



US007934308B2

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

(10) **Patent No.:** **US 7,934,308 B2**
(45) **Date of Patent:** **May 3, 2011**

(54) **METHOD FOR MAKING A WAVEGUIDE
MICROWAVE ANTENNA**

(75) Inventors: **Ali Louzir**, Rennes (FR); **Dominique Lo Hine Tong**, Rennes (FR); **Florent Averty**, Rennes (FR); **Christian Person**, Locmaria Plouzané (FR); **Jean-Philippe Coupez**, Le Relecq Kerhuon (FR)

(73) Assignee: **Thomson Licensing**, Boulogne-Billcourt (FR)

(*) 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.: **10/529,934**

(22) PCT Filed: **Oct. 1, 2003**

(86) PCT No.: **PCT/FR03/50071**

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(2), (4) Date: **Nov. 2, 2006**

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(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**
H01P 11/00 (2006.01)

(52) **U.S. Cl.** **29/600**; 343/786; 264/334

(58) **Field of Classification Search** 29/600,
29/601, 830, 831; 343/876, 772, 872, 784,
343/700 MS; 264/219, 334

See application file for complete search history.

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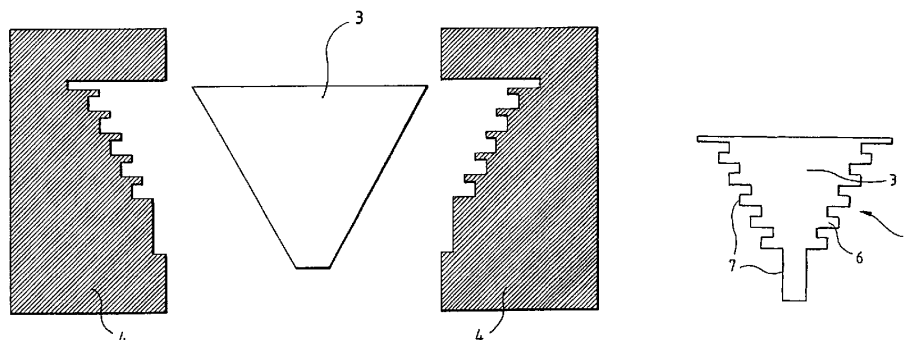
Primary Examiner — Minh Trinh

(74) *Attorney, Agent, or Firm* — Robert D. Shedd; Joseph J. Opalch; Brian J. Cromarty

(57) **ABSTRACT**

The invention concerns a method for making a waveguide microwave antenna with corrugated horn, which consists in forming the corrugations of the horn on the outer surface of a synthetic material form block followed by surface metallization of the foam block configured to produce the antenna.

2 Claims, 2 Drawing Sheets



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US007936306B2

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

(10) **Patent No.:** **US 7,936,306 B2**
(45) **Date of Patent:** ***May 3, 2011**

(54) **MULTILAYER ANTENNA ARRANGEMENT**

(75) Inventors: **Frank Mierke**, München (DE); **Gerald Schillmeier**, München (DE); **Thomas Lankes**, Rosenheim (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 437 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/236,181**

(22) Filed: **Sep. 23, 2008**

(65) **Prior Publication Data**

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

(52) **U.S. Cl.** **343/700 MS; 343/711; 343/713**

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

See application file for complete search history.

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Primary Examiner — Douglas W Owens

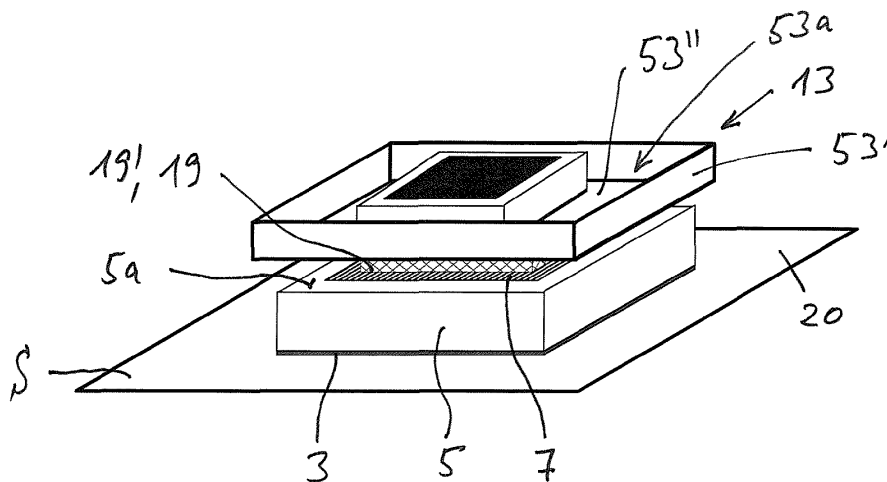
Assistant Examiner — Dieu Hien T Duong

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

(57) **ABSTRACT**

A multilayer antenna arrangement is distinguished in particular by the following features: a further patch antenna (B) comprising a dielectric carrier and a radiation plane is provided above the base portion or central portion of the patch arrangement, the radiation plane being provided on the upper side, opposite the base portion or central portion, of the dielectric carrier, and the further patch antenna (B) is buried at least in part in the parasitic patch arrangement, which is configured so as to be box-shaped or box-like, and/or the parasitic patch arrangement which is configured so as to be box-shaped or box-like is formed, completely or in part, as electrically conductive planes, which are provided on the further patch antenna (B) at least in partial regions on the circumferential edge surface or outer surface thereof.

15 Claims, 8 Drawing Sheets



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US007936307B2

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

(10) **Patent No.:** **US 7,936,307 B2**
(45) **Date of Patent:** **May 3, 2011**

(54) **COVER ANTENNAS**

(75) Inventors: **Hawk Yin Pang**, Tokyo (JP); **Jani Ollikainen**, Helsinki (FI); **Marko Leinonen**, Haukipudas (FI)

(73) Assignee: **Nokia Corporation**, Espoo (FI)

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

(21) Appl. No.: **11/492,677**

(22) Filed: **Jul. 24, 2006**

(65) **Prior Publication Data**

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

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

(58) **Field of Classification Search** 343/700 MS, 343/702, 713, 850, 853, 860, 767, 790, 858, 343/859, 846, 770; 455/575.7

See application file for complete search history.

(56) **References Cited**

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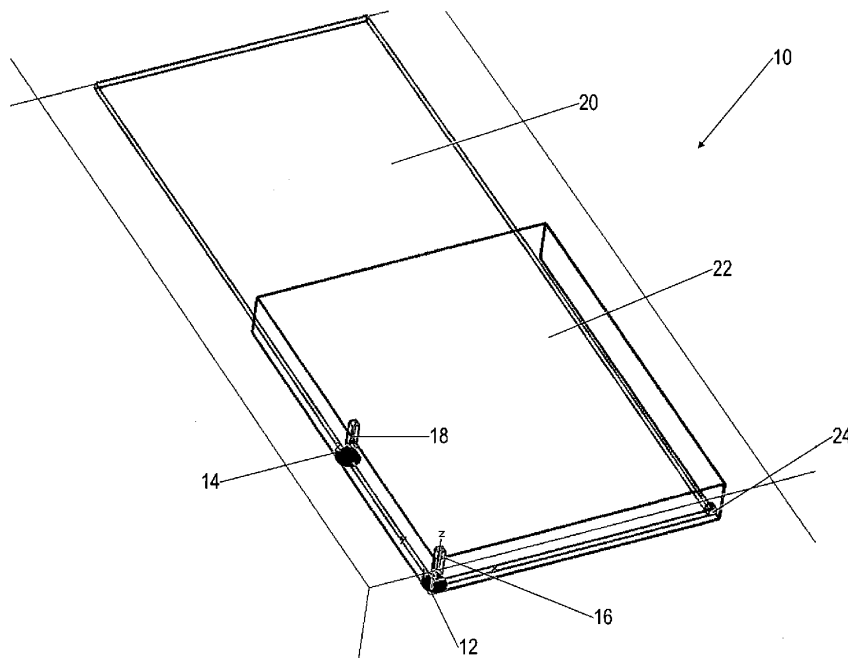
Primary Examiner — Douglas W Owens

Assistant Examiner — Chuc D Tran

(57) **ABSTRACT**

The specification and drawings present a new apparatus, method and software product for using a cover antenna (e.g., conductive, metallic, etc.) in an electronic device, with multiple coupled feeds (e.g., dual feed) to the antenna and with one or more switches and a matching circuit. Then it is possible to use a metal plate as a metal cover, e.g., for mobile devices, which will act as an antenna with multiple feedings for cellular and non-cellular radios.

29 Claims, 5 Drawing Sheets



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US007936308B2

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

(10) **Patent No.:** **US 7,936,308 B2**
(45) **Date of Patent:** ***May 3, 2011**

(54) **LOW PROFILE FULL WAVELENGTH
MEANDERING ANTENNA**

(75) Inventors: **Yihong Qi**, Waterloo (CA); **Perry Jarmuszewski**, Waterloo (CA); **Ying Tong Man**, 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 195 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/337,690**

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

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. 11/014,287, filed on Dec. 16, 2004, now Pat. No. 7,486,241.

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

(52) **U.S. Cl.** **343/702**; 343/741; 343/828

(58) **Field of Classification Search** 343/700 MS, 343/702, 731, 741, 744, 806, 825, 828, 895
See application file for complete search history.

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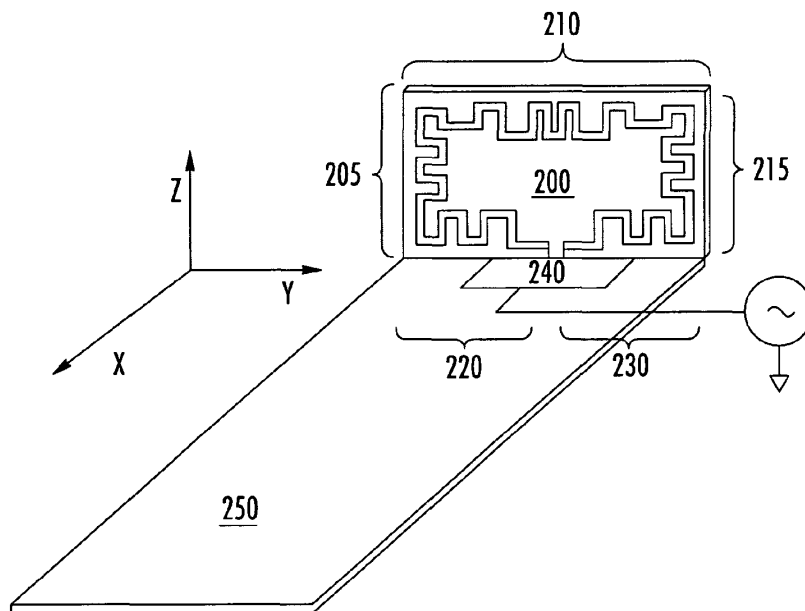
Primary Examiner — Michael C Wimer

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

(57) **ABSTRACT**

A low profile antenna has a meander length based on the full electrical wavelength of the signal being transmitted or received. The antenna can have either an open-loop structure or a closed-loop structure with a matching network. The low profile enables the antenna to be used in a card for a device such as a personal computer, personal digital assistant, wireless telephone and so on with minimal risk of the antenna breaking off, as compared with a prior art antenna having a higher height and thus more likelihood of being broken from its card.

17 Claims, 13 Drawing Sheets



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US007936314B2

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

(10) **Patent No.:** **US 7,936,314 B2**
(45) **Date of Patent:** **May 3, 2011**

(54) **DUAL POLARIZED ANTENNA**

(56) **References Cited**

(75) Inventors: **Akio Kuramoto**, Minato-ku (JP);
Hiroyuki Yusa, Minato-ku (JP)

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

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(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
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Primary Examiner — Michael C Wimer

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

(21) Appl. No.: **12/305,540**

(22) PCT Filed: **Apr. 11, 2008**

(86) PCT No.: **PCT/JP2008/057136**

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(2), (4) Date: **Dec. 18, 2008**

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PCT Pub. Date: **Nov. 6, 2008**

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(30) **Foreign Application Priority Data**

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H01Q 1/38 (2006.01)
H01Q 21/24 (2006.01)

(52) **U.S. Cl.** **343/826**; 343/725; 343/728; 343/853

(58) **Field of Classification Search** 343/700 MS,
343/725, 728, 729, 795, 797, 826, 828, 829,
343/831, 844, 853, 893

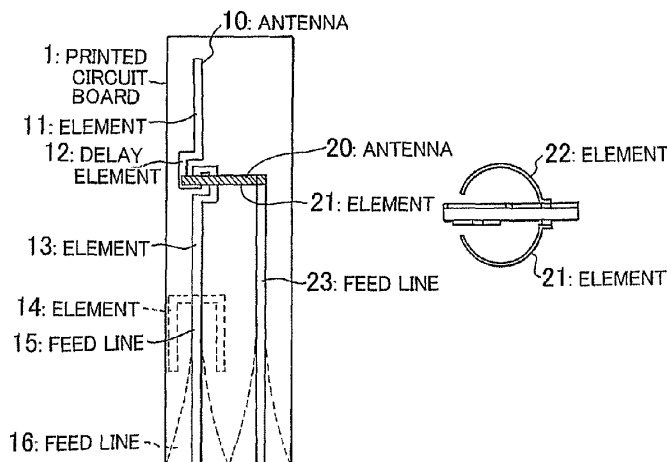
See application file for complete search history.

ABSTRACT

To provide a dual polarized antenna capable of reducing correlation between antenna elements.

A dual polarized antenna is constituted by a vertically polarized antenna and a horizontally polarized antenna formed on a printed circuit board and radiates two kinds of polarized waves. The vertically polarized antenna has a configuration in which: a first microstripline is extended along the longitudinal direction of the printed circuit board from the lower portion of the printed circuit board; a first conductive radiating element is disposed at one end of the first microstripline; a phase delay circuit is serially connected to the first conductive radiating element; a second conductive radiating element is added to one end of the phase delay circuit; and a third conductive radiating element is added to a ground conductor which is disposed on the rear side of the surface of the printed circuit board on which the first conductive radiating element and first microstripline are connected at a corresponding portion thereof.

13 Claims, 5 Drawing Sheets



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US007936315B2

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

(10) **Patent No.:** **US 7,936,315 B2**
(45) **Date of Patent:** **May 3, 2011**

(54) **ANTENNA SYSTEM AND METHOD FOR MAKING THE SAME**

(75) Inventors: **Chao-Hui Yu**, Tu-Cheng (TW);
Hung-Jen Chen, Tu-Cheng (TW);
Yu-Yuan Wu, Tu-Cheng (TW)

(73) Assignee: **Cheng Uei 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 345 days.

(21) Appl. No.: **12/242,235**

(22) Filed: **Sep. 30, 2008**

(65) **Prior Publication Data**

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(51) **Int. Cl.**
H01Q 1/50 (2006.01)

(52) **U.S. Cl.** **343/850; 343/852; 343/876**

(58) **Field of Classification Search** 343/850,
343/852, 876; 455/134, 142, 143, 550.1,
455/556.1, 557

See application file for complete search history.

(56) **References Cited**

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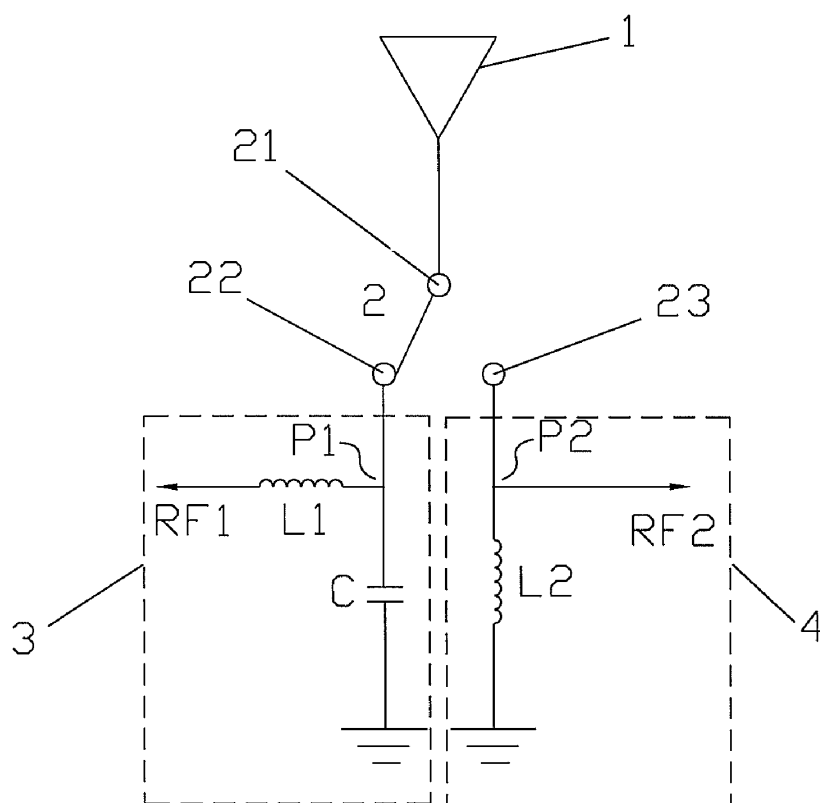
Primary Examiner — Hoang V Nguyen

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

(57) **ABSTRACT**

An antenna system adapted for a communication device has a common antenna with a predetermined length, an AM matching circuit matching with the common antenna and an FM matching circuit matching with the common antenna. A switch alternatively electrically connects the common antenna to the AM matching circuit and the FM matching circuit for achieving the AM function and FM function.

4 Claims, 7 Drawing Sheets



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US007936316B2

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

(10) **Patent No.:** **US 7,936,316 B2**
(45) **Date of Patent:** **May 3, 2011**

(54) **SMART ANTENNA**

(56) **References Cited**

(75) Inventors: **Nobuo Nakajima**, Tokyo (JP); **Koichi Gyoda**, Tokyo (JP); **Eiji Shibuya**, Kobe (JP); **Takehiro Onomatsu**, Osaka (JP); **Hideto Yoshimura**, Osaka (JP)
(73) Assignees: **Funai Electric Co., Ltd.**, Daito-shi, Osaka (JP); **The University of Electro-Communications**, Choufu-shi, Tokyo (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 153 days.

(21) Appl. No.: **12/156,158**

(22) Filed: **May 31, 2008**

(65) **Prior Publication Data**
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Primary Examiner — Michael C Wimer

(74) Attorney, Agent, or Firm — Yokoi & Co., U.S.A., Inc.;
Toshiyuki Yokoi

(30) **Foreign Application Priority Data**

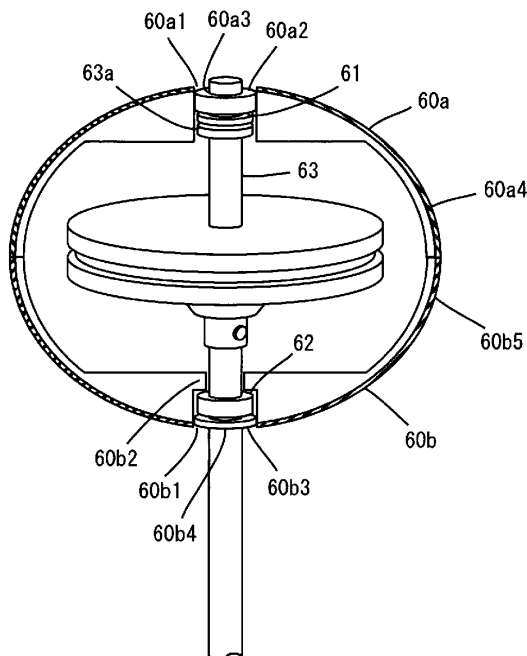
Jun. 15, 2007 (JP) 2007-158680

(57) **ABSTRACT**

The present invention discloses a smart antenna that includes: a switch unit that switches a direction for receiving radio waves; and an outer covering unit that covers the smart antenna and is made of an insulating material.

(51) **Int. Cl.**
H01Q 1/42 (2006.01)
(52) **U.S. Cl.** **343/872**
(58) **Field of Classification Search** 343/702,
343/833, 834, 761, 872, 757, 763, 880, 882
See application file for complete search history.

7 Claims, 7 Drawing Sheets



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US007936317B2

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

(10) **Patent No.:** **US 7,936,317 B2**
(45) **Date of Patent:** **May 3, 2011**

(54) **TELEVISION RECEIVING APPARATUS**

(56) **References Cited**

(75) Inventors: **Nobuo Nakajima**, Tokyo (JP); **Koichi Gyoda**, Tokyo (JP); **Eiji Shibuya**, Kobe (JP); **Takehiro Onomatsu**, Osaka (JP); **Hidetoshi Yoshimura**, Osaka (JP)

(73) Assignees: **Funai Electric Co., Ltd.**, Daito-shi, Osaka (JP); **The University of Electro-Communications**, Choufu-shi, Tokyo (JP); **DX Antenna Company, Limited**, Kobe-shi, Hyogo-ken (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 350 days.

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

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

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H01Q 1/24 (2006.01)
H01Q 1/12 (2006.01)

(52) **U.S. Cl.** **343/878**; 343/702; 343/872; 343/883

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

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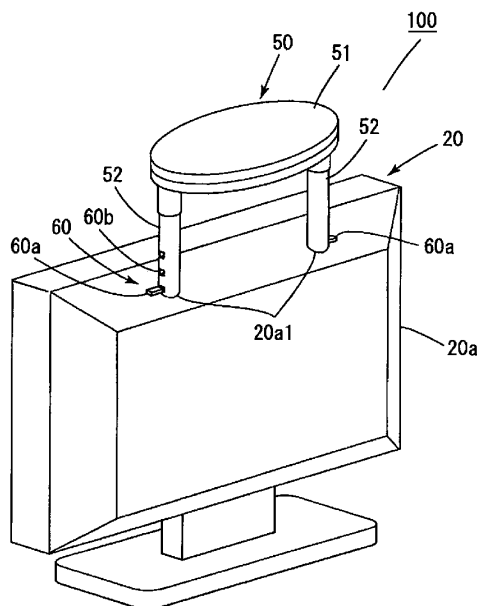
Primary Examiner — Trinh V Dinh

(74) *Attorney, Agent, or Firm* — Yokoi & Co., U.S.A., Inc.; Toshiyuki Yokoi

(57) **ABSTRACT**

A television receiving apparatus **100** includes a television receiver **20**, and a smart antenna **10** having directivity capable of being electrically changed so as to match radio waves to be received. A handle **50** is provided with a mechanism holding the smart antenna **10** therein, fixed to the television receiver **20** and capable of changing the distance between the smart antenna **10** and the television receiver **20** as an antenna holding box. The antenna having directivity capable of being electrically changed so as to match with radio waves to be received is disposed so that the aesthetic appearance can be improved and the signal receiving sensitivity of the antenna can be enhanced.

5 Claims, 6 Drawing Sheets



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US007936318B2

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

(10) **Patent No.:** **US 7,936,318 B2**
(45) **Date of Patent:** **May 3, 2011**

(54) **ANTENNA WITH MULTIPLE FOLDS**

(75) Inventors: **Philip Pak-Lin Kwan**, Beaverton, OR (US); **Paul Beard**, Milpitas, CA (US)

(73) Assignee: **Cypress Semiconductor Corporation**, San Jose, CA (US)

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

(21) Appl. No.: **11/048,999**

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

(65) **Prior Publication Data**

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

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

(58) **Field of Classification Search** 343/700 MS, 343/702, 803, 804, 895
See application file for complete search history.

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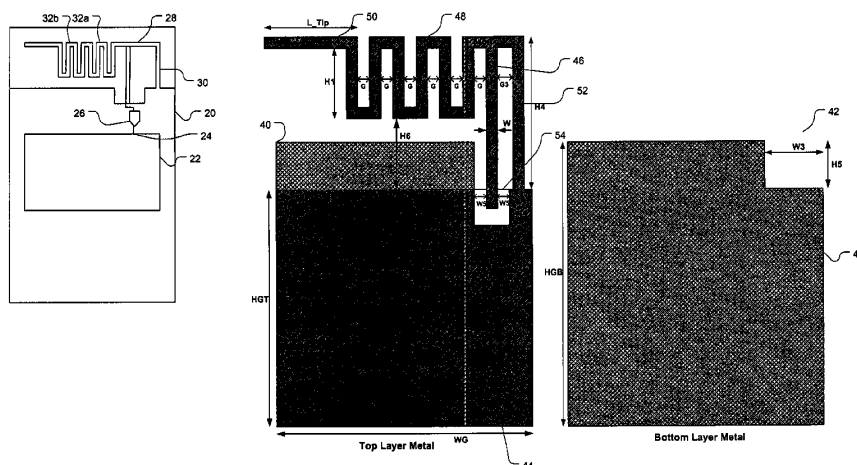
Primary Examiner — Douglas W Owens

Assistant Examiner — Minh D A

(57) **ABSTRACT**

A wireless device has a module with a communications port and an antenna electrically coupled to the communications port, the antenna having multiple folds. The antenna has a shunt stub connected to a ground plane and a radiating portion that has multiple folds, or wiggles, allowing good electrical performance to be achieved with a minimal size.

18 Claims, 6 Drawing Sheets



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US007940217B2

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

(10) **Patent No.:** **US 7,940,217 B2**
(45) **Date of Patent:** **May 10, 2011**

(54) **TREE TRUNK ANTENNA**

(75) Inventors: **John Howard**, Upper Mount Bethal, PA (US); **Charilaos Paraskevaidis**, East Hanover, NJ (US)

(73) Assignee: **ET Industries, Inc.**, Boonton, NJ (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 120 days.

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(21) Appl. No.: **12/200,329**

Primary Examiner — Hoang V Nguyen

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

(74) Attorney, Agent, or Firm — Hoffman & Baron, LLP

(65) **Prior Publication Data**

US 2009/0058753 A1 Mar. 5, 2009

Related U.S. Application Data

(60) Provisional application No. 60/967,043, filed on Aug. 31, 2007.

(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, 841

See application file for complete search history.

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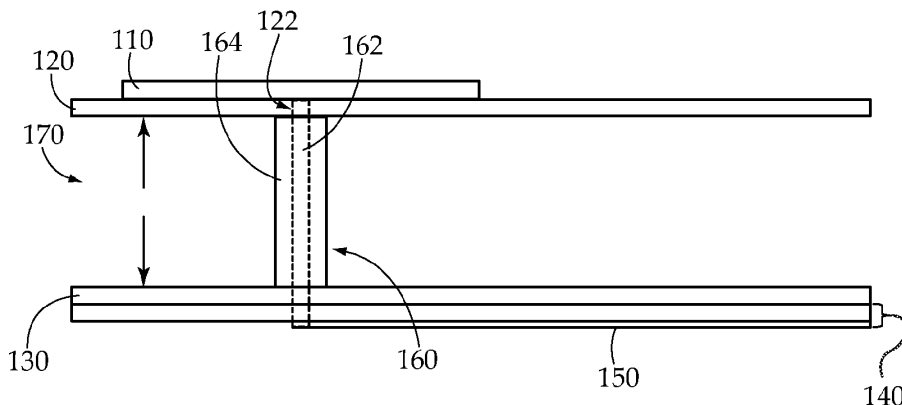
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(57) **ABSTRACT**

Embodiments of the present invention include a patch antenna having a patch element, a ground plane, a feedline, and an electromagnetic shield. The patch element transmitting and/or receives electromagnetic signals. The ground plane is spaced at a specified distance from the patch element. The feedline guides the electromagnetic signal and extends through an opening in the ground plane and to the patch element. The feedline is electrically coupled to the patch element to guide an electromagnetic signal to or from the patch element. The electromagnetic shield extends, at least partially, between the ground plane and the patch element and is electrically coupled to the ground plane. The electromagnetic shield is configured to control an impedance associated with the feedline between the ground plane and the patch element.

19 Claims, 2 Drawing Sheets



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US007940218B2

(12) **United States Patent**
Jansen

(10) **Patent No.:** **US 7,940,218 B2**
(45) **Date of Patent:** ***May 10, 2011**

(54) **MULTILAYER PCB ANTENNA**

(75) Inventor: **Stefan Jansen**, Valby (DK)

(73) Assignee: **Nokia Corporation**, Espoo (FI)

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

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **10/084,981**

(22) Filed: **Mar. 1, 2002**

(65) **Prior Publication Data**

US 2002/0122007 A1 Sep. 5, 2002

(30) **Foreign Application Priority Data**

Mar. 2, 2001 (GB) 0105251.3

Mar. 5, 2001 (GB) 0105413.9

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

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

(58) **Field of Classification Search** 343/741,
343/742, 702, 700 MS, 795, 726, 826, 893,
343/895, 846

See application file for complete search history.

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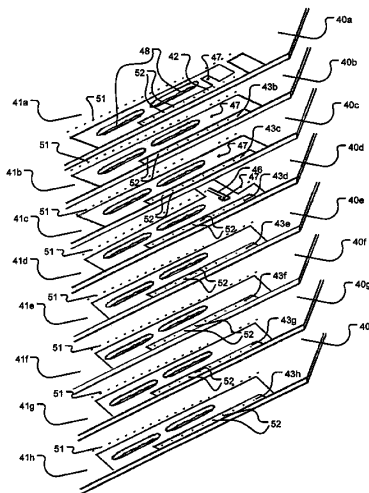
Primary Examiner — Michael C Wimer

(74) *Attorney, Agent, or Firm* — Harrington & Smith

(57) **ABSTRACT**

An antenna may include an element formed from conductor patterns on a plurality of layers including at least one buried layer of a multilayer PCB. The conductor patterns are in stacked relation and interconnected through the PCB. A mobile phone may include such an antenna.

60 Claims, 3 Drawing Sheets



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US007940219B2

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

(10) **Patent No.:** **US 7,940,219 B2**
(45) **Date of Patent:** **May 10, 2011**

(54) **ANTENNA, METHOD OF ADJUSTING
RESONANCE FREQUENCY THEREOF, AND
WIRELESS COMMUNICATION DEVICE**

(75) Inventors: **Kouji Soekawa**, Kawasaki (JP); **Masaru
Kanazawa**, Kawasaki (JP)

(73) Assignee: **Fujitsu Limited**, Kawasaki (JP)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 741 days.

(21) Appl. No.: **11/378,285**

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

(65) **Prior Publication Data**

US 2007/0146213 A1 Jun. 28, 2007

(30) **Foreign Application Priority Data**

Dec. 28, 2005 (JP) 2005-379367

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 5/01 (2006.01)

(52) **U.S. Cl.** **343/702**; 343/826

(58) **Field of Classification Search** 343/700 MS,
343/702, 795, 846, 833, 729, 730, 826, 828,
343/829

See application file for complete search history.

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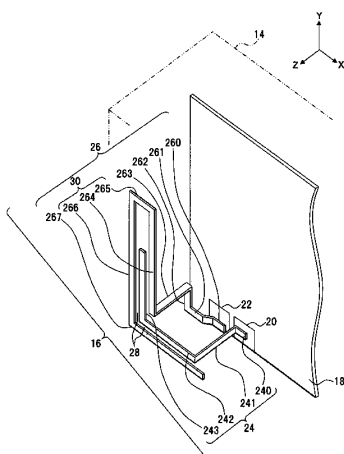
Primary Examiner — Michael C Wimer

(74) *Attorney, Agent, or Firm* — Fujitsu Patent Center

(57) **ABSTRACT**

An antenna adaptable to a plurality of frequencies is com-
prised of a first element that is connected to a feeding point
(feeding portion) for operation and a second element that is
connected to a grounding point (grounding portion) in prox-
imity to the first element to be operated by coupling feeding
with the first element and is configured to be operated at either
or both of a first frequency and a second frequency higher than
the first frequency.

10 Claims, 34 Drawing Sheets



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US007940221B2

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

(10) **Patent No.:** **US 7,940,221 B2**
(45) **Date of Patent:** **May 10, 2011**

(54) **ELECTRONIC DEVICE AND TELESCOPIC ANTENNA MODULE**

(75) Inventors: **Hen-An Chen**, Taipei (TW); **Chih-Ming Wang**, Taipei (TW)

(73) Assignee: **Wistron NeWeb Corp.**, Hsinchu (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 385 days.

(21) Appl. No.: **12/336,446**

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

(65) **Prior Publication Data**

US 2009/0256760 A1 Oct. 15, 2009

(30) **Foreign Application Priority Data**

Apr. 10, 2008 (TW) 97112996 A

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

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

(58) **Field of Classification Search** 343/702,
343/848, 906
See application file for complete search history.

(56) **References Cited**

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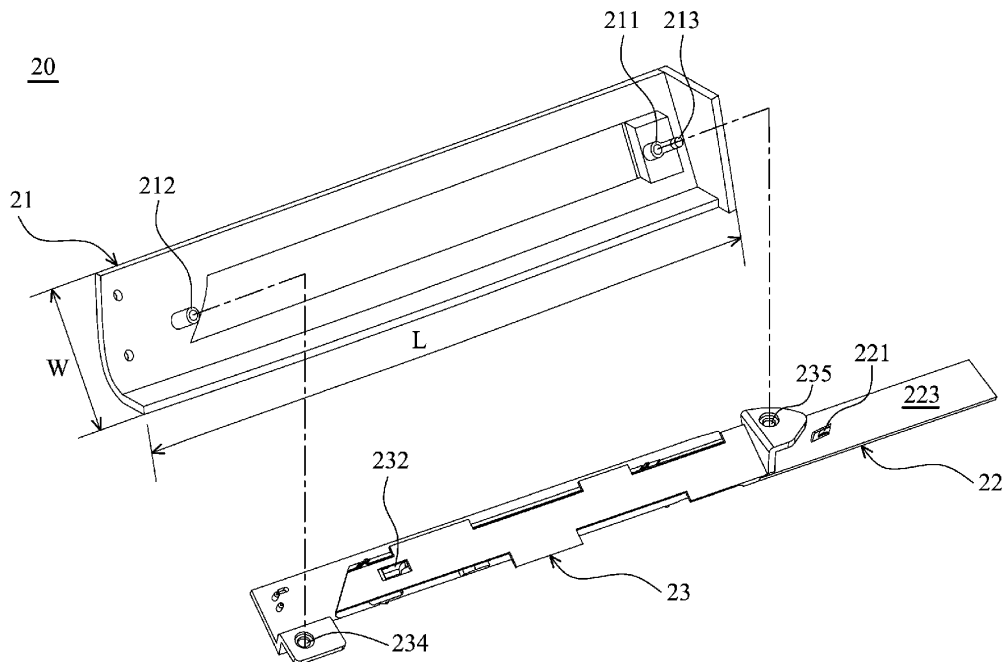
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Primary Examiner — Tan Ho

(57) **ABSTRACT**

An electronic device and a telescopic antenna module are disclosed. The electronic device includes a housing and the telescopic antenna module. The telescopic antenna module includes an antenna with a ground terminal, a telescopic support with a sliding mechanism and an antenna module shell. The antenna is movably connected to the sliding mechanism. The antenna module shell is made of conductive material. The antenna is connected to the antenna module shell via the ground terminal for ground connection.

14 Claims, 5 Drawing Sheets



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US007940223B2

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

(10) **Patent No.:** **US 7,940,223 B2**
(45) **Date of Patent:** ***May 10, 2011**

(54) **INTERNAL DIVERSITY ANTENNA
ARCHITECTURE**

(75) Inventors: **Weiping Dou**, Milpitas, CA (US);
Stephen Senatore, So. San Francisco,
CA (US); **Arthur Zarnowitz**, San Jose,
CA (US)

(73) Assignee: **Hewlett-Packard Development
Company L.P.**, Houston, TX (US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 16 days.

This patent is subject to a terminal dis-
claimer.

(21) Appl. No.: **12/434,434**

(22) Filed: **May 1, 2009**

(65) **Prior Publication Data**

US 2009/0295651 A1 Dec. 3, 2009

Related U.S. Application Data

(63) Continuation of application No. 11/361,860, filed on
Feb. 24, 2006, now Pat. No. 7,548,208.

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

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

(58) **Field of Classification Search** 343/702,
343/725, 700 MS, 749-751, 729, 847
See application file for complete search history.

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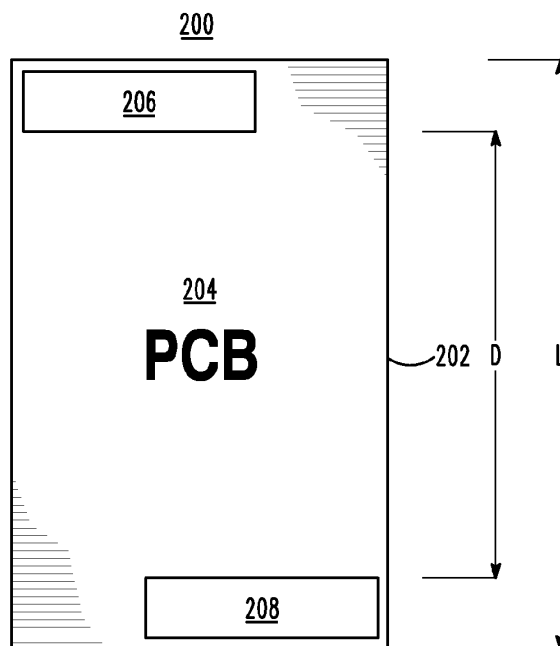
Primary Examiner — Huedung Mancuso

(74) *Attorney, Agent, or Firm* — Kacvinsky Daisak PLLC

(57) **ABSTRACT**

Various embodiments of an internal diversity antenna archi-
tecture are described. In one embodiment, a wireless device
may include a housing enclosing a printed circuit board, a first
diversity antenna, and a second diversity antenna internal to
the housing. The second diversity antenna may be positioned
substantially near the bottom of the housing or the bottom the
printed circuit board. Other embodiments are described and
claimed.

25 Claims, 4 Drawing Sheets



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US007940226B2

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

(10) **Patent No.:** **US 7,940,226 B2**
(45) **Date of Patent:** **May 10, 2011**

(54) **SURFACE-MOUNT ANTENNA AND
ANTENNA DEVICE**

7,675,729 B2 * 3/2010 Anthony et al. 361/118
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(75) Inventors: **Nobuhito Tsubaki**, Sagamihara (JP);
Kazunari Kawahata, Yokohama (JP)

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

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 342 days.

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(21) Appl. No.: **12/331,564**

(22) Filed: **Dec. 10, 2008**

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(65) **Prior Publication Data**

US 2009/0109106 A1 Apr. 30, 2009

Written Opinion issued Sep. 4, 2007 with English-language translation.

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Related U.S. Application Data

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filed on Jun. 6, 2007.

Primary Examiner — Huedung Mancuso

(74) Attorney, Agent, or Firm — Ostrolenk Faber LLP

(30) **Foreign Application Priority Data**

Jun. 12, 2006 (JP) 2006-162913

(57) **ABSTRACT**

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

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

(58) **Field of Classification Search** 343/745;
343/745 MS, 702, 850; 361/188; 455/41.1
See application file for complete search history.

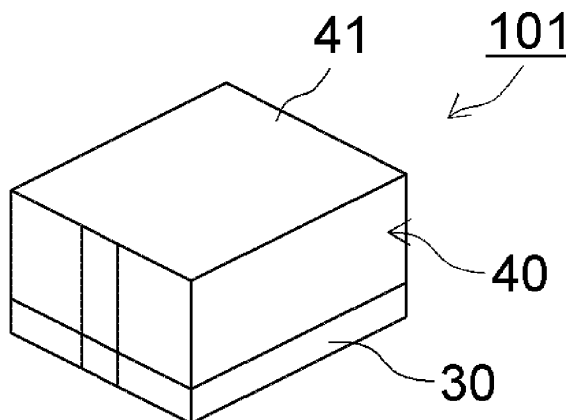
A ground electrode is formed on the lower surface of a ferroelectric substrate, a control electrode including capacitor electrodes and an inductor electrode is formed on the upper surface of the ferroelectric substrate, and an upper-surface radiating electrode and an end-surface radiating electrode are formed on a paraelectric substrate. The shapes and dimensions of the ferroelectric substrate, paraelectric substrate, and radiating electrodes are determined such that when the ferroelectric substrate and the paraelectric substrate are stacked in layers, a circuit including the radiating electrodes resonates at frequencies outside a frequency band exhibiting frequency dispersion of a dielectric constant.

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10 Claims, 12 Drawing Sheets



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US007944324B2

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

(10) **Patent No.:** **US 7,944,324 B2**

(45) **Date of Patent:** **May 17, 2011**

(54) **COMPACT ORTHOMODE TRANSDUCTION
DEVICE OPTIMIZED IN THE MESH PLANE,
FOR AN ANTENNA**

(75) Inventors: **Thierry Girard**, Toulouse (FR); **Harry
Chane-Kee-Sheung**, Toulouse (FR);
Pierre Bosshard, Tournefeuille (FR);
Laurence Laval, Toulouse (FR)

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

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 199 days.

(21) Appl. No.: **12/375,297**

(22) PCT Filed: **Jul. 27, 2007**

(86) PCT No.: **PCT/EP2007/057797**

§ 371 (c)(1),

(2), (4) Date: **May 18, 2009**

(87) PCT Pub. No.: **WO2008/012369**

PCT Pub. Date: **Jan. 31, 2008**

(65) **Prior Publication Data**

US 2009/0309674 A1 Dec. 17, 2009

(30) **Foreign Application Priority Data**

Jul. 28, 2006 (FR) 06 53180

(51) **Int. Cl.**
H01P 1/161 (2006.01)
H01P 5/12 (2006.01)

(52) **U.S. Cl.** **333/126; 333/137; 333/252**

(58) **Field of Classification Search** **333/21 R,**
333/21 A, 137, 122, 135, 239, 248, 252, 125,
333/126

See application file for complete search history.

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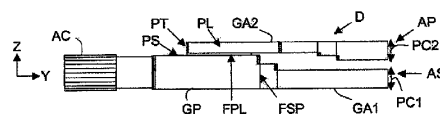
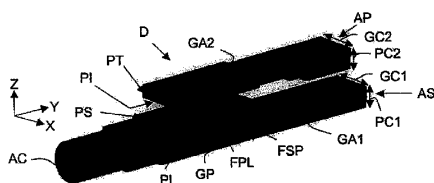
Primary Examiner — Stephen E Jones

(74) Attorney, Agent, or Firm — Baker & Hostetler LLP

(57) **ABSTRACT**

An orthomode transducer device (D), for an antenna, com-
prises (i) a main guide (GP) designed for the propagation
along a main axis of first and second modes having polariza-
tions orthogonal to each other and provided with a first end
coupled to a circular port (AC) and a second end, (ii) a first
auxiliary guide (GA1) designed for the propagation of the
first mode along a first auxiliary axis and provided with a first
end coupled in series to the second end of the main guide via
a series window (FSP) and with a second end coupled to a
series port (AS), and (iii) a second auxiliary guide (GA2)
designed for the propagation of the second mode along a
second auxiliary axis, coupled to the main guide via a parallel
window (FPL) and provided with a first end coupled to a
parallel port (AP). The first (GA1) and second (GA2) auxil-
iary guides are superposed. The parallel window (FPL) is
defined between an upper wall (PS) of the main guide (GP)
and a lower wall (PI) of the second auxiliary guide (GA2) and
oriented in relation to the main axis so as to enable coupling
of the main guide to the second auxiliary guide for the selec-
tive transfer of the second mode from one to the other, and so
as to make the first mode propagate between the main guide
and the first auxiliary guide.

20 Claims, 3 Drawing Sheets



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US007944397B2

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

(10) **Patent No.:** **US 7,944,397 B2**
(45) **Date of Patent:** **May 17, 2011**

(54) **CHIP ANTENNA**

(75) Inventors: **Jae-Man Lee**, Goyang-si (KR);
Sae-Won Oh, Incheon (KR);
Seung-Yong Lee, Pucheon-si (KR)

(73) Assignee: **Ace Antenna Corp.**, Incheon (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 441 days.

(21) Appl. No.: **12/067,796**

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

(86) PCT No.: **PCT/KR2006/003785**

§ 371 (c)(1),
(2), (4) Date: **Mar. 21, 2008**

(87) PCT Pub. No.: **WO2007/035064**

PCT Pub. Date: **Mar. 29, 2007**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Sep. 23, 2005 (KR) 10-2005-0088706
Sep. 23, 2005 (KR) 10-2005-0088726
Dec. 30, 2005 (KR) 10-2005-0134843

(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

See application file for complete search history.

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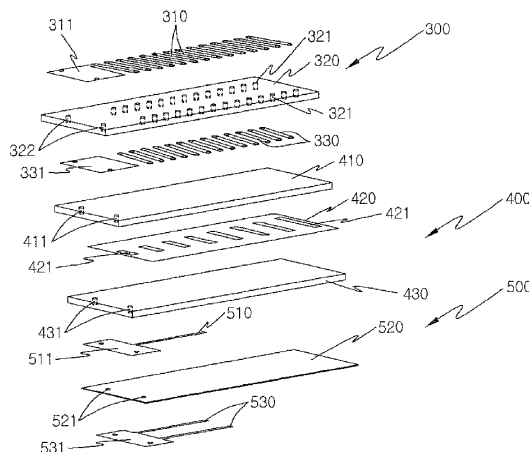
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(57) **ABSTRACT**

The present invention relates in general, to a chip antenna and, more particularly, to a dual-band small-sized chip antenna, in which a first antenna element, including a plurality of coil members, is coupled with a second antenna element, having a plurality of circuit patterns, in a zigzag fashion, thus forming resonance frequencies, and relates to a multi-band chip antenna fed with current from external part wherein the third antenna element having coil formed in helical form and the fourth antenna formed parallel with the third antenna element and in helical form are connected to the fifth antenna having a plurality of circuit pattern on the layered-substrate, and relates to chip antenna using multi-layered radiator to generate the mutual coupling of two radiator by placing non-feeding radiation element having fixed pattern between the radiator for performing the radiation of the low frequency band and the radiator for performing the radiation of the high frequency band and to have wide band characteristic by forming multiple current path to radiator.

6 Claims, 15 Drawing Sheets



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(54) **INTEGRATED CIRCUIT HAVING A LOW EFFICIENCY ANTENNA**

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

(52) **U.S. Cl.** **343/700 MS**; 343/795; 343/820

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

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(57) **ABSTRACT**

An integrated circuit (IC) includes an RF transceiver, a die, a package substrate, an antenna element, and a transmission line circuit. The die supports the RF transceiver and the package substrate supports the die. The antenna element has a length less than approximately one-tenth of a wavelength or greater than one-and-one-half times the wavelength for a frequency band of approximately 55 GHz to 64 GHz. The transmission line circuit coupling the RF transceiver to the antenna element.

9 Claims, 38 Drawing Sheets

