



US 20150270602A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0270602 A1**

(43) **Pub. Date: Sep. 24, 2015**

(54) **ANTENNA DEVICE OF MOBILE TERMINAL**

Publication Classification

(71) Applicant: **Samsung Electronics Co., Ltd.**,
Gyeonggi-do (KR)

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

(72) Inventors: **Sang Bong SUNG**, Gyeongsangbuk-do
(KR); **In Jin Hwang**,
Gyeongsangbuk-do (KR)

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

(21) Appl. No.: **14/731,801**

(57) **ABSTRACT**

(22) Filed: **Jun. 5, 2015**

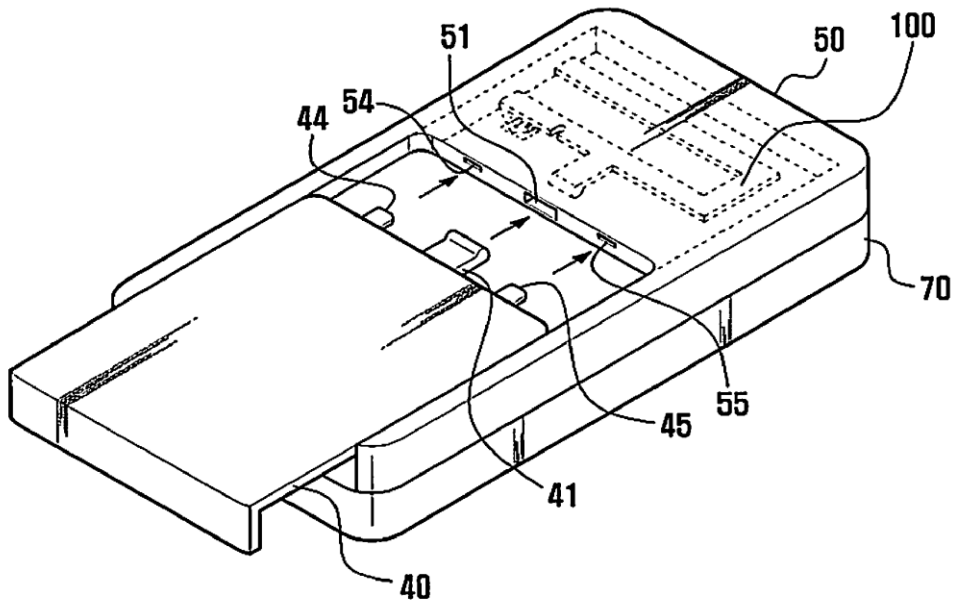
Related U.S. Application Data

(63) Continuation of application No. 13/962,483, filed on Aug. 8, 2013, now Pat. No. 9,054,419, which is a continuation of application No. 13/458,453, filed on Apr. 27, 2012, now Pat. No. 8,531,342, which is a continuation of application No. 12/489,044, filed on Jun. 22, 2009, now Pat. No. 8,188,930.

Foreign Application Priority Data

(30) Jun. 20, 2008 (KR) 10-2008-0058619

Various mobile communication terminals, apparatuses, and methods having antenna improvements are discussed. An apparatus is described which includes an outer front side having a display disposed therein; an outer rear side a conductive part and a non-conductive part; a battery disposed between the outer front side and the outer rear side; and an antenna including a radiation unit capable of receiving a signal, at least a portion of the radiation unit being disposed between the outer front side and the non-conductive part of the outer rear side, a feeding unit which electrically connects the radiation unit to a circuit board, and a ground part which electrically connects the radiation unit to the conductive part of the outer rear side.





US 20150270606A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0270606 A1**

(43) **Pub. Date: Sep. 24, 2015**

(54) **HANDHELD DEVICE**

Publication Classification

(71) Applicant: **Acer Incorporated**, New Taipei City (TW)

(51) **Int. Cl.**
H01Q 1/48 (2006.01)
H01Q 1/24 (2006.01)

(72) Inventors: **Chih-Hua Chang**, New Taipei City (TW); **Wan-Chu Wei**, New Taipei City (TW)

(52) **U.S. Cl.**
CPC . *H01Q 1/48* (2013.01); *H01Q 1/243* (2013.01)

(21) Appl. No.: **14/334,682**

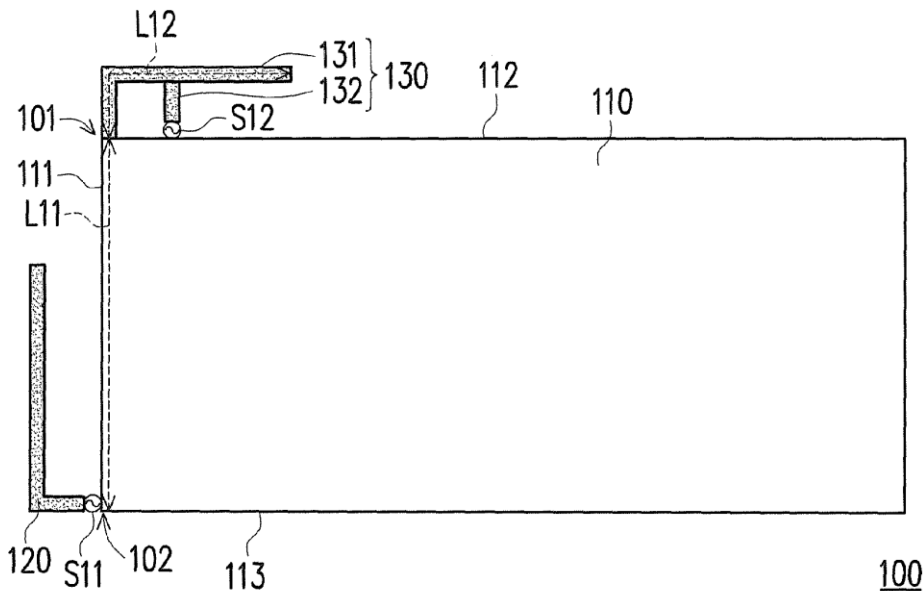
(57) **ABSTRACT**

(22) Filed: **Jul. 18, 2014**

A handheld device including a ground plane, a first antenna element and a second antenna element is provided. The ground plane includes a short edge and a first long edge adjacent to each other to form a first corner. The first antenna element is opposite to the short edge of the ground plane. The second antenna element is opposite to the first long edge of the ground plane and includes a first radiation portion. An end of the first radiation portion is electrically connected to the first long edge and adjacent to the first corner. The handheld device uses the second antenna element to adjust an equivalent ground plane length of the first antenna element.

(30) **Foreign Application Priority Data**

Mar. 19, 2014 (TW) 103110323





US 20150270613A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0270613 A1**

(43) **Pub. Date: Sep. 24, 2015**

(54) **BROADBAND SWITCHABLE ANTENNA**

(52) **U.S. Cl.**

CPC *H01Q 9/0442* (2013.01)

(71) Applicant: **FutureWei Technologies, Inc.**, Plano, TX (US)

(57)

ABSTRACT

(72) Inventors: **Wee Kian Toh**, San Diego, CA (US);
Ping Shi, San Diego, CA (US)

System and method embodiments are provided for a broadband switchable antenna. The embodiments enable an easily tunable, temporally switchable antenna with good low- and high-band performance with controlled high impedance loci that easily coexists with other wireless device components. In an embodiment, a broadband switchable antenna includes an antenna feed; a high-band antenna arm comprising a first end electrically coupled to an antenna feed and a second end electrically coupled to ground; a switch coupled to the antenna feed at a position proximate to the first end of the high-band antenna arm; and a low-band antenna arm comprising a first end electrically coupled to the switch, wherein the antenna is configured to operate in a high-band mode when the switch is open and to operate in a low-band mode when the switch is closed.

(73) Assignee: **FutureWei Technologies, Inc.**, Plano, TX (US)

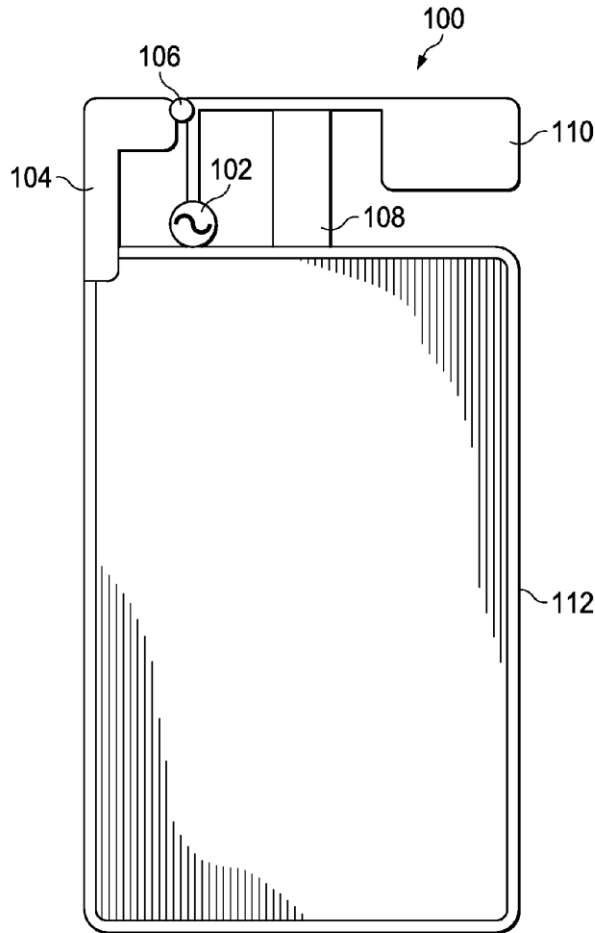
(21) Appl. No.: **14/219,292**

(22) Filed: **Mar. 19, 2014**

Publication Classification

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

(2006.01)





US 20150270614A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0270614 A1**

(43) **Pub. Date: Sep. 24, 2015**

(54) **ANTENNA**

Publication Classification

(71) Applicants: **DENSO CORPORATION**, Aichi (JP);
NIPPON SOKEN, INC., Aichi (JP)

(51) **Int. Cl.**
H01Q 9/06 (2006.01)

H01Q 7/00 (2006.01)

(72) Inventors: **Yuuji Kakuya**, Okazaki-city (JP);
Munenori Matsumoto, Kariya-city (JP);
Akira Takaoka, Okazaki-city (JP);
Toshifumi Shimoda, Anjo-city (JP);
Takatoshi Sekizawa, Kariya-city (JP);
Nobuya Watabe, Nagoya-city (JP)

(52) **U.S. Cl.**
CPC . **H01Q 9/065** (2013.01); **H01Q 7/00** (2013.01)

(57) **ABSTRACT**

(21) Appl. No.: **14/436,124**

(22) PCT Filed: **Oct. 23, 2013**

(86) PCT No.: **PCT/JP2013/006255**

§ 371 (c)(1),

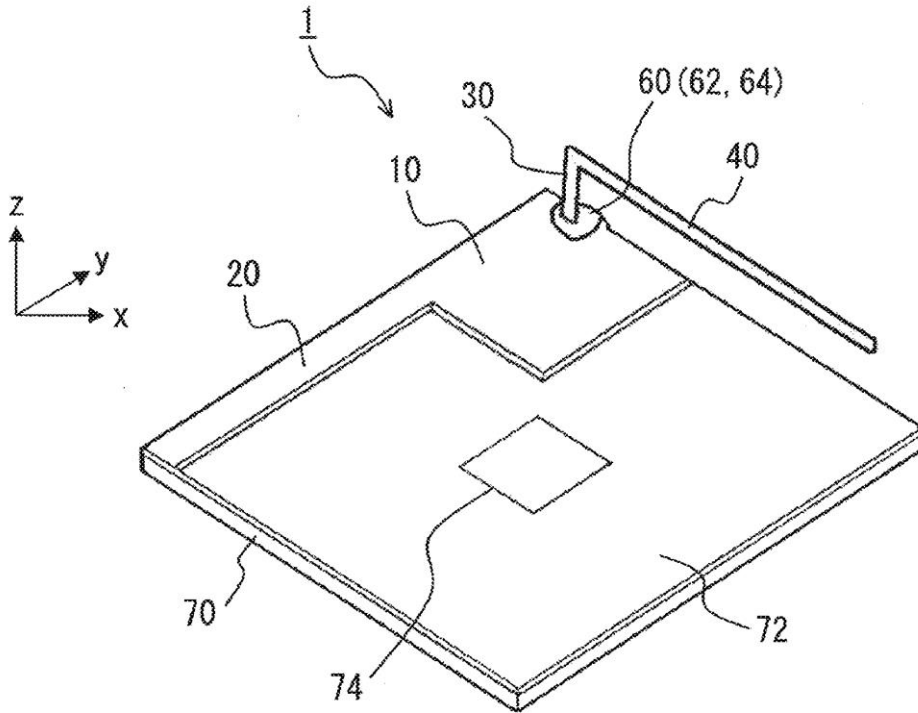
(2) Date: **Apr. 16, 2015**

In an antenna, a first element is connected to a GND of a feeder, on the same plane as a GND of a wireless circuit, and isolated from the GND of the wireless circuit. A second element is on the same plane as the GND of the wireless circuit and a first end connected to the first element and a second end as an open end. The third element has a first end connected to a power source of the feeder and located in a region occupied by the first element perpendicularly to the first element so that its first end source faces down. The fourth element has a first end connected to a second end of the third element and a second end as an open end, is parallel to the first element, and is perpendicular to a line connecting the first and second ends of the second element.

(30) **Foreign Application Priority Data**

Oct. 24, 2012 (JP) 2012-234802

Oct. 16, 2013 (JP) 2013-215644





US 20150270618A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0270618 A1**

(43) **Pub. Date: Sep. 24, 2015**

(54) **ELECTRONIC DEVICE WITH INDIRECTLY FED SLOT ANTENNAS**

Publication Classification

(71) Applicant: **Apple Inc.**, Cupertino, CA (US)

(51) **Int. Cl.**
H01Q 13/10 (2006.01)
H01Q 1/22 (2006.01)
H01Q 1/24 (2006.01)

(72) Inventors: **Jiang Zhu**, Sunnyvale, CA (US); **Harish Rajagopalan**, Cupertino, CA (US); **Rodney A. Gomez Angulo**, Sunnyvale, CA (US); **Qingxiang Li**, Mountain View, CA (US); **Robert W. Schlub**, Cupertino, CA (US); **John Raff**, Menlo Park, CA (US)

(52) **U.S. Cl.**
CPC *H01Q 13/10* (2013.01); *H01Q 1/243* (2013.01); *H01Q 1/2258* (2013.01)

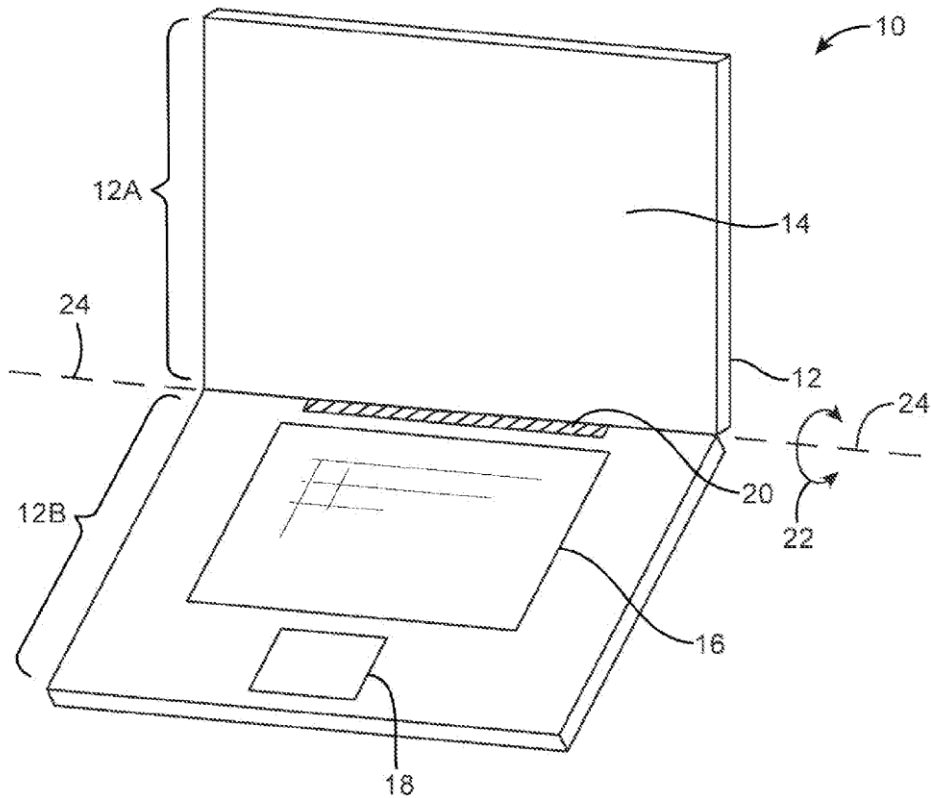
(73) Assignee: **Apple Inc.**, Cupertino, CA (US)

(57) **ABSTRACT**

An electronic device may be provided with antennas. Antennas for the electronic device may be formed from slot antenna structures. A slot antenna structure may be formed from portions of a metal housing for an electronic device. The slots of the slot antenna structures may be indirectly fed to form first and second indirectly fed slot antennas. The first and second indirectly fed slot antennas may be formed from slots in a rear surface of an electronic device and a sidewall of the electronic device. The slots may have open ends along an edge of the sidewall and may have closed ends that face each other. A hybrid antenna may also be formed in the electronic device.

(21) Appl. No.: **14/220,467**

(22) Filed: **Mar. 20, 2014**





US 20150270619A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0270619 A1**

(43) **Pub. Date: Sep. 24, 2015**

(54) **ELECTRONIC DEVICE WITH SLOT ANTENNA AND PROXIMITY SENSOR**

(52) **U.S. Cl.**
CPC **H01Q 13/10** (2013.01); **H01Q 1/2266** (2013.01); **H01Q 1/243** (2013.01); **G01V 3/00** (2013.01)

(71) Applicant: **Apple Inc.**, Cupertino, CA (US)

(72) Inventors: **Jiang Zhu**, Sunnyvale, CA (US);
Rodney A. Gomez Angulo, Sunnyvale, CA (US); **Qingxiang Li**, Mountain View, CA (US)

(57) **ABSTRACT**

(73) Assignee: **Apple Inc.**, Cupertino, CA (US)

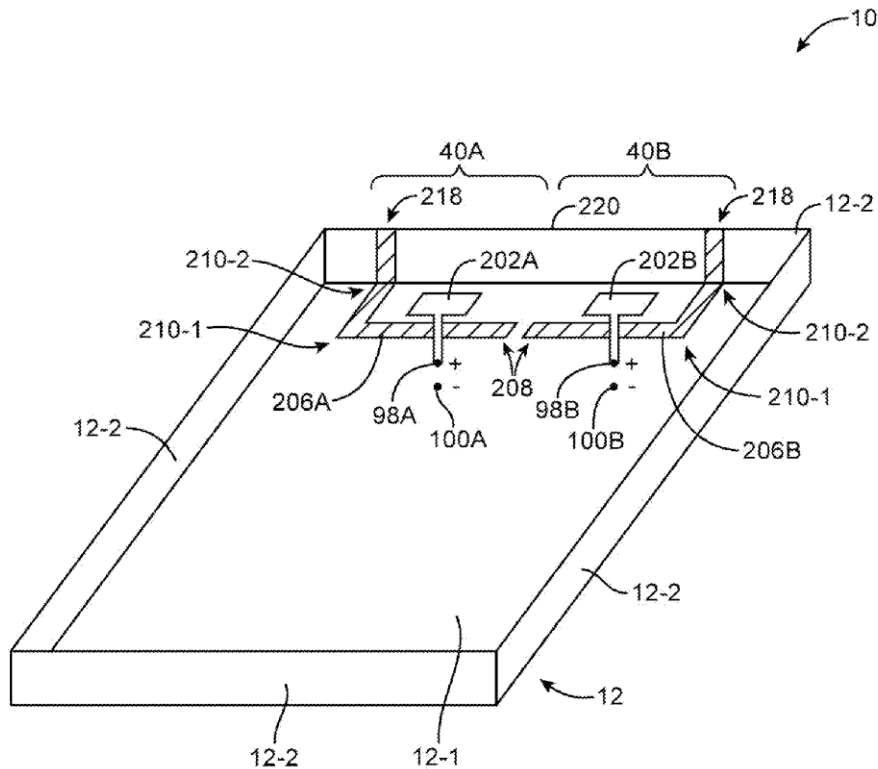
(21) Appl. No.: **14/221,133**

(22) Filed: **Mar. 20, 2014**

An electronic device may be provided with slot antennas. A slot antenna may be formed from metal structures that have a dielectric gap defining an antenna slot. The metal structures may include multiple metal layers that overlap a plastic antenna window and that serve as capacitive electrodes in a capacitive proximity sensor. The metal structures may also include a metal electronic device housing. The metal electronic device housing and the metal layers may be formed on opposing sides of the antenna slot. The metal layers may have a notch that locally widens the antenna slot at an open end of the antenna slot. One of the metal layers may be shorted to the metal electronic device housing at an opposing closed end of the antenna slot. The antenna slot may be indirectly fed using a near-field-coupled antenna feed structure such as a metal patch that overlaps the antenna slot.

Publication Classification

(51) **Int. Cl.**
H01Q 13/10 (2006.01)
H01Q 1/24 (2006.01)
G01V 3/00 (2006.01)
H01Q 1/22 (2006.01)





US 20150280311A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0280311 A1**
(43) **Pub. Date: Oct. 1, 2015**

(54) **SYSTEMS AND METHODS FOR A SURFACE-MOUNTABLE STAMPED ANTENNA**

B23K 1/20 (2006.01)
H01Q 1/50 (2006.01)
B23K 1/00 (2006.01)

(71) Applicant: **MOTOROLA MOBILITY LLC**,
CHICAGO, IL (US)

(52) **U.S. CL.**
CPC *H01Q 1/243* (2013.01); *H01Q 1/50*
(2013.01); *B23K 1/0016* (2013.01); *B23K 1/20*
(2013.01); *B23K 31/02* (2013.01)

(72) Inventors: **Lynn M. Greetis**, Palatine, IL (US); **Se Hun Chung**, Libertyville, IL (US); **Kah Jon Goo**, Carpentersville, IL (US); **Soo Won Hong**, Vernon Hills, IL (US); **Michael L. Johnson**, Carol Stream, IL (US)

(57) **ABSTRACT**

(73) Assignee: **MOTOROLA MOBILITY LLC**,
CHICAGO, IL (US)

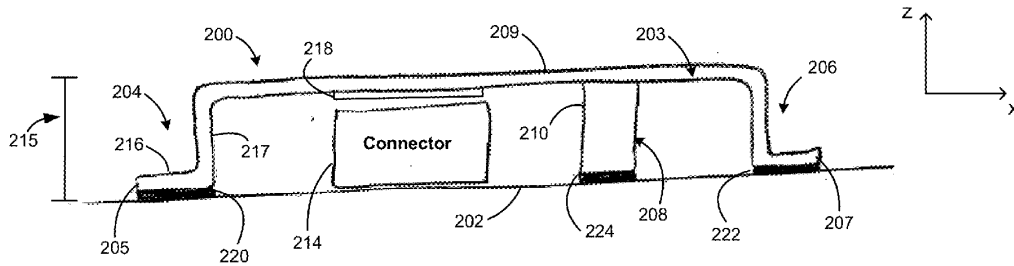
Systems and methods are provided for an antenna structure (100) configured for attachment to a circuit board (102). The antenna structure includes a main body (103) having a first end (105), a second end (107) opposite from the first end, and a side (109) extending between the first end and the second end. The antenna structure further includes a first support (104) formed from the first end, a second support (106) formed from the second end, and a third support (108) extending from the side of the main body. The main body, the first support, the second support, and the third support are formed from a single conductive sheet. Each of the supports is mechanically attached to the circuit board, and only one of the supports is electrically coupled to an antenna feed of the circuit board.

(21) Appl. No.: **14/229,080**

(22) Filed: **Mar. 28, 2014**

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
B23K 31/02 (2006.01)





US 20150280312A1

(19) **United States**

(12) **Patent Application Publication**
Poggio

(10) **Pub. No.: US 2015/0280312 A1**

(43) **Pub. Date: Oct. 1, 2015**

(54) **PORTABLE ELECTRONIC DEVICE WITH
MERGED REAR HOUSING AND ANTENNA**

Publication Classification

(75) Inventor: **Frank Thomas Poggio**, Rolling Meadows, IL (US)

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

(73) Assignee: **BlackBerry Limited**, Waterloo, ON (CA)

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

(21) Appl. No.: **14/420,849**

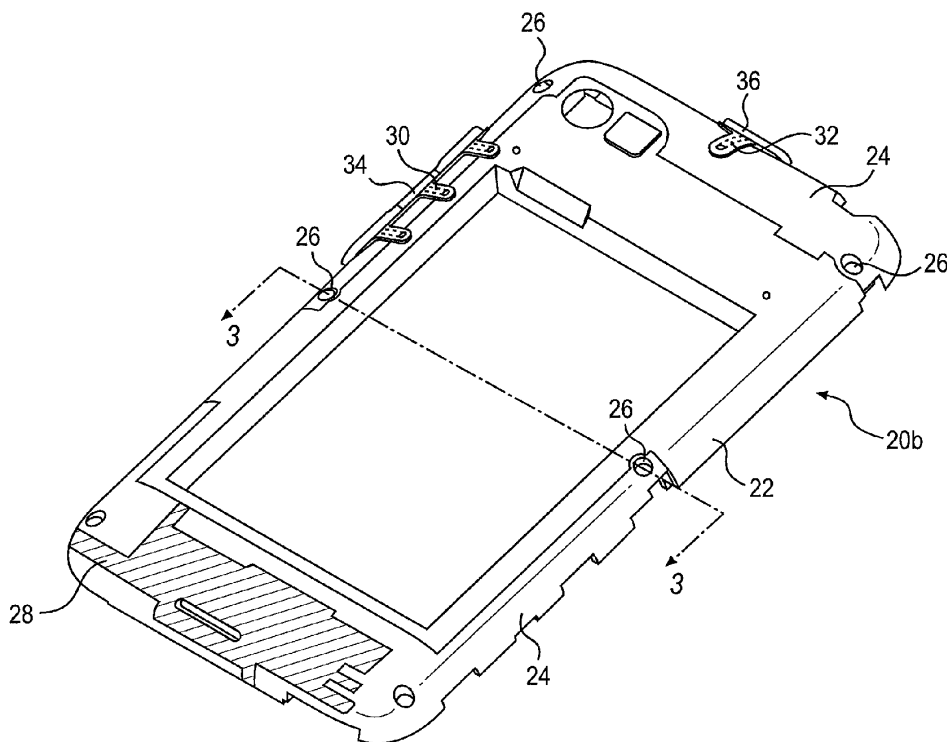
(57) **ABSTRACT**

(22) PCT Filed: **Aug. 10, 2012**

(86) PCT No.: **PCT/US12/50412**

§ 371 (c)(1),
(2), (4) Date: **May 28, 2015**

A portable electronic device includes a rear housing formed entirely of a modified plastic material configured for laser direct structuring, and an antenna formed on a surface of the rear housing using laser direct structuring.





US 20150280318A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0280318 A1**

(43) **Pub. Date: Oct. 1, 2015**

(54) **COMBINATION LTE AND WIGIG ANTENNA**

Publication Classification

(71) Applicant: **Intel Corporation**, Santa Clara, CA (US)

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

(72) Inventors: **Songnan Yang**, San Jose, CA (US);
Helen K. Pan, Portland, OR (US);
Manish A. Hiranandani, Santa Clara, CA (US);
Fan (Cherry) Xia, Shanghai (CN);
Ulun Karacaoglu, San Diego, CA (US)

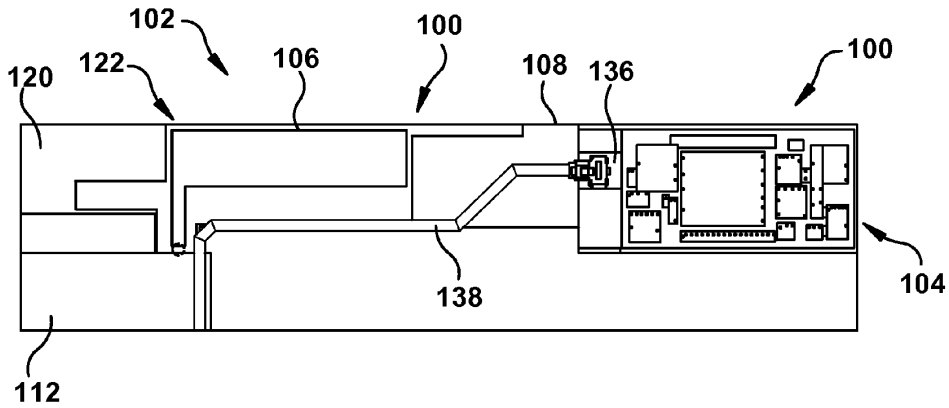
(52) **U.S. Cl.**
CPC **H01Q 1/48** (2013.01)

(57) **ABSTRACT**

A combined antenna device includes a coupled feed antenna including a first grounded coupling element and a millimeter wave phased array antenna having a ground plane structure including a portion of the first grounded coupling element.

(21) Appl. No.: **14/230,316**

(22) Filed: **Mar. 31, 2014**





US 20150280319A1

(19) **United States**

(12) **Patent Application Publication**
Yeh

(10) **Pub. No.: US 2015/0280319 A1**

(43) **Pub. Date: Oct. 1, 2015**

(54) **FREQUENCY-SWITCHABLE ACTIVE ANTENNA SYSTEM AND CONTROL METHOD THEREOF**

(52) **U.S. Cl.**
CPC ... *H01Q 3/00* (2013.01); *H01Q 1/50* (2013.01)

(71) Applicant: **Ming-Hao Yeh**, New Taipei City (TW)

(57) **ABSTRACT**

(72) Inventor: **Ming-Hao Yeh**, New Taipei City (TW)

(21) Appl. No.: **14/311,959**

(22) Filed: **Jun. 23, 2014**

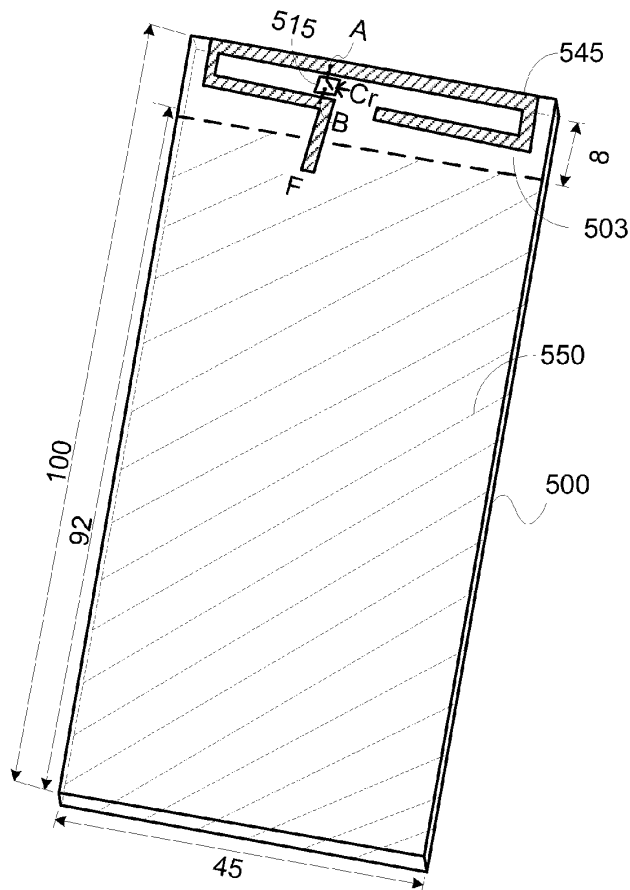
(30) **Foreign Application Priority Data**

Mar. 28, 2014 (TW) 103111766

Publication Classification

(51) **Int. Cl.**
H01Q 3/00 (2006.01)
H01Q 1/50 (2006.01)

An active antenna system includes a printed circuit board, an antenna radiation element, a metal ground surface, and a first switching circuit. The printed circuit board has an antenna clearance region. The antenna radiation element has a feed port, a first physical position and a second physical position. The metal ground surface is formed on a first layer of the printed circuit board and outside the antenna clearance region. A first terminal of the first switching circuit is connected to the first physical position. A second terminal of the first switching circuit is connected to the second physical position. A control terminal of the first switching circuit receives a control signal. The first physical position and the second physical position are selectively connected with each other or disconnected from each other according to the control signal.





US 20150280323A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0280323 A1**
(43) **Pub. Date: Oct. 1, 2015**

(54) **SPACE SAVING MULTIBAND ANTENNA**

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

(71) Applicant: **MICROSOFT TECHNOLOGY LICENSING, LLC**, Redmond, WA (US)

CPC **H01Q 9/0414** (2013.01); **H01Q 5/335** (2015.01); **H01Q 5/328** (2015.01)

(72) Inventors: **Luyi Liu**, Sammamish, WA (US); **Devis Iellici**, Cambridge (GB)

(57) **ABSTRACT**

(21) Appl. No.: **14/440,561**

There is disclosed a multiband antenna device comprising a conductive elongate antenna element configured for electrical connection to a conductive groundplane at a grounding point, and for electrical connection to a radio transmitter/receiver at a feeding point. The antenna element comprises a first portion and a second portion. The first portion is configured to extend in a first direction along a first outside edge of the groundplane, and then in a second direction along a second outside edge of the groundplane. The second portion of the antenna element is configured to double back next to the first portion in a third, substantially counter-parallel direction back along the second outside edge of the groundplane, and then in a fourth direction along the first outside edge of the groundplane. The second portion of the antenna element terminates with a high impedance portion, and the high impedance portion of the antenna element is positioned between the first edge of the ground plane and the first portion of the antenna element so as to form a narrow gap that electromagnetically couples the first and second portions of the antenna element.

(22) PCT Filed: **Nov. 8, 2013**

(86) PCT No.: **PCT/US2013/069342**

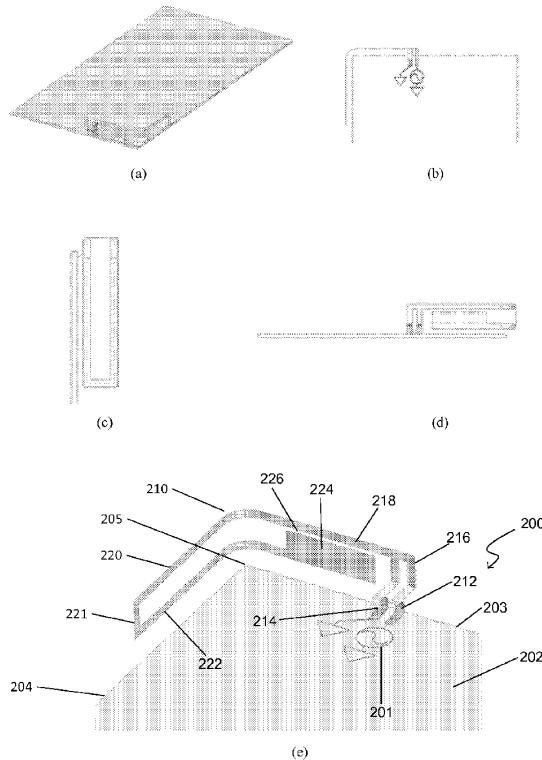
§ 371 (c)(1),
(2) Date: **May 4, 2015**

(30) **Foreign Application Priority Data**

Nov. 8, 2012 (GB) 1220131.5

Publication Classification

(51) **Int. Cl.**
H01Q 9/04 (2006.01)
H01Q 5/328 (2006.01)
H01Q 5/335 (2006.01)



Basic embodiment of the antenna



US 20150280771A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0280771 A1**

(43) **Pub. Date: Oct. 1, 2015**

(54) **TUNABLE ANTENNA SYSTEMS**

(52) **U.S. Cl.**

CPC **H04B 1/40** (2013.01)

(71) Applicant: **Apple Inc.**, Cupertino, CA (US)

(72) Inventors: **Matthew A. Mow**, Los Altos, CA (US);
Robert W. Schlub, Cupertino, CA (US);
Mattia Pascolini, San Francisco, CA (US);
Robert J. Hill, Salinas, CA (US);
Ruben Caballero, San Jose, CA (US)

(57)

ABSTRACT

An electronic device has wireless communications circuitry including an adjustable antenna system coupled to a radio-frequency transceiver. The adjustable antenna system may include one or more adjustable electrical components that are controlled by storage and processing circuitry in the electronic device. The adjustable electrical components may include switches and components that can be adjusted between numerous different states. The adjustable electrical components may be coupled between antenna system components such as transmission line elements, matching network elements, antenna elements and antenna feeds. By adjusting the adjustable electrical components, the storage and processing circuitry can tune the adjustable antenna system to ensure that the adjustable antenna system covers communications bands of interest.

(21) Appl. No.: **14/737,394**

(22) Filed: **Jun. 11, 2015**

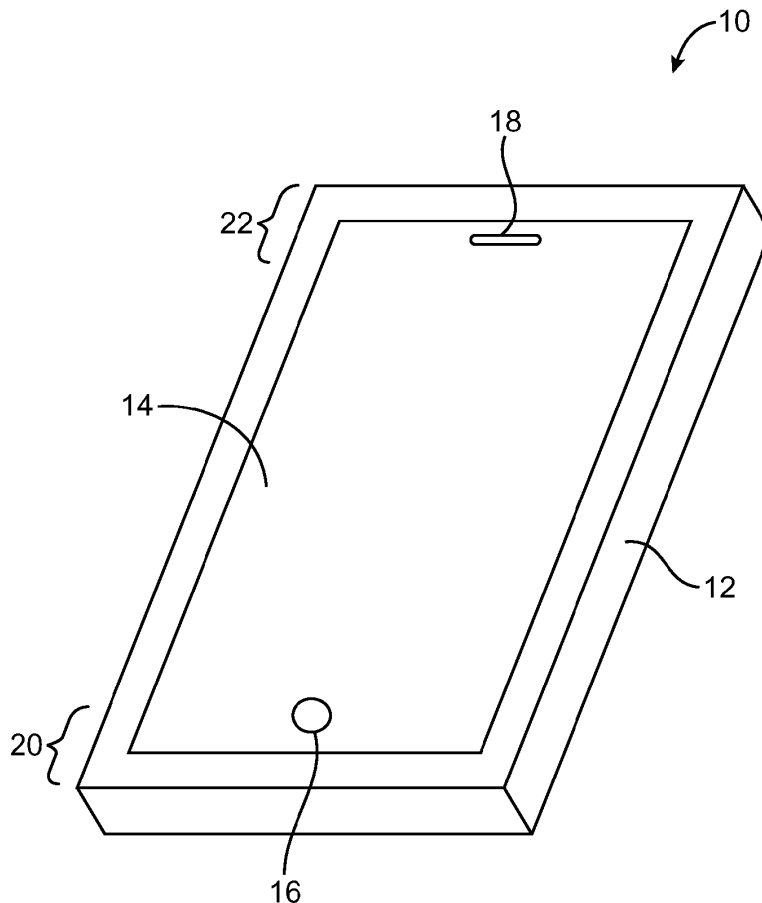
Related U.S. Application Data

(63) Continuation of application No. 12/831,180, filed on Jul. 6, 2010, now Pat. No. 9,070,969.

Publication Classification

(51) **Int. Cl.**
H04B 1/40

(2006.01)





US 20150288055A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0288055 A1**

(43) **Pub. Date: Oct. 8, 2015**

(54) **ANTENNA MODULE AND ELECTRONIC DEVICES COMPRISING THE SAME**

(71) Applicant: **Samsung Electronics Co., Ltd.**,
Suwon-si (KR)

(72) Inventors: **Byeong Hwan YOUM**, Suwon-si (KR);
Jong Kwon KO, Suwon-si (KR); **Hyung Jin KIM**, Seoul (KR); **Seung Hwan KIM**, Seoul (KR); **Kyung Bin KIM**, Hwaseong-si (KR); **Austin KIM**, Seongnam-si (KR); **Joon Ho BYUN**, Yongin-si (KR); **Yu Ri SIN**, Seoul (KR)

(21) Appl. No.: **14/677,217**

(22) Filed: **Apr. 2, 2015**

(30) **Foreign Application Priority Data**

Apr. 4, 2014 (KR) 10-2014-0040492
Apr. 7, 2014 (KR) 10-2014-0041476

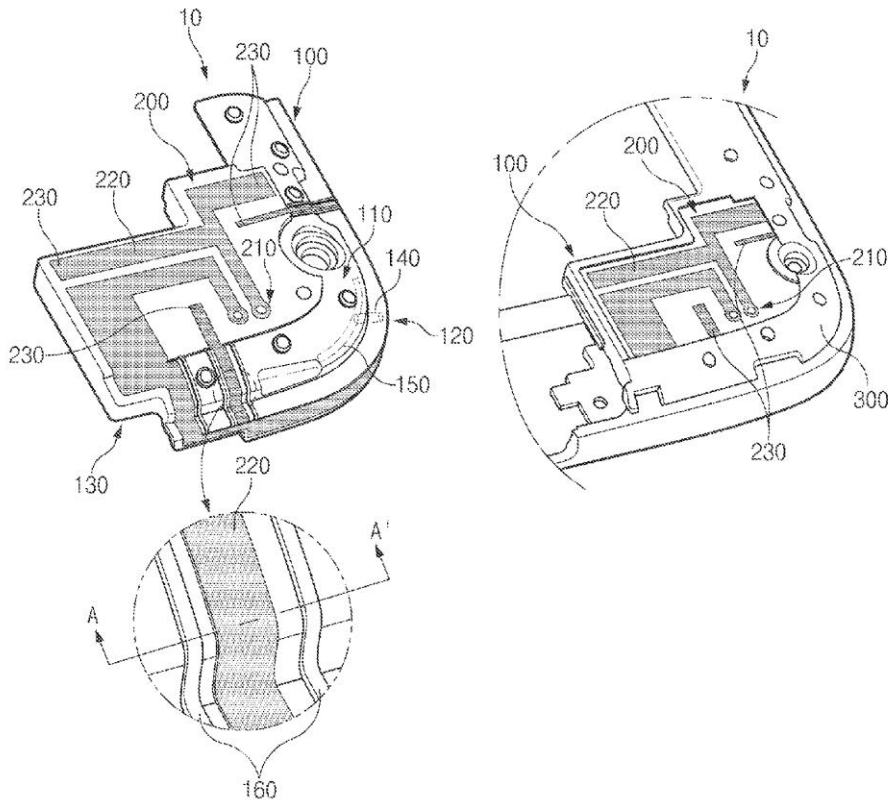
Publication Classification

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

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

(57) **ABSTRACT**

An antenna module and an electronic device are provided. The antenna module may include a first case including a case surface, wherein at least one antenna protection part is disposed on the first case, and wherein the at least one antenna projection part is formed to be distinguishable from the case surface, an antenna including a pattern, wherein at least a part of the pattern of the antenna is adjacently disposed to the antenna protection part.





US 20150288056A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0288056 A1**

(43) **Pub. Date: Oct. 8, 2015**

(54) **ELECTRONIC DEVICE CASE WITH
ANTENNA AND ELECTRONIC DEVICE FOR
USE THEREWITH**

Publication Classification

(71) Applicant: **Samsung Electronics Co., Ltd.**,
Gyeonggi-do (KR)

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 21/30 (2006.01)
H01Q 1/50 (2006.01)

(72) Inventors: **Chi Jeong CHOI**, Gyeonggi-do (KR);
Yun Bum LEE, Busan (KR)

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 1/50*
(2013.01); *H01Q 21/30* (2013.01)

(73) Assignee: **Samsung Electronics Co., Ltd.**

(57) **ABSTRACT**

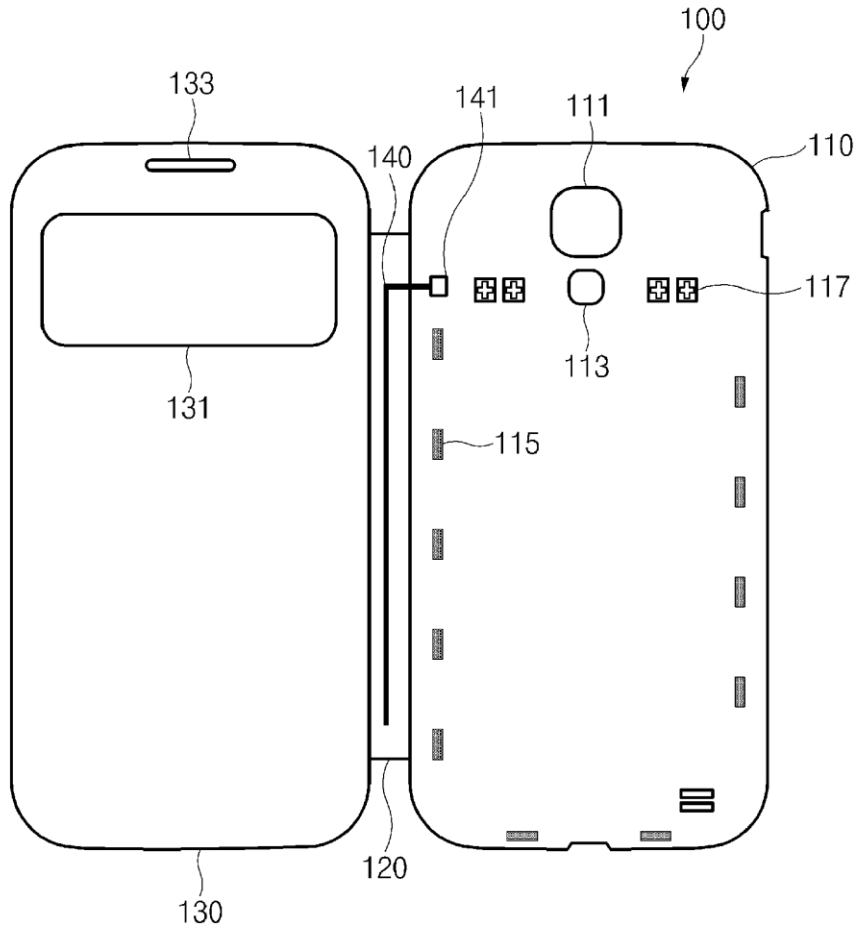
(21) Appl. No.: **14/678,191**

A case for an electronic device is provided. The case includes a rear cover configured to attach to at least a portion of a rear side of the electronic device, and a front cover configured to removably cover at least a portion of a front side of the electronic device. The case also includes a connection portion that connects the front cover and the rear cover, and includes an antenna structure for transmitting and receiving signals in at least one frequency band.

(22) Filed: **Apr. 3, 2015**

(30) **Foreign Application Priority Data**

Apr. 3, 2014 (KR) 10-2014-0039845





US 20150288059A1

(19) **United States**

(12) **Patent Application Publication**
Zuniga

(10) **Pub. No.: US 2015/0288059 A1**

(43) **Pub. Date: Oct. 8, 2015**

(54) **LOW-COST ULTRA WIDEBAND LTE ANTENNA**

Publication Classification

(71) Applicant: **Eleazar ZUNIGA**, Escondido, CA (US)

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 5/10 (2006.01)
H01Q 5/364 (2006.01)

(72) Inventor: **Eleazar Zuniga**, Escondido, CA (US)

(73) Assignee: **TAOGLAS GROUP HOLDINGS LIMITED, INC.**, Wexford (IE)

(52) **U.S. Cl.**
CPC **H01Q 1/38** (2013.01); **H01Q 5/364** (2015.01); **H01Q 5/10** (2015.01)

(21) Appl. No.: **14/438,611**

(22) PCT Filed: **Oct. 8, 2013**

(57) **ABSTRACT**

(86) PCT No.: **PCT/US13/63947**

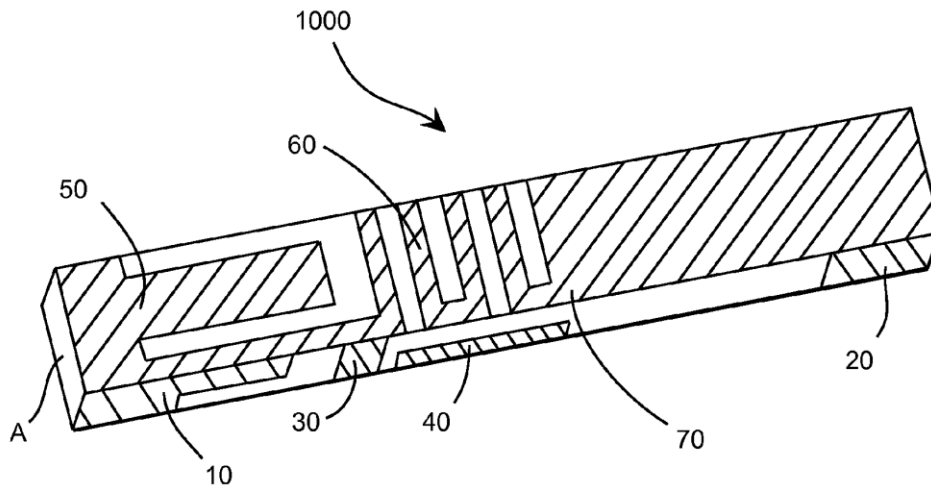
§ 371 (c)(1),

(2) Date: **May 1, 2015**

Related U.S. Application Data

(60) Provisional application No. 61/711,196, filed on Oct. 8, 2012.

An antenna capable of operating among all LTE bands, and also capable of operation among all remote side cellular applications, such as GSM, AMPS, GPRS, CDMA, WCDMA, UMTS, and HSPA among others. The antenna provides a low cost alternative to active-tunable antennas suggested in the prior art for the same multi-platform objective.





US 20150288064A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0288064 A1**

(43) **Pub. Date: Oct. 8, 2015**

(54) **SWITCHABLE ANTENNA**

(52) **U.S. Cl.**

CPC *H01Q 3/44* (2013.01)

(71) Applicant: **Wistron NeWeb Corporation**, Hsinchu (TW)

(57) **ABSTRACT**

(72) Inventors: **Chi-Kang Su**, Hsinchu (TW);
Cheng-Geng Jan, Hsinchu (TW)

A switchable antenna includes a substrate, a first antenna element, a second antenna element, a first switch element, a second switch element, a first radiating portion on an upper surface of the substrate including a first center, a first bend section and a second bend section, and a second radiating portion on a lower surface of the substrate including a second center, a third bend section and a fourth bend section. The third and the fourth bend sections extending from the second center are respectively disposed corresponding to the first and the second bend sections extending from the first center. The first and the second antenna elements on the upper surface are disposed corresponding to the first and the second bend sections. The first and the second switch elements are respectively configured to switch the first and the second antenna elements between a reflector and a parasitic radiating element.

(21) Appl. No.: **14/605,982**

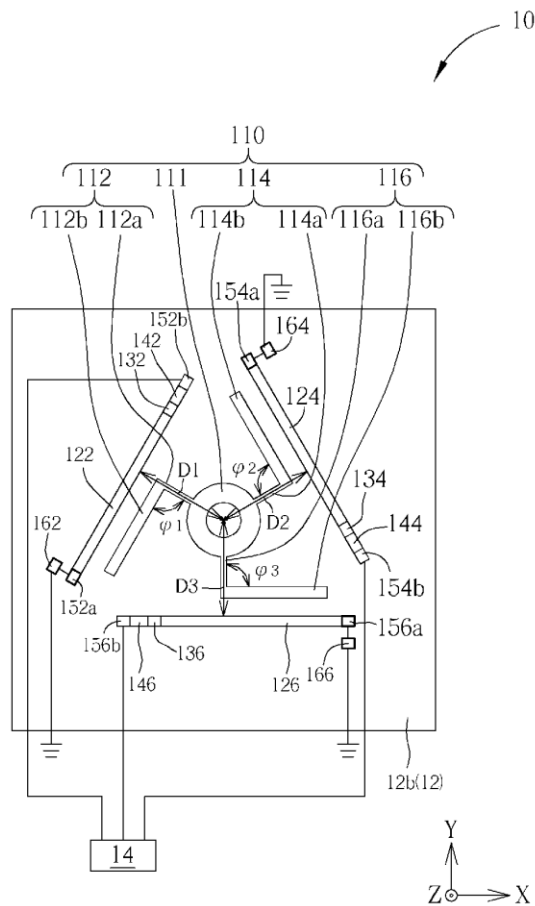
(22) Filed: **Jan. 26, 2015**

(30) **Foreign Application Priority Data**

Apr. 7, 2014 (TW) 103112732

Publication Classification

(51) **Int. Cl.**
H01Q 3/44 (2006.01)





US 20150288066A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0288066 A1**

(43) **Pub. Date: Oct. 8, 2015**

(54) **MULTIBAND ANTENNA AND WIRELESS DEVICE**

Publication Classification

(71) Applicant: **Asahi Glass Company, Limited**, Tokyo (JP)

(51) **Int. Cl.**
H01Q 5/50 (2006.01)
H01Q 1/48 (2006.01)
H01Q 1/50 (2006.01)

(72) Inventors: **Ryuta SONODA**, Tokyo (JP); **Koji IKAWA**, Tokyo (JP); **Toshiki SAYAMA**, Tokyo (JP)

(52) **U.S. Cl.**
CPC . **H01Q 5/50** (2015.01); **H01Q 1/50** (2013.01);
H01Q 1/48 (2013.01)

(73) Assignee: **Asahi Glass Company, Limited**, Tokyo (JP)

(57) **ABSTRACT**

(21) Appl. No.: **14/747,178**

(22) Filed: **Jun. 23, 2015**

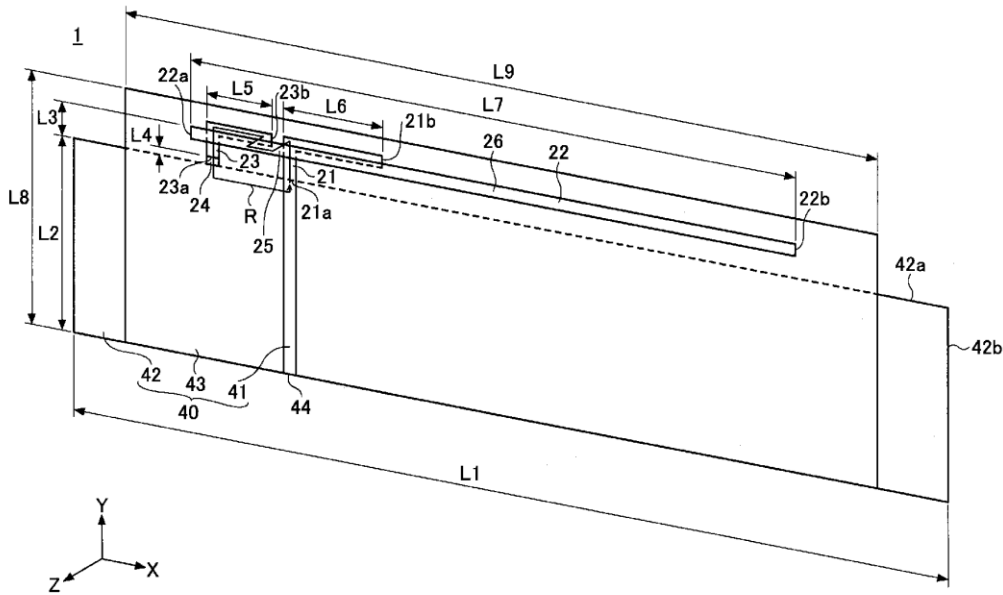
Related U.S. Application Data

(63) Continuation of application No. PCT/JP2013/084964, filed on Dec. 26, 2013.

(30) **Foreign Application Priority Data**

Dec. 28, 2012 (JP) 2012-289053

A multiband antenna includes a feeding element connected to a feeding point, a radiating element functioning as a radiating conductor, the radiating element being positioned apart from the feeding element and fed with electric power by electromagnetically coupling to the feeding element, a ground plane, and a non-feeding element being positioned close to the radiating element and connected to the ground plane via a reactance element. The reactance element has a reactance that causes the multiband antenna to match with a frequency other than a resonance frequency of a resonance mode of the radiating element.





US 20150288067A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0288067 A1**

(43) **Pub. Date: Oct. 8, 2015**

(54) **RERADIATION ANTENNA AND WIRELESS CHARGER**

Publication Classification

(71) Applicant: **LG Electronics Inc.**, Seoul (KR)

(51) **Int. Cl.**
H01Q 9/04 (2006.01)
H01Q 1/22 (2006.01)
H02J 7/02 (2006.01)
H01Q 1/48 (2006.01)

(72) Inventors: **Jaesoon KWON**, Seoul (KR); **Jeongkyo SEO**, Seoul (KR); **Joosung HWANG**, Seoul (KR)

(52) **U.S. Cl.**
CPC **H01Q 9/0407** (2013.01); **H01Q 1/48** (2013.01); **H01Q 1/22** (2013.01); **H02J 7/025** (2013.01)

(73) Assignee: **LG Electronics Inc.**, Seoul (KR)

(21) Appl. No.: **14/621,772**

(22) Filed: **Feb. 13, 2015**

(57) **ABSTRACT**

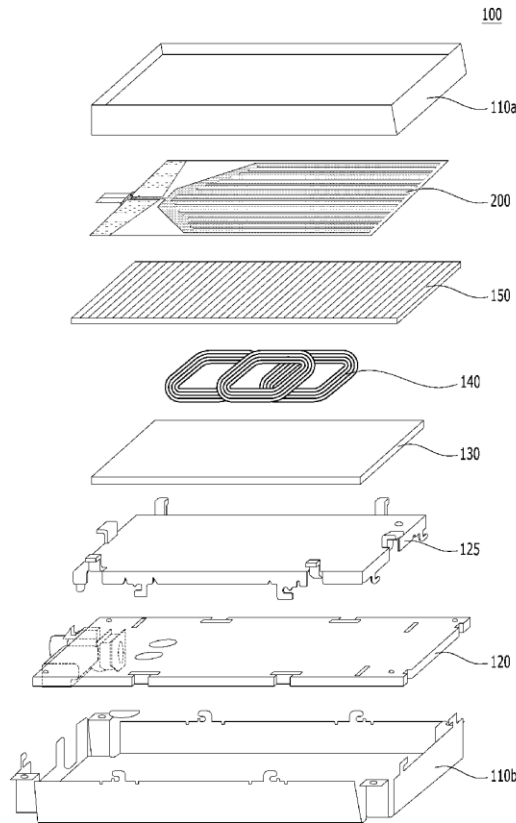
Related U.S. Application Data

A reradiation antenna including an insulation panel; a ground contact formed on one side of the insulation panel; a slot formed by eliminating a part of the ground contact by exposing the insulation panel; a power feeding unit formed on the insulation panel between the slot and separated from the ground contact and connected with a power source using a first end of the power feeding unit; and a radiation unit formed on one side of the insulation panel, and connected with a second end of the power feeding unit positioned at an opened end of the slot.

(60) Provisional application No. 61/974,411, filed on Apr. 2, 2014.

Foreign Application Priority Data

(30) Apr. 24, 2014 (KR) 10-2014-0049192
Jul. 2, 2014 (KR) 10-2014-0082355





US 20150288071A1

(19) **United States**

(12) **Patent Application Publication**
Toyao

(10) **Pub. No.: US 2015/0288071 A1**

(43) **Pub. Date: Oct. 8, 2015**

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

Publication Classification

(71) Applicant: **NEC Corporation**, Minato-ku, Tokyo
(JP)

(51) **Int. Cl.**
H01Q 15/00 (2006.01)

(72) Inventor: **Hiroshi Toyao**, Tokyo (JP)

(52) **U.S. Cl.**
CPC **H01Q 15/0086** (2013.01)

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

(57) **ABSTRACT**

(21) Appl. No.: **14/437,253**

A small antenna operating at a plurality of frequency bands includes a first conductor plane in which a first split ring resonator and a second split ring resonator that have different resonant frequencies are formed and a feed line including a first branch line, a second branch line and a branch portion. Each of the split ring resonators includes a conductor region along an opening edge of an opening formed in the first conductor plane and a split portion cutting through a portion of the conductor region. One end of the first branch line is connected to the first split ring resonator and the other end extends to the branch portion across the conductor region; one end of the second branch line is connected to the second split ring resonator and the other end extends to the branch portion across the conductor region.

(22) PCT Filed: **Nov. 12, 2013**

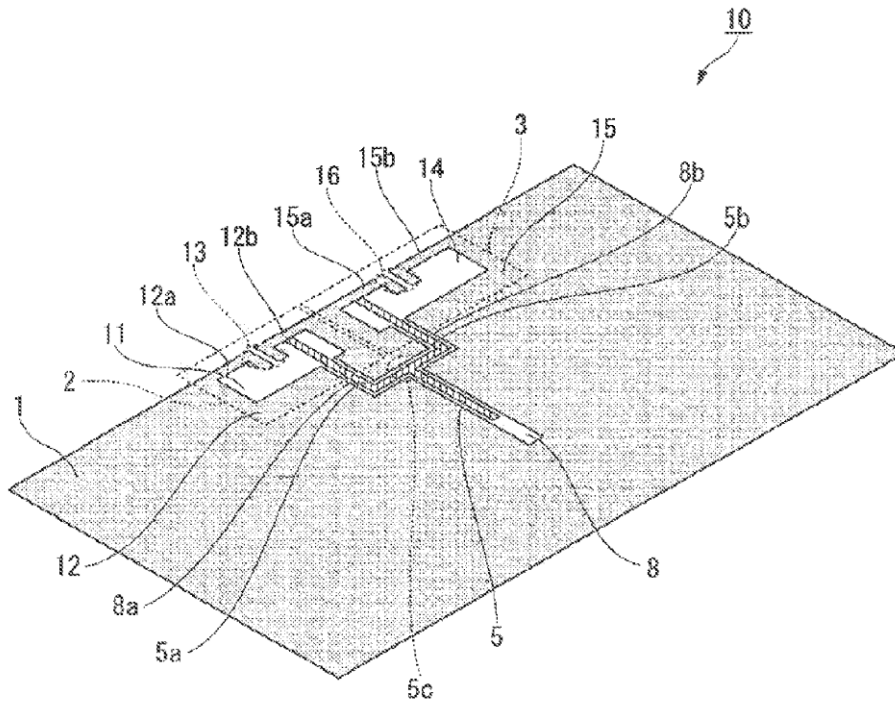
(86) PCT No.: **PCT/JP2013/080586**

§ 371 (c)(1),

(2) Date: **Apr. 21, 2015**

(30) **Foreign Application Priority Data**

Nov. 12, 2012 (JP) 2012-248169





US 20150288074A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0288074 A1**

(43) **Pub. Date: Oct. 8, 2015**

(54) **SAR REDUCTION IN RADIO TRANSMITTING DEVICES**

H01Q 9/42 (2006.01)

H01Q 1/24 (2006.01)

(71) Applicant: **MICROSOFT CORPORATION**,
Redmond, WA (US)

(52) **U.S. Cl.**

CPC *H01Q 19/22* (2013.01); *H01Q 1/24*
(2013.01); *H01Q 1/38* (2013.01); *H01Q 9/42*
(2013.01)

(72) Inventors: **Marc Harper**, Issaquah, WA (US);
Devis Iellici, Cambridge (GB)

(21) Appl. No.: **14/438,455**

(57)

ABSTRACT

(22) PCT Filed: **Oct. 23, 2013**

(86) PCT No.: **PCT/US13/66441**

§ 371 (c)(1),

(2) Date: **Apr. 24, 2015**

(30) **Foreign Application Priority Data**

Oct. 24, 2012 (GB) 1219096.3

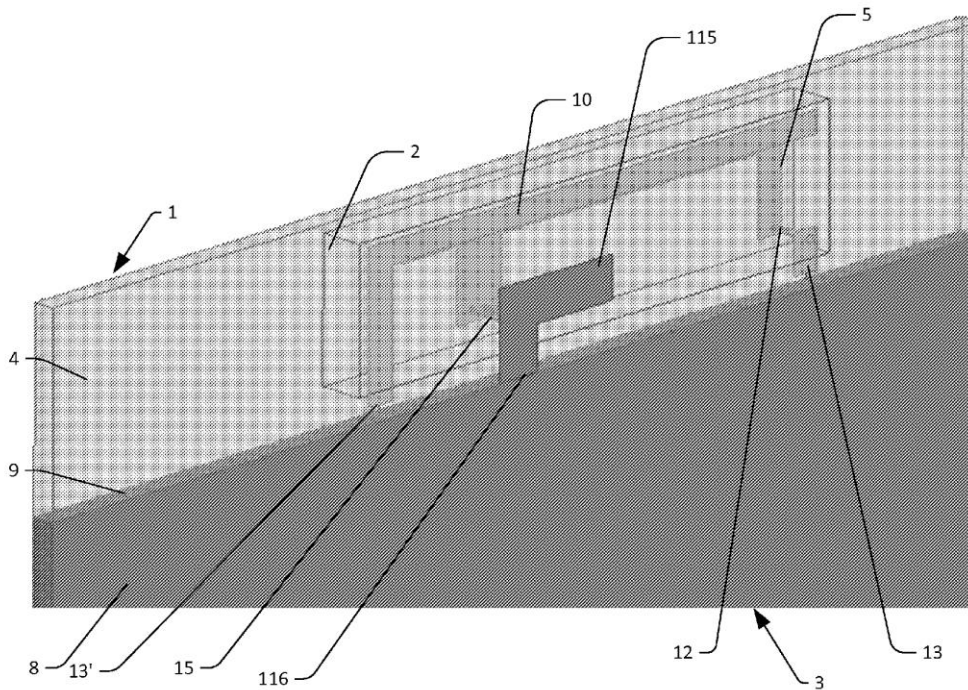
Publication Classification

(51) **Int. Cl.**

H01Q 19/22 (2006.01)

H01Q 1/38 (2006.01)

An antenna device (1) comprising a non-conductive substrate (2), wherein the antenna is in the form of a conductive pattern printed on either one or both sides of the non-conductive substrate. The conductive printed pattern includes an antenna element (5) configured for electrical connection to a coplanar groundplane (8) at a ground connection (13,13'), and further configured for electrical connection to a transmitter/receiver at a feed connection, and a passive antenna arm (115) connected to the coplanar groundplane at a passive antenna arm ground connection (116). A SAR reduction system comprising a grounded parasitic resonating conducting element is positioned on one side of the non-conductive substrate and is adapted to couple with the passive antenna arm and reduce the electromagnetic field generated by the antenna element at a predetermined frequency.





US 20150295302A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0295302 A1**
(43) **Pub. Date: Oct. 15, 2015**

(54) **ANTENNA MODULE AND ELECTRONIC DEVICE INCLUDING THE SAME**

Publication Classification

(71) Applicant: **Samsung Electronics Co., Ltd.**,
Gyeonggi-do (KR)

(51) **Int. Cl.**
H01Q 1/22 (2006.01)
G06K 19/077 (2006.01)
H01Q 7/00 (2006.01)

(72) Inventors: **In-young LEE**, Gyeonggi-do (KR);
Hwan-myung NOH, Gyeonggi-do (KR);
Byung-gil JEON, Incheon (KR)

(52) **U.S. Cl.**
CPC **H01Q 1/2266** (2013.01); **H01Q 1/2225**
(2013.01); **H01Q 7/00** (2013.01); **G06K**
19/07773 (2013.01)

(21) Appl. No.: **14/518,064**

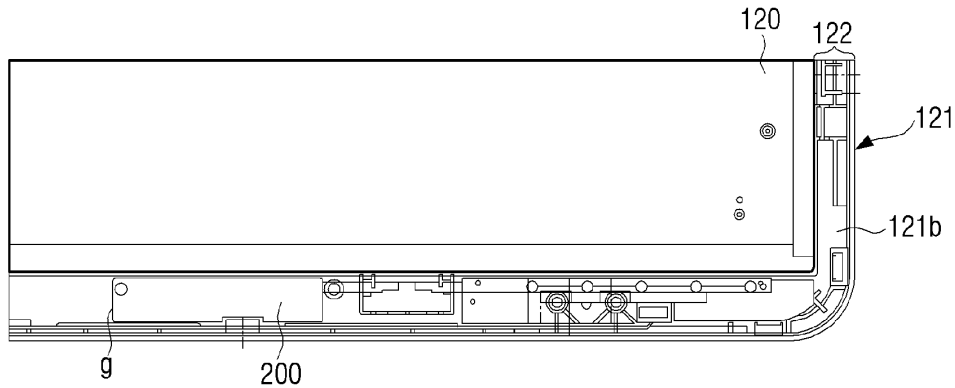
(57) **ABSTRACT**

(22) Filed: **Oct. 20, 2014**

An electronic device with an antenna, e.g., for near field communication (NFC) is disclosed. The electronic device includes a display, a fixing frame fixing the display and including a bezel area at a periphery of the display, and a communication module disposed at the bezel area. The communication module includes a circuit board, which has an antenna radiator and a communication circuit disposed thereon. The communication module performs wireless communication with an external apparatus via the communication circuit and antenna radiator.

(30) **Foreign Application Priority Data**

Apr. 10, 2014 (KR) 10-2014-0042984





US 20150295303A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0295303 A1**

(43) **Pub. Date: Oct. 15, 2015**

(54) **ELECTRONIC DEVICE HAVING ANTENNA STRUCTURE**

Publication Classification

(71) Applicants: **Li-Chun Lee**, Taipei City (TW);
Chieh-Tsao Hwang, Taipei City (TW);
Shih-Chia Liu, Taipei City (TW);
Yen-Hao Yu, Taipei City (TW);
Jhin-Ciang Chen, Taipei City (TW)

(51) **Int. Cl.**
H01Q 1/22 (2006.01)
H01Q 21/00 (2006.01)
H01Q 13/10 (2006.01)
(52) **U.S. Cl.**
CPC **H01Q 1/2266** (2013.01); **H01Q 13/10**
(2013.01); **H01Q 21/0006** (2013.01)

(72) Inventors: **Li-Chun Lee**, Taipei City (TW);
Chieh-Tsao Hwang, Taipei City (TW);
Shih-Chia Liu, Taipei City (TW);
Yen-Hao Yu, Taipei City (TW);
Jhin-Ciang Chen, Taipei City (TW)

(57) **ABSTRACT**

(73) Assignee: **COMPAL ELECTRONICS, INC.**,
Taipei City (TW)

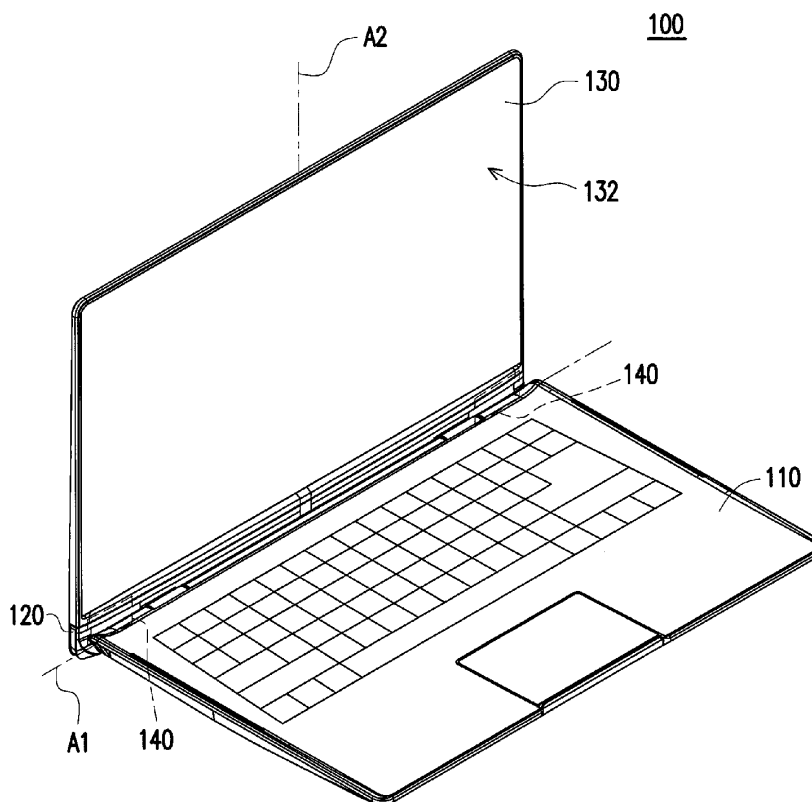
An electronic device having antenna structure is provided. The electronic device includes a first body, a pivot assembly, a second body and an antenna structure. The pivot assembly is pivoted to the first body along a first axis. The second body is pivoted to the pivot assembly along a second axis. The antenna structure is disposed in the pivot assembly and has a first radiation portion, a second radiation portion and a third radiation portion. The first radiation portion and the second radiation portion have a slot therebetween to form a slot antenna. The third radiation portion forms a monopole antenna and is aligned to the slot. The third radiation portion and the slot are not coplanar.

(21) Appl. No.: **14/557,453**

(22) Filed: **Dec. 2, 2014**

Related U.S. Application Data

(60) Provisional application No. 61/979,505, filed on Apr. 14, 2014.





US 20150295311A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0295311 A1**

(43) **Pub. Date: Oct. 15, 2015**

(54) **ANTENNA SYSTEM USING CAPACITIVELY COUPLED COMPOUND LOOP ANTENNAS WITH ANTENNA ISOLATION PROVISION**

H01Q 21/30 (2006.01)

H01Q 9/04 (2006.01)

(52) **U.S. Cl.**

CPC *H01Q 5/307* (2015.01); *H01Q 9/0407* (2013.01); *H01Q 7/00* (2013.01); *H01Q 21/30* (2013.01)

(71) Applicant: **DOCKON AG**, Zurich (CH)

(72) Inventors: **Jonathan Neil Bringuier**, Carlsbad, CA (US); **Ryan James Orsi**, San Diego, CA (US); **Matthew Robert Foster**, San Diego, CA (US)

(57)

ABSTRACT

An antenna system is provided, including a first antenna, a second antenna, a ground plane, and a resonant isolator coupled to the first and second antennas. Each of the antennas is configured to be a capacitively-coupled compound loop antenna, and the resonant isolator is configured to provide isolation between the two antennas at resonance. The two antennas may be symmetrical or asymmetrical and include a first element that emits a magnetic field and a second element that generates an electrical field that is orthogonal to the magnetic field. The radiating element of the second element may be capacitively coupled to the remainder of the second element. The resonant isolator may be comprised of a single conductive element or two conductive elements that are capacitively coupled.

(73) Assignee: **DOCKON AG**, Zurich (CH)

(21) Appl. No.: **14/253,678**

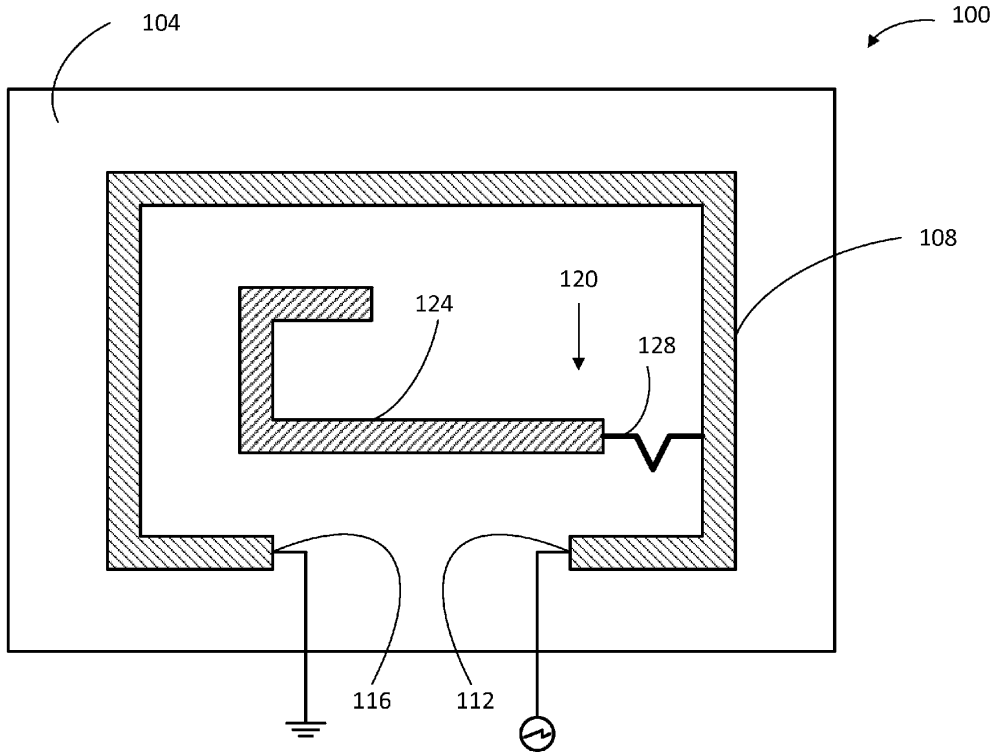
(22) Filed: **Apr. 15, 2014**

Publication Classification

(51) **Int. Cl.**

H01Q 5/307 (2006.01)

H01Q 7/00 (2006.01)





US 20150295312A1

(19) **United States**

(12) **Patent Application Publication**

LEE et al.

(10) **Pub. No.: US 2015/0295312 A1**

(43) **Pub. Date: Oct. 15, 2015**

(54) **WIDEBAND ANTENNA MODULE**

Publication Classification

(71) Applicant: **QUANTA COMPUTER INC.**, Tao Yuan Hsien (TW)

(51) **Int. Cl.**
H01Q 5/35 (2006.01)
H01Q 5/20 (2006.01)
H01Q 1/48 (2006.01)

(72) Inventors: **Chi-Hsuan LEE**, Tao Yuan Hsien (TW);
Pei-Ling TENG, Tao Yuan Hsien (TW);
Kuo-Cheng CHEN, Tao Yuan Hsien (TW)

(52) **U.S. Cl.**
CPC . *H01Q 5/35* (2015.01); *H01Q 1/48* (2013.01);
H01Q 5/20 (2015.01)

(21) Appl. No.: **14/570,326**

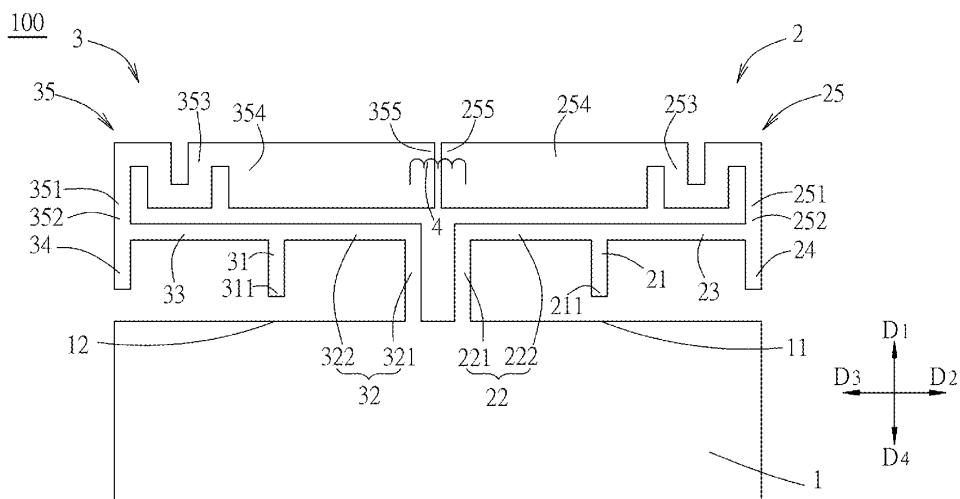
(57) **ABSTRACT**

A wideband antenna module includes a ground conductor, two radiating conductors and a decoupling inductor. Each of the radiating conductors includes a feed-in portion, a ground portion and three radiating portions. The feed-in portion is spaced apart from the ground conductor and has a feed-in end part. The ground portion is connected to the feed-in portion and the ground conductor. For each of the radiating conductors, the radiating portions are arranged in sequence from the feed-in portion to a free end part. The decoupling inductor is connected between the free end parts of the two radiating conductors.

(22) Filed: **Dec. 15, 2014**

(30) **Foreign Application Priority Data**

Apr. 11, 2014 (TW) 103113461





US 20150295314A1

(19) **United States**

(12) **Patent Application Publication**
Oh

(10) **Pub. No.: US 2015/0295314 A1**

(43) **Pub. Date: Oct. 15, 2015**

(54) **LOOP ANTENNA HAVING A
PARASITICALLY COUPLED ELEMENT**

(52) **U.S. Cl.**
CPC **H01Q 7/00** (2013.01); **H01Q 21/0006**
(2013.01); **H01Q 21/0087** (2013.01)

(71) Applicant: **NOKIA CORPORATION**, Espoo (FI)

(72) Inventor: **Sung-Hoon Oh**, Cupertino, CA (US)

(57) **ABSTRACT**

(21) Appl. No.: **14/438,476**

An antenna, a portable electronic device incorporating an antenna and a method of operation are provided to enable both wide and multiple frequency band response. The antenna may include a feeding arm and a parasitic element. The feeding arm may include a conductive loop antenna and a conductive excitation arm portion. The loop antenna portion may extend from a first end that is configured to be grounded to a second end that is configured to be driven by radio frequency circuitry. The excitation arm may be coupled at a first end to the loop antenna portion and extend outwardly therefrom to an open end. The parasitic element may extend from a first end is configured to be grounded to a second end that is open. The parasitic element may extend along opposite sides of the excitation arm portion so as to be coupled thereto.

(22) PCT Filed: **Oct. 26, 2012**

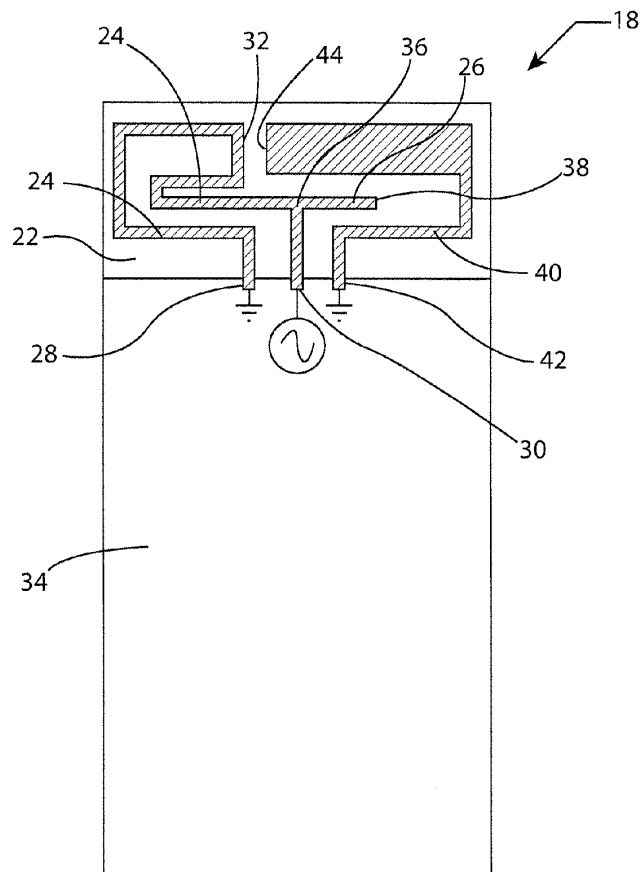
(86) PCT No.: **PCT/IB2012/055928**

§ 371 (c)(1),

(2) Date: **Apr. 24, 2015**

Publication Classification

(51) **Int. Cl.**
H01Q 7/00 (2006.01)
H01Q 21/00 (2006.01)





US 20150295317A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0295317 A1**

(43) **Pub. Date: Oct. 15, 2015**

(54) **ANTENNA DEVICE**

(52) **U.S. Cl.**

CPC **H01Q 9/0407** (2013.01)

(71) Applicant: **Harada Industry Co., Ltd.**, Tokyo (JP)

(57)

ABSTRACT

(72) Inventors: **Jun Ito**, Tokyo (JP); **Junichi Kawahata**, Tokyo (JP)

An antenna device includes a first antenna element. The first antenna element includes a first conductive line portion extending from a power supply point, a first turn-back portion connected to the first conductive line portion, a second conductive line portion extending from the first turn-back portion, a second turn-back portion connected to the second conductive line portion, a third conductive line portion extending from the second turn-back portion, a first shortcircuit portion shortcircuiting the first conductive line portion and the second conductive line portion, the first shortcircuit portion being located between a reference portion and the first turn-back portion, the reference portion being located between the first turn-back portion and the second turn-back portion, and a second shortcircuit portion shortcircuiting the reference portion and the third conductive line portion.

(21) Appl. No.: **14/679,304**

(22) Filed: **Apr. 6, 2015**

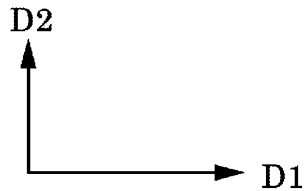
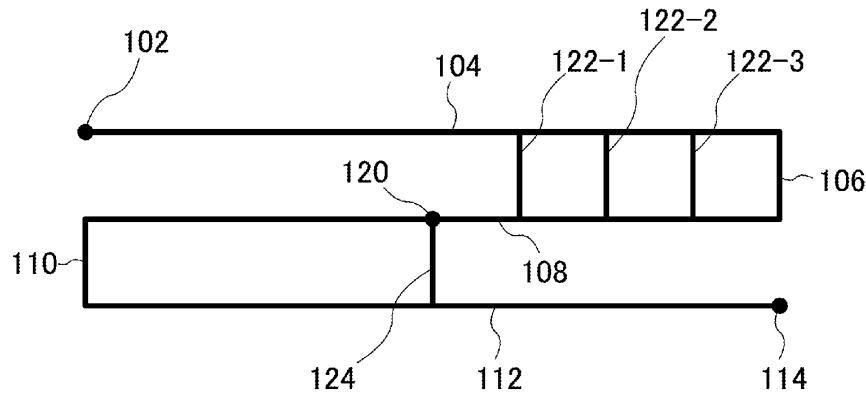
(30) **Foreign Application Priority Data**

Apr. 11, 2014 (JP) 2014-081513

Publication Classification

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

10





US 20150295322A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0295322 A1**

(43) **Pub. Date: Oct. 15, 2015**

(54) **ANTENNA APPARATUS INCLUDING MULTIPLE ANTENNA ELEMENTS FOR SIMULTANEOUSLY TRANSMITTING OR RECEIVING MULTIPLE WIDEBAND RADIO SIGNALS**

Publication Classification

(51) **Int. Cl.**
H01Q 9/28 (2006.01)
H01Q 5/10 (2006.01)
H01Q 1/24 (2006.01)

(71) Applicant: **Panasonic Intellectual Property Corporation of America**, Torrance, CA (US)

(52) **U.S. Cl.**
CPC *H01Q 9/285* (2013.01); *H01Q 1/243* (2013.01); *H01Q 5/10* (2015.01)

(72) Inventors: **Kenichi ASANUMA**, Osaka (JP);
Atsushi YAMAMOTO, Kyoto (JP);
Tsutomu SAKATA, Osaka (JP)

(57) **ABSTRACT**

An antenna apparatus includes antenna elements, each made of a conductive plate. The antenna elements are provided along a reference axis passing through first and second positions of the antenna apparatus, and close to a section between the first and second positions. Each of the antenna elements has first and second portions along a circumference of the antenna element, the first portion is close to the reference axis and electromagnetically coupled to the other antenna element, and the second portion is remote from the reference axis. The first portions of the respective antenna elements are shaped so that the antenna elements are the closest to each other near the first position, and a distance between the antenna elements gradually increases from the first position to the second position. The antenna apparatus has feed points provided on the antenna elements, respectively, and near the first position.

(21) Appl. No.: **14/747,014**

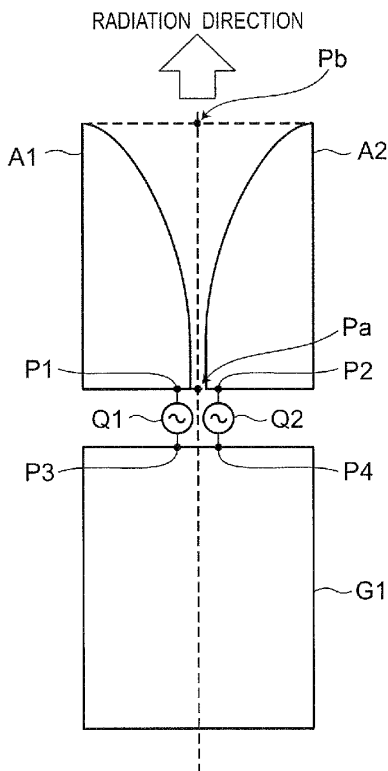
(22) Filed: **Jun. 23, 2015**

Related U.S. Application Data

(63) Continuation of application No. 13/638,788, filed on Oct. 1, 2012, filed as application No. PCT/JP2011/006056 on Oct. 28, 2011.

(30) **Foreign Application Priority Data**

Feb. 4, 2011 (JP) 2011-022278





US 20150303550A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0303550 A1**

(43) **Pub. Date: Oct. 22, 2015**

(54) **COMMUNICATION DEVICE ANTENNA**

(52) **U.S. Cl.**

CPC *H01Q 1/24* (2013.01)

(71) Applicant: **KING SLIDE TECHNOLOGY CO.,LTD.**, Kaohsiung City (TW)

(57) **ABSTRACT**

(72) Inventors: **Hsin-Cheng Su**, Kaohsiung City (TW);
Chun-Ta Liu, Kaohsiung City (TW);
Shu-Chen Lin, Kaohsiung City (TW)

The present invention relates to a communication device antenna, including a metal housing, a first antenna and a second antenna. The metal housing has a first lateral side and a second lateral side. The first antenna includes a first metal part, a second metal part, a third metal part and a fourth metal part. The third metal part is connected between the first and second metal parts, and adjacent to the first lateral side of the metal housing. The fourth metal part is connected to the metal housing. The second antenna includes a first metal part and a second metal part. The first metal part of the second antenna is connected to the signal feed point and the second metal part of the first antenna. The second metal part of the second antenna is connected to the ground point and the fourth metal part of the first antenna.

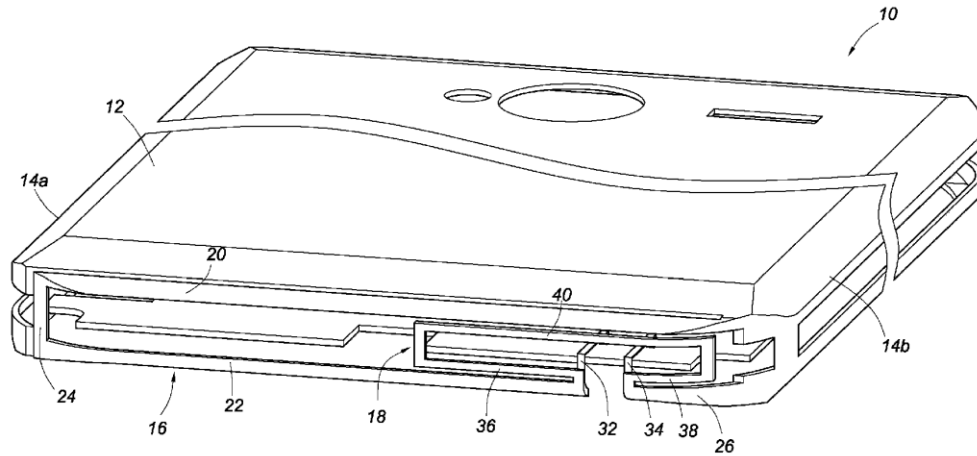
(73) Assignee: **KING SLIDE TECHNOLOGY CO.,LTD.**, Kaohsiung City (TW)

(21) Appl. No.: **14/253,870**

(22) Filed: **Apr. 16, 2014**

Publication Classification

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





US 20150303551A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0303551 A1**

(43) **Pub. Date: Oct. 22, 2015**

(54) **COMMUNICATION DEVICE ANTENNA**

(52) **U.S. Cl.**

CPC *H01Q 1/243* (2013.01)

(71) Applicant: **KING SLIDE TECHNOLOGY CO.,LTD.**, Kaohsiung City (TW)

(57) **ABSTRACT**

(72) Inventors: **Hsin-Cheng Su**, Kaohsiung City (TW);
Chun-Ta Liu, Kaohsiung City (TW);
Shu-Chen Lin, Kaohsiung City (TW)

The present invention relates to a communication device antenna, including a metal housing, an antenna and a conductor. The metal housing has a first lateral side and a second lateral side. The antenna includes a first metal part, a second metal part, a third metal part and a fourth metal part. The third metal part is extended and connected between the first metal part and the second metal part, and the third metal part is located adjacent to the first lateral side of the metal housing. The fourth metal part is connected to a ground point, and the fourth metal part is connected to the first metal part and the metal housing. The conductor is located adjacent to the second metal part of the antenna. A coupling gap is defined between the conductor and the second metal part. The conductor is connected to a signal feed point.

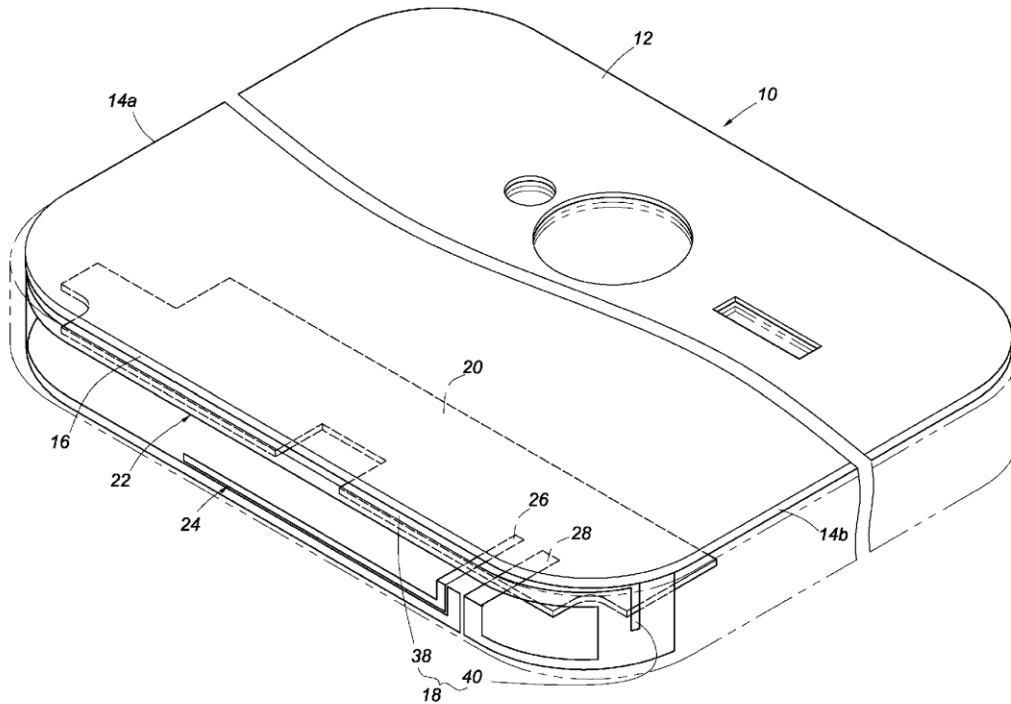
(73) Assignee: **KING SLIDE TECHNOLOGY CO.,LTD.**, Kaohsiung City (TW)

(21) Appl. No.: **14/253,875**

(22) Filed: **Apr. 16, 2014**

Publication Classification

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





US 20150303552A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0303552 A1**

(43) **Pub. Date: Oct. 22, 2015**

(54) **COMMUNICATION DEVICE ANTENNA**

(52) **U.S. Cl.**

CPC *H01Q 1/24* (2013.01)

(71) Applicant: **KING SLIDE TECHNOLOGY CO.,LTD.**, Kaohsiung City (TW)

(57)

ABSTRACT

(72) Inventors: **Hsin-Cheng Su**, Kaohsiung City (TW);
Chun-Ta Liu, Kaohsiung City (TW);
Shu-Chen Lin, Kaohsiung City (TW)

The present invention relates to a communication device antenna including a metal housing and an excitation component. The metal housing has a first lateral side, a second lateral side and a connection side extended and connected between the first lateral side and the second lateral side. An opening is formed and located adjacent to the connection side. A coupling gap is defined between the excitation component and the connection side of the metal housing. The excitation component is connected to the signal feed point and the ground point. The excitation component is configured to perform electromagnetic energy excitation, such that the metal housing can be utilized as a radiation unit.

(73) Assignee: **KING SLIDE TECHNOLOGY CO.,LTD.**, Kaohsiung City (TW)

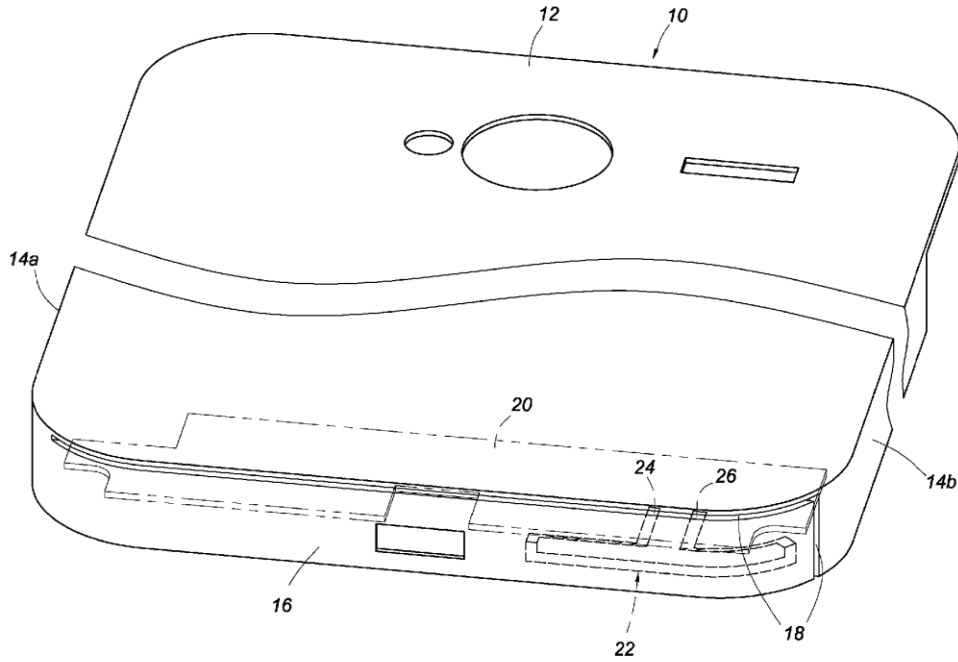
(21) Appl. No.: **14/253,880**

(22) Filed: **Apr. 16, 2014**

Publication Classification

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

(2006.01)





US 20150303553A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0303553 A1**

(43) **Pub. Date: Oct. 22, 2015**

(54) **MANUFACTURING METHOD OF ANTENNA SHAPING**

H01Q 1/38 (2006.01)
C23C 18/38 (2006.01)

(71) Applicant: **NATIONAL CHUNG SHAN INSTITUTE OF SCIENCE AND TECHNOLOGY**, Longtan Township (TW)

(52) **U.S. Cl.**
CPC . *H01Q 1/36* (2013.01); *H01Q 1/38* (2013.01);
C23C 18/38 (2013.01); *C23F 1/00* (2013.01);
C23F 17/00 (2013.01)

(72) Inventors: **CHI-HAW CHIANG**, LONGTAN TOWNSHIP (TW); **REN-RUEY FANG**, LONGTAN TOWNSHIP (TW); **MENG-BIN LIN**, LONGTAN TOWNSHIP (TW)

(57) **ABSTRACT**

(21) Appl. No.: **14/551,129**

A manufacturing method of antenna shaping includes providing a nonplanar insulating substrate; coarsening and modifying a surface of the substrate and rendering the substrate surface hydrophilic by a plasma process to form a modified substrate; performing copper electroless plating on the modified substrate; electroplating a copper layer to attain a required thickness; defining antenna wiring width and clearance by multi-axis mechanical processing; and performing antenna metal wiring shaping with a copper etching plating solution. Furthermore, metal wiring shaping and processing is performed with a mechanical cutting tool of a multi-axis processing machine without using any photomask, so as to control substrate surface coarsening uniformity and enhance hydrophilicity of the surface of the modified substrate, with a precise plating technique for enhancing the quality of copper wire coating, cutting costs, and speeding up the processing process.

(22) Filed: **Nov. 24, 2014**

(30) **Foreign Application Priority Data**

Apr. 16, 2014 (TW) 103113783

Publication Classification

(51) **Int. Cl.**
H01Q 1/36 (2006.01)
C23F 17/00 (2006.01)
C23F 1/00 (2006.01)



US 20150303555A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0303555 A1**

(43) **Pub. Date: Oct. 22, 2015**

(54) **MANUFACTURING METHOD OF
NONPLANAR 3D ANTENNA SHAPING**

C23C 18/38 (2006.01)
H01Q 1/36 (2006.01)

(71) Applicant: **NATIONAL CHUNG SHAN
INSTITUTE OF SCIENCE AND
TECHNOLOGY**, Longtan Township
(TW)

(52) **U.S. Cl.**
CPC . *H01Q 1/38* (2013.01); *H01Q 1/36* (2013.01);
C23F 1/02 (2013.01); *C23C 18/38* (2013.01)

(72) Inventors: **CHI-HAW CHIANG**, LONGTAN
TOWNSHIP (TW); **REN-RUEY FANG**, LONGTAN
TOWNSHIP (TW); **MENG-BIN LIN**,
LONGTAN TOWNSHIP (TW)

(57) **ABSTRACT**

(21) Appl. No.: **14/551,227**

(22) Filed: **Nov. 24, 2014**

(30) **Foreign Application Priority Data**

Apr. 16, 2014 (TW) 103113784

Publication Classification

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
C23F 1/02 (2006.01)

A manufacturing method of nonplanar 3D antenna shaping includes providing a nonplanar insulating substrate; performing coarsening and modification on the surface of the substrate, followed by rendering the substrate surface hydrophilic in a plasma process to form a modified substrate; performing copper electroless plating on the modified substrate to plate a copper layer on the substrate, so as to achieve a required thickness. The width of the metal wiring is efficiently reduced to microscale by 3D photolithography; therefore, the range of its low-frequency application is reduced to less than 2 GHz. The method involves controlling substrate surface coarseness uniformity, modifying the substrate surface hydrophilic, and applying a precise plating technique with a view to enhancing the quality of copper wire coating. The method not only enhances antenna low-frequency performance but is also conducive to miniaturization of antennas, thereby allowing a tool carrying an antenna to reduce weight and power consumption.



US 20150303556A1

(19) **United States**

(12) **Patent Application Publication**
Flores-Cuadras et al.

(10) **Pub. No.: US 2015/0303556 A1**

(43) **Pub. Date: Oct. 22, 2015**

(54) **MULTIPATH OPEN LOOP ANTENNA WITH WIDEBAND RESONANCES FOR WAN COMMUNICATIONS**

Publication Classification

(71) Applicant: **Taoglas Group Holdings Limited**,
Enniscorthy (IE)

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 21/28 (2006.01)

(72) Inventors: **Javier Ruben Flores-Cuadras**, Tijuana (MX); **Ming Wei-Chen**, Zhongli City (TW)

(52) **U.S. Cl.**
CPC . **H01Q 1/38** (2013.01); **H01Q 21/28** (2013.01)

(73) Assignee: **TAOGLAS GROUP HOLDINGS LIMITED**, Enniscorthy (IE)

(57) **ABSTRACT**

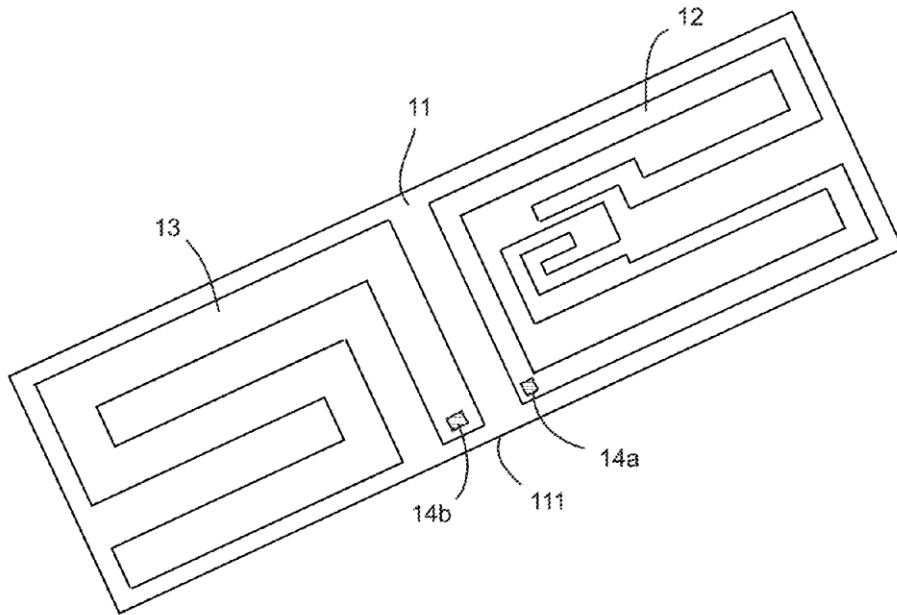
(21) Appl. No.: **14/603,201**

The disclosure concerns an antenna with open loops and multipath current distribution to achieve ultra wideband characteristics and antenna miniaturization, while simultaneously keeping high performance for a more reliable WAN communication, with higher data transfer, less dropping connections and improved sensitivity. To further reduce spatial requirements, the antenna may be incorporated on a flex substrate for bending with the contour of a device housing or the like.

(22) Filed: **Jan. 22, 2015**

Related U.S. Application Data

(60) Provisional application No. 61/930,143, filed on Jan. 22, 2014.





US 20150303557A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0303557 A1**

(43) **Pub. Date: Oct. 22, 2015**

(54) **ELECTRONIC DEVICE AND ANTENNA USING COMPONENTS OF ELECTRONIC DEVICE**

(30) **Foreign Application Priority Data**

Apr. 16, 2014 (KR) 10-2014-0045562

(71) Applicant: **Samsung Electronics Co., Ltd.**,
Gyeonggi-do (KR)

Publication Classification

(72) Inventors: **Yeon Woo KIM**, Seoul (KR); **Gyu Sub KIM**, Seoul (KR); **Kyung Gu KIM**, Gyeonggi-do (KR); **Woo Sup LEE**, Gyeonggi-do (KR); **Se Hyun PARK**, Gyeonggi-do (KR); **Joon Ho BYUN**, Gyeonggi-do (KR); **Jin Woo JUNG**, Seoul (KR); **Jae Bong CHUN**, Gyeonggi-do (KR)

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H04B 1/40 (2006.01)

(52) **U.S. Cl.**
CPC ... **H01Q 1/38** (2013.01); **H04B 1/40** (2013.01)

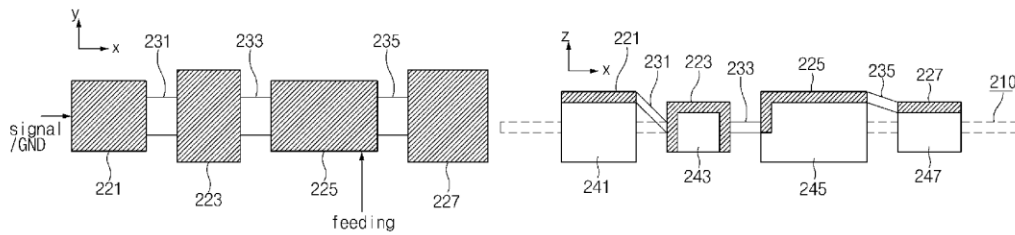
(73) Assignee: **Samsung Electronics Co., Ltd.**

(57) **ABSTRACT**

(21) Appl. No.: **14/688,316**

An electronic device is provided that includes a circuit board and an antenna fed from the circuit board. The antenna includes a plurality of conductive components. Each of the plurality of conductive components is disposed on a portion of a respective one of a plurality of electronic components of the electronic device. The plurality of conductive components are connected by at least one connection component.

(22) Filed: **Apr. 16, 2015**





US 20150303568A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0303568 A1**

(43) **Pub. Date: Oct. 22, 2015**

(54) **ANTENNAS FOR NEAR-FIELD AND NON-NEAR-FIELD COMMUNICATIONS**

(52) **U.S. CL.**
CPC **H01Q 5/0034** (2013.01)

(71) Applicant: **Apple Inc.**, Cupertino, CA (US)

(57) **ABSTRACT**

(72) Inventors: **Salih Yarga**, Sunnyvale, CA (US);
Miroslav Samardzija, Mountain View, CA (US); **Robert W. Schlub**, Cupertino, CA (US)

An electronic device may be provided with antenna structures. The antenna structures may be coupled to non-near-field communications circuitry such as cellular telephone transceiver circuitry or wireless local area network circuitry. When operated at non-near-field communication frequencies, the antenna structures may be configured to serve as one or more inverted-F antennas or other antennas for supporting far field wireless communications. Proximity sensor circuitry and near-field communications circuitry may also be coupled to the antenna structures. When operated at proximity sensor frequencies, the antenna structures may be used in forming capacitive proximity sensor electrode structures. When operated at near-field communications frequencies, the antenna structures may be used in forming an inductive near-field communications loop antenna.

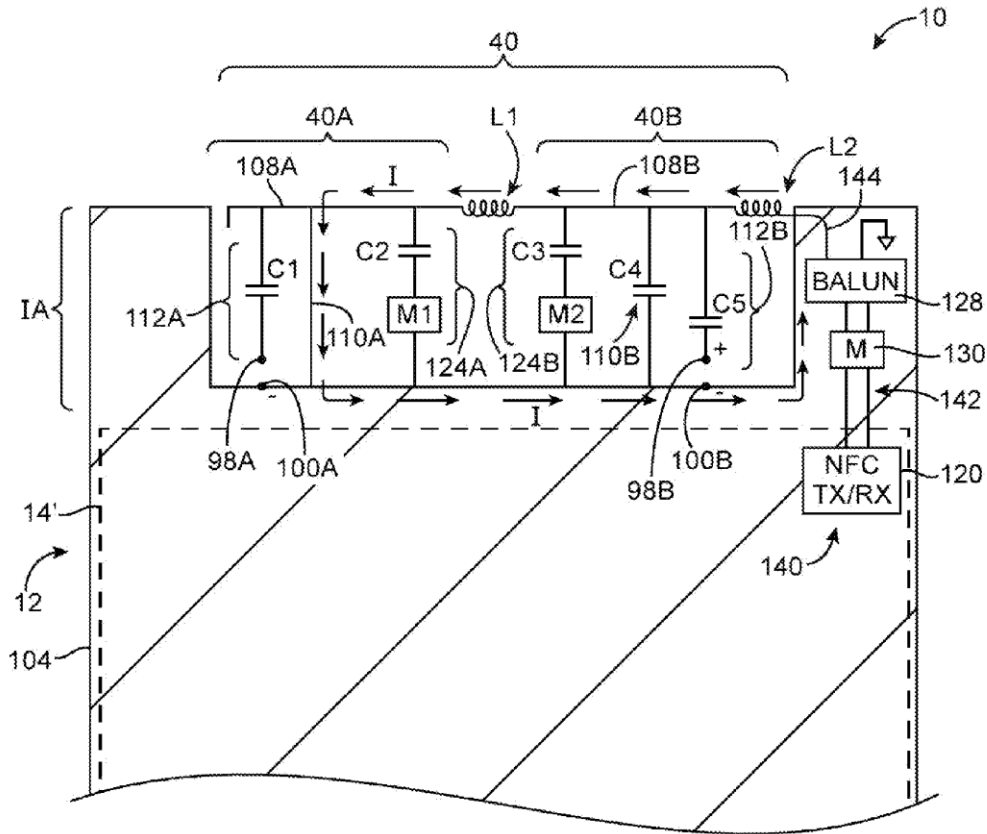
(73) Assignee: **Apple Inc.**, Cupertino, CA (US)

(21) Appl. No.: **14/254,604**

(22) Filed: **Apr. 16, 2014**

Publication Classification

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





US 20150303570A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0303570 A1**

(43) **Pub. Date: Oct. 22, 2015**

(54) **LOOP ANTENNA FOR MOBILE HANDSET
AND OTHER APPLICATIONS**

(52) **U.S. CL.**
CPC . *H01Q 5/378* (2015.01); *H01Q 7/00* (2013.01)

(71) Applicant: **Microsoft Technology Licensing, LLC,**
Redmond, WA (US)

(57) **ABSTRACT**

(72) Inventors: **Marc Harper,** Issaquah, WA (US);
Devis Iellici, Cambridge (GB);
Christopher Tomlin, Cambridge (GB)

(21) Appl. No.: **14/789,817**

(22) Filed: **Jul. 1, 2015**

Related U.S. Application Data

(63) Continuation of application No. 13/878,971, filed on
Apr. 11, 2013, filed as application No. PCT/GB2011/
050183 on Sep. 28, 2011.

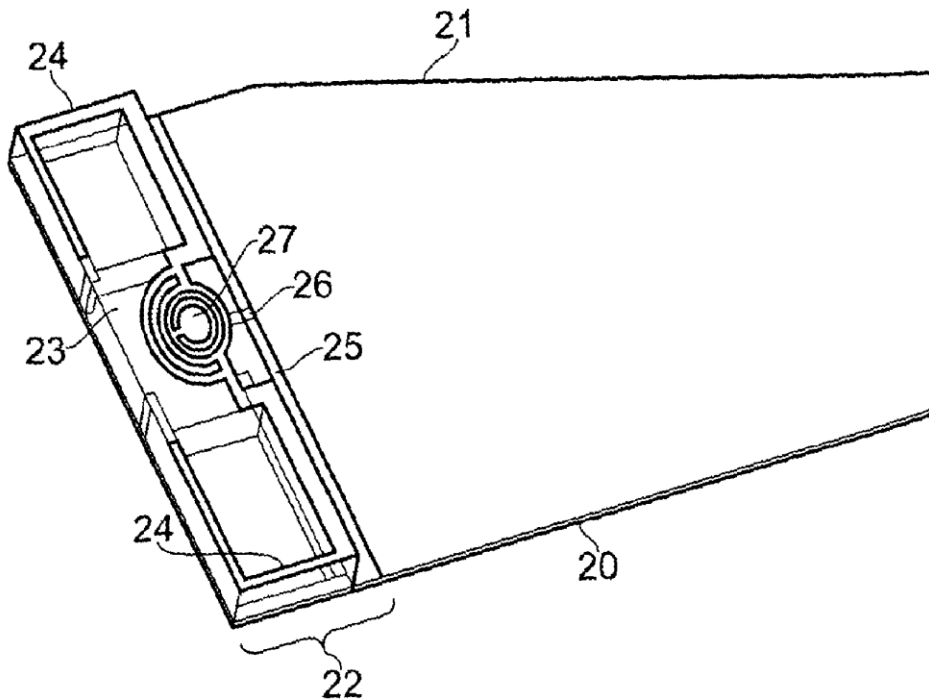
Foreign Application Priority Data

(30) Oct. 15, 2010 (GB) 1017472.0

Publication Classification

(51) **Int. Cl.**
H01Q 5/378 (2006.01)
H01Q 7/00 (2006.01)

There is disclosed an antenna system for mobile handsets and other devices. The antenna system comprises a dielectric substrate having first and second opposed surfaces, a conductive track on the substrate, and a separate, directly driven antenna to drive the parasitic loop antenna formed by the conductive track. Two grounding points are provided adjacent to each other on the first surface of the substrate, with the arms of the conductive track extending in generally opposite directions from the grounding points. The conductive tracks then extend towards an edge of the dielectric substrate, before passing to the second surface of the dielectric substrate and then passing across the second surface of the dielectric substrate following a path generally following the path taken on the first surface of the dielectric substrate. The conductive tracks then connect to respective sides of a conductive arrangement formed on the second surface of the dielectric substrate that extends into a central part of a loop formed by the conductive track on the second surface of the dielectric substrate.





US 20150303577A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0303577 A1**

(43) **Pub. Date: Oct. 22, 2015**

(54) **MIMO ANTENNA AND WIRELESS DEVICE**

(30) **Foreign Application Priority Data**

(71) Applicant: **ASAHI GLASS COMPANY, LIMITED**, Tokyo (JP)

Jan. 10, 2013 (JP) 2013-002988

Publication Classification

(72) Inventors: **Ryuta SONODA**, Tokyo (JP); **Koji IKAWA**, Tokyo (JP); **Toshiki SAYAMA**, Tokyo (JP)

(51) **Int. Cl.**
H01Q 9/06 (2006.01)
H01Q 21/00 (2006.01)

(73) Assignee: **ASAHI GLASS COMPANY, LIMITED**, Tokyo (JP)

(52) **U.S. Cl.**
CPC **H01Q 9/065** (2013.01); **H01Q 21/00** (2013.01)

(21) Appl. No.: **14/790,472**

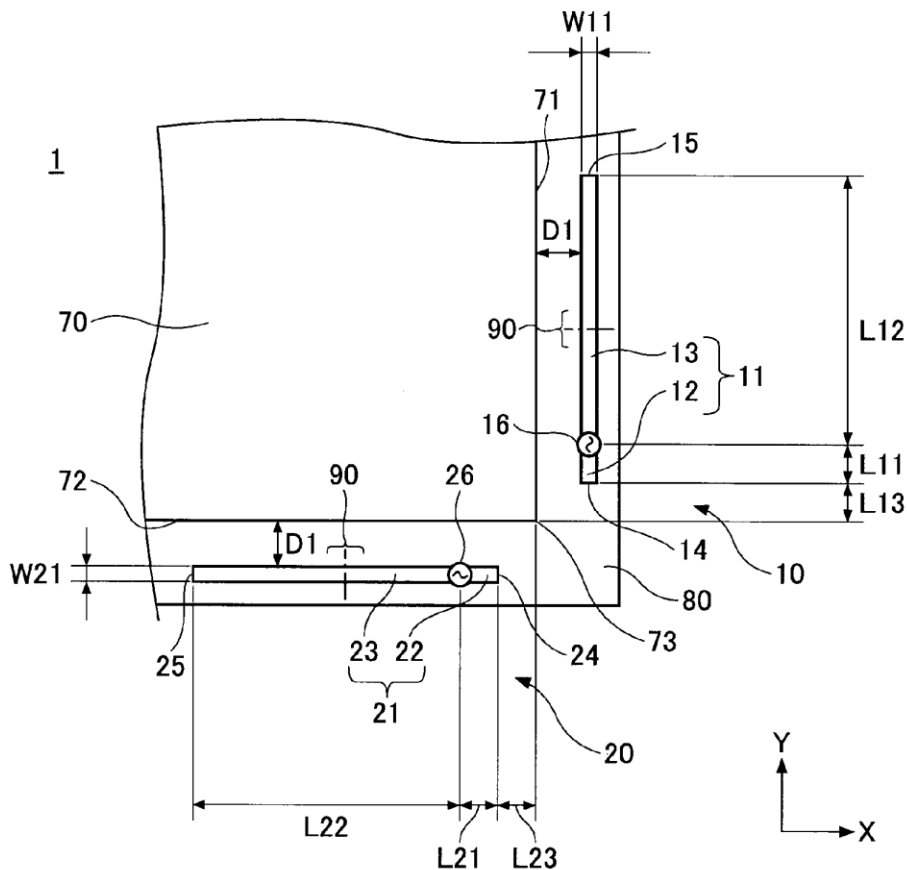
(57) **ABSTRACT**

(22) Filed: **Jul. 2, 2015**

A MIMO antenna is provided that includes a ground plane, and a plurality of dipole antenna elements that are arranged in the vicinity of the ground plane. Each of the plurality of dipole antenna elements includes a radiating element including a conductor portion extending along an outer edge portion of the ground plane, and a feeding portion that feeds the radiating element.

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2014/050356, filed on Jan. 10, 2014.





US 20150303579A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0303579 A1**

(43) **Pub. Date: Oct. 22, 2015**

(54) **WIDEBAND DEFORMED DIPOLE ANTENNA FOR LTE AND GPS BANDS**

Related U.S. Application Data

(60) Provisional application No. 61/711,194, filed on Oct. 8, 2012.

(71) Applicant: **Taoglas Group Holdings Limited, Inc.**, Wexford (IE)

Publication Classification

(72) Inventors: **Wayne Yang**, Taoyuan (TW); **Ronan Quinlan**, San Diego, CA (US)

(51) **Int. Cl.**
H01Q 9/20 (2006.01)
H01Q 1/38 (2006.01)

(73) Assignee: **TAOGLAS GROUP HOLDINGS LIMITED, INC.**, Wexford (IE)

(52) **U.S. Cl.**
CPC ... **H01Q 9/20** (2013.01); **H01Q 1/38** (2013.01)

(21) Appl. No.: **14/438,613**

(57) **ABSTRACT**

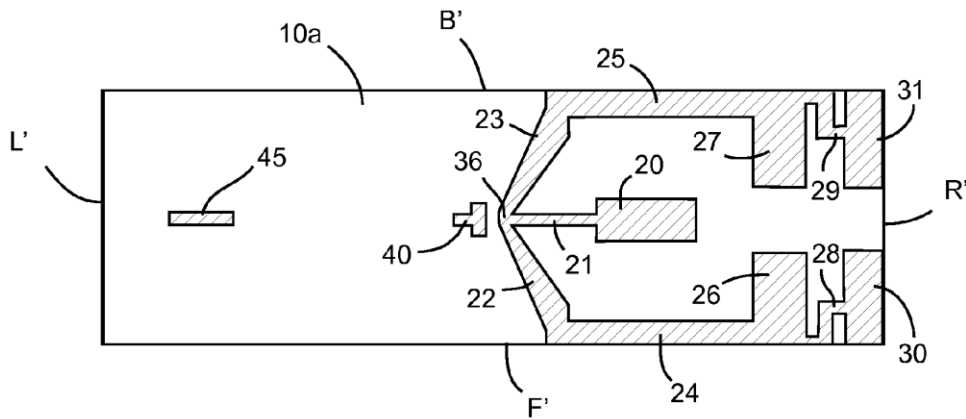
(22) PCT Filed: **Oct. 8, 2013**

A deformed dipole is suggested with trace elements configured for wideband LTE and GPS operation. The deformed dipole comprises a first dipole conductor disposed on a first surface and first side of the circuit board and a second dipole conductor disposed on an opposite surface and opposite side of the circuit board.

(86) PCT No.: **PCT/US2013/063949**

§ 371 (c)(1),

(2) Date: **May 1, 2015**



Top View



US 20150303589A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0303589 A1**

(43) **Pub. Date: Oct. 22, 2015**

(54) **QUADRI-POLARIZED ANTENNA
OSCILLATOR, QUADRI-POLARIZED
ANTENNA AND QUADRI-POLARIZED
MULTI-ANTENNA ARRAY**

(52) **U.S. CL.**
CPC **H01Q 21/28** (2013.01); **H01Q 1/405**
(2013.01)

(71) Applicant: **China Telecom Corporation Limited,**
Beijing (CN)

(57) **ABSTRACT**

(72) Inventors: **Qi Bi,** Morris Plains, NJ (US); **Weiliang
Xie,** Beijing (CN)

(21) Appl. No.: **14/588,000**

(22) Filed: **Dec. 31, 2014**

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2013/
072284, filed on Mar. 7, 2013.

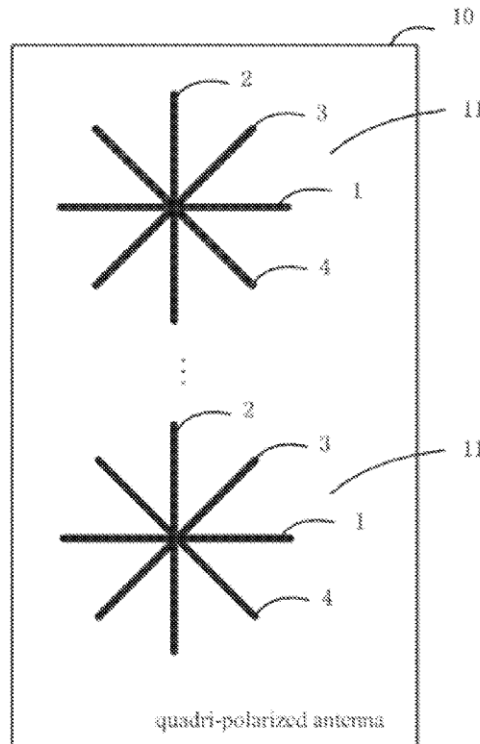
(30) **Foreign Application Priority Data**

Jul. 5, 2012 (CN) 201210231562.8

Publication Classification

(51) **Int. Cl.**
H01Q 21/28 (2006.01)
H01Q 1/40 (2006.01)

A quadri-polarized antenna oscillator, a quadri-polarized antenna, and a quadri-polarized multi-antenna array are provided. The quadri-polarized antenna oscillator comprises four polarized oscillators, wherein midpoints of the four polarized oscillators are coincident; a polarization direction of a first polarized oscillator is a horizontal direction; a polarization direction of a second polarized oscillator is perpendicular to the horizontal direction; a polarization direction of a third polarized oscillator has a 45° angle with the horizontal direction; and a polarization direction of a fourth polarized oscillator has a -45° angle with the horizontal direction. By integrating four polarized oscillators having different polarization directions into one antenna oscillator, the width of the MIMO multi-antenna is reduced, and the horizontal space between two columns of dual-polarized antennas is not required any more, thus the deployment of LTE and 4G networks are favourably implemented without extra space requirement to the top surface of a base station.





US 20150303590A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0303590 A1**

(43) **Pub. Date: Oct. 22, 2015**

(54) **METHODS FOR REDUCING NEAR-FIELD RADIATION AND SPECIFIC ABSORPTION RATE (SAR) VALUES IN COMMUNICATIONS DEVICES**

(71) Applicant: **SKYXCROSS, INC.**, San Jose, CA (US)

(72) Inventors: **Mark T Montgomery**, Melbourne Beach, FL (US); **Frank M Caimi**, Vero Beach, FL (US); **Paul A Tornatta**, Melbourne, FL (US); **Mark W Kishler**, Rockledge, FL (US); **Li Chen**, Melbourne, FL (US)

(21) Appl. No.: **14/754,900**

(22) Filed: **Jun. 30, 2015**

Related U.S. Application Data

(63) Continuation of application No. 14/225,640, filed on Mar. 26, 2014, now Pat. No. 9,100,096, which is a continuation of application No. 13/726,871, filed on Dec. 26, 2012, now Pat. No. 8,723,743, which is a continuation of application No. 12/786,032, filed on May 24, 2010, now Pat. No. 8,344,956, which is a continuation-in-part of application No. 12/750,196, filed on Mar. 30, 2010, now Pat. No. 8,164,538, which is a continuation of application No. 12/099,320, filed

on Apr. 8, 2008, now Pat. No. 7,688,273, which is a continuation-in-part of application No. 11/769,565, filed on Jun. 27, 2007, now Pat. No. 7,688,275.

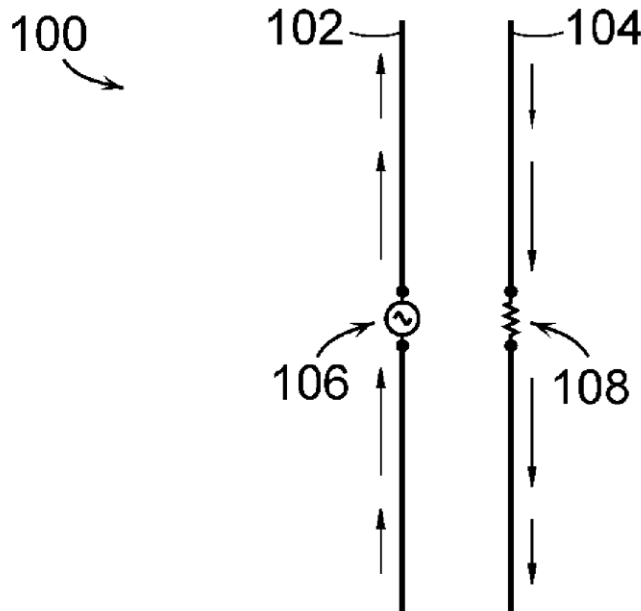
(60) Provisional application No. 60/925,394, filed on Apr. 20, 2007, provisional application No. 60/916,655, filed on May 8, 2007, provisional application No. 61/181,176, filed on May 26, 2009.

Publication Classification

(51) **Int. Cl.**
H01Q 21/29 (2006.01)
H01Q 3/26 (2006.01)
(52) **U.S. Cl.**
CPC . **H01Q 21/29** (2013.01); **H01Q 3/26** (2013.01)

(57) **ABSTRACT**

A method is provided introducing a phase difference between signals at antenna ports of an antenna such that a first signal at one of the antenna ports has a different phase than a second signal at another one of antenna ports to obtain an antenna pattern control. A reduced power is used that is lower than the power used in a non-pattern control operation of the antenna such that a wireless link performance criteria is met with equipment at a far-field point using the reduced power compared to the non-pattern control operation, thereby reducing a specific absorption rate.





US 20150303979A1

(19) **United States**

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

(10) **Pub. No.: US 2015/0303979 A1**

(43) **Pub. Date: Oct. 22, 2015**

(54) **ELECTRONIC DEVICE HAVING
SENSOR-COMBINED ANTENNA DEVICE**

(52) **U.S. CL.**
CPC ... **H04B 1/44** (2013.01); **H04B 1/74** (2013.01)

(71) Applicant: **Samsung Electronics Co., Ltd.**,
Gyeonggi-do (KR)

(57) **ABSTRACT**

(72) Inventors: **In-Ho SHIN**, Daegu (KR); **Ji-Woong OH**, Seoul (KR)

(21) Appl. No.: **14/691,701**

(22) Filed: **Apr. 21, 2015**

(30) **Foreign Application Priority Data**

Apr. 22, 2014 (KR) 10-2014-0047885

Publication Classification

(51) **Int. Cl.**
H04B 1/44 (2006.01)
H04B 1/74 (2006.01)

An electronic device including an antenna device with an integrated sensor is provided. In an embodiment, first and second antenna radiators are operably connected. A communication module transmits or receive communication signals through the first and/or second antenna radiator. A separation circuit such as a series connected inductor is connected in a path between the first and second antenna radiators. The separation circuit prevents passage of the communication signals through the path while enabling passage of a sensing signal acquired through the first and second antenna radiators. A sensor module such as a proximity sensor receives the sensing signal acquired through the first and second antenna radiators. A processor controls a function of the electronic device based on the sensing signal.

