



US007808435B2

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

(10) **Patent No.:** **US 7,808,435 B2**
(45) **Date of Patent:** **Oct. 5, 2010**

(54) **ANTENNA STRUCTURE AND WIRELESS COMMUNICATION APPARATUS INCLUDING SAME**

6,597,317 B2 7/2003 Talvitie
6,693,594 B2* 2/2004 Pankinaho et al. 343/700 MS
7,136,020 B2 11/2006 Yamaki
2001/0048390 A1 12/2001 Nagumo et al.

(75) Inventors: **Shoji Nagumo**, Sagamihara (JP);
Kazuyuki Furuya, Yokohama (JP); **Mie Shimizu**, Yokohama (JP); **Hirotaka Fujii**, Sagamihara (JP)

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(73) Assignee: **Murata Manufacturing Co., Ltd.**,
Kyoto (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 81 days.

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(21) Appl. No.: **12/188,550**

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

International Search Report (Apr. 2005).

(65) **Prior Publication Data**

US 2009/0015497 A1 Jan. 15, 2009

(Continued)

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2006/323818, filed on Nov. 29, 2006.

Primary Examiner—Tan Ho

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

(30) **Foreign Application Priority Data**

Feb. 14, 2006 (JP) 2006-036830

(57) **ABSTRACT**

(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, 750

See application file for complete search history.

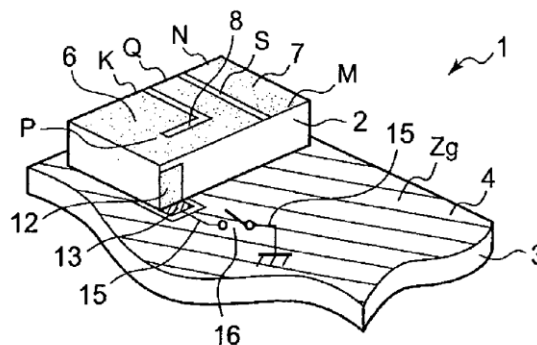
In an antenna structure in which a base is mounted in a ground region on a circuit board, the base having formed thereon a driven radiating electrode and a parasitic radiating electrode, the parasitic radiating electrode causing multiple resonance at least in a harmonic resonant frequency band of the driven radiating electrode, capacitance loading means for loading a capacitance to a harmonic-mode zero voltage region of the driven radiating electrode is provided. The capacitance loading means is electrically connected to a ground electrode in the ground region on the circuit board via a grounding conduction path and switching means. By switching the switching means ON/OFF, capacitance loading by the capacitance loading means to the harmonic-mode zero voltage region of the driven radiating electrode is switched ON/OFF to switch a base resonant frequency in a base resonant frequency band of the driven radiating electrode.

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20 Claims, 11 Drawing Sheets





US007808436B2

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

(10) **Patent No.:** **US 7,808,436 B2**
(45) **Date of Patent:** **Oct. 5, 2010**

(54) **FOLDING TYPE COMMUNICATION
TERMINAL DEVICE**

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7,228,112 B2* 6/2007 Ota et al. 455/90.3

(75) Inventors: **Mitsuharu Nakasato**, Miyagi (JP);
Hironori Kikuchi, Miyagi (JP); **Satoru
Watanabe**, Kanagawa (JP)

(Continued)

(73) Assignee: **Panasonic Corporation**, Osaka (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 575 days.

CN 1416194 A 5/2003

(Continued)

(21) Appl. No.: **11/573,208**

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(22) PCT Filed: **Aug. 9, 2005**

International Search Report dated Nov. 15, 2005.

(86) PCT No.: **PCT/JP2005/014586**

(Continued)

§ 371 (c)(1),
(2), (4) Date: **Feb. 5, 2007**

Primary Examiner—Michael C Wimer
Assistant Examiner—Kyana R Robinson
(74) *Attorney, Agent, or Firm*—Pearne & Gordon LLP

(87) PCT Pub. No.: **WO2006/016585**

PCT Pub. Date: **Feb. 16, 2006**

(57) **ABSTRACT**

(65) **Prior Publication Data**

US 2008/0316113 A1 Dec. 25, 2008

(30) **Foreign Application Priority Data**

Aug. 10, 2004 (JP) 2004-233351

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

(52) **U.S. Cl.** 343/702; 455/575.3; 455/575.7

(58) **Field of Classification Search** 343/702,
343/841; 455/575.3, 575.7

See application file for complete search history.

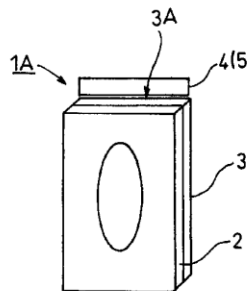
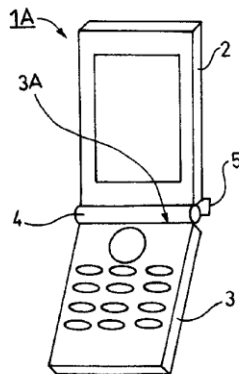
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6,897,825 B2 5/2005 Kim et al.

In a communication terminal in which a first enclosure and a second enclosure are foldable, to provide the communication terminal with an antenna characteristic with a wide band performance in either when the enclosures are opened or folded. In a folding communication terminal comprising an upper enclosure 2 and a lower enclosure 3 which are foldable through a hinge, and an antenna 5 attached to the lower enclosure 3, the antenna 5 is arranged along the edge of the end face 3A on the upper side abutting on the hinge of the lower enclosure 3, a conductor is placed in the upper enclosure 2 not provided with the antenna, and a second printed board 31 is provided so that when the upper enclosure 2 and the lower enclosure 3 are opened, it is connected to the antenna 5 at a high frequency to operate as the antenna, thereby transmitting/receiving an electromagnetic wave.

8 Claims, 9 Drawing Sheets





US007808437B2

(12) **United States Patent**
Ying

(10) **Patent No.:** **US 7,808,437 B2**
(45) **Date of Patent:** **Oct. 5, 2010**

- (54) **ANTENNA ARRANGEMENT**
- (75) Inventor: **Zhinong Ying**, Lund (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 555 days.
- (21) Appl. No.: **11/720,634**
- (22) PCT Filed: **Dec. 2, 2005**
- (86) PCT No.: **PCT/EP2005/056425**
§ 371 (c)(1),
(2), (4) Date: **Nov. 14, 2007**
- (87) PCT Pub. No.: **WO2006/061352**
PCT Pub. Date: **Jun. 15, 2006**
- (65) **Prior Publication Data**
US 2008/0252538 A1 Oct. 16, 2008
- (30) **Foreign Application Priority Data**
Dec. 7, 2004 (EP) 04028916
- (51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/38 (2006.01)
H01Q 13/10 (2006.01)
- (52) **U.S. Cl.** **343/702; 343/700 MS; 343/767**

(58) **Field of Classification Search** 343/700 MS, 343/702, 767, 846, 848, 893
See application file for complete search history.

- (56) **References Cited**
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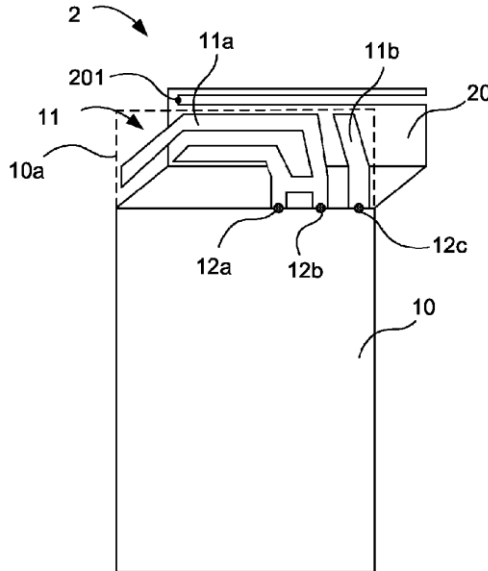
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Primary Examiner—Shih-Chao Chen
(74) *Attorney, Agent, or Firm*—Renner, Otto, Boisselle & Sklar, LLP

(57) **ABSTRACT**
An antenna arrangement comprising a multi-layer PCB (10) with a ground plane (20) in a first layer and a first antenna (11) in a second layer, and an extended ground plane (20) connected to the ground plane of the PCB. A second antenna (110, 120, 130, 140, 150) is formed integral with the extended ground plane (20). The extended ground plane is positioned opposite the first antenna.

15 Claims, 3 Drawing Sheets





US007808438B2

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

(10) **Patent No.:** **US 7,808,438 B2**
(45) **Date of Patent:** **Oct. 5, 2010**

(54) **HANDHELD ELECTRONIC DEVICES WITH ISOLATED ANTENNAS**
(75) Inventors: **Robert W. Schlub**, Campbell, CA (US); **Robert J. Hill**, Salinas, CA (US); **Juan Zavala**, Watsonville, CA (US); **Ruben Caballero**, San Jose, CA (US)

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6,980,154 B2 12/2005 Vance et al.
7,027,838 B2 4/2006 Zhou et al.
7,116,276 B2 10/2006 Lee
7,119,747 B2 10/2006 Lin et al.

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

(Continued)

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EP 1 315 238 A 7/2003

(21) Appl. No.: **12/504,246**

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

(Continued)

(65) **Prior Publication Data**
US 2009/0275370 A1 Nov. 5, 2009

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

Related U.S. Application Data

(62) Division of application No. 11/650,071, filed on Jan. 4, 2007, now Pat. No. 7,595,759.

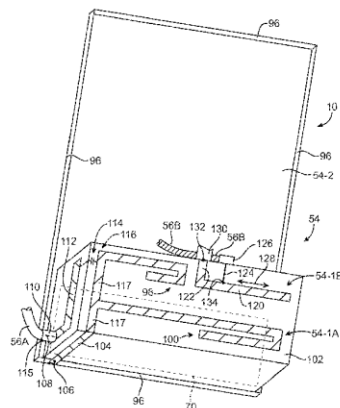
(57) **ABSTRACT**

(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, 725, 767, 829, 846**
See application file for complete search history.

Handheld electronic devices are provided that contain wireless communications circuitry having at least first and second antennas. An antenna isolation element reduces signal interference between the antennas, so that the antennas may be used in close proximity to each other. A planar ground element may be used as a ground by the first and second antennas. The first antenna may be formed using a hybrid planar-inverted-F and slot arrangement in which a planar resonating element is located above a rectangular slot in the planar ground element. The second antenna may be formed from an L-shaped strip. The planar resonating element of the first antenna may have first and second arms. The first arm may resonate at a common frequency with the second antenna and may serve as the isolation element. The second arm may resonate at approximately the same frequency as the slot portion of the hybrid antenna.

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5 Claims, 12 Drawing Sheets





US007808442B2

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

(10) **Patent No.:** **US 7,808,442 B2**
(45) **Date of Patent:** **Oct. 5, 2010**

- (54) **MULTI-BAND ANTENNA**
- (75) Inventors: **Yi-Hung Chiu**, Taipei Hsien (TW);
Chia-Tien Li, Taipei Hsien (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 0 days.
- (21) Appl. No.: **12/129,685**
- (22) Filed: **May 30, 2008**
- (65) **Prior Publication Data**
US 2009/0224979 A1 Sep. 10, 2009
- (30) **Foreign Application Priority Data**
Mar. 5, 2008 (TW) 97107723 A
- (51) **Int. Cl.**
H01Q 1/48 (2006.01)
H01Q 21/30 (2006.01)
- (52) **U.S. Cl.** **343/826; 343/829; 343/833; 343/846**

(58) **Field of Classification Search** 343/702, 343/833, 846, 700 MS, 826, 828, 829, 831
See application file for complete search history.

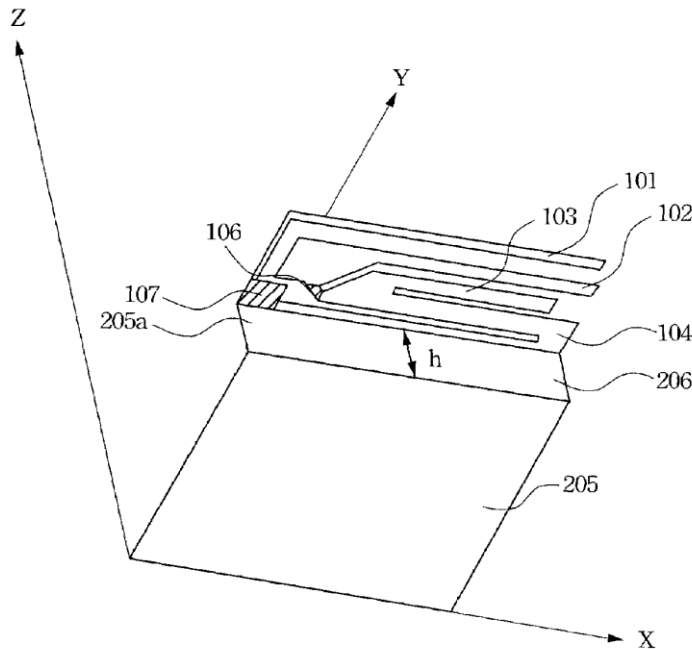
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Primary Examiner—Michael C Wimer
(74) *Attorney, Agent, or Firm*—Pai Patent & Trademark Law Firm; Chao-Chang David Pai

(57) **ABSTRACT**
The present invention discloses a multi-band antenna. The antenna includes a ground portion, a parasitic unit connecting with the ground portion and operated at a first frequency band, a first radiation portion having a feeding point and operated at a second frequency band, a second radiation portion connecting with the feeding point and operated at a third frequency band. The first radiation portion and the second radiation portion are located between the parasitic unit and the ground portion.

33 Claims, 12 Drawing Sheets

200





US007812768B2

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

(10) **Patent No.:** **US 7,812,768 B2**
(45) **Date of Patent:** **Oct. 12, 2010**

- (54) **MULTIPLE INPUT MULTIPLE OUTPUT ANTENNA**
- (75) Inventors: **Xiao-Feng Liu**, Shenzhen (CN); **Cho-Ju Chung**, Taipei Hsien (TW); **Teng-Huei Chu**, Taipei Hsien (TW)
- (73) Assignees: **Hong Fu Jin Precision Industry (ShenZhen) Co., Ltd.**, Shenzhen, Guangdong Province (CN); **Hon Hai Precision Industry Co., Ltd.**, Tu-Cheng, Taipei Hsien (TW)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 283 days.
- (21) Appl. No.: **12/185,107**
- (22) Filed: **Aug. 3, 2008**
- (65) **Prior Publication Data**
US 2009/0267857 A1 Oct. 29, 2009
- (30) **Foreign Application Priority Data**
Apr. 28, 2008 (CN) 2008 1 0301365
- (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, 893, 878
See application file for complete search history.

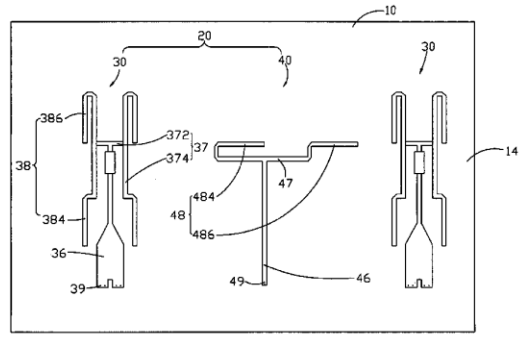
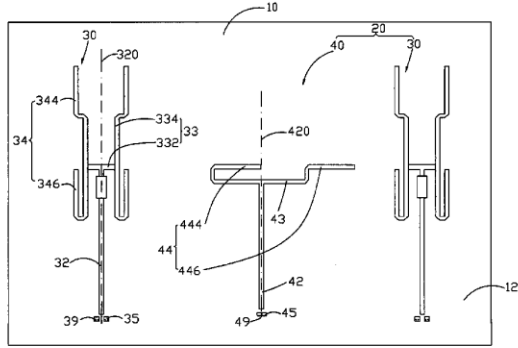
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Primary Examiner—Shih-Chao Chen
(74) *Attorney, Agent, or Firm*—Frank R. Niranjana

(57) **ABSTRACT**
A MIMO antenna (20) is disposed on a substrate (10) including a first surface (12) and a second surface (14). The MIMO antenna includes a pair of parallel first antennas (30) spaced apart from each other and a second antenna (40) spaced apart from the first antennas. The second antenna is disposed between the first antennas. Each of the first and second antennas is disposed on the first and second surface of the substrate and is a dipole antenna.

18 Claims, 13 Drawing Sheets





US007812772B2

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

(10) **Patent No.:** **US 7,812,772 B2**
(45) **Date of Patent:** **Oct. 12, 2010**

(54) **ANTENNA, AND ASSOCIATED METHOD,
FOR A MULTI-BAND RADIO DEVICE**

(75) Inventors: **Geyi Wen**, Waterloo (CA); **Dong Wang**,
Waterloo (CA); **Mark Pecan**, Waterloo
(CA)

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

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 61 days.

(21) Appl. No.: **11/843,851**

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

(65) **Prior Publication Data**

US 2009/0051597 A1 Feb. 26, 2009

(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.

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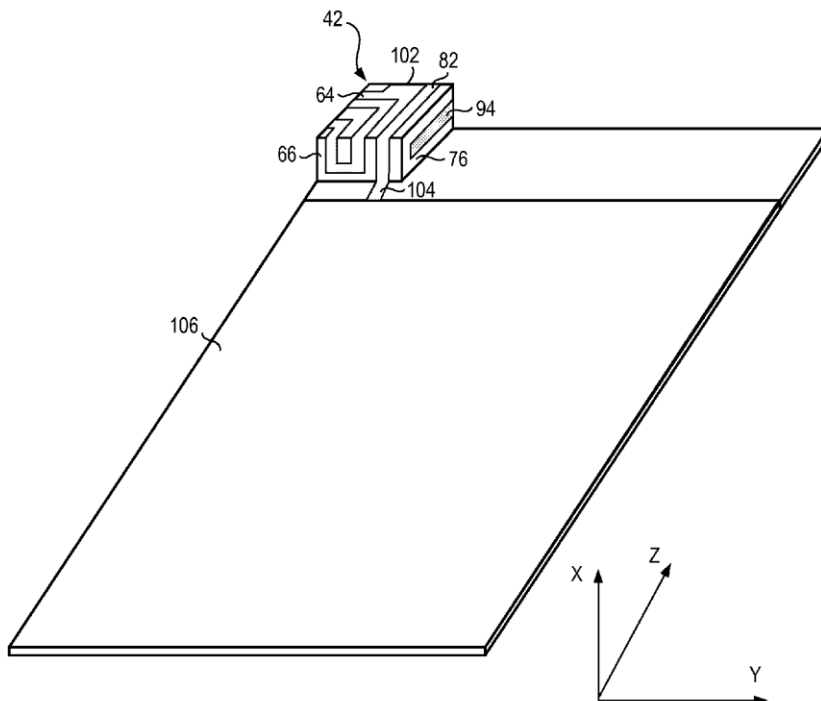
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Primary Examiner—Hoang V Nguyen

(57) **ABSTRACT**

Antenna apparatus, and an associated method, for a mobile station, or other radio device. A folded conducting strip is formed upon multiple sides of a cube-shaped, or other three-dimensional substrate of small dimensions. The conducting strip exhibits resonance at multiple frequencies, such as at frequencies encompassing the 800/900/1800/1900/2200 MHz frequencies. Because of the positioning of the conducting strip upon the multiple sides of the substrate, a conducting strip of increase length is provided while permitting the dimensional requirements of the antenna structure to be small. Multiple antennas are able to be positioned at the radio device to provide for multiple-input, multiple-output radio operation.

13 Claims, 9 Drawing Sheets





US007812773B2

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

(10) **Patent No.:** **US 7,812,773 B2**
(45) **Date of Patent:** **Oct. 12, 2010**

(54) **MOBILE WIRELESS COMMUNICATIONS DEVICE ANTENNA ASSEMBLY WITH ANTENNA ELEMENT AND FLOATING DIRECTOR ELEMENT ON FLEXIBLE SUBSTRATE AND RELATED METHODS**

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(75) Inventors: **Yihong Qi**, St. Agatha (CA); **Ying Tong Man**, Waterloo (CA); **Adrian Cooke**, Kitchener (CA)

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

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

(21) Appl. No.: **11/863,324**

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

(65) **Prior Publication Data**

US 2009/0085812 A1 Apr. 2, 2009

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

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

(58) **Field of Classification Search** 343/700 MS, 343/702, 833; 379/429, 430, 433.01, 433.11-433.13; 455/575.7, 25

See application file for complete search history.

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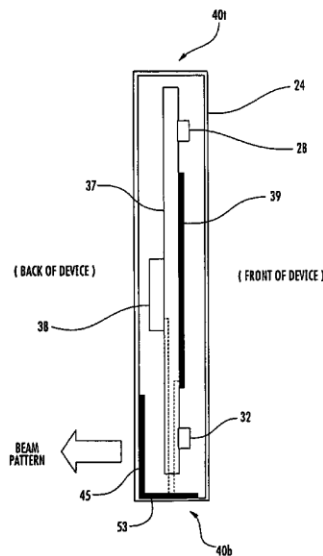
Primary Examiner—Rexford N Barnie
Assistant Examiner—Matthew C Tabler

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

(57) **ABSTRACT**

A mobile wireless communications device may include a portable housing, a circuit board carried by the portable housing and having a ground plane thereon, wireless communications circuitry carried by the circuit board, and an antenna assembly carried by the housing. More particularly, the antenna assembly may include a flexible substrate, an electrically conductive antenna element on the flexible substrate and connected to the wireless communications circuitry and the ground plane, and a floating, electrically conductive director element on the flexible substrate for directing a beam pattern of the antenna element.

25 Claims, 7 Drawing Sheets





US007812774B2

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

(10) **Patent No.:** **US 7,812,774 B2**
(45) **Date of Patent:** **Oct. 12, 2010**

(54) **ACTIVE TUNED LOOP-COUPLED ANTENNA**

(75) Inventors: **Alf Friman**, Växjö (SE); **Sverker Petersson**, Nybro (SE); **Laurent Desclos**, San Diego, CA (US); **Jeffrey Shamblin**, San Marcos, CA (US)

(73) Assignee: **Ethertronics, Inc.**, 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 232 days.

(21) Appl. No.: **12/117,669**

(22) Filed: **May 8, 2008**

(65) **Prior Publication Data**
US 2009/0278756 A1 Nov. 12, 2009

(51) **Int. Cl.**
H01Q 7/00 (2006.01)

(52) **U.S. Cl.** **343/748**; 343/745

(58) **Field of Classification Search** 343/745, 343/748, 850, 860, 861

See application file for complete search history.

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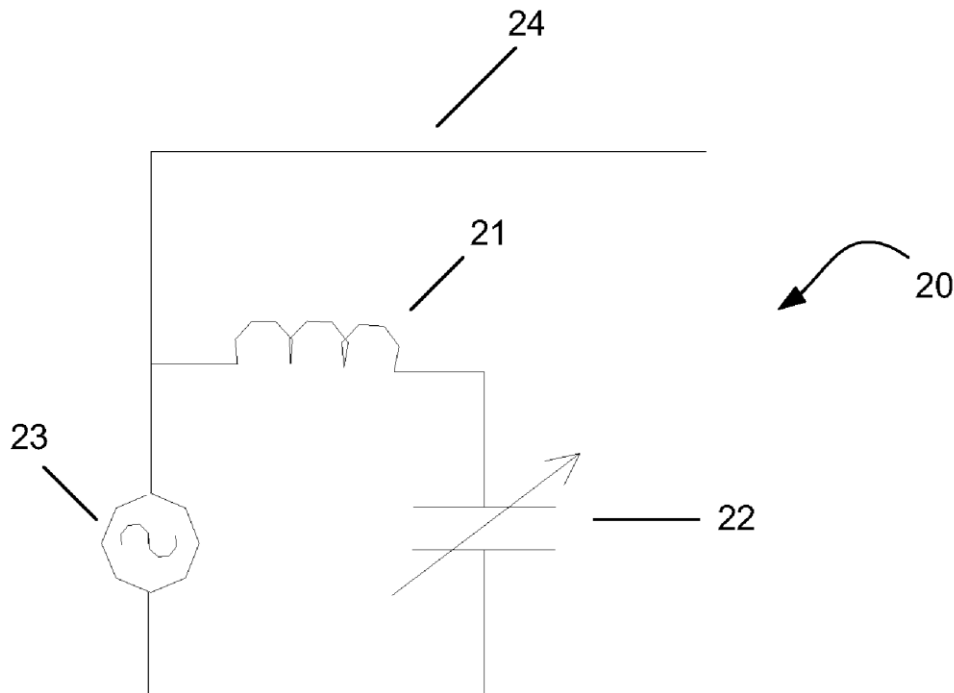
Primary Examiner—Hoang V Nguyen

(74) *Attorney, Agent, or Firm*—Coastal Patent, LLC; Joshua S. Schoonover

(57) **ABSTRACT**

An active tuned loop-coupled antenna capable of optimizing performance over incremental bandwidths and capable of tuning over a large total bandwidth to be used in wireless communications. The active loop is capable of serving as the radiating element or a radiating element can be coupled to this active loop. Multiple active tuned loops can be coupled together to extend the total bandwidth of the antenna. Active components can be incorporated into the antenna structure to provide yet additional extension of the bandwidth along with increased optimization of antenna performance over the frequency range of the antenna.

27 Claims, 10 Drawing Sheets





US007812777B2

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

(10) **Patent No.:** **US 7,812,777 B2**
(45) **Date of Patent:** **Oct. 12, 2010**

(54) **ANTENNA COIL TO BE MOUNTED ON A CIRCUIT BOARD AND ANTENNA DEVICE**

(75) Inventors: **Kuniaki Yosui**, Kanazawa (JP);
Hiroyuki Kubo, Kusatsu (JP);
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(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 351 days.

(21) Appl. No.: **11/843,901**

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

(65) **Prior Publication Data**

US 2008/0007473 A1 Jan. 10, 2008

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2007/055069, filed on Mar. 14, 2007.

(30) **Foreign Application Priority Data**

Jul. 7, 2006 (JP) 2006-187484
Jul. 20, 2006 (JP) 2006-198253
Feb. 26, 2007 (JP) 2007-045422

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

(52) **U.S. Cl.** **343/788; 343/787; 343/702**

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

See application file for complete search history.

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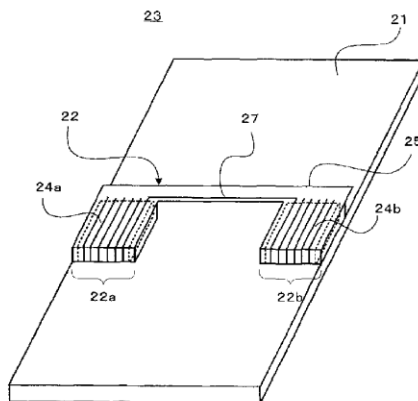
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Primary Examiner—Douglas W Owens
Assistant Examiner—Dieu Hien T Duong
(74) *Attorney, Agent, or Firm*—Keating & Bennett, LLP

(57) **ABSTRACT**

In an antenna coil including a first magnetic core, a second magnetic core, and a flexible board, coil conductors are provided on a surface of the flexible board. By winding the flexible board around the first magnetic core and the second magnetic core, a first coil portion is disposed around the first magnetic core and a second coil portion is disposed around the second magnetic core. The winding direction of the second coil portion is opposite to that of the first coil portion. The first coil portion and the second coil portion are connected to define one coil as a whole.

14 Claims, 11 Drawing Sheets





US007817093B2

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

(10) **Patent No.:** **US 7,817,093 B2**
(45) **Date of Patent:** **Oct. 19, 2010**

(54) **PORTABLE COMPUTER AND ANTENNA
DISTANCE SETTING MECHANISM**

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(75) Inventors: **Hiroaki Agata**, Yokohama (JP); **Mitsuo Horiuchi**, Sagami-hara (JP); **Hirohide Komiyama**, Zama (JP); **Shigeki Mori**, Yamato (JP); **Tetsuya Ohtani**, Yokohama (JP); **Osamu Yamamoto**, Yamato (JP)

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

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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 335 days.

(21) Appl. No.: **12/058,398**

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(22) Filed: **Mar. 28, 2008**

Primary Examiner—Trinh V Dinh

(74) Attorney, Agent, or Firm—FERENCE & ASSOCIATES LLP

(65) **Prior Publication Data**

US 2008/0238788 A1 Oct. 2, 2008

(57) **ABSTRACT**

(30) **Foreign Application Priority Data**

Mar. 28, 2007 (JP) 2007-083667

An apparatus has an antenna distance setting mechanism that sets a distance between a cosmetic cover and a radio antenna. An upper housing and a radio antenna, which has a ground and a radiating element and is movably attached to the upper housing, are covered by a cosmetic cover formed of a dielectric material. An antenna distance setting mechanism includes a radio antenna supporting member, elastic members, and protrusions. The radio antenna-supporting member is movably attached to the upper housing. When the cosmetic cover is attached to the upper housing, an inner wall of the cosmetic cover pushes the ends of the protrusions against an elastic force of the elastic members to set the distance between the radiating element and the inner wall of the cosmetic cover to a predetermined distance.

(51) **Int. Cl.**

H01Q 1/24 (2006.01)
H01Q 1/42 (2006.01)
G06F 1/16 (2006.01)

(52) **U.S. Cl.** **343/702**; 343/872; 361/679.55; 361/679.01

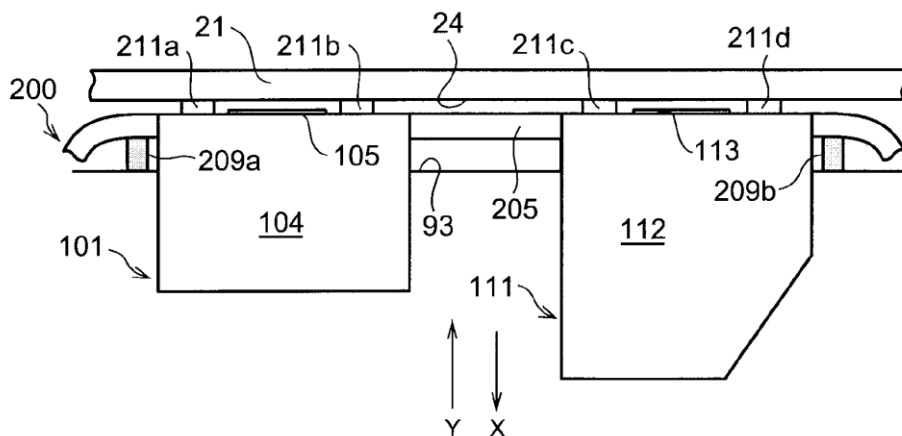
(58) **Field of Classification Search** None
See application file for complete search history.

(56) **References Cited**

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20 Claims, 4 Drawing Sheets





US007817094B2

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

(10) **Patent No.:** **US 7,817,094 B2**
(45) **Date of Patent:** **Oct. 19, 2010**

(54) **ANTENNA, AND WIRELESS MODULE, WIRELESS UNIT AND WIRELESS APPARATUS HAVING THE ANTENNA**
(75) Inventors: **Satoshi Adachi**, Yokohama (JP); **Makoto Katagishi**, Chigasaki (JP); **Ikuo Murata**, Yokohama (JP); **Masumi Iwamura**, Yokohama (JP); **Ken Takei**, Kawasaki (JP); **Takahiro Sugiyama**, Hitachi (JP); **Yohei Shirakawa**, Hitachi (JP)

(73) Assignees: **Hitachi, Ltd.**, Tokyo (JP); **Hitachi Media Electronics Co., Ltd.**, Iwate (JP); **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.

(21) Appl. No.: **12/213,318**

(22) Filed: **Jun. 18, 2008**

(65) **Prior Publication Data**
US 2008/0258984 A1 Oct. 23, 2008

Related U.S. Application Data
(62) Division of application No. 11/448,128, filed on Jun. 7, 2006, now Pat. No. 7,714,787.

(30) **Foreign Application Priority Data**
Jun. 7, 2005 (JP) 2005-166671

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
(52) **U.S. Cl.** **343/702**; 343/745; 343/750;
343/752
(58) **Field of Classification Search** 343/745,
343/702, 750, 752

See application file for complete search history.

(56) **References Cited**
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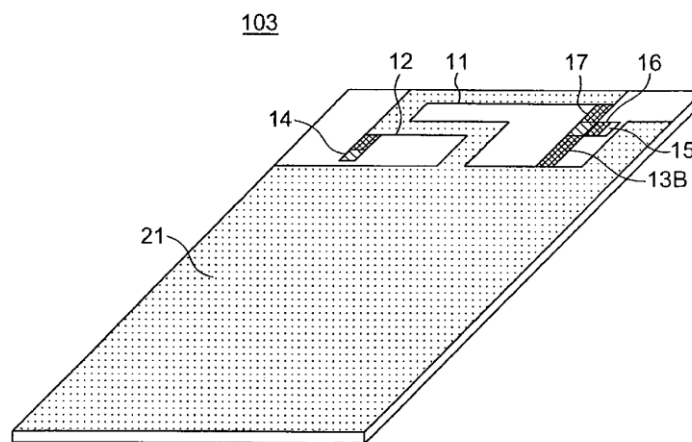
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Primary Examiner—Douglas W Owens
Assistant Examiner—Dieu Hien T Duong
(74) *Attorney, Agent, or Firm*—McDermott Will & Emery LLP

(57) **ABSTRACT**
In an antenna that has high sensitivity to frequencies of narrow bands and over a wide band and that can be small-sized, and in a wireless module, wireless unit and wireless apparatus using this antenna, the antenna is comprised of a transmission line, and variable capacitance means connected to this transmission line, and the variable capacitance means controls the resonant frequency.

2 Claims, 19 Drawing Sheets





US007817103B2

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

(10) **Patent No.:** **US 7,817,103 B2**
(45) **Date of Patent:** **Oct. 19, 2010**

(54) **DUAL-BAND MULTI-PITCH PARASITIC HALF-WAVE (MPPH) ANTENNA**

(75) Inventors: **Stephen L. Kersten**, Coral Springs, FL (US); **Ovadia Grossman**, Tel Aviv (IL); **Sooliam Ooi**, Plantation, 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 288 days.

(21) Appl. No.: **12/039,369**

(22) Filed: **Feb. 28, 2008**

(65) **Prior Publication Data**

US 2009/0219220 A1 Sep. 3, 2009

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

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

(58) **Field of Classification Search** 343/711-713, 343/700 MS, 702, 895

See application file for complete search history.

(56) **References Cited**

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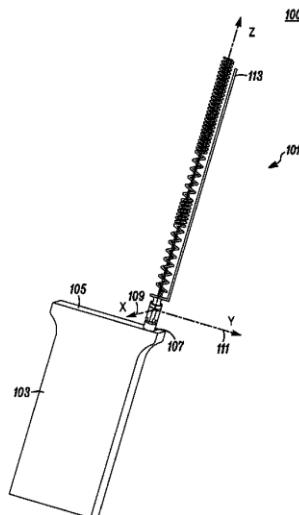
Primary Examiner—Huedung Mancuso

(74) *Attorney, Agent, or Firm*—Barbara R. Doutre

(57) **ABSTRACT**

A dual band multi-pitch helical antenna (101) includes a first section (201) positioned adjacent to the feed point having a widely spaced pitch. A second section (203) is attached to the first section (201) having a narrowly spaced pitch. A third section (205) is attached to the second section (203) having a widely spaced pitch, while a fourth section (207) is attached to the third section (205) having a narrowly spaced pitch. The antenna further includes a parasitic element (213a/213b) that is positioned adjacent to each of the first section (201), second section (203), third section (205), and fourth section (207) for enhancing broad-band antenna performance. A matching network (216) is connected between an antenna feed point and the first section (201) for matching the dual band multi-pitch helical antenna to a predetermined feed point impedance such that the antenna is resonant in at least two frequency bands.

20 Claims, 4 Drawing Sheets





US007821459B2

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

(10) **Patent No.:** **US 7,821,459 B2**
(45) **Date of Patent:** **Oct. 26, 2010**

(54) **MULTI-BAND ANTENNA**

(75) Inventors: **Wen-Fong Su**, Tu-Cheng (TW);
Chen-Ta Hung, Tu-Cheng (TW);
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(73) Assignee: **Hon Hai Precision Ind. Co., Ltd.**,
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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 414 days.

(21) Appl. No.: **11/825,891**

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

(65) **Prior Publication Data**
US 2008/0007461 A1 Jan. 10, 2008

(30) **Foreign Application Priority Data**
Jul. 10, 2006 (TW) 95125030 A

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

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

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

(56) **References Cited**

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Primary Examiner—Tho G Phan

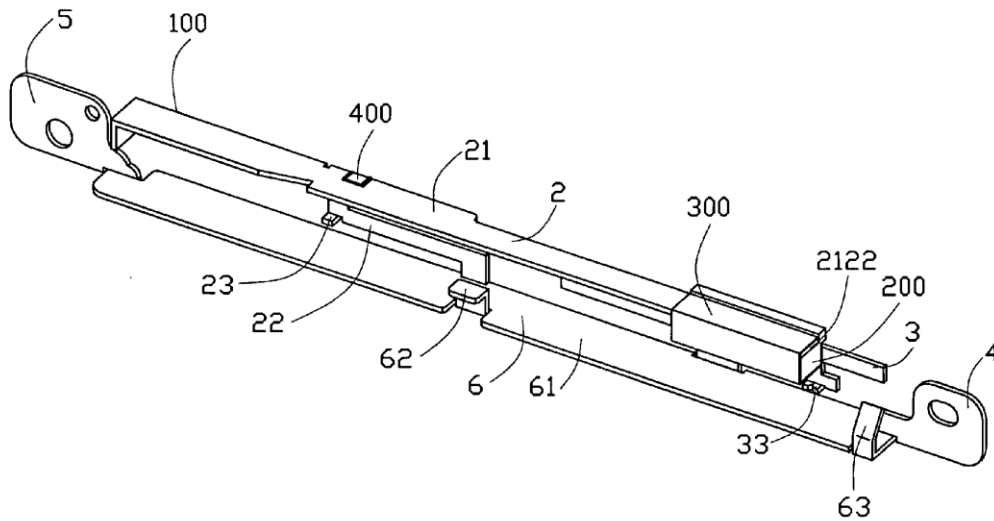
(74) *Attorney, Agent, or Firm*—Wei Te Chung; Andrew C.
Cheng; Ming Chieh Chang

(57) **ABSTRACT**

A multi-band antenna includes a radiating element having at
least two frequency bands and comprising a gap on one side
edge thereof, a grounding element coupling and being per-
pendicular to said radiating element, and a reactance
assembled to said radiating element and received in said gap.

16 Claims, 5 Drawing Sheets

1





US007821460B2

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

(10) **Patent No.:** **US 7,821,460 B2**
(45) **Date of Patent:** **Oct. 26, 2010**

(54) **TUNABLE PATCH ANTENNA OF PLANAR CONSTRUCTION**

(75) Inventors: **Gerald Schillmeier**, München (DE);
Frank Mierke, München (DE)

(73) Assignee: **Kathrein-Werke KG**, Rosenheim (DE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 94 days.

(21) Appl. No.: **11/889,842**

(22) Filed: **Aug. 16, 2007**

(65) **Prior Publication Data**

US 2008/0042915 A1 Feb. 21, 2008

(30) **Foreign Application Priority Data**

Aug. 17, 2006 (DE) 10 2006 038 528

(51) **Int. Cl.**
H01Q 5/00 (2006.01)

(52) **U.S. Cl.** **343/700 MS; 343/767; 343/825; 343/846**

(58) **Field of Classification Search** **343/745, 343/700 MS, 789, 825, 767, 846, 826**
See application file for complete search history.

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Primary Examiner—Douglas W Owens

Assistant Examiner—Jae K Kim

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

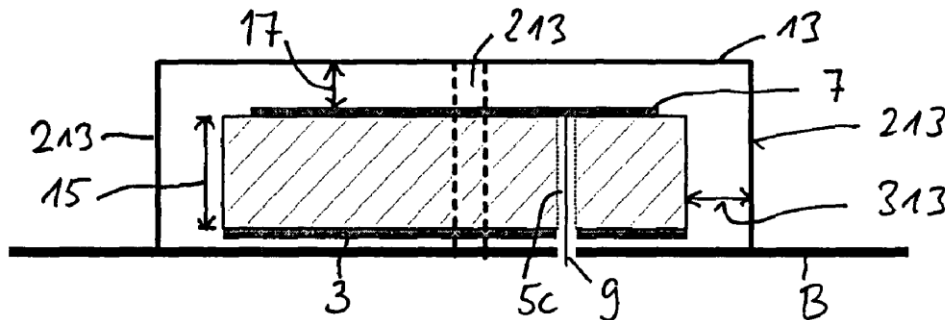
(57) **ABSTRACT**

An improved tunable antenna of planar construction is distinguished by the following features:

in plan view perpendicular to the effective surface (7), the electrically conductive structure (13, 113) completely or partially covers the effective surface (7),

the electrically conductive structure (13, 113) is coupled and/or connected galvanically or capacitively or serially and/or with interposition with at least one electrical component (125) with the ground surface (3) and/or a chassis (B) located on a potential or ground.

29 Claims, 5 Drawing Sheets





US007821461B2

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

(10) **Patent No.:** **US 7,821,461 B2**
(45) **Date of Patent:** **Oct. 26, 2010**

- (54) **ANTENNA**
- (75) Inventors: **Ming-Iu Lai**, Taipei (TW);
Chun-Hsiung Wang, Taipei (TW)
- (73) Assignee: **ASUSTek Computer Inc.**, Taipei (TW)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 358 days.
- (21) Appl. No.: **12/118,612**
- (22) Filed: **May 9, 2008**
- (65) **Prior Publication Data**
US 2008/0278381 A1 Nov. 13, 2008
- (30) **Foreign Application Priority Data**
May 10, 2007 (TW) 96116641 A
- (51) **Int. Cl.**
H01Q 1/38 (2006.01)
- (52) **U.S. Cl.** **343/700 MS; 343/846;**
343/829; 343/850; 343/865
- (58) **Field of Classification Search** None
See application file for complete search history.

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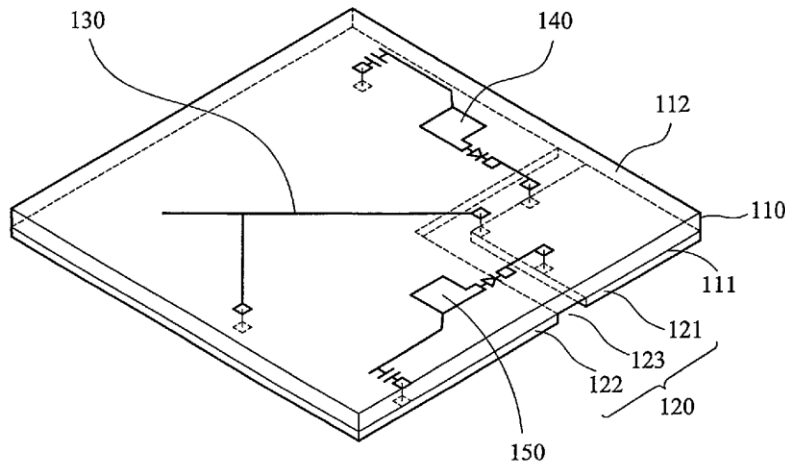
Primary Examiner—Trinh V Dinh

(57) **ABSTRACT**

An antenna includes a base plate, a grounding component, a feed-in conductor, a first controlling unit and a second controlling unit. The base plate includes a first surface and a second surface. The grounding component is provided on the first surface and includes a first part, a second part and a notch formed between the first part and the second part. The feed-in conductor is provided on the second surface and includes a first conducting part. The first conducting part extends across the notch, and is coupled to the first part. The first controlling unit is provided on the second surface and includes a first wire. The first wire extends across the notch, and is coupled to the first part. The second controlling unit is provided on the second surface and includes a second wire. The second wire extends across the notch, and is coupled to the first part.

24 Claims, 7 Drawing Sheets

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US007821467B2

(12) **United States Patent**
Sugiyama

(10) **Patent No.:** **US 7,821,467 B2**
(45) **Date of Patent:** **Oct. 26, 2010**

(54) **TUNABLE ANTENNA MODULE WITH
FREQUENCY CORRECTION CIRCUIT AND
MANUFACTURING METHOD THEREOF**

(75) Inventor: **Takahiro Sugiyama**, 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 64 days.

(21) Appl. No.: **12/195,546**

(22) Filed: **Aug. 21, 2008**

(65) **Prior Publication Data**

US 2009/0051610 A1 Feb. 26, 2009

(30) **Foreign Application Priority Data**

Aug. 22, 2007 (JP) 2007-215743

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

(52) **U.S. Cl.** **343/745**

(58) **Field of Classification Search** 343/745,
343/860, 702

See application file for complete search history.

(56) **References Cited**

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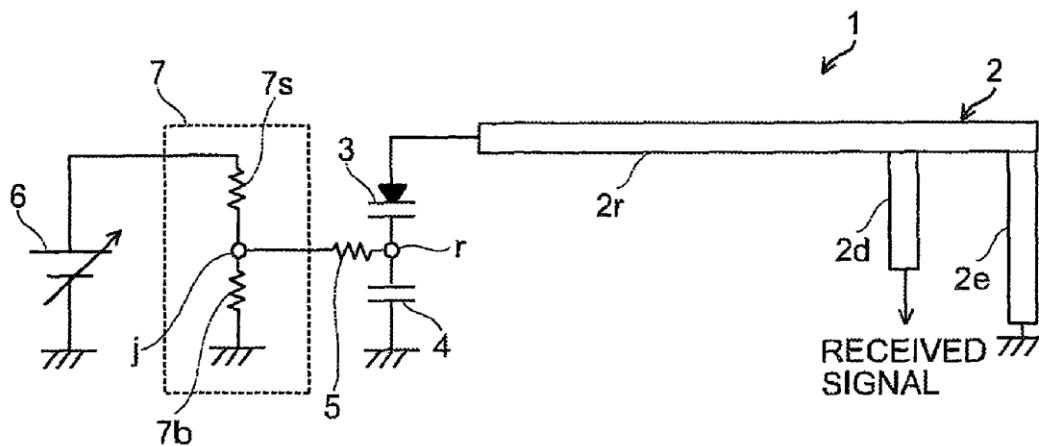
Primary Examiner—Huedung Mancuso

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

(57) **ABSTRACT**

A tunable antenna module with frequency correction circuit having an antenna element, a variable capacity means connected to the antenna element, and a frequency control source that generates a controlling voltage for varying the capacity of the variable capacity means to vary a tuning frequency according to the frequency of radio wave received by the antenna element. The module further has a voltage divider circuit comprised of resistors for dividing the controlling voltage, and connected between the frequency control source and the variable capacity means. The tuning frequency is corrected by the voltage divider circuit.

7 Claims, 4 Drawing Sheets





US007821468B2

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

(10) **Patent No.:** **US 7,821,468 B2**
(45) **Date of Patent:** **Oct. 26, 2010**

(54) **CHIP ANTENNA, AN ANTENNA DEVICE,
AND A COMMUNICATION EQUIPMENT**

(75) Inventors: **Hiroyuki Aoyama**, Kumagaya (JP);
Masayuki Gonda, Kumagaya (JP);
Sigeo Fujii, Kumagaya (JP); **Shuuichi
Takano**, Tottori (JP)

(73) Assignee: **Hitachi Metals, 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 873 days.

(21) Appl. No.: **11/690,231**

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

(65) **Prior Publication Data**
US 2007/0222689 A1 Sep. 27, 2007

(30) **Foreign Application Priority Data**
Mar. 23, 2006 (JP) 2006-081063
Apr. 24, 2006 (JP) 2006-118661
Jun. 21, 2006 (JP) 2006-171428

(51) **Int. Cl.**
H01Q 1/00 (2006.01)
H01Q 1/38 (2006.01)
(52) **U.S. Cl.** **343/787**; 343/702; 343/700 MS;
343/872

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

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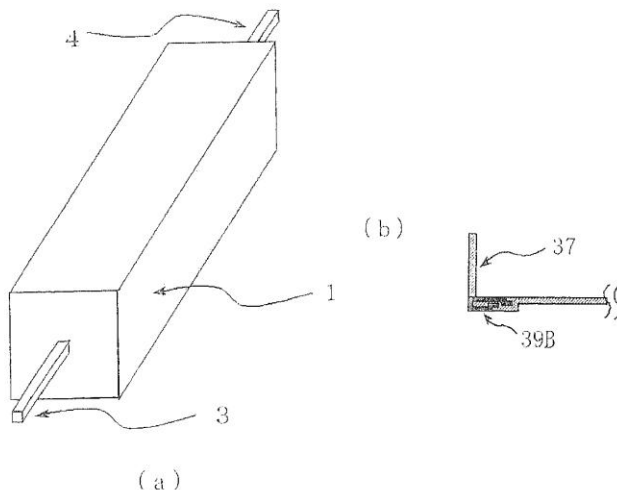
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Senterfitt

(57) **ABSTRACT**

The linear conductor **2** penetrates the magnetic base **1** along with the longitudinal direction of the magnetic base **1**. The linear conductor **2** has a straight shape. The straight shape conductor **2** is installed so that it is surrounded by outside planes of the magnetic base **1**, such as the side of a rectangular parallelepiped or a cylindrical peripheral face, and it penetrates both end sides of the magnetic base **1** in the longitudinal direction.

14 Claims, 29 Drawing Sheets





US007821469B2

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

(10) **Patent No.:** **US 7,821,469 B2**
(45) **Date of Patent:** **Oct. 26, 2010**

- (54) **PRINTED ANTENNA**
- (75) Inventors: **Zhi-Cheng Yu**, Shenzhen (CN); **Cho-Ju Chung**, Taipei Hsien (TW)
- (73) Assignees: **Hong Fu Jin Precision Industry (ShenZhen) Co., Ltd.**, Shenzhen, Guangdong Province (CN); **Hon Hai Precision Industry Co., Ltd.**, Tu-Cheng, Taipei Hsien (TW)

(58) **Field of Classification Search** 343/846, 343/848, 828, 829, 830, 831, 702, 700 MS, 343/833
See application file for complete search history.

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(21) Appl. No.: **12/206,725**

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

(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
Apr. 16, 2008 (CN) 2008 1 0301147

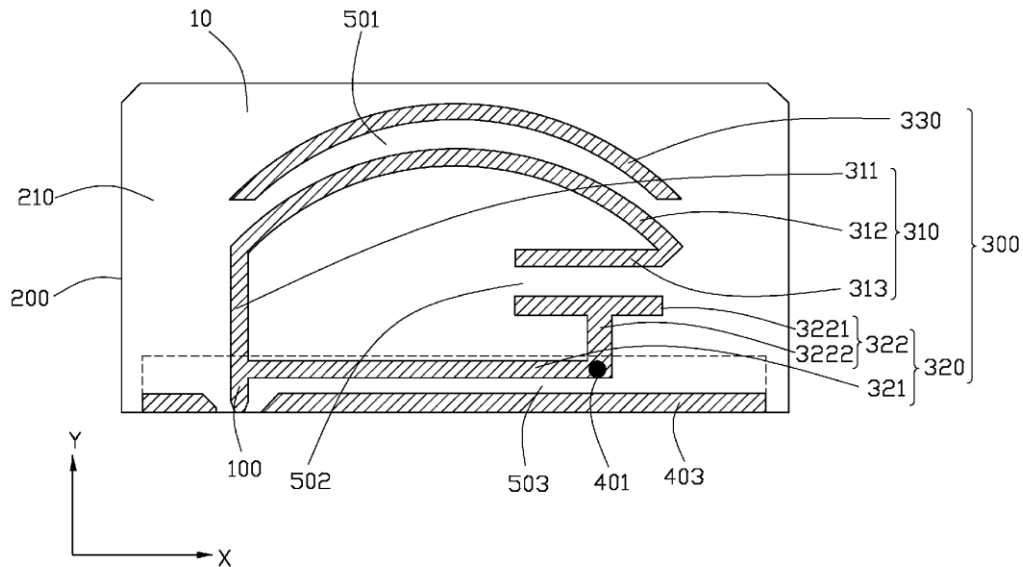
(51) **Int. Cl.**
H01Q 1/38 (2006.01)

(52) **U.S. Cl.** **343/828**; 343/829; 343/833

(57) **ABSTRACT**

A printed antenna is positioned on a substrate, and includes a feeding portion and a radiating portion. The feeding portion is configured for feeding electromagnetic signals. The radiating portion is electronically connected to the feeding portion for transceiving the electromagnetic signals, and includes a first radiator, a second radiator, and a guiding portion. The first radiator is electronically connected to the feeding portion, and includes an arc-shaped radiating section. The second radiator is electronically connected to the feeding portion and the first radiator. The guiding portion is arc-shaped. The guiding portion and the second radiator are respectively positioned on different sides of the first radiator. A space between the guiding portion and the arc-shaped radiating section of the first radiator defines a first slot.

12 Claims, 5 Drawing Sheets





US007821470B2

(12) **United States Patent**
Azhari

(10) **Patent No.:** **US 7,821,470 B2**
(45) **Date of Patent:** **Oct. 26, 2010**

- (54) **ANTENNA ARRANGEMENT**
- (75) Inventor: **Alexander Azhari**, Stockholm (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 103 days.

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(74) Attorney, Agent, or Firm—Harrity & Harrity, LLP

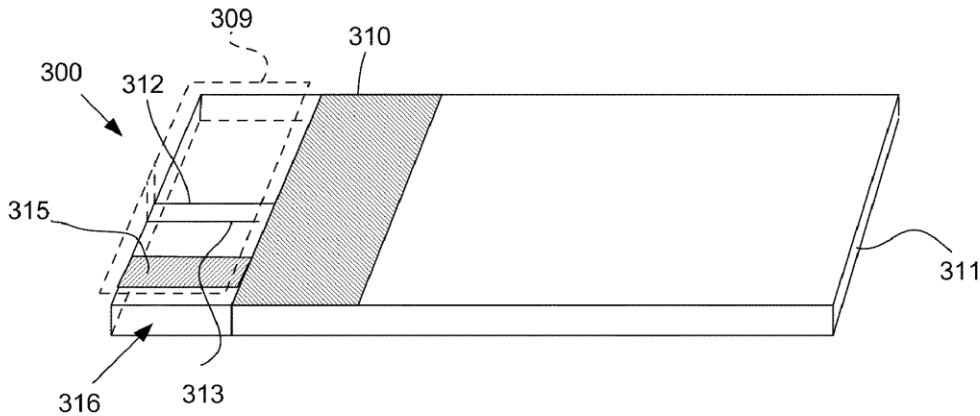
- (21) Appl. No.: **12/175,784**
- (22) Filed: **Jul. 18, 2008**
- (65) **Prior Publication Data**
US 2010/0013714 A1 Jan. 21, 2010
- (51) **Int. Cl.**
H01Q 1/38 (2006.01)
- (52) **U.S. Cl.** **343/846**; 343/700 MS;
343/833
- (58) **Field of Classification Search** 343/702,
343/834, 846, 700 MS, 833
See application file for complete search history.

(57) **ABSTRACT**

An antenna for a wireless communication may include a ground plane provided on a carrying structure, a feed element, and a radiating element coupled to the feed element, the radiating element being substantially parallel to and vertically displaced from the ground plane by the feed element and a shortening element. The antenna may also include a parasitic element provided directly on the carrying structure as part of the carrying structure ground layer.

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6 Claims, 3 Drawing Sheets





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

(10) **Patent No.:** **US 7,821,471 B2**
(45) **Date of Patent:** **Oct. 26, 2010**

(54) **ASYMMETRICAL FLAT ANTENNA, METHOD OF MANUFACTURING THE ASYMMETRICAL FLAT ANTENNA, AND SIGNAL-PROCESSING UNIT USING THE SAME**

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(73) Assignee: **Sony 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 302 days.

(21) Appl. No.: **11/677,286**

(22) Filed: **Feb. 21, 2007**

(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
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(51) **Int. Cl.**
H01Q 1/50 (2006.01)
H01Q 1/38 (2006.01)

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

(58) **Field of Classification Search** 343/700 MS, 343/702, 893, 850, 853, 860, 862, 863, 864, 343/846

See application file for complete search history.

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

(57) **ABSTRACT**

An asymmetrical flat antenna contains an insulation layer. The antenna also contains a conductive power supply pattern that is provided on the insulation layer and a conductive antenna pattern that extends from the power supply pattern and is provided on the insulation layer. The conductive antenna pattern has an asymmetrical configuration with respect to the power supply pattern.

20 Claims, 32 Drawing Sheets

