



US008125395B2

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

(10) **Patent No.:** **US 8,125,395 B2**
(45) **Date of Patent:** **Feb. 28, 2012**

(54) **MULTI-BAND ANTENNA**

(56) **References Cited**

(75) Inventors: **Wen-Chieh Yang**, 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)

Primary Examiner — Jacob Y Choi
Assistant Examiner — Robert Karacsony

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 490 days.

(57) **ABSTRACT**

A multi-band has as an elongated grounding plate disposed vertically with a top edge defined thereon. A simulation induction portion includes a first conduction strip extended obliquely from a substantial middle of the top edge and a second conduction strip extended along the top edge from a free end of the first conduction strip to form an obtuse angle between the first and second conduction strips. A connecting portion extends perpendicularly and opposite to the grounding plate from a free end of the second conduction strip. A feeding point disposes on the connecting portion, adjacent to the second conduction strip. A high frequency radiator and a low frequency radiator are extended opposite to each other from a free end of the connecting portion.

(21) Appl. No.: **12/481,575**

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

(65) **Prior Publication Data**
US 2010/0315308 A1 Dec. 16, 2010

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

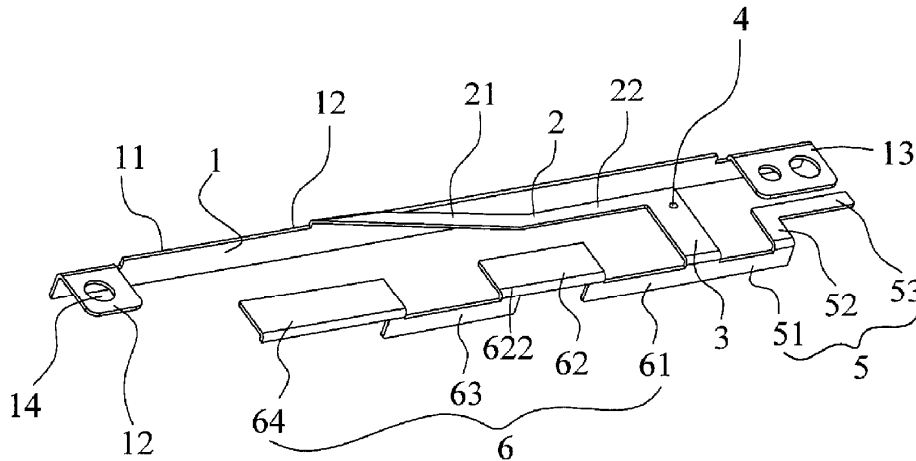
(52) **U.S. Cl.** **343/702; 343/846**

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

See application file for complete search history.

4 Claims, 5 Drawing Sheets

100
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US008125396B2

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

(10) **Patent No.:** **US 8,125,396 B2**
(45) **Date of Patent:** **Feb. 28, 2012**

(54) **HANDHELD ELECTRONIC DEVICE**

(56) **References Cited**

(75) Inventors: **Huan-Chu Huang**, Taoyuan County (TW); **Jen-Chen Lu**, Taoyuan County (TW)

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(73) Assignee: **HTC Corporation**, Taoyuan County (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 247 days.

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(21) Appl. No.: **12/481,590**

Primary Examiner — Douglas W Owens

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

Assistant Examiner — Jennifer F Hu

(65) **Prior Publication Data**

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

(30) **Foreign Application Priority Data**

Dec. 17, 2008 (TW) 97149287 A

(57) **ABSTRACT**

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

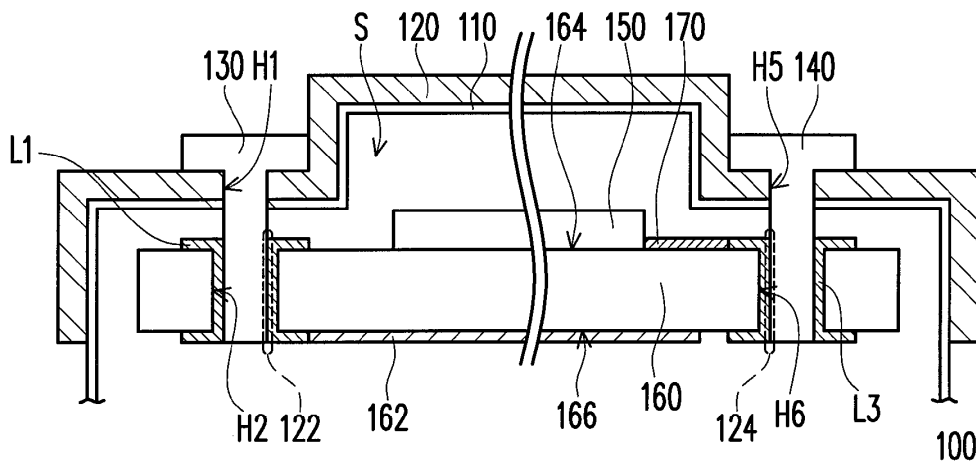
A handheld electronic device comprising an appearance provided with a containing space for disposing a communication module and a substrate having a ground plane; an antenna disposed on a surface of the appearance; and, a first fastening element and a second fastening element for fixing the appearance and the substrate. The first fastening element and the second fastening element electrically connect the antenna to the ground plane and the communication module.

(52) **U.S. Cl.** 343/702; 343/846; 343/872

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

See application file for complete search history.

16 Claims, 3 Drawing Sheets





US008125397B2

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

(10) **Patent No.:** **US 8,125,397 B2**
(45) **Date of Patent:** **Feb. 28, 2012**

(54) **ANTENNA WITH NEAR-FIELD RADIATION CONTROL**

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

(21) Appl. No.: **13/156,728**

(22) Filed: **Jun. 9, 2011**

(65) **Prior Publication Data**

US 2011/0248896 A1 Oct. 13, 2011

Related U.S. Application Data

(63) Continuation of application No. 12/474,075, filed on May 28, 2009, now Pat. No. 7,961,154, which is a continuation of application No. 11/774,383, filed on Jul. 6, 2007, now Pat. No. 7,541,991, which is a continuation of application No. 10/940,869, filed on Sep. 14, 2004, now Pat. No. 7,253,775, which is a continuation of application No. 10/317,659, filed on Dec. 12, 2002, now Pat. No. 6,791,500.

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

(52) **U.S. Cl.** **343/702**; 343/803; 343/818; 343/833

(58) **Field of Classification Search** 343/702, 343/793, 795, 803, 806, 815, 817, 818, 819, 343/833, 834

See application file for complete search history.

(56) **References Cited**

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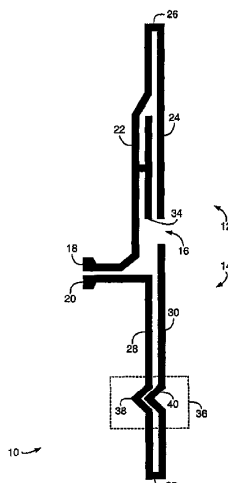
Primary Examiner — Tho G Phan

(74) *Attorney, Agent, or Firm* — Jones Day

(57) **ABSTRACT**

An antenna and a wireless mobile communication device incorporating the antenna are provided. The antenna includes a first conductor section electrically coupled to a first feeding point, a second conductor section electrically coupled to a second feeding point, and a near-field radiation control structure adapted to control characteristics of near-field radiation generated by the antenna. Near-field radiation control structures include a parasitic element positioned adjacent the first conductor section and configured to control characteristics of near-field radiation generated by the first conductor section, and a diffuser in the second conductor section configured to diffuse near-field radiation generated by the second conductor section into a plurality of directions.

32 Claims, 4 Drawing Sheets





US008125404B2

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

(10) **Patent No.:** **US 8,125,404 B2**
(45) **Date of Patent:** **Feb. 28, 2012**

(54) **MONOPOLE ANTENNA WITH HIGH GAIN AND WIDE BANDWIDTH**

(75) Inventors: **Shang-Jen Chen**, Tu-cheng (TW);
Lung-Sheng Tai, Tu-cheng (TW);
Chun-Ming Chiu, Tu-cheng (TW);
Shu-Yean Wang, Tu-cheng (TW)

(73) Assignee: **Hon Hai Precision Ind. Co., Ltd.**, 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 325 days.

(21) Appl. No.: **12/386,623**

(22) Filed: **Apr. 21, 2009**

(65) **Prior Publication Data**

US 2009/0262040 A1 Oct. 22, 2009

(30) **Foreign Application Priority Data**

Apr. 21, 2008 (TW) 97114428 A

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

(52) **U.S. Cl.** **343/895; 343/700 MS; 343/850**

(58) **Field of Classification Search** 343/700 MS,
343/850, 860, 864, 895
See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Jacob Y Choi

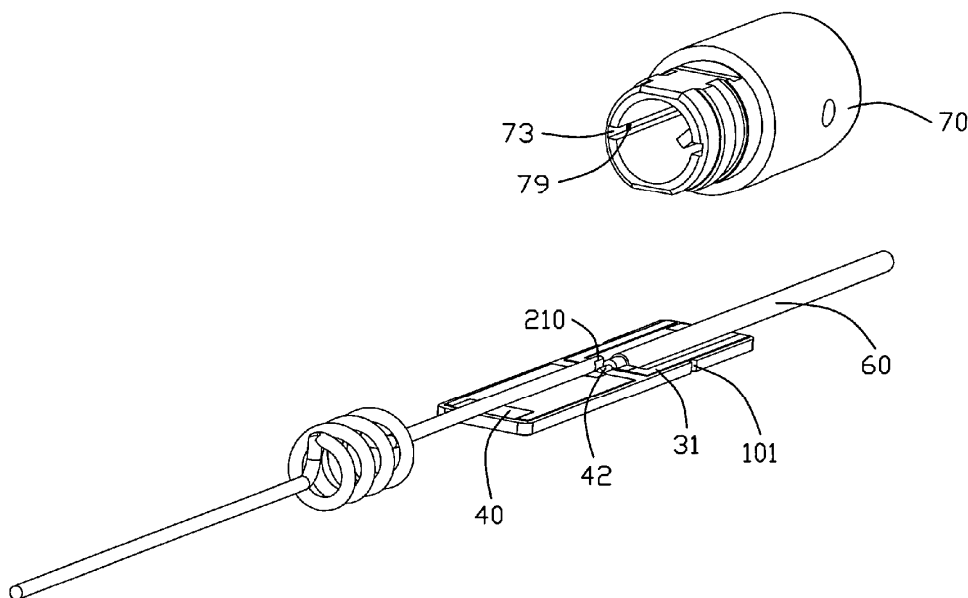
Assistant Examiner — Shawn Buchanan

(74) *Attorney, Agent, or Firm* — Wei Te Chung; Andrew C. Cheng; Ming Chieh Chang

(57) **ABSTRACT**

A monopole antenna includes a base board having a first side and a second side, a grounding element attached on the first side of the base board, a coupling element attached on the first side of the base board and being spaced apart from the grounding element, and a radiating element connected to the coupling element and exposed out the base board.

8 Claims, 5 Drawing Sheets





US008130149B2

(12) **United States Patent**
Tabakovic

(10) **Patent No.:** **US 8,130,149 B2**
(45) **Date of Patent:** **Mar. 6, 2012**

(54) **WIDEBAND STRIP FED PATCH ANTENNA**

(75) Inventor: **Haris Tabakovic**, Syracuse, NY (US)

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

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

(21) Appl. No.: **12/258,090**

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

(65) **Prior Publication Data**

US 2010/0103049 A1 Apr. 29, 2010

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

(52) **U.S. Cl.** **343/700 MS; 343/830**

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

See application file for complete search history.

(56) **References Cited**

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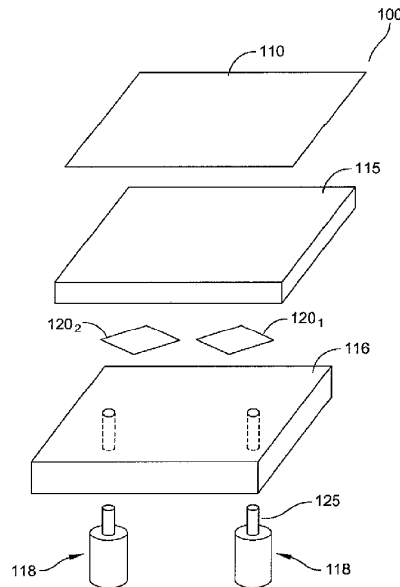
Primary Examiner — Trinh Dinh

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

(57) **ABSTRACT**

A microstrip patch antenna comprises a patch antenna element comprising a first conductive layer; dual probe feeds separate from each other and spaced from and field coupled to the patch antenna element for transmitting or receiving RF signals, each of the dual probe feeds having a conductor segment and a deltoid shaped conductive strip orthogonal to the conductor segment; the deltoid shaped conductive strips being coplanar; and a first dielectric material layer separating the first conductive layer and the coplanar deltoid shaped conductive strips.

29 Claims, 12 Drawing Sheets





US008130150B2

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

(10) **Patent No.:** **US 8,130,150 B2**
(45) **Date of Patent:** ***Mar. 6, 2012**

(54) **HYBRID ANTENNA FOR USE WITH WWAN
WLAN AND WMAN**

(75) Inventors: **Shu-Yean Wang**, Tu-cheng (TW);
Chen-Ta Hung, Tu-cheng (TW);
Yun-Lung Ke, Tu-cheng (TW)

(73) Assignee: **Hon Hai Precision Ind. Co., Ltd.**, 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 333 days.

This patent is subject to a terminal dis-
claimer.

(21) Appl. No.: **12/386,116**

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

(65) **Prior Publication Data**
US 2009/0256779 A1 Oct. 15, 2009

(30) **Foreign Application Priority Data**
Apr. 14, 2008 (TW) 97113435 A

(51) **Int. Cl.**
H01Q 5/00 (2006.01)

(52) **U.S. Cl.** **343/700 MS**; 343/893; 343/702;
343/846; 343/829

(58) **Field of Classification Search** 343/700 MS,
343/702, 829, 846, 893
See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Jacob Y Choi

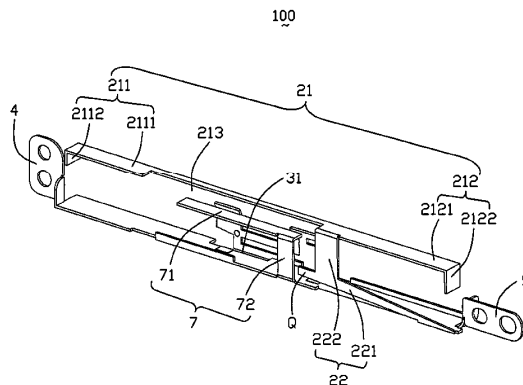
Assistant Examiner — Shawn Buchanan

(74) *Attorney, Agent, or Firm* — Wei Te Chung; Andrew C.
Cheng; Ming Chieh Chang

(57) **ABSTRACT**

A multi-band antenna includes a grounding element, a first antenna connected to the grounding element, a second antenna connected to the grounding element and a coupling radiating arm extending from the grounding element. The grounding element extends along a lengthwise direction and includes first and second lengthwise sides. The first antenna includes a first connecting element extending from the grounding element and a first radiating element electrically connected to the first connecting element. The second antenna includes a second connecting element extending from the grounding element and a second radiating element electrically connected to the second connecting element. The first radiating element includes a first radiating portion extending from the first connecting element in both a longitudinal direction and a transverse direction and a second radiating portion substantially being leptosomatic. The second radiating element substantially extends in a lengthwise direction and forms a first radiating section operating on a first frequency band and a second radiating section operating on a second frequency band. The first antenna is located between the first antenna and the second antenna in a vertical direction. The coupling radiating arm is between the first radiating section of the second radiating element of the second antenna and the grounding element in a vertical direction.

20 Claims, 4 Drawing Sheets





US008130151B2

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

(10) **Patent No.:** **US 8,130,151 B2**
(45) **Date of Patent:** **Mar. 6, 2012**

(54) **MONOPOLE ANTENNA WITH ULTRA WIDE BAND**

(75) Inventors: **Lung-Sheng Tai**, Tu-Cheng (TW);
Chun-Ming Chiu, Tu-Cheng (TW)

(73) Assignee: **Hon Hai Precision Ind. Co., Ltd.**, 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 335 days.

(21) Appl. No.: **12/423,022**

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

(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
Apr. 14, 2008 (TW) 097113433

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

(52) **U.S. Cl.** **343/700 MS; 343/846**
(58) **Field of Classification Search** 343/700 MS,
343/846

See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Hoang V Nguyen

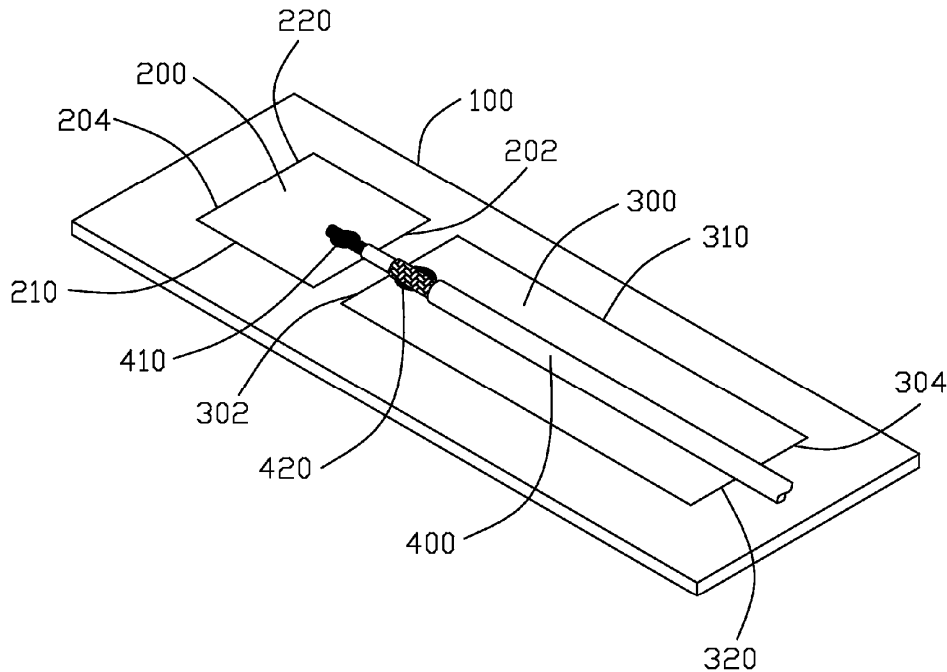
(74) *Attorney, Agent, or Firm* — Wei Te Chung; Andrew C. Cheng; Ming Chieh Chang

(57) **ABSTRACT**

A monopole antenna includes a base board with a first side and a second side, a radiating element, a grounding element and a feeding line. The radiating element and the grounding element are located on the first side of the base board. The grounding element is two times longer than the radiating element. The feeding line includes an inner conductor connected to the radiating element and an outer conductor connected to the grounding element.

16 Claims, 4 Drawing Sheets

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US008130153B2

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

(10) **Patent No.:** **US 8,130,153 B2**
(45) **Date of Patent:** **Mar. 6, 2012**

(54) **ELECTRONIC DEVICE AND ELECTRONIC ASSEMBLY**

(75) Inventors: **Boon Ping Koh**, Petaling Jaya (MY);
Nur Ainunnazli Aminuddin, Subang Jaya (MY); **Seng Shin Lim**, Kulim (MY); **Sooliam Ooi**, Plantation, FL (US)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 694 days.

(21) Appl. No.: **12/129,815**

(22) Filed: **May 30, 2008**

(65) **Prior Publication Data**

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

(52) **U.S. Cl.** **343/702; 343/846; 343/841**

(58) **Field of Classification Search** **343/702, 343/895, 901, 846, 841**

See application file for complete search history.

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Primary Examiner — Douglas W Owens

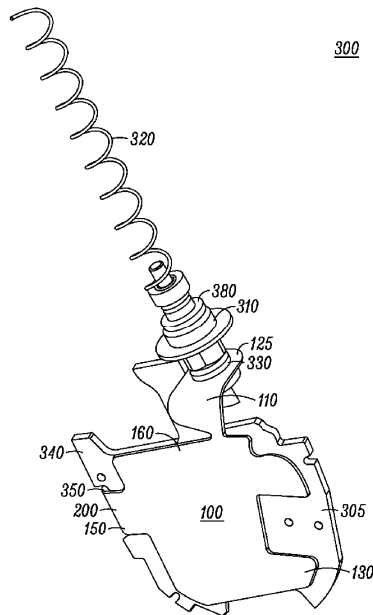
Assistant Examiner — Dieu H Duong

(74) *Attorney, Agent, or Firm* — Terri Hughes Smith; Anthony P. Curtis; Daniel R. Bestor

(57) **ABSTRACT**

An electronic assembly and electronic device used for radio frequency communications are presented. The electronic device has a housing and an antenna feed point at least partially enclosed in the housing. There is at least one circuit board enclosed in the housing. An antenna counterpoise is coupled to the feed point. The counterpoise is enclosed in the housing and the counterpoise includes a foldable metallic patch that is folded around the circuit board such that the circuit board is sandwiched between opposite facing portions of the foldable metallic patch.

18 Claims, 4 Drawing Sheets





US008130158B2

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

(10) **Patent No.:** **US 8,130,158 B2**
(45) **Date of Patent:** **Mar. 6, 2012**

(54) **ANTENNA APPARATUS AND COMMUNICATION SYSTEM INCLUDING THE SAME**

(75) Inventors: **Shigemi Kurashima**, Shinagawa (JP);
Masahiro Yanagi, Shinagawa (JP);
Takashi Arita, Shinagawa (JP)

(73) Assignee: **Fujitsu Component Limited**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 355 days.

(21) Appl. No.: **12/421,770**

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

(65) **Prior Publication Data**
US 2010/0053011 A1 Mar. 4, 2010

(30) **Foreign Application Priority Data**
Aug. 27, 2008 (JP) 2008-217586
Oct. 1, 2008 (JP) 2008-256429

(51) **Int. Cl.**
H01Q 11/12 (2006.01)
(52) **U.S. Cl.** **343/741**; 343/744; 343/866
(58) **Field of Classification Search** 343/741,
343/744, 866
See application file for complete search history.

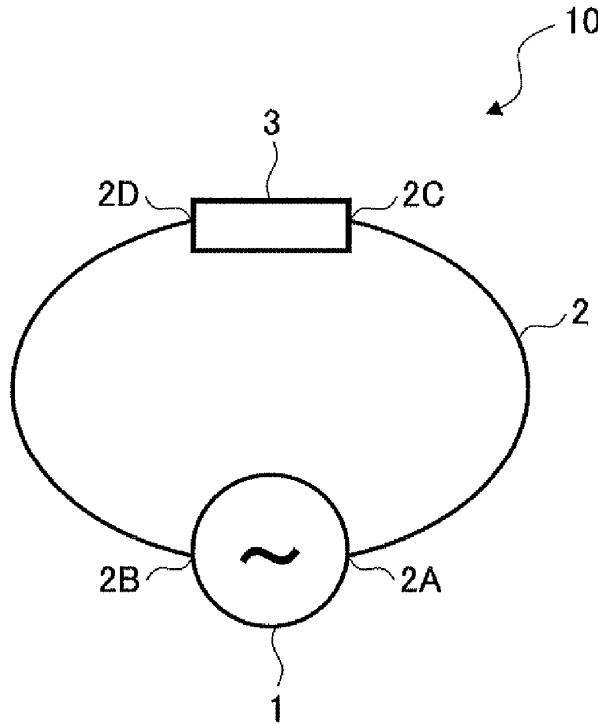
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Primary Examiner — Hoang V Nguyen
(74) *Attorney, Agent, or Firm* — IPUSA, PLLC

(57) **ABSTRACT**
An antenna apparatus is disclosed that includes a feeding portion; a looped antenna element connected to the feeding portion; and a resistor inserted into the looped antenna element.

3 Claims, 9 Drawing Sheets





US008130164B2

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

(10) **Patent No.:** **US 8,130,164 B2**
(45) **Date of Patent:** **Mar. 6, 2012**

(54) **BROADBAND COPLANAR ANTENNA ELEMENT**

(75) Inventors: **Kostyantyn Semonov**, Irvine, CA (US);
Alexander Rabinovich, Cypress, CA (US); **Bill Vassilakis**, Orange, CA (US)

(73) Assignee: **Powerwave Technologies, Inc.**, Santa Ana, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 669 days.

(21) Appl. No.: **12/212,533**

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

(65) **Prior Publication Data**
US 2009/0079653 A1 Mar. 26, 2009

Related U.S. Application Data

(60) Provisional application No. 60/994,557, filed on Sep. 20, 2007.

(51) **Int. Cl.**
H01Q 9/28 (2006.01)
(52) **U.S. Cl.** **343/795; 343/700 MS**
(58) **Field of Classification Search** **343/700 MS, 343/795, 815, 833**
See application file for complete search history.

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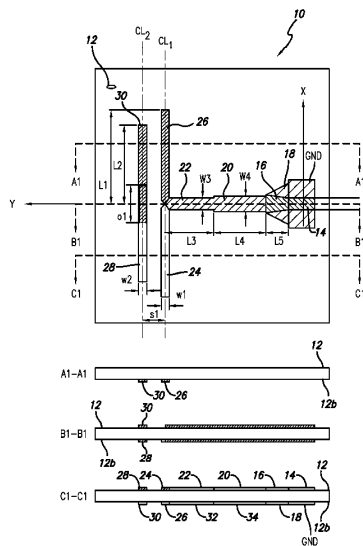
Primary Examiner — Tan Ho

(74) *Attorney, Agent, or Firm* — OC Patent Law Group

(57) **ABSTRACT**

A broadband antenna element configuration having a radiation pattern useful in an antenna array containing a plurality of driven radiating elements that are spatially arranged is disclosed. The antenna element is coplanarly disposed on a suitable planar substrate of dielectric material. The antenna element utilizes a pair of balanced dipole arm elements symmetrically disposed about the centerline of a balanced feed network. Balanced feed network elements are disposed in a broadside symmetrical configuration on first plane and second plane on each side of the aforementioned dielectric. Disposed proximate to each dipole arm element are partially overlapping, parallel planar, frequency bandwidth expanding microstrip lines. The combination of dipole arms and parasitically coupled microstrip lines provides a broad bandwidth radiating element suitable for use in antenna arrays.

17 Claims, 6 Drawing Sheets





US008130169B2

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

(10) **Patent No.:** **US 8,130,169 B2**
(45) **Date of Patent:** **Mar. 6, 2012**

(54) **MULTI-INPUT MULTI-OUTPUT ANTENNA SYSTEM**

(75) Inventors: **Jui-Hung Chou**, Taichung (TW);
Saou-Wen Su, Taipei (TW)

(73) Assignees: **Silitek Electronic (Guangzhou) Co., Ltd.**, Guangzhou (CN); **Lite-On Technology Corporation**, Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 324 days.

(21) Appl. No.: **12/476,492**

(22) Filed: **Jun. 2, 2009**

(65) **Prior Publication Data**
US 2009/0309806 A1 Dec. 17, 2009

(30) **Foreign Application Priority Data**
Jun. 13, 2008 (CN) 2008 1 0028815

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

(52) **U.S. Cl.** **343/905**

(58) **Field of Classification Search** 343/700 MS, 343/702, 795, 830, 846, 841, 905
See application file for complete search history.

(56) **References Cited**

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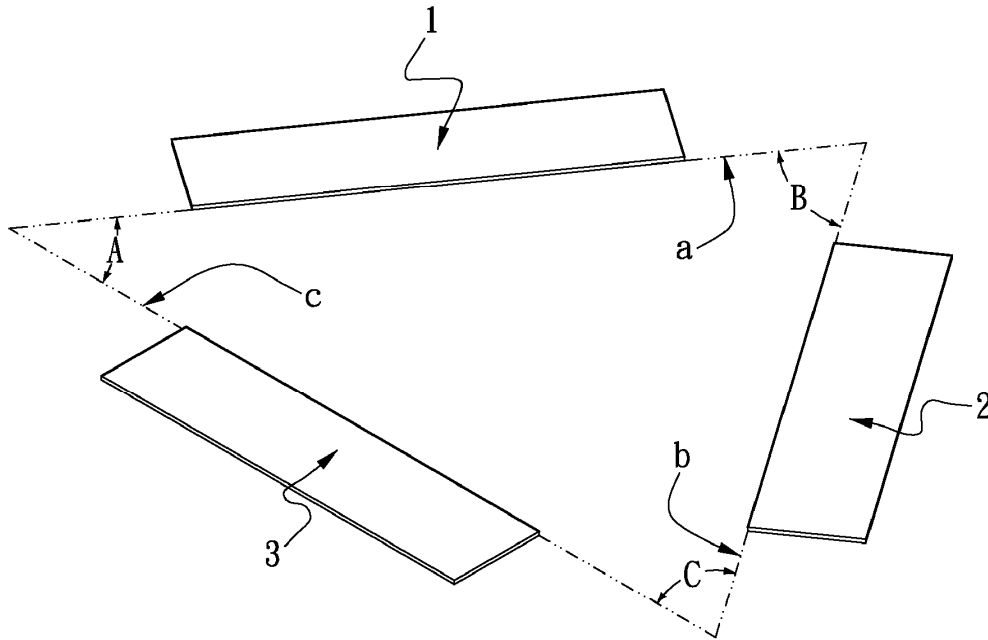
Primary Examiner — Huedung Mancuso

(74) *Attorney, Agent, or Firm* — Li & Cai Intellectual Property (USA) Office

(57) **ABSTRACT**

A multi-input and multi-output antenna system is disclosed. The antenna system includes a predetermined quantity of dual-feed and dual-band antennas that are arranged into a polygon on a plane. The dual-feed and dual-band antenna includes a substrate, a grounding unit disposed on the substrate and having two opposite sides, a first radiating unit disposed on the substrate near one side of the grounding unit, and a second radiating unit disposed on the substrate near the other side. The second radiating unit has a shorting element that is electrically connected to the grounding unit. The polygon is bounded by lengthwise projection lines of the dual-feed and dual-band antennas.

20 Claims, 5 Drawing Sheets





US008131331B2

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

(10) **Patent No.:** **US 8,131,331 B2**
(45) **Date of Patent:** **Mar. 6, 2012**

(54) **PORTABLE AND FOLDABLE RADIO
TERMINAL WITH MULTIPLE FREQUENCY
ANTENNA**

(75) Inventors: **Daigo Imano**, Miyagi (JP); **Hironori Kikuchi**, Miyagi (JP); **Kenichi Sato**, Miyagi (JP); **Yasuhiro Kitajima**, Kanagawa (JP); **Nobuhiro Iwai**, Kanagawa (JP); **Tatsuya Sano**, Tokyo (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 63 days.

(21) Appl. No.: **12/812,441**

(22) PCT Filed: **Dec. 24, 2008**

(86) PCT No.: **PCT/JP2008/003930**

§ 371 (c)(1),
(2), (4) Date: **Jul. 9, 2010**

(87) PCT Pub. No.: **WO2009/087732**

PCT Pub. Date: **Jul. 16, 2009**

(65) **Prior Publication Data**

US 2010/0279747 A1 Nov. 4, 2010

(30) **Foreign Application Priority Data**

Jan. 10, 2008 (JP) 2008-003185

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

(52) **U.S. Cl.** **455/575.7; 455/550.1; 455/562.1; 455/575.1**

(58) **Field of Classification Search** 455/90.3, 455/63.4, 82-83, 87, 107, 129, 550.1, 562.1, 455/575.1, 575.3, 575.8; 343/702, 745, 749, 343/822-824, 852, 860-861, 900, 913
See application file for complete search history.

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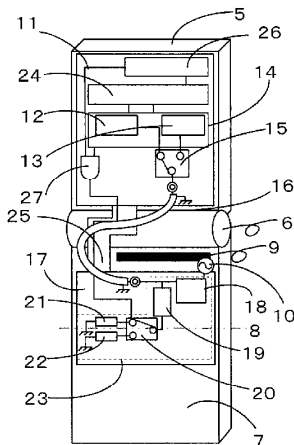
International Search Report relating to International Application No. PCT/JP2008/003930, mailed Apr. 7, 2009, 4 pages.

Primary Examiner — Meless Zewdu
(74) *Attorney, Agent, or Firm* — Seed IP Law Group PLLC

(57) **ABSTRACT**

A foldable portable radio device adapted to a plurality of frequency bands has a good antenna performance in all the use frequency bands even in both open and folded states. In the foldable portable radio device, a control section (24) controls switching means (20) to connect a sub-matching circuit (19) and a first circuit element (21) when a first use frequency band is used and further when the foldable portable radio device is in the open state and to connect the sub-matching circuit (19) and a second circuit element (22) when a first use frequency band is used and further when the foldable portable radio device is in the closed state, or when a second use frequency band is used irrespective of the open/closed state of the foldable portable radio device.

9 Claims, 6 Drawing Sheets





US008134506B2

(12) **United States Patent**
Leisten

(10) **Patent No.:** **US 8,134,506 B2**
(45) **Date of Patent:** **Mar. 13, 2012**

(54) **ANTENNA ARRANGEMENT**
(75) Inventor: **Oliver Paul Leisten**, Raunds (GB)
(73) Assignee: **Sarantel Limited**, Wellingborough (GB)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 992 days.

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(21) Appl. No.: **12/002,322**
(22) Filed: **Dec. 14, 2007**

(65) **Prior Publication Data**
US 2009/0153413 A1 Jun. 18, 2009

Related U.S. Application Data
(60) Provisional application No. 60/921,767, filed on Apr. 3, 2007.

(30) **Foreign Application Priority Data**
Dec. 14, 2006 (GB) 0624976.7

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
(52) **U.S. Cl.** **343/702; 343/895**
(58) **Field of Classification Search** **343/702, 343/753, 844, 895, 793**
See application file for complete search history.

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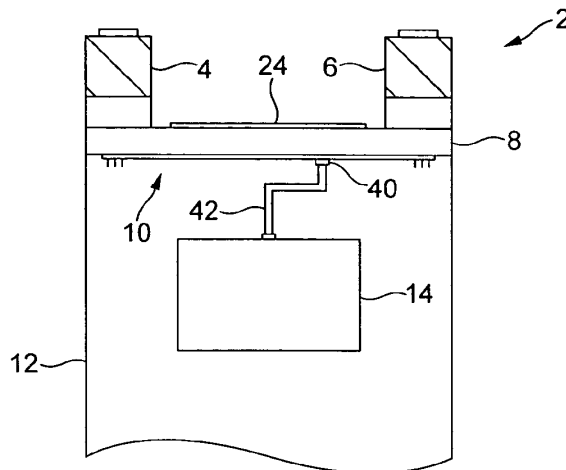
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Primary Examiner — Dieu H Duong
(74) *Attorney, Agent, or Firm* — John Bruckner PC

(57) **ABSTRACT**
An antenna arrangement which includes two antennas which are resonant at a common operating frequency. The arrangement includes a circuit which combines output signals from each of the antennas to provide a combined signal output. Each antenna has an electrically insulative core of solid material having a relative dielectric constant greater than 5 and a three-dimensional antenna element structure. The structure includes at least a pair of elongate conductive antenna elements disposed on or adjacent a surface of the core.

18 Claims, 7 Drawing Sheets





US008134507B2

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

(10) **Patent No.:** **US 8,134,507 B2**
(45) **Date of Patent:** **Mar. 13, 2012**

(54) **MOBILE ELECTRONIC DEVICE**

(75) Inventors: **Kuo-Cheng Chen**, Taoyuan County (TW); **Jen-Chen Lu**, Taoyuan County (TW); **Huan-Chu Huang**, Taoyuan County (TW)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 410 days.

(21) Appl. No.: **12/436,102**

(22) Filed: **May 5, 2009**

(65) **Prior Publication Data**

US 2010/0141535 A1 Jun. 10, 2010

(30) **Foreign Application Priority Data**

Dec. 5, 2008 (TW) 97147403 A

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

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

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

(56) **References Cited**

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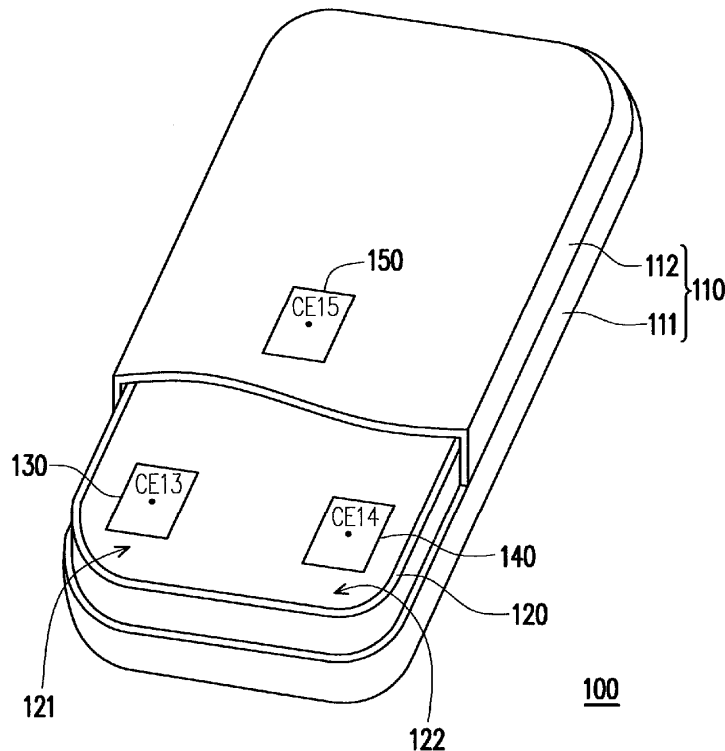
Primary Examiner — Tho G Phan

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

(57) **ABSTRACT**

A mobile electronic device including an appearance, a first antenna and a metal part is provided. The appearance is used to accommodate a substrate. The first antenna is disposed on the substrate, and the metal part is disposed on an external surface of the appearance. During overall operation, the mobile electronic device receives or transmits signals through a first bandwidth radio frequency band by the first antenna and the metal part.

14 Claims, 4 Drawing Sheets





US008134509B2

(12) **United States Patent**
Adachi

(10) **Patent No.:** **US 8,134,509 B2**
(45) **Date of Patent:** **Mar. 13, 2012**

(54) **ELECTRONIC DEVICE**

FOREIGN PATENT DOCUMENTS

(75) Inventor: **Katsumi Adachi**, Kato (JP)

JP 05-014027 1/1993
JP 2001-067139 3/2001

(73) Assignee: **Fujitsu Limited**, Kawasaki (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 403 days.

Primary Examiner — Hoang V Nguyen
(74) *Attorney, Agent, or Firm* — Staas & Halsey LLP

(21) Appl. No.: **12/461,124**

(57) **ABSTRACT**

(22) Filed: **Jul. 31, 2009**

An electronic device includes a housing that has a rectangular plate section and a sidewall section provided with a control opening for slide control member provision, and an antenna housing groove extending in a longitudinal direction of the sidewall section; a protrusion that is provided upright at a point adjacent to one end of the antenna housing groove; a plate piece-like antenna unit that has a length to be completely housed in the antenna housing groove and including a radio communication antenna; a control member that is placed to extend across inside and outside of the housing through the control opening provided with a control piece to be slid; and a lever member that is placed in the housing, the lever member rotating about the rotation shaft in response to slide of the control piece, and thereby pushing out the antenna unit from the housing.

(65) **Prior Publication Data**

US 2010/0090911 A1 Apr. 15, 2010

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

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

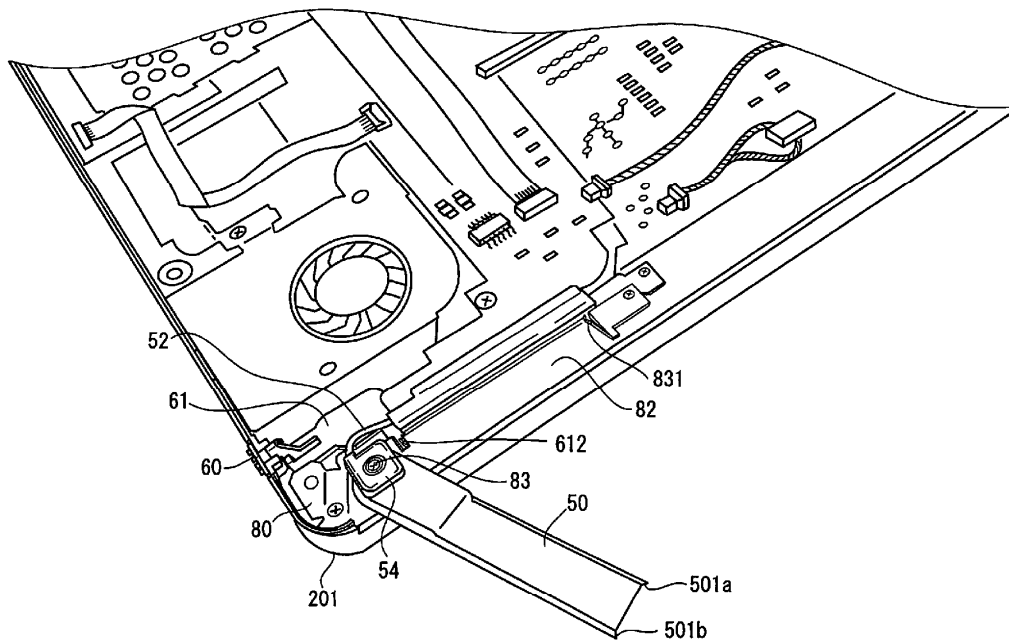
(58) **Field of Classification Search** 343/702,
343/900; 455/575.1, 575.3, 575.4, 575.7
See application file for complete search history.

(56) **References Cited**

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8 Claims, 19 Drawing Sheets





US008138977B2

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

(10) **Patent No.:** **US 8,138,977 B2**
(45) **Date of Patent:** **Mar. 20, 2012**

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

(75) Inventors: **Zhijun Zhang**, Santa Clara, CA (US); **Fletcher R. Rothkopf**, Mountain View, CA (US); **Robert W. Schlub**, Campbell, CA (US); **Ruben Caballero**, 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 305 days.

(21) Appl. No.: **11/890,865**

(22) Filed: **Aug. 7, 2007**

(65) **Prior Publication Data**

US 2009/0040115 A1 Feb. 12, 2009

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

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

(58) **Field of Classification Search** 343/702, 343/872; 455/575.1, 575.7, 575.8
See application file for complete search history.

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Primary Examiner — Jacob Y Choi

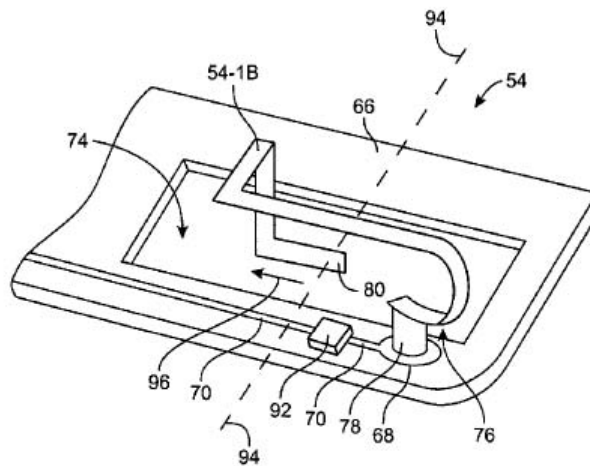
Assistant Examiner — Robert Karacsony

(74) *Attorney, Agent, or Firm* — Treyz Law Group; G. Victor Treyz; Nancy Y. Ru

(57) **ABSTRACT**

Handheld electronic devices are provided that contain wireless communications circuitry. The wireless communications circuitry may include antenna structures. An antenna may be located in an upper right corner of the handheld device as the handheld device is operated in a portrait mode. When the handheld device is rotated counterclockwise and operated in a landscape mode, the antenna is located in an unobstructed upper left corner of the device. The antenna may be formed from a strip of conductor. A proximal end of the strip of conductor may be connected to a transmission line. A distal end of the strip of conductor may be routed away from housing surfaces by bends formed in the strip. A printed circuit board in the handheld electronic device may have a hole. The distal end of the strip of conductor may be located adjacent to the hole.

18 Claims, 17 Drawing Sheets





US008138978B1

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

(10) **Patent No.:** **US 8,138,978 B1**
(45) **Date of Patent:** **Mar. 20, 2012**

(54) **INTEGRATED EXTERNAL ANTENNA**

(75) Inventors: **Bradford Edward Vier**, Austin, TX (US); **Don A. Bobo**, Leander, TX (US); **Todd Winfield Steigerwald**, Austin, TX (US); **Loren Howell**, Georgetown, TX (US); **Andrew Love**, Liberty Hill, TX (US)

(73) Assignee: **Motion Computing, Inc.**, Austin, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 902 days.

(21) Appl. No.: **11/972,982**

(22) Filed: **Jan. 11, 2008**

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

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

(58) **Field of Classification Search** 343/702, 343/846, 793-795, 900-902, 906; 455/90

See application file for complete search history.

(56) **References Cited**

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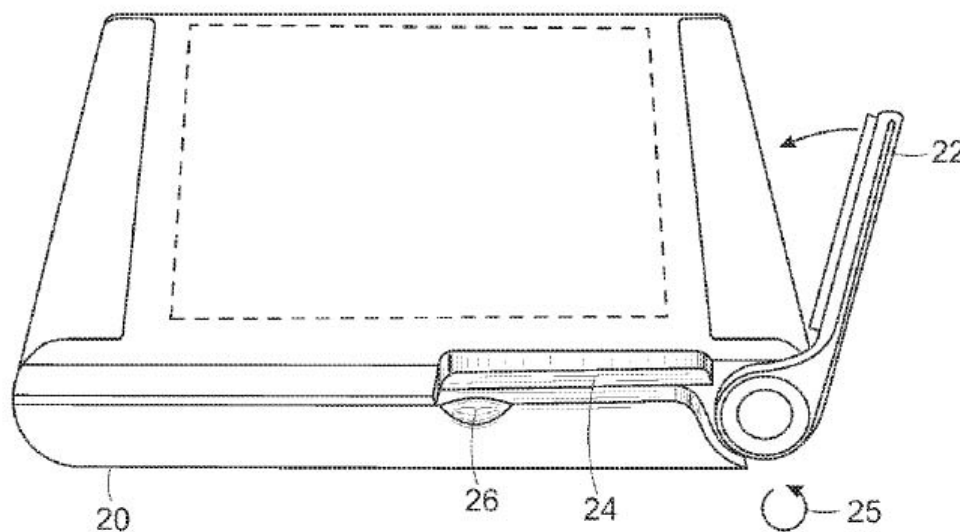
Primary Examiner — Huedung Mancuso

(74) *Attorney, Agent, or Firm* — Charles D. Huston; Daffer McDaniel, LLP

(57) **ABSTRACT**

An antenna system for an electronic device enables the device to communicate via numerous wireless communication protocols, such as wireless broadband communication protocols. The antenna is able to extend from the body of the electronic device in order to meet efficiency and specific absorption rate requirements, while retracting into the footprint of the device when not in use. The antenna is easily disassembled and reassembled from the device without the use of tools, and may automatically disassemble from the device in order to avoid sustaining damage or exposing a user to excessive electromagnetic radiation.

21 Claims, 4 Drawing Sheets





US008138979B2

(12) **United States Patent**
Koyama

(10) **Patent No.:** **US 8,138,979 B2**
(45) **Date of Patent:** **Mar. 20, 2012**

- (54) **PORTABLE WIRELESS APPARATUS**
- (75) Inventor: **Tadashi Koyama**, Kanagawa (JP)
- (73) Assignee: **Kyocera Corporation**, Kyoto (JP)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 365 days.

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- (21) Appl. No.: **12/279,758**
- (22) PCT Filed: **Feb. 22, 2007**
- (86) PCT No.: **PCT/JP2007/053319**
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(2), (4) Date: **Aug. 18, 2008**
- (87) PCT Pub. No.: **WO2007/099859**
PCT Pub. Date: **Sep. 7, 2007**
- (65) **Prior Publication Data**
US 2010/0231458 A1 Sep. 16, 2010

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- (30) **Foreign Application Priority Data**
Feb. 24, 2006 (JP) 2006-049061

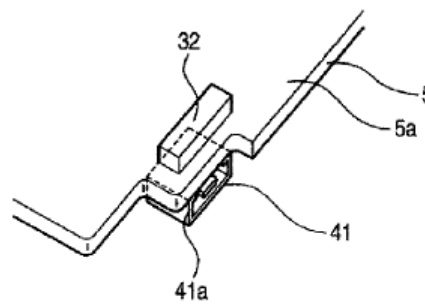
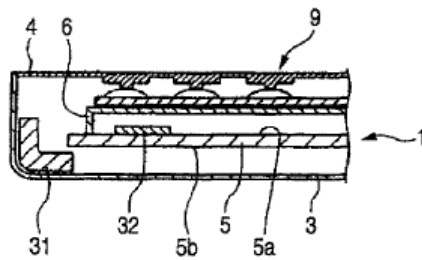
Primary Examiner — Jacob Y Choi
Assistant Examiner — Robert Karacsony
 (74) *Attorney, Agent, or Firm* — DLA Piper LLP (US)

- (51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/52 (2006.01)
- (52) **U.S. Cl.** **343/702; 343/841**
- (58) **Field of Classification Search** **343/702, 343/700 MS, 725, 893, 841; 439/668**
See application file for complete search history.

(57) **ABSTRACT**
 A diversity type portable wireless apparatus **100** includes two antennas **31** and **32**, the two antennas **31** and **32** are arranged at one end within a housing **1**; at least one antenna **32** is mounted on a circuit board **5** provided with the housing **1**; and a component, for example, a shield case **6** is arranged in the vicinity of one antenna **32**, while the component contains a metal portion electrically connected to a reference potential portion formed on the circuit board **5**.

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5 Claims, 5 Drawing Sheets





US008138980B2

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

(10) **Patent No.:** **US 8,138,980 B2**
(45) **Date of Patent:** **Mar. 20, 2012**

(54) **ANTENNA DEVICE FOR RADIO APPARATUS AND PORTABLE RADIO APPARATUS**

(75) Inventors: **Daigo Imano**, Miyagi (JP); **Mitsuharu Nakasato**, Miyagi (JP); **Nobuaki Tanaka**, Kanagawa (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 0 days.

(21) Appl. No.: **12/885,293**

(22) Filed: **Sep. 17, 2010**

(65) **Prior Publication Data**

US 2011/0043416 A1 Feb. 24, 2011

Related U.S. Application Data

(62) Division of application No. 11/570,129, filed as application No. PCT/JP2005/017815 on Sep. 28, 2005, now Pat. No. 7,859,467.

(30) **Foreign Application Priority Data**

Sep. 28, 2004 (JP) 2004-281586
Apr. 13, 2005 (JP) 2005-116049

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

(52) **U.S. Cl.** ... **343/702**; 343/901; 343/900; 343/700 MS

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

(56) **References Cited**

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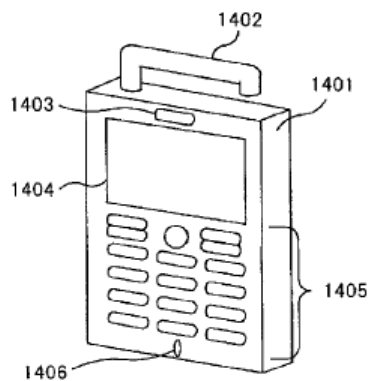
Primary Examiner — Trinh V Dinh

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

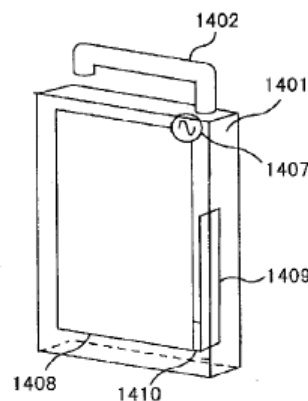
(57) **ABSTRACT**

An object of the present invention is to provide an antenna device for a radio apparatus in which the amount of energy (SAR) absorbed by a head of a human body can be reduced without lowering the power of radio waves transmitted during a call. There is provided a board **108** serving as a base plate of an antenna element, an antenna element **102** disposed in a longitudinally end portion of the board **108** through a feeding portion **107**, a conductor plate **109** disposed substantially in parallel with a main surface of the board **108** and disposed on the opposite side to a surface having a sound hole of a receiver portion, and a plurality of short-circuit conductors **110** disposed on a lower end portion of the conductor plate **109**. The conductor plate **109** is short-circuited to a lower end portion of the board **108** through the short-circuit conductors **110**.

3 Claims, 13 Drawing Sheets



(a)



(b)



US008138981B2

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

(10) **Patent No.:** **US 8,138,981 B2**
(45) **Date of Patent:** **Mar. 20, 2012**

- (54) **ANTENNA SET, PORTABLE WIRELESS DEVICE, AND USE OF A CONDUCTIVE ELEMENT FOR TUNING THE GROUND-PLANE OF THE ANTENNA SET**
- (75) Inventors: **Jaume Anguera**, Vinaros (ES); **Antonio Condes**, Sta. Coloma de Cervelló (ES)
- (73) Assignee: **Fractus, S.A.**, Barcelona (ES)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/014,283**
 (22) Filed: **Jan. 26, 2011**

(65) **Prior Publication Data**
 US 2011/0175776 A1 Jul. 21, 2011

Related U.S. Application Data
 (63) Continuation of application No. 12/066,897, filed as application No. PCT/EP2006/009019 on Sep. 15, 2006, now Pat. No. 7,903,034.
 (60) Provisional application No. 60/718,537, filed on Sep. 19, 2005.

(30) **Foreign Application Priority Data**
 Sep. 19, 2005 (EP) 05108616

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)

(52) **U.S. Cl.** 343/702; 343/846; 343/700 MS
 (58) **Field of Classification Search** 343/702, 343/700 MS, 846

See application file for complete search history.

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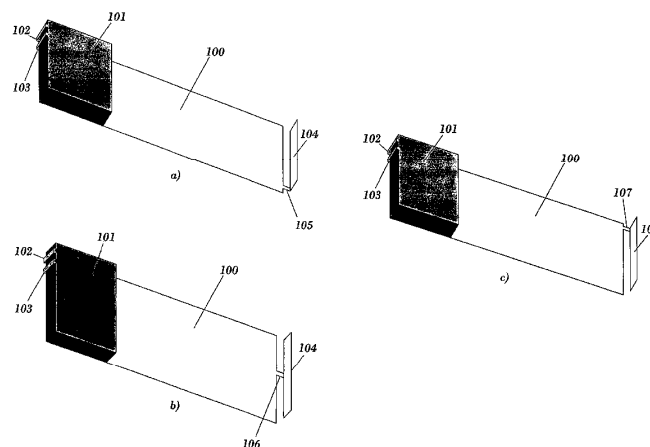
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(Continued)

Primary Examiner — Hoang V Nguyen
 (74) *Attorney, Agent, or Firm* — Winstead PC

(57) **ABSTRACT**

An antenna set comprising at least one antenna element and a ground plane, is complemented by a conductive element coupled to the ground plane, so as to modify the frequency performance of the antenna set, adding an operating band to the antenna set, and/or increasing the bandwidth of one operating band of the antenna set, and/or enhancing voltage standing wave ration, efficiency and/or gain of the antenna set. Thus, the conductive element can be used to tune the antenna set in accordance with specific requirements concerning, for example, compatibility with different wireless services.

19 Claims, 17 Drawing Sheets





US008138984B2

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

(10) **Patent No.:** **US 8,138,984 B2**
(45) **Date of Patent:** **Mar. 20, 2012**

(54) **PLANAR ANTENNA**

(75) Inventors: **Shyh-Jong Chung**, Guanxi Township (TW); **Sy-Been Wang**, Zhubei (TW); **Ching-Wei Ling**, Xinhua Township (TW)

(73) Assignee: **National Chiao Tung University**, Hsinchu (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 374 days.

(21) Appl. No.: **12/510,618**

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

(65) **Prior Publication Data**
US 2010/0188294 A1 Jul. 29, 2010

(30) **Foreign Application Priority Data**
Jan. 23, 2009 (TW) 98103116 A

(51) **Int. Cl.**
H01Q 13/00 (2006.01)
(52) **U.S. Cl.** **343/767; 343/770**
(58) **Field of Classification Search** **343/767, 343/770, 702**
See application file for complete search history.

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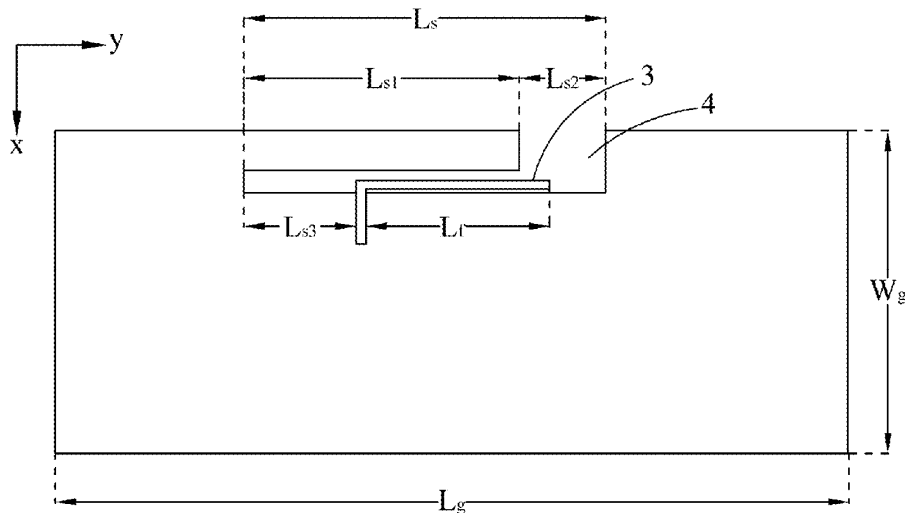
Primary Examiner — Tan Ho

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

(57) **ABSTRACT**

The present invention discloses a planar antenna including a substrate, a ground plane and a feed line. The ground plane is disposed on one side of the substrate. The ground plane includes a hollow portion. The feed line disposed on another side of the substrate and corresponding to the hollow portion for feeding a signal. The present invention also discloses a planar antenna including a substrate, a ground plane and a feed line. The ground plane is disposed on one side of the substrate. The ground plane includes a first hollow portion and a second hollow portion. The feed line is disposed on another side of the substrate and having a first branch feed portion and a second branch feed portion for feeding a signal, and the first branch feed portion and the second branch feed portion are aligned with the first hollow portion and the second hollow portion respectively.

22 Claims, 23 Drawing Sheets





US008138987B2

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

(10) **Patent No.:** **US 8,138,987 B2**
(45) **Date of Patent:** **Mar. 20, 2012**

(54) **COMPACT MULTIBAND ANTENNA**

(75) Inventors: **Ephraim Kapuliansky**, Nazerath Illit (IL); **Matti Martiskainen**, Tiberias Illit (IL); **Anatoly Berezin**, Tiberias (IL); **Steve Krupa**, Tiberias (IL)

(73) Assignee: **Galtronics Corporation Ltd.**, Tiberias (IL)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 344 days.

(21) Appl. No.: **12/466,156**

(22) Filed: **May 14, 2009**

(65) **Prior Publication Data**

US 2010/0013732 A1 Jan. 21, 2010

Related U.S. Application Data

(60) Provisional application No. 61/134,990, filed on Jul. 15, 2008.

(51) **Int. Cl.**
H01Q 7/00 (2006.01)

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

(58) **Field of Classification Search** 343/866,
343/702, 725, 867, 700 MS

See application file for complete search history.

(56) **References Cited**

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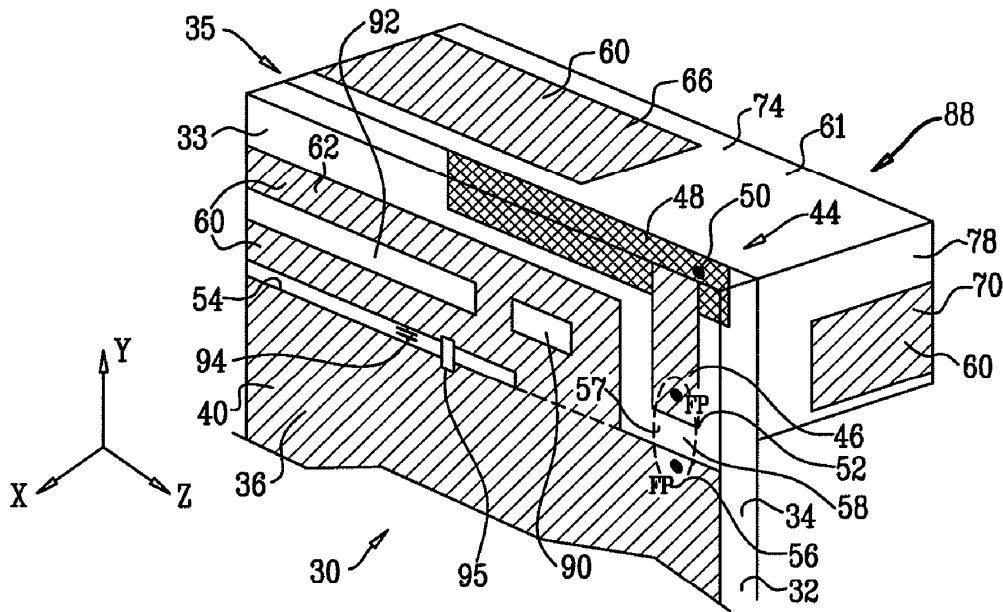
Primary Examiner — Huedung Mancuso

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

(57) **ABSTRACT**

An antenna, including a dielectric carrier having a bounding surface, and a conductive monopole resonant at a first frequency, the monopole having at least one conducting section mounted on the bounding surface. The antenna further includes a labyrinthine conductive coupling element mounted on the bounding surface so as to encompass the dielectric carrier. The coupling element is located with respect to the conductive monopole so as to transfer from the conductive monopole a second frequency lower than the first frequency.

34 Claims, 13 Drawing Sheets





US008140130B2

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

(10) **Patent No.:** **US 8,140,130 B2**
(45) **Date of Patent:** **Mar. 20, 2012**

(54) **ELECTRONIC DEVICE PROVIDED WITH A BATTERY UNIT**

(75) Inventors: **Chi-Hsiung Lin**, Taipei (TW); **Tsan-Hsi Lin**, Taipei (TW); **Wei-Tse Cheng**, Taipei (TW)

(73) Assignee: **Inventec Appliances Corp.**, Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 614 days.

(21) Appl. No.: **12/342,892**

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

(65) **Prior Publication Data**
US 2009/0209299 A1 Aug. 20, 2009

(30) **Foreign Application Priority Data**
Feb. 20, 2008 (TW) 97105950 A

(51) **Int. Cl.**
H04B 1/38 (2006.01)
(52) **U.S. Cl.** **455/572**; 320/112; 320/114; 320/135
(58) **Field of Classification Search** 455/572
See application file for complete search history.

(56) **References Cited**

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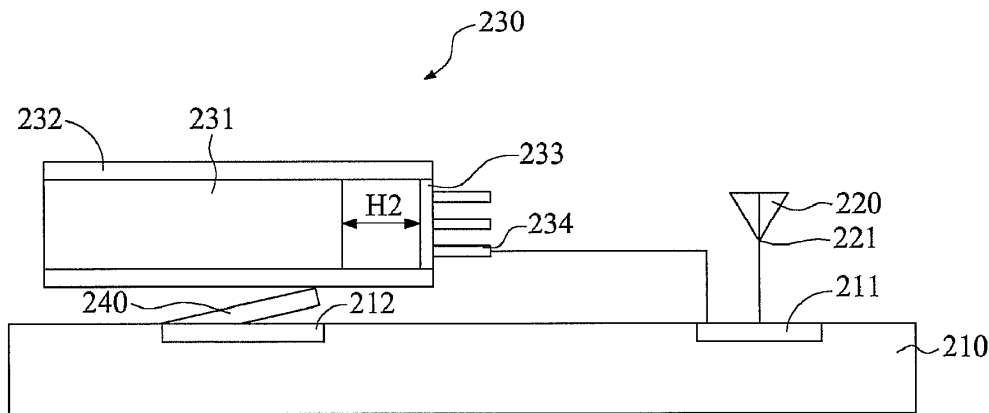
Primary Examiner — Khai M Nguyen

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

(57) **ABSTRACT**

An electronic device includes a printed circuit board having a first ground contact and a second ground contact; an antenna unit having a ground contact end coupled to the first ground contact of the printed circuit board; and a battery unit. The battery unit includes a cell body, a cell cover having an internal surface defining a first chamber for confining the cell body therein and an external surface defining a second chamber that projects from the first chamber. The cell cover is connected electrically to the second ground contact of the printed circuit board. A protection printed circuit board is contained within the second chamber in such a manner to electrically connect with the cell cover. An electric coupler interconnects the protection printed circuit board to the first ground contact of the printed circuit board.

8 Claims, 2 Drawing Sheets





US008144060B2

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

(10) **Patent No.:** **US 8,144,060 B2**
(45) **Date of Patent:** **Mar. 27, 2012**

(54) **MULTIPLE FEEDPOINT ANTENNA**

(75) Inventors: **Richard Barry Angell**, Nevada City, CA (US); **Nelson Young**, Browns Valley, CA (US)

(73) Assignee: **2Wire, Inc.**, San Jose, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 756 days.

(21) Appl. No.: **12/131,724**

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

(65) **Prior Publication Data**

US 2009/0295643 A1 Dec. 3, 2009

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

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

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

See application file for complete search history.

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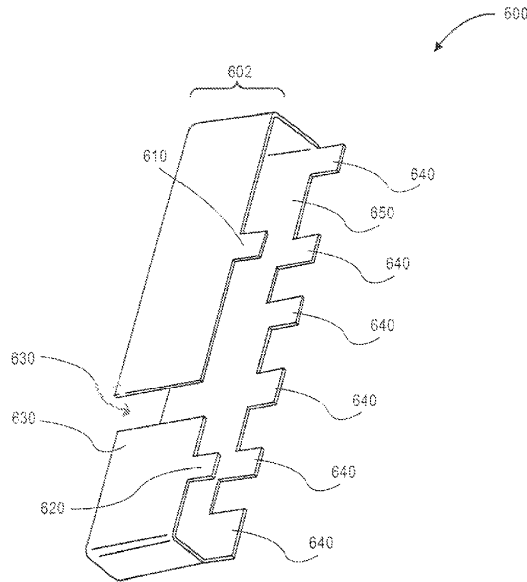
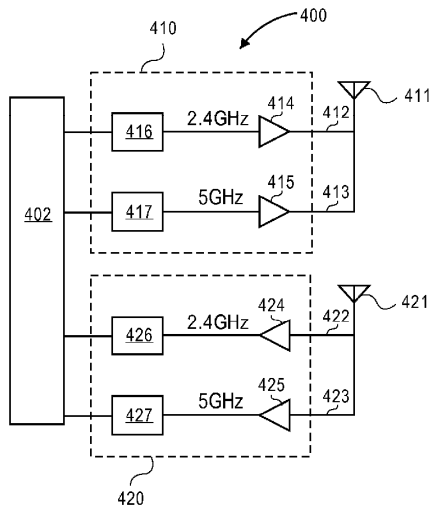
Primary Examiner — Tan Ho

(74) *Attorney, Agent, or Firm* — Head, Johnson & Kachigian P.C.

(57) **ABSTRACT**

An antenna unit includes one or more antenna circuits coupled to one or more antenna structures. Each antenna structure includes a first feed point and a second feed point to receive signals from a transceiver unit or transmit signals to the transceiver unit. The first feed point of each antenna structure is configured to maximize coupling into an associated antenna structure at a first frequency band and the second feed point of each antenna structure is configured to maximize coupling into an associated antenna structure at a second frequency band. Each antenna structure has a slot that separates each antenna structure into a first patch associated with the first feed point and the first frequency band and a second patch associated with the second feed point and the second frequency band. Each antenna circuit is operatively coupled to the transceiver unit without an intervening multiplexing functionality or circuitry.

21 Claims, 10 Drawing Sheets





US008144061B2

(12) **United States Patent**
Sakuma

(10) **Patent No.:** **US 8,144,061 B2**
(45) **Date of Patent:** **Mar. 27, 2012**

(54) **ANTENNA AND COMMUNICATION DEVICE**
HAVING SAME

(75) Inventor: **Masao Sakuma**, Shinjuku (JP)

(73) Assignee: **Fujitsu Semiconductor Limited**,
Yokohama (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 389 days.

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Korean Office Action dated Aug. 23, 2011 with English Translation.

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(21) Appl. No.: **12/423,557**

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

(65) **Prior Publication Data**

US 2009/0273523 A1 Nov. 5, 2009

(30) **Foreign Application Priority Data**

Apr. 30, 2008 (JP) 2008-118893

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

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

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

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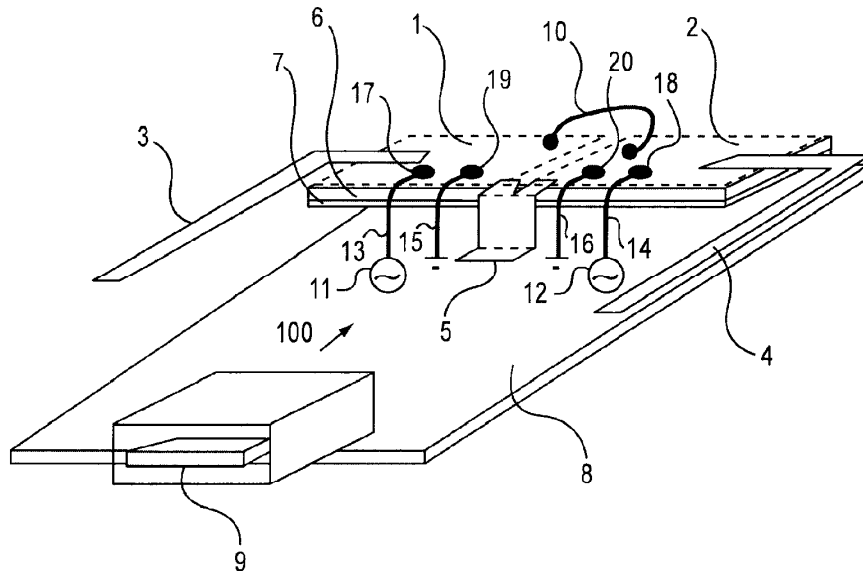
Primary Examiner — Hoang V Nguyen

(74) *Attorney, Agent, or Firm* — Arent Fox LLP

(57) **ABSTRACT**

An antenna device, including a radiating element having a feed portion and a floating conduction member, which is provided between the radiating element and a conduction board having a high-frequency signal source which generates high-frequency signals for supplying to the feed portion, and which is electrically floated.

17 Claims, 11 Drawing Sheets





US008144062B2

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

(10) **Patent No.:** **US 8,144,062 B2**
(45) **Date of Patent:** **Mar. 27, 2012**

(54) **MULTI-BAND ANTENNA**

(75) Inventors: **Yun-Lung Ke**, Tu-cheng (TW);
Chen-Ta Hung, Tu-cheng (TW);
Shu-Yean Wang, Tu-cheng (TW);
Chun-Ming Chiu, Tu-cheng (TW)

(73) Assignee: **Hon Hai Precision Ind. Co., Ltd.**, 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 676 days.

(21) Appl. No.: **12/313,951**

(22) Filed: **Nov. 26, 2008**

(65) **Prior Publication Data**

US 2009/0135072 A1 May 28, 2009

(30) **Foreign Application Priority Data**

Nov. 26, 2007 (TW) 96144716 A

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

(52) **U.S. Cl.** **343/702**; 343/700 MS; 343/825;
343/826

(58) **Field of Classification Search** 343/700 MS,
343/702, 825, 826
See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Jacob Y Choi

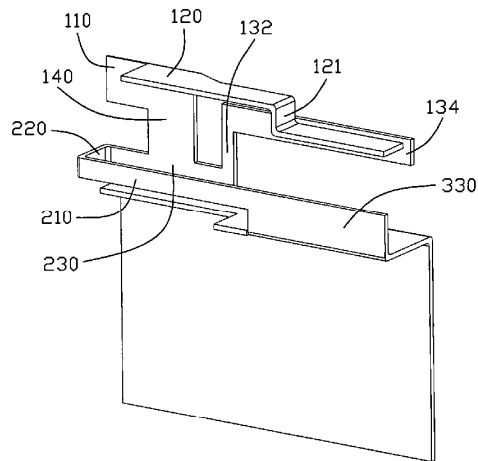
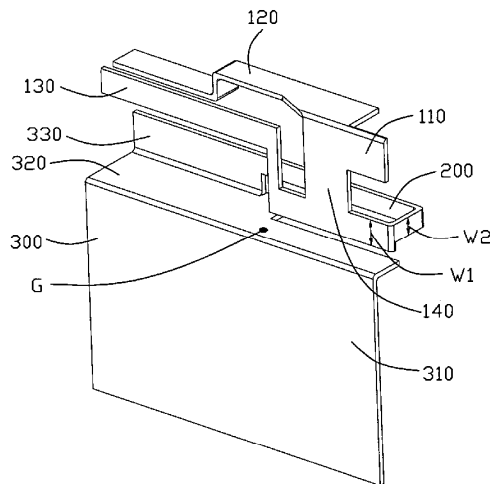
Assistant Examiner — Shawn Buchanan

(74) *Attorney, Agent, or Firm* — Wei Te Chung; Andrew C. Cheng; Ming Chieh Chang

(57) **ABSTRACT**

A multi-band antenna includes a grounding portion (300), a number of radiating members and a short-circuit portion (200). The short-circuit portion comprises a first short-circuit piece (210) connecting with the grounding portion and located in a first plane, a third short-circuit piece (230) located in a third plane and connecting with the radiating members, and a second short-circuit piece (220) connecting the first short-circuit piece with the third short-circuit piece and located in a second plane, with the first and third short-circuit pieces disposed on the same side of the second short-circuit piece. The radiating members comprises a first radiating member (110, 140) in the third plane and a second radiating member (120, 140) extending towards the first plane.

11 Claims, 6 Drawing Sheets





US008144064B2

(12) **United States Patent**
Milosevic

(10) **Patent No.:** **US 8,144,064 B2**
(45) **Date of Patent:** **Mar. 27, 2012**

(54) **PHYSICALLY SMALL TUNABLE NARROW BAND ANTENNA**

2006/0214857 A1 9/2006 Ollikainen
2008/0305749 A1* 12/2008 Ben-Bassat 455/77
2008/0305750 A1* 12/2008 Alon et al. 455/77

(75) Inventor: **Svetlan Milosevic**, Toronto (CA)

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(73) Assignee: **ATI Technologies ULC**, Markham, Ontario (CA)

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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 731 days.

(21) Appl. No.: **12/147,149**

(22) Filed: **Jun. 26, 2008**

(65) **Prior Publication Data**

US 2009/0322632 A1 Dec. 31, 2009

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

(52) **U.S. Cl.** **343/723; 343/703; 343/712; 343/745; 343/752**

(58) **Field of Classification Search** **343/700 MS, 343/702, 723, 745, 829, 846, 848, 703, 712, 343/752**

See application file for complete search history.

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Primary Examiner — Douglas W Owens

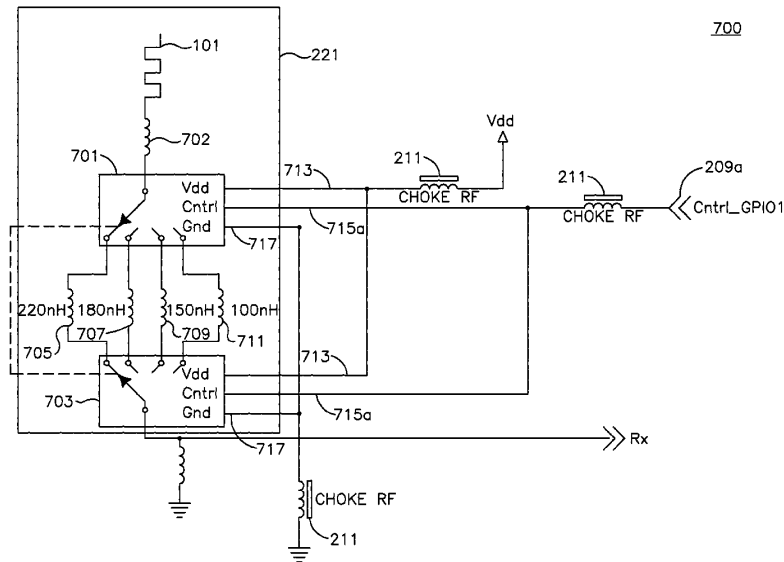
Assistant Examiner — Chuc Tran

(74) *Attorney, Agent, or Firm* — Volpe and Koenig, P.C.

(57) **ABSTRACT**

A narrow band, tunable antenna uses a series of small inductors wired in series to produce different resonant frequencies from a single antenna across a wide frequency spectrum. Radio Frequency (RF) switches are positioned in parallel with the inductors and are capable of shunting a selected inductor out of the antenna circuit thereby changing the electrical length of the antenna and consequently, the resonant frequency. The RF switch control circuitry is isolated from the RF current in the antenna.

12 Claims, 8 Drawing Sheets





US008144065B2

(12) **United States Patent**
Brown

(10) **Patent No.:** **US 8,144,065 B2**
(45) **Date of Patent:** **Mar. 27, 2012**

(54) **PLANAR COMPOUND LOOP ANTENNA**

(75) Inventor: **Forrest James Brown**, Carson City, NV (US)

(73) Assignee: **DockOn AG**, Zurich (CH)

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

(21) Appl. No.: **12/878,016**

(22) Filed: **Sep. 8, 2010**

(65) **Prior Publication Data**

US 2011/0018775 A1 Jan. 27, 2011

Related U.S. Application Data

(63) Continuation-in-part of application No. 12/921,124, filed as application No. PCT/GB2009/050296 on Mar. 26, 2009.

(60) Provisional application No. 61/303,594, filed on Feb. 11, 2010.

(30) **Foreign Application Priority Data**

Mar. 26, 2008 (GB) 0805393.6

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

(52) **U.S. Cl.** **343/726; 343/748**

(58) **Field of Classification Search** **343/726, 343/728, 729, 741, 748, 866**
See application file for complete search history.

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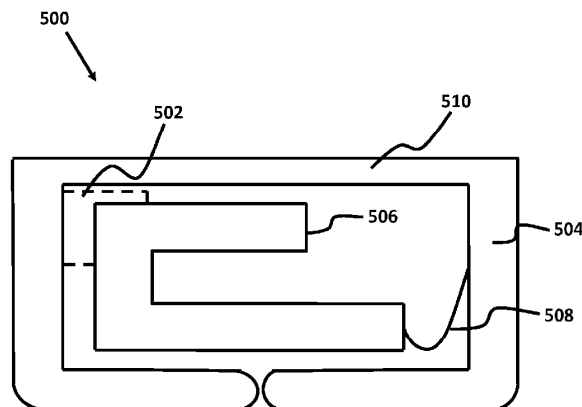
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(57) **ABSTRACT**

The present invention relates to planar compound field antennas. Improvements relate particularly, but not exclusively, to compound loop antennas having coplanar electric field radiators and magnetic loops with electric fields orthogonal to magnetic fields that achieve performance benefits in higher bandwidth (lower Q), greater radiation intensity/power/gain, and greater efficiency.

44 Claims, 11 Drawing Sheets





US008144071B2

(12) **United States Patent**
Thornell-Pers

(10) **Patent No.:** **US 8,144,071 B2**
(45) **Date of Patent:** **Mar. 27, 2012**

(54) **ANTENNA DEVICE AND PORTABLE RADIO COMMUNICATION DEVICE COMPRISING SUCH AN ANTENNA DEVICE**

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(76) Inventor: **Anders Thornell-Pers**, Beijing (CN)

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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 514 days.

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(52) **U.S. Cl.** **343/860**; 343/700 MS; 343/876;
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(58) **Field of Classification Search** 343/860
See application file for complete search history.

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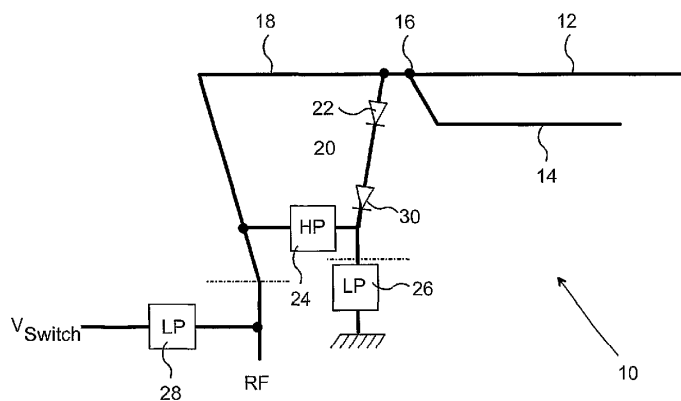
Primary Examiner — Trinh Dinh

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

(57) **ABSTRACT**

A quad-band antenna device (10) for a portable radio communication device comprises two radiating elements (12, 14) of different lengths and two common conductors (18, 20) of different lengths. One of the common conductors can be selectively connected in and out with respect to radio frequency signals in order to adjust the total electrical length of the antenna device, thereby making it operable in four different frequency bands.

19 Claims, 3 Drawing Sheets





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

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- (54) **MULTI-BAND ANTENNA FOR NOTEBOOK COMPUTER**
- (75) Inventors: **Chi-Ming Chiang**, Pa-Te (TW); **Daniel Chang**, Pa-Te (TW); **Shih-Chi Lai**, Pa-Te (TW)
- (73) Assignee: **Auden Techno Corp.**, Pa-Te, Tao-Yuan Hsien (TW)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 477 days.
- (21) Appl. No.: **12/535,605**
- (22) Filed: **Aug. 4, 2009**
- (65) **Prior Publication Data**
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- (51) **Int. Cl.**
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H01Q 1/38 (2006.01)
- (52) **U.S. Cl.** **343/860**; 343/702; 343/700 MS
- (58) **Field of Classification Search** 343/702, 343/700 MS, 745, 846, 828, 829, 831, 860
See application file for complete search history.

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(74) *Attorney, Agent, or Firm* — Guice Patents PLLC

(57) **ABSTRACT**
A multi-band antenna includes an insulative carrier board arranged on the top side of the display screen of a notebook computer, a main antenna which has the top metal strip thereof disposed at the top edge of the insulative carrier board and the grounding metal strip thereon arranged on the insulative carrier board, an inverted L antenna arranged on the insulative carrier board, a first capacitor, a second capacitor, an antenna feed-in terminal and/or an inductor set between the inverted L antenna and the main antenna to achieve optimal matching subject to adjustment of the capacitance values of the first and second capacitors and the inductance value and position of the inductor.

10 Claims, 8 Drawing Sheets

