



US007920094B2

(12) **United States Patent**
Hansen

(10) **Patent No.:** **US 7,920,094 B2**
(45) **Date of Patent:** **Apr. 5, 2011**

(54) **ANTENNA STRUCTURE HAVING PATCH ELEMENTS**
(75) Inventor: **Thomas Hansen**, Hildesheim (DE)
(73) Assignee: **Robert Bosch GmbH**, Stuttgart (DE)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 74 days.

(21) Appl. No.: **11/660,424**
(22) PCT Filed: **Jun. 17, 2005**
(86) PCT No.: **PCT/EP2005/052822**
§ 371 (c)(1),
(2), (4) Date: **Sep. 26, 2007**
(87) PCT Pub. No.: **WO2006/018338**
PCT Pub. Date: **Feb. 23, 2006**

(65) **Prior Publication Data**
US 2008/0211720 A1 Sep. 4, 2008

(30) **Foreign Application Priority Data**
Aug. 17, 2004 (DE) 10 2004 039 743

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 21/08 (2006.01)

(52) **U.S. Cl.** **343/700 MS**; 343/853; 343/810;
343/824; 343/825; 343/826
(58) **Field of Classification Search** 343/700 MS,
343/846, 737, 770, 824, 853
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,995,277 A 11/1976 Olyphant, Jr. et al.
4,079,268 A 3/1978 Fletcher et al.
4,742,354 A 5/1988 Wen et al.
2003/0107518 A1 6/2003 Li et al.

FOREIGN PATENT DOCUMENTS

DE 199 51 123 2/2001
EP 1199772 4/2002
WO WO 2002/07 1535 9/2002

OTHER PUBLICATIONS

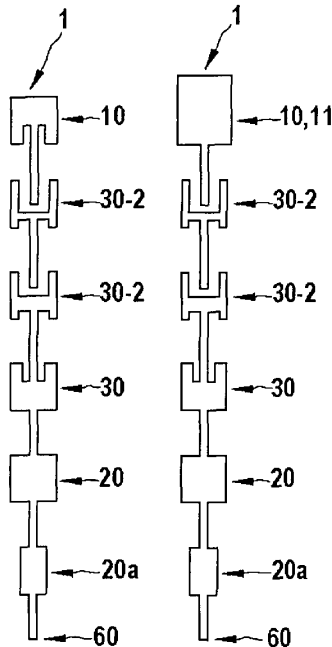
Volski V. et al; Compact Low-Cost 4 Elements Microstrip Antenna Array for WLAN; Wireless Technology, 2004, 7th European Conference on Amsterdam, The Netherlands; Oct. 11-12, 2004.

Primary Examiner — Trinh V Dinh
(74) *Attorney, Agent, or Firm* — Kenyon & Kenyon LLP

(57) **ABSTRACT**

In an antenna structure having a plurality of serially fed patch elements, at least one of the patch elements has a slot coupling to the continuation of the feed line for influencing the radiation of this patch element.

17 Claims, 6 Drawing Sheets





US007920095B2

(12) **United States Patent**
Wei

(10) **Patent No.:** **US 7,920,095 B2**
(45) **Date of Patent:** **Apr. 5, 2011**

(54) **THREE-DIMENSIONAL MULTI-FREQUENCY ANTENNA**

(75) Inventor: **Shen-Pin Wei**, Taipei Hsien (TW)

(73) Assignee: **Wistron NeWeb Corporation**,
Hsi-Chih, 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 697 days.

(21) Appl. No.: **11/845,089**

(22) Filed: **Aug. 26, 2007**

(65) **Prior Publication Data**

US 2009/0033557 A1 Feb. 5, 2009

(30) **Foreign Application Priority Data**

Jul. 31, 2007 (TW) 96128114 A

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

(52) **U.S. Cl.** **343/700 MS; 343/703; 343/749**

(58) **Field of Classification Search** 343/700 MS, 343/702, 781 CA, 754, 781 P, 840, 781 R, 343/785, 175, 802, 725, 790, 752, 742, 780, 343/749, 708, 727, 703, 729; 342/379, 352; 340/572.2; 333/139

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,170,464 B2 1/2007 Tang et al.
2007/0115200 A1* 5/2007 Ishimiya 343/803
2008/0122717 A1* 5/2008 Su et al. 343/787

OTHER PUBLICATIONS

K. L. Wong, L. C. Chou, and C. M. Su, "Dual-Band Flat-Plate Antenna With a Shorted Parasitic Element for Laptop Applications," IEEE Trans. Antennas Propagat., vol. 53, No. 1, pp. 539-544, Jan. 2005.

* cited by examiner

Primary Examiner — Douglas W Owens

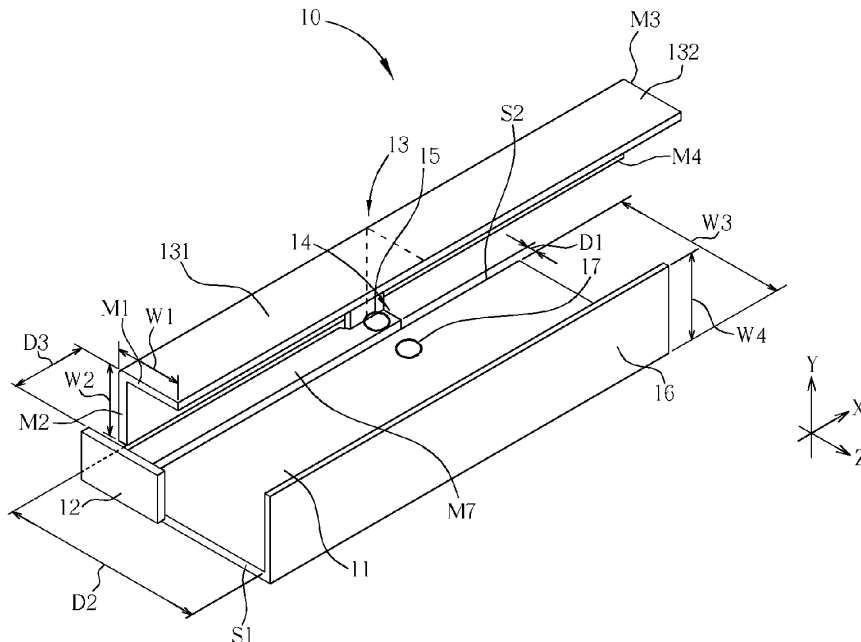
Assistant Examiner — Jae K Kim

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

(57) **ABSTRACT**

A three-dimensional multi-frequency antenna includes a substrate; a shorting wall vertically formed on a first edge of the substrate; a radiation element including a first radiator corresponding to a first resonance frequency band, and a second radiator corresponding to a second resonance frequency band, the first radiator and the second radiator capable of generating a frequency-multiplying third resonance frequency extending toward opposite directions; and a connection element, for connecting the shorting wall and the radiation element, separated from a second edge of the substrate by a gap; wherein the width of the radiation element and the gap conforms to a specific ratio.

20 Claims, 12 Drawing Sheets





US007920097B2

(12) **United States Patent**
Quintero Illera et al.

(10) **Patent No.:** **US 7,920,097 B2**
(45) **Date of Patent:** **Apr. 5, 2011**

- (54) **MULTIBAND ANTENNA**
- (75) Inventors: **Ramiro Quintero Illera**, Barcelona (ES); **Carles Puente Baliarda**, Barcelona (ES)
- (73) Assignee: **Fractus, S.A.**, Barcelona (ES)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 95 days.
- (21) Appl. No.: **12/229,483**
- (22) Filed: **Aug. 22, 2008**
- (65) **Prior Publication Data**
US 2009/0066582 A1 Mar. 12, 2009

Related U.S. Application Data

- (63) Continuation of application No. 11/702,791, filed on Feb. 6, 2007, now Pat. No. 7,439,923, which is a continuation of application No. 10/823,257, filed on Apr. 13, 2004, now Pat. No. 7,215,287, which is a continuation of application No. PCT/EP01/11912, filed on Oct. 16, 2001.

- (51) **Int. Cl.**
H01Q 1/24 (2006.01)
- (52) **U.S. Cl.** **343/702**; 343/700 MS; 343/895
- (58) **Field of Classification Search** 343/700 MS, 343/702, 800, 846, 895
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

- 3,521,284 A 7/1970 Shelton, Jr. et al.
- 3,599,214 A 8/1971 Altmayer
- 3,622,890 A 11/1971 Fujimoto et al.
- 3,683,376 A 8/1972 Pronovost

- 3,818,490 A 6/1974 Leahy
- 3,967,276 A 6/1976 Goubau
- 3,969,730 A 7/1976 Fuchser
- 4,024,542 A 5/1977 Ikawa et al.
- 4,131,893 A 12/1978 Munson et al.
- 4,141,016 A 2/1979 Nelson
- 4,471,358 A 9/1984 Glasser
- 4,471,493 A 9/1984 Schober
- 4,504,834 A 3/1985 Garay et al.
- 4,543,581 A 9/1985 Nemet
- 4,571,595 A 2/1986 Phillips et al.
- 4,584,709 A 4/1986 Kneisel et al.
- 4,590,614 A 5/1986 Erat
- 4,623,894 A 11/1986 Lee et al.
- 4,673,948 A 6/1987 Kuo
- 4,730,195 A 3/1988 Phillips et al.
- 4,839,660 A 6/1989 Hadzoglou
- 4,843,468 A 6/1989 Drewery
- 4,847,629 A 7/1989 Shimazaki

(Continued)

FOREIGN PATENT DOCUMENTS

- CA 2416437 A1 1/2002
(Continued)

OTHER PUBLICATIONS

Jani Ollikaninen et al., "Internal Dual-Band Patch Antenna for Mobile Phones", European Space Agency, Millennium Conference on Antennas & Propagation, Apr. 9-14, 2000.

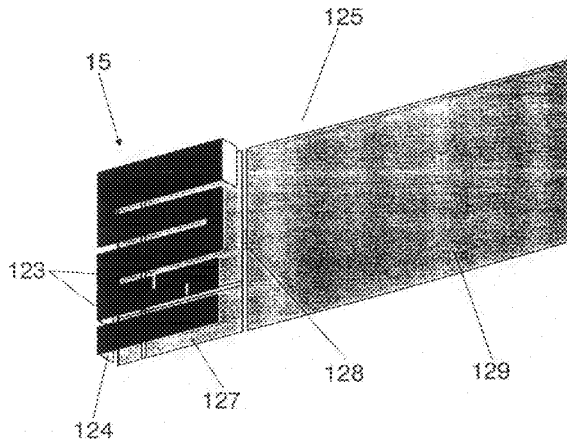
(Continued)

Primary Examiner — Tho G Phan
(74) *Attorney, Agent, or Firm* — Winstead PC

(57) **ABSTRACT**

A multiband antenna includes at least two polygons. The at least two polygons are spaced by means of a non-straight gap shaped as a space-filling curve, in such a way that the whole gap length is increased yet keeping its size and the same overall antenna size allowing for an effective tuning of frequency bands of the antenna.

50 Claims, 7 Drawing Sheets





US007924226B2

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

(10) **Patent No.:** **US 7,924,226 B2**
(45) **Date of Patent:** **Apr. 12, 2011**

(54) **TUNABLE ANTENNA**

(75) Inventors: **Jordi Soler Castany**, Mataró (ES);
Carles Puente Baliarda, Barcelona
(ES); **José Mumbro Forn**, Barcelona
(ES)

(73) Assignee: **Fractus, S.A.**, Barcelona (ES)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 871 days.

(21) Appl. No.: **11/576,015**

(22) PCT Filed: **Sep. 1, 2005**

(86) PCT No.: **PCT/EP2005/054297**
§ 371 (c)(1),
(2), (4) Date: **Mar. 26, 2007**

(87) PCT Pub. No.: **WO2006/034940**
PCT Pub. Date: **Apr. 6, 2006**

(65) **Prior Publication Data**
US 2008/0062049 A1 Mar. 13, 2008

Related U.S. Application Data

(60) Provisional application No. 60/613,394, filed on Sep. 27, 2004, provisional application No. 60/640,380, filed on Dec. 30, 2004.

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

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

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

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,680,135 A 7/1972 Boyer
3,713,162 A 1/1973 Munson et al.
4,243,990 A 1/1981 Nemit
4,381,566 A 4/1983 Kane
4,626,862 A 12/1986 Ma
4,843,468 A 6/1989 Drewery
5,363,114 A 11/1994 Shoemaker

(Continued)

FOREIGN PATENT DOCUMENTS

EP 0 655 797 A1 5/1995

(Continued)

OTHER PUBLICATIONS

Anagnostou, D., Smart reconfigurable antennas for satellite applications, IEEE: Core Technologies for space system configurations, Nov. 2001.

(Continued)

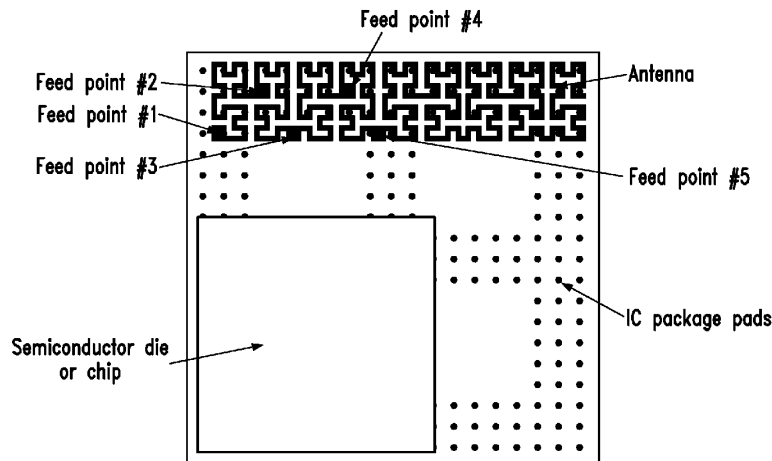
Primary Examiner — Tan Ho

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

(57) **ABSTRACT**

The invention refers to an antenna comprising: a conducting trace (15, 20), said conducting trace (15, 20) defining a curve (1, 4, 5, 6, 6', 6'', 8), said curve (1, 4, 5, 6, 6', 6'', 8) including two or more feeding points (16a, 16b, 16c, 17, 18, 19), a portion of said curve (1, 4, 5, 6, 6', 6'', 8) being shaped according a geometry selected from a group of geometries including a space-filling curve, a grid-dimension curve, a box-counting curve and a contour curve or the curve (1, 4, 5, 6, 6', 6'', 8) or a portion of said curve having a shape of a multilevel structure. Further the invention refers to a related SMD component, an IC-package, a wireless device and a method for contacting an antenna.

104 Claims, 31 Drawing Sheets





US007924229B2

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

(10) **Patent No.:** **US 7,924,229 B2**
(45) **Date of Patent:** **Apr. 12, 2011**

(54) **ANTENNA APPARATUS AND METHOD FOR ADJUSTING CHARACTERISTICS THEREOF**

(75) Inventors: **Tetsuya Shibata**, Tokyo (JP); **Yasumasa Harihara**, Tokyo (JP); **Hideaki Shimoda**, Tokyo (JP)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 379 days.

(21) Appl. No.: **12/236,619**

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

(65) **Prior Publication Data**

US 2009/0079651 A1 Mar. 26, 2009

(30) **Foreign Application Priority Data**

Sep. 26, 2007 (JP) 2007-249846

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

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

(58) **Field of Classification Search** **343/700 MS, 343/702, 860**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,034,752	B2 *	4/2006	Sekiguchi et al.	343/700 MS
7,319,431	B2 *	1/2008	Jeon et al.	343/700 MS
2002/0190907	A1 *	12/2002	Konishi et al.	343/702
2004/0113846	A1 *	6/2004	Achim	343/700 MS

FOREIGN PATENT DOCUMENTS

JP	10-256825	9/1998
JP	2007-067993	3/2007

* cited by examiner

Primary Examiner — Douglas W Owens

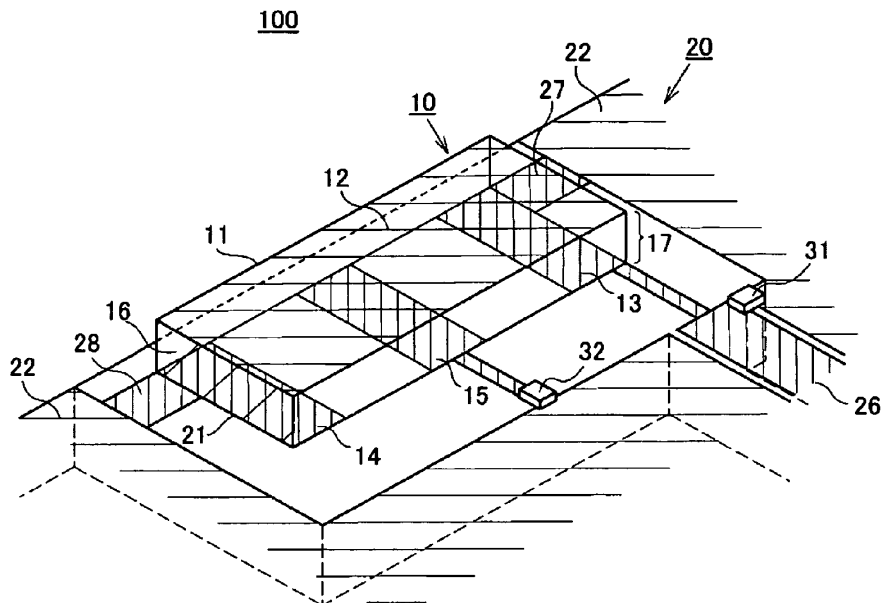
Assistant Examiner — Dieu Hien T Duong

(74) *Attorney, Agent, or Firm* — Young Law Firm, P.C.

(57) **ABSTRACT**

An antenna apparatus includes an antenna block and a substrate. The antenna block has a base that is made of a substantially cuboid dielectric body, an upper-surface conductor formed on an upper surface of the base, first and second pad electrodes that are formed on both ends of a bottom surface of the base in a longitudinal direction of the base, respectively, and a lateral-surface conductor connecting the upper-surface conductor and the second pad electrode. The substrate has a region mounting the antenna block, a ground pattern provided around the mounting region, first and second lands that are provided within the mounting region so as to correspond to the positions of the first and second pad electrodes, a feed line that is connected to the first land, an impedance-adjusting pattern connecting the first land and the ground pattern, and a frequency-adjusting pattern connecting the second land and the ground pattern.

12 Claims, 11 Drawing Sheets





US007924230B2

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

(10) **Patent No.:** **US 7,924,230 B2**
(45) **Date of Patent:** **Apr. 12, 2011**

(54) **MULTI-FREQUENCY ANTENNA SUITABLY WORKING IN DIFFERENT WIRELESS NETWORKS**

(75) Inventors: **Chen-Ta Hung**, Tu-Cheng (TW);
Hsien-Sheng Tseng, Tu-Cheng (TW);
Lung-Sheng Tai, Tu-Cheng (TW);
Shu-Yean Wang, Tu-Cheng (TW)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 174 days.

(21) Appl. No.: **12/378,644**

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

(65) **Prior Publication Data**

US 2009/0153430 A1 Jun. 18, 2009

Related U.S. Application Data

(63) Continuation of application No. 11/906,691, filed on Oct. 2, 2007, now Pat. No. 7,498,992, which is a continuation of application No. 11/201,463, filed on Aug. 11, 2005, now Pat. No. 7,289,071.

(30) **Foreign Application Priority Data**

May 23, 2005 (TW) 94116677 A

(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** 343/700 MS, 343/702, 846
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,456,243	B1	9/2002	Poilasne et al.	
6,507,322	B2	1/2003	Fang et al.	
6,639,560	B1	10/2003	Kadambi et al.	
6,714,162	B1	3/2004	Kadambi et al.	
6,717,551	B1	4/2004	Desclos et al.	
6,906,667	B1	6/2005	Poilasne et al.	
6,919,857	B2	7/2005	Shamblin et al.	
6,950,069	B2	9/2005	Gaucher et al.	
6,992,627	B1	1/2006	Honda et al.	
7,161,543	B2	1/2007	Cheng et al.	
7,170,452	B2 *	1/2007	Yang	343/702
7,230,571	B2 *	6/2007	Gaucher et al.	343/700 MS
2004/0090378	A1 *	5/2004	Dai et al.	343/700 MS
2004/0174305	A1	9/2004	Kuo et al.	
2005/0093752	A1	5/2005	Cheng et al.	

* cited by examiner

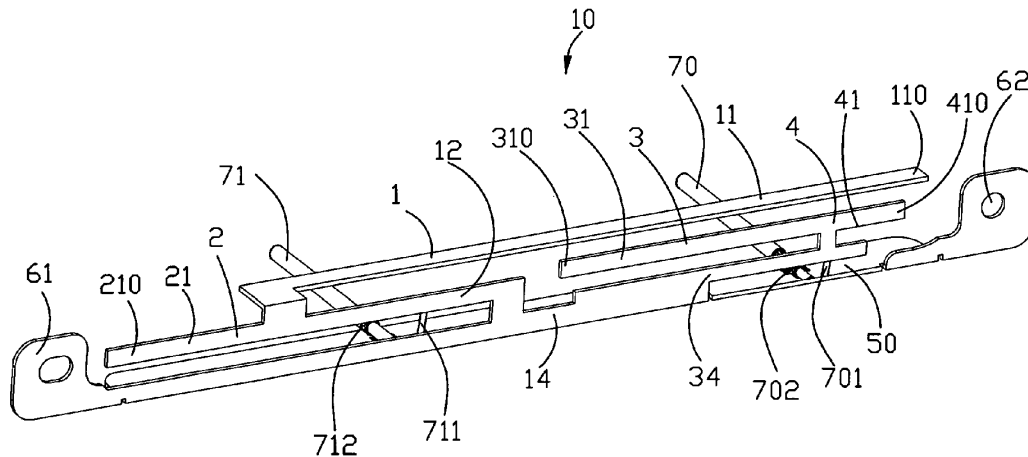
Primary Examiner — Hoang V Nguyen

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

(57) **ABSTRACT**

A multi-frequency antenna includes a first antenna (1) and a second antenna (2) both operating at wireless wide area network, a third antenna (3) and a fourth antenna (4) both operating at wireless local area network. The first antenna, the second antenna, the third antenna and the fourth antenna are integrally made from a metal sheet and have a common grounding portion (50). The first and the second antennas have a first connecting portion (12) on which a feeding point (120) is located, and the third and the fourth antenna have a second connecting portion (34) on which another feeding point (340) is located.

20 Claims, 5 Drawing Sheets





US007924231B2

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

(10) **Patent No.:** **US 7,924,231 B2**
(45) **Date of Patent:** **Apr. 12, 2011**

(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.: **12/941,006**

(22) Filed: **Nov. 5, 2010**

(65) **Prior Publication Data**
US 2011/0050513 A1 Mar. 3, 2011

Related U.S. Application Data
(63) Continuation of application No. 12/564,803, filed on Sep. 22, 2009, now Pat. No. 7,843,396, which is a 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** 343/700 MS, 343/702, 767, 846
See application file for complete search history.

(56) **References Cited**
U.S. PATENT DOCUMENTS
2,942,263 A 6/1960 Baldwin
3,394,373 A 7/1968 Makraney
3,969,730 A * 7/1976 Fuchser 343/770

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	Ljimatainen	
5,048,118 A	9/1991	Brooks	
5,061,943 A	10/1991	Rammos	
5,408,241 A	4/1995	Shattuck	
5,561,437 A	10/1996	Phillips	
5,565,877 A *	10/1996	Du et al.	343/715
5,684,672 A	11/1997	Karidis et al.	

(Continued)

FOREIGN PATENT DOCUMENTS

EP 1 286 413 2/2003

(Continued)

OTHER PUBLICATIONS

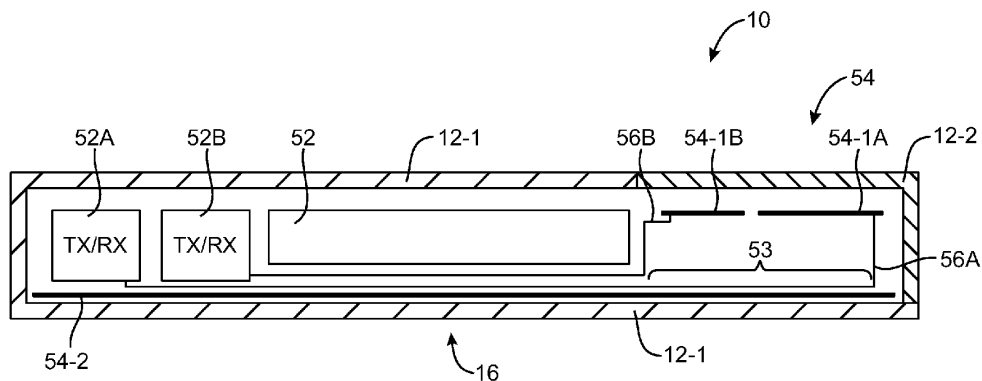
Hobson et al. U.S. Appl. No. 60/833,587, filed Jan. 5, 2007.

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

(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.

15 Claims, 20 Drawing Sheets





US007924233B2

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

(10) **Patent No.:** **US 7,924,233 B2**
(45) **Date of Patent:** **Apr. 12, 2011**

(54) **THREE-DIMENSIONAL ANTENNA AND RELATED WIRELESS COMMUNICATION DEVICE**

(58) **Field of Classification Search** 343/736,
343/700 MS, 702
See application file for complete search history.

(75) Inventors: **Chih-Ming Wang**, Taipei Hsien (TW);
Feng-Chi Eddie Tsai, Taipei Hsien (TW);
Yi-Chih Wang, Taipei Hsien (TW)

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,531,432 A *	11/1950	Himmel	.....	343/736
3,725,936 A *	4/1973	Sherman	.....	342/432
4,511,898 A	4/1985	Bush		
5,200,756 A	4/1993	Feller		
6,650,302 B2	11/2003	Sanad		

(73) Assignee: **Wistron NeWeb Corporation**,
Hsi-Chih, 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 369 days.

* cited by examiner

Primary Examiner — Hoang V Nguyen

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

(21) Appl. No.: **12/332,348**

(57) **ABSTRACT**

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

A three-dimensional antenna includes a substrate, a radiator, a second radiator, a signal feeding element, and a grounding element. The radiator is installed on the substrate. The radiator includes a first child radiator and a second child radiator. The first child radiator has a first end and a second end. The second child radiator has a first end and a second end, wherein the second end of the second child radiator is coupled to the second end of the first child radiator. The second radiator is coupled to the radiator. The signal feeding element is coupled to the first end of the first child radiator. The grounding element is coupled between the substrate and the first end of the second child radiator. The first child radiator and the second child radiator form an inverted V-shape installed on the substrate.

(65) **Prior Publication Data**

US 2009/0102729 A1 Apr. 23, 2009

Related U.S. Application Data

(63) Continuation-in-part of application No. 11/737,146, filed on Apr. 19, 2007, now Pat. No. 7,482,980.

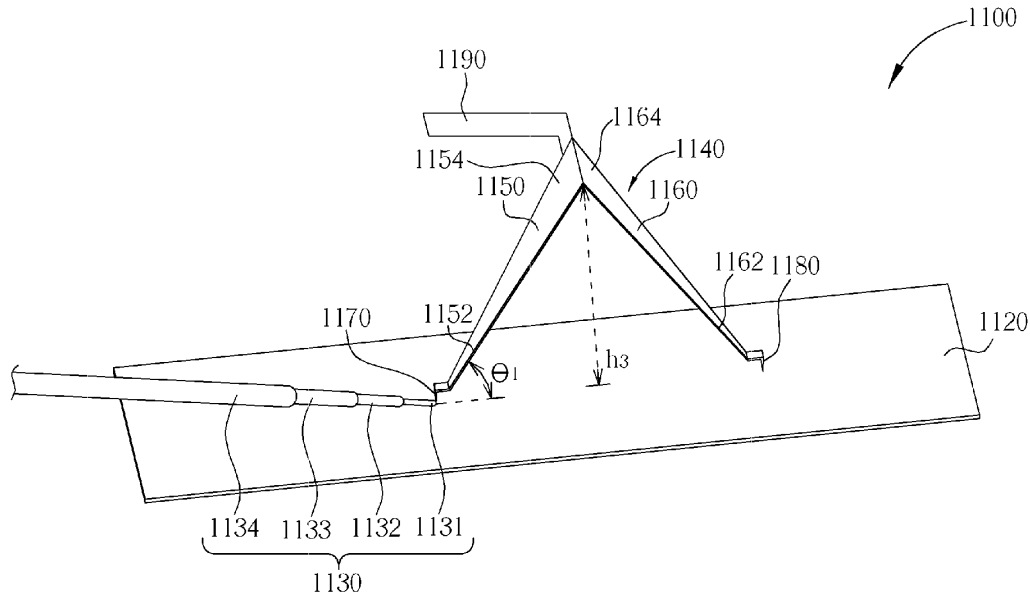
(30) **Foreign Application Priority Data**

Dec. 22, 2006 (TW) 95148343 A

(51) **Int. Cl.**
H01Q 11/06 (2006.01)

22 Claims, 46 Drawing Sheets

(52) **U.S. Cl.** **343/736; 343/700 MS; 343/702**





US007928911B2

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

(10) **Patent No.:** **US 7,928,911 B2**
(45) **Date of Patent:** **Apr. 19, 2011**

(54) **DIGITAL TELEVISION (DTV) ANTENNA APPARATUS**

(75) Inventors: **Yen-Yu Chen**, Chung Ho (TW);
Kuo-Ying Su, Chung Ho (TW);
Yung-Da Lin, Chung Ho (TW)

(73) Assignee: **Avermedia Technologies, Inc.**, Chung Ho, 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 380 days.

(21) Appl. No.: **12/146,886**

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

(65) **Prior Publication Data**

US 2009/0256753 A1 Oct. 15, 2009

(30) **Foreign Application Priority Data**

Apr. 15, 2008 (TW) 97113633 A

(51) **Int. Cl.**
H01Q 9/04 (2006.01)

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

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

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,749,996 A * 6/1988 Tresselt 343/700 MS
2006/0267834 A1 * 11/2006 Qi et al. 342/357.1

FOREIGN PATENT DOCUMENTS

JP H09-260934 * 3/1997
WO 01/63690 * 8/2001

* cited by examiner

Primary Examiner — Jacob Y Choi

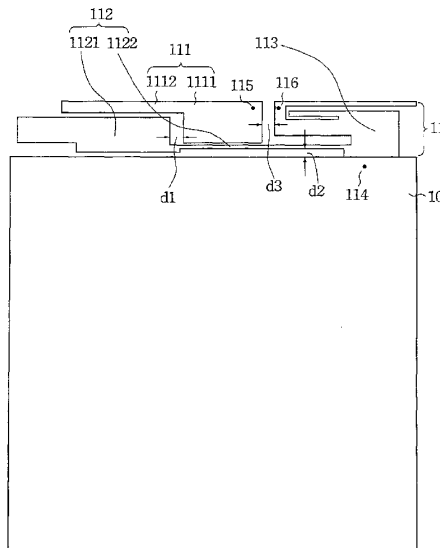
Assistant Examiner — Darleen J Stockley

(74) *Attorney, Agent, or Firm* — Thomas, Kayden, Horstemeyer & Risley, LLP

(57) **ABSTRACT**

The present invention discloses a DTV antenna apparatus build in a portable device. The portable device includes a system ground. The DTV antenna includes a ground plane with a short circuit point, an extending metal arm with a grounding point and a radiation element. The ground plane is the system ground. The radiation element and the ground plane are arranged in parallel to each other. The extending metal arm connects with the short circuit point. The antenna receives signals with frequencies in the range from 470 MHz to 870 MHz. The radiation element includes a radiation arm and a parasitic arm. The radiation arm has a feeding terminal. The parasitic arm connects with the short circuit point.

16 Claims, 4 Drawing Sheets





US007928912B2

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

(10) **Patent No.:** **US 7,928,912 B2**
(45) **Date of Patent:** **Apr. 19, 2011**

(54) **MULTIBAND ANTENNA**

(75) Inventors: **Wen-Hua Chen**, Beijing (CN); **Xin Wang**, Beijing (CN); **Zheng-He Feng**, Beijing (CN)

(73) Assignees: **Tsinghua University**, Beijing (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 381 days.

(21) Appl. No.: **12/171,428**

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

(65) **Prior Publication Data**
US 2009/0015487 A1 Jan. 15, 2009

(30) **Foreign Application Priority Data**
Jul. 13, 2007 (CN) 2007 1 0076042

(51) **Int. Cl.**
H01Q 9/04 (2006.01)
(52) **U.S. Cl.** **343/700 MS**; 343/702; 343/826; 343/828; 343/846
(58) **Field of Classification Search** 343/700 MS, 343/702, 826, 828, 829, 830, 833, 834, 846
See application file for complete search history.

(56) **References Cited**

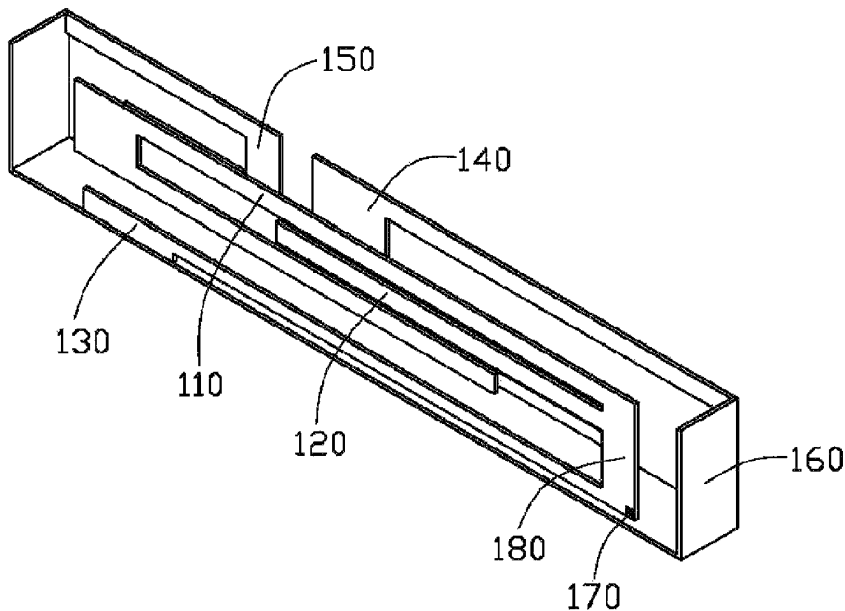
U.S. PATENT DOCUMENTS
6,697,023 B1 * 2/2004 Tiao-Hsing et al. 343/702
* cited by examiner

Primary Examiner — Jacob Y Choi
Assistant Examiner — Darleen J Stockley
(74) *Attorney, Agent, or Firm* — D. Austin Bonderer

(57) **ABSTRACT**

A multiband antenna includes a long radiating branch, a short radiating branch, a short strip, a feed point, a grounding portion, a connecting portion, a long parasitic strip, and a short parasitic strip. The feed point, the long radiating branch, the short radiating branch, and the short strip are in a first plane. The grounding portion connects to the short strip. The connecting portion connects the long radiating branch, the short radiating branch, and the short strip. The long radiating branch, the short strip, and the connecting portion form a first inverted-L shaped antenna structure. The short radiating branch, the short strip, and the connecting portion form a second inverted-L shaped antenna structure. The long parasitic strip and the short parasitic strip are in a second plane and respectively connected to the grounding portion. The first plane is parallel to the second plane.

7 Claims, 6 Drawing Sheets





US007928913B2

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

(10) **Patent No.:** **US 7,928,913 B2**
(45) **Date of Patent:** **Apr. 19, 2011**

(54) **METHOD AND APPARATUS FOR A TUNABLE CHANNELIZING PATCH ANTENNA**

(75) Inventors: **Noriaki Kaneda**, Westfield, NJ (US);
Carsten Metz, München (DE)

(73) Assignee: **Alcatel-Lucent USA Inc.**, Murray Hill, NJ (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 163 days.

(21) Appl. No.: **12/194,565**

(22) Filed: **Aug. 20, 2008**

(65) **Prior Publication Data**
US 2010/0045550 A1 Feb. 25, 2010

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

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

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

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,475,108	A *	10/1984	Moser	.....	343/700 MS
4,529,987	A *	7/1985	Bhartia et al.	.....	343/700 MS
4,777,490	A *	10/1988	Sharma et al.	.....	343/754
4,780,724	A *	10/1988	Sharma et al.	.....	343/700 MS
4,827,266	A *	5/1989	Sato et al.	.....	343/700 MS
6,005,519	A *	12/1999	Burns	.....	343/700 MS
6,501,427	B1 *	12/2002	Lilly et al.	.....	343/700 MS
6,677,901	B1 *	1/2004	Nalbandian	.....	343/700 MS

* cited by examiner

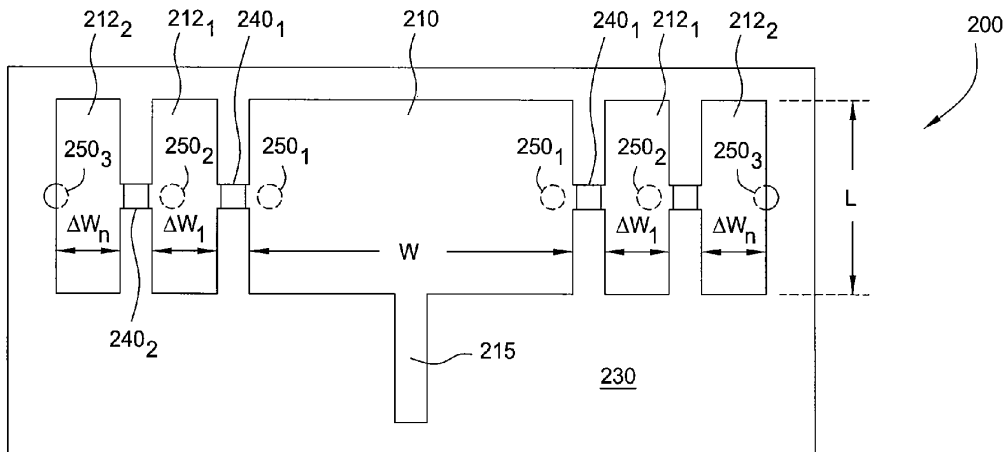
Primary Examiner — HoangAnh T Le

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

(57) **ABSTRACT**

A method and apparatus providing a tunable channelized patch antenna by selectively adjoining one or more radiating element extensions successively to a radiating element of the patch antenna, and adjusting fringe capacitance at active outer edges of the patch antenna.

22 Claims, 7 Drawing Sheets





US007928914B2

(12) **United States Patent**
Bit-Babik et al.

(10) **Patent No.:** **US 7,928,914 B2**
(45) **Date of Patent:** **Apr. 19, 2011**

(54) **MULTI-FREQUENCY CONDUCTIVE-STRIP ANTENNA SYSTEM**

(75) Inventors: **Giorgi G. Bit-Babik**, Sunrise, FL (US);
Carlo Di Nallo, Plantation, FL (US);
Antonio Faraone, Plantation, FL (US)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1432 days.

(21) Appl. No.: **10/945,234**

(22) Filed: **Sep. 20, 2004**

(65) **Prior Publication Data**
US 2005/0280586 A1 Dec. 22, 2005

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

(56) **References Cited**

U.S. PATENT DOCUMENTS

- 5,767,810 A 6/1998 Hagiwara et al.
- 6,307,512 B1 10/2001 Geeraert
- 6,504,507 B2 1/2003 Geeraert
- 6,664,931 B1 12/2003 Nguyen et al.
- 6,819,287 B2* 11/2004 Sullivan et al. 343/700 MS
- 6,822,611 B1* 11/2004 Kontogeorgakis et al. ... 343/702
- 6,903,686 B2* 6/2005 Vance et al. 343/700 MS
- 2001/0043159 A1 11/2001 Masuda et al.

- 2001/0054979 A1 12/2001 Bahr et al.
- 2002/0079743 A1 6/2002 Ma et al.
- 2002/0109635 A1 8/2002 Geeraert
- 2002/0149526 A1 10/2002 Tran et al.
- 2003/0142022 A1* 7/2003 Ollikainen et al. 343/702
- 2004/0075611 A1* 4/2004 Kenoun et al. 343/702

FOREIGN PATENT DOCUMENTS

- GB 2284712 A 6/1995
- WO 02067375 A1 8/2002
- WO 03096474 A1 11/2003

OTHER PUBLICATIONS

Ollikainen, J.; Kivekas, O.; Vainikainen, P. "Low-Loss Tuning Circuits for Frequency-Tunable Small Resonant Antennas" Helsinki University of Technology IEEE 2002 PIMRC 2002.

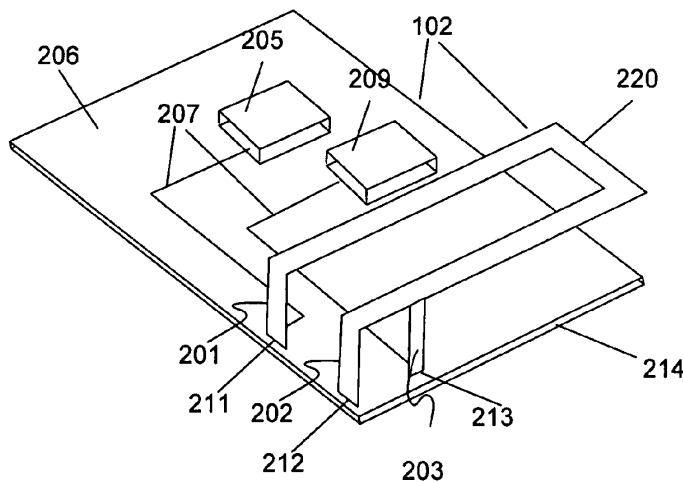
* cited by examiner

Primary Examiner — Hung T Vy
Assistant Examiner — Binh V Ho

(57) **ABSTRACT**

To address the above-mentioned need an antenna (100) is provided having a conductive-strip radiating element (102) supported above a substrate (206) via three legs (201-203). The point where the substrate contacts the three legs form two antenna ports and a ground utilized for feeding the RF signal, tuning the antenna, and grounding. More particularly, a first leg (201) of the radiating element is used solely as a tuning port, while a second leg (202) is grounded, and a third leg (203) is utilized solely as a feed port. The tuning port is substantially maximally distal to the feed port on the substrate. Reactive loads are provided at the tuning port to effectively tune the central operating frequency of the antenna.

19 Claims, 3 Drawing Sheets





US007928915B2

(12) **United States Patent**
Sanz Arronte et al.

(10) **Patent No.:** **US 7,928,915 B2**
(45) **Date of Patent:** **Apr. 19, 2011**

(54) **MULTILEVEL GROUND-PLANE FOR A MOBILE DEVICE**

(75) Inventors: **Alfonso Sanz Arronte**, Barcelona (ES);
David Gala Gala, Barcelona (ES);
Antonio Condes Martinez, Barcelona (ES); **Carles Puente Baliarda**, Barcelona (ES)

(73) Assignee: **Fractus, S.A.**, Barcelona (ES)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 867 days.

(21) Appl. No.: **11/662,044**

(22) PCT Filed: **Sep. 20, 2005**

(86) PCT No.: **PCT/EP2005/010131**

§ 371 (c)(1), (2), (4) Date: **Sep. 11, 2007**

(87) PCT Pub. No.: **WO2006/032455**

PCT Pub. Date: **Mar. 30, 2006**

(65) **Prior Publication Data**

US 2008/0074332 A1 Mar. 27, 2008

Related U.S. Application Data

(60) Provisional application No. 60/611,889, filed on Sep. 21, 2004.

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

(52) **U.S. Cl.** **343/702; 343/700 MS; 343/846; 343/849**

(58) **Field of Classification Search** **343/700 MS, 343/702, 846, 849**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,696,438 A	10/1972	Ingerson
5,262,792 A	11/1993	Egashira
5,495,261 A	2/1996	Baker et al.
5,497,167 A	3/1996	Luoma
5,646,637 A	7/1997	Miller
5,703,600 A	12/1997	Burrell et al.
5,903,822 A	5/1999	Sekine et al.
6,002,367 A	12/1999	Engblom et al.
6,140,966 A	10/2000	Pankinaho
6,140,975 A	10/2000	Cohen

(Continued)

FOREIGN PATENT DOCUMENTS

CA 2416437 A1 7/2001

(Continued)

OTHER PUBLICATIONS

Puente Baliarda, C. Fractal antennas. Tesi Doctoral, PhD thesis, Universitat Politecnica de Catalunya, May 1997.

(Continued)

Primary Examiner — Douglas W Owens

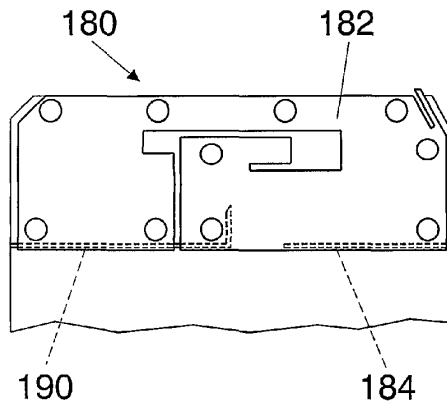
Assistant Examiner — Dieu Hien T Duong

(74) *Attorney, Agent, or Firm* — Winstead PC

(57) **ABSTRACT**

In accordance with the teachings described herein, a multilevel ground-plane for a mobile device is provided. The multilevel ground-plane includes a first conductive surface, a second conductive surface, and a conducting strip that couples the first conducting surface to the second conducting surface. A mobile device having a multilevel ground-plane may include a printed circuit board, an antenna radiating element attached to a surface of the printed circuit board, and the multilevel ground plane integral with the printed circuit board and electromagnetically coupled to the antenna radiating element.

33 Claims, 23 Drawing Sheets





US007928916B2

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

(10) **Patent No.:** **US 7,928,916 B2**
(45) **Date of Patent:** **Apr. 19, 2011**

(54) **MULTI-BAND ANTENNA**

(75) Inventors: **Chen-Ta Hung**, Tu-cheng (TW);
Shang-Jen Chen, Tu-cheng (TW);
Chun-Ming Chiu, Tu-cheng (TW)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 350 days.

(21) Appl. No.: **12/290,078**

(22) Filed: **Oct. 27, 2008**

(65) **Prior Publication Data**
US 2009/0109098 A1 Apr. 30, 2009

(30) **Foreign Application Priority Data**
Oct. 26, 2007 (TW) 96140331 A

(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

7,289,071	B2 *	10/2007	Hung et al.	343/702
7,525,490	B2 *	4/2009	Hung et al.	343/702
7,642,967	B2 *	1/2010	Wang et al.	343/702
2007/0040754	A1	2/2007	Liu et al.	
2007/0060222	A1	3/2007	Finn et al.	
2007/0096999	A1	5/2007	Wang et al.	

* cited by examiner

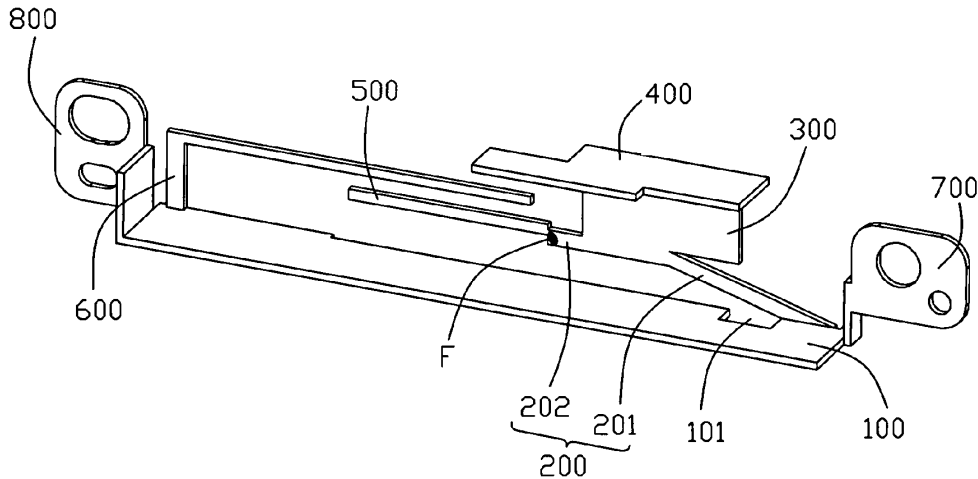
Primary Examiner — Hoang V Nguyen

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

(57) **ABSTRACT**

A multi-band antenna includes a grounding element, a connecting element extending from one end of the grounding element, a first conductive portion extending from the connecting element, a second conductive portion extending from the first conductive portion and narrower than the first conductive portion, a first coupling portion extending from the connecting element in a first direction, a second coupling portion extending from the other end of the grounding element and opposite to the connecting element. The second coupling portion extending in a second direction opposite to the first direction and overlap the first coupling portion.

17 Claims, 3 Drawing Sheets





US007928919B2

(12) **United States Patent**
Margomenos

(10) **Patent No.:** **US 7,928,919 B2**
(45) **Date of Patent:** **Apr. 19, 2011**

(54) **MICROWAVE ANTENNA AND METHOD FOR MAKING SAME**

(56) **References Cited**

(75) Inventor: **Alexandros Margomenos**, Pasadena, CA (US)

U.S. PATENT DOCUMENTS

2,643,336	A *	6/1953	Valensi	.....	343/911 R
3,395,059	A *	7/1968	Butler et al.	.....	156/78
3,633,206	A *	1/1972	McMillan	.....	343/754
4,931,808	A *	6/1990	Lalezari et al.	.....	343/753
6,195,061	B1 *	2/2001	Hizal et al.	.....	343/786
6,198,456	B1 *	3/2001	Le Halle et al.	.....	343/786

(73) Assignee: **Toyota Motor Engineering & Manufacturing North America, Inc.**, Erlanger, KY (US)

* 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 0 days.

Primary Examiner — Tho G Phan

(74) *Attorney, Agent, or Firm* — Gifford, Krass, Sprinkle, Anderson & Citkowski, P.C.

(21) Appl. No.: **12/888,473**

(57) **ABSTRACT**

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

A method for fabricating a microwave horn antenna in which a thermoplastic sacrificial layer is mounted to a thermoplastic horn layer. A heated horn embossing plate having at least one horn shaped embossing element is then moved into the horn layer so that the horn element penetrates through the horn layer and extends partially into the sacrificial layer thus forming a horn opening in the horn layer complementary in shape to the horn element. The horn layer and sacrificial layer are then separated from each other and the horn opening and at least a portion of the back surface of the horn layer is covered with a metal coating. A thermoplastic wave guide layer formed by embossing wave guide channels into the layer is covered with metal and attached to the back side of the horn layer to form the antenna. Alternatively, a portion of the horn and the remaining portion of a microwave channel are formed in both a first and second thermoplastic section. These portions of the microwave guide channel and horn are then coated with a metal material and the sections are secured together in a facing relationship so that the horn portions and wave guide channel portions on both the first and second sections register with each other.

(65) **Prior Publication Data**

US 2011/0010926 A1 Jan. 20, 2011

Related U.S. Application Data

(62) Division of application No. 12/098,663, filed on Apr. 7, 2008, now Pat. No. 7,817,097.

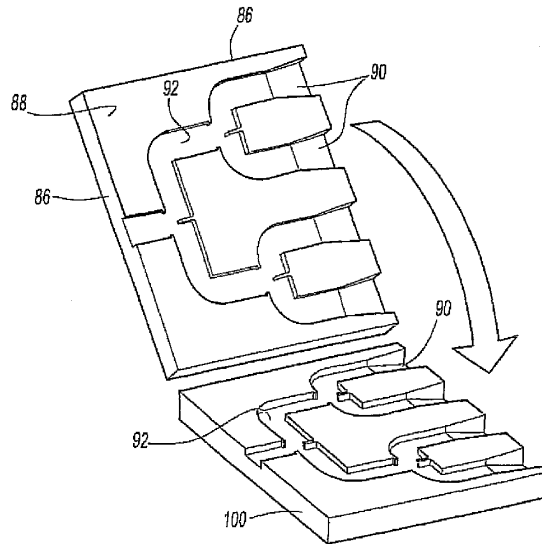
(51) **Int. Cl.**
H01Q 13/00 (2006.01)

(52) **U.S. Cl.** **343/786; 343/772**

(58) **Field of Classification Search** 343/771, 343/772, 786

See application file for complete search history.

6 Claims, 2 Drawing Sheets





US007928920B2

(12) **United States Patent**
Yagi

(10) **Patent No.:** **US 7,928,920 B2**
(45) **Date of Patent:** **Apr. 19, 2011**

(54) **FILM ANTENNA AND ELECTRONIC EQUIPMENT**

7,176,843 B2 2/2007 Shimasaki et al.
7,248,224 B2 7/2007 Yuanzhu
7,265,720 B1 9/2007 Ponce De Leon et al.
7,372,406 B2 5/2008 Shiotsu et al.

(Continued)

(75) Inventor: **Shigeru Yagi**, Tokyo (JP)

(73) Assignee: **Casio Computer 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 391 days.

FOREIGN PATENT DOCUMENTS
DE 101 47 921 A1 4/2003
(Continued)

(21) Appl. No.: **12/117,042**

(22) Filed: **May 8, 2008**

(65) **Prior Publication Data**

US 2008/0284662 A1 Nov. 20, 2008

OTHER PUBLICATIONS

U.S. Appl. No. 12/011,952; First Named Inventor: Shigeru Yagi; Title: "Plane Circular Polarization Antenna and Electronic Apparatus"; Filed: Jan. 30, 2008, published as US 2008/0180339, and issued as USP 7,777,682.

(Continued)

(30) **Foreign Application Priority Data**

May 17, 2007 (JP) 2007-131729

Primary Examiner — Douglas W Owens

Assistant Examiner — Dieu Hien T Duong

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

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

(52) **U.S. Cl.** 343/793; 343/702; 343/873; 343/820

(58) **Field of Classification Search** 343/793, 343/795, 702, 700 MS, 872, 873, 820
See application file for complete search history.

(57) **ABSTRACT**

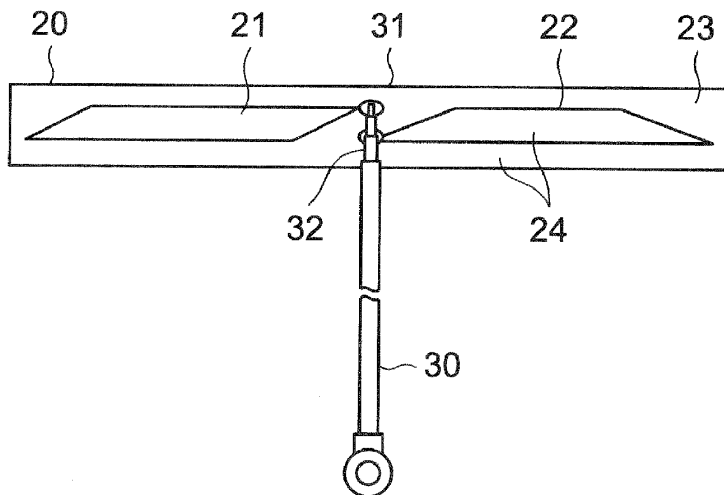
A film antenna comprises a base film formed of an insulating material; and first and second antenna elements of film-like electric conductors formed on the base film, wherein each of the first and second antenna elements is a planar shape in which two end faces from a feed point to a tip have two different lengths or a planar shape in which an end face and a diagonal line from a feed point to a tip have two different lengths, a core wire of a coaxial cable is connected to the first antenna element at the feed point, an external conductor of the coaxial cable is connected to the second antenna element at the feed point, and the first and second antenna elements have an area as a capacitor for performing impedance matching.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,926,150 A 7/1999 McLean et al.
6,421,014 B1 7/2002 Sanad
6,529,170 B1 3/2003 Nishizawa et al.
6,600,448 B2 7/2003 Ikegaya et al.
6,621,464 B1 9/2003 Fang et al.
6,847,328 B1 1/2005 Libonati et al.
6,853,336 B2* 2/2005 Asano et al. 343/702
6,870,504 B2 3/2005 Ikegaya et al.
6,917,333 B2 7/2005 Ikegaya et al.

14 Claims, 6 Drawing Sheets





US007929311B1

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

(10) **Patent No.:** **US 7,929,311 B1**
(45) **Date of Patent:** **Apr. 19, 2011**

(54) **PORTABLE ELECTRONIC DEVICE**
(75) Inventors: **Yen-Jung Tseng**, Tu-Cheng (TW);
Cho-Kang Hsu, Tu-Cheng (TW)
(73) Assignee: **Chi Mei Communication 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 0 days.

(21) Appl. No.: **12/814,558**
(22) Filed: **Jun. 14, 2010**

(30) **Foreign Application Priority Data**
Sep. 30, 2009 (CN) 2009 1 0308055

(51) **Int. Cl.**
H05K 1/14 (2006.01)
(52) **U.S. Cl.** **361/737**; 361/732; 361/769; 361/785;
439/64; 439/153; 439/159; 439/267; 439/329;
439/374; 439/626; 439/630; 343/702; 343/841;
343/860; 343/873

(58) **Field of Classification Search** 361/737,
361/732, 769, 785; 439/64, 153, 159, 267,
439/329, 374, 626, 630; 343/702, 841, 860,
343/873
See application file for complete search history.

(56) **References Cited**
U.S. PATENT DOCUMENTS
4,887,188 A * 12/1989 Yoshida et al. 361/679.31
4,920,353 A * 4/1990 Mori et al. 343/702
4,958,165 A * 9/1990 Axford et al. 343/770
5,223,801 A * 6/1993 Bergman 331/76
5,401,176 A * 3/1995 Lwee 439/64
5,519,577 A * 5/1996 Dudas et al. 361/737
6,295,031 B1 * 9/2001 Wallace et al. 343/702

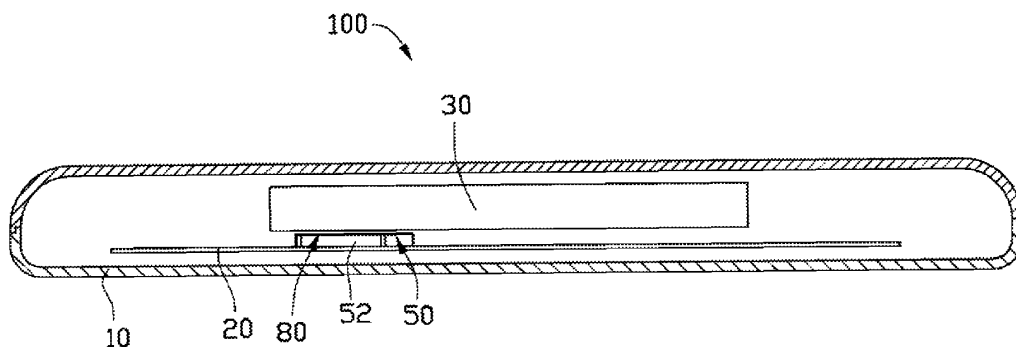
6,297,774	B1 *	10/2001	Chung	.....	343/700 R
7,208,916	B1 *	4/2007	Boatwright et al.	.....	320/150
7,255,603	B2 *	8/2007	Kato et al.	.....	439/630
7,261,240	B2 *	8/2007	Akiho et al.	.....	235/492
7,367,503	B2 *	5/2008	Harai et al.	.....	235/441
7,391,378	B2 *	6/2008	Mikkola et al.	.....	343/702
2001/0029588	A1 *	10/2001	Nakamura et al.	.....	713/300
2003/0216082	A1 *	11/2003	Sato et al.	.....	439/630
2004/0135733	A1 *	7/2004	Chou et al.	.....	343/841
2005/0037659	A1 *	2/2005	Wu	.....	439/374
2005/0054320	A1 *	3/2005	Noro et al.	.....	455/344
2005/0059299	A1 *	3/2005	Zhu et al.	.....	439/607
2005/0225950	A1 *	10/2005	Matsuda et al.	.....	361/737
2005/0247786	A1 *	11/2005	Chen	.....	235/441
2005/0272283	A1 *	12/2005	Chang	.....	439/92
2006/0040560	A1 *	2/2006	Uchida et al.	.....	439/630
2006/0139214	A1 *	6/2006	Deng et al.	.....	343/700 MS
2006/0172573	A1 *	8/2006	Laitinen et al.	.....	439/159
2006/0281500	A1 *	12/2006	Huang et al.	.....	455/575.1
2008/0007464	A1 *	1/2008	Hsu	.....	343/702
2008/0018541	A1 *	1/2008	Pang et al.	.....	343/702
2008/0062048	A1 *	3/2008	Hsu et al.	.....	343/702
2008/0143610	A1 *	6/2008	Wang et al.	.....	343/702
2008/0194288	A1 *	8/2008	Castaneda et al.	.....	455/553.1
2008/0252536	A1 *	10/2008	Anguera et al.	.....	343/702
2008/0305665	A1 *	12/2008	Hong et al.	.....	439/153
2008/0305669	A1 *	12/2008	Hong et al.	.....	439/329
2008/0305685	A1 *	12/2008	Hong et al.	.....	439/626
2009/0002242	A1 *	1/2009	Lasarov et al.	.....	343/702

(Continued)

Primary Examiner — Ishwarbhai B Patel
Assistant Examiner — Xiaoliang Chen
(74) *Attorney, Agent, or Firm* — Steven M. Reiss

(57) **ABSTRACT**
A portable electronic device includes a housing, a circuit board received in the housing, and a memory card retaining mechanism received in the housing. The memory card retaining mechanism includes a plurality of conductive parts. The plurality of conductive parts cooperatively form an antenna integrated with the memory card retaining mechanism and connected to the circuit board.

6 Claims, 7 Drawing Sheets





US007932861B2

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

(10) **Patent No.:** **US 7,932,861 B2**
(45) **Date of Patent:** **Apr. 26, 2011**

- (54) **COMPLEX ANTENNA**
- (75) Inventors: **Chen-Ta Hung**, Tu-cheng (TW);
Lung-Sheng Tai, Tu-cheng (TW);
Wen-Fong Su, Tu-cheng (TW)
- (73) Assignee: **Hon Hai Precision Ind. Co., Ltd.**, New Taipei (TW)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 423 days.

7,554,498	B1 *	6/2009	Lee et al.	343/702
7,633,448	B2 *	12/2009	Su et al.	343/702
2005/0190108	A1	9/2005	Lin	
2006/0250309	A1	11/2006	Fang	
2008/0007461	A1 *	1/2008	Su et al.	343/700 MS
2008/0094293	A1 *	4/2008	Chang et al.	343/702

FOREIGN PATENT DOCUMENTS

TW 200642171 12/2006

* cited by examiner

Primary Examiner — Douglas W Owens

Assistant Examiner — Chuc D Tran

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

- (21) Appl. No.: **12/148,029**
- (22) Filed: **Apr. 16, 2008**

- (65) **Prior Publication Data**
US 2008/0252533 A1 Oct. 16, 2008

- (30) **Foreign Application Priority Data**
Apr. 16, 2007 (TW) 96113284 A

- (51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 9/04 (2006.01)
- (52) **U.S. Cl.** **343/700 MS**; 343/702; 343/829; 343/846
- (58) **Field of Classification Search** 343/700 MS, 343/702, 829, 846
See application file for complete search history.

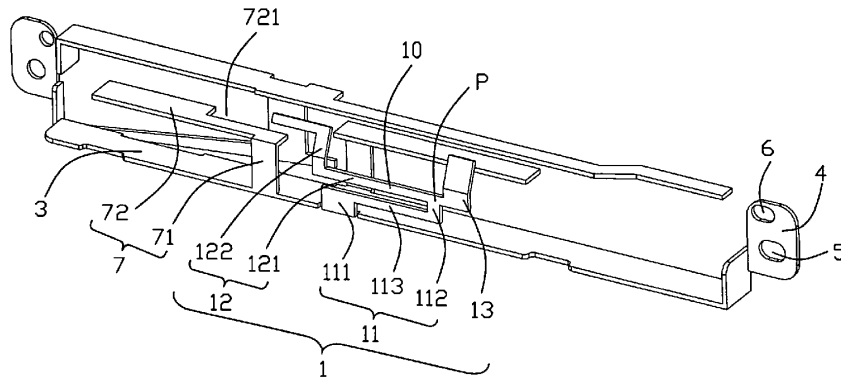
- (56) **References Cited**
U.S. PATENT DOCUMENTS
6,861,986 B2 3/2005 Fang
7,034,754 B2 * 4/2006 Hung et al. 343/700 MS
7,450,076 B1 * 11/2008 Lin et al. 343/702

(57) **ABSTRACT**

A complex antenna comprising a grounding element having a first and second longitudinal sides; a first antenna, operating in a first wireless network, comprising a first radiating body spaced apart from the grounding element and a first connecting element connecting the first radiating body and the grounding element; a second antenna, operating in a second wireless network, comprising a second radiating body spaced apart from the grounding element and a second connecting element connecting the second radiating body and the grounding element; wherein the first antenna extending from the first side of the grounding element and working in a first lower frequency band and a first higher frequency band; the second antenna extends from the second side of the grounding element and working in a second lower frequency band and a second higher frequency band.

19 Claims, 8 Drawing Sheets

100





US007932862B2

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

(10) **Patent No.:** **US 7,932,862 B2**
(45) **Date of Patent:** **Apr. 26, 2011**

(54) **ANTENNA FOR A WIRELESS PERSONAL AREA NETWORK AND A WIRELESS LOCAL AREA NETWORK**

(75) Inventors: **Tiao-Hsing Tsai**, Taiwan (TW);
Chih-Wei Liao, Tao Yuan Shien (TW);
Chao-Hsu Wu, Tao Yuan Shien (TW);
Cheng-Hsiung Wu, Tao Yuan Shien (TW)

(73) Assignee: **Quanta Computer, Inc.**, 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 139 days.

(21) Appl. No.: **12/174,480**

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

(65) **Prior Publication Data**
US 2009/0243938 A1 Oct. 1, 2009

(30) **Foreign Application Priority Data**
Apr. 1, 2008 (TW) 97111857 A

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

(52) **U.S. Cl.** **343/700 MS; 343/702; 343/795**

(58) **Field of Classification Search** **343/700 MS, 343/702, 795**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,030,622	A *	4/1962	Leitner et al.	343/793
4,513,292	A *	4/1985	Bowman	343/795
6,424,311	B1 *	7/2002	Tsai et al.	343/795
6,529,172	B2 *	3/2003	Zimmerman	343/797
6,714,162	B1 *	3/2004	Kadambi et al.	343/700 MS
6,812,892	B2 *	11/2004	Tai et al.	343/700 MS
6,906,678	B2 *	6/2005	Chen	343/795
6,937,196	B2 *	8/2005	Korva	343/702
7,271,771	B2 *	9/2007	Usui et al.	
7,425,924	B2 *	9/2008	Chung et al.	343/702
7,602,341	B2 *	10/2009	Wei-Shan et al.	343/700 MS

* cited by examiner

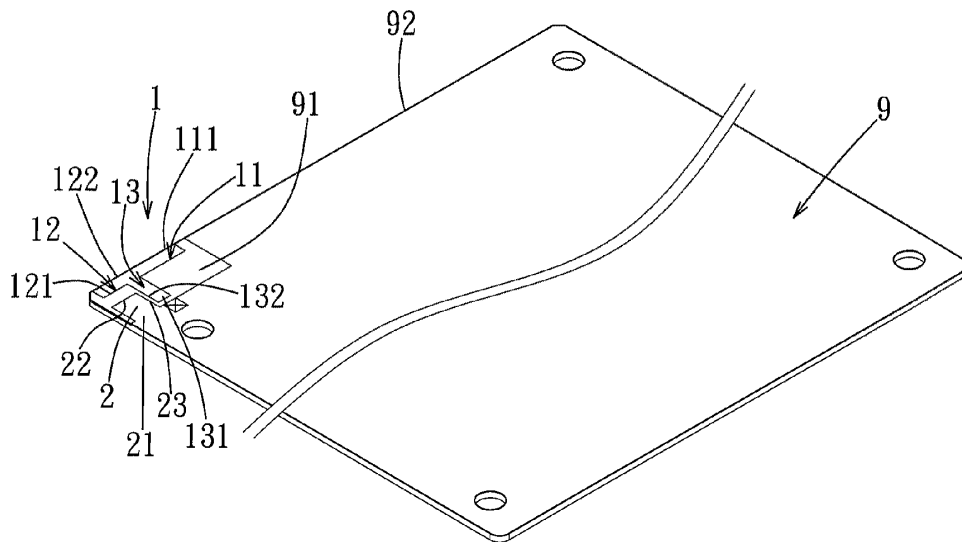
Primary Examiner — Tho G Phan

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

(57) **ABSTRACT**

An antenna includes a T-shaped radiating element and a coupling element. The radiating element includes opposite first and second radiating portions, and a feeding portion that extends transversely to the first and second radiating portions and that is connected to a junction of the first and second radiating portions. The coupling element is disposed between the second radiating portion and the feeding portion of the radiating element, and is coupled electromagnetically to at least one of the second radiating portion and the feeding portion of the radiating element.

9 Claims, 7 Drawing Sheets





US007932863B2

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

(10) **Patent No.:** **US 7,932,863 B2**
(45) **Date of Patent:** **Apr. 26, 2011**

(54) **SHAPED GROUND PLANE FOR RADIO APPARATUS**
(75) Inventors: **Jaume Anguera Pros**, Castellon (ES);
Carles Puente Baliarda, Barcelona (ES)

(73) Assignee: **Fractus, S.A.**, Barcelona (ES)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 687 days.

(21) Appl. No.: **11/793,406**
(22) PCT Filed: **Dec. 29, 2005**
(86) PCT No.: **PCT/EP2005/057215**
§ 371 (c)(1),
(2), (4) Date: **Jul. 19, 2007**

(87) PCT Pub. No.: **WO2006/070017**
PCT Pub. Date: **Jul. 6, 2006**

(65) **Prior Publication Data**
US 2008/0231521 A1 Sep. 25, 2008

Related U.S. Application Data
(60) Provisional application No. 60/640,645, filed on Dec. 30, 2004.

(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, 846**
See application file for complete search history.

(56) **References Cited**
U.S. PATENT DOCUMENTS
4,141,014 A 2/1979 Sletten
(Continued)

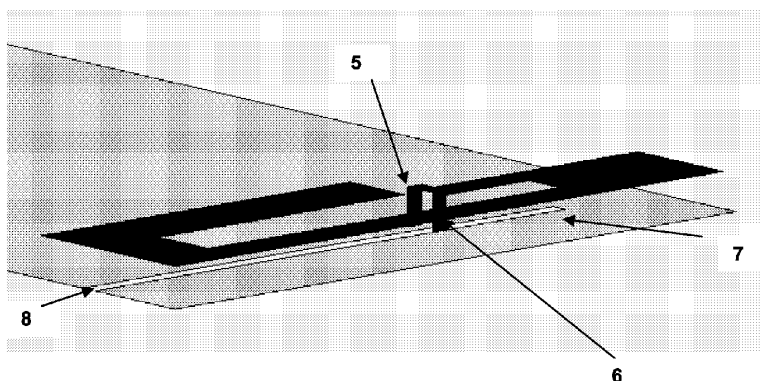
FOREIGN PATENT DOCUMENTS
CA 2416437 A1 1/2002
(Continued)

OTHER PUBLICATIONS
Karaboikis, M. et al, "Compact dual-printed inverted-F antenna diversity systems for portable wireless devices", IEEE Antennas and wireless propagation letters, vol. 3, 2004.
(Continued)

Primary Examiner — Douglas W Owens
Assistant Examiner — Dieu Hien T Duong
(74) *Attorney, Agent, or Firm* — Winstead PC

(57) **ABSTRACT**
This invention refers to an antenna structure for a wireless device comprising a ground plane and an antenna element, wherein the ground plane has a slot with at least a short end, an open end and a length substantially close to a quarter wavelength. The feeding and ground connections of the antenna structure are placed at the two different sides of said slot and the distance of at least one of them to the short end of the slot is equal or smaller than an eighth of the wavelength. The invention further refers to an antenna structure for a wireless device comprising a ground plane and an antenna element, wherein the ground plane has a slot with at least two short ends, and a length substantially close to half wavelength. The feeding and ground connections of the antenna structure are placed at the two different sides of said slot and the distance of at least one of them to a short end of the slot is equal or smaller than a quarter of the wavelength. Further the invention refers to a corresponding wireless device, a corresponding mobile phone and to a method for integrating such an antenna structure within a wireless device.

41 Claims, 14 Drawing Sheets





US007932864B2

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

(10) **Patent No.:** **US 7,932,864 B2**
(45) **Date of Patent:** **Apr. 26, 2011**

(54) **MOBILE WIRELESS COMMUNICATIONS
DEVICE WITH ANTENNA CONTACT
HAVING REDUCED RF INDUCTANCE**

FOREIGN PATENT DOCUMENTS

EP	1328069	7/2003
KR	2001-52175	6/2001
WO	97/37399	10/1997
WO	99/43043	8/1999
WO	2006/001557	1/2006

(75) Inventors: **Lizhong Zhu**, Waterloo (CA); **George Mankaruse**, Kitchener (CA); **Michael Corrigan**, Waterloo (CA); **Perry Jarmuszewski**, Waterloo (CA); **Jun Jun Xu**, Waterloo (CA)

OTHER PUBLICATIONS

Solbach et al., "Linearized Combiner Circuits for Power- and Low Noise-Amplifier Applications," Universitat Duisburg-Essen, 3 pages.
 Luong et al., "Design of a Full-Custom Accurate I-Q Modulator," Proceedings of EPAC 2004, Lucerne, Switzerland, pp. 2029-2031.
 Ashtiani et al., "Direct Multilevel Carrier Modulation Using Millimeter-Wave Balanced Vector Modulators," IEEE Transactions on Microwave Theory and Techniques, vol. 46, No. 12, Dec. 1998, pp. 2611-2619.
 Grebennikov et al., "High-Efficiency Balanced Switched-Path Monolithic SiGe HBT Power Amplifiers for Wireless Applications," Proceedings of the 37th European Microwave Conference, Oct. 2007, Munich, Germany, pp. 1189-1192.
 Andre et al., "High Efficiency, High Linearity GaN HEMT Amplifiers for WiMAX Applications," High Frequency Electronics, Jun. 2007, pp. 16, 18, 20, 22, 24, 25, 26, 28, 29.

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 453 days.

* cited by examiner

(21) Appl. No.: **12/173,043**

Primary Examiner — Michael C Wimer

(22) Filed: **Jul. 15, 2008**

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

(65) **Prior Publication Data**

US 2010/0013718 A1 Jan. 21, 2010

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

(52) **U.S. Cl.** **343/702**; 343/906; 455/575.7

(58) **Field of Classification Search** 343/702, 343/841, 906; 439/607.02, 876, 916; 174/351, 174/359; 455/575.5, 575.7
See application file for complete search history.

(57) **ABSTRACT**

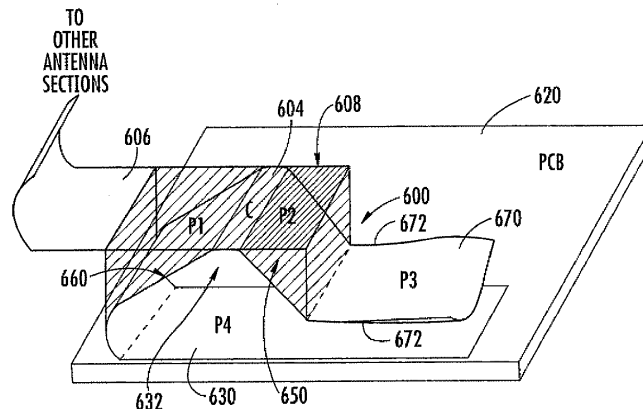
A mobile wireless communications device includes a housing and at least one circuit board. Radio frequency (RF) circuitry is carried by the circuit board and includes a transceiver. A processor is carried by the at least one circuit board and operative with the RF circuitry. An antenna is mounted within the housing. An antenna contact is secured on the at least one circuit board and operatively connects the RF circuitry and engages the antenna at an antenna contact point. Electromagnetic interference (EMI) shielding is positioned at the antenna contact point and reduces RF inductance effects.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,092,783 A	3/1992	Suarez et al.	439/71
5,132,645 A	7/1992	Mayer	333/109
5,389,890 A	2/1995	Burrage	330/124
6,049,725 A	4/2000	Emmert et al.	455/573
6,215,454 B1 *	4/2001	Tran	343/841
6,519,448 B1	2/2003	Dress et al.	455/41
6,760,010 B1	7/2004	Webb	345/168
7,157,965 B1	1/2007	Kim	330/124
2004/0087322 A1	5/2004	Aasgaard	455/462

24 Claims, 11 Drawing Sheets





US007932865B2

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

(10) **Patent No.:** **US 7,932,865 B2**
(45) **Date of Patent:** **Apr. 26, 2011**

(54) **COPLANAR COUPLED-FED MULTIBAND ANTENNA FOR THE MOBILE DEVICE**

(75) Inventors: **Kin-Lu Wong**, Kaohsiung (TW);
Chih-Hung Huang, Taipei (TW)

(73) Assignee: **Acer Incorporated**, 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 315 days.

(21) Appl. No.: **12/232,587**

(22) Filed: **Sep. 19, 2008**

(65) **Prior Publication Data**
US 2009/0273521 A1 Nov. 5, 2009

(30) **Foreign Application Priority Data**
May 5, 2008 (TW) 97116539 A

(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**
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2003/0117325 A1* 6/2003 Jo et al. 343/702
2008/0106478 A1* 5/2008 Hill 343/702

FOREIGN PATENT DOCUMENTS

TW 490884 B 6/2002

* cited by examiner

Primary Examiner — Douglas W Owens

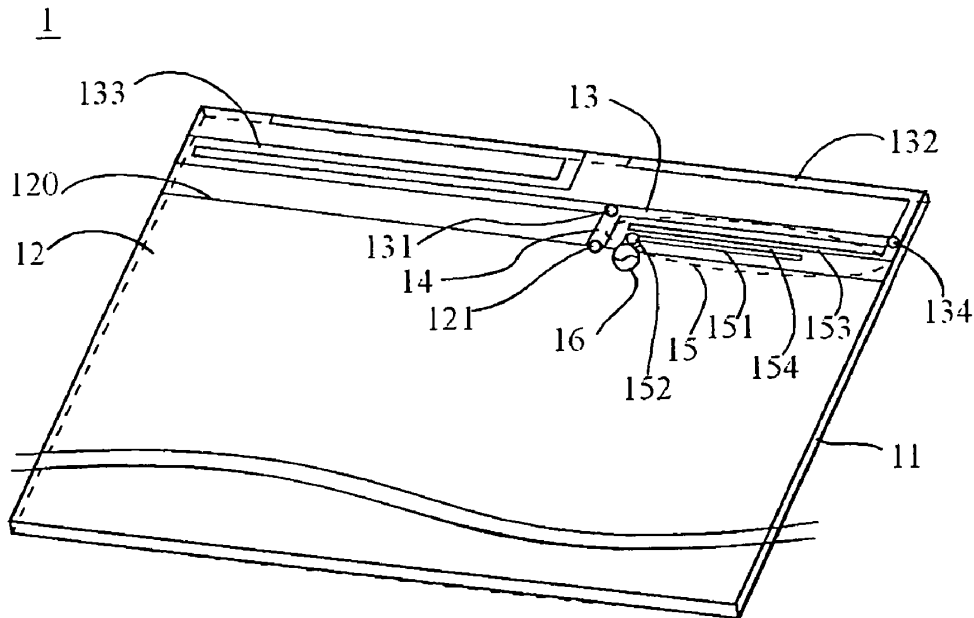
Assistant Examiner — Dieu Hien T Duong

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

(57) **ABSTRACT**

The present invention is related to a coplanar coupled-fed multiband antenna for the mobile communication device. The antenna mainly comprises a dielectric substrate, a ground plane located on one surface of the dielectric substrate, and a radiating portion, a shorting metal portion, and a feeding portion, which are all on the same surface of the dielectric substrate near one edge of the ground plane. One end of the shorting metal portion is connected to the radiating portion, and the other end is connected to the ground plane. The feeding portion comprises a first feeding metal portion and a second feeding metal portion. The first feeding metal portion has a feeding point for the antenna. One end of the second feeding metal portion is connected to the radiating portion, and there is a gap between the second feeding metal portion and the first feeding metal portion.

13 Claims, 9 Drawing Sheets





US007932866B2

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

(10) **Patent No.:** **US 7,932,866 B2**
(45) **Date of Patent:** **Apr. 26, 2011**

(54) **ANTENNA**

(75) Inventors: **Jiunn-Ming Huang**, Taipei (TW);
Shen-Pin Wei, Taipei (TW); **Yuan-Li Chang**, Taipei (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 44 days.

(21) Appl. No.: **12/492,002**

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

(65) **Prior Publication Data**

US 2009/0256772 A1 Oct. 15, 2009

Related U.S. Application Data

(63) Continuation of application No. 11/769,638, filed on Jun. 27, 2007, now Pat. No. 7,646,342.

(30) **Foreign Application Priority Data**

Oct. 31, 2006 (TW) 95140196 A

(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** 343/700 MS, 343/702, 895, 725, 846

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,147,652 A	11/2000	Sekine	
6,812,892 B2 *	11/2004	Tai et al.	343/700 MS
6,891,504 B2	5/2005	Cheng et al.	
6,930,641 B2	8/2005	Ohara et al.	
7,298,334 B2 *	11/2007	Fang et al.	343/700 MS

FOREIGN PATENT DOCUMENTS

CN	1441980 A	9/2003
CN	1492540 A	4/2004
TW	1227576	2/2005

OTHER PUBLICATIONS

China Patent Office, Office Action, Patent Application Serial No. 200610143539.8, Dec. 21, 2010, China.

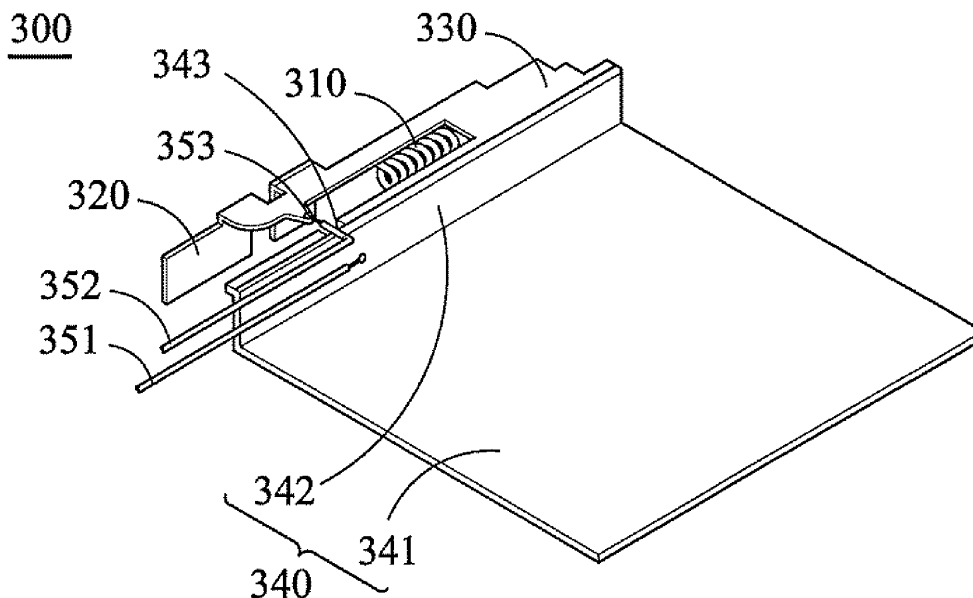
* cited by examiner

Primary Examiner — Hoang V Nguyen

(57) **ABSTRACT**

An antenna comprises a first transmission element, a second transmission element, a conductive element, a ground element, a ground line and a signal line. The conductive element is connected to the ground element. The first transmission element is connected to the conductive element. The first transmission element comprises a first spiral structure and a first axis. The second transmission element is connected to the conductive element. The ground line is electrically connected to the ground element. The signal line is electrically connected to the conductive element at a feed point.

14 Claims, 10 Drawing Sheets





US007932869B2

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

(10) **Patent No.:** **US 7,932,869 B2**
(45) **Date of Patent:** **Apr. 26, 2011**

(54) **ANTENNA WITH VOLUME OF MATERIAL**

(75) Inventors: **Chulmin Han**, San Diego, CA (US);
Rowland Jones, Carlsbad, CA (US);
Jeffrey Shamblin, San Marcos, CA
(US); **Sabastian 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 298 days.

(21) Appl. No.: **11/840,861**

(22) Filed: **Aug. 17, 2007**

(65) **Prior Publication Data**

US 2009/0046028 A1 Feb. 19, 2009

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

(52) **U.S. Cl.** **343/787**; 343/873; 343/895

(58) **Field of Classification Search** 343/700 MS,
343/702, 787, 873, 895, 741, 867, 872
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,900,845 A * 5/1999 Mandai et al. 343/895
5,903,240 A * 5/1999 Kawahata et al. 343/700 MS

5,973,651 A * 10/1999 Suesada et al. 343/752
6,456,243 B1 9/2002 Poilasne et al.
6,674,405 B2 * 1/2004 Wang 343/700 MS
2004/0027286 A1 2/2004 Poilasne et al.
2005/0192727 A1 9/2005 Shostak et al.
2006/0220966 A1 10/2006 Sarychev et al.

OTHER PUBLICATIONS

International Search Report for PCT Application No. PCT/US2008/073612.

Rowson, "Optimized Performance When Integrating Multiple Antennas"; Antenna Systems & Technology, Sep./Oct. 2006, USA.

* cited by examiner

Primary Examiner — Michael C Wimer

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

(57) **ABSTRACT**

An antenna includes one or more antenna elements and a volume of material contained at least partly within a volume of the one or more antenna elements. The volume of material has at least one electromagnetic property that is different from free space. The volume of material may include dielectric material and/or ferrite material. The antenna elements may be isolated magnetic dipole (IMD) antenna elements. The electromagnetic property may be permeability and/or permittivity.

27 Claims, 8 Drawing Sheets

