



US007952526B2

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

(10) **Patent No.:** **US 7,952,526 B2**
(45) **Date of Patent:** **May 31, 2011**

(54) **COMPACT DUAL-BAND RESONATOR USING ANISOTROPIC METAMATERIAL**

(75) Inventors: **Cheng-Jung Lee**, Los Angeles, CA (US); **Kevin M. K. H. Leong**, Los Angeles, CA (US); **Tatsuo Itoh**, Rolling Hills, CA (US)

(73) Assignee: **The Regents of the University of California**, Oakland, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 936 days.

(21) Appl. No.: **11/844,249**

(22) Filed: **Aug. 23, 2007**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 60/841,668, filed on Aug. 30, 2006.

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H01Q 1/38 (2006.01)
H01Q 15/02 (2006.01)

(52) **U.S. Cl.** **343/700 MS; 343/909**

(58) **Field of Classification Search** **343/700 MS, 343/702, 754, 749, 846, 909**
See application file for complete search history.

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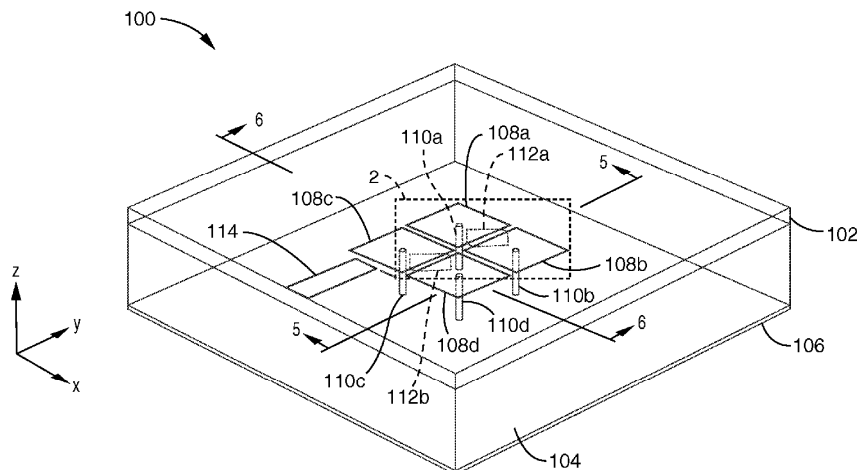
Primary Examiner — Shih-Chao Chen

(74) *Attorney, Agent, or Firm* — John P. O'Banion

(57) **ABSTRACT**

A dual-band resonator with compact size, such as a resonant type dual-band antenna, which uses an anisotropic metamaterial is described. The artificial anisotropic medium is implemented by employing a composite right/left-handed transmission line. The dispersion relation and the antenna physical size only depend on the composition of the unit cell and the number of cells used. By engineering the characteristics of the unit cells to be different in two orthogonal directions, the corresponding propagation constants can be controlled, thus enabling dual-band antenna resonances. In addition, the antenna dimensions can be markedly minimized by maximally reducing the unit cell size. A dual-band antenna is also described which is designed for operation at frequencies for PCS/Bluetooth applications, and which has a physical size of $\frac{1}{18}\lambda_0 \times \frac{1}{18}\lambda_0 \times \frac{1}{19}\lambda_0$, where λ_0 is the free space wavelength at 2.37 GHz.

43 Claims, 10 Drawing Sheets





US007952528B2

(12) **United States Patent**
Nysen

(10) **Patent No.:** **US 7,952,528 B2**
(45) **Date of Patent:** **May 31, 2011**

(54) **ANTENNA CONFIGURATIONS FOR
COMPACT DEVICE WIRELESS
COMMUNICATION**

(75) Inventor: **Paul A. Nysen**, Pala, CA (US)

(73) Assignee: **Sierra Wireless, Inc.**, Richmond, BC
(CA)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 223 days.

(21) Appl. No.: **12/203,900**

(22) Filed: **Sep. 3, 2008**

(65) **Prior Publication Data**
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Related U.S. Application Data
(60) Provisional application No. 60/967,449, filed on Sep.
4, 2007.

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
(52) **U.S. Cl.** **343/702; 343/700 MS; 343/795**
(58) **Field of Classification Search** **343/700 MS,**
343/702, 795, 722, 850
See application file for complete search history.

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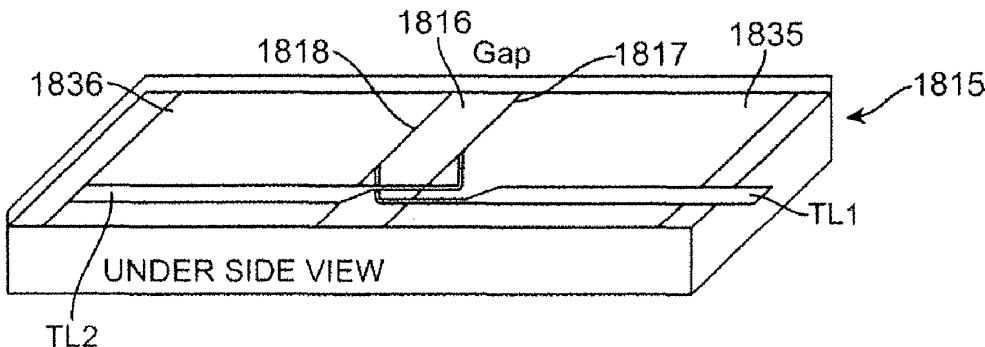
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Primary Examiner — Tho G Phan
(74) *Attorney, Agent, or Firm* — Nixon Peabody LLP

(57) **ABSTRACT**
A duplex antenna system includes first and second antenna
portions that are at least partially separated by a gap, a first
feed line coupled to the first antenna portion, the first feed line
being overlapped by the gap and the second antenna portion,
and a second feed line coupled to the second antenna portion,
the second feed line being overlapped by the gap and the first
antenna portion.

46 Claims, 28 Drawing Sheets





US007952529B2

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

(10) **Patent No.:** **US 7,952,529 B2**
(45) **Date of Patent:** **May 31, 2011**

(54) **DUAL BAND ANTENNA**
(75) Inventors: **Chih-Yung Huang**, Taichung County (TW); **Pi-Hsi Cheng**, Jhubei (TW); **Chang-Jung Lee**, Longtan Township, Taoyuan County (TW)

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

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R. Hossa et al., Improvement of Compact Terminal Antenna Performance by Incorporating Open-End Slots in Ground Plane, IEEE Microwave and Wireless Components Letters, Jun. 2004, pp. 283-285, vol. 14, Issue: 6.
Taiwanese office action dated Dec. 23, 2010, 5 pages.

(21) Appl. No.: **12/292,157**

(22) Filed: **Nov. 13, 2008**

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(65) **Prior Publication Data**
US 2009/0135071 A1 May 28, 2009

Primary Examiner — Hoang V Nguyen
(74) *Attorney, Agent, or Firm* — Bacon & Thomas, PLLC

(30) **Foreign Application Priority Data**
Nov. 22, 2007 (TW) 96144318 A

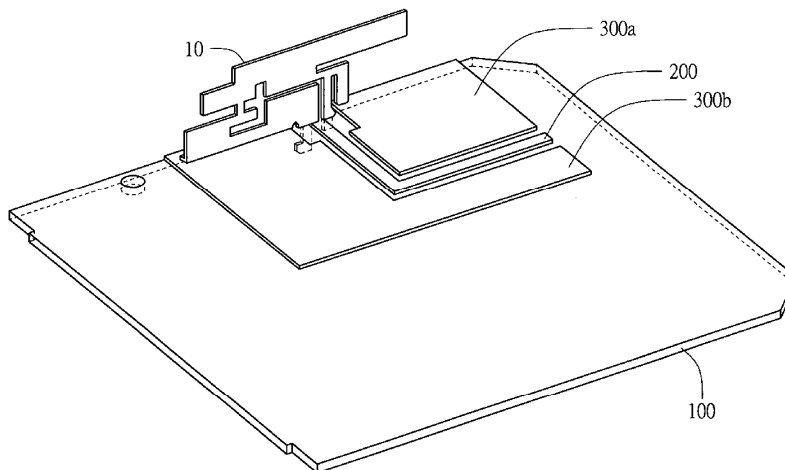
(57) **ABSTRACT**

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)
(52) **U.S. Cl.** **343/702**; 343/700 MS; 343/846
(58) **Field of Classification Search** 343/702, 343/700 MS, 846
See application file for complete search history.

An antenna set on a circuit board is provided. The circuit board includes a signal transmitting unit and a grounding unit. The antenna includes a conductive supporting portion, a radiator and a grounding portion. The radiator operating in a first frequency band includes a feeding branch coupled to the signal transmitting unit for receiving a feeding signal. The grounding portion is connected to the radiator through the conductive supporting portion. The grounding portion includes a slot cavity and a grounding branch. The slot cavity is extended from a top surface of the grounding portion into the interior of the grounding portion. The grounding branch is coupled to the grounding unit. A resonant cavity is formed between the radiator and the slot cavity. The resonance of the resonant cavity operates in a second frequency band.

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11 Claims, 12 Drawing Sheets





US007953371B2

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

(10) **Patent No.:** **US 7,953,371 B2**
(45) **Date of Patent:** **May 31, 2011**

(54) **LOCAL WIRELESS COMMUNICATION MODULE COMBINED WITH ANTENNA AND MOBILE TERMINAL HAVING THE SAME**

(75) Inventors: **Sang Tae Lee**, Seongnam-si (KR); **Jae Hyou Lee**, 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 886 days.

(21) Appl. No.: **11/854,452**

(22) Filed: **Sep. 12, 2007**

(65) **Prior Publication Data**
US 2008/0081614 A1 Apr. 3, 2008

(30) **Foreign Application Priority Data**
Oct. 2, 2006 (KR) 10-2006-0096901

(51) **Int. Cl.**
H04B 7/00 (2006.01)

(52) **U.S. Cl.** **455/41.2; 455/557; 455/575.1**

(58) **Field of Classification Search** **455/41.1, 455/41.2, 41.3, 550.1, 552.1, 553.1, 556.1, 455/557, 426.1, 575.1, 575.2, 575.6, 575.7, 381/370, 374, 376; 320/112, 114**
See application file for complete search history.

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Primary Examiner — Lana N Le

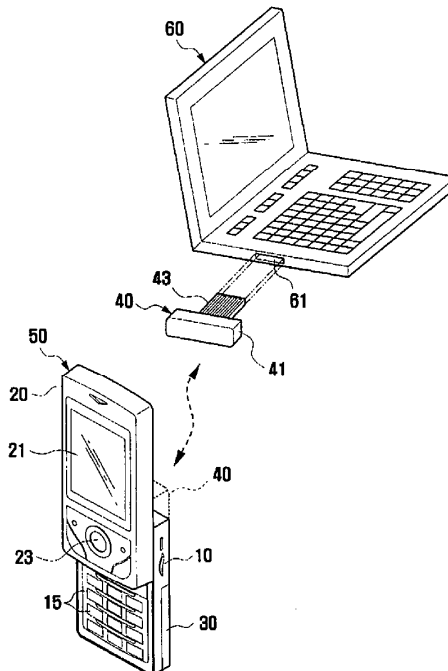
Assistant Examiner — Ping Y Hsieh

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

(57) **ABSTRACT**

A mobile terminal having a local wireless communication module combined with an antenna is disclosed that eliminates the inconvenience of carrying a data cable for connecting of a mobile terminal to a computer and enabling easy connection of the mobile terminal to a computer whenever necessary. A local wireless communication module combined with an antenna for a mobile terminal is provided that is usable as an RF communication antenna when joined to a USB socket of the mobile terminal or as a local wireless communication module for executing local wireless communication between the mobile terminal and a computer when detached from the mobile terminal and joined to a USB socket of the computer.

18 Claims, 4 Drawing Sheets





US007956810B2

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

(10) **Patent No.:** **US 7,956,810 B2**
(45) **Date of Patent:** **Jun. 7, 2011**

(54) **ANTENNA DEVICE AND ANTENNA SYSTEM UTILIZING SAID ANTENNA DEVICE**

(56) **References Cited**

(75) Inventors: **Saou-Wen Su**, Taipei (TW); **Jui-Hung Chou**, Tai-Chung (TW)

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2009/0046019	A1 *	2/2009	Sato	343/702

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

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

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(21) Appl. No.: **12/042,336**

(22) Filed: **Mar. 5, 2008**

Primary Examiner — Huedung Mancuso

(65) **Prior Publication Data**

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(74) *Attorney, Agent, or Firm* — Kile Goekjian Reed & McManus PLLC

(30) **Foreign Application Priority Data**

Nov. 15, 2007 (TW) 96143256 A

(57) **ABSTRACT**

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

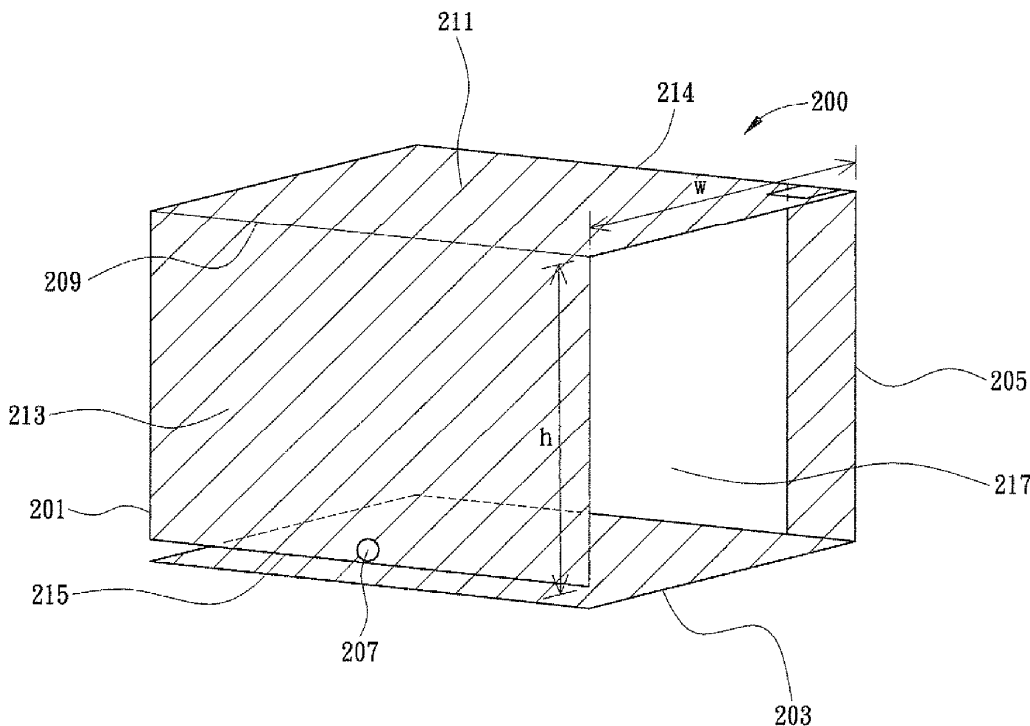
An antenna device includes a first conductive piece, a second conductive piece, a third conductive piece and a feeding point. The second conductive piece is electrically coupled to a predetermined voltage level. The third conductive piece is electrically connected to the first conductive piece and the second conductive piece. The feeding point is located on the first conductive piece.

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

(58) **Field of Classification Search** 343/702, 343/700 MS, 803, 833-834, 846

See application file for complete search history.

14 Claims, 9 Drawing Sheets





US007956811B2

(12) **United States Patent**
Huang

(10) **Patent No.:** **US 7,956,811 B2**
(45) **Date of Patent:** **Jun. 7, 2011**

(54) **ANTENNA AND ANTENNA SET WITH LOWER HEIGHT**

(75) Inventor: **Chi-Cheng Huang**, Taoyuan County (TW)
(73) Assignee: **Delta Networks, 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 334 days.

(21) Appl. No.: **12/166,086**

(22) Filed: **Jul. 1, 2008**

(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
Apr. 18, 2008 (TW) 97114257 A

(51) **Int. Cl.**
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(52) **U.S. Cl.** **343/700 MS; 343/702**
(58) **Field of Classification Search** **343/700 MS, 343/846, 702, 848**
See application file for complete search history.

(56) **References Cited**

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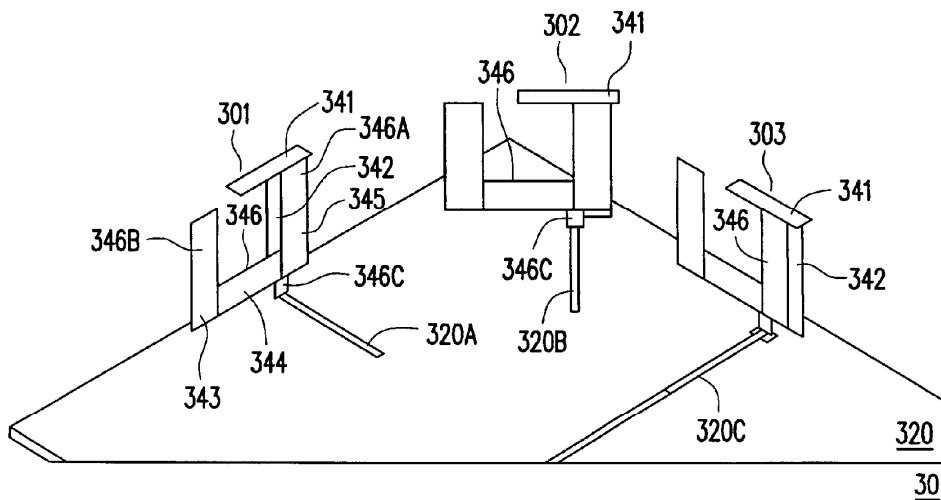
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Primary Examiner — HoangAnh T Le
(74) *Attorney, Agent, or Firm* — J.C. Patents

(57) **ABSTRACT**

An antenna and an antenna set are provided. The antenna is composed of a horseshoe sheet member and two rectangular sheet members. The horseshoe sheet member and the two rectangular sheet members are all made of a metal material. The antenna is made of a metal material, such as tinplate, and the antenna is adapted for receiving or emitting wireless signals of vertical polarization and horizontal polarization. The antenna set includes three antennae as above disposed on a substrate. The antenna set is adapted for polarization diversity, pattern diversity, and space diversity. Comparing with the conventional antenna and antenna set, the antenna and the antenna set according to the present invention have lower costs and lower heights, and can be designed as embedded antennae or hidden antennae.

10 Claims, 12 Drawing Sheets





US007956812B2

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

(10) **Patent No.:** **US 7,956,812 B2**
(45) **Date of Patent:** **Jun. 7, 2011**

(54) **WIDE-BAND ANTENNA AND MANUFACTURING METHOD THEREOF**

(75) Inventors: **Yean-Cheng Chen**, Taipei (TW);
Chih-Ming Wang, Taipei (TW);
Kuan-Hsueh Tseng, Taipei (TW)

(73) Assignee: **Winstron Neweb Corp.**, Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 254 days.

(21) Appl. No.: **12/469,221**

(22) Filed: **May 20, 2009**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

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Oct. 28, 2008 (TW) 97141360 A

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

(58) **Field of Classification Search** 343/700 MS,
343/702, 850, 853, 846, 848
See application file for complete search history.

(56) **References Cited**

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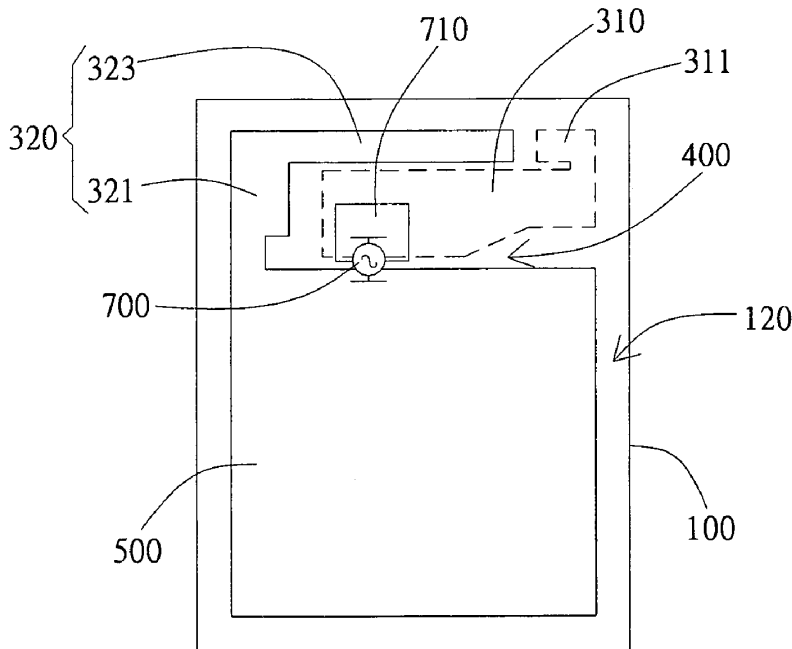
Primary Examiner — Huedung Mancuso

(74) *Attorney, Agent, or Firm* — Thomas, Kayden,
Horstemeyer & Risley, LLP

(57) **ABSTRACT**

A wide-band antenna and a manufacturing method thereof are provided. The wide-band antenna includes a substrate, a first radiator, a second radiator, a grounding portion, and a signal feeding portion. The first radiator is disposed on a first surface of the substrate while the second radiator is disposed on the first surface or a second surface opposite to the first surface. The first radiator and the second radiator are spaced apart by a predetermined distance. The grounding portion is disposed on the substrate to couple with the second radiator. The signal feeding portion has a coupling unit disposed on the second surface and at least partially overlapping the first radiator. The signal feeding portion is coupled with the grounding portion and feeds signals to excite the first radiator to form a first band mode through coupling effect by the coupling unit. The first radiator feeds signals to excite the second radiator to form a second band mode by coupling effect.

29 Claims, 10 Drawing Sheets





US007956814B2

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

(10) **Patent No.:** **US 7,956,814 B2**
(45) **Date of Patent:** **Jun. 7, 2011**

(54) **ARRANGEMENT OF AN ANTENNA ON A CONTAINER**

(75) Inventors: **Hans-Joerg Reinheimer**, Wettenberg (DE); **Knut Buchweitz**, Jena (DE); **Jakob Heierli**, Reute (CH)

(73) Assignee: **REEL Reinheimer Elektronik GmbH**, Wettenberg (DE)

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

(21) Appl. No.: **12/323,035**

(22) Filed: **Nov. 25, 2008**

(65) **Prior Publication Data**

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Related U.S. Application Data

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(30) **Foreign Application Priority Data**

May 29, 2006 (DE) 10 2006 025 214

(51) **Int. Cl.**
H01Q 1/32 (2006.01)
H01Q 1/42 (2006.01)

(52) **U.S. Cl.** **343/713; 343/872**

(58) **Field of Classification Search** **343/711, 343/713, 872, 895, 900**

See application file for complete search history.

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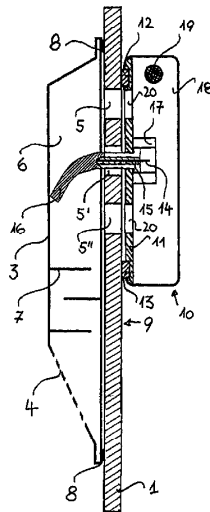
Primary Examiner — Shih-Chao Chen

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

(57) **ABSTRACT**

An antenna carrier (10) with an antenna (14) for electromagnetic radiation to be fastened to a wall (1) of a container composed of steel plate and having ventilation openings (5) which are covered on the exterior side of the container wall (1) by a cover (3) which protects against sprayed water, and which forms a cavity (6) in front of the ventilation openings (5), in which the cover (3) is composed of plastic, the antenna (14) projects through a ventilation opening (5) into the cavity (6) formed by the cover, the antenna carrier (10) is fastened on the interior side (9) of the container wall (1), and the antenna carrier (10) is the ground reference surface of the antenna (14) and is constructed as a magnetizable metal plate (11).

15 Claims, 2 Drawing Sheets





US007956815B2

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

(10) **Patent No.:** **US 7,956,815 B2**
(45) **Date of Patent:** **Jun. 7, 2011**

(54) **LOW-PROFILE ANTENNA STRUCTURE**

(75) Inventors: **Masataka Ohira**, Soraku-gun (JP);
Wuqiong Luo, Soraku-gun (JP);
Makoto Taroumaru, Soraku-gun (JP);
Amane Miura, Soraku-gun (JP);
Shigeru Saito, Soraku-gun (JP);
Masazumi Ueba, Soraku-gun (JP);
Takashi Ohira, Soraku-gun (JP)

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(73) Assignee: **Advanced Telecommunications Research Institute International**, 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 633 days.

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(21) Appl. No.: **11/969,762**

(22) Filed: **Jan. 4, 2008**

(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
Jan. 12, 2007 (JP) 2007-005077

(51) **Int. Cl.**
H01Q 9/04 (2006.01)
H01Q 9/00 (2006.01)
(52) **U.S. Cl.** **343/730; 343/700 MS; 343/702**
(58) **Field of Classification Search** **343/730, 343/702, 700 MS**
See application file for complete search history.

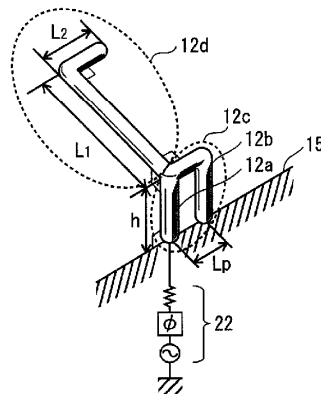
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Primary Examiner — Jacob Y Choi
Assistant Examiner Darleen J Stockley

(57) **ABSTRACT**
A low-profile antenna structure can control its directivity with great flexibility. Excited elements **11** and **12** are symmetrically arranged on a y-axis, whereas parasitic elements **13** and **14** are symmetrically arranged on an x-axis, with respect to an origin. The excited elements, as well as the parasitic elements, each have an inverted-F antenna structure and are a distance of $\lambda/4$ apart from each other. Feed circuits **21** and **22** are respectively connected to and feed signals to the excited elements **11** and **12**, such that phases of the signals to be fed are different from each other by a desired degree. Variable reactors **23** and **24** (i) are respectively connected to the parasitic elements **13** and **14**, and (ii) in accordance with reactance values thereof, can each change an electrical length of the corresponding one of the parasitic elements.

10 Claims, 30 Drawing Sheets

12





US007961149B2

(12) **United States Patent**
Tsai

(10) **Patent No.:** **US 7,961,149 B2**
(45) **Date of Patent:** ***Jun. 14, 2011**

(54) **ANTENNA STRUCTURE**
(75) Inventor: **Hsiao-Ming Tsai**, 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 0 days.
This patent is subject to a terminal disclaimer.

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)
(52) **U.S. Cl.** **343/700 MS; 343/702; 343/846**
(58) **Field of Classification Search** 343/700 MS, 343/702, 846, 850, 873
See application file for complete search history.

(21) Appl. No.: **12/834,812**

(56) **References Cited**
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(22) Filed: **Jul. 12, 2010**

Primary Examiner — Shih-Chao Chen

(65) **Prior Publication Data**
US 2010/0277391 A1 Nov. 4, 2010

(57) **ABSTRACT**
An antenna structure includes a circuit board with a ground surface and a printed antenna. The printed antenna includes a signal feed-in portion, a first radiating unit connected to the signal feed-in portion and a second radiating unit connected to the first radiating unit. The first radiating unit includes a first printed thickness, and the second radiating unit includes a second printed thickness. At least part of the second printed thickness is larger than the first printed thickness.

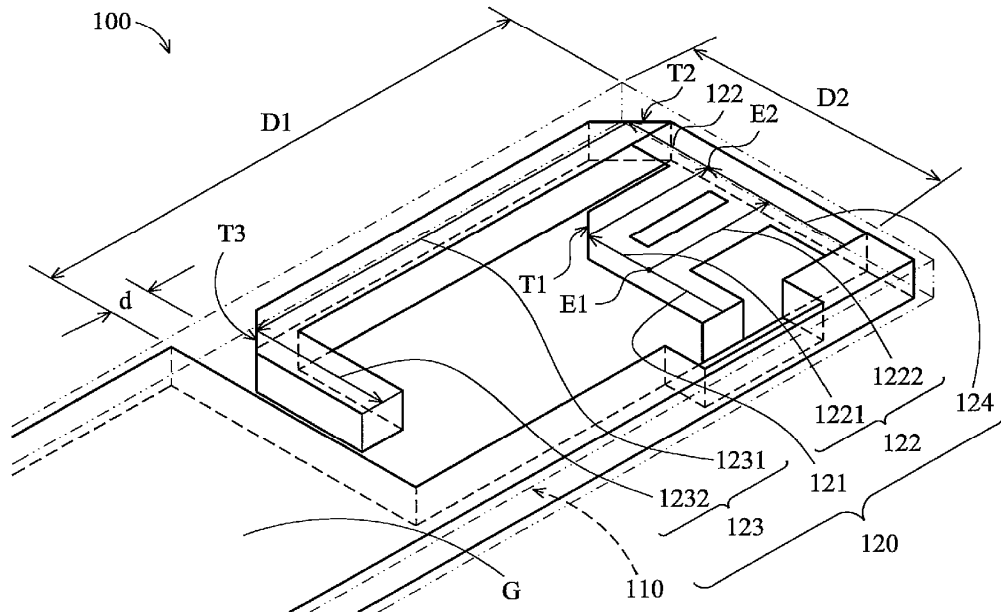
Related U.S. Application Data

(63) Continuation of application No. 12/183,014, filed on Jul. 30, 2008, now Pat. No. 7,773,036.

Foreign Application Priority Data

(30) Aug. 24, 2007 (TW) 96131466 A

16 Claims, 3 Drawing Sheets





US007961150B2

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

(10) **Patent No.:** **US 7,961,150 B2**
(45) **Date of Patent:** **Jun. 14, 2011**

(54) **PORTABLE TERMINAL APPARATUS WITH TV FUNCTION AND TV ANTENNA WITH FUNCTION AS INPUT PEN**

(75) Inventors: **Gai Kyou**, Tokyo (JP); **Chitoshi Aramaki**, Tokyo (JP); **Hideki Terauchi**, Tokyo (JP); **Yoshiki Miyazawa**, 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 70 days.

(21) Appl. No.: **12/412,782**

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

(65) **Prior Publication Data**

US 2009/0184884 A1 Jul. 23, 2009

Related U.S. Application Data

(62) Division of application No. 11/261,592, filed on Oct. 31, 2005, now Pat. No. 7,541,987.

(30) **Foreign Application Priority Data**

Nov. 1, 2004 (JP) 2004-318615

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

(52) **U.S. Cl.** 343/702; 343/901; 345/179

(58) **Field of Classification Search** 343/702, 343/901; 345/179

See application file for complete search history.

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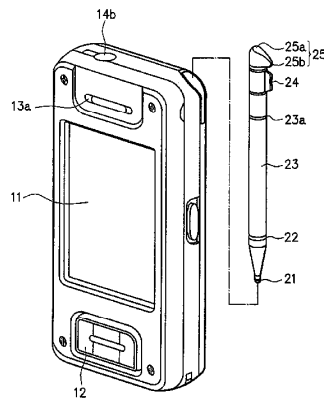
Primary Examiner — Tho G Phan

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

(57) **ABSTRACT**

A portable terminal apparatus with TV function and a TV antenna with function as an input pen, in which the TV antenna is integrated with the input pen for the touch panel while ensuring sufficient sensitivity so that the internal space of the apparatus is effectively utilized, thus rendering the apparatus smaller and lighter. In the case of using a TV antenna with function as an input pen as an input pen, a mounting operation portion is pushed in a longitudinal direction with a fingertip for pushing it into the apparatus. Thereby, the hold state of the apparatus is released by a function of a latch switch, and the TV antenna with function as an input pen is pushed out to be pulled out of the apparatus. That is, the cellular phone has a configuration in which the TV antenna with function as an input pen cannot be pushed to be detached from the apparatus unless the user contracts a multistage antenna section and houses it completely in a pen body.

13 Claims, 32 Drawing Sheets





US007961152B2

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

(10) **Patent No.:** **US 7,961,152 B2**
(45) **Date of Patent:** **Jun. 14, 2011**

(54) **ELECTRONIC DEVICE HAVING HELICAL RESILIENT MEMBER SERVING AS ELECTRIC INDUCTANCE ELEMENT**

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7,226,293 B2* 6/2007 Na et al. 439/66

(75) Inventors: **Yu-Chiang Cheng**, Taipei (TW);
Ping-Cheng Chang, Pingtung County (TW); **Cheng-Zing Chou**, Xinying (TW)

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(73) Assignee: **Getac Technology Corporation**, Hsinchu (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 1254 days.

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Communication from the Chinese Patent Office dated Aug. 7, 2009 with regard to the counterpart Chinese Application 2007101056381.

(21) Appl. No.: **11/584,616**

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(22) Filed: **Oct. 23, 2006**

Primary Examiner — Jacob Y Choi
Assistant Examiner — Kyana R Robinson

(65) **Prior Publication Data**
US 2007/0236317 A1 Oct. 11, 2007

(57) **ABSTRACT**

(30) **Foreign Application Priority Data**

Apr. 7, 2006 (TW) 95112536 A

An electronic device includes a helical resilient member serving as an electrical inductance element. The electronic device also includes an antenna, a signal feeding line, and a transmitting/receiving module. The helical resilient member has first and second ends with a predetermined number of turns of coil arranged therebetween the first and second ends, and is made of electrically conductive materials so that the turns of coil defines an electrical inductance. The signal feeding line is connected between the helical resilient member and a signal feed point of the antenna. The transmitting/receiving module is connected to the helical resilient member so as to couple the inductance of the helical resilient member to the transmitting/receiving module.

(51) **Int. Cl.**
H01Q 9/00 (2006.01)

(52) **U.S. Cl.** **343/749**; 336/177

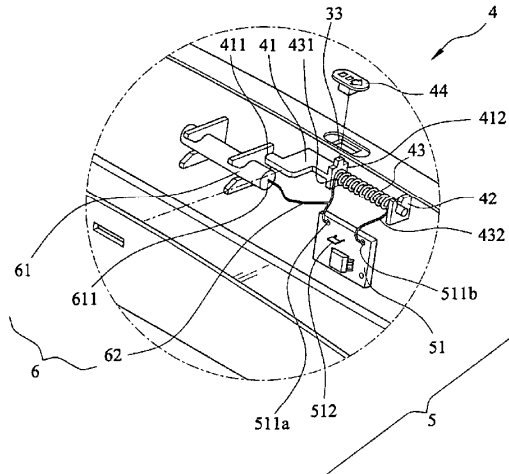
(58) **Field of Classification Search** 336/77,
336/177; 343/749, 722, 745, 860
See application file for complete search history.

9 Claims, 4 Drawing Sheets

(56) **References Cited**

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US007961154B2

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

(10) **Patent No.:** **US 7,961,154 B2**
(45) **Date of Patent:** ***Jun. 14, 2011**

(54) **ANTENNA WITH NEAR-FIELD RADIATION CONTROL**

(75) Inventors: **Yihong Qi**, Waterloo (CA); **Perry Jarmuszewski**, Waterloo (CA); **Adam D. Stevenson**, Waterloo (CA)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 99 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/474,075**

(22) Filed: **May 28, 2009**

(65) **Prior Publication Data**

US 2009/0231228 A1 Sep. 17, 2009

Related U.S. Application Data

(63) Continuation of application No. 11/774,383, filed on Jul. 6, 2007, now Pat. No. 7,541,991, which is a continuation of application No. 10/940,869, filed on Sep. 14, 2004, now Pat. No. 7,253,775, which is a continuation of application No. 10/317,659, filed on Dec. 12, 2002, now Pat. No. 6,791,500.

(51) **Int. Cl.**
H01Q 19/10 (2006.01)

(52) **U.S. Cl.** **343/803**; 343/702; 343/795; 343/804; 343/818; 343/834

(58) **Field of Classification Search** 343/702, 343/803, 804, 815, 817, 818, 819, 833, 834, 343/795

See application file for complete search history.

(56) **References Cited**

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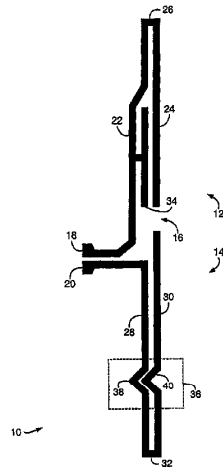
Primary Examiner — Tho G Phan

(74) *Attorney, Agent, or Firm* — Jones Day

(57) **ABSTRACT**

An antenna and a wireless mobile communication device incorporating the antenna are provided. The antenna includes a first conductor section electrically coupled to a first feeding point, a second conductor section electrically coupled to a second feeding point, and a near-field radiation control structure adapted to control characteristics of near-field radiation generated by the antenna. Near-field radiation control structures include a parasitic element positioned adjacent the first conductor section and configured to control characteristics of near-field radiation generated by the first conductor section, and a diffuser in the second conductor section configured to diffuse near-field radiation generated by the second conductor section into a plurality of directions.

23 Claims, 4 Drawing Sheets





US007965239B2

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

(10) **Patent No.:** **US 7,965,239 B2**
(45) **Date of Patent:** **Jun. 21, 2011**

- (54) **ANTENNA STRUCTURE**
- (75) Inventors: **Chung-Wen Yang**, Taipei (TW);
Yu-Yuan Wu, Taipei (TW); **Hung-Jen Chen**, Taipei (TW)
- (73) Assignee: **Cheng Uei Precision Industry Co., Ltd.**, Taipei (TW)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 222 days.

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(21) Appl. No.: **12/491,242**

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

Primary Examiner — Douglas W Owens

Assistant Examiner — Jennifer Hu

(65) **Prior Publication Data**
US 2010/0328159 A1 Dec. 30, 2010

(57) **ABSTRACT**

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

An antenna structure includes a low frequency radiator, a high frequency radiator, and a connecting element. The connecting element has a rear end and a front end opposite to the rear end. A feeding element and a grounding element are extended from the front end of the connecting element and arranged adjacent to each other. The low frequency radiator includes a substantially inverted-L shaped first radiating part extended from the rear end of the connecting element, a meander-like second radiating part extended frontward from a front end of the first radiating part, and a substantially lying U-shaped third radiating part with a rearward opening extended from a free end of the second radiating part. The high frequency radiator includes a first extension piece extended frontward from the front end of the connecting element and located under the second radiating part with space.

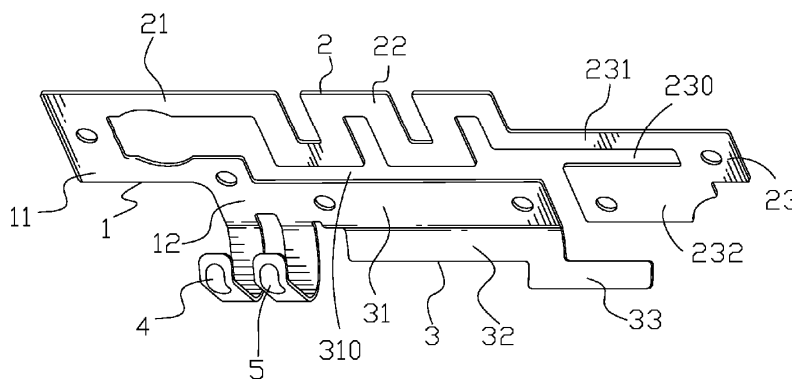
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5 Claims, 2 Drawing Sheets

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US007965240B2

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

(10) **Patent No.:** **US 7,965,240 B2**
(45) **Date of Patent:** **Jun. 21, 2011**

(54) **DUAL-BAND PLANAR INVERTED-F ANTENNA**

(75) Inventors: **Young-min Moon**, Seoul (KR);
Young-eil Kim, Suwon-Si (KR);
Gyoo-soo Chae, Cheonan-si (KR)

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

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

(21) Appl. No.: **12/764,562**

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

(65) **Prior Publication Data**
US 2010/0201581 A1 Aug. 12, 2010

Related U.S. Application Data
(63) Continuation of application No. 11/347,217, filed on Feb. 6, 2006, now Pat. No. 7,733,271.

(30) **Foreign Application Priority Data**
Feb. 4, 2005 (KR) 10-2005-0010759

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
(52) **U.S. Cl.** **343/700 MS; 343/702**
(58) **Field of Classification Search** None
See application file for complete search history.

(56) **References Cited**
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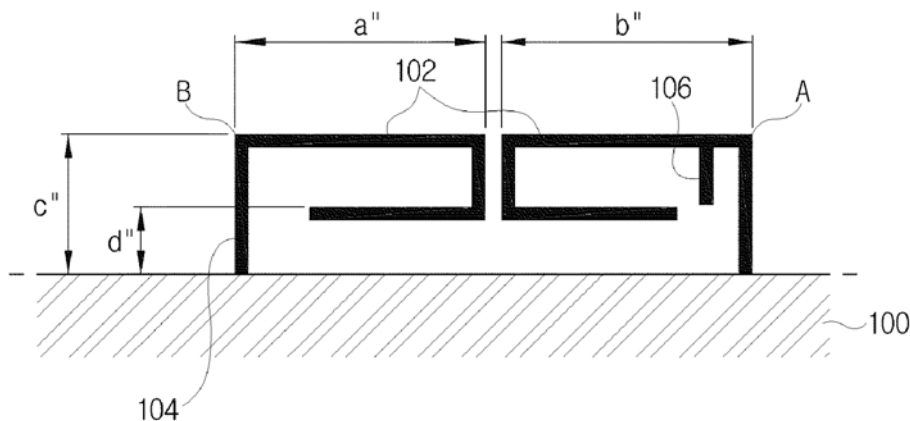
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Primary Examiner — Trinh V Dinh
(74) *Attorney, Agent, or Firm* — Sughrue Mion, PLLC

(57) **ABSTRACT**
An improved and more compact structure of a built-in antenna for handheld terminals, improving radiation pattern and efficiency. Provided is a planar inverted-F antenna having a radiation part having an inductive radiation portion and a parasitic radiation portion which are spaced in a certain distance apart from a ground surface, a power-supply part horizontally spaced apart from the ground surface and for directly supplying currents to the connected inductive radiation portion, and connection parts for connecting the radiation portions to the ground. The planar inverted-F antenna has an inductive antenna portion and a parasitic antenna portion, thereby reducing its volume compared to the conventional inverted-F antenna. Complicated manufacturing and processing procedures are simplified by connecting the power-supplying part and a PCB.

4 Claims, 7 Drawing Sheets





US007965242B2

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

(10) **Patent No.:** **US 7,965,242 B2**
(45) **Date of Patent:** **Jun. 21, 2011**

(54) **DUAL-BAND ANTENNA**

(56) **References Cited**

(75) Inventors: **Oleg Jurievich Abramov**, St. Petersburg (RU); **Farid Ibragimovich Nagaev**, St. Petersburg (RU); **Randy Salo**, San Diego, CA (US)

(73) Assignee: **Airgain, Inc.**, Carlsbad, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1182 days.

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Primary Examiner — HoangAnh T Le

(74) Attorney, Agent, or Firm — Procopio, Cory, Hargreaves & Savitch LLP

(21) Appl. No.: **11/627,796**

(22) Filed: **Jan. 26, 2007**

(65) **Prior Publication Data**

US 2010/0328163 A1 Dec. 30, 2010

Related U.S. Application Data

(60) Provisional application No. 60/762,644, filed on Jan. 27, 2006.

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

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

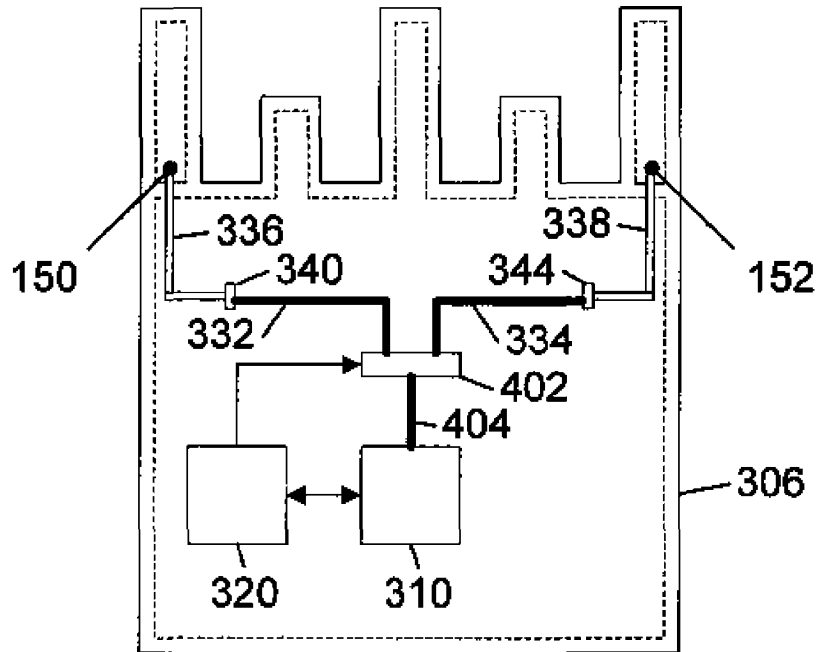
(58) **Field of Classification Search** **343/702, 343/700 MS, 834, 905**

See application file for complete search history.

(57) **ABSTRACT**

Systems and methods for a dual-band antenna and methods for manufacturing the same are described. One system and method includes a plurality of antenna elements. Groups of the antenna elements cooperate to form directional antennas at various frequencies. Using an active element, configurable at different frequencies and reflectors tuned to different frequencies, directed transmission or direction of positive gain for the antenna system is achieved. The system can be used for various wireless communication protocols and at various frequency ranges.

39 Claims, 7 Drawing Sheets





US007965247B2

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

(10) **Patent No.:** **US 7,965,247 B2**
(45) **Date of Patent:** ***Jun. 21, 2011**

- (54) **MULTIBAND ANTENNAS AND DEVICES**
- (75) Inventors: **Thomas S. Laubner**, Merrimac, MA (US); **Robert Schilling**, Londonderry, NH (US)
- (73) Assignee: **M/A-COM Technology Solutions Holdings, Inc.**, Lowell, MA (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.

(58) **Field of Classification Search** 343/702, 343/713, 711, 900
See application file for complete search history.

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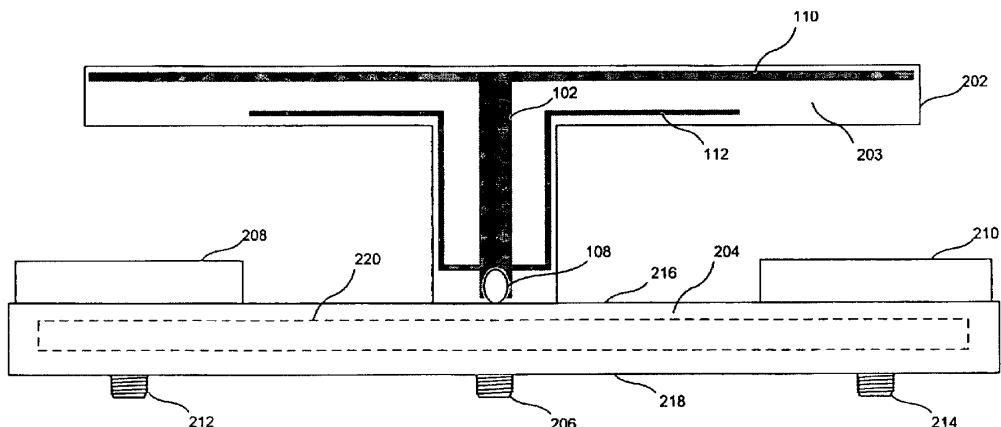
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Primary Examiner — HoangAnh T Le
(74) *Attorney, Agent, or Firm* — Christopher P. Maiorana, PC

- (21) Appl. No.: **12/728,422**
- (22) Filed: **Mar. 22, 2010**
- (65) **Prior Publication Data**
US 2010/0225550 A1 Sep. 9, 2010
- Related U.S. Application Data**
- (63) Continuation of application No. 11/532,942, filed on Sep. 19, 2006, now Pat. No. 7,683,843.
- (60) Provisional application No. 60/734,403, filed on Nov. 8, 2005.
- (51) **Int. Cl.**
H01Q 1/32 (2006.01)
- (52) **U.S. Cl.** **343/713; 343/711**

(57) **ABSTRACT**
An apparatus includes an antenna (e.g., a monopole), a first load, and a second load. The antenna, which extends substantially along an axis, has a first end and a second end. The first load is coupled to the antenna at the first end, while the second load is coupled to the antenna between the first end and the second end. Both the first and second loads are symmetrical with reference to the axis. The apparatus is arranged to operate in at least two frequency bands, such as the AMPS band from about 824 MHz to 894 MHz and the PCS band from about 1850 MHz to 1990 MHz.

19 Claims, 5 Drawing Sheets





US007969361B2

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

(10) **Patent No.:** **US 7,969,361 B2**
(45) **Date of Patent:** **Jun. 28, 2011**

(54) **PLANAR INVERTED-F ANTENNA**
(75) Inventors: **Jesus Alfonso Castaneda**, Los Angeles, CA (US); **Seow-Eng McIlroy**, Westchester, CA (US)

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(73) Assignee: **Broadcom Corporation**, Irvine, 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 862 days.

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(21) Appl. No.: **11/679,659**

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(22) Filed: **Feb. 27, 2007**

(65) **Prior Publication Data**

Primary Examiner — Douglas W Owens

US 2008/0001824 A1 Jan. 3, 2008

Assistant Examiner — Dieu Hien T Duong

Related U.S. Application Data

(74) *Attorney, Agent, or Firm* — Sterne, Kessler, Goldstein & Fox P.L.L.C.

(60) Provisional application No. 60/781,739, filed on Mar. 14, 2006.

(57) **ABSTRACT**

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

A low profile Planar Inverted-F Antenna (PIFA) comprises a radiating strip, an inductive tuning portion, a vertical feed portion, and a retracted ground plane. The radiating strip is approximately parallel to the ground plane and is suspended above the ground plane by the feed element at a certain distance. Further, the radiating strip, in part or entirely, overhangs the ground plane. In this way, the radiating strip may be suspended very close to the ground plane, but yet exhibits a large bandwidth.

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

(58) **Field of Classification Search** 343/700 MS, 343/702, 860, 745

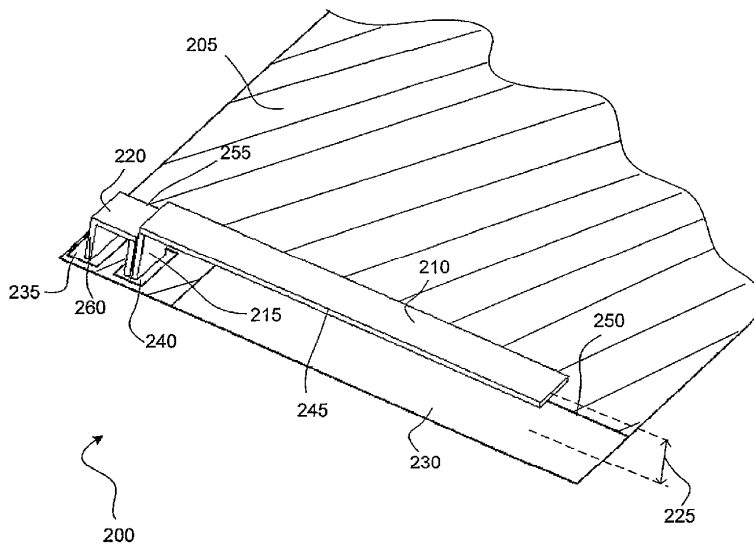
See application file for complete search history.

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24 Claims, 10 Drawing Sheets

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US007969362B2

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

(10) **Patent No.:** **US 7,969,362 B2**
(45) **Date of Patent:** **Jun. 28, 2011**

(54) **SUPER WIDE BANDWIDTH COUPLING ANTENNA**

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(73) Assignee: **Joinsoon Electronic Manufacturing Co., Ltd.**, Taipei County (TW)

Primary Examiner — Jacob Y Choi

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(74) *Attorney, Agent, or Firm* — Leong C. Lei

(21) Appl. No.: **11/872,039**

(22) Filed: **Oct. 15, 2007**

(65) **Prior Publication Data**
US 2009/0096675 A1 Apr. 16, 2009

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
(52) **U.S. Cl.** **343/700 MS**; 343/702; 343/745
(58) **Field of Classification Search** 343/700 MS,
343/702, 841, 846, 878, 745
See application file for complete search history.

(57) **ABSTRACT**

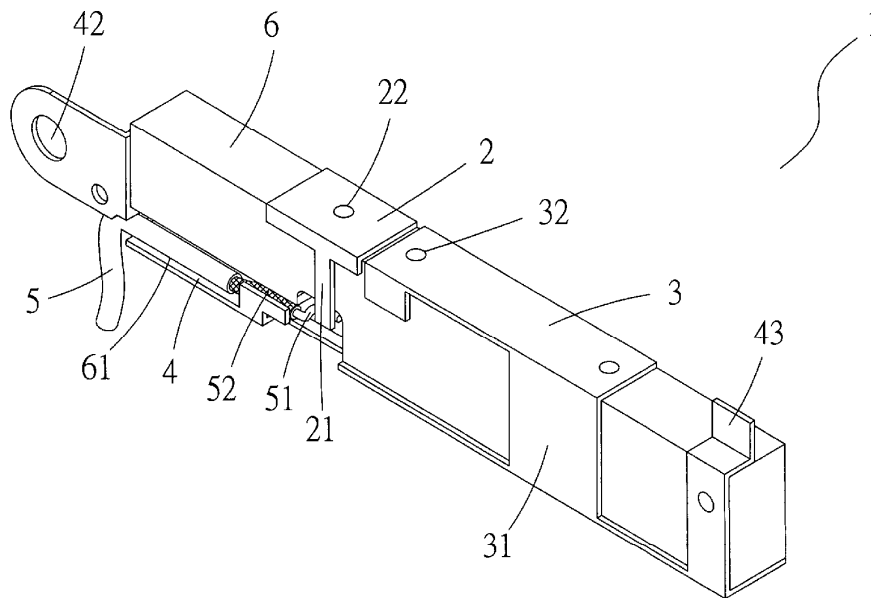
A super wide bandwidth coupling antenna comprises a first radiation portion made of electric conductor; the first radiation having a body and a feeding frame extending from a body of the first radiation portion; a second radiation portion formed by an electric conductor; a supporting frame extending from a body of the second radiation portion; a ground portion made of electric conductor; one end of the ground portion being connected to the supporting frame of the second radiation portion; a signal feeding wire having a main signal end wire which is electrically connected to the feeding frame of the first radiation portion; a ground end wire of the signal feeding wire being electrically connected to the ground portion; an isolation post for positioning the first radiation portion and second radiation portion with an insulating gap between the first radiation portion and second radiation portion.

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3 Claims, 9 Drawing Sheets





US007969365B2

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

(10) **Patent No.:** **US 7,969,365 B2**
(45) **Date of Patent:** **Jun. 28, 2011**

(54) **BOARD-TO-BOARD RADIO FREQUENCY ANTENNA ARRANGEMENT**

(75) Inventors: **Yecheil Asraff**, Modi'in (IL); **Shuki Levy**, Ramat Gan (IL); **Michael Nikolaevsky**, Holon (IL); **Haim Tzfati**, Rishon Le Zion (IL)

(73) Assignee: **Symbol Technologies, Inc.**, Holtsville, NY (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 397 days.

(21) Appl. No.: **12/332,546**

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

(65) **Prior Publication Data**
US 2010/0149041 A1 Jun. 17, 2010

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

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

(58) **Field of Classification Search** **343/702, 343/853, 700 MS; 342/372-375, 70**
See application file for complete search history.

(56) **References Cited**

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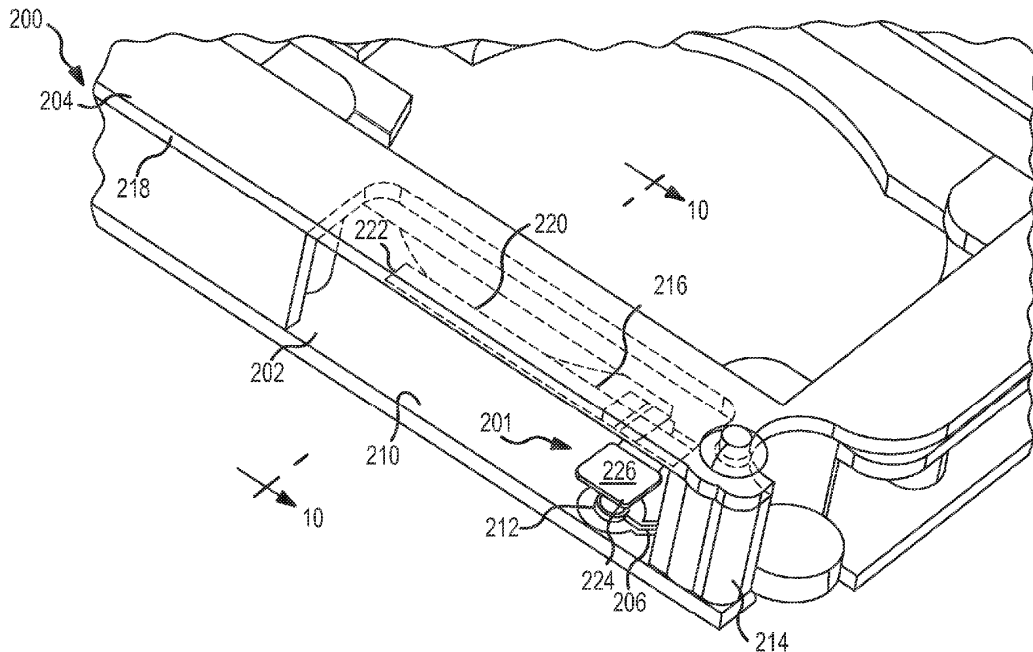
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Primary Examiner — Huedung Mancuso

(57) **ABSTRACT**

A radio frequency (RF) antenna arrangement for an electronic device includes a conductive ground reference element formed on a first circuit board, and a conductive antenna radiating element formed on a second circuit board. The two boards are coupled together such that the conductive ground reference element and the conductive antenna radiating element are facing each other. The RF antenna arrangement also includes a conductive radiating leg element for the conductive antenna radiating element, an electrical contact pin mounted on the first circuit board, and a conductive ground leg element that electrically couples the conductive antenna radiating element to the conductive ground reference element. The electrical contact pin is in physical and electrical contact with the conductive radiating leg element, and the electrical contact pin facilitates RF signal transmission to and from the conductive radiating leg element.

20 Claims, 9 Drawing Sheets





US007969371B2

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

(10) **Patent No.:** **US 7,969,371 B2**
(45) **Date of Patent:** **Jun. 28, 2011**

(54) **SMALL MONOPOLE ANTENNA HAVING LOOP ELEMENT INCLUDED FEEDER**

(75) Inventors: **Je-Hoon Yun**, Daejon (KR); **Jung-Ick Moon**, Daejon (KR); **Joung-Myoun Kim**, Daejon (KR); **Chang-Joo Kim**, 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 229 days.

(21) Appl. No.: **11/996,451**

(22) PCT Filed: **Jul. 21, 2006**

(86) PCT No.: **PCT/KR2006/002887**
§ 371 (c)(1),
(2), (4) Date: **Feb. 24, 2009**

(87) PCT Pub. No.: **WO2007/011191**
PCT Pub. Date: **Jan. 25, 2007**

(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
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Oct. 10, 2005 (KR) 10-2005-0094942

(51) **Int. Cl.**
H01Q 11/12 (2006.01)
H01Q 1/24 (2006.01)

(52) **U.S. Cl.** **343/741; 343/866; 343/702**

(58) **Field of Classification Search** **343/741, 343/742, 702, 866, 867**

See application file for complete search history.

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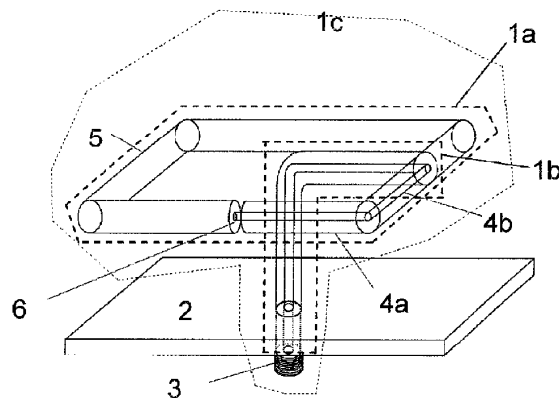
Primary Examiner — HoangAnh T Le

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

(57) **ABSTRACT**

Provided is a small monopole antenna having a loop feeder. The small monopole antenna having a loop feeder includes: a loop element forming a loop along a predetermined plane and having a loop feeder at the center thereof; a non-feeding type monopole antenna element including one end connected to a wire of the loop element and other end connected to a ground unit by being bended at the center of the loop element; a ground unit for grounding other end of the non-feeding type monopole antenna; and a first connecting unit for connecting the non-feeding type monopole antenna to an external device for feeding the loop feeder of the loop element through the non-feeding type monopole antenna.

24 Claims, 14 Drawing Sheets





US007969381B2

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

(10) **Patent No.:** **US 7,969,381 B2**
(45) **Date of Patent:** **Jun. 28, 2011**

(54) **PATCH ANTENNA**
(75) Inventors: **Masaru Kanazawa**, Kawasaki (JP);
Tabito Tonooka, Kawasaki (JP)
(73) Assignee: **Fujitsu Limited**, Kawasaki (JP)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 148 days.

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(21) Appl. No.: **11/902,834**
(22) Filed: **Sep. 26, 2007**

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(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
Dec. 25, 2006 (JP) 2006-347355

Primary Examiner — Jacob Y Choi
Assistant Examiner — Robert Karacsony
(74) *Attorney, Agent, or Firm* — Westerman, Hattori, Daniels & Adrian, LLP

(51) **Int. Cl.**
H01Q 3/24 (2006.01)
H01Q 1/24 (2006.01)
H01Q 1/38 (2006.01)
H04M 1/00 (2006.01)
(52) **U.S. Cl.** **343/876**; 343/702; 343/700 MS;
455/575.3
(58) **Field of Classification Search** 343/702,
343/700 MS, 876, 756; 455/575.1, 575.3,
455/575.7, 90.3
See application file for complete search history.

(57) **ABSTRACT**
A wireless device has a housing, a patch antenna, and an open/shut sensing unit which senses the open/shut state of the housing and forms an open/shut signal indicating the open/shut state. The patch antenna has a first element which corresponds to a first polarized wave, a second element which corresponds to a second polarized wave and is to be added to the first element, and a switching unit. The switching unit disconnects and connects the second element from and to the first element based on the open/shut signal to make the patch antenna suitable for the first or second polarized wave.

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7 Claims, 6 Drawing Sheets

