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(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2021/0194121 A1**

(43) **Pub. Date: Jun. 24, 2021**

KIM et al.

(54) **ANTENNA APPARATUS AND ANTENNA MODULE**

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

(72) Inventors: **Nam Ki KIM**, Suwon-si (KR); **Jeong Ki RYOO**, Suwon-si (KR)

(73) Assignee: **Samsung Electro-Mechanics Co., Ltd.**, Suwon-si (KR)

(21) Appl. No.: **17/193,250**

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

Related U.S. Application Data

(63) Continuation of application No. 16/165,001, filed on Oct. 19, 2018, now Pat. No. 10,978,796.

(30) **Foreign Application Priority Data**

Dec. 28, 2017 (KR) 10-2017-0183036
Jun. 4, 2018 (KR) 10-2018-0064245

Publication Classification

(51) **Int. Cl.**

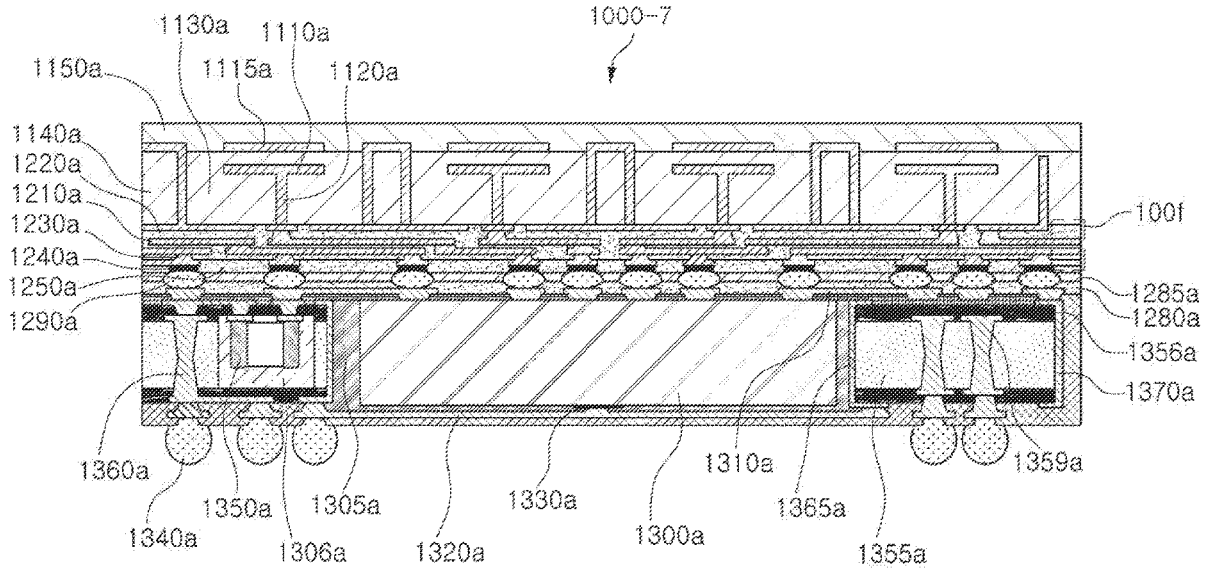
H01Q 1/48	(2006.01)
H01Q 9/16	(2006.01)
H01Q 1/22	(2006.01)
H01Q 21/06	(2006.01)
H01L 23/498	(2006.01)
H01L 23/552	(2006.01)
H01L 23/66	(2006.01)
H01Q 9/04	(2006.01)
H01Q 21/08	(2006.01)
H01Q 1/52	(2006.01)
H01Q 19/24	(2006.01)
H01Q 9/26	(2006.01)
H01Q 25/00	(2006.01)

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

CPC ***H01Q 1/48*** (2013.01); *H01Q 19/104* (2013.01); ***H01Q 1/2283*** (2013.01); ***H01Q 21/065*** (2013.01); ***H01L 23/49822*** (2013.01); ***H01L 23/552*** (2013.01); ***H01L 23/66*** (2013.01); ***H01Q 9/045*** (2013.01); ***H01Q 21/08*** (2013.01); ***H01Q 1/523*** (2013.01); ***H01Q 19/24*** (2013.01); ***H01Q 9/26*** (2013.01); ***H01Q 9/0414*** (2013.01); ***H01Q 25/00*** (2013.01); *H01Q 1/526* (2013.01); *H01L 2223/6677* (2013.01); *H01L 2924/15192* (2013.01); *H01L 2224/32225* (2013.01); ***H01Q 9/16*** (2013.01)

(57) **ABSTRACT**

An antenna apparatus includes: a feed line; a first ground layer including surface disposed above or below the feed line and spaced apart from the feed line; and an antenna pattern electrically connected to an end of the feed line and configured to transmit and/or receive a radio frequency (RF) signal, wherein the first ground layer includes a first protruding region protruding in a first longitudinal direction of the surface toward the antenna pattern and at least partially overlapping the feed line above or below the feed line, and second and third protruding regions protruding in the first longitudinal direction from positions spaced apart from the first protruding region in opposite lateral directions of the surface.



US 20210194132A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0194132 A1**

SOMA et al. (43) **Pub. Date: Jun. 24, 2021**

(54) **ANTENNA AND COMMUNICATION DEVICE**

(71) Applicant: **JAPAN AVIATION ELECTRONICS INDUSTRY, LIMITED**, Shibuya-ku, Tokyo (JP)

(72) Inventors: **Tatsuya SOMA**, Tokyo (JP); **Keishi KOSAKA**, Tokyo (JP)

(73) Assignee: **JAPAN AVIATION ELECTRONICS INDUSTRY, LIMITED**, Shibuya-ku, Tokyo (JP)

(21) Appl. No.: **17/271,435**

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

(86) PCT No.: **PCT/JP2019/035430**

§ 371 (c)(1),
(2) Date: **Feb. 25, 2021**

(30) **Foreign Application Priority Data**

Sep. 12, 2018 (JP) 2018-170131

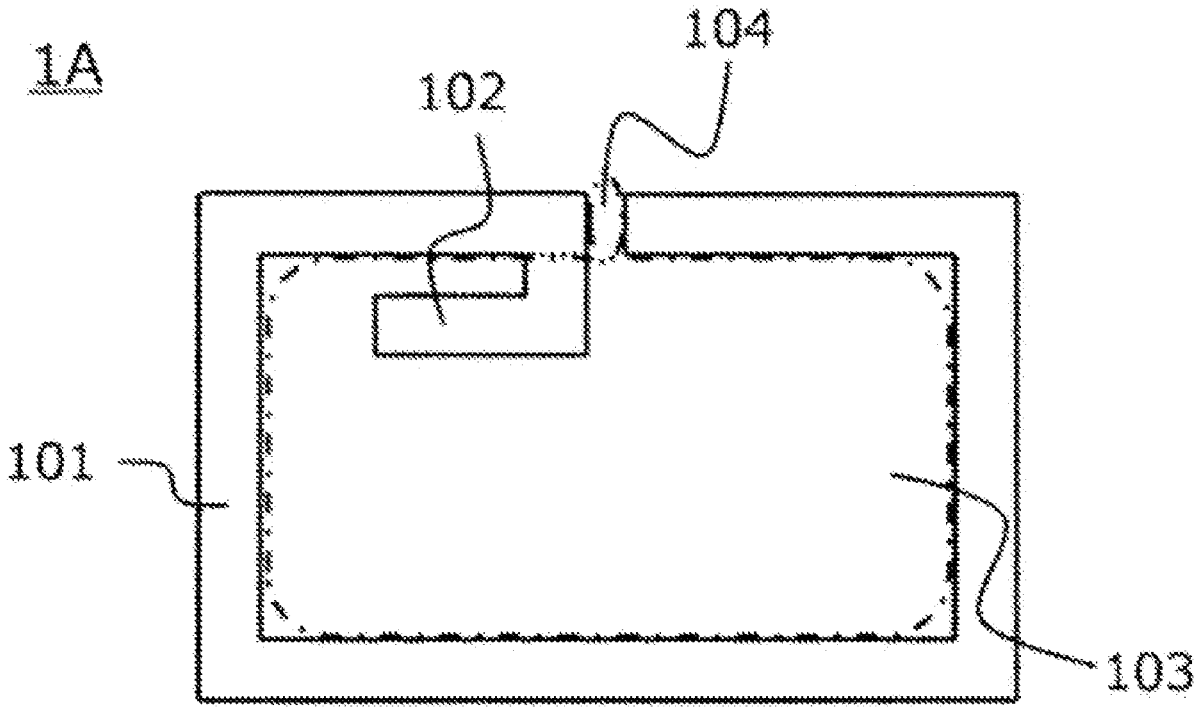
Publication Classification

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

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

(57) **ABSTRACT**

An antenna includes a split-ring conductive portion and a ring-inside conductive portion. The split-ring conductive portion is positioned outside a region and is positioned in an area which extends along an outline of the region except for a split. The ring-inside conductive portion is positioned inside the region. The ring-inside conductive portion is continuous with one of parts of the split-ring conductive portion, the split being put between the parts of the split-ring conductive portion. At least a part of the ring-inside conductive portion is bent so as to extend parallel to the split-ring conductive portion.



US 20210194134A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0194134 A1**

KIMURA et al. (43) **Pub. Date: Jun. 24, 2021**

(54) **ANTENNA**

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

(72) Inventors: **Yuichi KIMURA**, Saitama-shi (JP); **Masahiro TATEMATSU**, Tokyo (JP)

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

(21) Appl. No.: **17/129,171**

(22) Filed: **Dec. 21, 2020**

(30) **Foreign Application Priority Data**

Dec. 24, 2019 (JP) 2019-233482

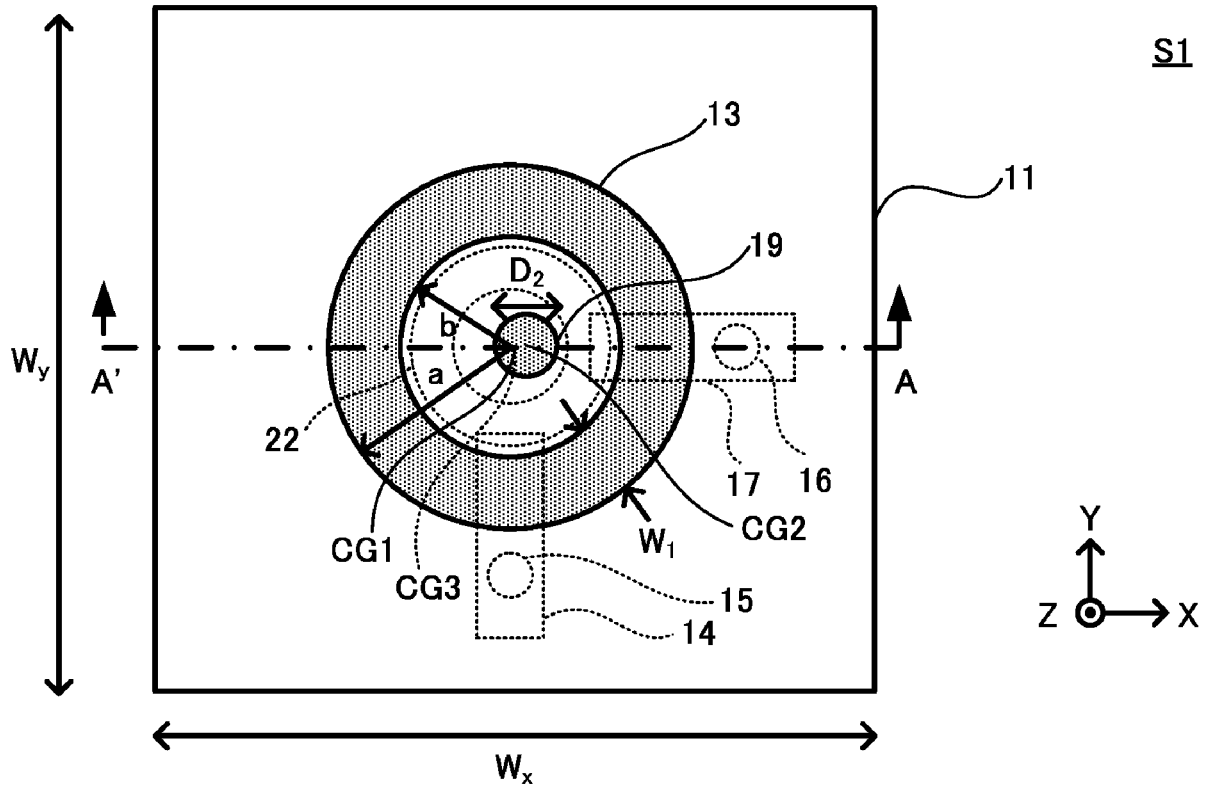
Publication Classification

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

(52) **U.S. Cl.**
CPC ***H01Q 9/045*** (2013.01)

(57) **ABSTRACT**

An antenna includes: a dielectric layer including a first and second surface placed in layering; a ring-shaped conductor layer formed on the first surface; a first and second feedline that are closer to the first surface than the second, and are formed at positions different from those of the surfaces; a reference potential conductor layer formed on the second surface; and a conductor pin located in the inner diameter of the ring-shaped conductor layer in planar view from the direction of the layering, that is connected to the reference potential conductor layer. In the planar view, the first and second feedlines include portions overlapping with the ring-shaped conductor layer, and the extending directions of the feedlines intersect with each other. The ring-shaped conductor layer is connected to neither the reference potential conductor layer nor the conductor pin, and neither the first nor second feedline is connected to the conductor pin.



US 20210194138A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0194138 A1**

HUNG (43) **Pub. Date: Jun. 24, 2021**

(54) **ANTENNAS IN FRAMES FOR DISPLAY PANELS**

(71) Applicant: **HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P.**, Spring, TX (US)

(72) Inventor: **Kuan-Jung HUNG**, Taipei City / Taiwan Province (CN)

(73) Assignee: **HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P.**, Houston, TX (US)

(21) Appl. No.: **16/080,227**

(22) PCT Filed: **Apr. 24, 2017**

(86) PCT No.: **PCT/US2017/029121**

§ 371 (c)(1),
(2) Date: **Aug. 27, 2018**

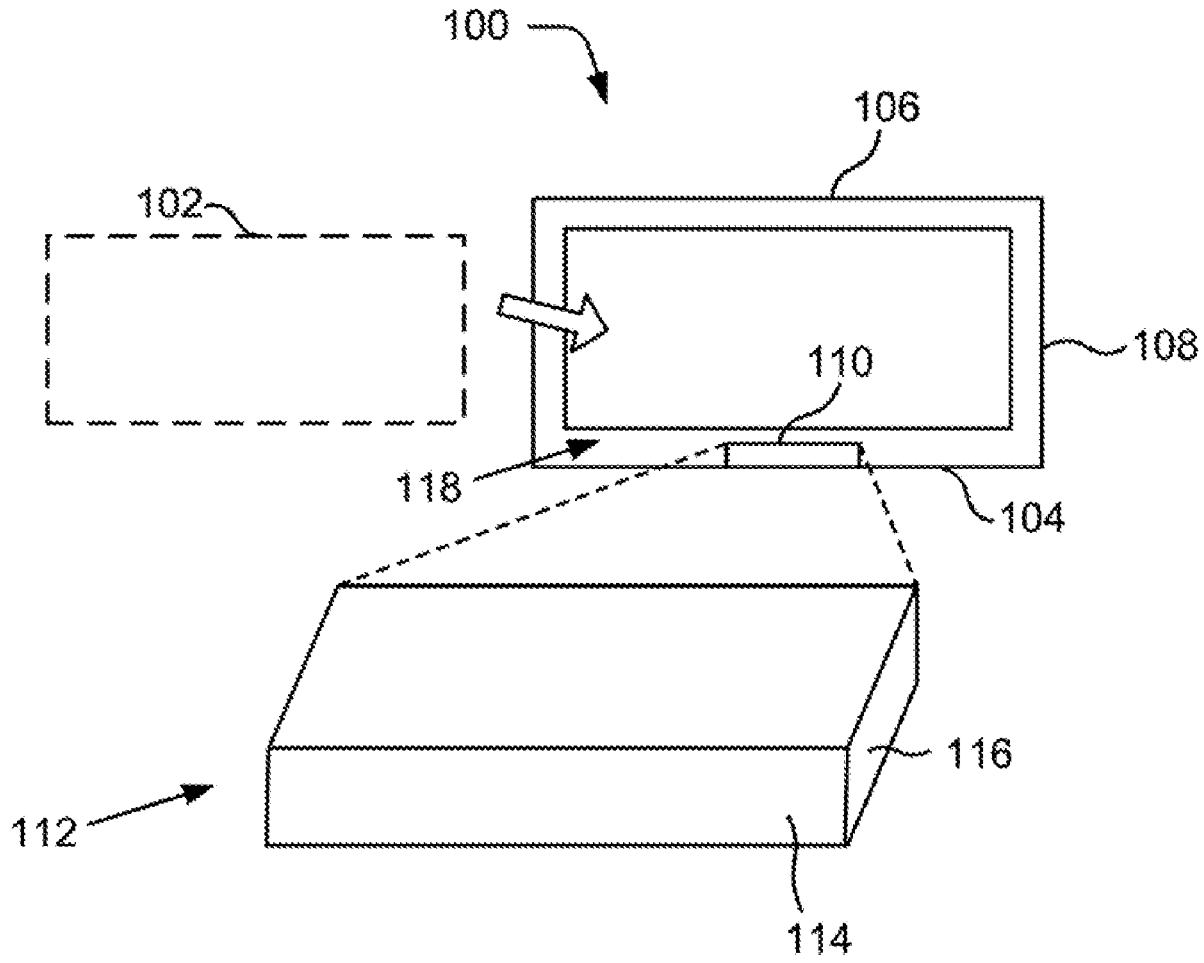
Publication Classification

(51) **Int. Cl.**
H01Q 9/42 (2006.01)
H01Q 1/22 (2006.01)

(52) **U.S. Cl.**
CPC ***H01Q 9/42*** (2013.01); ***H01Q 1/2258*** (2013.01)

(57) **ABSTRACT**

The present subject matter describes an antenna positioned inside a frame for a display panel of an electronic device. In an example implementation, the antenna comprises a cuboidal antenna holder having a first excitation surface and a second excitation surface perpendicular to the first excitation surface.



US 20210194151A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0194151 A1**

Baek et al. (43) **Pub. Date: Jun. 24, 2021**

(54) **ANTENNA ARRAY AND VEHICLE INCLUDING THE SAME**

(71) Applicants: **HYUNDAI MOTOR COMPANY**, Seoul (KR); **KIA MOTORS CORPORATION**, Seoul (KR); **IUCF-HYU (Industry-University Cooperation Foundation Hanyang University)**, Seoul (KR)

(72) Inventors: **Jisoo Baek**, Gwangmyeong-si (KR); **Jaehoon Choi**, Seoul (KR); **Hojoo Lee**, Seongnam-si (KR); **Minbeom Ko**, Seongnam-si (KR); **Yeonjeong O**, Seoul (KR)

(73) Assignees: **HYUNDAI MOTOR COMPANY**, Seoul (KR); **KIA MOTORS CORPORATION**, Seoul (KR); **IUCF-HYU (Industry-University Cooperation Foundation Hanyang University)**, Seoul (KR)

(21) Appl. No.: **17/096,562**

(22) Filed: **Nov. 12, 2020**

(30) **Foreign Application Priority Data**

Dec. 18, 2019 (KR) 10-2019-0169658

Publication Classification

(51) **Int. Cl.**

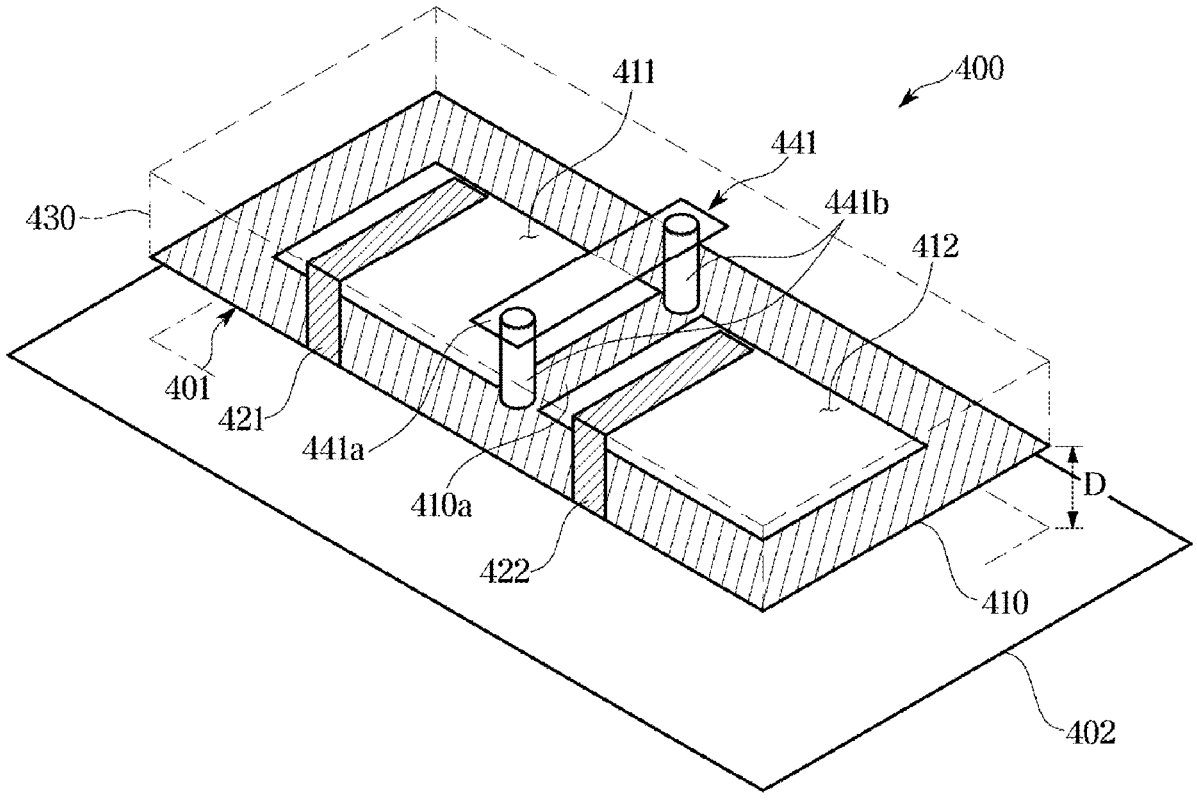
H01Q 21/00	(2006.01)
H01Q 7/00	(2006.01)
H01Q 1/32	(2006.01)
H01Q 1/28	(2006.01)

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

CPC ***H01Q 21/0068*** (2013.01); ***H01Q 21/0018*** (2013.01); ***H01Q 1/283*** (2013.01); ***H01Q 1/3275*** (2013.01); ***H01Q 7/00*** (2013.01)

(57) **ABSTRACT**

An antenna array has wideband high gain characteristics and includes: a dielectric; a loop provided on a first surface of the dielectric and that has a first slot and a second slot; a first feed pin provided at a position corresponding to the first slot on a second surface of the dielectric; a second feed pin provided at a position corresponding to the second slot on the second surface of the dielectric; and a divider provided between the first feed pin and the second feed pin, and electrically connected to the loop.



US 20210194190A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2021/0194190 A1

KHOURI et al. (43) Pub. Date: Jun. 24, 2021

(54) **ELECTRICAL EQUIPMENT ADAPTED TO DETECT THE PRESENCE OF AN EXTERNAL ANTENNA**

(71) Applicant: **SAGEMCOM ENERGY & TELECOM SAS**, RUEIL MALMAISON (FR)

(72) Inventors: **Rami KHOURI**, RUEIL MALMAISON (FR); **Alain TISNE**, RUEIL MALMAISON (FR)

(21) Appl. No.: **17/126,844**

(22) Filed: **Dec. 18, 2020**

(30) **Foreign Application Priority Data**

Dec. 19, 2019 (FR) 1914872

Publication Classification

(51) **Int. Cl.**

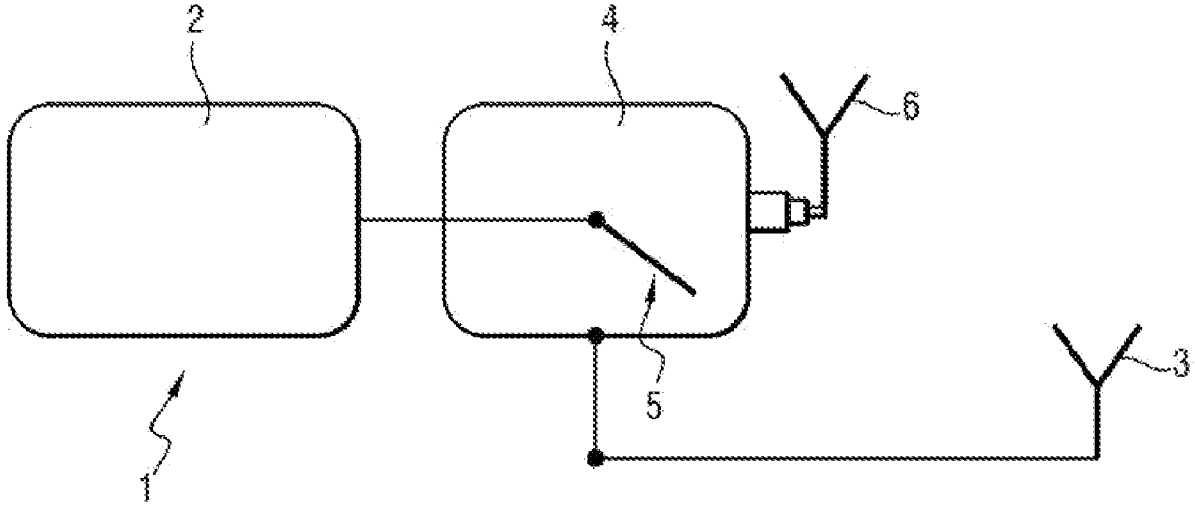
H01R 24/52	(2006.01)
H01Q 1/24	(2006.01)
H01Q 1/22	(2006.01)

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

CPC ***H01R 24/52*** (2013.01); *H01R 2201/02* (2013.01); ***H01Q 1/2225*** (2013.01); ***H01Q 1/243*** (2013.01)

(57) **ABSTRACT**

Electrical equipment includes an internal antenna, an external connector, a first radio module, a second radio module, an RF link enabling the second radio module to be connected to the external connector, a detector device arranged, when a test signal is transmitted over the external connector via the RF link, to produce a detection signal representative of whether or not the external antenna is connected to the external connector; and control means arranged to control the second radio module so that it generates and transmits the test signal via the RF link, to acquire the detection signal, and depending on the detection signal, to connect or disconnect the first radio module to or from the external connector.



US 20210194512A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0194512 A1**

CLEMENTE (43) **Pub. Date: Jun. 24, 2021**

(54) **UNIT CELL OF A TRANSMITTER ARRAY**

(71) Applicant: **Commissariat a l'Energie Atomique et aux Energies Alternatives**, Paris (FR)

(72) Inventor: **Antonio CLEMENTE**, Grenoble Cedex 09 (FR)

(73) Assignee: **Commissariat a l'Energie Atomique et aux Energies Alternatives**, Paris (FR)

(21) Appl. No.: **17/124,754**

(22) Filed: **Dec. 17, 2020**

(30) **Foreign Application Priority Data**

Dec. 18, 2019 (FR) 19 14716

Publication Classification

(51) **Int. Cl.**

H04B 1/00	(2006.01)
H01Q 1/52	(2006.01)
H01Q 1/48	(2006.01)
H01Q 3/34	(2006.01)

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

CPC ***H04B 1/0064*** (2013.01); ***H01Q 3/34*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 1/523*** (2013.01)

(57) **ABSTRACT**

Unit cell of a transmitter array, comprising:

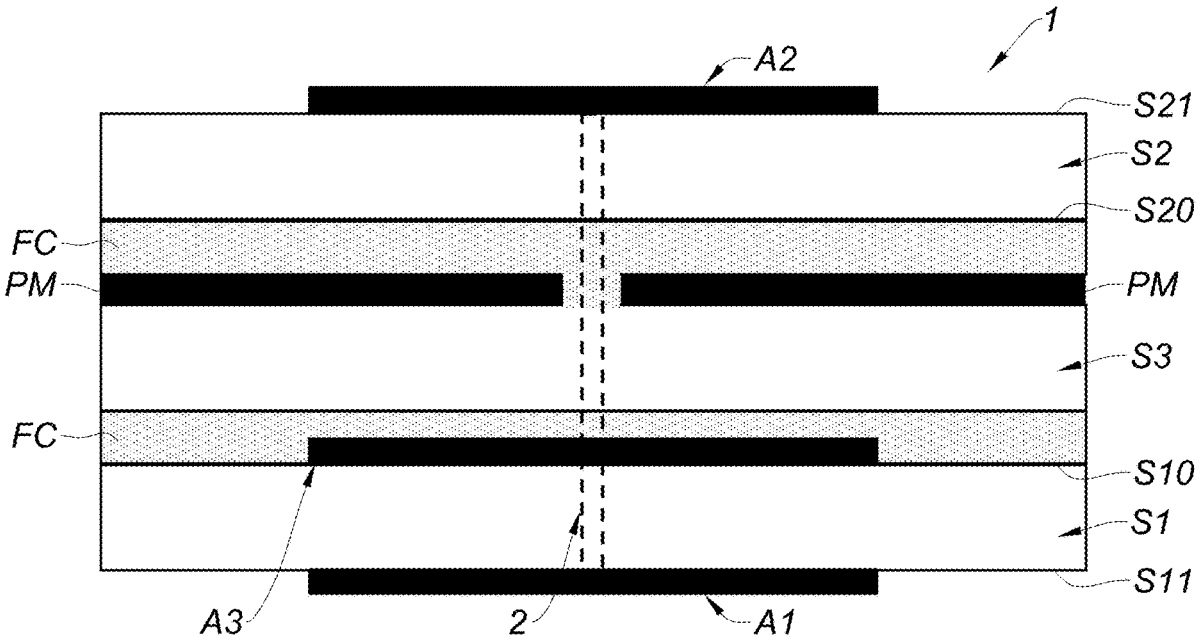
a ground plane;

first and second dielectric substrates, arranged on either side of the ground plane, and each having a first surface, oriented toward the ground plane, and a second, opposed, surface;

first and second planar antennas, extending on the second surfaces of the first and second dielectric substrates, respectively;

a via, arranged to pass through the first and second dielectric substrates so as to electrically connect the first and second planar antennas; the via being electrically isolated from the ground plane;

the unit cell further comprising a third planar antenna, extending between the ground plane and the first surface of the first dielectric substrate, and electrically connected to the via.



US 20210203054A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2021/0203054 A1

MOON et al. (43) Pub. Date: Jul. 1, 2021

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

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

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

(21) Appl. No.: **17/196,305**

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

Related U.S. Application Data

(63) Continuation of application No. 16/884,406, filed on May 27, 2020, which is a continuation of application No. PCT/KR2019/010468, filed on Aug. 19, 2019.

(30) **Foreign Application Priority Data**

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

Publication Classification

(51) **Int. Cl.**

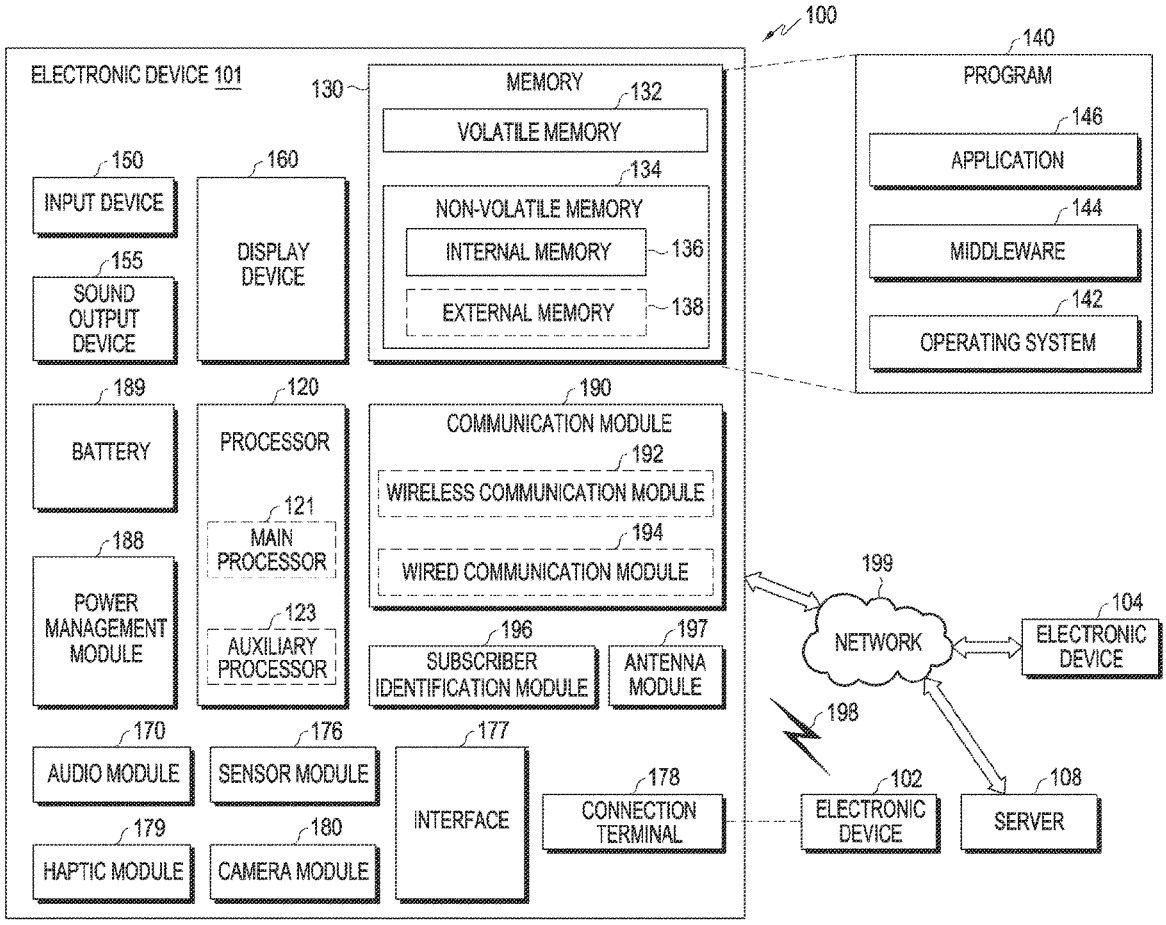
H01Q 1/02	(2006.01)
H01Q 1/42	(2006.01)
H01Q 1/24	(2006.01)
H01Q 1/22	(2006.01)

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

CPC ***H01Q 1/02*** (2013.01); ***H01Q 1/2208*** (2013.01); ***H01Q 1/243*** (2013.01); ***H01Q 1/42*** (2013.01)

(57) **ABSTRACT**

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 20210203070A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0203070 A1**

WU et al. (43) **Pub. Date: Jul. 1, 2021**

(54) **ELECTRONIC DEVICE AND ANTENNA STRUCTURE THEREOF**

(71) Applicant: **PEGATRON CORPORATION**, TAIPEI CITY (TW)

(72) Inventors: **CHIEN-YI WU**, TAIPEI CITY (TW); **CHAO-HSU WU**, TAIPEI CITY (TW); **SHIH-KENG HUANG**, TAIPEI CITY (TW); **TSE-HSUAN WANG**, TAIPEI CITY (TW); **YI-RU YANG**, TAIPEI CITY (TW); **Hau-Yuen Tan**, TAIPEI CITY (TW)

(21) Appl. No.: **17/124,878**

(22) Filed: **Dec. 17, 2020**

(30) **Foreign Application Priority Data**

Dec. 25, 2019 (TW) 108147531

Publication Classification

(51) **Int. Cl.**

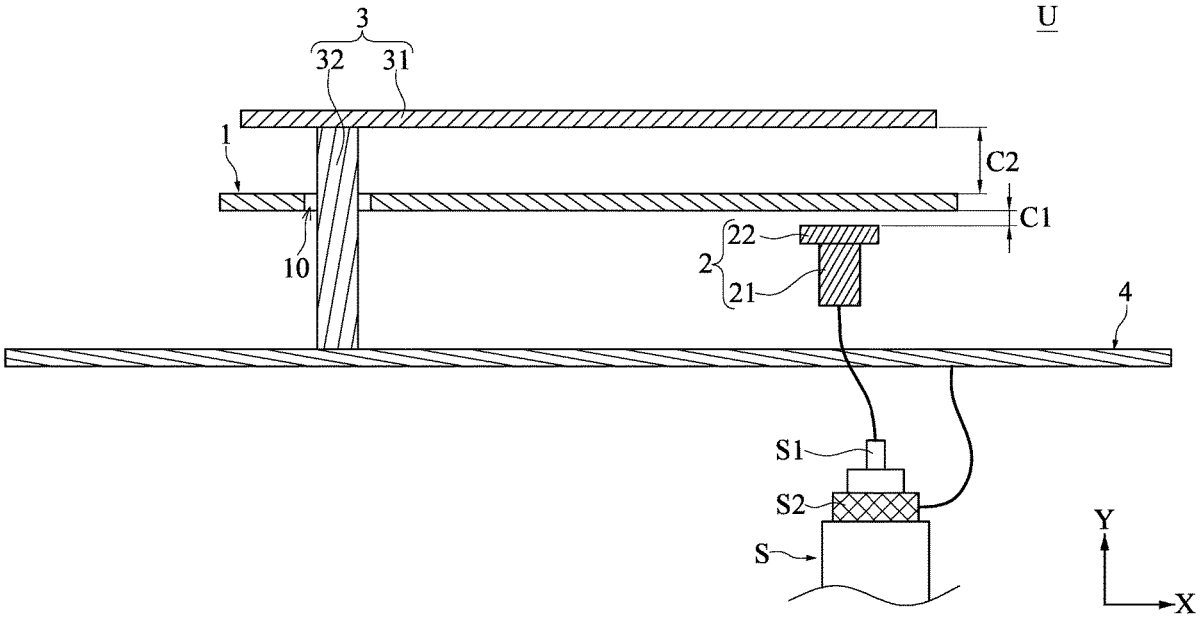
H01Q 5/335	(2006.01)
H01Q 9/04	(2006.01)
H01Q 1/48	(2006.01)

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

CPC ***H01Q 5/335*** (2015.01); *H04B 1/18* (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 9/0442*** (2013.01)

(57) **ABSTRACT**

An electronic device and an antenna structure thereof are provided. The antenna structure includes a first radiating member, a feeding member disposed on the first radiating member, a second radiating member, and a grounding member. A first predetermined gap is between the feeding member and the first radiating member. The feeding member, the first predetermined gap, and the first radiating member resonate to generate a low frequency band and a high frequency band. The second radiating member including a main body and a grounding part is disposed on the first radiating member. A second predetermined gap is between the main body and the first radiating member. The grounding part, the main body, and the second predetermined gap resonate to increase a bandwidth of the low frequency band. The grounding member is disposed on the first radiating member and electrically connected to the grounding part.



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(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0203080 A1**

WONG et al. (43) **Pub. Date: Jul. 1, 2021**

(54) **HIGHLY-INTEGRATED MULTI-ANTENNA ARRAY**

(71) Applicant: **INDUSTRIAL TECHNOLOGY RESEARCH INSTITUTE**, Hsinchu (TW)

(72) Inventors: **Kin-Lu WONG**, Kaohsiung City (TW); **Wei-Yu LI**, Yilan City (TW); **Wei CHUNG**, Hengshan Township (TW)

(73) Assignee: **INDUSTRIAL TECHNOLOGY RESEARCH INSTITUTE**, Hsinchu (TW)

(21) Appl. No.: **16/728,926**

(22) Filed: **Dec. 27, 2019**

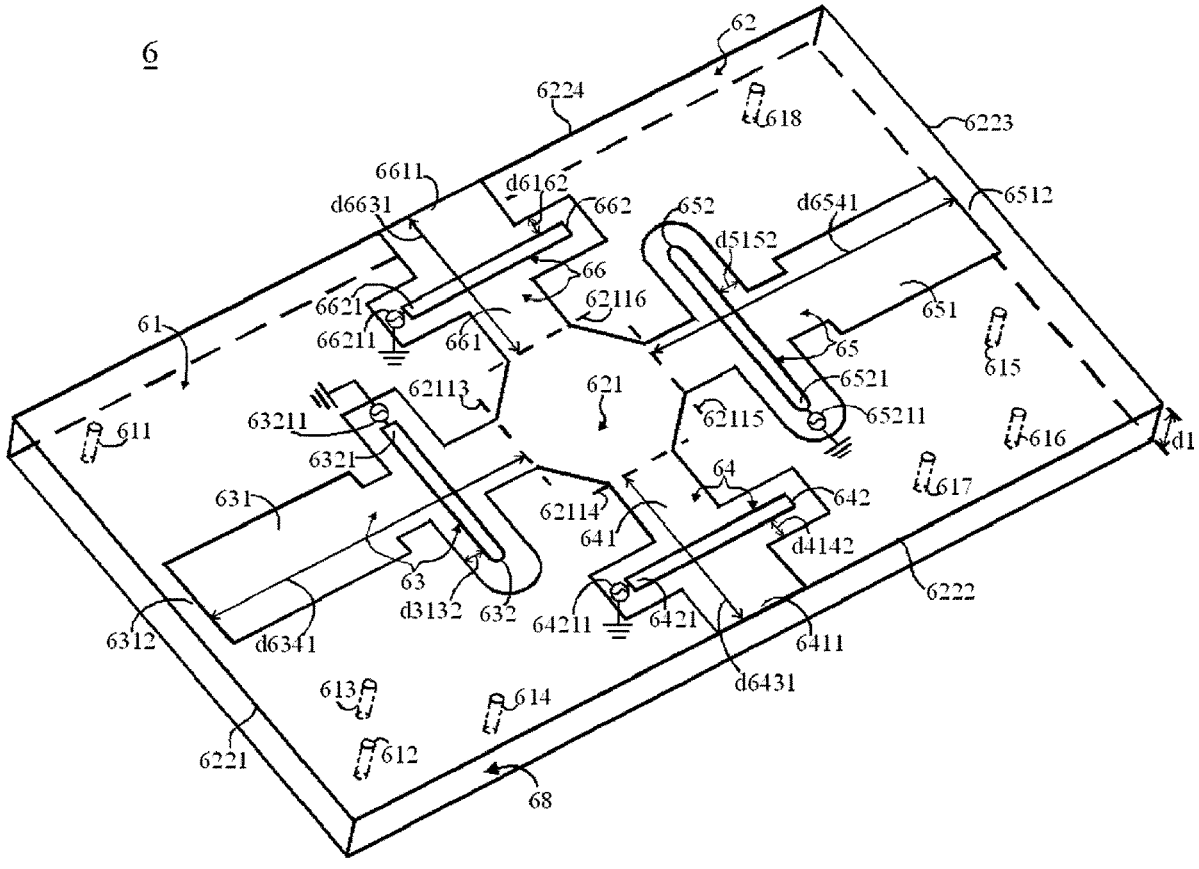
Publication Classification

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

(52) **U.S. Cl.**
CPC ***H01Q 21/064*** (2013.01)

(57) **ABSTRACT**

A highly-integrated multi-antenna array comprising a first conductor layer, a second conductor layer, a plurality of conjoined conducting structures, a plurality of slot antennas, and a conjoined slot structure is provided. The first conductor layer and the second conductor layer are spaced apart by a first interval, and are electrically connected by the conjoined conducting structures. Each slot antenna has a radiating slot structure and a signal coupling line, which partially overlap or cross each other. All radiating slot structures are formed at the second conductor layer. Each signal coupling line is spaced apart from the second conductor layer by a coupling interval and has a signal feeding point. Each slot antenna is excited to generate at least one resonant mode covering at least one identical first communication band. The conjoined slot structure is formed at the second conductor layer and connects with all radiating slot structures.



US 20210203082A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0203082 A1**

OH et al. (43) **Pub. Date: Jul. 1, 2021**

(54) **ANTENNA**

(71) Applicant: **LG INNOTEK CO., LTD.**, Seoul (KR)

(72) Inventors: **Sae Won OH**, Seoul (KR); **Young Hwan KIM**, Seoul (KR)

(73) Assignee: **LG INNOTEK CO., LTD.**, Seoul (KR)

(21) Appl. No.: **17/056,644**

(22) PCT Filed: **Apr. 30, 2019**

(86) PCT No.: **PCT/KR2019/005192**

§ 371 (c)(1),
(2) Date: **Nov. 18, 2020**

(30) **Foreign Application Priority Data**

Jun. 11, 2018 (KR) 10-2018-0066653

Publication Classification

(51) **Int. Cl.**

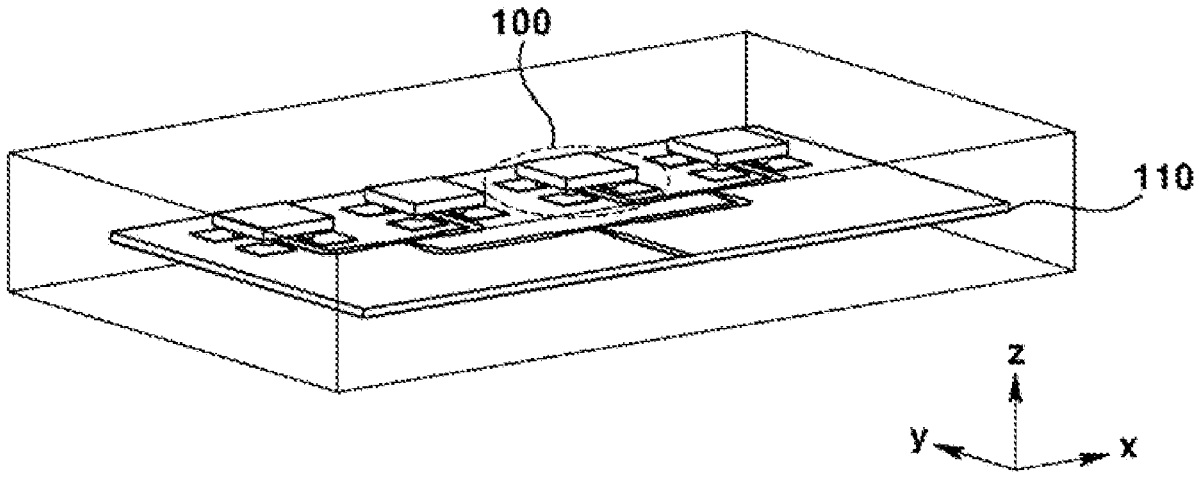
H01Q 21/06	(2006.01)
H01Q 9/04	(2006.01)
H01Q 1/38	(2006.01)

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

CPC ***H01Q 21/065*** (2013.01); ***H01Q 1/38*** (2013.01); ***H01Q 9/04*** (2013.01)

(57) **ABSTRACT**

An antenna according to one embodiment comprises: a substrate; a radiator attached to the substrate and radiating an electromagnetic signal; a metal plate antenna disposed to be spaced apart from the radiator in the vertical direction of the radiator; a fixing rod for supporting the metal plate antenna; and a sub patch antenna comprising a first surface attached to the fixing rod and a second surface attached to the substrate, wherein a partial region of the metal plate antenna and a partial region of the radiator overlap in the vertical direction.



US 20210203083A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2021/0203083 A1**

(43) **Pub. Date: Jul. 1, 2021**

WANG et al.

(54) **ANTENNA OF A TERMINAL DEVICE**

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

(72) Inventors: **Yijin WANG**, Dongguan (CN); **Huan-chu HUANG**, Dongguan (CN); **Xianjing JIAN**, Dongguan (CN)

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

(21) Appl. No.: **17/199,941**

(22) Filed: **Mar. 12, 2021**

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2019/101703, filed on Aug. 21, 2019.

(30) **Foreign Application Priority Data**

Sep. 14, 2018 (CN) 201811076748.4

Publication Classification

(51) **Int. Cl.**

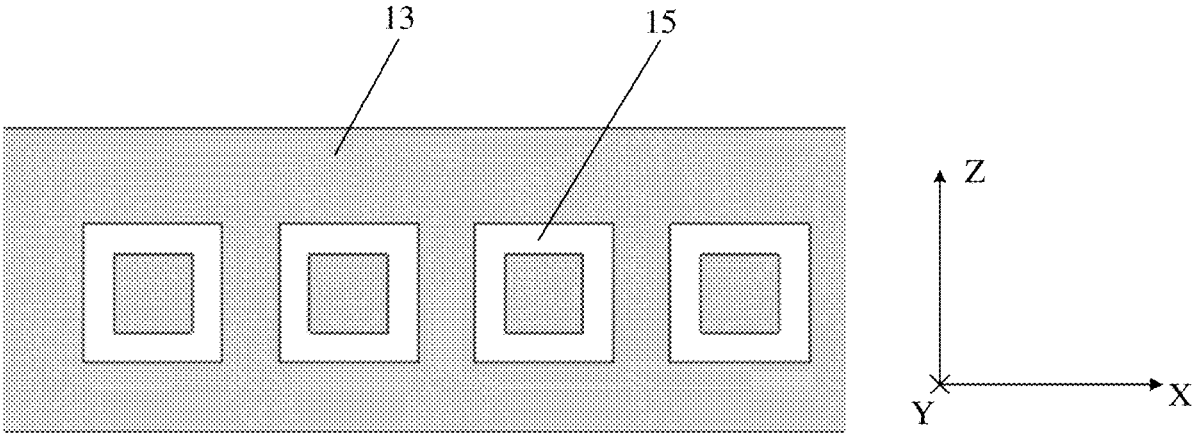
H01Q 21/08	(2006.01)
H01Q 13/10	(2006.01)
H01Q 21/00	(2006.01)
H01Q 1/48	(2006.01)

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

CPC ***H01Q 21/08*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 21/0006*** (2013.01); ***H01Q 13/10*** (2013.01)

(57) **ABSTRACT**

An antenna of a terminal device, the antenna includes a metal frame, a side of the metal frame is provided with at least two slots, and the slots are ring-shaped slots. Portions of the metal frame at two sides of each slot of the at least two slots are provided with two groups of feed points, and each group of feed points includes an antenna feed point located on a portion of the metal frame at the inner side of the slot, and a ground feed point located on another portion of the metal frame at the outer side of the slot. The metal frame is electrically connected to a floor in the terminal device.



US 20210210837A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0210837 A1**

HSU et al. (43) **Pub. Date: Jul. 8, 2021**

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

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

(72) Inventors: **CHO-KANG HSU**, New Taipei (TW); **MIN-HUI HO**, New Taipei (TW); **TE-CHANG LIN**, New Taipei (TW)

(21) Appl. No.: **17/136,896**

(22) Filed: **Dec. 29, 2020**

(30) **Foreign Application Priority Data**

Jan. 6, 2020 (CN) 202010009650.8

Publication Classification

(51) **Int. Cl.**

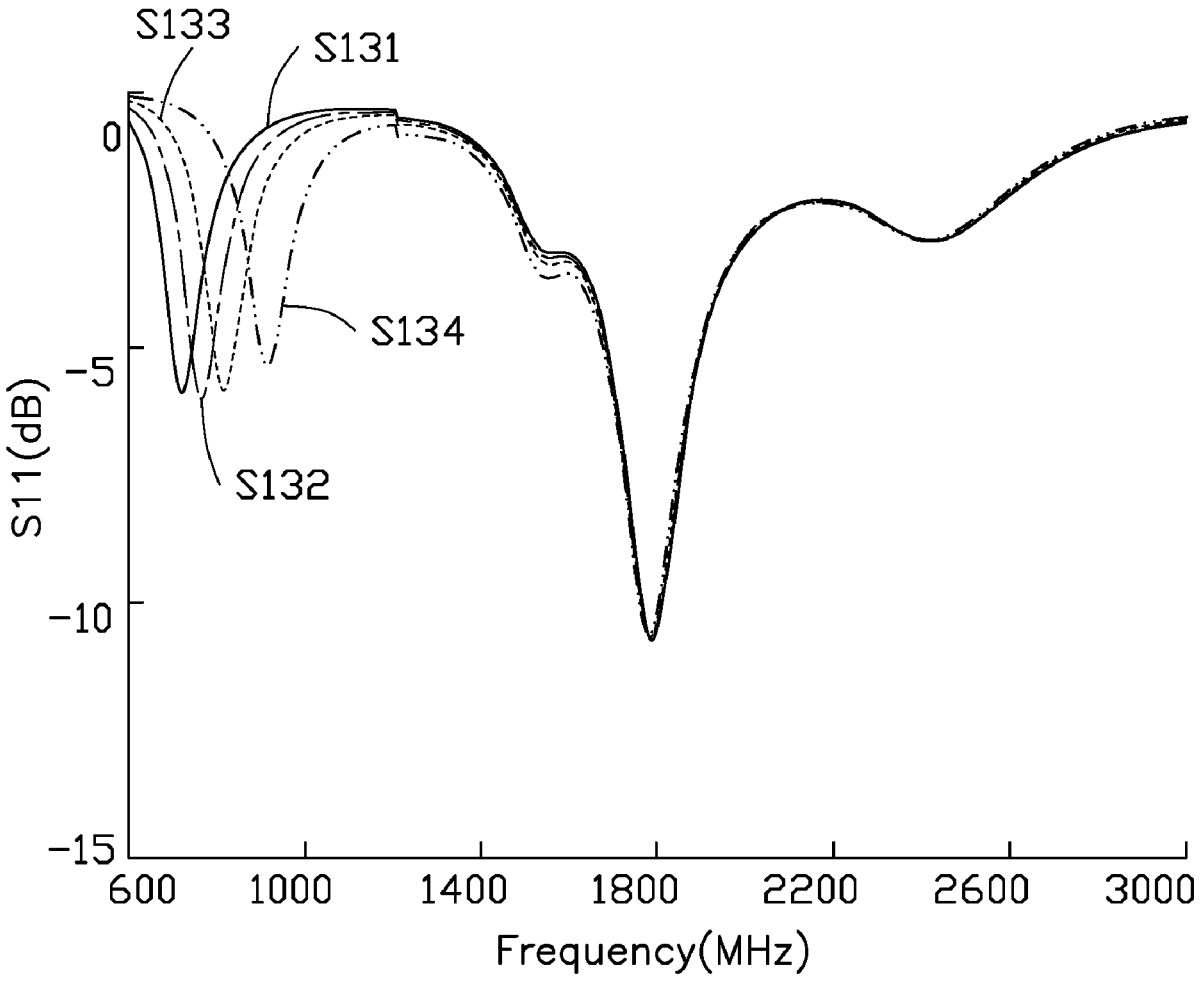
H01Q 1/24	(2006.01)
H01Q 13/10	(2006.01)
H04B 1/00	(2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H04B 1/006*** (2013.01); ***H01Q 13/10*** (2013.01)

(57) **ABSTRACT**

An antenna structure with wide radiation bandwidth in a reduced physical space includes a housing, a first feed portion, and a second feed portion. The housing includes a metallic side frame, a metallic middle frame, and a metallic back board. The metallic side frame defines first and second gaps, and the metallic back board defines a slot. The slot, the first gap, and the second gap divide the metallic side frame to give a first radiation portion. The first and second feed portions are both electrically connected to the first radiation portion. When the first feed portion supplies a current, the current flows through the first radiation portion, toward the second gap to excite a first working mode. When the second feed portion supplies a current, the current flows through the first radiation portion, toward the first gap to excite a second working mode.



US 20210210838A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0210838 A1**

HSU et al. (43) **Pub. Date: Jul. 8, 2021**

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

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

(72) Inventors: **CHO-KANG HSU**, New Taipei (TW); **MIN-HUI HO**, New Taipei (TW); **TE-CHANG LIN**, New Taipei (TW)

(21) Appl. No.: **17/136,907**

(22) Filed: **Dec. 29, 2020**

(30) **Foreign Application Priority Data**

Jan. 6, 2020 (CN) 202010009964.8

Publication Classification

(51) **Int. Cl.**

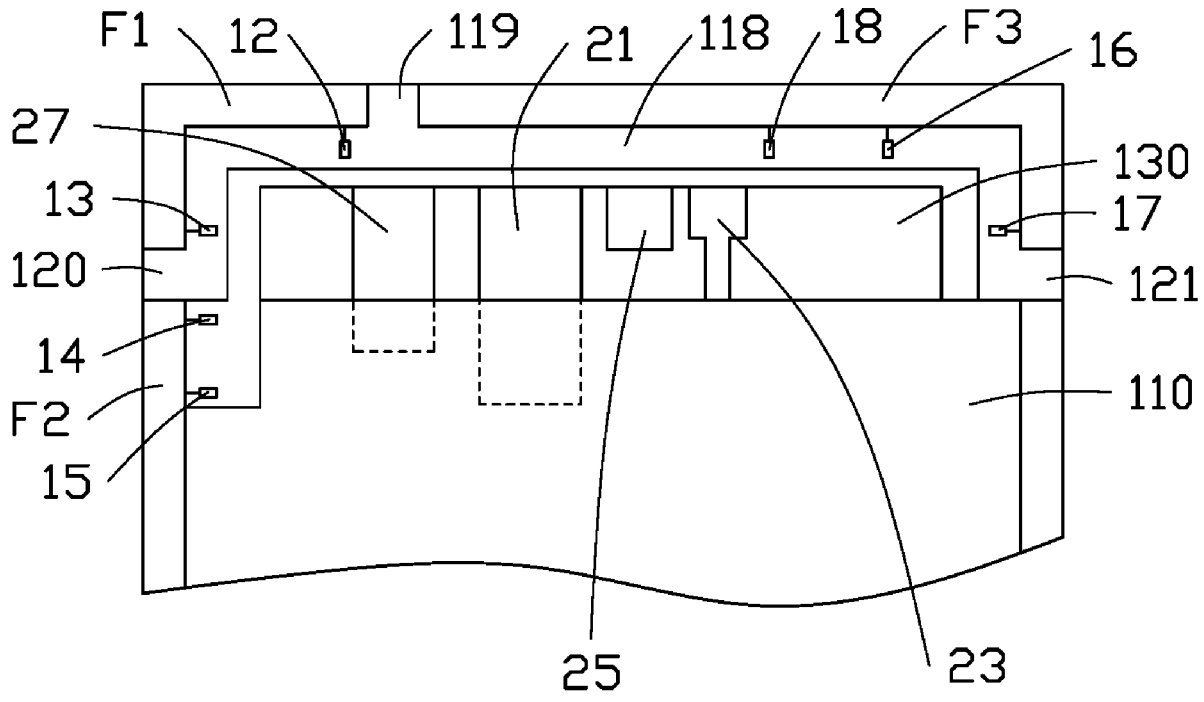
H01Q 1/24	(2006.01)
H01Q 1/38	(2006.01)
H01Q 1/50	(2006.01)
H01Q 13/10	(2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H01Q 13/106*** (2013.01); ***H01Q 1/50*** (2013.01); ***H01Q 1/38*** (2013.01)

(57) **ABSTRACT**

An antenna structure with wide radiation bandwidth in a reduced physical space includes a housing, a first feed portion, and a second feed portion. The housing includes a metallic side frame, a metallic middle frame, and a metallic back board. The metallic side frame defines a first gap and a second gap. The metallic back board defines a slot. The slot, the first and second gaps divide a first radiation portion and a second radiation from the metallic side frame. The first feed portion is electrically connected to the first radiation portion. The second feed portion is electrically connected to the second radiation portion. The metallic middle frame and the metallic back board are connected to each other to form a system ground plane to provide a ground for the antenna structure.



US 20210210839A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0210839 A1**

HSU et al. (43) **Pub. Date: Jul. 8, 2021**

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

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

(72) Inventors: **CHO-KANG HSU**, New Taipei (TW); **MIN-HUI HO**, New Taipei (TW)

(21) Appl. No.: **17/136,921**

(22) Filed: **Dec. 29, 2020**

(30) **Foreign Application Priority Data**

Jan. 6, 2020 (CN) 202010009963.3

Publication Classification

(51) **Int. Cl.**

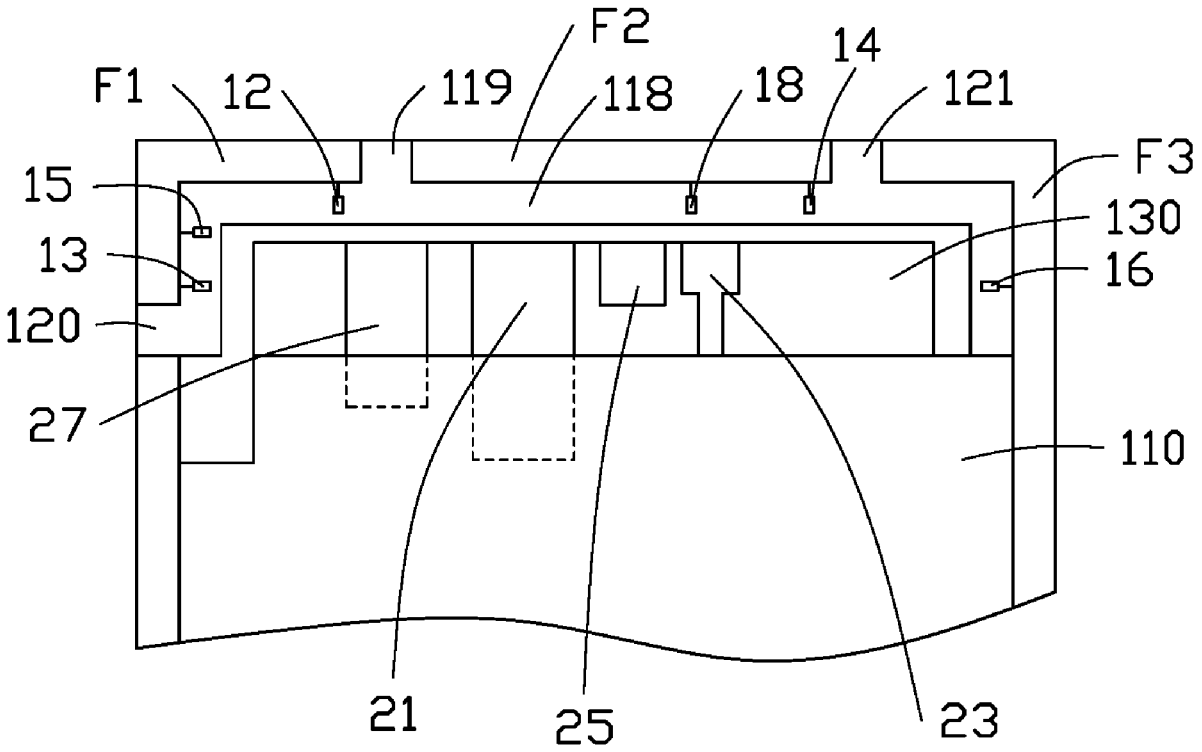
H01Q 1/24	(2006.01)
H01Q 1/38	(2006.01)
H01Q 1/50	(2006.01)
H01Q 13/10	(2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H01Q 13/106*** (2013.01); ***H01Q 1/50*** (2013.01); ***H01Q 1/38*** (2013.01)

(57) **ABSTRACT**

An antenna structure with wide radiation bandwidth in a reduced physical space includes a housing, a first feed portion, and a second feed portion. The housing includes a metallic side frame, a metallic middle frame, and a metallic back board. The metallic side frame defines first and second gaps and the metallic back board defines a slot. The slot, and the first and second gaps, create a first radiation portion from the metallic side frame. The first and second feed portions are both electrically connected to the first radiation portion. When the first feed portion feeds current, the current flows through the first radiation portion, toward the second gap to excite a GPS mode and a WIFI 2.4 GHz mode. When the second feed portion feeds current, the current flows through the first radiation portion, toward the first gap to excite a WIFI 5 GHz mode.



US 20210210854A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0210854 A1**

BAI et al. (43) **Pub. Date: Jul. 8, 2021**

(54) **MULTI-BAND ANTENNA AND COMMUNICATIONS DEVICE**

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

(72) Inventors: **Xue BAI**, Dongguan (CN); **Naibiao WANG**, Dongguan (CN); **Guoqing XIE**, Dongguan (CN); **Weihong XIAO**, Dongguan (CN)

(21) Appl. No.: **17/206,534**

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

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2019/106174, filed on Sep. 17, 2019.

(30) **Foreign Application Priority Data**

Sep. 20, 2018 (CN) 201811099935.4

Publication Classification

(51) **Int. Cl.**

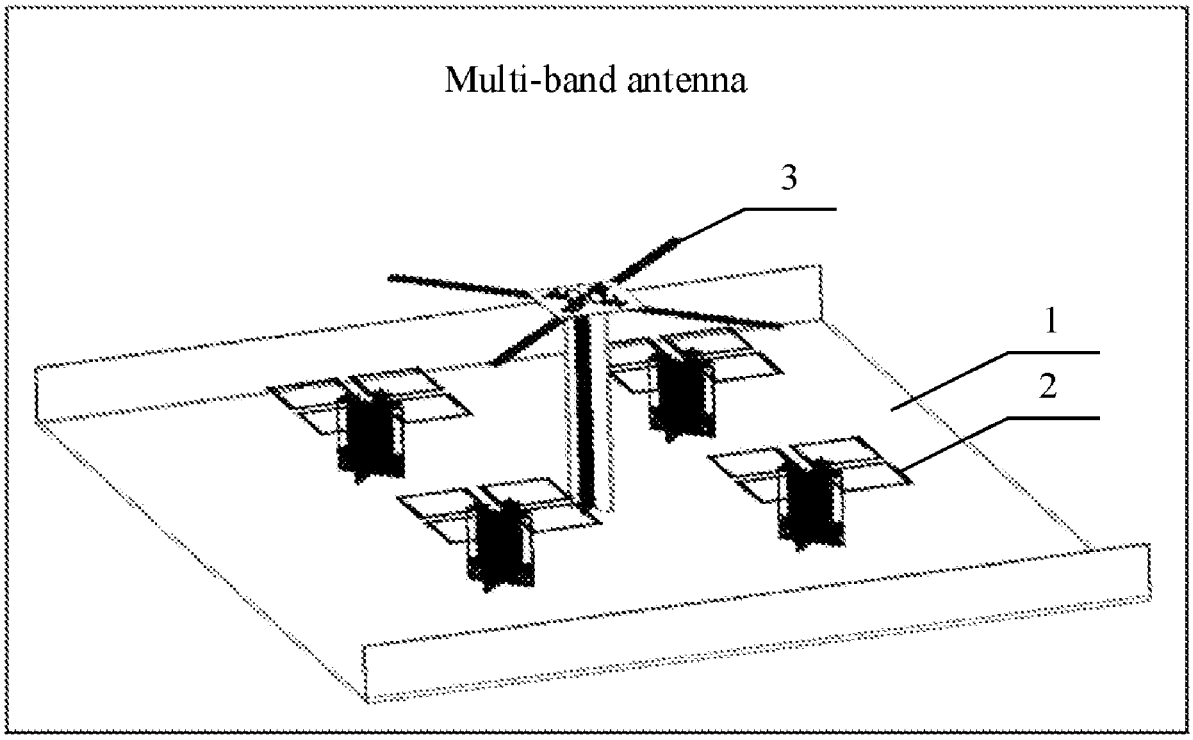
H01Q 5/307	(2006.01)
H01Q 21/26	(2006.01)
H01Q 19/10	(2006.01)

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

CPC ***H01Q 5/307*** (2015.01); ***H01Q 19/108*** (2013.01); ***H01Q 21/26*** (2013.01)

(57) **ABSTRACT**

Embodiments of the present invention pertain to the field of communications technologies and disclose a multi-band antenna and a communications device. The multi-band antenna includes a reflection panel, at least one high-frequency unit, and at least one low-frequency unit. Each high-frequency unit includes a balun structure, a coupling structure, and a radiation arm structure. The balun structure includes two balun sub-structures, the coupling structure includes two coupling sub-structures, and the radiation arm structure includes two radiation arms. The high-frequency unit and the low-frequency unit are disposed on the reflection panel. Each coupling sub-structure is separately electrically connected to one balun sub-structure and one radiation arm. The coupling sub-structure is configured to transmit a signal whose frequency is higher than a preset threshold, and block a signal whose frequency is lower than the preset threshold.



US 20210210859A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0210859 A1**

Jafargholi et al. (43) **Pub. Date: Jul. 8, 2021**

(54) **REDUCING MUTUAL COUPLING AND BACK-LOBE RADIATION OF A MICROSTRIP ANTENNA**

(71) Applicants: **Amir Jafargholi**, Tehran (IR); **Ali Jafargholi**, Tehran (IR); **Mehdi Veysi**, Irvine, CA (US); **Jun H. Choi**, Buffalo, NY (US)

(72) Inventors: **Amir Jafargholi**, Tehran (IR); **Ali Jafargholi**, Tehran (IR); **Mehdi Veysi**, Irvine, CA (US); **Jun H. Choi**, Buffalo, NY (US)

(73) Assignees: **Amir Jafargholi**, Tehran (IR); **Amirkabir University of Technology**, Tehran (IR)

(21) Appl. No.: **17/207,617**

(22) Filed: **Mar. 20, 2021**

Related U.S. Application Data

(63) Continuation of application No. 16/236,592, filed on Dec. 30, 2018.

(60) Provisional application No. 62/612,448, filed on Dec. 31, 2017.

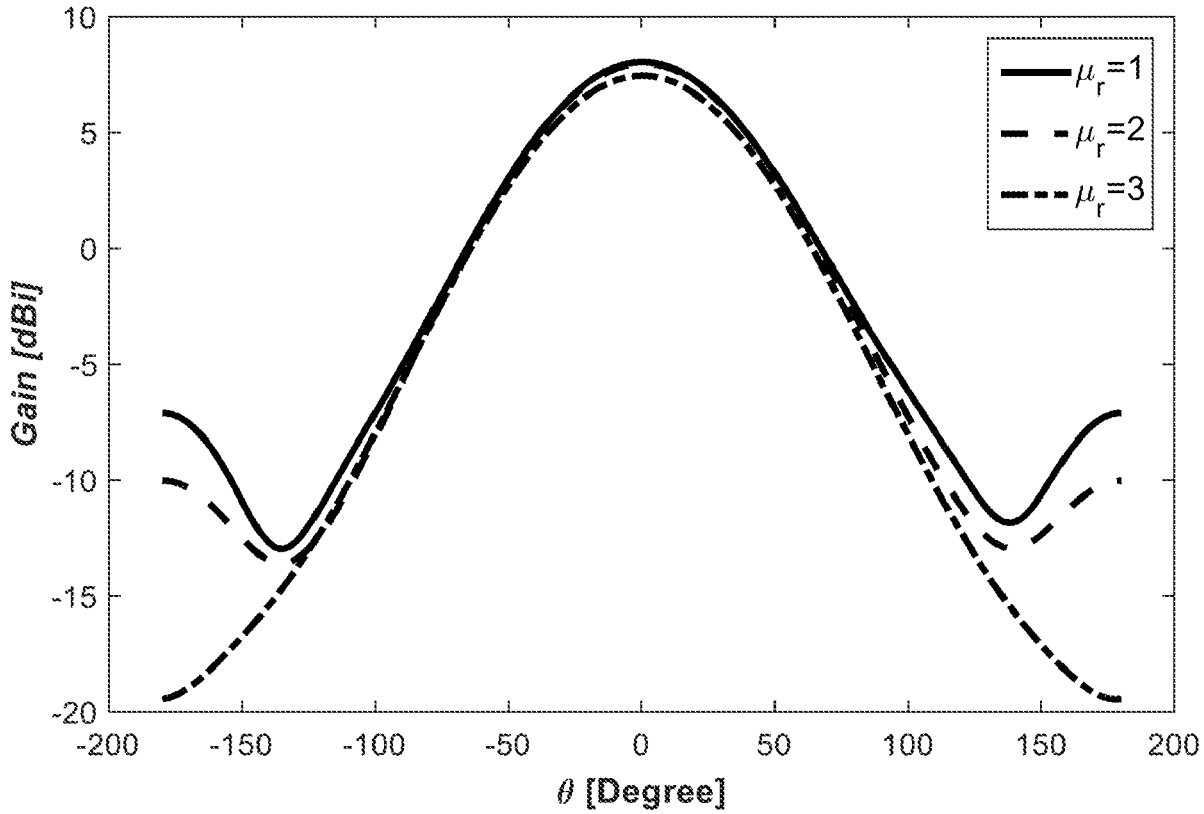
Publication Classification

(51) **Int. Cl.**
H01Q 15/00 (2006.01)
H01Q 9/04 (2006.01)

(52) **U.S. Cl.**
CPC ***H01Q 15/0086*** (2013.01); ***H01Q 9/0457*** (2013.01)

(57) **ABSTRACT**

A microstrip antenna is disclosed. The microstrip antenna includes a dielectric substrate with a first relative permittivity, a metal patch, and a magneto-dielectric superstrate. The metal patch is printed on the dielectric substrate, and the magneto-dielectric superstrate is placed above the metal patch.



US 20210210865A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0210865 A1**

Li et al. (43) **Pub. Date: Jul. 8, 2021**

(54) **SLOTTED SUBSTRATE INTEGRATED AIR WAVEGUIDE ANTENNA ARRAY**

(71) Applicant: **The Board of Trustees of the University of Alabama**, Tuscaloosa, AL (US)

(72) Inventors: **Linfeng Li**, Tuscaloosa, AL (US); **Stephen Yan**, Northport, AL (US)

(21) Appl. No.: **17/092,836**

(22) Filed: **Nov. 9, 2020**

Related U.S. Application Data

(60) Provisional application No. 62/957,983, filed on Jan. 7, 2020.

Publication Classification

(51) **Int. Cl.**

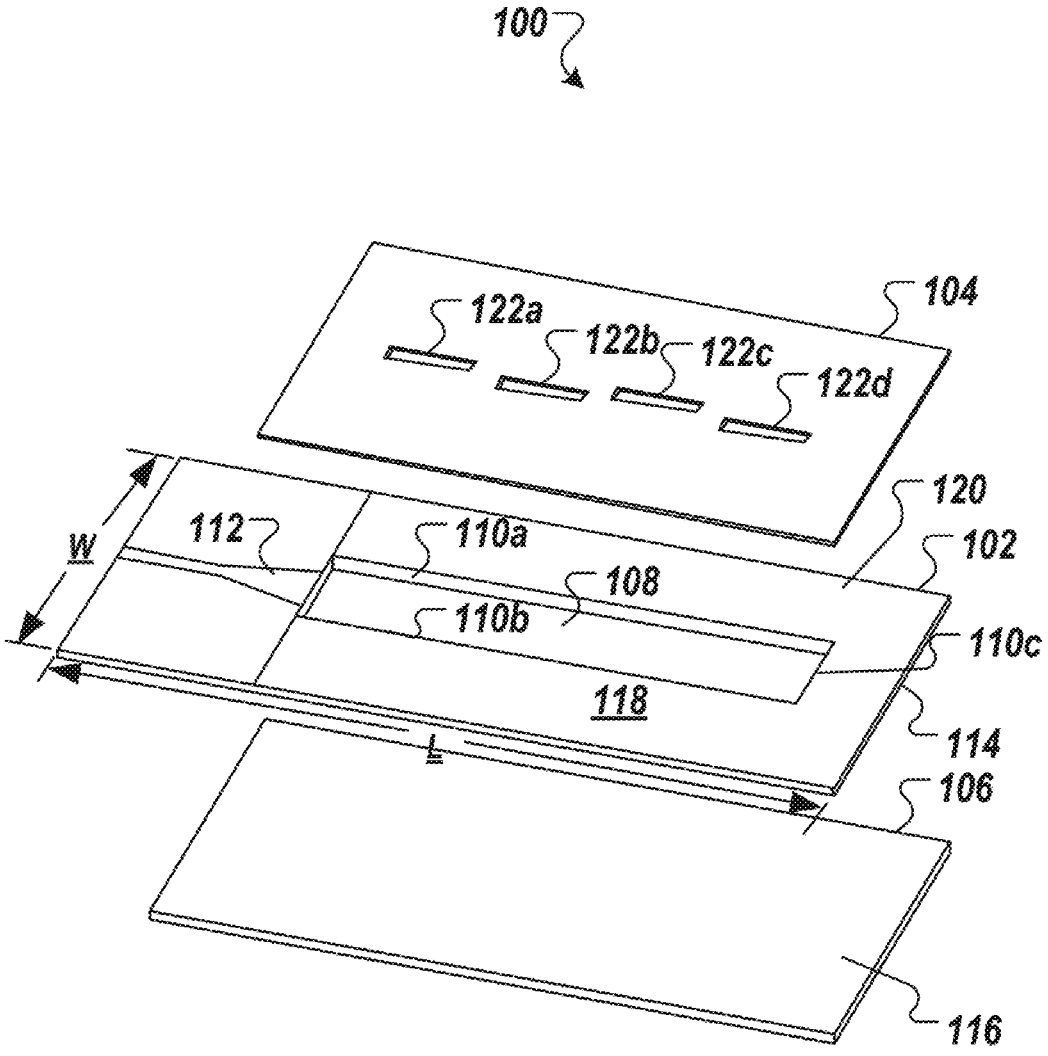
H01Q 21/00	(2006.01)
H01Q 13/26	(2006.01)
H01Q 1/38	(2006.01)

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

CPC ***H01Q 21/005*** (2013.01); ***H01Q 1/38*** (2013.01); ***H01Q 13/26*** (2013.01)

(57) **ABSTRACT**

A slotted Substrate Integrated Air Waveguide (slotted SIAW) antenna array comprising a ground plane having a reflective planar surface formed of a conductive material; an air waveguide structure fixably attached to, or formed onto, the reflective surface of the ground plane and having a slotted aperture defined, in part, by two conductive side walls that terminates at a conductive end wall, where a portion of the conductive side walls and a portion of the conductive end wall define an aperture-facing radiative conductive surface of the aperture and electrically couples with a conductive antenna feedline; and a slotted cover plate fixably attached to, or formed onto, the slotted-waveguide structure and having an area that fully covers the slotted aperture and has two or more radiating slotted apertures coincident to the slotted aperture and to the reflective planar surface of the ground plane.



US 20210210867A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0210867 A1**

PANTHER et al. (43) **Pub. Date: Jul. 8, 2021**

(54) **CAPACITIVELY COUPLED PATCH ANTENNA**

(71) Applicant: **TALLYSMAN WIRELESS INC.**, KANATA (CA)

(72) Inventors: **GYLES PANTHER**, OTTAWA (CA); **RONY E. AMAYA**, KANATA (CA); **JAMES STUART WIGHT**, OTTAWA (CA)

(21) Appl. No.: **17/209,976**

(22) Filed: **Mar. 23, 2021**

Related U.S. Application Data

(63) Continuation of application No. 16/891,877, filed on Jun. 3, 2020, now Pat. No. 10,992,058, which is a continuation-in-part of application No. 15/726,747, filed on Oct. 6, 2017, now Pat. No. 10,553,951, which is a continuation-in-part of application No. 14/389,682, filed on Sep. 30, 2014, now Pat. No. 9,806,423, filed as application No. PCT/CA2013/050275 on Apr. 5, 2013.

(60) Provisional application No. 61/620,665, filed on Apr. 5, 2012.

Publication Classification

(51) **Int. Cl.**

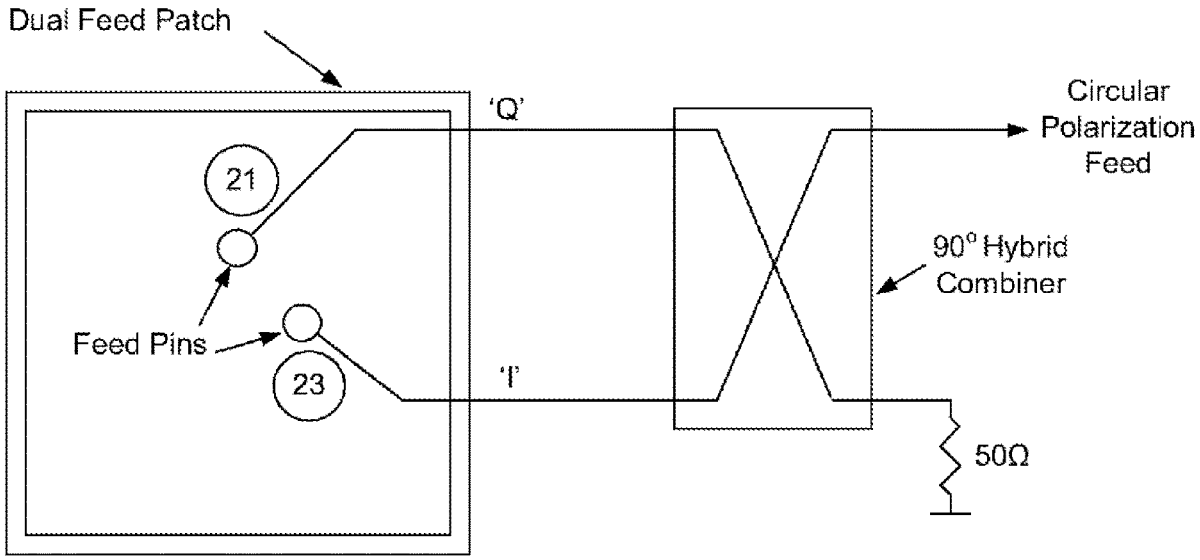
H01Q 21/06	(2006.01)
H01Q 9/04	(2006.01)
H01Q 15/24	(2006.01)
H01Q 1/48	(2006.01)

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

CPC ***H01Q 21/065*** (2013.01); ***H01Q 9/0457*** (2013.01); ***H01Q 9/0421*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 15/244*** (2013.01)

(57) **ABSTRACT**

Systems and methods relating to patch antennas. A patch antenna has a substrate, a resonant metal plate at one side of the substrate, and a ground plane at the other opposite side of the substrate. Two feed pins are used to couple the antenna to other circuitry. The feed pins pass through the substrate and holes in at the ground plane. The ted pins are physically disconnected from both the resonant metal plate and the ground plane. The feed pins are capacitively coupled to the resonant metal plate to provide an electronic connection between other circuitry and the patch antenna.



US 20210210868A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0210868 A1**

Avser et al. (43) **Pub. Date: Jul. 8, 2021**

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

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

(72) Inventors: **Bilgehan Avser**, San Bruno, CA (US); **Harish Rajagopalan**, San Jose, CA (US); **Simone Paulotto**, Redwood City, CA (US); **Jennifer M. Edwards**, San Francisco, CA (US); **Hao Xu**, Cupertino, CA (US); **Rodney A. Gomez Angulo**, Santa Clara, CA (US); **Matthew A. Mow**, Los Altos, CA (US); **Mattia Pascolini**, San Francisco, CA (US)

(21) Appl. No.: **17/212,935**

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

Related U.S. Application Data

(63) Continuation of application No. 16/146,649, filed on Sep. 28, 2018, now Pat. No. 10,992,057.

Publication Classification

(51) **Int. Cl.**

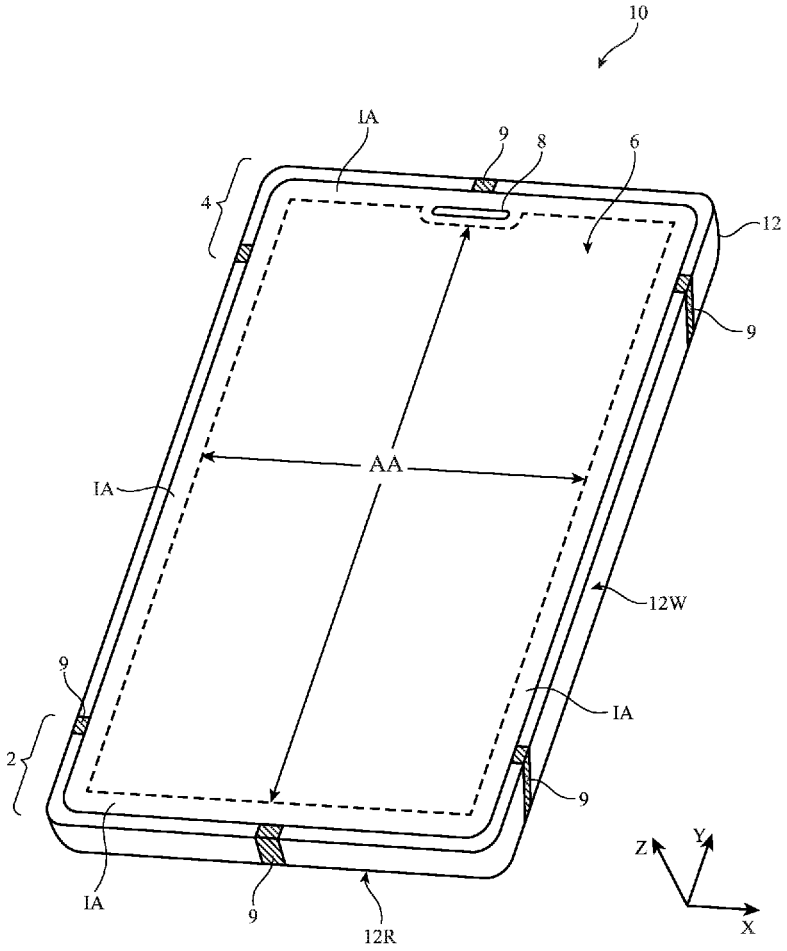
H01Q 21/06	(2006.01)
H01Q 1/38	(2006.01)
H01Q 5/357	(2006.01)
H01Q 5/28	(2006.01)

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

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

(57) **ABSTRACT**

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



US 20210210869A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0210869 A1**

LEE et al. (43) **Pub. Date: Jul. 8, 2021**

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

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

(72) Inventors: **Sungyoung LEE**, Suwon-si (KR); **Sanghun PARK**, Suwon-si (KR); **Gunwoo LEE**, Suwon-si (KR); **Jongjoo JE**, Suwon-si (KR)

(21) Appl. No.: **17/193,524**

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

Related U.S. Application Data

(63) Continuation of application No. 16/971,526, filed on Aug. 20, 2020, filed as application No. PCT/KR2020/010157 on Jul. 31, 2020.

(30) **Foreign Application Priority Data**

Aug. 2, 2019 (KR) 10-2019-0094589

Publication Classification

(51) **Int. Cl.**

H01Q 21/08 (2006.01)

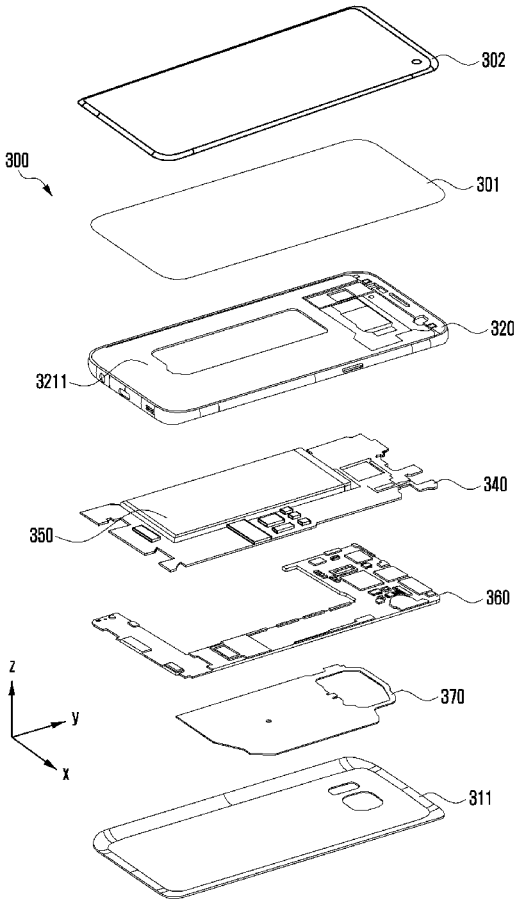
H01Q 1/24 (2006.01)

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

CPC ***H01Q 21/08*** (2013.01); ***H01Q 1/243*** (2013.01)

(57) **ABSTRACT**

According to various embodiments, an electronic device may include: a housing including a side member including a conductive member and a non-conductive member coupled with the conductive member; and at least one antenna structure disposed in an internal space of the housing and including a substrate disposed to face the side member, and at least one antenna element which is disposed on the substrate such that a beam pattern is formed through the non-conductive member in a direction in which the side member faces, wherein: when the side member is viewed from the outside, a boundary region between the conductive member and the non-conductive member is disposed in a region not overlapping the substrate; in the boundary region, the conductive member includes at least one concave part formed to at least partially receive the non-conductive member; and the at least one concave part includes two or more stepped parts which gradually get higher or lower as the stepped parts are further leftward or rightward from the substrate, when the side member is viewed from the outside.



US 20210218130A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0218130 A1**

CHEN et al. (43) **Pub. Date: Jul. 15, 2021**

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

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

(72) Inventors: **YUNG-CHIN CHEN**, New Taipei (TW); **KUN-LIN SUNG**, New Taipei (TW); **YI-CHIEH LEE**, New Taipei (TW)

(21) Appl. No.: **17/106,347**

(22) Filed: **Nov. 30, 2020**

(30) **Foreign Application Priority Data**

Jan. 14, 2020 (CN) 202010037127.6

Publication Classification

(51) **Int. Cl.**

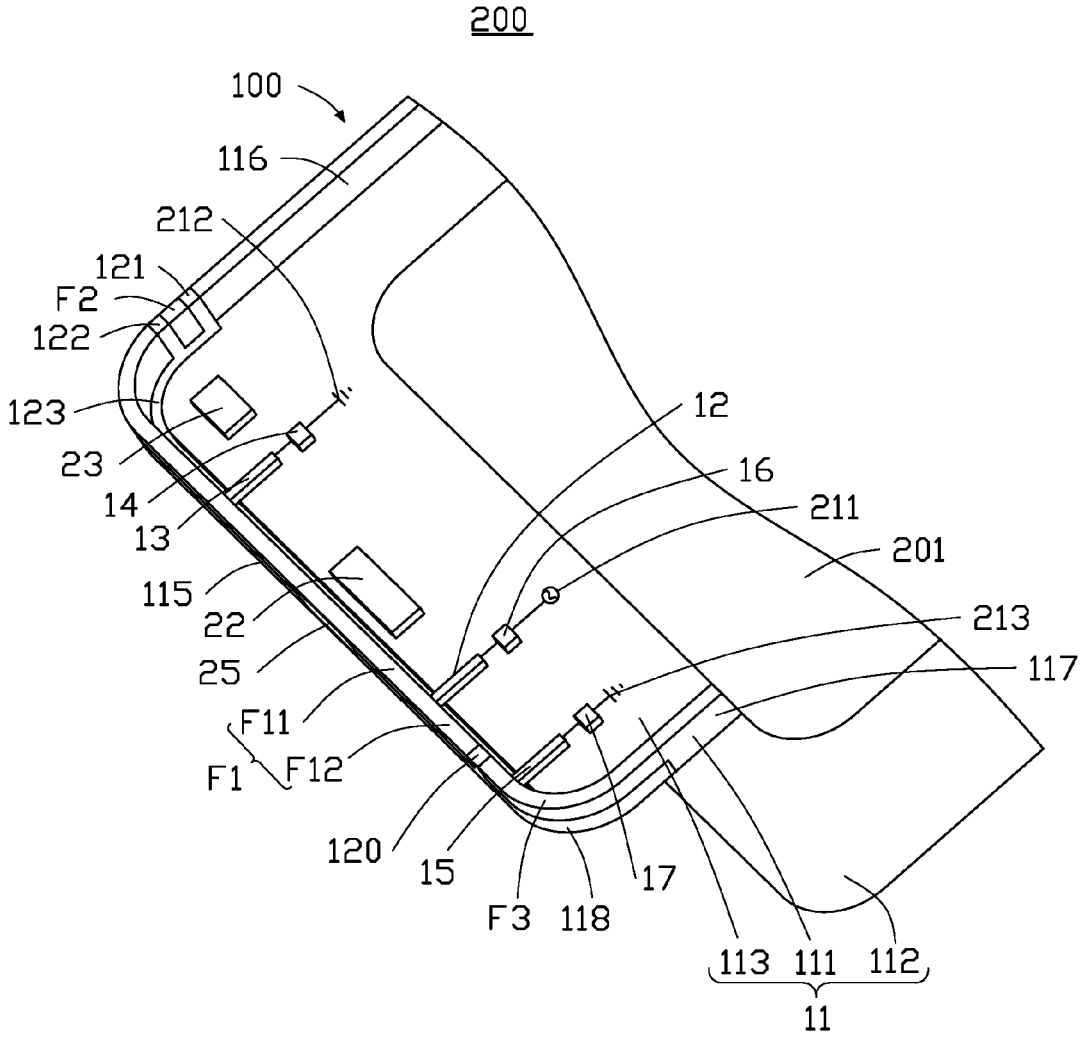
H01Q 1/24	(2006.01)
H01Q 1/48	(2006.01)
H01Q 5/378	(2006.01)
H01Q 13/10	(2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H01Q 13/10*** (2013.01); ***H01Q 5/378*** (2015.01); ***H01Q 1/48*** (2013.01)

(57) **ABSTRACT**

An antenna structure includes a metal frame, a feeding portion, and a first ground portion. The metal frame is provided with a slot, a first gap, a second gap, and a third gap. The first gap, the second gap, and the third gap are coupled to the slot, and the slot, the first gap, the second gap, and the third gap divide the metal frame into a radiating portion and a first coupling portion. A portion of the metal frame between the first gap and the third gap form the radiating portion, and a portion of the metal frame between the second gap and the third gap form the first coupling portion. The feeding portion is electrically coupled to the radiating portion to feed an electric signal to the radiating portion. The first ground portion is electrically coupled to the radiating portion to provide ground to the radiating portion.



US 20210218136A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2021/0218136 A1

(43) Pub. Date: Jul. 15, 2021

WANG et al.

(54) ANTENNA OF A TERMINAL DEVICE

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

(72) Inventors: **Yijin WANG**, Dongguan (CN); **Huan-chu HUANG**, Dongguan (CN); **Xianjing JIAN**, Dongguan (CN)

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

(21) Appl. No.: **17/200,164**

(22) Filed: **Mar. 12, 2021**

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2019/101509, filed on Aug. 20, 2019.

(30) **Foreign Application Priority Data**

Sep. 14, 2018 (CN) 201811076745.0

Publication Classification

(51) **Int. Cl.**

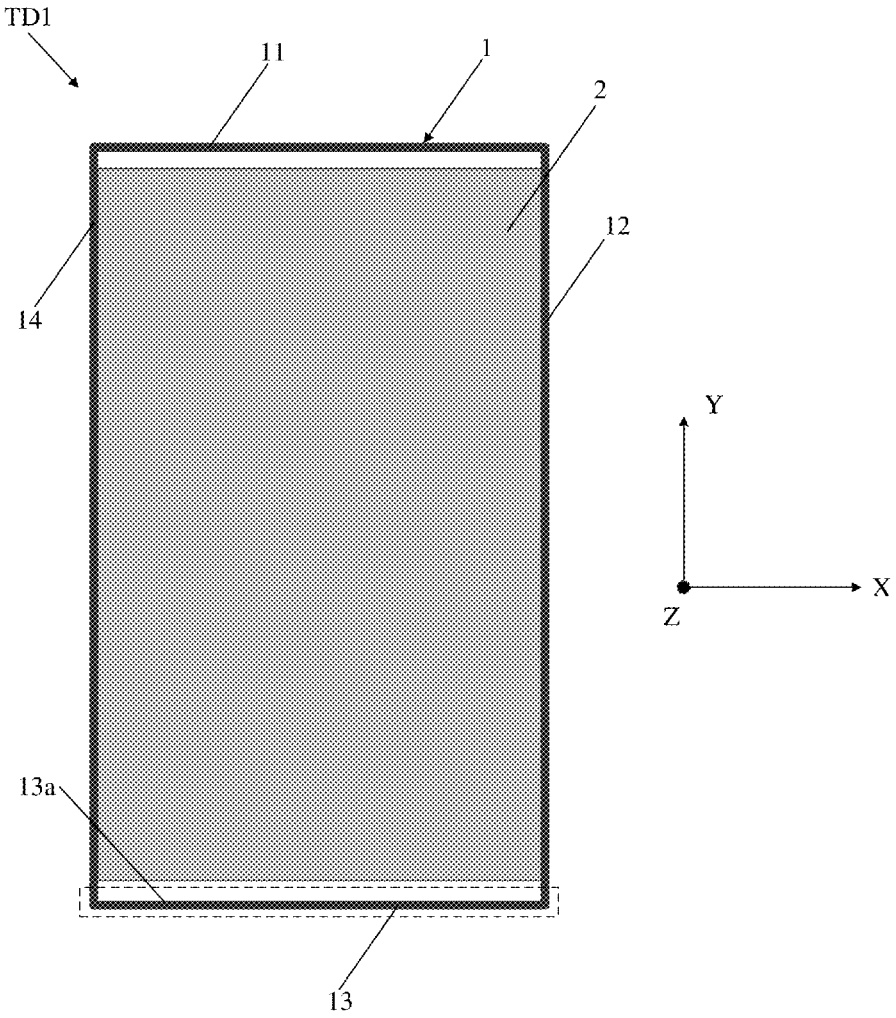
H01Q 1/44	(2006.01)
H01Q 1/36	(2006.01)
H01Q 1/48	(2006.01)
H01Q 1/50	(2006.01)
H01Q 21/00	(2006.01)

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

CPC ***H01Q 1/44*** (2013.01); ***H01Q 1/36*** (2013.01); ***H01Q 21/0006*** (2013.01); ***H01Q 1/50*** (2013.01); ***H01Q 1/48*** (2013.01)

(57) **ABSTRACT**

An antenna of a terminal device, the antenna includes a metal frame, a side of the metal frame is provided with at least two slot units, each slot unit includes a first slot ring and a second slot ring, the first slot ring and the second slot ring communicate through a third slot, an outer edge circumference of the first slot ring is different from that of the second slot ring. Portions of the metal frame on both sides of the third slot are provided with an antenna feed point and a ground feed point, respectively. The metal frame is electrically connected with a ground plate in the terminal device.



US 20210218155A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2021/0218155 A1

HUANG et al. (43) Pub. Date: Jul. 15, 2021

(54) **TERMINAL DEVICE**

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

(72) Inventors: **Huan-chu HUANG**, Dongguan (CN); **Yijin WANG**, Dongguan (CN); **Xianjing JIAN**, Dongguan (CN)

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

(21) Appl. No.: **17/213,898**

(22) Filed: **Mar. 26, 2021**

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2019/101512, filed on Aug. 20, 2019.

(30) **Foreign Application Priority Data**

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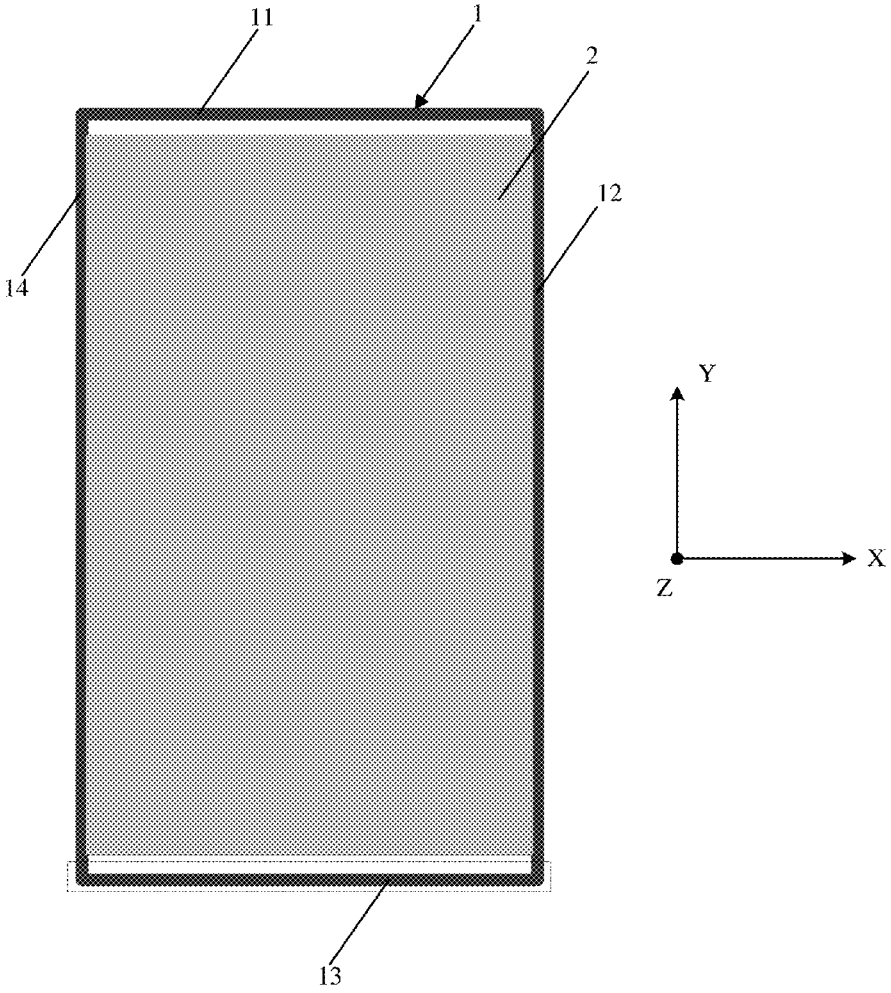
(57) **ABSTRACT**

A terminal device includes feed sources, a metal frame, coupling patches, and radiating patches, where at least two grooves are formed in the outer side surface of the metal frame, two first through holes are formed in each groove, a coupling patch and a radiating patch are arranged in each groove; the coupling patch in each groove is arranged between the radiating patch and the bottom of the groove, and two second through holes are formed in the coupling patch; two antenna feed points are arranged on each radiating patch, each feed source is connected to one antenna feed point through one first through hole and one second through hole; and the metal frame, the coupling patch, and the radiating patch are not in contact with one another, and an area of the radiating patch is less than an area of the coupling patch.



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(54) **COMMUNICATION DEVICE**

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(57) **ABSTRACT**

A communication device with an RF (Radio Frequency) node and a detection node includes a first radiation element, a second radiation element, a first inductor, a second inductor, a third inductor, a first capacitor, and a second capacitor. The first radiation element is coupled to a first node. The second radiation element is coupled to a second node. The first inductor is coupled between the RF node and the ground voltage. The first capacitor is coupled between the RF node and the first node. The second inductor is coupled between the first node and the second node. The second capacitor is coupled between the second node and the ground voltage. The third inductor is coupled between the detection node and the second node. An antenna structure and a sensing pad are formed by the first radiation element and the second radiation element.