



US007277055B2

(12) **United States Patent**
Tamaoka

(10) **Patent No.:** **US 7,277,055 B2**
(45) **Date of Patent:** **Oct. 2, 2007**

(54) **COMPACT ANTENNA**

FOREIGN PATENT DOCUMENTS

(75) Inventor: **Hiroyuki Tamaoka**, Tokyo (JP)
(73) Assignee: **The Furukawa Electric Co., Ltd.**,
Tokyo (JP)
(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

JP	05-259724	10/1993
JP	2001-223519	8/2001
JP	2002-076735	3/2002
JP	2002-158529	5/2002
JP	2002-290132	10/2002
JP	2002-299933	10/2002
JP	2003-163528	6/2003
JP	2003-218623	7/2003
WO	WO 01/06596	1/2001
WO	WO 01/18909	3/2001

(21) Appl. No.: **11/396,624**

(22) Filed: **Apr. 4, 2006**

* cited by examiner

(65) **Prior Publication Data**
US 2006/0176220 A1 Aug. 10, 2006

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

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2004/
013415, filed on Sep. 15, 2004.

Foreign Application Priority Data

(30) Apr. 9, 2004 (JP) 2004-116116

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

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

(58) **Field of Classification Search** 343/700 MS,
343/702, 873, 846
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

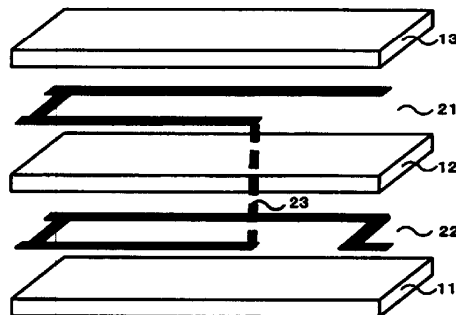
4,980,694 A * 12/1990 Hines 343/702
5,541,610 A * 7/1996 Imanishi et al. 343/702
6,181,278 B1 * 1/2001 Kakimoto et al. ... 343/700 MS

(57) **ABSTRACT**

The multi-band antenna **1** is provided with a dielectric having the three-layer structure obtained by stacking layers so as that a central dielectric layer **12** made of a low dielectric constant material is sandwiched by lower and upper side dielectric layers **11**, **13** made of high dielectric constant materials, a fed element **12** formed between the central dielectric layer **12** and the upper dielectric layer **13** and its base end being connected to a feed point on a specified side face of the dielectric having the three-layer structure, a grounded parasitic element **22** formed between the central dielectric layer **12** and the lower dielectric layer **11** and its base end being grounded on a specified side face, wherein the fed element **21** and the grounded parasitic element **22** is formed from the base end to the open end by a element obtained by connecting a plurality of line conductors and folding at least around the side face opposite to the specified face.

18 Claims, 11 Drawing Sheets

↓
1





US007277057B2

(12) **United States Patent**
Schaffer

(10) **Patent No.:** **US 7,277,057 B2**
(45) **Date of Patent:** **Oct. 2, 2007**

(54) **PROVIDING INTEGRATED CHASSIS
ANTENNA FOR PROCESSOR-BASED
DEVICES**

(75) Inventor: **Michael J. Schaffer**, Beaverton, OR
(US)

(73) Assignee: **Intel Corporation**, Santa Clara, CA
(US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 1379 days.

(21) Appl. No.: **10/046,596**

(22) Filed: **Oct. 23, 2001**

(65) **Prior Publication Data**
US 2003/0076266 A1 Apr. 24, 2003

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 3/02 (2006.01)

(52) **U.S. Cl.** **343/702; 343/700 MS;**
343/702; 343/725; 343/749

(58) **Field of Classification Search** 343/702,
343/700 MS, 846, 829, 725, 893, 749, 826,
343/828, 793, 795, 906

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,646,635	A *	7/1997	Cockson et al.	343/702
5,828,339	A *	10/1998	Patel	343/700 MS
5,828,341	A *	10/1998	Delamater	343/702
6,337,666	B1 *	1/2002	Bishop	455/575
6,342,860	B1 *	1/2002	Haussler et al.	343/702
6,400,321	B1 *	6/2002	Fenwick et al.	343/700 MS
6,433,747	B1 *	8/2002	Cumro et al.	343/700 MS
6,448,932	B1 *	9/2002	Stoiljkovic et al. ..	343/700 MS
6,456,242	B1 *	9/2002	Crawford	343/700 MS
2002/0101378	A1 *	8/2002	Quinn et al.	343/702

* cited by examiner

Primary Examiner—Douglas W. Owens

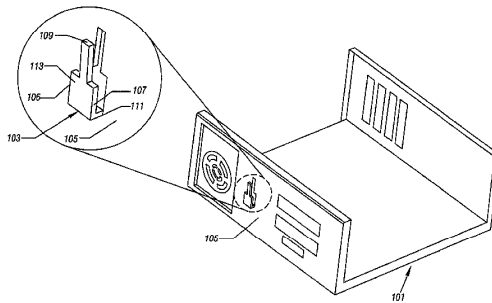
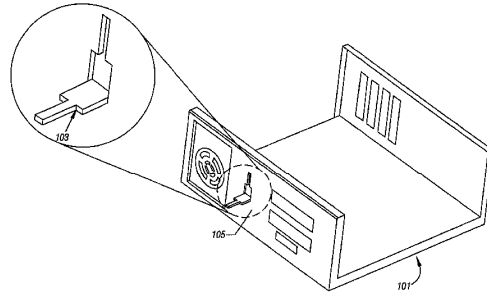
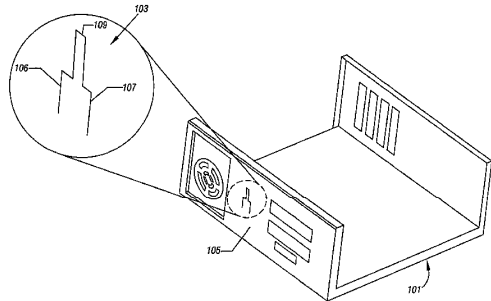
Assistant Examiner—Chuc Tran

(74) *Attorney, Agent, or Firm*—Trop, Pruner & Hu, P.C.

(57) **ABSTRACT**

In one embodiment of the present invention, the antenna is punched out and formed from a front surface of a chassis. The antenna may be connected to a wireless device by a coaxial cable. The center conductor of the coaxial cable may be coupled to the feed point of the antenna and the shield of the coaxial cable may be terminated at the front edge of the chassis to reduce radio frequency radiation from the coaxial shield.

23 Claims, 9 Drawing Sheets





US007277058B2

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

(10) **Patent No.:** **US 7,277,058 B2**
(45) **Date of Patent:** **Oct. 2, 2007**

- (54) **WIRELESS COMMUNICATION DEVICE ANTENNA FOR IMPROVED COMMUNICATION WITH A SATELLITE**
- (75) Inventors: **Antonio Faraone**, Plantation, FL (US);
Giorgi G. Bit-Babik, Sunrise, FL (US)
- (73) Assignee: **Motorola, Inc.**, Schaumburg, IL (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.: **11/027,308**
- (22) Filed: **Dec. 30, 2004**

- (65) **Prior Publication Data**
US 2006/0145930 A1 Jul. 6, 2006

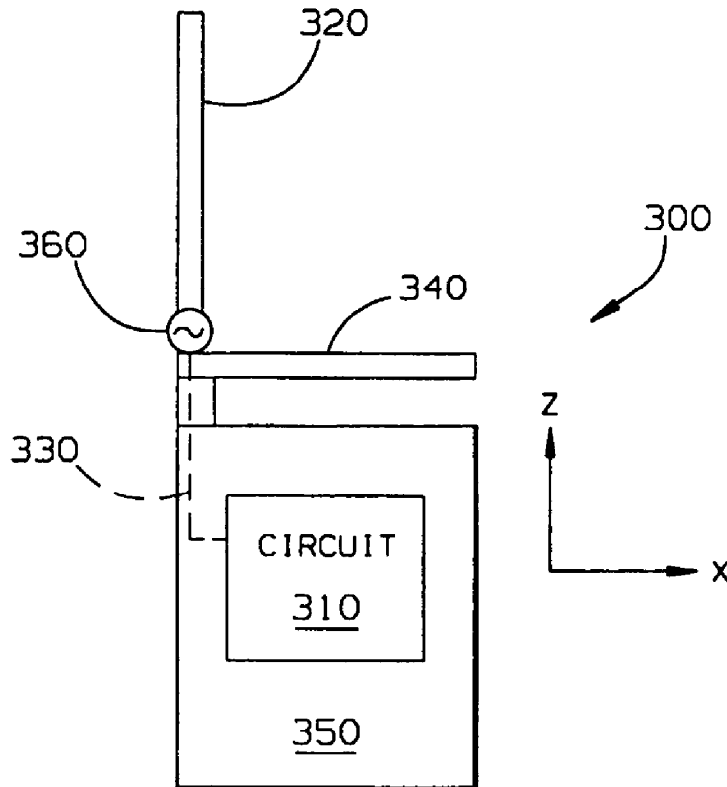
- (51) **Int. Cl.**
H01Q 1/24 (2006.01)
 - (52) **U.S. Cl.** **343/702; 343/815**
 - (58) **Field of Classification Search** **343/702, 343/700 MS, 815, 833, 834**
- See application file for complete search history.

- (56) **References Cited**
U.S. PATENT DOCUMENTS
6,028,567 A * 2/2000 Lahti 343/895
6,100,848 A * 8/2000 Hayes 343/702
6,229,489 B1 * 5/2001 Holshouser et al. 343/702
7,023,388 B2 * 4/2006 Shimabara 343/702
2005/0057407 A1 * 3/2005 Imaizumi et al. 343/702
* cited by examiner

Primary Examiner—Tho Phan

- (57) **ABSTRACT**
A wireless communication device includes a mobile wireless communication signal creation and reception circuit (310) coupled to a resonator (320) capable of sending and/or receiving wireless communication signals. A parasitic element (340) is coupled to the resonator (320) in an approximately orthogonal arrangement such that the parasitic element (340) and the resonator (320) resonate together to send and/or receive a wireless communication signal. Preferably, the parasitic element (340) and resonator (320) are contained within a housing (520) of a wireless communication device handset (500) to provide improved communications with a satellite (700).

15 Claims, 3 Drawing Sheets





US007277059B2

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

(10) **Patent No.:** **US 7,277,059 B2**
(45) **Date of Patent:** **Oct. 2, 2007**

- (54) **MONOPOLE ANTENNA ASSEMBLY**
- (75) Inventors: **Hsien-Chu Lin**, Tu-Chen (TW);
Lung-Sheng Tai, Tu-Chen (TW);
Chia-Ming Kuo, Tu-chen (TW);
Zhen-Da Hung, Tu-Chen (TW)
- (73) Assignee: **Hon Hai Precision Ind. 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 146 days.

5,015,194 A *	5/1991	Seas	439/314
5,654,740 A *	8/1997	Schulha	345/156
5,913,174 A *	6/1999	Casarez et al.	455/557
5,936,581 A *	8/1999	Roshitsh et al.	343/702
6,188,918 B1 *	2/2001	Cockson	455/575.7
6,236,574 B1 *	5/2001	Han	361/816
6,331,838 B1 *	12/2001	Scott et al.	343/715
6,356,237 B1 *	3/2002	Kim	343/713
6,473,043 B1 *	10/2002	Hwang	343/702
2002/0015000 A1 *	2/2002	Reece et al.	343/795
2004/0108960 A1 *	6/2004	Kuo et al.	343/767
2004/0233121 A1 *	11/2004	Lin et al.	343/906
2005/0017912 A1 *	1/2005	Azoulay et al.	343/725

(21) Appl. No.: **10/841,380**

(22) Filed: **May 7, 2004**

(65) **Prior Publication Data**
US 2004/0222940 A1 Nov. 11, 2004

(30) **Foreign Application Priority Data**
May 7, 2003 (TW) 92208373 U

- (51) **Int. Cl.**
H01Q 1/12 (2006.01)
- (52) **U.S. Cl.** **343/718**; 343/900
- (58) **Field of Classification Search** 343/906,
343/892, 700 MS, 702, 718, 900
See application file for complete search history.

(56) **References Cited**
U.S. PATENT DOCUMENTS
3,509,570 A * 4/1970 Lindsey et al. 343/718

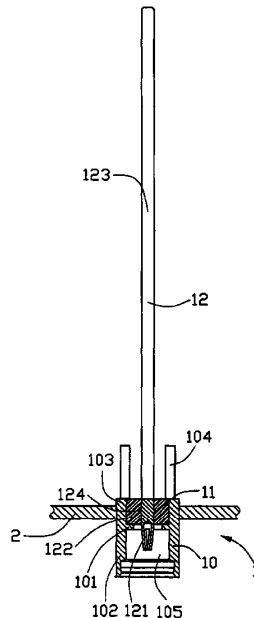
* cited by examiner

Primary Examiner—Don Wong
Assistant Examiner—Angela M Lie
(74) *Attorney, Agent, or Firm*—Wei Te Chung

(57) **ABSTRACT**

A monopole antenna assembly mounted onto a bracket (2) of an electronic device includes an electronic connector (1) having a long contact (12) extending outwardly. The long contact acts as a radiating element of a monopole antenna. The long contact can be easily obtained by modifying the size of contact in stamping process. The connector electrically and mechanically cooperates with a socket, such as a female connector, of the electronic device. Thus an electrical path is formed between the monopole antenna and the electrical device via connector and the socket.

1 Claim, 7 Drawing Sheets





US007277060B2

(12) **United States Patent**
Fukuchi

(10) **Patent No.:** **US 7,277,060 B2**
(45) **Date of Patent:** **Oct. 2, 2007**

(54) **ANTENNA**

6,882,322 B1 * 4/2005 Apostolos et al. 343/767
6,900,770 B2 * 5/2005 Apostolos 343/725
7,057,568 B2 * 6/2006 Louzir et al. 343/767

(75) Inventor: **Keisuke Fukuchi**, Hitachi (JP)

(73) Assignee: **Hitachi Cable, Ltd.**, Tokyo (JP)

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

FOREIGN PATENT DOCUMENTS

JP 2004-343424 12/2004
JP 2005-094499 4/2005
JP 2005-150804 6/2005

(21) Appl. No.: **11/484,609**

(22) Filed: **Jul. 12, 2006**

(65) **Prior Publication Data**

US 2007/0013596 A1 Jan. 18, 2007

* cited by examiner

Primary Examiner—Hoanganh Le

(74) *Attorney, Agent, or Firm*—Antonelli, Terry, Stout & Kraus, LLP.

(30) **Foreign Application Priority Data**

Jul. 12, 2005 (JP) 2005-203265
Feb. 13, 2006 (JP) 2006-035327

(57) **ABSTRACT**

In an antenna to be used for UWB communication, a taper slot is formed in a rectangular conductive plate, a vertical slit for separating the conductive plate is formed at the top of the taper slot, a feeding point part and a grounding point part are formed at the conductive plate and on both sides of the vertical slit, and the lower slits are formed on the oblique sides of the taper slot near the feeding point part and the grounding point part.

(51) **Int. Cl.**

H01Q 13/10 (2006.01)

(52) **U.S. Cl.** **343/767; 343/768**

(58) **Field of Classification Search** **343/767, 343/768, 770**

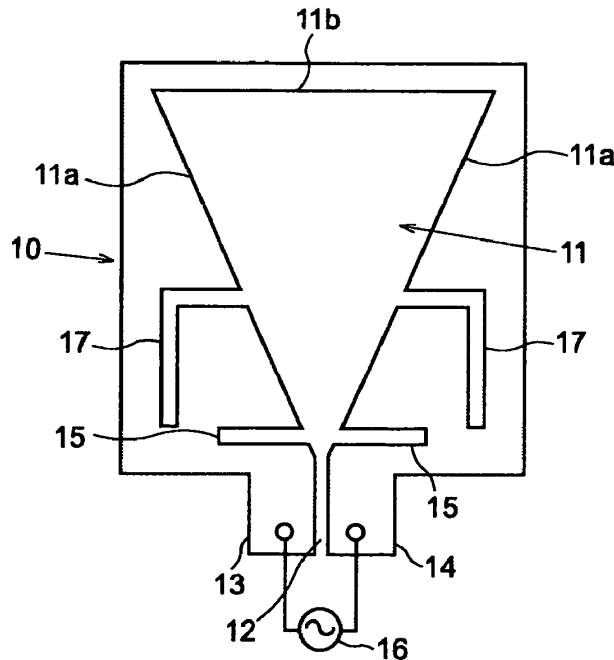
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,839,036 B1 * 1/2005 Apostolos et al. 343/770

18 Claims, 5 Drawing Sheets





US007277061B2

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

(10) **Patent No.:** **US 7,277,061 B2**
(45) **Date of Patent:** **Oct. 2, 2007**

(54) **SINGLE APERTURE MONOPULSE ANTENNA**

(75) Inventors: **Vincent Francis Fusco**, Belfast (GB);
Bandaru Subbarao, Chennai (IN)

(73) Assignee: **The Queens University of Belfast**,
Belfast (IE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 9 days.

(21) Appl. No.: **11/071,423**

(22) Filed: **Mar. 3, 2005**

(65) **Prior Publication Data**

US 2005/0200548 A1 Sep. 15, 2005

(30) **Foreign Application Priority Data**

Mar. 6, 2004 (GB) 0405112.4

(51) **Int. Cl.**

H01Q 13/00 (2006.01)

H01Q 19/00 (2006.01)

(52) **U.S. Cl.** **343/778; 343/772; 343/786; 343/756**

(58) **Field of Classification Search** **343/786, 343/772, 776, 778, 756**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,560,976 A	2/1971	Foldes	343/100
3,569,870 A *	3/1971	Foldes	333/21 R
3,699,583 A *	10/1972	Beguín	343/756
4,096,482 A *	6/1978	Walters	343/778
4,473,828 A	9/1984	Mörz et al.	343/786
6,281,855 B1 *	8/2001	Aoki	343/786

FOREIGN PATENT DOCUMENTS

JP 06029721 1/1999

* cited by examiner

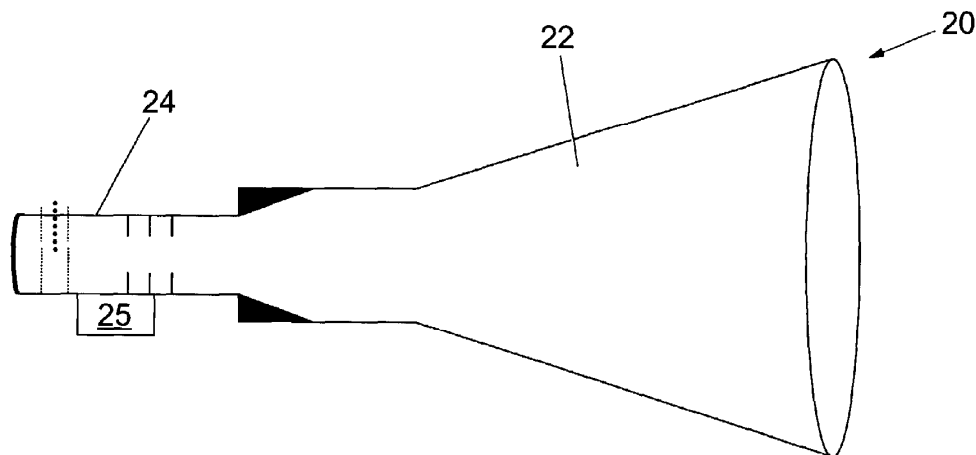
Primary Examiner—Hoang V. Nguyen

(74) *Attorney, Agent, or Firm*—Drinker Biddle & Reath LLP

(57) **ABSTRACT**

An antenna comprises a polarizer, a phasing network and a field radiating element such as a horn. The polarizer and phasing network generate a plurality of phase shifted circularly polarised waves which are superimposed to produce multiple antenna field patterns from a single antenna aperture.

17 Claims, 10 Drawing Sheets





US007277062B1

(12) **United States Patent**
Loyet

(10) **Patent No.:** **US 7,277,062 B1**
(45) **Date of Patent:** **Oct. 2, 2007**

- (54) **MULTI-RESONANT MICROSTRIP DIPOLE ANTENNA**
- (75) Inventor: **Lowell Lee Loyet**, Woodinville, WA (US)
- (73) Assignee: **AT&T Mobility II LLC**, Atlanta, GA (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.

Katherin. "UMTS Antennas from the World's Largest Antenna Supplier" (1999) Product-Marketing, Mobile Communication Antennas, 4 pages, month not available.
 NOKIA. "Transmission Solution for Nokia Mobile Networks"(2000) Product Bulletin, 4 pages, month not available.
 Katherin. "Technical Information and New Products: Cellular Systems" located at www.katherin.de/de/mca/techn-infos/download/9985654.pdf, last viewed Oct. 23, 2006, 16 pages.

* cited by examiner

Primary Examiner—Hoang V. Nguyen
(74) *Attorney, Agent, or Firm*—Amin, Turocy & Calvin, LLP

- (21) Appl. No.: **11/424,664**
- (22) Filed: **Jun. 16, 2006**

(57) **ABSTRACT**

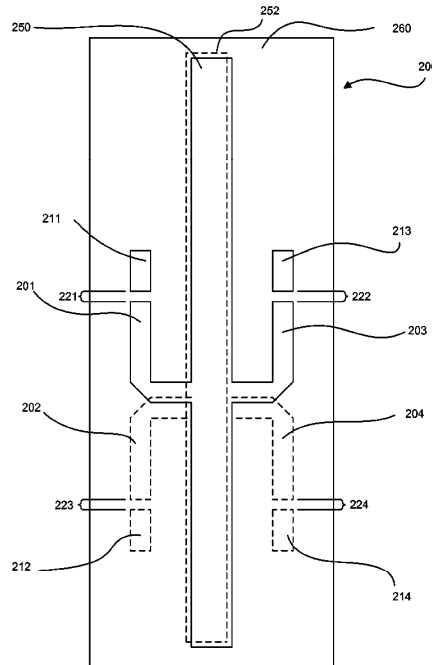
- (51) **Int. Cl.**
H01Q 9/28 (2006.01)
- (52) **U.S. Cl.** **343/795; 343/700 MS**
- (58) **Field of Classification Search** 343/795, 343/801, 802, 810, 812, 813, 814, 816, 700 MS
See application file for complete search history.

A multi-band antenna for use, for example, in a wireless communications network, employs multi-resonant microstrip dipoles that resonate at multiple frequencies due to microstrip "islands." Gaps in the microstrips create an open RF circuit except for desired frequencies. At a desired frequency, RF energy sees a gap as a short circuit between an island and the rest of a dipole antenna, thus, resonating at the desired frequency. In one instance, the multi-band antenna includes a first, second, third, and fourth dipole elements. Gaps between the first and third dipole elements and the second and fourth dipole elements are sufficiently small that the first, second, third, and fourth dipole elements form a second dipole having a corresponding dipole wavelength longer than that of the first dipole.

- (56) **References Cited**
U.S. PATENT DOCUMENTS
6,529,170 B1 * 3/2003 Nishizawa et al. 343/795
6,965,353 B2 * 11/2005 Shirosaka et al. 343/802

OTHER PUBLICATIONS
 Nortel Networks. "GSM 900/1800/1900 Univity GSM Base Transceiver Station eCell" (2002) Product Bulletin, 2 pages, month not available.

22 Claims, 7 Drawing Sheets





US007277738B2

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

(10) **Patent No.:** **US 7,277,738 B2**
(45) **Date of Patent:** **Oct. 2, 2007**

(54) **INTEGRATED ANTENNA AND PC CARD CARRYING CASE**

(75) Inventors: **John K. Reece**, Colorado Springs, CO (US); **John L. Aden**, Ocala, FL (US)

(73) Assignee: **Intel Corporation**, Santa Clara, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 534 days.

(21) Appl. No.: **10/403,432**

(22) Filed: **Mar. 31, 2003**

(65) **Prior Publication Data**
US 2005/0261027 A1 Nov. 24, 2005

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

(52) **U.S. Cl.** **455/575.7; 455/575.1; 455/575.3**

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

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

5,701,515 A * 12/1997 Gradler 710/14

5,828,346 A *	10/1998	Park	.....	343/826
5,898,933 A *	4/1999	Kaschke	.....	455/575.7
6,172,645 B1 *	1/2001	Hollander et al.	.....	343/702
6,181,284 B1 *	1/2001	Madsen et al.	.....	343/702
6,509,876 B1 *	1/2003	Jones et al.	.....	343/702
6,545,643 B1 *	4/2003	Sward et al.	.....	343/702
6,561,328 B1 *	5/2003	Huang	.....	190/18 A
6,731,951 B1 *	5/2004	Takebe et al.	.....	455/557
2003/0100352 A1 *	5/2003	Moles	.....	455/572

* cited by examiner

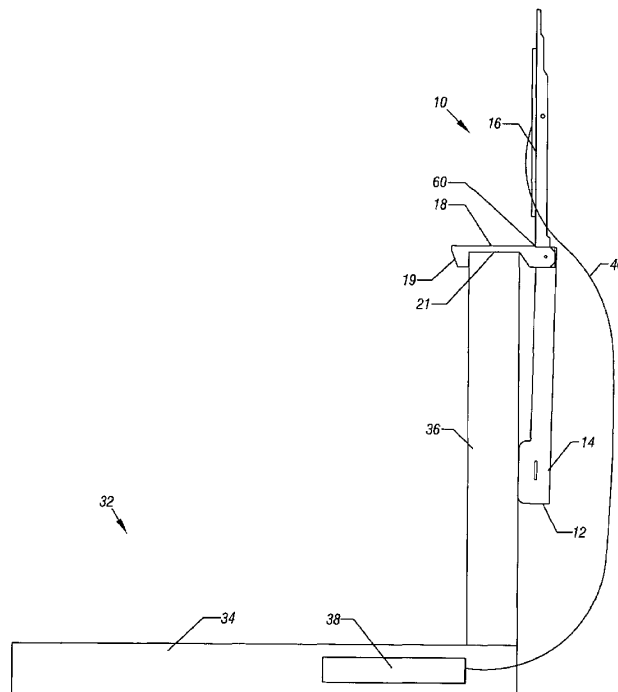
Primary Examiner—Sanh D. Phu

(74) *Attorney, Agent, or Firm*—Trop, Pruner & Hu, P.C.

(57) **ABSTRACT**

A carrying case for a personal computer card may include an integral antenna. The carrying case may be secured onto a laptop computer so that the antenna extends above the laptop computer. The case may include a pair of hingedly connected portions, one of which may extend along the screen of the laptop computer and the other which may extend above the laptop computer while the case is secured to the upper edge of the laptop computer display screen. A cable may extend from the antenna within the case down to a personal computer card plugged into the computer.

19 Claims, 7 Drawing Sheets





US007280074B1

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

(10) **Patent No.:** **US 7,280,074 B1**
(45) **Date of Patent:** **Oct. 9, 2007**

(54) **MULTIPLE FREQUENCY BAND PLANAR ANTENNA**

6,812,892 B2* 11/2004 Tai et al. 343/700 MS
6,985,114 B2* 1/2006 Egashira 343/702
7,057,560 B2* 6/2006 Erkocevic 343/700 MS

(75) Inventors: **Sheng-Yuan Chi**, Banciao (TW);
Chia-Bin Yang, Taipei (TW); **Shiwei Wang**, Taipei (TW)

* cited by examiner

(73) Assignee: **Delta Networks, Inc.**, Taipei (TW)

Primary Examiner—Hoang V. Nguyen
(74) *Attorney, Agent, or Firm*—J.C. Patents

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 7 days.

(57) **ABSTRACT**

(21) Appl. No.: **11/394,962**

A multiple frequency band planar antenna formed on one-side surface of a circuit board comprises: a first antenna pattern, a second antenna pattern, a third antenna pattern and a fourth antenna pattern, each antenna pattern further comprising an elongated portion and a conductor portion; wherein the second elongated portion at a point between its two ends is short-circuited to a feeding transmission line formed on another-side surface of the circuit board through a via. Thus, the multiple frequency band planar antenna can operate at three frequency bands with their central frequencies at 2.4 GHz, 3.5 GHz and 5.8 GHz, respectively, suitable for both WiFi LAN and WiMAX MAN applications.

(22) Filed: **Mar. 30, 2006**

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

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

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

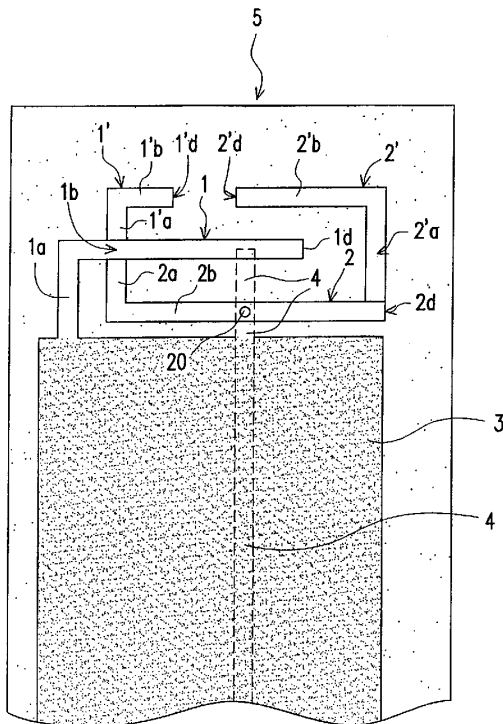
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,535,167 B2 3/2003 Masuda et al. 343/700 MS

12 Claims, 8 Drawing Sheets





US007280082B2

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

(10) **Patent No.:** **US 7,280,082 B2**
(45) **Date of Patent:** **Oct. 9, 2007**

(54) **ANTENNA ARRAY WITH VANE-SUPPORTED ELEMENTS**

(75) Inventors: **David M. Theobold**, Akron, OH (US);
Stephen V. Saliga, Akron, OH (US)

(73) Assignee: **Cisco Technology, Inc.**, San Jose, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 265 days.

(21) Appl. No.: **10/682,983**

(22) Filed: **Oct. 10, 2003**

(65) **Prior Publication Data**

US 2005/0078046 A1 Apr. 14, 2005

(51) **Int. Cl.**
H01Q 21/26 (2006.01)

(52) **U.S. Cl.** **343/797**; 343/770

(58) **Field of Classification Search** 343/762,
343/772, 778, 844, 846, 767, 770, 771, 795,
343/797, 702, 853

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,227,808	A	7/1993	Davis	343/915
5,268,701	A	12/1993	Smith	343/767
6,072,439	A *	6/2000	Ippolito et al.	343/797
6,078,288	A *	6/2000	Adams et al.	342/372
6,140,972	A *	10/2000	Johnston et al.	343/725
6,359,596	B1	3/2002	Claiborne	343/795

6,369,778	B1	4/2002	Dockery	343/895
6,552,691	B2 *	4/2003	Mohuchy et al.	343/770
6,697,029	B2 *	2/2004	Teillet et al.	343/797
6,747,606	B2 *	6/2004	Harel et al.	343/808
6,933,905	B2 *	8/2005	Ippolito	343/797
2003/0227420	A1 *	12/2003	Roper et al.	343/797

FOREIGN PATENT DOCUMENTS

EP	1 182 731	A2	2/2002
WO	WO-02-23669	A1	3/2002

OTHER PUBLICATIONS

Int'l Search Report for International Application No. PCT/US2004/028785 filed on Sep. 3, 2004.

* cited by examiner

Primary Examiner—Douglas W. Owens

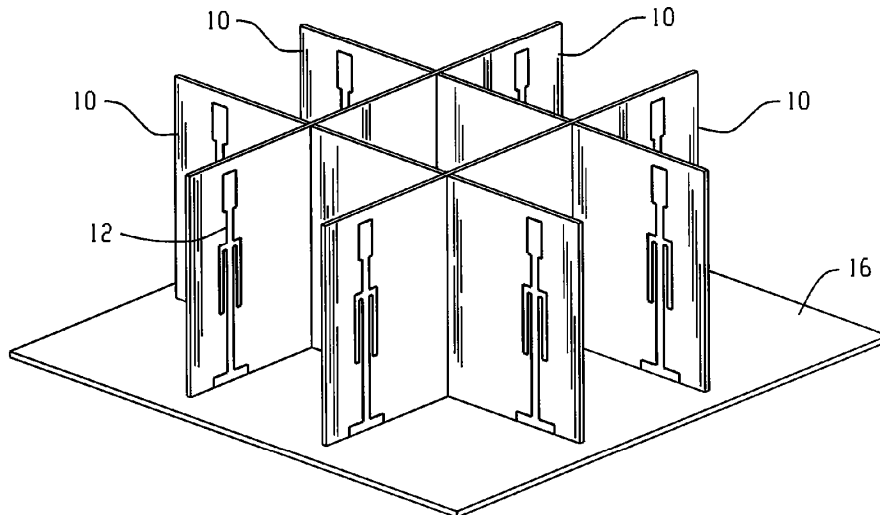
Assistant Examiner—Jimmy Vu

(74) *Attorney, Agent, or Firm*—Tucker Ellis & West LLP

(57) **ABSTRACT**

A multiple element antenna array is disclosed in which a plurality of panels each support one or more antenna elements. One or more of the panels are preferably interlaced, so as to be affixed to a circuit board. The panels are configured so as to affix to the circuit board at a predetermined angle, which is preferably a right angle to the surface of the circuit board. Each antenna element includes a connection point for establishing a circuit board connection. The present multiple element antenna array is preferably incorporated into a wireless device; preferably an access point for a wireless local area network (WLAN). The wireless device further includes a radio transceiver comprising a plurality of circuit elements mounted on the circuit board.

20 Claims, 4 Drawing Sheets





US007280084B2

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

(10) **Patent No.:** **US 7,280,084 B2**
(45) **Date of Patent:** **Oct. 9, 2007**

(54) **ANTENNA SYSTEM FOR GENERATING AND UTILIZING SEVERAL SMALL BEAMS FROM SEVERAL WIDE-BEAM ANTENNAS**

(75) Inventors: **Germar Jochen Herbert**, Nuremberg (DE); **Martin Willem Klomp**, Spalt (DE)

(73) Assignee: **Koninklijke KPN N.V.**, Groningen (NL)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 186 days.

(21) Appl. No.: **10/893,762**

(22) Filed: **Jul. 16, 2004**

(65) **Prior Publication Data**
US 2005/0037813 A1 Feb. 17, 2005

Related U.S. Application Data
(60) Provisional application No. 60/487,631, filed on Jul. 16, 2003.

(51) **Int. Cl.**
H01Q 1/50 (2006.01)
(52) **U.S. Cl.** **343/850; 343/853**
(58) **Field of Classification Search** 343/850, 343/853, 871

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,499,471	A *	2/1985	Luh	.....	342/373
4,799,065	A *	1/1989	Thompson	.....	343/779
6,252,560	B1 *	6/2001	Tanaka et al.	.....	343/853
6,608,591	B2 *	8/2003	Wastberg	.....	342/373
6,922,169	B2 *	7/2005	Moh'd Izzat et al.	.....	342/360
7,019,710	B1 *	3/2006	Shurvinton et al.	.....	343/853
2001/0036843	A1 *	11/2001	Thompson	.....	455/562

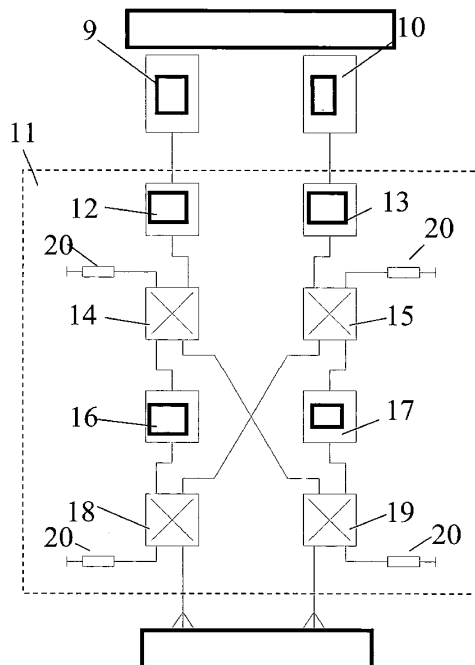
* cited by examiner

Primary Examiner—Thuy V. Tran
Assistant Examiner—Dieu Hien T Duong
(74) *Attorney, Agent, or Firm*—Michaelson & Associates; Peter L. Michaelson

(57) **ABSTRACT**

Antenna systems, in particular but not exclusively, for use in base transceiver stations of wireless telecommunication networks. Specifically, the present invention combines two or more wide-beam antennas to generate relatively narrow beams and can be used in any sectorized wireless network such as, but not limited to, GSM, CDMA, TDMA and UMTS. Illustratively, two electrically separated beams, creating two electrically separated sectors, can be formed with both beams having characteristics of a combined antenna but advantageously generated using only half the number of separate antennas than conventionally taught to achieve the same beam width for each sector.

5 Claims, 5 Drawing Sheets





US007283094B2

(12) **United States Patent**
Lee

(10) **Patent No.:** **US 7,283,094 B2**
(45) **Date of Patent:** **Oct. 16, 2007**

(54) **DUAL BAND ANTENNA ASSEMBLY AND METHOD FOR DESIGNING THE SAME**

6,933,902 B2* 8/2005 Yeh 343/762
2005/0007279 A1* 1/2005 Chang 343/700 MS

(75) Inventor: **Ming-Chou Lee, Hsin Tien (TW)**

(73) Assignee: **Airoha Technology Corp., Hsinchu (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 64 days.

Primary Examiner—Hoang V. Nguyen

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

(57) **ABSTRACT**

(21) Appl. No.: **11/301,871**

(22) Filed: **Dec. 13, 2005**

(65) **Prior Publication Data**

US 2006/0132361 A1 Jun. 22, 2006

(30) **Foreign Application Priority Data**

Dec. 17, 2004 (TW) 93139517 A

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

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

(58) **Field of Classification Search** **343/700 MS, 343/846, 895, 702**

See application file for complete search history.

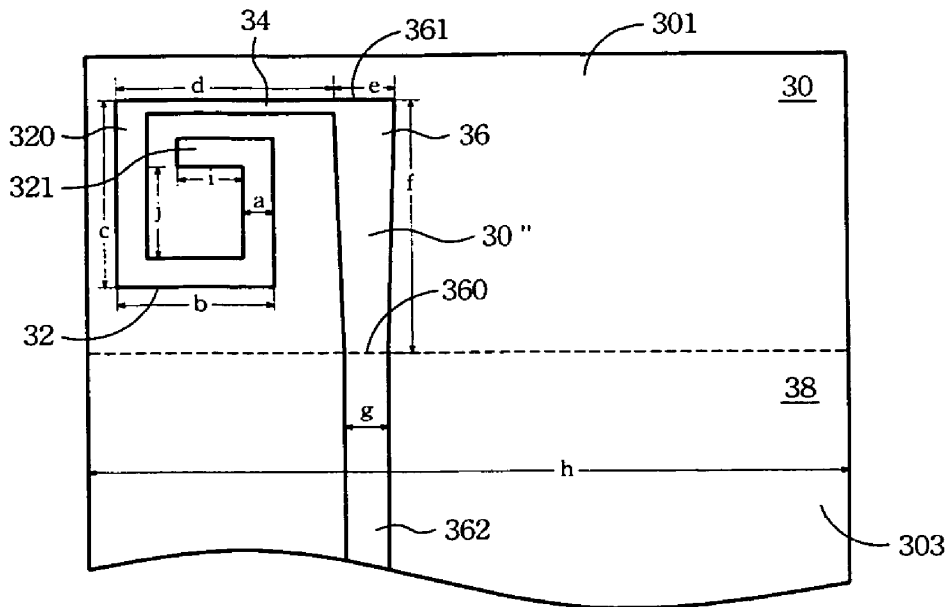
A dual band antenna assembly includes a radiating metal strip fabricated on a baseboard. The radiating metal strip includes a winding strip section having a heading end and a tail end, a connected strip section having one connecting end coupled integrally to the tail end of the winding strip section and the other connecting end, a lump-like strip section having a first terminal end serving as a feeding pin and a second terminal end coupled integrally to the other connecting end of the connected strip section. A first signal-working band is defined when a current path flows through the feeding pin and the second terminal end of the lump-like strip section to generate a first resonance. A second signal-working band is defined when a current path flows through the lump-like strip section, the connected strip section and the winding strip section to generate a second resonance.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,856,294 B2* 2/2005 Kadambi et al. 343/702

21 Claims, 6 Drawing Sheets





US007283097B2

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

(10) **Patent No.:** **US 7,283,097 B2**
(45) **Date of Patent:** **Oct. 16, 2007**

(54) **MULTI-BAND ANTENNA WITH PATCH AND SLOT STRUCTURES**

(75) Inventors: **Geyi Wen**, Waterloo (CA); **Perry Jarmuszewski**, Waterloo (CA); **Adam D. Stevenson**, Waterloo (CA)

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

(*) 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.: **11/456,025**

(22) Filed: **Jul. 6, 2006**

(65) **Prior Publication Data**

US 2006/0232485 A1 Oct. 19, 2006

Related U.S. Application Data

(63) Continuation of application No. 10/723,840, filed on Nov. 26, 2003, now Pat. No. 7,224,312.

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

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

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

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,049,314 A * 4/2000 Munson et al. 343/846
6,140,966 A 10/2000 Pankinaho 343/700 MS
6,157,348 A 12/2000 Openlander 343/846
6,343,208 B1 1/2002 Ying 455/575.7
6,408,190 B1 6/2002 Ying 455/553
6,670,923 B1 * 12/2003 Kadambi et al. 343/700 MS

7,023,387 B2 * 4/2006 Wen et al. 343/700 MS
7,136,024 B2 * 11/2006 Yuanzhu et al. 343/767
7,145,516 B2 * 12/2006 Ko et al. 343/767
7,151,493 B2 * 12/2006 Wen et al. 343/700 MS
2003/0011521 A1 1/2003 Edimo et al. 343/700 MS
2004/0026039 A1 * 2/2004 Goto et al. 156/345.41
2004/0164906 A1 * 8/2004 Shih 343/700 MS
2006/0244668 A1 * 11/2006 Iellici et al. 343/729

FOREIGN PATENT DOCUMENTS

EP 1172885 1/2002
EP 1241733 9/2002
WO 0227859 4/2002
WO 0227862 4/2002

* cited by examiner

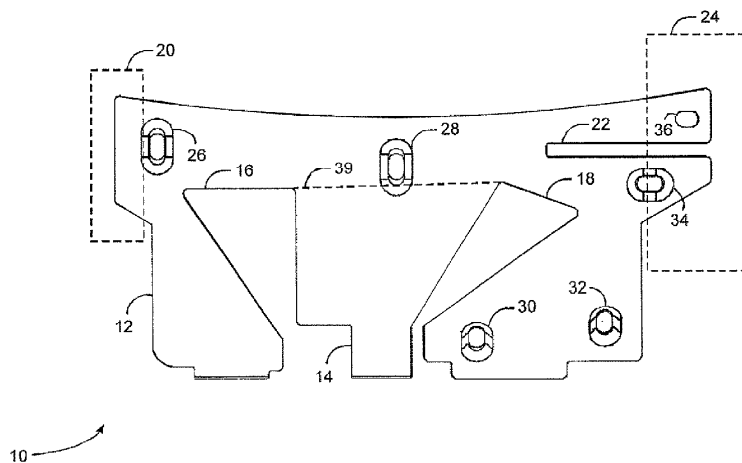
Primary Examiner—Tan Ho

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

(57) **ABSTRACT**

A multiple-band antenna having first and second operating frequency bands is provided. The antenna includes a first patch structure associated primarily with the first operating frequency band, a second patch structure electrically coupled to the first patch structure and associated primarily with the second operating frequency band, a first slot structure disposed between a first portion of the first patch structure and the second patch structure and associated primarily with the first operating frequency band, and a second slot structure disposed between a second portion of the first patch structure and the second patch structure and associated primarily with the second operating frequency band. A mounting structure for the multiple-band antenna is also provided. The mounting structure includes a first surface and a second surface opposite to and overlapping the first surface. The first and second patch structures are mounted to the first surface, and a feeding point and ground point, respectively connected to the first and second patch structures, are mounted to the second surface.

27 Claims, 7 Drawing Sheets





US007283098B2

(12) **United States Patent**
Lim

(10) **Patent No.:** **US 7,283,098 B2**
(45) **Date of Patent:** **Oct. 16, 2007**

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

7,012,571 B1 * 3/2006 Ozkar et al. 343/702
2002/0000941 A1 1/2002 Johnson

(75) Inventor: **Byung-Man Lim**, Seoul (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 132 days.

FOREIGN PATENT DOCUMENTS

EP 1 111 712 6/2001
WO WO98/56066 12/1998

(21) Appl. No.: **11/186,661**

* cited by examiner

(22) Filed: **Jul. 21, 2005**

Primary Examiner—Hoang V. Nguyen

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

(65) **Prior Publication Data**

US 2006/0145932 A1 Jul. 6, 2006

(57) **ABSTRACT**

(30) **Foreign Application Priority Data**

Dec. 17, 2004 (KR) 10-2004-0107871

Disclosed is an antenna apparatus for a portable terminal which has a variable movement antenna apparatus variably moving a position of a ground surface of an antenna. A sliding type portable terminal includes a body housing, a sliding housing slidably moved to and from the body housing; built-in antenna provided in the body housing; and a variable movement antenna apparatus variably moving a position of a ground surface by separating the ground surface of the antenna and by slidably moving the separated ground surface in the lengthwise direction of the body housing so as to be closer to and farther away from the body housing.

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

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

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

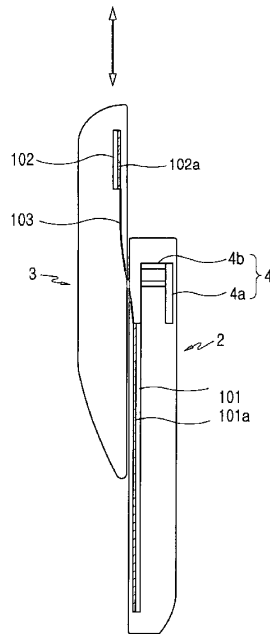
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,542,125 B1 4/2003 Hoffmeister et al.

6 Claims, 7 Drawing Sheets





US007283099B2

(12) **United States Patent**
Na

(10) **Patent No.:** US 7,283,099 B2
(45) **Date of Patent:** Oct. 16, 2007

(54) **BUILT-IN ANTENNA MODULE OF WIRELESS COMMUNICATION TERMINAL**

(75) Inventor: **Gi Lyong Na**, Kyungki-Do (KR)
(73) Assignee: **Samsung Electro-Mechanics Co., Ltd.**, Kyungki-Do (KR)

(*) 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.: **11/531,571**

(22) Filed: **Sep. 13, 2006**

(65) **Prior Publication Data**
US 2007/0057856 A1 Mar. 15, 2007

(30) **Foreign Application Priority Data**
Sep. 14, 2005 (KR) 10-2005-0085709

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
(52) **U.S. Cl.** 343/702
(58) **Field of Classification Search** 343/702,
343/873, 700 MS, 906; 29/600
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,546,357 A * 10/1985 Laughon et al. 343/702
5,572,223 A * 11/1996 Phillips et al. 343/702

* cited by examiner

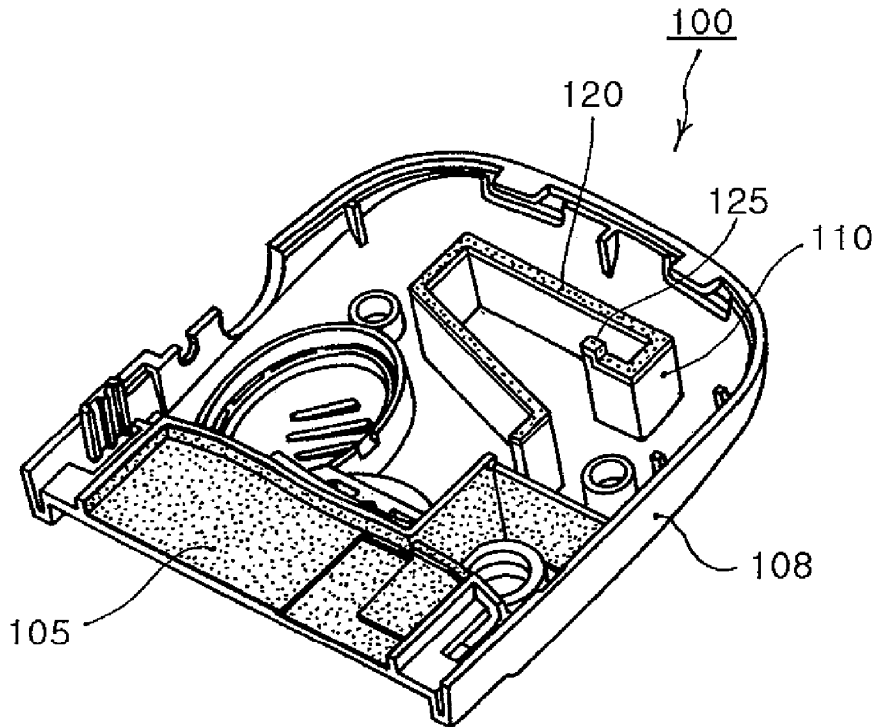
Primary Examiner—Tho Phan

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

(57) **ABSTRACT**

A built-in antenna module of a wireless communication terminal is provided. In the antenna module, a substrate is disposed inside a terminal body and has a plurality of electronic parts mounted therein. At least one radiator rib is integrally extended from the terminal body along a predetermined pattern in accordance with properties of the antenna. A radiator line is made of a conductive elastomer which is dispensed and coated onto an upper end of the radiator rib. The radiator line has an end electrically connected to a feeding part of the substrate. The invention simplifies a process for manufacturing the antenna module, thereby improving work productivity and saving manufacturing costs. The invention also allows the antenna to be modified in design more flexibly and the terminal product to be miniaturized.

11 Claims, 5 Drawing Sheets





US007283103B2

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

(10) **Patent No.:** **US 7,283,103 B2**
(45) **Date of Patent:** **Oct. 16, 2007**

(54) **COMPACT BROADBAND ANTENNA**

(75) Inventors: **Chad M. Wangsvick**, Tucson, AZ
(US); **Gary M. Salvail**, Camarillo, CA
(US); **Joseph A. Robson**, Tucson, AZ
(US)

(73) Assignee: **Raytheon Company**, Waltham, MA
(US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 165 days.

(21) Appl. No.: **10/838,549**

(22) Filed: **May 4, 2004**

(65) **Prior Publication Data**

US 2007/0188394 A1 Aug. 16, 2007

(51) **Int. Cl.**
H01Q 13/00 (2006.01)
H01Q 9/28 (2006.01)
H01Q 1/48 (2006.01)

(52) **U.S. Cl.** **343/775; 343/808; 343/846**

(58) **Field of Classification Search** **343/700 MS, 343/772, 775, 808, 846**
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,239,700	A *	4/1941	Carter	.....	343/807
3,401,387	A *	9/1968	Milligan et al.	.....	343/767
3,414,903	A *	12/1968	Bartlett et al.	.....	343/753
3,978,486	A *	8/1976	Reinders	.....	343/781 CA
4,719,470	A *	1/1988	Munson	.....	343/700 MS
5,506,592	A *	4/1996	MacDonald et al.	.....	343/846
5,990,845	A *	11/1999	Sharp et al.	.....	343/846
6,198,454	B1 *	3/2001	Sharp et al.	.....	343/773

6,697,031	B2 *	2/2004	Jocher	.....	343/895
6,842,141	B2 *	1/2005	Suh et al.	.....	343/700 MS
7,006,047	B2 *	2/2006	Marsan et al.	.....	343/705

FOREIGN PATENT DOCUMENTS

JP 10150318 A 6/1998

OTHER PUBLICATIONS

Eskelinen, Pekka, Improvements of an inverted trapezoidal pulse antenna, IEEE Antennas and Propagation Magazine, vol. 43, No. 3, Jun. 2001.

* cited by examiner

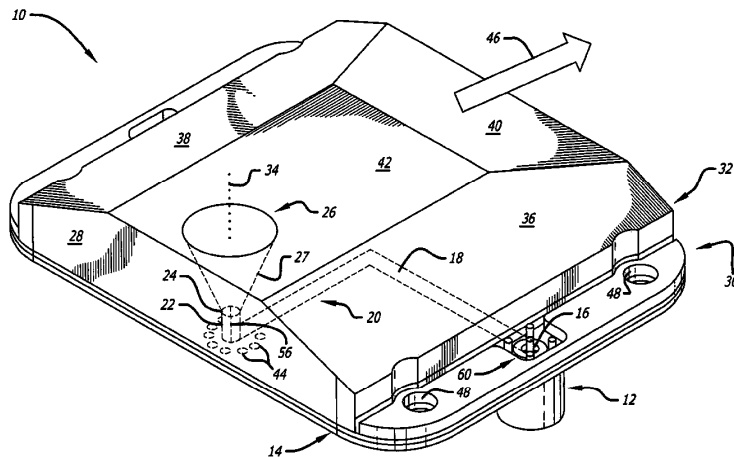
Primary Examiner—Shih-Chao Chen

(74) *Attorney, Agent, or Firm*—Rene Grossman, Esq.; Leonard A. Alkov Esq.; H. St. Julian, Esq.

(57) **ABSTRACT**

A compact broadband antenna. The antenna includes a first mechanism for receiving input electromagnetic energy. A second mechanism provides radiated electromagnetic energy upon receipt of the input electromagnetic energy. The radiated electromagnetic energy is provided via an antenna element having one or more angled surfaces. A third mechanism directs the radiated electromagnetic energy in a specific direction. In a more specific embodiment, the third mechanism includes a reflective backstop that is selectively positioned behind the second mechanism to reflect back-radiated energy forward of the second mechanism, thereby causing reflected electromagnetic energy to combine in phase with forward-radiated energy from the second mechanism. The third mechanism further includes plural layers of dielectric material. One or more of the plural layers of dielectric material partially surround an angled radiating surface of the second mechanism, which is implemented via a substantially conical transmit element in the specific embodiment.

37 Claims, 6 Drawing Sheets





US007286086B2

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

(10) **Patent No.:** **US 7,286,086 B2**
(45) **Date of Patent:** **Oct. 23, 2007**

(54) **GAIN-ADJUSTABLE ANTENNA**
(75) Inventors: **Chien-Hsing Fang**, Taipei (TW);
Jin-Shu Chang, Taipei (TW)
(73) Assignee: **Wistron NeWeb Corp.**, Taipei Hsien
(TW)
(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 64 days.

(58) **Field of Classification Search** 343/801,
343/810, 816, 795, 700 MS, 846, 853, 754
See application file for complete search history.

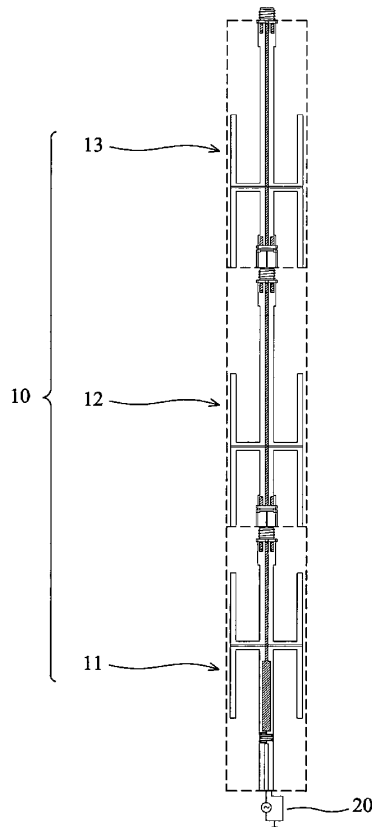
(56) **References Cited**
U.S. PATENT DOCUMENTS
5,568,161 A * 10/1996 Fulmer, Sr. 343/816
6,661,381 B2 * 12/2003 Chen 343/700 MS
6,809,699 B2 * 10/2004 Chen et al. 343/795

* cited by examiner
Primary Examiner—Hoang V. Nguyen
(74) *Attorney, Agent, or Firm*—Quintero Law Office

(21) Appl. No.: **11/262,453**
(22) Filed: **Oct. 27, 2005**
(65) **Prior Publication Data**
US 2006/0176218 A1 Aug. 10, 2006
(30) **Foreign Application Priority Data**
Feb. 5, 2005 (TW) 94103953 A
(51) **Int. Cl.**
H01Q 1/38 (2006.01)
(52) **U.S. Cl.** **343/700 MS**; 343/846;
343/853

(57) **ABSTRACT**
A gain-adjustable antenna has at least a first antenna unit
with a first radiation element and a second antenna unit with
a second radiation element. The first and second antenna
units are detachably connected by way of connecting the
first and second radiation element to form an array antenna
to adjust the gain and the radiation pattern.

14 Claims, 12 Drawing Sheets





US007286087B1

(12) **United States Patent**
Lee

(10) **Patent No.:** **US 7,286,087 B1**
(45) **Date of Patent:** **Oct. 23, 2007**

(54) **DUAL-BAND INVERTED-F ANTENNA**

(56) **References Cited**

(75) Inventor: **Chang-Jung Lee**, Taoyuan County (TW)

U.S. PATENT DOCUMENTS

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

7,136,025 B2 * 11/2006 Lin et al. 343/770
2004/0263391 A1 * 12/2004 He et al. 343/700 MS
2005/0259024 A1 * 11/2005 Hung et al. 343/770

(*) 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—Shih-Chao Chen

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

(21) Appl. No.: **11/593,107**

(57) **ABSTRACT**

(22) Filed: **Nov. 6, 2006**

(30) **Foreign Application Priority Data**

Apr. 7, 2006 (TW) 95112306 A

A dual-band inverted-F antenna includes a first radiating unit, a second radiating unit and a third radiating unit. The first radiating unit has a first long side and a first short side. The second radiating unit has a second long side and a second short side. The second long side is disposed opposite the first short side of the first radiating unit. The third radiating unit has a first radiating part, a second radiating part and a third radiating part. The second radiating part and the third radiating part are respectively extended from one side of the first radiating part. There is a gap between the third radiating unit and the first radiating unit.

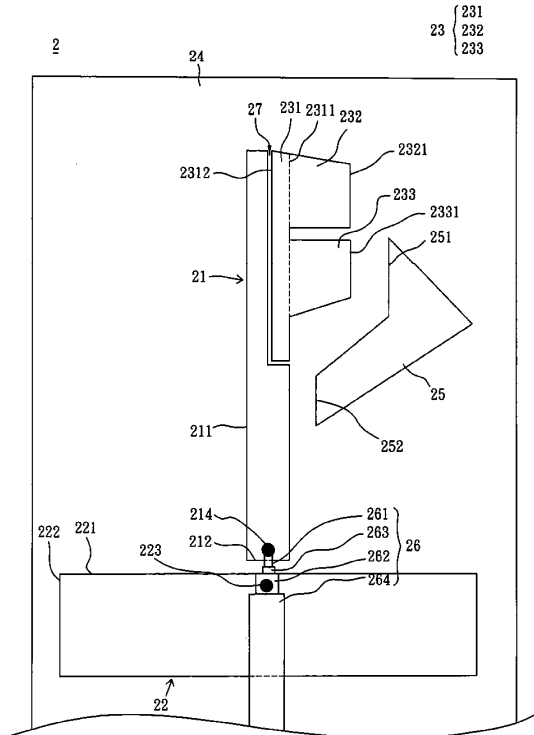
(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 9/38 (2006.01)
H01Q 19/00 (2006.01)

(52) **U.S. Cl.** **343/700 MS**; 343/830;
343/833

(58) **Field of Classification Search** 343/700 MS,
343/767, 830, 833

See application file for complete search history.

19 Claims, 14 Drawing Sheets





US007286090B1

(12) **United States Patent**
Rowell

(10) **Patent No.:** **US 7,286,090 B1**
(45) **Date of Patent:** **Oct. 23, 2007**

(54) **MEANDER FEED STRUCTURE ANTENNA SYSTEMS AND METHODS**

(75) Inventor: **Corbett Rowell, Sha Tin (HK)**

(73) Assignee: **Hong Kong Applied Science and Technology Research Institute Co., Ltd., Hong Kong (CN)**

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 3 days.

(21) Appl. No.: **11/392,234**

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

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

(52) **U.S. Cl.** **343/702; 343/803**

(58) **Field of Classification Search** **343/700 MS, 343/702, 803, 905**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,860,020 A	8/1989	Wong et al.	
5,892,490 A	4/1999	Asakura et al.	
6,054,952 A	4/2000	Shen et al.	
6,861,986 B2	3/2005	Fang et al.	
7,119,746 B2 *	10/2006	Luk et al.	343/702
7,132,999 B2 *	11/2006	Yamagajo et al.	343/895
7,205,954 B2 *	4/2007	Yamagajo et al.	343/803
2002/0175872 A1	11/2002	Apostolos	
2003/0092420 A1	5/2003	Sugimoto et al.	

2003/0098812 A1	5/2003	Zhinong et al.	
2003/0193438 A1	10/2003	Yoon	
2005/0062651 A1	3/2005	Kuo et al.	
2006/0017621 A1 *	1/2006	Okawara et al.	343/700 MS
2006/0077105 A1	4/2006	Jeong	

FOREIGN PATENT DOCUMENTS

EP	1 267 439 A1	5/2002
EP	1648050	4/2006
GB	2 370 419 A	6/2002
GB	2 404 497 A	2/2005
GB	2 413 900 A	11/2005
JP	11205029	7/1999
WO	WO 02/39540 A3	5/2002

OTHER PUBLICATIONS

International Search Report for PCT/CN2007/000773 dated Jun. 28, 2007, 3 pgs.

* cited by examiner

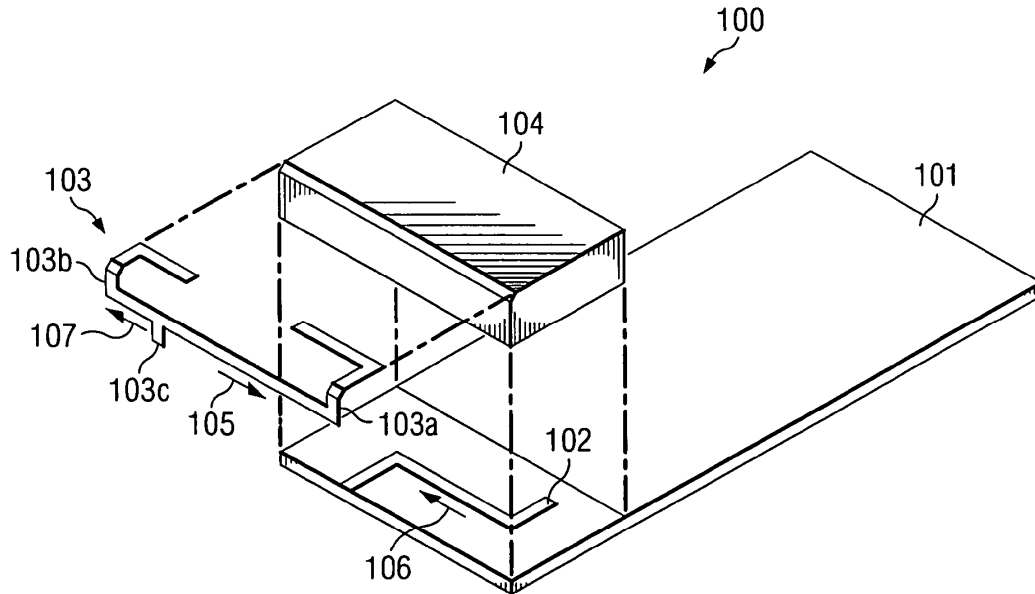
Primary Examiner—Tan Ho

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

(57) **ABSTRACT**

A transmitting and receiving system including an antenna element having first and second current paths, and a meander feed line connected to said first and second current paths, the meander feed line including a radiating portion parallel to the first current path, wherein a current in the radiating portion is in a direction opposite of a current in the first current path, and wherein a current in the second current path is in a direction the same as the current in said radiating portion.

22 Claims, 4 Drawing Sheets





US007286091B2

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

(10) **Patent No.:** **US 7,286,091 B2**
(45) **Date of Patent:** **Oct. 23, 2007**

- (54) **CO-LOCATED ANTENNAS**
- (75) Inventors: **Kuo-Chiang Chen**, Sugar Land, TX (US); **Thomas D. Barber**, Houston, TX (US)
- (73) Assignee: **Schlumberger Technology Corporation**, Sugar Land, TX (US)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 130 days.

5,170,302 A *	12/1992	Matsumoto	.....	360/123
5,508,616 A	4/1996	Sato et al.		
5,699,048 A	12/1997	Galloway		
5,757,191 A	5/1998	Gianzero		
5,781,436 A	7/1998	Forgang et al.		
5,999,883 A	12/1999	Gupta et al.		
6,044,325 A	3/2000	Chakravarthy et al.		
6,181,138 B1	1/2001	Hagiwara et al.		
6,393,364 B1	5/2002	Gao et al.		
6,476,609 B1	11/2002	Bittar		
6,642,827 B1 *	11/2003	McWilliams et al.	.....	336/107
7,038,457 B2 *	5/2006	Chen et al.	.....	324/339

(21) Appl. No.: **11/256,226**

(22) Filed: **Oct. 21, 2005**

(65) **Prior Publication Data**

US 2006/0043973 A1 Mar. 2, 2006

Related U.S. Application Data

(62) Division of application No. 10/250,225, filed on Jun. 13, 2003, now Pat. No. 7,038,457.

(51) **Int. Cl.**
H01Q 1/04 (2006.01)
G01V 3/28 (2006.01)

(52) **U.S. Cl.** **343/719; 343/893; 324/339**

(58) **Field of Classification Search** **343/719, 343/893**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,187,252 A	6/1965	Hungerford		
3,609,521 A	9/1971	Desbrandes		
3,808,520 A	4/1974	Runge		
4,302,723 A	11/1981	Moran		
4,319,191 A	3/1982	Meador et al.		
4,360,777 A	11/1982	Segesman		
4,500,860 A *	2/1985	Vermilyea	.....	335/216
4,972,150 A	11/1990	Tabbagh		
5,115,198 A	5/1992	Gianzero et al.		

(Continued)

FOREIGN PATENT DOCUMENTS

GB 2391392 A * 4/2004

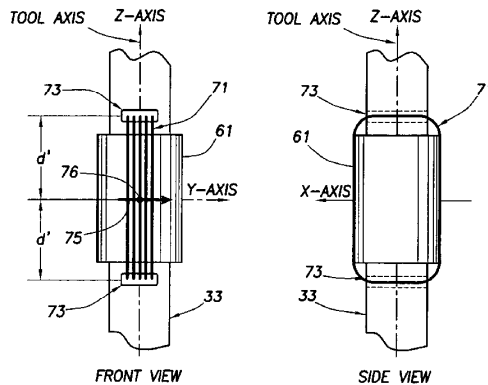
(Continued)

Primary Examiner—Trinh Vo Dinh
(74) *Attorney, Agent, or Firm*—Bryan L. White; Kevin P. McEnaney; Brigitte L. Echols

(57) **ABSTRACT**

Techniques for implementing antenna configurations with substantially co-located axes are disclosed. A method for constructing co-located antennas includes winding a first antenna on a support, the first antenna having a first magnetic dipole in a first orientation; and winding a second antenna on the support through a first set of openings in the support, the second antenna having a second magnetic dipole in a second orientation, wherein the first orientation is different from the second orientation, and wherein a center of the first magnetic dipole substantially co-locates with a center of the second magnetic dipole.

8 Claims, 5 Drawing Sheets





US007286094B2

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

(10) **Patent No.:** **US 7,286,094 B2**
(45) **Date of Patent:** **Oct. 23, 2007**

(54) **THREE-DIMENSIONAL
OMNI-DIRECTIONAL ANTENNA DESIGNS
FOR ULTRA-WIDEBAND APPLICATIONS**

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

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

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 146 days.

(21) Appl. No.: **11/007,949**

(22) Filed: **Dec. 9, 2004**

(65) **Prior Publication Data**

US 2005/0156804 A1 Jul. 21, 2005

(30) **Foreign Application Priority Data**

Dec. 11, 2003 (EP) 03028574

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

(52) **U.S. Cl.** **343/773; 343/772**

(58) **Field of Classification Search** **343/700 MS,**
343/754, 785, 846, 773, 702, 772
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,454,766 A 11/1948 Brillouin 250/33.63

(Continued)

FOREIGN PATENT DOCUMENTS

DE 1 466 400 4/1970

(Continued)

Primary Examiner—Douglas W. Owens
Assistant Examiner—Jimmy Vu

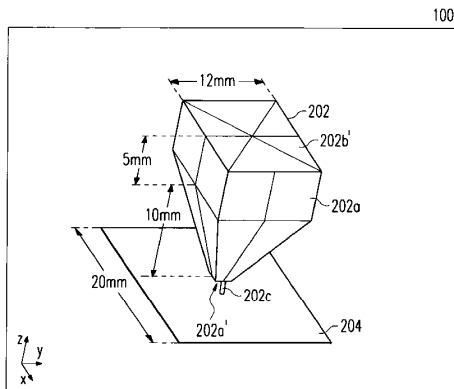
(74) *Attorney, Agent, or Firm*—Oblon, Spivak, McClelland,
Maier & Neustadt, P.C.

(57) **ABSTRACT**

The present invention generally relates to the field of micro-wave antennas, and, more particularly, to a number of three-dimensional designs for the radiation element of an ultra-wideband monopole antenna with a symmetrical omni-directional radiation pattern operated in the frequency range between 3.1 GHz and 10.6 GHz. Said antenna is connected to the analog front-end circuitry of a wireless communication device used for transmitting and/or receiving micro-wave signals and meets the FCC requirements in terms of antenna gain, radiation pattern, polarization, frequency bandwidth, group delay, and size. It comprises a radiation element consisting of an air- and/or dielectric-filled cavity structure with a base plane and a radiator plane. A metallic ground plane having a relatively high surface impedance to electromagnetic waves within said frequency range, which is printed on a dielectric substrate, serves as a reflector. The monopole antenna further comprises an antenna feeding circuitry used for electronically steering the symmetrical omni-directional radiation pattern and a feeding line connecting the antenna feeding circuitry with the base plane of the radiation element. Thereby, parts of the analog front-end circuitry can optionally be placed within the air-filled part of the radiation element of the antenna.

The proposed designs include a radiation element having the form of a truncated right circular cone, rotational-symmetric radiation elements with a convexly- or concavely-shaped 3D surface, respectively, a radiation element in the form of a truncated right regular pyramid with a square base plane, and radiation elements with a combined structure comprising a conical, pyramidal, convexly- or concavely-shaped first part and a closed cylindrical or cuboidal second part whose top plane is arranged on top of the congruent base plane of said first part. Further embodiments include radiation elements with the form of a radially notched cylinder or hemisphere as well as combined structures consisting of at least two convexly-shaped elements or two conical parts, respectively, stacked on top of each other.

20 Claims, 6 Drawing Sheets





US007286095B2

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

(10) **Patent No.:** **US 7,286,095 B2**
(45) **Date of Patent:** **Oct. 23, 2007**

(54) **INVERTED FEED DISCONE ANTENNA AND RELATED METHODS**

(75) Inventors: **Francis Eugene Parsche**, Palm Bay, FL (US); **Robert Patrick Maloney**, Palm Bay, FL (US); **Robert Nathan Lavallee**, Palm Bay, FL (US)

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

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

(21) Appl. No.: **11/156,684**

(22) Filed: **Jun. 20, 2005**

(65) **Prior Publication Data**
US 2006/0284779 A1 Dec. 21, 2006

(51) **Int. Cl.**
H01Q 13/00 (2006.01)
(52) **U.S. Cl.** **343/773; 343/772; 343/700 MS**
(58) **Field of Classification Search** **343/790, 343/773, 759, 796, 895, 772, 700 MS**
See application file for complete search history.

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

2,368,663 A 2/1945 Kandoian

4,851,859 A	7/1989	Rappaport	343/790
5,506,592 A *	4/1996	MacDonald et al.	343/846
6,791,508 B2 *	9/2004	Berry et al.	343/895
6,967,626 B2 *	11/2005	Apostolos	343/774
7,002,527 B2 *	2/2006	Sugawara	343/750
7,006,047 B2 *	2/2006	Marsan et al.	343/705
7,023,397 B2 *	4/2006	Kurashima et al.	343/845
7,027,004 B2 *	4/2006	Hauemberger et al.	343/790
2004/0164918 A1 *	8/2004	Nilsson	343/773
2004/0233118 A1 *	11/2004	Jocher	343/773
2005/0140557 A1 *	6/2005	Kuroda et al.	343/773

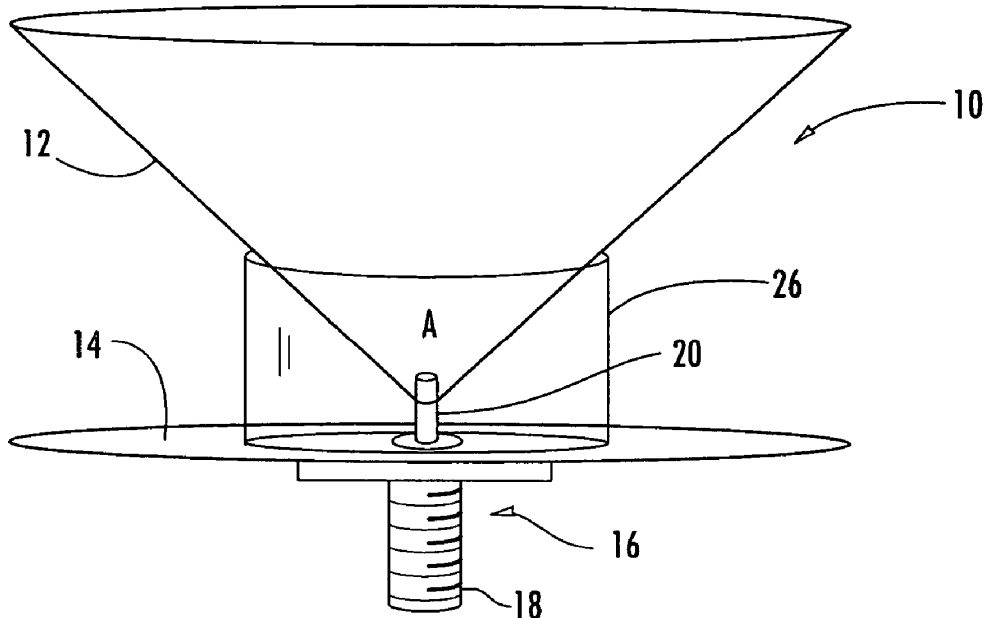
* cited by examiner

Primary Examiner—Trinh Dinh
Assistant Examiner—Dieu Hien T Duong
(74) *Attorney, Agent, or Firm*—Allen, Dyer, Dopplet, Milbrath & Gilchrist, P.A.

(57) **ABSTRACT**

The discone antenna includes a conical antenna element, having an apex, and a disc antenna element adjacent the apex of the conical antenna element. An inverted antenna feed structure, such as a flanged coaxial connector or coaxial cable, is connected to the disc and conical antenna elements and extends outwardly from the disc antenna element on a side thereof opposite the apex of the conical antenna element. The discone antenna with such an inverted feed structure facilitates an inverted positioning, for example, on vehicles, rooftops and/or control towers, etc., that will increase the bandwidth pattern in the direction of the potential target.

12 Claims, 3 Drawing Sheets





US007286097B1

(12) **United States Patent**
Van Buren et al.

(10) **Patent No.:** **US 7,286,097 B1**
(45) **Date of Patent:** **Oct. 23, 2007**

(54) **YAGI ANTENNA WITH BALANCING TAB**

5,898,410 A * 4/1999 DeMarre 343/792.5
6,326,922 B1 * 12/2001 Hegendoerfer 343/700 MS
6,483,476 B2 * 11/2002 Cox 343/815
2006/0066441 A1 * 3/2006 Knadle et al. 340/10.1

(75) Inventors: **Alan Van Buren**, Cedar City, UT (US);
Richard M. Kline, Cedar City, UT (US)

(73) Assignee: **Wilson Electronics, Inc.**, Saint George, UT (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 28 days.

* cited by examiner

Primary Examiner—Hoang V. Nguyen
Assistant Examiner—Robert Karacsony
(74) *Attorney, Agent, or Firm*—Leon D. Rosen

(21) Appl. No.: **11/449,294**

(22) Filed: **Jun. 8, 2006**

(51) **Int. Cl.**
H01Q 21/00 (2006.01)
H01Q 11/04 (2006.01)
H01Q 21/12 (2006.01)
H01Q 19/00 (2006.01)
H01Q 19/30 (2006.01)

(52) **U.S. Cl.** **343/811**; 343/810; 343/812;
343/813; 343/814; 343/815; 343/816; 343/817;
343/818; 343/819

(58) **Field of Classification Search** 343/810,
343/811, 812, 813, 814, 815, 816, 817, 818,
343/819

See application file for complete search history.

(56) **References Cited**

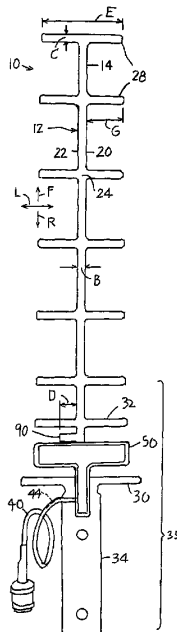
U.S. PATENT DOCUMENTS

4,218,686 A * 8/1980 Blonder 343/819

(57) **ABSTRACT**

An antenna minimizes radiation from the outer conductor (44) of a coaxial cable (40) that is coupled to the antenna by providing a balancing tab (90) that lies near the connection (72) of the cable outer conductor (44) to the antenna. One antenna includes a Yagi structure (12) constructed of a plate of metal that forms a long boom (20) and a plurality of directors (28) extending laterally across the boom, with an electrical coupling loop mounted at a rear region of the Yagi structure. The coupling loop includes a folded dipole in the form of a metal coupling plate that forms a loop (54) with a gap (70), the loop having a laterally elongated front loop end (60). The Yagi structure is formed with a balancing tab (90) that lies forward of the loop, that has a lateral length (D) less than half that of one of the directors, and that extends from only one side (22) of the boom which is the side to which the outer coax conductor (44) is connected to the loop. The metal coupling plate lies facewise adjacent to a face (24) of the Yagi plate, with a dielectric spacer (76) between them.

13 Claims, 2 Drawing Sheets





US007286098B2

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

(10) **Patent No.:** **US 7,286,098 B2**
(45) **Date of Patent:** **Oct. 23, 2007**

(54) **CIRCULAR POLARIZATION ANTENNA AND COMPOSITE ANTENNA INCLUDING THIS ANTENNA**

(75) Inventors: **Kazushige Ogino**, Kobe (JP); **Yoshio Umezawa**, Kobe (JP); **Kazuo Takayama**, Kobe (JP); **Koji Nagao**, Kobe (JP); **Katsuhiro Tsuruta**, Kobe (JP)

(73) Assignee: **Fujitsu Ten Limited**, Kobe-Shi (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 169 days.

(21) Appl. No.: **10/929,758**

(22) Filed: **Aug. 30, 2004**

(65) **Prior Publication Data**
US 2005/0052334 A1 Mar. 10, 2005

(30) **Foreign Application Priority Data**
Aug. 29, 2003 (JP) 2003-209615
Feb. 19, 2004 (JP) 2004-043178
Feb. 19, 2004 (JP) 2004-043239
Jun. 23, 2004 (JP) 2004-185084

(51) **Int. Cl.**
H01Q 19/00 (2006.01)
H01Q 19/10 (2006.01)
H01Q 1/38 (2006.01)
H01Q 11/12 (2006.01)
H01Q 1/32 (2006.01)

(52) **U.S. Cl.** **343/833; 343/700 MS; 343/834; 343/742**

(58) **Field of Classification Search** **343/700 MS, 343/711, 713, 742, 833, 834, 873, 844**
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,440,658 A 4/1969 Bogner

(Continued)

FOREIGN PATENT DOCUMENTS

DE 1 860 195 10/1962

(Continued)

OTHER PUBLICATIONS

B. Cetiner et al, "Monolithic Integration of RF MEMS Switches with a Diversity Antenna on PCB Substrate"; IEEE Transactions on Microwave Theory and Techniques, vol. 51, No. 1, Jan. 2003, pp. 332-335.

(Continued)

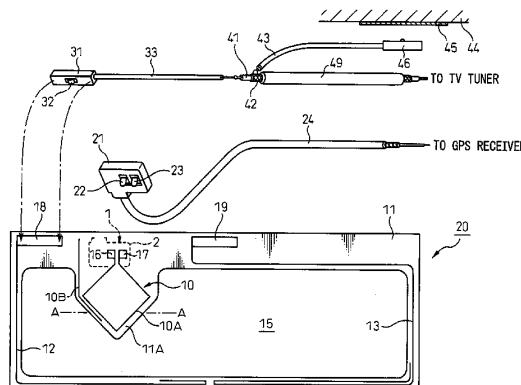
Primary Examiner—Shih-Chao Chen

(74) *Attorney, Agent, or Firm*—Christie, Parker & Hale, LLP

(57) **ABSTRACT**

When configuring a film antenna for receiving a circular polarized wave, at least one loop antenna is formed on a transparent plastic film and, at the same time, a non-powered element constituted by a wire-shaped conductor independent from the antenna conductor configuring the loop is arranged near this loop antenna. The non-powered element arranged on the side of the loop antenna is configured by a first part and a second part. The first part is made close to the loop antenna in a substantially parallel state. When a monopole antenna is used in place of the loop antenna, by combining this with a wire-shaped conductor orthogonal to this, it becomes possible to receive a circular polarized wave by a configuration providing a power transfer part between the two. It is also possible to configure a composite antenna by mounting another antenna on the transparent plastic film. This antenna can be used as an antenna of a navigation system.

73 Claims, 48 Drawing Sheets





US007286099B1

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

(10) **Patent No.:** **US 7,286,099 B1**
(45) **Date of Patent:** **Oct. 23, 2007**

(54) **ROTATION-INDEPENDENT HELICAL ANTENNA**

(75) Inventors: **Erik Lier**, Newtown, PA (US);
Bernard F. Lindinger, Elkins Park, PA (US); **Leon R. Smolenski**, Perkasi, PA (US)

(73) Assignee: **Lockheed Martin Corporation**, Bethesda, MD (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 139 days.

(21) Appl. No.: **11/217,439**

(22) Filed: **Sep. 2, 2005**

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

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

(58) **Field of Classification Search** 343/895,
343/715, 900

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,982,964	A *	5/1961	Bresk et al.	343/895
4,097,867	A *	6/1978	Eroncig	343/715
6,172,655	B1 *	1/2001	Volman	343/895
6,181,296	B1 *	1/2001	Kulisan et al.	343/895
6,198,449	B1 *	3/2001	Muhlhauser et al.	343/753
7,142,171	B1 *	11/2006	Patel et al.	343/895
2004/0257298	A1 *	12/2004	Larouche et al.	343/895

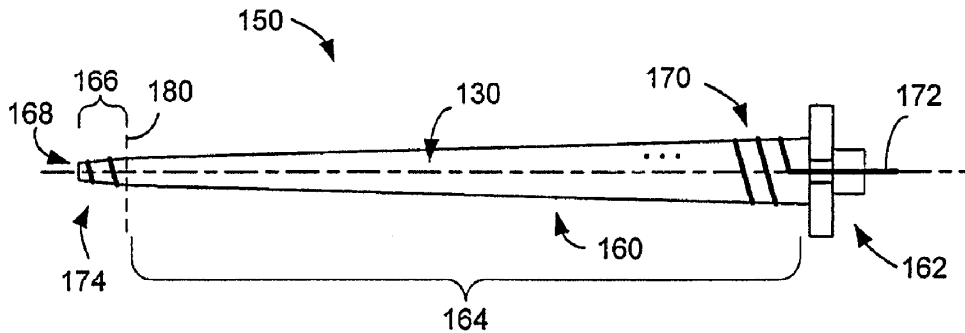
* cited by examiner

Primary Examiner—Hoanganh Le
(74) *Attorney, Agent, or Firm*—McDermott Will & Emery LLP

(57) **ABSTRACT**

A helical antenna having a central axis defined between a base end and a distal end comprises a helical conductor wound about the central axis and having a feed line disposed at the base end and along the central axis, and may also include an elongated dielectric core about which the electrical conductor is wound.

18 Claims, 5 Drawing Sheets





US007289065B2

(12) **United States Patent**
Prieto-Burgos et al.

(10) **Patent No.:** **US 7,289,065 B2**
(45) **Date of Patent:** **Oct. 30, 2007**

- (54) **ANTENNA**
- (75) Inventors: **Carlos Prieto-Burgos**, Sant Boi (ES);
Rainer Wansch, Hagenau (DE)
- (73) Assignee: **Fraunhofer-Gesellschaft zur
Foerderung der angewandten
Forschung e.V.** (DE)
- (*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 119 days.

5,926,150	A	7/1999	McLean	
5,955,995	A	9/1999	Silverstein	
6,307,510	B1	10/2001	Taylor et al.	
6,351,239	B1	2/2002	Mizuno et al.	
6,906,675	B2	6/2005	Satoh	
2003/0146876	A1*	8/2003	Greer et al.	343/702
2004/0017325	A1	1/2004	Satoh et al.	
2004/0155831	A1	8/2004	Goebel et al.	
2005/0110687	A1*	5/2005	Starkie et al.	343/700 MS

- (21) Appl. No.: **11/225,961**
- (22) Filed: **Sep. 14, 2005**

FOREIGN PATENT DOCUMENTS

DE	100 25 262	A1	8/2001
EP	1 231 571	A2	8/2002
JP	2000-314337		10/2001
JP	2001189615		10/2001

- (65) **Prior Publication Data**
US 2006/0109177 A1 May 25, 2006

OTHER PUBLICATIONS

International Search Report (ISA); PCT/EP2005/009617; Sep. 7, 2005.
Boyle K R: "Differentially slotted and differentially filed PIFAs"
Electronics Letters, IEE Stevenage, GB, Bd. 39, Nr. 1, Jan. 9, 2003;
pp. 9-10; ISSN: 0013-5194.

- (30) **Foreign Application Priority Data**
Sep. 21, 2004 (DE) 10 2004 045 707

* cited by examiner

- (51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 9/28 (2006.01)
- (52) **U.S. Cl.** **343/700 MS; 343/795**
- (58) **Field of Classification Search** **343/700 MS,**
343/795, 793, 846
See application file for complete search history.

Primary Examiner—Hoang V. Nguyen
(74) *Attorney, Agent, or Firm*—Beyer Weaver LLP

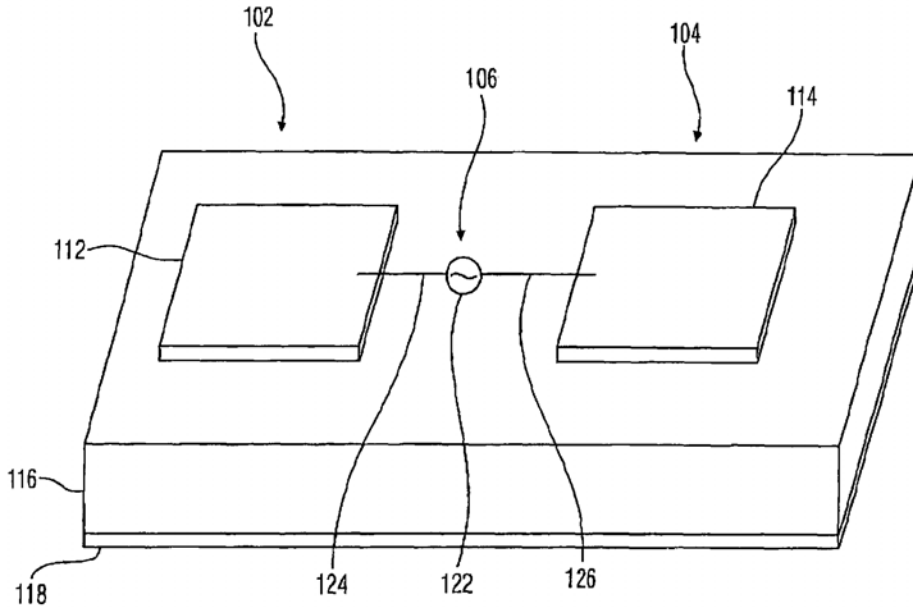
- (56) **References Cited**
U.S. PATENT DOCUMENTS

(57) ABSTRACT

An antenna comprises a first planar antenna and a second planar antenna. A coupler for coupling serves for coupling the first planar antenna to a first component of a differential signal and for coupling the second planar antenna to a second component of the differential signal.

4,922,259 A 5/1990 Hall et al.

9 Claims, 5 Drawing Sheets





US007289068B2

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

(10) **Patent No.:** **US 7,289,068 B2**
(45) **Date of Patent:** **Oct. 30, 2007**

(54) **PLANAR ANTENNA WITH MULTIPLE RADIATORS AND NOTCHED GROUND PATTERN**

(75) Inventors: **Shohhei Fujio**, Machida (JP); **Kazuo Masuda**, Kamakura (JP); **Takeshi Asano**, Atsugi (JP); **Masahiro Tsumita**, Zama (JP); **Masaki Kinugasa**, Sagamihara (JP)

(73) Assignee: **Lenovo (Singapore) Pte. Ltd.**, Singapore (SG)

(*) 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.: **11/475,658**

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

(65) **Prior Publication Data**
US 2007/0001911 A1 Jan. 4, 2007

(30) **Foreign Application Priority Data**
Jun. 30, 2005 (JP) 2005-192363

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

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

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

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,624,789 B1* 9/2003 Kangasvieri et al. 343/702

FOREIGN PATENT DOCUMENTS

JP 2001-119238 4/2001
JP 2004-186931 7/2004

* cited by examiner

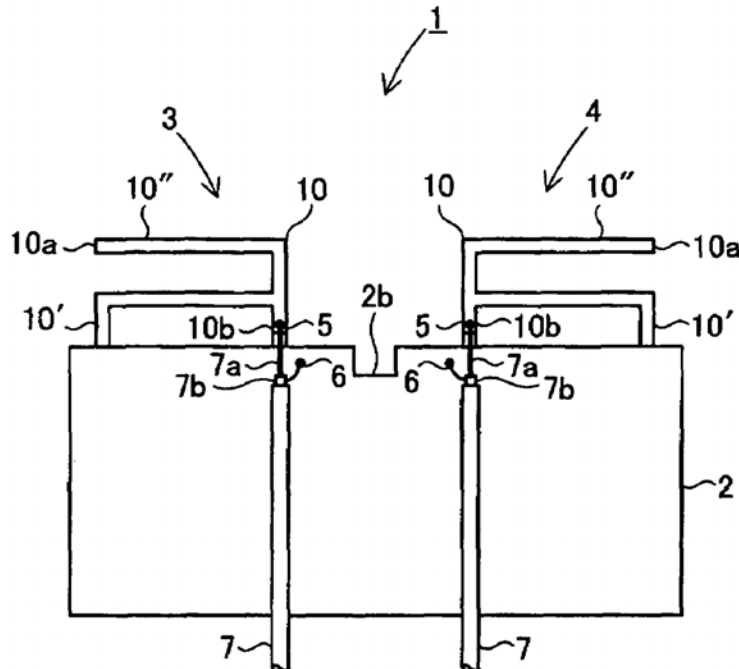
Primary Examiner—Hoang V. Nguyen

(74) *Attorney, Agent, or Firm*—John L. Rogitz

(57) **ABSTRACT**

An antenna consisting of a single small and lightweight package, where each radiating element operates independently with reduced interference among the radiating elements. An integrated multi-element planar antenna includes a ground pattern 2 with a notch 2b formed at an end 2a, first radiating element 3 placed on one side of the notch 2b and equipped with a feeder 5, and second radiating element 4 placed on the other side of the notch 2b and equipped with a feeder 5. For example, inverted F antennas are used as the first radiating element 3 and second radiating element 4. The first radiating element 3 and second radiating element 4 are placed symmetrically about the notch 2b such that separation distance will be the largest at locations where their radiation fields are the highest.

25 Claims, 9 Drawing Sheets





US007289069B2

(12) **United States Patent**
Ranta

(10) **Patent No.:** **US 7,289,069 B2**
(45) **Date of Patent:** **Oct. 30, 2007**

(54) **WIRELESS DEVICE ANTENNA**
(75) Inventor: **Tero Ranta**, Turku (FI)
(73) Assignee: **Nokia Corporation**, Espoo (FI)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 105 days.

6,907,200 B2 *	6/2005	Okuno	398/147
6,963,309 B2 *	11/2005	Andersson et al.	343/702
7,010,334 B2 *	3/2006	Saito	455/575.7
7,102,578 B2 *	9/2006	Minemura	343/702
7,126,547 B2 *	10/2006	Kim et al.	343/702
7,130,591 B2 *	10/2006	Iwai et al.	455/90.3
2004/0017315 A1 *	1/2004	Fang et al.	343/700 MS

* cited by examiner

Primary Examiner—Hoanganh Le

(74) *Attorney, Agent, or Firm*—Ware, Fressola, Van Der Sluys & Adolphson

(21) Appl. No.: **11/029,632**

(22) Filed: **Jan. 4, 2005**

(65) **Prior Publication Data**

US 2006/0145931 A1 Jul. 6, 2006

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

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

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

See application file for complete search history.

(56) **References Cited**

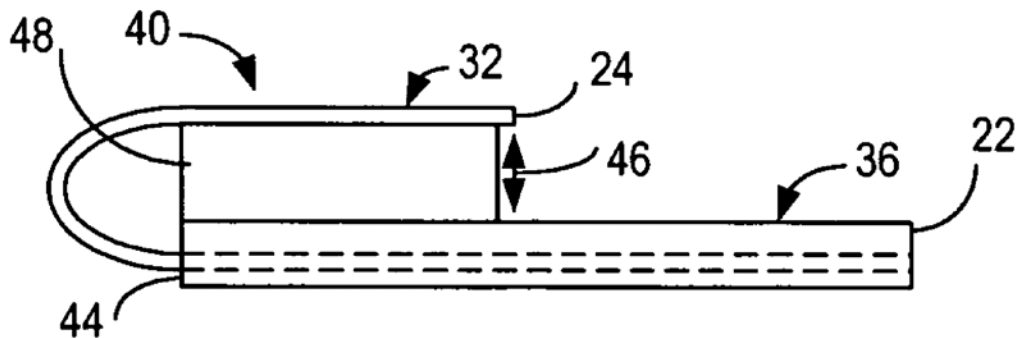
U.S. PATENT DOCUMENTS

5,451,965 A *	9/1995	Matsumoto	343/702
5,542,106 A *	7/1996	Krenz et al.	455/575.7
5,608,413 A *	3/1997	Macdonald	343/700 MS
5,990,839 A *	11/1999	Scheffe et al.	343/702

(57) **ABSTRACT**

A wireless device antenna is constructed using flex-rigid printed wiring board technology wherein a first main printed wiring board is flexibly connected to a second printed wiring board carrying at least one radiating element having an approximate length, width and pattern defining an intended antenna functionality which may be cellular, non-cellular or both. The first main printed wiring board and the second printed wiring board are flexibly and electrically connected to one another by a flexible element. An RF transmission line formed in the metallization layers common to the first main printed wiring board and the second printed wiring board connect transceiver circuitry carried on the first main printed wiring board to respective radiating elements carried on the second printed wiring board.

25 Claims, 3 Drawing Sheets





US007289071B2

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

(10) **Patent No.:** **US 7,289,071 B2**
(45) **Date of Patent:** **Oct. 30, 2007**

- (54) **MULTI-FREQUENCY ANTENNA SUITABLY WORKING IN DIFFERENT WIRELESS NETWORKS**
- (75) Inventors: **Chen-Ta Hung**, Tu-Cheng (TW);
Hsien-Sheng Tseng, Tu-Cheng (TW);
Lung-Sheng Tai, Tu-Cheng (TW);
Shu-Yean Wang, Tu-Cheng (TW)
- (73) Assignee: **Hon Hai Precision Ind. Co., Ltd.**,
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 7 days.
- (21) Appl. No.: **11/201,463**
- (22) Filed: **Aug. 11, 2005**
- (65) **Prior Publication Data**
US 2006/0262016 A1 Nov. 23, 2006
- (30) **Foreign Application Priority Data**
May 23, 2005 (TW) 94116677
- (51) **Int. Cl.**
H01Q 1/24 (2006.01)
- (52) **U.S. Cl.** **343/702; 343/846**
- (58) **Field of Classification Search** **343/702, 343/700 MS, 846**
See application file for complete search history.
- (56) **References Cited**
U.S. PATENT DOCUMENTS
5,181,044 A 1/1993 Matsumoto

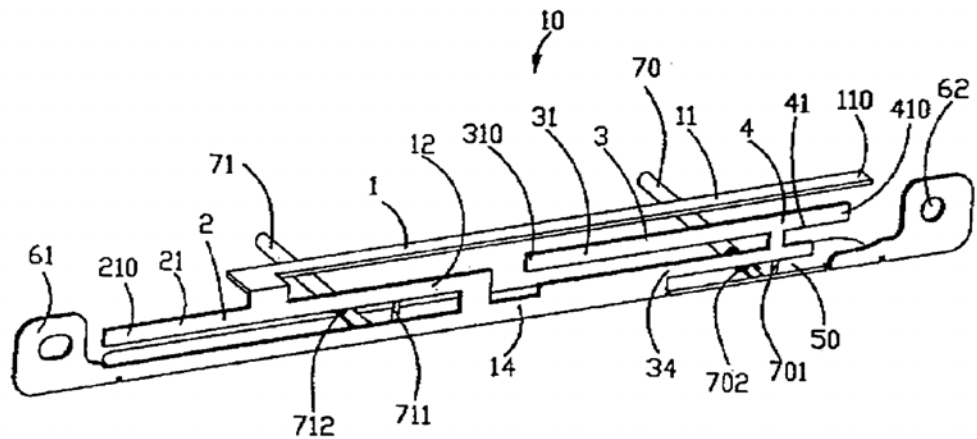
6,404,394	B1	6/2002	Hill	
6,600,448	B2	7/2003	Ikegaya	
6,724,348	B2	4/2004	Fang	
6,812,892	B2	11/2004	Tai	
6,861,986	B2	3/2005	Fang	
6,891,504	B2	5/2005	Cheng	
7,030,830	B2*	4/2006	Azoulay et al.	343/815
7,057,560	B2*	6/2006	Erkocevic	343/700 MS
7,119,747	B2*	10/2006	Lin et al.	343/702
7,136,025	B2	11/2006	Lin	
7,161,543	B2*	1/2007	Cheng et al.	343/702
2004/0090378	A1*	5/2004	Dai et al.	343/700 MS
2004/0160370	A1*	8/2004	Ghosh et al.	343/702
2005/0093752	A1	5/2005	Cheng	
2005/0104788	A1	5/2005	Hung	
2005/0116865	A1	6/2005	Fang	
2005/0190108	A1	9/2005	Lin	
2006/0250309	A1	11/2006	Fang	

* cited by examiner
Primary Examiner—Hoang V. Nguyen
(74) Attorney, Agent, or Firm—Wei Te Chun

(57) **ABSTRACT**

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

33 Claims, 5 Drawing Sheets





US007289073B2

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

(10) **Patent No.:** **US 7,289,073 B2**
(45) **Date of Patent:** ***Oct. 30, 2007**

(54) **METHOD FOR IMPROVING THE EFFICIENCY OF TRANSPARENT THIN FILM ANTENNAS AND ANTENNAS MADE BY SUCH METHOD**

5,355,144 A *	10/1994	Walton et al.	343/713
5,926,141 A	7/1999	Lindenmeier et al.	343/713
6,097,345 A *	8/2000	Walton	343/769
6,329,950 B1 *	12/2001	Harrell et al.	343/700 MS
6,417,811 B1	7/2002	Adrian	
6,606,062 B2	8/2003	Ngounou Kouam et al.	

(75) Inventors: **Hyok J. Song**, Los Angeles, CA (US); **Tsung Yuan Hsu**, Westlake Village, CA (US); **Daniel F. Sievenpiper**, Santa Monica, CA (US); **Timothy J. Talty**, Beverly Hills, MI (US); **Hui-Pin Hsu**, Northridge, CA (US)

OTHER PUBLICATIONS

R.N. Simons and R. Q. Lee, "Feasibility Study of Optically Transparent Microstrip Patch Antenna", IEEE Antennas and Propagation Society International Symposium 1997 Digest, Montreal, Quebec, Jul. 14-18, vol. 4, 1997, pp. 2100-2103.

K. Oshima et al., "Use of a Transparent Conductive Thin-film on a Glass Substrate in Active Integrated Antenna Arrays with Double Strong Coupling", IEEE MTT-S Digest, 2002, pp. 1569-1572.

Simons et al., "Finite Width Coplanar Waveguide Patch Antenna with Vertical Fed Through Connect", NASA Technical Memorandum 107136, prepared for 1996 IEEE AP-S International Symposium and URSI Radio Science Meeting Cosponsored by IEEE, AP-S, and U.R.S.I., Baltimore, Maryland, Jul. 16-21, 1996, pp. 1-6.

(73) Assignee: **GM Global Technology Operations, Inc.**, Detroit, MI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 49 days.

This patent is subject to a terminal disclaimer.

* cited by examiner

Primary Examiner—Hoanganh Le

(21) Appl. No.: **11/208,211**

(57) **ABSTRACT**

(22) Filed: **Aug. 19, 2005**

A method for improving the efficiency of antennas having transparent thin-film conductive surfaces, and antennas improved by the method are disclosed. For a selected frequency of antenna operation, values for surface current density in areas distributed over the surface of the thin-film are determined. Regions of the surface containing areas having concentrated current flow are identified based upon the determined values of current density. Antenna efficiency is improved by increasing conductivity in areas of the thin-film surface found to have concentrated current flow. The method enables the improvement of the efficiency of antennas having transparent thin-film conducting surfaces, without unnecessarily obstructing the optical view through the thin-film surfaces of the antennas.

(65) **Prior Publication Data**

US 2007/0040746 A1 Feb. 22, 2007

(51) **Int. Cl.**
H01Q 1/32 (2006.01)

(52) **U.S. Cl.** **343/713; 343/711**

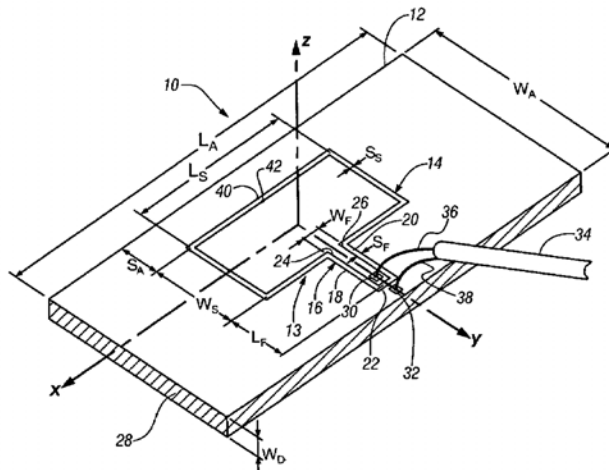
(58) **Field of Classification Search** **343/713, 343/711, 712, 705, 708, 767, 768, 769**
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,063,246 A	12/1977	Greiser	
5,353,038 A *	10/1994	Osborne et al.	343/708

11 Claims, 5 Drawing Sheets





US007289074B2

(12) **United States Patent**
Yamaguchi

(10) **Patent No.:** **US 7,289,074 B2**
(45) **Date of Patent:** **Oct. 30, 2007**

- (54) **COMPOSITE ANTENNA DEVICE**
- (75) Inventor: **Fumie Yamaguchi**, Tokyo (JP)
- (73) Assignee: **The Furukawa Electric Co., Ltd.**, Tokyo (JP)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

- (21) Appl. No.: **11/287,837**
- (22) Filed: **Nov. 28, 2005**

(65) **Prior Publication Data**
US 2006/0114161 A1 Jun. 1, 2006

Related U.S. Application Data
(63) Continuation of application No. PCT/JP2004/001374, filed on Feb. 10, 2004.

(30) **Foreign Application Priority Data**
May 27, 2003 (JP) 2003-148470

- (51) **Int. Cl.**
H01Q 1/32 (2006.01)
- (52) **U.S. Cl.** **343/713; 343/728; 343/872**

(58) **Field of Classification Search** 343/700 MS, 343/711-713, 728, 853, 872, 702, 873
See application file for complete search history.

- (56) **References Cited**
U.S. PATENT DOCUMENTS
5,300,936 A * 4/1994 Izadian 343/700 MS
5,831,577 A * 11/1998 Nichols et al. 342/357.03
6,144,343 A 11/2000 Furuya et al.

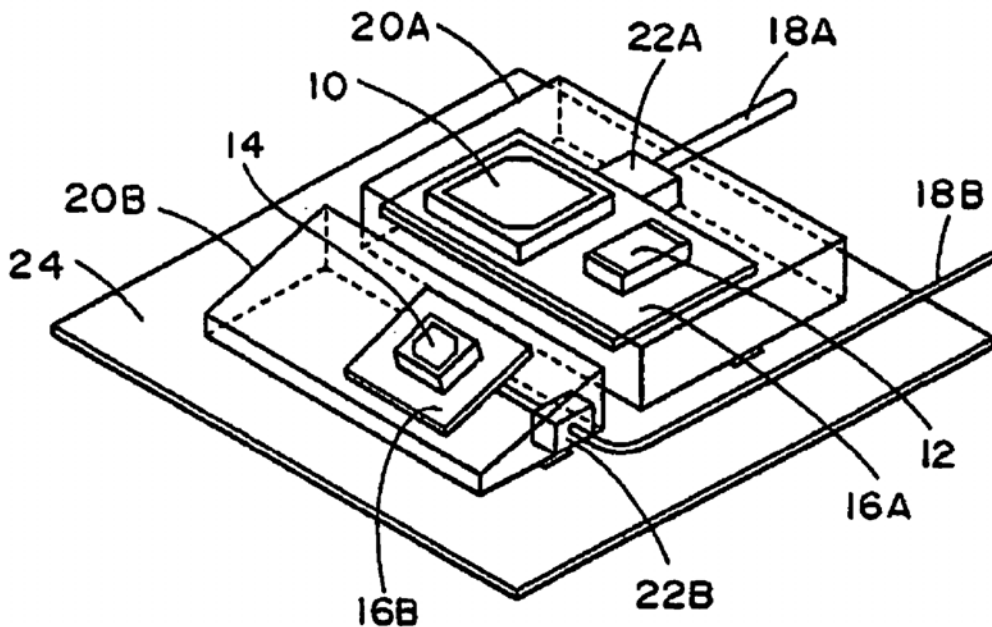
FOREIGN PATENT DOCUMENTS

JP	6-252619 A	9/1994
JP	9-294012 A	11/1997
JP	11-215040 A	8/1999
JP	2001-230628 A	8/2001
JP	2001-267843 A	9/2001

* cited by examiner
Primary Examiner—Michael C. Wimer
(74) *Attorney, Agent, or Firm*—Frishauf, Holtz, Goodman & Chick, P.C.

(57) **ABSTRACT**
A composite antenna device comprising a plurality of antennas, the plurality of antennas having at least one particular antenna which differs in antenna characteristics, and at least either the particular antenna or at least one other antenna being of subassembly configuration.

6 Claims, 2 Drawing Sheets





US007289075B2

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

(10) **Patent No.:** US 7,289,075 B2
(45) **Date of Patent:** Oct. 30, 2007

- (54) **PLANAR ANTENNA**
- (75) Inventors: **Osamu Kagaya**, Kanagawa (JP); **Kiyoshi Oshima**, Kanagawa (JP); **Koji Ikawa**, Kanagawa (JP)
- (73) Assignee: **Asahi Glass Company, Limited**, Tokyo (JP)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 169 days.

2004/0008144 A1 1/2004 Kubota
2005/0128161 A1 6/2005 Kagaya et al.

FOREIGN PATENT DOCUMENTS

EP 0 786 824 A1 7/1997

(Continued)

OTHER PUBLICATIONS

Kazuhide Hirose, et al., "Dual Loop Array Antenna Fed by Quasi-Balanced Pair Line", Information and Communication Engineers, Communication Society Conference, 2004, p. 68 (with partial English translation).

(Continued)

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

- (21) Appl. No.: **11/004,904**
- (22) Filed: **Dec. 7, 2004**
- (65) **Prior Publication Data**
US 2005/0128161 A1 Jun. 16, 2005

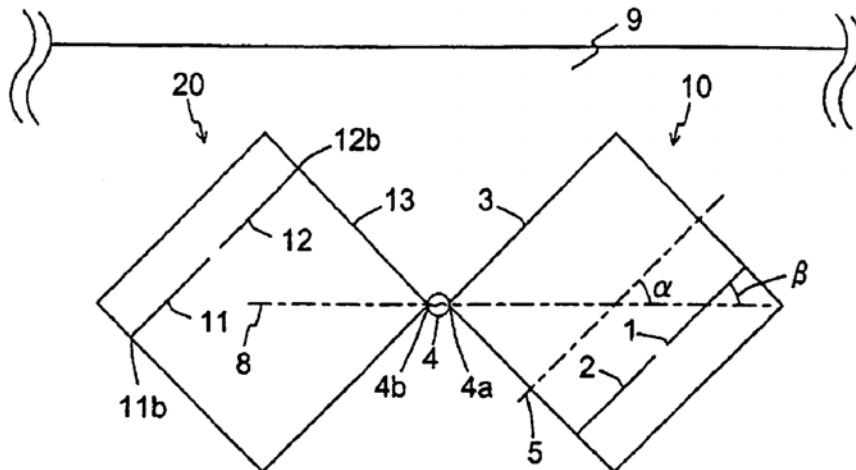
(57) **ABSTRACT**

There are disposed first coupling conductors, which comprise a pair of coupling branch lines 1 and 2 connected to the first antenna conductor 3 and extend inward from the first antenna conductor. The coupling branch lines 1 and 2 have open ends 1a and 2a disposed so as to be adjacent to each other and be capacitively coupled to each other. The open ends 1a and 2a of the coupling branch lines 1 and 2 are located at closest or substantially closest portions to each other. The second antenna conductor 13 includes second coupling conductors, which comprise a pair of coupling branch lines 11 and 12 connected to the second antenna conductor 13 and extending inward from the second antenna conductor. The coupling branch lines 11 and 12 have open ends disposed so as to be adjacent to each other and be capacitively coupled to each other. The open ends of the coupling branch lines 11 and 12 are located at closest or substantially closest portions to each other.

- (30) **Foreign Application Priority Data**
Dec. 10, 2003 (JP) 2003-411246
Feb. 18, 2004 (JP) 2004-041634
- (51) **Int. Cl.**
H01Q 11/12 (2006.01)
- (52) **U.S. Cl.** 343/741; 343/744
- (58) **Field of Classification Search** 343/713,
343/748, 726, 728, 741-744
See application file for complete search history.

- (56) **References Cited**
U.S. PATENT DOCUMENTS
3,771,159 A 11/1973 Kawaguchi et al.
4,547,776 A * 10/1985 Bolt et al. 343/741
5,285,210 A 2/1994 Sato et al.
5,402,134 A 3/1995 Miller et al.
6,252,550 B1 6/2001 Vernon
2002/0018020 A1 2/2002 Vernon

43 Claims, 22 Drawing Sheets





US007289076B2

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

(10) **Patent No.:** **US 7,289,076 B2**
(45) **Date of Patent:** **Oct. 30, 2007**

(54) **SMALL PLANAR ANTENNA WITH ENHANCED BANDWIDTH AND SMALL STRIP RADIATOR**

(75) Inventors: **Yuri Tikhov**, Suwon-si (KR);
Young-hoon Min, Anyang-si (KR);
Yong-jin Kim, Seoul (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 0 days.

(21) Appl. No.: **11/207,725**

(22) Filed: **Aug. 22, 2005**

(65) **Prior Publication Data**
US 2006/0038725 A1 Feb. 23, 2006

(30) **Foreign Application Priority Data**
Aug. 21, 2004 (KR) 10-2004-0066159
Jul. 8, 2005 (KR) 10-2005-0061666

(51) **Int. Cl.**
H01Q 13/10 (2006.01)

(52) **U.S. Cl.** **343/770; 343/767**

(58) **Field of Classification Search** **343/767, 343/770, 768**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,268,696 A * 12/1993 Buck et al. 343/372
6,573,872 B2 * 6/2003 Oberschmidt et al. 343/767

2003/0156065 A1 8/2003 Jo et al.
2005/0285809 A1* 12/2005 Louzir et al. 343/770

FOREIGN PATENT DOCUMENTS

EP 1 589 680 A1 10/2005
WO WO 03/034544 A1 4/2003
WO WO 03/094293 A1 11/2003
WO WO 2004/047222 A1 6/2004

OTHER PUBLICATIONS

Azadegan R et al., "Design of miniaturized slot antennas", IEEE Antennas and Propagation Society International Symposium. 2001 Digest. APS. Boston, MA Jul. 8-13, 2001, New York, NY: IEEE, US, vol. 1 of 4, Jul. 8, 2001, pp. 565-568, XP010564702.
Korean Office Action dated Nov. 15, 2006 issued in corresponding KR Patent Application No. 2005-61666.

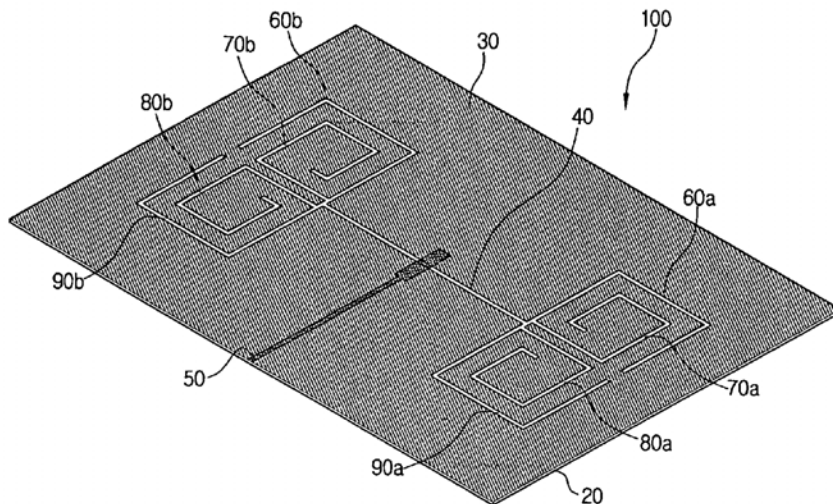
* cited by examiner

Primary Examiner—Hoanganh Le
(74) *Attorney, Agent, or Firm*—Sughrue Mion Pllc.

(57) **ABSTRACT**

A planar small antenna and a small strip radiator are provided which have increased bandwidth. The small strip radiator has a main strip pattern and a plurality of convoluted strip patterns terminating the main strip pattern at each end. The plurality of convoluted strip patterns are arranged in mirror-symmetrical arrangement with reference to the longitudinal axis of the main strip such that one pair of convoluted strip patterns is convoluted clockwise while another pair is convoluted counterclockwise. As a result, an electrically small antenna radiator requires less metal or conductive material than conventional radiators, and also can operate without adversely affecting the radiation characteristics of the antenna.

14 Claims, 13 Drawing Sheets





US007289077B2

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

(10) **Patent No.:** **US 7,289,077 B2**
(45) **Date of Patent:** **Oct. 30, 2007**

(54) **FREQUENCY-DISPERSIVE ANTENNA
APPLIED IN PARTICULAR TO A
METEOROLOGICAL RADAR**

(75) Inventors: **Jean-Paul Artis**, Plouzane (FR);
G rard Debionne, Mery sur Oise (FR);
Georges Guillaumot, Tigery (FR);
Maxence Marcant, Milizac (FR)

(73) Assignee: **Thales**, Neuilly-sur Seine (FR)

(*) 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.: **11/445,462**

(22) Filed: **Jun. 2, 2006**

(65) **Prior Publication Data**
US 2007/0069967 A1 Mar. 29, 2007

(30) **Foreign Application Priority Data**
Jun. 3, 2005 (FR) 05 05646

(51) **Int. Cl.**
H01Q 13/10 (2006.01)

(52) **U.S. Cl.** 343/771; 343/770; 333/114

(58) **Field of Classification Search** 343/771,
343/770, 768; 333/114

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,079,561 A * 1/1992 Park 343/771
5,210,543 A * 5/1993 Kurtz 343/771
5,650,793 A * 7/1997 Park 343/771

* cited by examiner

Primary Examiner—Hoang V. Nguyen

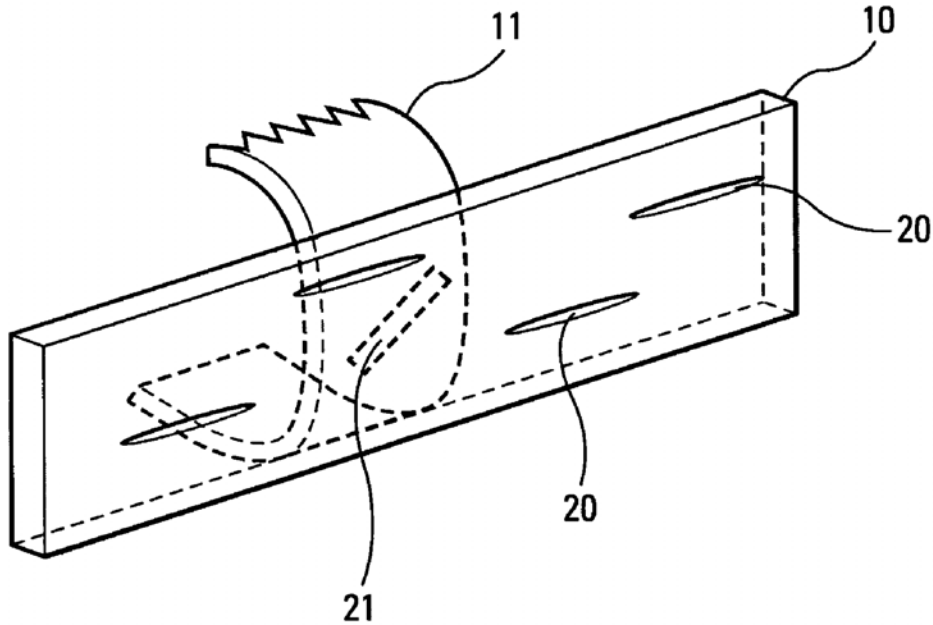
(74) *Attorney, Agent, or Firm*—Lowe Hauptman Ham &
Berner, LLP

(57) **ABSTRACT**

The invention relates to a frequency-dispersive antenna. The antenna comprises radiating waveguides on which are formed slots. The antenna comprises at least one feed waveguide linked by coupling slots to the radiating waveguides. The variation of the pointing direction of the beam from the antenna in at least one plane is obtained by varying the frequency of the wave guided by the feed waveguide. The length of the feed waveguide between the coupling slots of two adjacent radiating waveguides is greater than the distance separating the coupling slots of these two adjacent radiating waveguides.

In particular, the invention applies to an airborne antenna suited to the detection and locating of meteorological phenomena.

7 Claims, 4 Drawing Sheets





US00D554111S

(12) **United States Design Patent** (10) **Patent No.:** **US D554,111 S**
Su et al. (45) **Date of Patent:** **** Oct. 30, 2007**

(54) **MULTI-BAND ANTENNA**
(75) Inventors: **Wen-Fong Su**, Tu-Cheng (TW);
Yao-Shien Huang, Tu-Cheng (TW);
Chen-Ta Hung, Tu-Cheng (TW)
(73) Assignee: **Hon Hai Precision Ind. Co., Ltd.**,
Taipei Hsien (TW)
(**) Term: **14 Years**
(21) Appl. No.: **29/271,654**
(22) Filed: **Jan. 24, 2007**
(51) **LOC (8) Cl.** **14-03**
(52) **U.S. Cl.** **D14/230**
(58) **Field of Classification Search** D14/138,
D14/230-238, 299, 358; D12/42, 43; 343/700 R-705,
343/871-908, 795, 840, 711-713, 819, 846;
455/90.2, 90.3, 91, 128, 269, 344, 347, 562.1
See application file for complete search history.

(56) **References Cited**
U.S. PATENT DOCUMENTS
D456,388 S * 4/2002 Hwang D14/230
6,552,686 B2 * 4/2003 Ollikainen et al. .. 343/700 MS
6,577,278 B1 * 6/2003 Hood et al. 343/700 MS
6,614,400 B2 * 9/2003 Egorov 343/702

6,664,931 B1 * 12/2003 Nguyen et al. 343/767
D492,672 S * 7/2004 Hung et al. D14/230
D534,527 S * 1/2007 Hung et al. D14/230
D534,902 S * 1/2007 Su et al. D14/230
D534,903 S * 1/2007 Hung et al. D14/230
D535,290 S * 1/2007 Su et al. D14/230

* cited by examiner
Primary Examiner—Louis S. Zarfes
Assistant Examiner—John Windmuller
(74) *Attorney, Agent, or Firm*—Wei Te Chung

(57) **CLAIM**

The ornamental design for a multi-band antenna, as shown.

DESCRIPTION

FIG. 1 is a front, top and right side perspective view of a multi-band antenna showing our new design;
FIG. 2 is a front elevational view thereof;
FIG. 3 is a rear elevational view thereof;
FIG. 4 is a left side elevational view thereof;
FIG. 5 is a right side elevational view thereof;
FIG. 6 is a top plan view thereof; and,
FIG. 7 is a bottom plan view thereof.

1 Claim, 6 Drawing Sheets

