US 20210257718A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0257718 A1**

Huang et al. (43) **Pub. Date: Aug. 19, 2021**

(54) **ANTENNA MODULE**

(71) Applicant: **PEGATRON CORPORATION**, Taipei City (TW)

(72) Inventors: **Chin-Ting Huang**, Taipei City (TW); **Sony Chayadi**, Taipei City (TW); **Hsi-Kai Hung**, Taipei City (TW); **Chun-Kai Wang**, Taipei City (TW)

(73) Assignee: **PEGATRON CORPORATION**, TAIPEI CITY (TW)

(21) Appl. No.: **17/125,538**

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

(30) **Foreign Application Priority Data**

Feb. 15, 2020 (TW) 109104837

Publication Classification

(51) **Int. Cl.**

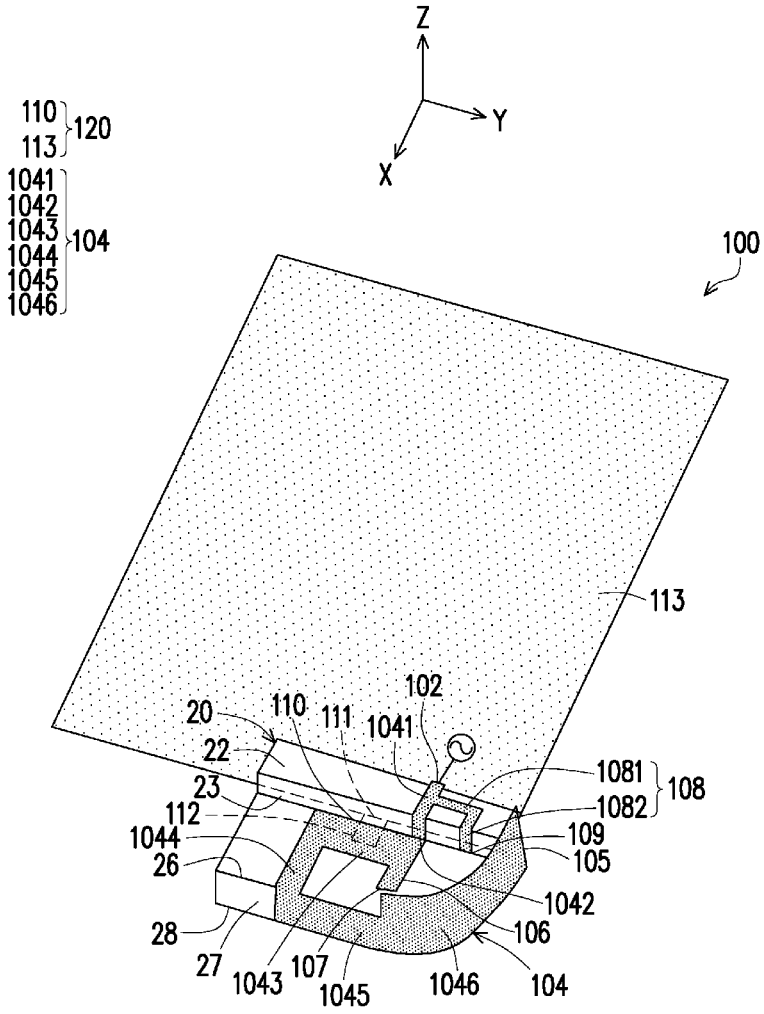
H01Q 1/24	(2006.01)
H01Q 9/16	(2006.01)
H01Q 1/48	(2006.01)
H01Q 5/357	(2006.01)

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

CPC ***H01Q 1/245*** (2013.01); ***H01Q 5/357*** (2015.01); ***H01Q 1/48*** (2013.01); ***H01Q 9/16*** (2013.01)

(57) **ABSTRACT**

An antenna module includes a feeding end, a first radiator, a second radiator, a third radiator, and a ground structure. The first radiator excites a first frequency and a second frequency. The second radiator extends from the first radiator and excites a third frequency with a part of the first radiator. The third radiator extends from the first radiator and excites a fourth frequency with a part of the first radiator. The ground structure includes a main ground surface and an extending portion extending from the main ground surface. The main ground surface is located below the feeding end, and the extending portion extends from the main ground surface to a bottom of the first radiator and is apart from the first radiator. An extending direction of a portion of the first radiator above the extending portion is orthogonal to an extending direction of the extending portion.



US 20210257722A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0257722 A1**

Li et al. (43) **Pub. Date: Aug. 19, 2021**

(54) **BASE STATION ANTENNAS HAVING ARRAYS WITH FREQUENCY SELECTIVE SHARED RADIATING ELEMENTS**

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

(72) Inventors: **Yunzhe Li**, Suzhou (CN); **YueMin Li**, Suzhou (CN); **GuoLong Xu**, Suzhou (CN); **Bo Wu**, Suzhou (CN)

(21) Appl. No.: **17/307,209**

(22) Filed: **May 4, 2021**

Related U.S. Application Data

(63) Continuation of application No. 16/829,152, filed on Mar. 25, 2020, now Pat. No. 11,031,678.

(30) **Foreign Application Priority Data**

Apr. 10, 2019 (CN) 201910282492.0

Publication Classification

(51) **Int. Cl.**

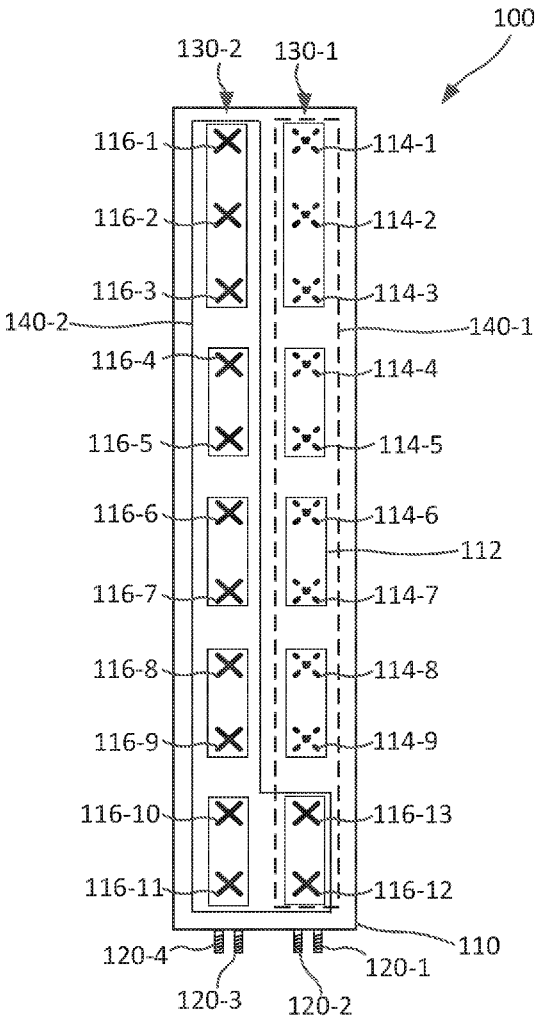
H01Q 1/24	(2006.01)
H01Q 5/50	(2006.01)
H01Q 21/00	(2006.01)
H04B 1/00	(2006.01)

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

CPC ***H01Q 1/246*** (2013.01); ***H04B 1/0057*** (2013.01); ***H01Q 21/0025*** (2013.01); ***H01Q 5/50*** (2015.01)

(57) **ABSTRACT**

Base station antennas include a first array of radiating elements that is coupled to a first RF port through a first feed network, a second array of radiating elements that is coupled to a second RF port through a second feed network, and first and second circuit elements. The first circuit element has a first port coupled to the first feed network, a second port coupled to a first port of the second circuit element and a third port coupled to a first radiating element of the first array of radiating elements. The second circuit element has a second port coupled to a first radiating element of the second array of radiating elements and a third port coupled to the second feed network.



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(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0257727 A1**

UCHIMURA (43) **Pub. Date: Aug. 19, 2021**

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

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

(72) Inventor: **Hiroshi UCHIMURA**, Kagoshima-shi (JP)

(21) Appl. No.: **17/306,844**

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

Related U.S. Application Data

(63) Continuation of application No. 16/795,574, filed on Feb. 20, 2020, now Pat. No. 11,031,687, which is a continuation of application No. PCT/JP2019/032876, filed on Aug. 22, 2019.

(30) **Foreign Application Priority Data**

Aug. 27, 2018 (JP) 2018-158793

Publication Classification

(51) **Int. Cl.**

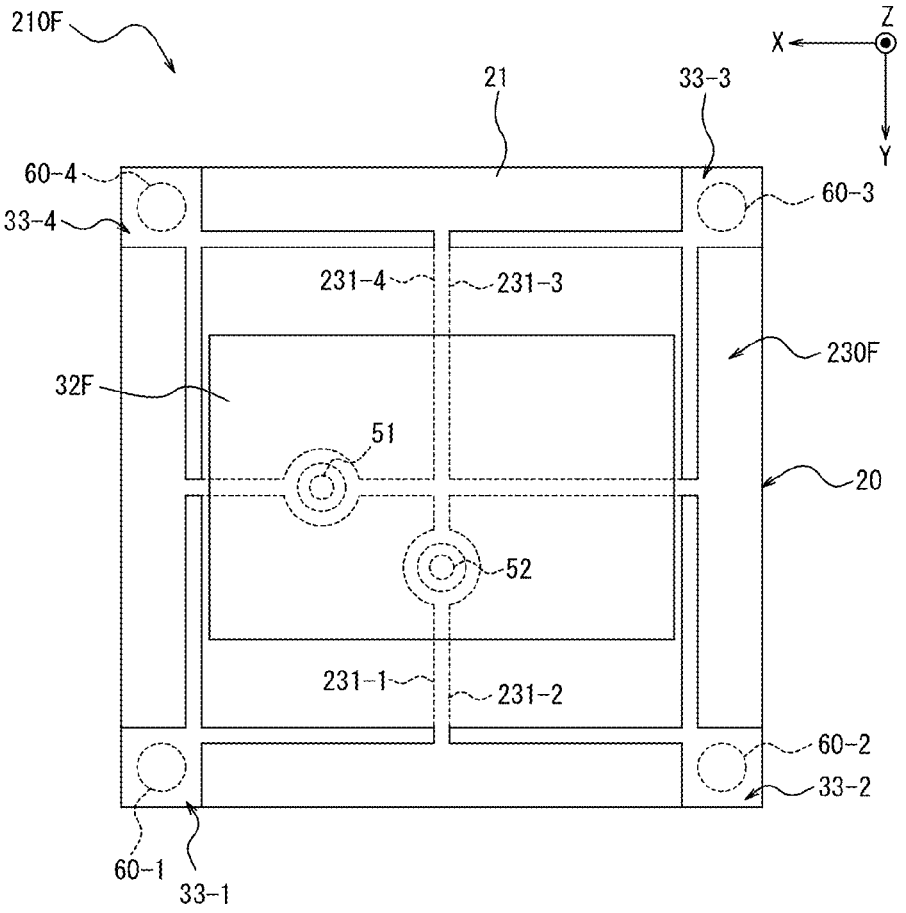
H01Q 1/52	(2006.01)
H01Q 1/24	(2006.01)
H01Q 9/04	(2006.01)
H01Q 5/307	(2006.01)

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

CPC ***H01Q 1/528*** (2013.01); ***H01Q 1/24*** (2013.01); ***H01Q 5/307*** (2015.01); ***H01Q 9/0421*** (2013.01); ***H01Q 9/0457*** (2013.01)

(57) **ABSTRACT**

A resonant structure includes a conducting portion extending along a first plane and including first conductors, a ground conductor located away from the conducting portion and extending along the first plane, and a first predetermined number of connecting conductors extending from the ground conductor towards the conducting portion. At least two first conductors are connected to different connecting conductors. A first connecting pair of two of the connecting conductors is aligned along a first direction in the first plane and a second connecting pair of two of the connecting conductors is aligned along a second direction, in the first plane, intersecting the first direction. The resonant structure resonates at a first frequency along a first current path including the ground conductor, conducting portion, and first connecting pair and at a second frequency along a second current path including the ground conductor, conducting portion, and second connecting pair.



US 20210257728A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0257728 A1**

Sakong et al. (43) **Pub. Date: Aug. 19, 2021**

(54) **ANTENNA FOR WIRELESS COMMUNICATION AND ELECTRONIC DEVICE INCLUDING THE SAME**

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

(72) Inventors: **Min Sakong**, Gyeongsangbuk-do (KR); **Dong Ryul Shin**, Daegu (KR); **Yoon Jae Lee**, Seoul (KR); **Seong Tae Jeong**, Gyeonggi-do (KR); **Jin Woo Jung**, Seoul (KR)

(21) Appl. No.: **17/306,508**

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

Related U.S. Application Data

(63) Continuation of application No. 15/656,669, filed on Jul. 21, 2017, now Pat. No. 10,998,622.

(30) **Foreign Application Priority Data**

Jul. 21, 2016 (KR) 10-2016-0092871
Mar. 28, 2017 (KR) 10-2017-0039558

Publication Classification

(51) **Int. Cl.**

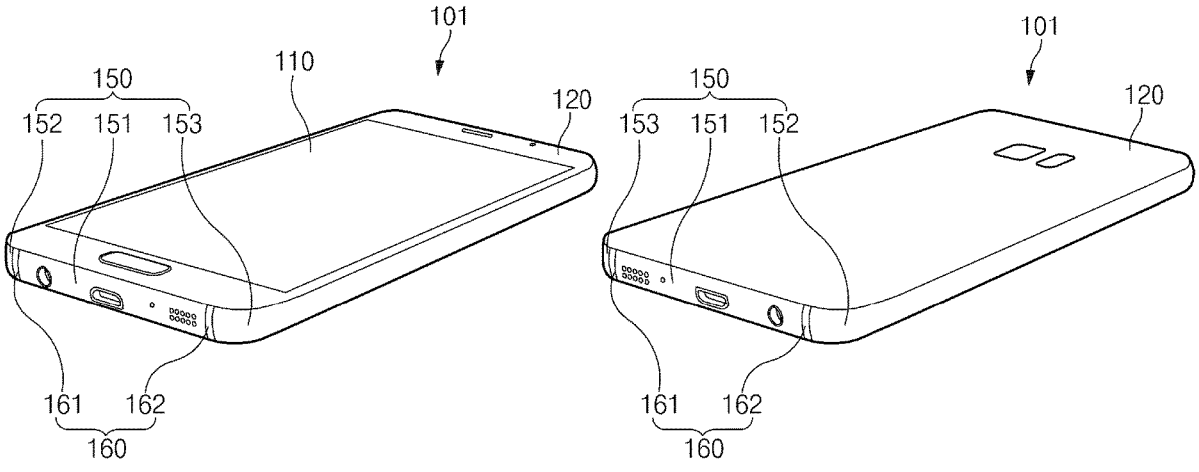
H01Q 3/00	(2006.01)
H01Q 1/24	(2006.01)
H01Q 1/48	(2006.01)
H04B 1/3827	(2006.01)

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

CPC ***H01Q 3/00*** (2013.01); ***H01Q 1/243*** (2013.01); ***H04B 1/3838*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 1/245*** (2013.01)

(57) **ABSTRACT**

A communication method performed in an electronic device including a conductive pattern and the electronic device are provided. The electronic device includes a conductive pattern used as a radiator for wireless communication, a feeding unit connected with the conductive pattern, a ground unit connected with the conductive pattern, a first impedance matching circuit disposed in a first area adjacent to the feeding unit and connected to the conductive pattern, a second impedance matching circuit disposed in a second area adjacent to the conductive pattern and connected to the conductive pattern, and a control unit that matches impedance by controlling at least one of the first impedance matching circuit and the second impedance matching circuit by a closed-loop scheme.



US 20210257734A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0257734 A1**

SU et al. (43) **Pub. Date: Aug. 19, 2021**

(54) **TUNABLE ANTENNA MODULE**

(71) Applicant: **Wistron NeWeb Corp.**, Hsinchu (TW)

(72) Inventors: **Tse SU**, Hsinchu (TW); **Chung-Yen HSIAO**, Hsinchu (TW); **Huang-Tse PENG**, Hsinchu (TW)

(21) Appl. No.: **17/101,624**

(22) Filed: **Nov. 23, 2020**

(30) **Foreign Application Priority Data**

Feb. 18, 2020 (TW) 109105113

Publication Classification

(51) **Int. Cl.**

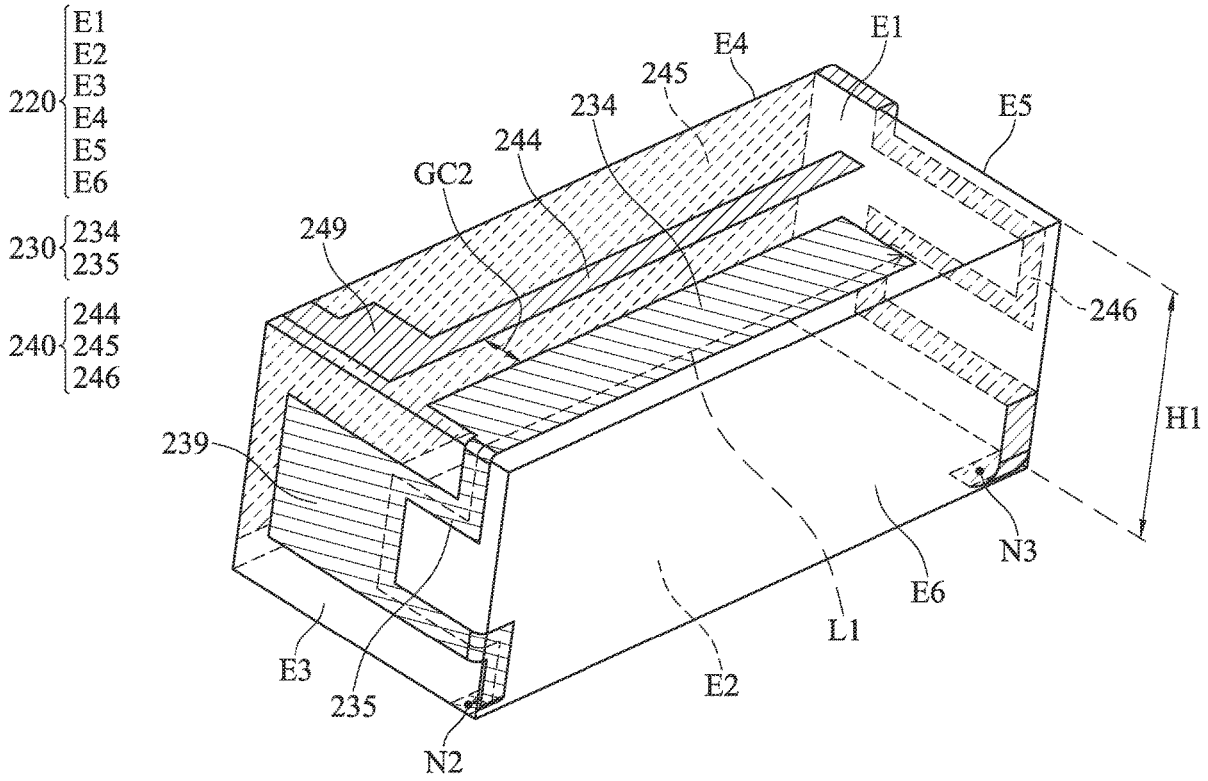
H01Q 5/328	(2006.01)
H01Q 1/48	(2006.01)
H01Q 1/24	(2006.01)

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

CPC ***H01Q 5/328*** (2015.01); ***H01Q 1/243*** (2013.01); ***H01Q 1/48*** (2013.01)

(57) **ABSTRACT**

A tunable antenna module includes a ground metal plane, a nonconductive support element, a first radiation metal element, a second radiation metal element, a switch element, and a plurality of impedance elements. The ground metal plane provides a ground voltage. The first radiation metal element is coupled to a signal source. The second radiation metal element is adjacent to and separate from the first radiation metal element. The switch element selects one of the impedance elements, such that the second radiation metal element is coupled through the selected impedance element to the ground voltage. The nonconductive support element has a 3D (Three-Dimensional) structure. The first radiation metal element and the second radiation metal element are distributed over the nonconductive support element.



US 20210257735A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0257735 A1**

LEE et al. (43) **Pub. Date: Aug. 19, 2021**

(54) **ANTENNA DEVICE**

(71) Applicant: **DENSO CORPORATION**, Kariya-city (JP)

(72) Inventors: **JUNGAUN LEE**, Kariya-city (JP); **SHO MATSUMOTO**, Kariya-city (JP)

(21) Appl. No.: **17/155,947**

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

(30) **Foreign Application Priority Data**

Feb. 19, 2020 (JP) 2020-026492

Publication Classification

(51) **Int. Cl.**

H01Q 5/50 (2006.01)

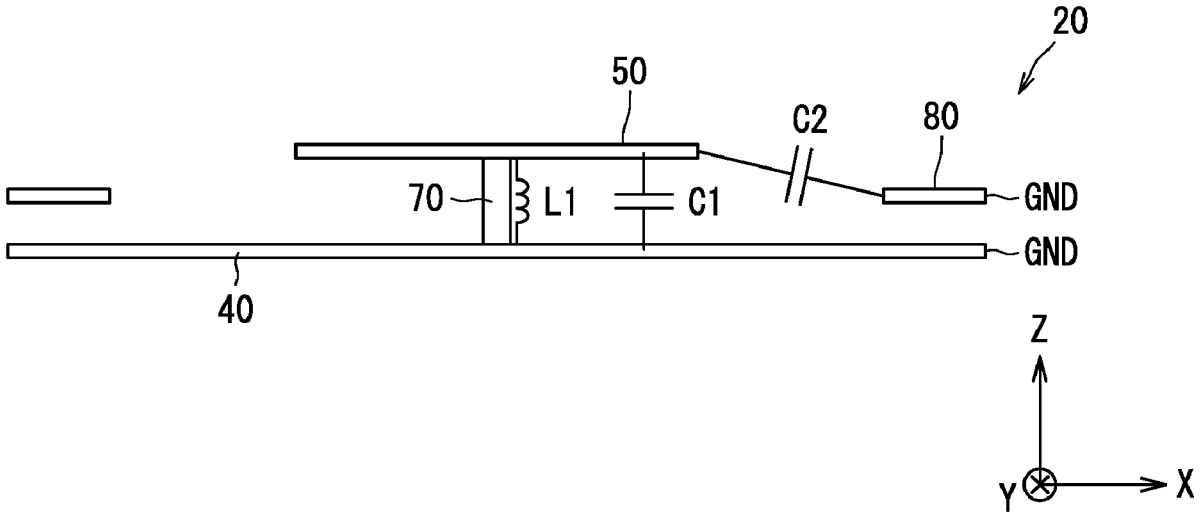
H01Q 1/48 (2006.01)

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

CPC ***H01Q 5/50*** (2015.01); ***H01Q 1/48*** (2013.01)

(57) **ABSTRACT**

An antenna device is a device of 0th-resonance antenna, which includes: a ground plate providing a ground potential; an opposed conductor arranged to have a predetermined distance from the ground plate in a plate thickness direction of the ground plate and configured for connection to a feeder line; and a short-circuit part electrically connecting the opposed conductor and the ground plate. The antenna device further includes an intermediate conductor having a same potential as the ground plate and arranged in between the ground plate and the opposed conductor in the plate thickness direction. The intermediate conductor includes a penetration part that includes the opposed conductor in a plan view in the plate thickness direction.



US 20210257737A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0257737 A1**

Yang (43) **Pub. Date: Aug. 19, 2021**

(54) **STACKED PATCH ANTENNAS USING DIELECTRIC SUBSTRATES WITH PATTERNED CAVITIES**

(71) Applicant: **NovAtel Inc.**, Calgary (CA)

(72) Inventor: **Ning Yang**, Calgary (CA)

(21) Appl. No.: **17/235,639**

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

Related U.S. Application Data

(63) Continuation of application No. 16/566,096, filed on Sep. 10, 2019, now Pat. No. 10,985,467, which is a continuation of application No. 15/151,122, filed on May 10, 2016, now Pat. No. 10,454,174.

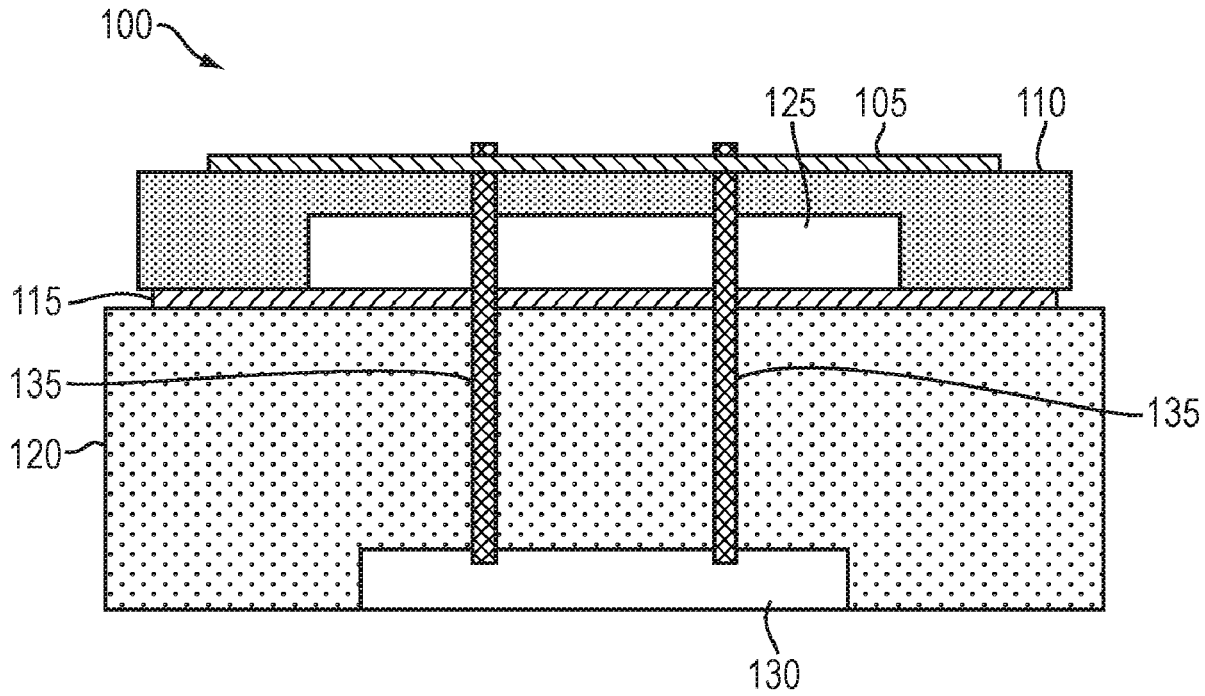
Publication Classification

(51) **Int. Cl.**
H01Q 9/04 (2006.01)
H01Q 1/38 (2006.01)

(52) **U.S. Cl.**
CPC ***H01Q 9/0414*** (2013.01); ***H01Q 1/38*** (2013.01)

(57) **ABSTRACT**

A GNSS RHCP stacked patch antenna with wide dual band, high efficiency and small size is made of a molded high-permittivity material, such as ceramics, with a patterned cavity in the dielectric substrate. The perforated cavities in the substrate reduce the effective dielectric constant, increase the bandwidth and efficiency. The high-order modes can be manipulated through the design of cavities.



US 20210265734A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0265734 A1**

TOYAO et al. (43) **Pub. Date: Aug. 26, 2021**

(54) **MULTIBAND ANTENNA**

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

(72) Inventors: **Hiroshi TOYAO**, Tokyo (JP); **Kenta TSUCHIYA**, Tokyo (JP)

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

(21) Appl. No.: **17/123,372**

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

(30) **Foreign Application Priority Data**

Feb. 26, 2020 (JP) 2020-030284

Publication Classification

(51) **Int. Cl.**

H01Q 13/10 (2006.01)

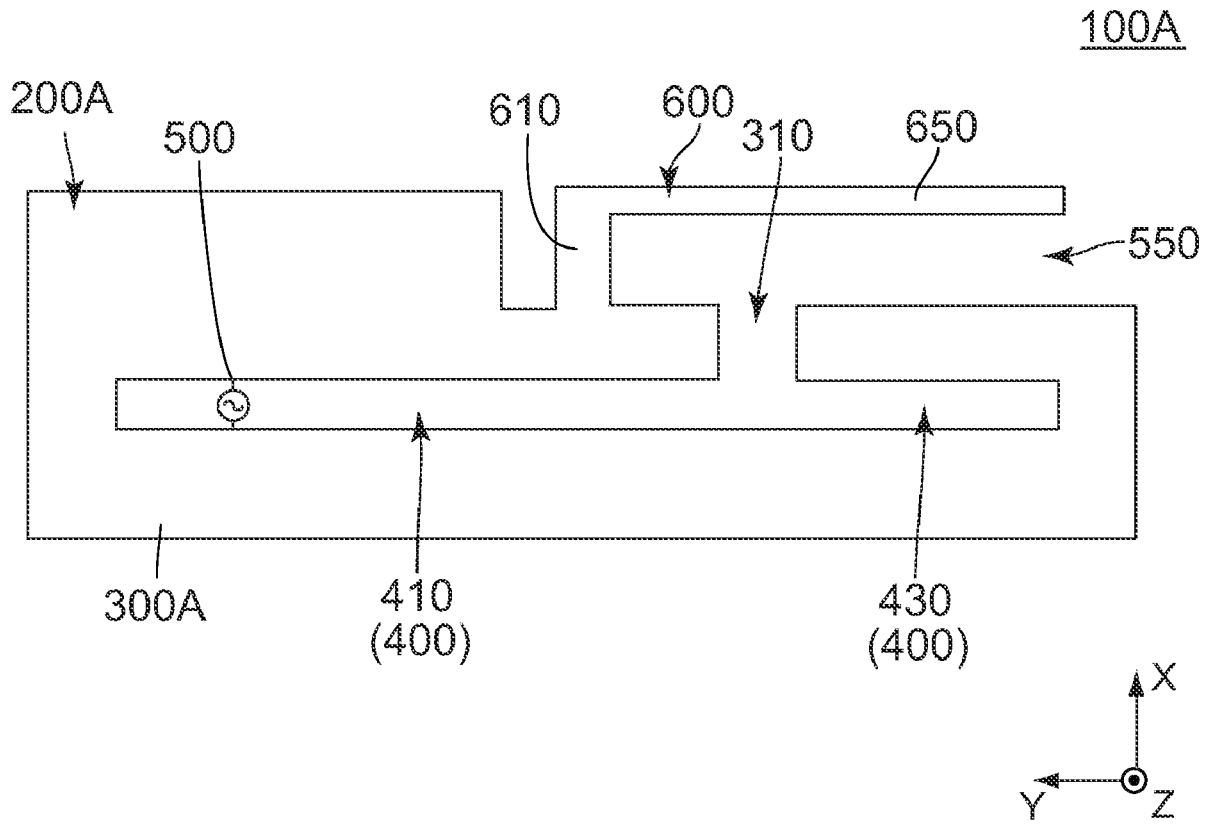
H01Q 5/307 (2006.01)

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

CPC ***H01Q 13/10*** (2013.01); ***H01Q 5/307*** (2015.01)

(57) **ABSTRACT**

A multiband antenna comprises a slot antenna and a radiation element. The slot antenna has a conductive plate. The conductive plate is formed with an opening portion and a slot. The slot partially opens through the opening portion. The slot extends long in a first direction. The radiation element has a first portion and a second portion. The first portion extends from the conductive plate toward an orientation away from the slot in a second direction perpendicular to the first direction. The first portion has a first length in the second direction. The second portion extends in the first direction from the first portion. The second portion has a second length in the first direction. The second length is greater than the first length.



US 20210265735A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0265735 A1**

HARPER (43) **Pub. Date: Aug. 26, 2021**

(54) **HYBRID CAVITY MODE ANTENNA**

(71) Applicant: **Microsoft Technology Licensing, LLC**, Redmond, WA (US)

(72) Inventor: **Marc HARPER**, Snohomish, WA (US)

(21) Appl. No.: **16/887,209**

(22) Filed: **May 29, 2020**

Related U.S. Application Data

(60) Provisional application No. 62/981,129, filed on Feb. 25, 2020.

Publication Classification

(51) **Int. Cl.**

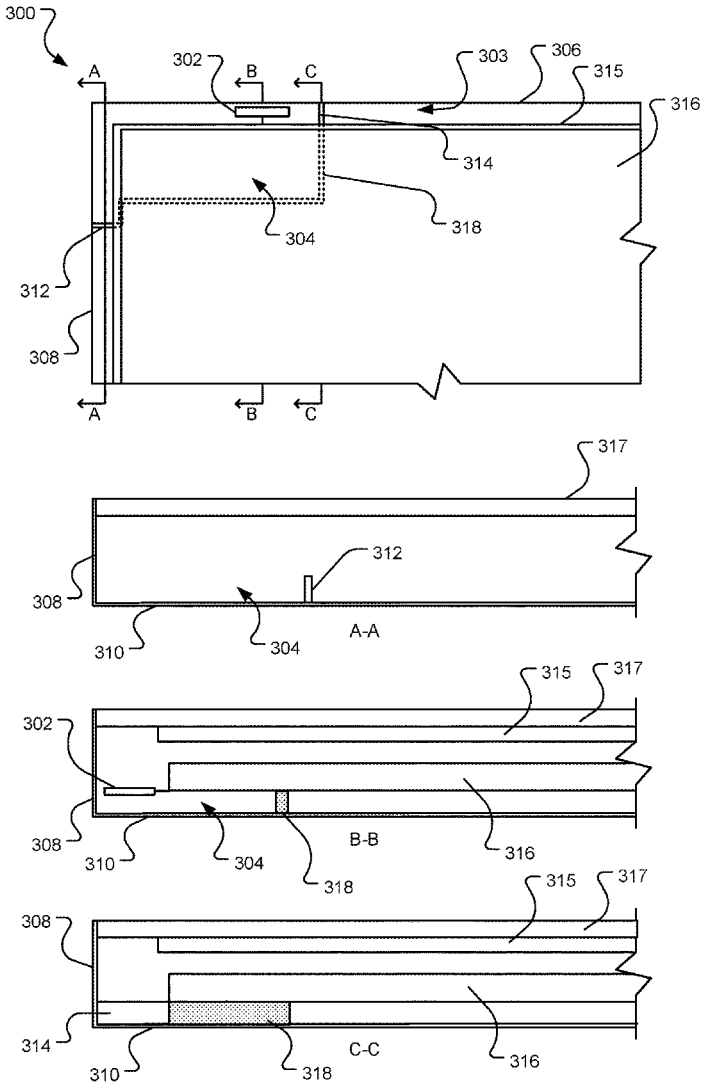
H01Q 13/18	(2006.01)
H05K 1/02	(2006.01)
H01Q 7/00	(2006.01)
H01Q 9/40	(2006.01)

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

CPC ***H01Q 13/18*** (2013.01); ***H01Q 9/40*** (2013.01); ***H01Q 7/00*** (2013.01); ***H05K 1/0243*** (2013.01)

(57) **ABSTRACT**

A communication device includes a metal chassis, a printed circuit board positioned within the metal chassis, and a hybrid cavity mode antenna. The hybrid cavity mode antenna includes a conductive wall defining at least a portion of a cavity, wherein the cavity is further defined by one or more surfaces of the metal chassis and the printed circuit board, and an electrically-fed antenna configured to radiate a first radiofrequency signal in a first frequency range. The electrically-fed antenna is electrically driven from the printed circuit board of the communication device. The electrically-fed antenna is positioned within the cavity to drive the cavity to radiate a second radiofrequency signal in a second frequency range.



US 20210273314A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2021/0273314 A1

(43) Pub. Date: Sep. 2, 2021

Nguyen

(54) ELECTRONIC APPARATUS

(71) Applicant: **LENOVO (SINGAPORE) PTE. LTD.**, SINGAPORE (SG)

(72) Inventor: **Xuan Tung Nguyen**, YOKOHAMA (JP)

(73) Assignee: **LENOVO (SINGAPORE) PTE. LTD.**, SINGAPORE (SG)

(21) Appl. No.: **16/871,031**

(22) Filed: **May 10, 2020**

(30) **Foreign Application Priority Data**

Feb. 28, 2020 (JP) 2020032628

Publication Classification

(51) **Int. Cl.**

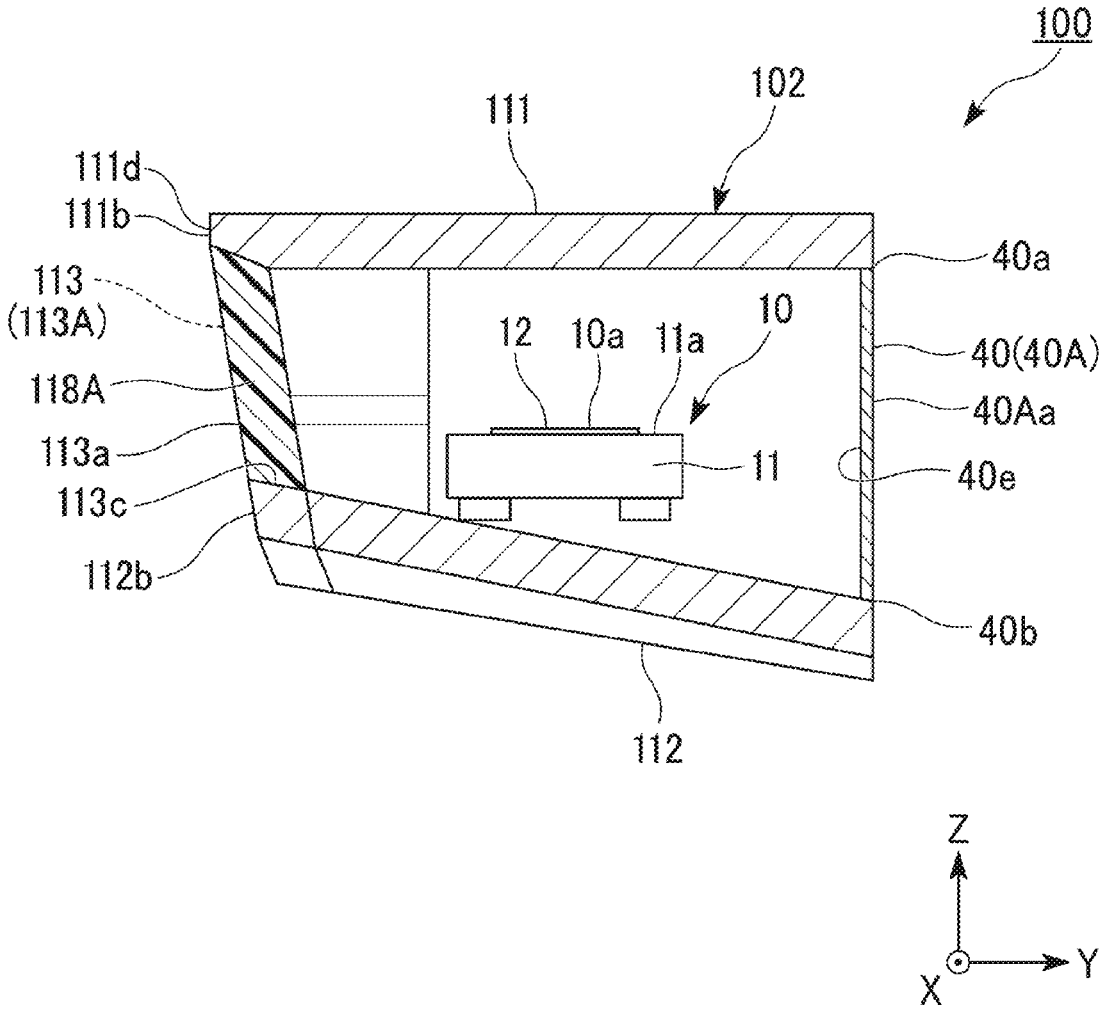
H01Q 1/22	(2006.01)
G06F 1/16	(2006.01)
H01Q 9/04	(2006.01)
H01Q 15/14	(2006.01)
H01Q 1/52	(2006.01)

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

CPC ***H01Q 1/2266*** (2013.01); ***G06F 1/1656*** (2013.01); *G06F 1/1616* (2013.01); ***H01Q 15/14*** (2013.01); ***H01Q 1/526*** (2013.01); ***H01Q 9/0407*** (2013.01)

(57) **ABSTRACT**

An electronic apparatus includes: a chassis composed at least of an upper plate, a lower plate, and a side face; at least one plate-like antenna having a radio wave transmission/reception part which deals with radio waves in a millimeter wave band and forms one surface of the antenna; and a conductive reflection member having a main part with a reflection surface reflecting the radio waves in the millimeter wave band. The antenna is placed in an outer peripheral edge area including an outer peripheral edge of the upper plate in plan view in such a manner that the radio wave transmission/reception part faces the upper plate. The reflection member is so placed that the antenna is sandwiched between the reflection member and the side face in plan view. At least the side face transmits the radio waves. The reflection surface is directed toward the antenna.



US 20210273318A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0273318 A1**

Nguyen (43) **Pub. Date: Sep. 2, 2021**

(54) **RF ANTENNA ARRANGEMENT CONFIGURED TO BE A PART OF A LID TO AN APPARATUS**

(71) Applicant: **DISH Technologies L.L.C.**, Englewood, CO (US)

(72) Inventor: **Phuc H. Nguyen**, Parker, CO (US)

(21) Appl. No.: **17/325,204**

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

Related U.S. Application Data

(60) Division of application No. 16/745,961, filed on Jan. 17, 2020, now Pat. No. 11,018,411, which is a continuation of application No. 15/331,494, filed on Oct. 21, 2016, now Pat. No. 10,581,141.

Publication Classification

(51) **Int. Cl.**

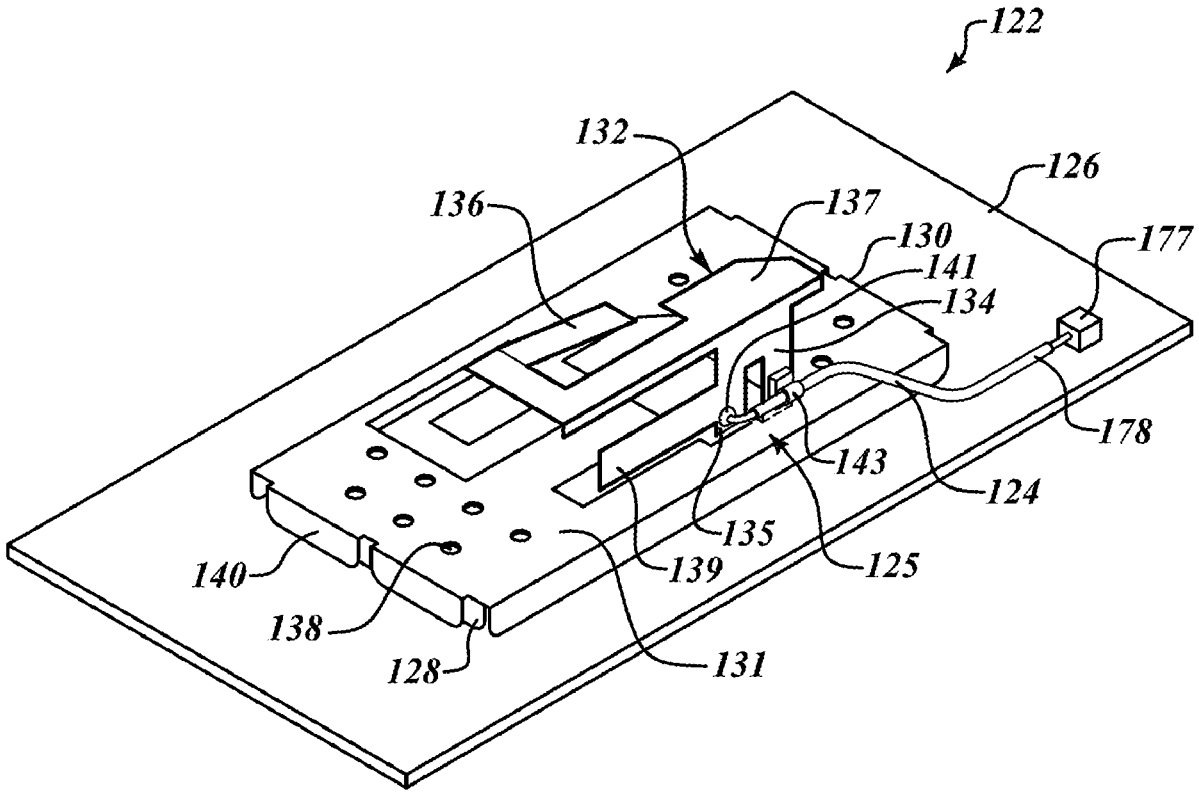
H01Q 1/24	(2006.01)
H01Q 5/371	(2006.01)
H01Q 1/52	(2006.01)
H05K 9/00	(2006.01)
H01Q 1/44	(2006.01)
H01Q 1/22	(2006.01)
H01Q 1/38	(2006.01)
H01Q 1/48	(2006.01)

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

CPC ***H01Q 1/24*** (2013.01); ***H01Q 5/371*** (2015.01); ***H01Q 1/526*** (2013.01); ***H05K 9/0026*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 1/22*** (2013.01); ***H01Q 1/2283*** (2013.01); ***H01Q 1/38*** (2013.01); ***H01Q 1/44*** (2013.01)

(57) **ABSTRACT**

An RF antenna arrangement has the same or slightly larger footprint as the RF shield for radio chips on a printed circuit board. The apparatus includes a printed circuit board, a digital processor, a radio chip(s), a radio frequency shield, a lid, and an RF antenna arrangement(s). The lid has the same or slightly larger footprint as the RF shield, which enables the lid to fit on the RF shield. The RF antenna is formed as an integral part of the lid. The apparatus also includes an RF transmission coaxial cable(s) having a first end physically and electrically connected to the RF antenna arrangement(s) and the surface of the lid, and a second end electrically coupled to an RF connector. By forming the antenna arrangement(s) from the lid, this invention solves the space constraint problems of antenna placements for wireless device applications. Additionally, this invention is cost-effective and simple to manufacture.



US 20210273322A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0273322 A1**

KIM et al. (43) **Pub. Date: Sep. 2, 2021**

(54) **ELECTRONIC DEVICE HAVING FLEXIBLE ANTENNA DISPOSED THEREON**

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

(72) Inventors: **Jaehyung KIM**, Gyeonggi-do (KR); **Hakjin KIM**, Gyeonggi-do (KR); **Minseok PARK**, Gyeonggi-do (KR); **Hanbin LEE**, Gyeonggi-do (KR); **Sangmin HAN**, Gyeonggi-do (KR)

(21) Appl. No.: **17/260,607**

(22) PCT Filed: **Sep. 19, 2019**

(86) PCT No.: **PCT/KR2019/012127**

§ 371 (c)(1),
(2) Date: **Jan. 15, 2021**

(30) **Foreign Application Priority Data**

Sep. 21, 2018 (KR) 10-2018-0114047

Publication Classification

(51) **Int. Cl.**

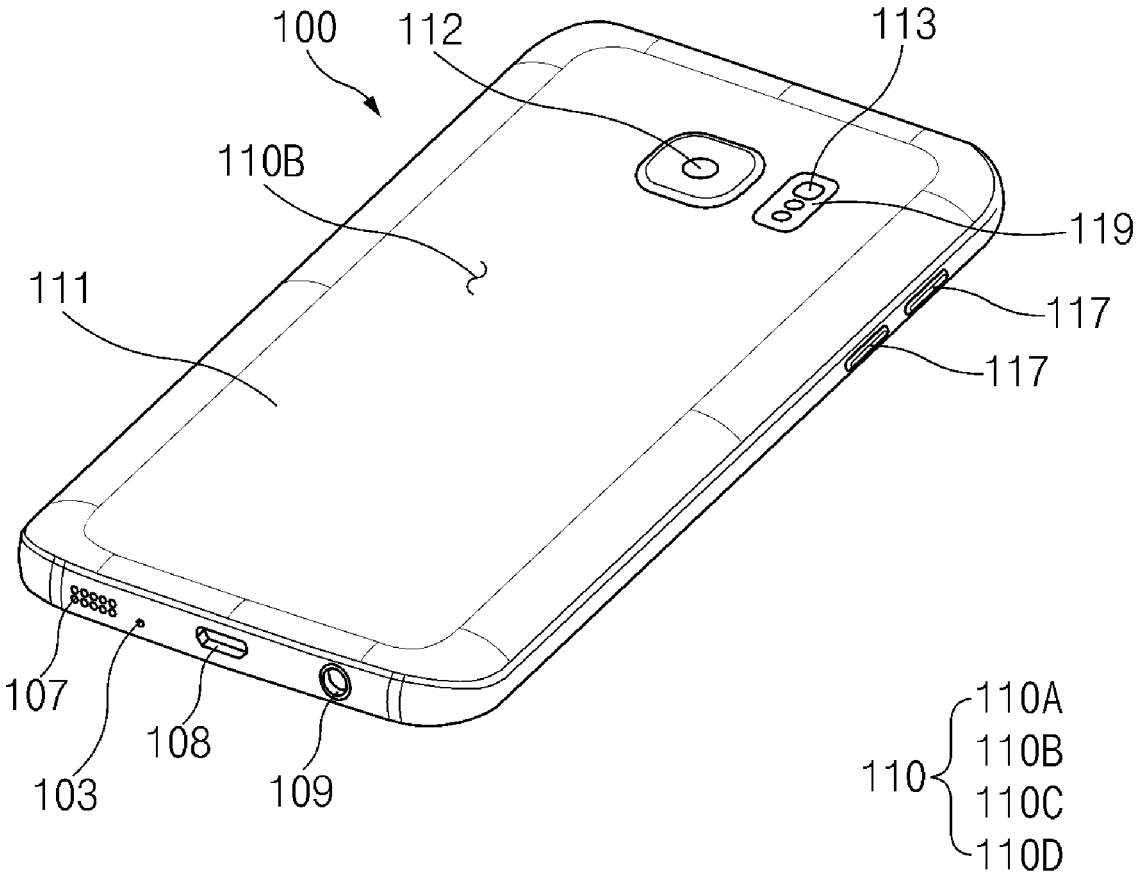
H01Q 1/38	(2006.01)
H04M 1/02	(2006.01)
H01Q 1/24	(2006.01)

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

CPC ***H01Q 1/38*** (2013.01); ***H01Q 1/243*** (2013.01); ***H04M 1/0266*** (2013.01)

(57) **ABSTRACT**

Disclosed is an electronic device including a housing including a front plate, a back plate facing in an opposite direction of the front plate, and a rear structure surrounding a space between the front plate and the back plate and including at least one opening, a display viewable through at least part of the front plate of the electronic device, a supporting member interposed between the display and the rear structure, at least one component interposed between the supporting member and the rear structure and at least partially overlapping with the opening when viewed from above the back plate, an antenna structure interposed between the supporting member and the rear structure, and a wireless communication circuit electrically connected to at least one of the first conductive pattern and/or the second conductive pattern and transmitting and/or receiving a signal having a specified frequency. The antenna structure includes a connection part at least partially overlapping with the opening, interposed between the component and the back plate, and including a first conductive pattern when viewed from above the back plate and a first portion connected to the connection part and including a second conductive pattern electrically connected to the first conductive pattern. Besides, various embodiments as understood from the specification are also possible.



US 20210273340A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2021/0273340 A1**

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

Sun et al.

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

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

(72) Inventors: **Qiao Sun**, Xi'an (CN); **Kun Li**, Xi'an (CN); **Liang Lu**, Xi'an (CN); **Xianghua Long**, Shenzhen (CN)

(21) Appl. No.: **17/259,027**

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

(86) PCT No.: **PCT/CN2019/095515**

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(2) Date: **Jan. 8, 2021**

(30) **Foreign Application Priority Data**

Jul. 11, 2018 (CN) 201810762908.4

Publication Classification

(51) **Int. Cl.**

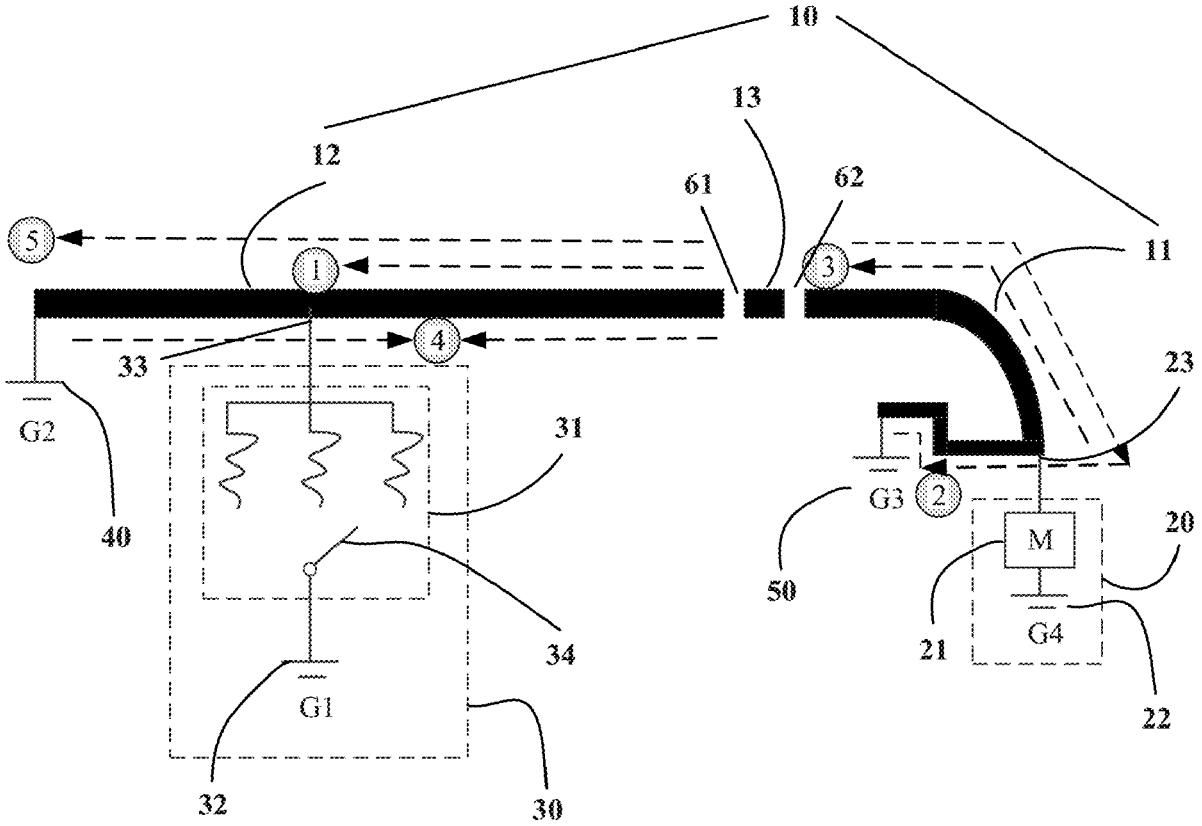
H01Q 9/42	(2006.01)
H01Q 1/24	(2006.01)
H01Q 1/36	(2006.01)
H01Q 5/28	(2006.01)
H01Q 5/10	(2006.01)
H01Q 5/328	(2006.01)

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

CPC ***H01Q 9/42*** (2013.01); ***H01Q 1/243*** (2013.01); ***H01Q 1/36*** (2013.01); *H01Q 1/48* (2013.01); ***H01Q 5/10*** (2015.01); ***H01Q 5/328*** (2015.01); ***H01Q 5/28*** (2015.01)

(57) **ABSTRACT**

An antenna apparatus includes a radiator, a first grounding branch, and a second grounding branch. The radiator includes a feed point, a first radiation section, and a second radiation section. The first radiation section and the second radiation section are disposed on two sides of the feed point by a first gap and a second gap. A first ground end is disposed at one end of the first radiation section away from the first gap, and a second ground end is disposed at one end of the second radiation section away from the second gap. The first and second grounding branches intersect with the radiator. A matching circuit is coupled in series in the first grounding branch, and a first high-frequency filter is coupled in series in the second grounding branch.



US 20210273341A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0273341 A1**

Wu et al. (43) **Pub. Date: Sep. 2, 2021**

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

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

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

(21) Appl. No.: **17/230,794**

(22) Filed: **Apr. 14, 2021**

Related U.S. Application Data

(63) Continuation of application No. 16/173,574, filed on Oct. 29, 2018, now Pat. No. 11,011,850.

(30) **Foreign Application Priority Data**

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Dec. 29, 2017 (CN) 201721928944.0

Publication Classification

(51) **Int. Cl.**

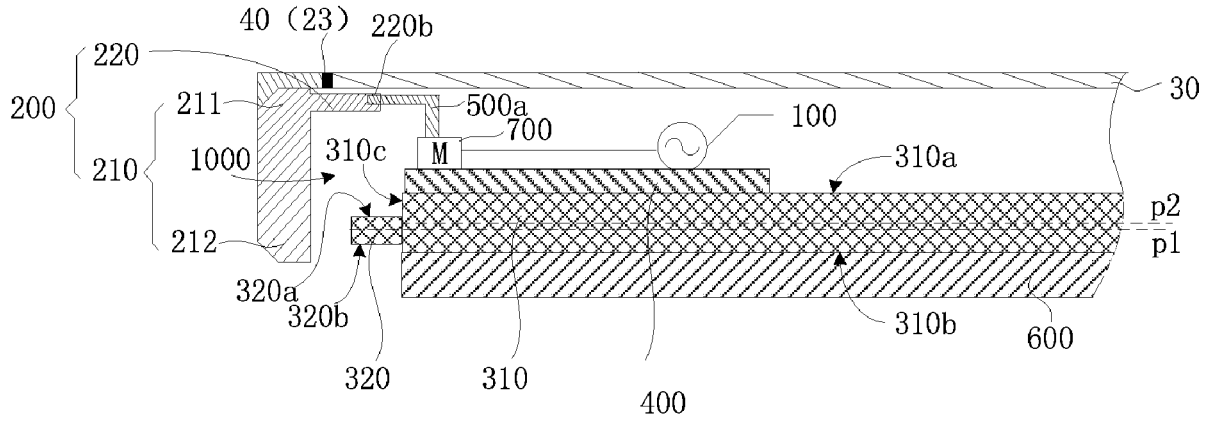
H01Q 13/18	(2006.01)
H01Q 1/24	(2006.01)
H01Q 1/48	(2006.01)
H01Q 1/44	(2006.01)
H01Q 5/357	(2006.01)

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

CPC ***H01Q 13/18*** (2013.01); ***H01Q 1/243*** (2013.01); ***H01Q 5/357*** (2015.01); ***H01Q 1/44*** (2013.01); ***H01Q 1/48*** (2013.01)

(57) **ABSTRACT**

An antenna apparatus and an electronic device are provided. The antenna apparatus includes an excitation source, a conductive member, an antenna radiator comprising a radiator body and a power feeding portion, a first extension portion and a support member, the radiator body comprises a first end and a second end opposite to the first end, and the power feeding portion is disposed at the first end; the first extension portion disposed adjacent to the second end of the antenna radiator, the support member disposed at an end of the first extension portion away from the second end of the antenna radiator, an excitation signal generated by the excitation source transmitted to the support member through the conductive member, the power feeding portion, the first end, the radiator body, the second end, and the first extension portion in sequence.



US 20210274027A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0274027 A1**

LEE et al. (43) **Pub. Date: Sep. 2, 2021**

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

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

(72) Inventors: **Hyung Joo LEE**, Seongnam-si (KR); **Gyu Sub KIM**, Seoul (KR); **Dong Yeon KIM**, Suwon-si (KR); **Chae Up YOO**, Seoul (KR)

(21) Appl. No.: **17/323,472**

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

Related U.S. Application Data

(63) Continuation of application No. 16/589,734, filed on Oct. 1, 2019, now Pat. No. 11,050,863, which is a continuation of application No. 15/991,568, filed on May 29, 2018, now Pat. No. 10,516,772, which is a continuation of application No. 15/673,097, filed on Aug. 9, 2017, now Pat. No. 10,015,294, which is a continuation of application No. 15/234,547, filed on Aug. 11, 2016, now Pat. No. 9,762,710.

(30) **Foreign Application Priority Data**

Aug. 13, 2015 (KR) 10-2015-0114638

Publication Classification

(51) **Int. Cl.**

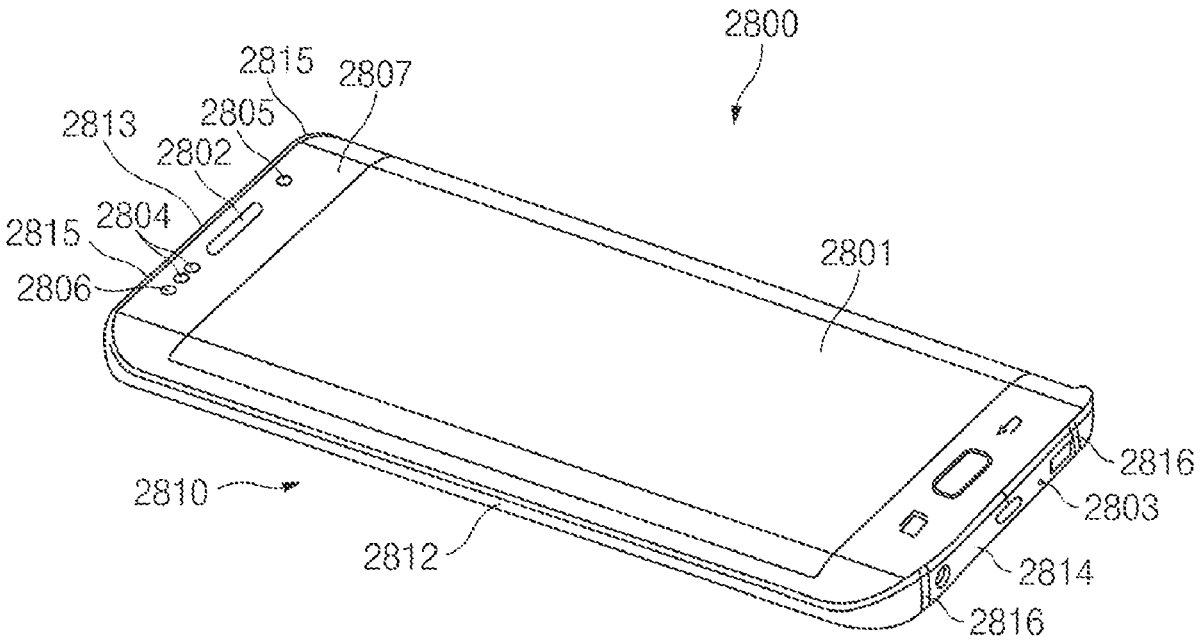
H04M 1/02	(2006.01)
H01Q 1/24	(2006.01)
H01Q 1/48	(2006.01)
H01Q 1/52	(2006.01)
H01Q 5/314	(2006.01)
H01Q 5/328	(2006.01)
H01Q 5/35	(2006.01)
H04B 1/3827	(2006.01)
H04B 1/48	(2006.01)

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

CPC ***H04M 1/0202*** (2013.01); ***H01Q 1/243*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 1/521*** (2013.01); *H04W 4/80* (2018.02); ***H01Q 5/328*** (2015.01); ***H01Q 5/35*** (2015.01); ***H04B 1/3833*** (2013.01); ***H04B 1/48*** (2013.01); ***H01Q 5/314*** (2015.01)

(57) **ABSTRACT**

An electronic device is provided. The electronic device includes a housing including a first surface, a second surface disposed facing an opposite side of the first surface, and a side surface configured to surround at least a portion of a space between the first surface and the second surface, a first elongated metal member configured to form a first portion of the side surface and including a first end and a second end, at least one communication circuit electrically connected to a first point of the first elongated metal member through a capacitive element, at least one ground member disposed in an interior of the housing, and a first conductive member configured to electrically connect a second point of the first elongated metal member to the ground member. The second point of the first elongated metal member is disposed closer to the second end than to the first point.



US 20210280961A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0280961 A1**

KIM et al. (43) **Pub. Date: Sep. 9, 2021**

(54) **ELECTRONIC DEVICE COMPRISING ARRAY ANTENNA**

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

(72) Inventors: **Jaehyung KIM**, Gyeonggi-do (KR); **Jinkyu BANG**, Gyeonggi-do (KR); **Jaebong CHUN**, Gyeonggi-do (KR)

(21) Appl. No.: **17/259,445**

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

(86) PCT No.: **PCT/KR2019/008557**

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(30) **Foreign Application Priority Data**

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Publication Classification

(51) **Int. Cl.**

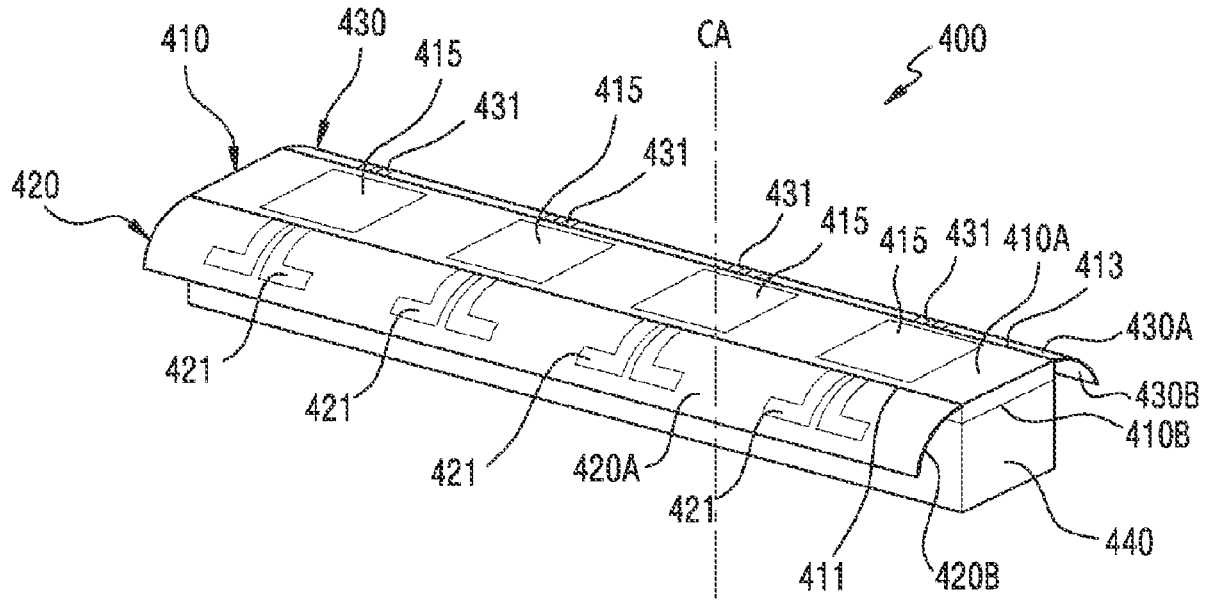
H01Q 1/24	(2006.01)
H05K 5/00	(2006.01)
H05K 1/14	(2006.01)
H05K 5/02	(2006.01)
H01Q 9/04	(2006.01)
H01Q 9/16	(2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H05K 5/0017*** (2013.01); ***H05K 1/142*** (2013.01); ***H05K 5/0226*** (2013.01); *H04B 1/40* (2013.01); ***H01Q 9/16*** (2013.01); *H05K 2201/10098* (2013.01); *H05K 2201/10128* (2013.01); *H05K 2201/09018* (2013.01); ***H01Q 9/0407*** (2013.01)

(57) **ABSTRACT**

An electronic device comprising an array antenna according to various embodiments of the present invention may comprise: a housing comprising a first plate, a second plate facing away from the first plate, and a side member surrounding the space between the first plate and the second plate; a display visible through a part of the first plate; a first printed circuit board comprising a first surface facing the side member, a second surface facing away from the first surface, a first edge adjacent close to the first plate, and a second edge closer to the second plate than the first edge, the first printed circuit board comprising one or more conductive plates on the first surface; a second printed circuit board extending from the first edge so as to bend at an obtuse angle with regard to the first surface, the second printed circuit board comprising one or more first conductive patterns; a third printed circuit board extending from the second edge so as to bend at an obtuse angle with regard to the first surface, the third printed circuit board comprising one or more second conductive patterns, and a wireless communication circuit electrically connected to the conductive plates, the first conductive patterns, and the second conductive patterns and configured to transmit and/or receive signals. Various other embodiments may be possible.



US 20210280962A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2021/0280962 A1**

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

KIM et al.

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

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

(72) Inventors: **Kyungbin KIM**, Suwon-si (KR); **Chongo YOON**, Suwon-si (KR); **Sumin YUN**, Suwon-si (KR); **Hyunseock ROH**, Suwon-si (KR); **Gyubok PARK**, Suwon-si (KR); **Jinwoo JUNG**, Suwon-si (KR); **Jaebong CHUN**, Suwon-si (KR); **Hochul HWANG**, Suwon-si (KR)

(21) Appl. No.: **17/327,022**

(22) Filed: **May 21, 2021**

Related U.S. Application Data

(63) Continuation of application No. 17/082,520, filed on Oct. 28, 2020, now Pat. No. 11,018,415.

(30) **Foreign Application Priority Data**

Oct. 28, 2019 (KR) 10-2019-0134682

Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

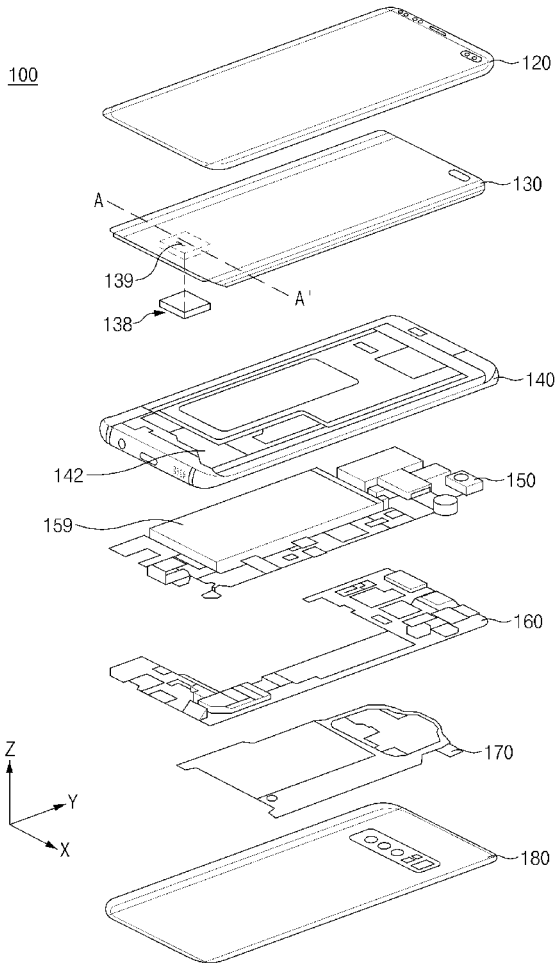
H04M 1/02 (2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H04M 1/0277*** (2013.01); ***H04M 1/0266*** (2013.01)

(57) **ABSTRACT**

An electronic device is provided. The electronic device includes a housing structure that includes a ceramic portion including a ceramic material, and a polymer portion formed on an inner surface of the ceramic portion and including a polymer material, and an antenna structure that is disposed within the housing structure and radiates a radio frequency (RF) signal to an outside of the housing structure. The housing structure includes a first portion including at least a portion of a region through which the RF signal passes, and a second portion formed around the first portion. In the first portion, a ratio of a thickness of the polymer portion to an entire thickness of the first portion is a first ratio. In the second portion, a ratio of a thickness of the polymer portion to an entire thickness of the second portion is a second ratio.



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(19) **United States**

(12) **Patent Application Publication**

LEE et al.

(10) **Pub. No.: US 2021/0280966 A1**

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

(54) **ELECTRONIC DEVICE**

(71) Applicant: **DENSO CORPORATION**, Kariya-city (JP)

(72) Inventors: **Jungaun LEE**, Kariya-city (JP); **Sho MATSUMOTO**, Kariya-city (JP)

(21) Appl. No.: **17/173,338**

(22) Filed: **Feb. 11, 2021**

(30) **Foreign Application Priority Data**

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Publication Classification

(51) **Int. Cl.**

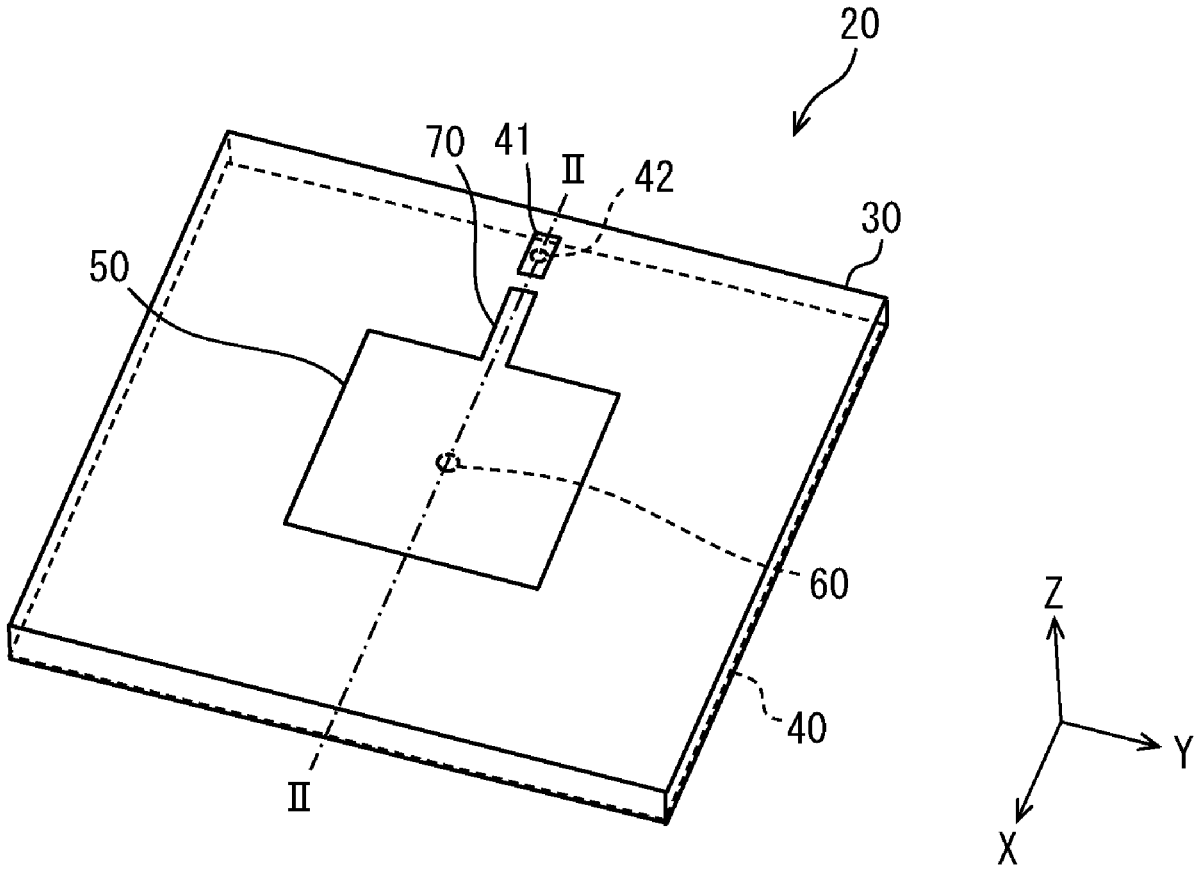
H01Q 1/42	(2006.01)
H05K 5/02	(2006.01)
H05K 5/04	(2006.01)

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

CPC ***H01Q 1/42*** (2013.01); ***H05K 5/04*** (2013.01); ***H05K 5/0247*** (2013.01)

(57) **ABSTRACT**

An antenna device includes one or more zeroth-order resonant antennas and a metal body. Each of the zeroth-order resonant antennas includes a ground plate configured to provide a ground potential, an opposing conductor arranged at a predetermined distance from the ground plate in a plate thickness direction of the ground plate, a power supply line electrically connected to the opposing conductor, and a short-circuit portion electrically connecting the opposing conductor and the ground plate. The metal body is configured to limit a propagation direction of a radio wave transmitted from or received by the one or more zeroth-order resonant antennas and has an opening.



US 20210280970A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2021/0280970 A1**

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

UEDA

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

(71) Applicant: **Murata Manufacturing Co., Ltd.**, Kyoto (JP)

(72) Inventor: **Hideki UEDA**, Kyoto (JP)

(21) Appl. No.: **17/314,454**

(22) Filed: **May 7, 2021**

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2019/042311, filed on Oct. 29, 2019.

(30) **Foreign Application Priority Data**

Nov. 9, 2018 (JP) 2018-211160

Publication Classification

(51) **Int. Cl.**

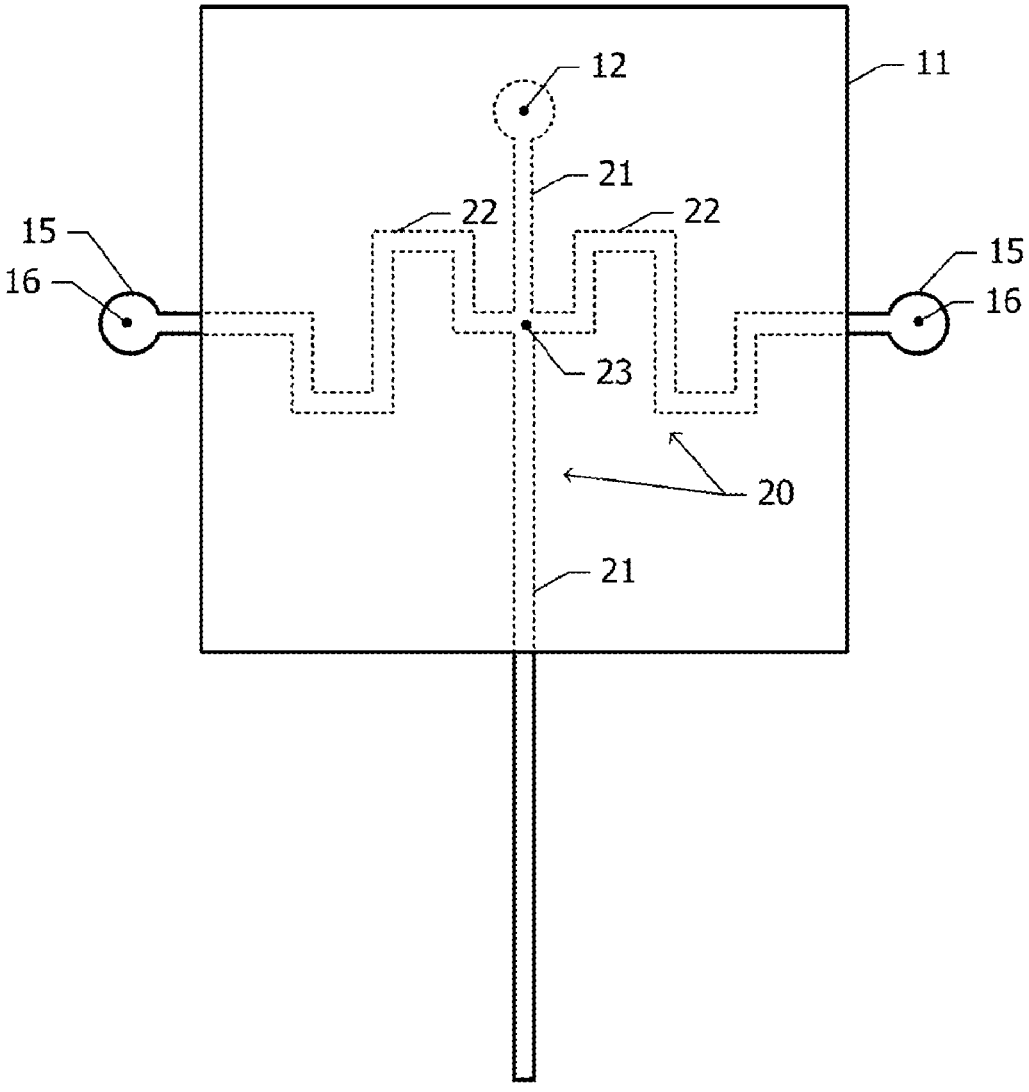
H01Q 3/24	(2006.01)
H01Q 9/04	(2006.01)
H01Q 9/32	(2006.01)

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

CPC ***H01Q 3/24*** (2013.01); ***H01Q 9/32*** (2013.01); ***H01Q 9/0421*** (2013.01)

(57) **ABSTRACT**

A ground plane, at least one composite antenna, and a power feeding line configured to supply power to the at least one composite antenna are provided in or on a substrate. The composite antenna includes a power feeding element configuring a patch antenna together with the ground plane, and at least one linear antenna configured to flow an electric current having a component in a vertical direction with respect to the ground plane. The power feeding line includes a main line connected to the power feeding element, and a branch line branched from the main line and connected to the linear antenna.



US 20210280973A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0280973 A1**

Chan et al. (43) **Pub. Date: Sep. 9, 2021**

(54) **ANTENNA STRUCTURE**

(71) Applicants: **Chun-Cheng Chan**, Taipei City (TW); **Shih-Chia Liu**, Taipei City (TW); **Yen-Hao Yu**, Taipei City (TW); **Li-Chun Lee**, Taipei City (TW); **Chao-Lin Wu**, Taipei City (TW); **Jui-Hung Lai**, Taipei City (TW); **Chih-Heng Lin**, Taipei City (TW)

(72) Inventors: **Chun-Cheng Chan**, Taipei City (TW); **Shih-Chia Liu**, Taipei City (TW); **Yen-Hao Yu**, Taipei City (TW); **Li-Chun Lee**, Taipei City (TW); **Chao-Lin Wu**, Taipei City (TW); **Jui-Hung Lai**, Taipei City (TW); **Chih-Heng Lin**, Taipei City (TW)

(73) Assignee: **COMPAL ELECTRONICS, INC.**, Taipei City (TW)

(21) Appl. No.: **16/995,784**

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

(30) **Foreign Application Priority Data**

Mar. 3, 2020 (TW) 109106932

Publication Classification

(51) **Int. Cl.**

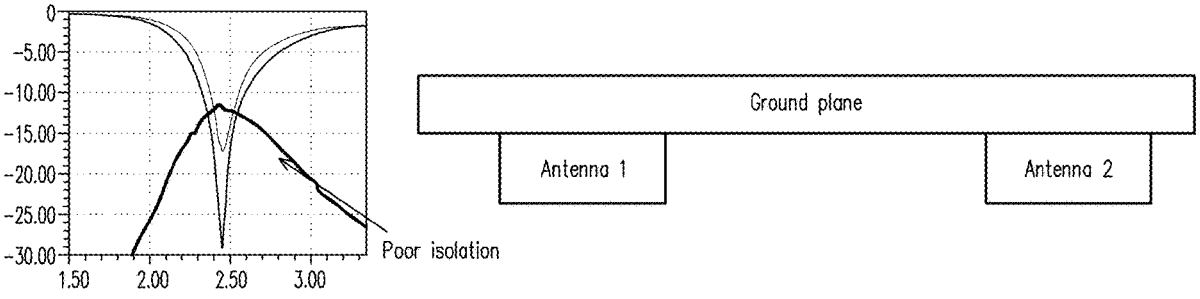
H01Q 5/371 (2006.01)
H01Q 9/04 (2006.01)
H01Q 1/38 (2006.01)

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

CPC ***H01Q 5/371*** (2015.01); ***H01Q 1/38*** (2013.01); ***H01Q 9/0407*** (2013.01)

(57) **ABSTRACT**

The disclosure provides an antenna structure, including at least one supporting module, a first antenna, and a second antenna. The first antenna is disposed on the at least one supporting module and includes a first feeding point and a first zero-current zone. The first antenna is connected to a ground plane. The second antenna is disposed on the at least one supporting module and includes a second feeding point and a second zero-current zone. The second antenna is connected to the ground plane. The first feeding point of the first antenna is disposed in the second zero-current zone of the second antenna, and the second feeding point of the second antenna is disposed in the first zero-current zone of the first antenna.



US 20210280975A1

(19) **United States**

(12) **Patent Application Publication**

PARK et al.

(10) **Pub. No.: US 2021/0280975 A1**

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

(54) **ELECTRONIC APPARATUS**

(71) Applicant: **Samsung Display Co., Ltd.**, Yongin-Si (KR)

(72) Inventors: **YONG-HAN PARK**, Hwaseong-si (KR); **YOUNG-RAN SON**, Seoul (KR); **HYUNJUNG KIM**, Seongnam-si (KR)

(21) Appl. No.: **17/160,869**

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

(30) **Foreign Application Priority Data**

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Publication Classification

(51) **Int. Cl.**

H01Q 7/00 (2006.01)

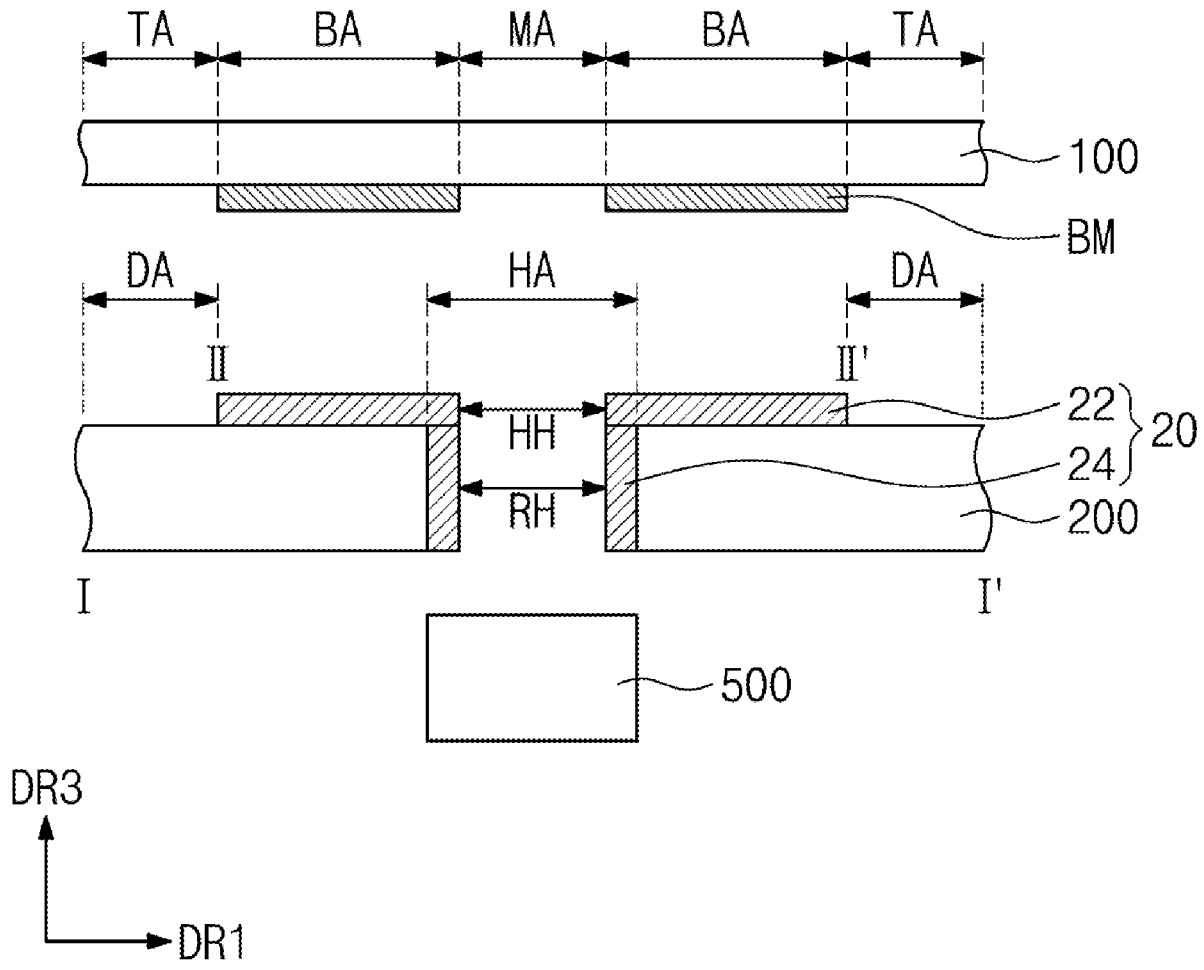
H01L 27/32 (2006.01)

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

CPC ***H01Q 7/00*** (2013.01); *H01L 2251/5338* (2013.01); ***H01L 27/3244*** (2013.01)

(57) **ABSTRACT**

An electronic apparatus includes a display module including a display area through which an image is displayed and a non-display area adjacent to the display area and provided with a through hole through which a signal is transmitted, which is defined in the display area, an electronic module disposed under the display module, overlapping the through hole, and transmitting or receiving the signal, and an antenna module disposed on the display module and including a first portion through which an opening corresponding to the through hole is defined and a second portion extending from the first portion and inserted into the through hole.



US 20210280979A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0280979 A1**

Jamaly (43) **Pub. Date: Sep. 9, 2021**

(54) **DUAL-POLARIZED PLANAR ULTRA-WIDEBAND ANTENNA**

(71) Applicant: **Swisscom AG**, Bern (CH)

(72) Inventor: **Nima Jamaly**, Bern (CH)

(21) Appl. No.: **17/327,062**

(22) Filed: **May 21, 2021**

Related U.S. Application Data

(63) Continuation of application No. 15/780,483, filed on May 31, 2018, now Pat. No. 11,024,974, filed as application No. PCT/EP2016/079268 on Nov. 30, 2016.

(30) **Foreign Application Priority Data**

Dec. 1, 2015 (EP) 15197294.0

Publication Classification

(51) **Int. Cl.**

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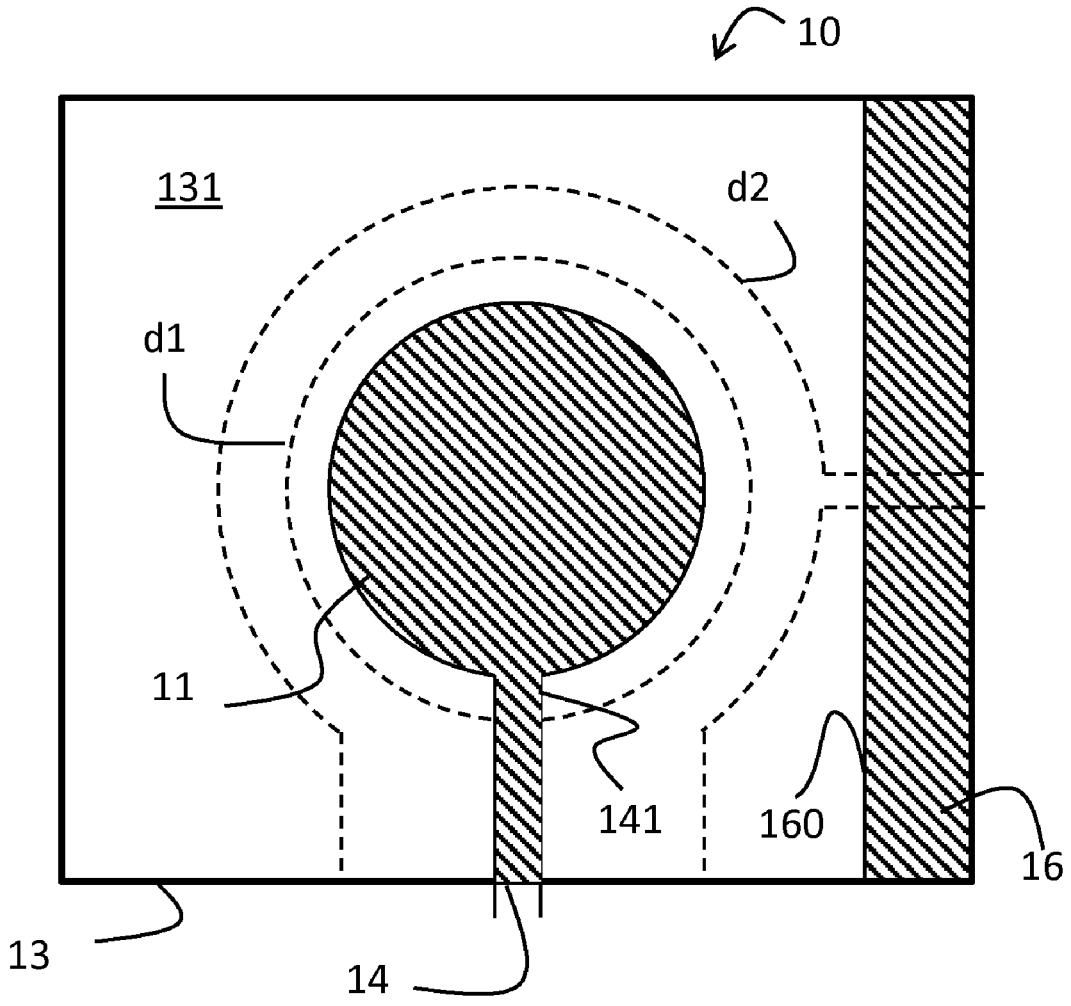
H01Q 1/38	(2006.01)
H01Q 21/24	(2006.01)
H01Q 21/28	(2006.01)
H01Q 1/48	(2006.01)

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

CPC ***H01Q 9/40*** (2013.01); ***H01Q 1/38*** (2013.01); *H01Q 9/42* (2013.01); ***H01Q 21/28*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 21/24*** (2013.01)

(57) **ABSTRACT**

Methods and systems are provided for implementing and utilizing dual-polarized planar ultra-wideband antennas. An example planar antenna may include a substrate, a monopole conductor, a first ground conductor, and a second ground conductor. The monopole conductor may be connected to a first signal feeding line. The first ground conductor may be connected through a ground connector to ground potential. The first ground conductor may be further connected to a second signal feeding line. The second ground conductor may connected to ground potential located on a particular side of the substrate. The planar antenna may be configured to transmit and receive radiation in two mutually cross-polarized modes.



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(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0280981 A1**

KIM et al. (43) **Pub. Date: Sep. 9, 2021**

(54) **ELECTRONIC DEVICE HAVING 5G ANTENNA**

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

(72) Inventors: **Dongjin KIM**, Seoul (KR); **Cheolwan PARK**, Seoul (KR); **Youngbae KWON**, Seoul (KR); **Byungwoon JUNG**, Seoul (KR); **Jihun HA**, Seoul (KR)

(73) Assignee: **LG ELECTRONICS INC.**, Seoul (KR)

(21) Appl. No.: **16/918,630**

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

(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**

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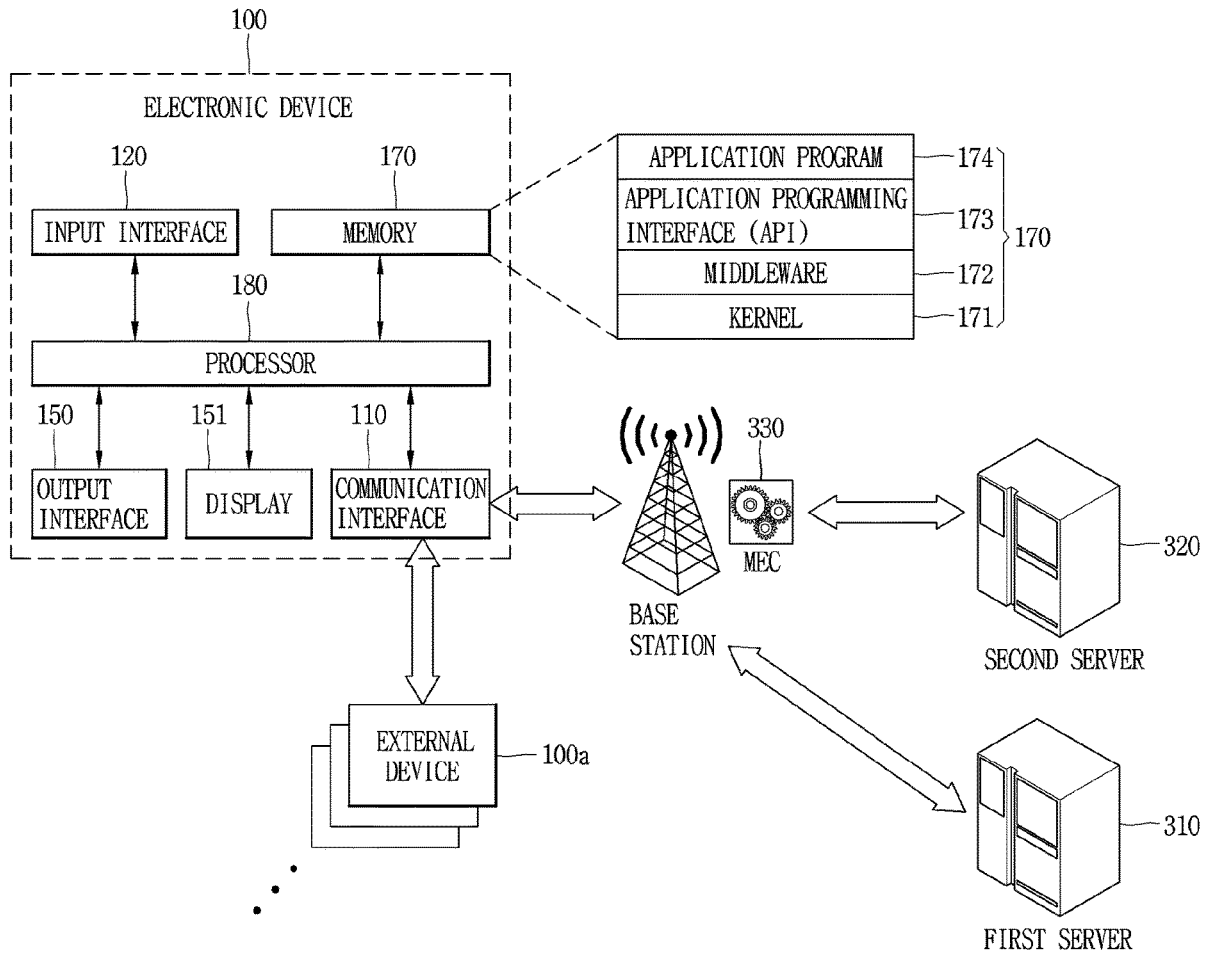
H01Q 3/36	(2006.01)
H01Q 3/26	(2006.01)
H01Q 1/24	(2006.01)
H01Q 21/28	(2006.01)

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

CPC ***H01Q 13/106*** (2013.01); ***H01Q 3/36*** (2013.01); ***H01Q 21/28*** (2013.01); ***H01Q 1/245*** (2013.01); ***H01Q 3/2617*** (2013.01)

(57) **ABSTRACT**

An electronic device having a fifth-generation (5G) antenna according to an embodiment is provided. The electronic device includes a cover glass through which electromagnetic waves are transmitted, a metal frame having a metal rim formed on side surfaces of the electronic device, an antenna module configured to transmit or receive beamformed signals through a plurality of antenna elements, and a frame mold made of a dielectric and disposed between the metal frame and the antenna module, wherein a frame slot is formed in a lower portion of the metal frame so that the signals transmitted or received in the antenna module is radiated through the frame slot.



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(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0280984 A1**

Tanaka (43) **Pub. Date: Sep. 9, 2021**

(54) **ANTENNA**

(71) Applicant: **CANON KABUSHIKI KAISHA**, Tokyo (JP)

(72) Inventor: **Yu Tanaka**, Tokyo (JP)

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H01Q 5/371	(2006.01)
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H01Q 3/24	(2006.01)
H01Q 21/06	(2006.01)

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

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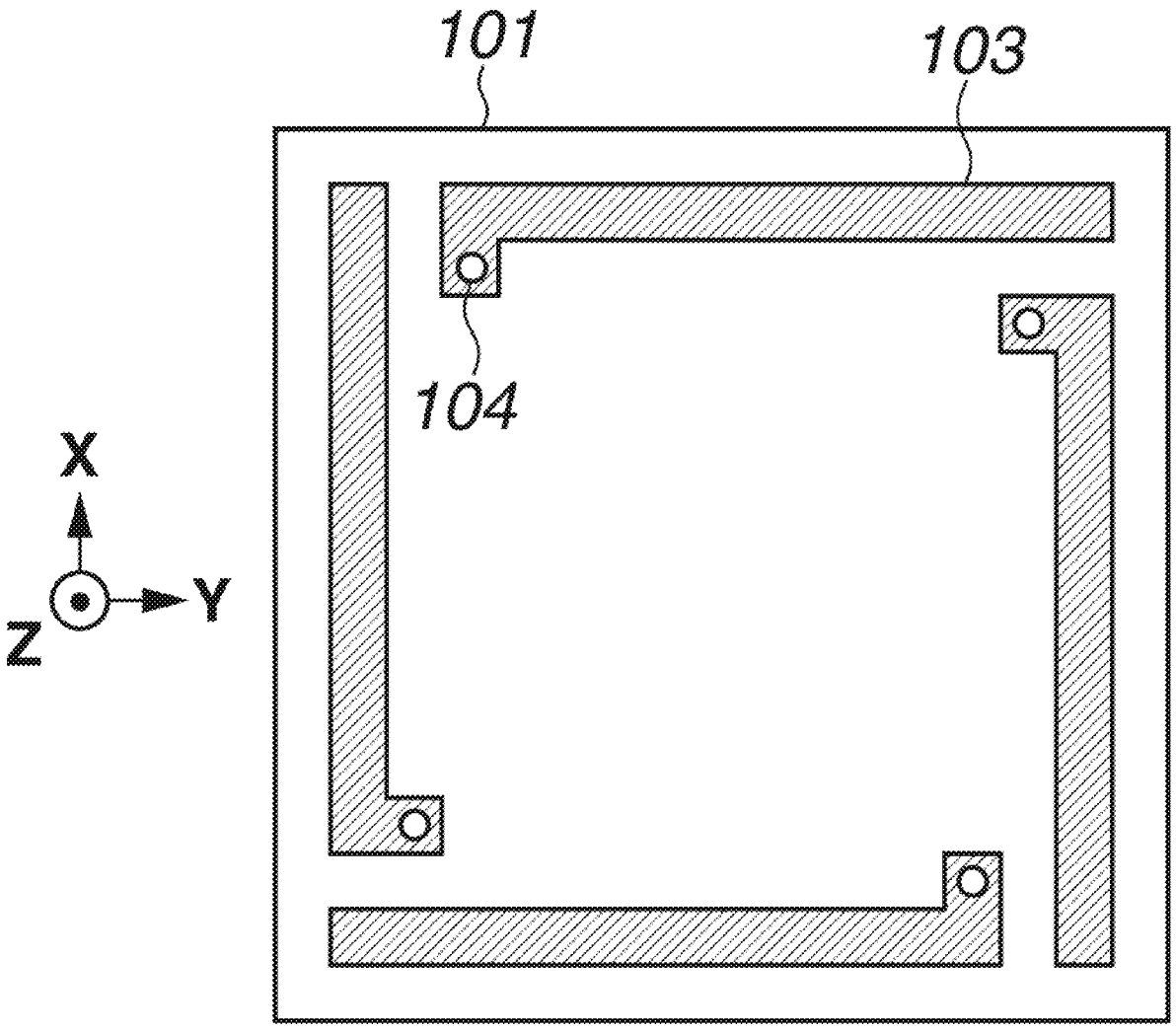
(57) **ABSTRACT**

An antenna includes a control unit and first to Nth antenna elements. N is an integer that is four or more. The control unit controls input of signals to each antenna element. Among each antenna element, open ends of the second to Nth antenna elements extend in directions different from a direction in which the first antenna element extends. Among signals input to each antenna element, signals input to the second to Nth antenna elements have phases different from a phase of a signal input to the first antenna element. The control unit controls a state to be in a first state, where signals are input to each antenna element to radiate a circularly polarized wave in a first direction or a second state, where signals are input to one or more of the antenna elements to radiate a linearly polarized wave in a direction different from the first direction.



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(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0288399 A1**

Zhao et al. (43) **Pub. Date: Sep. 16, 2021**

(54) **MULTIPLE FEED SLOT ANTENNA**

(71) Applicant: **Motorola Mobility LLC**, Chicago, IL (US)

(72) Inventors: **Junsheng Zhao**, Vernon Hills, IL (US); **Eric Le Roy Krenz**, Crystal Lake, IL (US); **Hugh Smith**, Palatine, IL (US)

(73) Assignee: **Motorola Mobility LLC**, Chicago, IL (US)

(21) Appl. No.: **17/335,585**

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Related U.S. Application Data

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Publication Classification

(51) **Int. Cl.**

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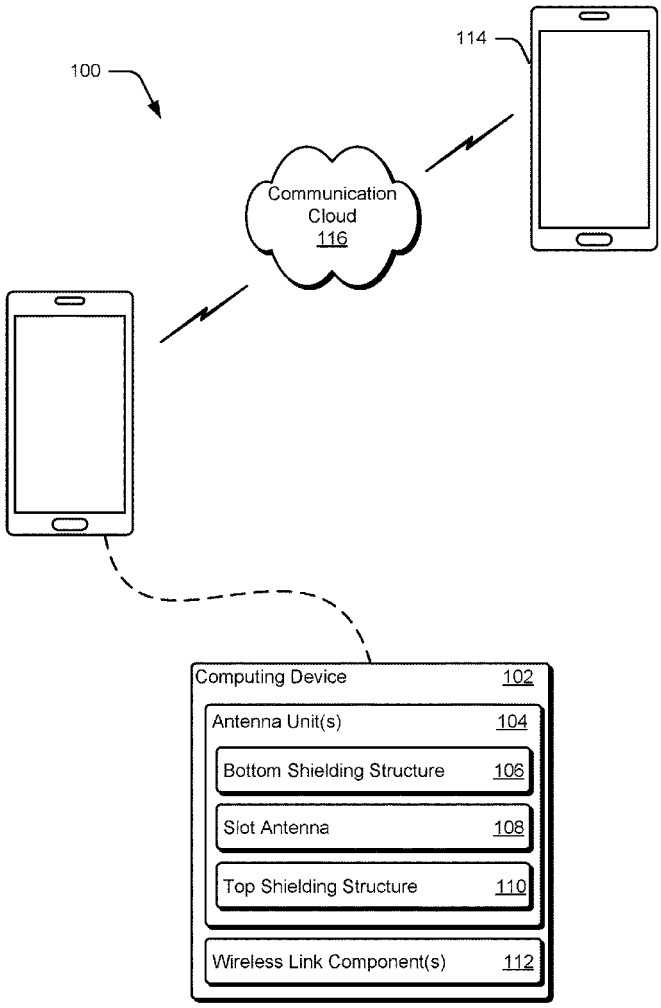
G06F 1/16	(2006.01)
H01Q 1/24	(2006.01)
H01Q 21/00	(2006.01)

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

CPC ***H01Q 1/38*** (2013.01); ***H01Q 21/0043*** (2013.01); ***H01Q 1/243*** (2013.01); ***G06F 1/1698*** (2013.01)

(57) **ABSTRACT**

Multiple feed, front-shielded, coplanar waveguide, direct-fed, cavity-backed slot antennas are described. Various implementations form an antenna unit capable of millimeter waveform and/or microwave waveform transmissions. An antenna comprises a conductive plate that includes an aperture. The aperture has a shape that extends along an axis that bisects the aperture into first and second bisected portions, the first bisected portion having a first geometry type, and the second portion having a second geometry type that is a bilateral symmetry shape type of the first geometry type. In implementations, the aperture is configured to radiate waveforms within a frequency range from about between 600 Megahertz (MHz) to 72 Gigahertz (GHz) by applying multiple signal feeds to the conductive plate.



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(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0288409 A1**

DELAVEAUD et al. (43) **Pub. Date: Sep. 16, 2021**

(54) **FREQUENCY RECONFIGURABLE MONOPOLAR WIRE-PLATE ANTENNA**

(71) Applicants: **Commissariat à l'Energie Atomique et aux Energies Alternatives**, Paris (FR); **UNIVERSITE BREST BRETAGNE OCCIDENTALE**, Paris (FR)

(72) Inventors: **Christophe DELAVEAUD**, Grenoble Cedex (FR); **Lotfi BATEL**, Grenoble Cedex (FR); **Jean-François PINTOS**, Grenoble Cedex (FR); **Jean-Luc MATTEI**, Locmaria-Plouzane (FR); **Alexis CHEVALIER**, Landeda (FR); **Vincent LAUR**, Milizac (FR)

(73) Assignees: **Commissariat à l'Energie Atomique et aux Energies Alternatives**, Paris (FR); **UNIVERSITE BREST BRETAGNE OCCIDENTALE**, Brest (FR)

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

CPC ***H01Q 9/40*** (2013.01); ***H01Q 1/48*** (2013.01)

(57) **ABSTRACT**

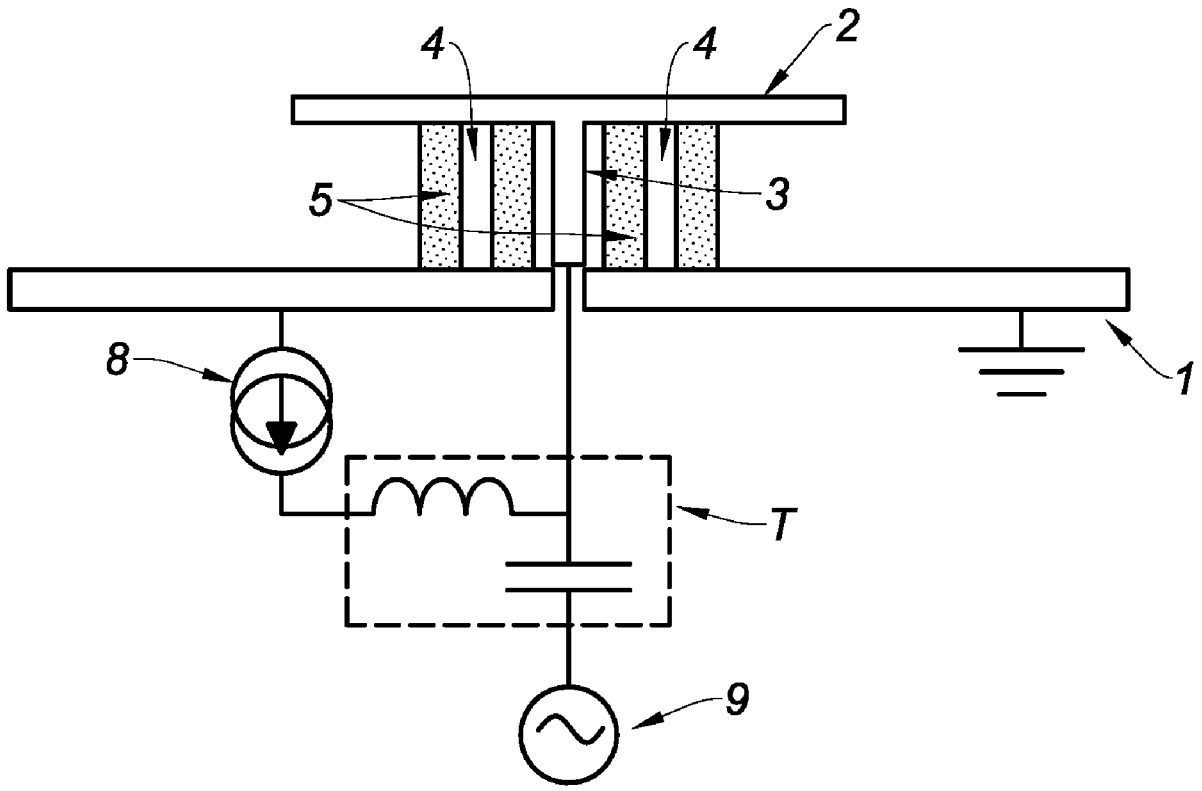
A monopole wire-plate antenna that is reconfigurable in a frequency range of operation, comprising:

a ground plane (**1**);

a capacitive roof (**2**);

a probe feed (**3**), which is electrically insulated from the ground plane (**1**), and which extends between the ground plane (**1**) and the capacitive roof (**2**) so as to electrically feed the capacitive roof (**2**);

at least one shorting wire (**4**), which is arranged to electrically connect the capacitive roof (**2**) to the ground plane (**1**), and which is coated in a magneto-dielectric material (**5**) having a complex magnetic permeability, which varies as a function of a static magnetic field applied to the magneto-dielectric material (**5**).



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(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0288411 A1**

Zhao et al. (43) **Pub. Date: Sep. 16, 2021**

(54) **FRONT-SHIELDED, COPLANAR WAVEGUIDE, DIRECT-FED, CAVITY-BACKED SLOT ANTENNA**

(71) Applicant: **Motorola Mobility LLC**, Chicago, IL (US)

(72) Inventors: **Junsheng Zhao**, Vernon Hills, IL (US); **Eric Le Roy Krenz**, Crystal Lake, IL (US); **Hugh Smith**, Palatine, IL (US)

(73) Assignee: **Motorola Mobility LLC**, Chicago, IL (US)

(21) Appl. No.: **17/335,528**

(22) Filed: **Jun. 1, 2021**

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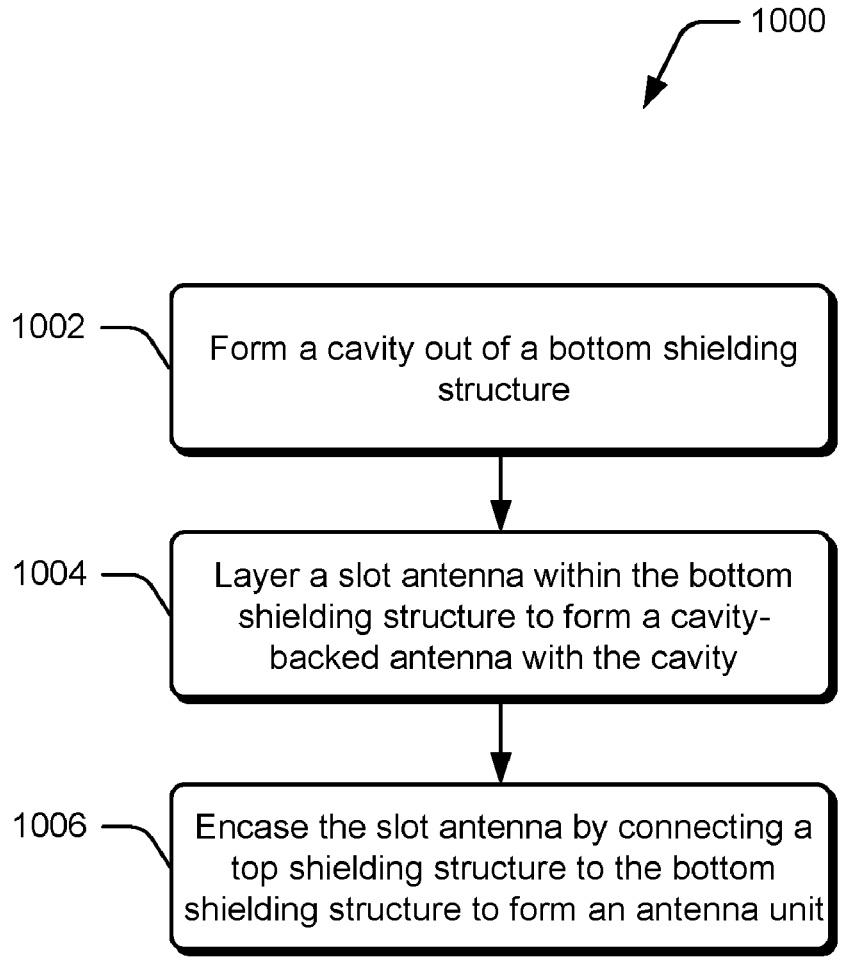
H01Q 1/40	(2006.01)
H01Q 21/00	(2006.01)

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

CPC ***H01Q 13/18*** (2013.01); ***H01Q 1/243*** (2013.01); *H01Q 1/2266* (2013.01); ***H01Q 21/0037*** (2013.01); ***H01Q 1/40*** (2013.01)

(57) **ABSTRACT**

Front-shielded, coplanar waveguide, direct-fed, cavity-backed slot antennas are described. Various implementations form an antenna unit capable of millimeter waveform and/or microwave waveform transmissions. A bottom shielding structure of the antenna unit defines a cavity, where various implementations include one or more dampening structures within the cavity. Some implementations includes a slot antenna within the cavity defined by the bottom shielding structure, such as a coplanar waveguide (CPW) direct-fed slot antenna, to form a cavity-backed slot antenna. Some implementations connect a top shielding structure to the bottom shielding structure to encase the slot antenna. In one or more implementations, the top shielding structure includes aperture windows to allow waveforms within a frequency range from about between 600 Megahertz (MHz) to 72 Gigahertz (GHz). and radiated by the slot antenna to radiate outward from the antenna unit.



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(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0288675 A1**

YUEN et al. (43) **Pub. Date: Sep. 16, 2021**

(54) **ADJUSTABLE MULTI-BAND PLANAR ANTENNA**

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

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

(21) Appl. No.: **16/631,053**

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

(86) PCT No.: **PCT/CN2018/119497**

§ 371 (c)(1),
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(51) **Int. Cl.**

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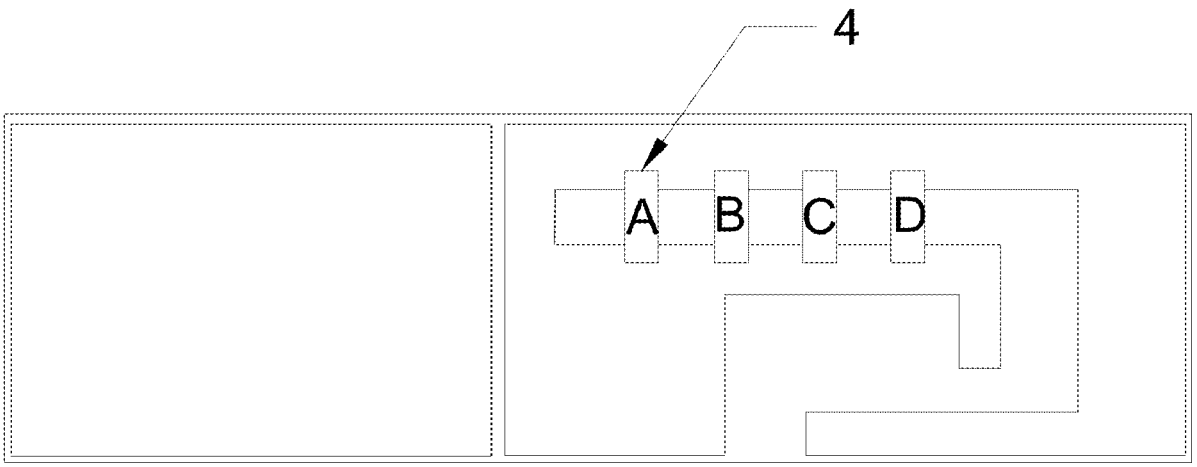
H01Q 1/48	(2006.01)

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

CPC ***H04B 1/006*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 9/0442*** (2013.01)

(57) **ABSTRACT**

The utility model discloses an adjustable multi-band planar antenna, which comprises a ground plane, a resonance branch A, and a resonance branch B. The three components are all disposed on the top surface of a PCB. The said resonance branch A and resonance branch B assume an "L" shape. The planar antenna in the utility model comprises two resonance branches, which enables the antenna to support multiple bands and multiple systems (such as GSM, NB-IoT, GPS, WCDMA, LTE, Bluetooth). The antenna can perform frequency tuning in a high frequency band or a low frequency band, so that it obtains better transmission and reception effects at a specific frequency.



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(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2021/0288686 A1**

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

PARK et al.

(54) **SMALL ANTENNA APPARATUS AND METHOD FOR CONTROLLING THE SAME**

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

(72) Inventors: **Jungsik PARK**, Bucheon-si (KR); **Sooung CHUN**, Suwon-si (KR)

(21) Appl. No.: **17/337,713**

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

Related U.S. Application Data

(63) Continuation of application No. 16/884,487, filed on May 27, 2020, now Pat. No. 11,031,965, which is a continuation of application No. 16/155,248, filed on Oct. 9, 2018, now Pat. No. 10,680,671, which is a continuation of application No. 15/082,280, filed on Mar. 28, 2016, now Pat. No. 10,128,883, which is a continuation of application No. 13/727,205, filed on Dec. 26, 2012, now Pat. No. 9,306,288.

(30) **Foreign Application Priority Data**

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H01Q 9/42	(2006.01)
H01Q 9/16	(2006.01)
H04W 88/02	(2006.01)
H01Q 1/48	(2006.01)

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

CPC ***H04B 1/18*** (2013.01); ***H01Q 1/243*** (2013.01); ***H01Q 9/145*** (2013.01); *H04B 1/0458* (2013.01); ***H01Q 9/16*** (2013.01); ***H04W 88/02*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 9/42*** (2013.01)

(57) **ABSTRACT**

An antenna apparatus for a mobile terminal is provided. The antenna apparatus includes an antenna pattern, a first electric circuit and a second electric circuit respectively connected between both ends of the antenna pattern and a system ground, and a third electric circuit disposed between the antenna pattern and a feeding line, wherein the first electric circuit and the second electric circuit extend electrical wavelengths of the antenna pattern and the third electric circuit increases input impedance matching.