



US007545331B2

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

(10) **Patent No.:** **US 7,545,331 B2**  
(45) **Date of Patent:** **Jun. 9, 2009**

(54) **ANTENNA DEVICE FOR PORTABLE TERMINAL**

(75) Inventors: **Hyu-Myung Jeon**, Seongnam-si (KR);  
**Dae-Chul Kang**, Suwon-si (KR);  
**Yong-Jin Kim**, Seoul (KR); **Yu-Jin Chung**, Suwon-si (KR); **Tae-Hui Cho**, Gunpo-si (KR)

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

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

(21) Appl. No.: **11/482,409**

(22) Filed: **Jul. 7, 2006**

(65) **Prior Publication Data**

US 2007/0080874 A1 Apr. 12, 2007

(30) **Foreign Application Priority Data**

Sep. 23, 2005 (KR) ..... 10-2005-0088788

(51) **Int. Cl.**

**H01Q 1/24** (2006.01)

**H01Q 1/10** (2006.01)

**H01Q 1/36** (2006.01)

(52) **U.S. Cl.** ..... **343/702**; 343/889; 343/895

(58) **Field of Classification Search** ..... 343/702, 343/889, 895, 900, 793, 797, 810-820, 846

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,861,859	A *	1/1999	Kanayama et al.	343/895
6,369,764	B1 *	4/2002	Ishikawa	343/702
6,756,943	B2 *	6/2004	Kim et al.	343/702
7,061,433	B2 *	6/2006	Kim et al.	343/702

FOREIGN PATENT DOCUMENTS

JP 11-243310 9/1999

\* cited by examiner

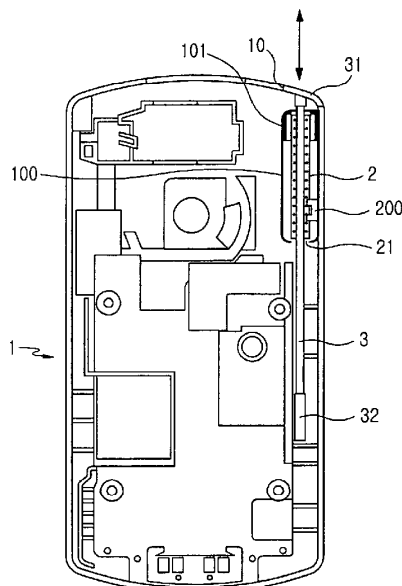
*Primary Examiner*—Shih-Chao Chen

(74) *Attorney, Agent, or Firm*—The Farrell Law Firm, PC

(57) **ABSTRACT**

An antenna device for a portable terminal, which allows a whip antenna and helical antenna of a terminal to be retracted and withdrawn along an extension from the terminal, while not causing them to protrude out of the terminal. The antenna device provided with a whip antenna and helical antenna further includes an antenna housing disposed at a desired position in the main body, which permits the whip antenna to be retracted and withdrawn through the helical antenna, while causing the helical antenna to be withdrawn along an extension from the main body at the same time, and permits the helical antenna to be retracted, so that it can be inserted into the main body; and a housing coupling portion disposed in the main body for supporting the antenna housing.

**10 Claims, 8 Drawing Sheets**





US007545336B2

(12) **United States Patent**  
**Naito**

(10) **Patent No.:** **US 7,545,336 B2**

(45) **Date of Patent:** **\*Jun. 9, 2009**

(54) **CARD TYPE WIRELESS DEVICE, ANTENNA COIL, AND METHOD FOR MANUFACTURING COMMUNICATION MODULE**

(75) Inventor: **Hikomichi Naito, Okazaki (JP)**

(73) Assignee: **Denso Corporation, Kariya, Aichi-Pref. (JP)**

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 353 days.

This patent is subject to a terminal disclaimer.

6,046,584	A	4/2000	Nakane et al.	
6,194,893	B1	2/2001	Yokotani et al.	
6,291,990	B1	9/2001	Nakane et al.	
6,452,381	B1	9/2002	Nakatani et al.	
6,924,767	B2	8/2005	Kitahara et al.	
7,050,007	B2	5/2006	Akiho et al.	
7,057,514	B2 *	6/2006	Mickle et al.	340/572.7
2002/0027531	A1 *	3/2002	Brown et al.	343/895
2004/0075616	A1	4/2004	Endo et al.	
2004/0085247	A1 *	5/2004	Mickle et al.	343/701
2005/0024285	A1	2/2005	Kato et al.	
2005/0040997	A1	2/2005	Akiho et al.	
2005/0270249	A1	12/2005	Saegusa et al.	
2006/0267854	A1	11/2006	Naito	
2007/0097011	A1 *	5/2007	Saegusa et al.	343/878
2008/0121242	A1 *	5/2008	Revie et al.	128/899

FOREIGN PATENT DOCUMENTS

(21) Appl. No.: **11/406,351**

(22) Filed: **Apr. 19, 2006**

(65) **Prior Publication Data**

US 2006/0267853 A1 Nov. 30, 2006

(30) **Foreign Application Priority Data**

May 31, 2005 (JP) ..... 2005-158916

(51) **Int. Cl.**  
**H01Q 7/08** (2006.01)

(52) **U.S. Cl.** ..... **343/788**

(58) **Field of Classification Search** ..... **343/788, 343/895, 702, 866-867, 741-742**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,321,240	A	6/1994	Takahira et al.
5,864,323	A	1/1999	Berthon

JP	2002-271127	9/2002
JP	2004-64193	2/2004
JP	2005-210223	8/2005

\* cited by examiner

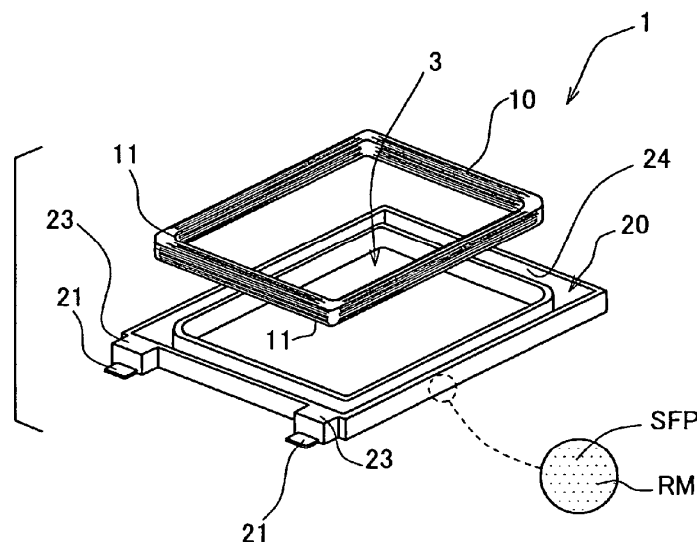
*Primary Examiner*—Huedung Mancuso

(74) *Attorney, Agent, or Firm*—Nixon & Vanderhye PC

(57) **ABSTRACT**

An antenna coil includes: an air-core type flat coil body; and a coil support member disposed between the coil body and a substrate so that the coil body is supported on a surface of the substrate. The thickness of the coil body is smaller than a radius of a circle, an area of which is equal to an area of a region surrounded with an outline of a projected coil body, the projected coil body provided by projecting the coil body on a projection plane perpendicular to the axial direction of the coil body. The coil support member is made of resin hardened soft magnetic material.

**22 Claims, 8 Drawing Sheets**





US007545339B2

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

(10) **Patent No.:** **US 7,545,339 B2**  
(45) **Date of Patent:** **Jun. 9, 2009**

(54) **PLANAR ANTENNA APPARATUS FOR  
ULTRA WIDE BAND APPLICATIONS**

2005/0156788 A1 7/2005 Lin

FOREIGN PATENT DOCUMENTS

(75) Inventors: **Mohamed Ratni**, Esslingen (DE);  
**Dragan Krupzevic**, Stuttgart (DE)

DE 197 29 664 A1 2/1999  
EP 1 564 842 A1 8/2005  
JP 2003-115714 4/2003  
WO WO 2005/062422 A1 7/2005

(73) Assignee: **Sony Deutschland GmbH**, Berlin (DE)

\* 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 337 days.

*Primary Examiner*—Huedung Mancuso

(74) *Attorney, Agent, or Firm*—Oblon, Spivak, McClelland, Maier & Neustadt, P.C.

(21) Appl. No.: **11/529,371**

(57) **ABSTRACT**

(22) Filed: **Sep. 29, 2006**

The present invention relates to the field of microwave antenna and particularly to transmitting and receiving planar antenna design having an omni-directional radiation pattern for ultra wideband (UWB) applications. The object is to provide a planar antenna design for UWB system which is capable of transmitting/receiving microwave signals within the UWB frequency band, capable of a simple planar feeding and a printed low-cost manufacturing antenna, achieves a significant cost reduction by simultaneously applying antenna layout prints while manufacturing classical radio frequency (RF) front-end chip circuits and capable to cope with symmetrical omni-directional transmitting/receiving signals. It is solved by an antenna apparatus for a wireless electronic equipment operable to transmit and/or receive electromagnetic waves in ultra wideband technology comprising at least one radiator device operable to transmit and/or receive an electromagnetic wave, a ground plane device operable to reflect an electromagnetic wave transmitted and/or received by the radiator device and a feeding device) operable to supply signals from and/or to the radiator device, characterised in that the radiator device and the ground plane device are arranged along a common symmetry axis and are planar on the same plane, whereby the radiator device tapers towards the ground plane device.

(65) **Prior Publication Data**

US 2007/0103369 A1 May 10, 2007

(30) **Foreign Application Priority Data**

Nov. 9, 2005 (EP) ..... 05024462

(51) **Int. Cl.**  
**H01Q 9/38** (2006.01)

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

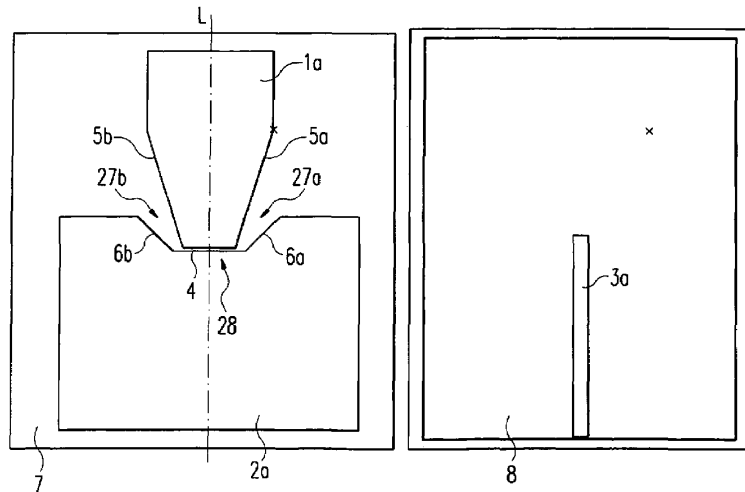
(58) **Field of Classification Search** ..... 343/830,  
343/846-848, 767-769, 700 MS  
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,828,340 A 10/1998 Johnson  
6,850,192 B2 \* 2/2005 Yeh ..... 343/700 MS  
7,042,401 B2 \* 5/2006 Park et al. .... 343/700 MS  
7,050,013 B2 \* 5/2006 Kim et al. .... 343/770  
7,116,276 B2 \* 10/2006 Lee ..... 343/700 MS  
7,239,283 B2 \* 7/2007 Chua ..... 343/746  
7,324,049 B2 \* 1/2008 Myoung et al. .... 343/700 MS  
7,352,333 B2 \* 4/2008 McCorkle ..... 343/767

**21 Claims, 5 Drawing Sheets**





US007548204B2

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

(10) **Patent No.:** **US 7,548,204 B2**  
(45) **Date of Patent:** **Jun. 16, 2009**

(54) **BROADBAND ANTENNA SMALLER  
STRUCTURE HEIGHT**

(75) Inventors: **Eugen Arnold**, Ulm (DE); **Ingo Walter**,  
Siegen (DE); **Ullrich Fuchs**, Dettingen  
(DE); **Birgit Michael**, Ulm (DE)

(73) Assignee: **EADS Deutschland GmbH**, Ottobrunn  
(DE)

(\* ) Notice: Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
U.S.C. 154(b) by 396 days.

6,667,716	B2 *	12/2003	Chen .....	343/700	MS
6,911,940	B2 *	6/2005	Poilasne et al. ....	343/700	MS
7,012,572	B1 *	3/2006	Schaffner et al. ....	343/725	
2001/0050636	A1	12/2001	Weinberger		
2002/0021249	A1	2/2002	Kuck		
2003/0020668	A1 *	1/2003	Peterson .....	343/846	
2003/0052827	A1	3/2003	Umeara et al.		
2005/0159195	A1	7/2005	Huber et al.		

(21) Appl. No.: **11/187,881**

(22) Filed: **Jul. 25, 2005**

(65) **Prior Publication Data**

US 2006/0044201 A1 Mar. 2, 2006

(30) **Foreign Application Priority Data**

Jul. 23, 2004 (DE) ..... 10 2004 036 001

(51) **Int. Cl.**  
**H01Q 1/38** (2006.01)  
**H01Q 1/48** (2006.01)

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

(58) **Field of Classification Search** ..... 343/713,  
343/700 MS, 746, 907, 904, 846, 848, 793,  
343/797, 810-820

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,546,358	A	10/1985	Edlin et al.		
5,440,316	A	8/1995	Podgorski et al.		
5,734,350	A	3/1998	Deming et al.		
6,002,367	A *	12/1999	Engblom et al. ....	343/700	MS
6,249,254	B1 *	6/2001	Bateman et al. ....	343/700	MS
6,326,919	B1 *	12/2001	Diximus et al. ....	343/700	MS
6,466,176	B1	10/2002	Maoz et al.		
6,590,540	B1 *	7/2003	Adams et al. ....	343/718	

FOREIGN PATENT DOCUMENTS

DE	102 04 877	A1	8/2003
EP	1 052 723	A2	11/2000

(Continued)

OTHER PUBLICATIONS

Jieh-Sen Kuo and Kin-Lu Wong "Dual-Frequency Operation of A Planar Inverted-L Antenna with Tapered Patch Width" Department of Electrical Engineering National Sun Yat-Sen University Kaohsiung, Taiwan 804, R.O.C. Microwave And Optical Technology Letter? vol. 28, No. 2, Jan. 20, 2001.\*

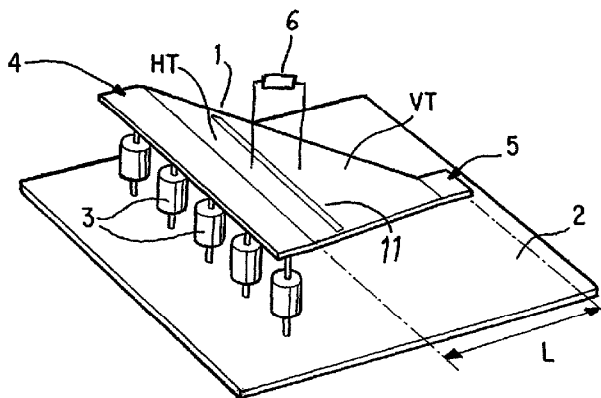
(Continued)

*Primary Examiner*—Shih-Chao Chen  
(74) *Attorney, Agent, or Firm*—Crowell & Moring LLP

(57) **ABSTRACT**

An antenna having a radiating surface (1) and a base surface (2). One or more discrete components (3) are arranged between the radiating surface (1) and the base surface (2). The radiating surface (1) has a tapering with respect to its width B and with respect to its height H from the base surface (2).

**4 Claims, 5 Drawing Sheets**





US007548207B1

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

(10) **Patent No.:** **US 7,548,207 B1**  
(45) **Date of Patent:** **Jun. 16, 2009**

(54) **CIRCULARLY POLARIZED ANTENNA**

7,019,699 B2\* 3/2006 Komatsu et al. .... 343/711  
7,071,878 B2\* 7/2006 Masutani ..... 343/700 MS

(75) Inventors: **Fang-Hsien Chu**, Taipei County (TW);  
**Hua-Ming Chen**, Taipei County (TW);  
**Yang-Kai Wang**, Taipei County (TW);  
**Ching-Shun Wang**, Taipei County (TW)

\* cited by examiner

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

*Primary Examiner*—James Cho  
(74) *Attorney, Agent, or Firm*—Darby & Darby P.C.

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

(57) **ABSTRACT**

(21) Appl. No.: **12/026,727**

A circularly polarized antenna includes a dielectric substrate, a closed-loop radiating element, a micro-strip radiating element, a feeding element, and a grounding element. The closed-loop radiating element is formed on a first surface of the dielectric substrate. The micro-strip radiating element is formed on the first surface of the dielectric substrate, is surrounded by the closed-loop radiating element, and is coupled to the closed-loop radiating element. The feeding element is formed on the first surface of the dielectric substrate, is surrounded by the closed-loop radiating element, and is coupled to the micro-strip radiating element. The grounding element is formed on a second surface of the dielectric substrate.

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

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

(52) **U.S. Cl.** ..... **343/700 MS; 343/866; 343/741**

(58) **Field of Classification Search** ..... **343/700 MS, 343/866, 741**

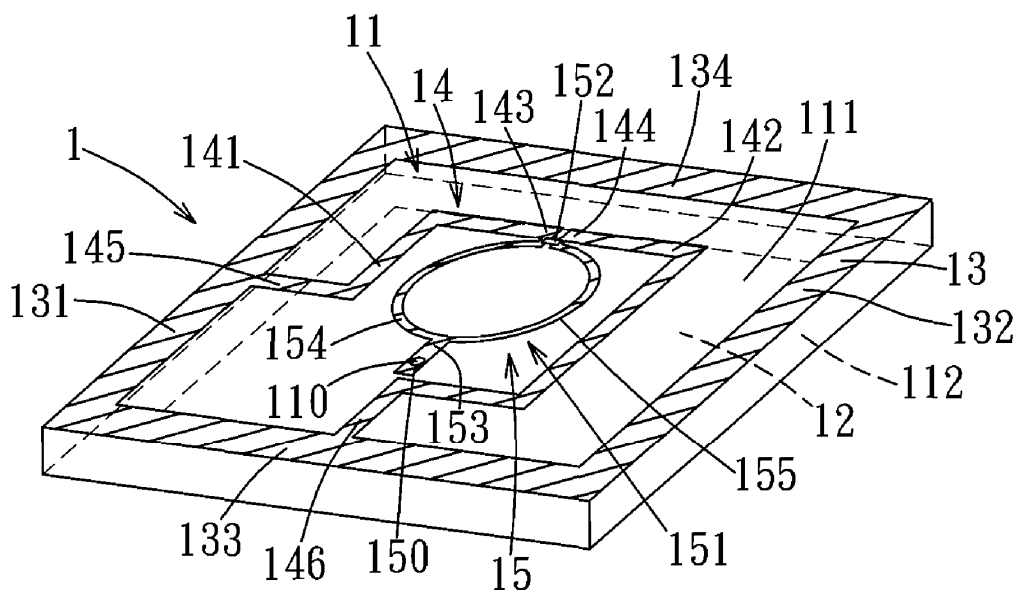
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,992,630 B2\* 1/2006 Parsche ..... 343/700 MS

**14 Claims, 5 Drawing Sheets**





US007548214B2

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

(10) **Patent No.:** **US 7,548,214 B2**  
(45) **Date of Patent:** **Jun. 16, 2009**

(54) **DUAL-BAND DIPOLE ANTENNA**

(75) Inventors: **Jui-Hung Chou**, Taichung (TW);  
**Saou-Wen Su**, Hsinchu (TW)

(73) Assignees: **Lite-On Technology Corporation**,  
Taipei (TW); **Silitek Electronic (GZ)**  
**Co., Ltd.**, Guangzhou (CN)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 14 days.

(21) Appl. No.: **11/979,649**

(22) Filed: **Nov. 7, 2007**

(65) **Prior Publication Data**

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(51) **Int. Cl.**  
**H01Q 9/28** (2006.01)

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

(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

6,600,450 B1 \* 7/2003 Efanov et al. .... 343/726

6,621,464 B1 9/2003 Fang et al.  
6,961,028 B2 \* 11/2005 Joy et al. .... 343/895  
7,145,517 B1 \* 12/2006 Cheng ..... 343/795  
7,151,500 B2 \* 12/2006 Su et al. .... 343/795  
7,183,993 B2 \* 2/2007 Dai et al. .... 343/795  
7,230,578 B2 6/2007 Ke et al.

\* cited by examiner

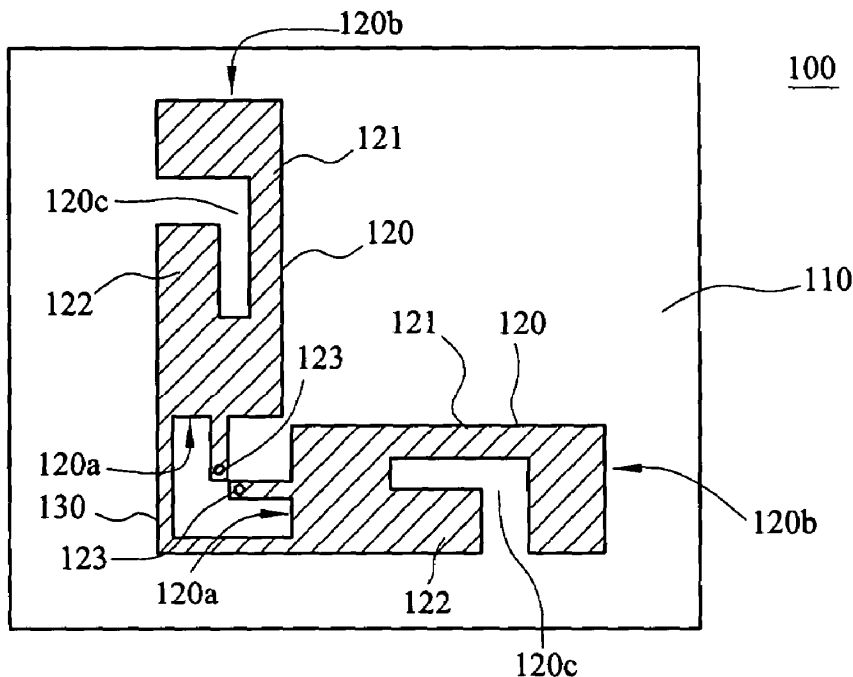
*Primary Examiner*—Don P Le

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

(57) **ABSTRACT**

A dual-band dipole antenna includes two radiating arms and a short-circuited element. The two radiating arms and the short-circuited element are formed monolithically. Each radiating arm has a feed-in end and a radiating end. Each radiating arm has a slot that divides the radiating arm into a first radiating portion and a second radiating portion. The resonant frequencies of the first radiating portion and the second radiating portion are different to radiate/receive wireless signals in two frequencies respectively. The short-circuited element is connected to the feed-in end of each radiating arm, so as to electrically connect the two radiating arms. The short-circuited element also makes an included angle formed between the two radiating arms, so as to obtain the effect of dipole gains of the radio waves transferred or received by the two radiating arms.

**10 Claims, 11 Drawing Sheets**





US007548217B2

(12) **United States Patent  
Chang**

(10) **Patent No.:** US 7,548,217 B2  
(45) **Date of Patent:** Jun. 16, 2009

(54) **PARTIALLY REFLECTIVE SURFACE  
ANTENNA**

(75) Inventor: **The-Nan Chang**, Taipei (TW)

(73) Assignee: **Tatung University & Tatung  
Company**, 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.: **12/061,718**

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

(65) **Prior Publication Data**  
US 2009/0115680 A1 May 7, 2009

(30) **Foreign Application Priority Data**  
Nov. 6, 2007 (TW) ..... 96141820 A

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

(52) **U.S. Cl.** ..... **343/909; 343/700 MS;**  
343/756; 343/912

(58) **Field of Classification Search** ..... 343/756,  
343/700 MS, 912, 755, 853, 909  
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,455,594 A \* 10/1995 Blasing et al. .... 343/700 MS  
6,597,327 B2 \* 7/2003 Kanamaluru et al. .... 343/909  
6,759,994 B2 \* 7/2004 Rao et al. .... 343/912  
6,836,258 B2 \* 12/2004 Best et al. .... 343/909  
7,161,539 B2 \* 1/2007 Chang et al. .... 343/700 MS  
7,319,429 B2 \* 1/2008 Chang et al. .... 343/700 MS

\* cited by examiner

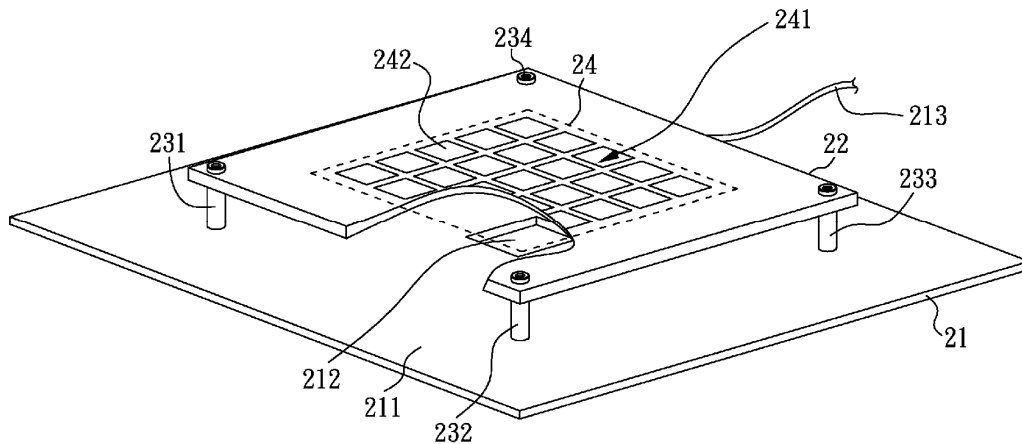
*Primary Examiner*—Tho G Phan

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

(57) **ABSTRACT**

A partially reflect surface antenna includes a substrate, a reflective sheet and a plurality of supporting units. The substrate has an upper surface formed thereon a signal I/O for receiving and outputting high frequency signal. The reflective sheet partially reflects the high frequency signal and includes an array antenna block located at the surface of the reflective sheet. The plurality of supporting units support the reflective sheet to locate at the upper surface of the substrate and to maintain a predetermined distance between the reflective sheet and the substrate. The area of the array antenna block ranges from 0.31 to 0.8 times of the surface area of the reflective sheet.

**17 Claims, 14 Drawing Sheets**





US007551142B1

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

(10) **Patent No.:** **US 7,551,142 B1**  
(45) **Date of Patent:** **Jun. 23, 2009**

(54) **HYBRID ANTENNAS WITH DIRECTLY FED ANTENNA SLOTS FOR HANDHELD ELECTRONIC DEVICES**

(75) Inventors: **Zhijun Zhang**, Beijing (CN); **Robert J. Hill**, Salinas, CA (US); **Robert W. Schlub**, Campbell, CA (US); **Juan Zavala**, Watsonville, 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.: **11/956,314**

(22) Filed: **Dec. 13, 2007**

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

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

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

See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

6,670,923	B1	12/2003	Kadambi et al.
6,741,214	B1	5/2004	Kadambi et al.
6,747,601	B2	6/2004	Boyle
6,856,294	B2	2/2005	Kadambi et al.
6,980,154	B2	12/2005	Vance et al.
7,027,838	B2	4/2006	Zhou et al.
7,116,267	B2	10/2006	Schuster et al.
7,119,747	B2	10/2006	Lin et al.
7,123,208	B2	10/2006	Puente Baliarda et al.

2003/0107518	A1	6/2003	Li et al.
2004/0145521	A1	7/2004	Hebron et al.
2004/0257283	A1*	12/2004	Asano et al. .... 343/702
2006/0055606	A1	3/2006	Boyle
2008/0231521	A1*	9/2008	Anguera Pros et al. .... 343/702

**OTHER PUBLICATIONS**

Hill et al. U.S. Appl. No. 11/650,187, filed Jan. 4, 2007.  
Hill et al. U.S. Appl. No. 11/821,192, filed Jun. 21, 2007.  
Hill et al. U.S. Appl. No. 11/897,033, filed Aug. 28, 2007.  
Zhang et al. U.S. Appl. No. 11/895,053, filed Aug. 22, 2007.

\* cited by examiner

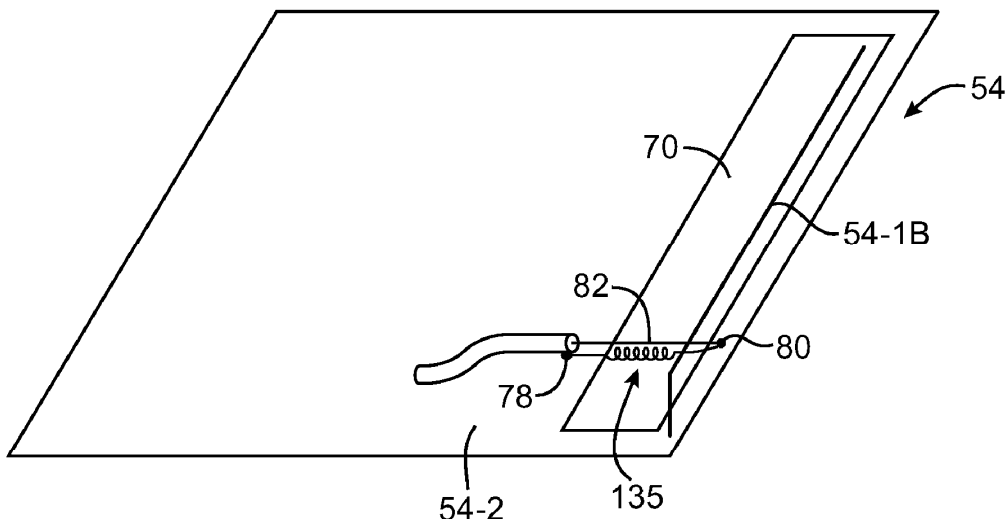
*Primary Examiner*—Anh Q Tran

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

(57) **ABSTRACT**

A handheld electronic device is provided that contains wireless communications circuitry. The wireless communications circuitry may include antennas. An antenna in the handheld electronic device may have a ground plane element. A slot antenna resonating element may be formed from an opening in the ground plane element. A near-field-coupled antenna resonating element may be electromagnetically coupled to the slot antenna resonating element through electromagnetic near-field coupling. A transmission line may directly feed the slot antenna resonating element. The transmission line may indirectly feed the near-field-coupled antenna resonating element through the slot antenna resonating element. The slot antenna resonating element may have one or more associated resonant frequencies and the near-field-coupled antenna resonating element may have one or more associated resonant frequencies. The antenna may be configured to cover one or more distinct communications bands.

**14 Claims, 24 Drawing Sheets**







US007554488B2

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

(10) **Patent No.:** **US 7,554,488 B2**  
(45) **Date of Patent:** **Jun. 30, 2009**

(54) **PLANAR ANTENNA**

(75) Inventors: **Chia-Hao Mei**, Shenzhen (CN); **Jia-Lin Teng**, Shenzhen (CN)

(73) Assignee: **Hon Hai Precision Industry Co., Ltd.**,  
Tu-Chung, Taipei Hsien (TW)

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(22) Filed: **Oct. 17, 2006**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority 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, 895, 748**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,531,985	B1 *	3/2003	Jones et al.	343/702
6,781,547	B2 *	8/2004	Lee	343/700 MS
6,897,808	B1 *	5/2005	Murch et al.	343/700 MS
7,333,068	B2 *	2/2008	Biddulph	343/794
2004/0201532	A1 *	10/2004	Apostolos et al.	343/742

\* cited by examiner

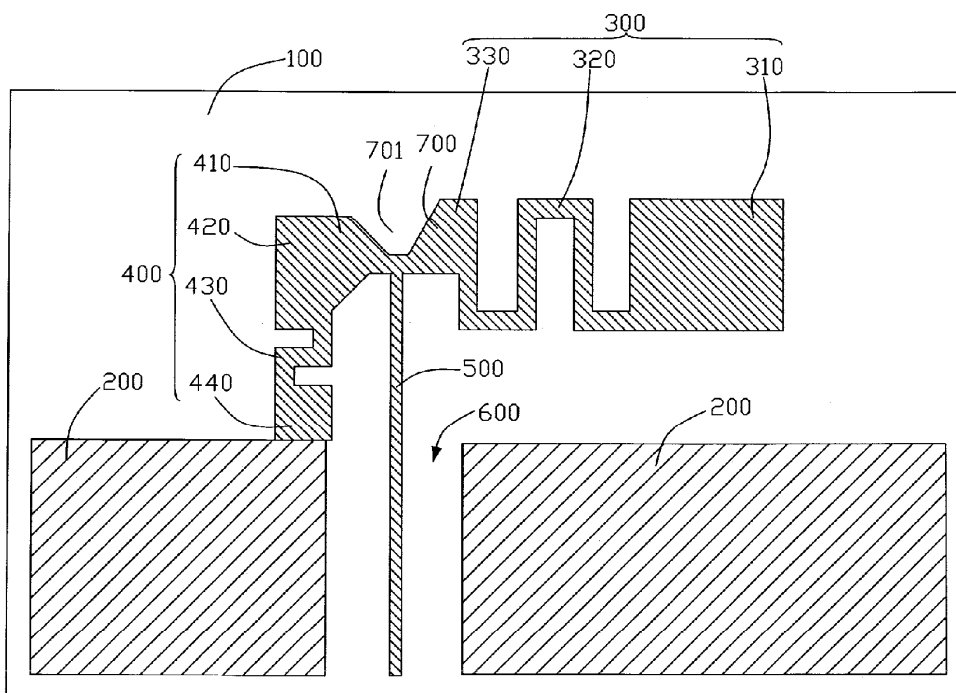
*Primary Examiner*—Huedung Mancuso

(74) *Attorney, Agent, or Firm*—Wei Te Chung

(57) **ABSTRACT**

A planar antenna disposed on a substrate (100) includes a metallic ground plane (200), a radiating part (300), an open-short transforming part (400), a joint portion (700), and a feeding part (500). The metallic ground plane is laid on the substrate. The radiating part transmits and receives radio frequency (RF) signals, and includes a first bent portion (320) and an open end (310). The first bent portion is electrically connected to the open end. The open-short transforming part is electrically connected between the radiating part and the metallic ground plane, and includes a second bent portion (430). The joint portion connects the open-short transforming part and the radiating part, and defines a recessed portion (701). The feeding part is electrically connected to the joint portion, for feeding signals.

**20 Claims, 22 Drawing Sheets**





US007554492B2

(12) **United States Patent**  
**Cheng**

(10) **Patent No.:** **US 7,554,492 B2**  
(45) **Date of Patent:** **Jun. 30, 2009**

(54) **PRINTED ANTENNA AND PRINTED ANTENNA MODULE**

- (75) Inventor: **Shih-Chieh Cheng**, Tainan 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 153 days.

(21) Appl. No.: **11/882,038**

(22) Filed: **Jul. 30, 2007**

(65) **Prior Publication Data**  
US 2008/0084353 A1 Apr. 10, 2008

(30) **Foreign Application Priority Data**  
Oct. 5, 2006 (TW) ..... 95137232 A  
Oct. 31, 2006 (CH) ..... 2006 1 0137648

(51) **Int. Cl.**  
**H01Q 1/38** (2006.01)  
**H01Q 1/48** (2006.01)

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

(58) **Field of Classification Search** ..... **343/700 MS, 343/702, 846, 848, 873**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,982,332 A *	11/1999	Lewis, Jr. ....	343/749
6,476,767 B2 *	11/2002	Aoyama et al. ....	343/700 MS
2007/0139270 A1 *	6/2007	Takei et al. ....	343/700 MS

\* cited by examiner

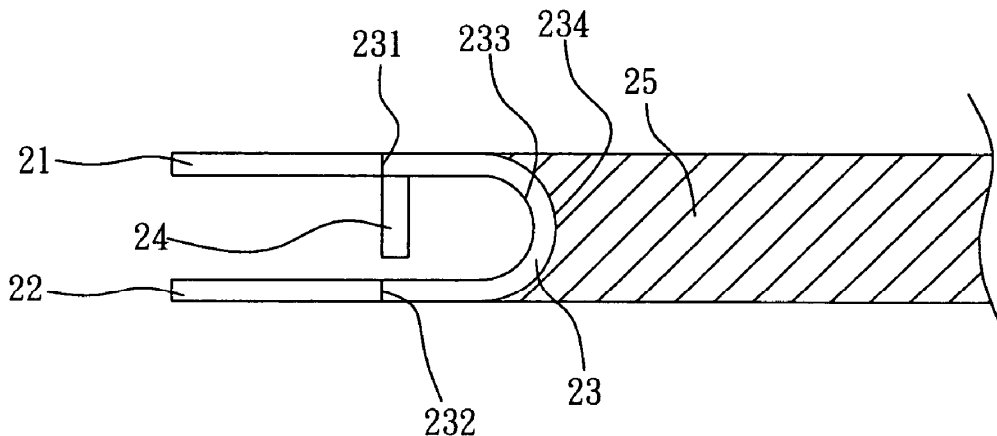
*Primary Examiner*—Shih-Chao Chen

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

(57) **ABSTRACT**

A printed antenna includes a radiating portion, a capacitance matching portion, an inductance matching portion, a feeding portion and a grounding portion. The capacitance matching portion is disposed parallel to the radiating portion. One end of the inductance matching portion is electrically connected with the radiating portion, and the other end of the inductance matching portion is electrically connected with the capacitance matching portion. The feeding portion, which is electrically connected with one inner side of the inductance matching portion, is located among the capacitance matching portion, the inductance matching portion, and the radiating portion. The feeding portion is roughly perpendicular to the radiating portion. The grounding portion is electrically connected with an outer side of the inductance matching portion. In addition, a printed antenna module including several printed antennas is also disclosed.

**20 Claims, 8 Drawing Sheets**





US007554495B2

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

(10) **Patent No.:** **US 7,554,495 B2**  
(45) **Date of Patent:** **Jun. 30, 2009**

(54) **ANTENNA APPARATUS**

2005/0270240 A1 12/2005 Qi et al.

(75) Inventors: **Ryouichi Enoshima**, Higashiyamato (JP); **Takayuki Shimizu**, Higashiyamato (JP)

FOREIGN PATENT DOCUMENTS

(73) Assignee: **Casio Hitachi Mobile Communications Co., Ltd.**, Tokyo (JP)

DE	103 41 310 A1	3/2004
EP	1 113 524 A2	7/2001
EP	1 414 108 A2	4/2004
JP	8-84013	3/1996
JP	10-209733	8/1998

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 68 days.

(21) Appl. No.: **11/703,264**

(Continued)

(22) Filed: **Feb. 7, 2007**

OTHER PUBLICATIONS

(65) **Prior Publication Data**

US 2007/0205949 A1 Sep. 6, 2007

European Search Report issued in the corresponding European Application No. 07 00 2209.

(30) **Foreign Application Priority Data**

Feb. 10, 2006 (JP) ..... 2006-033603

*Primary Examiner*—Hoang V Nguyen

(74) *Attorney, Agent, or Firm*—Cohen Pontani Lieberman & Pavane LLP

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

(57) **ABSTRACT**

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

(58) **Field of Classification Search** ..... 343/702, 343/700 MS, 741, 866

See application file for complete search history.

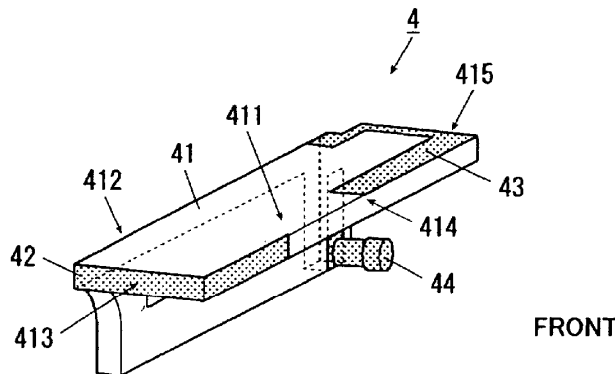
An antenna apparatus has a first antenna element and a second antenna element branched from one power feed point. The first antenna element and the second antenna element, which have different lengths, are arranged nearly in a loop as a whole with a predetermined clearance provided between distal ends thereof. The first antenna element and the second antenna element are arranged in such a way that the end faces of the distal ends thereof do not face each other with a lengthwise direction of the end face of the distal end of the first antenna element being approximately orthogonal to a lengthwise direction of the end face of the distal end of the second antenna element. Therefore, the antenna apparatus can suppress electric coupling of a plurality of antenna elements which transmit and/or receive radio waves of different frequency bands.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,903,240 A *	5/1999	Kawahata et al. ....	343/700 MS
6,535,170 B2 *	3/2003	Sawamura et al. ....	343/702
6,680,700 B2	1/2004	Hilgers	
6,717,551 B1	4/2004	Desclos et al.	
6,950,072 B2	9/2005	Miyata et al.	
6,956,531 B2	10/2005	Sugiyama et al.	
6,963,310 B2	11/2005	Horita et al.	
6,965,346 B2 *	11/2005	Sung et al. ....	343/702
7,034,754 B2 *	4/2006	Hung et al. ....	343/700 MS
7,042,400 B2	5/2006	Okubo et al.	
2003/0174092 A1	9/2003	Sullivan et al.	

**11 Claims, 7 Drawing Sheets**





US007554497B2

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

(10) **Patent No.:** **US 7,554,497 B2**  
(45) **Date of Patent:** **Jun. 30, 2009**

(54) **ANTENNA DEVICE AND WIRELESS DEVICE**

(75) Inventors: **Isao Ohba**, Hachioji (JP); **Hikomichi Suzuki**, Hamura (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 106 days.

(21) Appl. No.: **11/900,219**

(22) Filed: **Sep. 11, 2007**

(65) **Prior Publication Data**

US 2008/0211721 A1 Sep. 4, 2008

(30) **Foreign Application Priority Data**

Sep. 13, 2006 (JP) ..... P2006-248595

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

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

(58) **Field of Classification Search** ..... **343/702, 343/700 MS, 846, 872, 876**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,012,571 B1\* 3/2006 Ozkar et al. .... 343/702

7,209,086 B2\* 4/2007 Chung ..... 343/702  
7,245,950 B2\* 7/2007 Iwai et al. .... 455/575.7  
2009/0033563 A1\* 2/2009 Kanasaki et al. .... 343/702

**FOREIGN PATENT DOCUMENTS**

JP 2004-096209 A 3/2004  
JP 2005-217623 A 8/2005  
JP 2005-277865 A 10/2005

\* cited by examiner

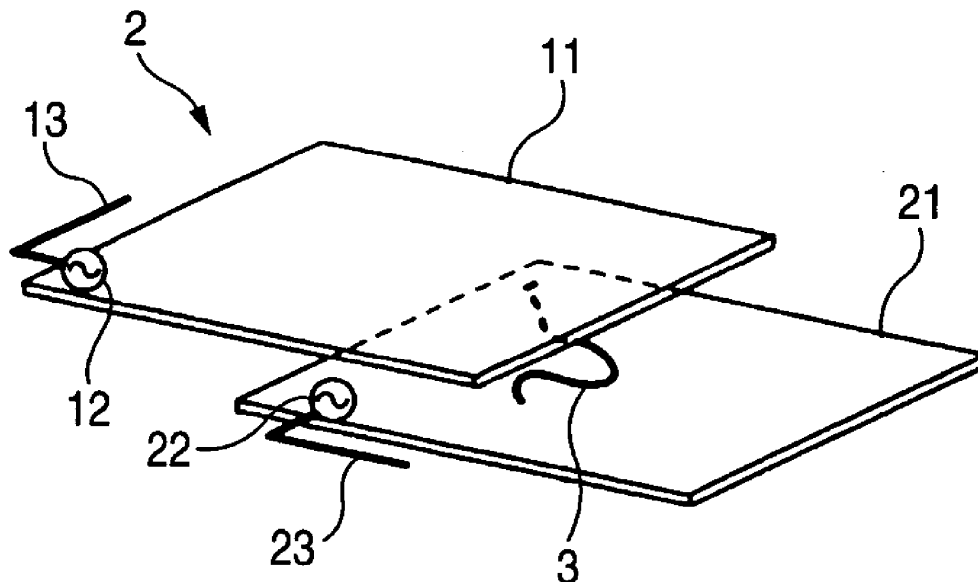
*Primary Examiner*—Shih-Chao Chen

(74) *Attorney, Agent, or Firm*—Frishauf, Holtz, Goodman & Chick, P.C.

(57) **ABSTRACT**

According to an aspect of the invention, there is provided an antenna device housed within a wireless device, including: a first case and a second case at least partly overlapping with each other, the first and second cases electrically connected with each other and slidable to open and close the antenna device; a first board housed within the first case; a second board housed within the second case; a first unbalanced antenna element connected to a first feeding point located in a vicinity of a first edge departing from the second case among edges of the first board when the first case and the second case are slid in a direction to open the wireless device; and a second unbalanced antenna element being connected to a second feeding point located in a vicinity of a second edge substantially perpendicular to the first edge among edges of the second board.

**6 Claims, 14 Drawing Sheets**





US007554498B1

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

(10) **Patent No.:** **US 7,554,498 B1**  
(45) **Date of Patent:** **Jun. 30, 2009**

(54) **ANTENNA FOR WWAN**  
(75) Inventors: **Cheng-Han Lee**, Kaohsiung (TW);  
**Ching-Chia Mai**, Kaohsiung (TW);  
**Wei-Hung Juan**, Kaohsiung (TW);  
**Chi-Yueh Wang**, Kaohsiung (TW)

6,424,304 B1 \* 7/2002 Jan et al. .... 343/702  
6,606,071 B2 \* 8/2003 Cheng et al. .... 343/767  
6,724,348 B2 \* 4/2004 Fang ..... 343/702  
6,781,546 B2 \* 8/2004 Wang et al. .... 343/700 MS  
6,809,690 B2 \* 10/2004 Tao ..... 343/702  
7,050,010 B2 \* 5/2006 Wang et al. .... 343/702

(73) Assignee: **Yageo Corporation**, Kaohsiung (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.

\* cited by examiner  
*Primary Examiner*—Tho G Phan  
(74) *Attorney, Agent, or Firm*—Volentine & Whitt, PLLC

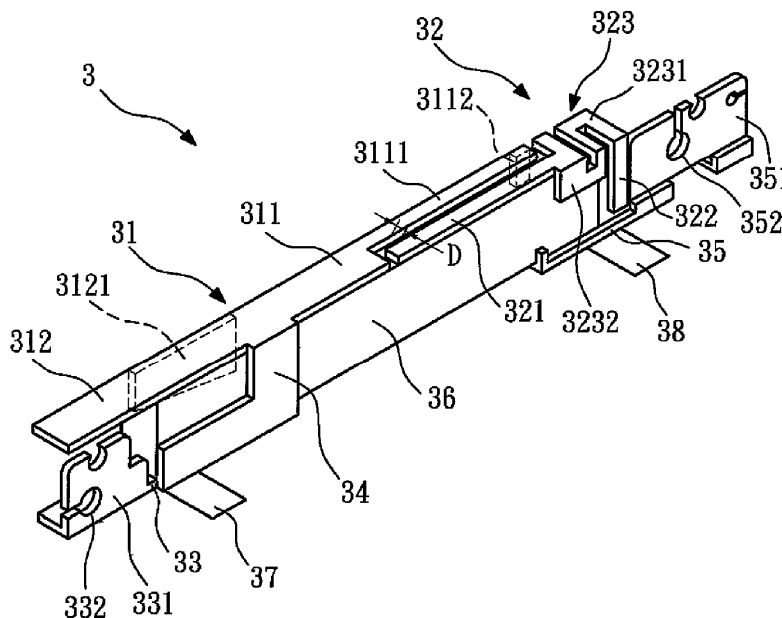
(21) Appl. No.: **12/099,806**  
(22) Filed: **Apr. 9, 2008**  
(30) **Foreign Application Priority Data**  
Dec. 26, 2007 (TW) ..... 96150367 A  
(51) **Int. Cl.**  
**H01Q 1/24** (2006.01)  
(52) **U.S. Cl.** ..... **343/702**; 343/700 MS;  
343/846  
(58) **Field of Classification Search** ..... 343/700 MS,  
343/702, 846, 829  
See application file for complete search history.

(57) **ABSTRACT**

An antenna for WWAN is disclosed, which includes a first radiating metal strip, a second radiating metal strip, a first ground strip, a connecting metal strip and a second ground strip. The first radiating metal strip has a first portion and a second portion. The second radiating metal strip is independent. The first portion is coupled with the second radiating metal strip to induce a first resonance. The second portion cooperates with the second radiating metal strip to induce a second resonance. The connecting metal strip connects the first radiating metal strip to the first ground strip. The second ground strip is independent. The ground strips are used for grounding effect and can be selectively connected to a ground end of a wireless electronic device. Therefore, the antenna can be mounted in any place of the wireless electronic device, and has stable electrical characteristic.

(56) **References Cited**  
U.S. PATENT DOCUMENTS  
6,339,400 B1 1/2002 Flint et al.

**20 Claims, 4 Drawing Sheets**





US007554501B2

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

(10) **Patent No.:** **US 7,554,501 B2**  
(45) **Date of Patent:** **Jun. 30, 2009**

(54) **LOOP ANTENNA HAVING MATCHING CIRCUIT INTEGRALLY FORMED**

(75) Inventors: **Wee-sang Park**, Yongin-si (KR);  
**Yoon-taek Lim**, Yongin-si (KR);  
**Young-eil Kim**, Yongin-si (KR);  
**Yong-jin Kim**, Yongin-si (KR)

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

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 19 days.

(21) Appl. No.: **11/645,774**

(22) Filed: **Dec. 27, 2006**

(65) **Prior Publication Data**

US 2008/0036678 A1 Feb. 14, 2008

(30) **Foreign Application Priority Data**

Aug. 8, 2006 (KR) ..... 10-2006-0074501

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

(52) **U.S. Cl.** ..... 343/741; 343/742; 343/866

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

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,641,576 A \* 2/1972 Farbanish ..... 343/743

3,956,751 A *	5/1976	Herman	.....	343/744
4,342,999 A *	8/1982	Woodward et al.	.....	343/702
4,518,965 A *	5/1985	Hidaka	.....	343/742
4,647,937 A	3/1987	Hidaka et al.		
2004/0178958 A1	9/2004	Kadambi et al.		
2005/0024290 A1	2/2005	Aisenbrey		
2005/0092836 A1 *	5/2005	Kudo	.....	235/436
2006/0143899 A1	7/2006	Tuttle et al.		

FOREIGN PATENT DOCUMENTS

JP	2002117383 A	4/2002
JP	2004021484 A	1/2004
KR	1020060040312 A	10/2006
KR	100688253 B1	2/2007

\* cited by examiner

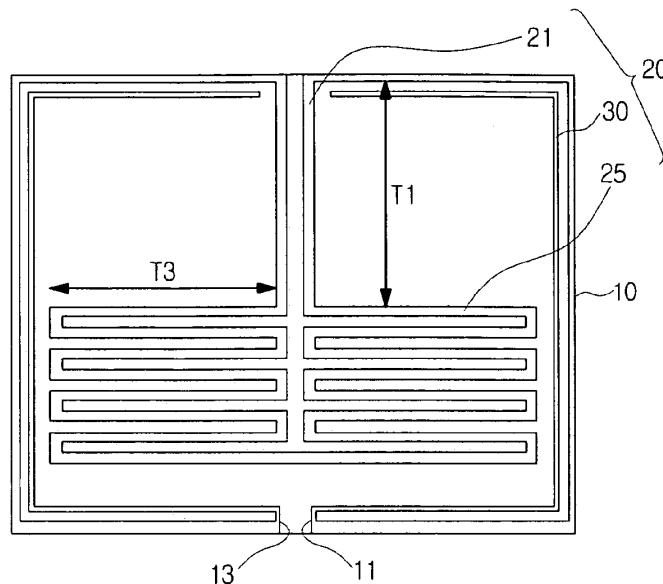
Primary Examiner—Tho G Phan

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

(57) **ABSTRACT**

A loop antenna is provided having a matching circuit integrally formed includes a radiator which is formed in a loop shape; and a matching circuit including an extension part extended from one side of the radiator to an inner side of the loop and a bend part bent from an end of the extension part several times. Accordingly, the space for the installation of the loop antenna can be reduced and the design modification of the matching circuit can be facilitated.

**15 Claims, 7 Drawing Sheets**





US007554503B2

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

(10) **Patent No.:** **US 7,554,503 B2**  
(45) **Date of Patent:** **Jun. 30, 2009**

(54) **WIDE BAND ANTENNA**

(75) Inventors: **Cheng-Hsuan Hsu**, Hsin-Tien (TW);  
**Sheng-Chih Lin**, Hsin-Tien (TW);  
**Tsung-Wen Chiu**, Hsin-Tien (TW);  
**Fu-Ren Hsiao**, Hsin-Tien (TW)

(73) Assignee: **Advanced Connectek Inc.**, 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 0 days.

(21) Appl. No.: **12/014,269**

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

(65) **Prior Publication Data**  
US 2008/0174496 A1 Jul. 24, 2008

(30) **Foreign Application Priority Data**  
Jan. 19, 2007 (TW) ..... 96102098 A

(51) **Int. Cl.**  
**H01Q 13/10** (2006.01)  
**H01Q 1/38** (2006.01)  
**H01Q 5/00** (2006.01)  
**H01Q 9/04** (2006.01)

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

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

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,248,224 B2 \* 7/2007 Yuanzhu ..... 343/700 MS

7,352,329 B2 \* 4/2008 Chung et al. .... 343/700 MS  
2003/0103010 A1 6/2003 Boyle  
2005/0128151 A1 \* 6/2005 Kwak et al. .... 343/702  
2005/0259024 A1 \* 11/2005 Hung et al. .... 343/770  
2006/0033668 A1 \* 2/2006 Ryu ..... 343/702  
2007/0132640 A1 \* 6/2007 Kim et al. .... 343/700 MS  
2008/0198088 A1 \* 8/2008 Lin et al. .... 343/850  
2009/0040113 A1 \* 2/2009 Tseng et al. .... 343/700 MS

\* cited by examiner

*Primary Examiner*—Vibol Tan

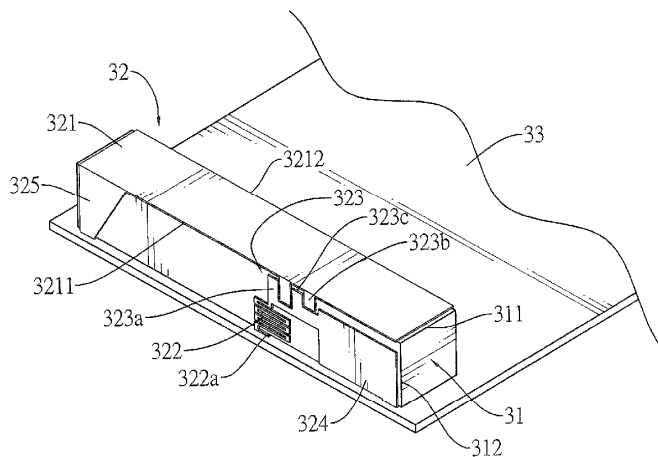
*Assistant Examiner*—Dylan White

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

(57) **ABSTRACT**

A wide band antenna has a ground plane, a dielectric member and a radiating patch. The dielectric member is mounted on the ground plane. The radiating patch is held by the dielectric member, is mounted on the ground plane and has a main conductor, a feeding conductor, a coupling conductor, an extension conductor and a shorting conductor. The main conductor has a first resonant mode. The extension conductor has a second resonant mode. The coupling conductor is capable of feeding high frequency signals into the main conductor and the extension conductor by capacitive coupling effect. With the main conductor, the extension conductor and the coupling conductor, the size of the wide band antenna is effectively reduced.

**14 Claims, 8 Drawing Sheets**





US007554506B2

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

(10) **Patent No.:** **US 7,554,506 B2**  
(45) **Date of Patent:** **Jun. 30, 2009**

(54) **FULL BAND SLEEVE MONOPOLE ANTENNA WITH EQUIVALENT ELECTRICAL LENGTH**

(58) **Field of Classification Search** ..... 343/790,  
343/791, 792, 700 MS, 895  
See application file for complete search history.

(75) Inventors: **Tsung-Ying Chung**, Taipei Hsien (TW);  
**Chang-Hsiu Huang**, Taipei Hsien (TW)

(56) **References Cited**

(73) Assignee: **Wistron NeWeb Corporation**,  
Hsi-Chih, Taipei Hsien (TW)

U.S. PATENT DOCUMENTS

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1 day.

5,231,412 A \* 7/1993 Eberhardt et al. .... 343/790  
6,963,313 B2 \* 11/2005 Du ..... 343/790  
7,193,566 B2 \* 3/2007 Chen et al. .... 343/700 MS  
7,365,688 B2 \* 4/2008 Tseng et al. .... 343/700 MS

\* cited by examiner

(21) Appl. No.: **12/049,380**

*Primary Examiner*—Hoang V Nguyen

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

(22) Filed: **Mar. 17, 2008**

(57) **ABSTRACT**

(65) **Prior Publication Data**

US 2008/0252542 A1 Oct. 16, 2008

An inductance is coupled to the radiator and a set of inductances is coupled to the sleeve for increasing the resonant electrical lengths of the radiator and the sleeve. A set of impedances is coupled to the sleeve to absorb the reflective power of the radiator for increasing the bandwidth of the antenna. The winding layout of radiator and sleeve and the disposition of passive elements (such as inductance and resistance) allow the sleeve monopole antenna with full band FM radiation to have small size.

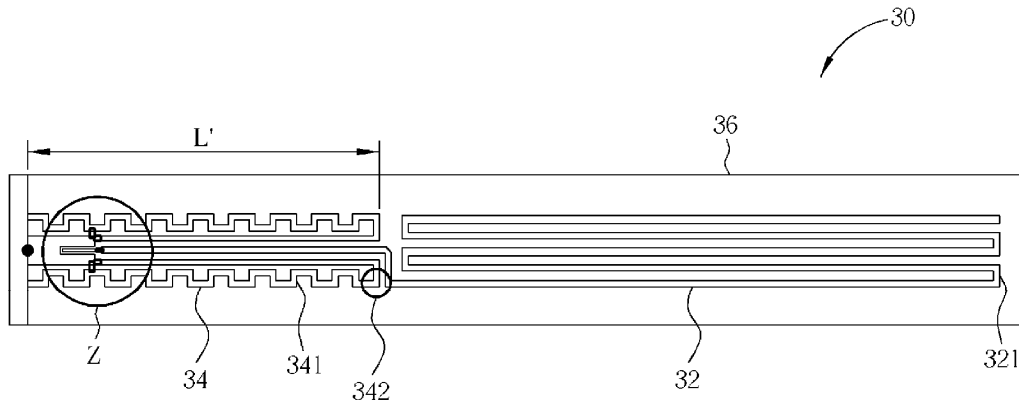
(30) **Foreign Application Priority Data**

Apr. 11, 2007 (TW) ..... 96205768 U

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

(52) **U.S. Cl.** ..... **343/790; 343/700 MS;**  
343/895

**9 Claims, 7 Drawing Sheets**







US007554509B2

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

(10) **Patent No.:** **US 7,554,509 B2**  
(45) **Date of Patent:** **Jun. 30, 2009**

(54) **COLUMN ANTENNA APPARATUS AND METHOD FOR MANUFACTURING THE SAME**

(75) Inventors: **Kang-Neng Hsu**, Hsinchu (TW);  
**Chih-Ming Chen**, Hsinchu (TW);  
**Liang-Neng Lee**, Hsinchu (TW);  
**Kuo-Wei Wu**, Hsinchu (TW)

(73) Assignee: **Inpaq Technology Co., Ltd.**, Hsinchu (TW)

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 317 days.

(21) Appl. No.: **11/509,655**

(22) Filed: **Aug. 25, 2006**

(65) **Prior Publication Data**  
US 2008/0048918 A1 Feb. 28, 2008

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

(52) **U.S. Cl.** ..... **343/895**

(58) **Field of Classification Search** ..... 343/895,  
343/850-853, 900

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,134,422 A \* 7/1992 Auriol ..... 343/895

5,191,352 A \* 3/1993 Branson ..... 343/895  
5,793,338 A \* 8/1998 Standke et al. .... 343/895  
5,986,616 A \* 11/1999 Edvardsson ..... 343/853  
6,300,917 B1 \* 10/2001 Leisten et al. .... 343/895  
6,424,316 B1 \* 7/2002 Leisten ..... 343/895  
7,345,650 B2 \* 3/2008 Bae et al. .... 343/895  
2006/0017650 A1 \* 1/2006 Allen et al. .... 343/900  
2006/0103586 A1 \* 5/2006 Yang et al. .... 343/895

\* cited by examiner

*Primary Examiner*—Huedung Mancuso

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

(57) **ABSTRACT**

A column antenna apparatus and a manufacturing method thereof are disclosed. This invention forms a metal layer with at least two spiral structures on a column body. The column antenna apparatus can simplify the manufacturing process and enhance the yield rate. The column antenna apparatus includes a column body, a metal layer and at least two spiral structures. The metal layer is formed on the surface of the column body, and the at least two spiral structures are formed on the metal layer for increasing bandwidth of low frequency. Each spiral structure is formed by removing a part of the metal layer, and the column body is exposed via the at least two spiral structures.

**18 Claims, 7 Drawing Sheets**

