



US007825859B2

(12) **United States Patent**
Teshima

(10) **Patent No.:** **US 7,825,859 B2**
(45) **Date of Patent:** **Nov. 2, 2010**

(54) **ANTENNA DEVICE OPERABLE IN MULTIPLE FREQUENCY BANDS**

(75) Inventor: **Masao Teshima**, Tokyo (JP)

(73) Assignee: **Kabushiki Kaisha Toshiba**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 583 days.

(21) Appl. No.: **11/973,806**

(22) Filed: **Oct. 10, 2007**

(65) **Prior Publication Data**

US 2008/0266182 A1 Oct. 30, 2008

(30) **Foreign Application Priority Data**

Apr. 25, 2007 (JP) 2007-115235

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

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

(58) **Field of Classification Search** 343/700 MS,
343/702, 846, 741

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,136,022 B2 11/2006 Sato et al.
7,345,637 B2* 3/2008 Mizoguchi et al. 343/702
7,535,422 B2* 5/2009 Liu et al. 343/702

7,605,764 B2* 10/2009 Ishimiya 343/702
2003/0210191 A1* 11/2003 Mohammadian et al. 343/702
2008/0074332 A1* 3/2008 Arronte et al. 343/702
2008/0198082 A1* 8/2008 Castany et al. 343/770
2008/0231521 A1* 9/2008 Pros et al. 343/702

FOREIGN PATENT DOCUMENTS

JP 2002-064324 A 2/2002
JP 2005-094501 A 4/2005
JP 3775795 5/2006
JP 2006-196994 A 7/2006

* cited by examiner

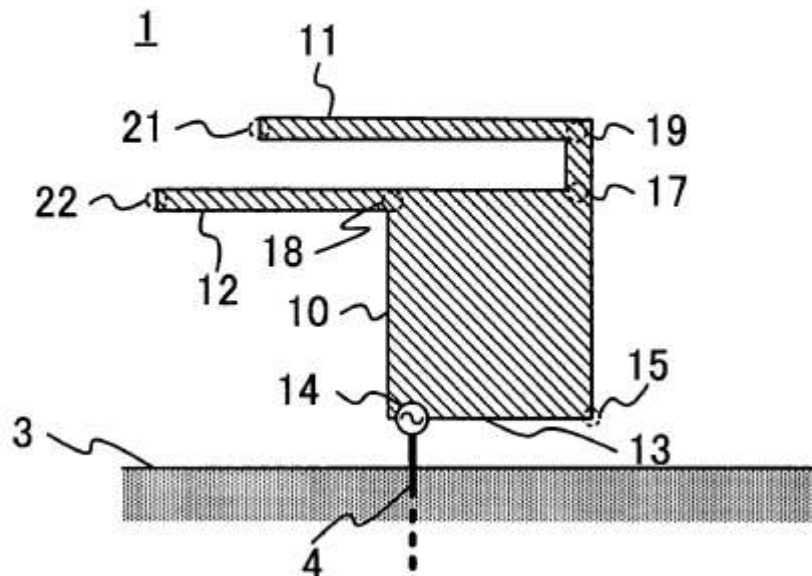
Primary Examiner—Huedung Mancuso

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

(57) **ABSTRACT**

An antenna device usable in a radio apparatus having a printed board includes a ground conductor provided in the printed board, a fed partial element, a first branch element and a second branch element. The fed partial element is shaped as an area including a feed portion near an end of a first side of the area facing a side of the ground conductor, and a first branch portion and a second branch portion each near a portion of a fringe of the area other than the first side. The fed partial element may be fed at the feed portion. The first branch element branches off from the first branch portion and is folded back in a direction approaching the feed portion. The second branch element branches off from the second branch portion and is shaped in a direction close to the direction of the first branch element.

20 Claims, 7 Drawing Sheets





US007825860B2

(12) **United States Patent**
Ying

(10) **Patent No.:** **US 7,825,860 B2**
(45) **Date of Patent:** **Nov. 2, 2010**

(54) **ANTENNA ASSEMBLY**

2008/0062045 A1 3/2008 Dinallo et al.

(75) Inventor: **Zhinong Ying**, Lund (SE)

FOREIGN PATENT DOCUMENTS

(73) Assignee: **Sony Ericsson Mobile Communications AB**, Lund (SE)

EP	1 460 713	A1	9/2004
EP	1 505 689	A1	2/2005
EP	1 569 300	A1	8/2005
WO	WO 02/078123	A1	10/2002
WO	WO 2005/101571	A1	10/2005
WO	WO 2007/122870		11/2007
WO	WO 2008/030852		3/2008

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

OTHER PUBLICATIONS

(21) Appl. No.: **12/104,013**

Co-pending U.S. Appl. No. 12/104,208, filed Apr. 16, 2008, entitled "Antenna Assembly, Printed Wiring Board and Device," Zhinong Ying et al.

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

International Search Report and Written Opinion issued in corresponding international application No. PCT/EP2008/063335, mailed Dec. 4, 2008, 13 pages.

(65) **Prior Publication Data**

US 2009/0262022 A1 Oct. 22, 2009

* cited by examiner

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 1/24 (2006.01)

Primary Examiner—Hoang V Nguyen

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

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

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

See application file for complete search history.

(57) **ABSTRACT**

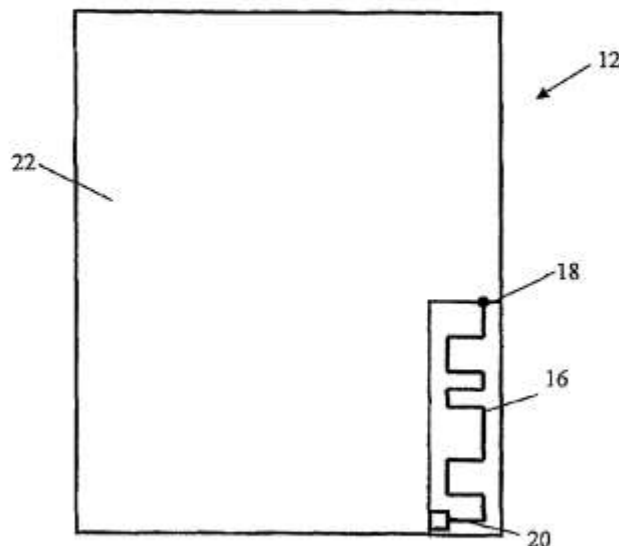
An antenna assembly may include a printed wiring board (PWB) and a dielectric substrate including a first antenna pattern, the dielectric substrate being configured to be mounted on the PWB. The antenna assembly may include a second antenna pattern that may be configured to be used as a radiating element of an FM Tx antenna or a Near Field Communication (NFC) antenna. The second antenna pattern may be provided a) on/in the dielectric substrate, or b) on the PWB at the interface between the dielectric substrate and the PWB, or c) partly on a surface of the dielectric substrate and partly on a surface of said PWB.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,304,220	B1 *	10/2001	Herve et al.	.....	343/700 MS
7,023,385	B2 *	4/2006	Harihara	.....	343/700 MS
7,405,697	B2	7/2008	Ying		
7,466,277	B2 *	12/2008	Ishizuka et al.	.....	343/702
2003/0001785	A1	1/2003	Park		
2005/0231428	A1	10/2005	Iguchi et al.		
2005/0243001	A1	11/2005	Miyata et al.		
2007/0109203	A1 *	5/2007	Park et al.	.....	343/702

19 Claims, 2 Drawing Sheets





US007825861B2

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

(10) **Patent No.:** **US 7,825,861 B2**
(45) **Date of Patent:** **Nov. 2, 2010**

(54) **RADIO MODULE**
(75) Inventors: **Koichi Sato**, Tachikawa (JP); **Yusuke Miura**, Hachioji (JP)
(73) Assignee: **Kabushiki Kaisha Toshiba**, Tokyo (JP)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 780 days.

7,002,521	B2 *	2/2006	Egawa et al.	343/702
7,342,541	B2	3/2008	Harano	
7,456,795	B2 *	11/2008	Chiba et al.	343/702
2003/0169206	A1	9/2003	Egawa	
2005/0219129	A1	10/2005	Harano	
2006/0028380	A1	2/2006	Harano	

(21) Appl. No.: **11/825,066**
(22) Filed: **Jul. 3, 2007**

FOREIGN PATENT DOCUMENTS

JP	2000-40910	A	2/2000
JP	2000-049520	A	2/2000
JP	2000-315909	A	11/2000
JP	2002-094311	A	3/2002
JP	2002-353719	A	12/2002

(65) **Prior Publication Data**
US 2008/0007468 A1 Jan. 10, 2008

(Continued)

(30) **Foreign Application Priority Data**
Jul. 7, 2006 (JP) 2006-188578

OTHER PUBLICATIONS
Japanese Office Action (and English translation thereof) dated Mar. 25, 2008, issued in a counterpart Japanese Application.

(Continued)

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
(52) **U.S. Cl.** **343/702**
(58) **Field of Classification Search** 343/702,
343/700 MS, 845-846, 829, 833-834; 455/550.1
See application file for complete search history.

Primary Examiner—Huedung Mancuso
(74) Attorney, Agent, or Firm—Holtz, Holtz, Goodman & Chick, PC

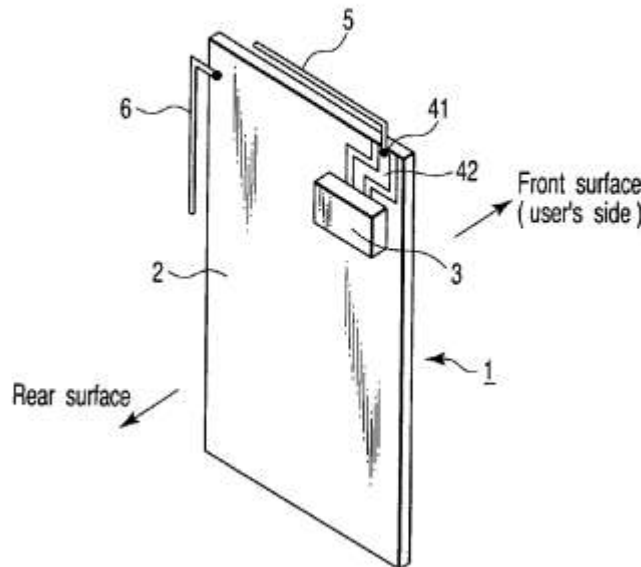
(56) **References Cited**

U.S. PATENT DOCUMENTS

6,211,830	B1 *	4/2001	Monma et al.	343/702
6,507,318	B2 *	1/2003	Ito et al.	343/702
6,563,467	B1 *	5/2003	Buris et al.	343/702
6,697,025	B2 *	2/2004	Koyanagi et al.	343/741
6,947,000	B2	9/2005	Ito	
6,985,113	B2 *	1/2006	Nishimura et al.	343/702

(57) **ABSTRACT**
A conductor is mounted on a circuit board parallel to its side along which a radiation of a radio frequency signal is generated. The proximal end of the L-shaped conductor is electrically connected to a ground pattern formed on the rear surface of a circuit board 1, and the distal end of the L-shaped conductor is open. The position at which the conductor is connected to the ground pattern is set to be a position spaced apart by a quarter-wavelength of a radio-frequency signal from a feed point of an antenna. The total length of the conductor is set to be a half-wavelength of the radio-frequency signal.

17 Claims, 24 Drawing Sheets





US007825863B2

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

(10) **Patent No.:** **US 7,825,863 B2**
(45) **Date of Patent:** **Nov. 2, 2010**

- (54) **COMPACT ANTENNA**
- (75) Inventors: **Matti Martiskainen**, Tiberias (IL); **Daniel Cho**, Kyung Ki-Do (KR); **Steve Krupa**, Cambridge (GB); **Snir Azulay**, Tiberias (IL); **Yona Haim**, Tiberias (IL.)
- (73) Assignee: **Galtronics 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 516 days.

(21) Appl. No.: **11/940,959**

(22) Filed: **Nov. 15, 2007**

(65) **Prior Publication Data**

US 2008/0180333 A1 Jul. 31, 2008

Related U.S. Application Data

(60) Provisional application No. 60/859,629, filed on Nov. 16, 2006.

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

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

(58) **Field of Classification Search** **343/700 MS, 343/702, 833, 846, 848, 895**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

- 6,081,242 A 6/2000 Wingo
- 6,366,243 B1 4/2002 Isohatata et al.
- 6,538,607 B2 3/2003 Barna et al.
- 6,611,235 B2 8/2003 Barna et al.
- 6,856,294 B2 2/2005 Kadambi et al.
- 6,917,335 B2 7/2005 Kadambi et al.
- 6,956,534 B2 10/2005 Hagiwara et al.

- 7,053,844 B2 5/2006 Gaucher et al.
- 7,084,813 B2 8/2006 Pathak et al.
- 7,088,299 B2 8/2006 Siegler et al.
- 7,136,019 B2 11/2006 Mikkola et al.
- 7,170,450 B2 * 1/2007 Chang et al. 343/700 MS
- 7,183,982 B2 2/2007 Kadambi et al.
- 7,319,432 B2 * 1/2008 Andersson 343/702
- 7,701,401 B2 * 4/2010 Suzuki et al. 343/702
- 2003/0103010 A1 6/2003 Boyle
- 2003/0201942 A1 10/2003 Poilasne et al.
- 2004/0090366 A1 5/2004 Wong et al.
- 2005/0184914 A1 8/2005 Ollikainen et al.
- 2007/0229358 A1 10/2007 Chi et al.
- 2008/0309562 A1 * 12/2008 Tsutsumi et al. 343/700 MS
- 2009/0189815 A1 * 7/2009 Hotta et al. 343/700 MS

FOREIGN PATENT DOCUMENTS

- FI 114260 9/2004
- WO 2004/027922 4/2004
- WO WO-2004/027922 4/2004

OTHER PUBLICATIONS

U.S. Appl. No. 60/859,629.

H. Soutome, et al., "A wide bandwidth monopole antenna using a human-body as a ground plane", The Institute of Electronics, Information and Communication Engineers, IEICE Technical Report SR2005-44 (Jul. 2005)—an English abstract.

* cited by examiner

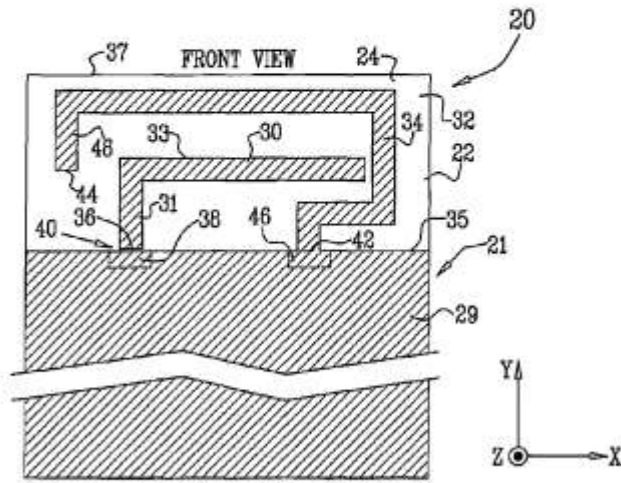
Primary Examiner—Tan Ho

(74) *Attorney, Agent, or Firm*—Fish & Richardson P.C.

(57) **ABSTRACT**

An antenna, including a planar dielectric substrate and a conductive ground plane formed on the substrate. A conductive monopole is formed on the substrate and has an end point located in proximity to a feed region of the ground plane. A conductive coupling element is formed on the substrate and is coupled to the ground plane at a coupling region of the ground plane. The coupling element is folded around the monopole.

66 Claims, 19 Drawing Sheets





US007825864B2

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

(10) **Patent No.:** **US 7,825,864 B2**
(45) **Date of Patent:** ***Nov. 2, 2010**

- (54) **DUAL BAND WLAN ANTENNA**
- (75) Inventors: **James Li**, Santa Clara, CA (US); **Jing Jiang**, San Jose, CA (US)
- (73) Assignee: **Marvell World Trade Ltd.**, St. Michael (BB)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 292 days.

7,006,043	B1	2/2006	Nalbandian	
7,403,162	B2 *	7/2008	Li et al.	343/702
7,423,597	B2 *	9/2008	Li et al.	343/702
2002/0163473	A1	11/2002	Koyama et al.	
2003/0210187	A1	11/2003	Lu et al.	
2004/0004572	A1	1/2004	Ma	
2004/0239568	A1	12/2004	Masutani	
2005/0062652	A1	3/2005	Huang	

This patent is subject to a terminal disclaimer.

(Continued)

FOREIGN PATENT DOCUMENTS

- (21) Appl. No.: **12/215,819**
- (22) Filed: **Jun. 30, 2008**

EP 0 795 926 A2 9/1997

- (65) **Prior Publication Data**
US 2009/0002241 A1 Jan. 1, 2009

(Continued)

OTHER PUBLICATIONS

- Related U.S. Application Data**
- (63) Continuation of application No. 11/581,717, filed on Oct. 16, 2006, now Pat. No. 7,403,162, which is a continuation of application No. 11/519,979, filed on Sep. 12, 2006, now Pat. No. 7,423,597.
- (60) Provisional application No. 60/771,634, filed on Feb. 9, 2006.

802.11n; IEEE P802.11-04/0889r6; Wireless LANs, TGn Sync Proposal Technical Specification; 131 pages, May 2005.

(Continued)

Primary Examiner—Hoang Anh T Le

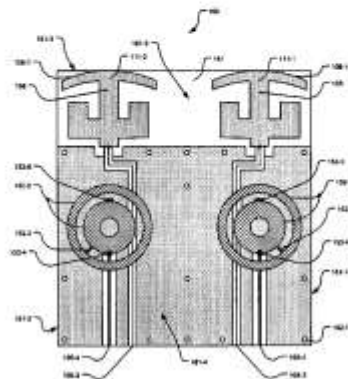
- (51) **Int. Cl.**
H01Q 1/24 (2006.01)
- (52) **U.S. Cl.** **343/702; 343/700 MS**
- (58) **Field of Classification Search** **343/700 MS, 343/702, 725, 729**
See application file for complete search history.

(57) **ABSTRACT**

An antenna system includes first and second antennas that are arranged on a substrate and that include an arc-shaped element having a concave side and a convex side, a conducting element that extends substantially radially from a center of said concave side, and a U-shaped element having a base portion with a center that communicates with said conducting element and two side portions that extend from ends of said base portion towards said concave side. Third and fourth antennas are arranged on said substrate and include an inner ring and an outer ring that is concentric to said inner ring.

- (56) **References Cited**
U.S. PATENT DOCUMENTS
4,343,976 A 8/1982 Nasretin et al.
5,714,961 A 2/1998 Kot et al.
6,184,828 B1 2/2001 Shoki
6,597,316 B2 7/2003 Rao et al.

20 Claims, 38 Drawing Sheets





US007830315B2

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

(10) **Patent No.:** **US 7,830,315 B2**
(45) **Date of Patent:** **Nov. 9, 2010**

(54) **ANTENNA APPARATUS AND RADIO COMMUNICATING APPARATUS**

(75) Inventors: **Yuichi Sugiyama, Kawasaki (JP); Kouji Soekawa, Kawasaki (JP)**

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 104 days.

(21) Appl. No.: **11/864,462**

(22) Filed: **Sep. 28, 2007**

(65) **Prior Publication Data**

US 2008/0150810 A1 Jun. 26, 2008

(30) **Foreign Application Priority Data**

Dec. 21, 2006 (JP) 2006-344795

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/36 (2006.01)

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

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

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,958,730 B2*	10/2005	Nagumo et al.	343/702
2002/0163470 A1*	11/2002	Nagumo et al.	343/700 MS
2005/0122267 A1*	6/2005	Sim et al.	343/702
2005/0128151 A1*	6/2005	Kwak et al.	343/702
2005/0134509 A1*	6/2005	Lin	343/702
2005/0140554 A1*	6/2005	Wang et al.	343/702
2005/0184914 A1*	8/2005	Ollikainen et al.	343/702
2005/0200537 A1*	9/2005	Jarmuszewski et al.	343/702
2005/0225488 A1*	10/2005	Nakagawa et al.	343/702

2005/0270240 A1*	12/2005	Qi et al.	343/702
2005/0270241 A1*	12/2005	Qi et al.	343/702
2005/0270242 A1*	12/2005	Qi et al.	343/702
2006/0145923 A1*	7/2006	Autti	343/700 MS
2006/0145934 A1*	7/2006	Park et al.	343/702
2006/0152411 A1*	7/2006	Iguchi et al.	343/700 MS
2006/0181464 A1*	8/2006	Erkocevic	343/702
2006/0192712 A1*	8/2006	Park et al.	343/700 MS
2006/0197705 A1*	9/2006	Chen et al.	343/700 MS
2006/0208952 A1*	9/2006	Qi et al.	343/702
2006/0214858 A1*	9/2006	Qi et al.	343/702

FOREIGN PATENT DOCUMENTS

JP	5-283926 A	10/1993
JP	2002-330025 A	11/2002
JP	2003-37426 A	2/2003

* cited by examiner

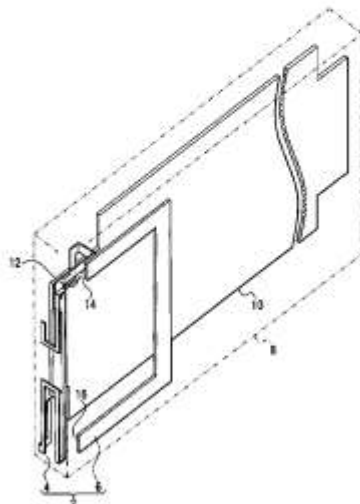
Primary Examiner—Rexford N Barnie
Assistant Examiner—Matthew C Tabler

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

(57) **ABSTRACT**

The present invention relates to an antenna apparatus capable of multifrequency resonance and realizes downsizing and multifrequency resonance. The present invention relates to an antenna apparatus capable of multifrequency resonance or a radio communicating apparatus (e.g., portable phone) including the antenna apparatus; toward a feed element connected to and supplied with electricity from a feeding unit of a circuit substrate (printed circuit substrate), a non-feed element is disposed with over the circuit substrate or outside the circuit substrate; and the feed side or the open side of the feed element is electromagnetically coupled to the non-feed element to enable resonance in the frequency band of the non-feed element in addition to resonance in the frequency band of the feed element.

27 Claims, 40 Drawing Sheets





US007830316B2

(12) **United States Patent**
Wang

(10) **Patent No.:** **US 7,830,316 B2**
(45) **Date of Patent:** **Nov. 9, 2010**

- (54) **FOLDABLE ELECTRONIC DEVICE WITH ANTENNA**
- (75) Inventor: **Chen-Sheng Wang**, Taipei (TW)
- (73) Assignee: **ASUSTeK Computer Inc.**, Taipei (TW)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 191 days.

5,684,672 A *	11/1997	Karidis et al.	361/679,26
5,828,341 A *	10/1998	Delamater	343/702
6,031,497 A *	2/2000	Nam	343/702
6,239,754 B1	5/2001	Kim	
2004/0140937 A1	7/2004	Yang	

* cited by examiner

Primary Examiner—Shih-Chao Chen
(74) *Attorney, Agent, or Firm*—Jianq Chyun IP Office

- (21) Appl. No.: **12/183,051**
- (22) Filed: **Jul. 30, 2008**
- (65) **Prior Publication Data**
US 2009/0033571 A1 Feb. 5, 2009
- (30) **Foreign Application Priority Data**
Aug. 2, 2007 (TW) 96128410 A

(57) **ABSTRACT**

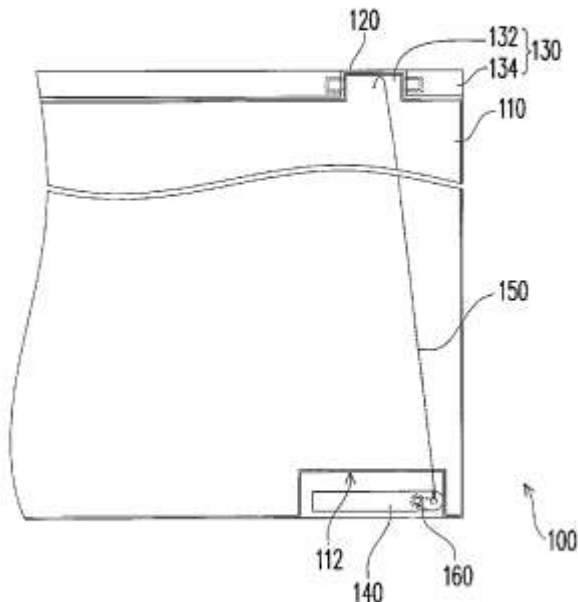
A foldable electronic device with an antenna including a first body, a second body, a pivotal mechanism, an antenna and a driving element is provided. The first body has a holding recess on one side thereof. The second body is located on the other side of the first body. The pivotal mechanism is used to pivotally connect the first body to the second body. Two sides of the driving element are connected to the pivotal mechanism and the antenna, respectively. When the first body is opened relatively to the second body, the pivotal mechanism drives the driving element to generate a first linear displacement. The first linear displacement drives the antenna to have a second rotation displacement to allow the antenna to extend out of the receiving groove.

- (51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/10 (2006.01)
- (52) **U.S. Cl.** **343/702; 343/901**
- (58) **Field of Classification Search** 343/702,
343/872, 900, 901

See application file for complete search history.

- (56) **References Cited**
U.S. PATENT DOCUMENTS
5,448,251 A 9/1995 Gerszberg et al.

7 Claims, 6 Drawing Sheets





US007830317B2

(12) **United States Patent**
Yamazaki

(10) **Patent No.:** **US 7,830,317 B2**
(45) **Date of Patent:** **Nov. 9, 2010**

(54) **ELECTRONIC APPARATUS**

- (75) Inventor: **Fuminori Yamazaki**, Fussa (JP)
- (73) Assignee: **Kabushiki Kaisha Toshiba**, Tokyo (JP)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 146 days.

(21) Appl. No.: **12/338,777**

(22) Filed: **Dec. 18, 2008**

(65) **Prior Publication Data**
US 2009/0322625 A1 Dec. 31, 2009

(30) **Foreign Application Priority Data**
Jun. 30, 2008 (JP) 2008-170171

- (51) **Int. Cl.**
H01Q 1/24 (2006.01)
- (52) **U.S. Cl.** **343/702**
- (58) **Field of Classification Search** **343/702,**
343/700 MS, 725, 767, 850-855
See application file for complete search history.

- (56) **References Cited**
U.S. PATENT DOCUMENTS
6,856,294 B2* 2/2005 Kadambi et al. 343/702
7,595,759 B2* 9/2009 Schlub et al. 343/702
2008/0231521 A1* 9/2008 Anguera Pros et al. 343/702
2010/0073242 A1* 3/2010 Ayala Vazquez et al. 343/702
2010/0156741 A1* 6/2010 Vazquez et al. 343/846

FOREIGN PATENT DOCUMENTS

JP	10-13287	1/1998
JP	11-298223	10/1999
JP	2000-188506	7/2000
JP	2003-078333	3/2003
JP	2005-039797	2/2005
JP	2007-049644	2/2007
JP	2007-307722	11/2007
WO	2007/058230 A1	5/2007

OTHER PUBLICATIONS

Notice of Reason for Rejection with English translation in a corresponding Japanese application, application No. 2008-170171 dated Apr. 27, 2009.

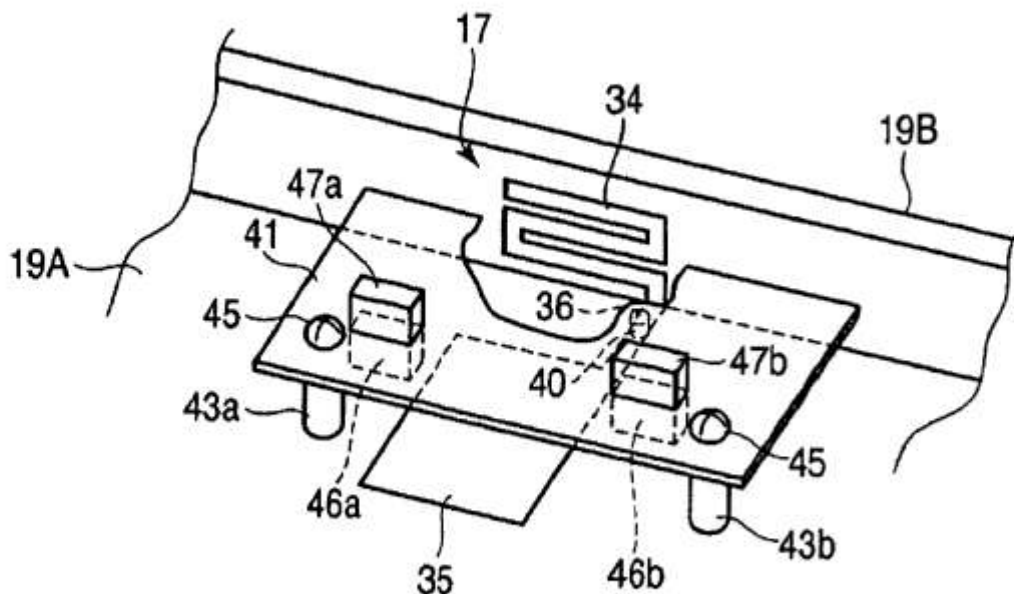
* cited by examiner

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

(57) **ABSTRACT**

According to one embodiment, an antenna incorporated in an electronic apparatus includes an antenna element formed of a metal thin film and provided on the inner surface of a side wall of a housing, an antenna ground formed of a metal thin film and provided on the inner surface of the bottom wall of the housing, and a conductor portion formed of a metal thin film, provided at least on the inner surface of the bottom wall and connecting the antenna element to the antenna ground. The feed pin of a feed terminal mounted on a printed circuit board is kept in contact with the conductor portion on the bottom wall to feed power from a wireless module to the antenna.

6 Claims, 8 Drawing Sheets





US007830320B2

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

(10) **Patent No.:** **US 7,830,320 B2**
(45) **Date of Patent:** **Nov. 9, 2010**

(54) **ANTENNA WITH ACTIVE ELEMENTS**

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

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

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

(21) Appl. No.: **11/841,207**

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

(65) **Prior Publication Data**

US 2009/0051611 A1 Feb. 26, 2009

(51) **Int. Cl.**
H01Q 9/16 (2006.01)
H01Q 1/24 (2006.01)

(52) **U.S. Cl.** **343/747; 343/702; 343/895**

(58) **Field of Classification Search** **343/702, 343/729, 861, 747, 745, 895, 700 MS, 748**
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,765,536 B2 * 7/2004 Phillips et al. 343/702
2004/0027286 A1 2/2004 Poilasne et al.

2005/0192727 A1 9/2005 Shostak et al.
2005/0275596 A1 * 12/2005 Harano 343/702
2006/0220966 A1 10/2006 Sarychev et al.
2007/0069958 A1 * 3/2007 Ozkar 343/700 MS
2008/0001829 A1 * 1/2008 Rahola et al. 343/702

OTHER PUBLICATIONS

Rowson, Sebastian, Gregory Poilasne, and Laurent Desclos, "Isolated Magnetic Dipole Antenna: Application to GPS," *Microwave and Optical Technology Letters*, vol. 41, No. 6, Jun. 20 2004.*
International Search Report for PCT Application No. PCT/US2008/073612.

* cited by examiner

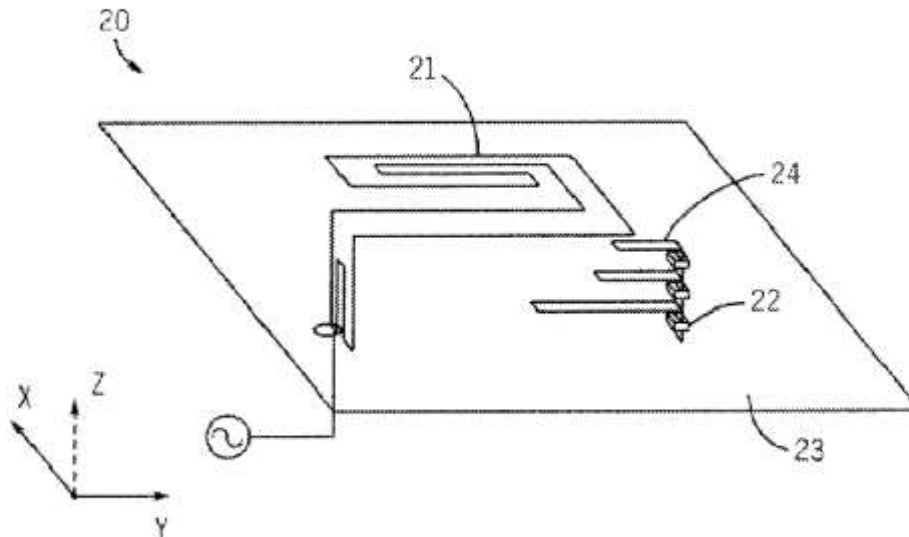
Primary Examiner—HoangAnh T Le

(74) *Attorney, Agent, or Firm*—Coastal Patent Agency; Joshua S. Schoonover

(57) **ABSTRACT**

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

6 Claims, 9 Drawing Sheets





US007830321B2

(12) **United States Patent**
Fukuchi

(10) **Patent No.:** **US 7,830,321 B2**

(45) **Date of Patent:** **Nov. 9, 2010**

(54) **ANTENNA FOR ULTRA WIDE BAND TELECOMMUNICATIONS**

(75) Inventor: **Keisuke Fukuchi**, Hitachi (JP)

(73) Assignee: **Hitachi Cable, Ltd.**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 311 days.

(21) Appl. No.: **11/688,597**

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

(65) **Prior Publication Data**

US 2007/0222694 A1 Sep. 27, 2007

(30) **Foreign Application Priority Data**

Mar. 23, 2006 (JP) 2006-080711

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

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

(58) **Field of Classification Search** **343/767, 343/770, 702, 817, 818, 795, 846**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,762,729 B2* 7/2004 Egashira 343/767

6,914,573 B1*	7/2005	McCorkle	.....	343/767
7,352,333 B2*	4/2008	McCorkle	.....	343/767
2006/0033670 A1*	2/2006	Schadler	.....	343/767
2006/0055619 A1*	3/2006	Sarabandi et al.	.....	343/866

FOREIGN PATENT DOCUMENTS

JP	2004-343424	12/2004
JP	2005-094437	4/2005
JP	2005-094499	4/2005

OTHER PUBLICATIONS

Kai Chang, Microwave and Optical Technology Letters; Print ISSN: 0895-2477; Online 1098-2760 at Wiley InterScience, www.interscience.wiley.com; May 5, 2000; p. 205-211; vol. 25 / No. 3.

* cited by examiner

Primary Examiner—Hoang V Nguyen

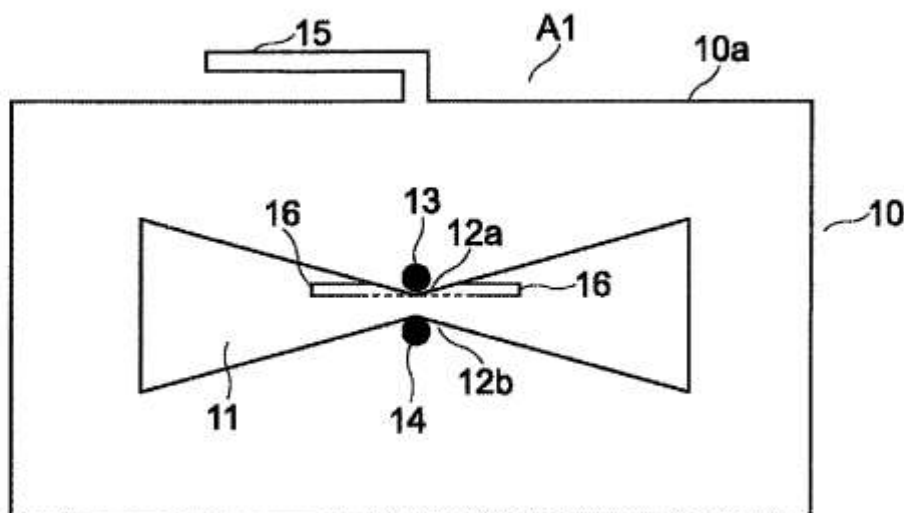
Assistant Examiner—Robert Karacsony

(74) *Attorney, Agent, or Firm*—Antonelli, Terry, Stout & Kraus, LLP.

(57) **ABSTRACT**

An antenna for an ultra wide band telecommunications, provided with a rectangular conductive plate where a bow tie slot is formed, an auxiliary element extended from said rectangular conductive plate above one of two vertical angle parts opposed at a center part of the bow tie slot, a feeding part formed at one of the vertical angle parts, and a grounding part formed at the other vertical angle part.

15 Claims, 4 Drawing Sheets





US007830326B2

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

(10) **Patent No.:** **US 7,830,326 B2**
(45) **Date of Patent:** **Nov. 9, 2010**

(54) **MULTI-BAND ANTENNA**

(75) Inventors: **Chen-Ta Hung**, Tu-cheng (TW);
Shu-Yean Wang, Tu-cheng (TW);
Yao-Shien Huang, Tu-cheng (TW)

6,861,986 B2 3/2005 Fang
7,242,352 B2* 7/2007 Tavassoli Hozouri, . 343/700 MS
2005/0190108 A1 9/2005 Lin
2006/0250309 A1 11/2006 Fang

(73) Assignee: **Hon Hai Precision Ind. Co., Ltd.**,
Taipei Hsien (TW)

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 0 days.

TW 563274 11/2003

(21) Appl. No.: **12/151,438**

* cited by examiner

(22) Filed: **May 7, 2008**

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

(65) **Prior Publication Data**

US 2008/0278382 A1 Nov. 13, 2008

(30) **Foreign Application Priority Data**

May 7, 2007 (TW) 96116050 A

(57) **ABSTRACT**

(51) **Int. Cl.**

H01Q 21/00 (2006.01)

(52) **U.S. Cl.** **343/826; 343/830**

(58) **Field of Classification Search** 343/700 MS,
343/702, 795, 826, 828–830, 846

See application file for complete search history.

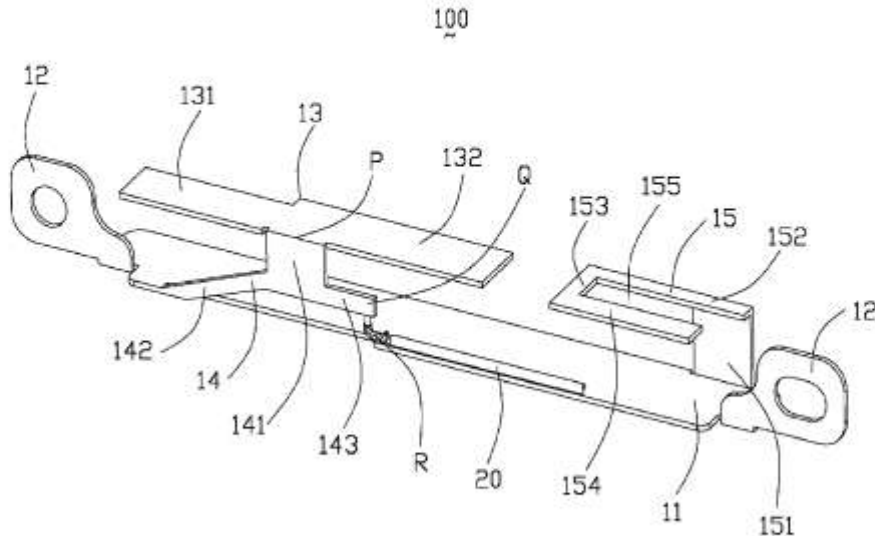
Provided herewith a multi-band antenna comprising a grounding element lying in a first plane and comprising two longitudinal sides, a radiating element spaced apart from the grounding element and comprising a first radiating arm having a first length and a second radiating arm having a second length being about equal to the first length, a connecting element lying in a second plane and electrically connecting the grounding element and the radiating element; a feeding line comprising an inner conductor for feeding signal and an outer conductor electrically connecting to the grounding element; and a coupling radiating element extending vertically from the grounding element and comprising a first radiating portion lying in a third plane and a second radiating portion being perpendicular to the third plane.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,759,988 B2* 7/2004 Purr et al. 343/700 MS

20 Claims, 3 Drawing Sheets





US007830327B2

(12) **United States Patent**
He

(10) **Patent No.:** **US 7,830,327 B2**
(45) **Date of Patent:** **Nov. 9, 2010**

(54) **LOW COST ANTENNA DESIGN FOR WIRELESS COMMUNICATIONS**

(75) Inventor: **Ziming He**, Irvine, CA (US)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 138 days.

(21) Appl. No.: **12/152,726**

(22) Filed: **May 16, 2008**

(65) **Prior Publication Data**

US 2008/0284661 A1 Nov. 20, 2008

Related U.S. Application Data

(60) Provisional application No. 60/930,738, filed on May 18, 2007.

(51) **Int. Cl.**
H01Q 1/36 (2006.01)
H01Q 9/30 (2006.01)

(52) **U.S. Cl.** **343/828; 343/829; 343/846**

(58) **Field of Classification Search** 343/700 MS, 343/702, 846, 795, 806, 808, 809, 828, 829
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,552,686 B2* 4/2003 Ollikainen et al. 343/700 MS
7,113,133 B2* 9/2006 Chen et al. 343/700 MS

OTHER PUBLICATIONS

R. Garg, P. Bhartia, I. Bahl and A. Ittipiboon, *Microstrip Antenna Design Handbook*, pp. 620-621, Boston and London: Artech House, 2001.

K. Hirasawa and M. Haneishi, *Analysis, Design, and Measurement of Small and Low-Profile Antennas*, pp. 161-181, Boston and London: Artech House, 1992.

Constantine A. Balanis, *Antenna Theory: Analysis and Design*, 2nd Edition, pp. 767-768, New York: J. Wiley & Sons, 1997.

* cited by examiner

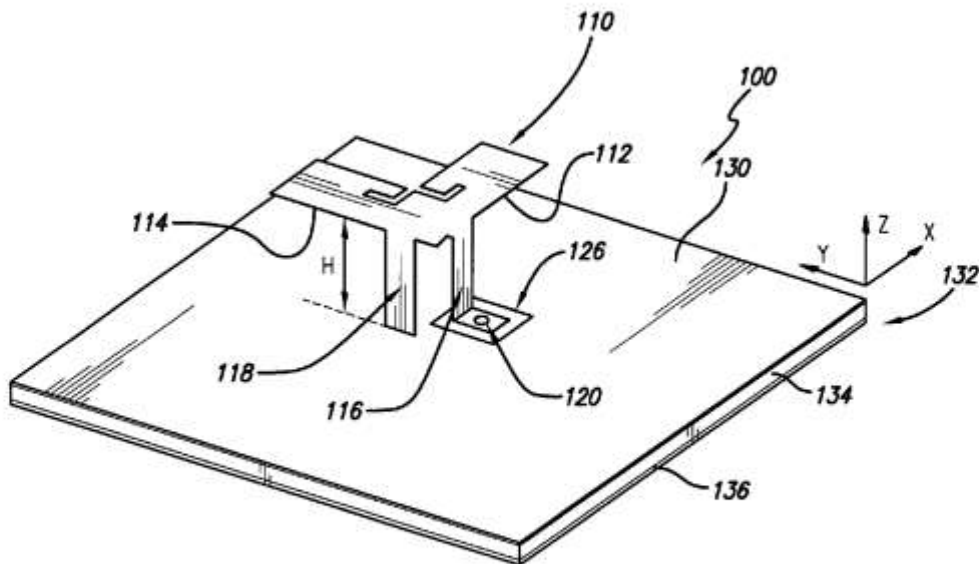
Primary Examiner—Michael C Wimer

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

(57) **ABSTRACT**

A low cost and multi-featured antenna is disclosed. The antenna employs a radiating element mounted to a ground plane and having first and second branches spaced above the ground plane forming a generally L shaped planar radiating structure. The antenna can be either linear or circular polarization, and can be either single band or dual band, and only one feeding port is needed to obtain circular polarization. The antenna can be easily applied to various frequency bands.

11 Claims, 10 Drawing Sheets





US007830330B2

(12) **United States Patent**
Pelzer

(10) **Patent No.:** **US 7,830,330 B2**
(45) **Date of Patent:** **Nov. 9, 2010**

(54) **ANTENNA CONFIGURATION**

(75) Inventor: **Heiko Pelzer**, Erkelenz (DE)

(73) Assignee: **NXP B.V.**, Eindhoven (NL)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 142 days.

(21) Appl. No.: **10/594,021**

(22) PCT Filed: **Mar. 3, 2005**

(86) PCT No.: **PCT/IB2005/050788**

§ 371 (c)(1),
(2), (4) Date: **Apr. 24, 2007**

(87) PCT Pub. No.: **WO2005/093899**

PCT Pub. Date: **Oct. 6, 2005**

(65) **Prior Publication Data**

US 2007/0229387 A1 Oct. 4, 2007

(30) **Foreign Application Priority Data**

Mar. 25, 2004 (EP) 04101236

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

(52) **U.S. Cl.** **343/876**; 343/700 MS;
343/702; 343/850; 343/860

(58) **Field of Classification Search** 343/700 MS,
343/745

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,774,025 A * 6/1998 Adam et al. 333/24.1
6,819,290 B2 * 11/2004 Hani et al. 343/700 MS
2009/0066584 A1 * 3/2009 Thornell-Pers 343/702

FOREIGN PATENT DOCUMENTS

EP 1 109 251 6/2001
EP 1 289 053 3/2003
EP 1469549 A1 * 10/2004
EP 1471597 A1 * 10/2004
JP 11 136025 5/1999
WO WO 0120718 A1 * 3/2001

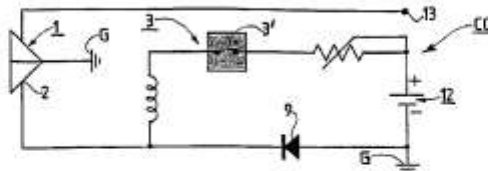
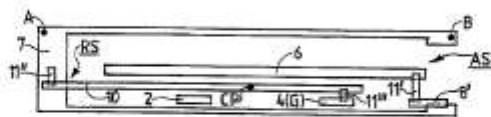
* cited by examiner

Primary Examiner—Trinh Vo Dinh

(57) **ABSTRACT**

Regarding an antenna configuration (1) preferably provided for a telecommunication device and comprising a first resonator structure (6) and second resonator structure (RS) being capacitive coupled with the first resonator structure (6) it is suggested to provide the antenna configuration (1) with a control electrode (2) and a switching stage (3), said control electrode (2) by means of the switching stage (3) being switchably connected to ground (G) and said switching stage (3) enabling to change capacitive coupling of the two resonator structures (6, RS) and thus to change the resonance frequency of the antenna configuration (1) and making possible to switch between a first frequency range and a second frequency range for enhancing the bandwidth and achieving improved matching of the antenna configuration (1).

8 Claims, 3 Drawing Sheets





US007839335B2

(12) **United States Patent**
Chen

(10) **Patent No.:** **US 7,839,335 B2**
(45) **Date of Patent:** **Nov. 23, 2010**

(54) **ANTENNA AND WIRELESS NETWORK DEVICE HAVING THE SAME**

6,922,172 B2* 7/2005 Oshiyama et al. 343/700 MS
6,995,720 B2* 2/2006 Shikata 343/702
7,705,786 B2* 4/2010 Iellici et al. 343/702

(75) Inventor: **Yu Ren Chen**, Luodong Township, Yilan County (TW)

* cited by examiner

(73) Assignee: **Cameo Communications Inc.**, (TW)

Primary Examiner—Tho G Phan

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

(57) **ABSTRACT**

(21) Appl. No.: **11/790,467**

An antenna applied to a wireless network device comprises a base, a pair of embedded portions, and an antenna portion. The base has two sides opposite to each other. Each of the embedded portions has a side wall portion and a locking wing portion. The side wall portion is substantially vertical to the base and connected to the sides of the base, while the locking wing portion is connected to the side wall portion, substantially parallel to the base, and spaced apart from the base with a first height. The antenna portion is provided with a ground member, a radiation member, and a signal member. The ground member is substantially vertical to the base, connected to one of the two sides of the base, and spaced apart from the embedded portion with an interval. The radiation member is connected to the ground member, substantially parallel to the base, and spaced apart from the base with a second height. The signal member is connected to the radiation member, substantially vertical to the base, and formed with a free end separated from the base. When the antenna is positioned in at least one slot formed on a substrate of the wireless network device, the radiation member is spaced apart from the substrate with a height difference between the second height and the first height.

(22) Filed: **Apr. 25, 2007**

(65) **Prior Publication Data**

US 2008/0268908 A1 Oct. 30, 2008

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

(52) **U.S. Cl.** **343/700 MS; 343/702; 343/873**

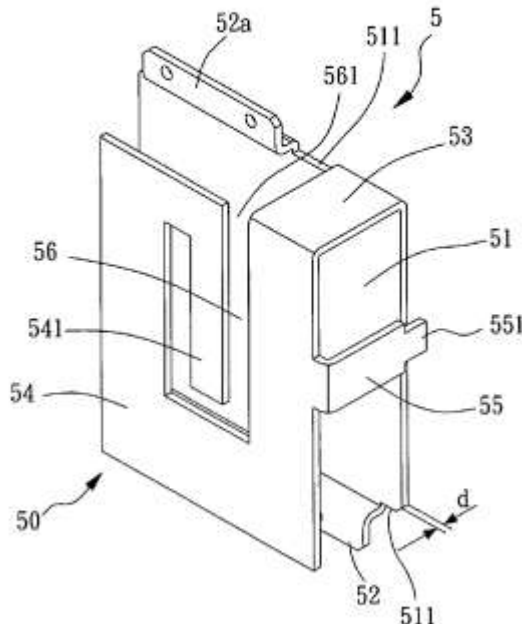
(58) **Field of Classification Search** 343/700 MS, 343/702, 829, 846, 873
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,344,823 B1* 2/2002 Deng 343/700 MS
6,670,923 B1* 12/2003 Kadambi et al. 343/700 MS
6,724,348 B2* 4/2004 Fang 343/702
6,831,607 B2* 12/2004 Hebron et al. 343/700 MS

7 Claims, 9 Drawing Sheets





US007839341B2

(12) **United States Patent**
Seo

(10) **Patent No.:** **US 7,839,341 B2**
(45) **Date of Patent:** **Nov. 23, 2010**

(54) **ANTENNA AND MOBILE TERMINAL USING THE SAME**

(75) Inventor: **Dong Kyu Seo**, Ulsan-si (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 713 days.

(21) Appl. No.: **11/774,161**

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

(65) **Prior Publication Data**

US 2008/0007467 A1 Jan. 10, 2008

(30) **Foreign Application Priority Data**

Jul. 7, 2006 (KR) 10-2006-0063805

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

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

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

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,285,327 B1 * 9/2001 See 343/702

6,603,430 B1	8/2003	Hill et al.	
2002/0075189 A1*	6/2002	Carillo et al.	343/702
2002/0135523 A1*	9/2002	Romero et al.	343/741
2004/0246180 A1	12/2004	Okado	
2005/0190108 A1	9/2005	Lin et al.	
2008/0055046 A1*	3/2008	Shimizu	340/10.1
2008/0117027 A1*	5/2008	Tsirlina et al.	340/10.6

FOREIGN PATENT DOCUMENTS

EP 1168495 1/2002

* cited by examiner

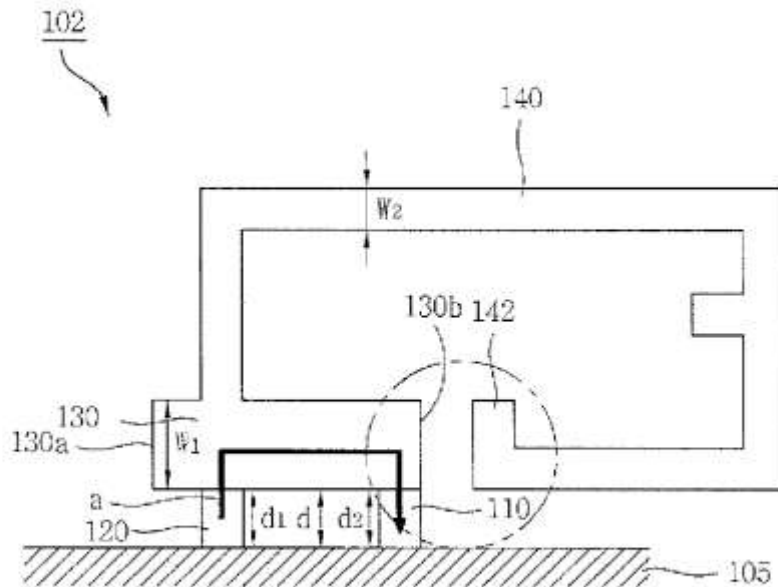
Primary Examiner—Huedung Mancuso

(74) *Attorney, Agent, or Firm*—Lee, Hong, Degerman, Kang & Waimey

(57) **ABSTRACT**

An antenna and a mobile terminal using the same is provided. The mobile terminal according to an aspect of the present invention includes a shielding unit and an antenna comprising a feed unit and a ground unit formed over the shielding unit, a first pattern connected to a top surface of the feed unit and the ground unit and isolated from the shielding unit, and a second pattern connected to a first end of the first pattern and having an open end formed close to a portion of the first pattern second end connected to the ground unit. The first pattern has a high frequency band characteristic, and the second pattern has a low frequency band characteristic.

20 Claims, 4 Drawing Sheets





US007839343B2

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

(10) **Patent No.:** **US 7,839,343 B2**

(45) **Date of Patent:** **Nov. 23, 2010**

(54) **MOBILE WIRELESS COMMUNICATIONS DEVICE COMPRISING A TOP-MOUNTED AUXILIARY INPUT/OUTPUT DEVICE AND A BOTTOM-MOUNTED ANTENNA**

(75) Inventors: **Yihong Qi**, Waterloo (CA); **Ying Tong Man**, Kitchener (CA); **Perry Jarmuszewski**, Waterloo (CA)

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

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

(21) Appl. No.: **12/571,662**

(22) Filed: **Oct. 1, 2009**

(65) **Prior Publication Data**

US 2010/0022268 A1 Jan. 28, 2010

Related U.S. Application Data

(63) Continuation of application No. 12/167,170, filed on Jul. 2, 2008, now Pat. No. 7,612,726, which is a continuation of application No. 11/422,165, filed on Jun. 5, 2006, now Pat. No. 7,405,703, which is a continuation of application No. 11/042,269, filed on Jan. 25, 2005, now Pat. No. 7,088,294.

(60) Provisional application No. 60/576,159, filed on Jun. 2, 2004, provisional application No. 60/576,637, filed on Jun. 3, 2004.

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

(52) **U.S. Cl.** **343/702; 343/741; 343/866**

(58) **Field of Classification Search** **343/702, 343/700 MS, 741, 866, 895; 455/575.1, 455/90**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,571,595 A	2/1986	Phillips et al.	343/745
4,723,305 A	2/1988	Phillips et al.	455/89
5,337,061 A	8/1994	Pye et al.	343/702
5,451,965 A	9/1995	Matsumoto	343/702
5,557,293 A	9/1996	McCoy et al.	343/867
5,973,650 A	10/1999	Nakanishi	343/742

(Continued)

FOREIGN PATENT DOCUMENTS

CA 2489837 12/2003

(Continued)

OTHER PUBLICATIONS

Film type inverted F antenna, Honda Tsushin Kogyo Co., Ltd., Jun. 17, 2003.

(Continued)

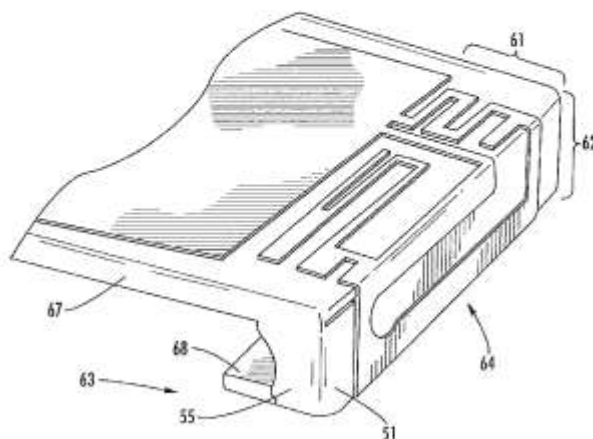
Primary Examiner—Hoang V Nguyen

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

(57) **ABSTRACT**

A mobile wireless communications device may include a housing having an upper portion and a lower portion, a dielectric substrate carried by the housing, circuitry carried by the dielectric substrate, and an audio output transducer carried by the upper portion of the housing and connected to the circuitry. The device may further include a user input interface carried by the housing and connected to the circuitry, and at least one auxiliary input/output device carried by the upper portion of the housing and connected to the circuitry. An antenna may also be carried within the lower portion of the housing comprising a pattern of conductive traces on the dielectric substrate.

22 Claims, 11 Drawing Sheets





US007839344B2

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

(10) **Patent No.:** **US 7,839,344 B2**
(45) **Date of Patent:** **Nov. 23, 2010**

(54) **WIDEBAND MULTIFUNCTION ANTENNA OPERATING IN THE HF RANGE, PARTICULARLY FOR NAVAL INSTALLATIONS**

(75) Inventors: **Gaetano Marrocco**, Montecompatri (IT); **Fernando Bardati**, Rome (IT); **Manlio Proia**, Rome (IT); **Piero Tognolatti**, Rome (IT); **Lorenzo Mattioni**, Rome (IT); **Raffaele Perelli**, Ardea (IT); **Giampiero Colasanti**, Rome (IT); **Giovanni Falcione**, Rome (IT)

(73) Assignee: **Selex Communications S.p.A.**, Genoa (IT)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 192 days.

(21) Appl. No.: **11/914,634**

(22) PCT Filed: **May 18, 2006**

(86) PCT No.: **PCT/IB2006/051583**

§ 371 (c)(1),

(2), (4) Date: **Nov. 16, 2007**

(87) PCT Pub. No.: **WO2006/123311**

PCT Pub. Date: **Nov. 23, 2006**

(65) **Prior Publication Data**

US 2008/0278407 A1 Nov. 13, 2008

(30) **Foreign Application Priority Data**

May 19, 2005 (IT) TO2005A0344

(51) **Int. Cl.**
H01Q 1/34 (2006.01)

(52) **U.S. Cl.** **343/709; 343/749**

(58) **Field of Classification Search** **343/900, 343/866, 867, 868, 804, 709, 742, 745, 749**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,652,888 A * 3/1987 Deasy 343/791

(Continued)

FOREIGN PATENT DOCUMENTS

DE 40 27 234 A1 3/1992

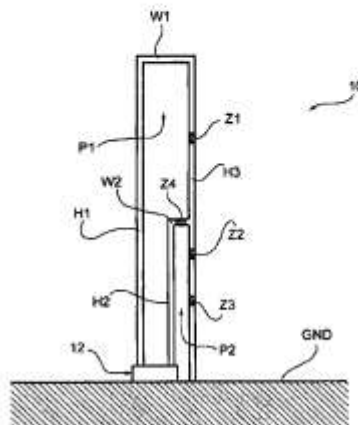
Primary Examiner—HoangAnh T Le

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

(57) **ABSTRACT**

A linear antenna for operation in the HF frequency range, particularly for naval communications is disclosed, comprising a radiating arrangement (H1, H2, H3, W1, W2), adapted to be operatively associated with a ground conductor (20) and at least one electrical impedance device (Z1-Z4), characterized in that it includes: a plurality of wire radiating elements with a predominantly vertical extension, forming a first and a second conducting branch (H1, H2) adapted to be operatively coupled to a feed circuit, and a return conducting branch (H3) adapted to be operatively coupled to a ground conductor (20); and a plurality of wire radiating elements with a predominantly transverse extension, forming connecting conducting branches (W1, W2) for connecting the conducting branches (H1, H2) adapted to be coupled to the feed circuit (12), to the conducting branch (H3) adapted to be coupled to the ground conductor (20), the radiating elements being positioned in such a way as to form, in a plane in which the antenna lies, two nested closed paths (P1, P2) between the feed circuit (12) and the ground conductor (20), having at least one radiating element in common, and—a plurality of electrical impedance devices (Z1-Z4) interposed along the conducting branches (H1, H2, H3, W1, W2) and adapted to impede the flow of current within corresponding predetermined frequency ranges in such a way as to establish selectively, according to the operating frequency, a plurality of different current paths along the conducting branches (H1, H2, H3, W1, W2), corresponding to a plurality of different electrical and/or geometrical configurations of the antenna (10).

32 Claims, 2 Drawing Sheets





US007839347B2

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

(10) **Patent No.:** **US 7,839,347 B2**
(45) **Date of Patent:** **Nov. 23, 2010**

(54) **ANTENNA ASSEMBLIES WITH TAPERED LOOP ANTENNA ELEMENTS AND REFLECTORS**

(75) Inventors: **Richard E. Schneider**, Wildwood, MO (US); **John Edwin Ross, III**, Moab, UT (US); **Corey Feit**, St. Louis, MO (US); **Dale Picolet**, House Springs, MO (US); **Chad Stuemke**, St. Louis, MO (US)

(73) Assignee: **Antennas Direct, Inc.**, Ellisville, MO (US)

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

(21) Appl. No.: **12/040,464**

(22) Filed: **Feb. 29, 2008**

(65) **Prior Publication Data**

US 2009/0146899 A1 Jun. 11, 2009

Related U.S. Application Data

(60) Provisional application No. 60/992,331, filed on Dec. 5, 2007.

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

(52) **U.S. Cl.** **343/741; 343/834; 343/866**

(58) **Field of Classification Search** **343/741, 343/742, 834, 866, 867**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,480,155 A 8/1949 Masters
D170,203 S 8/1953 Leonard
D171,560 S 2/1954 Rutter
D177,200 S 3/1956 Valulis
D179,111 S 11/1956 Ballan et al.
3,015,101 A 12/1961 Turner et al.

3,123,826 A 3/1964 Durham
3,239,838 A 3/1966 Kelleher
3,273,158 A 9/1966 Fouts et al.
D209,402 S 11/1967 Burlingame
D211,025 S 5/1968 Callaghan
3,434,145 A 3/1969 Wells
3,721,990 A * 3/1973 Gibson et al. 343/726
4,184,163 A 1/1980 Woodward

(Continued)

FOREIGN PATENT DOCUMENTS

JP D1213590 6/2004

(Continued)

OTHER PUBLICATIONS

IEEE Spectrum: Antennas for the New Airwaves, <http://www.spectrum.ieee.org/print/7328>, Published Feb. 2009, 9 pages, Authors Richard Schneider and John Ross.

(Continued)

Primary Examiner—Tho G Phan
(74) *Attorney, Agent, or Firm*—Harness, Dickey & Pierce, P.L.C.

(57) **ABSTRACT**

According to various aspects, exemplary embodiments are provided of antenna assemblies. In one exemplary embodiment, an antenna assembly generally includes at least one antenna element having a generally annular shape with an opening. At least one reflector element is spaced-apart from the antenna element for reflecting electromagnetic waves generally towards the antenna element.

46 Claims, 17 Drawing Sheets

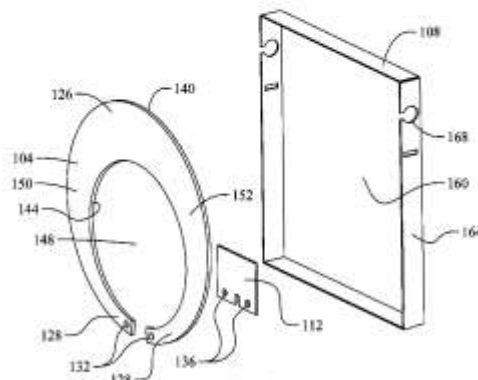


Fig. 3



US007839350B2

(12) **United States Patent**
Nagai

(10) **Patent No.:** **US 7,839,350 B2**
(45) **Date of Patent:** **Nov. 23, 2010**

(54) **ANTENNA DEVICE**
(75) Inventor: **Shuichi Nagai, Kyoto (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 261 days.

2003/0186725 A1 10/2003 Miya et al.
2006/0045460 A1* 3/2006 Sangawa et al. 385/147
2007/0183515 A1 8/2007 Lim et al.

(21) Appl. No.: **12/092,739**
(22) PCT Filed: **Aug. 4, 2006**
(86) PCT No.: **PCT/JP2006/315469**
§ 371 (c)(1),
(2), (4) Date: **May 6, 2008**

FOREIGN PATENT DOCUMENTS

JP	4-140905	5/1992
JP	4-253402	9/1992
JP	7-273509	10/1995
JP	8-97620	4/1996
JP	8-195620	7/1996
JP	9-238002	9/1997
JP	10-294616	11/1998

(87) PCT Pub. No.: **WO2007/069366**
PCT Pub. Date: **Jun. 21, 2007**

(Continued)

OTHER PUBLICATIONS

(65) **Prior Publication Data**
US 2009/0046029 A1 Feb. 19, 2009

Partial English language translation of JP 2001-060823, Mar. 6, 2001.

(30) **Foreign Application Priority Data**
Dec. 12, 2005 (JP) 2005-358221

(Continued)

(51) **Int. Cl.**
H01Q 1/50 (2006.01)
(52) **U.S. Cl.** **343/850; 343/700 MS;**
343/851; 343/852
(58) **Field of Classification Search** None
See application file for complete search history.

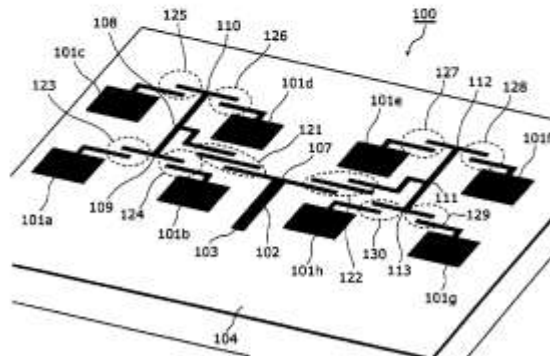
Primary Examiner—Trinh V Dinh
(74) *Attorney, Agent, or Firm*—Greenblum & Bernstein, P.L.C.

(57) **ABSTRACT**

(56) **References Cited**
U.S. PATENT DOCUMENTS
4,079,268 A 3/1978 Fletcher et al.
6,700,462 B2 3/2004 Nakamura et al.
6,943,737 B2* 9/2005 Ryken et al. 343/700 MS
7,312,763 B2* 12/2007 Mohamadi 343/853
2003/0085836 A1 5/2003 Mikami et al.

An antenna device according to the present invention includes; a plurality of antenna elements; a line which is electro-magnetically connected to each of the antenna elements and is branched from at least one branch point in the line; and filters formed in the line between a first branch point and each of said plurality of antenna elements. Here, the first branch point is the electrically farthest branch point from each of the antenna elements among all branch points.

7 Claims, 11 Drawing Sheets





US007840242B2

(12) **United States Patent**
Yoshino

(10) **Patent No.:** **US 7,840,242 B2**
(45) **Date of Patent:** **Nov. 23, 2010**

(54) **EARPHONE ANTENNA**
(75) Inventor: **Yoshitaka Yoshino**, Tokyo (JP)
(73) Assignee: **Sony 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 459 days.

5,581,626 A * 12/1996 Palmer 381/103
7,292,705 B2 * 11/2007 Harano 381/384
2006/0166719 A1 * 7/2006 Arad et al. 455/575.2

FOREIGN PATENT DOCUMENTS

JP 9-199237 7/1997
JP 2003-163529 6/2003

* cited by examiner

Primary Examiner—Rafael Pérez-Gutiérrez
Assistant Examiner—Marcos Batista
(74) *Attorney, Agent, or Firm*—K&L Gates LLP

(21) Appl. No.: **11/538,736**
(22) Filed: **Oct. 4, 2006**
(65) **Prior Publication Data**
US 2007/0105438 A1 May 10, 2007

(57) **ABSTRACT**

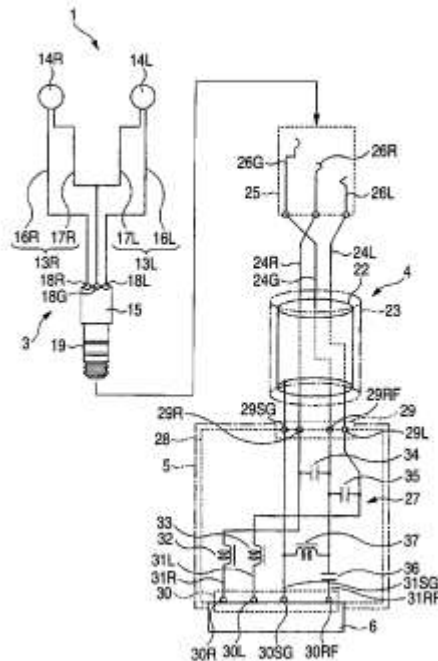
(30) **Foreign Application Priority Data**
Oct. 7, 2005 (JP) 2005-295434

An earphone antenna includes: earphone cords; an earphone portion; a coaxial cable; and a pin plug connector portion; wherein the earphone cords cooperate with a shielded line of the coaxial cable using a connection point with the coaxial cable as a feeding point to constitute an antenna for receiving RF signals; wherein conductor lines constituting a core wire of the coaxial cable form signal lines for transmitting audio signals and a ground line; and wherein the coaxial cable is connected with a separation-superimposition circuit portion which is mounted at a side of the pin plug connector portion or at a side of a wireless electronic device and acts to separate the RF signals and the audio signals and to superimpose the audio signals.

(51) **Int. Cl.**
H04B 1/00 (2006.01)
(52) **U.S. Cl.** **455/575.2**; 381/74; 381/370
(58) **Field of Classification Search** 455/572,
455/569.1, 569.2, 575.2, 296-307, 270-278.1;
381/370-383, 55, 74, 111, 123, 77, 79; 343/718,
343/722; 349/577, 669
See application file for complete search history.

(56) **References Cited**
U.S. PATENT DOCUMENTS
4,369,521 A * 1/1983 Sawada 455/270

5 Claims, 6 Drawing Sheets





US007840243B2

(12) **United States Patent**
Hirai

(10) **Patent No.:** **US 7,840,243 B2**
(45) **Date of Patent:** **Nov. 23, 2010**

(54) **ANTENNA ARRANGEMENT IN A MOBILE TERMINAL APPARATUS**

(75) Inventor: **Masayoshi Hirai**, Yokohama (JP)

(73) Assignee: **Panasonic Corporation**, Osaka (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 541 days.

(21) Appl. No.: **11/814,482**

(22) PCT Filed: **Jan. 26, 2006**

(86) PCT No.: **PCT/JP2006/300877**

§ 371 (c)(1),
(2), (4) Date: **Jul. 20, 2007**

(87) PCT Pub. No.: **WO2006/077983**

PCT Pub. Date: **Jul. 27, 2006**

(65) **Prior Publication Data**

US 2009/0131125 A1 May 21, 2009

(30) **Foreign Application Priority Data**

Jan. 21, 2005 (JP) P.2005-014113

(51) **Int. Cl.**
H04M 1/00 (2006.01)
H04M 9/00 (2006.01)

(52) **U.S. Cl.** **455/575.7; 455/575.1; 455/575.3; 379/428.01**

(58) **Field of Classification Search** 455/550.1, 455/575.1, 575.3, 575.5, 575.7; 379/428.01
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,451,965 A * 9/1995 Matsumoto 343/702
7,526,083 B2 * 4/2009 Kim et al. 379/433.13

2001/0034242 A1* 10/2001 Takagi 455/550
2001/0051510 A1* 12/2001 Nakamura 455/90
2002/0173281 A1* 11/2002 Kobayashi 455/90
2004/0106428 A1* 6/2004 Shoji 455/550.1
2004/0198417 A1* 10/2004 Yoda 455/550.1
2006/0019696 A1* 1/2006 Brunel et al. 455/550.1

(Continued)

FOREIGN PATENT DOCUMENTS

JP 05-259656 A 10/1993

(Continued)

Primary Examiner—Andrew Wendell

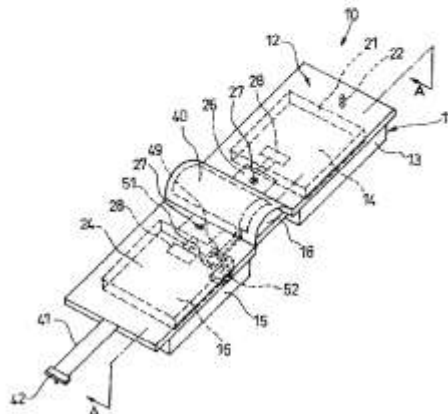
(74) *Attorney, Agent, or Firm*—Seed IP Law Group PLLC

(57) **ABSTRACT**

There is provided a mobile terminal apparatus in which downsizing of the mobile terminal apparatus can be achieved and an antenna characteristic can be suitably supplied.

In a mobile terminal apparatus 10, upper and lower housing 13 and 15 are coupled with each other by a coupling part 18 so as to be openable and closable, upper and lower circuit boards 21 and 24 are provided in the upper and lower housing 13 and 15, upper and lower protective cover parts 31 and 32 cover the upper and lower housing; and a flexible part 33 couples the upper and lower protective cover parts so as to be openable and closable and covers the coupling part. In the mobile terminal apparatus 10, an antenna power feeding land 51 is provided in one of the upper and lower circuit boards, a power feeding terminal of the antenna part 40 is electrically connected to this one circuit board via the antenna power feeding land, and the antenna part is housed in the flexible part.

6 Claims, 7 Drawing Sheets





US007843390B2

(12) **United States Patent**
Liu

(10) **Patent No.:** **US 7,843,390 B2**
(45) **Date of Patent:** **Nov. 30, 2010**

(54) **ANTENNA**
(75) Inventor: **Chih-Kai Liu**, Taipei Hsien (TW)
(73) Assignee: **Wistron Neweb Corp.**, 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 1104 days.

6,950,069	B2*	9/2005	Gaucher et al.	343/702
7,026,999	B2*	4/2006	Umehara et al.	343/702
7,046,196	B1*	5/2006	Langley et al.	343/700 MS
7,119,743	B2*	10/2006	Iguchi et al.	343/700 MS
7,319,432	B2*	1/2008	Andersson	343/702
7,324,050	B2*	1/2008	Chung et al.	343/700 MS
7,385,556	B2*	6/2008	Chung et al.	343/700 MS
7,432,860	B2*	10/2008	Huynh	343/700 MS

(21) Appl. No.: **11/524,913**
(22) Filed: **Sep. 22, 2006**
(65) **Prior Publication Data**
US 2007/0268186 A1 Nov. 22, 2007
(30) **Foreign Application Priority Data**
May 18, 2006 (TW) 95117726 A

FOREIGN PATENT DOCUMENTS

TW 542419 7/2003

* cited by examiner

Primary Examiner—Tan Ho

(74) *Attorney, Agent, or Firm*—Rosenberg, Klein & Lee

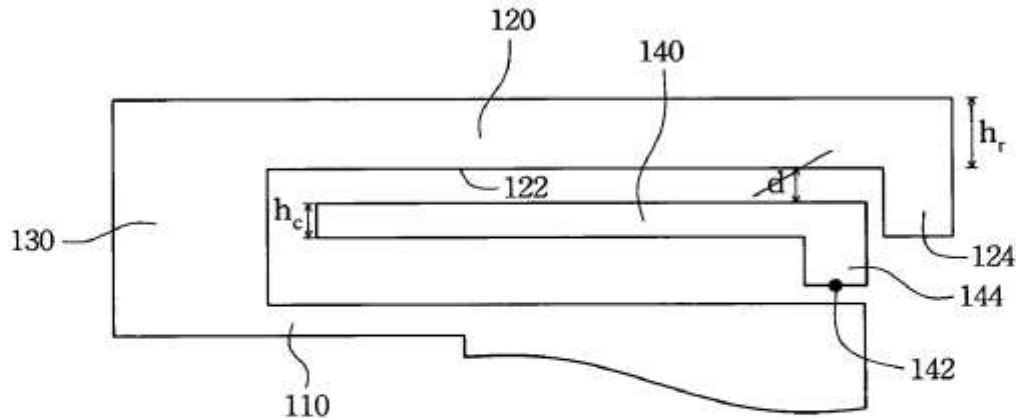
(51) **Int. Cl.**
H01Q 1/38 (2006.01)
(52) **U.S. Cl.** **343/700 MS**
(58) **Field of Classification Search** 343/700 MS,
343/846
See application file for complete search history.

(57) **ABSTRACT**

An antenna includes a grounding element, a radiating element, an interconnecting element and a conductive element. The interconnecting element connects the radiating element and the grounding element. The conductive element is disposed between the grounding element and the radiating element and apart from the grounding element and the radiating element. Moreover, the conductive element has a feed positioned thereon.

(56) **References Cited**
U.S. PATENT DOCUMENTS
6,650,294 B2* 11/2003 Ying et al. 343/700 MS

7 Claims, 3 Drawing Sheets





US007843395B2

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

(10) **Patent No.:** **US 7,843,395 B2**
(45) **Date of Patent:** **Nov. 30, 2010**

(54) **TOUCH PEN HAVING AN ANTENNA AND ELECTRONIC DEVICE HAVING THE TOUCH PEN**

(75) Inventors: **Li-Ying Chen**, Taipei Hsien (TW);
Ju-Wen Teng, Taipei Hsien (TW)

(73) Assignees: **Giga-Byte Communications Inc.**,
Tainan (TW); **Giga-Byte Technology Co., Ltd.**, Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 861 days.

(21) Appl. No.: **11/751,714**

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

(65) **Prior Publication Data**

US 2008/0291178 A1 Nov. 27, 2008

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

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

(58) **Field of Classification Search** **343/702, 343/900, 901; 455/575.7**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,739,793 A * 4/1998 Adachi 343/702

5,889,512 A	3/1999	Moller et al.	
6,262,684 B1	7/2001	Stewart et al.	
6,275,193 B1	8/2001	Nilsen et al.	
7,656,355 B2 *	2/2010	Hsin	343/702
2009/0073056 A1 *	3/2009	Hsin	343/702

FOREIGN PATENT DOCUMENTS

EP	1653325 A1	10/2005
EP	1635421 A1	3/2006

* cited by examiner

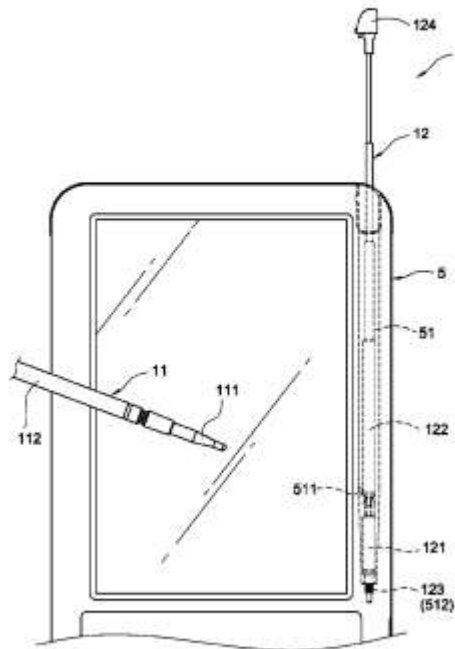
Primary Examiner—HoangAnh T Le

(74) *Attorney, Agent, or Firm*—Chun-Ming Shih; HDLS IPR Services

(57) **ABSTRACT**

An electronic apparatus has a touch pen. The touch pen includes a pen tube and an antenna. The pen tube has a hollow tube body and a touch end. The tube body is used to accommodate the antenna. Further, the antenna has a fixed tube body and a telescopic tube body. The interior of the fixed tube body is provided with electronic circuit and is electrically connected with the telescopic tube body. Therefore, when the touch pen is accommodated in the electronic device and is electrically connected with the electronic device, the electronic device can receive the wireless signals via the antenna within the touch pen. Alternatively, the antenna is provided within the electronic device directly and is electrically connected thereto, so that the electronic device can be kept to have a function of receiving the wireless signals during the use of the touch pen.

23 Claims, 6 Drawing Sheets





US007843396B2

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

(10) **Patent No.:** **US 7,843,396 B2**

(45) **Date of Patent:** **Nov. 30, 2010**

(54) **ANTENNAS FOR HANDHELD ELECTRONIC DEVICES WITH CONDUCTIVE BEZELS**

(75) Inventors: **Robert J. Hill**, Salinas, CA (US);
Robert W. Schlub, Campbell, CA (US);
Ruben Caballero, San Jose, CA (US)

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

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

(21) Appl. No.: **12/564,803**

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

(65) **Prior Publication Data**

US 2010/0007564 A1 Jan. 14, 2010

Related U.S. Application Data

(63) Continuation of application No. 11/821,192, filed on Jun. 21, 2007, now Pat. No. 7,612,725.

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

(52) **U.S. Cl.** **343/702; 343/700 MS; 343/767; 343/846**

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

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,942,263 A * 6/1960 Baldwin 343/767
3,394,373 A * 7/1968 Makrancy 342/104
4,894,663 A 1/1990 Urbish
4,980,694 A 12/1990 Hines
5,021,010 A 6/1991 Wright

5,041,838 A 8/1991 Liimatainen
5,048,118 A 9/1991 Brooks
5,061,943 A 10/1991 Rammos
5,408,241 A * 4/1995 Shattuck et al. 343/700 MS

(Continued)

FOREIGN PATENT DOCUMENTS

EP 1 286 413 2/2003

(Continued)

OTHER PUBLICATIONS

Hobson et al. U.S. Appl. No. 60/833,587, filed Jan. 5, 2007.

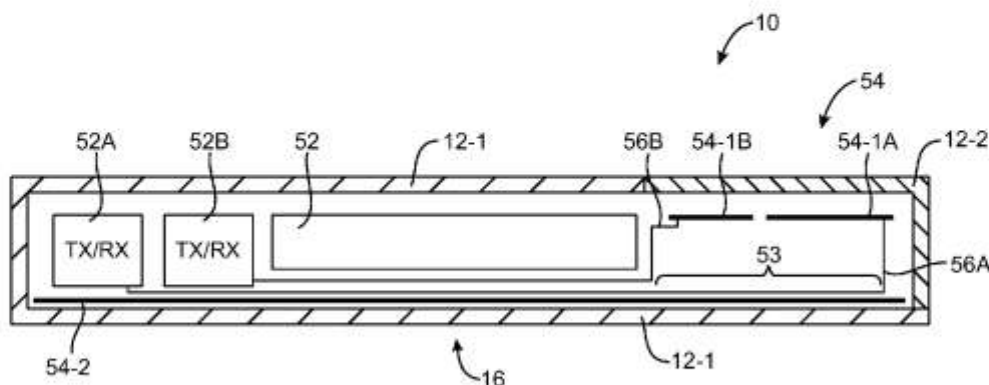
(Continued)

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

(57) **ABSTRACT**

A handheld electronic device may be provided that contains wireless communications circuitry. The handheld electronic device may have a housing and a display. The display may be attached to the housing a conductive bezel. The handheld electronic device may have one or more antennas for supporting wireless communications. A ground plane in the handheld electronic device may serve as ground for one or more of the antennas. The ground plane and bezel may define an opening. A rectangular slot antenna or other suitable slot antenna may be formed from or within the opening. One or more antenna resonating elements may be formed above the slot. An electrical switch that bridges the slot may be used to modify the perimeter of the slot so as to tune the communications bands of the handheld electronic device.

16 Claims, 20 Drawing Sheets





US007843397B2

(12) **United States Patent**
Boyle

(10) **Patent No.:** **US 7,843,397 B2**
(45) **Date of Patent:** **Nov. 30, 2010**

(54) **TUNING IMPROVEMENTS IN**
"INVERTED-L" PLANAR ANTENNAS

(75) Inventor: **Kevin R. Boyle**, Horsham (GB)

(73) Assignee: **EPCOS AG**, Munich (DE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 388 days.

6,466,176 B1	10/2002	Maoz et al.
6,549,169 B1	4/2003	Matsuyoshi et al.
6,614,398 B2	9/2003	Kushihii et al.
6,873,291 B2	3/2005	Aoyama et al.
6,882,317 B2*	4/2005	Koskiniemi et al. 343/700 MS
2002/0044092 A1*	4/2002	Kushihii 343/702
2003/0006936 A1	1/2003	Aoyama et al.
2003/0071763 A1	4/2003	McKinzie, III et al.
2003/0098813 A1	5/2003	Koskiniemi et al.

(21) Appl. No.: **10/565,928**

(22) PCT Filed: **Jul. 16, 2004**

(86) PCT No.: **PCT/IB2004/002369**

§ 371 (c)(1),
(2), (4) Date: **Jan. 20, 2006**

(87) PCT Pub. No.: **WO2005/011055**

PCT Pub. Date: **Feb. 3, 2005**

(65) **Prior Publication Data**

US 2008/0055174 A1 Mar. 6, 2008

(30) **Foreign Application Priority Data**

Jul. 24, 2003 (GB) 0317305.1

(51) **Int. Cl.**
H01Q 9/00 (2006.01)

(52) **U.S. Cl.** **343/745; 343/700 MS**

(58) **Field of Classification Search** **343/700 MS,**
343/702, 745

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,827,266 A *	5/1989	Sato et al.	343/700 MS
6,236,368 B1 *	5/2001	Johson	343/702
6,255,994 B1 *	7/2001	Saito	343/700 MS
6,466,170 B2	10/2002	Zhou	

(Continued)

FOREIGN PATENT DOCUMENTS

CN 1407832 A 4/2003

(Continued)

OTHER PUBLICATIONS

Lui, G. K. H., et al., "Compact Dual-Frequency PIFA Designs Using LC Resonators," IEEE Transactions on Antennas and Propagation, vol. 49, No. 7, Jul. 2001, pp. 1016-1019.

(Continued)

Primary Examiner—Douglas W Owens
Assistant Examiner—Dieu Hien T Duong
(74) *Attorney, Agent, or Firm*—Slater & Matsil, L.L.P.

(57) **ABSTRACT**

A communications apparatus, includes a housing (40) containing a printed circuit board (PCB) (12) having a ground plane (16) and electronic components in rf shields (18) thereon. A planar antenna (10) is mounted spaced from the ground plane and a dielectric (14) is present in a space between the PCB and the planar antenna. A feed (36) couples the planar antenna (10) to the rf components.

20 Claims, 5 Drawing Sheets

