



US007557759B2

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

(10) **Patent No.:** **US 7,557,759 B2**
(45) **Date of Patent:** **Jul. 7, 2009**

(54) **INTEGRATED MULTI-BAND ANTENNA**

(75) Inventors: **Ching-Chi Lin**, Taipei Hsien (TW);
Hung-Jen Chen, Taipei Hsien (TW);
Kai Shih, Taipei Hsien (TW); **Yu-Yuan Wu**, Taipei Hsien (TW); **Jia-Hung Su**, 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 213 days.

(21) Appl. No.: **11/772,433**

(22) Filed: **Jul. 2, 2007**

(65) **Prior Publication Data**

US 2009/0009413 A1 Jan. 8, 2009

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

(52) **U.S. Cl.** **343/702**; 343/731; 343/806;
343/828

(58) **Field of Classification Search** 343/702,
343/731, 741, 744, 806, 828, 895
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,198,442 B1 * 3/2001 Rutkowski et al. 343/702

7,109,923 B2 * 9/2006 Ollikainen et al. 343/700 MS
7,486,241 B2 * 2/2009 Qi et al. 343/702
2004/0090372 A1 * 5/2004 Nallo et al. 343/700 MS

* cited by examiner

Primary Examiner—Douglas W. Owens

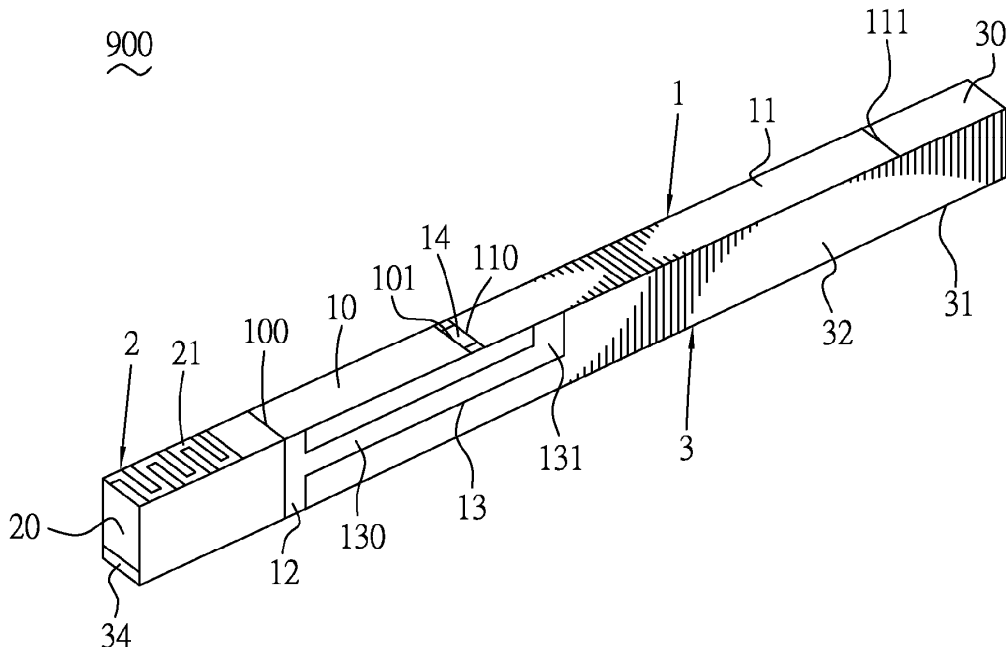
Assistant Examiner—Chuc Tran

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

(57) **ABSTRACT**

An integrated multi-band antenna has a first radiating conductor, a second radiating conductor spaced from the first radiating conductor, a trap element connected to the first and second radiating conductors, a third radiating conductor with a first feeding point connected to the first radiating conductor, a fourth radiating conductor connected to the second and third radiating conductors, a meandering radiating conductor having two ends which respectively connect a fifth radiating conductor with a second radiating conductor and a sixth radiating conductor parallel to the meandering radiating conductor and a ground portion arranged close to the first radiating conductor and spaced from the fifth radiating conductor. The second, third and fourth radiating conductors resonate at a first frequency bandwidth. The first, second and third radiating conductor and the trap element resonate a second frequency bandwidth. The fifth, sixth and meandering radiating conductors resonate a third and a fourth frequency bandwidths.

18 Claims, 5 Drawing Sheets





US007557760B2

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

(10) **Patent No.:** **US 7,557,760 B2**
(45) **Date of Patent:** **Jul. 7, 2009**

(54) **INVERTED-F ANTENNA AND MOBILE COMMUNICATION TERMINAL USING THE SAME**

6,980,165	B2 *	12/2005	Yuasa et al.	343/718
7,330,154	B2 *	2/2008	Kanazawa	343/702
2003/0001780	A1 *	1/2003	Hill et al.	343/700 MS
2004/0137950	A1 *	7/2004	Bolin et al.	455/562.1
2006/0139214	A1	6/2006	Deng et al.	

(75) Inventors: **Ki Won Chang**, Gyeonggi-do (KR); **Duk Woo Lee**, Gyeonggi-do (KR); **Jeong Sik Seo**, Daejeon (KR)

FOREIGN PATENT DOCUMENTS

(73) Assignee: **Samsung Electro-Mechanics Co., Ltd.**, Suwon, Gyeonggi-Do (KR)

GB	2 417 834	A	8/2006
WO	02-078123	A1	10/2002

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 132 days.

OTHER PUBLICATIONS

(21) Appl. No.: **11/797,536**

UK Intellectual Property Office, Search Report mailed Aug. 23, 2007.

(22) Filed: **May 4, 2007**

* cited by examiner

(65) **Prior Publication Data**

US 2007/0262909 A1 Nov. 15, 2007

Primary Examiner—Tho G Phan

(30) **Foreign Application Priority Data**

May 4, 2006 (KR) 10-2006-0040486

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

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

(57) **ABSTRACT**

(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.

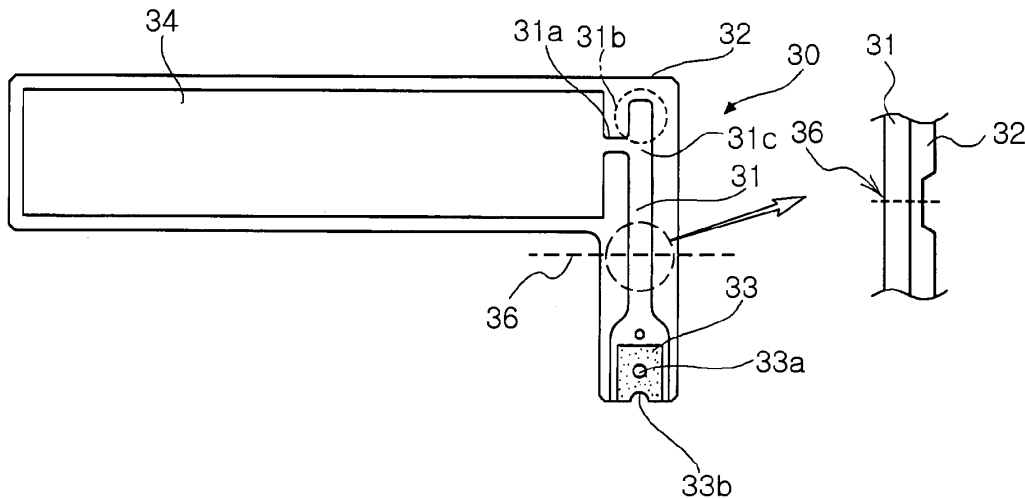
An inverted-F antenna and a mobile communication terminal using the same. The antenna includes a flexible board and a radiation plate formed on the flexible board. The antenna further includes a signal line having a first end formed on the flexible board and connected to the radiation plate and a second end extending from the first end and provided as a connecting terminal for feeding and grounding. The mobile communication terminal includes an RF board, a ground plate formed on the RF board, a feed line formed on the RF board for supplying a signal, and the inverted-F antenna as described above.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,966,097 A * 10/1999 Fukasawa et al. 343/700 MS

18 Claims, 7 Drawing Sheets
(1 of 7 Drawing Sheet(s) Filed in Color)





US007557761B2

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

(10) **Patent No.:** **US 7,557,761 B2**
(45) **Date of Patent:** **Jul. 7, 2009**

(54) **ARRAY ANTENNA APPARATUS HAVING AT LEAST TWO FEEDING ELEMENTS AND OPERABLE IN MULTIPLE FREQUENCY BANDS**

6,958,730	B2 *	10/2005	Nagumo et al.	343/702
7,084,831	B2 *	8/2006	Takagi et al.	343/860
7,129,893	B2 *	10/2006	Otaka et al.	343/700 MS
2005/0128162	A1 *	6/2005	Takagi et al.	343/895
2007/0080872	A1	4/2007	Nishikido et al.	
2008/0266190	A1 *	10/2008	Ohba et al.	343/702

(75) Inventors: **Hiroshi Iwai**, Osaka (JP); **Atsushi Yamamoto**, Kyoto (JP); **Tsutomu Sakata**, Osaka (JP); **Toshiteru Hayashi**, Kanagawa (JP); **Kenichi Yamada**, Kanagawa (JP)

FOREIGN PATENT DOCUMENTS

EP	1 296 407	3/2003
JP	2005-130216	5/2005
WO	01/97325	12/2001
WO	02/39544	5/2002

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

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

* cited by examiner

Primary Examiner—HoangAnh T Le

(74) *Attorney, Agent, or Firm*—Wenderoth, Lind & Ponack, L.L.P.

(21) Appl. No.: **12/015,005**

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

(57) **ABSTRACT**

(65) **Prior Publication Data**

US 2008/0174508 A1 Jul. 24, 2008

An array antenna apparatus includes a first feeding element having a first feed point, a second feeding element having a second feed point, and a first parasitic element electrically connected to the respective first and second feeding elements. In a first frequency band, respective resonances in the feeding elements occur independent of each other, by eliminating electromagnetic mutual coupling between the feeding elements, and exciting the first feeding element through the first feed point as well as exciting the second feeding element through the second feed point. In a second frequency band lower than the first frequency band, a loop antenna having a certain electrical length is formed by the first and second feeding elements and the first parasitic element, and a resonance of the loop antenna substantially occurs by exciting the first feeding element through the first feed point.

(30) **Foreign Application Priority Data**

Jan. 19, 2007 (JP) 2007-010162

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

(52) **U.S. Cl.** **343/702; 343/853**

(58) **Field of Classification Search** **343/702, 343/850, 853, 855, 860, 893, 700 MS**

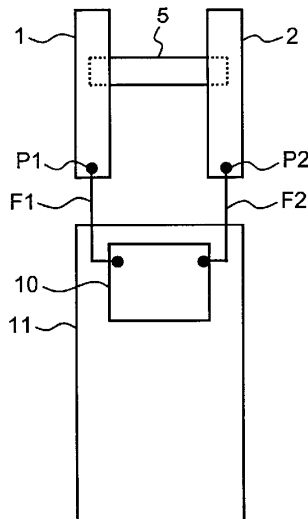
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,624,790	B1 *	9/2003	Wong et al.	343/702
6,771,223	B1	8/2004	Shoji et al.	

13 Claims, 33 Drawing Sheets





US007561108B2

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

(10) **Patent No.:** **US 7,561,108 B2**
(45) **Date of Patent:** **Jul. 14, 2009**

(54) **ANTENNA ARRAY CAPABLE OF REDUCING SIDE LOBE LEVEL**

4,783,661 A * 11/1988 Smith 343/700 MS
5,173,711 A * 12/1992 Takeuchi et al. 343/700 MS
6,218,989 B1 * 4/2001 Schneider et al. 343/700 MS
6,795,021 B2 * 9/2004 Ngai et al. 343/700 MS

(75) Inventors: **Kuo-Chan Fu**, Taipei (TW);
Tsung-Wen Chiu, Taipei (TW);
Chen-Hsuan Hsu, Taipei (TW);
Po-Sheng Chen, Taipei (TW); **Fu-Ren Hsiao**, Taipei (TW)

* cited by examiner

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

Primary Examiner—Michael C Wimer

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 196 days.

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

(57) **ABSTRACT**

(21) Appl. No.: **11/781,277**

An antenna array unit is provided by the present invention. The antenna array unit includes: a ground, a feeder cable, a first signal feeding member, a plurality of second signal feeding members, a plurality of third signal feeding members, a plurality of first rectangular radiating members and a plurality of second rectangular radiating members. The first rectangular radiating members have first and second non-radiating sides, two radiating sides able to generate a coupling effect with a radiating side adjacent thereto. The second rectangular radiating members have first and second non-radiating sides, two radiating sides and able to generate a coupling effect with a radiating side adjacent thereto. The present invention is characterized in that at least one current disturbing member is formed at each non-radiating second side of the plurality of the first and the second rectangular radiating members and adjacent to the nearest radiating side generating the coupling effect.

(22) Filed: **Jul. 23, 2007**

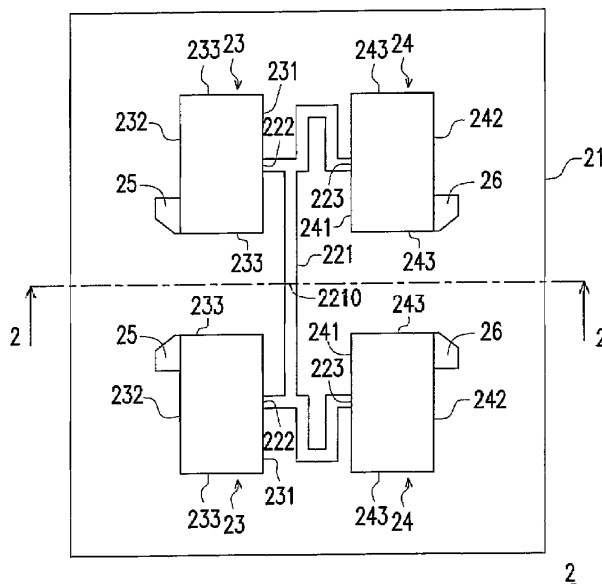
(65) **Prior Publication Data**
US 2008/0048924 A1 Feb. 28, 2008

(30) **Foreign Application Priority Data**
Jul. 21, 2006 (TW) 95126734 A

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
(52) **U.S. Cl.** **343/700 MS; 343/841**
(58) **Field of Classification Search** 343/700 MS,
343/824, 841, 846
See application file for complete search history.

(56) **References Cited**
U.S. PATENT DOCUMENTS
4,460,894 A * 7/1984 Robin et al. 343/700 MS

6 Claims, 5 Drawing Sheets





US007561110B2

(12) **United States Patent**
Chen

(10) **Patent No.:** **US 7,561,110 B2**
(45) **Date of Patent:** **Jul. 14, 2009**

(54) **PRINTED ANTENNA AND A WIRELESS NETWORK DEVICE HAVING THE ANTENNA**

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

(73) Assignee: **Cameo Communications 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 360 days.

(21) Appl. No.: **11/415,248**

(22) Filed: **May 2, 2006**

(65) **Prior Publication Data**

US 2007/0164920 A1 Jul. 19, 2007

(30) **Foreign Application Priority Data**

Jan. 13, 2006 (TW) 95200898 U

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

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

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

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,949,376 A * 9/1999 McDonald et al. 343/700 MS

6,882,338 B2 *	4/2005	Flowers	345/174
2004/0036654 A1 *	2/2004	Hsieh	343/702
2005/0093752 A1 *	5/2005	Cheng et al.	343/702
2005/0168392 A1 *	8/2005	Hagiwara	343/773
2006/0164308 A1 *	7/2006	Cohen	343/700 MS
2007/0063902 A1 *	3/2007	Leisten	343/702

* cited by examiner

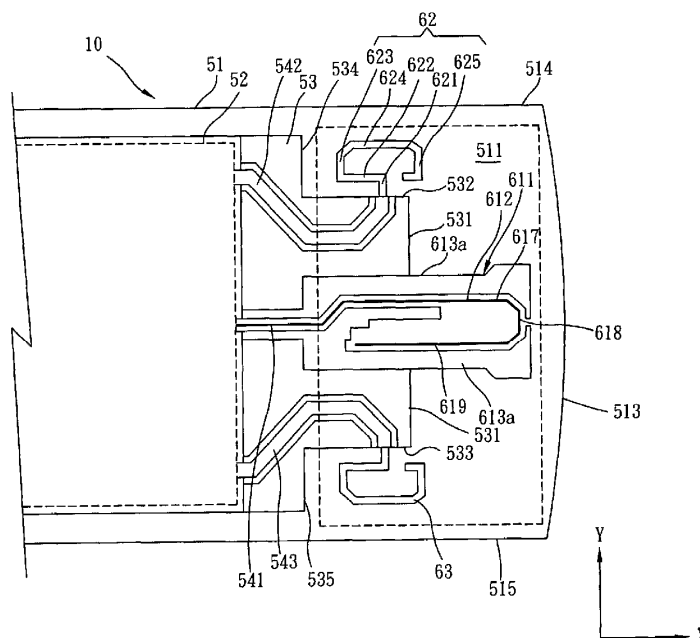
Primary Examiner—Huedung Mancuso

(74) *Attorney, Agent, or Firm*—TroxeLL Law Office, PLLC

(57) **ABSTRACT**

A printed antenna suitable for wireless networking device comprising a base plate, a grounding member, a first antenna, a second antenna and a third antenna is disclosed. The base plate is made of dielectric material where on a surface of which a first direction and a second direction perpendicular to each other are defined. The grounding member is electrically grounded and covers at least a partial area of the base plate surface. The first antenna is a dipole antenna extending from the grounding member generally towards the first direction. The second antenna is a monopole antenna extending from the grounding member generally towards the second direction. The third antenna is a monopole antenna extending from the grounding member generally towards the second direction. The second antenna and the third antenna are substantially disposed on the two opposing sides of first antenna.

15 Claims, 9 Drawing Sheets





US007561111B2

(12) **United States Patent**
Yu

(10) **Patent No.:** **US 7,561,111 B2**
(45) **Date of Patent:** **Jul. 14, 2009**

(54) **MODULIZED ANTENNA STRUCTURE**

6,683,574 B2* 1/2004 Su 343/700 MS
6,836,247 B2* 12/2004 Soutiaguine et al. .. 343/700 MS
7,202,826 B2* 4/2007 Grant et al. 343/713

(75) Inventor: **Jen-Huan Yu**, Taipei (TW)

(73) Assignee: **Compal Electronics, Inc.**, Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 233 days.

* cited by examiner

Primary Examiner—Tan Ho

(74) *Attorney, Agent, or Firm*—Ming Chow; Sinorica, LLC

(21) Appl. No.: **11/724,132**

(22) Filed: **Mar. 14, 2007**

(57) **ABSTRACT**

(65) **Prior Publication Data**

US 2007/0285317 A1 Dec. 13, 2007

(30) **Foreign Application Priority Data**

Jun. 13, 2006 (TW) 95120936 A

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

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

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

See application file for complete search history.

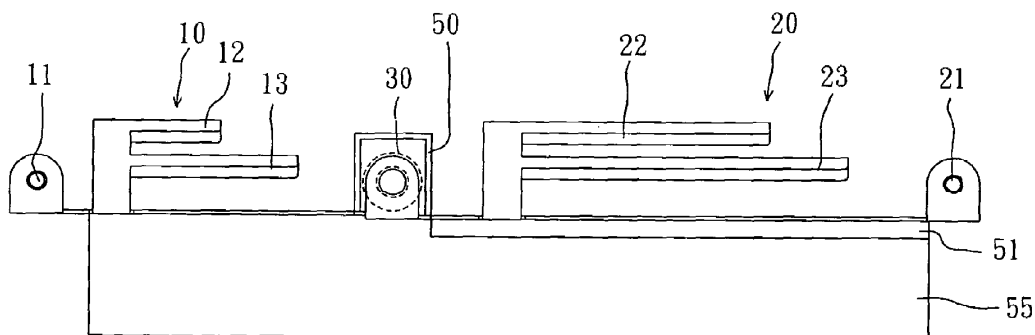
The present invention relates to a modulized antenna structure, which comprises: a first antenna module for receiving a first transmission signal in which at least one side of the first antenna module has a first opening; a second antenna module for receiving a second transmission signal in which at least one side of the second antenna module has a second opening; and a fixed component, while being assembled, with the fixed component, the first antenna module is partially overlapped with the second antenna modules and the first opening is fully overlapped with the second opening, thus the fixed component can pass through the first and second openings and be fixed on the screen of an electronic device.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,990,838 A * 11/1999 Burns et al. 343/702

27 Claims, 5 Drawing Sheets





US007564410B2

(12) **United States Patent**
Lee

(10) **Patent No.:** **US 7,564,410 B2**
(45) **Date of Patent:** **Jul. 21, 2009**

(54) **DUAL RADIATING TYPE INNER ANTENNA FOR MOBILE COMMUNICATION TERMINAL**

6,956,536 B2* 10/2005 Lee 343/793
7,091,907 B2* 8/2006 Brachat 343/700 MS

(75) Inventor: **Jong In Lee**, Hwaseong-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 195 days.

* cited by examiner

Primary Examiner—Michael C Wimer

Assistant Examiner—Jennifer F Hu

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

(21) Appl. No.: **11/706,852**

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

(65) **Prior Publication Data**

US 2008/0007476 A1 Jan. 10, 2008

(30) **Foreign Application Priority Data**

Jul. 10, 2006 (KR) 10-2006-0064632

(51) **Int. Cl.**

H01Q 1/38 (2006.01)

H01Q 1/24 (2006.01)

H01Q 21/00 (2006.01)

(52) **U.S. Cl.** **343/702; 343/700 MS; 343/853; 343/850**

(58) **Field of Classification Search** **343/702, 343/700 MS, 853, 850**
See application file for complete search history.

(56) **References Cited**

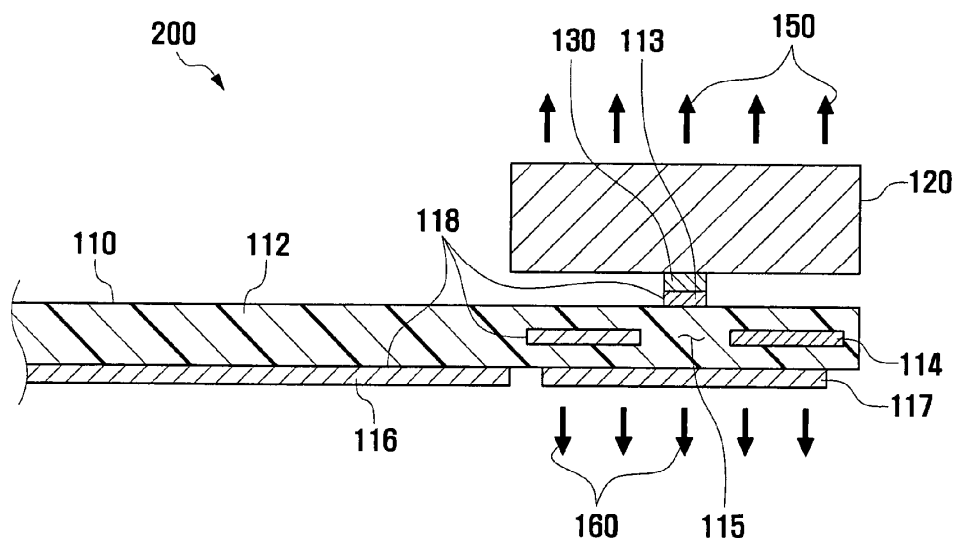
U.S. PATENT DOCUMENTS

6,940,457 B2* 9/2005 Lee et al. 343/700 MS

(57) **ABSTRACT**

The dual radiating type inner antenna includes a Printed Circuit Board (PCB), a first radiation plate disposed at an upper part of the PCB, a power supply unit connecting the PCB and the first radiation plate to supply a current to the first radiation plate, a power supply pad, a floating patch, and a second radiation plate. Current supplied to the power supply pad is radiated as first electromagnetic waves through the first radiation plate after passing through the power supply unit; and is radiated as second electromagnetic waves through the second radiation plate after being coupled through the slot of the floating patch to the power supply pad. Therefore, the inner antenna simultaneously radiates electromagnetic waves of different frequency bands, so that a usable frequency bandwidth can be expanded and the gain of the antenna can be increased. Accordingly, the inner antenna can maintain a stable antenna performance by solving a deterioration problem caused by a frequency shift due to an effect of a human body.

5 Claims, 3 Drawing Sheets





US007564411B2

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

(10) **Patent No.:** **US 7,564,411 B2**
(45) **Date of Patent:** **Jul. 21, 2009**

(54) **FREQUENCY TUNABLE PLANAR INTERNAL ANTENNA**

(75) Inventors: **Mika Piisila**, Kempele (FI); **Mauri Suvanto**, Oulu (FI)

(73) Assignee: **Flextronics AP, LLC**, Broomfield, CO (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 27 days.

(21) Appl. No.: **11/729,499**

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

(65) **Prior Publication Data**

US 2007/0229381 A1 Oct. 4, 2007

Related U.S. Application Data

(60) Provisional application No. 60/787,449, filed on Mar. 29, 2006.

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 3/24 (2006.01)

(52) **U.S. Cl.** **343/702; 343/876**

(58) **Field of Classification Search** 343/702, 343/700 MS, 767, 770, 876
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,764,190 A 6/1998 Murch et al. 343/702
6,140,966 A * 10/2000 Pankinaho 343/700 MS
6,680,705 B2 1/2004 Tan et al. 343/702

6,693,594 B2 * 2/2004 Pankinaho et al. 343/700 MS
6,792,246 B2 9/2004 Takeda et al. 455/41.1
7,026,996 B2 4/2006 Harano 343/700
7,026,999 B2 4/2006 Umehara et al. 343/702
7,119,743 B2 10/2006 Iguchi et al. 343/700
7,319,432 B2 1/2008 Andersson 343/702
2005/0007283 A1 1/2005 Jo et al. 343/702
2005/0195124 A1 9/2005 Puente Baliarda et al. .. 343/893
2007/0139280 A1 * 6/2007 Vance 343/702

FOREIGN PATENT DOCUMENTS

CN 1324012 A 11/2001

* cited by examiner

Primary Examiner—Hoang V Nguyen

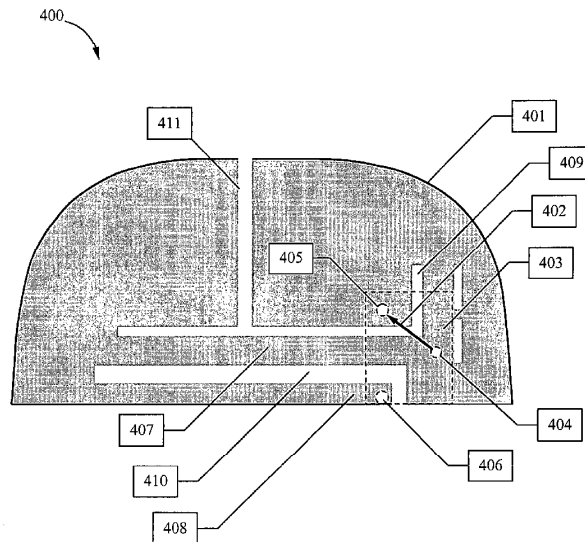
Assistant Examiner—Robert Karacsony

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

(57) **ABSTRACT**

A frequency tunable internal antenna includes a substantially planar radiating element with a feed point and a switching element all coupled to the radiating element. The radiating element includes a plurality of slots configured to form a first branch and a second branch within the radiating element. The plurality of slots are configured relative to the feed point such that in operation the first branch acts as a first resonator having a first native electrical length and the second branch acts as a second resonator having a second native electrical length. The switching element is configurable in a first position and a second position, where in the first position the switching element connects to a portion of the first branch to decrease the electrical length of the first resonator, and in the second position the switching element connects to a portion of the second branch to decrease the electrical length of the second resonator. In some embodiments the antenna is a PIFA antenna and further includes a short point.

33 Claims, 5 Drawing Sheets





US007564413B2

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

(10) **Patent No.:** **US 7,564,413 B2**
(45) **Date of Patent:** **Jul. 21, 2009**

(54) **MULTI-BAND ANTENNA AND MOBILE COMMUNICATION TERMINAL HAVING THE SAME**

7,113,133 B2* 9/2006 Chen et al. 343/700 MS
7,466,277 B2* 12/2008 Ishizuka et al. 343/702
2006/0145924 A1 7/2006 Chen et al.

(75) Inventors: **Hyun Hak Kim**, Gyeonggi-Do (KR);
Jong Kweon Park, Daejeon (KR); **Jung Nam Lee**, Daejeon (KR); **Jae Chan Lee**, Gyeonggi-Do (KR)

OTHER PUBLICATIONS

Korean Intellectual Property Office, Office Action mailed Apr. 22, 2008.

(73) Assignee: **Samsung Electro-Mechanics Co., Ltd.**, Suwon, Kyungki-Do (KR)

* 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 2 days.

Primary Examiner—James Cho

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

(21) Appl. No.: **12/026,373**

(57) **ABSTRACT**

(22) Filed: **Feb. 5, 2008**

There is provided a mobile communication terminal including: a dielectric substrate; a ground surface formed on a first area of the dielectric substrate; a radiation part disposed on a second area where the ground surface is not formed, at a predetermined distance from the dielectric substrate, the radiation part having first and second slots formed thereon; a feeding line formed on the second area of the dielectric substrate and having one end connected to the radiation part; a ground line disposed on the second area of the dielectric substrate at a predetermined distance from the feeding line and having one end connected to the radiation part and another end connected to the ground surface; and a matching ground surface formed on the second area of the dielectric substrate, the matching ground surface disposed in a superimposed relationship with a portion of the radiation part and extending from the ground surface to be capacitively coupled to the radiation part.

(65) **Prior Publication Data**

US 2008/0204340 A1 Aug. 28, 2008

(30) **Foreign Application Priority Data**

Feb. 28, 2007 (KR) 10-2007-0020302

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

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

(58) **Field of Classification Search** **343/702, 343/770, 767, 700 MS, 846**

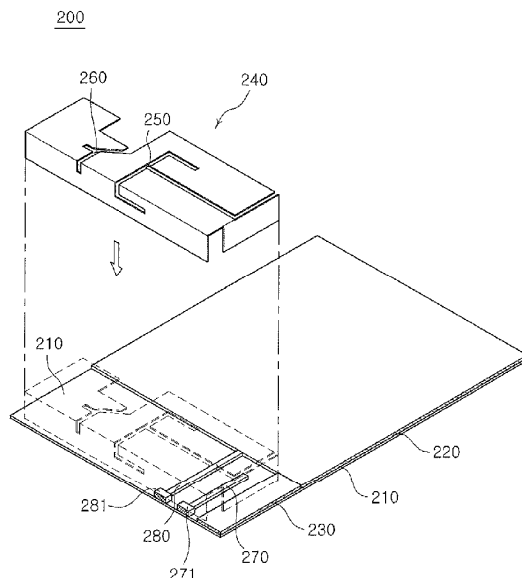
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,903,690 B2* 6/2005 Leclerc et al. 343/700 MS

11 Claims, 8 Drawing Sheets





US007564423B2

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

(10) **Patent No.:** **US 7,564,423 B2**
(45) **Date of Patent:** **Jul. 21, 2009**

(54) **PRINTED DIPOLE ANTENNA**

(56) **References Cited**

(75) Inventors: **Yun-Long Ke**, Tu-Cheng (TW);
Wen-Fong Su, Tu-Cheng (TW);
Yao-Shien Huang, Tu-Cheng (TW);
Chen-Ta Hung, Tu-Cheng (TW);
Shih-Tung Chang, Tu-Cheng (TW);
Chin-Pao Kuo, Tu-Cheng (TW)

U.S. PATENT DOCUMENTS
4,860,019 A * 8/1989 Jiang et al. 343/795

FOREIGN PATENT DOCUMENTS

TW 253069 12/2004

(73) Assignee: **Hon Hai Precision Ind. Co., Ltd.**,
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 215 days.

Primary Examiner—Michael C Wimer
(74) *Attorney, Agent, or Firm*—Wei Te Chung

(21) Appl. No.: **11/446,692**

(57) **ABSTRACT**

(22) Filed: **Jun. 5, 2006**

A printed dipole antenna used in an electronic device comprising a PCB comprising some through holes; a grounding element locating on one side of the PCB; a radiating element locating on common side of the PCB with the grounding element; a coaxial cable comprising an inner conductor connecting to the radiating element and a braiding layer connecting to the grounding element; and a short circuit element locating on another side of the PCB electrically connecting the radiating element and the grounding element by said through holes. When the printed dipole antenna encounter an intense electromagnetic field, the interferential signal transmitting from the intense electromagnetic field would arrive to the grounding element through the radiating element. The interferential signal cannot arrive to the system and is unable disturb the working of the printed dipole antenna.

(65) **Prior Publication Data**

US 2006/0273977 A1 Dec. 7, 2006

(30) **Foreign Application Priority Data**

Jun. 3, 2005 (TW) 94209329 U

(51) **Int. Cl.**

H01Q 1/38 (2006.01)

H01Q 9/28 (2006.01)

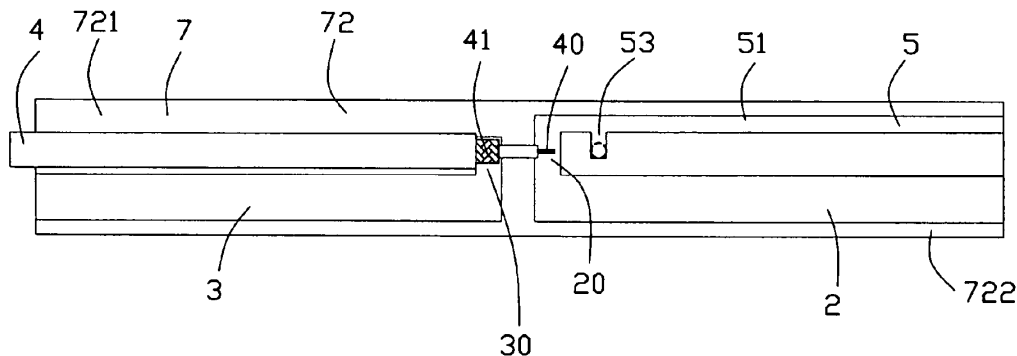
(52) **U.S. Cl.** **343/795**; 343/829

(58) **Field of Classification Search** 343/795,
343/829

See application file for complete search history.

13 Claims, 6 Drawing Sheets

1





US007564424B2

(12) **United States Patent**
Umehara

(10) **Patent No.:** **US 7,564,424 B2**
(45) **Date of Patent:** **Jul. 21, 2009**

(54) **ANTENNA HAVING MULTIPLE RADIATING ELEMENTS**

(75) Inventor: **Naoko Umehara, Takatsuki (JP)**

(73) Assignee: **Sharp Kabushiki Kaisha, Osaka-shi (JP)**

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

(21) Appl. No.: **11/430,029**

(22) Filed: **May 9, 2006**

(65) **Prior Publication Data**
US 2006/0256030 A1 Nov. 16, 2006

(30) **Foreign Application Priority Data**
May 10, 2005 (JP) 2005-137522

(51) **Int. Cl.**
H01Q 1/36 (2006.01)
(52) **U.S. Cl.** **343/895; 343/702; 343/876**
(58) **Field of Classification Search** **343/700 MS, 343/702, 895, 876**
See application file for complete search history.

(56) **References Cited**
U.S. PATENT DOCUMENTS
5,914,691 A * 6/1999 Mandai et al. 343/728
6,040,806 A 3/2000 Kushihi et al.
6,388,626 B1 * 5/2002 Gamalielsson et al. 343/702
6,720,924 B2 4/2004 Tomomatsu et al.
6,882,320 B2 * 4/2005 Park et al. 343/702
6,946,997 B2 9/2005 Yuanzhu

7,148,851 B2 12/2006 Takaki et al.
7,304,615 B2 * 12/2007 Nakamura 343/788
2002/0075186 A1 * 6/2002 Hamada et al. 343/700 MS
2007/0109203 A1 * 5/2007 Park et al. 343/702

FOREIGN PATENT DOCUMENTS

JP 11-068456 3/1999
JP 2001-036328 2/2001
JP 2002-111344 4/2002
JP 2002-319810 10/2002
JP 2003-037423 2/2003
JP 2003-298334 10/2003
JP 2004-274223 A 9/2004
JP 2004-328237 A 11/2004
JP 2005-20450 A 1/2005
JP 2005-45599 A 2/2005

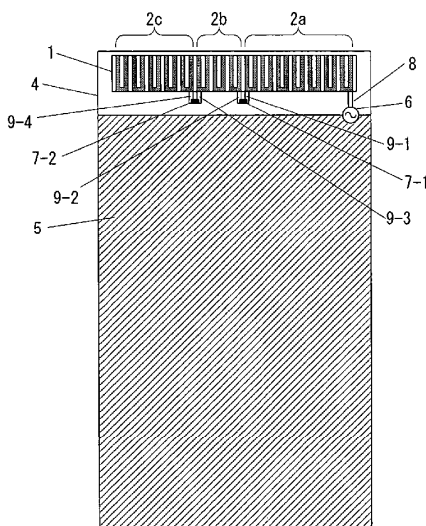
* cited by examiner

Primary Examiner—Tan Ho
(74) *Attorney, Agent, or Firm*—Birch, Stewart, Kolasch & Birch, LLP

(57) **ABSTRACT**

An antenna includes a first radiating element (2a), a second radiating element (2b), a third radiating element (2c), a first switch element (7-1) for switching an electrical connection between the first radiating element (2a) and the second radiating element (2b), a second switch element (7-2) for switching an electrical connection between the second radiating element (2b) and the third radiating element (2c). The first radiating element (2a), the second radiating element (2b) and the third radiating element (2c) are conductor patterns formed on a dielectric member (1) that is separate from a printed circuit board (4) and has a dielectric constant larger than that of the printed circuit board (4).

35 Claims, 10 Drawing Sheets





US007567211B2

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

(10) **Patent No.:** **US 7,567,211 B2**
(45) **Date of Patent:** **Jul. 28, 2009**

(54) **ANTENNA**

(75) Inventors: **Cheng-Hsuan Hsu**, Hsin-Tien (TW);
Chia-Wen Hsu, 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.: **12/028,966**

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

(65) **Prior Publication Data**
US 2008/0198085 A1 Aug. 21, 2008

(30) **Foreign Application Priority Data**
Feb. 15, 2007 (TW) 96105848 A

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

(52) **U.S. Cl.** **343/700 MS; 343/795; 343/846**

(58) **Field of Classification Search** 343/700 MS, 343/795, 846
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,741,219 B2 5/2004 Shor
6,747,605 B2* 6/2004 Lebaric et al. 343/795
7,224,315 B2* 5/2007 Tsai et al. 343/700 MS
2004/0201525 A1* 10/2004 Bateman et al. 343/700 MS

* cited by examiner

Primary Examiner—James Cho

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

(57) **ABSTRACT**

An antenna is formed integrally into one piece and has a ground plane, a feeding strip and two pairs of radiating patches. The feeding strip is connected integrally to the ground plane. The pairs of the radiating patches are formed symmetrically and integrally on the feeding strip. The antenna formed integrally into one piece simplifies the manufacture of the antenna lowers the manufacturing cost of the antenna.

11 Claims, 9 Drawing Sheets

