



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);
James R. Pollock, Hudson, OH (US);
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
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(21) Appl. No.: **12/832,332**

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

(65) **Prior Publication Data**
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Related U.S. Application Data

(60) Provisional application No. 61/224,766, filed on Jul.
10, 2009.

(51) **Int. Cl.**
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,
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343/843, 845, 846, 850, 852, 860, 862, 863,
343/873, 908

See application file for complete search history.

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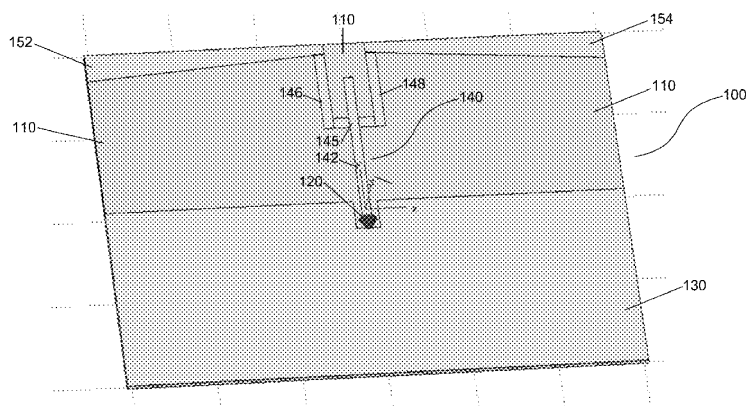
Primary Examiner — Levi Gannon

(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)

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patent is extended or adjusted under 35
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(21) Appl. No.: **12/247,994**

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(65) **Prior Publication Data**

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Related U.S. Application Data

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8, 2007.

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(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**

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Primary Examiner — Hoang V Nguyen

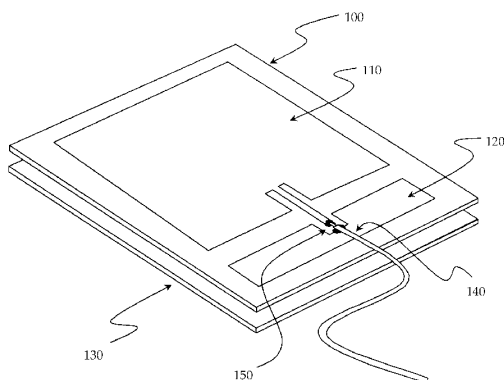
Assistant Examiner — Kyana R McCain

(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**

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Primary Examiner — Jacob Y Choi

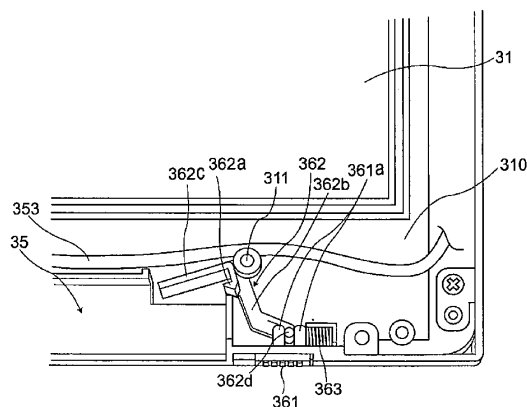
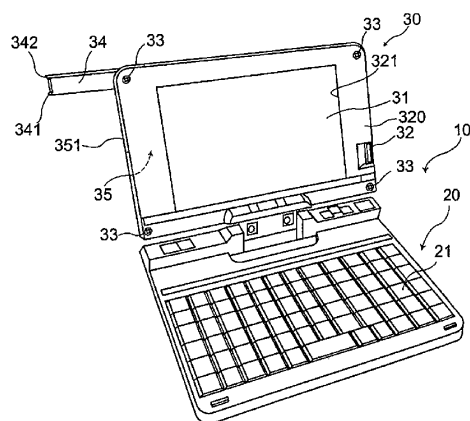
Assistant Examiner — Graham Smith

(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





US008427377B2

(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.

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(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.

(56) **References Cited**

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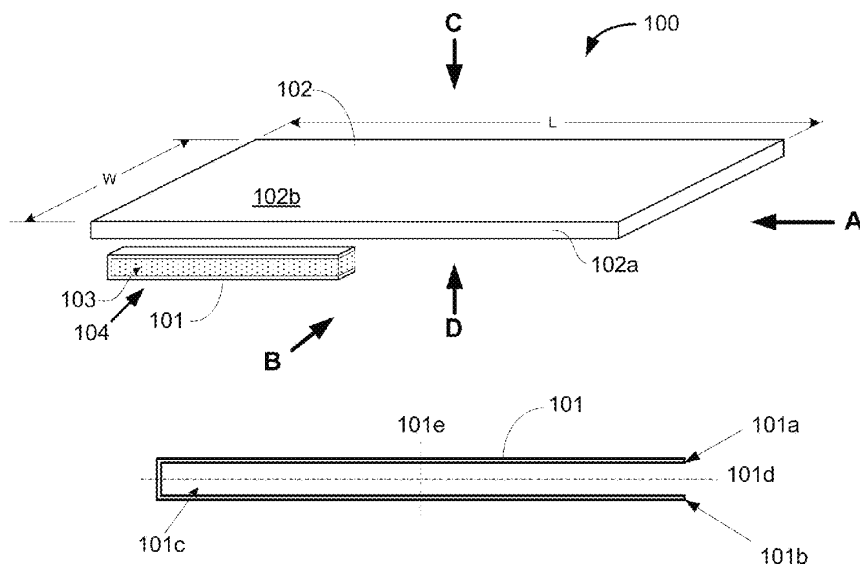
Primary Examiner — Tan Ho

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

(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.

17 Claims, 12 Drawing Sheets



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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**

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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**

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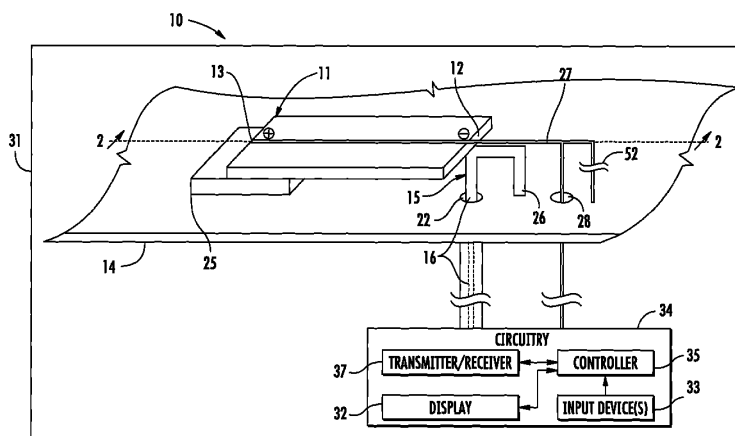
Primary Examiner — Hoang V Nguyen

(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 Shedletsky**, 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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H01Q 1/24 (2006.01)

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USPC **343/702**; 343/878

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

(56) **References Cited**

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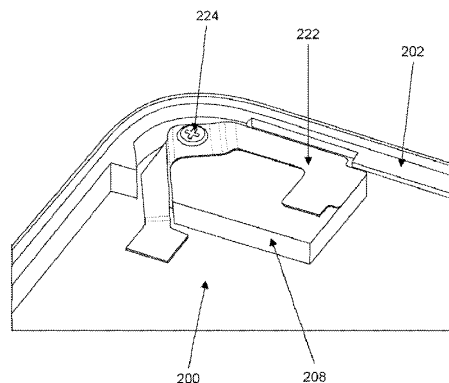
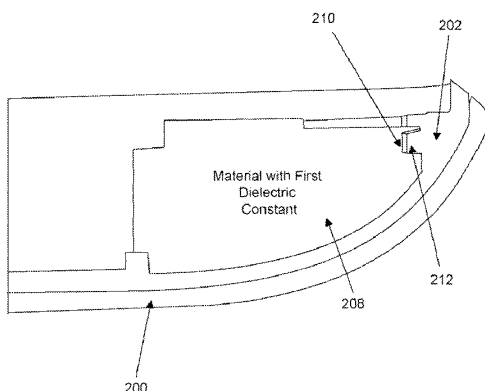
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Primary Examiner — Anh Tran

(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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(2), (4) Date: **Dec. 22, 2008**

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PCT Pub. Date: **Jan. 3, 2008**

(65) **Prior Publication Data**

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H01Q 1/24 (2006.01)

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H01Q 21/30 (2006.01)

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

USPC **343/700 MS**; 343/725; 343/846

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

(56) **References Cited**

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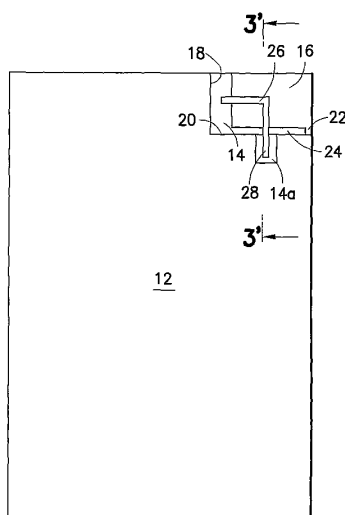
Primary Examiner — Michael C Wimer

(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.

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(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

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H01Q 5/00 (2006.01)

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

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Primary Examiner — Shawki Ismail

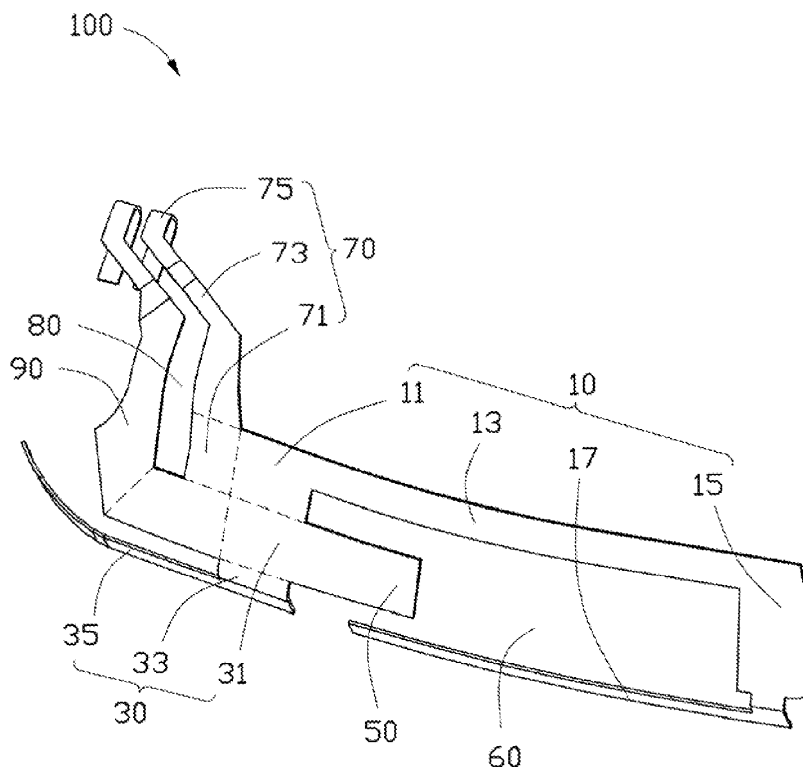
Assistant Examiner — Christopher Lo

(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: **Cirotech 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**

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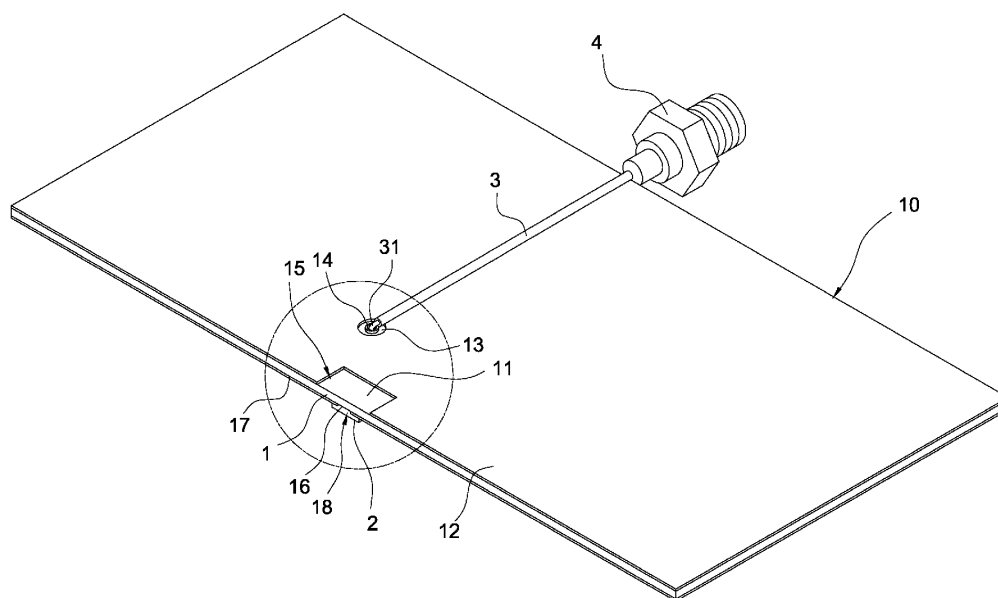
Primary Examiner — Hoang V Nguyen

(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



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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**

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(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**

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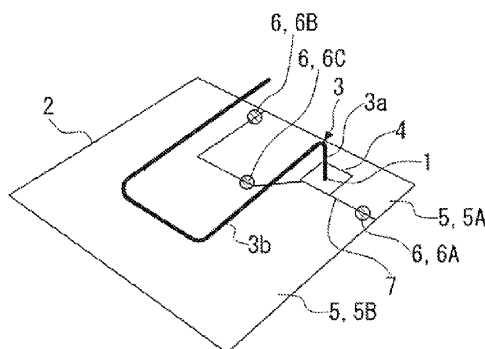
Primary Examiner — Tho G Phan

(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**

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(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**

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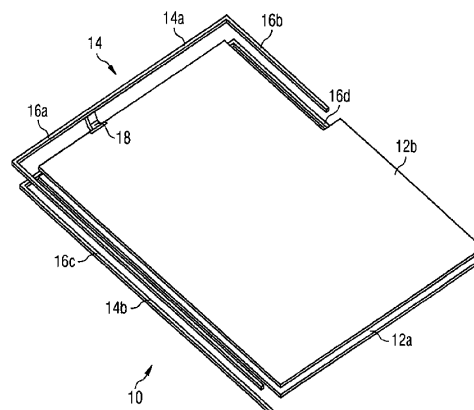
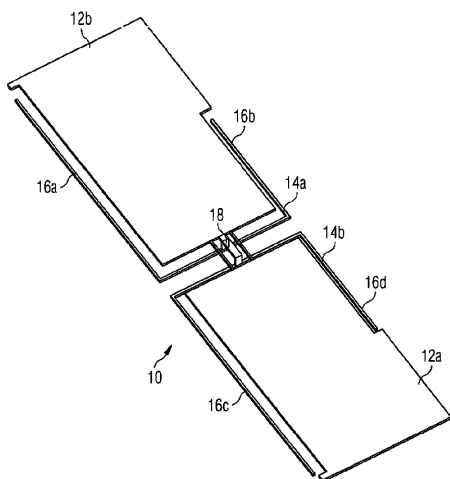
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Primary Examiner — Vibol Tan

(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.

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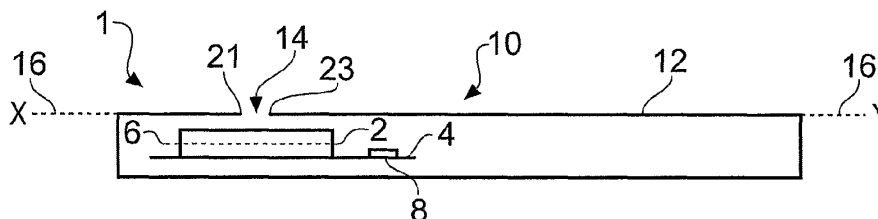
Primary Examiner — Hoanganh Le

(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



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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**

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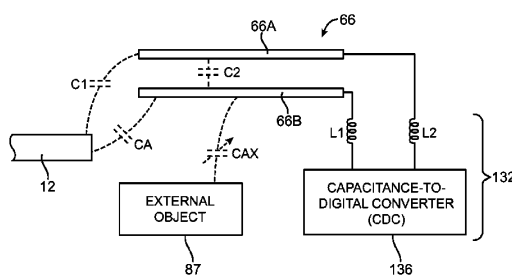
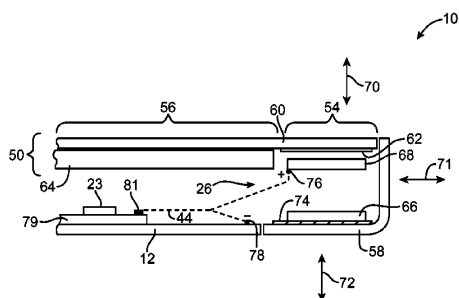
Primary Examiner — Dieu H Duong

(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.

(21) Appl. No.: **12/846,898**

(22) Filed: **Jul. 30, 2010**

(65) **Prior Publication Data**

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(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.

(56) **References Cited**

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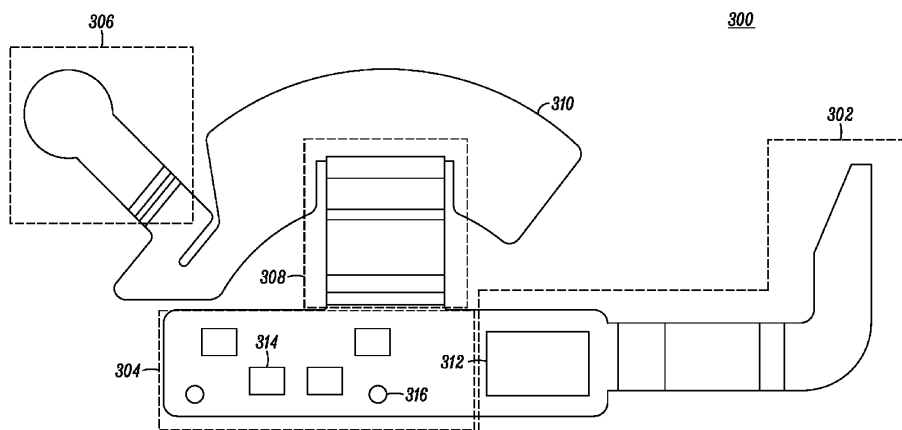
Primary Examiner — Daniel D Chang

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

(57) **ABSTRACT**

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.

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**

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

(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 408 days.

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

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

(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**

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

(56) **References Cited**

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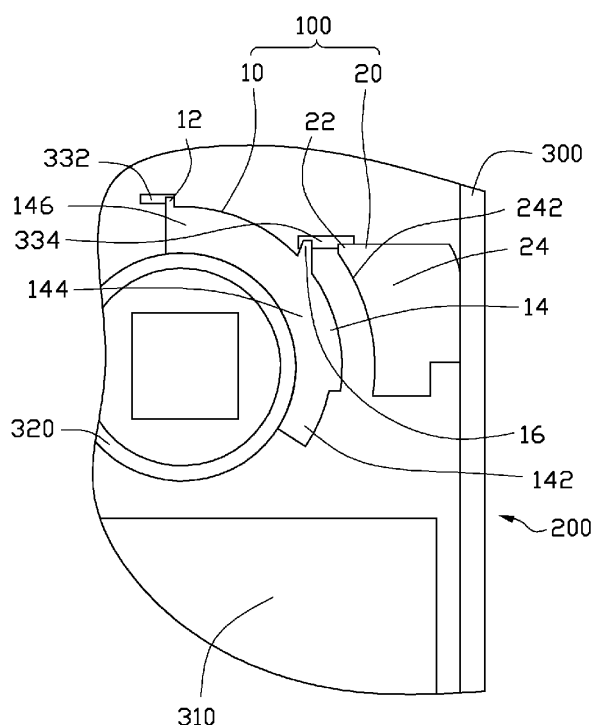
Primary Examiner — Dieu H Duong

(74) *Attorney, Agent, or Firm* — Altis Law Group, Inc.

(57) **ABSTRACT**

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.

9 Claims, 3 Drawing Sheets



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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.

(56) **References Cited**

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Primary Examiner — Hoang V Nguyen

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

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

(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.

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

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

(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.

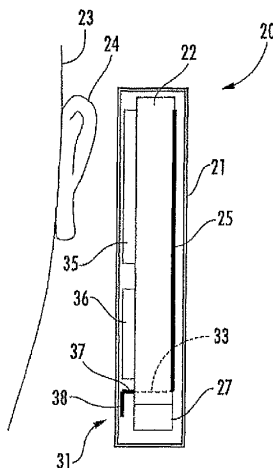
(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)

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

(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.

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.

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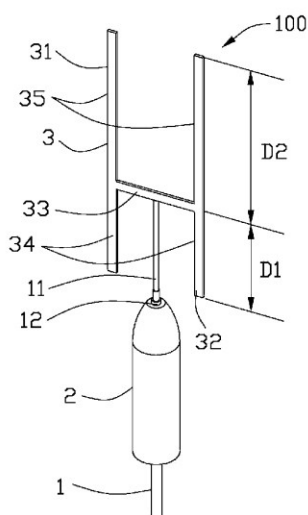
Primary Examiner — Anh Tran

(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.

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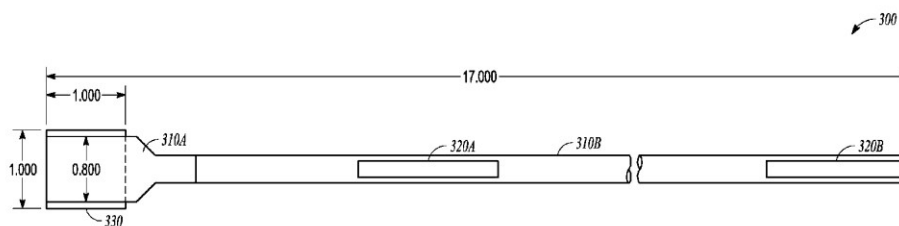
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Primary Examiner — Nhan Le**(74) Attorney, Agent, or Firm** — Fogg & Powers LLC**(57) ABSTRACT**

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: **Kim 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**

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Primary Examiner — Shawki Ismail

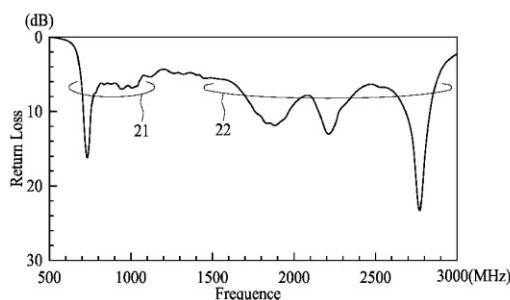
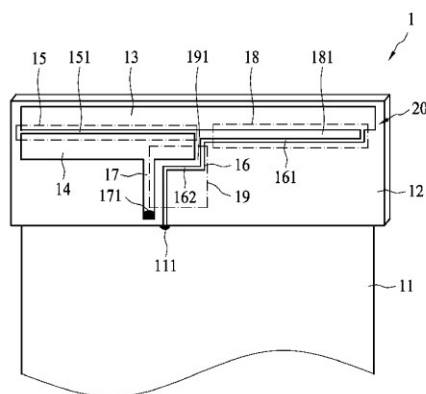
Assistant Examiner — Dylan White

(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

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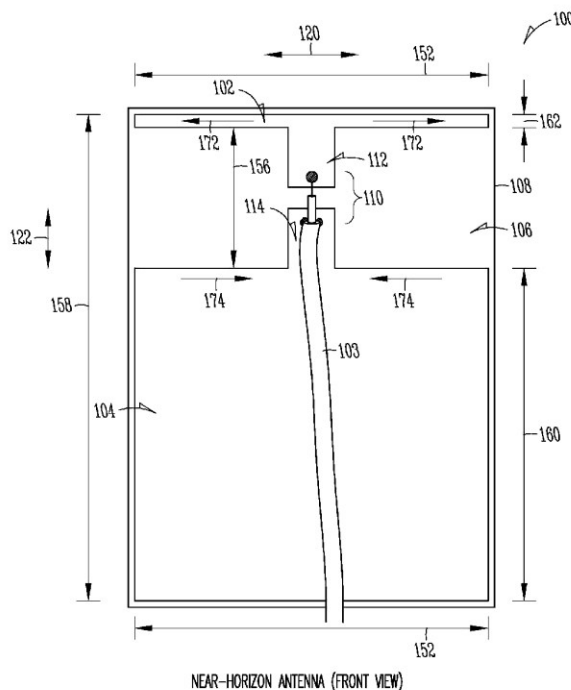
Primary Examiner — Michael C Wimer

(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**

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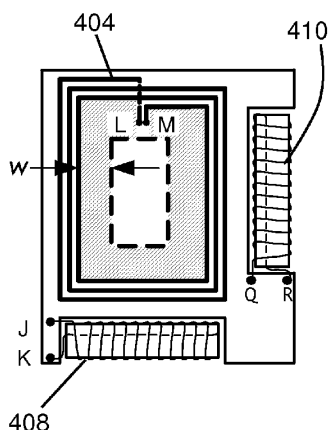
Primary Examiner — Jason M Crawford

(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.

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(21) Appl. No.: **12/488,141**

(22) Filed: **Jun. 19, 2009**

(65) **Prior Publication Data**

US 2010/0015931 A1 Jan. 21, 2010

(30) **Foreign Application Priority Data**

Jul. 16, 2008 (JP) 2008-184744

(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.

(56) **References Cited**

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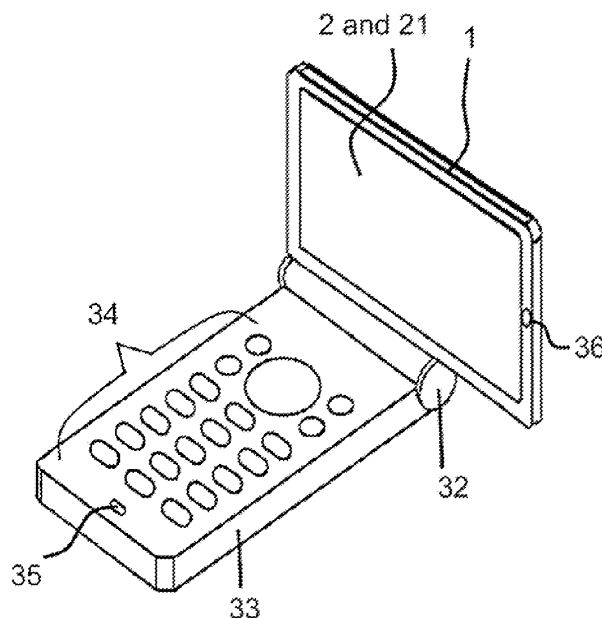
Primary Examiner — Phuoc Doan

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

(57) **ABSTRACT**

A wireless apparatus includes a display, a display case enclosing 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 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.

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**

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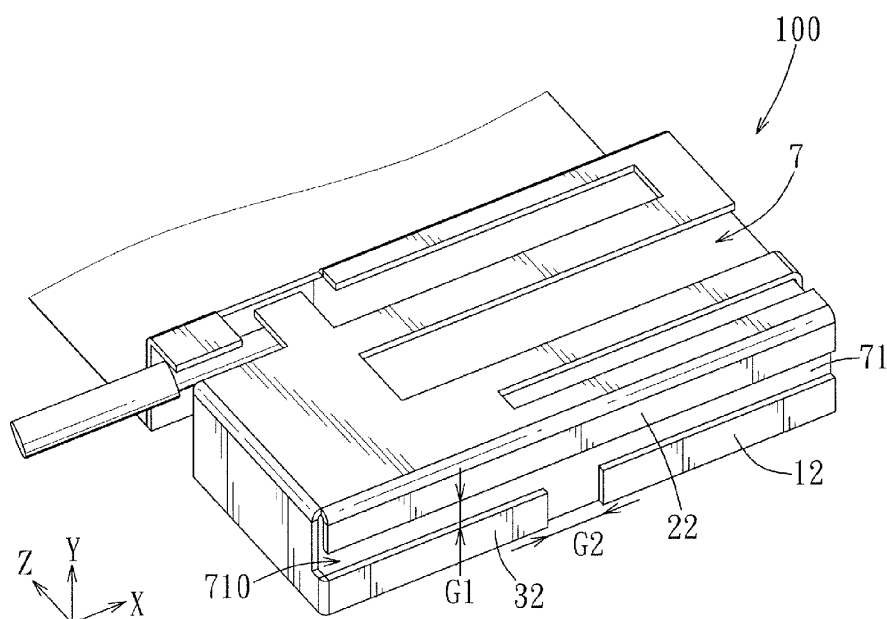
Primary Examiner — Trinh Dinh

(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



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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**

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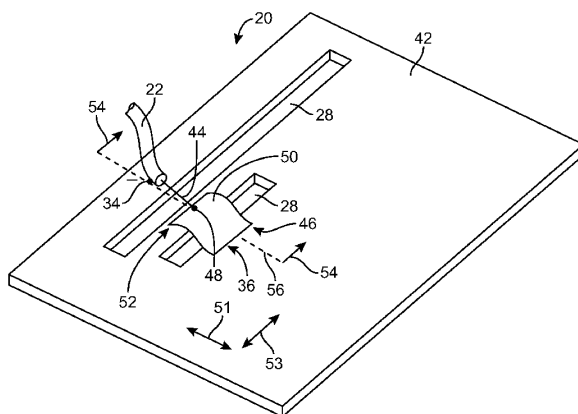
Primary Examiner — Robert Karacsony

(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**

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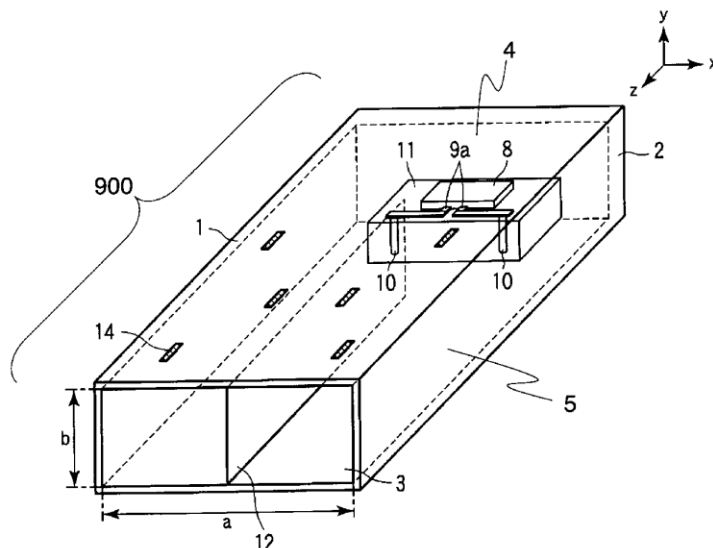
Primary Examiner — Benny Lee

(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



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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.

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Primary Examiner — Robert Karacsony

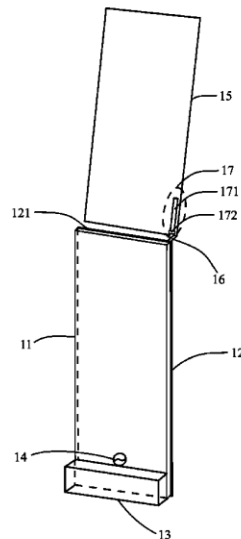
(74) *Attorney, Agent, or Firm* — Jianq Chyun IP Office

(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

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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**

(75) Inventors: **Il-kyu Kim**, Seongnam-si (KR);
Chang-won Jung, Hwaseong-si (KR);
Young-eil Kim, Suwon-si (KR); **Jin-soo**
Park, Yongin-si (KR); **Yong-jin Kim**,
Seoul (KR)

(73) Assignee: **Samsung Electronics Co., Ltd.**,
Suwon-si (KR)

(*) 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**

Jul. 3, 2007 (KR) 10-2007-0066611

(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**

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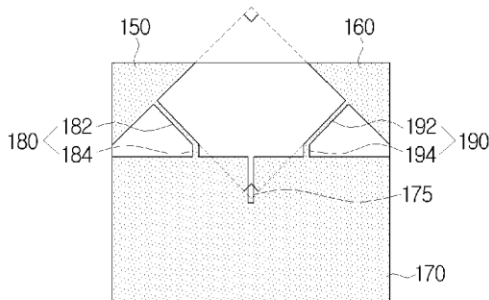
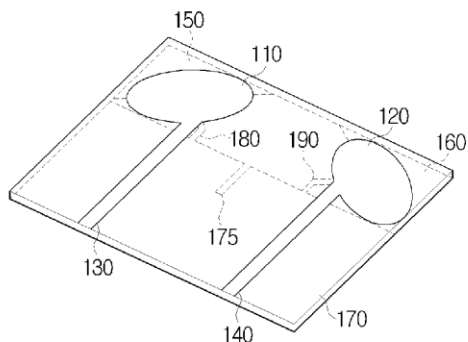
Primary Examiner — Robert Karacsony

(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



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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);
Andrey Astakhov, Moscow (RU);
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.**
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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.

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Primary Examiner — Jacob Y Choi

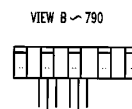
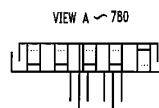
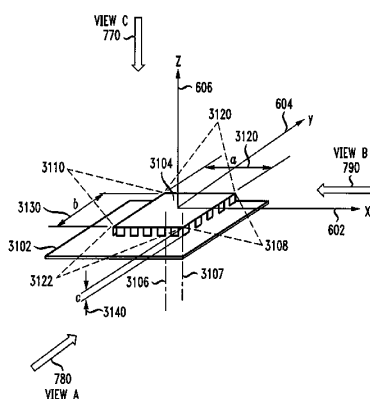
Assistant Examiner — Graham Smith

(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.

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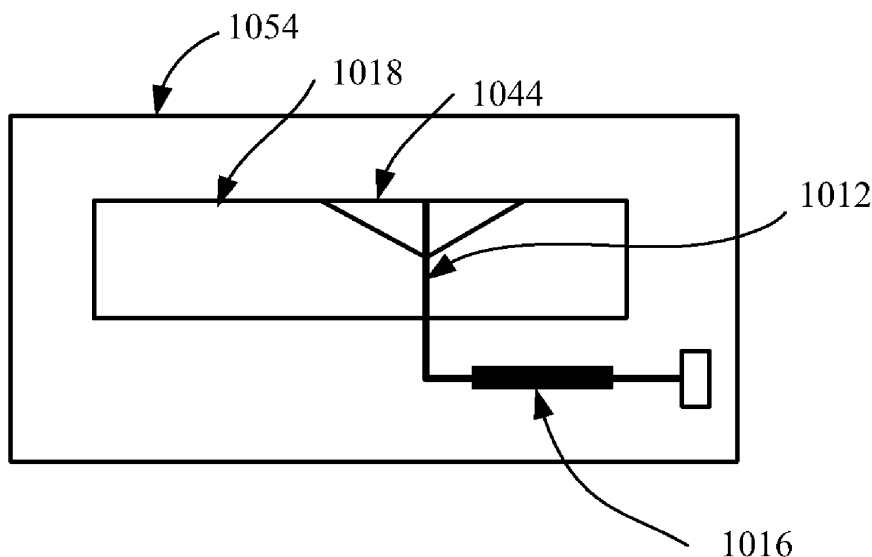
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Primary Examiner — Hoang V Nguyen
(74) *Attorney, Agent, or Firm* — Holland & Hart LLP

(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**

(56) **References Cited**

(75) Inventor: **Snir Azulay**, Tiberias (IL)

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(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.

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

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

(86) PCT No.: **PCT/IL2010/000407**

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§ 371 (c)(1),
(2), (4) Date: **Jun. 24, 2010**

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(65) **Prior Publication Data**

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Primary Examiner — Don Le

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

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

(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.

(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

