



US008514132B2

(12) **United States Patent**
Rao

(10) **Patent No.:** **US 8,514,132 B2**
(45) **Date of Patent:** **Aug. 20, 2013**

(54) **COMPACT MULTIPLE-BAND ANTENNA FOR WIRELESS DEVICES**

(75) Inventor: **Qinjiang Rao**, Waterloo (CA)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 706 days.

(21) Appl. No.: **12/615,267**

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

(65) **Prior Publication Data**

US 2011/0109515 A1 May 12, 2011

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

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

(58) **Field of Classification Search**
USPC **343/700 MS, 702, 725**
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,166,694	A	12/2000	Ying
6,329,951	B1	12/2001	Wen et al.
6,343,208	B1	1/2002	Ying
6,353,443	B1	3/2002	Ying
6,408,190	B1	6/2002	Ying
6,573,869	B2	6/2003	Moore
6,614,400	B2	9/2003	Egorov

(Continued)

FOREIGN PATENT DOCUMENTS

EP	1973192	9/2008
JP	2002-111364	4/2002

(Continued)

OTHER PUBLICATIONS

Z. D. Liu, P.S. Hall and D. Wake, "Dual-Frequency Planar Inverted-F Antenna," *IEEE Trans. on Antenna and Propagation*, vol. 45, No. 9, pp. 1451-1457, Oct. 1997.

(Continued)

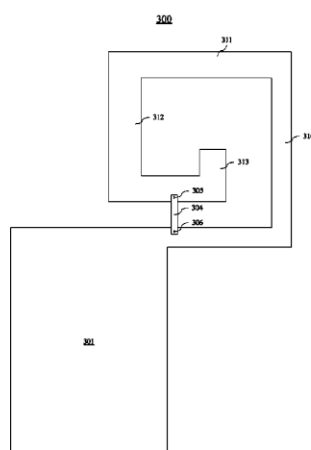
Primary Examiner — Robert Karacsony

(74) *Attorney, Agent, or Firm* — Moffat & Co.; Timothy Clise; Joseph Ulvr

(57) **ABSTRACT**

A compact multiple-band antenna for wireless devices having a plurality of operating frequency bands is provided. In one embodiment, a multiple-band antenna for a wireless device, comprises a ground area; a first radiating member having a first end, an intermediate portion and a second end and cooperatively receiving and substantially radiating RF signals at a first, second and third resonant frequency, wherein said first end of said first radiating member is electrically connected to said ground area and said intermediate portion is electrically connected to a first feed point; a second radiating member having a first end and a second end and cooperatively receiving and substantially radiating RF signals at a first, second and third resonant frequency, wherein said first end of said second radiating member is electrically connected to said second end of said first radiating member; a third radiating member having a first end and a second end and cooperatively receiving and substantially radiating RF signals at a first, second and third resonant frequency, wherein said first end of said third radiating member is electrically connected to said second end of said second radiating member; and a fourth radiating member having a first end, an intermediate portion and a second end and providing a fourth resonant frequency, wherein said first end of said fourth radiating member is electrically connected to said second end of said third radiating member, said intermediate portion of said fourth radiating member is electrically connected to a second feed point and said second end of said fourth radiating member is unconnected.

13 Claims, 8 Drawing Sheets





US008514134B2

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

(10) **Patent No.:** **US 8,514,134 B2**
(45) **Date of Patent:** **Aug. 20, 2013**

(54) **MIMO ANTENNA HAVING PARASITIC ELEMENTS**

(75) Inventors: **Chan Ho Kim**, Incheon-shi (KR); **Jin Myung Kim**, Seongnam-shi (KR); **Chang-Gyu Choi**, Incheon-shi (KR); **Gyoung Rok Beak**, Siheung-shi (KR); **Young Hun Park**, Cheongju-shi (KR); **Heung Ju Ahn**, Suwon-shi (KR); **Yeon Ho Yang**, Goyang-shi (KR)

(73) Assignee: **Mobitech Corp.**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 244 days.

(21) Appl. No.: **13/202,589**

(22) PCT Filed: **Oct. 19, 2009**

(86) PCT No.: **PCT/KR2009/006003**

§ 371 (c)(1),

(2), (4) Date: **Aug. 22, 2011**

(87) PCT Pub. No.: **WO2010/098529**

PCT Pub. Date: **Sep. 2, 2010**

(65) **Prior Publication Data**

US 2011/0298666 A1 Dec. 8, 2011

(30) **Foreign Application Priority Data**

Feb. 27, 2009 (KR) 10-2009-0016593

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

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

(58) **Field of Classification Search**

USPC 343/700 MS, 829, 846, 815, 833, 343/834

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,401,988	A *	8/1983	Kaloi	343/700 MS
5,382,959	A *	1/1995	Pett et al.	343/700 MS
6,326,921	B1 *	12/2001	Egorov et al.	343/700 MS
6,982,672	B2 *	1/2006	Lin et al.	343/700 MS
7,187,328	B2 *	3/2007	Tanaka et al.	343/700 MS
7,636,063	B2 *	12/2009	Channabasappa	343/700 MS
8,072,384	B2 *	12/2011	Morrow	343/700 MS

FOREIGN PATENT DOCUMENTS

KR	10-2006-0129910	A	12/2006
KR	10-0699472	B1	3/2007
KR	10-2008-0028613	A	4/2008
WO	2008-131157	A1	10/2008

OTHER PUBLICATIONS

International Search Report for International Application No. PCT/KR2009/006003.

* cited by examiner

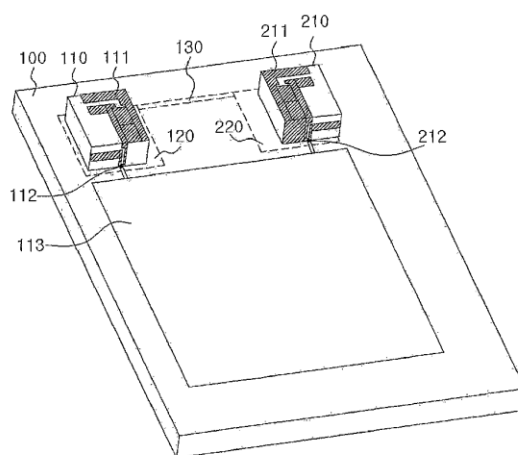
Primary Examiner — Tho G Phan

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

(57) **ABSTRACT**

A Multiple-Input Multiple-Output (MIMO) antenna having parasitic elements is provided. The MIMO antenna includes a plurality of antenna elements, a plurality of parasitic elements, and a bridge. The plurality of antenna elements is symmetrically disposed on one side surface of a board while maintaining a predetermined distance therebetween. The plurality of parasitic elements is disposed on the other side surface of the board in a one-to-one correspondence with the plurality of antenna elements. The bridge is formed of a metal pattern line, and is configured to connect the plurality of parasitic elements to each other.

6 Claims, 12 Drawing Sheets





US008514138B2

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

(10) **Patent No.:** **US 8,514,138 B2**
(45) **Date of Patent:** **Aug. 20, 2013**

(54) **MEANDER SLOT ANTENNA STRUCTURE
AND ANTENNA MODULE UTILIZING THE
SAME**

(75) Inventors: **Kuo-Fong Hung**, Changhua (TW);
Ming-Hao Yeh, Taipei (TW)

(73) Assignee: **Mediatek Inc.**, Hsin-Chu (TW)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 338 days.

(21) Appl. No.: **13/005,366**

(22) Filed: **Jan. 12, 2011**

(65) **Prior Publication Data**

US 2012/0176292 A1 Jul. 12, 2012

(51) **Int. Cl.**
H01Q 13/10 (2006.01)
H01Q 1/48 (2006.01)

(52) **U.S. Cl.**
USPC **343/767**; 343/700 MS; 343/846;
343/770; 343/829

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

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,593,891	B2 *	7/2003	Zhang	343/767
6,618,020	B2 *	9/2003	Wang et al.	343/767
6,774,850	B2	8/2004	Chen	
6,940,460	B2 *	9/2005	Maoz et al.	343/702
7,450,072	B2	11/2008	Kim et al.	
7,518,557	B2 *	4/2009	Lin et al.	343/700 MS
2009/0033577	A1 *	2/2009	Kim et al.	343/767
2009/0046027	A1 *	2/2009	Lin et al.	343/756
2009/0079647	A1 *	3/2009	Jung et al.	343/767
2009/0231215	A1	9/2009	Taura	

2009/0256765	A1 *	10/2009	Lu et al.	343/767
2010/0053022	A1	3/2010	Mak et al.	
2010/0188294	A1	7/2010	Chung et al.	
2010/0277261	A1 *	11/2010	Hung et al.	333/21 A
2011/0188552	A1	8/2011	Yoon et al.	

FOREIGN PATENT DOCUMENTS

EP	2 003 728	12/2008
JP	A 199623224	1/1996
JP	A 2002325015	11/2002
JP	2003-234615	8/2003
JP	A 200415160	1/2004
JP	A 2004147327	5/2004
JP	A 2005510927	4/2005
WO	WO 2003/047025	6/2003
WO	WO 2004/038859	5/2004
WO	WO 2004/105182	12/2004
WO	WO 2007/058230	5/2007

OTHER PUBLICATIONS

English language translation of abstract of JP 2003-234615 (pub-
lished Aug. 22, 2003).

(Continued)

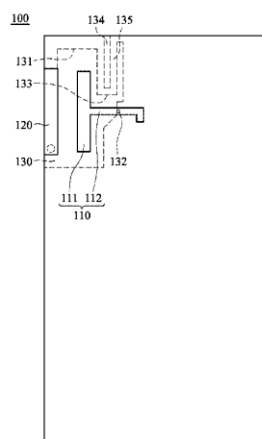
Primary Examiner — Trinh Dinh

(74) *Attorney, Agent, or Firm* — McClure, Qualey &
Rodack, LLP

(57) **ABSTRACT**

A meander slot antenna structure for transmitting a wireless signal is provided. The meander slot antenna structure includes a substrate, a ground element, a feed conductor and a couple conductor. The substrate includes a first surface and a second surface, wherein the first surface is opposite to the second surface. The ground element is disposed on the second surface, wherein a meander slot is formed in the ground element. The feed conductor is disposed on the first surface, wherein the feed conductor corresponds to the meander slot. The couple conductor is disposed on the first surface and coupled with the feed conductor, wherein a via passes through the substrate and electrically connects the couple conductor to the ground element.

23 Claims, 12 Drawing Sheets





US008514146B2

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

(10) **Patent No.:** **US 8,514,146 B2**
(45) **Date of Patent:** **Aug. 20, 2013**

(54) **SINGLE-LAYER METALLIZATION AND VIA-LESS METAMATERIAL STRUCTURES**

(75) Inventors: **Ajay Gummalla**, San Diego, CA (US);
Maha Achour, San Diego, CA (US);
Cheng-Jung Lee, San Diego, CA (US);
Vaneet Pathak, San Diego, CA (US);
Gregory Poilasne, El Cajon, CA (US)

(73) Assignee: **Tyco Electronics Services GmbH** (CH)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 984 days.

(21) Appl. No.: **12/250,477**

(22) Filed: **Oct. 13, 2008**

(65) **Prior Publication Data**

US 2009/0128446 A1 May 21, 2009

Related U.S. Application Data

(60) Provisional application No. 60/979,384, filed on Oct. 11, 2007, provisional application No. 60/987,750, filed on Nov. 13, 2007, provisional application No. 61/024,876, filed on Jan. 30, 2008, provisional application No. 61/091,203, filed on Aug. 22, 2008.

(51) **Int. Cl.**
H01Q 15/02 (2006.01)

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

(58) **Field of Classification Search**
USPC 343/909, 911
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,014,024	A	3/1977	Parker et al.
5,511,238	A	4/1996	Bayraktaroglu
5,874,915	A	2/1999	Lee et al.
6,005,515	A	12/1999	Allen et al.
6,366,254	B1	4/2002	Sievenpiper et al.
6,489,927	B2	12/2002	LeBlanc et al.
6,512,494	B1	1/2003	Diaz et al.
6,525,695	B2	2/2003	McKinzie, III
6,545,647	B1	4/2003	Sievenpiper et al.
6,774,850	B2	8/2004	Chen
6,842,140	B2	1/2005	Killen et al.
6,859,114	B2	2/2005	Eleftheriades et al.
6,897,831	B2	5/2005	McKinzie et al.
6,906,674	B2	6/2005	McKinzie et al.
6,943,731	B2	9/2005	Killen et al.
6,950,069	B2	9/2005	Gaucher et al.
6,958,729	B1	10/2005	Metz
6,995,711	B2	2/2006	Killen et al.
7,068,234	B2	6/2006	Sievenpiper

(Continued)

FOREIGN PATENT DOCUMENTS

JP	2006501719	A	1/2006
JP	4918594	A	2/2012

(Continued)

OTHER PUBLICATIONS

"International Application Serial No. PCT/US2008/079753, International Written Opinion mailed Jan. 29, 2009", 5 pgs.

(Continued)

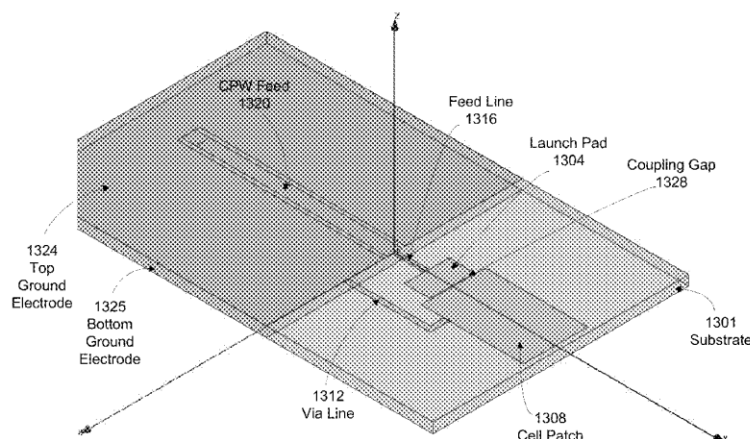
Primary Examiner — Hoang V Nguyen

Assistant Examiner — Kyana R McCain

(57) **ABSTRACT**

Techniques and apparatus based on metamaterial structures provided for antenna and transmission line devices, including single-layer metallization and via-less metamaterial structures.

34 Claims, 49 Drawing Sheets





US008519894B2

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

(10) **Patent No.:** **US 8,519,894 B2**
(45) **Date of Patent:** **Aug. 27, 2013**

(54) **ELECTRONIC APPARATUS AND ANTENNA
MODULE THEREOF**

(75) Inventors: **Chun-Fei Yang**, Taipei Hsien (TW);
Hung-Chih Fu, Taipei Hsien (TW)

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

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 376 days.

(21) Appl. No.: **12/461,219**

(22) Filed: **Aug. 5, 2009**

(65) **Prior Publication Data**
US 2010/0289704 A1 Nov. 18, 2010

(30) **Foreign Application Priority Data**
May 14, 2009 (TW) 98116069 A

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

(56) **References Cited**
U.S. PATENT DOCUMENTS
7,321,334 B2 * 1/2008 Yu 343/702
7,564,412 B2 * 7/2009 Walker et al. 343/702

7,646,350 B2 1/2010 Chuang et al.
7,733,276 B2 * 6/2010 Levy et al. 343/702
7,777,682 B2 * 8/2010 Yagi 343/725
2004/0104853 A1 6/2004 Chen
2009/0231206 A1 * 9/2009 Shamblin et al. 343/700 MS
2009/0315788 A1 * 12/2009 Hirota 343/702
2009/0322627 A1 * 12/2009 Sato et al. 343/702

FOREIGN PATENT DOCUMENTS

CN 2852417 Y 12/2006
CN 101291010 A 10/2008
TW 547788 8/2003

OTHER PUBLICATIONS

Office action dated Jul. 26, 2012 in corresponding CN Application
200910143285.3 (See p. 7).

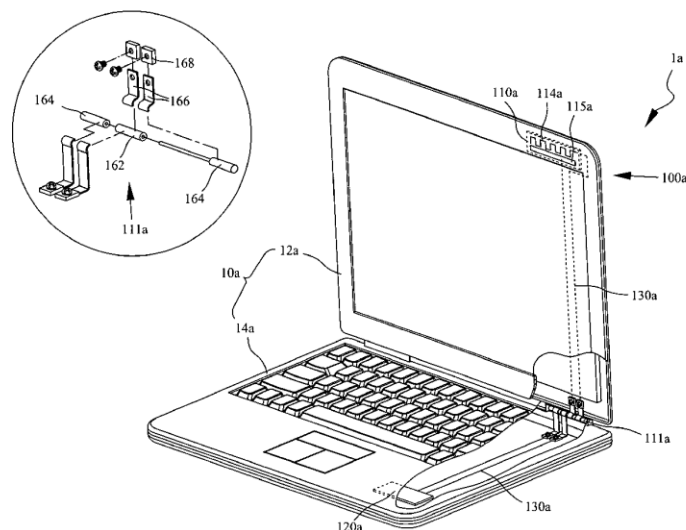
* cited by examiner

Primary Examiner — Michael C Wimer
Assistant Examiner — Hasan Islam
(74) *Attorney, Agent, or Firm* — Bacon & Thomas, PLLC

(57) **ABSTRACT**

An antenna structure for an electronic apparatus is disclosed. The electronic apparatus comprises a case composed of a first case and a second case, and the first case combines correspondingly with the second case. The antenna structure comprises an antenna element and a system antenna module. The antenna element is disposed on the inner side of the first case and comprises a connection portion. The system antenna module disposed in the case comprises a corresponding connection portion, and the position of the corresponding connection portion corresponds to the connection portion. The connection portion can be in contact with the corresponding connection portion to form an electrical connection between them by combining the first case and the second case.

4 Claims, 5 Drawing Sheets





US008519896B2

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

(10) **Patent No.:** **US 8,519,896 B2**
(45) **Date of Patent:** **Aug. 27, 2013**

(54) **ANTENNA HAVING LINE-SHAPED ELECTRODE ON BOARD END SURFACE**

(75) Inventors: **Kengo Onaka**, Kanagawa-ken (JP);
Takashi Ishihara, Tokyo-to (JP)

(73) Assignee: **Murata Manufacturing Co., Ltd.** (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 444 days.

(21) Appl. No.: **12/911,542**

(22) Filed: **Oct. 25, 2010**

(65) **Prior Publication Data**
US 2011/0109510 A1 May 12, 2011

(30) **Foreign Application Priority Data**
Nov. 6, 2009 (JP) 2009-254970

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

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,700,543 B2 * 3/2004 Konishi et al. 343/700 MS
7,786,940 B2 * 8/2010 Hirano 343/702
2007/0188383 A1 8/2007 Onaka et al.
2009/0040120 A1 * 2/2009 Tsubaki et al. 343/702
2009/0295653 A1 * 12/2009 Komura 343/702

FOREIGN PATENT DOCUMENTS

CN	101341630	A	1/2009
CN	101395758	A	3/2009
JP	2001-24416	A	1/2001
JP	2002-299933	A	10/2002
JP	2004-129234		4/2004
JP	2006-74446	A	3/2006
JP	4129803		8/2008
JP	2009-171096		7/2009
WO	2005/107010	A1	11/2005
WO	2007/043150	A1	4/2007

OTHER PUBLICATIONS

Japanese Office Action "Notification of Reason for Rejection" dated Mar. 6, 2012; Japanese Patent Application No. 2009-254970 with translation.

The Office Action issued from State Intellectual Property Office of People's Republic of China dated Apr. 3, 2013, which corresponds to Chinese Patent Application No. 201010535073.2 and is related to U.S. Appl. No. 12/911,542 with translation.

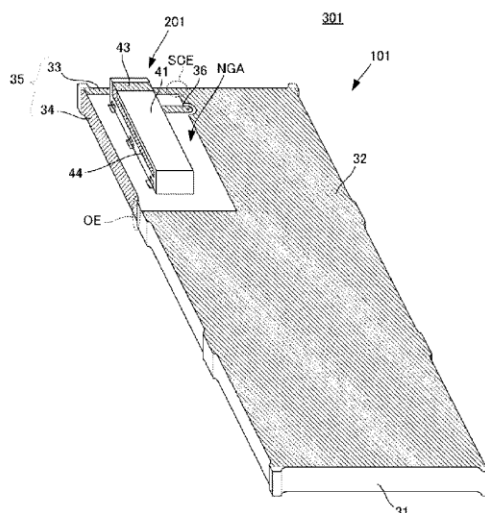
* cited by examiner

Primary Examiner — Hoanganh Le
(74) *Attorney, Agent, or Firm* — Studebaker & Brackett PC

(57) **ABSTRACT**

An antenna includes a board having a substrate and a ground electrode, electrodes provided on external surfaces of the substrate, a feeding element provided near an end surface of the board. The feeding element includes an electrically insulating base member and a feeding radiation electrode provided on the base member. A non-feeding element including a substantially line-shaped electrode is provided on the board and includes at least one end thereof connected to the ground electrode and electromagnetically coupled with the feeding element. At least part of the substantially line-shaped electrodes is provided on the end surface of the board.

11 Claims, 7 Drawing Sheets





US008519900B2

(12) **United States Patent**
Chen

(10) **Patent No.:** **US 8,519,900 B2**
(45) **Date of Patent:** **Aug. 27, 2013**

(54) **GLOBAL POSITIONING SYSTEM ANTENNA**

(56) **References Cited**

(75) Inventor: **Hsi-Chieh Chen**, Tu-Cheng (TW)

U.S. PATENT DOCUMENTS

(73) Assignee: **Chi Mei Communication Systems, Inc.**, New Taipei (TW)

6,894,646	B2 *	5/2005	Washiro et al.	343/700 MS
7,091,911	B2 *	8/2006	Qi et al.	343/702
8,009,119	B2 *	8/2011	Hung	343/893
8,013,796	B2 *	9/2011	Liu et al.	343/702

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 435 days.

* cited by examiner

(21) Appl. No.: **12/890,697**

Primary Examiner — Jerome Jackson, Jr.

(22) Filed: **Sep. 26, 2010**

Assistant Examiner — Hai Tran

(65) **Prior Publication Data**

US 2012/0001817 A1 Jan. 5, 2012

(74) *Attorney, Agent, or Firm* — Altis Law Group, Inc.

(30) **Foreign Application Priority Data**

Jun. 30, 2010 (TW) 99121477

(57) **ABSTRACT**

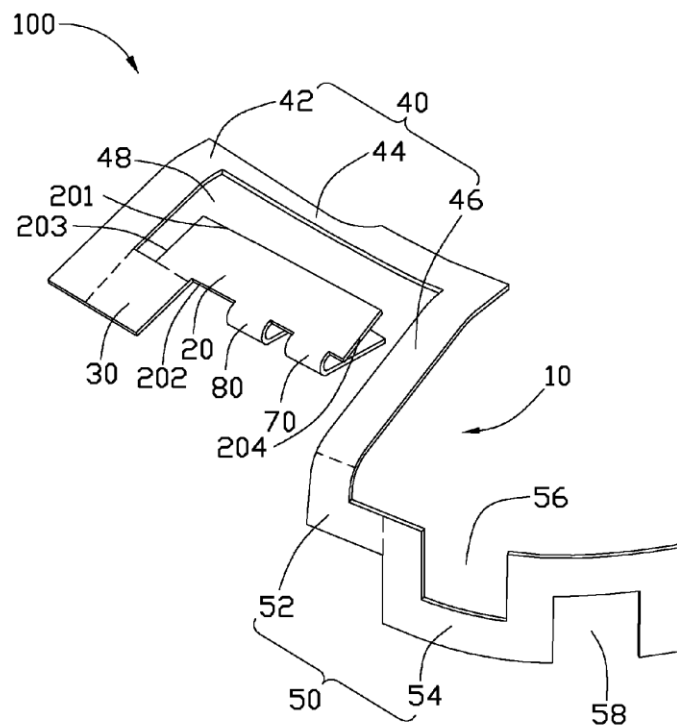
(51) **Int. Cl.**
H01Q 13/10 (2006.01)

A global positioning system antenna includes a radiator. The radiator includes a base section, an extension section connected to an edge of the base section, a first curved section connected to an edge of the extension section, and a second curved section connected to a distal end of the first curved section. The first curved section and the base section define a slot therebetween. The second curved section defines a first gap and a second gap thereon. The first gap and the second gap face each other.

(52) **U.S. Cl.**
USPC 343/767

(58) **Field of Classification Search**
USPC 343/767
See application file for complete search history.

14 Claims, 2 Drawing Sheets





US008519903B2

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

(10) **Patent No.:** **US 8,519,903 B2**

(45) **Date of Patent:** ***Aug. 27, 2013**

(54) **CONFORMABLE ANTENNA**

(56) **References Cited**

(75) Inventors: **Randell Cozzolino**, Phoenix, AZ (US);
Gary Wannagot, Gilbert, AZ (US); **Snir Azulay**, Tiberias, IL (US)

(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 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/526,737**

(22) Filed: **Jun. 19, 2012**

(65) **Prior Publication Data**

US 2012/0256803 A1 Oct. 11, 2012

Related U.S. Application Data

(63) Continuation of application No. 12/468,579, filed on May 19, 2009, now Pat. No. 8,203,499.

(60) Provisional application No. 61/128,284, filed on May 19, 2008.

(51) **Int. Cl.**
H01Q 9/16 (2006.01)

(52) **U.S. Cl.**
USPC **343/821**

(58) **Field of Classification Search**
USPC 343/821, 850, 856; 29/601
See application file for complete search history.

U.S. PATENT DOCUMENTS

6,445,297	B1 *	9/2002	Nicholson	340/572.7
6,549,169	B1	4/2003	Matsuyoshi et al.	
7,161,548	B2	1/2007	Tsukamoto	
7,205,953	B2 *	4/2007	Knadle et al.	343/792.5
7,427,964	B2 *	9/2008	Sergi	343/793
7,463,211	B2 *	12/2008	Mertel et al.	343/815
2002/0040466	A1	4/2002	Khazei	
2002/0175877	A1	11/2002	Schantz	
2004/0060162	A1	4/2004	Moren	

OTHER PUBLICATIONS

An International Search Report dated Aug. 18, 2009, which issued during the prosecution of Applicant's PCT/IL2009/000494.

An International Preliminary Report on Patentability dated Dec. 2, 2010, which issued during the prosecution of Applicant's PCT/IL2009/000494.

* cited by examiner

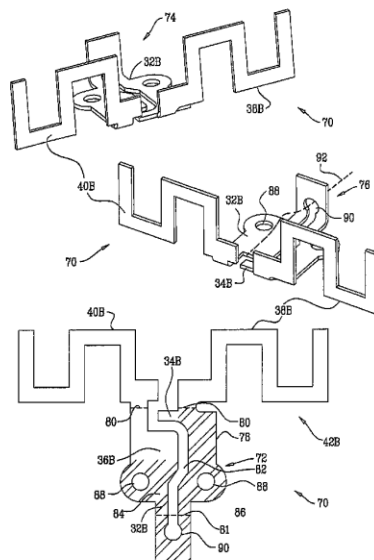
Primary Examiner — Huedung Mancuso

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

(57) **ABSTRACT**

A polymorphic antenna, including a metallic template configurable in at least first and second possible different three-dimensional shapes, the antenna, when configured in the at least first and second different three-dimensional shapes, having a common antenna feed point, a common balun coupled to the common antenna feed point; and a common dipole coupled to the common antenna feed point and to the common balun. The antenna operates in a common frequency band when configured in either of the at least first and second different three-dimensional shapes when fed via the common antenna feed point.

20 Claims, 16 Drawing Sheets





US008519904B2

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

(10) **Patent No.:** **US 8,519,904 B2**
(45) **Date of Patent:** **Aug. 27, 2013**

(54) **KEYBOARD STRUCTURE WITH ANTENNA FUNCTION**

(75) Inventors: **Jun-Ting Hsu**, Taoyuan County (TW); **Yih-Ming Yang**, Taipei (TW); **Ming-Fu Yen**, Taipei County (TW); **Hsi-Wang Lee**, Taipei County (TW)

(73) Assignees: **Lite-On Electronics (Guangzhou) Limited**, 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 175 days.

(21) Appl. No.: **12/953,620**

(22) Filed: **Nov. 24, 2010**

(65) **Prior Publication Data**
US 2012/0075189 A1 Mar. 29, 2012

(30) **Foreign Application Priority Data**
Sep. 27, 2010 (CN) 2010 1 0292693

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

(52) **U.S. Cl.**
USPC **343/845; 345/169**

(58) **Field of Classification Search**

USPC 345/168-169
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,954,181 B2 * 10/2005 Park et al. 343/702
7,388,547 B2 * 6/2008 Lee 343/702
8,124,926 B2 * 2/2012 Ishida 250/227.14

* cited by examiner

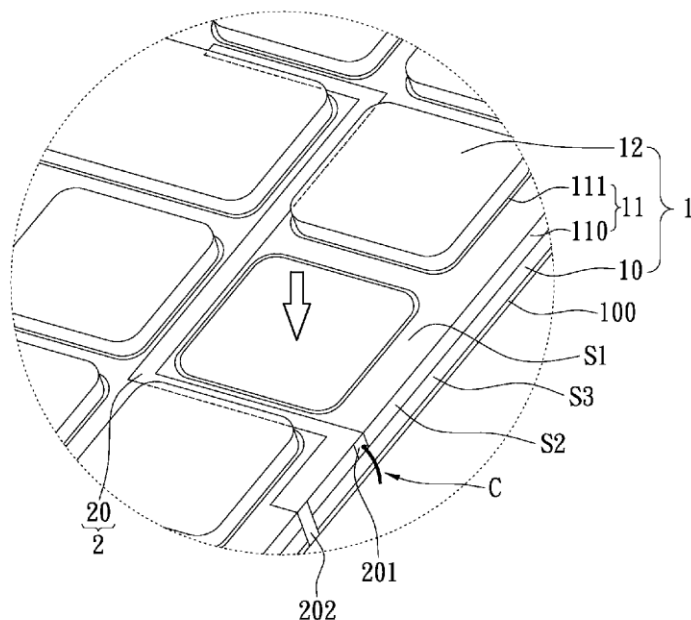
Primary Examiner — Duc Dinh

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

(57) **ABSTRACT**

A keyboard structure with antenna function includes a keyboard unit and an antenna unit. The keyboard unit includes a keyboard signal circuit board, at least one keyboard frame disposed on the keyboard signal circuit board, and a plurality of pressing elements passing through the keyboard frame and movably disposed on the keyboard signal circuit board. The antenna unit includes at least one metal circuit disposed on the keyboard frame. Thus, the length of a signal transmission line between the metal circuit and a wireless antenna module can be substantially reduced. Therefore, not only the insertion loss of the instant disclosure can be reduced to obtain better quality of wireless communication, but also the manufacturing cost and time of the instant disclosure also can be reduced effectively.

8 Claims, 13 Drawing Sheets





US008521240B2

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

(10) **Patent No.:** **US 8,521,240 B2**
(45) **Date of Patent:** **Aug. 27, 2013**

(54) **PORTABLE TERMINAL**

(75) Inventors: **Mitsuhiro Nishizono**, Kanagawa (JP);
Hiroshi Sakai, 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 25 days.

(21) Appl. No.: **13/258,938**

(22) PCT Filed: **Mar. 26, 2010**

(86) PCT No.: **PCT/JP2010/055444**

§ 371 (c)(1),

(2), (4) Date: **Sep. 22, 2011**

(87) PCT Pub. No.: **WO2010/110449**

PCT Pub. Date: **Sep. 30, 2010**

(65) **Prior Publication Data**

US 2012/0028692 A1 Feb. 2, 2012

(30) **Foreign Application Priority Data**

Mar. 26, 2009 (JP) 2009-077771

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

(52) **U.S. Cl.**
USPC **455/575.4**; 455/575.1; 455/575.7

(58) **Field of Classification Search**
USPC 455/575.4, 575.7, 575.1
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2006/0111159 A1* 5/2006 Ide 455/575.1
2009/0085696 A1* 4/2009 Abdul-Gaffoor et al. ... 333/24 C

FOREIGN PATENT DOCUMENTS

JP 2006-67361 A 3/2006
JP 2006-254082 A 9/2006
JP 2007-336038 A 12/2007
JP 2009-044326 A 2/2009

OTHER PUBLICATIONS

International Search Report for PCT/JP2010/055444, mailed Jun. 29, 2010.

* cited by examiner

Primary Examiner — Kamran Afshar

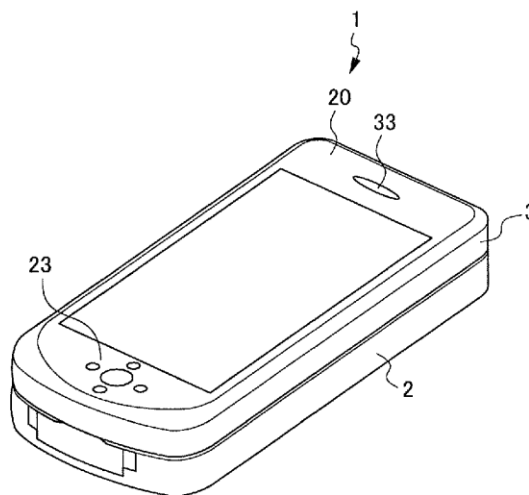
Assistant Examiner — Omoniyi Obayanju

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

(57) **ABSTRACT**

Provided is a portable terminal capable of ensuring satisfactory antenna characteristics regardless of a change in state, and of accommodating a plurality of frequency bands. A first circuit unit comprises: a first signal source; a first power feeding unit connected to a first antenna unit; a second power feeding unit connected to a first connection unit; a first switching unit which connects the first power feeding unit or the second power feeding unit to the first signal source by switching; and a first control unit which controls the first switching unit so as to connect the second power feeding unit to the first signal source when the portable terminal is transitioned to a second state. A first disconnection unit is disposed between the first connection unit and the first circuit unit and disconnects a first signal.

8 Claims, 12 Drawing Sheets





US008525731B2

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

(10) **Patent No.:** **US 8,525,731 B2**
(45) **Date of Patent:** **Sep. 3, 2013**

(54) **SMALL ANTENNA USING SRR STRUCTURE IN WIRELESS COMMUNICATION SYSTEM AND METHOD FOR MANUFACTURING THE SAME**

(75) Inventors: **Jeongho Ju**, Seoul (KR); **Jae-Ick Choi**, Daejeon (KR); **Wangjoo Lee**, Daejeon (KR); **Dong-Ho Kim**, Daejeon (KR)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 455 days.

(21) Appl. No.: **12/913,985**

(22) Filed: **Oct. 28, 2010**

(65) **Prior Publication Data**

US 2011/0128187 A1 Jun. 2, 2011

(30) **Foreign Application Priority Data**

Nov. 30, 2009 (KR) 10-2009-0117393

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

(52) **U.S. Cl.**
USPC **343/700 MS**; 343/742; 343/867

(58) **Field of Classification Search**
USPC 343/700 MS, 741, 742, 866, 867
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,057,803 A * 10/1991 Ooi et al. 333/204
5,892,490 A 4/1999 Asakura et al.

6,600,451 B2 * 7/2003 Mimura et al. 343/741
8,314,740 B2 * 11/2012 Blumberg, Jr. 343/741
2006/0145927 A1 7/2006 Choi et al.

FOREIGN PATENT DOCUMENTS

KR 10-2006-0064473 A 6/2006
KR 2006-0064457 A 6/2006
KR 2009-0081256 A 7/2009
KR 10-2009-0092466 A 9/2009
KR 2009-0095741 A 9/2009
KR 2009-0114816 A 11/2009

OTHER PUBLICATIONS

Jung-Min Kim et al., "Compact Stripline-Fed Meander Slot Antenna", Electronics Letters, vol. 37, No. 16, pp. 995-996, Aug. 2001.

* cited by examiner

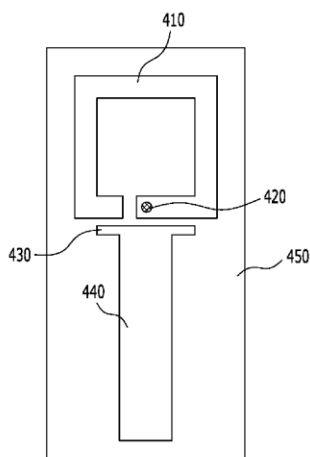
Primary Examiner — Hoang V Nguyen

(74) *Attorney, Agent, or Firm* — Rabin & Berdo, P.C.

(57) **ABSTRACT**

A small antenna using an SRR structure in a wireless communication system includes: a first radiation unit positioned over a dielectric substrate formed of a predetermined dielectric medium and having a predetermined ring shape; a feed unit positioned over the dielectric substrate and configured to feed a signal to the first radiation unit; a second radiation unit positioned under the dielectric substrate and having a predetermined ring shape; a via formed through the dielectric substrate to connect the first and second radiation units; a ground unit positioned under the dielectric substrate and configured to ground the first and second radiation units; and a metal line unit positioned under the dielectric substrate to connect the second radiation unit and the ground unit. The feed unit includes first and second capacitors which accomplish impedance matching when the signal is fed to the first radiation unit.

16 Claims, 5 Drawing Sheets





US008525732B2

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

(10) **Patent No.:** **US 8,525,732 B2**
(45) **Date of Patent:** **Sep. 3, 2013**

(54) **ANTENNA DEVICE**

(75) Inventors: **Naoaki Utagawa**, Tokyo (JP); **Kei Suzuki**, Tokyo (JP); **Yasumasa Harihara**, Tokyo (JP); **Masaki Matsushima**, Tokyo (JP); **Takeshi Ohashi**, Tokyo (JP)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 231 days.

(21) Appl. No.: **12/963,083**

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

(65) **Prior Publication Data**

US 2011/0133993 A1 Jun. 9, 2011

(30) **Foreign Application Priority Data**

Dec. 9, 2009 (JP) 2009-279272

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

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

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

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,300,909 B1 * 10/2001 Tsubaki et al. 343/700 MS
6,614,398 B2 * 9/2003 Kushihi et al. 343/700 MS
7,319,431 B2 * 1/2008 Jeon et al. 343/700 MS

7,538,732 B2 * 5/2009 Ishihara et al. 343/702
2001/0040527 A1 11/2001 Nagumo et al.
2002/0145569 A1 10/2002 Onaka et al.
2007/0040749 A1 2/2007 Jeon et al.
2009/0040120 A1 2/2009 Tsubaki et al.
2009/0179815 A1 7/2009 Sotoma et al.
2010/0225542 A1 9/2010 Suzuki et al.

FOREIGN PATENT DOCUMENTS

CN 101432928 A 5/2009
EP 2 226 891 A1 9/2010
JP 10-013138 1/1998
JP 2001-284954 A 10/2001
JP 2002-314330 A 10/2002
JP 2006-340368 A 12/2006
JP 2009-171096 A 7/2009

OTHER PUBLICATIONS

European Search Report issued in European Patent Application No. 10015443.4-2220, mailed Mar. 14, 2011.

* cited by examiner

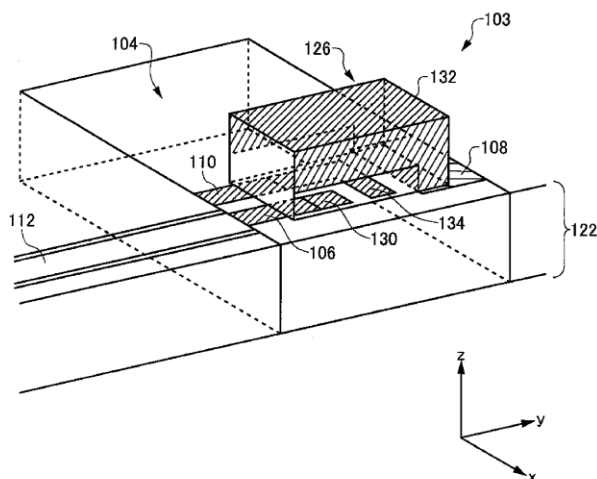
Primary Examiner — Tan Ho

(74) *Attorney, Agent, or Firm* — McDermott Will & Emery LLP

(57) **ABSTRACT**

A radiation electrode **132** is printed on the upper surface of the dielectric body, side surface thereof, and bottom surface thereof in a folded configuration. A feeding electrode **130** and ground electrode **134** are printed on the bottom surface of the antenna elements **124**. The feeding electrode **130** and radiation electrode **132** on the upper surface are opposed to each other as parallel planes. The ground electrode **134** and radiation electrode **132** are also opposite to each other as parallel planes. No electrode is formed on one of the side surfaces of the antenna element **124** that is opposed to the side surface at the side of which the radiation electrode **132** is folded.

4 Claims, 13 Drawing Sheets



101





US008525733B2

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

(10) **Patent No.:** **US 8,525,733 B2**
(45) **Date of Patent:** **Sep. 3, 2013**

(54) **LOW-PROFILE WIDE-BANDWIDTH RADIO
FREQUENCY ANTENNA**

(71) Applicant: **Apple Inc.**, Cupertino, CA (US)

(72) Inventors: **Dean Kitchener**, Essex (GB); **Andrew
Urquhart**, Hertfordshire (GB)

(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.

6,831,607	B2	12/2004	Hebron et al.
6,847,329	B2	1/2005	Ikegaya et al.
6,903,690	B2	6/2005	Leclerc et al.
7,256,743	B2	8/2007	Korva
7,345,634	B2	3/2008	Ozkar et al.
2002/0126051	A1	9/2002	Jha
2004/0145525	A1	7/2004	Annabi et al.
2005/0280589	A1	12/2005	Chiang et al.
2006/0038721	A1	2/2006	Ozkar et al.

FOREIGN PATENT DOCUMENTS

CN	2865039	Y	1/2007
EP	1052723	A2	11/2000
EP	1315238	A2	5/2003
EP	1536511	A1	6/2005

(21) Appl. No.: **13/764,899**

(22) Filed: **Feb. 12, 2013**

(65) **Prior Publication Data**

US 2013/0162498 A1 Jun. 27, 2013

Related U.S. Application Data

(63) Continuation of application No. 13/229,870, filed on
Sep. 12, 2011, now Pat. No. 8,416,137, which is a
continuation of application No. 12/415,604, filed on
Mar. 31, 2009, now Pat. No. 8,040,289.

(60) Provisional application No. 61/050,028, filed on May
2, 2008.

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 1/50 (2006.01)

(52) **U.S. Cl.**
USPC **343/700 MS**; 343/846; 343/860

(58) **Field of Classification Search**
USPC 343/700 MS, 846, 860
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,317,084	B1	11/2001	Chen et al.
6,426,723	B1	7/2002	Smith et al.

OTHER PUBLICATIONS

First Office Action and Search Report in Chinese Application No.
200980125509.6, issued Dec. 28, 2012, pp. 1-27.

(Continued)

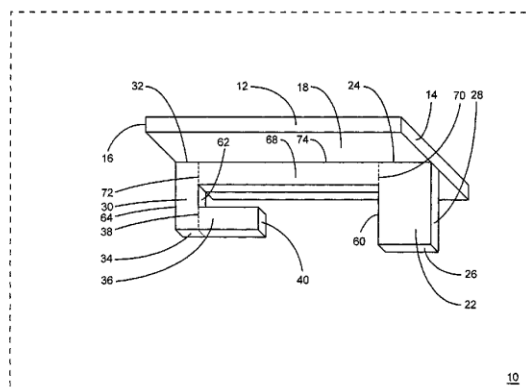
Primary Examiner — Hoang V Nguyen

(74) *Attorney, Agent, or Firm* — Meyertons, Hood, Kivlin,
Kowert & Goetzel, P.C.

(57) **ABSTRACT**

The present invention relates to an RE antenna structure that includes a planar structure and a loading plate, such that the planar structure is mounted between a ground plane and the loading plate to form an RF antenna. The loading plate may be about parallel to the ground plane and the planar structure may be about perpendicular to the loading plate and the ground plane. The loading plate may allow the height of the RF antenna structure above the ground plane to be relatively small. For example, the height may be significantly less than one-quarter of a wavelength of RF signals of interest. The planar structure may include two conductive matching elements to help increase the bandwidth of the RF antenna structure.

20 Claims, 29 Drawing Sheets





US008525734B2

(12) **United States Patent**
Krogerus

(10) **Patent No.:** **US 8,525,734 B2**

(45) **Date of Patent:** **Sep. 3, 2013**

(54) **ANTENNA DEVICE**

(75) Inventor: **Joonas Veli-Allan Krogerus**, Espoo (FI)

(73) Assignee: **Nokia Corporation**, Espoo (FI)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 766 days.

(21) Appl. No.: **12/520,719**

(22) PCT Filed: **Dec. 21, 2006**

(86) PCT No.: **PCT/IB2006/004186**

§ 371 (c)(1),

(2), (4) Date: **Feb. 26, 2010**

(87) PCT Pub. No.: **WO2008/084273**

PCT Pub. Date: **Jul. 17, 2008**

(65) **Prior Publication Data**

US 2010/0214180 A1 Aug. 26, 2010

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

(52) **U.S. Cl.**
USPC **343/702; 343/745**

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

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,559,521 A 9/1996 Evans et al.
5,668,561 A * 9/1997 Perrotta et al. 343/702

5,986,608 A * 11/1999 Korisch et al. 343/702
6,504,507 B2 * 1/2003 Geeraert 343/700 MS
6,624,789 B1 9/2003 Kangasvieri et al.
2003/0050032 A1 * 3/2003 Masaki 455/272
2003/0151555 A1 8/2003 Holshouser
2006/0262026 A1 11/2006 Gainey et al.
2008/0252536 A1 * 10/2008 Anguera et al. 343/702

FOREIGN PATENT DOCUMENTS

EP 0716470 A 6/1996
EP 1052723 A 11/2000
EP 1278155 A 1/2003
EP 1294048 A 3/2003
JP 10261914 A 9/1998

OTHER PUBLICATIONS

Skrivervik, "Terminal Antennas : Developments and Trends", Ecole Polytechnique Fédérale de Lausanne, Feb. 2004.
Vainikainen et al., "Resonator-based analysis of the combination of mobile handset antenna and chassis", IEEE Trans. on Ant. and Prop., vol. 50, No. 10, pp. 1433-1444, Oct. 2002.
Kivekas et al., "Bandwidth, SAR, and efficiency of internal mobile phone antennas", IEEE Trans. on EMC, vol. 46, No. 1, Feb. 2004 pp. 71-86.
Lindberg et al., "A Bandwidth Enhancement Technique for Mobile Handset Antennas Using Wavetraps", IEEE Trans. on Ant. and Prop., vol. 54, No. 8, Aug. 2006, pp. 2226-2233.

* cited by examiner

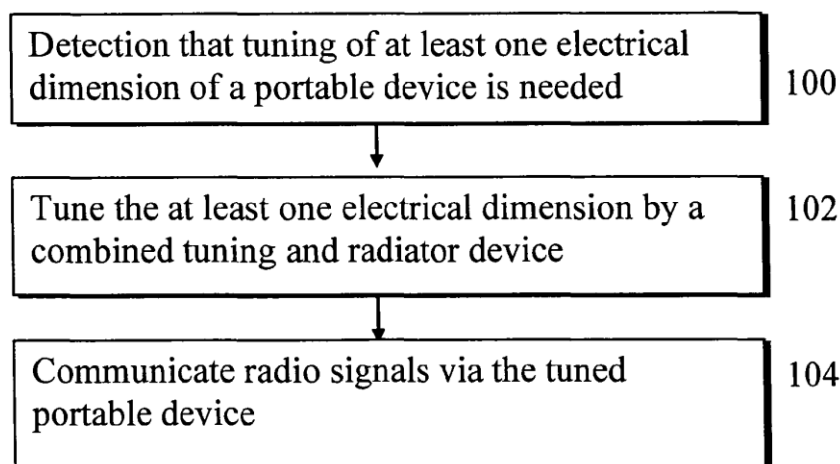
Primary Examiner — Tho G Phan

(74) Attorney, Agent, or Firm — Nokia Corporation

(57) **ABSTRACT**

An antenna device for a portable electronic device and an electronic device provided with such an antenna are disclosed. The antenna device is configured to provide in a combination a tuning element for tuning at least one electrical dimension of the portable electronic device and an antenna radiator element of the portable electronic device.

20 Claims, 13 Drawing Sheets





US008525735B2

(12) **United States Patent
Kilpi**(10) **Patent No.: US 8,525,735 B2**(45) **Date of Patent: Sep. 3, 2013**(54) **FOLDABLE/SLIDEABLE APPARATUS FOR
RADIO COMMUNICATION WITH
BACKSPACE FOR AN ANTENNA**(75) Inventor: **Pekka Kilpi**, Helsinki (FI)(73) Assignee: **Nokia Corporation**, Espoo (FI)(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 968 days.(21) Appl. No.: **12/599,496**(22) PCT Filed: **May 7, 2007**(86) PCT No.: **PCT/EP2007/004349**

§ 371 (c)(1),

(2), (4) Date: **Nov. 9, 2009**(87) PCT Pub. No.: **WO2008/135070**PCT Pub. Date: **Nov. 13, 2008**(65) **Prior Publication Data**

US 2010/0302107 A1 Dec. 2, 2010

(51) **Int. Cl.**
H01Q 1/24 (2006.01)(52) **U.S. Cl.**
USPC **343/702**; 455/575.4; 455/575.7(58) **Field of Classification Search**
USPC **343/702**; 455/575.3-7
See application file for complete search history.(56) **References Cited**

U.S. PATENT DOCUMENTS

6,677,903 B2 * 1/2004 Wang 343/702
7,274,335 B2 * 9/2007 Kim et al. 343/7027,456,794 B2 * 11/2008 Sakamoto et al. 343/702
7,840,243 B2 * 11/2010 Hirai 455/575.7
7,880,678 B2 * 2/2011 Degner et al. 343/702
7,962,186 B2 * 6/2011 Cui et al. 455/575.7
8,260,385 B2 * 9/2012 Kim et al. 455/575.7
2001/0009847 A1 * 7/2001 Kim et al. 455/90
2002/0080074 A1 * 6/2002 Wang 343/700 MS
2003/0201945 A1 * 10/2003 Reece et al. 343/795
2005/0049019 A1 * 3/2005 Lee 455/575.4
2005/0179602 A1 8/2005 Ryu et al.
2005/0208985 A1 * 9/2005 Park et al. 455/575.4
2009/0239595 A1 * 9/2009 Sung et al. 455/575.7
2012/0274518 A1 * 11/2012 Ying 343/702

FOREIGN PATENT DOCUMENTS

EP 1612953 A 1/2006
EP 1672878 A 6/2006
WO 2006077983 A 7/2006

OTHER PUBLICATIONS

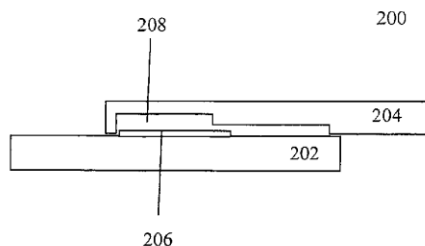
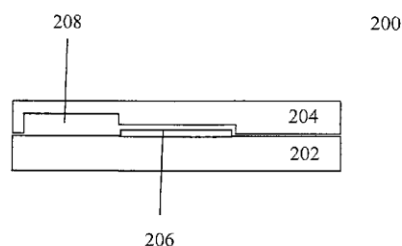
International Search Report and Written Opinion for Corresponding
PCT Application No. PCT/EP2007/004349 sent on Mar. 18, 2008, p.
1-13.

* cited by examiner

Primary Examiner — Douglas W Owens

Assistant Examiner — Jennifer F Hu

(74) Attorney, Agent, or Firm — Nokia Corporation

(57) **ABSTRACT**An apparatus for radio communication comprising an
antenna element and first and second parts, wherein the appa-
ratus is arranged such that the first and second parts are
movable with respect to one another between first and second
configurations, and wherein movement of the apparatus from
the first configuration into the second configuration provides
a backspace which can be used as a backspace for the antenna
element.**16 Claims, 6 Drawing Sheets**



US008525736B2

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

(10) **Patent No.:** **US 8,525,736 B2**
(45) **Date of Patent:** **Sep. 3, 2013**

(54) **ANTENNA DEVICE**

(75) Inventors: **Shinsuke Yukimoto**, Tokyo (JP); **Takao Yokoshima**, Tokyo (JP)

(73) Assignees: **Mitsubishi Cable Industries, Ltd.**, Tokyo (JP); **Mitsubishi Materials Corporation**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 833 days.

(21) Appl. No.: **12/667,614**

(22) PCT Filed: **Jul. 3, 2008**

(86) PCT No.: **PCT/JP2008/001755**

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

(87) PCT Pub. No.: **WO2009/004811**

PCT Pub. Date: **Jan. 8, 2009**

(65) **Prior Publication Data**

US 2010/0194658 A1 Aug. 5, 2010

(30) **Foreign Application Priority Data**

Jul. 5, 2007 (JP) 2007-176941
Jul. 5, 2007 (JP) 2007-176942

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/50 (2006.01)

(52) **U.S. Cl.**
USPC **343/702; 343/860**

(58) **Field of Classification Search**

USPC 343/702, 850, 860, 846, 745, 749,
343/866

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,147,652 A * 11/2000 Sekine 343/702
7,242,364 B2 * 7/2007 Ranta 343/860

FOREIGN PATENT DOCUMENTS

CN 1663075 A 8/2005
JP 11-154815 A 6/1999
JP 2005-39594 A 2/2005
WO 2004/001902 A1 12/2003

OTHER PUBLICATIONS

International Search Report for Appln. No. PCT/JP2008/001755 dated Sep. 2, 2008.

Notice of 2nd Refusal dated Sep. 25, 2012 issued in corresponding Chinese patent application No. 200780011966.3.

* cited by examiner

Primary Examiner — Robert Karacsony

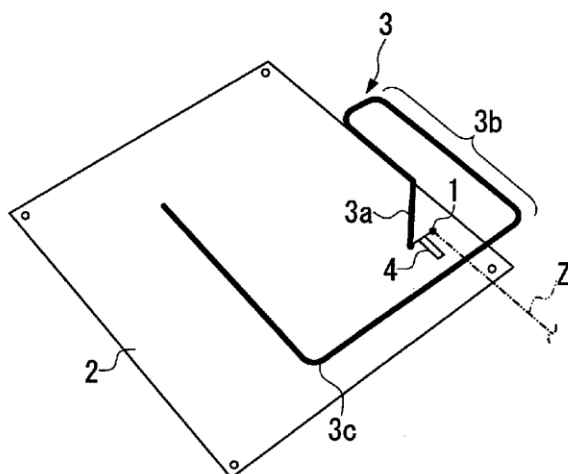
Assistant Examiner — Hasan Islam

(74) *Attorney, Agent, or Firm* — Carter, DeLuca, Farrell & Schmidt, LLP

(57) **ABSTRACT**

An antenna element has an upstanding section erected from a base member; a tuning section extended from the upper end of the upstanding section into one direction in a parallel plane parallel to the base member, bent in the middle, and then extended in the direction opposite the one direction; and an open element section extended from the front end of the tuning section in the direction in which the open element section spirally turns in the parallel plane about the upstanding section.

10 Claims, 22 Drawing Sheets





US008525737B2

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

(10) **Patent No.:** **US 8,525,737 B2**

(45) **Date of Patent:** **Sep. 3, 2013**

(54) **ANTENNA ASSEMBLY AND PORTABLE
TERMINAL HAVING THE SAME**

(75) Inventors: **Sungjung Rho**, Seoul (KR); **Jaegon
Lee**, Seoul (KR); **Ansun Hyun**, Seoul
(KR); **Yochuol Ho**, Seongnam (KR);
Euntaek Jeong, Anyang (KR)

(73) Assignee: **LG Electronics Inc.**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 384 days.

(21) Appl. No.: **12/875,604**

(22) Filed: **Sep. 3, 2010**

(65) **Prior Publication Data**

US 2011/0057859 A1 Mar. 10, 2011

(30) **Foreign Application Priority Data**

Sep. 4, 2009 (KR) 10-2009-0083659

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

(52) **U.S. Cl.**
USPC **343/702; 343/909**

(58) **Field of Classification Search**

USPC 343/700 MS, 702, 909, 749, 846
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,111,544 A * 8/2000 Dakeya et al. 343/700 MS
2003/0214441 A1 * 11/2003 Back et al. 343/700 MS
2007/0229363 A1 * 10/2007 Kurashima et al. 343/700 MS
2008/0079642 A1 * 4/2008 Ishizuka et al. 343/702

* cited by examiner

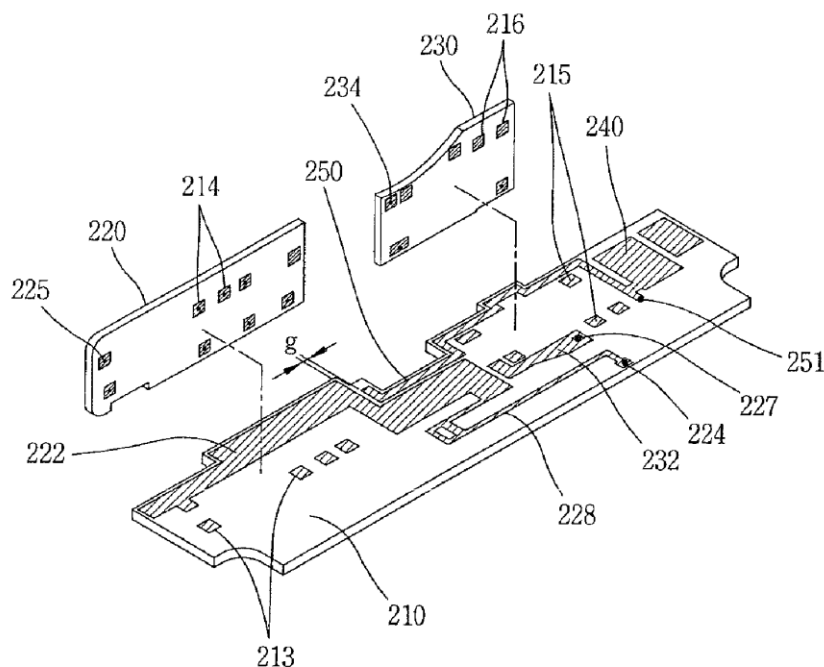
Primary Examiner — Dieu H Duong

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

(57) **ABSTRACT**

An antenna assembly includes a patch coupled to a first board, a conductive pattern coupled to a second board, a first connector electrically coupled to the patch, and a second connector to couple the conductive pattern to a circuit of the first board. The patch has a first section adjacent a first surface and a second section adjacent an opposing second surface of the second board, and the first connector electrically couples the first section to the second section of the patch. The assembly may include a plurality of antennas, and portable terminal may use the assembly to communicate in different frequency bands.

18 Claims, 8 Drawing Sheets





US008525738B2

(12) United States Patent
Wu et al.**(10) Patent No.: US 8,525,738 B2****(45) Date of Patent: Sep. 3, 2013****(54) WIRELESS COMMUNICATION DEVICE AND METHOD THEREOF****(75) Inventors:** **Wei-Yang Wu**, Taoyuan County (TW);
Hsiao-Chuan Lin, 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 434 days.**(21) Appl. No.: 12/879,021****(22) Filed: Sep. 10, 2010****(65) Prior Publication Data**

US 2011/0194589 A1 Aug. 11, 2011

(30) Foreign Application Priority Data

Feb. 11, 2010 (TW) 99104483 A

(51) Int. Cl.
H01B 1/24 (2006.01)**(52) U.S. Cl.**
USPC **343/702; 343/901****(58) Field of Classification Search**
USPC 343/702, 901
See application file for complete search history.**(56) References Cited****U.S. PATENT DOCUMENTS**5,644,320 A * 7/1997 Rossi 343/702
5,812,093 A 9/1998 Thompson et al.6,809,775 B2 10/2004 Yule
6,917,328 B2 7/2005 Rabinowitz et al.
7,425,923 B2 * 9/2008 Ko et al. 343/702
2002/0033773 A1 * 3/2002 Hirabayashi 343/702**FOREIGN PATENT DOCUMENTS**CN 1152805 6/1997
CN 1236200 11/1999
EP 1708305 10/2006**OTHER PUBLICATIONS**

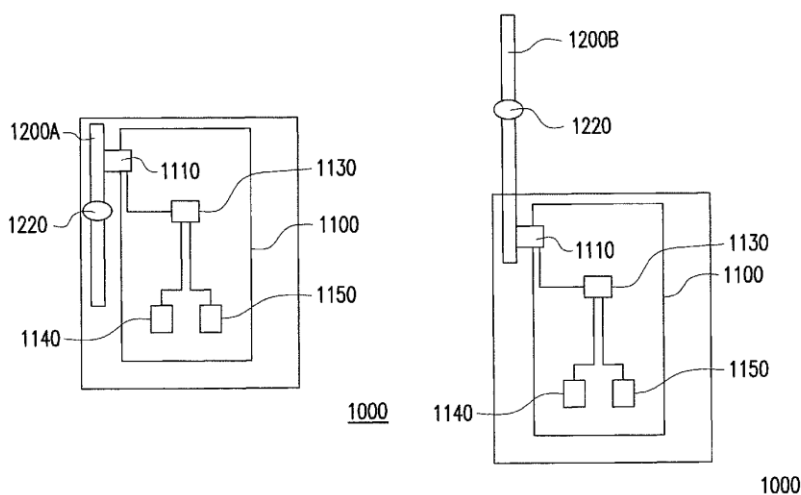
"Extended Search Report of European Counterpart Application", issued on Feb. 2, 2011, p. 1-p. 5.

"First Office Action of China Counterpart Application", issued on Mar. 14, 2013, p. 1-p. 8.

* cited by examiner

Primary Examiner — Dieu H Duong*(74) Attorney, Agent, or Firm* — Jianq Chyun IP Office**(57) ABSTRACT**

A wireless communication device including a system ground plane and a retractable antenna is provided. The system ground plane includes a feed point. When the retractable antenna is configured to be a first length, the wireless communication device transceives a first signal of a first bandwidth through the retractable antenna for a first radio frequency system. When the retractable antenna is configured to be a second length, the wireless communication device transceives the first signal and a second signal of a second bandwidth through the retractable antenna respectively for the first radio frequency system and the second radio frequency system. A center frequency of the first bandwidth range is substantially a first odd multiple of a reference frequency, and a center frequency of the second bandwidth range is substantially a second odd multiple of the reference frequency, and the first odd multiple is different to the second odd multiple.

14 Claims, 8 Drawing Sheets



US008525739B2

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

(10) **Patent No.:** **US 8,525,739 B2**
(45) **Date of Patent:** **Sep. 3, 2013**

(54) **ANTENNA DEVICE AND PORTABLE
TERMINAL HAVING THE SAME**

(75) Inventors: **Jaegon Lee**, Seoul (KR); **Ansun Hyun**,
Seoul (KR); **Euntaek Jeoung**,
Gyeonggi-Do (KR); **Yochuol Ho**,
Gyeonggi-Do (KR); **Viktor Kalinichev**,
Moscow (RU)

(73) Assignee: **LG Electronics Inc.**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 366 days.

(21) Appl. No.: **12/908,790**

(22) Filed: **Oct. 20, 2010**

(65) **Prior Publication Data**

US 2011/0128192 A1 Jun. 2, 2011

(30) **Foreign Application Priority Data**

Dec. 2, 2009 (KR) 10-2009-0118688

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

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

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

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,262,495	B1 *	7/2001	Yablonovitch et al.	307/101
6,433,756	B1 *	8/2002	Sievenpiper et al.	343/909
6,906,674	B2 *	6/2005	McKinzie et al.	343/767
8,188,928	B2 *	5/2012	Lin et al.	343/700 MS
2003/0201938	A1	10/2003	Dening et al.	
2008/0129511	A1	6/2008	Yuen et al.	

FOREIGN PATENT DOCUMENTS

WO WO 02/41447 A1 5/2002

* cited by examiner

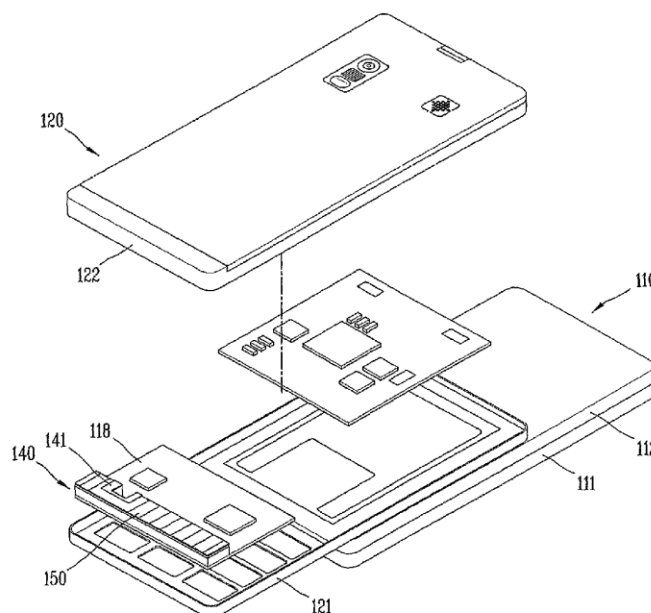
Primary Examiner — Hoanganh Le

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

(57) **ABSTRACT**

Disclosed are an antenna device and a portable terminal having the same. The portable terminal includes a terminal body, a radiator including a conductive material, and configured in a preset pattern to transmit or receive wireless signals, a circuit board mounted to the terminal body, and configured to process the wireless signal by being electrically connected to the radiator, and an artificial magnetic conductor module disposed near the radiator, and configured to reflect the wireless signal.

15 Claims, 12 Drawing Sheets





US008525740B2

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

(10) **Patent No.:** **US 8,525,740 B2**
(45) **Date of Patent:** **Sep. 3, 2013**

(54) **MOBILE TERMINAL**

(56) **References Cited**

(75) Inventors: **Younsuk Jeong**, Gyeonggi-Do (KR);
Wooyoung Choi, Gyeonggi-Do (KR)

U.S. PATENT DOCUMENTS

7,505,006	B2 *	3/2009	Ollikainen et al.	343/702
7,903,034	B2 *	3/2011	Anguera et al.	343/702
2004/0125029	A1	7/2004	Maoz et al.	
2009/0243944	A1	10/2009	Jung et al.	

(73) Assignee: **LG Electronics Inc.**, Seoul (KR)

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 350 days.

WO	WO 2006/134402	A1	12/2006
WO	WO 2007/084051	A1	7/2007
WO	WO 2009/037353	A1	3/2009

(21) Appl. No.: **12/939,907**

* cited by examiner

(22) Filed: **Nov. 4, 2010**

Primary Examiner — Hoang V Nguyen

(65) **Prior Publication Data**

US 2011/0156962 A1 Jun. 30, 2011

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

(30) **Foreign Application Priority Data**

Dec. 30, 2009 (KR) 10-2009-0134762

(57) **ABSTRACT**

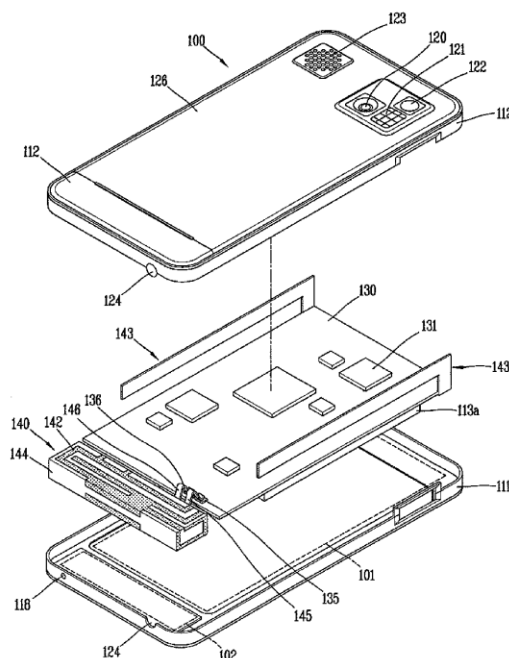
(51) **Int. Cl.**
H01Q 1/24 (2006.01)

(52) **U.S. Cl.**
USPC **343/702**; 343/846; 343/848

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

According to an embodiment of the present invention, the mobile terminal includes, a terminal body, a printed circuit board (PCB) mounted in the interior of the terminal body, and an internal antenna connected to the PCB, and configured to transmit and receive signals, wherein the internal antenna includes a ground formed on the PCB, a radiator connected to the ground and configured to be operable at a first band, and to feed the signals to the PCB, and a ground extension part extending in at least one direction from the ground, and configured to expand a ground surface of the ground in order for the internal antenna to include a second band, which is lower than a first band, as an operation band.

18 Claims, 13 Drawing Sheets





US008525742B2

(12) **United States Patent**
Yang

(10) **Patent No.:** **US 8,525,742 B2**
(45) **Date of Patent:** ***Sep. 3, 2013**

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

(71) Applicant: **Airgain, Inc.**, Carlsbad, CA (US)

(72) Inventor: **Xiao Ping Yang**, Carlsbad, CA (US)

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

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

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/674,928**

(22) Filed: **Nov. 12, 2012**

(65) **Prior Publication Data**

US 2013/0063306 A1 Mar. 14, 2013

Related U.S. Application Data

(63) Continuation of application No. 13/329,895, filed on Dec. 19, 2011, now Pat. No. 8,310,402, which is a continuation of application No. 11/866,354, filed on Oct. 2, 2007, now Pat. No. 8,081,123.

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

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

(52) **U.S. Cl.**

USPC **343/702**; 343/700 MS

(58) **Field of Classification Search**

USPC 343/702, 700 MS, 893, 876
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,222,494 B1 * 4/2001 Erkocevic 343/790
8,310,402 B2 * 11/2012 Yang 343/702
2010/0328163 A1 * 12/2010 Abramov et al. 343/702

* cited by examiner

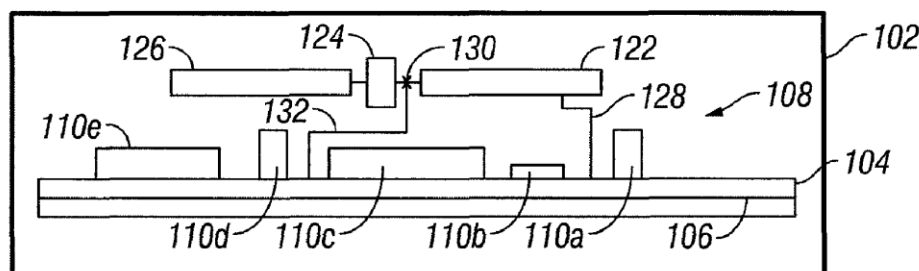
Primary Examiner — Hoanganh Le

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

(57) **ABSTRACT**

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

11 Claims, 10 Drawing Sheets





US008525743B2

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

(10) **Patent No.:** **US 8,525,743 B2**
(45) **Date of Patent:** ***Sep. 3, 2013**

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

(71) Applicant: **Research In Motion Limited**, Waterloo (CA)

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

(73) Assignee: **BlackBerry Limited**, Waterloo, Ontario

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

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/686,518**

(22) Filed: **Nov. 27, 2012**

(65) **Prior Publication Data**

US 2013/0082892 A1 Apr. 4, 2013

Related U.S. Application Data

(63) Continuation of application No. 13/529,531, filed on Jun. 21, 2012, now Pat. No. 8,339,323, which is a continuation of application No. 13/358,126, filed on Jan. 25, 2012, now Pat. No. 8,223,078, which is a continuation of application No. 13/156,728, filed on Jun. 9, 2011, now Pat. No. 8,125,397, which is a 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 1/12 (2006.01)

(52) **U.S. Cl.**
USPC **343/702**; 343/795; 343/803; 343/818; 343/833

(58) **Field of Classification Search**
USPC 343/702, 795, 803, 818, 833
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,184,747 A 5/1965 Kach
3,521,284 A 7/1970 Shelton, Jr. et al.

(Continued)

FOREIGN PATENT DOCUMENTS

EP 0543645 5/1993
EP 0571124 11/1993

(Continued)

OTHER PUBLICATIONS

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

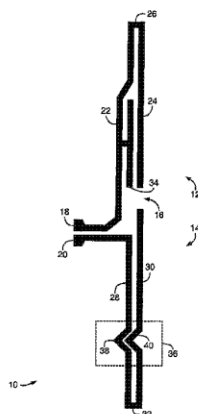
Primary Examiner — Tho G Phan

(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





US008525749B2

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

(10) **Patent No.:** **US 8,525,749 B2**
(45) **Date of Patent:** **Sep. 3, 2013**

(54) **GROUND STRUCTURE OF ANTENNA OF MOBILE TERMINAL**

(75) Inventors: **Han Min Cho**, Yongin-si (KR); **Sang Moo Cha**, Suwon-si (KR); **Yong Tae Kim**, Hwaseong-si (KR); **Ung Ryeol Lee**, Suwon-si (KR)

(73) Assignee: **Samsung Electronics Co., Ltd.**,
Suwon-si (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 356 days.

(21) Appl. No.: **12/860,983**

(22) Filed: **Aug. 23, 2010**

(65) **Prior Publication Data**
US 2011/0050533 A1 Mar. 3, 2011

(30) **Foreign Application Priority Data**
Aug. 28, 2009 (KR) 10-2009-0080754

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

(52) **U.S. Cl.**

USPC **343/848**; 343/702; 343/846

(58) **Field of Classification Search**

None

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,012,571	B1 *	3/2006	Ozkar et al.	343/702
7,042,404	B2 *	5/2006	Jo et al.	343/702
8,228,240	B2 *	7/2012	Kim et al.	343/702
2007/0052596	A1 *	3/2007	Liu et al.	343/702

* cited by examiner

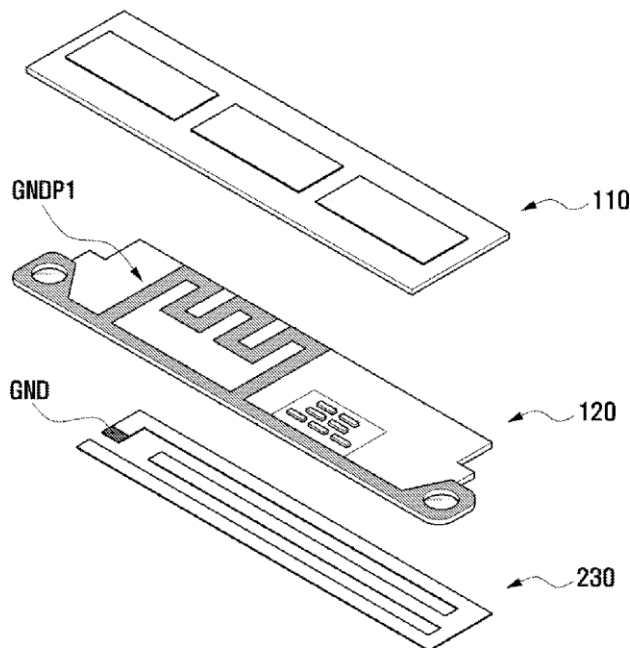
Primary Examiner — Anh Tran

(74) Attorney, Agent, or Firm — Jefferson IP Law, LLP

(57) **ABSTRACT**

An antenna ground structure of a mobile terminal is disclosed. The antenna ground structure of a mobile terminal is arranged to provide the ground pattern on a Printed Circuit Board (PCB) adjacent to the antenna and to electrically connect the ground pattern to the ground unit of the antenna, so that the area of the ground of the antenna may be expanded to improve Specific Absorption Rate (SAR) and communication performance.

11 Claims, 5 Drawing Sheets





US008525750B2

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

(10) **Patent No.:** **US 8,525,750 B2**

(45) **Date of Patent:** **Sep. 3, 2013**

(54) **VARYING ANGLE ANTENNA FOR
ELECTROMAGNETIC RADIATION
DISSIPATION DEVICE**

(75) Inventors: **Kevin B. Tucek**, McKinney, TX (US);
Steven C. Shanks, McKinney, TX (US)

(73) Assignee: **Erchonia Corporation**, McKinney, TX
(US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 349 days.

(21) Appl. No.: **13/094,166**

(22) Filed: **Apr. 26, 2011**

(65) **Prior Publication Data**

US 2011/0193767 A1 Aug. 11, 2011

Related U.S. Application Data

(63) Continuation of application No. 12/868,287, filed on
Aug. 25, 2010, now Pat. No. 7,973,736, which is a
continuation of application No. 12/215,231, filed on
Jun. 26, 2008, now Pat. No. 7,800,554.

(51) **Int. Cl.**
H01Q 1/36 (2006.01)
H01Q 1/38 (2006.01)

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

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

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,624,536	B1	9/2003	Sawada et al.	
7,486,241	B2 *	2/2009	Qi et al.	343/702
2003/0006384	A1	1/2003	Masaki et al.	

FOREIGN PATENT DOCUMENTS

JP	3044424	U	12/1997
JP	200049487	A	2/2000
JP	2003008278	A	1/2003

* cited by examiner

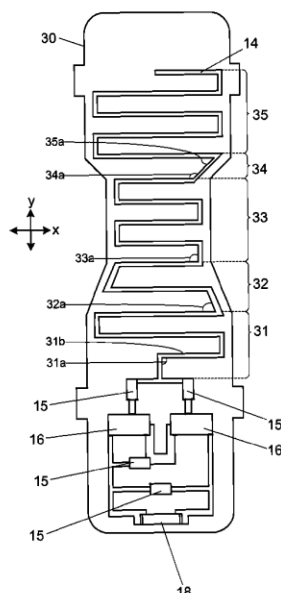
Primary Examiner — Hoang V Nguyen

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

(57) **ABSTRACT**

A varying angle antenna design can be used with an electro-magnetic radiation dissipation device to reduce exposure to electromagnetic radiation. The antenna captures radiation from an active emission source, such as a cellular telephone as it transmits. The device converts the captured radiation into an electric current and dissipates the collected current by spending it to operate a thermal, mechanical, or electrical device. The varying angle antenna is a printed circuit board trace antenna comprising a microstrip having several serially connected meandering segments. One or more meandering segments include 90-degree bends in the microstrip, and one or more meandering segments include bends of more and less than 90 degrees. Portions of the microstrip that are horizontally oriented are all parallel, while portions of the microstrip that are vertically oriented can be parallel or angled, depending on the bend angle. Near the center of the antenna, the microstrip segments are narrower.

20 Claims, 4 Drawing Sheets





US008531252B2

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

(10) **Patent No.:** **US 8,531,252 B2**
(45) **Date of Patent:** **Sep. 10, 2013**

(54) **ANTENNA DUPLEXER AND
COMMUNICATION APPARATUS
EMPLOYING THE SAME**

(75) Inventors: **Hiroyuki Nakamura**, Osaka (JP);
Tetsuya Tsurunari, Osaka (JP); **Joji
Fujiwara**, Osaka (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 719 days.

(21) Appl. No.: **12/668,699**

(22) PCT Filed: **Jul. 8, 2008**

(86) PCT No.: **PCT/JP2008/001815**

§ 371 (c)(1),
(2), (4) Date: **Jan. 12, 2010**

(87) PCT Pub. No.: **WO2009/011101**

PCT Pub. Date: **Jan. 22, 2009**

(65) **Prior Publication Data**

US 2010/0188165 A1 Jul. 29, 2010

(30) **Foreign Application Priority Data**

Jul. 13, 2007 (JP) 2007-183962

(51) **Int. Cl.**
H03H 9/70 (2006.01)
H04B 1/48 (2006.01)

(52) **U.S. Cl.**
USPC **333/133**; 333/129; 333/132; 455/82;
455/83; 455/552.1

(58) **Field of Classification Search**

USPC 333/126, 129, 132, 133; 455/78,
455/82, 83, 552.1

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,564,076 A 10/1996 Auvray
6,014,551 A * 1/2000 Pesola et al. 455/86
6,308,051 B1 * 10/2001 Atokawa 455/78
6,759,924 B2 * 7/2004 Sakuragawa et al. 333/133
6,759,925 B2 * 7/2004 Satoh et al. 333/133

(Continued)

FOREIGN PATENT DOCUMENTS

JP 7-059162 3/1995
JP 2003-152590 * 5/2003

(Continued)

OTHER PUBLICATIONS

T. Metzger et al.; "Selection of Micro-Acoustic Technologies for the
Realization of Single-ended / Balanced WCDMA Duplexers"; 2008
IEEE MTT-S International Microwave Symposium Digest, Jun.
15-20, 2008, pp. 835-839.*

(Continued)

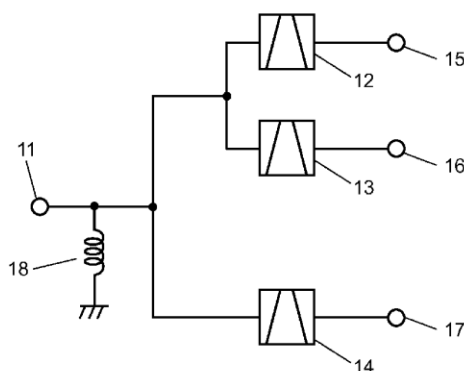
Primary Examiner — Barbara Summons

(74) *Attorney, Agent, or Firm* — Wenderoth, Lind & Ponack,
L.L.P.

(57) **ABSTRACT**

A small antenna duplexer that includes antenna terminal, first
filter electrically connected to this antenna terminal and pass-
ing a first frequency band, second filter electrically connected
to antenna terminal and passing a second frequency band, and
third filter electrically connected to antenna terminal and
passing a third frequency band. First filter and third filter are
used for one band, and second filter and third filter are used for
another band.

15 Claims, 9 Drawing Sheets





US008531337B2

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

(10) **Patent No.:** **US 8,531,337 B2**
(45) **Date of Patent:** **Sep. 10, 2013**

(54) **ANTENNA DIVERSITY SYSTEM AND SLOT
 ANTENNA COMPONENT**

(75) Inventors: **Jordi Soler Castany**, Mataró (ES); **José Mumburu Forn**, Barcelona (ES); **Carles Puente Baliarda**, Barcelona (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 1008 days.

(21) Appl. No.: **11/914,178**

(22) PCT Filed: **May 12, 2006**

(86) PCT No.: **PCT/EP2006/062285**

§ 371 (c)(1),

(2), (4) Date: **Nov. 12, 2007**

(87) PCT Pub. No.: **WO2006/120250**

PCT Pub. Date: **Nov. 16, 2006**

(65) **Prior Publication Data**

US 2008/0198082 A1 Aug. 21, 2008

Related U.S. Application Data

(60) Provisional application No. 60/680,693, filed on May 13, 2005, provisional application No. 60/778,323, filed on Mar. 2, 2006.

(30) Foreign Application Priority Data

May 13, 2005 (EP) 05104026
 Feb. 27, 2006 (EP) 06110437

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 13/10 (2006.01)

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

(58) Field of Classification Search

USPC 343/700 MS, 767, 770, 893, 702, 343/846

See application file for complete search history.

(56) References Cited

U.S. PATENT DOCUMENTS

3,680,135 A 7/1972 Boyer
 3,750,017 A * 7/1973 Bowman et al. 324/72

(Continued)

FOREIGN PATENT DOCUMENTS

EP 0108816 A 5/1984
 EP 0969375 1/2000

(Continued)

OTHER PUBLICATIONS

Plicanic, V., Antenna diversity studies and evaluation, University of Carolina and Ericsson Mobile Communications, MAster of Science Thesis, May 2004.

(Continued)

Primary Examiner — Michael C Wimer

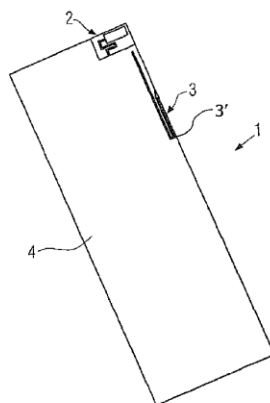
Assistant Examiner — Hasan Islam

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

(57) ABSTRACT

The present invention refers to an antenna diversity system comprising at least a first antenna and a second antenna wherein the first antenna substantially behaves as an electric current source or as a magnetic current source, and the second antenna substantially behaves as an electric current source or as a magnetic current source and a corresponding wireless device. Further the invention relates to an SMT-type slot-antenna component comprising at least one conductive surface or sheet of metal in which the pattern of a slot is created, at least one contact terminal accessible from the exterior of said component to electrically connect the conductive surface included in the slot-antenna component with the ground plane of a circuit board such as a printed circuit board and a corresponding wireless device.

110 Claims, 26 Drawing Sheets





US008531338B2

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

(10) **Patent No.:** **US 8,531,338 B2**
(45) **Date of Patent:** **Sep. 10, 2013**

(54) **WIRELESS COMMUNICATION DEVICE**

(75) Inventors: **Chin-Hung Ma**, Taoyuan (TW);
Chi-Sheng Liu, Taoyuan (TW)

(73) Assignee: **FIH (Hong Kong) Limited**, Kowloon
(HK)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 576 days.

(21) Appl. No.: **12/819,291**

(22) Filed: **Jun. 21, 2010**

(65) **Prior Publication Data**

US 2011/0156965 A1 Jun. 30, 2011

(30) **Foreign Application Priority Data**

Dec. 25, 2009 (TW) 98144871 A

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 3/24 (2006.01)

H01Q 1/50 (2006.01)

(52) **U.S. Cl.**

USPC **343/702**; 343/876; 343/906

(58) **Field of Classification Search**

USPC 343/702, 872, 876, 906; 455/572.1,
455/572.3, 572.4, 572.7

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2009/0224982 A1* 9/2009 Isoda et al. 343/702

* cited by examiner

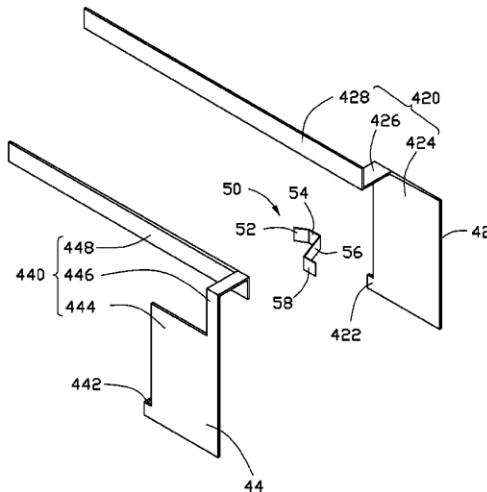
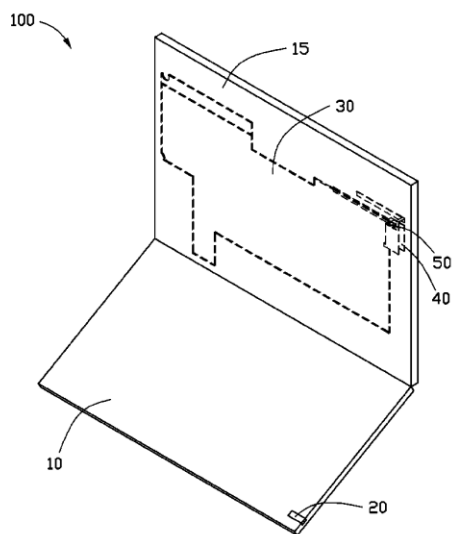
Primary Examiner — Robert Karacsony

(74) *Attorney, Agent, or Firm* — Altis Law Group, Inc.

(57) **ABSTRACT**

A wireless communication device includes a main body, a cover, a base board, an elastic member, and an antenna module. The cover is attached to the main body. The base board includes a feeding point and a grounding point. The elastic member is connected to one of the feeding point and the grounding point. The antenna module includes a first antenna and a second antenna connected to the other feeding point and the grounding point of the base board. The base board, the elastic and the antenna module are mounted in the cover. The elastic member selectively causes the first antenna or the second antenna to contact to the one of the feeding points and the grounding point of the base board when in an open or closed state.

20 Claims, 7 Drawing Sheets





US008531339B2

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

(10) **Patent No.:** **US 8,531,339 B2**
(45) **Date of Patent:** **Sep. 10, 2013**

(54) **HAND-HELD ELECTRONIC DEVICE**

(56) **References Cited**

(75) Inventors: **Lin-Chin Huang**, Taoyuan County (TW); **Chia-Yan Hsu**, Taoyuan County (TW); **Kuo-Chuan Liao**, Taoyuan County (TW); **Ming-Chun Huang**, Taoyuan County (TW)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 246 days.

(21) Appl. No.: **13/015,881**

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

(65) **Prior Publication Data**

US 2011/0291897 A1 Dec. 1, 2011

(30) **Foreign Application Priority Data**

Jun. 1, 2010 (TW) 99117548 A

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

(52) **U.S. Cl.**
USPC **343/702**; 343/904

(58) **Field of Classification Search**
USPC 343/702, 904; 455/575.1, 575.8; 379/433.01, 433.08

See application file for complete search history.

U.S. PATENT DOCUMENTS
8,188,930 B2 * 5/2012 Sung et al. 343/702
2007/0057852 A1 * 3/2007 Leizerovich et al. 343/702
2008/0174420 A1 7/2008 Hsu et al.
2009/0005117 A1 1/2009 Bashan et al.
2010/0188300 A1 * 7/2010 Anguera et al. 343/702
2011/0148718 A1 * 6/2011 Wang et al. 343/702

FOREIGN PATENT DOCUMENTS
CN 101291153 A 8/2008
TW M265773 5/2005
TW 200832129 A 8/2008
TW 201018180 A 5/2010

* cited by examiner

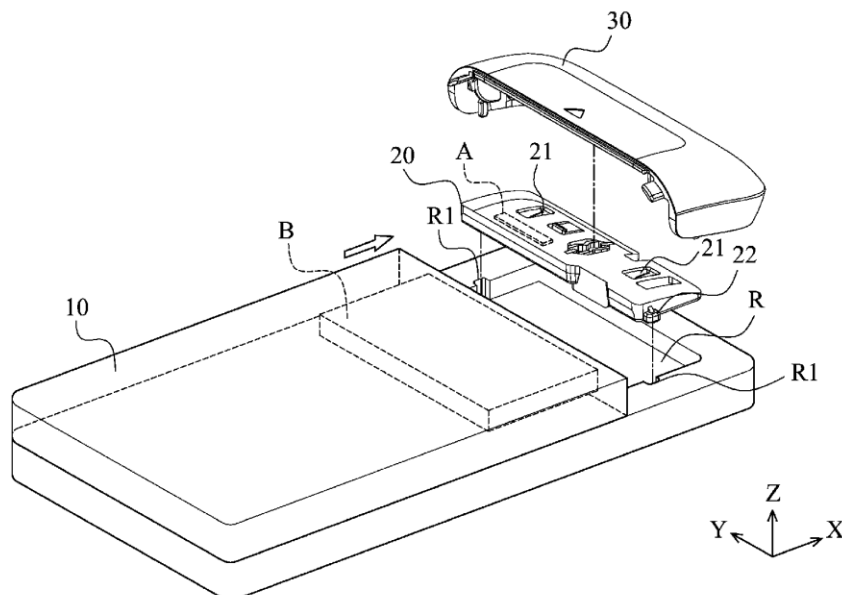
Primary Examiner — Hoanganh Le

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

(57) **ABSTRACT**

An electronic device is provided, including a main body, a battery detachably received in the main body, a stopper disposed in a predetermined position to restrict the battery in the main body, an antenna disposed on the stopper, and a cover connected with the stopper and movable relative to the stopper between a first position and a second position. When the cover is in the first position, the cover is engaged with the main body and restricts the stopper in the predetermined position. When the cover is moved from the first position along a first direction to the second position, the cover is disengaged from the main body, and the stopper is releasable from the predetermined position along a second direction.

10 Claims, 4 Drawing Sheets





US008531340B2

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

(10) **Patent No.:** **US 8,531,340 B2**
(45) **Date of Patent:** **Sep. 10, 2013**

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

(75) Inventors: **Tiao-Hsing Tsai**, New Taipei (TW);
Chao-Hsu Wu, Luzhu Township,
Taoyuan County (TW); **Yuan-Chang**
Chao, Dayuan Township, Taoyuan
County (TW); **Tsung-Ming Kuo**, Tainan
(TW)

(73) Assignee: **Quanta Computer, Inc.**, 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 230 days.

(21) Appl. No.: **13/099,992**

(22) Filed: **May 3, 2011**

(65) **Prior Publication Data**

US 2012/0146858 A1 Jun. 14, 2012

(30) **Foreign Application Priority Data**

Dec. 13, 2010 (TW) 99143470 A

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

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

(58) **Field of Classification Search**
USPC 343/702, 700 MS, 129, 810, 793
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2007/0171130 A1 * 7/2007 Chung et al. 343/700 MS
2009/0243943 A1 * 10/2009 Mumburu et al. 343/702
2011/0263217 A1 * 10/2011 Chiu et al. 455/129

* cited by examiner

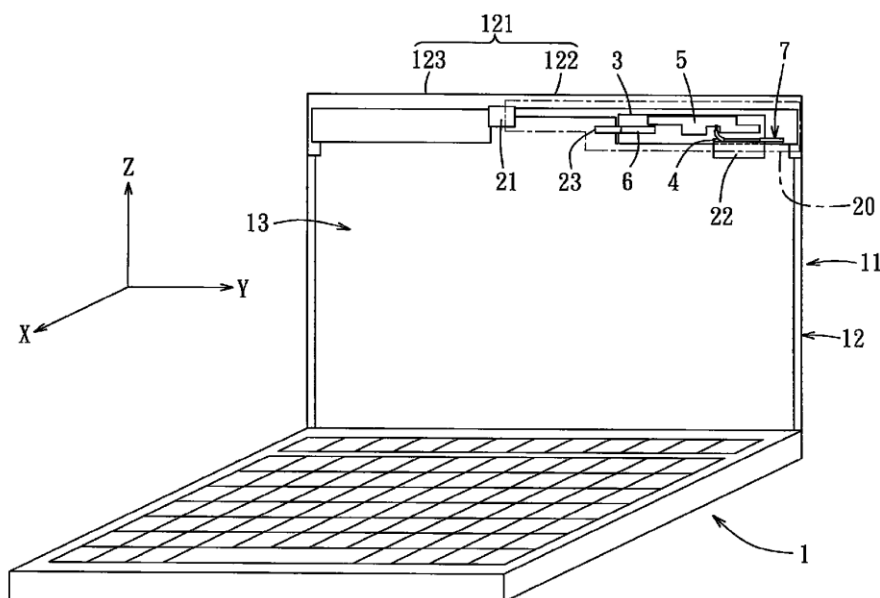
Primary Examiner — Thien M Le

(74) *Attorney, Agent, or Firm* — Brinks Hofer Gilson &
Lione

(57) **ABSTRACT**

A multi-band antenna module is disposed in a housing of an electronic device. The housing has a grounding plane disposed therein and includes a metal frame part having two ends electrically connected to opposite side edges of the grounding plane. The multi-band antenna module includes a conductor, a substrate, a grounding section, and a first radiator section. The conductor is to be coupled across the metal frame part and the grounding plane so as to cooperate with the grounding plane and a portion of the metal frame part to form a closed loop thereamong, in which the substrate is disposed. The first radiator section and the grounding section are disposed on the substrate, with the grounding section to be coupled electrically to the grounding plane. A portion of the first radiator section is disposed to cooperate with the closed loop to resonate in a first frequency band. Another portion of the first radiator section is disposed to cooperate with the grounding section to resonate in a second frequency band.

9 Claims, 8 Drawing Sheets





US008531341B2

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

(10) **Patent No.:** **US 8,531,341 B2**
(45) **Date of Patent:** ***Sep. 10, 2013**

(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.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/418,655**

(22) Filed: **Mar. 13, 2012**

(65) **Prior Publication Data**

US 2012/0169550 A1 Jul. 5, 2012

Related U.S. Application Data

(63) Continuation of application No. 13/073,872, filed on Mar. 28, 2011, now Pat. No. 8,144,063, which is a continuation of application No. 11/969,684, filed on Jan. 4, 2008, now Pat. No. 7,916,089.

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

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

(58) **Field of Classification Search**
USPC 343/702, 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.
6,040,803 A * 3/2000 Spall 343/700 MS
6,184,845 B1 2/2001 Leisten et al.
6,414,643 B2 7/2002 Cheng et al.
6,456,249 B1 9/2002 Johnson

(Continued)

FOREIGN PATENT DOCUMENTS

CN 1706070 12/2005
CN 1875522 12/2006

(Continued)

OTHER PUBLICATIONS

Guterman et al., U.S. Appl. No. 12/888,350, filed Sep. 22, 2010.

(Continued)

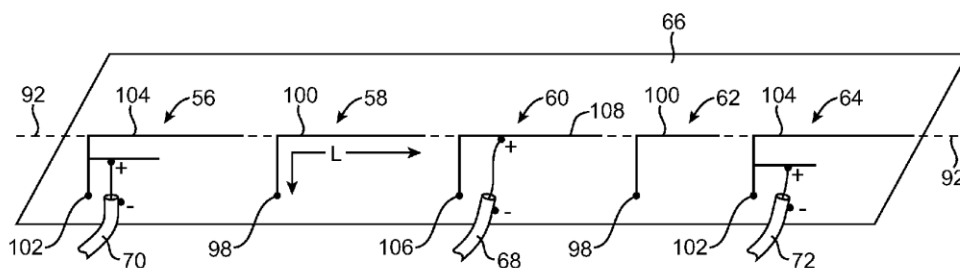
Primary Examiner — Huedung Mancuso

(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





US008531348B2

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

(10) **Patent No.:** **US 8,531,348 B2**
(45) **Date of Patent:** **Sep. 10, 2013**

(54) **ELECTRONIC DEVICE WITH EMBEDDED ANTENNA**

(75) Inventors: **Min-Chung Wu**, Taoyuan County (TW);
Shao-Chin Lo, Miaoli (TW)

(73) Assignee: **Ralink Technology Corp.**, Jhubei,
Hsinchu County (TW)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 378 days.

(21) Appl. No.: **12/894,191**

(22) Filed: **Sep. 30, 2010**

(65) **Prior Publication Data**

US 2011/0080333 A1 Apr. 7, 2011

(30) **Foreign Application Priority Data**

Oct. 6, 2009 (TW) 98133844 A
Nov. 26, 2009 (TW) 98140322 A

(51) **Int. Cl.**
H01Q 1/50 (2006.01)

(52) **U.S. Cl.**
USPC **343/906**; 343/873; 343/700 MS;
343/702; 343/846; 439/916

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

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,537,123	A *	7/1996	Mandai et al.	.....	343/700 MS
5,912,647	A *	6/1999	Tsuru et al.	.....	343/700 MS
6,140,971	A *	10/2000	Kitamura	.....	343/702
6,774,849	B2 *	8/2004	Umebara et al.	.....	343/700 MS
6,842,142	B2 *	1/2005	Takesako et al.	.....	343/700 MS
8,154,470	B2 *	4/2012	Chang et al.	.....	343/906
8,217,853	B2 *	7/2012	Tai et al.	.....	343/906
2002/0000938	A1 *	1/2002	Hoashi et al.	.....	343/700 MS
2008/0153329	A1 *	6/2008	Lin	.....	
2009/0167631	A1 *	7/2009	Tai et al.	.....	343/906
2010/0315297	A1 *	12/2010	Wu et al.	.....	343/702
2011/0095963	A1 *	4/2011	Wu et al.	.....	343/906

FOREIGN PATENT DOCUMENTS

CN	201060951	Y	5/2008
CN	201156584	Y	11/2008
TW	200828668		7/2008
WO	0161781	A1	8/2001

* cited by examiner

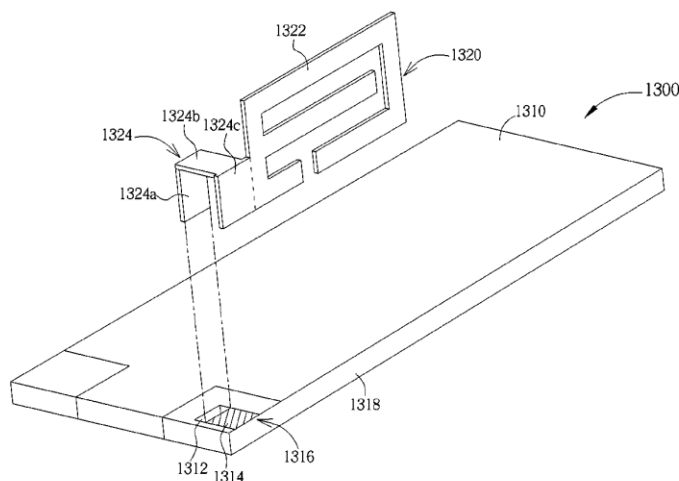
Primary Examiner — Trinh Dinh

(74) *Attorney, Agent, or Firm* — Winston Hsu; Scott Margo

(57) **ABSTRACT**

An electronic device with an embedded three-dimensional antenna is disclosed. The electronic device includes a printed circuit board (PCB) and an embedded three-dimensional antenna. The embedded three-dimensional antenna includes a radiation element and a connection element. The connection element includes a first connection part and a second connection part. The first and second connection parts are coupled to the PCB, and utilized for transferring signals of the embedded three-dimensional antenna to the PCB. The first and second connection parts further clamp the PCB to attach the embedded three-dimensional antenna on the PCB.

11 Claims, 17 Drawing Sheets





US008537052B2

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

(10) **Patent No.:** **US 8,537,052 B2**
(45) **Date of Patent:** **Sep. 17, 2013**

(54) **ANTENNA AND ELECTRONIC DEVICE
EQUIPPED WITH THE SAME**

(75) Inventors: **Nagahisa Furutani**, Kawasaki (JP);
Manabu Kai, Kawasaki (JP); **Satoru
Nogami**, Inagi (JP)

(73) Assignees: **Fujitsu Limited**, Kawasaki (JP); **Fujitsu
Frontech Limited**, Inagi (JP)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 175 days.

(21) Appl. No.: **12/696,527**

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

(65) **Prior Publication Data**

US 2010/0214188 A1 Aug. 26, 2010

(30) **Foreign Application Priority Data**

Feb. 24, 2009 (JP) 2009-041470

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

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

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

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,050,295 A * 9/1991 Sullivan et al. 29/830
6,107,920 A * 8/2000 Eberhardt et al. 340/572.7

6,914,562 B2 7/2005 Forster
7,750,813 B2 * 7/2010 Deavours et al. 340/572.7
7,843,389 B2 * 11/2010 Luk et al. 343/700 MS
2006/0054710 A1 * 3/2006 Forster et al. 235/492
2006/0227053 A1 10/2006 Ishikura
2007/0164868 A1 7/2007 Deavours et al.
2007/0273527 A1 11/2007 Yamagajo et al.
2009/0140947 A1 * 6/2009 Sasagawa et al. 343/845

FOREIGN PATENT DOCUMENTS

FR 2616015 A1 12/1988
JP 2006-157905 A 6/2006
JP 2006-287452 A 10/2006
JP 2007-318323 A 12/2007
WO 2008/054148 A1 5/2008

OTHER PUBLICATIONS

Japanese Office Action dated Jul. 17, 2012, issued in corresponding
Japanese Patent Application No. 2009-041470, w/ English transla-
tion (5 pages).

Chinese Office Action dated Jun. 4, 2012, issued in corresponding
Japanese Patent Application No. 201010116643.4, with English
translation (10 pages).

* cited by examiner

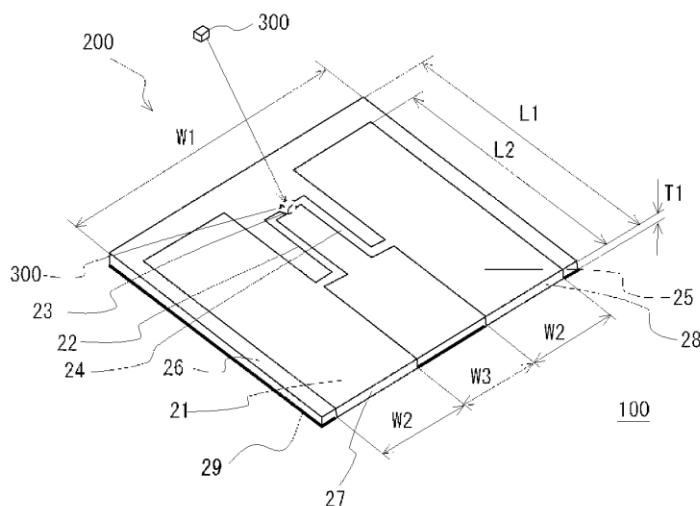
Primary Examiner — Hoanganh Le

(74) *Attorney, Agent, or Firm* — Westerman, Hattori,
Daniels & Adrian, LLP

(57) **ABSTRACT**

An antenna includes a dielectric substrate, a ground electrode
provided on a first surface of the dielectric substrate, a first
antenna element and a second antenna elements provided to a
second surface of the dielectric substrate, the first and second
antenna elements having an identical resonance frequency
and an identical Q value, a transmission line connecting the
first and second antenna elements, and a feed part provided in
the transmission line.

2 Claims, 20 Drawing Sheets





US008537054B2

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

(10) **Patent No.:** **US 8,537,054 B2**
(45) **Date of Patent:** **Sep. 17, 2013**

(54) **ANTENNA WITH MULTIPLE RESONATING CONDITIONS**

(75) Inventors: **Li-Jean Yen**, Hsinchu (TW); **Chia-Tien Li**, Hsinchu (TW)

(73) Assignee: **Wistron NeWeb Corporation**, Hsinchu Science Park, Hsinchu (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 206 days.

(21) Appl. No.: **13/196,878**

(22) Filed: **Aug. 2, 2011**

(65) **Prior Publication Data**
US 2012/0299779 A1 Nov. 29, 2012

(30) **Foreign Application Priority Data**
May 27, 2011 (TW) 100118609 A

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

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

(58) **Field of Classification Search**

USPC 343/700 MS, 702, 829, 846
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,646,606 B2 *	11/2003	Mikkola et al.	343/700 MS
6,876,329 B2 *	4/2005	Milosavljevic	343/700 MS
7,256,743 B2 *	8/2007	Korva	343/702
7,501,983 B2 *	3/2009	Mikkola	343/700 MS
2007/0132641 A1 *	6/2007	Korva et al.	343/700 MS

* cited by examiner

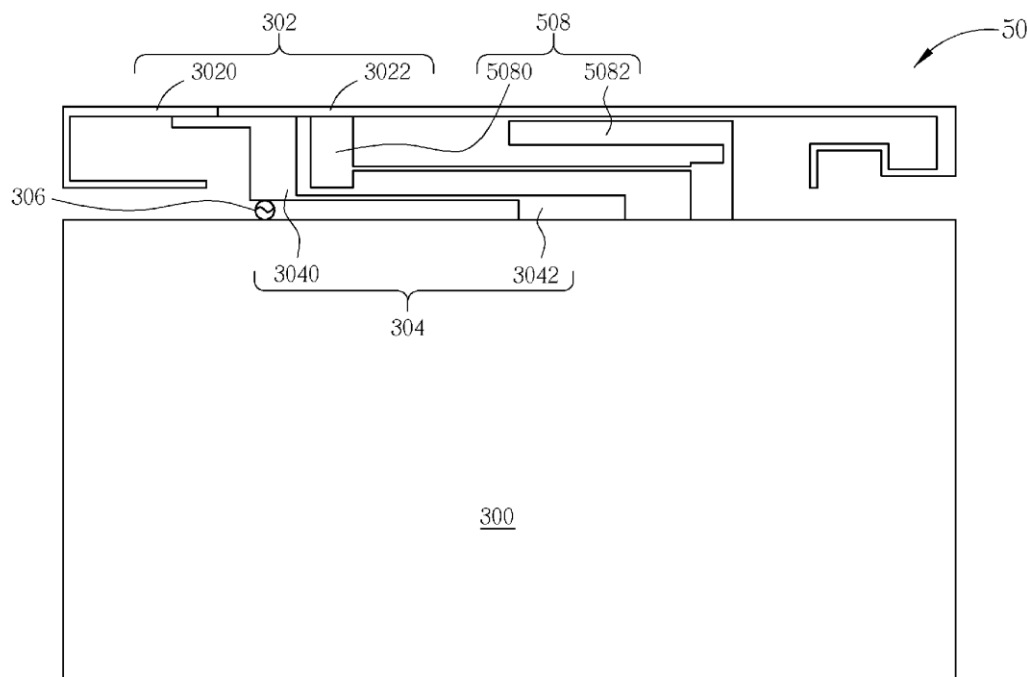
Primary Examiner — Tho G Phan

(74) *Attorney, Agent, or Firm* — Winston Hsu; Scott Margo

(57) **ABSTRACT**

An antenna with multiple resonating conditions includes a grounding element electrically connected to a ground, a radiating element, a connection element electrically connected between the grounding element and the radiating element, a feed-in element electrically connected between the connection element and the grounding element for receiving feed-in signals, and a radiating-condition generating element electrically connected to the grounding element and extending from the grounding element to the radiating element.

12 Claims, 10 Drawing Sheets





US008537055B2

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

(10) **Patent No.:** **US 8,537,055 B2**
(45) **Date of Patent:** **Sep. 17, 2013**

(54) **PORTABLE ELECTRONIC DEVICE AND
MAGNETIC ANTENNA CIRCUIT**

(75) Inventors: **Kenji Waku**, Kanagawa (JP); **Tadashi Koyama**, Kanagawa (JP); **Masayuki Saito**, Kanagawa (JP); **Yasuhiro Katayama**, Kanagawa (JP); **Katsuji Morishita**, Kanagawa (JP); **Shinobu Kato**, 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 994 days.

(21) Appl. No.: **12/528,970**

(22) PCT Filed: **Feb. 27, 2008**

(86) PCT No.: **PCT/JP2008/053449**

§ 371 (c)(1),

(2), (4) Date: **Oct. 28, 2009**

(87) PCT Pub. No.: **WO2008/105477**

PCT Pub. Date: **Sep. 4, 2008**

(65) **Prior Publication Data**

US 2010/0103055 A1 Apr. 29, 2010

(30) **Foreign Application Priority Data**

Feb. 27, 2007 (JP) 2007-047727

Feb. 27, 2007 (JP) 2007-047728

Mar. 27, 2007 (JP) 2007-081083

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

(52) **U.S. Cl.**
USPC 343/702; 343/850; 343/895

(58) **Field of Classification Search**

USPC 343/702, 850, 860, 895
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,654,668 A 3/1987 Schwartz et al.
7,242,356 B2 * 7/2007 Lu et al. 343/702

(Continued)

FOREIGN PATENT DOCUMENTS

JP 61-230504 10/1986
JP H06-335084 A 12/1994

(Continued)

OTHER PUBLICATIONS

International Search Report, PCT/JP2008/053449, Japanese Patent Office, issued May 13, 2008.

(Continued)

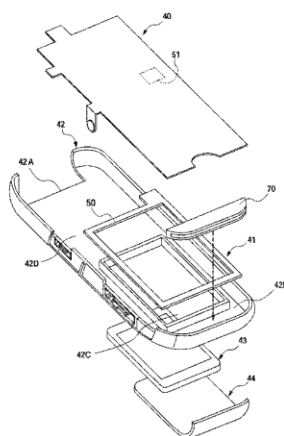
Primary Examiner — Tan Ho

(74) *Attorney, Agent, or Firm* — Procopio, Cory, Hargreaves & Savitch LLP

(57) **ABSTRACT**

A portable electronic device and a magnetic field antenna circuit are provided for making it possible to keep an antenna resonance frequency in a fixed range even if temperature changes. A mobile telephone device (1) is provided with a second communication unit driven by a chargeable battery (43) to execute a predetermined function and an RFID unit (41) accompanied with magnetic communication. The RFID unit (41) includes a magnetic antenna unit (50), which can transmit or receive a wireless signal by a magnetic field, and a capacitor (52), one terminal of which is connected with the magnetic antenna unit (50) to generate a predetermined resonance frequency. The capacitor (52) is characterized in having a temperature-reactance characteristic reverse to an amount of an inductance value that fluctuates as the magnetic antenna unit (50) changes in accordance with temperatures.

16 Claims, 25 Drawing Sheets





US008537056B2

(12) **United States Patent**
Ho

(10) **Patent No.:** **US 8,537,056 B2**
(45) **Date of Patent:** **Sep. 17, 2013**

(54) **ANTENNA AND PORTABLE DEVICE
EMPLOYING THE SAME**

(75) Inventor: **Chin-Lung Ho**, Taipei Hsien (TW)

(73) Assignee: **Hon Hai 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 404 days.

(21) Appl. No.: **12/910,845**

(22) Filed: **Oct. 24, 2010**

(65) **Prior Publication Data**
US 2012/0075146 A1 Mar. 29, 2012

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

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

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

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,061,437 B2 *	6/2006	Lin et al.	343/702
8,212,727 B2 *	7/2012	Hsu	343/702
2005/0184914 A1 *	8/2005	Ollikainen et al.	343/702
2007/0268189 A1 *	11/2007	Kuramoto et al.	343/700 MS
2008/0129637 A1 *	6/2008	Chi et al.	343/866
2010/0097272 A1 *	4/2010	Kim et al.	343/700 MS
2011/0128195 A1 *	6/2011	Ryou et al.	343/702

* cited by examiner

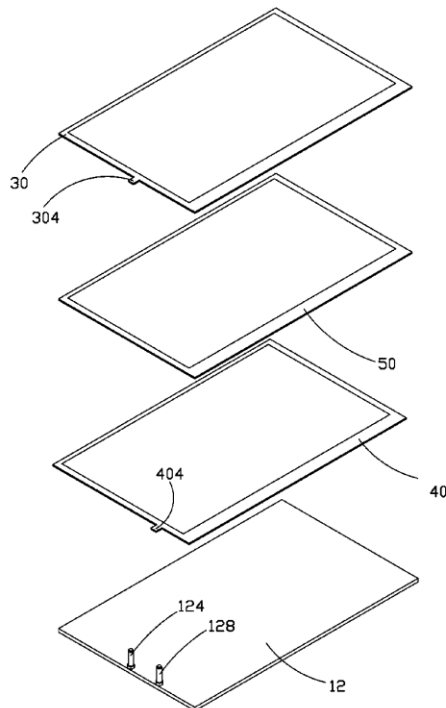
Primary Examiner — Hoanganh Le

(74) *Attorney, Agent, or Firm* — Altis Law Group, Inc.

(57) **ABSTRACT**

A portable device includes a main body and an antenna mounted on the main body. The main body includes a printed circuit board (PCB). A first guide pole and a second guide pole are configured on the PCB. The antenna includes a first conductor portion, a second conductor portion and an insulated portion. The first conductor portion includes a first connecting end electrically connected to the PCB via the first guide pole. The first connecting end acts as a feed portion of the antenna. The second conductor portion is disposed between the first conductor portion and the PCB and includes a second connecting end electrically connected to the PCB via the second guide pole. The insulated portion is sandwiched between the first conductor portion and the second conductor portion to insulate the first conductor portion from the second conductor portion.

9 Claims, 4 Drawing Sheets





US008537057B2

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

(10) **Patent No.:** **US 8,537,057 B2**
(45) **Date of Patent:** **Sep. 17, 2013**

(54) **MOBILE TERMINAL WITH TWO ANTENNAS
FOR REDUCING THE RF RADIATION
EXPOSURE OF THE USER**

(75) Inventors: **Alexander Friederich**, Aalborg (DK);
Ole Jagielski, Frederikshavn (DK);
Sinan Köksoy, Aalborg Ost (DK);
Simon Svendsen, Aalborg Ost (DK)

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

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 184 days.

(21) Appl. No.: **12/914,738**

(22) Filed: **Oct. 28, 2010**
(Under 37 CFR 1.47)

(65) **Prior Publication Data**
US 2011/0304512 A1 Dec. 15, 2011

Related U.S. Application Data
(63) Continuation of application No. 12/306,555, filed as
application No. PCT/EP2007/056300 on Jun. 25,
2007, now abandoned.

(30) **Foreign Application Priority Data**
Jun. 30, 2006 (EP) 06116453

(51) **Int. Cl.**
H01Q 21/00 (2006.01)
H01Q 1/50 (2006.01)
H01Q 1/42 (2006.01)
H01Q 1/40 (2006.01)

(52) **U.S. Cl.**
USPC **343/702**; 343/853; 343/860; 343/872;
343/873; 343/893

(58) **Field of Classification Search**
USPC 343/702, 853, 860, 872, 873, 893
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,146,139	B2 *	12/2006	Nevermann	455/115.1
2003/0016178	A1 *	1/2003	Byun et al.	343/702
2007/0052589	A1 *	3/2007	Liu	343/700 MS
2007/0146210	A1 *	6/2007	Hilgers	343/702

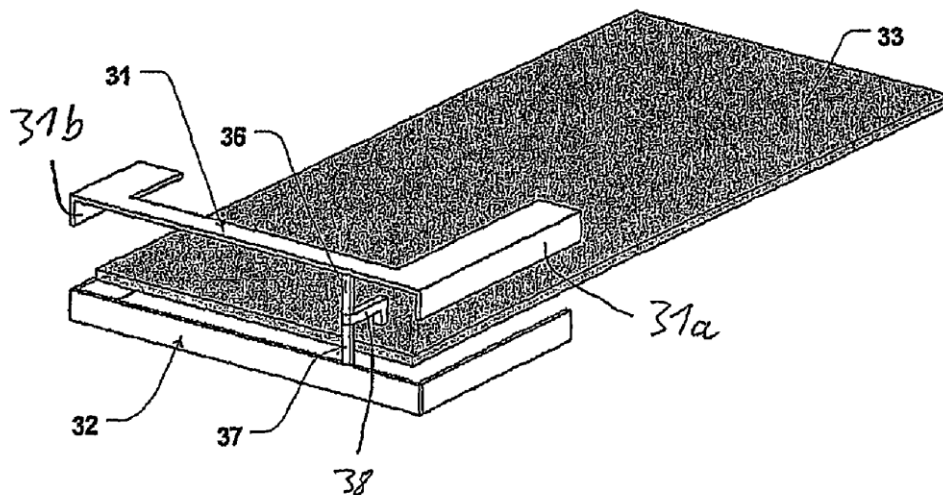
* cited by examiner

Primary Examiner — Jacob Y Choi
Assistant Examiner — Graham Smith

(57) **ABSTRACT**

For a mobile terminal for receiving wireless transmissions from a transmitter and transmitting wireless transmissions to a receiver it proposed to provide an antenna arrangement having a plurality of antenna elements each provided on or within a common body or a respective body of the terminal in a defined spatial relation to a conducting chassis part, wherein at least one first antenna element is located on a first side and at least one second antenna element is located on a second side of the same conductive chassis part or of the respective conducting chassis part, wherein high frequency circuitry, for transmitting a respective wireless transmission, is adapted to simultaneously drive said first antenna element and said second antenna element by feeding the same or corresponding high frequency signals to said first antenna element and to said second antenna element.

13 Claims, 6 Drawing Sheets





US008537058B2

(12) **United States Patent**
Kao

(10) **Patent No.:** **US 8,537,058 B2**
(45) **Date of Patent:** **Sep. 17, 2013**

(54) **ANTENNA ASSEMBLY AND ELECTRONIC
DEVICE USING THE SAME**

(75) Inventor: **Kung-Ming Kao**, Tu-Cheng (TW)

(73) Assignee: **Chi Mei Communication Systems,
Inc.**, 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 397 days.

(21) Appl. No.: **12/955,027**

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

(65) **Prior Publication Data**
US 2012/0050115 A1 Mar. 1, 2012

(30) **Foreign Application Priority Data**
Aug. 25, 2010 (TW) 99128427 A

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

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

(58) **Field of Classification Search**

USPC 343/702, 880, 757, 700 MS
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,172,645	B1 *	1/2001	Hollander et al.	343/702
6,501,429	B2 *	12/2002	Nakamura et al.	343/702
6,933,896	B2 *	8/2005	Sward et al.	343/702
7,286,092	B2 *	10/2007	Trejtner et al.	343/757
7,342,542	B2 *	3/2008	Sadamori et al.	343/702
7,443,351	B2 *	10/2008	Komine	343/702
7,609,214	B2 *	10/2009	Cha et al.	343/702
2003/0160729	A1 *	8/2003	Komiyama	343/702

* cited by examiner

Primary Examiner — Huedung Mancuso

(74) *Attorney, Agent, or Firm* — Altis Law Group, Inc.

(57) **ABSTRACT**

An antenna assembly includes a slide mechanism, a chassis, and an antenna. The slide mechanism includes a fixed plate and a slide plate slidably mounted on the fixed plate. The chassis is mounted on the slide plate. The antenna is mounted on the chassis. The antenna is contained between the fixed plate and the slide plate when the slide mechanism is retracted, and exposed when the slide mechanism is extended.

9 Claims, 4 Drawing Sheets

