



US008427337B2

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

(10) **Patent No.:** **US 8,427,337 B2**
(45) **Date of Patent:** **Apr. 23, 2013**

(54) **PLANAR DIPOLE ANTENNA**

(75) Inventors: **Mark S. Wilbur**, Concord, OH (US);
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Justin M. Hennigan, Ashtabula, OH (US)

(73) Assignee: **Aclara RF Systems Inc.**, Solon, OH (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 249 days.

(21) Appl. No.: **12/832,332**

(22) Filed: **Jul. 8, 2010**

(65) **Prior Publication Data**

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Related U.S. Application Data

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H01Q 9/26 (2006.01)
H01Q 9/28 (2006.01)
H01Q 1/38 (2006.01)

(52) **U.S. Cl.**
USPC **340/870.02**; 343/793; 343/803; 343/807;
343/816; 343/822; 343/845; 343/846; 343/850;
343/852; 343/862; 343/863; 343/908

(58) **Field of Classification Search** 340/870.02,
340/870.03; 343/700 MS, 702, 719, 767,
343/770, 793, 795, 803, 807, 816, 820-822,
343/843, 845, 846, 850, 852, 860, 862, 863,
343/873, 908

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,387,379	A	6/1983	Hardie	
4,780,724	A	10/1988	Sharma et al.	
4,978,965	A	12/1990	Mohuchy	
5,268,701	A	12/1993	Smith	
5,914,695	A	6/1999	Liu et al.	
5,952,896	A	9/1999	Mett et al.	
5,999,141	A *	12/1999	Weldon	343/803
6,018,324	A	1/2000	Kitchener	

(Continued)

OTHER PUBLICATIONS

Madhuri Bharadwaj Eunni, "A Novel Planar Microstrip Antenna Design for UHF RFID," B.E., Electronics and Communication Engineering, A.M.A. College of Engineering, Kancheepuram-Madras University, India, pp. 1-116, May 2004.

(Continued)

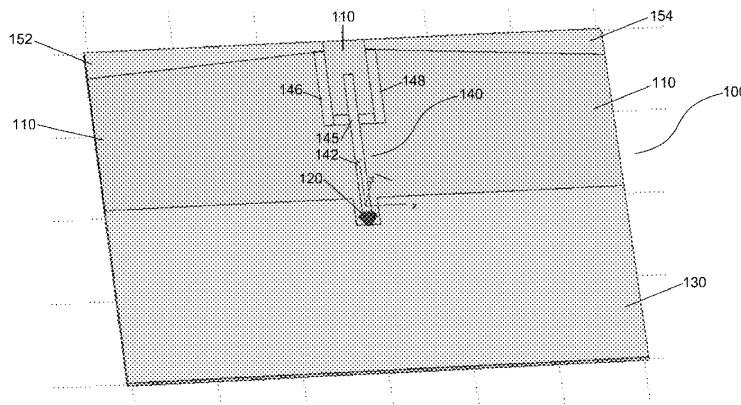
Primary Examiner — Levi Gannon

(74) Attorney, Agent, or Firm — Brinks Hofer Gilson & Lione

(57) **ABSTRACT**

A planar dipole antenna is described. The antenna may include a ground element, a feed point, a matching element, and first and second radiating elements disposed on a substrate, and a feed point. The ground element may have a substantially rectangular shape and the feed point may be arranged adjacent to the ground element. The matching element may be connected to the feed point and may include a central bar connected to a first and second arm. The first and second arms may be substantially symmetrically disposed on the substrate in respect to the central bar. The first and second radiating elements may have substantially trapezoidal shapes and may extend from the first and second arms of the matching element, respectively. The first and second radiating elements may be substantially symmetrically disposed on the substrate in respect to the central bar of the matching element.

25 Claims, 12 Drawing Sheets





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

(10) **Patent No.:** **US 8,427,373 B2**
(45) **Date of Patent:** **Apr. 23, 2013**

(54) **RFID PATCH ANTENNA WITH COPLANAR REFERENCE GROUND AND FLOATING GROUNDS**

(75) Inventors: **Bing Jiang**, San Diego, CA (US);
Richard John Campero, San Clemente, CA (US); **Steve Edward Trivelpiece**, Irvine, CA (US)

(73) Assignee: **Sensormatic Electronics, LLC.**, Boca Raton, FL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 653 days.

(21) Appl. No.: **12/247,994**

(22) Filed: **Oct. 8, 2008**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 60/978,389, filed on Oct. 8, 2007.

(51) **Int. Cl.**
H01Q 1/38 (2006.01)

(52) **U.S. Cl.**
USPC **343/700 MS**; 343/846

(58) **Field of Classification Search** 343/700 MS, 343/846
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,021,799 A * 6/1991 Kobus et al. 343/795
6,259,408 B1 7/2001 Brady et al.
7,737,908 B2 * 6/2010 Yanagi et al. 343/846

2002/0175865 A1 11/2002 Cassel et al.
2003/0210187 A1 11/2003 Wong et al.
2004/0233110 A1 11/2004 Hung et al.
2006/0033666 A1 2/2006 Su et al.
2006/0097925 A1 * 5/2006 Lee 343/700 MS
2006/0152364 A1 7/2006 Walton
2008/0030422 A1 2/2008 Gevargiz et al.
2010/0019038 A1 * 1/2010 Puente Baliarda et al. ... 235/439
2010/0220017 A1 * 9/2010 Ollikainen et al. 343/702

FOREIGN PATENT DOCUMENTS

JP 63-171004 7/1988
JP 10-135726 5/1998
JP 10135726 A * 5/1998
JP 2004-328693 11/2004
JP 2005-286997 10/2005
JP 2006-279451 10/2006
WO WO 95/03640 2/1995
WO WO 01/37372 5/2001

OTHER PUBLICATIONS

Coulibaly, Y., et al., "A New Single Layer Broadband CPW Fed-Printed Monopole Antenna for Wireless Applications", IEEE, 2004, pp. 1541-1544.
International Search Report issued Jan. 22, 2009 in corresponding PCT/US08/079247.
International Search Report issued Sep. 14, 2009 in corresponding PCT/US09/046657.

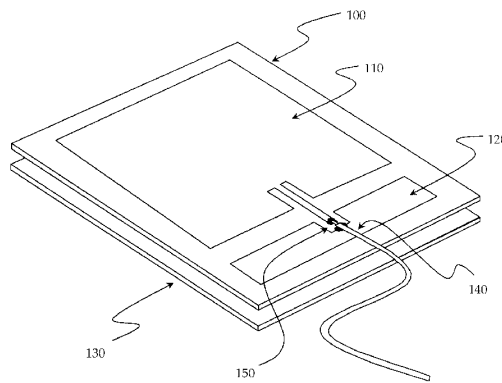
* cited by examiner

Primary Examiner — Hoang V Nguyen
Assistant Examiner — Kyana R McCain
(74) *Attorney, Agent, or Firm* — Rick Comoglio

(57) **ABSTRACT**

In accordance with a preferred embodiment of the invention, reader antennas are provided within storage fixtures for transporting RF signals between, for example, an RFID reader and an RFID tag. In a preferred embodiment, the RFID-enabled storage fixtures are implemented using an intelligent network, which may allow enhanced flexibility in controlling systems for interrogation of RFID antennas.

25 Claims, 11 Drawing Sheets



Patch antenna with coplanar reference ground, as described in the current invention.



US008427375B2

(12) **United States Patent**
Sato

(10) **Patent No.:** **US 8,427,375 B2**
(45) **Date of Patent:** **Apr. 23, 2013**

(54) **ELECTRONIC APPARATUS**

(75) Inventor: **Yutaka Sato**, Kawasaki (JP)

(73) Assignee: **Fujitsu Limited**, Kawasaki (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 415 days.

(21) Appl. No.: **12/379,546**

(22) Filed: **Feb. 24, 2009**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Jun. 27, 2008 (JP) 2008-169643

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 3/02 (2006.01)

H04M 1/00 (2006.01)

(52) **U.S. Cl.**

USPC **343/702**; 343/882; 455/575.7

(58) **Field of Classification Search** 343/702;

343/882; 455/575.7

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,123,756 A * 10/1978 Nagata et al. 343/702
5,271,684 A * 12/1993 Phillips 403/106
6,317,085 B1 * 11/2001 Sandhu et al. 343/702
7,050,008 B2 5/2006 Saito et al.
2002/0187805 A1 * 12/2002 Song 455/556

2004/0207558 A1 10/2004 Saito et al.
2007/0265028 A1 * 11/2007 Jorgensen 455/550.1
2008/0100518 A1 * 5/2008 Lev et al. 343/702

FOREIGN PATENT DOCUMENTS

JP 43-13954 6/1943
JP 6-58468 8/1994
JP 09-246826 9/1997
JP 2004-64211 2/2004
JP 2004-228790 8/2004
JP 2004-328316 11/2004
JP 2007-035361 2/2007

OTHER PUBLICATIONS

Japanese Office Action for Application 2008-169643 issued Jun. 26, 2012.

* cited by examiner

Primary Examiner — Jacob Y Choi

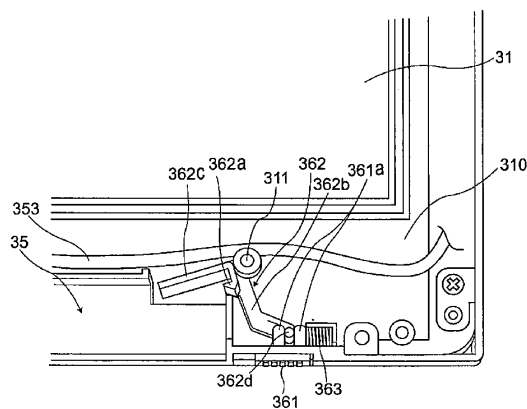
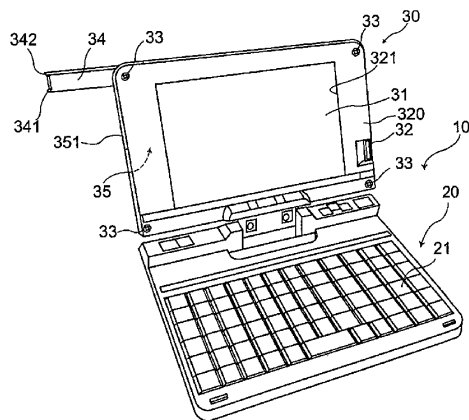
Assistant Examiner — Graham Smith

(74) *Attorney, Agent, or Firm* — Staas & Halsey LLP

(57) **ABSTRACT**

An electronic apparatus that includes a housing for housing an electronic component and an antenna body, the housing having a base body formed of a plate section and a side surface section, and a cover for covering an edge of the base body, the plate section including an antenna housing section and a protruding section, whereas the side surface section including an opening for communicating to the outside of the housing, and the antenna body having a plate piece-like shape with a length to be housed in the antenna housing section, having an antenna for radio communications and a bearing section with an insertion hole which penetrates front and back surfaces of the antenna body to receive insertion of the protruding section, the antenna body being housed in the antenna housing section between the plate section and the cover, and protruding from the housing when being rotated.

7 Claims, 36 Drawing Sheets





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(12) **United States Patent**
Wang

(10) **Patent No.:** **US 8,427,377 B2**
(45) **Date of Patent:** ***Apr. 23, 2013**

(54) **ANTENNA SYSTEM**
(75) Inventor: **Shu-Li Wang**, Santa Clara, CA (US)
(73) Assignee: **Apple Inc.**, Cupertino, CA (US)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 201 days.
This patent is subject to a terminal disclaimer.

5,227,805 A	7/1993	King et al.
5,469,178 A	11/1995	Nguyen et al.
6,121,935 A	9/2000	Reece et al.
6,400,321 B1	6/2002	Fenwick et al.
6,603,430 B1	8/2003	Hill et al.
6,697,025 B2	2/2004	Koyangi et al.
6,812,902 B2	11/2004	Rossman et al.
6,867,738 B2	3/2005	Birnbaum et al.
6,909,401 B2	6/2005	Rutfors et al.
6,924,773 B1	8/2005	Paratte
7,627,349 B2 *	12/2009	Vetelainen et al. 455/566
7,773,041 B2 *	8/2010	Wang 343/741

OTHER PUBLICATIONS

H. Nakano et al., "Low-Profile Inverted-F Antenna with Parasitic Elements on an Infinite Ground Plane," IEE Proceedings online No. 19982067, IEE Proc.-Microw. Antennas Propag., vol. 145, No. 4, Aug. 1998, pp. 321-325.
Constantine A. Balanis, "Linear Elements Near or on Infinite Perfect Conductors," Antenna Theory, 3rd Ed. Copyright 2005, Published by John Wiley & Sons, Hoboken, New Jersey, pp. 184-187, complete reference total pages 12.
Hishashi Moroshita et al., "A Balance-Fed Loop Antenna System for Handset," Paper: Special Section on Multi-Dimensional Mobile Information Networks, IEICE Trans. Fundamental, vol. E82-A, No. 7, Jul. 1999, pp. 1138-1143.

* cited by examiner

Primary Examiner — Tan Ho

(74) *Attorney, Agent, or Firm* — Nancy Y. Ru

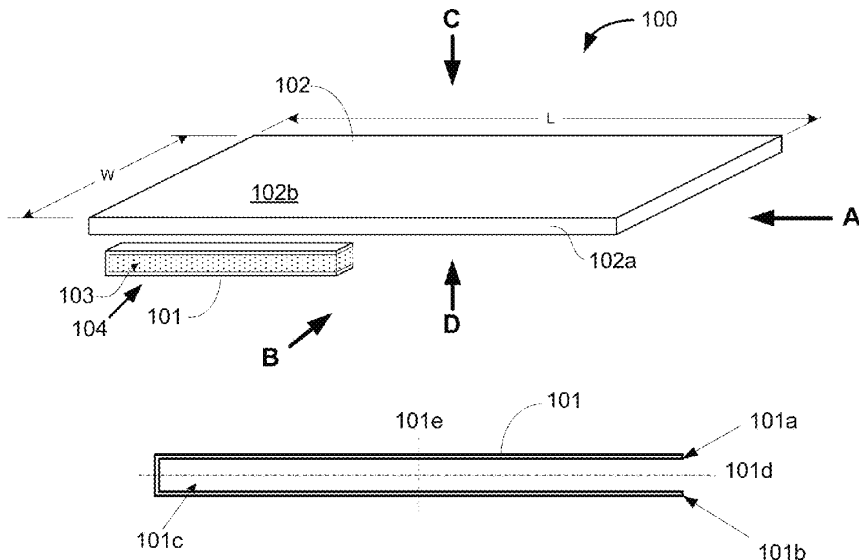
(21) Appl. No.: **12/764,788**
(22) Filed: **Apr. 21, 2010**
(65) **Prior Publication Data**
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Related U.S. Application Data
(62) Division of application No. 11/486,223, filed on Jul. 12, 2006, now Pat. No. 7,773,041.
(51) **Int. Cl.**
H01Q 1/24 (2006.01)
(52) **U.S. Cl.**
USPC **343/702**; 343/741; 343/866
(58) **Field of Classification Search** 343/741, 343/742, 702, 866
See application file for complete search history.

(57) **ABSTRACT**

An antenna system includes a dielectrically-loaded loop element electromagnetically coupled to a planar element. The antenna system exhibits uniform, broadband radiation and reception patterns.

(56) **References Cited**
U.S. PATENT DOCUMENTS
4,445,123 A 4/1984 Wright
5,113,196 A 5/1992 Ponce de Leon

17 Claims, 12 Drawing Sheets





US008427378B2

(12) **United States Patent**
Parsche

(10) **Patent No.:** **US 8,427,378 B2**
(45) **Date of Patent:** **Apr. 23, 2013**

(54) **ELECTRONIC DEVICE HAVING SOLAR CELL ANTENNA ELEMENT AND RELATED METHODS**

(75) Inventor: **Francis Eugene Parsche**, Palm Bay, FL (US)

(73) Assignee: **Harris Corporation**, Melbourne, FL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 374 days.

(21) Appl. No.: **12/844,035**

(22) Filed: **Jul. 27, 2010**

(65) **Prior Publication Data**
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H01Q 1/24 (2006.01)

(52) **U.S. Cl.**
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(58) **Field of Classification Search** 343/702, 343/700 MS, 904; 136/291, 24, 258, 261, 136/262; 250/347
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,864,317 A	9/1989	Sorko-Ram	343/720
4,879,570 A	11/1989	Takizawa et al.	343/713
5,161,255 A	11/1992	Tsuchiya	455/345
5,752,676 A	5/1998	Shapira et al.	244/173
5,760,706 A	6/1998	Kiss	340/825.69
5,986,618 A	11/1999	Aakula et al.	343/872
6,087,991 A	7/2000	Kustas	343/700 MS

6,191,746 B1	2/2001	Nagy	343/713
6,317,090 B1	11/2001	Nagy et al.	343/713
6,394,395 B1	5/2002	Poturalski et al.	244/173
6,522,301 B2	2/2003	Takayama et al.	343/709
6,590,150 B1*	7/2003	Kiefer	136/258
6,894,659 B2	5/2005	Pepperling et al.	343/878
6,952,530 B2	10/2005	Helvajian et al.	398/128
7,129,493 B2*	10/2006	Garner et al.	250/347
2008/0055177 A1	3/2008	Dixon	343/787
2011/0130179 A1*	6/2011	Luan	455/575.7

FOREIGN PATENT DOCUMENTS

DE 19938199 1/2001

OTHER PUBLICATIONS

Henze et al., "Photovoltaic Power Supply and Antennas in One Device for Wireless Telecommunication Equipment", IEEE, Sep. 2005, pp. 71-76.

Henze et al., "Investigation of Planar Antennas With Photovoltaic Solar Cells for Mobile Communications", IEEE, vol. 1, Sep. 2004, pp. 622-626.

IXOLAR™ High Efficiency SolarBIT, Technical Information XOB17, IXYS Semiconductor GmbH, Jun. 2009, pp. 1-4.

* cited by examiner

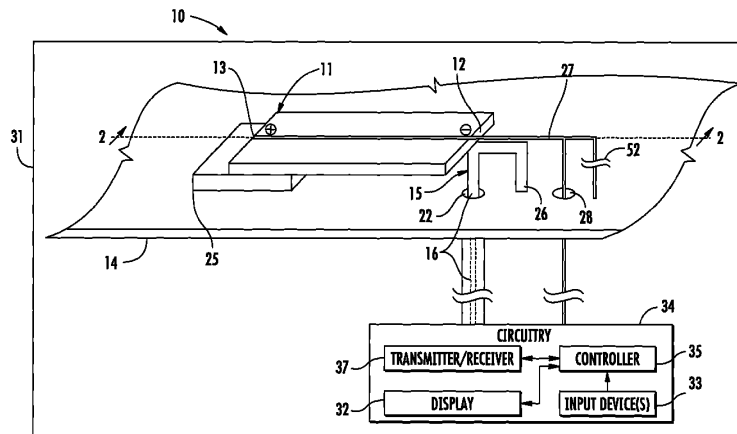
Primary Examiner — Hoang V Nguyen

(74) *Attorney, Agent, or Firm* — Allen, Dyer, Doppelt, Milbrath & Gilchrist, P.A.

(57) **ABSTRACT**

An antenna may include a ground plane and a solar cell spaced above the ground plane. The solar cell may have first and second power output terminals. The antenna may include a coaxial antenna feed line including an inner conductor coupled to the first power output terminal, and an outer conductor coupled to the ground plane so that the solar cell also serves as a patch antenna element. The antenna may further include a drive shunt conductor extending between the first terminal and the ground plane.

20 Claims, 10 Drawing Sheets





US008427379B2

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

(10) **Patent No.:** **US 8,427,379 B2**
(45) **Date of Patent:** **Apr. 23, 2013**

(54) **MODULAR MATERIAL ANTENNA ASSEMBLY**

(75) Inventors: **Fletcher R. Rothkopf**, Los Altos, CA (US); **Phillip M. Hobson**, Menlo Park, CA (US); **Adam Mittelman**, San Francisco, CA (US); **Anna-Katrina Shedletsy**, Sunnyvale, CA (US)

(73) Assignee: **Apple Inc.**, Cupertino, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 348 days.

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(22) Filed: **Aug. 19, 2010**

(65) **Prior Publication Data**

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(52) **U.S. Cl.**
USPC **343/702**; 343/878

(58) **Field of Classification Search** 343/702, 343/878
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,074,419 A	2/1978	Hannie et al.
5,045,971 A	9/1991	Ono et al.
5,128,829 A	7/1992	Loew
5,180,644 A	1/1993	Bresin et al.
5,373,300 A	12/1994	Jenness et al.
5,468,947 A	11/1995	Danielson et al.
5,568,358 A	10/1996	Nelson et al.
5,737,183 A	4/1998	Kobayashi et al.
5,784,256 A	7/1998	Nakamura et al.

5,796,575 A	8/1998	Podwalny et al.
6,038,328 A	3/2000	Hsu
6,137,890 A	10/2000	Markow
6,144,368 A	11/2000	Ooka et al.
6,153,834 A	11/2000	Cole et al.
6,408,171 B1	6/2002	Schuelke et al.
6,427,017 B1	7/2002	Toki
6,452,811 B1	9/2002	Tracy et al.
6,536,589 B2	3/2003	Chang
6,746,797 B2	6/2004	Benson et al.

(Continued)

FOREIGN PATENT DOCUMENTS

CN	1079348	12/1993
CN	1188387	7/1998

(Continued)

OTHER PUBLICATIONS

Evaluation Report for Utility Model Patent ZL2009201775365 dated May 28, 2010.

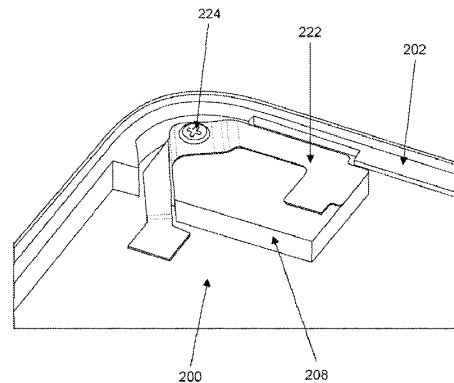
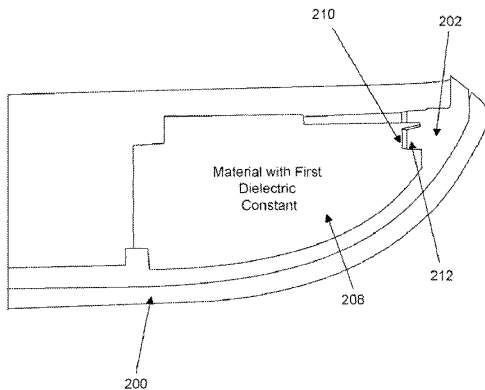
(Continued)

Primary Examiner — Anh Tran

(57) **ABSTRACT**

A modular material antenna assembly is provided that includes an antenna block having a portion with a shape that interlocks with a corresponding portion of an electrically non-conductive frame and secures the antenna block to the electrically non-conductive frame. The electrically non-conductive frame is attached to an interior of an electrically conductive housing so that the electrically non-conductive frame and the electrically conductive housing form an integrated structure. An antenna flex is then mechanically secured to the antenna block. The antenna flex may also be electrically connected to a circuit board. The frame is designed to support a cover glass for the portable electronic device and may be affixed to a housing. The dielectric constant of the antenna block is substantially less than the dielectric constant of the frame.

26 Claims, 11 Drawing Sheets





US008432313B2

(12) **United States Patent**
Ma

(10) **Patent No.:** **US 8,432,313 B2**
(45) **Date of Patent:** **Apr. 30, 2013**

(54) **CONFORMAL AND COMPACT WIDEBAND ANTENNA**

(75) Inventor: **Guozhong Ma**, Farnborough (GB)
(73) Assignee: **Nokia Corporation**, Espoo (FI)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 845 days.

(21) Appl. No.: **12/308,722**
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(86) PCT No.: **PCT/IB2006/001736**
§ 371 (c)(1),
(2), (4) Date: **Dec. 22, 2008**

(87) PCT Pub. No.: **WO2008/001148**
PCT Pub. Date: **Jan. 3, 2008**

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H01Q 1/24 (2006.01)
H01Q 1/38 (2006.01)
H01Q 21/30 (2006.01)
(52) **U.S. Cl.**
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(58) **Field of Classification Search** **343/700 MS, 343/725, 729, 846, 848**
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,320,545	B1	11/2001	Nagumo et al.	343/700
6,452,558	B1 *	9/2002	Saitou et al.	343/725
7,218,282	B2 *	5/2007	Humpfer et al.	343/700 MS
7,268,730	B2 *	9/2007	Park et al.	343/700 MS
2001/0043159	A1	11/2001	Masuda et al.	343/700
2005/0116867	A1	6/2005	Park et al.	343/725
2005/0253761	A1	11/2005	Tung	343/702
2006/0044191	A1	3/2006	Harihara	343/700 MS

FOREIGN PATENT DOCUMENTS

EP	0 590 955	A2	4/1994
EP	1 102 348	A1	5/2001
EP	1 231 669	A1	8/2002

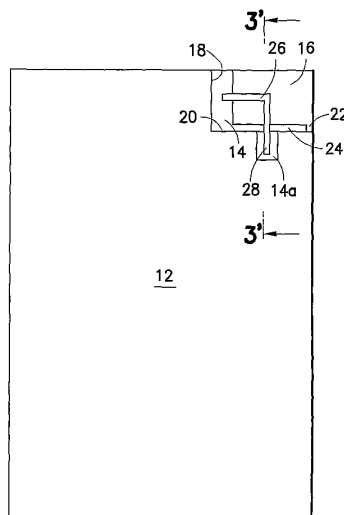
OTHER PUBLICATIONS

Guo Y X et al: "L-probe proximity-fed short-circuited patch antennas", Electronics Letters, IEE Stevenage, GB, vol. 35, No. 24, Nov. 25, 1999, pp. 2069-2070, XP006013020, ISSN: 0013-5194, DOI: 10.1049/EL: 19991446 (2 pages).

* cited by examiner
Primary Examiner — Michael C Wimer
(74) *Attorney, Agent, or Firm* — Harrington & Smith

(57) **ABSTRACT**
A substrate such as a printed wiring board defines a cutout of grounding metallization. A monopole radiating element is spaced laterally from edges of the grounding metallization in the cutout. A patch radiating element is spaced laterally from edges of the grounding metallization in the cutout. The monopole and patch radiating elements overlie at least a portion of one another to enable inductive coupling through an aperture characterized by the absence of grounding metallization, and the patch radiating element is shorted at a corner to the grounding metallization.

23 Claims, 11 Drawing Sheets





US008432317B2

(12) **United States Patent
Chen**

(10) **Patent No.:** US 8,432,317 B2
(45) **Date of Patent:** Apr. 30, 2013

- (54) **ANTENNA MODULE**
- (75) Inventor: **Hsi-Chieh Chen**, Tu-Cheng (TW)
- (73) Assignee: **Chi Mei Communication Systems, Inc.**, New Taipei (TW)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 279 days.
- (21) Appl. No.: **12/862,786**
- (22) Filed: **Aug. 25, 2010**
- (65) **Prior Publication Data**
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- (30) **Foreign Application Priority Data**
Jun. 30, 2010 (TW) 99121605
- (51) **Int. Cl.**
H01Q 5/00 (2006.01)
- (52) **U.S. Cl.**
USPC **343/700 MS; 343/702; 343/846; 343/895**

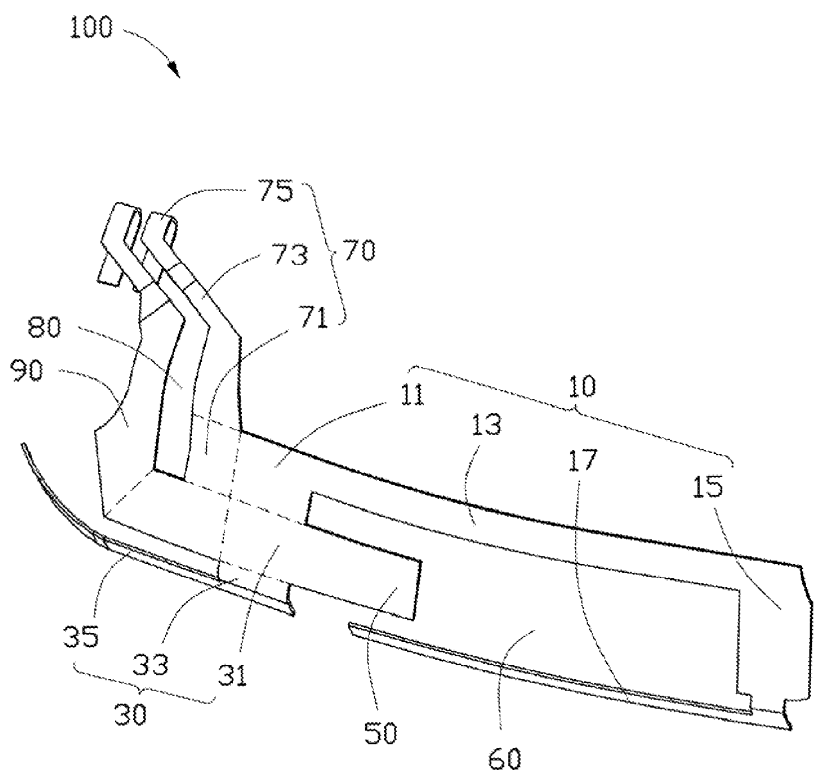
(58) **Field of Classification Search** 343/700 MS, 343/846, 702, 745-748, 829, 830; 29/600, 29/592.1, 832, 840-842
See application file for complete search history.

(56) **References Cited**
U.S. PATENT DOCUMENTS
7,498,992 B2 * 3/2009 Hung et al. 343/702
8,051,550 B2 * 11/2011 Cheng et al. 29/600
* cited by examiner

Primary Examiner — Shawki Ismail
Assistant Examiner — Christopher Lo
(74) *Attorney, Agent, or Firm* — Altis Law Group, Inc.

(57) **ABSTRACT**
An antenna module for a portable device includes a first antenna section, a second antenna section, a third antenna section, a feed section, and a ground section. The first antenna section and the third antenna section form a first groove. The feed section and the ground section are parallel to each other. The first antenna section and the second antenna section jointly connect with the feed section.

16 Claims, 3 Drawing Sheets





US008432318B2

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

(10) **Patent No.:** **US 8,432,318 B2**
(45) **Date of Patent:** **Apr. 30, 2013**

(54) **CAPACITIVE ANTENNA STRUCTURE**

(75) Inventors: **Tsai-Yi Yang**, Tainan Hsien (TW);
Wei-Hung Hsu, Tainan Hsien (TW)
(73) Assignee: **Cirocomm Technology Corp.**, Tainan
Hsien (TW)
(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 424 days.

(21) Appl. No.: **12/950,104**

(22) Filed: **Nov. 19, 2010**

(65) **Prior Publication Data**
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(51) **Int. Cl.**
H01Q 1/38 (2006.01)
(52) **U.S. Cl.**
USPC **343/700 MS**
(58) **Field of Classification Search** 343/700 MS,
343/702, 749
See application file for complete search history.

(56) **References Cited**

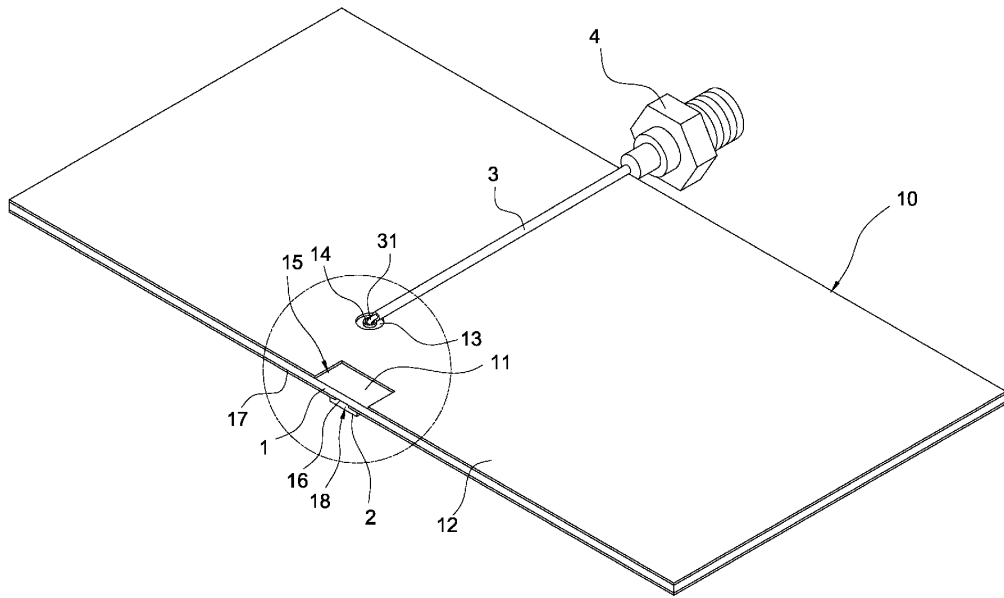
U.S. PATENT DOCUMENTS
8,035,564 B2 * 10/2011 Yang et al. 343/700 MS
* cited by examiner

Primary Examiner — Hoang V Nguyen
(74) *Attorney, Agent, or Firm* — Chun-Ming Shih; HDLS
IPR Services

(57) **ABSTRACT**

A capacitive antenna structure comprises a substrate and a sheet-shaped capacitor. The substrate has a radiating metal layer and a grounding metal layer thereon. The radiating metal layer has a first groove to expose the front surface of the substrate, the first groove having a signal feeding hole therein and having a second groove on the edge. The grounding metal layer has a third groove on the edge to expose the substrate, the third groove being opposite to the second groove, the third groove having a first contact and a second contact on two sides respectively to electrically connect to the capacitor. The third groove may connect to a fourth groove to expose the substrate, the fourth groove having a signal transmission line therein, and the signal transmission line having the signal feeding hole to connect a cable.

10 Claims, 7 Drawing Sheets





US008432319B2

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

(10) **Patent No.:** **US 8,432,319 B2**
(45) **Date of Patent:** **Apr. 30, 2013**

(54) **ANTENNA DEVICE**
(75) Inventors: **Shinsuke Yukimoto**, Tokyo (JP); **Takao Yokoshima**, Tokyo (JP)

(73) Assignees: **Mitsubishi Cable Industries, Ltd.**, Tokyo (JP); **Mitsubishi Materials Corporation**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 324 days.

(21) Appl. No.: **12/992,707**

(22) PCT Filed: **May 14, 2009**

(86) PCT No.: **PCT/JP2009/002105**

§ 371 (c)(1),
(2), (4) Date: **Dec. 29, 2010**

(87) PCT Pub. No.: **WO2009/139166**

PCT Pub. Date: **Nov. 19, 2009**

(65) **Prior Publication Data**

US 2011/0140981 A1 Jun. 16, 2011

(30) **Foreign Application Priority Data**

May 15, 2008 (JP) 2008-128867
Apr. 28, 2009 (JP) 2009-108897

(51) **Int. Cl.**
H01Q 1/24 (2006.01)

(52) **U.S. Cl.**
USPC **343/700 MS**; 343/846; 343/848

(58) **Field of Classification Search** 343/700 MS,
343/829, 846, 848, 849

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,355,740	A *	11/1967	Mayes	343/792.5
3,366,963	A *	1/1968	Goff	343/741
3,508,271	A *	4/1970	Kuecken	343/745
5,572,222	A *	11/1996	Mailandt et al.	343/700 MS
6,326,919	B1 *	12/2001	Diximus et al.	343/700 MS
6,339,402	B1 *	1/2002	McKivergan	343/702
6,985,108	B2 *	1/2006	Mikkola et al.	343/700 MS

FOREIGN PATENT DOCUMENTS

JP	09-167214	A	6/1997
JP	11-154815	A	6/1999
JP	2006-180463	A	7/2006
JP	2007-243276	A	9/2007

OTHER PUBLICATIONS

International Search Report for Appln. No. PCT/JP2009/002105 mailed Aug. 4, 2009.

* cited by examiner

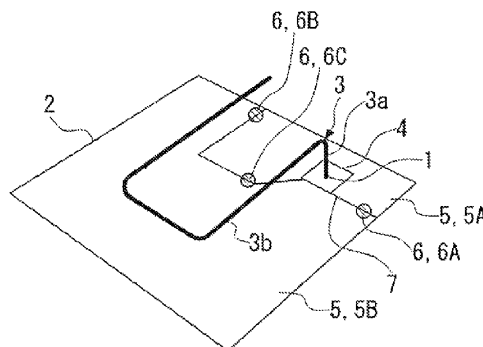
Primary Examiner — Tho G Phan

(74) *Attorney, Agent, or Firm* — Carter, DeLuca, Farrell & Schmidt

(57) **ABSTRACT**

An antenna device, wherein the polarization is improved by an identical antenna or substrate, and a higher gain and a smaller size are provided even when the installation conditions are changed. The antenna includes a base provided with a power feed point electrically connected to a power feed unit in a wireless circuit, an antenna element set up on the base and electrically connected to the power feed point, and a ground pattern provided on the base. The antenna element includes a rise part which rises from the base and an element part extending from the top edge of the rise in any direction in the plane parallel to the base. The ground pattern is divided into at least two ground regions by a boundary, and a ground connection part which electrically and locally connects the ground regions.

8 Claims, 5 Drawing Sheets





US008432320B2

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

(10) **Patent No.:** **US 8,432,320 B2**
(45) **Date of Patent:** **Apr. 30, 2013**

- (54) **MOBILE TERMINAL WITH A MONOPOLE LIKE ANTENNA**
- (75) Inventors: **Ole Jagielski**, Frederikshavn (DK);
Simon Svendsen, Aalborg Ost (DK)
- (73) Assignee: **Hewlett-Packard Development Company, L.P.**, Houston, TX (US)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 623 days.
- (21) Appl. No.: **12/296,335**
- (22) PCT Filed: **Apr. 11, 2007**
- (86) PCT No.: **PCT/EP2007/053506**
§ 371 (c)(1),
(2), (4) Date: **Jun. 16, 2010**
- (87) PCT Pub. No.: **WO2007/118824**
PCT Pub. Date: **Oct. 25, 2007**
- (65) **Prior Publication Data**
US 2010/0245177 A1 Sep. 30, 2010
- (30) **Foreign Application Priority Data**
Apr. 18, 2006 (EP) 06112695
- (51) **Int. Cl.**
H01Q 9/00 (2006.01)
H01Q 1/24 (2006.01)
- (52) **U.S. Cl.**
USPC **343/702**; 343/700 MS; 343/749
- (58) **Field of Classification Search** 343/702,
343/700 MS, 749, 829, 833, 834, 846, 895
See application file for complete search history.

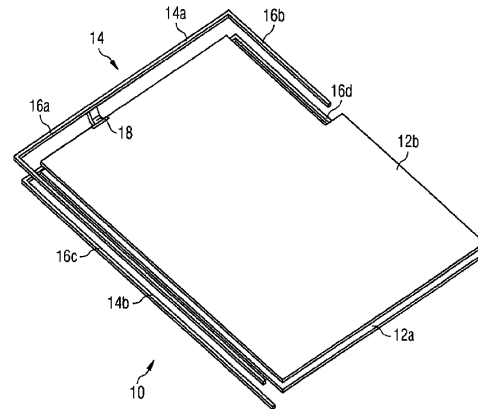
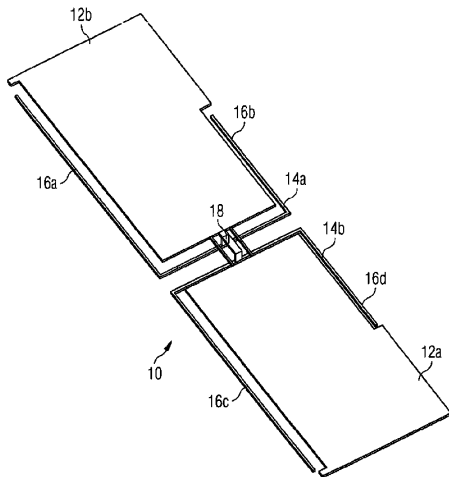
- (56) **References Cited**
U.S. PATENT DOCUMENTS
6,344,823 B1 * 2/2002 Deng 343/700 MS
6,535,170 B2 * 3/2003 Sawamura et al. 343/702
6,897,814 B2 * 5/2005 Iwai et al. 343/702
7,215,289 B2 * 5/2007 Harano 343/702
7,750,857 B2 * 7/2010 Kim 343/702
2003/0013490 A1 * 1/2003 Shoji et al. 455/562
2010/0214180 A1 * 8/2010 Krogerus 343/702
* cited by examiner

Primary Examiner — Vibol Tan

(57) **ABSTRACT**

A mobile terminal comprising: a casing with at least one body which has electronic means; an antenna arrangement having at least one antenna element (14) provided on or within said body or on or within at least one of several bodies of said casing in a defined spatial relation to a conducting chassis part (12) of the body or the respective bodies allowing a high frequency interaction between the antenna arrangement and the conducting chassis part, said conducting chassis part being limited by a periphery of the conducting chassis part. Said antenna element has at least one arm (16a, 16b) which extends outwardly of said periphery along at least one chassis part edge for promoting said high frequency interaction or/and that said antenna arrangement has at least two arms (16a, 16b) of different length which are provided by the same or at least two different antenna elements and which extend in different or opposed directions along at least one chassis part edge, wherein a shorter arm (16b) has an effective electrical length shorter than a quarter wavelength at a resonance frequency within the or a particular predetermined frequency band and a longer arm (16a) has an effective electrical length longer than a quarter wavelength at said resonance frequency, to improve the band width of said frequency band.

18 Claims, 19 Drawing Sheets





US008432321B2

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

(10) **Patent No.:** **US 8,432,321 B2**
(45) **Date of Patent:** **Apr. 30, 2013**

(54) **ANTENNA ARRANGEMENT AND ANTENNA HOUSING**

(75) Inventors: **Aimo Arkko**, Ruutana (FI); **Jani Ollikainen**, Helsinki (FI)

(73) Assignee: **Nokia Corporation**, Espoo (FI)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 500 days.

(21) Appl. No.: **12/595,056**

(22) PCT Filed: **Apr. 10, 2007**

(86) PCT No.: **PCT/IB2007/002217**

§ 371 (c)(1),

(2), (4) Date: **Nov. 12, 2009**

(87) PCT Pub. No.: **WO2008/122831**

PCT Pub. Date: **Oct. 16, 2008**

(65) **Prior Publication Data**

US 2010/0073247 A1 Mar. 25, 2010

(51) **Int. Cl.**
H01Q 1/24 (2006.01)

(52) **U.S. Cl.**
USPC **343/702; 343/767**

(58) **Field of Classification Search** **343/702, 343/767, 764**
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,396,202 A 3/1995 Scheck 333/230
5,661,493 A 8/1997 Uher et al. 343/700

5,914,693 A 6/1999 Takei et al.
6,282,433 B1 8/2001 Holshouser 455/556
6,337,662 B1 1/2002 Cassel 343/702
6,424,300 B1 7/2002 Sanford et al. 343/702
6,624,789 B1 9/2003 Kangasvieri et al. 343/702
6,801,166 B2 10/2004 Mikkola et al. 343/700 MS
6,879,293 B2* 4/2005 Sato 343/702
6,937,196 B2 8/2005 Korva 343/702
8,054,231 B2* 11/2011 Ahn et al. 343/702
2001/0053677 A1* 12/2001 Schiffer 455/128
2002/0050951 A1* 5/2002 Durham 343/700 MS
2004/0051670 A1* 3/2004 Sato 343/702
2006/0049987 A1 3/2006 Herrick 343/700 MS
2006/0097941 A1* 5/2006 Bettner et al. 343/767
2009/0153410 A1* 6/2009 Chiang et al. 343/702
2009/0153412 A1* 6/2009 Chiang et al. 343/702
2009/0153416 A1* 6/2009 Arbin et al. 343/702

FOREIGN PATENT DOCUMENTS

EP 0 018 476 3/1980
EP 0250832 A2 1/1988
JP 57103406 A 6/1982
JP 09074312 9/1995
JP 11074723 A 3/1999
JP 2004242034 2/2003
JP 2005167833 A 6/2005
WO WO-01/20716 A1 3/2001
WO WO-2004/100313 A1 11/2004
WO WO-2006/040609 A 4/2006
WO WO-2006/114477 A1 11/2006

* cited by examiner

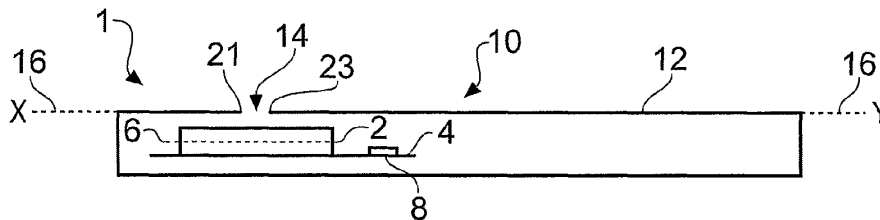
Primary Examiner — Hoanganh Le

(74) Attorney, Agent, or Firm — Harrington & Smith

(57) **ABSTRACT**

An antenna arrangement including an antenna occupying at least a first plane; a conductive structure that is isolated from the antenna but is arranged to be parasitically fed by the antenna, the conductive structure having a slot and occupying at least a second plane different to but adjacent the first plane.

20 Claims, 2 Drawing Sheets





US008432322B2

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

(10) **Patent No.:** **US 8,432,322 B2**
(45) **Date of Patent:** **Apr. 30, 2013**

(54) **ELECTRONIC DEVICES WITH CAPACITIVE PROXIMITY SENSORS FOR PROXIMITY-BASED RADIO-FREQUENCY POWER CONTROL**

(75) Inventors: **David T. Amm**, Sunnyvale, CA (US); **Robert W. Schlub**, Campbell, CA (US); **Omar S. Leung**, Palo Alto, CA (US); **Brian M. King**, Santa Cruz, CA (US); **Qingxiang Li**, Mountain View, CA (US); **Enrique Ayala Vazquez**, Watsonville, CA (US); **Rodney Andres Gomez Angulo**, Sunnyvale, CA (US); **Yi Jiang**, Sunnyvale, CA (US); **Ruben Caballero**, San Jose, CA (US)

(73) Assignee: **Apple Inc.**, Cupertino, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 414 days.

(21) Appl. No.: **12/632,695**

(22) Filed: **Dec. 7, 2009**

(65) **Prior Publication Data**

US 2011/0012793 A1 Jan. 20, 2011

Related U.S. Application Data

(60) Provisional application No. 61/226,683, filed on Jul. 17, 2009.

(51) **Int. Cl.**
H01Q 1/24 (2006.01)

(52) **U.S. Cl.**
USPC **343/702**; 343/872; 324/658

(58) **Field of Classification Search** 343/702, 343/872; 324/658

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,337,353 A 8/1994 Boie et al.
5,463,406 A 10/1995 Vannatta et al.
5,650,597 A 7/1997 Redmayne

(Continued)

FOREIGN PATENT DOCUMENTS

DE 102005035935 2/2007
EP 0 564 164 10/1993

(Continued)

OTHER PUBLICATIONS

U.S. Appl. No. 12/061,159, filed Apr. 2, 2008, Ligtenberg et al.

(Continued)

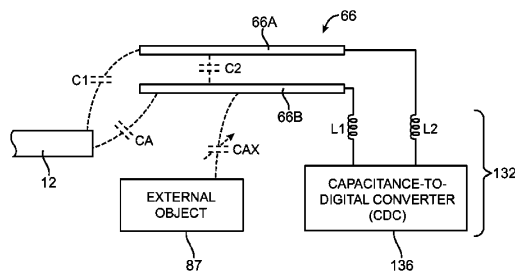
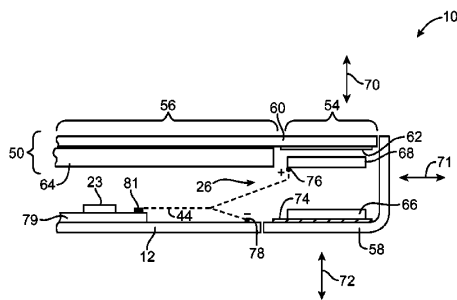
Primary Examiner — Dieu H Duong

(74) *Attorney, Agent, or Firm* — Treyz Law Group; G. Victor Treyz; Chih-Yun Wu

(57) **ABSTRACT**

An electronic device may have a housing in which an antenna is mounted. An antenna window may be mounted in the housing to allow radio-frequency signals to be transmitted from the antenna and to allow the antenna to receive radio-frequency signals. Near-field radiation limits may be satisfied by reducing transmit power when an external object is detected in the vicinity of the dielectric antenna window and the antenna. A capacitive proximity sensor may be used in detecting external objects in the vicinity of the antenna. The proximity sensor may have conductive layers separated by a dielectric. A capacitance-to-digital converter may be coupled to the proximity sensor by inductors. The capacitive proximity sensor may be interposed between an antenna resonating element and the antenna window. The capacitive proximity sensor may serve as a parasitic antenna resonating element and may be coupled to the housing by a capacitor.

19 Claims, 12 Drawing Sheets





US008432323B2

(12) **United States Patent**
Bit-Babik et al.

(10) **Patent No.:** **US 8,432,323 B2**
(45) **Date of Patent:** **Apr. 30, 2013**

(54) **ANTENNA INTEGRATED WITH A PORTABLE COMMUNICATION DEVICE**
(75) Inventors: **Giorgi Bit-Babik**, Sunrise, FL (US);
Jody H. Akens, Weston, FL (US);
Thomas J. Chappell, Coconut Creek, FL (US)
(73) Assignee: **Motorola Solutions, Inc.**, Schaumburg, IL (US)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 327 days.

2003/0164798	A1	9/2003	Nevermann	
2004/0171404	A1	9/2004	Annamaa et al.	
2006/0038733	A1 *	2/2006	Wedel et al.	343/795
2007/0035454	A1	2/2007	Zarnowitz et al.	
2011/0037664	A1 *	2/2011	Cho et al.	343/702
2012/0026046	A1 *	2/2012	Bit-Babik et al.	343/702

FOREIGN PATENT DOCUMENTS

WO 2007077461 A1 7/2007

OTHER PUBLICATIONS

PCT International Search Report Dated Jan. 2, 2012 for Counterpart Application PCT/US2011/042500.

* cited by examiner

(21) Appl. No.: **12/846,898**
(22) Filed: **Jul. 30, 2010**

Primary Examiner — Daniel D Chang
(74) *Attorney, Agent, or Firm* — Anthony P. Curtis; Daniel R. Bestor

(65) **Prior Publication Data**
US 2012/0026046 A1 Feb. 2, 2012

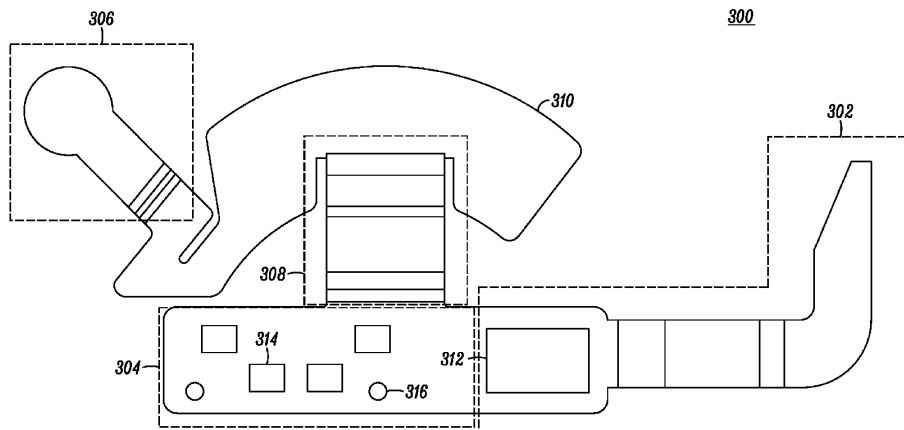
(57) **ABSTRACT**

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H04B 1/38 (2006.01)
(52) **U.S. Cl.**
USPC **343/702; 455/575.7**
(58) **Field of Classification Search** 343/702,
343/700 MS, 846-849; 455/575.1-575.9,
455/90.1-90.3
See application file for complete search history.

A radio is presented in which a short-range antenna, along with a speaker, is contained within a non-conductive speaker bracket. The antenna is a PIFA that is bent and extends through the speaker bracket so that the distance between the free end of the PIFA and various metallic components of the radio including the chassis and speaker is maximized. The structure containing the PIFA is flexible and also contains a contact area where feed/ground contact for the PIFA is made as well as contact for audio components including a speaker and microphone. A flexible cable and extension portion of the flexible structure routes the signals to the audio components far enough away from the PIFA so that the amount of crosstalk is insignificant. The free end of the PIFA and launch pad where feed/ground contact for the PIFA is made are non-planar.

(56) **References Cited**
U.S. PATENT DOCUMENTS
7,068,227 B2 6/2006 Ying
7,750,854 B2 * 7/2010 Wedel et al. 343/702

19 Claims, 10 Drawing Sheets





US008432324B2

(12) **United States Patent**
Chen

(10) **Patent No.:** **US 8,432,324 B2**
(45) **Date of Patent:** **Apr. 30, 2013**

(54) **ANTENNA MODULE AND COMMUNICATION DEVICE HAVING THE SAME**

(58) **Field of Classification Search** 343/702,
343/700 MS, 893
See application file for complete search history.

(75) Inventor: **Lung-Pao Chen**, Taipei Hsien (TW)

(56) **References Cited**

(73) Assignee: **Hon Hai Precision Industry Co., Ltd.**,
New Taipei (TW)

U.S. PATENT DOCUMENTS
6,549,169 B1 * 4/2003 Matsuyoshi et al. 343/702
6,847,328 B1 * 1/2005 Libonati et al. 343/700 MS
2008/0143610 A1 * 6/2008 Wang et al. 343/702

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 408 days.

* cited by examiner
Primary Examiner — Dieu H Duong
(74) *Attorney, Agent, or Firm* — Altis Law Group, Inc.

(21) Appl. No.: **12/878,957**

(57) **ABSTRACT**

(22) Filed: **Sep. 9, 2010**

An antenna module includes a first antenna and a second antenna which work at the same frequency. The first antenna includes a first feed portion, a first radiation portion, and a first ground portion. The second antenna includes a second feed portion and a second radiation portion. The first radiation portion is arc-shaped. The second radiation portion includes an arced edge and is coupled to the first radiation portion via the arced edge. The first feed portion and the second feed portion are connected to a signal terminal of a printed circuit board of a communication device and configured for feeding in electromagnetic waves. The ground portion is connected to a ground of the printed circuit board.

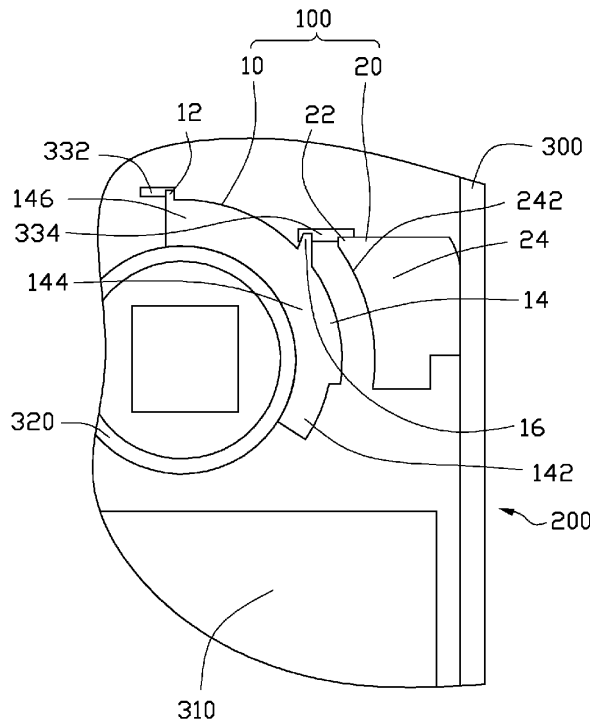
(65) **Prior Publication Data**
US 2012/0038517 A1 Feb. 16, 2012

(30) **Foreign Application Priority Data**
Aug. 13, 2010 (CN) 2010 1 0253524

(51) **Int. Cl.**
H01Q 1/24 (2006.01)

(52) **U.S. Cl.**
USPC **343/702; 343/893**

9 Claims, 3 Drawing Sheets





US008432325B2

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

(10) **Patent No.:** **US 8,432,325 B2**
(45) **Date of Patent:** **Apr. 30, 2013**

(54) **MOBILE WIRELESS COMMUNICATIONS DEVICE INCLUDING A GROUND PATCH PROVIDING SPECIFIC ABSORPTION RATE (SAR) REDUCTION AND RELATED METHODS**

(58) **Field of Classification Search** 343/702,
343/846, 700 MS
See application file for complete search history.

(75) Inventors: **Yihong Qi**, Waterloo (CA); **Ying Tong Man**, Waterloo (CA); **Perry Jarmuszewski**, Waterloo (CA)

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,765,536	B2	7/2004	Phillips et al.	343/702
6,819,287	B2	11/2004	Sullivan et al.	343/700 MS
6,864,842	B2	3/2005	Hung et al.	343/700 MS
7,397,432	B2	7/2008	Ku et al.	343/702

FOREIGN PATENT DOCUMENTS

CA	2571338	3/2007
EP	0603082	6/1994
EP	0878863	11/1998
EP	1331691	7/2003
GB	2351848	1/2001
GB	2390957	1/2004
WO	03026064	3/2003
WO	2005004277	1/2005

(73) Assignee: **Research In Motion Limited**, Waterloo, Ontario (CA)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

Primary Examiner — Hoang V Nguyen

(21) Appl. No.: **13/567,736**

(22) Filed: **Aug. 6, 2012**

(74) *Attorney, Agent, or Firm* — Allen, Dyer, Doppelt, Milbrath & Gilchrist, P.A.

(65) **Prior Publication Data**

US 2012/0293389 A1 Nov. 22, 2012

Related U.S. Application Data

(63) Continuation of application No. 13/206,552, filed on Aug. 10, 2011, now Pat. No. 8,253,635, which is a continuation of application No. 12/872,533, filed on Aug. 31, 2010, now Pat. No. 8,013,797, which is a continuation of application No. 12/472,638, filed on May 27, 2009, now Pat. No. 7,791,547, which is a continuation of application No. 11/733,360, filed on Apr. 10, 2007, now Pat. No. 7,554,496.

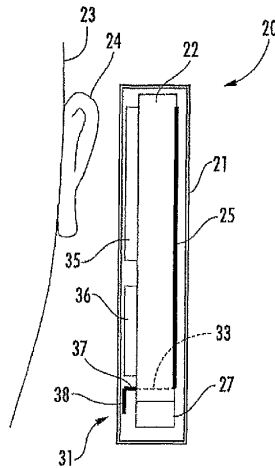
(57) **ABSTRACT**

A mobile wireless communications device may include a portable housing, a dielectric substrate carried by the portable housing having a front side facing toward a user and a back side opposite the front side, and a ground plane carried by the dielectric substrate. The device may further include at least one circuit carried by the dielectric substrate, and an antenna carried by the dielectric substrate adjacent an end thereof and electrically connected to the at least one circuit. A ground patch may be adjacent the front side of the dielectric substrate that is electrically connected to the ground plane and spaced apart from and at least partially overlapping the antenna.

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)

(52) **U.S. Cl.**
USPC **343/702; 343/846**

20 Claims, 3 Drawing Sheets





US008432327B2

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

(10) **Patent No.:** **US 8,432,327 B2**
(45) **Date of Patent:** **Apr. 30, 2013**

(54) **DUAL-BAND DIPOLE ANTENNA**

(75) Inventors: **John Chow**, Saratoga, CA (US);
Yun-Cheng Hou, Tu-Cheng (TW);
Chang-Ching Lin, Tu-Cheng (TW);
Sheng-Che Chang, Tu-Cheng (TW);
Chun-Chieh Tseng, Tu-Cheng (TW);
Taiichi Yamaguchi, Yokohama (JP)

(73) Assignee: **Hon Hai Precision Industry Co., Ltd.**,
New Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 400 days.

(21) Appl. No.: **12/787,380**

(22) Filed: **May 25, 2010**

(65) **Prior Publication Data**
US 2010/0295746 A1 Nov. 25, 2010

(51) **Int. Cl.**
H01Q 9/16 (2006.01)

(52) **U.S. Cl.**
USPC **343/793**; 343/795; 343/820

(58) **Field of Classification Search** 343/793,
343/795, 820-822
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS
5,406,295 A 4/1995 Baranski et al.
6,906,678 B2 6/2005 Chen
2002/0190912 A1* 12/2002 Lebaric et al. 343/795

2004/0108955 A1 6/2004 SjoBlom
2005/0237252 A1* 10/2005 Thudor et al. 343/770
2007/0024503 A1* 2/2007 Tsai et al. 343/700 MS

FOREIGN PATENT DOCUMENTS

TW M266567 6/2005

OTHER PUBLICATIONS

Multi-Band Operation of a Compact H-Shaped Microstrip Antenna,
Microwave and Optical Technology Letters, Dec. 5, 2002, vol. 35,
No. 5.

* cited by examiner

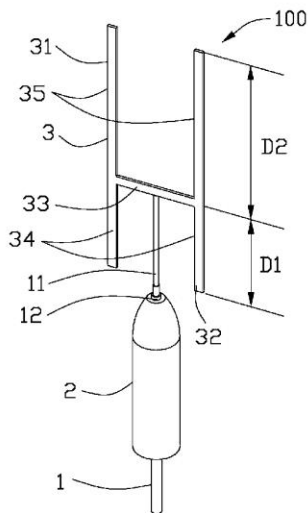
Primary Examiner — Anh Tran

(74) *Attorney, Agent, or Firm* — Wei Te Chung; Ming-Chieh
Chang

(57) **ABSTRACT**

A dual-band dipole antenna (100) includes a ground radiating
portion (2), a signal radiating portion (3) and a feed wire (1).
The feed wire (1) has a ground portion (12) connected to the
ground radiating portion (2), and a core conduct (11)
connected to the signal radiating portion (3). The signal radiating
portion (3) has a first branch (31), a second branch (32) having
a same length and a same width as the first branch (31), and a
middle portion (33) connecting the first branch (31) and the
second branch (32) at connecting points. Each of the first
branch (31) and the second branch (32) has a first radiating
length (D1) extending from the connecting point and a second
radiating length (D2) extending from the connecting point.

8 Claims, 7 Drawing Sheets





US008433269B2

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

(10) **Patent No.:** **US 8,433,269 B2**
(45) **Date of Patent:** **Apr. 30, 2013**

(54) **COMPACT SATELLITE ANTENNA**

(75) Inventors: **Robert Wayne Ridgeway**, Saratoga Springs, UT (US); **Paul A. Dahl**, Pleasant Grove, UT (US)

(73) Assignee: **Digi International Inc.**, Minnetonka, MN (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 252 days.

(21) Appl. No.: **12/917,783**

(22) Filed: **Nov. 2, 2010**

(65) **Prior Publication Data**

US 2011/0105062 A1 May 5, 2011

Related U.S. Application Data

(60) Provisional application No. 61/257,833, filed on Nov. 3, 2009.

(51) **Int. Cl.**
H04B 1/04 (2006.01)

(52) **U.S. Cl.**
USPC **455/129**; 455/550.1; 455/575.7; 343/872

(58) **Field of Classification Search** 455/120, 455/121, 129, 550.1, 575.1, 575.5, 575.7; 343/745, 750, 872

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,963,098 A 10/1990 Myer et al.
5,576,720 A 11/1996 Gorenz, Jr. et al.
5,779,496 A 7/1998 Bolinger et al.
5,886,590 A 3/1999 Quan et al.

6,166,615 A 12/2000 Winslow et al.
6,388,623 B1 * 5/2002 Sakota et al. 343/700 MS
6,409,550 B1 6/2002 Splichal et al.
6,559,809 B1 5/2003 Mohammadian et al.
6,759,984 B2 7/2004 Wielsma
6,773,286 B1 8/2004 Wu
6,824,419 B1 11/2004 Wu
6,842,143 B2 * 1/2005 Otaka et al. 343/700 MS
7,034,750 B2 4/2006 Asakura et al.

(Continued)

FOREIGN PATENT DOCUMENTS

CN 2482238 3/2002
EP 0856906 A2 8/1998

(Continued)

OTHER PUBLICATIONS

Yanagi, Masahiro, et al., "A Planar UWB Monopole Antenna Formed on a Printed Circuit Board", 1 pg.

(Continued)

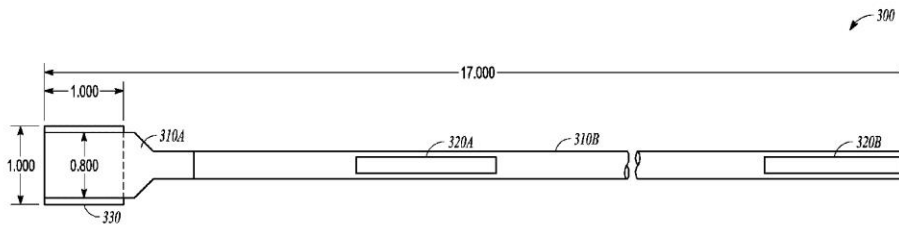
Primary Examiner — Nhan Le

(74) *Attorney, Agent, or Firm* — Fogg & Powers LLC

(57) **ABSTRACT**

An apparatus, such as an antenna assembly, can include a flexible dielectric sheet, a first flexible conductor coupled to the flexible dielectric sheet, a second flexible conductor coupled to the flexible dielectric sheet, a matching section electrically coupled to the first and second conductors, and a hollow dielectric housing having a curved interior surface. The first and second flexible conductors can be sized, shaped, and laterally spaced a specified distance from each other to provide a specified input impedance corresponding to a specified range of operating frequencies for use in wireless information transfer between the antenna assembly and a satellite. The first and second flexible conductors can be located along the curved interior surface of the hollow dielectric housing following an arc-shaped path along the curved interior surface.

20 Claims, 10 Drawing Sheets





US008436774B2

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

(10) **Patent No.:** **US 8,436,774 B2**
(45) **Date of Patent:** **May 7, 2013**

(54) **MOBILE COMMUNICATION DEVICE**

(75) Inventors: **Kin Lu Wong**, Kaohsiung (TW); **Ming Fang Tu**, Hsinchu (TW); **Chun Yih Wu**, Taipei (TW); **Wei Yu Li**, Yilan (TW)

(73) Assignees: **Industrial Technology Research Institute**, Chutung, Hsinchu (TW); **National Sun Yat-Sen University**, Kaohsiung (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 339 days.

(21) Appl. No.: **12/872,450**

(22) Filed: **Aug. 31, 2010**

(65) **Prior Publication Data**

US 2011/0122027 A1 May 26, 2011

Related U.S. Application Data

(60) Provisional application No. 61/263,938, filed on Nov. 24, 2009.

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 5/00 (2006.01)
H01Q 9/04 (2006.01)

(52) **U.S. Cl.**
USPC **343/700 MS**

(58) **Field of Classification Search** 343/700 MS
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,932,865 B2* 4/2011 Wong et al. 343/702
7,978,141 B2* 7/2011 Chi et al. 343/741

2004/0008141 A1 1/2004 Sato et al.
2004/0233109 A1* 11/2004 Ying et al. 343/700 MS
2007/0257842 A1 11/2007 Tseng
2008/0100516 A1* 5/2008 DiNallo et al. 343/702
2008/0278377 A1 11/2008 Vance
2009/0273530 A1 11/2009 Chi et al.
2010/0328164 A1* 12/2010 Huynh 343/702

(Continued)

FOREIGN PATENT DOCUMENTS

CN 1318879 A 10/2001
CN 1469672 A 1/2004

(Continued)

OTHER PUBLICATIONS

Full European Search Report for corresponding Application No. EP 10189359.2 for search completed May 20, 2011.

(Continued)

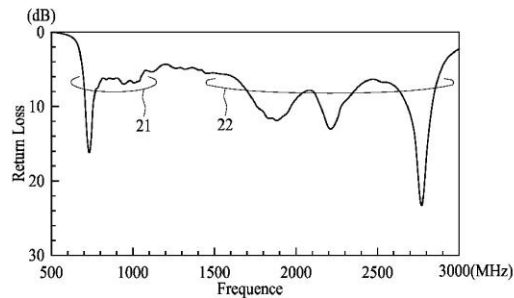
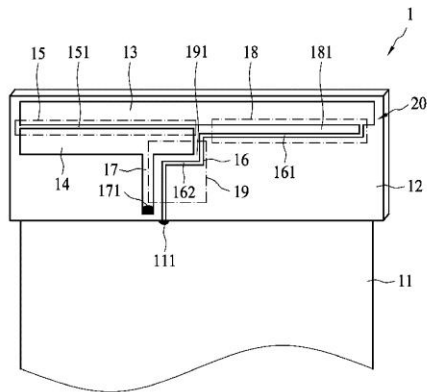
Primary Examiner — Shawki Ismail
Assistant Examiner — Dylan White

(74) *Attorney, Agent, or Firm* — Egbert Law Offices, PLLC

(57) **ABSTRACT**

A mobile communication device includes a ground plane and an antenna. The antenna is disposed on a dielectric substrate and includes a radiating metal portion, a coupling metal portion, and an inductive shorting metal portion. The radiating metal portion provides a resonant path for the antenna to generate first and second operating bands. The coupling metal portion is coupled to the radiating metal portion to form a first coupling portion and is connected to a source through a connecting metal strip. One end of the inductive shorting metal portion is electrically connected to the radiating metal portion, and the other end is electrically connected to the ground plane. The inductive shorting metal portion includes a first fractional section coupled to the radiating metal portion to form a second coupling portion, and a second fractional section coupled to the coupling metal portion to form a third coupling portion.

21 Claims, 5 Drawing Sheets





US008436776B2

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

(10) **Patent No.:** **US 8,436,776 B2**
(45) **Date of Patent:** **May 7, 2013**

(54) **NEAR-HORIZON ANTENNA STRUCTURE AND FLAT PANEL DISPLAY WITH INTEGRATED ANTENNA STRUCTURE**

(75) Inventors: **Seong-Youp Suh**, San Jose, CA (US); **Anand S. Konanur**, Sunnyvale, CA (US); **Songnan Yang**, San Jose, CA (US); **Salih Yarga**, Columbus, OH (US)

(73) Assignee: **Intel Corporation**, Santa Clara, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 454 days.

(21) Appl. No.: **12/533,140**

(22) Filed: **Jul. 31, 2009**

(65) **Prior Publication Data**

US 2011/0025566 A1 Feb. 3, 2011

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 1/24 (2006.01)

(52) **U.S. Cl.**
USPC **343/702**; 343/700 MS; 343/795

(58) **Field of Classification Search** 343/700 MS, 343/702, 826, 828, 829, 830, 846, 848, 795
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,418,543 A * 5/1995 Bolton 343/713
7,864,116 B2 * 1/2011 Kurashima et al. 343/700 MS

* cited by examiner

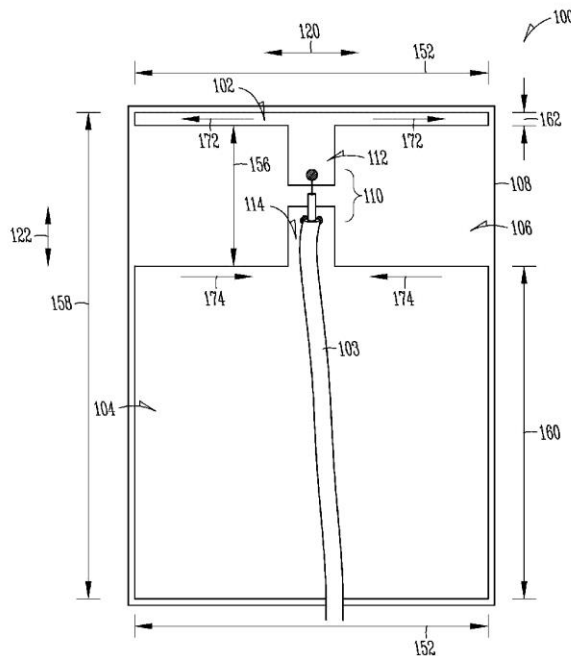
Primary Examiner — Michael C Wimer

(74) *Attorney, Agent, or Firm* — Schwegman, Lundberg & Woessner, P.A.

(57) **ABSTRACT**

A near-horizon antenna structure includes an upper radiating element having a straight conductive trace disposed on a planar surface of a non-conductive substrate, a rectangular lower radiating element serving as a ground plane disposed on the planar surface, and a feed point provided between the upper and lower radiating elements. When the planar surface is positioned vertically, the far-field effects of horizontal current flowing in opposite directions on the radiating elements cancel to provide an antenna pattern with increased gain in horizontal directions and reduced gain in vertical directions. A flat panel display and a portable communication device are also provided with one or more near-horizon antenna structures integrated therein.

20 Claims, 6 Drawing Sheets



NEAR-HORIZON ANTENNA (FRONT VIEW)



US008436780B2

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

(10) **Patent No.:** **US 8,436,780 B2**
(45) **Date of Patent:** **May 7, 2013**

(54) **PLANAR LOOP ANTENNA SYSTEM**

(75) Inventors: **Hans Gregory Schantz**, Hampton Cove, AL (US); **Eric Richards**, Madison, AL (US); **Andrew Compston**, Stanford, CA (US)

(73) Assignee: **Q-Track Corporation**, Huntsville, AL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 269 days.

(21) Appl. No.: **12/857,528**

(22) Filed: **Aug. 16, 2010**

(65) **Prior Publication Data**

US 2012/0007787 A1 Jan. 12, 2012

Related U.S. Application Data

(63) Continuation-in-part of application No. 12/834,821, filed on Jul. 12, 2010.

(51) **Int. Cl.**
H01Q 7/08 (2006.01)

(52) **U.S. Cl.**
USPC **343/788**; 343/866

(58) **Field of Classification Search** 343/788, 343/866

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

716,134 A	12/1902	Stone	342/417
1,483,383 A	2/1924	Sandell	455/274
2,266,262 A	12/1941	Polydorff	343/764
2,282,030 A	5/1942	Busignies	342/432
2,339,234 A	1/1944	Polydorff	343/788
2,399,382 A	4/1946	Polydorff	343/788

2,432,858 A	12/1947	Brown	343/791
2,521,550 A	9/1950	Smith	343/742
3,046,549 A	7/1962	Kalmus	342/385
3,121,228 A	2/1964	Kalmus	342/488

(Continued)

FOREIGN PATENT DOCUMENTS

EP	1226729 A1	7/2002
GB	5811	0/1903

OTHER PUBLICATIONS

W.J. Polydoroff, *High Frequency Magnetic Materials: Their Characteristics and Principal Applications*, (New York: John Wiley & Sons, 1960), pp. 166-169.

(Continued)

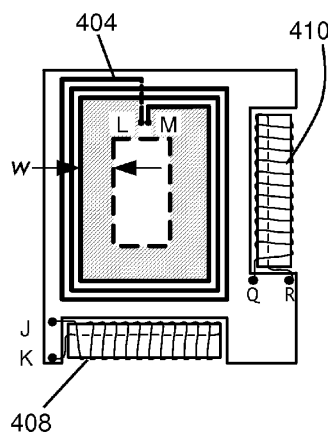
Primary Examiner — Jason M Crawford

(74) *Attorney, Agent, or Firm* — James Richards

(57) **ABSTRACT**

An inexpensive planar antenna fabricated as a plurality of parallel layers of multi turn spiral loops co-located with conductive material at the center of the loops, there being an exclusion zone free of conductive material between the innermost loop and the conductive material at the center. The conductive material may comprise circuit elements, for example batteries, amplifiers, antenna drivers or other functional elements as well as passive elements. In one embodiment, the loop traces may be staggered. In another embodiment, the loop traces are varied in width as a function of position within the loop cross section. In further embodiments, the planar form is integrated with additional orthogonal planar antennas substantially coplanar with the first planar antenna and having axes orthogonal to the first planar antenna and to one another. In further embodiments the exclusion zone is extended by design rules and confining routes in a circuit section. The antenna system may be configured as a three dimensional omnidirectional antenna and is well adapted for small form factor hand held and portable wireless applications.

25 Claims, 6 Drawing Sheets





US008437709B2

(12) **United States Patent**
Kanazawa

(10) **Patent No.:** **US 8,437,709 B2**
(45) **Date of Patent:** **May 7, 2013**

- (54) **WIRELESS APPARATUS**
- (75) Inventor: **Masaru Kanazawa**, Kawasaki (JP)
- (73) Assignee: **Fujitsu Limited**, Kawasaki (JP)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 558 days.

2008/0150812 A1 * 6/2008 Kanazawa et al. 343/702
 2010/0282852 A1 * 11/2010 Koenck et al. 235/472.01
 2011/0279310 A1 11/2011 Shibohta

FOREIGN PATENT DOCUMENTS

JP 2006-25223 A 1/2006
 JP 2006-526322 A 11/2006
 JP 2007-306347 A 11/2007
 JP 2007-335989 A 12/2007
 WO WO-2009-035039 A1 3/2009

- (21) Appl. No.: **12/488,141**
- (22) Filed: **Jun. 19, 2009**
- (65) **Prior Publication Data**
US 2010/0015931 A1 Jan. 21, 2010

OTHER PUBLICATIONS

Japanese Office Action mailed on May 29, 2012 for corresponding Japanese Application No. 2008-184744, with Partial English-language Translation.

* cited by examiner

- (30) **Foreign Application Priority Data**
Jul. 16, 2008 (JP) 2008-184744

Primary Examiner — Phuoc Doan

(74) *Attorney, Agent, or Firm* — Fujitsu Patent Center

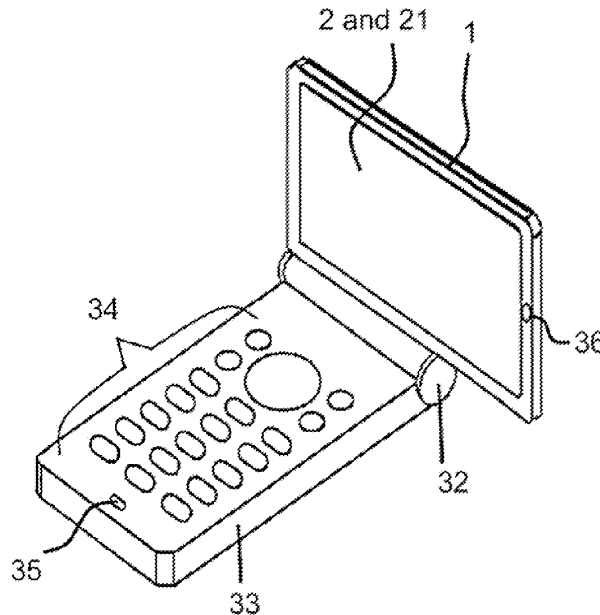
- (51) **Int. Cl.**
H04B 1/38 (2006.01)
- (52) **U.S. Cl.**
USPC **455/90.3**; 343/702
- (58) **Field of Classification Search** 455/90.3,
455/566; 343/702; 701/41
See application file for complete search history.

(57) **ABSTRACT**

A wireless apparatus includes a display, a display case encasing the display, a body supporting the display case capable of rolling sideways the display, a first antenna element arranged in the display case, a second antenna element arranged in crossed direction of the first antenna element direction in the display case, and an antenna switch configured to switch between the first antenna and the second antenna in accordance with rolling positions of the display case with the body.

- (56) **References Cited**
U.S. PATENT DOCUMENTS
7,420,513 B2 9/2008 Tsutsumi et al.
2006/0290575 A1 12/2006 Pelzer
2007/0285334 A1 12/2007 Tsutsumi et al.

7 Claims, 7 Drawing Sheets





US008441399B2

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

(10) **Patent No.:** **US 8,441,399 B2**
(45) **Date of Patent:** **May 14, 2013**

(54) **THREE-DIMENSIONAL SLOT ANTENNA**

(75) Inventors: **Chao-Hsu Wu**, Luzhu Township, Taoyuan County (TW); **Yuan-Chang Chao**, Dayuan Township, Taoyuan County (TW)

(73) Assignee: **Quanta Computer Inc.**, Tao Yuan Shien (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 310 days.

(21) Appl. No.: **13/008,039**

(22) Filed: **Jan. 18, 2011**

(65) **Prior Publication Data**
US 2012/0050134 A1 Mar. 1, 2012

(30) **Foreign Application Priority Data**
Aug. 26, 2010 (TW) 99128634 A

(51) **Int. Cl.**
H01Q 1/38 (2006.01)

(52) **U.S. Cl.**
USPC **343/700 MS; 343/767; 343/702**

(58) **Field of Classification Search** None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,564,411 B2 *	7/2009	Piisila et al.	343/702
8,299,972 B2 *	10/2012	Lai	343/702
2009/0153423 A1 *	6/2009	Dinallo et al.	343/767
2010/0013713 A1 *	1/2010	Peng et al.	343/700 MS
2010/0289712 A1 *	11/2010	Zheng et al.	343/767

* cited by examiner

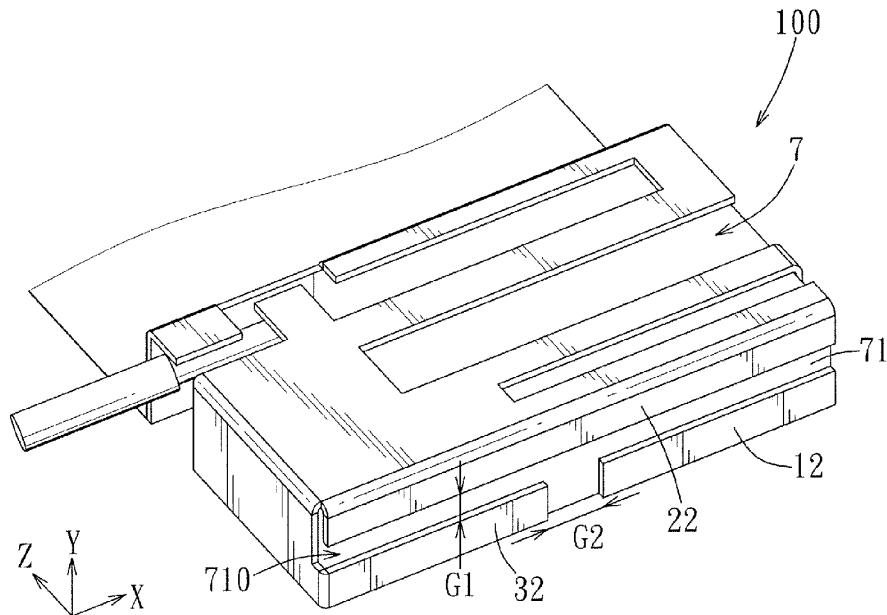
Primary Examiner — Trinh Dinh

(74) *Attorney, Agent, or Firm* — Hammer & Associates, P.C.

(57) **ABSTRACT**

A three-dimensional slot antenna includes a loop conductor, a first conductor arm, a second conductor arm, and a third conductor arm. The first radiator section, the second radiator section and the third radiator section are disposed on a same plane. The second radiator section cooperates with the first and third radiator sections to form a first slot segment. The first radiator section further cooperates with the third radiator section to form a second slot segment. The first and second slot segments form a substantially T-shaped slot.

12 Claims, 13 Drawing Sheets





US008441404B2

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

(10) **Patent No.:** **US 8,441,404 B2**
(45) **Date of Patent:** **May 14, 2013**

(54) **FEED NETWORKS FOR SLOT ANTENNAS IN ELECTRONIC DEVICES**

(75) Inventors: **Bing Chiang**, Cupertino, CA (US);
Gregory Allen Springer, Sunnyvale, CA (US); **Douglas B. Kough**, San Jose, CA (US); **Enrique Ayala**, Watsonville, CA (US); **Matthew Ian McDonald**, San Jose, CA (US)

(73) Assignee: **Apple Inc.**, Cupertino, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1290 days.

(21) Appl. No.: **11/959,165**

(22) Filed: **Dec. 18, 2007**

(65) **Prior Publication Data**

US 2009/0153410 A1 Jun. 18, 2009

(51) **Int. Cl.**
H01Q 13/10 (2006.01)

(52) **U.S. Cl.**
USPC **343/770**

(58) **Field of Classification Search** 343/767,
343/770, 700 MS
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,369,771	B1	4/2002	Chiang et al.	
6,473,042	B1 *	10/2002	Fang et al.	343/700 MS
6,670,923	B1	12/2003	Kadambi et al.	
6,677,909	B2 *	1/2004	Sun et al.	343/767
6,741,214	B1	5/2004	Kadambi et al.	
6,747,601	B2	6/2004	Boyle	
6,774,852	B2	8/2004	Chiang et al.	
6,856,294	B2	2/2005	Kadambi et al.	

6,888,510	B2	5/2005	Jo et al.	
6,980,154	B2	12/2005	Vance et al.	
7,027,838	B2	4/2006	Zhou et al.	
7,116,267	B2	10/2006	Schuster et al.	
7,119,747	B2	10/2006	Lin et al.	
7,123,208	B2	10/2006	Puente Baliarda et al.	
7,239,290	B2	7/2007	Poilasne et al.	
2003/0107518	A1	6/2003	Li et al.	
2004/0145521	A1	7/2004	Hebron et al.	
2005/0017914	A1 *	1/2005	Huang	343/770
2005/0200545	A1 *	9/2005	Bancroft	343/770
2006/0055606	A1	3/2006	Boyle	
2006/0284778	A1 *	12/2006	Sanford et al.	343/770

OTHER PUBLICATIONS

Hill et al. U.S. Appl. No. 11/650,187, filed Jan. 4, 2007.
Hill et al. U.S. Appl. No. 11/821,192, filed Jun. 21, 2007.

(Continued)

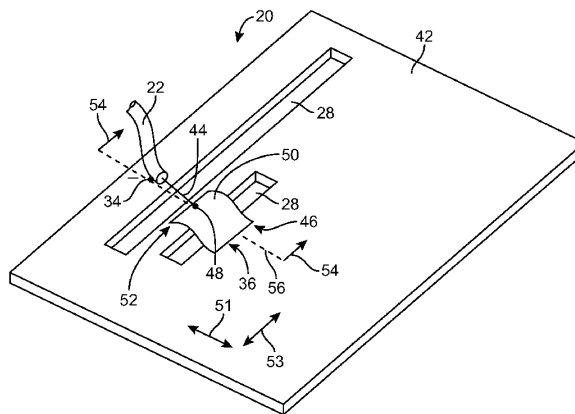
Primary Examiner — Robert Karacsony

(74) *Attorney, Agent, or Firm* — Treyz Law Group; G. Victor Treyz; David C. Kellogg

(57) **ABSTRACT**

Electronic devices and antennas for electronic devices are provided. The antennas may have ground plane elements with dielectric-filled openings. The dielectric-filled openings may be configured to form one or more rectangular slots. The antennas may be fed using transmission lines having first and second conductors. The first conductor of a given transmission line may be coupled to the ground plane element on one side of the slots. The second conductor of the transmission line may be coupled to a planar conductive element. The planar conductive element may couple to the ground plane element on the other side of the slots. The slots may be separated by a portion of the ground plane element. The planar conductive element may bridge at least one of the slots and may overlap the portion of the ground plane element that separates the slots without electrically contacting that portion of the ground plane element.

28 Claims, 18 Drawing Sheets





US008441405B2

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

(10) **Patent No.:** **US 8,441,405 B2**
(45) **Date of Patent:** **May 14, 2013**

(54) **SLOT ANTENNA DEVICE INCLUDING A TRANSMISSION LINE TO WAVEGUIDE TRANSFORMER HAVING DIFFERENTIAL FEED PINS**

(75) Inventors: **Yukako Tsutsumi**, Kanagawa-ken (JP); **Tetsu Shijo**, Tokyo (JP); **Takayoshi Ito**, Kanagawa-ken (JP); **Shuichi Obayashi**, Kanagawa-ken (JP); **Hiroki Shoki**, Tokyo (JP)

(73) Assignee: **Kabushiki Kaisha Toshiba**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 191 days.

(21) Appl. No.: **12/634,162**

(22) Filed: **Dec. 9, 2009**

(65) **Prior Publication Data**
US 2010/0148892 A1 Jun. 17, 2010

(30) **Foreign Application Priority Data**
Dec. 12, 2008 (JP) 2008-317003

(51) **Int. Cl.**
H01Q 13/22 (2006.01)
H01P 5/103 (2006.01)

(52) **U.S. Cl.**
USPC **343/771**; 333/26

(58) **Field of Classification Search** 333/26, 333/34, 248, 113, 115; 343/771
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,483,396 B1 * 11/2002 Kwon et al. 333/108
6,573,810 B2 * 6/2003 Cayrou et al. 333/135

FOREIGN PATENT DOCUMENTS

JP 2005-204344 7/2005

* cited by examiner

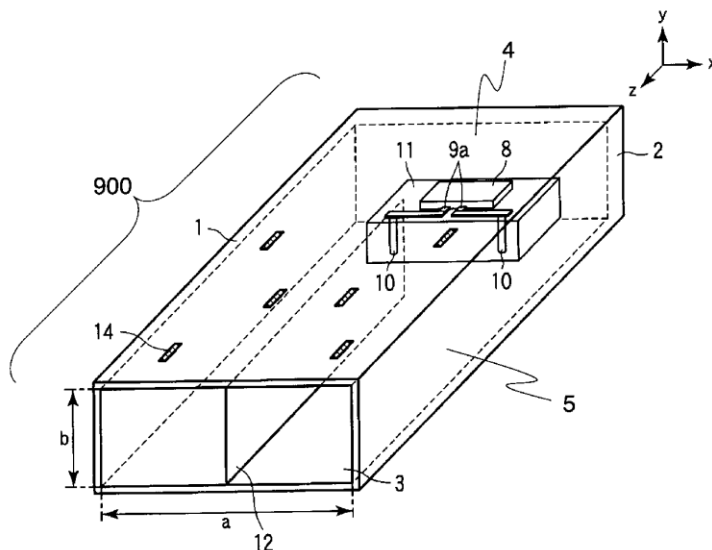
Primary Examiner — Benny Lee

(74) *Attorney, Agent, or Firm* — Oblon, Spivak, McClelland, Maier & Neustadt, L.L.P.

(57) **ABSTRACT**

A transformer between a waveguide and a transmission-line includes a high-frequency circuit module, transmission-lines, a waveguide, and feed pins. The high-frequency circuit module has differential-pair terminals to input and output a differential signal. The transmission-lines are connected to the differential-pair terminals. The waveguide includes first to third metal walls. The feed pins are connected to the transmission-lines inside of the waveguide. The feed pins have a first distance of approximately $(\lambda_g/2)$ from each other. One of the feed pins has a second distance of approximately $(\lambda_g*(1+2\alpha)/4)$ from the third metal plane. " λ_g " is a wavelength in the waveguide and " α " is an integer which is equal or larger than "0". Each of the feed pins has a third distance of approximately $(a/2)$ from the first or second wall. "a" is length of the waveguide along the third metal wall.

8 Claims, 27 Drawing Sheets





US008441407B2

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

(10) **Patent No.:** **US 8,441,407 B2**

(45) **Date of Patent:** **May 14, 2013**

(54) **MOBILE COMMUNICATION DEVICE**

(75) Inventors: **Kin-Lu Wong**, Hsichih (TW);
Cheng-Tse Lee, Hsichih (TW)

(73) Assignee: **Acer Incorporated**, New Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 568 days.

(21) Appl. No.: **12/554,904**

(22) Filed: **Sep. 5, 2009**

(65) **Prior Publication Data**

US 2010/0309063 A1 Dec. 9, 2010

(30) **Foreign Application Priority Data**

Jun. 6, 2009 (TW) 98118973 A

(51) **Int. Cl.**
H01Q 1/48 (2006.01)
H01Q 1/24 (2006.01)

(52) **U.S. Cl.**
USPC **343/846**; 343/702

(58) **Field of Classification Search** 343/700 MS,
343/702, 767, 770, 846
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,750,821 B2 6/2004 Fang et al.
7,209,087 B2* 4/2007 Tang et al. 343/702

7,397,439 B2* 7/2008 Kanno et al. 343/767
2004/0125029 A1* 7/2004 Maoz et al. 343/702
2007/0063901 A1 3/2007 Tang et al.
2007/0159401 A1* 7/2007 Baliarda et al. 343/702
2008/0100514 A1* 5/2008 Abdul-Gaffoor et al. 343/702
2008/0143612 A1* 6/2008 Iwai et al. 343/702

FOREIGN PATENT DOCUMENTS

CN 101099267 1/2008
WO WO2008084273 A2* 7/2008

OTHER PUBLICATIONS

"First Office Action of China counterpart application" issued on Jun. 7, 2012, p. 1-p. 5, in which the listed references were cited.

* cited by examiner

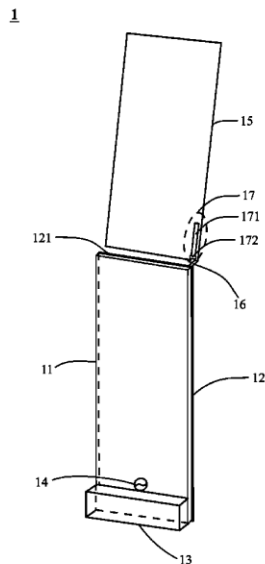
Primary Examiner — Robert Karacsony

(74) *Attorney, Agent, or Firm* — Jianq Chyun IP Office

(57) **ABSTRACT**

The present invention is related to a mobile communication device. The device comprises a dielectric substrate, a first ground plane, an antenna element, a second ground plane, and an equivalent band-stop circuit. The first ground plane is disposed on the dielectric substrate. The antenna element is disposed on the dielectric substrate or nearby the dielectric substrate and is connected to a signal source disposed on the dielectric substrate. The second ground plane is disposed nearby one edge of the first ground plane and is connected to the first ground plane through a metal strip. The equivalent band-stop circuit is disposed on the second ground plane and includes a slit and a capacitive element. The open end of the slit is near the metal strip. The capacitive element is mounted across the slit.

10 Claims, 5 Drawing Sheets



1



US008441408B2

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

(10) **Patent No.:** **US 8,441,408 B2**
(45) **Date of Patent:** **May 14, 2013**

(54) **MINIATURIZED MULTIPLE INPUT
MULTIPLE OUTPUT (MIMO) ANTENNA**

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(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 900 days.

(21) Appl. No.: **11/937,075**

(22) Filed: **Nov. 8, 2007**

(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
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(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 1/48 (2006.01)
H01Q 21/00 (2006.01)

(52) **U.S. Cl.**
USPC **343/848**; 343/700 MS; 343/893

(58) **Field of Classification Search** 343/846,
343/700 MS, 893, 848
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,549,170	B1 *	4/2003	Kuo et al.	343/702
7,106,256	B2	9/2006	Watanabe et al.	
7,245,259	B2 *	7/2007	Puckey et al.	343/700 MS
7,289,068	B2 *	10/2007	Fujio et al.	343/700 MS
7,629,930	B2 *	12/2009	Murch et al.	343/700 MS
2005/0110683	A1 *	5/2005	Song et al.	343/700 MS
2006/0038723	A1	2/2006	Watanabe et al.	

FOREIGN PATENT DOCUMENTS

JP	2005167966	A	6/2005
KR	100699472		3/2007

* cited by examiner

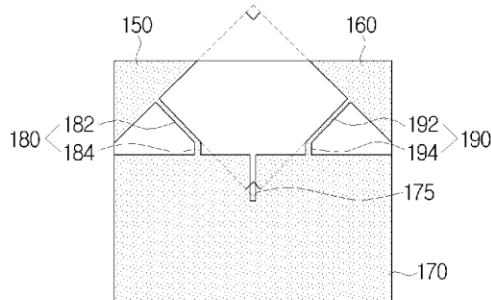
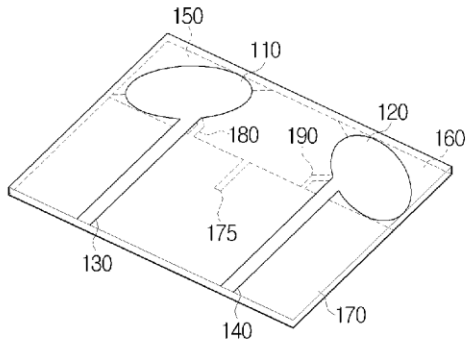
Primary Examiner — Robert Karacsony

(74) *Attorney, Agent, or Firm* — Sughrue Mion, PLLC

(57) **ABSTRACT**

A miniaturized multiple input multiple output (MIMO) antenna includes a first antenna element disposed in a first side of a substrate in a round form; a second antenna element in a round form symmetrically with the first antenna element and disposed in the first side of the substrate; and a ground disposed in a second side of the substrate. The first antenna element and the second antenna element are disposed such that electro magnetic waves resonating in the first antenna element and the second antenna element are orthogonally polarized. Accordingly, the antenna size can be reduced. The miniaturized antenna facilitates the component design in the small terminal.

10 Claims, 10 Drawing Sheets





US008446322B2

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

(10) **Patent No.:** **US 8,446,322 B2**
(45) **Date of Patent:** **May 21, 2013**

(54) **PATCH ANTENNA WITH CAPACITIVE ELEMENTS**

(75) Inventors: **Dmitry Tatarnikov**, Moscow (RU);
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Anton Stepanenko, Dedovsk (RU);
Pavel Shamatulsky, Moscow (RU)

(73) Assignee: **Topcon GPS, LLC**, Oakland, NJ (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 350 days.

(21) Appl. No.: **12/275,761**

(22) Filed: **Nov. 21, 2008**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 61/004,744, filed on Nov. 29, 2007.

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 1/48 (2006.01)
H01Q 1/24 (2006.01)

(52) **U.S. Cl.**
USPC 343/700 MS; 343/846; 343/702

(58) **Field of Classification Search**
USPC 343/700 MS, 846, 702
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,495,503 A 1/1985 Morman
6,137,453 A 10/2000 Wang et al.
6,297,776 B1* 10/2001 Pankinaho 343/700 MS
6,882,316 B2 4/2005 McKinzie, III et al.

7,710,324 B2* 5/2010 Tatarnikov et al. 343/700 MS
2001/0015701 A1 8/2001 Ito et al.
2003/0058175 A1 3/2003 Akiyama et al.
2006/0038721 A1 2/2006 Ozkar et al.
2006/0071859 A1 4/2006 Condon et al.
2007/0268188 A1 11/2007 Guha et al.
2008/0198086 A1* 8/2008 Coupez et al. 343/824

FOREIGN PATENT DOCUMENTS

EP 1 536 511 6/2005
WO WO 01/57952 8/2001
WO WO2005117208 12/2005

OTHER PUBLICATIONS

“Capacitors and Capacitance,” John D. Kraus, Electromagnetics, Second Edition, McGraw Hill, 1973, pp. 49-50.*
PCT International Search Report corresponding to PCT Application PCT/US2008/013071 filed Nov. 24, 2008 (6 pages).
PCT Written Opinion of the International Searching Authority corresponding to PCT Application PCT/US2008/013071 filed Nov. 24, 2008 (9 pages).
U.S. Appl. No. 11/280,424, filed Nov. 16, 2005, Inventor: Dmitry Tatarnikov, et al.

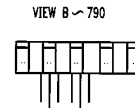
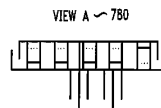
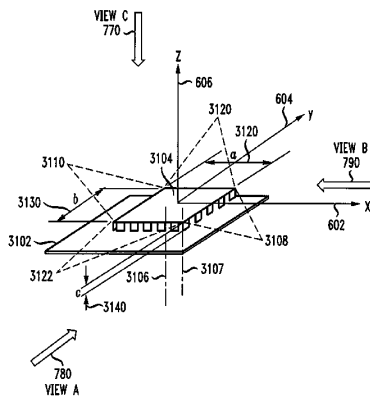
(Continued)

Primary Examiner — Jacob Y Choi
Assistant Examiner — Graham Smith
(74) *Attorney, Agent, or Firm* — Wolff & Samson, PC

(57) **ABSTRACT**

Disclosed is a micropatch antenna comprising a radiating element and a ground plane separated by an air gap. Small size, light weight, wide bandwidth, and wide directional pattern are achieved without the introduction of a high-permittivity dielectric substrate. Capacitive elements are configured along the perimeter of at least one of the radiating element and ground plane. Capacitive elements may comprise extended continuous structures or a series of localized structures. The geometry of the radiating element, ground plane, and capacitive elements may be varied to suit specific applications, such as linearly-polarized or circularly-polarized electromagnetic radiation.

1 Claim, 28 Drawing Sheets





US008446328B2

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

(10) **Patent No.:** **US 8,446,328 B2**
(45) **Date of Patent:** **May 21, 2013**

(54) **ANTENNA**

(75) Inventors: **Forrest J. Brown**, Carson City, NV (US); **Forrest Wolf**, Reno, NV (US)
(73) Assignee: **Pinyon Technologies, Inc.**, Reno, NV (US)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/427,610**

(22) Filed: **Apr. 21, 2009**

(65) **Prior Publication Data**
US 2010/0134369 A1 Jun. 3, 2010

Related U.S. Application Data
(63) Continuation of application No. 11/694,916, filed on Mar. 30, 2007, now Pat. No. 7,522,114, which is a continuation-in-part of application No. 11/055,490, filed on Feb. 9, 2005, now Pat. No. 7,202,830.

(51) **Int. Cl.**
H01Q 13/10 (2006.01)
(52) **U.S. Cl.**
USPC **343/767; 343/770**
(58) **Field of Classification Search**
USPC **343/767, 770, 771, 700 MS**
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,958,165	A *	9/1990	Axford et al.	343/770
5,068,670	A *	11/1991	Maoz	343/767
5,489,913	A *	2/1996	Raguenet et al.	343/767
6,677,909	B2 *	1/2004	Sun et al.	343/767
6,703,983	B2 *	3/2004	Huang	343/768
6,975,276	B2 *	12/2005	Brown	343/767
6,992,637	B2 *	1/2006	Hwang et al.	343/770
6,995,712	B2 *	2/2006	Boyanov	343/700 MS
7,057,569	B2 *	6/2006	Isoifovich et al.	343/770
7,372,409	B2 *	5/2008	Morton	343/700 MS
7,388,550	B2 *	6/2008	McLean	343/725

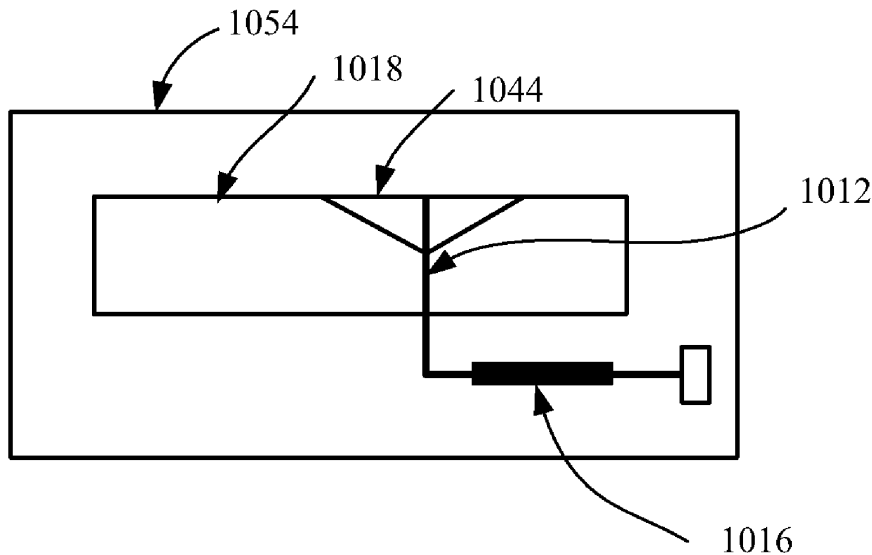
* cited by examiner

Primary Examiner — Hoang V Nguyen
(74) *Attorney, Agent, or Firm* — Holland & Hart LLP

(57) **ABSTRACT**

A high gain, phased array antenna includes a conducting sheet having a number of one or more slots defined therein. For each slot, an electrical microstrip feed line is electronically coupled with a corresponding slot to form a magnetically-coupled LC resonance element. A main feed line couples with the one or more microstrip feed lines. At least one slot and/or microstrip feed line includes at least one segment with greater width than other segments.

8 Claims, 21 Drawing Sheets





US008446334B2

(12) **United States Patent**
Azulay

(10) **Patent No.:** **US 8,446,334 B2**
(45) **Date of Patent:** **May 21, 2013**

(54) **MULTI-ANTENNA MULTIBAND SYSTEM**

(75) Inventor: **Snir Azulay**, Tiberias (IL)
(73) Assignee: **Galtronics Corporation Ltd.**, Tiberias (IL)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 397 days.

(21) Appl. No.: **12/810,402**

(22) PCT Filed: **May 23, 2010**

(86) PCT No.: **PCT/IL2010/000407**
§ 371 (c)(1),
(2), (4) Date: **Jun. 24, 2010**

(87) PCT Pub. No.: **WO2010/134081**
PCT Pub. Date: **Nov. 25, 2010**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 61/180,472, filed on May 22, 2009, provisional application No. 61/270,200, filed on Jul. 2, 2009.

(51) **Int. Cl.**
H01Q 21/00 (2006.01)
H01Q 1/24 (2006.01)

(52) **U.S. Cl.**
USPC **343/853**; 343/700 MS; 343/848

(58) **Field of Classification Search**
USPC 343/700 MS, 702, 846, 848, 853, 343/893

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,684,672	A	11/1997	Karidis et al.	
7,467,973	B2	12/2008	Lee et al.	
7,825,863	B2 *	11/2010	Martiskainen et al.	343/702
8,013,254	B2	9/2011	Lee et al.	
2006/0017626	A1 *	1/2006	Kannan et al.	343/702
2007/0205946	A1 *	9/2007	Buris et al.	343/700 MS
2007/0281631	A1	12/2007	Nast	
2008/0180333	A1	7/2008	Martiskainen et al.	
2008/0297422	A1	12/2008	Ishida	
2009/0316612	A1	12/2009	Poilasne et al.	

FOREIGN PATENT DOCUMENTS

WO	WO 2008/059509	5/2008
WO	WO 2010/134081	11/2010

OTHER PUBLICATIONS

Sayanagi et al., "A low loss flexible stripline for 1.9GHz Antenna", IEMT/IMC Proceedings, 1997, Kyoto, Japan.
An International Search Report and a Written Opinion, both dated Sep. 14, 2010, which issued during the prosecution of Applicant's PCT/IL10/00407.

* cited by examiner

Primary Examiner — Don Le

(74) *Attorney, Agent, or Firm* — Sughrue Mion, PLLC

(57) **ABSTRACT**

An antenna system including at least one flexible dielectric sheet, a plurality of individual antennas mounted on the at least one flexible dielectric sheet, a feed network mounted on the at least one flexible dielectric sheet, the feed network being connected to and feeding the individual antennas and at least one conductive ground plane mounted on the at least one flexible dielectric sheet.

25 Claims, 8 Drawing Sheets

