



US 20130341411A1

(19) **United States**

(12) **Patent Application Publication**
Kai et al.

(10) **Pub. No.: US 2013/0341411 A1**

(43) **Pub. Date: Dec. 26, 2013**

(54) **ANTENNA AND RFID TAG**

(52) **U.S. CL.**

CPC *G06K 19/07783* (2013.01); *H01Q 7/00*
(2013.01)

(71) Applicant: **FUJITSU LIMITED**, Kawasaki-shi (JP)

USPC **235/492**; 343/867

(72) Inventors: **Manabu Kai**, Yokohama (JP); **Teruhisa Ninomiya**, Yokohama (JP)

(73) Assignee: **FUJITSU LIMITED**, Kawasaki-shi (JP)

(57)

ABSTRACT

(21) Appl. No.: **13/895,622**

(22) Filed: **May 16, 2013**

(30) **Foreign Application Priority Data**

Jun. 22, 2012 (JP) 2012-140989

Publication Classification

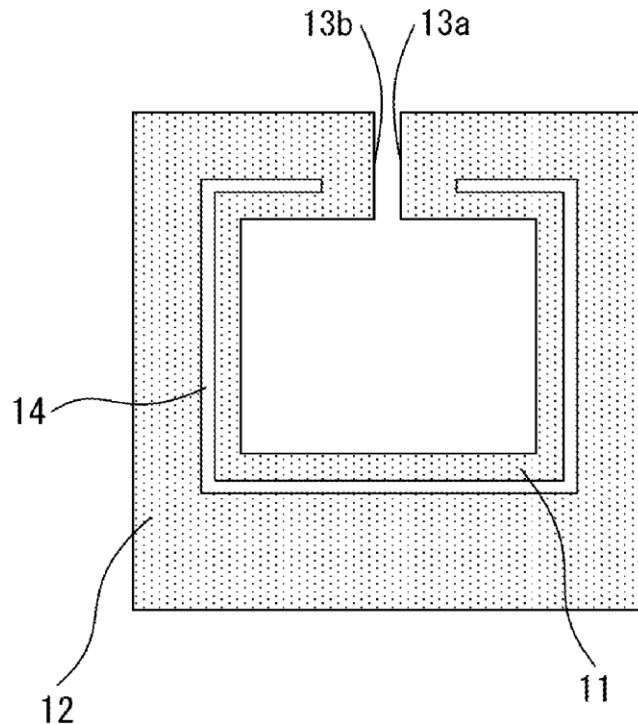
(51) **Int. Cl.**

G06K 19/077 (2006.01)

H01Q 7/00 (2006.01)

An antenna includes a first loop, a second loop which encloses an outer side of the first loop and is separated from the first loop by a slit and both end of which are merged with both ends of the first loop, and IC chip connection parts provided in a portion where the first loop and the second loop are merged, wherein a loop length of the first loop and a loop length of the second loop are equal to or shorter than one third of a wavelength corresponding to a desired frequency resonant with an IC chip connected to the IC chip connection parts.

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US 20130342408A1

(19) **United States**

(12) **Patent Application Publication**
Chang et al.

(10) **Pub. No.: US 2013/0342408 A1**

(43) **Pub. Date: Dec. 26, 2013**

(54) **ELECTRONIC DEVICE**

Publication Classification

(71) Applicant: **ACER INCORPORATED**, New Taipei City (TW)

(51) **Int. Cl.**
H01Q 1/22 (2006.01)

(72) Inventors: **Chih-Hua Chang**, New Taipei City (TW); **Chung-Cheng Su**, New Taipei City (TW)

(52) **U.S. Cl.**
CPC **H01Q 1/22** (2013.01)
USPC **343/720**

(73) Assignee: **ACER INCORPORATED**, New Taipei City (TW)

(57) **ABSTRACT**

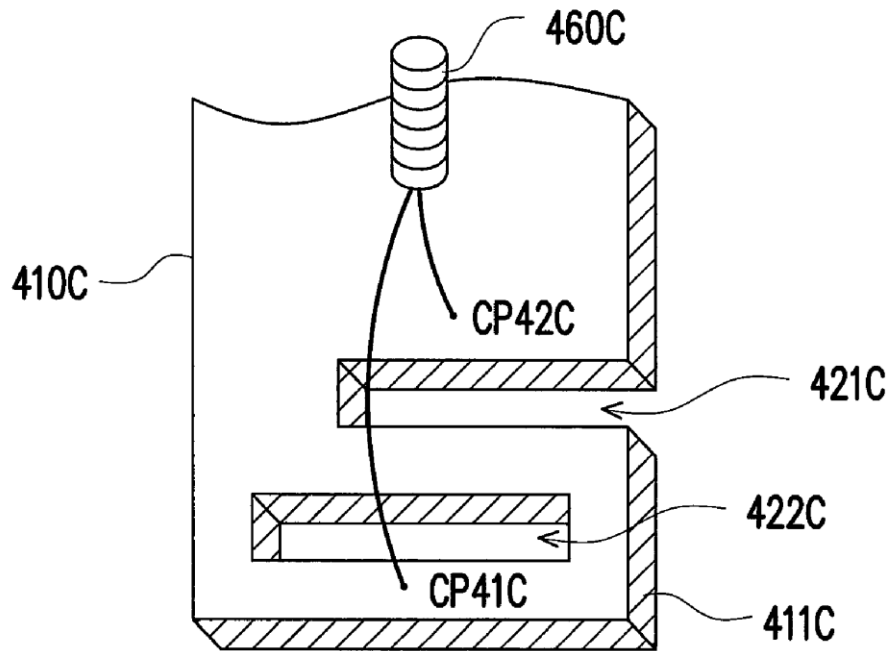
(21) Appl. No.: **13/705,167**

(22) Filed: **Dec. 5, 2012**

(30) **Foreign Application Priority Data**

Jun. 21, 2012 (TW) 101122237

An electronic device including a metal casing, a first slot and a speaker is provided. The metal casing is electrically connected to a system ground plane. The first slot passes through the metal casing. The metal casing forms a slot antenna by using the first slot so as to receive or transmit a first radiofrequency signal. The speaker is disposed inside the metal casing, and corresponds to the first slot.





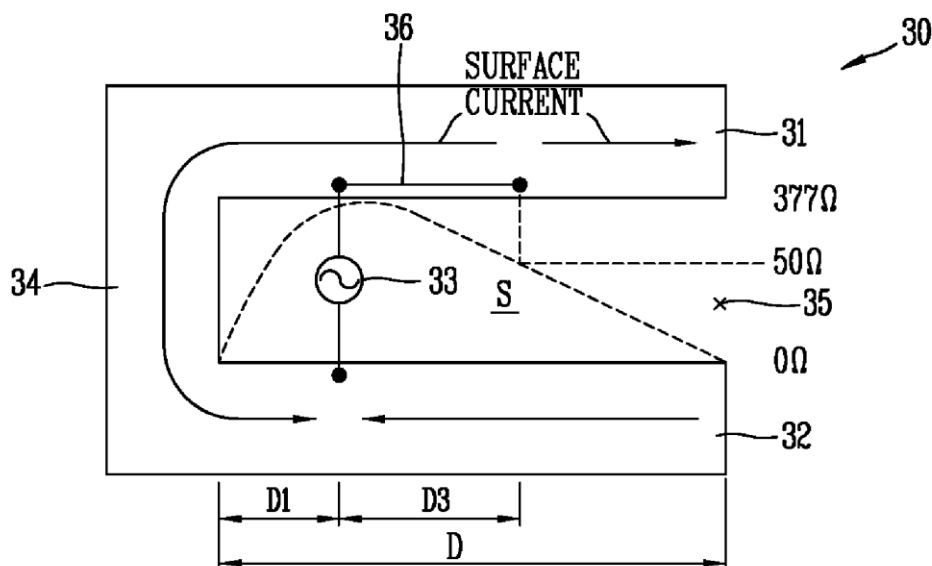
US 20130342411A1

(19) **United States**(12) **Patent Application Publication**
JUNG et al.(10) **Pub. No.: US 2013/0342411 A1**(43) **Pub. Date: Dec. 26, 2013**(54) **ANTENNA DEVICE AND MOBILE
TERMINAL HAVING THE SAME****Publication Classification**(71) Applicant: **LG Electronics Inc.**, Seoul (KR)(51) **Int. Cl.**
H01Q 13/10 (2006.01)(72) Inventors: **Byungwoon JUNG**, Seoul (KR);
Jaewoo LEE, Seoul (KR); **Daeyong
KWAK**, Seoul (KR); **Hanphil RHYU**,
Seoul (KR); **Sungjung RHO**, Seoul
(KR)(52) **U.S. Cl.**
CPC **H01Q 13/106** (2013.01)
USPC **343/767**(57) **ABSTRACT**

A mobile terminal comprises: a terminal body having an upper part and a lower part; and an antenna device disposed on the upper part or the lower part of the terminal body, and configured to transmit and receive radio signals, wherein the antenna device comprises: a first member and a second member which form a slot of which one side is open; a feeding portion having one end connected to one of the first member and the second member such that the antenna device resonates in a first frequency band, and forming an electric field in the slot; and a feeding extension portion extending from the feeding portion such that the antenna device resonates in a second frequency band.

(21) Appl. No.: **13/922,276**(22) Filed: **Jun. 20, 2013**(30) **Foreign Application Priority Data**

Jun. 21, 2012 (KR) 10-2012-0066744
Nov. 22, 2012 (KR) 10-2012-0133296





US 20130342415A1

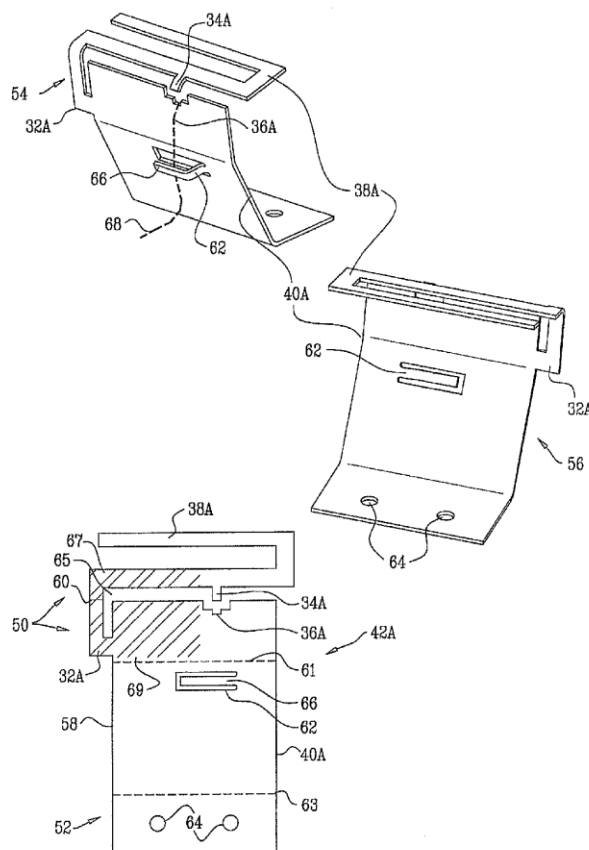
(19) **United States**(12) **Patent Application Publication**
COZZOLINO et al.(10) **Pub. No.: US 2013/0342415 A1**(43) **Pub. Date: Dec. 26, 2013**(54) **CONFORMABLE ANTENNA**

(60) Provisional application No. 61/128,284, filed on May 19, 2008.

(71) Applicant: **GALTRONICS CORPORATION LTD.**, Tiberias (IL)**Publication Classification**(72) Inventors: **Randell COZZOLINO**, Phoenix, AZ (US); **Gary WANNAGOT**, Gilbert, AZ (US); **Snir AZULAY**, Tiberias (IL)(51) **Int. Cl.**
H01Q 9/26 (2006.01)(52) **U.S. Cl.**
CPC **H01Q 9/26** (2013.01)
USPC **343/821; 29/600**(73) Assignee: **GALTRONICS CORPORATION LTD.**, Tiberias (IL)(57) **ABSTRACT**(21) Appl. No.: **13/974,469**(22) Filed: **Aug. 23, 2013****Related U.S. Application Data**

(63) Continuation of application No. 13/526,737, filed on Jun. 19, 2012, now Pat. No. 8,519,903, which is a continuation of application No. 12/468,579, filed on May 19, 2009, now Pat. No. 8,203,499.

A polymorphic antenna, including a metallic template configurable in at least first and second possible different three-dimensional shapes, the antenna, when configured in the at least first and second different three-dimensional shapes, having a common antenna feed point, a common balun coupled to the common antenna feed point; and a common dipole coupled to the common antenna feed point and to the common balun. The antenna operates in a common frequency band when configured in either of the at least first and second different three-dimensional shapes when fed via the common antenna feed point.





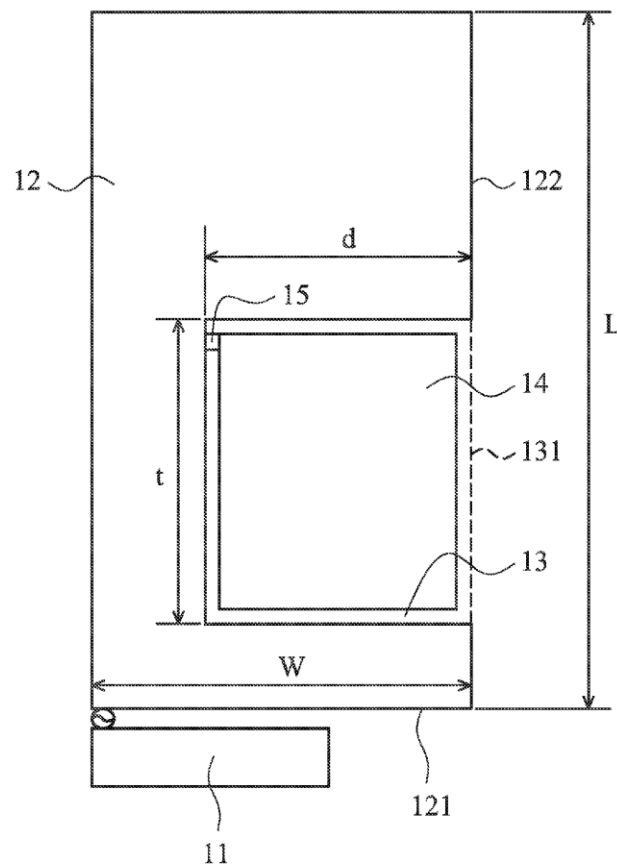
US 20130342417A1

(19) **United States**(12) **Patent Application Publication**
WONG et al.(10) **Pub. No.: US 2013/0342417 A1**(43) **Pub. Date: Dec. 26, 2013**(54) **COMMUNICATION DEVICE AND ANTENNA
ELEMENT THEREIN****Publication Classification**(75) Inventors: **Kin-Lu WONG**, Kaohsiung City (TW);
Wun-Jian LIN, Kaohsiung City (TW)(51) **Int. Cl.**
H01Q 1/48 (2006.01)(52) **U.S. Cl.**
USPC **343/848**(73) Assignee: **ACER INCORPORATED**, Taipei
Hsien (TW)(57) **ABSTRACT**

A communication device including an antenna element, a ground element and a battery element is provided. The ground element has a short edge and a long edge as a first edge and a long edge as a second edge. The antenna element is close to the first edge or at a dented section of the first edge. There is a notch in the ground element, and an open edge of the notch is at the second edge. The length of the notch is at least 0.3 times the maximum length of the ground element, and the width of the notch is at least 0.4 times the maximum width of the ground element.

(21) Appl. No.: **13/599,092**(22) Filed: **Aug. 30, 2012**(30) **Foreign Application Priority Data**

Jun. 22, 2012 (TW) 101122356

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US 20130342418A1

(19) **United States**

(12) **Patent Application Publication**
TSENG et al.

(10) **Pub. No.: US 2013/0342418 A1**

(43) **Pub. Date: Dec. 26, 2013**

(54) **WIRELESS LOCAL AREA NETWORK
ADAPTER**

Publication Classification

(71) Applicant: **CHI MEI COMMUNICATION
SYSTEMS, INC.**, New Taipei (TW)

(51) **Int. Cl.**
H01Q 1/48 (2006.01)

(72) Inventors: **TING-CHIH TSENG**, New Taipei
(TW); **KUN-LIN SUNG**, New Taipei
(TW)

(52) **U.S. Cl.**
CPC **H01Q 1/48** (2013.01)
USPC **343/848**

(73) Assignee: **CHI MEI COMMUNICATION
SYSTEMS, INC.**, New Taipei (TW)

(57) **ABSTRACT**

(21) Appl. No.: **13/775,110**

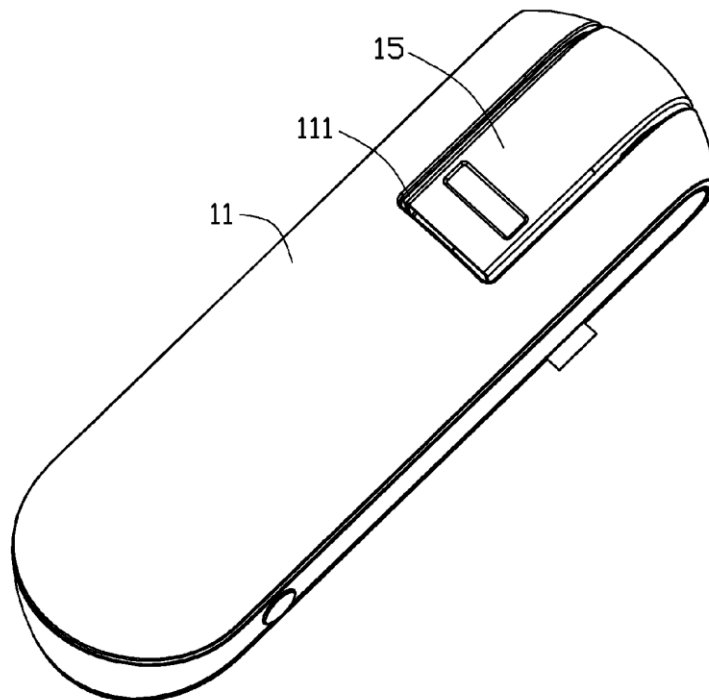
(22) Filed: **Feb. 22, 2013**

(30) **Foreign Application Priority Data**

Jun. 25, 2012 (TW) 101212194

A wireless local area network adapter includes a housing, a printed circuit board, an antenna, at least one elastic sheet and a plug. The printed circuit board includes a first ground plane. The antenna is electronically connected to the first ground plane. The elastic sheet is positioned on the printed circuit board, and is electronically connected to the first ground plane. The plug includes a shell, at least one part of the shell made of metal, the at least one elastic sheet contacting the metal part of the shell for electronically connecting the shell.

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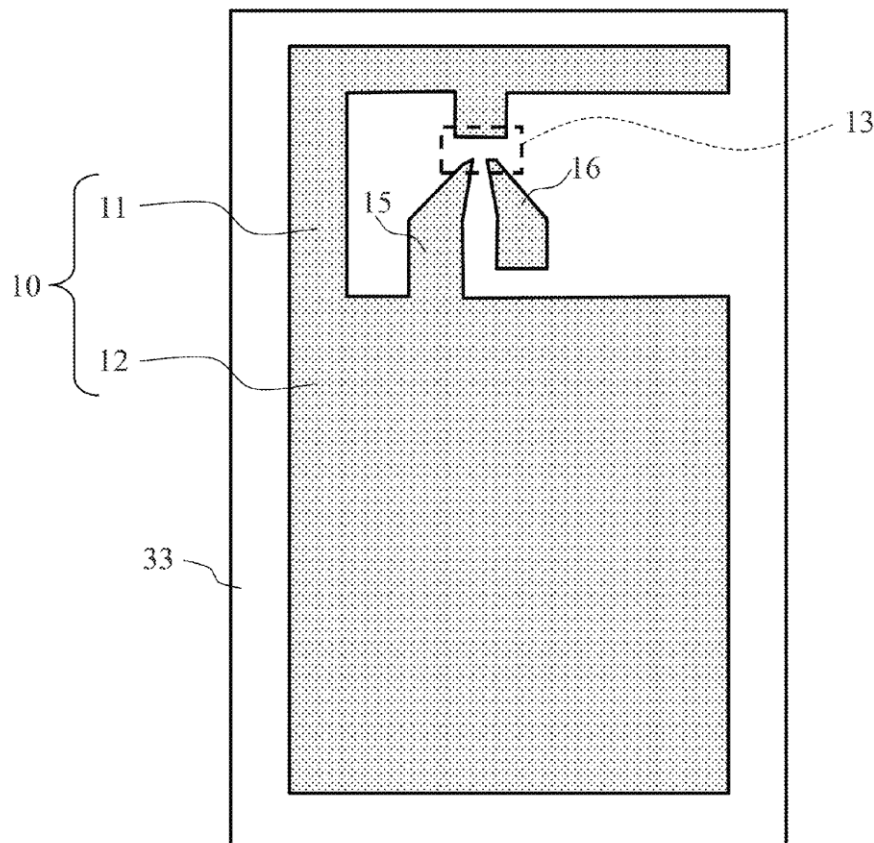
US 20130342419A1

(19) **United States**(12) **Patent Application Publication**
Takigahira et al.(10) **Pub. No.: US 2013/0342419 A1**(43) **Pub. Date: Dec. 26, 2013**(54) **ANTENNA UNIT AND PLANAR WIRELESS
DEVICE**(71) Applicant: **Fujikura Ltd.**, Tokyo (JP)(72) Inventors: **Masato Takigahira**, Sakura-shi (JP);
Hiroyuki Hayashi, Sakura-shi (JP)(73) Assignee: **FUJIKURA LTD.**, Tokyo (JP)(21) Appl. No.: **14/011,039**(22) Filed: **Aug. 27, 2013****Related U.S. Application Data**(63) Continuation of application No. PCT/JP2012/050700,
filed on Jan. 16, 2012.(30) **Foreign Application Priority Data**

Mar. 2, 2011 (JP) 2011-045167

Publication Classification(51) **Int. Cl.**
H01Q 1/48 (2006.01)(52) **U.S. Cl.**
CPC **H01Q 1/48** (2013.01)
USPC **343/848**(57) **ABSTRACT**

An object of the present invention is to provide a planar type antenna unit and a planar type wireless device capable of reducing a projecting area of the wireless device. To achieve the above object, the planar type wireless device of the present invention is provided with a grounded planar antenna 10 which includes a radiating element 11 and a ground plate 12, a thin-film battery 20 which includes a positive-electrode current collector 21 opposing a negative-electrode current collector which is formed by the ground plate 12, and a transmitter/receiver IC arranged at a power feeding point 13 of the grounded planar antenna 10 and including a transmitter-receiver circuit which receives power from the negative-electrode current collector of the thin-film battery 20 and the positive-electrode current collector 21 of the thin-film battery 20, and transmits and receives signals by operating the radiating element 11 of the grounded planar antenna 10.





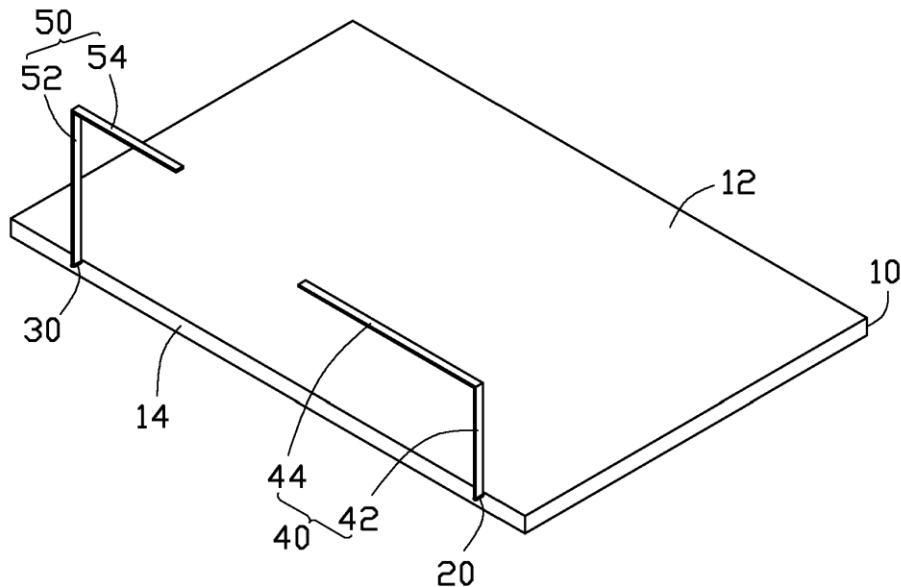
US 20130342420A1

(19) **United States**(12) **Patent Application Publication**
LU(10) **Pub. No.: US 2013/0342420 A1**(43) **Pub. Date: Dec. 26, 2013**(54) **ANTENNA ASSEMBLY WITH MULTIBAND FUNCTION**(71) Applicant: **Chi Mei Communication Systems, Inc.**, New Taipei (TW)(72) Inventor: **CHUN-YU LU**, New Taipei (TW)(21) Appl. No.: **13/911,341**(22) Filed: **Jun. 6, 2013**(30) **Foreign Application Priority Data**

Jun. 26, 2012 (TW) 101122735

Publication Classification(51) **Int. Cl.**
H01Q 5/01 (2006.01)(52) **U.S. Cl.**CPC **H01Q 5/01** (2013.01)USPC **343/850**(57) **ABSTRACT**

A simple antenna assembly suitable for several wireless frequency bands includes a base board, a first radiator, and a second radiator. The base board has opposite sides connected by an edge and includes a feed point and a grounding point. The first radiator is electronically connected to the feed point, and the second radiator is electronically connected to the grounding point. The first radiator and the second radiator are positioned at opposite sides of an edge of the base board and spaced from each other. The first radiator receives and transmits wireless signals having a first central frequency, and the second radiator is coupled with the first radiator to cooperatively receive and transmit wireless signals having a second central frequency.

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US 20130342425A1

(19) **United States**

(12) **Patent Application Publication**
WONG et al.

(10) **Pub. No.: US 2013/0342425 A1**

(43) **Pub. Date: Dec. 26, 2013**

(54) **COMMUNICATION DEVICE AND ANTENNA
SYSTEM THEREIN**

Publication Classification

(75) Inventors: **Kin-Lu WONG**, Kaohsiung City (TW);
Tsung-Ju WU, Kaohsiung City (TW)

(51) **Int. Cl.**
H01Q 21/00 (2006.01)

(52) **U.S. Cl.**
USPC **343/893**

(73) Assignee: **ACER INCORPORATED**, Taipei
Hsien (TW)

(57) **ABSTRACT**

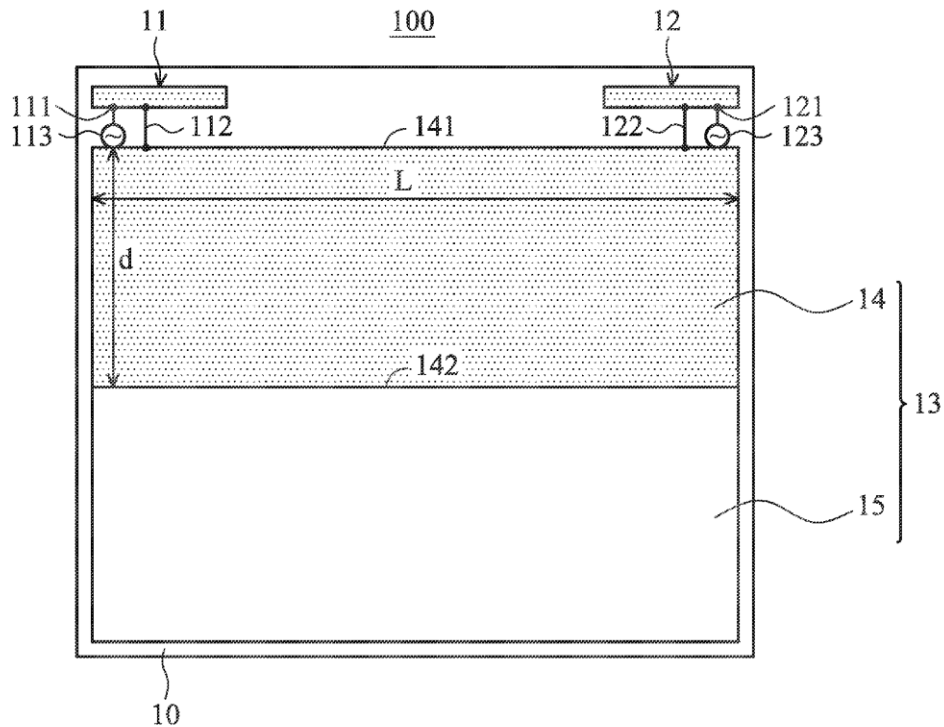
A communication device including a supporting plate and an antenna system is provided. The supporting plate includes a conductive plate and a non-conductive plate. The conductive plate has a first edge and a second edge. The antenna system includes at least two antennas, which are both disposed at the first edge of the conductive plate and operate in at least a first band. A distance between the first edge and the second edge of the conductive plate is about 0.25 wavelength of the lowest frequency in the first band, and the distance is smaller than a length of the first edge.

(21) Appl. No.: **13/599,059**

(22) Filed: **Aug. 30, 2012**

(30) **Foreign Application Priority Data**

Jun. 22, 2012 (TW) 101122355





US 20130342973A1

(19) **United States**(12) **Patent Application Publication**
Lin(10) **Pub. No.: US 2013/0342973 A1**(43) **Pub. Date: Dec. 26, 2013**(54) **ELECTRONIC DEVICE**(52) **U.S. Cl.**

USPC 361/679.01

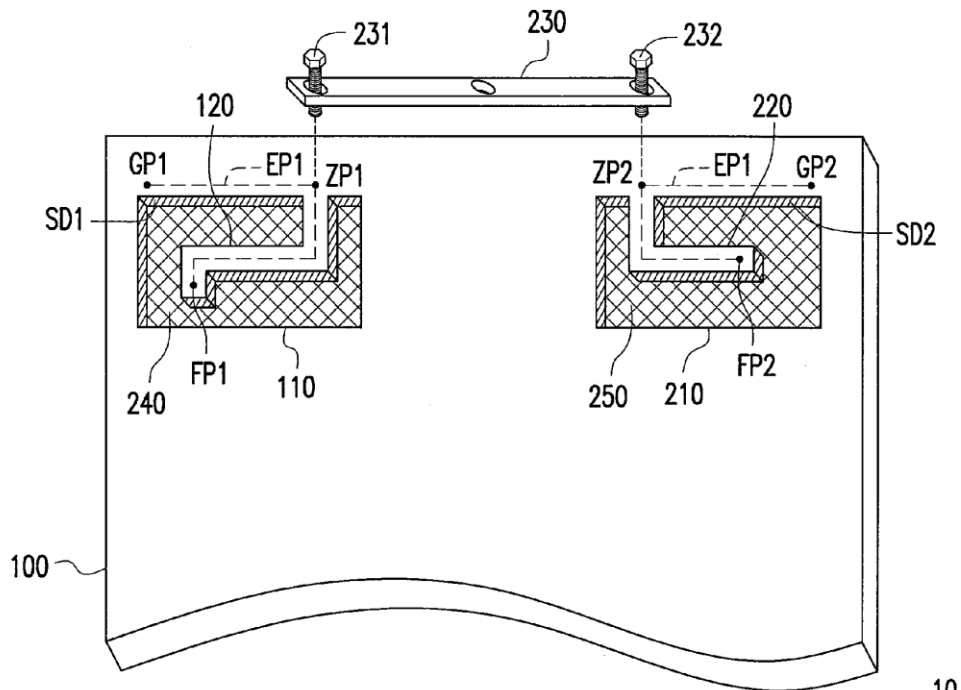
(75) Inventor: **Ching-Chi Lin**, New Taipei City (TW)(73) Assignee: **ACER INCORPORATED**, New Taipei City (TW)(57) **ABSTRACT**(21) Appl. No.: **13/591,234**(22) Filed: **Aug. 22, 2012**(30) **Foreign Application Priority Data**

Jun. 25, 2012 (TW) 101122647

Publication Classification(51) **Int. Cl.****H05K 5/04**

(2006.01)

An electronic device is provided. The electronic device includes a metal housing, a first opening, a first metal line, a first grounding point and a first current zero point. The first opening passes through the metal housing, wherein a first end of the first metal line is electrically connected to a side of the first opening, and a second end of the first metal line has a first feeding point. The first grounding point and the first current zero point are located on the side of the first opening. The metal housing forms a first loop antenna to transmit or receive a first radio frequency signal by a first excitation path from the first feeding point to the first grounding point.

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US 20140002308A1

(19) **United States**

(12) **Patent Application Publication**
CHEN et al.

(10) **Pub. No.: US 2014/0002308 A1**

(43) **Pub. Date: Jan. 2, 2014**

(54) **MULTI-BAND ANTENNA FOR TABLET
COMPUTER**

Publication Classification

(75) Inventors: **WEN-SHAN CHEN**, TAINAN CITY
(TW); **WEI-CHIANG JHANG**,
TAINAN CITY (TW)

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

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

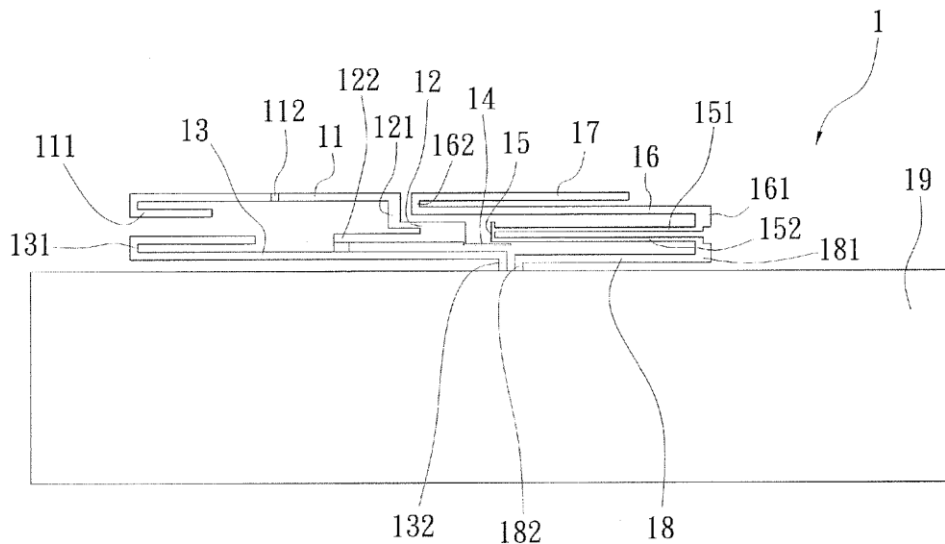
(73) Assignee: **SOUTHERN TAIWAN UNIVERSITY
OF TECHNOLOGY**, TAINAN CITY
(TW)

(57) **ABSTRACT**

A multi-band antenna for tablet computers is revealed. The antenna includes a first path, a second path, a third path, a fourth path, a fifth path, a sixth path, a seventh path, an eighth path and a grounding portion, connected to one another. Thereby the antenna can cover the GSM850/900/1800/1900/UMTS and LTE700/2300/2700 operations.

(21) Appl. No.: **13/537,290**

(22) Filed: **Jun. 29, 2012**





US 20140002310A1

(19) **United States**(12) **Patent Application Publication**
KIM(10) **Pub. No.: US 2014/0002310 A1**(43) **Pub. Date: Jan. 2, 2014**(54) **ANTENNA APPARATUS**(71) Applicant: **LG INNOTEK CO., LTD.**, Seoul (KR)(72) Inventor: **Chang Wook KIM**, Seoul (KR)(21) Appl. No.: **13/928,596**(22) Filed: **Jun. 27, 2013**(30) **Foreign Application Priority Data**

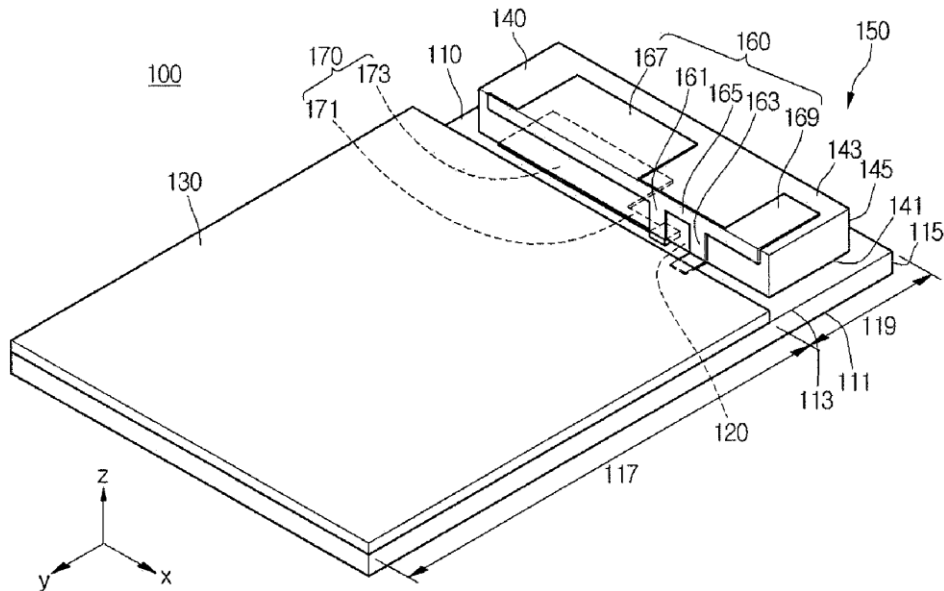
Jun. 28, 2012 (KR) 10-2012-0070373

Publication Classification(51) **Int. Cl.**
H01Q 9/04 (2006.01)(52) **U.S. Cl.**CPC **H01Q 9/04** (2013.01)USPC **343/700 MS**

(57)

ABSTRACT

Disclosed is an antenna apparatus. The antenna apparatus includes a feeding pad for supplying a signal, a main device extended from the feeding pad, and a sub-device extended from the feeding pad and spaced apart from the main device while overlapping with the main device. The antenna apparatus includes the sub-device overlapped with the main device, so that the resonance frequency band of the antenna apparatus is enlarged.





US 20140002315A1

(19) **United States**

(12) **Patent Application Publication**
LIM

(10) **Pub. No.: US 2014/0002315 A1**

(43) **Pub. Date: Jan. 2, 2014**

(54) **ANTENNA AND METHOD FOR
MANUFACTURING THE SAME**

Publication Classification

(71) Applicant: **LG INNOTEK CO., LTD.**, Seoul (KR)

(72) Inventor: **Dong Uk LIM**, Seoul (KR)

(73) Assignee: **LG INNOTEK CO., LTD.**, Seoul (KR)

(21) Appl. No.: **13/755,820**

(22) Filed: **Jan. 31, 2013**

(30) **Foreign Application Priority Data**

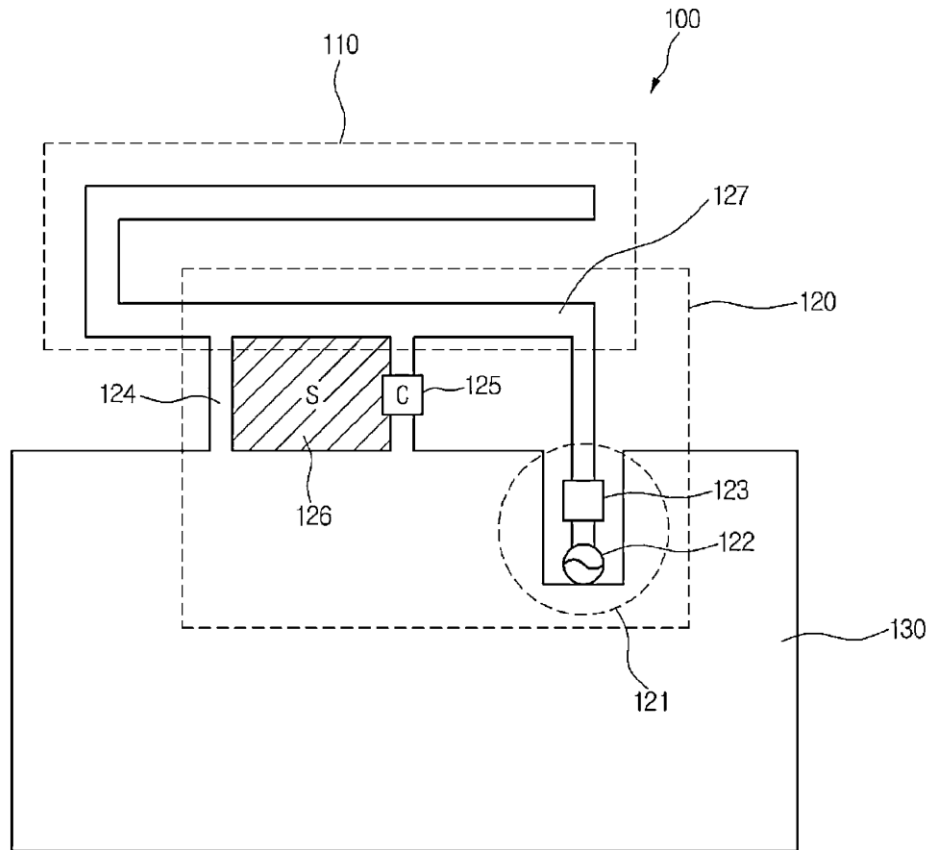
Jun. 29, 2012 (KR) 10-2012-0071193

(51) **Int. Cl.**
H01Q 1/50 (2006.01)
H01Q 1/24 (2006.01)
H01P 11/00 (2006.01)
H01Q 1/36 (2006.01)

(52) **U.S. Cl.**
CPC . *H01Q 1/50* (2013.01); *H01Q 1/36* (2013.01);
H01Q 1/243 (2013.01); *H01P 11/00* (2013.01)
USPC 343/702; 343/700 MS; 343/749; 29/600

(57) **ABSTRACT**

An antenna according to an embodiment includes a structure, and an antenna pattern on the structure, wherein the antenna pattern includes a feeding structure and a radiator integrated with the feeding structure for radiating a signal provided from the feeding structure to an outside.





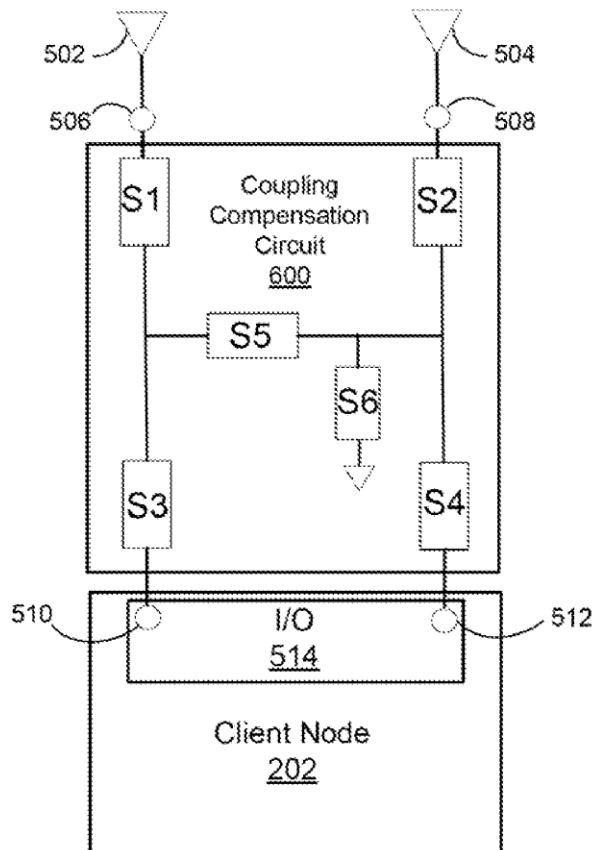
US 20140002323A1

(19) **United States**(12) **Patent Application Publication****Ali et al.**(10) **Pub. No.: US 2014/0002323 A1**(43) **Pub. Date: Jan. 2, 2014**(54) **METHOD AND APPARATUS TO CONTROL
MUTUAL COUPLING AND CORRELATION
FOR MULTI-ANTENNA APPLICATIONS**(75) Inventors: **Shirook M. Ali**, Milton (CA); **James
Paul Warden**, Fort Worth, TX (US)(73) Assignee: **BLACKBERRY LIMITED**, Waterloo,
ON (CA)(21) Appl. No.: **14/005,214**(22) PCT Filed: **May 31, 2011**(86) PCT No.: **PCT/US11/38543**

§ 371 (c)(1),

(2), (4) Date: **Sep. 13, 2013****Related U.S. Application Data**(60) Provisional application No. 61/452,723, filed on Mar.
15, 2011.**Publication Classification**(51) **Int. Cl.**
H01Q 21/28 (2006.01)(52) **U.S. Cl.**
CPC **H01Q 21/28** (2013.01)
USPC **343/852**(57) **ABSTRACT**

The present invention provides a method and apparatus to manipulate the mutual coupling and the correlation between the antennas (502, 504) on the handset (202) without the need to change the physical distance between them or to change their orientation. The manipulation in the mutual coupling and in the correlation is achieved using a circuit that is connected between the antennas' terminals (506, 508) and the terminals (510, 512) of the RF front end/power amplifier (514). This circuit can be fixed or tunable. The coupling control takes place between two transmitting antennas (502, 504) or two receiving antennas (502, 504).





US 20140009342A1

(19) **United States**

(12) **Patent Application Publication**
Wei

(10) **Pub. No.: US 2014/0009342 A1**

(43) **Pub. Date: Jan. 9, 2014**

(54) **MULTI-BAND ANTENNA AND ELECTRONIC
DEVICE PROVIDED WITH THE SAME**

Publication Classification

(71) Applicant: **WISTRON NEWEB CORP.**, Hsinchu
County (TW)

(51) **Int. Cl.**
H01Q 9/04 (2006.01)

(72) Inventor: **Shih-Chiang Wei**, Hsinchu County
(TW)

(52) **U.S. Cl.**
CPC **H01Q 9/04** (2013.01)
USPC **343/700 MS**

(73) Assignee: **WISTRON NEWEB CORP.**, Hsinchu
County (TW)

(57) **ABSTRACT**

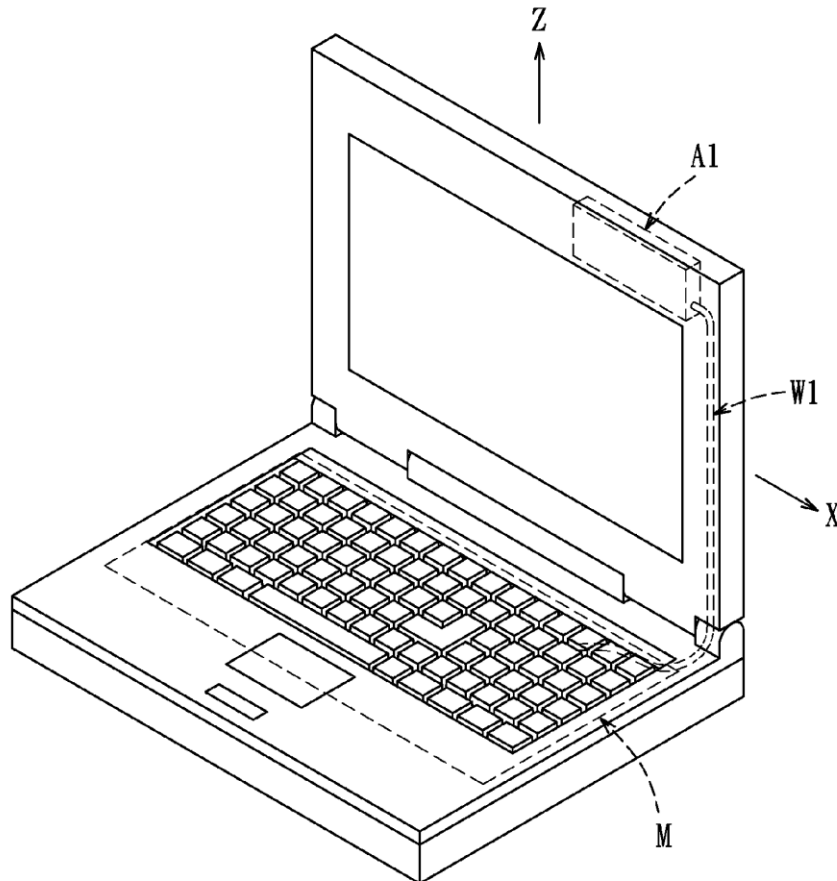
A multi-band antenna includes a ground plane, and a radiating unit including an L-shaped first radiating arm, a U-shaped second radiating arm, a feed-in arm and a coupling arm. The first and second radiating arms are connected to the ground plane, and have respective free end portions that are spaced apart from and overlap the ground plane, that face each other, and that define an opening in spatial communication with an inner space defined by the first and second radiating arms and the ground plane. The feed-in arm is disposed in the inner space between the first radiating arm and the ground plane, is connected to the ground plane, and overlaps the opening. The coupling arm is connected to the connecting segment, and overlaps the free end portions.

(21) Appl. No.: **13/743,724**

(22) Filed: **Jan. 17, 2013**

(30) **Foreign Application Priority Data**

Jul. 3, 2012 (TW) 101123878





US 20140009343A1

(19) **United States**(12) **Patent Application Publication**
Iellici(10) **Pub. No.: US 2014/0009343 A1**(43) **Pub. Date: Jan. 9, 2014**(54) **DUAL ANTENNA STRUCTURE HAVING
CIRCULAR POLARISATION
CHARACTERISTICS**(71) Applicant: **Devis Iellici**, Cambridge (GB)(72) Inventor: **Devis Iellici**, Cambridge (GB)(73) Assignee: **Microsoft Corporation**, Redmond, WA
(US)(21) Appl. No.: **13/979,433**(22) PCT Filed: **Jan. 13, 2013**(86) PCT No.: **PCT/GB12/50071**

§ 371 (c)(1),

(2), (4) Date: **Sep. 13, 2013**(30) **Foreign Application Priority Data**

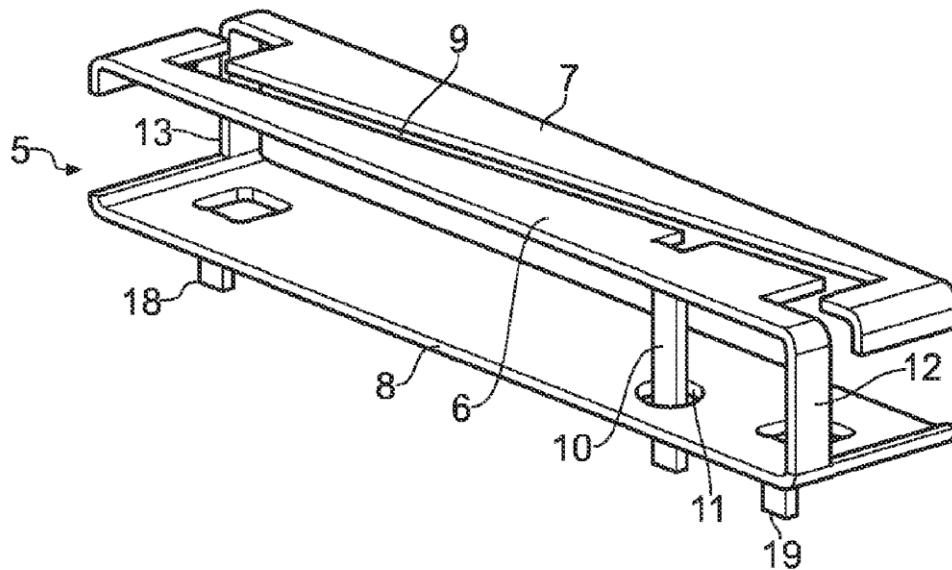
Jan. 14, 2011 (GB) 1100617.8

Publication Classification(51) **Int. Cl.****H01Q 1/36** (2006.01)**H01Q 9/04** (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/36** (2013.01); **H01Q 9/0428**
(2013.01)USPC **343/700 MS**; 29/600

(57)

ABSTRACT

There is disclosed an antenna device made up of at least first, second and third conductive metal plates arranged in a parallelepiped configuration. The third plate defines a lower plane and the first and second plates together define an upper plane substantially parallel to the lower plane. The first and second plates are separated by a slot in the upper plane, and the second and third plates are connected to each other by a grounding connection. The first plate comprises a first, active antenna arm that is provided with a feed connection, and the second plate comprises a second antenna arm that may be passive or active. The antenna device generates a circularly polarised radiation pattern that is good for personal navigation devices, while being significantly more compact than existing ceramic patch antennas that are typically used in these devices.





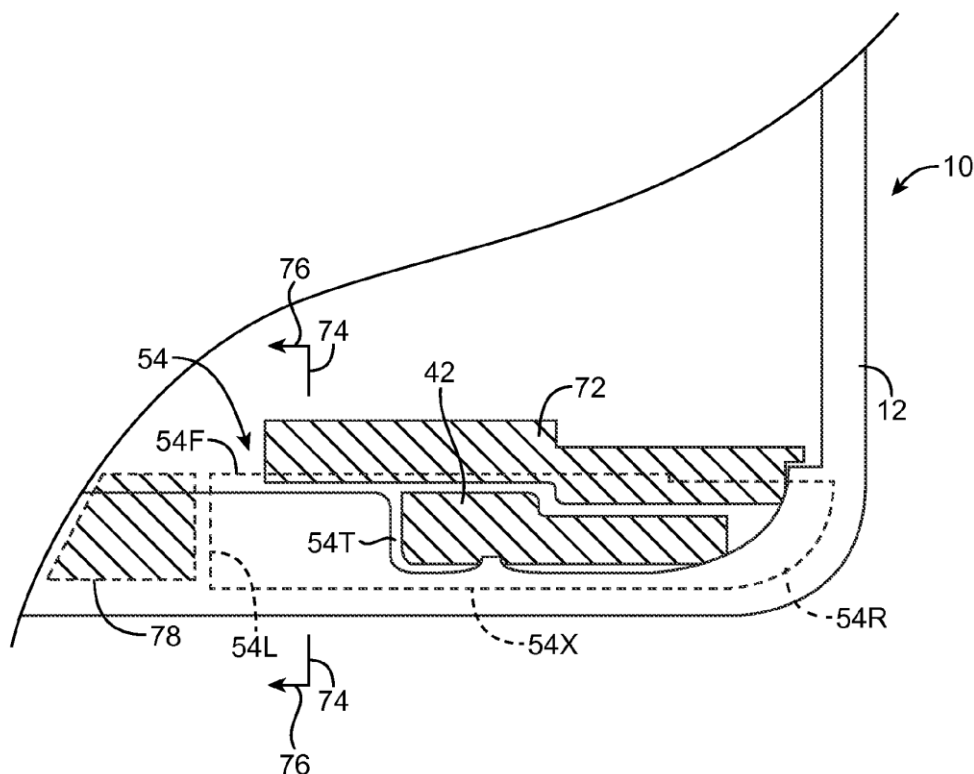
US 20140009344A1

(19) **United States**(12) **Patent Application Publication****Zhu et al.**(10) **Pub. No.: US 2014/0009344 A1**(43) **Pub. Date: Jan. 9, 2014**(54) **ANTENNAS INTEGRATED WITH SPEAKERS
AND METHODS FOR SUPPRESSING CAVITY
MODES**(52) **U.S. CL.**

USPC 343/702

(76) Inventors: **Jiang Zhu**, Sunnyvale, CA (US);
Qingxiang Li, Mountain View, CA (US);
Rodney A. Gomez Angulo, Sunnyvale,
CA (US); **Miroslav Samardzija**,
Mountain View, CA (US); **Gordon
Coutts**, Sunnyvale, CA (US); **Robert W.
Schlub**, Cupertino, CA (US)(57) **ABSTRACT**

An electronic device may be provided with a speaker box antenna for transmitting and receiving radio-frequency signals. A speaker box antenna may be formed from a hollow dielectric speaker box containing a speaker driver. An opening in the speaker box adjacent to the speaker driver may be aligned with a speaker port opening in a conductive electronic device housing structure. The speaker box may be surrounded by conductive structures that form a cavity for the antenna. The conductive structures may include parts of the conductive electronic device housing structure. The speaker box may have opposing upper and lower surfaces. Metal plates may form parts of the upper and lower surfaces and may be shorted together using a conductive layer such as a strip of metal tape. Frequencies of operation may be selected for the antenna that suppress undesired cavity modes and enhance antenna performance.

(21) Appl. No.: **13/540,999**(22) Filed: **Jul. 3, 2012****Publication Classification**(51) **Int. Cl.**
H01Q 1/24 (2006.01)



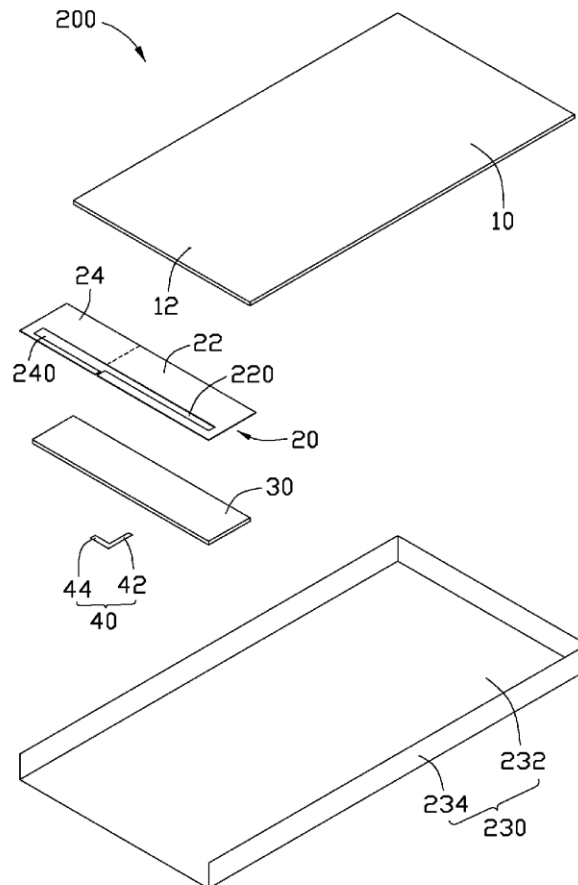
US 20140009352A1

(19) **United States**(12) **Patent Application Publication**
SUNG et al.(10) **Pub. No.: US 2014/0009352 A1**(43) **Pub. Date: Jan. 9, 2014**(54) **ANTENNA ASSEMBLY AND WIRELESS
COMMUNICATION DEVICE EMPLOYING
SAME****Publication Classification**(51) **Int. Cl.**
H01Q 13/10 (2006.01)(52) **U.S. Cl.**
USPC **343/770; 343/767**(57) **ABSTRACT**

A wireless communication device includes a housing and an antenna assembly. The antenna assembly includes a base board, a feed member electronically connecting with the base board to carry an electrical current, and a radio member including a first radio portion, the first radio portion defining a first slot. The radiator couples with the feed member, inducing an electrical current in the first radio portion. The radio member is electronically connected to the base board through the metal housing, enabling the induced electrical current to flow through the first radio portion, the metal housing, and the base board to form a current loop. The induced electrical current flows through the first slot to excite a first resonance mode, enabling the antenna assembly to receive/transmit a first wireless signal.

(71) Applicants: **KUN-LIN SUNG**, Tu-Cheng (TW);
TING-CHIH TSENG, Tu-Cheng (TW);
YEN-HUI LIN, Tu-Cheng (TW)(72) Inventors: **KUN-LIN SUNG**, Tu-Cheng (TW);
TING-CHIH TSENG, Tu-Cheng (TW);
YEN-HUI LIN, Tu-Cheng (TW)(21) Appl. No.: **13/650,112**(22) Filed: **Oct. 11, 2012**(30) **Foreign Application Priority Data**

Jul. 6, 2012 (TW) 101124421

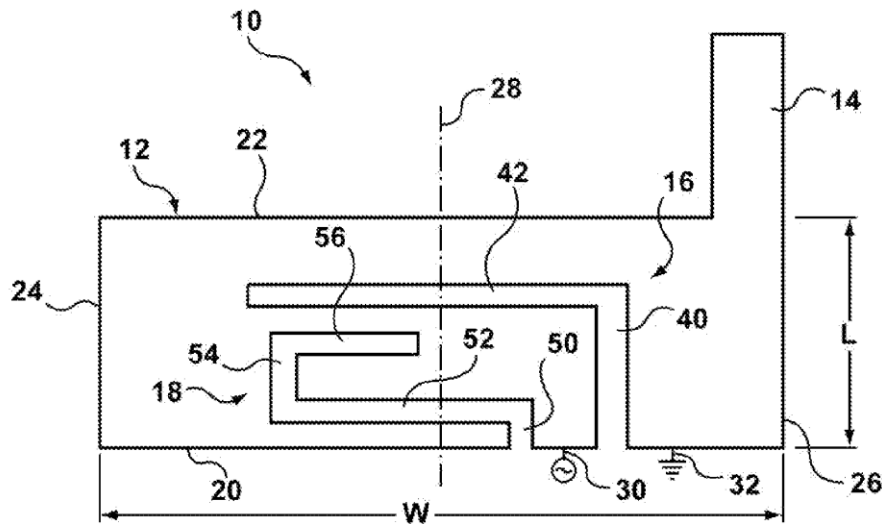




US 20140009354A1

(19) **United States**(12) **Patent Application Publication**
BADARUZZAMAN et al.(10) **Pub. No.: US 2014/0009354 A1**(43) **Pub. Date: Jan. 9, 2014**(54) **MULTI-SLOT ANTENNA AND MOBILE
DEVICE****Publication Classification**(71) Applicant: **BlackBerry Limited**, Waterloo (CA)(51) **Int. Cl.**
H01Q 13/10 (2006.01)(72) Inventors: **Firass Mirza BADARUZZAMAN**,
Forest Park, IL (US); **Michael KÜHN**,
Bochum (DE); **Shing Lung Steven**
YANG, San Diego, CA (US)(52) **U.S. Cl.**
CPC **H01Q 13/106** (2013.01)
USPC **343/770**(21) Appl. No.: **14/018,923**(57) **ABSTRACT**(22) Filed: **Sep. 5, 2013****Related U.S. Application Data**(63) Continuation of application No. 12/835,601, filed on
Jul. 13, 2010, now Pat. No. 8,587,491.

A mobile communications device having a patch antenna which has defined therein at least two slots each having two or more parts. The at least two slots may include an L-shaped slot and a C-shaped slot, wherein the slots can be open or closed. The L-shaped slot may be an open-slot projecting into the patch antenna from the edge. Ground and signal connections may be at the edge of the patch on either side of the L-shaped slot. The C-shaped slot may be nested within the L-shaped slot.

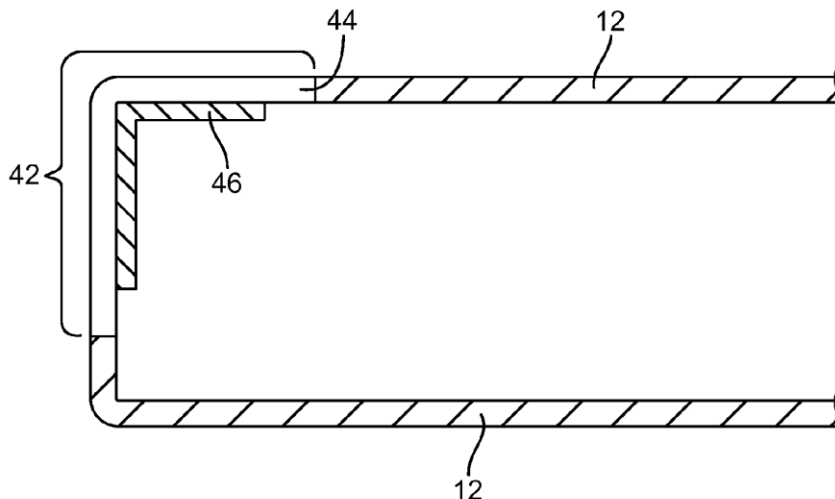
(60) Provisional application No. 61/226,500, filed on Jul.
17, 2009.



US 20140009355A1

(19) **United States**(12) **Patent Application Publication**
Samardzija et al.(10) **Pub. No.: US 2014/0009355 A1**(43) **Pub. Date: Jan. 9, 2014**(54) **ELECTRONIC DEVICE PLATE ANTENNA**(76) Inventors: **Miroslav Samardzija**, Mountain View, CA (US); **Rodney A. Gomez Angulo**, Sunnyvale, CA (US); **Qingxiang Li**, Mountain View, CA (US); **Robert W. Schlub**, Cupertino, CA (US); **Ruben Caballero**, San Jose, CA (US)(21) Appl. No.: **13/543,054**(22) Filed: **Jul. 6, 2012****Publication Classification**(51) **Int. Cl.**
H01Q 1/42 (2006.01)(52) **U.S. Cl.**USPC **343/789**(57) **ABSTRACT**

An electronic device may be provided with antenna structures. The antenna structures may include a plate antenna. The electronic device may have a conductive housing such as a metal housing with an opening. A dielectric antenna window may be formed within the opening. A dielectric support structure such as a flexible printed circuit may overlap the opening. A conductive trace on the dielectric support structure may form an antenna resonating element plate for the plate antenna. The plate may have a periphery that is separated from adjacent portions of the metal housing by a gap. The antenna resonating element plate may have a rectangular shape with a bend that lies along an edge of the conductive housing. The dielectric antenna window may have a bend that also lies along the edge of the conductive housing.





US 20140009358A1

(19) **United States**(12) **Patent Application Publication****Yang et al.**(10) **Pub. No.: US 2014/0009358 A1**(43) **Pub. Date: Jan. 9, 2014**(54) **EMBEDDED ANTENNA DEVICE FOR
ELECTRONIC COMMUNICATION DEVICE**(30) **Foreign Application Priority Data**

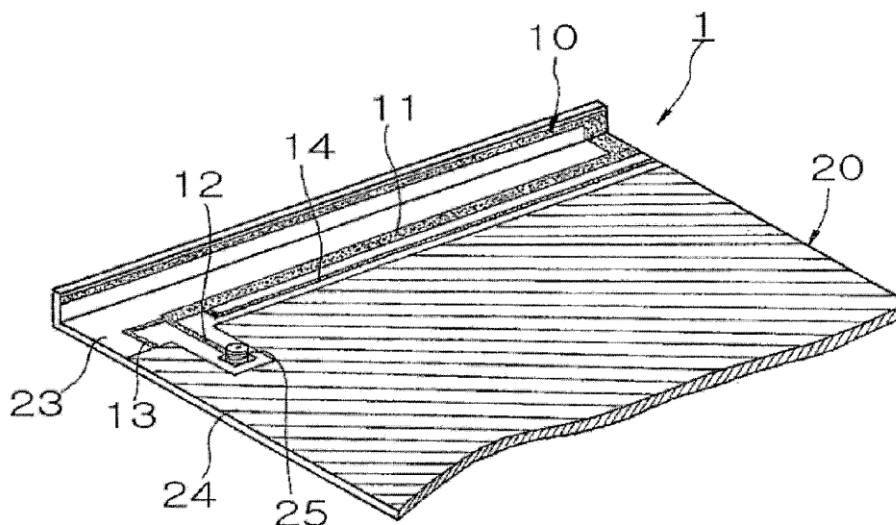
Mar. 24, 2011 (KR) 10-2011-0026177

Publication Classification(51) **Int. Cl.**
H01Q 1/48 (2006.01)(52) **U.S. Cl.**
CPC **H01Q 1/48** (2013.01)
USPC **343/845**(75) Inventors: **Tae-Sik Yang**, Suwon-si (KR);
Ju-Hyung Lee, Gwacheon-si (KR);
Hyeong-Dong Kim, Seoul (KR);
Sin-Hyung Jeon, Seoul (KR); **Joong-Ho
Jeong**, Seoul (KR)(73) Assignees: **INDUSTRY-UNIVERSITY
COOPERATION FOUNDATION
HANYANG UNIVERSITY**, Seoul
(KR); **SAMSUNG ELECTRONICS
CO., LTD.**, Suwon-si, Gyeonggi-do
(KR)(21) Appl. No.: **14/005,694**(22) PCT Filed: **Mar. 26, 2012**(86) PCT No.: **PCT/KR12/02187**

§ 371 (c)(1),

(2), (4) Date: **Sep. 17, 2013**(57) **ABSTRACT**

A built-in antenna device for an electronic device for communication is provided. The antenna device includes a substrate, an antenna radiator, and a transmission line. The substrate includes a grounding region and a non-grounding region. The antenna radiator is disposed in the non-grounding region of the substrate and fed from a feeding portion provided to the substrate. The transmission line branches from the antenna radiator and is disposed in vicinity of the grounding region to have a predetermined length and a predetermined width. The antenna device controls reactance by coupling the transmission line with the grounding region to allow the antenna radiator to operate in at least one desired band.



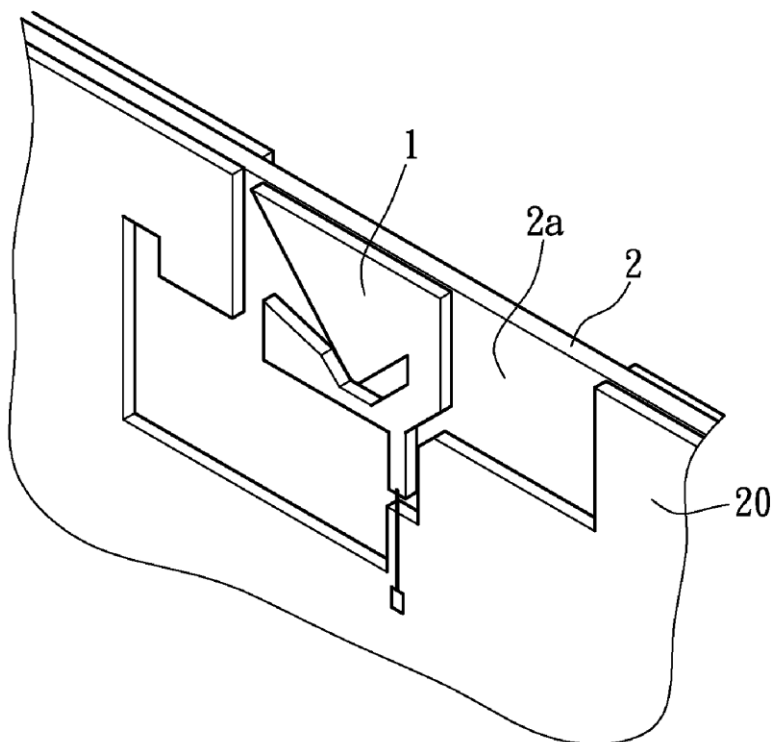


US 20140009359A1

(19) **United States**(12) **Patent Application Publication**
HUANG et al.(10) **Pub. No.: US 2014/0009359 A1**(43) **Pub. Date: Jan. 9, 2014**(54) **WIDEBAND MONOPOLE ANTENNA AND
ELECTRONIC DEVICE****Publication Classification**(71) Applicant: **ARCADYAN TECHNOLOGY
CORPORATION**, Hsinchu (TW)(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 1/48 (2006.01)(72) Inventors: **CHIH-YUNG HUANG**, TAICHUNG
CITY (TW); **KUO-CHANG LO**,
MIAOLI COUNTY (TW); **JIAN-JHIH
DU**, TAIPEI CITY (TW)(52) **U.S. Cl.**
USPC **343/846; 343/700 MS**(73) Assignee: **ARCADYAN TECHNOLOGY
CORPORATION**, HSINCHU (TW)(57) **ABSTRACT**(21) Appl. No.: **13/668,281**(22) Filed: **Nov. 4, 2012**(30) **Foreign Application Priority Data**

Jul. 4, 2012 (TW) 101124127

The present invention discloses an electronic device including a signal transmission module and a wideband monopole antenna. A feeding portion of the antenna is coupled to the signal transmission module through a feeding cable. A first radiating portion and a second radiating portion of the antenna are respectively coupled to the feeding portion, wherein the feeding portion, the first radiating portion, and a signal ground portion define a first slot, while the second radiating portion and the signal ground portion define a second slot. In the first slot, the spacing between the first radiating portion and the signal ground portion is not less than a first distance. In the second slot, the spacing between the second radiating portion and the signal ground portion is not less than a second distance. Thus, the voltage standing wave ratio of the antenna within a frequency band is less than a threshold.

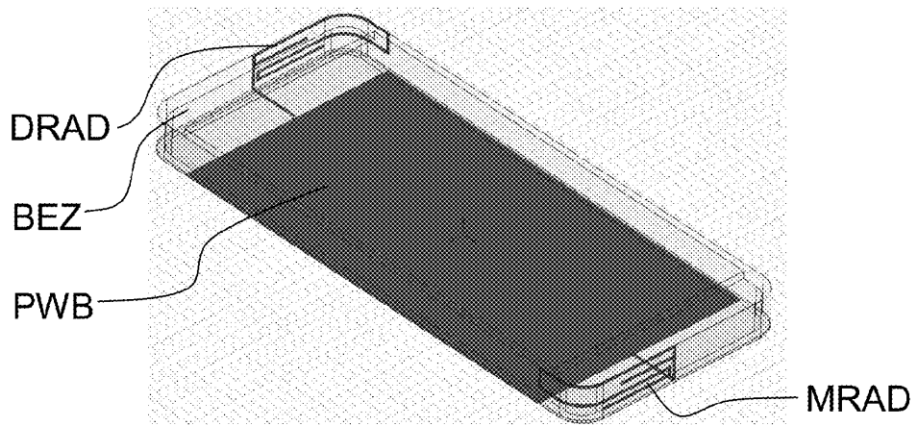




US 20140009360A1

(19) **United States**(12) **Patent Application Publication**
Ikonen et al.(10) **Pub. No.: US 2014/0009360 A1**(43) **Pub. Date: Jan. 9, 2014**(54) **MOBILE COMMUNICATION DEVICE WITH
IMPROVED ANTENNA PERFORMANCE**(75) Inventors: **Pekka Ikonen**, Espoo (FI); **Juha Ellä**,
Halikko (FI)(73) Assignee: **EPCOS AG**, München (DE)(21) Appl. No.: **13/885,671**(22) PCT Filed: **Nov. 25, 2010**(86) PCT No.: **PCT/EP2010/068225**§ 371 (c)(1),
(2), (4) Date: **Aug. 1, 2013****Publication Classification**(51) **Int. Cl.**
H01Q 1/50 (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/50** (2013.01)USPC **343/852**(57) **ABSTRACT**

The present invention concerns a mobile communication device comprising a ground plane, a main antenna comprising a main radiator (MRAD) that can couple electromagnetically to the ground plane and to a first signal path (SPm), a diversity antenna comprising a diversity radiator (DRAD), a reconfigurable input matching circuit that couples the diversity radiator (DRAD) to the ground plane and to a second signal path (SPd), and a control unit (CU) coupled to the reconfigurable input matching circuit and adapted to change the coupling of the diversity radiator (DRAD) to the ground plane during operation. The present invention further concerns to a method to enhance the performance of the device.



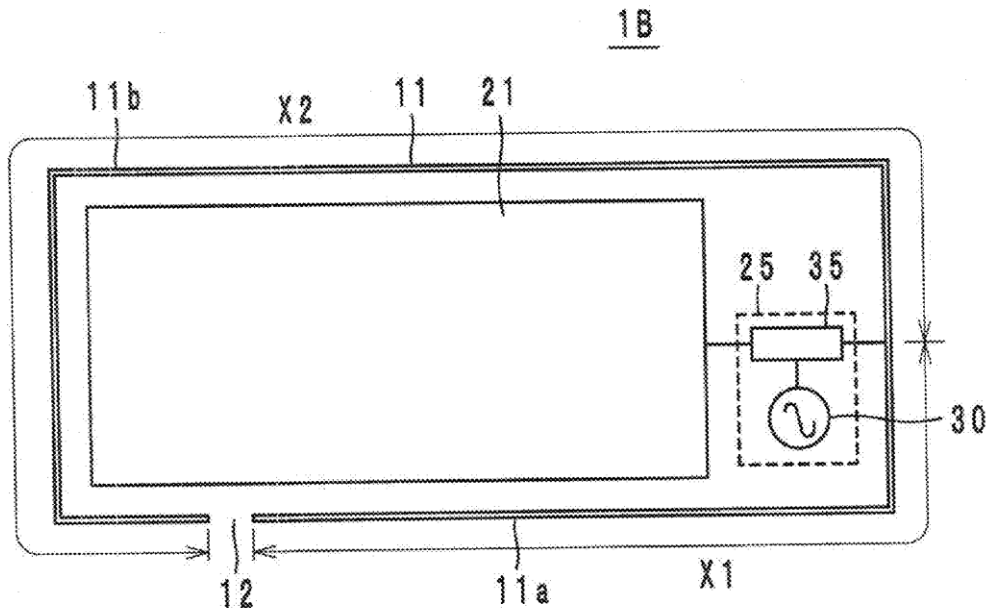


US 20140009361A1

(19) **United States**(12) **Patent Application Publication**
KATO(10) **Pub. No.: US 2014/0009361 A1**(43) **Pub. Date: Jan. 9, 2014**(54) **ANTENNA DEVICE AND COMMUNICATION
TERMINAL APPARATUS****Publication Classification**(71) Applicant: **Murata Manufacturing Co., Ltd.**,
Nagaokakyo-shi (JP)(51) **Int. Cl.**
H01Q 1/50 (2006.01)(72) Inventor: **Noboru KATO**, Nagaokakyo-shi (JP)(52) **U.S. Cl.**
CPC **H01Q 1/50** (2013.01)
USPC **343/860**(73) Assignee: **MURATA MANUFACTURING CO.,
LTD.**, Nagaokakyo-shi (JP)(57) **ABSTRACT**(21) Appl. No.: **14/019,573**(22) Filed: **Sep. 6, 2013****Related U.S. Application Data**(63) Continuation of application No. PCT/JP2012/055505,
filed on Mar. 5, 2012.(30) **Foreign Application Priority Data**

Mar. 8, 2011 (JP) 2011-050547

An antenna device includes a plate-shaped radiating element, a frame-shaped radiating element arranged to surround the plate-shaped radiating element, and a feeding unit that includes a feeding circuit and a frequency stabilizing circuit and that is connected between the plate-shaped radiating element and the frame-shaped radiating element. The plate-shaped radiating element and the frame-shaped radiating element are connected to the feeding circuit through the frequency stabilizing circuit as a result of a first terminal portion of the frequency stabilizing circuit being connected to the frame-shaped radiating element, a second terminal portion of the frequency stabilizing circuit being connected to the plate-shaped radiating element, and a third terminal portion of the frequency stabilizing circuit being connected to the feeding circuit.





US 20140011553A1

(19) **United States**

(12) **Patent Application Publication**
Kaikkonen et al.

(10) **Pub. No.: US 2014/0011553 A1**

(43) **Pub. Date: Jan. 9, 2014**

(54) **ANTENNA DEVICE AND A PORTABLE
RADIO COMMUNICATION DEVICE
COMPRISING SUCH AN ANTENNA DEVICE**

Publication Classification

(51) **Int. Cl.**
H04M 1/02 (2006.01)

(52) **U.S. Cl.**
CPC **H04M 1/026** (2013.01)
USPC **455/575.7**

(71) Applicant: **Laird Technologies AB**, Kista (SE)

(72) Inventors: **Andrei Kaikkonen**, Jarfalla (SE); **Peter
Lindberg**, Uppsala (SE); **Lukasz
Grynczel**, Upplands Vasby (SE)

(73) Assignee: **Laird Technologies AB**, Kista (SE)

(21) Appl. No.: **13/964,213**

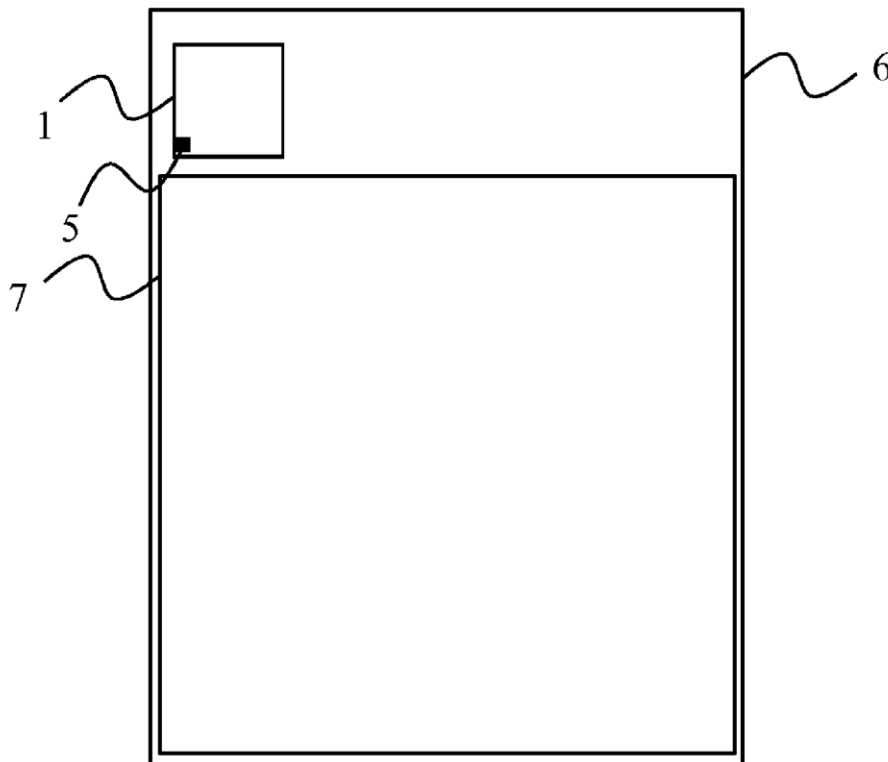
(22) Filed: **Aug. 12, 2013**

Related U.S. Application Data

(63) Continuation of application No. PCT/EP2011/
053849, filed on Mar. 15, 2011.

(57) **ABSTRACT**

Exemplary embodiments are disclosed of antenna devices for portable radio communication devices. In an exemplary embodiment, there is an antenna device for a portable radio communication device adapted for receiving radio signals in at least one frequency band. The antenna device includes a radiating element having a first branch and a second branch connected to a common elongated feeding section.

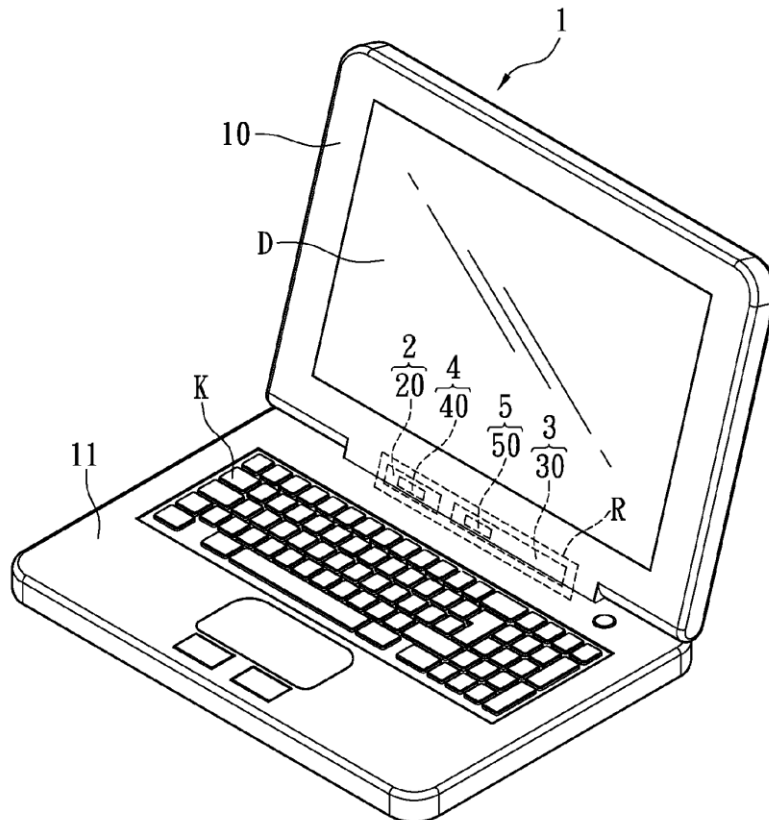




US 20140015714A1

(19) **United States**(12) **Patent Application Publication**
HONG et al.(10) **Pub. No.: US 2014/0015714 A1**(43) **Pub. Date: Jan. 16, 2014**(54) **PORTABLE ELECTRONIC DEVICE AND
HINGE MECHANISM**(52) **U.S. Cl.**
USPC **343/702**(75) Inventors: **YAN-MING HONG**, HSINCHU CITY
(TW); **PO-CHUN HUANG**,
TAICHUNG CITY (TW);
CHENG-HAN SUNG, TAICHUNG
CITY (TW); **CHIH-WEI CHEN**,
MIAOLI COUNTY (TW)(57) **ABSTRACT**

A portable electronic device includes a casing unit, a first support unit, a second support unit, a first antenna unit, a second antenna unit, a first conducting unit and a second conducting unit. The casing unit includes a first outer casing and a second outer casing pivotally connected with the first outer casing. The first outer casing includes a hinge structure pivotally connected with the second outer casing. The first support unit includes a first support body disposed in the hinge structure, and the second support unit includes a second support body disposed in the hinge structure. The first antenna unit includes a first antenna structure disposed on the first support body and separated from the second outer casing. The second antenna unit includes a second antenna structure disposed on the second support body and separated from the second outer casing.

(73) Assignee: **INPAQ TECHNOLOGY CO., LTD.**,
HSINCHU (TW)(21) Appl. No.: **13/547,112**(22) Filed: **Jul. 12, 2012****Publication Classification**(51) **Int. Cl.**
H01Q 1/24 (2006.01)



US 20140015715A1

(19) **United States**

(12) **Patent Application Publication**
Kadosawa et al.

(10) **Pub. No.: US 2014/0015715 A1**

(43) **Pub. Date: Jan. 16, 2014**

(54) **PORTABLE TERMINAL DEVICE AND
WIRELESS COMMUNICATION METHOD**

Publication Classification

(71) Applicant: **FUJITSU LIMITED**, Kawasaki-shi (JP)

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

(72) Inventors: **Yoshihisa Kadosawa**, Funabashi (JP);
Masaru Kanazawa, Kawasaki (JP)

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01)
USPC **343/702**

(21) Appl. No.: **13/933,577**

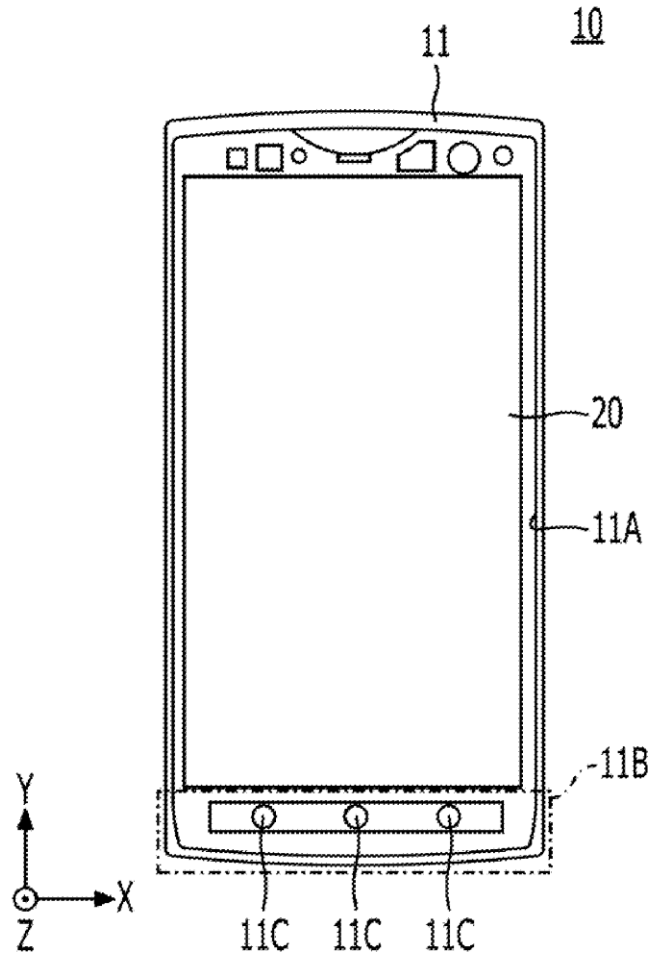
(57) **ABSTRACT**

(22) Filed: **Jul. 2, 2013**

A portable terminal includes a metal frame on which an LCD is mounted, the metal frame being grounded; and an antenna element that includes a feed point between a first end and a second end and is formed from the same piece of sheet metal used for the metal frame, the first end of the antenna element being connected to the metal frame.

(30) **Foreign Application Priority Data**

Jul. 12, 2012 (JP) 2012-156884





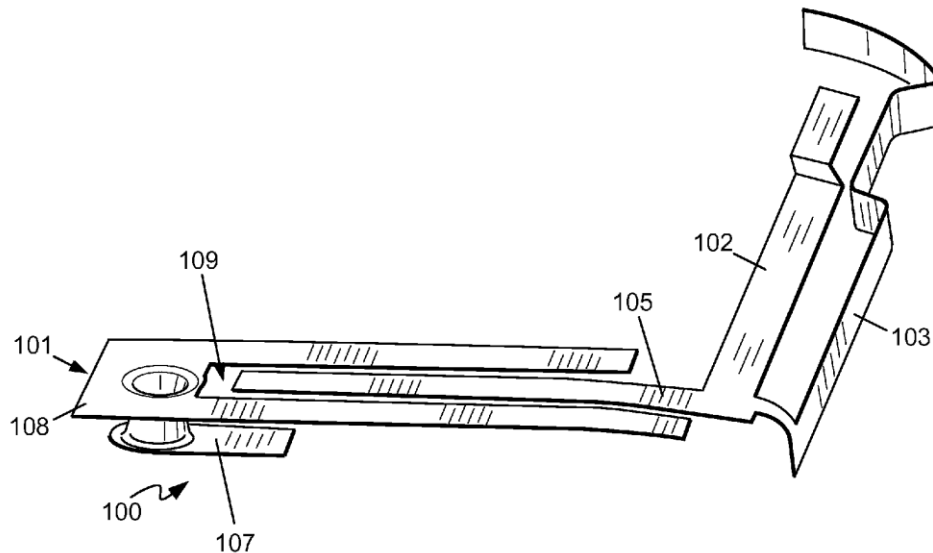
US 20140015718A1

(19) **United States**(12) **Patent Application Publication**
HANDRO et al.(10) **Pub. No.: US 2014/0015718 A1**(43) **Pub. Date: Jan. 16, 2014**(54) **TRI-BAND ANTENNA FOR NONCELLULAR WIRELESS APPLICATIONS**(76) Inventors: **Andreas HANDRO**, Munster (DE);
Michael KUHN, Bochum (DE);
Christopher WEHRMANN, Bochum (DE)(21) Appl. No.: **13/547,648**(22) Filed: **Jul. 12, 2012****Publication Classification**(51) **Int. Cl.**
H01Q 5/00 (2006.01)(52) **U.S. Cl.**CPC **H01Q 5/0031** (2013.01)USPC **343/745; 343/700 MS**

(57)

ABSTRACT

A tri-band antenna for noncellular wireless applications is provided. The antenna comprises: a first radiating arm for generating a first resonance in a first frequency band, the first radiating arm further enabled for connection to an antenna tuning circuit; the first radiating arm comprising a capacitive coupling structure; a coupling arm separated by a gap from the first radiating arm; a second radiating arm for generating a second resonance in a second frequency band lower than the first frequency band, the second radiating arm connected to the coupling arm such that the second radiating arm is capacitively coupled to the first radiating arm; and a third radiating arm for generating a third resonance in a third frequency band lower than the second frequency band, the third radiating arm connected to the coupling arm such that the third radiating arm is capacitively coupled to the first radiating arm.





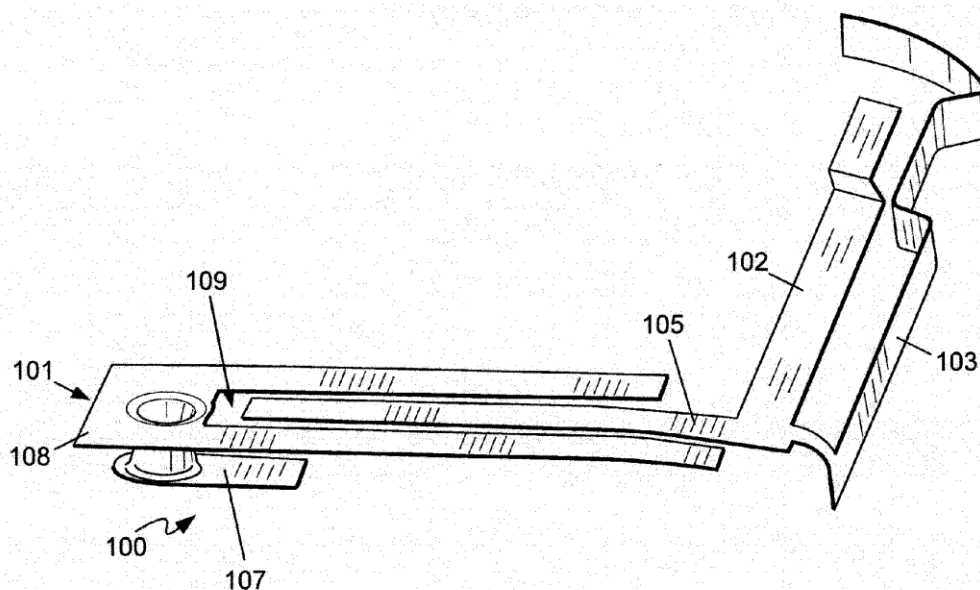
US 20140015720A1

(19) **United States**(12) **Patent Application Publication****Handro et al.**(10) **Pub. No.: US 2014/0015720 A1**(43) **Pub. Date: Jan. 16, 2014**(54) **TRI-BAND ANTENNA FOR NONCELLULAR WIRELESS APPLICATIONS**(71) Applicant: **Research In Motion Limited**, Waterloo (CA)(72) Inventors: **Andreas Handro**, Munster (DE);
Michael Kuhn, Bochum (DE);
Christopher Wehrmann, Bochum (DE)(21) Appl. No.: **13/940,071**(22) Filed: **Jul. 11, 2013**(30) **Foreign Application Priority Data**

Jul. 12, 2012 (EP) 12176191.0-2220

Publication Classification(51) **Int. Cl.**
H01Q 5/00 (2006.01)(52) **U.S. Cl.**
CPC **H01Q 5/0031** (2013.01); **H01Q 5/0027** (2013.01)
USPC **343/745**; **343/700 MS**(57) **ABSTRACT**

A tri-band antenna for noncellular wireless applications is provided. The antenna comprises: a first radiating arm for generating a first resonance in a first frequency band, the first radiating arm further enabled for connection to an antenna tuning circuit; the first radiating arm comprising a capacitive coupling structure; a coupling arm separated by a gap from the first radiating arm; a second radiating arm for generating a second resonance in a second frequency band lower than the first frequency band, the second radiating arm connected to the coupling arm such that the second radiating arm is capacitively coupled to the first radiating arm; and a third radiating arm for generating a third resonance in a third frequency band lower than the second frequency band, the third radiating arm connected to the coupling arm such that the third radiating arm is capacitively coupled to the first radiating arm.



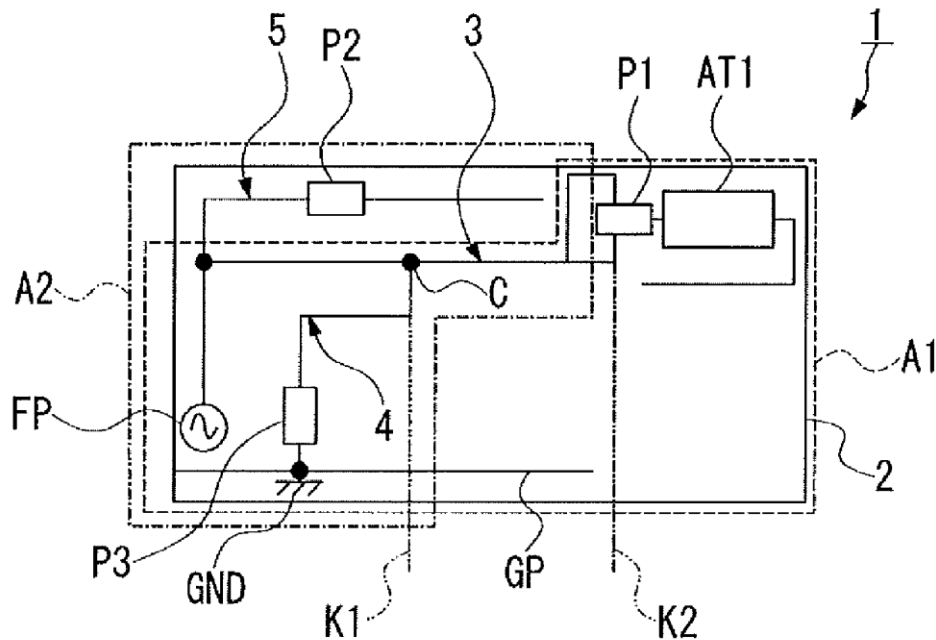


US 20140015721A1

(19) **United States**(12) **Patent Application Publication**
Yukimoto et al.(10) **Pub. No.: US 2014/0015721 A1**(43) **Pub. Date: Jan. 16, 2014**(54) **ANTENNA APPARATUS****Publication Classification**(71) Applicant: **MITSUBISHI MATERIALS CORPORATION**, Tokyo (JP)(51) **Int. Cl.**
H01Q 1/38 (2006.01)(72) Inventors: **Shinsuke Yukimoto**, Chichibu-Gun (JP);
Ryo Saito, Chichibu-Gun (JP)(52) **U.S. Cl.**
CPC **H01Q 1/38** (2013.01)
USPC **343/749**(73) Assignee: **MITSUBISHI MATERIALS CORPORATION**, Tokyo (JP)(57) **ABSTRACT**(21) Appl. No.: **13/899,165**(22) Filed: **May 21, 2013**(30) **Foreign Application Priority Data**

Nov. 24, 2010 (JP) 2010-261786

Provided is an antenna device which is capable of flexibly adjusting multiple resonance frequencies. The antenna device is provided with a substrate main body (2), a ground pattern (GP), a first element (3), a second element (4) and a third element (5).





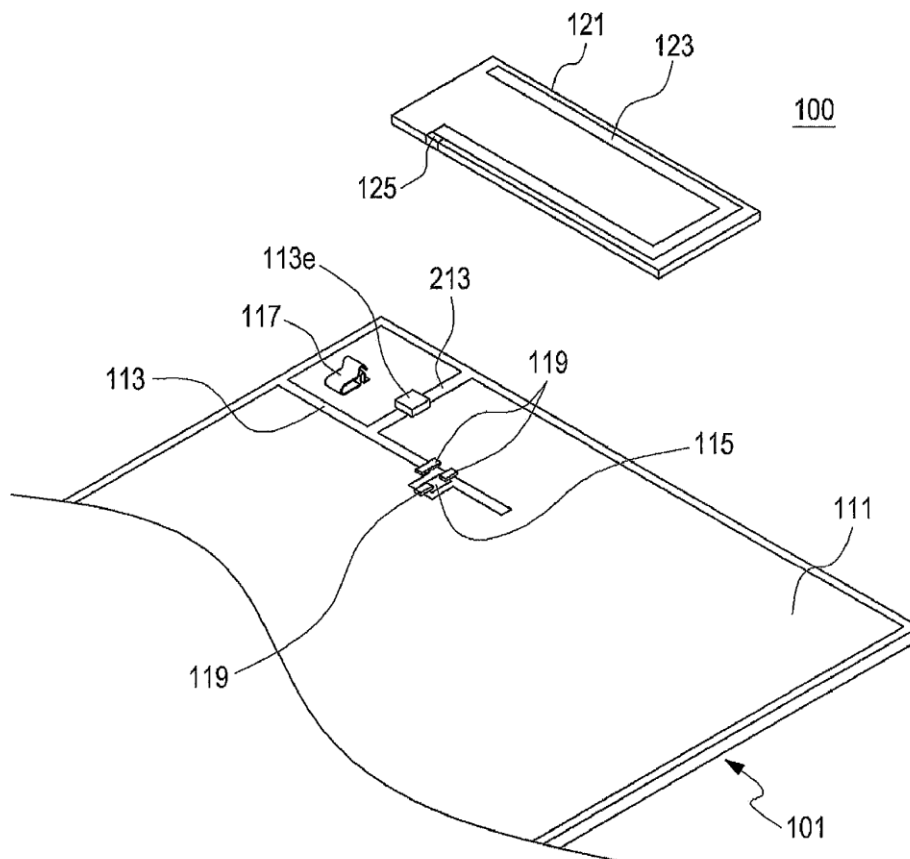
US 20140015723A1

(19) **United States**(12) **Patent Application Publication****Cho et al.**(10) **Pub. No.: US 2014/0015723 A1**(43) **Pub. Date: Jan. 16, 2014**(54) **BROADBAND VARIABLE ANTENNA DEVICE
AND PORTABLE TERMINAL HAVING THE
SAME**(71) Applicant: **Samsung Electronics Co., Ltd.**
Gyeonggi-do (KR)(72) Inventors: **Bum-Jin Cho**, Gyeonggi-do (KR);
Gyu-Sub Kim, Gyeonggi-do (KR);
Joon-Ho Byun, Gyeonggi-do (KR)(21) Appl. No.: **13/939,109**(22) Filed: **Jul. 10, 2013**(30) **Foreign Application Priority Data**

Jul. 10, 2012 (KR) 10-2012-0074930

Publication Classification(51) **Int. Cl.**
H01Q 13/10 (2006.01)(52) **U.S. Cl.**
CPC **H01Q 13/106** (2013.01); **H01Q 13/103**
(2013.01)
USPC **343/750**; **343/770**(57) **ABSTRACT**

Disclosed is an antenna device for a portable terminal, including a circuit board having a conductive layer attached on a surface, a first slit formed by partially removing the conductive layer in a position adjacent to one side of the circuit board, the first slit extending in parallel with a lateral periphery of the circuit board, a radiation portion comprising part of the conductive layer positioned on the lateral periphery of the circuit board in one side of the first slit, and a feed line placed on the first slit and adapted to feed the radiation portion from the other side of the first slit. The radiation portion further comprises a second slit extending from the first slit to the lateral periphery of the circuit board across part of the conductive layer forming the radiation portion, and a frequency adjustment element placed on the second slit.

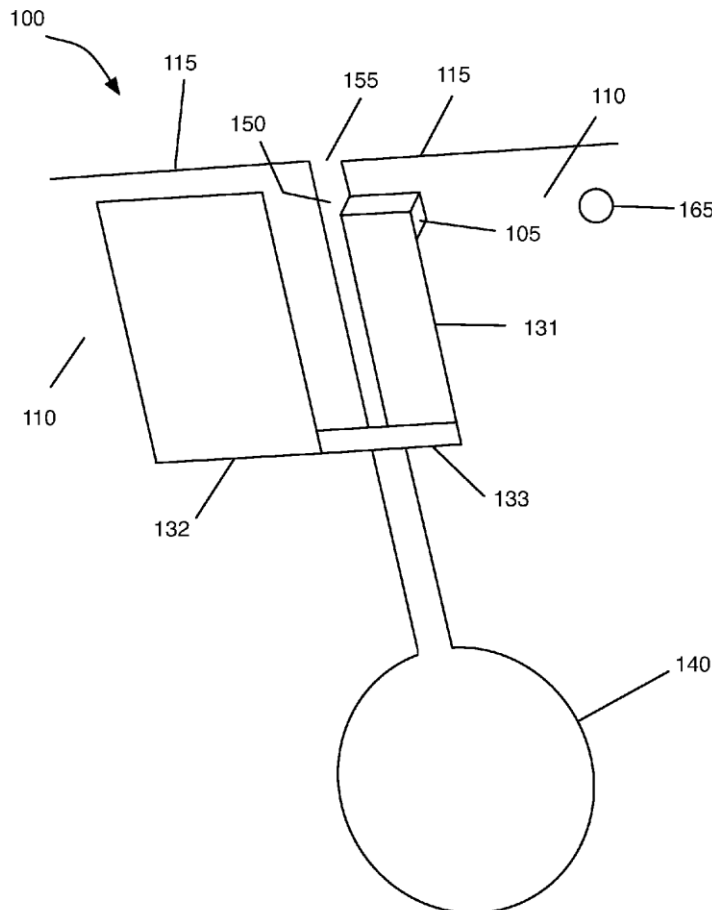




US 20140015724A1

(19) **United States**(12) **Patent Application Publication**
Bungo(10) **Pub. No.: US 2014/0015724 A1**(43) **Pub. Date: Jan. 16, 2014**(54) **ANTENNA APPARATUS AND TERMINAL
DEVICE ASSOCIATED WITH ANTENNA
APPARATUS**(52) **U.S. Cl.**
USPC **343/767**(75) Inventor: **Akihiro Bungo**, Tokyo (JP)(73) Assignee: **SONY MOBILE
COMMUNICATIONS JAPAN, INC.**,
Tokyo (JP)(21) Appl. No.: **13/545,488**(22) Filed: **Jul. 10, 2012****Publication Classification**(51) **Int. Cl.**
H01Q 13/10 (2006.01)(57) **ABSTRACT**

An antenna apparatus may include a conductor layer having an aperture and a slit that adjoins the aperture; and a resonance tuning component including a first element, a second element, and a third element coupled with the first and second elements. The slit may have an opening at a periphery of the conductor layer. A first gap may be arranged between the first element and the conductor layer. At least a part of the first element may be coupled with the conductor layer. A second gap may be arranged between the second element and the conductor layer. The antenna apparatus may include a capacitor and an inductor. The capacitor may be connected with the inductor in parallel between the first element and the conductor layer. The terminal device may include the antenna apparatus.





(12) **Patent Application Publication**
HONG et al.

(43) **Pub. Date:** Jan. 16, 2014

(52) **U.S. Cl.**
USPC 343/841; 343/872

(57) **ABSTRACT**

An all-metal casing structure includes a casing unit, a first substrate unit, a second substrate unit, an antenna unit and a conductive unit. The casing unit includes at least one metal casing having at least one through opening. The first substrate unit includes at least one first substrate body disposed in the metal casing and neighboring to the through opening. The second substrate unit includes at least one second substrate body disposed in the metal casing and neighboring to the first substrate body. The antenna unit includes at least one antenna module disposed on the first substrate body and corresponding to the through opening, and the antenna module is electrically connected to the second substrate body. The conductive unit includes at least two conductive elements separated from each other by a predetermined distance and electrically connected between the metal casing and the first substrate body.

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Uejima et al.(10) **Pub. No.: US 2014/0015729 A1**(43) **Pub. Date: Jan. 16, 2014**(54) **ANTENNA DEVICE****Publication Classification**(75) Inventors: **Hiroyuki Uejima**, Ishikawa (JP); **Yoshio Koyanagi**, Kanagawa (JP); **Suguru Kojima**, Kanagawa (JP); **Takanori Hirobe**, Ishikawa (JP); **Kouta Aoki**, Kanagawa (JP); **Masao Ootani**, Kanagawa (JP)(51) **Int. Cl.**
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USPC 343/850(73) Assignee: **PANASONIC CORPORATION**, Osaka (JP)(21) Appl. No.: **14/007,896**(22) PCT Filed: **Jun. 6, 2012**(86) PCT No.: **PCT/JP2012/003714**§ 371 (c)(1),
(2), (4) Date: **Sep. 26, 2013**(57) **ABSTRACT**

A first antenna element **102**, a second antenna element **103**, and a MEMS (micro-electromechanical system) switch **104** are provided, and a feeding point **110** is provided at one end of the first antenna element **102**. The other end **113** of the first antenna element **102** is connected to a first terminal **106** of the MEMS switch **104**, and one end **114** of the second antenna element **103** is connected to a second terminal **107** of the MEMS switch **104**. The one end of the first antenna element **102** is grounded to a ground pattern **101** via an inductor **115**, and a ground terminal **105** of the MEMS switch **104** is connected to the other end **113** of the first antenna element **102**.

