



US007212161B2

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

(10) **Patent No.:** **US 7,212,161 B2**
(45) **Date of Patent:** **May 1, 2007**

(54) **LOW-PROFILE EMBEDDED ANTENNA ARCHITECTURES FOR WIRELESS DEVICES**

(75) Inventors: **Zhi Ning Chen**, Singapore (SG); **Brian Paul Gaucher**, Brookfield, CT (US); **Thomas Richard Hildner**, Cary, NC (US); **Duixian Liu**, Yorktown Heights, NY (US)

(73) Assignee: **Lenovo (Singapore) Pte. Ltd.**, Singapore (SG)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 8 days.

(21) Appl. No.: **10/993,552**

(22) Filed: **Nov. 19, 2004**

(65) **Prior Publication Data**
US 2006/0109184 A1 May 25, 2006

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

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

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

See application file for complete search history.

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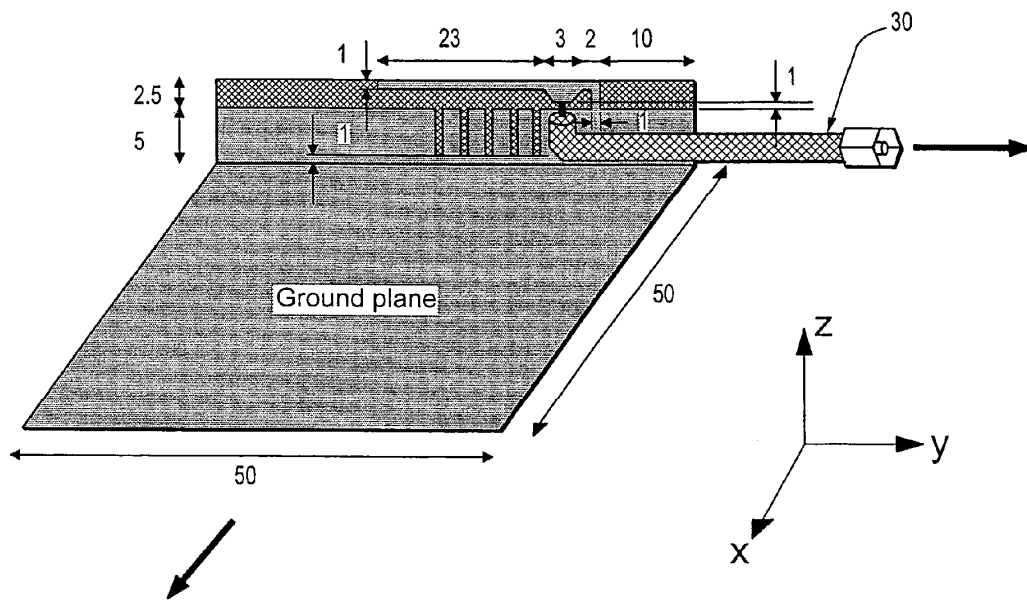
Primary Examiner—Trinh Vo Dinn

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

(57) **ABSTRACT**

Low-profile, compact embedded 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 suitable antenna characteristics (e.g., impedance matching and radiation efficiency) over a desired bandwidth of operation. Compact antenna designs with reduced antenna size (e.g., antenna height) and increased operational bandwidth (e.g., broadband impedance matching) are achieved using slotted ground plane designs and/or doubling antenna feeding schemes.

40 Claims, 15 Drawing Sheets





US007212163B2

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

(10) **Patent No.:** **US 7,212,163 B2**
(45) **Date of Patent:** **May 1, 2007**

(54) **CIRCULAR POLARIZED ARRAY ANTENNA**

(75) Inventors: **Kao-Cheng Huang**, Stuttgart (DE);
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(73) Assignee: **Sony Deutschland GmbH**, Cologne (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.

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(21) Appl. No.: **11/053,997**

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

(65) **Prior Publication Data**

US 2005/0200531 A1 Sep. 15, 2005

(30) **Foreign Application Priority Data**

Feb. 11, 2004 (EP) 04003076
Sep. 29, 2004 (EP) 04023212

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

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

(58) **Field of Classification Search** **373/700 MS, 373/786, 846, 848, 893**
See application file for complete search history.

(56) **References Cited**

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Primary Examiner—Hoanganh Le

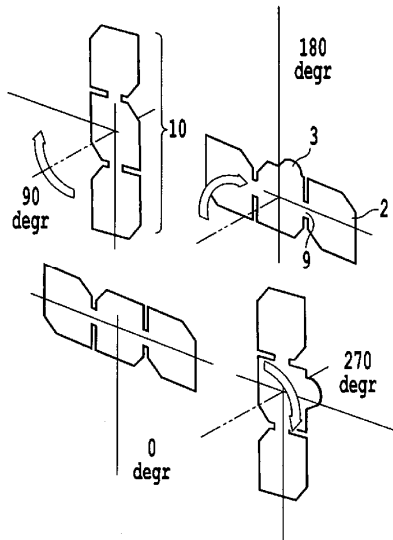
Assistant Examiner—Tung Le

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

(57) **ABSTRACT**

A circular polarized array antenna includes: groups of at least one set of patches for radiating and/or receiving a circular polarized electromagnetic wave; and a network of feeding lines, each feeding line being coupled to and extending longitudinally or vertically to one of the sets for transferring signal energy to and/or from the set. Each of the feeding lines coupled to the sets is pointing into a direction different from the pointing direction of the other feeding lines in order to achieve a circular orientation of the network of feeding lines.

70 Claims, 7 Drawing Sheets





US007212164B2

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

(10) **Patent No.:** **US 7,212,164 B2**
(45) **Date of Patent:** **May 1, 2007**

(54) **RADIO TERMINAL DEVICE ANTENNA AND RADIO TERMINAL DEVICE**

(75) Inventors: **Kentaro Miyano**, Kanagawa (JP); **Yoichi Nakagawa**, Tokyo (JP); **Masahiro Mimura**, Tokyo (JP); **Yoshio Koyanagi**, Kanagawa (JP); **Kyohei Fujimoto**, Kanagawa (JP)

(73) Assignee: **Matsushita Electric Industrial Co., Ltd.**, Osaka (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 81 days.

(21) Appl. No.: **10/505,372**

(22) PCT Filed: **Sep. 25, 2003**

(86) PCT No.: **PCT/JP03/12223**

§ 371 (c)(1),
(2), (4) Date: **Aug. 20, 2004**

(87) PCT Pub. No.: **WO2004/030146**

PCT Pub. Date: **Apr. 8, 2004**

(65) **Prior Publication Data**

US 2005/0119035 A1 Jun. 2, 2005

(30) **Foreign Application Priority Data**

Sep. 26, 2002 (JP) 2002-280994
Sep. 19, 2003 (JP) 2003-327822

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

(52) **U.S. Cl.** **343/702; 343/741; 343/876; 343/893**

(58) **Field of Classification Search** 343/700 MS, 343/702, 876, 741, 866, 821, 893
See application file for complete search history.

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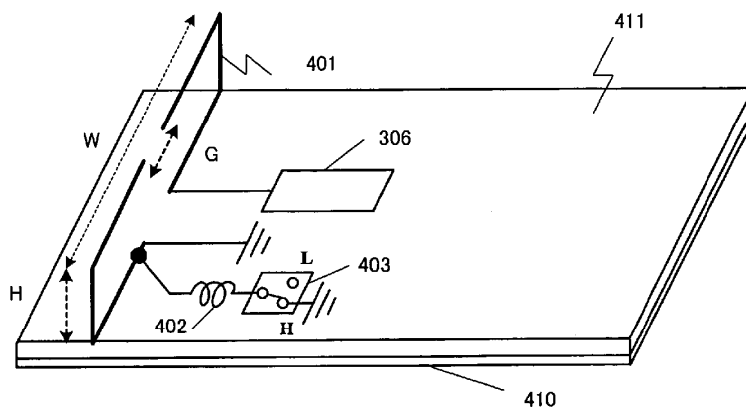
Primary Examiner—Tan Ho

(74) *Attorney, Agent, or Firm*—RatnerPrestia

(57) **ABSTRACT**

A radio terminal device has an antenna element, a coil, a switch, an RF circuit section and a conductive substrate. The switch is used to switch between a case where current distribution exists only in the antenna element and its vicinities and a case where the current distribution exists not only in the antenna element and its vicinities but also in other places. Additionally, the switch is switched in accordance with the usage pattern in which the user uses the radio terminal device (e.g., telephone call and data communication). This allows the transmission/reception to be performed with the antenna polarization and directivity suitable for the usage pattern. Thus, there can be provided a radio terminal device that exhibits a reception characteristic suitable for a respective situation.

22 Claims, 16 Drawing Sheets





US007212165B2

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

(10) **Patent No.:** **US 7,212,165 B2**
(45) **Date of Patent:** **May 1, 2007**

(54) **CHIP ANTENNA**

(75) Inventors: **Chang-Fa Yang**, Hsinchuang (TW);
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(73) Assignee: **National Taiwan University of Science and Technology**, 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.: **10/960,310**

(22) Filed: **Oct. 6, 2004**

(65) **Prior Publication Data**
US 2005/0104787 A1 May 19, 2005

(30) **Foreign Application Priority Data**
Nov. 19, 2003 (TW) 92132453 A

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

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

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

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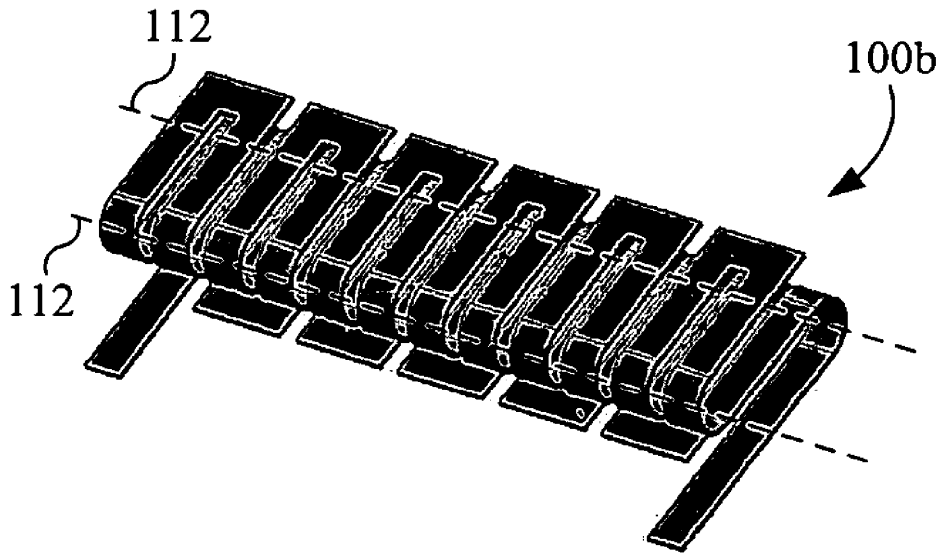
Primary Examiner—Tho Phan

(74) *Attorney, Agent, or Firm*—Michael A. Glenn; Glenn Patent Group

(57) **ABSTRACT**

A chip antenna has an antenna body and a package. The antenna body has multiple meandered metal lines and is encapsulated with the package. The material of the package is a dielectric composite formed with polymers and ceramic powders, which has a dielectric constant designed for the antenna. The characteristics of the chip antenna are determined by the structures of the antenna body and the dielectric constant of the package. Thus, a requirement for tiny structures in antenna applications can be satisfied.

6 Claims, 9 Drawing Sheets





US007212166B2

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

(10) **Patent No.:** **US 7,212,166 B2**
(45) **Date of Patent:** **May 1, 2007**

(54) **ANTENNA STRUCTURE**

(75) Inventors: **Hung-Wei Tseng**, Tainan (TW);
Yueh-Lin Tsai, Shulin Town, Yunlin
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(73) Assignee: **Inpaq Technology Co., Ltd.**, Hsinchu
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(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

(21) Appl. No.: **11/063,775**

(22) Filed: **Feb. 24, 2005**

(65) **Prior Publication Data**

US 2006/0017618 A1 Jan. 26, 2006

(30) **Foreign Application Priority Data**

Jul. 9, 2004 (TW) 93210915 U

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

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

(58) **Field of Classification Search** **343/702,**
343/700 MS, 824, 853
See application file for complete search history.

(56) **References Cited**

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Primary Examiner—Hoanganh Le

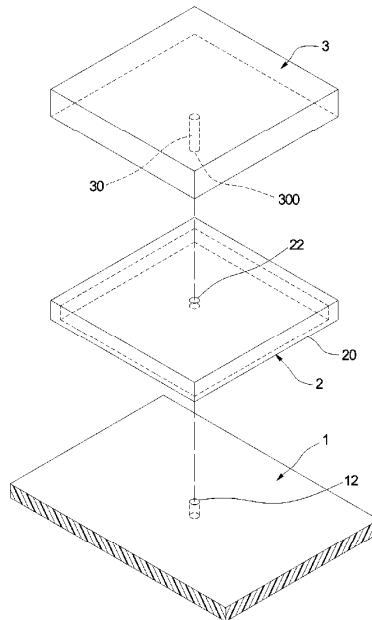
Assistant Examiner—Huedung Mancuso

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

(57) **ABSTRACT**

An antenna module has a PCB with a plurality of contacts, a support element, and an antenna module. The support element has a support portion extended downwardly therefrom. The antenna module is connected with the support element. The antenna structure has a metal support element fixed on the PCB with a plurality of contacts. The support element is used to support an antenna module for electrically connecting the antenna module on the PCB with the contacts. When the antenna module connects to the PCB, the antenna contact does not project out the bottom side of the PCB. Therefore, the bottom side of the PCB is level. The antenna structure has a metal support used to shield the noise interference between the antenna module and the PCB.

13 Claims, 8 Drawing Sheets





US007212167B2

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

(10) **Patent No.:** **US 7,212,167 B2**
(45) **Date of Patent:** **May 1, 2007**

(54) **INTEGRATED LOOP ANTENNA FOR VEHICULAR APPLICATIONS**

(75) Inventors: **Dedimuni Rusiru Vinodaka Leclaratne**, Kent (GB); **Peter Callaghan**, Kent (GB); **John Randall**, Kent (GB)

(73) Assignee: **Harada Industry Co., Ltd.**, Kent (GB)

(*) 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.: **10/522,220**

(22) PCT Filed: **Jul. 24, 2003**

(86) PCT No.: **PCT/GB03/03260**

§ 371 (c)(1),
(2), (4) Date: **Sep. 29, 2005**

(87) PCT Pub. No.: **WO2004/010529**

PCT Pub. Date: **Jan. 29, 2004**

(65) **Prior Publication Data**
US 2006/0097934 A1 May 11, 2006

(30) **Foreign Application Priority Data**
Jul. 24, 2002 (GB) 0217157.7

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

(52) **U.S. Cl.** **343/713**
(58) **Field of Classification Search** 343/711-713
See application file for complete search history.

(56) **References Cited**

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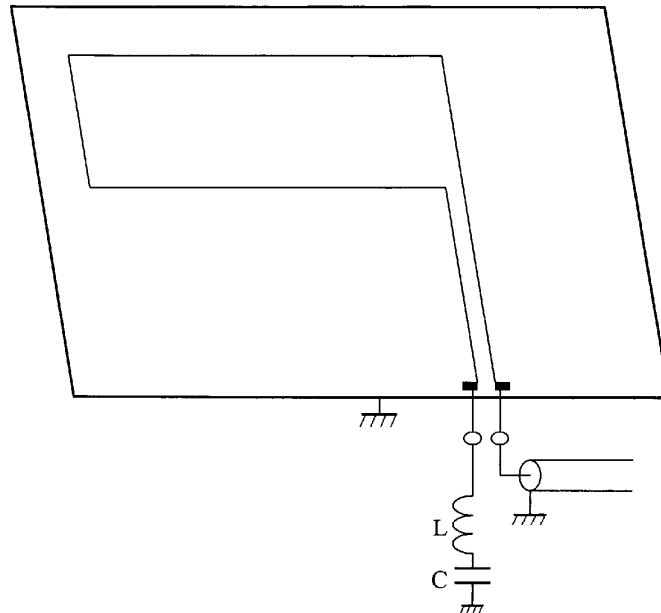
Primary Examiner—Michael C. Wimer

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

(57) **ABSTRACT**

A vehicular screen antenna includes a conductor extending on a dielectric, such as a window. The conductor is configured as a loop having entry and exit segments, the loop being positioned generally centrally on the dielectric. The entry and exit segments extend proximate each other from the loop towards a first edge of the dielectric and are oriented on the dielectric so as to extend generally vertically when the dielectric is fitted to a vehicle.

19 Claims, 5 Drawing Sheets





US007212171B2

(12) **United States Patent**
Lee

(10) **Patent No.:** **US 7,212,171 B2**
(45) **Date of Patent:** **May 1, 2007**

- (54) **DIPOLE ANTENNA**
- (75) Inventor: **Chang-Jung Lee**, Taoyuan County (TW)
- (73) Assignee: **Arcadyan Technology Corporation**, Hsinchu (TW)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 66 days.

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Primary Examiner—Tan Ho

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

- (21) Appl. No.: **11/209,811**
- (22) Filed: **Aug. 24, 2005**
- (65) **Prior Publication Data**
US 2007/0052611 A1 Mar. 8, 2007

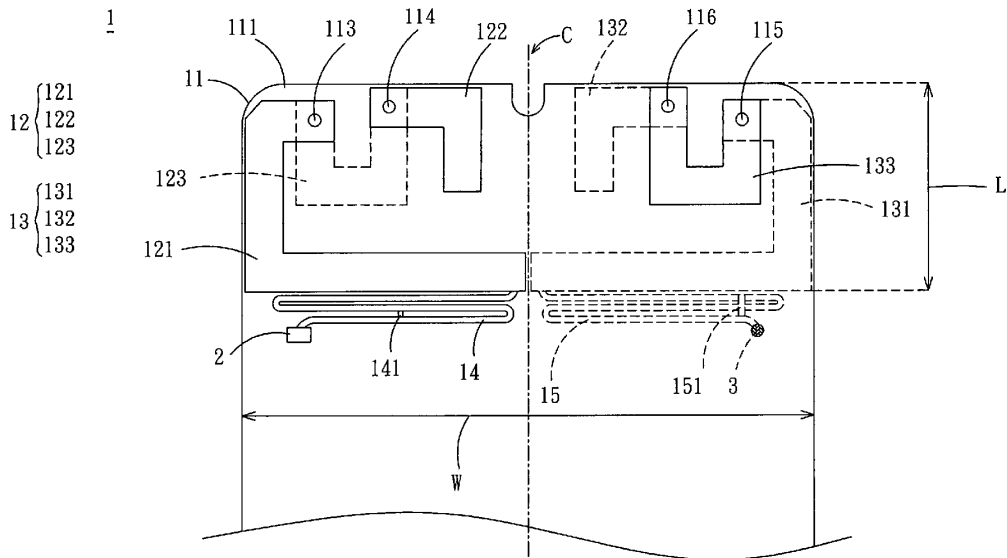
- (51) **Int. Cl.**
H01Q 9/28 (2006.01)
- (52) **U.S. Cl.** **343/795; 343/700 MS**
- (58) **Field of Classification Search** **343/700 MS, 343/795**
See application file for complete search history.

- (56) **References Cited**
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6,424,311 B1* 7/2002 Tsai et al. 343/795

(57) **ABSTRACT**

A dipole antenna includes a substrate, a first radiating member and a second radiating member. The substrate has a first surface and a second surface opposite to the first surface. The first radiating member and the second radiating member are symmetrically disposed on the first surface and the second surface of the substrate, and electrically connected to a grounding point and a feeding point, respectively. The first radiating member has a first radiating part, a second radiating part and a third radiating part, which are respectively disposed on the first surface and the second surface of the substrate and electrically connected to one another. The second radiating member has a fourth radiating part, a fifth radiating part and a sixth radiating part, which are respectively disposed on the first surface and the second surface of the substrate and are electrically connected to one another.

18 Claims, 6 Drawing Sheets





US007215283B2

(12) **United States Patent**
Boyle

(10) **Patent No.:** **US 7,215,283 B2**
(45) **Date of Patent:** **May 8, 2007**

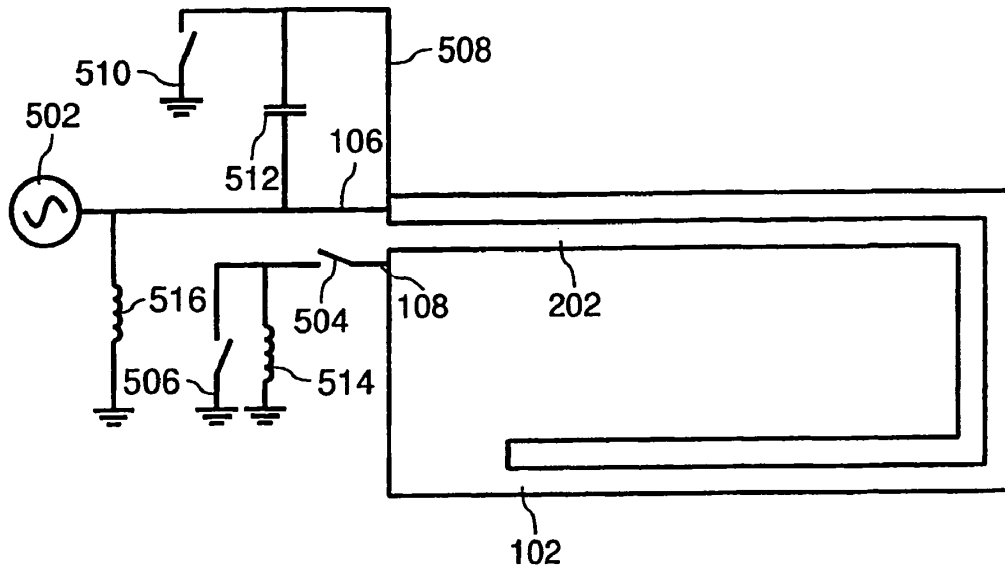
- (54) **ANTENNA ARRANGEMENT**
- (75) Inventor: **Kevin R. Boyle**, Horsham (GB)
- (73) Assignee: **NXP B.V.**, Eindhoven (NL)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 190 days.
- (21) Appl. No.: **10/512,617**
- (22) PCT Filed: **Apr. 17, 2003**
- (86) PCT No.: **PCT/IB03/01538**
§ 371 (c)(1),
(2), (4) Date: **Oct. 26, 2004**
- (87) PCT Pub. No.: **WO03/094290**
PCT Pub. Date: **Nov. 13, 2003**
- (65) **Prior Publication Data**
US 2006/0055606 A1 Mar. 16, 2006
- (30) **Foreign Application Priority Data**
Apr. 30, 2002 (GB) 0209818.4
- (51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/38 (2006.01)
- (52) U.S. Cl. 343/700 MS; 343/702
- (58) **Field of Classification Search** 343/700 MS,
343/702, 846
See application file for complete search history.

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- Primary Examiner*—Michael C. Wimer

(57) **ABSTRACT**

An antenna arrangement comprises a patch conductor (102) supported substantially parallel to a ground plane (104). The patch conductor includes first (106) and second (108) connection points, and further incorporates a slot (202) between the first and second points. The antenna can be operated in a first mode when the second connection point is connected to ground and in a second mode when the second connection point is open circuit. By connection of a variable impedance (514), for example a variable inductor, between the second connection point and the ground plane, operation of the arrangement at frequencies between the operating frequencies of the first and second modes is enabled.

10 Claims, 7 Drawing Sheets





US007215284B2

(12) **United States Patent**
Collinson

(10) **Patent No.:** **US 7,215,284 B2**
(45) **Date of Patent:** **May 8, 2007**

(54) **PASSIVE SELF-SWITCHING DUAL BAND ARRAY ANTENNA**

(75) Inventor: **Donald L. Collinson**, Lafayette, NY (US)

(73) Assignee: **Lockheed Martin Corporation**, Bethesda, MD (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.

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Primary Examiner—Tan Ho

(74) Attorney, Agent, or Firm—Plevy, Howard & Darcy PC

(21) Appl. No.: **11/128,729**

(22) Filed: **May 13, 2005**

(65) **Prior Publication Data**

US 2006/0256024 A1 Nov. 16, 2006

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

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

(58) **Field of Classification Search** 343/700 MS, 343/767, 770, 860
See application file for complete search history.

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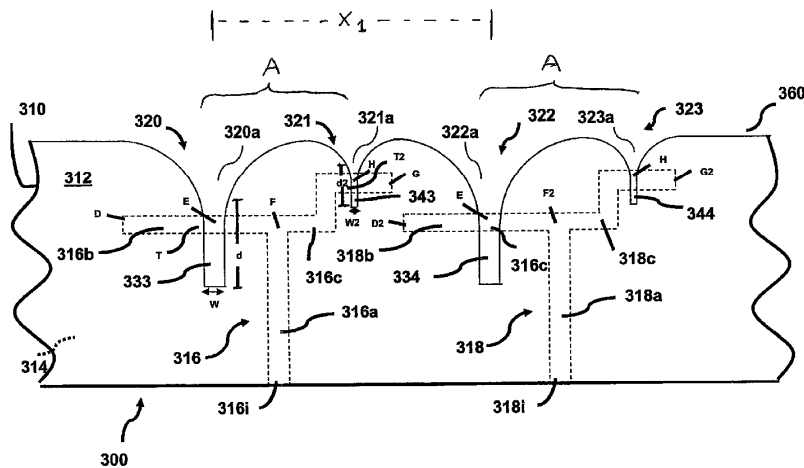
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(57) **ABSTRACT**

A dual band antenna array comprises a pair of coplanar antenna elements, the first antenna element excitable at a frequency within a first frequency band, the second antenna element excitable at a frequency within a second frequency band. A single transmission feed line in a second plane has an input for receiving a signal, the feed line dividing at a branch point into a first line segment for communicatively coupling the first antenna element with the input at a first feed point, and a second line segment for communicatively coupling the second antenna element with the input at a second feed point. The first and second line segments have lengths adapted for impedance matching at the first and second frequency bands, respectively, relative to the feed line input, to selectively allow energy transmission in one of the first and second line segments while reflecting energy in the other line segment according to the input signal frequency, whereby the activated antenna elements are passively switched based on the input signal frequency.

39 Claims, 3 Drawing Sheets





US007215285B2

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

(10) **Patent No.:** **US 7,215,285 B2**
(45) **Date of Patent:** **May 8, 2007**

(54) **BI-FREQUENCY SYMMETRICAL PATCH ANTENNA**

(75) Inventors: **Jia-Jiu Song**, Taipei County (TW);
Wei-Tong Cheng, Hsinchu (TW)

(73) Assignee: **Smartant Telecom Co., Ltd.**, Hsinchu (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 22 days.

(21) Appl. No.: **11/168,391**

(22) Filed: **Jun. 29, 2005**

(65) **Prior Publication Data**

US 2007/0001922 A1 Jan. 4, 2007

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

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

(58) **Field of Classification Search** **343/700 MS, 343/853, 795, 850**

See application file for complete search history.

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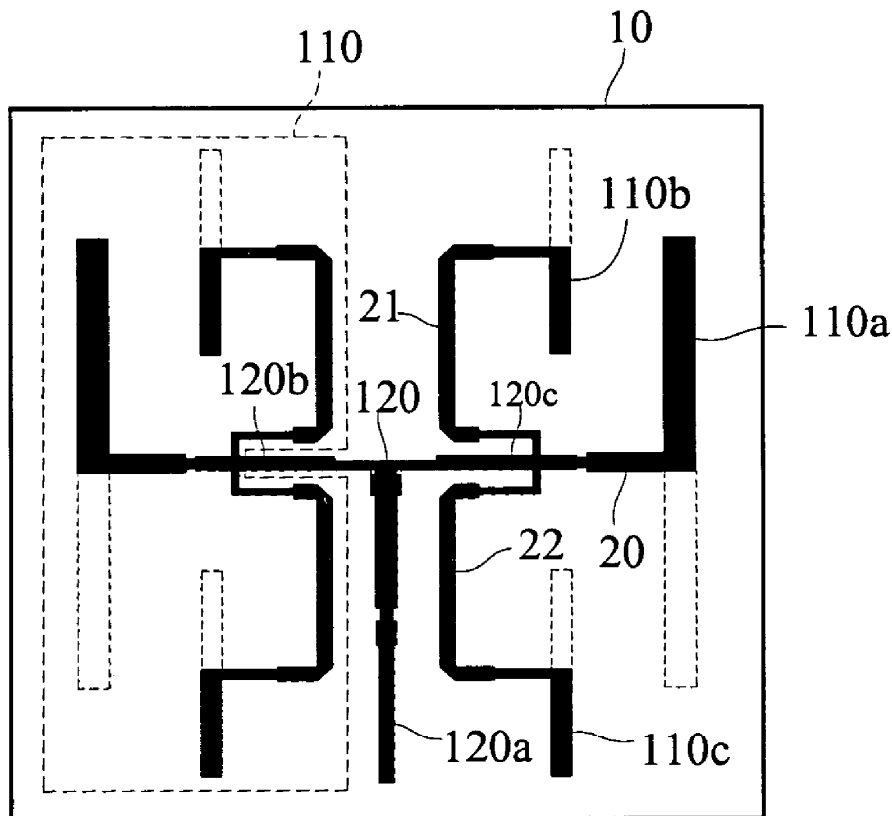
Primary Examiner—Hoang V. Nguyen

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

(57) **ABSTRACT**

A bi-frequency symmetrical patch antenna includes two bi-frequency symmetrical radiation units, each having a first band radiation section and two second band radiation sections, to radiate a feed-in signal in a selected direction. Further, the antenna has a power distribution unit, to evenly distribute the feed-in power, corresponding to the feed-in signal, to each bi-frequency symmetrical radiation unit. The power distribution unit has two side arms connecting respectively to each bi-frequency symmetrical radiation unit to increase the bandwidth range of the bi-frequency antenna.

20 Claims, 10 Drawing Sheets





US007215286B2

(12) **United States Patent**
Chen

(10) **Patent No.:** **US 7,215,286 B2**
(45) **Date of Patent:** **May 8, 2007**

- (54) **NOTEBOOK AND ANTENNA THEREOF**
- (75) Inventor: **Chih-Lung Chen**, Taipei Hsien (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 11 days.

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- 6,943,738 B1 * 9/2005 Mattsson et al. 343/700 MS
- 2004/0178957 A1 * 9/2004 Chang et al. 343/700 MS

- (21) Appl. No.: **11/182,463**
- (22) Filed: **Jul. 15, 2005**

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Primary Examiner—Hoanganh Le
 (74) *Attorney, Agent, or Firm*—Quintero Law Office

- (65) **Prior Publication Data**
US 2006/0232482 A1 Oct. 19, 2006

(57) **ABSTRACT**

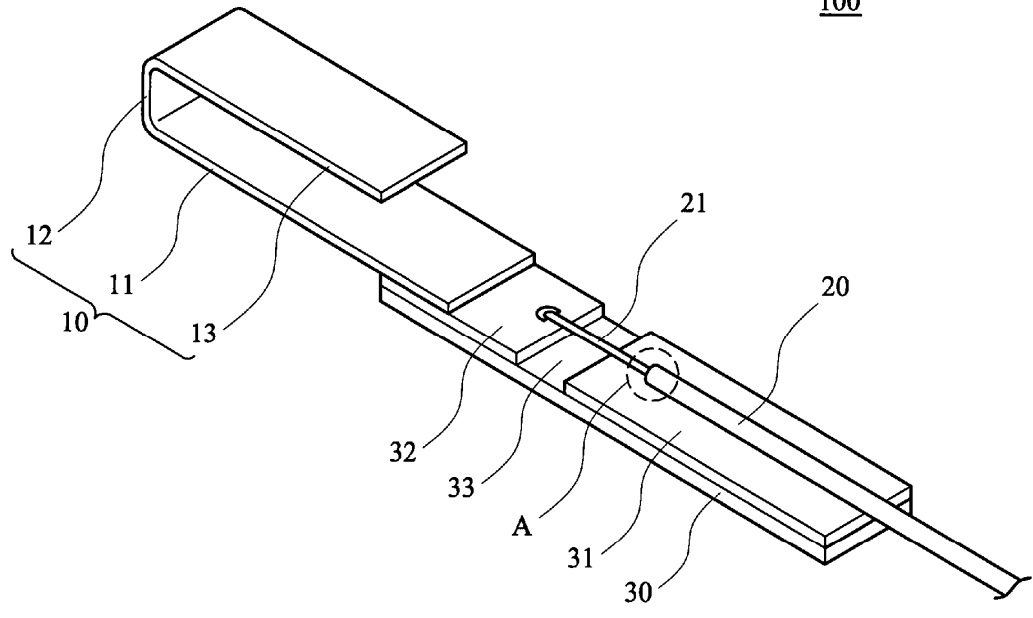
- (30) **Foreign Application Priority Data**
Apr. 15, 2005 (TW) 94205921 U

An antenna comprises an antenna body, a cable, a substrate, a ground element and a conductive element. The antenna body, which is U-shaped, comprises a first portion, a second portion and a third portion. The first portion is planar, the second portion is connected to an end of the first portion, the third portion is connected to an end of the second portion, and the first portion is parallel to the third portion. The ground element and the conductive element are disposed on the substrate. An isolation gap is formed between the ground element and the conductive element. The first portion is coupled to the conductive element. The cable comprises a signal line coupled to the conductive element.

- (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, 848
See application file for complete search history.

- (56) **References Cited**
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14 Claims, 8 Drawing Sheets





US007215287B2

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

(10) **Patent No.:** **US 7,215,287 B2**
(45) **Date of Patent:** **May 8, 2007**

- (54) **MULTIBAND ANTENNA** 4,504,834 A 3/1985 Garay et al.
- 4,543,581 A 9/1985 Nemet
- (75) Inventors: **Ramiro Quintero Illera**, Barcelona 4,571,595 A 2/1986 Phillips et al.
- (ES); **Carles Puente Baliarda**, 4,584,709 A 4/1986 Kneisel et al.
- Barcelona (ES)

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

(Continued)

(*) 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.: **10/823,257**

(Continued)

(22) Filed: **Apr. 13, 2004**

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(65) **Prior Publication Data**

US 2004/0257285 A1 Dec. 23, 2004

Ali, M. et al., "A Triple-Band Internal Antenna for Mobile Hand-held Terminals," IEEE, pp. 32-35 (1992).

Related U.S. Application Data

(Continued)

(63) Continuation of application No. PCT/EP01/11912, filed on Oct. 16, 2001.

Primary Examiner—Tho Phan

(74) *Attorney, Agent, or Firm*—Jenkins & Gilchrist, P.C.

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

(57) **ABSTRACT**

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

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

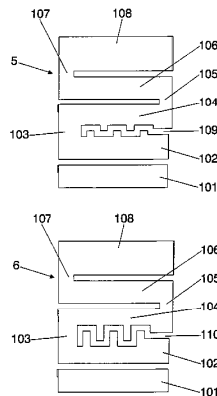
The present invention relates generally to a new family of antennas with a multiband behaviour, so that the frequency bands of the antenna can be tuned simultaneously to the main existing wireless services. In particular, the invention consists of shaping at least one of the gaps between some of the 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.

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49 Claims, 7 Drawing Sheets





US007215288B2

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

(10) **Patent No.:** **US 7,215,288 B2**
(45) **Date of Patent:** **May 8, 2007**

(54) **ELECTROMAGNETICALLY COUPLED
SMALL BROADBAND MONOPOLE
ANTENNA**

(75) Inventors: **Ikmo Park**, Yongin-si (KR); **Jong-Ho Jung**, Yongin-si (KR); **Young-Min Moon**, Seoul (KR); **Seong-Soo Lee**, Suwon-si (KR); **Young-Il Kim**, Suwon-si (KR)

(73) Assignees: **Samsung Electronics Co., Ltd.** (KR); **Ajou University Industry Cooperation Foundation** (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.: **10/936,200**

(22) Filed: **Sep. 8, 2004**

(65) **Prior Publication Data**
US 2005/0116867 A1 Jun. 2, 2005

(30) **Foreign Application Priority Data**
Sep. 8, 2003 (KR) 10-2003-0062835
Sep. 2, 2004 (KR) 10-2004-0070113

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

(56) **References Cited**
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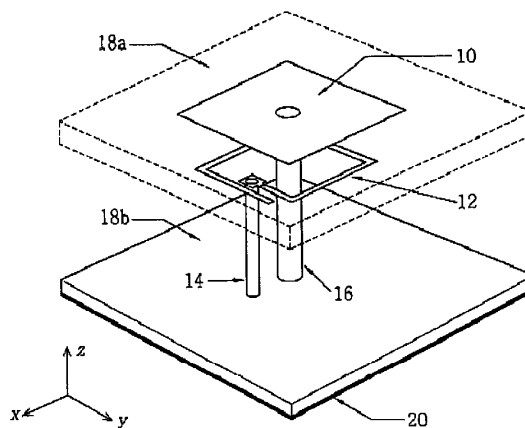
(Continued)

Primary Examiner—Hoang V. Nguyen
(74) *Attorney, Agent, or Firm*—The Farrell Law Firm

(57) **ABSTRACT**

A small broadband monopole antenna including a shorted patch and a probe with a strip line that are electromagnetically coupled with each other. The probe with a strip line has a length of about $\lambda/4$, where λ is a wavelength. The strip line may be one of a spiral type, a folded type and a helix type. A resonance frequency of the antenna can be adjusted by varying the inductance and the capacitance of the resonance circuits. In addition, a double-band antenna or a single-band antenna having a broad bandwidth can be designed in accordance with application purpose of the antenna.

29 Claims, 32 Drawing Sheets





US007215289B2

(12) **United States Patent**
Harano

(10) **Patent No.:** **US 7,215,289 B2**
(45) **Date of Patent:** **May 8, 2007**

(54) **ANTENNA DEVICE AND PORTABLE RADIO TERMINAL**

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2005/0110692 A1 *	5/2005	Andersson	343/702

(75) Inventor: **Nobuya Harano**, Shizuoka (JP)

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(73) Assignee: **NEC Corporation**, Tokyo (JP)

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

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(21) Appl. No.: **11/150,256**

Primary Examiner—Tan Ho

(22) Filed: **Jun. 13, 2005**

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

(65) **Prior Publication Data**

US 2005/0275596 A1 Dec. 15, 2005

(57) **ABSTRACT**

(30) **Foreign Application Priority Data**

Jun. 14, 2004	(JP)	2004-176143
May 16, 2005	(JP)	2005-142586

An antenna device capable of being applied to a portable radio terminal and showing a good antenna characteristic regardless of the direction, and a portable radio terminal provided with the antenna device. The antenna device applied to a portable radio terminal whose housing length is equal to or more than $\lambda/4$ with respect to the wavelength λ of transmission-reception signals comprises an antenna element disposed on one end of the housing in the longitudinal direction in which at least one point of one end is connected to a signal wiring pattern on a substrate and the other end is an open end, and a parasitic element disposed on the same side of the housing as the antenna element in which one point of one end is connected to a ground wiring on the substrate and the other end is an open end, wherein the open end of the antenna element and the open end of the parasitic element are approximated to each other and capacity coupled.

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

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

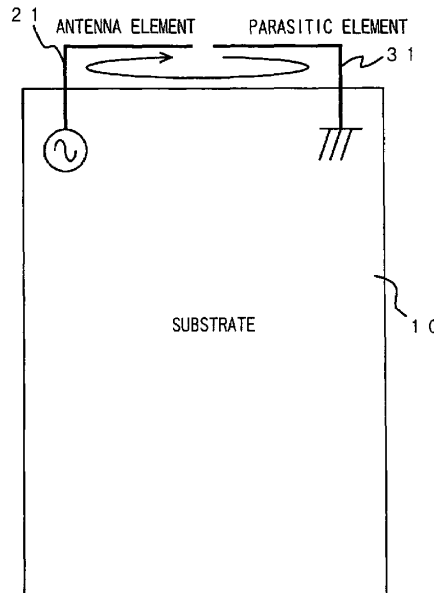
(58) **Field of Classification Search** **343/700 MS, 343/702, 895, 833, 834**
See application file for complete search history.

(56) **References Cited**

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25 Claims, 28 Drawing Sheets





US007215292B2

(12) **United States Patent**
McLean

(10) **Patent No.:** **US 7,215,292 B2**
(45) **Date of Patent:** **May 8, 2007**

(54) **PXM ANTENNA FOR HIGH-POWER, BROADBAND APPLICATIONS**

- (75) Inventor: **James S. McLean**, Austin, TX (US)
- (73) Assignee: **TDK Corporation**, Chiba (JP)
- (*) 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.: **11/175,531**

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

(65) **Prior Publication Data**

US 2006/0012535 A1 Jan. 19, 2006

Related U.S. Application Data

(60) Provisional application No. 60/587,318, filed on Jul. 13, 2004.

(51) **Int. Cl.**
H01Q 21/00 (2006.01)

(52) **U.S. Cl.** **343/725**; 343/726; 343/867; 343/797

(58) **Field of Classification Search** 343/741, 343/742, 860, 866, 867, 773, 797, 725, 726
See application file for complete search history.

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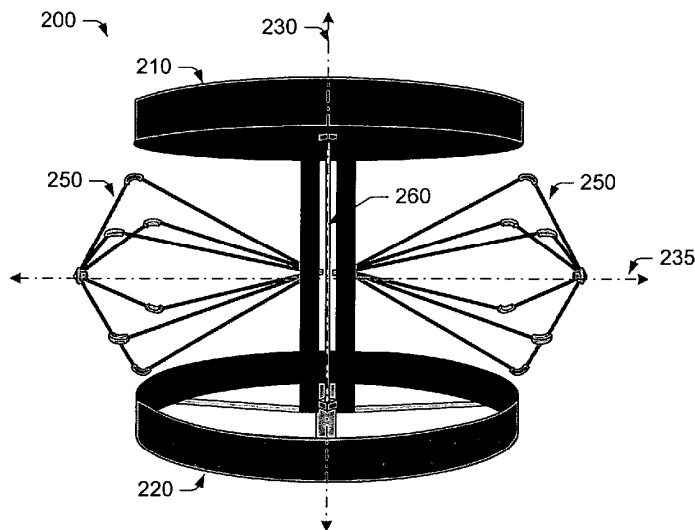
Primary Examiner—Tan Ho

(74) *Attorney, Agent, or Firm*—Kevin L. Daffer; Daffer McDaniel, LLP

(57) **ABSTRACT**

A broadband antenna including both electric and magnetic dipole radiators is provided herein. The broadband antenna may be referred to as a "P×M antenna" and may include a pair of magnetic loop elements, each having multiple feed points symmetrically spaced around the loop element. The broadband antenna may also include an electric dipole element arranged between the pair of magnetic loop elements. In general, the electric dipole element and the magnetic loop elements may be coupled together through a network of transmission lines, as opposed to being incorporated into a single radiative element.

28 Claims, 4 Drawing Sheets





US007215293B2

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

(10) **Patent No.:** **US 7,215,293 B2**
(45) **Date of Patent:** **May 8, 2007**

- (54) **HIGH-GAIN LOOP ANTENNA**
- (75) Inventors: **An-Chia Chen**, Changhua Hsien (TW);
Chia-Lun Tang, Miao-Li Hsien (TW)
- (73) Assignee: **Industrial Technology Research Institute**, Hsinchu (TW)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 28 days.

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- (21) Appl. No.: **11/222,347**
- (22) Filed: **Sep. 8, 2005**
- (65) **Prior Publication Data**
US 2007/0008223 A1 Jan. 11, 2007
- (30) **Foreign Application Priority Data**
Jul. 8, 2005 (TW) 94123212 A
- (51) **Int. Cl.**
H01Q 11/12 (2006.01)
- (52) **U.S. Cl.** **343/741; 343/745; 343/866**
- (58) **Field of Classification Search** **343/700; 343/741, 742, 744, 745, 829, 846, 866, 867**
See application file for complete search history.

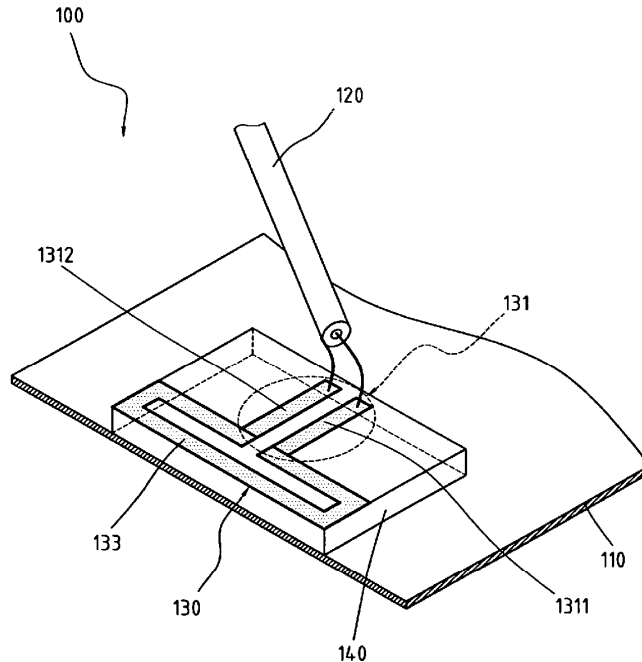
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Primary Examiner—Tho Phan

(57) **ABSTRACT**

A high gain loop antenna comprises a conductor ground plane, a feeding signal line, a radiation element including two matching sections and a conductor loop, and a dielectric element formed between the conductor ground plane and the radiation element. Both matching sections connect to the feeding signal line and the radiation element for matching the input impedance. The input impedance can be changed by adjusting the distance between the two matching sections or the lengths of the two matching sections. The conductor loop is to activate the operating mode of the antenna when the current component flows through the loop antenna.

- (56) **References Cited**
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12 Claims, 7 Drawing Sheets





US007215294B2

(12) **United States Patent**
Jocher

(10) **Patent No.:** **US 7,215,294 B2**
(45) **Date of Patent:** **May 8, 2007**

- (54) **ANTENNA WITH REFLECTOR**
- (75) Inventor: **Ronald William Jocher**, East Hanover, NJ (US)
- (73) Assignee: **Lucent Technologies Inc.**, Murray Hill, NJ (US)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 8 days.

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- (21) Appl. No.: **10/443,861**
- (22) Filed: **May 23, 2003**
- (65) **Prior Publication Data**
US 2004/0233118 A1 Nov. 25, 2004

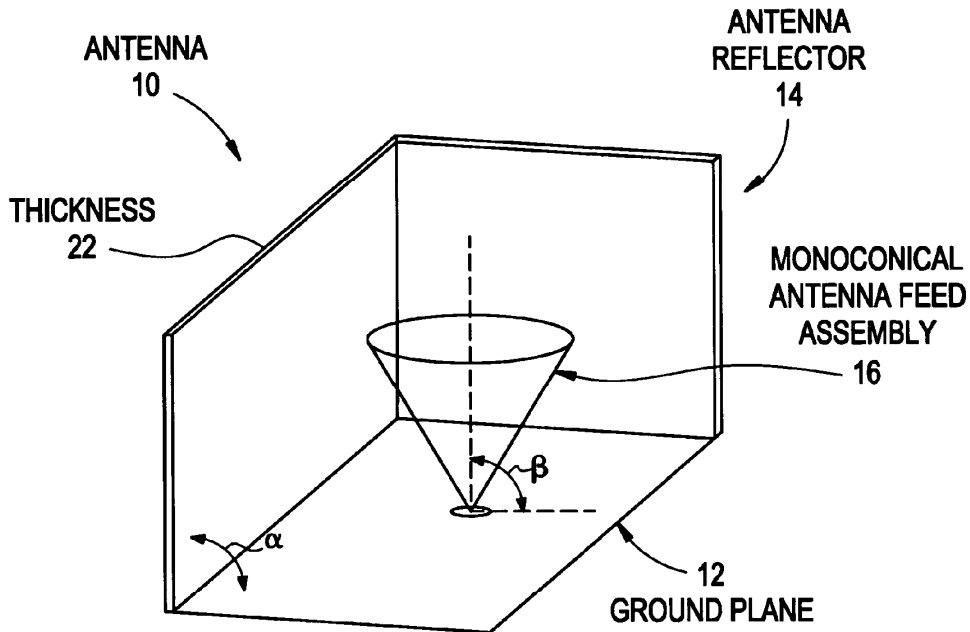
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Primary Examiner—Hoanganh Le

- (51) **Int. Cl.**
H01Q 13/00 (2006.01)
- (52) **U.S. Cl.** **343/773; 343/775; 343/834**
- (58) **Field of Classification Search** **343/773,**
343/775, 783, 700 MS, 897, 898, 877, 834,
343/835, 846, 848
See application file for complete search history.

(57) **ABSTRACT**
An antenna which includes a monoconical antenna feed assembly, where the feed assembly has a base and an apex, a ground plane adjacent to the monoconical antenna feed assembly near the apex, and an antenna reflector coupled to the ground plane, where the antenna reflector at least partially surrounds the monoconical antenna feed assembly. The monoconical feed point is used to drive a reflector antenna. The broadband characteristics of the monoconical image vertical antenna (typical ground plane geometry) are used as the feed point for the reflector to give modest amount of gain while maintaining larger than previously developed bandwidths.

- (56) **References Cited**
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20 Claims, 3 Drawing Sheets





US007218230B2

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

(10) **Patent No.:** **US 7,218,230 B2**
(45) **Date of Patent:** **May 15, 2007**

(54) **MULTI-DIMENSIONAL ANTENNA IN RFID SYSTEM FOR READING TAGS AND ORIENTATING MULTI-DIMENSIONAL OBJECTS**

(75) Inventors: **Ming-Che Wu**, Hsinchu (TW); **Tien-Fa Hou**, HsinChu (TW)

(73) Assignee: **G-Time Electronic Co., Ltd.**, Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 218 days.

(21) Appl. No.: **11/118,212**

(22) Filed: **Apr. 29, 2005**

(65) **Prior Publication Data**
US 2006/0197669 A1 Sep. 7, 2006

Related U.S. Application Data

(63) Continuation-in-part of application No. 11/062,815, filed on Feb. 23, 2005.

(51) **Int. Cl.**
G08B 13/14 (2006.01)

(52) **U.S. Cl.** **340/572.1; 340/572.4; 340/572.7; 340/10.1; 340/10.3; 340/10.51; 343/883; 700/214**

(58) **Field of Classification Search** 340/572.1, 340/572.4, 572.7, 572.8, 10.1, 10.3, 10.51, 340/825.49, 825.69, 825.72; 343/711, 883; 700/213, 214

See application file for complete search history.

(56) **References Cited**

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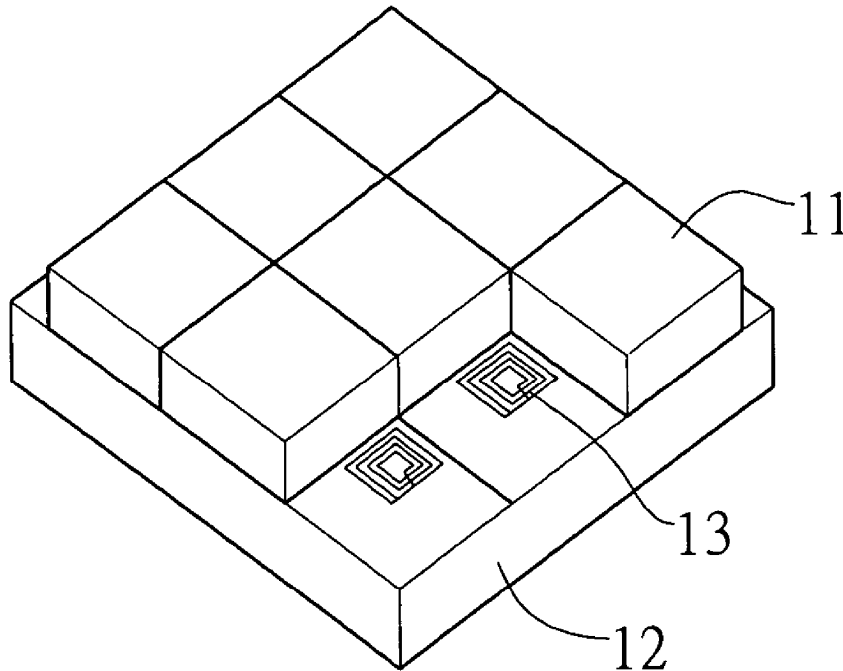
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Primary Examiner—Hung Nguyen

(57) **ABSTRACT**

A RFID system applying to a three-dimensional jigsaw is provided. The RFID system includes a jigsaw substrate having a plurality of blocks, a plurality of jigsaw units corresponding to each blocks of the jigsaw substrate, a RFID reader having a plurality of antennas positioned in a position of each blocks of the jigsaw substrate, and a plurality of tags positioned in a position of each face of a three-dimensional jigsaw unit corresponding to the positions of the antennas, wherein the RFID reader communicates to the tags using modulated radio signals through the antennas and the tags respond with modulated radio signals in order to determine whether the orientation of the three-dimensional jigsaw unit is correct or not.

20 Claims, 6 Drawing Sheets





US007218280B2

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

(10) **Patent No.:** **US 7,218,280 B2**
(45) **Date of Patent:** **May 15, 2007**

(54) **ANTENNA ELEMENT AND A METHOD FOR MANUFACTURING THE SAME**

FOREIGN PATENT DOCUMENTS

(75) Inventors: **Petteri Annamaa**, Oulunsalo (FI);
Matti Niemi, Arkkukari (FI); **Kimmo Antila**, Kiviniemi (FI); **Ilkka Niemela**, Oulunsalo (FI)

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

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

Primary Examiner—Hoang V. Nguyen
Assistant Examiner—Ephrem Alemu
(74) *Attorney, Agent, or Firm*—Darby & Darby

(21) Appl. No.: **11/089,636**

(57) **ABSTRACT**

(22) Filed: **Mar. 25, 2005**

A radiating antenna element intended for small-sized radio devices and a method for manufacturing the same. The element (300) is manufactured of a plate comprising a dielectric substrate coated with conductive material on one side. The radiating conductor branches corresponding to the operating bands of the antenna are formed on the plate by removing the conductive coating by laser narrowly from the border line of the area (330) between the designed conductor branches. The conductor area confined by the created border groove can be used as a parasitic additional radiator. If needed, the conductor area confined by the border groove (331) can also be split into a number of small conductor areas (CA1, CA2), in order to make sure that the conductor area does not radiate or have any substantial effect on the coupling between the radiating conductor branches. A relatively wide area "invisible" on the operating frequencies of the radiating branches of the antenna can be formed between the branches by the customary laser technique. This means lower manufacturing costs compared to the use of the etching process, and the creation of problem waste is also avoided.

(65) **Prior Publication Data**

US 2005/0237243 A1 Oct. 27, 2005

(30) **Foreign Application Priority Data**

Apr. 26, 2004 (FI) 20040584

(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, 846, 848

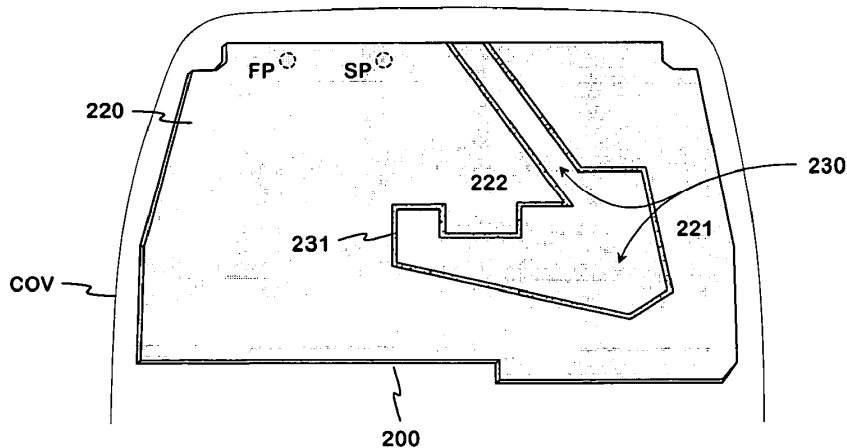
See application file for complete search history.

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10 Claims, 4 Drawing Sheets





US007218282B2

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

(10) **Patent No.:** **US 7,218,282 B2**
(45) **Date of Patent:** **May 15, 2007**

- (54) **ANTENNA DEVICE**
- (75) Inventors: **Harald Humpfer**, Erlangen (DE);
Rainer Wansch, Erlangen (DE)
- (73) Assignee: **Fraunhofer-Gesellschaft zur
Foerderung der angewandten
Forschung e.V.**, Munich (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.

6,812,892	B2 *	11/2004	Tai et al.	343/700	MS
6,864,841	B2 *	3/2005	Dai et al.	343/700	MS
6,897,810	B2 *	5/2005	Dai et al.	343/700	MS
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John Wiley and Sons, Inc., Hoboken, NJ, USA, 2003, pp. 26-53.

(Continued)

Primary Examiner—Shih-Chao Chen
(74) *Attorney, Agent, or Firm*—Michael A. Glenn; Glenn
Patent Group

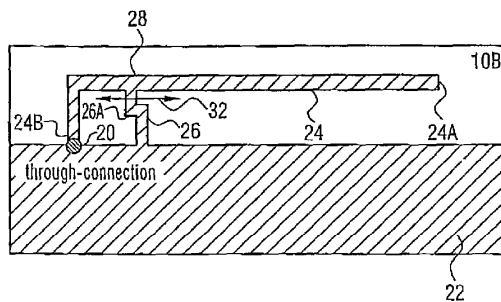
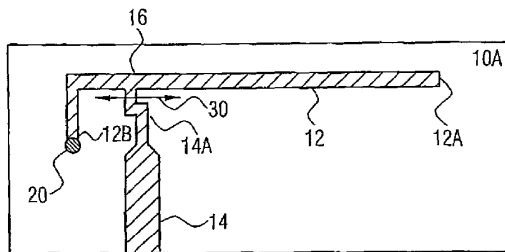
- (21) Appl. No.: **11/260,985**
- (22) Filed: **Oct. 27, 2005**
- (65) **Prior Publication Data**
US 2006/0109179 A1 May 25, 2006
- Related U.S. Application Data**
- (63) Continuation of application No. PCT/EP04/04482,
filed on Apr. 28, 2004.
- (30) **Foreign Application Priority Data**
Apr. 28, 2003 (DE) 103 19 093
- (51) **Int. Cl.**
H01Q 1/24 (2006.01)
- (52) **U.S. Cl.** **343/700 MS; 343/702**
- (58) **Field of Classification Search** **343/700 MS,**
343/702, 725, 728, 846, 848
See application file for complete search history.

(57) **ABSTRACT**

An antenna device includes a first radiation electrode having an open end and a short-circuited end connected to ground and being coupled to a feed line at a feeding point. Furthermore, the antenna device has a second radiation electrode having an open end and a short-circuited end connected to ground, wherein a portion of the second radiation electrode is part of an electric circuit. The first radiation electrode, the feed line and the electric circuit are arranged such that an alternating current through the feed line to the short-circuited end of the first radiation electrode, for feeding the second radiation electrode, induces an alternating current into the electric circuit via magnetic coupling.

- (56) **References Cited**
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6,404,395 B1 6/2002 Masuda

7 Claims, 6 Drawing Sheets





US007218287B2

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

(10) **Patent No.:** **US 7,218,287 B2**
(45) **Date of Patent:** **May 15, 2007**

- (54) **DIPOLE ANTENNA** 6,621,464 B1 * 9/2003 Fang et al. 343/795
- (75) Inventors: **Chen-Ta Hung**, Santa Clara, CA (US);
Wen-Fong Su, Tu-Chen (TW);
Lung-Sheng Tai, Tu-Chen (TW) 6,791,506 B2 * 9/2004 Suganthan et al. 343/795
- (73) Assignee: **Hon Hai Precision Ind. Co., Ltd.**,
Taipei Hsien (TW) 6,906,678 B2 * 6/2005 Chen 343/795
- (*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days. 6,961,028 B2 * 11/2005 Joy et al. 343/895

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(21) Appl. No.: **11/173,715**

Primary Examiner—Tan Ho

(22) Filed: **Jun. 30, 2005**

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

(65) **Prior Publication Data**
US 2006/0125697 A1 Jun. 15, 2006

(57) **ABSTRACT**

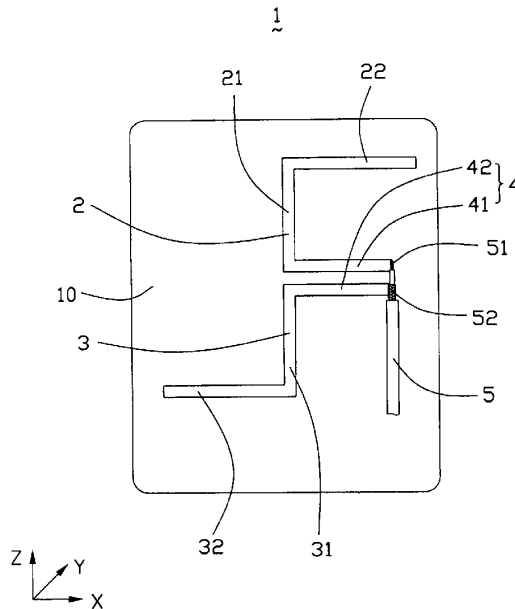
(30) **Foreign Application Priority Data**
Dec. 10, 2004 (CN) 2004 1 0066198

A dipole antenna (1) includes a first radiating trace (21) and a first grounding trace (31) respectively extending in substantially opposite directions, a second radiating trace (22) extending from an end of the first radiating trace in a direction which substantially perpendicular to the first radiating trace, and a second grounding trace (32) extending from an end of the first grounding trace in an opposite direction to the second radiating trace. The total length of the first and second radiating traces are 1/4 operating wavelength of the dipole antenna.

- (51) **Int. Cl.**
H01Q 9/28 (2006.01)
 - (52) **U.S. Cl.** 343/795; 343/700 MS
 - (58) **Field of Classification Search** 343/700 MS,
343/702, 795
- See application file for complete search history.

(56) **References Cited**
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10 Claims, 8 Drawing Sheets





US007221052B2

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

(10) **Patent No.:** **US 7,221,052 B2**
(45) **Date of Patent:** **May 22, 2007**

(54) **CHIP SCALE PACKAGE WITH MICRO ANTENNA AND METHOD FOR MANUFACTURING THE SAME**

6,580,107	B2 *	6/2003	Asano et al.	257/282
6,768,190	B2	7/2004	Yang et al.	
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2001/0028103	A1 *	10/2001	Usami	257/679
2004/0238952	A1 *	12/2004	Farnworth et al.	257/734

(75) Inventors: **Min-Lung Huang**, Kao-Hsiung (TW);
Tsung-Hua Wu, Kao-Hsiung Hsien (TW)

(73) Assignee: **Advanced Semiconductor Engineering, Inc.**, Kao-Hsiung (TW)

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

TW 506138 10/2002

(21) Appl. No.: **11/163,133**

* cited by examiner

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

Primary Examiner—Michelle Estrada
(74) *Attorney, Agent, or Firm*—Winston Hsu

(65) **Prior Publication Data**
US 2006/0081982 A1 Apr. 20, 2006

(57) **ABSTRACT**

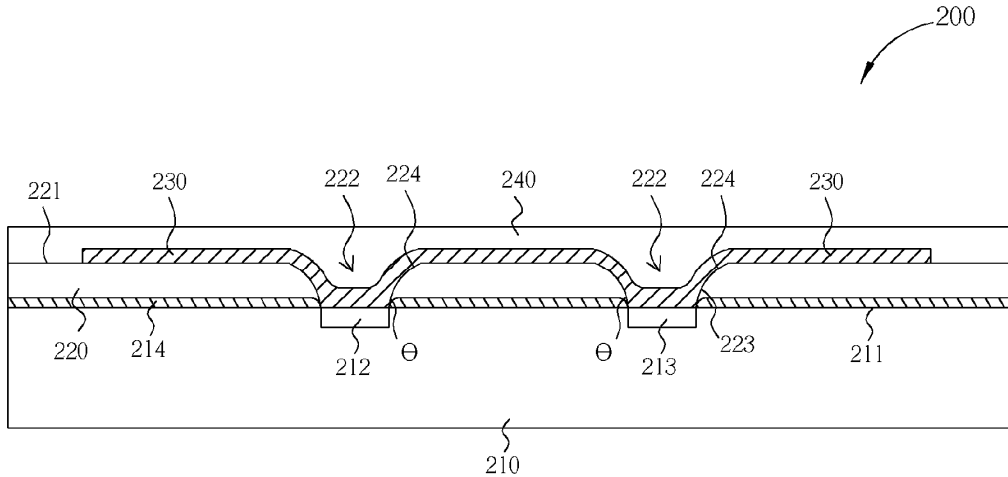
(30) **Foreign Application Priority Data**
Oct. 19, 2004 (TW) 93131688 A

A chip scale package with micro antenna includes a chip, a first dielectric layer and an antenna. The chip has an active surface, a first bonding pad and a second bonding pad on the active surface. The first dielectric layer is formed on the active surface of the chip. The first dielectric layer has a plurality of openings to expose the first bonding pad and the second bonding pad. Each of the openings has an expanding inclined sidewall. The antenna is formed on the upper surface of the first dielectric layer and connected to the first bonding pad and the second bonding pad through the inclined sidewall of the openings for preventing antenna cracking.

(51) **Int. Cl.**
H01L 23/48 (2006.01)
(52) **U.S. Cl.** **257/734; 257/679; 257/E33.066**
(58) **Field of Classification Search** **257/679, 257/734, E33.066**
See application file for complete search history.

(56) **References Cited**
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6,121,683 A * 9/2000 Yamazaki et al. 257/734

8 Claims, 9 Drawing Sheets





US007221320B2

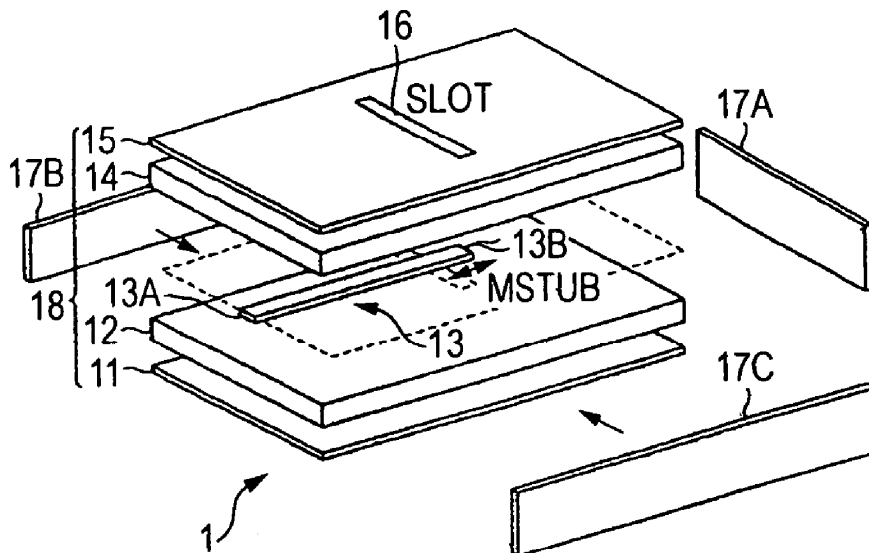
(12) **United States Patent**
Sathath

(10) **Patent No.:** **US 7,221,320 B2**
(45) **Date of Patent:** **May 22, 2007**

- (54) **ANTENNA AND INFORMATION PROCESSING APPARATUS**
 - (75) Inventor: **Anwar Sathath**, Oume (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 0 days.
 - (21) Appl. No.: **11/170,619**
 - (22) Filed: **Jun. 30, 2005**
 - (65) **Prior Publication Data**
US 2006/0001571 A1 Jan. 5, 2006
 - (30) **Foreign Application Priority Data**
Jun. 30, 2004 (JP) 2004-194932
 - (51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 13/10 (2006.01)
 - (52) **U.S. Cl.** **343/700 MS; 343/767**
 - (58) **Field of Classification Search** **343/700 MS, 343/702, 767, 846**
- See application file for complete search history.

- (56) **References Cited**
- U.S. PATENT DOCUMENTS
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- Primary Examiner*—Shih-Chao Chen
- (74) *Attorney, Agent, or Firm*—Pillsbury Winthrop Shaw Pittman LLP

- (57) **ABSTRACT**
- An antenna has a multilayer substrate in which are laminated a first conductive plate, a first dielectric layer disposed on the first conductive plate, a conductive strip line which is disposed on the first dielectric layer and which has an input/output terminal for an electric signal and an open terminal, a second dielectric layer disposed so as to sandwich the strip line in cooperation with the first dielectric layer, and a second conductive plate which is disposed on the second dielectric layer and which has a slot. In addition, the antenna has a third conductive plate for covering, of all the side surfaces of the multilayer substrate, a surface opposing the open terminal of the strip line.
- 14 Claims, 4 Drawing Sheets**





US007221321B2

(12) **United States Patent**
Reuss

(10) **Patent No.:** **US 7,221,321 B2**
(45) **Date of Patent:** **May 22, 2007**

(54) **DUAL-FREQUENCY DUAL POLARIZATION ANTENNA**

(75) Inventor: **Terry Reuss**, Gauteng (ZA)
(73) Assignee: **Jasco Trading (Proprietary) Limited**, Gauteng (ZA)
(*) 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.: **11/274,991**

(22) Filed: **Nov. 16, 2005**

(65) **Prior Publication Data**
US 2006/0139212 A1 Jun. 29, 2006

(30) **Foreign Application Priority Data**
Nov. 17, 2004 (ZA) 04/9203

(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, 848, 702
See application file for complete search history.

(56) **References Cited**

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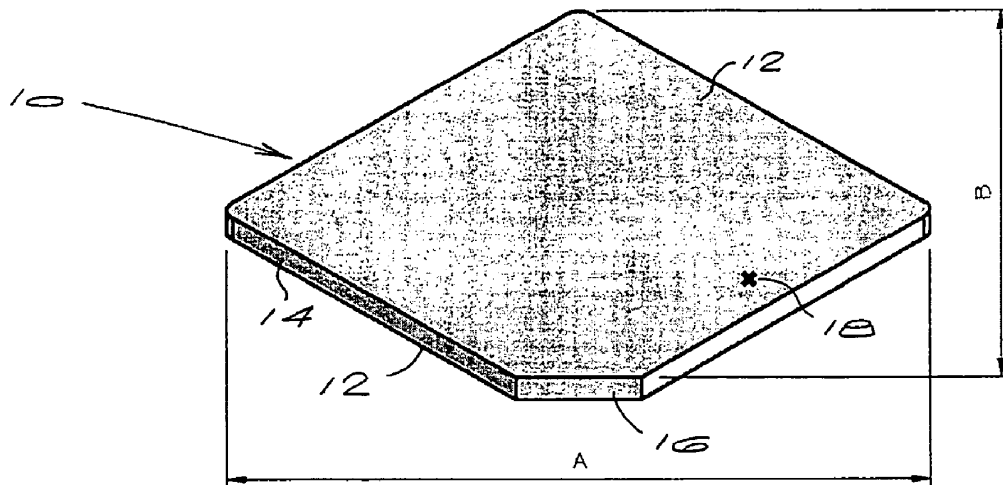
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Primary Examiner—Hoanganh Le
(74) *Attorney, Agent, or Firm*—Ladas & Parry LLP

(57) **ABSTRACT**

An antenna includes a multi sided electrical conductor forming a ground plane has two diagonals of different lengths. A multi sided electrical conductor forming a radiator has two diagonals of different lengths and a dielectric substrate is connected to the ground plane and to the radiator thereby to separate the ground plane from the radiator.

7 Claims, 4 Drawing Sheets





US007221325B2

(12) **United States Patent**
Ide

(10) **Patent No.:** **US 7,221,325 B2**
(45) **Date of Patent:** **May 22, 2007**

(54) **ANTENNA SYSTEM AND PORTABLE RADIO DEVICE**

6,900,768 B2* 5/2005 Iguchi et al. 343/702

(75) Inventor: **Yoshiyuki Ide**, Tokyo (JP)

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(73) Assignee: **NEC Corporation**, Tokyo (JP)

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

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(21) Appl. No.: **11/200,300**

European Search Report issued Nov. 11, 2005.

(22) Filed: **Aug. 10, 2005**

* cited by examiner

(65) **Prior Publication Data**

US 2006/0049994 A1 Mar. 9, 2006

Primary Examiner—Hoang V. Nguyen

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

(30) **Foreign Application Priority Data**

Sep. 8, 2004 (JP) 2004-260513

(57) **ABSTRACT**

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

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

(58) **Field of Classification Search** 343/895,
343/702, 725, 700 MS

See application file for complete search history.

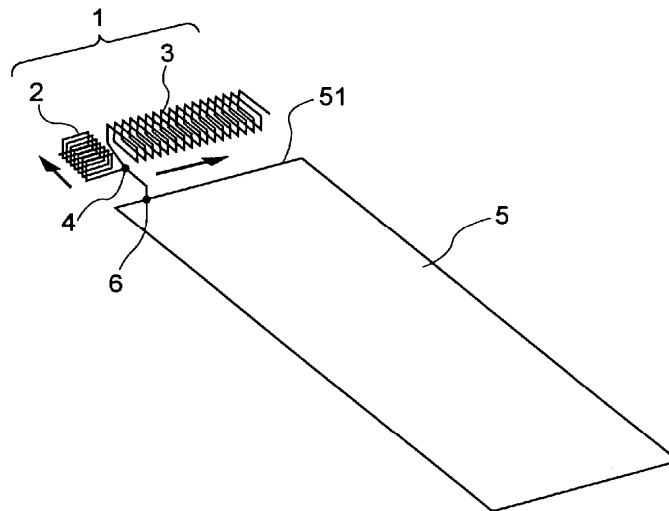
An object of the present invention is to secure good communication quality in a small-housing portable radio in which an antenna system having two antenna elements for providing for multi-frequency-bands is built. A substrate on which a high-frequency circuit and an earth plate are mounted and an antenna system is built in the housing of a portable radio device. A shorter coil element of two coil elements is set so that the direction of the antenna current is vertical to one side of a substrate and the longer coil element is set so that the direction of the antenna current is parallel with the side. Therefore, it is possible to set two coil elements in a small space in a housing after setting the substrate while directions of the antenna currents of the coil elements are orthogonal to each other (while mutual interference between the elements is small). Therefore, it is possible to secure good communication quality even for a small-housing portable radio device.

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7 Claims, 5 Drawing Sheets





US007221326B2

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

(10) **Patent No.:** **US 7,221,326 B2**
(45) **Date of Patent:** **May 22, 2007**

(54) **BICONICAL ANTENNA**
(75) Inventors: **Shogo Ida**, Shiga (JP); **Daisuke Muto**, Shiga (JP)
(73) Assignee: **Git Japan, Inc.**, Shiga (JP)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 22 days.

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Primary Examiner—Hoanganh Le
Assistant Examiner—Huedung Mancuso
(74) *Attorney, Agent, or Firm*—Steptoe & Johnson LLP;
Tyson York Winarski

(21) Appl. No.: **11/185,498**
(22) Filed: **Jul. 20, 2005**
(65) **Prior Publication Data**
US 2006/0022885 A1 Feb. 2, 2006

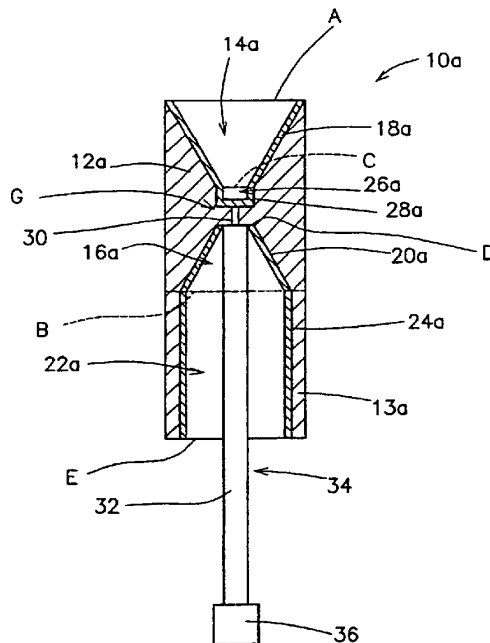
(30) **Foreign Application Priority Data**
Jul. 27, 2004 (JP) 2004-218229
Jul. 27, 2004 (JP) 2004-218431

(51) **Int. Cl.**
H01Q 13/00 (2006.01)
(52) **U.S. Cl.** **343/773**
(58) **Field of Classification Search** 343/773,
343/774, 725, 700 MS, 908, 810-816, 829-830
See application file for complete search history.

(56) **References Cited**
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(57) **ABSTRACT**
A biconical antenna according to the present invention includes a columnar dielectric member having frustum-shaped cavities extending respectively from an upper surface and a lower surface toward a center of the columnar dielectric member, wherein flat surfaces of apex portions of the frustum-shaped cavities are parallel and in opposition to one another; a frustum-shaped feeder portion made of a conductive film provided on an inner surface of the upper cavity; and a frustum-shaped ground portion made of a conductive film provided on an inner surface of the lower cavity. The present invention realizes a more compact biconical antenna by filling the dielectric member between the feeder portion and the ground portion of the biconical antenna.

6 Claims, 16 Drawing Sheets





US007224312B2

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

(10) **Patent No.:** **US 7,224,312 B2**
(45) **Date of Patent:** **May 29, 2007**

(54) **MULTIPLE-BAND ANTENNA WITH PATCH AND SLOT STRUCTURES**

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

(73) Assignee: **Research in Motion Limited**, Ontario (CA)

(*) 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.: **10/723,840**

(22) Filed: **Nov. 26, 2003**

(65) **Prior Publication Data**

US 2004/0201530 A1 Oct. 14, 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** **343/702, 343/700 MS, 770, 745, 725**
See application file for complete search history.

(56) **References Cited**

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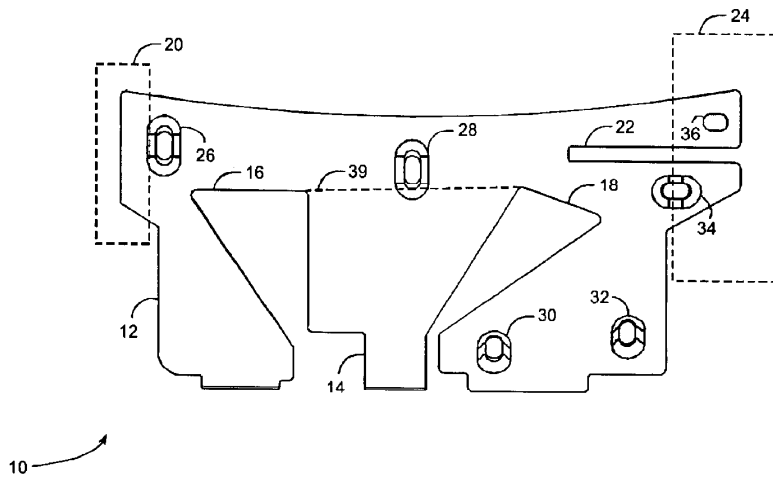
Primary Examiner—Tan Ho

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

(57) **ABSTRACT**

A multiple-band antenna having first and second operating frequency bands is provided. The antenna includes a first patch structure associated primarily with the first operating frequency band, a second patch structure electrically coupled to the first patch structure and associated primarily with the second operating frequency band, a first slot structure disposed between a first portion of the first patch structure and the second patch structure and associated primarily with the first operating frequency band, and a second slot structure disposed between a second portion of the first patch structure and the second patch structure and associated primarily with the second operating frequency band. A mounting structure for the multiple-band antenna is also provided. The mounting structure includes a first surface and a second surface opposite to and overlapping the first surface. The first and second patch structures are mounted to the first surface, and a feeding point and ground point, respectively connected to the first and second patch structures, are mounted to the second surface.

27 Claims, 7 Drawing Sheets





US007224313B2

(12) **United States Patent**
McKinzie, III et al.

(10) **Patent No.:** **US 7,224,313 B2**
(45) **Date of Patent:** **May 29, 2007**

(54) **MULTIBAND ANTENNA WITH PARASITICALLY-COUPLED RESONATORS**

(58) **Field of Classification Search** 343/700 MS, 343/702, 815, 817, 830
See application file for complete search history.

(75) Inventors: **William E. McKinzie, III**, Fulton, MD (US); **James Y. Scott**, Owings Mills, MD (US); **Jeremy M. Marsh**, Silver Spring, MD (US); **Gregory S. Mendolia**, Ellicott City, MD (US); **Yizhen Lin**, San Jose, CA (US)

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Primary Examiner—Shih-Chao Chen

(74) *Attorney, Agent, or Firm*—Luce, Forward, Hamilton & Scripps LLP; Nicola A. Pisano, Esq.

(73) Assignee: **Actiontec Electronics, Inc.**, Sunnyvale, CA (US)

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

(21) Appl. No.: **10/843,677**

(57) **ABSTRACT**

(22) Filed: **May 10, 2004**

A multiband antenna includes at least two resonators that are driven directly and resonate in different frequency bands and a parasitically coupled resonator that resonates in one of the frequency bands. The coupled resonator is grounded with a conductive trace at one end and is thus not directly fed by the RF feed of the antenna. The coupled resonator increases the efficiency bandwidth near the frequency of operation for the coupled resonator. The antenna is fabricated from a stamped metal that is bent around or overmolded by a spacer layer. A clip formed integrally with the antenna by bending a portion of the ground plane permits attachment to the metal shield of the display of a laptop computer and is thus grounded along its length.

(65) **Prior Publication Data**

US 2005/0024268 A1 Feb. 3, 2005

Related U.S. Application Data

(60) Provisional application No. 60/469,317, filed on May 9, 2003.

(51) **Int. Cl.**

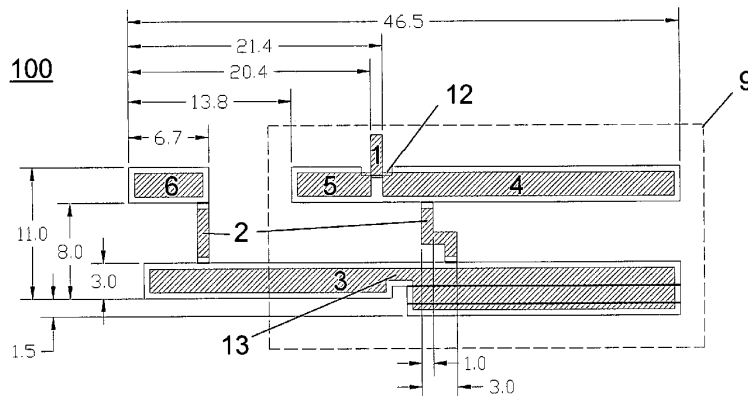
H01Q 1/38 (2006.01)







H01Q 21/12 (2006.01)

H01Q 1/24 (2006.01)

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

47 Claims, 16 Drawing Sheets



- | | | | |
|---|--------------|---|---|
|  | RF Feed |  | 2.4GHz resonator for the dual-band PIFA |
|  | RF Short |  | Directly excited 5GHz resonator |
|  | Ground Plane |  | Coupled 5GHz resonator |

All measured units are in Millimeters



US007224315B2

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

(10) **Patent No.:** **US 7,224,315 B2**
(45) **Date of Patent:** **May 29, 2007**

(54) **ELECTRONIC DEVICE AND ANTENNA STRUCTURE THEREOF**

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6,747,605 B2* 6/2004 Lebaric et al. 343/795

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

(73) Assignee: **Wistron NeWeb Corp.**, Taipei Hsien (TW)

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Primary Examiner—Hoang V. Nguyen

(74) *Attorney, Agent, or Firm*—Quintero Law Office

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 54 days.

(57) **ABSTRACT**

(21) Appl. No.: **11/273,867**

An antenna structure comprises a substrate, a reflective element, a first radiation unit, a second radiation unit, a first impedance matching unit, a second impedance matching unit, a feed point, a first conductive line and a second conductive line. The substrate comprises a first surface and a second surface. The reflective element is disposed on the second surface. The first and the second radiation units are disposed on both sides of the reflective element. The first impedance matching unit is disposed on the first surface corresponding to the first radiation unit. The second impedance matching unit is disposed on the first surface corresponding to the second radiation unit. The feed point is coupled between the first impedance matching unit and the second impedance matching unit. The first conductive line is coupled to the feed point. The second conductive line is coupled to the reflective element.

(22) Filed: **Nov. 14, 2005**

(65) **Prior Publication Data**

US 2007/0018902 A1 Jan. 25, 2007

(30) **Foreign Application Priority Data**

Jul. 22, 2005 (TW) 94212492 U

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

(52) **U.S. Cl.** **343/700 MS**; 343/816

(58) **Field of Classification Search** 343/700 MS, 343/795, 816, 820

See application file for complete search history.

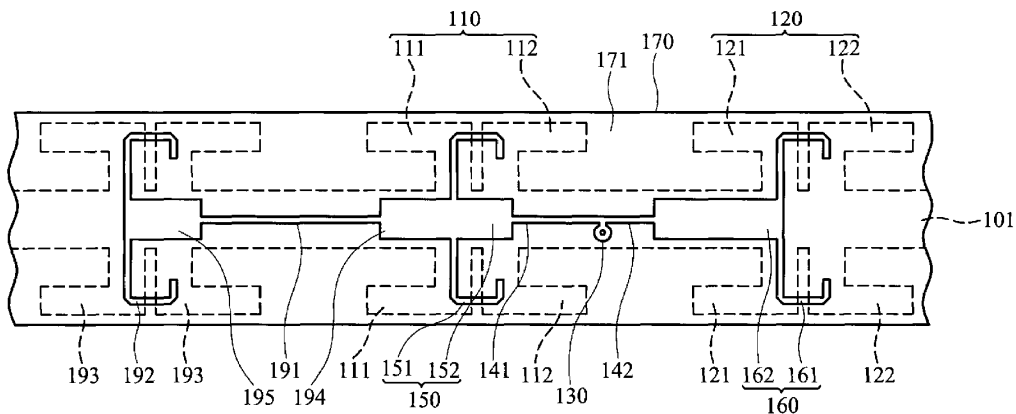
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20 Claims, 7 Drawing Sheets

100'





US007224316B2

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

(10) **Patent No.:** US 7,224,316 B2
(45) **Date of Patent:** May 29, 2007

(54) **RETRACTABLE STUBBY ANTENNA**
(75) Inventors: **Mete Ozkar**, Raleigh, NC (US);
Gregory Poilasne, San Diego, CA (US)
(73) Assignee: **Kyocera Wireless Corp.**, San Diego,
CA (US)
(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

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(21) Appl. No.: **11/148,643**
(22) Filed: **Jun. 9, 2005**

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(65) **Prior Publication Data**
US 2006/0290577 A1 Dec. 28, 2006

Primary Examiner—Don Wong
Assistant Examiner—Marie Antoinette Cabucos

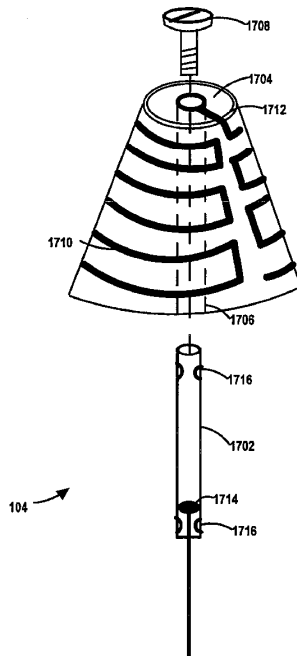
(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/12 (2006.01)
(52) **U.S. Cl.** **343/702; 343/718**
(58) **Field of Classification Search** **343/702,**
343/718
See application file for complete search history.

(57) **ABSTRACT**

A retractable stubby antenna is movable relative to a housing along a longitudinal axis. In a retracted position, at least a portion of the retractable stubby antenna is positioned within the housing. In an extended position at least a portion of the retractable stubby antenna is positioned outside of the housing such that a greater portion of the antenna is positioned outside the housing in the extended position than in the retracted position. A radiating helical element is connected to device circuitry through a connection interface including an antenna interface and a housing connection interface.

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5 Claims, 11 Drawing Sheets





US007224318B2

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

(10) **Patent No.:** **US 7,224,318 B2**
(45) **Date of Patent:** **May 29, 2007**

(54) **ANTENNA APPARATUS AND METHOD FOR MOUNTING ANTENNA**

(75) Inventors: **Seishin Mikami**, Toyota (JP); **Toru Yamazaki**, Chita (JP); **Katsuhiro Ohara**, Kariya (JP)

(73) Assignee: **DENSO Corporation**, Kariya (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.: **10/603,342**

(22) Filed: **Jun. 25, 2003**

(65) **Prior Publication Data**
US 2004/0008143 A1 Jan. 15, 2004

(30) **Foreign Application Priority Data**
Jun. 28, 2002 (JP) 2002-190369

(51) **Int. Cl.**
H01Q 1/32 (2006.01)
H01Q 9/04 (2006.01)

(52) **U.S. Cl.** **343/713**; 343/700 MS;
343/712; 343/725; 343/769; 343/752; 343/789;
343/830

(58) **Field of Classification Search** 343/700 MS,
343/712-713, 727, 741, 728, 702, 726, 853,
343/725, 789, 746, 847, 848, 785, 769, 752,
343/828-830, 846
See application file for complete search history.

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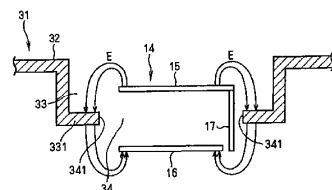
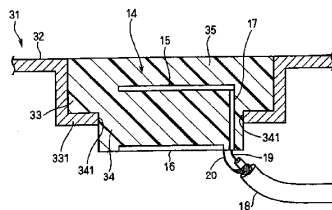
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Primary Examiner—Tho Phan
Assistant Examiner—Chuc Tran
(74) *Attorney, Agent, or Firm*—Harness, Dickey & Pierce, PLC

(57) **ABSTRACT**

A planar antenna has a radiating element and a ground plate. A body of a vehicle has an internal edge that is formed by making a hole in the body. The planar antenna is located in the hole so that an imaginary plane of the internal edge is located between the radiating element and the ground plate. In such a structure, electric lines of force perpendicularly pass through the body beside the planar antenna. As a result, electric fields are maintained in the vertical direction even if the planar antenna is mounted on the vehicle. This maintains a horizontal directivity of the planar antenna.

9 Claims, 7 Drawing Sheets





US007224321B2

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

(10) **Patent No.:** **US 7,224,321 B2**
(45) **Date of Patent:** **May 29, 2007**

(54) **BROADBAND SMART ANTENNA AND ASSOCIATED METHODS**

(75) Inventors: **Bing A. Chiang**, Melbourne, FL (US); **Michael J. Lynch**, Merritt Island, FL (US); **Joseph T. Richeson**, deceased, late of Melbourne, FL (US); by **Dee M. Richeson**, legal representative, Wood River, IL (US); **Douglas H. Wood**, Palm Bay, FL (US)

(73) Assignee: **InterDigital Technology Corporation**, Wilmington, DE (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.: **11/190,745**

(22) Filed: **Jul. 27, 2005**

(65) **Prior Publication Data**

US 2006/0022890 A1 Feb. 2, 2006

Related U.S. Application Data

(60) Provisional application No. 60/592,084, filed on Jul. 29, 2004.

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

(52) **U.S. Cl.** **343/833**; 343/700 MS; 343/810; 343/834

(58) **Field of Classification Search** 343/833
See application file for complete search history.

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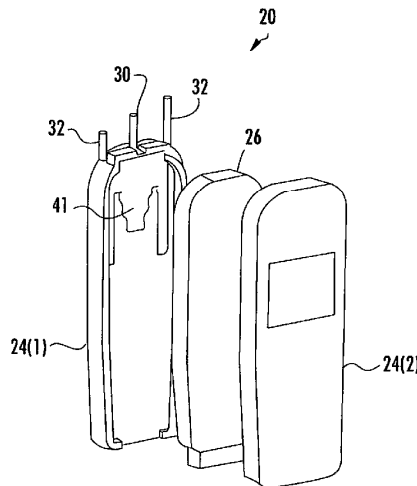
Primary Examiner—Don Wong
Assistant Examiner—Binh Van Ho

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

(57) **ABSTRACT**

A smart antenna includes a ground plane, an active antenna element adjacent the ground plane, and passive antenna elements adjacent the ground plane. The passive antenna elements have different sizes for defining different resonant frequencies for increasing a bandwidth of the smart antenna. Dielectric layers having different dielectric constants may also be used for coating the passive antenna elements for defining different resonant frequencies. Impedance elements are connected to the ground plane and are selectively connectable to the passive antenna elements for antenna beam steering.

20 Claims, 8 Drawing Sheets





US007225003B2

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

(10) **Patent No.:** **US 7,225,003 B2**
(45) **Date of Patent:** **May 29, 2007**

(54) **MOBILE TERMINAL INCLUDING FIRST AND SECOND HOUSINGS AND AN ANTENNA**

(75) Inventors: **Hideaki Shoji**, Hyogo (JP); **Takatoshi Katsura**, Hyogo (JP); **Yoshinori Matsunami**, Hyogo (JP); **Yasuhito Imanishi**, Hyogo (JP); **Tetsuya Tanaka**, Hyogo (JP); **Hirokazu Taketomi**, Hyogo (JP)

(73) Assignee: **Mitsubishi Denki 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 0 days.

(21) Appl. No.: **11/240,384**

(22) Filed: **Oct. 3, 2005**

(65) **Prior Publication Data**

US 2006/0025185 A1 Feb. 2, 2006

Related U.S. Application Data

(63) Continuation of application No. 10/181,445, filed as application No. PCT/JP00/09373 on Dec. 28, 2000.

(51) **Int. Cl.**
H04M 1/00 (2006.01)
H01Q 11/12 (2006.01)

(52) **U.S. Cl.** **455/575.5; 455/575.7; 455/117; 455/575.5**

(58) **Field of Classification Search** **455/575.3, 455/575.1, 575.5, 550.1, 575.7, 575.8, 90.3, 455/117; 379/433.01, 433.04, 428.01, 429**
See application file for complete search history.

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

(57) **ABSTRACT**

A mobile phone includes a lower housing having one end and the other end, an upper housing having one end pivotally connected to the lower housing, and an antenna accommodated close to one end of the lower housing. The other end of the upper housing pivots toward and away from the other end of the lower housing. The mobile phone is used in close proximity to a user's head with the other end of the upper housing being distanced from the other end of the lower housing. Upon use, the lower housing is disposed relative to the upper housing so that the upper housing intervenes between the antenna and the user's head.

4 Claims, 20 Drawing Sheets

