



US008319688B2

(12) **United States Patent**  
**Parsche**

(10) **Patent No.:** **US 8,319,688 B2**

(45) **Date of Patent:** **\*Nov. 27, 2012**

(54) **PLANAR SLOT ANTENNA HAVING  
MULTI-POLARIZATION CAPABILITY AND  
ASSOCIATED METHODS**

(75) Inventor: **Francis Eugene Parsche**, Palm Bay, FL  
(US)

(73) Assignee: **Harris Corporation**, Melbourne, FL  
(US)

(\* ) Notice: Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
U.S.C. 154(b) by 454 days.

This patent is subject to a terminal dis-  
claimer.

(21) Appl. No.: **12/388,004**

(22) Filed: **Feb. 18, 2009**

(65) **Prior Publication Data**

US 2010/0207829 A1 Aug. 19, 2010

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

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

(58) **Field of Classification Search** ..... **343/767,**  
**343/770, 700 MS**

See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

1,892,221 A	12/1932	Runge	343/853
2,507,528 A *	5/1950	Kandoian	343/767
2,615,134 A	10/1952	Carter	250/33.67
2,791,769 A	5/1957	Lindenblad	343/770
3,474,452 A	10/1969	Bogner	343/726
4,160,978 A	7/1979	DuHamel	343/742

4,208,660 A *	6/1980	McOwen, Jr.	343/769
4,588,993 A	5/1986	Babij et al.	343/351
5,061,943 A *	10/1991	Ramos	343/770
5,675,346 A	10/1997	Nishikawa et al.	343/700
5,691,731 A	11/1997	Van Erven	343/742
5,714,961 A *	2/1998	Kot et al.	343/769
5,769,879 A	6/1998	Richards et al.	607/101
5,838,283 A	11/1998	Nakano	343/741
5,977,921 A	11/1999	Niccolai et al.	343/741

(Continued)

**FOREIGN PATENT DOCUMENTS**

EP 0516303 12/1992

**OTHER PUBLICATIONS**

Nikolaou, Symeon, et. al., Pattern and Frequency Reconfigurable  
Annular Slot Antenna Using PIN Diodes, Feb. 2006, IEEE Trans. on  
Antennas and Propagation, vol. 54, No. 2, pp. 439-448.\*

(Continued)

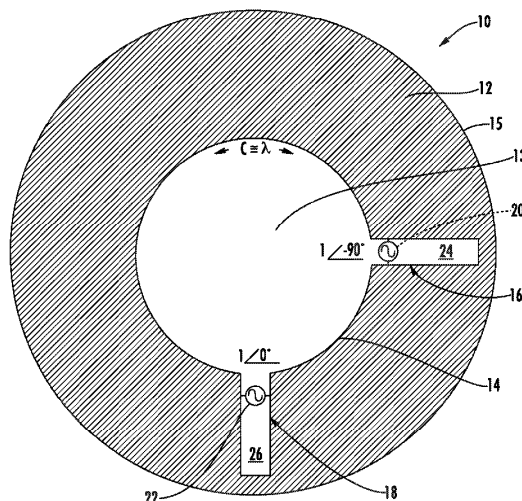
*Primary Examiner* — Hoanganh Le

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

(57) **ABSTRACT**

The antenna apparatus may include a planar, electrically con-  
ductive, slot antenna element having a geometrically shaped  
opening therein defining an inner perimeter, and a pair of  
spaced apart signal feedpoints along the inner perimeter sepa-  
rated by a distance of one quarter of the inner perimeter to  
impart a traveling wave current distribution. The inner perime-  
ter of the planar, electrically conductive, slot antenna ele-  
ment may be equal to about one operating wavelength  
thereof. The antenna apparatus may provide at least one of  
linear, circular, dual linear and dual circular polarizations,  
and it may provide an in situ or conformal antenna for  
vehicles or aircraft.

**25 Claims, 7 Drawing Sheets**





US008319690B2

(12) **United States Patent**  
**Oh**

(10) **Patent No.:** **US 8,319,690 B2**

(45) **Date of Patent:** **Nov. 27, 2012**

(54) **MOBILE TERMINAL HAVING ADDITIONAL ANTENNA PATTERN IN MAIN BODY**

(75) Inventor: **Kyung Jin Oh**, Hwaseong-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 777 days.

(21) Appl. No.: **12/284,812**

(22) Filed: **Sep. 25, 2008**

(65) **Prior Publication Data**

US 2009/0102727 A1 Apr. 23, 2009

(30) **Foreign Application Priority Data**

Sep. 27, 2007 (KR) ..... 10-2007-0097436

(51) **Int. Cl.**  
**H01Q 1/24** (2006.01)  
**H01Q 9/30** (2006.01)

(52) **U.S. Cl.** ..... **343/702; 343/900; 343/909**

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

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,455,595	A *	10/1995	Yokoyama et al.	343/702
5,748,150	A *	5/1998	Rudisill	343/702
5,909,194	A *	6/1999	Umeda et al.	343/702
6,195,050	B1 *	2/2001	Kim	343/700 MS
6,239,755	B1 *	5/2001	Klemens et al.	343/702
6,337,671	B1 *	1/2002	Lee	343/901
6,417,808	B1 *	7/2002	Ide	343/702
6,452,556	B1 *	9/2002	Ha et al.	343/702
6,768,464	B1 *	7/2004	Shoji et al.	343/702
7,221,324	B2 *	5/2007	Kim	343/702
7,292,192	B2 *	11/2007	Aritake	343/702
7,642,977	B2 *	1/2010	Seo	343/729
2004/0070542	A1 *	4/2004	Takebe	343/702

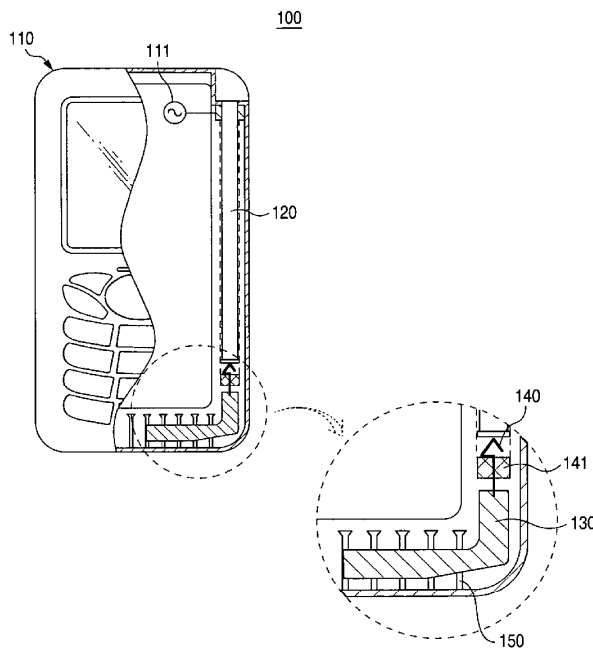
\* cited by examiner

Primary Examiner — Trinh Dinh

(57) **ABSTRACT**

The present invention relates to a mobile terminal having an antenna pattern in a main body of the mobile terminal. The mobile terminal includes: a main body having a feed point; a first antenna disposed in the main body, and a second antenna; wherein the second antenna is connected to the first antenna when the first antenna is retracted into the main body. According to the present invention, a digital broadcast signal can be received efficiently without extending an antenna to the outside of a main body of a mobile terminal. Further, damage to an antenna and wear of an antenna connection part are decreased.

**20 Claims, 5 Drawing Sheets**





US008319691B2

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

(10) **Patent No.:** **US 8,319,691 B2**  
(45) **Date of Patent:** **Nov. 27, 2012**

(54) **MULTI-BAND ANTENNA**

(56) **References Cited**

(75) Inventors: **Tiao-Hsing Tsai**, Yunghe (TW);  
**Cheng-Hsiung Wu**, Kaohsiung (TW);  
**Chao-Hsu Wu**, Lujhu Township,  
Taoyuan County (TW)

U.S. PATENT DOCUMENTS

4,907,006	A *	3/1990	Nishikawa et al.	.....	343/700 MS
6,054,955	A *	4/2000	Schlegel et al.	.....	343/702
7,034,754	B2 *	4/2006	Hung et al.	.....	343/700 MS
7,233,290	B2 *	6/2007	Liu et al.	.....	343/700 MS
7,411,556	B2 *	8/2008	Sanz et al.	.....	343/702
7,425,924	B2 *	9/2008	Chung et al.	.....	343/702

(73) Assignee: **Quanta Computer Inc.**, Tao Yuan Shien (TW)

\* cited by examiner

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 371 days.

Primary Examiner — Tho G Phan

(74) Attorney, Agent, or Firm — Berenato & White, LLC

(21) Appl. No.: **12/789,647**

(57) **ABSTRACT**

(22) Filed: **May 28, 2010**

A multi-band antenna includes a ground section, a feed-in section, a first conductor arm, and a second conductor arm. The feed-in section has a first end, a second end opposite to the first end, and a feed-in point for feeding in radio frequency signals. The first end of the feed-in section is connected electrically to the ground section. The first conductor arm has a connecting section that extends from the second end of the feed-in section, and an extending section that extends from the connecting section, that is distal from the ground section, and that has a first end portion. The second conductor arm extends from the second end of the feed-in section, and has a second end portion that is adjacent to the first end portion of the extending section.

(65) **Prior Publication Data**

US 2011/0128185 A1 Jun. 2, 2011

(30) **Foreign Application Priority Data**

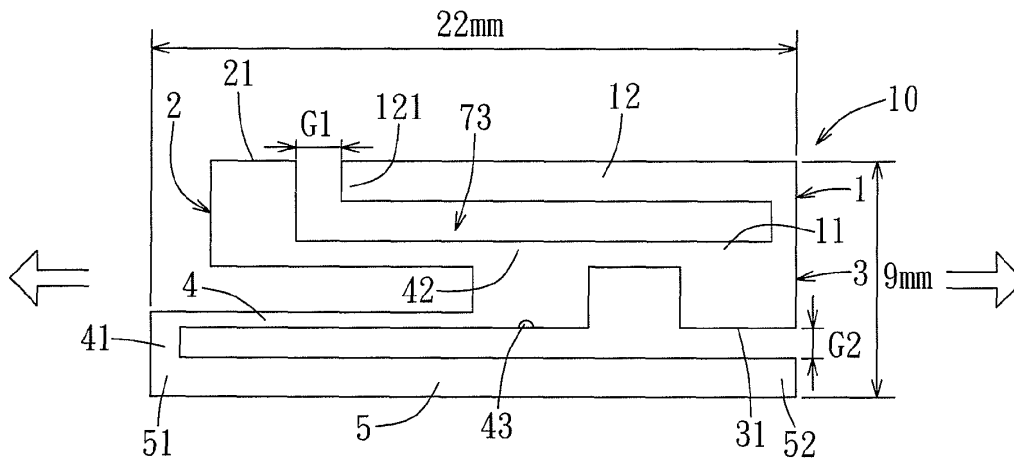
Nov. 27, 2009 (TW) ..... 98140596 A

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

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

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

**12 Claims, 10 Drawing Sheets**





US008319692B2

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

(10) **Patent No.:** **US 8,319,692 B2**  
(45) **Date of Patent:** **\*Nov. 27, 2012**

(54) **CAVITY ANTENNA FOR AN ELECTRONIC DEVICE**

(75) Inventors: **Bing Chiang**, Cupertino, CA (US);  
**Gregory A. Springer**, Sunnyvale, 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.: **13/344,442**

(22) Filed: **Jan. 5, 2012**

(65) **Prior Publication Data**  
US 2012/0105294 A1 May 3, 2012

**Related U.S. Application Data**

(63) Continuation of application No. 12/401,599, filed on Mar. 10, 2009, now Pat. No. 8,102,321.

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

(52) **U.S. Cl.** ..... **343/702; 343/898**

(58) **Field of Classification Search** ..... **343/702, 343/767, 898, 700 MS**

See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

3,573,834	A	4/1971	McCabe et al.	
4,733,245	A	3/1988	Mussler	
H1219	H *	8/1993	Miller	343/708
5,461,393	A	10/1995	Gordon	
5,703,600	A	12/1997	Burrell et al.	
6,081,729	A	6/2000	Bauerschmidt et al.	

6,127,987	A	10/2000	Maruyama et al.	
6,225,959	B1	5/2001	Gordon	
6,339,400	B1	1/2002	Flint et al.	
6,380,930	B1	4/2002	Van Ruyumbeke	
6,538,618	B2 *	3/2003	Yamamoto et al.	343/789
6,621,466	B2	9/2003	Kuck	
6,646,605	B2	11/2003	McKinzie et al.	
6,680,712	B2 *	1/2004	Yamamoto et al.	343/789

(Continued)

**FOREIGN PATENT DOCUMENTS**

CN 1256802 A 6/2000  
(Continued)

**OTHER PUBLICATIONS**

Shiu et al., U.S. Appl. No. 13/221,554, filed Aug. 30, 2011.

(Continued)

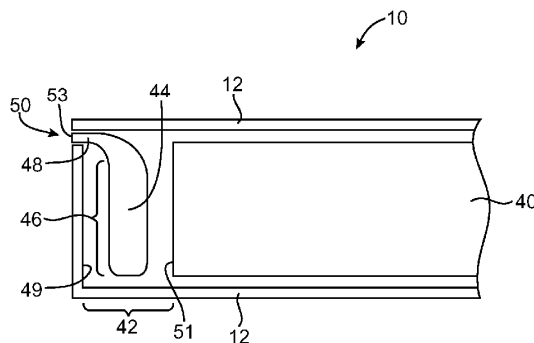
*Primary Examiner* — Hoanganh Le

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

(57) **ABSTRACT**

A cavity antenna for an electronic device such as a portable computer is provided. The antenna may be formed from a conductive cavity and an antenna probe that serves as an antenna feed. The conductive cavity may have the shape of a folded rectangular cavity. A dielectric support structure may be used in forming the antenna cavity. A fin may protrude from one end of the dielectric support structure. The antenna probe may be formed from conductive structures mounted on the fin. An inverted-F antenna configuration or other antenna configuration may be used in forming the antenna probe. The electronic device may have a housing with conductive walls. When the cavity antenna mounted within an electronic device, a planar rectangular end face of the fin may protrude through a thin rectangular opening in the conductive walls to allow the antenna to operate without being blocked by the housing.

**16 Claims, 12 Drawing Sheets**





US008319695B2

(12) **United States Patent**  
**Rofougaran**

(10) **Patent No.:** **US 8,319,695 B2**

(45) **Date of Patent:** **Nov. 27, 2012**

(54) **ADJUSTABLE INTEGRATED CIRCUIT  
ANTENNA STRUCTURE**

(56) **References Cited**

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

U.S. PATENT DOCUMENTS

3,045,237	A *	7/1962	Marston	343/754
3,818,480	A *	6/1974	West	342/435
4,599,585	A *	7/1986	Vorhaus et al.	333/164
5,532,708	A *	7/1996	Krenz et al.	343/795
2003/0151556	A1	8/2003	Cohen	

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

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.

WO 2005074124 A1 8/2005

\* cited by examiner

(21) Appl. No.: **13/114,443**

*Primary Examiner* — Tho G Phan

(22) Filed: **May 24, 2011**

(74) *Attorney, Agent, or Firm* — Garlick & Markison; Holly L. Rudnick

(65) **Prior Publication Data**

US 2011/0221643 A1 Sep. 15, 2011

**Related U.S. Application Data**

(62) Division of application No. 11/648,825, filed on Dec. 29, 2006, now Pat. No. 7,973,730.

(57) **ABSTRACT**

An adjustable integrated circuit antenna structure includes an antenna, a ground plane, a plurality of transmission line circuit elements and a coupling circuit. The coupling circuit is operable to couple at least one of the plurality of transmission line circuit elements into a transmission line circuit based on a transmission line characteristic signal. The transmission line circuit has at least one of a bandwidth, an impedance, a quality factor, and a frequency band in accordance with the transmission line circuit characteristic signal.

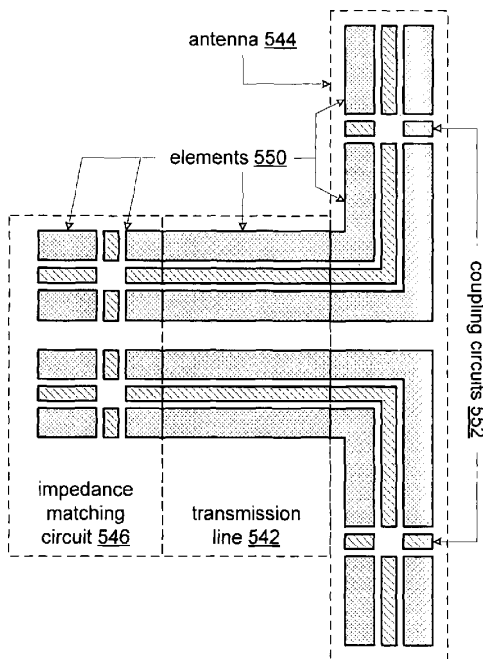
(51) **Int. Cl.**  
**H01Q 9/00** (2006.01)

(52) **U.S. Cl.** ..... **343/750; 343/700 MS; 343/745; 343/751**

(58) **Field of Classification Search** ..... **343/700, 343/702, 745, 750, 751**

See application file for complete search history.

**20 Claims, 38 Drawing Sheets**





US008320850B1

(12) **United States Patent**  
**Khlat**

(10) **Patent No.:** **US 8,320,850 B1**  
(45) **Date of Patent:** **Nov. 27, 2012**

(54) **POWER CONTROL LOOP USING A TUNABLE ANTENNA MATCHING CIRCUIT**

(75) Inventor: **Nadim Khlat**, Cugnaux (FR)

(73) Assignee: **RF Micro Devices, Inc.**, Greensboro, NC (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.: **12/726,817**

(22) Filed: **Mar. 18, 2010**

**Related U.S. Application Data**

(60) Provisional application No. 61/161,333, filed on Mar. 18, 2009.

(51) **Int. Cl.**  
**H03C 1/52** (2006.01)  
**H01Q 11/12** (2006.01)  
**H04B 1/04** (2006.01)

(52) **U.S. Cl.** ..... **455/107; 455/123**

(58) **Field of Classification Search** ..... 455/522, 455/77, 107, 120, 121, 123, 125, 127.1, 127.2  
See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

6,725,021	B1 *	4/2004	Anderson et al. ....	455/115.1
7,359,681	B2 *	4/2008	Cho .....	455/107
7,379,714	B2 *	5/2008	Haque et al. ....	455/107
8,000,737	B2 *	8/2011	Caimi et al. ....	455/550.1
2002/0142790	A1 *	10/2002	Samelis et al. ....	455/522
2003/0153345	A1 *	8/2003	Cramer, III .....	455/522

**OTHER PUBLICATIONS**

Litwinczuk, N., "Computer-aided design of automatic antenna matching devices," IEEE 6th International Symposium on Electro-

magnetic Compatibility and Electromagnetic Ecology, 2005, pp. 166-170, IEEE.

Meng, Fanfan, et al., "A Mismatch Detector for Adaptive Antenna Impedance Matching," 36th European Microwave Conference, 2006, pp. 1457-1460, Sep. 10-15, 2006, IEEE.

Mileusnic, Mladen, et al., "Design and implementation of fast antenna tuners for IIF radio systems," Proceedings of 1997 International Conference on Information, Communications and Signal Processing, 1997, pp. 1722-1726, vol. 3, IEEE.

Moritz, J.R., et al., "Frequency agile antenna tuning and matching," Eighth International Conference on HF Radio Systems and Techniques, IEE Conf. Publ. No. 474, 2000, pp. 169-174, IEEE.

Sjoblom, Peter, et al., "An Adaptive Impedance Tuning CMOS Circuit for ISM 2.4-GHz Band," IEEE Transactions on Circuits and Systems I: Regular Papers, Jun. 2005, pp. 1115-1124, vol. 52, No. 6, IEEE.

Song, H. et al., "Automatic Antenna Tuning Unit for Software-Defined and Cognitive Radio," 2007 IEEE Antennas and Propagation Society International Symposium, Jun. 9-15, 2007, pp. 85-88, IEEE.

\* cited by examiner

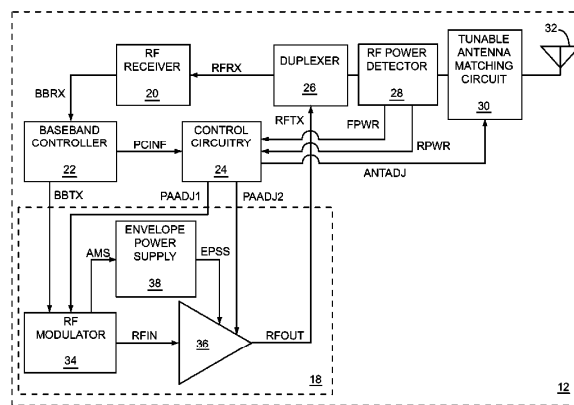
*Primary Examiner* — Nguyen Vo

(74) *Attorney, Agent, or Firm* — Withrow & Terranova, P.L.L.C.

(57) **ABSTRACT**

The present disclosure relates to combining tunable antenna matching circuit adjustments and RF power amplifier output power adjustments of a first RF terminal in response to output power adjustment commands received from a second RF terminal. The output power adjustment commands may be part of an output power control loop between the first RF terminal and the second RF terminal to control the output power from the first RF terminal. The first RF terminal may include an RF receiver, an RF power amplifier, and a tunable antenna matching circuit coupled between an output of the RF power amplifier and an antenna. The tunable antenna matching circuit adjustments may be impedance adjustments of the tunable antenna matching circuit and the RF power amplifier output power adjustments may result from adjustments to one or more input signals to the RF power amplifier.

**22 Claims, 11 Drawing Sheets**





US008320980B2

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

(10) **Patent No.:** **US 8,320,980 B2**  
(45) **Date of Patent:** **Nov. 27, 2012**

- (54) **ANTENNA ASSEMBLY OF MOBILE TERMINAL**
- (75) Inventors: **Jong Deok Lee**, Suwon-si (KR); **Sang Up Lee**, Yongin-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 321 days.
- (21) Appl. No.: **12/455,535**
- (22) Filed: **Jun. 3, 2009**
- (65) **Prior Publication Data**  
US 2009/0305755 A1 Dec. 10, 2009
- (30) **Foreign Application Priority Data**  
Jun. 5, 2008 (KR) ..... 10-2008-0052931
- (51) **Int. Cl.**  
**H04M 1/00** (2006.01)
- (52) **U.S. Cl.** ..... **455/575.7; 455/550.1; 455/575.1; 455/575.3; 455/575.4; 343/702**

(58) **Field of Classification Search** ..... 455/575.7, 455/550.1, 575.1, 575.3, 575.4; 343/702  
See application file for complete search history.

(56) **References Cited**

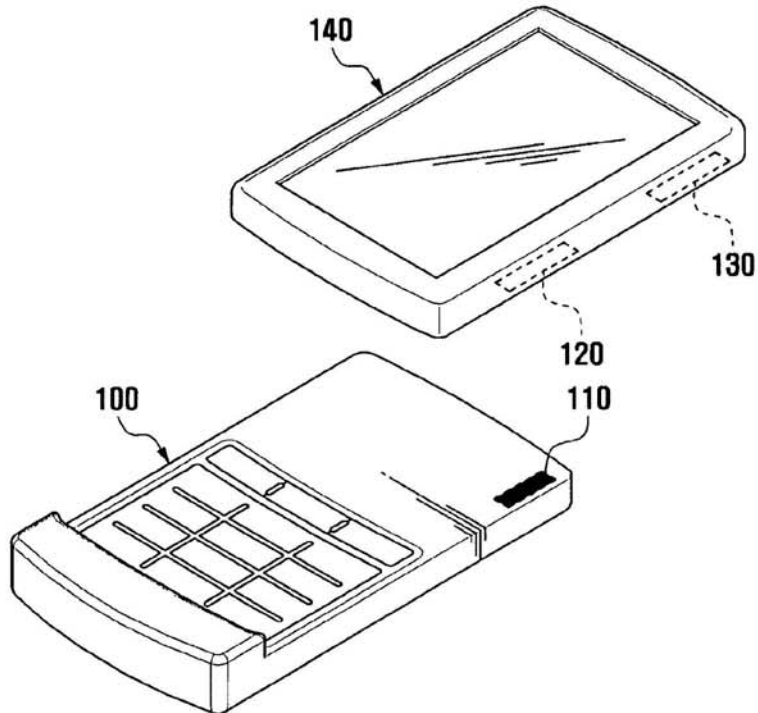
- U.S. PATENT DOCUMENTS
- 6,861,989 B2 \* 3/2005 Morningstar et al. .... 343/702
- 7,286,089 B2 \* 10/2007 Lee et al. .... 343/702
- FOREIGN PATENT DOCUMENTS
- KR 1020080039733 A 5/2008
- \* cited by examiner

*Primary Examiner* — Temica M Beamer

(57) **ABSTRACT**

An antenna assembly of a mobile terminal is provided. The antenna assembly of a mobile terminal includes: a main antenna disposed at a side of the mobile terminal; a first coupling antenna coupled to the main antenna in a first mechanical state of the mobile terminal; and a second coupling antenna coupled to the main antenna in a second mechanical state according to a mechanical operation of the mobile terminal.

**20 Claims, 11 Drawing Sheets**





US008325091B2

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

(10) **Patent No.:** **US 8,325,091 B2**  
(45) **Date of Patent:** **Dec. 4, 2012**

(54) **DUAL-BAND ANTENNA**

(75) Inventors: **Ping Li**, Shanghai (CN); **Chong Zhang**, Shanghai (CN); **Cho-Ju Chung**, Taipei Hsien (TW)

(73) Assignees: **Ambit Microsystems (Shanghai) Ltd.**, Shanghai (CN); **Hon Hai Precision Industry Co., Ltd.**, Tu-Cheng, New Taipei (TW)

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 393 days.

(21) Appl. No.: **12/758,032**

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

(65) **Prior Publication Data**  
US 2011/0187618 A1 Aug. 4, 2011

(30) **Foreign Application Priority Data**  
Feb. 2, 2010 (CN) ..... 2010 2 0302141 U

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

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

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

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

5,521,610	A *	5/1996	Rodal	.....	343/797
6,762,723	B2 *	7/2004	Nallo et al.	.....	343/700 MS
6,788,254	B2 *	9/2004	Oh et al.	.....	343/700 MS
2003/0132885	A1 *	7/2003	Kuramoto et al.	.....	343/702
2008/0268908	A1	10/2008	Chen	.....	
2009/0243940	A1 *	10/2009	Humphrey	.....	343/700 MS
2010/0164835	A1 *	7/2010	Tai et al.	.....	343/906

\* cited by examiner

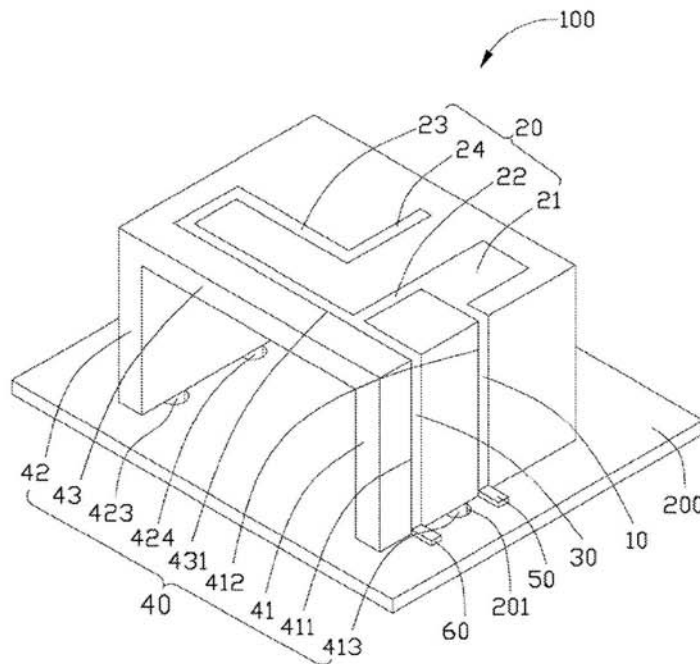
*Primary Examiner* — Tho G Phan

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

(57) **ABSTRACT**

A dual-band antenna includes a feeding portion, a radiating portion, a grounding portion, and an insulating support portion. The insulating support portion includes a first support wall, a second support wall, and a third support wall. The third support wall is parallel to the substrate, and perpendicularly connected to the first support wall and the second support wall, to position the radiating portion.

**7 Claims, 2 Drawing Sheets**







US008325093B2

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

(10) **Patent No.:** **US 8,325,093 B2**  
(45) **Date of Patent:** **Dec. 4, 2012**

(54) **PLANAR ULTRAWIDEBAND MODULAR ANTENNA ARRAY**

(75) Inventors: **Steven S. Holland**, Amherst, MA (US);  
**Marinos N. Vouvakis**, Amherst, MA (US)

(73) Assignee: **University of Massachusetts**, Boston, MA (US)

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 121 days.

(21) Appl. No.: **12/848,301**

(22) Filed: **Aug. 2, 2010**

(65) **Prior Publication Data**

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**Related U.S. Application Data**

(60) Provisional application No. 61/230,271, filed on Jul. 31, 2009.

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

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

(58) **Field of Classification Search** ..... 343/700 MS,  
343/702, 846, 829-830, 848, 853  
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,706,015	A *	1/1998	Chen et al. ....	343/700 MS
6,369,770	B1 *	4/2002	Gothard et al. ....	343/794
6,396,456	B1 *	5/2002	Chiang et al. ....	343/795
6,483,464	B2 *	11/2002	Rawnick et al. ....	343/700 MS
6,639,558	B2 *	10/2003	Kellerman et al. ....	343/700 MS
7,528,780	B2 *	5/2009	Thiam et al. ....	343/700 MS

\* cited by examiner

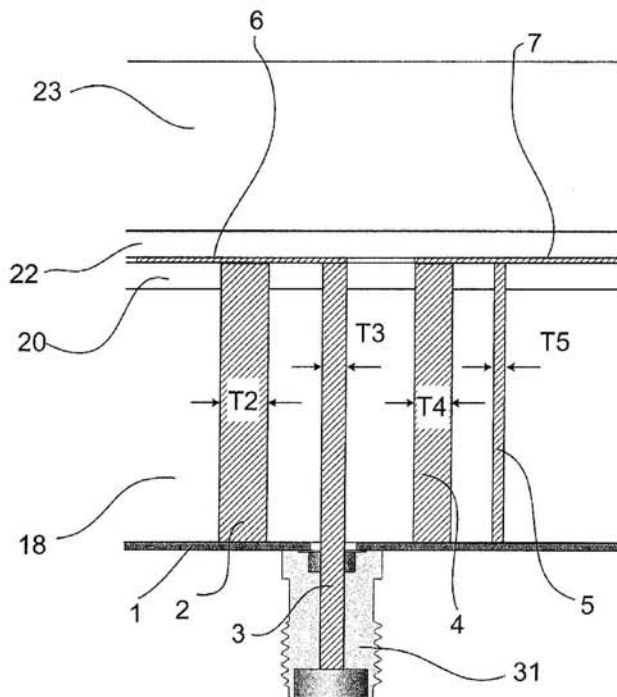
*Primary Examiner* — Huedung Mancuso

(74) *Attorney, Agent, or Firm* — Brian M. Dingman; Mirick, O'Connell, DeMallie & Lougee, LLP

(57) **ABSTRACT**

A planar ultrawideband modular antenna for connection to a feed network. The antenna has a ground plane, and an array of antenna elements spaced from the ground plane, each antenna element comprising a pair of arms. A first fed arm is electrically coupled to the feed network. The grounded arm is directly electrically coupled to the ground plane. There are one or more conductors such as conductive vias electrically connecting the fed arm to the ground plane, and optionally there are one or more additional conductors electrically connecting the grounded arm to the ground plane.

**29 Claims, 28 Drawing Sheets**





US008325094B2

(12) **United States Patent**  
**Ayala Vazquez et al.**

(10) **Patent No.:** **US 8,325,094 B2**  
(45) **Date of Patent:** **Dec. 4, 2012**

(54) **DIELECTRIC WINDOW ANTENNAS FOR ELECTRONIC DEVICES**

(75) Inventors: **Enrique Ayala Vazquez**, Watsonville, CA (US); **Gregory A. Springer**, Sunnyvale, CA (US); **Bing Chiang**, Melbourne, FL (US); **Douglas B. Kough**, San Jose, CA (US); **Robert W. Schlub**, Campbell, CA (US); **Yi Jiang**, Cupertino, CA (US); **Rodney Andres Gomez Angulo**, Sunnyvale, 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 688 days.

(21) Appl. No.: **12/486,496**

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

(65) **Prior Publication Data**  
US 2010/0321253 A1 Dec. 23, 2010

(51) **Int. Cl.**  
**H01Q 1/24** (2006.01)  
(52) **U.S. Cl.** ..... **343/702; 343/700 MS**  
(58) **Field of Classification Search** ..... **343/702, 343/700 MS, 767, 770**  
See application file for complete search history.

(56) **References Cited**  
**U.S. PATENT DOCUMENTS**  
4,733,245 A 3/1988 Mussler  
6,181,284 B1 \* 1/2001 Madsen et al. .... 343/702  
6,225,959 B1 5/2001 Gordon  
6,396,444 B1 5/2002 Goward et al.  
6,667,719 B2 12/2003 LaKovski  
6,759,986 B1 7/2004 Saliga et al.

6,894,650 B2 5/2005 Darden et al.  
7,847,753 B2 \* 12/2010 Ishibashi et al. .... 343/897  
2003/0128165 A1 \* 7/2003 LaKovski ..... 343/702  
2004/0085244 A1 \* 5/2004 Kadambi et al. .... 343/700 MS  
2004/0227679 A1 \* 11/2004 Lu ..... 343/702  
2006/0132362 A1 \* 6/2006 Yuanzhu ..... 343/700 MS  
2009/0153412 A1 6/2009 Chiang et al.

**OTHER PUBLICATIONS**

Ayala Vazquez et al., U.S. Appl. No. 12/553,944, filed Sep. 3, 2009.  
Bevelacqua et al., U.S. Appl. No. 12/750,661, filed Mar. 30, 2010.  
Shiu et al., U.S. Appl. No. 12/750,660, filed Mar. 30, 2010.  
Chiang et al., U.S. Appl. No. 12/500,570, filed Jul. 9, 2009.  
Chiang, U.S. Appl. No. 12/356,496, filed Jan. 20, 2009.  
Chiang et al., U.S. Appl. No. 12/401,599, filed Mar. 10, 2009.  
Guterman et al., U.S. Appl. No. 12/553,943, filed Sep. 3, 2009.  
Vazquez et al., U.S. Appl. No. 12/238,384, filed Sep. 25, 2008.  
Chiang et al., U.S. Appl. No. 11/959,306, filed Dec. 18, 2007.

\* cited by examiner

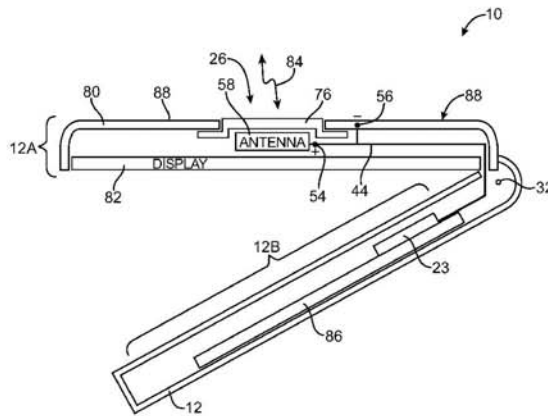
*Primary Examiner* — Hoanganh Le

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

(57) **ABSTRACT**

Logo antennas are provided for electronic devices such as portable computers. An electronic device may have a housing with conductive housing walls. A logo antenna may be formed from an antenna resonating element such as a patch antenna resonating element, a monopole antenna resonating element, or other antenna resonating element structure. A conductive cavity may be placed behind the antenna resonating element. A dielectric antenna window that serves as a logo may be used to cover the antenna resonating element. The dielectric antenna window may be mounted in an opening in the conductive housing walls. A positive antenna feed terminal may be coupled to the antenna resonating element. A ground antenna feed terminal may be coupled to the cavity and portions of the conductive housing walls. The dielectric antenna window may be shaped in the form of a logo.

**11 Claims, 10 Drawing Sheets**





US008325095B2

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

(10) **Patent No.:** **US 8,325,095 B2**  
(45) **Date of Patent:** **Dec. 4, 2012**

(54) **ANTENNA ELEMENT AND PORTABLE RADIO**  
  
(75) Inventors: **Tomoaki Nishikido**, Sendai (JP); **Hironori Kikuchi**, Sendai (JP); **Yoshio Koyanagi**, Yokohama (JP); **Kenichi Sato**, Sendai (JP); **Hiroaki Ohmori**, Sendai (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 364 days.

(21) Appl. No.: **12/672,391**  
(22) PCT Filed: **Aug. 10, 2007**  
(86) PCT No.: **PCT/JP2007/065751**  
§ 371 (c)(1),  
(2), (4) Date: **Feb. 5, 2010**  
(87) PCT Pub. No.: **WO2009/022389**  
PCT Pub. Date: **Feb. 19, 2009**

(65) **Prior Publication Data**  
US 2011/0128191 A1 Jun. 2, 2011

(51) **Int. Cl.**  
**H01Q 1/24** (2006.01)  
**H01Q 1/38** (2006.01)  
(52) **U.S. Cl.** ..... **343/702**; **343/700 MS**; **343/846**  
(58) **Field of Classification Search** ..... **343/702**,  
**343/700 MS**, **846**  
See application file for complete search history.

(56) **References Cited**  
  
U.S. PATENT DOCUMENTS  
7,250,911 B2\* 7/2007 Lindell ..... 343/702  
7,453,405 B2\* 11/2008 Nishikido et al. .... 343/702  
7,508,348 B2\* 3/2009 Abdul-Gaffoor et al. .... 343/702  
2002/0075192 A1 6/2002 Iwai  
2006/0214856 A1 9/2006 Nakano

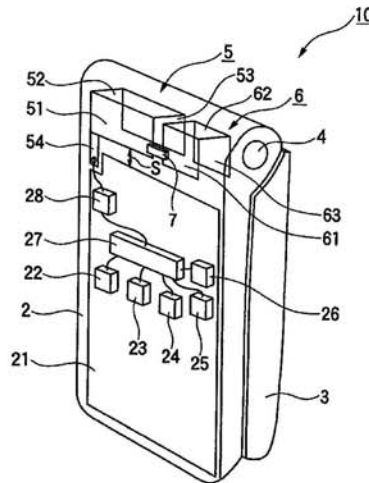
FOREIGN PATENT DOCUMENTS  
JP 08-084013 A 3/1996  
(Continued)

OTHER PUBLICATIONS  
International Search Report mailed Sep. 25, 2007, in corresponding International Application No. PCT/JP2007/065751.  
(Continued)

*Primary Examiner* — Hoang V Nguyen  
(74) *Attorney, Agent, or Firm* — Seed IP Law Group PLLC

(57) **ABSTRACT**  
There is provided an antenna element capable of implementing miniaturization, acquisition of a high gain, and broadening of a band and coping with multiple bands. The antenna element includes a first antenna element **5** having shape of a box (a rectangular-parallelepiped shape) in which a first conductor plate **51**, a second conductor plate **52**, and a third conductor plate **53** are arranged so as to define at least three surfaces of a substantial rectangular parallelepiped and in which electric power is fed from a substantial corner of a lower circuit board (a ground plate) **21** to the first conductor plate **51**; and a second antenna element **6** having shape of a box (a rectangular-parallelepiped shape) in which a fourth conductor plate **61**, a fifth conductor plate **62**, and a sixth conductor plate **63** are arranged so as to define at least three surfaces of a substantial rectangular parallelepiped, the fourth conductor plate **61** being connected by way of a resonance circuit **7** to the first antenna element **5** at a portion thereof apart from a feeding point of the first antenna element **5**.

**5 Claims, 6 Drawing Sheets**





US008325096B2

(12) **United States Patent**  
**Ayala Vazquez et al.**

(10) **Patent No.:** **US 8,325,096 B2**  
(45) **Date of Patent:** **\*Dec. 4, 2012**

(54) **CLUTCH BARREL ANTENNA FOR WIRELESS ELECTRONIC DEVICES**

(75) Inventors: **Enrique Ayala Vazquez**, Watsonville, CA (US); **Hao Xu**, Cupertino, CA (US); **Gregory A. Springer**, Sunnyvale, CA (US); **Bing Chiang**, Cupertino, CA (US); **Eduardo Lopez Camacho**, Watsonville, CA (US); **Douglas B. Kough**, San Jose, CA (US)

6,392,610	B1	5/2002	Braun et al.
6,414,643	B2	7/2002	Cheng et al.
6,421,029	B1	7/2002	Tanabe
6,448,942	B2	9/2002	Weinberger et al.
6,539,608	B2	4/2003	McKinnon et al.
6,570,538	B2	5/2003	Vaisanen et al.
6,667,719	B2	12/2003	LaKowski
6,781,546	B2	8/2004	Wang et al.
6,847,329	B2	1/2005	Ikegaya et al.
7,345,646	B1	3/2008	Lin et al.
7,705,789	B2	4/2010	Suzuki et al.
2001/0040529	A1	11/2001	Cheng et al.

(Continued)

(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.

**OTHER PUBLICATIONS**

U.S. Appl. No. 12/142,744, filed Jun. 19, 2008, Ayala et al.

(Continued)

(21) Appl. No.: **13/269,150**

(22) Filed: **Oct. 7, 2011**

(65) **Prior Publication Data**

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**Related U.S. Application Data**

(63) Continuation of application No. 12/238,385, filed on Sep. 25, 2008, now Pat. No. 8,059,039.

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

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

(58) **Field of Classification Search** ..... **343/702, 343/700 MS, 767, 770**

See application file for complete search history.

(56) **References Cited**

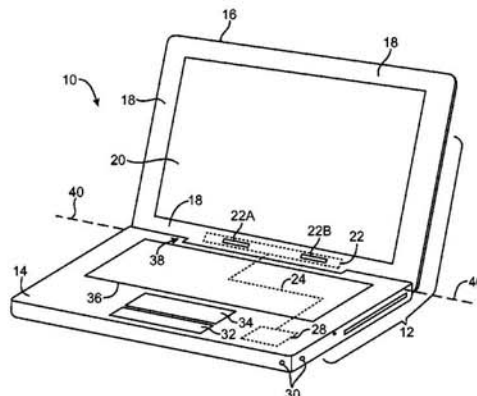
**U.S. PATENT DOCUMENTS**

5,258,892	A	11/1993	Stanton et al.
5,608,413	A	3/1997	Macdonald
6,272,356	B1	8/2001	Dolman et al.

(57) **ABSTRACT**

Wireless portable electronic devices such as laptop computers are provided with antennas. An antenna may be provided within a clutch barrel in a laptop computer. The clutch barrel may have a dielectric cover. Antenna elements may be mounted within the clutch barrel cover on an antenna support structure. There may be two or more antenna elements mounted to the antenna support structure. These antenna elements may be of different types. A first antenna element for the clutch barrel antenna may be formed from a dual band antenna element having a closed slot and an open slot. A second antenna element for the clutch barrel antenna may be formed from a dual band antenna element of a hybrid type having a planar resonating element arm and a slot resonating element. Flex circuit structures may be used in implanting the first and second antenna elements for the clutch barrel antenna.

**21 Claims, 13 Drawing Sheets**





US008325101B2

(12) **United States Patent**  
**Payne**

(10) **Patent No.:** **US 8,325,101 B2**  
(45) **Date of Patent:** **Dec. 4, 2012**

- (54) **CROSS-DIPOLE ANTENNA CONFIGURATIONS**
- (75) Inventor: **William Ernest Payne**, Dallas, GA (US)
- (73) Assignee: **Venti Group, LLC**, Laguna Hills, CA (US)
- (\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 212 days.

2,847,670 A	8/1958	Cox
2,867,804 A	1/1959	Gihring
2,976,534 A	3/1961	Kampinsky
3,262,121 A	7/1966	Holloway
3,413,644 A	11/1968	Laus et al.
3,546,705 A	12/1970	Lemson

(Continued)

**FOREIGN PATENT DOCUMENTS**

EP	1100148	5/2001
----	---------	--------

(Continued)

**OTHER PUBLICATIONS**

Ronald E. Goans; Basic Antenna Theory; Apr. 8, 2008; Department of Physics and Astronomy, The University of Tennessee, Knoxville, Tennessee 37996, USA.

(Continued)

- (21) Appl. No.: **12/841,048**
- (22) Filed: **Jul. 21, 2010**

- (65) **Prior Publication Data**  
US 2011/0068992 A1 Mar. 24, 2011

**Related U.S. Application Data**

- (63) Continuation-in-part of application No. 12/784,992, filed on May 21, 2010, which is a continuation-in-part of application No. 12/534,703, filed on Aug. 3, 2009.

- (51) **Int. Cl.**  
**H01Q 21/28** (2006.01)
- (52) **U.S. Cl.** ..... **343/797; 343/792**
- (58) **Field of Classification Search** ..... **343/797, 343/793, 792**  
See application file for complete search history.

- (56) **References Cited**

**U.S. PATENT DOCUMENTS**

2,086,976 A	7/1937	Brown
2,245,693 A	6/1941	Lindenblad
2,275,030 A	3/1942	Epstein
2,290,800 A	7/1942	Brown
2,420,967 A	5/1947	Moore
2,432,858 A	12/1947	Brown
2,570,579 A	10/1951	Masters
2,643,334 A	6/1953	Cox

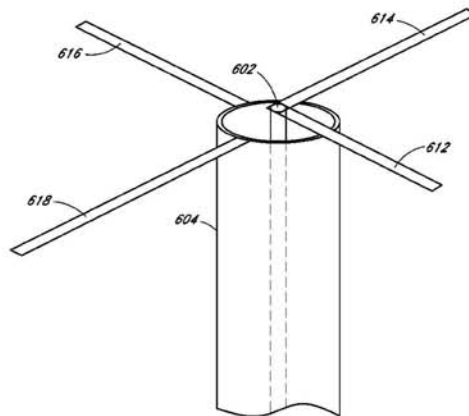
*Primary Examiner* — Hoang V Nguyen

(74) *Attorney, Agent, or Firm* — Knobbe Martens Olson & Bear LLP

(57) **ABSTRACT**

An apparatus has an improved antenna pattern for a cross dipole antenna. Such antennas desirably have an omnidirectional antenna pattern. Conventional cross dipole antennas exhibit nulls in their antenna patterns, which can cause antennas to deviate from a standard or specification. Applicant recognized and confirmed that the connection of a coaxial cable to the antenna arms is a cause of the nulls in the antenna pattern, and has devised techniques disclosed herein to compensate or cancel the effects of the connection. In one embodiment, the arms of the cross dipole antenna that are coupled to a center conductor of the coaxial cable remain of conventional length, but the arms of the cross dipole antenna that are coupled to a shield of the coaxial cable are lengthened by a fraction of the radius of the outer diameter of the coaxial cable.

**62 Claims, 15 Drawing Sheets**





US008325103B2

(12) **United States Patent**  
**Autti**

(10) **Patent No.:** **US 8,325,103 B2**  
(45) **Date of Patent:** **Dec. 4, 2012**

- (54) **ANTENNA ARRANGEMENT**
- (75) **Inventor:** **Marko Tapio Autti**, Oulu (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 266 days.

EP	1 383 198	A1	1/2004
EP	1 594 185	A1	2/2005
EP	1 231 674	B1	3/2008
WO	WO 96/41397		12/1996

**OTHER PUBLICATIONS**

"A Top-Loaded, Inductively-Coupled Small Antenna for HF Ground Wave Transmission", S.Lim et al, vol. 3; (Jun. 20-25, 2004), pp. 3187-3190.  
 "A Feeding Method for Small Helical Antennas" Nozomu Hasebe, vol. 90; (Nov. 15, 2006), pp. 33-41.

- (21) **Appl. No.:** **12/775,653**
- (22) **Filed:** **May 7, 2010**

\* cited by examiner

- (65) **Prior Publication Data**  
US 2011/0273361 A1 Nov. 10, 2011

*Primary Examiner* — Hoanganh Le  
 (74) *Attorney, Agent, or Firm* — Harrington & Smith

- (51) **Int. Cl.**  
**H01Q 1/00** (2006.01)  
**H01Q 1/24** (2006.01)
- (52) **U.S. Cl.** ..... **343/904; 343/702**
- (58) **Field of Classification Search** ..... 343/904,  
343/702, 700 MS, 846, 848  
See application file for complete search history.

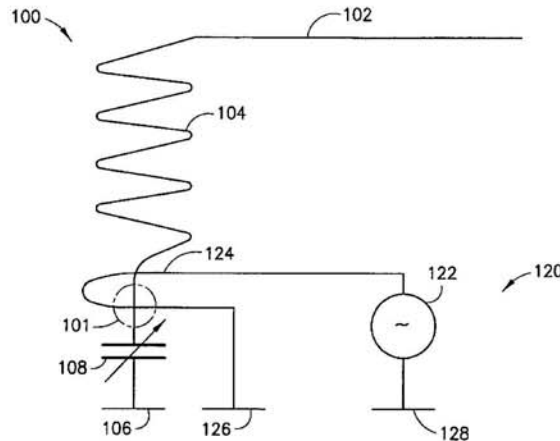
(57) **ABSTRACT**

An apparatus such as for example an antenna sub-assembly includes a multiband antenna circuitry and feed circuitry. The multiband antenna circuitry includes a resonator; a first ground port configured to couple the resonator to a common voltage potential; and at least one reactive component disposed between the resonator and the first ground port. The feed circuitry includes: a signal feed port configured to couple to a radio; a second ground port configured to couple the feed circuitry to the common voltage potential; and a feeding element disposed between the signal feed port and the second ground port, the feeding element configured to inductively couple the feed circuitry to the antenna circuitry between the resonator and the first ground port. In some example embodiments there is a variable reactance to enable the resonator to be tunable. In those and/or other embodiments there is a second and even a third resonator for multi-band operation.

- (56) **References Cited**  
**U.S. PATENT DOCUMENTS**
- |              |     |         |                 |       |         |
|--------------|-----|---------|-----------------|-------|---------|
| 5,359,340    | A   | 10/1994 | Yokota          | ..... | 343/792 |
| 6,765,536    | B2  | 7/2004  | Phillips et al. | ..... | 343/702 |
| 7,061,440    | B2  | 6/2006  | Choo et al.     | ..... | 343/728 |
| 8,170,522    | B2* | 5/2012  | Guan et al.     | ..... | 455/330 |
| 2003/0098812 | A1* | 5/2003  | Ying et al.     | ..... | 343/702 |
| 2007/0285321 | A1  | 12/2007 | Chung et al.    | ..... | 343/702 |
| 2009/0058735 | A1  | 3/2009  | Hill et al.     | ..... | 343/702 |

- FOREIGN PATENT DOCUMENTS**
- |    |           |    |         |
|----|-----------|----|---------|
| EP | 0 747 990 | A1 | 12/1996 |
| EP | 1 109 251 | A2 | 6/2001  |
| EP | 1 318 567 | A1 | 12/2002 |

**18 Claims, 6 Drawing Sheets**





US008325955B2

(12) **United States Patent**  
**Tang**

(10) **Patent No.:** **US 8,325,955 B2**  
(45) **Date of Patent:** **Dec. 4, 2012**

- (54) **METHOD FOR IMPROVING COMPATIBILITY OF HEARING AID WITH ANTENNA**
- (75) Inventor: **Chia-Lun Tang, Pa-Te (TW)**
- (73) Assignee: **Auden Techno Corp., 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 1073 days.
- (21) Appl. No.: **12/049,694**
- (22) Filed: **Mar. 17, 2008**
- (65) **Prior Publication Data**  
US 2009/0232337 A1 Sep. 17, 2009
- (51) **Int. Cl.**  
**H04R 25/00** (2006.01)
- (52) **U.S. Cl.** ..... **381/315; 381/312; 381/313; 381/314; 381/316; 381/331**
- (58) **Field of Classification Search** ..... **381/23.1, 381/315**  
See application file for complete search history.

- (56) **References Cited**  
U.S. PATENT DOCUMENTS
- |           |      |         |                 |       |            |
|-----------|------|---------|-----------------|-------|------------|
| 3,742,358 | A *  | 6/1973  | Cesaro          | ..... | 455/9      |
| 6,249,256 | B1 * | 6/2001  | Luxon et al.    | ..... | 343/702    |
| 6,510,058 | B1 * | 1/2003  | Kozakiewicz     | ..... | 361/760    |
| 6,707,682 | B2 * | 3/2004  | Akiba et al.    | ..... | 361/763    |
| 6,855,883 | B1 * | 2/2005  | Matsui          | ..... | 174/393    |
| 6,856,131 | B2 * | 2/2005  | Miyazawa et al. | ..... | 324/252    |
| 6,927,730 | B2 * | 8/2005  | Tang et al.     | ..... | 343/700 MS |
| 7,209,087 | B2 * | 4/2007  | Tang et al.     | ..... | 343/702    |
| 7,292,193 | B2 * | 11/2007 | Jang            | ..... | 343/702    |
| 7,362,271 | B2 * | 4/2008  | Iwai et al.     | ..... | 343/700 MS |
| 7,385,557 | B2 * | 6/2008  | Kim             | ..... | 343/702    |

7,471,249	B2 *	12/2008	Tang et al.	.....	343/702
7,498,990	B2 *	3/2009	Park et al.	.....	343/702
7,612,722	B2 *	11/2009	Haho et al.	.....	343/702
7,829,810	B2 *	11/2010	Nakajima	.....	200/333
7,982,676	B2 *	7/2011	Chen et al.	.....	343/702
2002/0015293	A1 *	2/2002	Akiba et al.	.....	361/793
2002/0126049	A1 *	9/2002	Okabe et al.	.....	343/700 MS
2004/0212535	A1 *	10/2004	Tang et al.	.....	343/700 MS
2005/0243009	A1 *	11/2005	Wong et al.	.....	343/829
2006/0071871	A1 *	4/2006	Tang et al.	.....	343/826
2006/0089184	A1 *	4/2006	Kim et al.	.....	455/575.5
2006/0145924	A1 *	7/2006	Chen et al.	.....	343/700 MS
2007/0003088	A1 *	1/2007	Lehtola	.....	381/330
2007/0046543	A1 *	3/2007	Choi et al.	.....	343/700 MS
2007/0109196	A1 *	5/2007	Tang et al.	.....	343/700 MS
2007/0159380	A1 *	7/2007	Nagaishi et al.	.....	342/70
2007/0176833	A1 *	8/2007	Haho et al.	.....	343/702
2007/0296638	A1 *	12/2007	Kim et al.	.....	343/702
2008/0007468	A1 *	1/2008	Sato et al.	.....	343/702
2008/0039043	A1 *	2/2008	Yamazaki et al.	.....	455/269
2008/0079642	A1 *	4/2008	Ishizuka et al.	.....	343/702
2008/0136597	A1 *	6/2008	Choi et al.	.....	340/10.1
2008/0204340	A1 *	8/2008	Kim et al.	.....	343/770
2009/0009407	A1 *	1/2009	Hong et al.	.....	343/702

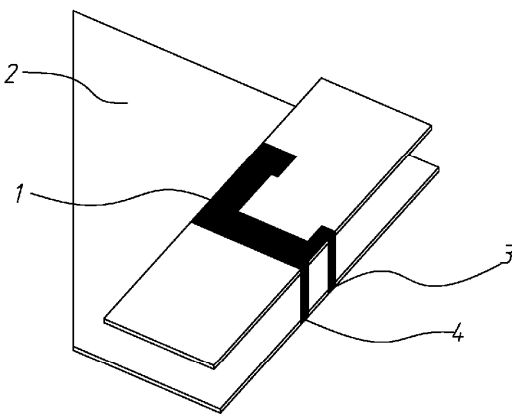
(Continued)

*Primary Examiner* — Fernando L Toledo  
*Assistant Examiner* — Mohammed Shamsuzzaman  
(74) *Attorney, Agent, or Firm* — Guice Patents PLLC

(57) **ABSTRACT**

A method for improving compatibility of a hearing aid with an antenna, in which at least a metal frame is provided near by a grounding surface of the antenna to change the direction of radiation of the antenna, thereby to enhance the directivity of the antenna on the side away from a hearing aid, and to reduce the quantity of radiation proceeding toward the hearing aid and to improve the near-field quantity (for about 3 dB) of an electric field of an HAC tested plane. This method can further increase the heights of the metal frames to reduce the near-field quantity of the electric field of HAC (hearing aid compatibility) tested plane.

**5 Claims, 12 Drawing Sheets**





US008326235B2

(12) **United States Patent**  
**Sato**

(10) **Patent No.:** **US 8,326,235 B2**  
(45) **Date of Patent:** **Dec. 4, 2012**

(54) **COMMUNICATION DEVICE**  
(75) Inventor: **Masaru Sato**, 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 206 days.

7,079,816 B2 \* 7/2006 Khorram et al. .... 455/78  
7,453,329 B2 11/2008 Inoue  
2008/0032653 A1 2/2008 Inoue

**FOREIGN PATENT DOCUMENTS**

JP 11-46101 A1 2/1999  
JP 2004-363862 A1 12/2004  
WO WO 2006/100726 A1 9/2006

\* cited by examiner

(21) Appl. No.: **12/837,930**  
(22) Filed: **Jul. 16, 2010**  
(65) **Prior Publication Data**  
US 2011/0076939 A1 Mar. 31, 2011

*Primary Examiner* — Tuan H Nguyen  
(74) *Attorney, Agent, or Firm* — Kratz, Quintos & Hanson, LLP

(30) **Foreign Application Priority Data**  
Sep. 28, 2009 (JP) ..... 2009-223293

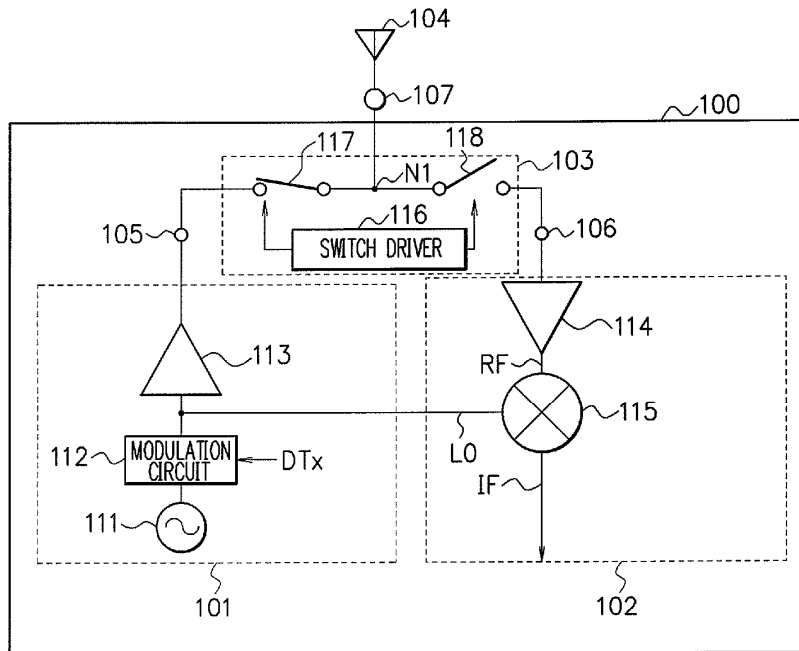
(57) **ABSTRACT**

(51) **Int. Cl.**  
**H04B 1/44** (2006.01)  
(52) **U.S. Cl.** ..... **455/78**; 455/82; 455/83; 327/308;  
327/404; 333/103  
(58) **Field of Classification Search** ..... 455/39,  
455/78, 82, 83; 327/308, 404; 333/81 R,  
333/103  
See application file for complete search history.

There is provided a communication device including: a first node connected to an antenna; a transmission unit outputting a signal to the antenna via the first node; a reception unit having a signal input thereto from the antenna via the first node; a first switch provided between the first node and the transmission unit; and a second switch provided between the first node and the reception unit, and in which the second switch is alternately turned on and off repeatedly, and the reception unit includes an amplifier amplifying a signal that the transmission unit outputs via the first and second switches and a mixer mixing a signal amplified in the amplifier and a local signal.

(56) **References Cited**  
U.S. PATENT DOCUMENTS  
6,118,985 A \* 9/2000 Kawakyu et al. .... 455/78

**5 Claims, 7 Drawing Sheets**







US008326249B2

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

(10) **Patent No.:** **US 8,326,249 B2**  
(45) **Date of Patent:** **Dec. 4, 2012**

(54) **METHODS AND APPARATUS FOR SUPPORTING COMMUNICATIONS USING A FIRST POLARIZATION DIRECTION ELECTRICAL ANTENNA AND A SECOND POLARIZATION DIRECTION MAGNETIC ANTENNA**

(75) Inventors: **Juergen Cezanne**, Ocean Township, NJ (US); **Saurabha R. Tavildar**, Jersey City, NJ (US); **Bikram Reddy Anreddy**, Bridgewater, NJ (US); **Xinzhou Wu**, Monmouth Junction, NJ (US); **Rajiv Laroia**, Far Hills, NJ (US)

(73) Assignee: **QUALCOMM Incorporated**, 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 987 days.

(21) Appl. No.: **12/043,860**

(22) Filed: **Mar. 6, 2008**

(65) **Prior Publication Data**  
US 2009/0224990 A1 Sep. 10, 2009

(51) **Int. Cl.**  
**H04B 1/06** (2006.01)  
**H04B 7/00** (2006.01)

(52) **U.S. Cl.** ..... **455/272; 455/269**

(58) **Field of Classification Search** ..... 455/269, 455/272, 274, 279.1, 63.4, 78, 83, 562.1, 455/575.7, 13.3, 25; 343/787, 701, 725, 343/726, 728, 732

See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

5,036,331 A 7/1991 Dallabetta et al.  
6,044,254 A 3/2000 Ohta et al.  
6,411,824 B1 6/2002 Eidson

6,437,750 B1 8/2002 Grimes et al.  
6,470,193 B1 10/2002 Stolt  
6,486,848 B1 11/2002 Poilasne et al.  
6,546,236 B1 4/2003 Canada et al.  
6,963,301 B2 \* 11/2005 Schantz et al. .... 342/125  
7,038,628 B1 5/2006 Rausch  
8,024,003 B2 9/2011 Cezanne et al.  
2007/0282482 A1 \* 12/2007 Beucher et al. .... 700/225  
2008/0159236 A1 \* 7/2008 Ch'ng et al. .... 370/335

**FOREIGN PATENT DOCUMENTS**

DE 480853 8/1929  
DE 10025992 1/2002  
EP 1617515 1/2006  
JP 2000077934 3/2000  
JP 2001332930 11/2001

**OTHER PUBLICATIONS**

International Search Report and Written Opinion—PCT/US2009/036425—International Search Authority—European Patent Office, Oct. 6, 2009. Kraus J.D. et al., "Antennas for all applications", Antennas, 2002, p. 726-727, vol. Ed.3, McGraw-Hill, New York—ISBN 978-0-07-112240-5 ; ISBN 0-07-112240-0, XP002529286.

\* cited by examiner

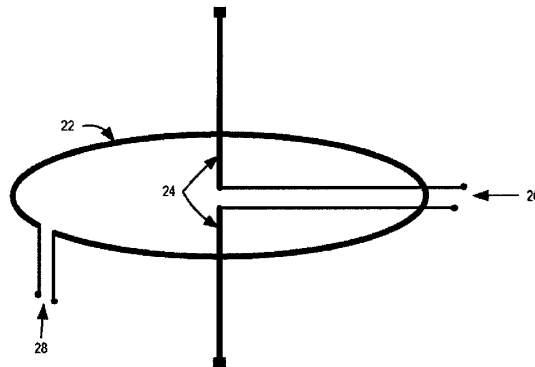
*Primary Examiner* — Eugene Yun

(74) *Attorney, Agent, or Firm* — Michelle Gallardo; Nicholas J. Pauley; Jonathan T. Velasco

(57) **ABSTRACT**

A communications device, e.g., a mobile wireless terminal, includes a plurality of antennas having different associated polarization directions. The plurality of antennas includes an electrical antenna, e.g., a dipole antenna and a magnetic antenna, e.g., a loop antenna or a slot antenna. In one embodiment the electrical antenna is used for receiving and/or transmitting signals associated with a vertical polarization direction, while the magnetic antenna is used for receiving and/or transmitting signals associated with a horizontal polarization direction. In some embodiments different data streams are communicated concurrently via the electrical and magnetic antennas. Methods for operating the communications device to switch between the electrical and magnetic antennas and/or to control reception and/or transmission are described. The novel antenna configuration facilitates the use of the horizontal polarization direction communications between the communications device and a base station without the need for directionally azimuth positioning the magnetic antenna.

**22 Claims, 19 Drawing Sheets**





US008326347B2

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

(10) **Patent No.:** **US 8,326,347 B2**  
(45) **Date of Patent:** **\*Dec. 4, 2012**

(54) **WIRELESS COMMUNICATION SYSTEM INTEGRATED INTO A COMPUTER DISPLAY**

(75) Inventors: **Matthew J. Wagner**, Houston, TX (US);  
**Robin T. Castell**, Spring, TX (US);  
**Timothy Neill**, Houston, TX (US)

(73) Assignee: **Hewlett-Packard Development Company, L.P.**, Houston, TX (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.

5,861,873 A	1/1999	Kikinis	
5,913,174 A	6/1999	Casarez et al.	
5,983,073 A	11/1999	Ditzik	
6,047,301 A	4/2000	Bjorklund et al.	
6,115,762 A	9/2000	Bell et al.	
6,181,284 B1 *	1/2001	Madsen et al.	343/702
6,259,932 B1	7/2001	Constien	
6,339,400 B1 *	1/2002	Flint et al.	343/702
6,356,442 B1 *	3/2002	Lunsford	361/679.56
6,356,443 B2 *	3/2002	Jenks et al.	361/679.56
6,434,403 B1	8/2002	Ausems et al.	
6,456,245 B1 *	9/2002	Crawford	343/702
6,531,985 B1	3/2003	Jones et al.	
6,545,643 B1 *	4/2003	Sward et al.	343/702
6,587,698 B1	7/2003	Dosch	
6,628,236 B2 *	9/2003	Kim et al.	343/702
6,677,906 B2	1/2004	Quinn et al.	

(Continued)

(21) Appl. No.: **13/448,114**

(22) Filed: **Apr. 16, 2012**

(65) **Prior Publication Data**

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**Related U.S. Application Data**

(63) Continuation of application No. 10/034,224, filed on Dec. 28, 2001, now Pat. No. 8,185,147.

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

(52) **U.S. Cl.** ..... **455/550.1**; 455/556.1; 455/557; 455/556.2; 455/575.7; 455/101; 455/423; 455/73; 343/702; 343/873; 343/346; 343/700 MS

(58) **Field of Classification Search** ..... 455/556.1, 455/557, 73, 575.7, 423, 556.2, 550.1; 343/702, 343/700 MS, 846

See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

5,799,068 A	8/1998	Kikinis et al.
5,844,985 A	12/1998	Kulberg et al.
5,850,612 A	12/1998	Kulberg et al.

**OTHER PUBLICATIONS**

Wagner et al., Appeal Brief filed Jul. 1, 2008, U.S. Appl. No. 10/034,224, filed Dec. 28, 2001.

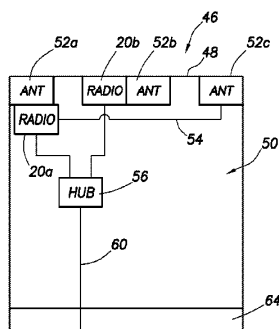
(Continued)

*Primary Examiner* — Marceau Milord

(57) **ABSTRACT**

An electronic device has a display in which the casing of the display includes a plurality of recessed cavities into which radio and antenna modules can be inserted to provide the electronic device with a wireless communication capability. The display can have cavities for one or more radios and one or more antenna modules. A radio electrically connects to one or more antenna modules via conductor(s) contained within the display and connects to the host electronic device via a serial bus (e.g., USB). Accordingly, the display can have a plurality of radio/antenna combinations thereby concurrently providing the electronic device with multiple wireless communication capabilities.

**13 Claims, 2 Drawing Sheets**





US008326376B2

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

(10) **Patent No.:** **US 8,326,376 B2**  
(45) **Date of Patent:** **Dec. 4, 2012**

(54) **PORTABLE APPARATUS**  
(75) Inventors: **Masahiro Kaneko**, Shinagawa (JP);  
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**Kurashima**, Shinagawa (JP); **Yuriko**  
**Segawa**, Shinagawa (JP); **Takashi Arita**,  
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6,028,555 A \* 2/2000 Harano ..... 343/702  
6,061,028 A \* 5/2000 Sakata ..... 343/702  
6,380,899 B1 \* 4/2002 Madsen et al. .... 343/702  
6,421,016 B1 \* 7/2002 Phillips et al. .... 343/702  
7,327,318 B2 \* 2/2008 Frank et al. .... 343/700 MS  
7,724,195 B2 5/2010 Yuba et al.  
2004/0204188 A1 \* 10/2004 Stevens ..... 455/575.1  
2006/0071857 A1 \* 4/2006 Pelzer ..... 343/700 MS  
2006/0097048 A1 \* 5/2006 Mori ..... 235/439  
2006/0109182 A1 \* 5/2006 Rosenberg et al. .... 343/702  
2006/0111075 A1 \* 5/2006 Seol ..... 455/343.6  
2006/0281500 A1 \* 12/2006 Huang et al. .... 455/575.1

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

(\* ) Notice: Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
U.S.C. 154(b) by 752 days.

**FOREIGN PATENT DOCUMENTS**

JP 10-190331 7/1998  
JP 2000-013119 1/2000  
JP 2000-196327 7/2000  
JP 2000-209013 7/2000  
WO WO 03043101 A2 \* 5/2003

(21) Appl. No.: **11/528,313**

(22) Filed: **Sep. 28, 2006**

(65) **Prior Publication Data**  
US 2007/0238492 A1 Oct. 11, 2007

(30) **Foreign Application Priority Data**  
Apr. 11, 2006 (JP) ..... 2006-108872

(51) **Int. Cl.**  
**H04W 74/00** (2009.01)  
(52) **U.S. Cl.** ..... **455/575.1**; 455/343.1; 455/343.2;  
455/343.3; 455/343.5; 455/343.6; 343/849  
(58) **Field of Classification Search** ..... 455/573,  
455/343.1, 575.1, 575.2, 575.3, 575.4, 575.5,  
455/575.6; 343/700, 745, 829, 845, 846,  
343/847, 848, 849  
See application file for complete search history.

(56) **References Cited**  
**U.S. PATENT DOCUMENTS**  
4,780,724 A \* 10/1988 Sharma et al. .... 343/700 MS  
5,736,965 A \* 4/1998 Mosebrook et al. .... 343/702

**OTHER PUBLICATIONS**

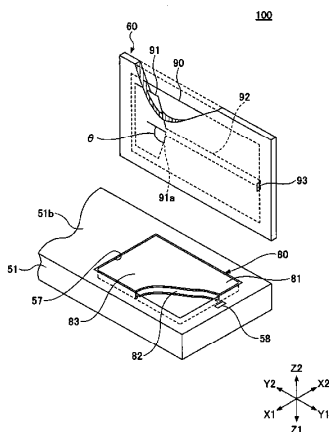
“An Omnidirectional and Low-VSWR Antenna for the FCC-ap-  
proved UWB Frequency Band” by T. Taniguchi and T. Kobayashi  
(Tokyo Denki University) in 2003 IEEE AP-S International Symp.,  
vol. 3, pp. 460-463, Jun. 22-27, 2003. (Disclosure on Mar. 22 at B201  
classroom) disclosures a background art of the present invention.

(Continued)

*Primary Examiner* — Kamran Afshar  
*Assistant Examiner* — Khalid Shaheed  
(74) *Attorney, Agent, or Firm* — Staas & Halsey LLP

(57) **ABSTRACT**  
A portable apparatus including a flat antenna apparatus is  
disclosed. The portable apparatus operates with a battery. The  
flat antenna apparatus includes an antenna element and a  
ground element, where the ground element is a surface of the  
battery.

**7 Claims, 8 Drawing Sheets**





US008326380B2

(12) **United States Patent**  
**Kaneoya**

(10) **Patent No.:** **US 8,326,380 B2**  
(45) **Date of Patent:** **Dec. 4, 2012**

(54) **FOLDABLE PORTABLE WIRELESS COMMUNICATION APPARATUS**

(75) Inventor: **Masanori Kaneoya, Musashimurayama (JP)**

(73) Assignee: **Casio Hitachi Mobile Communications Co., 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 1160 days.

(21) Appl. No.: **11/489,988**

(22) Filed: **Jul. 20, 2006**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Jul. 21, 2005 (JP) ..... 2005-211695  
Mar. 28, 2006 (JP) ..... 2006-088117

(51) **Int. Cl.**

**H04M 1/00** (2006.01)  
**H04Q 1/24** (2006.01)

(52) **U.S. Cl.** ..... **455/575.3; 455/90.3; 343/702**

(58) **Field of Classification Search** ..... 455/90.2, 455/90.3, 347, 575.1, 575.3; 343/702, 718, 343/700 MS, 906

See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

6,346,925 B1 \* 2/2002 Matsumoto ..... 343/895  
6,603,431 B2 \* 8/2003 Talvitie et al. .... 343/702

6,677,907 B2 \* 1/2004 Shoji et al. .... 343/702  
7,068,228 B2 \* 6/2006 Soutome ..... 343/702  
7,130,591 B2 \* 10/2006 Iwai et al. .... 455/90.3  
7,526,326 B2 \* 4/2009 Vance et al. .... 455/575.7  
2005/0239519 A1 \* 10/2005 Saitou et al. .... 455/575.1

**FOREIGN PATENT DOCUMENTS**

JP 2004-186970 7/2004  
JP 2004-229048 8/2004  
JP 2004-297535 10/2004  
JP 2005-057664 3/2005  
JP 2005-136668 5/2005

\* cited by examiner

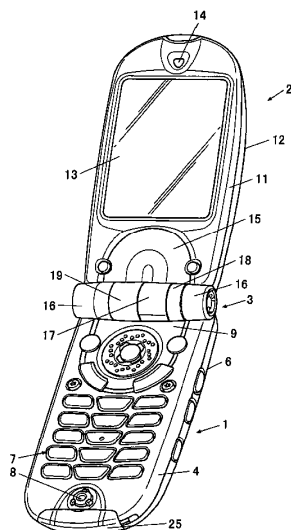
*Primary Examiner* — Quochien B Vuong

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

(57) **ABSTRACT**

A foldable portable wireless communication apparatus which ensures miniaturization of housing and good antenna characteristic has first casing including transmitter and/or operation section, and second housing including receiver and/or display section and rotatably linked with the first casing through hinge section provided on one end portion of the first housing on the front face side thereof. An antenna board is provided in area at back of the hinge section inside the first housing, and a circuit board having a radio-frequency circuit section mounted thereon is provided in area not overlapping the hinge section inside the first housing. A connection conductor connecting the antenna board and the high frequency wave input/output point of the radio-frequency circuit section is configured into a monopole antenna by setting the direction of extension of the connection conductor in the lengthwise direction of the first housing in the vicinity of the high frequency wave input/output point.

**11 Claims, 7 Drawing Sheets**





US008330655B2

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

(10) **Patent No.:** **US 8,330,655 B2**  
(45) **Date of Patent:** **Dec. 11, 2012**

(54) **CONNECTORS WITH EMBEDDED ANTENNAS**

(75) Inventors: **Stephen P. Zadesky**, Portola Valley, CA (US); **Christopher D. Prest**, Mountain View, 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 586 days.

(21) Appl. No.: **12/543,457**

(22) Filed: **Aug. 18, 2009**

(65) **Prior Publication Data**

US 2011/0043413 A1 Feb. 24, 2011

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

(52) **U.S. Cl.** ..... **343/702; 343/906**

(58) **Field of Classification Search** ..... **343/702, 343/767, 906**

See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

5,596,337 A \* 1/1997 Merenda ..... 343/770  
5,726,666 A \* 3/1998 Hoover et al. .... 343/770

6,419,506 B2	7/2002	Jones et al.	
6,975,274 B2 *	12/2005	Sanchez et al.	343/702
7,231,236 B2	6/2007	Cho	
7,466,289 B2	12/2008	Lin et al.	
7,605,707 B2 *	10/2009	German et al.	340/572.8
7,663,561 B2 *	2/2010	Hisaeda	343/713
7,777,689 B2 *	8/2010	Fratti et al.	343/895
2005/0253726 A1	11/2005	Yoshida et al.	
2006/0049942 A1	3/2006	Sakama et al.	
2008/0136716 A1	6/2008	Annamaa et al.	
2008/0238783 A1 *	10/2008	Wong et al.	343/700 MS
2009/0051621 A1	2/2009	Liang et al.	

**FOREIGN PATENT DOCUMENTS**

EP	1 686 025 A2	8/2006
EP	2 083 472	7/2009

\* cited by examiner

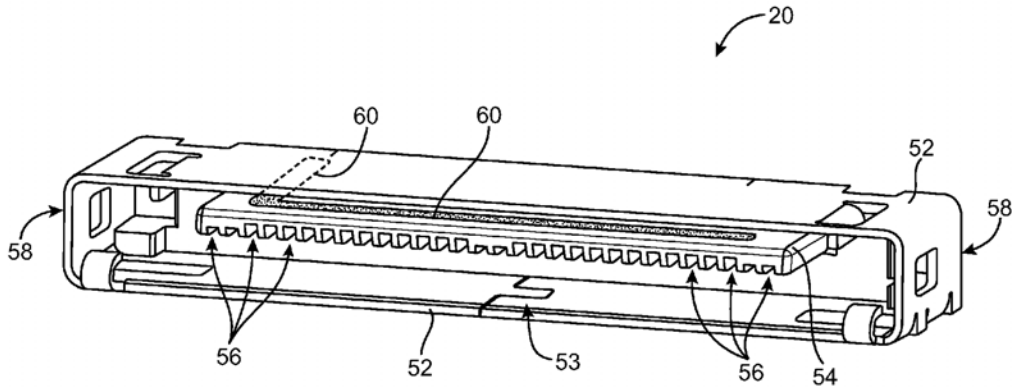
*Primary Examiner* — Tho G Phan

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

(57) **ABSTRACT**

Connectors for electronic devices are provided with embedded antennas. The connectors may be 30-pin connectors. A 30-pin connector may have a conductive shell structure that defines a cavity and a planar dielectric member that extends into the cavity and that has contact pins. An antenna may be formed from an antenna resonating element on the planar dielectric member and an antenna ground formed from the conductive shell structure. An antenna may be formed from a slot in the conductive shell. The antenna and the pins may be electrically coupled to an electronic device using a cable.

**20 Claims, 6 Drawing Sheets**





US008330656B2

(12) **United States Patent**  
**Chiu**

(10) **Patent No.:** **US 8,330,656 B2**  
(45) **Date of Patent:** **Dec. 11, 2012**

(54) **ELECTRONIC DEVICE AND FIXING STRUCTURE THEREOF**

(75) Inventor: **Yi-Tsung Chiu**, Tao Yuan Shien (TW)

(73) Assignee: **Quanta Computer Inc.**, Kuei Shan Hsian, Tao Yuan Shien (TW)

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 635 days.

(21) Appl. No.: **12/545,985**

(22) Filed: **Aug. 24, 2009**

(65) **Prior Publication Data**  
US 2010/0277375 A1 Nov. 4, 2010

(30) **Foreign Application Priority Data**  
Apr. 29, 2009 (TW) ..... 98207231 U

(51) **Int. Cl.**  
**H01Q 1/24** (2006.01)  
(52) **U.S. Cl.** ..... **343/702; 343/878**  
(58) **Field of Classification Search** ..... **343/702, 343/878**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,705,790 B2\* 4/2010 Booth et al. .... 343/702  
2007/0115187 A1\* 5/2007 Zhang et al. .... 343/702

\* cited by examiner

*Primary Examiner* — Hoang V Nguyen

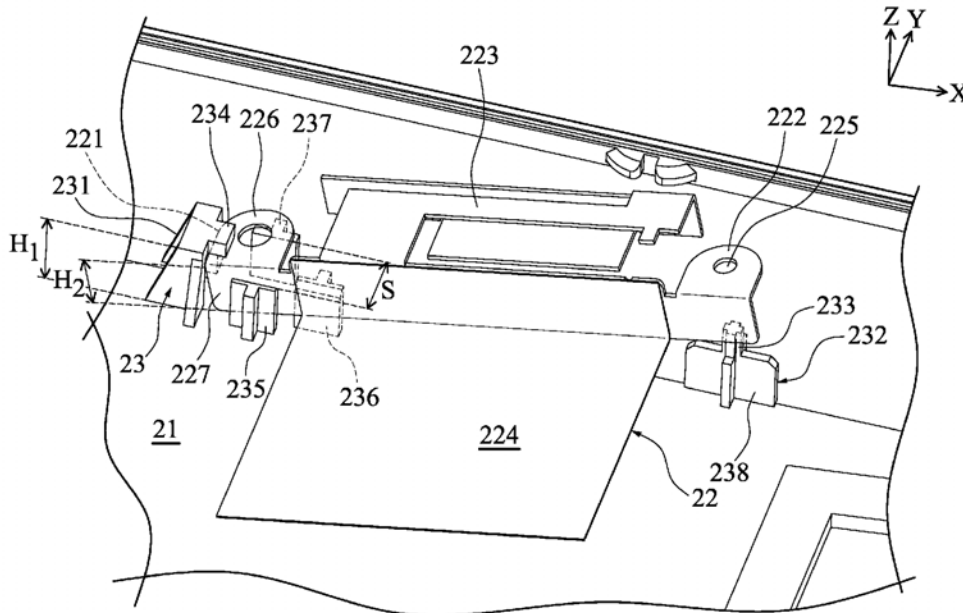
*Assistant Examiner* — Kyana R McCain

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

(57) **ABSTRACT**

An electronic device and a fixing module are provided. The electronic device further includes a housing and an antenna module. The antenna module includes an antenna, a first engaging portion and a second engaging portion. The first engaging portion and the second engaging portion are installed on two ends of the antenna. The first engaging portion includes an upper surface. The fixing module installed on the housing includes a first limiting element and a second limiting element. When the antenna module is fixed with the fixing module, the first limiting element is engaged with the first engaging portion, and the second limiting element is engaged with the second limiting element. The first limiting element includes a protrusion. When the antenna module is fixed with the fixing module, the protrusion covers the upper surface of the first engaging portion.

**16 Claims, 5 Drawing Sheets**





US008330657B2

(12) **United States Patent**  
**Liu**

(10) **Patent No.:** **US 8,330,657 B2**  
(45) **Date of Patent:** **Dec. 11, 2012**

(54) **ANTENNA AND PORTABLE WIRELESS COMMUNICATION DEVICE USING THE SAME**

(75) Inventor: **Chien-Chang Liu, Tu-Cheng (TW)**

(73) Assignee: **Chi Mei Communications Systems, Inc., Tu-Cheng, New Taipei (TW)**

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 391 days.

(21) Appl. No.: **12/627,056**

(22) Filed: **Nov. 30, 2009**

(65) **Prior Publication Data**  
US 2011/0050532 A1 Mar. 3, 2011

(30) **Foreign Application Priority Data**  
Aug. 28, 2009 (CN) ..... 2009 1 0306263

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

(52) **U.S. Cl.** ..... **343/702; 34/702; 34/700 MS**

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

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,255,994	B1 *	7/2001	Saito	.....	343/700 MS
6,753,815	B2 *	6/2004	Okubora et al.	.....	343/700 MS
7,619,569	B2 *	11/2009	Wu et al.	.....	343/700 MS
2005/0012668	A1 *	1/2005	Hsu	.....	343/700 MS

\* cited by examiner

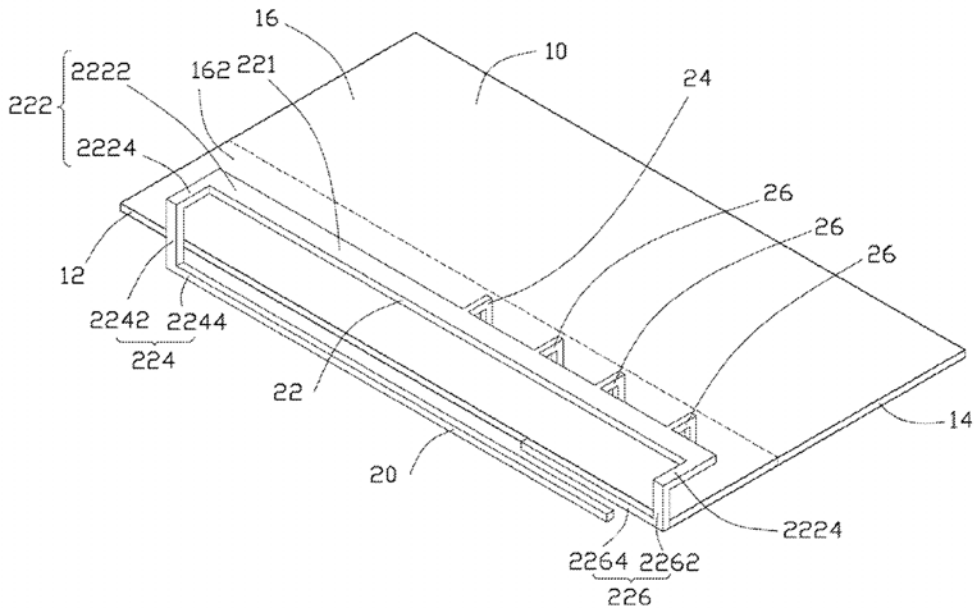
*Primary Examiner* — Dieu H Duong

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

(57) **ABSTRACT**

A portable wireless communication device includes a base circuit board, an antenna, and a switch. The base circuit board is a printed circuit board including a feed point and a ground point. The antenna is disposed on the base circuit board including a radiating portion, a feed portion, and a plurality of ground portions. The feed portion electrically connected to the feed point. The switch is electrically connected between the ground point and the plurality of ground portions to choose one ground portion to electrically connect to the ground point and obtain wide working frequency bands.

**16 Claims, 6 Drawing Sheets**





US008330658B2

(12) **United States Patent**  
**Ishii**

(10) **Patent No.:** **US 8,330,658 B2**  
(45) **Date of Patent:** **Dec. 11, 2012**

- (54) **PORTABLE COMMUNICATION DEVICE**
- (75) Inventor: **Junichi Ishii**, Tokyo (JP)
- (73) Assignee: **NEC 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 311 days.
- (21) Appl. No.: **12/672,626**
- (22) PCT Filed: **Oct. 17, 2008**
- (86) PCT No.: **PCT/JP2008/068823**  
§ 371 (c)(1),  
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- (87) PCT Pub. No.: **WO2009/051211**  
  
PCT Pub. Date: **Apr. 23, 2009**

- (65) **Prior Publication Data**  
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- (30) **Foreign Application Priority Data**  
Oct. 18, 2007 (JP) ..... 2007-270853
- (51) **Int. Cl.**  
**H01Q 1/24** (2006.01)
- (52) **U.S. Cl.** ..... **343/702; 343/876**
- (58) **Field of Classification Search** ..... **343/702, 343/876; 455/575.1, 575.4, 575.7**  
See application file for complete search history.

- (56) **References Cited**
- U.S. PATENT DOCUMENTS

7,609,212 B2 *	10/2009	Sato et al.	343/702
7,830,313 B2 *	11/2010	Isoda et al.	343/702
2005/0239416 A1	10/2005	Shimizu	

- FOREIGN PATENT DOCUMENTS

EP	1432067 A2	6/2004
JP	2002217755 A	8/2002
JP	2004500741 A	1/2004
JP	2005354420 A	12/2005
JP	2006303719 A	11/2006
JP	3961526 B	5/2007
JP	2007201918 A	8/2007
WO	0211231 A1	2/2002
WO	2007018146 A	2/2007
WO	2009034648 A1	3/2009

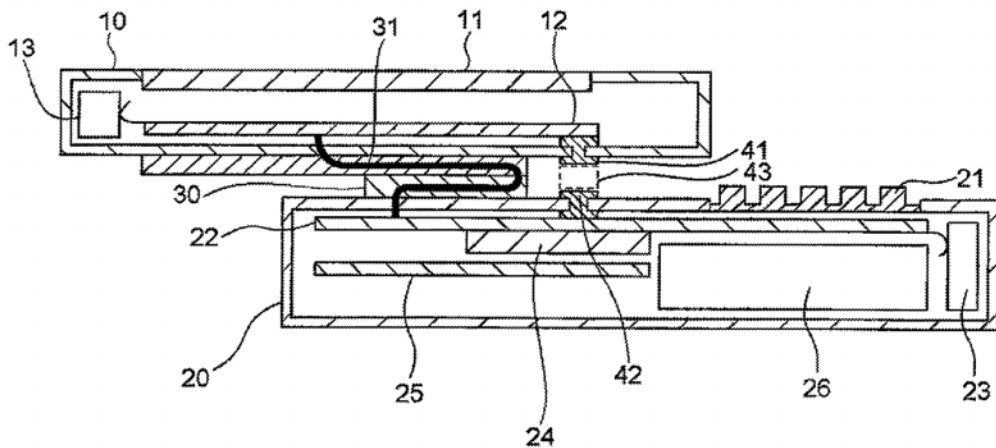
- OTHER PUBLICATIONS

  - International Search Report for PCT/JP2008/068823 mailed Jan. 27, 2009.
  - Extended European search report for EP08839533.0 dated May 29, 2012.

\* cited by examiner  
*Primary Examiner* — Hoang V Nguyen

(57) **ABSTRACT**  
A portable communication device includes a first housing and a second housing that are slidably placed one on another and can shift between an open state and a closed state, a wireless circuit installed in the first housing, a first antenna installed in the second housing, and a noncontact switching member that connects together the first antenna and the wireless circuit in a noncontact manner in the open state and disconnects the noncontact between the first antenna and the wireless circuit in the closed state.

**7 Claims, 14 Drawing Sheets**







US008330665B2

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

(10) **Patent No.:** **US 8,330,665 B2**  
(45) **Date of Patent:** **Dec. 11, 2012**

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

2008/0224943 A1\* 9/2008 Konaka ..... 343/876  
2009/0251383 A1 10/2009 Tani et al.

**FOREIGN PATENT DOCUMENTS**

(76) Inventors: **Andrei Kaikkonen**, Järfälla (SE); **Peter Lindberg**, Uppsala (SE); **Axel von Arbin**, Täby (SE)

EP 1120855 8/2001  
EP 1545013 6/2005  
EP 1594188 11/2005  
EP 1594188 A1\* 11/2005

(Continued)

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 322 days.

**OTHER PUBLICATIONS**

(21) Appl. No.: **12/745,230**

International Preliminary Report on Patentability for International Application No. PCT/SE2008/051342 dated Jun. 10, 2010 (6 pages).

(22) PCT Filed: **Nov. 25, 2008**

(Continued)

(86) PCT No.: **PCT/SE2008/051342**

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

*Primary Examiner* — Douglas W Owens

*Assistant Examiner* — Collin Dawkins

(87) PCT Pub. No.: **WO2009/070100**

PCT Pub. Date: **Jun. 4, 2009**

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

(65) **Prior Publication Data**

US 2010/0302114 A1 Dec. 2, 2010

(57) **ABSTRACT**

(30) **Foreign Application Priority Data**

Nov. 30, 2007 (EP) ..... 07445044

The present invention relates to an antenna device for a portable radio communication device adapted for receiving and/or transmitting radio signals in at least a first and a second operating frequency band, said antenna device comprising a half-loop radiating element, comprising a feeding portion and a grounding portion, and arranged to operate at FM frequencies. The antenna device comprises a capacitor at said feeding portion and an inductor at said grounding portion, and said half-loop radiating element is arranged to simultaneously with FM frequencies operate at frequencies at least ten times higher than FM frequencies, wherein said capacitor is arranged to short circuit said half-loop radiating element to ground for frequencies at least ten times higher than FM frequencies and said inductor is arranged to short circuit said half-loop radiating element to ground for FM frequencies.

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

(52) **U.S. Cl.** ..... 343/722; 343/752; 343/741

(58) **Field of Classification Search** ..... 343/722,  
343/752, 741, 702

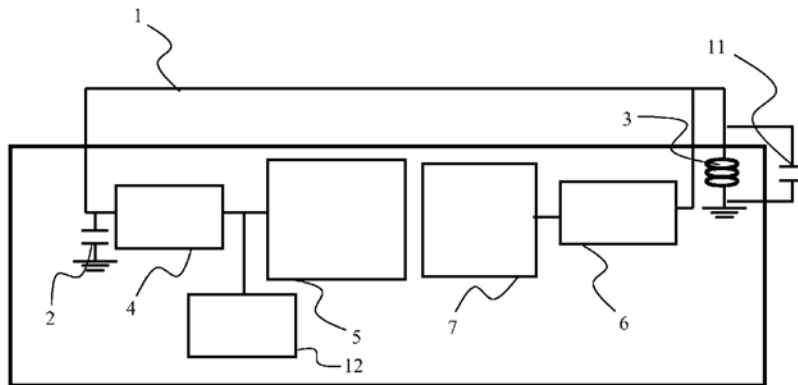
See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

5,767,813 A 6/1998 Verma et al.  
2002/0118075 A1\* 8/2002 Ohwada et al. .... 333/32

**17 Claims, 2 Drawing Sheets**





US008330666B2

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

(10) **Patent No.:** **US 8,330,666 B2**  
(45) **Date of Patent:** **Dec. 11, 2012**

(54) **MULTIBAND ANTENNA**

(75) Inventors: **Tun-Yuan Tsou**, Tu-Cheng (TW);  
**Yi-Chieh Lee**, Tu-Cheng (TW)

(73) Assignee: **Chi Mei Communications Systems, Inc.**, Tu-Cheng, New Taipei (TW)

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 464 days.

(21) Appl. No.: **12/693,641**

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

(65) **Prior Publication Data**  
US 2010/0309067 A1 Dec. 9, 2010

(30) **Foreign Application Priority Data**  
Jun. 8, 2009 (CN) ..... 2009 1 0303052

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

(52) **U.S. Cl.** ..... **343/726; 343/730**

(58) **Field of Classification Search** ..... 343/726,  
343/727, 728, 729, 730, 700 MS  
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,109,936	B2 *	9/2006	Mizoguchi et al.	343/726
7,868,836	B2 *	1/2011	Vendik et al.	343/726
2004/0183739	A1 *	9/2004	Bisiules et al.	343/795
2008/0111757	A1 *	5/2008	Bisiules et al.	343/799
2008/0266191	A1 *	10/2008	Hilgers	343/726

FOREIGN PATENT DOCUMENTS

CN 1734836A A 2/2006

\* cited by examiner

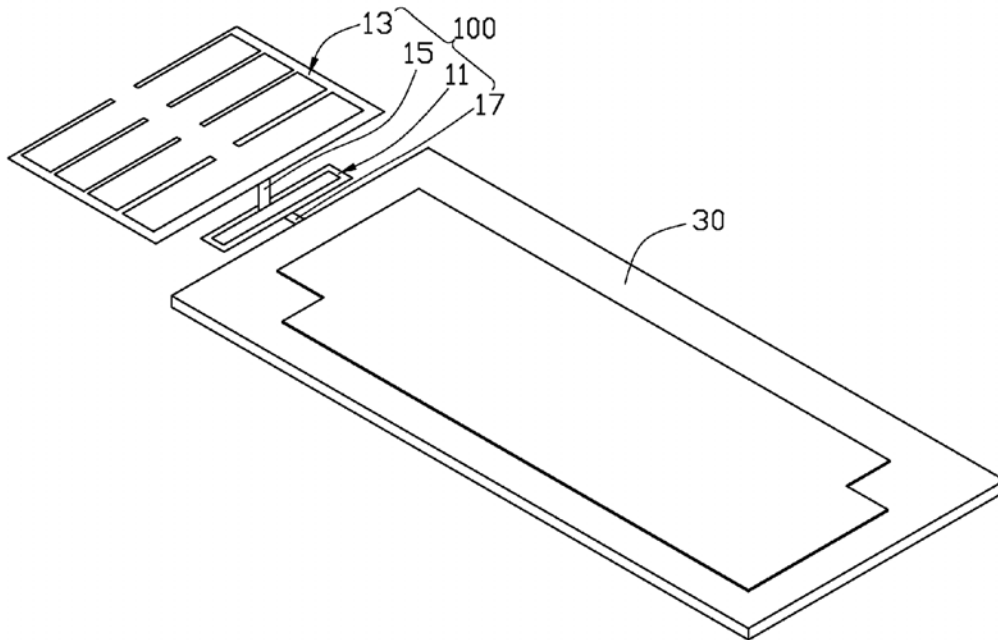
*Primary Examiner* — Hoanganh Le

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

(57) **ABSTRACT**

A multiband antenna includes a first radio unit closed loop and a second radio unit connected to the first radio unit and symmetrical structure. When the multiband antenna functions, the first radio unit functions as a balanced loop antenna, and the second radio unit functions as a dipole antenna.

**18 Claims, 4 Drawing Sheets**





US008330668B2

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

(10) **Patent No.:** **US 8,330,668 B2**  
(45) **Date of Patent:** **\*Dec. 11, 2012**

(54) **DUAL STAGGER OFF SETTABLE AZIMUTH BEAM WIDTH CONTROLLED ANTENNA FOR WIRELESS NETWORK**

(75) Inventors: **Gang Yi Deng**, Irvine, CA (US); **Bill Vassilakis**, Orange, CA (US); **Matthew J. Hunton**, Liberty Lake, WA (US); **Alexander Rabinovich**, Cypress, CA (US); **Nando Hunt**, Newport Beach, 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 323 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/080,483**

(22) Filed: **Apr. 3, 2008**

(65) **Prior Publication Data**

US 2008/0246681 A1 Oct. 9, 2008

**Related U.S. Application Data**

(60) Provisional application No. 60/922,130, filed on Apr. 6, 2007.

(51) **Int. Cl.**  
**H01Q 19/06** (2006.01)  
**H01Q 3/12** (2006.01)  
**H01Q 21/00** (2006.01)

(52) **U.S. Cl.** ..... **343/754; 343/761; 343/835; 343/839; 343/853; 343/893; 343/796; 343/797**

(58) **Field of Classification Search** ..... **343/754, 343/761, 835, 839, 853**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,795,397	A	3/1931	Hoyt	
2,473,421	A	5/1945	Fubini et al.	
2,535,049	A	12/1950	De Rosa	
5,274,391	A	12/1993	Connolly	
5,572,222	A	11/1996	Mailandt et al.	
5,949,303	A	9/1999	Arvidsson et al.	
5,966,102	A *	10/1999	Runyon	343/820
5,969,689	A	10/1999	Martek et al.	
6,034,649	A	3/2000	Wilson et al.	
6,067,053	A	5/2000	Runyon et al.	
6,285,336	B1	9/2001	Zimmerman	
6,515,633	B2	2/2003	Ippolito	
6,529,172	B2	3/2003	Zimmerman	

(Continued)

FOREIGN PATENT DOCUMENTS

EP 0566522 10/1993

(Continued)

OTHER PUBLICATIONS

International Search Authority, Written Opinion pertaining to Application No. PCT/US08/04332 mailed Jun. 20, 2008.

(Continued)

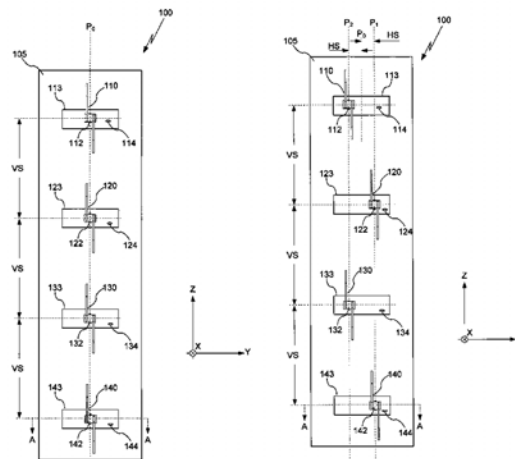
*Primary Examiner* — Trinh Dinh

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

(57) **ABSTRACT**

An antenna adapted for wireless networks and having a variably controlled stagger antenna array architecture is disclosed. The antenna array contains a plurality of driven radiating elements that are spatially arranged having each radiating element or element groups orthogonally movable relative to a main vertical axis so as to provide a controlled variation of the antenna array's azimuth radiation pattern.

**14 Claims, 8 Drawing Sheets**





US008334810B2

(12) **United States Patent**  
**Foo**

(10) **Patent No.:** **US 8,334,810 B2**  
(45) **Date of Patent:** **Dec. 18, 2012**

- (54) **RESONANT CAP LOADED HIGH GAIN PATCH ANTENNA**
- (75) Inventor: **Senglee Foo**, 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 625 days.

6,788,661	B1	9/2004	Ylitalo et al.
7,084,815	B2	8/2006	Phillips et al.
7,099,686	B2*	8/2006	Ro et al. .... 455/550.1
7,196,674	B2	3/2007	Timofeev et al.
7,817,096	B2	10/2010	Linehan
2004/0090369	A1*	5/2004	McCarrick ..... 343/700 MS
2007/0063791	A1	3/2007	Wu et al.
2007/0182634	A1	8/2007	Yamamoto et al.
2009/0021437	A1	1/2009	Foo
2009/0046017	A1	2/2009	Foo
2009/0074109	A1	3/2009	Foo
2009/0096702	A1	4/2009	Vassilakis et al.
2009/0278746	A1*	11/2009	Aurinsalo et al. .... 343/700 MS

- (21) Appl. No.: **12/490,212**
- (22) Filed: **Jun. 23, 2009**
- (65) **Prior Publication Data**  
US 2009/0322642 A1 Dec. 31, 2009

**OTHER PUBLICATIONS**  
International Search Report and Written Opinion pertaining to Application No. PCT/US2008/80050 dated Dec. 22, 2008.  
Office Action dated Mar. 1, 2011 from U.S. Appl. No. 12/252,324.  
Office Action dated Sep. 28, 2011 from U.S. Appl. No. 12/252,324.

- (60) **Related U.S. Application Data**  
Provisional application No. 61/133,147, filed on Jun. 25, 2008.

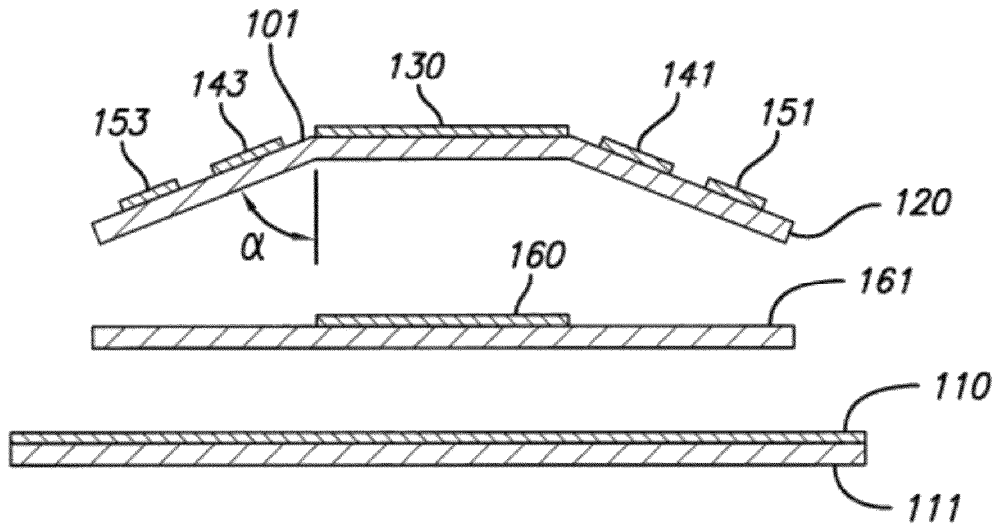
\* cited by examiner  
*Primary Examiner* — Hoanganh Le  
(74) *Attorney, Agent, or Firm* — OC Patent Law Group

- (51) **Int. Cl.**  
**H01Q 1/38** (2006.01)
- (52) **U.S. Cl.** ..... **343/700 MS; 343/893**
- (58) **Field of Classification Search** ..... **343/700 MS, 343/702, 816, 893**  
See application file for complete search history.

(57) **ABSTRACT**  
An antenna architecture containing a broadband resonant cap positioned over a radiating patch is disclosed. The resonant cap consists of a rectangular resonant patch at the center with parasitic patches in close proximity of the four edges of the resonant patch. The parasitic patches may be coplanar with the resonant patch or may be mounted at an angle with respect to the vertical axis of the resonant patch. The resonant cap reduces the HPBW of the emitted radiation and improves emission directivity.

- (56) **References Cited**  
**U.S. PATENT DOCUMENTS**  
5,661,494 A \* 8/1997 Bondyopadhyay .... 343/700 MS  
5,949,303 A 9/1999 Arvidsson et al.

**16 Claims, 3 Drawing Sheets**





US008334812B2

(12) **United States Patent**  
**Brannan**

(10) **Patent No.:** **US 8,334,812 B2**  
(45) **Date of Patent:** **Dec. 18, 2012**

(54) **MICROWAVE ABLATION ANTENNA  
RADIATION DETECTOR**

(75) Inventor: **Joseph D. Brannan**, Erie, CO (US)

(73) Assignee: **Vivant Medical, Inc.**, Boulder, CO (US)

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 686 days.

(21) Appl. No.: **12/542,785**

(22) Filed: **Aug. 18, 2009**

(65) **Prior Publication Data**

US 2010/0321257 A1 Dec. 23, 2010

**Related U.S. Application Data**

(63) Continuation-in-part of application No. 12/487,917, filed on Jun. 19, 2009.

(51) **Int. Cl.**  
**G01R 29/10** (2006.01)

(52) **U.S. Cl.** ..... **343/703; 340/600; 600/430; 606/33**

(58) **Field of Classification Search** ..... **343/703; 343/841; 340/573.1, 600; 600/430; 606/33**  
See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

4,215,275	A	7/1980	Wickersheim	
4,448,547	A	5/1984	Wickersheim	
4,560,286	A	12/1985	Wickersheim	
4,580,557	A	4/1986	Hertzmann	
4,753,248	A	6/1988	Engler et al.	
5,375,596	A *	12/1994	Twiss et al.	600/424
5,671,133	A	9/1997	Fujita	
6,222,193	B1	4/2001	Thurston et al.	
6,424,869	B1	7/2002	Carr	

7,025,765	B2	4/2006	Balbierz et al.	
7,197,356	B2 *	3/2007	Carr	600/430
2002/0075189	A1	6/2002	Carillo	
2002/0087079	A1	7/2002	Kaufman et al.	
2007/0191825	A1	8/2007	Cronin et al.	
2010/0145328	A1 *	6/2010	Hancock et al.	606/33
2010/0286686	A1 *	11/2010	Hancock	606/33

**FOREIGN PATENT DOCUMENTS**

DE	390937	3/1924
DE	1099658	2/1961
DE	1139927	11/1962
DE	1149832	6/1963
DE	1439302	1/1969
DE	2439587	2/1975
DE	2455174	5/1975
DE	2407559	8/1975
DE	2415263	10/1975

(Continued)

**OTHER PUBLICATIONS**

U.S. Appl. No. 08/483,742, filed Jun. 7, 1995.

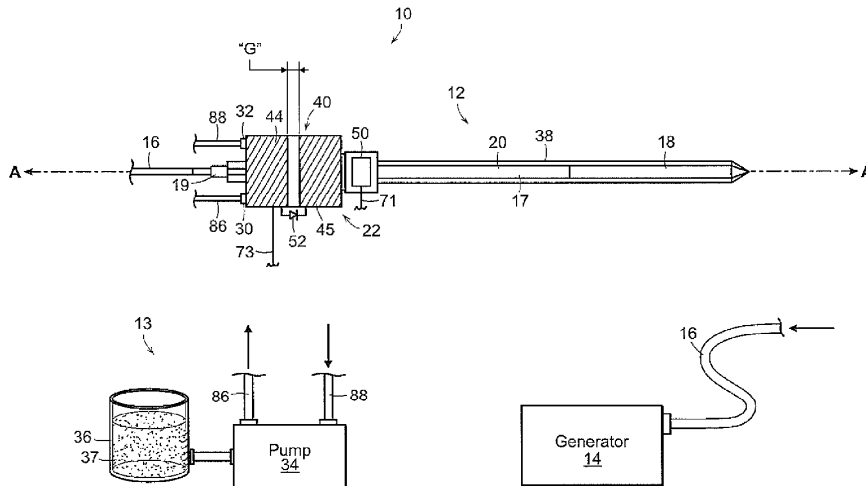
(Continued)

*Primary Examiner* — Tho G Phan

(57) **ABSTRACT**

A radiation detector is disclosed. The radiation detector is disposed on a microwave antenna assembly. The radiation detector includes a receiving antenna adapted to receive microwave energy. The receiving antenna includes a first tubular antenna member and a second tubular antenna member disposed concentrically about a longitudinal axis defined by the microwave antenna assembly. The detector also includes at least one rectifier coupled to the receiving antenna adapted to rectify at least a portion of the microwave energy and a filter coupled to the at least one rectifier and adapted to convert the rectified microwave energy into a detection signal.

**21 Claims, 4 Drawing Sheets**





US008334814B2

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

(10) **Patent No.:** **US 8,334,814 B2**  
(45) **Date of Patent:** **Dec. 18, 2012**

(54) **ANTENNA FOR CIRCULAR POLARIZATION, HAVING A CONDUCTIVE BASE SURFACE**

(75) Inventors: **Stefan Lindenmeier**, Gauting (DE);  
**Heinz Lindenmeier**, Planegg (DE);  
**Jochen Hopf**, Haar (DE); **Leopold Reiter**, Gilching (DE)

4,791,426 A 12/1988 Lindenmeier et al.  
4,914,446 A 4/1990 Lindenmeier et al.  
5,021,797 A \* 6/1991 Dienes ..... 343/727  
5,029,308 A 7/1991 Lindenmeier et al.  
5,049,892 A 9/1991 Lindenmeier et al.  
5,097,270 A 3/1992 Lindenmeier et al.  
5,138,330 A 8/1992 Lindenmeier et al.

(Continued)

(73) Assignee: **Delphi Delco Electronics Europe GmbH**, Troy, MI (US)

**FOREIGN PATENT DOCUMENTS**

JP 2006 186880 7/2000

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

**OTHER PUBLICATIONS**

U.S. Appl. No. 12/689,969, filed Jan. 19, 2010.

(Continued)

(21) Appl. No.: **12/786,236**

*Primary Examiner* — Anh Tran

(22) Filed: **May 24, 2010**

(74) *Attorney, Agent, or Firm* — J. Gordon Lewis

(65) **Prior Publication Data**

US 2010/0302112 A1 Dec. 2, 2010

(30) **Foreign Application Priority Data**

May 30, 2009 (DE) ..... 10 2009 023 514

(57) **ABSTRACT**

An antenna for circular polarization having an electrical dipole radiator which is oriented essentially parallel to an electrically conductive base surface in a plane of symmetry SE oriented perpendicular to the electrically conductive base surface. The dipole is in connection with a slot radiator which is configured in an electrically conductive base surface, with its longitudinal expanse along the intersection line between the plane of symmetry SE and the electrically conductive base surface. The slot radiator connection location is formed by means of connection points situated at the longitudinal edges and lying opposite one another. The electrical dipole radiator and the slot radiator are tuned to one another in their resonance frequencies. The slot radiator and the electrical dipole radiator with dipole feed line are connected with the antenna connection location by way of a combining network, in terms of magnitude and phase, in such a manner that circular polarization exists in the remote field at the frequency at which the radiators are tuned to one another.

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

(52) **U.S. Cl.** ..... 343/727; 343/713; 343/725; 343/767

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

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

3,942,119 A 3/1976 Meinke et al.  
4,070,677 A 1/1978 Meinke et al.  
4,095,228 A 6/1978 Meinke et al.  
4,129,871 A \* 12/1978 Johns ..... 343/727  
4,602,260 A 7/1986 Lindenmeier et al.  
4,752,968 A 6/1988 Lindenmeier et al.

**20 Claims, 5 Drawing Sheets**

