



US 20190190121A1

(19) **United States**(12) **Patent Application Publication**
Kai(10) **Pub. No.: US 2019/0190121 A1**(43) **Pub. Date: Jun. 20, 2019**(54) **ANTENNA APPARATUS AND DESIGN
PROGRAM FOR ANTENNA APPARATUS****Publication Classification**(71) Applicant: **FUJITSU LIMITED**, Kawasaki-shi
(JP)(72) Inventor: **Manabu Kai**, Yokohama (JP)(73) Assignee: **FUJITSU LIMITED**, Kawasaki-shi
(JP)(21) Appl. No.: **16/223,059**(22) Filed: **Dec. 17, 2018**(30) **Foreign Application Priority Data**

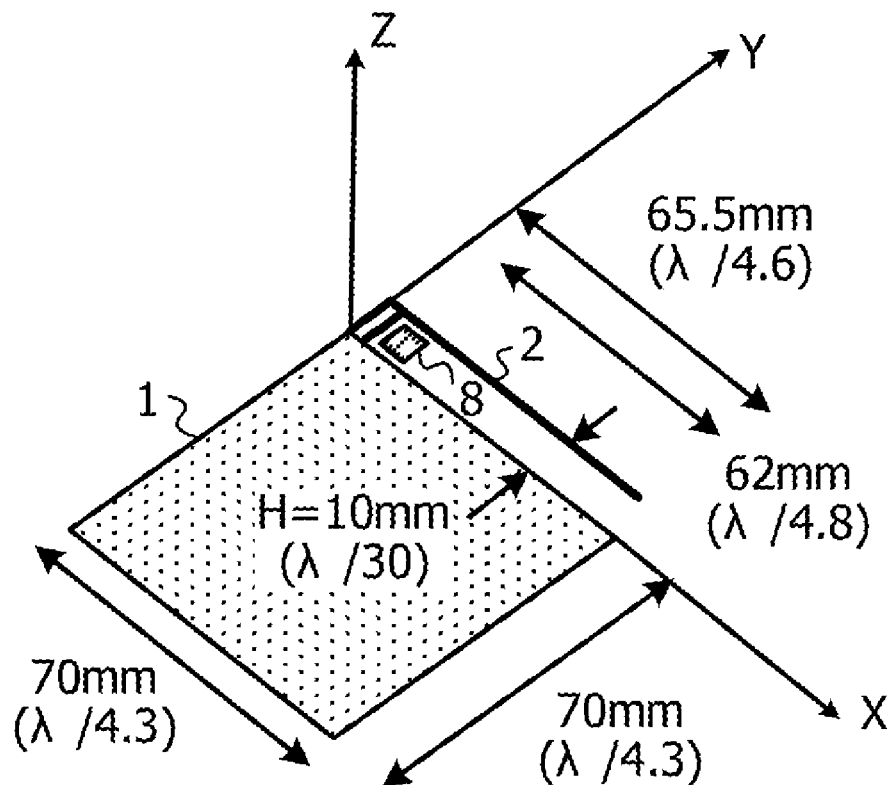
Dec. 20, 2017 (JP) 2017-243870

(51) **Int. Cl.****H01Q 1/24** (2006.01)**H01Q 9/04** (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/243** (2013.01); **H01Q 9/0421**
(2013.01)

(57)

ABSTRACT

An antenna apparatus includes a ground conductor, an antenna element including an antenna that is parallel to the ground conductor and that has a first end portion and a second end portion, a feed line that is coupled to the first end portion of the antenna and that feeds the antenna through the ground conductor, and a short-circuit line that is coupled to the first end portion of the antenna and that electrically short-circuits the antenna to the ground conductor, and a dummy conductor mounted between the first end portion or the second end portion of the antenna and the ground conductor.





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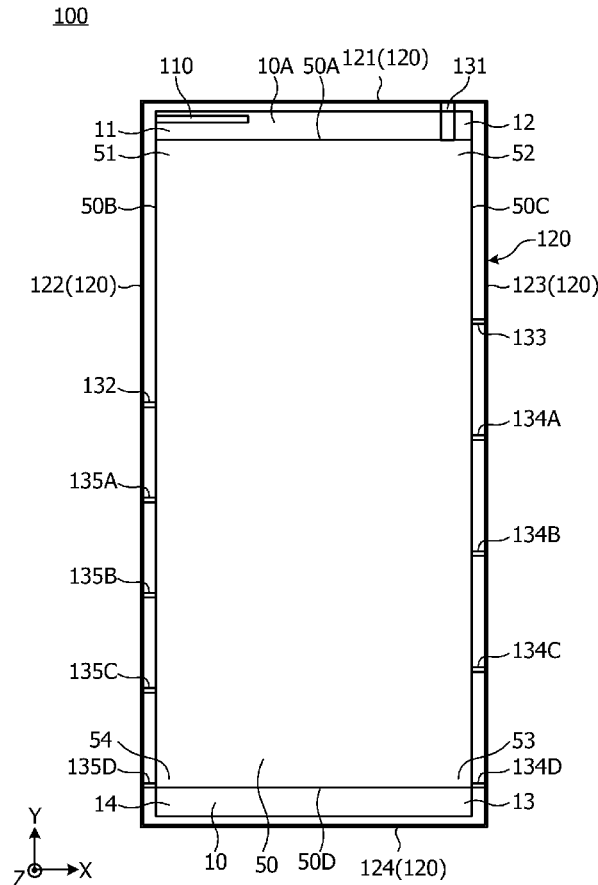
(19) **United States**(12) **Patent Application Publication**
KOGA et al.(10) **Pub. No.: US 2019/0190124 A1**(43) **Pub. Date: Jun. 20, 2019**(54) **ANTENNA DEVICE AND WIRELESS
COMMUNICATION DEVICE****Publication Classification**(51) **Int. Cl.***H01Q 1/24* (2006.01)*H01Q 5/10* (2006.01)*H01Q 5/371* (2006.01)*H01Q 7/00* (2006.01)*H01Q 5/378* (2006.01)*H01Q 9/04* (2006.01)(52) **U.S. Cl.**CPC *H01Q 1/243* (2013.01); *H01Q 5/10*(2015.01); *H01Q 9/04* (2013.01); *H01Q 7/00*(2013.01); *H01Q 5/378* (2015.01); *H01Q**5/371* (2015.01)(71) Applicant: **FUJITSU LIMITED**, Kawasaki-shi
(JP)(72) Inventors: **Yohei KOGA**, Kawasaki (JP); **Takashi
YAMAGAJO**, Yokosuka (JP); **Manabu
KAI**, Yokohama (JP); **Tabito
TONOOKA**, Kawasaki (JP)(73) Assignee: **FUJITSU LIMITED**, Kawasaki-shi
(JP)(21) Appl. No.: **16/286,419**(22) Filed: **Feb. 26, 2019****Related U.S. Application Data**(63) Continuation of application No. PCT/JP2018/
012696, filed on Mar. 28, 2018.(30) **Foreign Application Priority Data**

Jun. 15, 2017 (JP) 2017-118088

(57)

ABSTRACT

An antenna device includes: a ground plane which has an edge side; a metal member arranged along the edge side of the ground plane; a first connection line which couples the metal member and the ground plane; a second connection line which couples the metal member and the ground plane; and a power feeding element which has a power feeding point, extends along the metal member from the power feeding point between the first connection line and the second connection line, and is electromagnetic-field-coupled to the metal member.





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(19) **United States**(12) **Patent Application Publication**
TSOU et al.(10) **Pub. No.: US 2019/0190150 A1**(43) **Pub. Date: Jun. 20, 2019**(54) **ANTENNA STRUCTURE AND WIRELESS
COMMUNICATION DEVICE USING SAME**(71) Applicant: **Chiun Mai Communication Systems,
Inc.**, New Taipei (TW)(72) Inventors: **TUN-YUAN TSOU**, New Taipei (TW);
SHU-WEI JHANG, New Taipei (TW)(21) Appl. No.: **16/184,065**(22) Filed: **Nov. 8, 2018**(30) **Foreign Application Priority Data**

Nov. 28, 2017 (CN) 201711217005.X

Publication Classification(51) **Int. Cl.**

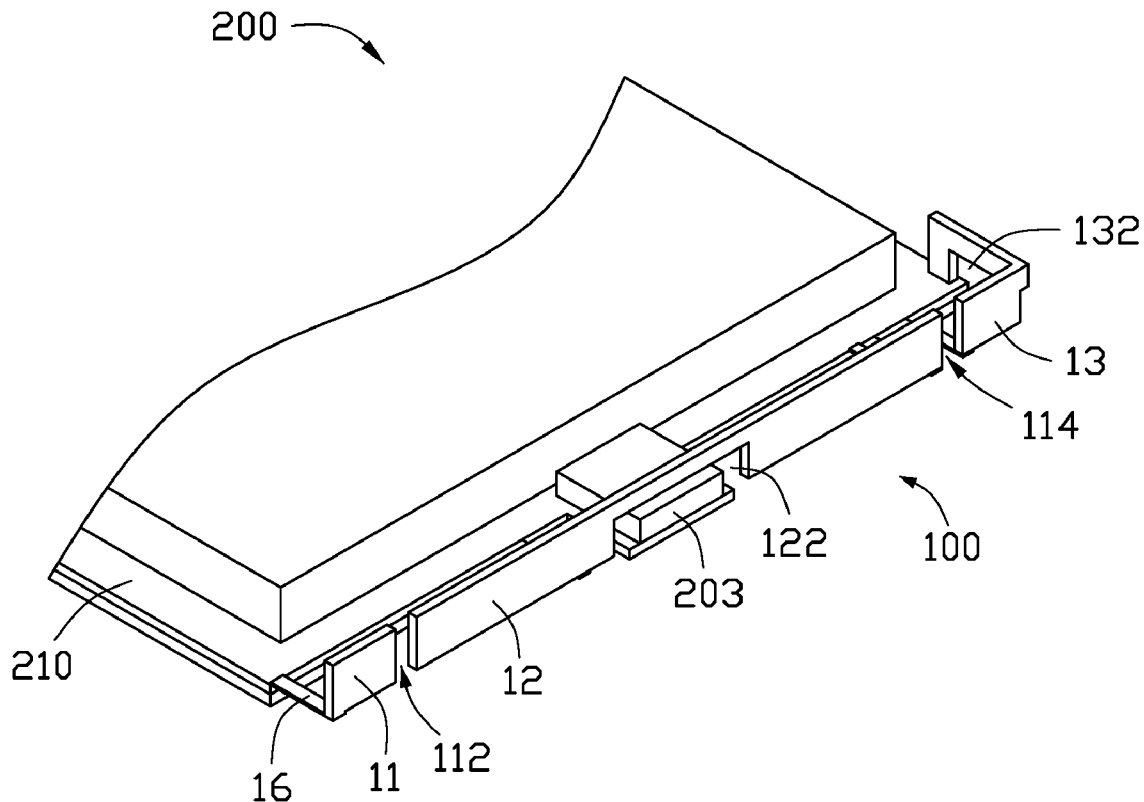
H01Q 5/385	(2006.01)
H01Q 1/48	(2006.01)
H01Q 23/00	(2006.01)
H01Q 1/24	(2006.01)

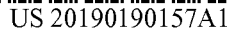
(52) **U.S. Cl.**CPC **H01Q 5/385** (2015.01); **H01Q 1/243**
(2013.01); **H01Q 23/00** (2013.01); **H01Q 1/48**
(2013.01)

(57)

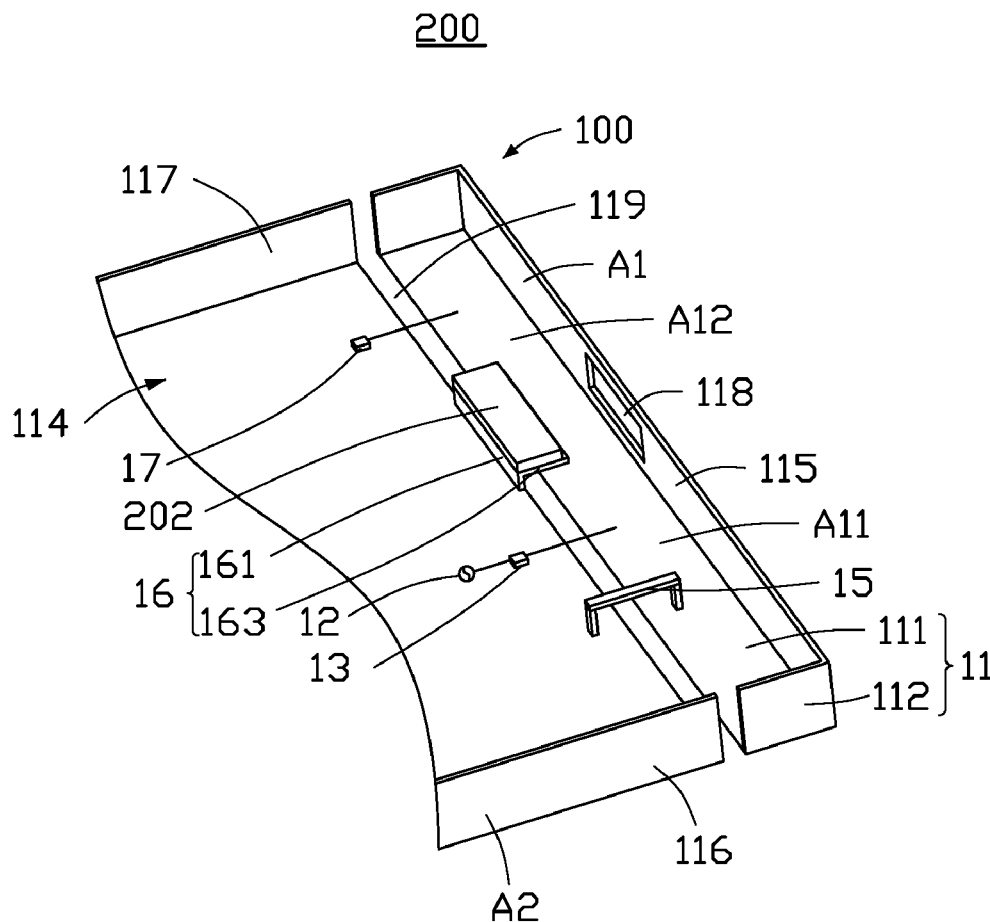
ABSTRACT

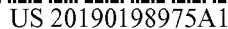
An antenna structure utilizing metal housing of a wireless communication device as antenna includes first, second, and third metallic members, and a feed portion. A first gap is between the first and second metallic members. A second gap is between the second and third metallic members. The current feed portion is connected to the second metallic member, and current entering the second metallic member flows towards the first gap and the second gap respectively to excite radiation signals in a first frequency band. The first and third metallic members obtain the current by coupling and excite radiation signals in a second and a third frequency bands respectively. Frequencies of the third frequency band are higher than frequencies of the second frequency band, which are higher than the frequencies of the first frequency band. A wireless communication device using the antenna structure is provided.



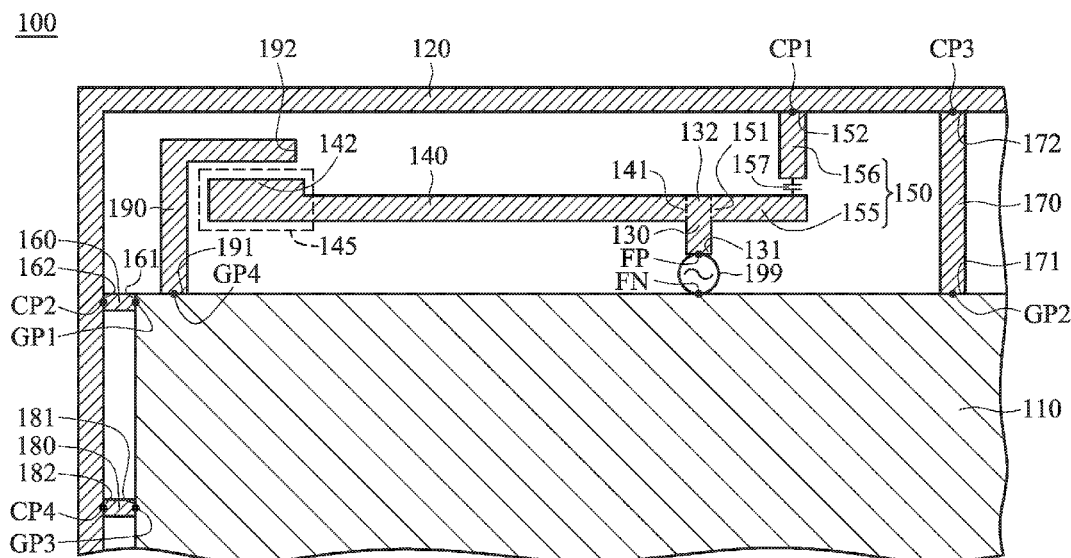


(43) **Pub. Date:** **Jun. 20, 2019**





(43) **Pub. Date:** **Jun. 27, 2019**





US 20190198977A1

(19) **United States**

(12) **Patent Application Publication**
LI

(10) **Pub. No.: US 2019/0198977 A1**

(43) **Pub. Date: Jun. 27, 2019**

(54) **TUNABLE ANTENNA AND MOBILE PHONE**

H01Q 5/378 (2006.01)

(71) Applicant: **ZTE Corporation**, Shenzhen (CN)

(52) **H01Q 1/52** (2006.01)

(72) Inventor: **Qun LI**, Shenzhen (CN)

U.S. Cl.
CPC **H01Q 1/243** (2013.01); **H01Q 1/52**
(2013.01); **H01Q 5/378** (2015.01); **H01Q**
1/2283 (2013.01)

(21) Appl. No.: **16/099,027**

(22) PCT Filed: **Sep. 13, 2016**

(86) PCT No.: **PCT/CN2016/098869**

(57) **ABSTRACT**

§ 371 (c)(1),
(2) Date: **Nov. 5, 2018**

(30) **Foreign Application Priority Data**

May 18, 2016 (CN) 201610333016.3

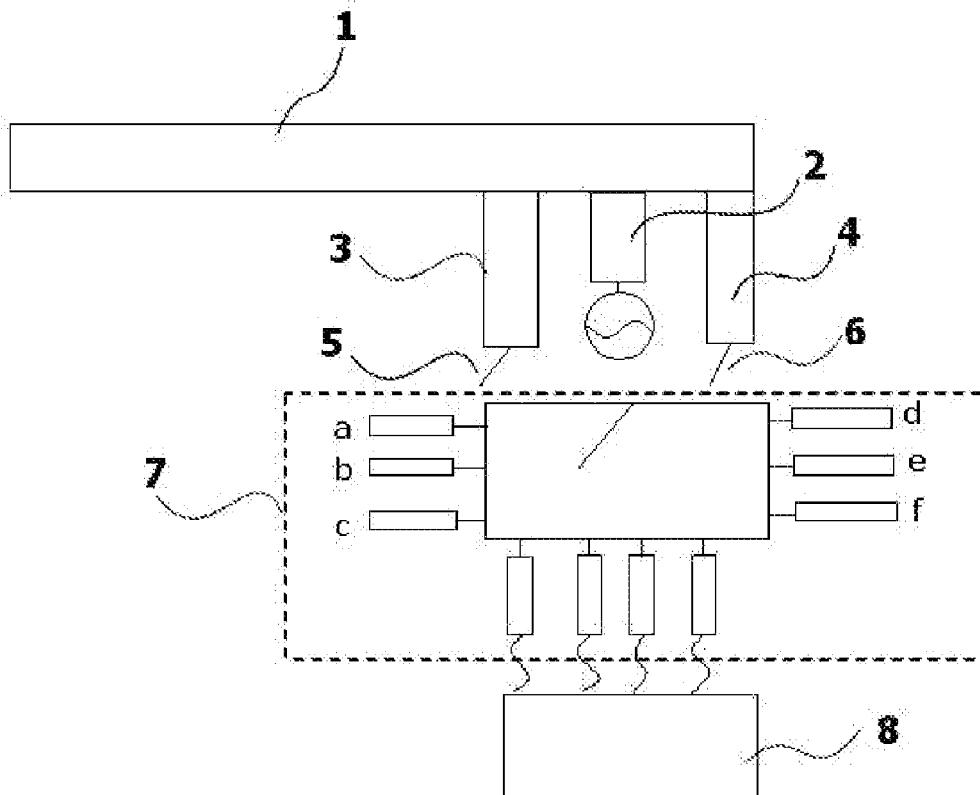
Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 1/22 (2006.01)

Provided are a tunable antenna and a mobile phone equipped with the tunable antenna, the tunable antenna including a mainboard and an antenna body, where a first connecting structure and a second connecting structure are configured between the antenna body and the mainboard, such that when a USB cable is not inserted, the antenna body is connected with the mainboard through the first connecting structure, and when the USB cable is inserted, the antenna body is connected with the mainboard through the second connecting structure

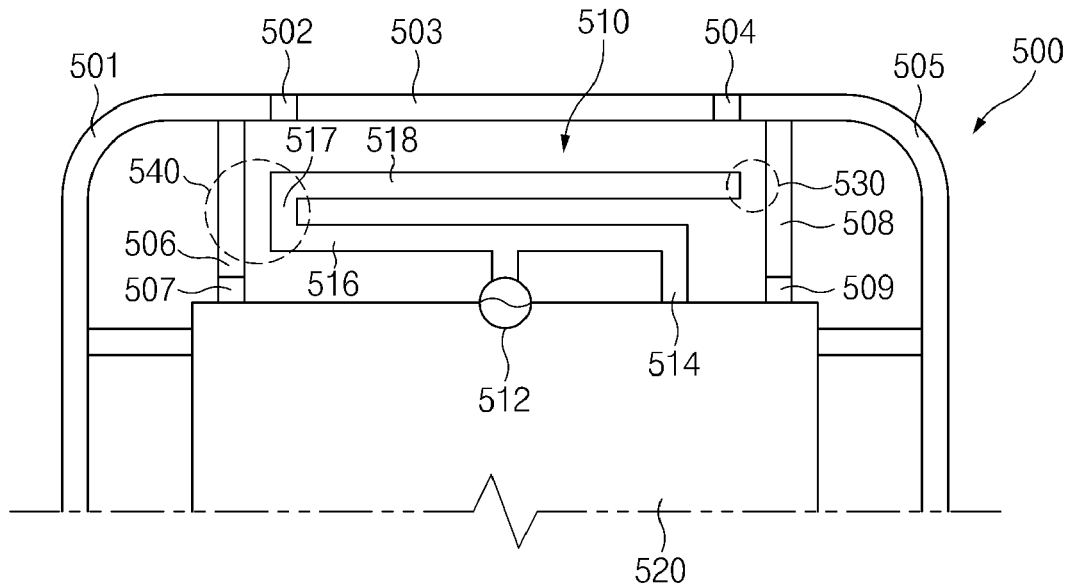




US 20190198978A1

(19) **United States**(12) **Patent Application Publication**
Shin et al.(10) **Pub. No.: US 2019/0198978 A1**(43) **Pub. Date: Jun. 27, 2019**(54) **ANTENNA USING COUPLING AND
ELECTRONIC DEVICE INCLUDING THE
SAME**(30) **Foreign Application Priority Data**

Oct. 24, 2014 (KR) 10-2014-0145540

(71) Applicant: **Samsung Electronics Co., Ltd.,**
Gyeonggi-do (KR)**Publication Classification**(72) Inventors: **Dong Ryul Shin**, Daegu (KR); **Min
Sakong**, Gyeongsangbuk-do (KR);
Chae Up Yoo, Seoul (KR); **Jin Woo
Jung**, Seoul (KR); **Ho Saeng Kim**,
Gyeonggi-do (KR); **Byung Chan Jang**,
Gyeongsangbuk-do (KR)(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 5/378 (2006.01)
H01Q 9/42 (2006.01)(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 9/42**
(2013.01); **H01Q 1/241** (2013.01); **H01Q**
5/378 (2015.01)(21) Appl. No.: **16/291,567**(22) Filed: **Mar. 4, 2019**(57) **ABSTRACT****Related U.S. Application Data**(63) Continuation of application No. 14/922,967, filed on
Oct. 26, 2015, now Pat. No. 10,224,603.An electronic device is provided. The electronic device
includes a housing including a segment part used to insulate
a portion of the housing and an antenna disposed at a
position corresponding to the segment part.



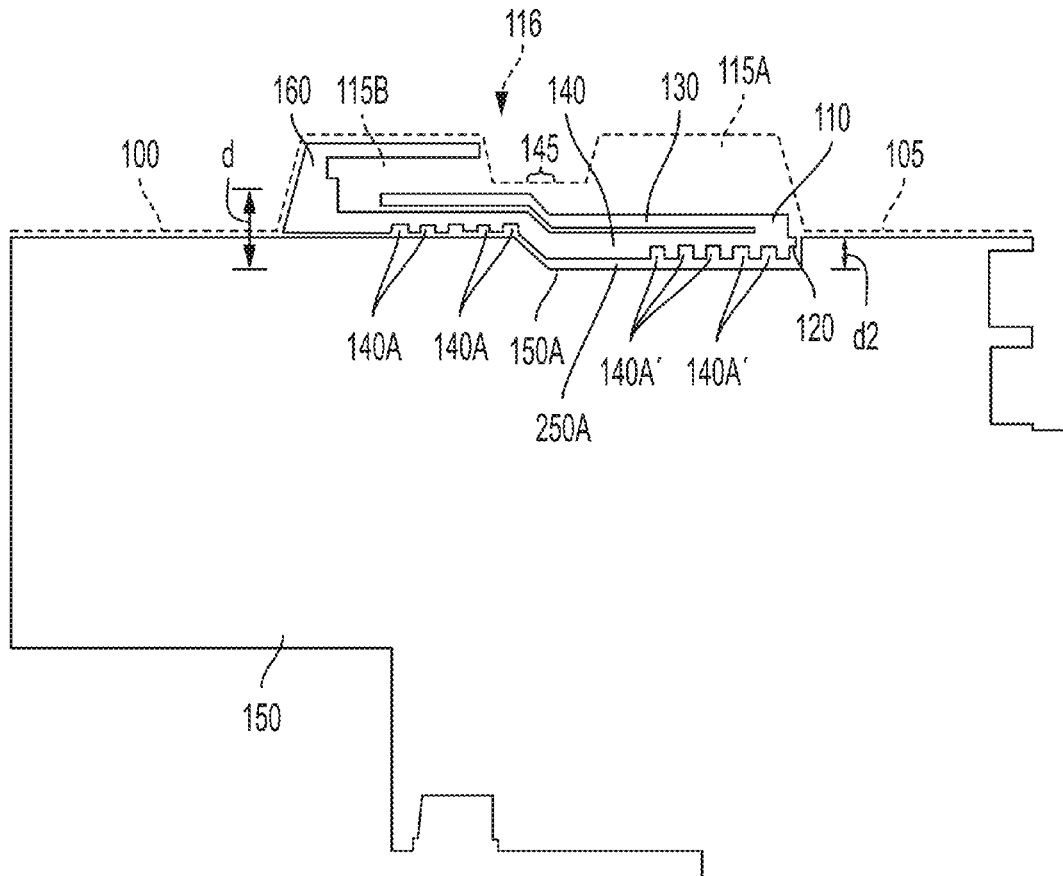
US 20190199000A1

(19) **United States**(12) **Patent Application Publication**
GAMBAHAYA(10) **Pub. No.: US 2019/0199000 A1**(43) **Pub. Date: Jun. 27, 2019**(54) **TRACE ANTENNAS AND CIRCUIT BOARD INCLUDING TRACE ANTENNAS**(52) **U.S. Cl.**CPC **H01Q 9/42** (2013.01); **H01Q 1/38** (2013.01); **H01Q 1/2283** (2013.01); **H01Q 9/40** (2013.01)(71) Applicant: **TAOGLAS GROUP HOLDINGS LIMITED**, Enniscorthy (IE)(72) Inventor: **Sifiso GAMBAHAYA**, Wexford (IE)(21) Appl. No.: **16/176,742**(22) Filed: **Oct. 31, 2018**(30) **Foreign Application Priority Data**

Nov. 7, 2017 (GB) 1718424.3

Publication Classification(51) **Int. Cl.****H01Q 9/42** (2006.01)**H01Q 9/40** (2006.01)**H01Q 1/22** (2006.01)**H01Q 1/38** (2006.01)(57) **ABSTRACT**

Disclosed are multi-band trace antennas and circuit boards including a multi-band trace antenna for the transmission and/or reception of information in a wireless communication system. The circuit board is configurable to include a multi-band trace antenna. Additionally, the circuit board can comprise a feed point adjacent an edge of the circuit board, the feed point being connected to a pair of closely coupled traces of unequal length, a first of the traces extending away from the feed point along the edge of the circuit board, and a second of the traces extending away from the feed point inboard of the first antenna trace, the circuit board comprises a ground plane coplanar with the traces, an edge of the ground plane extending alongside and closely coupled with the second of the traces to cause an area of the ground plane adjacent the edge to radiate at a selected lower operational frequency of the antenna, wherein an edge of a longer of the pair of closely coupled traces is indented to vary a width of the trace at a plurality of points along its length and to increase radiation of the shorter of the pair of closely coupled traces at a selected higher operational frequency of the antenna.





US 20190207298A1

(19) **United States**

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

(10) **Pub. No.: US 2019/0207298 A1**

(43) **Pub. Date: Jul. 4, 2019**

(54) **ELECTRONIC DEVICE WITH ADVANCED ANTENNA**

H04M 1/02 (2006.01)

H01Q 1/22 (2006.01)

(71) Applicant: **GUANGDONG OPPO MOBILE TELECOMMUNICATIONS CORP., LTD.**, Dongguan (CN)

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

CPC *H01Q 1/243* (2013.01); *H01Q 1/2266* (2013.01); *H04M 1/0266* (2013.01); *H01Q 1/52* (2013.01)

(72) Inventors: **Huanhong LIU**, Dongguan (CN); **Haijun TANG**, Dongguan (CN); **Qing WU**, Dongguan (CN); **Guolin LIU**, Dongguan (CN)

(57)

ABSTRACT

(21) Appl. No.: **16/149,290**

(22) Filed: **Oct. 2, 2018**

(30) **Foreign Application Priority Data**

Dec. 29, 2017 (CN) 201711499643.5

Dec. 29, 2017 (CN) 201721927245.4

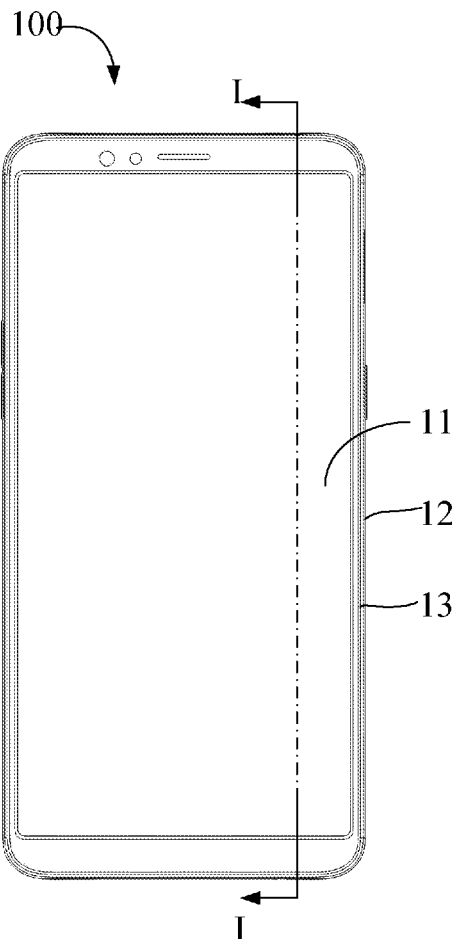
Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 1/52 (2006.01)

The present disclosure provides an electronic device with advanced antenna. The electronic device includes: a display screen; a metal frame surrounding a side edge of the display screen; and a connecting component disposed between the side edge of the display screen and a top end of the metal frame; wherein a height of the connecting component is larger than a preset height such that a portion of the side edge of the display screen not facing the metal frame has at least the preset height. Since the height of the connecting component is larger than the preset height such that the area of the portion of the side edge of the display screen which faces directly the metal frame may be smaller than a predetermined value. Thus, interruption between the display screen and the metal frame may be reduced or eliminated.





US 20190207300A1

(19) **United States**(12) **Patent Application Publication****Wu et al.**(10) **Pub. No.: US 2019/0207300 A1**(43) **Pub. Date:****Jul. 4, 2019**(54) **ELECTRONIC DEVICES WITH ENHANCED ANTENNA PERFORMANCE**(52) **U.S. Cl.**CPC **H01Q 1/244** (2013.01); **H01Q 1/20** (2013.01); **H01Q 9/0407** (2013.01)(71) Applicant: **Guangdong Oppo Mobile Telecommunications Corp., Ltd.**, Dongguan (CN)

(57)

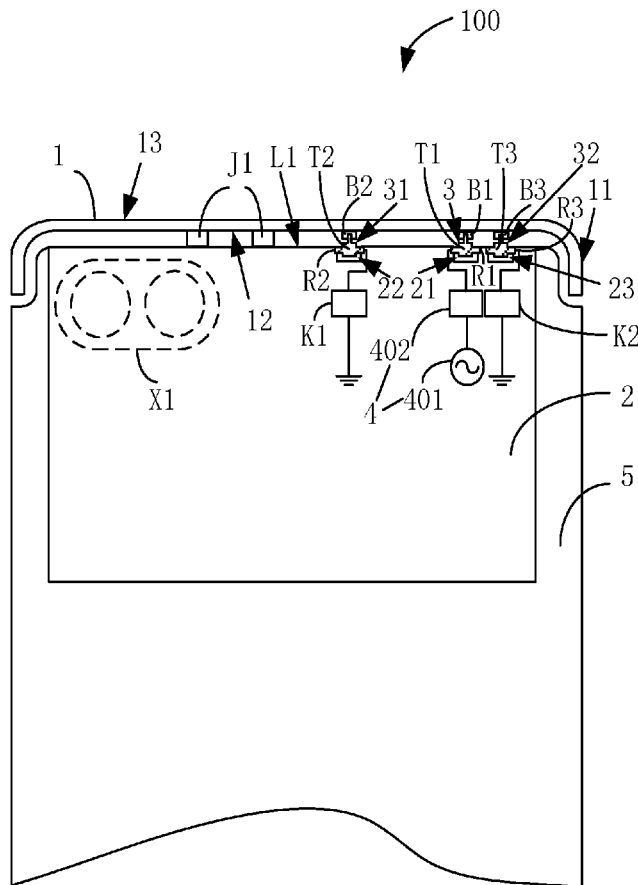
ABSTRACT(72) Inventors: **Qing Wu**, Dongguan (CN); **Haijun Tang**, Dongguan (CN); **Huanhong Liu**, Dongguan (CN); **Guolin Liu**, Dongguan (CN)(21) Appl. No.: **16/196,843**(22) Filed: **Nov. 20, 2018**(30) **Foreign Application Priority Data**

Dec. 29, 2017 (CN) 201711499644X

Dec. 29, 2017 (CN) 2017219277354

Publication Classification(51) **Int. Cl.****H01Q 1/24** (2006.01)**H01Q 9/04** (2006.01)**H01Q 1/20** (2006.01)

An electronic device is provided. The electronic device includes a metal frame, a circuit board, a first connection structure, and an antenna module. The metal frame is provided with a first contact portion extending outwardly from an inner surface of the metal frame. The first connection structure includes a first resilient piece, the first resilient piece has a first end and a second end opposite to the first end, the first end of the resilient piece is electrically coupled with the first contact portion via abutting against the first contact portion. The antenna module disposed on the circuit board is electrically coupled with the second end of the first resilient piece extending through the circuit board, and is electrically coupled with the metal frame via the first resilient piece, such that the metal frame is operable to be antenna resonating elements of the antenna module.





US 20190207310A1

(19) **United States**(12) **Patent Application Publication**
Gu(10) **Pub. No.: US 2019/0207310 A1**(43) **Pub. Date: Jul. 4, 2019**(54) **ANTENNA SYSTEM AND MOBILE
TERMINAL**(71) Applicant: **AAC Technologies Pte. Ltd.**,
Singapore city (SG)(72) Inventor: **Haichuan Gu**, Shenzhen (CN)(21) Appl. No.: **16/057,947**(22) Filed: **Aug. 8, 2018**(30) **Foreign Application Priority Data**

Dec. 29, 2017 (CN) 201711478842.8

Publication Classification(51) **Int. Cl.**

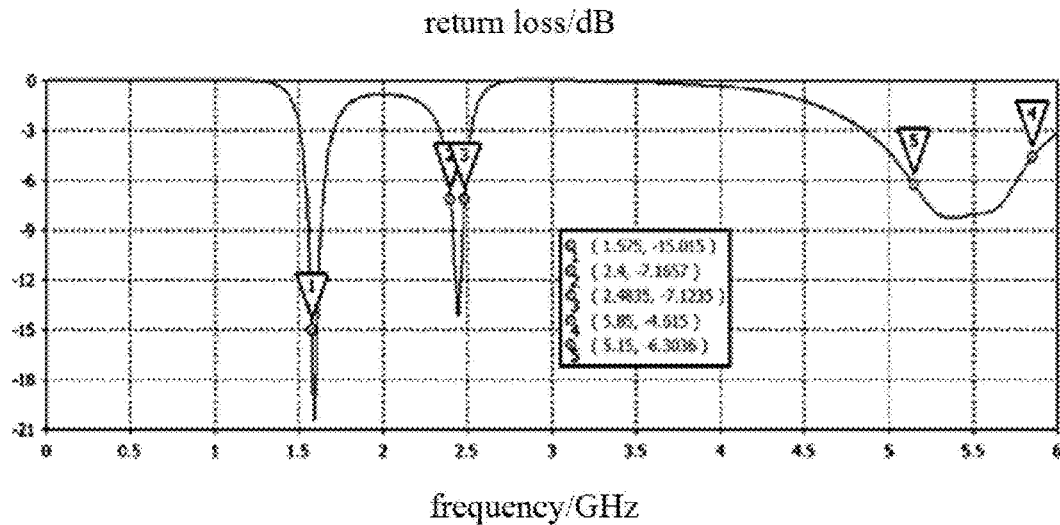
<i>H01Q 5/335</i>	(2006.01)
<i>H01Q 1/22</i>	(2006.01)
<i>H01Q 1/24</i>	(2006.01)
<i>H01Q 13/16</i>	(2006.01)

(52) **U.S. Cl.**CPC *H01Q 5/335* (2015.01); *H01Q 13/16*
(2013.01); *H01Q 1/243* (2013.01); *H01Q*
1/2291 (2013.01)

(57)

ABSTRACT

The antenna system includes: an upper frame, including a feeding point, a ground point, and a connection ground, wherein the ground point is arranged between the feeding point and the connection ground; system ground; feed source; matching network, including a first-order band elimination filter and a first capacitor that are connected in series; and first inductor. The upper frame is disposed at one side periphery of the system ground, and a clearance region is formed between the system ground and the upper frame. The feed source is connected to the feeding point through the matching network, the ground point is connected to the system ground through the first inductor, and the connection ground is connected to the system ground, so as to form a GPS antenna, a WIFI 2.4G antenna and a WIFI 5G antenna.





US 20190207314A1

(19) **United States**(12) **Patent Application Publication**
Oladeinde et al.(10) **Pub. No.: US 2019/0207314 A1**(43) **Pub. Date: Jul. 4, 2019**(54) **PATCH ANTENNA WITH ISOLATED FEEDS**(71) Applicant: **Intel Corporation**, Santa Clara, CA
(US)(72) Inventors: **Adewale K Oladeinde**, Hillsboro, OR
(US); **Telesphor Kamgaing**, Chandler,
AZ (US)(21) Appl. No.: **16/305,716**(22) PCT Filed: **Jun. 30, 2016**(86) PCT No.: **PCT/US2016/040462**

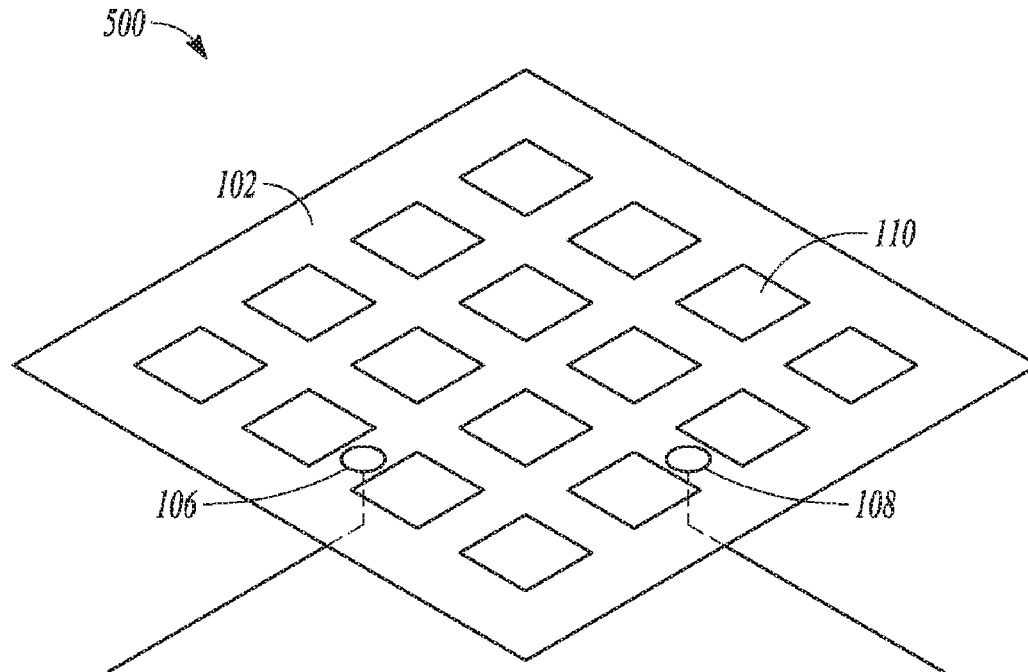
§ 371 (c)(1),

(2) Date: **Nov. 29, 2018****Publication Classification**(51) **Int. Cl.****H01Q 9/04** (2006.01)**H01Q 21/22** (2006.01)**H01Q 21/06** (2006.01)**H01Q 21/00** (2006.01)**H01Q 1/52** (2006.01)**H01Q 21/24** (2006.01)(52) **U.S. Cl.**CPC **H01Q 9/045** (2013.01); **H01Q 21/22**(2013.01); **H01Q 21/24** (2013.01); **H01Q****21/0025** (2013.01); **H01Q 1/521** (2013.01);**H01Q 21/065** (2013.01)

(57)

ABSTRACT

Methods and devices disclosed herein relate to a patch antenna. The patch antenna can include a patch having a conductive sheet including at least one edge. The patch can include a first polarization direction and a second polarization direction. A first antenna feed can be coupled to the patch. The first antenna feed can be positioned to transmit or receive a first signal along the first polarization direction. A second antenna feed can be coupled to the patch. The second antenna feed can be positioned to transmit or receive a second signal along the second polarization direction. At least one antenna aperture can be isolated from an edge of the patch and disposed along an aperture path. An orientation of the aperture path can bisect the first polarization direction and the second polarization direction. In one example, the antenna aperture can be located between the first antenna feed and the second antenna feed.





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(19) **United States**

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

(10) **Pub. No.: US 2019/0207318 A1**

(43) **Pub. Date: Jul. 4, 2019**

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

Publication Classification

(71) Applicant: **GUANGDONG OPPO MOBILE TELECOMMUNICATIONS CORP., LTD.**, Dongguan (CN)

(51) **Int. Cl.**
H01Q 13/10 (2006.01)
H01Q 1/48 (2006.01)
H01Q 1/24 (2006.01)

(72) Inventors: **Qing WU**, Dongguan (CN); **Haijun Tang**, Dongguan (CN); **Huanhong Liu**, Dongguan (CN); **Guolin Liu**, Dongguan (CN)

(52) **U.S. Cl.**
CPC **H01Q 13/10** (2013.01); **H01Q 1/243** (2013.01); **H01Q 1/48** (2013.01)

(73) Assignee: **GUANGDONG OPPO MOBILE TELECOMMUNICATIONS CORP., LTD.**, Dongguan (CN)

(57) **ABSTRACT**

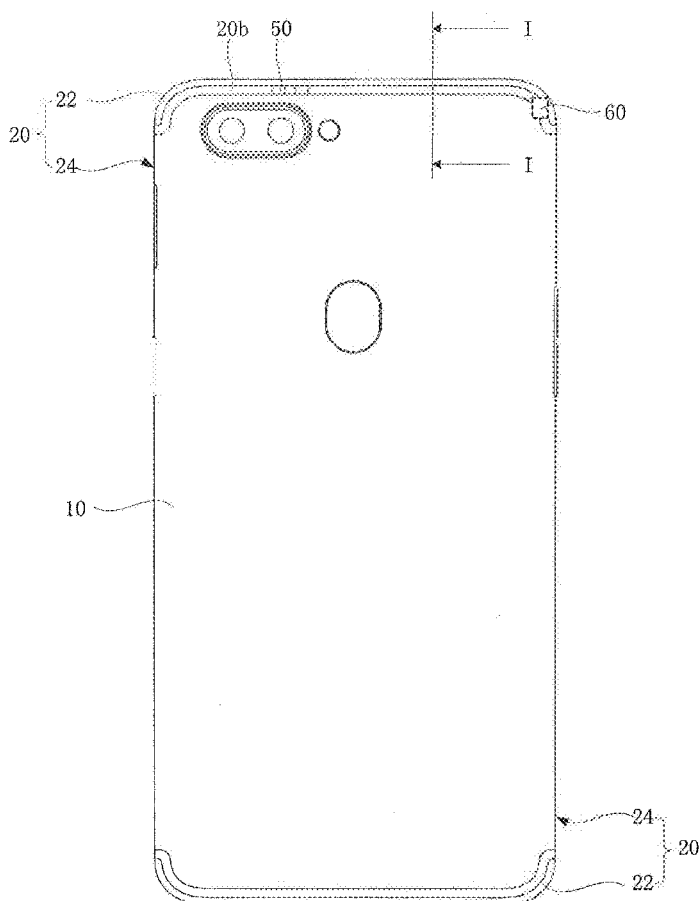
An antenna assembly may include an excitation source configured to generate an excitation signal, an antenna radiator including a first end and an opposing second end, a reference ground disposed corresponding to the antenna radiator, adjacent to the first end and including a first surface adjacent to the first end and an opposing second surface adjacent to the second end, a support body arranged on the second surface of the reference ground and extending along a direction from the first end to the second end, and a conductive sheet arranged on the support body, adjacent and coupled to the second end and configured to transmit the excitation signal from the excitation source to the antenna radiator, the antenna radiator may be configured to generate an electromagnetic signal according to the excitation signal.

(21) Appl. No.: **16/190,509**

(22) Filed: **Nov. 14, 2018**

(30) **Foreign Application Priority Data**

Dec. 29, 2017 (CN) 201711499681.0
Dec. 29, 2017 (CN) 201721928957.8





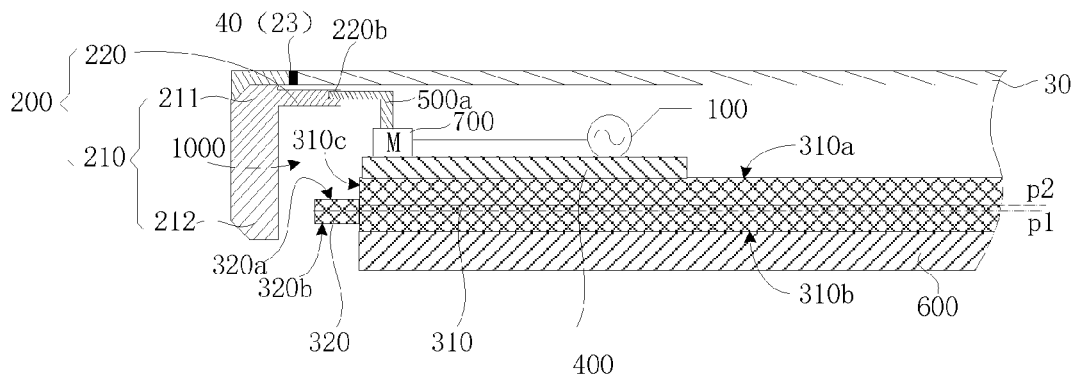
US 20190207319A1

(19) **United States**(12) **Patent Application Publication****Wu et al.**(10) **Pub. No.: US 2019/0207319 A1**(43) **Pub. Date: Jul. 4, 2019**(54) **ANTENNA APPARATUS AND ELECTRONIC DEVICE**(71) Applicant: **Guangdong Oppo Mobile Telecommunications Corp., Ltd.**, Dongguan (CN)(72) Inventors: **Qing Wu**, Dongguan (CN); **Haijun Tang**, Dongguan (CN); **Huanhong Liu**, Dongguan (CN); **Guolin Liu**, Dongguan (CN)(21) Appl. No.: **16/173,574**(22) Filed: **Oct. 29, 2018**(30) **Foreign Application Priority Data**Dec. 29, 2017 (CN) 201711499678.9
Dec. 29, 2017 (CN) 201721928944.0**Publication Classification**(51) **Int. Cl.**
H01Q 13/18 (2006.01)
H01Q 1/24 (2006.01)**H01Q 1/42** (2006.01)**H01Q 5/357** (2006.01)(52) **U.S. Cl.**CPC **H01Q 13/18** (2013.01); **H01Q 5/357** (2015.01); **H01Q 1/422** (2013.01); **H01Q 1/243** (2013.01)

(57)

ABSTRACT

An antenna apparatus and an electronic device are provided. The antenna apparatus includes an antenna radiator, a support member, and a first extension portion. The antenna radiator includes a radiator body and a power feeding portion. The radiator body includes a first end and a second end. The power feeding portion is disposed at the first end and configured to receive an excitation signal. The support member includes a first surface, a second surface opposite to the second surface, and a side surface disposed between the first surface and the second surface and adjacent to the radiator body. The first extension portion is located adjacent to the second end and electrically connected to the support member through the side surface. The first extension portion, the side surface, and the antenna radiator cooperatively define a gap region constituting at least part of a clearance area of the antenna radiator.





US 20190207323A1

(19) **United States**(12) **Patent Application Publication**
JOUNG et al.(10) **Pub. No.: US 2019/0207323 A1**(43) **Pub. Date: Jul. 4, 2019**(54) **ANTENNA MODULE****Publication Classification**(71) Applicant: **Samsung Electro-Mechanics Co., Ltd.**,
Suwon-si (KR)(72) Inventors: **Il Kweon JOUNG**, Suwon-si (KR);
Yong Hyen PARK, Suwon-si (KR);
Jung Won LEE, Suwon-si (KR)(73) Assignee: **Samsung Electro-Mechanics Co., Ltd.**,
Suwon-si (KR)(21) Appl. No.: **16/166,494**(22) Filed: **Oct. 22, 2018**(30) **Foreign Application Priority Data**

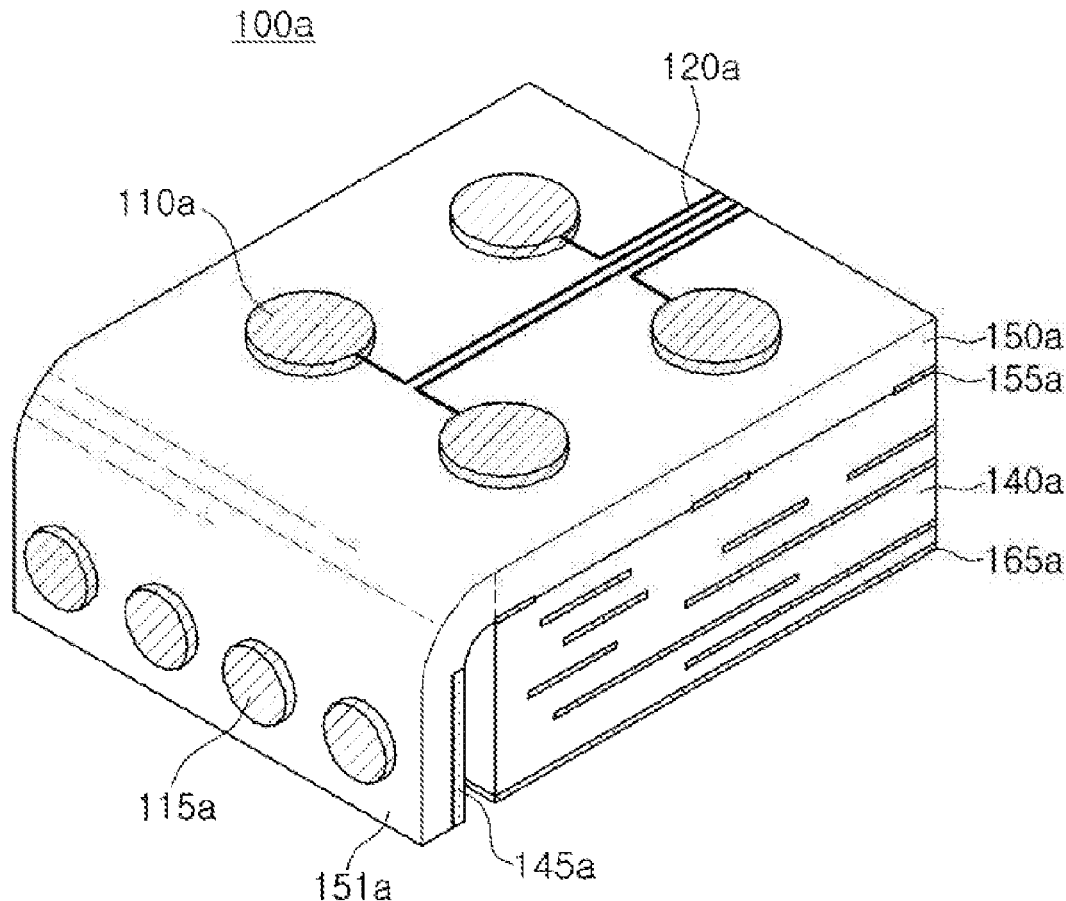
Dec. 28, 2017	(KR)	10-2017-0183034
Dec. 28, 2017	(KR)	10-2017-0183035
Apr. 27, 2018	(KR)	10-2018-0049390

(51) **Int. Cl.****H01Q 21/06** (2006.01)**H01Q 9/04** (2006.01)**H01Q 1/52** (2006.01)**H01Q 1/22** (2006.01)(52) **U.S. Cl.**CPC **H01Q 21/065** (2013.01); **H01Q 1/2283**(2013.01); **H01Q 1/526** (2013.01); **H01Q****9/0414** (2013.01)

(57)

ABSTRACT

An antenna module including two or more substrates stacked and having different flexibility, a patch antenna disposed above or within an uppermost substrate from among the two or more substrates, and an IC disposed below or within a lowermost substrate from among the two or more substrates, and electrically connected to the patch antenna through the substrates, wherein the two or more substrates comprise a first substrate and a second substrate, and wherein the second substrate is more flexible than the first substrate, and extends in a lateral direction to have an overlap region overlapping the first substrate and an extension region not overlapping the first substrate.





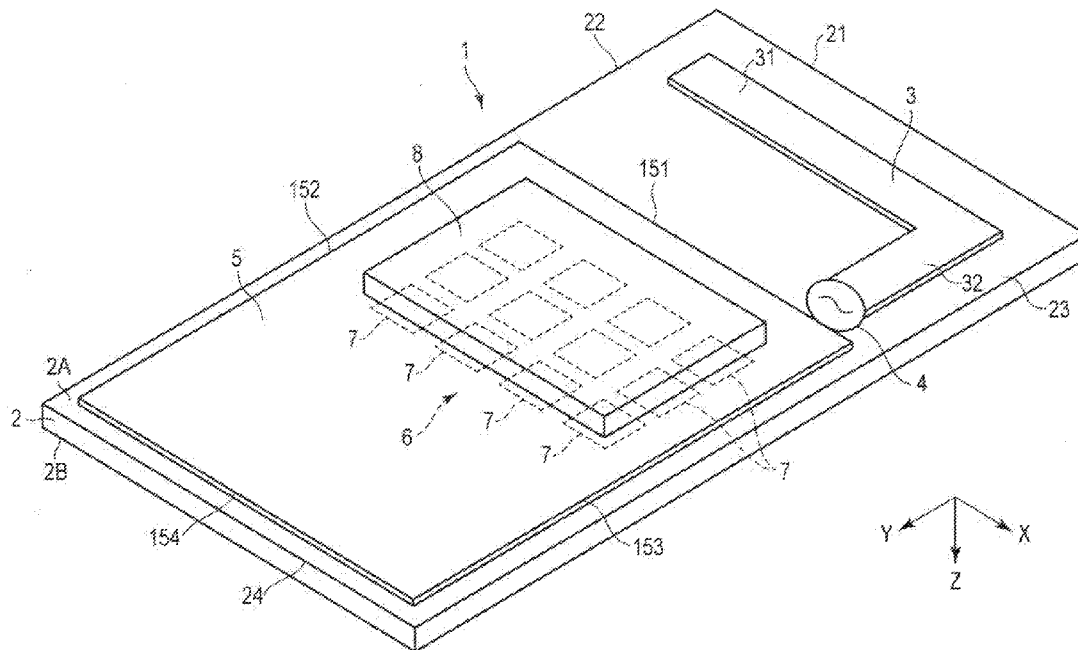
US 20190207324A1

(19) **United States**(12) **Patent Application Publication**
TESHIMA et al.(10) **Pub. No.: US 2019/0207324 A1**(43) **Pub. Date: Jul. 4, 2019**(54) **ANTENNA MODULE AND ELECTRONIC
DEVICE**(71) Applicant: **KABUSHIKI KAISHA TOSHIBA,**
Tokyo (JP)(72) Inventors: **Masao TESHIMA,** Tokyo (JP);
Akihiro TSUJIMURA, Tokyo (JP)(73) Assignee: **KABUSHIKI KAISHA TOSHIBA,**
Tokyo (JP)(21) Appl. No.: **16/298,858**(22) Filed: **Mar. 11, 2019****Related U.S. Application Data**(63) Continuation of application No. 15/019,018, filed on
Feb. 9, 2016, now Pat. No. 10,270,186.(60) Provisional application No. 62/212,140, filed on Aug.
31, 2015.**Publication Classification**(51) **Int. Cl.****H01Q 21/28** (2006.01)**H01Q 21/06** (2006.01)**H01Q 1/24** (2006.01)**H01Q 3/24** (2006.01)**H01Q 9/42** (2006.01)(52) **U.S. Cl.**CPC **H01Q 21/28** (2013.01); **H01Q 21/065**(2013.01); **H01Q 9/42** (2013.01); **H01Q 3/24**(2013.01); **H01Q 1/243** (2013.01)

(57)

ABSTRACT

According to one embodiment, an antenna module includes a substrate, a first antenna, an array antenna, and a radio frequency (RF) module. The first antenna includes a first radiation element arranged on the substrate and a first ground plane arranged on the substrate. The array antenna includes a plurality of second radiation elements arranged on the substrate. The substrate includes a first surface and a second surface. The first ground plane is arranged on at least the first surface of the substrate. The plurality of second radiation elements are arranged on the second surface of the substrate and opposed to the first ground plane via the substrate.





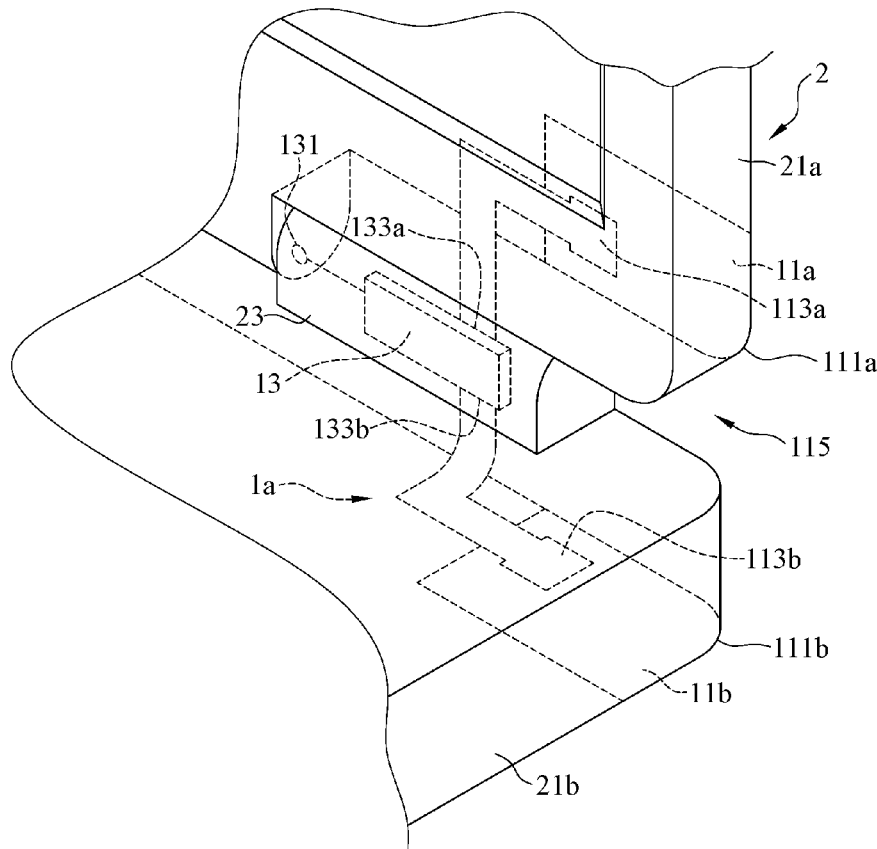
US 20190212789A1

(19) **United States**(12) **Patent Application Publication**
TING et al.(10) **Pub. No.: US 2019/0212789 A1**(43) **Pub. Date: Jul. 11, 2019**(54) **PORTABLE ELECTRONIC DEVICE AND
ANTENNA THEREOF****Publication Classification**(71) Applicants: **INVENTEC (PUDONG)
TECHNOLOGY CORPORATION**,
Shanghai City (CN); **INVENTEC
CORPORATION**, Taipei City (TW)(51) **Int. Cl.**
G06F 1/16 (2006.01)
H01Q 1/22 (2006.01)
H01F 27/29 (2006.01)
(52) **U.S. Cl.**
CPC **G06F 1/1698** (2013.01); **H01F 27/29**
(2013.01); **H01Q 1/22** (2013.01); **G06F**
1/1681 (2013.01)(72) Inventors: **Ssu Han TING**, Taipei City (TW);
Chih-Cheng LI, Taipei City (TW)(73) Assignees: **INVENTEC (PUDONG)
TECHNOLOGY CORPORATION**,
Shanghai City (CN); **INVENTEC
CORPORATION**, Taipei City (TW)(57) **ABSTRACT**

A portable electronic device comprises a main body and an antenna. The main body comprises a first casing, a second casing and a hinge. The antenna comprises a first metal layer, a second metal layer and a balun transformer. The first metal layer formed at the first casing has a first bending side edge. The second metal layer formed at the second casing has a second bending side edge. A tapered slot is formed between the second bending side edge and the first bending side edge, and comprises a necking end and a flaring end. The balun transformer disposed in the first casing, the second casing or the hinge has one signal input terminal and two signal output terminals, receives a feed signal and a ground signal via the signal input terminal to generate two balanced signals, and respectively outputs the balanced signals via the signal output terminals.

(21) Appl. No.: **16/189,121**(22) Filed: **Nov. 13, 2018**(30) **Foreign Application Priority Data**

Jan. 9, 2018 (CN) 201810020029.4





US 20190214706A1

(19) **United States**(12) **Patent Application Publication**
KIM et al.(10) **Pub. No.: US 2019/0214706 A1**(43) **Pub. Date: Jul. 11, 2019**(54) **MOBILE TERMINAL**(52) **U.S. Cl.**(71) Applicant: **LG ELECTRONICS INC.**, Seoul
(KR)CPC **H01Q 1/243** (2013.01); **H04M 1/0262**
(2013.01); **H01Q 9/26** (2013.01); **H04M**
1/0274 (2013.01); **H04M 1/0266** (2013.01)(72) Inventors: **Dongjin KIM**, Seoul (KR); **Changil**
KIM, Seoul (KR); **Moonsoo SONG**,
Seoul (KR); **Namyong KIM**, Seoul
(KR)(57) **ABSTRACT**(73) Assignee: **LG ELECTRONICS INC.**, Seoul
(KR)(21) Appl. No.: **16/327,122**(22) PCT Filed: **Sep. 20, 2016**(86) PCT No.: **PCT/KR2016/010487**

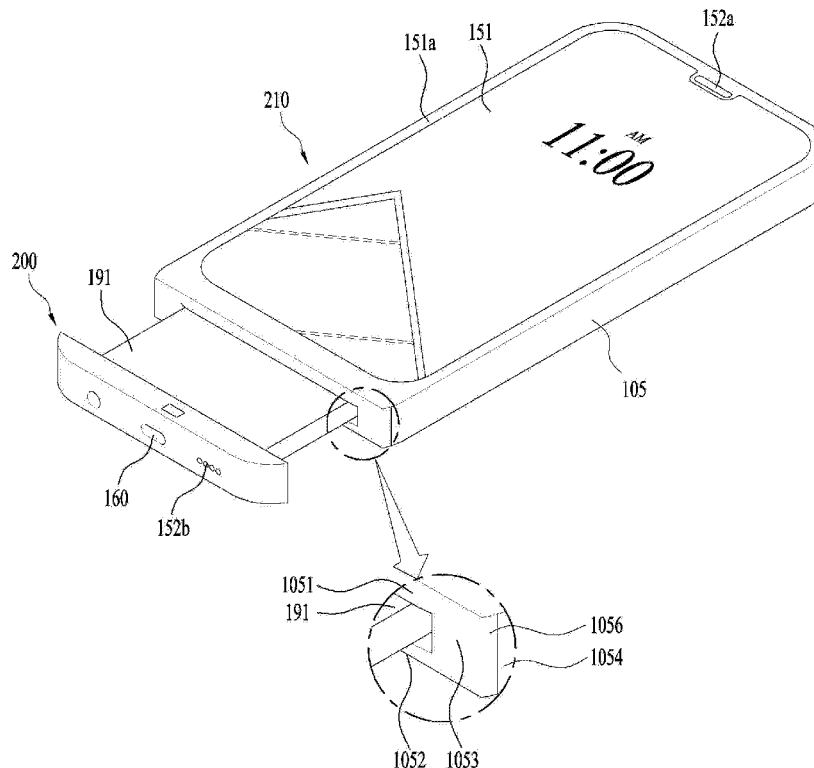
§ 371 (c)(1),

(2) Date: **Feb. 21, 2019**(30) **Foreign Application Priority Data**

Aug. 22, 2016 (KR) 10-2016-0105948

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

Disclosed is a mobile terminal comprising: a housing including a rear case positioned on a rear surface thereof and a side case positioned on a side surface thereof; a display unit disposed on a front surface of the housing; and a wireless communication unit, mounted on the main board, for processing a radio signal, wherein the side case includes a first metal part and a second metal part formed in a layered structure and spaced apart in the thickness direction of the first metal part and the housing, wherein the first metal part and the second metal part extend to a first side surface of the housing and to at least a portion of a second side surface and a third side surface located on the right and left sides of the first side surface, wherein at least one of the first metal part and the second metal part is connected to the wireless communication unit to transmit and receive an RF signal. The performance of the mobile terminal can be secured even when the performance of a mobile communication antenna is expanded and thus the mobile terminal is adjacent.





US 20190214707A1

(19) **United States**(12) **Patent Application Publication**
KIM et al.(10) **Pub. No.: US 2019/0214707 A1**(43) **Pub. Date: Jul. 11, 2019**(54) **MOBILE TERMINAL****Publication Classification**

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

(72) Inventors: **Minseok KIM**, Seoul (KR); **Hansu KIM**, Seoul (KR); **Kangjae JUNG**, Seoul (KR); **Youngbae KWON**, Seoul (KR); **Sungjung RHO**, Seoul (KR); **Changwon YUN**, Seoul (KR); **Kyoungwon JEON**, Seoul (KR); **Duckyun KIM**, Seoul (KR); **Hyoungwook LIM**, Seoul (KR); **Yunmo KANG**, Seoul (KR); **Hayong KIM**, Seoul (KR)

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 9/42 (2006.01)
H01Q 21/28 (2006.01)
H01Q 7/00 (2006.01)
H01Q 1/38 (2006.01)

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 9/42** (2013.01); **H04M 1/026** (2013.01); **H01Q 7/00** (2013.01); **H01Q 1/38** (2013.01); **H01Q 21/28** (2013.01)

(73) Assignee: **LG ELECTRONICS INC.**, Seoul (KR)(21) Appl. No.: **16/356,647**(22) Filed: **Mar. 18, 2019****Related U.S. Application Data**

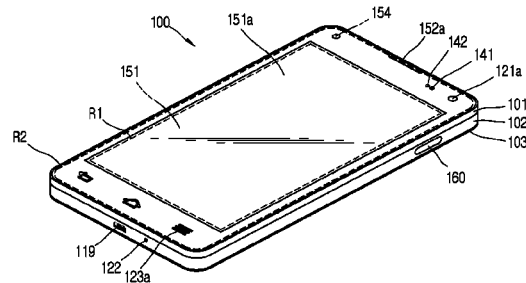
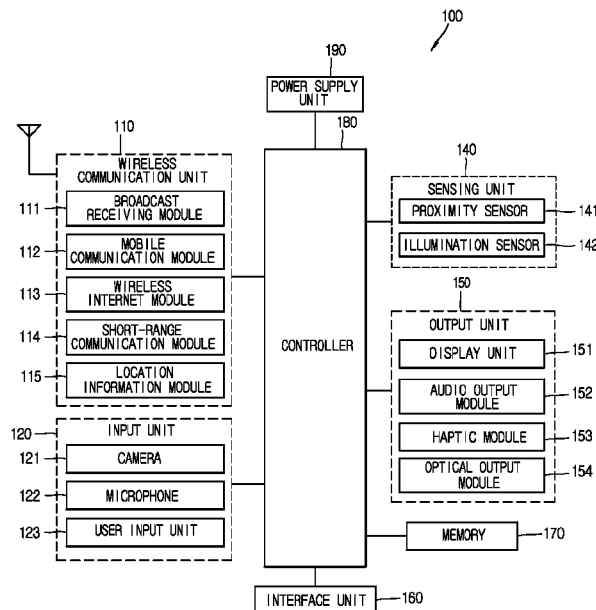
(63) Continuation of application No. 15/244,963, filed on Aug. 23, 2016, now Pat. No. 10,256,527.

(30) **Foreign Application Priority Data**

Jan. 11, 2016 (KR) 10-2016-0003385
Jan. 12, 2016 (KR) 10-2016-0003901

(57) **ABSTRACT**

A mobile terminal includes a window including a transparent region and an opaque region surrounding the transparent region, a metal case provided below the window to accommodate the window, having a rear surface portion facing the window and a side surface portion formed to extend from the rear surface portion toward a front surface, and exposed outwardly, a non-metal member formed in a region formed by cut away a portion of the case and having a slot formation portion spaced apart from the side surface portion at a predetermined interval and a pair of sectioning portions extending from the slot formation portion and traversing the side surface portion to section the side surface portion into first to third members, and first to third antenna patterns formed in the opaque region and electrically connected to the first to third members to form first and third antennas, respectively.





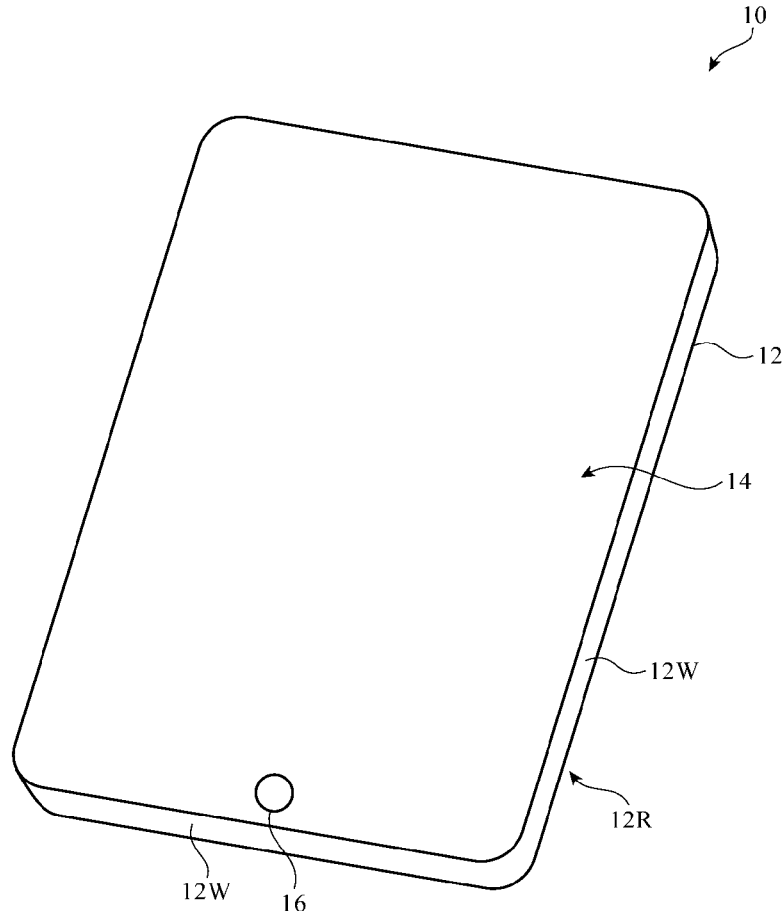
US 20190214708A1

(19) **United States**(12) **Patent Application Publication****Ouyang et al.**(10) **Pub. No.: US 2019/0214708 A1**(43) **Pub. Date: Jul. 11, 2019**(54) **ELECTRONIC DEVICES WITH
MILLIMETER WAVE ANTENNAS AND
METAL HOUSINGS**(71) Applicant: **Apple Inc.**, Cupertino, CA (US)(72) Inventors: **Yuehui Ouyang**, Sunnyvale, CA (US);
Yi Jiang, Cupertino, CA (US);
Matthew A. Mow, Los Altos, CA (US);
Mattia Pascolini, San Francisco, CA
(US); **Ruben Caballero**, San Jose, CA
(US); **Basim Noori**, Scotts Valley, CA
(US)(21) Appl. No.: **16/357,165**(22) Filed: **Mar. 18, 2019****Related U.S. Application Data**(62) Division of application No. 14/883,495, filed on Oct.
14, 2015.**Publication Classification**(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/42 (2006.01)**H01Q 21/28** (2006.01)**H01Q 1/40** (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/243** (2013.01); **H01Q 1/42**
(2013.01); **H01Q 9/16** (2013.01); **H01Q 1/40**
(2013.01); **H01Q 21/28** (2013.01)

(57)

ABSTRACT

An electronic device may be provided with wireless circuitry. The wireless circuitry may include one or more antennas. The antennas may include millimeter wave antenna arrays. Non-millimeter-wave antennas such as cellular telephone antennas may have conductive structures separated by a dielectric gap. In a device with a metal housing, a plastic-filled slot may form the dielectric gap. The conductive structures may be slot antenna structures, inverted-F antenna structures such as an inverted-F antenna resonating element and a ground, or other antenna structures. The plastic-filled slot may serve as a millimeter wave antenna window. A millimeter wave antenna array may be mounted in alignment with the millimeter wave antenna window to transmit and receive signals through the window. Millimeter wave antenna windows may also be formed from air-filled openings in a metal housing such as audio port openings.





(19) **United States**

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

(10) Pub. No.: US 2019/0214714 A1

(43) **Pub. Date:** **Jul. 11, 2019**

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

H01O 5/371 (2006.01)

H01Q 1/24 (2006.01)

(52) U.S. Cl.

CPC ***H01Q 1/36*** (2013.01); ***H01Q 1/243***
(2013.01); ***H01Q 5/371*** (2015.01); ***H01Q***
5/335 (2015.01)

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

(72) Inventors: **CHANG-JE CHEN**, New Taipei (TW);
SHU-WEI JHANG, New Taipei (TW);
TUN-YUAN TSOU, New Taipei (TW);
YI-TE CHOU, New Taipei (TW);
YUNG-CHIN CHEN, New Taipei
(TW); **CHANG-CHING HUANG**,
New Taipei (TW)

(57)

ABSTRACT

An antenna structure includes a housing, a feed portion, a ground portion, a first radiator, and a second radiator. The housing includes a first radiating portion and a second radiating portion. The first radiator and the second radiator are both positioned in the housing. When the feed portion feeds current, the current flows through the first radiating portion and is grounded through the ground portion to activate a first operating mode. When the feed portion feeds current, the current is further coupled to the first radiator through the first radiating portion, and the first radiator activates a second operating mode. When the second radiator feeds current, the second radiator activates a third operating mode. When the second radiator feeds current, the current is further coupled to the second radiating portion through the second radiator, and the second radiating portion activates a fourth operating mode.

(21) Appl. No.: 16/234,410

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

(30) **Foreign Application Priority Data**

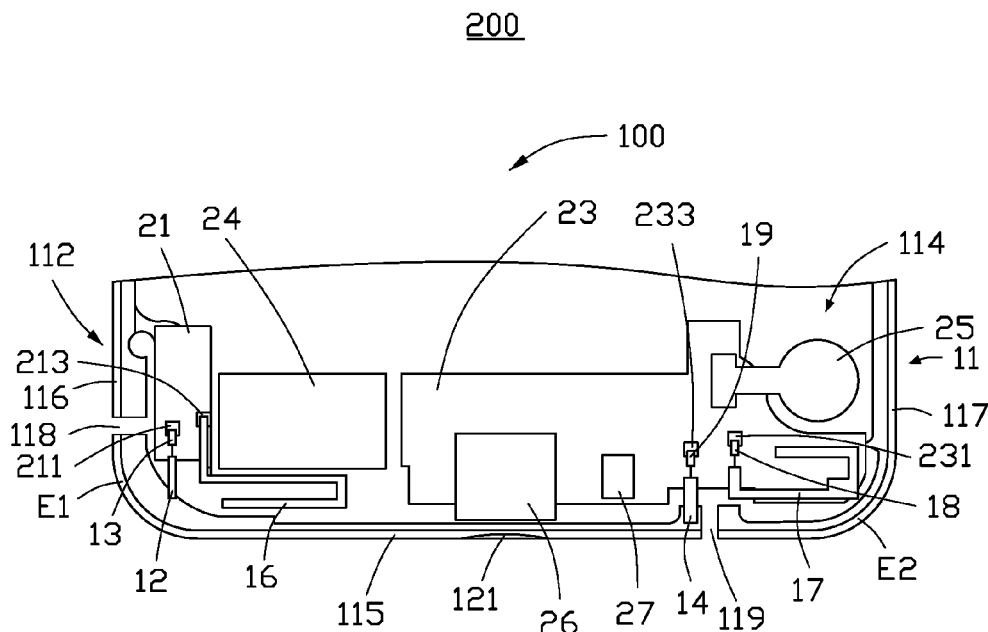
Dec. 27, 2017 (CN) 201711448309.7

Publication Classification

(51) **Int. Cl.**

H01Q 1/36 (2006.01)

H01Q 5/335 (2006.01)





US 20190214725A1

(19) **United States**(12) **Patent Application Publication**
KOGA et al.(10) **Pub. No.: US 2019/0214725 A1**(43) **Pub. Date: Jul. 11, 2019**(54) **MULTIBAND ANTENNA AND RADIO
COMMUNICATION APPARATUS****Publication Classification**(71) Applicant: **FUJITSU LIMITED**, Kawasaki-shi
(JP)(72) Inventors: **Yohei KOGA**, Kawasaki (JP); **Manabu
KAI**, Yokohama (JP); **Masatomo
MORI**, Kawasaki (JP); **Tabito
TONOOKA**, Kawasaki (JP); **Takashi
YAMAGAJI**, Yokosuka (JP)(73) Assignee: **FUJITSU LIMITED**, Kawasaki-shi
(JP)(21) Appl. No.: **16/357,103**(22) Filed: **Mar. 18, 2019****Related U.S. Application Data**(63) Continuation of application No. PCT/JP2018/
004179, filed on Feb. 7, 2018.(30) **Foreign Application Priority Data**

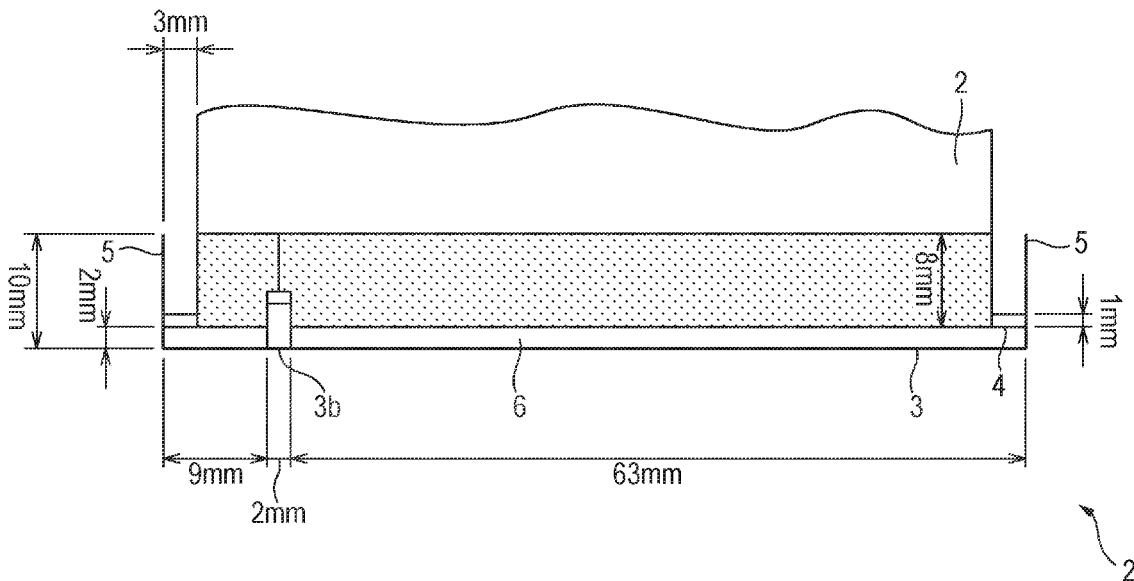
Mar. 9, 2017 (JP) 2017-045029

(51) **Int. Cl.****H01Q 5/307** (2006.01)**H01Q 21/30** (2006.01)**H01Q 1/24** (2006.01)(52) **U.S. Cl.**CPC **H01Q 5/307** (2015.01); **H01Q 1/24**
(2013.01); **H01Q 21/30** (2013.01)

(57)

ABSTRACT

A multiband antenna includes a ground conductor, a first conductor disposed at a predetermined distance from the ground conductor, formed linearly, and configured to have a length to resonate at first and second frequencies, the first conductor including a power feeding point, a second conductor coupled to the first conductor at both ends of the second conductor, disposed closer to a side of the ground conductor than the first conductor, formed linearly, and configured to form a slit between the first and second conductors and resonate together with the first conductor at a third frequency, and a third conductor provided at one or more ends of the first conductor and configured to extend from a first end of the one or more ends to the side of the ground conductor to be electromagnetically coupled to the ground conductor at the third frequency, wherein the conductors has conductivity.





US 20190214726A1

(19) **United States**

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

(10) **Pub. No.: US 2019/0214726 A1**

(43) **Pub. Date: Jul. 11, 2019**

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

H01Q 9/40 (2006.01)

H01Q 9/06 (2006.01)

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

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

CPC **H01Q 5/321** (2015.01); **H01Q 9/065** (2013.01); **H01Q 9/40** (2013.01); **H01Q 1/38** (2013.01)

(72) Inventors: **Takashi YAMAGAJO**, Yokosuka (JP); **Manabu Kai**, Yokohama (JP); **Yohei Koga**, Kawasaki (JP); **Tablto Tonooka**, Kawasaki (JP); **Hirotake Sumi**, Kawasaki (JP)

(57)

ABSTRACT

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

(21) Appl. No.: **16/228,734**

(22) Filed: **Dec. 20, 2018**

(30) **Foreign Application Priority Data**

Jan. 5, 2018 (JP) 2018-000721

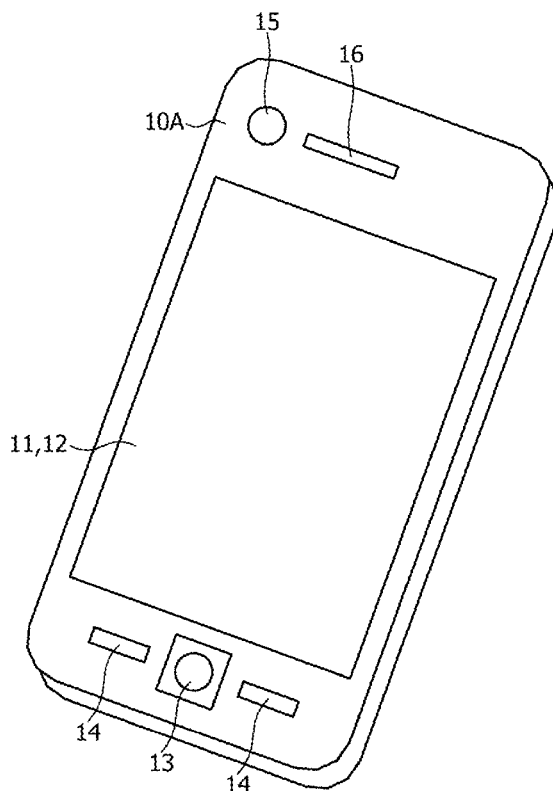
Publication Classification

(51) **Int. Cl.**

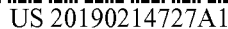
H01Q 5/321 (2006.01)

H01Q 1/38 (2006.01)

An antenna device includes a ground plane having an edge side, a monopole antenna element that communicates in a first frequency, and that has a first feeding point, a first line that extends from the first feeding point in a direction away from the edge side of the ground plane, and a second line that is coupled to the first line and extends along the edge side, a plurality of dipole feeding elements that communicate at a second frequency higher than the first frequency, and are disposed, with respect to the ground plane, in positions that match the positions of the second line with respect to the ground plane, and a plurality of reflectors that reflect electromagnetic waves radiated by the plurality of feeding elements, and are disposed respectively in correspondence to the plurality of feeding elements between the ground plane and the plurality of feeding elements.



10



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

(43) **Pub. Date:** **Jul. 11, 2019**

Publication Classification

H03H 7/38 (2006.01)

CPC ***H01Q 5/335*** (2015.01); ***H03H 7/38***
(2013.01); ***H01Q 9/0457*** (2013.01); ***H01Q***
1/48 (2013.01)

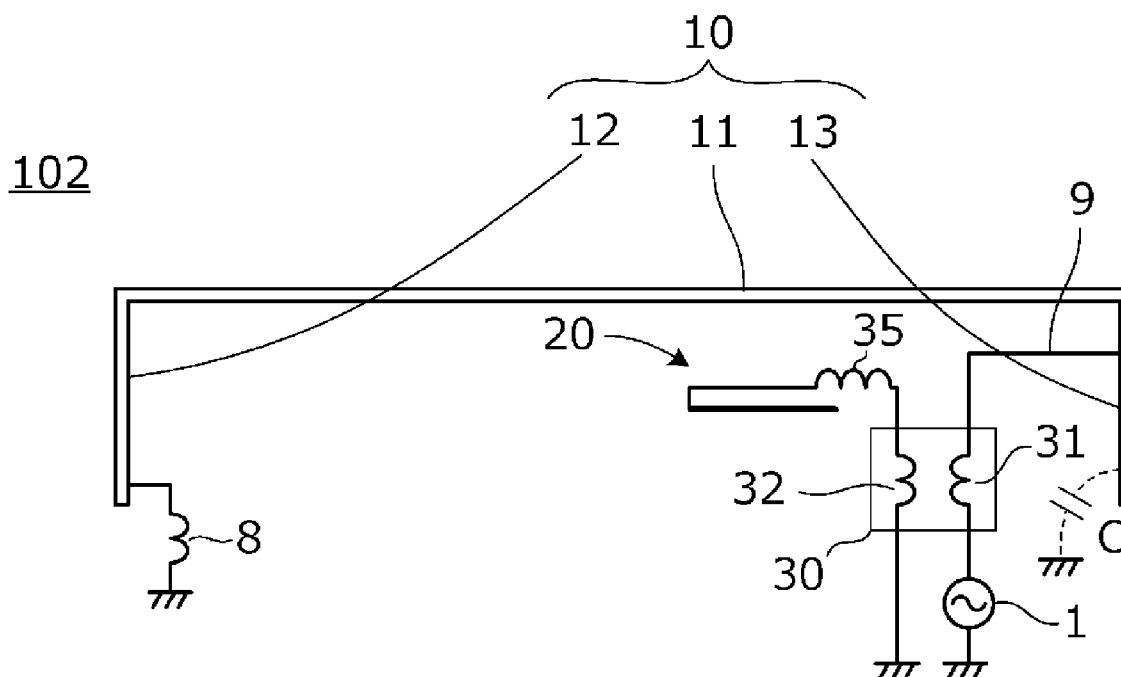
(57) **ABSTRACT**(57) **ABSTRACT**

Related U.S. Application Data

An antenna device includes a radiating element, a coupling circuit, and a non-radiating resonant circuit. The coupling circuit includes first and second coupling elements, the first coupling element being connected between a feeder circuit and the radiating element, the second coupling element being coupled to the first coupling element. An end of the second coupling element is grounded, and another end of the second coupling element is connected to the non-radiating resonant circuit. A frequency characteristic of a return loss of the radiating element when seen from the feeder circuit is adjusted by a resonant frequency characteristic of the non-radiating resonant circuit.

(30) **Foreign Application Priority Data**

Nov. 29, 2016	(JP)	2016-231024
Dec. 28, 2016	(JP)	2016-255729
Apr. 18, 2017	(JP)	2017-082043
May 26, 2017	(JP)	2017-104650
Aug. 18, 2017	(JP)	2017-158218





US 20190214729A1

(19) **United States**(12) **Patent Application Publication**
CHEN(10) **Pub. No.: US 2019/0214729 A1**(43) **Pub. Date: Jul. 11, 2019**(54) **ANTENNA STRUCTURE AND WIRELESS
COMMUNICATION DEVICE USING SAME**(71) Applicant: **Chiun Mai Communication Systems,
Inc.**, New Taipei (TW)(72) Inventor: **CHANG-JE CHEN**, New Taipei (TW)(21) Appl. No.: **15/974,768**(22) Filed: **May 9, 2018**(30) **Foreign Application Priority Data**

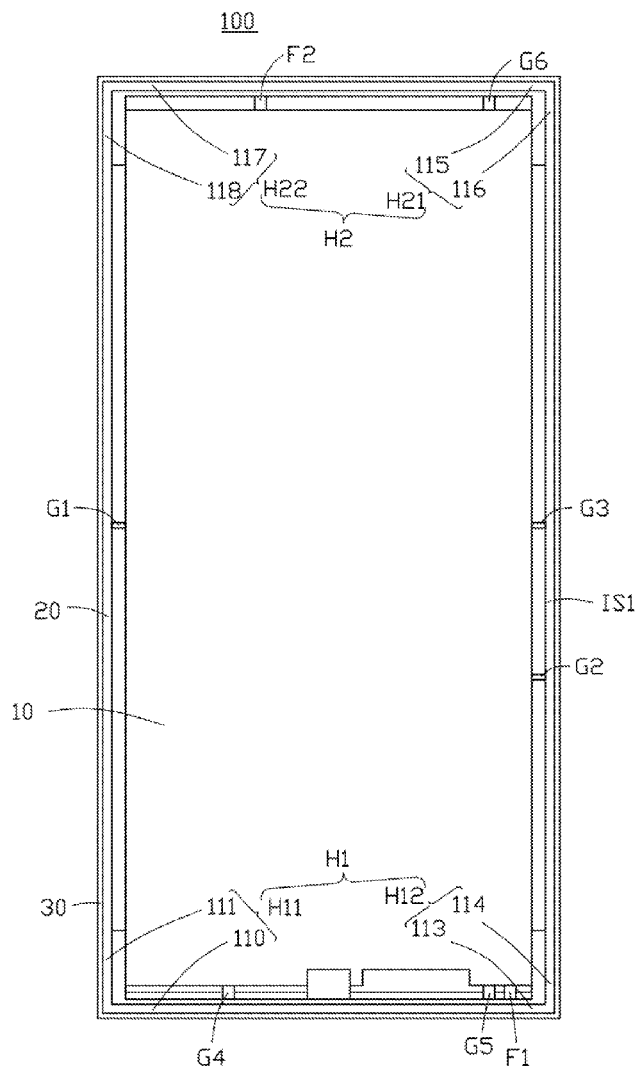
Jan. 5, 2018 (CN) 201810010809.0

Publication Classification(51) **Int. Cl.****H01Q 5/371** (2006.01)**H01Q 9/04** (2006.01)**H01Q 5/25** (2006.01)**H01Q 3/42** (2006.01)(52) **U.S. Cl.**CPC **H01Q 5/371** (2015.01); **H01Q 3/42**
(2013.01); **H01Q 5/25** (2015.01); **H01Q**
9/0464 (2013.01)

(57)

ABSTRACT

An antenna structure includes a first feeding source, a second feeding source, and a ring-shaped frame. The ring-shaped frame defines a first radiating portion and a second radiating portion. A current signal flows from the first feeding source to the first radiating portion, the first radiating portion activates a first resonance mode and a second resonance mode simultaneously to generate radiation signals in a first frequency band and a second frequency band. A current signal flows from the second feeding source to the second radiating portion, the second radiating portion activates a third resonance mode and a fourth resonance mode simultaneously to generate radiation signals in a third frequency band and a fourth frequency band. A wireless communication device is also provided.





US 20190214739A1

(19) **United States**

(12) **Patent Application Publication**

Rodríguez-Cano et al.

(10) **Pub. No.: US 2019/0214739 A1**

(43) **Pub. Date: Jul. 11, 2019**

(54) **CORNER ANTENNA ARRAY DEVICES,
SYSTEMS, AND METHODS**

Publication Classification

(51) **Int. Cl.**

H01Q 21/06 (2006.01)

H01Q 1/24 (2006.01)

H01Q 9/36 (2006.01)

H01Q 19/10 (2006.01)

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

CPC **H01Q 21/06** (2013.01); **H01Q 19/106**

(2013.01); **H01Q 9/36** (2013.01); **H01Q 1/243**

(2013.01)

(71) Applicant: **wiSpry, Inc.**, Irvine, CA (US)

(72) Inventors: **Rocio Rodríguez-Cano**, Aalborg (DK);
Shuai Zhang, Aalborg SV (DK); **Gert
Frølund Pedersen**, Storvorde (DK)

(21) Appl. No.: **16/240,260**

(22) Filed: **Jan. 4, 2019**

Related U.S. Application Data

(60) Provisional application No. 62/614,118, filed on Jan.
5, 2018.

(57)

ABSTRACT

Devices, systems, and methods in which antenna elements are positioned together as an array at a corner of a mobile device, at least two of the antenna elements being oriented to provide beams in different directions with respect to the corner of the mobile device.

