



US008068058B2

(12) **United States Patent**
Sullivan

(10) **Patent No.:** **US 8,068,058 B2**
(45) **Date of Patent:** **Nov. 29, 2011**

(54) **ANTENNA ASSEMBLY WITH CONNECTORS HAVING AN INTERNAL CONDUCTIVE CHANNEL**

(75) Inventor: **Jonathan L. Sullivan**, Lincoln, NE (US)

(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 643 days.

(21) Appl. No.: **12/166,598**

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

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 60/948,291, filed on Jul. 6, 2007.

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H01Q 9/04 (2006.01)
H01Q 1/38 (2006.01)

(52) **U.S. Cl.** **343/700 MS; 343/702; 343/841; 343/895; 343/906**

(58) **Field of Classification Search** **343/700 MS, 343/702, 841, 873, 895, 906**
See application file for complete search history.

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Primary Examiner — Douglas W Owens

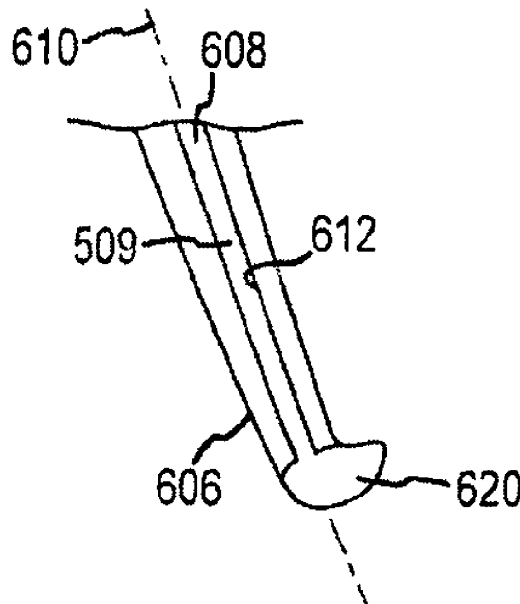
Assistant Examiner — Chuc Tran

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

(57) **ABSTRACT**

The present invention provides an antenna with an integral electrical connection to a printed circuit board. The electrical connection is accomplished by providing a connection beam from a conductive layer to the circuit board. The connection beam is provided with a channel extending through the connection beam, such as a channel through the geometric center of the beam, and the channel is plated. The connection beam terminates with a contact point. The beam is deflectable to provide contact force.

17 Claims, 5 Drawing Sheets





US008068059B2

(12) **United States Patent**
Konishi

(10) **Patent No.:** **US 8,068,059 B2**
(45) **Date of Patent:** **Nov. 29, 2011**

(54) **ANTENNA DEVICE, ELECTRONIC DEVICE
AND ANTENNA COVER**

(75) Inventor: **Michihiro Konishi**, Kawasaki (JP)

(73) Assignee: **Fujitsu Limited**, Kawasaki (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 242 days.

(21) Appl. No.: **12/230,395**

(22) Filed: **Aug. 28, 2008**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. PCT/JP2007/053762, filed on Feb. 28, 2007.

(30) **Foreign Application Priority Data**

Feb. 28, 2006 (JP) 2006-052471

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/42 (2006.01)

(52) **U.S. Cl.** **343/702; 343/872; 343/911 R**

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

(56) **References Cited**

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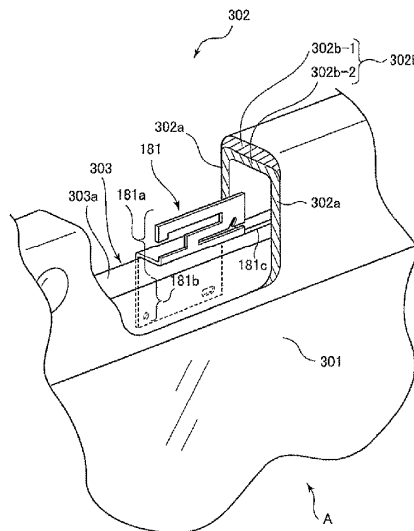
Primary Examiner — Trinh Dinh

(74) *Attorney, Agent, or Firm* — Fujitsu Patent Center

(57) **ABSTRACT**

An antenna device is mounted in a note PC and is used for communication between the note PC and the external of the note PC. The antenna device is provided with an antenna for wireless LAN for transmitting and receiving radio waves, and a cover. The cover is formed of a dielectric material for covering the antenna with a wall and a ceiling, and strengthens the directivity of radio wave communication on the wall side of the antenna device by a double layer structure of the ceiling that is thicker than the wall.

10 Claims, 34 Drawing Sheets





US008068060B2

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

(10) **Patent No.:** **US 8,068,060 B2**
(45) **Date of Patent:** ***Nov. 29, 2011**

(54) **COMBINATION OF TUBE ASSEMBLY AND CLIP FOR WIRELESS ANTENNA GROUNDING**

(75) Inventors: **Chao Chen**, Waterloo (CA); **Timothy H. Kyowski**, Brantford (CA)

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

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

(21) Appl. No.: **12/776,975**

(22) Filed: **May 10, 2010**

(65) **Prior Publication Data**
US 2010/0220032 A1 Sep. 2, 2010

Related U.S. Application Data
(63) Continuation of application No. 12/128,782, filed on May 29, 2008, now Pat. No. 7,739,784, which is a continuation of application No. 11/676,342, filed on Feb. 19, 2007, now Pat. No. 7,394,434, which is a continuation of application No. 11/274,121, filed on Nov. 16, 2005, now Pat. No. 7,196,671, which is a continuation of application No. 10/723,838, filed on Nov. 26, 2003, now Pat. No. 7,053,842.

(60) Provisional application No. 60/430,082, filed on Dec. 2, 2002.

(30) **Foreign Application Priority Data**
Nov. 29, 2002 (CA) 2413360

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
(52) **U.S. Cl.** **343/702**; 343/846; 343/901
(58) **Field of Classification Search** 343/702, 343/715, 846, 872, 901, 906
See application file for complete search history.

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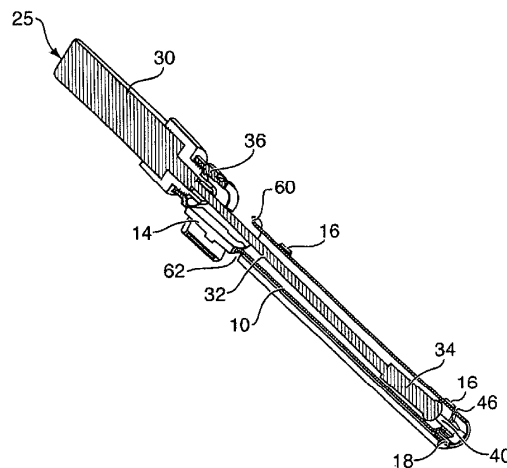
Primary Examiner — Tan Ho

(74) *Attorney, Agent, or Firm* — Moffat & Co.

(57) **ABSTRACT**

An antenna tube configured to accommodate a grounding clip and an antenna, the antenna tube having a cylindrical tube having an upper end and an inner end opposite the upper end; a circumferentially extending groove in the cylindrical tube located between the upper end and the inner end; and a tapered lip at the inner end of the cylindrical tube, wherein the grounding clip fits between the circumferentially extending groove and the tapered lip, and at least a portion of the antenna slidably fits into the upper end of the cylindrical tube.

16 Claims, 6 Drawing Sheets





US008068061B2

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

(10) **Patent No.:** **US 8,068,061 B2**
(45) **Date of Patent:** ***Nov. 29, 2011**

(54) **MOBILE WIRELESS COMMUNICATIONS DEVICE INCLUDING AN ELECTRICALLY CONDUCTIVE, ELECTRICALLY FLOATING ELEMENT AND RELATED METHODS**

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

(73) Assignee: **Research In Motion Limited**, Waterloo, 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.
This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/901,633**

(22) Filed: **Oct. 11, 2010**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. 11/467,955, filed on Aug. 29, 2006, now Pat. No. 7,812,770.

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/42 (2006.01)

(52) **U.S. Cl.** **343/702**; 343/817; 343/818; 343/833; 343/872; 343/700 MS

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

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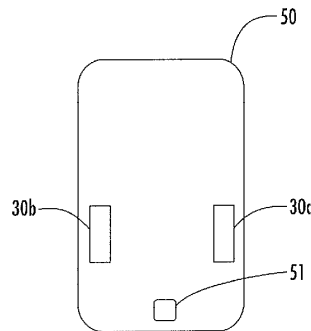
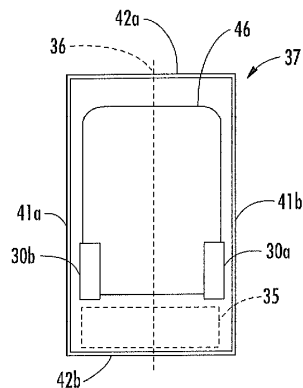
Primary Examiner — Trinh Dinh

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

(57) **ABSTRACT**

A mobile wireless communications device may include a portable housing having an interior and comprising a removable panel providing access to the interior, a printed circuit board (PCB) carried by the portable housing. The device may further include an antenna connected to the PCB and carried by the bottom portion of the PCB, and at least one electrically floating, electrically conductive, antenna beam shaping element secured to the removable panel.

31 Claims, 4 Drawing Sheets





US008068067B2

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

(10) **Patent No.:** **US 8,068,067 B2**
(45) **Date of Patent:** **Nov. 29, 2011**

(54) **ANTENNA INTEGRALLY FORMED WITH CASE AND METHOD OF MANUFACTURING THE SAME**

(75) Inventors: **Ha Ryong Hong**, Gyeonggi-Do (KR); **Young Suk Kim**, Gunggi-Do (KR); **Dae Seong Jeon**, Gyeonggi-Do (KR); **Jae Suk Sung**, Gyeonggi-Do (KR)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 616 days.

(21) Appl. No.: **12/183,883**

(22) Filed: **Jul. 31, 2008**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Aug. 21, 2007 (KR) 10-2007-0084007

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/40 (2006.01)

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

(58) **Field of Classification Search** 343/702, 343/872, 873, 878

See application file for complete search history.

(56) **References Cited**

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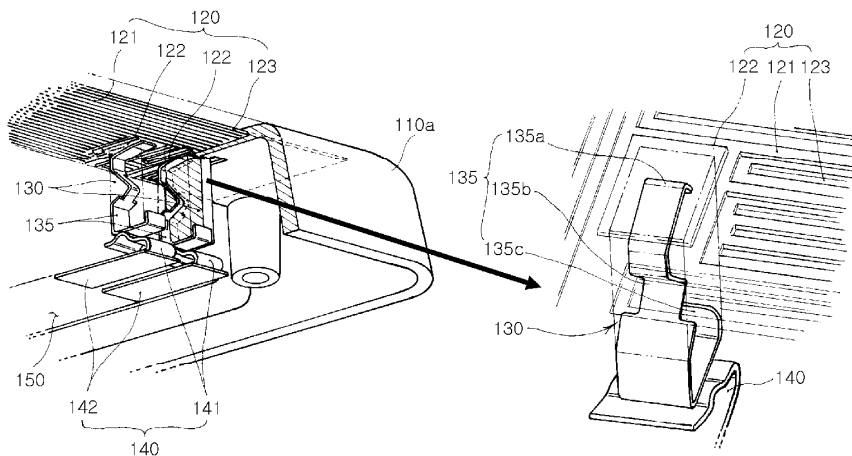
Primary Examiner — Tan Ho

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

(57) **ABSTRACT**

There are provided an antenna integrally formed with a case and a method of manufacturing the same. An antenna integrally formed with a case according to an aspect of the invention includes: a case unit formed of a dielectric material; a radiator integrally formed with the case unit and having terminal units extending from a radiation unit tightly contacting the surface of the case unit; vertical ribs each having an internal connection portion contacting an upper end of the terminal unit and extending downward from an inner surface of the case unit by a predetermined length; and outer connection portions provided on a board disposed adjacent to the case unit and electrically connected to individual lower ends of the internal connection portions.

17 Claims, 8 Drawing Sheets





US008072384B2

(12) **United States Patent**
Morrow

(10) **Patent No.:** **US 8,072,384 B2**
(45) **Date of Patent:** **Dec. 6, 2011**

(54) **DUAL-POLARIZED ANTENNA MODULES**

OTHER PUBLICATIONS

- (75) Inventor: **Jarrett D. Morrow**, Bow, NH (US)
- (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 541 days.

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(21) Appl. No.: **12/353,884**

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

Primary Examiner — Hoang V Nguyen

(65) **Prior Publication Data**
US 2010/0177012 A1 Jul. 15, 2010

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

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H01Q 1/38 (2006.01)

(57) **ABSTRACT**

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

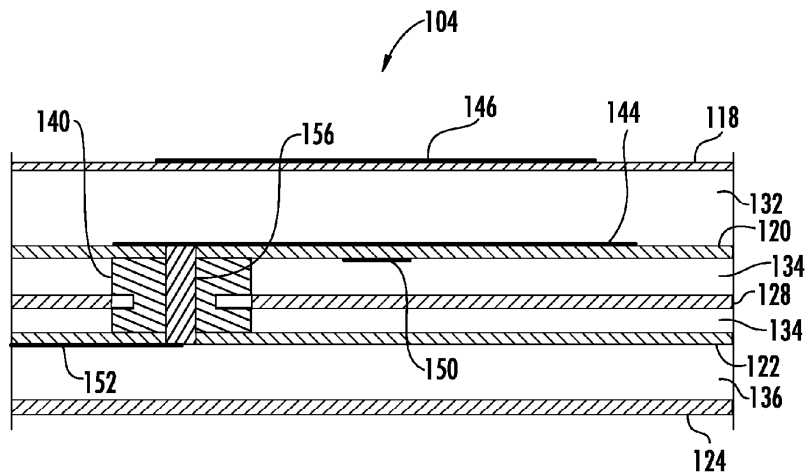
An array antenna module includes multiple antenna assemblies. Each antenna assembly generally includes a first radiating element and a second radiating element spaced apart from the first radiating element and capacitively coupled thereto. A first transmission line is capacitively coupled to the first radiating element, and a second transmission line is electrically coupled to the first radiating element by a connector. The antenna assembly is operable to transmit at least one or more signals to at least one or more wireless application devices and/or to receive at least one or more signals from at least one or more wireless application devices. The first radiating element, second radiating element, first transmission line, and/or second transmission line are coupled to substrates. And at least one or more of the substrates may include epoxy resin bonded glass fabric such as, for example, flame retardant 4.

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50 Claims, 7 Drawing Sheets





US008072389B2

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

(10) **Patent No.:** **US 8,072,389 B2**
(45) **Date of Patent:** **Dec. 6, 2011**

(54) **INTEGRATED MULTI-BAND ANTENNA MODULE**

(76) Inventors: **Pao-Sui Chang**, Taoyuan County (TW);
Yu-Sheng Wu, Taoyuan County (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 260 days.

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

(65) **Prior Publication Data**
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H01Q 1/38 (2006.01)
H01Q 5/00 (2006.01)
H01Q 9/04 (2006.01)

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

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

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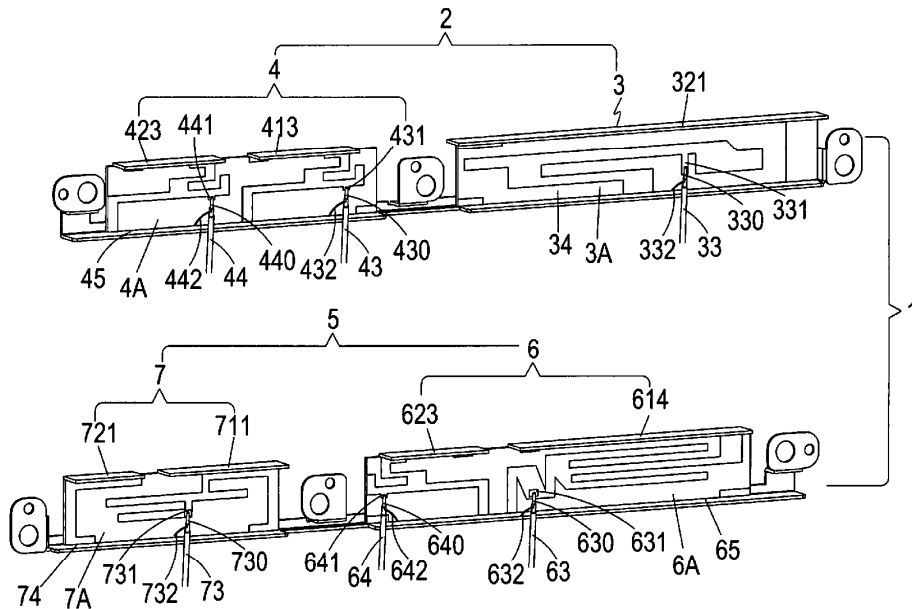
Primary Examiner — Douglas W Owens

Assistant Examiner — Jennifer Hu

(57) **ABSTRACT**

An integrated multi-band antenna module includes a first antenna body having a first body and a second body, and a second antenna body having a third body and a fourth body. The first to the fourth body have relative radiating portions, feed lines, and ground lines. The radiating portions have relative arms, antenna portions, feed arms, and conducting top plates. Resonant excitation sources are formed by capacitive coupling effects from gaps between the above components. The capacitive coupling effects also lower the inductance effect and the reflection loss. Mirror effect and large-scaling conducting top plates are used to raise a radiating effect. The relative gaps form the capacitive coupling effects to receive optimized frequencies so that a small-size integrated antenna with multi-band, high radiating effect, good resonant effect, and suitable for an ultra wide bandwidth operation is achieved.

4 Claims, 4 Drawing Sheets





US008072390B2

(12) **United States Patent**
Breiter

(10) **Patent No.:** **US 8,072,390 B2**
(45) **Date of Patent:** **Dec. 6, 2011**

- (54) **ANTENNA ARRANGEMENT**
- (75) Inventor: **Richard Breiter**, Frederiksberg (DK)
- (73) Assignee: **Nokia Corporation**, Espoo (FI)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 470 days.

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- (21) Appl. No.: **12/224,231**
- (22) PCT Filed: **Feb. 22, 2006**
- (86) PCT No.: **PCT/IB2006/001078**
§ 371 (c)(1),
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- (65) **Prior Publication Data**
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Primary Examiner — Dieu H Duong

(74) *Attorney, Agent, or Firm* — Alfred A. Fressola; Ware, Fressola, Van der Sluys & Adolphson LLP

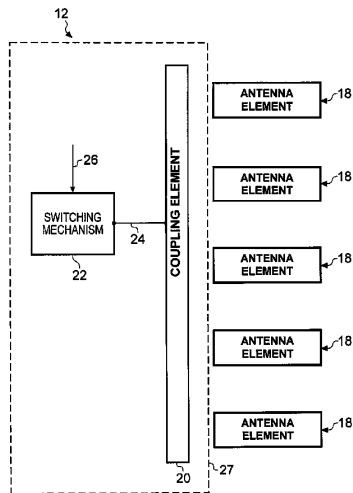
- (51) **Int. Cl.**
H01Q 1/50 (2006.01)
- (52) **U.S. Cl.** **343/852**; 343/876; 343/702; 343/893
- (58) **Field of Classification Search** 343/700 MS, 343/852, 729, 725, 771, 722, 768, 802, 778, 343/872, 749, 753, 719, 713, 703, 846, 702, 343/727, 730, 742, 795, 829, 770, 895, 844, 343/708, 715, 792.5, 754, 853, 876, 893
See application file for complete search history.

(57) **ABSTRACT**

An antenna arrangement comprises a first antenna element; a second antenna element; a coupling element for electromagnetically coupling to the first antenna element and the second antenna element; and a switching mechanism, connected to the coupling element, for switching between a first electrical configuration and a second electrical configuration. When the switching mechanism is in the first electrical configuration, the coupling element has a first impedance and when the switching mechanism is in the second electrical configuration, the coupling element has a second impedance.

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16 Claims, 7 Drawing Sheets





US008073405B2

(12) **United States Patent
Tougou**

(10) **Patent No.: US 8,073,405 B2**
(45) **Date of Patent: Dec. 6, 2011**

(54) **MIMO TRANSMITTER**

- (75) Inventor: **Hitomaro Tougou**, Yokohama (JP)
- (73) Assignee: **Panasonic Corporation**, Osaka (JP)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 176 days.

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Primary Examiner — Quochien B Vuong
(74) *Attorney, Agent, or Firm* — Seed IP Law Group PLLC

- (21) Appl. No.: **12/666,283**
- (22) PCT Filed: **Jul. 5, 2007**
- (86) PCT No.: **PCT/JP2007/063488**
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(65) **Prior Publication Data**
US 2010/0184393 A1 Jul. 22, 2010

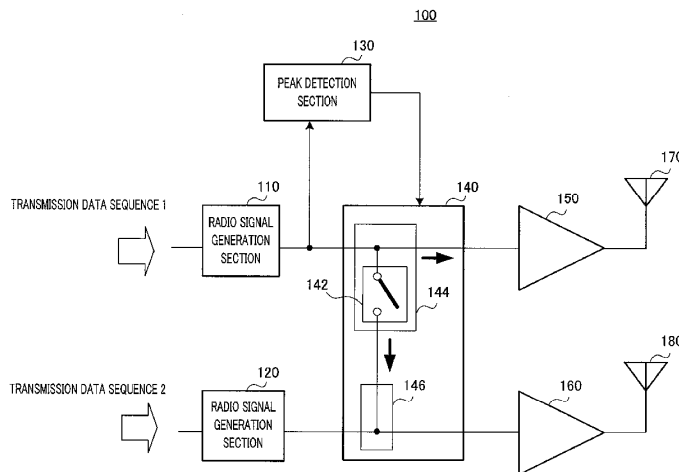
- (51) **Int. Cl.**
H04B 1/02 (2006.01)
H03C 7/02 (2006.01)
- (52) **U.S. Cl.** **455/101**; 455/115.3; 455/127.2;
375/297; 375/299
- (58) **Field of Classification Search** 455/67.11,
455/101, 115.1, 115.3, 127.1, 127.2; 375/297,
375/299
See application file for complete search history.

- (56) **References Cited**
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(57) **ABSTRACT**

A MIMO transmitter capable of highly efficient power amplification over a wide dynamic range or for a high PAPR signal. In the MIMO transmitter (100), an amplifier (150) amplifies an input signal and outputs the amplified signal to an antenna (170). An amplifier (160) amplifies an input signal and outputs the amplified signal to an antenna (180). A peak detection part (130) detects an envelope of a first transmission sequence. A branch switching part (140) switches over to input all of the first transmission sequence to the amplifier (150) or to input part of the first transmission sequence together with a second transmission sequence to the amplifier (160) based on comparison results between the envelope detection result of the first transmission sequence and a threshold value. This constitution can reduce a peak of the input signal of the amplifier, and thus the amplifier can be efficiently used. As a result, the MIMO transmitter capable of highly efficient power amplification for a high PAPR signal and the like can be realized.

4 Claims, 6 Drawing Sheets





US008073514B2

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

(10) **Patent No.:** **US 8,073,514 B2**
(45) **Date of Patent:** **Dec. 6, 2011**

- (54) **ELECTRONIC DEVICE HAVING A DUAL AUTODIPLEXING ANTENNA**
- (75) Inventors: **Greg R. Black**, Vernon Hills, IL (US);
Vijay L. Asrani, Round Lake, IL (US);
Adrian Napoles, Lake Villa, IL (US)
- (73) Assignee: **Motorola Mobility, Inc.**, Libertyville, IL (US)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 588 days.

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Primary Examiner — William D Cumming

- (21) Appl. No.: **12/144,455**
- (22) Filed: **Jun. 23, 2008**
- (65) **Prior Publication Data**
US 2008/0268926 A1 Oct. 30, 2008

Related U.S. Application Data

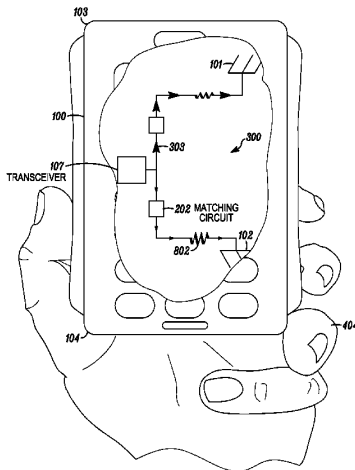
- (62) Division of application No. 11/428,027, filed on Jun. 30, 2006, now Pat. No. 7,724,194.
- (51) **Int. Cl.**
H04M 1/00 (2006.01)
- (52) **U.S. Cl.** **455/575.7; 370/297; 343/702; 343/753; 324/639; 438/29**
- (58) **Field of Classification Search** **455/575.7; 370/297; 343/702, 753; 324/639; 438/29**
See application file for complete search history.

(57) **ABSTRACT**

A dual autodiplexing antenna (300) redirects power flow (303) from an unloaded antenna to a loaded antenna, thereby improving communication performance under loaded conditions. The dual autodiplexing antenna (300) includes a first antenna (101) disposed at a first end (103) of a portable two-way communication device (100). A second antenna (102) is disposed at the distal end (104) of the portable two-way communication device (100). The first antenna (101) and second antenna (102) are coupled to a transceiver (107) by a first transmission line matching circuit (201) and a second transmission line matching circuit (202), respectively. In one embodiment, the first antenna (101) is configured to primarily operate in a first bandwidth, while the second antenna (102) is configured to primarily operate in a second bandwidth. When one of the first antenna (101) or second antenna (102) is loaded, power flow (303) is redirected to the lesser loaded antenna.

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6 Claims, 10 Drawing Sheets





US008077093B2

(12) **United States Patent**
Dean

(10) **Patent No.:** **US 8,077,093 B2**
(45) **Date of Patent:** **Dec. 13, 2011**

(54) **PATCH RADIATOR WITH CAVITY BACKED SLOT**

(75) Inventor: **Stuart J. Dean**, Kemptville (CA)

(73) Assignee: **TenXc Wireless Inc.**, Ottawa, Ontario (CA)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 513 days.

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Primary Examiner — Tho G Phan

(74) *Attorney, Agent, or Firm* — Sunstein Kann Murphy & Timbers LLP

(21) Appl. No.: **12/293,183**

(22) PCT Filed: **Mar. 9, 2007**

(86) PCT No.: **PCT/CA2007/000385**

§ 371 (c)(1),
(2), (4) Date: **Oct. 17, 2008**

(87) PCT Pub. No.: **WO2007/106975**

PCT Pub. Date: **Sep. 27, 2007**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Mar. 17, 2006 (CA) 2540219

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

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

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

(56) **References Cited**

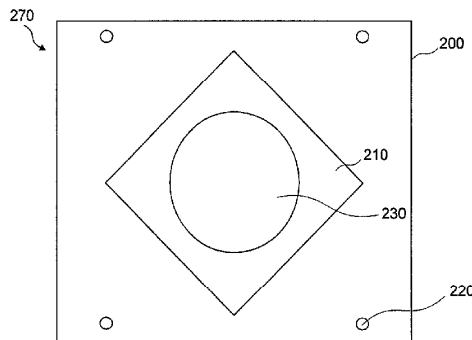
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(57) **ABSTRACT**

A patch radiator for use in beamformed or steerable antenna systems which maximizes upper frequency limit and simultaneously minimizes the lower frequency limit, by providing an annular patch configuration in which a central region of the patch element is devoid of material, whereby this central region is of a different shape from the shape of the exterior perimeter of the patch element. One possible configuration of such a patch radiator comprises a square exterior shape, enclosing a central circular region of removed material. In this manner, the upper frequency limit threshold tends to rise as the interior annular perimeter is reduced. Preferably, the exterior and interior perimeters have no interior angles of more than 180°.

25 Claims, 4 Drawing Sheets





US008077096B2

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

(10) **Patent No.:** **US 8,077,096 B2**
(45) **Date of Patent:** **Dec. 13, 2011**

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

(75) Inventors: **Bing Chiang**, Cupertino, CA (US);
Douglas Blake Kough, San Jose, CA (US);
Enrique Ayala Vazquez, Watsonville, 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 654 days.

(21) Appl. No.: **12/101,121**

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

(65) **Prior Publication Data**

US 2009/0256757 A1 Oct. 15, 2009

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

(52) **U.S. Cl.** **343/702; 343/767; 343/846**

(58) **Field of Classification Search** 343/702,
343/767, 700 MS, 770, 829, 846
See application file for complete search history.

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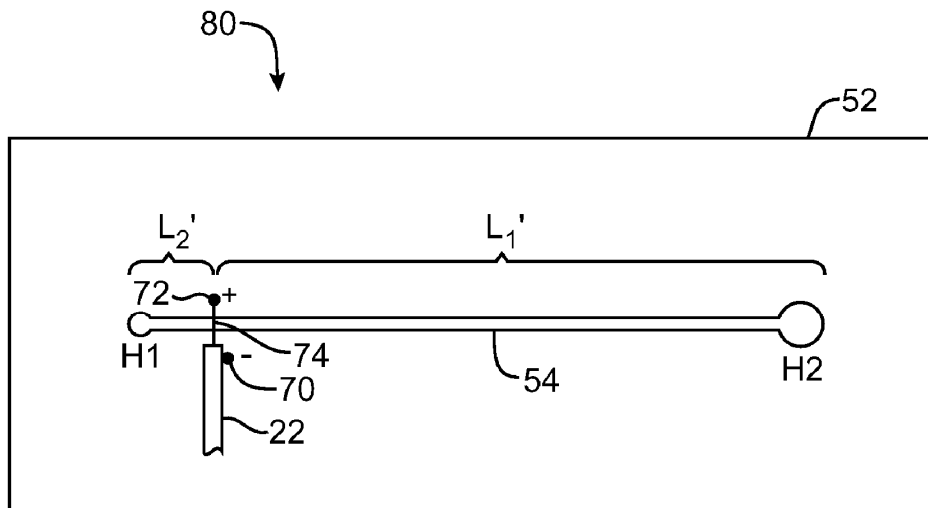
Primary Examiner — Tho G Phan

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

(57) **ABSTRACT**

Slot antennas are provided for electronic devices such as portable electronic devices. The slot antennas may have a dielectric-filled slot that is formed in a ground plane element. The ground plane element may be formed from part of a conductive device housing. The slot may have one or more holes at its ends. The holes may affect the impedance characteristics of the slot antennas so that the length of the slot antennas may be reduced. For example, the holes can be used to synthesize the impedance of the slot antennas so that the slot antennas have a resonant frequency that is different from their natural resonant frequency. The holes may affect the impedance of the slot antennas in multiple radio-frequency bands.

18 Claims, 10 Drawing Sheets





US008077097B2

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

(10) **Patent No.:** **US 8,077,097 B2**
(45) **Date of Patent:** **Dec. 13, 2011**

(54) **DUAL-BAND ANTENNA AND ELECTRONIC DEVICE EMPLOYING THE SAME**

(75) Inventors: **Cho-Ju Chung**, Taipei Hsien (TW);
Teng-Huei Chu, Taipei Hsien (TW)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 430 days.

(21) Appl. No.: **12/471,392**

(22) Filed: **May 24, 2009**

(65) **Prior Publication Data**
US 2010/0265142 A1 Oct. 21, 2010

(30) **Foreign Application Priority Data**
Apr. 16, 2009 (CN) 2009 2 0302267 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, 866, 748, 895
See application file for complete search history.

(56) **References Cited**
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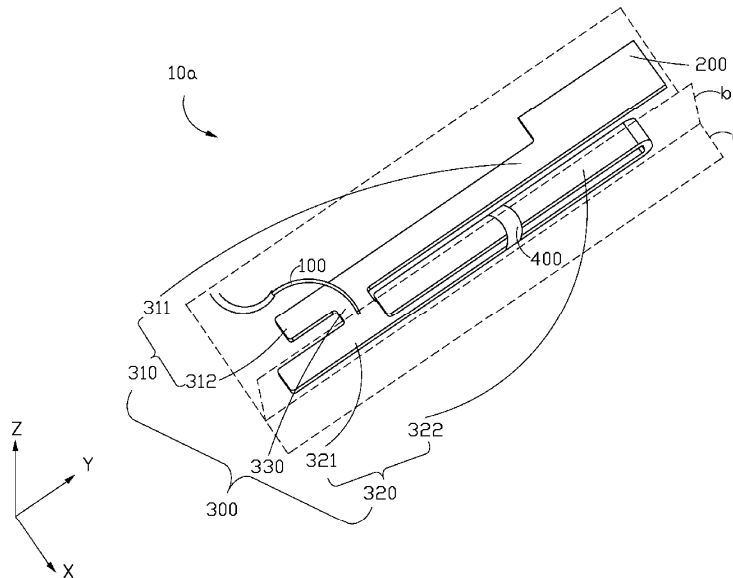
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Primary Examiner — Huedung Mancuso
(74) *Attorney, Agent, or Firm* — Altis Law Group, Inc.

(57) **ABSTRACT**

A dual-band antenna includes a feed portion, a ground portion, a radiating portion and a fine-tuning portion. The feed portion is operable to feed electromagnetic signals. The radiating portion includes a first radiator, a second radiator and a connecting portion. The first radiator is elongated and has a first end electrically connected to the ground portion, and a second end of the first radiator is floating. The second radiator is U shaped, with two open ends floating. The connecting portion is connected to the first radiator, the second radiator and the feed portion. The feed portion feeds electromagnetic signal to the first radiator and the second radiator via the connecting portion. The fine-tuning portion is arranged around the second radiator, operable to control operating frequency bands of the second radiator.

14 Claims, 6 Drawing Sheets





US008077105B2

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

(10) **Patent No.:** **US 8,077,105 B2**
(45) **Date of Patent:** **Dec. 13, 2011**

(54) **DIRECTIVE BAR-TYPE ANTENNA**

FOREIGN PATENT DOCUMENTS

(75) Inventors: **Masayuki Takahashi**, Tsurugashima (JP); **Shuichi Ogata**, Tsurugashima (JP); **Masanori Eiri**, Tsurugashima (JP); **Kinya Kishita**, Tsurugashima (JP); **Satoru Kimura**, Tsurugashima (JP)

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Primary Examiner — Hoang V Nguyen

(74) *Attorney, Agent, or Firm* — Cozen O'Connor

(73) Assignee: **Toko Inc.**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 316 days.

(57) **ABSTRACT**

Disclosed is a directional bar-type antenna which comprising a plurality of bar-shaped antenna elements including a core and a coil wound around the core. The first bar-shaped antenna element is disposed at a position of a mirror image of the second bar-shaped antenna element with respect to the core of the third bar-shaped antenna element. The first and second bar-shaped antenna elements is positioned such that one end of each of the first and second bar-shaped antenna elements is close to the third bar-shaped antenna element, and the other end is far from the third bar-shaped antenna element. In the present invention, a winding direction of the coil of the first bar-shaped antenna element is preferably identical to that of the coil of the second bar-shaped antenna element, and is opposite to that of the coil of the third bar-shaped antenna element. The directional bar-type antenna of present invention can meet a need for providing asymmetrical directionality in a forward-rearward direction of an antenna for use in a specific system, such as a keyless entry system, and solve a problem in terms of cost and external appearance, in a technique of partially surrounding a bar-type antenna by a shielding member, in view of difficulty in freely controlling directionality of an antenna in an induced electromagnetic field domain, and a need to allow the bar-type antenna to have a difference between respective receiving sensitivities in forward and rearward directions in the induced electromagnetic field domain (while facilitating a reduction in size and cost).

(21) Appl. No.: **12/418,265**

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

(65) **Prior Publication Data**

US 2009/0251376 A1 Oct. 8, 2009

(30) **Foreign Application Priority Data**

Apr. 4, 2008 (JP) 2008-097872
Apr. 25, 2008 (JP) 2008-114981

(51) **Int. Cl.**
H01Q 7/08 (2006.01)

(52) **U.S. Cl.** **343/788**; 343/787

(58) **Field of Classification Search** 343/787,
343/788

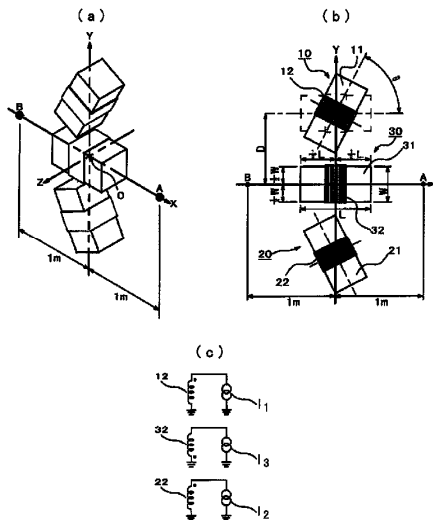
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4 Claims, 14 Drawing Sheets





US008077107B2

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

(10) **Patent No.:** **US 8,077,107 B2**
(45) **Date of Patent:** **Dec. 13, 2011**

- (54) **ANTENNA APPARATUS**
- (75) Inventors: **Makoto Higaki**, Kawasaki (JP); **Kazuhiro Inoue**, Inagi (JP); **Yukako Tsutsumi**, Yokohama (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 264 days.
- (21) Appl. No.: **12/184,735**
- (22) Filed: **Aug. 1, 2008**
- (65) **Prior Publication Data**
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- (30) **Foreign Application Priority Data**
Sep. 21, 2007 (JP) 2007-245337
- (51) **Int. Cl.**
H01Q 9/28 (2006.01)
- (52) **U.S. Cl.** **343/795**; 343/700 MS
- (58) **Field of Classification Search** 343/793, 343/700 MS, 834, 835, 836, 837, 838, 702, 343/795
See application file for complete search history.
- (56) **References Cited**

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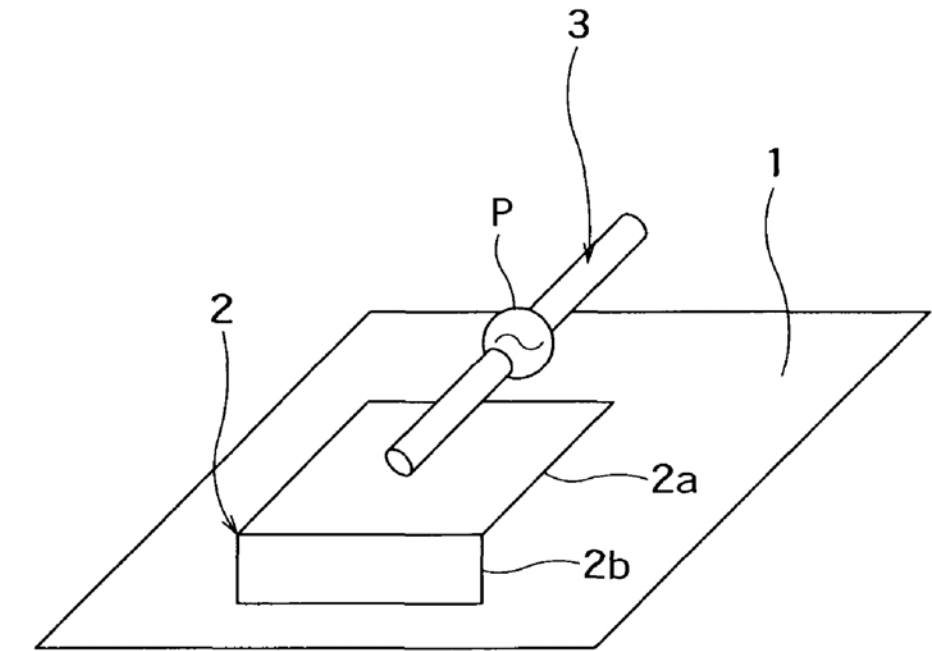
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Primary Examiner — Dieu H. Duong
(74) *Attorney, Agent, or Firm* — Oblon, Spivak, McClelland, Maier & Neustadt, L.L.P.

(57) **ABSTRACT**

There is provided an antenna apparatus including: a finite ground plane; a plate-like conductive element configured to include a first conductive plate disposed so as to oppose the finite ground plane and a second conductive plate that shorts a first edge of the first conductive plate to the finite ground plane; and an antenna configured to include an antenna element and a feeding point feeding power to the antenna element, which is positioned in the vicinity of a second edge in a side opposite to the first edge of the first conductive plate.

15 Claims, 9 Drawing Sheets





US008077110B2

(12) **United States Patent**
Soler Castany et al.

(10) **Patent No.:** **US 8,077,110 B2**
(45) **Date of Patent:** **Dec. 13, 2011**

(54) **ANTENNA STRUCTURE FOR A WIRELESS DEVICE WITH A GROUND PLANE SHAPED AS A LOOP**

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(75) Inventors: **Jordi Soler Castany**, Barcelona (ES);
Carles Puente Baliarda, Barcelona (ES)

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

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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.: **12/834,177**

Bhavsar, Samir A.: Letter: *Fractus v. Samsung et al.*, Case No. 6:09-cv-00203-LED: Disclosure of Material Information to the USPTO; Oct. 28, 2009.

(22) Filed: **Jul. 12, 2010**

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(65) **Prior Publication Data**

US 2010/0302122 A1 Dec. 2, 2010

Wimer, Michael C.; USPTO Office Actions for U.S. Appl. No. 10/422,578; Oct. 4, 2004, Apr. 7, 2005, Aug. 24, 2005, Jan. 26, 2006, Mar. 12, 2007, Aug. 23, 2007 and Mar. 26, 2008.

Related U.S. Application Data

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(63) Continuation of application No. 11/719,151, filed as application No. PCT/EP2005/055959 on Nov. 14, 2005, now Pat. No. 7,782,269.

Primary Examiner — Tan Ho

(60) Provisional application No. 60/627,653, filed on Nov. 12, 2004.

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

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

(57) **ABSTRACT**

(52) **U.S. Cl.** **343/846; 343/702; 343/718**

This invention refers to an antenna structure for a wireless device comprising a ground plane and an antenna element, wherein the ground plane has the shape of an open loop. The invention further refers to an antenna structure for a wireless device, such as a light switch or a wristsensor or wristwatch, comprising an open loop ground plane having a first end portion and a second end portion, the open loop ground plane defining an opening between the first end portion and the second end portion; and an antenna component positioned within the opening defined between the first end portion and the second end portion and overlapping at least one of the first end portion or the second end portion. Further the invention refers to a corresponding wireless device and to a method for integrating such an antenna structure in a wireless device.

(58) **Field of Classification Search** **343/846, 343/848, 702, 700 MS, 718**

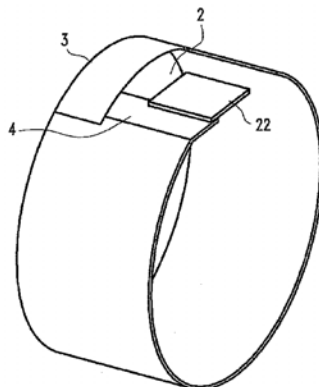
See application file for complete search history.

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42 Claims, 21 Drawing Sheets





US008077116B2

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

(10) **Patent No.:** **US 8,077,116 B2**
(45) **Date of Patent:** **Dec. 13, 2011**

(54) **ANTENNA WITH ACTIVE ELEMENTS**

(75) Inventors: **Jeffrey Shamblin**, San Marcos, CA (US); **Chulmin Han**, San Diego, CA (US); **Rowland Jones**, Carlsbad, CA (US); **Sebastian Rowson**, San Diego, CA (US); **Laurent Desclos**, San Diego, CA (US)

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

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

(21) Appl. No.: **12/894,052**

(22) Filed: **Sep. 29, 2010**

(65) **Prior Publication Data**
US 2011/0012800 A1 Jan. 20, 2011

Related U.S. Application Data
(63) Continuation of application No. 11/841,207, filed on Aug. 20, 2007, now Pat. No. 7,830,320.

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

(52) **U.S. Cl.** **343/895; 343/700 MS**
(58) **Field of Classification Search** **343/895, 343/700 MS, 702, 747, 745, 749**
See application file for complete search history.

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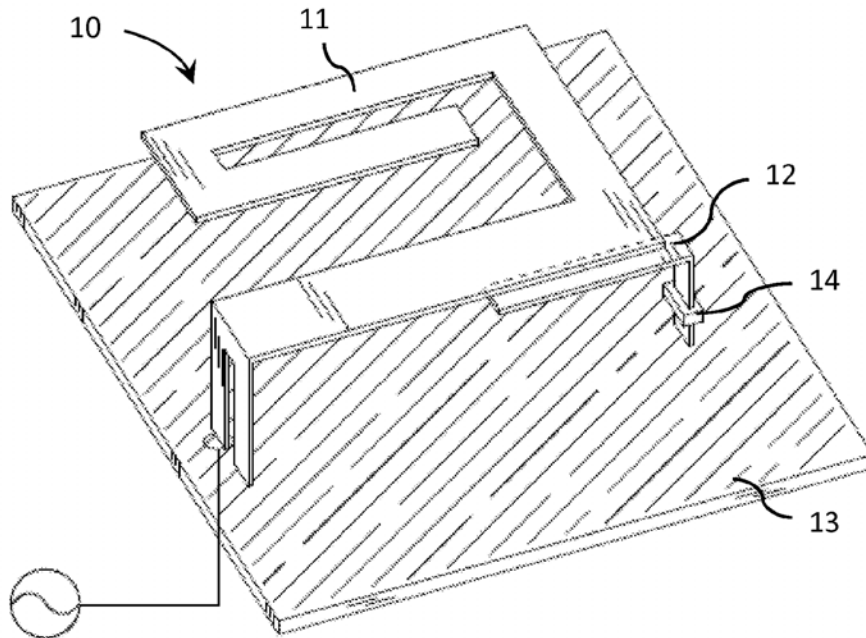
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Primary Examiner — Hoanganh Le
(74) *Attorney, Agent, or Firm* — Coastal Patent Agency

(57) **ABSTRACT**

A multi-frequency antenna comprising an IMD element, one or more active tuning elements and one or more parasitic elements. The IMD element is used in combination with the active tuning and parasitic elements for enabling a variable frequency at which the antenna operates, wherein, when excited, the parasitic elements may couple with the IMD element to change an operating characteristic of the IMD element.

18 Claims, 10 Drawing Sheets





US008081116B2

(12) **United States Patent**
Yoshioka

(10) **Patent No.:** **US 8,081,116 B2**
(45) **Date of Patent:** **Dec. 20, 2011**

(54) **BROADBAND ANTENNA UNIT COMPRISING A FOLDED PLATE-SHAPED MONOPOLE ANTENNA PORTION AND AN EXTENDING PORTION**

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2008/0036666	A1*	2/2008	Shih	343/702

(75) Inventor: **Hiroki Yoshioka**, Tokyo (JP)

(73) Assignee: **Mitsumi Electric Co., Ltd.**, Tama-shi (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 835 days.

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(21) Appl. No.: **12/069,332**

(Continued)

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

(65) **Prior Publication Data**

US 2008/0198075 A1 Aug. 21, 2008

Primary Examiner — Douglas W. Owens

Assistant Examiner — Dieu H Duong

(74) *Attorney, Agent, or Firm* — Holtz, Holtz, Goodman & Chick PC

(30) **Foreign Application Priority Data**

Feb. 20, 2007	(JP)	2007-038737
Jul. 31, 2007	(JP)	2007-200132

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

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

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

See application file for complete search history.

(57) **ABSTRACT**

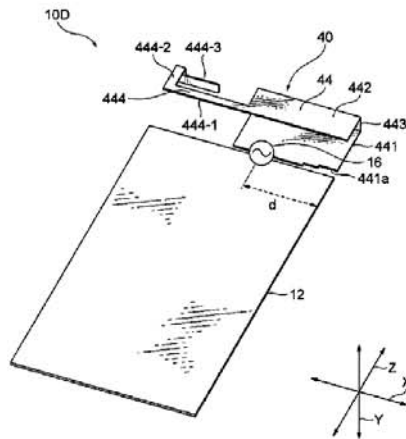
In a broadband antenna unit including a ground plate, an antenna element disposed in the vicinity of an end of the ground plate, and a dielectric substrate for mounting the antenna element therein, the antenna element includes a folded plate-shaped monopole antenna portion having a U-shape in cross section and an extending portion extending from the folded plate-shaped monopole antenna portion. The antenna element is disposed on the side of one side edge of the ground plate. The broadband antenna unit has a feeding point between the ground plate and the antenna element that is disposed at a feeding position apart from the one side by a predetermined distance. A ratio between a width of the ground plate and the predetermined distance is substantially 5:2 when a ratio between the width of the ground plate and a width of the folded plate-shaped monopole antenna portion is 2:1.

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9 Claims, 24 Drawing Sheets





US008081120B2

(12) **United States Patent**
Yoshioka

(10) **Patent No.:** **US 8,081,120 B2**
(45) **Date of Patent:** **Dec. 20, 2011**

(54) **BROADBAND ANTENNA UNIT COMPRISING A FOLDED PLATE-SHAPED MONOPOLE ANTENNA PORTION AND TWO CONDUCTIVE ELEMENTS**

2006/0139214	A1 *	6/2006	Deng et al.	343/700 MS
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(75) Inventor: **Hiroki Yoshioka**, Tokyo (JP)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 465 days.

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(21) Appl. No.: **12/236,659**

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

Extended European Search Report dated Jan. 12, 2009 issued in counterpart European Appl. No. 08164806.5.

(65) **Prior Publication Data**

US 2009/0079638 A1 Mar. 26, 2009

(Continued)

(30) **Foreign Application Priority Data**

Sep. 26, 2007 (JP) 2007-248328

Primary Examiner — Dieu H Duong

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

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

ABSTRACT

(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.

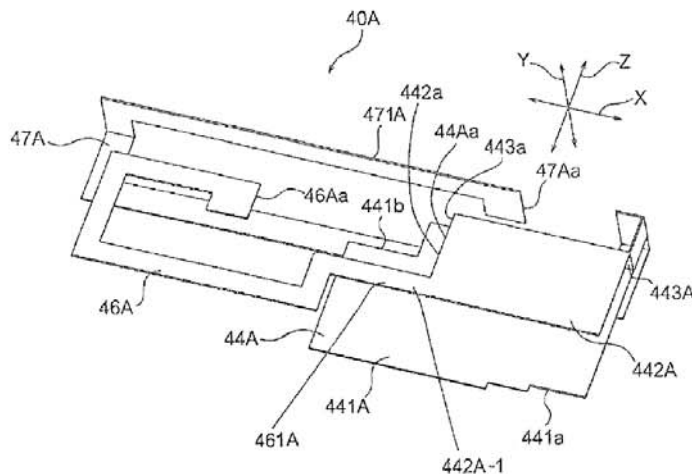
In a broadband antenna unit including a ground plate, an antenna element disposed in the vicinity of an end of the ground plate, and a dielectric substrate for mounting the antenna element therein, the antenna element includes a folded plate-shaped monopole antenna portion having a U-shape in cross section, a first conductive element extending from a first location of the folded plate-shaped monopole antenna portion, and a second conductive element extending from a second location of the folded plate-shaped monopole antenna portion. The antenna element is disposed on the side of one side edge of the ground plate. The broadband antenna unit has a feeding point between the ground plate and the antenna element that is disposed at a feeding position apart from the one side by a predetermined distance.

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10 Claims, 10 Drawing Sheets





US008081122B2

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

(10) **Patent No.:** **US 8,081,122 B2**
(45) **Date of Patent:** **Dec. 20, 2011**

(54) **FOLDED SLOTTED MONOPOLE ANTENNA**

(56) **References Cited**

(75) Inventors: **David Kearney**, Dublin (IE); **Joseph Modro**, Dublin (IE)

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(73) Assignee: **TDK 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 262 days.

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Primary Examiner — Dieu H Duong
(74) *Attorney, Agent, or Firm* — Oliff & Berridge, PLC

(21) Appl. No.: **12/457,434**

(57) **ABSTRACT**

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

A slotted monopole wideband antenna, comprising an insulating rectangular chip mounted on a carrier substrate, said carrier substrate including a feeding structure, and said chip comprising a first side adjacent to said feeding structure, a feed point of the antenna is located near said first side. An electrically conducting lamina is folded over four faces of said insulating chip, said lamina being connected to the feed point at one end, and to ground at another end. At least two slots are formed in an upper section of said folded lamina, said slots having the effect of lowering the principal resonance of said antenna, thereby providing a miniaturized antenna suitable for integration in a mobile wireless communications handset.

(65) **Prior Publication Data**
US 2010/0315303 A1 Dec. 16, 2010

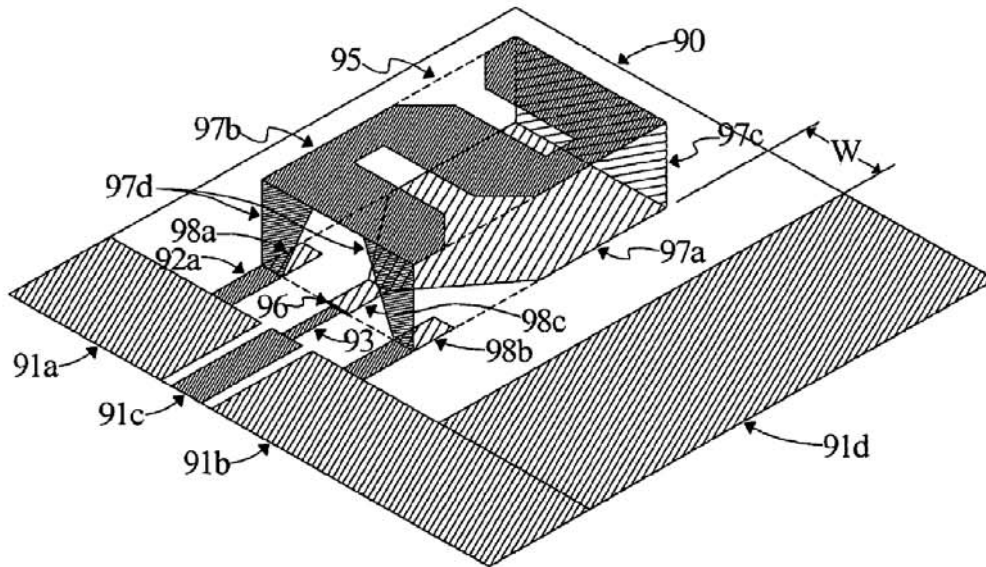
(51) **Int. Cl.**
H01Q 9/04 (2006.01)

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

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

See application file for complete search history.

19 Claims, 12 Drawing Sheets





US008081123B2

(12) **United States Patent**
Yang

(10) **Patent No.:** **US 8,081,123 B2**
(45) **Date of Patent:** **Dec. 20, 2011**

(54) **COMPACT MULTI-ELEMENT ANTENNA WITH PHASE SHIFT**

(75) Inventor: **Xiao Ping Yang**, San Diego, CA (US)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 399 days.

(21) Appl. No.: **11/866,354**

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

(65) **Prior Publication Data**

US 2008/0079640 A1 Apr. 3, 2008

Related U.S. Application Data

(60) Provisional application No. 60/827,846, filed on Oct. 2, 2006.

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

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

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

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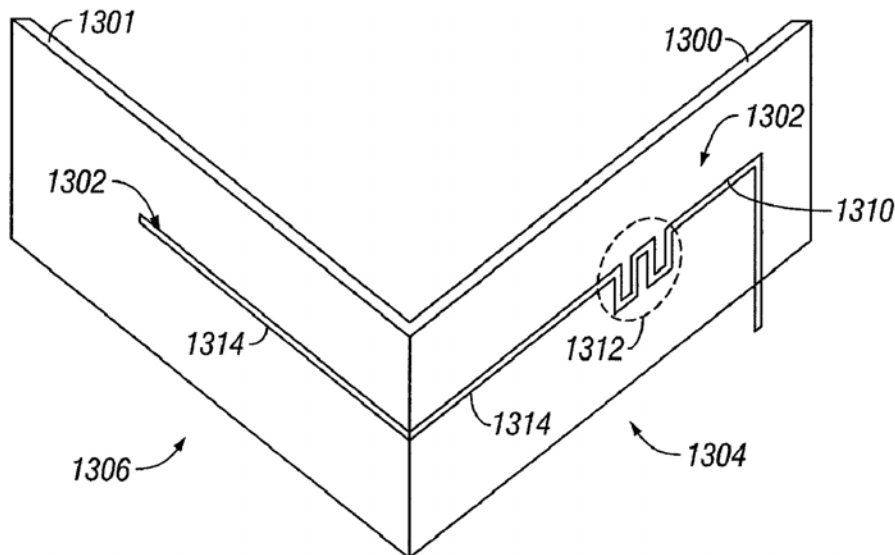
Primary Examiner — Hoanganh Le

(74) *Attorney, Agent, or Firm* — Clause Eight IPS; Michael Catania

(57) **ABSTRACT**

A phased array antenna system includes a first radiation element that is made of a material and has a length selected to resonate at a desired frequency. A phase-shift element is coupled to one end of the first radiation element. A second radiation element is coupled to the end of the phase-shift element opposite the first radiation element, so that a radio signal passes through the first radiation element through the phase-shift element and through the second radiation element, the second radiation element is made of a material and has a length selected to resonate such that the first and second radiation elements cooperate to form a desired beam pattern from the antenna system.

1 Claim, 10 Drawing Sheets





US008081127B2

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

(10) **Patent No.:** **US 8,081,127 B2**
(45) **Date of Patent:** **Dec. 20, 2011**

(54) **ELECTRONIC DEVICE, ANTENNA THEREOF, AND METHOD OF FORMING THE ANTENNA**

(75) Inventors: **Yin-Yu Chen**, Taipei (TW); **Chen-Yu Chou**, Taipei (TW); **Ming-Feng Tsai**, Taipei (TW); **Chih-Wei Lee**, Taipei (TW)

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

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

(21) Appl. No.: **12/405,927**

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

(65) **Prior Publication Data**
US 2009/0315793 A1 Dec. 24, 2009

(30) **Foreign Application Priority Data**
Jun. 20, 2008 (TW) 97123141 A

(51) **Int. Cl.**
H01Q 9/06 (2006.01)
H01Q 1/22 (2006.01)

(52) **U.S. Cl.** **343/745**; 343/702; 343/749; 343/829; 343/846; 343/850

(58) **Field of Classification Search** 343/700 MS, 343/702, 749, 829, 830, 846, 745
See application file for complete search history.

(56) **References Cited**

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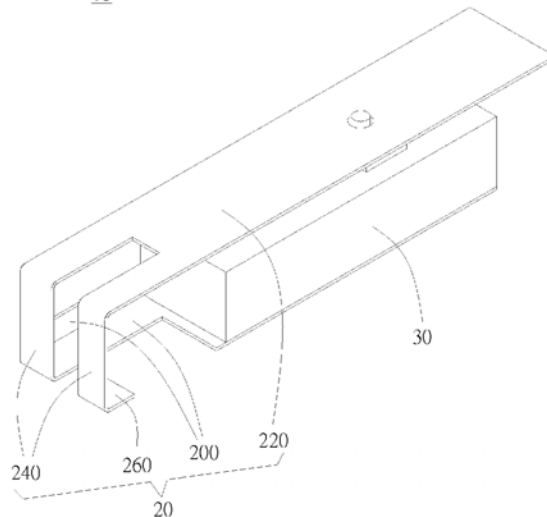
Primary Examiner — Douglas W Owens
Assistant Examiner — Chuc Tran

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

(57) **ABSTRACT**

The antenna of the invention includes a transceiver unit and a dielectric unit. The transceiver unit has a ground portion, a radial portion, a conductive portion and a feed portion. The ground portion and the radial portion are disposed apart in parallel, so as to form a space therebetween. The distance between the ground portion and the radial portion is defined as a transceiver unit height. The dielectric unit is disposed in the space. That is, the dielectric unit is disposed between the ground portion and the radial portion. The dielectric unit has a dielectric unit thickness less than the transceiver unit height. In one embodiment, the ratio of the dielectric unit thickness to the transceiver unit height is preferably between 0.4 and 0.7.

18 Claims, 6 Drawing Sheets





US008081128B2

(12) **United States Patent**
Ueki

(10) **Patent No.:** **US 8,081,128 B2**
(45) **Date of Patent:** **Dec. 20, 2011**

- (54) **ANTENNA DEVICE AND WIRELESS COMMUNICATION APPARATUS**
- (75) Inventor: **Noriyuki Ueki, Machida (JP)**
- (73) Assignee: **Murata Manufacturing Co., Ltd., Kyoto (JP)**
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 256 days.

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Primary Examiner — Huedung Mancuso

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

- (21) Appl. No.: **12/614,494**
- (22) Filed: **Nov. 9, 2009**
- (65) **Prior Publication Data**
US 2010/0045552 A1 Feb. 25, 2010

Related U.S. Application Data

- (63) Continuation of application No. PCT/JP2008/054732, filed on Mar. 14, 2008.

Foreign Application Priority Data

May 17, 2007 (JP) 2007-131289

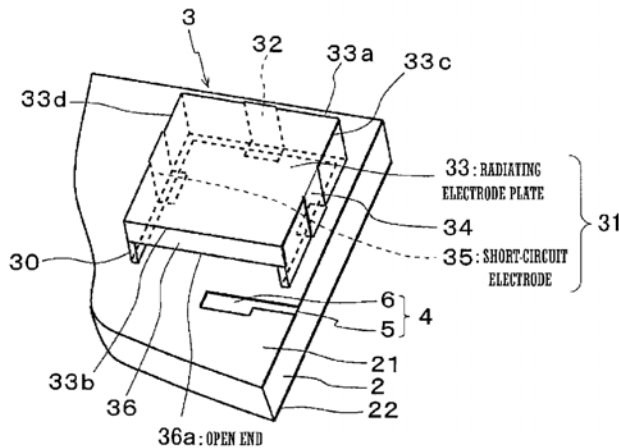
- (51) **Int. Cl.**
H01Q 9/00 (2006.01)
- (52) **U.S. Cl.** **343/745**
- (58) **Field of Classification Search** 343/745,
343/702, 700 MS, 893, 767, 768-770
See application file for complete search history.

- (56) **References Cited**
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et al. 343/700 MS
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(57) **ABSTRACT**

A multi-resonant antenna device having good VSWR characteristics even in the UWB band, and a wireless communication apparatus including the antenna device are provided. The antenna device includes a substrate, an antenna main body surface-mounted at a corner of the substrate, and slits. The antenna device resonates at two different resonance frequencies. The slits are arranged to bring a VSWR value at a frequency between the two resonance frequencies closer to VSWR values at the two resonance frequencies. The slits include capacitive adjustment slit portions and inductive adjustment slit portions. The slits are provided in an area where the density of a current flowing on ground conductor surfaces is highest. The slits are arranged perpendicularly or substantially perpendicularly to a direction of this current. Specifically, the slits are provided near and parallel or substantially parallel to an open end of the radiating electrode portion. The lengths of the slits are set to one-eighth of a wavelength at a frequency corresponding to the highest VSWR value in the range between the two resonance frequencies.

10 Claims, 17 Drawing Sheets





US008081136B2

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

(10) **Patent No.:** **US 8,081,136 B2**
(45) **Date of Patent:** **Dec. 20, 2011**

- (54) **DUAL-BAND ANTENNA**
- (75) Inventors: **Huang Chih Yung**, Dongshih Township, Taichung County (TW); **Luo Guo Chang**, Toufen Township, Miaoli 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 492 days.

- (21) Appl. No.: **12/317,545**
- (22) Filed: **Dec. 24, 2008**
- (65) **Prior Publication Data**
US 2010/0156746 A1 Jun. 24, 2010

- (30) **Foreign Application Priority Data**
Sep. 9, 2008 (TW) 97134611 A

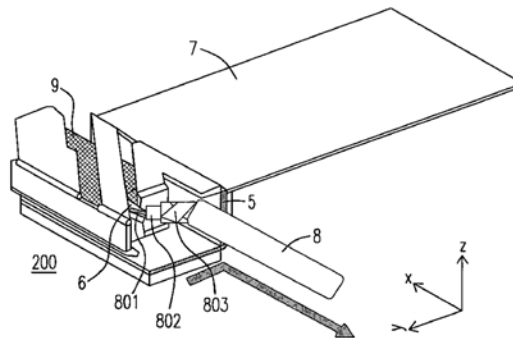
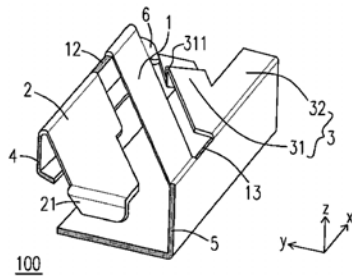
- (51) **Int. Cl.**
H01Q 1/50 (2006.01)
- (52) **U.S. Cl.** 343/860; 343/702; 343/914; 343/895
- (58) **Field of Classification Search** 343/700 MS, 343/702, 895, 746, 914, 860
See application file for complete search history.

- (56) **References Cited**
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Primary Examiner — Jacob Y Choi
Assistant Examiner — Shawn Buchanan
(74) *Attorney, Agent, or Firm* — Haverstock & Owens LLP

(57) **ABSTRACT**
The dual-band antenna is provided. The dual-band antenna includes an impedance matching control element, a first connection part, a first radiation element, a second radiation element, and a ground element. The first radiation element operates in a first frequency band, is connected to the impedance matching control element, and extends along a first direction having an obtuse angle with respect to a longitudinal direction of the first connection part. The second radiation element operates in a second frequency band. The ground element is electrically connected to the impedance matching control element and the second radiation element.

19 Claims, 12 Drawing Sheets





US008085202B2

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

(10) **Patent No.:** **US 8,085,202 B2**
(45) **Date of Patent:** **Dec. 27, 2011**

(54) **WIDEBAND, HIGH ISOLATION TWO PORT ANTENNA ARRAY FOR MULTIPLE INPUT, MULTIPLE OUTPUT HANDHELD DEVICES**

(75) Inventors: **Mina Ayatollahi**, Waterloo (CA); **Qinjian Rao**, Waterloo (CA); **Dong Wang**, 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 402 days.

(21) Appl. No.: **12/405,955**

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

(65) **Prior Publication Data**

US 2010/0238072 A1 Sep. 23, 2010

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

(52) **U.S. Cl.** **343/700 MS**; 343/702; 343/846; 343/909

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

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Primary Examiner — Douglas W Owens

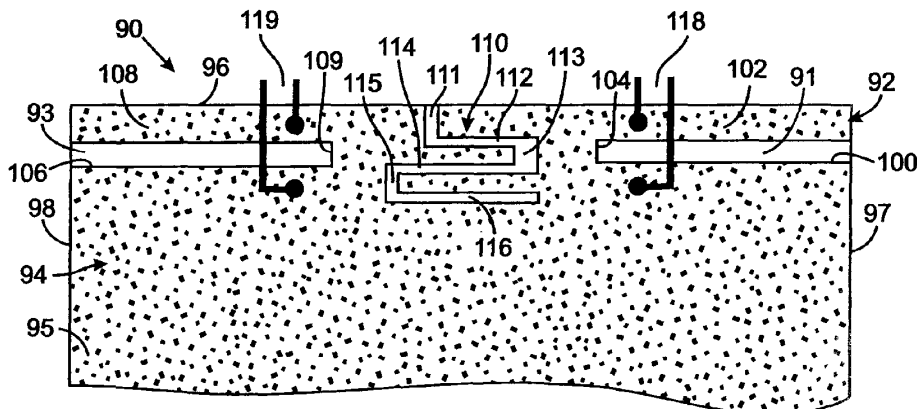
Assistant Examiner — Chuc Tran

(74) *Attorney, Agent, or Firm* — Hamilton & Terrile, LLP; Gary W. Hamilton

(57) **ABSTRACT**

A multiple input-multiple output antenna assembly with high isolation between the antennas is disclosed. The antenna assembly includes a substrate with a ground layer at its surface. Two antennas are disposed opposing each other on the substrate. An isolation element in a form of a patterned slot is interposed between the first and second antennas on the ground plane. A first signal port is provided for applying a first signal to excite the first antenna and a second signal port is provided for applying a second signal to excite the second antenna. The isolation element provides isolation that inhibits electromagnetic propagation between the two antennas.

4 Claims, 4 Drawing Sheets





US008085203B1

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

(10) **Patent No.:** **US 8,085,203 B1**
(45) **Date of Patent:** **Dec. 27, 2011**

(54) **GROUND SURROUNDED NON-RESONANT
SLOT-LIKE PATCH ANTENNA**

(75) Inventors: **Joseph Klein**, Chatsworth, CA (US);
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(US)

(73) Assignee: **Aero Antenna Inc.**

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 401 days.

(21) Appl. No.: **12/426,032**

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

Related U.S. Application Data

(60) Provisional application No. 61/046,027, filed on Apr.
18, 2008.

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

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

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

(56) **References Cited**

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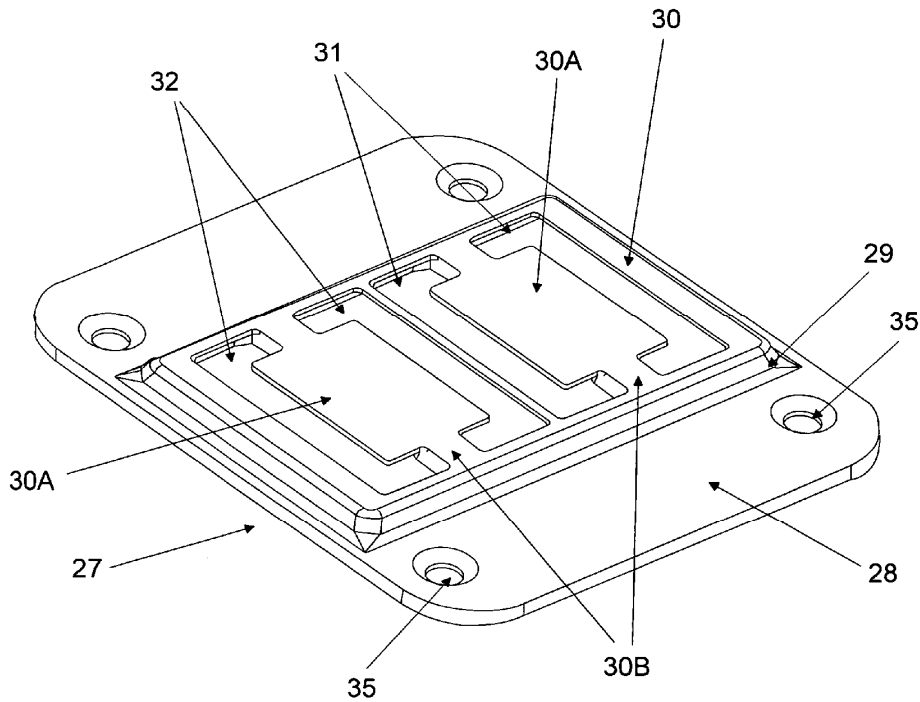
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Primary Examiner — Hoang V Nguyen

(57) **ABSTRACT**

The present invention is a single or multiple non-resonant slot antenna where said slots are formed from a continuous upward extension of the conducting ground plane with lateral horizontal planar extensions to form a top plane defining said slots.

11 Claims, 6 Drawing Sheets





US008085204B2

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

(10) **Patent No.:** **US 8,085,204 B2**
(45) **Date of Patent:** **Dec. 27, 2011**

(54) **ULTRA-WIDEBAND ANTENNA**

(56) **References Cited**

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

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(73) Assignee: **Cheng Uei Precision Industry Co., Ltd.**, New Taipei (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 381 days.

Primary Examiner — Douglas W Owens

Assistant Examiner — Dieu H. Duong

(21) Appl. No.: **12/509,442**

(57) **ABSTRACT**

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

An ultra-wideband has an elongated grounding plate disposed horizontally with a long front edge defined thereon. A connecting portion extends upwards from an end of the front edge. A first antenna radiator includes a first radiating strip extended from a side of the connecting portion and a second radiating strip connecting with a free end of the first radiating strip. A third antenna radiator includes a third radiating strip suspended over the grounding plate, a fourth radiating strip connecting with an end of a long front edge of the third radiating strip and an upper side of the second radiating strip, a fifth radiating strip extended downwards from the long front edge of the third radiating strip connecting with the connecting portion. A third antenna radiator extends downwards from a middle of the long front edge of the third radiating strip. A feeding point disposes on the second radiating strip.

(65) **Prior Publication Data**

US 2011/0018781 A1 Jan. 27, 2011

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

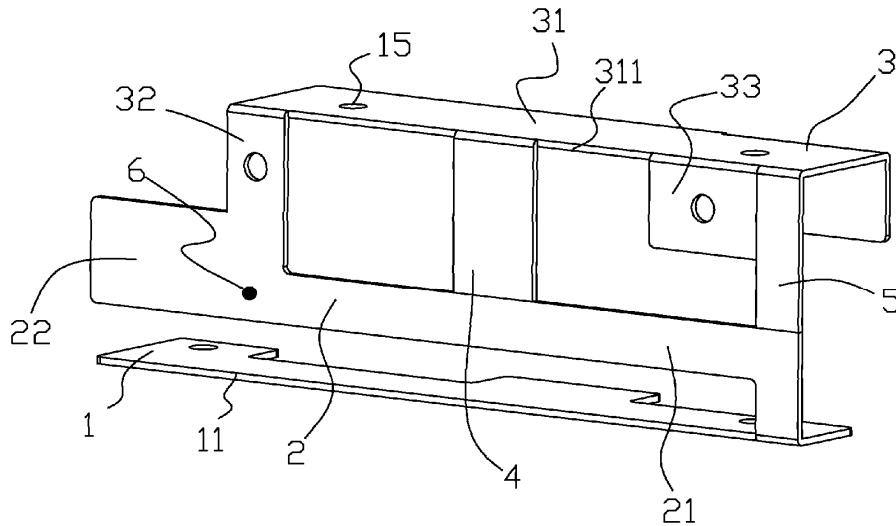
(52) **U.S. Cl.** **343/700 MS; 343/702**

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

See application file for complete search history.

3 Claims, 3 Drawing Sheets

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US008085205B2

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

(10) **Patent No.:** **US 8,085,205 B2**
(45) **Date of Patent:** **Dec. 27, 2011**

(54) **ANTENNA MODULE AND AN ELECTRONIC DEVICE HAVING THE ANTENNA MODULE**

(75) Inventors: **Yin-Yu Chen**, Taipei Hsien (TW);
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(73) Assignee: **Wistron Corporation**, 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 317 days.

(21) Appl. No.: **12/453,013**

(22) Filed: **Apr. 28, 2009**

(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
Jul. 29, 2008 (TW) 97128652 A

(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
See application file for complete search history.

(56) **References Cited**

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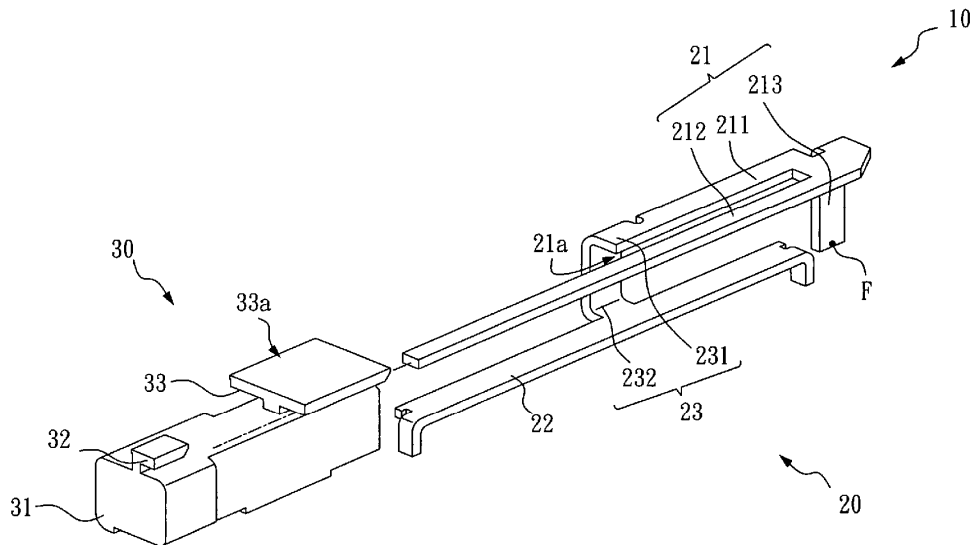
Primary Examiner — Dieu H Duong

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

(57) **ABSTRACT**

An antenna module for wireless signal transmission of an electronic device is disclosed. The antenna module comprises an antenna body and a fixing part. The antenna body comprises a radiating element, a grounding element, a connecting element, and a feeding point. The radiating element has a first radiating area and a second radiating area. The connecting element has a first end and a second end. The first end is connected with the first radiating area of the radiating element and the second end is connected with the grounding element. The feeding point is disposed on the radiating element and is used to feed a signal. The fixing part comprises a main body and a first clip portion. The main body is used to match the shape of the antenna body. The first clip portion is used to clip and fix the antenna body.

10 Claims, 6 Drawing Sheets





US008086182B2

(12) **United States Patent**
Rofougaran

(10) **Patent No.:** **US 8,086,182 B2**
(45) **Date of Patent:** **Dec. 27, 2011**

(54) **PROGRAMMABLE ANTENNA WITH PROGRAMMABLE IMPEDANCE MATCHING AND METHODS FOR USE THEREWITH**

(75) Inventor: **Ahmadreza (Reza) Rofougaran,**
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(73) Assignee: **Broadcom Corporation,** Irvine, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 339 days.

(21) Appl. No.: **12/468,282**

(22) Filed: **May 19, 2009**

(65) **Prior Publication Data**
US 2010/0297962 A1 Nov. 25, 2010

(51) **Int. Cl.**
H04B 1/00 (2006.01)

(52) **U.S. Cl.** **455/63.4**

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

(56) **References Cited**

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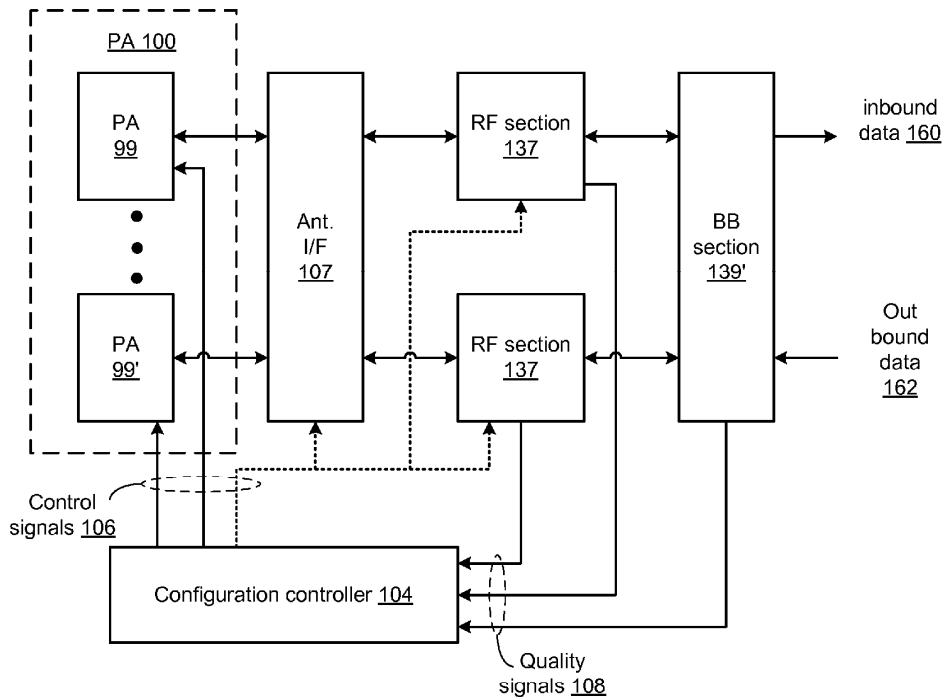
Primary Examiner — Lincoln Donovan
Assistant Examiner — Sijin Chen

(74) *Attorney, Agent, or Firm* — Garlick, Harrison & Markison; Bruce E. Stuckman

(57) **ABSTRACT**

A wireless transceiver includes a programmable antenna, that is configurable to a selected one of a plurality of antenna configurations, based on a control signal. An antenna interface is coupled to the programmable antenna. An RF transceiver section can include at least one power amplifier having an output section that includes a first plurality of tunable inductors that impedance match the output section to the antenna interface. The RF transceiver section can further include at least one low noise amplifier having an input section that includes a first plurality of tunable inductors that impedance match the input section to the antenna interface.

14 Claims, 14 Drawing Sheets



Transceiver 125



US008086190B2

(12) **United States Patent**
Rofougaran

(10) **Patent No.:** **US 8,086,190 B2**
(45) **Date of Patent:** **Dec. 27, 2011**

(54) **METHOD AND SYSTEM FOR RECONFIGURABLE DEVICES FOR MULTI-FREQUENCY COEXISTENCE**

(75) Inventor: **Ahmadreza Rofougaran**, Newport Coast, CA (US)

(73) Assignee: **Broadcom Corporation**, Irvine, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 639 days.

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(21) Appl. No.: **12/056,475**

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(22) Filed: **Mar. 27, 2008**

EP 1146592 10/2001

(65) **Prior Publication Data**

US 2009/0243779 A1 Oct. 1, 2009

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Primary Examiner — Sanh Phu

(74) Attorney, Agent, or Firm — McAndrews, Held & Malloy, Ltd.

(51) **Int. Cl.**
H04B 1/04 (2006.01)

(52) **U.S. Cl.** **455/103**; 455/552.1; 455/426.2; 455/41.2; 455/88; 455/42; 340/10.1; 340/572.7

(58) **Field of Classification Search** 455/103, 455/552.1, 426.2, 41.2, 88, 42; 340/10.1, 340/572.7

See application file for complete search history.

(57) **ABSTRACT**

Aspects of a method and system for reconfigurable devices for multi-frequency coexistence are provided. In this regard, an IC may be configured based on a frequency of signals processed by the IC. In instances that the IC may process signals of a first frequency, the IC may be configured such that a loop communicatively coupled to the integrated circuit may function as an inductor. In instances that the IC may process signals of a second frequency, the IC may be configured such that the loop may function as an antenna for transmitting and/or receiving the signals. The loop may be within and/or on the IC and/or a package such as a multilayer package to which the IC may be bonded. The loop may be fabricated with stripline and/or microstrip transmission line. In instances that the loop may function as an inductor, the loop may be communicatively coupled as part of a VCO tank circuit.

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20 Claims, 5 Drawing Sheets

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