



US008614647B2

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

(10) **Patent No.:** **US 8,614,647 B2**
(45) **Date of Patent:** **Dec. 24, 2013**

(54) **ANTENNA DEVICE AND ELECTRONIC
DEVICE INCLUDING ANTENNA DEVICE**

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2013/0050036 A1* 2/2013 Kashiwagi et al. 343/749

(75) Inventors: **Hiroyuki Hotta**, Hamura (JP); **Koichi Sato**, Tachikawa (JP); **Isao Ohba**, Hachioji (JP)

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JP 2008-124617 5/2008
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(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 168 days.

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(21) Appl. No.: **13/291,388**

(22) Filed: **Nov. 8, 2011**

(65) **Prior Publication Data**

US 2012/0188134 A1 Jul. 26, 2012

(30) **Foreign Application Priority Data**

Jan. 25, 2011 (JP) 2011-013007

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Primary Examiner — Tan Ho

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

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

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

(58) **Field of Classification Search**
USPC 343/700 MS, 702, 722, 749
See application file for complete search history.

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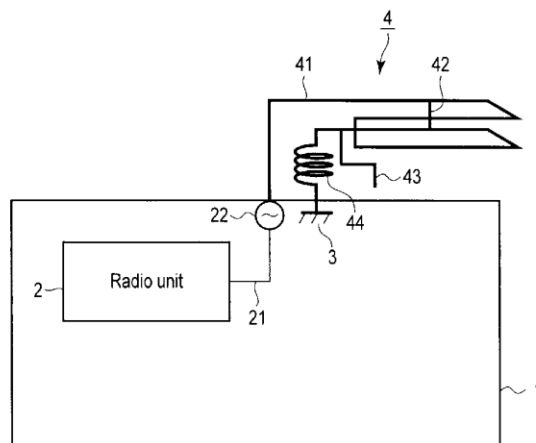
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(57) **ABSTRACT**

According to one embodiment, an antenna device includes a first element, a stub, and an open end element. The first element has a folded monopole structure in which a conductor is folded at a folding portion to form a forward portion and a backward portion. A base end of the forward portion is connected to a feeding point, and a distal end of the backward portion is connected to a ground via a first lumped parameter. The stub is provided between the forward portion and the backward portion of the first element so as to shunt the forward portion and the backward portion. The open end element includes a conductor placed in parallel to the first lumped parameter. A base end of the conductor is connected between the stub of the backward portion of the first element and the ground, and the distal end of the conductor is open.

18 Claims, 16 Drawing Sheets





US008618988B2

(12) **United States Patent**
Fabrega-Sanchez et al.

(10) **Patent No.:** **US 8,618,988 B2**
(45) **Date of Patent:** **Dec. 31, 2013**

(54) **CO-LOCATION INSENSITIVE MULTI-BAND ANTENNA**

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(75) Inventors: **Jorge Fabrega-Sanchez**, San Diego, CA (US); **Joe Le**, Poway, CA (US)

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

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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 1106 days.

(21) Appl. No.: **11/868,257**

(22) Filed: **Oct. 5, 2007**

(65) **Prior Publication Data**

US 2009/0091508 A1 Apr. 9, 2009

* cited by examiner

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/36 (2006.01)

Primary Examiner — Robert Karacsony

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

(57) **ABSTRACT**

(58) **Field of Classification Search**
USPC 343/702, 700 MS, 872, 873, 895
See application file for complete search history.

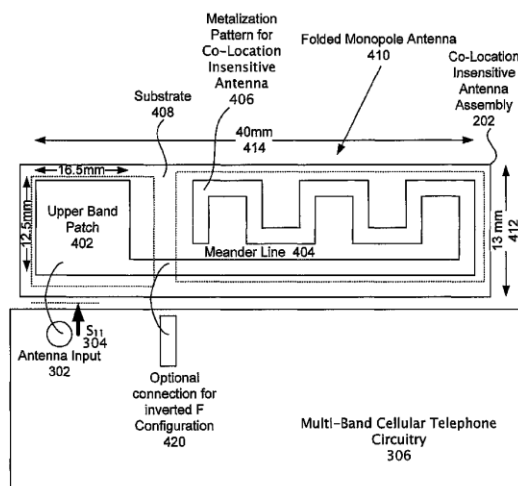
The present example provides a co-location insensitive multi-band antenna. The antenna may be co-located with an antenna operated at another band and tends to reject interference from that antenna. The co-location insensitive multi-band antenna tends to provide a compact design that may be printed on a printed wiring board, on a case of a radio, such as a cellular telephone or may be self supporting. In general, the desired in band performance and out of band signal rejection may be achieved by a meander line coupled to a upper band patch. The meander line tends to provide a good lower band match, and the upper band patch tends to provide a good high band match, or resonance. The upper band patch also tends to cause a sharp roll off in return loss before the high band, that tends to reject frequencies from a co-located antenna transmitting below the high band.

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17 Claims, 7 Drawing Sheets





US008618989B2

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

(10) **Patent No.:** **US 8,618,989 B2**
(45) **Date of Patent:** **Dec. 31, 2013**

(54) **ELECTRONIC DEVICE CASE, METHOD AND MOLD FOR MANUFACTURING THE SAME, AND MOBILE COMMUNICATIONS TERMINAL**

(75) Inventors: **Jae Suk Sung**, Gyunggi-do (KR); **Sung Eun Cho**, Gyunggi-do (KR); **Ha Ryong Hong**, Gyunggi-do (KR); **Dae Kyu Lee**, Gyunggi-do (KR); **Dae Seong Jeon**, Gyunggi-do (KR); **Ki Won Chang**, Gyunggi-do (KR); **Tae Sung Kim**, Seoul (KR); **Dae Ki Lim**, Gyunggi-do (KR); **Hyun Do Park**, Gyunggi-do (KR); **Nam Il Seo**, Seoul (KR)

(73) Assignee: **Samsung Electro-Mechanics Co., Ltd.**, Suwon, Gyunggi-Do (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 905 days.

(21) Appl. No.: **12/608,818**

(22) Filed: **Oct. 29, 2009**

(65) **Prior Publication Data**
US 2010/0271270 A1 Oct. 28, 2010

(30) **Foreign Application Priority Data**
Apr. 23, 2009 (KR) 10-2009-0035635

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

(52) **U.S. Cl.**
USPC **343/702; 343/873**

(58) **Field of Classification Search**
USPC 343/702, 872, 873
See application file for complete search history.

(56) **References Cited**

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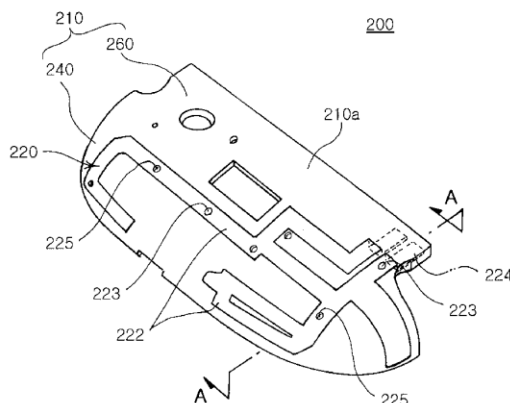
Primary Examiner — Tho G Phan

(74) *Attorney, Agent, or Firm* — McDermott Will & Emery LLP

(57) **ABSTRACT**

An electronic device case having an antenna pattern embedded therein according to an aspect of the invention may include: a radiator having an antenna pattern portion transmitting and receiving a signal and a connection terminal portion allowing the signal to be transmitted to and received from a circuit board of an electronic device; a connection portion partially forming the radiator and connecting the antenna pattern portion and the connection terminal portion to be arranged in different planes; a radiator frame manufactured by injection molding on the radiator so that the antenna pattern portion of the radiator is provided on one side of the radiator frame and the connection terminal portion is provided on the other side thereof; and a case frame covering the one side of the radiator frame on which the antenna pattern portion is provided so that the antenna pattern portion is embedded between the case frame and the radiator frame.

14 Claims, 19 Drawing Sheets





US008618990B2

(12) **United States Patent**
Somero

(10) **Patent No.:** **US 8,618,990 B2**
(45) **Date of Patent:** **Dec. 31, 2013**

(54) **WIDEBAND ANTENNA AND METHODS**

(75) Inventor: **Vesna Somero**, Oulu (FI)

(73) Assignee: **Pulse Finland Oy**, Kempele (FI)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 330 days.

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(21) Appl. No.: **13/086,319**

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(22) Filed: **Apr. 13, 2011**

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(65) **Prior Publication Data**

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

"An Adaptive Microstrip Patch Antenna for Use in Portable Transceivers", Rostbakken et al., Vehicular Technology Conference, 1996, Mobile Technology For The Human Race, pp. 339-343.

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

(Continued)

(58) **Field of Classification Search**
USPC 343/722, 702, 844, 772, 793
See application file for complete search history.

Primary Examiner — Thien M Le

(74) Attorney, Agent, or Firm — Gazdzinski & Associates, PC

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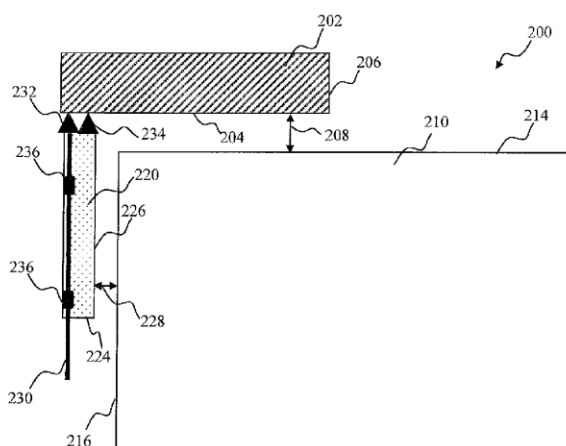
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(57) **ABSTRACT**

A wideband antenna for use portable radio devices, and methods for operating the same. In one embodiment, a monopole antenna is used within a laptop computing device. The antenna comprises a monopole radiator coupled to an auxiliary ground plane element, and is placed substantially outside of the footprint of the computer display ground plane. In one implementation, the auxiliary ground element is configured not to have electrical connections to the ground plane of the laptop. In another implementation, a solid state switch selectively connects an antenna parasitic element to the main ground thus enabling selective control of the antenna lower frequency operating band.

32 Claims, 11 Drawing Sheets





US008618991B2

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

(10) **Patent No.:** **US 8,618,991 B2**
(45) **Date of Patent:** **Dec. 31, 2013**

(54) **MOBILE COMMUNICATION TERMINAL**

(56) **References Cited**

(75) Inventors: **Byungwoon Jung**, Seoul (KR);
Youngbae Kwon, Incheon (KR); **Jina Park**, Incheon (KR); **Ansun Hyun**, Seoul (KR); **Changwon Yun**, Gyeonggi-Do (KR)

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

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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 305 days.

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(21) Appl. No.: **13/214,721**

Primary Examiner — Tan Ho

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

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

(65) **Prior Publication Data**

US 2012/0105287 A1 May 3, 2012

(30) **Foreign Application Priority Data**

Nov. 1, 2010 (KR) 10-2010-0107861

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

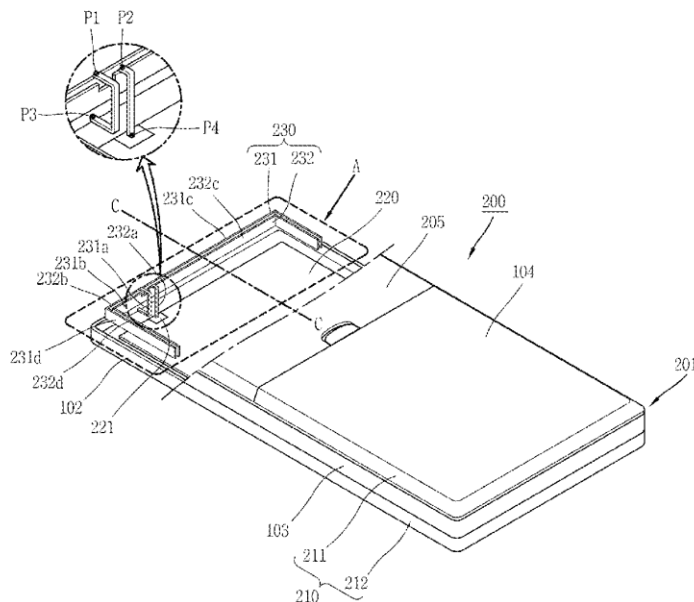
(52) **U.S. Cl.**
USPC **343/702; 343/700 MS**

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

(57) **ABSTRACT**

A mobile communication terminal including a wireless communication unit configured to communicate with at least one other terminal; a body including a metal frame having a specified length and a width; a power feeding portion formed on an internal circuit board in the terminal and configured to supply RF signals; and an antenna portion disposed inside the terminal. Further, the antenna portion includes a shorting arm overlapping and being separated from the metal frame, and electrically connected to the metal frame at a first location offset from a middle of an edge of the metal frame; and a feeding arm disposed in parallel to the shorting arm, and electrically connected to the power feeding portion at a second location offset from the middle.

20 Claims, 9 Drawing Sheets





US008618992B2

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

(10) **Patent No.:** **US 8,618,992 B2**
(45) **Date of Patent:** ***Dec. 31, 2013**

(54) **ANTENNA DUPLEXER AND COMMUNICATION DEVICE USING THE SAME**

(71) Applicant: **Panasonic Corporation**, Osaka (JP)

(72) Inventors: **Joji Fujiwara**, Osaka (JP); **Tetsuya Tsurunari**, Osaka (JP); **Hiroyuki Nakamura**, Osaka (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 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/845,440**

(22) Filed: **Mar. 18, 2013**

(65) **Prior Publication Data**
US 2013/0210374 A1 Aug. 15, 2013

Related U.S. Application Data

(63) Continuation of application No. 12/989,807, filed as application No. PCT/JP2009/006256 on Nov. 20, 2009, now Pat. No. 8,436,778.

(30) **Foreign Application Priority Data**
Nov. 27, 2008 (JP) 2008-302080

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

(52) **U.S. Cl.**
USPC 343/722; 343/750; 343/758; 333/133

(58) **Field of Classification Search**
USPC 343/722, 750, 758, 702; 333/133
See application file for complete search history.

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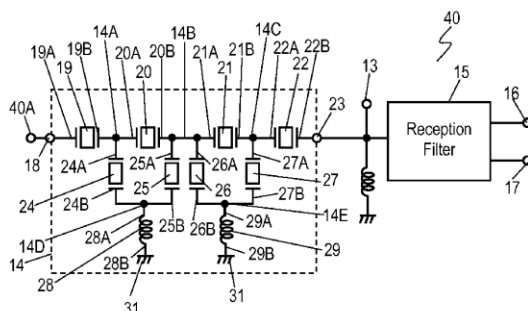
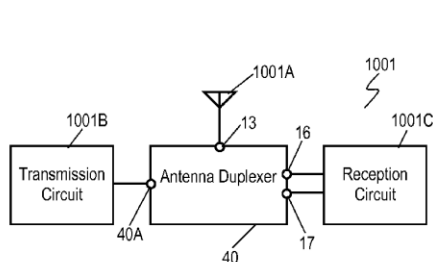
Primary Examiner — Dieu H Duong

(74) *Attorney, Agent, or Firm* — Wenderoth, Lind & Ponack, L.L.P.

(57) **ABSTRACT**

An antenna duplexer includes a transmission filter and a reception filter both coupled with an antenna terminal. The transmission filter has a lower pass band than the reception filter. The transmission filter includes a first series resonator coupled with a first terminal, a second series resonator connected to the first series resonator at a first node, a first parallel resonator connected to a first port of the first series resonator, a second parallel resonator connected to a first node and the first parallel resonator at a second node, a third parallel resonator connected to the first node, a fourth parallel resonator connected to the third parallel resonator at a third node, a first inductance element coupled with the second node and a ground, and a second inductance element coupled with the third node and the ground. The second inductance element has a lower inductance than the first inductance element.

8 Claims, 3 Drawing Sheets





US008618993B2

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

(10) **Patent No.:** **US 8,618,993 B2**
(45) **Date of Patent:** **Dec. 31, 2013**

(54) **LOOP ANTENNA**

(75) Inventors: **Je-Hoon Yun**, Daejon (KR); **Jung-Ick Moon**, Daejon (KR); **Soon-Soo Oh**, Daejon (KR); **Min-Sung Kwon**, Daejon (KR); **Sung-Uk You**, Daejon (KR); **Chang-Joo Kim**, Daejon (KR); **Chieteuk Ahn**, Daejon (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 686 days.

(21) Appl. No.: **12/447,256**

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

(86) PCT No.: **PCT/KR2007/005331**

§ 371 (c)(1),

(2), (4) Date: **Aug. 19, 2009**

(87) PCT Pub. No.: **WO2008/051057**

PCT Pub. Date: **May 2, 2008**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Oct. 26, 2006 (KR) 10-2006-0104713

(51) **Int. Cl.**

H01Q 11/12 (2006.01)

H01Q 7/00 (2006.01)

H01Q 1/38 (2006.01)

H01Q 5/00 (2006.01)

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

USPC **343/741; 343/866; 343/700 MS**

(58) **Field of Classification Search**

USPC 343/741, 866, 700 MS
See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Douglas W Owens

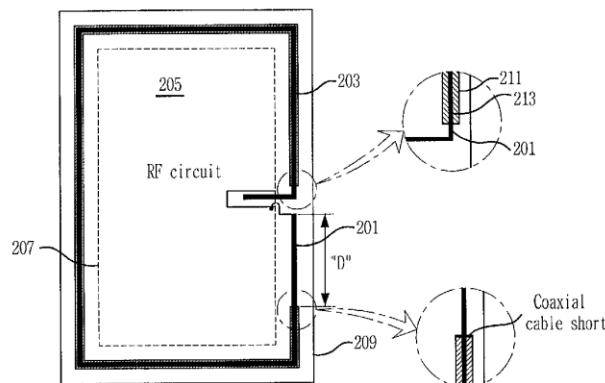
Assistant Examiner — Jennifer F Hu

(74) *Attorney, Agent, or Firm* — Rabin & Berdo, P.C.

(57) **ABSTRACT**

Provided is a loop antenna. The loop antenna includes a first antenna element embodied as a coaxial cable, a second antenna element embodied as a line and connected to one end of the first antenna element in series, a third antenna element embodied as a line, having one end connected to a ground plane and the other end connected to the other end of the first antenna element in series, and a power feeding cable for supplying power to the second antenna element.

11 Claims, 12 Drawing Sheets





US008619000B2

(12) **United States Patent**
Shinkawa

(10) **Patent No.:** **US 8,619,000 B2**
(45) **Date of Patent:** **Dec. 31, 2013**

(54) **ANTENNA DEVICE**

FOREIGN PATENT DOCUMENTS

(75) Inventor: **Tomohiro Shinkawa**, Akita (JP)

JP 2003-87030 A 3/2003

(73) Assignee: **Mitsumi Electric Co., Ltd.**, Tokyo (JP)

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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 586 days.

Dalia Mohammed Nashaat, Hala A. Elsadek, and Hani Ghali, Single Feed Compact Quad-Band PIFA Antenna for Wireless Communication Applications, Aug. 2005, IEEE Transactions on Antennas and Propagation, vol. 53, No. 3, pp. 2631-2635.*

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(21) Appl. No.: **12/891,988**

(22) Filed: **Sep. 28, 2010**

(65) **Prior Publication Data**

US 2011/0074648 A1 Mar. 31, 2011

Primary Examiner — Jerome Jackson, Jr.

Assistant Examiner — Hai Tran

(74) *Attorney, Agent, or Firm* — Holtz, Holtz, Goodman & Chick, PC

(30) **Foreign Application Priority Data**

Sep. 30, 2009 (JP) 2009-227325

(57) **ABSTRACT**

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

(52) **U.S. Cl.**
USPC 343/848; 343/700; 343/702; 343/725

(58) **Field of Classification Search**
USPC 343/848
See application file for complete search history.

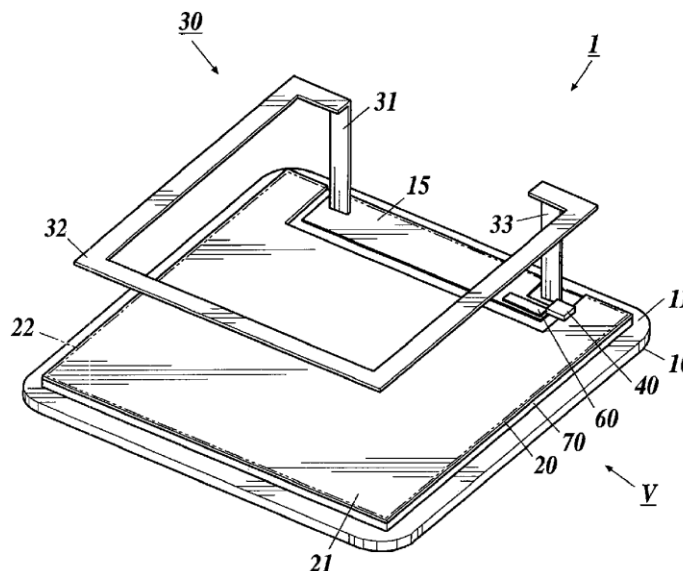
An antenna device includes a ground section including a planar section, a feeding section, a first feeding element arranged along the planar section of the ground section, and a second feeding element including a loop-like body portion arranged parallel to the first feeding element at a predetermined distance from the first feeding element, the loop-like body portion including one end portion bent to be electrically connected to the ground section, and the other end portion bent to be electrically connected to the feeding section. Both of the one end portion and the other end portion of the second feeding element are provided in a vicinity of an outer periphery of the ground section.

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7 Claims, 7 Drawing Sheets





(12) **United States Patent**
Wakabayashi

- (54) **MULTI-ANTENNA APPARATUS AND MOBILE DEVICE**
- (75) Inventor: **Naoyuki Wakabayashi**, Daito (JP)
- (73) Assignee: **Funai Electric Co., Ltd.**, Daito-shi (JP)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 419 days.

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- (30) **Foreign Application Priority Data**

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Primary Examiner — Huedung Mancuso

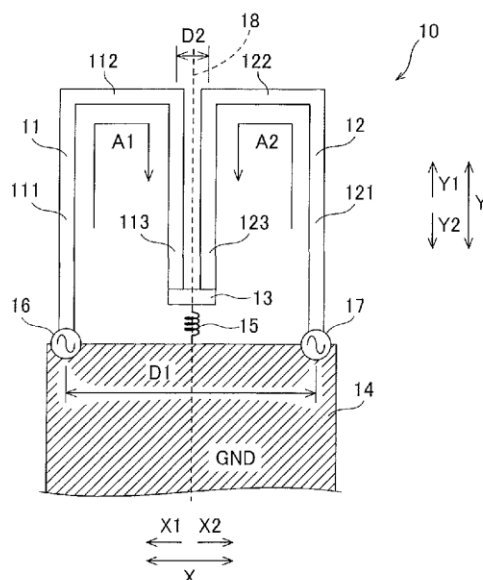
(74) *Attorney, Agent, or Firm* — Crowell & Moring LLP

- (51) **Int. Cl.**
H01Q 1/50 (2006.01)
- (52) **U.S. Cl.**
USPC **343/860**
- (58) **Field of Classification Search**
USPC 343/860, 867, 876, 893, 700 MS, 702
See application file for complete search history.

(56) **References Cited**

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US008624783B2

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

(10) **Patent No.:** **US 8,624,783 B2**

(45) **Date of Patent:** **Jan. 7, 2014**

(54) **INTERNAL ANTENNA MODULE AND
WIRELESS COMMUNICATION APPARATUS
HAVING THE SAME**

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

(73) Assignee: **Samsung Electronics Co., Ltd.**, 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 477 days.

(21) Appl. No.: **12/631,994**

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

(65) **Prior Publication Data**

US 2010/0141537 A1 Jun. 10, 2010

(30) **Foreign Application Priority Data**

Dec. 8, 2008 (KR) 10-2008-0123750

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

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

(58) **Field of Classification Search**

USPC 343/700 MS, 702
See application file for complete search history.

(56) **References Cited**

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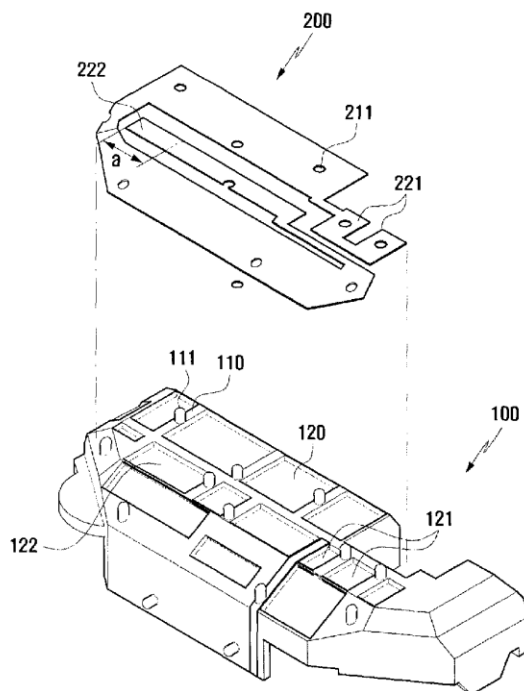
Primary Examiner — Dieu H Duong

(74) *Attorney, Agent, or Firm* — Cha & Reiter, LLC

(57) **ABSTRACT**

An internal antenna module and a wireless communication apparatus having the same are disclosed. The internal antenna module includes a carrier having a partition formed on a surface thereof and a space defined by the partition; and a radiator disposed on the partition of the carrier. The space is formed in a region of the surface of the carrier excluding a region required to support the radiator. Therefore, influence of the carrier is minimized so that the radiation performance may be improved.

9 Claims, 4 Drawing Sheets





US008624785B2

(12) **United States Patent**
Chen

(10) **Patent No.:** **US 8,624,785 B2**
(45) **Date of Patent:** **Jan. 7, 2014**

(54) **DUAL-BAND ANTENNA**

(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 299 days.

(21) Appl. No.: **13/082,537**

(22) Filed: **Apr. 8, 2011**

(65) **Prior Publication Data**

US 2012/0001805 A1 Jan. 5, 2012

(30) **Foreign Application Priority Data**

Jun. 30, 2010 (TW) 99121600 A

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

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

(58) **Field of Classification Search**

USPC 343/702, 700 MS
See application file for complete search history.

(56) **References Cited**

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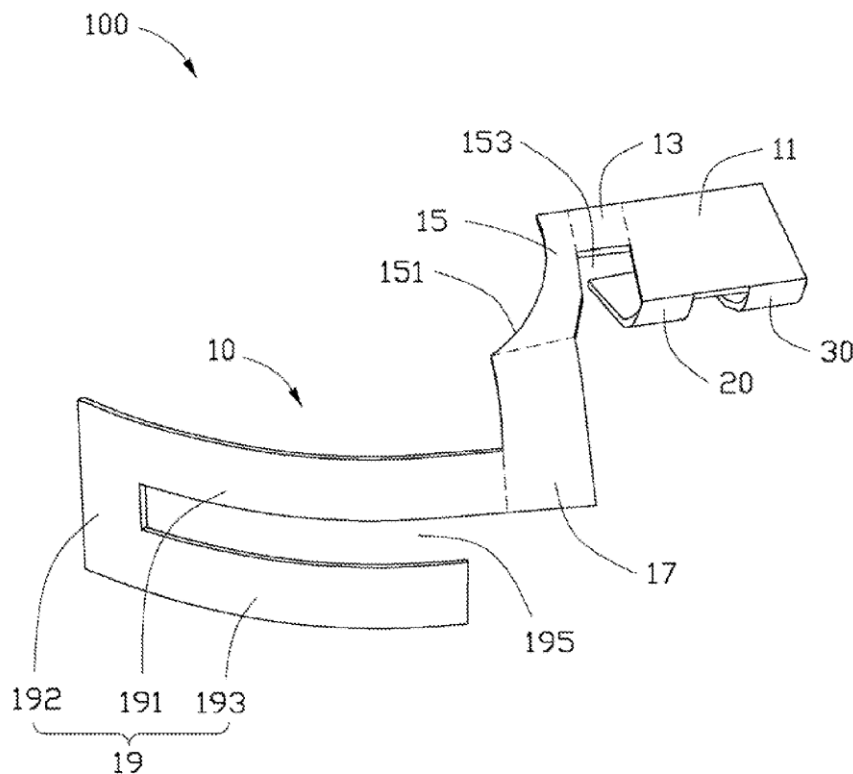
Primary Examiner — Karl D Frech

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

(57) **ABSTRACT**

A dual-band antenna includes a radiator unit. The radiator unit includes a base portion, an extension portion extending from the base portion, a connecting portion extending from the extension portion, a transition portion extending from the connecting portion, and a u-shaped portion extending from the transition section. The connecting portion, the extension portion, and the base portion define a first slot. The u-shaped portion defines a second slot.

11 Claims, 3 Drawing Sheets





US008629810B2

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

(10) **Patent No.:** **US 8,629,810 B2**
(45) **Date of Patent:** **Jan. 14, 2014**

(54) **MULTIBAND ANTENNA AND PORTABLE
ELECTRONIC DEVICE USING THE SAME**

(75) Inventors: **Hsing-Yuan Hsieh**, Shindian (TW);
Jia-Ming Deng, Shenzhen (CN)

(73) Assignees: **Shenzhen Futaihong Precision
Industry Co., Ltd.**, Shenzhen (CN);
FIH (Hong Kong) Limited, Kowloon
(HK)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 793 days.

(21) Appl. No.: **12/821,266**

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

(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
Mar. 3, 2010 (CN) 2010 1 0116921

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

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

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

(56) **References Cited**

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Primary Examiner — Hoang V Nguyen

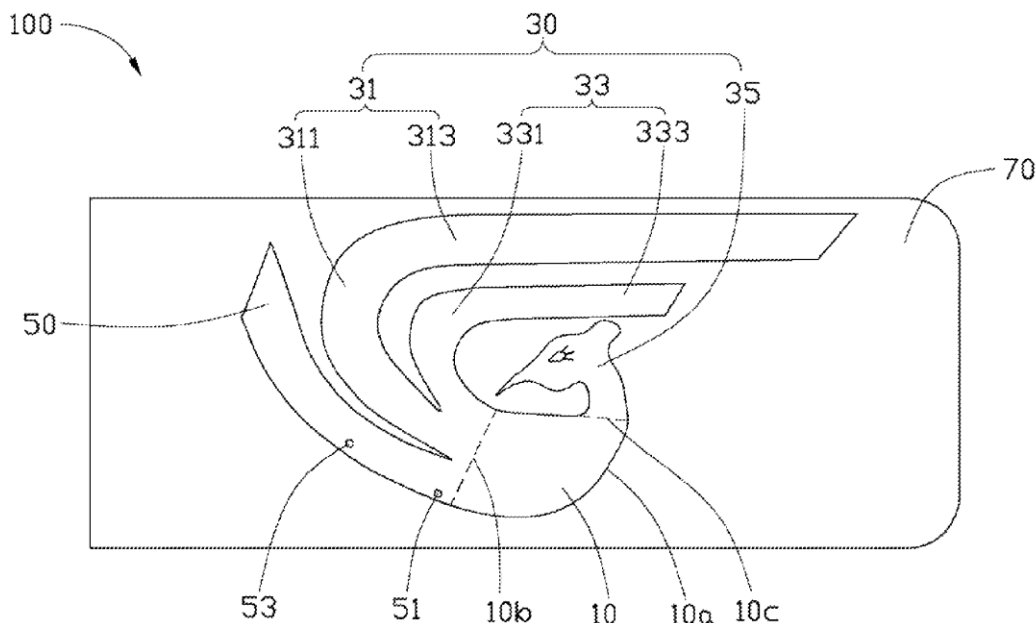
Assistant Examiner — Kyana R McCain

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

(57) **ABSTRACT**

A multiband antenna includes a first radiating unit, a second radiating unit connected to the first radiating unit and including a first radiating arm, a second radiating arm, and a third radiating arm, and a connecting unit connected to the first radiating unit. The first radiating unit, the second radiating unit, and the connecting unit are all planar sheets positioned coplanar with each other. The first radiating unit is a sector having a first radii side, a second radii side and an arc side. The first radiating arm, the second radiating arm, and the connecting unit are connected to the first radii side, and the third radiating arm is connected to the second radii side.

19 Claims, 3 Drawing Sheets





US008629811B2

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

(10) **Patent No.:** **US 8,629,811 B2**
(45) **Date of Patent:** **Jan. 14, 2014**

(54) **DUAL BAND ELECTRICALLY SMALL
TUNABLE ANTENNA**

(75) Inventors: **John E. Grandfield**, Bristol, RI (US);
Michael P. Abban, Weymouth, MA
(US); **Brad D. Gaynor**, Newton, MA
(US)

(73) Assignee: **The Charles Stark Draper Laboratory,
Inc.**, 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 308 days.

(21) Appl. No.: **13/233,411**

(22) Filed: **Sep. 15, 2011**

(65) **Prior Publication Data**
US 2013/0069838 A1 Mar. 21, 2013

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

(52) **U.S. Cl.**
USPC **343/729; 343/700 MS**

(58) **Field of Classification Search**

USPC 343/700 MS, 895, 729, 725
See application file for complete search history.

(56) **References Cited**

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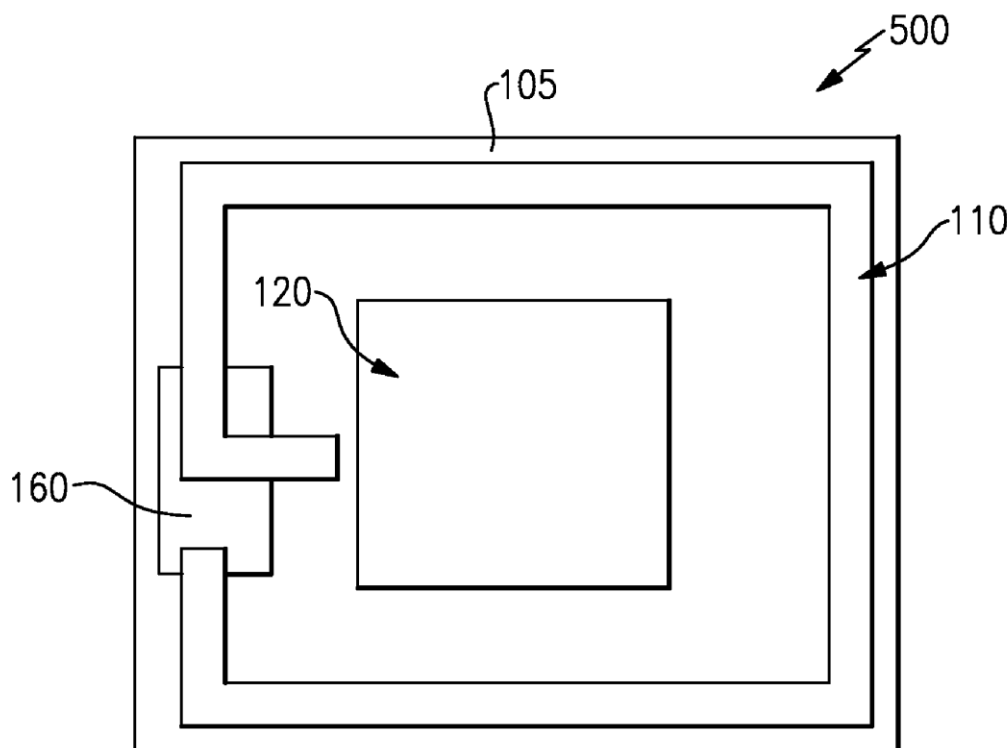
Primary Examiner — Hoanganh Le

(74) *Attorney, Agent, or Firm* — Lando & Anastasi, LLP

(57) **ABSTRACT**

An electrically small dual-band planar tunable UHF/L-Band
antenna. In one example, the dual-band antenna includes a
combination of a semi-spiral antenna for the UHF frequen-
cies and a microstrip patch antenna for the L-band frequen-
cies.

14 Claims, 4 Drawing Sheets





US008629813B2

(12) **United States Patent**
Milosavljevic

(10) **Patent No.:** **US 8,629,813 B2**
(45) **Date of Patent:** **Jan. 14, 2014**

(54) **ADJUSTABLE MULTI-BAND ANTENNA AND METHODS**

(75) Inventor: **Zlatoljub Milosavljevic**, Espoo (FI)

(73) Assignee: **Pusle Finland Oy**, Kempele (FI)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 494 days.

(21) Appl. No.: **12/673,966**

(22) PCT Filed: **Aug. 20, 2008**

(86) PCT No.: **PCT/FI2008/050469**

§ 371 (c)(1),
(2), (4) Date: **Jan. 7, 2011**

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PCT Pub. Date: **Mar. 5, 2009**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Aug. 30, 2007 (FI) 20075597

(51) **Int. Cl.**
H01Q 1/50 (2006.01)

(52) **U.S. Cl.**
USPC **343/852; 343/850**

(58) **Field of Classification Search**
USPC 343/850, 852, 745, 746, 749
See application file for complete search history.

(56) **References Cited**

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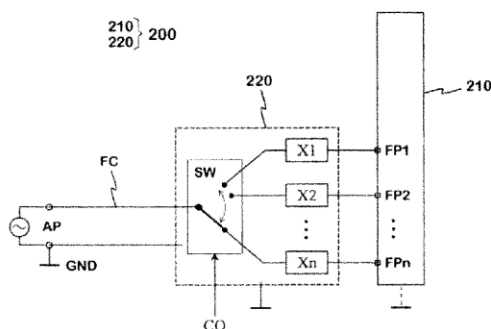
Primary Examiner — Hoang V Nguyen

(74) Attorney, Agent, or Firm — Gazdzinski & Associates, PC

(57) **ABSTRACT**

An adjustable multi-band planar antenna especially applicable in mobile terminals. In one embodiment, the feed of the antenna is connected by a multiple-way switch to at least two alternative points of the radiator element. When the feed point is changed, the resonance frequencies and thus the operating bands of the antenna change. In addition to varying the basic dimensions of the antenna, the distance between one feed point to another and a possible short-circuit point in the radiator, the value of the series capacitance produced by a reactive circuit that is formed between the feed point and switch, and the distance between the ground plane and the radiator, are parameters that may affect the antenna design.

26 Claims, 4 Drawing Sheets





US008633859B2

(12) **United States Patent**
Chou

(10) **Patent No.:** **US 8,633,859 B2**
(45) **Date of Patent:** **Jan. 21, 2014**

(54) **ANTENNA MODULE**

(75) Inventor: **Ming-Yu Chou**, New Taipei (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 378 days.

(21) Appl. No.: **13/216,740**

(22) Filed: **Aug. 24, 2011**

(65) **Prior Publication Data**

US 2012/0313836 A1 Dec. 13, 2012

(30) **Foreign Application Priority Data**

Jun. 13, 2011 (TW) 100120555 A

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

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

(58) **Field of Classification Search**

USPC 343/700 MS, 702, 893
See application file for complete search history.

(56) **References Cited**

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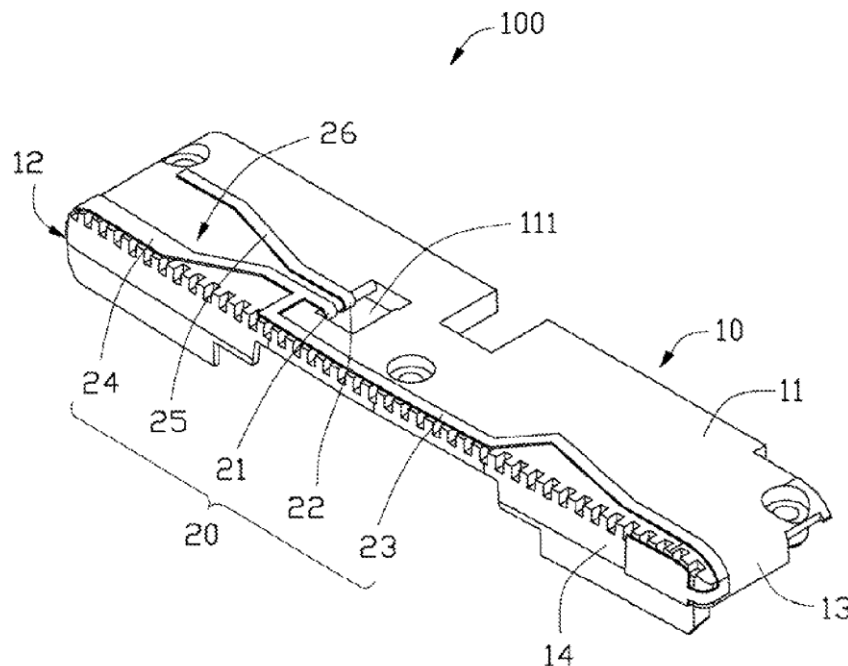
Primary Examiner — Tan Ho

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

(57) **ABSTRACT**

An antenna module includes a support and an antenna. The support includes an upper surface and has a through hole defined in a middle of the upper surface. The antenna includes a feed unit, a first radiator unit, and a second radiator unit. One end of the feed unit is positioned on the upper surface. The other end of the feed unit passes through the through hole, and extends and attaches to a surface opposite to the upper surface. The first radiator unit and the second radiator unit are both connected to the end of the feed unit positioned on the upper surface, and both extend away from the feed unit.

13 Claims, 3 Drawing Sheets





US008633860B2

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

(10) **Patent No.:** **US 8,633,860 B2**

(45) **Date of Patent:** ***Jan. 21, 2014**

(54) **DUAL FEED ANTENNA**

(56) **References Cited**

(71) Applicant: **Skycross, Inc.**, Fremont, CA (US)

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(72) Inventors: **Mark T. Montgomery**, Melbourne Beach, FL (US); **Paul A. Tornatta, Jr.**, Melbourne Beach, FL (US)

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(73) Assignee: **Skycross, Inc.**, Fremont, 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 0 days.

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This patent is subject to a terminal disclaimer.

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(21) Appl. No.: **13/757,192**

"International Search Report and Written Opinion", PCT/US2009/069233, Jun. 30, 2010.

(22) Filed: **Feb. 1, 2013**

(Continued)

(65) **Prior Publication Data**

US 2013/0169491 A1 Jul. 4, 2013

Primary Examiner — Tan Ho

(74) Attorney, Agent, or Firm — Guntin & Gust, PLC; Ed Guntin

Related U.S. Application Data

(63) Continuation of application No. 12/644,718, filed on Dec. 22, 2009, now Pat. No. 8,373,603.

(60) Provisional application No. 61/140,370, filed on Dec. 23, 2008.

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

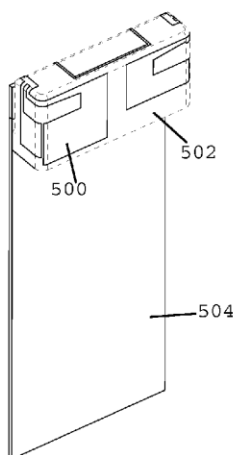
(52) **U.S. Cl.**
USPC **343/702; 343/700 MS**

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

ABSTRACT

The subject disclosure may include, for example, a multi-port antenna structure including an antenna having a first antenna port to transmit electromagnetic signals and a second antenna port to receive electromagnetic signals, where the antenna is coupled to a housing assembly of a communication device to transmit energy between the housing assembly and the first antenna port and second antenna port, and where first resonant modes of the housing assembly for the first antenna port and second resonant modes of the housing assembly for the second antenna port are such that the first and second antenna ports are substantially isolated from each other. Other embodiments are disclosed.

20 Claims, 9 Drawing Sheets





US008633864B2

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

(10) **Patent No.:** **US 8,633,864 B2**
(45) **Date of Patent:** **Jan. 21, 2014**

(54) **ANTENNA HAVING AN ANTENNA TO
RADOME RELATION WHICH MINIMIZES
USER LOADING EFFECT**

(75) Inventors: **Tadd M. Scarpelli**, Third Lake, IL (US);
Eric L. Krenz, Crystal Lake, IL (US)

(73) Assignee: **Motorola Mobility LLC**, Libertyville,
IL (US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 1337 days.

(21) Appl. No.: **10/873,870**

(22) Filed: **Jun. 21, 2004**

(65) **Prior Publication Data**
US 2005/0280585 A1 Dec. 22, 2005

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

(52) **U.S. Cl.**
USPC **343/872; 343/915**

(58) **Field of Classification Search**
USPC 343/700 MS, 700 R, 701-703, 867-873,
343/880-882, 912-916
See application file for complete search history.

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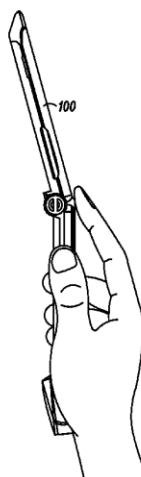
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Primary Examiner — Wilson Lee

(57) **ABSTRACT**

An antenna is provided, which is located within an enclosure. The antenna includes one or more arms, where each arm has an electrical length corresponding to an intended frequency band of transmission, and along said length of the arm a source of external loading will have a variable effect. The enclosure includes one or more anticipated points of contact, where a source of external loading will be brought into proximity with said enclosure, and where the one or more arms are constructed and arranged to locate the relatively high impedance areas of the antenna at least a predetermined distance from the one or more anticipated points of interest, and the relatively low impedance areas of the antenna are located more proximate the anticipated points of interest.

18 Claims, 3 Drawing Sheets





US008634791B2

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

(10) **Patent No.:** **US 8,634,791 B2**
(45) **Date of Patent:** ***Jan. 21, 2014**

(54) **MOBILE WIRELESS COMMUNICATIONS
DEVICE ANTENNA ASSEMBLY WITH
FLOATING DIRECTOR ELEMENTS ON
FLEXIBLE SUBSTRATE AND RELATED
METHODS**

(75) Inventors: **Ying Tong Man**, Waterloo (CA); **Yihong Qi**, St. Agatha (CA); **Adrian Cooke**,
Kitchener (CA); **Krystyna Bandurska**,
Waterloo (CA)

(73) Assignee: **BlackBerry Limited**, Waterloo, Ontario
(CA)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
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This patent is subject to a terminal dis-
claimer.

(21) Appl. No.: **13/079,112**

(22) Filed: **Apr. 4, 2011**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. 11/947,178, filed on
Nov. 29, 2007, now Pat. No. 7,941,116.

(51) **Int. Cl.**
H04B 1/40 (2006.01)
H01Q 1/38 (2006.01)

(52) **U.S. Cl.**
USPC **455/269**; 343/700 MS; 455/575.1

(58) **Field of Classification Search**
USPC 455/82, 129, 269, 274, 562.1, 575.1;
343/702, 700 MS, 748, 866, 895
See application file for complete search history.

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WO	2007/051295	5/2007		H01Q 1/27

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Primary Examiner — Blane J Jackson

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

(57) **ABSTRACT**

A mobile wireless communications device may include a portable housing, a circuit board carried by the portable housing and comprising a ground plane, and wireless communications circuitry carried by the circuit board. The device may also include an antenna assembly carried by the housing. The antenna assembly may include a flexible substrate, an electrically conductive antenna element on the flexible substrate and connected to the wireless communications circuitry and the ground plane, and at least one pair of floating, electrically conductive director elements on opposite sides of the flexible substrate for directing a beam pattern of the antenna element.

13 Claims, 6 Drawing Sheets

