



US 20210399406A1

(19) **United States**(12) **Patent Application Publication**
TSAI(10) **Pub. No.: US 2021/0399406 A1**(43) **Pub. Date: Dec. 23, 2021**(54) **ANTENNA STRUCTURE AND ELECTRONIC
DEVICE USING SAME**(52) **U.S. Cl.**CPC *H01Q 1/2266* (2013.01); *H01Q 1/243*
(2013.01); *H01Q 21/28* (2013.01)(71) Applicant: **Chiun Mai Communication Systems,
Inc.**, New Taipei (TW)

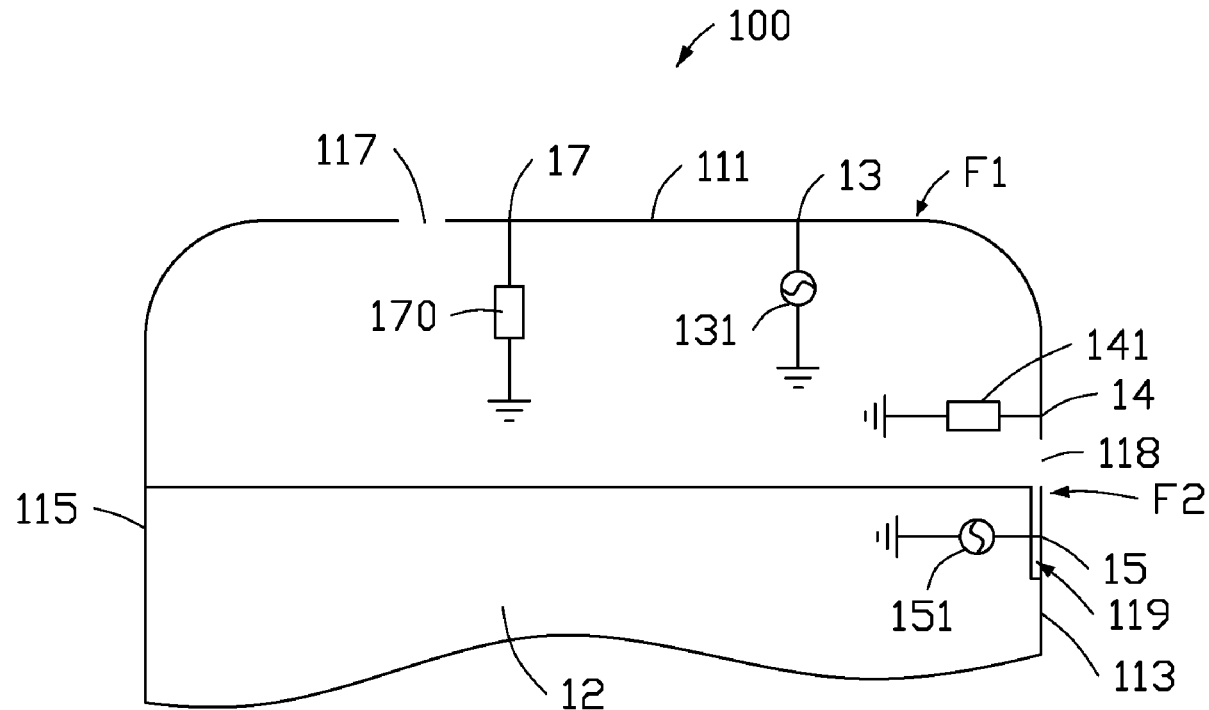
(57)

ABSTRACT(72) Inventor: **PANG-CHUN TSAI**, New Taipei (TW)(21) Appl. No.: **17/332,334**(22) Filed: **May 27, 2021**(30) **Foreign Application Priority Data**

Jun. 17, 2020 (CN) 202010552493.5

Publication Classification(51) **Int. Cl.***H01Q 1/22* (2006.01)*H01Q 21/28* (2006.01)

An antenna structure of reduced size but able to operate at multiple frequencies, and applied to an electronic device, includes a housing, a first feed point, a first radiation portion, a first ground point, a second radiation portion, and a second feed point. The housing has at least one portion made of metal material with first and second gaps therein. The housing between first and second gaps forms the first radiation portion. The first feed point feeds current and signal to the first radiation portion. The first ground point is spaced from the first feed point and is grounded through a first inductive element. The second radiation portion is adjacent to the first radiation portion. The second feed point is electrically connected to a second signal point and feeds current and signal to the second radiation portion.





US 20210399411A1

(19) **United States**

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

(10) **Pub. No.: US 2021/0399411 A1**

(43) **Pub. Date: Dec. 23, 2021**

(54) **ANTENNA DEVICE**

Publication Classification

(71) Applicant: **InnoLux Corporation**, Miao-Li County (TW)

(51) **Int. Cl.**

H01Q 1/36 (2006.01)

H01Q 9/04 (2006.01)

(72) Inventors: **Yi-Hung LIN**, Miao-Li County (TW);
Tang-Chin HUNG, Miao-Li County (TW); **Chia-Chi HO**, Miao-Li County (TW); **I-Yin LI**, Miao-Li County (TW)

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

CPC **H01Q 1/36** (2013.01); **H01Q 3/44** (2013.01); **H01Q 9/0407** (2013.01)

(21) Appl. No.: **17/462,461**

(22) Filed: **Aug. 31, 2021**

Related U.S. Application Data

(63) Continuation of application No. 16/546,504, filed on Aug. 21, 2019, now Pat. No. 11,139,562.

(60) Provisional application No. 62/731,141, filed on Sep. 14, 2018.

(30) **Foreign Application Priority Data**

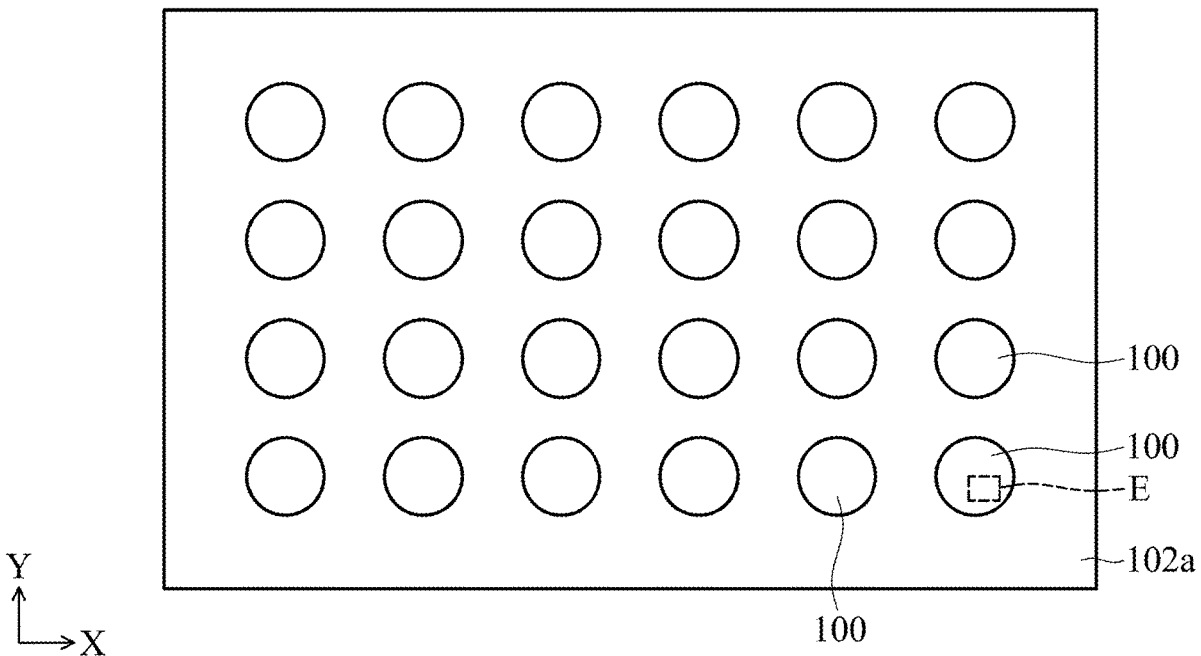
Apr. 15, 2019 (CN) 201910300447.3

(57)

ABSTRACT

An antenna device is provided. The antenna device includes a first substrate, a first conductive layer, a first insulating structure, a second substrate, a second conductive layer and a liquid-crystal layer. The first conductive layer is disposed on the first substrate. The first insulating structure is disposed on the first conductive layer, and the first insulating structure includes a first region and a second region. The second substrate is disposed opposite to the first substrate. The second conductive layer is disposed on the second substrate. The liquid-crystal layer is disposed between the first conductive layer and the second conductive layer. The thickness of the first region is less than the thickness of the second region, and at least a portion of the first region is disposed in an overlapping region of the first conductive layer and the second conductive layer.

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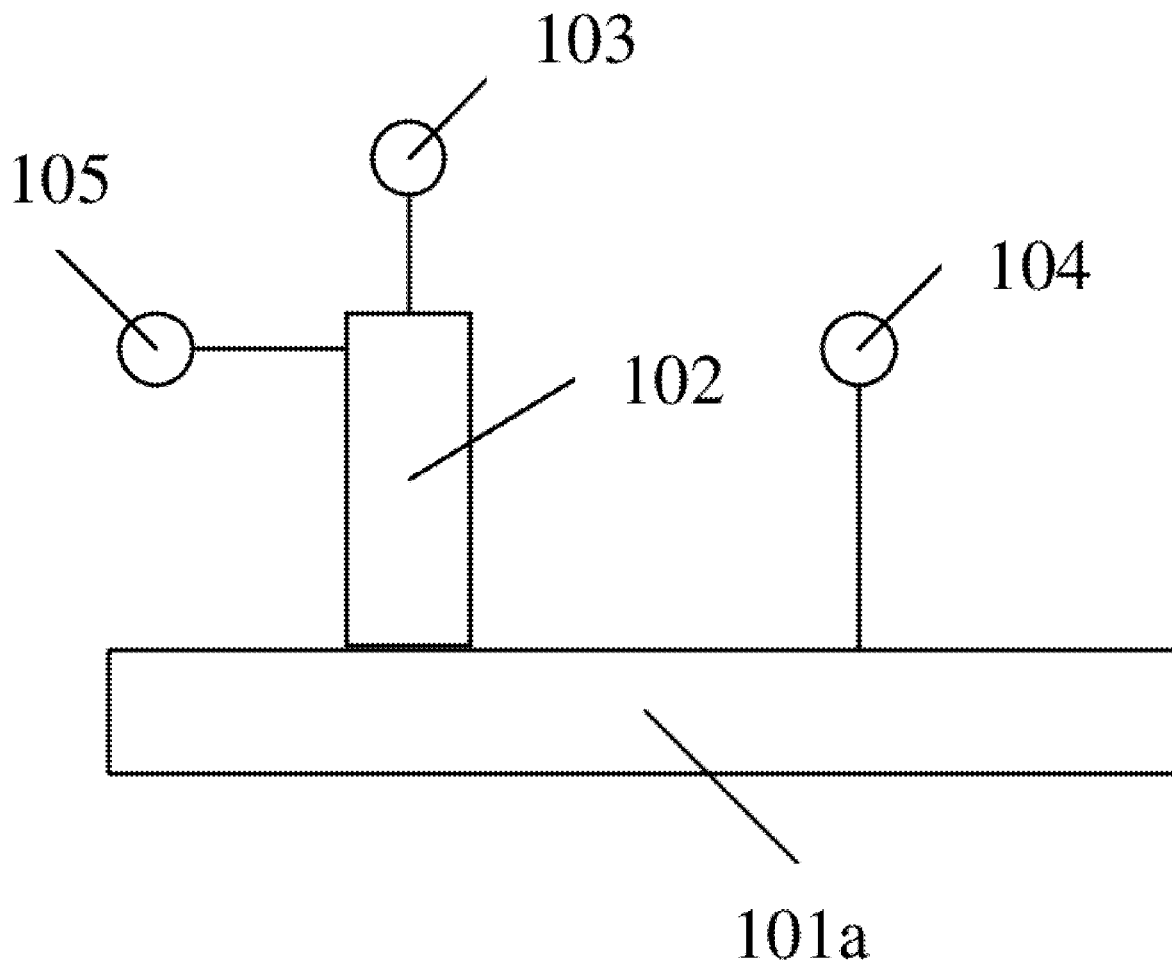
US 20210399420A1

(19) **United States**(12) **Patent Application Publication**
LI(10) **Pub. No.: US 2021/0399420 A1**(43) **Pub. Date: Dec. 23, 2021**(54) **ANTENNA MODULE AND TERMINAL**
DEVICE(52) **U.S. Cl.**CPC *H01Q 5/314* (2015.01); *H01Q 1/243*
(2013.01)(71) Applicant: **Beijing Xiaomi Mobile Software Co.,**
Ltd., Beijing (CN)(72) Inventor: **Yueliang LI**, Beijing (CN)(73) Assignee: **Beijing Xiaomi Mobile Software Co.,**
Ltd.(21) Appl. No.: **17/101,669**(22) Filed: **Nov. 23, 2020**(30) **Foreign Application Priority Data**

Jun. 23, 2020 (CN) 202010584138.6

Publication Classification(51) **Int. Cl.***H01Q 5/314* (2006.01)*H01Q 1/24* (2006.01)(57) **ABSTRACT**

An antenna module includes: a first radiator; a conductive sheet connected to the first radiator; a ground feeding point connected to the conductive sheet; a first feeding point connected to the first radiator; and at least one second feeding point apart from the first feeding point and connected to the conductive sheet at a position different from the ground feeding point, wherein the first feeding point, the first radiator, the conductive sheet, and the ground feeding point form a first path for radiating and receiving radio signals in a first frequency band, the second feeding point, the conductive sheet, and the first radiator form a second path for radiating and receiving radio signals in a second frequency band, and a central frequency of the first frequency band is not equal to that of the second frequency band.





US 20210399422A1

(19) **United States**(12) **Patent Application Publication**
FANG et al.(10) **Pub. No.: US 2021/0399422 A1**(43) **Pub. Date: Dec. 23, 2021**(54) **ANTENNA STRUCTURE**(71) Applicant: **Wistron Corp.**, New Taipei City (TW)(72) Inventors: **Ying-Sheng FANG**, New Taipei City (TW); **Po-Tsang LIN**, New Taipei City (TW); **Shih Ming CHUANG**, New Taipei City (TW); **Chia-Wei SU**, New Taipei City (TW)(21) Appl. No.: **16/934,246**(22) Filed: **Jul. 21, 2020**(30) **Foreign Application Priority Data**

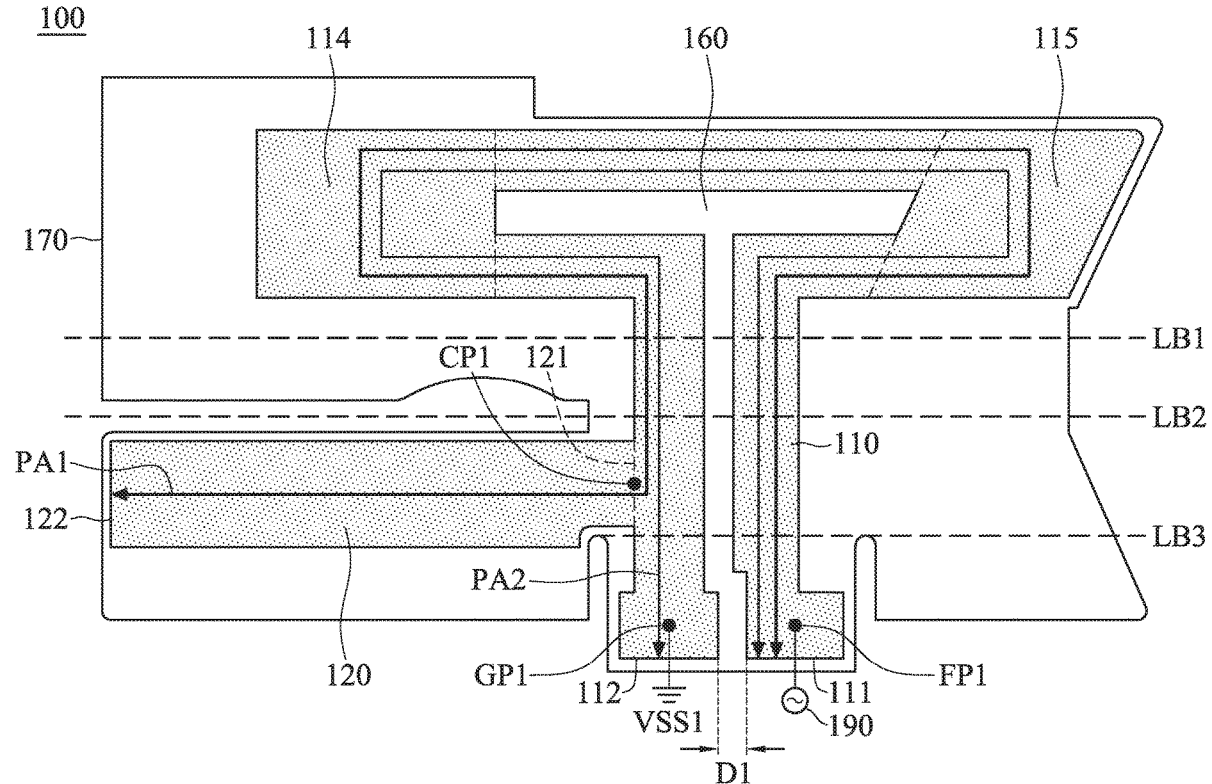
Jun. 23, 2020 (TW) 109121293

Publication Classification(51) **Int. Cl.****H01Q 7/00** (2006.01)**H01Q 5/357** (2006.01)**H01Q 9/16** (2006.01)**H01Q 11/14** (2006.01)(52) **U.S. Cl.**CPC **H01Q 7/005** (2013.01); **H01Q 11/14** (2013.01); **H01Q 9/16** (2013.01); **H01Q 5/357** (2015.01)

(57)

ABSTRACT

An antenna structure includes a loop radiation element and a first radiation element. The loop radiation element has a first end and a second end. A feeding point is positioned at the first end of the loop radiation element. A grounding point is positioned at the second end of the loop radiation element. The first radiation element has a first end and a second end. The first end of the first radiation element is coupled to a first connection point on the loop radiation element. The second end of the first radiation element is open. The antenna structure covers a first frequency band and a second frequency band.





US 20210399424A1

(19) **United States**(12) **Patent Application Publication****Tao et al.**(10) **Pub. No.: US 2021/0399424 A1**(43) **Pub. Date: Dec. 23, 2021**(54) **ANTENNA DEVICE**(71) Applicant: **Taoglas Group Holdings Limited,**
Enniscorthy (IE)(72) Inventors: **Yu Tao,** Taoyuan City (TW); **Yung Sheng Tseng,** Taoyuan City (TW)(21) Appl. No.: **17/351,601**(22) Filed: **Jun. 18, 2021**(30) **Foreign Application Priority Data**

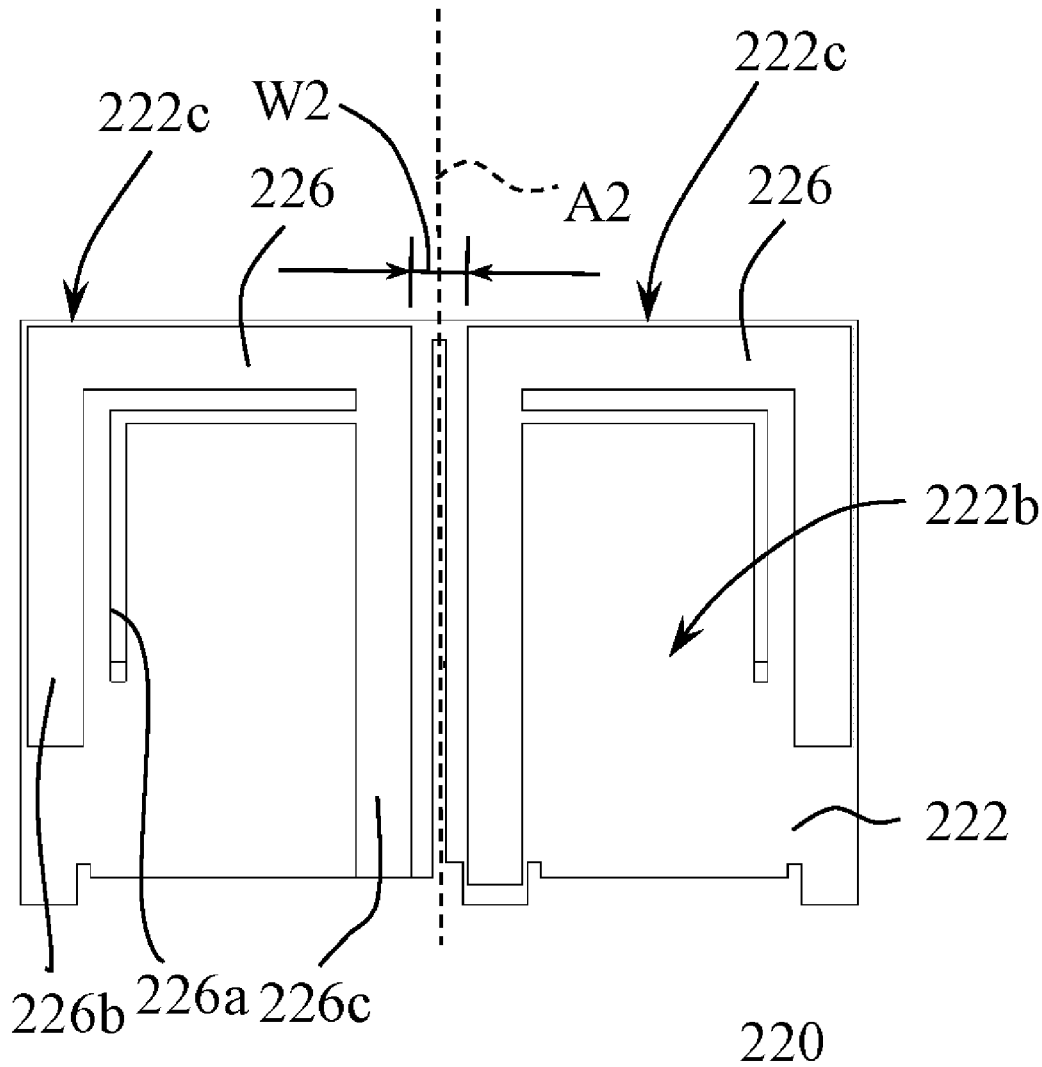
Jun. 20, 2020 (TW) 109120981

Publication Classification(51) **Int. Cl.**
H01Q 9/04 (2006.01)
H01Q 1/48 (2006.01)
H01Q 1/12 (2006.01)(52) **U.S. Cl.**CPC **H01Q 9/0407** (2013.01); **H01Q 1/12**
(2013.01); **H01Q 1/48** (2013.01)

(57)

ABSTRACT

An antenna device comprising a first antenna, a second antenna and a circuit board. The first antenna includes a first insulating layer, a first signal-feeding line and two first grounding lines. The first signal-feeding line is disposed on a first surface of the first insulating layer. The first grounding lines are disposed on a second surface of the first insulating layer. The second antenna includes a second insulating layer, a second signal-feeding line and two second grounding lines. The second signal-feeding line is disposed on a first surface of the second insulating layer. The second grounding lines are disposed on a second surface of the second insulating layer. The first insulating layer and the second insulating layer intersect at about 90 degrees. The first and second antennas are disposed on a first surface of the circuit board. The first axis and the second axis are adjacent and substantially parallel.





US 20210399428A1

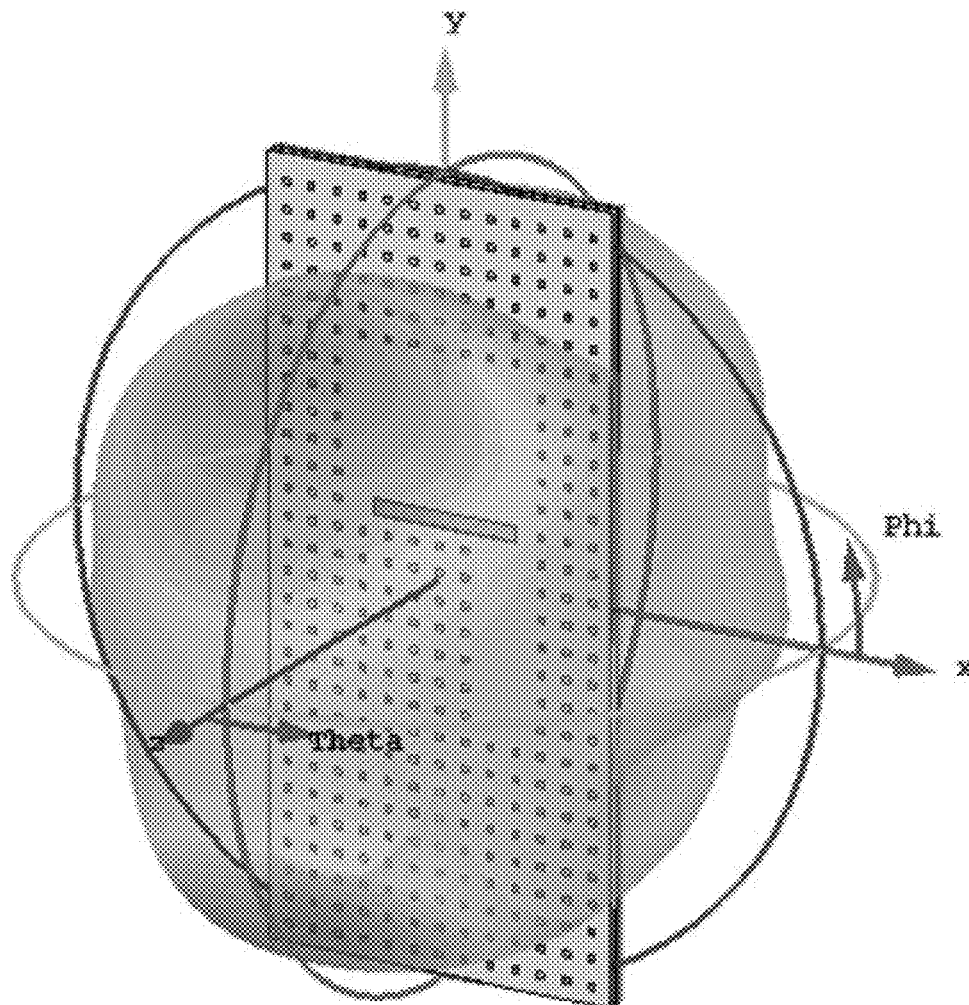
(19) **United States**(12) **Patent Application Publication**
SUZUKI et al.(10) **Pub. No.: US 2021/0399428 A1**(43) **Pub. Date: Dec. 23, 2021**(54) **ANTENNA APPARATUS**(71) Applicant: **SONY CORPORATION**, Tokyo (JP)(72) Inventors: **Yuichiro SUZUKI**, Tokyo (JP);
Takayoshi ITO, Tokyo (JP); **Tomihiko OMURO**, Tokyo (JP); **Toru OZONE**, Tokyo (JP); **Jin SATO**, Tokyo (JP); **Yoshiaki HIRAOKA**, Tokyo (JP)(73) Assignee: **Sony Group Corporation**, Tokyo (JP)(21) Appl. No.: **17/288,922**(22) PCT Filed: **Nov. 9, 2018**(86) PCT No.: **PCT/JP2018/041653**

§ 371 (c)(1),

(2) Date: **Apr. 27, 2021****Publication Classification**(51) **Int. Cl.****H01Q 13/10** (2006.01)**H01Q 21/24** (2006.01)(52) **U.S. Cl.**CPC **H01Q 13/10** (2013.01); **H01Q 21/24** (2013.01)(57) **ABSTRACT**

To provide a technology that can suppress the reduction of an antenna gain while maintaining the quality of the design of the exterior furnishing of the antenna.

Provided is an antenna apparatus including: an antenna module that includes a first slot antenna that transmits or receives a first wireless signal, a first feed element that supplies power to the first slot antenna, a second slot antenna that transmits or receives a second wireless signal having a polarization direction orthogonal to a polarization direction of the first wireless signal, and a second feed element that supplies power to the second slot antenna; and a metal plate that includes a first slot, and a second slot a longitudinal direction of which is orthogonal to a longitudinal direction of the first slot.





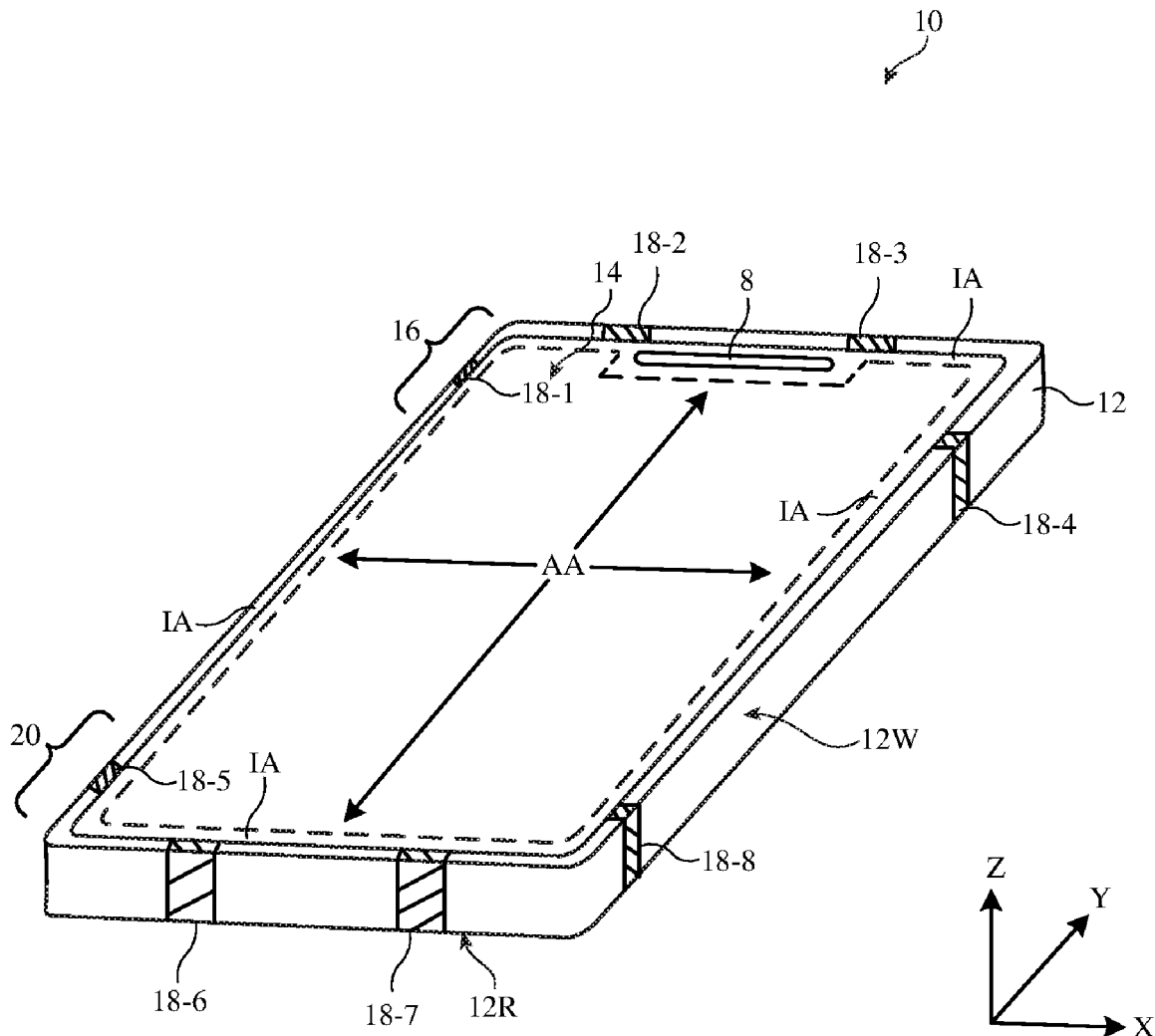
US 20210399429A1

(19) **United States**(12) **Patent Application Publication****Garrido Lopez et al.**(10) **Pub. No.: US 2021/0399429 A1**(43) **Pub. Date: Dec. 23, 2021**(54) **ELECTRONIC DEVICES HAVING
ANTENNAS FOR COVERING MULTIPLE
FREQUENCY BANDS****H01Q 5/50** (2006.01)**H04B 7/0413** (2006.01)(52) **U.S. Cl.**CPC **H01Q 13/18** (2013.01); **H04B 7/0413**
(2013.01); **H01Q 5/50** (2015.01); **H01Q**
21/005 (2013.01)(71) Applicant: **Apple Inc.**, Cupertino, CA (US)(72) Inventors: **David Garrido Lopez**, Campbell, CA
(US); **Aobo Li**, Saratoga, CA (US);
Forhad Hasnat, Cupertino, CA (US);
Harish Rajagopalan, San Jose, CA
(US); **Mikal Askarian Amiri**, Tempe,
AZ (US); **Rodney A. Gomez Angulo**,
Santa Clara, CA (US)(21) Appl. No.: **16/905,498**(22) Filed: **Jun. 18, 2020****Publication Classification**(51) **Int. Cl.****H01Q 13/18** (2006.01)**H01Q 21/00** (2006.01)

(57)

ABSTRACT

An electronic device may have a first conductive sidewall at an upper end, a second conductive sidewall at a lower end, and a conductive rear wall. First and second antennas may be formed at the upper end and may include slots with edges defined by the first sidewall and the rear wall. Third, fourth, fifth, and sixth antennas may be formed at the lower end and may include slots with edges defined by the second sidewall and the rear wall. Each antenna may cover multiple frequency bands. First order and third order modes of the slots may contribute to the frequency responses of the third through sixth antennas. A display controller may be mounted at the lower end and may impose a lower limit on the frequencies covered by the third through sixth antennas. The first and second antennas may cover lower frequencies than the third through sixth antennas.





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(19) **United States**

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

(10) **Pub. No.: US 2021/0399431 A1**

(43) **Pub. Date: Dec. 23, 2021**

(54) **BASE STATION ANTENNA**

Publication Classification

(71) Applicant: **CommScope Technologies LLC**,
Hickory, NC (US)

(51) **Int. Cl.**
H01Q 17/00 (2006.01)
H01Q 1/24 (2006.01)

(72) Inventors: **HAIYAN CHEN**, Suzhou (CN);
Pengfei Guo, Suzhou (CN)

(52) **U.S. Cl.**
CPC **H01Q 17/00** (2013.01); **H04W 88/08**
(2013.01); **H01Q 1/246** (2013.01)

(21) Appl. No.: **17/342,685**

(57) **ABSTRACT**

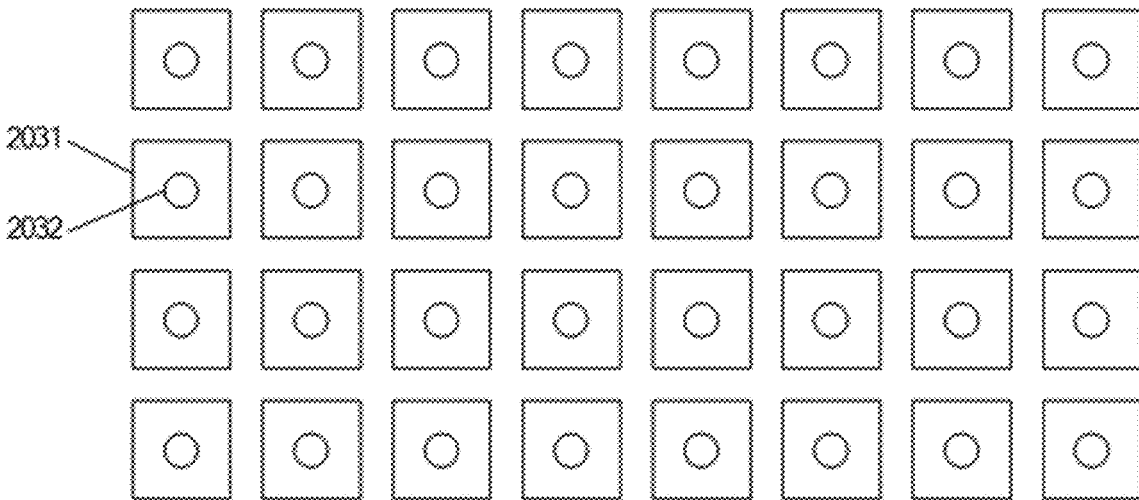
(22) Filed: **Jun. 9, 2021**

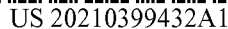
A base station antenna may include a radiation element configured to operate in a predetermined frequency band; and an absorbing device arranged above the radiation element and configured to absorb electromagnetic radiation of the predetermined frequency band. The absorbing device may be made of a metamaterial.

(30) **Foreign Application Priority Data**

Jun. 17, 2020 (CN) 202010552770.2

200





(12) **Patent Application Publication**
OKAJIMA

(43) **Pub. Date:** **Dec. 23, 2021**

Publication Classification

(51) **Int. Cl.**
H01Q 19/02 (2006.01)
H01Q 9/04 (2006.01)

(52) **U.S. Cl.**
CPC *H01Q 19/02* (2013.01); *H01Q 9/0485*
(2013.01); *H01Q 9/0457* (2013.01); *H01Q*
9/0421 (2013.01)

(57) **ABSTRACT**

An antenna device is supported by a supporting member. The antenna device includes a dielectric substrate and a patch antenna. The patch antenna comprises a radiating element and a ground conductor that are provided to the dielectric substrate. The linear conductor fixes a relative position between the antenna device and the supporting member in a direction orthogonal to a normal direction of the dielectric substrate. At least a part of the linear conductor is electromagnetically coupled with the patch antenna to act as a linear antenna.

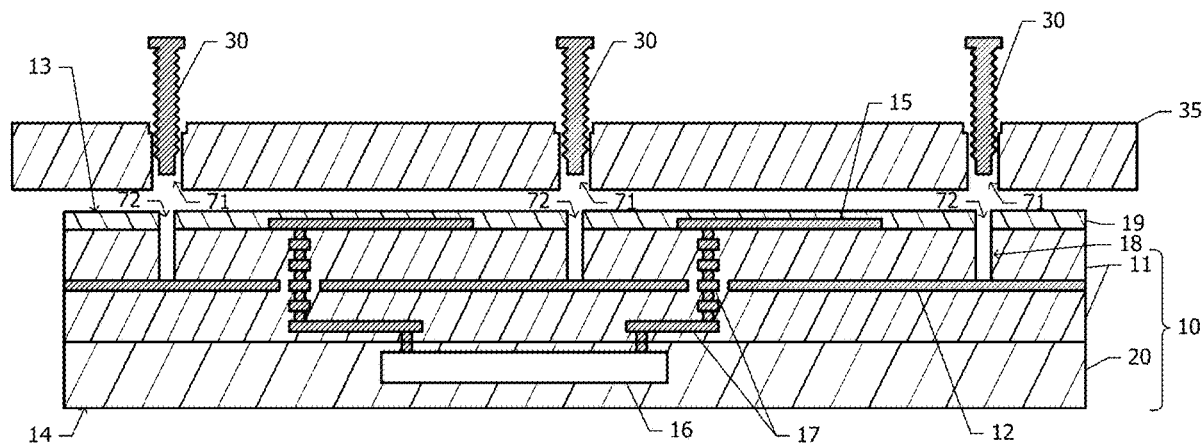
(22) Filed: **Sep. 2, 2021**

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2020/008117,
filed on Feb. 27, 2020.

(30) **Foreign Application Priority Data**

Mar. 4, 2019 (JP) 2019-038863





US 20210399435A1

(19) **United States**(12) **Patent Application Publication**
YOSHIKAWA(10) **Pub. No.: US 2021/0399435 A1**(43) **Pub. Date: Dec. 23, 2021**(54) **ANTENNA, WIRELESS COMMUNICATION
MODULE, AND WIRELESS
COMMUNICATION DEVICE**(52) **U.S. Cl.**CPC **H01Q 21/0006** (2013.01); **H01Q 1/48**
(2013.01); **H01Q 13/08** (2013.01)(71) Applicant: **KYOCERA Corporation**, Kyoto-shi,
Kyoto (JP)

(57)

ABSTRACT(72) Inventor: **Hiromichi YOSHIKAWA**,
Yokohama-shi, Kanagawa (JP)(21) Appl. No.: **17/288,914**(22) PCT Filed: **Oct. 25, 2019**(86) PCT No.: **PCT/JP2019/042058**

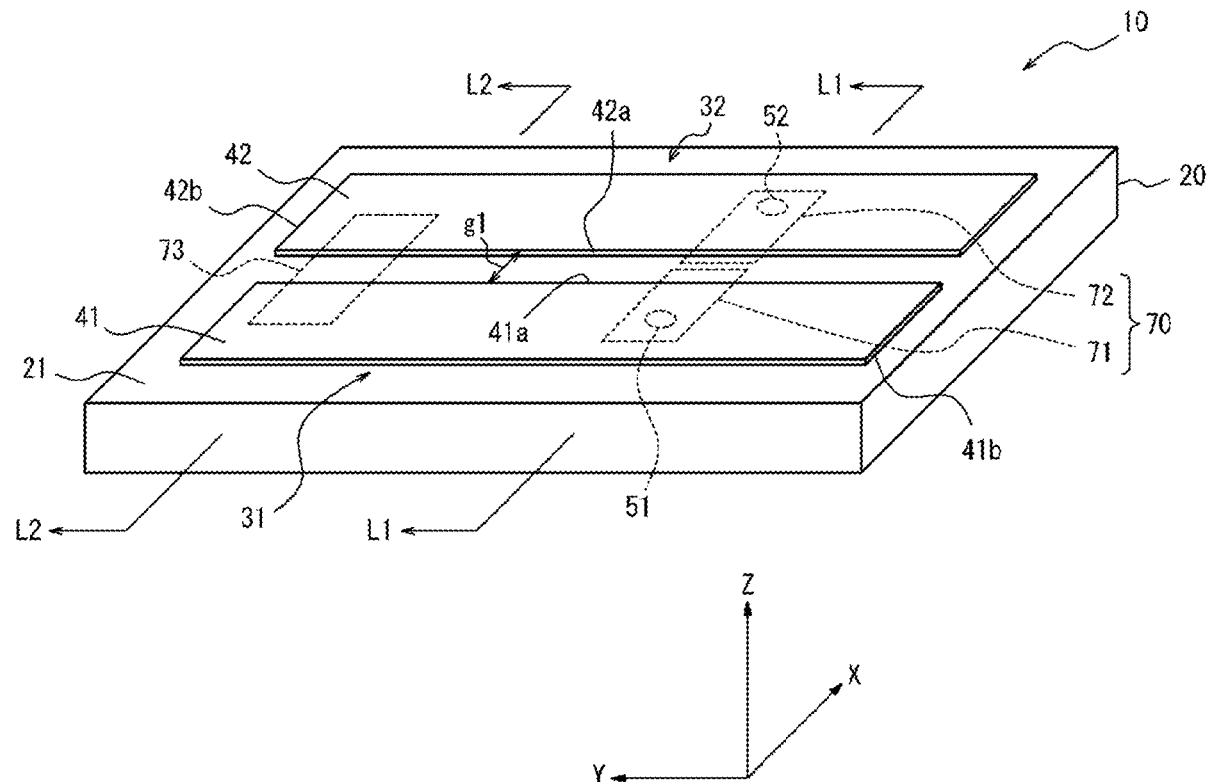
§ 371 (c)(1),

(2) Date: **Apr. 27, 2021**(30) **Foreign Application Priority Data**

Oct. 31, 2018 (JP) 2018-206002

Publication Classification(51) **Int. Cl.****H01Q 21/00** (2006.01)**H01Q 13/08** (2006.01)

An antenna includes first and second antenna elements and first and second couplers. The first antenna element includes a first radiation conductor and a first feeder line. The second antenna element includes a second radiation conductor and a second feeder line. The second feeder line is coupled to the first feeder line such that a first component, which is a capacitance component or an inductance component, is dominant. The first coupler couples the first and second feeder lines such that a second component is dominant. The first radiation conductor and the second radiation conductor are arranged at an interval of $\frac{1}{2}$ or less of a resonance wavelength. The second radiation conductor is coupled to the first radiation conductor with a first coupling method in which a capacitive coupling or a magnetic field coupling is dominant. The second coupler couples the first and second radiation conductors with a second coupling method.





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(19) **United States**

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

(10) **Pub. No.: US 2021/0399438 A1**

(43) **Pub. Date: Dec. 23, 2021**

(54) **ANTENNA DEVICE**

(71) Applicant: **CommScope Technologies LLC**,
Hickory, NC (US)

(72) Inventors: **Changfu Chen**, Suzhou (CN); **Xiaotuo Wang**, Suzhou (CN); **Xun Zhang**,
Suzhou (CN)

(21) Appl. No.: **17/348,890**

(22) Filed: **Jun. 16, 2021**

(30) **Foreign Application Priority Data**

Jun. 18, 2020 (CN) 202010559668.5

Publication Classification

(51) **Int. Cl.**

H01Q 21/24 (2006.01)

H01Q 1/52 (2006.01)

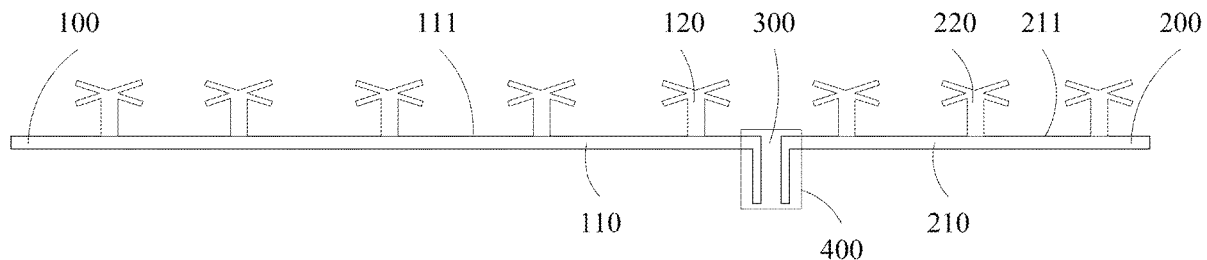
H01Q 15/14 (2006.01)

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

CPC **H01Q 21/24** (2013.01); **H01Q 15/14**
(2013.01); **H01Q 1/52** (2013.01)

(57) **ABSTRACT**

The present disclosure relates to an antenna device comprising: a first antenna comprising a first reflecting member configured to reflect at least a portion of a signal radiated by the antenna device; a second antenna comprising a second reflecting member configured to reflect at least a portion of the signal radiated by the antenna device, there is a spacing between the first reflecting member and the second reflecting member; and a coupling capacitor comprising a first polar plate and a second polar plate, the first polar plate is disposed on a side, close to the spacing, of a first reflecting surface of the first reflecting member, and the second polar plate is disposed on a side, close to the spacing, of a second reflecting surface of the second reflecting member.





US 20210408668A1

(19) **United States**(12) **Patent Application Publication**
LEE(10) **Pub. No.: US 2021/0408668 A1**(43) **Pub. Date: Dec. 30, 2021**(54) **ELECTRONIC DEVICE AND ANTENNA
ASSEMBLY****Publication Classification**(71) Applicant: **GETAC TECHNOLOGY
CORPORATION**, Taipei City (TW)(72) Inventor: **KUN-CHENG LEE**, Taipei City (TW)(21) Appl. No.: **17/357,476**(22) Filed: **Jun. 24, 2021****Related U.S. Application Data**(60) Provisional application No. 63/044,206, filed on Jun.
25, 2020.(30) **Foreign Application Priority Data**

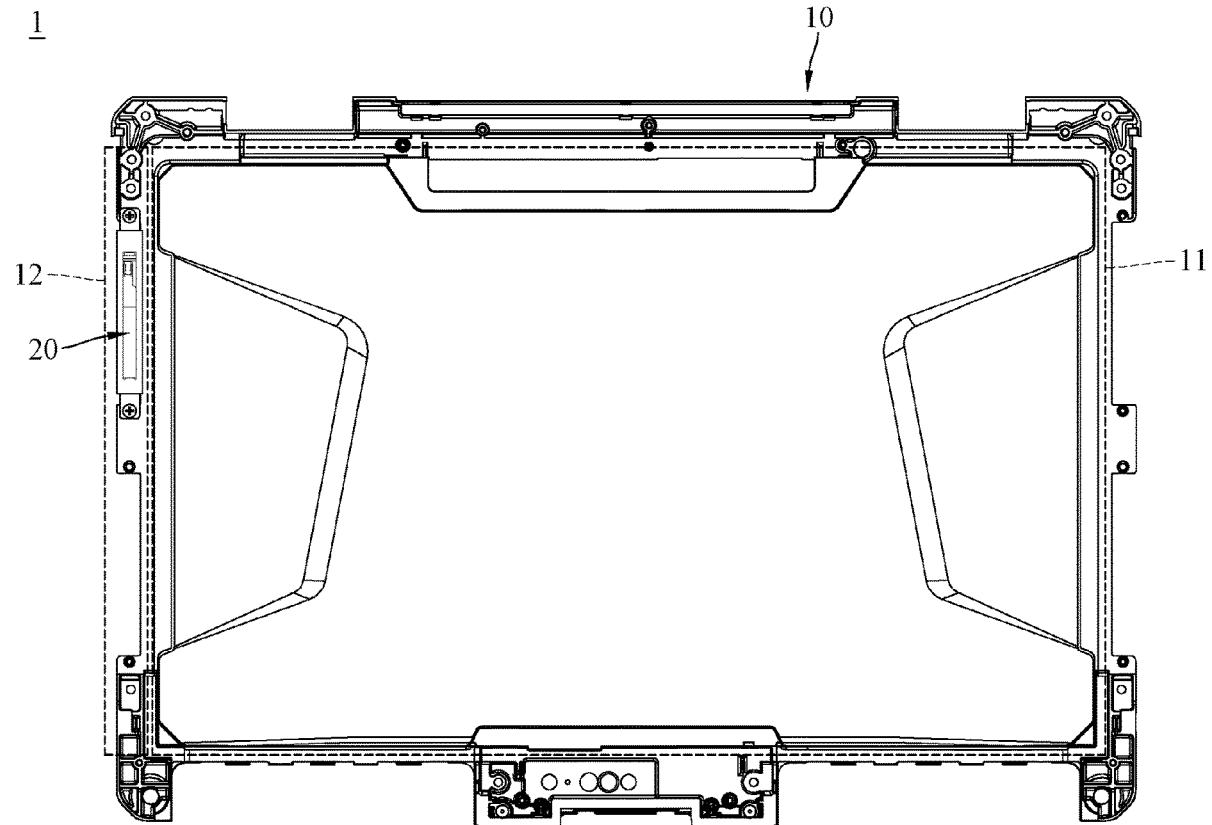
Nov. 13, 2020 (CN) 202011268948.7

(51) **Int. Cl.****H01Q 1/24** (2006.01)**H01Q 1/42** (2006.01)**H05K 5/06** (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/243** (2013.01); **H05K 5/06**
(2013.01); **H01Q 1/42** (2013.01)

(57)

ABSTRACT

An electronic device includes a casing and an antenna assembly. The casing has a waterproof area and a peripheral area. The peripheral area is defined at the periphery of the waterproof area. The antenna assembly is disposed at the peripheral area. The antenna assembly includes a housing, a circuit board, an antenna and a cover. The housing has a receiving recess. The circuit board is disposed in the receiving recess. The antenna is disposed in the receiving recess and electrically connected to the circuit board. The cover is mounted on the housing and hermetically seals the receiving recess.



(19) **United States**

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

(10) **Pub. No.: US 2021/0408684 A1**

(43) **Pub. Date: Dec. 30, 2021**

(54) **A PLANAR LOOP ANTENNA, ITS APPLICATIONS AND APPLICATION METHODS**

Publication Classification

(51) **Int. Cl.**

H01Q 5/307 (2006.01)

H01Q 1/38 (2006.01)

H01Q 7/00 (2006.01)

H01Q 1/48 (2006.01)

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

CPC *H01Q 5/307* (2015.01); *H01Q 1/48* (2013.01); *H01Q 7/00* (2013.01); *H01Q 1/38* (2013.01)

(71) Applicant: **Innovation Sound Technology Co., LTD.**, Guangdong (CN)

(72) Inventors: **Shunming YUEN**, Guangdong (CN); **Wai Yin MUNG**, Guangdong (CN); **Ka Ming WU**, Guangdong (CN)

(21) Appl. No.: **16/611,152**

(22) PCT Filed: **Oct. 25, 2018**

(86) PCT No.: **PCT/CN2018/111922**

§ 371 (c)(1),

(2) Date: **Nov. 5, 2019**

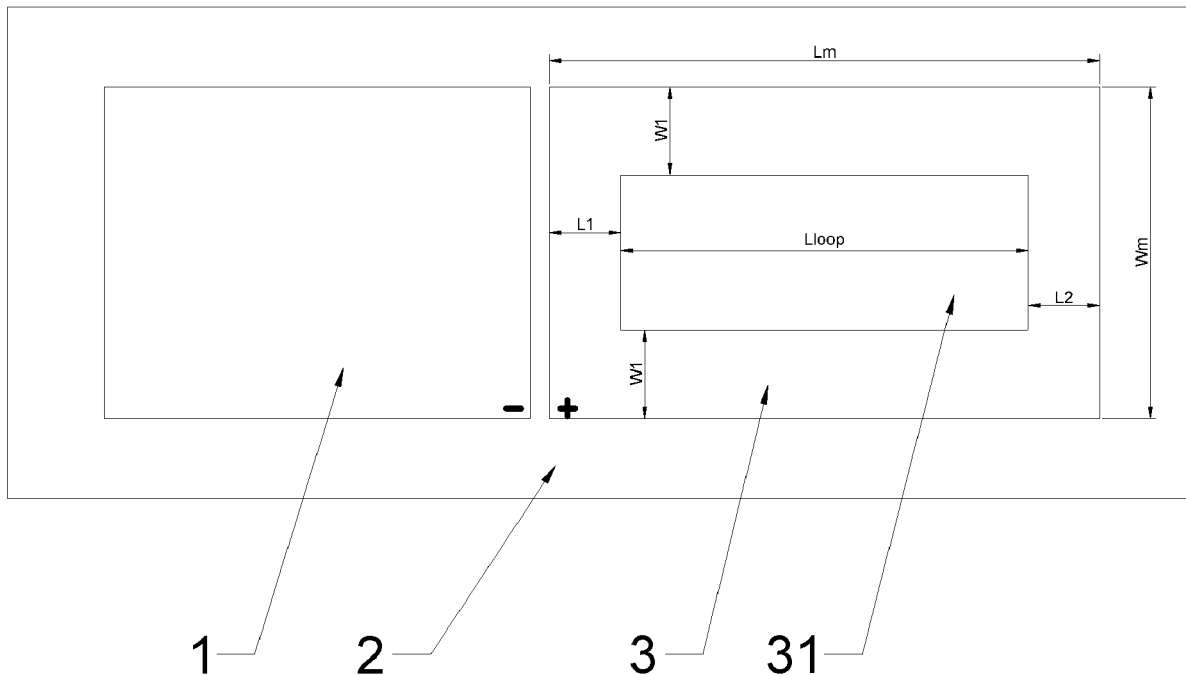
(30) **Foreign Application Priority Data**

Oct. 22, 2018 (CN) 201811231147.6

(57)

ABSTRACT

The Invention discloses a planar loop antenna, its applications and application methods, which comprises a PCB, a ground plane and a plane antenna. The said ground plane and the plane antenna are fixed on the PCB, and a rectangular cavity is disposed in the center of the plane antenna. The loop antenna proposed in the present invention, by adjusting the lengths of L1 and L2, obtains different operating frequencies, and meets the use of different antenna products. In addition, the present invention is able to support a spectrum system within 1.5-2.6 GHz and a higher LTE spectrum within 3.3-3.9 GHz by adjusting L1 and L2.





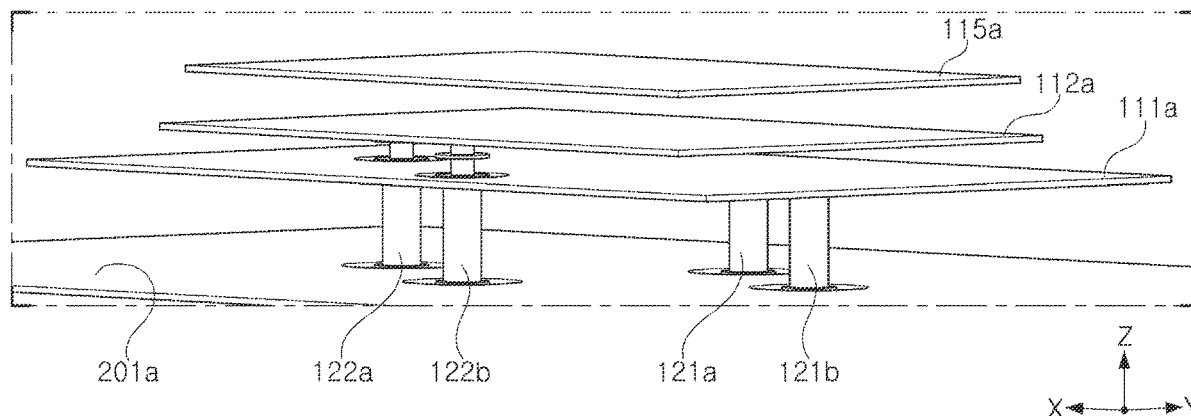
US 20210408687A1

(19) **United States**(12) **Patent Application Publication**
LEE et al.(10) **Pub. No.: US 2021/0408687 A1**(43) **Pub. Date: Dec. 30, 2021**(54) **ANTENNA APPARATUS****Publication Classification**(71) Applicant: **Samsung Electro-Mechanics Co., Ltd.**,
Suwon-si (KR)(72) Inventors: **Won Cheol LEE**, Suwon-si (KR); **Nam Ki KIM**, Suwon-si (KR); **Jae Min KEUM**, Suwon-si (KR); **Jeong Ki RYOO**, Suwon-si (KR)(73) Assignee: **Samsung Electro-Mechanics Co., Ltd.**,
Suwon-si (KR)(21) Appl. No.: **17/473,214**(22) Filed: **Sep. 13, 2021****Related U.S. Application Data**(63) Continuation of application No. 16/672,888, filed on
Nov. 4, 2019, now Pat. No. 11,158,948.(30) **Foreign Application Priority Data**Mar. 20, 2019 (KR) 10-2019-0031892
Jun. 13, 2019 (KR) 10-2019-0069810(51) **Int. Cl.****H01Q 9/04** (2006.01)**H01Q 5/335** (2006.01)**H01Q 5/40** (2006.01)(52) **U.S. Cl.**CPC **H01Q 9/045** (2013.01); **H01Q 5/40**
(2015.01); **H01Q 5/335** (2015.01); **H01Q**
9/0414 (2013.01)

(57)

ABSTRACT

An antenna apparatus includes a first patch antenna pattern comprising a through-hole, a second patch antenna pattern disposed above the first patch antenna pattern and spaced apart from the first patch antenna pattern, a first feed via electrically connected to the first patch antenna pattern, a second feed via penetrating through the through-hole of the first patch antenna pattern, and a feed pattern disposed between the first patch antenna pattern and the second patch antenna pattern, and having one end connected to the second feed via, and another end connected to the second patch antenna pattern at a point closer to an edge of the second patch antenna pattern than the second feed.





US 20210409043A1

(19) **United States**(12) **Patent Application Publication**
DUAN et al.(10) **Pub. No.: US 2021/0409043 A1**(43) **Pub. Date: Dec. 30, 2021**(54) **ELECTRONIC DEVICE****Publication Classification**(71) Applicant: **Lenovo (Beijing) Co., Ltd.**, Beijing (CN)(72) Inventors: **Zhiyuan DUAN**, Beijing (CN); **Aihua TAO**, Beijing (CN); **Peng WANG**, Beijing (CN); **Bo ZHU**, Beijing (CN); **Kangkang CHEN**, Beijing (CN)(51) **Int. Cl.****H04B 1/00** (2006.01)**H04M 1/02** (2006.01)**H04B 7/12** (2006.01)**H04B 7/0404** (2006.01)(52) **U.S. Cl.**CPC **H04B 1/0064** (2013.01); **H04M 1/0268**(2013.01); **H04M 2250/10** (2013.01); **H04B****7/12** (2013.01); **H04B 7/0404** (2013.01);**H04M 1/0264** (2013.01)(21) Appl. No.: **17/208,374**(22) Filed: **Mar. 22, 2021**(30) **Foreign Application Priority Data**

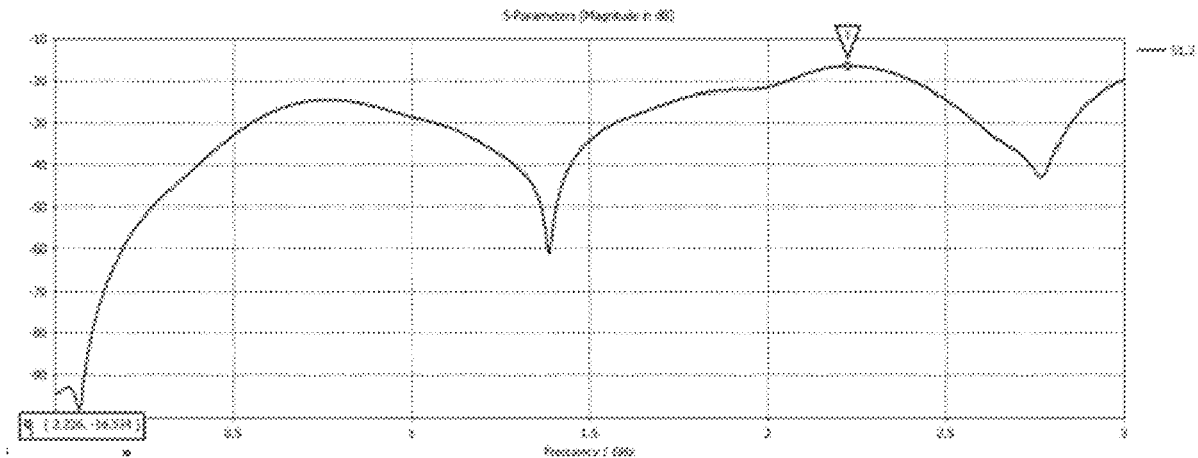
Jun. 30, 2020 (CN) 202010621796.8

Jun. 30, 2020 (CN) 202010624135.0

(57)

ABSTRACT

The present disclosure provides an electronic device. The electronic device includes a body and a display screen. The display screen is fixed to the body. A back of the body includes a spacing area not covered by the display screen, the spacing area including a conductor layer. The electronic device further includes an antenna of the electronic device disposed in the spacing area to emit or receive radio frequency signals. The antenna includes the conductor layer.





US 20220006168A1

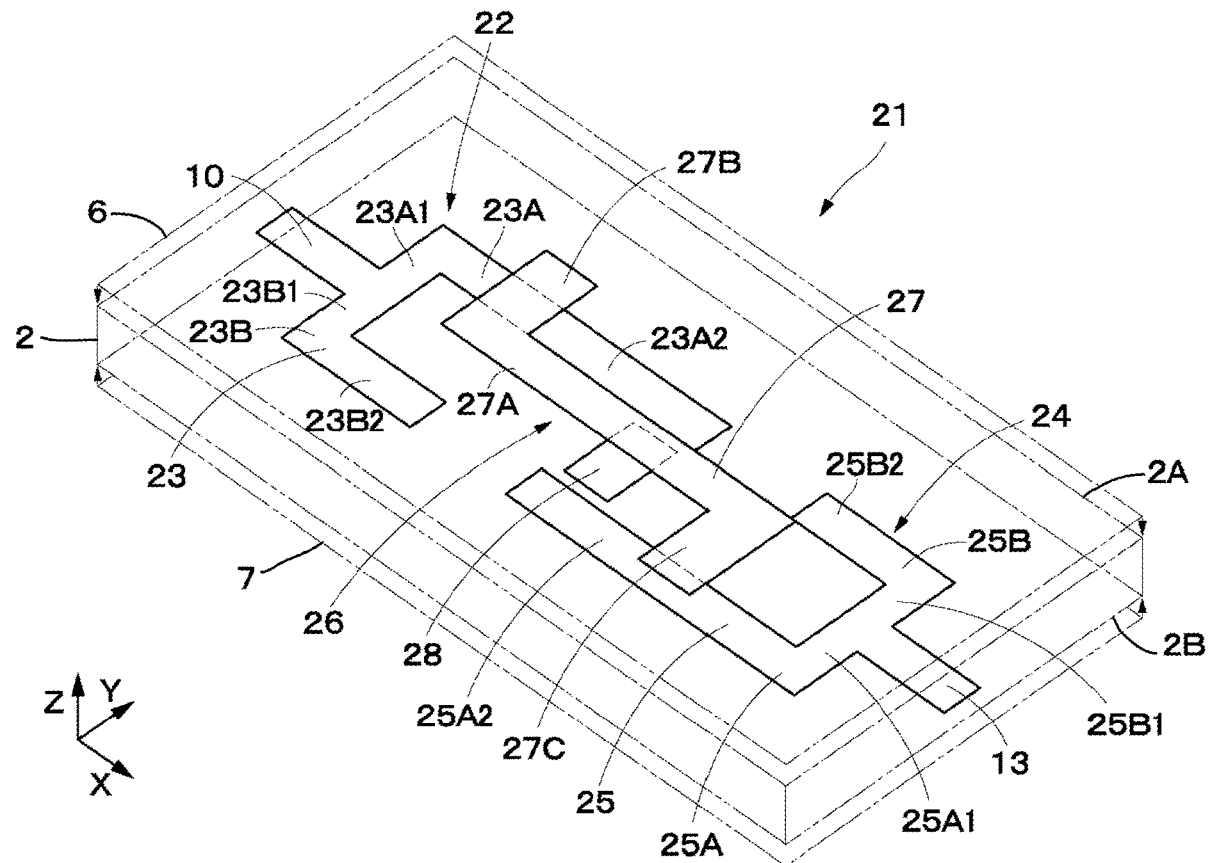
(19) **United States**(12) **Patent Application Publication**
TAGUCHI et al.(10) **Pub. No.: US 2022/0006168 A1**(43) **Pub. Date: Jan. 6, 2022**(54) **FILTER, ANTENNA MODULE, AND
COMMUNICATION DEVICE****Publication Classification**(51) **Int. Cl.****H01P 1/203** (2006.01)**H01P 7/08** (2006.01)(52) **U.S. Cl.**CPC **H01P 1/203** (2013.01); **H01P 7/08**
(2013.01)(71) Applicant: **Murata Manufacturing Co., Ltd.**,
Kyoto (JP)(72) Inventors: **Yoshinori TAGUCHI**, Kyoto (JP);
Toshiro HIRATSUKA, Kyoto (JP)(21) Appl. No.: **17/477,121**(22) Filed: **Sep. 16, 2021****Related U.S. Application Data**(63) Continuation of application No. PCT/JP2020/
005236, filed on Feb. 12, 2020.(30) **Foreign Application Priority Data**

Mar. 25, 2019 (JP) 2019-056306

(57)

ABSTRACT

A filter includes a multilayer substrate and resonators (8), (11), and (14) at three stages provided in the multilayer substrate and coupled to a next stage. The multilayer substrate is provided with a floating electrode for coupling an open end portion (9A2) of a linear conductor of the resonator (8) at an input stage and an open end portion (12B2) of a linear conductor of the resonator (11) at an output stage. The multilayer substrate is provided with a floating electrode for coupling an open end portion (9B2) of the linear conductor of the resonator (8) at the input stage and an open end portion (12A2) of the linear conductor of the resonator (11) at the output stage.





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

(10) **Pub. No.: US 2022/0006176 A1**
(43) **Pub. Date: Jan. 6, 2022**

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 5/30 (2006.01)
H04M 1/02 (2006.01)
H05K 5/00 (2006.01)
H05K 5/02 (2006.01)

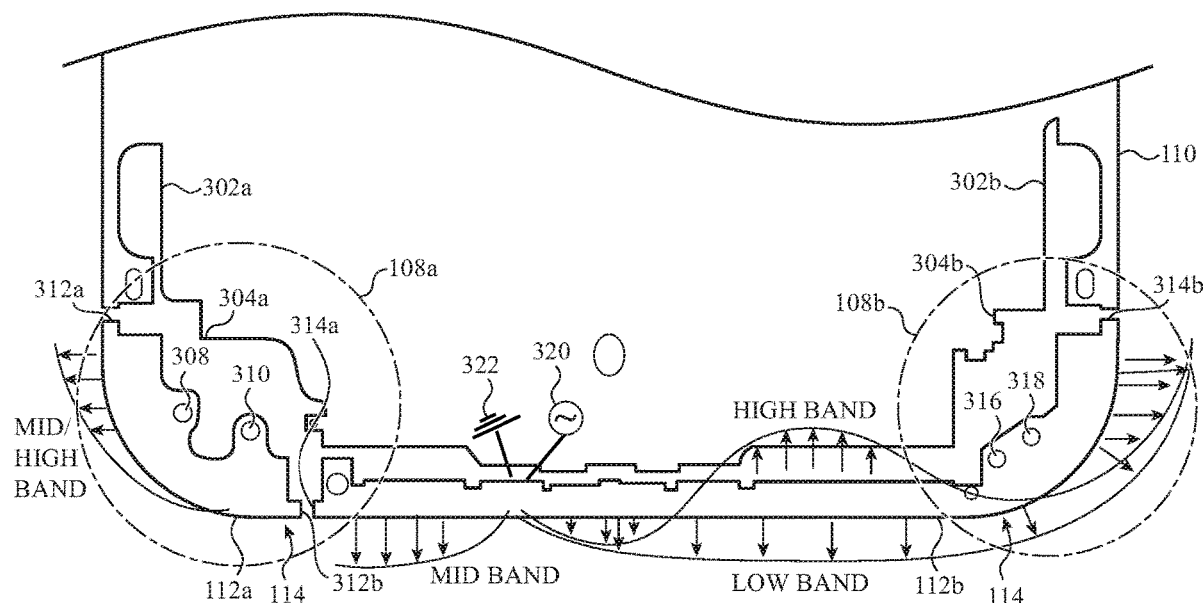
(52) **U.S. Cl.**
CPC ***H01Q 1/243*** (2013.01); ***H01Q 5/30***
(2015.01); ***H05K 5/0217*** (2013.01); ***H05K***
5/0017 (2013.01); ***H05K 5/0208*** (2013.01);
H04M 1/0283 (2013.01)

(57) **ABSTRACT**

A device includes a display and a housing. The housing surrounds the display and has four corners defining portions of an exterior surface of the device. The housing includes a first housing segment defining at least part of a first corner of the four corners and configured to operate as an antenna; a second housing segment defining at least part of a second corner of the four corners; and a third housing segment defining at least part of a third corner of the four corners. The third corner forms part of the housing diagonally opposite the second corner. The housing further includes a non-conductive housing component that structurally couples the first housing segment to another portion of the housing.

(63) Continuation of application No. 16/142,285, filed on Sep. 26, 2018.

(60) Provisional application No. 62/725,237, filed on Aug. 30, 2018.





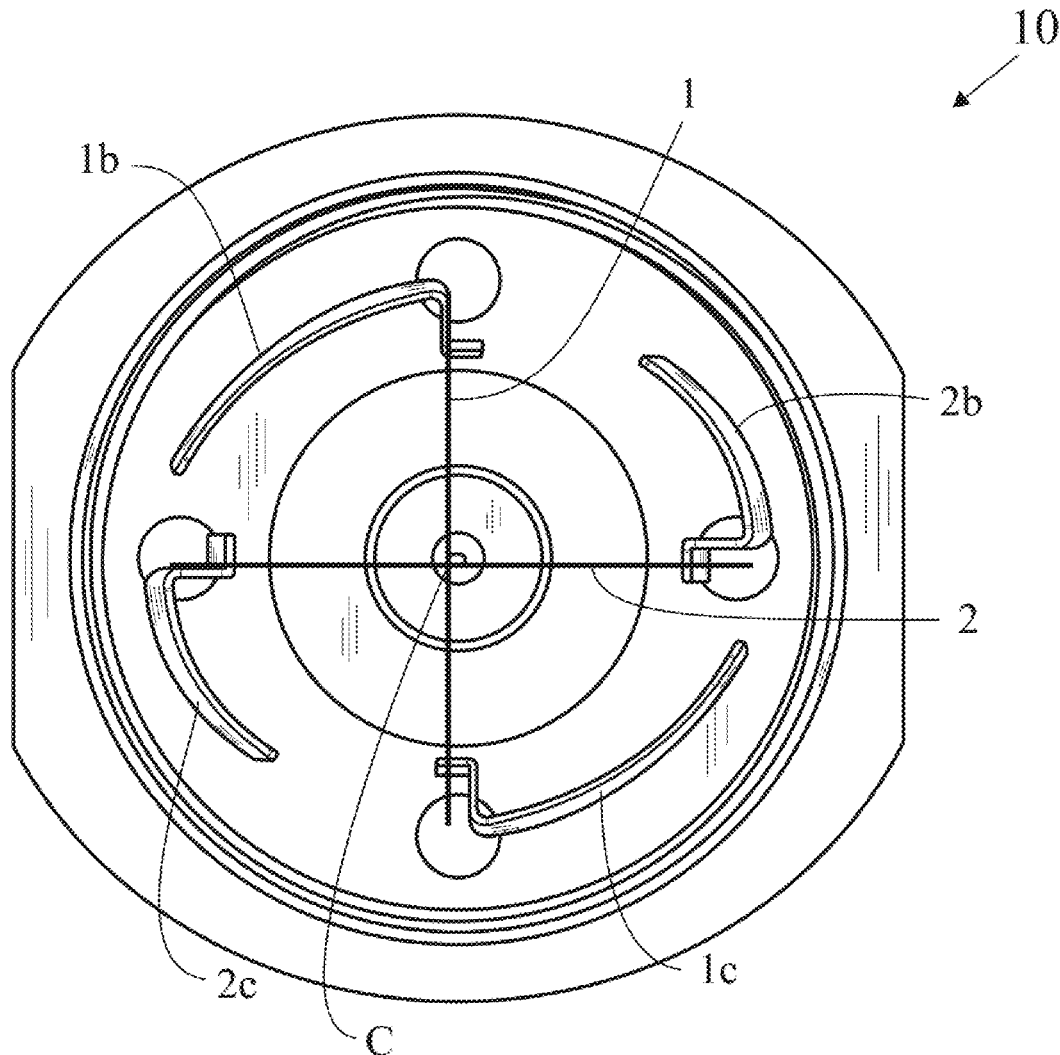
US 20220006177A1

(19) **United States**(12) **Patent Application Publication**
Wang(10) **Pub. No.: US 2022/0006177 A1**(43) **Pub. Date: Jan. 6, 2022**(54) **5G ULTRA-WIDEBAND MONOPOLE ANTENNA**(71) Applicant: **Airgain, Inc.**, San Diego, CA (US)(72) Inventor: **Daniel Wang**, Sydney (AU)(73) Assignee: **Airgain, Inc.**, San Diego, CA (US)(21) Appl. No.: **17/359,788**(22) Filed: **Jun. 28, 2021****Related U.S. Application Data**

(60) Provisional application No. 63/048,044, filed on Jul. 3, 2020.

Publication Classification(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 9/40 (2006.01)**H01Q 1/38** (2006.01)**H01Q 5/307** (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/246** (2013.01); **H01Q 9/40**
(2013.01); **H01Q 1/007** (2013.01); **H01Q**
5/307 (2015.01); **H01Q 1/38** (2013.01)(57) **ABSTRACT**

An ultra-wideband monopole antenna for 5G application is disclosed comprising a first quarter wavelength conductor and a second quarter wavelength conductor, for transmitting and/or receiving electromagnetic waves. A flat portion of the first quarter wavelength conductor and a flat portion of the second quarter wavelength conductor are preferably arranged and located perpendicular and intersecting to each other. Two curved wings of the first quarter wavelength conductor and two curved wings of the second quarter wavelength conductor are preferably arranged and located concentrically and having a same center. The first and second quarter wavelength conductors are joined to deliver ultra wideband frequency in the range of 600-960 MHz and 1710-6000 MHz.





US 20220006181A1

(19) **United States**(12) **Patent Application Publication**
YOSHIKAWA(10) **Pub. No.: US 2022/0006181 A1**(43) **Pub. Date: Jan. 6, 2022**(54) **ANTENNA, WIRELESS COMMUNICATION
MODULE, AND WIRELESS
COMMUNICATION DEVICE****H01Q 5/35** (2006.01)**H01Q 9/04** (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/521** (2013.01); **H01Q 9/0421**
(2013.01); **H01Q 5/35** (2015.01); **H01Q**
21/065 (2013.01)(71) Applicant: **KYOCERA Corporation**, Kyoto-shi,
Kyoto (JP)(72) Inventor: **Hiromichi YOSHIKAWA**,
Yokohama-shi, Kanagawa (JP)

(57)

ABSTRACT(21) Appl. No.: **17/288,892**(22) PCT Filed: **Oct. 25, 2019**(86) PCT No.: **PCT/JP2019/042060**

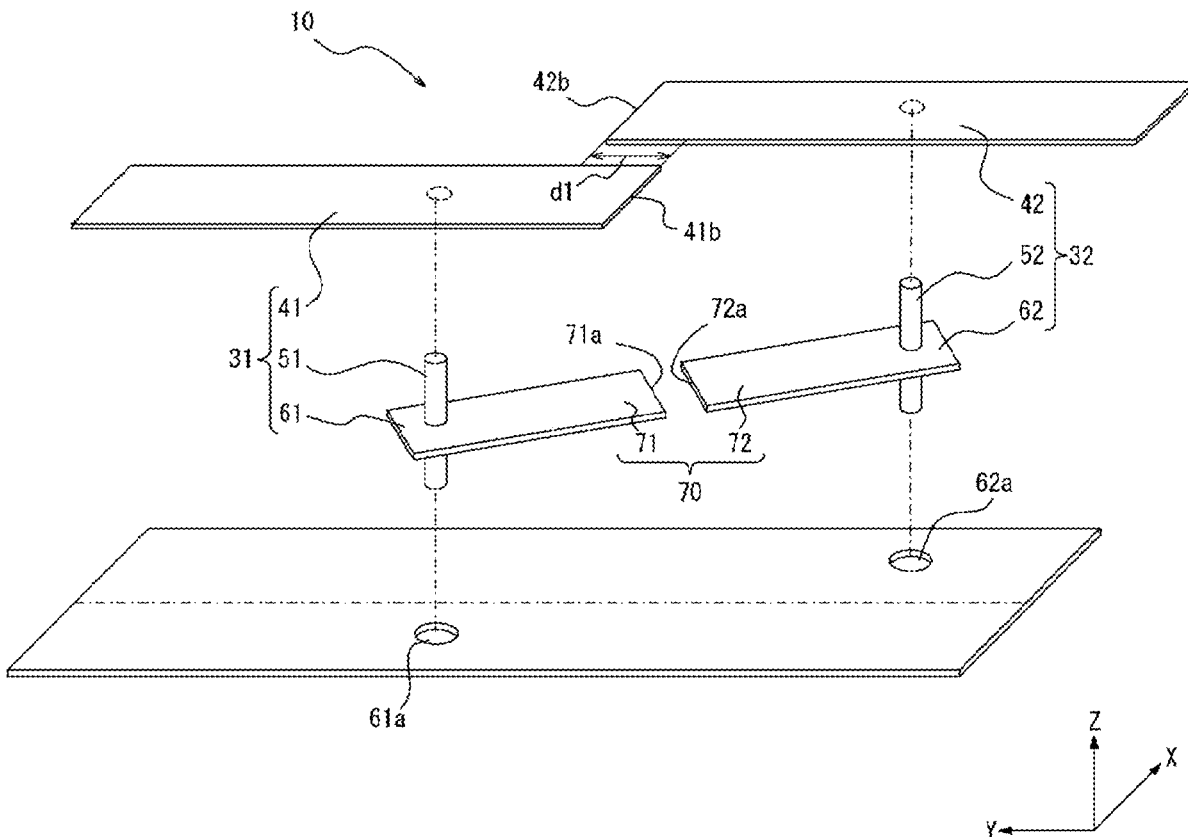
§ 371 (c)(1),

(2) Date: **Apr. 26, 2021**(30) **Foreign Application Priority Data**

Oct. 31, 2018 (JP) 2018-205980

Publication Classification(51) **Int. Cl.****H01Q 1/52** (2006.01)**H01Q 21/06** (2006.01)

An antenna includes a first antenna element, a second antenna element, and a first coupler. The first antenna element includes a first radiation conductor and a first feeder line and resonates in a first frequency band. The second antenna element includes a second radiation conductor and a second feeder line and resonates in a second frequency band. The second feeder line is coupled to the first feeder line such that a first component, which is one of a capacitance component and an inductance component, is dominant. The first coupler couples the first and second feeder lines such that a second component different from the first component is dominant. The first and second radiation conductors are arranged at an interval of $\frac{1}{2}$ or less of a resonance wavelength in a first direction. The first and second radiation conductors are arranged to be shifted in a second direction intersecting the first direction.





US 20220006183A1

(19) **United States**(12) **Patent Application Publication****Xu et al.**(10) **Pub. No.: US 2022/0006183 A1**(43) **Pub. Date: Jan. 6, 2022**(54) **DUAL POLARIZED ANTENNA STRUCTURE****H01Q 1/48** (2006.01)**H01Q 21/06** (2006.01)(71) Applicants: **Hanyang WANG**, Munich (DE);
Huawei Technologies Co., Ltd.,
Shenzhen (CN)(52) **U.S. Cl.****CPC** **H01Q 1/523** (2013.01); **H01Q 21/062**
(2013.01); **H01Q 1/48** (2013.01); **H01Q 21/24**
(2013.01)(72) Inventors: **Hang Xu**, Canterbury (GB); **Steven Gao**, Canterbury (GB); **Hanyang Wang**, Reading (GB); **Hai Zhou**, Reading (GB)

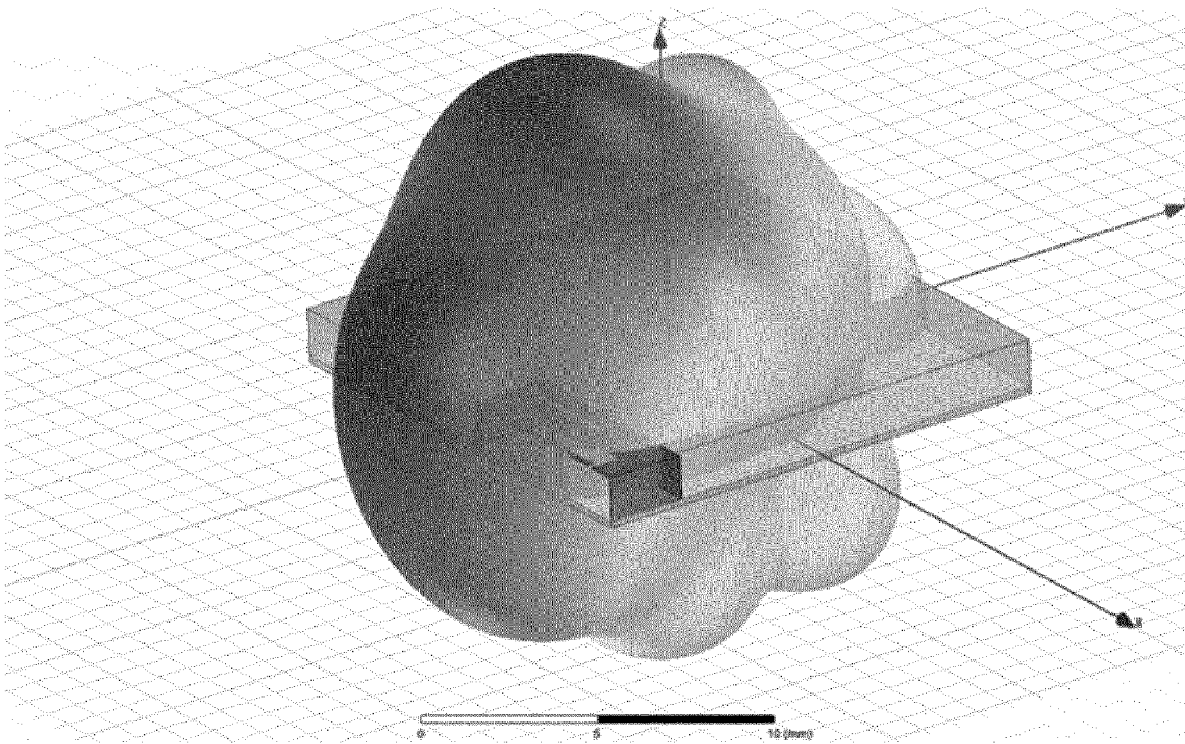
(57)

ABSTRACT(21) Appl. No.: **17/311,198**(22) PCT Filed: **Dec. 7, 2018**(86) PCT No.: **PCT/EP2018/083981**

§ 371 (c)(1),

(2) Date: **Jun. 4, 2021****Publication Classification**(51) **Int. Cl.****H01Q 1/52** (2006.01)**H01Q 21/24** (2006.01)

An antenna structure includes a first signal connector and a second signal connector. The antenna structure further includes a cavity antenna defined by a set of planar walls. The cavity antenna is coupled to the first signal connector and configured to emit a field polarized linearly in a first direction when driven by a signal at the first signal connector. The antenna structure further includes a dipole antenna defined by a pair of arms that are integrated with a wall of the cavity antenna. The dipole antenna is coupled to the second signal connector and configured to a field polarized linearly in a second direction offset from the first direction when driven by a signal at the second signal connector.





US 20220006191A1

(19) **United States**(12) **Patent Application Publication**
SHIBATA et al.(10) **Pub. No.: US 2022/0006191 A1**(43) **Pub. Date: Jan. 6, 2022**(54) **DUAL BAND PATCH ANTENNA****Publication Classification**(71) Applicant: **TDK Corporation**, Tokyo (JP)(51) **Int. Cl.**
H01Q 5/307 (2006.01)
H01Q 9/04 (2006.01)(72) Inventors: **Tetsuya SHIBATA**, Tokyo (JP); **Naoki SOTOMA**, Tokyo (JP)(52) **U.S. Cl.**
CPC **H01Q 5/307** (2015.01); **H01Q 9/0407** (2013.01)(73) Assignee: **TDK Corporation**, Tokyo (JP)(21) Appl. No.: **17/477,999**(22) Filed: **Sep. 17, 2021****Related U.S. Application Data**

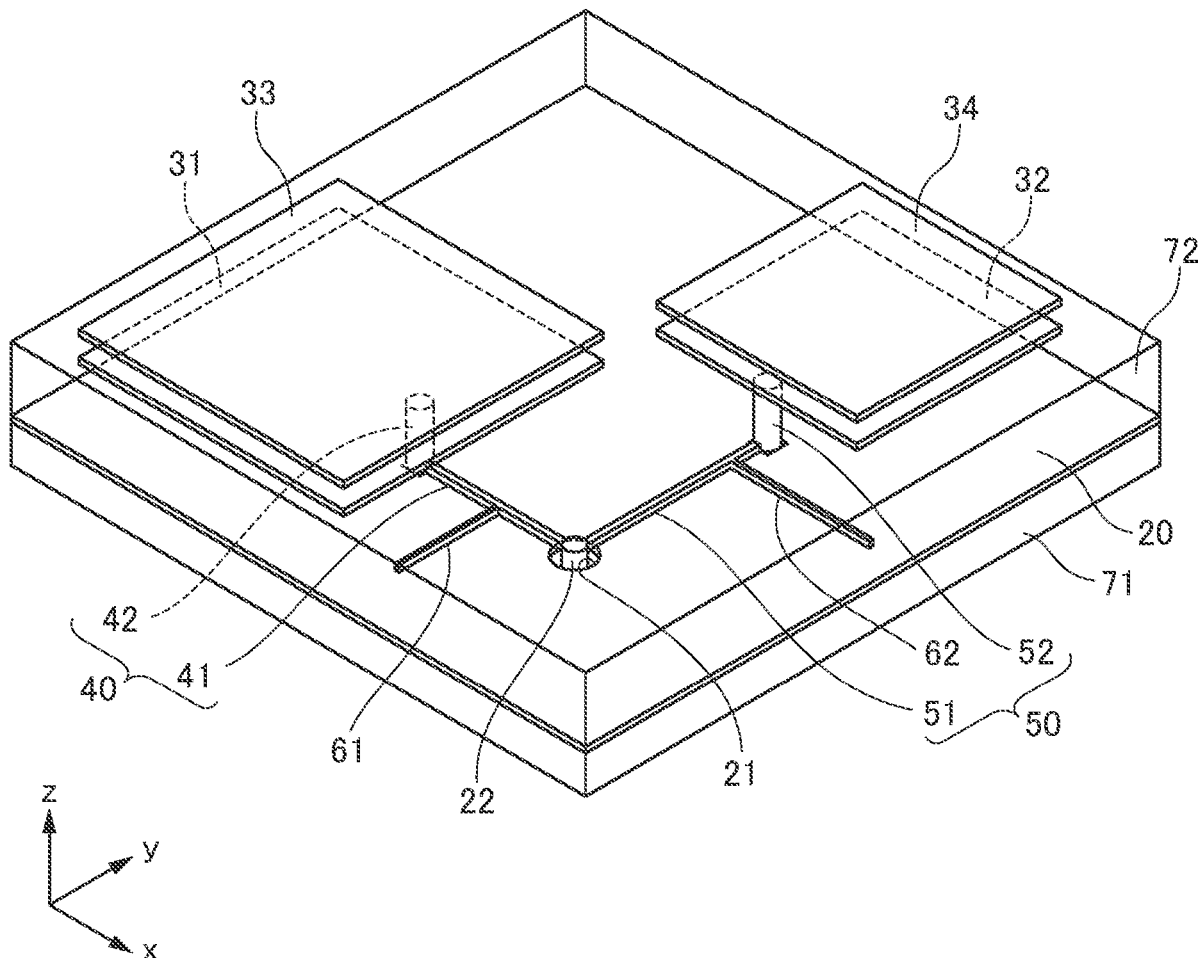
(63) Continuation of application No. 16/191,060, filed on Nov. 14, 2018.

Foreign Application Priority Data

(30) Nov. 17, 2017 (JP) 2017-221423

ABSTRACT

Disclosed herein is a dual band patch antenna that includes a first feeding part, first and second radiation conductors, a first feeding conductor having one end connected to the first feeding part and other end connected to the first radiation conductor, a second feeding conductor having one end connected to the first feeding part and other end connected to the second radiation conductor, a first open stub having one end connected to the first feeding conductor and other end opened, and a second open stub having one end connected to the second feeding conductor and other end opened.

10B



US 20220006192A1

(19) **United States**(12) **Patent Application Publication**
ZHAO et al.(10) **Pub. No.: US 2022/0006192 A1**(43) **Pub. Date: Jan. 6, 2022**(54) **5G DUAL-POLARIZED ANTENNA MODULE
AND TERMINAL DEVICE**(71) Applicant: **SHENZHEN SUNWAY
COMMUNICATION CO., LTD.,**
Shenzhen, Guangdong (CN)(72) Inventors: **Yue ZHAO**, Shenzhen (CN); **Anping
ZHAO**, Shenzhen (CN)(73) Assignee: **SHENZHEN SUNWAY
COMMUNICATION CO., LTD.,**
Shenzhen, Guangdong (CN)(21) Appl. No.: **16/769,428**(22) PCT Filed: **Apr. 7, 2020**(86) PCT No.: **PCT/CN2020/083464**

§ 371 (c)(1),

(2) Date: **Jun. 3, 2020**(30) **Foreign Application Priority Data**

Jan. 10, 2020 (CN) 202010024407.3

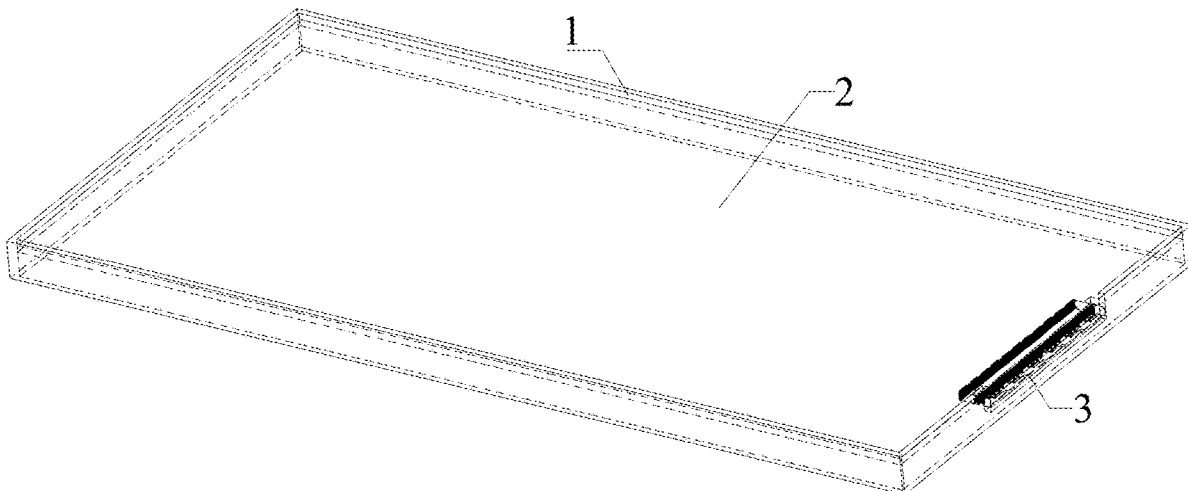
Publication Classification(51) **Int. Cl.**
H01Q 5/378 (2006.01)
H01Q 1/24 (2006.01)**H01Q 1/38** (2006.01)**H01Q 1/48** (2006.01)**H01Q 1/50** (2006.01)**H01Q 21/24** (2006.01)**H01Q 9/16** (2006.01)**H01Q 5/20** (2006.01)(52) **U.S. Cl.**CPC **H01Q 5/378** (2015.01); **H01Q 1/242**(2013.01); **H01Q 1/38** (2013.01); **H01Q 5/20**(2015.01); **H01Q 1/50** (2013.01); **H01Q 21/24**(2013.01); **H01Q 9/16** (2013.01); **H01Q 1/48**

(2013.01)

(57)

ABSTRACT

A 5G dual-polarized antenna module and a terminal device are disclosed. The 5G dual-polarized antenna module comprises a substrate, a first metal ground and at least one antenna unit group are disposed in the substrate, the first metal ground partitions the substrate into a first region and a second region, the antenna unit group includes a first antenna unit and a second antenna unit which are located in the first region, and the first antenna unit comprises a dipole element and a parasitic element matched with the dipole element; the second antenna unit comprises a T-shaped probe, which is partially located between the dipole element and the parasitic element; and a first ground layer conductive with the first metal ground is disposed on the bottom surface of the substrate. The 5G dual-polarized antenna module thus being particularly suitable for light and thin terminal devices.





US 20220006197A1

(19) **United States**

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

(10) **Pub. No.: US 2022/0006197 A1**

(43) **Pub. Date: Jan. 6, 2022**

(54) **COUPLED-FEED DIPOLE ANTENNA**

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

(71) Applicant: **Innovation Sound Technology Co., LTD.**, Guangdong (CN)

CPC **H01Q 9/16** (2013.01); **H01Q 1/48** (2013.01)

(72) Inventors: **Shun Ming YUEN**, Guangdong (CN);
Wai Yin MUNG, Guangdong (CN); **Ka Ming WU**, Guangdong (CN)

(57) **ABSTRACT**

(21) Appl. No.: **16/631,035**

(22) PCT Filed: **Dec. 6, 2018**

(86) PCT No.: **PCT/CN2018/119460**

§ 371 (c)(1),

(2) Date: **Jan. 14, 2020**

(30) **Foreign Application Priority Data**

Dec. 3, 2018 (CN) 201822007695.2

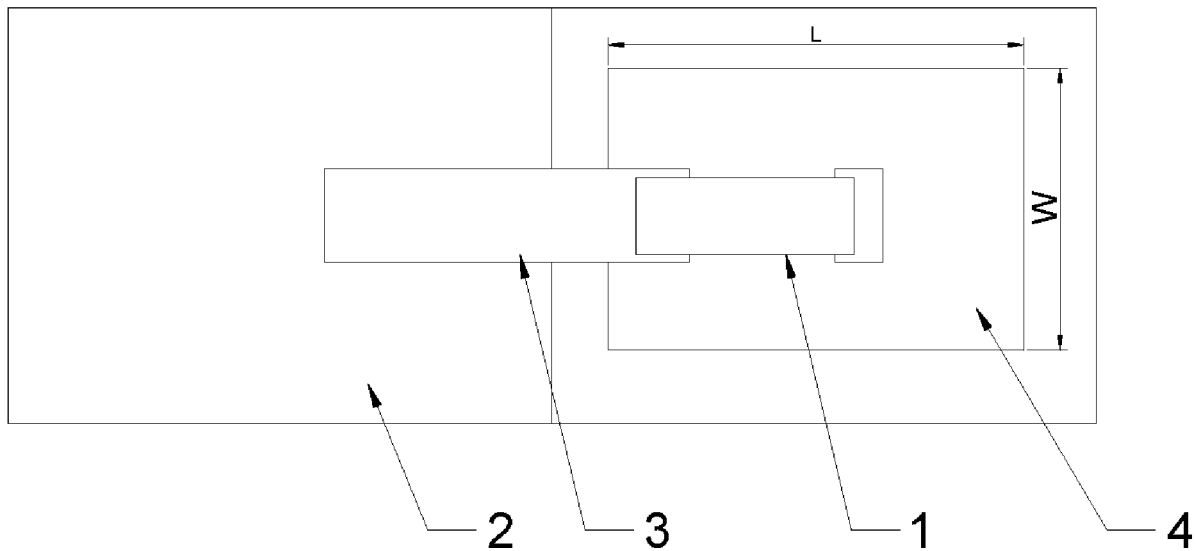
Publication Classification

(51) **Int. Cl.**

H01Q 9/16 (2006.01)

H01Q 1/48 (2006.01)

The utility model discloses a coupled-feed dipole antenna, which comprises a PCB, a metal patch, an LTCC antenna, and a transmission line. The said LTCC antenna and the transmission line are disposed on the bottom of the PCB, the ground plane is disposed on the top surface of the PCB, the LTCC antenna is connected to the transmission line, and the signal input is transmitted to the antenna through the transmission line. The said metal patch is disposed on the top surface of the PCB, and fixed to the LTCC antenna by soldering. The utility model sets the LTCC antenna and the metal patch together, turning the original monopole antenna into a coupled-feed dipole antenna. By setting the size of a patch (metal sheet), the antenna resonance working frequency can be lowered to a low frequency without increasing the antenna length.





US 20220006204A1

(19) **United States**

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

(10) **Pub. No.: US 2022/0006204 A1**

(43) **Pub. Date: Jan. 6, 2022**

(54) **5G MMW DUAL-POLARIZED ANTENNA
MODULE AND TERMINAL DEVICE**

H01Q 1/38 (2006.01)

H01Q 1/48 (2006.01)

H01Q 1/50 (2006.01)

H01Q 9/04 (2006.01)

(71) Applicant: **SHENZHEN SUNWAY
COMMUNICATION CO., LTD.**,
Shenzhen, Guangdong (CN)

(72) Inventors: **Yue ZHAO**, Shenzhen (CN); **Anping
ZHAO**, Shenzhen (CN)

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

CPC *H01Q 21/24* (2013.01); *H01Q 1/242*
(2013.01); *H01Q 9/0407* (2013.01); *H01Q*
1/48 (2013.01); *H01Q 1/50* (2013.01); *H01Q*
1/38 (2013.01)

(73) Assignee: **SHENZHEN SUNWAY
COMMUNICATION CO., LTD.**,
Shenzhen, Guangdong (CN)

(21) Appl. No.: **16/769,358**

(22) PCT Filed: **Apr. 7, 2020**

(86) PCT No.: **PCT/CN2020/083479**

§ 371 (c)(1),

(2) Date: **Jun. 3, 2020**

(30) **Foreign Application Priority Data**

Jan. 10, 2020 (CN) 202010024430.2

Publication Classification

(51) **Int. Cl.**

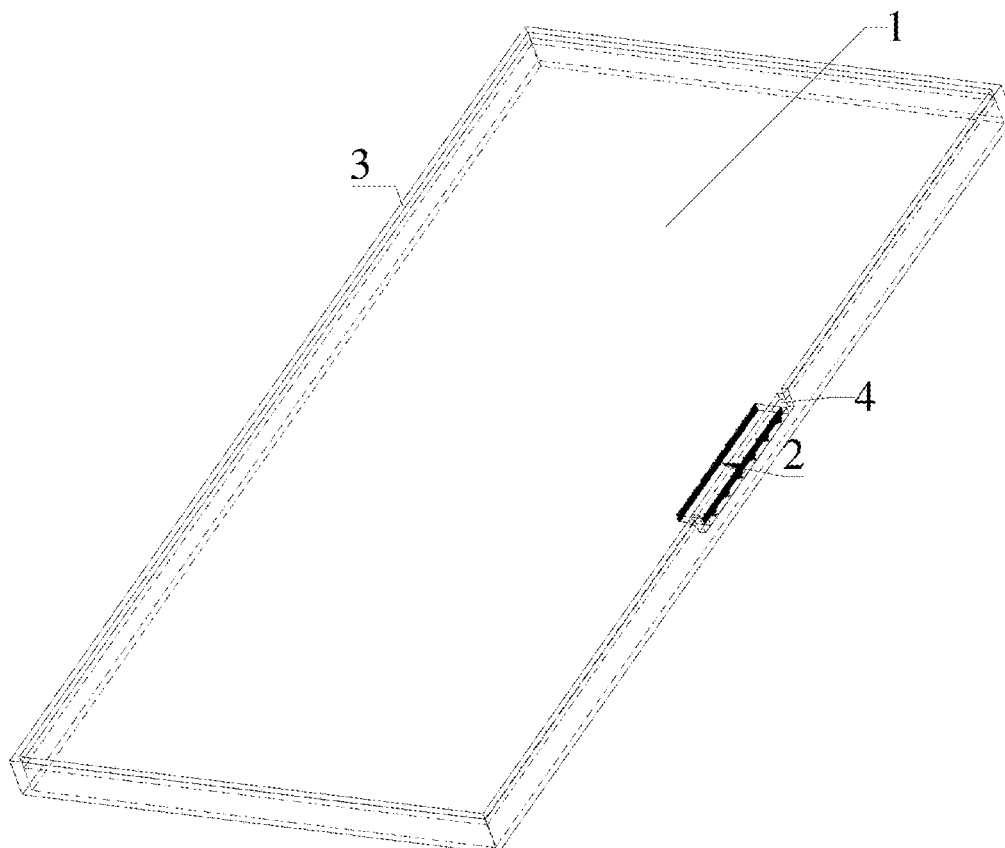
H01Q 21/24 (2006.01)

H01Q 1/24 (2006.01)

(57)

ABSTRACT

A 5G MMW dual-polarized antenna module includes a substrate. A metal ground and an antenna unit group are disposed in the substrate. The metal ground partitions the substrate into a first region and a second region. The antenna unit group includes a first antenna unit, a patch antenna and a probe. The first antenna unit includes a first branch and a second branch connected to the first branch, wherein the first branch is disposed in the first region, and an end, away from the first branch, of the second branch is located in the second region. The probe includes a first part and a second part connected to the first part, wherein the second part is disposed in the first region. The MMW dual-polarized antenna module can fulfill lateral radiation in light and thin terminal devices.





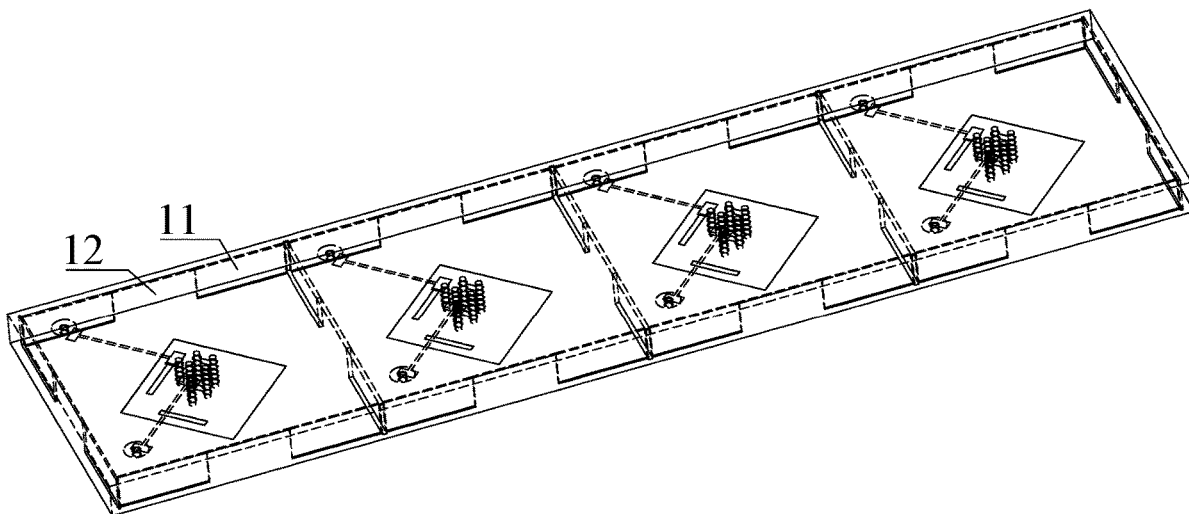
US 20220013884A1

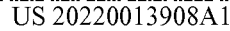
(19) **United States**(12) **Patent Application Publication**
ZHAO(10) **Pub. No.: US 2022/0013884 A1**(43) **Pub. Date: Jan. 13, 2022**(54) **5G MMW DUAL-POLARIZED ANTENNA
UNIT, ANTENNA ARRAY AND TERMINAL
DEVICE****H01Q 21/06** (2006.01)**H01Q 21/24** (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/243** (2013.01); **H01Q 21/24**
(2013.01); **H01Q 21/065** (2013.01); **H01Q**
9/0421 (2013.01)(71) Applicant: **SHENZHEN SUNWAY
COMMUNICATION CO., LTD.**,
Shenzhen (CN)(72) Inventor: **Yue ZHAO**, Shenzhen (CN)(73) Assignee: **SHENZHEN SUNWAY
COMMUNICATION CO., LTD.**,
Shenzhen (CN)(21) Appl. No.: **17/098,640**(22) Filed: **Nov. 16, 2020****Related U.S. Application Data**(63) Continuation of application No. PCT/CN2020/
123515, filed on Oct. 26, 2020.(30) **Foreign Application Priority Data**

Jul. 7, 2020 (CN) 202010643740.2

Publication Classification(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 9/04 (2006.01)(57) **ABSTRACT**

A 5G MMW dual-polarized antenna unit, an antenna array and a terminal device are disclosed. The 5G MMW dual-polarized antenna unit comprises a substrate and two feeder assemblies disposed in the substrate, wherein a square radiation patch conductive with the feeder assemblies is disposed on a top surface of the substrate, and a ground layer and feeder ports conductive with the feeder assemblies are disposed on a bottom surface of the substrate; each feeder assembly comprises an impedance transformation micro-strip line, and the two impedance transformation micro-strip lines are perpendicular to each other; and a short-circuit structure allowing the radiation patch to be conductive with the ground layer is disposed in the substrate and is located an intersection of extension lines of the two impedance transformation micro-strip lines. The 5G MMW dual-polarized antenna unit effectively improves the antenna performance and satisfies application requirements of 5G communication terminals in this waveband.





(43) **Pub. Date:** **Jan. 13, 2022**

A mobile device includes a metal mechanism element, a first radiation element, a second radiation element, and a dielectric substrate. A closed slot is formed in the metal mechanism element. The closed slot has a first edge and a second edge which are opposite to each other. The first radiation element has a feeding point. The second radiation element is coupled to the first edge of the closed slot, and is adjacent to the first radiation element. The second radiation element is at least partially disposed between the first radiation element and the second edge of the closed slot. The first radiation element and the second radiation element are disposed on the dielectric substrate. An antenna structure is formed by the first radiation element, the second radiation element, and the closed slot of the metal mechanism element.