



US 20180366812A1

(19) **United States**

(12) **Patent Application Publication**

KIM et al.

(10) **Pub. No.: US 2018/0366812 A1**

(43) **Pub. Date: Dec. 20, 2018**

(54) **ELECTRONIC DEVICE COMPRISING ANTENNA**

Publication Classification

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

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

(72) Inventors: **Ji Ho KIM**, Anyang-si (KR); **Kyung Moon SEOL**, Yongin-si (KR); **Kyi Hyun JANG**, Seoul (KR); **Kyung Kyun KANG**, Suwon-si (KR); **Gyu Bok PARK**, Suwon-si (KR); **Hyun Jeong LEE**, Suwon-si (KR); **Hyo Seok NA**, Yongin-si (KR); **So Young LEE**, Gwacheon-si (KR); **Jae Bong CHUN**, Suwon-si (KR)

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H04M 1/0266* (2013.01); *H04M 1/0277* (2013.01)

(21) Appl. No.: **16/010,838**

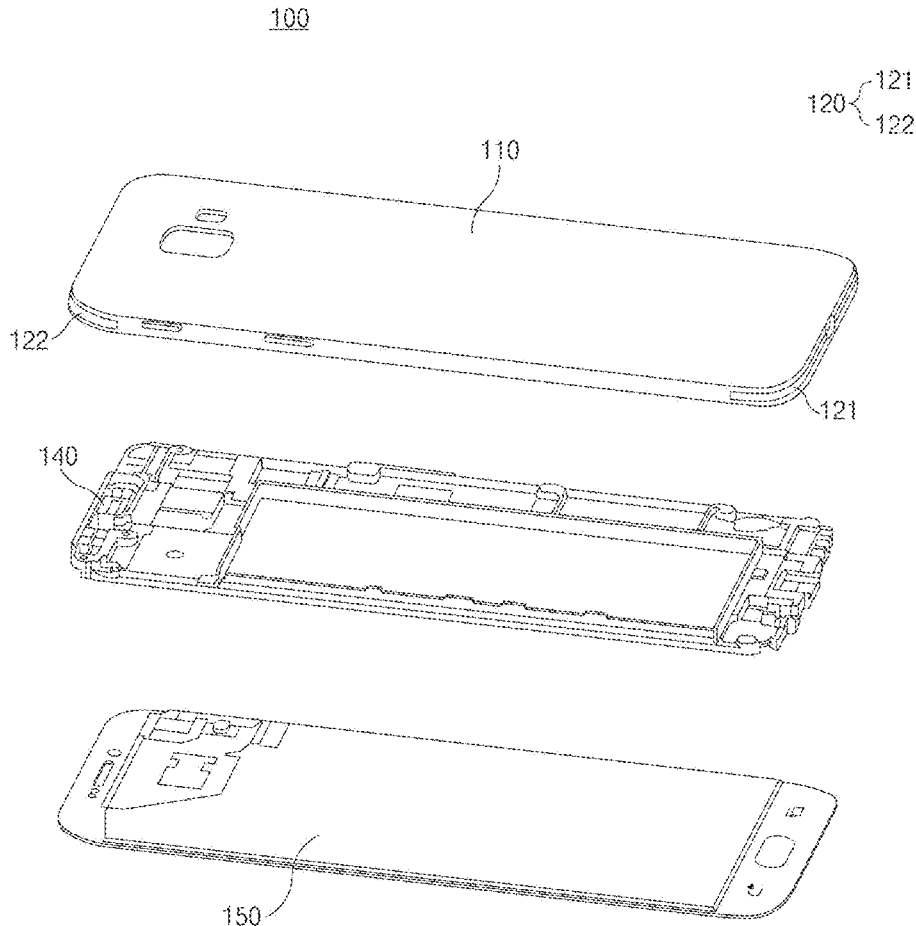
(57) **ABSTRACT**

(22) Filed: **Jun. 18, 2018**

An electronic device is provided. The electronic device includes a housing that includes a slit, a first antenna element extending along a portion of the housing, a second antenna element spaced apart from at least a portion of the first antenna element by the slit and extends along another portion of the housing, and a wireless communication circuit positioned inside the housing and electrically connected to the first antenna element. The first antenna element is electrically connected to the second antenna element.

(30) **Foreign Application Priority Data**

Jun. 20, 2017 (KR) 10-2017-0078005





(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2018/0366813 A1**

KIM et al. (43) **Pub. Date: Dec. 20, 2018**

(54) **ELECTRONIC DEVICE COMPRISING ANTENNA**

1/48 (2013.01); *H01Q 21/00* (2013.01); *H04M 1/0266* (2013.01)

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

(57) **ABSTRACT**

(72) Inventors: **Hyeongtae KIM**, Gyeonggi-do (KR); **Seunggil JEON**, Gyeonggi-do (KR)

According to various examples, an electronic device comprising: a housing, which is a foldable housing and includes a first housing part including a first surface and a second surface oppositely facing the first surface, a second housing part including a first surface facing the first surface of the first housing part when folded in a first direction, and a second surface facing the second surface of the first housing part when folded in a second direction, and a connection part connecting the first housing part and the second housing part; a communication circuit disposed inside the housing; a first antenna pattern disposed inside the first housing part; a second antenna pattern disposed inside the second housing part; a first display exposed to the first surface of the first housing part; a second display exposed to the first surface of the second housing part; a first conductive member exposed to the second surface of the first housing part, and electrically connected to the first antenna pattern; and a second conductive member exposed to the second surface of the second housing part, and electrically connected to the second antenna pattern, wherein the communication circuit is electrically connected to the first antenna pattern and/or the second antenna pattern, and the first conductive member and the second conductive member can be electrically connected or coupled with each other, when the housing is folded in the second direction.

(21) Appl. No.: **16/060,300**

(22) PCT Filed: **Nov. 14, 2016**

(86) PCT No.: **PCT/KR2016/013100**

§ 371 (c)(1),
(2) Date: **Jun. 7, 2018**

(30) **Foreign Application Priority Data**

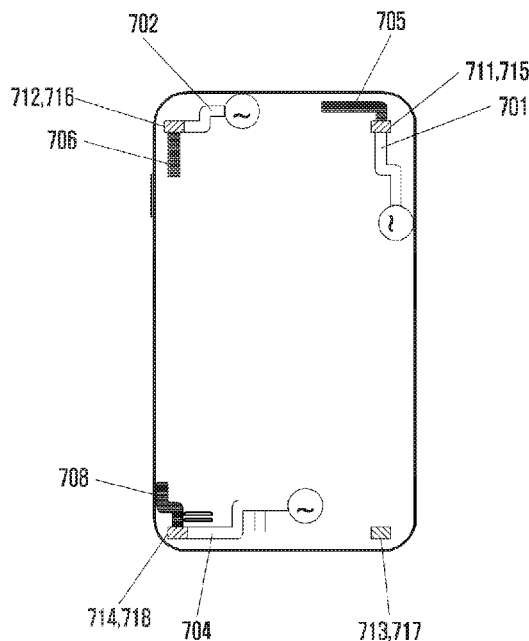
Dec. 7, 2015 (KR) 10-2015-0173203

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H04M 1/02 (2006.01)
H01Q 1/48 (2006.01)
H01Q 21/00 (2006.01)

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H04M 1/0216* (2013.01); *H04M 1/0268* (2013.01); *H01Q*

700





US 20180366814A1

(19) **United States**

(12) **Patent Application Publication**

Li et al.

(10) **Pub. No.: US 2018/0366814 A1**

(43) **Pub. Date: Dec. 20, 2018**

(54) **ANTENNA AND MOBILE TERMINAL**

H01Q 5/328 (2006.01)

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

H01Q 1/48 (2006.01)

H01Q 9/42 (2006.01)

H01Q 5/371 (2006.01)

H01Q 5/335 (2006.01)

(72) Inventors: **Jianming Li**, Taipei (TW); **Hanyang Wang**, Reading (GB)

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

CPC *H01Q 1/243* (2013.01); *H01Q 1/38*

(2013.01); *H01Q 5/328* (2015.01); *H01Q*

5/335 (2015.01); *H01Q 9/42* (2013.01); *H01Q*

5/371 (2015.01); *H01Q 1/48* (2013.01)

(21) Appl. No.: **16/118,926**

(22) Filed: **Aug. 31, 2018**

Related U.S. Application Data

(63) Continuation of application No. 15/118,323, filed on Aug. 11, 2016, now Pat. No. 10,069,193, filed as application No. PCT/CN2015/072407 on Feb. 6, 2015.

(57)

ABSTRACT

An antenna and a mobile terminal with the antenna including 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 generate a first resonance frequency. An electrical length of the first radiator is less than or equal to one eighth of a wavelength corresponding to the first resonance frequency.

(30) **Foreign Application Priority Data**

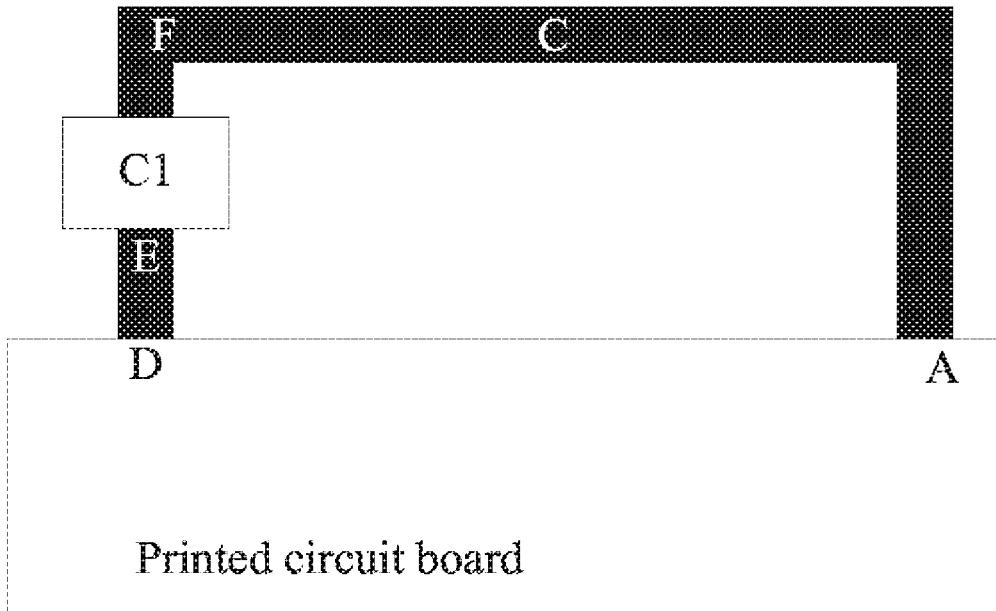
Feb. 12, 2014 (CN) 201410049276.9

Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 1/38 (2006.01)





(19) **United States**

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

(10) **Pub. No.: US 2018/0366827 A1**

(43) **Pub. Date: Dec. 20, 2018**

(54) **LOOP ANTENNA AND ELECTRONIC APPARATUS**

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

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

(57) **ABSTRACT**

(72) Inventors: **Takashi YAMAGAJO**, Yokosuka (JP);
Manabu Kai, Yokohama (JP)

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

A loop antenna includes: a substrate; a feeding element including a first portion and a second portion which are provided on a first surface of the substrate, have electrical conductivity, are fed with electric power from a feeding point, the first portion extending from the feeding point in a first direction, the second portion extending from the feeding point in a second direction; and an emitting element which has electrical conductivity, is formed in a loop shape in such a manner that the emitting element surrounds the substrate along a surface perpendicular to the first surface, and includes a first end provided so as to electromagnetically couple to the first portion on the first surface and a second end provided so as to electromagnetically couple to the second portion on the first surface, a gap being disposed between the first end and the second end.

(21) Appl. No.: **15/993,676**

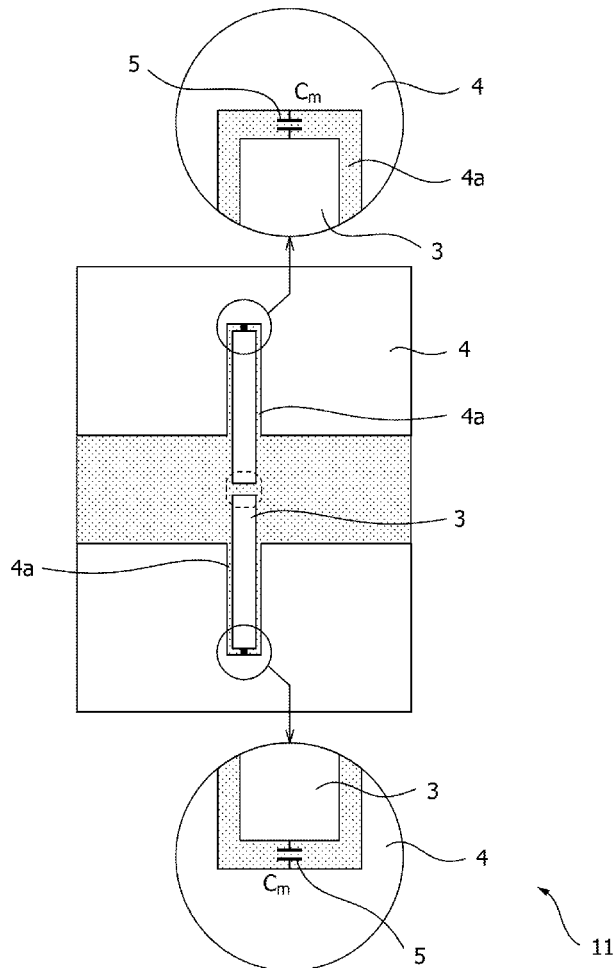
(22) Filed: **May 31, 2018**

(30) **Foreign Application Priority Data**

Jun. 15, 2017 (JP) 2017-117720

Publication Classification

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





(19) **United States**

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

(10) **Pub. No.: US 2018/0366832 A1**

(43) **Pub. Date: Dec. 20, 2018**

(54) **AN ANTENNA ARRANGEMENT ON A CIRCUIT BOARD**

(52) **U.S. Cl.**
CPC **H01Q 13/16** (2013.01); **H01Q 1/48** (2013.01); **H04Q 1/38** (2013.01)

(71) Applicant: **SONY MOBILE COMMUNICATIONS INC.**, Tokyo (JP)

(57) **ABSTRACT**

(72) Inventors: **Zhinong YING**, Lund (SE); **Thomas BOLIN**, Lund (SE)

(21) Appl. No.: **15/780,596**

The present invention relates to an antenna arrangement on a circuit board (10) extending along a length direction, L, and a width direction, W, the width direction being orthogonal to the length direction. The antenna arrangement comprising: a cell-band antenna (20); a ground plane (30) associated with the cell-band antenna; and a slit antenna (40) arranged in a slit antenna portion (32) of the ground plane, the slit antenna comprising a slit (42) in the ground plane, the slit having in the width direction a slit extension extending from an in the length direction extending edge (34) of the ground plane, the slit extension being 50-95% of an in the width direction extending total width of the slit antenna portion.

(22) PCT Filed: **Jan. 28, 2016**

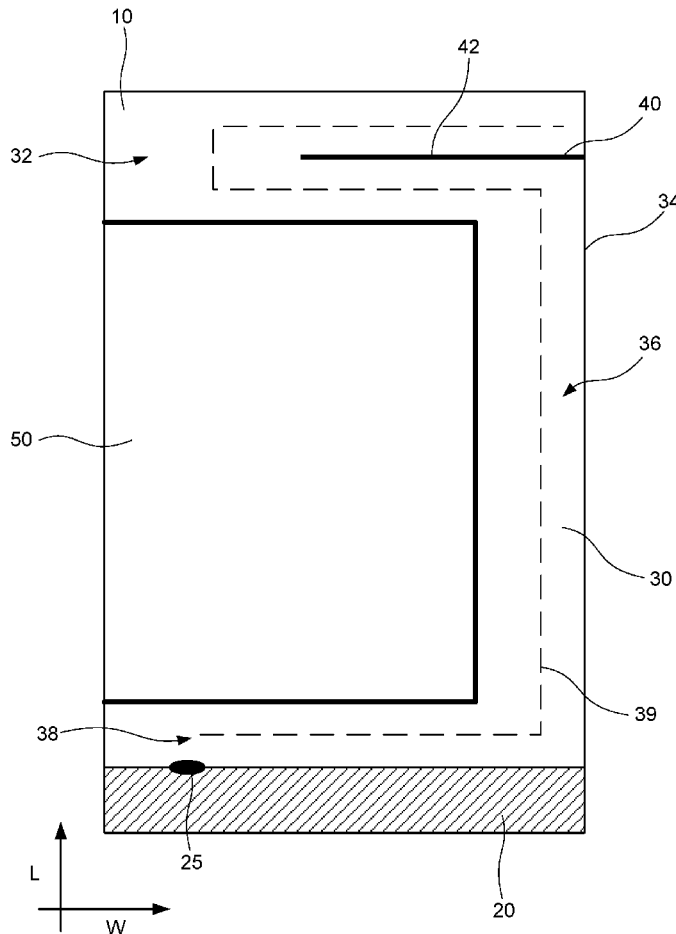
(86) PCT No.: **PCT/IB2016/050431**

§ 371 (c)(1),

(2) Date: **May 31, 2018**

Publication Classification

(51) **Int. Cl.**
H01Q 13/16 (2006.01)
H04Q 1/38 (2006.01)
H01Q 1/48 (2006.01)





US 20180375189A1

(19) **United States**

(12) **Patent Application Publication**

Hawaka et al.

(10) **Pub. No.: US 2018/0375189 A1**

(43) **Pub. Date: Dec. 27, 2018**

(54) **ELECTRONIC APPARATUS**

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

(71) Applicant: **LENOVO (SINGAPORE) PTE. LTD.**,
Singapore (SG)

CPC **H01Q 1/2266** (2013.01); **H01Q 1/48**
(2013.01); **H01Q 1/526** (2013.01)

(72) Inventors: **Shigekazu Hawaka**, Yokohama-shi
(JP); **Osamu Yamamoto**, Yokohama-shi
(JP); **Takaaki Okada**, Yokohama-shi
(JP)

(57) **ABSTRACT**

(73) Assignee: **LENOVO (SINGAPORE) PTE. LTD.**,
Singapore (SG)

The present disclosure provides an electronic apparatus having an antenna unit at a body chassis. The electronic apparatus includes: a body chassis; an antenna supporting member disposed in an antenna space at a periphery of the body chassis, and having an upper face on which an antenna pattern is formed, the antenna space being surrounded with a dielectric cover; a shield wall for the antenna space, including a conductive thin film covering an entire lateral face of the antenna supporting member close to a center of the body chassis, an upper antenna ground element connected to the conductive thin film and the rear face of a keyboard cover member, and a lower antenna ground element connected to the conductive thin film and the rear face of a bottom-face cover member. The conductive thin film, the upper antenna ground element and the lower antenna ground element define the shield wall.

(21) Appl. No.: **15/699,672**

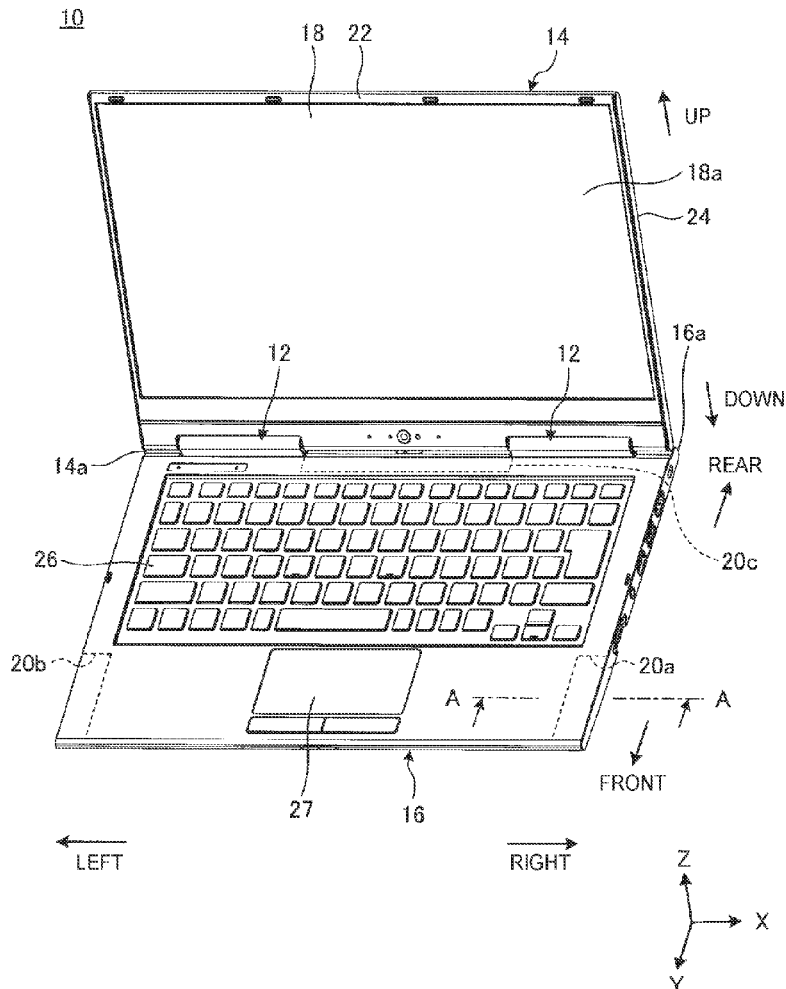
(22) Filed: **Sep. 8, 2017**

(30) **Foreign Application Priority Data**

Jun. 22, 2017 (JP) 2017122208

Publication Classification

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





US 20180375193A1

(19) **United States**

(12) **Patent Application Publication**

Zhang et al.

(10) **Pub. No.: US 2018/0375193 A1**

(43) **Pub. Date: Dec. 27, 2018**

(54) **ANTENNA SYSTEM AND MOBILE TERMINAL**

(71) Applicant: **AAC Technologies Pte. Ltd.**,
Singapore city (SG)

(72) Inventors: **Liwan Zhang**, Shenzhen (CN); **Kai Dong**, Shenzhen (CN)

(21) Appl. No.: **15/828,572**

(22) Filed: **Dec. 1, 2017**

(30) **Foreign Application Priority Data**

Jun. 22, 2017 (CN) 201710482126.0

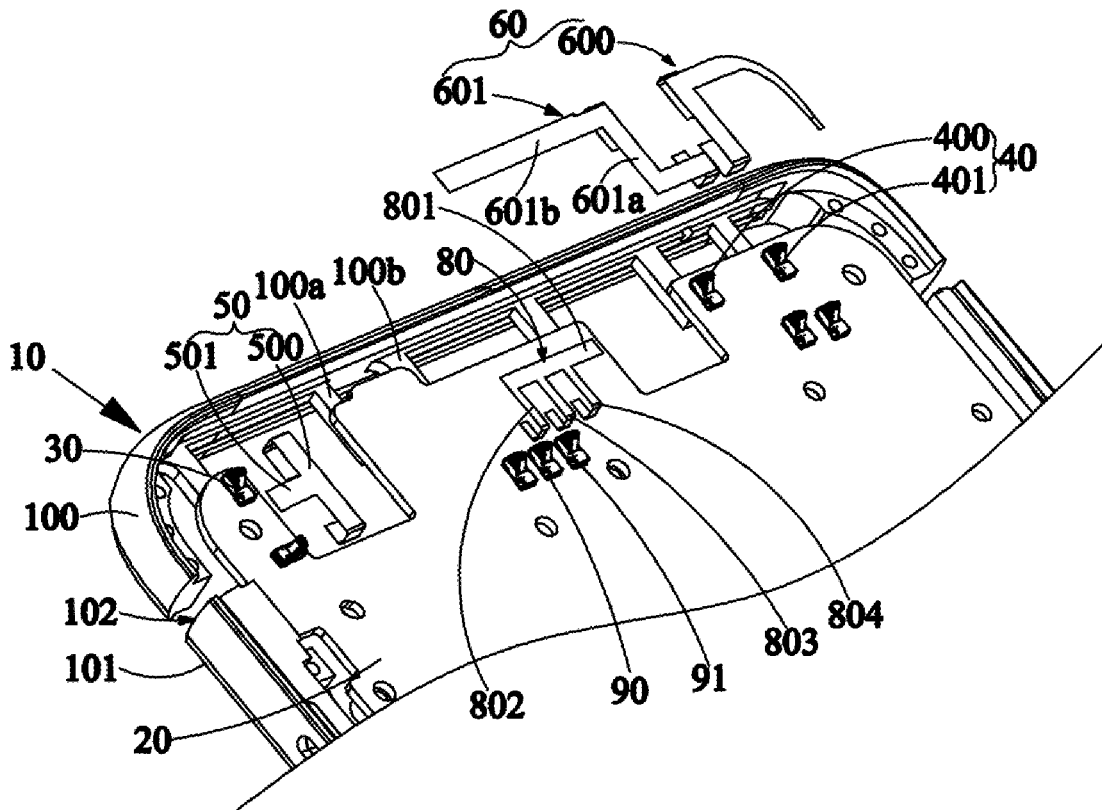
Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/38 (2006.01)
H01Q 1/48 (2006.01)
H01Q 5/30 (2006.01)
H01Q 5/335 (2006.01)
H01Q 9/04 (2006.01)

(52) **U.S. Cl.**
 CPC *H01Q 1/243* (2013.01); *H01Q 1/38* (2013.01); *H01Q 1/48* (2013.01); *H01Q 1/521* (2013.01); *H01Q 5/335* (2015.01); *H01Q 9/0407* (2013.01); *H01Q 5/30* (2015.01)

(57) **ABSTRACT**

An antenna system, including a metal frame including a radiation portion and a grounding portion separately arranged, and a gap zone is defined therebetween; a main board including a system ground, a first radio frequency feeding end and a second radio frequency feeding end; a first conductive member; a second conductive member; a three-in-one antenna unit; and a diversity antenna unit; the three-in-one antenna unit is connected with the first radio frequency feeding end, and the diversity antenna unit is electrically connected with the second radio frequency feeding end; the three-in-one antenna unit and the diversity antenna unit are connected with the radiation portion respectively through the first conductive member and the second conductive member; the radiation portion includes a first grounding point and a second grounding point which are connected with the system ground and arranged between the diversity antenna unit and the three-in-one antenna unit.





US 20180375196A1

(19) **United States**

(12) **Patent Application Publication**

Han et al.

(10) **Pub. No.: US 2018/0375196 A1**

(43) **Pub. Date: Dec. 27, 2018**

(54) **ANTENNA SYSTEM AND COMMUNICATION DEVICE CONTAINING THE SAME**

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H04M 1/0283* (2013.01); *H01Q 13/10* (2013.01)

(71) Applicant: **AAC Technologies Pte. Ltd.**,
Singapore City (SG)

(57) **ABSTRACT**

(72) Inventors: **Hongjuan Han**, Shenzhen (CN);
Yuehua Yue, Shenzhen (CN)

The present disclosure relates to an antenna system and a communication device. The antenna system includes a rear housing, a metal middle frame including two side frame portions and a bottom frame portion, a mainboard and a first tuning switch. The bottom frame portion defines a first slit and a second slit and includes a first, second and third positions, a third slit communicated with the first and second slits is defined between the rear housing and the bottom frame portion along an extending direction of the side frame portion. The mainboard includes a feeding point, a first ground point and a second ground point, the feeding point connected with the first position, the first ground point connected with the second position, the second ground point connected with the third position by the first tuning switch, thereby forming a first antenna, a second antenna and a third antenna.

(21) Appl. No.: **15/869,183**

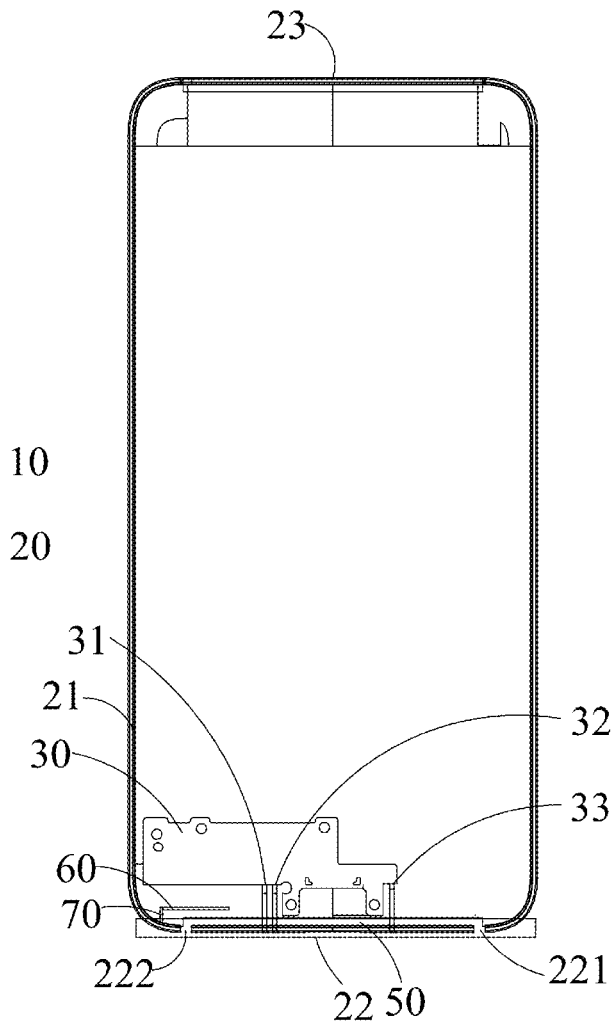
(22) Filed: **Jan. 12, 2018**

(30) **Foreign Application Priority Data**

Jun. 22, 2017 (CN) 201710482838.2

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 13/10 (2006.01)
H04M 1/02 (2006.01)





US 20180375197A1

(19) **United States**

(12) **Patent Application Publication**

Liu et al.

(10) **Pub. No.: US 2018/0375197 A1**

(43) **Pub. Date: Dec. 27, 2018**

(54) **ANTENNA SYSTEM AND MOBILE TERMINAL**

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 1/06* (2013.01); *H04M 1/0283* (2013.01); *H04M 1/0266* (2013.01)

(71) Applicant: **AAC Technologies Pte. Ltd.**,
Singapore city (SG)

(72) Inventors: **Jianchuan Liu**, Shenzhen (CN);
Yuehua Yue, Shenzhen (CN); **Wei Yan**,
Shenzhen (CN); **Li Han**, Shenzhen
(CN); **Chi Xie**, Shenzhen (CN)

(57) **ABSTRACT**

A mobile terminal, including a display screen, a rear cover facing the display screen, a metal frame, and a circuit board; the metal frame and the circuit board are between the display screen and the rear cover and extend along outer profile of the rear cover. The antenna system includes at least one antenna unit. Each antenna unit includes a first gap in the metal frame and a second gap communicated with the first gap; the first gap extends along perimeter of the metal frame to form a strip-like hollow; the second gap extends from the middle of the first gap toward the rear cover until through the metal frame so as to divide the metal frame into a first section and a second section; the first section and the second section are electrically connected with the feeding point to form a first radiator and a second radiator, respectively.

(21) Appl. No.: **15/893,813**

(22) Filed: **Feb. 12, 2018**

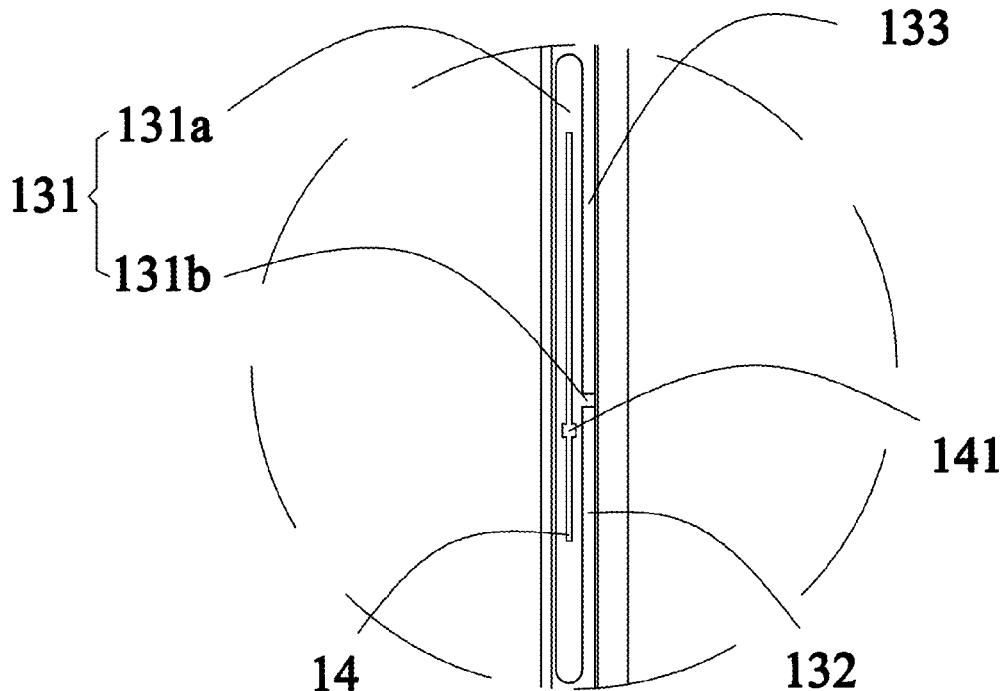
(30) **Foreign Application Priority Data**

Jun. 21, 2017 (CN) 201710476833.9

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H04M 1/02 (2006.01)
H01Q 1/06 (2006.01)

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US 20180375208A1

(19) **United States**

(12) **Patent Application Publication**
LEE

(10) **Pub. No.: US 2018/0375208 A1**

(43) **Pub. Date: Dec. 27, 2018**

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

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

CPC *H01Q 5/15* (2015.01); *H01Q 13/106* (2013.01); *H01Q 5/307* (2015.01); *H01Q 1/38* (2013.01)

(71) Applicant: **ASUSTEK COMPUTER INC.,**
TAIPEI (TW)

(72) Inventor: **Cheng-Tse LEE, TAIPEI (TW)**

(57) **ABSTRACT**

The invention discloses a communication device and an antenna assembly thereof. The communication device includes a metal rim, a device metal member, and an antenna assembly. The device metal member is disposed in the metal rim. The antenna assembly includes an insulating substrate, two electrical coupling portions, a feeding part, and a feeding signal source. The insulating substrate is disposed between the device metal member and the metal rim. The two electrical coupling portions are disposed at two opposite ends of the insulating substrate and electrically coupled to the device metal member and the metal rim. The feeding part is disposed on the insulating substrate and electrically coupled to the metal rim, so as to form a first slot section and a second slot section. The feed part is electrically coupled to the metal rim. The feeding signal source is disposed on the insulating substrate, located between the feeding part and the device metal member, and electrically coupled to the feeding part and the device metal member.

(21) Appl. No.: **16/018,471**

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

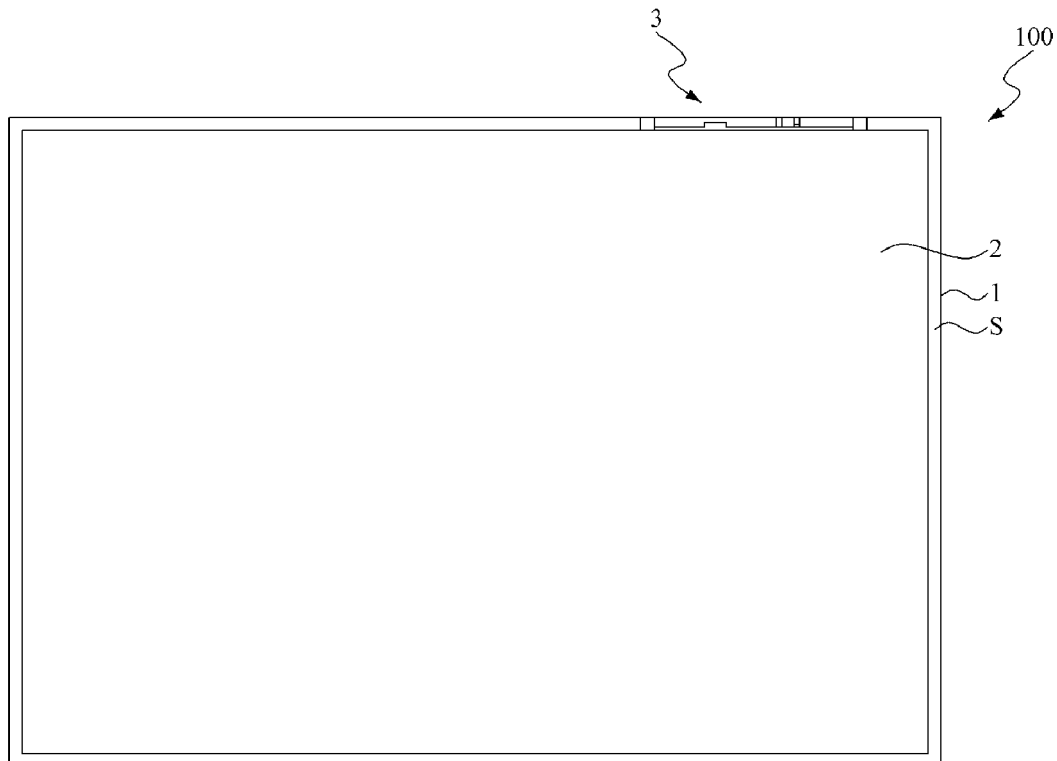
(30) **Foreign Application Priority Data**

Jun. 27, 2017 (TW) 106121456

Publication Classification

(51) **Int. Cl.**

H01Q 5/15 (2006.01)
H01Q 1/38 (2006.01)
H01Q 5/307 (2006.01)
H01Q 13/10 (2006.01)





US 20180375209A1

(19) **United States**

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

(10) **Pub. No.: US 2018/0375209 A1**

(43) **Pub. Date: Dec. 27, 2018**

(54) **ANTENNA AND ELECTRONIC DEVICE**

Publication Classification

(71) Applicant: **Beijing Xiaomi Mobile Software Co., Ltd.**, Beijing (CN)

(51) **Int. Cl.**
H01Q 5/30 (2006.01)
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)
H01Q 9/04 (2006.01)

(72) Inventors: **Yuquan SU**, Beijing (CN); **Hai ZHAO**, Beijing (CN)

(52) **U.S. Cl.**
CPC *H01Q 5/30* (2015.01); *H01Q 9/0407* (2013.01); *H01Q 1/48* (2013.01); *H01Q 1/243* (2013.01)

(73) Assignee: **Beijing Xiaomi Mobile Software Co., Ltd.**, Beijing (CN)

(57) **ABSTRACT**

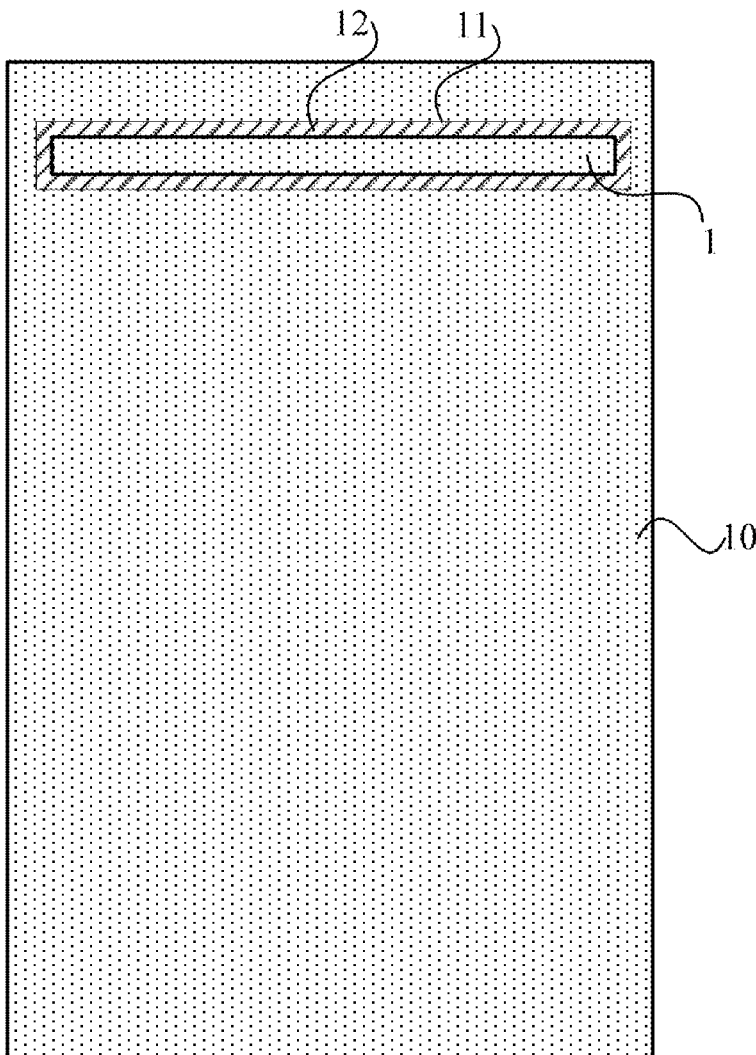
(21) Appl. No.: **16/019,204**

The present disclosure provides an antenna and an electronic device. The antenna includes: a radiator, a feed terminal, a capacitive circuit, a resonant circuit, and a ground terminal. The antenna includes: a radiator, a feed terminal, a capacitive circuit, a resonant circuit, and a ground terminal. The feed terminal is electrically connected to a preset connection point on the radiator via the capacitive circuit. A first end of the resonant circuit is electrically connected to the radiator, and a second end of the resonant circuit is electrically connected to the ground terminal.

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

(30) **Foreign Application Priority Data**

Jun. 27, 2017 (CN) 201710497977.2





US 20180375212A1

(19) **United States**

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

(10) **Pub. No.: US 2018/0375212 A1**

(43) **Pub. Date: Dec. 27, 2018**

(54) **WIRELESS COMMUNICATION MODULE**

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

(71) Applicant: **Arcadyan Technology Corporation**,
Hsinchu City (TW)

CPC **H01Q 13/18** (2013.01); **H01Q 3/40**
(2013.01); **H01Q 9/04** (2013.01)

(72) Inventors: **Shin-Lung KUO**, Kaohsiung City
(TW); **Shih-Chieh CHENG**, Tainan
City (TW)

(57) **ABSTRACT**

(21) Appl. No.: **16/000,691**

A wireless communication module including a substrate, a first antenna, a second antenna and a resonator group is provided. The first antenna and the second antenna are disposed on the substrate. The resonator group is disposed between the first antenna and the second antenna and separated from the first antenna and the second antenna. The resonator group includes a first resonator and a second resonator. The first resonator includes a first resonant cavity, a first extension slot, a first conductive portion and a second conductive portion. The first extension slot extends towards a lateral surface of the substrate from the first resonant cavity. The first conductive portion and the second conductive portion are located within the first resonant cavity and separated from each other. The second resonator includes a second resonant cavity and a second extension slot extending towards the lateral surface from the second resonant cavity.

(22) Filed: **Jun. 5, 2018**

(30) **Foreign Application Priority Data**

Jun. 23, 2017 (TW) 106120993

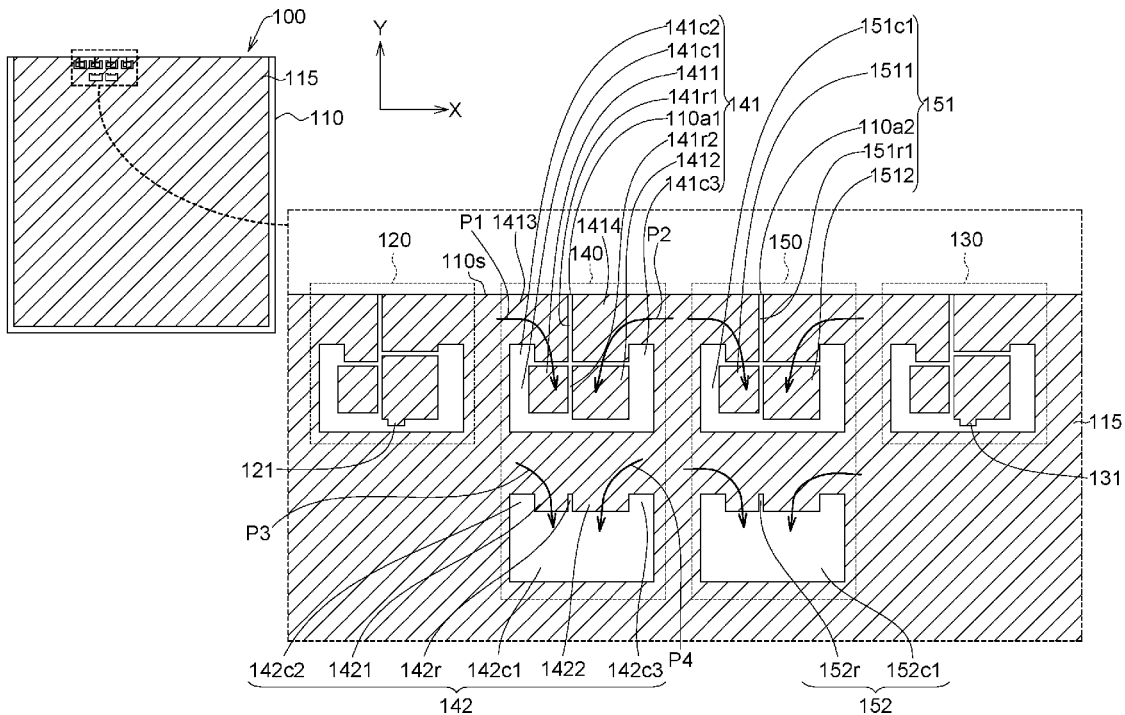
Publication Classification

(51) **Int. Cl.**

H01Q 13/18 (2006.01)

H01Q 9/04 (2006.01)

H01Q 3/40 (2006.01)





US 20180375222A1

(19) **United States**

(12) **Patent Application Publication**

Liu et al.

(10) **Pub. No.: US 2018/0375222 A1**

(43) **Pub. Date: Dec. 27, 2018**

(54) **ANTENNA SYSTEM**

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

(71) Applicant: **AAC Technologies Pte. Ltd.**,
Singapore city (SG)

CPC **H01Q 21/293** (2013.01); **H01Q 21/0075**
(2013.01); **H01Q 21/0025** (2013.01); **H01Q**
21/061 (2013.01)

(72) Inventors: **Jianchuan Liu**, Shenzhen (CN); **Mao**
Liu, Shenzhen (CN); **Yuehua Yue**,
Shenzhen (CN)

(57) **ABSTRACT**

(21) Appl. No.: **15/869,187**

An antenna system includes a feeding point, an antenna array comprising four antenna units and a power division network comprising four power division modules, the antenna array and the power division network are respectively arranged at two opposite planes, one end of each of the four power division modules is respectively connected with one of the four antenna units, and the other ends of the four power division modules are connected with each other and are connected with the feeding point, so as to form a 5G antenna. In the antenna system, the power division network and the antenna array are structured as separate layers to reduce an area of a millimeter wave array formed by the power division network and the antenna array, so that the cellphone can have enough space for the millimeter wave array, thereby reducing difficulties of applying the millimeter wave to a mobile terminal.

(22) Filed: **Jan. 12, 2018**

(30) **Foreign Application Priority Data**

Jun. 22, 2017 (CN) 201710482127.5

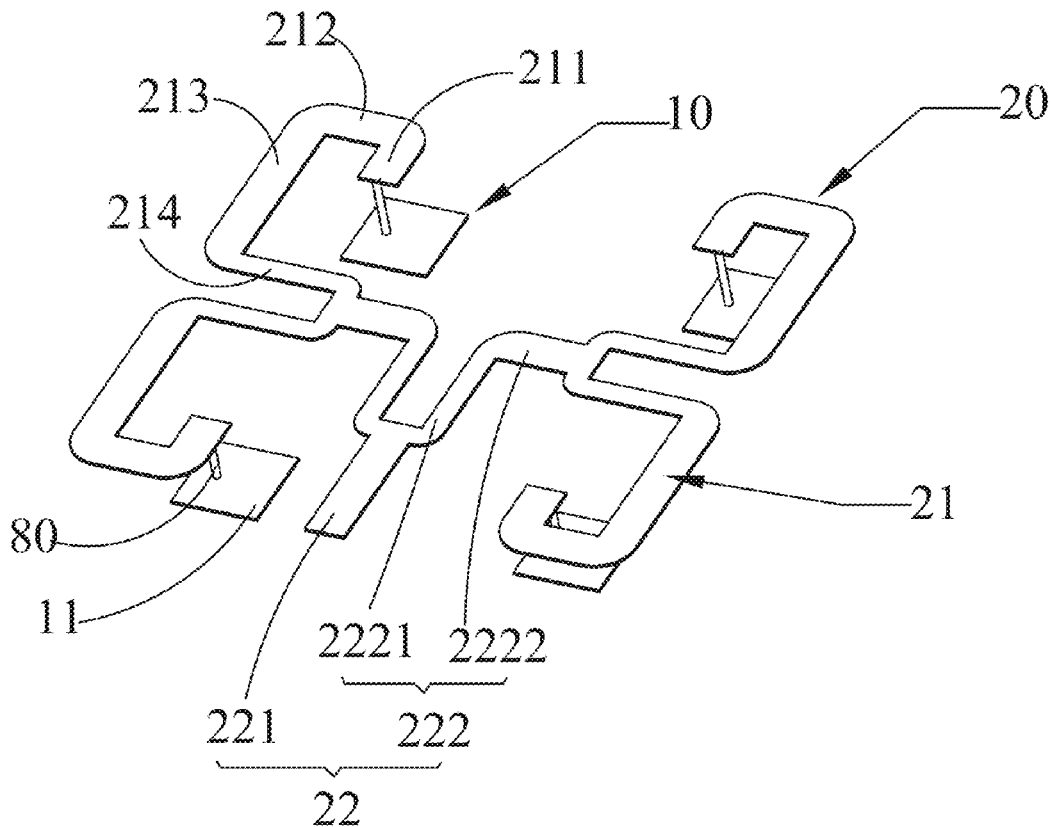
Publication Classification

(51) **Int. Cl.**

H01Q 21/29 (2006.01)

H01Q 21/06 (2006.01)

H01Q 21/00 (2006.01)





US 20180375971A1

(19) **United States**

(12) **Patent Application Publication**

Sun et al.

(10) **Pub. No.: US 2018/0375971 A1**

(43) **Pub. Date: Dec. 27, 2018**

(54) **MOBILE COMMUNICATIONS TERMINAL**

Publication Classification

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

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

(72) Inventors: **Qiao Sun**, Xi'an (CN); **Yi Wang**, Xi'an (CN); **Hanyang Wang**, Reading (GB); **Yibo Chen**, Shenzhen (CN); **Bao Lu**, Shenzhen (CN); **Shiqiang Lu**, Xi'an (CN)

(52) **U.S. Cl.**
CPC **H04M 1/0202** (2013.01)

(57) **ABSTRACT**

A mobile communications terminal includes a metal backplane, a circuit board, and a metal frame. A feeding structure is located between a first ground point and a second ground point. A slot is located between the first ground point and the feeding structure. The first antenna uses, as a radiator, a part of the metal frame between the slot and the first ground point. The second antenna uses, as a radiation slot, a gap between the metal backplane and the part of the metal frame between the slot and the first ground point. The third antenna uses, as another radiation slot, a gap between the metal backplane and a part of the metal frame between the slot and the second ground point.

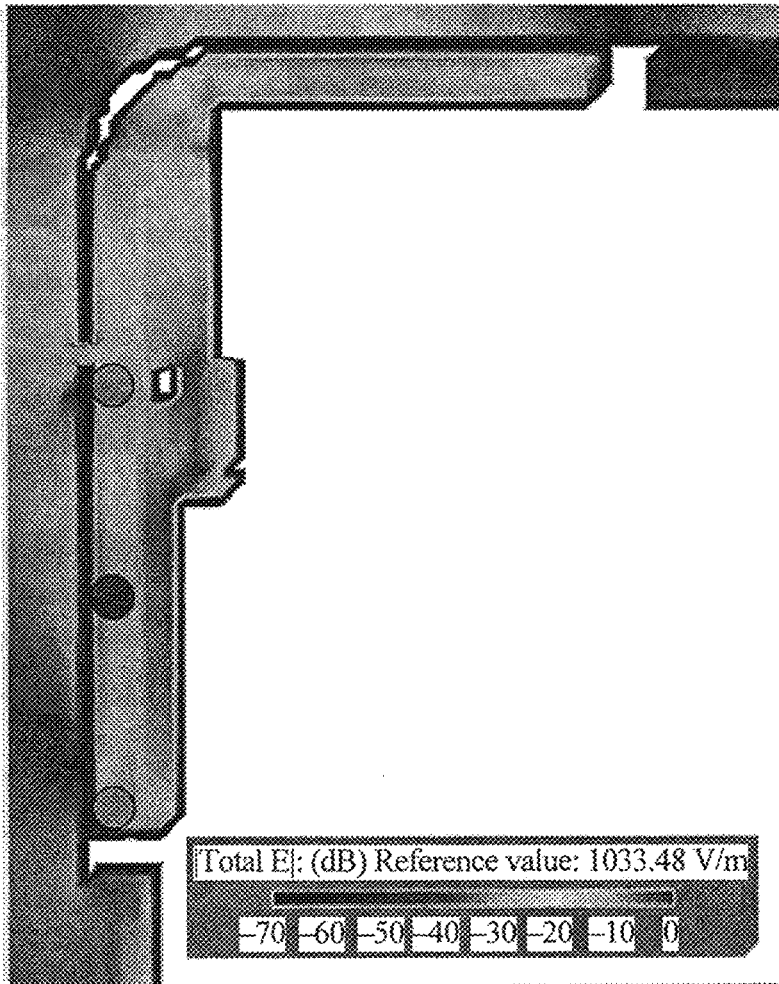
(21) Appl. No.: **16/063,519**

(22) PCT Filed: **Dec. 17, 2015**

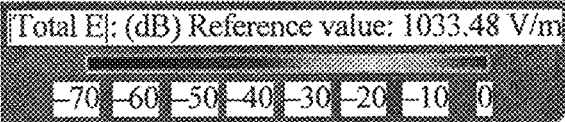
(86) PCT No.: **PCT/CN2015/097707**

§ 371 (c)(1),

(2) Date: **Jun. 18, 2018**



- Minimum electric field point
- Maximum electric field point





US 20180375973A1

(19) **United States**

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

(10) **Pub. No.: US 2018/0375973 A1**

(43) **Pub. Date: Dec. 27, 2018**

(54) **MOBILE TERMINAL HAVING CASE, METHOD FOR MANUFACTURING SAME**

B21D 51/16 (2006.01)

B22D 17/00 (2006.01)

B29C 45/14 (2006.01)

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

H01Q 1/24 (2006.01)

H01Q 1/38 (2006.01)

H01Q 1/48 (2006.01)

(72) Inventors: **Insu SONG**, Seoul (KR); **Sukho HONG**, Seoul (KR); **Dongjin KIM**, Seoul (KR); **Jaewook LEE**, Seoul (KR)

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

H04B 1/3827 (2006.01)

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

CPC *H04M 1/026* (2013.01); *G06F 1/1658*

(2013.01); *B21D 51/16* (2013.01); *B22D*

17/00 (2013.01); *H04B 1/3833* (2013.01);

H01Q 1/243 (2013.01); *H01Q 1/38* (2013.01);

H01Q 1/48 (2013.01); *B29C 45/14* (2013.01)

(21) Appl. No.: **16/062,299**

(22) PCT Filed: **Sep. 28, 2016**

(57)

ABSTRACT

(86) PCT No.: **PCT/KR2016/010840**

§ 371 (c)(1),

(2) Date: **Jun. 14, 2018**

The mobile terminal having a conductive case which forms an external appearance of a terminal body, according to the present invention, comprises: a rear base which comprises a first side part; and an inner case which is mounted on the inside of the rear case and comprises a second side part, wherein the first side part and the second side part are electrically separated from each other, and the first side part and the second side part comprise a first conductive member and a second conductive member which are electrically separated from each other. Thus, it is possible to provide various forms of antennas by using a plurality of conductive members provided on the side parts.

(30) **Foreign Application Priority Data**

Dec. 17, 2015 (KR) 10-2015-0181239

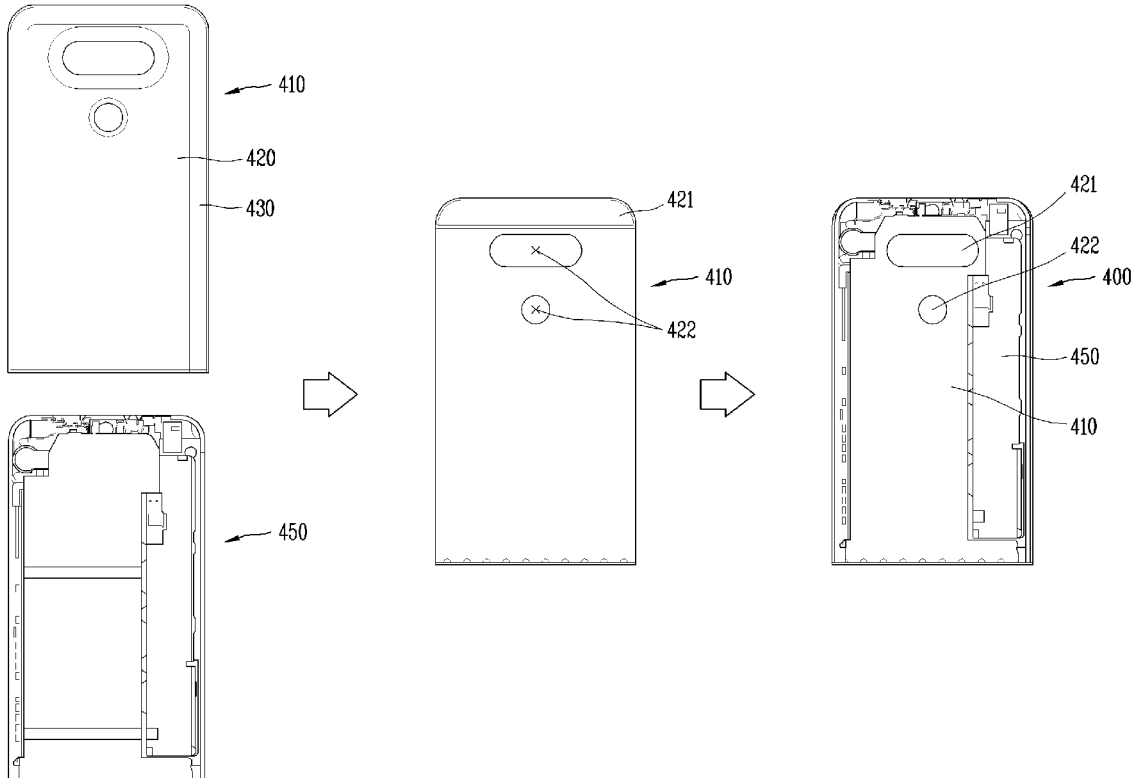
Sep. 20, 2016 (KR) 10-2016-0120017

Publication Classification

(51) **Int. Cl.**

H04M 1/02 (2006.01)

G06F 1/16 (2006.01)





(19) **United States**

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

(10) **Pub. No.: US 2019/0006734 A1**

(43) **Pub. Date: Jan. 3, 2019**

(54) **ANTENNA SYSTEM**

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

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

CPC **H01Q 1/2266** (2013.01); **H01Q 1/247** (2013.01); **H01Q 1/2283** (2013.01)

(72) Inventors: **Simon Svendsen**, Aalborg (DK); **Ole Jagielski**, Viborg (DK)

(57) **ABSTRACT**

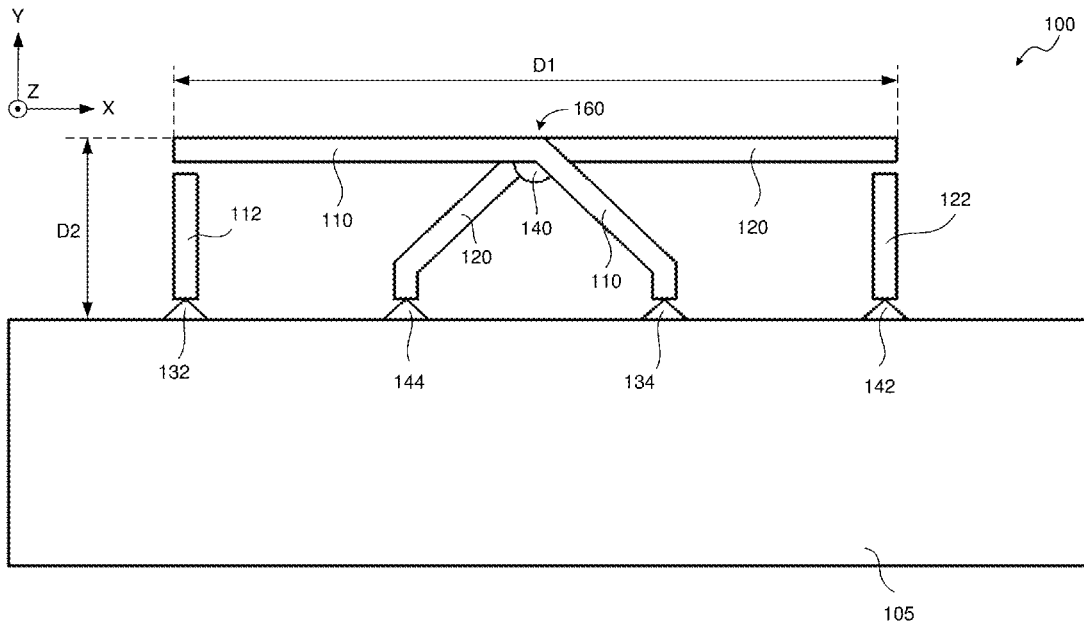
(21) Appl. No.: **15/635,906**

Described is an antenna system for wireless communication. The antenna system can include a support plane; a first antenna element coupled to the support plane; and a second antenna element coupled to the support plane and positioned in balance with the first antenna. The support plane can include a slot that is configured to create a balanced relationship between the first and the second antenna elements. The system can include an electrical component connected across a width of the slot and configured to tune a current balance between the first and the second antenna elements.

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

Publication Classification

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





(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2019/0006735 A1**

Lee et al. (43) **Pub. Date: Jan. 3, 2019**

(54) **RADIO ANTENNA INTEGRATION IN A MOBILE COMPUTING DEVICE**

(52) **U.S. CL.**
CPC **H01Q 1/2266** (2013.01); **G06F 1/1656** (2013.01)

(71) Applicant: **INTEL CORPORATION**, Santa Clara, CA (US)

(72) Inventors: **Warren Lee**, San Jose, CA (US); **Kwan Ho Lee**, Mountain View, CA (US); **Ulun Karacaoglu**, San Diego, CA (US); **Manish A. Hiranandani**, Santa Clara, CA (US); **Songnan Yang**, San Jose, CA (US)

(57) **ABSTRACT**

Techniques for integrating a plurality of radio antennas in an electronic device are described. An example of an electronic device includes a display housing with a display screen and top bezel disposed above the display screen, and a plurality of components disposed in the top bezel. The plurality of components include a first cellular communication antenna disposed on a first side of the top bezel, and a second cellular communication antenna disposed on a second side of the top bezel opposite the first side. The plurality of components also include a first WiFi antenna disposed adjacent to the second cellular communication antenna, and a second WiFi antenna disposed adjacent to the second cellular communication antenna on an opposite side from the first WiFi antenna.

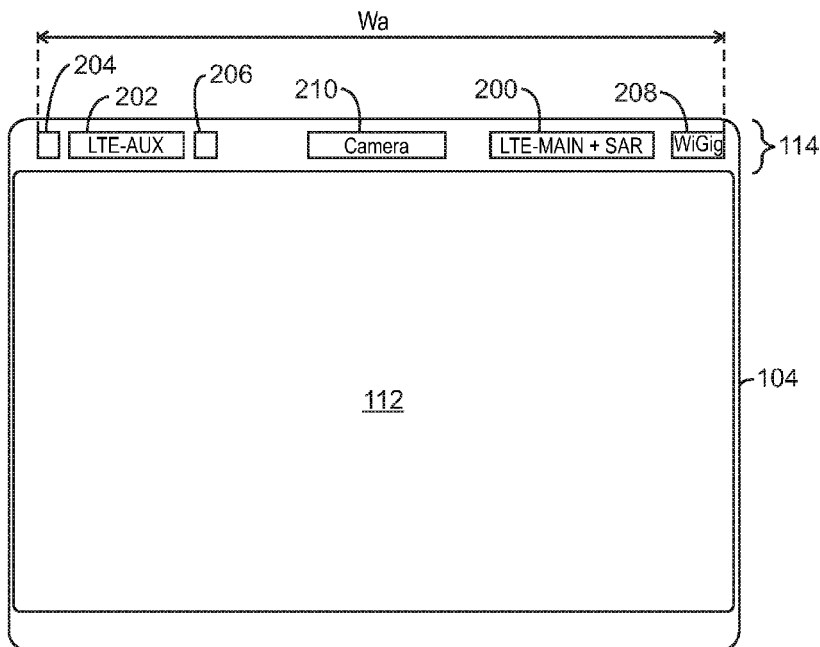
(73) Assignee: **Intel Corporation**, Santa Clara, CA (US)

(21) Appl. No.: **15/640,413**

(22) Filed: **Jun. 30, 2017**

Publication Classification

(51) **Int. Cl.**
H01Q 1/22 (2006.01)
G06F 1/16 (2006.01)





US 20190006736A1

(19) **United States**

(12) **Patent Application Publication**

Hsu et al.

(10) **Pub. No.: US 2019/0006736 A1**

(43) **Pub. Date: Jan. 3, 2019**

(54) **ELECTRONIC DEVICE**

Publication Classification

(71) Applicant: **Wistron Corp.**, New Taipei City (TW)

(51) **Int. Cl.**
H01Q 1/22 (2006.01)
H05K 5/02 (2006.01)
G06F 1/16 (2006.01)

(72) Inventors: **Yu Chen Hsu**, New Taipei City (TW);
Ching Pin Hsu, New Taipei City (TW);
Chien An Chou, New Taipei City (TW)

(52) **U.S. Cl.**
CPC *H01Q 1/2266* (2013.01); *G06F 1/1618*
(2013.01); *H05K 5/0226* (2013.01)

(21) Appl. No.: **15/721,579**

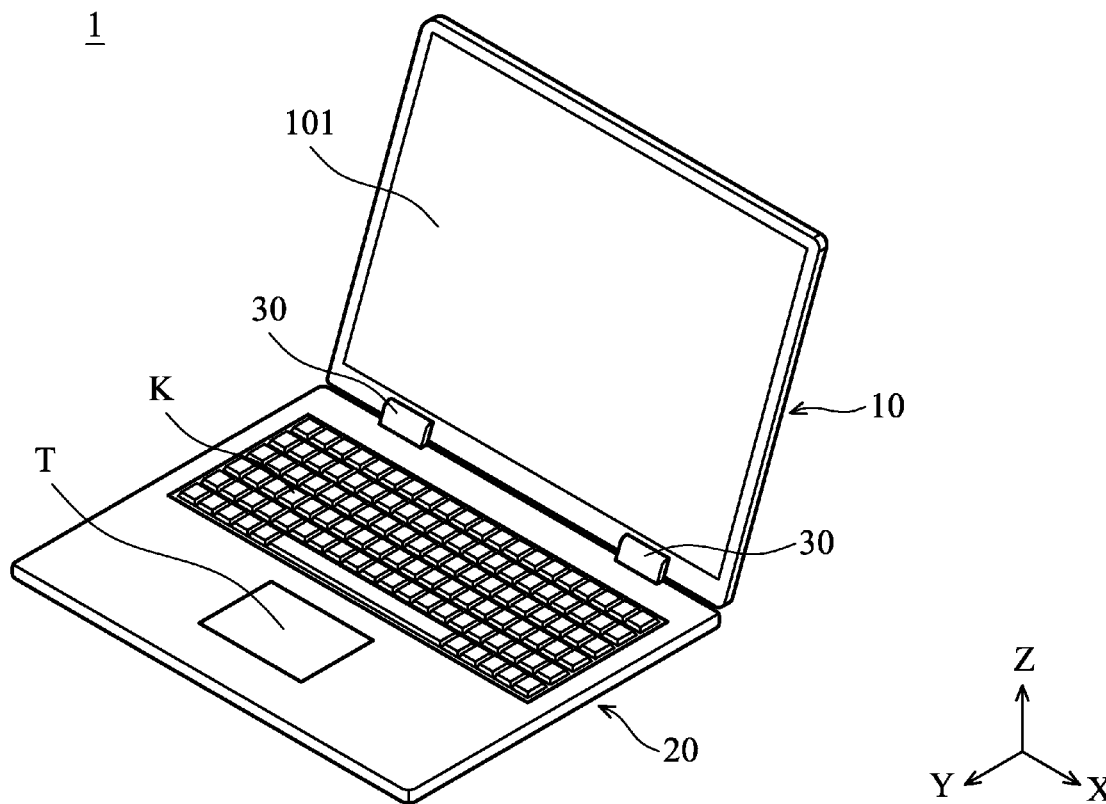
(57) **ABSTRACT**

(22) Filed: **Sep. 29, 2017**

An electronic device is provided, including a display module, an input module, a hinge module, and an antenna. The hinge module connects the display module and the input module and has a first side and an opposite second side. The antenna is disposed in the hinge module and is situated on the first side. When the display module is rotated with respect to the input module, the hinge module forces the antenna to move from the first side to the second side.

(30) **Foreign Application Priority Data**

Jun. 30, 2017 (TW) 106121975





US 20190006738A1

(19) **United States**

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

(10) **Pub. No.: US 2019/0006738 A1**

(43) **Pub. Date: Jan. 3, 2019**

(54) **WIDE BAND ANTENNA BACKED BY REFLECTING CAVITY AND AN ANTENNA SYSTEM**

H01Q 21/00 (2006.01)

H01Q 9/04 (2006.01)

H01Q 5/50 (2006.01)

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

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 15/14* (2013.01); *H01Q 5/50* (2015.01); *H01Q 9/045* (2013.01); *H01Q 21/0087* (2013.01)

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

(57) **ABSTRACT**

(21) Appl. No.: **15/729,629**

The disclosure relates generally to a broadband antenna element with a reflecting cavity, which includes a metal frame, a feeder line, a feed screw, a pillar and an insulating sleeve. The reflecting cavity is formed by the inner concave of the outer side of the metal frame. The reflecting cavity includes the first wall and the second wall distributed from bottom to top. The first wall, the pillar, the second wall and the feeder line are arranged orderly and are connected with the feed screw. The pillar and the feed screw are connected by screw thread. The feed screw is connected with the second wall through an insulating sleeve. The pillar is a good conductor and under surface of the pillar contacts with the first wall, and the under surface area of the pillar is larger than the upper surface area of the pillar.

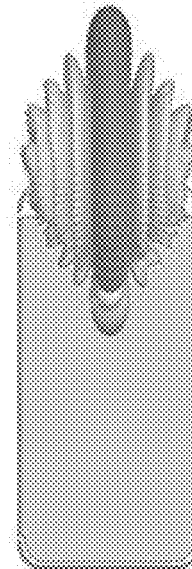
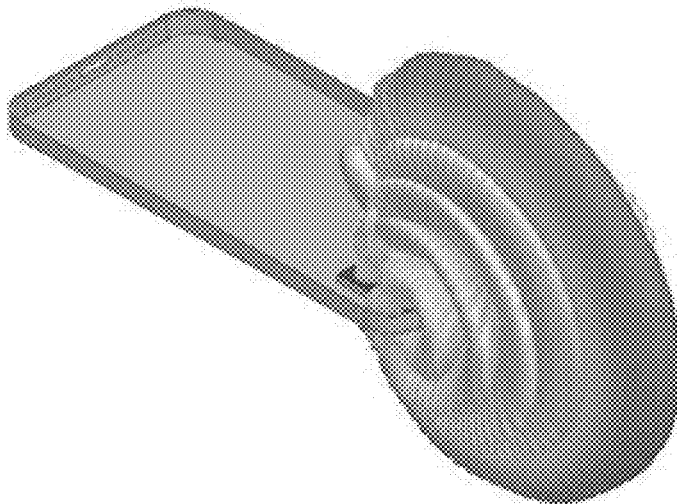
(22) Filed: **Oct. 10, 2017**

(30) **Foreign Application Priority Data**

Jun. 30, 2017 (CN) 201710527218.6

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 15/14 (2006.01)





US 20190006739A1

(19) **United States**

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

(10) **Pub. No.: US 2019/0006739 A1**

(43) **Pub. Date: Jan. 3, 2019**

(54) **ANTENNA AND ANTENNA SYSTEM
APPLIED IN METAL COVER**

H01Q 15/14 (2006.01)

H01Q 21/00 (2006.01)

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

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 1/36*
(2013.01); *H01Q 21/0006* (2013.01); *H01Q*
3/28 (2013.01); *H01Q 15/14* (2013.01); *H01Q*
3/38 (2013.01)

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

(57) **ABSTRACT**

(21) Appl. No.: **15/729,641**

An antenna system applied in the metal back cover of a 5G mobile terminal contains a metal back cover, a feeder line and at least one antenna element. The metal back cover is composed of a bottom case & a frame. The antenna element is composed of a feed screw, a pillar, a insulating sleeve and a reflecting cavity. The reflecting cavity is formed by the inner concave of the outer side of the metal frame. The reflecting cavity includes the first wall and the second wall distributed from bottom to top. The first wall is a part of the bottom case. The first wall, the pillar, the second wall and the feeder line are arranged orderly and are connected with the feed screw. The pillar and the feed screw are connected by screw thread. The feed screw is connected with the second wall through an insulating sleeve.

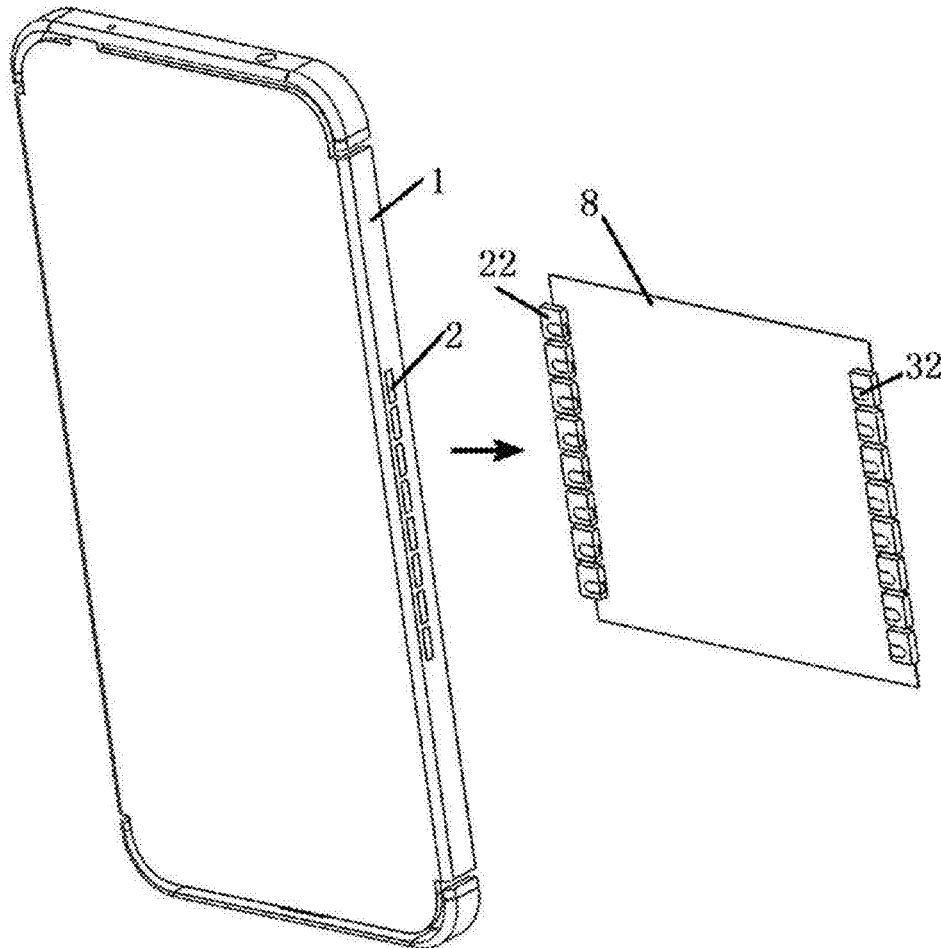
(22) Filed: **Oct. 10, 2017**

(30) **Foreign Application Priority Data**

Jun. 30, 2017 (CN) 201710525437.0

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/36 (2006.01)
H01Q 3/38 (2006.01)
H01Q 3/28 (2006.01)





US 20190006740A1

(19) **United States**

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

(10) **Pub. No.: US 2019/0006740 A1**

(43) **Pub. Date: Jan. 3, 2019**

(54) **METAL FRAME BODY AND TERMINAL INCLUDING SAME**

Publication Classification

(71) Applicant: **Beijing Xiaomi Mobile Software Co., Ltd., Beijing (CN)**

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H04M 1/02 (2006.01)
G01S 19/36 (2006.01)

(72) Inventors: **Wei KUANG, Beijing (CN); Yuchuan SU, Beijing (CN)**

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 1/2266** (2013.01); **G01S 19/36** (2013.01); **H04M 1/026** (2013.01)

(73) Assignee: **Beijing Xiaomi Mobile Software Co., Ltd., Beijing (CN)**

(21) Appl. No.: **16/019,734**

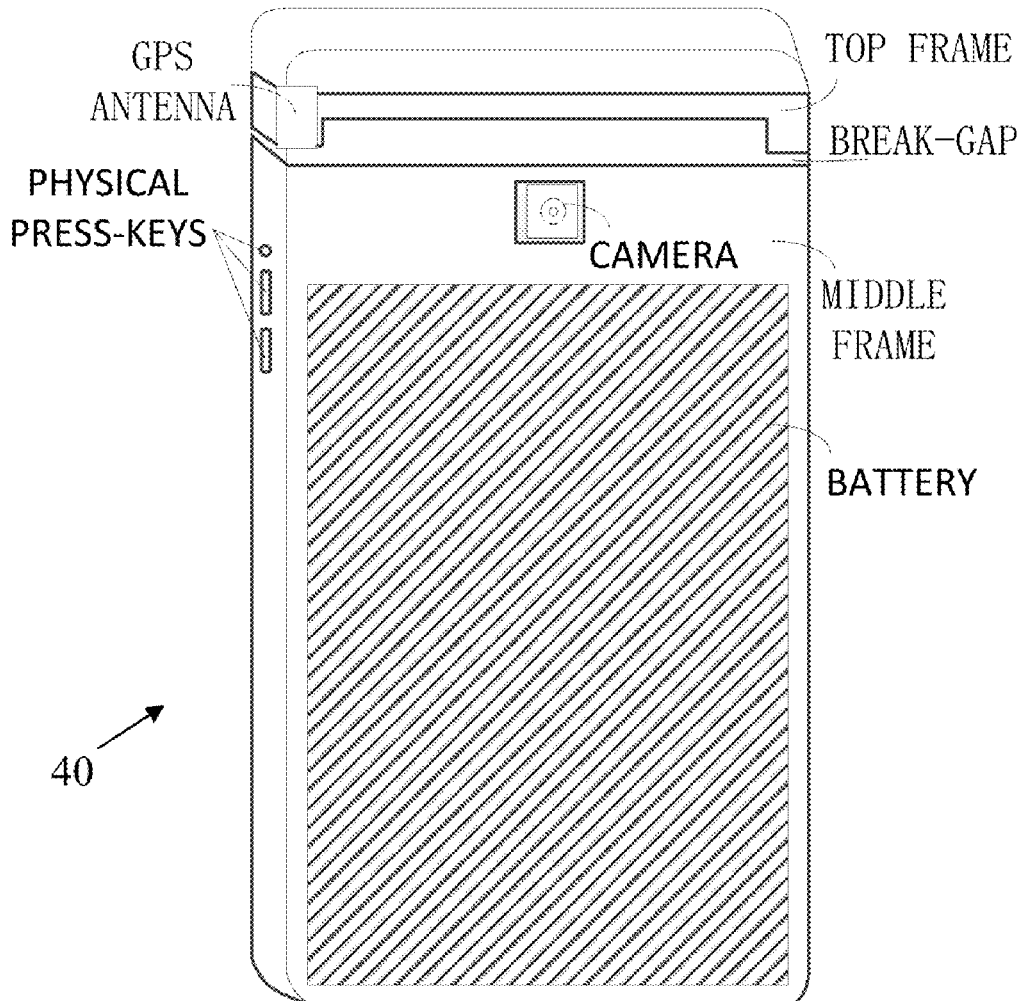
(57) **ABSTRACT**

(22) Filed: **Jun. 27, 2018**

A terminal includes a metal frame body having: a top frame configured to receive a global positioning system (GPS) antenna; and a middle frame provided with a slot corresponding to the GPS antenna in position, wherein the top frame and the middle frame are electrically isolated from each other by a gap.

(30) **Foreign Application Priority Data**

Jun. 30, 2017 (CN) 201710527568.2





US 20190006747A1

(19) **United States**

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

(10) **Pub. No.: US 2019/0006747 A1**

(43) **Pub. Date: Jan. 3, 2019**

(54) **ELECTRONIC DEVICE**

H01Q 9/42 (2006.01)

(71) Applicant: **Lenovo (Beijing) Co., Ltd.**, Beijing (CN)

H01Q 1/24 (2006.01)

H01Q 21/30 (2006.01)

H01Q 1/22 (2006.01)

(72) Inventors: **Wenlei WANG**, Beijing (CN); **Zhaowei HU**, Beijing (CN); **Xiaozhun SHEN**, Beijing (CN); **Dafei MO**, Beijing (CN)

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

CPC *H01Q 1/523* (2013.01); *H04M 1/0283*

(2013.01); *H01Q 1/2291* (2013.01); *H01Q*

1/243 (2013.01); *H01Q 21/30* (2013.01);

H01Q 9/42 (2013.01)

(21) Appl. No.: **15/941,578**

(22) Filed: **Mar. 30, 2018**

(57)

ABSTRACT

(30) **Foreign Application Priority Data**

Jun. 30, 2017 (CN) 201710524844.X

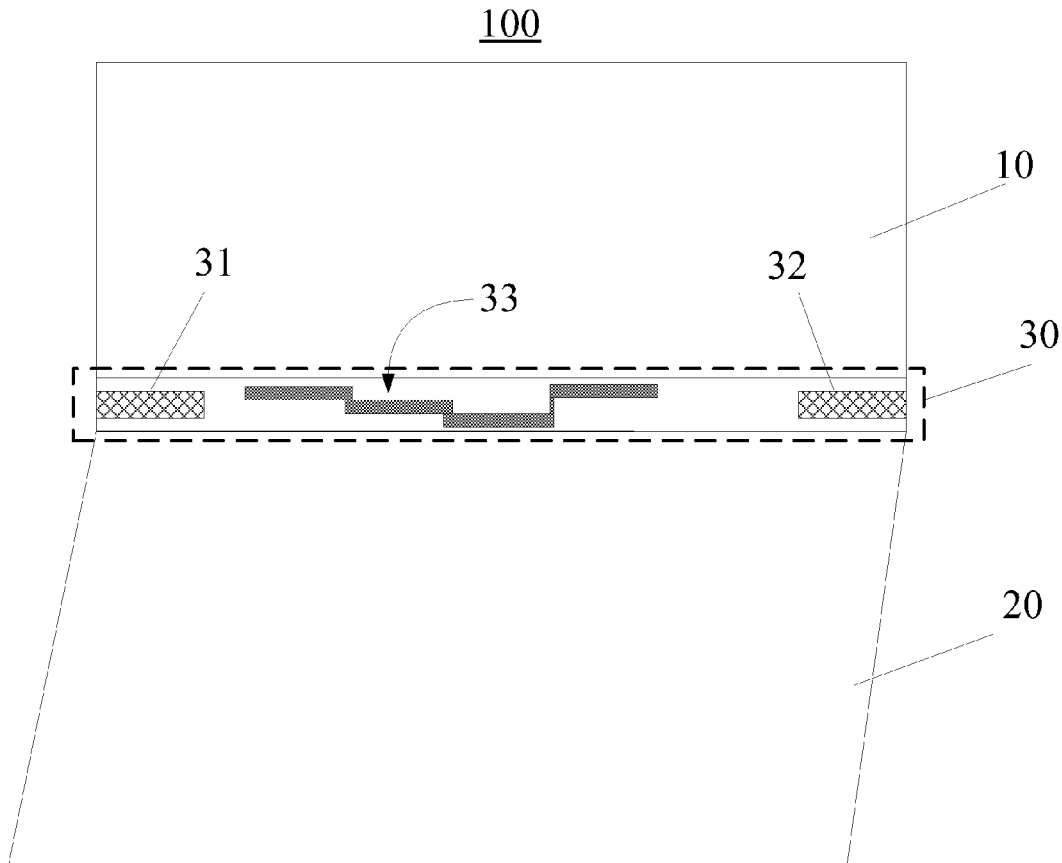
An electronic device includes a first body, a second body, and a rotating shaft structure connected to the first body and the second body. The rotating shaft structure includes a first shaft and a second shaft arranged opposite to each other and fixedly connected to the first body and the second body. The rotating shaft structure further includes an antenna radiator including a plurality of metal shafts electrically coupled to each other and provided in an interspace between the first shaft and the second shaft.

Publication Classification

(51) **Int. Cl.**

H01Q 1/52 (2006.01)

H04M 1/02 (2006.01)





US 20190006751A1

(19) **United States**

(12) **Patent Application Publication**

Chen et al.

(10) **Pub. No.: US 2019/0006751 A1**

(43) **Pub. Date: Jan. 3, 2019**

(54) **ANTENNA DEVICE AND ELECTRONIC DEVICE COMPRISING ANTENNA**

Publication Classification

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

(72) Inventors: **Kuo Cheng Chen**, Gyeonggi-do (KR);
Se Hyun Park, Gyeonggi-do (KR); **Tae Young Kim**,
Gyeonggi-do (KR); **Ahmed Hussain**, Gyeonggi-do (KR);
Igor Shcherbatko, Gyeonggi-do (KR); **Je Hun Jong**,
Seoul (KR); **Jin Woo Jung**, Seoul (KR); **Jae Hoon Jo**,
Gyeonggi-do (KR)

(51) **Int. Cl.**
H01Q 3/24 (2006.01)
H01Q 3/36 (2006.01)
H01Q 1/24 (2006.01)
H04B 7/10 (2006.01)
H01Q 21/00 (2006.01)
H01Q 21/06 (2006.01)
H01Q 25/02 (2006.01)

(52) **U.S. Cl.**
 CPC *H01Q 3/247* (2013.01); *H01Q 3/36*
 (2013.01); *H01Q 1/246* (2013.01); *H01Q*
25/02 (2013.01); *H01Q 21/005* (2013.01);
H01Q 21/065 (2013.01); *H04B 7/10* (2013.01)

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

(21) Appl. No.: **16/022,023**

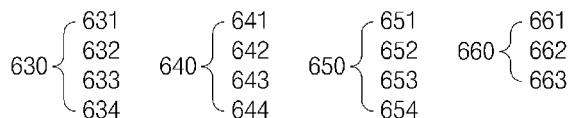
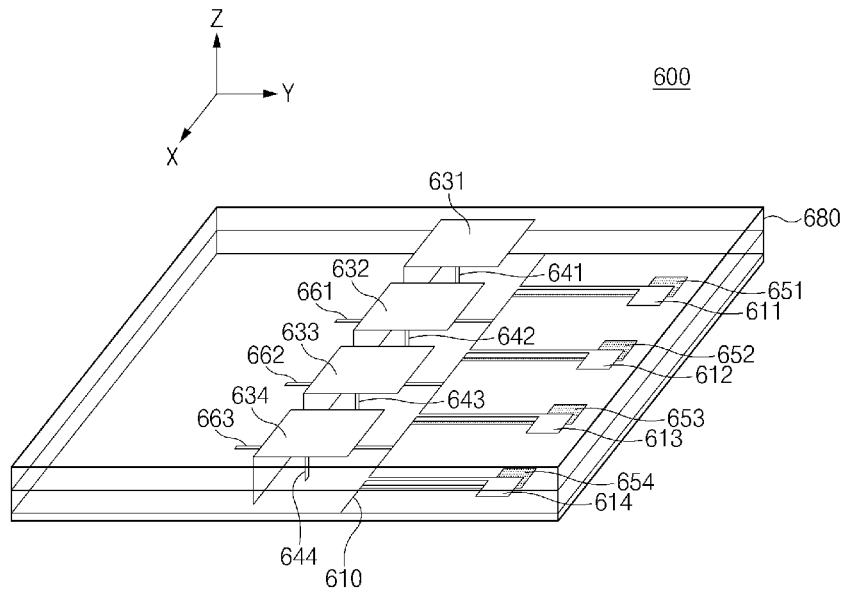
(22) Filed: **Jun. 28, 2018**

(30) **Foreign Application Priority Data**

Jun. 28, 2017 (KR) 10-2017-0081751

(57) **ABSTRACT**

An antenna device includes a ground member including a plane part and a plurality of extension parts extending from one end of the plane part in a first direction and arranged along a second direction, a plurality of patch-type radiators arranged on the plane part along the second direction and configured to radiate vertical polarization, and a plurality of straight radiators spaced apart from the ground member, respectively arranged to be adjacent to the plurality of extension parts, extending in the first direction, and configured to radiate horizontal polarization.





(19) **United States**

(12) **Patent Application Publication**

Liao et al.

(10) **Pub. No.: US 2019/0006755 A1**

(43) **Pub. Date: Jan. 3, 2019**

(54) **MULTI-BAND ANTENNA**

Publication Classification

(71) Applicants: **Wen-Jiao Liao**, Taipei City (TW);
Hao-Ju Hsieh, Taipei City (TW);
Yen-Hao Yu, Taipei City (TW);
Shih-Chia Liu, Taipei City (TW);
Liang-Che Chou, Taipei City (TW);
Li-Chun Lee, Taipei City (TW)

(51) **Int. Cl.**
H01Q 5/335 (2006.01)
H01Q 13/10 (2006.01)
H01Q 21/06 (2006.01)
H01Q 1/36 (2006.01)
H01Q 9/30 (2006.01)

(72) Inventors: **Wen-Jiao Liao**, Taipei City (TW);
Hao-Ju Hsieh, Taipei City (TW);
Yen-Hao Yu, Taipei City (TW);
Shih-Chia Liu, Taipei City (TW);
Liang-Che Chou, Taipei City (TW);
Li-Chun Lee, Taipei City (TW)

(52) **U.S. Cl.**
CPC **H01Q 5/335** (2015.01); **H01Q 13/10**
(2013.01); **H01Q 9/30** (2013.01); **H01Q 1/36**
(2013.01); **H01Q 21/064** (2013.01)

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

(57) **ABSTRACT**

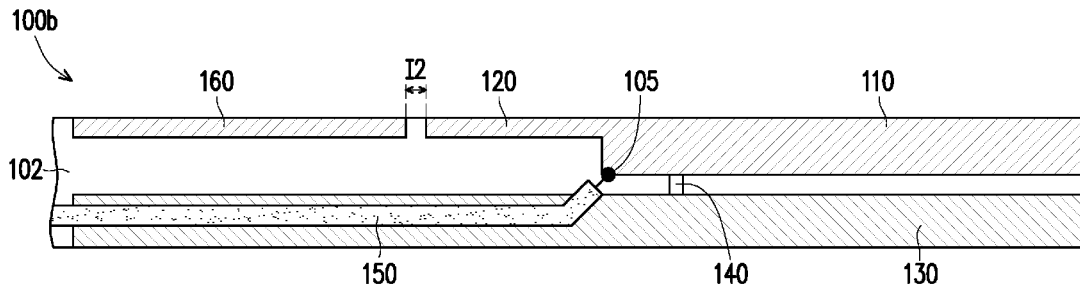
A multi-band antenna including a ground portion, a first radiation portion, a second radiation portion, a feeding portion and a matching portion is provided. The first radiation portion is disposed beside the ground portion, a first gap is existed between the ground portion and the first radiation portion so as to form a first slot, and the first slot has a first open terminal located at the first gap. The second radiation portion is connected to the first radiation portion. The feeding portion is located between the first radiation portion and the second radiation portion. The matching portion is located in the first slot and connected to the first radiation portion and the ground portion. The feeding portion excites the first slot to generate a first resonant mode. The second radiation portion generates a second resonant mode.

(21) Appl. No.: **16/026,075**

(22) Filed: **Jul. 3, 2018**

Related U.S. Application Data

(60) Provisional application No. 62/528,419, filed on Jul. 3, 2017.





(19) **United States**

(12) **Patent Application Publication**
LEE

(10) **Pub. No.: US 2019/0006761 A1**

(43) **Pub. Date: Jan. 3, 2019**

(54) **ANTENNA FOR A PORTABLE COMPUTER**

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

(71) Applicant: **LENOVO (SINGAPORE) PTE. LTD.,**
SINGAPORE (SG)

CPC **H01Q 9/42** (2013.01); **H01Q 5/378**
(2015.01); **H01Q 5/35** (2015.01)

(72) Inventor: **SUNGGYOO LEE, MACHIDA-SHI**
(JP)

(57) **ABSTRACT**

(21) Appl. No.: **16/126,833**

(22) Filed: **Sep. 10, 2018**

Related U.S. Application Data

(63) Continuation of application No. 13/468,452, filed on
May 10, 2012, now abandoned.

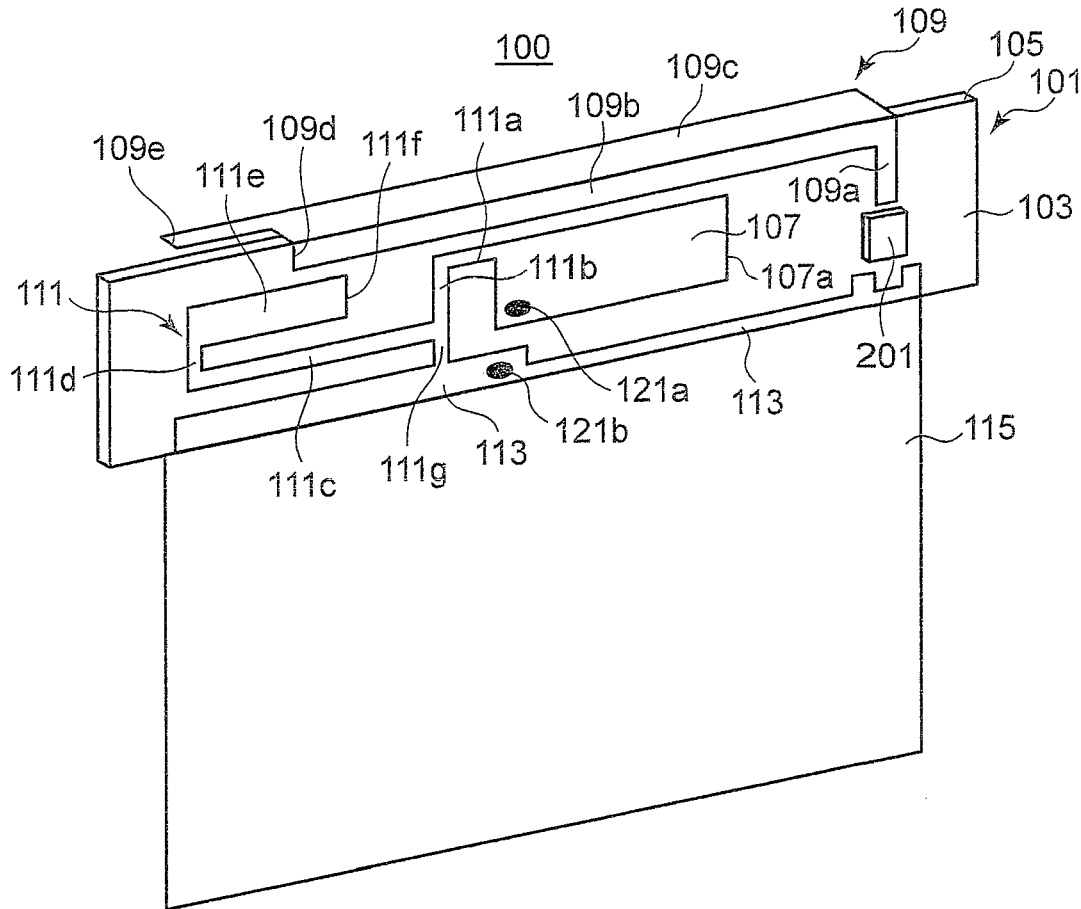
Foreign Application Priority Data

May 24, 2011 (JP) 2011-116272

Publication Classification

(51) **Int. Cl.**
H01Q 9/42 (2006.01)
H01Q 5/35 (2006.01)
H01Q 5/378 (2006.01)

An antenna for a portable computer is disclosed. The antenna includes a ground element, a first and second radiating elements, and a driven element. The ground element is linearly extended on a surface of a circuit substrate. The first radiating element, which is adapted to a first frequency band, includes a horizontal-portion pattern extending substantially parallel to the ground element on the surface of the circuit substrate. The driven element, which is provided on the surface of the circuit substrate between the ground element and the horizontal-portion pattern, supplies electromagnetic-wave energy to the first radiating element. The second radiating element is provided on the surface of the circuit substrate between the ground element and the horizontal-portion pattern. The second radiating has contact with the driven element, and is adapted to a second frequency band and a third frequency band that is higher than the second frequency band.





US 20190006763A1

(19) **United States**

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

(10) **Pub. No.: US 2019/0006763 A1**

(43) **Pub. Date: Jan. 3, 2019**

(54) **SLOT ANTENNA AND ELECTRONIC DEVICE**

Publication Classification

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

(51) **Int. Cl.**
H01Q 13/10 (2006.01)
H01Q 1/38 (2006.01)
H01Q 21/06 (2006.01)

(72) Inventors: **Hanyang WANG**, Reading (GB);
Jianming LI, Beijing (CN); **Xuefei ZHANG**, Shenzhen (CN); **Chi LIU**, Shenzhen (CN)

(52) **U.S. Cl.**
CPC *H01Q 13/10* (2013.01); *H01Q 21/064* (2013.01); *H01Q 1/38* (2013.01)

(73) Assignee: **HUAWEI TECHNOLOGIES CO., LTD.**, Shenzhen (CN)

(57) **ABSTRACT**

(21) Appl. No.: **15/576,723**

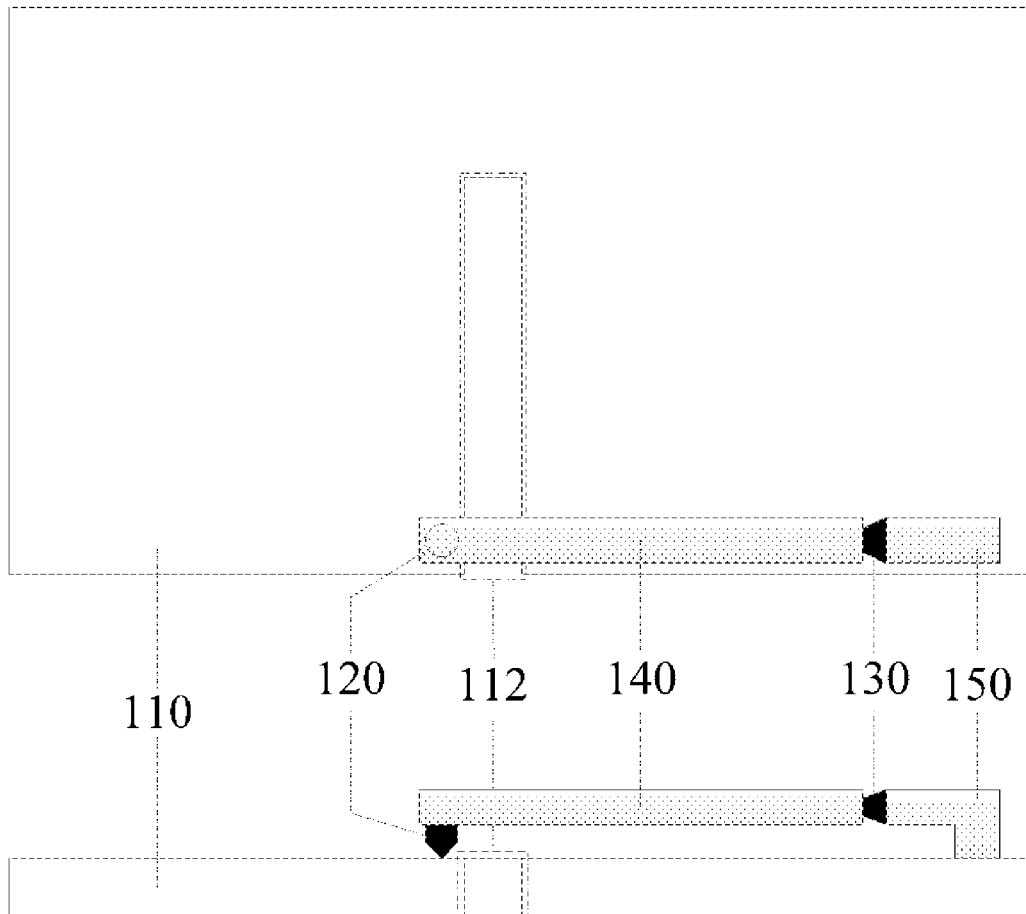
A slot antenna includes: a printed circuit board having a slot, a first capacitor, a radio frequency signal source, a transmission line, and a ground cable. The printed circuit board is grounded; one end of the slot is open, and the other end is closed; the first capacitor and the ground cable are disposed on the printed circuit board, the first capacitor is located on the open end of the slot, and is disposed on one side of the slot; the first capacitor is connected to the radio frequency signal source by using the transmission line, and the radio frequency signal source connects the transmission line to the ground cable; and the radio frequency signal source is configured to: stimulate a feeding signal, and feed the feeding signal to the open end of the slot by using the first capacitor.

(22) PCT Filed: **May 28, 2015**

(86) PCT No.: **PCT/CN2015/080123**

§ 371 (c)(1),

(2) Date: **Nov. 24, 2017**





US 20190006764A1

(19) **United States**

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

(10) **Pub. No.: US 2019/0006764 A1**

(43) **Pub. Date: Jan. 3, 2019**

(54) **MOBILE DEVICE**

Publication Classification

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

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

(72) Inventors: **Ming-Ching YEN**, New Taipei City (TW); **Kun-Sheng CHANG**, New Taipei City (TW); **Chien-Wen CHEN**, New Taipei City (TW); **Ching-Chi LIN**, New Taipei City (TW)

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

(57) **ABSTRACT**

A mobile device includes a metal mechanism element, a ground plane, a feeding element, a parasitic element, and a dielectric substrate. The metal mechanism element has a slot. The ground plane is coupled to the metal mechanism element. The feeding element is coupled to a signal source. The feeding element extends across the slot. The parasitic element is coupled to the ground plane. The parasitic element extends across the slot. The ground plane, the feeding element, and the parasitic element are disposed on the dielectric substrate. An antenna structure is formed by the feeding element, the parasitic element, and the slot of the metal mechanism element.

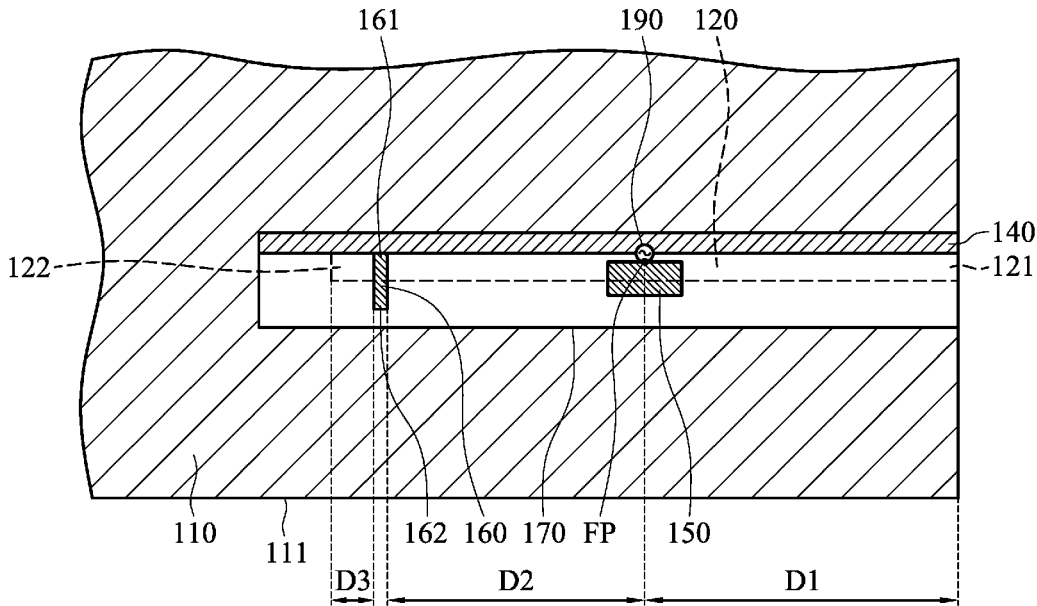
(21) Appl. No.: **15/886,026**

(22) Filed: **Feb. 1, 2018**

(30) **Foreign Application Priority Data**

Jun. 30, 2017 (TW) 106121976

100





US 20190006766A1

(19) **United States**

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

(10) **Pub. No.: US 2019/0006766 A1**

(43) **Pub. Date: Jan. 3, 2019**

(54) **COMPACT SLOT-TYPE ANTENNA**

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

CPC **H01Q 13/106** (2013.01); **H01Q 13/08** (2013.01)

(71) Applicants: **Misao HANEISHI**, Saitama-shi, Saitama (JP); **SEIKO SOLUTIONS INC.**, Chiba-shi, Chiba (JP); **CHIKOUJI GAKUEN EDUCATIONAL FOUNDATION**, Fukaya-shi, Saitama (JP)

(57) **ABSTRACT**

(72) Inventors: **Yoshiyuki YONEI**, Chiba-shi, Chiba (JP); **Masahiro SOBU**, Chiba-shi, Chiba (JP); **Akinori MATSUI**, Fukaya-shi, Saitama (JP); **Misao HANEISHI**, Saitama-shi, Saitama (JP)

The purpose of the present invention is to further reduce the size of a compact slot-type antenna in which a slot and a stripline are electromagnetically coupled. In a compact slot-type antenna 20, a stripline 40 is used rather than an electrical connection to perform electromagnetically coupled power feeding for feeding electric power by electromagnetic coupling. The stripline 40 is configured from a first line section 41 extending in the longitudinal direction of the slot 21, and a second line section 42 extending in an orthogonal direction, the second line section 42 being connected to the first line section 41, and the first line section 41 being arranged inside the projection region of the slot 21. One end side of the second line section 42 is connected to the first line section 41, and the other end side is connected to a high-frequency circuit. A compact slot-type antenna can be devised because the first line section 41, which is the tip portion of the stripline 40, is arranged inside the slot 21. Also, the antenna can be made even smaller at the same frequency on the basis of the new finding that forming a slit 22 that extends from the slot 21 to the side of a metal substrate 11 reduces the resonance frequency f.

(21) Appl. No.: **15/512,734**

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

(86) PCT No.: **PCT/JP2015/069440**

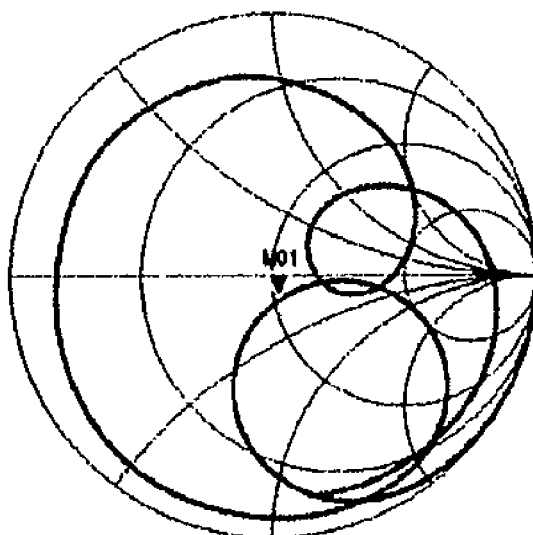
§ 371 (c)(1),
(2) Date: **Mar. 20, 2017**

(30) **Foreign Application Priority Data**

Sep. 22, 2014 (JP) 2014-192480

Publication Classification

(51) **Int. Cl.**
H01Q 13/10 (2006.01)
H01Q 13/08 (2006.01)



M01 : S(1,1)
Freq 2.400G Hz
Z = 61.910 - j 9.503 Ohm

Freq(0.1GHz to 10.0GHz)

SMITH CHART CHARACTERISTIC



US 20190007085A1

(19) **United States**

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

(10) **Pub. No.: US 2019/0007085 A1**

(43) **Pub. Date: Jan. 3, 2019**

(54) **MOBILE TERMINAL**

Publication Classification

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

(51) **Int. Cl.**

<i>H04B 1/3888</i>	(2015.01)
<i>H04M 1/18</i>	(2006.01)
<i>H04M 1/02</i>	(2006.01)
<i>H01Q 1/24</i>	(2006.01)
<i>H01Q 1/44</i>	(2006.01)
<i>H01Q 5/30</i>	(2015.01)
<i>G06F 1/20</i>	(2006.01)
<i>G06F 1/16</i>	(2006.01)
<i>H04B 1/38</i>	(2015.01)

(72) Inventors: **Yeomin YOUN**, Seoul (KR); **Jaehyun CHOI**, Seoul (KR); **Jungsun AHN**, Seoul (KR); **Changil KIM**, Seoul (KR); **Kangjae JUNG**, Seoul (KR)

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

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

CPC *H04B 1/3888* (2013.01); *H04M 1/18* (2013.01); *H04M 1/0249* (2013.01); *H04M 1/0202* (2013.01); *H01Q 1/243* (2013.01); *H04B 2001/3894* (2013.01); *H01Q 5/30* (2015.01); *G06F 1/203* (2013.01); *G06F 1/1698* (2013.01); *G06F 1/1656* (2013.01); *G06F 1/1626* (2013.01); *H01Q 1/44* (2013.01)

(21) Appl. No.: **16/122,600**

(22) Filed: **Sep. 5, 2018**

Related U.S. Application Data

(63) Continuation of application No. 15/961,227, filed on Apr. 24, 2018, now Pat. No. 10,122,401, which is a continuation of application No. 15/783,873, filed on Oct. 13, 2017, now Pat. No. 9,985,679, which is a continuation of application No. 15/498,210, filed on Apr. 26, 2017, now Pat. No. 9,819,383, which is a continuation of application No. 14/480,149, filed on Sep. 8, 2014, now Pat. No. 9,680,206.

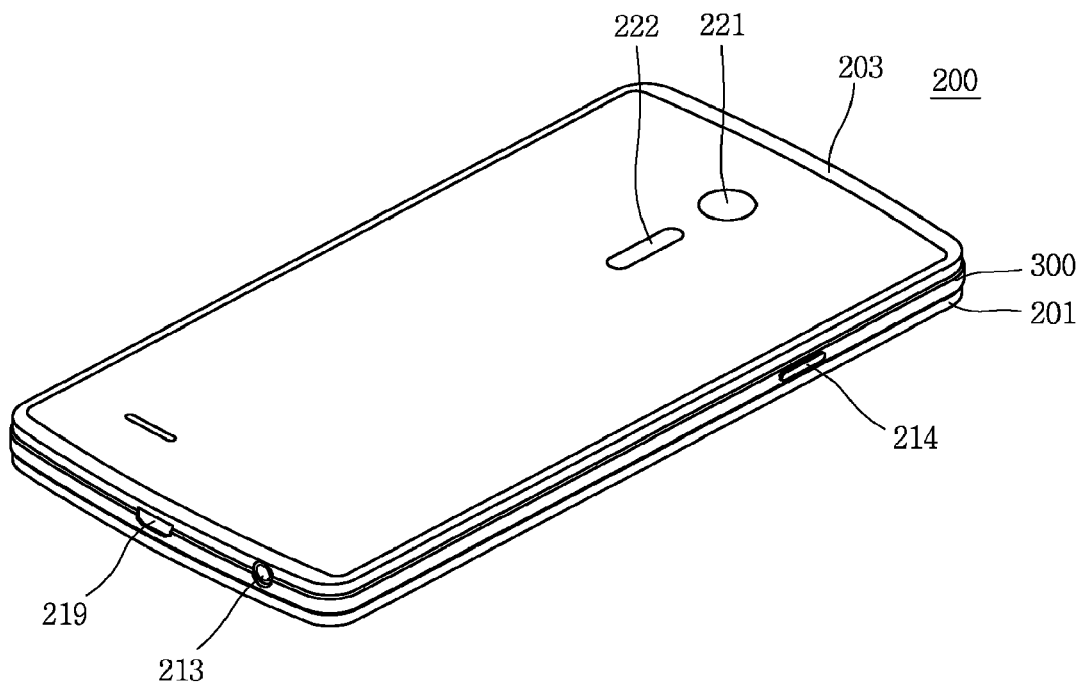
Foreign Application Priority Data

Dec. 3, 2013 (KR) 10-2013-0149413

(57)

ABSTRACT

A mobile terminal includes a metal frame including a base portion and an edge portion formed along the outer edge of the base portion, first and second cases bonded to the front and back sides of the metal frame so as to expose the edge portion to the outside, first and second waterproof layers formed between the cases and the metal frame, conductive members that operate a radiator for antennas, together with the edge portion, and are formed on one side of the second case, and feeding portions for feeding the conductive members, the feeding portions being disposed in an enclosed space formed by the waterproof layers.





US 20190007533A1

(19) **United States**

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

(10) **Pub. No.: US 2019/0007533 A1**

(43) **Pub. Date: Jan. 3, 2019**

(54) **ELECTRONIC DEVICE WITH METAL FRAME ANTENNA**

H01Q 9/30 (2006.01)

H01Q 5/385 (2015.01)

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

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

CPC *H04M 1/0218* (2013.01); *H01Q 1/243*
(2013.01); *H01Q 9/30* (2013.01); *H04M*
1/0214 (2013.01); *H01Q 5/385* (2015.01);
H04M 1/0235 (2013.01); *H04M 1/0268*
(2013.01); *H04M 1/026* (2013.01)

(72) Inventors: **Jaehyung KIM**, Gyeonggi-do (KR);
Jinkyu Bang, Gyeonggi-do (KR); **Jinu Kim**,
Seoul (KR); **Donghwan Kim**, Gyeonggi-do (KR);
Taegyu Kim, Gyeonggi-do (KR); **Kiyong Chang**,
Seoul (KR)

(57) **ABSTRACT**

(21) Appl. No.: **16/126,534**

(22) Filed: **Sep. 10, 2018**

Related U.S. Application Data

(63) Continuation of application No. 15/351,161, filed on
Nov. 14, 2016, now Pat. No. 10,075,569.

Foreign Application Priority Data

Nov. 13, 2015 (KR) 10-2015-0159787

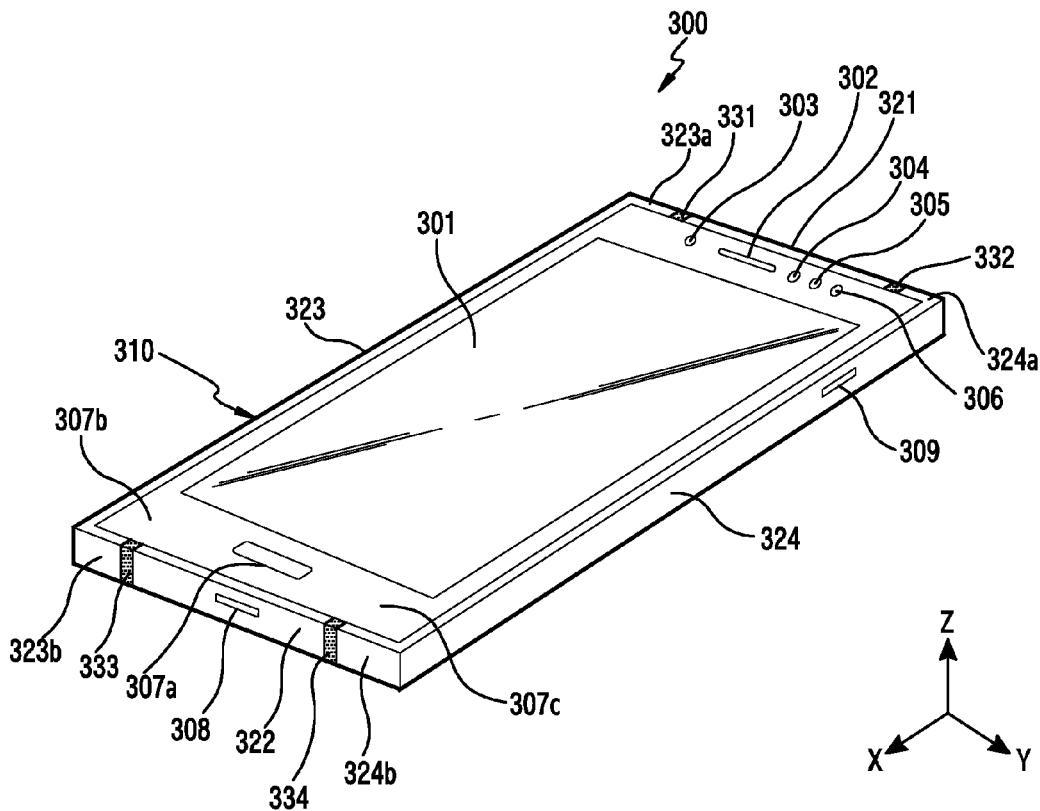
Publication Classification

(51) **Int. Cl.**

H04M 1/02 (2006.01)

H01Q 1/24 (2006.01)

An electronic device is provided. The electronic device includes a housing and a connection part. The housing includes a first housing portion that includes a first side face, and a second housing portion that includes a second side face. The connection part connects the first housing portion and the second housing portion. A first conductive member extends along at least a portion of the first side face, a first non-conductive member is disposed on the first side face, a second conductive member extends along at least a portion of the second side face, a second non-conductive member is disposed on the second side face, and when the second housing portion faces the first housing portion, the first non-conductive member and the second non-conductive member are substantially aligned.





US 20190013570A1

(19) **United States**

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

(10) **Pub. No.: US 2019/0013570 A1**

(43) **Pub. Date: Jan. 10, 2019**

(54) **ANTENNA SYSTEM WITH ANTENNA SWAPPING AND ANTENNA TUNING**

H04B 1/401 (2015.01)

H01Q 9/04 (2006.01)

H01Q 7/00 (2006.01)

H01Q 21/28 (2006.01)

H01Q 9/42 (2006.01)

H04B 7/06 (2006.01)

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

(72) Inventors: **Ruben Caballero**, San Jose, CA (US); **Mattia Pascolini**, San Francisco, CA (US); **Mohit Narang**, Cupertino, CA (US); **Matt A. Mow**, Los Altos, CA (US); **Robert W. Schlub**, Cupertino, CA (US)

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

CPC **H01Q 1/243** (2013.01); **H04M 1/0202**

(2013.01); **H04B 1/401** (2013.01); **H01Q**

9/0421 (2013.01); **H04B 7/0689** (2013.01);

H01Q 21/28 (2013.01); **H01Q 9/42** (2013.01);

H04B 7/0602 (2013.01); **H01Q 7/00** (2013.01)

(21) Appl. No.: **16/030,726**

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

Related U.S. Application Data

(63) Continuation of application No. 15/795,810, filed on Oct. 27, 2017, now Pat. No. 10,020,563, which is a continuation of application No. 14/608,048, filed on Jan. 28, 2015, now Pat. No. 9,806,401, which is a continuation of application No. 12/941,011, filed on Nov. 5, 2010, now Pat. No. 8,947,302.

Publication Classification

(51) **Int. Cl.**

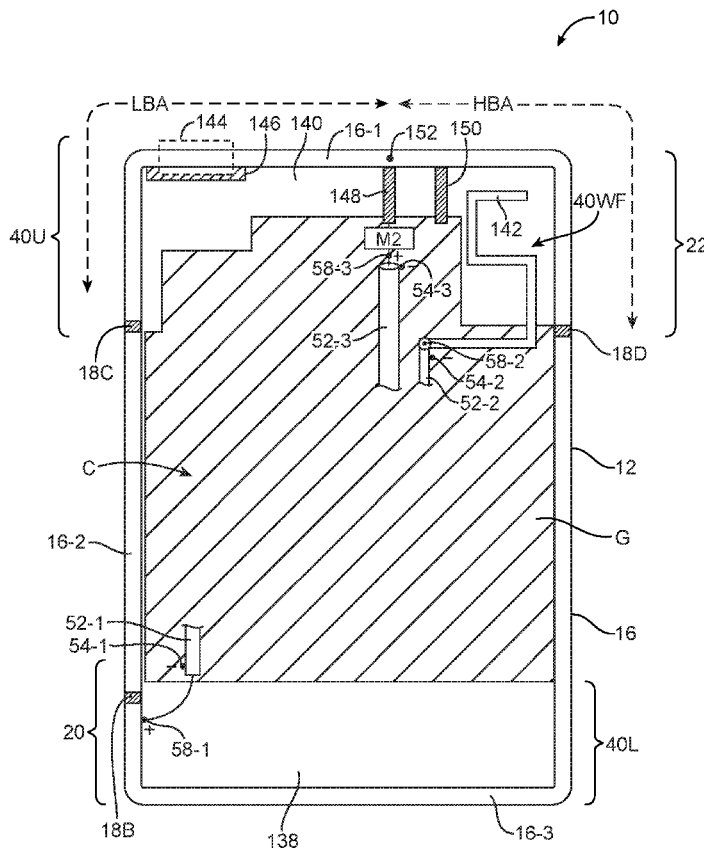
H01Q 1/24 (2006.01)

H04M 1/02 (2006.01)

(57)

ABSTRACT

Electronic devices may be provided that contain wireless communications circuitry. The wireless communications circuitry may include radio-frequency transceiver circuitry and first and second antennas. An electronic device may include a housing. The first antenna may be located at an upper end of the housing and the second antenna may be located at a lower end of the housing. A peripheral conductive member may run around the edges of the housing and may be used in forming the first and second antennas. The radio-frequency transceiver circuitry may have a transmit-receive port and a receive port. Switching circuitry may connect the first antenna to the transmit-receive port and the second antenna to the receiver port or may connect the first antenna to the receiver port and the second antenna to the transmit-receive port.





US 20190013584A1

(19) **United States**

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

(10) **Pub. No.: US 2019/0013584 A1**

(43) **Pub. Date: Jan. 10, 2019**

(54) **ELECTRONIC DEVICE**

H01Q 1/22 (2006.01)

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

H01Q 21/00 (2006.01)

H01Q 3/26 (2006.01)

(72) Inventors: **Seungwoo RYU**, Seoul (KR); **Joohee LEE**, Seoul (KR); **Wonwoo LEE**, Seoul (KR); **Junyoung JUNG**, Seoul (KR); **Ansun HYUN**, Seoul (KR)

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

CPC *H01Q 5/35* (2015.01); *H01Q 1/243* (2013.01); *H01Q 3/26* (2013.01); *H01Q 21/0006* (2013.01); *H01Q 1/2283* (2013.01)

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

(57) **ABSTRACT**

(21) Appl. No.: **15/878,270**

(22) Filed: **Jan. 23, 2018**

(30) **Foreign Application Priority Data**

Jul. 5, 2017 (KR) 10-2017-0085553

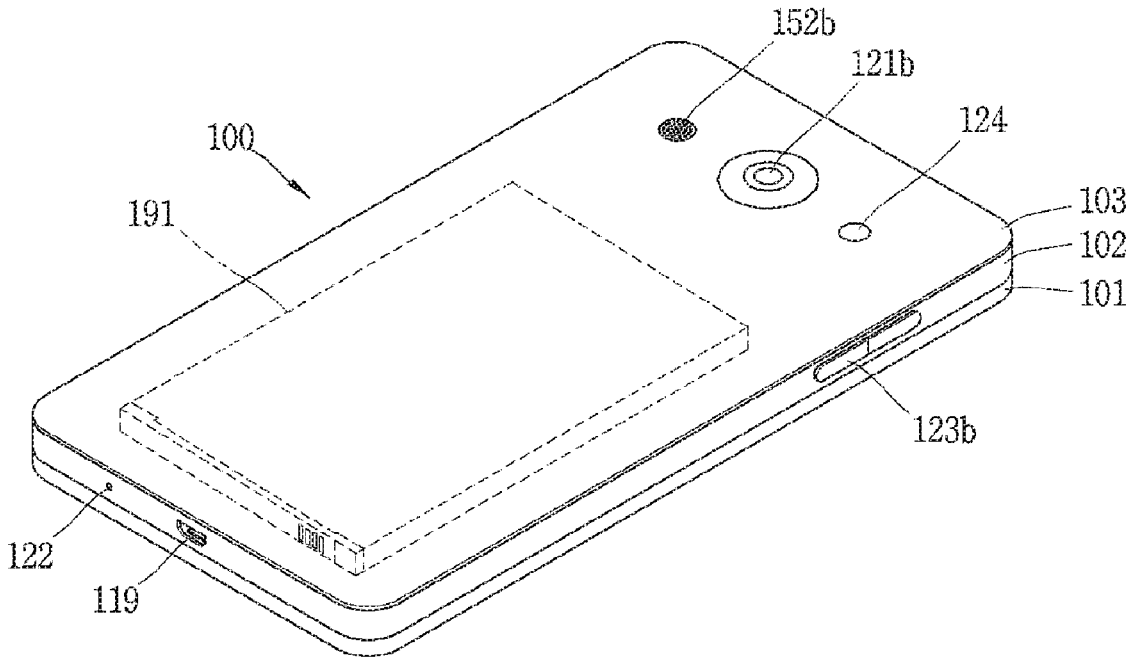
Publication Classification

(51) **Int. Cl.**

H01Q 5/35 (2006.01)

H01Q 1/24 (2006.01)

An electronic device includes: a body; a circuit board disposed in the body; and an antenna device mounted to one region of the body, and having first and second antenna units spaced apart from each other by a specific interval, in order to transceive a radio signal at a specific frequency band, wherein each of the first and second antenna units includes: a dielectric substance disposed to form a gap with the circuit board; an antenna chip disposed at the circuit board; and a pair of feeding portions for connecting the antenna chip with the dielectric substance.





US 20190013586A1

(19) **United States**

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

(10) **Pub. No.: US 2019/0013586 A1**

(43) **Pub. Date: Jan. 10, 2019**

(54) **DIPOLE ANTENNA**

H01Q 5/20 (2006.01)

H01Q 5/342 (2006.01)

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

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

CPC *H01Q 9/065* (2013.01); *H01Q 1/241* (2013.01); *H01Q 5/342* (2015.01); *H01Q 1/36* (2013.01); *H01Q 5/20* (2015.01); *H01Q 9/0407* (2013.01)

(72) Inventors: **Chih-Yung HUANG**, Taichung County (TW); **Kuo-Chang LO**, Miaoli County (TW)

(21) Appl. No.: **15/697,931**

(57) **ABSTRACT**

(22) Filed: **Sep. 7, 2017**

A dipole antenna includes a substrate, a first region and a second region, which is used for frequency with wavelength λ . The substrate is flat rectangular and insulating material, which has a substrate width W which is at least 2.5 mm and a substrate length L . The substrate width W , the substrate length L and the wavelength λ complies with the formula: $L/W = \lambda(\pm 10\%)$. The first region and the second region is conducting material, the first region is disposed on the substrate and shifting to one side of the substrate, the second region is disposed on the substrate and shifting to another side of the substrate. Part of the first region is disposed adjacent to part of the second region and an adjacent region is formed between and a coupling effect is reduced.

(30) **Foreign Application Priority Data**

Jul. 4, 2017 (TW) 106122431

Publication Classification

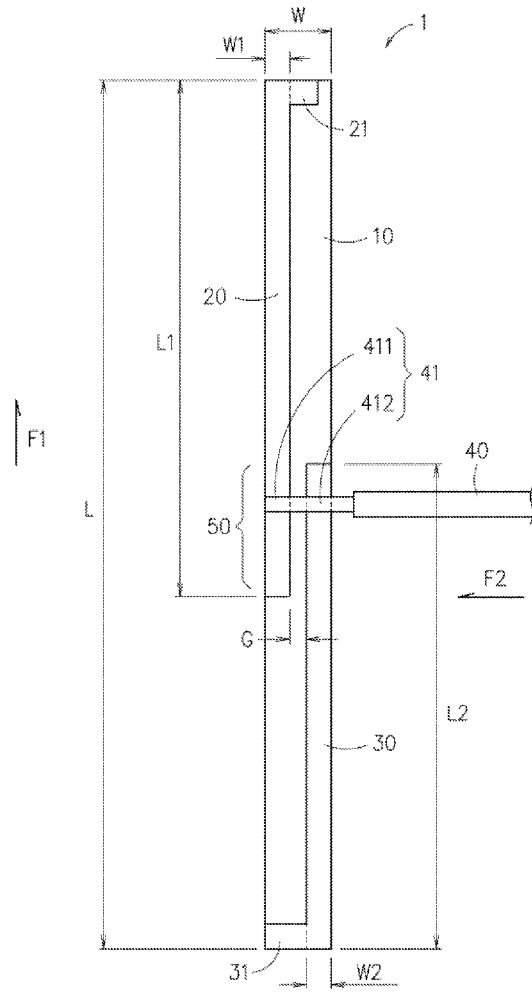
(51) **Int. Cl.**

H01Q 9/06 (2006.01)

H01Q 1/24 (2006.01)

H01Q 9/04 (2006.01)

H01Q 1/36 (2006.01)





US 20190013588A1

(19) **United States**

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

(10) **Pub. No.: US 2019/0013588 A1**

(43) **Pub. Date: Jan. 10, 2019**

(54) **SLOT ANTENNA AND TERMINAL**

Publication Classification

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

(51) **Int. Cl.**
H01Q 13/08 (2006.01)
H01Q 1/48 (2006.01)
H01Q 1/24 (2006.01)

(72) Inventors: **Chih-Hua CHANG**, Taipei (TW);
CHIEN-MING LEE, Shanghai (CN);
Hanyang WANG, Reading (GB);
Yen-Cheng LAI, Taipei (TW); **Yu Chan YANG**, Taipei (TW)

(52) **U.S. Cl.**
CPC **H01Q 13/08** (2013.01); **H01Q 1/243** (2013.01); **H01Q 1/48** (2013.01)

(73) Assignee: **HUAWEI TECHNOLOGIES CO., LTD.**, Shenzhen (CN)

(57) **ABSTRACT**

(21) Appl. No.: **16/065,813**

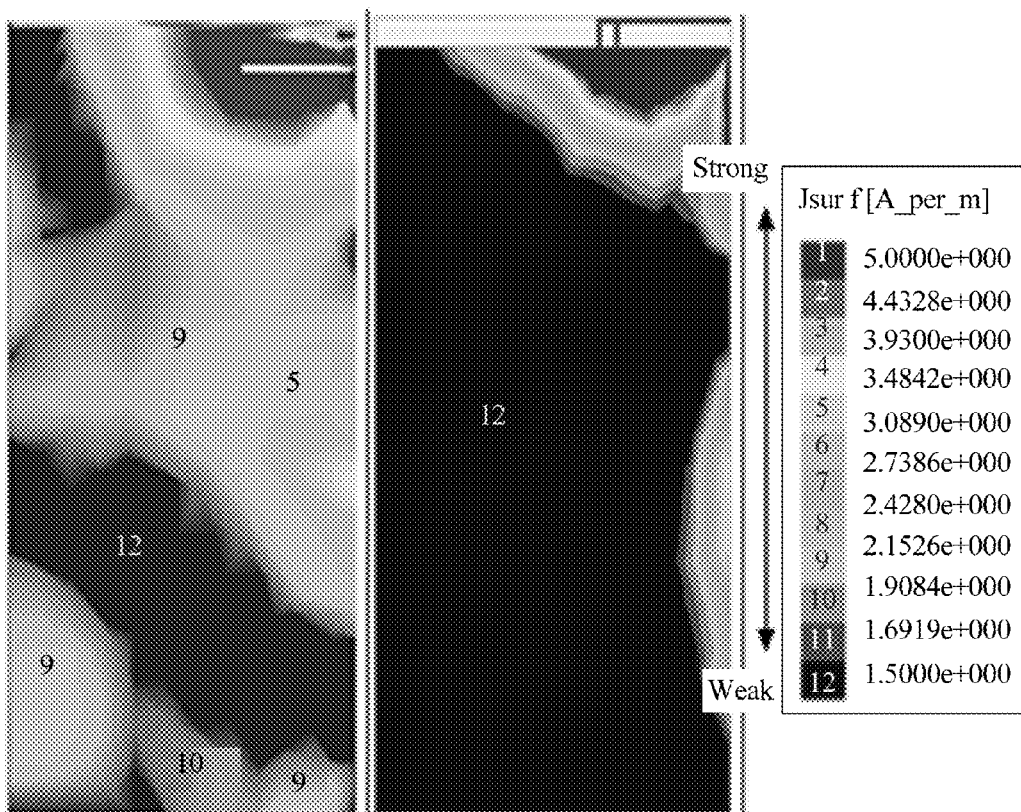
This application discloses a slot antenna and a terminal. The slot antenna includes a ground plane, an open slot disposed on the ground plane, a slot feeder, and a resonant circuit. The resonant circuit effectively excites a current on a surface of the ground plane, so that the ground plane becomes a primary radiator, and the antenna is a secondary radiator. Therefore, a volume of the antenna can be reduced without affecting radiation efficiency of the antenna.

(22) PCT Filed: **Dec. 24, 2015**

(86) PCT No.: **PCT/CN2015/098689**

§ 371 (c)(1),

(2) Date: **Jun. 24, 2018**





US 20190020098A1

(19) **United States**

(12) **Patent Application Publication**
Hu

(10) **Pub. No.: US 2019/0020098 A1**

(43) **Pub. Date: Jan. 17, 2019**

(54) **ANTENNA STRUCTURE**

H01Q 1/38 (2006.01)

H01Q 13/20 (2006.01)

H01Q 5/25 (2006.01)

(71) Applicant: **Wistron Corp.**, New Taipei City (TW)

(72) Inventor: **Pei-Cheng Hu**, New Taipei City (TW)

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

CPC *H01Q 1/243* (2013.01); *H01Q 1/48* (2013.01); *H01Q 5/25* (2015.01); *H01Q 13/20* (2013.01); *H01Q 1/38* (2013.01)

(21) Appl. No.: **15/716,254**

(22) Filed: **Sep. 26, 2017**

(30) **Foreign Application Priority Data**

(57) **ABSTRACT**

Jul. 14, 2017 (TW) 106123620

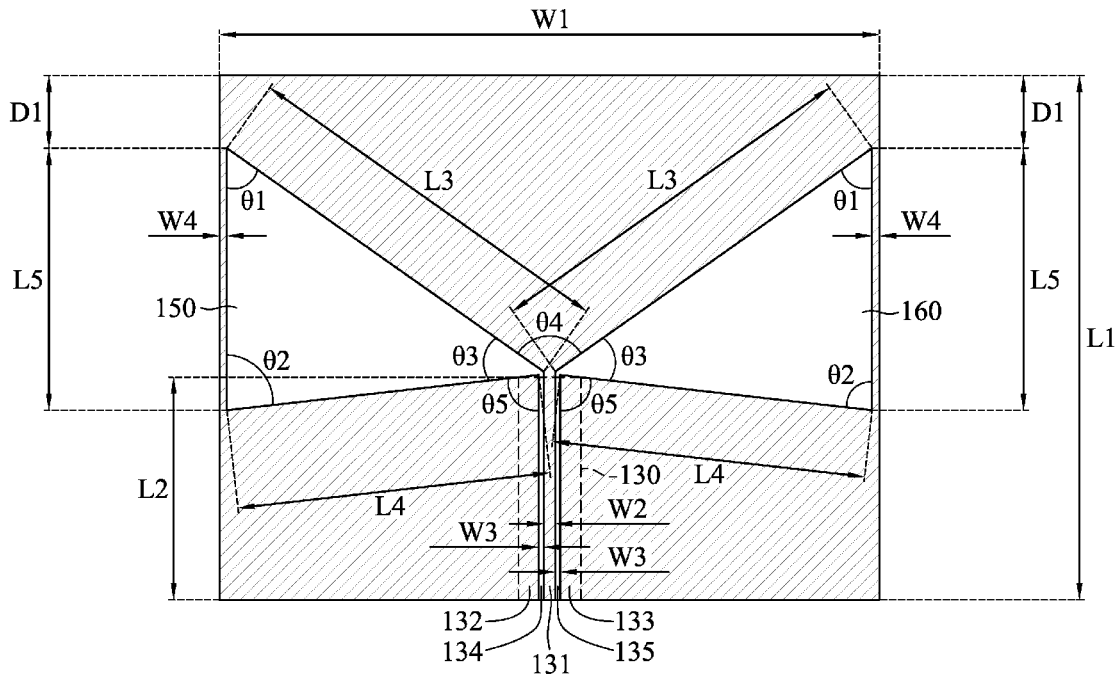
An antenna structure includes a dielectric substrate and a metal element. The metal element is disposed on the dielectric substrate, and includes a transmission element and a radiation element. A first triangular hollow region and a second triangular hollow region are formed on the radiation element.

Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 1/48 (2006.01)





(19) **United States**

(12) **Patent Application Publication**

Paulotto et al.

(10) **Pub. No.: US 2019/0020110 A1**

(43) **Pub. Date: Jan. 17, 2019**

(54) **MULTI-BAND MILLIMETER WAVE PATCH ANTENNAS**

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

CPC **H01Q 5/20** (2015.01); **H01Q 5/35** (2015.01); **H01Q 5/392** (2015.01); **H01Q 19/005** (2013.01); **H01Q 9/0414** (2013.01); **H01Q 21/065** (2013.01); **H01Q 5/42** (2015.01)

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

(72) Inventors: **Simone Paulotto**, Redwood City, CA (US); **Basim H. Noori**, San Jose, CA (US); **Matthew A. Mow**, Los Altos, CA (US)

(57)

ABSTRACT

An electronic device may be provided with wireless circuitry including first and second patch antennas. The first patch antenna may include a first resonating element formed over a ground plane. The second patch antenna may include a second resonating element over the first resonating element. A cross-shaped parasitic element may be formed over the second resonating element. First and second feed terminals may be coupled to the second resonating element. An opening may be formed in the first resonating element. First and second transmission lines may be coupled to the first and second feed terminals through the opening. The cross-shaped parasitic element may include arms that overlap the first and second feed terminals. The first resonating element may cover first frequencies between 10 GHz and 300 GHz and the second resonating element may cover second frequencies that are higher than the first frequencies.

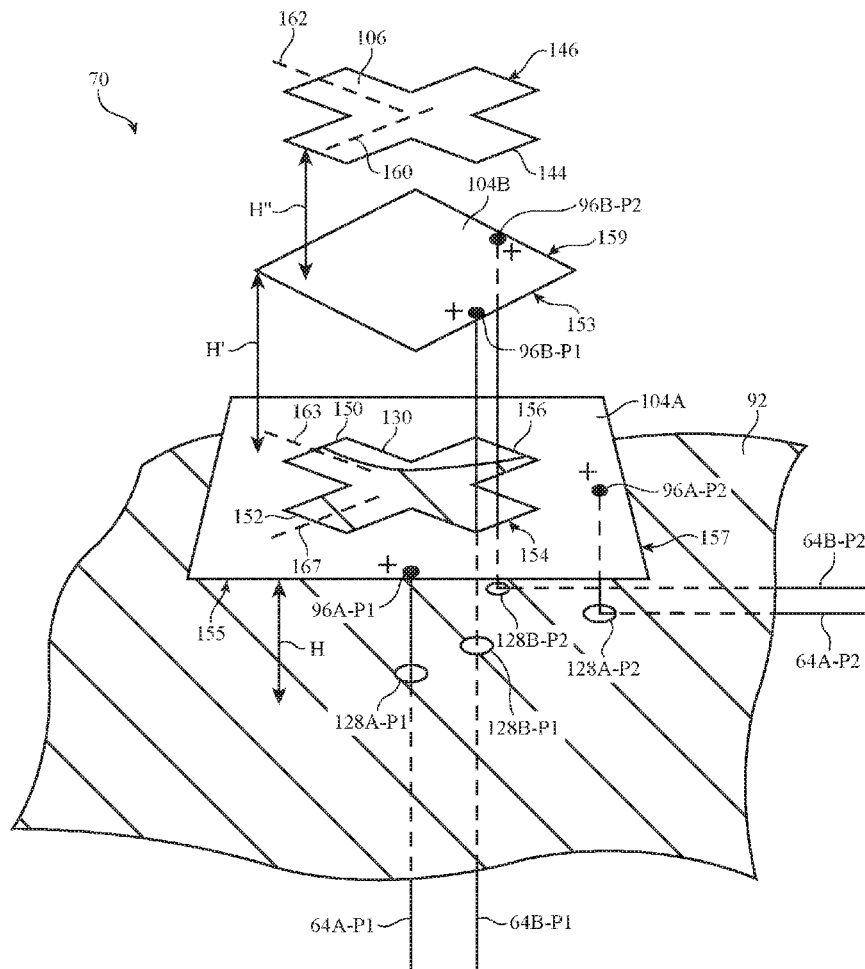
(21) Appl. No.: **15/650,627**

(22) Filed: **Jul. 14, 2017**

Publication Classification

(51) **Int. Cl.**

- H01Q 5/20** (2006.01)
- H01Q 5/35** (2006.01)
- H01Q 5/392** (2006.01)
- H01Q 5/42** (2006.01)
- H01Q 9/04** (2006.01)
- H01Q 21/06** (2006.01)
- H01Q 19/00** (2006.01)





(19) **United States**

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

(10) **Pub. No.: US 2019/0020111 A1**

(43) **Pub. Date: Jan. 17, 2019**

(54) **ANTENNA STRUCTURE**

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

(71) Applicant: **WISTRON NEWEB CORPORATION, HSINCHU (TW)**

CPC **H01Q 5/335** (2015.01); **H01Q 9/0421** (2013.01); **H01Q 1/48** (2013.01); **H01Q 1/242** (2013.01); **H01Q 9/16** (2013.01)

(72) Inventors: **SHIH-HSIEN TSENG, HSINCHU (TW); CHIA-HAO CHANG, HSINCHU (TW)**

(57) **ABSTRACT**

(21) Appl. No.: **15/863,602**

(22) Filed: **Jan. 5, 2018**

(30) **Foreign Application Priority Data**

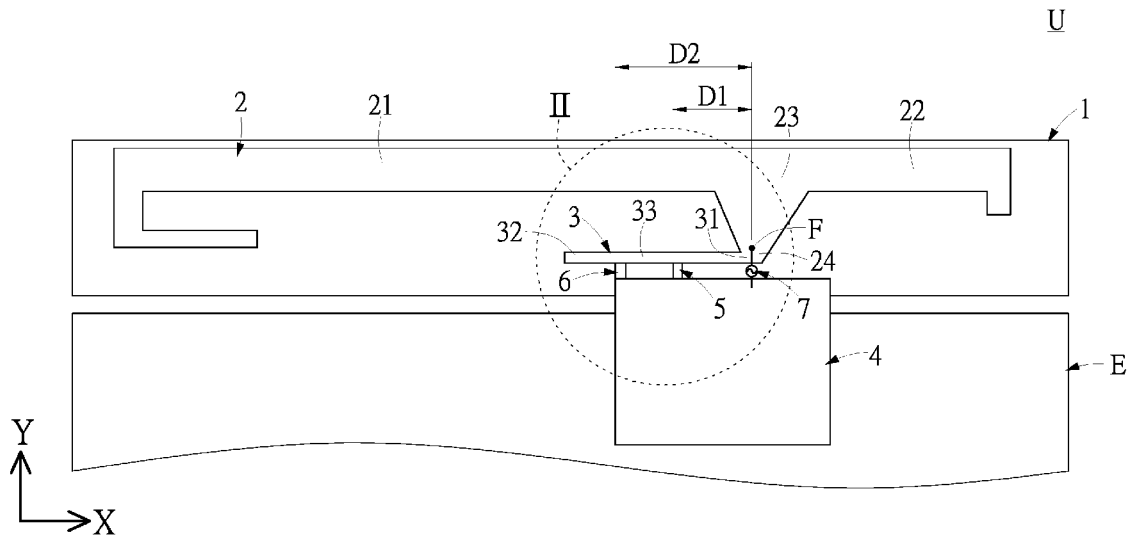
Jul. 17, 2017 (TW) 106123810

An antenna structure includes a substrate, a radiation element, a conducting element, a grounding element, a first inductor, a second inductor, and a feeding element. The radiation element is disposed on the substrate. The radiation element includes a first radiation portion, a second radiation portion, a third radiation portion, and a feeding portion connected between the first radiation portion, the second radiation portion, and the third radiation portion. The conducting element is disposed on the substrate. The conducting element connects with the feeding portion. The grounding element and the feeding portion are separated from each other. The first inductor is disposed on the substrate, and coupled between the conducting element and the grounding element. The second inductor is disposed on the substrate, and coupled between the conducting element and the grounding element.

Publication Classification

(51) **Int. Cl.**

H01Q 5/335 (2006.01)
H01Q 9/04 (2006.01)
H01Q 9/16 (2006.01)
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)





(19) **United States**

(12) **Patent Application Publication**

Paulotto et al.

(10) **Pub. No.: US 2019/0020114 A1**

(43) **Pub. Date: Jan. 17, 2019**

(54) **MILLIMETER WAVE PATCH ANTENNAS**

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

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

CPC **H01Q 9/0442** (2013.01); **H01Q 5/378** (2015.01); **H01Q 9/40** (2013.01); **H01Q 5/40** (2015.01); **H01Q 1/521** (2013.01)

(72) Inventors: **Simone Paulotto**, Redwood City, CA (US); **Basim H. Noori**, San Jose, CA (US); **Matthew A. Mow**, Los Altos, CA (US)

(57) **ABSTRACT**

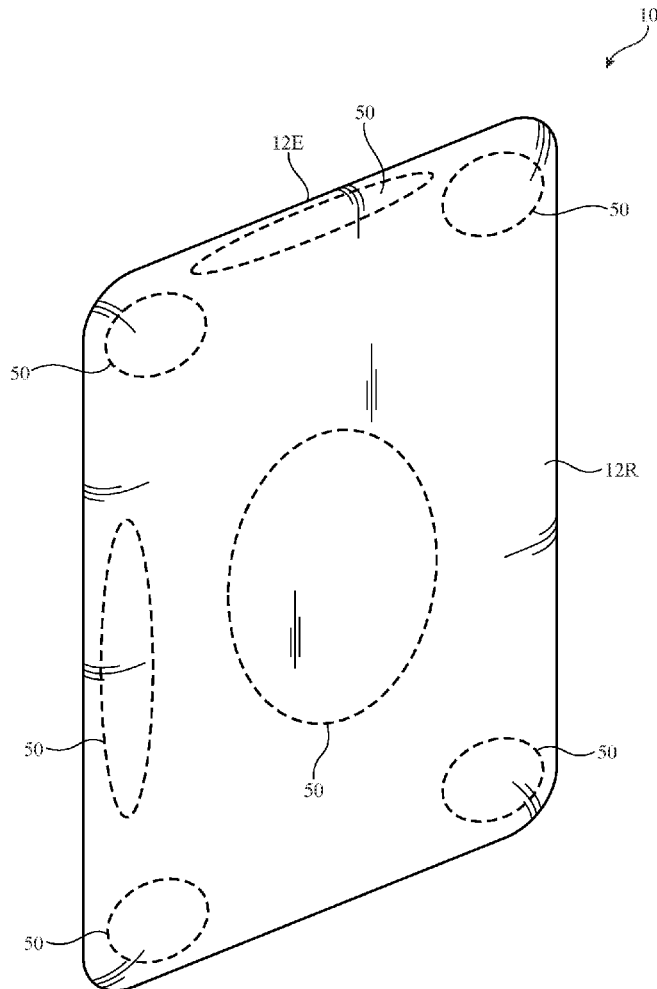
An electronic device may include a millimeter wave antenna having a ground plane, resonating element, feed, and parasitic element. The resonating element may include first, second, and third layer of traces that are shorted together. The second traces may be interposed between the first and third traces and the third traces may be interposed between the second traces and the parasitic. The third traces may have a width that is less than the widths of the second and third traces. The third traces and the parasitic may define a constrained volume having an associated cavity resonance that lies outside of a frequency band of interest. If desired, the resonating element may include a single layer of conductive traces having a grid of openings that disrupt impedance in a transverse direction, thereby mitigating the trapping of energy within the frequency band of interest between the resonating element and the parasitic.

(21) Appl. No.: **15/650,689**

(22) Filed: **Jul. 14, 2017**

Publication Classification

(51) **Int. Cl.**
H01Q 9/04 (2006.01)
H01Q 5/378 (2006.01)
H01Q 1/52 (2006.01)
H01Q 5/40 (2006.01)
H01Q 9/40 (2006.01)





(19) **United States**

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

(10) **Pub. No.: US 2019/0020365 A1**

(43) **Pub. Date: Jan. 17, 2019**

(54) **ELECTRONIC DEVICE WITH MILLIMETER WAVE ANTENNAS**

H04B 1/03 (2006.01)

H01Q 1/22 (2006.01)

H01Q 21/06 (2006.01)

H01Q 21/00 (2006.01)

H01Q 1/24 (2006.01)

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

CPC *H04B 1/04* (2013.01); *H01Q 21/28* (2013.01); *H04B 1/1081* (2013.01); *H04B 1/03* (2013.01); *H04B 2001/0408* (2013.01); *H01Q 21/065* (2013.01); *H01Q 21/0025* (2013.01); *H01Q 1/243* (2013.01); *H01Q 1/2266* (2013.01)

(21) Appl. No.: **16/138,881**

(57)

ABSTRACT

(22) Filed: **Sep. 21, 2018**

Related U.S. Application Data

(63) Continuation of application No. 15/499,745, filed on Apr. 27, 2017, now Pat. No. 10,084,490, which is a continuation of application No. 15/097,868, filed on Apr. 13, 2016, now Pat. No. 9,667,290.

(60) Provisional application No. 62/149,430, filed on Apr. 17, 2015.

An electronic device may be provided with wireless circuitry. The wireless circuitry may include one or more antennas. The antennas may include phased antenna arrays each of which includes multiple antenna elements. Phased antenna arrays may be mounted along edges of a housing for the electronic device, behind a dielectric window such as a dielectric logo window in the housing, in alignment with dielectric housing portions at corners of the housing, or elsewhere in the electronic device. A phased antenna array may include arrays of patch antenna elements on dielectric layers separated by a ground layer. A baseband processor may distribute wireless signals to the phased antenna arrays at intermediate frequencies over intermediate frequency signal paths. Transceiver circuits at the phased antenna arrays may include upconverters and downconverters coupled to the intermediate frequency signal paths.

Publication Classification

(51) **Int. Cl.**

H04B 1/04 (2006.01)

H01Q 21/28 (2006.01)

H04B 1/10 (2006.01)

