



US008361062B2

(12) **United States Patent**
Bonn

(10) **Patent No.:** **US 8,361,062 B2**
(45) **Date of Patent:** ***Jan. 29, 2013**

(54) **SLIDABLE CHOKE MICROWAVE ANTENNA**

(75) Inventor: **Kenlyn S. Bonn**, Arvada, CO (US)

(73) Assignee: **Vivant Medical, Inc.**, Boulder, CO (US)

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

This patent is subject to a terminal disclaimer.

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(21) Appl. No.: **13/268,143**

(22) Filed: **Oct. 7, 2011**

(65) **Prior Publication Data**

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Related U.S. Application Data

(62) Division of application No. 12/129,482, filed on May 29, 2008, now Pat. No. 8,059,059.

(51) **Int. Cl.**
A61B 18/04 (2006.01)
H01Q 1/10 (2006.01)

(52) **U.S. Cl.** **606/33; 343/902; 343/906**

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

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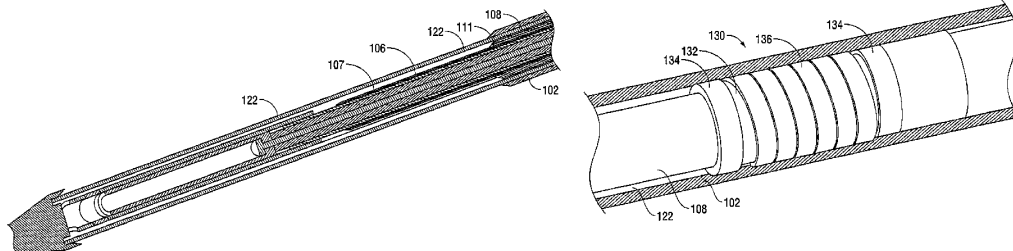
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Primary Examiner — Trinh Dinh

(57) **ABSTRACT**

A microwave antenna assembly is disclosed. The antenna assembly includes a feedline having an inner conductor, an outer conductor and an inner insulator disposed therebetween and a radiating portion including a dipole antenna coupled to the feedline and a trocar coupled to the dipole antenna at a distal end thereof. The antenna assembly also includes a slidable outer jacket disposed about the radiating portion and the feedline. The slidable outer jacket being configured to slide about at least one of the radiating portion and the feedline from a closed configuration, in which the slidable outer jacket is mated with the trocar and a retracted configuration, in which the slidable outer jacket is retracted in a proximally exposing at least a portion the radiating portion.

10 Claims, 15 Drawing Sheets



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US008362783B2

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

(10) **Patent No.:** **US 8,362,783 B2**
(45) **Date of Patent:** **Jan. 29, 2013**

(54) **METHOD FOR VERIFYING A
COMPLETENESS OF AN ANTENNA**

(75) Inventors: **Tracy M. Baker**, Belle Center, OH
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(73) Assignee: **AGC Automotive Americas Co.**,
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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 696 days.

(21) Appl. No.: **12/548,879**

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

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 61/190,286, filed on Aug.
27, 2008.

(51) **Int. Cl.**
G01R 31/00 (2006.01)

(52) **U.S. Cl.** **324/505; 324/503**

(58) **Field of Classification Search** **324/503–505**
See application file for complete search history.

(56) **References Cited**

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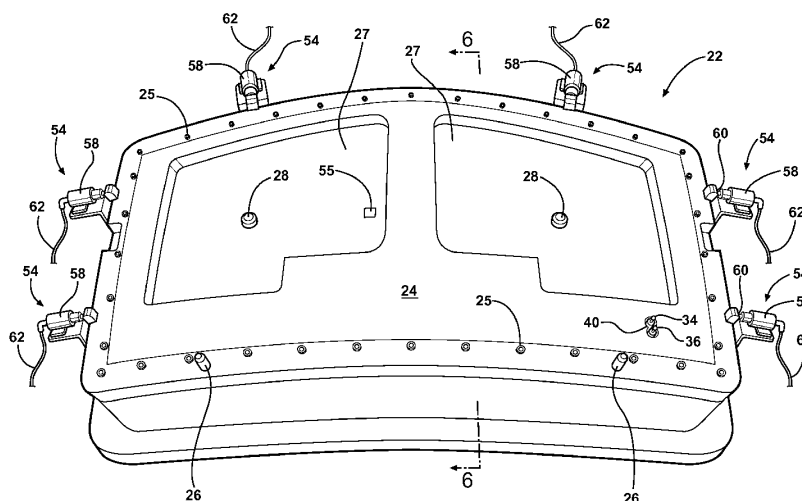
Primary Examiner — Joshua Benitez Rosario

(74) *Attorney, Agent, or Firm* — Howard & Howard
Attorneys PLLC

(57) **ABSTRACT**

A method verifies a completeness of an antenna disposed on a window. The antenna is electrically conductive and has a first end and a second end spaced from each other. The method comprises the step of placing the window on a fixture for supporting the window. The method also includes the steps of automatically aligning a distributing probe and the first end of the antenna and automatically aligning a receiving probe and the second end of the antenna. The method further includes the step of activating a current source to pass an electrical current from the distributing probe to the receiving probe through the antenna. The method also includes the step of indicating passage of the electrical current from the antenna to the receiving probe with the indicator to verify a completeness of the antenna.

26 Claims, 7 Drawing Sheets



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US008362954B2

(12) **United States Patent**
Nogami

(10) **Patent No.:** **US 8,362,954 B2**
(45) **Date of Patent:** **Jan. 29, 2013**

(54) **ARRAY ANTENNA, TAG COMMUNICATION DEVICE, TAG COMMUNICATION SYSTEM, AND BEAM CONTROL METHOD FOR ARRAY ANTENNA**

(75) Inventor: **Hidekatsu Nogami**, Kyoto (JP)

(73) Assignee: **Omron 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 165 days.

(21) Appl. No.: **12/744,299**

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

(86) PCT No.: **PCT/JP2009/053261**

§ 371 (c)(1),
(2), (4) Date: **Aug. 9, 2010**

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PCT Pub. Date: **Mar. 9, 2009**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Feb. 29, 2008 (JP) 2008-049959

(51) **Int. Cl.**
H01Q 3/00 (2006.01)

(52) **U.S. Cl.** **342/372; 342/373**

(58) **Field of Classification Search** **342/81, 342/372, 373; 343/700 MS, 777**

See application file for complete search history.

(56) **References Cited**

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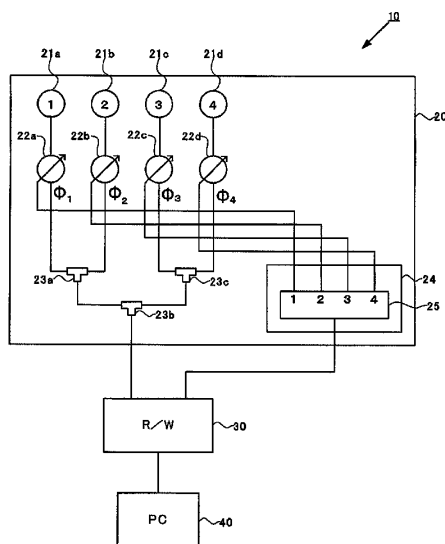
Primary Examiner — Dao Phan

(74) *Attorney, Agent, or Firm* — Dickstein Shapiro LLP

(57) **ABSTRACT**

Provided are an array antenna capable of miniaturizing an array antenna while reducing side lobes, a tag communication device and tag communication system provided with the array antenna, and a beam control method for the array antenna. When XY coordinates and a feeding phase of each antenna element (21a to 21d) are defined as the antenna element (21a) (0, Y1)· ϕ_1 , the antenna element (21b) (−X1, 0)· ϕ_2 , the antenna element (21c) (X2, 0)· ϕ_3 , the antenna element (21d) (0, −Y2)· ϕ_4 , wavelengths of λ , and directivity directions of θ , each of the feeding phases is set so that the following conditional equations $\phi_1 = \phi_4$, $\phi_2 = 2\pi \cdot X1 \cdot \sin(\theta)/\lambda + \phi_1$, $\phi_3 = \phi_1 - 2\pi \cdot X2 \cdot \sin(\theta)/\lambda$ are all satisfied.

11 Claims, 7 Drawing Sheets



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US008362956B2

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

(10) **Patent No.:** **US 8,362,956 B2**
(45) **Date of Patent:** **Jan. 29, 2013**

(54) **ELECTRICALLY SMALL, SOURCE
DIRECTION RESOLVING ANTENNAS**

(76) Inventors: **Nader Behdad**, Madison, WI (US);
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(US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 238 days.

(21) Appl. No.: **12/949,276**

(22) Filed: **Nov. 18, 2010**

(65) **Prior Publication Data**

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(51) **Int. Cl.**
G01S 5/04 (2006.01)

(52) **U.S. Cl.** **342/442**

(58) **Field of Classification Search** 342/434,
342/442, 445, 448

See application file for complete search history.

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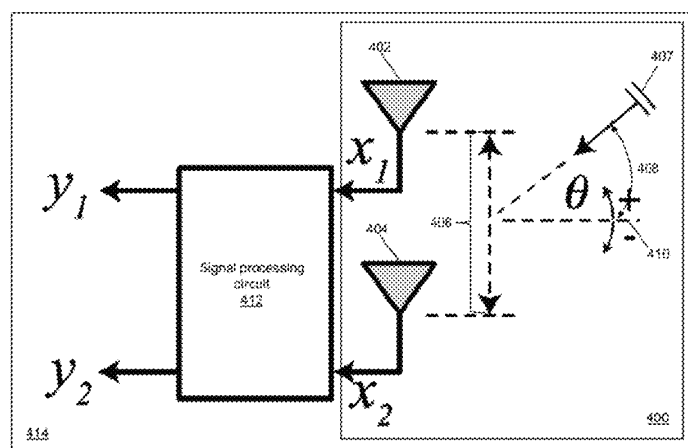
Primary Examiner — Dao Phan

(74) *Attorney, Agent, or Firm* — Bell & Manning, LLC

(57) **ABSTRACT**

An electrically small receiver system is provided. The receiver system includes a plurality of antennas and a signal processing circuit. The plurality of antennas includes a first antenna configured to receive a first signal and a second antenna configured to receive a second signal. The signal processing circuit includes a first resonant loop and a second resonant loop. The first resonant loop is mounted to receive the first signal from the first antenna. The second resonant loop is mounted to receive the second signal from the second antenna. The first resonant loop and the second resonant loop are coupled such that the first output signal and the second output signal are generated as a function of the first signal and the second signal. A phase difference between the first output signal and the second output signal is greater than a phase difference between the first signal and the second signal.

20 Claims, 13 Drawing Sheets



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US008362958B2

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

(10) **Patent No.:** **US 8,362,958 B2**
(45) **Date of Patent:** **Jan. 29, 2013**

(54) **APERTURE ANTENNA**

(75) Inventors: **Shih-Kai Lin**, Taipei (TW); **Bing-Syun Li**, Taipei (TW); **Yi-Cheng Lin**, Taipei (TW)

(73) Assignee: **National Taiwan University**, Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 758 days.

(21) Appl. No.: **12/536,322**

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

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Feb. 2, 2009 (TW) 98103203 A

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 13/10 (2006.01)

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

(58) **Field of Classification Search** **343/700 MS, 343/767**

See application file for complete search history.

(56) **References Cited**

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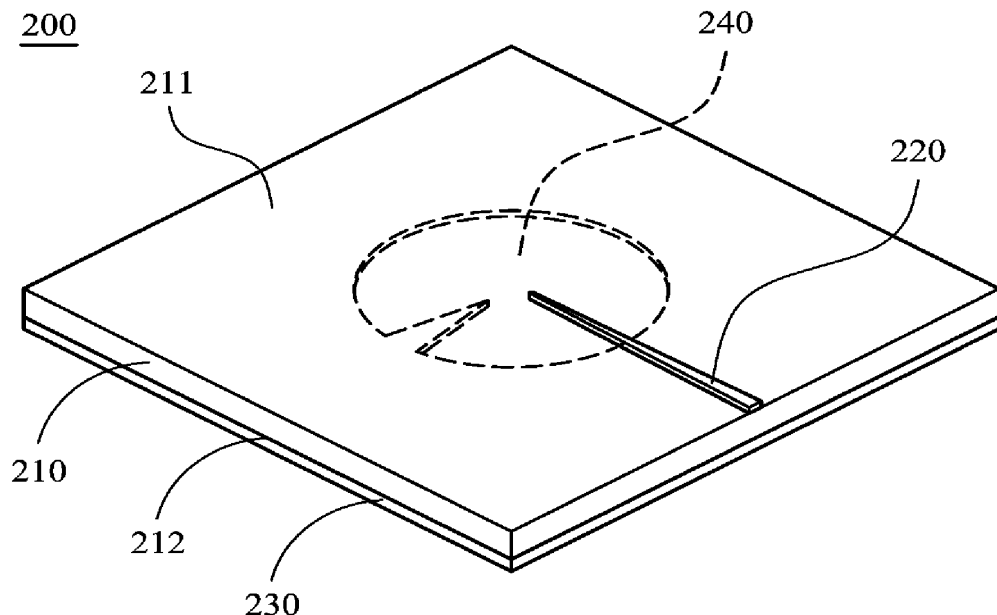
Primary Examiner — Jacob Y Choi

Assistant Examiner — Hasan Islam

(57) **ABSTRACT**

An aperture antenna for transmitting a circularly polarized signal is provided. The aperture antenna includes an antenna substrate, a feed conductor and an antenna ground layer. The feed conductor is microstrip-fed or coplanar-wave-guide-fed. The antenna ground layer has an aperture, the aperture has a feed portion, a signal turning point, a first edge and a second edge, the first edge connects the feed portion to the signal turning point in a first direction, and the second edge connects the feed portion to the signal turning point in a second direction, the first direction is opposite to the second direction. When the aperture antenna transmits the circularly polarized signal, a traveling wave travels on the first edge, and at least one standing wave is formed on the second edge.

11 Claims, 8 Drawing Sheets



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US008362960B2

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

(10) **Patent No.:** **US 8,362,960 B2**
(45) **Date of Patent:** **Jan. 29, 2013**

(54) **HANDHELD DEVICE WITH TWO ANTENNAS, AND METHOD OF ENHANCING THE ISOLATION BETWEEN THE ANTENNAS**

(75) Inventors: **Josep Mumbru**, Barcelona (ES); **Jaume Anguera**, Castellon (ES); **Jordi Soler**, Girona (ES); **Carles Puente**, Barcelona (ES)

(73) Assignee: **Fractus, S.A.**, Barcelona (ES)

(*) 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.: **13/341,051**

(22) Filed: **Dec. 30, 2011**

(65) **Prior Publication Data**

US 2012/0098719 A1 Apr. 26, 2012

Related U.S. Application Data

(63) Continuation of application No. 11/988,888, filed as application No. PCT/EP2006/007050 on Jul. 18, 2006, now Pat. No. 8,115,686.

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(30) **Foreign Application Priority Data**

Jul. 21, 2005 (EP) 05106694

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

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

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

(58) **Field of Classification Search** **343/702, 343/700 MS, 846, 767, 848**

See application file for complete search history.

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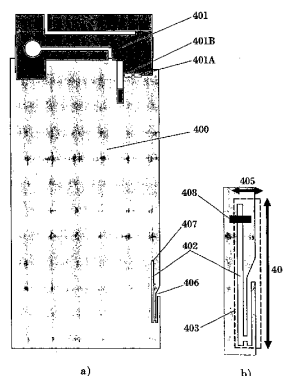
Primary Examiner — Hoang V Nguyen

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

(57) **ABSTRACT**

The invention relates to a handheld device comprising a first antenna (401, 701, 901, 931, 961, 1101, 1151, 1301, 1501) arranged to operate in at least a first frequency band, and a second antenna (402, 702, 902, 1102, 1302, 1502, 2210) arranged to operate in at least a second frequency band, wherein said second frequency band is different from said first frequency band. According to the invention, the second antenna comprises a slot antenna comprising at least one slot in at least one conductive layer. The invention also relates to enhancement of the isolation between first and second antennas in a handheld device.

20 Claims, 23 Drawing Sheets



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US008362962B2

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

(10) **Patent No.:** **US 8,362,962 B2**
(45) **Date of Patent:** **Jan. 29, 2013**

(54) **ANTENNA AND METHOD FOR STEERING
ANTENNA BEAM DIRECTION**

(75) Inventors: **Sebastian Rowson**, San Diego, CA
(US); **Laurent Desclos**, San Diego, CA
(US); **Jeffrey Shamblin**, San Marcos,
CA (US)
(73) Assignee: **ETHERTRONICS, Inc.**, San Diego,
CA (US)
(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/029,564**

(22) Filed: **Feb. 17, 2011**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. 12/043,090, filed on
Mar. 5, 2008, now Pat. No. 7,911,402.

(51) **Int. Cl.**
H01Q 9/38 (2006.01)

(52) **U.S. Cl.** **343/745; 343/700 MS; 343/795;**
343/815

(58) **Field of Classification Search** **343/700,**
343/745, 795, 815

See application file for complete search history.

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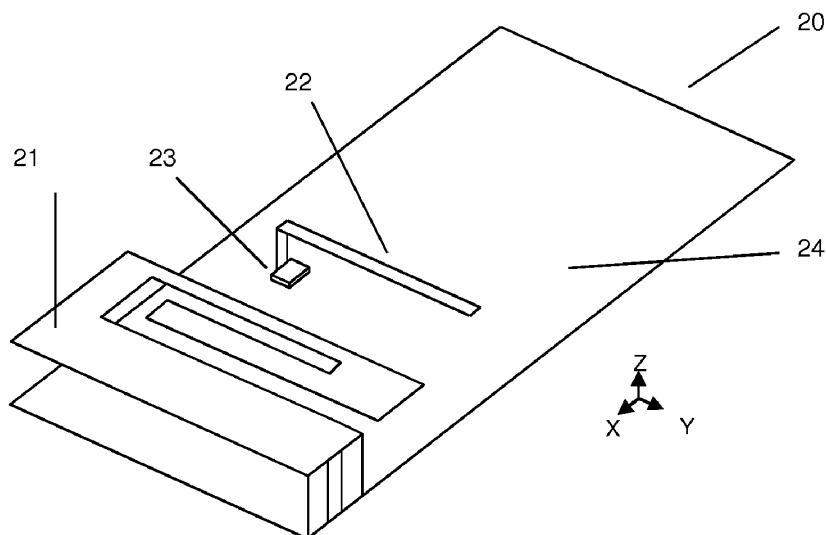
Primary Examiner — Tho G Phan

(74) *Attorney, Agent, or Firm* — Coastal Patent Agency;
Joshua S. Schoonover

(57) **ABSTRACT**

An antenna comprising an IMD element, and one or more parasitic and active tuning elements is disclosed. The IMD element, when used in combination with the active tuning and parasitic elements, allows antenna operation at multiple resonant frequencies. In addition, the direction of antenna radiation pattern may be arbitrarily rotated in accordance with the parasitic and active tuning elements.

19 Claims, 13 Drawing Sheets



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US008362968B2

(12) **United States Patent**
Fukuda

(10) **Patent No.:** **US 8,362,968 B2**
(45) **Date of Patent:** **Jan. 29, 2013**

(54) **ARRAY ANTENNA, RADIO COMMUNICATION APPARATUS, AND ARRAY ANTENNA CONTROL METHOD**

(75) Inventor: **Junichi Fukuda**, 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 746 days.

(21) Appl. No.: **12/528,147**

(22) PCT Filed: **Dec. 11, 2007**

(86) PCT No.: **PCT/JP2007/073844**

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(2), (4) Date: **Aug. 21, 2009**

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(30) **Foreign Application Priority Data**

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H01Q 3/24 (2006.01)

(52) **U.S. Cl.** **343/876; 343/702; 343/853**

(58) **Field of Classification Search** **343/702, 343/853, 876**

See application file for complete search history.

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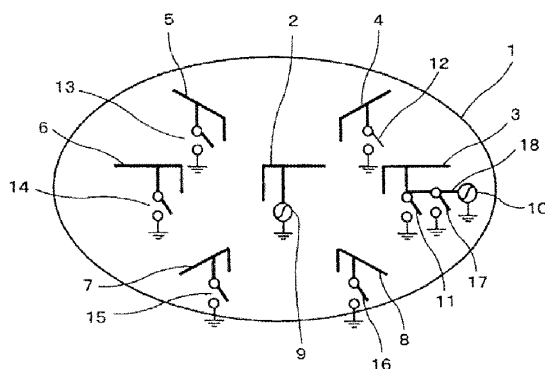
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Primary Examiner — Tho G Phan

(57) **ABSTRACT**

An array antenna includes a group of antenna elements and a switching section. The group of antenna elements has a configuration in which a plurality of antenna elements is arranged. The switching section has a plurality of switch elements capable of individually switching the feeding points of the antenna elements included in the group of antenna elements. By switching of the switch elements, the group of antenna elements is converted into an antenna for MIMO communication to transmit and receive a plurality of signals in parallel, or into a directional array antenna to control the directivity towards the direction at which the signals arrive.

19 Claims, 6 Drawing Sheets



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US008364212B2

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

(10) **Patent No.:** **US 8,364,212 B2**
(45) **Date of Patent:** ***Jan. 29, 2013**

(54) **PORTABLE WIRELESS DEVICE**

(75) Inventors: **Kenji Waku**, Kanagawa (JP); **Kunihiko Watanabe**, Kanagawa (JP); **Yasuhiro Abe**, Kanagawa (JP); **Tei Riku**, Kanagawa (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 587 days.

This patent is subject to a terminal disclaimer.

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Japanese language office action dated May 8, 2012 and its English language translation issued in corresponding Japanese application 2006294692.

Primary Examiner — Dominic E Rego

(74) *Attorney, Agent, or Firm* — DLA Piper (US) LLP

(21) Appl. No.: **12/513,144**

(22) PCT Filed: **Oct. 29, 2007**

(86) PCT No.: **PCT/JP2007/071067**

§ 371 (c)(1),
(2), (4) Date: **Dec. 17, 2009**

(87) PCT Pub. No.: **WO2008/053859**

PCT Pub. Date: **May 8, 2008**

(65) **Prior Publication Data**

US 2010/0093411 A1 Apr. 15, 2010

(30) **Foreign Application Priority Data**

Oct. 30, 2006	(JP)	2006-294691
Oct. 30, 2006	(JP)	2006-294692

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

(52) **U.S. Cl.** **455/575.1**; 455/347

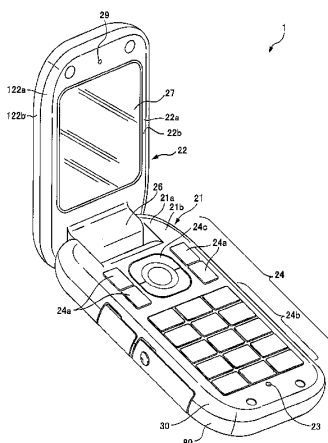
(58) **Field of Classification Search** 455/347–349,
455/550.1, 575.1–575.8, 90.3; 361/616,
361/667, 724–727, 747, 769; 429/97, 100;
439/500; 403/166, 331

See application file for complete search history.

(57) **ABSTRACT**

The present invention has an object of attaining further miniaturization and reducing the thickness of a portable wireless device with a built-in antenna. The cellular telephone device 1 according to the one embodiment of the present invention includes a case body 60 having a first case portion 62 which is arranged so as to cover the electronic components, along with being electrically conductive to the reference potential pattern, and a nonconductive second case portion 64 arranged to be continuous to the first case portion 62 along with being arranged in the outer periphery of the circuit substrate 70. In the portion that is arranged to be layered in the second case portion 64 in a flexible wiring substrate 50, an antenna element 66 is arranged.

12 Claims, 10 Drawing Sheets



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US008368597B2

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

(10) **Patent No.:** **US 8,368,597 B2**
(45) **Date of Patent:** **Feb. 5, 2013**

(54) **ANTENNA PATTERN FRAME AND METHOD OF MANUFACTURING THE SAME**

(75) Inventors: **Jae Suk Sung**, Gyunggi-Do (KR); **Dae Seong Jeon**, Gyunggi-Do (KR); **Hyun Kil Nam**, Gyunggi-Do (KR); **Sung Eun Cho**, Gyunggi-Do (KR); **Tae Sung Kim**, Seoul (KR); **Chan Gwang An**, Gyunggi-Do (KR); **Hyun Do Park**, Gyunggi-Do (KR); **Chang Mok Han**, Chungcheongnam-Do (KR); **Byung Hwa Lee**, Gyunggi-Do (KR); **Jung Eun Noh**, Gyunggi-Do (KR)

(73) Assignee: **Samsung Electro-Mechanics Co., Ltd.**, 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 521 days.

(21) Appl. No.: **12/645,992**

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

(65) **Prior Publication Data**

US 2010/0271283 A1 Oct. 28, 2010

(30) **Foreign Application Priority Data**

Apr. 23, 2009 (KR) 10-2009-0035636

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

(52) **U.S. Cl.** **343/700 MS**; 343/702; 29/600

(58) **Field of Classification Search** 343/700 MS, 343/702; 29/600

See application file for complete search history.

(56) **References Cited**

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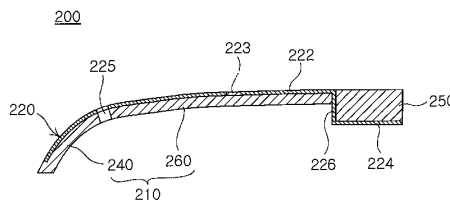
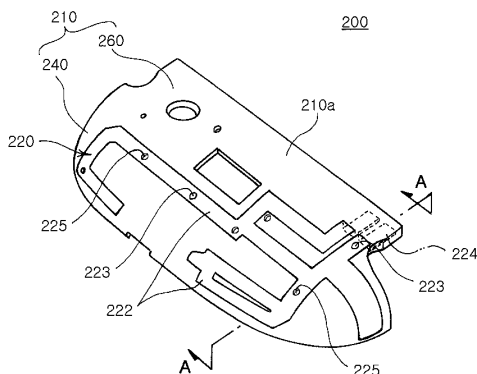
Primary Examiner — Tan Ho

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

(57) **ABSTRACT**

An antenna pattern frame 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 may be provided on one side of the radiator frame and the connection terminal portion may be provided on the other side thereof, while the antenna pattern portion is embedded in the electronic device case; and a contact surface extension provided on the radiator to prevent the radiator from being loosened from the radiator frame during injection molding of the radiator frame, and increasing a contact area with respect to the radiator frame.

18 Claims, 19 Drawing Sheets



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

(54) MULTIBAND ANTENNA

(75) Inventors: **Chang-Hsin Kuo**, Tu-Cheng (TW);
Shih-Tsung Kan, 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 368 days.

Primary Examiner — Tan Ho

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

(21) Appl. No.: 12/784,504

(22) Filed: **May 21, 2010**

(65) **Prior Publication Data**

US 2011/0193748 A1 Aug. 11, 2011

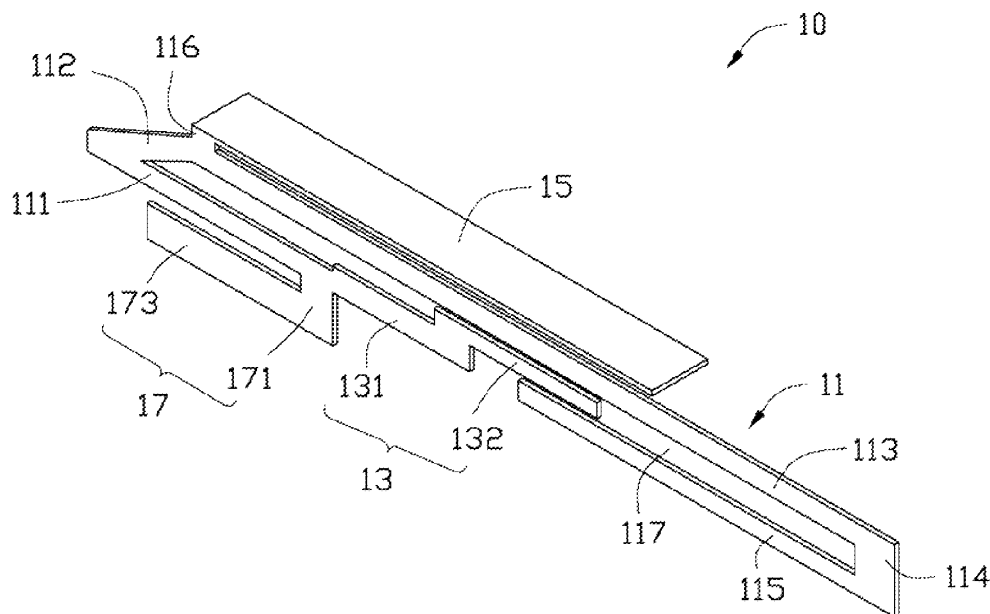
(30) **Foreign Application Priority Data**

(51) **Int. Cl.**
H01O 1/38 (2006.01)

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

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

See application file for complete search history.



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US008368599B2

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

(10) **Patent No.:** **US 8,368,599 B2**
(45) **Date of Patent:** **Feb. 5, 2013**

(54) **SIMPLY FABRICABLE SMALL ZERO-ORDER RESONANT ANTENNA WITH EXTENDED BANDWIDTH AND HIGH EFFICIENCY**

(75) Inventors: **Sungjoon Lim**, Gyeonggi-Do (KR);
Taehee Jang, Gyeonggi-Do (KR)

(73) Assignee: **Chung-Ang University Industry-Academy Cooperation Foundation**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 336 days.

(21) Appl. No.: **12/807,176**

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

(65) **Prior Publication Data**
US 2011/0050505 A1 Mar. 3, 2011

(30) **Foreign Application Priority Data**
Sep. 1, 2009 (KR) 10-2009-0081727

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

(52) **U.S. Cl.** 343/700 MS; 343/749

(58) **Field of Classification Search** 343/702, 343/749, 750, 700 MS
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

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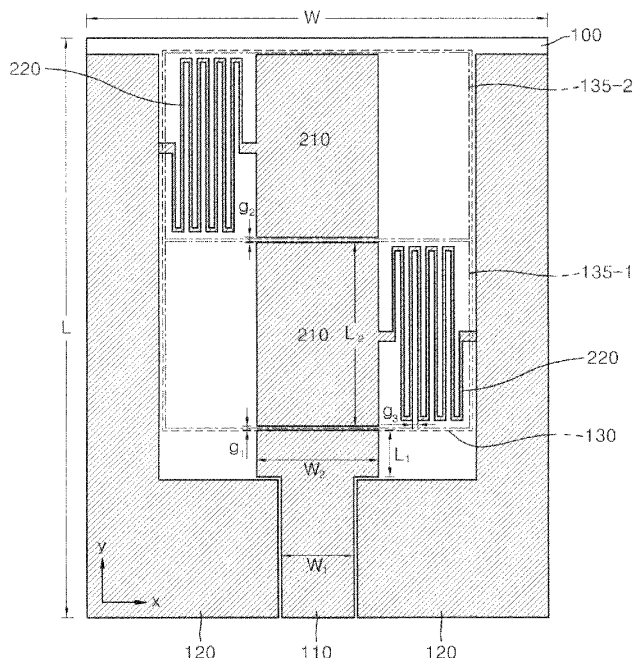
Primary Examiner — Don Le

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

(57) **ABSTRACT**

Provided is a simply fabricable small zeroth-order resonant antenna with extended bandwidth and high efficiency. The zeroth-order resonant antenna includes a feeding patch, a transmission line, and a pair of ground patches. The feeding patch is disposed on a top surface of a substrate having a mono-layer structure, and is configured to receive a signal from the outside. The transmission line includes a unit cell disposed on the top surface of the substrate and is configured to transmit a signal delivered from the feeding patch. The pair of ground patches is longitudinally disposed on the top surface of the substrate in the same direction as a longitudinal direction of the transmission line around the transmission line. The unit cell includes an upper patch and an inductor unit. The upper patch is disposed on the top surface of the substrate and is configured to receive a signal.

20 Claims, 23 Drawing Sheets



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US008368600B2

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

(10) **Patent No.:** **US 8,368,600 B2**

(45) **Date of Patent:** **Feb. 5, 2013**

(54) **DUAL-BAND ANTENNA AND WIRELESS NETWORK DEVICE HAVING THE SAME**

(75) Inventors: **Yu-Jen Wang**, Taipei (TW); **Wei-Bin Lee**, Taipei (TW)

(73) Assignee: **Cameo Communications Inc** (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 346 days.

(21) Appl. No.: **12/807,601**

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

(65) **Prior Publication Data**

US 2011/0001669 A1 Jan. 6, 2011

(30) **Foreign Application Priority Data**

Jun. 9, 2010 (TW) 99210940 U

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

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

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

See application file for complete search history.

(56) **References Cited**

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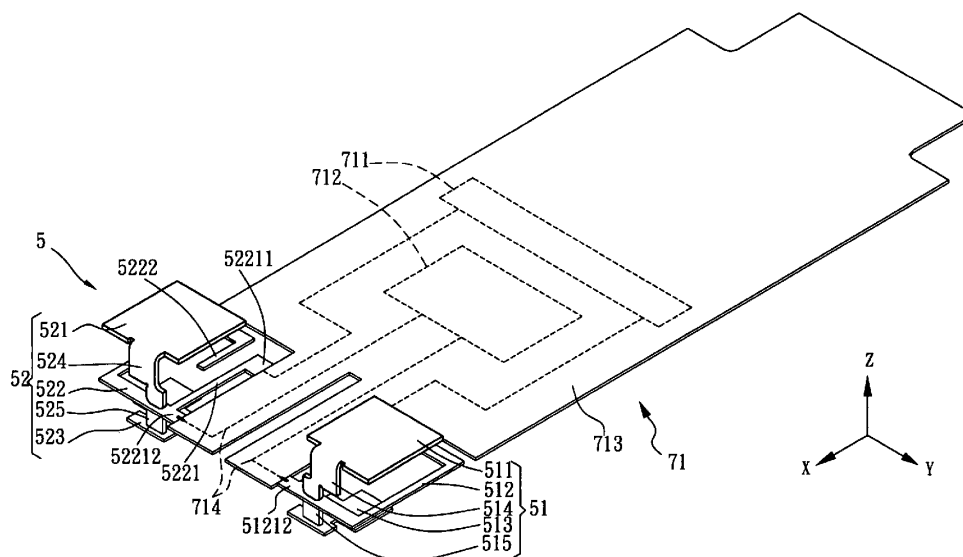
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Primary Examiner — Hoang V Nguyen

(57) **ABSTRACT**

A dual-band antenna for use in a wireless network device comprises first, second, and third radiators. The first and second radiators are connected by a stand portion. The second radiator is a generally C-shaped plate having a connecting section and a free-end portion. A ground end and an input end are provided at predetermined positions of the connecting section and are respectively and electrically connected to a grounding portion and a control circuit of a substrate. The free-end portion overlaps with the orthogonal projection of the first radiator and is parallel to the first radiator. The third radiator is electrically connected to the second radiator via a conductive post and is parallel to the second radiator. The second and third radiators are provided on the substrate while the first radiator is provided outside the substrate. The first, second, and third radiators are parallel to and spaced apart from one another.

10 Claims, 12 Drawing Sheets



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US008368601B2

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

(10) **Patent No.:** **US 8,368,601 B2**
(45) **Date of Patent:** **Feb. 5, 2013**

(54) **MULTIPROTOCOL ANTENNA STRUCTURE
AND METHOD FOR SYNTHESIZING A
MULTIPROTOCOL ANTENNA PATTERN**

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

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

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 536 days.

(21) Appl. No.: **12/536,132**

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

(65) **Prior Publication Data**

US 2011/0032157 A1 Feb. 10, 2011

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 5/00 (2006.01)

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

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

(56) **References Cited**

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Primary Examiner — Jacob Y Choi

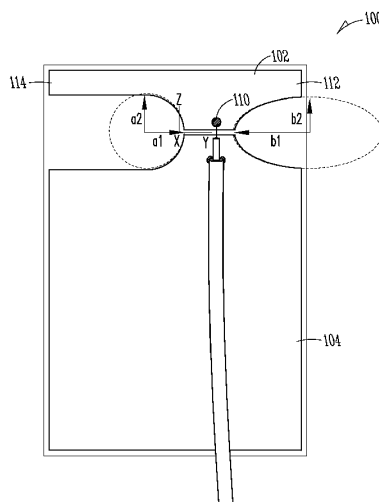
Assistant Examiner — Hasan Islam

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

(57) **ABSTRACT**

Embodiments of a planar asymmetric antenna structure with
shifted feed position for multi-protocol operations are dis-
closed. The antenna structure includes two elliptically taper-
ing right and left arms, each with a different radius, and an
off-center feed point positioned between the right and left
arms. One arm has a smaller elliptical tapering than the other
arm and the feed point is positioned closer to one arm than the
other arm. A method of synthesizing a multiprotocol antenna
pattern is also disclosed. The method includes providing sub-
stantially equally surface currents on both arms of an antenna
structure to generate a near-horizontal pattern in far-field at a
lower frequency band, providing greater surface currents on
the right arm to generate a far-field pattern with a large hori-
zontal component at a higher frequency band, and providing
greater surface currents on the left arm to generate an asym-
metric far-field pattern at a middle frequency band.

18 Claims, 8 Drawing Sheets



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US008368602B2

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

(10) **Patent No.:** **US 8,368,602 B2**
(45) **Date of Patent:** **Feb. 5, 2013**

(54) **PARALLEL-FED EQUAL CURRENT DENSITY
DIPOLE ANTENNA**

(75) Inventors: **Robert J. Hill**, Salinas, CA (US);
Robert W. Schlub, Cupertino, 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 315 days.

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(21) Appl. No.: **12/793,641**

(22) Filed: **Jun. 3, 2010**

(65) **Prior Publication Data**

US 2011/0300907 A1 Dec. 8, 2011

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

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

(58) **Field of Classification Search** **343/702,**
343/767, 768, 700 MS, 846
See application file for complete search history.

(56) **References Cited**

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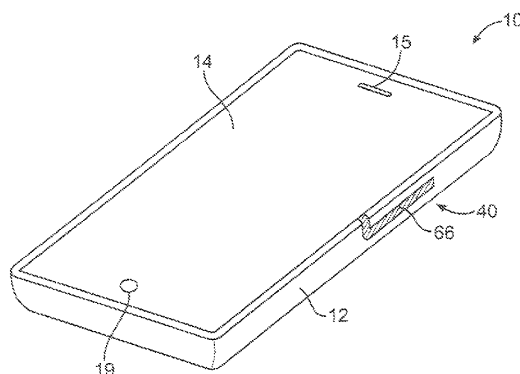
Primary Examiner — Hoang V Nguyen

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

(57) **ABSTRACT**

Electronic devices such as handheld devices may have wireless communications circuitry. The wireless communications circuitry may include a broadband antenna and circuitry that covers multiple communications bands. The broadband antenna may be formed from a parallel-fed dipole. The antenna may have first and second antenna resonating element regions on opposing sides of a slot. The slot may be an open slot that has one open end and one closed end. The slot may be formed from an opening in conductive housing structures in a conductive housing for an electronic device. The conductive housing structures may include sidewall structures, rear housing wall structures, and other conductive structures. The antenna may have a feed with a feed line that crosses the slot. An interposed dielectric substrate member may separate the feed line from the conductive structures. The feed line may have sections with different widths to minimize feed line length.

19 Claims, 20 Drawing Sheets



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US008368612B2

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

(10) **Patent No.:** **US 8,368,612 B2**

(45) **Date of Patent:** **Feb. 5, 2013**

(54) **EMBEDDED ANTENNA APPARATUS**

(56) **References Cited**

(75) Inventors: **Sang Jin Eom**, Incheon (KR); **Austin Kim**, Seongnam-si (KR); **Young Eil Kim**, Suwon-si (KR); **Jun Seok Yang**, Seoul (KR)

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

(*) 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.: **12/765,392**

(22) Filed: **Apr. 22, 2010**

(65) **Prior Publication Data**

US 2010/0271282 A1 Oct. 28, 2010

(30) **Foreign Application Priority Data**

Apr. 22, 2009 (KR) 10-2009-0035085

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

(52) **U.S. Cl.** **343/873**

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

See application file for complete search history.

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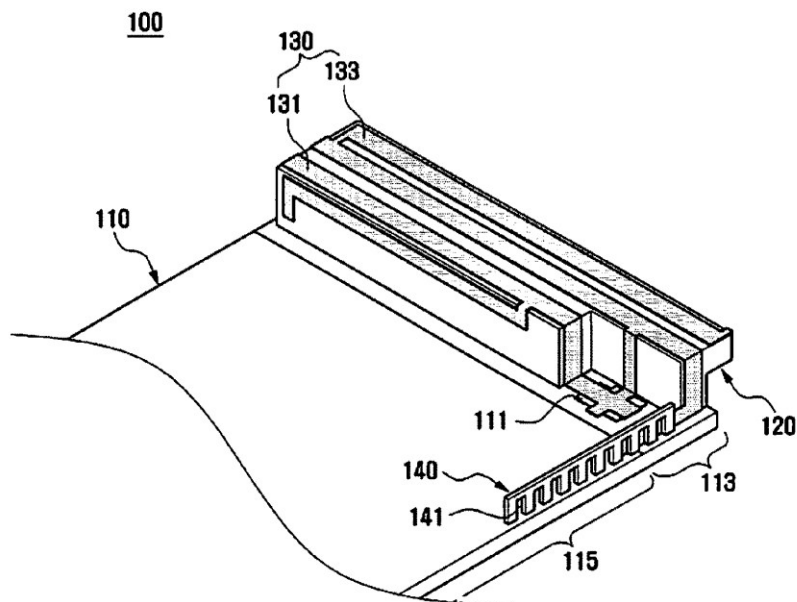
Primary Examiner — Huedung Mancuso

(74) *Attorney, Agent, or Firm* — The Farrell Law Firm, P.C.

(57) **ABSTRACT**

An embedded antenna apparatus of a communication terminal is provided. The antenna apparatus includes a plate board having a feeding pad disposed on a side of the board; a device carrier mounted on a side of the board to expose the feeding pad; a radiation device including at least two radiation lines extending from the feeding pad to a surface of the device carrier along different paths, the at least two radiation lines radiating at a preset frequency band when electric power is fed through the feeding pad; and a ground plate having a flat plate shape mounted in an edge of the side of the board and disposed perpendicular to the side of the board, and contacting one end each of the at least two radiation lines to ground the radiation device.

10 Claims, 11 Drawing Sheets



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US008368613B2

(12) **United States Patent**
Hornung

(10) **Patent No.:** **US 8,368,613 B2**

(45) **Date of Patent:** **Feb. 5, 2013**

(54) **WIRELESS COMMUNICATION SYSTEM**

(56) **References Cited**

(75) Inventor: **Craig Warren Hornung**, Harrisburg, PA (US)

U.S. PATENT DOCUMENTS

(73) Assignee: **Tyco Electronics Corporation**, Berwyn, PA (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 457 days.

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Primary Examiner — Dieu H Duong

(21) Appl. No.: **12/776,790**

(57) **ABSTRACT**

(22) Filed: **May 10, 2010**

An antenna includes a flexible film substrate having a signal element and a ground element. A signal contact is mounted to the flexible film substrate. The signal contact is electrically connected to the signal element by a compression connection and the signal contact includes a wire termination configured to be terminated to a center conductor of a coaxial cable. A ground contact is mounted to the flexible film substrate. The ground contact is electrically connected to the ground element by a compression connection and includes a wire termination configured to be terminated to a cable braid of the coaxial cable.

(65) **Prior Publication Data**

US 2011/0273339 A1 Nov. 10, 2011

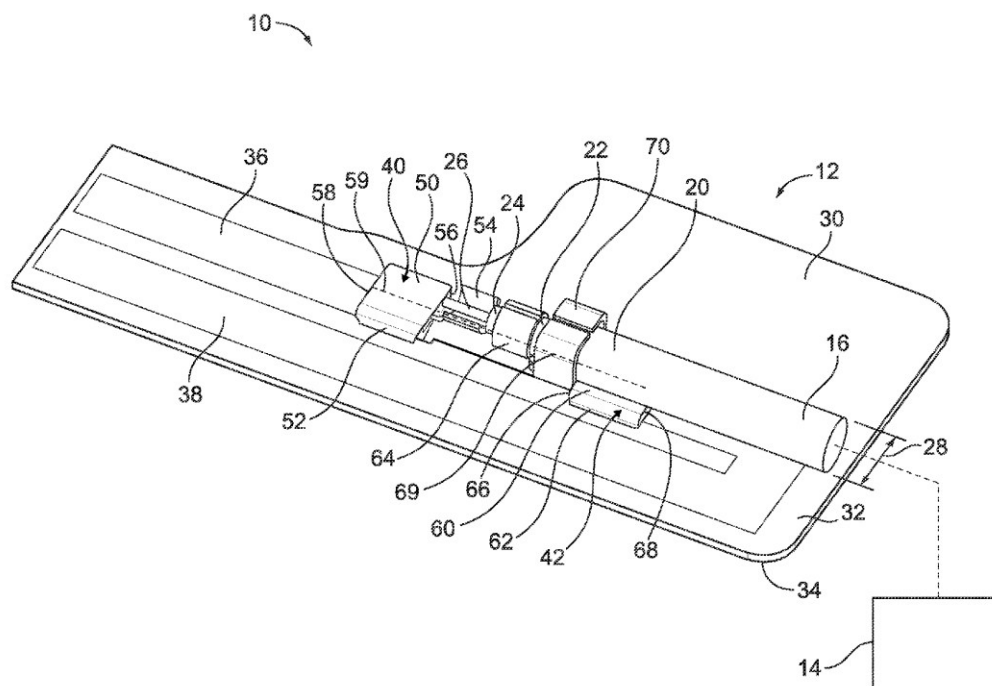
(51) **Int. Cl.**
H01Q 1/50 (2006.01)

(52) **U.S. Cl.** **343/906**; 343/702

(58) **Field of Classification Search** 343/906,
343/702; 439/63, 581, 98

See application file for complete search history.

20 Claims, 5 Drawing Sheets



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US008369796B2

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

(10) **Patent No.:** **US 8,369,796 B2**
(45) **Date of Patent:** **Feb. 5, 2013**

(54) **MULTI-BAND TUNABLE FREQUENCY
RECONFIGURABLE ANTENNAS USING
HIGHER ORDER RESONANCES**

(75) Inventors: **Helen K. Pan**, Portland, OR (US);
Songnan Yang, Knoxville, TN (US);
Debabani Choudhury, Thousand Oaks,
CA (US); **Vijay K. Nair**, Mesa, AZ (US)

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

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 1268 days.

(21) Appl. No.: **11/644,741**

(22) Filed: **Dec. 22, 2006**

(65) **Prior Publication Data**

US 2008/0150830 A1 Jun. 26, 2008

(51) **Int. Cl.**
H04B 1/44 (2006.01)

(52) **U.S. Cl.** **455/78**; 455/575.7; 455/552.1;
455/82; 455/121; 455/115.1; 455/123; 455/226.1;
455/101; 455/277.2; 455/83; 343/702; 343/876;
343/846; 343/810; 343/818

(58) **Field of Classification Search** 455/78,
455/575.7, 552.1, 82, 83, 121, 115.1, 123,
455/226.1, 101, 277.2; 343/876, 702, 700,
343/846, 810, 818

See application file for complete search history.

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date Feb. 14, 2012, 4 pages.

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Primary Examiner — Matthew Anderson

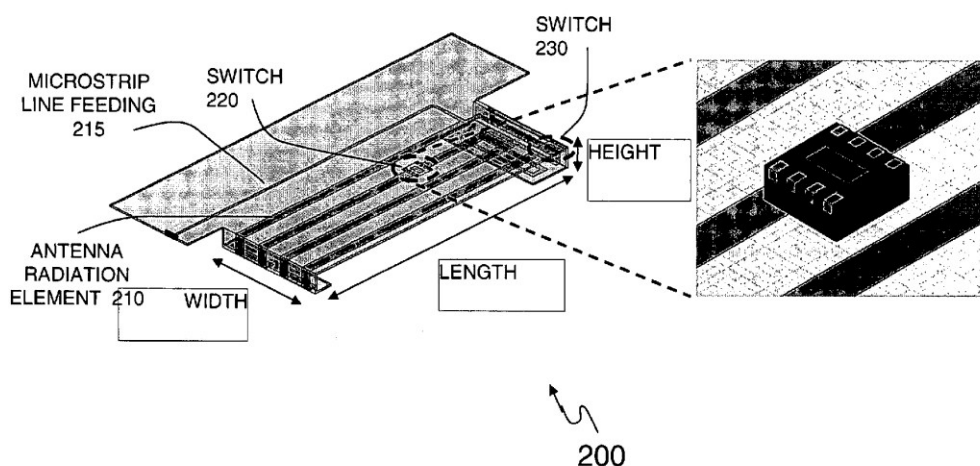
Assistant Examiner — Ganiyu A Hanidu

(74) *Attorney, Agent, or Firm* — Kacvinsky Daisak PLLC

(57) **ABSTRACT**

A wireless device using natural higher order harmonics on
multi-band reconfigurable antenna designs where the antenna
higher order resonance is used to build a multi-band to multi-
band frequency reconfigurable antenna.

14 Claims, 8 Drawing Sheets



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US008373597B2

(12) **United States Patent**
Schadler

(10) **Patent No.:** **US 8,373,597 B2**
(45) **Date of Patent:** **Feb. 12, 2013**

(54) **HIGH-POWER-CAPABLE CIRCULARLY
POLARIZED PATCH ANTENNA APPARATUS
AND METHOD**

(75) Inventor: **John L. Schadler**, Raymond, ME (US)

(73) Assignee: **SPX Corporation**, Charlotte, NC (US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 938 days.

(21) Appl. No.: **11/882,383**

(22) Filed: **Aug. 1, 2007**

(65) **Prior Publication Data**
US 2008/0036665 A1 Feb. 14, 2008

Related U.S. Application Data

(60) Provisional application No. 60/836,398, filed on Aug.
9, 2006.

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 19/00 (2006.01)

(52) **U.S. Cl.** **343/700 MS; 343/833**

(58) **Field of Classification Search** **343/700 MS,**
343/846, 833, 834, 835, 829, 830, 826, 844
See application file for complete search history.

(56) **References Cited**

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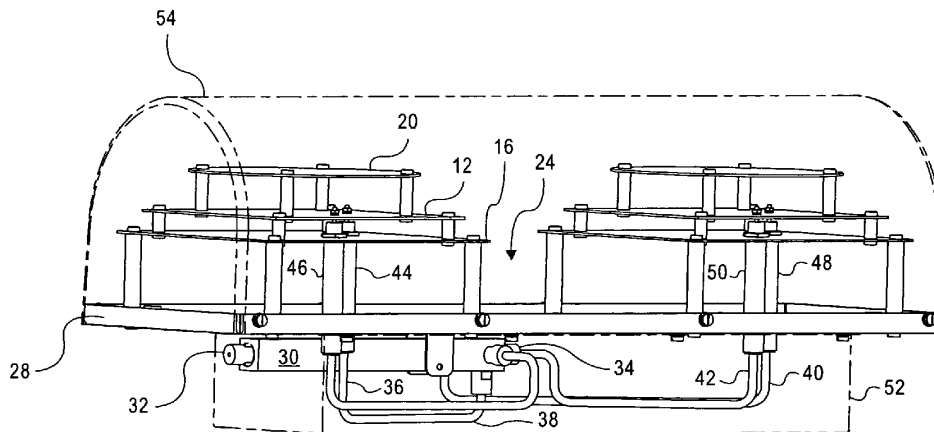
Primary Examiner — Robert Karacsony

(74) *Attorney, Agent, or Firm* — Baker & Hostetler, LLP

(57) **ABSTRACT**

A circularly polarized patch antenna uses a square quarter-wavelength conductive plate, spaced away from a slightly larger backing conductor. Excitation uses a coaxial feed stem pair, whereof respective inner conductors join the patch at orthogonal locations on a reference circle, and outer conductors intrude past points of joining to the backing conductor to establish gaps that interact with patch and backing conductor size and spacing to jointly establish terminal impedance. A parasitic element in the propagation path broadens bandwidth, while a frame behind serves to define a cavity reflector. A power divider behind the frame converts a single applied broadcast signal into two equal signals with orthogonal phase, which signals are delivered to the feed stems with equal-length coaxial lines.

11 Claims, 8 Drawing Sheets



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US008373598B2

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

(10) **Patent No.:** **US 8,373,598 B2**

(45) **Date of Patent:** **Feb. 12, 2013**

(54) **ANTENNA DEVICE AND DUAL-BAND ANTENNA**

(56) **References Cited**

(75) Inventors: **Tiao-Hsing Tsai**, Yunghe (TW);
Chieh-Ping Chiu, Erlun Township,
Yunlin County (TW); **I-Ping Yen**,
Yonghe (TW); **Feng-Jen Weng**, Tao
Yuan Shien (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 448 days.

(21) Appl. No.: **12/709,785**

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

(65) **Prior Publication Data**

US 2011/0084889 A1 Apr. 14, 2011

(30) **Foreign Application Priority Data**

Oct. 8, 2009 (TW) 98134112 A

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

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

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

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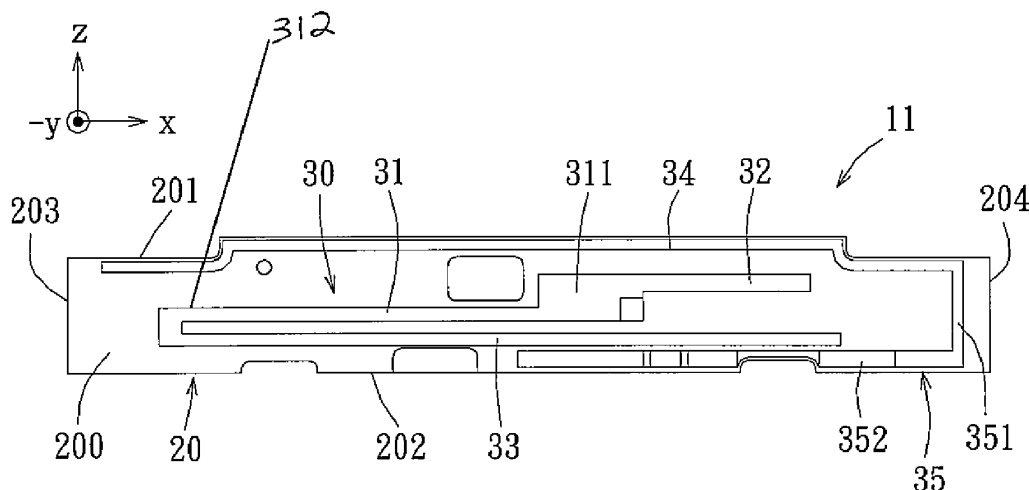
Primary Examiner — Trinh Dinh

(74) *Attorney, Agent, or Firm* — Berenato & White, LLC

(57) **ABSTRACT**

An antenna device includes a substrate, and a dual-band antenna disposed on a surface of the substrate. The dual-band antenna includes a feed-in section, a first radiator arm, a second radiator arm, a third radiator arm, and a ground section. The feed-in section is for signal feed-in, and has opposite first and second ends. The first radiator arm extends from the first end of the feed-in section and is parallel to the feed-in section. The second radiator arm is connected to the second end of the feed-in section and extends parallel to the feed-in section. The third radiator arm is disposed adjacent to and extends parallel to the first radiator arm in a manner that the feed-in section is disposed between the third radiator arm and the second radiator arm. The ground section is connected to the third radiator arm.

13 Claims, 8 Drawing Sheets



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US008373599B2

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

(10) **Patent No.:** **US 8,373,599 B2**

(45) **Date of Patent:** **Feb. 12, 2013**

(54) **ANTENNA MODULE, WIRELESS COMMUNICATION DEVICE USING THE ANTENNA MODULE AND METHOD FOR ADJUSTING A PERFORMANCE FACTOR OF THE ANTENNA MODULE**

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

(58) **Field of Classification Search** **343/700 MS, 343/702, 893**

See application file for complete search history.

(75) Inventors: **Shih-Chieh Lin**, Taoyuan (TW);
Chin-Hung Ma, Taoyuan (TW)

(56) **References Cited**

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(73) Assignee: **FIH (Hong Kong) Limited**, Kowloon (HK)

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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 408 days.

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(21) Appl. No.: **12/788,436**

Primary Examiner — Don Le

(22) Filed: **May 27, 2010**

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

(65) **Prior Publication Data**

US 2011/0156964 A1 Jun. 30, 2011

(57) **ABSTRACT**

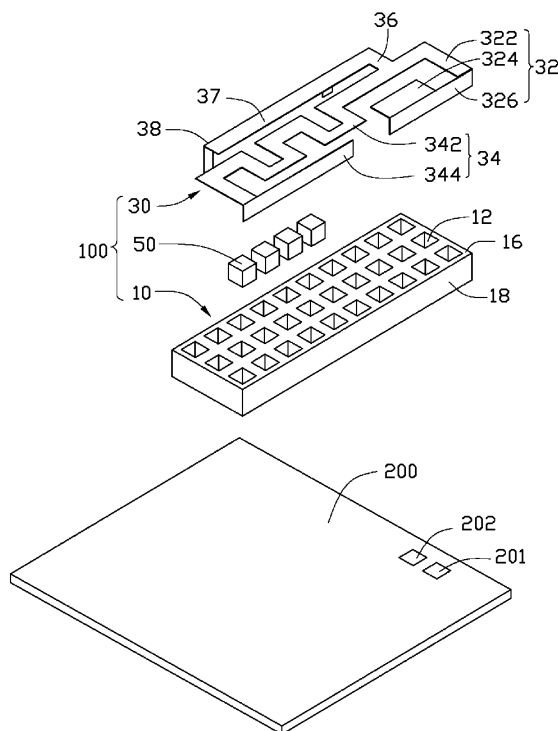
(30) **Foreign Application Priority Data**

Dec. 30, 2009 (TW) 98146032 A

An antenna module includes an antenna, a substrate defining a plurality of notches, and a plurality of filling blocks. The antenna is attached to the substrate. The filling blocks have a permittivity higher than the substrate and are received in a portion of the notches covered by the antenna to raise the permittivity of the substrate.

(51) **Int. Cl.**
H01Q 5/00 (2006.01)

19 Claims, 8 Drawing Sheets



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US008373600B2

(12) **United States Patent**
Chang

(10) **Patent No.:** **US 8,373,600 B2**

(45) **Date of Patent:** **Feb. 12, 2013**

(54) **SINGLE-BAND ANTENNA**

(75) Inventor: **Jin-Su Chang**, Hsinchu County (TW)

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

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 344 days.

(21) Appl. No.: **12/896,208**

(22) Filed: **Oct. 1, 2010**

(65) **Prior Publication Data**

US 2011/0080324 A1 Apr. 7, 2011

(30) **Foreign Application Priority Data**

Oct. 2, 2009 (TW) 98133580 A

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

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

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

(56) **References Cited**

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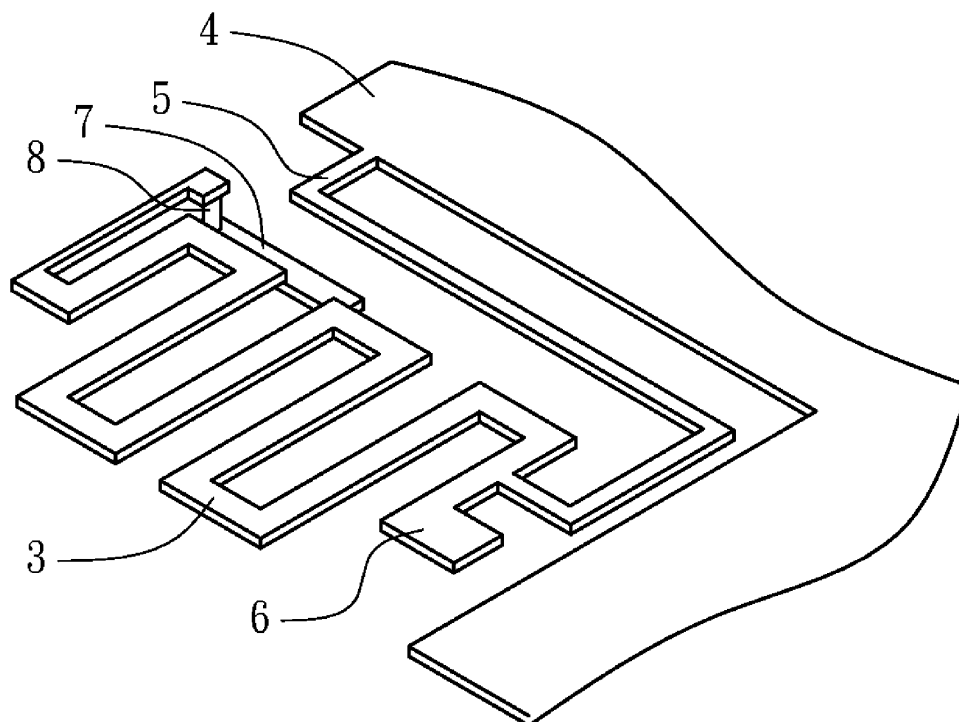
Primary Examiner — Trinh Dinh

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

(57) **ABSTRACT**

A single-band antenna, comprising: a substrate; a first radiation unit; a conductive material; an impedance matching circuit; a signal feed-in terminal; a second radiation unit; and a wire connecting unit. Therefore, the single-band antenna can be miniaturized to be installed with or inside a compact wireless transmission device with enhanced transceiving performance.

13 Claims, 10 Drawing Sheets



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US008373601B2

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

(10) **Patent No.:** **US 8,373,601 B2**

(45) **Date of Patent:** **Feb. 12, 2013**

(54) **MULTI-BAND ANTENNA**

(75) Inventors: **Chao-Hsu Wu**, Luzhu Township (TW);
Chi-Yin Fang, Pingtung (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 335 days.

(21) Appl. No.: **12/939,066**

(22) Filed: **Nov. 3, 2010**

(65) **Prior Publication Data**
US 2011/0316760 A1 Dec. 29, 2011

(30) **Foreign Application Priority Data**
Jun. 23, 2010 (TW) 99120422 A

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 1/24 (2006.01)
(52) **U.S. Cl.** **343/700 MS; 343/702**
(58) **Field of Classification Search** **343/700 MS, 343/702**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

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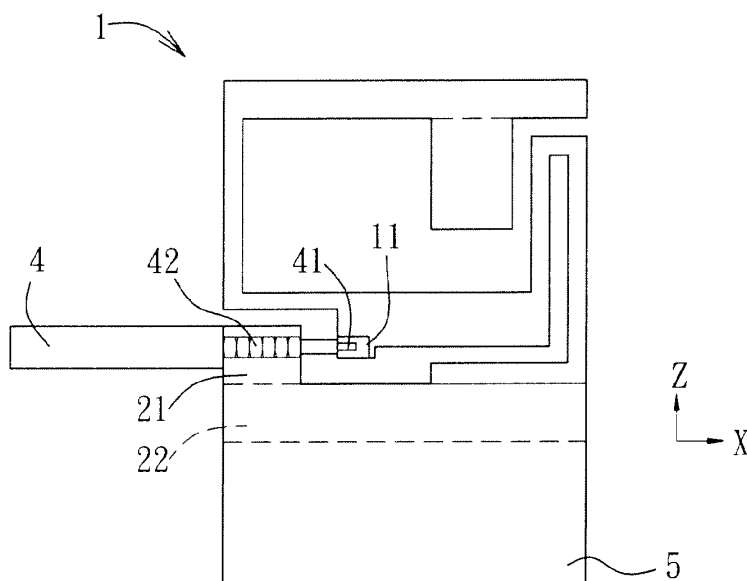
Primary Examiner — Hoang V Nguyen

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

(57) **ABSTRACT**

A multi-band antenna includes a connecting conductor, first and second conducting arms, and a loop conductor. The connecting conductor has a feed-in end and a connecting end. The first conducting arm is connected to the connecting end of the connecting conductor. The second connecting arm is connected to the connecting end of the connecting conductor and is substantially perpendicular to the first connecting arm. The loop conductor has first and second radiator sections, each adjacent and substantially parallel to a respective one of the first and second conducting arms. The loop conductor forms a substantially L-shaped gap with the first and second conducting arms, further has a grounding end adjacent to the feed-in end, and extends from the grounding end to the feed-in end.

12 Claims, 5 Drawing Sheets



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US008373602B2

(12) **United States Patent**
Hsu

(10) **Patent No.:** **US 8,373,602 B2**

(45) **Date of Patent:** **Feb. 12, 2013**

(54) **ANTENNA AND PORTABLE WIRELESS COMMUNICATION DEVICE USING THE SAME**

(58) **Field of Classification Search** 343/700 MS,
343/702, 793, 795, 846
See application file for complete search history.

(75) Inventor: **Cho-Kang Hsu**, Taipei (TW)

(56) **References Cited**

(73) Assignee: **Chi Mei Communication Systems, Inc.**, Tu-Cheng, New Taipei (TW)

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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 468 days.

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* cited by examiner

(21) Appl. No.: **12/617,358**

Primary Examiner — Robert Karacsony

(22) Filed: **Nov. 12, 2009**

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

(65) **Prior Publication Data**

US 2010/0328165 A1 Dec. 30, 2010

(30) **Foreign Application Priority Data**

Jun. 25, 2009 (CN) 2009 1 0303679

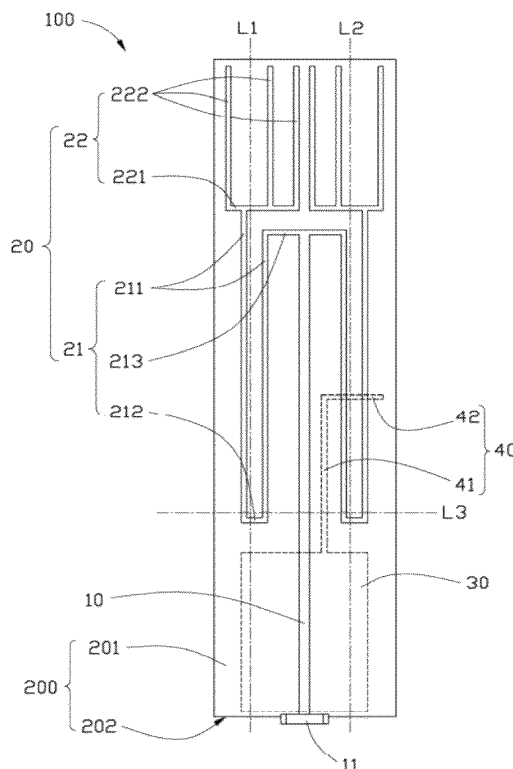
(57) **ABSTRACT**

An antenna mounted on a baseboard including a first surface and a second surface opposite to the first surface includes a feed portion, two radiating portions, a ground portion and a coupling portion. The feed portion and the two radiating portions are disposed on the first surface, and the two radiating portions are connected to the feed portion. The ground portion and the coupling portion are disposed on the second surface, and the coupling portion is connected to the ground portion. The coupling portion passes through the baseboard and couples with two radiating portions.

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

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

11 Claims, 4 Drawing Sheets



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US008373603B2

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

(10) **Patent No.:** **US 8,373,603 B2**
(45) **Date of Patent:** **Feb. 12, 2013**

(54) **DUAL FEED ANTENNA**

(75) Inventors: **Mark T. Montgomery**, Melbourne
Beach, FL (US); **Paul A. Tornatta**,
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 653 days.

(21) Appl. No.: **12/644,718**

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

(65) **Prior Publication Data**

US 2010/0156726 A1 Jun. 24, 2010

Related U.S. Application Data

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

(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, 895

See application file for complete search history.

(56) **References Cited**

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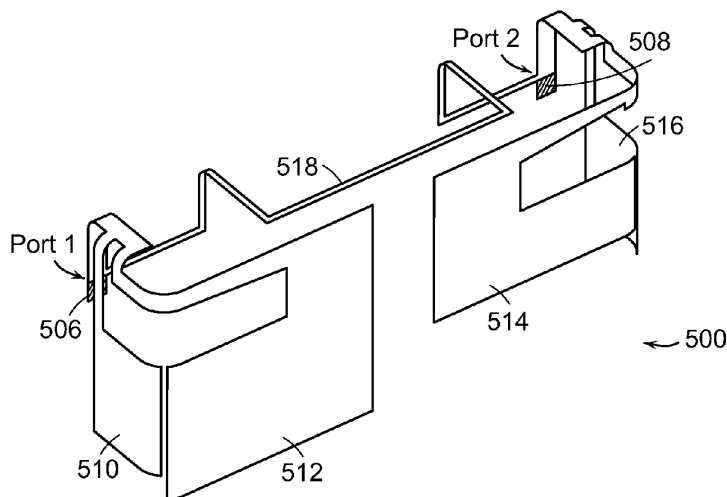
Primary Examiner — Tan Ho

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

(57) **ABSTRACT**

A multi-port antenna structure for a wireless-enabled com-
munications device includes a coupler-antenna having a first
antenna port for transmitting electromagnetic signals and a
second antenna port for receiving electromagnetic signals.
The coupler-antenna is positioned on a chassis of the wireless
enabled communications device to transmit energy between
the chassis and the first and second antenna ports. Resonant
modes of the chassis for one antenna port are orthogonal to
resonant modes of the chassis for the other antenna port, such
that the first and second antenna ports are isolated from each
other.

20 Claims, 10 Drawing Sheets



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US008373604B2

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

(10) **Patent No.:** **US 8,373,604 B2**
(45) **Date of Patent:** **Feb. 12, 2013**

(54) **MULTIBAND MOBILE COMMUNICATION
DEVICE AND ANTENNA THEREOF**

(75) Inventors: **Kin-Lu Wong**, Taipei Hsien (TW);
Wei-Yu Chen, Taipei Hsien (TW)

(73) Assignee: **Acer Inc.**, Taipei Hsien (TW)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 390 days.

(21) Appl. No.: **12/648,341**

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

(65) **Prior Publication Data**

US 2011/0095949 A1 Apr. 28, 2011

(30) **Foreign Application Priority Data**

Oct. 26, 2009 (TW) 98136192 A

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

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

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

See application file for complete search history.

(56) **References Cited**

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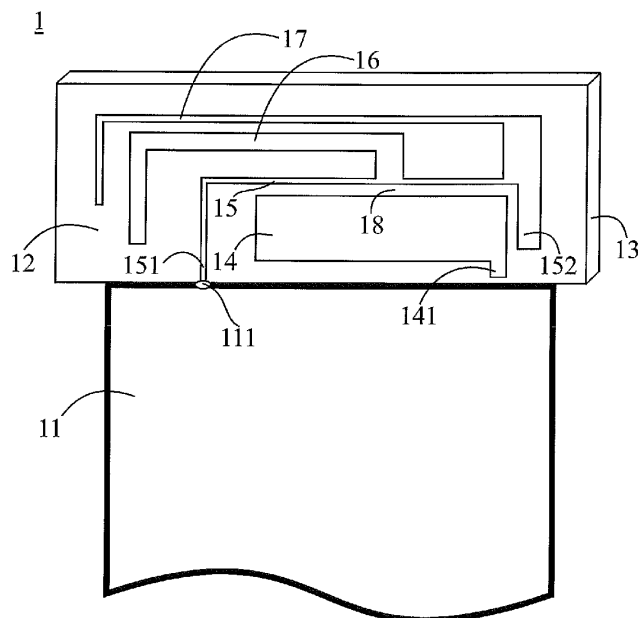
Primary Examiner — Robert Karacsony

(74) *Attorney, Agent, or Firm* — Alan Kamrath; Kamrath IP
Lawfirm, PA

(57) **ABSTRACT**

A multiband mobile communication device has a ground plane and an antenna. The antenna is disposed on a dielectric substrate. The antenna includes a monopole, a shorted radiating portion, a first radiating branch, and a second radiating branch. The monopole includes a feeding end, and the feeding end is the feeding point of the antenna. The shorted radiating portion has a shorting end electrically connected to the ground plane, and its other end is left open. The shorted radiating portion is extended along the monopole and has a coupling gap to the monopole. The first radiating branch has an end electrically connected to the shorted radiating portion, and its other end is left open. The first radiating branch is extended toward the shorting end of the shorted radiating portion and located on the opposite side of the monopole. The second radiating branch has an end electrically connected to the shorted radiating portion, and its other end is left open. The second radiating branch is extended along the first radiating branch, with the first radiating branch located between the second radiating branch and the shorted radiating portion.

9 Claims, 5 Drawing Sheets



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US008373606B2

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

(10) **Patent No.:** **US 8,373,606 B2**
(45) **Date of Patent:** **Feb. 12, 2013**

(54) **SLIM MOBILE COMMUNICATION DEVICE
AND ANTENNA STRUCTURE THEREOF**

(75) Inventors: **Kin-Lu Wong**, Taipei Hsien (TW);
Wei-Yu Chen, Taipei Hsien (TW)

(73) Assignee: **Acer Inc.**, Taipei Hsien (TW)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 455 days.

(21) Appl. No.: **12/789,903**

(22) Filed: **May 28, 2010**

(65) **Prior Publication Data**

US 2011/0215972 A1 Sep. 8, 2011

(30) **Foreign Application Priority Data**

Mar. 5, 2010 (TW) 99106538 A

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

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

(58) **Field of Classification Search** 343/700 MS,
343/702, 829, 846

See application file for complete search history.

(56) **References Cited**

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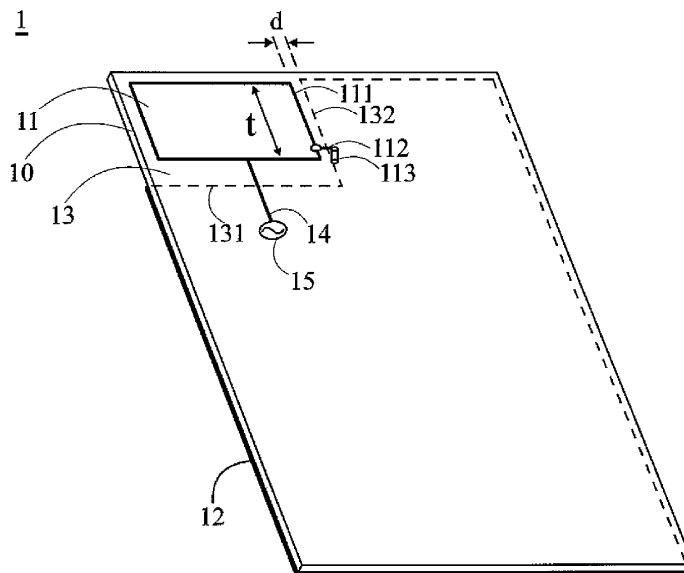
Primary Examiner — Tho G Phan

(74) *Attorney, Agent, or Firm* — Alan Kamrath; Kamrath IP
Lawfirm, P.A.

(57) **ABSTRACT**

A slim mobile communication device includes an antenna structure. The antenna structure includes a dielectric substrate, a ground element, an antenna element, and a feeding line. The antenna element is a planar structure and is disposed on a no-ground portion of the dielectric substrate. At least two edges of the no-ground portion are surrounded by a ground element of the dielectric substrate, wherein one of the edges used as a feeding edge and the other edges are non-feeding edges. A distance between the non-feeding side edge of the antenna element and the second edge of the no-ground portion is smaller than 3 mm. A length of the non-feeding side edge of the antenna element is at least 5 mm. The non-feeding side edge of the antenna element is short-circuited to the ground element. The feeding line is coupled to the feeding side edge of the antenna element.

15 Claims, 4 Drawing Sheets



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US008373607B2

(12) **United States Patent**
Chiang

(10) **Patent No.:** **US 8,373,607 B2**

(45) **Date of Patent:** **Feb. 12, 2013**

(54) **TUNABLE ANTENNA STRUCTURE HAVING
A VARIABLE CAPACITOR**

(75) Inventor: **Chi-Ming Chiang**, Bade (TW)

(73) Assignee: **Auden Techno Corp.**, Taoyuan County
(TW)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 371 days.

(21) Appl. No.: **12/856,070**

(22) Filed: **Aug. 13, 2010**

(65) **Prior Publication Data**

US 2012/0038528 A1 Feb. 16, 2012

(51) **Int. Cl.**

H01Q 9/04 (2006.01)

H01Q 1/38 (2006.01)

(52) **U.S. Cl.** **343/745**; 343/700 MS; 343/860

(58) **Field of Classification Search** 343/745,

343/860, 846, 702, 828, 829, 831, 700 MS

See application file for complete search history.

(56) **References Cited**

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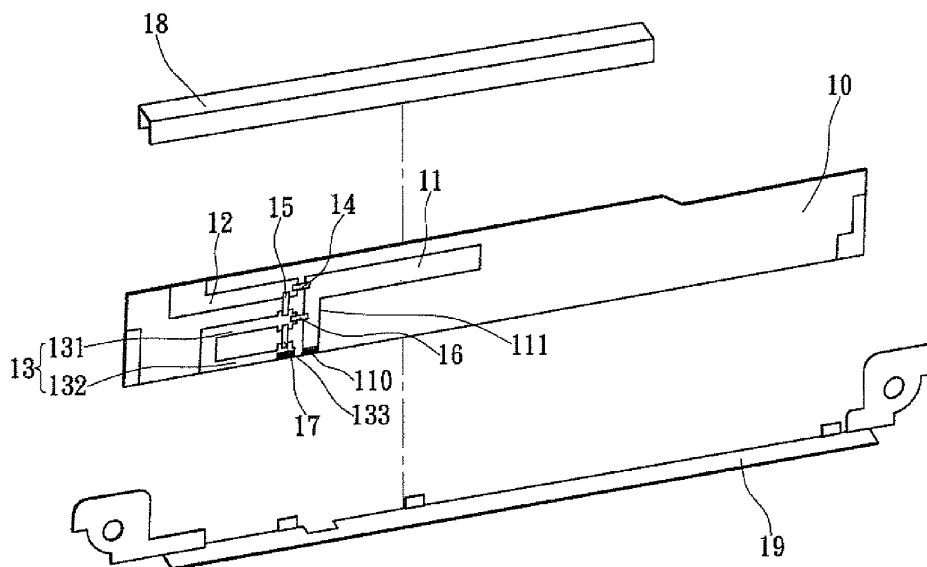
Primary Examiner — Daniel D Chang

(74) *Attorney, Agent, or Firm* — Houtteman Law LLC

(57) **ABSTRACT**

A tunable antenna structure having a variable capacitor includes a substrate, a first metal strip, a second metal strip and a third metal strip formed on the substrate, a variable capacitor element located between the first metal strip and the second metal strip, an inductor element located between the second metal strip and the third metal strip, a first capacitor element located between the first metal strip and the third metal strip, and a second capacitor element located on the third metal strip.

10 Claims, 3 Drawing Sheets



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US008373610B2

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

(10) **Patent No.:** **US 8,373,610 B2**
(45) **Date of Patent:** **Feb. 12, 2013**

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

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

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 930 days.

(21) Appl. No.: **11/958,988**

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

(65) **Prior Publication Data**

US 2009/0153409 A1 Jun. 18, 2009

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

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

(58) **Field of Classification Search** **343/767, 343/770, 771**

See application file for complete search history.

(56) **References Cited**

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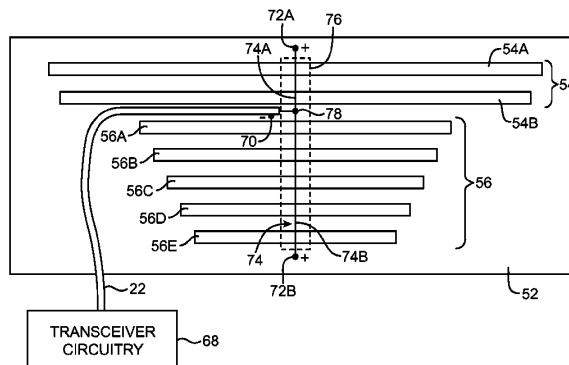
Primary Examiner — Robert Karacsony

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

(57) **ABSTRACT**

Microslot antennas may be provided for electronic devices such as portable electronic devices. The microslot antennas may have dielectric-filled microslots that are formed in a ground plane element. The ground plane element may be formed from part of a conductive device housing. The microslots may be narrow enough that they are not readily noticeable to the naked eye. The microslots may have lengths that allow the microslot antenna to provide antenna coverage in one or more communications bands. A first group of the microslots may be used to provide coverage in a first communications band and a second group of the microslots may be used to provide coverage in a second communications band.

18 Claims, 8 Drawing Sheets



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US008378892B2

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

(10) **Patent No.:** **US 8,378,892 B2**
(45) **Date of Patent:** **Feb. 19, 2013**

(54) **ANTENNA COMPONENT AND METHODS**

(75) Inventors: **Juha Sorvala**, Oulu (FI); **Petteri Annamaa**, Oulunsalo (FI); **Kimmo Koskiniemi**, 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 909 days.

(21) Appl. No.: **11/901,611**

(22) Filed: **Sep. 17, 2007**

(65) **Prior Publication Data**

US 2008/0088511 A1 Apr. 17, 2008

Related U.S. Application Data

(63) Continuation of application No. PCT/FI2005/050401, filed on Nov. 8, 2005.

(30) **Foreign Application Priority Data**

Mar. 16, 2005 (WO) PCT/FI2005/050089
Jun. 28, 2005 (WO) PCT/FI2005/050247

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

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

(58) **Field of Classification Search** 343/700 MS,
343/702, 833, 907, 908
See application file for complete search history.

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Primary Examiner — Jacob Y Choi

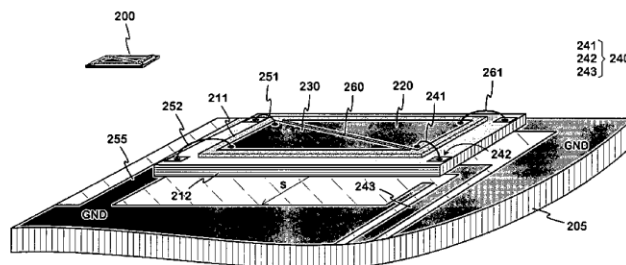
Assistant Examiner — Robert Karacsony

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

(57) **ABSTRACT**

An antenna component (200) with a dielectric substrate and two radiating antenna elements. The elements are located on the upper surface of the substrate and there is a narrow slot (260) between them. The antenna feed conductor (241) is connected to the first antenna element (220), which is connected also to the ground by a short-circuit conductor (261). The second antenna element (230) is parasitic; it is galvanically connected only to the ground. The component is preferably manufactured by a semiconductor technique by growing a metal layer e.g. on a quartz substrate and removing a part of it so that the antenna elements remain. In this case the component further comprises supporting material (212) of the substrate chip. The antenna component is very small-sized because of the high dielectricity of the substrate to be used and mostly because the slot between the antenna elements is narrow. The efficiency of an antenna made by the component is high.

24 Claims, 5 Drawing Sheets



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US008378894B2

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

(10) **Patent No.:** **US 8,378,894 B2**

(45) **Date of Patent:** **Feb. 19, 2013**

(54) **ANTENNA DEVICE**

(75) Inventors: **Masato Kikuchi**, Tokyo (JP); **Shunsuke Mochizuki**, Tokyo (JP); **Masahiro Yoshioka**, Tokyo (JP); **Ryosuke Araki**, Tokyo (JP); **Masaki Handa**, Tokyo (JP); **Takashi Nakanishi**, Tokyo (JP); **Hiroto Kimura**, Tokyo (JP); **Seiji Wada**, Kanagawa (JP); **Hiroshi Ichiki**, Kanagawa (JP); **Tetsujiro Kondo**, Tokyo (JP)

(73) Assignee: **Sony 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 363 days.

(21) Appl. No.: **12/273,038**

(22) Filed: **Nov. 18, 2008**

(65) **Prior Publication Data**

US 2009/0153405 A1 Jun. 18, 2009

(30) **Foreign Application Priority Data**

Dec. 18, 2007 (JP) 2007-326392

(51) **Int. Cl.**

H01Q 1/38 (2006.01)

H01Q 5/00 (2006.01)

H01Q 9/04 (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

See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Jacob Y Choi

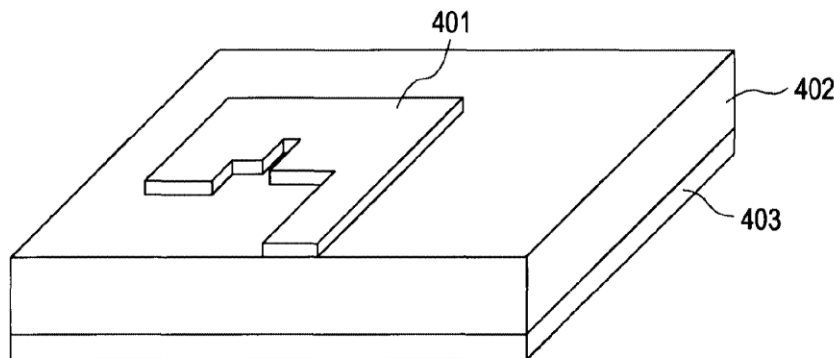
Assistant Examiner — Graham Smith

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

(57) **ABSTRACT**

A planar antenna device includes a dielectric layer and two conductor layers vertically sandwiching the dielectric layer. The lower conductor layer is used as a ground, and the upper conductor layer forms a radiating element having a structure in which four or more radiating element pieces of different sizes are connected to a feeder line.

6 Claims, 14 Drawing Sheets



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US008378896B2

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

(10) **Patent No.:** **US 8,378,896 B2**

(45) **Date of Patent:** **Feb. 19, 2013**

(54) **WIDE BAND ANTENNA**

(75) Inventors: **Chih-Yuan Yang**, Taipei Hsien (TW);
Shih-Yen Peng, Taipei Hsien (TW);
Chien-Tang Lin, Taipei Hsien (TW);
Hung-Chang Ko, Taipei Hsien (TW)

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

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 335 days.

(21) Appl. No.: **12/841,185**

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

(65) **Prior Publication Data**

US 2011/0156961 A1 Jun. 30, 2011

(30) **Foreign Application Priority Data**

Dec. 25, 2009 (CN) 2009 1 0312285

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

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

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

See application file for complete search history.

(56) **References Cited**

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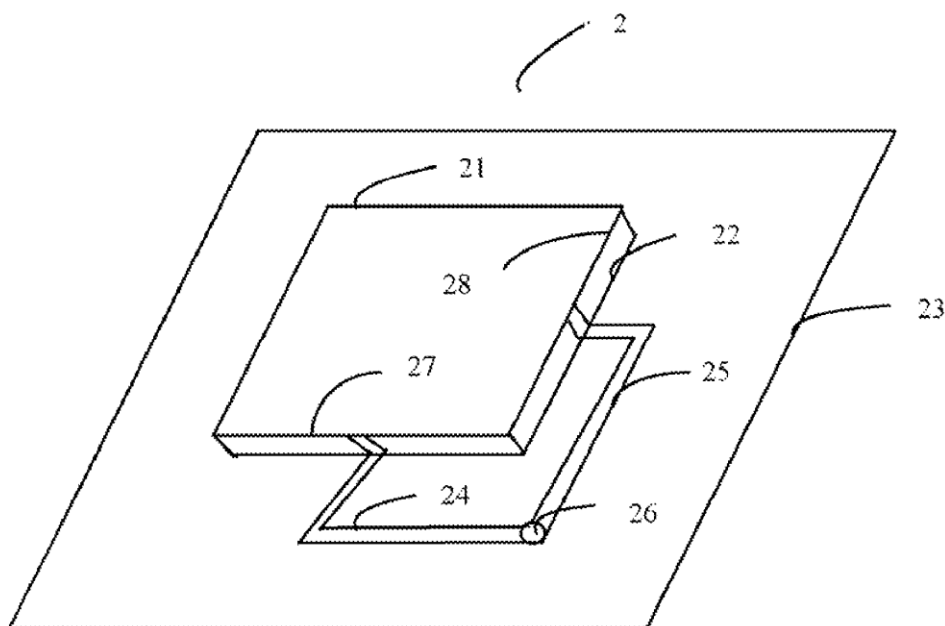
Primary Examiner — Hoang V Nguyen

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

(57) **ABSTRACT**

A wide band antenna includes a radiation element, a ground surface, a dielectric element, a connector; a first microstrip feeder and a second microstrip feeder. The radiation element is a rectangle shaped and includes a first side and a second side. The lengths of the first side and the second side are not equal. The dielectric element is positioned between the radiation element and the ground surface. One end of the first microstrip feeder is connected to the first side of the radiation element. One end of the second microstrip feeder is connected to the second side of the radiation element, the other ends of the first and second microstrip feeder are connected to the connector.

4 Claims, 4 Drawing Sheets



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US008378897B2

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

(10) **Patent No.:** **US 8,378,897 B2**
(45) **Date of Patent:** **Feb. 19, 2013**

(54) **PLANAR MULTI-BAND ANTENNA**

(75) Inventors: **Ming-Iu Lai**, Taipei (TW);
Chun-Hsiung Wang, Taipei (TW)

(73) Assignee: **Asustek Computer Inc.**, Taipei (TW)

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

(21) Appl. No.: **12/908,491**

(22) Filed: **Oct. 20, 2010**

(65) **Prior Publication Data**

US 2011/0095952 A1 Apr. 28, 2011

(30) **Foreign Application Priority Data**

Oct. 26, 2009 (TW) 98136236 A

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

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

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

See application file for complete search history.

(56) **References Cited**

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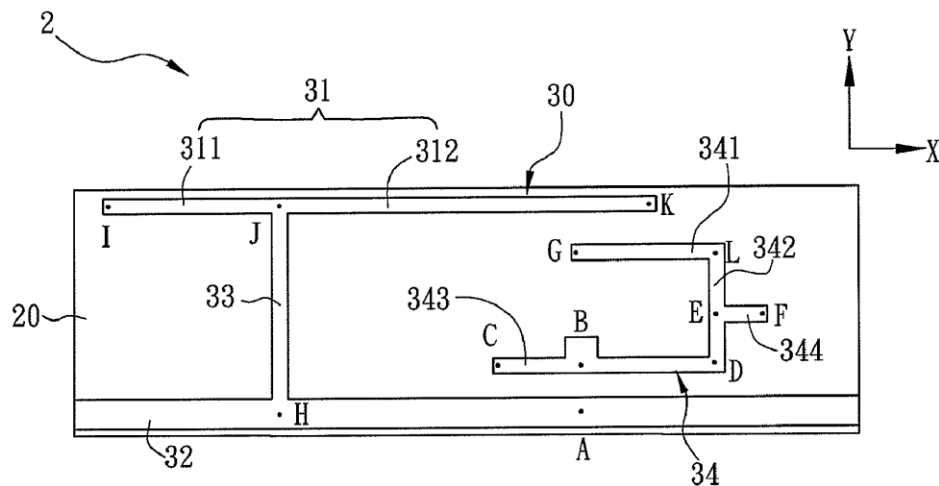
Primary Examiner — Hoanganh Le

(74) *Attorney, Agent, or Firm* — Muncy, Geissler, Olds & Lowe, PLLC

(57) **ABSTRACT**

A planar multi-band antenna includes a substrate and a metal pattern. The metal pattern includes a first metal wire, a second metal wire, a third metal wire and a fourth metal wire. The second metal wire is disposed opposite to the first metal wire and has a grounding point. Two ends of the third metal wire are connected to the first metal wire and second metal wire, respectively, and the first metal wire is divided into a first radiation portion and a second radiation portion. The fourth metal wire is partially located between the second radiation portion and the second metal wire and forms multiple bends, and has a first impedance matching portion and a feed point, and part of the fourth metal wire coincides with the second radiation portion in a projection direction. By the activation of the feeding point and the grounding point associates with the impedance matching portion, the antenna has plural bands.

16 Claims, 6 Drawing Sheets



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US008378899B2

(12) **United States Patent**
Galeev

(10) **Patent No.:** **US 8,378,899 B2**
(45) **Date of Patent:** **Feb. 19, 2013**

(54) **WIRELESS COMMUNICATION TERMINAL
WITH A MULTI-BAND ANTENNA THAT
EXTENDS BETWEEN SIDE SURFACES
THEREOF**

(75) Inventor: **Roustem Galeev**, Lund (SE)

(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 623 days.

(21) Appl. No.: **12/613,843**

(22) Filed: **Nov. 6, 2009**

(65) **Prior Publication Data**
US 2011/0109514 A1 May 12, 2011

(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,
343/872, 873

See application file for complete search history.

(56) **References Cited**

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Declaration; International Search Report; Written Opinion of the
International Searching Authority corresponding to International
Application No. PCT/IB2010/002583; Date of Mailing: Dec. 30,
2010; 12 pages.

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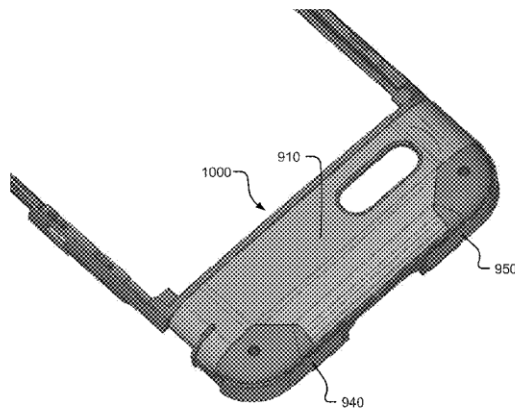
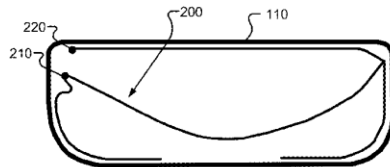
Primary Examiner — Robert Karacsony

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

(57) **ABSTRACT**

A wireless communications terminal can include a housing
having an interior surface that is configured to enclose at least
a controller circuit, a transceiver circuit, and a RF feed circuit
and to at least partially enclose a display device and a user
input interface. The housing extends between opposing top
and bottom surfaces, between opposing first and second side
surfaces, and between opposing front and back surfaces. A
first radiator line is connected on distal ends to a feed node
and to a ground node and extends in a loop across at least a
majority of a width of the housing between the first and
second side surfaces. The first radiator line resonates in a first
frequency range responsive to first electromagnetic radiation
coupled to the feed and ground nodes. A second radiator line
is connected to the feed node and extends away from an
adjacent portion of the first radiator line, and resonates in a
second frequency range responsive to second electromagnetic
radiation coupled to the feed and ground nodes. A third
radiator line is connected to the first radiator line at a branch
node that is spaced apart from the feed node and the ground
node, and extends away from an adjacent portion of the first
radiator line and resonates in a third frequency range respon-
sive to third electromagnetic radiation coupled to the feed and
ground nodes.

16 Claims, 4 Drawing Sheets



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US008378900B2

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

(10) **Patent No.:** **US 8,378,900 B2**
(45) **Date of Patent:** **Feb. 19, 2013**

(54) **ANTENNA ARRANGEMENT**

(75) Inventors: **Lassi Pentti Olavi Hyvönen**, Helsinki (FI); **Jussi Olavi Rahola**, Espoo (FI)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 319 days.

(21) Appl. No.: **12/669,329**

(22) PCT Filed: **Jul. 18, 2007**

(86) PCT No.: **PCT/IB2007/002961**

§ 371 (c)(1),

(2), (4) Date: **Jun. 14, 2010**

(87) PCT Pub. No.: **WO2009/027763**

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

(65) **Prior Publication Data**

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(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 1/48 (2006.01)

H01Q 9/00 (2006.01)

(52) **U.S. Cl.** **343/702**; 343/846; 343/745

(58) **Field of Classification Search** 343/702,
343/700 MS, 846, 745, 749

See application file for complete search history.

(56) **References Cited**

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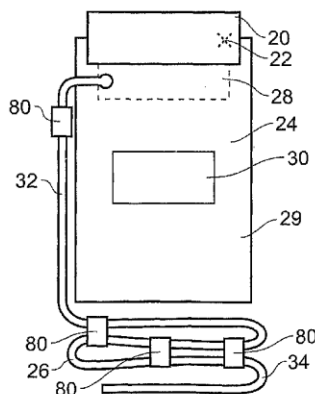
Primary Examiner — Hoang V Nguyen

(74) *Attorney, Agent, or Firm* — Alston & Bird LLP

(57) **ABSTRACT**

An antenna arrangement operable at a first resonant frequency f having a corresponding resonant wavelength λ the antenna arrangement comprising: an antenna comprising a feed; a ground plane coupled to the antenna comprising a first region and a second region; and a grounded conductive structure coupled to the first region of the ground plane, wherein the second region of the ground plane is configured such that, at the first resonant frequency f the current flows predominantly in the grounded conductive structure compared to the second region of the ground plane.

19 Claims, 6 Drawing Sheets



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US008378901B2

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

(10) **Patent No.:** **US 8,378,901 B2**
(45) **Date of Patent:** **Feb. 19, 2013**

(54) **HANDHELD ELECTRONIC DEVICE**

(75) Inventors: **Wei-Yang Wu**, Taoyuan (TW);
Ying-Cong Deng, Taoyuan (TW);
Chung-Ting Hung, Taoyuan (TW);
Kuo-Cheng Chen, Taoyuan (TW)

(73) Assignee: **HTC Corporation**, Taoyuan, Taoyuan
County (TW)

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

(21) Appl. No.: **12/694,432**

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

(65) **Prior Publication Data**

US 2010/0315300 A1 Dec. 16, 2010

(30) **Foreign Application Priority Data**

Jun. 15, 2009 (TW) 98119958 A

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

(52) **U.S. Cl.** **343/702; 343/841**

(58) **Field of Classification Search** **343/702,**
343/741, 846; 381/315, 322

See application file for complete search history.

(56) **References Cited**

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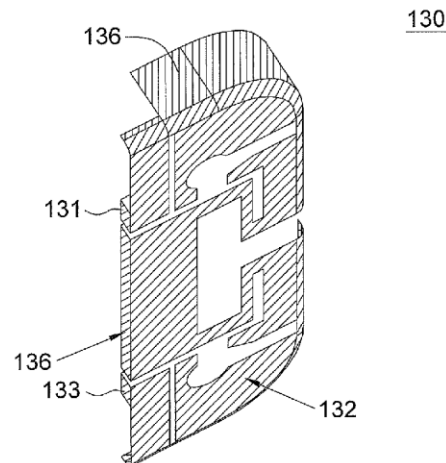
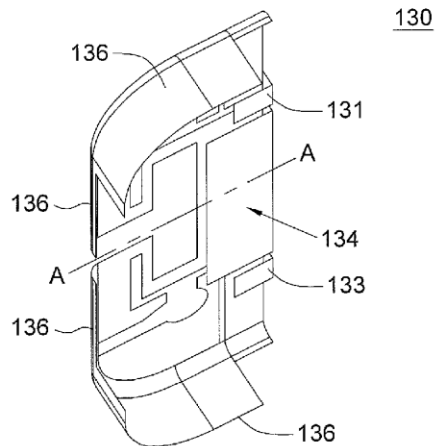
Primary Examiner — Hoanganh Le

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

(57) **ABSTRACT**

A handheld electronic device comprises a housing, a receiver, a balance antenna and a body. The housing comprises a top end and a bottom end. The receiver is located in the housing and near the top end, and the balance antenna is located in the housing and near the bottom end. The body is located in the housing and electrically couples to the receiver and the balance antenna.

8 Claims, 6 Drawing Sheets



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US008378902B2

(12) **United States Patent**
Lee

(10) **Patent No.:** **US 8,378,902 B2**
(45) **Date of Patent:** **Feb. 19, 2013**

(54) **ANTENNA OF PORTABLE ELECTRONIC DEVICES**

(75) Inventor: **Yi-Chieh Lee, 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 499 days.

(21) Appl. No.: **12/696,156**

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

(65) **Prior Publication Data**

US 2011/0001675 A1 Jan. 6, 2011

(30) **Foreign Application Priority Data**

Jul. 1, 2009 (CN) 2009 1 0303906

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

(52) **U.S. Cl.** **343/702; 343/700 MS; 343/729**

(58) **Field of Classification Search** **343/700 MS, 343/702, 725, 729**

See application file for complete search history.

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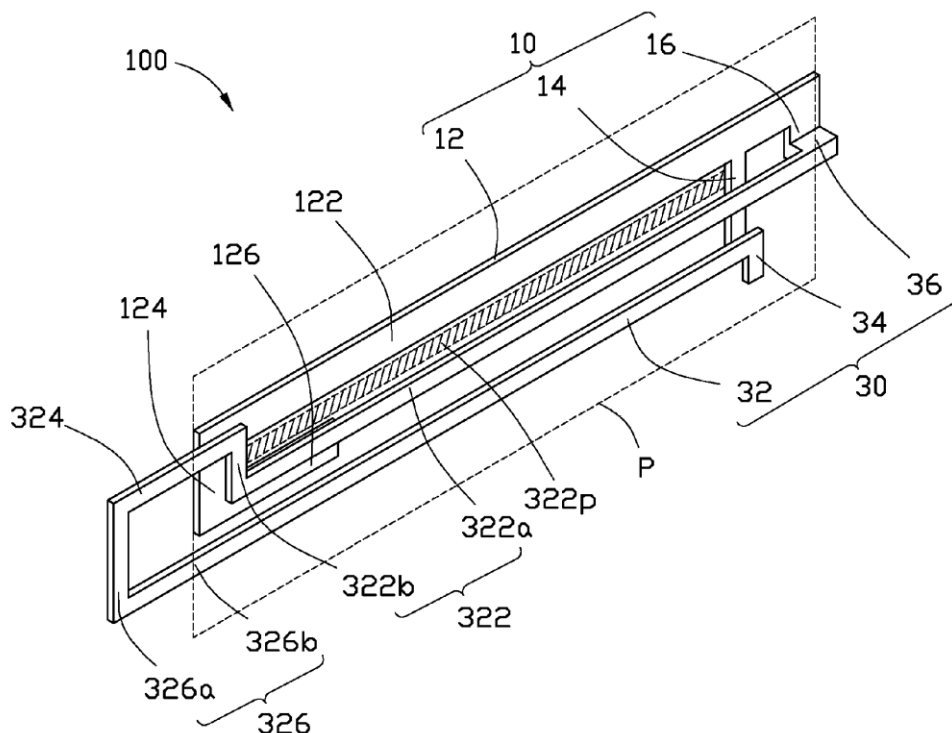
Primary Examiner — Hoanganh Le

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

(57) **ABSTRACT**

An antenna used in portable electronic devices includes a first antenna unit shaped as a planar inverted-F antenna (PIFA) and a second antenna unit shaped as a loop antenna and connected to the first antenna unit. The first antenna unit receives/sends wireless signals at relatively higher frequencies, the second antenna unit receives/sends wireless signals at relatively lower frequencies, and the first antenna unit is coupled with the second antenna unit to regulate the working frequency band of the antenna.

12 Claims, 3 Drawing Sheets



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US008378909B2

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

(10) **Patent No.:** US 8,378,909 B2
(45) **Date of Patent:** Feb. 19, 2013

(54) **ANTENNA AND WIRELESS COMMUNICATION APPARATUS**

(75) Inventors: **Jin Sato**, Beijing (CN); **Yuji Kaminishi**, Ishikawa-gun (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 435 days.

(21) Appl. No.: **12/548,753**

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

(65) **Prior Publication Data**

US 2009/0303140 A1 Dec. 10, 2009

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2008/056467, filed on Apr. 1, 2008.

(30) **Foreign Application Priority Data**

Apr. 5, 2007 (JP) 2007-099579

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 19/00 (2006.01)

(52) **U.S. Cl.** **343/725; 343/702; 343/833**

(58) **Field of Classification Search** **343/700 MS, 343/702, 833, 725**
See application file for complete search history.

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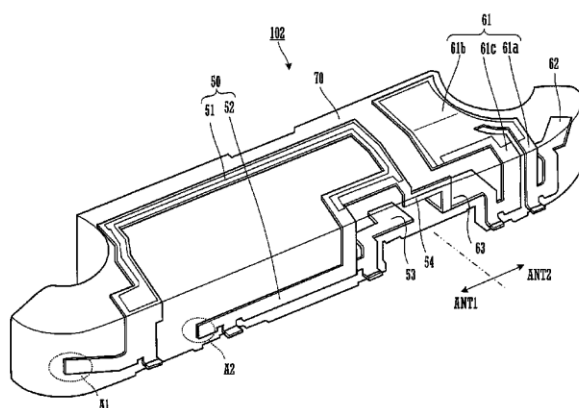
Primary Examiner — Robert Karacsony

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

(57) **ABSTRACT**

In an antenna, a first type radiation electrode and a second type radiation electrode are provided on the surface of a dielectric base, which has a predetermined external shape, or embedded in the dielectric base. The first type radiation electrode is provided with an open terminal at one end thereof and a feeding terminal at the other end thereof so as to constitute a monopole type antenna. The second type radiation electrode is provided with a capacitive-coupling feeding electrode at one end thereof and a ground connection terminal at the other end thereof so as to constitute a capacitive feed antenna. The one end of the first type radiation electrode is located opposite to the feeding electrode of the second type radiation electrode when viewed in the direction of the length of the dielectric base.

7 Claims, 7 Drawing Sheets



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US008378910B2

(12) **United States Patent**
Wolf

(10) **Patent No.:** **US 8,378,910 B2**
(45) **Date of Patent:** **Feb. 19, 2013**

(54) **SLOT ANTENNAS, INCLUDING MEANDER
SLOT ANTENNAS, AND USE OF SAME IN
CURRENT FED AND PHASED ARRAY
CONFIGURATION**

2005/0024287 A1 * 2/2005 Jo et al. 343/822
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(75) Inventor: **Forrest Wolf**, Reno, NV (US)

(73) Assignee: **Pinyon Technologies, Inc.**, Reno, NV
(US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 512 days.

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tion No. PCT/US2009/058471, 9 pages.

(21) Appl. No.: **12/567,535**

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(22) Filed: **Sep. 25, 2009**

(65) **Prior Publication Data**

US 2010/0085262 A1 Apr. 8, 2010

Primary Examiner — Huedung Mancuso

(74) Attorney, Agent, or Firm — Holland & Hart LLP

Related U.S. Application Data

(60) Provisional application No. 61/100,156, filed on Sep.
25, 2008.

(51) **Int. Cl.**
H01Q 13/00 (2006.01)

(52) **U.S. Cl.** **343/768**

(58) **Field of Classification Search** 343/868,
343/860, 822, 895, 700 MS, 702, 768
See application file for complete search history.

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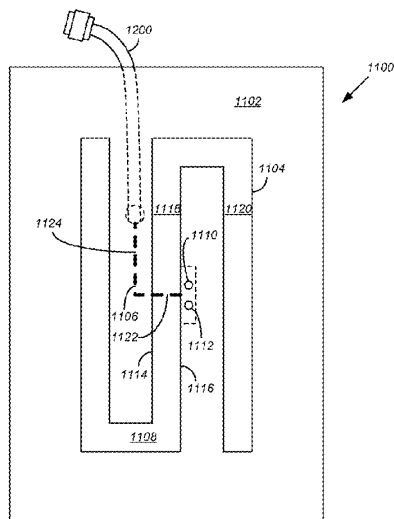
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2001/0015703 A1 8/2001 Nieminen

(57) **ABSTRACT**

In one embodiment, a meander slot antenna includes a con-
ducting sheet having a meander slot defined therein. The
meander slot has a closed area defined by the conducting
sheet. An electrical microstrip feed line crosses the meander
slot. The electrical microstrip feed line and meander slot
provide a magnetically coupled LC resonance element. A
dielectric material has at least one conductive via therein. The
at least one conductive via electrically connects the electrical
microstrip feed line and the conducting sheet at a side of the
meander slot. The dielectric material otherwise separates the
conducting sheet from the electrical microstrip feed line.
Other embodiments are also disclosed.

41 Claims, 33 Drawing Sheets



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US008378913B2

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

(10) **Patent No.:** **US 8,378,913 B2**
(45) **Date of Patent:** **Feb. 19, 2013**

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

(75) Inventors: **Wen-Szu Tao**, Hsinchu (TW); **Sy-Been Wang**, Hsinchu County (TW)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 323 days.

(21) Appl. No.: **12/967,173**

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

(65) **Prior Publication Data**

US 2011/0140989 A1 Jun. 16, 2011

(30) **Foreign Application Priority Data**

Dec. 15, 2009 (TW) 98142878 A

(51) **Int. Cl.**
H01Q 9/04 (2006.01)

(52) **U.S. Cl.** **343/790; 343/791**

(58) **Field of Classification Search** 343/790, 343/791, 792, 893
See application file for complete search history.

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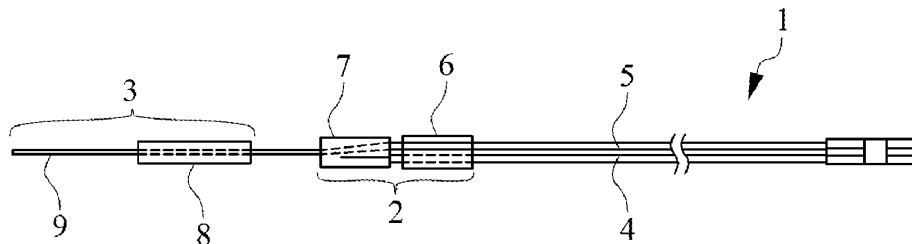
Primary Examiner — Tan Ho

(74) *Attorney, Agent, or Firm* — Morris Manning & Martin LLP; Tim Tingkang Xia, Esq.

(57) **ABSTRACT**

A dual-band antenna unit, comprising: a first radiation unit; a second radiation unit; a first signal feed-in unit electrically connected to the first radiation unit; and a second signal feed-in unit, electrically connected to the second radiation unit; wherein the first radiation unit, the second radiation unit, the first signal feed-in unit and the second signal feed-in unit are disposed in the dual-band antenna unit. Therefore, the number of antennas can be reduced to achieve lower cost while remaining the signal transmission quality.

17 Claims, 21 Drawing Sheets



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US008378914B2

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

(10) **Patent No.:** **US 8,378,914 B2**
(45) **Date of Patent:** **Feb. 19, 2013**

(54) **DIPOLE ANTENNA**

(75) Inventors: **Chang-Jung Lee**, Taoyuan County
(TW); **Jian-Jhih Du**, Taipei (TW)

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

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 277 days.

(21) Appl. No.: **12/647,288**

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

(65) **Prior Publication Data**
US 2010/0164825 A1 Jul. 1, 2010

(30) **Foreign Application Priority Data**
Dec. 25, 2008 (TW) 97150710 A

(51) **Int. Cl.**
H01Q 9/16 (2006.01)
(52) **U.S. Cl.** **343/795**; 343/807; 343/822
(58) **Field of Classification Search** 343/700 MS,
343/793, 795, 807, 822, 846
See application file for complete search history.

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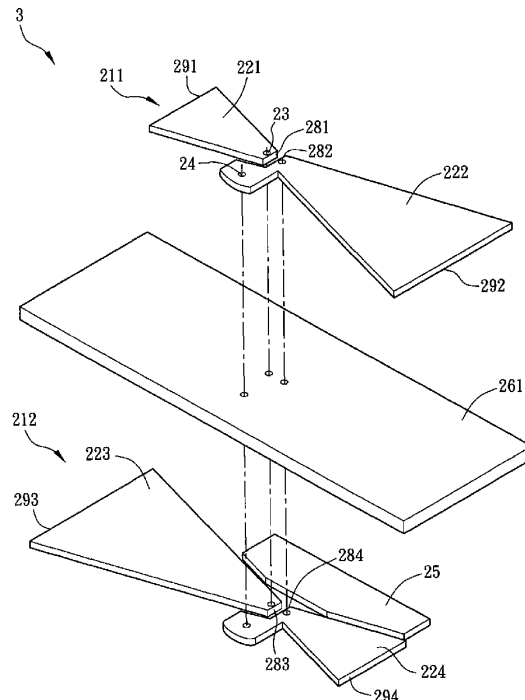
Primary Examiner — Robert Karacsony

(74) *Attorney, Agent, or Firm* — Muncy, Geissler, Olds &
Lowe, PLLC

(57) **ABSTRACT**

A dipole antenna includes a first radiating body and a second radiating body. The first radiating body has a first radiating part and a second radiating part. The area of the second radiating part is larger than that of the first radiating part. The second radiating body is disposed opposite to the first radiating body and has a third radiating part and a fourth radiating part. The area of the third radiating part is larger than that of the first radiating part. The area of the second radiating part is larger than that of the fourth radiating part. The first radiating part or the third radiating part has a feeding point. The second radiating part or the fourth radiating part has a ground point. The first radiating part is electrically connected to the third radiating part. The second radiating part is electrically connected to the fourth radiating part.

18 Claims, 7 Drawing Sheets



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US008378915B2

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

(10) **Patent No.:** **US 8,378,915 B2**
(45) **Date of Patent:** **Feb. 19, 2013**

(54) **ANTENNA ASSEMBLY**

(75) Inventors: **Per-Anders Arvidsson**, Solna (SE);
Mario Arias, Vallentuna (SE); **Michael**
Beausang, Bergsharmon (SE); **Jesper**
Uddin, Stockholm (SE); **Annika Hu**,
Akersberga (SE)

(73) Assignee: **Powerwave Technologies Sweden AB**,
Kista (SE)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 238 days.

(21) Appl. No.: **12/759,582**

(22) Filed: **Apr. 13, 2010**

(65) **Prior Publication Data**

US 2010/0265150 A1 Oct. 21, 2010

Related U.S. Application Data

(60) Provisional application No. 61/170,204, filed on Apr.
17, 2009.

(30) **Foreign Application Priority Data**

Apr. 17, 2009 (SE) 0900515

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H01Q 21/00 (2006.01)

(52) **U.S. Cl.** **343/836**; 343/837; 343/912

(58) **Field of Classification Search** 343/836,
343/837, 838, 912

See application file for complete search history.

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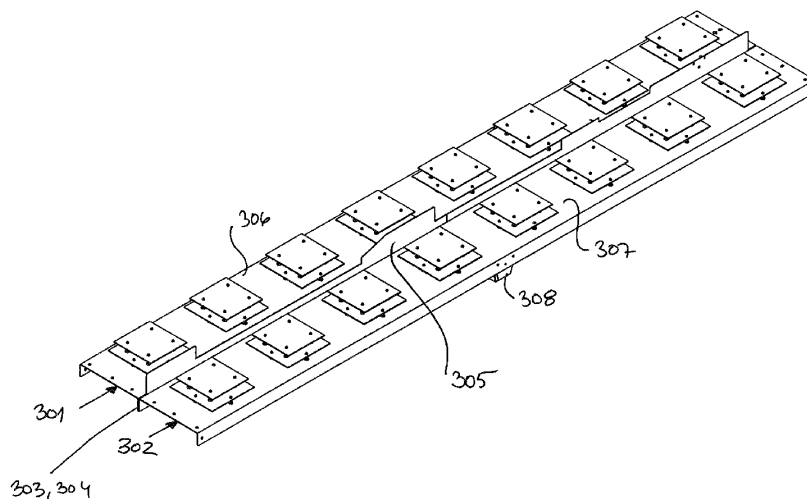
Primary Examiner — Tho G Phan

(74) *Attorney, Agent, or Firm* — OC Patent Law Group

(57) **ABSTRACT**

An antenna assembly and a method of mounting such an assembly are disclosed. A first and a second assembly portion are joined together, wherein the assembly portions each comprise a elongated reflector body serving as a reflector for electromagnetic power radiated by the antenna assembly portion, and a set of antenna element receiving means located in a linear row along a longitudinal direction of the reflector body for respectively receiving an antenna element, and side portions along the long sides of the said reflector body. The assembly method comprises the step of fastening the first and second assembly portions to each other along a respective side portion of the said assembly portions so as to form a dual array antenna assembly.

15 Claims, 4 Drawing Sheets



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