



US007973720B2

(12) **United States Patent**
Sorvala

(10) **Patent No.:** **US 7,973,720 B2**

(45) **Date of Patent:** **Jul. 5, 2011**

(54) **CHIP ANTENNA APPARATUS AND METHODS**

(75) Inventor: **Juha Sorvala**, Oulu (FI)

(73) Assignee: **LKP Pulse Finland OY**, Kempele (FI)

(*) 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.: **12/661,394**

(22) Filed: **Mar. 15, 2010**

(65) **Prior Publication Data**

US 2010/0176998 A1 Jul. 15, 2010

Related U.S. Application Data

(63) Continuation of application No. 11/648,431, filed on Dec. 28, 2006, now Pat. No. 7,679,565, which is a continuation of application No. PCT/FI2005/050089, filed on Mar. 16, 2005.

(30) **Foreign Application Priority Data**

Jun. 28, 2004 (FI) 20040892

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

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

(58) **Field of Classification Search** **343/700, 343/702, 829, 846**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,069,483 A 1/1978 Kaloi
4,401,988 A * 8/1983 Kaloi 343/700 MS
5,001,492 A * 3/1991 Shapiro et al. 343/700 MS

5,157,363 A 10/1992 Puurunen
5,281,326 A 1/1994 Galla
5,298,873 A 3/1994 Ala-Kojola
5,349,700 A 9/1994 Parker

(Continued)

FOREIGN PATENT DOCUMENTS

EP 0 376 643 A2 4/1990

(Continued)

OTHER PUBLICATIONS

"A Novel Approach of a Planar Multi-Band Hybrid Series Feed Network for Use in Antenna Systems Operating at Millimeter Wave Frequencies," by M.W. Elsallal and B.L. Hauck, Rockwell Collins, Inc., pp. 15-24, walsall@rockwellcollins.com and blhauck@rockwellcollins.com.

(Continued)

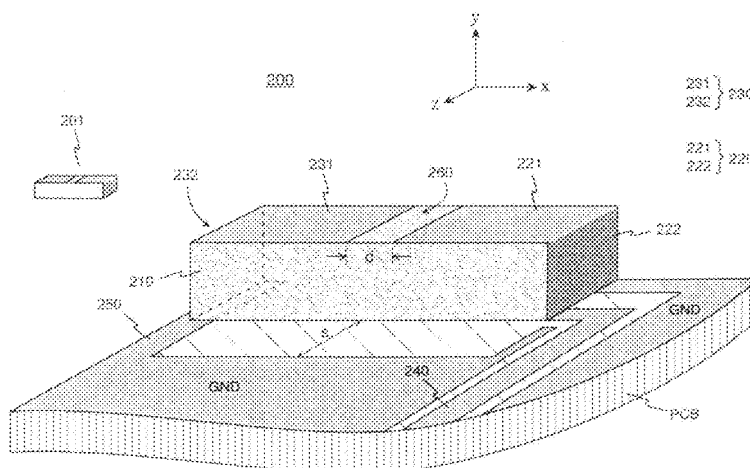
Primary Examiner — Tho G Phan

(74) Attorney, Agent, or Firm — Gazdzinski & Associates, PC

(57) **ABSTRACT**

A chip component with dielectric substrate and plurality of radiating antenna elements on the surface thereof. In one embodiment, two (2) substantially symmetric elements are used, each covering an opposite head and upper surface portion of the device. The surface between the elements comprises a slot. The chip is mounted on a circuit board (e.g., PCB) whose conductor pattern is part of the antenna. No ground plane is used under the chip or its sides to a certain distance. One of the antenna elements is coupled to the feed conductor on the PCB and to the ground plane, while the parasitic element is coupled only to the ground plane. The parasitic element is fed through coupling over the slot, and both elements resonate at the operating frequency. The antenna can be tuned and matched without discrete components, is substantially omni-directional, and has low substrate losses due to simple field image.

29 Claims, 5 Drawing Sheets



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US007973723B2

(12) **United States Patent**
Lin

(10) **Patent No.:** **US 7,973,723 B2**
(45) **Date of Patent:** **Jul. 5, 2011**

(54) **ELECTRIC DEVICE AND ANTENNA
MODULE THEREOF**

(75) Inventor: **Hui Lin**, Taoyuan (TW)

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

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 754 days.

(21) Appl. No.: **12/007,201**

(22) Filed: **Jan. 8, 2008**

(65) **Prior Publication Data**

US 2009/0073058 A1 Mar. 19, 2009

(30) **Foreign Application Priority Data**

Sep. 14, 2007 (TW) 96134579 A

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

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

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

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,021,813	A *	5/1977	Black et al.	343/768
6,025,805	A	2/2000	Smith et al.	
6,786,769	B2	9/2004	Lai	
7,532,164	B1 *	5/2009	Phillips et al.	343/700 MS
7,535,422	B2 *	5/2009	Liu et al.	343/702
7,598,912	B2 *	10/2009	Lee	343/700 MS
7,705,784	B2 *	4/2010	Lai et al.	343/700 MS
2007/0010300	A1	1/2007	Xue et al.	
2008/0122698	A1 *	5/2008	Ollikainen et al.	343/700 MS
2009/0303135	A1 *	12/2009	Reed et al.	343/702

FOREIGN PATENT DOCUMENTS

TW	547788	Y	8/2003
TW	549613	Y	8/2003
TW	568379	Y	12/2003
TW	M257522		2/2005

* cited by examiner

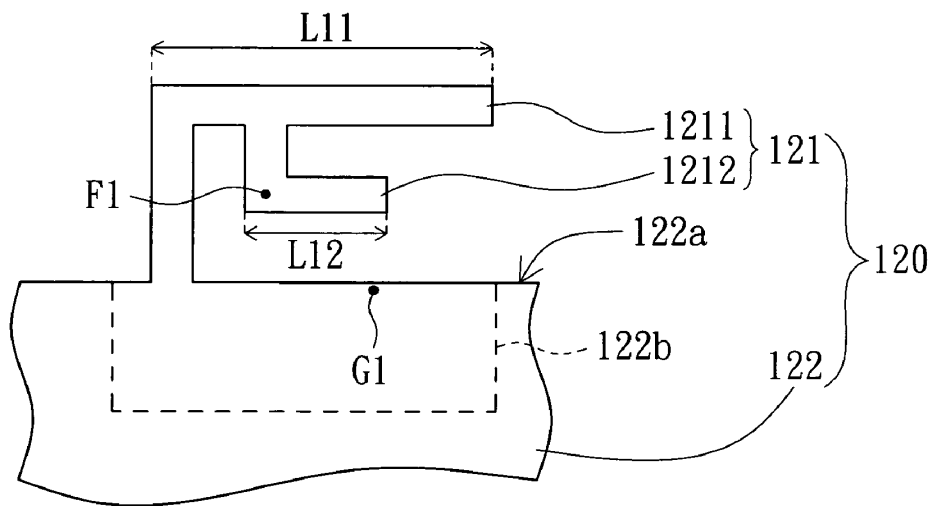
Primary Examiner — Huedung Mancuso

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

(57) **ABSTRACT**

An electronic device and an antenna module thereof are provided. The electronic device includes a plurality of electronic elements and the antenna module. The antenna module includes a radiating body and a grounding body. The grounding body covers the electronic elements for being a shielding casing. A radio frequency resonance is formed between the radiating body and the grounding body.

14 Claims, 24 Drawing Sheets



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US007973726B2

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

(10) **Patent No.:** **US 7,973,726 B2**

(45) **Date of Patent:** **Jul. 5, 2011**

(54) **MULTI-ANTENNA MODULE**

(75) Inventors: **Yi-Wei Tseng**, Taipei County (TW);
Sheng-Chih Lin, Taipei County (TW);
Tsung-Wen Chiu, Taipei County (TW);
Fu-Ren Hsiao, Taipei County (TW)

(73) Assignee: **Advanced Connectek, Inc.**, Taipei
County (TW)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 520 days.

(21) Appl. No.: **12/208,273**

(22) Filed: **Sep. 10, 2008**

(65) **Prior Publication Data**
US 2009/0231200 A1 Sep. 17, 2009

(30) **Foreign Application Priority Data**
Mar. 14, 2008 (TW) 97109034 A

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

(52) **U.S. Cl.** **343/702**; 343/700 MS; 343/829;
343/846; 343/833

(58) **Field of Classification Search** 343/700 MS,
343/702, 829, 846, 833
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,298,339 B1 * 11/2007 Ollikainen 343/702
7,375,695 B2 * 5/2008 Ishizuka et al. 343/745

7,439,914 B1 * 10/2008 Lin et al. 343/700 MS
7,525,490 B2 * 4/2009 Hung et al. 343/702
7,633,448 B2 * 12/2009 Su et al. 343/702
7,701,401 B2 * 4/2010 Suzuki et al. 343/702
7,724,201 B2 * 5/2010 Nysen et al. 343/821
7,834,809 B2 * 11/2010 Tseng et al. 343/700 MS
2009/0174611 A1 * 7/2009 Schlub et al. 343/702

FOREIGN PATENT DOCUMENTS

TW 268010 B 12/2006

* cited by examiner

Primary Examiner — Douglas W Owens

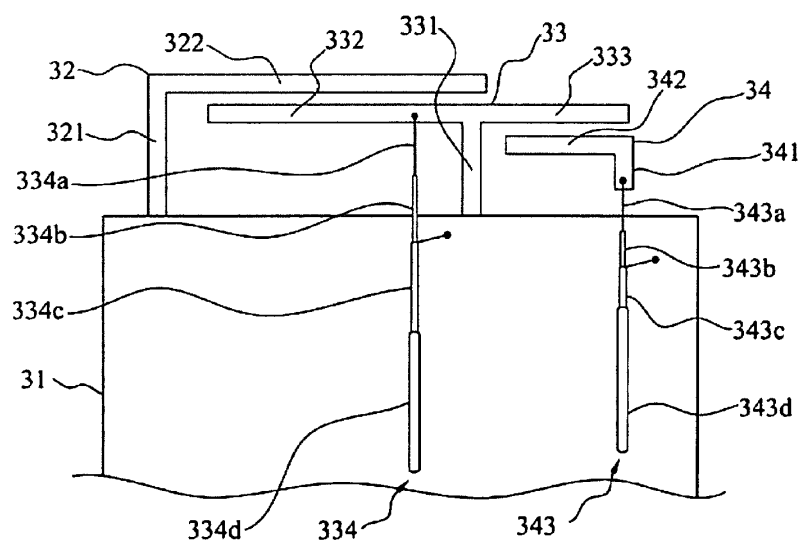
Assistant Examiner — Chuc D Tran

(74) *Attorney, Agent, or Firm* — Schmeiser Olsen & Watts
LLP

(57) **ABSTRACT**

A multi-antenna module comprises a ground plane, a primary conductor, a secondary conductor and a plurality of coupling conductors, wherein the framework of the parallel primary radiation arm and secondary radiation arm can infinitely expand the number of antenna units in the same antenna structure. The capacitive coupling effect of parallel radiation arms and the inductance of the radiation arms themselves can effectively reduce the signal interference between antennae, whereby a plurality of antennae can be integrated to achieve antenna miniaturization. The primary conductor, the secondary conductor and the coupling conductors are all connected to the same ground plane, whereby the layout space is reduced, and the multi-antenna module is easy-to-assemble for various electronic devices.

9 Claims, 7 Drawing Sheets



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

(10) **Patent No.:** **US 7,973,727 B2**

(45) **Date of Patent:** **Jul. 5, 2011**

(54) **MOBILE COMMUNICATION TERMINAL**

(56) **References Cited**

(75) Inventors: **Chan Gwang An**, Gyunggi-Do (KR);
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Eun Cho, Gyunggi-Do (KR); **Ha Ryong**
Hong, Gyunggi-Do (KR); **Hyun Kil**
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Gyunggi-Do (KR); **Dae Seong Jeon**,
Gyunggi-Do (KR)

U.S. PATENT DOCUMENTS

5,258,892	A	11/1993	Stanton	
7,339,533	B2 *	3/2008	Kurashima et al.	343/702
7,570,218	B2 *	8/2009	Tsujimura et al.	343/702

FOREIGN PATENT DOCUMENTS

JP	2002-329541	A	11/2002
JP	2004-328108	A	11/2004
KR	200356488	Y1	7/2004
KR	1020080008633	A	1/2008

(73) Assignee: **Samsung Electro-Mechanics Co., Ltd.**,
Gyunggi-do (KR)

OTHER PUBLICATIONS

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

Korean Office action for application No. 10-20080049044, issued
Apr. 5, 2010.

* cited by examiner

(21) Appl. No.: **12/243,697**

(22) Filed: **Oct. 1, 2008**

Primary Examiner — Hoang V Nguyen

(65) **Prior Publication Data**

US 2009/0295649 A1 Dec. 3, 2009

(74) *Attorney, Agent, or Firm* — Lowe, Hauptman, Ham &
Berner, LLP

(30) **Foreign Application Priority Data**

May 27, 2008 (KR) 10-2008-0049044

(57) **ABSTRACT**

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

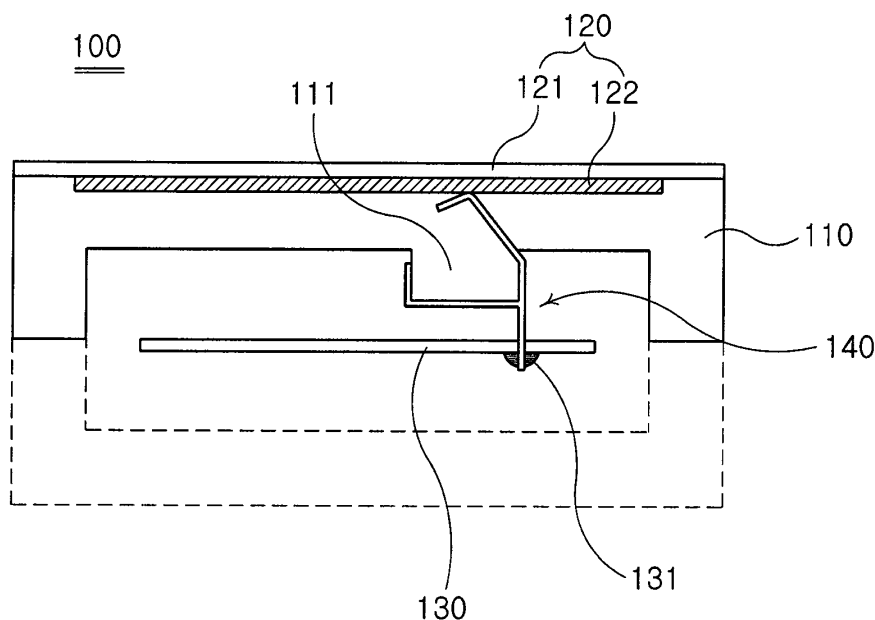
(52) **U.S. Cl.** **343/702**; 343/873

(58) **Field of Classification Search** 343/702,
343/700 MS, 872, 873, 906

See application file for complete search history.

There is provided a mobile communication terminal including: a housing of the mobile communication terminal; a film type antenna provided on the surface of the housing; a printed circuit board disposed inside the housing; and a connector electrically connecting the film type antenna and the printed circuit board.

15 Claims, 2 Drawing Sheets



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US007978140B2

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

(10) **Patent No.:** **US 7,978,140 B2**
(45) **Date of Patent:** **Jul. 12, 2011**

(54) **MULTIBAND ANTENNA AND
COMMUNICATION DEVICE HAVING THE
SAME**

7,436,360 B2 * 10/2008 Chen et al. 343/700 MS
7,808,433 B2 * 10/2010 Ruffors et al. 343/700 MS
7,825,863 B2 * 11/2010 Martiskainen et al. 343/702
2005/0264455 A1 * 12/2005 Talvitie et al. 343/702

(75) Inventors: **Kin-Lu Wong**, Taipei Hsien (TW);
Ting-Wei Kang, Taipei Hsien (TW)

FOREIGN PATENT DOCUMENTS

TW 1258891 4/1994
TW 1262620 12/1994

(73) Assignee: **Acer Inc.**, Taipei Hsien (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 240 days.

Primary Examiner — Huedung Mancuso

(74) *Attorney, Agent, or Firm* — Alan Kamrath; Kamrath &
Associates PA

(21) Appl. No.: **12/468,933**

(57) **ABSTRACT**

(22) Filed: **May 20, 2009**

A multiband antenna for a communication device is disclosed. The multiband antenna comprises a dielectric substrate, a ground portion, and a radiating metal portion. The dielectric substrate comprises two surfaces. The ground portion comprises a first ground plane, a second ground plane, and a connecting metal strip. The first ground plane is on one of the surfaces of the dielectric substrate and has a first connecting point and a shorting point. The second ground plane is near the first ground plane and has a second connecting point. At least one part of the connecting metal strip is on one surface of the dielectric substrate. The connecting metal strip has one end connected to the first connecting point and the other end connected to the second connecting point. The radiating metal portion is connected to the dielectric substrate, without overlapping the first ground plane. The radiating metal portion comprises a radiating section having one end connected to the shorting point and the other end as an open end; and a feeding section having one end connected to a signal source and the other end as an open end, wherein the open end of the feeding section has a spacing of less than 3 mm to the radiating portion.

(65) **Prior Publication Data**

US 2010/0214179 A1 Aug. 26, 2010

(30) **Foreign Application Priority Data**

Feb. 23, 2009 (TW) 98105708 A

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

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

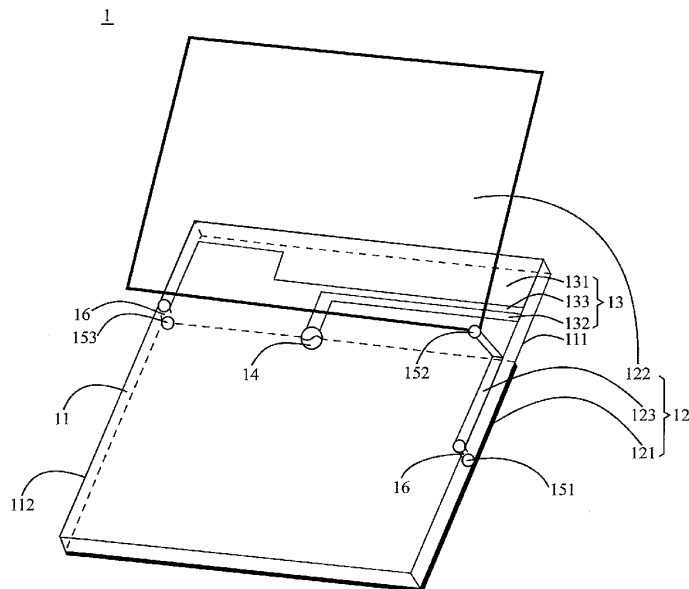
(58) **Field of Classification Search** 343/702,
343/700 MS, 767, 846, 741–744
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,466,176 B1 * 10/2002 Maoz et al. 343/767
7,215,283 B2 * 5/2007 Boyle 343/700 MS

20 Claims, 7 Drawing Sheets



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US007978141B2

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

(10) **Patent No.:** **US 7,978,141 B2**

(45) **Date of Patent:** **Jul. 12, 2011**

(54) **COUPLE-FED MULTI-BAND LOOP ANTENNA**

(75) Inventors: **Yun-Wen Chi**, Sinjhuang (TW); **Kin-Lu Wong**, Kaohsiung (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 363 days.

(21) Appl. No.: **12/286,254**

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

(65) **Prior Publication Data**

US 2009/0273530 A1 Nov. 5, 2009

(30) **Foreign Application Priority Data**

May 5, 2008 (TW) 97116537 A

(51) **Int. Cl.**
H01Q 11/12 (2006.01)
H01Q 1/38 (2006.01)

(52) **U.S. Cl.** **343/741**; 343/700 MS; 343/850; 343/860

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

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,861,854 A * 1/1999 Kawahata et al. 343/702
6,800,832 B2 * 10/2004 Hutchison et al. 219/130.21

6,903,690 B2 * 6/2005 Leclerc et al. 343/700 MS
6,903,691 B2 * 6/2005 Sato et al. 343/700 MS
7,196,667 B2 * 3/2007 Watada et al. 343/700 MS
7,265,726 B2 9/2007 Kenoun et al.
2002/0118075 A1 * 8/2002 Ohwada et al. 333/32
2007/0268191 A1 11/2007 Ishizuka et al.

FOREIGN PATENT DOCUMENTS

EP 0 814 535 A2 12/1997
EP 1 154 516 A1 11/2001
FR 2 860 927 A1 4/2005
JP 10-173425 A 6/1998

* cited by examiner

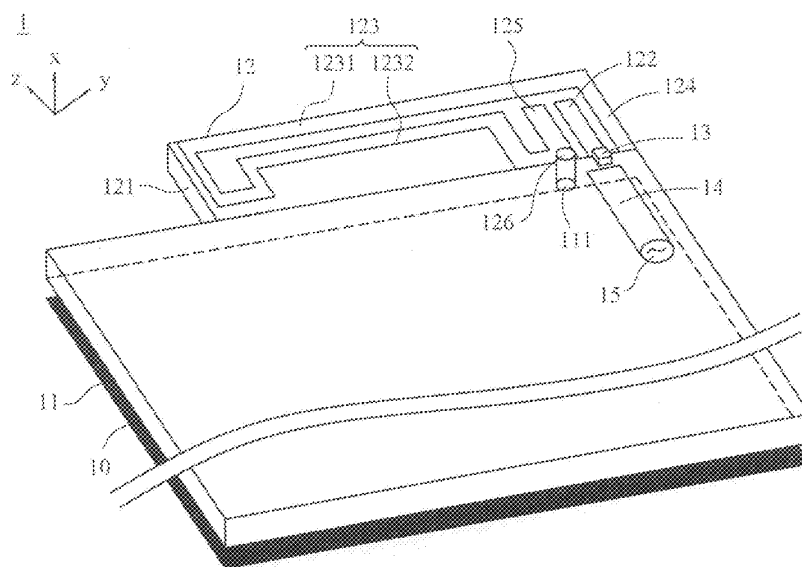
Primary Examiner — Trinh V Dinh

(74) *Attorney, Agent, or Firm* — Hudak, Shunk & Farine Co. LPA

(57) **ABSTRACT**

The present invention is related to a coupled-fed multi-band loop antenna. The antenna comprises a dielectric substrate, a ground plane located on the dielectric substrate and has a grounding point, a radiating portion which comprise a supporter, a coupling trip and a loop strip, and a matching circuit. The coupling strip and loop strip are both located on the supporter, with the coupling strip surrounded by the loop strip. The length of loop strip is about 0.25 wavelength of the antenna's first resonant mode. The loop strip has a first end paralleling with the coupling loop, a second end and a shorting point near the second end and electrically connected to the grounding point on the ground plane. The matching circuit is on the dielectric substrate. One terminal of the matching circuit is connected to the coupling strip, and the other is connected to a signal source.

7 Claims, 10 Drawing Sheets



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US007978149B2

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

(10) **Patent No.:** **US 7,978,149 B2**
(45) **Date of Patent:** **Jul. 12, 2011**

(54) **DIELECTRIC RESONATOR ANTENNA WITH
BENDING METALLIC PLANES**

(76) Inventors: **Tze-Hsuan Chang**, Taipei (TW);
Jean-Fu Kiang, Taipei (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.: **12/038,243**

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

(65) **Prior Publication Data**
US 2009/0102739 A1 Apr. 23, 2009

(30) **Foreign Application Priority Data**
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(51) **Int. Cl.**
H01Q 15/08 (2006.01)
(52) **U.S. Cl.** **343/911 R**
(58) **Field of Classification Search** 343/911 R,
343/700 MS, 789, 846-848
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,453,754	A *	9/1995	Fray		343/789
5,952,972	A *	9/1999	Ittipiboon et al.		343/700 MS
6,700,539	B2 *	3/2004	Lim		343/700 MS
6,903,692	B2 *	6/2005	Kivekas et al.		343/702
6,995,713	B2	2/2006	Le Bolzer et al.		
7,196,663	B2	3/2007	Bolzer et al.		
7,504,721	B2 *	3/2009	Chen et al.		257/724
7,710,325	B2 *	5/2010	Cheng		343/700 MS

FOREIGN PATENT DOCUMENTS

JP 2005142864 6/2005

* cited by examiner

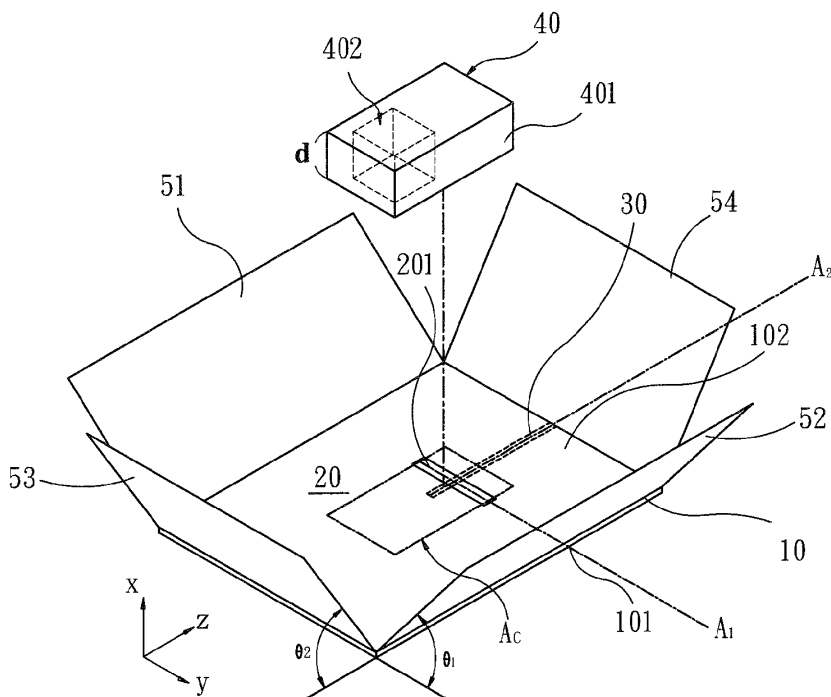
Primary Examiner — Huedung Mancuso

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

(57) **ABSTRACT**

The present invention relates to a dielectric resonator antenna (DRA) with bending metallic planes. The ground plane of the dielectric resonator antenna is bent around the DRA to increase the half-power beam width (HPBW) and the gain on H-plane, moreover, to improve the pattern on E-plane. The ground plane of the invention is further bent in different angles to reshape the radiation pattern of the dielectric resonator antenna, and a well is carved in the dielectric resonator antenna to increase its radiation bandwidth. The invention can also be adjusted as WiMAX sectorial antenna.

15 Claims, 4 Drawing Sheets



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

(10) **Patent No.:** **US 7,982,674 B2**

(45) **Date of Patent:** **Jul. 19, 2011**

(54) **DUAL-BAND ANTENNA**

(75) Inventors: **Wen-Chieh Yang**, Tu-Cheng (TW); **Kai Shih**, Tu-Cheng (TW); **Yu-Yuan Wu**, Tu-Cheng (TW)

(73) Assignee: **Cheng Uei Precision Industry Co., Ltd.**, Tu-Cheng, 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 347 days.

(21) Appl. No.: **12/350,397**

(22) Filed: **Jan. 8, 2009**

(65) **Prior Publication Data**

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

6,982,675 B2 * 1/2006 Kwak et al. 343/702
7,034,754 B2 * 4/2006 Hung et al. 343/700 MS

7,342,540 B2 * 3/2008 Nahar et al. 343/702
7,450,076 B1 * 11/2008 Lin et al. 343/702
7,633,448 B2 * 12/2009 Su et al. 343/702
2008/0007461 A1 * 1/2008 Su et al. 343/700 MS
2008/0094293 A1 * 4/2008 Chang et al. 343/702
2008/0252533 A1 * 10/2008 Hung et al. 343/700 MS

* cited by examiner

Primary Examiner — Douglas W Owens

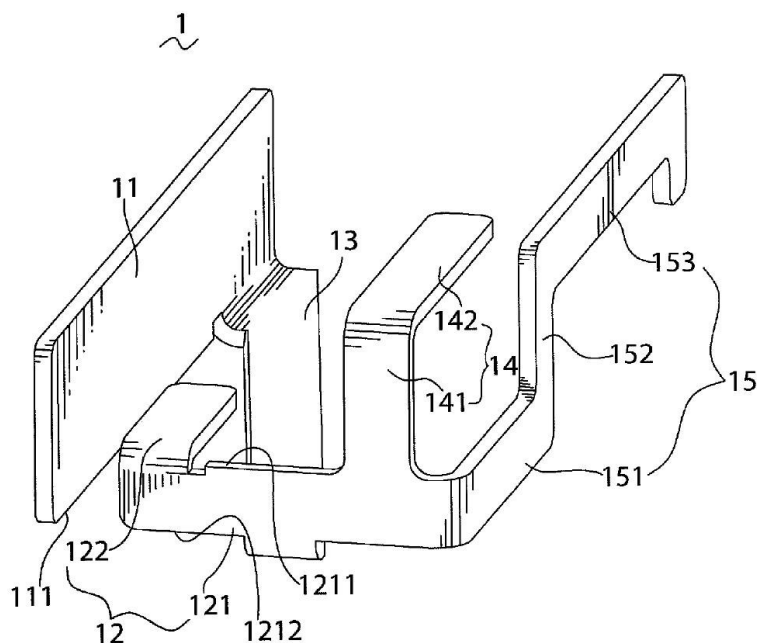
Assistant Examiner — Chuc D Tran

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

(57) **ABSTRACT**

A dual-band antenna has a feeding portion including a first feeding portion and a second feeding portion extending perpendicularly from a top of the first feeding portion. A first high-frequency portion spaced away from the second feeding portion extends upwards from the first feeding portion, and a second high-frequency portion extends perpendicularly from the first high-frequency portion and located at a same side with respect to the first feeding portion as the second feeding portion. A first low-frequency portion located at a same side with respect to the first feeding portion as the second high-frequency portion extends perpendicularly from an end of the first feeding portion. A second low-frequency portion extends upwards from the first low-frequency portion. A third low-frequency portion extends back to the first low-frequency portion from the second low-frequency portion. A grounding portion connected with the feeding portion by a connecting portion faces the low-frequency radiator.

6 Claims, 2 Drawing Sheets





US007982676B2

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

(10) **Patent No.:** **US 7,982,676 B2**

(45) **Date of Patent:** **Jul. 19, 2011**

(54) **ANTENNA STRUCTURE FOR A MOBILE PHONE**

(75) Inventors: **Chun-Hua Chen**, Pa-Te (TW);
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 353 days.

(21) Appl. No.: **12/289,486**

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

(65) **Prior Publication Data**
US 2010/0103068 A1 Apr. 29, 2010

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

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

(58) **Field of Classification Search** 343/702,
343/841, 790; 455/89-90

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,293,754 A *	10/1981	Komaki	200/512
6,095,820 A *	8/2000	Luxon et al.	343/702
6,249,256 B1 *	6/2001	Luxon et al.	343/702
7,829,810 B2 *	11/2010	Nakajima	200/333

* cited by examiner

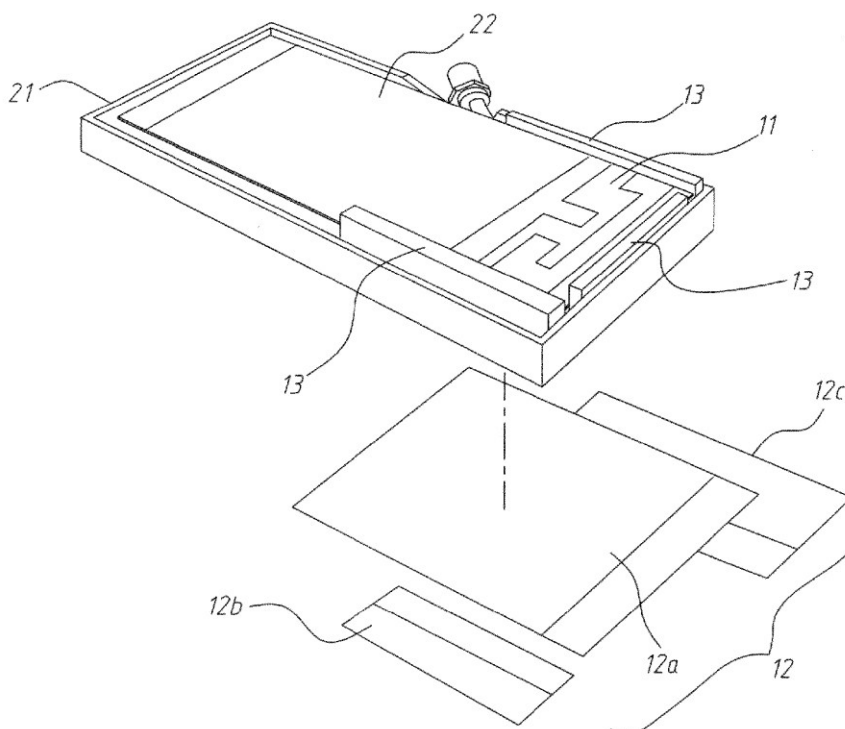
Primary Examiner — Huedung Mancuso

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

(57) **ABSTRACT**

An antenna structure for a mobile phone to improve its hearing aid compatibility (HAC) character by metal obscuring, the antenna structure mainly is composed of an antenna base board and a copper foil; the antenna base board is provided in a housing of the mobile phone near a sound outputting hole, and a metallic thin layer is made in the housing of the mobile phone in corresponding by position with the antenna base board, the ground surface between the metallic thin layer and a circuit board in the housing of the mobile phone will form an electrically conductive connection. With this structure, distribution of the strength of the electric field of the antenna structure will be improved; thereby the test results for HAC near the sound outputting hole can be evidently improved.

3 Claims, 9 Drawing Sheets
(2 of 9 Drawing Sheet(s) Filed in Color)



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US007982678B2

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

(10) **Patent No.:** **US 7,982,678 B2**
(45) **Date of Patent:** ***Jul. 19, 2011**

(54) **ANTENNA DEVICE AND ELECTRIC EQUIPMENT**

(75) Inventors: **Hiroyuki Hotta**, Hamura (JP); **Masao Teshima**, Kunitachi (JP); **Koichi Sato**, Tachikawa (JP)

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

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

This patent is subject to a terminal disclaimer.

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(22) Filed: **Jul. 27, 2010**

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Related U.S. Application Data

(63) Continuation of application No. 12/415,513, filed on Mar. 31, 2009, now Pat. No. 7,764,238.

(30) **Foreign Application Priority Data**

Jul. 29, 2008 (JP) 2008-195529

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

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

(58) **Field of Classification Search** 343/700, 343/702, 829, 846

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,434,579 A 7/1995 Kagoshima et al.
6,130,650 A * 10/2000 Curtis et al. 343/846
6,297,776 B1 10/2001 Pankinaho
6,686,886 B2 2/2004 Flint et al.

7,026,999 B2 4/2006 Umehara et al.
7,218,282 B2 * 5/2007 Humpfer et al. 343/700 MS
7,425,924 B2 9/2008 Chung et al.
7,764,238 B2 * 7/2010 Hotta et al. 343/702
2005/0110692 A1 5/2005 Andersson
2009/0009401 A1 1/2009 Suzuki et al.

FOREIGN PATENT DOCUMENTS

JP 2003124742 4/2003
JP 2003158419 5/2003
JP 2003168916 6/2003
JP 2003218623 7/2003
JP 2004201278 7/2004
JP 2005094501 4/2005
JP 2005252480 9/2005
JP 2007028255 2/2007
JP 3959396 8/2007
JP 2008028734 2/2008
JP 2008066779 3/2008
JP 2008092311 4/2008
JP 2008167467 7/2008

* cited by examiner

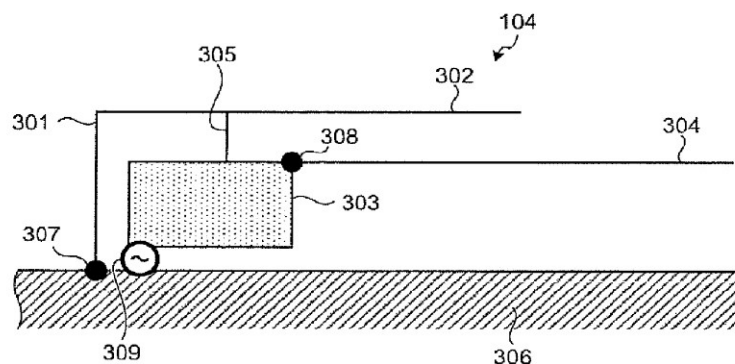
Primary Examiner — Tho G Phan

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

(57) **ABSTRACT**

According to one embodiment, an antenna device includes a short circuit path, a first open-ended element, a feed side element, a second open-ended element, and a short circuit element. A length, from a ground point to a second end of the first open-ended element through the short circuit path and the first open-ended element, is substantially a quarter of a wavelength of a first resonant frequency. A length, from the ground point to a second end of the second open-ended element through the short circuit path, the short circuit element, and the second open-ended element, is substantially a quarter of a wavelength of a second resonant frequency.

16 Claims, 23 Drawing Sheets



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US007982682B2

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

(10) **Patent No.:** **US 7,982,682 B2**

(45) **Date of Patent:** **Jul. 19, 2011**

(54) **ANTENNA APPARATUS**

(75) Inventors: **Sung-Gyoo Lee**, Tokyo (JP); **Masahiko Nakamura**, Chichibu-gun (JP); **Eiichirou Hirose**, Chichibu-gun (JP); **Koji Yanao**, Chichibu-gun (JP)

(73) Assignee: **Mitsubishi Materials Corporation**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 301 days.

(21) Appl. No.: **12/306,614**

(22) PCT Filed: **Jun. 29, 2007**

(86) PCT No.: **PCT/JP2007/063142**

§ 371 (c)(1),

(2), (4) Date: **Dec. 24, 2008**

(87) PCT Pub. No.: **WO2008/001899**

PCT Pub. Date: **Jan. 3, 2008**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Jun. 29, 2006 (JP) 2006-180513

(51) **Int. Cl.**

H01Q 1/48 (2006.01)

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

(58) **Field of Classification Search** 343/702, 343/829, 846, 848

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,288,680	B1 *	9/2001	Tsuru et al.	343/702
6,380,903	B1 *	4/2002	Hayes et al.	343/725
6,421,016	B1 *	7/2002	Phillips et al.	343/702
6,486,852	B1	11/2002	Hirose et al.	
2006/0290574	A1	12/2006	Tsai et al.	

FOREIGN PATENT DOCUMENTS

EP	1329985	A2	7/2003
EP	1703586	A1	9/2006
JP	2004-241837	A	8/2004
JP	2005-079747	A	3/2005
JP	3758495	B2	3/2006
WO	WO 2005/064743	A1	7/2005
WO	WO 2006/18711	A1	2/2006
WO	WO 2006/290574	A1	12/2006

OTHER PUBLICATIONS

European Search Report issued Mar. 22, 2010 for the corresponding European Patent Application No. 07767927.2.

* cited by examiner

Primary Examiner — Michael C Wimer

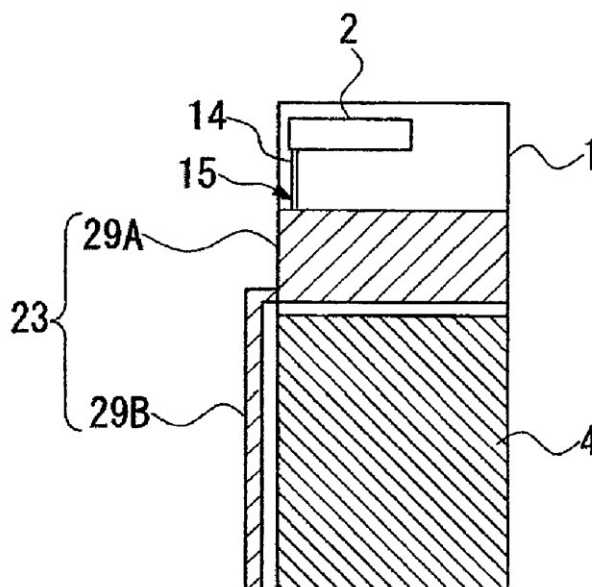
(74) *Attorney, Agent, or Firm* — Leason Ellis LLP.

(57)

ABSTRACT

An antenna apparatus includes: a substrate; an RF ground conductor which is branched to extend in at least two directions and at least a part of which is formed on a surface of the substrate, the RF ground conductor functioning as an antenna ground plane; and an antenna portion, one end of which is connected to the RF ground conductor.

3 Claims, 3 Drawing Sheets



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US007983721B2

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

(10) **Patent No.:** **US 7,983,721 B2**

(45) **Date of Patent:** **Jul. 19, 2011**

(54) **TRANSPARENT CONDUCTIVE ANTENNA
FOR A PORTABLE COMMUNICATION
DEVICE**

(75) Inventors: **Zhinong Ying**, Lund (SE); **Hong Ding**,
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(73) Assignee: **Sony Ericsson Mobile
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(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 587 days.

(21) Appl. No.: **11/628,282**

(22) PCT Filed: **Apr. 27, 2005**

(86) PCT No.: **PCT/EP2005/004497**

§ 371 (c)(1),
(2), (4) Date: **Nov. 30, 2006**

(87) PCT Pub. No.: **WO2005/119834**

PCT Pub. Date: **Dec. 15, 2005**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 60/578,437, filed on Jun.
9, 2004.

(30) **Foreign Application Priority Data**

Jun. 2, 2004 (EP) 04013003

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

(52) **U.S. Cl.** **455/575.1**; 343/702

(58) **Field of Classification Search** 455/575.1,
455/566, 575.7; 343/702

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,781,155	A	7/1998	Woo et al.	342/357
6,273,573	B1 *	8/2001	Abi-Abdallah	359/609
6,278,873	B1	8/2001	Itakura et al.	455/351
6,307,512	B1 *	10/2001	Geeraert	343/702
6,339,400	B1 *	1/2002	Flint et al.	343/702
2003/0197648	A1 *	10/2003	Quinn et al.	343/702
2004/0090382	A1	5/2004	Kushihi et al.	

FOREIGN PATENT DOCUMENTS

CN	1137324	A	12/1996
DE	44 43 596		6/1996

(Continued)

OTHER PUBLICATIONS

International Preliminary Report on Patentability for PCT/EP2005/
004497 dated Jun. 27, 2006.

European Search Report for Application No. 04 013 033.1-2220; Jul.
16, 2007.

Chinese Office Action for Application No. 200580017808.X mailed
May 26, 2010.

Primary Examiner — Lewis G West

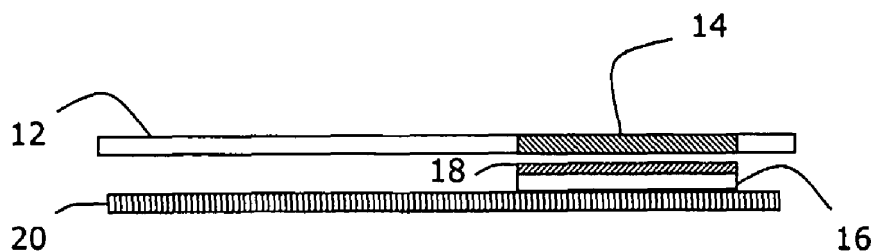
Assistant Examiner — David Bilodeau

(74) *Attorney, Agent, or Firm* — Myers Bigel Sibley &
Sajovec

(57) **ABSTRACT**

The present invention relates to a portable communication device and an antenna unit. The device includes a display having a display surface, a transparent non-conductive display window covering the display surface of the display, and an antenna having at least one antenna element, wherein the antenna element is provided as a transparent conductive layer provided on the display cover. With this antenna solution space is freed inside the device for use for other units or for further size reductions. Light passing through the window is furthermore not blocked.

11 Claims, 2 Drawing Sheets



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US007986273B2

(12) **United States Patent**
Tang

(10) **Patent No.:** **US 7,986,273 B2**

(45) **Date of Patent:** **Jul. 26, 2011**

(54) **MULTI-BAND MONOPOLE ANTENNA WITH
IMPROVED HAC PERFORMANCE**

(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 367 days.

(21) Appl. No.: **12/289,557**

(22) Filed: **Oct. 30, 2008**

(65) **Prior Publication Data**

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(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, 715, 846, 833-834
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,714,937 A * 2/1998 Campana, Jr. 340/573.1
6,340,952 B1 * 1/2002 Tsai et al. 343/741
6,876,329 B2 * 4/2005 Milosavljevic 343/700 MS

6,882,318 B2 * 4/2005 Nevermann 343/702
7,405,701 B2 7/2008 Ozkar
2005/0212706 A1 * 9/2005 Ying et al. 343/702
2006/0028380 A1 * 2/2006 Harano 343/702
2008/0231518 A1 * 9/2008 Tsutsumi et al. 343/700 MS

* cited by examiner

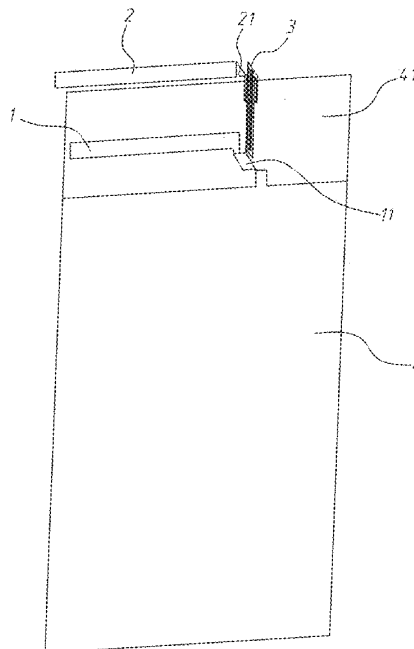
Primary Examiner — Huedung Mancuso

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

(57) **ABSTRACT**

A multi-band monopole antenna includes a first metal radiator and a second metal radiator extending in a same direction and arranged in parallel for exciting a high frequency band, and a detoured wire pattern connected between the feed end of the first metal radiator and the connection end of the second metal radiator for exciting a low frequency band. The detoured wire pattern has a circuit path length longer than one half of the high frequency band $\lambda/2$ so that the phase difference on current between the feed end of the first metal radiator and the connection end of the second metal radiator is about π (180-degrees); the electric fields generated at the lower sides of the first metal radiator and the second metal radiator have approximately the same size but reversed phases and the magnetic fields have the same characteristics; when the reversed phases of electromagnetic waves excited by the first and second metal radiators reach the HAC test surface, they cause a destructive interference, thereby improving hearing aid compatibility performance of the multi-band monopole antenna.

7 Claims, 11 Drawing Sheets



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US007986274B2

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

(10) **Patent No.:** **US 7,986,274 B2**
(45) **Date of Patent:** **Jul. 26, 2011**

(54) **MULTI-BAND ANTENNA**

(56) **References Cited**

(75) Inventors: **Wen-Chieh Yang**, Taipei Hsien (TW);
Kai Shih, Taipei Hsien (TW); **Yu-Yuan**
Wu, Taipei Hsien (TW)

(73) Assignee: **Cheng Uei Precision Industry Co.,**
Ltd., Taipei Hsien (TW)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
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(21) Appl. No.: **12/398,371**

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

(65) **Prior Publication Data**

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

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

See application file for complete search history.

U.S. PATENT DOCUMENTS
2006/0082506 A1 * 4/2006 Fang 343/700 MS
2009/0146906 A1 * 6/2009 Anguera Pros et al. 343/906
2009/0174611 A1 * 7/2009 Schlub et al. 343/702
2010/0149069 A1 * 6/2010 Kim 343/904

* cited by examiner

Primary Examiner — HoangAnh T Le

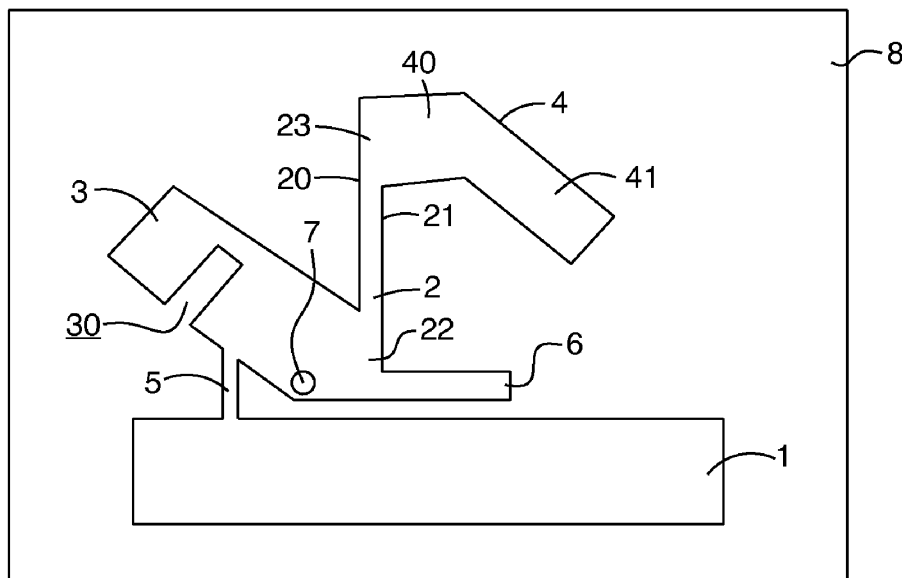
(74) *Attorney, Agent, or Firm* — WPAT, P.C.; Anthony King

(57) **ABSTRACT**

A multi-band antenna includes a ground portion, a radiating element spaced from the ground portion, a tuning conductor extending from the radiating element and parallel to the ground portion to form a gap therebetween, a short-circuit conductor interconnecting the ground portion and the radiating element, and a feed point disposed at the radiating element and adjacent to the short-circuit conductor. The radiating element, the short-circuit conductor and the feed point function as a first inverted-F antenna obtaining a first high frequency band, and a second inverted-F antenna obtaining a low frequency band and a second high frequency band higher than the first high frequency band. The ground portion and the tuning conductor cause a capacitance effect to shift the second high frequency band to be close to the first high frequency band. It can cover various wireless communication frequency bands.

20 Claims, 5 Drawing Sheets

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US007986275B2

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

(10) **Patent No.:** **US 7,986,275 B2**

(45) **Date of Patent:** **Jul. 26, 2011**

(54) **DUAL-BAND ANTENNA**

(75) Inventors: **Chih-Yung Huang**, Taichung County (TW); **Kuo-Chang Lo**, Miaoli County (TW)

(73) Assignee: **Arcadyan Technology Corporation**, Hsinchu (TW)

(*) 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.: **12/413,871**

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

(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
Aug. 22, 2008 (TW) 97132124 A
Oct. 28, 2008 (TW) 97141319 A

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

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

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

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,586,448 B2 * 9/2009 Wei 343/702
2008/0191957 A1 * 8/2008 Chang 343/845
* cited by examiner

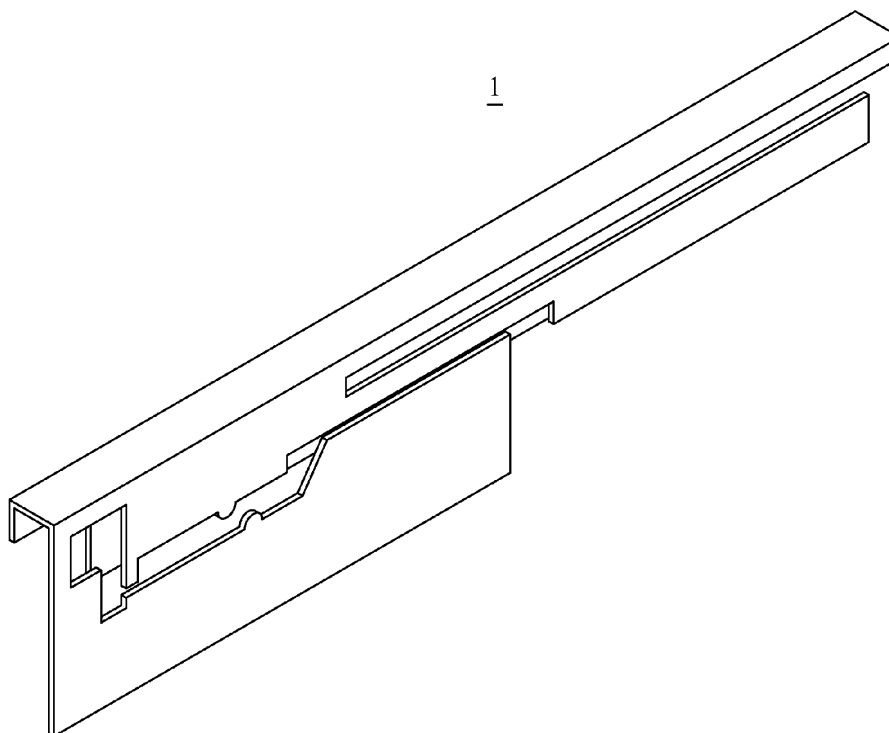
Primary Examiner — Hoang V Nguyen

(74) *Attorney, Agent, or Firm* — Tim Tingkang Xia; Morris, Manning & Martin, LLP

(57) **ABSTRACT**

The present invention discloses a dual-band antenna integrated with GSM wireless communication apparatuses, comprising: a first radiation unit; a first connecting portion; a second radiation unit; a second connecting portion; a grounding unit; a grounding extension unit; a signal feed-in terminal; and a signal grounding terminal. Therefore, the dual-band antenna integrated with GSM wireless communication apparatuses of the present invention has a broad effective operating band to significantly enhance the transceiving performance.

12 Claims, 12 Drawing Sheets



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US007986281B2

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

(10) **Patent No.:** **US 7,986,281 B2**

(45) **Date of Patent:** **Jul. 26, 2011**

(54) **MULTI-BAND ANTENNA**

(75) Inventors: **Lan-Yung Hsiao**, Taipei Hsien (TW);
Pei-Fen Wu, Taipei Hsien (TW);
Yu-Yuan Wu, Taipei Hsien (TW)

(73) Assignee: **Cheng Uei Precision Industry Co., Ltd.**, 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 422 days.

(21) Appl. No.: **12/354,952**

(22) Filed: **Jan. 16, 2009**

(65) **Prior Publication Data**

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

(52) **U.S. Cl.** **343/846**; 343/700 MS; 343/702;
343/893

(58) **Field of Classification Search** 343/700 MS,
343/702, 745, 845, 846, 847, 848, 893
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,166,694 A * 12/2000 Ying 343/702
6,734,825 B1 * 5/2004 Guo et al. 343/700 MS
7,256,743 B2 * 8/2007 Korva 343/702

7,432,861 B2 * 10/2008 Shih 343/700 MS
7,479,928 B2 * 1/2009 Tan et al. 343/702
7,525,488 B2 * 4/2009 Rowell 343/700 MS

* cited by examiner

Primary Examiner — Douglas W Owens

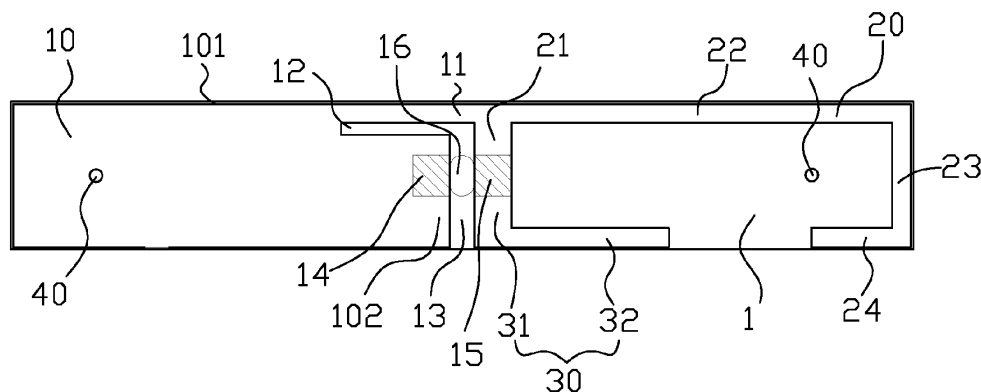
Assistant Examiner — Chuc D Tran

(74) *Attorney, Agent, or Firm* — WPAT, P.C.; Anthony King

(57) **ABSTRACT**

A multi-band antenna includes a first radiating portion, a second radiating portion extending perpendicularly from the first radiating portion, a third radiating portion extending perpendicularly from the second radiating portion and located at a same side with respect to the second radiating portion as the first radiating portion, a fourth radiating portion extending perpendicularly from the third radiating portion towards the first radiating portion, a fifth radiating portion in alignment with the first radiating portion, with a feeding portion connecting with the first radiating portion and the fifth radiating portion, a sixth radiating portion extending perpendicularly towards the fourth radiating portion from the fifth radiating portion and spaced away from the fourth radiating portion, and a grounding portion spaced from the first radiating portion, the feeding portion and the fifth radiating portion with a grounding area disposed thereon, and connected with the first radiating portion by a connecting portion.

8 Claims, 3 Drawing Sheets



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