



US007432859B2

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

(10) **Patent No.:** **US 7,432,859 B2**
(45) **Date of Patent:** **Oct. 7, 2008**

(54) **MULTI-BAND OMNI DIRECTIONAL ANTENNA**

(75) Inventors: **Michael Zinanti**, Wheat Ridge, CO (US); **Shanmuganthan Suganthan**, Watford (GB)

(73) Assignee: **Centurion Wireless Technologies, Inc.**, Lincoln, NE (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 58 days.

(21) Appl. No.: **11/217,760**

(22) Filed: **Sep. 1, 2005**

(65) **Prior Publication Data**

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H01Q 1/38 (2006.01)

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

(58) **Field of Classification Search** **343/700 MS**,
343/702, 795, 790-793, 803, 804, 891
See application file for complete search history.

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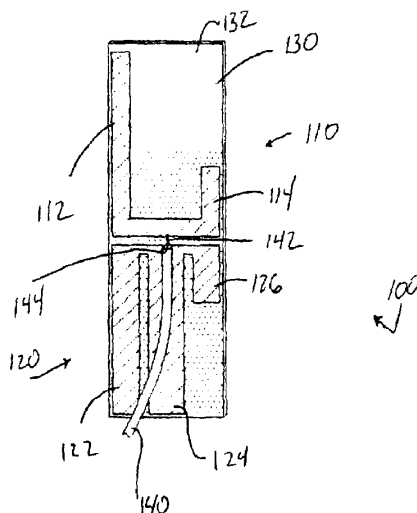
Primary Examiner—Huedung Mancuso

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

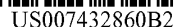
(57) **ABSTRACT**

The present invention provides a printed circuit board omni directional antenna. The omni directional antenna includes power dissipation elements. The power dissipation elements reduces the impact the power feed to the radiating elements has on the omni directional antenna's radiation pattern.

6 Claims, 2 Drawing Sheets



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(45) **Date of Patent:** **Oct. 7, 2008**

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US2007/060304, Mailing Date: Nov. 22, 2007.

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Primary Examiner—Tan Ho
(74) Attorney, Agent, or Firm—Coats & Bennett, P.L.L.C.

(57) **ABSTRACT**

The multi-band antenna described herein includes multiple antenna elements that collectively resonate in multiple different frequency bands. One exemplary antenna includes first and second vertically spaced antenna elements that connect to a ground plane. A feed antenna element positioned between the first and second antenna elements connects to an antenna feed. The electromagnetic coupling produced by the arrangement of these antenna elements produces multiple resonant frequencies, and therefore, defines multiple operating frequency bands of the multi-band antenna.

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

U.S. PATENT DOCUMENTS

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29 Claims, 8 Drawing Sheets



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US007432861B2

(12) **United States Patent**
Shih

(10) **Patent No.:** **US 7,432,861 B2**
(45) **Date of Patent:** **Oct. 7, 2008**

(54) **DUAL-BAND ANTENNA**

(75) Inventor: **Yen-Yi Shih**, Taipei Hsien (TW)

(73) Assignee: **Hon Hai Precision Industry Co., Ltd.**,
Tu-Cheng, 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 0 days.

(21) Appl. No.: **11/560,859**

(22) Filed: **Nov. 17, 2006**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Apr. 21, 2006 (TW) 95114366 A

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

(52) **U.S. Cl.** **343/700 MS; 343/846;**
343/767; 343/770

(58) **Field of Classification Search** 343/700 MS,
343/846, 767, 770

See application file for complete search history.

(56) **References Cited**

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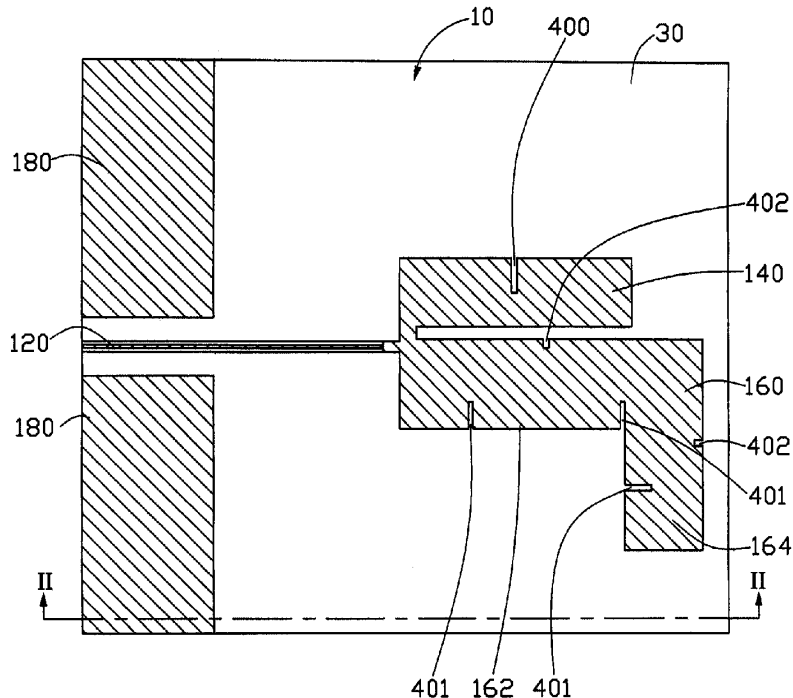
Primary Examiner—Hoang V Nguyen

(74) *Attorney, Agent, or Firm*—Wei Te Chung

(57) **ABSTRACT**

A dual-band antenna (10) is provided. The dual-band antenna printed on a substrate (30) includes a transmission portion (120), a first radiator (140), a second radiator (160), a first grounded portion (180), and a second grounded portion (190). The transmission portion is used for feeding electromagnetic signals. The first radiator is electronically connected to the transmission portion for transceiving electromagnetic signals with a first frequency. The second radiator is electronically connected to the transmission portion for transceiving electromagnetic signals with a second frequency. The first grounded portion is disposed on a first surface of the substrate. The second grounded portion is disposed on a second surface of the substrate. A length of the second grounded portion is greater than that of the first grounded portion. An antenna assembly is also provided in the present invention.

20 Claims, 13 Drawing Sheets



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US007432862B2

(12) **United States Patent**
Heyde

(10) **Patent No.:** **US 7,432,862 B2**
(45) **Date of Patent:** **Oct. 7, 2008**

(54) **BROADBAND PATCH ANTENNA**

SE WO 01/41256 A1 6/2001

(75) Inventor: **Wolfgang Heyde**, Herisau (CH)

OTHER PUBLICATIONS

(73) Assignee: **Huber + Suhner AG**, Herisau (CH)

(*) 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.: **11/566,265**

(22) Filed: **Dec. 4, 2006**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. PCT/CH2005/000319, filed on Jun. 7, 2005.

(30) **Foreign Application Priority Data**

Jun. 23, 2004 (CH) 1060/04

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

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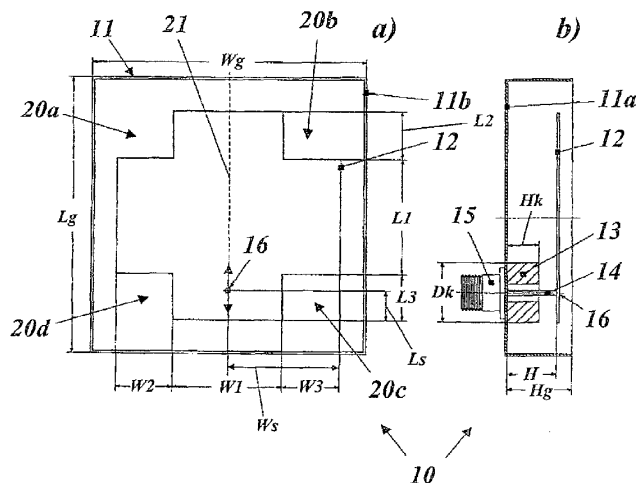
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(57) **ABSTRACT**

A broadband patch antenna including a planar metallic patch sheet that is provided with right-angled edges and is disposed at a predetermined first height above and parallel to the planar base area of an electrically conducting reflector, and a device for feeding an RF signal into the metallic patch sheet. The feeding device encompasses a conductor which is guided in a vertical direction and is insulated through the base area of the reflector and terminates at a feeding point on the metallic patch sheet. To significantly improve the broadband range while keeping the structure of the antenna simple, the metallic patch sheet has the shape of a cross and the conductor of the feeding device is an inner conductor of a coaxial conductor that is positioned between the base area of the reflector and the metallic patch sheet.

19 Claims, 3 Drawing Sheets



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US007432863B2

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

(10) **Patent No.:** **US 7,432,863 B2**

(45) **Date of Patent:** **Oct. 7, 2008**

(54) **PATCH ANTENNA FOR LOCAL AREA COMMUNICATIONS**

(75) Inventors: **Yong-jin Kim**, Seongnam-si (KR);
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(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.: **11/604,773**

(22) Filed: **Nov. 28, 2006**

(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
May 24, 2006 (KR) 10-2006-0046366

(51) **Int. Cl.**
H01Q 1/38 (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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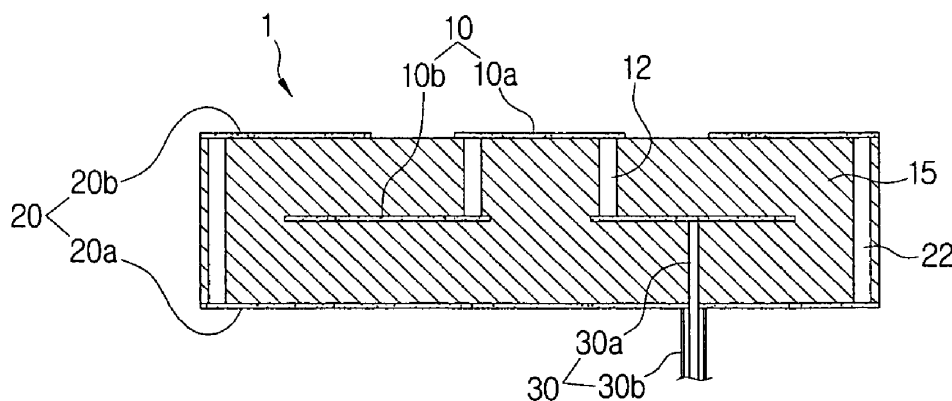
Primary Examiner—Tan Ho

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

(57) **ABSTRACT**

A patch antenna includes a radiator part which includes at least one first radiator attached to an area of one surface of a dielectric, and at least one second radiator disposed within the dielectric and electrically connected to the first radiator; and a ground part which comprises at least one first ground disposed on other surface of the dielectric and at least one second ground disposed on the one surface of the dielectric, the first ground and the second ground electrically connected to each other. Accordingly, the size of the patch antenna is drastically reduced, and a wide bandwidth, high gain, and directionality are obtained.

17 Claims, 4 Drawing Sheets



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US007432864B1

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

(10) **Patent No.:** **US 7,432,864 B1**

(45) **Date of Patent:** **Oct. 7, 2008**

(54) **MODULARIZED PLANAR ANTENNA
STRUCTURE**

(75) Inventors: **Tsai-Yi Yang**, Tainan Hsien (TW); **Te-Yi Chu**, Tainan Hsien (TW)

(73) Assignee: **Cirotech Technology Corp.**, Tainan (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.

(21) Appl. No.: **11/688,905**

(22) Filed: **Mar. 21, 2007**

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H01Q 1/12 (2006.01)

(52) **U.S. Cl.** **343/700 MS; 343/878**

(58) **Field of Classification Search** **343/700 MS, 343/702, 845, 878**

See application file for complete search history.

(56) **References Cited**

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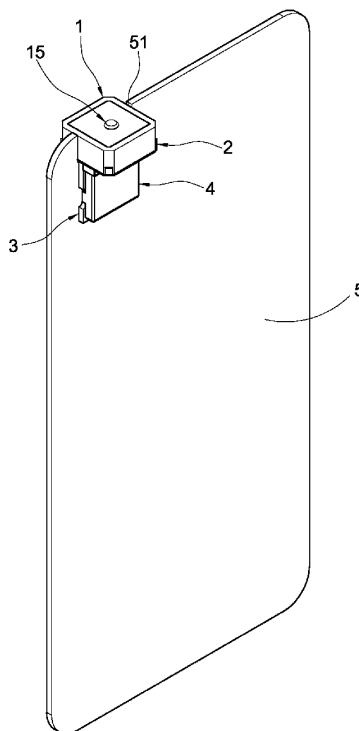
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Primary Examiner—Shih-Chao Chen

(57) **ABSTRACT**

A modularized planar antenna structure includes an antenna unit, a connection unit, a circuit board and a cover. The modularized planar antenna structure connects the antenna unit and circuit board. The antenna unit includes a signal feeder electrically connected the circuit board at end thereof such that the antenna unit is vertical to the circuit board. The cover is assembled to the circuit to protect the circuit board from electromagnetic interference or strike of external article. When the antenna structure is assembled to a main circuit board of an electronic device, the circuit board can be directly assembled to the main circuit board of an electronic device and the circular-polarized antenna unit points toward zenith direction to receive satellite signal.

19 Claims, 8 Drawing Sheets



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US007432865B2

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

(10) **Patent No.:** **US 7,432,865 B2**
(45) **Date of Patent:** **Oct. 7, 2008**

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

(75) Inventors: **Feng-Ghi Eddie Tsai**, Taipei Hsien (TW); **Chia-Tien Li**, Taipei Hsien (TW)

(73) Assignee: **Wistron Neweb Corp.**, Sijhih (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 127 days.

(21) Appl. No.: **11/242,802**

(22) Filed: **Oct. 5, 2005**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

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H01Q 1/38 (2006.01)

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

(58) **Field of Classification Search** 343/700 MS, 343/702, 846, 795, 895

See application file for complete search history.

(56) **References Cited**

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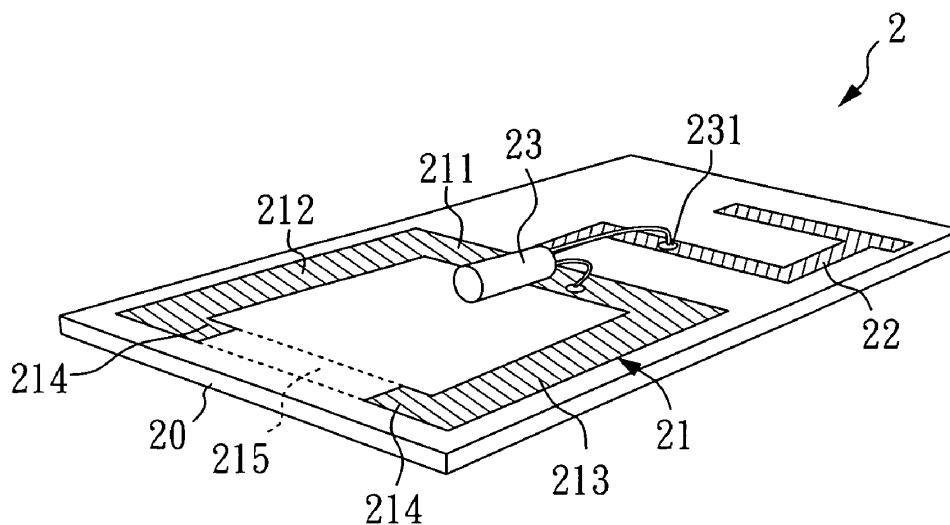
Primary Examiner—Michael C Wimer

(74) *Attorney, Agent, or Firm*—Bacon & Thomas, PLLC

(57) **ABSTRACT**

An antenna with an adjustable grounding element and a related portable device is disclosed. The grounding element of the antenna according to the present invention includes a first section, a second section and a third section, wherein the first section is separately connected to the second section and the third section, such that a shape of the grounding element is substantially hollowed, such as an upside-down U shape. Alternatively, the grounding element further comprises a fourth section having an opening. By adjusting the grounding element or positions or sizes of the opening of the fourth section can obtain different radiation patterns.

14 Claims, 12 Drawing Sheets



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US007432867B2

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

(10) **Patent No.:** **US 7,432,867 B2**

(45) **Date of Patent:** **Oct. 7, 2008**

(54) **ELECTRONIC DEVICE HAVING DIPOLE ANTENNA**

(75) Inventors: **Hung-Chih Wang**, Kao-Hsiung (TW);
Saou-Wen Su, Taipei (TW)

(73) Assignee: **Lite-On Technology Corp.**, Neihsu,
Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
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(21) Appl. No.: **11/609,310**

(22) Filed: **Dec. 11, 2006**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 9/16 (2006.01)

H01Q 1/40 (2006.01)

(52) **U.S. CL.** **343/702; 343/793; 343/873**

(58) **Field of Classification Search** **343/702,**
343/793, 872, 873

See application file for complete search history.

(56) **References Cited**

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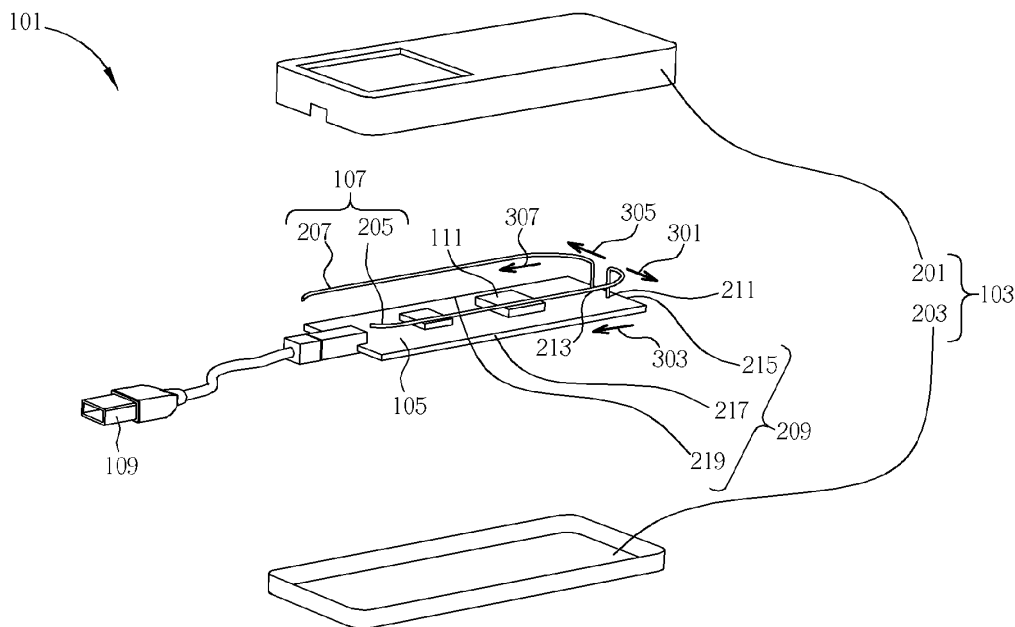
Primary Examiner—Shih-Chao Chen

(74) *Attorney, Agent, or Firm*—Winston Hsu

(57) **ABSTRACT**

The present invention provides an electronic device. The electronic device comprises a circuit board; and a dipole antenna, having a first conducting portion and a second conducting portion that are electrically coupled to the circuit board respectively and disposed substantially along an outline of the circuit board.

13 Claims, 4 Drawing Sheets



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US007432870B2

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

(10) **Patent No.:** **US 7,432,870 B2**
(45) **Date of Patent:** **Oct. 7, 2008**

(54) **PLANAR ANTENNA**

(75) Inventors: **Masao Teshima**, Kunitachi (JP); **Hiroshi Shimasaki**, Hamura (JP)

(73) Assignee: **Kabushiki Kaisha Toshiba**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 224 days.

(21) Appl. No.: **11/470,919**

(22) Filed: **Sep. 7, 2006**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

May 16, 2006 (JP) 2006-136977

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H01Q 13/10 (2006.01)

H01Q 9/28 (2006.01)

(52) **U.S. Cl.** **343/767; 343/770; 343/795**

(58) **Field of Classification Search** **343/767, 343/770, 795, 700 MS**

See application file for complete search history.

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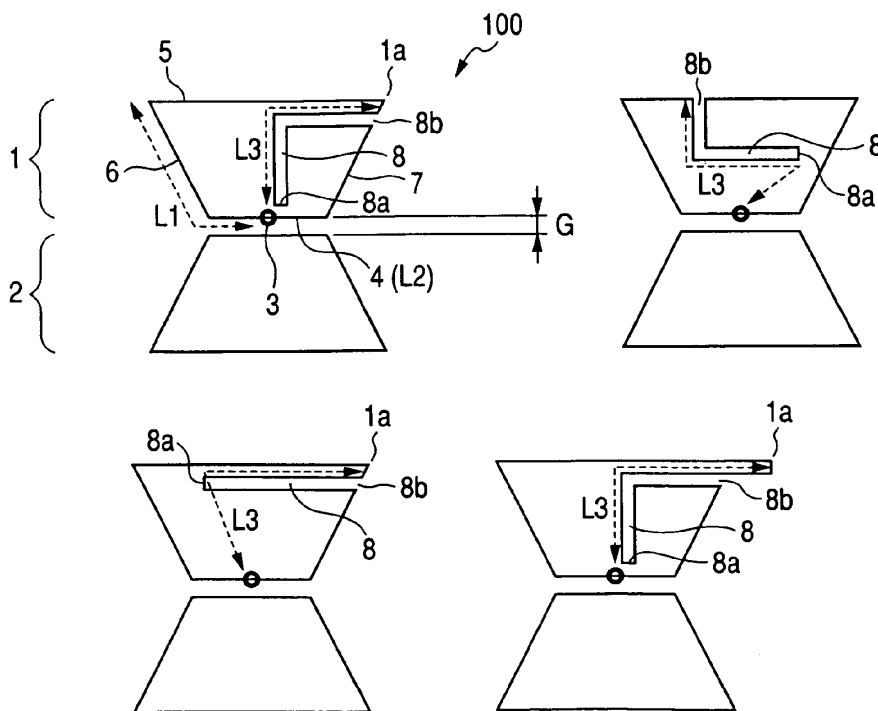
Primary Examiner—Hoang V Nguyen

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

(57) **ABSTRACT**

A planar antenna includes first and second radiation elements. A first partial periphery of the first radiation element and a second partial periphery of the second radiation element face each other at a uniform gap equal to or less than a tenth of the length of the first partial periphery. The first radiation element includes a third partial periphery parallel to a straight line for connecting the both ends of the first partial periphery, a feeding point at a central portion of the first partial periphery, and a slit having an opened end and a closed end. A distance from the feeding point to the opened end along the slit through the closed end is longer than a sum of a half of the first partial periphery and a longer one of the other two partial peripheries.

5 Claims, 12 Drawing Sheets



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US007432873B2

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

(10) **Patent No.:** **US 7,432,873 B2**
(45) **Date of Patent:** **Oct. 7, 2008**

(54) **MULTI-BAND PRINTED DIPOLE ANTENNA**

(75) Inventors: **Patrice Brachat**, Nice (FR); **Philippe Ratajczak**, Nice (FR); **Frédéric Devillers**, Nice (FR)

(73) Assignee: **France Telecom**, Paris (FR)

(*) 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.: **11/888,756**

(22) Filed: **Aug. 2, 2007**

(65) **Prior Publication Data**
US 2008/0030418 A1 Feb. 7, 2008

Related U.S. Application Data

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

(52) **U.S. Cl.** **343/795**; 343/810

(58) **Field of Classification Search** 343/795,
343/810, 812, 813, 700 MS
See application file for complete search history.

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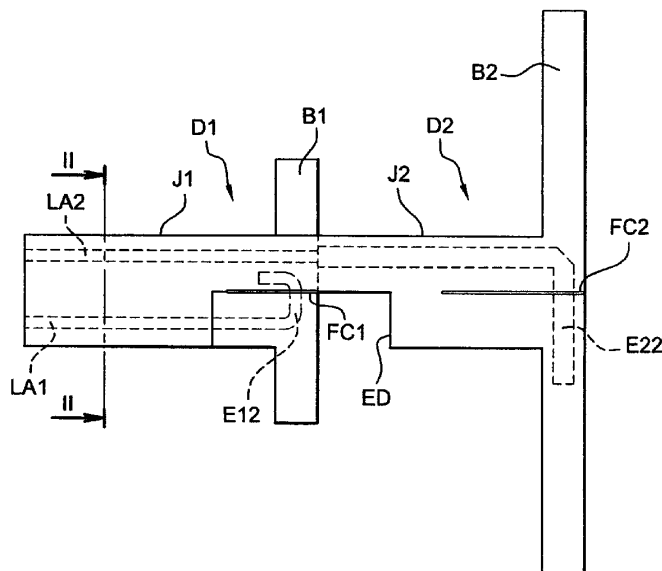
Primary Examiner—Hoang V Nguyen

(74) *Attorney, Agent, or Firm*—Lawrence E Laubscher, Sr;
Lawrence E Laubscher, Jr

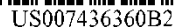
(57) **ABSTRACT**

The invention relates to a printed antenna comprising a dielectric substrate (CS1, CS2) supporting feeder lines (LA1, LA2) and first and second T-shaped dipoles (D1, D2) of different sizes for dual-band operation. Each dipole includes a stem (J1, J2) and two radiating arms (B1, B2) separated by a coupling slot (FC1, FC2) made in the stem. For compactness of the antenna, the stems are partly superimposed, the coupling slots are aligned and a decoupling cut-out (ED) is made in the second dipole so as to uncover the coupling slot of the first dipole, by virtue of their superposition. The substrate can comprise one, two or three layers. Plural antennas can constitute an antenna network used as a base element in one-dimensional or two-dimensional network.

9 Claims, 6 Drawing Sheets



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(10) **Patent No.:** US 7,436,360 B2
(45) **Date of Patent:** Oct. 14, 2008



US007436365B1

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

(10) **Patent No.:** **US 7,436,365 B1**
(45) **Date of Patent:** **Oct. 14, 2008**

(54) **COMMUNICATIONS ASSEMBLY AND ANTENNA RADIATOR ASSEMBLY**

(75) Inventors: **Yu Chee Tan**, Singapore (SG); **Xi Lin (Vick) Chen**, Singapore (SG); **Yew Siow (Roger) Tay**, Singapore (SG)

(73) Assignee: **Motorola, Inc.**, Schaumburg, IL (US)

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

(21) Appl. No.: **11/743,180**

(22) Filed: **May 2, 2007**

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H01Q 1/24 (2006.01)

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

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

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Primary Examiner Huedung Mancuso

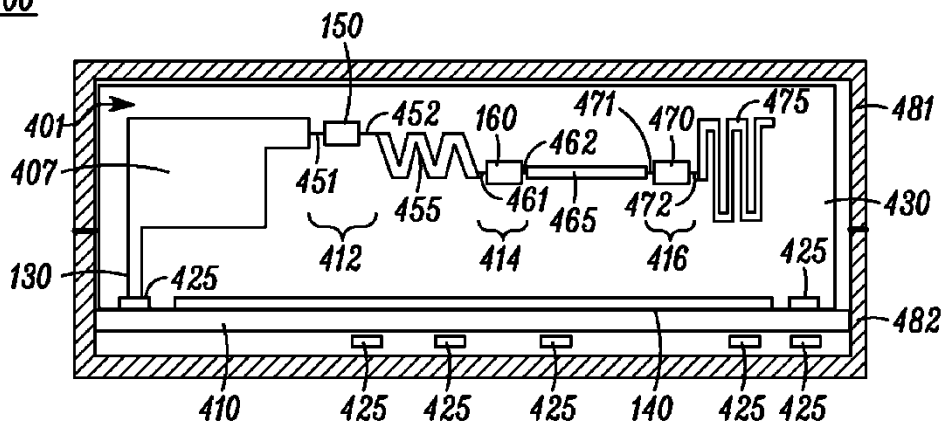
(74) *Attorney, Agent, or Firm*—Randall S. Vaas

(57) **ABSTRACT**

A radio communications assembly (200) and an antenna radiator assembly (201). The antenna radiator assembly (201) forms part of the radio communications assembly (200) and is housed in a housing (202, 203). The antenna radiator assembly (201) has a circuit board (210) supporting electrical conductors (225) one of which is coupled to a feed point (130). There is also a ground plane (140) and an antenna radiator element (107) is coupled to the feed point (130). The antenna radiator element (107) is spaced from the ground plane (140) and a tertiary antenna radiator arm (155) spaced from the antenna radiator element (107). There is also a first band stop filter (150) disposed in a space (212) between the tertiary antenna radiator arm (155) and the antenna radiator element (107). The first band stop filter (150) provides electrical coupling of the antenna radiator element (107) to the tertiary antenna radiator arm (155) at its band pass frequencies. Further, the first band stop filter (150) provides for electrically de-coupling of the antenna radiator element (107) from the tertiary antenna radiator arm (155) at its first band stop bandwidth.

22 Claims, 6 Drawing Sheets

400



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US007439910B2

(12) **United States Patent**
Lee

(10) **Patent No.:** **US 7,439,910 B2**
(45) **Date of Patent:** **Oct. 21, 2008**

(54) **THREE-DIMENSIONAL ANTENNA
STRUCTURE**

(75) Inventor: **Gwo-Yun Lee**, Taipei (TW)

(73) Assignee: **Compal Electronics, 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.

(21) Appl. No.: **11/309,198**

(22) Filed: **Jul. 13, 2006**

(65) **Prior Publication Data**

US 2007/0126639 A1 Jun. 7, 2007

(30) **Foreign Application Priority Data**

Dec. 7, 2005 (TW) 94143092 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** **343/702, 343/700 MS**

See application file for complete search history.

(56) **References Cited**

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Primary Examiner—Hoang V Nguyen

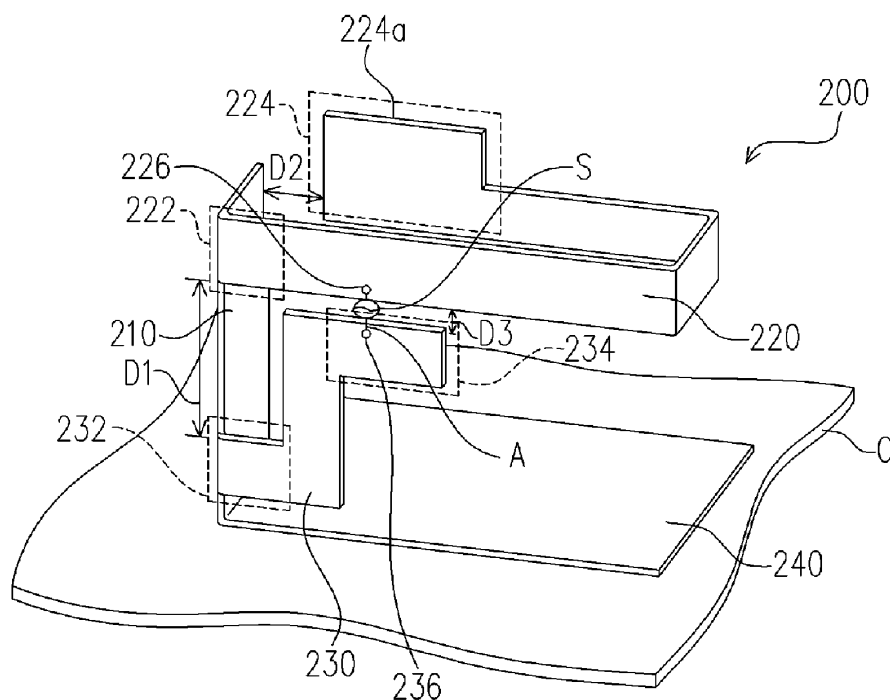
Assistant Examiner—Robert Karacsony

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

(57) **ABSTRACT**

A three-dimensional antenna structure suitable for being built in an electronic device includes a vertical patch, an annular patch and a ground patch. The vertical patch is suitable for generating a vertical current. One end of the annular patch is connected to the vertical patch, and the annular patch surrounds one side of the vertical patch for generating an annular current. An omni-directional radiation field is generated by the annular current and the vertical current. The annular patch has a feed point for electrically connecting to a signal source. One end of the ground patch is connected to the vertical patch. A distance exists between the end of the annular patch and the end of the ground patch. The other end of the ground patch has a shorting point next to the feed point and is suitable for electrically connecting to a ground.

13 Claims, 3 Drawing Sheets



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US007439911B2

(12) **United States Patent**
Wang

(10) **Patent No.:** **US 7,439,911 B2**
(45) **Date of Patent:** **Oct. 21, 2008**

(54) **SLOT AND MULTI-INVERTED-F COUPLING
WIDEBAND ANTENNA AND ELECTRONIC
DEVICE THEREOF**

(75) Inventor: **Chih-Ming Wang**, Hsinchu (TW)

(73) Assignee: **Wistron NeWeb Corp.**, 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 145 days.

(21) Appl. No.: **11/340,144**

(22) Filed: **Jan. 25, 2006**

(65) **Prior Publication Data**

US 2007/0103367 A1 May 10, 2007

(30) **Foreign Application Priority Data**

Nov. 9, 2005 (TW) 94139234 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, 846

See application file for complete search history.

(56) **References Cited**

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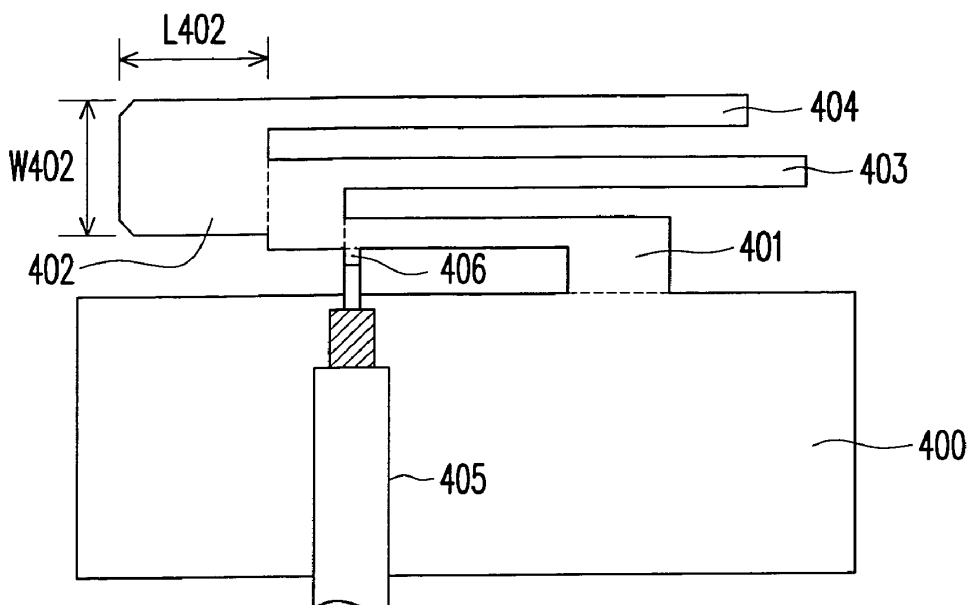
Primary Examiner—HoangAnh T Le

(74) *Attorney, Agent, or Firm*—J.C. Patents

(57) **ABSTRACT**

A slot and multi-inverted-F coupling wideband antenna and an electronic device using the aforementioned wideband antenna are disclosed. The antenna includes at least a ground portion, a first radiation portion, a second radiation portion, a third radiation portion, a fine tuning metal portion, and a transmission cable. The first radiation portion is electrically coupled to the ground portion. The fine tuning metal portion is electrically coupled to the first radiation portion. The second radiation portion is electrically coupled to the fine tuning metal portion and forms a first inverted-F antenna with the first radiation portion. The third radiation portion is electrically coupled to the fine tuning metal portion and forms a second inverted-F antenna with the first radiation portion. The transmission cable is electrically coupled to one of the first radiation portion and the fine tuning metal portion.

24 Claims, 14 Drawing Sheets



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US007439912B2

(12) **United States Patent**
Shih

(10) **Patent No.:** **US 7,439,912 B2**
(45) **Date of Patent:** **Oct. 21, 2008**

(54) **ULTRA-WIDEBAND ANTENNA**

(75) Inventor: **Yen-Yi Shih**, Taipei Hsien (TW)

(73) Assignee: **Hon Hai Precision Industry Co., Ltd.**,
Tu-Cheng, 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 0 days.

(21) Appl. No.: **11/565,660**

(22) Filed: **Dec. 1, 2006**

(65) **Prior Publication Data**

US 2007/0279290 A1 Dec. 6, 2007

(30) **Foreign Application Priority Data**

Jun. 2, 2006 (TW) 95119630

(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, 795, 846

See application file for complete search history.

(56) **References Cited**

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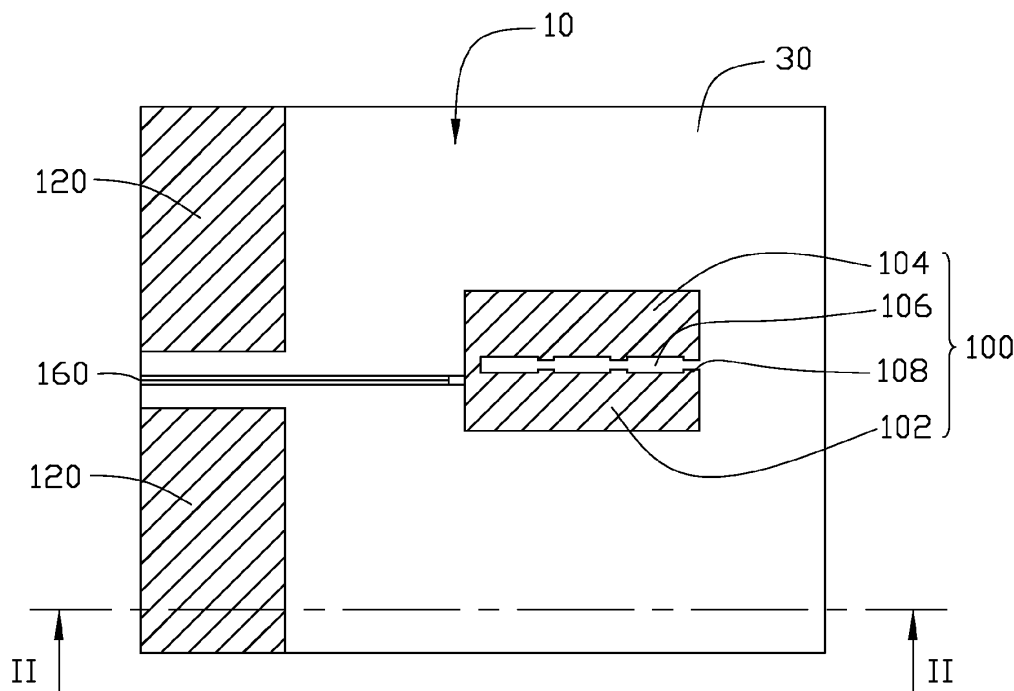
Primary Examiner—Hoang V Nguyen

(74) *Attorney, Agent, or Firm*—Wei Te Chung

(57) **ABSTRACT**

An ultra-wideband (UWB) antenna (10), disposed on a substrate (30), includes a body (100), a feeding part (160), and at least one first ground plane (120). The body, for receiving and transmitting electromagnetic signals, includes a first radiating part (102) and a second radiating part (104) connected to the first radiating part. The body defines a gap (106) between the first radiating part and the second radiating part. The feeding line, electrically connected to the body, feeds electromagnetic signals to the body. The at least one first ground plane is disposed on a side of the feeding part, and is grounded.

17 Claims, 13 Drawing Sheets



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US007439914B1

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

(10) **Patent No.:** **US 7,439,914 B1**
(45) **Date of Patent:** **Oct. 21, 2008**

(54) **ANTENNA UNIT**

(75) Inventors: **Ching-chi Lin**, Tu-Cheng (TW);
Jia-hung Su, Tu-Cheng (TW); **Kai Shih**,
Tu-Cheng (TW); **Yu-yuan Wu**,
Tu-Cheng (TW)

(73) Assignee: **Cheng Uei Precision Industry Co.,
Ltd.**, 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 0 days.

(21) Appl. No.: **11/790,706**

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

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

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

(58) **Field of Classification Search** 343/700 MS,
343/749, 702, 795, 803, 819, 722
See application file for complete search history.

(56) **References Cited**

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Primary Examiner—Tho G Phan

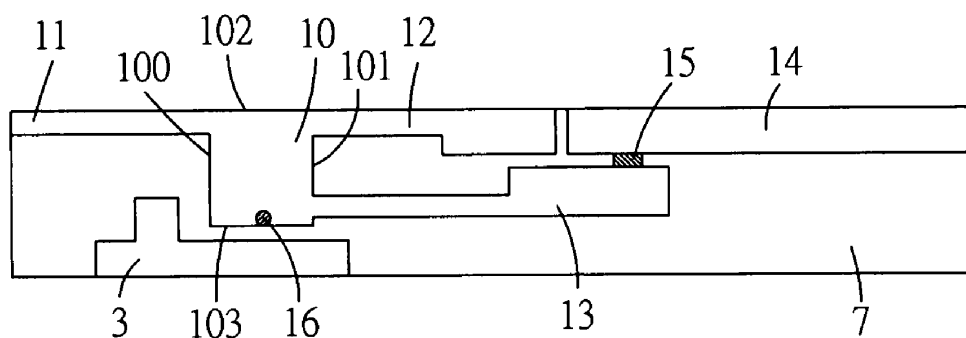
(74) *Attorney, Agent, or Firm*—Rosenberg, Klein & Lee

(57) **ABSTRACT**

An antenna unit has a first antenna operating at wireless telecommunication bands and a second antenna operating at wireless local area network bands. The first antenna has a first radiating conductor with a first feeding point defining opposite sides, a second, a third and a fourth radiating conductors extending from both sides of the first radiating conductor. A parasitic element defines opposite ends. One end of the parasitic element confronts the free end of the third radiating conductor. A trap circuit connects the fourth radiating conductor and the parasitic element. A second antenna has a third side, a fourth side and a stair-shape side. The connection of the sides of the second antenna forms a first protrusion with a second feeding point and a second protrusion confronting the first antenna. A slot is opened on the second antenna. A ground portion is spaced from the first radiating conductor and the first protrusion.

19 Claims, 5 Drawing Sheets

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US007439915B2

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

(10) **Patent No.:** **US 7,439,915 B2**
(45) **Date of Patent:** **Oct. 21, 2008**

(54) **ANTENNA UNIT AND FEEDING COMPONENT**

(75) Inventors: **Junichi Noro**, Akita (JP); **Kyuichi Sato**, Akita (JP); **Nobuaki Monma**, Akita (JP); **Shozo Miyamoto**, Akita (JP); **Takumi Suzuki**, Akita (JP)

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

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

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(21) Appl. No.: **11/960,362**

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(22) Filed: **Dec. 19, 2007**

JP 2005-020644 A 1/2005

(65) **Prior Publication Data**

US 2008/0129633 A1 Jun. 5, 2008

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Related U.S. Application Data

Primary Examiner—Tho G Phan

(62) Division of application No. 11/320,081, filed on Dec. 28, 2005, now Pat. No. 7,348,925.

(74) *Attorney, Agent, or Firm*—Frishauf, Holtz, Goodman & Chick, P.C.

(30) **Foreign Application Priority Data**

Mar. 28, 2005 (JP) 2005-091304

(57) **ABSTRACT**

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
(52) **U.S. Cl.** 343/700 MS; 343/846
(58) **Field of Classification Search** 343/700 MS, 343/846, 850, 829, 848, 702
See application file for complete search history.

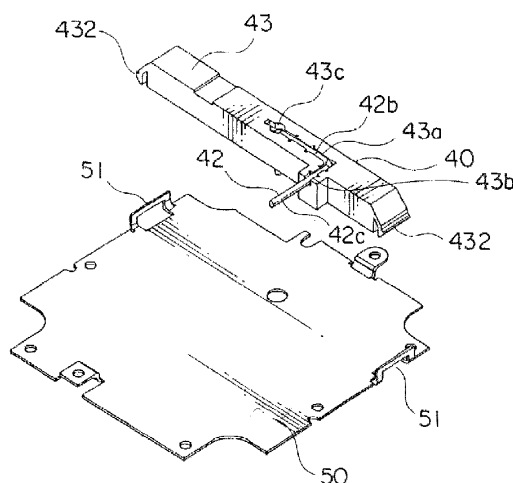
An antenna unit includes a feeding component **40** and a metal plate **50** on which the feeding component **40** is mounted. The feeding component **40** has an attaching member **43** made of resin to support a feeding line against the metal plate. The metal plate **50** has a pair of cut and raised parts **51** at both ends thereof while the attaching member **43** has a pair of locking hooks **432** at both ends thereof. The locking hooks are partly inserted into the cut and raised parts and thereby the feeding component is attached to the metal plate without projecting any parts of the attaching member from a rear surface of the metal plate.

(56) **References Cited**

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4 Claims, 7 Drawing Sheets



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US007439916B2

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

(10) **Patent No.:** **US 7,439,916 B2**
(45) **Date of Patent:** ***Oct. 21, 2008**

(54) **ANTENNA FOR MOBILE COMMUNICATION TERMINALS**

(75) Inventors: **Hanyang Wang**, Witney (GB); **Stuart Williams**, Fleet (GB)

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

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

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/004,991**

(22) Filed: **Dec. 21, 2007**

(65) **Prior Publication Data**

US 2008/0129612 A1 Jun. 5, 2008

Related U.S. Application Data

(63) Continuation of application No. 11/019,412, filed on Dec. 21, 2004, now Pat. No. 7,339,528.

(30) **Foreign Application Priority Data**

Dec. 24, 2003 (GB) 0330052.2

(51) **Int. Cl.**

H01Q 1/38 (2006.01)

H01Q 19/00 (2006.01)

H01Q 1/48 (2006.01)

(52) **U.S. Cl.** **343/700 MS; 343/833; 343/846**

(58) **Field of Classification Search** 343/700 MS, 343/702, 833, 844, 846, 848
See application file for complete search history.

(56) **References Cited**

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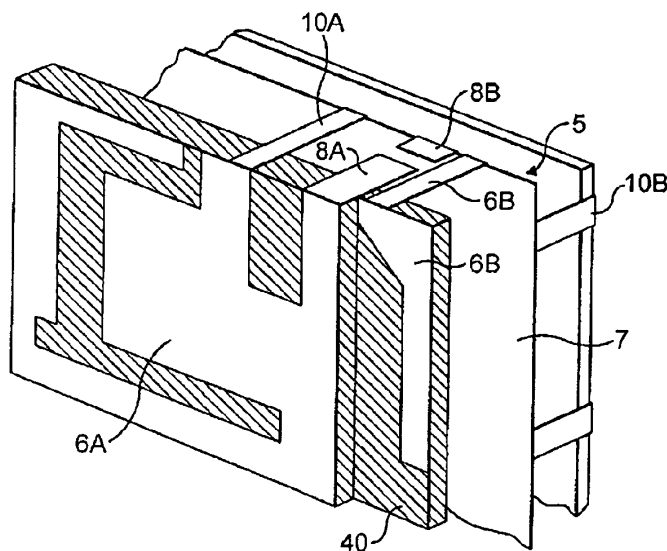
Primary Examiner—Shih-Chao Chen

(74) *Attorney, Agent, or Firm*—Harrington & Smith, PC

(57) **ABSTRACT**

An antenna comprising: a first substantially planar ground plate; a first substantially planar resonator positioned in a plane substantially parallel to the first ground plate; a second substantially planar ground plate positioned in a plane substantially parallel to the first ground plate; two or more connectors for electrically connecting the second ground plate to ground; and one or more connectors for electrically connecting the first resonator to the second ground plate; wherein the first resonator and the second ground plate are connected to at least one of receiver means and transmitter means by antenna feeding means.

31 Claims, 5 Drawing Sheets



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US007439919B2

(12) **United States Patent**
Jansen

(10) **Patent No.:** **US 7,439,919 B2**
(45) **Date of Patent:** **Oct. 21, 2008**

(54) **MULTILAYER PCB ANTENNA**

(75) Inventor: **Stefan Jansen**, København SV (DK)

(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 0 days.

(21) Appl. No.: **11/428,081**

(22) Filed: **Jun. 30, 2006**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. 10/084,981, filed on Mar. 1, 2002.

(30) **Foreign Application Priority Data**

Mar. 2, 2001 (GB) 0105251.3
Mar. 5, 2001 (GB) 0105413.9

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

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

(58) **Field of Classification Search** **343/700 MS, 343/702, 741, 742**

See application file for complete search history.

(56) **References Cited**

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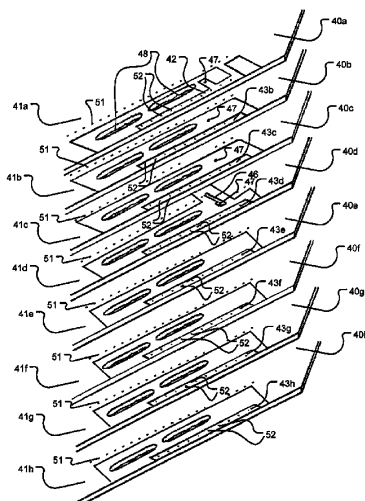
Primary Examiner—Michael C. Wimer

(74) *Attorney, Agent, or Firm*—Scott E. Kamholz; Foley Hoag LLP

(57) **ABSTRACT**

An inverted F-antenna may include an element formed from conductor patterns on a plurality of layers including at least one buried layer of a multilayer PCB, wherein (a) the conductor patterns are in stacked relation and interconnected through the PCB, (b) the conductor patterns comprise an F-shaped conductor pattern on one layer of the PCB and an I-, L- or F-shaped conductor pattern on the or each other layer, and (c) the or each I-, L- or F-shaped conductor pattern comprises an upright substantially coextensive with an upright of the F-shaped conductor pattern. A mobile phone may include such an antenna.

35 Claims, 3 Drawing Sheets



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US007439921B2

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

(10) **Patent No.:** **US 7,439,921 B2**
(45) **Date of Patent:** **Oct. 21, 2008**

(54) **CHIP ANTENNA APPARATUS FOR RECEIVING GLOBAL POSITIONING SYSTEM SIGNALS**

(75) Inventors: **Chuan-Lin Hu**, Sijhih (TW); **Yu-Wei Chen**, Sijhih (TW); **Chang-Lun Liao**, Sijhih (TW); **Shun-Tian Lin**, Taipei (TW); **Chang-Fa Yang**, Taipei (TW); **Yen-Ming Chen**, Taipei (TW); **Chao-Wei Wang**, Taipei (TW)

(73) Assignee: **Chant Sincere Co., Ltd.**, Hsi Chih, 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 0 days.

(21) Appl. No.: **11/564,067**

(22) Filed: **Nov. 28, 2006**

(65) **Prior Publication Data**

US 2007/0247370 A1 Oct. 25, 2007

(30) **Foreign Application Priority Data**

Apr. 20, 2006 (TW) 95114172 A

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

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

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

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Primary Examiner—Hoang V Nguyen

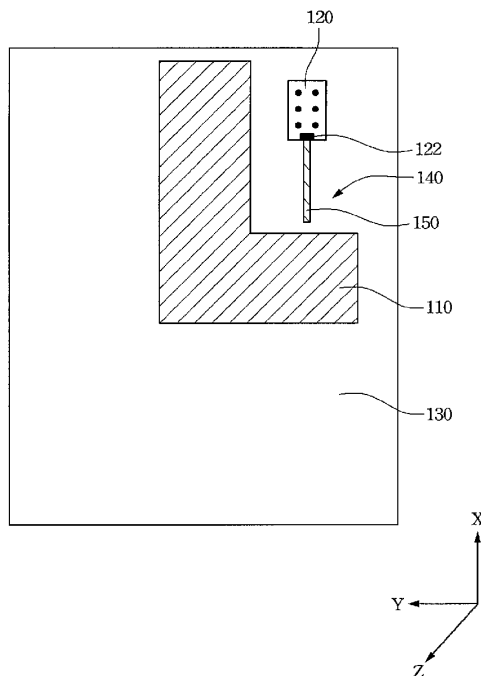
(74) *Attorney, Agent, or Firm*—Thomas, Kayden, Horstemeier & Risley

(57) **ABSTRACT**

A chip antenna apparatus for receiving global positioning system signals, includes a L-shaped ground area and an omni-directional chip antenna. The L-shaped ground area is disposed on a circuit board. The omni-directional chip antenna is disposed in a gap of the L-shaped ground area on the circuit board and electrically connected to the L-shaped ground area.

3 Claims, 14 Drawing Sheets

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US007439922B2

(12) **United States Patent**
Autti

(10) **Patent No.:** **US 7,439,922 B2**
(45) **Date of Patent:** **Oct. 21, 2008**

(54) **ANTENNA FOR A PORTABLE DEVICE**

(75) Inventor: **Marko Autti**, Oulu (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 2 days.

(21) Appl. No.: **11/641,561**

(22) Filed: **Dec. 19, 2006**

(65) **Prior Publication Data**

US 2008/0143631 A1 Jun. 19, 2008

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

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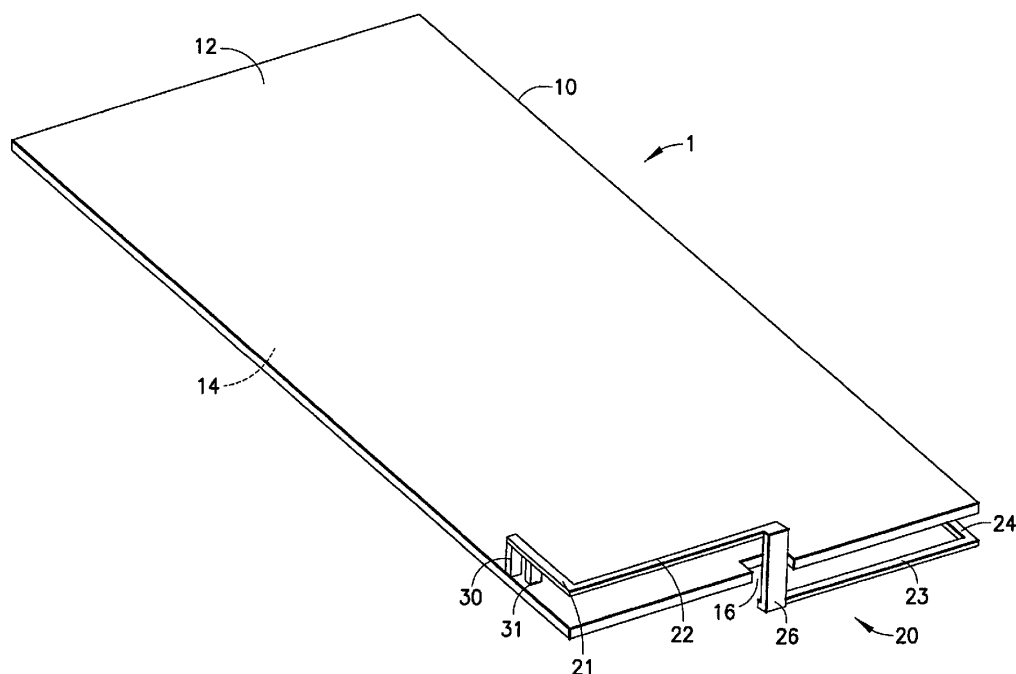
Primary Examiner—Hoang V Nguyen

(74) *Attorney, Agent, or Firm*—Ware, Fressola, Van Der Sluys & Adolphson, LLP

(57) **ABSTRACT**

A GPS antenna has two electrically connected L-sections disposed on opposite sides of a circuit board. The L-sections lie on two separate planes parallel to the circuit board surface. One L-section is connected to a feeding point located at one edge area of the circuit board and the other L-section is connected to a grounding point located at an opposite edge area of the circuit board. Optionally, a second grounding point is connected to the antenna element adjacent to the feeding point for impedance matching purposes. The antenna is configured for use in an electronic device such as a mobile phone.

19 Claims, 4 Drawing Sheets



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US007439923B2

(12) **United States Patent**
Quintero Illera et al.

(10) **Patent No.:** **US 7,439,923 B2**
(45) **Date of Patent:** **Oct. 21, 2008**

(54) **MULTIBAND ANTENNA**

(75) Inventors: **Ramiro Quintero Illera**, Barcelona (ES); **Carles Puente Ballarda**, 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.: **11/702,791**

(22) Filed: **Feb. 6, 2007**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. 10/823,257, filed on Apr. 13, 2004, now Pat. No. 7,215,287, which is a continuation of application No. PCT/EP01/011912, filed on Oct. 16, 2001.

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

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

(58) **Field of Classification Search** 343/700 MS, 343/702, 829, 846, 800, 895
See application file for complete search history.

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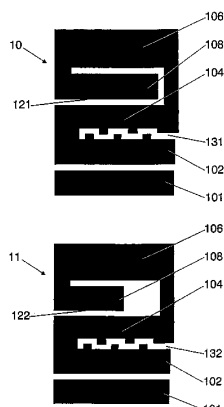
Primary Examiner—Tho G Phan

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

(57) **ABSTRACT**

The present invention relates generally to a new family of antennas with a multiband behavior, so that the frequency bands of the antenna can be tuned simultaneously to the main existing wireless services. In particular, the invention consists of shaping at least one of the gaps between some of the polygons of the multilevel structure in the form of a non-straight curve, shaped in such a way that the whole gap length is increased yet keeping its size and the same overall antenna size. Such a configuration allows an effective tuning of the frequency bands of the antenna, such that with the same overall antenna size, said antenna can be effectively tuned simultaneously to some specific services, such as for instance the five frequency bands that cover the services AMPS, GSM900, GSM1800, PCS1900, UMTS, Bluetooth™, IEEE802.11b, or HyperLAN.

50 Claims, 7 Drawing Sheets



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US007439926B2

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

(10) **Patent No.:** **US 7,439,926 B2**
(45) **Date of Patent:** **Oct. 21, 2008**

(54) **PLANAR ANTENNA FITTED WITH A REFLECTOR**

(75) Inventors: **Koichi Mikami**, Warabi (JP); **Noboru Matsuoka**, Warabi (JP)

(73) Assignee: **Nippon Antena Kabushiki Kaisha**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 97 days.

(21) Appl. No.: **10/530,135**

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

(86) PCT No.: **PCT/JP2004/008749**

§ 371 (c)(1),

(2), (4) Date: **Apr. 4, 2005**

(87) PCT Pub. No.: **WO2005/013422**

PCT Pub. Date: **Feb. 10, 2005**

(65) **Prior Publication Data**

US 2006/0238432 A1 Oct. 26, 2006

(30) **Foreign Application Priority Data**

Aug. 5, 2003 (JP) 2003-286502

May 21, 2004 (JP) 2004-151456

(51) **Int. Cl.**

H01Q 1/42 (2006.01)

H01Q 21/00 (2006.01)

(52) **U.S. Cl.** **343/789**; **343/867**

(58) **Field of Classification Search** **343/789**,
343/792.5, **866**, **867**

See application file for complete search history.

(56) **References Cited**

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Primary Examiner—Shih-Chao Chen

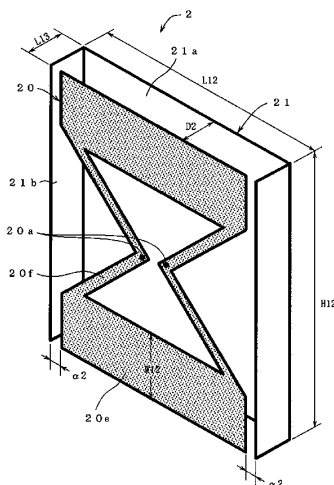
(74) Attorney, Agent, or Firm—Kirk Hahn

(57)

ABSTRACT

A planar antenna fitted with a reflector of small shape and small depth. A reflector **21** of planar shape is provided at the rear face of a radiator **20** of planar shape made of a triangular loop element. The side sections **21b** on both sides of the reflector **21** are bent towards the radiator **20** and the separation $\alpha 2$ between the leading edges of the side sections **21b** and the side edges of the radiator **20** is thereby reduced. In this way, an excellent electrical characteristic of the planar antenna **2** fitted with a reflector and can be achieved by reducing the separation **D2** of the radiator **20** and reflector **21**.

12 Claims, 16 Drawing Sheets



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US007439929B2

(12) **United States Patent**
Ozkar

(10) **Patent No.:** **US 7,439,929 B2**
(45) **Date of Patent:** **Oct. 21, 2008**

(54) **TUNING ANTENNAS WITH FINITE GROUND PLANE**

(75) Inventor: **Mete Ozkar**, Raleigh, NC (US)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 419 days.

(21) Appl. No.: **11/297,337**

(22) Filed: **Dec. 9, 2005**

(65) **Prior Publication Data**

US 2007/0132654 A1 Jun. 14, 2007

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

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

(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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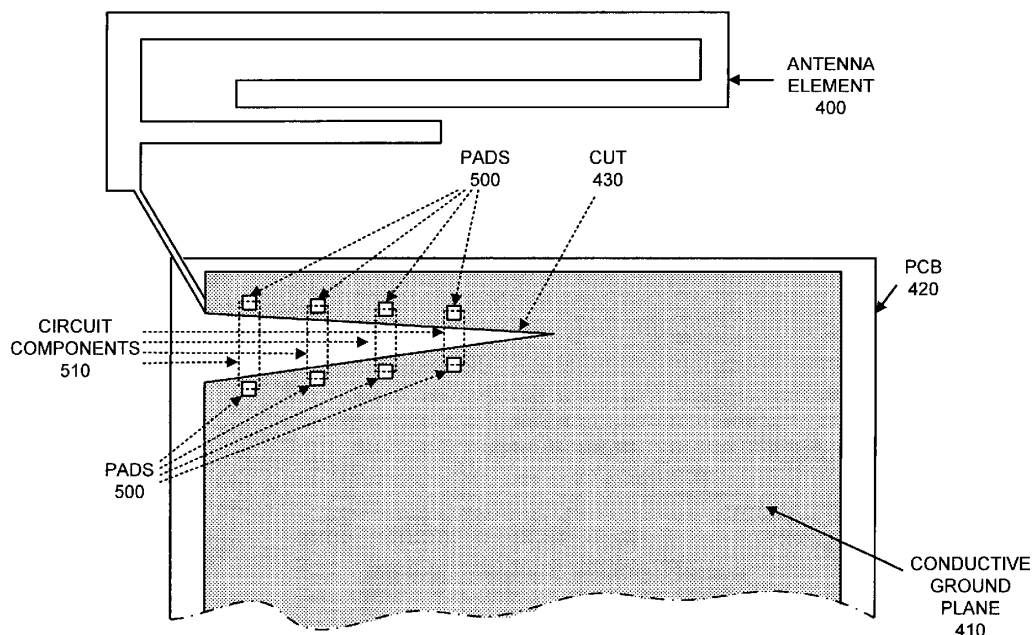
Primary Examiner—Tan Ho

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

(57) **ABSTRACT**

A method of changing a resonant frequency of an antenna includes coupling the antenna to a ground plane of a circuit board, where the ground plane includes conductive material. The method further includes removing a section of conductive material from a first location of the ground plane, where the shape of the removed section and the first location determine the resonant frequency of the antenna.

22 Claims, 7 Drawing Sheets



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US007439935B1

(12) **United States Patent**
Rodenbeck

(10) **Patent No.:** **US 7,439,935 B1**
(45) **Date of Patent:** **Oct. 21, 2008**

(54) **ANTENNA STRUCTURE WITH
DISTRIBUTED STRIP**

(75) Inventor: **Christopher T. Rodenbeck,**
Albuquerque, NM (US)

(73) Assignee: **Sandia Corporation,** Albuquerque, NM
(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.: **11/754,724**

(22) Filed: **May 29, 2007**

Related U.S. Application Data

(62) Division of application No. 11/243,860, filed on Oct.
5, 2005, now Pat. No. 7,345,647.

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

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

(58) **Field of Classification Search** 343/895,
343/700 MS, 702, 846, 767
See application file for complete search history.

(56) **References Cited**

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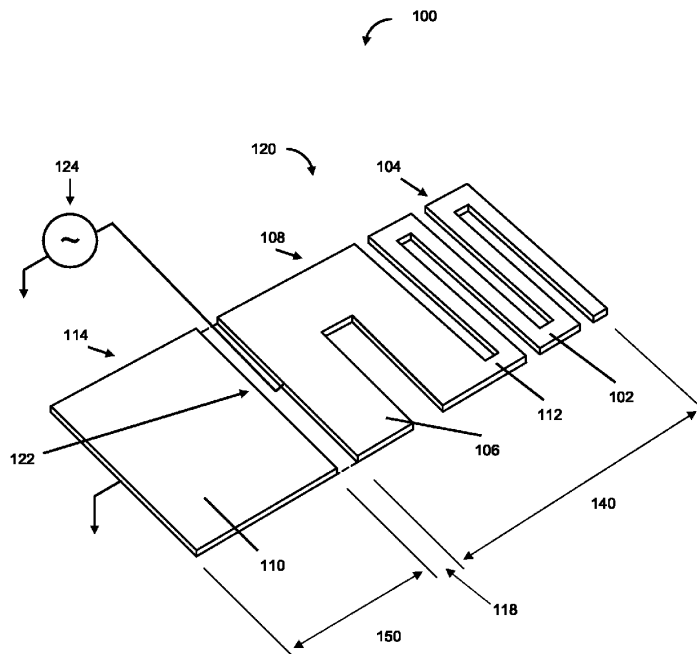
Primary Examiner—Huedung Mancuso

(74) *Attorney, Agent, or Firm*—William R. Conley

(57) **ABSTRACT**

An antenna comprises electrical conductors arranged to form a radiating element including a folded line configuration and a distributed strip configuration, where the radiating element is in proximity to a ground conductor. The folded line and the distributed strip can be electrically interconnected and substantially coplanar. The ground conductor can be spaced from, and coplanar to, the radiating element, or can alternatively lie in a plane set at an angle to the radiating element. Embodiments of the antenna include conductor patterns formed on a printed wiring board, having a ground plane, spacedly adjacent to and coplanar with the radiating element. Other embodiments of the antenna comprise a ground plane and radiating element on opposed sides of a printed wiring board. Other embodiments of the antenna comprise conductors that can be arranged as free standing “foils”. Other embodiments include antennas that are encapsulated into a package containing the antenna.

20 Claims, 7 Drawing Sheets



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US007443344B2

(12) **United States Patent**
Boyle

(10) **Patent No.:** **US 7,443,344 B2**
(45) **Date of Patent:** **Oct. 28, 2008**

(54) **ANTENNA ARRANGEMENT AND A MODULE
AND A RADIO COMMUNICATIONS
APPARATUS HAVING SUCH AN
ARRANGEMENT**

(75) Inventor: **Kevin R. Boyle**, Horsham (GB)

(73) Assignee: **NXP B.V.**, Eindhoven (NL)

(*) 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.: **10/568,010**

(22) PCT Filed: **Aug. 4, 2004**

(86) PCT No.: **PCT/IB2004/002628**

§ 371 (c)(1),
(2), (4) Date: **Feb. 10, 2006**

(87) PCT Pub. No.: **WO2005/018045**

PCT Pub. Date: **Feb. 24, 2005**

(65) **Prior Publication Data**

US 2006/0290569 A1 Dec. 28, 2006

(30) **Foreign Application Priority Data**

Aug. 15, 2003 (GB) 0319211.9

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 1/24 (2006.01)
H01Q 13/10 (2006.01)

(52) **U.S. Cl.** **343/700 MS; 343/702;
343/770**

(58) **Field of Classification Search** 343/700 MS,
343/702, 770, 848
See application file for complete search history.

(56) **References Cited**

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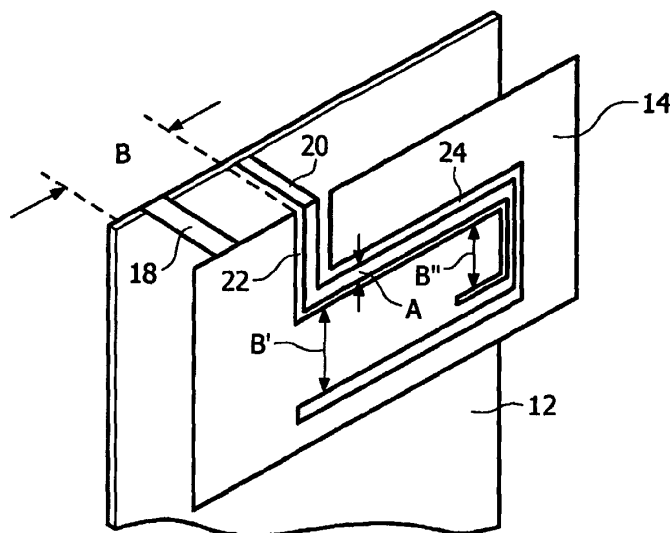
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Primary Examiner—Shih-Chao Chen

(57) **ABSTRACT**

An antenna arrangement for a radio communications apparatus such as a mobile phone, comprises a substantially planar patch conductor having a first feed connection point for connection to radio circuitry and a second feed connection point for connection to a ground plane, a first, differential slot in the patch conductor between the first and second connection points and a second, dual band slot located in the patch conductor outside the area between the first and second connection points. The length of the first slot is greater than a quarter wavelength, and provides a third resonant frequency increasing the bandwidth of the antenna. The width of the patch conductor between the first and the second slots is selected to obtain a low impedance transformation and thereby a low antenna resistance causing detuning the antenna. A user holding the phone increases the antenna resistance thereby tuning the antenna.

7 Claims, 4 Drawing Sheets



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US007443345B2

(12) **United States Patent**
Zhang

(10) **Patent No.:** **US 7,443,345 B2**
(45) **Date of Patent:** **Oct. 28, 2008**

- (54) **ANTENNA DEVICE**
- (75) Inventor: **Xin Zhang**, Hitachi (JP)
- (73) Assignee: **Hitachi Cable, Ltd.**, Tokyo (JP)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.
- (21) Appl. No.: **11/131,186**
- (22) Filed: **May 18, 2005**

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- (65) **Prior Publication Data**
- US 2006/0262027 A1 Nov. 23, 2006

- (51) **Int. Cl.**
H01Q 1/38 (2006.01)
- (52) **U.S. Cl.** **343/700 MS; 343/817; 343/818; 343/700 MS**
- (58) **Field of Classification Search** **343/700 MS, 343/817-818, 836-837, 853**
See application file for complete search history.

- (56) **References Cited**
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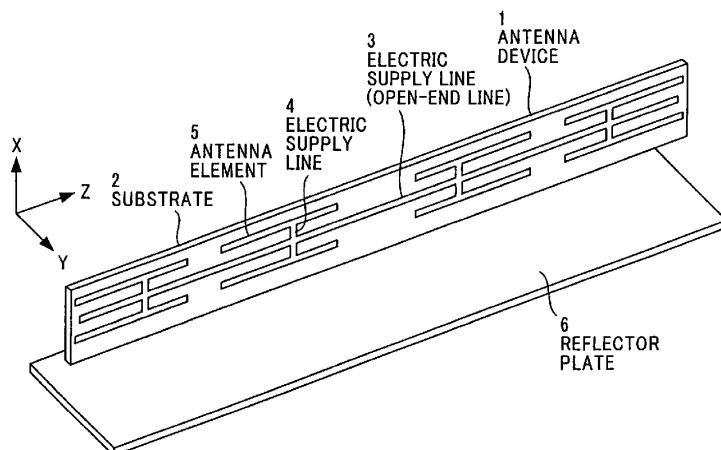
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Primary Examiner—Trinh V Dinh
(74) *Attorney, Agent, or Firm*—McGinn IP Law Group, PLLC

(57) **ABSTRACT**

An antenna device has: a dielectric substrate; an electric supply line that has a microstrip line and is formed on the dielectric substrate; an antenna element that has a microstrip line and is formed on the dielectric substrate; and a reflector plate disposed on the dielectric substrate at a predetermined angle of inclination. The electric supply line and the antenna element deviate from a dimensional factor that allows the electric supply line and the antenna element to have an omnidirectivity, and the electric supply line and the antenna element has a dimensional factor that allows the electric supply line and the antenna element to have an elliptical directivity.

7 Claims, 30 Drawing Sheets



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US007443346B2

(12) **United States Patent**
Shih

(10) **Patent No.:** **US 7,443,346 B2**
(45) **Date of Patent:** **Oct. 28, 2008**

(54) **PRINTED ANTENNA**

(75) Inventor: **Yen-Yi Shih**, Taipei Hsien (TW)

(73) Assignee: **Hon Hai Precision Industry Co., Ltd.**,
Tu-Cheng, 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 0 days.

(21) Appl. No.: **11/614,999**

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

(65) **Prior Publication Data**

US 2007/0279292 A1 Dec. 6, 2007

(30) **Foreign Application Priority Data**

Jun. 2, 2006 (CN) 95 1 19611

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

(52) **U.S. Cl.** **343/700 MS; 343/767;**
343/770

(58) **Field of Classification Search** 343/700 MS,
343/767, 770

See application file for complete search history.

(56) **References Cited**

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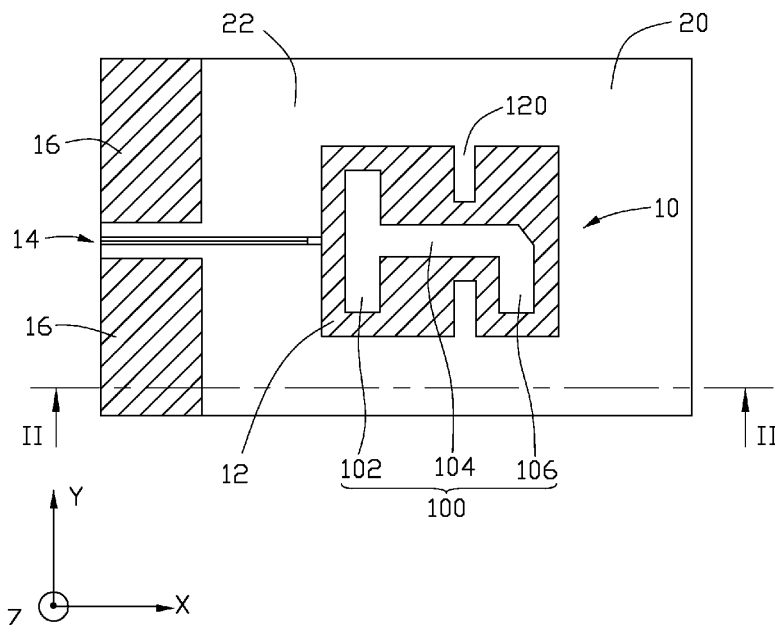
Primary Examiner—Robert Karacsony

(74) *Attorney, Agent, or Firm*—Wei Te Chung

(57) **ABSTRACT**

A printed antenna disposed on a substrate, includes a radiation part, a feed line, and at least one first ground part. The radiation part is for radiating and receiving electromagnetic signals, and includes a hollow portion and a pair of openings. The hollow portion is defined in the radiation part, and comprises a first slot connected to a second slot, which is connected to a third slot, wherein the second slot extends between the first slot and the third slot forming a substantially h-shaped pattern. The openings are formed at two edges of the radiation part. The feed line for feeding the electromagnetic signals to the radiation part is electrically connected to the radiation part. The at least one first ground part for grounding is disposed at one side of the feed line.

15 Claims, 6 Drawing Sheets



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US007443347B2

(12) **United States Patent**
Mei

(10) **Patent No.:** **US 7,443,347 B2**
(45) **Date of Patent:** **Oct. 28, 2008**

(54) **ANTENNA WITH COUPLING FEEDING**

(75) Inventor: **Chia-Hao Mei**, Taipei Hsien (TW)

(73) Assignee: **Hon Hai Precision Industry Co., Ltd.**,
Tu-Cheng, 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 19 days.

(21) Appl. No.: **11/617,768**

(22) Filed: **Dec. 29, 2006**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Oct. 18, 2006 (CN) 2006 1 0063154

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

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

(58) **Field of Classification Search** **343/700 MS,**
343/702, 846, 895

See application file for complete search history.

(56) **References Cited**

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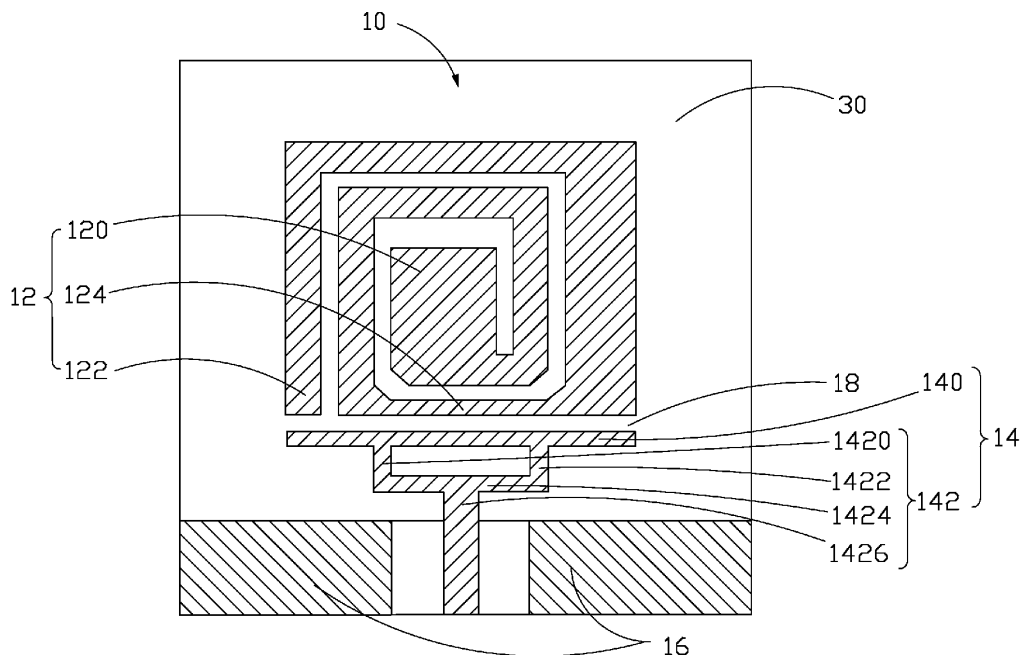
Primary Examiner—Hoang V Nguyen

(74) *Attorney, Agent, or Firm*—Wei Te Chung

(57) **ABSTRACT**

An antenna (10) is provided. The antenna (10) with coupling feeding, printed on a substrate (30) for transceiving electromagnetic signals. The antenna includes a radiator (12), a feeding portion (14), and a grounded portion (16). The radiator is for the transceiving electromagnetic signals. The feeding portion defines a gap with the radiator for coupling feeding the electromagnetic signals to the radiator via the gap. The grounded portion is disposed adjacent to the feeding portion.

10 Claims, 15 Drawing Sheets



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US007443348B2

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

(10) **Patent No.:** **US 7,443,348 B2**
(45) **Date of Patent:** **Oct. 28, 2008**

(54) **OMNI-DIRECTIONAL ANTENNA**

(75) Inventors: **Frederick O. Fortson**, Whitmore Lake, MI (US); **Richard Hansen**, Ann Arbor, MI (US); **Greg Soosik**, Canton, MI (US)

(73) Assignee: **Solidica, Inc.**, Ann Arbor, MI (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.: **11/755,265**

(22) Filed: **May 30, 2007**

(65) **Prior Publication Data**

US 2008/0030406 A1 Feb. 7, 2008

Related U.S. Application Data

(60) Provisional application No. 60/809,257, filed on May 30, 2006.

(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, 815, 833, 834, 829**
See application file for complete search history.

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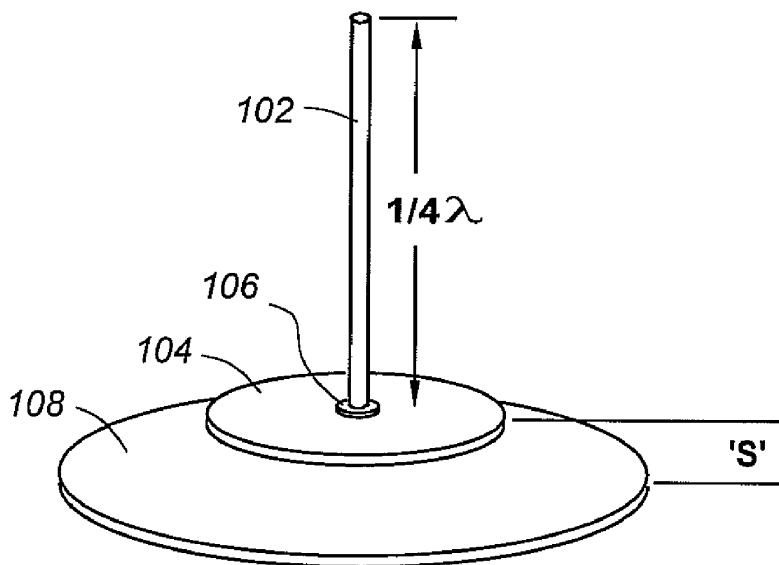
Primary Examiner—Tho G Phan

(74) *Attorney, Agent, or Firm*—Gifford, Krass, Sprinkle, Anderson & Citkowski, PC

(57) **ABSTRACT**

An omni-directional antenna includes an electrically conductive ground plane, an electrically conductive parasitic disc spaced upwardly apart from the ground plane and parallel thereto, and an electrically conductive vertical antenna element extending up through the center of the ground plane and parasitic disc. The vertical element terminates in a tip defining a length above the parasitic disc that is matched to a frequency of interest. The parasitic disc and ground plane are preferably both circular. To prevent electrical connection, the vertical element preferably extends through separate insulators in the parasitic disc and ground plane. The length of the vertical element is matched to a microwave frequency; in particular, the length of the vertical element is proportioned to one-quarter wavelength of the frequency of interest. The invention is particularly suited to microwave frequencies.

10 Claims, 1 Drawing Sheet



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US007443350B2

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

(10) **Patent No.:** **US 7,443,350 B2**
(45) **Date of Patent:** **Oct. 28, 2008**

(54) **EMBEDDED MULTI-MODE ANTENNA
ARCHITECTURES FOR WIRELESS DEVICES**

(75) Inventors: **Brian P. Gaucher**, Brookfield, CT (US);
Duixian Liu, Scarsdale, NY (US);
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(73) Assignee: **International Business Machines
Corporation**, Armonk, NY (US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 195 days.

(21) Appl. No.: **11/482,571**

(22) Filed: **Jul. 7, 2006**

(65) **Prior Publication Data**

US 2008/0007465 A1 Jan. 10, 2008

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

(52) **U.S. Cl.** **343/702; 343/700 MS;**
343/773; 343/846

(58) **Field of Classification Search** 343/700 MS,
343/702, 829, 846, 795, 773
See application file for complete search history.

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Declaration. International Application No. PCT/EP2007/056051;
International Filing Date: Jun. 19, 2007.

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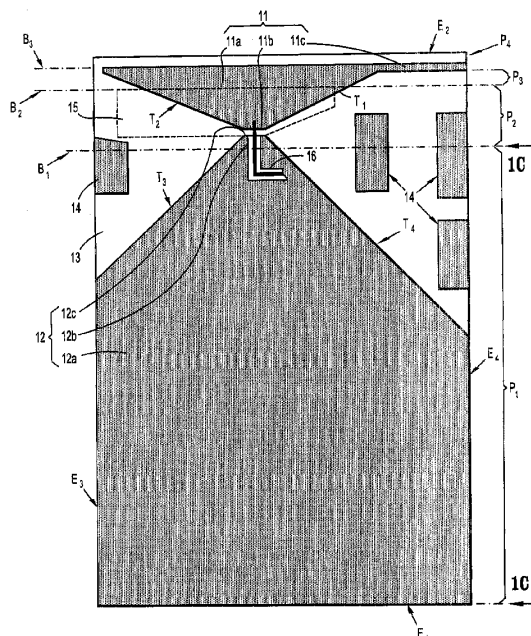
Primary Examiner—Tho G Phan

(74) *Attorney, Agent, or Firm*—F. Chau & Associates, LLC

(57) **ABSTRACT**

Low-profile, compact embedded multi-mode antenna
designs are provided for use with computing devices, such as
laptop computers, which enable ease of integration within
computing devices with limited space, while providing suit-
able antenna characteristics (e.g., impedance matching and
radiation efficiency) over an operating bandwidth of about 0.8
GHz to about 11 GHz.

35 Claims, 9 Drawing Sheets



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US007443352B1

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

(10) **Patent No.:** **US 7,443,352 B1**
(45) **Date of Patent:** **Oct. 28, 2008**

(54) **MULTI-BAND ANTENNA**

(75) Inventors: **Ching-Chi Lin**, Taipei Hsien (TW);
Jia-Hung Su, Taipei Hsien (TW); **Kai Shih**, Taipei Hsien (TW); **Yu-Yuan Wu**, Taipei Hsien (TW)

(73) Assignee: **Cheng Uei Precision Industry Co., Ltd.**, 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 0 days.

(21) Appl. No.: **11/833,800**

(22) Filed: **Aug. 3, 2007**

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

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

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

See application file for complete search history.

(56) **References Cited**

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Primary Examiner—Douglas W. Owens

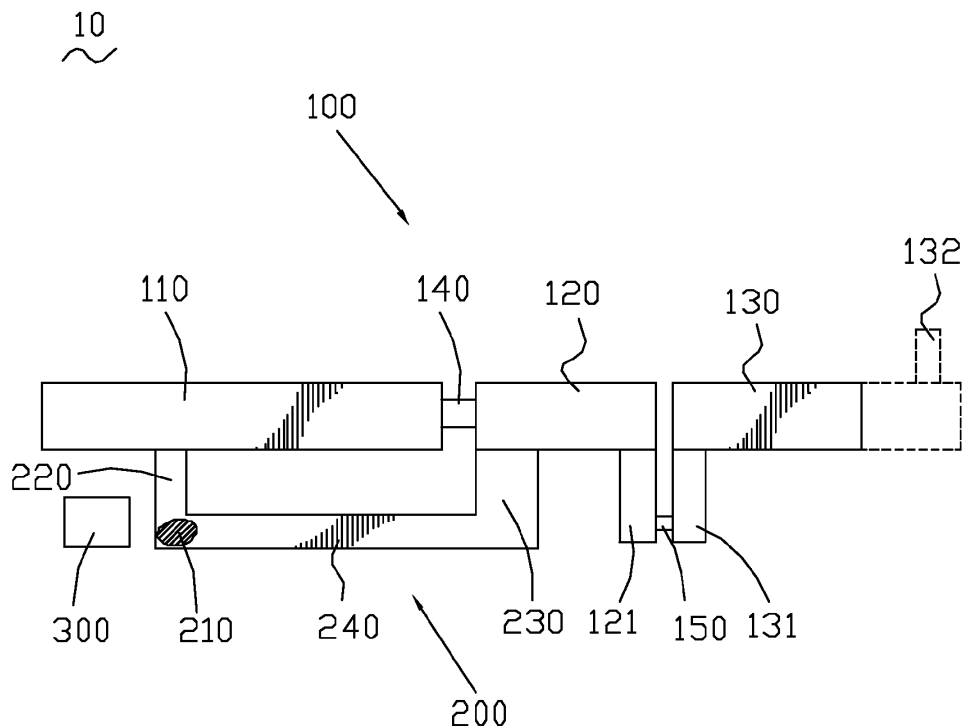
Assistant Examiner—Dieu Hien T Duong

(74) *Attorney, Agent, or Firm*—WPAT, P.C.; Anthony King

(57) **ABSTRACT**

The present invention discloses a multi-band antenna, the multi-band antenna has an antenna base, a power feed portion and a grounding point. The antenna base includes a first rectangular portion, a second rectangular portion and a third rectangular portion. A first connection portion connects the first rectangular portion with the second rectangular portion, a second connection portion connects the first extending portion with the second extending portion. The power feed portion is arranged below the antenna base, and the power feed portion connects to the first rectangular portion and the second rectangular portion. The grounding point is arranged below the first rectangular portion and near the power feed portion. The first and second connection portions control the size of the electric current through the antenna base. By the above-mention unique design, the multi-band antenna can receive and transmit the signals of the different frequency bands and has a smaller volume.

5 Claims, 2 Drawing Sheets



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US007443353B2

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

(10) **Patent No.:** **US 7,443,353 B2**
(45) **Date of Patent:** **Oct. 28, 2008**

(54) **VEHICLE-MOUNTED ANTENNA**

(75) Inventors: **Hiroshi Fujimoto**, Zama (JP);
Yoshinosuke Mukou, Tokyo (JP)

(73) Assignee: **Nissan Motor Co., Ltd.**, Yokohama-shi
(JP)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 30 days.

(21) Appl. No.: **11/389,155**

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

(65) **Prior Publication Data**

US 2006/0214863 A1 Sep. 28, 2006

(30) **Foreign Application Priority Data**

Mar. 28, 2005 (JP) 2005-090947

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

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

(58) **Field of Classification Search** 343/711-714,
343/702; 455/445, 436, 905

See application file for complete search history.

(56) **References Cited**

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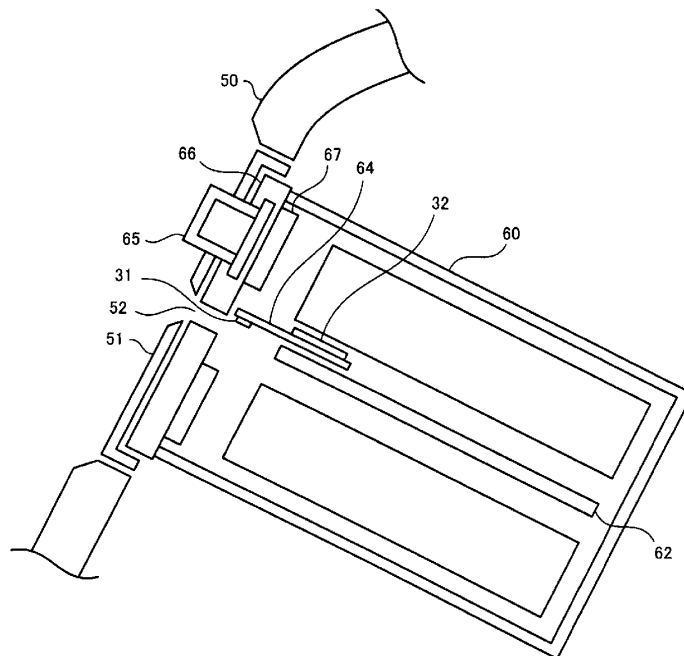
Primary Examiner—Huedung Cao Mancuso

(74) Attorney, Agent, or Firm—Foley & Lardner LLP

(57) **ABSTRACT**

A vehicle-mounted antenna for a vehicle-mounted information processing device performs wireless communication within a vehicle between the vehicle-mounted information processing device located at a rear side of a veneer plate and another electronic circuit within the vehicle. The vehicle-mounted information processing device reads data from a medium inserted via a media insertion opening formed in the veneer plate and executes various processing based on the read-in data. The vehicle-mounted antenna is arranged deeper than the media insertion opening, within a region set if the media insertion opening is extended in a direction substantially orthogonal with the veneer plate.

12 Claims, 3 Drawing Sheets



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US007443355B2

(12) **United States Patent**
Griffiths

(10) **Patent No.:** **US 7,443,355 B2**

(45) **Date of Patent:** **Oct. 28, 2008**

(54) **ANTENNA FEED-TUBE-TO-AMPLIFIER
COUPLING**

(75) Inventor: **Gary D. Griffiths**, Cranston, RI (US)

(73) Assignee: **KVH Industries, Inc.**, Middletown, RI
(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.: **11/558,220**

(22) Filed: **Nov. 9, 2006**

(65) **Prior Publication Data**

US 2008/0111758 A1 May 15, 2008

(51) **Int. Cl.**

H01Q 13/00 (2006.01)

H01Q 19/12 (2006.01)

H01Q 21/00 (2006.01)

H01Q 19/10 (2006.01)

(52) U.S. Cl. **343/786; 343/840; 343/781 CA;**
343/781 P; 343/836; 343/837

(58) **Field of Classification Search** 343/786,
343/840, 781 CA, 781 P, 836, 837
See application file for complete search history.

(56) **References Cited**

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Primary Examiner—Douglas W. Owens

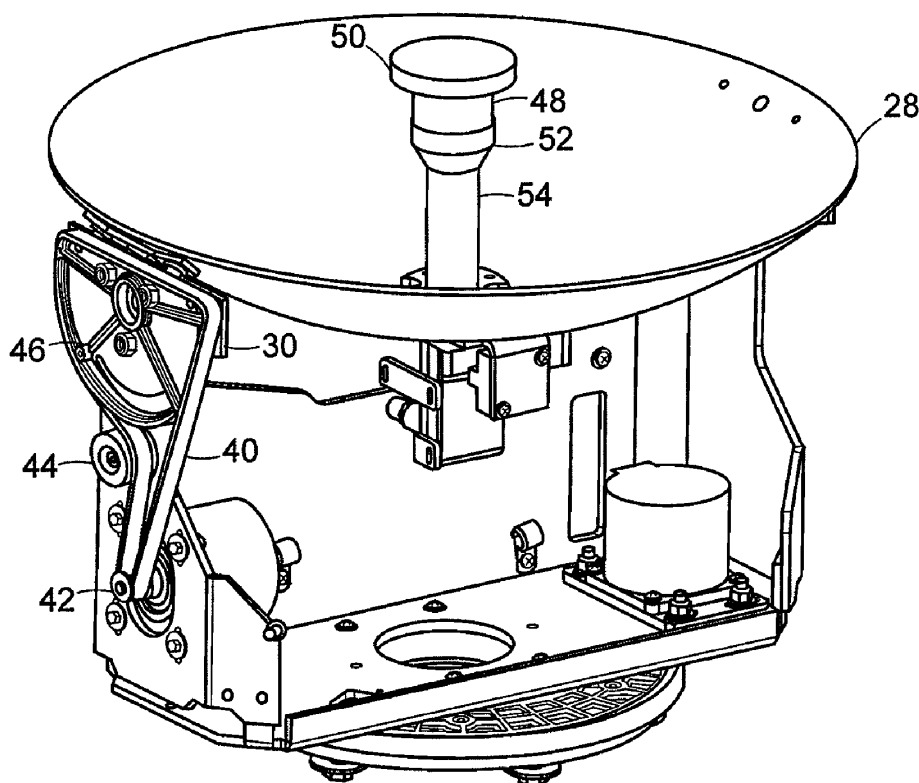
Assistant Examiner—Jennifer F Chang

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

(57) **ABSTRACT**

A first set of screws secures a Cassegrain-configuration microwave antenna's primary reflector to its low-noise block down-converter without additionally securing that reflector or the low-noise block down-converter to the antenna's feed tube, which a second set of screws separately secures to the low-noise block down-converter.

14 Claims, 5 Drawing Sheets



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US007443356B2

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

(10) **Patent No.:** **US 7,443,356 B2**
(45) **Date of Patent:** **Oct. 28, 2008**

(54) **ANTENNA MODULE**

(75) Inventors: **Arthur Roberts**, Pukerua Bay (NZ);
Coskun Nalbant, Balwyn North (AU);
Noel McDonald, Croydon (AU)

(73) Assignee: **ALCATEL**, Paris (FR)

(*) 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.: **11/029,457**

(22) Filed: **Jan. 6, 2005**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 60/545,896, filed on Feb. 20, 2004.

(51) **Int. Cl.**
H01Q 21/26 (2006.01)
H01Q 9/16 (2006.01)

(52) **U.S. Cl.** **343/797; 343/793**

(58) **Field of Classification Search** **343/797, 343/798, 700 MS, 772, 756, 793-795**
See application file for complete search history.

(56) **References Cited**

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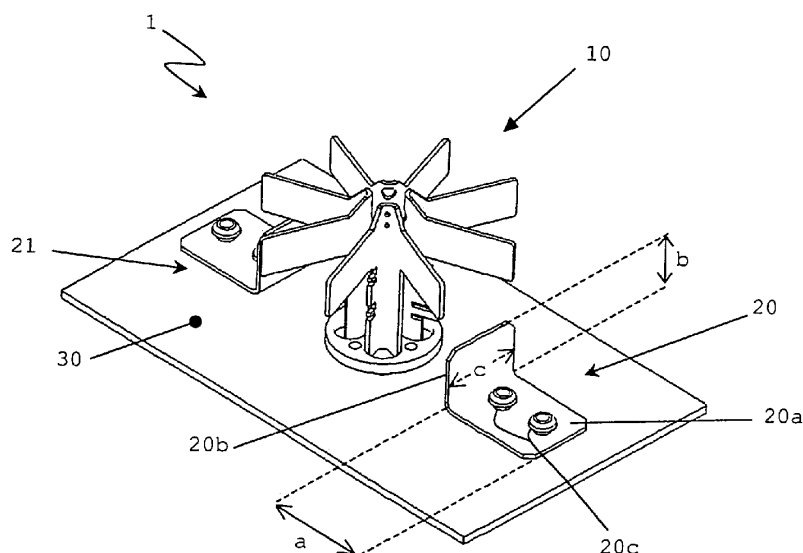
Primary Examiner—Hung T Vy

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

(57) **ABSTRACT**

An antenna module, in particular for a base station of a cellular mobile radio network, comprising a group of radiating elements capable of receiving and/or transmitting electromagnetic waves having at least two different, preferably linear orthogonal, polarizations, said antenna module further comprising at least one passive decoupling element. Said decoupling element extends with its longest dimension in a direction which is substantially perpendicular to a direction of propagation of said electromagnetic waves and/or substantially parallel to a ground plane and thus improves a degree of decoupling between said polarizations.

13 Claims, 3 Drawing Sheets



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US007443357B2

(12) **United States Patent**
Mei

(10) **Patent No.:** **US 7,443,357 B2**
(45) **Date of Patent:** **Oct. 28, 2008**

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

(75) Inventor: **Chia-Hao Mei**, Tu-Cheng (TW)

(73) Assignee: **Hon Hai Precision Industry Co., Ltd.**,
Tu-Cheng, 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 212 days.

(21) Appl. No.: **11/237,218**

(22) Filed: **Sep. 28, 2005**

(65) **Prior Publication Data**

US 2006/0145925 A1 Jul. 6, 2006

(30) **Foreign Application Priority Data**

Jan. 6, 2005 (CN) 2005 2 0053550 U

(51) **Int. Cl.**
H01Q 21/20 (2006.01)

(52) **U.S. Cl.** **343/800; 343/795; 343/700 MS**

(58) **Field of Classification Search** **343/700 MS,**
343/702, 895, 795, 745, 800
See application file for complete search history.

(56) **References Cited**

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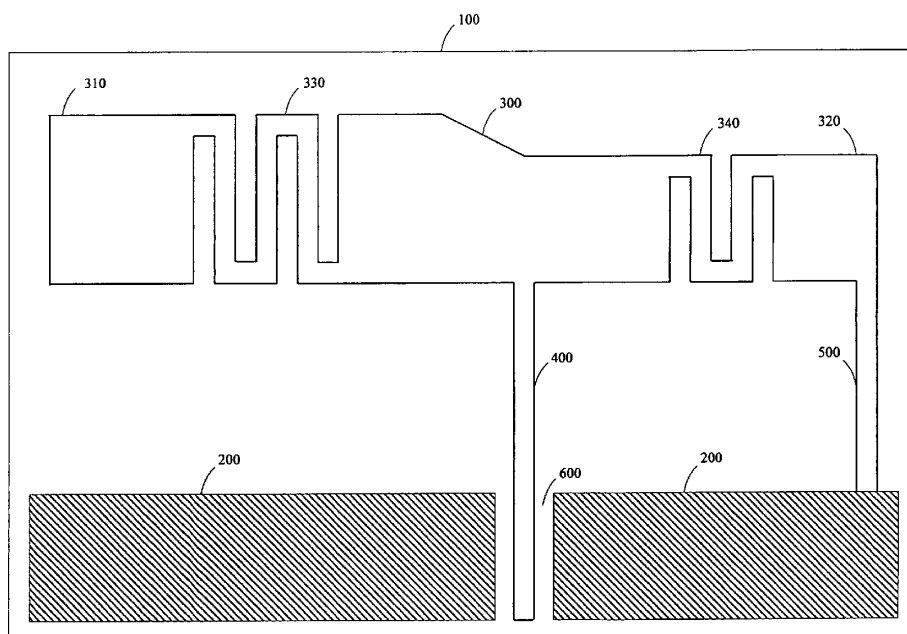
Primary Examiner—Huedung Mancuso

(74) Attorney, Agent, or Firm—Andrew C. Cheng

(57) **ABSTRACT**

A planar inverted-F antenna includes a body (300), a feed wire (400), a shorting strip (500), and a metallic ground plane (200). The body is used for radiating and receiving radio frequency signals, and includes a radiating end (310) and a shorting end (320). The shorting end is electrically connected to a metallic ground plane by the shorting strip. The feed wire is electrically connected to the body. The body includes bent portions (330, 340) disposed between the shorting end and the radiating end. Due to the bent portions, the planar inverted-F antenna has a compact profile and a smaller size. In addition, the bent portions generate an inductance effect that can regulate the input impedance of the planar inverted-F antenna.

18 Claims, 3 Drawing Sheets



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US007443361B2

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

(10) **Patent No.:** **US 7,443,361 B2**
(45) **Date of Patent:** **Oct. 28, 2008**

(54) **FRANGIBLE ANTENNA MOUNT**

(75) Inventors: **Clark Haynes**, Tulalip, WA (US); **Adam Eby**, Mechanicsville, IA (US)

(73) Assignee: **Intermec IP Corp.**, Everett, WA (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.: **11/566,189**

(22) Filed: **Dec. 1, 2006**

(65) **Prior Publication Data**

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

(52) **U.S. Cl.** **343/878; 343/880**

(58) **Field of Classification Search** 343/878,
343/880, 882, 900, 901, 715
See application file for complete search history.

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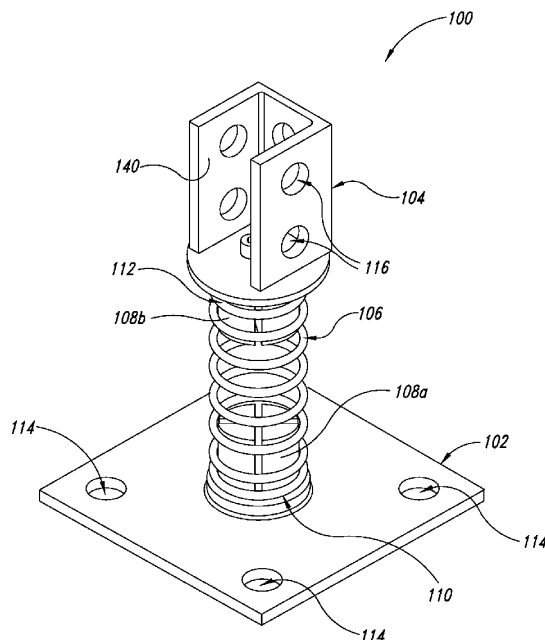
Primary Examiner—Hoang V Nguyen

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

(57) **ABSTRACT**

An antenna mount includes a base, a mounting member and a resilient member extending between the mounting member and the base. The resilient member may be removably coupled to the base via a first coupling member and/or coupled to the antenna mount via a second coupling member. The coupling members and the resilient member are configured to release or disengage in response to a force and/or torque exceeding a threshold force and/or torque.

15 Claims, 6 Drawing Sheets



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US007443362B2

(12) **United States Patent**
Yungers

(10) **Patent No.:** **US 7,443,362 B2**
(45) **Date of Patent:** **Oct. 28, 2008**

(54) **SOLENOID ANTENNA**

(75) Inventor: **Christopher R. Yungers**, St. Paul, MN (US)

(73) Assignee: **3M Innovative Properties Company**, Saint Paul, MN (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 202 days.

(21) Appl. No.: **11/184,633**

(22) Filed: **Jul. 19, 2005**

(65) **Prior Publication Data**

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

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

(58) **Field of Classification Search** **343/702, 343/741, 787, 788, 866, 867, 895; 340/572.7, 340/572.5, 10.1; 235/462.46**

See application file for complete search history.

(56) **References Cited**

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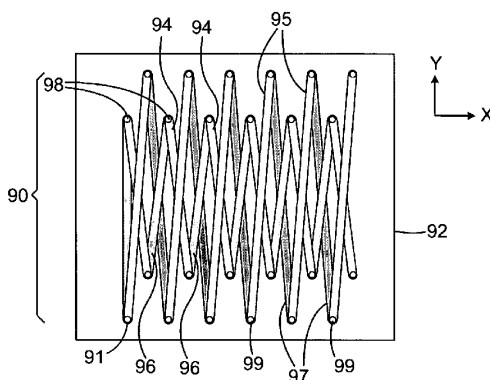
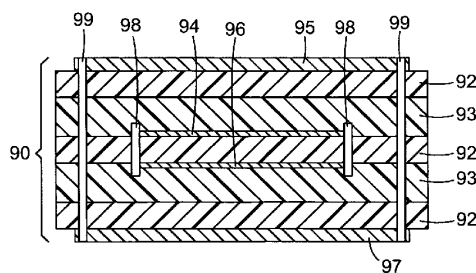
Primary Examiner—Michael C Wimer

(74) *Attorney, Agent, or Firm*—John A. Burtis

(57) **ABSTRACT**

The invention relates to a volumetrically efficient solenoid antenna fabricated on or within a substrate, such as a printed circuit board. The antenna may be used in many applications requiring a short-range wireless communication or sensing link, such as RFID systems, badge readers, contactless connectors, proximity sensors, and short-range data links. The antenna may be, for example, fabricated on or within a printed circuit board of an RFID reader, thereby enabling a perpendicular orientation of the RFID reader with respect to the z-axis of an RFID tag, where the x-y axes are the length and width of the tag. This perpendicular orientation enables the user to point or aim the RFID reader directly at the RFID tag for efficient information transfer between the reader and a single tag in a multiple tag environment.

27 Claims, 6 Drawing Sheets



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US007443363B2

(12) **United States Patent**
Ying

(10) **Patent No.:** **US 7,443,363 B2**
(45) **Date of Patent:** **Oct. 28, 2008**

(54) **COMPACT DIELECTRIC RESONATOR
ANTENNA**

(75) Inventor: **Zhinong Ying**, 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 38 days.

(21) Appl. No.: **11/534,480**

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

(65) **Prior Publication Data**

US 2008/0122703 A1 May 29, 2008

Related U.S. Application Data

(60) Provisional application No. 60/805,536, filed on Jun.
22, 2006.

(51) **Int. Cl.**

H01Q 15/02 (2006.01)

H01Q 15/08 (2006.01)

H01Q 19/06 (2006.01)

H01Q 1/38 (2006.01)

H01Q 1/24 (2006.01)

H01P 1/20 (2006.01)

(52) **U.S. Cl.** **343/911 R**; 343/702; 343/700 MS;
333/202

(58) **Field of Classification Search** 343/702,
343/911 R, 825, 826, 785; 333/202
See application file for complete search history.

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Primary Examiner—Michael C. Wimer

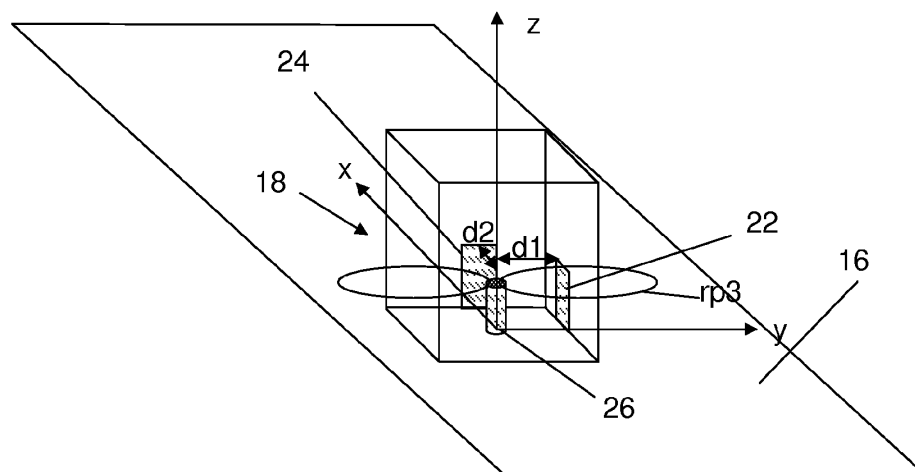
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(57) **ABSTRACT**

A dielectric radiator antenna arrangement for a communica-
tion device having a ground plane is provided. The antenna
arrangement may include a dielectric volume having a central
axis normal to the ground plane, and mode-exciting elements.
The mode-exciting elements may include a first mode-exciting
element provided in or attached to the dielectric volume
and extending in a plane provided at a first distance from the
central axis perpendicular to the ground plane, and a second
mode-exciting element provided in or attached to the dielec-
tric volume and extending in a plane provided at a second
distance from the central axis and perpendicular to both the
ground plane and the plane of the first mode-exciting element.
The antenna arrangement can be used for simultaneously
transmitting and receiving more than one signal at one fre-
quency with reduced coupling.

16 Claims, 3 Drawing Sheets



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(12) **United States Design Patent**
Imano et al.

(10) **Patent No.:** **US D579,446 S**

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(54) **ANTENNA**

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(**) Term: **14 Years**

(21) Appl. No.: **29/269,326**

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(30) **Foreign Application Priority Data**

Aug. 31, 2006 (JP) 2006-023245

(51) **LOC (8) Cl.** **14-03**

(52) **U.S. Cl.** **D14/230**

(58) **Field of Classification Search** D14/138,
D14/230-238, 299, 358; D12/42, 43; 343/700 MS,
343/700 R-705, 711-713, 741, 748, 767,
343/795, 819, 840, 846, 866, 871-908; 455/90.2,
455/90.3, 91, 128, 269, 344, 347, 562.1
See application file for complete search history.

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(57) **CLAIM**

The ornamental design for an antenna, as shown.

DESCRIPTION

FIG. 1 is a front perspective view of an antenna showing our new design;

FIG. 2 is a rear perspective view thereof;

FIG. 3 is a front elevational view thereof;

FIG. 4 is a rear elevational view thereof;

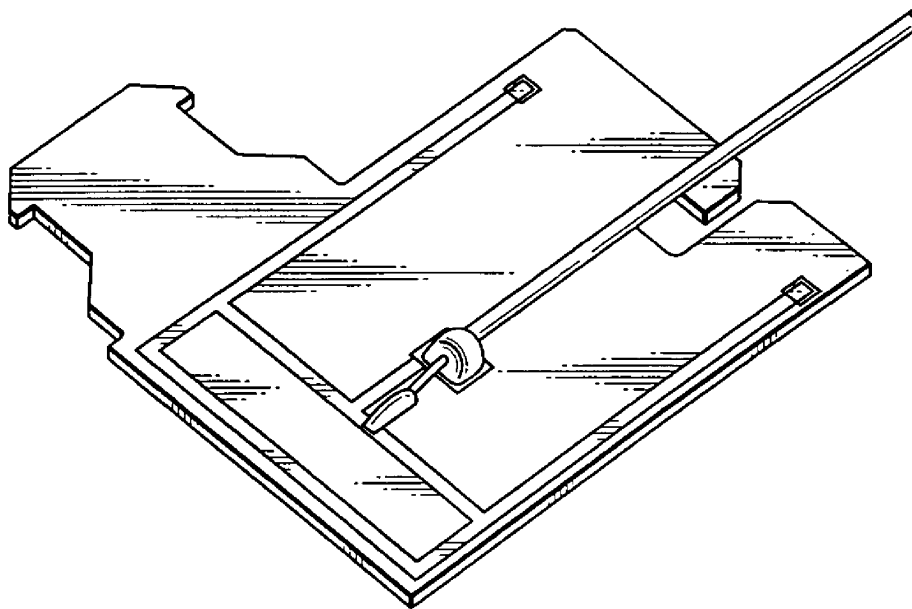
FIG. 5 is a top plan view thereof;

FIG. 6 is a bottom plan view thereof;

FIG. 7 is a right side elevational view thereof; and,

FIG. 8 is a left side elevational view thereof.

1 Claim, 4 Drawing Sheets



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