



US 20180309186A1

(19) **United States**

(12) **Patent Application Publication**

Yu et al.

(10) **Pub. No.: US 2018/0309186 A1**

(43) **Pub. Date: Oct. 25, 2018**

(54) **ANTENNA ARRAY SUITABLE FOR 5G MOBILE TERMINAL DEVICES**

H01Q 3/30 (2006.01)

H01Q 21/29 (2006.01)

(71) Applicant: **SPEED WIRELESS TECHNOLOGY INC.**, San Jose, CA (US)

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

CPC *H01Q 1/2283* (2013.01); *H01Q 21/22* (2013.01); *H01Q 21/29* (2013.01); *H01Q 1/241* (2013.01); *H01Q 3/30* (2013.01); *H01Q 1/38* (2013.01)

(72) Inventors: **Bin Yu**, Suzhou City (CN); **Zhanyi Qian**, Suzhou City (CN); **Xitong Wu**, Suzhou City (CN)

(57)

ABSTRACT

A new antenna array of the invention which has simple structure, small volume and can adopt a variety of realization forms, it can be easily integrated in the PCB of the mobile terminal using surface mount technology (SMT) or multi-layer PCB integration and other forms of technology. The antenna array is compact and can be configured with different number of antenna elements to meet the gain requirements. The antenna array is small in size and has a wide antenna bandwidth that can cover multiple 5G millimeter-wave bands while maintaining a directional high antenna gain and a stable radiation pattern. The antenna array can satisfy the millimeter-wave 5G communication requirements such as high gain, beam forming characteristics, beam scanning characteristics, and can be easily integrated into a portable mobile terminal.

(21) Appl. No.: **15/725,167**

(22) Filed: **Oct. 4, 2017**

(30) **Foreign Application Priority Data**

Apr. 20, 2017 (CN) 201710262532.6

Publication Classification

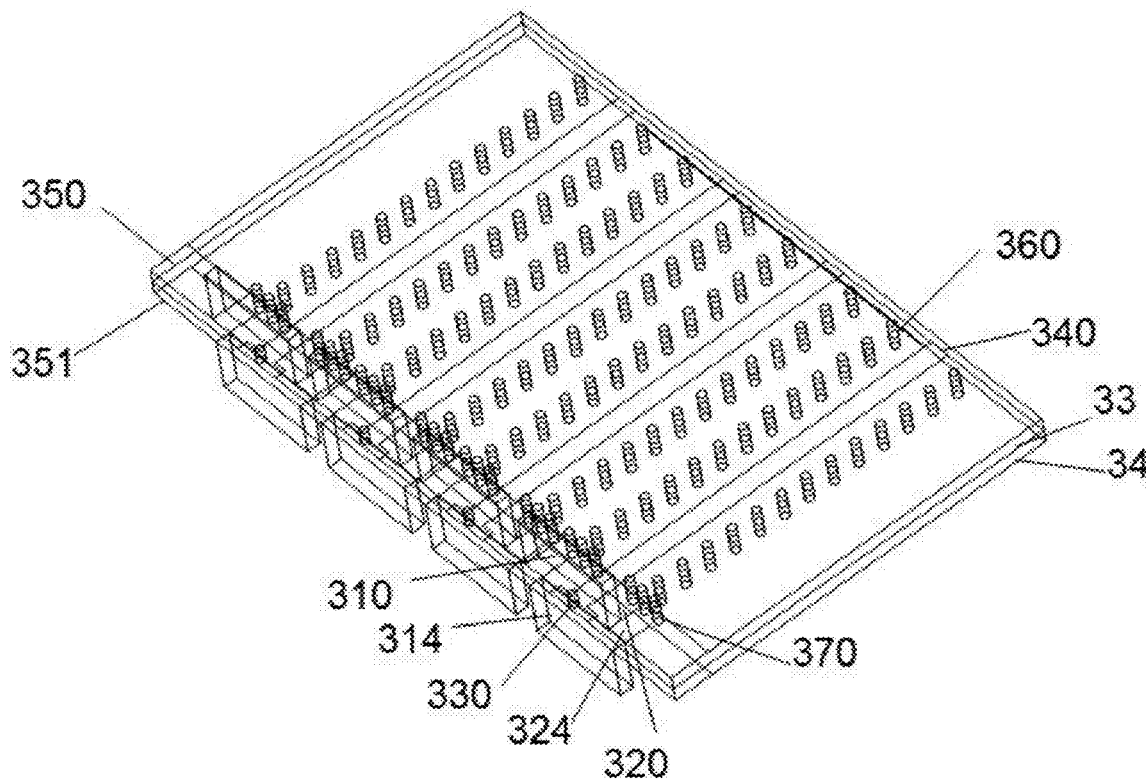
(51) **Int. Cl.**

H01Q 1/22 (2006.01)

H01Q 21/22 (2006.01)

H01Q 1/38 (2006.01)

H01Q 1/24 (2006.01)





(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2018/0309189 A1**

Gu et al.

(43) **Pub. Date: Oct. 25, 2018**

(54) **BROADBAND MIMO ANTENNA SYSTEM FOR ELECTRONIC DEVICE**

H01Q 5/30 (2006.01)

H01Q 9/04 (2006.01)

H01Q 1/48 (2006.01)

(71) Applicants: **Huanhuan Gu**, Waterloo (CA);
Enliang Wang, Waterloo (CA)

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

CPC *H01Q 1/243* (2013.01); *H01Q 21/0025* (2013.01); *H01Q 1/48* (2013.01); *H01Q 9/0421* (2013.01); *H01Q 5/30* (2015.01)

(72) Inventors: **Huanhuan Gu**, Waterloo (CA);
Enliang Wang, Waterloo (CA)

(21) Appl. No.: **15/494,048**

(57)

ABSTRACT

(22) Filed: **Apr. 21, 2017**

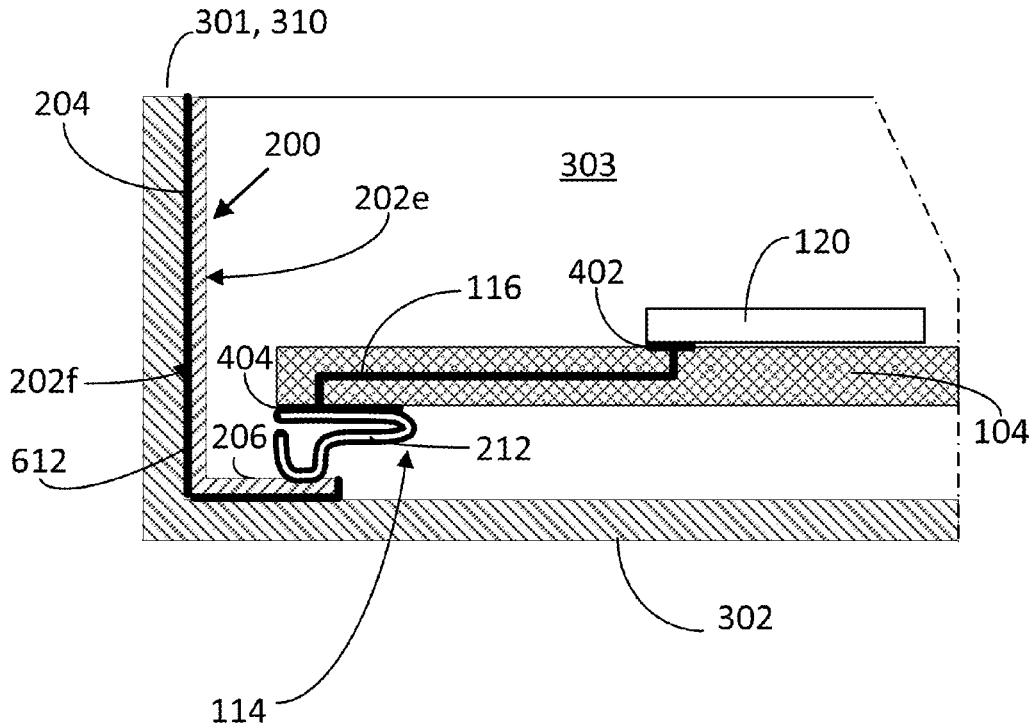
An antenna and an MIMO antenna system are described. At least one antenna secured to a housing of a device. The antenna has a size of $\frac{1}{4}$ wavelength of a central frequency of the antenna and body, the ground pad and the feed pad of the antenna have an impedance matching an RF communications circuit. A plurality of the antennas may be arranged in the housing to form a MIMO antenna system.

Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 21/00 (2006.01)





(19) **United States**

(12) **Patent Application Publication**

WEN et al.

(10) **Pub. No.: US 2018/0309193 A1**

(43) **Pub. Date: Oct. 25, 2018**

(54) **ANTENNA MODULE, MIMO ANTENNA, AND TERMINAL**

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

(72) Inventors: **Geyi WEN**, Nanjing (CN); **Jun WANG**, Hangzhou (CN); **Ming ZHANG**, Hangzhou (CN); **Xueliang SHI**, Hangzhou (CN)

(21) Appl. No.: **16/018,664**

(22) Filed: **Jun. 26, 2018**

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2016/106980, filed on Nov. 23, 2016.

Foreign Application Priority Data

Dec. 29, 2015 (CN) 201511020439.1

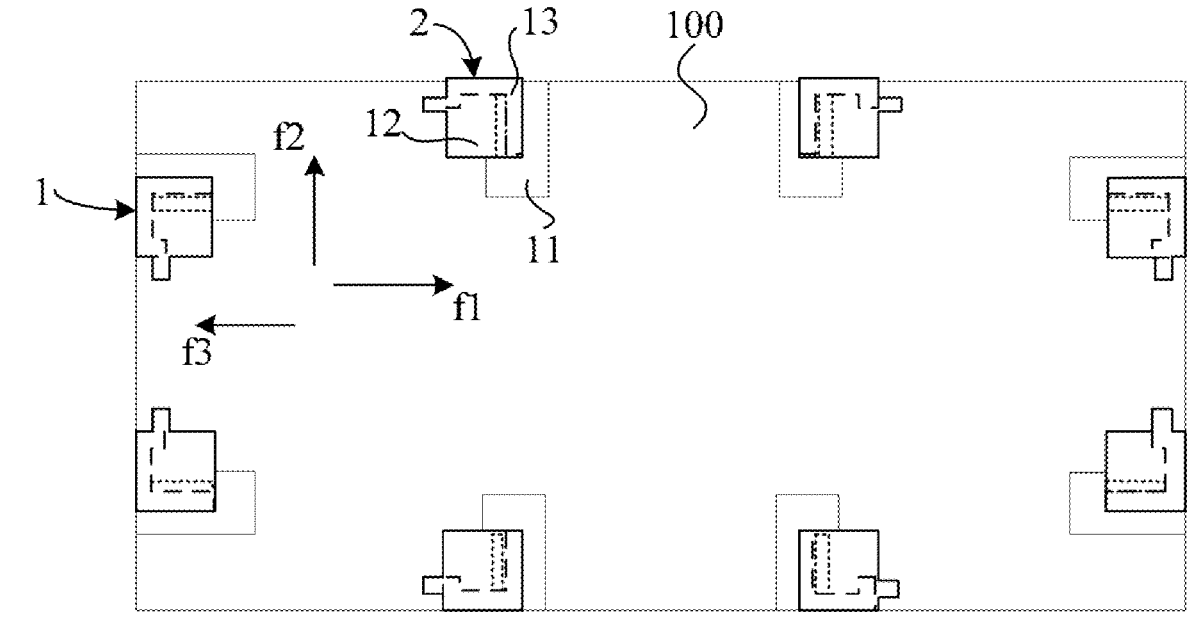
Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 5/371 (2006.01)
H01Q 5/378 (2006.01)
H01Q 21/06 (2006.01)

(52) **U.S. Cl.**
 CPC *H01Q 1/246* (2013.01); *H01Q 21/061* (2013.01); *H01Q 5/378* (2015.01); *H01Q 5/371* (2015.01)

(57) **ABSTRACT**

This application describes examples of antenna modules, MIMO antennas, and terminals. One example antenna module includes a clearance area, a support, and at least two branches. Each branch is disposed on the support, and a partial projection of the support on a horizontal plane falls within the clearance area, while a projection on the horizontal plane of one end that is of each branch and that is configured to connect to a feed point is outside the clearance area. A projection of a tail end on the horizontal plane is inside the clearance area.





(19) **United States**

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

(10) **Pub. No.: US 2018/0309198 A1**

(43) **Pub. Date: Oct. 25, 2018**

(54) **5G TERMINAL ANTENNA WITH RECONFIGURABLE RADIATION PATTERN**

(52) **U.S. Cl.**
CPC *H01Q 3/38* (2013.01); *H01Q 21/0025* (2013.01); *H01Q 13/085* (2013.01); *H01Q 1/243* (2013.01); *H01Q 1/38* (2013.01)

(71) Applicant: **SPEED WIRELESS TECHNOLOGY INC.**, San Jose, CA (US)

(72) Inventors: **Bin Yu**, Suzhou City (CN); **Xiaoyang Ma**, Suzhou City (CN)

(57) **ABSTRACT**

(21) Appl. No.: **15/724,229**

An antenna system with a reconfigurable radiation pattern characteristic for the fifth generation (5G) mobile terminal is described, which includes multiple antenna sub-arrays with different radiation patterns and a switch that connects each antenna sub-array and controls switching between different antenna sub-arrays. A switch is disposed between the antenna sub-arrays and an RF front-end module. By switching between the different sub-arrays, the radiation in a desired direction can be selected. Therefore, the problem of the beam coverage and beam scanning blind spot of 5G terminal antenna in millimeter waveband can be solved effectively. Through expanding the scanning angle of the beam scanning, the scheme of 5G terminal antenna with a reconfigurable radiation pattern can be realized. The antenna structure of this disclosure makes full use of the space of the PCB board, and has the advantages of miniaturization, simple processing and compact structure, etc.

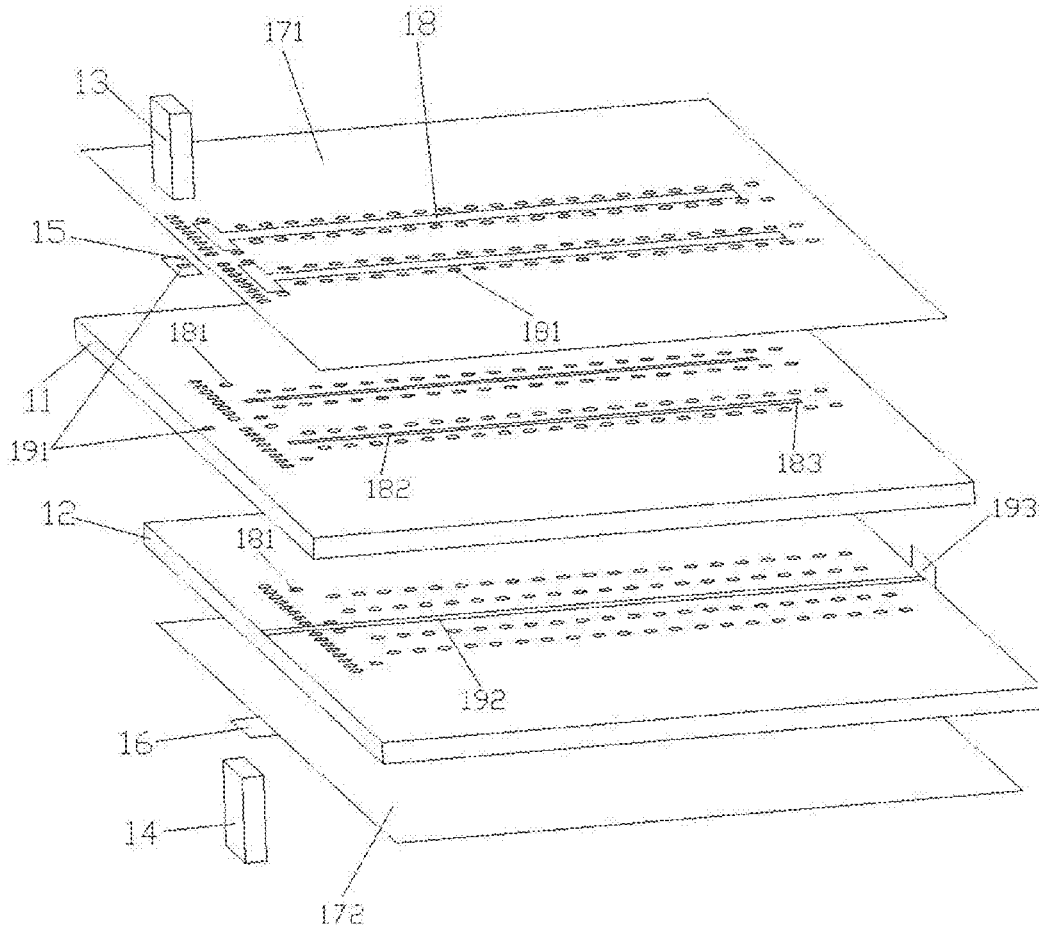
(22) Filed: **Oct. 3, 2017**

(30) **Foreign Application Priority Data**

Apr. 20, 2017 (CN) 201710261516.5

Publication Classification

(51) **Int. Cl.**
H01Q 3/38 (2006.01)
H01Q 21/00 (2006.01)
H01Q 1/38 (2006.01)
H01Q 1/24 (2006.01)





US 20180309199A1

(19) **United States**

(12) **Patent Application Publication**

Yu et al.

(10) **Pub. No.: US 2018/0309199 A1**

(43) **Pub. Date: Oct. 25, 2018**

(54) **ANTENNA ARRAY INTEGRATED ON THE METAL BACK COVER OF THE 5G MOBILE TERMINAL**

(52) **U.S. Cl.**
CPC *H01Q 5/28* (2015.01); *H01Q 5/357* (2015.01); *H01Q 5/45* (2015.01)

(71) Applicant: **SPEED WIRELESS TECHNOLOGY INC.**, San Jose, CA (US)

(57) **ABSTRACT**

(72) Inventors: **Bin Yu**, Suzhou City (CN); **Kang Yang**, Suzhou City (CN)

An antenna element includes a feed probe, an insulating sleeve, and a reflecting cavity. The reflecting cavity is formed by an inner concave of an outer side of the metal frame of the metal back cover. The reflecting cavity includes a first wall and a second wall. One end of the feed probe is connected with the first wall. The middle of the feed probe is connected with the second wall through an insulating sleeve, and the other end of the feed probe is connected with a signal feeder line. The present invention also provides an RF frontend system which includes the above mentioned antenna system. Through an architecture which includes a feed probe and a reflecting cavity, the present invention realizes that the 5G antenna is arranged at the sides of the mobile terminal. Therefore the 5G antenna can coexist with 3G, 4G, GPS, WIFI and other antennas.

(21) Appl. No.: **15/726,356**

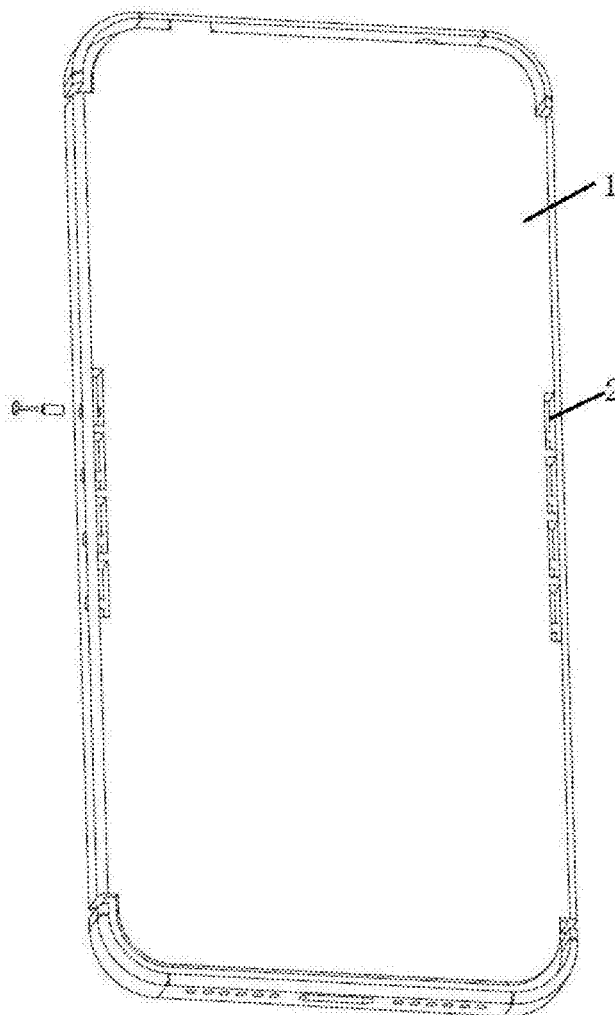
(22) Filed: **Oct. 5, 2017**

(30) **Foreign Application Priority Data**

Apr. 20, 2017 (CN) 201710260747.4

Publication Classification

(51) **Int. Cl.**
H01Q 5/28 (2006.01)
H01Q 5/45 (2006.01)





US 20180316081A1

(19) **United States**

(12) **Patent Application Publication**

Nguyen

(10) **Pub. No.: US 2018/0316081 A1**

(43) **Pub. Date: Nov. 1, 2018**

(54) **RADIO FREQUENCY ANTENNA FOR SHORT RANGE COMMUNICATIONS**

(52) **U.S. Cl.**
CPC *H01Q 1/2266* (2013.01); *H01Q 1/521* (2013.01); *H01Q 5/30* (2015.01)

(71) Applicant: **EchoStar Technologies L.L.C.**,
Englewood, CO (US)

(57) **ABSTRACT**

(72) Inventor: **Phuc H. Nguyen**, Parker, CO (US)

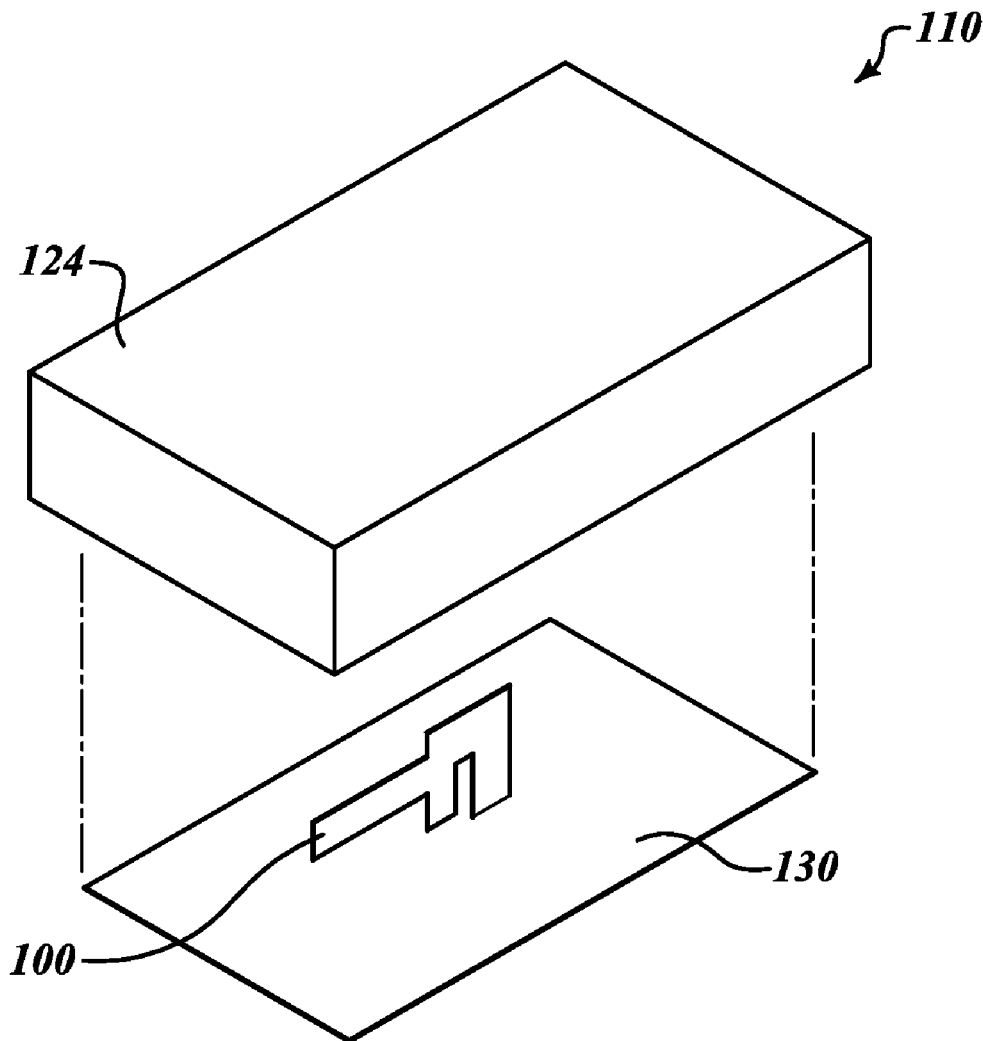
An antenna assembly includes a substrate, a first antenna having a first, second, third, fourth sections, which have different configuration respectively, and a first transmission cable, a second antenna having a fifth, sixth, seventh, eighth sections, which have different configuration respectively, and a second transmission cable. The first and fifth sections extend vertically from a surface of the substrate respectively. The second, third and fourth sections extend in parallel with the first section and extend from its next section. The sixth, seventh, eighth sections extend in parallel with the fifth section and extend from its next section. The first and second transmission cables physically and electrically are connected to the first and second antenna respectively. The second antenna is spaced away from the first antenna a selected distance. The first antenna is arranged having each of its sections extending perpendicular to each of its sections of the second antenna.

(21) Appl. No.: **15/582,360**

(22) Filed: **Apr. 28, 2017**

Publication Classification

(51) **Int. Cl.**
H01Q 1/22 (2006.01)
H01Q 5/30 (2006.01)
H01Q 1/52 (2006.01)





US 20180316088A1

(19) **United States**

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

(10) **Pub. No.: US 2018/0316088 A1**

(43) **Pub. Date: Nov. 1, 2018**

(54) **ANTENNA AND COMMUNICATIONS
DEVICE**

Publication Classification

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

(51) **Int. Cl.**
H01Q 1/52 (2006.01)
H01Q 1/50 (2006.01)
H01Q 1/38 (2006.01)

(72) Inventors: **Geyi WEN, Nanjing (CN); Ming
Zhang, Hangzhou (CN)**

(52) **U.S. Cl.**
CPC **H01Q 1/521** (2013.01); **H01Q 1/38**
(2013.01); **H01Q 1/50** (2013.01)

(73) Assignee: **Huawei Technologies Co., Ltd.,
Shenzhen (CN)**

(57) **ABSTRACT**

(21) Appl. No.: **16/021,318**

Embodiments of the present invention provide an antenna and a communications device. The antenna of the present invention includes a plurality of antenna units. Each antenna unit includes a plurality of antenna branches and one feed branch. Different antenna branches in a same antenna unit correspond to different frequency bands. At least one antenna unit pair exists in the plurality of antenna units. A distance between two antenna units in each antenna unit pair is less than a first preset distance. Radiation directions of antenna branches in each antenna unit pair that correspond to a same frequency band are different. By means of the present invention, isolation between the antenna units in the antenna can be increased.

(22) Filed: **Jun. 28, 2018**

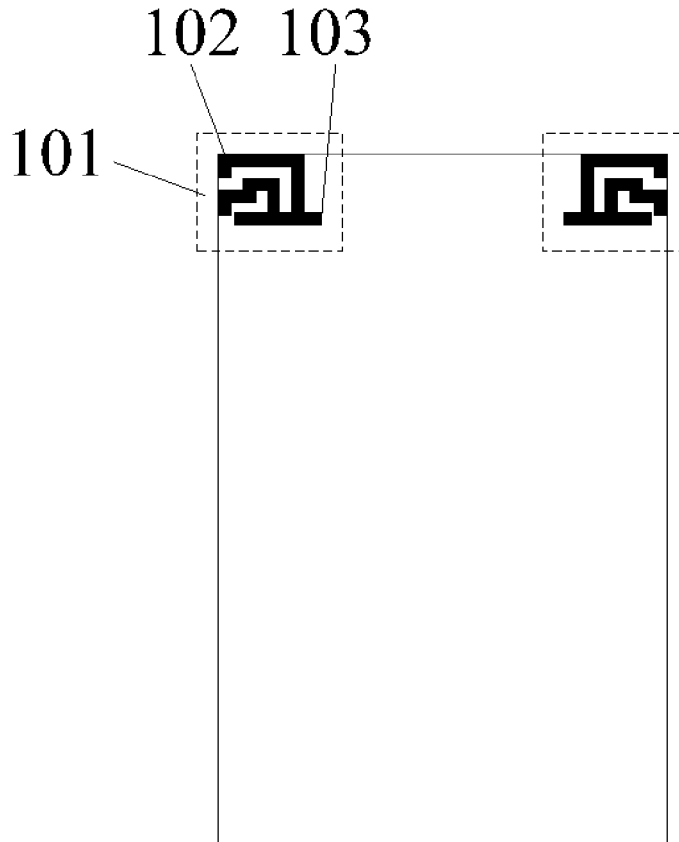
Related U.S. Application Data

(63) Continuation of application No. PCT/CN2016/
107785, filed on Nov. 29, 2016.

Foreign Application Priority Data

(30) Dec. 29, 2015 (CN) 201511024590.2

100





(19) **United States**

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

(10) **Pub. No.: US 2018/0323495 A1**

(43) **Pub. Date: Nov. 8, 2018**

(54) **MOBILE DEVICE AND ANTENNA STRUCTURE**

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 5/328** (2015.01); **H01Q 5/321** (2015.01); **H01Q 5/392** (2015.01)

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

(72) Inventors: **Shih-Chiang WEI**, Hsinchu (TW);
Yu-Yu CHIANG, Hsinchu (TW)

(57) **ABSTRACT**

A mobile device includes a supporting element, a ground element, and an antenna structure. The antenna structure includes a first feeding radiation element, a second feeding radiation element, a first parasitic radiation element, a second parasitic radiation element, and a third parasitic radiation element. The first feeding radiation element and the second feeding radiation element are both coupled to a signal feeding point. Each of the first parasitic radiation element, the second parasitic radiation element, and the third parasitic radiation element is coupled to the ground element. A first coupling gap is formed between the first parasitic radiation element and the first feeding radiation element. A second coupling gap is formed between the second parasitic radiation element and the first feeding radiation element. A third coupling gap is formed between the third parasitic radiation element and the second feeding radiation element.

(21) Appl. No.: **15/712,064**

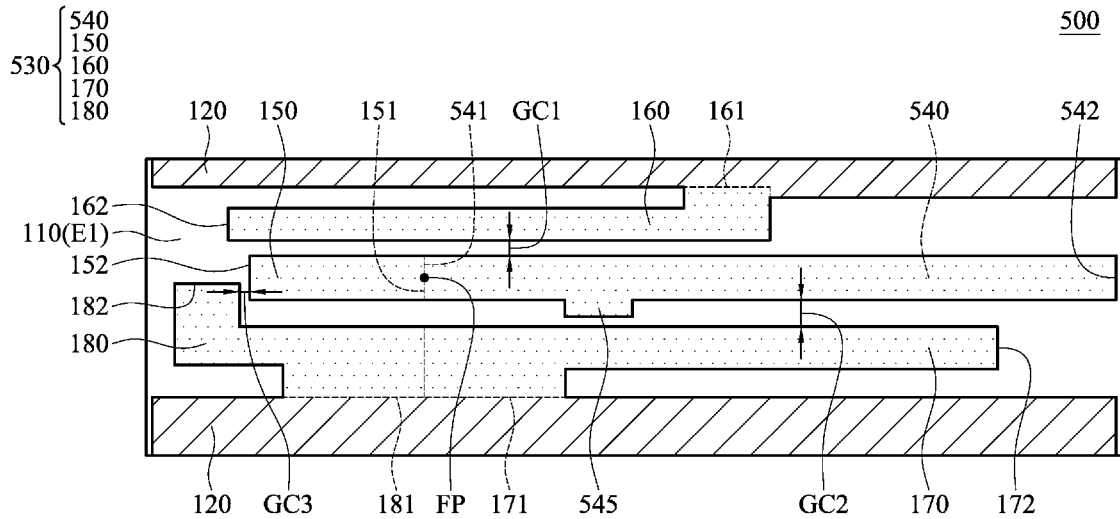
(22) Filed: **Sep. 21, 2017**

(30) **Foreign Application Priority Data**

May 4, 2017 (TW) 106114777

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 5/392 (2006.01)
H01Q 5/321 (2006.01)
H01Q 5/328 (2006.01)





US 20180323496A1

(19) **United States**

(12) **Patent Application Publication**

LEE et al.

(10) **Pub. No.: US 2018/0323496 A1**

(43) **Pub. Date: Nov. 8, 2018**

(54) **MOBILE TERMINAL**

Publication Classification

(71) Applicant: **LG ELECTRONICS INC.**, Seoul (KR)

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/38 (2006.01)
H04M 1/02 (2006.01)

(72) Inventors: **Youngjoon LEE**, Seoul (KR); **Taemin KWON**, Seoul (KR); **Sangmo KIM**, Seoul (KR); **Soocho BANG**, Seoul (KR); **Geunsu LEE**, Seoul (KR); **Kyujin CHOI**, Seoul (KR); **Baekbong PYO**, Seoul (KR); **Changho HONG**, Seoul (KR)

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H04M 1/0266* (2013.01); *H01Q 1/38* (2013.01)

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

(57) **ABSTRACT**

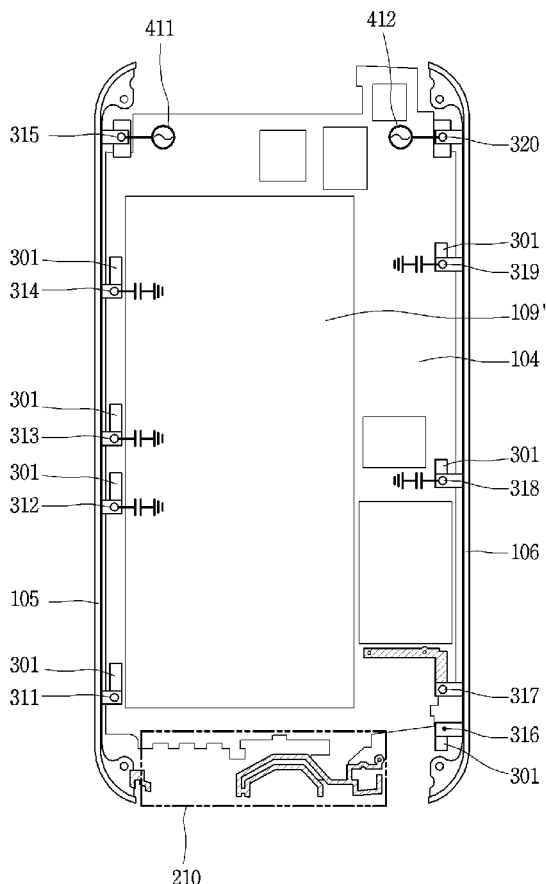
(21) Appl. No.: **15/865,380**

A mobile terminal including a terminal body having a display unit disposed on one surface thereof; a frame supporting the display unit; a metal member spaced apart from the frame and exposed to an outside of the mobile terminal; a plurality of connecting members connecting the metal member to the frame and grounding the metal member; and an antenna unit disposed adjacent to the frame and including a radiator radiating wireless signals in a first frequency band. Further, the metal member is divided into specific areas by the connecting members, and one area located adjacent to the radiator, generates a parasitic resonance at a second frequency band different from the first frequency band, and a frequency band of the antenna unit is shifted to a third frequency band including the first frequency band by the metal member and the radiator when a dielectric is placed adjacent to the metal member.

(22) Filed: **Jan. 9, 2018**

(30) **Foreign Application Priority Data**

May 2, 2017 (KR) 10-2017-0056485





US 20180323497A1

(19) **United States**

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

(10) **Pub. No.: US 2018/0323497 A1**

(43) **Pub. Date: Nov. 8, 2018**

(54) **MOBILE TERMINAL**

Publication Classification

- (71) Applicant: **LG ELECTRONICS INC.**, Seoul (KR)
- (72) Inventors: **Yunmo KANG**, Seoul (KR); **Kangjae JUNG**, Seoul (KR); **Sungjoon HONG**, Seoul (KR); **Byungwoon JUNG**, Seoul (KR); **Sungjung RHO**, Seoul (KR)
- (73) Assignee: **LG ELECTRONICS INC.**, Seoul (KR)

- (51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 7/00 (2006.01)
H01Q 1/48 (2006.01)
H01Q 1/50 (2006.01)
H01Q 1/38 (2006.01)
H01Q 21/30 (2006.01)
H01Q 9/26 (2006.01)
H01Q 5/50 (2006.01)
H01Q 5/35 (2006.01)
H01Q 13/10 (2006.01)
- (52) **U.S. Cl.**
 CPC *H01Q 1/243* (2013.01); *H01Q 7/00* (2013.01); *H01Q 1/48* (2013.01); *H01Q 1/50* (2013.01); *H01Q 1/38* (2013.01); *H01Q 13/10* (2013.01); *H01Q 9/26* (2013.01); *H01Q 5/50* (2015.01); *H01Q 5/35* (2015.01); *H01Q 21/30* (2013.01)

- (21) Appl. No.: **16/033,083**
- (22) Filed: **Jul. 11, 2018**

Related U.S. Application Data

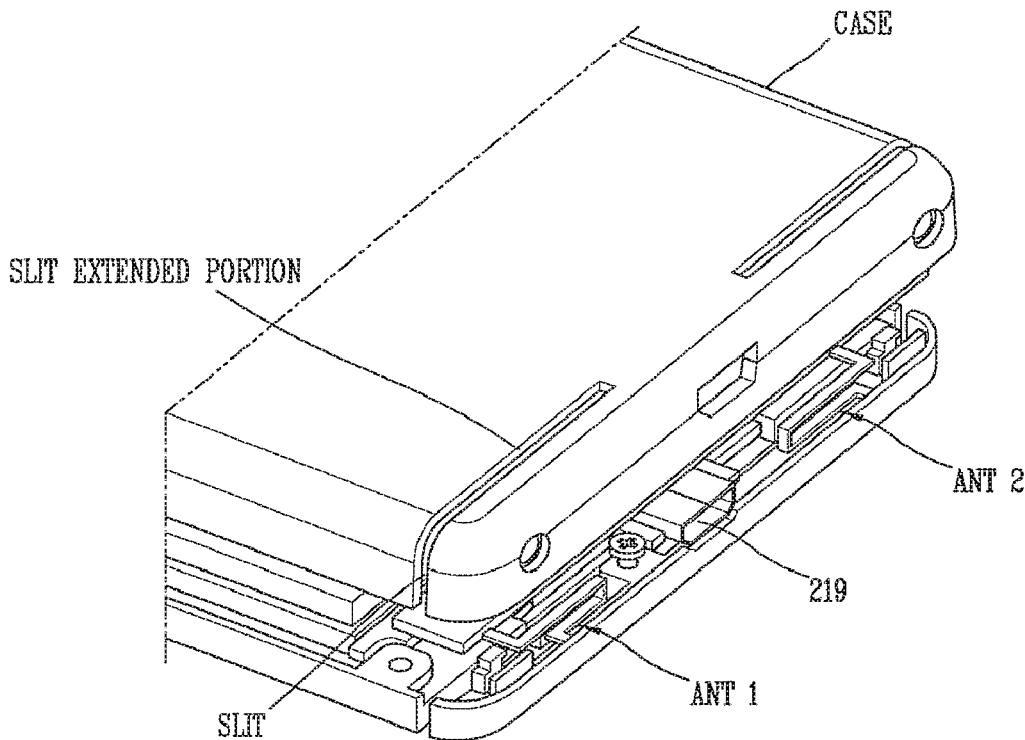
- (63) Continuation of application No. 15/860,427, filed on Jan. 2, 2018, now Pat. No. 10,056,680, which is a continuation of application No. 14/010,900, filed on Aug. 27, 2013, now Pat. No. 9,871,286.

Foreign Application Priority Data

Sep. 19, 2012 (KR) 10-2012-0104152

(57) **ABSTRACT**

A mobile terminal comprises: a terminal body; and a first antenna device and a second antenna device disposed at one side of the terminal body in an adjacent manner, and formed to operate at different frequency bands, wherein the first antenna device and the second antenna device are provided with conductive members each having a slit at one side thereof, and wherein the conductive members form part of an appearance of the terminal body.





(19) **United States**

(12) **Patent Application Publication**

Wu et al.

(10) **Pub. No.: US 2018/0331415 A1**

(43) **Pub. Date: Nov. 15, 2018**

(54) **ELECTRONIC DEVICE AND ANTENNA STRUCTURE THEREOF**

Publication Classification

(71) Applicant: **PEGATRON CORPORATION**, Taipei City (TW)

(51) **Int. Cl.**
H01Q 1/22 (2006.01)
H01Q 5/364 (2006.01)
H01Q 13/08 (2006.01)
H01Q 1/42 (2006.01)

(72) Inventors: **Chien-Yi Wu**, Taipei City (TW); **Ya-Jyun Li**, Taipei City (TW); **Yu-Yi Chu**, Taipei City (TW); **Chao-Hsu Wu**, Taipei City (TW); **Ching-Hsiang Ko**, Taipei City (TW); **Chia-Chi Chang**, Taipei City (TW)

(52) **U.S. Cl.**
CPC *H01Q 1/2258* (2013.01); *H01Q 1/42* (2013.01); *H01Q 13/085* (2013.01); *H01Q 5/364* (2015.01)

(73) Assignee: **PEGATRON CORPORATION**, TAIPEI CITY (TW)

(57) **ABSTRACT**

(21) Appl. No.: **15/895,870**

An antenna structure including a conductive housing, a substrate, a ground element and a radiation element is provided. The conductive housing includes an open slot and a conductive segment adjacent to each other. The radiation element is disposed on a first surface of the substrate and is electrically connected to the ground element. A second surface of the substrate faces the open slot and the conductive segment. The ground element is electrically connected to the conductive housing. The radiation element has a feeding point and forms a first path. An orthogonal projection of the radiation element on the conductive housing is partially overlapping with the conductive segment such that the conductive housing and the radiation element form a second path. The antenna structure operates in a first band and a second band through the first path and the second path.

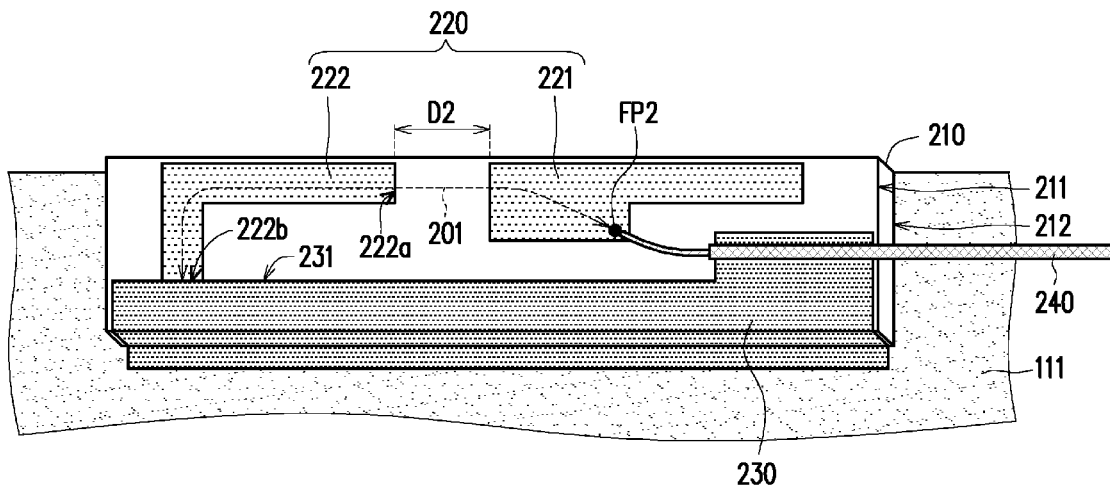
(22) Filed: **Feb. 13, 2018**

Related U.S. Application Data

(60) Provisional application No. 62/503,676, filed on May 9, 2017.

Foreign Application Priority Data

Jul. 3, 2017 (TW) 106122207





US 20180331418A1

(19) **United States**

(12) **Patent Application Publication**

KIM et al.

(10) **Pub. No.: US 2018/0331418 A1**

(43) **Pub. Date: Nov. 15, 2018**

(54) **ELECTRONIC DEVICE INCLUDING ANTENNA**

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

(72) Inventors: **Gyu Sub KIM**, Seoul (KR); **Jin Woo JUNG**, Seoul (KR); **Byoung Ryoul SONG**, Suwon-si (KR); **Sin Hyung JEON**, Suwon-si (KR); **So Young LEE**, Gwacheon-si (KR); **Jae Bong CHUN**, Suwon-si (KR)

(21) Appl. No.: **15/977,551**

(22) Filed: **May 11, 2018**

(30) **Foreign Application Priority Data**

May 12, 2017 (KR) 10-2017-0059451

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 9/04 (2006.01)
H01Q 1/38 (2006.01)
B29C 45/14 (2006.01)

(52) **U.S. Cl.**
 CPC *H01Q 1/243* (2013.01); *B29C 45/14655* (2013.01); *H01Q 1/38* (2013.01); *H01Q 9/0414* (2013.01)

(57) **ABSTRACT**

An electronic device is provided. The electronic device includes a front glass plate, a back glass plate, and a side member including a conductive portion, at least one conductive pattern formed on an edge portion of the front glass plate, a wireless communication circuit positioned inside a housing and electrically connected to the conductive portion and the at least one conductive pattern. In addition, various embodiments understood through the disclosure may be provided.

