



US007791541B2

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

(10) **Patent No.:** **US 7,791,541 B2**
(45) **Date of Patent:** **Sep. 7, 2010**

(54) **PRINTED CIRCUIT BOARD**

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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 205 days.

(21) Appl. No.: **11/944,571**

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(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Nov. 22, 2006 (KR) 10-2006-0115951

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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.

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Primary Examiner—Douglas W Owens

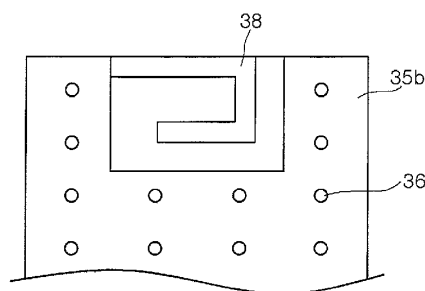
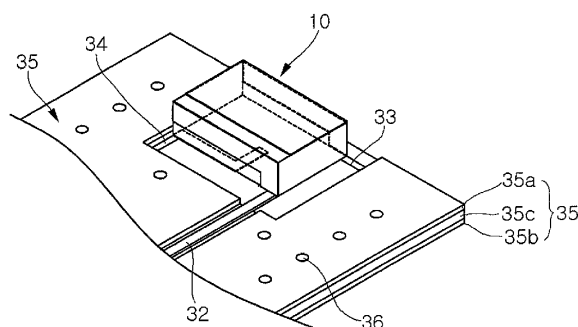
Assistant Examiner—Dieu Hien T Duong

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

(57) **ABSTRACT**

There is provided a printed circuit board comprising: a mounting area of a chip antenna provided on one surface thereof, and a tuning ground pattern formed on a surface opposing the one surface of the printed circuit board to have one end connected to a ground part so as to be used for tuning frequency characteristics of the chip antenna.

6 Claims, 5 Drawing Sheets



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US007791543B2

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

(10) **Patent No.:** **US 7,791,543 B2**
(45) **Date of Patent:** ***Sep. 7, 2010**

(54) **ANTENNA FOR RADIO FREQUENCY IDENTIFICATION TAG**

(75) Inventors: **Won Kyu Choi**, Daejeon (KR); **Jeong Seok Kim**, Daejeon (KR); **Gil Young Choi**, Daejeon (KR); **Cheol Sig Pyo**, Daejeon (KR); **Jong-suk Chae**, Daejeon (KR)

(73) Assignee: **Electronics and Telecommunications Research Institute**, Daejeon (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 187 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/126,020**

(22) Filed: **May 23, 2008**

(65) **Prior Publication Data**

US 2009/0096678 A1 Apr. 16, 2009

(30) **Foreign Application Priority Data**

Oct. 10, 2007 (KR) 10-2007-0102274

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H01Q 1/38 (2006.01)

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

(58) **Field of Classification Search** **343/700 MS, 343/850, 860; 340/572.7**

See application file for complete search history.

(56) **References Cited**

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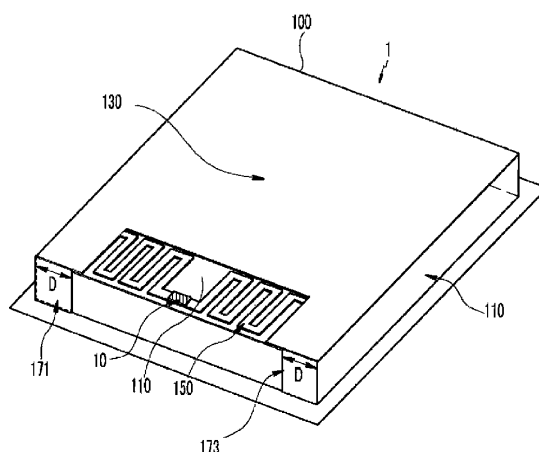
Primary Examiner—Hoang V Nguyen

(74) *Attorney, Agent, or Firm*—Jae Y. Park; Kile Goekjian Reed & McManus

(57) **ABSTRACT**

An antenna for an RFID tag having an RFID tag chip includes a dielectric material, a radiating patch radiating a signal from the RFID tag chip, and a feed line supplying power to the RFID tag chip through magnetic-coupling with the radiating patch. Accordingly, a small antenna that can be attached to metal can be realized.

8 Claims, 7 Drawing Sheets



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US007791545B2

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

(10) **Patent No.:** **US 7,791,545 B2**
(45) **Date of Patent:** **Sep. 7, 2010**

(54) **MULTIBAND ANTENNA**

(75) Inventors: **Sheng-Chih Lin**, Hsin-Tien (TW);
Tsung-Wen Chiu, Hsin-Tien (TW);
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(73) Assignee: **Advanced Connectek, Inc.**, Taipei (TW)

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

(21) Appl. No.: **11/943,799**

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

(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
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(51) **Int. Cl.**
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(52) **U.S. Cl.** **343/702**; 343/700 MS;
343/846

(58) **Field of Classification Search** 343/700 MS,
343/702, 846, 906
See application file for complete search history.

(56) **References Cited**

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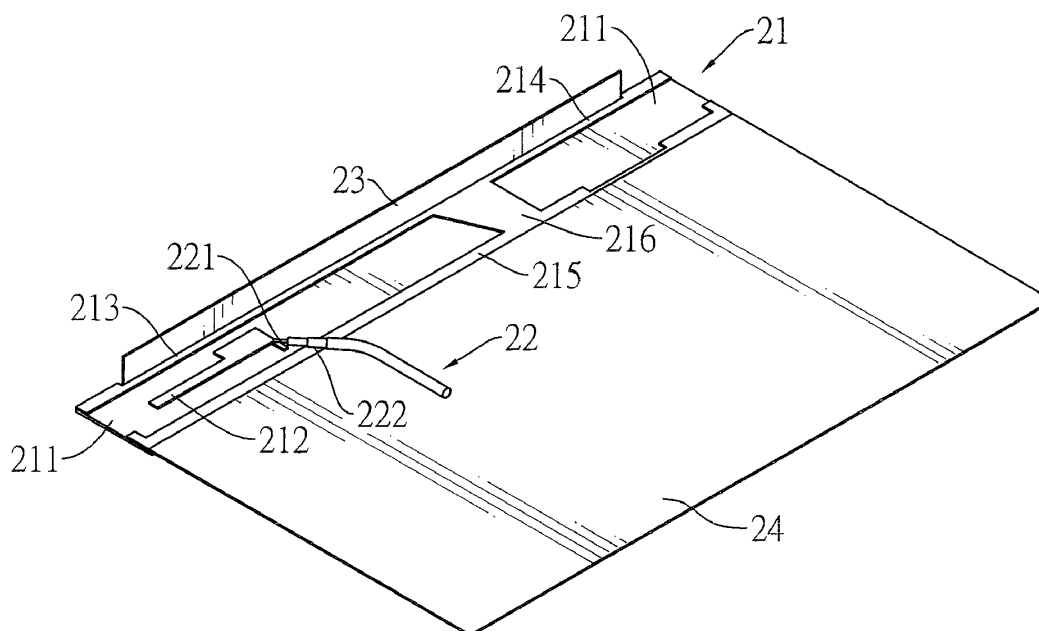
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Primary Examiner—James H. Cho
Assistant Examiner—Christopher Lo
(74) *Attorney, Agent, or Firm*—Schmeiser, Olsen & Watts LLP

(57) **ABSTRACT**

A multiband antenna with the broadband function has a radiator, a feed cable, a first extension conductor, and a second extension conductor. The radiator has a microwave substrate, a coupling conductor, a first conductor, a second conductor, a third conductor, and a connecting conductor. The coupling conductor is connected with a positive signal wire of the feed cable. The third conductor is connected with a negative signal of the feed cable for transmitting electrical signals. The radiator generates the multiband mode of the antenna. By connecting the first extension conductor and the second extension conductor with the radiator, the surface current distribution and impedance variation of the antenna can be effectively adjusted to achieve the broadband effect.

3 Claims, 5 Drawing Sheets



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US007791546B2

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

(10) **Patent No.:** **US 7,791,546 B2**
(45) **Date of Patent:** **Sep. 7, 2010**

(54) **ANTENNA DEVICE AND ELECTRONIC APPARATUS**

(75) Inventors: **Hiroyuki Hotta**, Hamura (JP); **Koichi Sato**, Tachikawa (JP); **Hiroshi Shimasaki**, Kunitachi (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 61 days.

(21) Appl. No.: **12/188,923**

(22) Filed: **Aug. 8, 2008**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Sep. 21, 2007 (JP) 2007-245205

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

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

See application file for complete search history.

(56) **References Cited**

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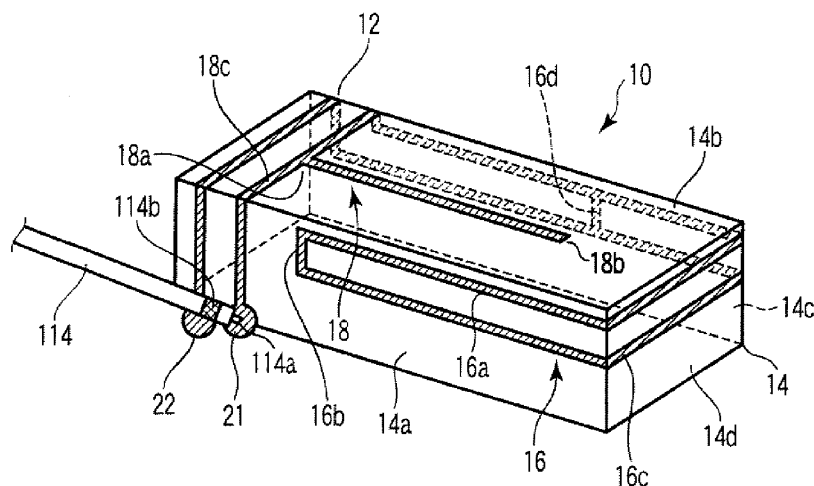
Primary Examiner—Tan Ho

(74) *Attorney, Agent, or Firm*—Blakely, Sokoloff, Taylor & Zafman LLP

(57) **ABSTRACT**

According to one embodiment, an antenna device includes a folded element and an end-free element wound around a core member. A feed portion for a folded element and an end-free element is located close to one end of the core member, and a ground portion for a folded element is located closer to the one end than the feed portion. A coaxial cable connected to the feed portion is led away the antenna device, and an external conductor of the coaxial cable is connected near the ground portion.

20 Claims, 17 Drawing Sheets



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US007791547B2

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

(10) **Patent No.:** **US 7,791,547 B2**
(45) **Date of Patent:** ***Sep. 7, 2010**

(54) **MOBILE WIRELESS COMMUNICATIONS
DEVICE INCLUDING A GROUND PATCH
PROVIDING SPECIFIC ABSORPTION RATE
(SAR) REDUCTION AND RELATED
METHODS**

(75) Inventors: **Yihong Qi**, St. Agatha (CA); **Ying Tong
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Jarmuszewski**, Waterloo (CA)

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

This patent is subject to a terminal dis-
claimer.

(21) Appl. No.: **12/472,638**

(22) Filed: **May 27, 2009**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. 11/733,360, filed on
Apr. 10, 2007, now Pat. No. 7,554,496.

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

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

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

See application file for complete search history.

(56) **References Cited**

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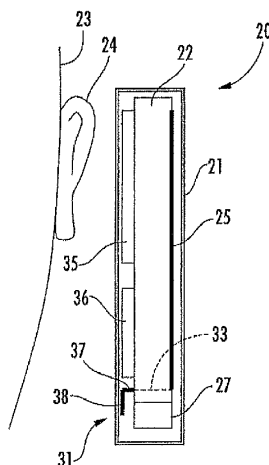
Primary Examiner—Hoang V Nguyen

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

(57) **ABSTRACT**

A mobile wireless communications device may include a portable housing, a dielectric substrate carried by the portable housing having a front side facing toward a user and a back side opposite the front side, and a ground plane carried by the dielectric substrate. The device may further include at least one circuit carried by the dielectric substrate, and an antenna carried by the dielectric substrate adjacent an end thereof and electrically connected to the at least one circuit. A ground patch may be adjacent the front side of the dielectric substrate that is electrically connected to the ground plane and spaced apart from and at least partially overlapping the antenna.

29 Claims, 3 Drawing Sheets



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US007796085B2

(12) **United States Patent**
Fujii

(10) **Patent No.:** **US 7,796,085 B2**
(45) **Date of Patent:** **Sep. 14, 2010**

(54) **ANTENNA AND WIRING BOARD**

(75) Inventor: **Tomoharu Fujii**, Nagano (JP)

(73) Assignee: **Shinko Electric Industries Co., Ltd.**,
Nagano-shi, Nagano (JP)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
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(21) Appl. No.: **11/586,624**

(22) Filed: **Oct. 26, 2006**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Oct. 28, 2005 (JP) P.2005-314506

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(52) **U.S. Cl.** **343/700 MS; 343/702;**
343/725; 343/846; 343/893

(58) **Field of Classification Search** 343/700 MS,
343/702, 725, 728, 846, 848, 830, 893
See application file for complete search history.

(56) **References Cited**

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Primary Examiner—Douglas W Owens

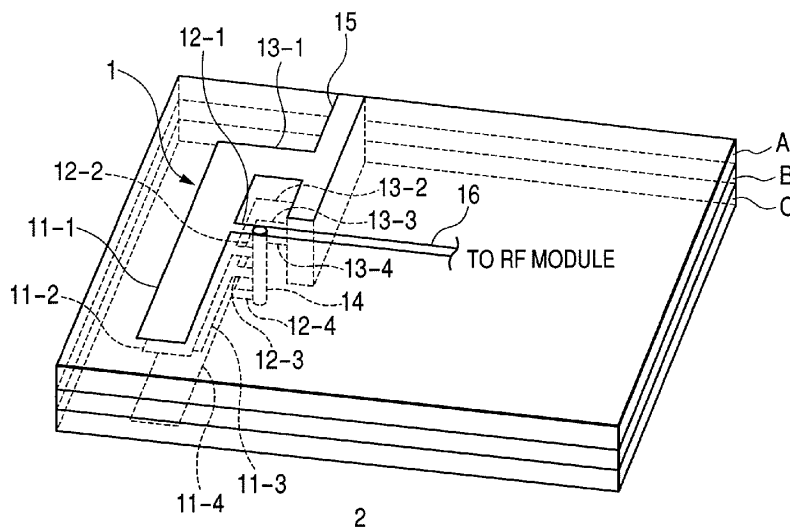
Assistant Examiner—Chuc D Tran

(74) *Attorney, Agent, or Firm*—Drinker Biddle & Reath LLP

(57) **ABSTRACT**

An antenna 1 which is incorporated in a multilayer wiring board 2 has: radiating elements 11-1, 11-2, 11-3, and 11-4 which are laid on faces of A-, B-, and C-layers of the wiring board 2, respectively; power supplying portions 12-1, 12-2, 12-3, and 12-4 which are laid on the faces of the layers, respectively to supply an electric power to the radiating elements 11-1, 11-2, 11-3, and 11-4; short-circuiting portions 13-1, 13-2, 13-3, and 13-4 which are laid on the faces of the layers, respectively to ground the radiating elements 11-1, 11-2, 11-3, and 11-4; and a connecting portion 14 which penetrates the A-, B-, and C-layers of the wiring board 2, and through which the power supplying portions 12-1, 12-2, 12-3, and 12-4 are electrically connected to each other.

5 Claims, 7 Drawing Sheets



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US007796086B2

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

(10) **Patent No.:** **US 7,796,086 B2**
(45) **Date of Patent:** **Sep. 14, 2010**

(54) **ANTENNA AND METHOD OF
MANUFACTURING AN ANTENNA**

(75) Inventors: **Orhan Coskun**, Izmir (TR); **Ayşe
Sevinc Aydinlik Bechteler**, Izmir (TR)

(73) Assignee: **Vestel Elektronik Sanayi ve Ticaret
A.S.**, Manisa (TR)

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

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(21) Appl. No.: **12/118,427**

(22) Filed: **May 9, 2008**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 60/938,607, filed on May
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H01Q 1/38 (2006.01)
H01Q 1/48 (2006.01)

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

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

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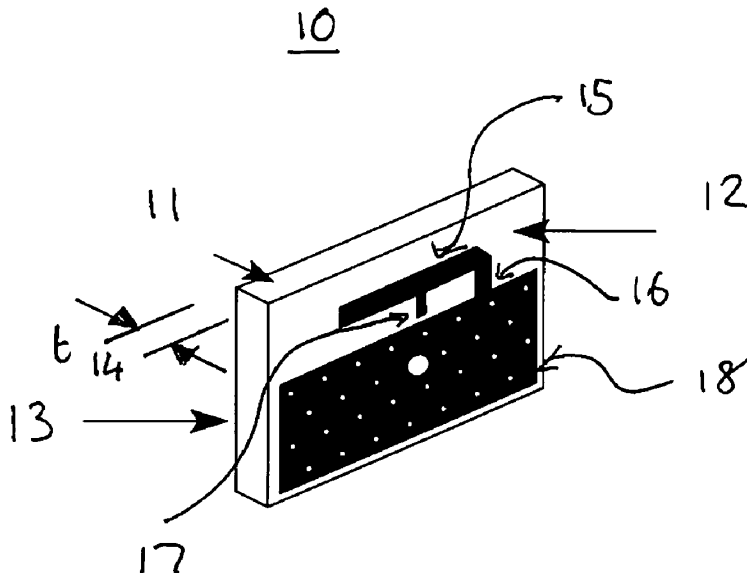
Primary Examiner—Hoang V Nguyen

(74) *Attorney, Agent, or Firm*—Conley Rose, P.C.

(57) **ABSTRACT**

An antenna (10) comprises a substrate (11) having a first and
a second opposed side (12,13); a single element for radiating
electromagnetic waves (15), wherein the radiating element
(15) is formed on the first substrate side (12); a first ground
plane (18) formed on the first substrate side (12), the first
ground plane (18) being electrically connected to the radiat-
ing element (15); and, a second ground plane (19) formed on
the second substrate side (13), the second ground plane (19)
being electrically connected to the first ground plane (18).

19 Claims, 11 Drawing Sheets



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US007796088B1

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

(10) **Patent No.:** **US 7,796,088 B1**
(45) **Date of Patent:** **Sep. 14, 2010**

(54) **STRETCHABLE ANTENNA ASSEMBLY AND
NOTEBOOK COMPUTER WITH THE
ANTENNA ASSEMBLY THEREOF**

(75) Inventors: **Hen-An Chen**, Taipei Hsien (TW);
San-Yi Kuo, Taipei Hsien (TW);
Bing-Chun Chung, Taipei Hsien (TW)

(73) Assignee: **Wistron Neweb Corporation**, Hsichih,
Taipei Hsien (TW)

(*) Notice: Subject to any disclaimer, the term of this
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(22) Filed: **Jan. 7, 2008**

(30) **Foreign Application Priority Data**

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H01Q 1/24 (2006.01)

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(58) **Field of Classification Search** 343/702,
343/872, 878, 880, 883; 455/575.1, 575.3,
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See application file for complete search history.

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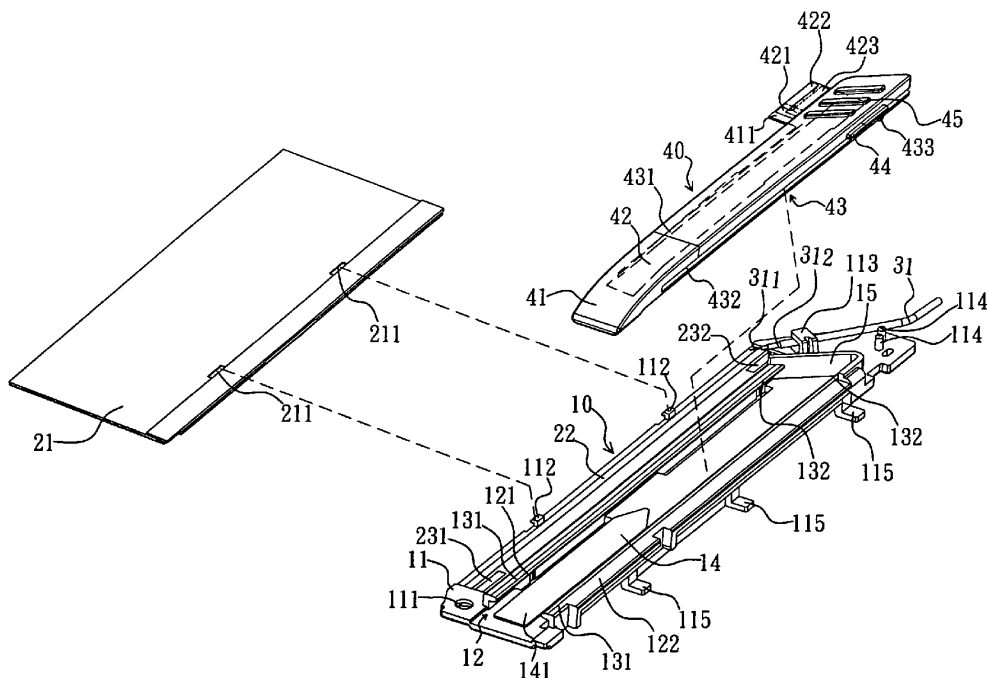
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Primary Examiner—Hoang V Nguyen

(57) **ABSTRACT**

A stretchable antenna assembly and a notebook computer with the antenna assembly thereof, comprising an antenna module and a holder which respectively has a guiding unit corresponding to the antenna module and the holder, and further the antenna module couples to a signal transmission element for activating with a first conductive element disposed at one side of the holder, resulting in preventing the antenna signal transmission from being interrupted whenever the antenna module is open or closed, and in further ensuring the precise locating function, and strengthening the receipt of signal.

25 Claims, 5 Drawing Sheets



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US007796090B2

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

(10) **Patent No.:** **US 7,796,090 B2**
(45) **Date of Patent:** **Sep. 14, 2010**

(54) **COMPACT MULTIBAND ANTENNA**

(75) Inventors: **Philippe Minard**, Saint Medard sur Ile (FR); **Jean-François Pintos**, Bourgbarre (FR); **Ali Louzir**, Rennes (FR); **Philippe Gilberton**, Geveze (FR)

(73) Assignee: **Thomson Licensing**,
Boulogne-Billancourt (FR)

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

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§ 371 (c)(1),
(2), (4) Date: **Mar. 5, 2008**

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PCT Pub. Date: **Mar. 15, 2007**

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H01Q 1/24 (2006.01)

(52) **U.S. CL.** **343/727; 343/702; 343/725**

(58) **Field of Classification Search** 343/727,
343/725, 702, 726, 846, 767, 795
See application file for complete search history.

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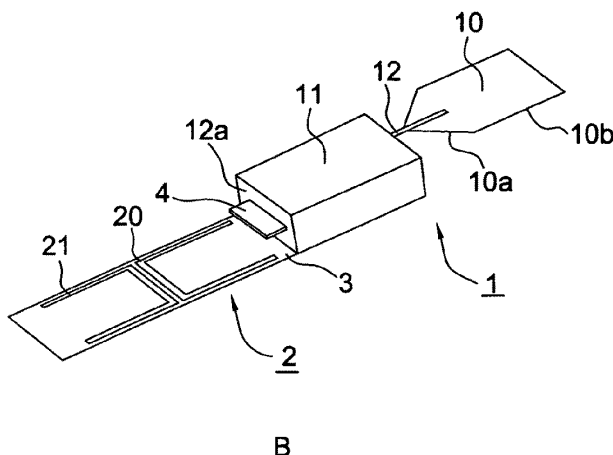
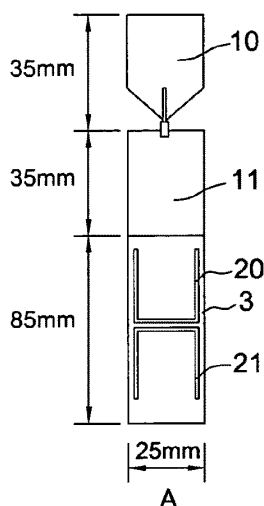
Primary Examiner—HoangAnh T Le

(74) *Attorney, Agent, or Firm*—Robert D. Shedd; Jeffrey M. Navon

(57) **ABSTRACT**

The present invention relates to a compact multiband antenna constituted by a first dipole type element comprising a first conductive arm connected to a second conductive arm having the shape of a box, mounted on a ground plane, the first and the second arms being supplied differentially and a second element of the slot type realized on said ground plane in the extension of said second arm.

8 Claims, 4 Drawing Sheets



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US007796092B2

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

(10) **Patent No.:** **US 7,796,092 B2**
(45) **Date of Patent:** **Sep. 14, 2010**

(54) **BROADBAND COMPOSITE DIPOLE
ANTENNA ARRAYS FOR OPTICAL WAVE
MIXING**

2005/0088358 A1 4/2005 Larry et al.

(75) Inventors: **Sandor Holly**, Woodland Hills, CA
(US); **William Daniel Mack**, Encino,
CA (US)

(Continued)

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(73) Assignee: **The Boeing Company**, Chicago, IL
(US)

EP 01101006 4/1989

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 313 days.

(Continued)

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(21) Appl. No.: **11/753,490**

PCT search report of Jul. 21, 2008.

(22) Filed: **May 24, 2007**

(Continued)

(65) **Prior Publication Data**
US 2008/0291108 A1 Nov. 27, 2008

Primary Examiner—Huedung Mancuso
(74) *Attorney, Agent, or Firm*—Haynes and Boone, LLP

(57) **ABSTRACT**

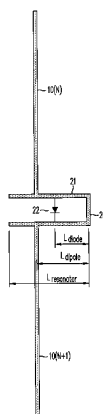
(51) **Int. Cl.**
H01Q 9/16 (2006.01)
(52) **U.S. Cl.** **343/820**
(58) **Field of Classification Search** 343/820,
343/852, 793
See application file for complete search history.

A broadband composite dipole array (CDA) includes an array of macro dipoles on a non-conducting substrate adapted to receive radiation at two frequencies. Each macro dipole is an array of micro dipoles adapted to receive radiation at substantially the mean of the two frequencies. The micro-dipoles are coupled to each other by a parallel resonant circuit including a nonlinear element, wherein the minimum impedance of the circuit is a substantially short circuit at the difference frequency $f_1 - f_2$, and the circuit has a substantially open circuit impedance in the range of frequencies from f_1 to f_2 . The micro dipoles resonate efficiently at both frequencies f_1 and f_2 with low-loss. The nonlinear element in the resonant circuit generates a signal at the difference frequency which is the resonant frequency of the macro dipole antenna. A composite of macro dipole antennas couple electromagnetically via a cluster of micro-dipole elements to broaden the bandwidth over a range of frequencies from f_1 to f_2 at which the macro dipole antenna resonates.

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15 Claims, 7 Drawing Sheets



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US00D623632S

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

(10) **Patent No.:** **US D623,632 S**
(45) **Date of Patent:** **** Sep. 14, 2010**

(54) **ANTENNA STRUCTURE**

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

(73) Assignee: **SkyCross, Inc.**, Viera, FL (US)

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

(21) Appl. No.: **29/350,010**

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

(51) **LOC (9) Cl.** **14-03**

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

(58) **Field of Classification Search** D14/138,
D14/230-238, 299, 358; D12/42, 43; 343/700 MS,
343/700 R-705, 711-713, 741, 748, 767,
343/795, 819, 840, 846, 866, 871-908; 455/90.2,
455/90.3, 91, 128, 269, 344, 347, 562.1;
333/193, 195

See application file for complete search history.

(56) **References Cited**

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Primary Examiner—T. Chase Nelson

Assistant Examiner—John Windmuller

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

(57) **CLAIM**

The ornamental design for an antenna structure, as shown and
described.

DESCRIPTION

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

FIG. 2 is a top plan view thereof;

FIG. 3 is a left side elevation view thereof;

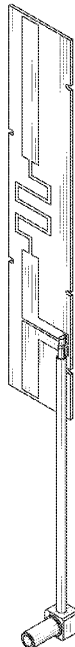
FIG. 4 is a front elevation view thereof;

FIG. 5 is a right side elevation view thereof;

FIG. 6 is a rear elevation view thereof; and,

FIG. 7 is a bottom plan view thereof.

1 Claim, 2 Drawing Sheets



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US007800546B2

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

(10) **Patent No.:** **US 7,800,546 B2**
(45) **Date of Patent:** **Sep. 21, 2010**

(54) **MOBILE WIRELESS COMMUNICATIONS
DEVICE INCLUDING MULTI-LOOP FOLDED
MONOPOLE ANTENNA AND RELATED
METHODS**

(75) Inventors: **Qinjiang Rao**, Waterloo (CA); **Geyi
Wen**, 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 208 days.

(21) Appl. No.: **11/850,751**

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

(65) **Prior Publication Data**
US 2009/0066586 A1 Mar. 12, 2009

(51) **Int. Cl.**
H01Q 1/22 (2006.01)

(52) **U.S. Cl.** **343/702**; 343/700 MS;
343/797; 343/853; 343/860; 343/895

(58) **Field of Classification Search** 343/702,
343/742, 767, 770, 867, 870, 895, 700 MS,
343/797, 853, 860

See application file for complete search history.

(56) **References Cited**

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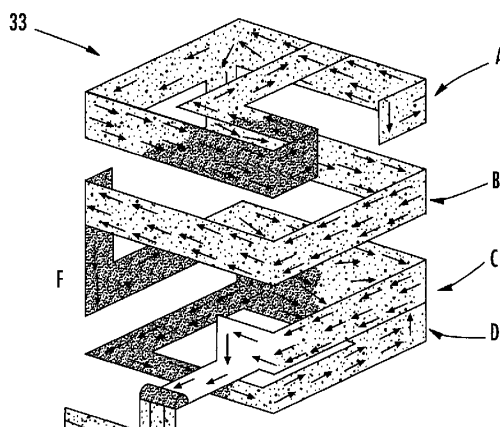
(Continued)

Primary Examiner—Douglas W Owens
Assistant Examiner—Chuc D Tran

(57) **ABSTRACT**

A mobile wireless communications device may include a portable housing, a printed circuit board (PCB) carried within the portable housing, and wireless communications circuitry carried by the PCB within the portable housing. Furthermore, a folded monopole antenna may be coupled to the wireless communications circuitry. The folded monopole antenna may include a dielectric body having a generally rectangular shape defining a bottom portion adjacent the PCB and a top portion opposite the bottom portion. The antenna may also include a conductive trace having a bottom loop adjacent the bottom portion of the dielectric body, a top loop adjacent the top portion of the dielectric body, and an intermediate wrap-around section extending around the dielectric body and between the bottom and top loops.

21 Claims, 6 Drawing Sheets



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US007800547B2

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

(10) **Patent No.:** **US 7,800,547 B2**
(45) **Date of Patent:** ***Sep. 21, 2010**

(54) **DUAL BAND WLAN ANTENNA**

(75) Inventors: **James Li**, Santa Clara, CA (US); **Jing Jiang**, San Jose, CA (US)

(73) Assignee: **Marvell World Trade Ltd.**, St. Michael (BB)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 193 days.

This patent is subject to a terminal disclaimer.

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Notification of Transmittal of The International Search Report and The Written Opinion of The International Searching Authority, or The Declaration; PCT/US2007/003594; Dated: Nov. 5, 2007; 24 pages.

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Primary Examiner—HoangAnh T Le

(57) **ABSTRACT**

An antenna system includes first, second, and third antennas that are arranged on a substrate and that include an arc-shaped element having a concave side and a convex side, a conducting element that extends substantially radially from a center of the concave side, and a U-shaped element having a base portion with a center that communicates with the conducting element and two side portions that extend from ends of the base portion towards the concave side.

(21) Appl. No.: **12/214,165**

(22) Filed: **Jun. 17, 2008**

(65) **Prior Publication Data**

US 2008/0291094 A1 Nov. 27, 2008

Related U.S. Application Data

(63) Continuation of application No. 11/581,502, filed on Oct. 16, 2006, now Pat. No. 7,394,433, which is a continuation of application No. 11/519,979, filed on Sep. 12, 2006, now Pat. No. 7,423,597.

(60) Provisional application No. 60/771,634, filed on Feb. 9, 2006.

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

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

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

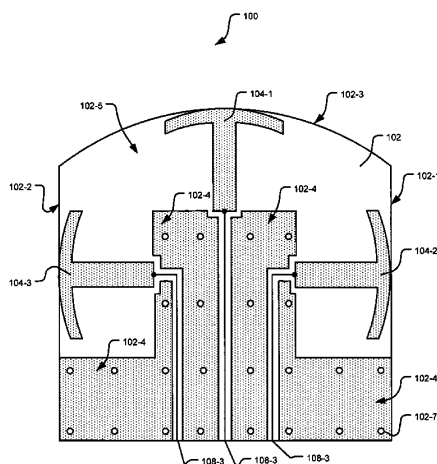
See application file for complete search history.

(56) **References Cited**

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34 Claims, 38 Drawing Sheets



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US007800549B2

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

(10) **Patent No.:** **US 7,800,549 B2**
(45) **Date of Patent:** **Sep. 21, 2010**

(54) **MULTI-BEAM ANTENNA**

(75) Inventors: **Gabriel M. Rebeiz**, La Jolla, CA (US);
James P. Ebling, Ann Arbor, MI (US);
Bernhard Schoenlinner, Trostberg (DE)

(73) Assignee: **TK Holdings, Inc. Electronics**, Pontiac,
MI (US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 4 days.

(21) Appl. No.: **11/929,791**

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

(65) **Prior Publication Data**

US 2008/0055175 A1 Mar. 6, 2008

Related U.S. Application Data

(63) Continuation of application No. 11/627,369, filed on
Jan. 25, 2007, which is a continuation-in-part of appli-
cation No. 10/907,305, filed on Mar. 28, 2005, now
abandoned, said application No. 11/627,369 is a con-
tinuation-in-part of application No. 11/161,681, filed
on Aug. 11, 2005, now Pat. No. 7,358,913, which is a
continuation-in-part of application No. 10/604,716,
filed on Aug. 12, 2003, now Pat. No. 7,042,420, which
is a continuation-in-part of application No. 10/202,
242, filed on Jul. 23, 2002, now Pat. No. 6,606,077,
which is a continuation-in-part of application No.
09/716,736, filed on Nov. 20, 2000, now Pat. No.
6,424,319.

(60) Provisional application No. 60/521,284, filed on Mar.
26, 2004, provisional application No. 60/522,077,
filed on Aug. 11, 2004, provisional application No.
60/166,231, filed on Nov. 18, 1999.

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

(52) **U.S. Cl.** **343/754; 343/911 R**

(58) **Field of Classification Search** 343/754,
343/753, 755, 911 R, 911 L
See application file for complete search history.

(56) **References Cited**

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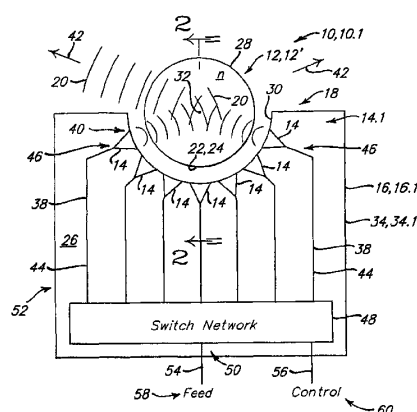
Primary Examiner—Tho G Phan

(74) Attorney, Agent, or Firm—Raggio & Dinnin, P.C.

(57) **ABSTRACT**

A plurality of antenna elements on a dielectric substrate are
adapted to launch or receive electromagnetic waves in or from
a direction substantially away from either a convex or con-
cave edge of the dielectric substrate, wherein at least two of
the antenna elements operate in different directions. Slotlines
of tapered-slot endfire antennas in a first conductive layer of
a first side of the dielectric substrate are coupled to microstrip
lines of a second conductive layer on the second side of the
dielectric substrate. A bi-conical reflector, conformal cylin-
drical dielectric lens, or discrete lens array improves the
H-plane radiation pattern. Dipole or Yagi-Uda antenna ele-
ments on the conductive layer of the dielectric substrate can
be used in cooperation with associated reflective elements,
either alone or in combination with a corner-reflector of con-
ductive plates attached to the conductive layers proximate to
the endfire antenna elements.

2 Claims, 25 Drawing Sheets



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US007804450B2

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

(10) **Patent No.:** **US 7,804,450 B2**
(45) **Date of Patent:** **Sep. 28, 2010**

(54) **HYBRID ANTENNA STRUCTURE**

(75) Inventors: **Jonathan L. Sullivan**, Lincoln, NE
(US); **Stefan Lofgren**, Stockholm (SE);
Ulf Palin, Stockholm (SE)

(73) Assignee: **Laird Technologies, Inc.**, Chesterfield,
MO (US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 647 days.

(21) Appl. No.: **11/780,964**

(22) Filed: **Jul. 20, 2007**

(65) **Prior Publication Data**

US 2009/0020328 A1 Jan. 22, 2009

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

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

(58) **Field of Classification Search** **343/700 MS,**
343/893, 895

See application file for complete search history.

(56) **References Cited**

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2008.

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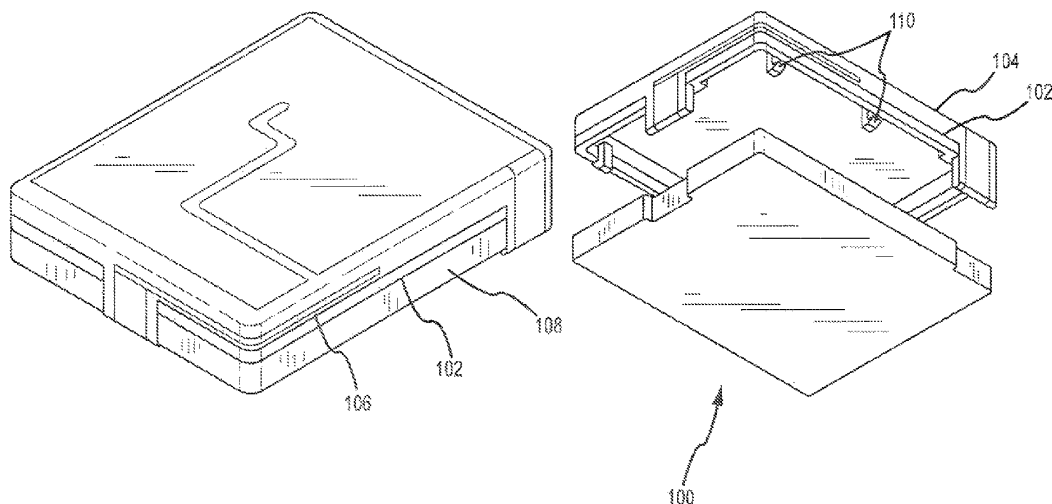
Primary Examiner—Shih-Chao Chen

(74) *Attorney, Agent, or Firm*—Harness, Dickey & Pierce,
P.L.C.

(57) **ABSTRACT**

An electrical component is provided that provides at least a
two shot injection molding structure. One of the at least two
shots of plastic comprises a laser direct structuring material.
Another of the at least two shots of plastic comprises a non-
platable plastic. The laser direct structuring material is selec-
tively activated such that a conductive trace can be plated on
the laser direct structuring material.

26 Claims, 6 Drawing Sheets



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US007804451B2

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

(10) **Patent No.:** **US 7,804,451 B2**
(45) **Date of Patent:** **Sep. 28, 2010**

(54) **WIRELESS COMMUNICATION DEVICE
HAVING A REDUCED SAR VALUE**

(75) Inventors: **Wolfgang Glocker**, Memmingen (DE);
Stefan Huber, München (DE);
Thorsten Kowalski, München (DE);
Martin Oelschläger, Berlin (DE);
Michael Schreiber, Aying-Göggenhofen
(DE); **Martin Weinberger**, München
(DE)

(73) Assignee: **Palm, 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.: **10/527,768**

(22) PCT Filed: **Sep. 11, 2003**

(86) PCT No.: **PCT/DE03/02983**

§ 371 (c)(1),
(2), (4) Date: **Sep. 23, 2005**

(87) PCT Pub. No.: **WO2004/027924**

PCT Pub. Date: **Apr. 1, 2004**

(65) **Prior Publication Data**

US 2006/0139216 A1 Jun. 29, 2006

(30) **Foreign Application Priority Data**

Sep. 12, 2002 (DE) 102 42 386
Oct. 18, 2002 (DE) 102 48 756

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

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

(58) **Field of Classification Search** 343/702,
343/841, 846; 455/575, 90, 575.1, 575.3–575.5,
455/575.7, 575.8, 90.3

See application file for complete search history.

(56) **References Cited**

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Primary Examiner—Hoang V Nguyen

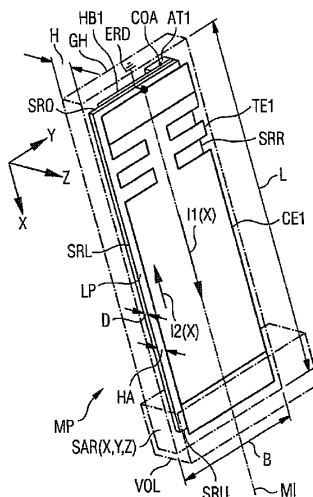
Assistant Examiner—Robert Karacsony

(74) Attorney, Agent, or Firm—K&L Gates LLP

(57) **ABSTRACT**

In order to reduce the SAR value in a wireless communication device (MP), an additional, current-conducting corrective element (CE1) is coupled to and configured in relation to the printed circuit board (LP) and the antenna (AT1) such that the amplitude level (IM1, NIM1) and/or the phase angle of electrical currents (I3, I1, I2) on the antenna (AT1), the printed circuit board (LP), and the corrective element (CE1) are adjusted relative to each other in such a way that the SAR distribution resulting from such currents becomes minimal.

37 Claims, 3 Drawing Sheets



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US007804453B2

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

(10) **Patent No.:** **US 7,804,453 B2**
(45) **Date of Patent:** **Sep. 28, 2010**

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

(75) Inventors: **Bing Chiang**, Cupertino, CA (US);
Douglas Blake Kough, San Jose, CA (US); **Enrique Ayala Vazquez**,
Watsonville, CA (US); **Eduardo Lopez Camacho**, Watsonville, CA (US);
Gregory Allen Springer, Sunnyvale, CA (US)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 212 days.

(21) Appl. No.: **12/104,359**

(22) Filed: **Apr. 16, 2008**

(65) **Prior Publication Data**

US 2009/0262029 A1 Oct. 22, 2009

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

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

(58) **Field of Classification Search** 343/702,
343/872; 455/575.1, 575.3, 575.8
See application file for complete search history.

(56) **References Cited**

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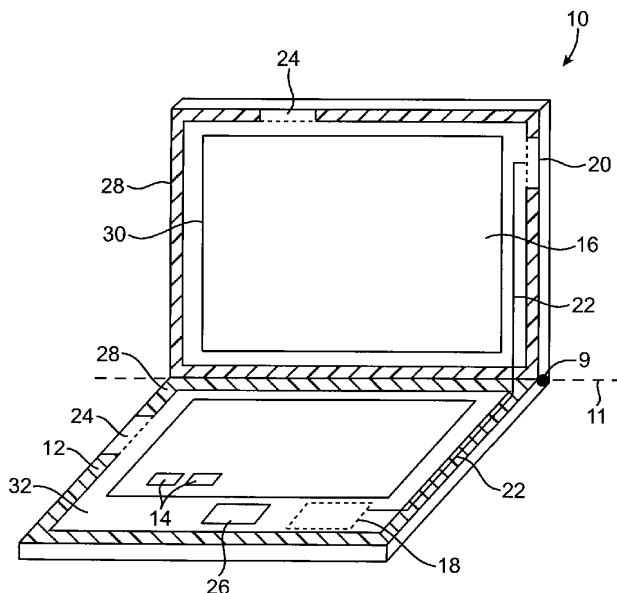
Primary Examiner—Hoang V Nguyen

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

(57) **ABSTRACT**

Antenna window structures and antennas are provided for electronic devices. The electronic devices may be laptop computers or other devices that have conductive housings. Antenna windows can be formed from dielectric members. The dielectric members can have elastomeric properties. An antenna may be mounted inside a conductive housing beneath a dielectric member. The antenna can be formed from a parallel plate waveguide structure. The parallel plate waveguide structure may have a ground plate and a radiator plate and may have dielectric material between the ground and radiator plates. The ground plate can have a primary ground plate portion and a ground strip. The ground strip may reflect radio-frequency signals so that they travel through the dielectric member. The antenna may handle radio-frequency antenna signals in one or more communications bands. The radio-frequency antenna signals pass through the dielectric member.

14 Claims, 10 Drawing Sheets



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US007804456B2

(12) **United States Patent**
Yekeh Yazdandoost et al.

(10) **Patent No.:** **US 7,804,456 B2**
(45) **Date of Patent:** **Sep. 28, 2010**

(54) **ULTRA WIDEBAND LOOP ANTENNA**

(56) **References Cited**

(75) Inventors: **Kamya Yekeh Yazdandoost**, Koganei (JP); **Ryuji Kohno**, Koganei (JP)

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(73) Assignee: **National Institute of Information and Communications Technology**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 379 days.

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(21) Appl. No.: **11/568,338**

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Julien Perruisseau-Carrier et al., Dual-Polarized Broadband Dipole, IEEE Antennas and Wireless Propagation Letters, vol. 2, 2003, pp. 310-312.

(86) PCT No.: **PCT/JP2004/019594**

§ 371 (c)(1),

(2), (4) Date: **Jun. 14, 2008**

(87) PCT Pub. No.: **WO2005/107011**

(Continued)

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

Primary Examiner—Hoang V Nguyen

(74) Attorney, Agent, or Firm—McGlew and Tuttle, P.C.

(65) **Prior Publication Data**

US 2008/0297424 A1 Dec. 4, 2008

(57) **ABSTRACT**

(30) **Foreign Application Priority Data**

Apr. 28, 2004 (JP) 2004-133759

The wideband L-loop antenna is presented in this invention. It has excellent performance for lower band of UWB system and has the attractive features of small size, inexpensive, and easy to design. The antenna composed of a single metallic layer is printed on the top of a substrate and a coupled tapered transmission line is printed on the top of the same substrate. A L shape portion is formed by widening partially or wholly the width of a part of antenna elements in comparison with the other part.

(51) **Int. Cl.**

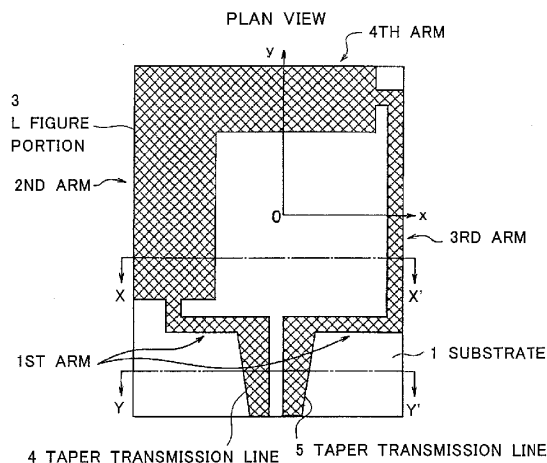
H01Q 11/12 (2006.01)

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

(58) **Field of Classification Search** 343/741, 343/866, 700 MS, 850

See application file for complete search history.

13 Claims, 11 Drawing Sheets



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US007804457B2

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

(10) **Patent No.:** **US 7,804,457 B2**
(45) **Date of Patent:** **Sep. 28, 2010**

(54) **MULTI-BAND ANTENNA WITH INDUCTOR
AND/OR CAPACITOR**

(75) Inventors: **Tadashi Oshiyama**, Gunma (JP);
Hirotoishi Mizuno, Gunma (JP); **Yusuke
Suzuki**, Gunma (JP)

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

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 380 days.

(21) Appl. No.: **11/645,012**

(22) Filed: **Dec. 26, 2006**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Dec. 27, 2005 (JP) P2005-375101

(51) **Int. Cl.**

H01Q 9/00 (2006.01)

H01Q 9/04 (2006.01)

(52) **U.S. Cl.** **343/749**; 343/825

(58) **Field of Classification Search** 343/895,
343/700 MS, 702, 752, 741, 744, 745, 747-750,
343/803, 825, 828, 829

See application file for complete search history.

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Primary Examiner—Hoang V Nguyen

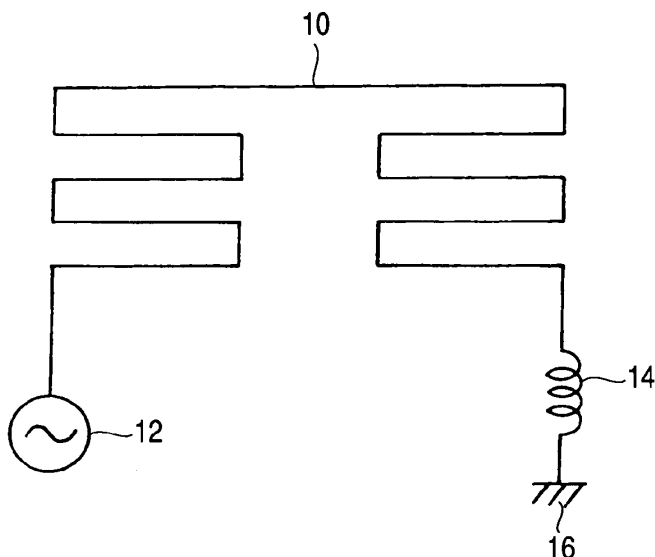
Assistant Examiner—Robert Karacsony

(74) *Attorney, Agent, or Firm*—Morgan, Lewis & Bockius
LLP

(57) **ABSTRACT**

A multi-band antenna is adapted to operate in a first frequency band and a second frequency band which is lower than the first frequency band. In the multi-band antenna, an antenna element has an electrical length of $\frac{3}{4}$ wavelength of the first frequency band. The antenna element has a first end adapted to be electrically connected to a power feeding point, and a second end. An inductor is electrically connected between the second end of the antenna element and a ground in a serial manner. The inductor has such an inductance that an electrical length of the antenna element and the inductor corresponds to $\frac{1}{2}$ wavelength of the second frequency band.

8 Claims, 10 Drawing Sheets



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US007804458B2

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

(10) **Patent No.:** **US 7,804,458 B2**
(45) **Date of Patent:** **Sep. 28, 2010**

- (54) **SLOT ANTENNA** 5,489,913 A * 2/1996 Raguenet et al. 343/767
(75) Inventors: **Mark Montgomery**, Melbourne Beach, 5,955,997 A 9/1999 Ho
FL (US); **Frank M. Caimi**, Vero Beach, 6,636,181 B2 * 10/2003 Asano et al. 343/702
FL (US) 7,079,081 B2 7/2006 Parsche
(73) Assignee: **SkyCross, Inc.**, Melbourne, FL (US) 2007/0194994 A1 * 8/2007 Waltho 343/702

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 147 days.

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(21) Appl. No.: **12/055,259**
(22) Filed: **Mar. 25, 2008**

Primary Examiner—Hoang V Nguyen
(74) *Attorney, Agent, or Firm*—John L. DeAngelis; Beusse
Wolter Sanks Mora & Maire, P.A.

(65) **Prior Publication Data**
US 2008/0231522 A1 Sep. 25, 2008

(57) **ABSTRACT**

Related U.S. Application Data

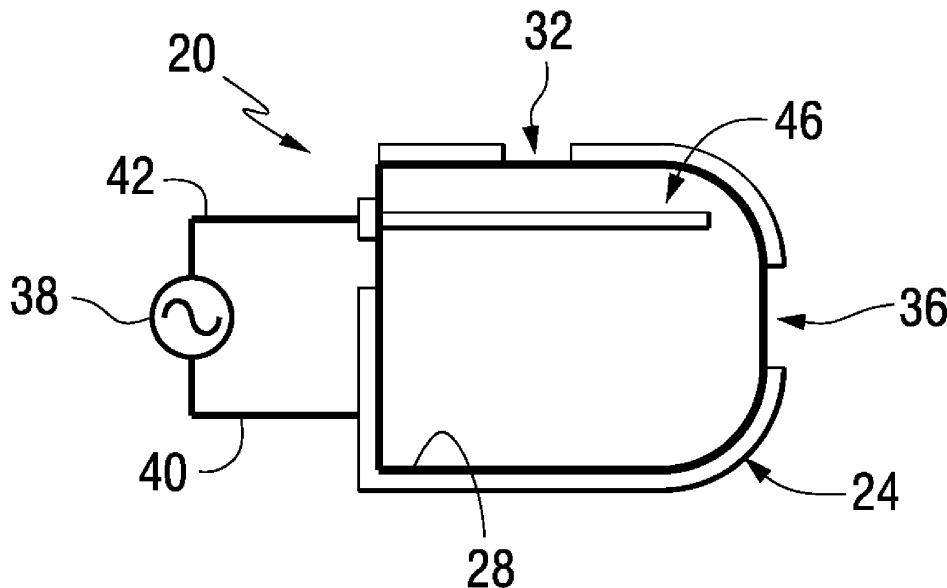
(60) Provisional application No. 60/896,930, filed on Mar. 25, 2007.

A communications device for sending and receiving an information signal. The communications device comprising an element having an opening defined therein for receiving an antenna, the element comprising first conductive material disposed proximate the opening and comprising transmitting and receiving circuits. The antenna comprises: a dielectric tubular member, second conductive material forming an exterior surface of the tubular member with the second conductive material defining a slot therein, a slot length approximately equal to one-half of a guided wavelength and a feed connected to the transmitting and receiving circuits and disposed proximate the slot for establishing currents in the second conductive material.

(51) **Int. Cl.**
H01Q 13/10 (2006.01)
H01Q 1/24 (2006.01)
(52) **U.S. Cl.** **343/767; 343/702**
(58) **Field of Classification Search** **343/767,**
343/770, 702, 700 MS
See application file for complete search history.

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17 Claims, 2 Drawing Sheets



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US007804459B2

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

(10) **Patent No.:** **US 7,804,459 B2**
(45) **Date of Patent:** **Sep. 28, 2010**

(54) **TRANSMISSION LINE LOADED DUAL-BAND MONOPOLE ANTENNA**

WO WO96/02075 1/1996
WO WO98/15031 4/1998

(75) Inventors: **Shyh-Jong Chung**, Hsinchu (TW);
Yu-Hsin Wang, Taichung (TW);
Yu-Chiang Cheng, Taipei (TW)

(73) Assignee: **Getac 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 222 days.

(21) Appl. No.: **12/213,611**

(22) Filed: **Jun. 23, 2008**

(65) **Prior Publication Data**
US 2009/0115678 A1 May 7, 2009

(30) **Foreign Application Priority Data**
Nov. 5, 2007 (TW) 96141724 A
Mar. 4, 2008 (TW) 97107522 A

(51) **Int. Cl.**
H01Q 9/04 (2006.01)
(52) **U.S. Cl.** **343/791; 343/790**
(58) **Field of Classification Search** **343/790, 343/791, 792, 900**
See application file for complete search history.

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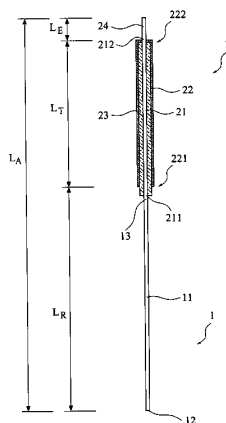
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Primary Examiner—HoangAnh T Le

(57) **ABSTRACT**

Disclosed is a transmission line loaded dual-band monopole antenna, which realizes operation in dual bands with a single antenna. The dual-band monopole antenna includes a monopole antenna and a transmission line load. The monopole antenna has a signal feeding terminal and a load connection terminal. The load connection terminal is connected to the transmission line load. The transmission line load includes a core transmission line, an outer circumferential conductor, and a short-circuit section. The core transmission line has an antenna connection terminal and a short-circuit terminal. The antenna connection terminal is connected to the load connection terminal of the monopole antenna. The outer circumferential conductor circumferentially surrounds and is spaced from the core transmission line and the outer circumferential conductor has an open terminal and a short-circuit terminal. The opening of the open terminal of the outer circumferential conductor faces the antenna connection terminal of the core transmission line so that the outer circumferential conductor forms an open structure facing the monopole antenna.

15 Claims, 17 Drawing Sheets



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US007804463B2

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

(10) **Patent No.:** **US 7,804,463 B2**
(45) **Date of Patent:** **Sep. 28, 2010**

(54) **ANTENNA-CARRYING ASSEMBLY**

(75) Inventors: **Brett William Degner**, Menlo Park, CA (US); **Chris Ligtenberg**, San Carlos, CA (US); **Bartley K. Andre**, Menlo Park, CA (US); **Douglas B. Kough**, San Jose, CA (US)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 615 days.

(21) Appl. No.: **11/835,944**

(22) Filed: **Aug. 8, 2007**

(65) **Prior Publication Data**

US 2009/0040129 A1 Feb. 12, 2009

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

(52) **U.S. Cl.** **343/878**; 343/700 MS; 343/702; 343/895

(58) **Field of Classification Search** 343/700 MS, 343/702, 878, 895; 235/441, 449, 451, 492, 235/472.01, 472.03

See application file for complete search history.

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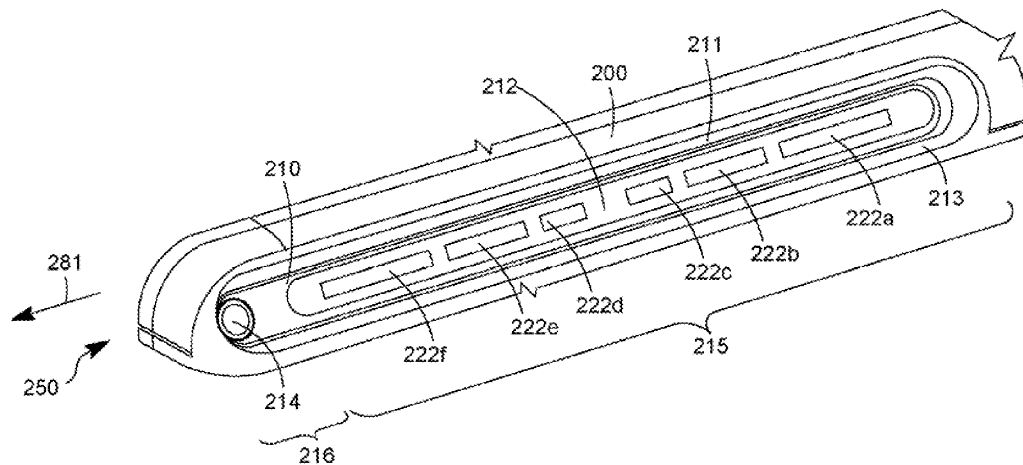
Primary Examiner—Douglas W Owens

Assistant Examiner—Chuc D Tran

(57) **ABSTRACT**

An antenna-carrying assembly for facilitating wireless communication using an electronic device is disclosed. The antenna-carrying assembly may include a body and one or more antenna elements carried by the body. The antenna-carrying assembly may also include a first attraction element carried by the body. The first attraction element is configured to magnetically couple the antenna-carrying assembly with a track and to slide along the track. At least one of the first attraction element and the track includes one or more magnetic elements.

30 Claims, 7 Drawing Sheets



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