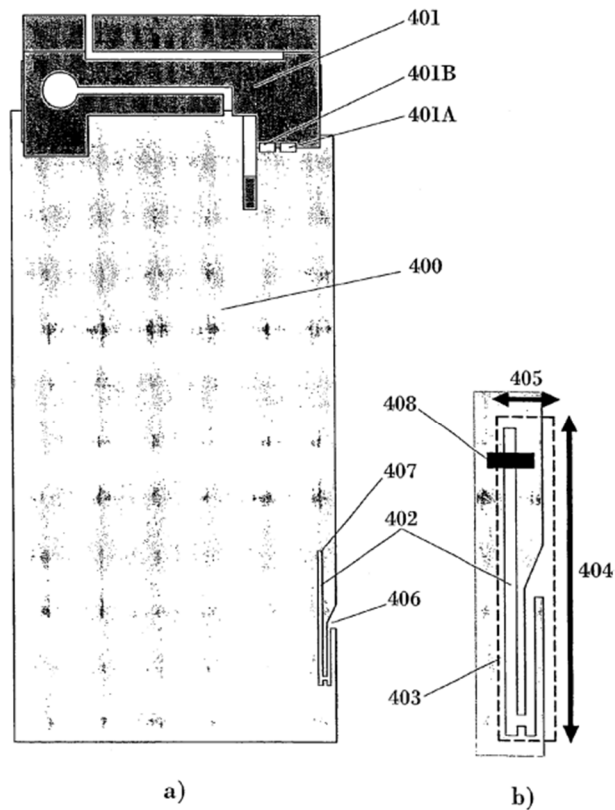


FIG. 4

Ex. 1001 at FIG. 4.

The challenged claims recite limitations relating to features discussed above. However, all the limitations in the challenged claims were known in the prior art and are obvious. *See* Section IX; Ex. 1003 ¶¶ 37-41; *see also id.* ¶¶ 24-36 (discussing technology background, citing Exs. 1005, 1008, 1010-1013, 1015-1022, 1025-1026, 1029-1030), 45-53 (discussing the prior art at issue in this petition), 54-168 (discussing prior art disclosures in view of each claim's limitations).

B. Prosecution History

The '960 examination was not robust. During prosecution, the Examiner repeatedly identified the alleged orthogonal antenna layout as the dispositive feature of novelty. Ex. 1002 at 622-624 (June 21, 2012 Final Rejection), 654 (Sept. 24, 2012 Notice of Allowance).² Specifically, the Examiner stated that prior art relied upon “fails to further teach that the first side and the second side are substantially orthogonal.” *Id.* at 654. However, the record indicates that this conclusion was reached without a thorough or meaningful evaluation of the relevant prior art.

For example, the Examiner’s own search records reflect limited search time and scope at the critical junctures where orthogonality became the basis for allowance. Ex. 1002 at 633-634 (June 21, 2012 EAST search reflects), 656

² The claims originally pending in this application (claims 1–20) were directed to subject matter related to a continuation of U.S. Application No. 11/988,888, which led the Examiner to raise a non-statutory double patenting rejection in the February 22, 2012 non-final Office Action. Ex. 1002 at 603-606 (June 21, 2012 Final Rejection). In response, Applicant canceled all pending claims (claims 1-20) and, on May 14, 2012, presented a new set of claims (claims 21-40). Ex. 1002 at 615 (May 14, 2012 Applicant Remarks), 610-614 (May 14, 2012 Claim Amendments).

(September 24, 2012 EAST). The June 21, 2012 EAST search reflects 13 searches conducted in approximately one hour, yet omits targeted searches directed to orthogonal antenna configurations. *Id.* at 633-634. The subsequent September 24, 2012 EAST search reflects 11 searches conducted in approximately 12 minutes, even though searches for orthogonally arranged antennas yield 1,164 hits of potentially relevant references. *Id.* at 656.

This limited search effort is particularly significant where the record itself reflects that orthogonal antenna arrangements were already known in the prior art. For example, Kangasvieri was cited in an Information Disclosure Statement during prosecution among dozens of references. *See* Ex. 1002 at 145 (Jan. 30, 2012 IDS Form). In addition, the '960 patent itself acknowledges that Figure 2 of the '960 patent depicts a conventional two-antenna system with an orthogonal antenna arrangement. *See* Ex. 1001 at 2:6-58, 2:59-3:3, 3:6-35, Fig. 2.

However, the record contains no indication that the Examiner substantively considered Kangasvieri or evaluated its teachings with respect to the asserted basis for allowance, including the alleged novelty of orthogonal antenna arrangements. Rather, the Examiner indicated that “all references considered except where lined through” on the IDS, and the limited search record discussed above confirms that the prior art, including Kangasvieri, was not meaningfully analyzed. Ex. 1002 at 628-632.

In view of the limited search record and the readily available prior art disclosing both orthogonal antenna arrangements, the Examiner's reliance on orthogonality as the basis for allowance does not reflect a robust examination. Accordingly, the prosecution history does not support any presumption of settled expectations.

VI. THE PRIOR ART

A. Kangasvieri (Ex. 1005)

Kangasvieri (Ex. 1005) is directed to antenna structures and methods for improving isolation between antennas in compact, multi-band mobile terminals. Ex. 1005 ¶¶ 1, 3, 4, 66, 69. Kangasvieri addresses the technical problem of limited duplex separation between the transmit and receive frequency bands, which has conventionally necessitated bulky, lossy duplex filters. *Id.* ¶ 2. To overcome this issue, Kangasvieri teaches modifying the device's ground plane by "providing a cut in the ground plane for causing the conducted power in the ground plane to undergo a 180-degree phase shift with respect to the radiated power in air." *Id.* ¶ 4, FIGS. 1, 2. Kangasvieri further teaches multiple antenna configurations, including embodiments in which a slot antenna is used and "the signal fed to the slot antenna undergoes a substantially 180-degree phase shift before it is coupled to the ground plane." *Id.* ¶ 4, FIGS. 5a, 5b; Ex. 1003 ¶¶ 45-46.

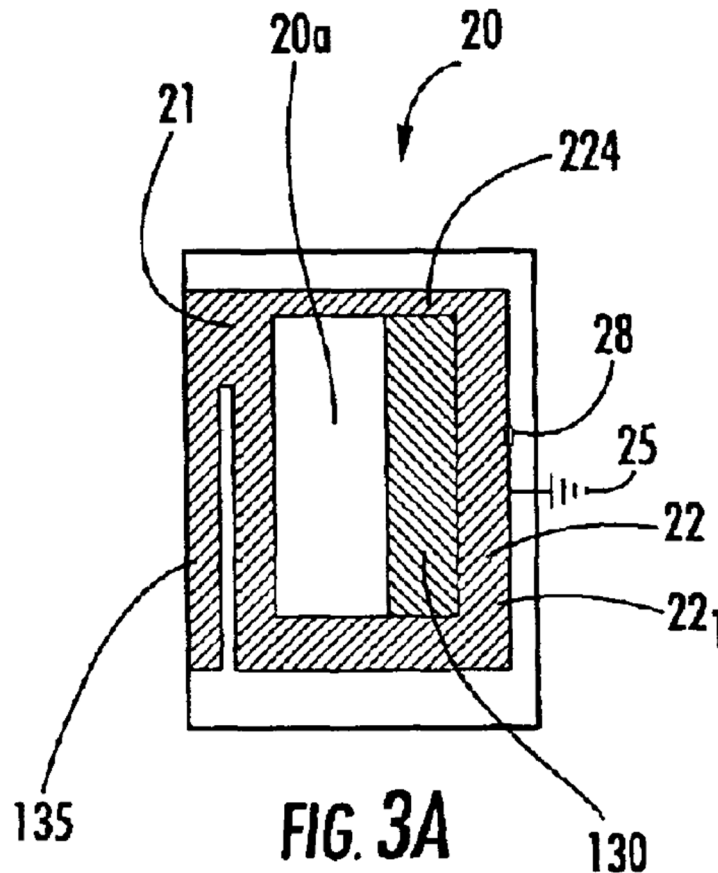
B. Chiba (Ex. 1006)

Chiba (Ex. 1006) is directed to a multifrequency inverted-F antenna for use as an internal antenna in compact radio communication devices, such as portable telephones. Ex. 1006 at 1:4-11; *see also id.* at Abstract. Specifically, a multifrequency inverted F-type antenna where “radio waves of multiple frequency bands can be received without increase in size to enable transmission and reception across multiple frequency bands without increasing antenna size or installation volume.” *Id.* at 2:33-36; Ex. 1003 ¶ 47.

C. Vance (Ex. 1007)

Vance (Ex. 1007) is directed to a multi-band planar inverted-F antenna (“PIFA”) structure for compact wireless terminals and handheld devices. Ex. 1007 at 2:51-66. Specifically, Vance teaches an antenna arranged to operate in a frequency band used for the wireless services recited in dependent claim 7.

Vance explains that “planar inverted-F antennas are configured to operate at a plurality of resonant frequency bandwidths of operation (typically between about 2-4),” and that “[t]he inverted-F conductive element can be configured to operate at . . . a third or more resonant frequency bands.” *Id.* at 2:51-66, 5:13-34. These bands may include conventional cellular communication bands, such as GSM, together with additional wireless service bands such as GPS. *Id.* at 5:13-55. For example, Figure 3A shows “antenna 20” configured to generate three resonance bands, including “band B at the GPS resonance (1575 MHz).” *Id.* at 9:20-42.



Id. at FIG.3; Ex. 1003 ¶¶ 48-50.

D. Inoue (Ex. 1009)

Inoue (Ex. 1009) teaches suppression of mutual coupling between adjacent antenna elements using a conductive structure connected to the ground plane rather than a slot formed in the ground plane. Ex. 1009 at 17-18 (§ 1 Introduction). Specifically, Inoue teaches the conductive strip recited in dependent claims 5 and 6.

Inoue investigates a linear array antenna designed to improve direction-of-arrival (“DOA”) estimation by reducing mutual coupling between elements and discloses a microstrip patch array antenna employing a “boxy metallic wall” around each microstrip patch. *Id.* Inoue expressly states that “mutual coupling of this

antenna is suppressed by the boxy metallic wall around the microstrip patch,” and further explains that “[t]he wall is connected to the ground plane of the microstrip antenna.” *Id.* at 18. Inoue also teaches that the dimensions of the metallic wall are selected relative to wavelength to optimize isolation performance, stating that the wall size was optimized to achieve “-30 dB of mutual coupling,” with dimensions including “ $L_x = 0.4\lambda$ ” and “ $L_y = 0.5\lambda$,” resulting in “-33 dB of maximum mutual coupling” at 5 GHz. *Id.*; Ex. 1003 ¶¶ 48-50.

VII. LEVEL OF ORDINARY SKILL

A person of ordinary skill in the art at the time of the alleged invention of the ’960 patent (“POSITA”) would have had an undergraduate degree in electrical engineering or a related field, and at least two years of experience in antenna design or related technologies. Ex. 1003 ¶¶ 21-23.³ Additional education could substitute for practical experience, and vice versa. *Id.*

This Petition does not turn on this precise definition, and the challenged claims would be unpatentable from the perspective of any POSITA at the relevant time.

³ Petitioner submits the declaration of Dr. Tentzeris (Ex. 1003), an expert in the field of the ’960 patent. Ex. 1003 ¶¶ 5-15; Ex. 1004.

VIII. CLAIM CONSTRUCTION

Under the applicable standard in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc), claim terms are typically given their ordinary and customary meanings as understood by a POSITA at the time of the invention based on the claim language, specification, and the prosecution history of record. *Phillips*, 415 F.3d at 1313; *see also id.* at 1312-16. The Board, however, only construes the claims when necessary to resolve the controversy. *Toyota Motor Corp. v. Cellport Sys., Inc.*, IPR2015-00633, Paper No. 11 at 16 (Aug. 14, 2015) (citing *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)). Petitioner applies the ordinary and customary meaning of the terms and believes that no express construction of any claim terms is necessary to assess whether the prior art reads on the challenged claims. Ex. 1003 ¶¶ 43-44.

IX. DETAILED EXPLANATIONS OF GROUNDS

A. Ground 1: The combination of Kangasvieri and Chiba Renders Obvious Claims 1-4 and 19-20.

1. Claim 1

a. A handheld device comprising:

To the extent limiting, Kangasvieri discloses the preamble. Ex. 1003 ¶¶ 56-58.

For example, Kangasvieri discloses a mobile terminal, such as a multi-band phone 200 as shown in Figure 4 below. Ex. 1005 ¶¶ 1 (“The present invention relates generally to an antenna structure and, more particularly, to an antenna structure for

use in a *mobile terminal*.”) (emphasis added), 35, 60 (“FIG. 4 is a schematic representation of a mobile phone having an improved antenna structure, according to the present invention.”), 69 (“FIG. 4 is a schematic representation of a multi-band mobile phone 200, according to the present invention.”). A POSITA would have thus understood that Kangasvieri’s mobile terminal is a handheld device as claimed. Ex. 1003 ¶ 57.

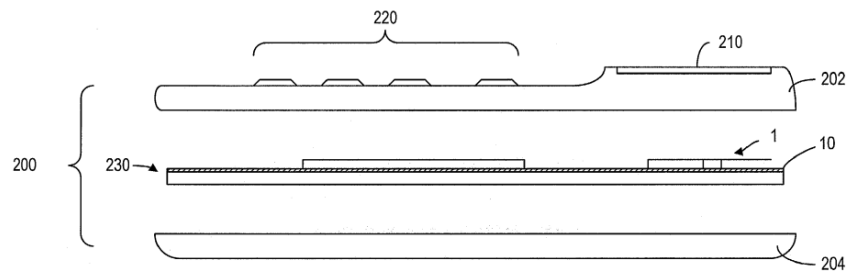


FIG. 4

Ex. 1005, FIG. 4; Ex. 1003 ¶ 57.

Accordingly, Kangasvieri discloses “[a] handheld device,” as recited. *See infra* Sections IX.A.1.b-h; Ex. 1003 ¶ 58.

b. a substantially rectangular ground plane;

Kangasvieri discloses this limitation. Ex. 1003 ¶¶ 59-63. As discussed above for claim limitation 1.a, Kangasvieri discloses a mobile terminal, such as a multi-band phone 200 as shown in Figure 4. *Supra* Section IX.A.1.a. As discussed below, Kangasvieri further discloses the multi-band phone 200 includes a printed wire board (PWB) with a ground plane.

For example, Kangasvieri discloses that a ground plane 10, highlighted in yellow in Figure 4 below, on the upper side of a printed wire board 230. Ex. 1005 ¶ 69 (“As shown, the mobile phone has an upper body 202 and a lower body 204 to accommodate a PWB (printed wire board) 230. ... As shown in FIG. 4, the ground plane 10 of the antenna system is on the upper side of the PWB 230.”).

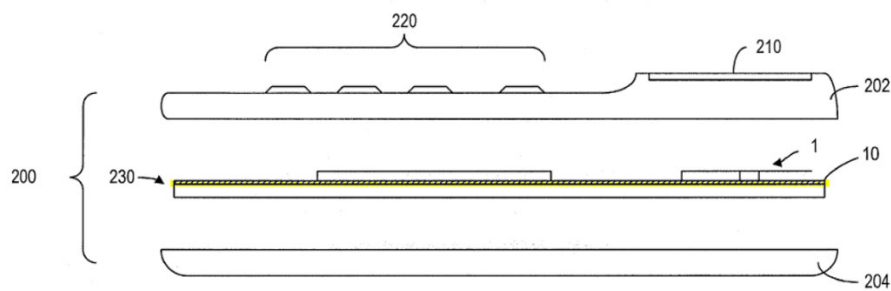


FIG. 4

Ex. 1005, FIG. 4 (Annotated); Ex. 1003 ¶ 60.

As shown in Figure 2, below, the ground plane 10, when viewed without regard to slot 20, is bounded by four outer edges forming corners labeled A, B, C, and D.

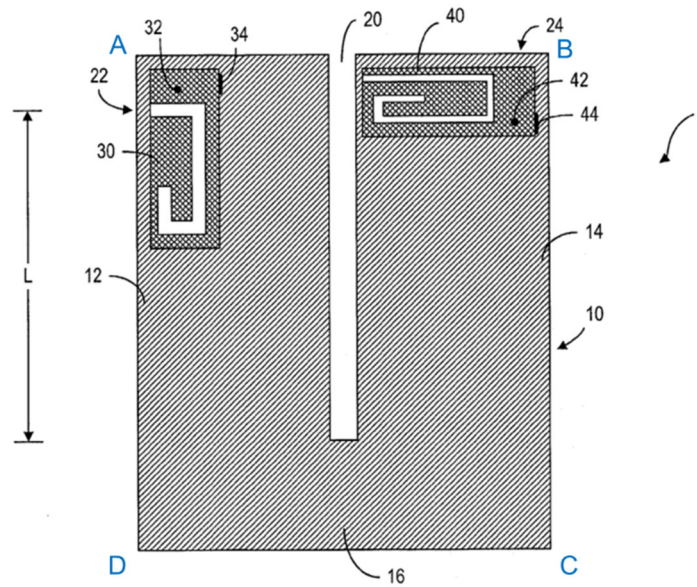


FIG. 2

Ex. 1005, FIG. 2 (annotated); Ex. 1003 ¶ 61. These edges define an outer perimeter consisting of four generally straight sides arranged in opposing pairs, with adjacent sides meeting at approximately right angles. *Id.* A POSITA would have understood that this outer boundary defines a substantially rectangular geometry, notwithstanding the presence of the slot 20, which is an internal feature that does not alter the overall external shape of the ground plane. Ex. 1003 ¶ 62.⁴ Accordingly, the ground plane 10 constitutes a “substantially rectangular” structure as required.

⁴ This understanding is consistent with the specification of the '960 patent, which describes embodiments in which slots are formed in a ground plane. Ex. 1001 at 20:13-27 (“wherein a slot (1304) has been created in a ground plane of said PCB

Accordingly, Kangasvieri discloses “a substantially rectangular ground plane,” as claimed. Ex. 1003 ¶ 63.

- c. a first antenna configured to transmit and receive electromagnetic wave signals in at least three frequency bands used for mobile communication services;**

The Kangasvieri-Chiba combination renders obvious this limitation. Ex. 1003 ¶¶ 64-82.

As discussed above for claim limitation 1.a, Kangasvieri discloses a mobile terminal, such as a multi-band phone 200 as shown in Figure 4. *Supra* Section IX.A.1.a. Kangasvieri further discloses “the PWB 230 has an antenna system 1 disposed thereon,” where “the ground plane 10 of the antenna system is on the upper side of the PWB 230.” Ex. 1005 ¶ 69, FIG. 4. Kangasvieri, for example, teaches that the antenna system, with reference to Figure 2 below, includes “a first antenna 22 and a second antenna 24.” *Id.* ¶ 65; Ex. 1003 ¶ 65.

(1300).”); 21:12-27, cl. 2 (“at least one slot in the substantially rectangular ground plane”); *see also infra* Section A.2. Accordingly, the inclusion of a slot in ground plane 10 of Kangasvieri, therefore, does not preclude the ground plane 10 from being substantially rectangular.

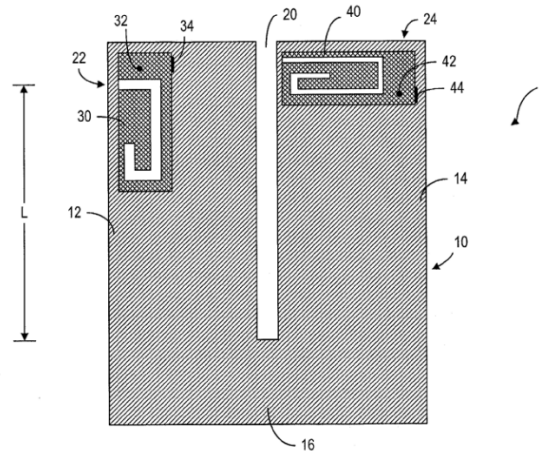


FIG. 2

Ex. 1005, FIG. 2. Kangasvieri explains that the antennas 22 and 24 as represented in Figure 2 above are each a planar inverted-F antenna (“PIFA”) used for mobile communication services. *Id.* ¶¶ 65, 71; *see also id.* ¶¶ 4, 63; Ex. 1003 ¶ 66.

Kangasvieri further teaches a multiple frequency band antenna system that is configured to transmit and receive electromagnetic wave signals. Ex. 1003 ¶ 67. For example, Kangasvieri teaches that “[a]dvantageously, the first antenna (80) is a *multiple-band antenna operating in at least a first frequency band and a second frequency band* different from the first frequency band.” Ex. 1005 ¶ 48 (emphasis added); *see also id.* ¶ 69 (“FIG. 4 is a schematic representation of a multi-band mobile phone 200, according to the present invention.”), cl. 17 (“the first antenna (80) is a multiple-band antenna operating in at least a first frequency band and a second frequency band different from the first frequency band”). Additionally, Kangasvieri teaches that “[i]n a multi-band mobile terminal, it is possible to use one PIFA and one *dual-band* slot antenna.” *Id.* ¶ 72 (emphasis added).

Although Kangasvieri discloses a multi-band antenna system, Kangasvieri does not explicitly teach “a first antenna configured to transmit and receive electromagnetic wave signals *in at least three frequency bands used for mobile communication services.*” As discussed below, however, it would have been obvious to implement Kangasvieri’s mobile device with a first antenna configured to transmit and receive electromagnetic wave signals *in at least three frequency bands used for mobile communication services* based on the teachings of Chiba. Ex. 1003 ¶ 68.

i. Chiba

Chiba teaches an antenna configured to transmit and receive electromagnetic wave signals in at least three frequency bands used for mobile communication services. Ex. 1003 ¶ 69.

For example, Chiba teaches a multifrequency inverted F-type antenna “used as an internal antenna of small, thin radio communication terminals such as, chiefly, portable telephones, and more particularly, it relates to a multifrequency inverted F-type antenna capable of receiving radio waves in multiple frequency bands without increasing its size.” Ex. 1006 at 1:4-10; *see also id.* at Abstract (“A multifrequency inverted F-type antenna which can receive [multifrequency] band radio waves without the enlargement of its shape.”). Figure 14 below illustrates the multifrequency inverted F-type antenna that is “capable of receiving radio waves of

three different frequency bands, namely, a first frequency band determined by the shape of the first emission conductor 142-1, a second frequency band determined by the shape of the second emission conductor 142-2, and a third frequency band determined by the shape of the third emission conductor 142-3.” *Id.* at 9:41-58; Ex. 1003 ¶ 70.

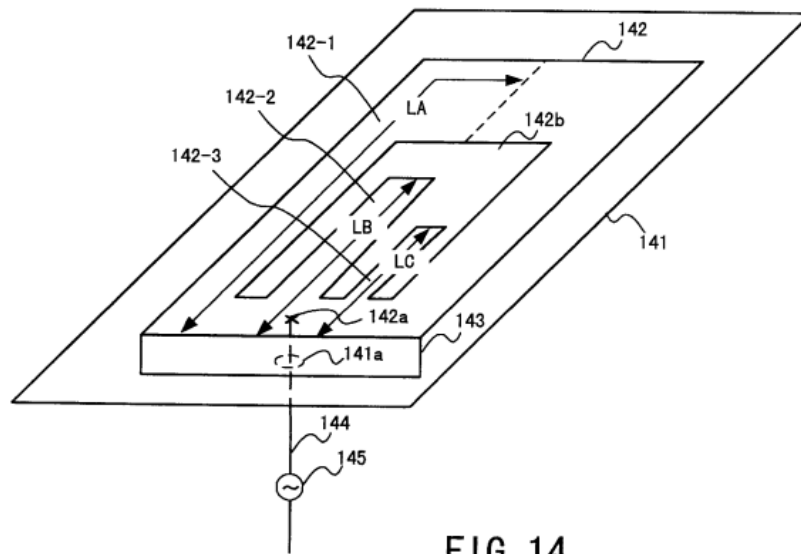


FIG. 14

Ex. 1006 at FIG. 14. Chiba further explains that “multifrequency inverted F-type antenna 120 according to the second embodiment is capable of receiving radio waves in the *three frequency bands*, namely, first frequency band, second frequency band and third frequency band, without increasing either the installation area or installation volume.” *Id.* at 10:1-6l; Ex. 1003 ¶ 71.

A POSITA would have understood that the multifrequency inverted F-type antenna, as illustrated in Figure 14, above is a PIFA. Ex. 1003 ¶ 72. For example, Figure 14 depicts a planar radiating conductor 142 arranged substantially parallel to a ground conductor 141, with the planar radiating conductor 142 spaced above the ground plane by a short-circuit plate 143. Ex. 1006 at FIG. 14; *see also id.* at 9:40-58. A POSITA would have recognized that such a configuration, namely, a flat planar radiating conductor positioned parallel to a ground plane defines the structural architecture for a PIFA. Ex. 1003 ¶ 72. Accordingly, based on the geometry shown in Figure 14 and the accompanying description in the specification, a POSITA would have recognized antenna 120 as a multifrequency implementation of the well-known PIFA architecture. *Id.*

A POSITA, furthermore, would have understood that Chiba's multifrequency inverted F-type antenna 120 is capable of both transmitting and receiving radio-frequency signals in three frequency bands. Ex. 1003 ¶ 73. Although portions of Chiba occasionally emphasize "receiving," the specification makes clear that the antenna is intended for use in portable telephones and radio communication terminals, which are inherently two-way communication devices. Ex. 1006 at 1:4-10; *see also id.* at Abstract. Indeed, Chiba states in reference to other related embodiment of the multifrequency inverted F-type antenna that the antenna supports "sending and receiving," such as sending and receiving GSM and PHS. *Id.* at 6:51-

62 (“The multifrequency inverted F-type antenna 30 shown in FIG. 3 may be assumed to be the internal antenna of a portable telephone constituting a dual-mode terminal capable of *sending and receiving* under the two systems”) (emphasis added); *see also id.* at 14:29-34 (Chiba further describes matching the antenna to a “sending/receiving circuit.”).⁵ These disclosures confirm that antenna 120 in Figure 14 is designed for both send and receive operations for mobile communication services rather than receive-only functionality. Ex. 1003 ¶ 73.

Moreover, under the well-established principle of antenna reciprocity, an antenna structure that resonates and receives at a given frequency band will likewise

⁵ A POSITA would have understood that the structural configuration shown in Figure 3, which is a planar radiating conductor disposed above a ground plane, is the same PIFA architecture illustrated in Figure 14. Ex. 1003 at n.2. The multifrequency inverted F-type antenna 120 of Figure 14 simply adds additional resonant paths to enable operation in additional frequency bands. *Compare* Ex. 1006 FIG. 3 *with* FIG. 14. Accordingly, a POSITA would have understood that the multifrequency inverted F-type antenna of Figure 14, like the dual-band antenna of Figure 3, is capable of both transmitting and receiving signals in its respective frequency bands. Ex. 1003 at n.2.

transmit at that same band when coupled to an appropriate transmitter. Ex. 1003 ¶ 74; Ex. 1014 at 10:18-21, Ex. 1027 at 5:48-59; Ex. 1031 at 144, 147).⁶ Figure 14, above, shows multiple radiating elements configured to resonate at distinct frequency bands, and a POSITA would therefore have understood that antenna 120 is capable of both sending and receiving radio waves in at least three frequency bands. Ex. 1003 ¶ 74.

Accordingly, Chiba teaches an antenna “configured to transmit and receive electromagnetic wave signals in at least three frequency bands used for mobile communication services,” along with the advantages of using such an antenna. Ex. 1006 at 10:1-6. Thus, as discussed below, A POSITA would have been motivated to replace the first antenna with Chiba’s antenna in Kangasvieri’s mobile terminal. *See infra* Section IX.A.1.c.2; Ex. 1003 ¶ 75.

ii. Reasons to Combine and Reasonable Expectation of Success

A POSITA would have been motivated in light of Chiba to configure the

⁶ To show that claim 1 is obvious, Petitioner relies here on the teachings of Kangasvieri and Chiba only. Exhibits 1014, 1027, and 1031 demonstrate what a POSITA would have known at the time of the alleged invention of the ’960 patent regarding antenna reciprocity. *Int’l Bus. Machines Corp. v. Intellectual Ventures II, LLC*, IPR2015-00089, Paper No. 44 at 15 (Apr. 25, 2016).

mobile terminal in Kangasvieri (as discussed above for claim limitation 1.a) so that its first antenna is a multifrequency inverted F-type antenna capable of sending and receiving radio waves in the *three frequency bands* used for mobile communication services as claimed. Ex. 1003 ¶ 76. Such an implementation would have been a straightforward combination of well-known technologies using known methods and would have had predictable results. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 416-18 (2007).

A POSITA would have recognized that Chiba and Kangasvieri disclose features in a similar technological field. Ex. 1003 ¶ 77. Both references relate to improving compact mobile terminals through enhanced antenna structures, including planar inverted-F antennas configured to operate in multiple frequency bands. Ex. 1005 ¶¶ 69, 72; Ex. 1006 at 10:1-6; Ex. 1003 ¶ 77.

A POSITA would have had reason to substitute Kangasvieri's PIFA with Chiba's similarly sized multifrequency PIFA as the first antenna. Ex. 1003 ¶ 78. This substitution would have predictably increased the number of supported communication bands without enlarging the antenna volume or ground-plane footprint of the mobile terminal. *Id.* ¶¶ 78-79; Ex. 1012 at 1:10-2:16⁷. Indeed, Chiba

⁷ Exhibit 1012 demonstrate what a POSITA would have known at the time of the alleged invention of the '960 patent regarding industry demand.

expressly teaches that its multifrequency PIFA achieves operation in three frequency bands without increasing the antenna's footprint or volume relative to conventional single-band PIFAs. Ex. 1006 at 10:1-6. Because both antennas share the same planar inverted-F structure, little to no structural redesign of the device would have been required. Ex. 1003 ¶ 80. Additionally, given the known industry demand for supporting multiple communication standards within limited space constraints, a POSITA would have appreciated the benefit of implementing Chiba's multi-band PIFA to enhance frequency capability while preserving compact form factor. *Id.*

The combination therefore represents the application of known PIFA design principles to obtain the foreseeable result of a mobile terminal capable of communicating across additional frequency bands and networks without increasing device size. Ex. 1003 ¶ 81. A POSITA would have had a reasonable expectation of success in making this modification. *See Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1364 (Fed. Cir. 2007) ("only a reasonable expectation of success, not a guarantee, is needed" in an obviousness analysis). Accordingly, it would have been obvious for the first antenna in the combined Kangasvieri-Chiba mobile terminal to transmit and receive in at least three frequency bands used for mobile communication services. Ex. 1003 ¶ 81.

The combination of Kangasvieri and Chiba, therefore, renders obvious "a first antenna configured to transmit and receive electromagnetic wave signals in at least

three frequency bands used for mobile communication services,” as claimed.

Ex. 1003 ¶ 82.

d. a second antenna configured to operate in at least one frequency band;

The Kangasvieri-Chiba combination renders obvious this limitation.

Ex. 1003 ¶¶ 83-87.

For example, as discussed above, Kangasvieri teaches a mobile terminal including both a first and second antenna. *Supra* Section IX.A.1.c. In particular, Kangasvieri teaches a “second antenna 24,” shown in Figure 2 below, that operates in at least one frequency band. Ex. 1005 ¶ 65; Ex. 1003 ¶ 84.

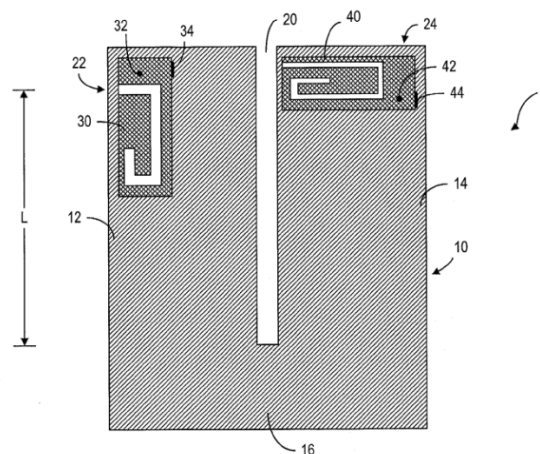


FIG. 2

Ex. 1005, FIG. 2. Kangasvieri further explains that in a multi-band mobile terminal, the first antenna may cover the PCS band and another lower frequency band (e.g., GSM 850), while the second antenna is used to cover the PCS Band. *Id.* ¶ 72. Thus,

Kangasvieri teaches a second antenna configured to operate in at least one frequency band, as required by the claim. Ex. 1003 ¶ 85.

The combination of Kangasvieri with Chiba does not eliminate or materially alter Kangasvieri's second antenna. Ex. 1003 ¶ 86. As discussed above, Chiba is relied upon only to replace Kangasvieri's first antenna with a multifrequency PIFA structure capable of operating in three or more frequency bands. *Supra* Section IX.A.1.c. The second antenna disclosed in Kangasvieri remains present in the combined system and continues to operate in at least one frequency band, consistent with Kangasvieri's disclosure. A POSITA would have understood that replacing the first antenna with Chiba's multifrequency PIFA would not affect the structure or operation of Kangasvieri's second antenna. Ex. 1003 ¶ 86.

Accordingly, the combination of Kangasvieri and Chiba renders obvious "a second antenna configured to operate in at least one frequency band," as claimed. Ex. 1003 ¶ 87.

- e. **the first antenna extends in a direction substantially parallel to a first side of the substantially rectangular ground plane;**

The Kangasvieri-Chiba combination renders obvious this limitation. Ex. 1003 ¶¶ 88-92. For example, as discussed above, the mobile terminal includes a first and second antenna arranged on ground plane 10. *Supra* Section IX.A.1.c.

Figure 2 of Kangasvieri, annotated, illustrates a printed circuit board including a ground plane 10 having a substantially rectangular shape, defined by corners A, B, C, and D as annotated. Ex. 1005, FIG. 2. For clarity, side AD (shown in blue) is identified as the claimed “first side” of the substantially rectangular ground plane, where side AD extends vertically between corners A and D. Ex. 1003 ¶ 89.

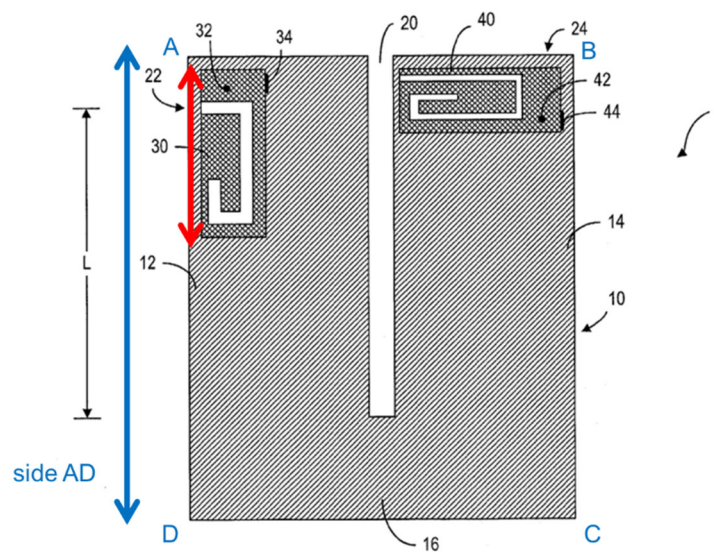


FIG. 2

Ex. 1005, FIG. 2 (annotated); Ex. 1003 ¶ 89. Additionally, the first antenna 30, as shown in Figure 2, is disposed adjacent to the upper left region of the ground plane 10. Specifically, as shown by the red arrow overlay, the first antenna extends primarily vertically, parallel to side AD of the rectangular ground plane 10. Ex. 1003 ¶ 90.

The combination of Kangasvieri with Chiba does not materially alter the orientation or location of Kangasvieri’s first antenna relative to the rectangular

ground plane as Chiba's multifrequency PIFA retains essentially the same footprint as Kangasvieri's first antenna, and Chiba's multifrequency PIFA would have been placed in the nearly same location and orientation on the ground plane. Ex. 1003 ¶ 91. Thus, the replaced first antenna continues to extend in a direction substantially parallel to the first side of the substantially rectangular ground plane, as disclosed in Kangasvieri. Ex. 1003 ¶ 91.

Accordingly, the combination of Kangasvieri and Chiba renders obvious "the first antenna extends in a direction substantially parallel to a first side of the substantially rectangular ground plane," as claimed. Ex. 1003 ¶ 92.

f. the second antenna extends in a direction substantially parallel to a second side of the substantially rectangular ground plane;

The Kangasvieri-Chiba combination renders obvious this limitation. Ex. 1003 ¶¶ 93-97. For example, as discussed above, the mobile terminal includes a first and second antenna arranged on ground plane 10. *Supra* Section IX.A.1.c.

Figure 2 of Kangasvieri, annotated, illustrates a printed circuit board including a ground plane 10 having a substantially rectangular shape, defined by corners A, B, C, and D as annotated. Ex. 1005, FIG. 2; Ex. 1003 ¶ 94. For clarity, side AB (shown in green) is identified as the claimed "second side" of the substantially rectangular ground plane, where side AB extends horizontally between corners A and B.

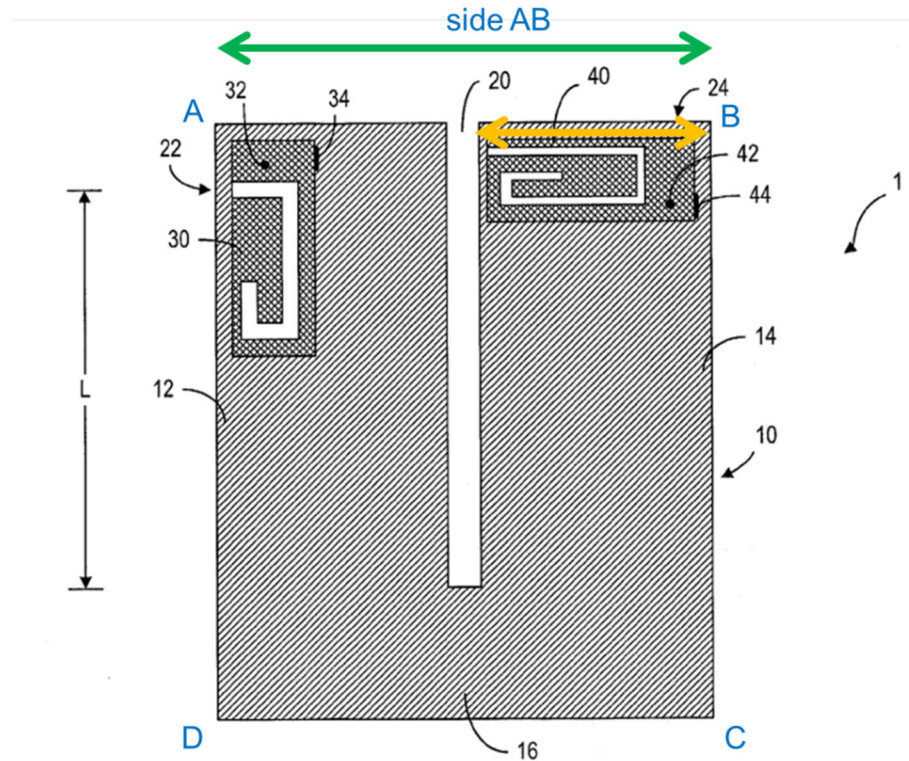


FIG. 2

Ex. 1005, FIG. 2 (annotated); Ex. 1003 ¶ 94. Additionally, the second antenna 40, as shown in Figure 2, is disposed near the upper region of the ground plane and extends primarily horizontally (shown in orange), running laterally across the top portion of the ground plane 10. Ex. 1003 ¶ 95. As depicted in the annotated figure, the longitudinal extension direction of the second antenna aligns with this horizontal orientation. Accordingly, the second antenna extends in a direction substantially parallel to side AB of the substantially rectangular ground plane. *Id.*

The combination of Kangasvieri with Chiba does not alter the orientation of Kangasvieri's second antenna relative to the rectangular ground plane. Ex. 1003 ¶ 96. Chiba's multifrequency PIFA retains essentially the same footprint as

Kangasvieri's first antenna and would be implemented in the same location and orientation on the ground plane. Thus, the second antenna continues to extend in a direction substantially parallel to the second side of the substantially rectangular ground plane, as disclosed in Kangasvieri. Ex. 1003 ¶ 96.

Accordingly, the combination of Kangasvieri and Chiba renders obvious "the second antenna extends in a direction substantially parallel to a second side of the substantially rectangular ground plane," as claimed. Ex. 1003 ¶ 97.

g. the first antenna is arranged near a short side of the substantially rectangular ground plane; and

The Kangasvieri-Chiba combination renders obvious this limitation. Ex. 1003 ¶¶ 98-102. For example, as discussed above, the mobile terminal includes a first and second antenna arranged on ground plane 10. *Supra* Section IX.A.1.c.

Figure 2 of Kangasvieri, annotated, illustrates a printed circuit board including a ground plane 10 having a substantially rectangular shape, defined by corners A, B, C, and D as annotated. Ex. 1005, FIG. 2; Ex. 1003 ¶ 99. In this configuration, the vertical sides (AD and BC) are longer than the horizontal sides (AB and CD) as shown in Figure 2. *Id.* Accordingly, sides AB (shown in green) and CD constitute the "short sides" of the rectangular ground plane 10. *Id.*

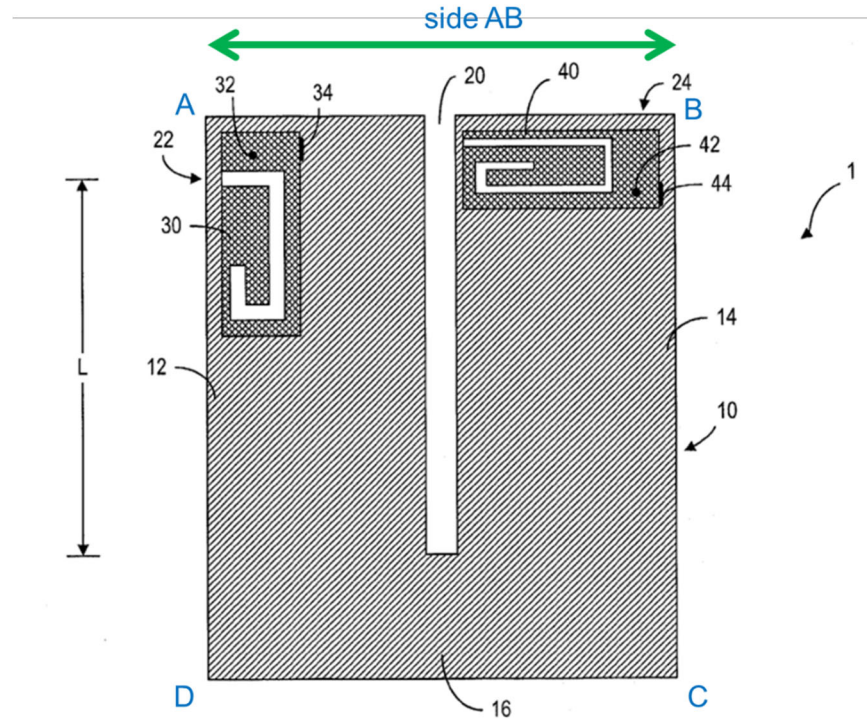


FIG. 2

Ex. 1005, FIG. 2 (annotated); Ex. 1003 ¶ 99. As depicted in the annotated Figure 2, the first antenna 30 is positioned adjacent to the upper left region of the ground plane; said differently, the first antenna is disposed proximate to side AB, which is a short side of the rectangular ground plane 10, and occupies the corner region near point A. Ex. 1003 ¶ 100. Accordingly, a POSITA would have recognized that the first antenna's placement is "near" the short side AB of the rectangular ground plane. *Id.*

The combination of Kangasvieri with Chiba does not materially alter the orientation of Kangasvieri's first antenna relative to the rectangular ground plane. Ex. 1003 ¶ 101. Chiba's multifrequency PIFA retains essentially the same footprint as Kangasvieri's first antenna and would be placed in the same location and

orientation on the ground plane. *Id.* Thus, the replaced first antenna remains positioned proximate to the short side of the substantially rectangular ground plane, as disclosed in Kangasvieri (and shown in Figure 2 above). *Id.*

Accordingly, the combination of Kangasvieri and Chiba renders obvious “the first antenna is arranged near a short side of the substantially rectangular ground plane,” as claimed. Ex. 1003 ¶ 102.

h. the first side and the second side are substantially orthogonal.

The Kangasvieri-Chiba combination renders obvious this limitation. Ex. 1003 ¶¶ 103-107. For example, as discussed above, the mobile terminal includes a first and second antenna arranged on ground plane 10. *Supra* Section IX.A.1.c.

Figure 2 of Kangasvieri, annotated, illustrates a printed circuit board including a ground plane 10 having a substantially rectangular shape, defined by corners A, B, C, and D as annotated. Ex. 1005, FIG. 2; Ex. 1003 ¶ 104. Side AD (shown in blue) extends vertically between corners A and D. Side AB (shown in green) extends horizontally between corners A and B. Ex. 1003 ¶ 104.

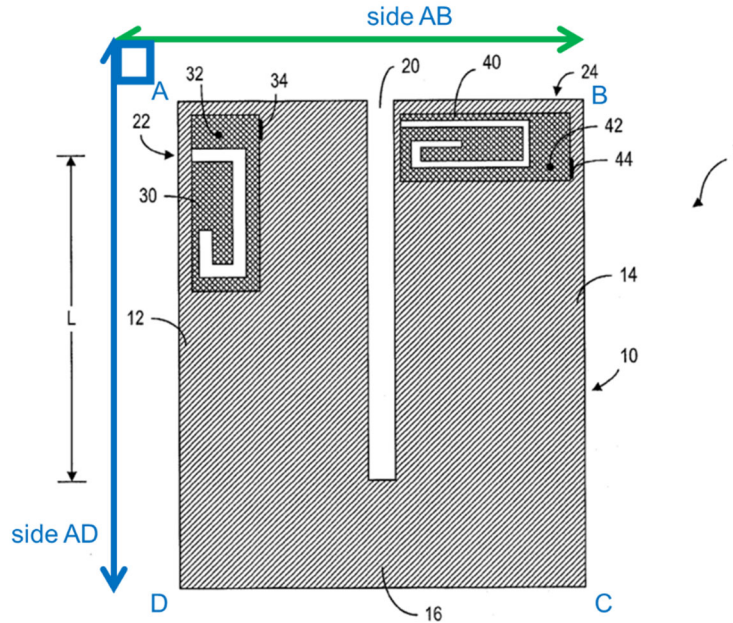


FIG. 2

Ex. 1005, FIG. 2 (annotated); Ex. 1003 ¶ 104. Because side AD is vertical and side AB is horizontal, the two sides intersect at corner A and form a right angle of 90 degrees.⁸ Ex. 1003 ¶ 105. That is, a POSITA would have recognized that sides AD and AB are perpendicular to one another and therefore substantially orthogonal. *Id.*

As discussed above, the combination of Kangasvieri with Chiba does not materially alter the orientation of Kangasvieri's first antenna relative to the rectangular ground plane. Ex. 1003 ¶ 106.

⁸ The specification of the '960 patent explains that "substantially orthogonal" encompasses angles within a range of approximately 60° to 120°. Ex. 1001 at 10:37-40.

Accordingly, the combination of Kangasvieri and Chiba renders obvious “the first side and the second side are substantially orthogonal,” as claimed. Ex. 1003 ¶ 107.

2. Claim 2

- a. The handheld device according to claim 1, wherein said handheld device further comprises at least one slot in the substantially rectangular ground plane, wherein said at least one slot is arranged for providing enhanced isolation between a feeding point of said first antenna and a feeding point of said second antenna by providing a high impedance path in said substantially rectangular ground plane between said feeding points in at least one frequency band corresponding to an operating band of one of said first and second antennas.**

The Kangasvieri-Chiba combination renders obvious claim 2. Ex. 1003 ¶¶ 108-117. As discussed above for claim 1, the combination relies on Kangasvieri for the mobile terminal layout, including the substantially rectangular ground plane, and relies on Chiba only to substitute Kangasvieri’s first antenna with a multifrequency PIFA structure. *Supra* Section IX.A.1.a-h. Kangasvieri further teaches this limitation as discussed below.

First, Kangasvieri teaches a slot 20 formed in the substantially rectangular ground plane 10 of the mobile terminal. Ex. 1005 ¶¶ 10 (“The antenna structure is characterized by a slot (20) provided between the first section (12) and the second section (14) of the ground plane (10)”), 65, FIG. 2; Ex. 1003 ¶ 109.

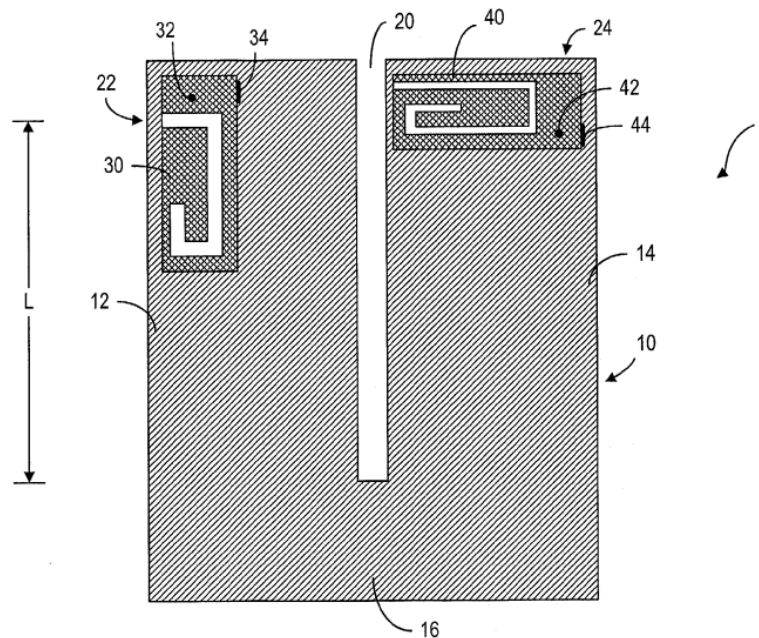


FIG. 2

Ex. 1005, FIG. 2. The slot 20 is visible in Figure 2 above, as well as Figure 1, as a physical gap running across the rectangular ground plane 10 “such that the ground plane 10 is separated into a first section 12 and a second section 14, galvanically connected via a connecting section 16.” *Id.* ¶ 65; *see also id.*, FIG. 1. Accordingly, Kangasvieri teaches “wherein said handheld device further comprises at least one slot in the substantially rectangular ground plane.” Ex. 1003 ¶ 109.

Second, Kangasvieri teaches that the slot’s purpose is to improve isolation between the antennas, and specifically isolation between their feed points. Ex. 1003 ¶ 110. Kangasvieri teaches that the first antenna 22 has a feed line 32 and the second antenna 24 has a feed line 42. Ex. 1005 ¶ 65. With reference to Figure 2 above, the first antenna 22 and feed line 32 are located on the first section 12 of the ground

plane, and the second antenna 24 and the feed line 42 are located on the second section 14 of the ground plane. Ex. 1005, Fig.2. Kangasvieri further provides that slot 20 formed in the ground plane 10 improves the isolation between the first antenna 22 and the second antenna 24. *Id.* ¶ 65; *see also id.* ¶ 64.

Kangasvieri explains that this isolation is tied to the slot's effect on current flowing between the two antenna feed regions as "the conducted power in the receive antenna via the ground plane 10 is phase-shifted by 180 degrees as compared to the power radiated in air from the transmit antenna." Ex. 1005 ¶ 65. Because the feed line of each antenna is connected to distinct sections of the ground plane (section 12 for antenna 22 and feed line 32, section 14 for antenna 24 and feed line 42), a POSITA would have understood that the slot 20 physically and electrically separates the two feeding regions. Ex. 1005 ¶ 65; *see also id.* ¶¶ 45 ("the radiating element (78, 88, 90) has a slot (76, 86) provided thereon for *effectively separating* the feed line (72, 82) and the grounding strip (74, 84) of the first antenna (70, 80) by a distance substantially equal to one half wavelength of a resonant frequency of the radiating element (78, 88, 90) of the first antenna."), 51 ("providing a slot (76, 86) on the radiating element (78, 88, 90) for *effectively separating* the feed line (72, 82) and the grounding strip (74, 84) of the first antenna (70, 80) by a distance substantially equal to one half wavelength of a resonant frequency of the radiating element (78, 88, 90) of the first antenna."); Ex. 1003 ¶ 111.

Accordingly, Kangasvieri teaches “wherein said at least one slot is arranged for providing enhanced isolation between a feeding point of said first antenna and a feeding point of said second antenna.” Ex. 1003 ¶ 112.

Third, a POSITA would have recognized that the effect of the slot is to provide a high-impedance path in the ground plane between the two feeding points at a frequency band corresponding to an operating band of the antennas. Ex. 1003 ¶ 113. For example, Kangasvieri discloses that “a primary object of the present invention to improve the isolation between antennas *operating in substantially the same frequency band* and disposed over a common ground plane for grounding.” Ex. 1005 ¶ 64 (emphasis added). Kangasvieri explains that “[t]o achieve this object, the present invention *uses a cut in the common ground plane to change the phase of the conducted power in the ground plane.*”⁹ Ex. 1005 ¶ 64 (emphasis added).

⁹ Kangasvieri uses the terms “cut” and “slot” interchangeably to describe the discontinuity formed in the ground plane to improve antenna isolation. *Compare* Ex. 1005, Abstract (“a cut is provided between the first and second sections of the ground plane”), ¶¶ 4 (“providing a cut in the ground plane”), 64 (“cut in the common ground plane”), *with* ¶¶ 10 (“a slot (20) provided between the first section and the second section of the ground plane”), 65 (“a slot 20 is provided in the ground plane 10”); Ex. 1003 n. 6.

Kangasvieri teaches that “[t]he object can be achieved by *providing a cut in the ground plane for causing the conducted power in the ground plane to undergo a 180-degree phase shift* with respect to the radiated power in air.” Ex. 1005 ¶ 4 (emphasis added). A POSITA would have understood that dimensions of the slot, where the length corresponds to a quarter-wave, provide the isolation between the feed points that cause the conducted power in the ground plane to undergo a 180-degree phase shift with respect to the radiated power in air. Ex. 1003 ¶ 114. For instance, “[t]he *length of the cut is substantially equal to one quarter-wavelength of the operating frequency band* of transmit/receive antenna pair *so as to provide isolation between the transmit antenna and the receive antenna.*” Ex. 1005 at Abstract (emphasis added). A POSITA would have understood that the quarter-wave slot presents high impedance, ideally approaching an open-circuit or infinite impedance condition, at its resonant frequency as the round-trip current path has a total electrical length of approximately one-half wavelength ($\lambda/2$), which produces a 180-degree phase shift.¹⁰ Ex. 1003 ¶ 114; Ex. 1005 ¶¶ 10 (“The slot has an effective

¹⁰ A POSITA would understand that the round-trip surface-current path around the slot is $(2 \times \lambda/4) + \Delta \approx \lambda/2$, where Δ represents the additional path length associated with traversing the slot width. Ex. 1003 at n. 7. Because the slot width is small relative to the slot length, the resulting electrical path length is approximately one-half

length (L) substantially equal to a quarter wavelength of the frequency band.”), 65; *see also id.* cl. 1. Accordingly, a POSITA would have understood that Kangasvieri’s quarter-wavelength slot structure functions as an effective high-impedance isolation element within the ground plane. Ex. 1003 ¶ 114.

Accordingly, Kangasvieri teaches “wherein said handheld device further comprises at least one slot in the substantially rectangular ground plane, wherein said at least one slot is arranged for providing enhanced isolation between a feeding point of said first antenna and a feeding point of said second antenna by providing a high impedance path in said substantially rectangular ground plane between said feeding points in at least one frequency band corresponding to an operating band of one of said first and second antennas.” Ex. 1003 ¶ 115.

The replacement of Kangasvieri’s first antenna with Chiba’s multifrequency PIFA does not materially alter the ground plane structure, the slot geometry, or the relative placement of the antenna feeding points. Ex. 1003 ¶ 116. So, a POSITA would have implemented Chiba’s multifrequency PIFA within Kangasvieri’s existing antenna position to preserve the disclosed device architecture. Accordingly, the slot 20 remains positioned in the substantially rectangular ground plane between

wavelength, corresponding to an approximately 180-degree phase shift at the operating frequency. *Id.*

the antenna feed regions, continuing to provide isolation as taught by Kangasvieri.
Id.

Thus, the Kangasvieri-Chiba combination discloses and/or suggests “wherein said handheld device further comprises at least one slot in the substantially rectangular ground plane, wherein said at least one slot is arranged for providing enhanced isolation between a feeding point of said first antenna and a feeding point of said second antenna by providing a high impedance path in said substantially rectangular ground plane between said feeding points in at least one frequency band corresponding to an operating band of one of said first and second antennas.” Ex. 1003 ¶ 117.

3. Claim 3

- a. **The handheld device according to claim 2, wherein said at least one slot in the substantially rectangular ground plane has an open end in correspondence with a perimeter of said substantially rectangular ground plane.**

The Kangasvieri-Chiba combination renders obvious claim 3. Ex. 1003 ¶¶ 118-122. As discussed above, Kangasvieri discloses a slot 20 formed in the ground plane 10. *Supra* Section IX.A.2; Ex. 1005, FIG. 2. The isometric and top views (Figures 1 and 2) depict the slot extending to the edge of the ground plane, thereby forming an open-ended slot at the perimeter. Ex. 1003 ¶ 118.

Kangasvieri further describes the slot as a “cut in the ground plane,” indicating a physical incision in the conductive ground structure. Ex. 1005 ¶ 4 (“The object can be achieved by providing a cut in the ground plane for causing the conducted power in the ground plane to undergo a 180-degree phase shift with respect to the radiated power in air.”); *see also* Abstract (“In an antenna structure having a transmit antenna disposed over a first section of a ground plane and a receive antenna disposed over a second section of the ground plane, a cut is provided between the first and second sections of the ground plane.”), FIG. 2. A POSITA would have understood that such a “cut” originates from and extends to the edge of the ground plane, as depicted in Figure 2, rather than forming a fully enclosed internal slot. Ex. 1003 ¶ 119.

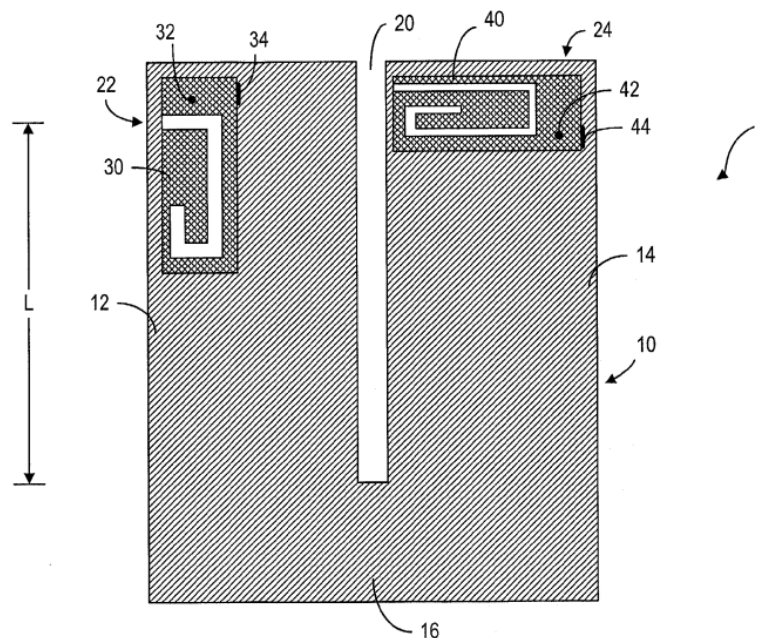


FIG. 2

Ex. 1005 FIG. 2.

Moreover, Kangasvieri explains that the slot 20 divides the ground plane 10 into a first section 12 and a second section 14, which remain galvanically connected only through a connecting section 16. Ex. 1005 ¶¶ 65, 66, FIGS. 1, 2. Accordingly, a POSITA would have understood that Kangasvieri's slot necessarily has an open end at the perimeter of the substantially rectangular ground plane as for the ground plane to be separated into two distinct sections connected solely by a connecting section 16, the slot must extend from the perimeter inward. Ex. 1003 ¶ 120.

Like discussed above, the combination of Kangasvieri with Chiba does not materially alter the ground plane structure, the slot geometry, or the relative placement of the antenna feed points. Ex. 1003 ¶ 121.

Thus, the Kangasvieri-Chiba combination renders obvious “[t]he handheld device according to claim 2, wherein said at least one slot in the substantially rectangular ground plane has an open end in correspondence with a perimeter of said substantially rectangular ground plane.” Ex. 1003 ¶ 122.

4. Claim 4

- a. The handheld device according to claim 2, wherein said at least one slot has a length of approximately $(2N-1)*A/4$, wherein A is a wavelength corresponding**

to a frequency within said operating band, and N is an integer, $N > 1$.

The Kangasvieri-Chiba combination renders obvious claim 4. Ex. 1003 ¶¶ 123-131. As discussed above for claim 2, the Kangasvieri-Chiba combination has a slot having an effective length of approximately one-quarter wavelength ($\lambda/4$) at the operating frequency of the antenna system. *Supra* Section IX.A.2; *see also* Ex. 1005 ¶¶ 10, 65, FIGS. 1-2. However, as discussed below, the extension to having a slot with a length of approximately $(2N-1) \cdot \lambda/4$, where $N > 1$ would have been obvious. Ex. 1003 ¶ 123.

Kangasvieri teaches this limitation. Ex. 1003 ¶ 124. For instance, the length formula for the slot “of approximately $(2N-1) \cdot \lambda/4$, wherein A is a wavelength corresponding to a frequency within said operating band” is simply the set of all odd-integer multiples of a quarter wavelength: $\lambda/4$, $3\lambda/4$, $5\lambda/4$, and so on. Each such length is functionally equivalent to $\lambda/4$ from the perspective of the underlying phase-cancellation mechanism that produces the claimed “enhanced isolation.” Ex. 1003 ¶ 124. A POSITA would have recognized this that each odd multiple of $\lambda/4$ produces a round-trip path along the slot edges of an odd multiple of $\lambda/2$, which in every case yields a net phase shift of an odd multiple of 180 degrees, that is, substantially 180-degree phase inversion. *Id.* The fundamental isolation mechanism is therefore preserved regardless of which odd multiple is selected. Ex. 1003 ¶ 125.

Put simply, the same cancellation effect of the slot occurs when $2L$ equals any odd half-wavelength, that is, when $L = (2N-1) \times \lambda/4$ for any positive integer N . In each case, the round-trip path produces a phase difference congruent to 180 degrees modulo 360 degrees, ensuring that the conducted and radiated energy remain in destructive phase alignment. Ex. 1003 ¶ 126. A POSITA would have readily understood that increasing N merely extends the effective slot path length by integer multiples without altering the fundamental cancellation mechanism. *Id.*

Here, Kangasvieri expressly teaches that electrical path length relative to wavelength controls antenna resonance, impedance characteristics, and the degree of phase shift experienced by conducted currents. Ex. 1005 ¶¶ 10, 65, FIGS. 1-2. That relationship is precisely what gives rise to the claimed isolation behavior. Ex. 1003 ¶ 127. Moreover, a POSITA would have recognized that designers also routinely selected odd multiples of $\lambda/4$ to accommodate practical engineering constraints such as PCB layout, antenna spacing, fabrication tolerances, and manufacturing resolution. *Id.* For instance, at lower operating frequencies, a $\lambda/4$ structure may become physically too large for a compact handheld device, while at higher frequencies, very small structures may present fabrication limitations. *Id.* In either case, selecting an odd multiple of $\lambda/4$ preserves the same underlying phase-cancellation mechanism and was a routine design choice. Ex. 1003 ¶ 128. Accordingly, the effective slot length is a result-effective variable, and selecting a

length corresponding to any odd integer multiple of $\lambda/4$ to achieve the known 180-degree phase cancellation effect would have been an obvious optimization within the routine skill of a POSITA. *In re Applied Materials, Inc.*, 692 F.3d 1289, 1297 (Fed. Cir. 2012) (“[a] recognition in the prior art that a property is affected by the variable is sufficient to find the variable result-effective.”).

A POSITA would further have recognized that the choice among odd multiples of $\lambda/4$ is dictated by ordinary engineering and fabrication considerations, not by any inventive insight. Ex. 1003 ¶ 129; *KSR Int’l Co.*, 550 U.S. at 416. Additionally, “patent law does not attach uniqueness to dimensional claims that have no significance in the operation of the claimed invention.” *Gardner v. TEC Systems, Inc.*, 725 F.2d 1338, 1349 (Fed. Cir. 1984) (affirming a finding of invalidity as “the dimensional limitations did not specify a device which performed and operated any differently from the prior art”).

Like discussed above, the combination of Kangasvieri with Chiba does not materially alter the ground plane structure or the slot function. Ex. 1003 ¶ 130.

Thus, the Kangasvieri-Chiba combination renders obvious “[t]he handheld device according to claim 2, wherein said at least one slot has a length of approximately $(2N-1)*A/4$, wherein A is a wavelength corresponding to a frequency within said operating band, and N is an integer, $N>1$.” Ex. 1003 ¶ 131.

5. Claim 19

- a. The handheld device according to claim 1, wherein the second antenna is arranged to operate in at least one frequency band used for a mobile communication service.**

The Kangasvieri-Chiba combination renders obvious claim 19. Ex. 1003 ¶¶ 132-135. As discussed above for claim 1, Kangasvieri expressly teaches that the second antenna operates in a frequency band used for mobile communication services. *Supra* Section IX.A.1.a-h. Specifically, Kangasvieri teaches that the second antenna may be used to cover the PCS band and further discusses operation in bands such as GSM 850. Ex. 1005 ¶¶ 65, 72. These bands are standard mobile communication service bands used in cellular networks. Ex. 1003 ¶ 132.

Thus, Kangasvieri teaches “wherein the second antenna is arranged to operate in at least one frequency band used for a mobile communication service”. Ex. 1003 ¶ 133.

The replacement of Kangasvieri’s first antenna with Chiba’s multifrequency PIFA does not modify or alter the operation of Kangasvieri’s second antenna. As explained above, Chiba is relied upon only for the structure and multi-band capability of the first antenna. The second antenna remains as disclosed in Kangasvieri and continues to operate in a mobile communication service band. Ex. 1003 ¶ 134.

Accordingly, the Kangasvieri-Chiba combination discloses and/or suggests “[t]he handheld device according to claim 1, wherein the second antenna is arranged to operate in at least one frequency band used for a mobile communication service.” Ex. 1003 ¶ 135.

6. Claim 20

- a. The handheld device according to claim 1, wherein the second antenna is selected from the group consisting of monopole antenna, PIFA, IFA, or patch antenna.**

The Kangasvieri-Chiba combination renders obvious claim 20. Ex. 1003 ¶¶ 136-138. As discussed above for claim 1, Kangasvieri expressly teaches a second antenna. *Supra* Section IX.A.1.d. Kangasvieri further teaches that the second antenna is implemented as a planar inverted-F antenna (PIFA) structure. Ex. 1005 ¶¶ 63, 72, FIG. 2.

As discussed above for Claim 19, the combination of Kangasvieri with Chiba affects only the first antenna and does not alter the type of Kangasvieri’s second antenna. *Supra* Section IX.A.4. Ex. 1003 ¶ 137.

Accordingly, the Kangasvieri-Chiba combination discloses and/or suggests “[t]he handheld device according to claim 1, wherein the second antenna is selected from the group consisting of monopole antenna, PIFA, IFA, or patch antenna”. Ex. 1003 ¶ 138.

**B. Ground 2: The combination of Kangasvieri, Chiba, and Inoue
Renders Obvious Claims 5 and 6.**

1. Claim 5

- a. The handheld device according to claim 1, further comprising at least one conductive strip connected to the substantially rectangular ground plane, wherein said at least one conductive strip is arranged so as to provide a high impedance path in said substantially rectangular ground plane between a feeding point of said first antenna and a feeding point of said second antenna in at least one frequency band corresponding to an operating band of one of said first and second antennas.**

The Kangasvieri-Chiba combination, in further view of Inoue renders obvious claim 5. Ex. 1003 ¶¶ 139-152. As discussed above for claim 1, the Kangasvieri-Chiba combination discloses a handheld device comprising a first antenna operating in at least three frequency bands used for mobile communication services, and a second antenna operating in at least one frequency band. *Supra* Section IX.A.1.a-h; *see also* Ex. 1005 ¶¶ 65, 69, 72, FIGS. 1-2.

As discussed above for claim 2, Kangasvieri further teaches the concept of modifying the ground plane of a mobile terminal to control surface current propagation and improve isolation between the two antennas. *Supra* Section IX.A.2; Ex. 1003 ¶ 140. Specifically, Kangasvieri achieves this isolation by introducing a slot 20 in the substantially rectangular ground plane, which provides enhanced isolation between a feeding point of first antenna and a feeding point of said second antenna by producing a 180-degree phase shift at the second feed point. Ex. 1005

¶¶ 4, 10, 45, 64, 65, FIGS. 1, 2. That is, Kangasvieri's slot provides a high impedance path in the substantially rectangular ground plane between the feeding points in at least one frequency band corresponding to an operating band of one of the first and second antennas. Ex. 1003 ¶ 140. Kangasvieri, however, does not expressly teach using a conductive strip connected to the ground plane as the structure providing the high-impedance path between feed points. *Id.*

It would have been obvious to a POSITA to implement the isolation function taught by Kangasvieri using a conductive strip based on the teachings of Inoue. Ex. 1003 ¶ 141.

i. Inoue

Inoue teaches a similar isolation objective using a conductive structure connected to the ground plane rather than a slot, explaining that mutual coupling between adjacent antenna elements is suppressed by a “boxy metallic wall” surrounding the microstrip patch. Ex. 1009 at 17-18 (§ 1 Introduction); Ex. 1003 ¶ 142. Specifically, Inoue discloses that “mutual coupling of this antenna is suppressed by the boxy metallic wall around the microstrip patch,” and further explains that “[t]he wall is connected to the ground plane of the microstrip antenna.” Ex. 1009 at 18. Thus, Inoue teaches a conductive structure connected to the ground plane that suppresses mutual coupling between neighboring antenna elements by

reducing unwanted interaction across the shared conductive surface. *Id.*; Ex. 1003 ¶ 143.

A POSITA would have understood that Inoue’s metallic wall performs the same fundamental function as Kangasvieri’s slot, namely, creating a high-impedance isolation region between adjacent antenna feed points to suppress coupling and improve independent antenna operation. Ex. 1003 ¶ 144. Although Inoue illustrates a boxy metallic wall surrounding the microstrip patch antenna, a POSITA would have understood that the relevant teaching is the use of a conductive structure connected to the ground plane to suppress mutual coupling by creating a high-impedance boundary. Ex. 1003 ¶ 145. The isolation effect arises from the conductive wall’s ability to alter surface-current propagation across the shared conductive plane, not from the fact that the wall completely surrounds the antenna element. *Id.*

A POSITA would have understood that Inoue’s “boxy metallic wall” corresponds to the recited “conductive strip” because the relevant characteristic is whether the structure is a conductive element connected to the ground plane and arranged to provide a high-impedance isolation path between antenna feed points, not whether the reference labels it as a “strip” or a “wall.” Ex. 1003 ¶ 146. Inoue’s metallic wall is an elongated conductive member having physical dimensions, including width, height, and depth, is physically connected to the ground plane, and

functions by altering current flow across the shared conductive surface to reduce coupling between adjacent antenna elements (including antenna feed regions). Ex. 1009 at 18; Ex. 1003 ¶ 146. A POSITA, therefore, would have recognized that Inoue's metallic wall is simply an implementation of the claimed conductive strip. Ex. 1003 ¶ 146.

ii. Reasons to Combine and Reasonable Expectation of Success

A POSITA would have been motivated, in light of Inoue, to configure the combined Kangasvieri-Chiba mobile terminal so that the isolation structure between the first and second antenna feed points includes at least one conductive wall (i.e., a conductive strip) connected to the substantially rectangular ground plane. Ex. 1003 ¶ 147. For instance, Kangasvieri and Inoue are directed to the same technological field: inter-antenna isolation in compact portable wireless devices having two antenna elements with separate feed points disposed over a common substantially rectangular ground plane. *Compare* Ex. 1005 ¶¶ 4, 65, FIGS. 5a, 5b. *with* Ex. 1009 at 17-18, FIGS. 5, 6. Because Inoue addresses the similar isolation problem and as discussed above, Inoue teaches that mutual coupling between adjacent antenna elements can be suppressed using a conductive metallic wall connected to the ground plane (Ex. 1009 at 18), a POSITA implementing the combined Kangasvieri-Chiba mobile terminal would have had direct reason to consider Inoue's teachings. Ex. 1003 ¶ 147.

A POSITA would have understood that, in adapting Inoue's teaching to the Kangasvieri-Chiba mobile terminal, a single conductive wall positioned between the adjacent antenna feed points on the common ground plane could provide a similar isolation function as Kangasvieri's slot or cut; namely, reducing coupling by creating a high-impedance boundary that suppresses unwanted current propagation between the antennas. Ex. 1003 ¶ 148.

Such a modification would have been a straightforward combination of known antenna-isolation techniques using known methods to achieve predictable results. *See KSR Int'l Co.*, 550 U.S. at 416-18. Indeed, a POSITA would have recognized that such a modification to the combined Kangasvieri-Chiba mobile terminal would have required little to no redesign of the overall mobile-terminal architecture or expansion of the ground plane, while also preserving ground-plane continuity and avoiding the need to cut or interrupt the ground plane, an important practical consideration as device size and available PCB area decrease. Ex. 1003 ¶ 149. Moreover, unlike a slot, which requires cutting or interrupting the ground plane, Inoue's conductive metallic wall is connected to the ground plane while preserving its overall continuity, allowing the designer to achieve a similar isolation objective, reducing mutual coupling between adjacent antenna elements, without introducing a structural discontinuity in the PCB. *Id.* That is, given Kangasvieri's compact mobile-terminal architecture and the well-recognized need to minimize

antenna coupling within a limited PCB footprint, a POSITA would have recognized that Inoue's metallic-wall approach offered a practical alternative to Kangasvieri's slot-based isolation structure. Ex. 1003 ¶ 149.

Indeed, the field of antenna design recognized both conductive isolation structures (such as conductive strips or conductive walls) and slot-based isolation structures as standard approaches for controlling surface-wave propagation and reducing electromagnetic coupling on ground planes. Ex. 1003 ¶ 150; Ex. 1008 at 12-13; Ex. 1025 at 2059-2060; Ex. 1026 at Abstract. A POSITA therefore would have understood that the choice between a slot and a conductive wall would have been a straightforward engineering decision based on ordinary design considerations such as PCB layout constraints, manufacturing preferences, mechanical robustness, and desired ground-plane continuity. Ex. 1003 ¶ 150. Because both approaches were known solutions to the same coupling problem, a POSITA would have had a reasonable expectation of success in substituting one for the other. *See Pfizer, Inc.*, 480 F.3d at 1364; Ex. 1003 ¶ 151.

Accordingly, the combination of Kangasvieri, Chiba, and Inoue renders obvious “[t]he handheld device according to claim 1, further comprising at least one conductive strip connected to the substantially rectangular ground plane, wherein said at least one conductive strip is arranged so as to provide a high impedance path in said substantially rectangular ground plane between a feeding point of said first

antenna and a feeding point of said second antenna in at least one frequency band corresponding to an operating band of one of said first and second antennas.” Ex. 1003 ¶ 152.

2. Claim 6

- a. The handheld device according to claim 5, wherein said at least one conductive strip has a length from its connection to the substantially rectangular ground plane, of approximately $(2N-1)*A/4$, wherein A is a wavelength corresponding to a frequency within said operating band, and N is an integer, $N>1$.**

The Kangasvieri-Chiba-Inoue combination renders obvious claim 6. Ex. 1003 ¶¶ 153-159. As discussed above for claim 5, the Kangasvieri-Chiba-Inoue combination teaches a conductive wall (“conductive strip”) connected to the substantially rectangular ground plane and arranged to provide a high-impedance path between the feed points of the first and second antennas. *Supra* Section IX.B.1. Additionally, the extension to having a conductive strip with a length of approximately $(2N-1)*A/4$, where $N>1$ would have been obvious as Kangasvieri and Inoue further teach that the effective length of that conductive structure is selected relative to wavelength to achieve the desired isolation performance. Ex. 1003 ¶ 153.

As discussed above for claim 4, Kangasvieri teaches that the isolation slot 20 is dimensioned such that the length of the cut is substantially equal to one quarter-wavelength of the operating frequency band to provide isolation between the

transmit and receive antennas. Ex. 1005, Abstract; *see also* Ex. 1005 ¶¶ 4, 10, 45, 64-65; *supra* Section IX.A.4. Thus, as explained above, Kangasvieri expressly teaches the underlying quarter-wavelength impedance principle used to create a high-impedance path between adjacent feed points. *Supra* Section IX.A.4; Ex. 1003 ¶ 154.

Inoue reinforces that conductive isolation structures connected to the ground plane are intentionally dimensioned relative to wavelength to optimize mutual coupling suppression. Ex. 1003 ¶ 155. In particular, Inoue states that “[t]he size of the wall L_x , L_y , h_x and h_y was optimized... to achieve -30 dB of mutual coupling between neighboring elements,” and further identifies optimized dimensions of “ $L_x = 0.4\lambda$, $L_y = 0.5\lambda$.” Ex. 1009 at 18. Inoue, thus, confirms that conductive isolation structures were routinely dimensioned based on wavelength-dependent RF behavior to achieve the desired impedance and isolation performance. Ex. 1003 ¶ 155.

A POSITA would have understood that once motivated to use a conductive isolation structure such as Inoue’s metallic wall in place of Kangasvieri’s slot, the length of that conductive structure would likewise be selected according to the same known quarter-wave design principles. Ex. 1003 ¶ 156. Specifically, a conductive wall, or equivalent conductive isolation structure having a length of approximately an odd multiple of a quarter wavelength, $L \approx (2N-1)*\lambda/4$, produces a high-impedance

transformation at the target operating frequency. *Id.* This is the same RF principle reflected in Kangasvieri's quarter-wave slot disclosure. *Id.*; Ex. 1005 ¶ 65.

A POSITA would have further understood would have recognized that selecting an electrical length corresponding to an odd multiple of $\lambda/4$ (e.g., $\lambda/4$, $3\lambda/4$, $5\lambda/4$) can achieve the same fundamental phase inversion associated with isolation structures such as a conductive wall or slot. Ex. 1003 ¶ 157. While higher-order multiples may introduce additional resonant behavior, the underlying mechanism, producing a phase shift that suppresses surface currents and reduces mutual coupling, remains the same. *Id.* A POSITA would have selected among these lengths based on routine design considerations, including available board space, antenna spacing, fabrication constraints, and the desired operating frequency. Ex. 1003 ¶¶ 157-158.

Accordingly, the combination of Kangasvieri, Chiba, and Inoue renders obvious “[t]he handheld device according to claim 5, wherein said at least one conductive strip has a length from its connection to the substantially rectangular ground plane, of approximately $(2N-1)*A/4$, wherein A is a wavelength corresponding to a frequency within said operating band, and N is an integer, $N>1$,” as recited in claim 5. Ex. 1003 ¶ 159.

**C. Ground 3: The combination of Kangasvieri, Chiba, and Vance
Renders Obvious Claim 7.**

3. Claim 7

- a. The handheld device according to claim 1, wherein the second antenna is arranged to operate in at least one frequency band used for a wireless service in accordance with Bluetooth™, IEEE802.11a, IEEE802.11b, IEEE802.11g, WLAN, WiFi, UWB, ZigBee, GPS, Galileo, SDARs, XDARS, WiMAX, DAB, FM, DVB-H, or DMB.**

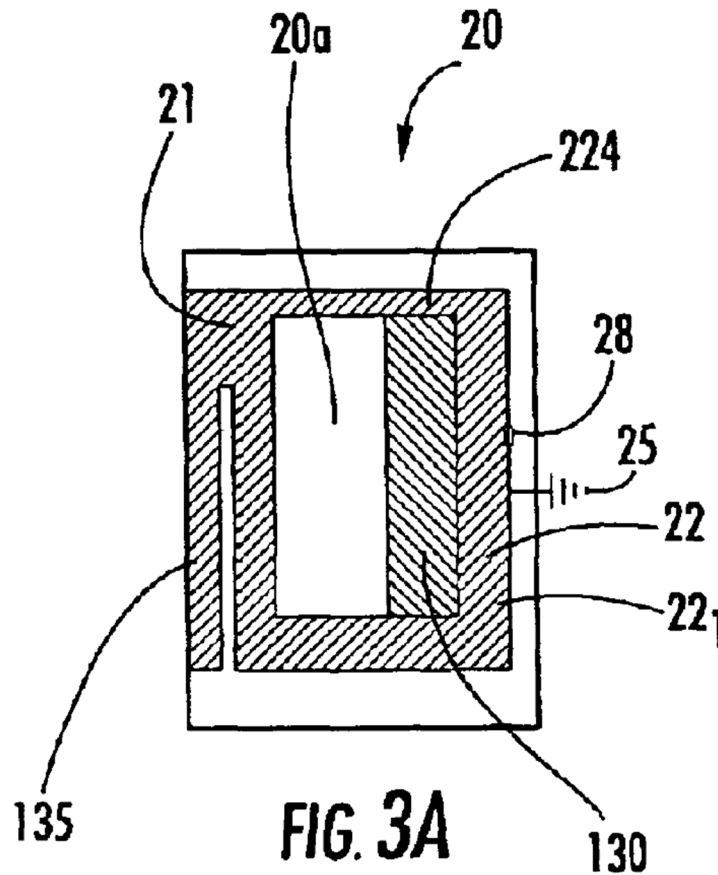
The combination of Kangasvieri, Chiba, and Vance renders obvious claim 7.

Ex. 1003 ¶¶ 160-169. As discussed above for claim 1, the combined Kangasvieri-Chiba mobile terminal comprises a first antenna operating in at least three frequency bands used for mobile communication services, and a second antenna operating in at least one frequency band. *Supra* Section IX.A.1.a-h; *see also* Ex. 1005 ¶¶ 65, 69, 72, FIGS. 1-2. Kangasvieri further teaches a second antenna configured for operation in a cellular communications band, such as GSM. Ex. 1005 ¶ 65. However, the Kangasvieri-Chiba combination does not expressly teach that the second antenna is arranged to operate in at least one frequency band used for a wireless service in accordance with Bluetooth™, IEEE802.11a, IEEE802.11b, IEEE802.11g, WLAN, WiFi, UWB, ZigBee, GPS, Galileo, SDARs, XDARS, WiMAX, DAB, FM, DVB-H, or DMB. As discussed below, Vance supplies this teaching. Ex. 1003 ¶ 160.

i. Vance

Vance teaches a known multi-band planar inverted-F antenna (“PIFA”) structure specifically designed for compact wireless terminals. Ex. 1007 at 5:13-34 (“The inverted-F conductive element can be configured to operate at a plurality, typically at least first and second, of resonant frequency bands and, in certain particular embodiments, can also be configured to operate at a third or more resonant frequency bands.”); *see also id.* at 2:51-66 (“planar inverted-F antennas are configured to operate at a plurality of resonant frequency bandwidths of operation (typically between about 2-4).”). Vance explains that the PIFA antenna is capable of operating in multiple distinct frequency bands, including a conventional cellular band such as GSM and an additional band used for another wireless service, such as GPS. *Id.* at 5:13-34, 5:40-55 (“the antenna may be configured to provide resonance for a global positioning System (GPS) as the terminal into which this antenna is to be built, can include a GPS receiver. GPS operates at approximately 1,575 MHz. . . . The additional resonance of *the antenna as described above permits the antenna to be used to receive these GPS signals.*”); Ex. 1003 ¶ 161.

For example, Figure 3A (below) illustrates an “antenna 20 [that] is configured to generate three resonance bands, . . . [and] includes a secondary band branch 135 (which creates band B at the GPS resonance (1575 MHz) and can widen the high-band resonance).” Ex. 1007 at 9:20-42.



Id. at FIG.3; Ex. 1003 ¶ 162. Accordingly, a POSITA would have understood that Vance teaches a single PIFA antenna element configured for multi-band operation, including cellular communications and additional connectivity functions, such as GPS. Ex. 1003 ¶ 162.

Thus, for the reasons above, Vance teaches an antenna capable of operating in at least one mobile communication band and also “arranged to operate in at least one frequency band used for a wireless service in accordance with Bluetooth™,

IEEE802.11a, IEEE802.11b, IEEE802.11g, WLAN, WiFi, UWB, ZigBee, GPS, Galileo, SDARs, XDARS, WiMAX, DAB, FM, DVB-H, or DMB.” Ex. 1003 ¶ 163.

ii. Reasons to Combine and Reasonable Expectation of Success

A POSITA would have been motivated to modify the combined Kangasvieri-Chiba mobile terminal by implementing Vance’s known multi-band PIFA antenna structure as the second antenna. Ex. 1003 ¶ 164.

First, all three references are directed to the same field of technology: compact internal antennas for portable wireless communication devices. E.g., Ex. 1005 ¶¶ 1, 35, 60, 69; Ex. 1006 at 1:4-10; Ex. 1007 at 5:13-34. Each reference addresses the common engineering problem of providing reliable wireless communications within the limited physical space of a handheld terminal. Ex. 1003 ¶ 165.

Second, Vance’s multi-band PIFA structure would have provided a known and predictable improvement to the combined Kangasvieri-Chiba mobile terminal by enabling the second antenna to operate not only in the cellular band already contemplated by Kangasvieri, but also in an additional service band, such as GPS or other connectivity frequencies. Ex. 1007 at 9:20-42; Ex. 1003 ¶ 166.

A POSITA would have recognized that implementing Vance’s multi-band PIFA in place of the second PIFA antenna in the combined Kangasvieri-Chiba handheld device would have been a straightforward use of a known antenna configuration to achieve its known advantage, multi-band operation in a compact

handset form factor. Ex. 1003 ¶¶ 166-167; Ex. 1012 at 1:10-2:16; *KSR Int’l Co.*, 550 U.S. at 416-18.

Because Vance’s antenna was expressly designed for handheld wireless terminals and for operation across multiple frequency bands, a POSITA would have had a reasonable expectation of success in using Vance’s structure within the combined Kangasvieri-Chiba mobile terminal. Ex. 1003 ¶ 168. Accordingly, it would have been obvious to configure the second antenna of the combined Kangasvieri-Chiba mobile terminal as a multi-band PIFA antenna operating in both the GSM band and an additional wireless-service band, as taught by Vance. Ex. 1003 ¶ 169.

Accordingly, the Kangasvieri-Chiba-Vance combination discloses and/or suggests [t]he handheld device according to claim 1, wherein the second antenna is arranged to operate in at least one frequency band used for a wireless service in accordance with Bluetooth™, IEEE802.11a, IEEE802.11b, IEEE802.11g, WLAN, WiFi, UWB, ZigBee, GPS, Galileo, SDARs, XDARS, WiMAX, DAB, FM, DVB-H, or DMB.” Ex. 1003 ¶ 169.

X. SECONDARY CONSIDERATIONS

There are no secondary considerations known to Petitioner that affect, let alone overcome, this strong case of obviousness. Should PO proffer any relevant evidence of secondary considerations, Petitioner reserves its rights to address.

XI. CONCLUSION

For these reasons, Petitioner respectfully requests institution.

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CLAIM LISTING APPENDIX

1. A handheld device comprising:

[a] a substantially rectangular ground plane;

[b] a first antenna configured to transmit and receive electromagnetic wave signals in at least three frequency bands used for mobile communication services;

[c] a second antenna configured to operate in at least one frequency band;

[d] the first antenna extends in a direction substantially parallel to a first side of the substantially rectangular ground plane;

[e] the second antenna extends in a direction substantially parallel to a second side of the substantially rectangular ground plane;

[f] the first antenna is arranged near a short side of the substantially rectangular ground plane; and

[g] the first side and the second side are substantially orthogonal.

2. The handheld device according to claim 1, wherein said handheld device further comprises at least one slot in the substantially rectangular ground plane, wherein said at least one slot is arranged for providing enhanced isolation between a feeding point of said first antenna and a feeding point of said second antenna by providing a high impedance path in said substantially rectangular ground plane between said feeding points in at least one frequency band corresponding to an operating band of one of said first and second antennas.

3. The handheld device according to claim 2, wherein said at least one slot in the substantially rectangular ground plane has an open end in correspondence with a perimeter of said substantially rectangular ground plane.

4. The handheld device according to claim 2, wherein said at least one slot has a length of approximately $(2N-1)*A/4$, wherein A is a wavelength corresponding to a frequency within said operating band, and N is an integer, $N>1$.

5. The handheld device according to claim 1, further comprising at least one conductive strip connected to the substantially rectangular ground plane, wherein said at least one conductive strip is arranged so as to provide a high impedance path in said substantially rectangular ground plane between a feeding point of said first antenna and a feeding point of said second antenna in at least one frequency band corresponding to an operating band of one of said first and second antennas.

6. The handheld device according to claim 5, wherein said at least one conductive strip has a length from its connection to the substantially rectangular ground plane, of approximately $(2N-1)*A/4$, wherein A is a wavelength corresponding to a frequency within said operating band, and N is an integer, $N>1$.

7. The handheld device according to claim 1, wherein the second antenna is arranged to operate in at least one frequency band used for a wireless service in accordance with Bluetooth™, IEEE802.11a, IEEE802.11b, IEEE802.11g, WLAN, WiFi, UWB, ZigBee, GPS, Galileo, SDARs, XDARS, WiMAX, DAB, FM, DVB-H, or DMB.

19. The handheld device according to claim 1, wherein the second antenna is arranged to operate in at least one frequency band used for a mobile communication service.

20. The handheld device according to claim 1, wherein the second antenna is selected from the group consisting of monopole antenna, PIFA, IFA, or patch antenna.

CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(d), the undersigned certifies that foregoing
PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO. 8,362,960
exclusive of the parts exempted as provided in 37 C.F.R. §42.24(a), contains 12,321
words and therefore complies with the type-volume limitations of 37 C.F.R.
§42.24(a).

Dated : June 12, 2026

Respectfully submitted,

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CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing **Petition for *Inter Partes* Review of U.S. Patent No. 8,362,960 and Exhibits 1001-1031** are being served on June 12, 2026, 2026 via Federal Express overnight mail on counsel of record for U.S. Patent No. 8,362,960 as addressed below:

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A courtesy copy is also being served on counsel for the patent holder in the pending litigation:

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