US 20160313769A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2016/0313769 A1**

(43) **Pub. Date: Oct. 27, 2016**

YOSHITANI et al.

(54) **ELECTRONIC DEVICE**

(71) Applicant: **Semiconductor Energy Laboratory Co., Ltd.**, Atsugi-shi (JP)

(72) Inventors: **Yusuke YOSHITANI**, Isehara (JP); **Hideaki KUWABARA**, Isehara (JP); **Natsuko TAKASE**, Atsugi (JP)

(21) Appl. No.: **15/095,286**

(22) Filed: **Apr. 11, 2016**

(30) **Foreign Application Priority Data**

Apr. 23, 2015 (JP) 2015-088420
Aug. 7, 2015 (JP) 2015-157021

Publication Classification

(51) **Int. Cl.**

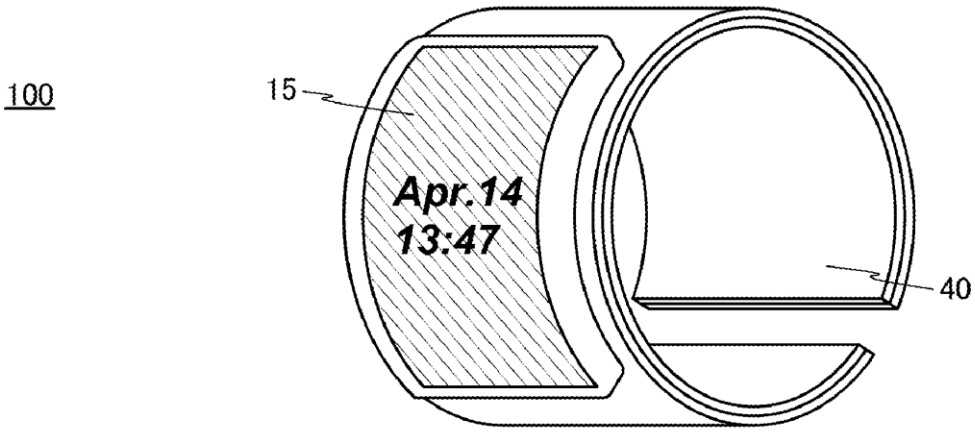
G06F 1/16	(2006.01)
G06F 3/041	(2006.01)
H01L 33/08	(2006.01)
H02J 7/02	(2006.01)
H01L 27/32	(2006.01)
G06F 3/16	(2006.01)
G09G 5/10	(2006.01)

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

CPC ***G06F 1/1675*** (2013.01); ***G06F 1/163*** (2013.01); ***G06F 3/16*** (2013.01); ***G06F 3/041*** (2013.01); ***G06F 1/1652*** (2013.01); ***G06F 1/1635*** (2013.01); ***G09G 5/10*** (2013.01); ***H02J 7/025*** (2013.01); ***H01L 27/3211*** (2013.01); ***H01L 33/08*** (2013.01); *G06F 2200/1633* (2013.01)

(57) **ABSTRACT**

A highly convenient electronic device used while being worn on a body is provided. The electronic device is an arm-worn electronic device including a display panel, a power storage device, a circuit, and a sealing structure. The display panel displays an image with power supplied from the power storage device. The circuit includes an antenna and charges the power storage device wirelessly. Inside the sealing structure, the display panel, the power storage device, and the circuit are provided. The sealing structure includes a portion that transmits visible light. The sealing structure can be worn on an arm or is connected to a structure body that can be worn on an arm.



US 20160315373A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2016/0315373 A1**

(43) **Pub. Date: Oct. 27, 2016**

Azad et al.

(54) **ELECTRONIC DEVICE WITH HOUSING SLOTS FOR ANTENNAS**

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

(72) Inventors: **Umar Azad**, San Jose, CA (US); **Harish Rajagopalan**, San Jose, CA (US); **Mattia Pascolini**, San Francisco, CA (US); **Rodney A. Gomez Angulo**, Sunnyvale, CA (US)

(21) Appl. No.: **14/693,274**

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

Publication Classification

(51) **Int. Cl.**

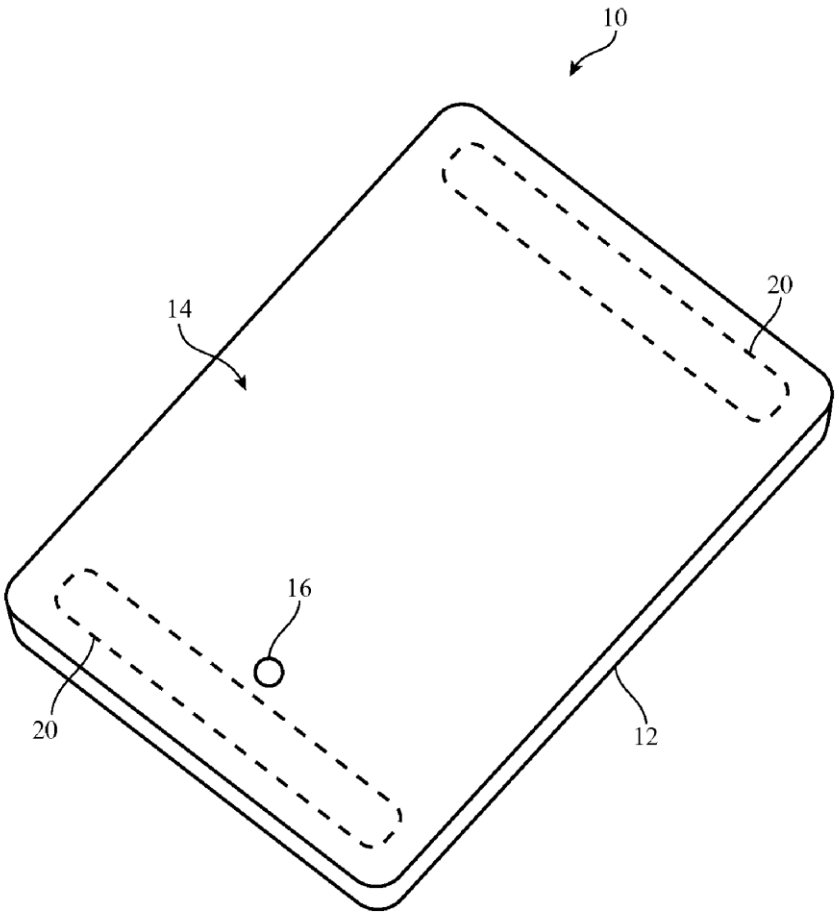
H01Q 1/24	(2006.01)
H01Q 7/00	(2006.01)
H01Q 1/48	(2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 7/00*** (2013.01)

(57) **ABSTRACT**

An electronic device housing may have a rear housing wall that forms a metal ground plane. A slot may be formed in the metal ground plane. The slot may have one or more open ends along an edge of the ground plane. A near-field communications loop antenna may overlap the slot. The near-field communications loop antenna may have one or more turns. A current path through the metal ground plane may form one of the turns in the near-field communications loop antenna. The slot may form portions of non-near-field-communications antennas in addition to the near-field communications loop antenna. The slot in the non-near-field-communications antennas may be fed using an indirect antenna feed structure. Components such as a capacitor and inductor may help allow non-near-field communications antenna and the near-field communications antenna to be formed from common portions of the metal ground plane.



US 20160315374A1

(19) **United States**

(12) **Patent Application Publication**

Wu et al.

(10) **Pub. No.: US 2016/0315374 A1**

(43) **Pub. Date: Oct. 27, 2016**

(54) **WIRELESS DEVICE**

(71) Applicant: **MEDIATEK INC.**, Hsin-Chu (TW)

(72) Inventors: **Min-Chung Wu**, Taoyuan City (TW); **Shao-Chin Lo**, Miaoli County (TW)

(21) Appl. No.: **15/202,587**

(22) Filed: **Jul. 6, 2016**

Related U.S. Application Data

(62) Division of application No. 12/959,373, filed on Dec. 3, 2010.

(60) Provisional application No. 61/290,177, filed on Dec. 25, 2009.

Publication Classification

(51) **Int. Cl.**

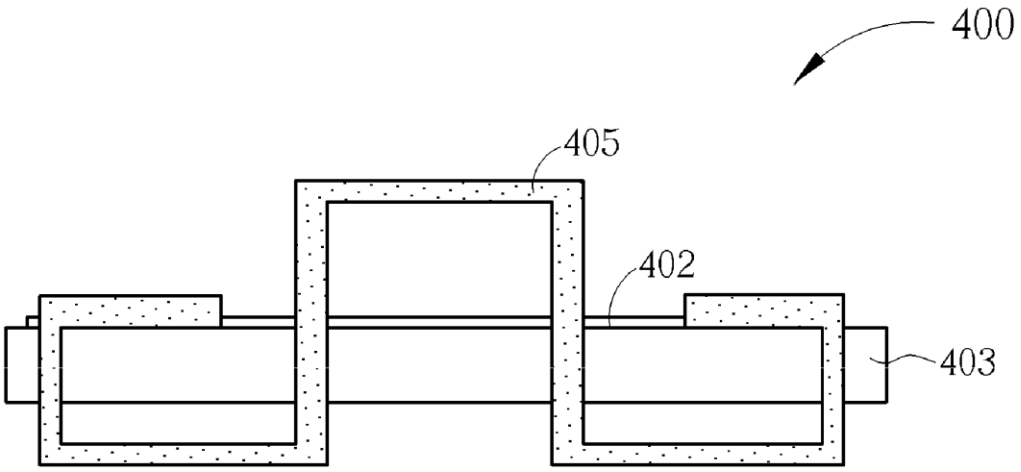
H01Q 1/24	(2006.01)
H01Q 9/40	(2006.01)
H01Q 1/48	(2006.01)
H01Q 1/38	(2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H01Q 1/38*** (2013.01); ***H01Q 9/40*** (2013.01); ***H01Q 1/48*** (2013.01)

(57) **ABSTRACT**

The present invention discloses a wireless device, which includes a substrate and an antenna. The antenna includes a printed antenna element and a 3-dimensional antenna element. The printed antenna element is printed on the substrate, while the 3-dimensional antenna element is disposed on the substrate and coupled to the printed antenna element. The printed antenna element and the 3-dimensional antenna element jointly have a physical length of a desired frequency.



US 20160315375A1

(19) **United States**

(12) **Patent Application Publication**

Wu et al.

(10) **Pub. No.: US 2016/0315375 A1**

(43) **Pub. Date: Oct. 27, 2016**

(54) **WIRELESS DEVICE**

(71) Applicant: **MEDIATEK INC.**, Hsin-Chu (TW)

(72) Inventors: **Min-Chung Wu**, Taoyuan City (TW); **Shao-Chin Lo**, Miaoli County (TW)

(21) Appl. No.: **15/202,589**

(22) Filed: **Jul. 6, 2016**

Related U.S. Application Data

(63) Continuation of application No. 12/959,373, filed on Dec. 3, 2010.

(60) Provisional application No. 61/290,177, filed on Dec. 25, 2009.

Publication Classification

(51) **Int. Cl.**

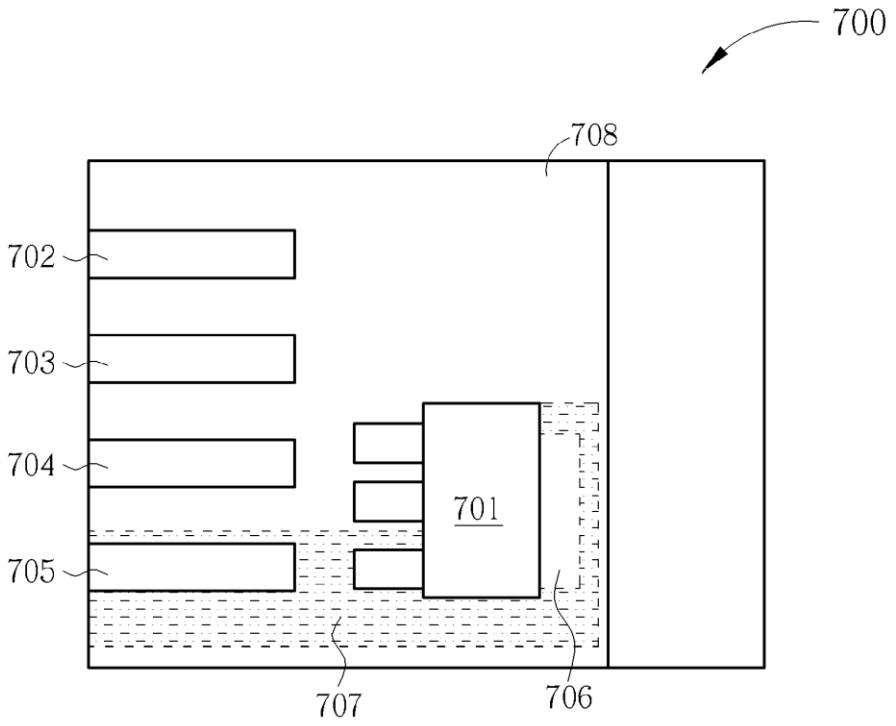
H01Q 1/24	(2006.01)
H01Q 9/40	(2006.01)
H01Q 1/38	(2006.01)
H01Q 1/48	(2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 9/40*** (2013.01); ***H01Q 1/38*** (2013.01)

(57) **ABSTRACT**

The present invention discloses a wireless device, which includes a substrate and an antenna. The antenna includes a printed antenna element and a 3-dimensional antenna element. The printed antenna element is printed on the substrate, while the 3-dimensional antenna element is disposed on the substrate and coupled to the printed antenna element. The printed antenna element and the 3-dimensional antenna element jointly have a physical length of a desired frequency.



US 20160315387A1

(19) **United States**

(12) **Patent Application Publication**

LEE et al.

(10) **Pub. No.: US 2016/0315387 A1**

(43) **Pub. Date: Oct. 27, 2016**

(54) **ANTENNA**

(71) Applicant: **EMW CO., LTD.**, Incheon (KR)

(72) Inventors: **Kyoung Ho LEE**, Gyeonggi-do (KR); **Young Tae KIM**, Daegu (KR); **Won Mo SEONG**, Gyeonggi-do (KR)

(21) Appl. No.: **15/103,448**

(22) PCT Filed: **Dec. 8, 2014**

(86) PCT No.: **PCT/KR2014/012019**

§ 371 (c)(1),
(2) Date: **Jun. 10, 2016**

(30) **Foreign Application Priority Data**

Dec. 11, 2013 (KR) 10-2013-0154123

Publication Classification

(51) **Int. Cl.**

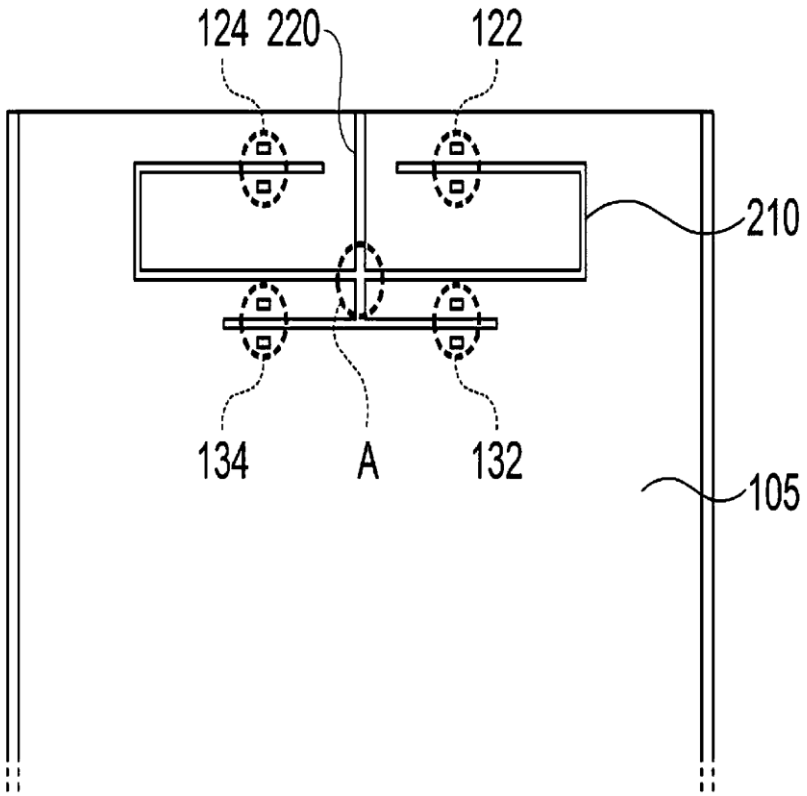
H01Q 5/371	(2006.01)
H01Q 1/36	(2006.01)
H01Q 13/10	(2006.01)
H01Q 1/48	(2006.01)
H01Q 9/14	(2006.01)
H01Q 1/24	(2006.01)
H01Q 7/00	(2006.01)

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

CPC ***H01Q 5/371*** (2015.01); ***H01Q 1/243*** (2013.01); ***H01Q 1/36*** (2013.01); ***H01Q 7/00*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 9/14*** (2013.01); ***H01Q 13/106*** (2013.01)

(57) **ABSTRACT**

An antenna using a length-adjustable slit includes a power supply line connected to a ground pad and a power supply pad for receiving a power supply signal from a PCB, the ground pad being connected to a case, a radiator formed on the case, the radiator including at least one slit having a dielectric embedded in the slit, and a plurality of switching terminals for controlling the resonant frequency of the slit.



US 20160315390A1

(19) **United States**

(12) **Patent Application Publication**

Oh et al.

(10) **Pub. No.: US 2016/0315390 A1**

(43) **Pub. Date: Oct. 27, 2016**

(54) **ANTENNA MODULE**

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

(72) Inventors: **Sang Bae Oh**, Seoul (KR); **In Pyo Park**, Seoul (KR)

(21) Appl. No.: **15/137,479**

(22) Filed: **Apr. 25, 2016**

(30) **Foreign Application Priority Data**

Apr. 24, 2015 (KR) 10-2015-0057841

Publication Classification

(51) **Int. Cl.**

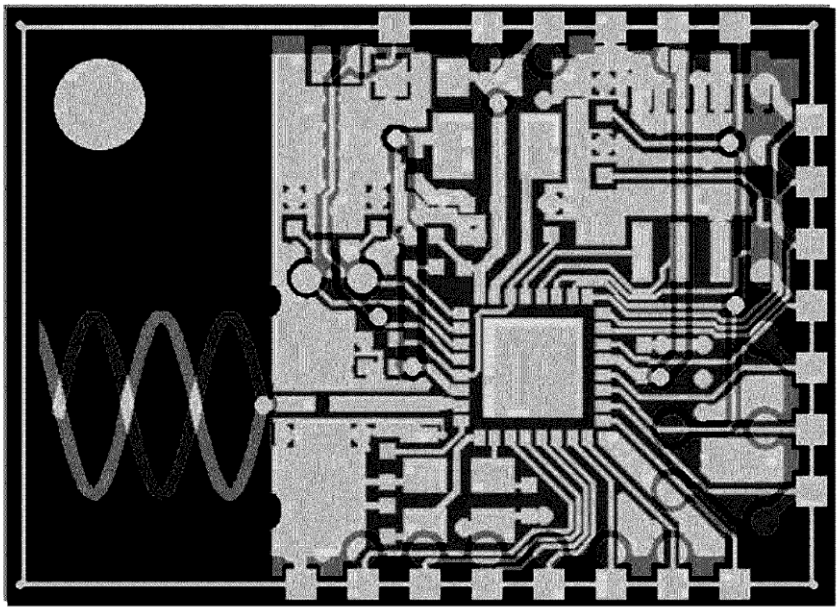
H01Q 9/04 (2006.01)
H01Q 1/22 (2006.01)
H01Q 1/50 (2006.01)
H01Q 1/48 (2006.01)

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

CPC ***H01Q 9/0407*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 1/2291*** (2013.01); ***H01Q 1/50*** (2013.01)

(57) **ABSTRACT**

An antenna module is provided. The antenna module according to one embodiment of the present invention includes a ground portion which has a lower ground plane, a dielectric layer disposed on the lower ground plane, and an upper ground plane disposed on the dielectric layer, and an antenna portion disposed at an adjoining surface of the ground portion and configured to have a patch layer, a dielectric layer disposed on the patch layer, and an antenna layer disposed on the dielectric layer, and having a plurality of unit patterns which continuously repeat.



US 20160315651A1

(19) **United States**

(12) **Patent Application Publication**

Hong et al.

(10) **Pub. No.: US 2016/0315651 A1**

(43) **Pub. Date: Oct. 27, 2016**

(54) **MOBILE TERMINAL**

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

(72) Inventors: **Sungjoon Hong**, Seoul (KR); **Kangjae Jung**, Seoul (KR); **Sungjung Rho**, Seoul (KR); **Youngbae Kwon**, Seoul (KR); **Jaewoo Lee**, Seoul (KR); **Deuksu Choi**, Seoul (KR)

(73) Assignee: **LG ELECTRONICS INC.**, Seoul (KR)

(21) Appl. No.: **14/937,621**

(22) Filed: **Nov. 10, 2015**

(30) **Foreign Application Priority Data**

Apr. 22, 2015 (KR) 10-2015-0056845
Jul. 1, 2015 (KR) 10-2015-0093901

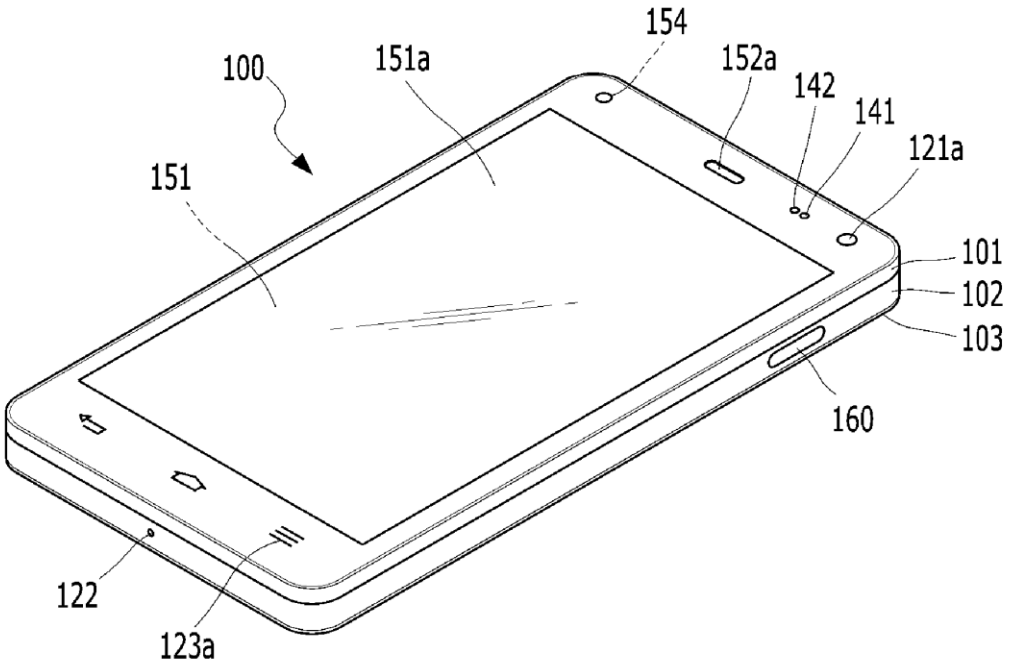
Publication Classification

(51) **Int. Cl.**
H04B 1/3888 (2006.01)

(52) **U.S. Cl.**
CPC ***H04B 1/3888*** (2013.01)

(57) **ABSTRACT**

There is disclosed a mobile terminal including a case having a display unit coupled to a front side, a first antenna mounted in the case and comprising a first slot extended in a first direction and having a closed end and an open end, a second antenna mounted in the case and comprising a second slot extended in a second direction opposite to the extended direction of the first slot and comprising a closed end and an open end, a power supply unit mounted in the case, a first feeder supplying the power of the power supply unit to the first antenna, and a second feeder supplying the power of the power supply unit to the second antenna.



US 20160321535A1

(19) **United States**

(12) **Patent Application Publication**

BAN et al.

(10) **Pub. No.: US 2016/0321535 A1**

(43) **Pub. Date: Nov. 3, 2016**

(54) **LOOP ANTENNA AND RADIO FREQUENCY TAG**

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

(72) Inventors: **Yasumitsu BAN**, Yokohama (JP); **Manabu Kai**, Yokohama (JP)

(21) Appl. No.: **15/136,633**

(22) Filed: **Apr. 22, 2016**

(30) **Foreign Application Priority Data**

Apr. 28, 2015 (JP) 2015-092082
Feb. 25, 2016 (JP) 2016-034834

Publication Classification

(51) **Int. Cl.**

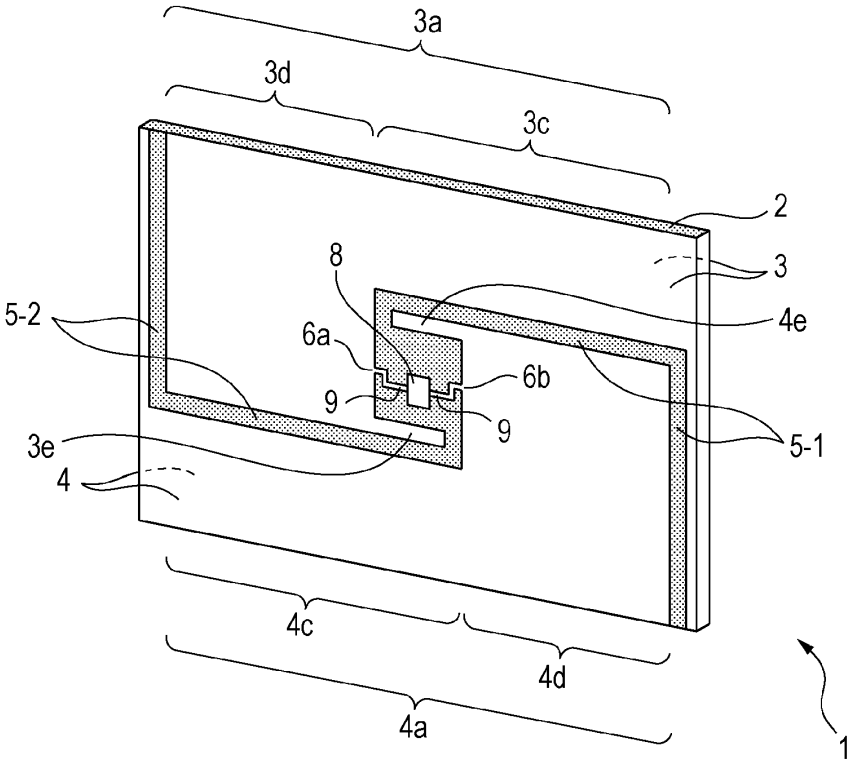
G06K 19/077 (2006.01)
H01Q 7/00 (2006.01)
H01Q 1/22 (2006.01)

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

CPC ***G06K 19/07788*** (2013.01); ***H01Q 1/2208*** (2013.01); ***H01Q 7/00*** (2013.01)

(57) **ABSTRACT**

A loop antenna includes first and second conductors configured to have conductivity, the first conductor including first and second patterns, the first pattern being provided along a first surface and including a first feed point, and the second pattern being coupled to the first pattern at a first end of the first surface and being provided to oppose the first pattern; and a second conductor configured to have conductivity, the second conductor including third and fourth patterns, the third pattern being provided on the first surface with a gap generating a capacitance between the first pattern and including a second feed point, the fourth pattern being electrically coupled to the third pattern at a second end opposing the first end on the first surface, the fourth pattern overlapping the second pattern so as to cause capacitive coupling or being connected to the second pattern.



US 20160322699A1

(19) **United States**

(12) **Patent Application Publication**

Mow et al.

(10) **Pub. No.: US 2016/0322699 A1**

(43) **Pub. Date: Nov. 3, 2016**

(54) **ELECTRONIC DEVICE WITH CONFIGURABLE SYMMETRIC ANTENNAS**

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

(72) Inventors: **Matthew A. Mow**, Los Altos, CA (US); **Xu Han**, San Jose, CA (US); **James G. Judkins**, Campbell, CA (US); **Liang Han**, Sunnyvale, CA (US); **Mattia Pascolini**, San Francisco, CA (US); **Ming-Ju Tsai**, Cupertino, CA (US); **Nanbo Jin**, Milpitas, CA (US); **Thomas E. Biedka**, San Jose, CA (US); **Victor C. Lee**, Sunnyvale, CA (US); **Yuehui Ouyang**, Sunnyvale, CA (US)

(21) Appl. No.: **14/701,323**

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

Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

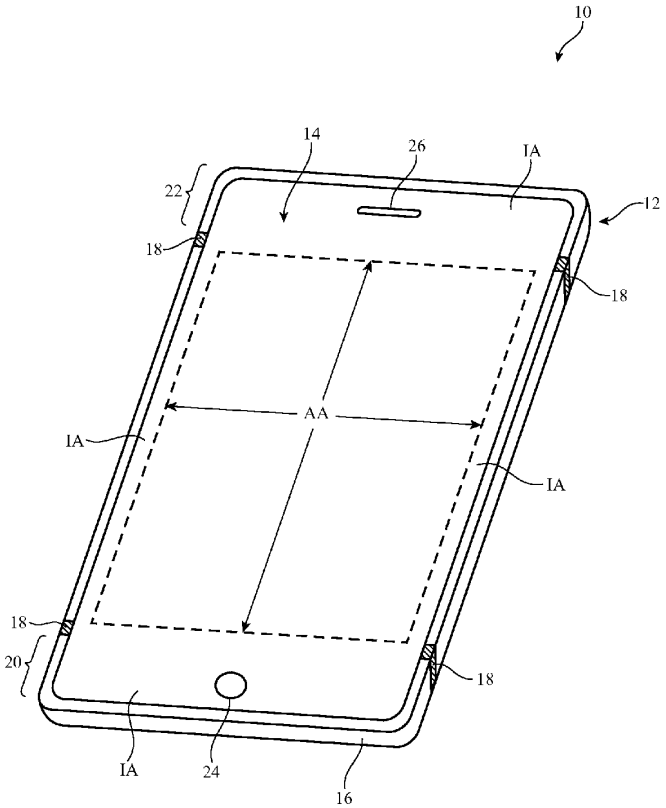
H01Q 13/10 (2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H01Q 13/10*** (2013.01); ***H01Q 13/103*** (2013.01)

(57) **ABSTRACT**

An electronic device may have wireless circuitry with antennas. An antenna resonating element arm for an antenna may be formed from peripheral conductive structures running along the edges of a device housing that are separated from a round by an elongated opening. The electronic device may have a central longitudinal axis that divides the antenna resonating element arm and other antenna structures into symmetrical halves that exhibit mirror symmetry with respect to the central longitudinal axis. The antenna structures may include symmetrical slot antenna resonating elements on opposing sides of the central longitudinal axis. Electrical components such as switches and antenna tuning inductors may be coupled to the antenna structures in a configuration that is symmetrical with respect to the central longitudinal axis. The electrical components may be used to place the antenna structures in an unflipped configuration or in a symmetrical flipped configuration.



US 20160322700A1

(19) **United States**

(12) **Patent Application Publication**

Choon et al.

(10) **Pub. No.: US 2016/0322700 A1**

(43) **Pub. Date: Nov. 3, 2016**

(54) **FULL-BAND ANTENNA SYSTEM**

(71) Applicants: **Tan Yew Choon**, Singapore (SG); **NG Guan Hong**, Singapore (SG); **TAY Yew Siow**, Singapore (SG)

(72) Inventors: **Tan Yew Choon**, Singapore (SG); **NG Guan Hong**, Singapore (SG); **TAY Yew Siow**, Singapore (SG)

(73) Assignee: **AAC Technologies Pte. Ltd.**, Singapore city (SG)

(21) Appl. No.: **14/930,225**

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

(30) **Foreign Application Priority Data**

Apr. 29, 2015 (CN) 201510212532.6

Publication Classification

(51) **Int. Cl.**

H01Q 1/50 (2006.01)

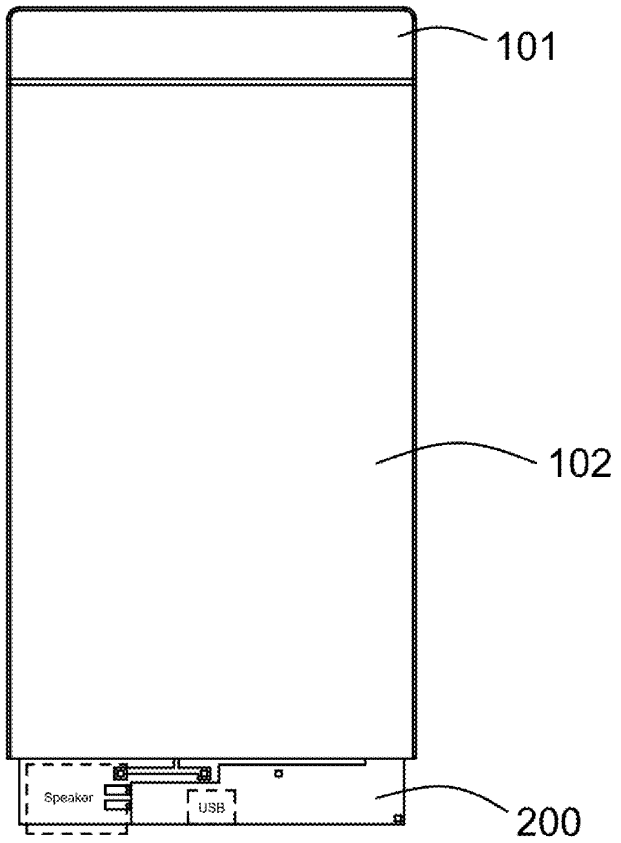
H01Q 1/38 (2006.01)

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

CPC . ***H01Q 1/50*** (2013.01); ***H01Q 1/38*** (2013.01)

(57) **ABSTRACT**

The disclosure provides a full-band antenna system including a metal backing and a main antenna module. The metal backing includes a header, a middle cover and a lower head. The main antenna module includes a circuit board, a feed part on the circuit board, a ground point and a matching circuit. The circuit board includes a substrate and an earth plate. The feed part and the matching circuit are located on the substrate, and the ground point is on the earth plate. The matching circuit is connected with the feed part, including a variable capacitance. By the variable capacitance of the matching circuit, it is beneficial to adjust the performance of antenna of all range of frequency conveniently and optimize the antenna's radiant efficiency up to the utmost extent.



US 20160322702A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2016/0322702 A1**

(43) **Pub. Date: Nov. 3, 2016**

SAYAMA et al.

(54) **ANTENNA DIRECTIVITY CONTROL SYSTEM AND RADIO DEVICE**

(71) Applicant: **Asahi Glass Company, Limited**, Chiyoda-ku (JP)

(72) Inventors: **Toshiki SAYAMA**, Chiyoda-ku (JP); **Ryuta SONODA**, Chiyoda-ku (JP); **Koji IKAWA**, Chiyoda-ku (JP)

(73) Assignee: **Asahi Glass Company, Limited**, Chiyoda-ku (JP)

(21) Appl. No.: **15/207,849**

(22) Filed: **Jul. 12, 2016**

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2015/051017, filed on Jan. 16, 2015.

(30) **Foreign Application Priority Data**

Jan. 20, 2014 (JP) 2014-008169

Publication Classification

(51) **Int. Cl.**

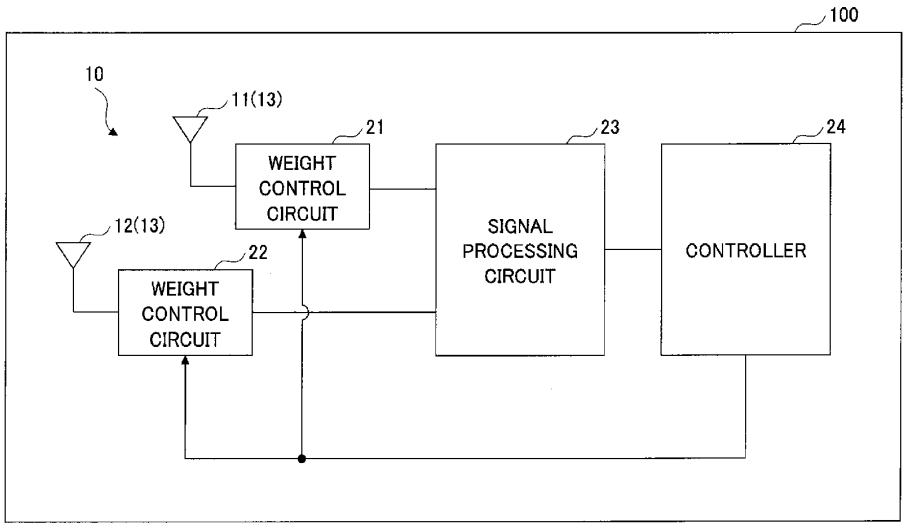
H01Q 3/28	(2006.01)
H01Q 1/24	(2006.01)
H01Q 1/48	(2006.01)
H01Q 21/28	(2006.01)

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

CPC ***H01Q 3/28*** (2013.01); ***H01Q 21/28*** (2013.01); ***H01Q 1/243*** (2013.01); ***H01Q 1/48*** (2013.01)

(57) **ABSTRACT**

An antenna directivity control system includes an antenna including a plurality of antenna elements, feeding points for the plurality of antenna elements being mutually different; and a controller for controlling weight for each of the plurality of antenna elements, wherein each of the plurality of antenna elements includes a feed element connected to the feed point, and a radiating element that functions, upon power being fed by establishing electromagnetic field coupling with the feed element, as a radiating conductor, and wherein the controller controls a directivity of the antenna by adjusting an amplitude of a signal at each of the feeding points.



US 20160322705A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2016/0322705 A1**

(43) **Pub. Date: Nov. 3, 2016**

HUANG et al.

(54) **ASSEMBLY-TYPE DUAL-BAND PRINTED ANTENNA**

(71) Applicant: **ARCADYAN TECHNOLOGY CORPORATION**, Hsinchu City (TW)

(72) Inventors: **CHIH-YUNG HUANG**, Taichung County (TW); **MIN-CHI WU**, Hsinchu County (TW); **KUO-CHANG LO**, Miaoli County (TW)

(21) Appl. No.: **15/096,334**

(22) Filed: **Apr. 12, 2016**

(30) **Foreign Application Priority Data**

Apr. 30, 2015 (TW) 104113963

Publication Classification

(51) **Int. Cl.**

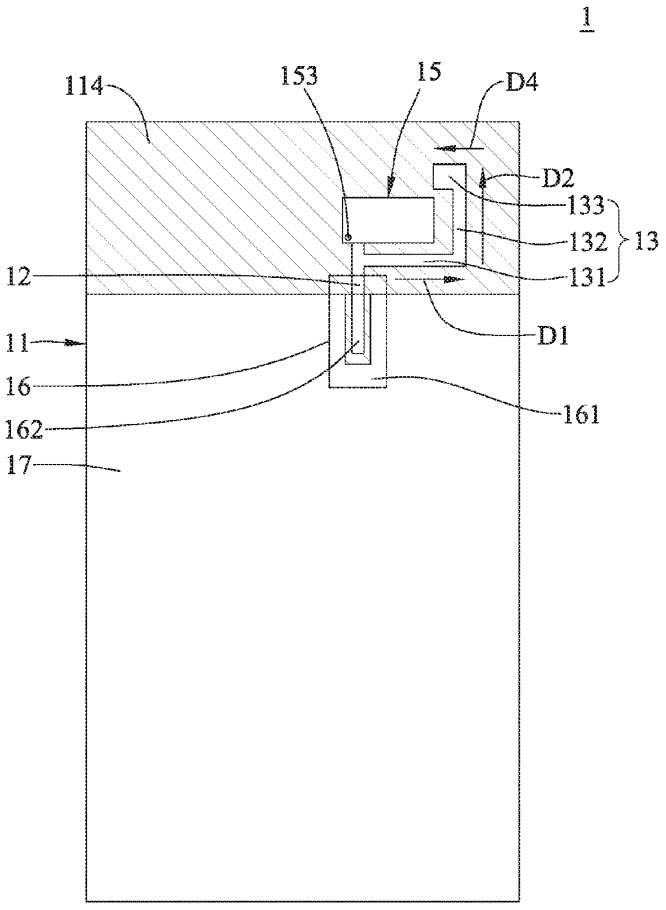
H01Q 5/307 (2006.01)
H01Q 1/24 (2006.01)
H01Q 9/06 (2006.01)

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

CPC ***H01Q 5/307*** (2015.01); ***H01Q 9/065*** (2013.01); ***H01Q 1/243*** (2013.01)

(57) **ABSTRACT**

An assembly-type dual-band printed antenna may include a substrate, an antenna signal feed-in end, a first radiator, a substrate assembly and a second radiator. The antenna signal feed-in end may be disposed on the substrate. The first radiator may be disposed on the substrate and may be coupled to the antenna signal feed-in end. The substrate assembly may be installed on the substrate and may include a via hole. The second radiator may be disposed on the substrate assembly and may be coupled to the first radiator through the via hole.



US 20160322709A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2016/0322709 A1**

TAO (43) **Pub. Date: Nov. 3, 2016**

(54) **ANTENNA SYSTEM**

(71) Applicant: **Wistron NeWeb Corp.**, Hsinchu (TW)

(72) Inventor: **YU TAO**, HSINCHU (TW)

(21) Appl. No.: **14/926,404**

(22) Filed: **Oct. 29, 2015**

(30) **Foreign Application Priority Data**

Apr. 30, 2015 (TW) 104113848

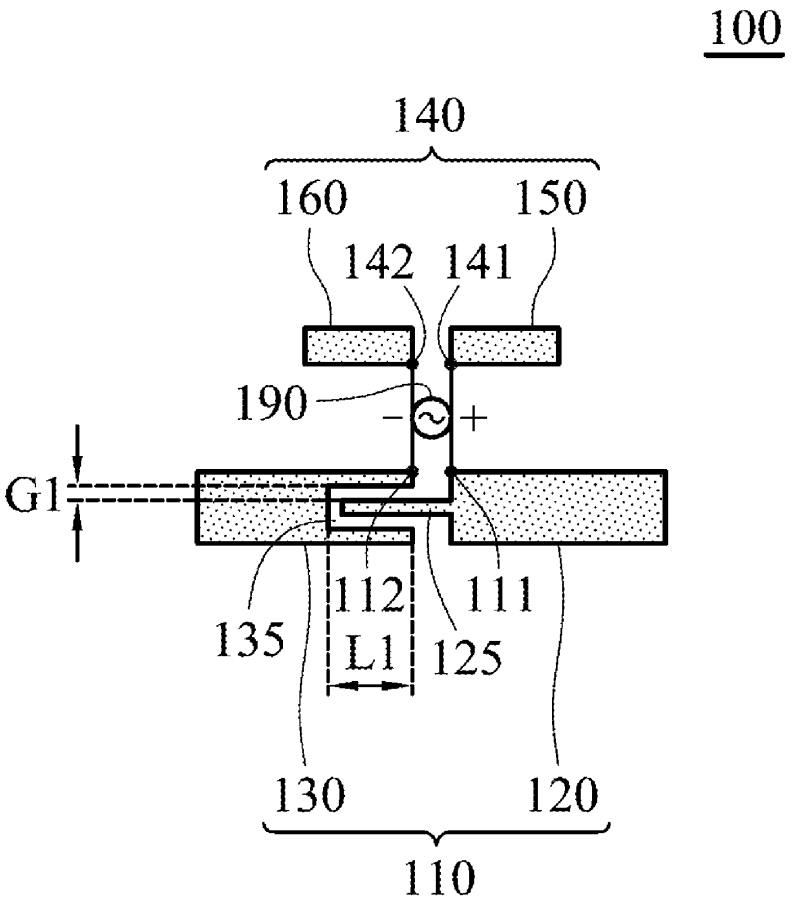
Publication Classification

(51) **Int. Cl.**
H01Q 9/06 (2006.01)
H01Q 1/50 (2006.01)

(52) **U.S. Cl.**
CPC ***H01Q 9/065*** (2013.01); ***H01Q 1/50*** (2013.01)

(57) **ABSTRACT**

An antenna system includes a first dipole antenna element and a second dipole antenna element. The first dipole antenna element includes a first feeding radiation element and a first grounding radiation element. The first feeding radiation element has an extension portion. The first grounding radiation element has an open slot. The extension portion extends into the interior of the open slot. The second dipole antenna element includes a second feeding radiation element and a second grounding radiation element. The first dipole antenna element and the second dipole antenna element are both excited by a signal source. The first dipole antenna element operates in a low-frequency band. The second dipole antenna element operates in a high-frequency band.



US 20160323053A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2016/0323053 A1**

(43) **Pub. Date: Nov. 3, 2016**

KANG et al.

(54) **ANTENNA SYSTEM AND HARMONIC SUPPRESSION ELEMENT**

(71) Applicant: **Media Tek Inc.**, Hsin-Chu (TW)

(72) Inventors: **Ting-Wei KANG**, Kaohsiung City (TW); **Shih-Huang YEH**, Hsinchu City (TW)

(21) Appl. No.: **14/936,976**

(22) Filed: **Nov. 10, 2015**

Related U.S. Application Data

(60) Provisional application No. 62/154,356, filed on Apr. 29, 2015.

Publication Classification

(51) **Int. Cl.**

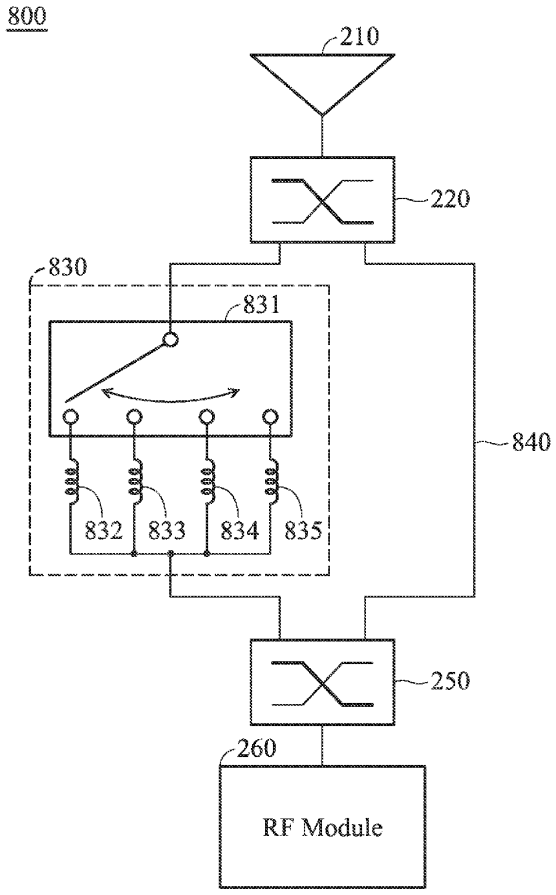
H04J 1/04	(2006.01)
H04L 27/30	(2006.01)
H04B 7/04	(2006.01)

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

CPC ***H04J 1/045*** (2013.01); ***H04B 7/04*** (2013.01); ***H04L 27/30*** (2013.01)

(57) **ABSTRACT**

An antenna system includes an antenna, a first frequency dividing circuit, a second frequency dividing circuit, and a plurality of matching circuits. The first frequency dividing circuit is coupled to the antenna. The matching circuits are coupled to the first frequency dividing circuit. The second frequency dividing circuit is coupled to the matching circuits. The matching circuits are configured to process different frequency signals, respectively.



US 20160329625A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2016/0329625 A1**

(43) **Pub. Date: Nov. 10, 2016**

LIN

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

(71) Applicant: **CHIUN MAI COMMUNICATION SYSTEMS, INC.**, New Taipei (TW)

(72) Inventor: **YEN-HUI LIN**, Tu-Cheng (TW)

(21) Appl. No.: **14/867,215**

(22) Filed: **Sep. 28, 2015**

(30) **Foreign Application Priority Data**

May 9, 2015 (CN) 201510293689.6

Publication Classification

(51) **Int. Cl.**

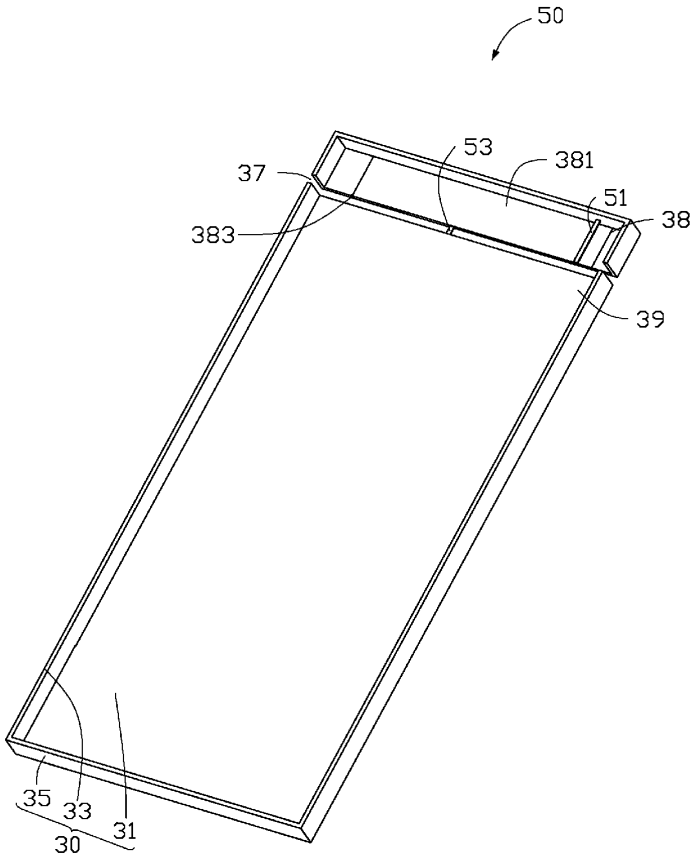
H01Q 1/24	(2006.01)
H01Q 5/335	(2006.01)
H01Q 1/50	(2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H01Q 1/50*** (2013.01); ***H01Q 5/335*** (2015.01)

(57) **ABSTRACT**

A wireless communication device includes a housing and an antenna. The housing has a first end portion and a second end portion opposite the first end portion and defining a slot adjacent to the first end portion. The slot divides the housing into an antenna portion and a housing portion. The antenna is coupled to the housing and includes the antenna portion, a feed end, a ground end, and an adjusting circuit. The ground end is received in the slot and connected between the antenna portion and the housing portion. The adjusting circuit is connected to the antenna portion by an adjusting point whereby the antenna portion is configured to operate in a first working frequency band and a second working frequency band.



US 20160329626A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2016/0329626 A1**

JEON et al. (43) **Pub. Date: Nov. 10, 2016**

(54) **RADIATOR FRAME HAVING ANTENNA PATTERN AND METHOD OF MAKING THE SAME**

(71) Applicant: **SAMSUNG ELECTRO-MECHANICS CO., LTD.**, Suwon-si (KR)

(72) Inventors: **Dae Seong JEON**, Suwon-si (KR); **Hyun Sam MUN**, Suwon-si (KR); **Sung Eun CHO**, Suwon-si (KR); **Hyeon Gil NAM**, Suwon-si (KR)

(73) Assignee: **SAMSUNG ELECTRO-MECHANICS CO., LTD.**, Suwon-si (KR)

(21) Appl. No.: **15/040,097**

(22) Filed: **Feb. 10, 2016**

(30) **Foreign Application Priority Data**

May 4, 2015 (KR) 10-2015-0062730

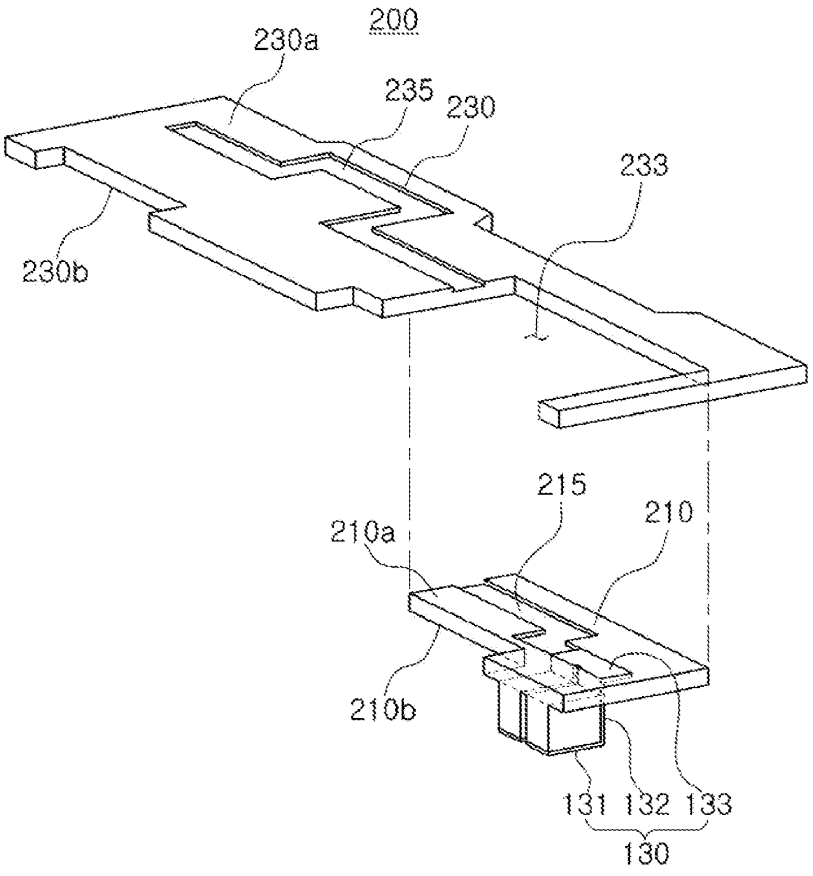
Publication Classification

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

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

(57) **ABSTRACT**

A radiator frame includes a molded frame; a connection terminal extending from one surface of the molded frame and through another surface thereof; an extension frame substantially surrounding the molded frame; and an antenna pattern extending from the one surface of the molded frame to one surface of the extension frame and electrically connected to the connection terminal.



US 20160329627A1

(19) **United States**

(12) **Patent Application Publication**

HONG et al.

(10) **Pub. No.: US 2016/0329627 A1**

(43) **Pub. Date: Nov. 10, 2016**

(54) **EMBEDDED ANTENNA**

(71) Applicant: **EMW CO., LTD.**, Incheon (KR)

(72) Inventors: **Chang Ho HONG**, Seoul (KR); **Won Mo SEONG**, Gyeonggi-do (KR)

(21) Appl. No.: **15/107,564**

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

(86) PCT No.: **PCT/KR2014/012667**

§ 371 (c)(1),
(2) Date: **Jun. 23, 2016**

(30) **Foreign Application Priority Data**

Dec. 23, 2013 (KR) 10-2013-0161479

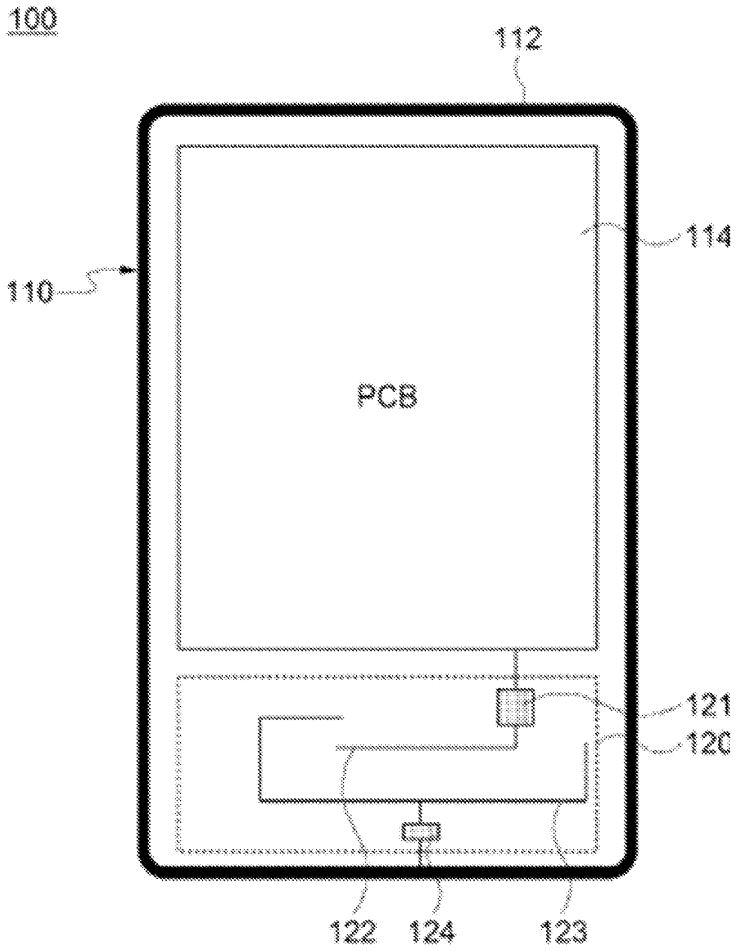
Publication Classification

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

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

(57) **ABSTRACT**

An embedded antenna includes a power transfer pad connected to a circuit inside a portable terminal having a metal exterior, and a first radiation unit which is connected to the power transfer pad so as to radiate a signal of a first passband, and a second radiation unit which is connected to the metal exterior so as to radiate a signal of a second passband.



US 20160329629A1

(19) **United States**

(12) **Patent Application Publication**

PARK et al.

(10) **Pub. No.: US 2016/0329629 A1**

(43) **Pub. Date: Nov. 10, 2016**

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

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

(72) Inventors: **Hoon PARK**, Seoul (KR); **Yeon-Woo KIM**, Seoul (KR); **Ho-Saeng KIM**, Gyeonggi-do (KR)

(21) Appl. No.: **15/216,379**

(22) Filed: **Jul. 21, 2016**

Related U.S. Application Data

(63) Continuation of application No. 14/532,235, filed on Nov. 4, 2014, now Pat. No. 9,413,080.

(30) **Foreign Application Priority Data**

Nov. 4, 2013 (KR) 10-2013-0133221

Publication Classification

(51) **Int. Cl.**

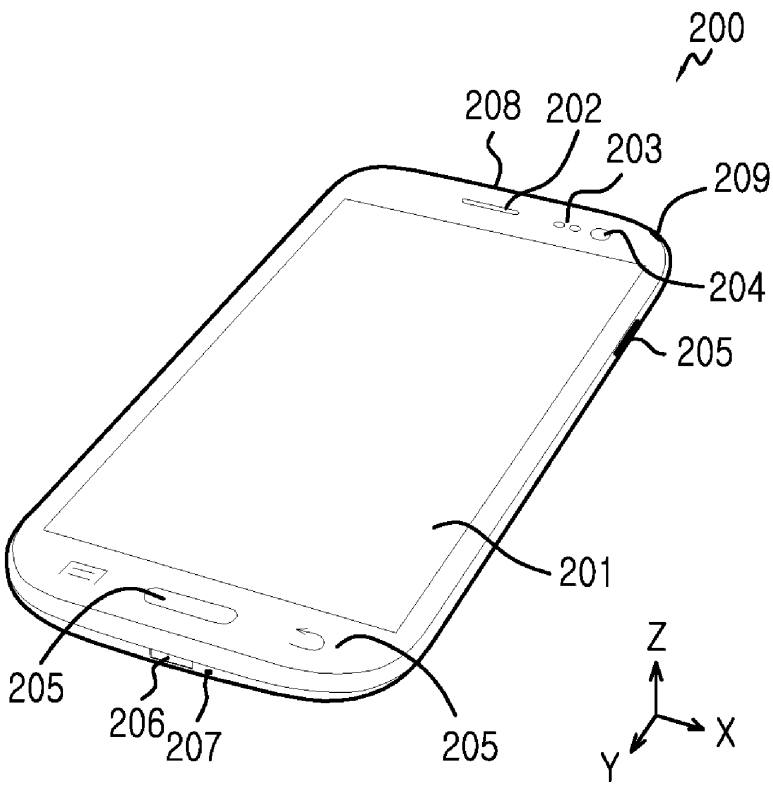
H01Q 1/24 (2006.01)
H01Q 7/00 (2006.01)
H01Q 21/30 (2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H01Q 21/30*** (2013.01); ***H01Q 7/00*** (2013.01)

(57) **ABSTRACT**

An electronic apparatus is provided. The electronic apparatus includes at least one first antenna radiator, a main board including a feed part that is spaced apart from at least one portion of the at least one first antenna radiator to overlap the at least one portion of the at least one first antenna radiator and feeds an electric current to the at least one first antenna radiator according to an indirect feed method, at least one second antenna radiator disposed on a housing of the electronic apparatus, at least one first connection member for electrically connecting the at least one first antenna radiator to the at least one second antenna radiator, and at least one second connection member for electrically connecting a ground part formed on the main board to the at least one second antenna radiator. Also, other various exemplary may be implemented.



US 20160336643A1

(19) **United States**

(12) **Patent Application Publication**

Pascolini et al.

(10) **Pub. No.: US 2016/0336643 A1**

(43) **Pub. Date: Nov. 17, 2016**

(54) **ELECTRONIC DEVICE WITH TUNABLE HYBRID ANTENNAS**

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

(72) Inventors: **Mattia Pascolini**, San Francisco, CA (US); **Umar Azad**, San Jose, CA (US); **Rodney A. Gomez Angulo**, Sunnyvale, CA (US); **Erdinc Irci**, Santa Clara, CA (US); **Qingxiang Li**, Mountain View, CA (US); **Matthew A. Mow**, Los Altos, CA (US); **Harish Rajagopalan**, San Jose, CA (US); **Miroslav Samardzija**, Mountain View, CA (US); **Ming-Ju Tsai**, Cupertino, CA (US)

(21) Appl. No.: **14/710,377**

(22) Filed: **May 12, 2015**

Publication Classification

(51) **Int. Cl.**

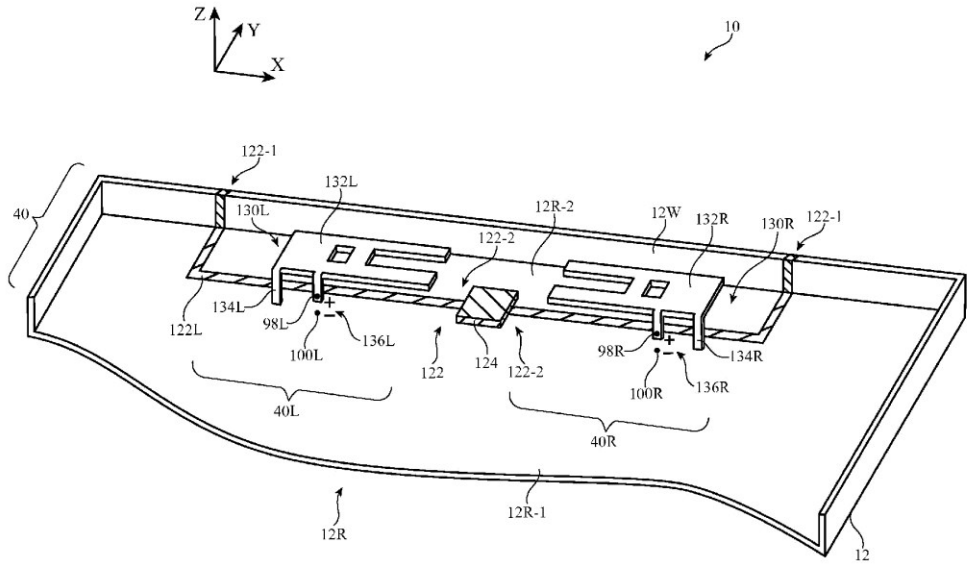
H01Q 1/24	(2006.01)
H01Q 9/04	(2006.01)
H01Q 13/10	(2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H01Q 13/103*** (2013.01); ***H01Q 9/0442*** (2013.01)

(57) **ABSTRACT**

An electronic device may have hybrid antennas that include slot antenna resonating elements formed from slots in a ground plane and planar inverted-F antenna resonating elements. The planar inverted-F antenna resonating elements may each have a planar metal member that overlaps one of the slots. The slot of each slot antenna resonating element may divide the ground plane into first and second portions. A return path and feed may be coupled in parallel between the planar metal member and the first portion of the ground plane. Tunable components such as tunable inductors may be used to tune the hybrid antennas. A tunable inductor may bridge the slot in hybrid antenna, may be coupled between the planar metal member of the planar inverted-F antenna resonating element and the ground plane, or multiple tunable inductors may bridge the slot on opposing sides of the planar inverted-F antenna resonating element.



US 20160336644A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2016/0336644 A1**

LEE et al. (43) **Pub. Date: Nov. 17, 2016**

(54) **ANTENNA STRUCTURE AND WIRELESS COMMUNICATION DEVICE USING THE SAME**

(71) Applicant: **Chiun Mai Communication Systems, Inc.**, New Taipei (TW)

(72) Inventors: **YI-CHIEH LEE**, New Taipei (TW); **YEN-HUI LIN**, New Taipei (TW)

(21) Appl. No.: **14/710,797**

(22) Filed: **May 13, 2015**

Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

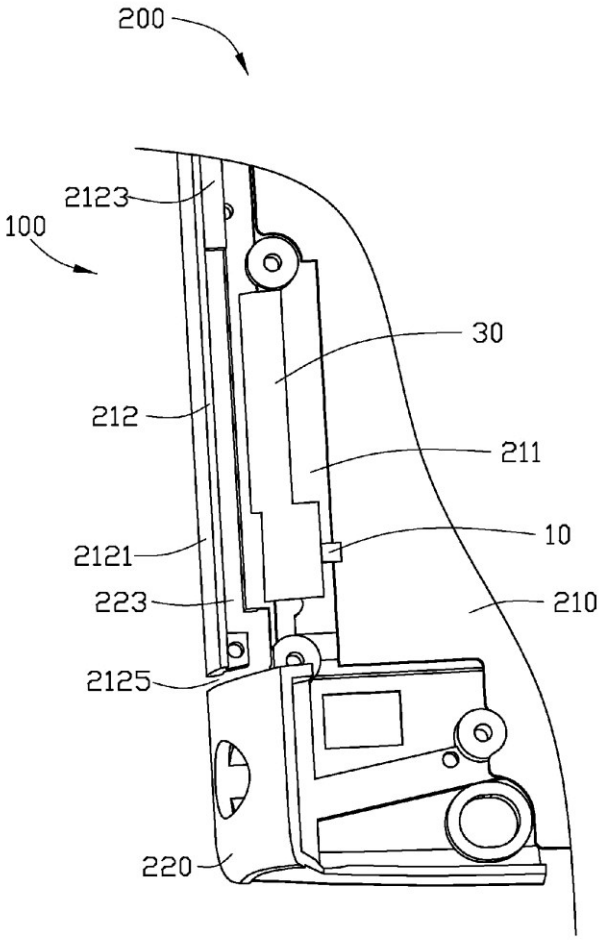
H01Q 5/335 (2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H01Q 5/335*** (2015.01)

(57) **ABSTRACT**

A wireless communication device includes a metallic housing and an antenna structure. The antenna structure includes a feed end and a radiator. The radiator is connected to the feed end and extends towards the metallic housing. The metallic housing defines a gap between the metallic housing and the radiator for coupling the metallic housing with the radiator through electromagnetic induction. A size of the gap is determined by a wavelength of wireless signals received or transmitted by the wireless communication device. The radiator and the metallic housing cooperatively resonate in at least two modes.



US 20160336649A1

(19) **United States**

(12) **Patent Application Publication**

Yu et al.

(10) **Pub. No.: US 2016/0336649 A1**

(43) **Pub. Date: Nov. 17, 2016**

(54) **ANTENNA AND MOBILE TERMINAL**

(71) Applicant: **HUAWEI DEVICE CO., LTD.**, Shenzhen (CN)

(72) Inventors: **Dong Yu**, Shanghai (CN); **Hanyang Wang**, Shenzhen (CN); **Jianming Li**, Taipei (TW)

(21) Appl. No.: **15/112,635**

(22) PCT Filed: **Feb. 6, 2015**

(86) PCT No.: **PCT/CN2015/072406**

§ 371 (c)(1),
(2) Date: **Jul. 19, 2016**

(30) **Foreign Application Priority Data**

Feb. 12, 2014 (CN) 201410049186.X

Publication Classification

(51) **Int. Cl.**

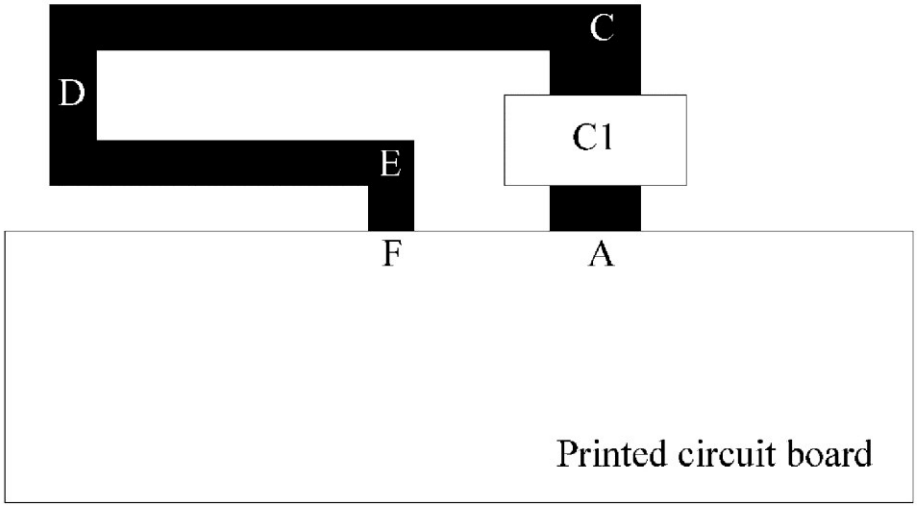
H01Q 1/38	(2006.01)
H01Q 1/48	(2006.01)
H01Q 7/00	(2006.01)
H01Q 9/42	(2006.01)
H01Q 1/24	(2006.01)
H01Q 5/335	(2006.01)

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

CPC ***H01Q 1/38*** (2013.01); ***H01Q 1/243*** (2013.01); ***H01Q 5/335*** (2015.01); ***H01Q 7/00*** (2013.01); ***H01Q 9/42*** (2013.01); ***H01Q 1/48*** (2013.01)

(57) **ABSTRACT**

An antenna-includes a first radiator and a first capacitor structure. A first end of the first radiator is electrically connected to a signal feed end of a printed circuit board by means of the first capacitor structure, and a second end of the first radiator is electrically connected to a ground end of the printed circuit board. The first radiator, the first capacitor structure, the signal feed end, and the ground end form a first antenna configured to produce a first resonance frequency. An electrical length of the first radiator is greater than one eighth of a wavelength corresponding to the first resonance frequency, and the electrical length of the first radiator is less than a quarter of the wavelength corresponding to the first resonance frequency.



US 20160337025A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2016/0337025 A1**

(43) **Pub. Date: Nov. 17, 2016**

Xu et al.

(54) **ANTENNA SWITCHING SYSTEM AND METHOD**

(71) Applicant: **Huawei Device Co., Ltd.**, Shenzhen (CN)

(72) Inventors: **Qiuliang Xu**, Shanghai (CN); **Liping Yang**, Shanghai (CN); **Changfeng Zhang**, Shanghai (CN); **Zhijun Chen**, Shanghai (CN)

(21) Appl. No.: **15/223,845**

(22) Filed: **Jul. 29, 2016**

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2014/072142, filed on Feb. 17, 2014.

Publication Classification

(51) **Int. Cl.**

H04B 7/08	(2006.01)
H01Q 5/378	(2006.01)
H04W 4/06	(2006.01)
H01Q 3/24	(2006.01)
H01Q 1/48	(2006.01)
H04L 5/14	(2006.01)
H04B 1/44	(2006.01)
H01Q 1/24	(2006.01)

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

CPC ***H04B 7/0805*** (2013.01); ***H04B 1/44*** (2013.01); ***H01Q 5/378*** (2015.01); ***H01Q 1/243*** (2013.01); ***H01Q 3/24*** (2013.01); ***H01Q 1/48*** (2013.01); ***H04L 5/14*** (2013.01); ***H04W 4/06*** (2013.01); *H04B 2001/0408* (2013.01)

(57) **ABSTRACT**

The present invention is applicable to the field of mobile terminals and provides an antenna switching system and method. The antenna switching system includes a radio-frequency transceiver circuit, a primary antenna, and a parasitic antenna, where the primary antenna is connected to the radio-frequency transceiver circuit, and further includes a switch circuit, configured to connect, when the parasitic antenna is used to receive or send a radio-frequency signal, the parasitic antenna and the radio-frequency transceiver circuit. If the parasitic antenna is grounded, the parasitic antenna may be configured to spread a spectrum. In addition, when carrier aggregation is needed, the parasitic antenna is connected to the radio-frequency transceiver circuit, so as to become an independent receive or transmit antenna.