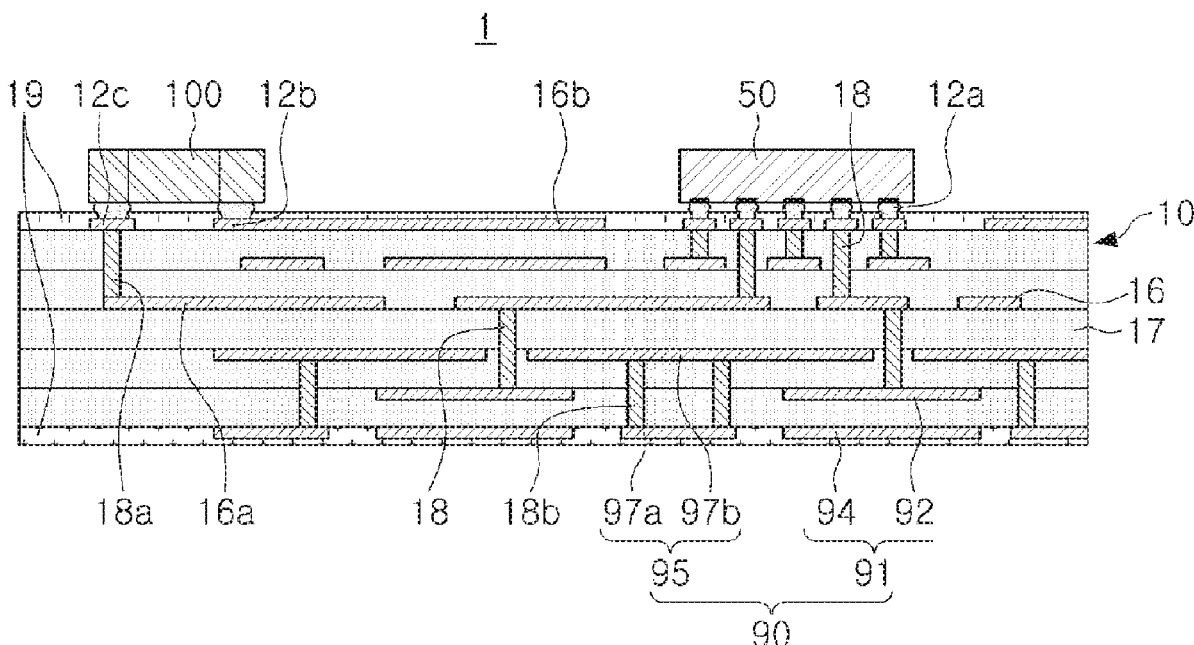




(43) **Pub. Date:** **Mar. 19, 2020**





US 20200091589A1

(19) **United States**(12) **Patent Application Publication**
CHEN et al.(10) **Pub. No.: US 2020/0091589 A1**(43) **Pub. Date: Mar. 19, 2020**(54) **ANTENNA STRUCTURE****Publication Classification**(71) Applicant: **Shenzhen Next Generation Communications Limited**, Shenzhen (CN)(72) Inventors: **JIA CHEN**, Shenzhen (CN); **KUO-CHENG CHEN**, New Taipei (TW); **JIAN-WEI CHANG**, New Taipei (TW); **ZHEN-CHANG TANG**, Shenzhen (CN); **BO PENG**, Shenzhen (CN); **WEI-YU YE**, Shenzhen (CN); **CHUN-SHENG WU**, New Taipei (TW)(51) **Int. Cl.****H01Q 1/24** (2006.01)**H01Q 5/10** (2006.01)**H01Q 5/30** (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/243** (2013.01); **H01Q 5/30** (2015.01); **H01Q 5/10** (2015.01)

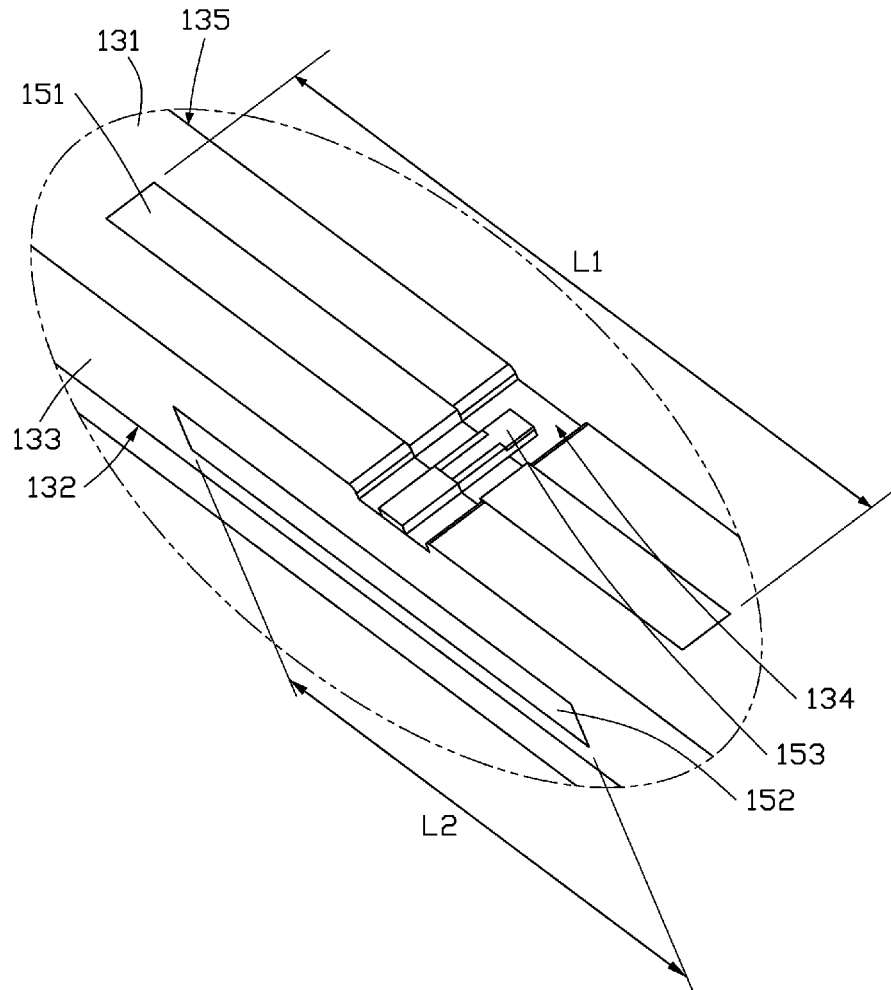
(57)

ABSTRACT

An antenna structure includes a metal frame. The metal frame includes a first surface, a second surface, and a third surface. The third surface is located between the first surface and the second surface. The metal frame includes at least one antenna. The at least one antenna includes a first gap, a second gap, and a feed portion. The first gap is disposed between the first surface and the second surface. The second gap is disposed in the third surface. The feed portion is mounted on the first surface and spans the first gap. When the feed portion supplies an electric current, the electric current is coupled to the first gap and the second gap.

(21) Appl. No.: **16/568,981**(22) Filed: **Sep. 12, 2019**(30) **Foreign Application Priority Data**

Sep. 13, 2018 (CN) 201811070579.3

16



US 20200091595A1

(19) **United States**(12) **Patent Application Publication**
LEE(10) **Pub. No.: US 2020/0091595 A1**(43) **Pub. Date: Mar. 19, 2020**(54) **ANTENNA STRUCTURE**(71) Applicant: **Wistron NeWeb Corp.**, Hsinchu (TW)(72) Inventor: **Yun-Tsan LEE**, Hsinchu (TW)(21) Appl. No.: **16/562,682**(22) Filed: **Sep. 6, 2019**(30) **Foreign Application Priority Data**

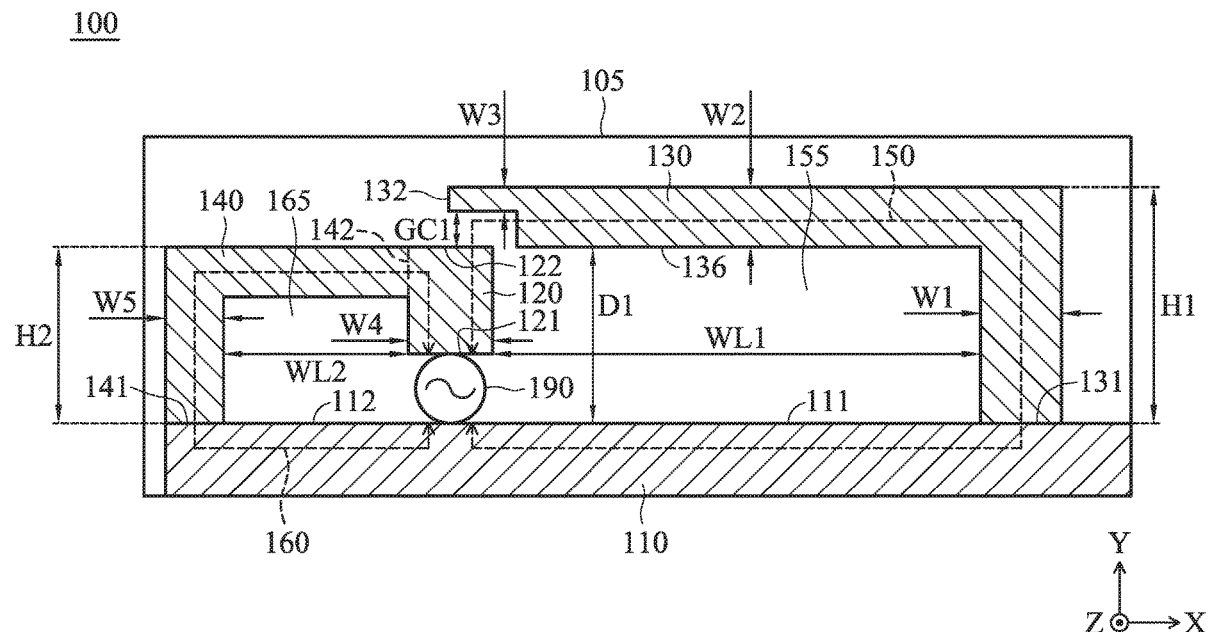
Sep. 19, 2018 (TW) 107132949

Publication Classification(51) **Int. Cl.****H01Q 1/36** (2006.01)**H01Q 1/48** (2006.01)**H01Q 1/52** (2006.01)**H01Q 1/22** (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/36** (2013.01); **H01Q 1/22**
(2013.01); **H01Q 1/52** (2013.01); **H01Q 1/48**
(2013.01)

(57)

ABSTRACT

An antenna structure includes a ground element, a feeding radiation element, a first radiation element, and a second radiation element. The feeding radiation element is coupled to a signal source. The first radiation element is coupled to the ground element. The first radiation element is adjacent to the feeding radiation element. The feeding radiation element is coupled through the second radiation element to the ground element. A first loop structure is formed by the feeding radiation element, the first radiation element, and the ground element. A second loop structure is formed by the feeding radiation element, the second radiation element, and the ground element. The second loop structure includes neither any branching portion nor any protruding portion.





US 20200099125A1

(19) **United States**(12) **Patent Application Publication**
YING et al.(10) **Pub. No.: US 2020/0099125 A1**(43) **Pub. Date: Mar. 26, 2020**(54) **ANTENNA OF MOBILE TERMINAL AND
MOBILE TERMINAL****Publication Classification**(71) Applicant: **HUAWEI TECHNOLOGIES CO.,
LTD.**, SHENZHEN, GUANGDONG
(CN)(72) Inventors: **Lijun YING**, Shanghai (CN); **Hanyang
WANG**, Reading (GB); **Liang XUE**,
Shanghai (CN); **Jiaqing YOU**,
Shanghai (CN); **Chien-Ming LEE**,
Shanghai (CN); **Xiaoli YANG**,
Shanghai (CN); **Dong YU**, Shanghai
(CN); **Lei WANG**, Shanghai (CN)(51) **Int. Cl.****H01Q 1/24** (2006.01)
H01Q 5/378 (2006.01)
H01Q 5/371 (2006.01)
H01Q 9/04 (2006.01)
H01Q 1/48 (2006.01)
H01Q 1/50 (2006.01)(52) **U.S. Cl.****CPC** **H01Q 1/243** (2013.01); **H01Q 5/378**
(2015.01); **H01Q 1/50** (2013.01); **H01Q 9/045**
(2013.01); **H01Q 1/48** (2013.01); **H01Q 5/371**
(2015.01)(21) Appl. No.: **16/495,806**(22) PCT Filed: **Sep. 16, 2017**(86) PCT No.: **PCT/CN2017/088683**

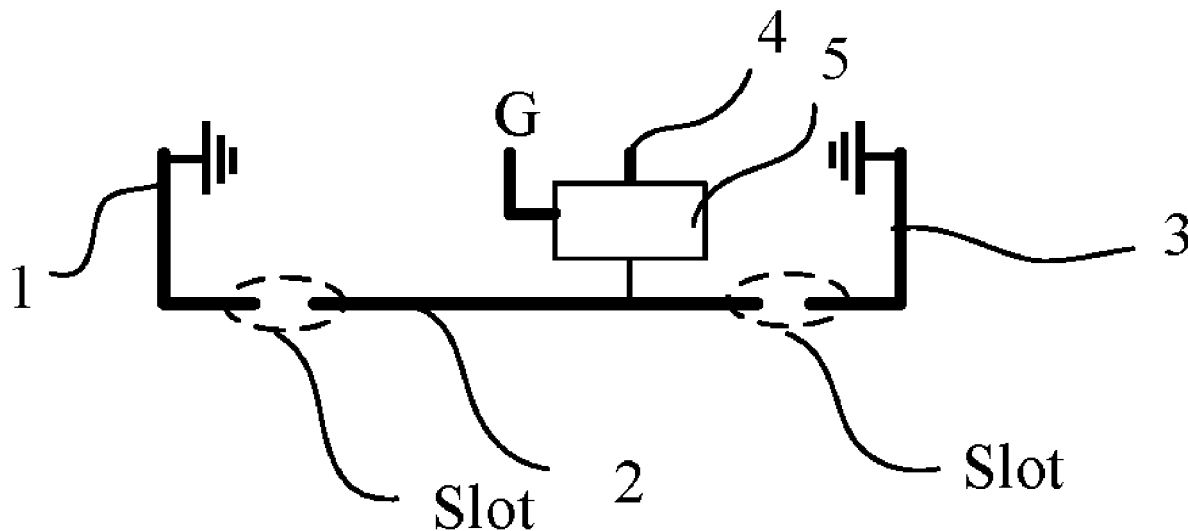
§ 371 (c)(1),

(2) Date: **Sep. 19, 2019**(30) **Foreign Application Priority Data**

Mar. 20, 2017 (CN) 201710166832.4

ABSTRACT

An antenna and a mobile terminal are provided. At least two slots are disposed in a metal bezel of the mobile terminal, and the two slots divide the metal bezel into three metal sections. A radiating element of the antenna includes a second metal section located between the two slots, a first conductor, and a second conductor. The first conductor and the second conductor are separately connected to the second metal section. A feed point is connected to the first conductor by using a matching network. A ground point is connected to the second conductor to form a loop antenna. An electrical length path of a current from the feed point to the second metal section is not equal to an electrical length path of a current from the ground point to the second metal section.





US 20200099126A1

(19) **United States**(12) **Patent Application Publication**
MA et al.(10) **Pub. No.: US 2020/0099126 A1**(43) **Pub. Date: Mar. 26, 2020**(54) **ANTENNA ARRANGEMENT FOR AN
ELECTRONIC DEVICE**(71) Applicant: **MICROSOFT TECHNOLOGY
LICENSING, LLC**, Redmond, WA
(US)(72) Inventors: **Guozhong MA**, Beijing (CN); **Anrong
ZHANG**, Beijing (CN); **Jie ZHANG**,
Beijing, WA (US); **Wei WANG**,
Beijing, WA (US)(21) Appl. No.: **16/696,445**(22) Filed: **Nov. 26, 2019****Related U.S. Application Data**(63) Continuation of application No. 15/751,149, filed on
Feb. 7, 2018, now Pat. No. 10,498,013, filed as
application No. PCT/US2016/042698 on Jul. 18,
2016.**Foreign Application Priority Data**

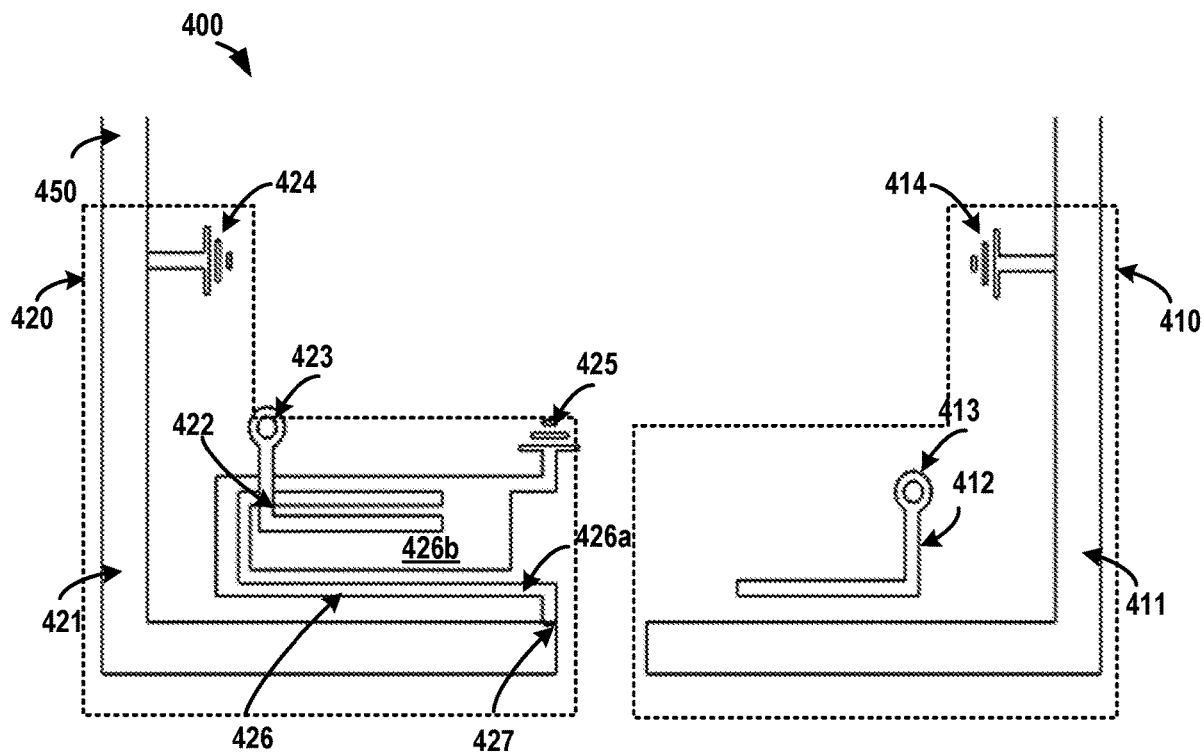
(30) Aug. 7, 2015 (CN) 201510484994.3

Publication Classification(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)**H01Q 1/52** (2006.01)**H01Q 21/00** (2006.01)**H01Q 9/42** (2006.01)**H01Q 21/28** (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/243** (2013.01); **H01Q 1/48**
(2013.01); **H01Q 1/523** (2013.01); **H01Q**
21/28 (2013.01); **H01Q 21/0087** (2013.01);
H01Q 9/42 (2013.01); **H01Q 1/521** (2013.01);
H01Q 21/0075 (2013.01)

(57)

ABSTRACT

The subject matter described herein relates to an antenna arrangement, an electronic device and a method for manufacturing the antenna arrangement. In one implementation, the antenna arrangement comprises a first antenna and a second antenna. The first antenna includes a first metal section connected to a first grounding point and a first initial radiator for feeding first radiations to the first metal section. The second antenna includes a second metal section connected to a second grounding point and a second initial radiator for feeding second radiations to the second metal section. The first and second metal sections are integral parts of a housing of the electronic device and separated by an opening. The second metal section is further connected to a third grounding point to provide isolation between the two antennae. Thus, a pair of antennae with a good antenna performance can be built with the same one structure.





US 20200099138A1

(19) **United States**(12) **Patent Application Publication****Garrido Lopez et al.**(10) **Pub. No.: US 2020/0099138 A1**(43) **Pub. Date: Mar. 26, 2020**(54) **ELECTRONIC DEVICE SLOT ANTENNAS**(71) Applicant: **Apple Inc.**, Cupertino, CA (US)(72) Inventors: **David Garrido Lopez**, Campbell, CA (US); **Harish Rajagopalan**, San Jose, CA (US); **Umar Azad**, Santa Clara, CA (US); **Rodney A. Gomez Angulo**, Santa Clara, CA (US)(21) Appl. No.: **16/141,793**(22) Filed: **Sep. 25, 2018****Publication Classification**(51) **Int. Cl.**

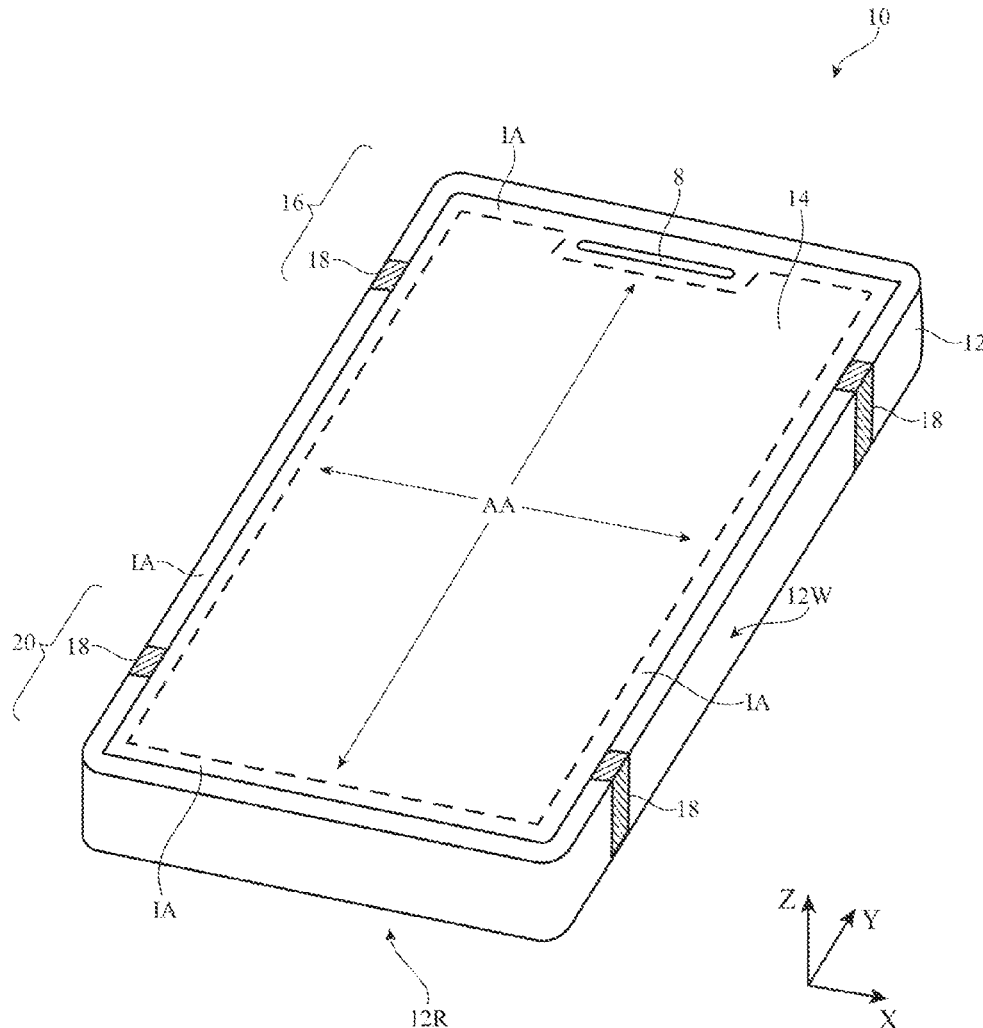
H01Q 13/10	(2006.01)
H01Q 1/24	(2006.01)
H01Q 21/30	(2006.01)
H01Q 9/42	(2006.01)
H01Q 21/28	(2006.01)
H01Q 9/04	(2006.01)

(52) **U.S. Cl.**CPC **H01Q 13/103** (2013.01); **H01Q 1/243** (2013.01); **H01Q 9/0407** (2013.01); **H01Q 9/42** (2013.01); **H01Q 21/28** (2013.01); **H01Q 21/30** (2013.01)

(57)

ABSTRACT

An electronic device may be provided an antenna, a display, and a housing. The display may include a conductive display structure and a cover layer. The housing may include peripheral conductive structures and a conductive rear wall. The peripheral structures may include a ledge separated from the conductive display structure by a gap. The peripheral structures and the rear wall may define opposing edges of a slot element for the antenna. Conductive bridging structures may be coupled between the conductive display structure and the ledge across the gap. The bridging structures may at least partially overlap locations along the length of the slot element where antenna currents around the slot element exhibit a maximum magnitude. The bridging structures may align the phase of current induced on the ledge with the phase of the current induced on the conductive display structure to maximize antenna efficiency through the cover layer.





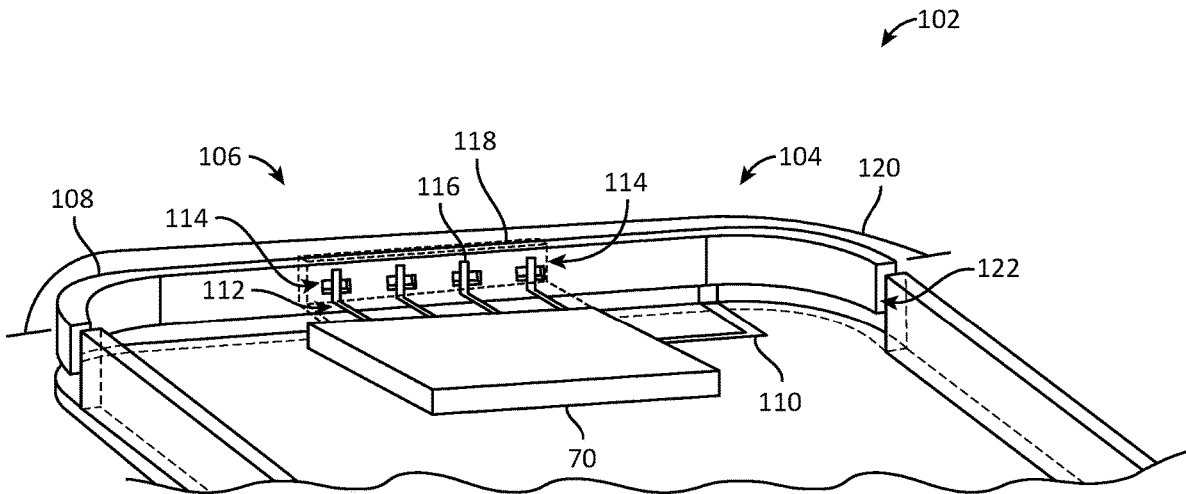
US 20200106157A1

(19) **United States**(12) **Patent Application Publication**
TRAN(10) **Pub. No.: US 2020/0106157 A1**(43) **Pub. Date: Apr. 2, 2020**(54) **COMMON-RADIATOR MULTI-BAND
ANTENNA SYSTEM**(52) **U.S. Cl.**CPC *H01Q 1/243* (2013.01); *H01Q 1/2291*
(2013.01); *G06F 1/1698* (2013.01)(71) Applicant: **QUALCOMM Incorporated**, San
Diego, CA (US)

(57)

ABSTRACT(72) Inventor: **Allen Minh-Triet TRAN**, San Diego,
CA (US)(21) Appl. No.: **16/145,880**(22) Filed: **Sep. 28, 2018****Publication Classification**(51) **Int. Cl.***H01Q 1/24* (2006.01)*G06F 1/16* (2006.01)*H01Q 1/22* (2006.01)

An example of a wireless communication antenna system includes: a sub-6 antenna including a radiator configured to radiate or receive first energy having a first frequency, the first frequency being below 6 GHz, the radiator being electrically conductive; a first feed configured and disposed to electrically couple the first energy to or from the radiator; and a second feed configured and disposed to electrically couple second energy to or from the radiator, the second energy having a second frequency, the second frequency being above 23 GHz; where the radiator is configured to radiate or receive the second energy.





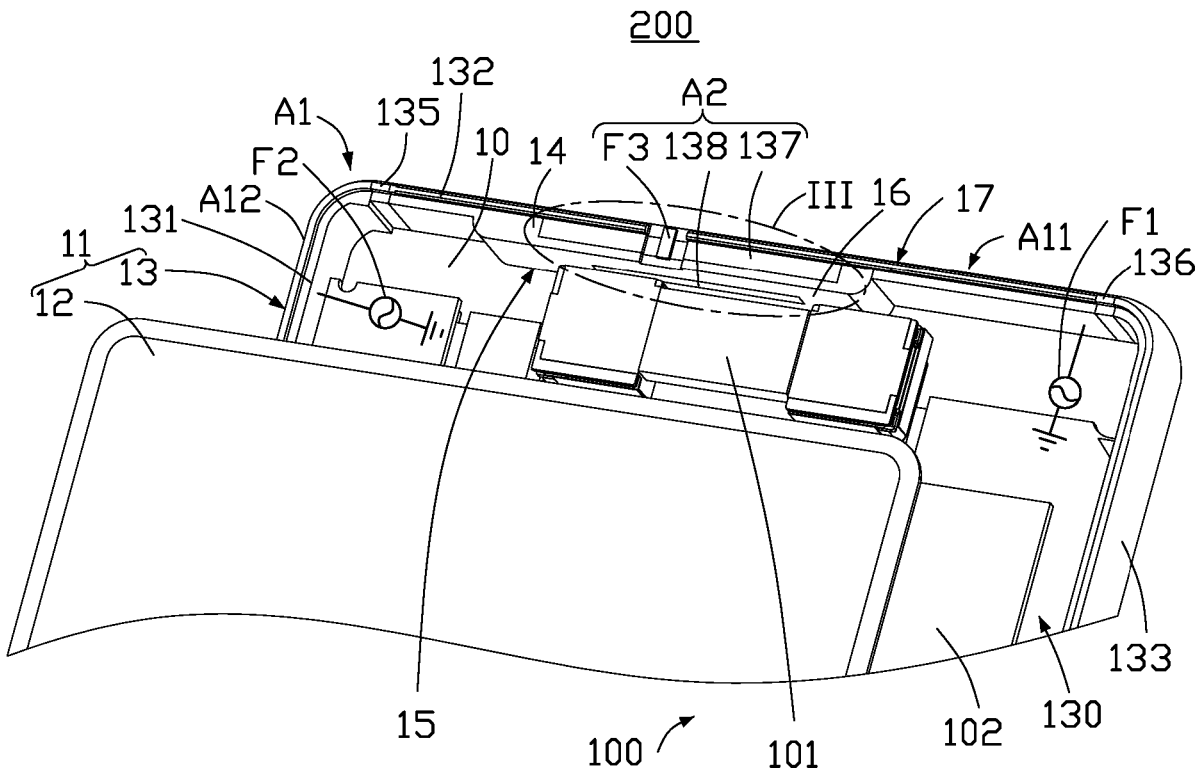
US 20200106160A1

(19) **United States**(12) **Patent Application Publication**
CHEN et al.(10) **Pub. No.: US 2020/0106160 A1**(43) **Pub. Date: Apr. 2, 2020**(54) **ANTENNA STRUCTURE****H01Q 5/328** (2006.01)**H01Q 5/10** (2006.01)**H01Q 9/04** (2006.01)**H01Q 9/40** (2006.01)(71) Applicant: **Shenzhen Next Generation Communications Limited**, Shenzhen (CN)(52) **U.S. Cl.**CPC **H01Q 1/243** (2013.01); **H01Q 1/36** (2013.01); **H01Q 9/40** (2013.01); **H01Q 5/10** (2015.01); **H01Q 9/0407** (2013.01); **H01Q 5/328** (2015.01)(72) Inventors: **JIA CHEN**, Shenzhen (CN); **KUO-CHENG CHEN**, New Taipei (TW); **JIAN-WEI CHANG**, New Taipei (TW); **ZHEN-CHANG TANG**, Shenzhen (CN); **BO PENG**, Shenzhen (CN); **WEI-YU YE**, Shenzhen (CN); **CHUN-SHENG WU**, New Taipei (TW); **YI-LING JIANG**, Shenzhen (CN)(21) Appl. No.: **16/571,476**(22) Filed: **Sep. 16, 2019**(30) **Foreign Application Priority Data**

Sep. 29, 2018 (CN) 201811150057.4

Publication Classification(51) **Int. Cl.****H01Q 1/24** (2006.01)**H01Q 1/36** (2006.01)(57) **ABSTRACT**

An antenna structure includes a metal frame, at least one feed source, and a feed portion. The metal frame includes at least one radiating portion and at least one slot. The at least one slot is disposed in the at least one radiating portion or adjacent to the at least one radiating portion. The at least one feed source and the at least one radiating portion form a first antenna. The feed portion and the at least one slot form a second antenna. The at least one feed source supplies an electric current for the first antenna, thereby exciting a first working mode and generating a radiation signal in a first frequency band. The feed portion spans the at least one slot to supply the electric current for the second antenna, thereby exciting a second working mode and generating a radiation signal in a second frequency band.





US 20200106164A1

(19) **United States**

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

(10) **Pub. No.: US 2020/0106164 A1**

(43) **Pub. Date: Apr. 2, 2020**

(54) **ELECTRONIC DEVICE**

Publication Classification

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

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

(72) Inventors: **Wei WANG**, Beijing (CN); **Jian REN**, Beijing (CN); **Zhiyuan DUAN**, Beijing (CN); **Shuangjie WU**, Beijing (CN)

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

(21) Appl. No.: **16/581,123**

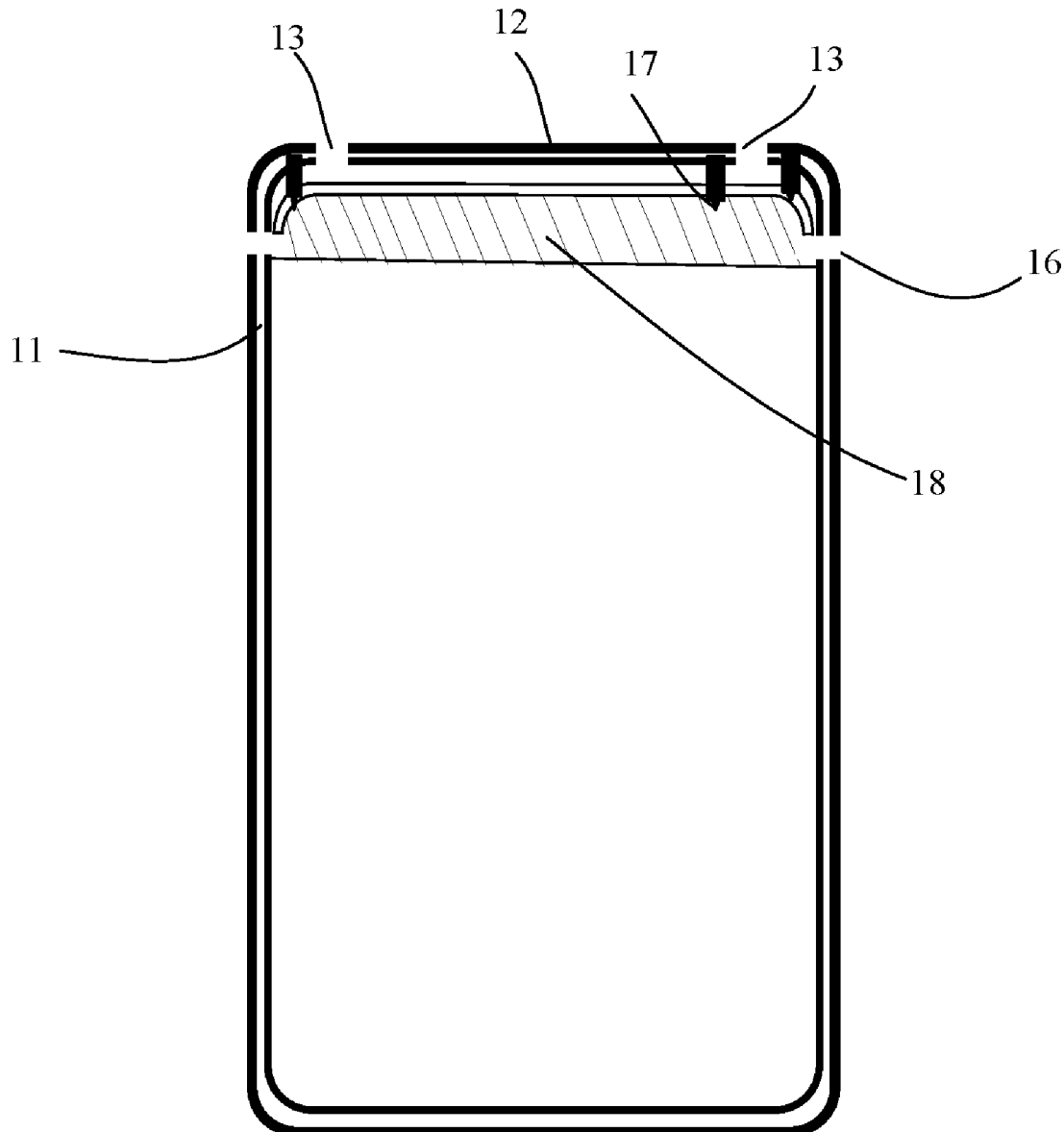
(22) Filed: **Sep. 24, 2019**

(30) **Foreign Application Priority Data**

Sep. 30, 2018 (CN) 201811162946.2

(57) **ABSTRACT**

An electronic device is provided. The device includes a metal frame. The metal frame includes a first side and the first side includes three metal segments separated by two first gaps. The three metal segments include a first metal segment and the first metal segment is used to realize a first antenna. An operating frequency band of the first antenna at least includes 5 GHz to enable the electronic device to support a fifth-generation mobile communication network.





US 20200106165A1

(19) **United States**

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

(10) **Pub. No.: US 2020/0106165 A1**

(43) **Pub. Date: Apr. 2, 2020**

(54) **ELECTRONIC DEVICE**

Publication Classification

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

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 21/06 (2006.01)
H01Q 5/50 (2006.01)
H01Q 13/10 (2006.01)

(72) Inventors: **Wei WANG**, Beijing (CN); **Jian REN**, Beijing (CN); **Zhiyuan DUAN**, Beijing (CN); **Shuangjie WU**, Beijing (CN)

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 13/10* (2013.01); *H01Q 5/50* (2015.01); *H01Q 21/064* (2013.01)

(21) Appl. No.: **16/581,731**

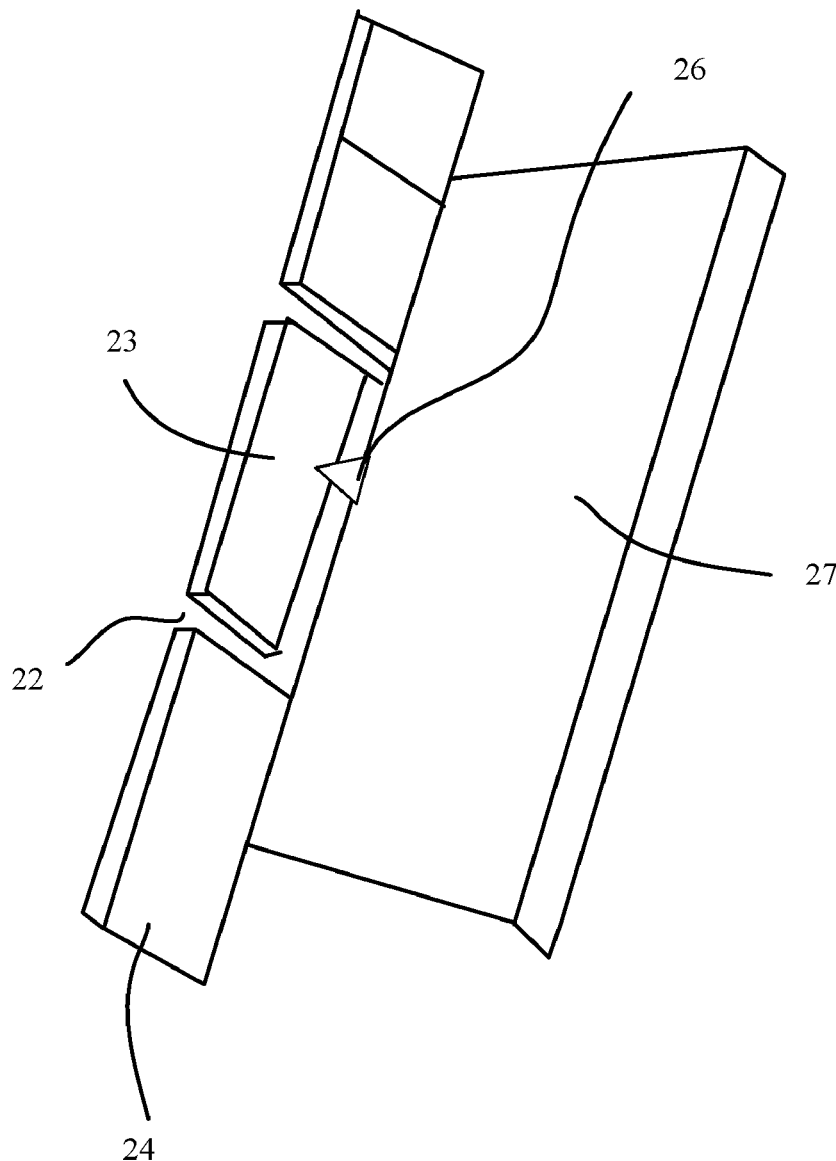
(57) **ABSTRACT**

(22) Filed: **Sep. 24, 2019**

(30) **Foreign Application Priority Data**

Sep. 30, 2018 (CN) 201811162945.8

The present disclosure provides an electronic device including: a metal housing having four antenna slots, which correspond to four antennas that enable the electronic device to support a fifth generation mobile communication network. The present disclosure can realize antennas that enable an electronic device having a metal back housing to support a fifth generation mobile communication network.





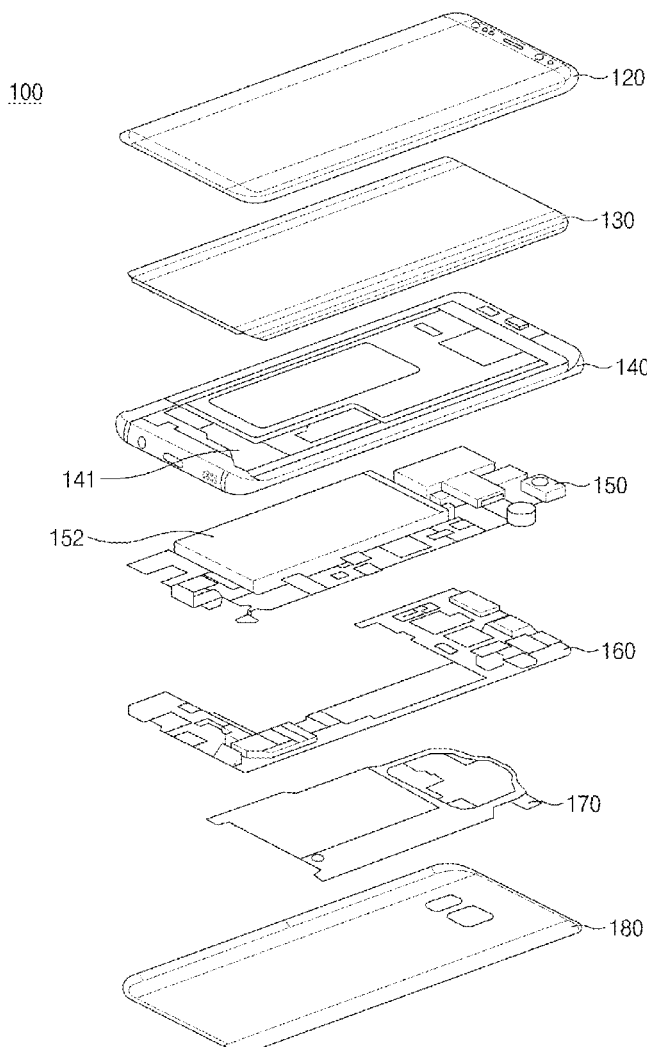
US 20200106167A1

(19) **United States**(12) **Patent Application Publication**
MOON et al.(10) **Pub. No.: US 2020/0106167 A1**(43) **Pub. Date: Apr. 2, 2020**(54) **ELECTRONIC DEVICE INCLUDING
ANTENNA MODULE**(71) Applicant: **Samsung Electronics Co., Ltd.**,
Suwon-si (KR)(72) Inventors: **Heecheul MOON**, Suwon-si (KR);
Sangyoup SEOK, Suwon-si (KR);
Kwonho SON, Suwon-si (KR)(21) Appl. No.: **16/591,552**(22) Filed: **Oct. 2, 2019**(30) **Foreign Application Priority Data**

Oct. 2, 2018 (KR) 10-2018-0117623

Publication Classification(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 23/00 (2006.01)**H01Q 9/16** (2006.01)
H04M 1/02 (2006.01)(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H04M 1/026**
(2013.01); **H01Q 9/16** (2013.01); **H01Q 23/00**
(2013.01)(57) **ABSTRACT**

An electronic device includes a housing that includes a front plate facing a first direction, a back plate facing a second direction opposite to the first direction, and a side member surrounding a space between the front plate and the back plate and at least a portion of which is formed of a metal material. A display is viewable through the front plate, and an antenna module is positioned in the space and includes a first surface facing a third direction different from the first direction and the second direction, a second surface facing a fourth direction different from the third direction, and at least one conductive element extended in a fifth direction, which is perpendicular to the third direction and the fourth direction and faces a first portion of the side member, adjacent to the side member, and between the first surface and the second surface.





US 20200106177A1

(19) **United States**(12) **Patent Application Publication****Zhou et al.**(10) **Pub. No.: US 2020/0106177 A1**(43) **Pub. Date: Apr. 2, 2020**(54) **ANTENNA AND MOBILE TERMINAL****Publication Classification**(71) Applicant: **Huawei Technologies Co., Ltd.**,
Shenzhen (CN)(72) Inventors: **Dawei Zhou**, Beijing (CN); **Yuanpeng Li**, Beijing (CN); **Tiezhu Liang**,
Beijing (CN); **Gonglei Zhang**, Beijing
(CN)(51) **Int. Cl.****H01Q 5/10** (2006.01)**H01Q 1/24** (2006.01)**H01Q 1/48** (2006.01)(52) **U.S. Cl.**CPC **H01Q 5/10** (2015.01); **H01Q 1/48**
(2013.01); **H01Q 1/24** (2013.01)(21) Appl. No.: **16/620,359**(22) PCT Filed: **Dec. 27, 2018**(86) PCT No.: **PCT/CN2018/124150**

§ 371 (c)(1),

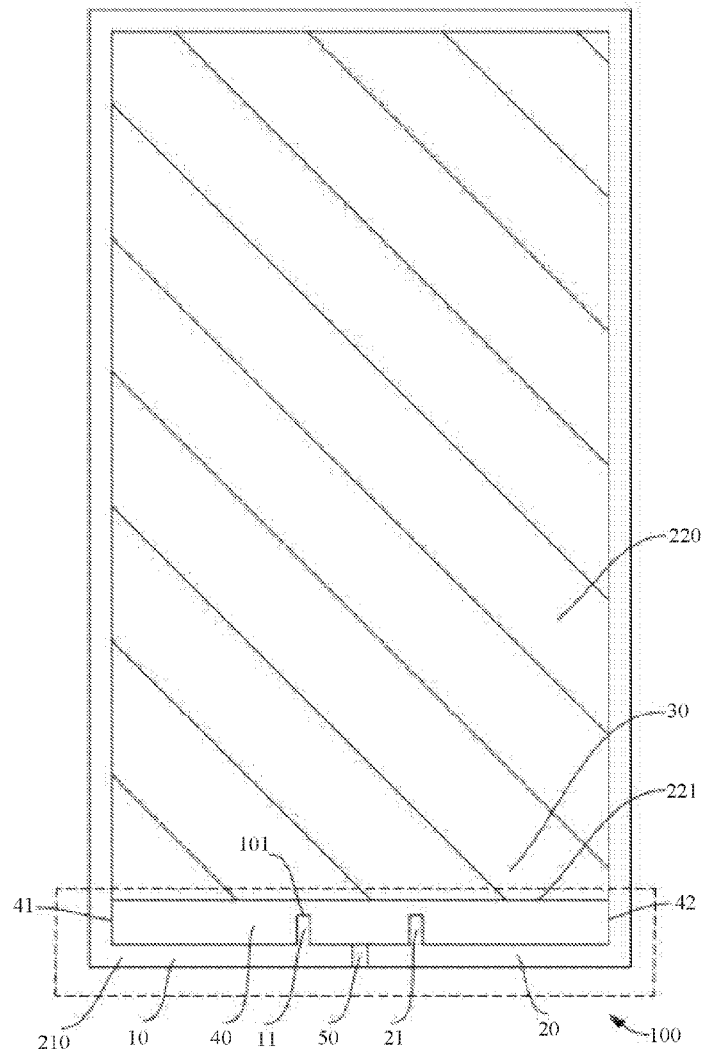
(2) Date: **Dec. 6, 2019**(30) **Foreign Application Priority Data**

Jun. 1, 2018 (CN) 201810554555.9

(57)

ABSTRACT

This application relates to an antenna disposed on a mobile terminal. The mobile terminal includes a radiation portion and a circuit board, the circuit board includes a lateral side and a grounding layer, and an insulating slot divides the radiation portion into a feed stub and a parasitic stub. A gap is encompassed by the circuit board and the radiation portion. There is a first branch that extends from the feed stub to the gap for feeding the antenna, and there is a second branch that extends from the parasitic stub to the gap and that is electrically connected to a grounding portion. The antenna excites a current loop winding around the gap on the grounding portion, the feed stub, and the parasitic stub.





US 20200106178A1

(19) **United States**(12) **Patent Application Publication**
CHOU(10) **Pub. No.: US 2020/0106178 A1**(43) **Pub. Date: Apr. 2, 2020**(54) **ANTENNA SYSTEM****H01Q 1/22** (2006.01)**H01Q 21/00** (2006.01)(71) Applicant: **Wistron Corp.**, New Taipei City (TW)(52) **U.S. Cl.**(72) Inventor: **Chen-Yu CHOU**, New Taipei City (TW)CPC **H01Q 5/20** (2015.01); **H01Q 21/0006** (2013.01); **H01Q 1/2291** (2013.01); **H01Q 1/243** (2013.01)(21) Appl. No.: **16/186,434**(22) Filed: **Nov. 9, 2018**

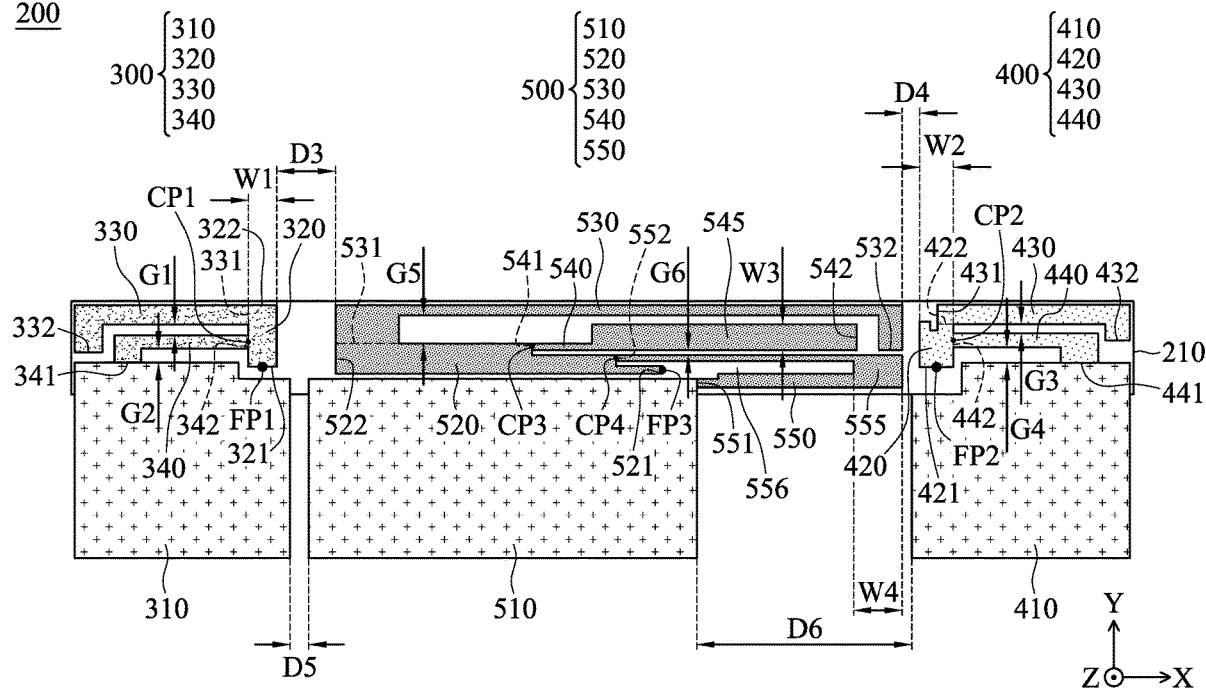
(57)

ABSTRACT(30) **Foreign Application Priority Data**

Oct. 2, 2018 (TW) 107134801

Publication Classification(51) **Int. Cl.****H01Q 5/20** (2006.01)**H01Q 1/24** (2006.01)

An antenna system includes a first antenna, a second antenna, and a third antenna. The third antenna is disposed between the first antenna and the second antenna. Both the first antenna and the second antenna operate in a first frequency band. The third antenna operates in a second frequency band which is different from the first frequency band. The first antenna, the second antenna, and the third antenna are all disposed on the same plane.

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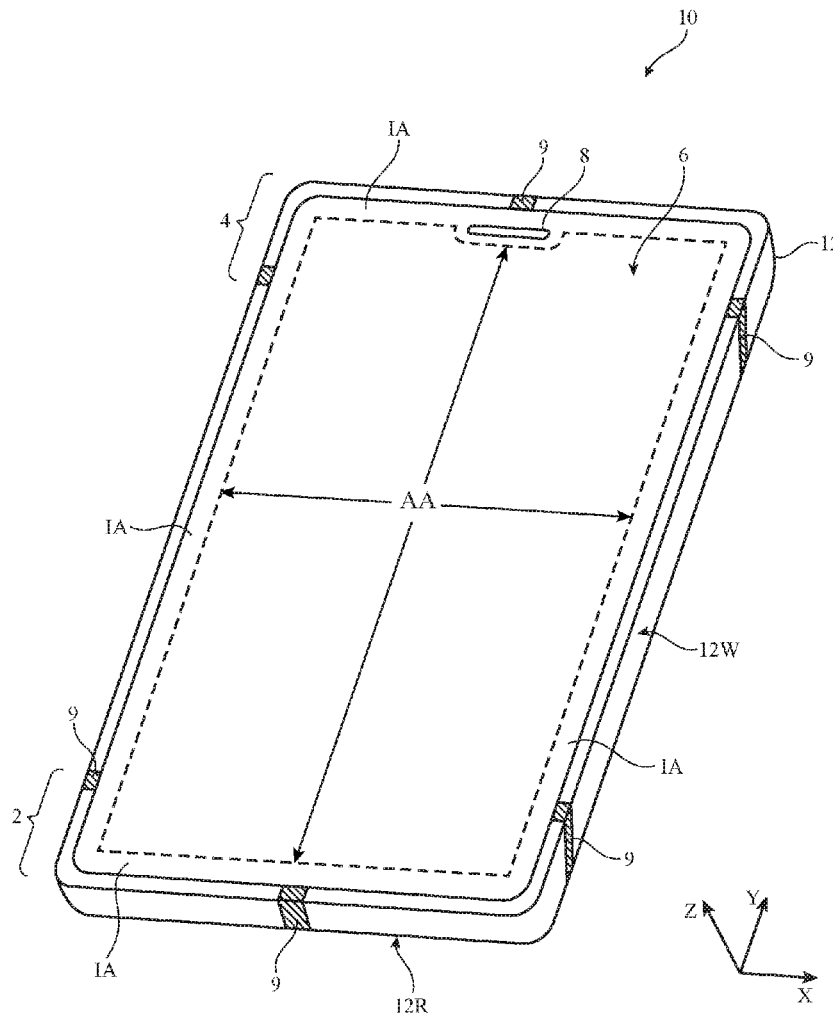
US 20200106181A1

(19) **United States**(12) **Patent Application Publication****Avser et al.**(10) **Pub. No.: US 2020/0106181 A1**(43) **Pub. Date:****Apr. 2, 2020**(54) **ELECTRONIC DEVICES HAVING
ANTENNAS WITH SYMMETRIC FEEDING**(52) **U.S. Cl.**CPC **H01Q 9/045** (2013.01); **H01Q 21/065**
(2013.01); **H01Q 1/24** (2013.01)(71) Applicant: **Apple Inc.**, Cupertino, CA (US)(72) Inventors: **Bilgehan Avser**, Mountain View, CA
(US); **Jennifer M. Edwards**, San
Francisco, CA (US); **Simone Paulotto**,
Redwood City, CA (US); **Harish**
Rajagopalan, San Jose, CA (US); **Hao**
Xu, Cupertino, CA (US); **Rodney A.**
Gomez Angulo, Santa Clara, CA (US);
Matthew A. Mow, Los Altos, CA (US);
Mattia Pascolini, San Francisco, CA
(US)

(57)

ABSTRACT

An electronic device may be provided with a phased antenna array. Each antenna in the array may include a patch element having first, second, third, and fourth positive antenna feed terminals. The first and second terminals may convey first signals with a first polarization. The third and fourth terminals may convey second signals with a second polarization. Phase shifting components such as phase shifting transmission line segments or phase shifter circuits may ensure that the first signals at the first terminal are out of phase with respect to the first signals at the second terminal and may ensure that the second signals at the third terminal are out of phase with respect to the second signals at the fourth terminal. This may allow antenna current density for both polarizations to be symmetrically distributed about a normal axis of the patch element.

(21) Appl. No.: **16/146,705**(22) Filed: **Sep. 28, 2018****Publication Classification**(51) **Int. Cl.****H01Q 9/04** (2006.01)**H01Q 1/24** (2006.01)**H01Q 21/06** (2006.01)



US 20200106184A1

(19) **United States**

(12) **Patent Application Publication**
FABREGA SANCHEZ et al.

(10) **Pub. No.: US 2020/0106184 A1**

(43) **Pub. Date: Apr. 2, 2020**

(54) **WIDE-BAND DIPOLE ANTENNA**

(71) Applicant: **QUALCOMM Incorporated**, San Diego, CA (US)

(72) Inventors: **Jorge FABREGA SANCHEZ**, San Diego, CA (US); **Mohammad Ali TASSOUDJI**, San Diego, CA (US)

(21) Appl. No.: **16/146,742**

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

Publication Classification

(51) **Int. Cl.**

H01Q 9/26 (2006.01)

H01Q 1/24 (2006.01)

H01Q 1/38 (2006.01)

H01Q 5/364 (2006.01)

H01Q 21/06 (2006.01)

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

CPC **H01Q 9/26** (2013.01); **H01Q 1/243**

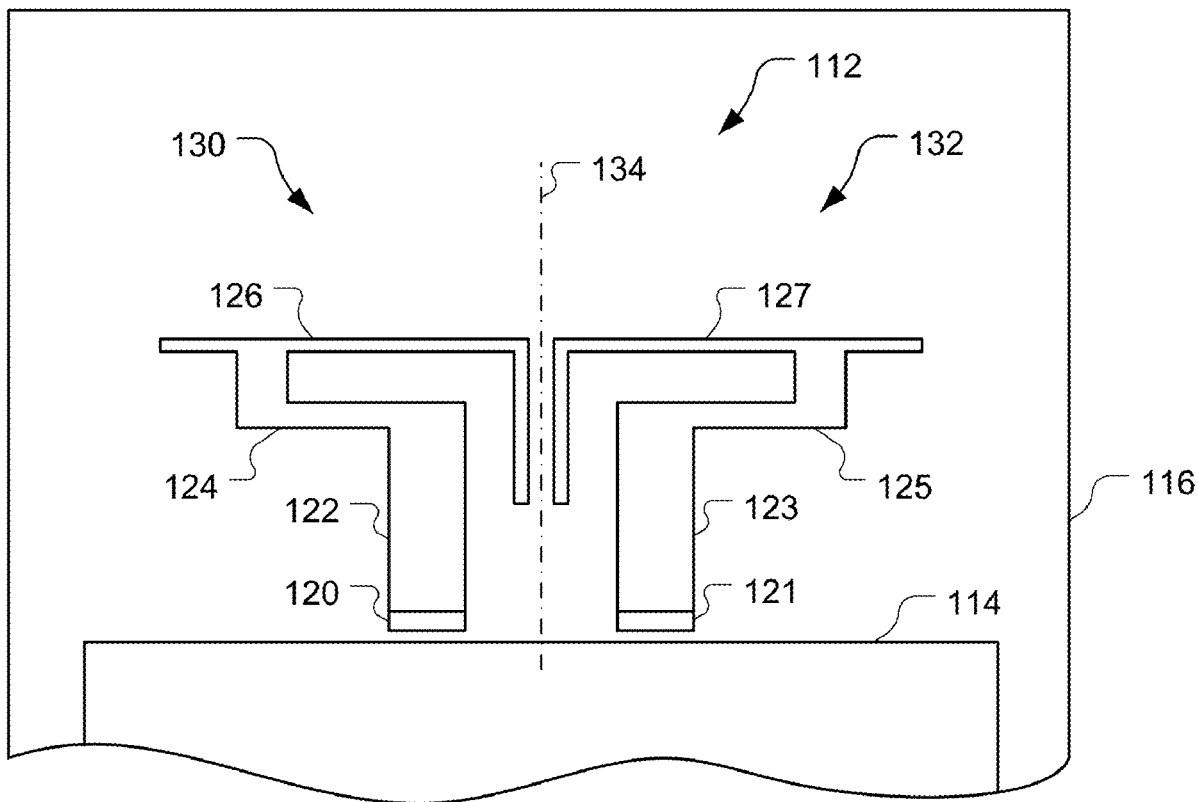
(2013.01); **H01Q 21/062** (2013.01); **H01Q**

5/364 (2015.01); **H01Q 1/38** (2013.01)

(57)

ABSTRACT

A millimeter-wave antenna system includes: a ground plane; and a folded dipole radiator including: a plurality of feeds each extending away from the ground plane from a proximal feed end to a distal end; a plurality of radiating arms each coupled to and extending away from the distal feed end of a respective one of the plurality of feeds; and a plurality of folded conductors each coupled to a respective one of the plurality of radiating arms and each having a distal portion extending toward the ground plane to a distal conductor end; where each of the plurality of feeds and each of the plurality of radiating arms comprises an electrical conductor; and where the folded dipole radiator is discontinuous, without a conductive connection between the plurality of feeds via the plurality of radiating arms.





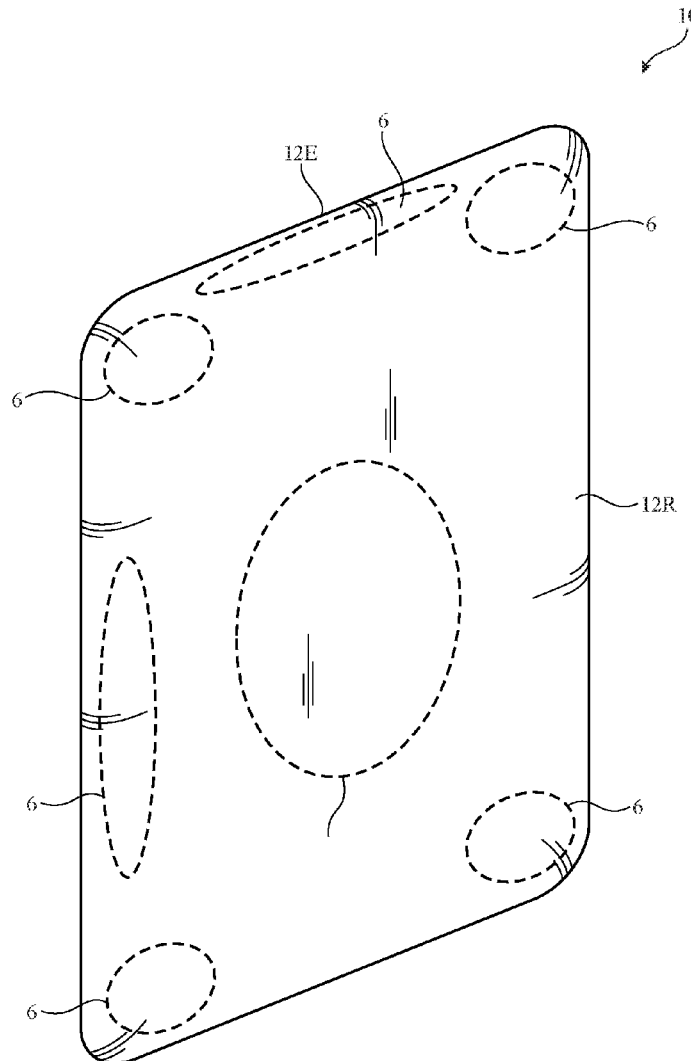
US 20200106185A1

(19) **United States**(12) **Patent Application Publication****Paulotto et al.**(10) **Pub. No.: US 2020/0106185 A1**(43) **Pub. Date: Apr. 2, 2020**(54) **ELECTRONIC DEVICES HAVING ANTENNA
MODULE ISOLATION STRUCTURES**(52) **U.S. Cl.**CPC *H01Q 11/14* (2013.01); *H01Q 3/443*
(2013.01); *H01Q 1/38* (2013.01); *H01Q 1/422*
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(57)

ABSTRACT

An electronic device may be provided with a phased antenna array controlled by phase and magnitude controllers within an integrated circuit. The array may be formed on antenna layers and the integrated circuit may be mounted to transmission line layers of a dielectric substrate. A ground plane may separate the transmission line layers from the antenna layers. A connector may be mounted to the surface of the transmission line layers and may be coupled to the integrated circuit using conductive traces. A passive resonator may be formed in the antenna layers and may include conductive structures that resonate at one-quarter of the effective wavelength of operation of the array to form an open circuit impedance for surface currents generated on the ground plane by the array. This may serve to block the surface currents from scattering at an edge of the ground plane and leaking onto the integrated circuit.

(21) Appl. No.: **16/146,488**(22) Filed: **Sep. 28, 2018****Publication Classification**(51) **Int. Cl.***H01Q 11/14* (2006.01)
H01Q 1/42 (2006.01)
H01Q 1/38 (2006.01)
H01Q 3/44 (2006.01)



(19) **United States**

(12) Patent Application Publication

Ayser et al.

(10) Pub. No.: US 2020/0106192 A1

(43) **Pub. Date:** **Apr. 2, 2020**

(54) **ELECTRONIC DEVICE HAVING
DUAL-BAND ANTENNAS MOUNTED
AGAINST A DIELECTRIC LAYER**

H01Q 5/357 (2006.01)

H01Q 1/38 (2006.01)

(52) U.S. Cl.

CPC *H01Q 21/065* (2013.01); *H01Q 21/064*
(2013.01); *H01Q 1/38* (2013.01); *H01Q 5/357*
(2015.01); *H01Q 5/28* (2015.01)

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(21) Appl. No.: 16/146,649

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

Publication Classification

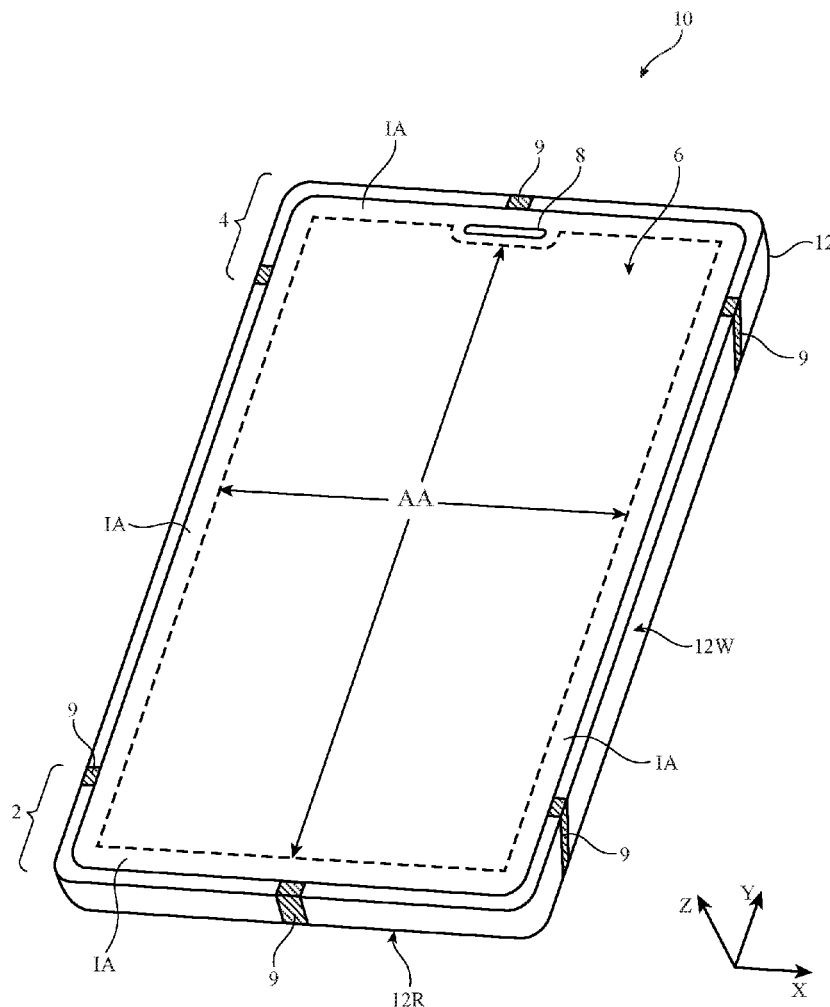
(51) **Int. Cl.**

H01Q 21/06 (2006.01)

H01Q 5/28 (2006.01)

(57) **ABSTRACT**

An electronic device may be provided with a cover layer and a phased antenna array mounted against the cover layer. Each antenna in the array may include a first patch element that is directly fed using first and second feeds and a second patch element that is directly fed using third and fourth feeds. A slot element may be formed in the first patch element. The first patch element may radiate in a first frequency band through the cover layer. The slot element may radiate in a second frequency band that is higher than the first frequency band through the cover layer. The second patch element may indirectly feed the slot element. Locating the radiating elements for each frequency band in the same plane may allow the antenna to radiate through the cover layer in both frequency bands with satisfactory antenna efficiency.





US 20200112080A1

(19) **United States**(12) **Patent Application Publication**
WU et al.(10) **Pub. No.: US 2020/0112080 A1**(43) **Pub. Date: Apr. 9, 2020**(54) **ANTENNA MODULE AND
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May 30, 2018 (TW) 107118548

Publication Classification(51) **Int. Cl.**
H01Q 1/22 (2006.01)
H01Q 1/24 (2006.01)**H01Q 13/10** (2006.01)**H01Q 5/357** (2006.01)**H01Q 5/50** (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/2266** (2013.01); **H01Q 1/24**
(2013.01); **H01Q 5/50** (2015.01); **H01Q 5/357**
(2015.01); **H01Q 13/106** (2013.01)(57) **ABSTRACT**

An antenna module includes a metal board, an inverted F metal plate and an antenna unit. A slot is provided between the inverted F metal plate and the metal board, the inverted F metal plate and the metal board are integrally formed, and the inverted F metal plate is disposed perpendicular to the metal board. The antenna unit is disposed corresponding to the slot and the inverted F metal plate, and includes a radiation part and a ground part. The radiation part is coupled to a signal feeding point and includes a first radiation body and a second radiation body. The first radiation body, the slot and the inverted F metal plate operate cooperatively to generate a wireless signal at a first operating frequency. The second radiation body, the slot and the inverted F metal plate operate cooperatively to generate a wireless signal at a second operating frequency.

