



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)

U.S. PATENT DOCUMENTS

7,728,776 B2 * 6/2010 Lin et al. 343/702
7,994,988 B2 * 8/2011 Wu et al. 343/702
2005/0116865 A1 * 6/2005 Fang et al. 343/702
2010/0060525 A1 * 3/2010 Yang et al. 343/700 MS
* cited by examiner

(73) Assignee: **Cheng Uei Precision Industry 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 490 days.

Primary Examiner — Jacob Y Choi
Assistant Examiner — Robert Karacsony

(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**

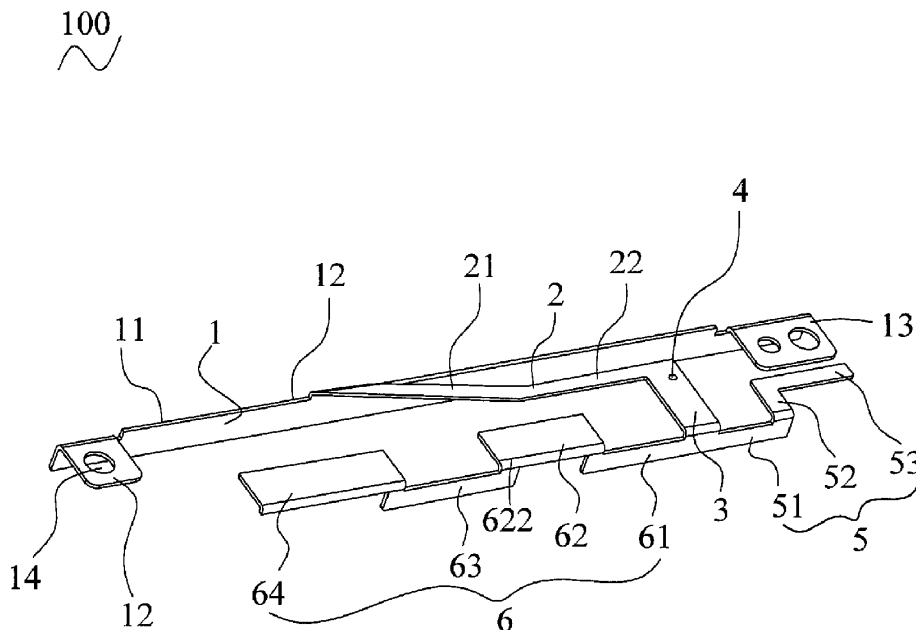
(58) **Field of Classification Search** 343/700 MS, 343/702, 846

See application file for complete search history.

(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.

4 Claims, 5 Drawing Sheets



Acrobat 文件



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)

(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 247 days.

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

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

(65) **Prior Publication Data**

US 2010/0149046 A1 Jun. 17, 2010

(30) **Foreign Application Priority Data**

Dec. 17, 2008 (TW) 97149287 A

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

(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.

U.S. PATENT DOCUMENTS

6,388,626	B1 *	5/2002	Gamalielsson et al.	343/702
6,563,042	B2 *	5/2003	Barabash	174/359
7,009,563	B2 *	3/2006	Mori et al.	343/700 MS
7,825,862	B2 *	11/2010	Cheng et al.	343/702
2002/0172023	A1 *	11/2002	Blakely et al.	361/763
2008/0165067	A1 *	7/2008	Kim	343/702
2009/0115669	A1 *	5/2009	Cheng	343/702

* cited by examiner

Primary Examiner — Douglas W Owens

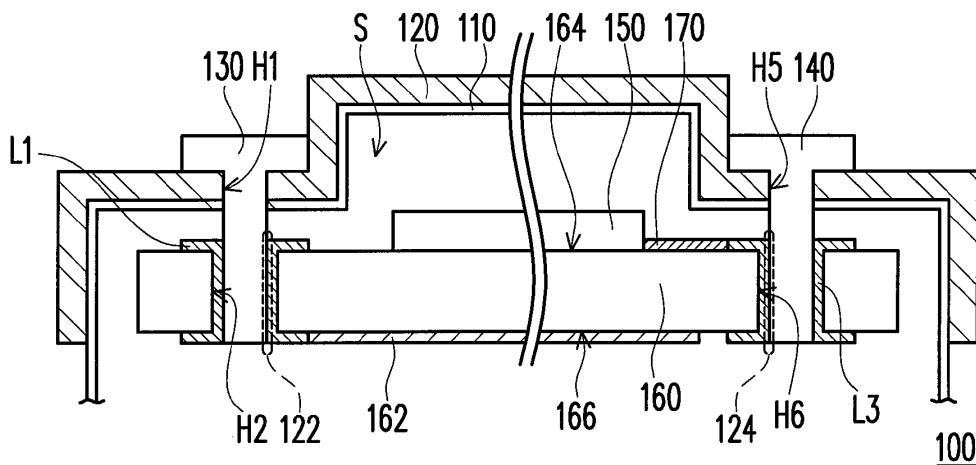
Assistant Examiner — Jennifer F Hu

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

(57) **ABSTRACT**

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.

16 Claims, 3 Drawing Sheets



Acrobat 文件



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**

U.S. PATENT DOCUMENTS

3,184,747 A *	5/1965	Kach	343/840
3,521,284 A	7/1970	Shelton, Jr. et al.	
3,599,214 A	8/1971	Altmayer	
3,622,890 A	11/1971	Fujimoto et al.	
3,683,376 A	8/1972	Pronovost	
3,771,162 A *	11/1973	Dienes	343/806
4,024,542 A	5/1977	Ikawa et al.	
4,403,222 A	9/1983	Bitter, Jr. et al.	
4,471,493 A	9/1984	Schober	
4,504,834 A	3/1985	Garay et al.	
4,543,581 A	9/1985	Nemet	

(Continued)

FOREIGN PATENT DOCUMENTS

EP 0543645 5/1993

(Continued)

OTHER PUBLICATIONS

Microwave Journal, May 1984, p. 242, advertisement of Solitron/Microwave, XP002032716.

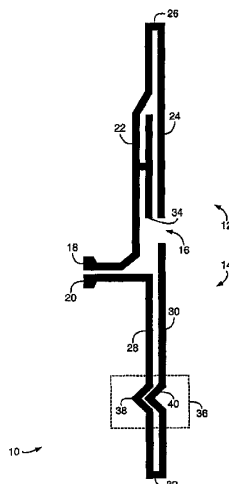
Primary Examiner — Tho G Phan

(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



Acrobat 文件



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**

U.S. PATENT DOCUMENTS

5,374,937 A * 12/1994 Tsunekawa et al. 343/702
5,412,392 A * 5/1995 Tsunekawa 343/702
7,262,739 B2 * 8/2007 Chen 343/725
7,659,793 B2 * 2/2010 Fukushima 333/17.1
2008/0062054 A1 * 3/2008 Ke et al. 343/730

FOREIGN PATENT DOCUMENTS

TW 560706 1/2003
TW 1276251 1/2006

* cited by examiner

Primary Examiner — Jacob Y Choi

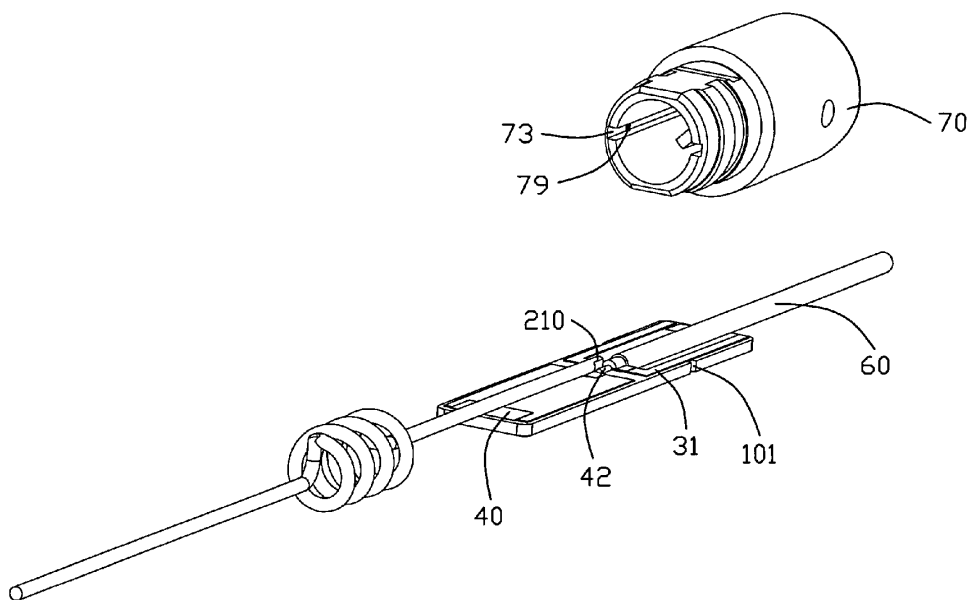
Assistant Examiner — Shawn Buchanan

(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



Acrobat 文件



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**

U.S. PATENT DOCUMENTS

2,615,005 A * 10/1952 White 343/817
5,001,492 A * 3/1991 Shapiro et al. 343/700 MS
5,270,722 A 12/1993 Delestre
5,444,453 A * 8/1995 Lalezari 343/700 MS
5,745,079 A 4/1998 Wang et al.
5,880,694 A * 3/1999 Wang et al. 343/700 MS
6,717,549 B2 4/2004 Rawnick et al.

6,844,852 B1 * 1/2005 Simons 343/700 MS
7,084,815 B2 * 8/2006 Phillips et al. 343/700 MS
7,403,159 B2 7/2008 Gooshchin
7,446,712 B2 * 11/2008 Itoh et al. 343/700 MS
7,468,699 B2 * 12/2008 Manholm et al. 343/700 MS
7,619,568 B2 * 11/2009 Gillette 343/700 MS
7,623,073 B2 * 11/2009 Teshirogi et al. 343/700 MS
7,667,650 B2 * 2/2010 Tiezzi et al. 343/700 MS
2003/0201937 A1 10/2003 Lee
2007/0290939 A1 12/2007 Teshirogi et al.
2008/0169992 A1 * 7/2008 Ortiz et al. 343/767
2008/0238793 A1 10/2008 Channabasappa
2009/0051598 A1 * 2/2009 McCarrick et al. 343/700 MS
2009/0128413 A1 * 5/2009 Crouch et al. 343/700 MS

OTHER PUBLICATIONS

International Search Report dated Dec. 22, 2009 for related applica-
tion PCT/US2009/061835.

* cited by examiner

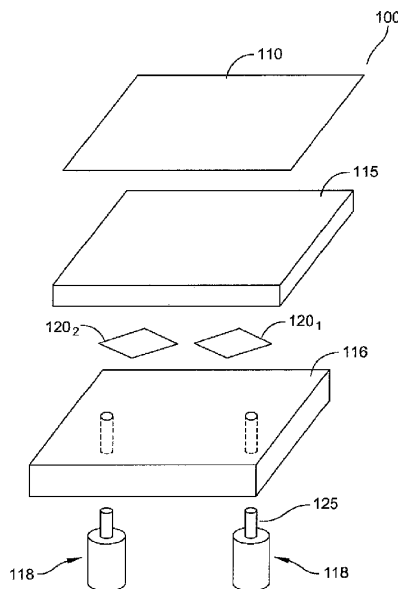
Primary Examiner — Trinh Dinh

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

(57) **ABSTRACT**

A microstrip patch antenna comprises a patch antenna ele-
ment 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



Acrobat 文件



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**

U.S. PATENT DOCUMENTS

7,289,071 B2 10/2007 Hung et al.
7,466,272 B1 * 12/2008 Su et al. 343/700 MS

7,932,861 B2 * 4/2011 Hung et al. 343/700 MS
2004/0233109 A1 11/2004 Ying
2006/0262016 A1 * 11/2006 Hung et al. 343/702
2007/0257847 A1 * 11/2007 Su et al. 343/700 MS
2007/0285321 A1 * 12/2007 Chung et al. 343/702
2009/0146884 A1 * 6/2009 Lee et al. 343/700 MS

* cited by examiner

Primary Examiner — Jacob Y Choi

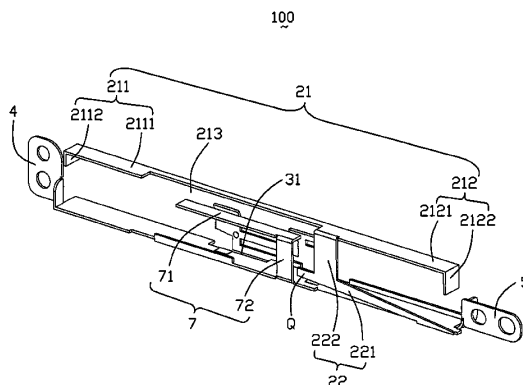
Assistant Examiner — Shawn Buchanan

(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 radiating section of the second radiating element of the second antenna and the grounding element in a vertical direction.

20 Claims, 4 Drawing Sheets



Acrobat 文件



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**

US 2009/0256770 A1 Oct. 15, 2009

(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**

U.S. PATENT DOCUMENTS

6,864,842 B2 * 3/2005 Hung et al. 343/700 MS

* cited by examiner

Primary Examiner — Hoang V Nguyen

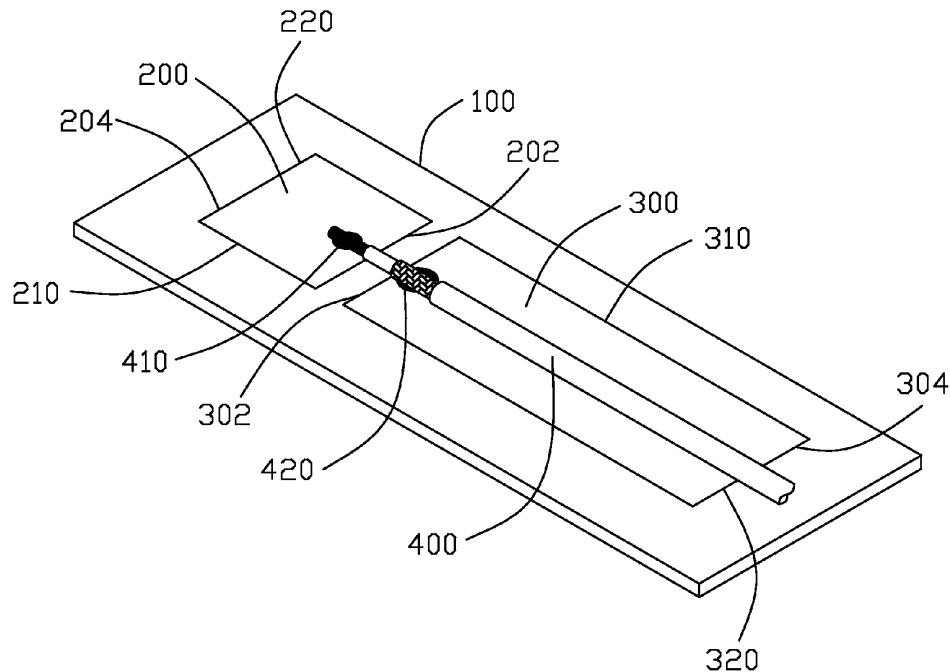
(74) *Attorney, Agent, or Firm* — Wei Te Chung; Andrew C. Cheng; Ming Chieh Chang

(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

1



Acrobat 文件



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**

US 2009/0295647 A1 Dec. 3, 2009

(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.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,796,578 A 8/1998 Jones
6,215,454 B1 * 4/2001 Tran 343/841

6,392,603 B1 * 5/2002 Kurz et al. 343/702
7,102,577 B2 9/2006 Richard
2004/0085248 A1 * 5/2004 Onaka et al. 343/702
2004/0203510 A1 * 10/2004 Claxton et al. 455/90.3
2006/0089682 A1 4/2006 Kronich
2007/0063904 A1 * 3/2007 Chen et al. 343/702
2008/0081657 A1 4/2008 Suzuki

FOREIGN PATENT DOCUMENTS

JP 10-084406 A 3/1998
KR 10-2003-0076039 A 9/2003

OTHER PUBLICATIONS

PCT Search Report Dated Dec. 24, 2009.

* cited by examiner

Primary Examiner — Douglas W Owens

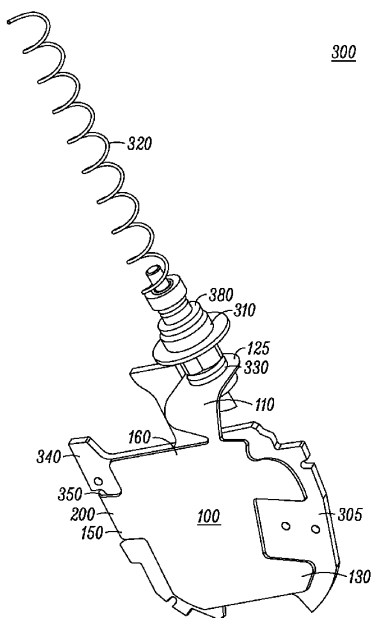
Assistant Examiner — Dieu H Duong

(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



Acrobat 文件



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.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,083,006 A * 4/1978 Yokoshima 455/115.1
6,243,045 B1 * 6/2001 Ishibashi 343/741
6,590,542 B1 * 7/2003 Briggs 343/742

FOREIGN PATENT DOCUMENTS

JP 2006-19979 A 1/2006

* cited by examiner

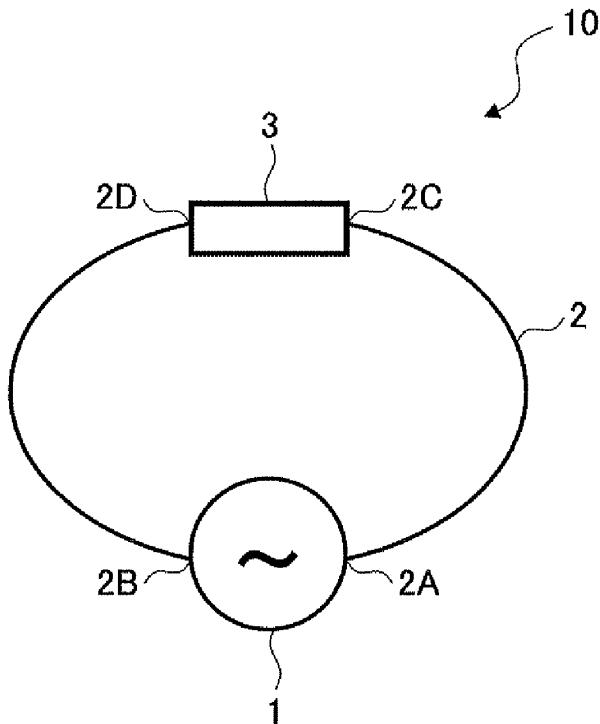
Primary Examiner — Hoang V Nguyen

(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 ele-
ment.

3 Claims, 9 Drawing Sheets



Acrobat 文件



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.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,812,855 A * 3/1989 Coe et al. 343/818
6,067,053 A 5/2000 Runyon et al.
6,670,923 B1 12/2003 Kadambi et al.

7,215,285 B2 * 5/2007 Song et al. 343/700 MS
2003/0218571 A1 * 11/2003 Yoon et al. 343/700 MS
2004/0125031 A1 7/2004 Jo et al.
2006/0290573 A1 12/2006 Puente Baliarda et al.
2009/0096698 A1 * 4/2009 Semonov et al. 343/795

OTHER PUBLICATIONS

PCT International Search Report and Written Opinion of the International Search Authority for Application No. PCT/US08/10851 dated Nov. 25, 2008.

* cited by examiner

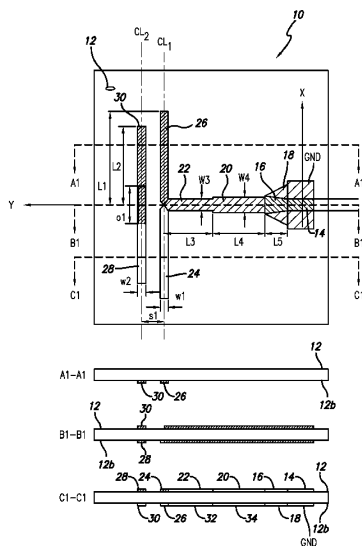
Primary Examiner — Tan Ho

(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



Acrobat 文件



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**

U.S. PATENT DOCUMENTS

6,624,789	B1 *	9/2003	Kangasvieri et al.	343/702
7,289,068	B2 *	10/2007	Fujio et al.	343/700 MS
7,535,422	B2 *	5/2009	Liu et al.	343/702
7,579,991	B2 *	8/2009	Mitsui	343/700 MS
7,808,438	B2 *	10/2010	Schlub et al.	343/702
7,898,485	B2 *	3/2011	Schlub et al.	343/702
7,928,923	B2 *	4/2011	Udagawa et al.	343/841
2009/0153404	A1 *	6/2009	Ryou et al.	343/700 MS

* cited by examiner

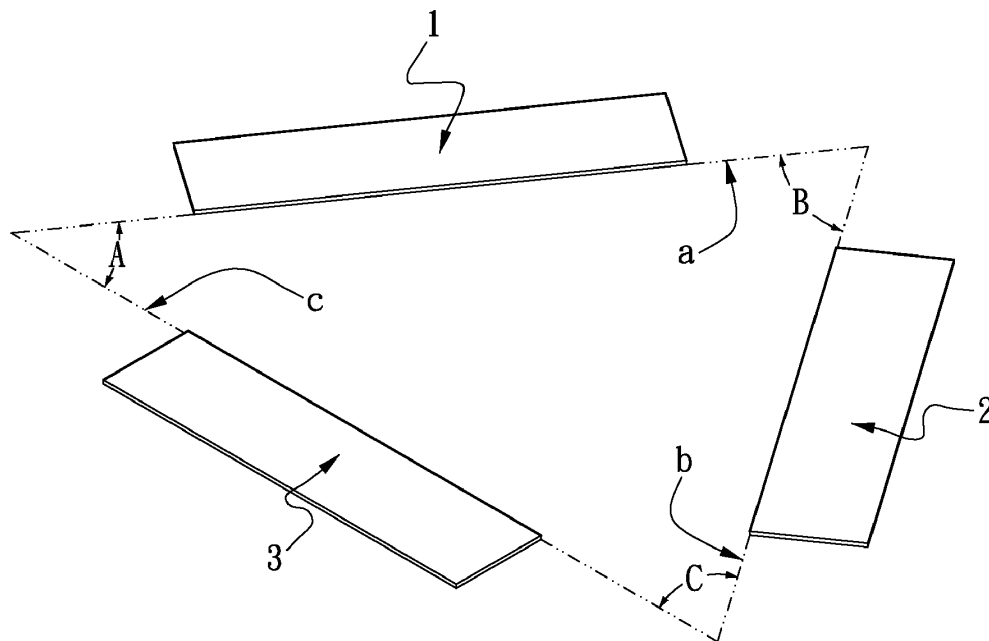
Primary Examiner — Huedung Mancuso

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

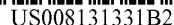
(57) **ABSTRACT**

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



Acrobat 文件



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

(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.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,335,368 A 8/1994 Tamura
6,229,489 B1* 5/2001 Holshouser et al. 343/702
(Continued)

FOREIGN PATENT DOCUMENTS

JP 4354425 A 12/1992
(Continued)

OTHER PUBLICATIONS

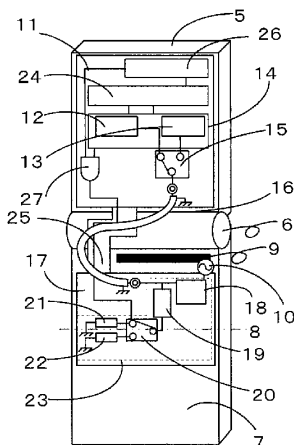
International Search Report relating to International Application No.
PCT/JP2008/003930, mailed Apr. 7, 2009, 4 pages.

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



Acrobat 文件



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.

(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.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,599,220 A 8/1971 Dempsey
4,008,479 A 2/1977 Smith
4,554,554 A 11/1985 Olesen et al.
4,608,574 A 8/1986 Webster et al.
5,191,352 A 3/1993 Branson
5,346,300 A 9/1994 Yamamoto et al.

5,349,365 A 9/1994 Ow et al.
5,635,945 A 6/1997 McConnell et al.
5,838,282 A 11/1998 Lalezari et al.
5,854,609 A 12/1998 Pyo et al.
5,945,963 A 8/1999 Leisten
5,963,180 A 10/1999 Leisten
6,011,524 A 1/2000 Jervis
6,031,495 A 2/2000 Simmons et al.
6,094,178 A 7/2000 Sanford
6,133,891 A 10/2000 Josypenko
6,150,984 A 11/2000 Suguro et al.
6,229,488 B1 5/2001 Lin et al.
6,229,499 B1 5/2001 Licul et al.
6,232,929 B1 5/2001 Ermutlu et al.
6,281,859 B1 8/2001 Winter et al.

(Continued)

FOREIGN PATENT DOCUMENTS

CN 2899134 Y 5/2007

(Continued)

OTHER PUBLICATIONS

International Search Report from PCT/GB2007/004748, Jul. 30, 2008.

(Continued)

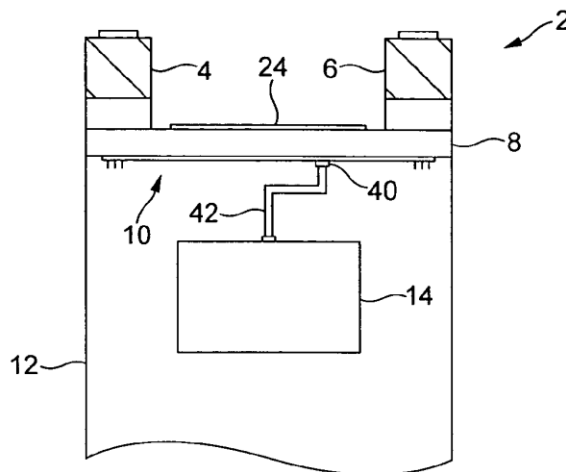
Primary Examiner — Dieu H Duong

(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



Acrobat 文件



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**

U.S. PATENT DOCUMENTS

2008/0150815 A1 *	6/2008	Nakahata et al.	343/718
2008/0182539 A1 *	7/2008	Hata et al.	455/269
2009/0174612 A1 *	7/2009	Ayala et al.	343/702

* cited by examiner

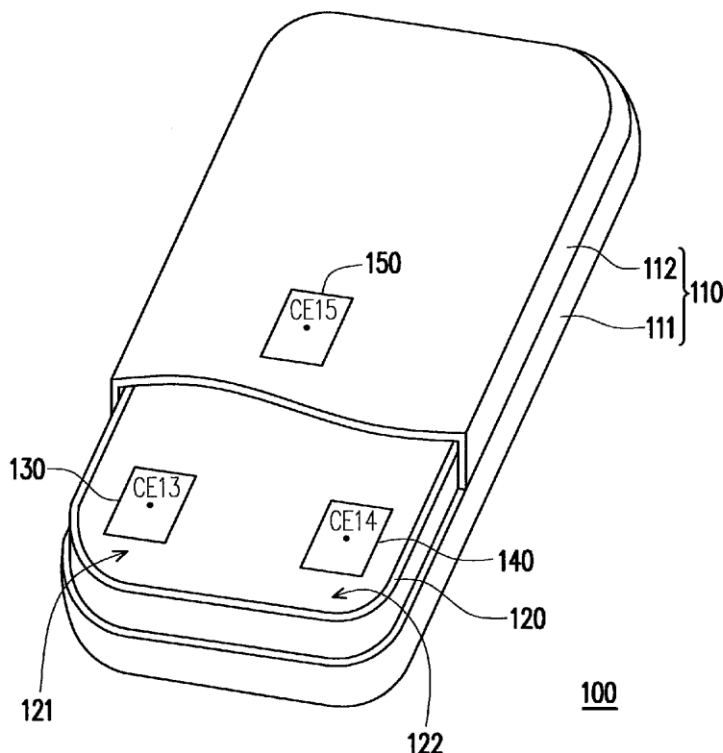
Primary Examiner — Tho G Phan

(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



Acrobat 文件



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)

* cited by examiner

(*) 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**

(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.

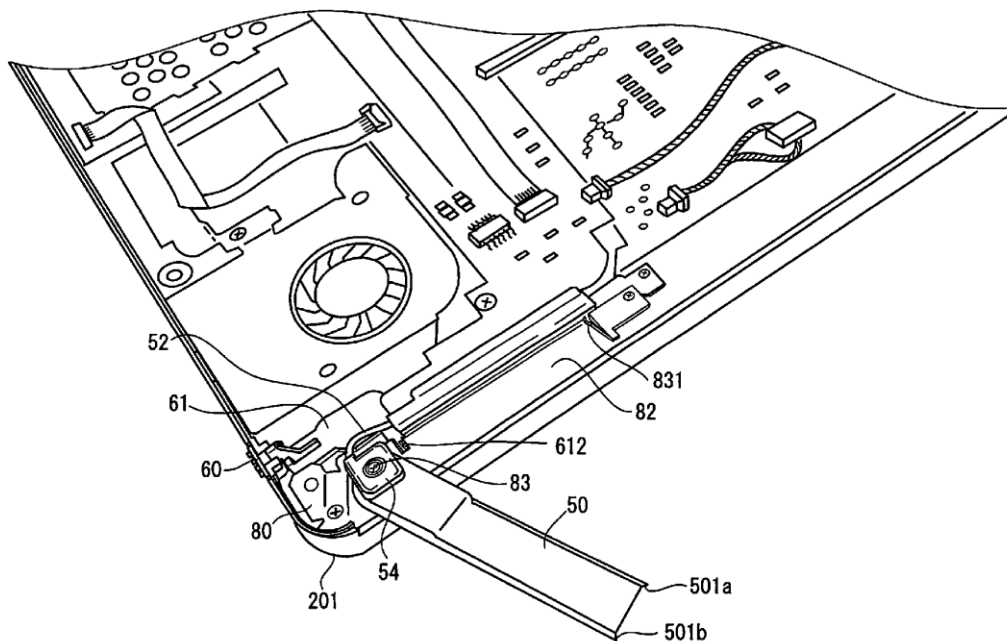
(56) **References Cited**

U.S. PATENT DOCUMENTS

7,050,008 B2 * 5/2006 Saito et al. 343/702
7,450,075 B2 * 11/2008 Kim et al. 343/702
2009/0033571 A1 * 2/2009 Wang 343/702

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.

8 Claims, 19 Drawing Sheets



Acrobat 文件



US008134517B2

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

(10) **Patent No.:** **US 8,134,517 B2**
(45) **Date of Patent:** **Mar. 13, 2012**

(54) **WIDE-BAND PLANAR ANTENNA**

(56) **References Cited**

(75) Inventors: **Chih-Ming Wang**, Taipei (TW);
Shang-Ching Tseng, Taipei (TW)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 407 days.

(21) Appl. No.: **12/567,417**

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

(65) **Prior Publication Data**

US 2010/0103069 A1 Apr. 29, 2010

(30) **Foreign Application Priority Data**

Oct. 28, 2008 (TW) 97141365 A

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

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

(58) **Field of Classification Search** 343/846,
343/702, 700 MS, 848, 850, 853
See application file for complete search history.

U.S. PATENT DOCUMENTS

6,373,436	B1 *	4/2002	Chen et al.	343/702
6,861,986	B2	3/2005	Fang et al.	
7,218,282	B2 *	5/2007	Humpfer et al.	343/700 MS
7,400,302	B2 *	7/2008	Winter	343/702
2005/0190110	A1 *	9/2005	Taromaru et al.	343/702
2011/0234470	A1 *	9/2011	Chen	343/895

FOREIGN PATENT DOCUMENTS

TW	I295517	4/2008
TW	200824189	6/2008

* cited by examiner

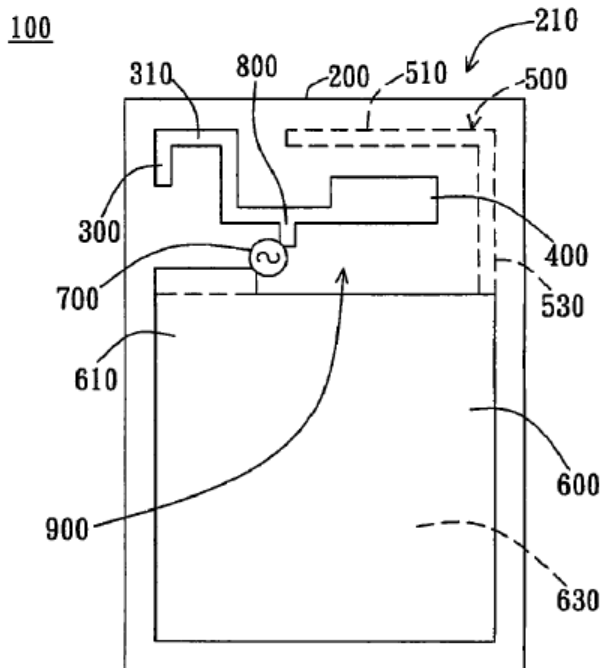
Primary Examiner — Huedung Mancuso

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

(57) **ABSTRACT**

The invention relates to a wide-band planar antenna. The wide-band planar antenna includes a substrate, a first radiator, a second radiator, a third radiator, a ground, and a signal source. The first radiator, the second radiator, and the third radiator are designed in a manner that the antenna of the invention can be applied to WiMAX communication devices. Besides, the wide-band planar antenna of the invention is more efficient than a general wide-band antenna and saves a significant amount of electrical power, and therefore, the antenna is particularly suitable for portable communicational devices.

16 Claims, 11 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.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,011,517 A	1/2000	Skurski	
6,054,955 A	4/2000	Schlegel, Jr. et al.	
6,348,894 B1	2/2002	Lahti	
6,642,907 B2 *	11/2003	Hamada et al.	343/873
6,879,293 B2 *	4/2005	Sato	343/702
7,080,787 B2	7/2006	Wulff et al.	
7,158,083 B2 *	1/2007	Satoh et al.	343/702
7,164,387 B2	1/2007	Sievenpiper	
2003/0124985 A1	7/2003	Shin et al.	

2004/0178957 A1	9/2004	Chang et al.	
2004/0223004 A1	11/2004	Lincke et al.	
2005/0017902 A1	1/2005	Oyama et al.	
2006/0066490 A1	3/2006	Ku et al.	
2007/0080865 A1 *	4/2007	Huang et al.	343/700 MS
2007/0135181 A1	6/2007	Ohki et al.	
2007/0296638 A1 *	12/2007	Kim et al.	343/702
2008/0001822 A1 *	1/2008	Vesterinen	343/700 MS
2008/0048929 A1 *	2/2008	Channabasappa	343/895

FOREIGN PATENT DOCUMENTS

CN	1520131	8/2004
EP	1 445 824 A	8/2004
EP	1 478 047 A1	11/2004
GB	2 434 697 A	8/2007
KR	10 2007 047 383 A	5/2007
WO	03/044891 A	5/2003

* cited by examiner

Primary Examiner — Jacob Y Choi

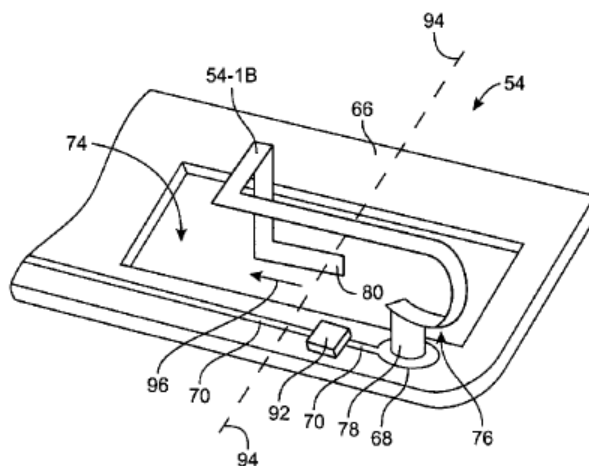
Assistant Examiner — Robert Karacsony

(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**

(56) **References Cited**

(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.

U.S. PATENT DOCUMENTS

5,907,306	A *	5/1999	Karabinis et al.	343/702
6,107,969	A *	8/2000	Gulino et al.	343/702
6,181,284	B1	1/2001	Madsen et al.	
6,232,924	B1 *	5/2001	Winstead et al.	343/702
6,266,017	B1	7/2001	Aldous	
6,297,779	B1	10/2001	Tsai	
6,359,591	B1 *	3/2002	Mou	343/702
7,167,726	B2	1/2007	Ghosh et al.	
7,579,993	B2 *	8/2009	Lev et al.	343/702

* cited by examiner

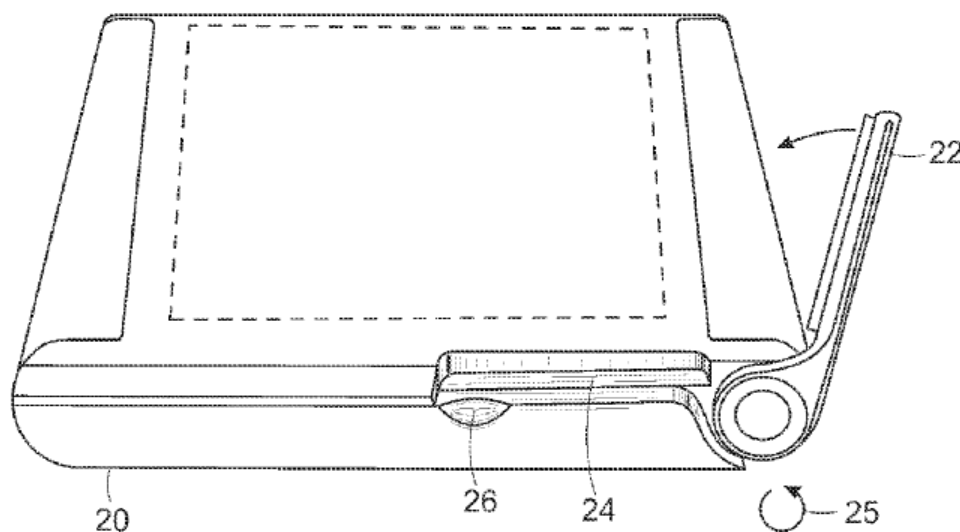
Primary Examiner — Huedung Mancuso

(74) *Attorney, Agent, or Firm* — Charles D. Huston; Daffier
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.

(21) Appl. No.: **12/279,758**

(22) PCT Filed: **Feb. 22, 2007**

(86) PCT No.: **PCT/JP2007/053319**

§ 371 (c)(1),

(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

(30) **Foreign Application Priority Data**

Feb. 24, 2006 (JP) 2006-049061

(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.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,573,628 A * 4/1971 Cramer et al. 343/702
5,517,676 A * 5/1996 Sekine et al. 455/575.5

6,055,422 A 4/2000 Saitoh
6,224,409 B1 * 5/2001 Chang 439/188
6,932,626 B2 * 8/2005 Costello et al. 439/108
7,053,837 B2 * 5/2006 Il et al. 343/700 MS
7,068,229 B2 * 6/2006 Lin 343/702
2001/0011963 A1 * 8/2001 Waters 343/767
2004/0119654 A1 6/2004 Koyama 343/846
2006/0017625 A1 * 1/2006 Tanaka et al. 343/702
2007/0188391 A1 * 8/2007 Tu et al. 343/702

FOREIGN PATENT DOCUMENTS

EP 1 398 847 A1 3/2004
GB 2312596 A 10/1997
JP 9-83229 3/1997
JP 9-289483 11/1997
JP 9-331282 12/1997
JP 11-298231 10/1999
JP 2000216716 A 8/2000
JP 2000286767 A 10/2000
JP 2000-307339 11/2000
JP 2002-171109 6/2002
JP 2003046407 A 2/2003
JP 2003-008320 10/2003
JP 2004-159288 6/2004
JP 2004-364149 12/2004
JP 2005151194 A 6/2005
JP 2006-33355 2/2006

* cited by examiner

Primary Examiner — Jacob Y Choi

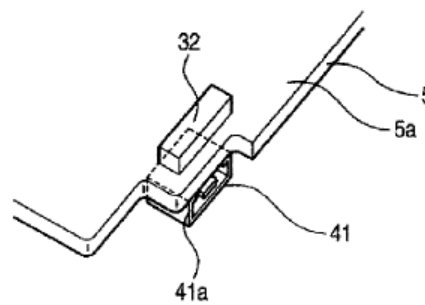
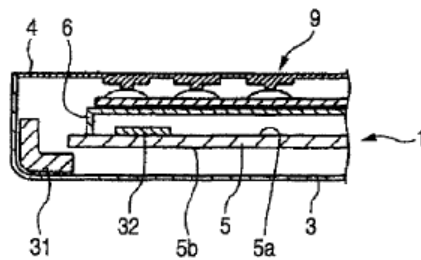
Assistant Examiner — Robert Karacsony

(74) *Attorney, Agent, or Firm* — DLA Piper LLP (US)

(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.

5 Claims, 5 Drawing Sheets



Acrobat 文件



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**

U.S. PATENT DOCUMENTS

6,456,248 B2 9/2002 Ito
6,940,460 B2 9/2005 Maoz et al.

7,151,955 B2 12/2006 Huber et al.
7,253,773 B2 8/2007 Chiba et al.
7,423,605 B2 * 9/2008 Qi et al. 343/818
7,804,451 B2 9/2010 Glocker et al.
7,859,467 B2 * 12/2010 Imano et al. 343/702

(Continued)

FOREIGN PATENT DOCUMENTS

CN 1329449 A 1/2002

(Continued)

OTHER PUBLICATIONS

Chinese Office Action in corresponding Chinese Patent Application No. 200580021352.4 mailed Apr. 29, 2010.

(Continued)

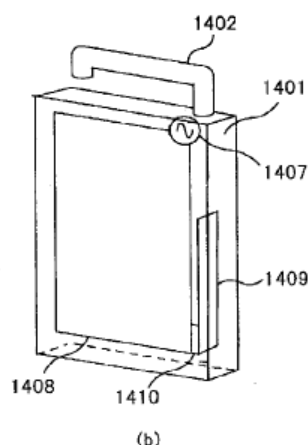
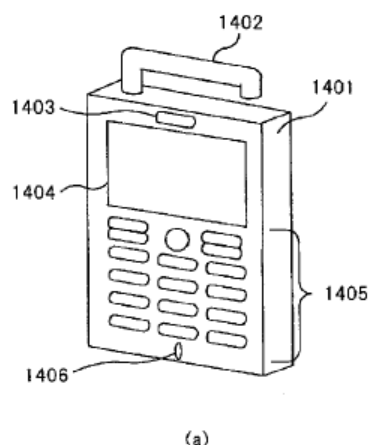
Primary Examiner — Trinh V Dinh

(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



Acrobat 文件



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.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,571,595	A	2/1986	Phillips et al.	
6,039,583	A	3/2000	Korsunsky et al.	
6,340,952	B1	1/2002	Tsai et al.	
6,466,176	B1	10/2002	Maoz et al.	
6,480,155	B1	11/2002	Eggleston	
6,614,399	B2 *	9/2003	Trumbull et al.	343/702
6,639,560	B1	10/2003	Kadambi et al.	
6,717,494	B2	4/2004	Kikuchi et al.	
6,759,989	B2 *	7/2004	Tarvas et al.	343/700 MS
6,791,498	B2	9/2004	Boyle et al.	
6,940,460	B2	9/2005	Maoz et al.	

(Continued)

FOREIGN PATENT DOCUMENTS

CA 2416437 A1 1/2002

(Continued)

OTHER PUBLICATIONS

Lindberg, P.; Öjefors, E., A bandwidth enhancement technique for mobile handset antennas using wavetraps, IEEE Transactions on antennas and propagation, vol. 54, No. 8, Aug. 2006.

(Continued)

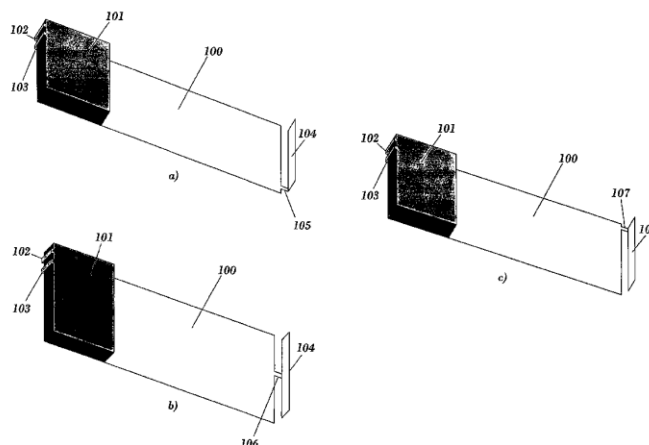
Primary Examiner — Hoang V Nguyen

(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



Acrobat 文件



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.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,696,942	B2 *	4/2010	Kim et al.	343/767
2005/0088354	A1 *	4/2005	Chang	343/767
2009/0079647	A1 *	3/2009	Jung et al.	343/767
2009/0128434	A1 *	5/2009	Chang et al.	343/767

OTHER PUBLICATIONS

Chung, et al. Five-Band Planar Antenna for Laptop Applications, Industrial Technology R&D Master Program of Electrical and Computer Engineering College, National Chiao Tung University, Jun. 2008.

* cited by examiner

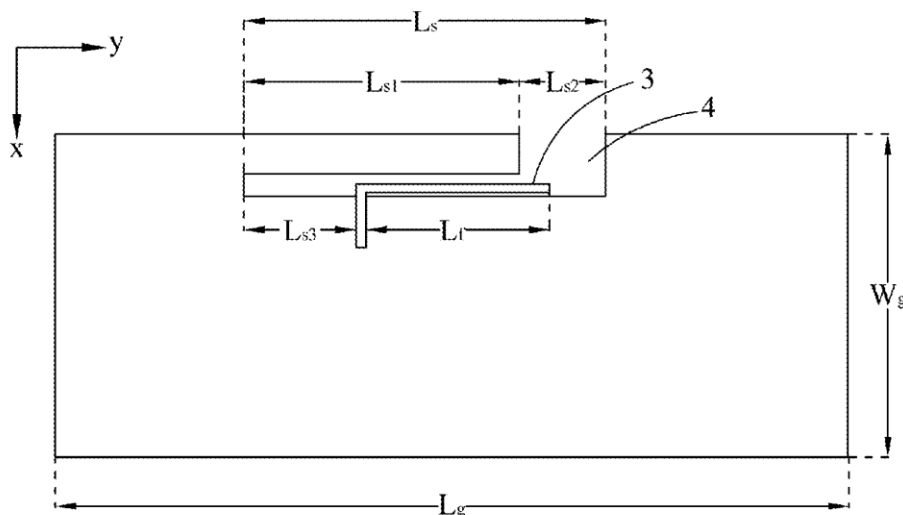
Primary Examiner — Tan Ho

(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



Acrobat 文件



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**

(56) **References Cited**

(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.

U.S. PATENT DOCUMENTS

7,843,390	B2	11/2010	Liu	
2003/0210193	A1 *	11/2003	Rossman et al.	343/725
2004/0087341	A1	5/2004	Edvardsson	
2004/0125020	A1 *	7/2004	Hendler et al.	343/700 MS
2005/0007293	A1 *	1/2005	Handelsman	343/867

OTHER PUBLICATIONS

An International Preliminary Report on Patentability, dated Jan. 27, 2011, which issued during the prosecution of Applicant's PCT/IL09/000491.

* cited by examiner

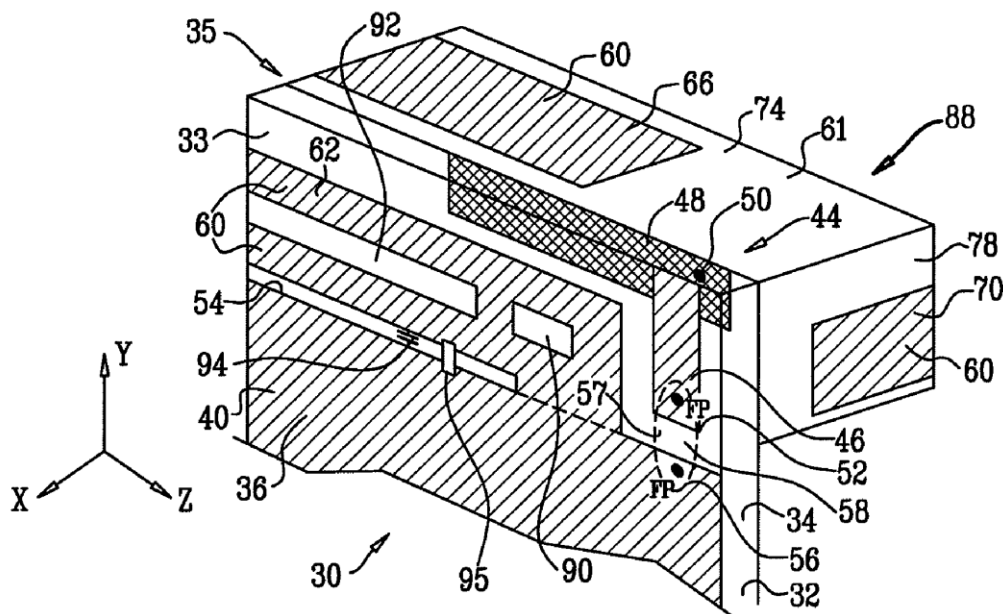
Primary Examiner — Huedung Mancuso

(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



Acrobat 文件



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**

U.S. PATENT DOCUMENTS

5,596,487 A *	1/1997	Castaneda et al.	361/814
7,787,255 B2 *	8/2010	Tsai et al.	361/753
7,801,577 B2 *	9/2010	Lee	455/575.1

* cited by examiner

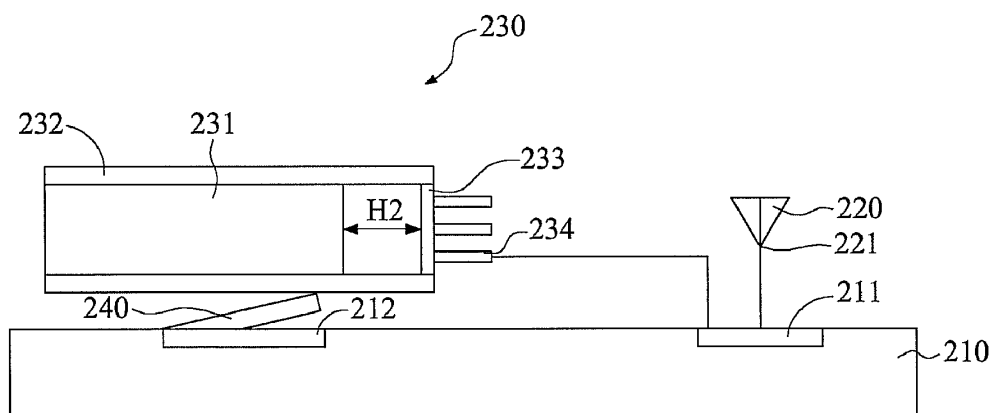
Primary Examiner — Khai M Nguyen

(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



Acrobat 文件



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.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,486,836 A 1/1996 Kuffner et al.
6,266,026 B1 7/2001 Stengel, Jr.

6,381,471 B1 4/2002 Dvorkin
6,448,932 B1 * 9/2002 Stoilkovic et al. 343/700 MS
6,512,489 B2 1/2003 Boyle
7,155,252 B2 12/2006 Martin et al.
7,289,068 B2 * 10/2007 Fujio et al. 343/700 MS
2009/0040109 A1 * 2/2009 Iguchi et al. 343/700 MS

* cited by examiner

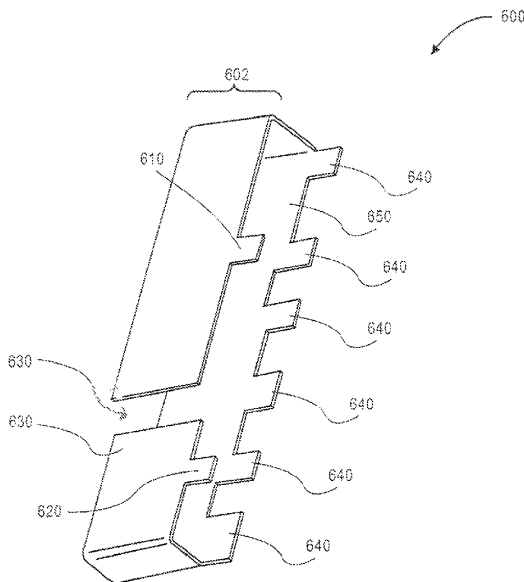
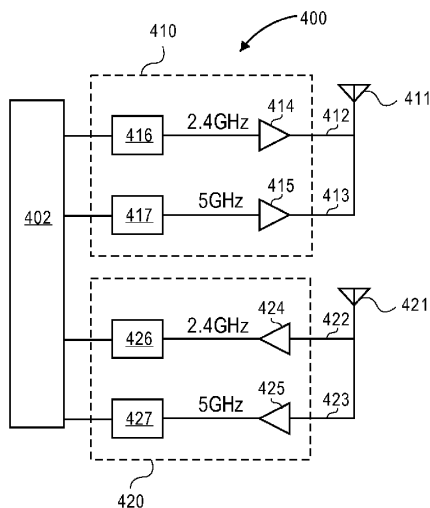
Primary Examiner — Tan Ho

(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



Acrobat 文件



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.

6,392,601 B1 *	5/2002	Ku et al.	343/700 MS
6,914,570 B2 *	7/2005	Asrani et al.	343/702
7,202,818 B2 *	4/2007	Anguera Pros et al.	343/700 MS
7,233,291 B2 *	6/2007	Elkobi et al.	343/702
7,446,712 B2 *	11/2008	Itoh et al.	343/700 MS
7,821,460 B2 *	10/2010	Schillmeier et al.	343/700 MS
2009/0058731 A1 *	3/2009	Geary et al.	343/700 MS

FOREIGN PATENT DOCUMENTS

JP	2007-13643 A	1/2007
JP	2007-142878 A	6/2007

OTHER PUBLICATIONS

Kim, Yongho et al.; "Study and Reduction of the Manual Coupling
between Two L-shaped Folded Monopole Antennas for Handset";
Technical Report of IEICE; Mar. 27, 2007.
Korean Office Action dated Aug. 23, 2011 with English Translation.

* cited by examiner

(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.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,051,477 A *	9/1977	Murphy et al.	343/700 MS
4,401,988 A *	8/1983	Kaloi 343/700 MS	

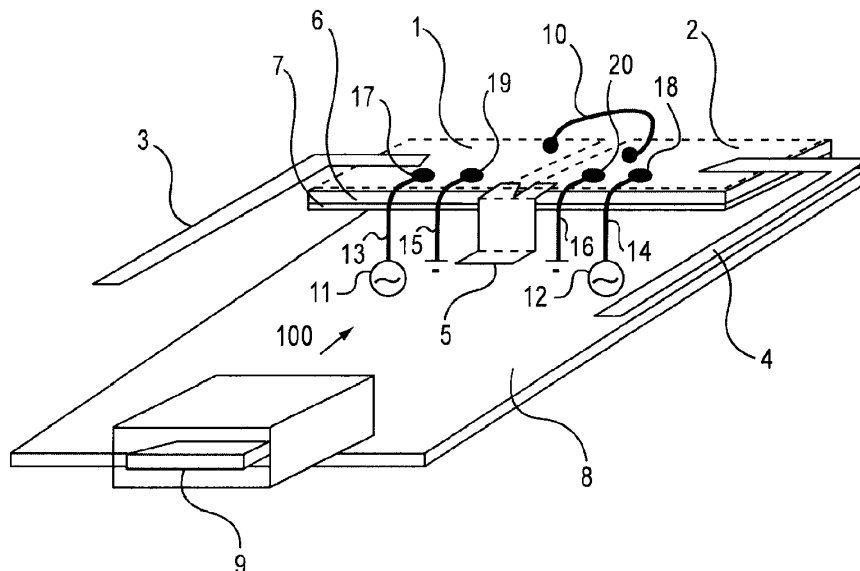
Primary Examiner — Hoang V Nguyen

(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



Acrobat 文件



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**

U.S. PATENT DOCUMENTS

6,714,162 B1 * 3/2004 Kadambi et al. 343/700 MS
6,897,810 B2 * 5/2005 Dai et al. 343/700 MS

7,289,071 B2 10/2007 Hung et al.
7,495,630 B2 * 2/2009 Hu et al. 343/846
7,535,422 B2 * 5/2009 Liu et al. 343/702
7,671,810 B2 * 3/2010 Yu 343/702
7,705,784 B2 * 4/2010 Lai et al. 343/700 MS
7,728,776 B2 * 6/2010 Lin et al. 343/702
7,825,859 B2 * 11/2010 Teshima 343/700 MS
7,893,877 B2 * 2/2011 Wang et al. 343/700 MS
2007/0040750 A1 * 2/2007 Tai et al. 343/700 MS
2007/0040754 A1 2/2007 Liu et al.
2007/0060222 A1 3/2007 Finn et al.
2007/0096999 A1 5/2007 Wang et al.

* cited by examiner

Primary Examiner — Jacob Y Choi

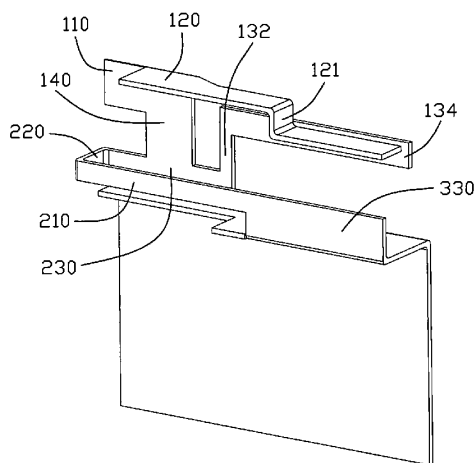
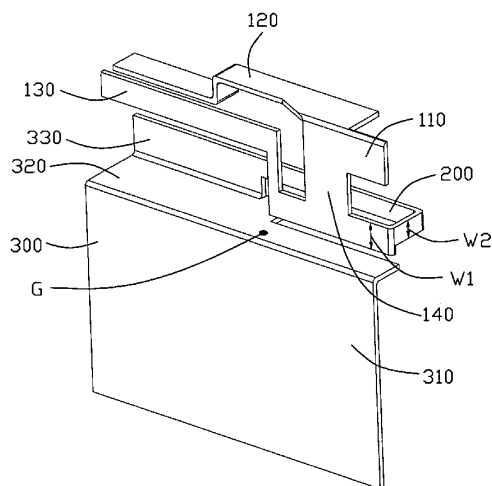
Assistant Examiner — Shawn Buchanan

(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



Acrobat 文件



US008144063B2

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

(10) **Patent No.:** **US 8,144,063 B2**
(45) **Date of Patent:** **Mar. 27, 2012**

(54) **ANTENNA ISOLATION FOR PORTABLE ELECTRONIC DEVICES**

(75) Inventors: **Robert W. Schlub**, Santa Clara, CA (US); **Robert J. Hill**, Salinas, 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 0 days.

(21) Appl. No.: **13/073,872**

(22) Filed: **Mar. 28, 2011**

(65) **Prior Publication Data**

US 2011/0169703 A1 Jul. 14, 2011

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

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

(58) **Field of Classification Search** **343/702, 343/700 MS, 833-835**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,509,056	A	4/1985	Ploussios
5,463,406	A	10/1995	Vannatta et al.
5,784,032	A	7/1998	Johnston et al.
5,917,458	A	6/1999	Ho et al.
6,184,845	B1	2/2001	Leisten et al.
6,552,692	B1	4/2003	Zeilinger et al.
6,570,538	B2	5/2003	Vaisanen et al.
6,639,558	B2	10/2003	Kellerman et al.
6,795,021	B2 *	9/2004	Ngai et al. 343/700 MS
6,987,485	B2	1/2006	Ito et al.
7,053,850	B1	5/2006	Bogdans et al.
7,403,160	B2 *	7/2008	Chiang et al. 343/702
7,405,702	B2	7/2008	Annamae et al.
7,525,504	B1 *	4/2009	Song et al. 343/850
7,592,969	B2	9/2009	Proctor et al.

7,595,759	B2	9/2009	Schlub et al.
7,688,273	B2 *	3/2010	Montgomery et al. 343/820
7,696,943	B2 *	4/2010	Chiang 343/833
2004/0056712	A1 *	3/2004	Lee et al. 330/51
2004/0070548	A1 *	4/2004	Cake 343/803
2005/0041624	A1	2/2005	Hui et al.
2006/0038736	A1	2/2006	Hui et al.
2006/0238437	A1	10/2006	Huang
2008/0316121	A1	12/2008	Hobson et al.
2009/0275370	A1	11/2009	Schlub et al.
2010/0080151	A1	4/2010	Proctor et al.

FOREIGN PATENT DOCUMENTS

CN	1706070	12/2005
CN	1875522	12/2006
CN	101036262	9/2007
EP	1083622	3/2001
WO	2006018711	12/2006

* cited by examiner

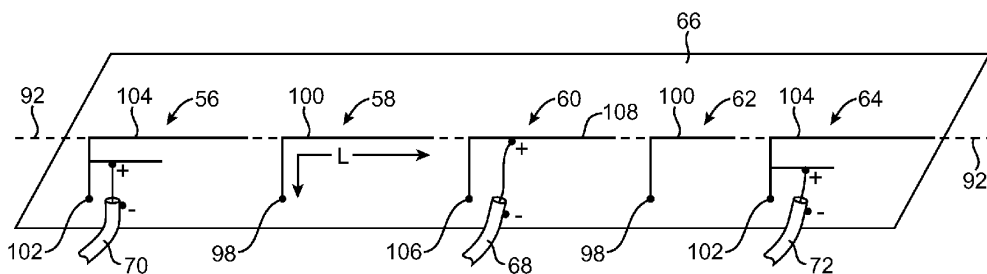
Primary Examiner — Huedung Mancuso

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

(57) **ABSTRACT**

Portable electronic devices are provided with wireless circuitry that includes antennas and antenna isolation elements. The antennas may include antennas that have multiple arms and that are configured to handle communications in multiple frequency bands. The antennas may also include one or more antennas that are configured to handle communications in a single frequency band. The antennas may be coupled to different radio-frequency transceivers. For example, there may be first, second, and third antennas and first and second transceivers. The first and third antennas may be coupled to the first transceiver and the second antenna may be coupled to the second transceiver. The antenna isolation elements may be interposed between the antennas and may serve to reduce radio-frequency interference between the antennas. There may be a first antenna isolation element between the first and second antennas and a second antenna isolation element between the second and third antennas.

19 Claims, 16 Drawing Sheets



Acrobat 文件



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)

OTHER PUBLICATIONS

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 731 days.

European Telecommunications Standard Institute, "Digital Video Broadcasting (DVB); Transmission System for Handheld Terminals (DVB-H)". ETSI EN 302 304, V1.1.1, (Nov. 2004).
Holopainen, "Antenna for Handheld DVB Terminal", Helsinki University of Technology, Department of Electrical and Communications Engineering, Radio Laboratory, Master's Theses, (2005).
Huang et al., "Tunable Antenna Design Procedure and Harmonics Suppression Methods of the Tunable DVB-H Antenna for Mobile Applications", European Microwave Conference, 2007, pp. 1062-1065, (Oct. 9-12, 2007).
Jackson et al., "Simple Approximate Formulas for Input Resistance, Bandwidth, and Efficiency of a Resonant Rectangular Patch", IEEE Transactions on Antennas and Propagation, vol. 39, No. 3, pp. 407-410, (Mar. 1991).

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

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

(65) **Prior Publication Data**

US 2009/0322632 A1 Dec. 31, 2009

* cited by examiner

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

Primary Examiner — Douglas W Owens

Assistant Examiner — Chuc Tran

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

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

(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.

(57) **ABSTRACT**

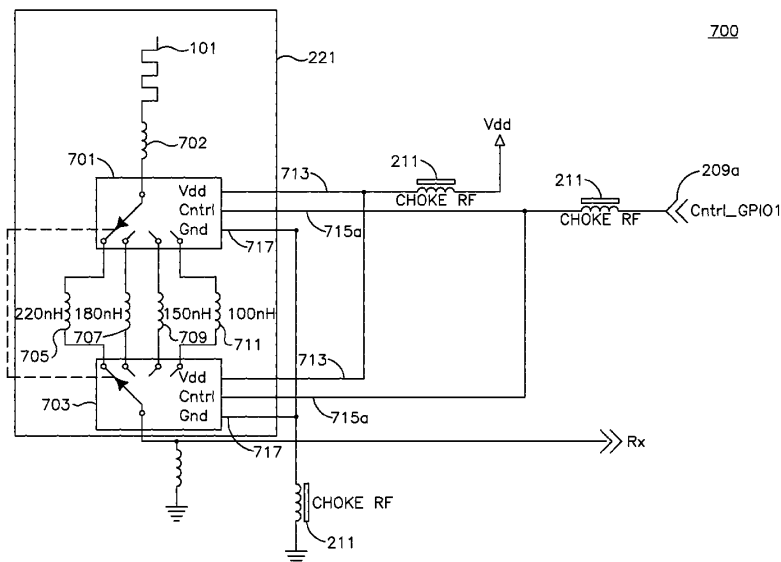
A narrow band, tunable antenna uses a series of small inductors wired in series to produce different resonant frequencies from a single antenna across a wide frequency spectrum. Radio Frequency (RF) switches are positioned in parallel with the inductors and are capable of shunting a selected inductor 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.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,872,489 A * 2/1999 Chang et al. 331/179
6,255,994 B1 * 7/2001 Saito 343/700 MS
7,151,501 B2 * 12/2006 Tran 343/823

12 Claims, 8 Drawing Sheets



Acrobat 文件



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.**

H01Q 7/00 (2006.01)

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.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,061,938 A 10/1991 Zahn et al.

5,376,942 A 12/1994 Shiga

5,751,252 A 5/1998 Phillips
6,437,750 B1 8/2002 Grimes et al.
6,677,901 B1 1/2004 Nalbandian
7,215,292 B2 5/2007 Mclean
2007/0080878 A1 4/2007 McLean
2007/0182658 A1 8/2007 Ozden et al.
2009/0073048 A1 3/2009 Kim
2009/0160717 A1* 6/2009 Tsutsumi et al. 343/726
2009/0224990 A1* 9/2009 Cezanne et al. 343/726
2010/0103061 A1 4/2010 Yung et al.

FOREIGN PATENT DOCUMENTS

EP 1672735 A1 6/2006
EP 1684379 A1 7/2006
EP 1753080 A1 2/2007
EP 1973192 A1 9/2008
JP 03-050922 A 3/1991
JP 05-183317 A 7/1993
JP 2003-258546 A 9/2003
WO 00-25385 A 5/2000
WO 2005-062422 A1 7/2005

OTHER PUBLICATIONS

Chan et al., "Printed Antenna Composed of a Bow-tie Dipole and a
Loop," IEEE Antennas and Propagation International Symposium
2007, Jun. 2007, pp. 681-684, IEEE, 1-4244-0878-4/07.

(Continued)

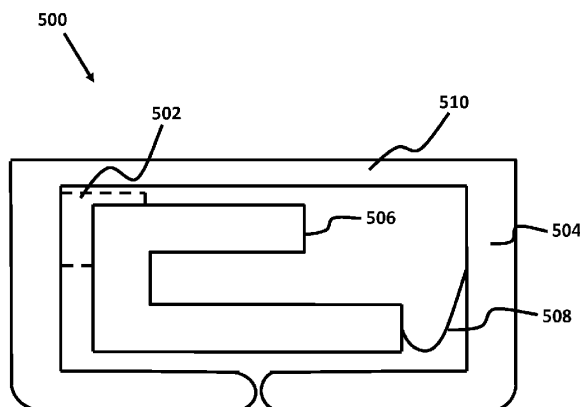
Primary Examiner — Hoanganh Le

(74) *Attorney, Agent, or Firm* — SilverSky Group, LLC

(57) **ABSTRACT**

The present invention relates to planar compound field anten-
nas. Improvements relate particularly, but not exclusively, to
compound loop antennas having coplanar electric field radia-
tors 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



Acrobat 文件



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**

6,476,769	B1	11/2002	Lehtola
7,071,875	B2	7/2006	Sugimoto et al.
7,741,998	B2 *	6/2010	Thornell-Pers
2007/0069957	A1 *	3/2007	Ranta

343/700 MS 343/700 MS

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

FOREIGN PATENT DOCUMENTS

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 514 days.

CA	2467282	A1	11/2004
EP	1 367 671	A2	12/2003
JP	04-008517		1/1992
JP	10190345		7/1998
JP	2003-179426		6/2003
JP	2003-347827		12/2003
JP	2004-129062		4/2004
JP	2004-172714		6/2004
WO	WO 99/22420		5/1999
WO	WO 01/28038	A1	4/2001
WO	WO 01/29927	A	4/2001
WO	WO 02/078123	A	10/2002
WO	WO 2005/048403	A	5/2005

(21) Appl. No.: **12/296,867**

(22) PCT Filed: **May 18, 2007**

(86) PCT No.: **PCT/SE2007/000492**

§ 371 (c)(1),
(2), (4) Date: **Aug. 19, 2009**

(87) PCT Pub. No.: **WO2007/136330**

PCT Pub. Date: **Nov. 29, 2007**

(65) **Prior Publication Data**

US 2010/0007574 A1 Jan. 14, 2010

OTHER PUBLICATIONS

Written Opinion and International Search Report from International application No. PCT/SE2007/000492 (published as WO 2007/136330 A2); (the application that the instant national phase claims priority to) dated Sep. 14, 2007, 8 pages.

(Continued)

(30) **Foreign Application Priority Data**

May 19, 2006 (EP) 06445028

Primary Examiner — Trinh Dinh

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

(51) **Int. Cl.**

H01Q 1/50 (2006.01)
H01Q 1/38 (2006.01)

(52) **U.S. Cl.** **343/860**; 343/700 MS; 343/876;
343/850

(58) **Field of Classification Search** 343/860
See application file for complete search history.

(56) **References Cited**

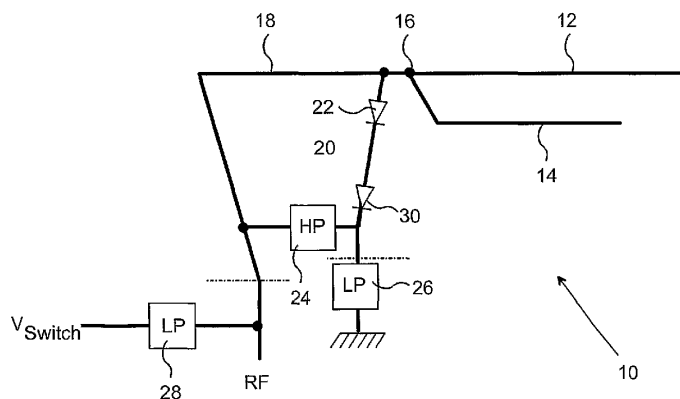
U.S. PATENT DOCUMENTS

5,754,143 A * 5/1998 Warnagiris et al. 343/767
6,329,962 B2 * 12/2001 Ying 343/895

(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



Acrobat 文件



US008144072B2

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

(10) **Patent No.:** **US 8,144,072 B2**
(45) **Date of Patent:** **Mar. 27, 2012**

(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**

US 2011/0032170 A1 Feb. 10, 2011

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

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,450,076 B1 *	11/2008	Lin et al.	343/702
7,557,759 B2 *	7/2009	Lin et al.	343/702
2010/0194654 A1 *	8/2010	Chiang	343/750
2011/0012789 A1 *	1/2011	Yang et al.	343/700 MS

* cited by examiner

Primary Examiner — Jacob Y Choi

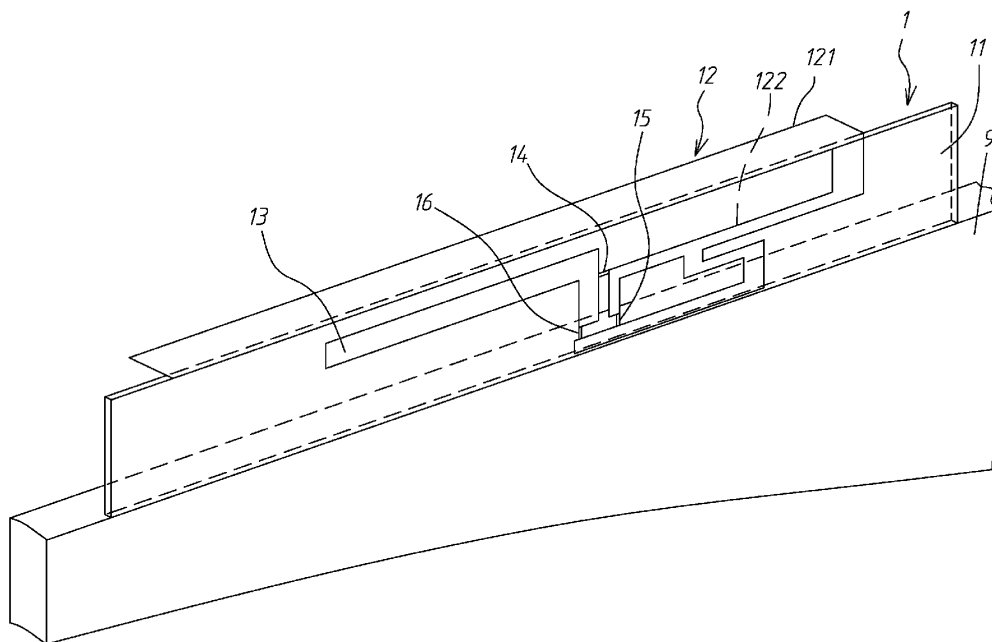
Assistant Examiner — Hasan Islam

(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



Acrobat 文件