



US007460069B2

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

(10) **Patent No.:** **US 7,460,069 B2**  
(45) **Date of Patent:** **Dec. 2, 2008**

(54) **MONOPOLE ANTENNA APPLICABLE TO MIMO SYSTEM**

(75) Inventors: **Se-hyun Park**, Suwon-si (KR);  
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(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **11/489,457**

(22) Filed: **Jul. 20, 2006**

(65) **Prior Publication Data**  
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(30) **Foreign Application Priority Data**  
Nov. 23, 2005 (KR) ..... 10-2005-0112272

(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.

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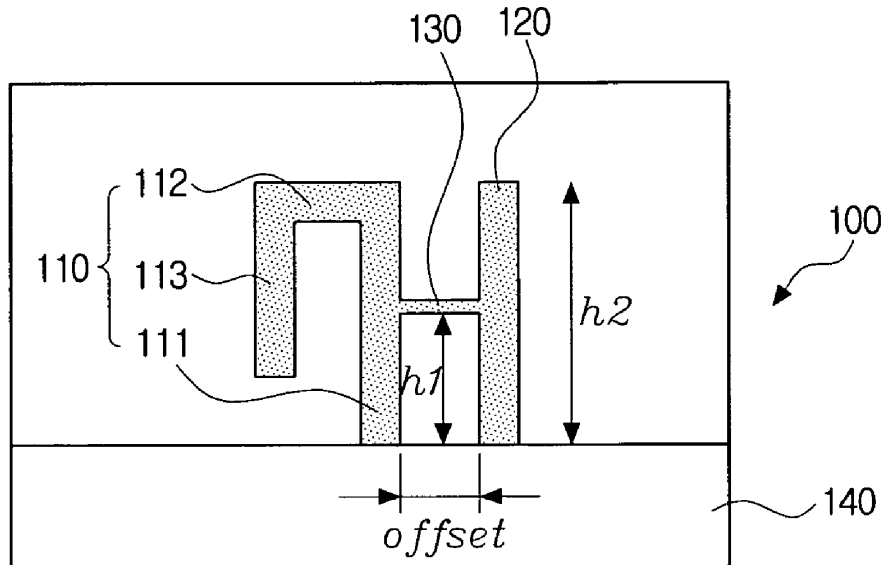
*Primary Examiner*—Hoang V Nguyen

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

(57) **ABSTRACT**

A monopole antenna capable of implementing an MIMO system, which includes a ground part formed of plate metal, a monopole antenna element connected to one side of the ground part and formed of strips bent multiple times, an auxiliary antenna element connected to one side of the ground part and disposed adjacent to the monopole antenna element to electrically connect to the monopole antenna element, and a short-circuit part interconnecting the monopole antenna element and the auxiliary antenna element. Accordingly, the monopole antenna element is bent multiple times so that the antenna can become compact in less than half a width compared to the conventional antenna, and when the MIMO system is constructed, the interference between the respective antennas can be reduced so that the array antenna can become compact in size.

**25 Claims, 8 Drawing Sheets**





US007460070B2

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

(10) **Patent No.:** **US 7,460,070 B2**  
(45) **Date of Patent:** **Dec. 2, 2008**

(54) **CHIP ANTENNA**

(75) Inventors: **Yen-Ming Chen**, Taipei (TW);  
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**Chang-Fa Yang**, Taipei (TW);  
**Shun-Iian Lin**, Taipei (TW);  
**Chuan-Lin Hu**, Sijhih (TW);  
**Chang-Lun Liao**, Sijhih (TW); **Yu-Wei Chen**, Sijhih (TW)

(73) Assignee: **Chant Sincere 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 86 days.

(21) Appl. No.: **11/598,019**

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

(65) **Prior Publication Data**  
US 2007/0115182 A1 May 24, 2007

(30) **Foreign Application Priority Data**  
Nov. 14, 2005 (TW) ..... 94139939 A

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

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

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

See application file for complete search history.

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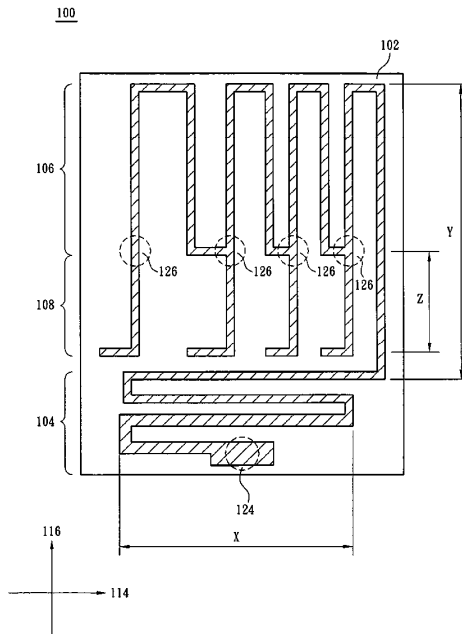
*Primary Examiner*—Tho G Phan

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

(57) **ABSTRACT**

A chip antenna has a dielectric material layer, a first meandered strip, a second meandered strip and several bended strips. The first meandered strip is meandered in one direction and disposed on the dielectric material layer. The second meandered strip is meandered in another direction and disposed on the dielectric material layer. The first meandered strip is connected to the second meandered strip. The bended strips are connected to the turns of the meandered strips.

**18 Claims, 15 Drawing Sheets**





US007460072B1

(12) **United States Patent**  
**Goldberger**

(10) **Patent No.:** **US 7,460,072 B1**  
(45) **Date of Patent:** **Dec. 2, 2008**

(54) **MINIATURE PATCH ANTENNA WITH INCREASED GAIN**

(75) Inventor: **Haim Goldberger**, Modi'in (IL)

(73) Assignee: **Origin GPS Ltd.**, Jerusalem (IL)

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 18 days.

(21) Appl. No.: **11/773,448**

(22) Filed: **Jul. 5, 2007**

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

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

(58) **Field of Classification Search** ..... **343/700 MS, 343/829, 846, 848**

See application file for complete search history.

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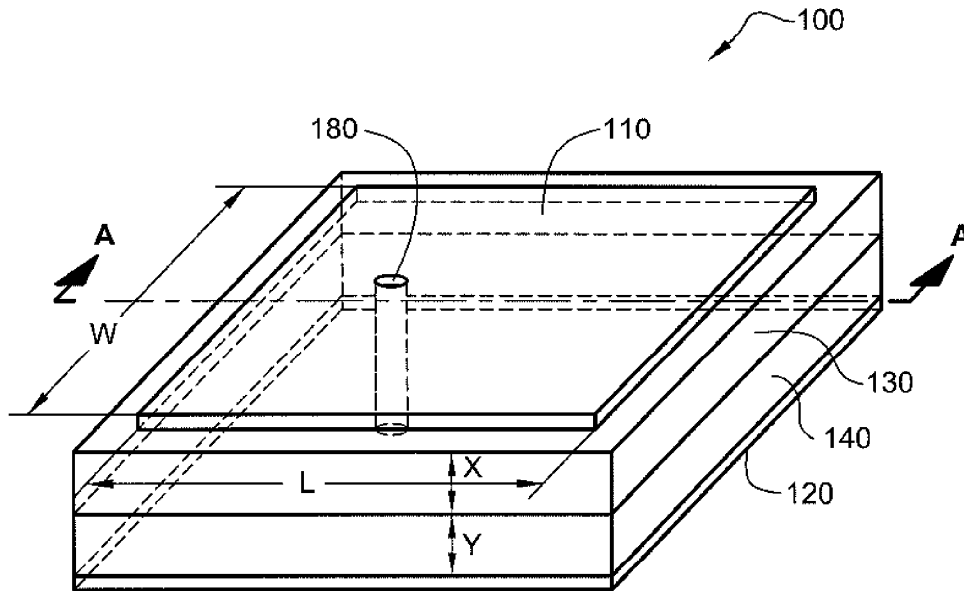
*Primary Examiner*—Tho G Phan

(74) *Attorney, Agent, or Firm*—Soroker - Agmon, Advocates & Patent Attorneys

(57) **ABSTRACT**

The present invention, relates to the preparation of a patch antenna with a specific effective dielectric constant; and a reduced dissipation factor. In an exemplary embodiment of the invention, size requirements and the desired resonant signal frequency dictate the permittivity value of the dielectric material to be used between the patch plate and the ground plate. Instead of using a dielectric material with the calculated permittivity value and its given dissipation factors a two layer dielectric of the same size with an effective dielectric constant that is equal to the desired dielectric constant, is used to replace the dielectric material and reduce the dissipation factor.

**18 Claims, 5 Drawing Sheets**





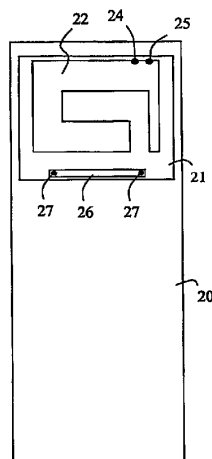
US007460074B2

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

(10) **Patent No.:** **US 7,460,074 B2**  
(45) **Date of Patent:** **Dec. 2, 2008**

- (54) **COMMUNICATION TERMINALS HAVING INTEGRATED ANTENNA AND SPEAKER ASSEMBLIES**
- (75) Inventors: **Zhinong Ying**, Lund (SE); **Wanqing Shi**, Hjärup (SE)
- (73) Assignee: **Sony Ericsson Mobile Communications AB**, Lund (SE)
- (\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 225 days.
- (21) Appl. No.: **10/560,792**
- (22) PCT Filed: **Jun. 4, 2004**
- (86) PCT No.: **PCT/EP2004/051037**  
§ 371 (c)(1),  
(2), (4) Date: **Dec. 15, 2005**
- (87) PCT Pub. No.: **WO2004/114637**  
PCT Pub. Date: **Dec. 29, 2004**
- (65) **Prior Publication Data**  
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- Related U.S. Application Data**
- (60) Provisional application No. 60/483,549, filed on Jun. 27, 2003.
- (30) **Foreign Application Priority Data**  
Jun. 20, 2003 (EP) ..... 03013926
- (51) **Int. Cl.**  
**H01Q 1/24** (2006.01)
- (52) **U.S. Cl.** ..... **343/702; 343/720; 343/829; 343/846**

- (58) **Field of Classification Search** ..... 343/702,  
343/720, 829, 846, 700 MS; 455/575.7  
See application file for complete search history.
- (56) **References Cited**  
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mailed Oct. 13, 2004.  
*Primary Examiner*—Douglas W. Owens  
*Assistant Examiner*—Chuc Tran  
(74) *Attorney, Agent, or Firm*—Myers Bigel Sibley & Sajovec  
**ABSTRACT**  
(57) Communications devices having a combined antenna and speaker for a radio receiving apparatus is provided. The combined antenna and speaker includes a speaker and a low profile built-in radio antenna element. The antenna element includes a flat sheet carrying a conductive antenna trace. An exciter is connected to the sheet and devised to induce vibrations therein for generating sound. This integrates a flat panel speaker with the antenna element, which saves components and may increase performance.  
**14 Claims, 3 Drawing Sheets**





US007463196B2

(12) **United States Patent**  
**Hilgers**

(10) **Patent No.:** **US 7,463,196 B2**  
(45) **Date of Patent:** **Dec. 9, 2008**

(54) **ANTENNA**

(75) Inventor: **Achim Hilgers**, Alsdorf (DE)  
(73) Assignee: **NXP B.V.**, Eindhoven (NL)  
(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 5 days.

(52) **U.S. Cl.** ..... **343/700 MS; 343/702**  
(58) **Field of Classification Search** ..... **343/700 MS, 343/702**  
See application file for complete search history.

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*Primary Examiner*—Trinh Vo Dinh  
*Assistant Examiner*—Dieu Hien T Duong

(21) Appl. No.: **10/589,838**  
(22) PCT Filed: **Feb. 15, 2005**  
(86) PCT No.: **PCT/IB2005/050577**

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PCT Pub. Date: **Sep. 9, 2005**

(65) **Prior Publication Data**  
US 2007/0279285 A1 Dec. 6, 2007

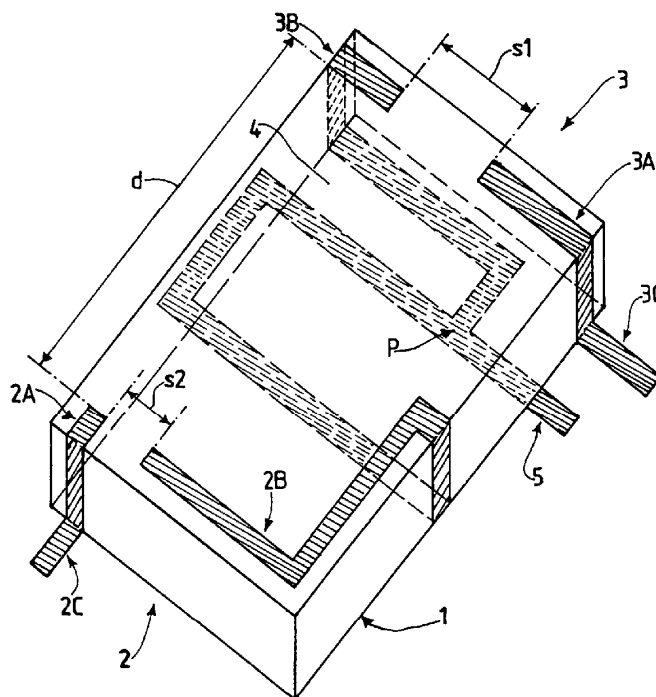
(30) **Foreign Application Priority Data**  
Feb. 18, 2004 (EP) ..... 04100635

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

(57) **ABSTRACT**

The invention relates to a dual-band antenna for preferable operation in the GSM and DCS frequency range. The dual-band antenna at the same time has the functionality of a diplexer. This makes it possible to produce wireless communication devices with one component less, which in turn reduces weight and production cost.

**15 Claims, 2 Drawing Sheets**





US007463197B2

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

(10) **Patent No.:** **US 7,463,197 B2**

(45) **Date of Patent:** **Dec. 9, 2008**

(54) **MULTI-BAND ANTENNA**

(75) Inventors: **Gholamreza Zeinolabedin Rafi**,  
Kitchener (CA); **Safieddin**  
**Safavi-Nacini**, Waterloo (CA); **Sujeet K.**  
**Chaudhuri**, Heidelberg (CA);  
**Wai-Cheung Tang**, Mannheim (CA)

(73) Assignee: **Mark IV Industries Corp.**, Ontario  
(CA)

(\* ) Notice: Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
U.S.C. 154(b) by 193 days.

(21) Appl. No.: **11/252,162**

(22) Filed: **Oct. 17, 2005**

(65) **Prior Publication Data**

US 2007/0085741 A1 Apr. 19, 2007

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

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

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

See application file for complete search history.

(56) **References Cited**

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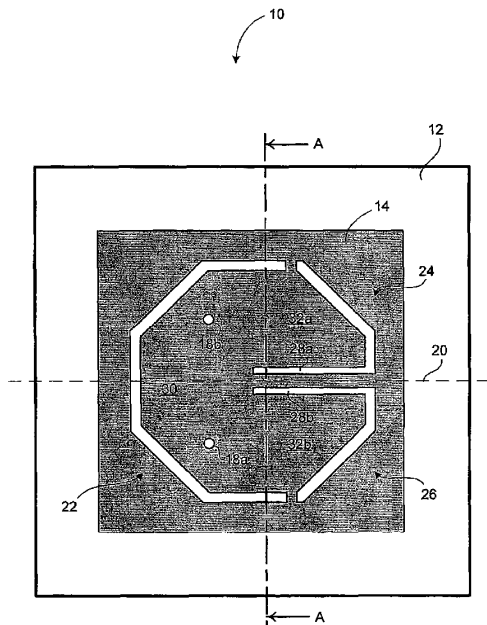
*Primary Examiner*—Michael C Wimer

(74) *Attorney, Agent, or Firm*—Eugene M. Cummings, P.C.

(57) **ABSTRACT**

A multi-band antenna for multi-band radio frequency tele-  
communications. The multi-band antenna includes a conduc-  
tive patch separated from a ground plane by a dielectric materi-  
al. A slot pattern formed in the conductive patch defines a  
perimeter substantially surrounding two feed pins and  
arranged symmetrically about a center line. The slot pattern  
includes one or more inwardly extending arms projected  
along axes that pass between the two feed pins. The axes may  
be parallel to the center line. The slot pattern may be arranged  
using folded slots. In one embodiment, circular polarization  
is realized at GPS frequency by using one feed pin and linear  
or circular polarization is realized by using one or two feed  
pins for other bands. The feed pins may be controlled inde-  
pendently without a fixed phase and amplitude arrangement  
necessary to achieve a fixed polarization (linear, circular, or  
elliptical), which allows for adaptive pattern and polarization  
agility.

**20 Claims, 9 Drawing Sheets**





US007463200B2

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

(10) **Patent No.:** **US 7,463,200 B2**  
(45) **Date of Patent:** **Dec. 9, 2008**

(54) **DIRECTIONAL ANTENNA CONFIGURATION FOR TDD REPEATER**

(75) Inventors: **Kenneth M. Gainey**, Satellite Beach, FL (US); **James A. Proctor, Jr.**, Melbourne Beach, FL (US); **Christopher A. Snyder**, Melbourne, FL (US); **James C. Otto**, West Melbourne, FL (US)

(73) Assignee: **QUALCOMM Incorporated**, San Diego, CA (US)

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 60 days.

(21) Appl. No.: **11/602,455**

(22) Filed: **Nov. 21, 2006**

(65) **Prior Publication Data**  
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**Related U.S. Application Data**

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

(52) **U.S. Cl.** ..... **343/700 MS; 343/725; 455/25; 455/63.4**

(58) **Field of Classification Search** ..... **343/700 MS, 343/725, 727, 853; 455/25, 63.4, 269**  
See application file for complete search history.

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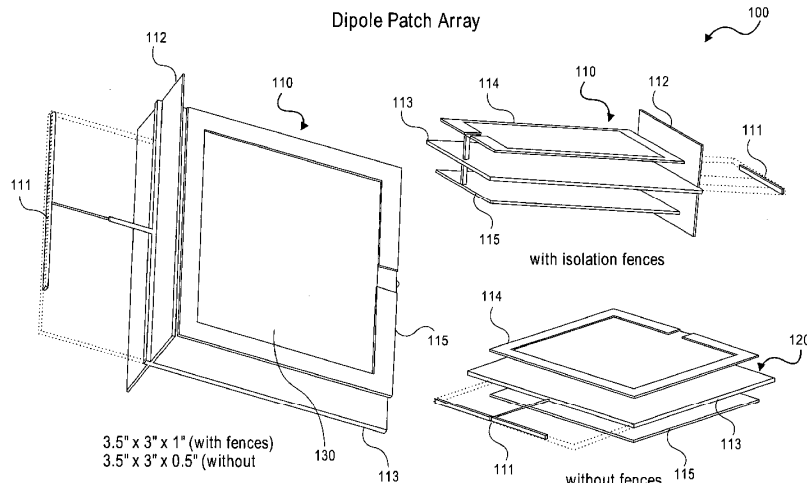
*Primary Examiner*—Tho G Phan

(74) *Attorney, Agent, or Firm*—Andrea L. Mays; Linda G. Gunderson; Thomas R. Rouse

(57) **ABSTRACT**

A wireless communication node, such as a repeater, including a frequency translating repeater, a physical layer (PHY) repeater, time divisional duplex repeater (TDD) and the like, is configured with a pair of directional patch antennae and an omni-directional antenna. The patch antennae can be selected depending on the orientation of the repeater package to communicate with a station such as an access point or a base station. The omni-directional antenna can be directed toward another station such as a client. The patch antennae and the omni-directional antenna can be orthogonally polarized to increase isolation and reduce electromagnetic coupling. Multiple antennae can be used in multiple-input-multiple-output (MIMO) configurations.

**26 Claims, 15 Drawing Sheets**





US007463201B2

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

(10) **Patent No.:** **US 7,463,201 B2**  
(45) **Date of Patent:** **Dec. 9, 2008**

(54) **APERIODIC ARRAY ANTENNA**  
(75) Inventors: **Bing Chiang**, Melbourne, FL (US); **Griffin K. Gothard**, Satellite Beach, FL (US); **Christopher A. Snyder**, Melbourne, FL (US); **William R. Palmer**, Melbourne, FL (US); **Michael J. Lynch**, Merritt Island, FL (US); **Thomas E. Gorsuch**, Indialantic, FL (US); **Kenneth M. Gainey**, Satellite Beach, FL (US); **James A. Proctor**, Melbourne Beach, FL (US)

(73) Assignee: **InterDigital Corporation**, Wilmington, DE (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.

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(Under 37 CFR 1.47)

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**Related U.S. Application Data**  
(63) Continuation of application No. 11/102,984, filed on Apr. 11, 2005, now Pat. No. 7,176,844, which is a continuation of application No. 10/357,276, filed on Jan. 31, 2003, now Pat. No. 6,888,504.  
(60) Provisional application No. 60/419,431, filed on Oct. 17, 2002, provisional application No. 60/353,249, filed on Feb. 1, 2002.

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

(52) **U.S. Cl.** ..... **343/702; 343/833; 343/834**  
(58) **Field of Classification Search** ..... 343/702, 343/815, 817, 833, 834, 819, 853, 835  
See application file for complete search history.

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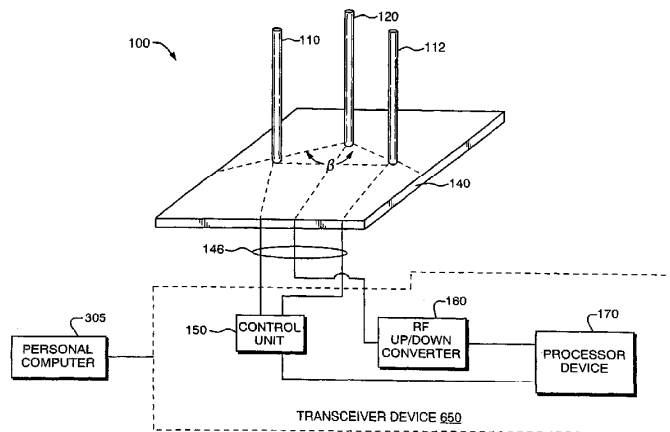
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*Primary Examiner*—Tho G Phan  
(74) *Attorney, Agent, or Firm*—Volpe and Koenig, P.C.

(57) **ABSTRACT**  
A wireless handset including an antenna array. The antenna array includes an active antenna element and two passive antenna elements. The active and passive antenna elements are arranged to form a triangle with a vertex. The vertex includes a vertex angle and the active antenna element is disposed at the vertex. The vertex angle is between 90 degrees and 180 degrees.

**3 Claims, 19 Drawing Sheets**







US007463209B2

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

(10) **Patent No.:** **US 7,463,209 B2**  
(45) **Date of Patent:** **Dec. 9, 2008**

(54) **PLANAR DIPOLE ANTENNA**  
(75) Inventors: **Chia-Lun Tang**, Miao-Li Hsien (TW);  
**Shih-Huang Yeh**, Tou-Liu (TW);  
**Kin-Lu Wong**, Kao-Hsiung (TW);  
**Yung-Tao Liu**, Kao-Hsiung (TW);  
**Ting-Chih Tseng**, Tai-Nan Hsien (TW)

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(73) Assignee: **Industrial Technology Research Institute**, Hsinchu (TW)

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(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 96 days.

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*Primary Examiner*—Michael C Wimer

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(57) **ABSTRACT**

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(30) **Foreign Application Priority Data**

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**H01Q 1/38** (2006.01)  
**H01Q 9/28** (2006.01)

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

(58) **Field of Classification Search** ..... 343/795,  
343/722, 802  
See application file for complete search history.

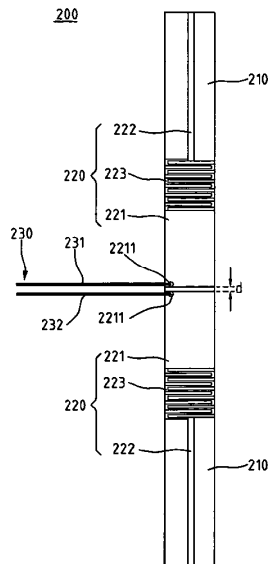
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A planar dipole antenna comprises a dielectric substrate, two radiation conductors, and a transmission line. The two radiation conductors are formed on the dielectric substrate and separated by a predefined distance. Each radiation conductor includes first and second metal plates, and a meandered metal line. The meandered metal line has two ends and at least three bending points. One end of the meandered metal line is connected to the first metal plate, while the other end is connected to the second metal plate. This antenna increases the receiver's gain up to 6.8 dBi through the use of the current distribution of three equal-phase areas. This overcomes the drawback of a conventional antenna with receiver's gain only about 2.2 dBi. This planar dipole antenna has a simple structure of single-sided circuitry, and is easily formed on the dielectric substrate by a standard printing or etching process.

**10 Claims, 9 Drawing Sheets**





US007466267B2

(12) **United States Patent**  
**Ishikura**

(10) **Patent No.:** **US 7,466,267 B2**  
(45) **Date of Patent:** **Dec. 16, 2008**

(54) **ANTENNA DEVICE AND ELECTRONIC APPARATUS**

(75) Inventor: **Hiroshi Ishikura**, Hirakata (JP)

(73) Assignee: **Digital Electronics 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 299 days.

(21) Appl. No.: **11/392,643**

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

(65) **Prior Publication Data**

US 2006/0227053 A1 Oct. 12, 2006

(30) **Foreign Application Priority Data**

Mar. 31, 2005 (JP) ..... 2005-102759

(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**

See application file for complete search history.

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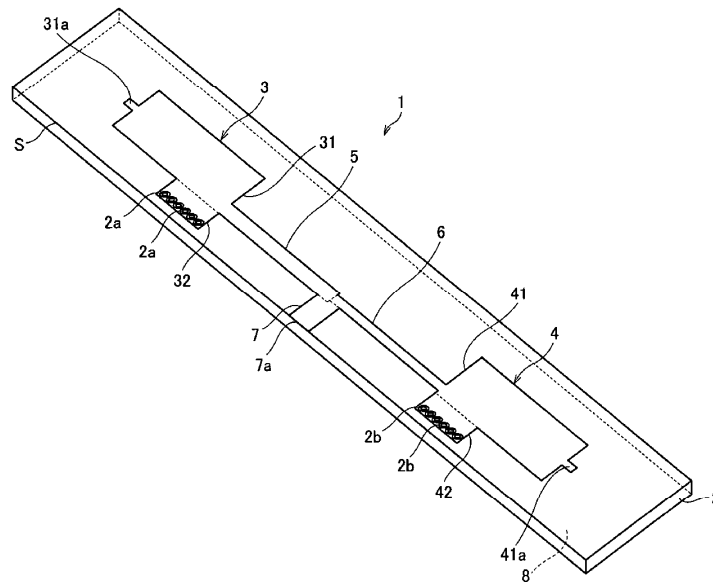
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*Primary Examiner*—HoangAnh T Le  
(74) *Attorney, Agent, or Firm*—Harness, Dickey & Pierce, PLC

(57) **ABSTRACT**

An antenna device includes a dielectric substrate, a ground plane, a pair of antenna elements, a feeding section, and a pair of transmission lines. The ground plane is formed on a surface of the dielectric substrate. The antenna elements are flat, have different resonant frequencies, are formed on another surface of the dielectric substrate, and respectively have ends electrically connected to the ground plane. The feeding section feeds power to each of the antenna elements. The transmission lines carry out impedance conversion such that parts of the transmission lines which are connected to the antenna elements have impedances matching input impedances of the antenna elements, respectively, and such that part of the feeding section which is fed with the power has an impedance matching an impedance of the feeding section.

**12 Claims, 15 Drawing Sheets**





US007466268B2

(12) **United States Patent**  
**Chen**

(10) **Patent No.:** **US 7,466,268 B2**  
(45) **Date of Patent:** **Dec. 16, 2008**

(54) **FREQUENCY ADJUSTABLE ANTENNA APPARATUS AND A MANUFACTURING METHOD THEREOF**

(75) Inventor: **Chih-Ming Chen**, Hsinchu (TW)

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

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 371 days.

(21) Appl. No.: **11/480,945**

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

(65) **Prior Publication Data**

US 2008/0007463 A1 Jan. 10, 2008

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

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

(58) **Field of Classification Search** ..... **343/700 MS; 343/702, 895, 906, 873**  
See application file for complete search history.

(56) **References Cited**

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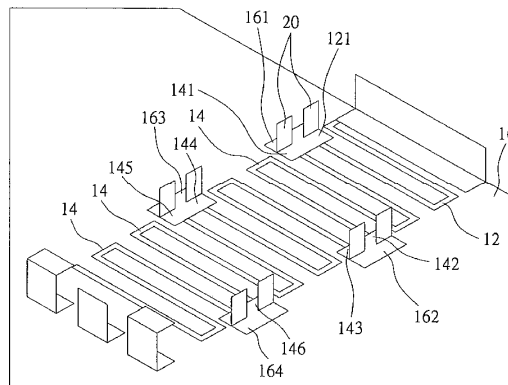
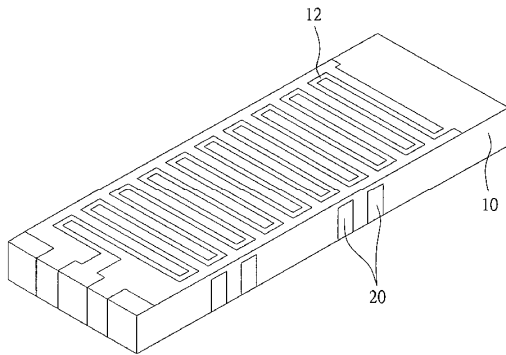
*Primary Examiner*—HoangAnh T Le

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

(57) **ABSTRACT**

A frequency adjustable antenna apparatus and a manufacturing method thereof are disclosed. The antenna apparatus includes a plurality of antenna paths and the length of the antenna path is changed via the soldering pads. Therefore, the receiving frequency of the antenna can be changed. The frequency adjustable antenna apparatus includes a body, a first path, at least one second path and a printed circuit board. The first path is located on an upper surface of the body and extends to a lower surface. The second path is located on the lower surface. The printed circuit board includes at least one soldering pad. When the lower surface of the body is pasted on the printed circuit board, the first path is connected with the second path via the soldering pads. Thereby, the length of the first path is changed to adjust the frequency of the antenna apparatus.

**24 Claims, 4 Drawing Sheets**





US007466269B2

(12) **United States Patent**  
**Haziza**

(10) **Patent No.:** **US 7,466,269 B2**  
(45) **Date of Patent:** **Dec. 16, 2008**

(54) **VARIABLE DIELECTRIC CONSTANT-BASED ANTENNA AND ARRAY**

(75) Inventor: **Dedi David Haziza**, Cupertino, CA (US)

(73) Assignee: **Wavebender, Inc.**, 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 0 days.

(21) Appl. No.: **11/747,148**

(22) Filed: **May 10, 2007**

(65) **Prior Publication Data**  
US 2008/0036664 A1 Feb. 14, 2008

**Related U.S. Application Data**

(63) Continuation of application No. 11/695,913, filed on Apr. 3, 2007.

(60) Provisional application No. 60/890,456, filed on Feb. 16, 2007, provisional application No. 60/859,799, filed on Nov. 17, 2006, provisional application No. 60/859,667, filed on Nov. 17, 2006, provisional application No. 60/808,187, filed on May 24, 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; 29/600, 601**  
See application file for complete search history.

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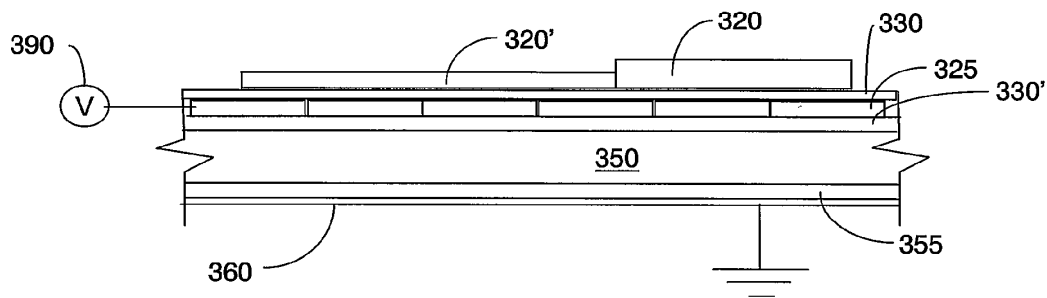
*Primary Examiner*—Hoang V Nguyen

(74) *Attorney, Agent, or Firm*—Nixon Peabody LLP; Joseph Bach, Esq.

(57) **ABSTRACT**

An antenna and antenna array are provided. A radiating elements and corresponding feed lines are provided over a variable dielectric constant material sandwiched between two panels. The sandwich may be in the form of an LCD. The dielectric constant in a selected area under the conductive line can be varied to control the phase of the radiating element. The dielectric constant in a selected area under the radiating element can be varied to control the resonance frequency of the radiating element. The dielectric constant in a selected area under the conductive line can be varied to also control the polarization of the radiating element.

**20 Claims, 2 Drawing Sheets**





US007466270B2

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

(10) **Patent No.:** **US 7,466,270 B2**  
(45) **Date of Patent:** **Dec. 16, 2008**

- (54) **PLANAR ANTENNA**
- (75) Inventors: **Naoaki Utagawa**, Gunma (JP); **Takashi Nozaki**, Gunma (JP); **Ichiro Tsuzuku**, Gunma (JP); **Naoki Sotoma**, Gunma (JP)
- (73) Assignee: **Yokowo 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.

2007/0171132 A1 7/2007 Utagawa et al. .... 343/700

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*Primary Examiner*—Tho G Phan

(74) *Attorney, Agent, or Firm*—Morgan, Lewis & Bockius LLP

- (21) Appl. No.: **11/812,093**
- (22) Filed: **Jun. 14, 2007**

(57) **ABSTRACT**

- (65) **Prior Publication Data**  
US 2007/0290931 A1 Dec. 20, 2007

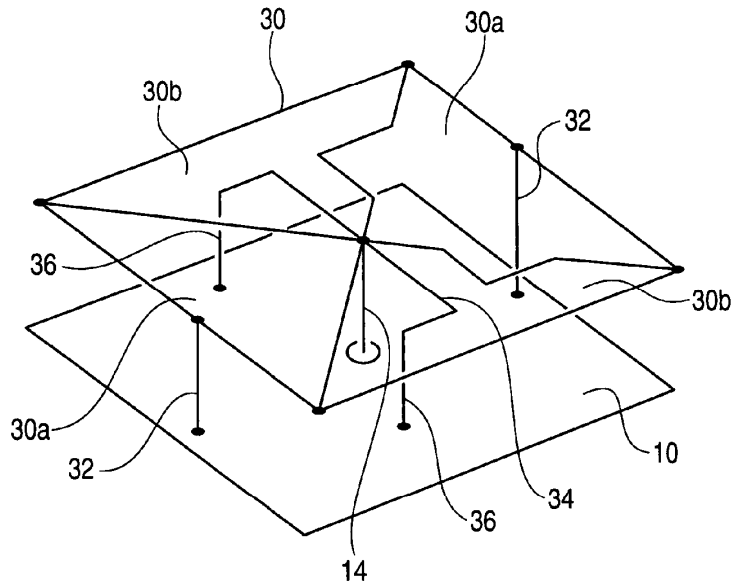
A plate member is adapted to be electrically grounded. A first radiating electrode opposes the plate member with a gap and extending parallel to the plate member. A second radiating electrode opposes the plate member with a gap and extending parallel to the plate member. A feeding pin is connected to a center part of the first radiating electrode and a center part of the second radiating electrode. The feeding pin is adapted to feed power to the first radiating electrode and the second radiating electrode. A pair of first short-circuiting pins are electrically connecting the plate member and an outer edge of the first radiating electrode at symmetrical positions relative to the feeding pin. A pair of second short-circuiting pins are electrically connecting the plate member and both ends of the second radiating electrode. The first radiating electrode is formed with blank portions which are located at such positions that are on hypothetical straight lines connecting the feeding pin and the short pins. The first radiating electrode and the second radiating electrode are flush with each other.

- (30) **Foreign Application Priority Data**  
Jun. 15, 2006 (JP) ..... 2006-166423

- (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, 343/846, 829, 830**  
See application file for complete search history.

- (56) **References Cited**  
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**6 Claims, 7 Drawing Sheets**





US007466271B2

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

(10) **Patent No.:** **US 7,466,271 B2**  
(45) **Date of Patent:** **Dec. 16, 2008**

(54) **MULTIPLE-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.: **11/838,751**

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

(65) **Prior Publication Data**  
US 2008/0030411 A1 Feb. 7, 2008

**Related U.S. Application Data**

(63) Continuation of application No. 11/456,025, filed on Jul. 6, 2006, now Pat. No. 7,283,097, which is a 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, 725, 745, 770**  
See application file for complete search history.

(56) **References Cited**

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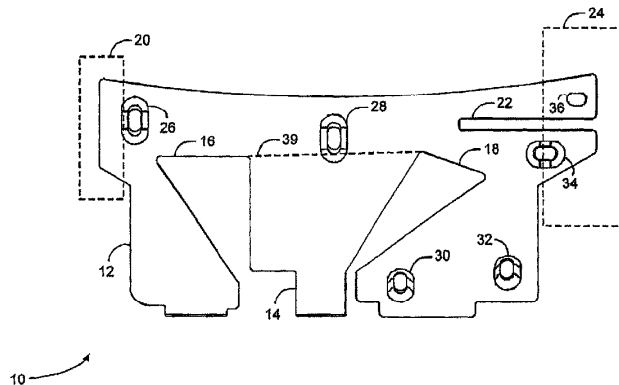
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*Primary Examiner*—Tan Ho  
(74) *Attorney, Agent, or Firm*—Allen, Dyer, Doppelt, Milbrath & Gilchrist P.A.

(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**





US007466272B1

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

(10) **Patent No.:** **US 7,466,272 B1**  
(45) **Date of Patent:** **Dec. 16, 2008**

(54) **DUAL-BAND ANTENNA**

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

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

*Primary Examiner*—HoangAnh T Le  
(74) *Attorney, Agent, or Firm*—WPAT, P.C.; Anthony King

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

(57) **ABSTRACT**

A dual-band antenna has a ground portion, a connection portion with a feeding point separated from the ground portion and a short portion connected to the ground portion and the connection portion. The short portion and the ground portion are formed an acute angle therebetween. The connection portion respectively connect a first radiating portion and a second radiating portion. The first radiating portion and the second radiating portion are parallel to said ground portion. The short portion is arranged between the ground portion and the first radiating portion. When the dual-band antenna operates at wireless operation, the connection portion, the first radiating portion and the second radiating portion resonate to obtain a first frequency range and a second frequency range. The short portion is formed as a function of an inductance.

(21) Appl. No.: **11/871,768**

(22) Filed: **Oct. 12, 2007**

(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, 848**

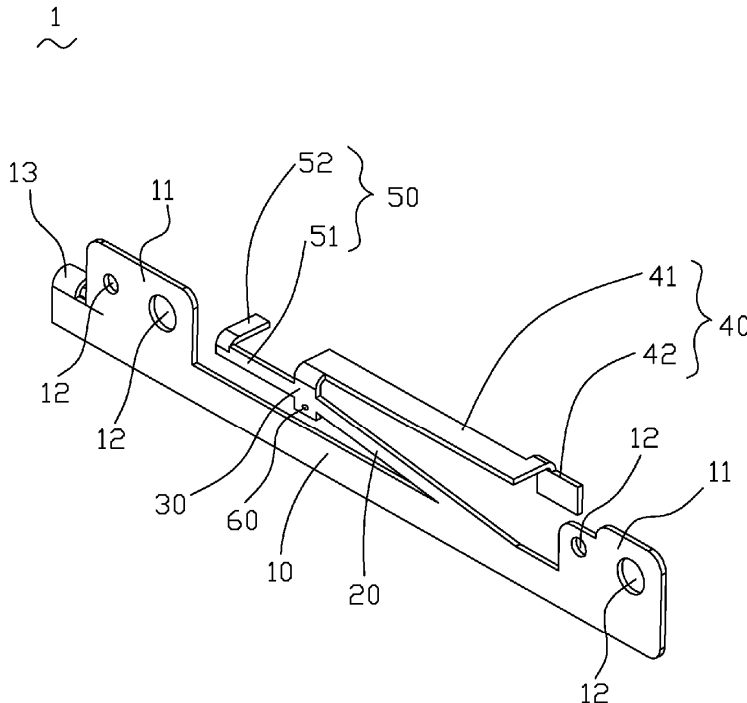
See application file for complete search history.

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**13 Claims, 4 Drawing Sheets**





US007466273B2

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

(10) **Patent No.:** **US 7,466,273 B2**  
(45) **Date of Patent:** **Dec. 16, 2008**

(54) **MULTIBAND ANTENNA USING WHIP HAVING INDEPENDENT POWER FEEDING IN WIRELESS TELECOMMUNICATION TERMINAL**

(75) Inventors: **Jin-Woo Lee**, Gyeonggi-do (KR);  
**Sang-Hyuk Mun**, Incheon (KR)

(73) Assignee: **Ace Technology**, Incheon (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.: **10/594,928**

(22) PCT Filed: **Mar. 31, 2004**

(86) PCT No.: **PCT/KR2004/000749**

§ 371 (c)(1),  
(2), (4) Date: **Sep. 29, 2006**

(87) PCT Pub. No.: **WO2005/101572**

PCT Pub. Date: **Oct. 27, 2005**

(65) **Prior Publication Data**

US 2007/0205948 A1 Sep. 6, 2007

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

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

(58) **Field of Classification Search** ..... 343/702,  
343/895, 793, 901, 893; 455/90.3

See application file for complete search history.

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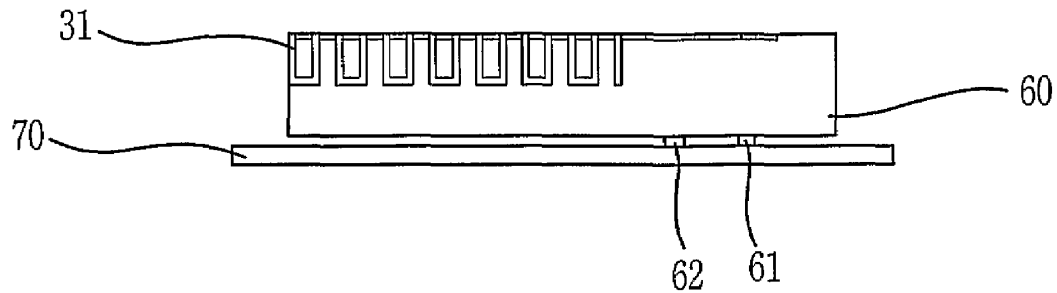
*Primary Examiner*—Tan Ho

(74) *Attorney, Agent, or Firm*—Venable LLP; Michael A. Sartori; Catherine M. Voorhees

(57) **ABSTRACT**

Provided is a multi-band antenna using a whip having independent power feeding in a wireless telecommunication terminal. The multi-band antenna of a wireless telecommunication terminal includes a first feed point for feeding an electric signal provided from an electric signal provider; a second feed point for feeding an electric signal provided from the electric signal provider; a plurality of radiators for radiating the electric signal fed from the first feed point into an electromagnetic wave signal; and a whip radiator for radiating the electric signal fed from the second feed point into an electromagnetic wave signal in order to increase the radiant efficiency of the electromagnetic wave signal radiated from a plurality of radiator and extend a bandwidth.

**18 Claims, 6 Drawing Sheets**







US007466274B2

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

(10) **Patent No.:** **US 7,466,274 B2**  
(45) **Date of Patent:** **Dec. 16, 2008**

(54) **MULTI-BAND ANTENNA**

(75) Inventors: **Ching-Chi Lin**, Taipei Hsien (TW); **Kai Shih**, Taipei Hsien (TW); **Yu-Yuan Wu**, Taipei Hsien (TW)

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

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

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*Primary Examiner*—Hoang V Nguyen

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

(21) Appl. No.: **11/613,248**

(22) Filed: **Dec. 20, 2006**

(65) **Prior Publication Data**

US 2008/0150829 A1 Jun. 26, 2008

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

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

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

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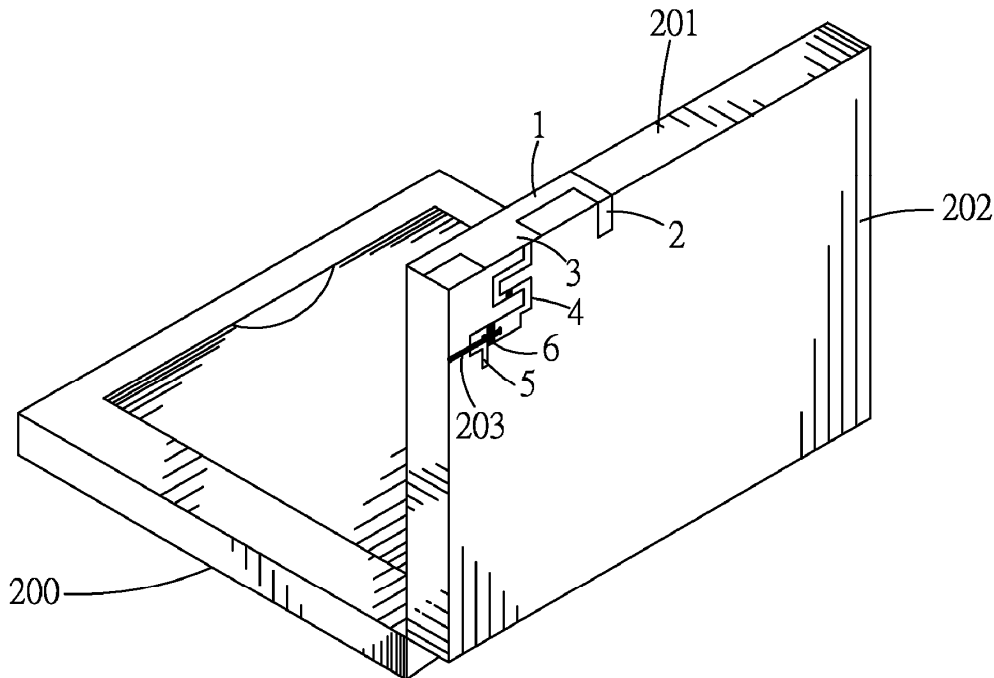
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(57) **ABSTRACT**

A multi-band antenna adapted to a portable electrical device capable of operating in various wireless communication bands includes a first radiating conductor having opposite elongated sides, a second radiating conductor extending from one end of the first radiating conductor, a third radiating conductor arranging about a central area of the first radiating. Both the second radiating conductor and the third radiating conductor extend from the same elongated side of the first radiating conductor. A feeding body is curved and extended from the third radiating conductor. According to a position that the feeding body connecting to the third radiating conductor and designed the feeding body, operation of the multi-band antenna has a preferred range of a low frequency bandwidth and a high frequency harmonic bandwidth.

**19 Claims, 2 Drawing Sheets**





US007466275B2

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

(10) **Patent No.:** **US 7,466,275 B2**  
(45) **Date of Patent:** **Dec. 16, 2008**

(54) **ANTENNA MODULE FOR MOBILE PHONE**

(75) Inventor: **Keh-Chang Cheng**, Taoyuan (TW)

(73) Assignee: **P-Two Industries Inc.**, Taoyuan (TW)

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 90 days.

(21) Appl. No.: **11/783,440**

(22) Filed: **Apr. 10, 2007**

(65) **Prior Publication Data**

US 2008/0081658 A1 Apr. 3, 2008

(30) **Foreign Application Priority Data**

Oct. 2, 2006 (TW) ..... 95217636 U

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

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

(58) **Field of Classification Search** ..... **343/702,**  
**343/700 MS, 846, 841**

See application file for complete search history.

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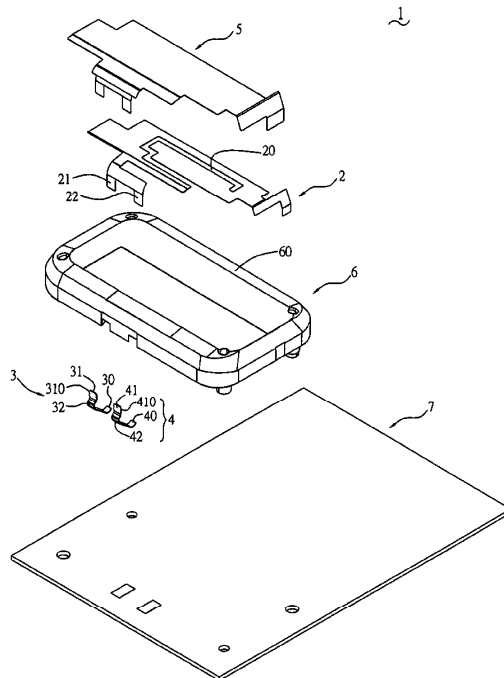
*Primary Examiner*—Hoang V Nguyen

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

(57) **ABSTRACT**

An antenna module of mobile phone has an antenna, a feed-in terminal and a grounding terminal. The antenna includes an antenna body for receiving and radiating electromagnetic waves, a feed-in portion and a grounding portion. The feed-in portion forms a first bump array with adhesive on a surface thereon. The grounding portion forms a second bump array with adhesive on a surface thereon. The first bump array and adhesive of the feed-in portion connect with the feed-in terminal, and the second bump array and adhesive of the grounding portion connect with the grounding terminal. The first bump array and the second bump array respectively pierce oxidation coatings on surfaces of the feed-in terminal and the grounding terminal, producing contact positive pressure, electrically connecting the feed-in portion and the grounding portion with the feed-in terminal and the grounding terminal.

**10 Claims, 6 Drawing Sheets**





US007466276B1

(12) **United States Patent**  
**Chen**

(10) **Patent No.:** **US 7,466,276 B1**  
(45) **Date of Patent:** **Dec. 16, 2008**

(54) **BROADBAND INVERTED-F ANTENNA**

(75) Inventor: **Po-Chuan Chen**, Hsinchu (TW)

(73) Assignee: **Alpha Networks Inc.**, Hsinchu (TW)

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 21 days.

(21) Appl. No.: **11/812,285**

(22) Filed: **Jun. 18, 2007**

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

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

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

See application file for complete search history.

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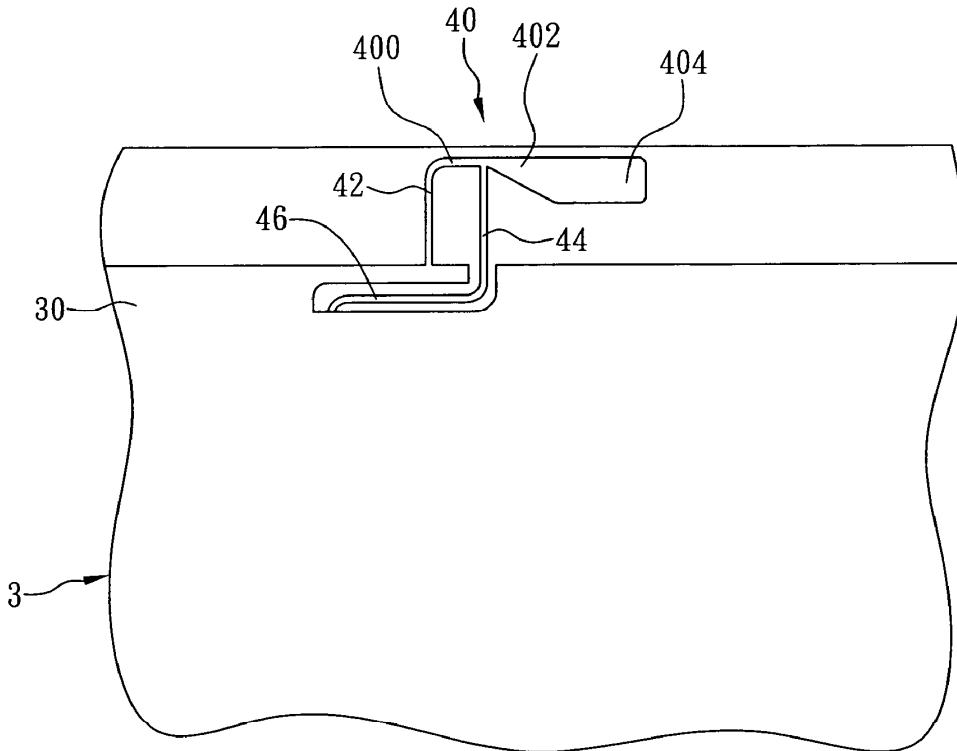
*Primary Examiner*—Tho G Phan

(74) *Attorney, Agent, or Firm*—Bacon & Thomas, PLLC

(57) **ABSTRACT**

An antenna body of a broadband inverted-F antenna is printed on a circuit board, wherein an interval is maintained between the antenna body and a grounding plane disposed at a position proximate to an edge of the circuit board. The antenna body is divided into a first, a second and a third portions. An end of the first portion is extended towards the grounding plane to form the short circuit line, and another end of the first portion is extended towards the grounding plane to form the feed line. A first end of the second portion is connected to another end of the first portion, a second end of the second portion is connected to an end of the third portion, and the first portion has a wire width smaller than the third portion, so that no metal is existing between the second and third portions and the grounding plane.

**11 Claims, 12 Drawing Sheets**





US007466277B2

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

(10) **Patent No.:** **US 7,466,277 B2**  
(45) **Date of Patent:** **Dec. 16, 2008**

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

(75) Inventors: **Kenichi Ishizuka**, Sagamihara (JP);  
**Kazunari Kawahata**, Machida (JP)

(73) Assignee: **Murata Manufacturing Co., Ltd.**,  
Kyoto (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.: **11/954,521**

(22) Filed: **Dec. 12, 2007**

(65) **Prior Publication Data**

US 2008/0079642 A1 Apr. 3, 2008

**Related U.S. Application Data**

(63) Continuation of application No. PCT/JP2006/306701, filed on Mar. 30, 2006.

(30) **Foreign Application Priority Data**

Jun. 17, 2005 (JP) ..... 2005-177764

(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, 829, 830, 846  
See application file for complete search history.

(56) **References Cited**

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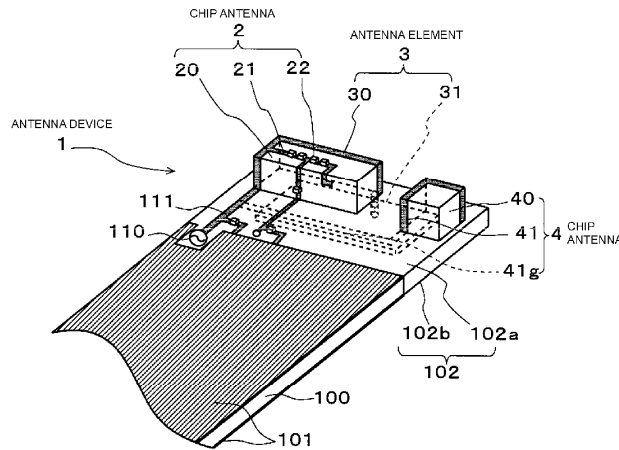
*Primary Examiner*—Tho G Phan

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

(57) **ABSTRACT**

A compact and thin antenna device can be mounted in a small area of a substrate and has a multiband capability adaptable to various applications. The antenna device includes a chip antenna, an antenna element, and a chip antenna. The chip antenna is produced by forming a radiation electrode on the surface of a dielectric base, and mounting a frequency variable circuit on the radiation electrode. Thus, it becomes possible to obtain a resonant frequency f1 of the chip antenna and further to vary the resonant frequency f1. The antenna element is produced by adding an auxiliary element to an additional radiation electrode for the chip antenna. The chip antenna includes a radiation electrode on a dielectric base and a conductive pattern. Thus, a resonant frequency f2 and a resonant frequency f3 of the antenna element and the chip antenna, respectively, can be obtained.

**12 Claims, 11 Drawing Sheets**





US007466283B2

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

(10) **Patent No.:** **US 7,466,283 B2**  
(45) **Date of Patent:** **Dec. 16, 2008**

(54) **COIL ANTENNA STRUCTURE AND PORTABLE ELECTRONIC APPARATUS**

7,280,076 B2 10/2007 Ninomiya et al.  
2004/0130500 A1 7/2004 Takei et al.

(75) Inventors: **Gaku Kamitani**, Kyoto (JP); **Hiroshi Marusawa**, Moriyama (JP); **Takehiro Konoike**, Yasu (JP); **Kazunari Kawahata**, Machida (JP)

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(73) Assignee: **Murata Manufacturing Co., Ltd.**, Kyoto (JP)

JP 08-124749 A 5/1996

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 63 days.

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(21) Appl. No.: **11/553,029**

International Search Report issued in the corresponding International Application No. PCT/JP2006/311831, mailed on Jul. 18, 2006.

(22) Filed: **Oct. 26, 2006**

(Continued)

(65) **Prior Publication Data**

US 2007/0052600 A1 Mar. 8, 2007

**Related U.S. Application Data**

*Primary Examiner*—Tan Ho  
(74) *Attorney, Agent, or Firm*—Keating & Bennett, LLP

(63) Continuation of application No. PCT/JP2006/311831, filed on Jun. 13, 2006.

(57) **ABSTRACT**

(30) **Foreign Application Priority Data**

Jun. 14, 2005 (JP) ..... 2005-174099  
Aug. 26, 2005 (JP) ..... 2005-245541  
Oct. 12, 2005 (JP) ..... 2005-297223

A coil antenna structure includes a first magnetic component extending in the thickness direction of a tabular primary casing. A second magnetic component and a third magnetic component, which are magnetically connected to the first magnetic component, are disposed on the first principal surface side and the second principal surface side of the primary casing, respectively. The first magnetic component is provided with a coil component surrounding it. In this manner, a U-shaped magnetic path is provided at an end portion of the primary casing so as to detour around a substrate defining an internal conductor. Likewise, a U-shaped magnetic path including fourth to sixth magnetic components is provided in a secondary casing defining a clamshell type casing together with the primary casing so as to detour around a substrate defining as an internal conductor.

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

(52) **U.S. Cl.** ..... **343/788; 343/702**

(58) **Field of Classification Search** ..... 343/718,  
343/799, 702, 788, 787

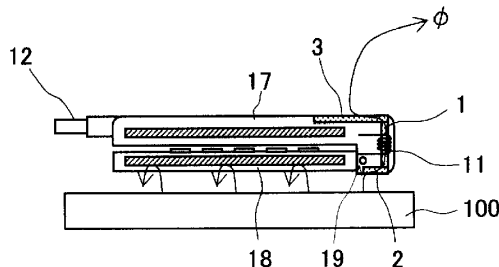
See application file for complete search history.

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**39 Claims, 13 Drawing Sheets**





US007468698B2

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

(10) **Patent No.:** **US 7,468,698 B2**  
(45) **Date of Patent:** **Dec. 23, 2008**

(54) **PATCH ANTENNA, ARRAY ANTENNA, AND MOUNTING BOARD HAVING THE SAME**

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

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

(75) Inventors: **Tomoharu Fujii**, Nagano (JP); **Yasutake Hirachi**, Kamakura (JP); **Hiroshi Nakano**, Yamanashi (JP)

(56) **References Cited**

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(73) Assignees: **Shinko Electric Industries Co., Ltd.**, Nagano (JP); **Eudyna Devices Inc.**, Yamanashi (JP)

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(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 189 days.

JP 621715 1/1994

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(21) Appl. No.: **11/264,592**

*Primary Examiner*—Michael C Wimer

(22) Filed: **Nov. 1, 2005**

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

(65) **Prior Publication Data**

US 2006/0097926 A1 May 11, 2006

(57) **ABSTRACT**

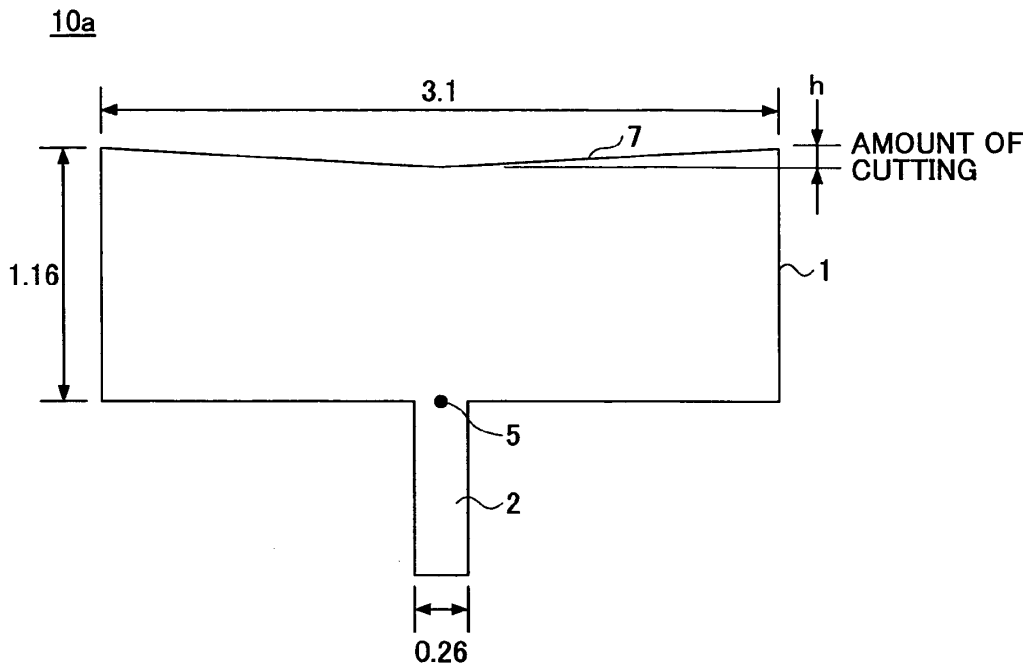
(30) **Foreign Application Priority Data**

Nov. 5, 2004 (JP) ..... 2004-322610

A patch antenna is disclosed that includes a dielectric substrate, a substantially rectangular radiation element formed of a conductive material on the dielectric substrate; and a feeder line connected to a feeding point for feeding to the radiation element. The feeding point has an impedance matching the impedance of the feeder line.

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

**10 Claims, 11 Drawing Sheets**





US007468699B2

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

(10) **Patent No.:** **US 7,468,699 B2**  
(45) **Date of Patent:** **Dec. 23, 2008**

(54) **TRIPLE POLARIZED PATCH ANTENNA**

(75) Inventors: **Lars Manholm**, Gothenburg (SE);  
**Fredrik Harrysson**, Gothenburg (SE)

(73) Assignee: **Telefonaktiebolaget L M Ericsson**  
**(Publ)**, Stockholm (SE)

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 12 days.

(21) Appl. No.: **11/722,910**

(22) PCT Filed: **Dec. 27, 2004**

(86) PCT No.: **PCT/SE2004/002010**

§ 371 (c)(1),  
(2), (4) Date: **Jun. 27, 2007**

(87) PCT Pub. No.: **WO2006/071139**

PCT Pub. Date: **Jul. 6, 2006**

(65) **Prior Publication Data**

US 2008/0136734 A1 Jun. 12, 2008

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

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

(58) **Field of Classification Search** ..... 343/700 MS,  
343/830, 853, 893  
See application file for complete search history.

(56) **References Cited**

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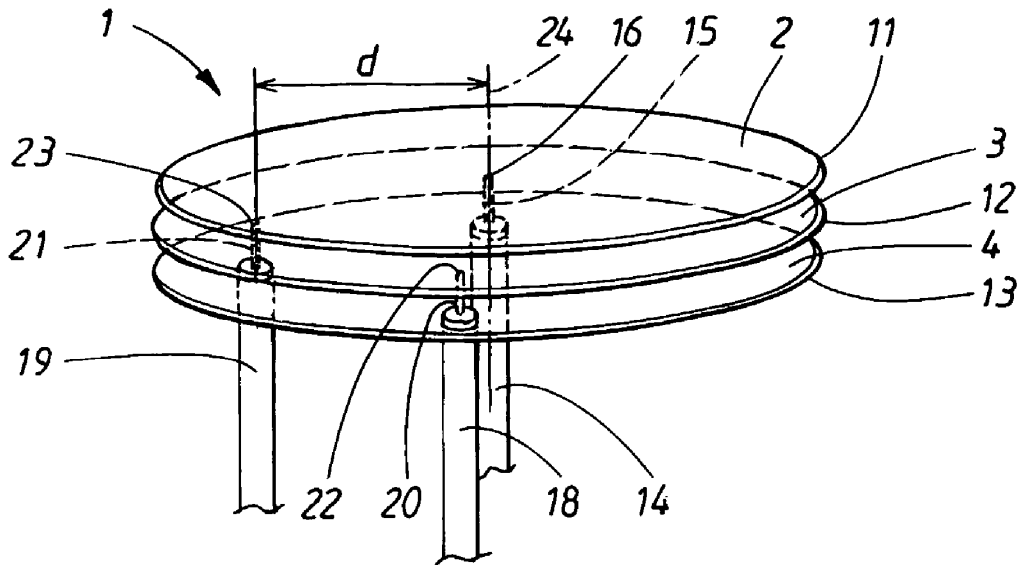
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*Primary Examiner*—Shih-Chao Chen

(57) **ABSTRACT**

An antenna arrangement for a Multiple Input Multiple Output (MIMO) radio system, the antenna arrangement transmitting and receiving in three essentially uncorrelated polarizations. The arrangement includes three parallel, stacked patches separated by first and second slots. A first feeding line feeds the first patch, and at least a second and third feeding line feed the second patch. In a first operating mode, the first feeding line generates a first constant E-field in the first slot between the edges of the first and second patches. In a second operating mode, the second feeding line contributes to a second, sinusoidally varying E-field in the second slot between the edges of the second and third patches. In a third operating mode, the third feeding line contributes to a third, sinusoidally varying E-field in the second slot between the edges of the second and third patches.

**10 Claims, 3 Drawing Sheets**





US007468700B2

(12) **United States Patent**  
**Milosavljevic**

(10) **Patent No.:** **US 7,468,700 B2**  
(45) **Date of Patent:** **Dec. 23, 2008**

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

- (75) Inventor: **Zlatoljub Milosavljevic**, Kempele (FI)
- (73) Assignee: **Pulse Finland Oy**, Kempele (FI)
- (\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 350 days.

(21) Appl. No.: **11/008,447**

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

(65) **Prior Publication Data**  
US 2005/0128152 A1 Jun. 16, 2005

(30) **Foreign Application Priority Data**  
Dec. 15, 2003 (FI) ..... 20031833

- (51) **Int. Cl.**  
**H01Q 1/24** (2006.01)
- (52) **U.S. Cl.** ..... **343/702**; 343/700 MS; 343/850
- (58) **Field of Classification Search** ..... 343/700 MS, 343/745, 829, 846, 850, 702, 876  
See application file for complete search history.

(56) **References Cited**  
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*Primary Examiner*—Douglas W. Owens

*Assistant Examiner*—Jimmy T Vu

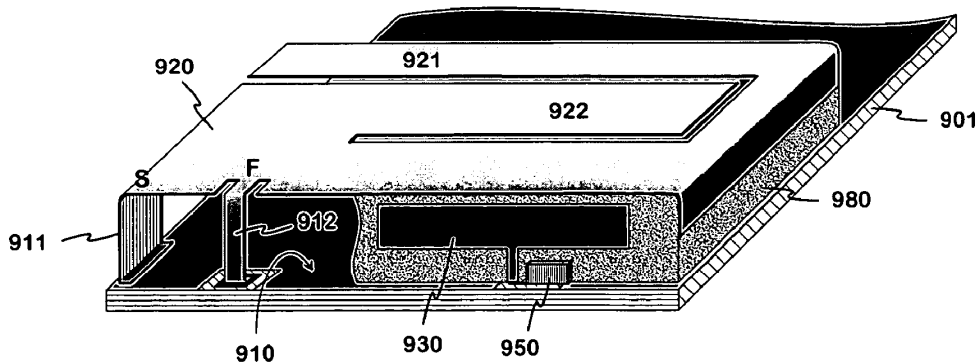
(74) *Attorney, Agent, or Firm*—Darby & Darby P.C.

(57) **ABSTRACT**

An adjustable multi-band planar antenna especially applicable in mobile terminals. A conductive element is placed in the structure of an antenna of PIFA type such that the conductive element has a significant electromagnetic coupling to the radiating plane. The parasitic element at issue is connected to a matching circuit (550) consisting of several reactive element. The parasitic element, the matching circuit and a line (540) between them constitute an adjusting circuit of the antenna. The circuit values of the matching circuit can be chosen from at least two alternatives. Alteration in the circuit values changes the coupling between the parasitic element and the ground, in which case an operation band of the antenna is displaced, because the electric length of the antenna's part corresponding that band is changed, measured from the short-circuit point. Regarding the shiftable operation band, proper impedance matching and a proper efficiency can be arranged for the antenna.

**10 Claims, 5 Drawing Sheets**

**900**







US007468701B2

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

(10) **Patent No.:** **US 7,468,701 B2**  
(45) **Date of Patent:** **Dec. 23, 2008**

(54) **ATTACHMENT/DETACHMENT MECHANISM FOR COMPACT ANTENNA**

(75) Inventors: **Hiroshi Fujikawa**, Tokyo (JP); **Keiichi Ogura**, Tokyo (JP)

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

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

(21) Appl. No.: **11/551,779**

(22) Filed: **Oct. 23, 2006**

(65) **Prior Publication Data**

US 2007/0205960 A1 Sep. 6, 2007

(30) **Foreign Application Priority Data**

Mar. 3, 2006 (JP) ..... 2006-058219

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

(52) **U.S. Cl.** ..... **343/702**; 343/715; 343/903;  
343/906

(58) **Field of Classification Search** ..... 343/702,  
343/715, 888, 900, 903, 906, 700 MS  
See application file for complete search history.

(56) **References Cited**

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*Primary Examiner*—Douglas W. Owens

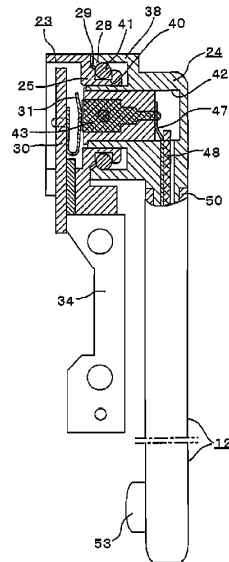
*Assistant Examiner*—Chuc Tran

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

(57) **ABSTRACT**

An attachment/detachment mechanism for an antenna is configured to avoid damage to the antenna when an excessively large force is applied to the antenna, regardless of the direction. A rotational L-shaped connector of an antenna section of the antenna is connected to an antenna housing disposed on a main electronic device unit. A fitting groove is formed on a male fitting cylinder on the rotational L-shaped connector side, and an O-ring is fitted to the groove. An engagement projection formed on an inner wall of a female fitting cylinder on the antenna housing frictionally engages with the O-ring. This configuration allows rotation and attachment/detachment of the antenna section relative to the antenna housing. A contact member is attached to the fitting cylinder to contact a contact spring 31 that presses the O-ring against the engagement projection.

**5 Claims, 5 Drawing Sheets**





US007468702B2

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

(10) **Patent No.:** **US 7,468,702 B2**  
(45) **Date of Patent:** **Dec. 23, 2008**

(54) **WIRELESS COMMUNICATION DEVICE WITH INTEGRATED ANTENNA**

(75) Inventors: **Gustavo D. Leizerovich**, Aventura, FL (US); **Donald W. Burnette**, Sunrise, FL (US); **Julio C. Castaneda**, Coral Springs, FL (US); **Orlando Gomez**, Hialeah, 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.: **11/929,317**

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

(65) **Prior Publication Data**  
US 2008/0055167 A1 Mar. 6, 2008

**Related U.S. Application Data**  
(62) Division of application No. 11/227,367, filed on Sep. 15, 2005, now Pat. No. 7,333,062.

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

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

(58) **Field of Classification Search** ..... 343/702, 343/741, 742, 866, 867, 872, 873  
See application file for complete search history.

(56) **References Cited**

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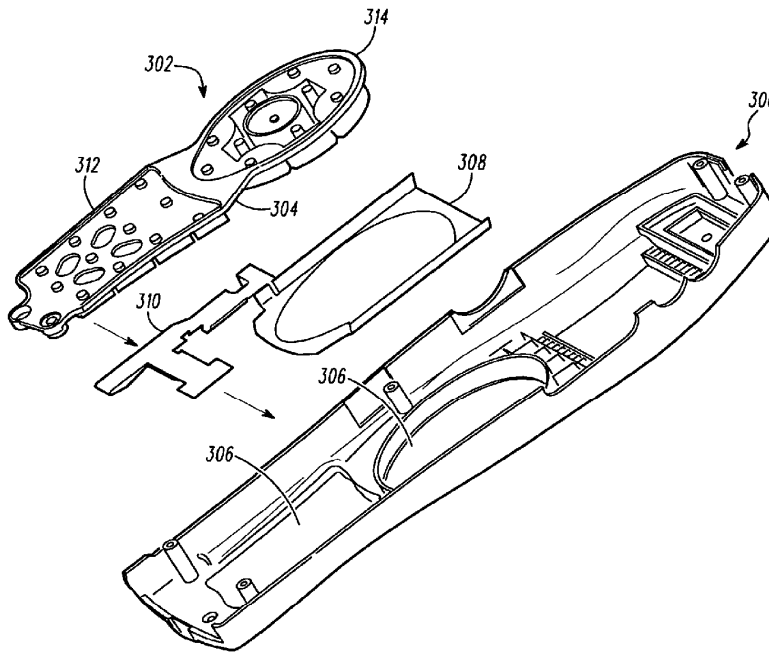
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*Primary Examiner*—HoangAnh T Le

(57) **ABSTRACT**

A near field communication loop antenna (308) is mechanically coupled to the cover (300) of a cellular telephone. The antenna (308) is coupled on the inside of the cover (300) between a keypad (302) and the cover (300), whereby the antenna (308) surrounds the keys (314) and is sandwiched between the keypad assembly (302) and the cover (300). A near field communication antenna (406) is coupled to the outside surface of the cover (300) surrounding a display and sandwiched between a lens (400) and the phone cover (300). A near field communication antenna embedded in the phone cover material, whereby the antenna surrounds either the keys or the display, is disclosed as well.

**11 Claims, 4 Drawing Sheets**





US007468708B2

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

(10) **Patent No.:** **US 7,468,708 B2**  
(45) **Date of Patent:** **Dec. 23, 2008**

(54) **MOBILE TERMINAL AND MOBILE TERMINAL ANTENNA FOR REDUCING ELECTROMAGNETIC WAVES RADIATED TOWARDS HUMAN BODY**

(75) Inventors: **Se-hyun Park**, Yongin-si (KR); **Wee-sang Park**, Yongin-si (KR); **Yong-eil Kim**, Yongin-si (KR); **Jae-hee Kim**, Pohang-si (KR)

(73) Assignees: **Samsung Electronics Co., Ltd.**, Suwon-si (KR); **Samsung Electro-Mechanics 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 12 days.

(21) Appl. No.: **11/634,865**

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

(65) **Prior Publication Data**  
US 2008/0001831 A1 Jan. 3, 2008

(30) **Foreign Application Priority Data**  
Jun. 30, 2006 (KR) ..... 10-2006-0060440

(51) **Int. Cl.**  
**H01Q 1/52** (2006.01)  
**H01Q 1/24** (2006.01)

(52) **U.S. Cl.** ..... **343/841; 343/702; 343/846**

(58) **Field of Classification Search** ..... 343/841, 343/702, 700 MS, 846  
See application file for complete search history.

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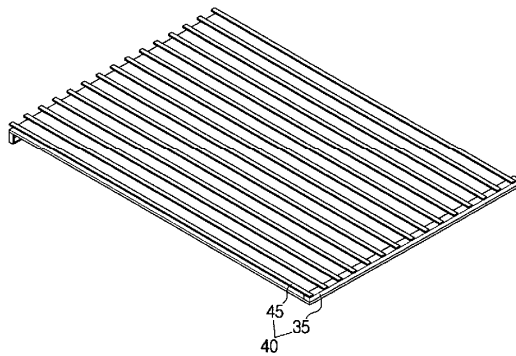
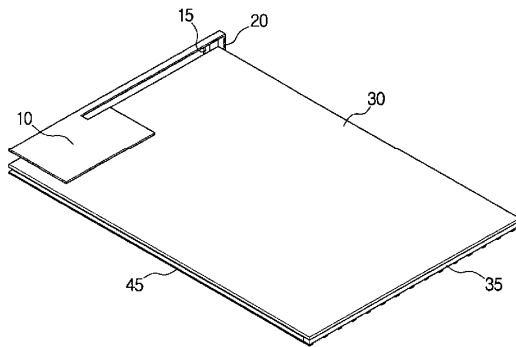
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(57) **ABSTRACT**

A mobile terminal and a mobile terminal antenna reduce the intensity of electromagnetic waves radiated in the direction of a human body. The mobile terminal antenna includes a radiator, which radiates electromagnetic waves; a ground which is connected with the radiator, and a radiation preventer which has a metallic bar on one side of the ground in parallel with the ground at an interval. Accordingly, the electromagnetic radiation exposure to the human body can be reduced by altering the radiation emission pattern, while the performance of the antenna can be simultaneously enhanced.

**6 Claims, 11 Drawing Sheets**





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(54) **ANTENNA**

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(\*\*) Term: **14 Years**

(21) Appl. No.: **29/317,794**

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(30) **Foreign Application Priority Data**

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(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 MS, 343/700 R-705, 711-713, 741, 748, 767, 343/795, 819, 840, 846, 866, 871-908; 455/90.2, 455/90.3, 91, 128, 269, 344, 347, 562.1  
See application file for complete search history.

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(57) **CLAIM**

The ornamental design for a antenna, as shown and described.

**DESCRIPTION**

FIG. 1 is a top perspective view of the antenna according to the present invention;

FIG. 2 is a bottom perspective view thereof;

FIG. 3 is a first side view thereof;

FIG. 4 is a second side view thereof;

FIG. 5 is a first end view thereof;

FIG. 6 is a second end view thereof;

FIG. 7 is a top plan view thereof; and,

FIG. 8 is a bottom plan view thereof.

**1 Claim, 4 Drawing Sheets**

