



(19) **United States**

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

(10) **Pub. No.: US 2021/0367319 A1**

(43) **Pub. Date: Nov. 25, 2021**

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

H01Q 1/24 (2006.01)

H01Q 1/42 (2006.01)

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

(52) **U.S. Cl.**
CPC *H01Q 1/02* (2013.01); *H01Q 1/42*
(2013.01); *H01Q 1/243* (2013.01); *H01Q*
1/2208 (2013.01)

(72) Inventors: **Heecheul MOON**, Suwon-si (KR);
Sangyoup SEOK, Suwon-si (KR);
Kwonho SON, Suwon-si (KR)

(57) **ABSTRACT**

(21) Appl. No.: **17/392,831**

(22) Filed: **Aug. 3, 2021**

Related U.S. Application Data

(63) Continuation of application No. 17/196,305, filed on Mar. 9, 2021, now Pat. No. 11,114,741, which is a continuation of application No. 16/884,406, filed on May 27, 2020, now Pat. No. 11,024,938, which is a continuation of application No. PCT/KR2019/010468, filed on Aug. 19, 2019.

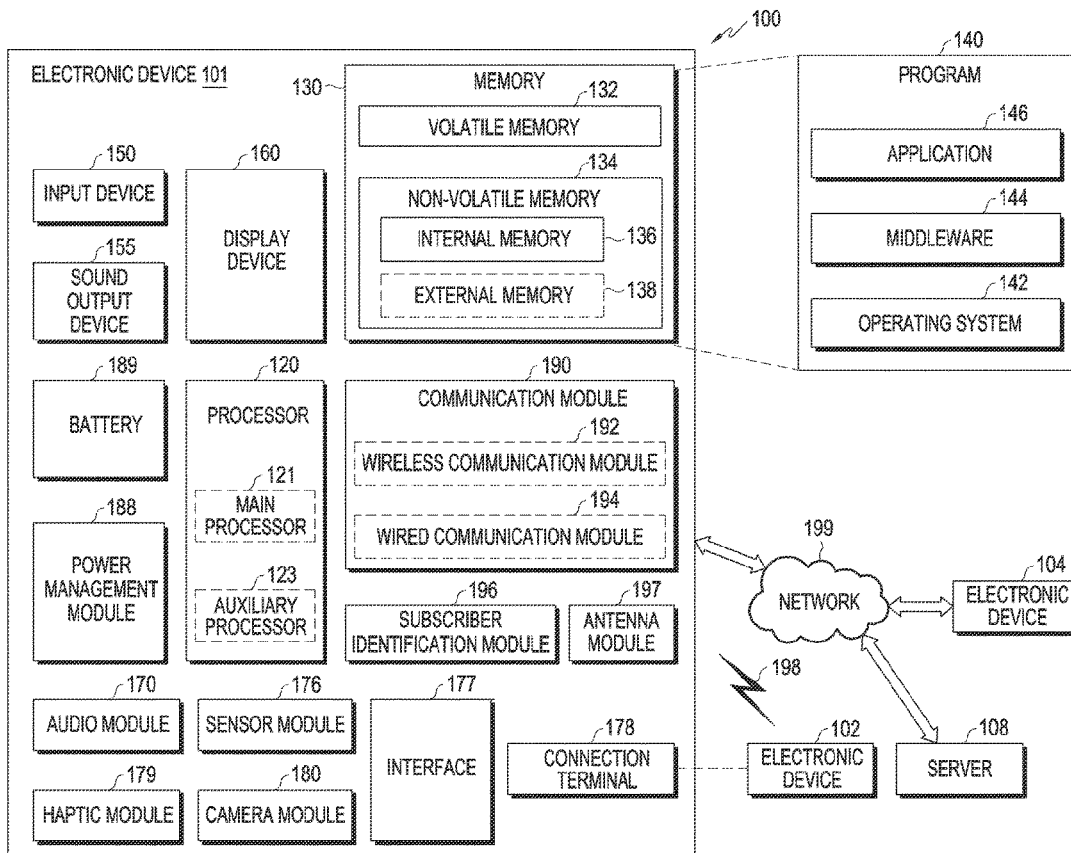
Foreign Application Priority Data

Aug. 22, 2018 (KR) 10-2018-0097964

Publication Classification

(51) **Int. Cl.**
H01Q 1/02 (2006.01)
H01Q 1/22 (2006.01)

An electronic device is provided. The electronic device including a housing comprising a front plate which faces a first direction, a back plate which faces a second direction opposite from the first direction, and a lateral member which surrounds a space between the front plate and the back plate and has at least one part formed from a metal material, a display seen through a first part of the front plate, an antenna module positioned inside the space, and a wireless communication circuit. The antenna module includes a first surface facing a third direction forming an acute angle with the second direction, a second surface facing a fourth direction opposite from the third direction, at least one first conductive element disposed on the first surface or inside the antenna module so as to face the third direction, and at least one second conductive element which is adjacent to the lateral member between the first surface and the second surface and extends in a fifth direction different from the third direction and the fourth direction and facing between the lateral surface and the first part of the front plate.





US 20210367321A1

(19) **United States**

(12) **Patent Application Publication**

Hung et al.

(10) **Pub. No.: US 2021/0367321 A1**

(43) **Pub. Date: Nov. 25, 2021**

(54) **SLOT ANTENNAS HAVING PARASITIC ELEMENTS**

Publication Classification

(71) Applicant: **Hewlett-Packard Development Company, L.P.**, Spring, TX (US)

(51) **Int. Cl.**
H01Q 1/22 (2006.01)
H01Q 13/10 (2006.01)
H01Q 5/385 (2006.01)

(72) Inventors: **Chen-Ta Hung**, Taipei City (TW); **Chi-Ting Hsu**, Taipei City (TW); **Ming-Shien Tsai**, Taipei City (TW)

(52) **U.S. Cl.**
CPC *H01Q 1/2266* (2013.01); *H01Q 13/10* (2013.01); *H01Q 1/48* (2013.01); *H01Q 5/385* (2015.01); *H01Q 1/2283* (2013.01)

(73) Assignee: **Hewlett-Packard Development Company, L.P.**, Spring, TX (US)

(57) **ABSTRACT**

(21) Appl. No.: **16/978,730**

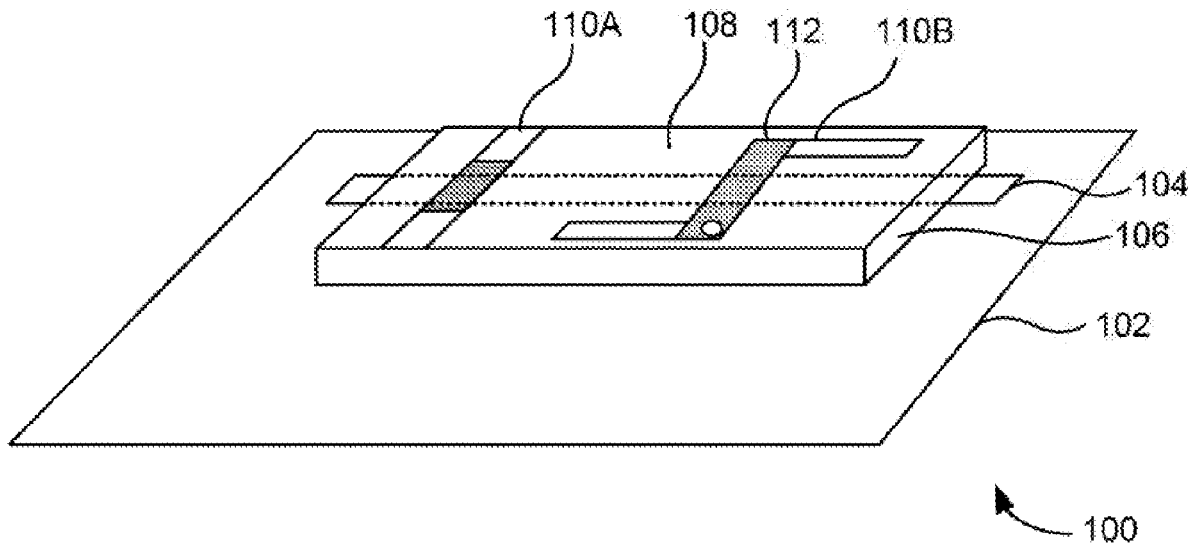
In one example, a slot antenna may include a ground plane defining a slot, an antenna cavity formed on the ground plane corresponding to the slot, an antenna printed circuit board (PCB) disposed on the antenna cavity, a first parasitic element and a second parasitic element disposed on the antenna PCB, and a feeding element formed on the second parasitic element. The feeding element may induce magnetic resonance and electric resonance for multiple frequency bands.

(22) PCT Filed: **Jul. 10, 2018**

(86) PCT No.: **PCT/US2018/041348**

§ 371 (c)(1),

(2) Date: **Sep. 7, 2020**





(19) **United States**

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

(10) **Pub. No.: US 2021/0367322 A1**

(43) **Pub. Date: Nov. 25, 2021**

(54) **ANTENNA HAVING SINGLE
NON-CONDUCTIVE PORTION AND
ELECTRONIC DEVICE INCLUDING THE
SAME**

Publication Classification

(51) **Int. Cl.**
H01Q 1/22 (2006.01)
G06F 1/16 (2006.01)
H01Q 1/38 (2006.01)
H05K 1/18 (2006.01)
(52) **U.S. Cl.**
CPC *H01Q 1/2266* (2013.01); *G06F 1/1616*
(2013.01); *H05K 2201/1031* (2013.01); *H01Q*
1/38 (2013.01); *H05K 1/181* (2013.01); *G06F*
1/1626 (2013.01)

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

(72) Inventors: **Sungkoo PARK**, Suwon-si (KR);
Hyungjoo LEE, Suwon-si (KR);
Shinho YOON, Suwon-si (KR);
Himchan YUN, Suwon-si (KR);
Soonho HWANG, Suwon-si (KR);
Jaebong CHUN, Suwon-si (KR)

(57) **ABSTRACT**

An electronic device is provided. The electronic device includes a foldable housing including, a hinge structure, a first housing structure including a first surface, a second surface, and a first side member, wherein the first side member encloses at least a portion of a space between the first surface and the second surface and includes a first conductive portion, a first non-conductive portion, and a second conductive portion, and a second housing structure including a third surface, a fourth surface, and a second side member, a printed circuit board, at least one wireless communication circuit including a first electrical path and a second electrical path, a first variable element including a first terminal, a second terminal, and a third terminal, and a second variable element including a fourth terminal, a fifth terminal, and a sixth terminal.

(21) Appl. No.: **17/394,909**

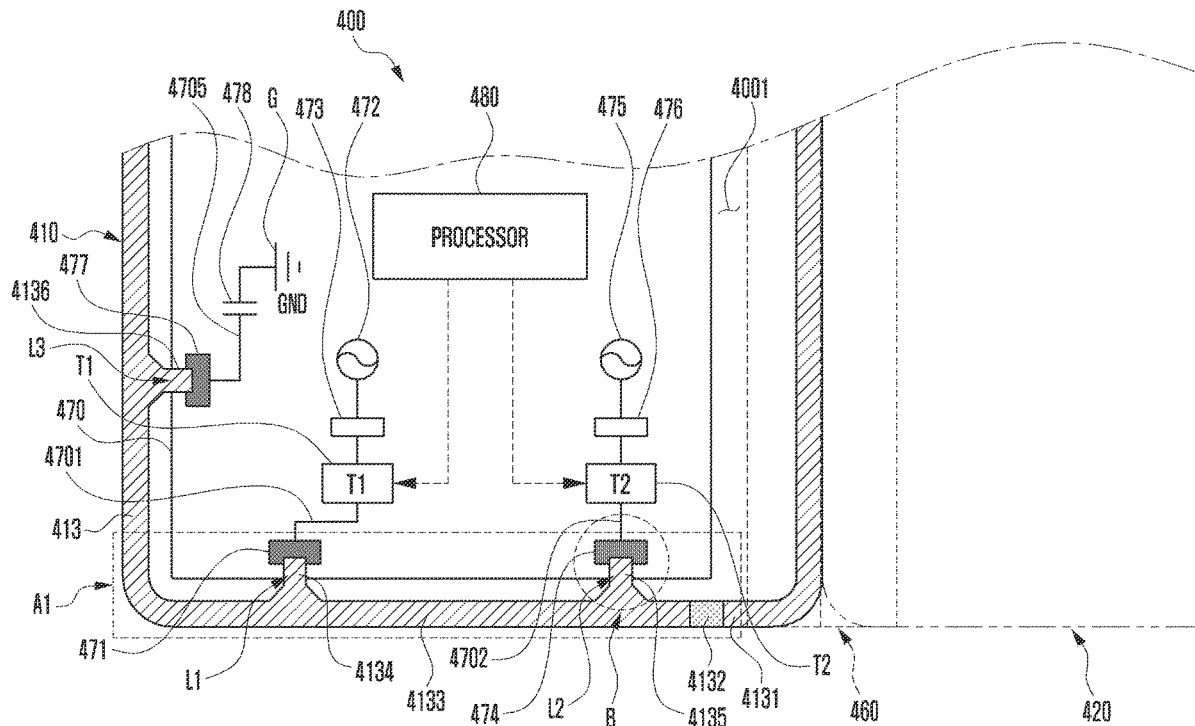
(22) Filed: **Aug. 5, 2021**

Related U.S. Application Data

(62) Division of application No. 16/596,108, filed on Oct. 8, 2019, now Pat. No. 11,114,744.

Foreign Application Priority Data

Oct. 16, 2018 (KR) 10-2018-0122922





US 20210367326A1

(19) **United States**

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

(10) **Pub. No.: US 2021/0367326 A1**

(43) **Pub. Date: Nov. 25, 2021**

(54) **MOBILE DEVICE AND ANTENNA MODULE THEREOF**

H01Q 1/48 (2006.01)

H01Q 21/28 (2006.01)

H01Q 9/04 (2006.01)

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

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

CPC *H01Q 1/243* (2013.01); *H01Q 1/38* (2013.01); *H01Q 9/0421* (2013.01); *H01Q 21/28* (2013.01); *H01Q 1/48* (2013.01)

(72) Inventors: **CHUNG-HSUAN CHEN**, HSINCHU (TW); **CHEN-MING LI**, HSINCHU (TW)

(57) **ABSTRACT**

A mobile device and an antenna module thereof are provided. The antenna module includes a substrate, a first antenna and a second antenna. The first antenna and the second antenna are disposed on the substrate. The substrate includes a substrate body, a first ground layer and a second ground layer. The first ground layer includes a first slot, the second ground layer includes a second slot, and a vertical projection of the first slot onto substrate body at least partially overlaps with a vertical projection of the second slot onto substrate body. The first slot and the second slot are located between the first antenna and the second antenna, and the first antenna is located closer to the first slot and the second slot than the second antenna.

(21) Appl. No.: **17/013,949**

(22) Filed: **Sep. 8, 2020**

(30) **Foreign Application Priority Data**

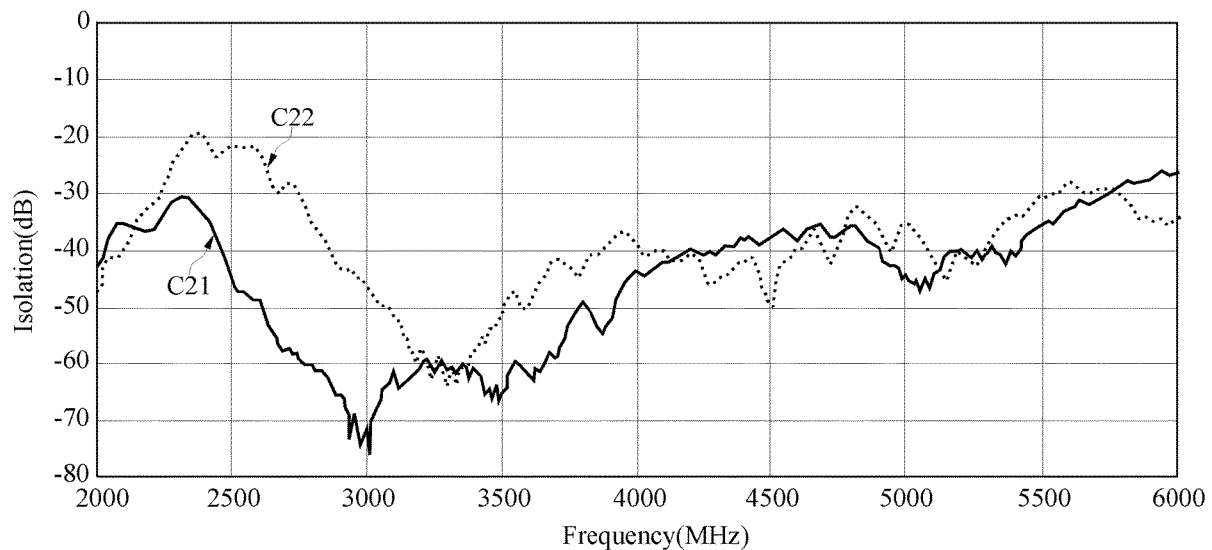
May 21, 2020 (TW) 109116968

Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 1/38 (2006.01)





(19) **United States**

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

(10) **Pub. No.: US 2021/0367327 A1**

(43) **Pub. Date: Nov. 25, 2021**

(54) **MOBILE DEVICE**

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

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

CPC **H01Q 1/243** (2013.01); **H01Q 5/392** (2015.01); **H01Q 1/38** (2013.01)

(72) Inventors: **Kun-Sheng CHANG**, New Taipei City (TW); **Ching-Chi LIN**, New Taipei City (TW)

(57) **ABSTRACT**

(21) Appl. No.: **17/152,105**

A mobile device includes a main radiation element, a parasitic radiation element, and an additional radiation element. The main radiation element has a first notch. The main radiation element includes a feeding region coupled to a signal source, and a grounding region coupled to a ground voltage. The parasitic radiation element is coupled to the ground voltage. The parasitic radiation element is adjacent to the feeding region of the main radiation element. The additional radiation element is coupled to the main radiation element. The additional radiation element and the parasitic radiation element substantially extend in the same direction. An antenna structure is formed by the main radiation element, the parasitic radiation element, and the additional radiation element.

(22) Filed: **Jan. 19, 2021**

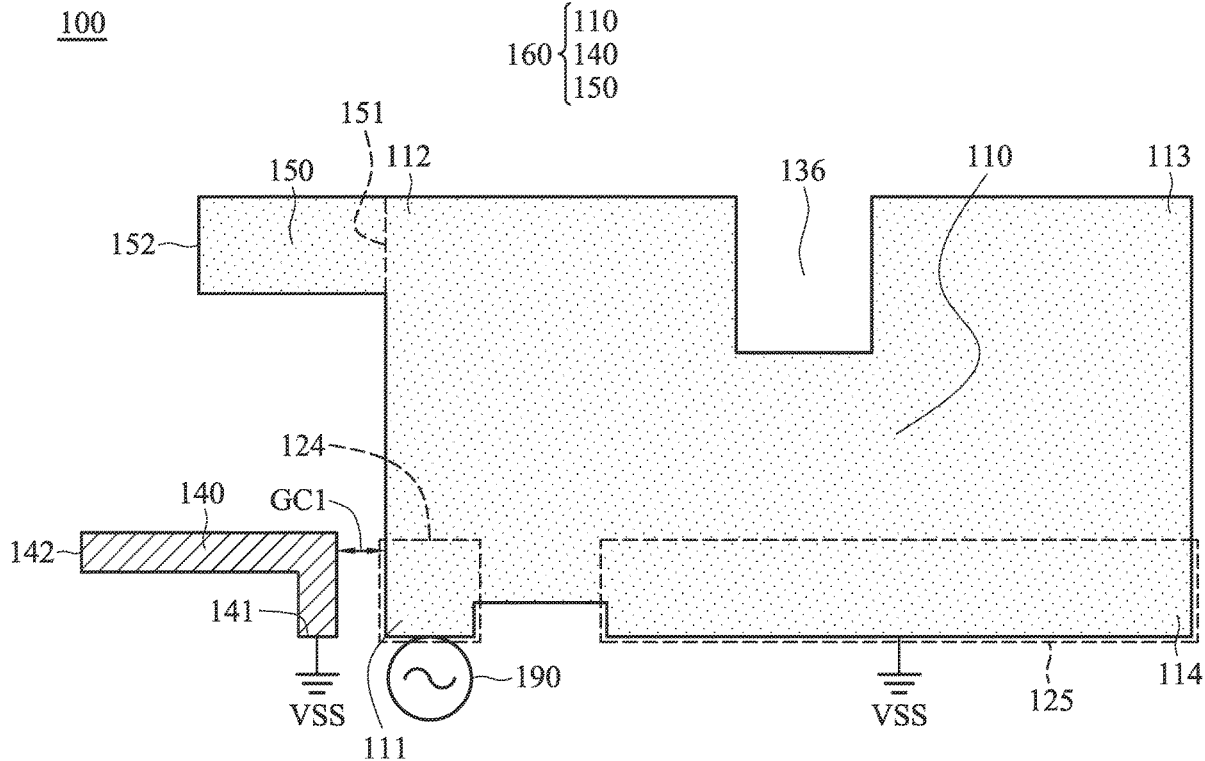
(30) **Foreign Application Priority Data**

May 21, 2020 (TW) 109116872

Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)
H01Q 1/38 (2006.01)
H01Q 5/392 (2006.01)





US 20210367333A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0367333 A1**
ZHAO et al. (43) **Pub. Date: Nov. 25, 2021**

(54) **ANTENNA AND COMMUNICATIONS DEVICE**

(52) **U.S. CL.**
CPC **H01Q 1/523** (2013.01); **H01Q 21/0075** (2013.01); **H01Q 21/245** (2013.01)

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

(72) Inventors: **Jie ZHAO**, Nanjing (CN); **Michael KADICHEVITZ**, Hod Hasharon (IL); **Xiao ZHOU**, Shanghai (CN); **Zui TAO**, Nanjing (CN)

(57) **ABSTRACT**

The application provides an antenna and a communications device, and pertains to the field of antenna technologies. The antenna includes a horizontally polarized antenna and a vertically polarized antenna that are disposed in a superposition manner. The horizontally polarized antenna includes a metal sheet, and the metal sheet can be separately connected to a double-sided parallel strip line in the horizontally polarized antenna and a first conductor of a coaxial cable. A diameter of a maximum inscribed circle of the metal sheet is greater than a line width of the double-sided parallel strip line, and both the metal sheet and the coaxial cable are located on a first side of a substrate. Therefore, the metal sheet can effectively suppress an induced current in the coaxial cable, and impact of the induced current on the vertically polarized antenna can be reduced.

(21) Appl. No.: **17/323,422**

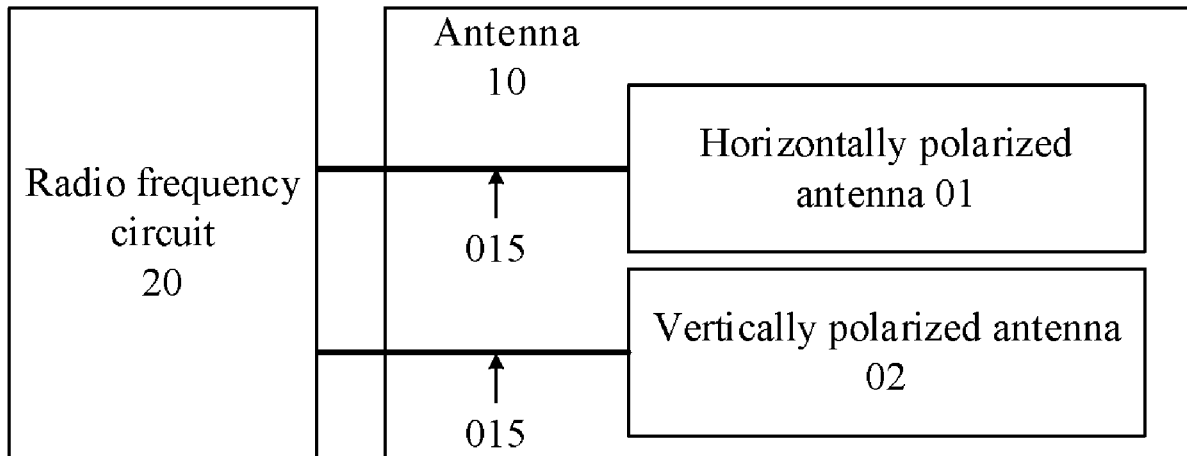
(22) Filed: **May 18, 2021**

(30) **Foreign Application Priority Data**

May 20, 2020 (CN) 202010431622.5

Publication Classification

(51) **Int. Cl.**
H01Q 1/52 (2006.01)
H01Q 21/24 (2006.01)
H01Q 21/00 (2006.01)





US 20210367345A1

(19) **United States**

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

(10) **Pub. No.: US 2021/0367345 A1**

(43) **Pub. Date: Nov. 25, 2021**

(54) **VERTICAL POLARIZED ANTENNA AND TERMINAL DEVICE**

(30) **Foreign Application Priority Data**

Jan. 19, 2018 (KR) 10-2018-0007336

(71) Applicants: **SK TELECOM CO., LTD.**, Seoul (KR); **POSTECH ACADEMY-INDUSTRY FOUNDATION**, Gyeongsangbuk-do (KR)

Publication Classification

(51) **Int. Cl.**
H01Q 13/18 (2006.01)
H01Q 1/24 (2006.01)
H01Q 21/06 (2006.01)
(52) **U.S. Cl.**
CPC *H01Q 13/18* (2013.01); *H01Q 21/064* (2013.01); *H01Q 1/243* (2013.01)

(72) Inventors: **Hee Chang SEONG**, Seoul (KR); **Joon Young SHIN**, Seoul (KR); **Sung Yong KANG**, Seoul (KR); **Won Bin HONG**, Seoul (KR); **Jun Ho PARK**, Seoul (KR)

(21) Appl. No.: **16/769,653**

(57) **ABSTRACT**

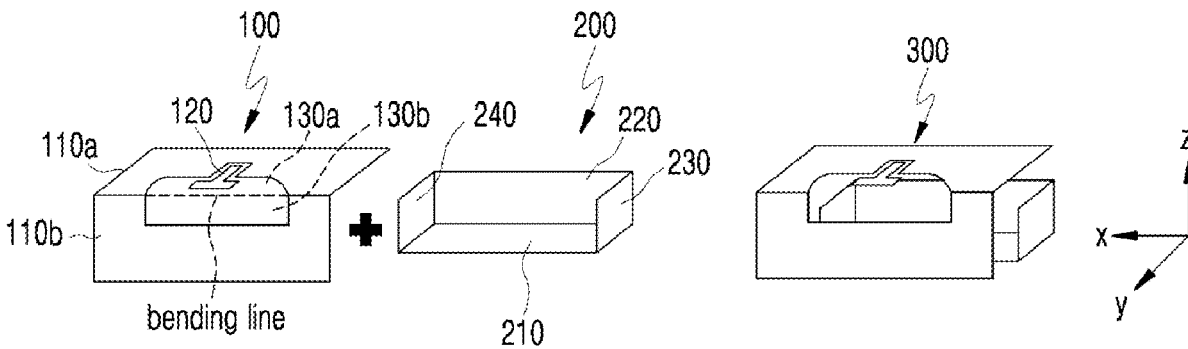
(22) PCT Filed: **Jan. 16, 2019**

(86) PCT No.: **PCT/KR2019/000646**

§ 371 (c)(1),

(2) Date: **Jun. 4, 2020**

The present disclosure provides technology that proposes an ultra-high frequency band (mmWave band) vertical polarization antenna having a new structure applicable to a slim planar structure (e.g., a terminal).





US 20210367350A1

(19) **United States**

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

(10) **Pub. No.: US 2021/0367350 A1**

(43) **Pub. Date: Nov. 25, 2021**

(54) **ANTENNA AND COMMUNICATIONS
DEVICE**

Publication Classification

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

(51) **Int. Cl.**
H01Q 15/24 (2006.01)
H01Q 21/00 (2006.01)
H01Q 9/30 (2006.01)

(72) Inventors: **Jie Zhao**, Nanjing (CN); **Xiao Zhou**,
Shanghai (CN); **Zui Tao**, Nanjing (CN)

(52) **U.S. Cl.**
CPC *H01Q 15/246* (2013.01); *H01Q 9/30*
(2013.01); *H01Q 21/0075* (2013.01)

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

(57) **ABSTRACT**

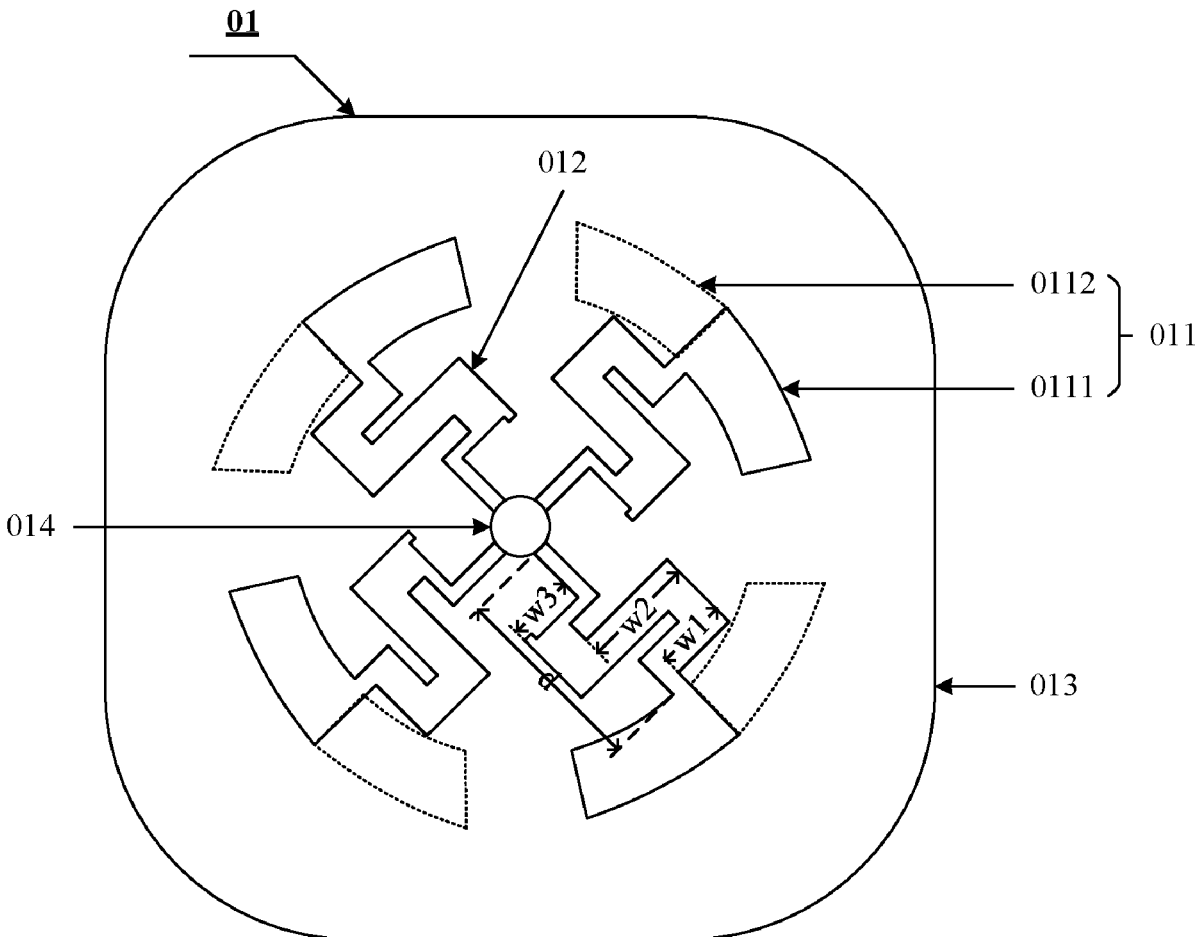
(21) Appl. No.: **17/324,757**

An antenna for wireless communications includes a horizontal polarization antenna and a vertical polarization antenna that are disposed in a stacked manner. The horizontal polarization antenna includes a radiation element and a double-sided parallel strip line. One end of the double-sided parallel strip line is connected to the radiation element. A length range of the double-sided parallel strip line is 0.58 to 1.35 times a waveguide wavelength of an electromagnetic wave in the double-sided parallel strip line at an operating frequency of the vertical polarization antenna.

(22) Filed: **May 19, 2021**

(30) **Foreign Application Priority Data**

May 20, 2020 (CN) 202010431978.9





US 20210367356A1

(19) **United States**

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

(10) **Pub. No.: US 2021/0367356 A1**

(43) **Pub. Date: Nov. 25, 2021**

(54) **ANTENNA DEVICE**

H01Q 1/50 (2006.01)

H04B 1/401 (2006.01)

(71) Applicant: **MITSUBISHI ELECTRIC CORPORATION**, Tokyo (JP)

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

CPC **H01Q 21/28** (2013.01); **H04B 1/401** (2013.01); **H01Q 1/50** (2013.01); **H01Q 1/52** (2013.01)

(72) Inventors: **Kengo NISHIMOTO**, Tokyo (JP);
Yasuhiro NISHIOKA, Tokyo (JP)

(57)

ABSTRACT

(73) Assignee: **MITSUBISHI ELECTRIC CORPORATION**, Tokyo (JP)

The antenna device includes a first radiation element, a second radiation element, a first input and output terminal, a second input and output terminal, a first phase shifter, a first susceptance element, a second susceptance element, a third susceptance element, a fourth susceptance element, a first variable matching circuit, and a second variable matching circuit, and when power is supplied from the first input and output terminal or the second input and output terminal, each susceptance value of the first susceptance element, the second susceptance element, the third susceptance element, and the fourth susceptance element are set so that an excitation amplitude of the first radiation element and an excitation amplitude of the second radiation element have a substantially equal amplitude, and coupling between the first input and output terminal and the second input and output terminal is reduced.

(21) Appl. No.: **17/387,434**

(22) Filed: **Jul. 28, 2021**

Related U.S. Application Data

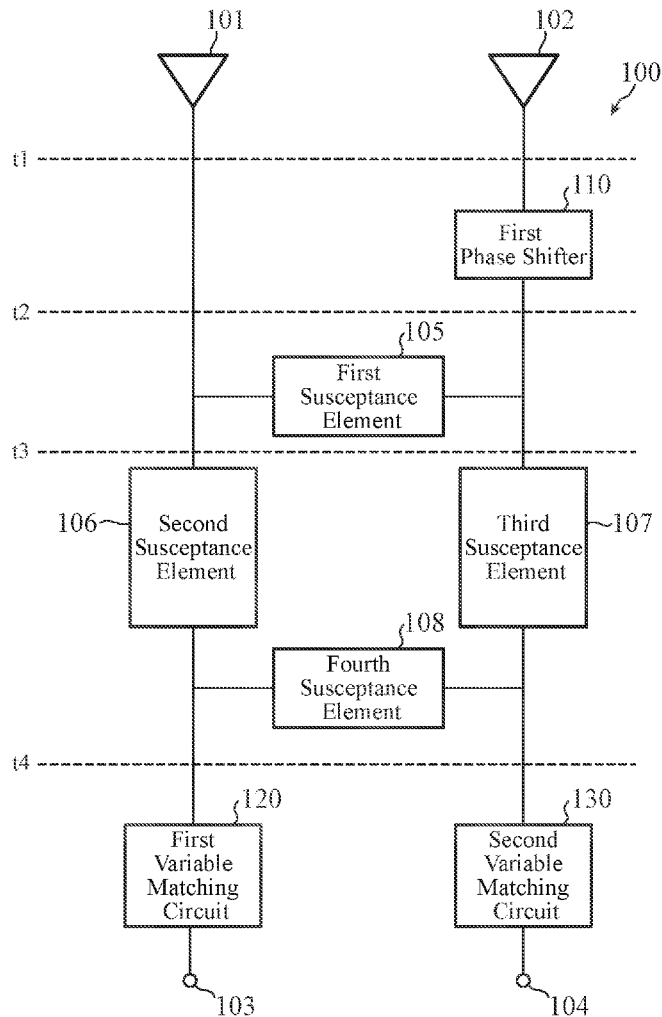
(63) Continuation of application No. PCT/JP2019/008087, filed on Mar. 1, 2019.

Publication Classification

(51) **Int. Cl.**

H01Q 21/28 (2006.01)

H01Q 1/52 (2006.01)





US 20210367357A1

(19) **United States**

(12) **Patent Application Publication**
Jia

(10) **Pub. No.: US 2021/0367357 A1**

(43) **Pub. Date: Nov. 25, 2021**

(54) **MILLIMETER-WAVE ANTENNA MODULE AND ELECTRONIC DEVICE**

(52) **U.S. Cl.**
CPC **H01Q 21/28** (2013.01); **H01Q 1/241** (2013.01); **H01Q 21/0031** (2013.01)

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

(57) **ABSTRACT**

(72) Inventor: **Yuhu Jia**, Dongguan (CN)

(21) Appl. No.: **17/397,398**

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

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2020/078926, filed on Mar. 12, 2020.

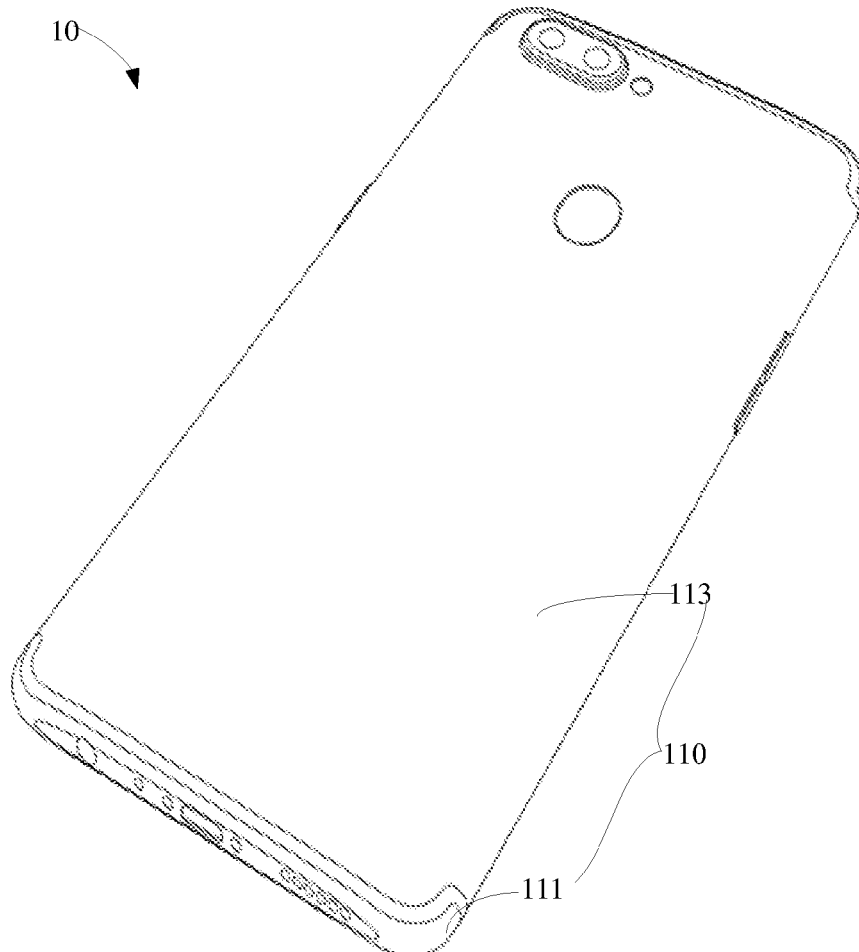
(30) **Foreign Application Priority Data**

Mar. 30, 2019 (CN) 201910211412.2

Publication Classification

(51) **Int. Cl.**
H01Q 21/28 (2006.01)
H01Q 21/00 (2006.01)
H01Q 1/24 (2006.01)

Provided are a millimeter-wave antenna module and an electronic device. The electronic device comprises a rear housing, a main circuit board disposed apart from and faced to the rear housing, and the millimeter-wave antenna module. The millimeter-wave antenna module comprises: an antenna array, disposed on the rear housing and configured to receive or transmit millimeter-wave signals; a feeding module, disposed between the rear housing and the main circuit board, and arranged opposite to the antenna array, wherein the feeding module is connected to the main circuit board, and configured to perform coupled feeding to the antenna array; and a buffer layer, disposed between the antenna array and the feeding module, and having a dielectric constant greater than that of air and less than that of the rear housing.





US 20210373141A1

(19) **United States**

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

(10) **Pub. No.: US 2021/0373141 A1**

(43) **Pub. Date: Dec. 2, 2021**

(54) **PHASED ARRAY FRONT-END DEVICES**

Publication Classification

(71) Applicant: **General Radar Corporation**, Menlo Park, CA (US)

(72) Inventors: **Jon Williams**, San Francisco, CA (US); **Dmitry Turbiner**, Mountain View, CA (US); **Brian Williams**, Issaquah, WA (US); **Christian Kurzke**, Saratoga, CA (US); **David Powell**, Oakland, CA (US); **Iliia Lebedev**, Cambridge, MA (US); **Sergey Klypin**, Sammamish, WA (US); **Barnabas Fung**, San Mateo, CA (US); **Devin Matthews**, San Francisco, CA (US)

(51) **Int. Cl.**
G01S 13/02 (2006.01)
H01Q 21/24 (2006.01)
G01S 7/03 (2006.01)
H01Q 1/32 (2006.01)
G01S 13/931 (2006.01)

(52) **U.S. Cl.**
CPC **G01S 13/02** (2013.01); **H01Q 21/245** (2013.01); **G01S 2013/0254** (2013.01); **H01Q 1/3233** (2013.01); **G01S 13/931** (2013.01); **G01S 7/03** (2013.01)

(21) Appl. No.: **17/026,253**

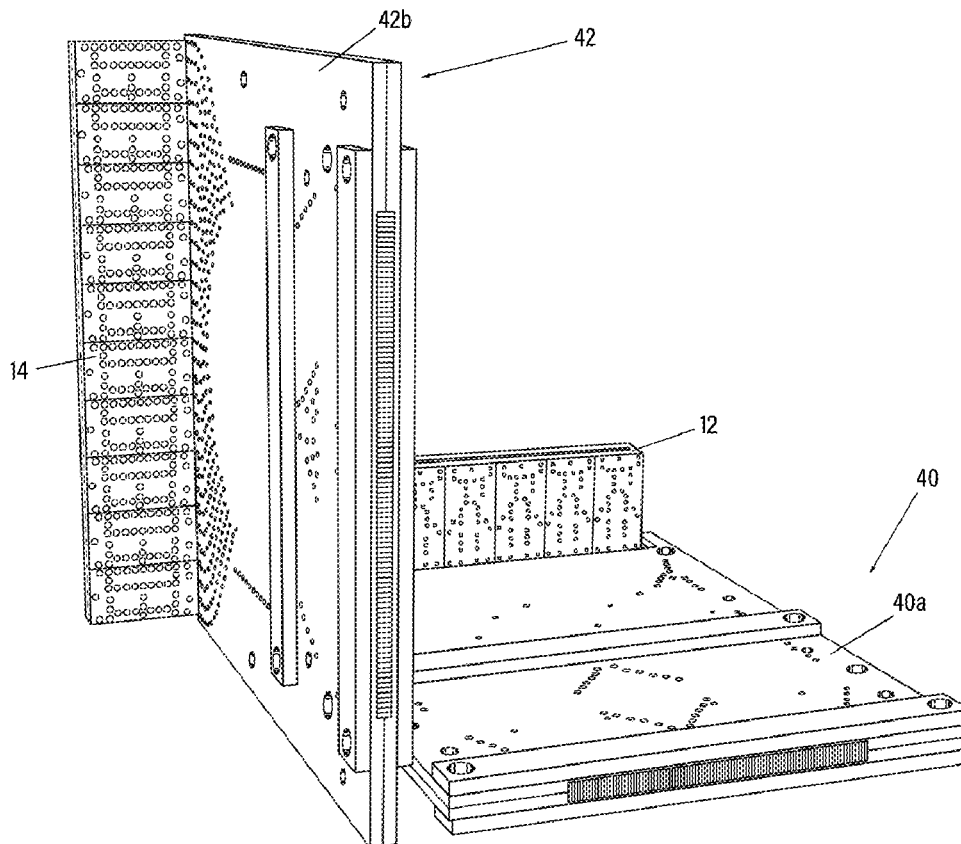
(22) Filed: **Sep. 20, 2020**

Related U.S. Application Data

(60) Provisional application No. 63/032,999, filed on Jun. 1, 2020, provisional application No. 63/033,023, filed on Jun. 1, 2020, provisional application No. 63/034,675, filed on Jun. 4, 2020, provisional application No. 63/034,729, filed on Jun. 4, 2020, provisional application No. 63/034,751, filed on Jun. 4, 2020, provisional application No. 63/034,769, filed on Jun. 4, 2020, provisional application No. 63/034,937, filed on Jun. 4, 2020.

(57) **ABSTRACT**

A radar system includes a transmit front end device including a transmit planar component, and a receive front end device including a receive planar component. Each of the transmit planar component and the receive planar component includes a first end, a second end, a cavity space and a linear array of antennas. The cavity space is bounded by beam ports along a first side of the cavity space and by array ports along a second side of the cavity space. The cavity space is in operative communication with the beam ports and with the array ports to form a Rotman lens. A linear array of antennas is located along the second end of the planar component. The transmit planar component and receive planar component are arranged such that the linear array of antennas of the transmit planar component and the linear array of antennas are perpendicular to one another.





(19) **United States**

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

(10) **Pub. No.: US 2021/0373679 A1**

(43) **Pub. Date: Dec. 2, 2021**

(54) **ELECTRONIC DEVICE INCLUDING ANTENNA STRUCTURE**

(57) **ABSTRACT**

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

(72) Inventors: **Yongjoo SHIN**, Gyeonggi-do (KR);
Yongwoon KIM, Gyeonggi-do (KR);
Nayoung CHU, Gyeonggi-do (KR);
Jinwan AN, Gyeonggi-do (KR); **Jiwoo LEE**, Gyeonggi-do (KR)

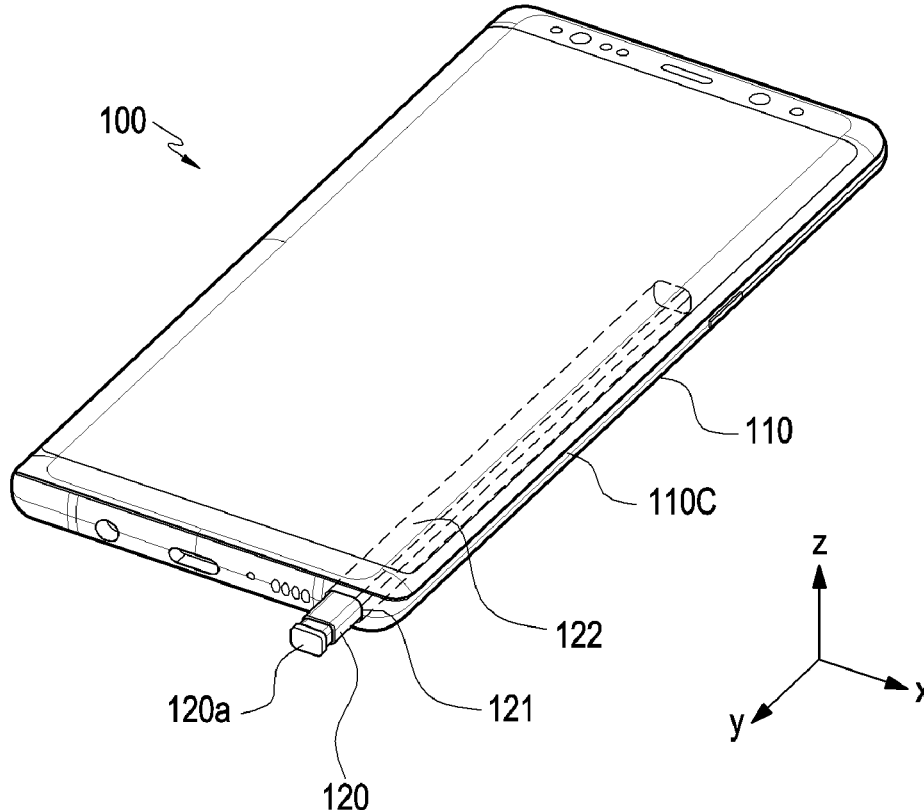
Various embodiments disclosed in the present invention relate to an electronic device antenna structure for communication with an external electronic device. According to various embodiments disclosed in the present invention, provided is an electronic device comprising: a pen housing extending to be long, including a first end part and a second end part, and including an inner space; a tip, which has a pointed end, is made of a dielectric and is located at the first end part; a printed circuit board (PCB) extending to be long, located in the inner space, and including a first surface facing a first direction and a second surface facing a second direction, which is opposite to the first direction; a wireless communication circuit located on the PCB in the inner space; and an antenna structure located in the inner space and electrically connected to the wireless communication circuit, wherein the antenna structure includes: a first conductive part located between the pen housing and the first surface of the PCB; a second conductive part electrically connected to the first conductive part toward a third direction which differs from the first direction and the second direction, and extending along the PCB; and a third conductive part electrically connected to the first conductive part toward a fourth direction which differs from the first direction, the second direction and the third direction, and extending along the PCB, and at least one part of the PCB is arranged between the second conductive part and the third conductive part when the first surface of the PCB is viewed from an upper surface thereof. Additional various embodiments can be provided.

(21) Appl. No.: **17/252,411**
(22) PCT Filed: **Jun. 19, 2019**
(86) PCT No.: **PCT/KR2019/007399**
§ 371 (c)(1),
(2) Date: **Dec. 15, 2020**

(30) **Foreign Application Priority Data**
Jun. 20, 2018 (KR) 10-2018-0071034

Publication Classification

(51) **Int. Cl.**
G06F 3/0354 (2006.01)
H01Q 1/24 (2006.01)
(52) **U.S. Cl.**
CPC .. **G06F 3/03545** (2013.01); **G06F 2203/0384**
(2013.01); **H01Q 1/243** (2013.01)





US 20210376438A1

(19) **United States**

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

(10) **Pub. No.: US 2021/0376438 A1**

(43) **Pub. Date: Dec. 2, 2021**

(54) **WAVEGUIDE MICROSTRIP LINE
CONVERTER AND ANTENNA DEVICE**

(52) **U.S. Cl.**
CPC *H01P 5/08* (2013.01); *H01P 3/081*
(2013.01)

(71) Applicant: **Mitsubishi Electric Corporation,**
Chiyoda-ku (JP)

(72) Inventors: **Takashi MARUYAMA,** Tokyo (JP);
Shigeo UDAGAWA, Tokyo (JP)

(57) **ABSTRACT**

(73) Assignee: **Mitsubishi Electric Corporation,**
Chiyoda-ku (JP)

A waveguide microstrip line converter includes a waveguide, a dielectric substrate, a ground conductor including a slot, and a line conductor. The line conductor includes a first section that is a microstrip line having a first line width, a conversion unit that is a second section positioned immediately above the slot and having a second line width greater than the first line width, and a third section extending from the second section in a first direction and performing impedance matching between the first section and the second section. One of the opposite ends of the third section in the first direction is connected to the second section. The first section extends in a second direction perpendicular to the first direction continuously from the other end of the opposite ends of the third section.

(21) Appl. No.: **16/957,478**

(22) PCT Filed: **Jan. 10, 2018**

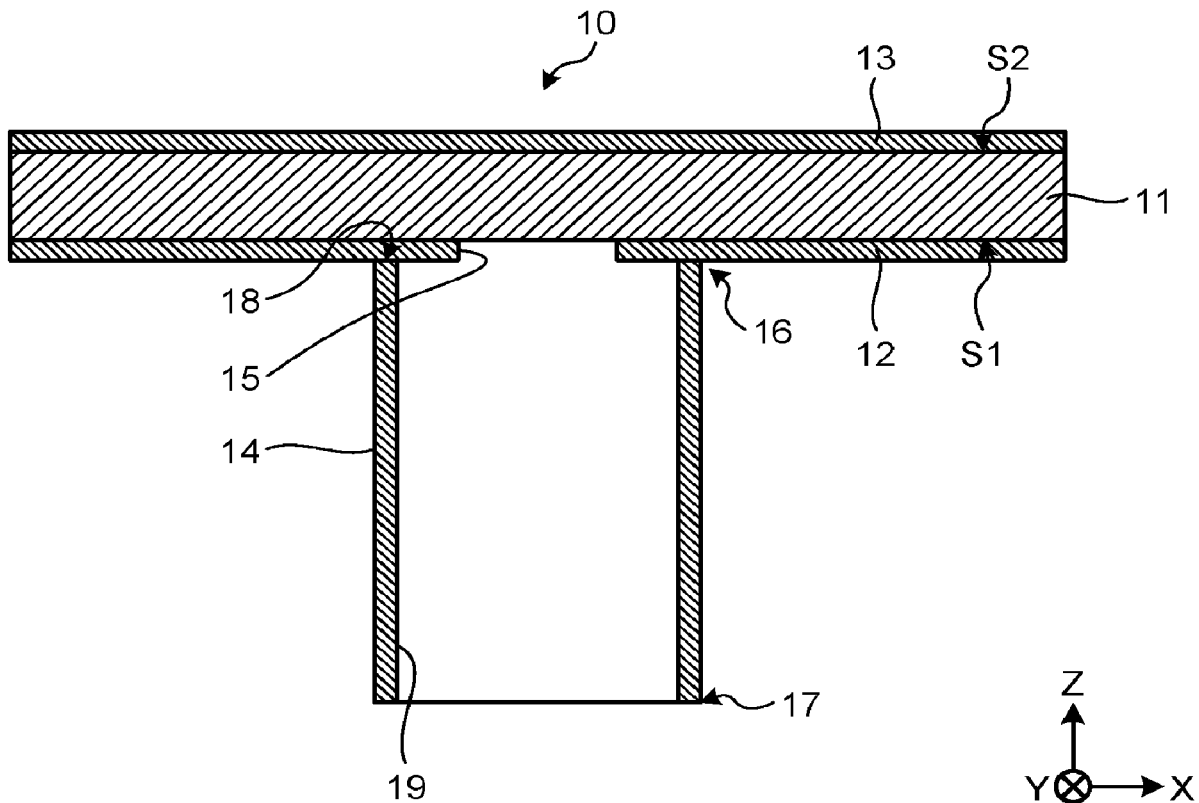
(86) PCT No.: **PCT/JP2018/000321**

§ 371 (c)(1),

(2) Date: **Jun. 24, 2020**

Publication Classification

(51) **Int. Cl.**
H01P 5/08 (2006.01)
H01P 3/08 (2006.01)





US 20210376452A1

(19) **United States**

(12) **Patent Application Publication**

WU et al.

(10) **Pub. No.: US 2021/0376452 A1**

(43) **Pub. Date: Dec. 2, 2021**

(54) **COUPLING ANTENNA APPARATUS AND ELECTRONIC DEVICE**

Publication Classification

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

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 13/10 (2006.01)
H01Q 5/357 (2006.01)

(72) Inventors: **Pengfei WU**, Shanghai (CN); **Chien-Ming LEE**, Shenzhen (CN); **Dong YU**, Shanghai (CN); **Chih Yu TSAI**, Taiwan (CN); **Chih-Hua CHANG**, Taiwan (CN); **Arun SOWPATI**, Shenzhen (CN)

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 5/357* (2015.01); *H01Q 13/10* (2013.01)

(21) Appl. No.: **17/290,904**

(57) **ABSTRACT**

(22) PCT Filed: **Nov. 5, 2019**

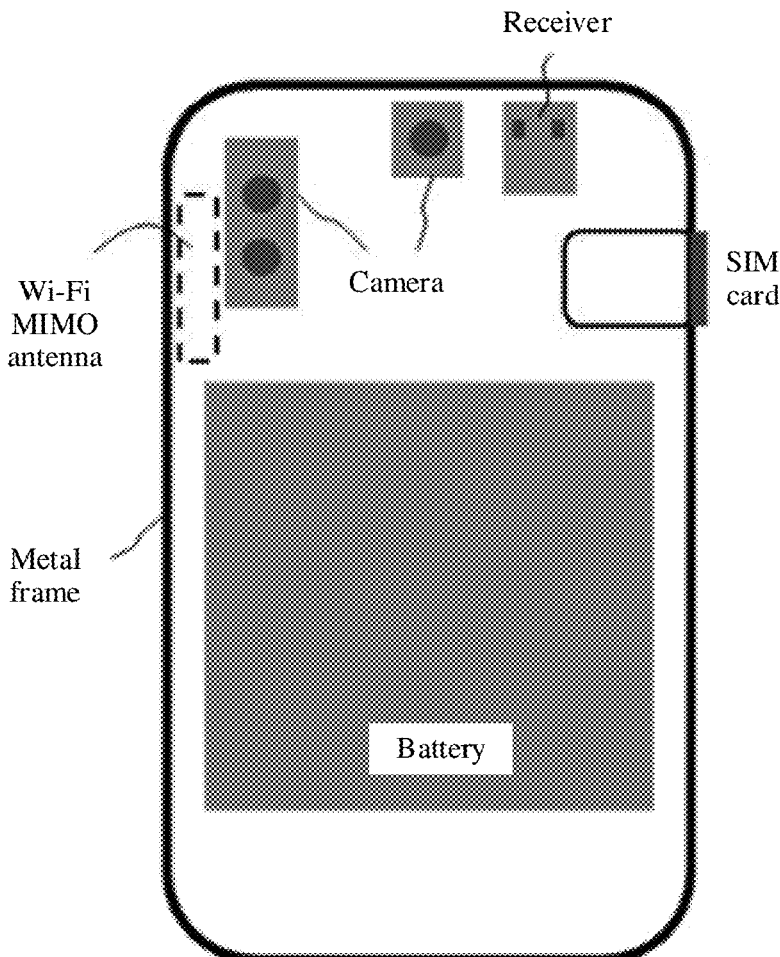
An antenna apparatus includes a feeding antenna inside an electronic device and one or more antenna elements, such as a floating metal antenna, disposed on a rear cover of the electronic device. The floating metal antenna and a feeding antenna inside the electronic device may form a coupling antenna structure. The feeding antenna may be an antenna fastened on an antenna support (which may be referred to as a support antenna). The feeding antenna may alternatively be a slot antenna formed by slitting on a metal middle frame of the electronic device. The antenna apparatus may be implemented in limited design space, thereby effectively saving antenna design space inside the electronic device. The antenna apparatus may generate excitation of a plurality of resonance modes, so that antenna bandwidth and radiation characteristics can be improved.

(86) PCT No.: **PCT/CN2019/115493**

§ 371 (c)(1),
(2) Date: **May 3, 2021**

(30) **Foreign Application Priority Data**

Nov. 6, 2018 (CN) 201811312284.2
Nov. 15, 2018 (CN) 201811362920.2





(19) **United States**

(12) **Patent Application Publication**

HAN et al.

(10) **Pub. No.: US 2021/0376453 A1**

(43) **Pub. Date: Dec. 2, 2021**

(54) **ELECTRONIC DEVICE INCLUDING ANTENNAS**

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

(72) Inventors: **Junhee HAN**, Gyeonggi-do (KR); **Heedong Kim**, Gyeonggi-do (KR); **Inho Shin**, Gyeonggi-do (KR); **Jiyoung Lim**, Gyeonggi-do (KR); **Yongwon Cho**, Gyeonggi-do (KR); **Jiwoo Lee**, Gyeonggi-do (KR)

(21) Appl. No.: **17/333,243**

(22) Filed: **May 28, 2021**

(30) **Foreign Application Priority Data**

May 29, 2020 (KR) 10-2020-0065342

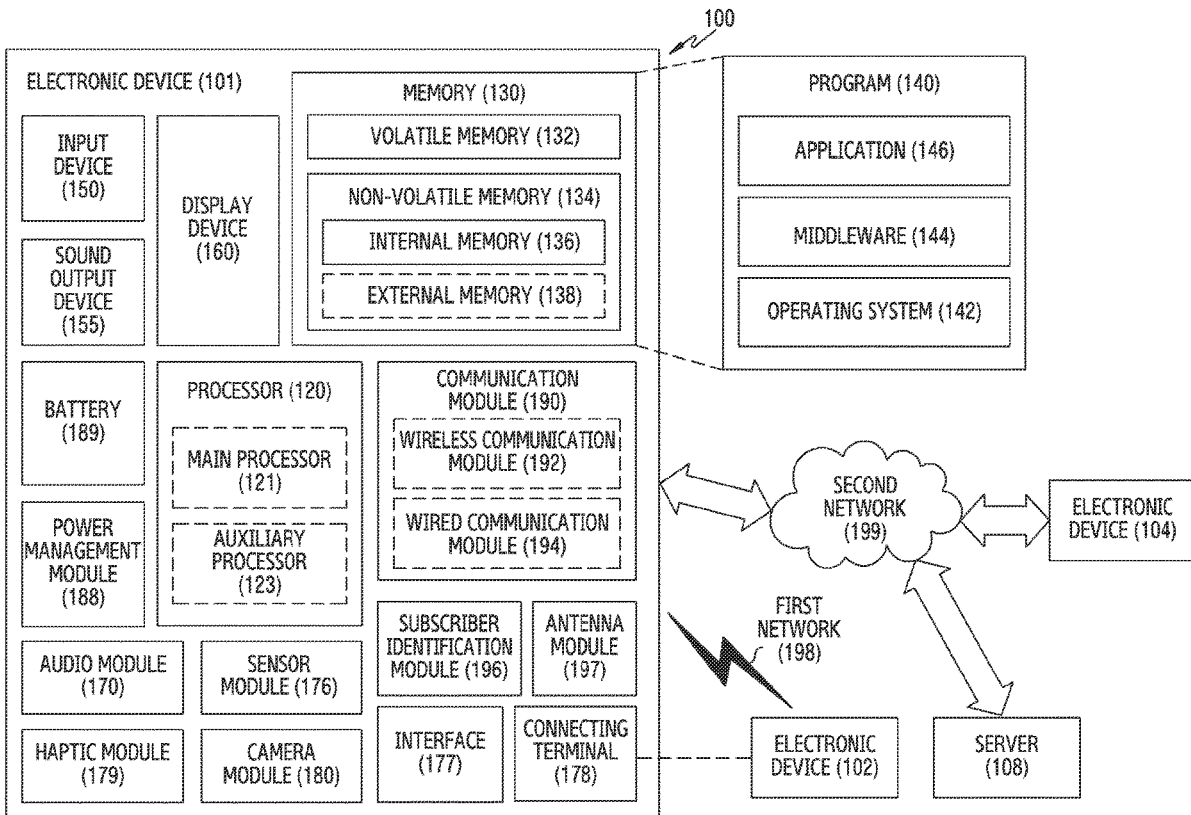
Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H04M 1/02 (2006.01)
G06F 3/0354 (2006.01)
H01Q 21/06 (2006.01)
H01Q 1/02 (2006.01)

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H04M 1/0264** (2013.01); **H04M 1/0266** (2013.01); **H04M 2250/52** (2013.01); **H01Q 21/064** (2013.01); **H01Q 1/02** (2013.01); **G06F 3/03545** (2013.01)

(57) **ABSTRACT**

An electronic device including antennas is provided. The electronic device includes a cover window including a view area and a non-view area formed along edges of the view area and including a view portion formed in at least one area, a frame including a first structure and a second structure which at least one electronic component is disposed, one surface of the first structure, forming the rear surface of the electronic device, including a nonconductive area including a window area and a conductive area surrounding the nonconductive area, a display, a PCB disposed in the second structure, wireless communication circuitry disposed on the printed circuit board, a first camera disposed in an area corresponding to the view portion of the second structure, a second camera disposed in an area of the second structure corresponding to the window area, a first antenna module configured to generate a first RF signal toward the cover window, and a second antenna module configured to generate a second RF signal toward the rear surface of the electronic device.





US 20210376459A1

(19) **United States**

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

(10) **Pub. No.: US 2021/0376459 A1**

(43) **Pub. Date: Dec. 2, 2021**

(54) **ANTENNA MODULE**

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

CPC **H01Q 1/48** (2013.01); **H01Q 9/0457** (2013.01)

(71) Applicants: **Inventec (Pudong) Technology Corporation**, Shanghai (CN); **INVENTEC CORPORATION**, Taipei City (TW)

(57) **ABSTRACT**

An antenna module includes a grounding plane, a first high-frequency radiator, a second high-frequency radiator, and a low-frequency grounding component. The first high-frequency radiator includes a first feeding portion, a first grounding portion, and a first radiating portion. The first grounding portion is coupled to the grounding plane. The second high-frequency radiator includes a second feeding portion, a second grounding portion, and a second radiating portion. The second grounding portion is coupled to the grounding plane. The low-frequency grounding component located between the first and second high-frequency radiators. The low-frequency grounding component includes a third grounding portion which is coupled to the grounding plane, a first coupling portion, and a second coupling portion. The low-frequency grounding component extends from the third grounding portion and extends in a first direction and a second direction of a first axis respectively to form the first and second coupling portions.

(72) Inventors: **Chih-Cheng LI**, TAIPEI CITY (TW); **Ssu-Han TING**, TAIPEI CITY (TW)

(21) Appl. No.: **16/902,283**

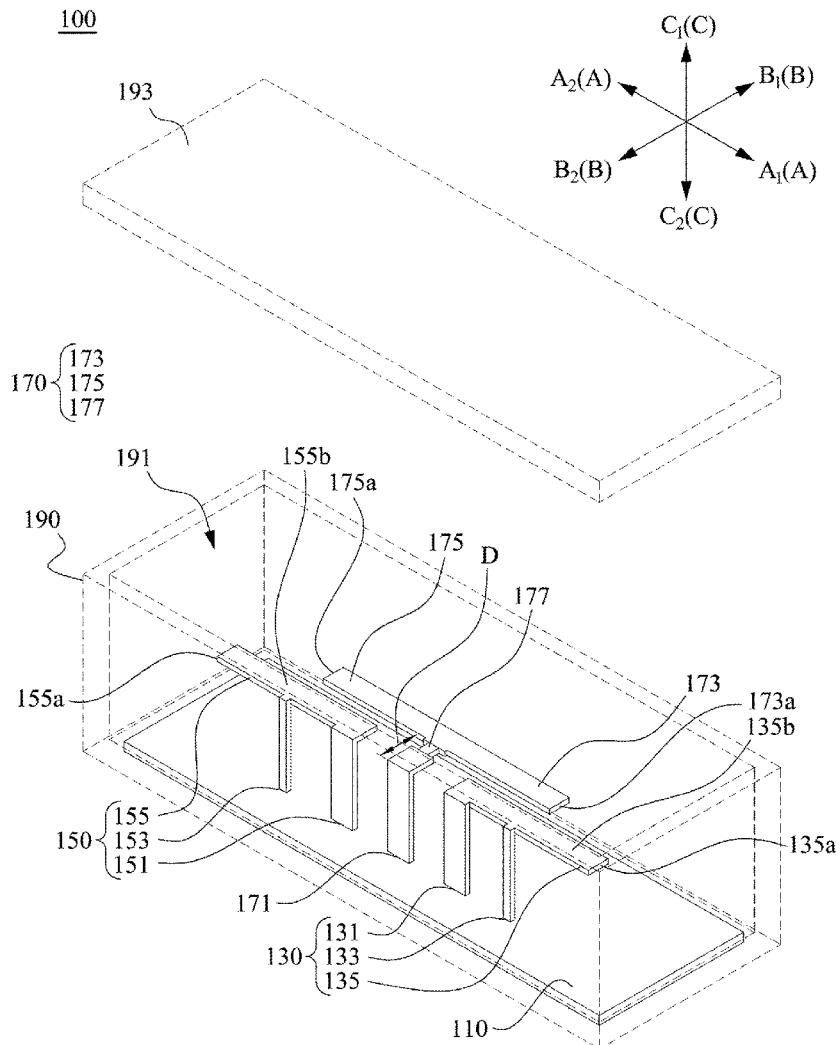
(22) Filed: **Jun. 16, 2020**

(30) **Foreign Application Priority Data**

Jun. 2, 2020 (CN) 202010490475.9

Publication Classification

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





US 20210376471A1

(19) **United States**

(12) **Patent Application Publication**

Kim et al.

(10) **Pub. No.: US 2021/0376471 A1**

(43) **Pub. Date: Dec. 2, 2021**

(54) **DISPLAY DEVICE**

(71) Applicants: **SAMSUNG ELECTRONICS CO., LTD.**, Suwon-si (KR); **FOUNDATION FOR RESEARCH AND BUSINESS, SEOUL NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**, Seoul (KR)

(72) Inventors: **Gyo Nyun Kim**, Suwon-si (KR); **Chang Won JUNG**, Seoul (KR); **Jung-Jin KIM**, Suwon-si (KR); **Dong Hoon LEE**, Suwon-si (KR)

(73) Assignees: **SAMSUNG ELECTRONICS CO., LTD.**, Suwon-si (KR); **FOUNDATION FOR RESEARCH AND BUSINESS, SEOUL NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**, Seoul (KR)

(21) Appl. No.: **17/257,516**

(22) PCT Filed: **Jan. 10, 2019**

(86) PCT No.: **PCT/KR2019/000407**

§ 371 (c)(1),
(2) Date: **Dec. 31, 2020**

(30) **Foreign Application Priority Data**

Jul. 2, 2018 (KR) 10-2018-0076427

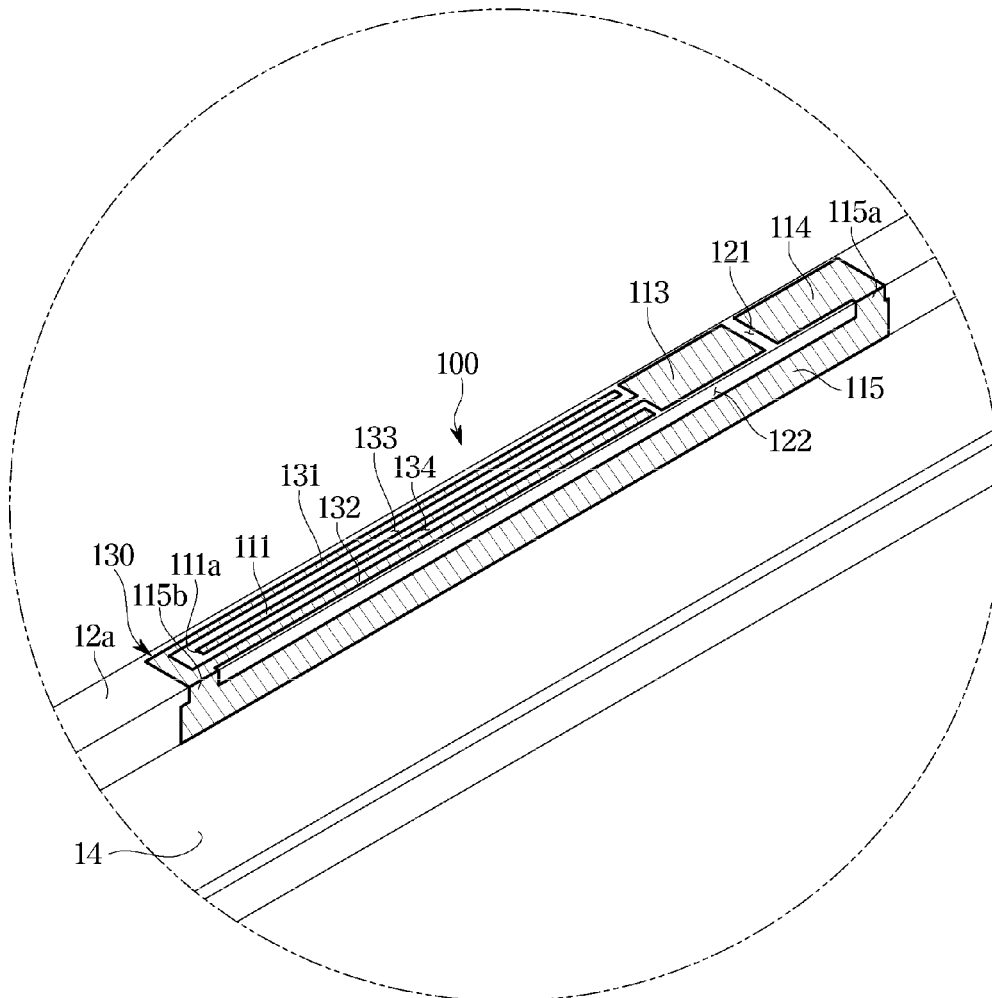
Publication Classification

(51) **Int. Cl.**
H01Q 5/50 (2006.01)
H01Q 1/48 (2006.01)
H01Q 1/24 (2006.01)

(52) **U.S. Cl.**
CPC **H01Q 5/50** (2015.01); **H01Q 1/24** (2013.01); **H01Q 1/48** (2013.01)

(57) **ABSTRACT**

The present disclosure relates to a display apparatus including a display panel, a bezel surface formed on a boundary of the display panel, and an antenna located on the bezel surface, wherein the antenna includes a composite right left handed (CRLH) structure including a series inductor, a series capacitor, a parallel inductor, and a parallel capacitor.





US 20210376477A1

(19) **United States**

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

(10) **Pub. No.: US 2021/0376477 A1**

(43) **Pub. Date: Dec. 2, 2021**

(54) **ANTENNA AND MOBILE TERMINAL**

H01Q 1/24 (2006.01)

H01Q 1/42 (2006.01)

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

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

CPC *H01Q 13/18* (2013.01); *H01Q 1/42* (2013.01); *H01Q 1/243* (2013.01); *H01Q 7/005* (2013.01)

(72) Inventors: **Fengwen CHEN**, Dongguan (CN); **Jiao LIANG**, Dongguan (CN); **Antti KARILAINEN**, Helsinki (FI); **Guozhong MA**, Shenzhen (CN); **Dongxing TU**, Shenzhen (CN); **Joonas KROGERUS**, Helsinki (FI); **Zlatoljub MILOSAVLJEVIC**, Helsinki (FI); **Konstantin SOKOLOV**, Helsinki (FI)

(57) **ABSTRACT**

A mobile terminal includes a display, a side frame, a back cover and an antenna. The antenna includes a conductive support and a feeding part. The conductive support includes a first portion and a third portion disposed opposite to each other, and a second portion and a fourth portion disposed opposite to each other. The four portions are made of conductive materials and jointly enclose a cavity. The second portion is disposed on an inner side of the display. The third portion is a part of the side frame. The fourth portion is located on an outer side or an inner side of the back cover, or is a part of the back cover. A gap is disposed between the fourth portion and the first portion, or is disposed in the fourth portion, and the antenna can radiate electromagnetic wave signal through the cavity and the gap.

(21) Appl. No.: **17/272,710**

(22) PCT Filed: **Sep. 7, 2018**

(86) PCT No.: **PCT/CN2018/104694**

§ 371 (c)(1),

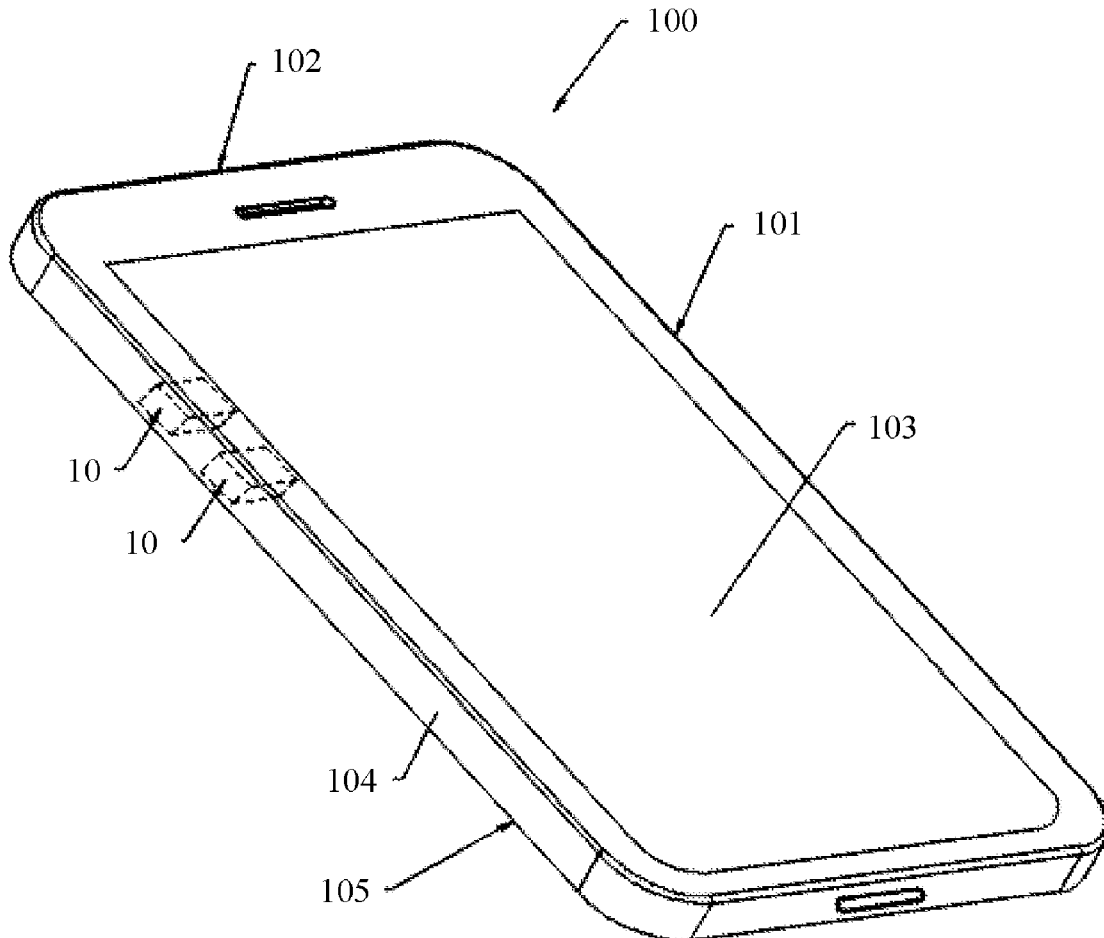
(2) Date: **Mar. 2, 2021**

Publication Classification

(51) **Int. Cl.**

H01Q 13/18 (2006.01)

H01Q 7/00 (2006.01)





US 20210376478A1

(19) **United States**

(12) **Patent Application Publication**
Shamblin

(10) **Pub. No.: US 2021/0376478 A1**

(43) **Pub. Date: Dec. 2, 2021**

(54) **MODAL ANTENNA SYSTEM INCLUDING
CLOSED-LOOP PARASITIC ELEMENT**

Publication Classification

(71) Applicant: **AVX Antenna, Inc. d/b/a Ethertronics,
Inc.**, San Diego, CA (US)

(51) **Int. Cl.**
H01Q 19/00 (2006.01)
H01Q 1/48 (2006.01)

(72) Inventor: **John Eric Shamblin**, San Diego, CA
(US)

(52) **U.S. Cl.**
CPC *H01Q 19/005* (2013.01); *H01Q 1/48*
(2013.01)

(21) Appl. No.: **17/306,441**

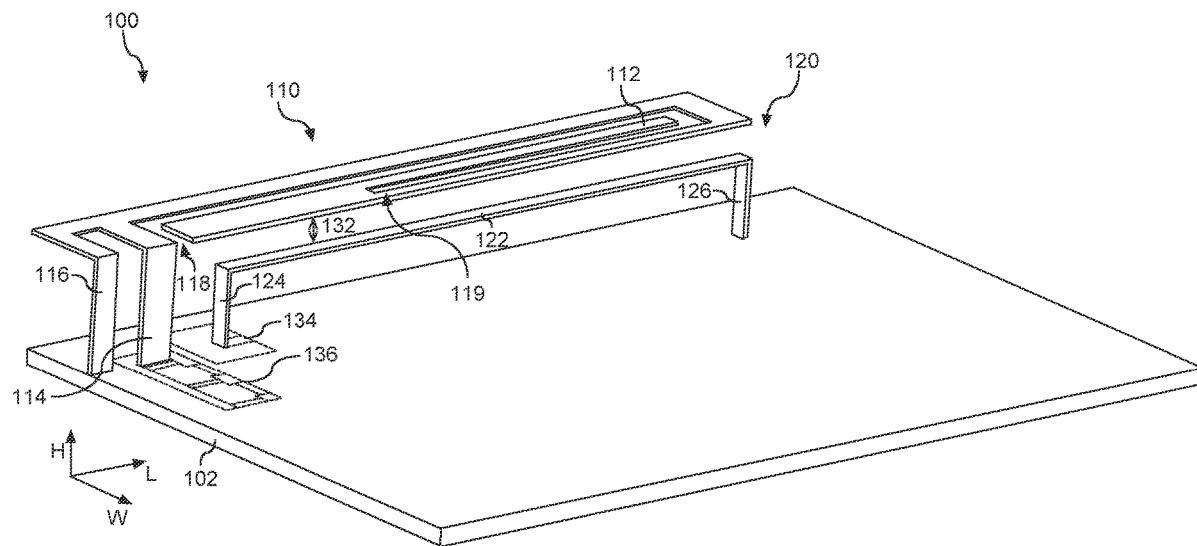
(57) **ABSTRACT**

(22) Filed: **May 3, 2021**

An antenna system can include a ground plane and a driven element spaced apart from the ground plane. The antenna system can include a parasitic element disposed proximate to the driven element. The parasitic element can be coupled to the ground plane by a first coupling and a second coupling. The second coupling can be independent from the first coupling. For instance, the first coupling can include one or more tunable components. The second coupling can fix the parasitic element to the ground plane.

Related U.S. Application Data

(60) Provisional application No. 63/030,941, filed on May 28, 2020.





US 20210376483A1

(19) **United States**

(12) **Patent Application Publication**

Chan et al.

(10) **Pub. No.: US 2021/0376483 A1**

(43) **Pub. Date: Dec. 2, 2021**

(54) **SUBSTRATE INTEGRATED WAVEGUIDE
FED ANTENNA**

(52) **U.S. Cl.**
CPC *H01Q 21/0037* (2013.01); *H01Q 21/062*
(2013.01); *H01Q 9/16* (2013.01)

(71) Applicant: **City University of Hong Kong,**
Kowloon (HK)

(72) Inventors: **Chi Hou Chan,** Kowloon (HK);
Manting Wang, Kowloon (HK)

(57) **ABSTRACT**

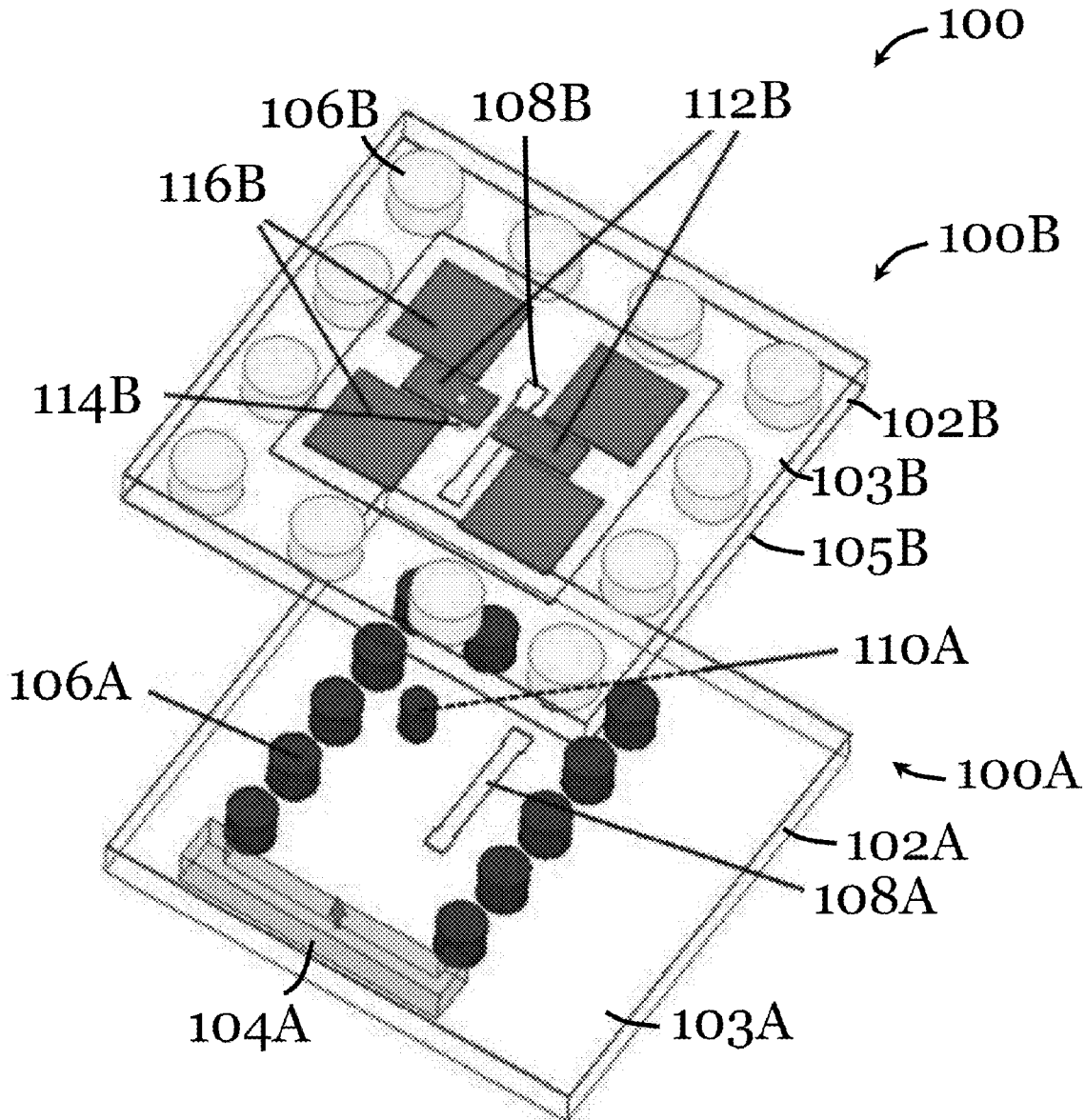
(21) Appl. No.: **16/889,089**

(22) Filed: **Jun. 1, 2020**

A substrate integrated waveguide fed antenna. The antenna includes an electric dipole, a parasitic patch arrangement operably coupled with the electric dipole, and a feed structure. The feed structure includes a substrate integrated waveguide operably coupled with the electric dipole for exciting the electric dipole. A slotted conductive surface with a slot is arranged between the electric dipole and the feed structure for operably coupling the feed structure with the electric dipole.

Publication Classification

(51) **Int. Cl.**
H01Q 21/00 (2006.01)
H01Q 9/16 (2006.01)
H01Q 21/06 (2006.01)





US 20210376485A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0376485 A1**

SHIN et al.

(43) **Pub. Date: Dec. 2, 2021**

(54) **ANTENNA INCLUDING CONDUCTIVE PATTERN AND ELECTRONIC DEVICE INCLUDING ANTENNA**

(52) **U.S. CI.**
CPC **H01Q 21/062** (2013.01); **H01Q 1/24** (2013.01); **H01Q 21/065** (2013.01); **H01Q 1/38** (2013.01)

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

(57) **ABSTRACT**

(72) Inventors: **Donghun SHIN**, Suwon-si (KR); **Mincheol SEO**, Suwon-si (KR); **Hosaeng KIM**, Suwon-si (KR); **Yoonjae LEE**, Suwon-si (KR); **Byungman LIM**, Suwon-si (KR); **Jaebong CHUN**, Suwon-si (KR)

An electronic device including an antenna and a conductive pattern formed around the antenna is provided. The electronic device includes a housing including a first plate, a second plate facing away from the first plate, and a side member surrounding a space between the first plate and the second plate, connected to the second plate or integrally formed with the second plate, and including a conductive material, an injection-molding material disposed in the space between the first plate and the second plate in the housing and formed of a non-conductive material, an antenna module including conductive radiators and supported by the injection-molding material, and a conductive pattern disposed on a first surface adjacent to the second plate of the injection-molding material or disposed inside the injection-molding material and disposed adjacent to a part of an edge of the antenna module corresponding to a boundary between the antenna module and the injection-molding material when viewed from the second plate in a direction of the first plate. A partial conductive radiator of the conductive radiators may be disposed to transmit and/or receive a signal through the second plate.

(21) Appl. No.: **17/397,113**

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

Related U.S. Application Data

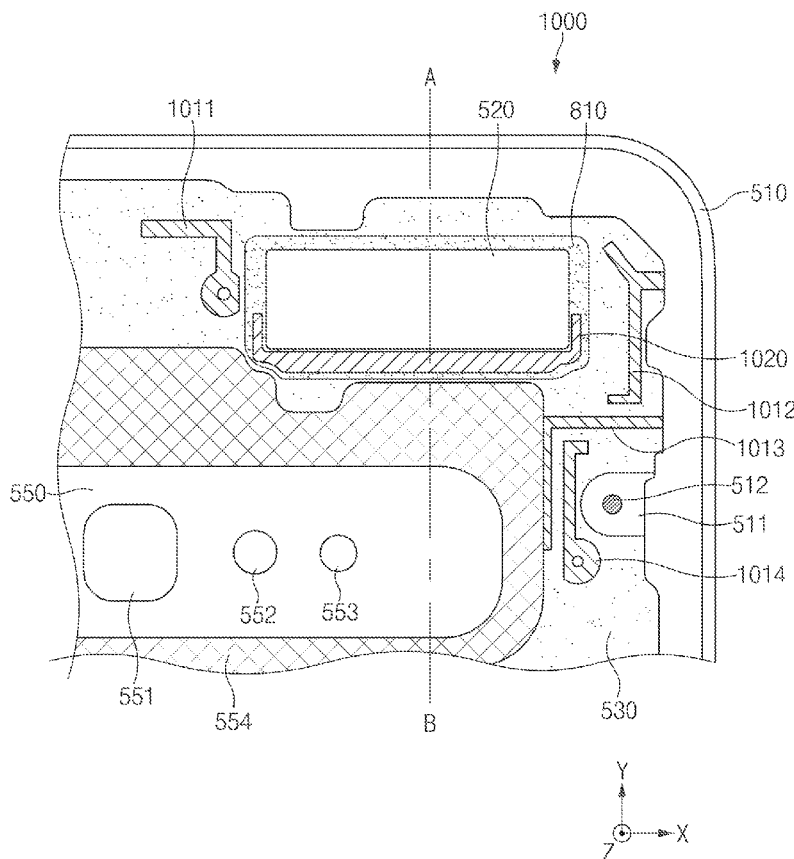
(63) Continuation of application No. 16/794,883, filed on Feb. 19, 2020, now Pat. No. 11,152,716.

Foreign Application Priority Data

Feb. 19, 2019 (KR) 10-2019-0019113

Publication Classification

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





(19) **United States**

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

(10) **Pub. No.: US 2021/0377372 A1**

(43) **Pub. Date: Dec. 2, 2021**

(54) **ANTENNA AND ELECTRONIC DEVICE INCLUDING SAME**

(52) **U.S. Cl.**
CPC **H04M 1/0216** (2013.01); **H04M 1/0249** (2013.01); **H01Q 1/243** (2013.01); **H04B 1/3888** (2013.01); **H04M 1/0268** (2013.01)

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

(57) **ABSTRACT**

(72) Inventors: **Hojin JUNG**, Suwon-si (KR);
Yongyoun KIM, Suwon-si (KR);
Jaesung SHIM, Suwon-si (KR);
Myeongsu OH, Suwon-si (KR); **Duho CHU**, Suwon-si (KR)

According to an embodiment of the present invention, an electronic device comprises: a foldable housing which comprises a hinge structure, a first housing structure connected to the hinge structure and including a first surface facing in a first direction, a second surface facing in a second direction that is opposite to the first direction, and a first side member that encompasses at least a portion of a space between the first and second surfaces and includes at least one first conductive part, and a second housing structure connected to the hinge structure, including a third surface facing in a third direction, a fourth surface facing in a fourth direction that is opposite to the third direction, and a second side member that encompasses at least a portion of a space between the third and fourth surfaces and includes at least one second conductive part, and which is folded with the first housing structure around the hinge structure, wherein the first surface faces the third surface in a folded state and the third direction is the same as the first direction in an unfolded state; a flexible display extending from the first surface to the third surface; and a wireless communication circuit electrically connected to the at least one second conductive part and configured to transmit and/or receive a signal having a specified frequency, wherein the at least one first conductive part and the at least one second conductive part may be electrically connected in the folded state. Other various embodiments may be possible.

(21) Appl. No.: **17/288,327**

(22) PCT Filed: **Oct. 23, 2019**

(86) PCT No.: **PCT/KR2019/013976**

§ 371 (c)(1),

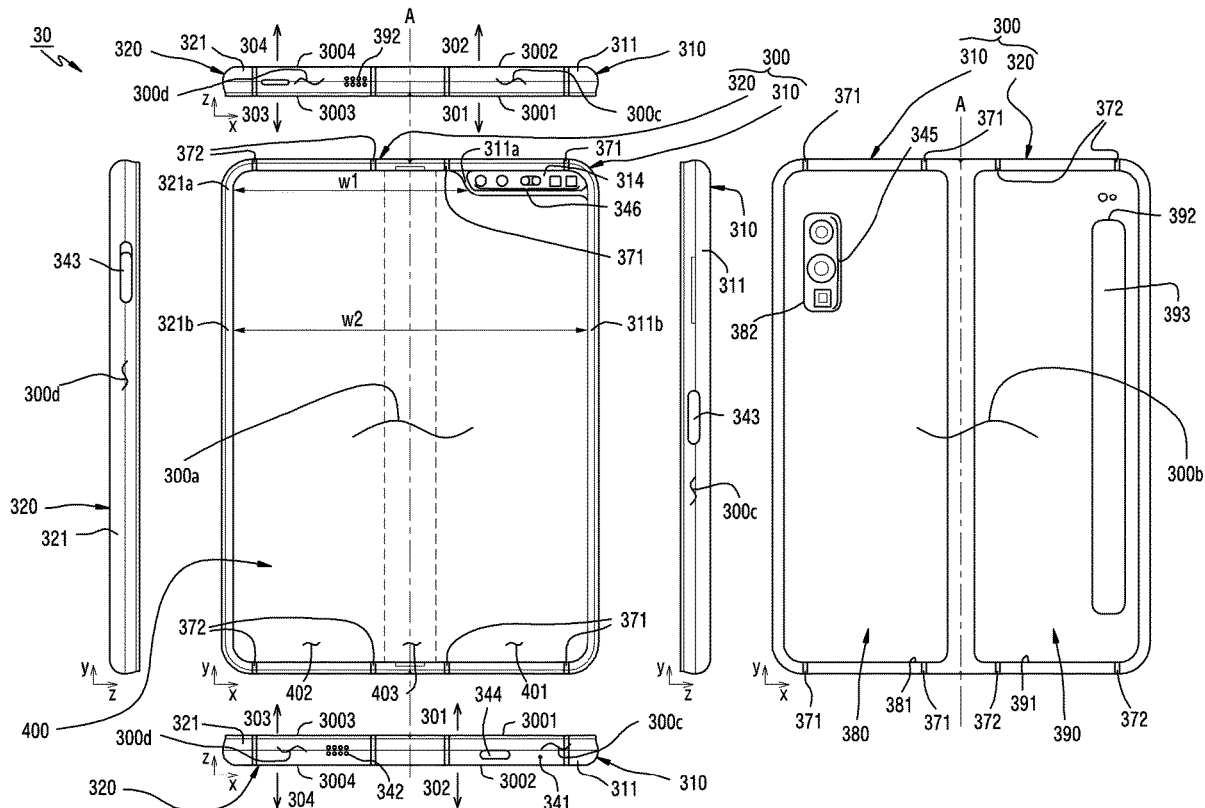
(2) Date: **Apr. 23, 2021**

(30) **Foreign Application Priority Data**

Oct. 24, 2018 (KR) 10-2018-0127508

Publication Classification

(51) **Int. Cl.**
H04M 1/02 (2006.01)
H04B 1/3888 (2006.01)
H01Q 1/24 (2006.01)





US 20210384625A1

(19) **United States**

(12) **Patent Application Publication**

Liu et al.

(10) **Pub. No.: US 2021/0384625 A1**

(43) **Pub. Date: Dec. 9, 2021**

(54) **PHASE SHIFTER AND ELECTRICALLY TUNABLE ANTENNA**

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

(72) Inventors: **Peng Liu**, Shenzhen (CN); **Xinming Liu**, Xi'an (CN); **Hongzhi Zhang**, Dongguan (CN); **Jiejun Zhou**, Xi'an (CN)

(21) Appl. No.: **17/406,357**

(22) Filed: **Aug. 19, 2021**

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2020/076081, filed on Feb. 20, 2020.

Foreign Application Priority Data

Feb. 20, 2019 (CN) 201910134990.0

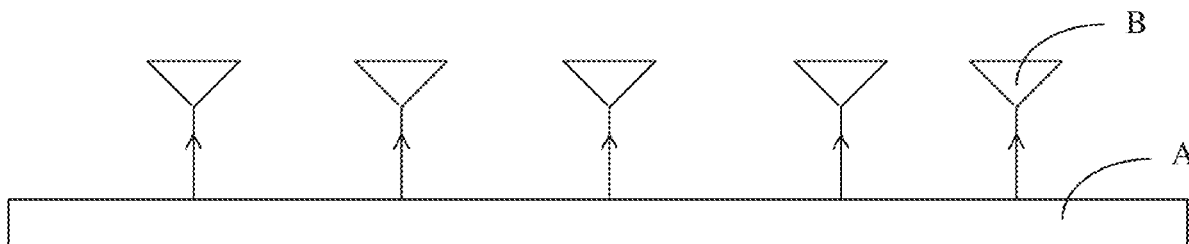
Publication Classification

(51) **Int. Cl.**
H01Q 3/34 (2006.01)
H01Q 5/335 (2006.01)
H01Q 13/18 (2006.01)
(52) **U.S. Cl.**
CPC *H01Q 3/34* (2013.01); *H01Q 13/18* (2013.01); *H01Q 5/335* (2015.01)

(57) **ABSTRACT**

This application provides a phase shifter and an electrically tunable antenna including the phase shifter, where the phase shifter includes a tuning accessory, and the tuning accessory includes a tuning portion for tuning input impedance of the phase shifter. One additional capacitance or inductance parameter is added in the phase shifter by using the tuning portion, to affect input impedance of a port, to further affect a port standing wave, thereby tuning the port standing wave by using the tuning accessory. In addition, the tuning accessory in this application is a molded part with a fixed structure.

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(19) **United States**

(12) **Patent Application Publication**
LI

(10) **Pub. No.: US 2021/0384626 A1**

(43) **Pub. Date: Dec. 9, 2021**

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

(71) Applicant: **VIVO MOBILE COMMUNICATION CO., LTD.**, Chang'an Dongguan (CN)

(72) Inventor: **Rihui LI**, Chang'an Dongguan (CN)

(73) Assignee: **VIVO MOBILE COMMUNICATION CO., LTD.**, Chang'an Dongguan (CN)

(21) Appl. No.: **16/625,523**

(22) PCT Filed: **May 21, 2018**

(86) PCT No.: **PCT/CN2018/087637**

§ 371 (c)(1),

(2) Date: **Dec. 20, 2019**

(30) **Foreign Application Priority Data**

Jun. 22, 2017 (CN) 201710481298.6

Publication Classification

(51) **Int. Cl.**

H01Q 5/335 (2006.01)

H01Q 5/328 (2006.01)

H01Q 9/42 (2006.01)

H01Q 1/24 (2006.01)

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

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

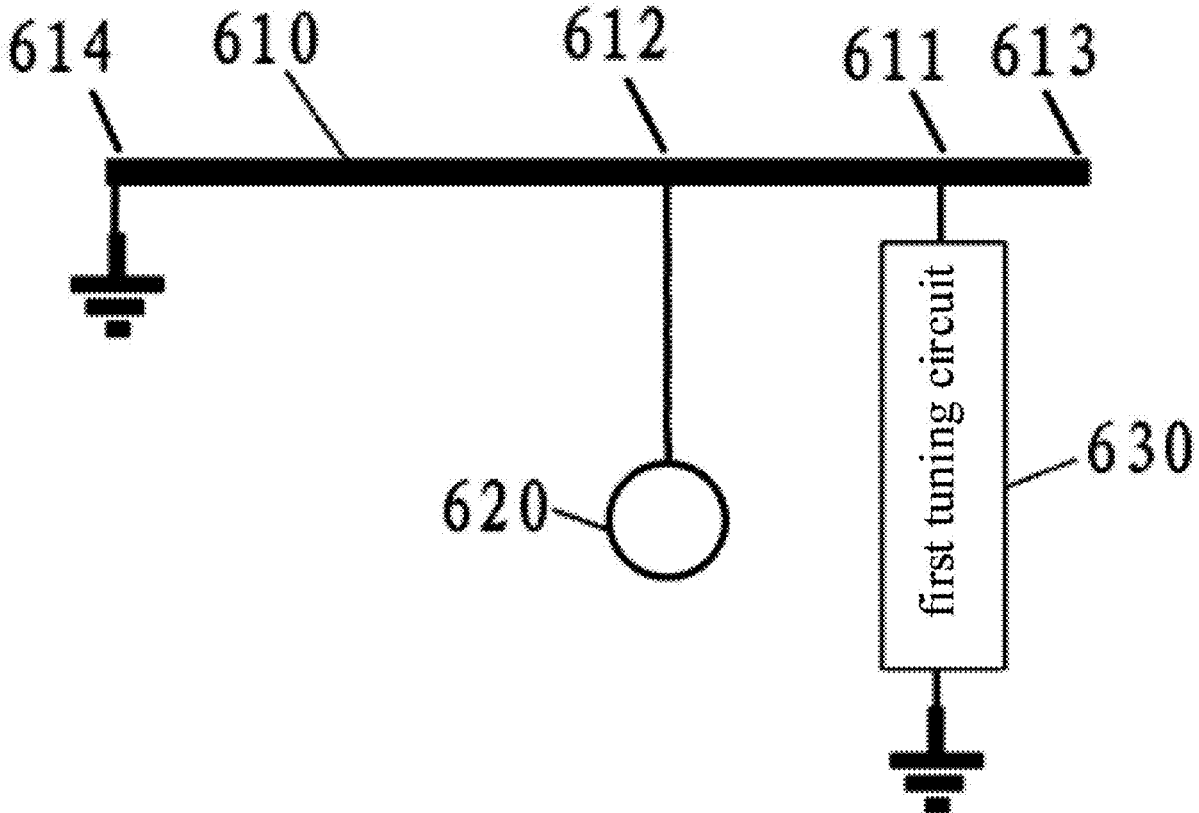
(2013.01); *H01Q 9/42* (2013.01); *H01Q 5/328*

(2015.01)

(57)

ABSTRACT

The present disclosure provides an antenna circuit and a mobile terminal. The antenna circuit includes: an antenna unit; a switching circuit connection point and a feed point are arranged on the antenna unit; an antenna feed is connected with the feed point; a first tuning circuit is connected with the switching circuit connection point, the first tuning circuit is configured to increase a bandwidth of a single resonant mode in an intermediate-high frequency and/or to tune a resonant frequency in the intermediate-high frequency; wherein a distance from the feed point to the end of the antenna unit is larger than a distance from the switching circuit connection point to the end of the antenna unit.





(19) **United States**

(12) **Patent Application Publication**

Kim et al.

(10) **Pub. No.: US 2021/0384630 A1**

(43) **Pub. Date: Dec. 9, 2021**

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

Publication Classification

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

(51) **Int. Cl.**
H01Q 5/50 (2006.01)
H01Q 1/24 (2006.01)

(72) Inventors: **Junwoo Kim**, Gyeonggi-do (KR);
Hojung Nam, Gyeonggi-do (KR);
Chankyu An, Gyeonggi-do (KR);
Sungkoo Park, Gyeonggi-do (KR);
Cheolhong Son, Gyeonggi-do (KR);
Soonho Hwang, Gyeonggi-do (KR)

(52) **U.S. Cl.**
CPC *H01Q 5/50* (2015.01); *H04M 1/0266* (2013.01); *H01Q 1/243* (2013.01)

(57) **ABSTRACT**

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

An electronic device including an improved antenna structure is provided. The electronic device includes an antenna structure including a side surface member including first to fifth conductive parts, a first to fifth insulation part between the conductive parts. The electronic device includes a display and a wireless communication circuit electrically connected with the first to the fifth conductive parts, and configured to transceive in a designated frequency band. The second conductive part includes a feeding structure that at least partially overlaps the display in within a predetermined distance of the first insulation part, and is electrically connected with the wireless communication circuit.

(21) Appl. No.: **17/406,672**

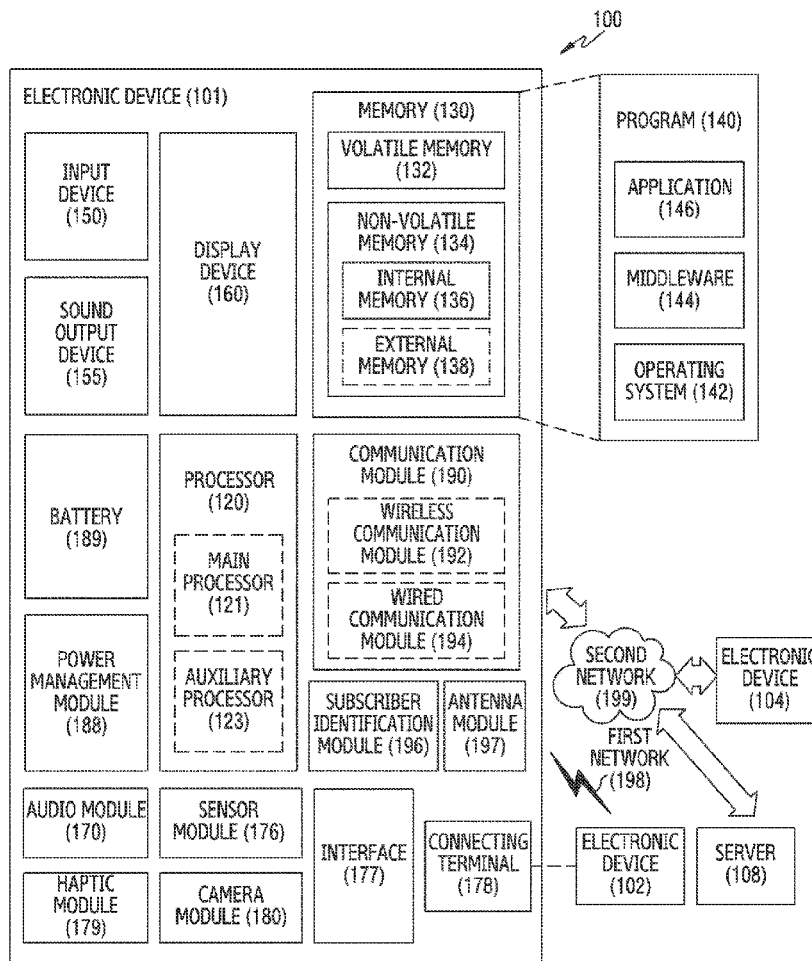
(22) Filed: **Aug. 19, 2021**

Related U.S. Application Data

(63) Continuation of application No. PCT/KR2020/002378, filed on Feb. 19, 2020.

Foreign Application Priority Data

Feb. 19, 2019 (KR) 10-2019-0019541





(19) **United States**

(12) **Patent Application Publication**
Yanagi

(10) **Pub. No.: US 2021/0384632 A1**

(43) **Pub. Date: Dec. 9, 2021**

(54) **ANTENNA AND ANTENNA MODULE**

Publication Classification

(71) Applicant: **FUJITSU COMPONENT LIMITED,**
Tokyo (JP)

(51) **Int. Cl.**
H01Q 9/04 (2006.01)
H01Q 1/48 (2006.01)
H01Q 19/10 (2006.01)

(72) Inventor: **Masahiro Yanagi,** Tokyo (JP)

(52) **U.S. Cl.**
CPC *H01Q 9/0407* (2013.01); *H01Q 1/2283*
(2013.01); *H01Q 19/104* (2013.01); *H01Q*
1/48 (2013.01)

(21) Appl. No.: **17/445,844**

(22) Filed: **Aug. 25, 2021**

Related U.S. Application Data

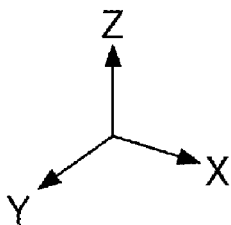
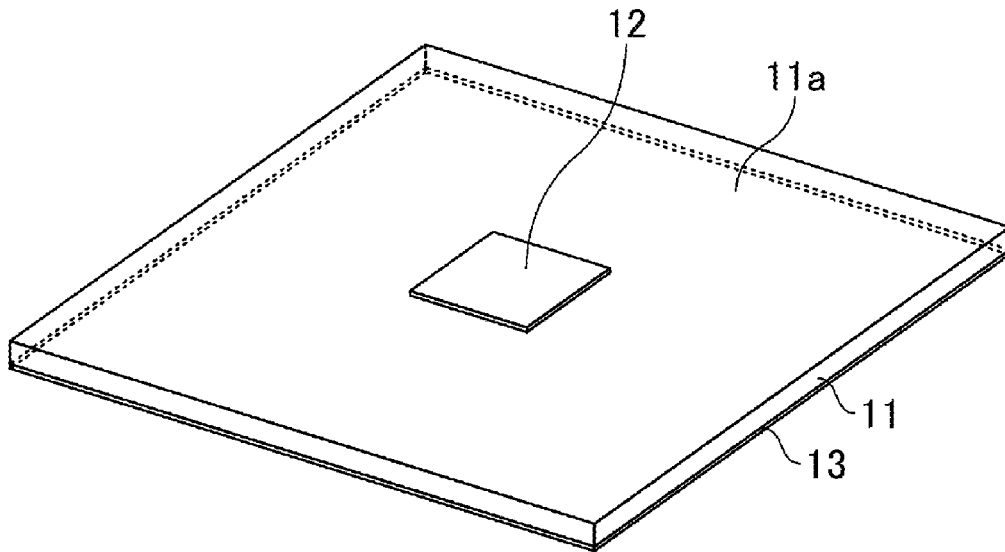
(62) Division of application No. 16/373,894, filed on Apr. 3, 2019, now Pat. No. 11,133,590.

Foreign Application Priority Data

Apr. 10, 2018 (JP) 2018-075215

(57) **ABSTRACT**

An antenna includes a dielectric substrate, an antenna element formed on a first surface of the dielectric substrate, a ground element formed on a second surface of the dielectric substrate, and a metal conductor plate disposed over, and at a spaced distance from, the first surface of the dielectric substrate, the metal conductor plate being larger than the ground element.





US 20210384634A1

(19) **United States**

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

(10) **Pub. No.: US 2021/0384634 A1**

(43) **Pub. Date: Dec. 9, 2021**

(54) **ANTENNA, ARRAY ANTENNA, RADIO COMMUNICATION MODULE, AND RADIO COMMUNICATION DEVICE**

Publication Classification

(51) **Int. Cl.**
H01Q 9/16 (2006.01)
H01Q 13/08 (2006.01)
H01Q 1/24 (2006.01)
H01Q 3/24 (2006.01)
H01Q 9/04 (2006.01)

(52) **U.S. Cl.**
 CPC *H01Q 9/16* (2013.01); *H01Q 13/08* (2013.01); *H01Q 21/06* (2013.01); *H01Q 3/24* (2013.01); *H01Q 9/0407* (2013.01); *H01Q 1/243* (2013.01)

(71) Applicant: **KYOCERA CORPORATION**,
Kyoto-sh, Kyoto (JP)

(72) Inventors: **Hiromichi YOSHIKAWA**,
Yokohama-shi, Kanagawa (JP); **Nobuki HIRAMATSU**,
Yokohama-shi, Kanagawa (JP); **Masamichi YONEHARA**,
Yokohama-shi, Kanagawa (JP)

(21) Appl. No.: **17/290,776**

(22) PCT Filed: **Oct. 29, 2019**

(86) PCT No.: **PCT/JP2019/042426**

§ 371 (c)(1),

(2) Date: **May 3, 2021**

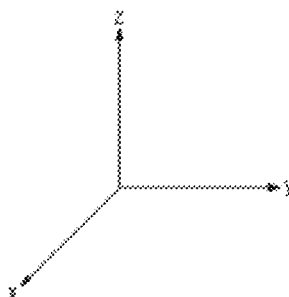
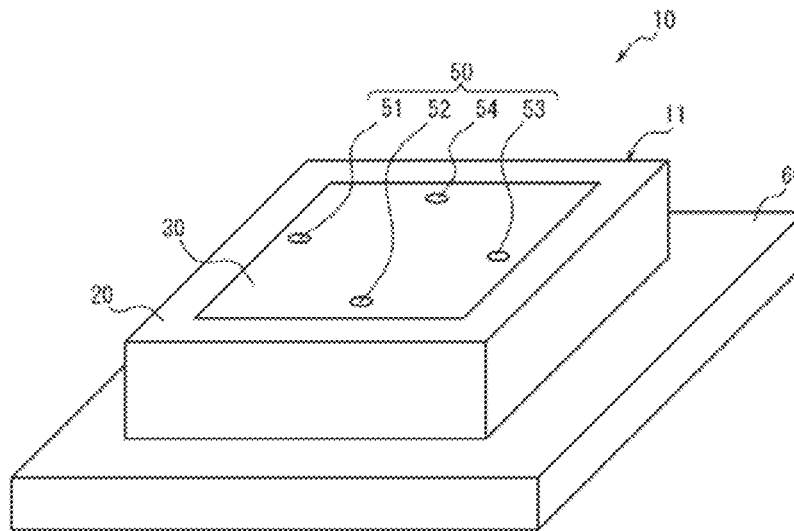
(30) **Foreign Application Priority Data**

Nov. 2, 2018 (JP) 2018-207477

Aug. 14, 2019 (JP) 2019-148850

(57) **ABSTRACT**

An antenna includes a radiation conductor, a ground conductor, first-fourth feeding lines, a first feeding circuit, and a second feeding circuit. The first feeding line to the fourth feeding line are configured to be electromagnetically connected to the radiation conductor. The first feeding circuit is configured to feed reversed-phased signals, which have mutually opposite phases, to the first feeding line and the third feeding line. The second feeding circuit is configured to feed reversed-phased signals, which have mutually opposite phases, to the second feeding line and the fourth feeding line. The radiation conductor is configured to be excited in a first direction due to the feed from the first feeding line and the third feeding line. The radiation conductor is configured to be excited in a second direction due to the feed from the second feeding line and the fourth feeding line.





US 20210384635A1

(19) **United States**

(12) **Patent Application Publication**
TSUCHIYA

(10) **Pub. No.: US 2021/0384635 A1**

(43) **Pub. Date: Dec. 9, 2021**

(54) **SLOT ANTENNA**

Publication Classification

(71) Applicant: **YAZAKI CORPORATION**, Tokyo (JP)

(51) **Int. Cl.**
H01Q 13/12 (2006.01)

(72) Inventor: **Kazuhiko TSUCHIYA**, Shizuoka (JP)

(52) **U.S. Cl.**
CPC **H01Q 13/12** (2013.01)

(73) Assignee: **YAZAKI CORPORATION**, Tokyo (JP)

(57) **ABSTRACT**

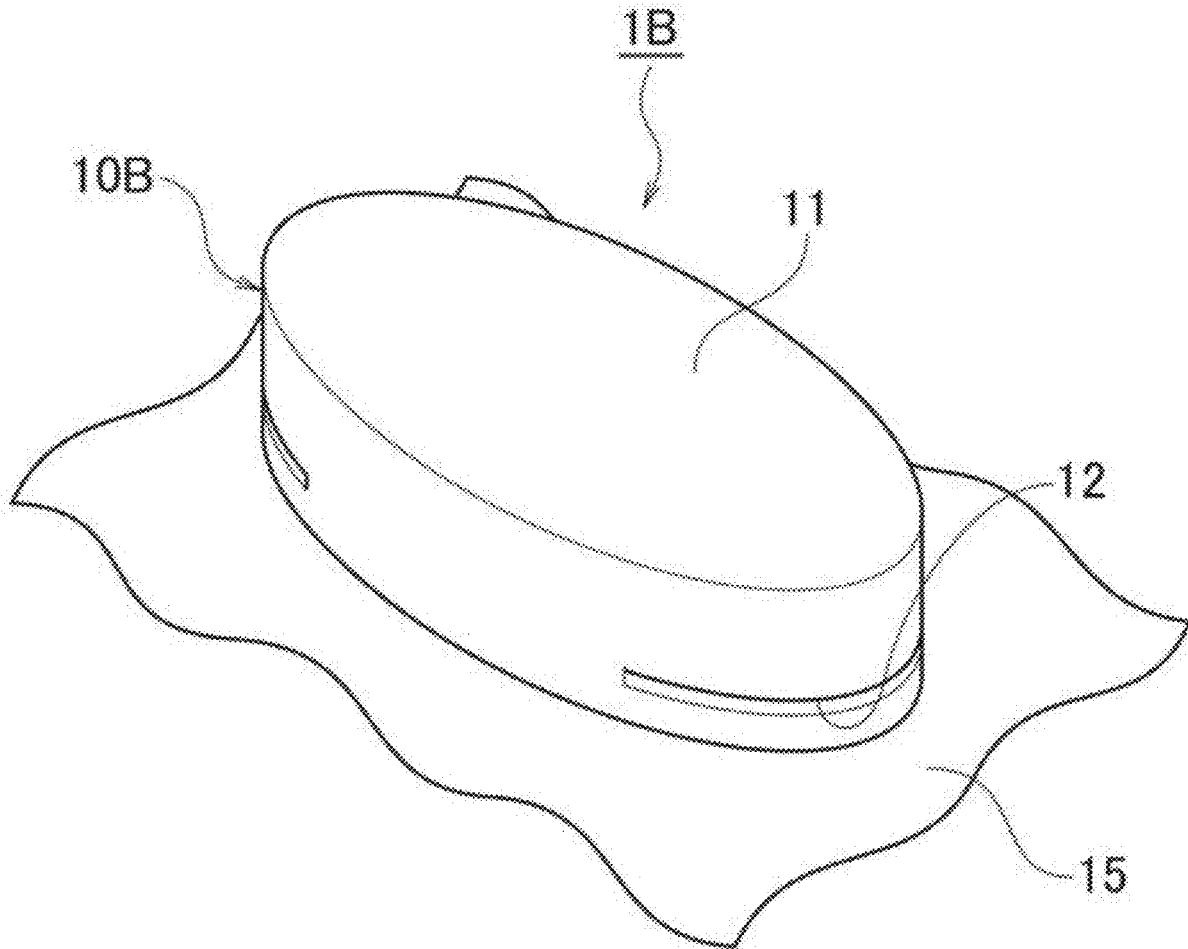
(21) Appl. No.: **17/336,594**

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

(30) **Foreign Application Priority Data**

Jun. 5, 2020 (JP) 2020-098427

A slot antenna is provided with a metal cylindrical antenna element. The antenna element is formed at a height of $\lambda/4$ or less when λ is a wavelength of an antenna frequency to be used. Further, the antenna element has a slot for vertical polarization having a length of $\lambda/2$ or more in a circumferential direction.





US 20210384641A1

(19) **United States**

(12) **Patent Application Publication**

Tang et al.

(10) **Pub. No.: US 2021/0384641 A1**

(43) **Pub. Date: Dec. 9, 2021**

(54) **BASE STATION ANTENNAS HAVING RF REFLECTORS THEREIN WITH INTEGRATED BACKSIDE MULTI-CHOKE ASSEMBLIES**

Publication Classification

(51) **Int. Cl.**
H01Q 19/10 (2006.01)
H01Q 1/24 (2006.01)
(52) **U.S. Cl.**
CPC *H01Q 19/106* (2013.01); *H01Q 1/246* (2013.01)

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

(72) Inventors: **Chengcheng Tang**, Murphy, TX (US); **Xiangyang Ai**, Plano, TX (US); **Gangyi Deng**, Allen, TX (US); **Amit Kaistha**, Coppel, TX (US); **Vijay Srinivasan**, Salcette (IN); **Yateen Sutar**, Vasco da Gama (IN)

(57) **ABSTRACT**

A base station antenna (BSA) includes a reflector having a main reflector surface thereon, which extends between first and second sidewalls thereof. First and second choke-within-a-choke assemblies are provided on first and second sides of the reflector, respectively. The first choke-within-a-choke assembly includes: a first relatively low-band choke defined on one side thereof by the first sidewall of the reflector, and a first relatively high-band choke contacting on two sides thereof a rear surface of the reflector and an inner surface of the first sidewall. The second choke-within-a-choke assembly includes: a second relatively low-band choke defined on one side thereof by the second sidewall of the reflector, and a second relatively high-band choke contacting on two sides thereof the rear surface of the reflector and an inner surface of the second sidewall.

(21) Appl. No.: **17/286,953**

(22) PCT Filed: **Oct. 11, 2019**

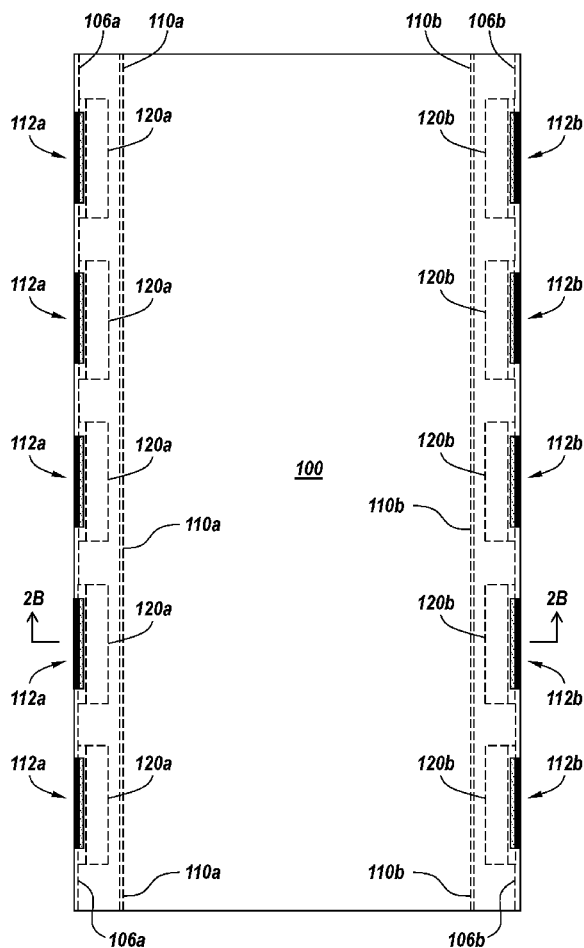
(86) PCT No.: **PCT/US2019/055839**

§ 371 (c)(1),

(2) Date: **Apr. 20, 2021**

Related U.S. Application Data

(60) Provisional application No. 62/892,900, filed on Aug. 28, 2019, provisional application No. 62/749,310, filed on Oct. 23, 2018.





US 20210384644A1

(19) **United States**

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

(10) **Pub. No.: US 2021/0384644 A1**

(43) **Pub. Date: Dec. 9, 2021**

(54) **ANTENNA, ARRAY ANTENNA, WIRELESS COMMUNICATION MODULE, AND WIRELESS COMMUNICATION DEVICE**

Publication Classification

(51) **Int. Cl.**
H01Q 21/08 (2006.01)
H01Q 9/04 (2006.01)
(52) **U.S. Cl.**
CPC *H01Q 21/08* (2013.01); *H01Q 9/045* (2013.01)

(71) Applicant: **KYOCERA CORPORATION**,
Kyoto-shi, Kyoto (JP)

(72) Inventors: **Hiroichi YOSHIKAWA**,
Yokohama-shi, Kanagawa (JP); **Nobuki HIRAMATSU**,
Yokohama-shi, Kanagawa (JP); **Masamichi YONEHARA**,
Yokohama-shi, Kanagawa (JP)

(57) **ABSTRACT**

The present disclosure provides a novel antenna. An antenna according to an example of a plurality of embodiments of the present disclosure includes a radiation conductor, a ground conductor, a first feeding line, a second feeding line, and a connecting conductor. The first feeding line is electromagnetically connected to the radiation conductor and configured to excite the radiation conductor in a first direction. The second feeding line is electromagnetically connected to the radiation conductor and configured to excite the radiation conductor in a second direction. The connecting conductor is positioned apart from the center of the radiation conductor. The connecting conductor is spaced apart from the first feeding line by a first distance. The connecting conductor is spaced apart from the second feeding line by a second distance. The first distance is substantially equal to the second distance.

(21) Appl. No.: **17/290,774**

(22) PCT Filed: **Oct. 29, 2019**

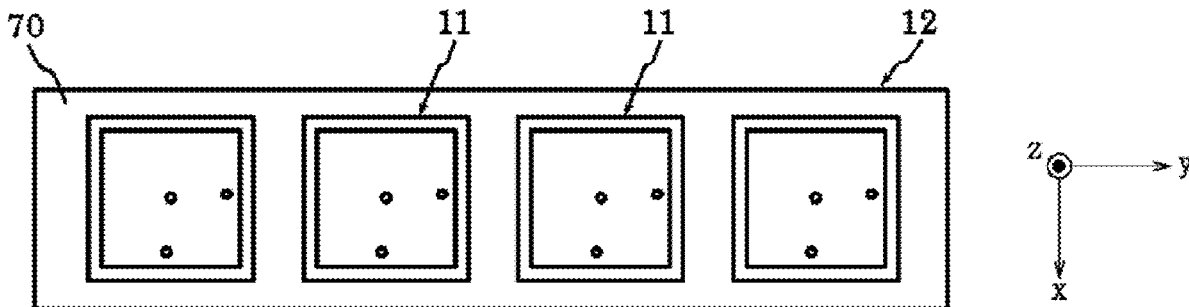
(86) PCT No.: **PCT/JP2019/042425**

§ 371 (c)(1),

(2) Date: **May 3, 2021**

(30) **Foreign Application Priority Data**

Nov. 2, 2018 (JP) 2018-207478





US 20210384648A1

(19) **United States**

(12) **Patent Application Publication**

Leung et al.

(10) **Pub. No.: US 2021/0384648 A1**

(43) **Pub. Date: Dec. 9, 2021**

(54) **BROADBEAM DIELECTRIC RESONATOR ANTENNA**

(52) **U.S. Cl.**
CPC *H01Q 25/002* (2013.01); *H01Q 13/10* (2013.01)

(71) Applicant: **City University of Hong Kong, Kowloon (HK)**

(57) **ABSTRACT**

(72) Inventors: **Kwok Wa Leung, Kowloon (HK); Zhen-Xing Xia, Kowloon (HK)**

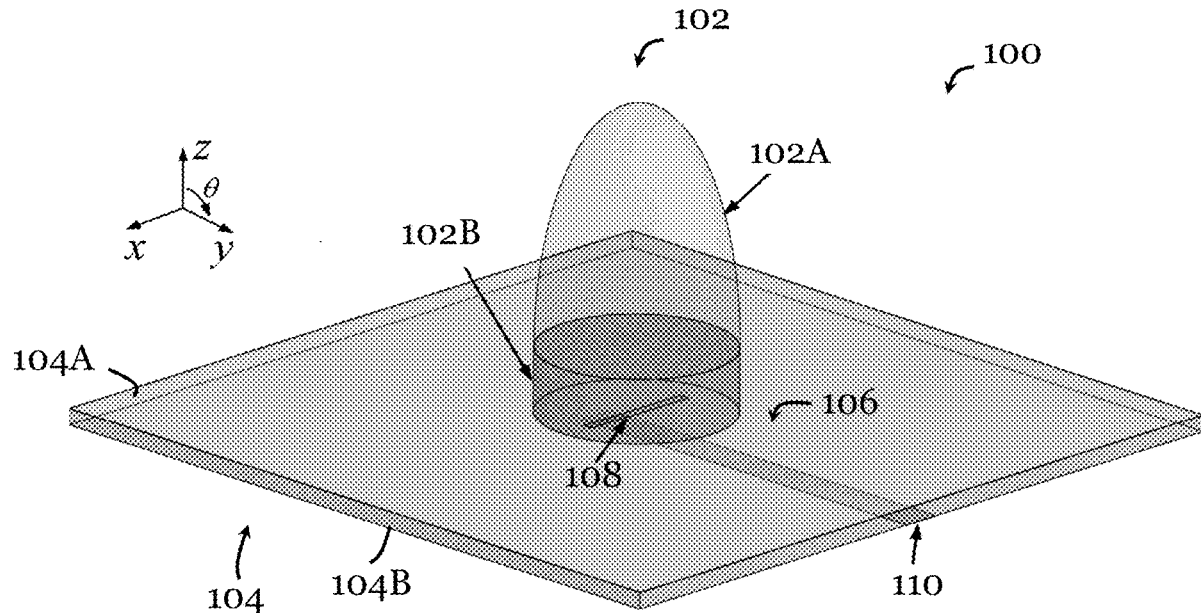
A dielectric resonator antenna and a dielectric resonator antenna array. The dielectric resonator antenna includes a ground plane, a dielectric resonator element operably coupled with the ground plane, and a feed network operably coupled with the dielectric resonator element for exciting the dielectric resonator antenna. The dielectric resonator element includes a first portion with a first shape and a second portion with a second shape different from the first shape. The dielectric resonator antenna, when excited, is arranged to provide wide half-power beam-widths in both E-plane and H-plane.

(21) Appl. No.: **16/892,613**

(22) Filed: **Jun. 4, 2020**

Publication Classification

(51) **Int. Cl.**
H01Q 25/00 (2006.01)
H01Q 13/10 (2006.01)





(19) **United States**

(12) **Patent Application Publication**
SON

(10) **Pub. No.: US 2021/0391641 A1**

(43) **Pub. Date: Dec. 16, 2021**

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

H01Q 21/06 (2006.01)

H04B 1/40 (2006.01)

H04M 1/02 (2006.01)

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

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

CPC **H01Q 1/243** (2013.01); **H01Q 1/38**
(2013.01); **H04M 1/0277** (2013.01); **H04B**
1/40 (2013.01); **H01Q 21/065** (2013.01)

(72) Inventor: **Dongil SON**, Suwon-si (KR)

(21) Appl. No.: **17/445,863**

(57)

ABSTRACT

(22) Filed: **Aug. 25, 2021**

Disclosed is an electronic device comprising a housing, a display, an antenna structure and at least one wireless communication circuit. The at least one wireless communication circuit is configured so as to transmit and/or receive a signal having a frequency between 3 GHz and 100 GHz, and may be configured so as to transmit and/or receive, in a first operation, a first signal having a first frequency by using not all but at least one conductive plate among a plurality of first conductive plates and a plurality of second conductive plates, and transmit and/or receive, in a second operation, a second signal having a second frequency differing from the first frequency by using not all but at least one conductive plate among the plurality of second conductive plates and the plurality of first conductive plates. In addition, various embodiments are possible as identified in the specification.

Related U.S. Application Data

(63) Continuation of application No. 17/055,940, filed on Nov. 16, 2020, filed as application No. PCT/KR2019/005864 on May 16, 2019.

Foreign Application Priority Data

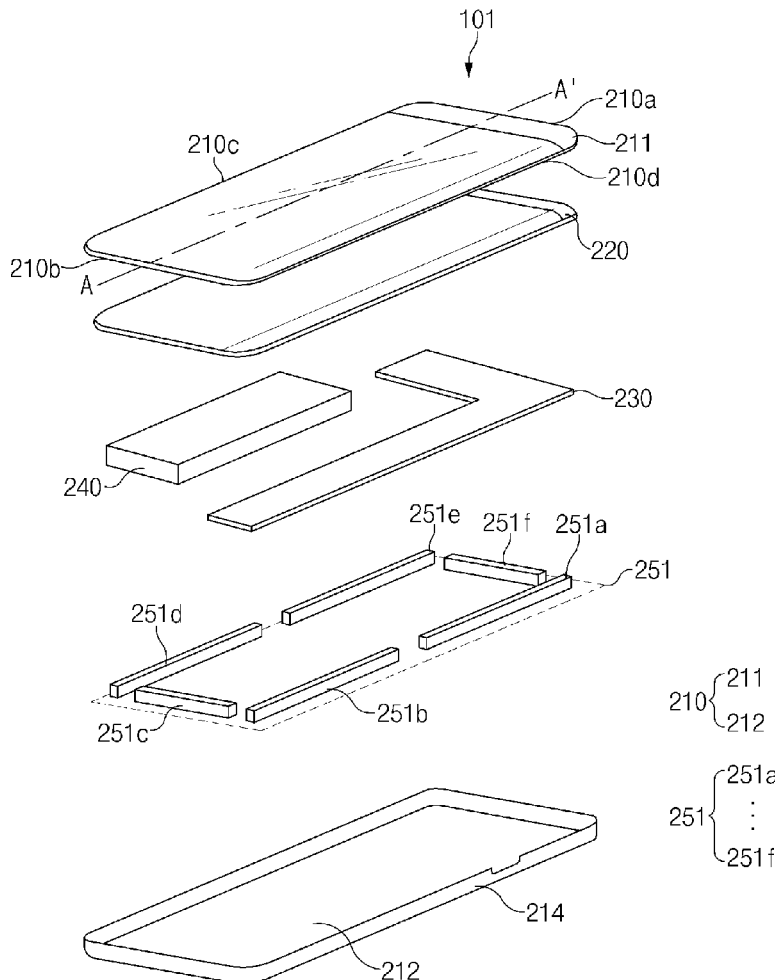
May 16, 2018 (KR) 10-2018-0055708

Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 1/38 (2006.01)





(19) **United States**

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

(10) **Pub. No.: US 2021/0391645 A1**

(43) **Pub. Date: Dec. 16, 2021**

(54) **ELECTRONIC DEVICE COMPRISING ANTENNA**

H01Q 1/12 (2006.01)

H01Q 1/24 (2006.01)

H01Q 1/42 (2006.01)

H01Q 9/04 (2006.01)

H01Q 21/06 (2006.01)

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

(72) Inventors: **Mincheol SEO**, Suwon-si (KR);
Hosaeng KIM, Suwon-si (KR);
Donghun SHIN, Suwon-si (KR);
Yoonjae LEE, Suwon-si (KR)

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

CPC *H01Q 1/38* (2013.01); *H01Q 5/371*

(2015.01); *H01Q 1/1221* (2013.01); *H01Q*

21/061 (2013.01); *H01Q 1/42* (2013.01);

H01Q 9/0407 (2013.01); *H01Q 1/243*

(2013.01)

(21) Appl. No.: **17/459,375**

(22) Filed: **Aug. 27, 2021**

Related U.S. Application Data

(63) Continuation of application No. 16/790,059, filed on
Feb. 13, 2020, now Pat. No. 11,133,581.

Foreign Application Priority Data

Feb. 13, 2019 (KR) 10-2019-0016597

Publication Classification

(51) **Int. Cl.**

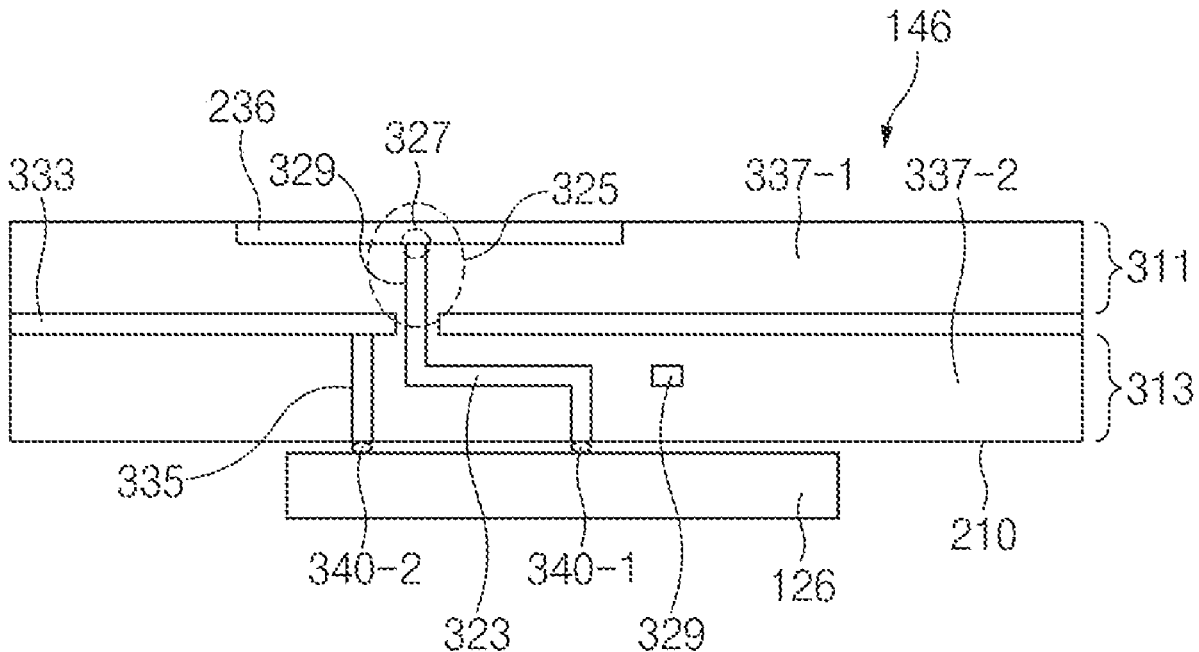
H01Q 1/38 (2006.01)

H01Q 5/371 (2006.01)

(57)

ABSTRACT

An electronic device is provided. The electronic device includes a support member, a front plate disposed on a front surface of the support member, a back plate disposed on a back surface of the support member, a non-conductive structure interposed between the back plate and an edge of the support member and fixed to the support member, and an antenna structure interposed between the back plate and an edge of the support member. At least a portion of the antenna structure may be disposed to face the non-conductive structure. In a region of the non-conductive structure, which faces the antenna structure, a separated distance from the antenna structure varies depending on a distance from a bottom surface of the support member to which the non-conductive structure is fixed.





US 20210391656A1

(19) **United States**

(12) **Patent Application Publication**
CHEN

(10) **Pub. No.: US 2021/0391656 A1**

(43) **Pub. Date: Dec. 16, 2021**

(54) **ANTENNA STRUCTURE AND ELECTRONIC DEVICE USING SAME**

(52) **U.S. Cl.**
CPC **H01Q 21/064** (2013.01); **H01Q 1/242** (2013.01); **H01Q 1/48** (2013.01)

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

(72) Inventor: **YI-TING CHEN**, New Taipei (TW)

(57) **ABSTRACT**

(21) Appl. No.: **17/313,305**

(22) Filed: **May 6, 2021**

(30) **Foreign Application Priority Data**

Jun. 12, 2020 (CN) 202010537241.5

Publication Classification

(51) **Int. Cl.**
H01Q 21/06 (2006.01)
H01Q 1/48 (2006.01)
H01Q 1/24 (2006.01)

An antenna structure of reduced size but operating at multiple frequencies, applied to an electronic device, includes a housing, a system ground plane, and a first feed point. The housing has at least one portion made of metal material and defines a first gap and a second gap. The housing between the first gap and the second gap forms a first radiation portion. The system ground plane is positioned in the housing and defines a first slit. The first slit corresponds to the first radiation portion and communicates with the second gap. The first feed point is positioned on the first radiation portion and is electrically connected to a first feed source for feeding current and signal to the first radiation portion.

