



US008339319B2

(12) **United States Patent**
Chen

(10) **Patent No.:** **US 8,339,319 B2**

(45) **Date of Patent:** **Dec. 25, 2012**

(54) **BROADBAND ANTENNA**

(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
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(21) Appl. No.: **12/894,117**

(22) Filed: **Sep. 29, 2010**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Mar. 25, 2010 (CN) 2010 2 0141776 U

(51) **Int. Cl.**

H01Q 1/38 (2006.01)

H01Q 1/24 (2006.01)

(52) **U.S. Cl.** **343/700 MS**; 343/829; 343/846

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

(56) **References Cited**

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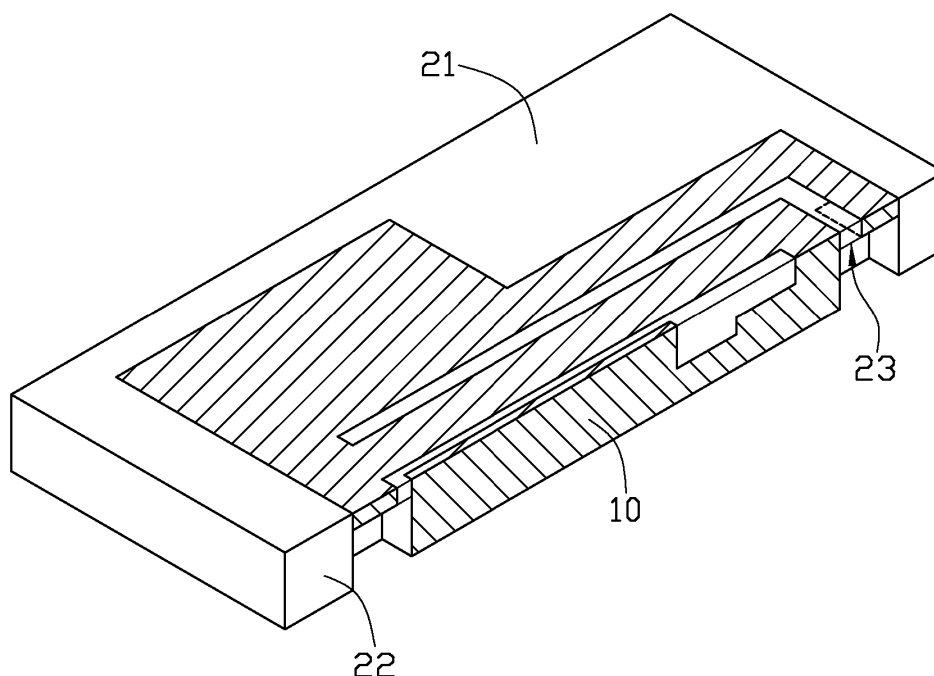
Primary Examiner — Trinh Dinh

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

(57) **ABSTRACT**

A broadband antenna printed on a substrate. The substrate includes a first surface, a second surface perpendicular to the first surface, and a third surface parallel to the first surface. The broadband antenna includes a grounding portion, a feeding portion, and a radiating portion. The grounding portion is located on the first surface. The feeding portion feeds electromagnetic signals and includes a first feeding section printed on the third surface and a second feeding section printed on the second surface. The radiating portion includes a first radiating section, a second radiating section, and a third radiating section. The first radiating section is printed on the first surface. The second radiating section comprises a first radiating segment and a second radiating segment. The third radiating section is printed on the second surface and formed a ladder portion.

10 Claims, 4 Drawing Sheets



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US008339321B2

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

(10) **Patent No.:** **US 8,339,321 B2**
(45) **Date of Patent:** **Dec. 25, 2012**

(54) **ANTENNA DEVICE AND PORTABLE RADIO APPARATUS**

(75) Inventors: **Kenya Nagano**, Sendai (JP); **Yoshio Koyanagi**, Yokohama (JP)

(73) Assignee: **Panasonic Corporation**, Osaka (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 361 days.

(21) Appl. No.: **12/671,907**

(22) PCT Filed: **Aug. 9, 2007**

(86) PCT No.: **PCT/JP2007/065614**

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

(87) PCT Pub. No.: **WO2009/019782**

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(65) **Prior Publication Data**

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

(52) **U.S. Cl.** **343/702; 343/876**

(58) **Field of Classification Search** 343/702,
343/876; 455/73, 78, 101, 552.1

See application file for complete search history.

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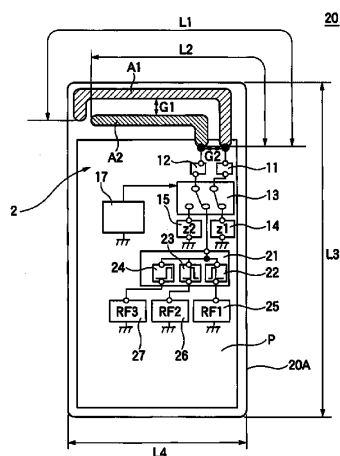
Primary Examiner — Hoang V Nguyen

(74) Attorney, Agent, or Firm — Seed IP Law Group PLLC

(57) **ABSTRACT**

A small antenna system which is incorporated in a portable radio apparatus and can ensure high antenna performance in a wide frequency band without impairing the design property or the operability and a portable radio apparatus are provided. An antenna device includes an antenna A1 having a resonance characteristic in a first frequency; an antenna A2 having a resonance characteristic in a second frequency and being spaced from the antenna A1 at a predetermined distance; a circuit board P provided in a mobile telephone 10, a wireless section 16 provided on the circuit board P for supplying or receiving high-frequency power; and a high-frequency switch 13 provided on the circuit board P for selecting connection of an output terminal or an input terminal of the wireless section 16 and a feeding point of the antenna A1 or the antenna A2 so that the feeding point of the antenna A1 or the antenna A2 can be switched and connecting to the wireless section 16.

10 Claims, 5 Drawing Sheets



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US008339322B2

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

(10) **Patent No.:** **US 8,339,322 B2**
(45) **Date of Patent:** **Dec. 25, 2012**

(54) **COMPACT MULTI-BAND ANTENNAS**

(75) Inventors: **Samuel Zaila**, Phoenix, AZ (US); **Marin Stoytchev**, Chandler, AZ (US)

(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 0 days.

(21) Appl. No.: **12/677,205**

(22) PCT Filed: **Feb. 18, 2010**

(86) PCT No.: **PCT/IL2010/000145**

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(2), (4) Date:

Mar. 9, 2010

(87) PCT Pub. No.: **WO2010/095136**

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(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 61/208,104, filed on Feb. 19, 2009.

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

(52) **U.S. Cl.** **343/702**; 343/722; 343/700 MS

(58) **Field of Classification Search** 343/702,
343/700 MS, 846, 850, 722

See application file for complete search history.

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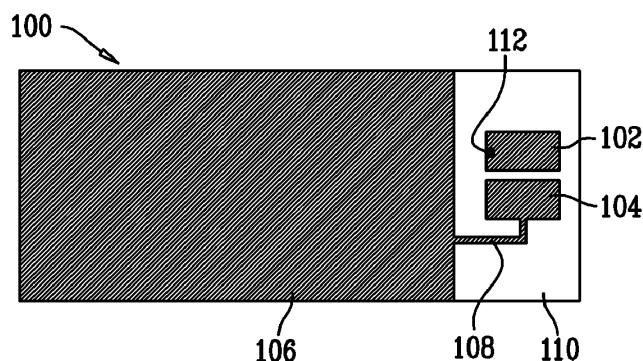
Primary Examiner — Hoang V Nguyen

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

(57) **ABSTRACT**

A multi-band antenna including a conductive ground plane element, a conductive driven element having a feed point and a conductive coupling element located on at least one but not all sides of the conductive driven element and coupled to the conductive ground plane element and to the conductive driven element, wherein a resonant frequency associated with the conductive coupling element is independent of a size of the conductive ground plane element.

23 Claims, 9 Drawing Sheets



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US008339328B2

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

(10) **Patent No.:** **US 8,339,328 B2**

(45) **Date of Patent:** **Dec. 25, 2012**

(54) **RECONFIGURABLE MULTI-BAND
ANTENNA AND METHOD FOR OPERATION
OF A RECONFIGURABLE MULTI-BAND
ANTENNA**

(76) Inventors: **Vijay Kris Narasimhan**, Ottawa (CA);
Colan Graeme Ryan, Ottawa (CA)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 273 days.

(21) Appl. No.: **12/444,992**

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

(86) PCT No.: **PCT/CA2007/001794**

§ 371 (c)(1),

(2), (4) Date: **Apr. 9, 2009**

(87) PCT Pub. No.: **WO2008/046193**

PCT Pub. Date: **Apr. 24, 2008**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 60/850,138, filed on Oct.
10, 2006.

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 5/00 (2006.01)
H01Q 9/04 (2006.01)
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)
H01Q 1/50 (2006.01)
H01Q 3/24 (2006.01)

(52) U.S. Cl. **343/876**; 343/700 MS; 343/702;
343/845; 343/860

(58) **Field of Classification Search** 343/702,
343/700 MS, 860, 876, 845
See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Douglas W Owens

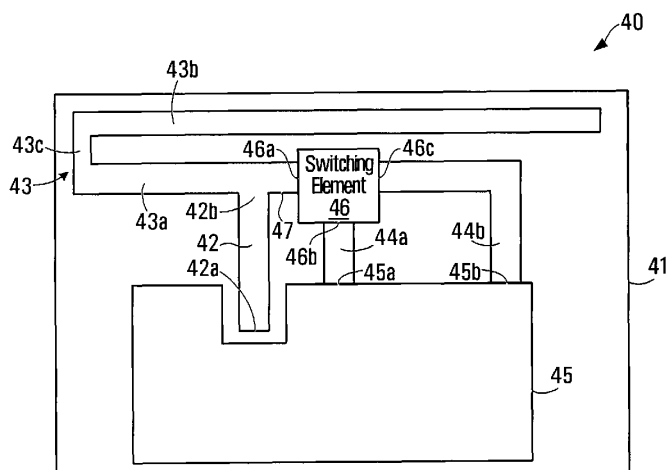
Assistant Examiner — Jennifer F Hu

(74) *Attorney, Agent, or Firm* — Barnes & Thornburg LLP

(57) **ABSTRACT**

A multi-band antenna is provided. The antenna includes a
radiating element resonant for at least two resonant frequen-
cies, and at least two matching elements that are electrically
connectable to the radiating element to substantially match an
input impedance of the antenna to a reference impedance for
each one of the at least two resonant frequencies. A method
for transmitting and receiving on one or more frequency
bands is also provided that includes selecting at least one
resonant frequency, selectively electrically connecting a
matching element corresponding to the at least one selected
resonant frequency to a radiating element resonant at the one
or more frequency bands, and receiving or transmitting a
wireless signal at the at least one selected resonant frequency
with the radiating element.

17 Claims, 9 Drawing Sheets



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US008340736B2

(12) **United States Patent**
Hiraoka

(10) **Patent No.:** **US 8,340,736 B2**

(45) **Date of Patent:** **Dec. 25, 2012**

(54) **MOBILE ELECTRONIC DEVICE**

(75) Inventor: **Yoshiaki Hiraoka**, Yokohama (JP)

(73) Assignee: **Kyocera Corporation**, Kyoto (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 117 days.

(21) Appl. No.: **12/748,342**

(22) Filed: **Mar. 26, 2010**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

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Feb. 25, 2010 (JP) 2010-039526

(51) **Int. Cl.**
H04M 1/00 (2006.01)

(52) **U.S. Cl.** **455/575.7; 455/575.1; 455/575.3**

(58) **Field of Classification Search** 455/90.3,
455/575.1, 575.3, 575.5, 575.7; 343/301,
343/702, 841

See application file for complete search history.

(56) **References Cited**

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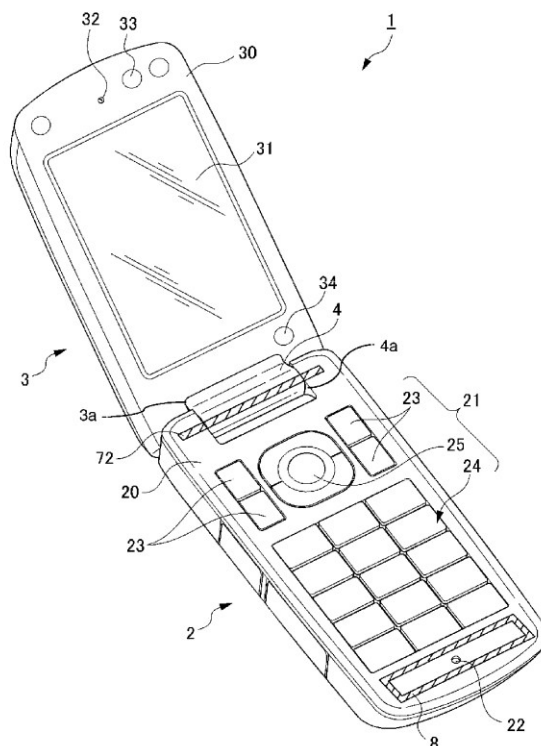
Primary Examiner — Tuan H Nguyen

(74) *Attorney, Agent, or Firm* — Richard C. Kim; Duane Morris, LLP

(57) **ABSTRACT**

A system and method for controlling antennas in a mobile electronic device is disclosed. The mobile electronic device comprises a first case comprising first antenna means and second case comprising second antenna means. The mobile electronic device is operable to communicate using the first antenna means when in a closed state and using the first and second antenna means when in an opened state.

15 Claims, 8 Drawing Sheets



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US008344950B2

(12) **United States Patent**
Su

(10) **Patent No.:** **US 8,344,950 B2**

(45) **Date of Patent:** **Jan. 1, 2013**

(54) **DUAL-LOOP ANTENNA AND
MULTI-FREQUENCY MULTI-ANTENNA
MODULE**

(75) Inventor: **Saou-Wen Su**, Keelung (TW)

(73) Assignees: **Sillitek Electronic (Guangzhou) Co.,
Ltd.**, Guangzhou (CN); **Lite-On
Technology Corporation**, Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 338 days.

(21) Appl. No.: **12/696,358**

(22) Filed: **Jan. 29, 2010**

(65) **Prior Publication Data**

US 2011/0063180 A1 Mar. 17, 2011

(30) **Foreign Application Priority Data**

Sep. 15, 2009 (CN) 2009 1 0175940

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

(52) **U.S. Cl.** **343/700 MS**; 343/742; 343/867

(58) **Field of Classification Search** 343/700 MS,
343/741, 742, 866, 867

See application file for complete search history.

(56) **References Cited**

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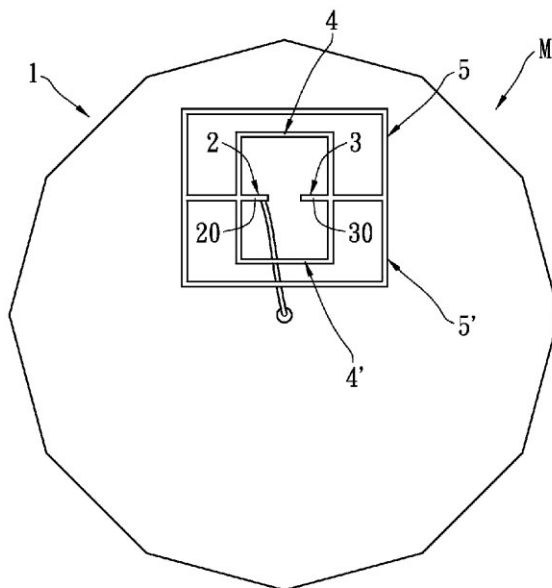
Primary Examiner — Hoanganh Le

(74) *Attorney, Agent, or Firm* — Li&Cai Intellectual Property (USA) Office

(57) **ABSTRACT**

A dual-loop antenna includes a grounding unit, a shorting unit, a feeding unit, a first loop radiating unit and a second loop radiating unit. The shorting unit has at least one shorting pin disposed on the grounding unit. The feeding unit has at least one feeding pin separated from the shorting pin by a predetermined distance and suspended above the grounding unit at a predetermined distance. The first loop radiating unit is disposed above the grounding unit at a predetermined distance. The first loop radiating unit has two ends respectively electrically connected to the shorting unit and the feeding unit. The second loop radiating unit is disposed above the grounding unit at a predetermined distance and around the first loop radiating unit. The second loop radiating unit has two ends respectively electrically connected to the shorting unit and the feeding unit.

20 Claims, 9 Drawing Sheets



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US008344952B2

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

(10) **Patent No.:** **US 8,344,952 B2**

(45) **Date of Patent:** **Jan. 1, 2013**

(54) **PORTABLE TERMINAL AND ANTENNA
MODULE THEREOF FOR RECEIVING
BROADCAST SIGNAL**

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(75) Inventors: **Kyung-Hack Yi**, Seoul (KR); **Dong-Ho Lee**, Seoul (KR)

(73) Assignee: **LG Electronics Inc.**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 664 days.

(21) Appl. No.: **12/465,416**

(22) Filed: **May 13, 2009**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

May 14, 2008 (KR) 10-2008-0044744

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

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

(58) **Field of Classification Search** **343/700 MS, 343/702**

See application file for complete search history.

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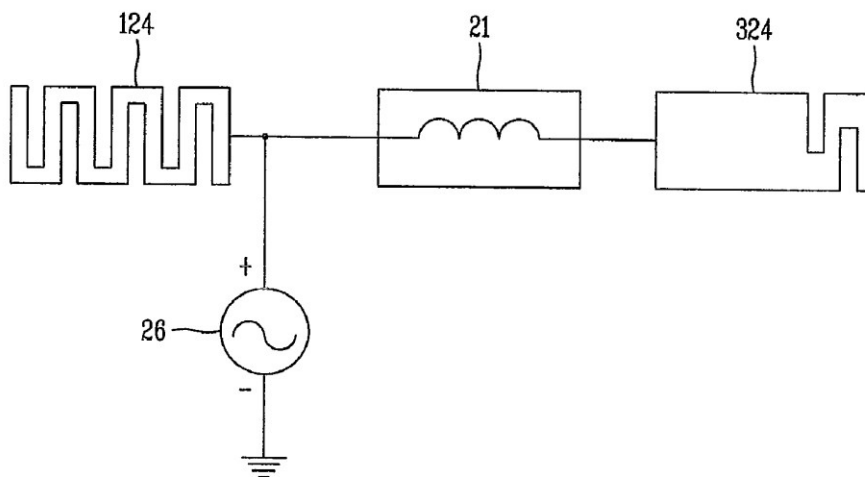
Primary Examiner — Tan Ho

(74) *Attorney, Agent, or Firm* — Birch, Stewart, Kolasch & Birch, LLP

(57) **ABSTRACT**

A portable terminal with an antenna for receiving broadcast signals, includes an antenna module having a chip antenna patterned on a dielectric chip so as to define a physical length of the antenna module that enables the chip antenna to operate within a broadcast band, and a conductive plate connected to the chip antenna and having an area such that conductive plate leads a main radiation of the antenna module on the broadcast band, whereby the physical length of the antenna module can be reduced as short as possible by employing the chip antenna. Accordingly, the chip antenna facilitates making the antenna module and the portable terminal be smaller in size. Also, the chip antenna is configured to lead a main radiation on the conductive plate, thereby increasing radio reception quality and improving radio performance.

17 Claims, 7 Drawing Sheets



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US008344954B2

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

(10) **Patent No.:** **US 8,344,954 B2**

(45) **Date of Patent:** **Jan. 1, 2013**

(54) **ANTENNA**

(75) Inventors: **Shih-Chieh Cheng**, Tainan County (TW); **Kuo-Chang Lo**, Miaoli County (TW)

(73) Assignee: **Arcadyan Technology Corporation**, Hsinchu (TW)

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(21) Appl. No.: **12/564,977**

(22) Filed: **Sep. 23, 2009**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Sep. 23, 2008 (TW) 97136487 A

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

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

(58) **Field of Classification Search** 343/700 MS, 343/702, 846; 455/575.7

See application file for complete search history.

(56) **References Cited**

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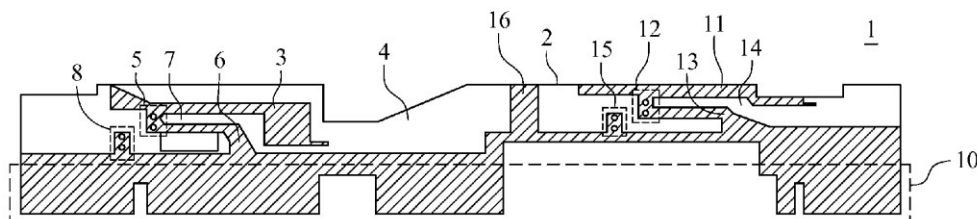
Primary Examiner — Michael C Wimer

(74) *Attorney, Agent, or Firm* — WPAT PC; Justin King

(57) **ABSTRACT**

An antenna is disclosed, which comprises: a substrate with a first surface and a second surface; a first radiation unit, disposed on the first surface; an insulating unit, disposed on the first surface on top of the first radiation unit; a first feed point, formed on the second surface and electrically connected to the first radiation unit; a grounding unit, disposed coplanar and connected with the first radiation unit; a first gap, formed between the first radiation unit and the grounding unit; and a second feed point, formed on the second surface and electrically connected to the grounding unit; wherein, as the second surface with the two feed points disposed thereon is adjacent to at least a metallic component and the radiation units are disposed on the first surface, the radiation units do not directly face the metallic component and thus prevent the same from being interfered by metallic shielding.

19 Claims, 3 Drawing Sheets



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US008344956B2

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

(10) **Patent No.:** **US 8,344,956 B2**

(45) **Date of Patent:** **Jan. 1, 2013**

(54) **METHODS FOR REDUCING NEAR-FIELD RADIATION AND SPECIFIC ABSORPTION RATE (SAR) VALUES IN COMMUNICATIONS DEVICES**

(75) Inventors: **Mark T. Montgomery**, Melbourne Beach, FL (US); **Frank M. Caimi**, Vero Beach, FL (US); **Paul A. Tornatta, Jr.**, Melbourne, FL (US); **Mark W. Kishler**, Rockledge, FL (US); **Li Chen**, Melbourne, FL (US)

(73) Assignee: **SkyCross, Inc.**, Viera, FL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 364 days.

(21) Appl. No.: **12/786,032**

(22) Filed: **May 24, 2010**

(65) **Prior Publication Data**

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Related U.S. Application Data

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(60) Provisional application No. 61/181,176, filed on May 26, 2009, provisional application No. 60/916,655, filed on May 8, 2007, provisional application No. 60/925,394, filed on Apr. 20, 2007.

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

(52) **U.S. Cl.** **343/702**; 343/820; 343/844; 342/159; 455/575.1; 455/575.5

(58) **Field of Classification Search** 343/702, 343/820, 844; 342/159; 455/41.1, 90, 575.1, 455/575.5

See application file for complete search history.

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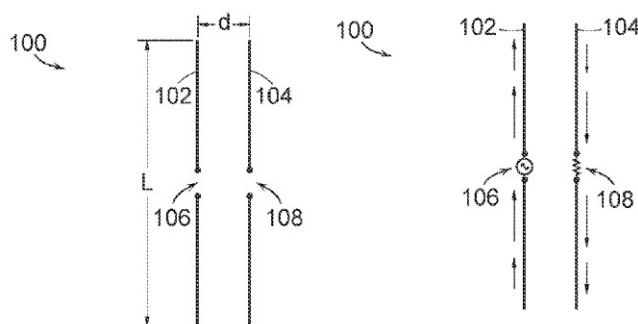
Primary Examiner — Tho G Phan

(74) *Attorney, Agent, or Firm* — Rajesh Vallabh; Foley Hoag LLP

(57) **ABSTRACT**

A method is provided for reducing near-field radiation and specific absorption rate (SAR) values in a communications device. The communications device includes a multimode antenna structure transmitting and receiving electromagnetic signals and circuitry for processing signals communicated to and from the antenna structure. The method includes adjusting the relative phase between signals fed to neighboring antenna ports of the antenna structure such that a signal fed to the one antenna port has a different phase than a signal fed to the neighboring antenna port to provide antenna pattern control and to increase gain in a selected direction toward a receive point. The method features using a transmit power lower than the transmit power used in a non-pattern control operation of the antenna structure such that the communications device obtains generally equivalent wireless link performance with the receive point using reduced transmit power compared to the non-pattern control operation, thereby reducing the specific absorption rate.

22 Claims, 69 Drawing Sheets



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US008345639B2

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

(10) **Patent No.:** **US 8,345,639 B2**
(45) **Date of Patent:** **Jan. 1, 2013**

(54) **BROAD PROPAGATION PATTERN ANTENNA**

(75) Inventors: **Marion P. Hensley**, Pendleton, IN (US);
Matthew R. Dexter, Indianapolis, IN (US)

(73) Assignee: **Raytheon Company**, Waltham, MA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 340 days.

(21) Appl. No.: **12/815,256**

(22) Filed: **Jun. 14, 2010**

(65) **Prior Publication Data**

US 2011/0305174 A1 Dec. 15, 2011

(51) **Int. Cl.**
H04W 4/00 (2009.01)

(52) **U.S. Cl.** **370/334**

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

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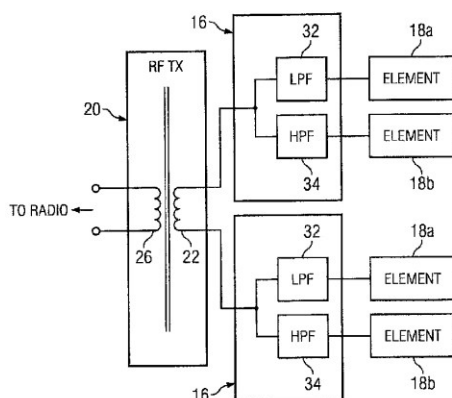
Primary Examiner — Jianye Wu

(74) *Attorney, Agent, or Firm* — Daly, Crowley, Mofford & Durkee, LLP

(57) **ABSTRACT**

An antenna includes a diplexer having a high pass filter coupled to first and second radiating elements and a low pass filter coupled to third and fourth radiating elements, the first and second radiating elements oriented in a different direction relative to the third and fourth radiating elements. Signals are transmitted to or receive from the first and second radiating elements with a greater intensity relative to the intensity with which the signals are transmitted to or received from the third and fourth radiating elements when the signal frequencies are above a low pass roll-off frequency of the low pass filter. Signals are transmitted to or received from the third and fourth radiating elements with a greater intensity relative to the intensity with which the signals are transmitted to or received from the first and second radiating elements when the signal frequencies are below a high pass roll-off frequency of the high pass filter.

19 Claims, 3 Drawing Sheets



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US008346092B2

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

(10) **Patent No.:** **US 8,346,092 B2**
(45) **Date of Patent:** **Jan. 1, 2013**

(54) **ANTENNA DEVICE**

(75) Inventors: **Ming Zhao**, Milan (IT); **Jianjun Chen**, Santa Clara, CA (US); **Xueru Liu**, Shenzhen (CN); **Pinghua He**, Shenzhen (CN)

(73) Assignee: **Huawei Technologies Co., Ltd.**, Shenzhen, Guangdong (CN)

(*) 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.: **13/240,910**

(22) Filed: **Sep. 22, 2011**

(65) **Prior Publication Data**

US 2012/0014697 A1 Jan. 19, 2012

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2009/071973, filed on May 26, 2009.

(51) **Int. Cl.**
H04B 10/00 (2006.01)

(52) **U.S. Cl.** **398/115**; 398/116; 398/117; 398/79; 398/138; 398/139

(58) **Field of Classification Search** 398/115, 398/116, 117, 79, 128, 130, 135, 138, 139, 398/164

See application file for complete search history.

(56) **References Cited**

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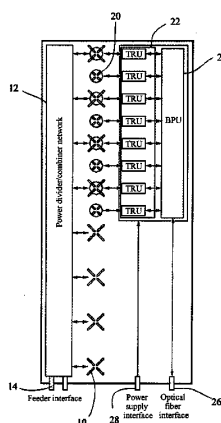
Primary Examiner — M. R. Sedighian

(74) *Attorney, Agent, or Firm* — Finnegan, Henderson, Farabow, Garrett & Dunner, LLP

(57) **ABSTRACT**

An antenna device is provided, which includes a first antenna unit and a second antenna unit. The first antenna unit includes a first radiation module, a power divider/combiner network connected to the first radiation module, and a feeder interface connected to the power divider/combiner network. The feeder interface is connected to a radio remote unit (RRU) or a macro base station through a feeder. The second antenna unit includes a second radiation module, a transceiver array connected to the second radiation module, a baseband processing unit (BPU) connected to the transceiver array, and an optical fiber interface connected to the BPU. The optical fiber interface is connected to a baseband unit (BBU) through an optical fiber. Therefore, after the existing passive antenna is replaced by the provided antenna device, the RRU or macro base station in the original network can still be used, which reduces waste of resources.

12 Claims, 5 Drawing Sheets



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US008346199B2

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

(10) **Patent No.:** **US 8,346,199 B2**
(45) **Date of Patent:** ***Jan. 1, 2013**

(54) **MOBILE WIRELESS COMMUNICATIONS
DEVICE WITH REDUCED MICROPHONE
NOISE FROM RADIO FREQUENCY
COMMUNICATIONS CIRCUITRY**

(58) **Field of Classification Search** 455/575.5,
455/575.8, 271, 283, 286, 300, 30
See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Christian Hannon

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

(57) **ABSTRACT**

A mobile wireless communications device includes a housing and circuit board in the housing and having radio frequency (RF) circuitry and a power amplifier and microphone mounted thereon. An antenna is carried within the housing and operative with the RF circuitry. An RF shield surrounds and isolates the microphone from the RF circuitry, power amplifier and antenna and shields the microphone from radiated energy generated from the RF circuitry, antenna or power amplifier.

19 Claims, 12 Drawing Sheets

(75) **Inventors:** **Michael Stephen Corrigan**, Waterloo (CA); **George Soliman Mankaruse**, Kitchener (CA); **Lizhong Zhu**, 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.
This patent is subject to a terminal disclaimer.

(21) **Appl. No.:** **13/460,136**

(22) **Filed:** **Apr. 30, 2012**

(65) **Prior Publication Data**

US 2012/0214555 A1 Aug. 23, 2012

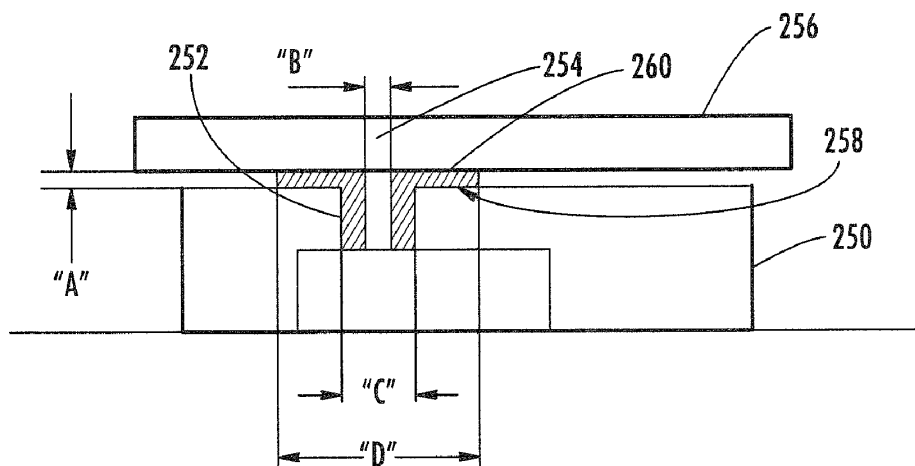
Related U.S. Application Data

(63) Continuation of application No. 13/009,314, filed on Jan. 19, 2011, now Pat. No. 8,190,112, which is a continuation of application No. 12/128,710, filed on May 29, 2008, now Pat. No. 7,899,427, which is a continuation of application No. 11/064,702, filed on Feb. 24, 2005, now Pat. No. 7,398,072.

(60) Provisional application No. 60/605,751, filed on Aug. 31, 2004.

(51) **Int. Cl.**
H04B 1/10 (2006.01)

(52) **U.S. Cl.** **455/301; 455/575.8; 455/300**



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US008348170B2

(12) **United States Patent**
Brod

(10) **Patent No.:** **US 8,348,170 B2**
(45) **Date of Patent:** **Jan. 8, 2013**

(54) **METHOD FOR PRODUCING AN ANTENNA
ON A SUBSTRATE**

(75) Inventor: **Volker Brod**, Bad Abbach (DE)

(73) Assignee: **Mühlbauer AG**, Roding (DE)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 345 days.

(21) Appl. No.: **12/691,287**

(22) Filed: **Jan. 21, 2010**

(65) **Prior Publication Data**

US 2010/0181385 A1 Jul. 22, 2010

(30) **Foreign Application Priority Data**

Jan. 21, 2009 (DE) 10 2009 005 570

(51) **Int. Cl.**
G06K 19/06 (2006.01)

(52) **U.S. Cl.** **235/492**

(58) **Field of Classification Search**
235/487; 340/572.7, 572.8; 343/700 R,
343/700 MS

See application file for complete search history.

(56) **References Cited**

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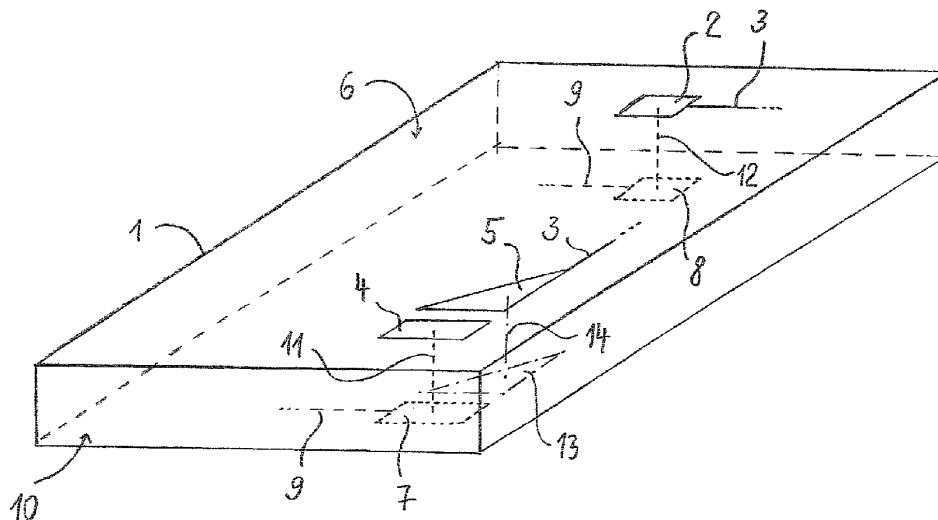
Primary Examiner — Seung Lee

(74) Attorney, Agent, or Firm — Henry M. Feiereisen LLC

(57) **ABSTRACT**

A simple and universal technique for fabricating different antenna structures, in particular a multilayer antenna structure, on a substrate is disclosed. Before the antenna is actually fabricated or placed on the substrate, connecting surfaces for connecting an antenna conductor and/or a chip or a chip module as well as through-platings extending through the antenna substrate are prepared between the connecting surfaces.

10 Claims, 3 Drawing Sheets



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US008350674B2

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

(10) **Patent No.:** **US 8,350,674 B2**
(45) **Date of Patent:** **Jan. 8, 2013**

(54) **RFID TAG INCLUDING A LOOP ANTENNA
AND RFID SYSTEM USING THE RFID TAG**

(75) Inventors: **Il Hwan Park**, Hwaseong-si (KR);
Chang Su Choi, Yongin-si (KR); **Jong
Soo Kim**, Seoul (KR)

(73) Assignee: **LS Industrial Systems Co., Ltd.**,
Anyang-si, Gyeonggi-do (KR)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 575 days.

(21) Appl. No.: **12/413,177**

(22) Filed: **Mar. 27, 2009**

(65) **Prior Publication Data**

US 2009/0243805 A1 Oct. 1, 2009

(30) **Foreign Application Priority Data**

Apr. 1, 2008 (KR) 10-2008-0030474

(51) **Int. Cl.**
H04Q 5/22 (2006.01)

(52) **U.S. Cl.** **340/10.1**; 340/572.1; 340/505;
340/572.5; 343/741; 343/866

(58) **Field of Classification Search** 340/10.1,
340/572.1, 505, 572.5; 343/741, 866, 61,
343/761

See application file for complete search history.

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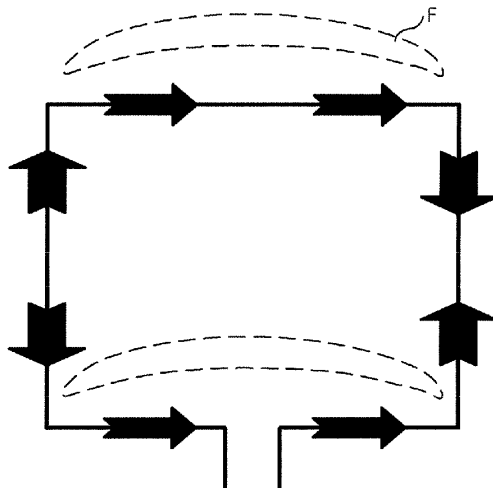
Primary Examiner — Hoi Lau

(74) Attorney, Agent, or Firm — Lee, Hong, Degerman,
Kang & Waimey

(57) **ABSTRACT**

An RFID tag and an RFID tag using the same are disclosed,
wherein the RFID tag comprises: a circuit unit arranged on a
first part of a board; and a loop type antenna on a second part
of the board.

9 Claims, 9 Drawing Sheets



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US008350702B2

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

(10) **Patent No.:** **US 8,350,702 B2**
(45) **Date of Patent:** **Jan. 8, 2013**

(54) **COMBINATION EAS AND RFID SECURITY TAG HAVING STRUCTURE FOR ORIENTING A HYBRID ANTENNA RFID ELEMENT**

(75) Inventors: **Richard L. Copeland**, Lake Worth, FL (US); **Edward Day**, Pembroke Pines, FL (US); **William Johnson, III**, Lake Worth, FL (US); **Dan Luo**, Lake Worth, FL (US); **Eugenio Morgado**, Royal Palm Beach, FL (US); **Dale W. Raymond**, Boca Raton, FL (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 450 days.

(21) Appl. No.: **12/822,634**

(22) Filed: **Jun. 24, 2010**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 61/270,024, filed on Jul. 1, 2009.

(51) **Int. Cl.**
G08B 13/14 (2006.01)

(52) **U.S. Cl.** **340/572.7**

(58) **Field of Classification Search** 340/572.7, 340/572.1-572.5, 572.8, 572.9, 10.1; 235/385
See application file for complete search history.

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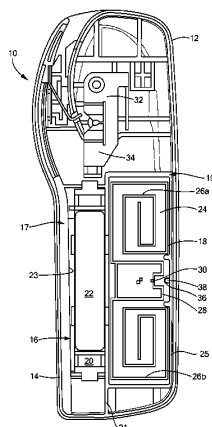
Primary Examiner — Phung Nguyen

(74) *Attorney, Agent, or Firm* — Alan M. Weisberg; Christopher & Weisberg, P.A.

(57) **ABSTRACT**

A security tag including independent EAS and RFID components disposed in a housing configured for geometric placement of the RFID and EAS components for optimum RFID performance. The EAS component is situated in a first compartment and the RFID component is situated in a second compartment. The RFID component includes a hybrid antenna RFID inlay and an IC chip. The tag housing includes a key structure that minimizes the de-tuning of both the EAS and RFID components by positioning the IC chip such that the IC chip is closer to a first side of the second compartment than the second side of the second compartment when the antenna inlay is inserted within the housing. The housing further includes one or more pins that raise the RFID inlay above the magnetic resonator of the EAS component to further insure optimal RFID read performance.

20 Claims, 6 Drawing Sheets



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US008350703B2

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

(10) **Patent No.:** **US 8,350,703 B2**
(45) **Date of Patent:** ***Jan. 8, 2013**

(54) **RFID TAGS AND PROCESSES FOR PRODUCING RFID TAGS**

(75) Inventors: **Glenn W. Gengel**, Hollister, CA (US);
Mark A. Hadley, Newark, CA (US);
Torn Pounds, Monte Sereno, CA (US);
Kenneth D. Schatz, San Jose, CA (US);
Paul S. Drzaic, Morgan Hill, CA (US)

(73) Assignee: **Alien Technology Corporation**, Morgan Hill, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 44 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/987,995**

(22) Filed: **Jan. 10, 2011**

(65) **Prior Publication Data**

US 2011/0186640 A1 Aug. 4, 2011

Related U.S. Application Data

(63) Continuation of application No. 12/366,617, filed on Feb. 5, 2009, now Pat. No. 7,868,766, which is a continuation of application No. 11/497,402, filed on Jul. 31, 2006, now Pat. No. 7,489,248, which is a continuation of application No. 10/807,775, filed on Mar. 23, 2004, now Pat. No. 7,253,735.

(60) Provisional application No. 60/457,263, filed on Mar. 24, 2003.

(51) **Int. Cl.**
G08B 13/14 (2006.01)

(52) **U.S. Cl.** **340/572.7; 29/846; 235/492; 257/678; 438/110**

(58) **Field of Classification Search** 340/572.1, 340/572.7; 29/825, 829, 846; 438/106, 107, 438/110; 257/678, 734; 235/492; 361/737, 361/749, 760, 761, 764
See application file for complete search history.

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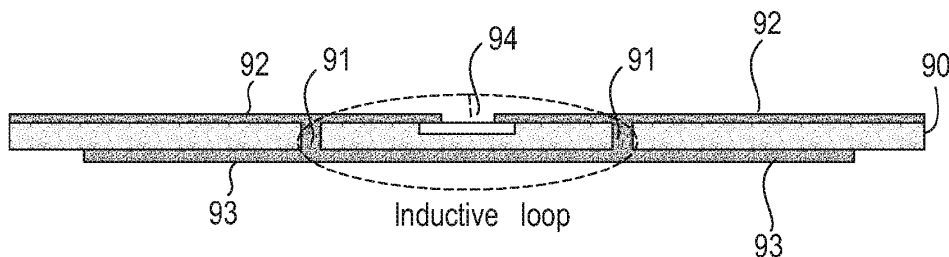
Primary Examiner — Thomas Mullen

(74) *Attorney, Agent, or Firm* — Blakely, Sokoloff, Taylor & Zafman LLP

(57) **ABSTRACT**

A Radio Frequency Identification (RFID) tag. The RFID tag comprises a flexible substrate and an integrated circuit embedded within the flexible substrate. The top surface of the integrated circuit is coplanar with the flexible substrate. At least one conductive element is formed on the flexible substrate. The conductive element is electrically connected to the integrated circuit. The conductive element serves as an antenna for the RFID tag.

14 Claims, 13 Drawing Sheets



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US008350759B2

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

(10) **Patent No.:** **US 8,350,759 B2**
(45) **Date of Patent:** **Jan. 8, 2013**

(54) **ANTENNA HAVING METAMATERIAL
SUPERSTRATE AND PROVIDING GAIN
IMPROVEMENT AND BEAMFORMING
TOGETHER**

(75) Inventors: **Jeong Ho Ju**, Seoul (KR); **Dong Ho Kim**, Daejeon (KR); **Jae Ick Choi**, Daejeon (KR); **Wang Joo Lee**, Daejeon (KR)

(73) Assignee: **Electronics and Telecommunications Research Institute**, Daejeon (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 222 days.

(21) Appl. No.: **12/634,276**

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

(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
Apr. 29, 2009 (KR) 10-2009-0037821

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
(52) **U.S. Cl.** **343/700 MS**; 343/909; 343/872
(58) **Field of Classification Search** 343/700 MS, 343/909, 872

See application file for complete search history.

(56) **References Cited**

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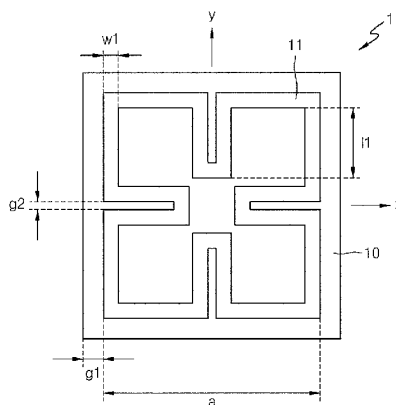
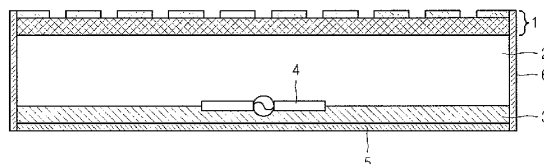
Primary Examiner — Dieu H Duong

(74) Attorney, Agent, or Firm — Ladas & Parry LLP

(57) **ABSTRACT**

Provided is antenna having metamaterial and providing gain improvement and beamforming together. The antenna includes a resonator and a superstrate. A feed antenna is disposed in the resonator. The superstrate includes a conductive pattern on the resonator for improving gain and beamforming of the feed antenna.

20 Claims, 7 Drawing Sheets



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US008350760B2

(12) **United States Patent**
Lee

(10) **Patent No.:** **US 8,350,760 B2**
(45) **Date of Patent:** **Jan. 8, 2013**

(54) **ANTENNA USING BUILDUP STRUCTURE
AND METHOD OF MANUFACTURING THE
SAME**

(75) Inventor: **Ho-Jun Lee**, Seongnam-si (KR)

(73) Assignee: **Korea Electronics Technology
Institute**, Seongnam-Si, Gyeonggi-Do
(KR)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 586 days.

(21) Appl. No.: **12/655,058**

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

(65) **Prior Publication Data**
US 2010/0156744 A1 Jun. 24, 2010

(30) **Foreign Application Priority Data**
Dec. 24, 2008 (KR) 10-2008-0133871

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

(52) **U.S. Cl.** **343/700 MS; 29/600**

(58) **Field of Classification Search** **343/700 MS;**
343/846, 872; 29/600; 340/572.7
See application file for complete search history.

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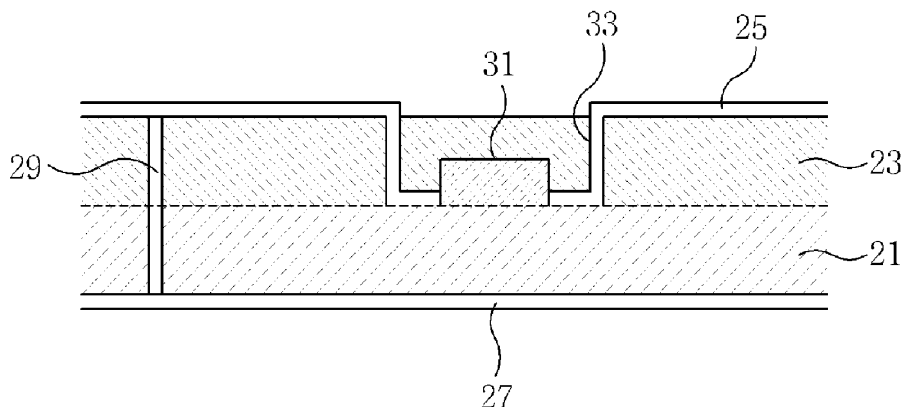
Primary Examiner — Tan Ho

(74) *Attorney, Agent, or Firm* — Lowe Hauptman Ham &
Bernier, LLP

(57) **ABSTRACT**

There are provided an antenna using a buildup structure and a method of manufacturing the same. In the antenna, a tag chip is positioned within a dielectric and is connected to a radiator through a connection line or a via-hole, thereby being strong against external environments, decreasing a defective rate and enabling to be used for the special purpose of being positioned within a metal or liquid.

14 Claims, 3 Drawing Sheets



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US008350761B2

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

(10) **Patent No.:** **US 8,350,761 B2**
(45) **Date of Patent:** **Jan. 8, 2013**

(54) **ANTENNAS FOR HANDHELD ELECTRONIC DEVICES**

(75) Inventors: **Robert J. Hill**, Salinas, CA (US);
Robert W. Schlub, Campbell, CA (US);
Juan Zavala, Watsonville, CA (US);
Ruben Caballero, San Jose, CA (US)

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

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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 1087 days.

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(21) Appl. No.: **11/650,187**

Hobson et al. U.S. Appl. No. 60/883,587, filed Jan. 5, 2007.

(22) Filed: **Jan. 4, 2007**

(Continued)

(65) **Prior Publication Data**
US 2008/0165065 A1 Jul. 10, 2008

Primary Examiner — Michael C Wimer

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

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

(57) **ABSTRACT**

(52) **U.S. Cl.** **343/702**; 343/767; 343/846; 455/575.7
(58) **Field of Classification Search** 343/700 MS,
343/702, 767, 846; 455/575.7
See application file for complete search history.

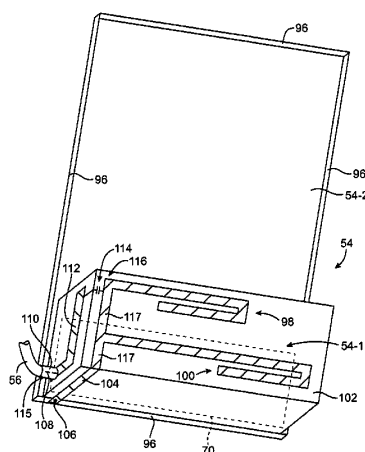
Handheld electronic devices are provided that contain wireless communications circuitry having at least one antenna. The antenna may have a planar ground element and a planar resonating element. The planar ground element may have a rectangular shape that matches a rectangular housing shape for a handheld electronic device. A dielectric-filled slot may be formed in one end of the planar ground element. The planar resonating element may be located above the slot. The antenna may be a hybrid antenna that contains both a slot antenna structure formed from the slot and a planar inverted-F structure formed from the planar resonating element and the planar ground element. The antenna may be fed using a single transmission line or two transmission lines. With two transmission lines, one transmission line may be associated with the slot antenna structure and one transmission line may be associated with the planar inverted-F antenna structure.

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24 Claims, 11 Drawing Sheets



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US008350762B2

(12) **United States Patent**
Kim

(10) **Patent No.:** **US 8,350,762 B2**
(45) **Date of Patent:** **Jan. 8, 2013**

(54) **MULTI BAND BUILT-IN ANTENNA**

(75) Inventor: **Byong-Nam Kim**, Gyeonggi-do (KR)

(73) Assignee: **Ace Antenna Corp.**, Incheon (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 661 days.

(21) Appl. No.: **12/530,212**

(22) PCT Filed: **Mar. 10, 2008**

(86) PCT No.: **PCT/KR2008/001340**

§ 371 (c)(1),

(2), (4) Date: **Jan. 19, 2010**

(87) PCT Pub. No.: **WO2008/108607**

PCT Pub. Date: **Sep. 12, 2008**

(65) **Prior Publication Data**

US 2010/0149069 A1 Jun. 17, 2010

(30) **Foreign Application Priority Data**

Mar. 8, 2007 (KR) 10-2007-0022850

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

(52) **U.S. Cl.** **343/702; 343/895**

(58) **Field of Classification Search** **343/702, 343/791, 792, 793, 895**

See application file for complete search history.

(56) **References Cited**

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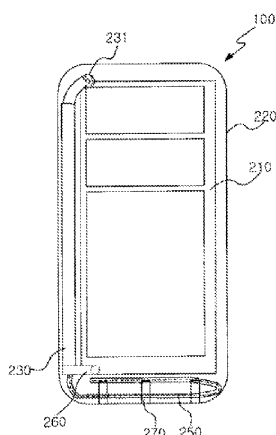
Primary Examiner — Tan Ho

(74) Attorney, Agent, or Firm — LRK Patent Law Firm

(57) **ABSTRACT**

A multi-band built-in antenna for a mobile communication terminal having a main board and a casing for protecting the main board, is disclosed. A transmission line is formed to be spaced apart from one outside surface of the main board by a predetermined interval and configured to include an external conductor, a dielectric, and a central conductor so as to transmit signals. A ground clip is configured to ground the transmission line by fastening the transmission line. A radiator is formed by bending the dielectric and central conductor of the transmission line, other than the external conductor of the transmission line, and is configured to operate in multiple bands. An open stub is connected to the ground clip, is bent a plurality of times, and is configured to be operated in a low frequency band, which is lower than the high frequency band.

26 Claims, 8 Drawing Sheets



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US008350764B2

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

(10) **Patent No.:** **US 8,350,764 B2**
(45) **Date of Patent:** **Jan. 8, 2013**

(54) **LOW FREQUENCY DUAL-ANTENNA DIVERSITY SYSTEM**

(75) Inventors: **Qinjiang Rao**, Waterloo (CA); **Dong Wang**, Waterloo (CA)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 353 days.

(21) Appl. No.: **12/797,599**

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

(65) **Prior Publication Data**

US 2011/0298669 A1 Dec. 8, 2011

(30) **Foreign Application Priority Data**

Jun. 8, 2010 (EP) 10165259

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

(52) **U.S. Cl.** **343/702**; 343/700 MS; 343/895

(58) **Field of Classification Search** 343/702,
343/700 MS, 895

See application file for complete search history.

(56) **References Cited**

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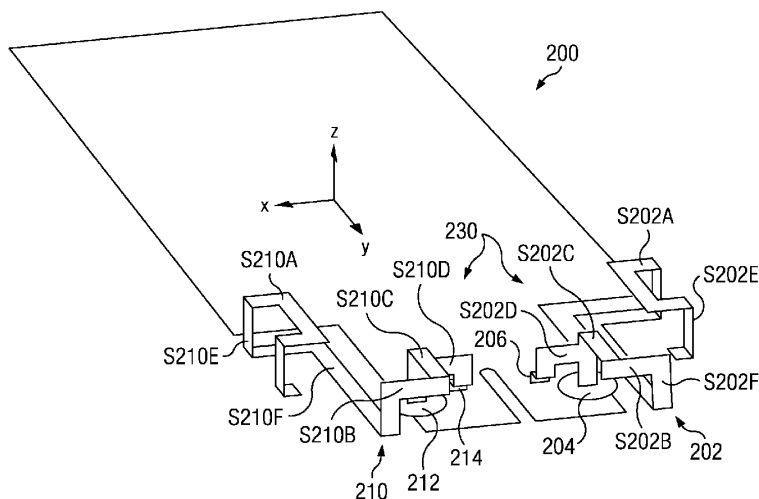
Primary Examiner — Hoang V Nguyen

(74) *Attorney, Agent, or Firm* — Moffat & Co.

(57) **ABSTRACT**

A dual-antenna diversity antenna system that operates within a low frequency band range is disclosed. Two antennas are folded separately onto a single three dimensional dielectric substrate in a meander pattern configuration. Each antenna has an independent feed port and ground pin. The two antennas are configured within a compact mobile terminal to produce high isolation and low correlation at resonating frequencies within the 700 Megahertz frequency band.

17 Claims, 14 Drawing Sheets



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US008350767B2

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

(10) **Patent No.:** **US 8,350,767 B2**
(45) **Date of Patent:** **Jan. 8, 2013**

(54) **NOTCH ANTENNA HAVING A LOW PROFILE STRIPLINE FEED**

(75) Inventors: **Glenn A. Brigham**, Chelmsford, MA (US); **Marat Davidovitz**, Belmont, MA (US); **Zhanna Davidovitz**, legal representative, Belmont, MA (US); **Sean M. Duffy**, Stow, MA (US); **Jeffrey Herd**, Rowley, MA (US)

(73) Assignee: **Massachusetts Institute of Technology**, Cambridge, MA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 617 days.

(21) Appl. No.: **12/126,418**

(22) Filed: **May 23, 2008**

(65) **Prior Publication Data**

US 2009/0322636 A1 Dec. 31, 2009

Related U.S. Application Data

(60) Provisional application No. 60/940,739, filed on May 30, 2007.

(51) **Int. Cl.**
H01Q 1/28 (2006.01)
H01Q 13/00 (2006.01)
H01Q 1/00 (2006.01)
H01Q 21/00 (2006.01)
G01S 13/74 (2006.01)
G01S 13/08 (2006.01)

(52) **U.S. Cl.** **343/725; 343/705; 343/785; 343/722; 343/776; 343/853; 342/44; 342/51**

(58) **Field of Classification Search** **343/725, 343/705, 785, 722, 776, 853, 778, 753, 756; 342/44, 51; 607/101; 333/133**

See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Jacob Y Choi

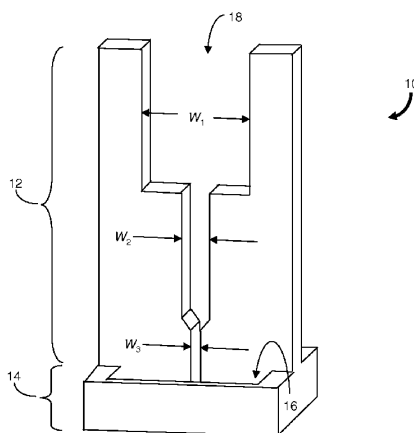
Assistant Examiner — Graham Smith

(74) *Attorney, Agent, or Firm* — Guerin & Rodriguez, LLP; William G. Guerin

(57) **ABSTRACT**

Described are a notch antenna and an array antenna based on a low profile stripline feed. The notch antenna includes a planar dielectric substrate having upper and lower surfaces. Each surface has a conductive layer with an opening therein. A notch antenna element is disposed on the conductive layer of the upper surface at the opening. A stripline embedded in the planar dielectric substrate extends under the notch antenna element. The stripline is adapted to couple an RF signal between the stripline and the notch antenna element. A conductive via is electrically coupled to the stripline and extends from the stripline to the opening in the conductive layer on the lower surface so that the RF signal is accessible at the lower surface.

8 Claims, 5 Drawing Sheets



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US008350772B2

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

(10) **Patent No.:** **US 8,350,772 B2**
(45) **Date of Patent:** **Jan. 8, 2013**

(54) **ANTENNA APPARATUS FOR PRINTED CIRCUIT BOARD HAVING AUXILIARY ANTENNA**

(75) Inventors: **Jae-Min Seo**, Gyeonggi-do (KR);
Jae-Sun Park, Gyeonggi-do (KR);
Kee-Dug Kim, Seoul (KR)

(73) Assignee: **Samsung Electronics Co., Ltd.**,
Samsung-ro, Yeongtong-gu, Suwon-si,
Gyeonggi-do (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 567 days.

(21) Appl. No.: **12/584,099**

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

(65) **Prior Publication Data**
US 2010/0053012 A1 Mar. 4, 2010

(30) **Foreign Application Priority Data**
Sep. 1, 2008 (KR) 10-2008-0085917

(51) **Int. Cl.**
H01Q 13/10 (2006.01)
H01Q 1/24 (2006.01)

(52) **U.S. CL.** **343/770; 343/702**
(58) **Field of Classification Search** 343/767,
343/770, 771, 700 MS, 850, 702
See application file for complete search history.

(56) **References Cited**

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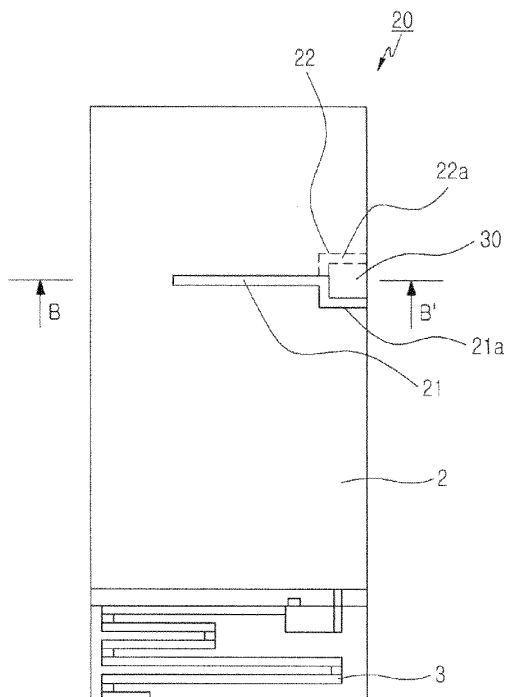
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Primary Examiner — Hoang V Nguyen
(74) *Attorney, Agent, or Firm* — Cha & Reiter, LLC

(57) **ABSTRACT**

An antenna apparatus for a printed circuit board including an auxiliary antenna which includes a printed circuit board and mounting components. An antenna pattern is formed on the printed circuit board, and the antenna apparatus includes a first auxiliary antenna unit formed on an upper surface of the printed circuit board; and a second auxiliary antenna unit provided at a location on a lower surface of the printed circuit board that corresponds to location of the first auxiliary antenna unit on the upper surface of the printed circuit board. Efficiency by the antenna apparatus according to the present invention can be increased by approximately 17%.

19 Claims, 5 Drawing Sheets



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US008350774B2

(12) **United States Patent**
Pickles

(10) **Patent No.:** **US 8,350,774 B2**
(45) **Date of Patent:** **Jan. 8, 2013**

(54) **DOUBLE BALUN DIPOLE**

(56) **References Cited**

(75) Inventor: **William R. Pickles**, Vienna, VA (US)

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(73) Assignee: **The United States of America, as represented by the Secretary of the Navy**, Washington, DC (US)

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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 410 days.

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(21) Appl. No.: **12/209,932**

M. Kragalott, W.R. Pickles, and M.S. Kluskens, "Design of a 5:1 bandwidth stripline notch array from FDTD analysis," IEEE Trans. Antennas Propagat., vol. 48, pp. 1733-1741, (Nov. 2000).

(22) Filed: **Sep. 12, 2008**

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(65) **Prior Publication Data**

US 2010/0271280 A1 Oct. 28, 2010

Primary Examiner — Tan Ho

(74) Attorney, Agent, or Firm — Amy L. Ressing; L. George Legg

Related U.S. Application Data

(60) Provisional application No. 60/972,422, filed on Sep. 14, 2007.

(57) **ABSTRACT**

(51) **Int. Cl.**
H01Q 9/28 (2006.01)

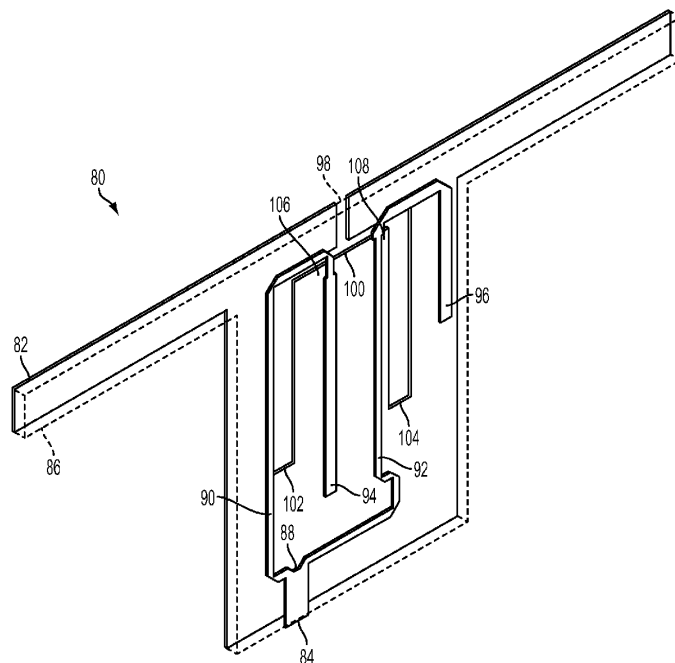
A double balun dipole antenna element includes a dielectric substrate having a first surface and an opposing second surface, a pair of coplanar Marchand baluns positioned in a mutually antiphase configuration on the first and second surfaces, and at least one feed line connected to the pair of Marchand baluns. A doubly polarized antenna element includes a pair of orthogonally interleaved double balun dipole antenna elements, which can be further configured into an array of such antenna elements.

(52) **U.S. Cl.** **343/795**; 343/821; 343/859

(58) **Field of Classification Search** 343/700 MS, 343/702, 858, 859, 795, 820, 821

See application file for complete search history.

16 Claims, 22 Drawing Sheets



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US008350775B2

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

(10) **Patent No.:** **US 8,350,775 B2**
(45) **Date of Patent:** **Jan. 8, 2013**

(54) **ANTENNA ARRANGEMENT FOR A MOBILE RADIO BASE STATION**

(75) Inventors: **Johann Obermaier**, Weiching (DE);
Matthias Riedel, Stephanskirchen (DE);
Stephen John Saddington, Vogtareuth (DE)

(73) Assignee: **Kathrein-Werke KG**, Rosenheim (DE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 524 days.

(21) Appl. No.: **12/376,615**

(22) PCT Filed: **Jul. 26, 2007**

(86) PCT No.: **PCT/EP2007/006638**

§ 371 (c)(1),
(2), (4) Date: **Feb. 6, 2009**

(87) PCT Pub. No.: **WO2008/017386**

PCT Pub. Date: **Feb. 14, 2008**

(65) **Prior Publication Data**

US 2010/0182213 A1 Jul. 22, 2010

(30) **Foreign Application Priority Data**

Aug. 10, 2006 (DE) 102006037518

(51) **Int. Cl.**
H01Q 9/16 (2006.01)
H01Q 21/00 (2006.01)
H01Q 19/10 (2006.01)

(52) **U.S. Cl.** **343/817**; 343/797; 343/834; 343/795;
343/847; 343/818

(58) **Field of Classification Search** 343/810-823,
343/847, 834, 795, 846

See application file for complete search history.

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Primary Examiner — Hoang V Nguyen

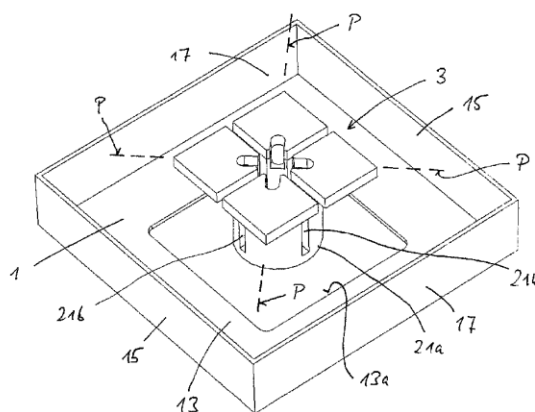
Assistant Examiner — Amal Patel

(74) *Attorney, Agent, or Firm* — Nixon & Vanderhye P.C.

(57) **ABSTRACT**

An improved antenna arrangement includes a reflector arrangement comprising a printed circuit board with an electrically conductive ground plane. The reflector arrangement also has a reflector frame with a coupling surface. The coupling surface is capacitively coupled to the ground plane. The coupling surface has a recess via which the ground plane, which is located underneath it, and/or the printed circuit board or an isolating intermediate layer which is provided above the ground plane or an isolating intermediate layer which is provided above the printed circuit board is exposed. The at least one antenna element arrangement is positioned and/or held on the printed circuit board in the area of the recess.

28 Claims, 8 Drawing Sheets



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US008354962B2

(12) **United States Patent**
Aoki

(10) **Patent No.:** **US 8,354,962 B2**
(45) **Date of Patent:** **Jan. 15, 2013**

(54) **ANTENNA AND MANUFACTURING METHOD THEREOF, SEMICONDUCTOR DEVICE INCLUDING ANTENNA AND MANUFACTURING METHOD THEREOF, AND RADIO COMMUNICATION SYSTEM**

(75) Inventor: **Tomoyuki Aoki**, Kanagawa (JP)

(73) Assignee: **Semiconductor Energy Laboratory Co., Ltd.** (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1177 days.

(21) Appl. No.: **11/604,583**

(22) Filed: **Nov. 27, 2006**

(65) **Prior Publication Data**

US 2007/0122960 A1 May 31, 2007

(30) **Foreign Application Priority Data**

Nov. 29, 2005 (JP) 2005-343012

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

(52) **U.S. Cl.** **343/700 MS; 343/895**

(58) **Field of Classification Search** **343/700 MS, 343/878, 895**

See application file for complete search history.

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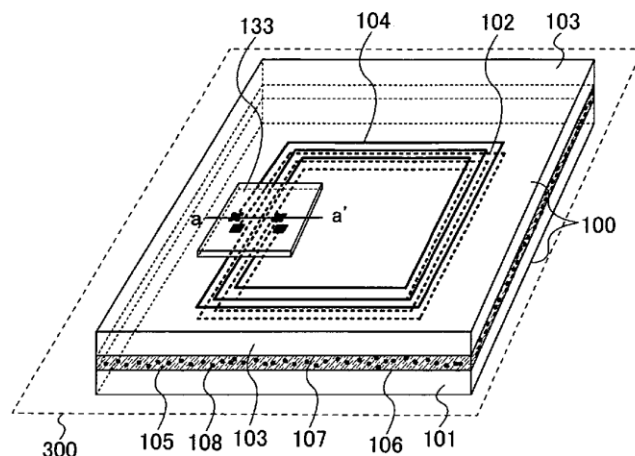
Primary Examiner — Tan Ho

(74) *Attorney, Agent, or Firm* — Husch Blackwell LLP

(57) **ABSTRACT**

An antenna includes a first substrate, a first pattern, a second substrate, a second pattern, and an anisotropic conductive material. The first substrate has an insulating surface. The first pattern is formed over the insulating surface of the first substrate, and made of a conductive material. The second substrate is provided so as to face the surface over which the first pattern of the first substrate is formed and has an insulating surface. The second pattern is formed over the insulating surface facing the first substrate of the second substrate, and made of a conductive material. The anisotropic conductive material electrically connects the first pattern and the second pattern. The whole region of the first pattern overlaps with the second pattern with the anisotropic conductive material interposed therebetween.

28 Claims, 14 Drawing Sheets



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US008354963B2

(12) **United States Patent**
Tai

(10) **Patent No.:** **US 8,354,963 B2**

(45) **Date of Patent:** **Jan. 15, 2013**

(54) **LOW-PROFILE THREE-DIMENSIONAL ANTENNA**

(75) Inventor: **Lung-Sheng Tai**, Tu-Cheng (TW)

(73) Assignee: **Hon Hai Precision Ind. 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 686 days.

(21) Appl. No.: **12/543,233**

(22) Filed: **Aug. 18, 2009**

(65) **Prior Publication Data**

US 2010/0039331 A1 Feb. 18, 2010

(30) **Foreign Application Priority Data**

Aug. 18, 2008 (TW) 97131448 A

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

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

(58) **Field of Classification Search** **343/700, 343/702, 846**

See application file for complete search history.

(56) **References Cited**

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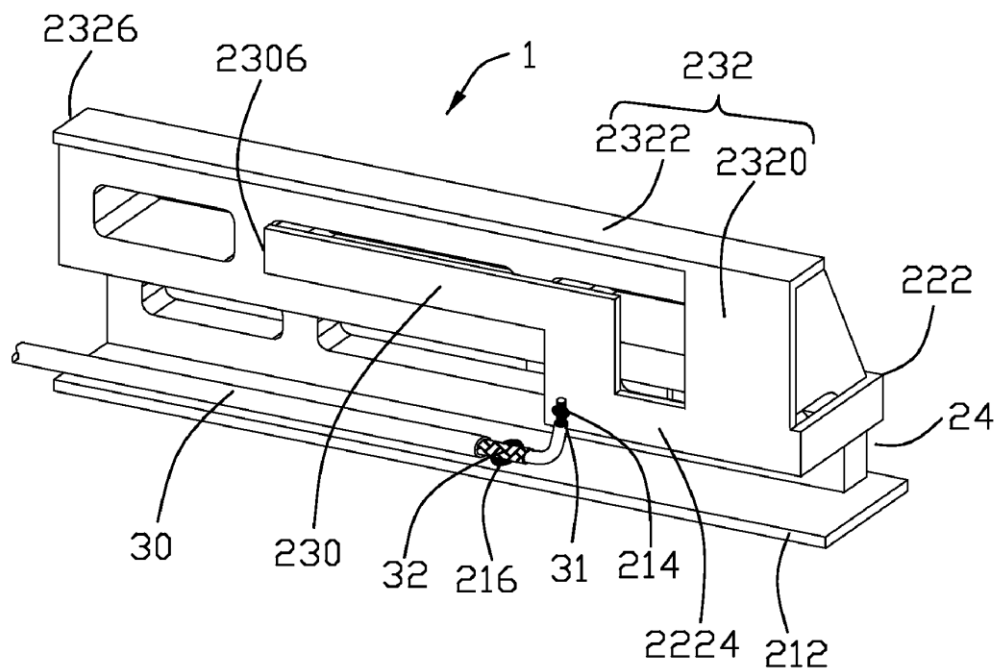
Primary Examiner — Tho G Phan

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

(57) **ABSTRACT**

A multi-band antenna includes a grounding element having a side edge, a connecting element, and a radiating element. The radiating element is electrically connected to the grounding element via the connecting element, and includes a first radiating portion and a second radiating portion respectively extending from the connecting element. The connecting element includes a folded connecting arm extending along three dimensions. A slot is formed between the connecting arm and the grounding element.

20 Claims, 4 Drawing Sheets



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US008354964B2

(12) **United States Patent**
Johnson

(10) **Patent No.:** **US 8,354,964 B2**
(45) **Date of Patent:** **Jan. 15, 2013**

(54) **ANTENNA SYSTEM HAVING COMPACT PIFA
RESONATOR WITH OPEN SECTIONS**

(76) Inventor: **Greg F. Johnson**, Aptos, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 399 days.

(21) Appl. No.: **12/576,908**

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

(65) **Prior Publication Data**
US 2010/0271279 A1 Oct. 28, 2010

Related U.S. Application Data
(60) Provisional application No. 61/104,255, filed on Oct. 9, 2008.
(51) **Int. Cl.**
H01Q 1/38 (2006.01)
(52) **U.S. Cl.** **343/700 MS; 343/702; 343/845; 343/846**
(58) **Field of Classification Search** **343/845, 343/846, 700 MS, 702**
See application file for complete search history.

(56) **References Cited**

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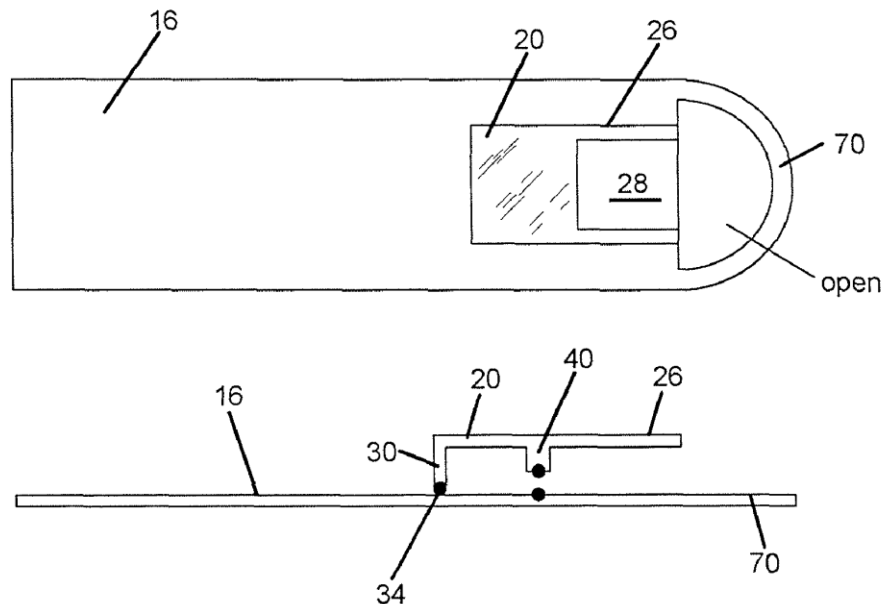
Primary Examiner — Dieu H Duong

(74) *Attorney, Agent, or Firm* — Briggs and Morgan, P.A.

(57) **ABSTRACT**

A low-height PIFA-fed antenna system having high gain, wide bandwidth and wide beamwidth for applications on wireless communications devices. The antenna is suitable for internal installation within a handset, such as a cellphone. The antenna includes a ground plane conductor, such as the ground plane of a wireless device, and a resonator element having a top portion with a split free end defining an open space. The antenna is well adapted for high volume manufacturing processes using conventional fabrication techniques such as metal stamping or selectively plated plastic.

19 Claims, 5 Drawing Sheets



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US008354965B2

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

(10) **Patent No.:** **US 8,354,965 B2**
(45) **Date of Patent:** **Jan. 15, 2013**

(54) **MULTIPLE ANTENNA COMMUNICATION APPARATUS**

(75) Inventors: **Min Chung Wu**, Hsinchu County (TW);
Shao Chin Lo, Hsinchu County (TW)

(73) Assignee: **Ralink Technology Corporation**,
Jhubei, Hsinchu County (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 368 days.

(21) Appl. No.: **12/842,797**

(22) Filed: **Jul. 23, 2010**

(65) **Prior Publication Data**

US 2011/0043411 A1 Feb. 24, 2011

(30) **Foreign Application Priority Data**

Aug. 21, 2009 (TW) 98128155 A

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

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

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

(56) **References Cited**

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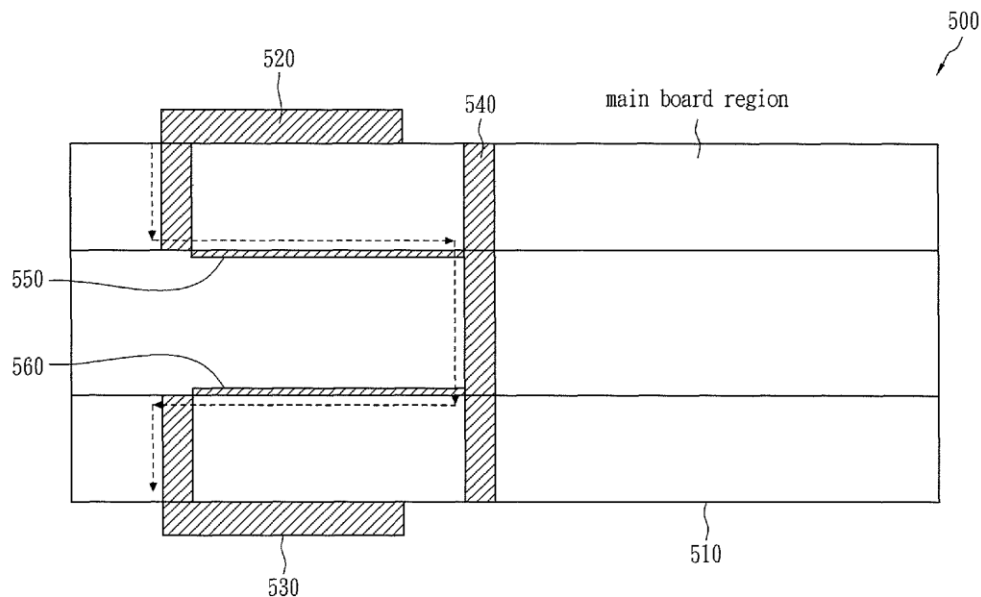
Primary Examiner — Hoang V Nguyen

(74) *Attorney, Agent, or Firm* — Hamre, Schumann, Mueller & Larson, P.C.

(57) **ABSTRACT**

A multiple antenna communication apparatus includes a printed circuit board having multiple layers and two antenna devices. The two antenna devices are disposed on antenna regions of the printed circuit board, and each antenna device comprises a ground terminal. Each ground terminal is coupled to a conductor on a different layer of the printed circuit board. The antenna regions on which the two antenna devices are disposed do not contain any main ground via.

18 Claims, 7 Drawing Sheets



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US008354966B2

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

(10) **Patent No.:** **US 8,354,966 B2**
(45) **Date of Patent:** **Jan. 15, 2013**

(54) **PERIPHERAL TELECOMMUNICATIONS
DEVICE HAVING MOVABLE COVER WITH
INTEGRATED ANTENNA**

(75) Inventors: **Peter Delmotte**, Leuven (BE);
Sheng-Gen Pan, Kamp-Lintfort (DE);
Roger Laurisch, Düsseldorf (DE);
Georg Steiner, Neukirchen-Vluyn (DE);
Walter Nijs, Holsbeek (BE)

(73) Assignee: **Option**, Leuven (BE)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 932 days.

(21) Appl. No.: **12/332,912**

(22) Filed: **Dec. 11, 2008**

(65) **Prior Publication Data**

US 2009/0158062 A1 Jun. 18, 2009

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/42 (2006.01)

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

(58) **Field of Classification Search** **343/702,**
343/700 MS, 872, 873

See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Jacob Y Choi

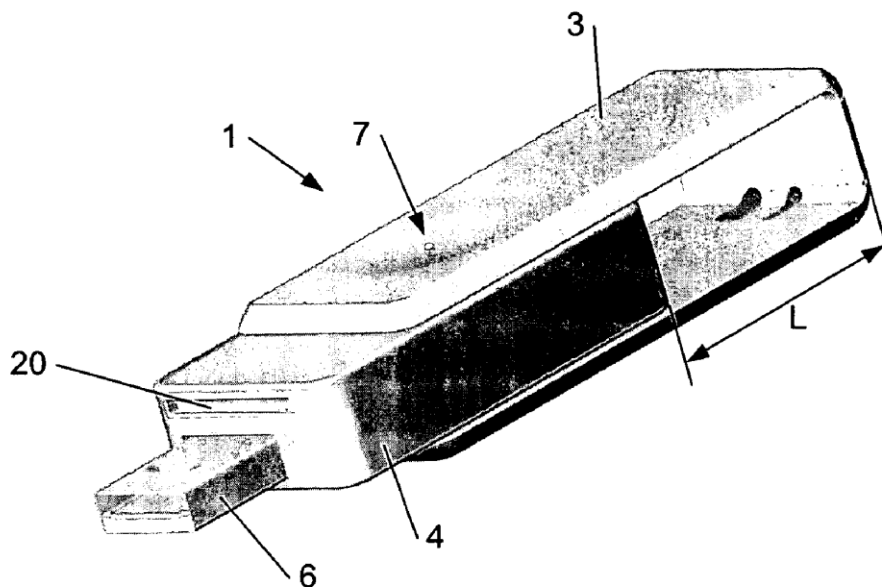
Assistant Examiner — Hasan Islam

(74) *Attorney, Agent, or Firm* — Browdy and Neimark,
PLLC

(57) **ABSTRACT**

A computer peripheral telecommunications device having an electronic interface for connection to a computer and being configured for adding wireless telecommunication functionality to the computer, the device comprising a movable cover portion for covering the electronic interface while not in use and an antenna integrated in the movable cover portion.

22 Claims, 7 Drawing Sheets



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US008354967B2

(12) **United States Patent**
Huynh

(10) **Patent No.:** **US 8,354,967 B2**
(45) **Date of Patent:** **Jan. 15, 2013**

(54) **ANTENNA ARRAY WITH CAPACITIVE COUPLED UPPER AND LOWER ANTENNA ELEMENTS AND A PEAK RADIATION PATTERN DIRECTED TOWARD THE LOWER ANTENNA ELEMENT**

(75) Inventor: **Minh-Chau Huynh**, Foster City, CA (US)

(73) Assignee: **Sony Ericsson Mobile Communications AB**, Lund (SE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 462 days.

(21) Appl. No.: **12/777,718**

(22) Filed: **May 11, 2010**

(65) **Prior Publication Data**

US 2011/0279330 A1 Nov. 17, 2011

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

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

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

See application file for complete search history.

(56) **References Cited**

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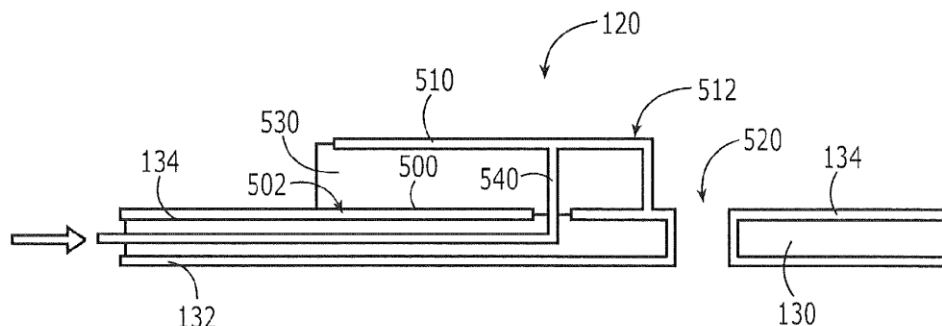
Primary Examiner — Hoanganh Le

(74) *Attorney, Agent, or Firm* — Myers Bigel Sibley & Sajovec, P.A.

(57) **ABSTRACT**

An antenna system includes a planar substrate, a conductive ground plane, and an upper antenna element. The conductive ground plane is on the substrate. A slot that is free of conductive material extends through the ground plane to define a lower antenna element from a portion of the ground plane. The upper antenna element is spaced apart and overlies at least a portion of the lower antenna element. A first location of the upper antenna element is electrically connected to the ground plane and a spaced apart second location of the upper antenna element is electrically connected to an antenna feed element. The upper antenna element is configured to electrically resonate responsive to a defined RF signal. The lower antenna element is configured to resonate through capacitive coupling to the resonating upper antenna element.

20 Claims, 7 Drawing Sheets



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US008354971B2

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

(10) **Patent No.:** **US 8,354,971 B2**
(45) **Date of Patent:** ***Jan. 15, 2013**

(54) **ANTENNA DEVICE**

(75) Inventors: **Hiromitsu Ito**, Hakusan (JP); **Hiroyuki Kubo**, Kanazawa (JP); **Kuniaki Yosui**, Kanazawa (JP)

(73) Assignee: **Murata Manufacturing Co., Ltd.**, Kyoto (JP)

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

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/352,373**

(22) Filed: **Jan. 18, 2012**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. 12/341,041, filed on Dec. 22, 2008, now Pat. No. 8,125,401, which is a continuation of application No. PCT/JP2006/326073, filed on Dec. 27, 2006.

(30) **Foreign Application Priority Data**

Jul. 7, 2006 (JP) 2006-187486
Sep. 1, 2006 (JP) 2006-237272

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

(52) **U.S. Cl.** **343/788; 343/787; 343/895**

(58) **Field of Classification Search** 343/787, 343/788, 895
See application file for complete search history.

(56) **References Cited**

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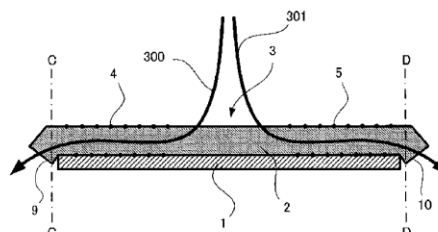
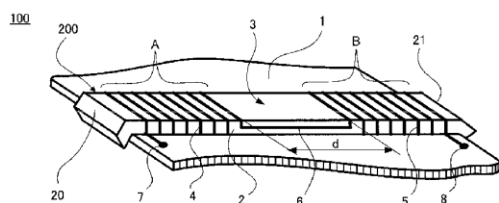
Primary Examiner — Dieu H Duong

(74) *Attorney, Agent, or Firm* — Keating & Bennett, LLP

(57) **ABSTRACT**

An antenna device having a magnetic core to be surface-mounted on a circuit substrate includes a pair of coil portions spaced apart from each other at a predetermined interval. The coil portions are connected by a connecting conductor. An end of the magnetic core includes a curved or bent portion curved toward the circuit substrate. This structure defines an RFID antenna device having an improved receiving sensitivity that can be surface-mounted without increasing the thickness of a casing of a mobile electronic device.

8 Claims, 5 Drawing Sheets



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US008354972B2

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

(10) **Patent No.:** **US 8,354,972 B2**
(45) **Date of Patent:** **Jan. 15, 2013**

(54) **DUAL-POLARIZED RADIATING ELEMENT,
DUAL-BAND DUAL-POLARIZED ANTENNA
ASSEMBLY AND DUAL-POLARIZED
ANTENNA ARRAY**

(58) **Field of Classification Search** 343/795-797,
343/799-800, 810, 812, 815, 817-818, 833,
343/834, 700 MS
See application file for complete search history.

(75) Inventors: **Carmen Borja**, Barcelona (ES);
Anthony Teillet, Trabuco Canyon, CA
(US)

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Primary Examiner — Jason M Crawford

(74) *Attorney, Agent, or Firm* — Winstead PC

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 630 days.

(21) Appl. No.: **12/602,927**

(22) PCT Filed: **Jun. 6, 2008**

(86) PCT No.: **PCT/EP2008/004539**

§ 371 (c)(1),

(2), (4) Date: **Dec. 3, 2009**

(87) PCT Pub. No.: **WO2008/148569**

PCT Pub. Date: **Dec. 11, 2008**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 60/943,612, filed on Jun.
13, 2007.

(30) **Foreign Application Priority Data**

Jun. 6, 2007 (EP) 07011177

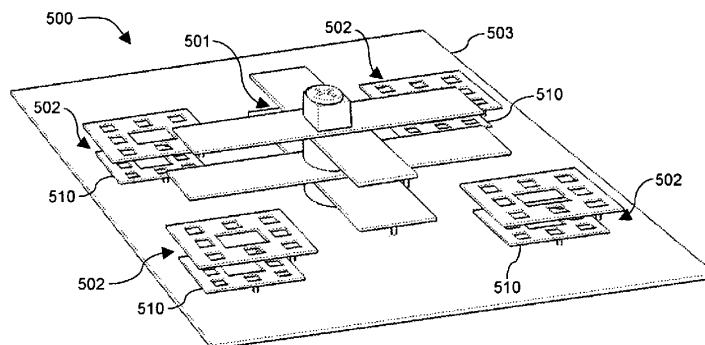
(51) **Int. Cl.**
H01Q 21/26 (2006.01)

(52) **U.S. Cl.** 343/797; 343/700 MS; 343/815

(57) **ABSTRACT**

The invention refers to a dual-polarized radiating element
(100) with: a first patch (101) provided for radiating in a first
polarization and a second patch (102) provided for radiating
in a second polarization which is substantially-orthogonal to
the first polarization, wherein the first patch (101) and the
second patch (102) overlap. Further the invention relates to a
dual-band dual-polarized antenna assembly (500) compris-
ing at least one patch antenna elements and/or one set of patch
antenna elements (501,502) and to corresponding antenna
arrays.

32 Claims, 21 Drawing Sheets



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US008355761B2

(12) **United States Patent**
Harada

(10) **Patent No.:** **US 8,355,761 B2**
(45) **Date of Patent:** **Jan. 15, 2013**

(54) **FOLDING/SLIDING MOBILE TERMINAL
WITH SEPARATE ANTENNAS IN TWO
SEPARATE CASINGS**

(75) Inventor: **Takashi Harada**, Tokyo (JP)

(73) Assignee: **NEC 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 291 days.

(21) Appl. No.: **12/744,397**

(22) PCT Filed: **Oct. 7, 2008**

(86) PCT No.: **PCT/JP2008/068227**

§ 371 (c)(1),

(2), (4) Date: **May 24, 2010**

(87) PCT Pub. No.: **WO2009/081638**

PCT Pub. Date: **Jul. 2, 2009**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Dec. 20, 2007 (JP) 2007-329172

(51) **Int. Cl.**
H04M 1/00 (2006.01)

(52) **U.S. Cl.** **455/575.1; 455/575.2; 455/575.3;
455/575.4; 455/575.6; 455/575.7; 455/90.1;
455/90.2; 455/90.3**

(58) **Field of Classification Search** **455/575.1–575.7,
455/90.1, 90.2, 90.3**
See application file for complete search history.

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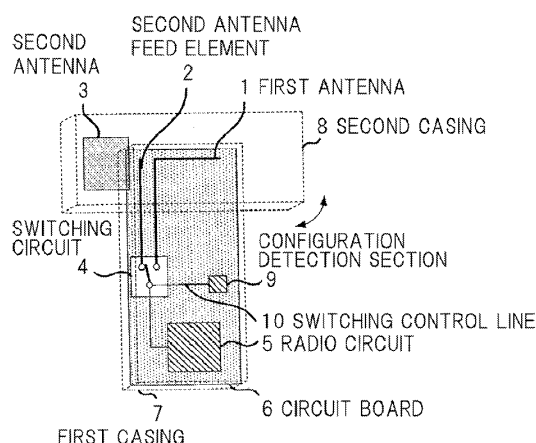
Primary Examiner — Kamran Afshar

Assistant Examiner — Sayed T Zewari

(57) **ABSTRACT**

A mobile terminal comprises at least a first casing (7) and a second casing (8). First casing (7) and second casing (8) are coupled together in a manner such that the combined configuration of the first and second casings can be varied. First casing (7) has at least a radio circuit (5) and a first antenna (1) connected to the radio circuit, and second casing (8) has at least a second antenna (3). First casing (7) has a feed element (2) connected to the radio circuit. When the combined configuration of the first and second casings is a predetermined configuration, feed element (2) of the first casing and the second antenna of second casing (8) are close to each other to be capacitively coupled together, so that second antenna is connected with radio circuit through feed element via high-frequency waves.

5 Claims, 6 Drawing Sheets



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US008358247B2

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

(10) **Patent No.:** **US 8,358,247 B2**
(45) **Date of Patent:** **Jan. 22, 2013**

(54) **TWIN-VEE-TYPE DUAL BAND ANTENNA**

(75) Inventors: **Chieh-Ping Chiu**, Erlun Township (TW); **Feng-Jen Weng**, Tao Yuan Shien (TW); **I-Ping Yen**, Yonghe (TW); **Hsiao-Wei Wu**, Zhongli (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 321 days.

(21) Appl. No.: **12/939,060**

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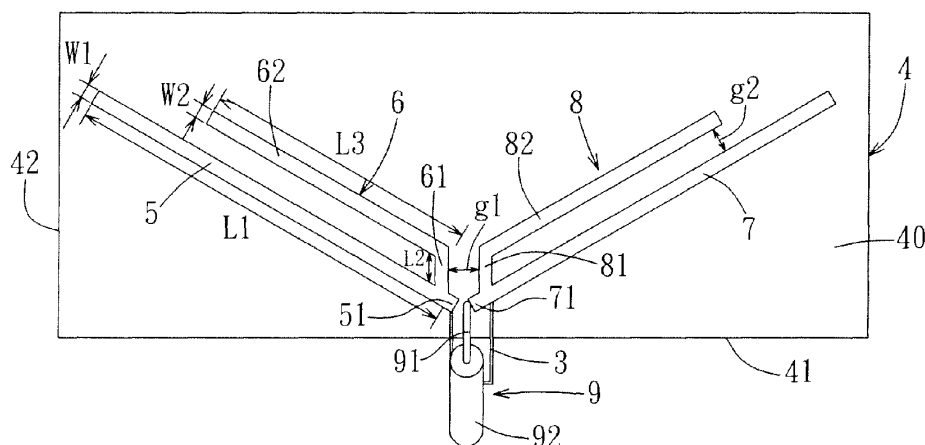
Primary Examiner — Hoang V Nguyen

(74) *Attorney, Agent, or Firm* — Steptoe & Johnson LLP

(57) **ABSTRACT**

A twin-Vee-type dual band antenna includes interconnected first and second conductor arms and interconnected first and second mirroring conductor arms disposed on a substrate. The second conductor arm has a radiator section extending parallel to the first conductor arm. The first mirroring conductor arm is symmetrical to the first conductor arm, and forms an angle (θ) of less than 180 degrees with the first conductor arm. The second mirroring conductor arm is symmetrical to the second conductor arm, and has a radiator section extending parallel to the first mirroring conductor arm.

14 Claims, 8 Drawing Sheets



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(54) **ANTENNA**

(75) Inventor: **Nobuyuki Mori**, Tokyo (JP)

(73) Assignee: **Sony Corporation** (JP)

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See application file for complete search history.

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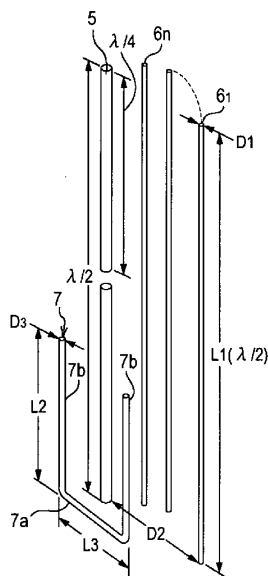
Primary Examiner — Huedung Mancuso

(74) *Attorney, Agent, or Firm* — Lerner, David, Littenberg, Krumholz & Mentlik, LLP

(57) **ABSTRACT**

An antenna includes: a dipole antenna; and a parasitic element arranged in parallel to the dipole antenna and having a linear structure and a meander structure, wherein a directivity and a return loss of the dipole antenna are controlled by setting a distance between the dipole antenna and the parasitic element and a shape and size of the meander structure.

4 Claims, 12 Drawing Sheets



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