US007990319B2

(12) **United States Patent**
Boyle

(10) **Patent No.: US 7,990,319 B2**
(45) **Date of Patent: Aug. 2, 2011**

(54) **RADIO DEVICE HAVING ANTENNA ARRANGEMENT SUITED FOR OPERATING OVER A PLURALITY OF BANDS**

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

(73) Assignee: **EPCOS AG**, Munich (DE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 113 days.

(21) Appl. No.: **11/912,837**

(22) PCT Filed: **Apr. 26, 2006**

(86) PCT No.: **PCT/IB2006/051302**

§ 371 (c)(1),
(2), (4) Date: **Jul. 22, 2008**

(87) PCT Pub. No.: **WO2006/114771**

PCT Pub. Date: **Nov. 2, 2006**

(65) **Prior Publication Data**

US 2009/0201209 A1 Aug. 13, 2009

(30) **Foreign Application Priority Data**

Apr. 27, 2005 (EP) 05300328

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 3/24 (2006.01)
H01Q 21/00 (2006.01)

(52) **U.S. Cl.** ..... **343/700 MS**; 343/876; 343/893

(58) **Field of Classification Search** ..... 343/700 MS, 343/702, 846, 876, 893
See application file for complete search history.

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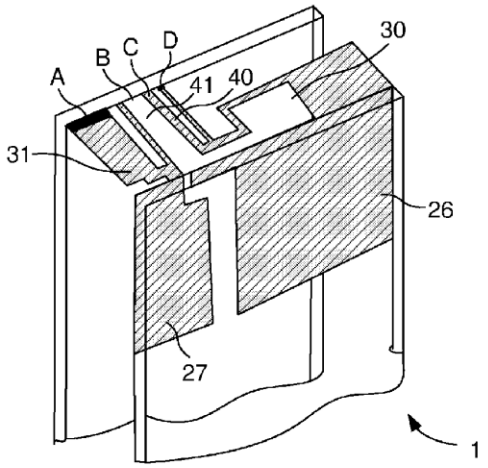
Primary Examiner — Shih-Chao Chen
(74) *Attorney, Agent, or Firm* — Slater & Matsil, L.L.P.

(57) **ABSTRACT**

This radio device operating over a plurality of bands comprises a casing having a front cover and a back cover, an antenna arrangement, a radio frequency circuit set and a matching unit for connecting the antenna arrangement to the radio frequency circuit set. The following measures are proposed: —the antenna arrangement is formed by at least two antenna parts, each of which being related to a set of bands, —the antenna parts are placed close together, —the arrangement comprises a part that is normal to the front cover and another one that is near the back cover and feeding points, —the matching unit comprises control switching means for tuning the arrangement to each band. Thanks to these measures, the coverage of the band is obtained with satisfactory performance.

9 Claims, 4 Drawing Sheets



US007990320B2

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

(10) **Patent No.: US 7,990,320 B2**
(45) **Date of Patent: Aug. 2, 2011**

(54) **ANTENNA WITH INNER SPRING CONTACT**

(75) Inventors: **Jaume Anguera Pros**, Vinaros (ES); **Juan Ignacio Ortigosa Vallejo**, Barcelona (ES); **Alfonso Sanz**, 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 323 days.

(21) Appl. No.: **11/989,435**

(22) PCT Filed: **Jul. 31, 2006**

(86) PCT No.: **PCT/EP2006/007565**

§ 371 (c)(1),
(2), (4) Date: **Apr. 8, 2008**

(87) PCT Pub. No.: **WO2007/014737**

PCT Pub. Date: **Feb. 8, 2007**

(65) **Prior Publication Data**

US 2009/0146906 A1 Jun. 11, 2009

Related U.S. Application Data

(60) Provisional application No. 60/704,542, filed on Aug. 2, 2005.

(30) **Foreign Application Priority Data**

Aug. 1, 2005 (EP) 05107095

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

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

(58) **Field of Classification Search** ..... 843/700 MS, 843/846, 702

See application file for complete search history.

(56) **References Cited**

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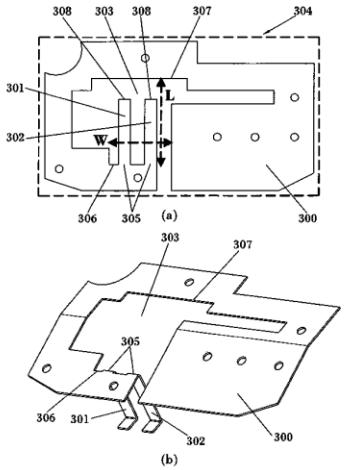
Primary Examiner — HoangAnh T Le
(74) *Attorney, Agent, or Firm* — Winstead PC

(57) **ABSTRACT**

One aspect of the invention relates to an antenna for a wireless device having spring contact elements based on strips (**301**, **302**; **403**; **503**, **504**; **602**, **603**; **612**, **613**; **622**, **623**; **632**; **642**; **652**, **653**; **682**; **703**, **704**; **753**, **754**; **756**; **802**, **803**; **1412**, **1413**; **1422**, **1423**) that, before bending, are housed in at least one gap (**303**, **601**, **681**, **804**, **1411**, **1421**) in a main body (**300**, **402**, **502**, **600**, **700**, **750**, **800** **1400**) of the antenna. The invention provides for a reduced stamping area overhead while allowing the spring contacts embodied by the strips to be placed close to the perimeter of the smallest possible rectangle that can house the main body. This can be helpful for mounting the antenna close to an edge of a printed circuit board (**401**, **501**, **701**, **801**) while not extending beyond said edge.

58 Claims, 13 Drawing Sheets



US007990321B2

(12) **United States Patent**
Shih

(10) **Patent No.: US 7,990,321 B2**
(45) **Date of Patent: Aug. 2, 2011**

(54) **MULTIBAND ANTENNA**

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

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 312 days.

(21) Appl. No.: **12/422,211**

(22) Filed: **Apr. 10, 2009**

(65) **Prior Publication Data**

US 2010/0182202 A1 Jul. 22, 2010

(30) **Foreign Application Priority Data**

Jan. 16, 2009 (CN) 2009 1 0300236

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

(56) **References Cited**

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2007/0279289 A1 12/2007 Baliarda et al.

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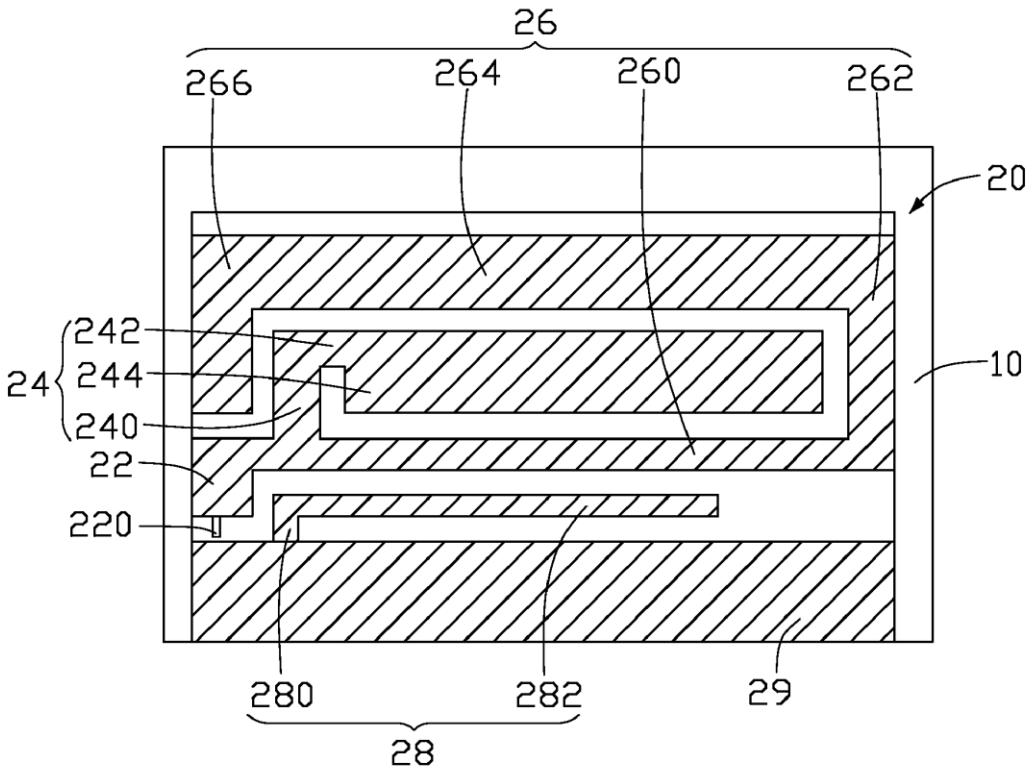
Primary Examiner — Hoang V Nguyen
(74) *Attorney, Agent, or Firm* — Frank R. Niranjan

(57) **ABSTRACT**

A multiband antenna is located on a substrate and comprises a first radiator, a second radiator, a feeding portion, a grounding portion and a third radiation. The first radiator transmits at least two frequency band signals. The second radiator is connected to the first radiator, and is arranged so as to surround the first radiator. The feeding portion feeds electromagnetic signals to the first radiator and the second radiator. The third radiator is located between the grounding portion and the second radiator, and electrically connected to the grounding portion.

15 Claims, 3 Drawing Sheets



US007990330B2

(12) **United States Patent**
Wu

(10) **Patent No.: US 7,990,330 B2**
(45) **Date of Patent: Aug. 2, 2011**

(54) **SLOT ANTENNA**

(75) Inventor: **Sueng-Chien Wu**, Taipei Hsien (TW)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 386 days.

(21) Appl. No.: **12/233,598**

(22) Filed: **Sep. 19, 2008**

(65) **Prior Publication Data**

US 2009/0303146 A1 Dec. 10, 2009

(30) **Foreign Application Priority Data**

Jun. 10, 2008 (CN) ..... 2008 2 0301090 U

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

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

(58) **Field of Classification Search** 343/770, 343/795, 702, 846, 786, 715, 705
See application file for complete search history.

(56) **References Cited**

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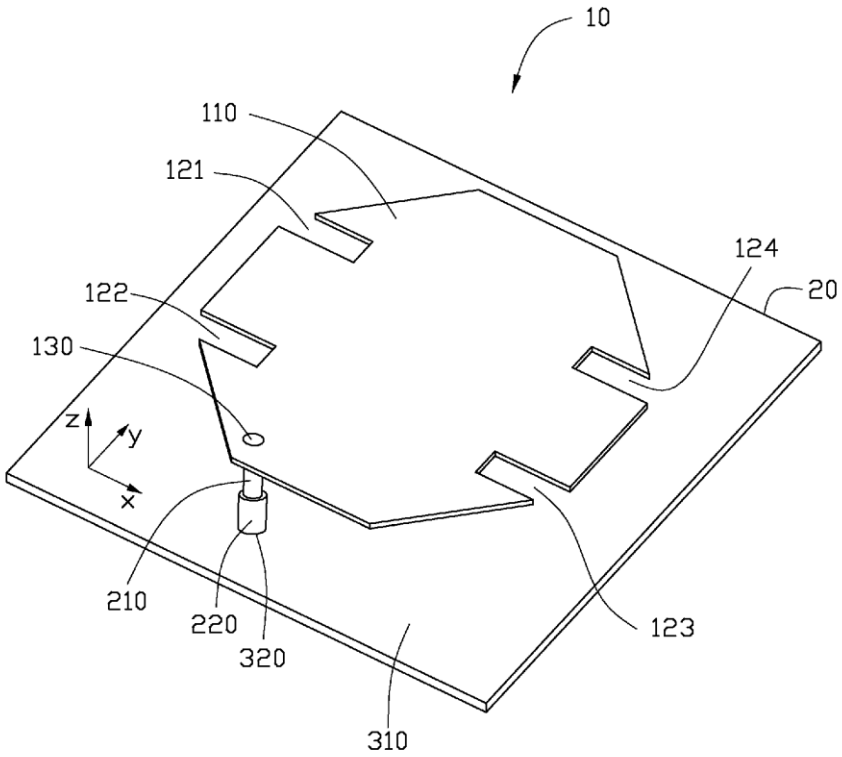
Primary Examiner — Douglas W Owens
Assistant Examiner — Jae K Kim
(74) *Attorney, Agent, or Firm* — Frank R. Niranjan

(57) **ABSTRACT**

A slot antenna is located on a substrate and includes a grounding portion, a radiating portion, and a feeding portion. The grounding portion is positioned on the substrate. The radiating portion is symmetrically octagonal-shaped and defines four trapezoidal-shaped slots on opposite sides. The radiating portion is parallel to the grounding portion. The feeding portion electrically connects the radiating portion to the grounding portion for feeding electromagnetic signals to the slot antenna.

10 Claims, 6 Drawing Sheets



US007994986B2

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

(10) **Patent No.: US 7,994,986 B2**
(45) **Date of Patent: Aug. 9, 2011**

(54) **ANTENNA WITH NEAR FIELD DEFLECTOR**

(75) Inventors: **Laurent Desclos**, San Diego, CA (US); **Sebastian Rowson**, San Diego, CA (US)

(73) Assignee: **Ethertronics, Inc.**, San Diego, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 544 days.

(21) Appl. No.: **11/840,617**

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

(65) **Prior Publication Data**

US 2009/0046022 A1 Feb. 19, 2009

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/52 (2006.01)

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

(58) **Field of Classification Search** 343/702, 343/833, 834, 841, 846; 455/575.7
See application file for complete search history.

(56) **References Cited**

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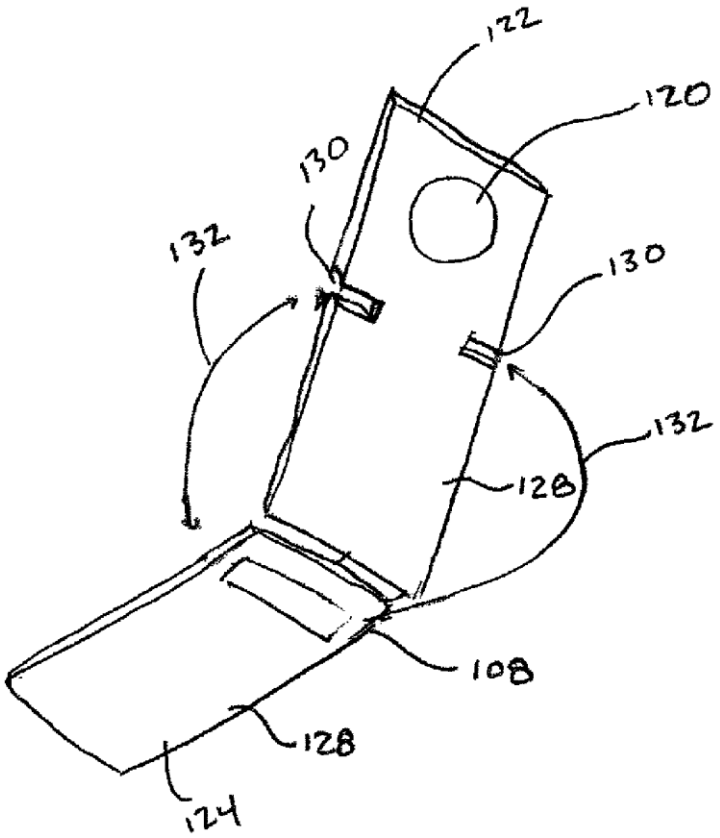
Primary Examiner — Michael C Wimer
(74) *Attorney, Agent, or Firm* — Coastal Patent Agency

(57) **ABSTRACT**

A mobile communication device having primary resonator coupled to a near field deflector. The near field deflector forms a false edge for near field deflection wherein the primary resonator couples with the false edge instead of to metallic portions of the device or the user.

2 Claims, 19 Drawing Sheets



US007994987B2

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

(10) **Patent No.: US 7,994,987 B2**
(45) **Date of Patent: Aug. 9, 2011**

(54) **NOTCHED ANTENNA STRUCTURE WITH A STEPPED SHAPED ELEMENT**

(75) Inventors: **Maksim Berezin**, Natanya (IL); **Moshe Ben Ayun**, Shoham (IL); **Ovadia Grossman**, Tel Aviv (IL); **Mark Rozental**, Gedera (IL)

(73) Assignee: **Motorola Solutions, 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 605 days.

(21) Appl. No.: **12/124,378**

(22) Filed: **May 21, 2008**

(65) **Prior Publication Data**

US 2009/0289854 A1 Nov. 26, 2009

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

(52) **U.S. Cl.** **343/702**; 343/767; 343/829

(58) **Field of Classification Search** 343/767, 343/702, 829, 830
See application file for complete search history.

(56) **References Cited**

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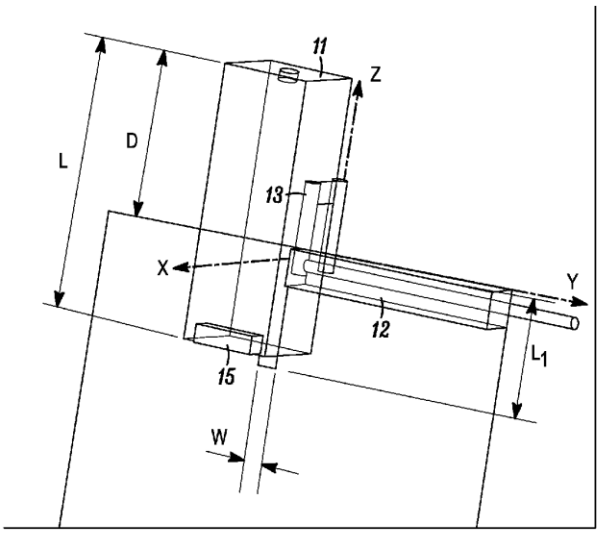
Primary Examiner — Douglas W Owens
Assistant Examiner — Dieu Hien T Duong

(57) **ABSTRACT**

An antenna assembly (**10**) includes a ground plane formed on a chassis (**12**) of the radio and the functional knob forming an antenna element (**11**). The antenna assembly further includes a slot or notch element (**14**) in the ground plane substantially adjacent to the functional knob and having a length less than ¼ wavelength, and a coaxial cable (**13**) feeding the antenna element. A shield of the coaxial cable can be directly connected to the ground plane and a center conductor of the coaxial cable can be directly coupled to the functional knob to provide a galvanic connection for narrowband performance or the center conductor can be electromagnetically coupled to the functional knob for wideband performance or both. The antenna assembly can create a zero volume notch type ground excitation.

19 Claims, 6 Drawing Sheets



US007994988B2

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

(10) **Patent No.: US 7,994,988 B2**
(45) **Date of Patent: Aug. 9, 2011**

(54) **DUAL-BAND ANTENNA**

(75) Inventors: **Hsin-Tsung Wu**, Tu-Cheng (TW); **Kai Shih**, Tu-Cheng (TW); **Yu-Yuan Wu**, Tu-Cheng (TW)

(73) Assignee: **Cheng Uei 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 380 days.

(21) Appl. No.: **12/267,930**

(22) Filed: **Nov. 10, 2008**

(65) **Prior Publication Data**

US 2010/0117918 A1 May 13, 2010

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

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

(58) **Field of Classification Search** ..... 343/845, 343/700 MS, 702, 770, 846, 860
See application file for complete search history.

(56) **References Cited**

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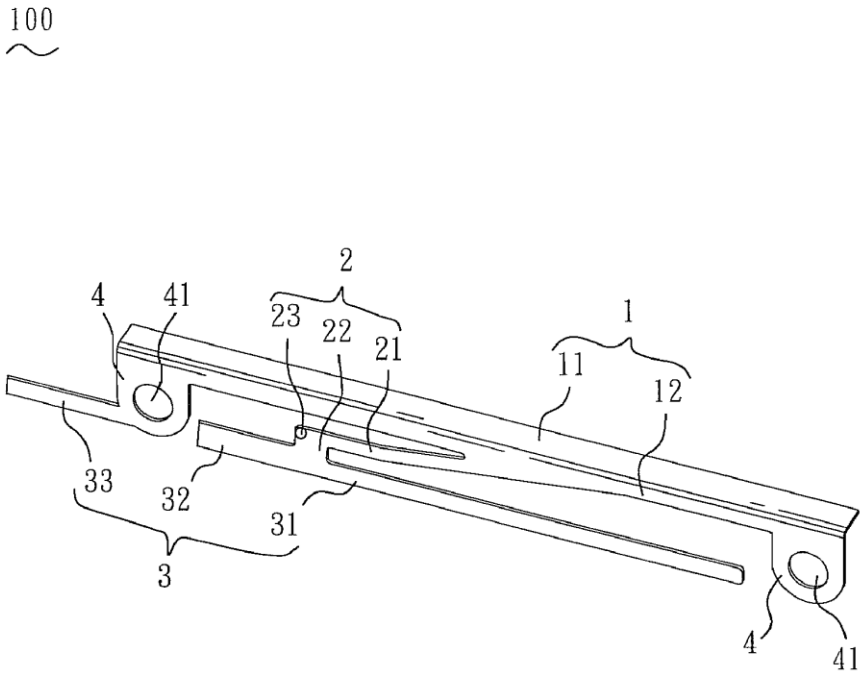
Primary Examiner — Jacob Y Choi
Assistant Examiner — Shawn Buchanan
(74) *Attorney, Agent, or Firm* — Muncy, Geissler, Olds, & Lowe, PLLC

(57) **ABSTRACT**

A dual-band antenna adapted for an Ultra-mobile Personal Computer has a grounding element including a first grounding portion of elongated plate shape and a second grounding portion extending substantially perpendicular to the first grounding portion from a long edge of the first grounding portion. A connecting element is connected with the second grounding portion. An installing element is connected with the second grounding portion and spaced away from the connecting portion. A radiating element includes a low frequency resonator extending from the connecting element, a high frequency resonator extending opposite to the low frequency resonator and towards the installing element from the connecting element, and an enhancing frequency resonator extending from an edge of the installing element back to the high frequency resonator. The low, high and enhancing frequency resonators are substantially aligned with each other and parallel to the second grounding portion.

5 Claims, 4 Drawing Sheets



US007994989B2

(12) **United States Patent**
Young

(10) **Patent No.: US 7,994,989 B2**
(45) **Date of Patent: Aug. 9, 2011**

(54) **HANDHELD DEVICE WITH SWITCHABLE SIGNAL RECEIVING MODES**

(75) Inventor: **Sea-Weng Young**, Taipei County (TW)

(73) Assignee: **Inventec Appliances 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 309 days.

(21) Appl. No.: **12/418,171**

(22) Filed: **Apr. 3, 2009**

(65) **Prior Publication Data**

US 2009/0256761 A1 Oct. 15, 2009

(30) **Foreign Application Priority Data**

Apr. 9, 2008 (TW) ..... 97112918 A

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

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

(58) **Field of Classification Search** 343/702, 343/900, 901, 876; 455/73, 11.1, 13.3, 78, 455/456.1

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

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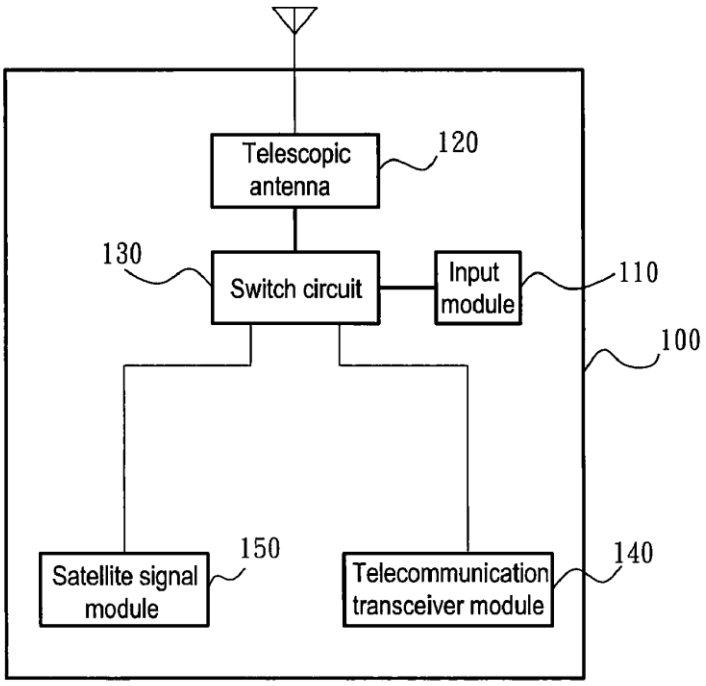
Primary Examiner — Hoang V Nguyen

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

(57) **ABSTRACT**

A handheld device with switchable signal receiving modes includes a telescopic antenna, a telecommunication transceiver module, a satellite signal module, and a switch circuit. Upon receiving a switch signal, the switch circuit couples the telescopic antenna to the telecommunication transceiver module, and adjusts the telescopic antenna to a first length, so that the telecommunication transceiver module transmits and receives a signal of a first frequency, or the switch circuit adjusts the telescopic antenna to a second length, so that the telecommunication transceiver module transmits and receives a signal of a second frequency. Alternatively, the switch circuit couples the telescopic antenna to the satellite signal module, and adjusts the telescopic antenna to the second length, so that the satellite signal module receives a satellite signal. Thereby, the handheld device can receive signals of various frequencies via one antenna, so that different functional modules transmit and receive signals of different frequencies.

12 Claims, 5 Drawing Sheets



US007994999B2

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

(10) **Patent No.: US 7,994,999 B2**
(45) **Date of Patent: Aug. 9, 2011**

(54) **MICROSTRIP ANTENNA**

(75) Inventors: **Hiroyuki Maeda**, Novi, MI (US); **Yingcheng Dai**, Novi, MI (US)

(73) Assignee: **Harada Industry Of America, Inc.**, Novi, MI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 921 days.

(21) Appl. No.: **11/948,628**

(22) Filed: **Nov. 30, 2007**

(65) **Prior Publication Data**

US 2009/0140927 A1 Jun. 4, 2009

(51) **Int. Cl.**
H01Q 13/10 (2006.01)
H01Q 1/38 (2006.01)
H01Q 5/00 (2006.01)

(52) **U.S. Cl.** ..... **343/853**; 343/700 MS; 343/855; 343/769

(58) **Field of Classification Search** ..... 343/700 MS, 343/749, 751, 767, 769, 770, 797, 850, 853, 343/857, 860, 862, 893
See application file for complete search history.

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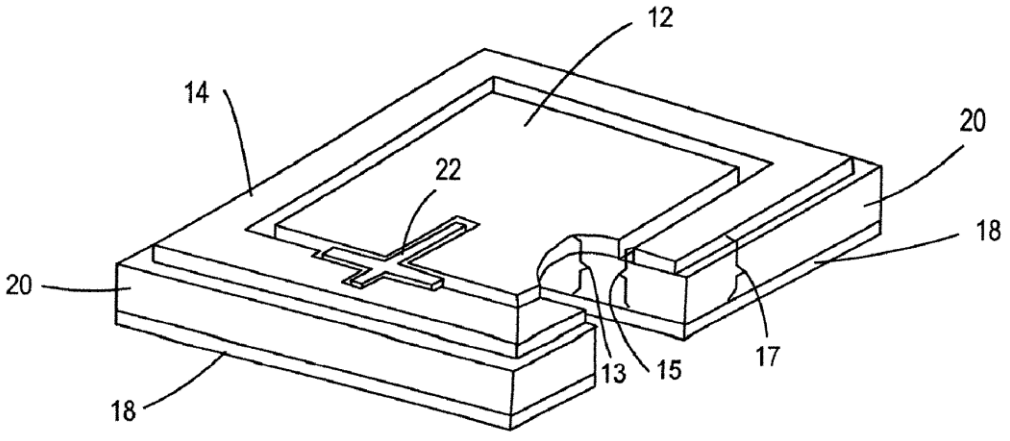
Primary Examiner — Jacob Y Choi
Assistant Examiner — Robert Karacsony
(74) *Attorney, Agent, or Firm* — Dickinson Wright PLLC

(57) **ABSTRACT**

A microstrip antenna that can be linear, co-circular, or dual-circularly polarized having co-planar radiating elements and operating at dual frequency bands wherein an inner radiating element is surrounded by and spaced from an outer radiating element. Each radiating element resonates at a different frequency. In one embodiment of the invention a feed network has a single, cross-shaped, feed line that is positioned between the inner and outer radiating elements and capacitively coupled to the inner and outer radiating elements. In another embodiment of the present invention, the radiating elements are fed separately by first and second feed networks each having a plurality of feed points. The radiating elements each have one active feed point that is either directly or indirectly coupled to its respective feed network.

20 Claims, 4 Drawing Sheets



US007995001B2

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

(10) **Patent No.: US 7,995,001 B2**
(45) **Date of Patent: Aug. 9, 2011**

(54) **ANTENNA FOR PORTABLE TERMINAL AND PORTABLE TERMINAL USING SAME**

(75) Inventors: **Tadahiro Ohmi**, Miyagi (JP); **Akihiro Morimoto**, Miyagi (JP); **Fumiaki Nakamura**, Miyagi (JP)

(73) Assignee: **Tadahiro Ohmi**, Sendai-shi, Miyagi (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.: **10/546,191**

(22) PCT Filed: **Feb. 17, 2004**

(86) PCT No.: **PCT/JP2004/001677**
§ 371 (c)(1),
(2), (4) Date: **Oct. 27, 2005**

(87) PCT Pub. No.: **WO2004/075343**
PCT Pub. Date: **Sep. 2, 2004**

(65) **Prior Publication Data**

US 2006/0119518 A1 Jun. 8, 2006

(30) **Foreign Application Priority Data**

Feb. 18, 2003 (JP) 2003-040167

(51) **Int. Cl.**
H01Q 15/00 (2006.01)

(52) **U.S. Cl.** ..... **343/911 R**; 343/787

(58) **Field of Classification Search** ..... 343/700 MS, 343/911 R, 787
See application file for complete search history.

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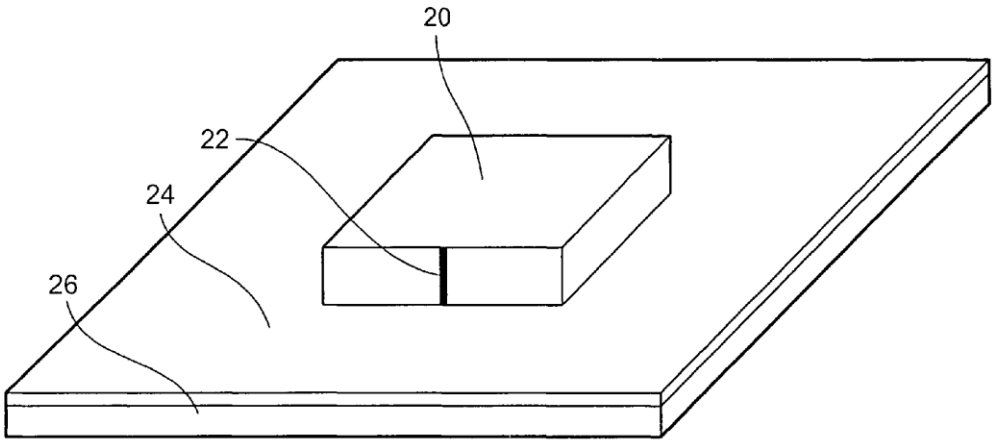
Primary Examiner — Jacob Y Choi
Assistant Examiner — Robert Karacsony
(74) *Attorney, Agent, or Firm* — Foley & Lardner LLP

(57) **ABSTRACT**

A dielectric resonator antenna which emits an electric wave by having a dielectric body resonate is disclosed. A magnetic material is contained in the electric body, thereby increasing the relative permeability to more than 1 and lowering the relative permittivity. Consequently, the Q-value of the resonance can be lowered while maintaining the rate of wavelength shortening. With this technique, a broadband dielectric resonator antenna can be realized.

18 Claims, 10 Drawing Sheets



US007999736B2

(12) **United States Patent**
Albrecht

(10) **Patent No.: US 7,999,736 B2**
(45) **Date of Patent: Aug. 16, 2011**

(54) **SLOT ANTENNA AND METHOD FOR ITS OPERATION**

(75) Inventor: **Stefan Albrecht**, Mauchenheim (DE)

(73) Assignee: **Pepperl + Fuchs GmbH**, Mannheim (DE)

(*) 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.: **12/446,814**

(22) PCT Filed: **Jul. 24, 2007**

(86) PCT No.: **PCT/EP2007/006582**

§ 371 (c)(1),
(2), (4) Date: **May 14, 2009**

(87) PCT Pub. No.: **WO2009/012796**

PCT Pub. Date: **Jan. 29, 2009**

(65) **Prior Publication Data**

US 2010/0117902 A1 May 13, 2010

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

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

(58) **Field of Classification Search** 342/372
See application file for complete search history.

(56) **References Cited**

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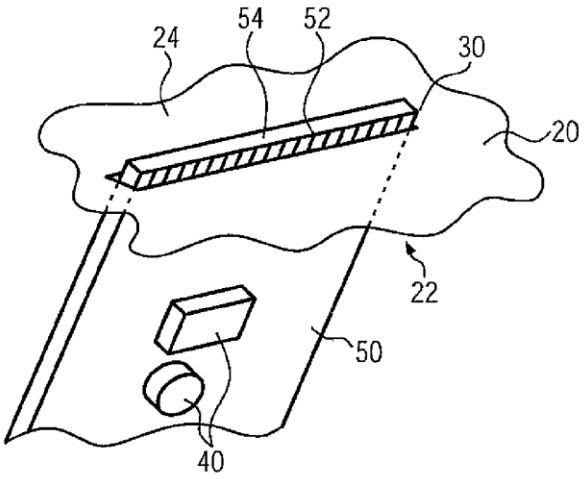
Primary Examiner — Harry Liu
(74) *Attorney, Agent, or Firm* — John A. Merecki; Hoffman Warnick LLC

(57) **ABSTRACT**

The invention relates to a slot antenna, more particularly to a transmitting antenna for RFID, comprising an antenna contour board having a plurality of antenna slots and at least one control circuit for enabling the antenna contour board to transmit and/or receive electromagnetic radiation. The slot antenna is characterized in that in at least one antenna slot of the antenna contour board there is inserted a circuit board carrying a control circuit. The invention further relates to an RFID method involving the use of the slot antenna of the invention.

13 Claims, 2 Drawing Sheets



US007999743B2

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

(10) **Patent No.: US 7,999,743 B2**
(45) **Date of Patent: Aug. 16, 2011**

(54) **MULTIBAND ANTENNA ARRAY FOR MOBILE RADIO EQUIPMENT**

(75) Inventors: **Stefan Huber**, München (DE); **Thorsten Kowalski**, München (DE); **Michael Schreiber**, Aying-Göggenhofen (DE)

(73) Assignee: **Hewlett-Packard Development Company, L.P.**, Houston, TX (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.: **10/543,008**

(22) PCT Filed: **Aug. 8, 2003**

(86) PCT No.: **PCT/DE03/02672**

§ 371 (c)(1),
(2), (4) Date: **Jul. 21, 2005**

(87) PCT Pub. No.: **WO2004/070875**

PCT Pub. Date: **Aug. 19, 2004**

(65) **Prior Publication Data**

US 2006/0055602 A1 Mar. 16, 2006

(30) **Foreign Application Priority Data**

Jan. 24, 2003 (DE) 103 02 805

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

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

(58) **Field of Classification Search** ..... 343/700 MS, 343/702, 833, 834, 837, 893

See application file for complete search history.

(56) **References Cited**

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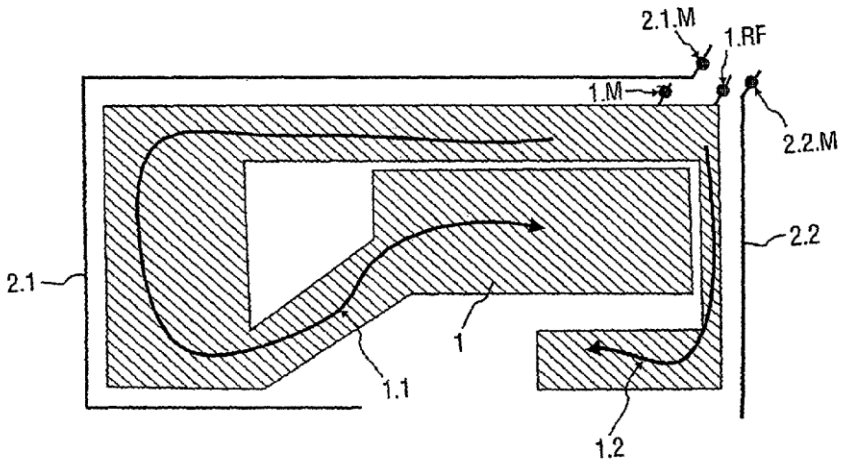
Primary Examiner — Jacob Y Choi
Assistant Examiner — Robert Karacsony

(57) **ABSTRACT**

A multiband antenna array for mobile radio equipment that includes a planar pitch antenna having at least two resonances and is provided with a connection to ground and a high-frequency interface and at least two parasitic transmitters which are located marginal to the planar patch antenna and are embodied so as to be free of a high-frequency interface. A particularly compact multiband antenna for several frequency bands is crated as a result of the special arrangement of the planar patch antenna and the parasitic transmitters.

10 Claims, 4 Drawing Sheets



US007999744B2

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

(10) **Patent No.: US 7,999,744 B2**
(45) **Date of Patent: Aug. 16, 2011**

(54) **WIDEBAND PATCH ANTENNA**

(75) Inventors: **Ching Hong Chin**, Hong Kong (CN); **Quan Xue**, Hong Kong (CN); **Hang Wong**, Hong Kong (CN); **Xiu Yin Zhang**, Hong Kong (CN)

(73) Assignee: **City University of Hong Kong**, Kowloon (HK)

(*) 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.: **11/953,210**

(22) Filed: **Dec. 10, 2007**

(65) **Prior Publication Data**

US 2009/0146883 A1 Jun. 11, 2009

(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

See application file for complete search history.

(56) **References Cited**

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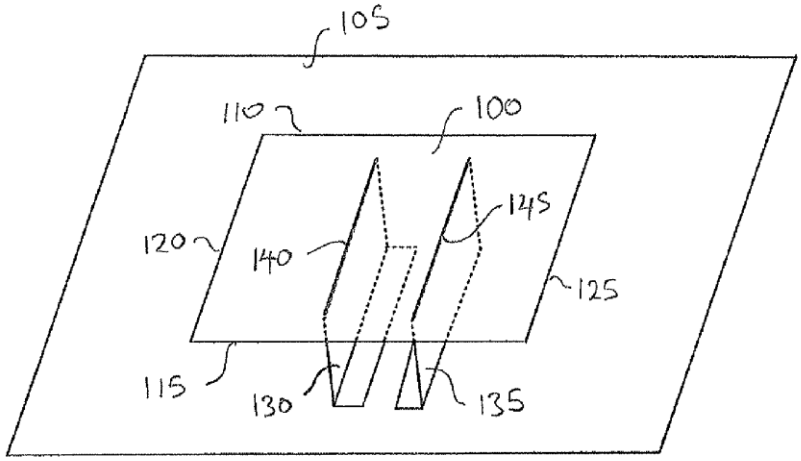
Primary Examiner — HoangAnh T Le

(74) *Attorney, Agent, or Firm* — Leydig, Voit & Mayer, Ltd.

(57) **ABSTRACT**

A patch antenna has a ground plane and a planar antenna plate that are parallel to and spaced from each other. A pair of planar feed plates have feed edges electrically contacting a surface of the antenna plate to couple electromagnetic energy into and/or out of the antenna plate.

5 Claims, 9 Drawing Sheets



US008004465B2

(12) **United States Patent**
Schano

(10) **Patent No.: US 8,004,465 B2**
(45) **Date of Patent: Aug. 23, 2011**

(54) **MULTIBAND OMNIDIRECTIONAL ANTENNA**

(75) Inventor: **Thomas Schano**, Giesen (DE)

(73) Assignee: **Robert Bosch GmbH**, Stuttgart (DE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 226 days.

(21) Appl. No.: **12/084,936**

(22) PCT Filed: **Oct. 31, 2006**

(86) PCT No.: **PCT/EP2006/067981**

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(2), (4) Date: **Mar. 10, 2009**

(87) PCT Pub. No.: **WO2007/057300**

PCT Pub. Date: **May 24, 2007**

(65) **Prior Publication Data**

US 2009/0303131 A1 Dec. 10, 2009

(30) **Foreign Application Priority Data**

Nov. 21, 2005 (DE) 10 2005 055 345

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

(52) **U.S. Cl.** ..... **343/700 MS**; 343/713

(58) **Field of Classification Search** ..... 343/700 MS, 343/711, 712, 713
See application file for complete search history.

(56) **References Cited**

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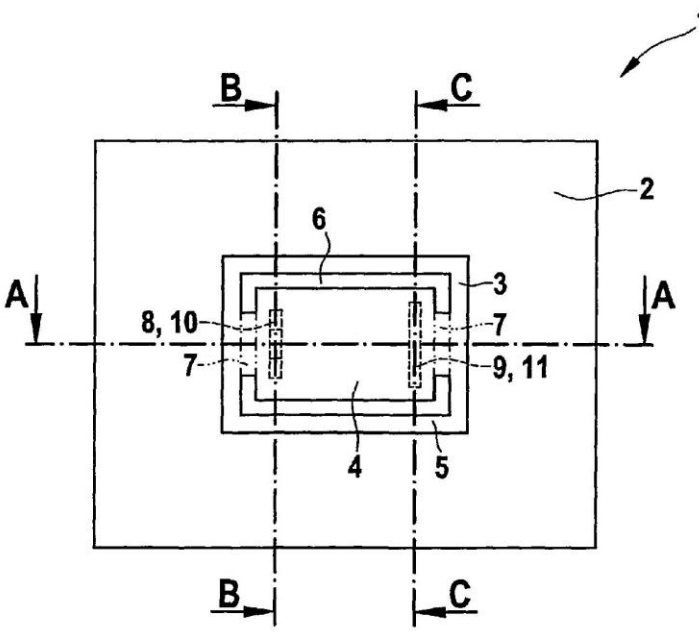
Primary Examiner — HoangAnh T Le
(74) *Attorney, Agent, or Firm* — Kenyon & Kenyon LLP

(57) **ABSTRACT**

A multiband omnidirectional antenna which includes a grounded face and an antenna element situated parallel to the grounded face, the antenna element having a first planar emitter, which has a planar design and extends parallel to the grounded face, a second planar emitter, which surrounds the first planar emitter at a distance, and at least two connection elements for connecting the first and the second planar emitters to each other.

7 Claims, 2 Drawing Sheets



US008004466B2

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

(10) **Patent No.: US 8,004,466 B2**
(45) **Date of Patent: Aug. 23, 2011**

(54) **ANTENNA**

(75) Inventors: **Hyun Hak Kim**, Gyunggi-do (KR); **Jong Kweon Park**, Daejeou (KR); **Jung Nam Lee**, Daejeon (KR); **Seok Min Woo**, Gyunggi-do (KR)

(73) Assignee: **Samsung Electro-Mechanics Co., Ltd.**, Gyunngi-do (KR)

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

(21) Appl. No.: **12/257,556**

(22) Filed: **Oct. 24, 2008**

(65) **Prior Publication Data**

US 2009/0284419 A1 Nov. 19, 2009

(30) **Foreign Application Priority Data**

May 13, 2008 (KR) 10-2008-0044110

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

(52) **U.S. Cl.** ..... **343/700 MS**; 343/846; 343/850

(58) **Field of Classification Search** ..... 343/343, 343/700 MS, 702, 907, 911 R, 767, 770, 343/846, 850

See application file for complete search history.

(56) **References Cited**

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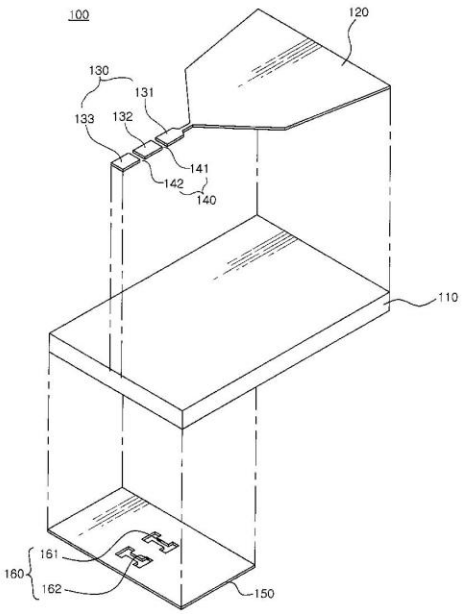
Primary Examiner — Hoang V Nguyen
(74) *Attorney, Agent, or Firm* — Lowe, Hauptman, Ham & Berner, LLP

(57) **ABSTRACT**

An antenna includes a dielectric substrate, a radiator disposed on one surface of the dielectric substrate, a feeding conductive pattern having one end connected with the radiator and the other end connected with an external feed line, a first slot disposed in the feeding conductive pattern, a ground plane disposed on the other surface of the dielectric substrate, and a second slot disposed on the ground plane.

20 Claims, 5 Drawing Sheets



US008004469B2

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

(10) **Patent No.: US 8,004,469 B2**
(45) **Date of Patent: *Aug. 23, 2011**

(54) **MOBILE WIRELESS COMMUNICATIONS DEVICE COMPRISING MULTI-FREQUENCY BAND ANTENNA AND RELATED METHODS**

(75) Inventors: **Yihong Qi**, Waterloo (CA); **Ying Tong Man**, Kitchener (CA); **Perry Jarmuszewski**, Waterloo (CA)

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

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

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/749,556**

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

(65) **Prior Publication Data**

US 2010/0184388 A1 Jul. 22, 2010

Related U.S. Application Data

(63) Continuation of application No. 12/173,087, filed on Jul. 15, 2008, now Pat. No. 7,696,935, which is a continuation of application No. 11/769,844, filed on Jun. 28, 2007, now Pat. No. 7,482,985, which is a continuation of application No. 11/422,158, filed on Jun. 5, 2006, now Pat. No. 7,271,772, which is a continuation of application No. 11/042,693, filed on Jan. 25, 2005, now Pat. No. 7,068,230.

(60) Provisional application No. 60/576,159, filed on Jun. 2, 2004, provisional application No. 60/576,637, filed on Jun. 3, 2004.

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

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

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

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

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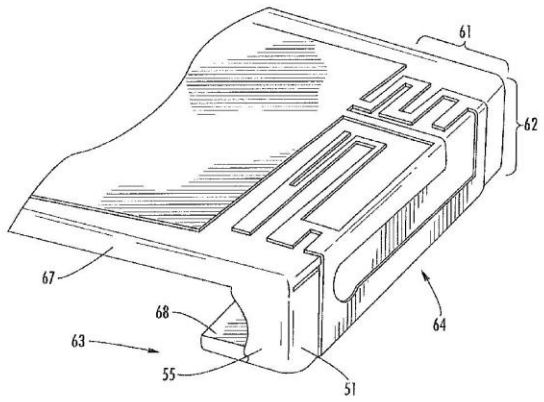
Primary Examiner — Hoang V Nguyen

(57) **ABSTRACT**

A mobile wireless communications device may include a housing and a multi-frequency band antenna carried within the housing. The multi-frequency band antenna may include a main loop conductor having a gap therein defining first and second ends of the main loop conductor, a first branch conductor having a first end connected adjacent the first end of the main loop conductor and having a second end defining a first feed point, and a second branch conductor having a first end connected adjacent the second end of the main loop conductor and a second end defining a second feed point. The antenna may further include a tuning branch conductor having a first end connected to the main loop conductor between the respective first ends of the first and second branches.

23 Claims, 11 Drawing Sheets



US008004470B2

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

(10) **Patent No.: US 8,004,470 B2**
(45) **Date of Patent: *Aug. 23, 2011**

(54) **ANTENNA, COMPONENT AND METHODS**

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

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

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

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/871,841**

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

(65) **Prior Publication Data**

US 2010/0321250 A1 Dec. 23, 2010

Related U.S. Application Data

(63) Continuation of application No. 11/648,429, filed on Dec. 28, 2006, now Pat. No. 7,786,938, which is a continuation of application No. PCT/FI2005/050247, filed on Jun. 28, 2005.

(30) **Foreign Application Priority Data**

Jun. 28, 2004 (FI) 20040892
Aug. 18, 2004 (FI) 20041088
Mar. 16, 2005 (WO) PCT/FI2005/050089

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

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

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

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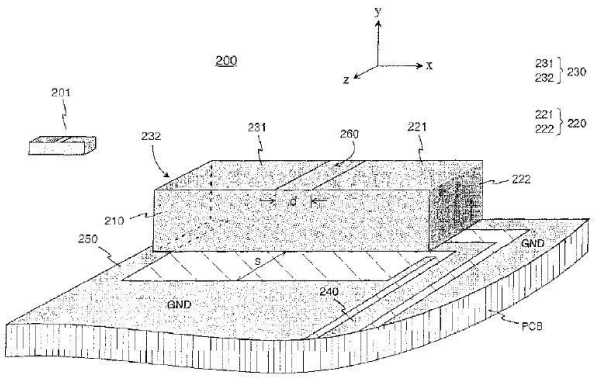
Primary Examiner — David G Phan
(74) *Attorney, Agent, or Firm* — Gazdzinski & Associates, PC

(57) **ABSTRACT**

An antenna component (and antenna) with a dielectric substrate and a plurality of radiating antenna elements on the surface of the substrate. In one embodiment, the plurality comprises two (2) elements, each of them covering one of the opposite heads and part of the upper surface of the device. The upper surface between the elements comprises a slot. The lower edge of one of the antenna elements is galvanically coupled to the antenna feed conductor on a circuit board, and at another point to the ground plane, while the lower edge of the opposite antenna element, or the parasitic element, is galvanically coupled only to the ground plane. The parasitic element obtains its feed through the electromagnetic coupling over the slot, and both elements resonate at the operating frequency. Omni-directionality is also achieved. Losses associated with the substrate are low due to the simple field image in the substrate.

23 Claims, 5 Drawing Sheets



US008004473B2

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

(10) **Patent No.: US 8,004,473 B2**
(45) **Date of Patent: Aug. 23, 2011**

(54) **ANTENNA DEVICE WITH AN ISOLATING UNIT**

(75) Inventors: **Shyh-Jong Chung**, Hsinchu (TW); **Ming Ta Lin**, Yunlin County (TW); **Chih Hung Tsai**, Koahsiung (TW)

(73) Assignee: **Realtek Semiconductor Corp.**, Hsinchu (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.: **12/244,562**

(22) Filed: **Oct. 2, 2008**

(65) **Prior Publication Data**

US 2009/0091507 A1 Apr. 9, 2009

(30) **Foreign Application Priority Data**

Oct. 4, 2007 (TW) ..... 96137262 A

(51) **Int. Cl.**
H01Q 1/52 (2006.01)

(52) **U.S. Cl.** **343/841**; 343/851

(58) **Field of Classification Search** 343/835, 343/841, 893, 850, 851
See application file for complete search history.

(56) **References Cited**

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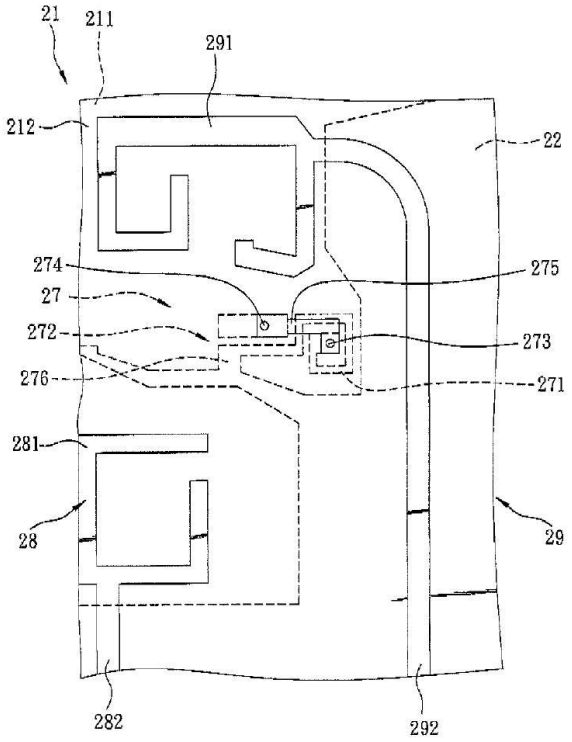
Primary Examiner — Hoang V Nguyen
(74) *Attorney, Agent, or Firm* — Stephen A. Bent; Foley & Lardner LLP

(57) **ABSTRACT**

An antenna device includes a pair of antennas and an isolating unit. The antennas have the same operating frequency. The isolating unit is disposed between the antennas, and includes an LC circuit that has a resonant frequency, which is the same as the operating frequency of the antennas, thereby improving isolation between the antennas.

20 Claims, 5 Drawing Sheets



US008009102B2

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

(10) **Patent No.: US 8,009,102 B2**
(45) **Date of Patent: Aug. 30, 2011**

(54) **MULTI-BAND ANTENNA AND MULTI-BAND ANTENNA SYSTEM WITH ENHANCED ISOLATION CHARACTERISTIC**

(75) Inventors: **Il-kyu Kim**, Seongnam-si (KR); **Chang-won Jung**, Hwaseong-si (KR); **Young-eil Kim**, Suwon-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 573 days.

(21) Appl. No.: **12/105,614**

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

(65) **Prior Publication Data**

US 2009/0079655 A1 Mar. 26, 2009

(30) **Foreign Application Priority Data**

Sep. 21, 2007 (KR) 10-2007-0096985

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

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

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

(56) **References Cited**

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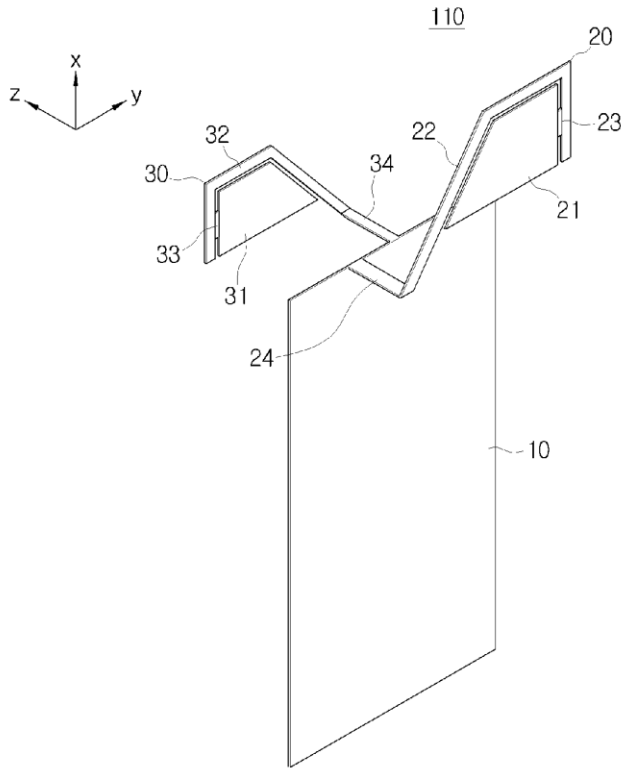
Primary Examiner — Trinh V Dinh
(74) *Attorney, Agent, or Firm* — NSIP Law, PC

(57) **ABSTRACT**

A Multi-Band antenna system includes an antenna which resonates in a plurality of frequency bands and a controller which drives the antenna. The antenna includes a ground plate and a plurality of radiators which are formed on both sides of the ground plate in directions perpendicular to a surface of the ground plate in a space at an edge of the ground plate, wherein each radiator is connected to the edge of the ground plate.

16 Claims, 10 Drawing Sheets



US008009103B2

(12) **United States Patent**
Chang

(10) **Patent No.: US 8,009,103 B2**
(45) **Date of Patent: Aug. 30, 2011**

(54) **TRIPLE-BAND ANTENNA**

(75) Inventor: **Yu-Min Chang**, Tu-Cheng (TW)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 398 days.

(21) Appl. No.: **12/401,727**

(22) Filed: **Mar. 11, 2009**

(65) **Prior Publication Data**

US 2010/0039344 A1 Feb. 18, 2010

(30) **Foreign Application Priority Data**

Aug. 13, 2008 (CN) 2008 1 030751

(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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2008/0180333	A1 *	7/2008	Martiskainen et al.	343/722

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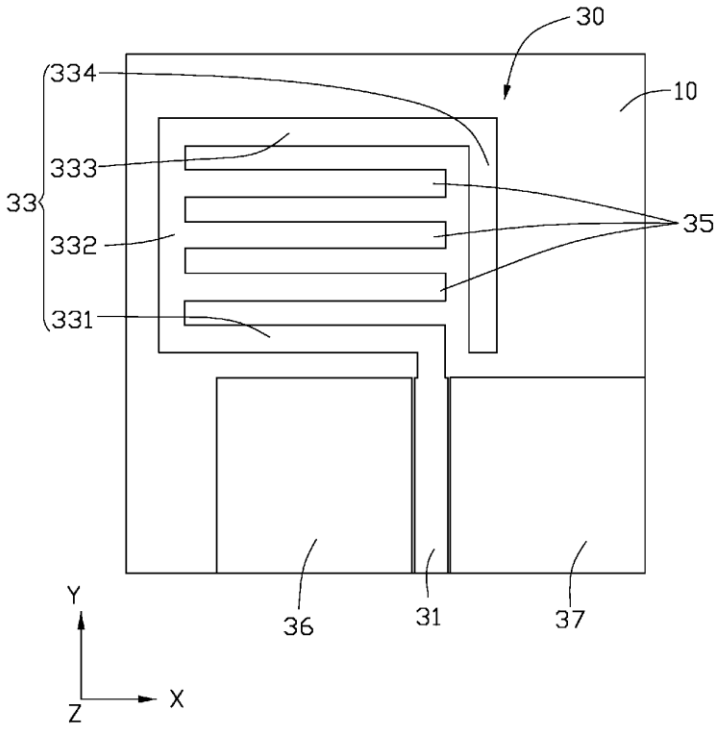
Primary Examiner — Hoanganh Le

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

(57) **ABSTRACT**

The disclosure discloses a triple-band antenna including a feed line, a first radiating body, a second radiating body and a grounding sheet. The first radiating body is a rectangular sheet. One end of the first radiating body is electrically connected with the end of the feed line. The second radiating body includes three parallel bar shape sheets extending from the first radiating body and surrounded by the first radiating body, and both share the feed line. The grounding sheet is disposed beside the feed line. The first radiating body and the second radiating body of the triple-band antenna generate three resonance frequencies according to the radio frequency received by the feed line to allow the triple-band antenna work under three different operating frequencies.

19 Claims, 14 Drawing Sheets



US008009106B2

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

(10) **Patent No.: US 8,009,106 B2**
(45) **Date of Patent: Aug. 30, 2011**

(54) **DUAL FREQUENCY ANTENNA AND COMMUNICATION SYSTEM**

(75) Inventors: **Chih-Yuan Yang**, Taipei Hsien (TW); **Po-Wei Kuo**, Taipei Hsien (TW); **Suo-Bing Su**, Taipei Hsien (TW); **Hung-Chang Ko**, Taipei Hsien (TW); **Wen-Chun Chen**, Taipei Hsien (TW)

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

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

(21) Appl. No.: **12/423,016**

(22) Filed: **Apr. 14, 2009**

(65) **Prior Publication Data**

US 2009/0256756 A1 Oct. 15, 2009

(30) **Foreign Application Priority Data**

Apr. 14, 2008 (CN) 2008 1 0301132

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

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

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

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

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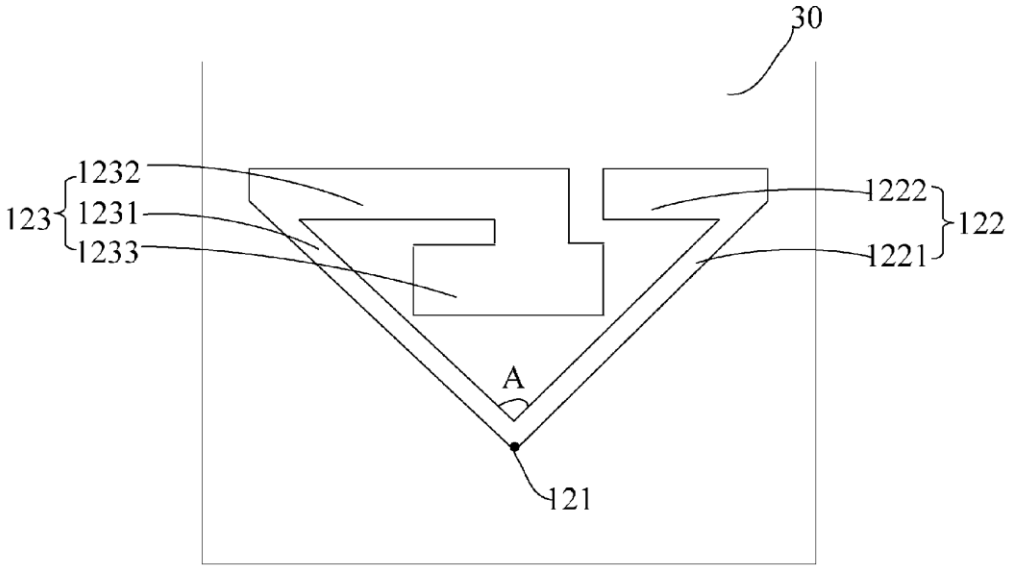
Primary Examiner — Hoang V Nguyen
(74) *Attorney, Agent, or Firm* — Altis Law Group, Inc.

(57) **ABSTRACT**

A dual frequency antenna includes a first scythe-shaped arm and a second scythe-shaped arm. The first scythe-shaped arm is configured for operating in a first band. The second scythe-shaped arm is configured for operating in a second band and includes an inverted-T-shaped strip with a foot of the inverted-T-shaped strip connected to the second scythe-shaped arm. The first scythe-shaped arm is attached to the second scythe-shaped arm at an apex. A head of the inverted-T-shaped strip is closer to the apex than the foot. A communication system is also provided.

20 Claims, 4 Drawing Sheets



US008009109B2

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

(10) **Patent No.: US 8,009,109 B2**
(45) **Date of Patent: Aug. 30, 2011**

(54) **INTERNAL ANTENNA HAVING SURFACE-MOUNTED RECEPTACLE**

(75) Inventors: **Soon-Jong So**, Gyeonggi-do (KR); **Sang-Hyuk Mun**, Incheon (KR); **Suk-Hwan Seo**, Gyeonggi-do (KR); **Ji-Soo Han**, Gyeonggi-do (KR)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 418 days.

(21) Appl. No.: **12/240,984**

(22) Filed: **Sep. 29, 2008**

(65) **Prior Publication Data**

US 2009/0085816 A1 Apr. 2, 2009

(30) **Foreign Application Priority Data**

Sep. 28, 2007 (KR) 10-2007-0097710

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

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

(58) **Field of Classification Search** ..... 343/700 MS, 343/702, 906

See application file for complete search history.

(56) **References Cited**

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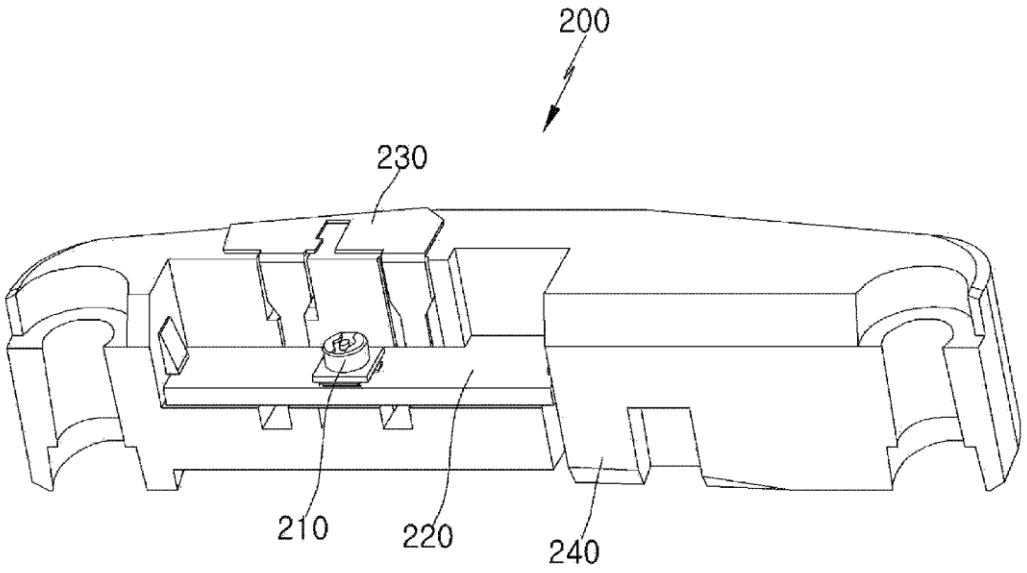
Primary Examiner — Hoanganh Le
(74) *Attorney, Agent, or Firm* — LRK Patent Law Firm

(57) **ABSTRACT**

Disclosed herein is an internal antenna having a surface-mounted receptacle. The internal antenna includes a printed circuit board, a radiator, and a frame. The printed circuit board is configured such that a receptacle is surface-mounted thereon. The radiator is connected to the printed circuit board. The frame is configured such that the printed circuit board and the radiator are mounted thereto.

9 Claims, 9 Drawing Sheets



US008009110B2

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

(10) **Patent No.: US 8,009,110 B2**
(45) **Date of Patent: Aug. 30, 2011**

(54) **ELECTRONIC APPARATUS WITH HIDDEN ANTENNA**

(75) Inventors: **Pei-Ling Teng**, Taoyuan County (TW); **Kuo-Cheng Chen**, Taoyuan County (TW)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 535 days.

(21) Appl. No.: **12/251,380**

(22) Filed: **Oct. 14, 2008**

(65) **Prior Publication Data**

US 2009/0167615 A1 Jul. 2, 2009

(30) **Foreign Application Priority Data**

Dec. 31, 2007 (TW) ..... 96151567 A

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

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

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

See application file for complete search history.

(56) **References Cited**

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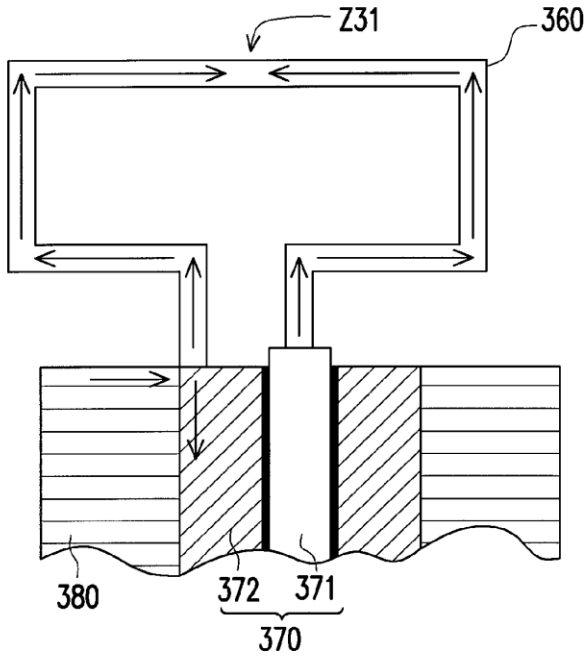
Primary Examiner — Huedung Mancuso
(74) *Attorney, Agent, or Firm* — Jianq Chyun IP Office

(57) **ABSTRACT**

An electronic apparatus with a hidden antenna comprises a metal frame and a substrate. The metal frame comprises a plurality of side walls and a notch is passed through at least one side wall. A feeding terminal is configured at a bottom side of the notch. A first shorting terminal and a second shorting terminal are configured at two lateral sides of the notch. A metal surface of the substrate is electrically connected to the first shorting terminal, the second shorting terminal and the side walls, and the notch is faced to the substrate. The metal frame receives or transmits an electromagnetic signal, and delivers the electromagnetic signal over the feeding terminal, and a length of the bottom side of the notch is one half of a wavelength of the electromagnetic signal.

16 Claims, 8 Drawing Sheets



US008009119B2

(12) **United States Patent**
Hung

(10) **Patent No.: US 8,009,119 B2**
(45) **Date of Patent: Aug. 30, 2011**

(54) **MULTIBAND ANTENNA**

(75) Inventor: **Chung-Yu Hung**, Tu-Cheng (TW)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 216 days.

(21) Appl. No.: **12/486,020**

(22) Filed: **Jun. 17, 2009**

(65) **Prior Publication Data**

US 2010/0123641 A1 May 20, 2010

(30) **Foreign Application Priority Data**

Nov. 14, 2008 (CN) 2008 1 0305561

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 21/30 (2006.01)

(52) **U.S. Cl.** **343/893**; 343/702; 343/846; 343/828

(58) **Field of Classification Search** ..... 343/700 MS, 343/702, 893, 828, 846
See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Douglas W Owens
Assistant Examiner — Jennifer F Hu
(74) *Attorney, Agent, or Firm* — Altis Law Group, Inc.

(57) **ABSTRACT**

A multiband antenna includes a first antenna unit for receiving/sending wireless signals having higher frequencies and a second antenna unit for receiving/sending wireless signals having lower frequencies than those frequencies received/sent by the first antenna unit. The first antenna unit includes a first main portion, a first resonating portion and a first connecting portion connected in order and positioned in a same plane. The second antenna unit includes a second connecting portion, a second resonating portion and a second main portion connected in order. The second connecting portion is coplanar with the first connecting portion, the second resonating portion is perpendicular to the second connecting portion, and the second main portion is perpendicular to both the first connecting portion and the second connecting portion.

12 Claims, 3 Drawing Sheets