US 20220085480A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0085480 A1**

Huang et al. (43) **Pub. Date: Mar. 17, 2022**

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

(71) Applicant: **Etheta Communication Technology (Shenzhen) Co., Ltd.**, Shenzhen (CN)

(72) Inventors: **Huan-Chu Huang**, Taoyuan (CN); **Dasong Gao**, Shenzhen (CN); **Zhixing Qi**, Shenzhen (CN); **Hong Lin**, Shenzhen (CN); **Yanchao Zhou**, Shenzhen (CN)

(21) Appl. No.: **17/537,444**

(22) Filed: **Nov. 29, 2021**

(30) **Foreign Application Priority Data**

Nov. 16, 2021 (CN) 202111354677.1

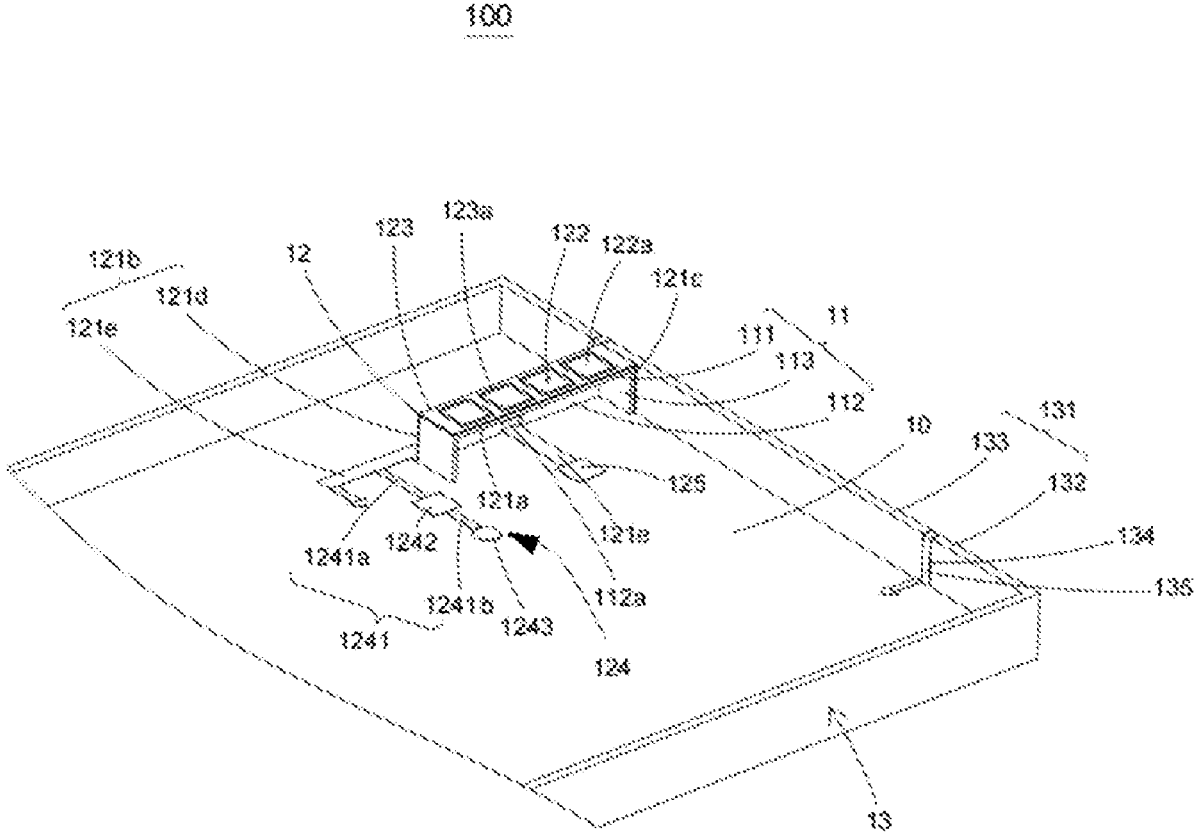
Publication Classification

(51) **Int. Cl.**
H01Q 1/12 (2006.01)
H01Q 1/52 (2006.01)

(52) **U.S. Cl.**
CPC ***H01Q 1/12*** (2013.01); ***H01Q 1/526*** (2013.01)

(57) **ABSTRACT**

The present disclosure discloses an antenna apparatus and an electronic device. The antenna apparatus includes a circuit board, an antenna stand arranged on the circuit board, and an antenna structure arranged on the antenna stand. The antenna structure includes a flexible printed circuit board, a millimeter wave (mm-wave) antenna arranged on the flexible printed circuit board, and a non-mm-wave antenna arranged on the flexible printed circuit board.



US 20220085483A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0085483 A1**

CHANG et al. (43) **Pub. Date: Mar. 17, 2022**

(54) **MOBILE DEVICE**

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

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

(21) Appl. No.: **17/216,892**

(22) Filed: **Mar. 30, 2021**

(30) **Foreign Application Priority Data**

Sep. 11, 2020 (TW) 109131252

Publication Classification

(51) **Int. Cl.**

H01Q 1/22 (2006.01)

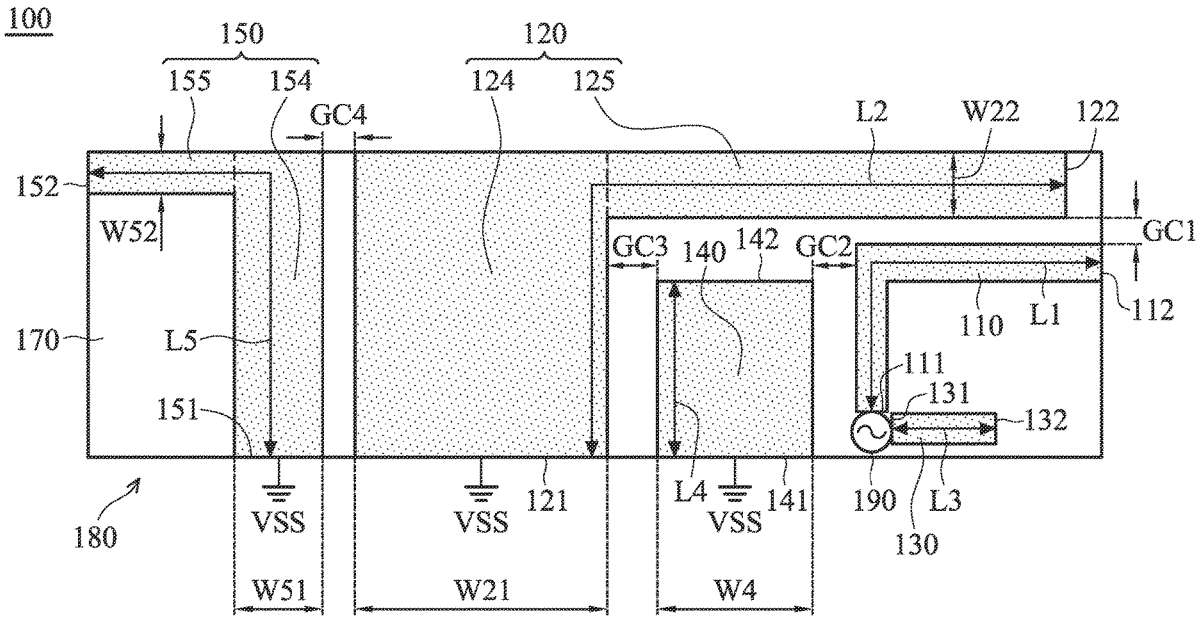
H01Q 5/307 (2006.01)

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

CPC ***H01Q 1/2266*** (2013.01); ***H01Q 5/307*** (2015.01)

(57) **ABSTRACT**

A mobile device includes a first radiation element, a second radiation element, a third radiation element, a fourth radiation element, a fifth radiation element, and a dielectric substrate. The first radiation element and the third radiation element are coupled to a signal source. The second radiation element is coupled to a ground voltage. The second radiation element is adjacent to the first radiation element. The first radiation element, the second radiation element, and the third radiation element substantially extend in the same direction. The fourth radiation element is coupled to the ground voltage. The fourth radiation element is between the first radiation element and the second radiation element. The fifth radiation element is coupled to the ground voltage. An antenna structure is formed by the first radiation element, the second radiation element, the third radiation element, the fourth radiation element, the fifth radiation element, and the dielectric substrate.



US 20220085486A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2022/0085486 A1**

(43) **Pub. Date: Mar. 17, 2022**

Lee

(54) **ANTENNA DEVICE**

(71) Applicant: **Tyco Electronics AMP Korea Co., Ltd.**, Jillyang-Eup Gyeongsan (KR)

(72) Inventor: **Chang Hyun Lee**, Suwon (KR)

(21) Appl. No.: **17/471,284**

(22) Filed: **Sep. 10, 2021**

(30) **Foreign Application Priority Data**

Sep. 15, 2020 (KR) 10-2020-0118440

Publication Classification

(51) **Int. Cl.**

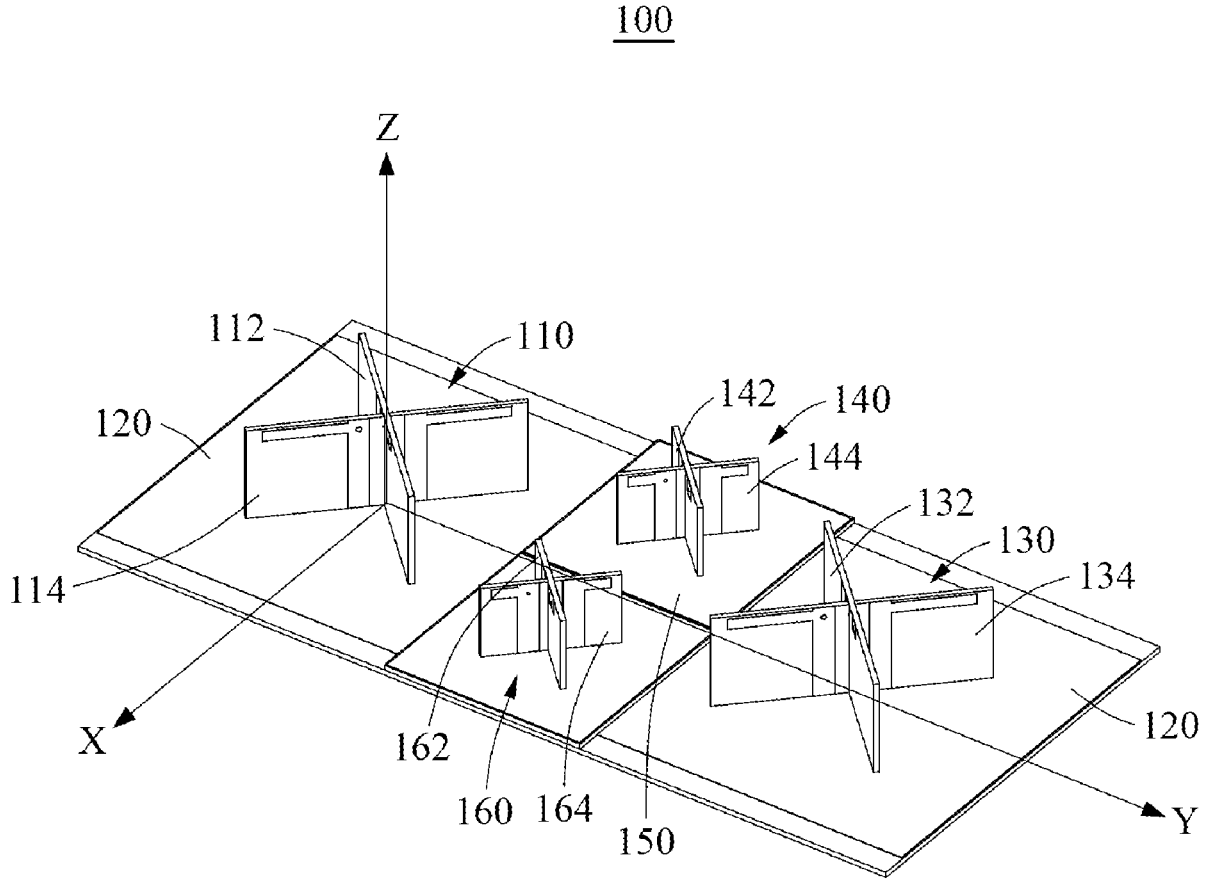
H01Q 1/22 (2006.01)
H01Q 1/48 (2006.01)
H01Q 21/26 (2006.01)
H01Q 5/35 (2006.01)

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

CPC ***H01Q 1/2291*** (2013.01); ***H01Q 5/35*** (2015.01); ***H01Q 21/26*** (2013.01); ***H01Q 1/48*** (2013.01)

(57) **ABSTRACT**

An antenna device includes a plurality of first antennas for communication in a first frequency band, a first ground plane configured to provide a ground voltage to the first antennas, a plurality of second antennas for communication in a second frequency band, and a second ground plane configured to provide a ground voltage to the second antennas, and the first ground plane and the second ground plane are electrically isolated from each other.



US 20220085488A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0085488 A1**

Irci et al. (43) **Pub. Date: Mar. 17, 2022**

(54) **WIRELESS DEVICES HAVING CO-EXISTING ANTENNA STRUCTURES**

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

(72) Inventors: **Erdinc Irci**, Sunnyvale, CA (US); **Aaron H. Squier**, San Francisco, CA (US); **Daisong Zhang**, Cupertino, CA (US); **Enrique Ayala Vazquez**, Watsonville, CA (US); **Hongfei Hu**, Cupertino, CA (US)

(21) Appl. No.: **17/222,557**

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

Related U.S. Application Data

(60) Provisional application No. 63/077,419, filed on Sep. 11, 2020.

Publication Classification

(51) **Int. Cl.**

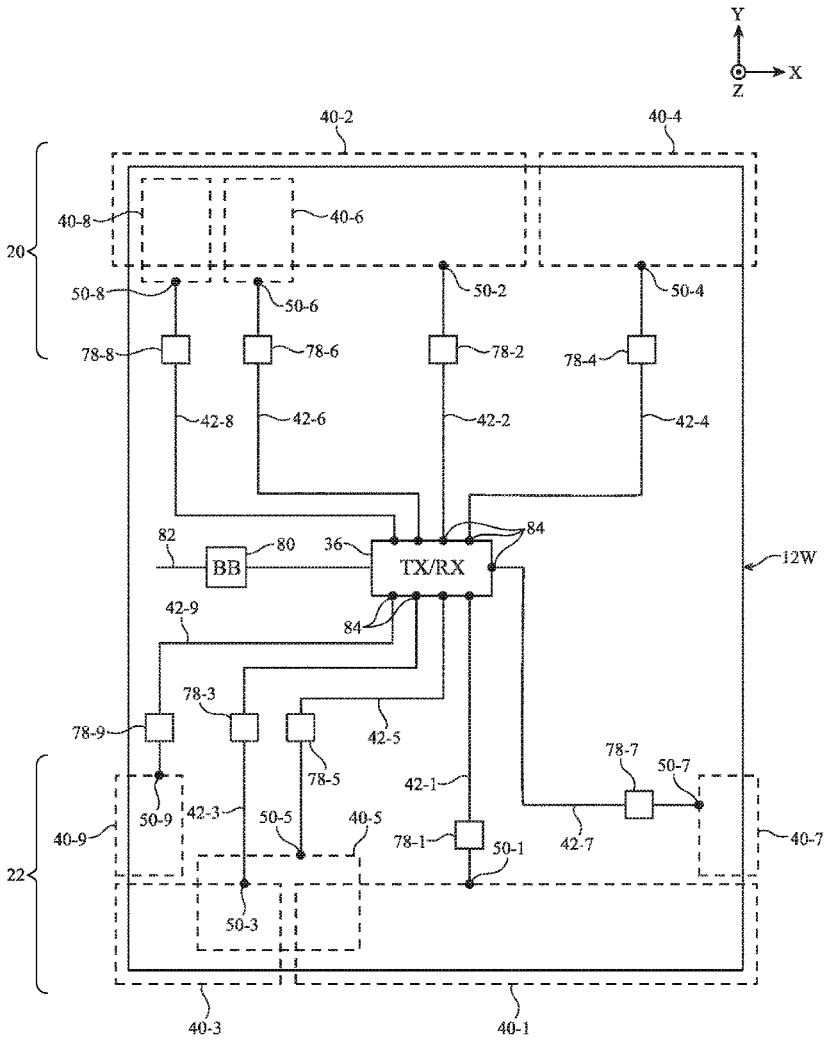
H01Q 1/24	(2006.01)
H01Q 13/10	(2006.01)
H01Q 5/35	(2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H01Q 5/35*** (2015.01); ***H01Q 13/10*** (2013.01)

(57) **ABSTRACT**

An electronic device may be provided with first, second, and third antennas and a dock flex. A first feed terminal for the first antenna may be coupled to a second feed terminal for the second antenna over a first path. The first path may be coupled to ground over a second path. Tuning components may be interposed on the first and second paths. The third antenna may be patterned on a first portion of the dock flex. Front end components for the first antenna may be mounted to a second portion of the dock flex. The first and second portions may extend from a tail of the dock flex. The tail may be wrapped around a plastic support block to hold the second portion over the first portion. The plastic support block may have a snap hook clip that holds the second portion in place.



US 20220085490A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0085490 A1**

MOON et al. (43) **Pub. Date: Mar. 17, 2022**

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

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

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

(21) Appl. No.: **17/532,799**

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

Related U.S. Application Data

(63) Continuation of application No. 16/591,552, filed on Oct. 2, 2019, now Pat. No. 11,183,747.

(30) **Foreign Application Priority Data**

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

Publication Classification

(51) **Int. Cl.**

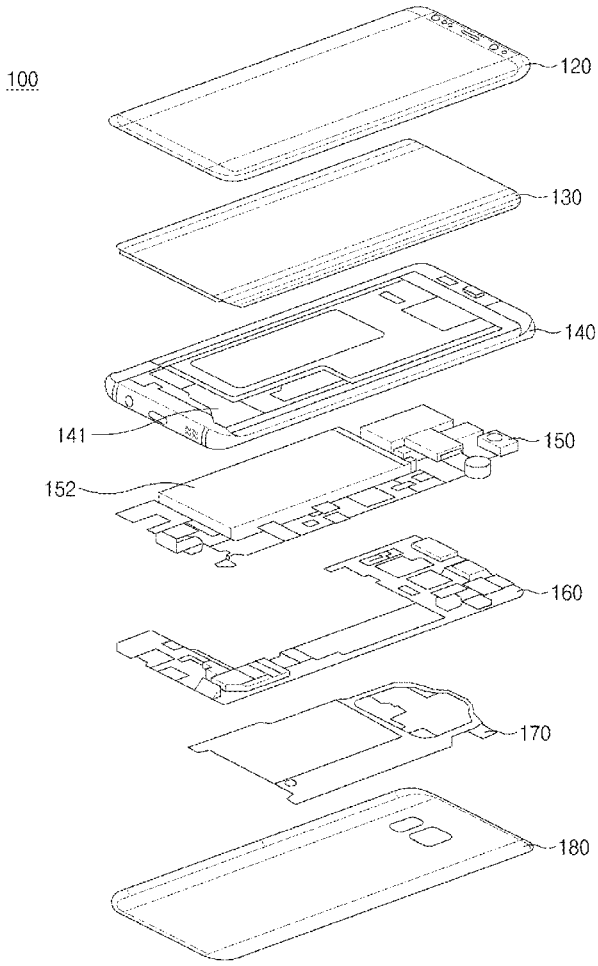
H01Q 1/24	(2006.01)
H01Q 9/16	(2006.01)
H01Q 23/00	(2006.01)
H04M 1/02	(2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H04M 1/026*** (2013.01); ***H01Q 23/00*** (2013.01); ***H01Q 9/16*** (2013.01)

(57) **ABSTRACT**

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



US 20220085493A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0085493 A1**

Jia (43) **Pub. Date: Mar. 17, 2022**

(54) **HOUSING ASSEMBLY, ANTENNA DEVICE, AND ELECTRONIC DEVICE**

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

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

(21) Appl. No.: **17/539,069**

(22) Filed: **Nov. 30, 2021**

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2020/095214, filed on Jun. 9, 2020.

(30) **Foreign Application Priority Data**

Jun. 30, 2019 (CN) 201910582091.7

Publication Classification

(51) **Int. Cl.**

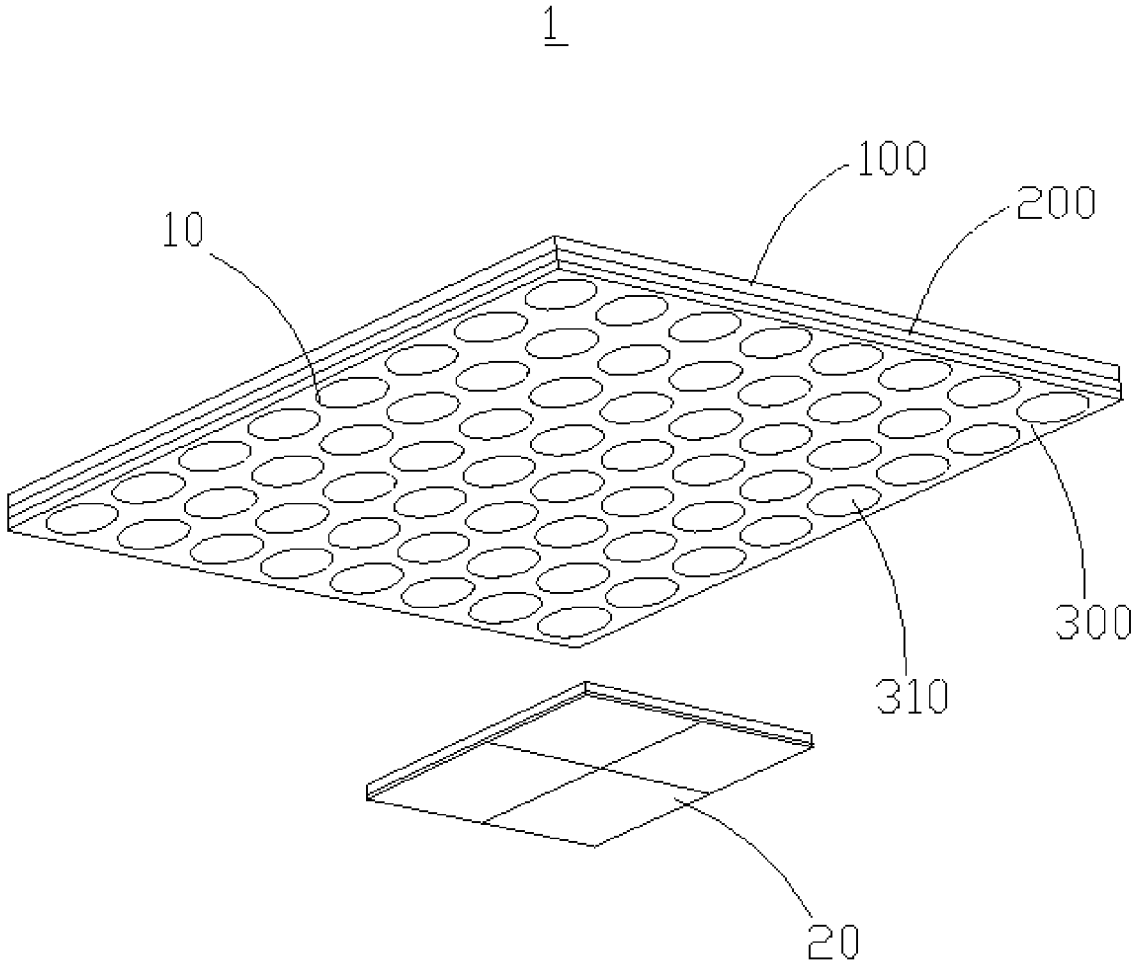
H01Q 1/42	(2006.01)
H04B 1/3827	(2006.01)
H01Q 1/36	(2006.01)
H01Q 9/04	(2006.01)
H01Q 21/06	(2006.01)

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

CPC ***H01Q 1/42*** (2013.01); ***H04B 1/3827*** (2013.01); ***H01Q 21/065*** (2013.01); ***H01Q 9/045*** (2013.01); ***H01Q 1/36*** (2013.01)

(57) **ABSTRACT**

A housing assembly, an antenna device, and an electronic device are provided. The housing assembly includes a dielectric substrate, an impedance matching layer, and a coupling structure. The dielectric substrate has a first transmittance to a radio frequency (RF) signal in a preset frequency band. The impedance matching layer is stacked with the dielectric substrate and is used for spatial impedance matching of the RF signal in the preset frequency band. The coupling structure is stacked with the dielectric substrate and includes one or more array layers of coupling elements, where the array layer has resonance characteristics in the preset frequency band. The housing assembly has a second transmittance to the RF signal in the preset frequency band in a region corresponding to the coupling structure, and the second transmittance is greater than the first transmittance.



US 20220085496A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0085496 A1**

Nair et al. (43) **Pub. Date: Mar. 17, 2022**

(54) **ANTENNA ARRAY ASSEMBLY HAVING HIGH CROSS POLAR ISOLATION**

(71) Applicant: **Cambium Networks Ltd**, Ashburton (GB)

(72) Inventors: **Deepu Nair**, Bangalore (IN); **Jomon Thomas**, Bangalore (IN); **Varun Hedge**, Bangalore (IN); **Visalakshy Tc**, Bangalore (IN); **Nigel King**, Ashburton (GB)

(73) Assignee: **Cambium Networks Ltd**, Ashburton (GB)

(21) Appl. No.: **17/534,005**

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

Related U.S. Application Data

(63) Continuation of application No. PCT/GB2020/051230, filed on May 20, 2020.

(30) **Foreign Application Priority Data**

May 23, 2019 (IN) 201941020484

Publication Classification

(51) **Int. Cl.**

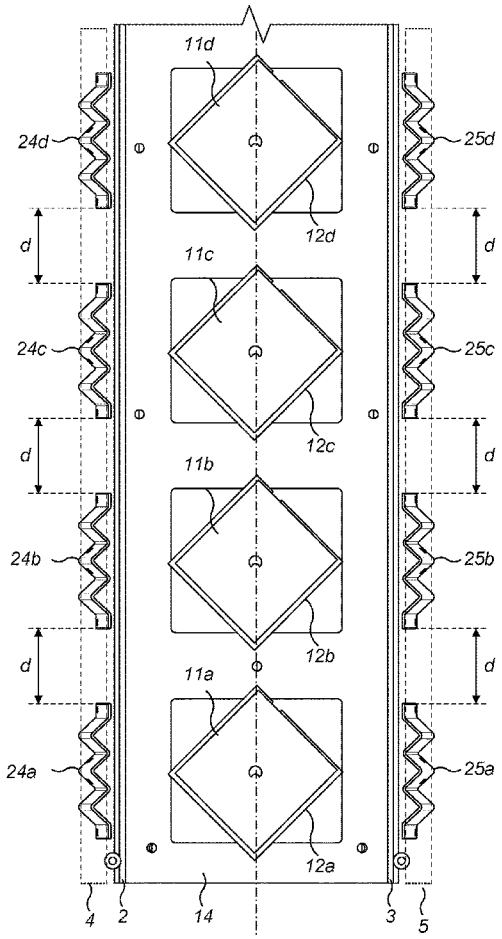
H01Q 1/52	(2006.01)
H01Q 21/08	(2006.01)
H01Q 9/04	(2006.01)

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

CPC ***H01Q 1/523*** (2013.01); *H01Q 1/48* (2013.01); ***H01Q 9/0414*** (2013.01); ***H01Q 21/08*** (2013.01)

(57) **ABSTRACT**

An antenna array assembly comprises a ground plate, a linear array of patch radiator elements disposed in a spaced parallel relationship with a first face of the ground plate and a first and second elongate passive radiator each comprising a plurality of conductive parts electrically isolated from the ground plate. The first and second elongate passive radiators are disposed symmetrically on either side of the linear array and parallel to a centre line of the linear array, on the same side of the ground plate as the linear array. At least some of the conductive parts of a respective elongate passive radiator are disposed in an arrangement having parallel ridges and grooves, in which, in a cross section in a plane parallel to the first face of the ground plate, the ridges extend towards the linear array and the grooves extend away from the linear array.



US 20220085497A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2022/0085497 A1**

(43) **Pub. Date: Mar. 17, 2022**

Khripkov et al.

(54) **BEAM STEERING ANTENNA STRUCTURE AND ELECTRONIC DEVICE COMPRISING SAID STRUCTURE**

(71) Applicants: **Alexander KHRIIPKOV**, Kista (SE); **Huawei Technologies Co., Ltd.**, Shenzhen (CN)

(72) Inventors: **Alexander Khripkov**, Helsinki (FI); **Janne Ilvonen**, Helsinki (FI); **Ruiyuan Tian**, Helsinki (FI); **Jari Kristian Van Wonterghem**, Munich (DE); **Jian Ou**, Munich (DE); **Dongxing Tu**, Shenzhen (CN); **Zlatoljub Milosavljevic**, Helsinki (FI); **Hongting Luo**, Shanghai (CN)

(21) Appl. No.: **17/420,612**

(22) PCT Filed: **Jan. 3, 2019**

(86) PCT No.: **PCT/EP2019/050095**

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

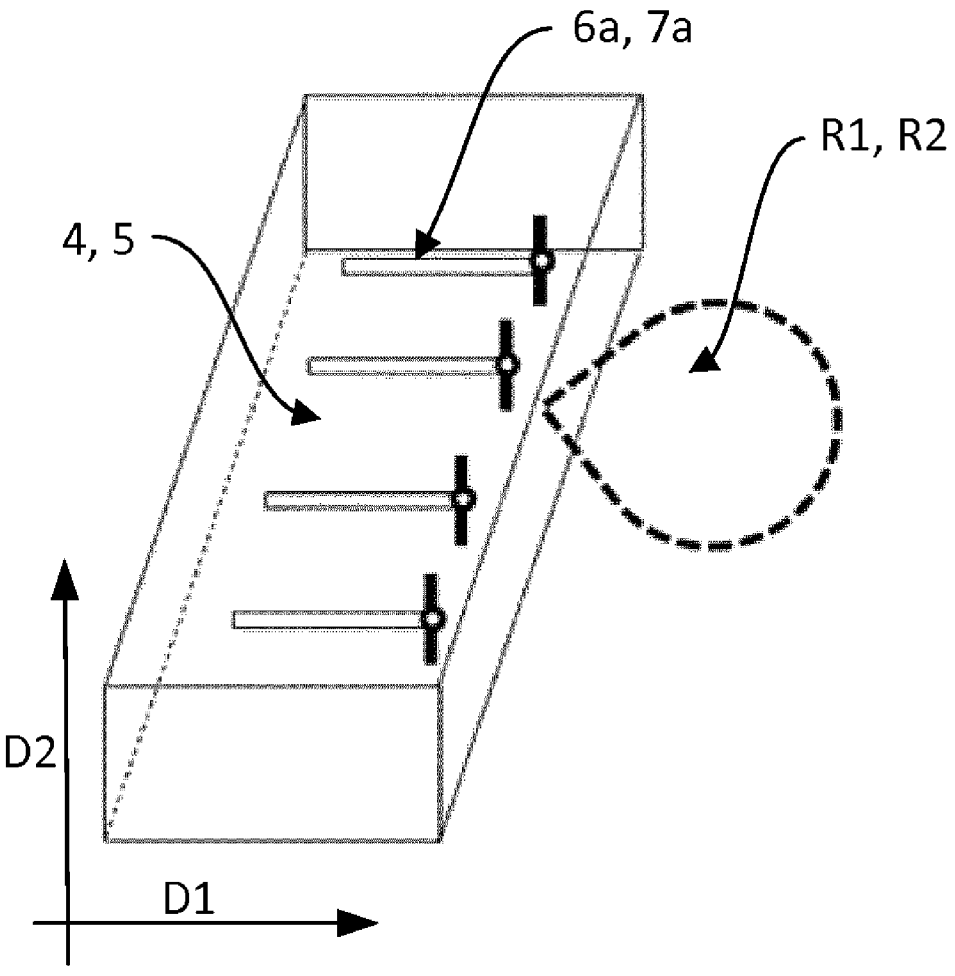
Publication Classification

(51) **Int. Cl.**
H01Q 3/26 (2006.01)
H04M 1/02 (2006.01)

(52) **U.S. Cl.**
CPC ***H01Q 3/26*** (2013.01); ***H04M 1/0266*** (2013.01)

(57) **ABSTRACT**

A beam steering antenna structure comprises a stacked antenna module and a first conductive component. The antenna module comprises a first substrate and a second substrate arranged superjacent such that main planes of the substrates extend in parallel. The first substrate comprises a first antenna array transmitting and receiving a first radiation beam. The second substrate comprises a second antenna array transmitting and receiving a second radiation beam. The first conductive component extends adjacent to the antenna module and is at least partially separated from the antenna module in a first direction perpendicular to the main plane of the conductive component. The antenna module is coupled to the conductive component by means of at least one of a galvanic, capacitive, or inductive coupling. At least one of the first and the second radiation beams is at least partially steered away from the other one by the first conductive component.



US 20220085501A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0085501 A1**

JIAN et al. (43) **Pub. Date: Mar. 17, 2022**

(54) **ANTENNA UNIT AND TERMINAL DEVICE**

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

(72) Inventors: **Xianjing JIAN**, Chang'an Dongguan (CN); **Huan-Chu HUANG**, Chang'an Dongguan (CN); **Yijin WANG**, Chang'an Dongguan (CN)

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

(21) Appl. No.: **17/531,742**

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

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2020/090102, filed on May 13, 2020.

(30) **Foreign Application Priority Data**

May 22, 2019 (CN) 201910430964.2

Publication Classification

(51) **Int. Cl.**

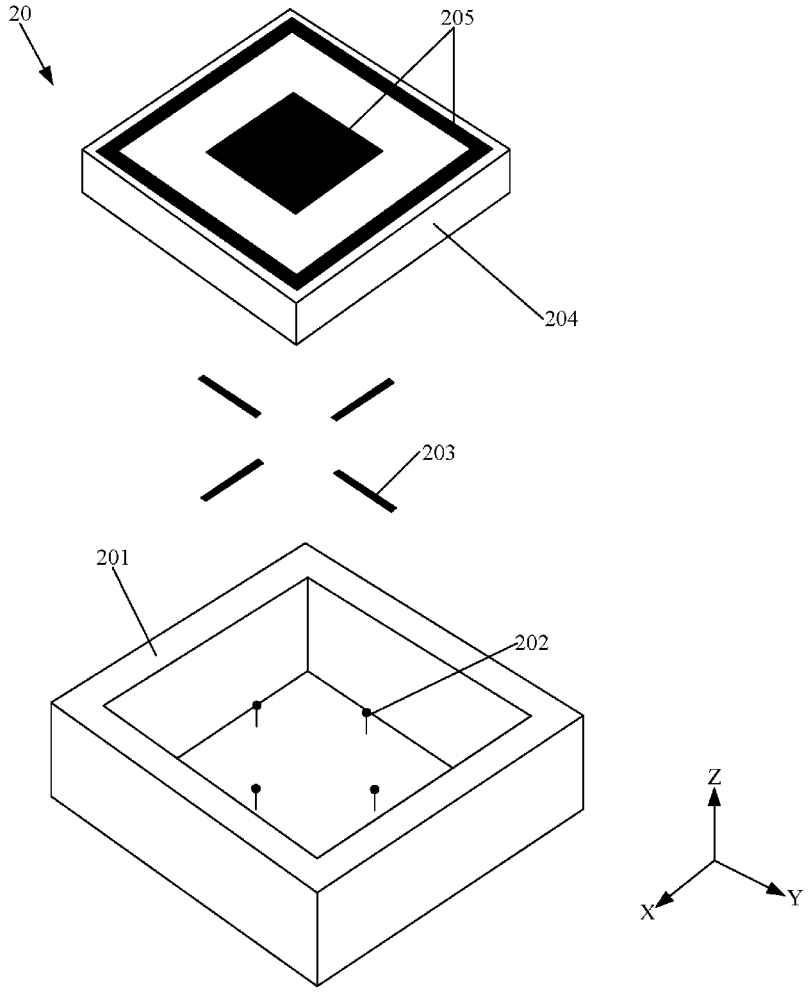
H01Q 5/371	(2006.01)
H01Q 5/50	(2006.01)
H01Q 9/04	(2006.01)

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

CPC ***H01Q 5/371*** (2015.01); ***H01Q 9/0407*** (2013.01); ***H01Q 5/50*** (2015.01)

(57) **ABSTRACT**

An antenna unit and a terminal device are provided. The antenna unit includes a target metal groove, M feed portions arranged at the bottom of the target metal groove, M coupling bodies and a first insulator which are arranged in the target metal groove, and at least two radiating bodies borne by the first insulator, wherein the M feed portions are insulated from the target metal groove, the M coupling bodies are located between the bottom of the target metal groove and the first insulator, each of the M feed portions is electrically connected to one coupling body respectively, each of the M coupling bodies is coupled with the at least two radiating bodies and the target metal groove, different radiating bodies have different resonance frequencies, and M is a positive integer.



US 20220085505A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2022/0085505 A1**

(43) **Pub. Date: Mar. 17, 2022**

LEE et al.

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

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

(72) Inventors: **Hyungjin LEE**, Suwon-si (KR); **Woncheol LEE**, Suwon-si (KR); **Myeong Woo HAN**, Suwon-si (KR); **Jeongki RYOO**, Suwon-si (KR); **Youngsik HUR**, Suwon-si (KR); **Wongi KIM**, Suwon-si (KR); **Gopal GARG**, Fremont, CA (US)

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

(21) Appl. No.: **17/124,535**

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

(30) **Foreign Application Priority Data**

Sep. 11, 2020 (KR) 10-2020-0117059

Publication Classification

(51) **Int. Cl.**

H01Q 9/04 (2006.01)

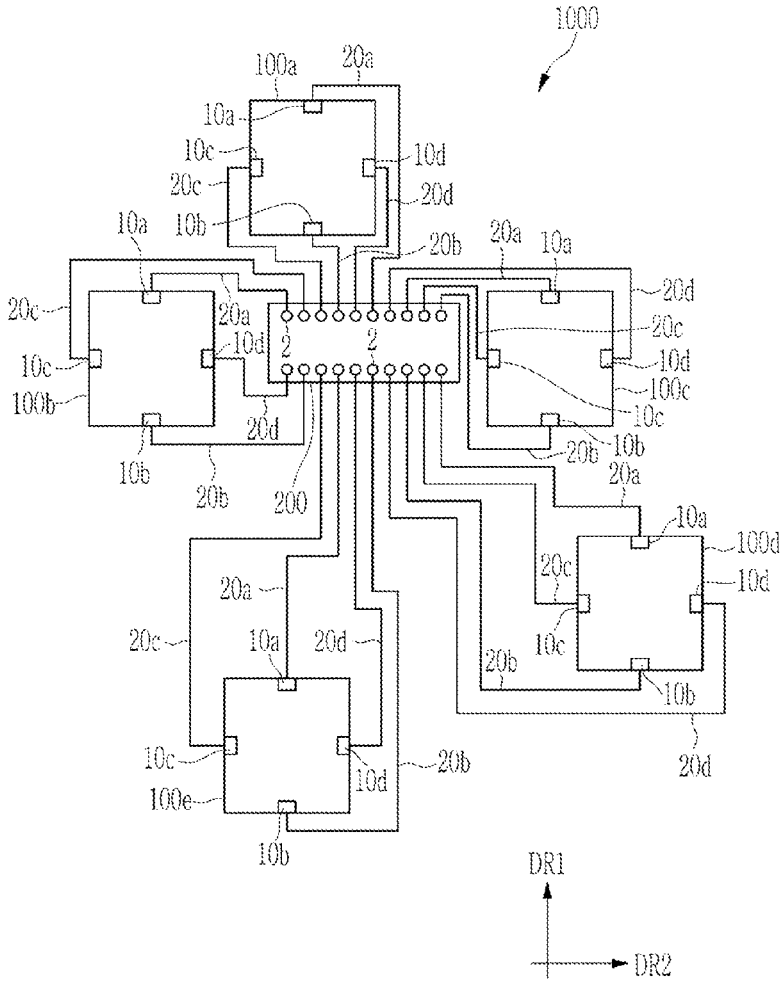
H01Q 21/06 (2006.01)

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

CPC ***H01Q 9/045*** (2013.01); *H01Q 1/243* (2013.01); ***H01Q 21/065*** (2013.01)

(57) **ABSTRACT**

An antenna apparatus includes antennas, each having first and second feeding portions facing each other across a dielectric layer, and third and fourth feeding portions facing each other across the dielectric layer, and a signal application unit configured to apply a wireless communication signal to the antennas, and including a plurality of output ports, wherein the first and second feeding portions are configured to receive electric signals having a first polarization characteristic, and are respectively connected to first and second output ports that are different from each other among the plurality of output ports, and the third and fourth feeding portions are configured to receive electric signals having a second polarization characteristic that is different from the first polarization characteristic, and are respectively connected to third and fourth output ports that are different from each other among the plurality of output ports.



US 20220085506A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2022/0085506 A1**

(43) **Pub. Date: Mar. 17, 2022**

LIM et al.

(54) **ANTENNA DEVICE**

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

(72) Inventors: **Daeki LIM**, Suwon-si (KR); **Youngsik HUR**, Suwon-si (KR); **Juhyoung PARK**, Suwon-si (KR); **Jeongki RYOO**, Suwon-si (KR); **Myeong Woo HAN**, Suwon-si (KR); **Woncheol LEE**, Suwon-si (KR)

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

(21) Appl. No.: **17/146,560**

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

(30) **Foreign Application Priority Data**

Sep. 16, 2020 (KR) 10-2020-0119014

Publication Classification

(51) **Int. Cl.**

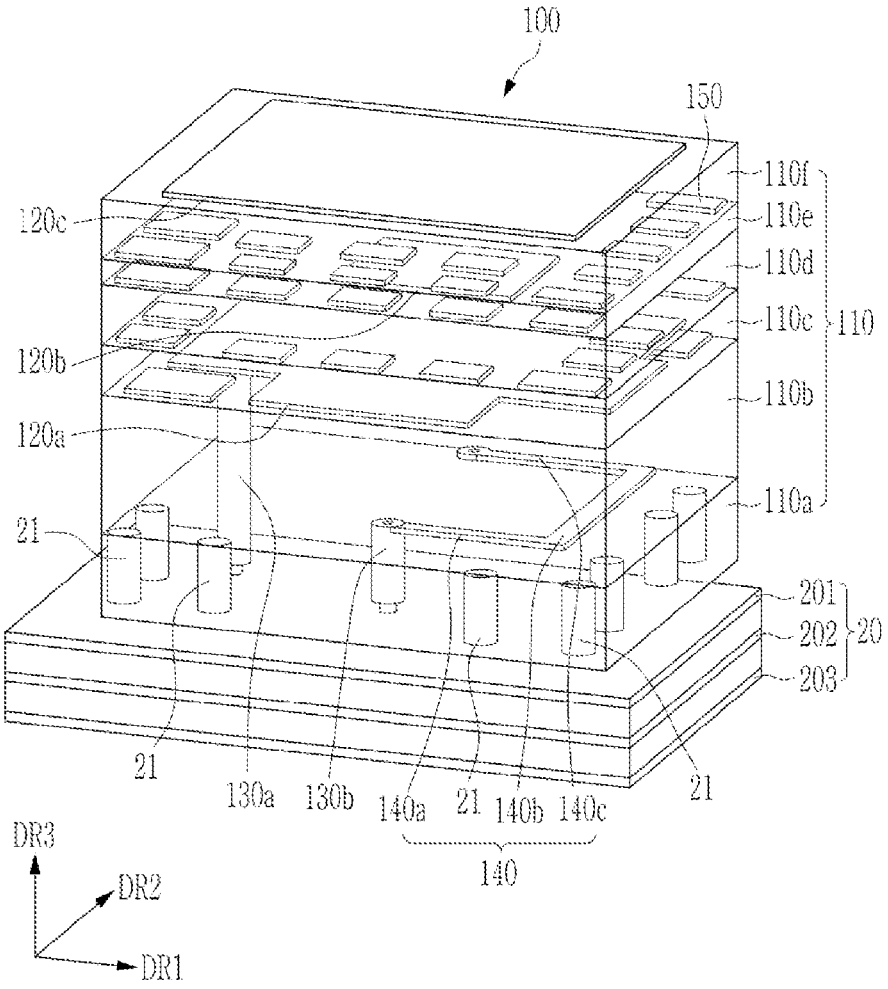
H01Q 9/04 (2006.01)
H01Q 1/48 (2006.01)
H01Q 5/307 (2006.01)

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

CPC ***H01Q 9/045*** (2013.01); ***H01Q 5/307*** (2015.01); ***H01Q 9/0414*** (2013.01); ***H01Q 1/48*** (2013.01)

(57) **ABSTRACT**

An antenna device includes: a dielectric layer including a first edge extending in a first direction and a second edge, shorter that the first edge, extending in a second direction; a first feed via penetrating a portion of the dielectric layer in a third direction, and disposed adjacent to the second edge; a second feed via penetrating a portion of the dielectric layer in the third direction, disposed adjacent to the first edge; a feed pattern connected to the second feed via; and an antenna patch disposed on the second feed via and the feed pattern in the third direction, and coupled to the first feed via, the second feed via, and the feed pattern. The antenna patch overlaps the first feed via in a direction parallel to the first direction or the second direction. The antenna patch overlaps the feed pattern in a direction parallel to the third direction.



US 20220085507A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2022/0085507 A1

XUE et al. (43) Pub. Date: Mar. 17, 2022

(54) **DUAL-POLARIZED WIDE-STOPBAND FILTERING ANTENNA AND COMMUNICATIONS DEVICE**

(71) Applicant: **SOUTH CHINA UNIVERSITY OF TECHNOLOGY**, Guangzhou City (CN)

(72) Inventors: **Quan XUE**, Guangzhou City (CN); **Wanchen YANG**, Guangzhou City (CN); **Wenquan CHE**, Guangzhou City (CN); **Yingqi ZHANG**, Guangzhou City (CN); **Yongzheng LI**, Guangzhou City (CN)

(73) Assignee: **SOUTH CHINA UNIVERSITY OF TECHNOLOGY**, Guangzhou City (CN)

(21) Appl. No.: **17/149,113**

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

(30) **Foreign Application Priority Data**

Sep. 15, 2020 (CN) 202010965272.0

Publication Classification

(51) **Int. Cl.**

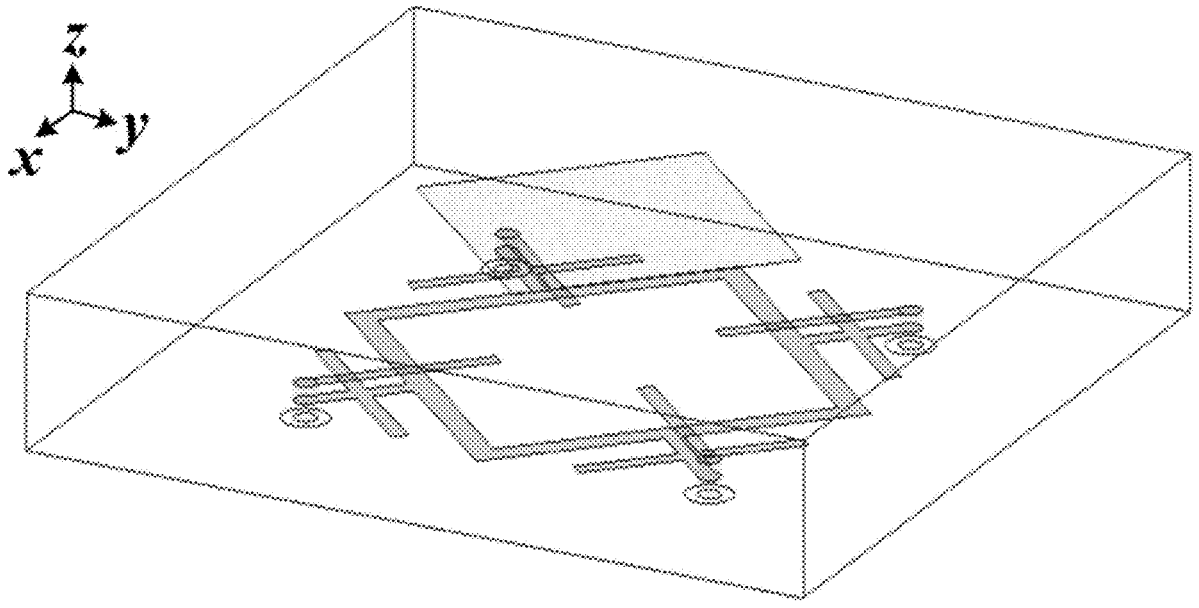
H01Q 9/04	(2006.01)
H01Q 25/00	(2006.01)
H01Q 1/48	(2006.01)

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

CPC ***H01Q 9/045*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 25/001*** (2013.01)

(57) **ABSTRACT**

The present invention discloses a dual-polarized wide-stopband filtering antenna and a communications device, the antenna comprising a dielectric substrate, a metal ground plate, a metal radiating patch, metal feeding arms, a metal square ring stub, metal transverse stubs, and metal probes, wherein the dielectric substrate is a rectangular cavity structure, the metal ground plate is disposed on the bottom surface of the dielectric substrate, and the metal radiating patch is disposed in the middle of the top surface of the dielectric substrate; the metal transverse stubs and the metal square ring stub are located inside the rectangular cavity and are connected on the same layer; the metal feeding arms are located between the metal square ring stub and the metal radiating patch; one end of the metal probe and a circular hole disposed on the metal ground plate form a coaxial feeding structure, and the other end of the metal probe is linked with the midpoint of the metal transverse stub and it is simultaneously connected to one end of the metal feeding arm to form a dual-polarized differential feeding structure; and the metal probes are connected to the metal transverse stubs. The antenna has a simple structure, can greatly reduce the volume of a radio frequency front end, and has no additional insertion loss.



US 20220085510A1

(19) **United States**

(12) **Patent Application Publication**

PARK et al.

(10) **Pub. No.: US 2022/0085510 A1**

(43) **Pub. Date: Mar. 17, 2022**

(54) **ANTENNA DEVICE**

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

(72) Inventors: **Juhyoung PARK**, Suwon-si (KR); **Daeki LIM**, Suwon-si (KR); **Youngsik HUR**, Suwon-si (KR); **Sungyong AN**, Suwon-si (KR); **Jae Yeong KIM**, Suwon-si (KR); **Chin Mo KIM**, Suwon-si (KR)

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

(21) Appl. No.: **17/149,968**

(22) Filed: **Jan. 15, 2021**

(30) **Foreign Application Priority Data**

Sep. 16, 2020 (KR) 10-2020-0119013

Publication Classification

(51) **Int. Cl.**

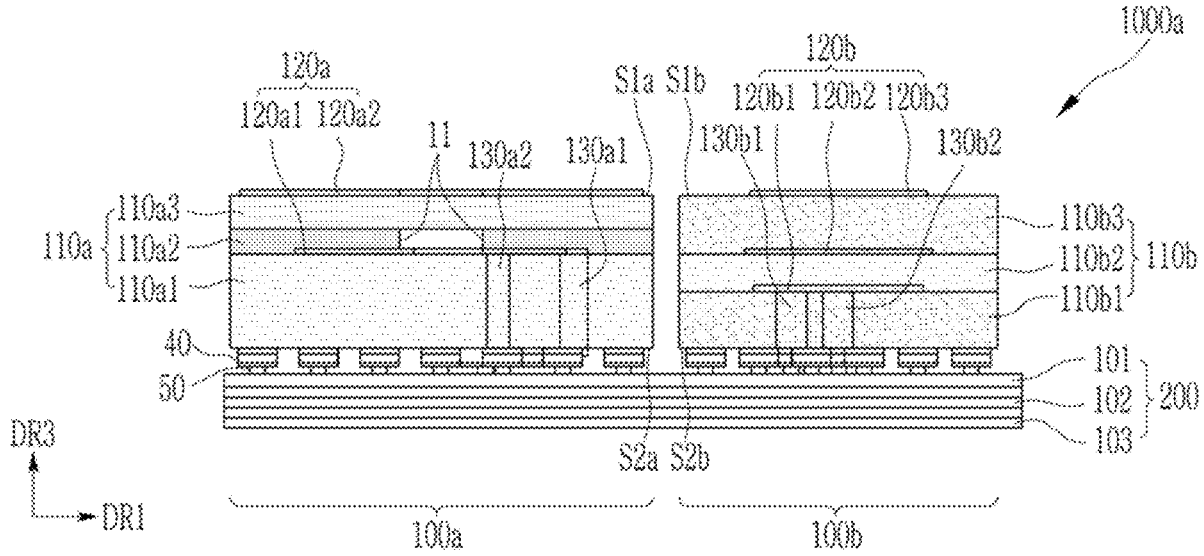
H01Q 9/04	(2006.01)
H04B 3/52	(2006.01)
H01Q 13/28	(2006.01)
H01P 3/16	(2006.01)
H01Q 1/24	(2006.01)

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

CPC ***H01Q 9/0421*** (2013.01); ***H04B 3/52*** (2013.01); ***H01Q 1/243*** (2013.01); ***H01P 3/16*** (2013.01); ***H01Q 9/0435*** (2013.01); ***H01Q 13/28*** (2013.01)

(57) **ABSTRACT**

An antenna device includes first and second dielectric layers. The first dielectric layer includes first and second sides facing each other in a third direction. The second dielectric layer includes third and fourth sides facing each other in the third direction. A first antenna patch is disposed on the first side of the first dielectric layer. A second antenna patch is disposed on the third side of the second dielectric layer. Signals with a first frequency bandwidth are transmitted or received electrical signals applied to the first antenna patch. Signals with a different second frequency bandwidth are transmitted or received by an electrical signal applied to the second antenna patch. A height of the second dielectric layer measured to the third side from the fourth side in a direction parallel to a third direction is greater than a height of the first dielectric layer measured to the first side from the second side.



US 20220085511A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0085511 A1**

HUANG et al. (43) **Pub. Date: Mar. 17, 2022**

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

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

(72) Inventors: **Huan-Chu HUANG**, Guangdong (CN); **Rongjie MA**, Guangdong (CN); **Xianjing JIAN**, Guangdong (CN); **Zhimin ZHU**, Guangdong (CN)

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

(21) Appl. No.: **17/531,603**

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

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2020/090051, filed on May 13, 2020.

(30) **Foreign Application Priority Data**

May 22, 2019 (CN) 201910430954.9

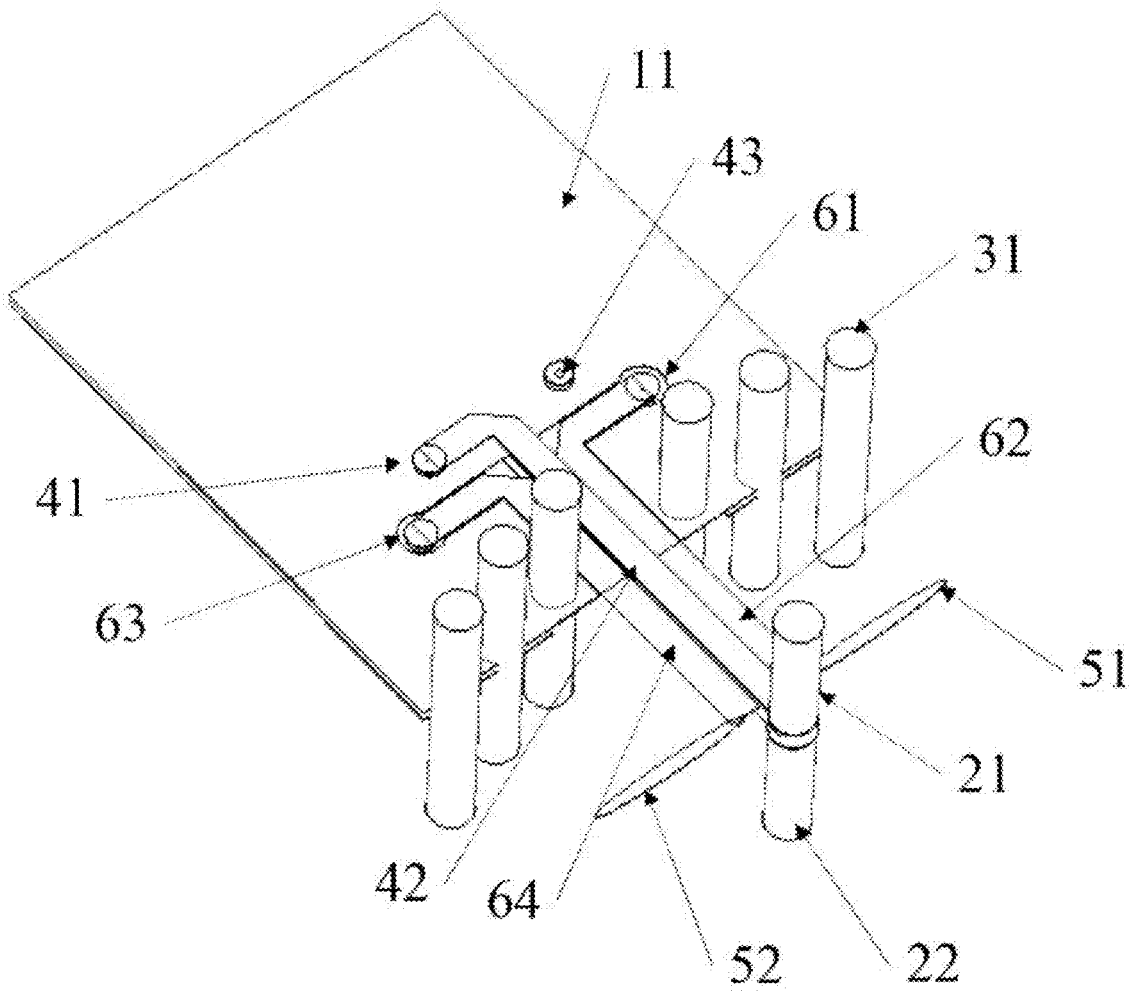
Publication Classification

(51) **Int. Cl.**
H01Q 9/06 (2006.01)
H01Q 19/18 (2006.01)

(52) **U.S. Cl.**
CPC ***H01Q 9/065*** (2013.01); ***H01Q 19/18*** (2013.01)

(57) **ABSTRACT**

An antenna element antenna element includes: a substrate, having a ground plate; a vertically polarized dipole antenna, including a first antenna branch and a second antenna branch, where the first antenna branch and the second antenna branch are disposed in the substrate at an interval; a reflector, including several reflection pillars, where the several reflection pillars are sequentially arranged in the substrate at intervals along a parabola; and a first feeding structure, where the first antenna branch and the second antenna branch are electrically connected to the ground plate via the first feeding structure.



US 20220085512A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0085512 A1**

HUANG et al. (43) **Pub. Date: Mar. 17, 2022**

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

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

(72) Inventors: **Huan-Chu HUANG**, Guangdong (CN); **Rongjie MA**, Guangdong (CN); **Xianjing JIAN**, Guangdong (CN)

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

(21) Appl. No.: **17/531,627**

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

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2020/090507, filed on May 15, 2020.

(30) **Foreign Application Priority Data**

May 22, 2019 (CN) 201910430968.0

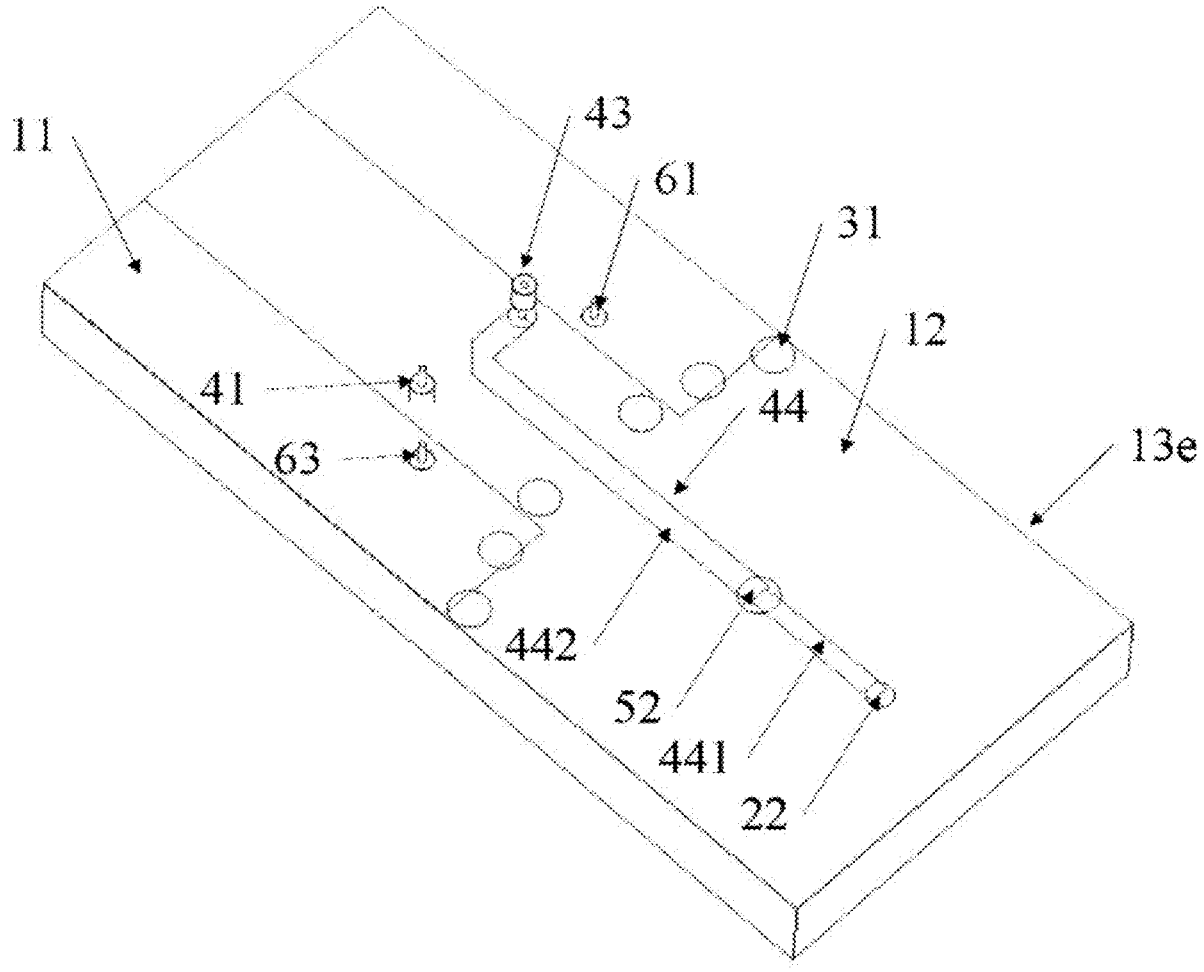
Publication Classification

(51) **Int. Cl.**
H01Q 9/06 (2006.01)
H01Q 19/18 (2006.01)

(52) **U.S. Cl.**
CPC ***H01Q 9/065*** (2013.01); ***H01Q 19/18*** (2013.01)

(57) **ABSTRACT**

An antenna element includes a substrate, a first vertically polarized dipole antenna, a second vertically polarized dipole antenna, a reflector and a first feeding structure. The substrate has a ground plate. The first vertically polarized dipole antenna includes a first antenna branch and a second antenna branch that are disposed in the substrate at an interval. The second vertically polarized dipole antenna includes a third antenna branch and a fourth antenna branch that are disposed in the substrate at an interval. The reflector includes several reflection pillars that are arranged in the substrate at intervals along a parabola. The first feeding structure electrically connects each of the first antenna branch, the second antenna branch, the third antenna branch, and the fourth antenna branch to the ground plate.



US 20220085513A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2022/0085513 A1

Shen et al. (43) Pub. Date: Mar. 17, 2022

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

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

(72) Inventors: **Laiwei Shen**, Shanghai (CN); **Liang Xue**, Shanghai (CN); **Jiaqing You**, Shanghai (CN)

(21) Appl. No.: **17/420,609**

(22) PCT Filed: **Jan. 4, 2019**

(86) PCT No.: **PCT/CN2019/070437**

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

Publication Classification

(51) **Int. Cl.**

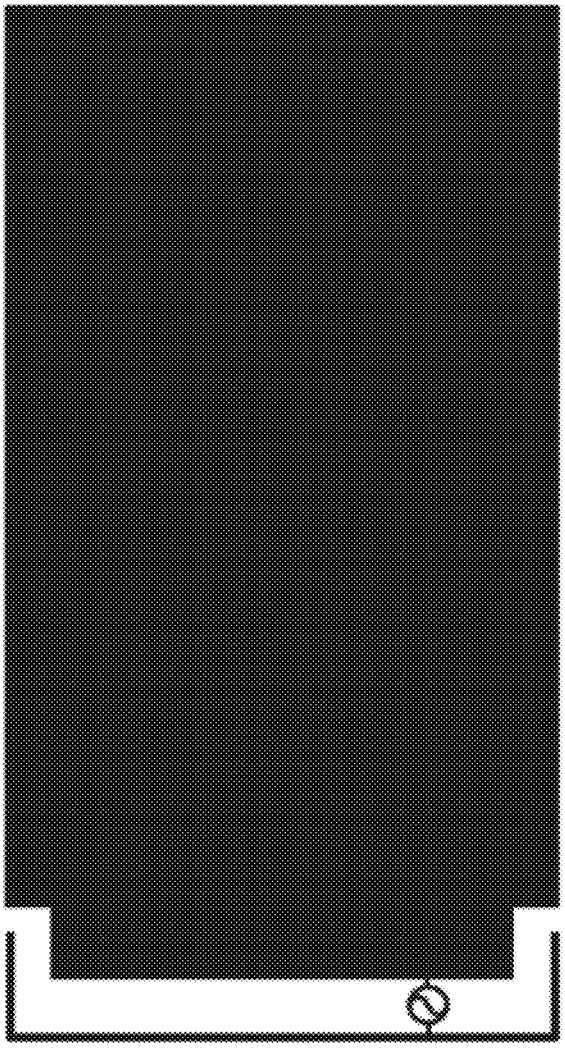
H01Q 13/10	(2006.01)
H01Q 1/24	(2006.01)
H01Q 1/44	(2006.01)
H01Q 21/28	(2006.01)
H01Q 5/378	(2006.01)

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

CPC ***H01Q 13/103*** (2013.01); ***H01Q 1/243*** (2013.01); ***H01Q 5/378*** (2015.01); ***H01Q 21/28*** (2013.01); ***H01Q 1/44*** (2013.01)

(57) **ABSTRACT**

An antenna system having a first antenna that includes a metal middle frame, a first metal frame, and a second metal frame. The middle frame is a ground of the first antenna. The first and second metal frames are side edges of the mobile terminal. A first gap is formed by the first, the second metal frames, and the middle frame. A first end of the first metal frame is connected to the middle frame by a first connection point, and a second end of the first metal frame is connected to a first end of the second metal frame. A first slit is located between a second end of the second metal frame and the middle frame. The first feed point on the first metal frame is connected to the middle frame. A length of the first metal frame is greater than a length of the second metal frame.



US 20220085518A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0085518 A1**

THOMAS et al. (43) **Pub. Date: Mar. 17, 2022**

(54) **ANTENNA ARRAY ASSEMBLY**

(71) Applicant: **Cambium Networks Ltd**, Ashburton (GB)

(72) Inventors: **Jomon THOMAS**, Bangalore (IN); **Deepu NAIR**, Bangalore (IN); **Visalakshy TC**, Bangalore (IN); **Nigel KING**, Ashburton (GB); **Varun HEDGE**, Bangalore (IN)

(73) Assignee: **Cambium Networks Ltd**, Ashburton (GB)

(21) Appl. No.: **17/534,045**

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

Related U.S. Application Data

(63) Continuation of application No. PCT/GB2020/051231, filed on May 20, 2020.

(30) **Foreign Application Priority Data**

May 23, 2019 (IN) 201941020526

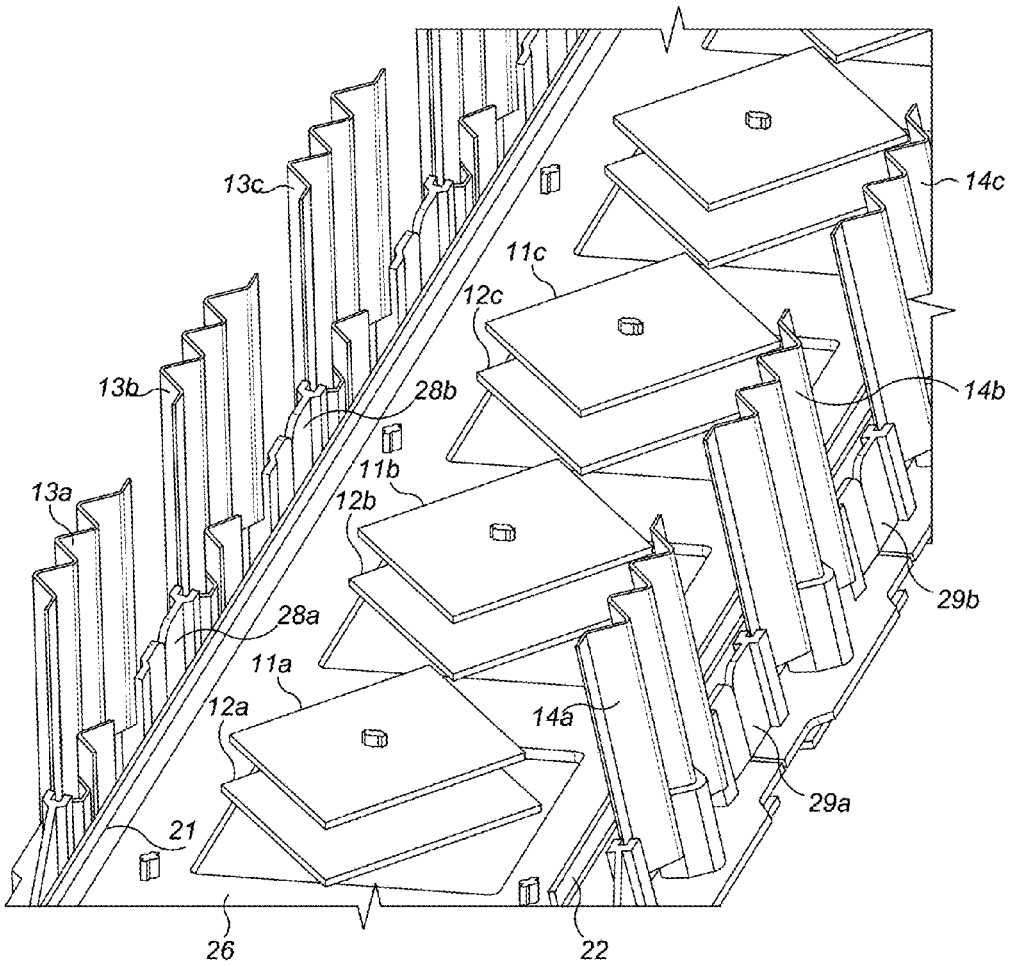
Publication Classification

(51) **Int. Cl.**
H01Q 21/08 (2006.01)
H01Q 9/04 (2006.01)

(52) **U.S. Cl.**
CPC ***H01Q 21/08*** (2013.01); *H01Q 1/48* (2013.01); ***H01Q 9/0414*** (2013.01)

(57) **ABSTRACT**

An antenna array assembly comprises a ground plate, a linear array of patch radiator elements disposed in a spaced parallel relationship with a first face of the ground plate, and a first, second, third and fourth elongate passive radiator, each comprising one or more substantially planar conductive parts which are electrically isolated from the ground plate. The first and second elongate passive radiators are disposed symmetrically on either side of the linear array and parallel to a centre line of the linear array, on the same side of the ground plate as the linear array. The third and fourth elongate passive radiators are disposed further from the linear array than are the first and second elongate passive radiators. Each of the third and fourth elongate passive radiators is narrower than and projects further from the ground plate than does each of the first and second elongate passive radiators.



US 20220085520A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0085520 A1**

Hinman (43) **Pub. Date: Mar. 17, 2022**

(54) **MULTI-BAND ACCESS POINT ANTENNA ARRAY**

(71) Applicant: **Mimosa Networks, Inc.**, Santa Clara, CA (US)

(72) Inventor: **Brian L. Hinman**, Los Gatos, CA (US)

(21) Appl. No.: **17/532,946**

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

Related U.S. Application Data

(63) Continuation of application No. 15/658,324, filed on Jul. 24, 2017.

(60) Provisional application No. 62/368,946, filed on Jul. 29, 2016.

Publication Classification

(51) **Int. Cl.**

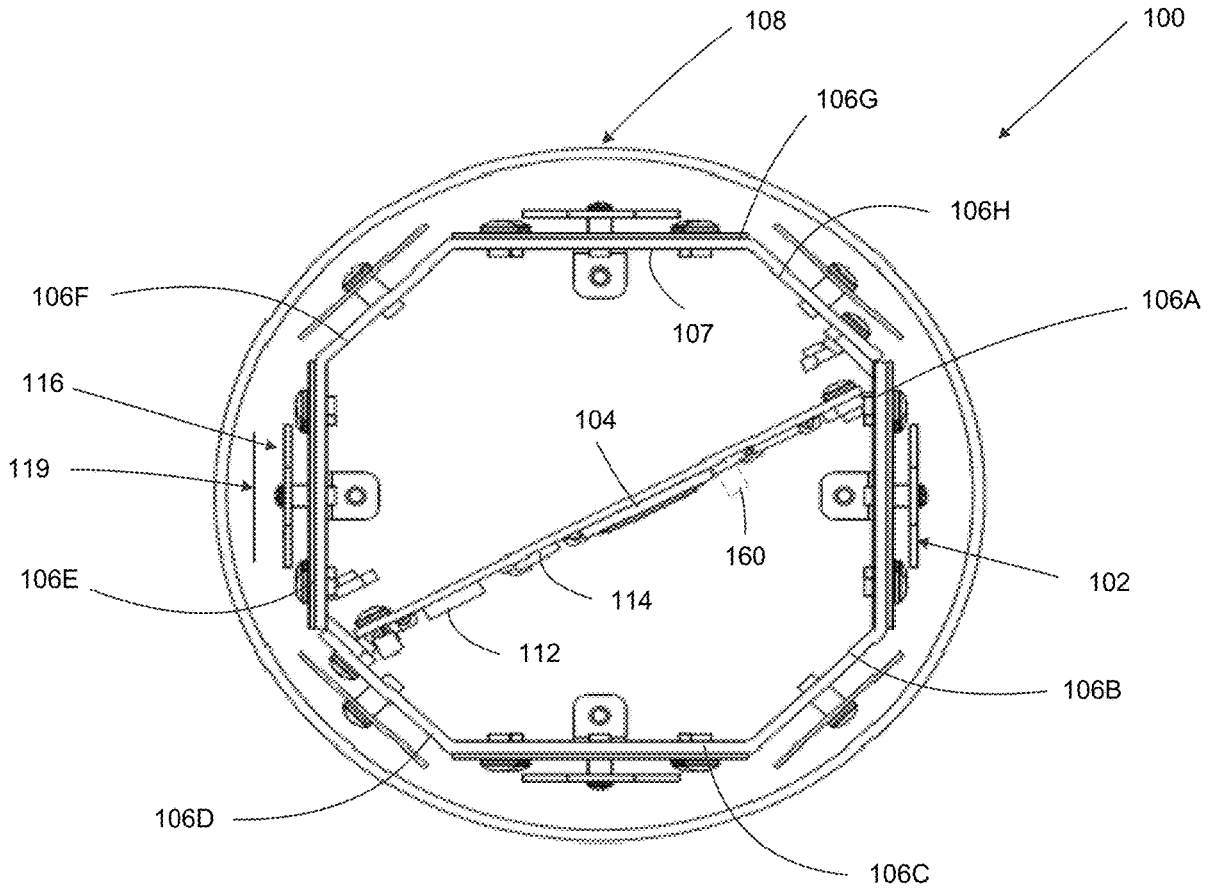
H01Q 21/28	(2006.01)
H01Q 21/20	(2006.01)
H01Q 1/00	(2006.01)
H01Q 1/22	(2006.01)
H01Q 9/04	(2006.01)
H01Q 21/08	(2006.01)
H01Q 5/40	(2006.01)
H01Q 21/24	(2006.01)
H01Q 5/30	(2006.01)
H01Q 1/48	(2006.01)

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

CPC ***H01Q 21/28*** (2013.01); ***H01Q 21/205*** (2013.01); ***H01Q 1/007*** (2013.01); ***H01Q 1/2291*** (2013.01); ***H01Q 9/0407*** (2013.01); *H04B 7/0617* (2013.01); ***H01Q 5/40*** (2015.01); ***H01Q 21/24*** (2013.01); ***H01Q 5/30*** (2015.01); ***H01Q 1/48*** (2013.01); ***H01Q 21/08*** (2013.01)

(57) **ABSTRACT**

Multi-band antenna arrays and methods of use are provided herein. An example device includes vertical surfaces arranged into a tubular configuration, where each of the vertical surfaces comprising antenna arrays is aligned along the vertical surfaces. The antenna elements are arrayed through a feed network in such a way that antenna gain is increased while elevation beam-width is reduced. The device also includes two or more radios connected to the antenna arrays on the vertical surfaces via the feed network.



US 20220086971A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2022/0086971 A1

MAEDA et al. (43) Pub. Date: Mar. 17, 2022

(54) HIGH-FREQUENCY HEATING APPARATUS

(71) Applicant: **Panasonic Intellectual Property Management Co., Ltd.**, Osaka (JP)

(72) Inventors: **KAZUKI MAEDA**, Shiga (JP); **DAISUKE HOSOKAWA**, Shiga (JP); **YOSHIHARU OOMORI**, Shiga (JP)

(21) Appl. No.: **17/420,408**

(22) PCT Filed: **Feb. 3, 2020**

(86) PCT No.: **PCT/JP2020/003934**

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

(30) **Foreign Application Priority Data**

Feb. 13, 2019 (JP) 2019-023095

Publication Classification

(51) **Int. Cl.**

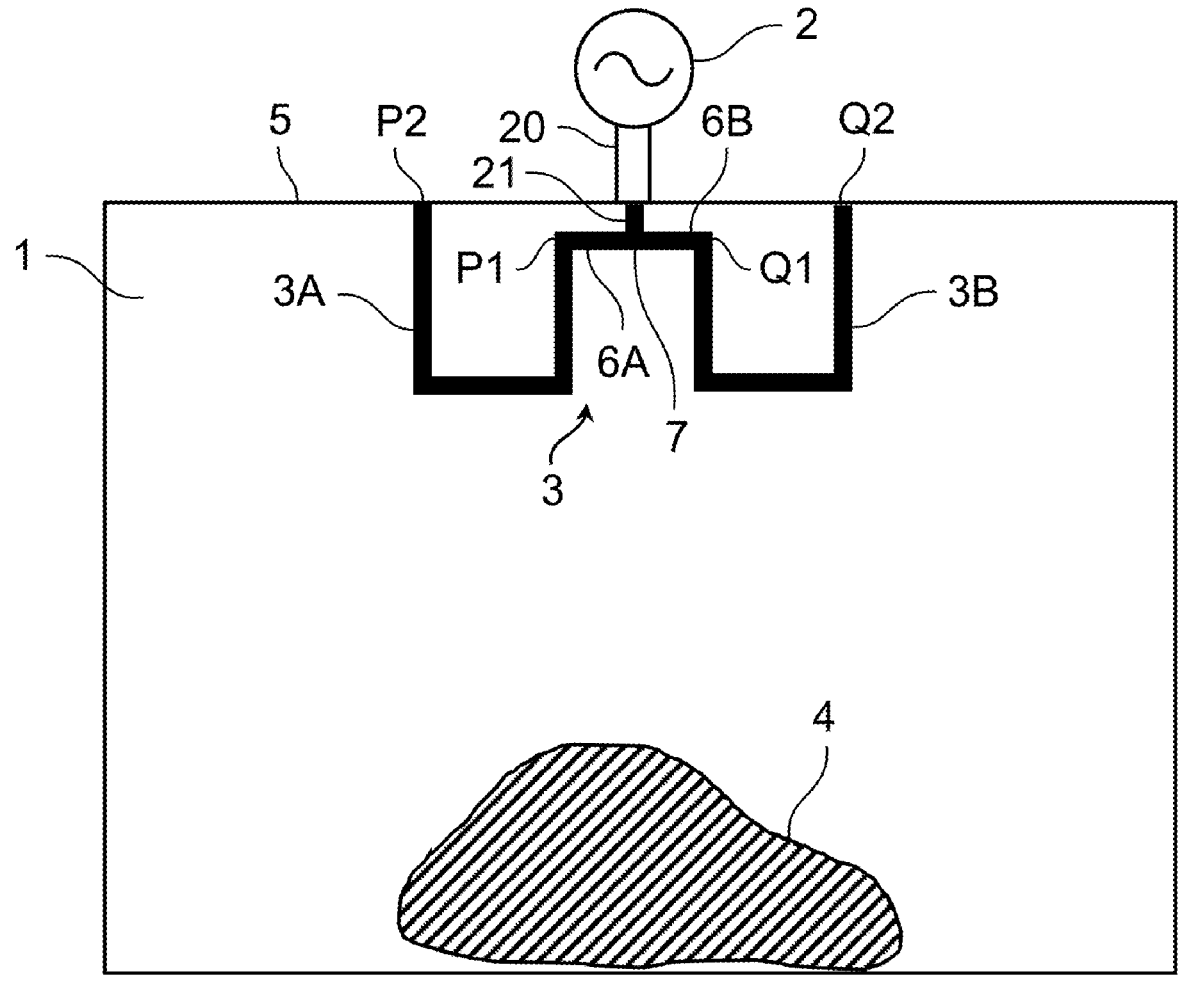
H05B 6/72	(2006.01)
H05B 6/68	(2006.01)
H05B 6/70	(2006.01)
H05B 6/76	(2006.01)

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

CPC ***H05B 6/72*** (2013.01); ***H05B 6/76*** (2013.01); ***H05B 6/70*** (2013.01); ***H05B 6/68*** (2013.01)

(57) **ABSTRACT**

A high-frequency heating apparatus includes heating chamber (**1**), generator (**2**), radiator (**3**), and controller (**30**). Heating chamber (**1**) has a wall surface including metal, and accommodates object (**4**) to be heated. Generator (**2**) generates high-frequency power at any frequency in a band of 2.4 GHz to 2.5 GHz. Radiator (**3**) includes loop antenna (**3**) including a plurality of loop portions (**3**A, **3**B), and radiates the high-frequency power generated by generator (**2**) to heating chamber (**1**). Controller (**30**) controls a frequency of the high-frequency power generated by generator (**2**). According to this aspect, a heating target can be uniformly heated or partially heated without a waveguide for transmitting high-frequency power.



US 20220094034A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0094034 A1**

WU et al. (43) **Pub. Date: Mar. 24, 2022**

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

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

(72) Inventors: **CHIEN-YI WU**, Taipei City (TW); **CHAO-HSU WU**, Taipei City (TW); **CHENG-HSIUNG WU**, Taipei City (TW); **CHING-HSIANG KO**, Taipei City (TW); **SHIH-KENG HUANG**, Taipei City (TW)

(21) Appl. No.: **17/371,643**

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

(30) **Foreign Application Priority Data**

Sep. 21, 2020 (TW) 109132589

Publication Classification

(51) **Int. Cl.**

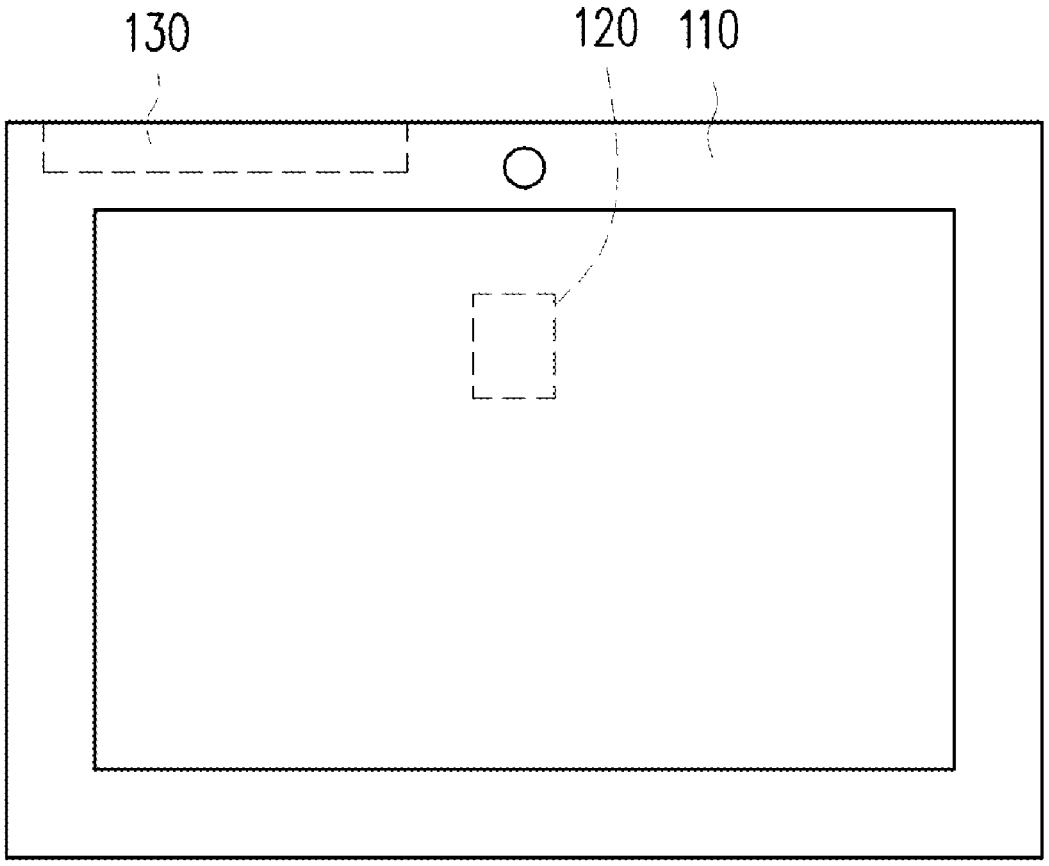
H01Q 1/20	(2006.01)
H01Q 1/50	(2006.01)
H01Q 21/28	(2006.01)
H01Q 1/10	(2006.01)

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

CPC ***H01Q 1/20*** (2013.01); ***H01Q 1/50*** (2013.01); *H01Q 1/244* (2013.01); ***H01Q 1/10*** (2013.01); ***H01Q 21/28*** (2013.01)

(57) **ABSTRACT**

An electronic device includes a device body, a processing unit, and an antenna module. The antenna module includes an insulating frame and an antenna structure. The insulating frame has a first surface, and a second surface corresponding to the first surface. The antenna structure includes a feeding portion, a first radiation portion, and a first extension portion. The feeding portion includes a first feeding terminal, a second feeding terminal, and a conductive via. The second feeding terminal is coupled to the processing unit, and the conductive via is configured to connect the first feeding terminal to the second feeding terminal. The first radiation portion is connected to the first feeding terminal, the first extension portion is disposed on the second surface and is connected to the first radiation portion, and a first slot is formed between the first extension portion and the second feeding terminal.



US 20220094035A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0094035 A1**

Lai et al. (43) **Pub. Date: Mar. 24, 2022**

(54) **ANTENNA HAVING COMPLEMENTARY MONOPOLE AND SLOT**

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

(72) Inventors: **Chien-Pai Lai**, Taipei City (TW); **Shih Huang Wu**, Spring, TX (US); **Po Chao Chen**, Taipei City (TW)

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

(21) Appl. No.: **17/296,721**

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

(86) PCT No.: **PCT/US2019/036546**

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

Publication Classification

(51) **Int. Cl.**

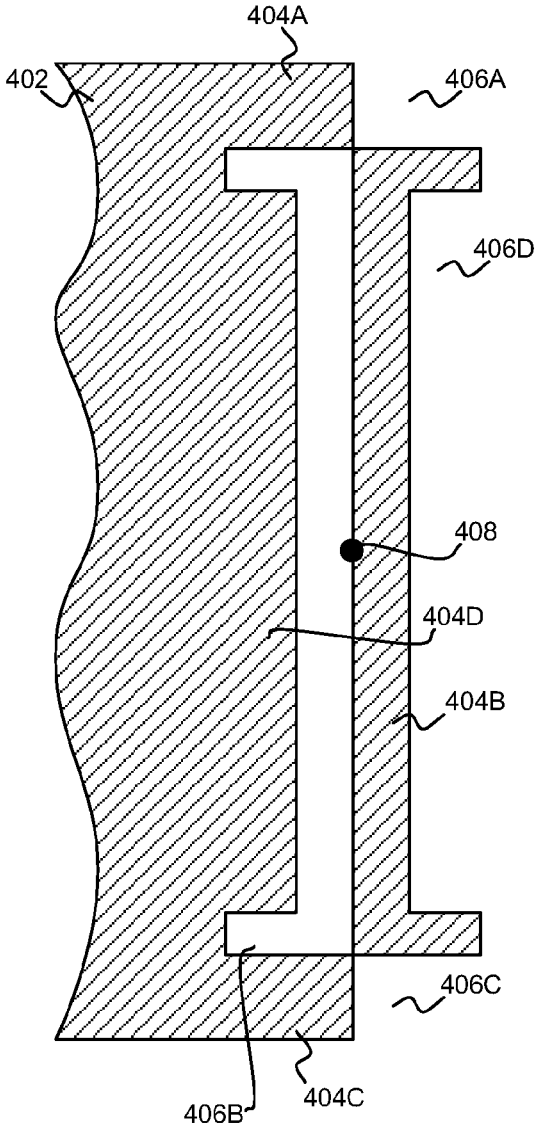
H01Q 1/22	(2006.01)
H01Q 9/42	(2006.01)
H01Q 1/24	(2006.01)

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

CPC ***H01Q 1/2266*** (2013.01); ***H01Q 1/243*** (2013.01); ***H01Q 9/42*** (2013.01)

(57) **ABSTRACT**

An antenna includes a conductive monopole and a non-conductive slot. The non-conductive slot of the antenna has a shape complementary to a shape of the conductive monopole of the antenna. The conductive monopole of the antenna and the non-conductive slot of the antenna are 180-degree rotationally symmetric to one another about a center of the antenna.



US 20220094036A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2022/0094036 A1

Yong et al. (43) Pub. Date: Mar. 24, 2022

(54) ELECTRONIC DEVICES HAVING DIFFERENTIALLY-LOADED MILLIMETER WAVE ANTENNAS

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

(72) Inventors: **Siwen Yong**, Mountain View, CA (US); **Jiangfeng Wu**, San Jose, CA (US); **Yi Jiang**, Cupertino, CA (US); **Simon G. Begashaw**, Santa Clara, CA (US); **Harish Rajagopalan**, San Jose, CA (US); **Hee-Joung Joun**, San Jose, CA (US); **Thomas W. Yang**, Sunnyvale, CA (US); **Mattia Pascolini**, San Francisco, CA (US)

(21) Appl. No.: **17/031,618**

(22) Filed: **Sep. 24, 2020**

Publication Classification

(51) **Int. Cl.**

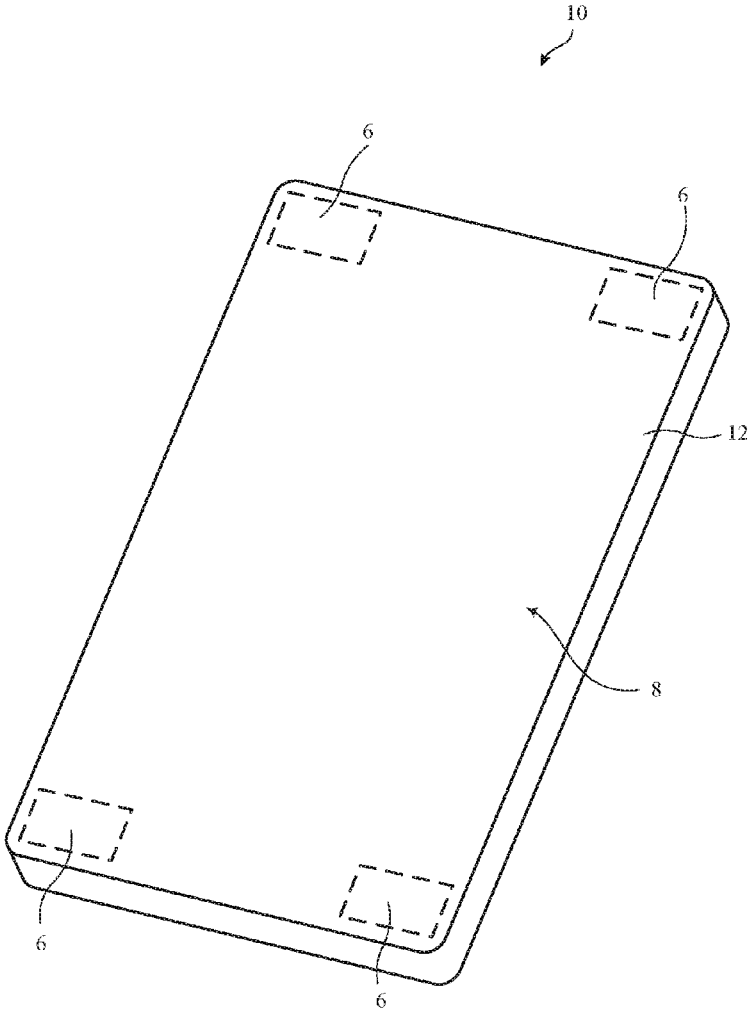
H01Q 1/22	(2006.01)
H01Q 1/38	(2006.01)
H01Q 3/26	(2006.01)

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

CPC ***H01Q 1/2283*** (2013.01); ***H01Q 3/2617*** (2013.01); ***H01Q 1/38*** (2013.01)

(57) **ABSTRACT**

An electronic device may have an antenna that conveys radio-frequency signals at frequencies greater than 10 GHz. The antenna may be embedded in a substrate. The substrate may have routing layers, first antenna layers on the routing layers, second antenna layers on the first antenna layers, and a third antenna layers on the second antenna layers. The antenna may include first traces on the first antenna layers, second traces on the second antenna layers, and third traces on the third antenna layers. The first antenna layers may have a first bulk dielectric permittivity. The second layers may have a second bulk dielectric permittivity. The third layers may have a third bulk dielectric permittivity. At least one of the first, second, and third bulk dielectric permittivities may be different from the others. This may differentially load the antenna across the antenna layers, thereby broadening the bandwidth of the antenna.



US 20220094038A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0094038 A1**

WANG et al. (43) **Pub. Date: Mar. 24, 2022**

(54) **ANTENNA UNIT, PREPARATION METHOD, AND ELECTRONIC DEVICE**

(71) Applicant: **BOE Technology Group Co., Ltd.**, Beijing (CN)

(72) Inventors: **Yali WANG**, Beijing (CN); **Xiyuan WANG**, Beijing (CN)

(21) Appl. No.: **17/458,606**

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

(30) **Foreign Application Priority Data**

Sep. 24, 2020 (CN) 202011013807.0

Publication Classification

(51) **Int. Cl.**

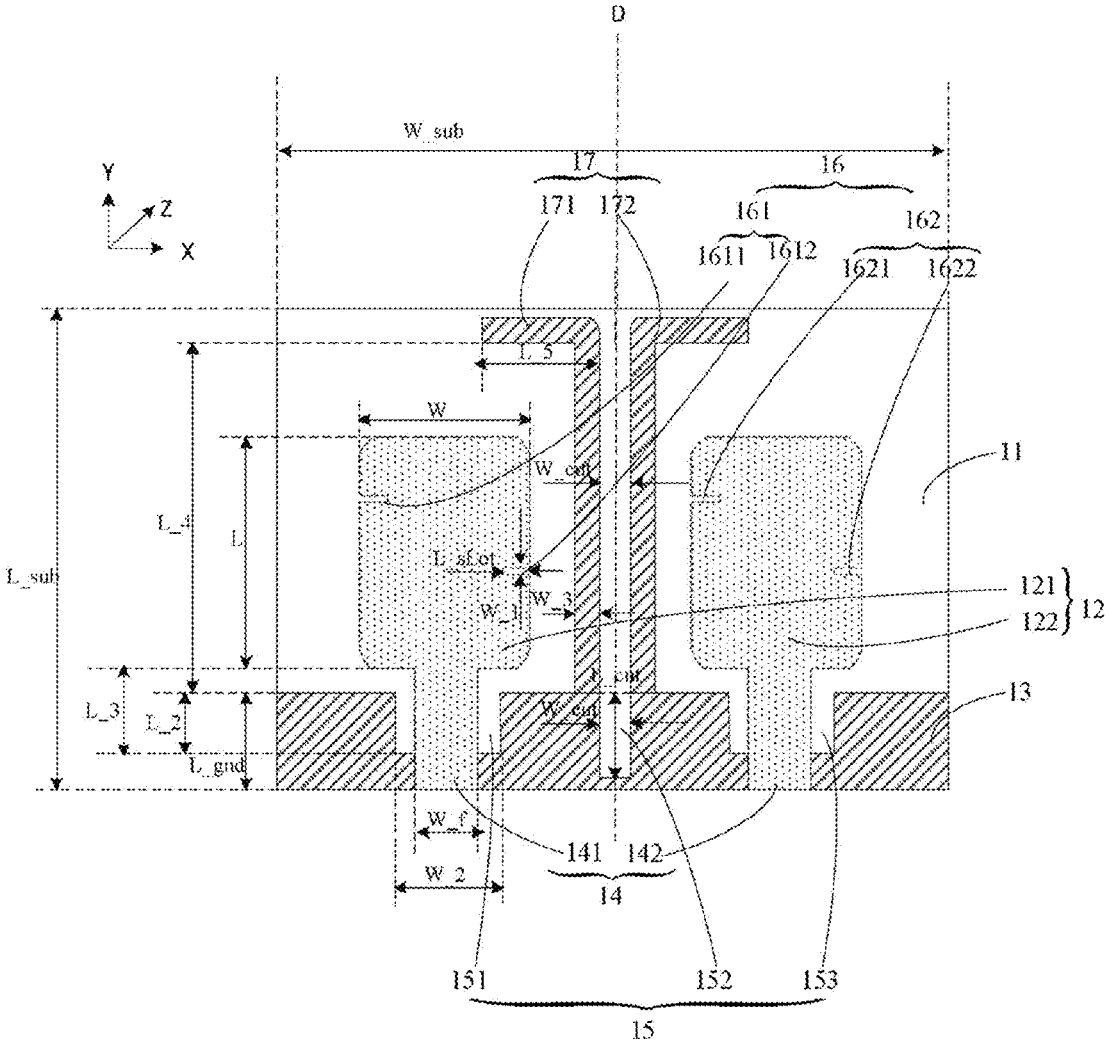
H01Q 1/24	(2006.01)
H01Q 1/38	(2006.01)
H01Q 1/48	(2006.01)
H01Q 9/04	(2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H01Q 9/045*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 1/38*** (2013.01)

(57) **ABSTRACT**

An antenna unit includes a dielectric substrate, an antenna layer, a ground layer, and an additional structure; the antenna layer is disposed on a first surface of the dielectric substrate; the ground layer is disposed on a second surface of the dielectric substrate; wherein the first surface and the second surface are opposite surfaces of the dielectric substrate; the additional structure includes any combination of the following structures: a floor meander structure disposed on the second surface and in a same layer as the ground layer to improve isolation of an antenna, a patch meander structure disposed on the first surface and in a same layer as the antenna layer to expand a bandwidth of an antenna, and a branch structure disposed on the second surface and in a same layer as the ground layer to improve isolation of an antenna and expand a bandwidth of the antenna.



US 20220094040A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2022/0094040 A1

Choi et al. (43) Pub. Date: Mar. 24, 2022

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

(71) Applicant: **SAMSUNG ELECTRONICS CO., LTD.**, Suwon-si (KR)

(72) Inventors: **Taihwan Choi**, Suwon-si (KR); **Junho Kim**, Suwon-si (KR)

(21) Appl. No.: **17/541,534**

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

Related U.S. Application Data

(63) Continuation of application No. PCT/KR2021/005709, filed on May 7, 2021.

(30) **Foreign Application Priority Data**

Jun. 23, 2020 (KR) 10-2020-0076676

Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

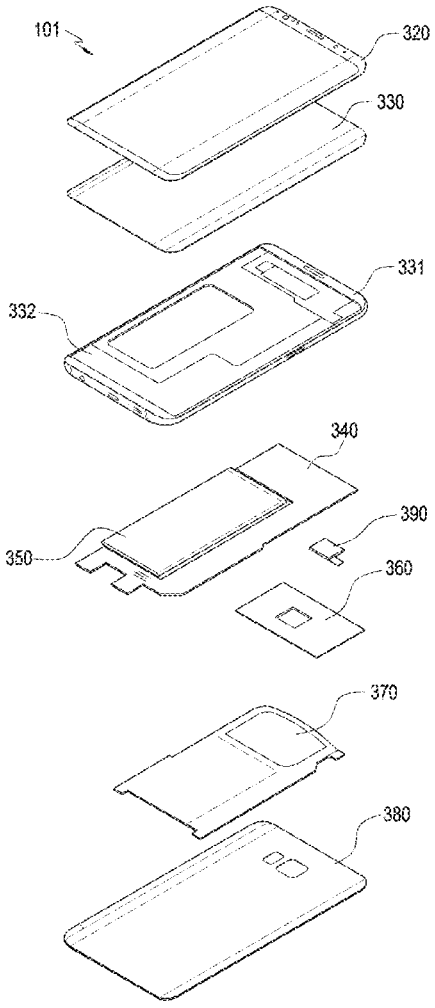
H01Q 1/38 (2006.01)

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

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

(57) **ABSTRACT**

According to various embodiments of the disclosure, an electronic device may comprise: a housing forming at least a portion of an exterior of the electronic device, a printed circuit board disposed in an inner space of the housing, and an antenna structure including at least one antenna positioned in the inner space and electrically connected with the printed circuit board. The antenna structure may include a conductive plate having an opening, the opening including a first opening and a second opening extending from the first opening toward an edge of the conductive plate, a first conductive strip at least partially disposed in the second opening to form a first feed, and a second conductive strip forming a second feed different from the first feed. The electronic device may further comprise a wireless communication circuit electrically connected with the first conductive strip and/or the second conductive strip and configured to transmit and/or receive an RF signal having a frequency in a range of about 3 GHz to 300 GHz.



US 20220094043A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0094043 A1**

Zhu et al. (43) **Pub. Date: Mar. 24, 2022**

(54) **TUNABLE ANTENNA SYSTEM FOR SMART WATCH**

(71) Applicant: **Google LLC**, Mountain View, CA (US)

(72) Inventors: **Jiang Zhu**, Cupertino, CA (US); **Maryam Tabesh**, San Francisco, CA (US)

(21) Appl. No.: **17/540,388**

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

Related U.S. Application Data

(63) Continuation of application No. 16/400,083, filed on May 1, 2019, now Pat. No. 11,205,837.

(60) Provisional application No. 62/674,681, filed on May 22, 2018.

Publication Classification

(51) **Int. Cl.**

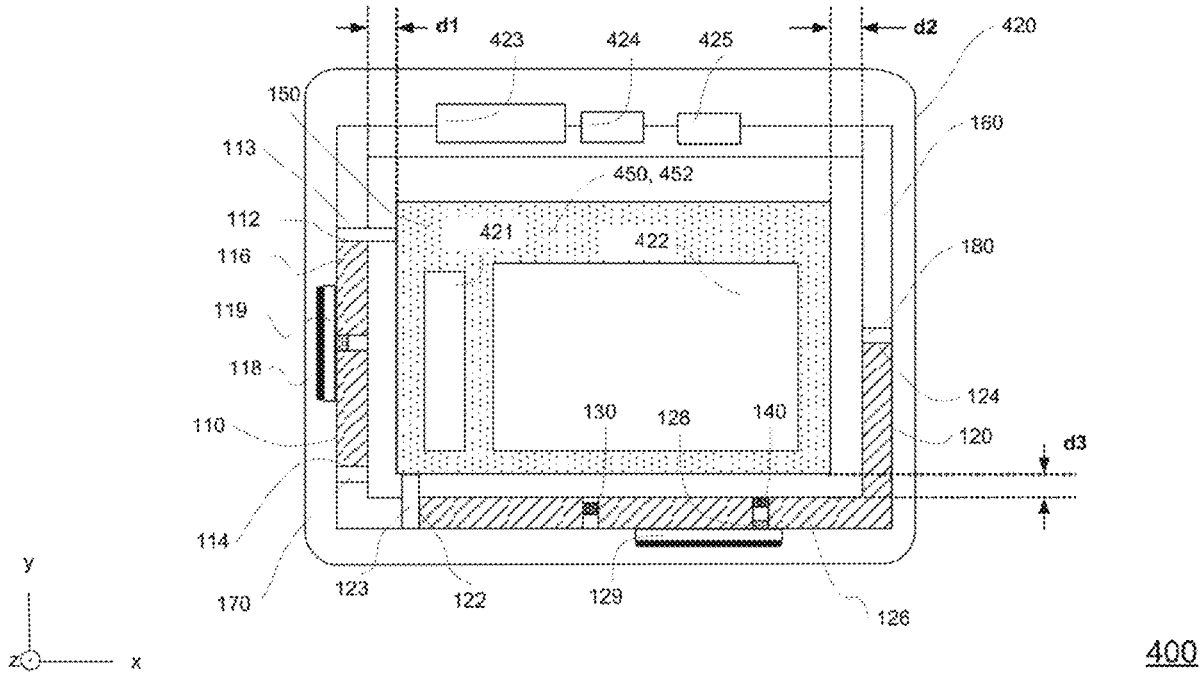
H01Q 1/27	(2006.01)
H01Q 5/30	(2006.01)
H01Q 23/00	(2006.01)

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

CPC ***H01Q 1/273*** (2013.01); ***H01Q 23/00*** (2013.01); ***H01Q 5/30*** (2015.01)

(57) **ABSTRACT**

A tunable antenna system is provided for a wearable personal computing device, such as a smartwatch. The tunable antenna system includes at least two antennas configured for respective sets of frequency ranges. One or more radiating elements of the antennas are formed from portions of a metal bezel of the wearable personal computing device. For at least one of the antennas, an aperture tuner and an impedance tuner positioned within the metal bezel are provided, e.g., to tune between various communication bands. Non-conductive slits may be positioned within the metal bezel to provide isolation between the antennas. A ground plane of the antenna system may be formed by a metallic component of the wearable personal computing device. The antenna system can be insulated from a wearer's skin by a non-metallic back cover and optionally a glass back plate arranged to contact the wearer's skin or clothing during use.



US 20220094046A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0094046 A1**

Compton (43) **Pub. Date: Mar. 24, 2022**

(54) **ELECTRONIC DEVICES HAVING HOUSING-INTEGRATED DIELECTRIC RESONATOR ANTENNAS**

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

(72) Inventor: **Lucas R. Compton**, San Francisco, CA (US)

(21) Appl. No.: **17/028,871**

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

Publication Classification

(51) **Int. Cl.**

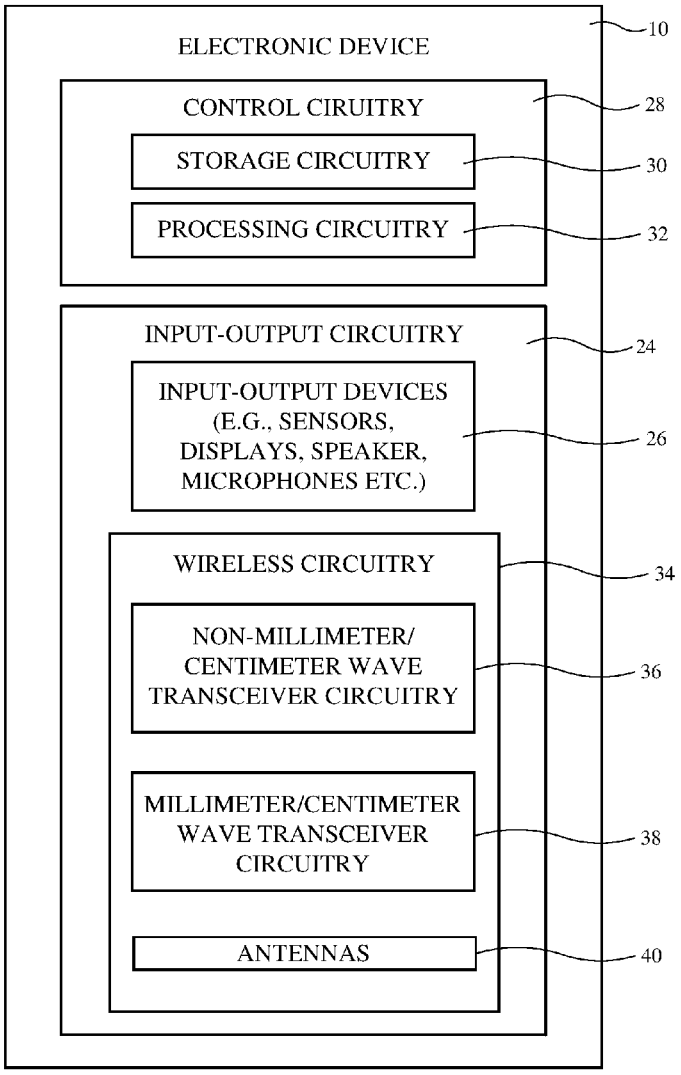
H01Q 1/38	(2006.01)
H01Q 9/04	(2006.01)
H01Q 9/42	(2006.01)
H01Q 1/24	(2006.01)

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

CPC ***H01Q 1/38*** (2013.01); ***H01Q 1/243*** (2013.01); ***H01Q 9/42*** (2013.01); ***H01Q 9/0485*** (2013.01)

(57) **ABSTRACT**

An electronic device may be provided with a conductive sidewall and a phased antenna array having a dielectric resonator antenna aligned with an aperture in the conductive sidewall. A feed probe may excite the antenna to radiate through the aperture at a frequency greater than 10 GHz. The antenna may include an injection-molded plastic substrate that affixes the antenna to the peripheral conductive housing structures, thereby integrating the antenna into the conductive sidewall. A hole or other machining operation may be used to expose the feed probe through the injection-molded plastic substrate. Conductive interconnect structures may be inserted into the substrate and coupled to the feed probe. The interconnect structures may be soldered to a circuit board. The circuit board may be coupled to the feed probe through the interconnect structures. The circuit board may be mounted to a rear surface or a side surface of the injection-molded plastic substrate.



US 20220094059A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0094059 A1**

Wang et al. (43) **Pub. Date: Mar. 24, 2022**

(54) **WIRELESS DEVICES HAVING ANTENNAS FOR COVERING MULTIPLE FREQUENCY BANDS**

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

(72) Inventors: **Yiren Wang**, Cupertino, CA (US); **Daisong Zhang**, Cupertino, CA (US); **Erdinc Irci**, Sunnyvale, CA (US); **Han Wang**, Campbell, CA (US); **Hongfei Hu**, Cupertino, CA (US); **Jingni Zhong**, Santa Clara, CA (US); **Liang Han**, Sunnyvale, CA (US); **Mattia Pascolini**, San Francisco, CA (US); **Ming Chen**, Cupertino, CA (US); **Nanbo Jin**, San Jose, CA (US); **Tiejun Yu**, Fremont, CA (US); **Yijun Zhou**, Mountain View, CA (US); **Yuan Tao**, Cupertino, CA (US); **Yuancheng Xu**, San Jose, CA (US)

(21) Appl. No.: **17/025,987**

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

Publication Classification

(51) **Int. Cl.**

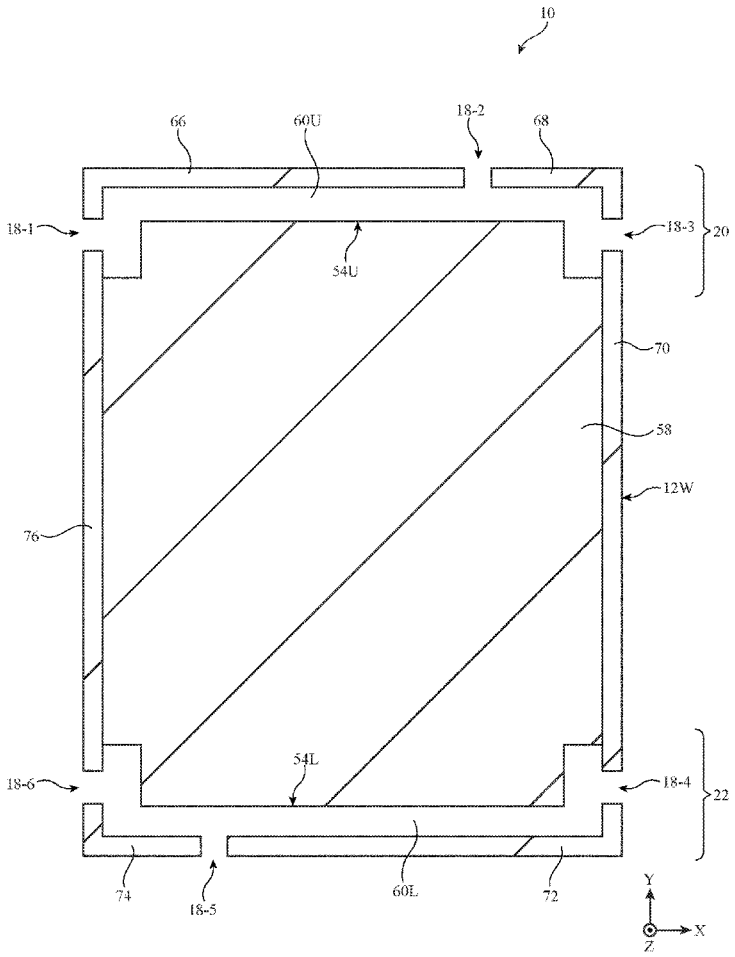
H01Q 5/25	(2015.01)
H01Q 1/24	(2006.01)
H01Q 5/28	(2015.01)
H01Q 9/42	(2006.01)

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

CPC ***H01Q 5/25*** (2015.01); ***H01Q 9/42*** (2013.01); ***H01Q 5/28*** (2015.01); ***H01Q 1/243*** (2013.01)

(57) **ABSTRACT**

An electronic device may be provided with wireless circuitry and a housing with upper and lower ends. The lower end may include first and second open slot antennas that are directly fed by respective feeds and that radiate in a cellular ultra-high band. The lower end may also include first and second inverted-F antennas. The upper end may include third and fourth inverted-F antennas. The first inverted-F antenna may have a first feed that conveys currents below 2700 MHz and a second feed that conveys antenna currents in the cellular ultra-high band, a wireless local area network band, and/or ultra-wideband frequency bands. If desired, the upper end may include a third open slot antenna that is directly fed by a corresponding antenna feed and that radiates in the cellular ultra-high band and/or in the ultra-wideband frequency bands.



US 20220094060A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0094060 A1**

CHANG et al. (43) **Pub. Date: Mar. 24, 2022**

(54) **MOBILE DEVICE**

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

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

(21) Appl. No.: **17/191,937**

(22) Filed: **Mar. 4, 2021**

(30) **Foreign Application Priority Data**

Sep. 21, 2020 (TW) 109132538

Publication Classification

(51) **Int. Cl.**

H01Q 5/307 (2006.01)

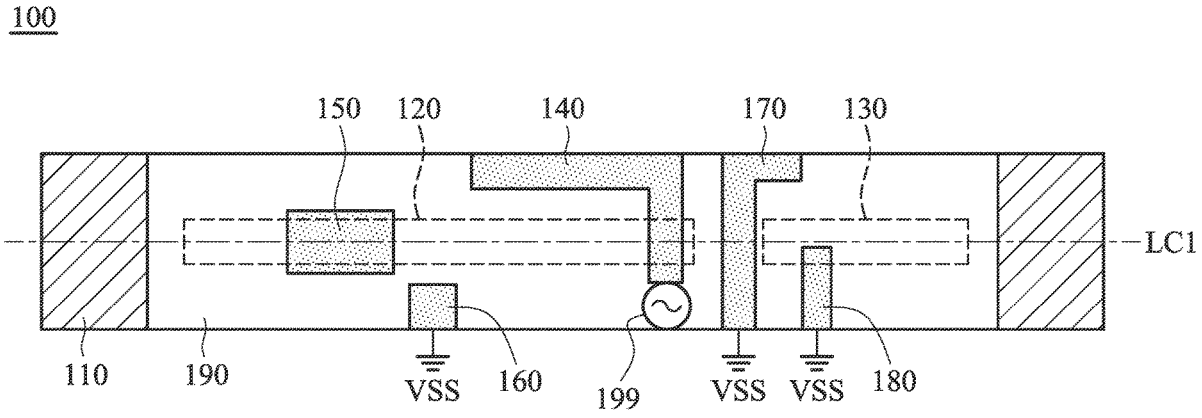
H01Q 9/42 (2006.01)

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

CPC ***H01Q 5/307*** (2015.01); *H01Q 1/2266* (2013.01); ***H01Q 9/42*** (2013.01)

(57) **ABSTRACT**

A mobile device includes a metal mechanism element, a first radiation element, a second radiation element, a third radiation element, a fourth radiation element, a fifth radiation element, and a dielectric substrate. The metal mechanism element has a first closed slot and a second closed slot, which are separated from one another. The first radiation element is coupled to a signal source, and extends across the first closed slot. The second radiation element is floating. The third radiation element is coupled to a ground voltage. The fourth radiation element is coupled to the ground voltage, and is positioned between the first closed slot and the second closed slot. An antenna structure is formed by the first radiation element, the second radiation element, the third radiation element, the fourth radiation element, the fifth radiation element, the first closed slot, and the second closed slot of the metal mechanism element.



US 20220094061A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2022/0094061 A1**

(43) **Pub. Date: Mar. 24, 2022**

Yong et al.

(54) **ELECTRONIC DEVICES HAVING CO-LOCATED MILLIMETER WAVE ANTENNAS**

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

(72) Inventors: **Siwen Yong**, Mountain View, CA (US); **Jiangfeng Wu**, San Jose, CA (US); **Yi Jiang**, Cupertino, CA (US); **Simon G. Begashaw**, Santa Clara, CA (US); **Mattia Pascolini**, San Francisco, CA (US)

(21) Appl. No.: **17/031,627**

(22) Filed: **Sep. 24, 2020**

Publication Classification

(51) **Int. Cl.**

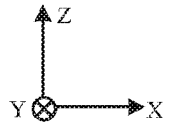
H01Q 5/385	(2006.01)
H01Q 9/04	(2006.01)
H01Q 1/24	(2006.01)

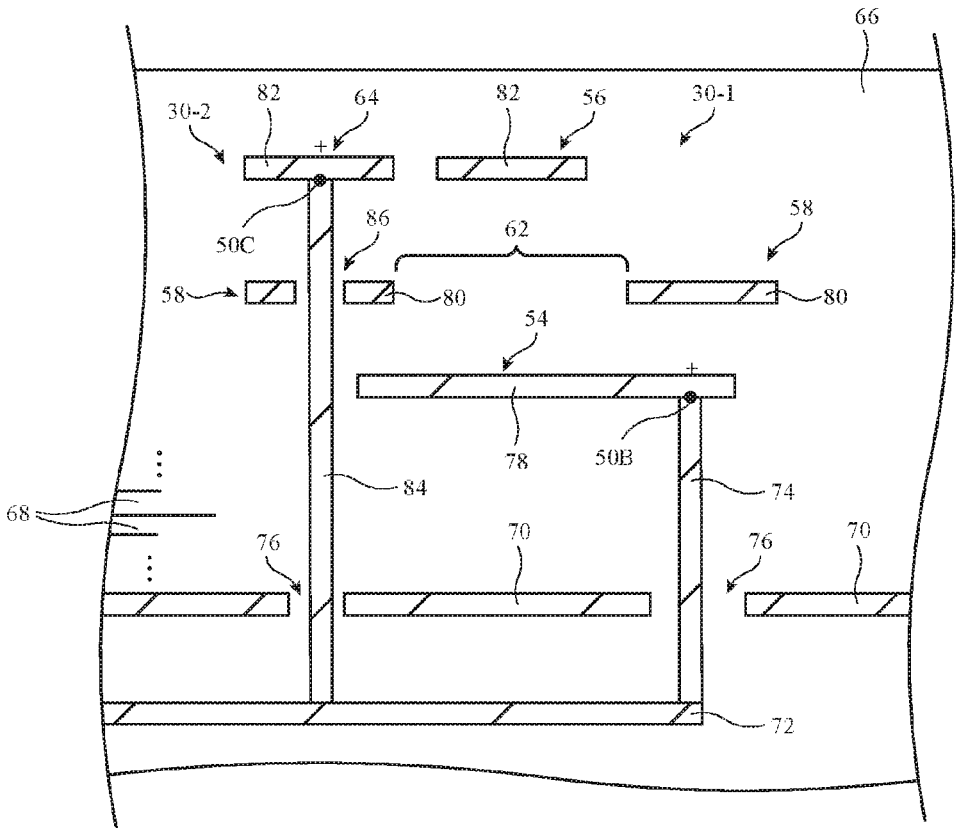
(52) **U.S. Cl.**

CPC ***H01Q 5/385*** (2015.01); ***H01Q 1/243*** (2013.01); ***H01Q 9/0414*** (2013.01)

(57) **ABSTRACT**

An electronic device may include a phased antenna array. The array may include co-located first and second antennas formed on a dielectric substrate. The first antenna may include a first patch element and multi-layer parasitic structures. The multi-layer parasitic structures may include a first set of co-planar parasitic elements. The first set of parasitic elements may overlap the first patch element and may be separated by a gap. The multi-layer parasitic structures may include an additional parasitic element that overlaps the gap. The second antenna may include a second patch element that is co-planar with the additional parasitic patch. The second patch element may at least partially overlap one of the parasitic elements in the first set. The first and second patch antennas may collectively cover first and second frequency bands while occupying a minimal amount of space on the dielectric substrate.





US 20220094062A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2022/0094062 A1**

(43) **Pub. Date: Mar. 24, 2022**

HUANG et al.

(54) **TRANSMISSION STRUCTURE WITH DUAL-FREQUENCY ANTENNA**

(71) Applicant: **Arcadyan Technology Corporation**, Hsinchu City (TW)

(72) Inventors: **Chih-Yung HUANG**, Taichung City (TW); **Kuo-Chang LO**, Miaoli County (TW)

(21) Appl. No.: **17/465,660**

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

(30) **Foreign Application Priority Data**

Sep. 23, 2020 (TW) 109132891

Publication Classification

(51) **Int. Cl.**

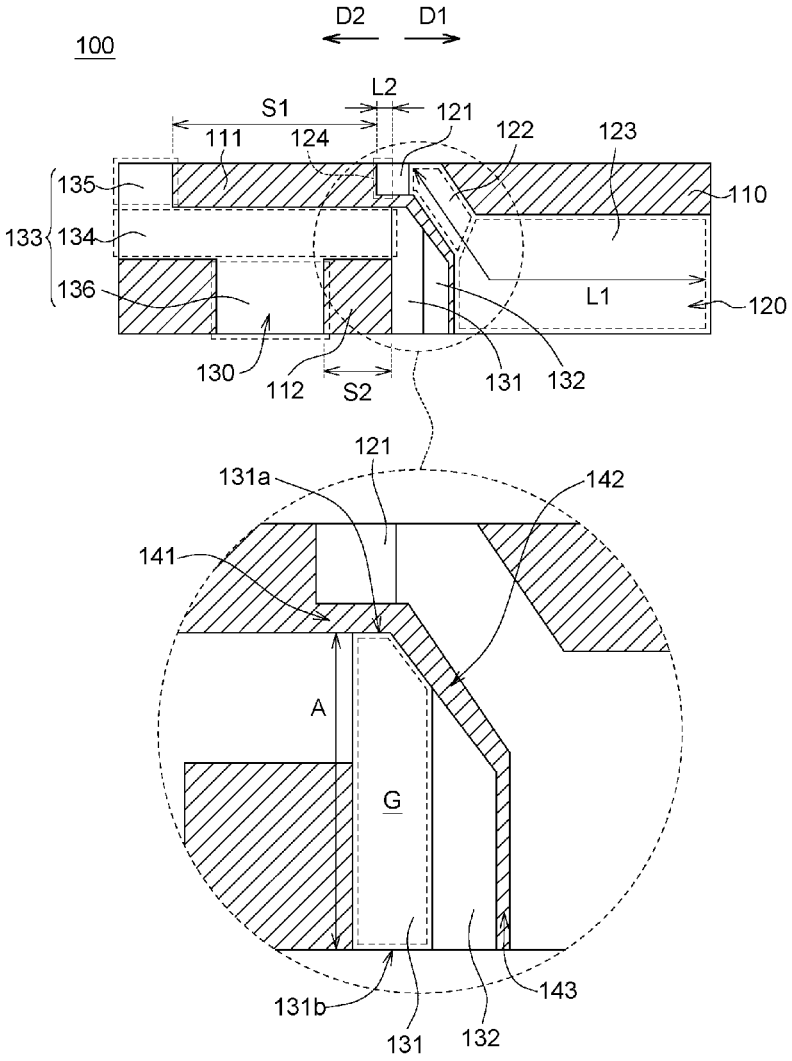
H01Q 5/392 (2006.01)
H01Q 1/38 (2006.01)
H01Q 11/14 (2006.01)
H01Q 21/28 (2006.01)

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

CPC ***H01Q 5/392*** (2015.01); ***H01Q 21/28*** (2013.01); ***H01Q 11/14*** (2013.01); ***H01Q 1/38*** (2013.01)

(57) **ABSTRACT**

A transmission structure with a dual-frequency antenna is provided. The transmission structure includes a substrate, a first radiator and a second radiator. The first radiator has a first electrical connection portion. The first radiator extends from the first electrical connection portion in a first direction and a second direction, wherein the first direction is opposite to the second direction. The second radiator has a second electrical connection portion adjacent to the first electrical connection portion. The second electrical connection portion has a first side and a second side, wherein the first side is closer to the first electrical connection portion than the second side, the second electrical connection portion forms a ground area between the first side and the second side, and the length of the ground area is greater than a first set value.



US 20220094067A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0094067 A1**

Rupakula et al. (43) **Pub. Date: Mar. 24, 2022**

(54) **ELECTRONIC DEVICES HAVING ANTENNAS WITH LOADED DIELECTRIC APERTURES**

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

(72) Inventors: **Bhaskara R. Rupakula**, Sunnyvale, CA (US); **Harish Rajagopalan**, San Jose, CA (US); **Hao Xu**, Cupertino, CA (US); **Jennifer M. Edwards**, San Francisco, CA (US); **Bilgehan Avser**, San Bruno, CA (US); **Siwen Yong**, Mountain View, CA (US)

(21) Appl. No.: **17/031,775**

(22) Filed: **Sep. 24, 2020**

Publication Classification

(51) **Int. Cl.**

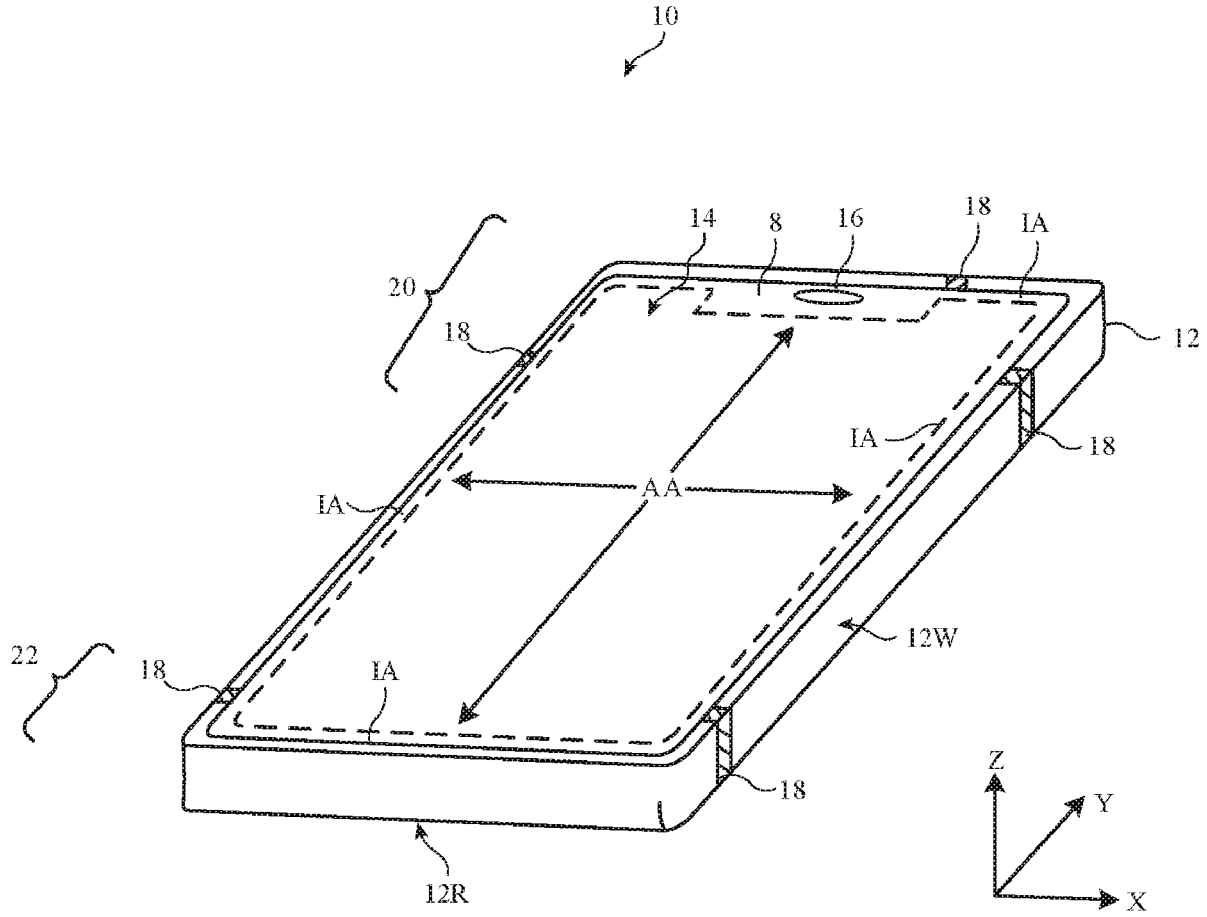
H01Q 13/18	(2006.01)
H01Q 1/38	(2006.01)

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

CPC ***H01Q 13/18*** (2013.01); ***H01Q 1/38*** (2013.01)

(57) **ABSTRACT**

An electronic device may be provided with a conductive sidewall. An aperture may be formed in the sidewall. The sidewall may have a cavity that extends from the aperture towards the interior of the device. The cavity may be filled with an injection-molded plastic substrate. A dielectric block having a dielectric constant greater than that of the injection-molded plastic substrate and the antenna layers may be embedded in the injection-molded plastic substrate. The dielectric block may at least partially overlap an antenna. The antenna may convey radio-frequency signals at a frequency greater than 10 GHz through the cavity, the dielectric block, the injection-molded plastic substrate, and the aperture. The dielectric block may increase the effective dielectric constant of the cavity, allowing the antenna to cover relatively low frequencies without increasing the size of the aperture.



US 20220094073A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2022/0094073 A1**

(43) **Pub. Date: Mar. 24, 2022**

PARK et al.

(54) **ELECTRONIC DEVICE COMPRISING ANTENNA FOR WIRELESS COMMUNICATION**

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

(72) Inventors: **Jungsik PARK**, Suwon-si (KR); **Yoonjung KIM**, Suwon-si (KR); **Gyubok PARK**, Suwon-si (KR); **Dongyeon KIM**, Suwon-si (KR); **Yonghwa KIM**, Suwon-si (KR); **Jinwoo PARK**, Suwon-si (KR); **Jinho LIM**, Suwon-si (KR)

(21) Appl. No.: **17/311,109**

(22) PCT Filed: **Dec. 6, 2019**

(86) PCT No.: **PCT/KR2019/017147**

§ 371 (c)(1),
(2) Date: **Jun. 4, 2021**

(30) **Foreign Application Priority Data**

Dec. 6, 2018 (KR) 10-2018-0156404

Publication Classification

(51) **Int. Cl.**

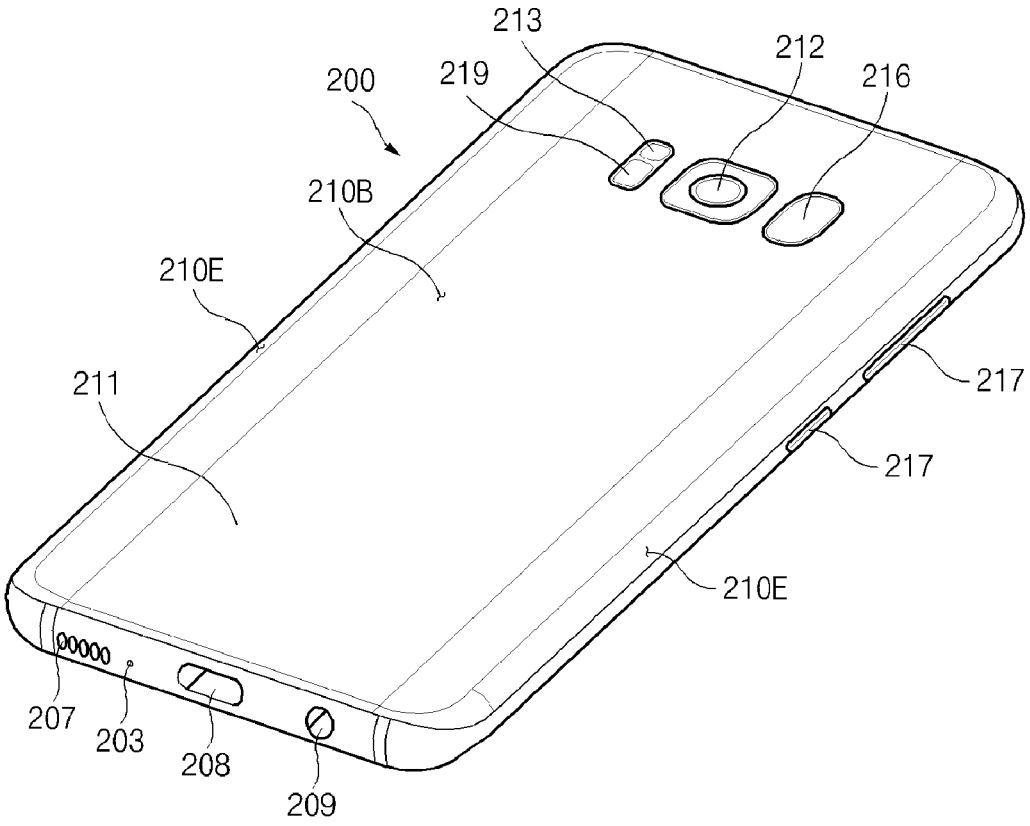
H01Q 21/00	(2006.01)
H04R 1/02	(2006.01)
H01Q 21/06	(2006.01)
H04M 1/02	(2006.01)
H01Q 5/307	(2015.01)
H01Q 1/24	(2006.01)

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

CPC ***H01Q 21/0025*** (2013.01); ***H04R 1/02*** (2013.01); ***H01Q 21/062*** (2013.01); ***H04M 1/0266*** (2013.01); *H04R 2499/11* (2013.01); ***H01Q 1/243*** (2013.01); ***H01Q 21/065*** (2013.01); *H04R 2499/15* (2013.01); ***H01Q 5/307*** (2015.01)

(57) **ABSTRACT**

An electronic device is provided. The electronic device includes a front plate disposed on a display, a back plate disposed on a back surface of the electronic device, a side member placed between the front plate and the back plate and forming an outer appearance of the electronic device together with the front plate and the back plate, and first, second, and third antenna modules including a plurality of conductive plates configured to transmit/receive a signal in a specified first frequency band and disposed between the front plate and the back plate so as to be adjacent to the side member. At least a portion of the side member is able to be used as an antenna of a signal in a specified second frequency band different from the specified first frequency band.



US 20220094077A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0094077 A1**

WU et al. (43) **Pub. Date: Mar. 24, 2022**

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

(71) Applicants: **Futaijing Precision Electronics (Yantai) Co., Ltd.**, Yantai (CN); **FIH (HONG KONG) LIMITED**, Kowloon (HK)

(72) Inventors: **CHING-LING WU**, New Taipei (TW); **HSIANG-NENG WEN**, New Taipei (TW); **CHI-SHENG LIU**, New Taipei (TW); **YUNG-YU TAI**, New Taipei (TW)

(21) Appl. No.: **17/228,952**

(22) Filed: **Apr. 13, 2021**

(30) **Foreign Application Priority Data**

Sep. 21, 2020 (CN) 202010998162.4

Publication Classification

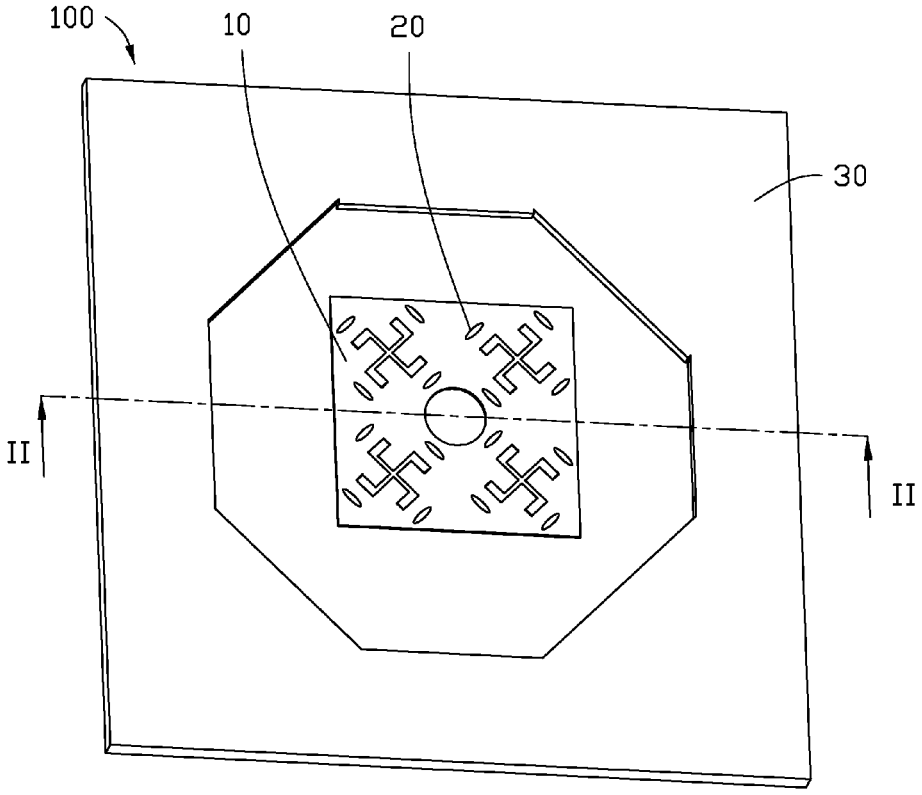
(51) **Int. Cl.**
H01Q 21/26 (2006.01)
H01Q 1/22 (2006.01)

(52) **U.S. Cl.**
CPC ***H01Q 21/26*** (2013.01); ***H01Q 1/2283*** (2013.01)

(57) **ABSTRACT**

An antenna structure includes a substrate and a plurality of radiation units, each radiation unit comprising a first radiator and a second radiator. The first radiator is positioned on a first surface of the substrate and includes a first radiation portion and a feed point. The feed point is electrically connected to the first radiation portion for feed current and signals to a corresponding radiation unit. The second radiator is positioned at a second surface of the substrate and is symmetrical with the first radiator about the substrate. The second radiator includes a second radiation portion and a ground portion. The ground portion is electrically connected to the second radiation portion to provide grounding for the radiation unit. The antenna structure has a good radiation efficiency and good isolation between radiators to reduce cross-interference.

200



US 20220094078A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0094078 A1**

Ma et al. (43) **Pub. Date: Mar. 24, 2022**

(54) **ELECTRONIC DEVICES HAVING MULTIPLE PHASED ANTENNA ARRAYS**

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

(72) Inventors: **Kexin Ma**, San Diego, CA (US); **Siwen Yong**, Mountain View, CA (US); **Jiangfeng Wu**, San Jose, CA (US); **Simon G. Begashaw**, Santa Clara, CA (US); **Madhusudan Chaudhary**, Campbell, CA (US); **Lijun Zhang**, Los Gatos, CA (US); **Yi Jiang**, Cupertino, CA (US); **Hao Xu**, Cupertino, CA (US); **Mattia Pascolini**, San Francisco, CA (US)

(21) Appl. No.: **17/031,780**

(22) Filed: **Sep. 24, 2020**

Publication Classification

(51) **Int. Cl.**

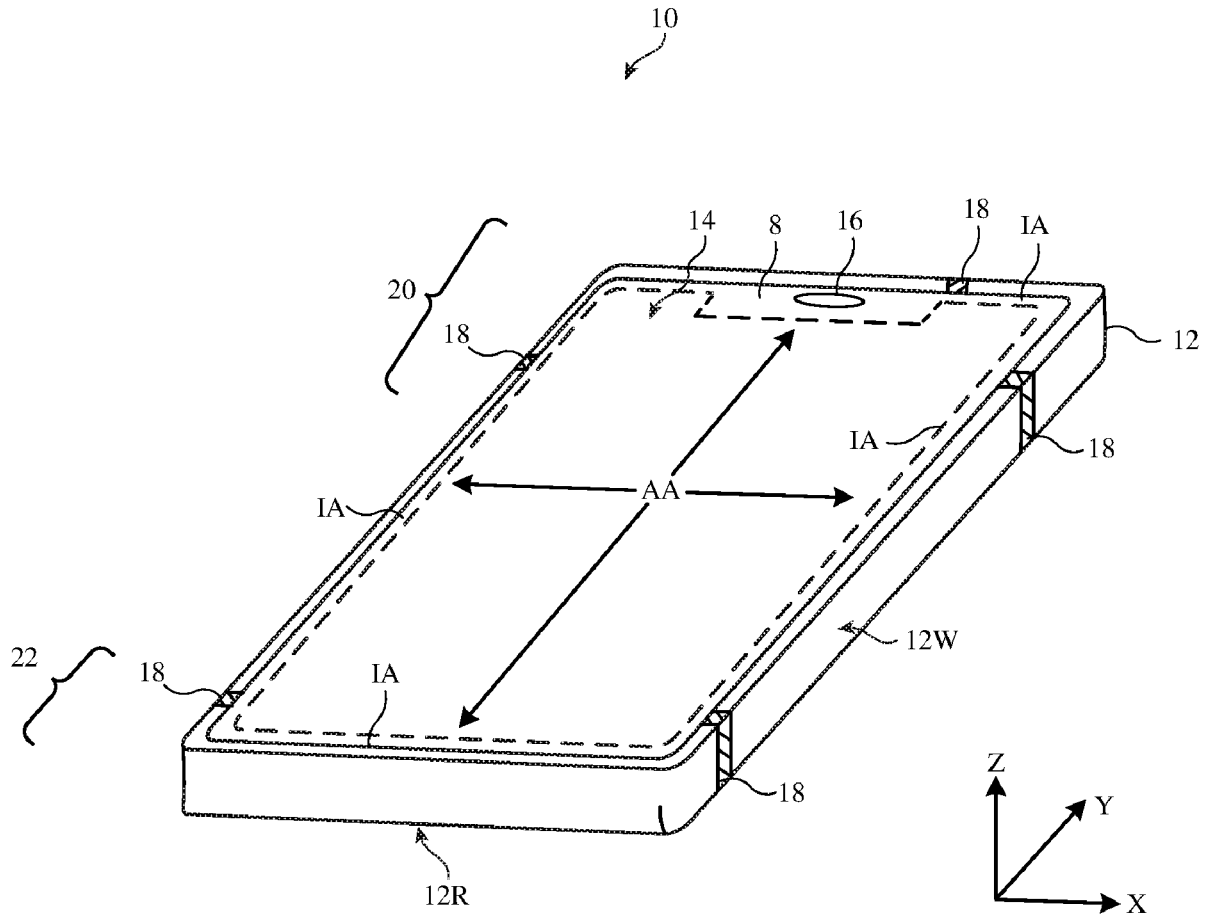
H01Q 21/28	(2006.01)
H01Q 3/26	(2006.01)
H01Q 1/22	(2006.01)

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

CPC ***H01Q 21/28*** (2013.01); ***H01Q 1/2208*** (2013.01); ***H01Q 3/2617*** (2013.01)

(57) **ABSTRACT**

An electronic device may include first and second phased antenna arrays that convey radio-frequency signals at frequencies greater than 10 GHz. The second array may have fewer antennas than the first array. Control circuitry may control the first and second arrays in a diversity mode and in a simultaneous array mode. In the diversity mode, the first array may form a first signal beam while the second array is inactive. When the first array is blocked by an object or otherwise exhibits unsatisfactory performance, the second array may form a second signal beam while the first array is inactive. In the simultaneous mode, the first and second arrays may form a combined array that produces a third signal beam. The combined array may maximize gain. Hierarchical beam searching operations may be performed. The arrays may be distributed across one or more modules.



US 20220094773A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0094773 A1**

LEE et al. (43) **Pub. Date: Mar. 24, 2022**

(54) **MOBILE TERMINAL**

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

(72) Inventors: **Jaewon LEE**, Seoul (KR); **Seungwoo RYU**, Seoul (KR); **Joohee LEE**, Seoul (KR); **Junyoung JUNG**, Seoul (KR); **Jaewan KIM**, Seoul (KR); **Sangjo PARK**, Seoul (KR)

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

(21) Appl. No.: **17/538,108**

(22) Filed: **Nov. 30, 2021**

Related U.S. Application Data

(63) Continuation of application No. 16/590,287, filed on Oct. 1, 2019, now Pat. No. 11,218,583, which is a continuation of application No. 16/034,215, filed on Jul. 12, 2018, now Pat. No. 10,455,065.

(60) Provisional application No. 62/565,116, filed on Sep. 29, 2017, provisional application No. 62/587,442, filed on Nov. 16, 2017.

(30) **Foreign Application Priority Data**

May 2, 2018 (KR) 10-2018-0050813

Publication Classification

(51) **Int. Cl.**

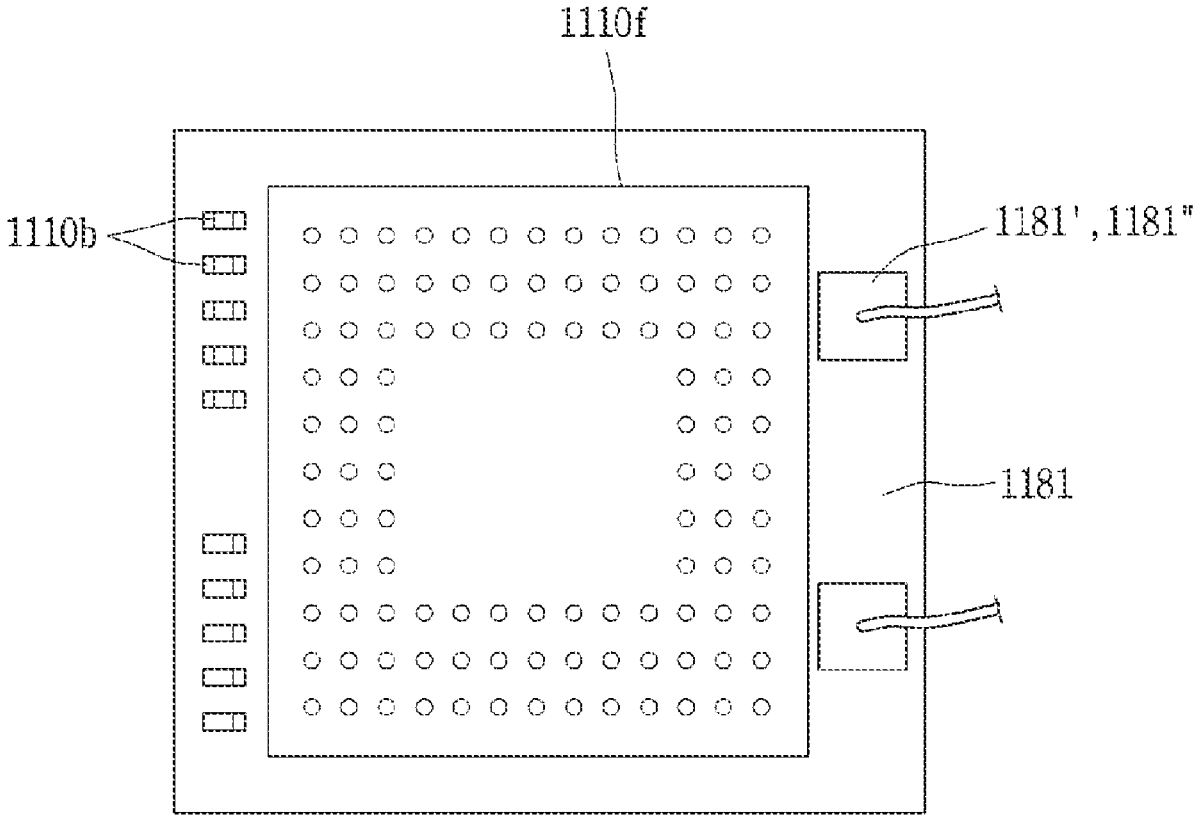
H04M 1/02	(2006.01)
H01Q 9/04	(2006.01)
H01Q 1/38	(2006.01)
H05K 5/00	(2006.01)
H01Q 1/24	(2006.01)
H01Q 21/06	(2006.01)
H01Q 1/22	(2006.01)

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

CPC ***H04M 1/0277*** (2013.01); ***H01Q 9/0435*** (2013.01); ***H01Q 1/38*** (2013.01); ***H05K 5/0047*** (2013.01); *H01Q 1/40* (2013.01); ***H01Q 21/065*** (2013.01); ***H01Q 1/2283*** (2013.01); *H04M 1/0274* (2013.01); ***H01Q 1/243*** (2013.01)

(57) **ABSTRACT**

The present disclosure discloses a mobile terminal, including a case forming a portion of an appearance; a circuit board disposed inside the case; a flexible printed circuit board electrically connected to the circuit board; a first connector mounted on the circuit board; a second connector mounted on the flexible printed circuit board and fastened to the first connector; and a first antenna having array elements mounted on the flexible printed circuit board, wherein the first antenna is disposed to face a side surface of the case to radiate beam-formed wireless signals through the side surface adjacent to one side of the circuit board.



US 20220102838A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0102838 A1**

BOLZ et al. (43) **Pub. Date: Mar. 31, 2022**

(54) **ANTENNA FOR IEEE 802.11 APPLICATIONS, WIRELESS DEVICE, AND WIRELESS COMMUNICATION SYSTEM**

(71) Applicant: **THE ANTENNA COMPANY INTERNATIONAL N.V.**, Willemstad (CW)

(72) Inventors: **Thomas BOLZ**, Sonsbeck (DE); **Diego CARATELLI**, RB Eersel (NL)

(21) Appl. No.: **17/441,684**

(22) PCT Filed: **Mar. 16, 2020**

(86) PCT No.: **PCT/NL2020/050174**

§ 371 (c)(1),
(2) Date: **Sep. 21, 2021**

(30) **Foreign Application Priority Data**

Mar. 22, 2019 (NL) 2022790

Publication Classification

(51) **Int. Cl.**

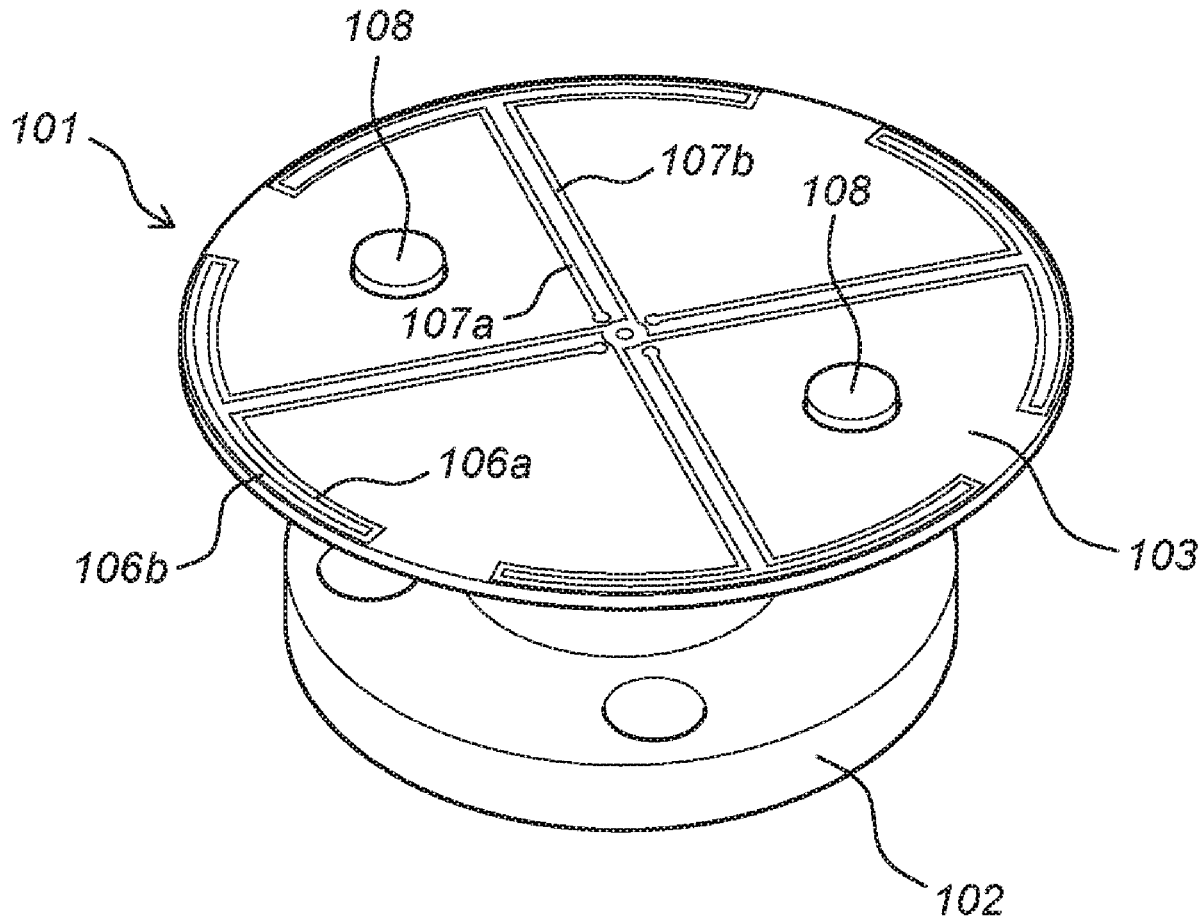
H01Q 1/22	(2006.01)
H01Q 9/28	(2006.01)
H01Q 9/26	(2006.01)
H01Q 21/20	(2006.01)
H01Q 21/30	(2006.01)

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

CPC ***H01Q 1/2291*** (2013.01); ***H01Q 9/285*** (2013.01); ***H01Q 21/30*** (2013.01); ***H01Q 21/205*** (2013.01); ***H01Q 9/26*** (2013.01)

(57) **ABSTRACT**

The invention relates to an antenna, in particular suitable for IEEE 802.11 applications. The invention also relates to a wireless device, such as a wireless access point (AP), a router, a gateway, and/or a bridge, comprising at least one antenna according to the invention. The invention further relates to a wireless communication system, comprising a plurality of antennas according to the invention, and, preferably, a plurality of wireless devices according to the invention.



US 20220102839A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2022/0102839 A1**

(43) **Pub. Date: Mar. 31, 2022**

SEO et al.

(54) **ELECTRONIC DEVICE AND METHOD FOR ANTENNA COUPLING**

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

(72) Inventors: **Pilwon SEO**, Gyeonggi-do (KR); **Bomi LEE**, Gyeonggi-do (KR); **Sangil IM**, Gyeonggi-do (KR); **Ilseub KIM**, Gyeonggi-do (KR); **Heedong KIM**, Gyeonggi-do (KR); **Yeonkwan SEO**, Gyeonggi-do (KR)

(21) Appl. No.: **17/475,507**

(22) Filed: **Sep. 15, 2021**

Related U.S. Application Data

(63) Continuation of application No. PCT/KR2020/003557, filed on Mar. 13, 2020.

(30) **Foreign Application Priority Data**

Mar. 15, 2019 (KR) 10-2019-0029690

Publication Classification

(51) **Int. Cl.**

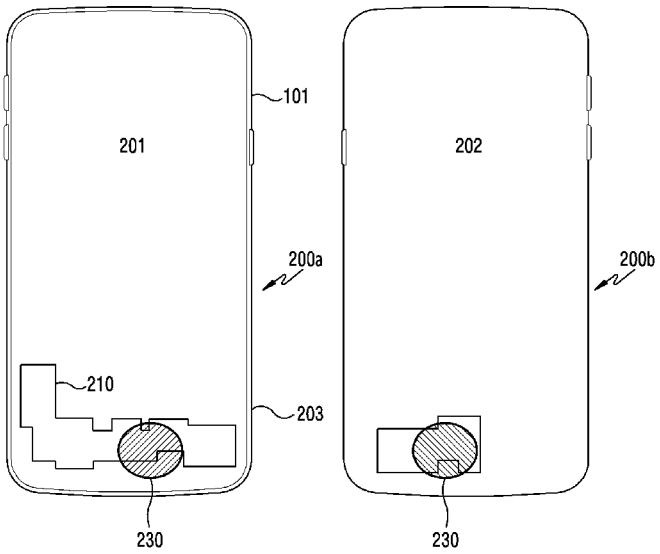
H01Q 1/24 (2006.01)
H04B 1/00 (2006.01)
H01Q 1/48 (2006.01)

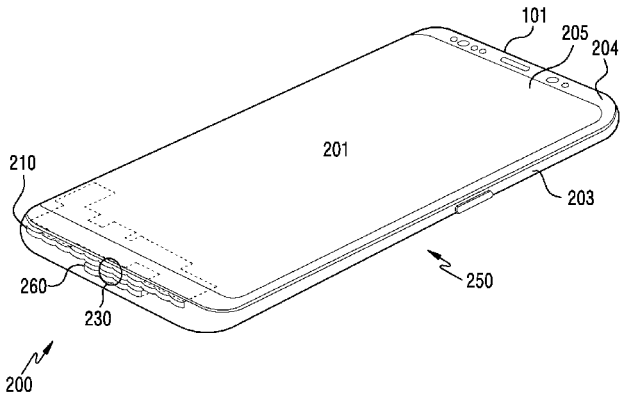
(52) **U.S. Cl.**

CPC ***H01Q 1/243*** (2013.01); ***H01Q 1/48*** (2013.01); ***H04B 1/0057*** (2013.01)

(57) **ABSTRACT**

An electronic device and method are disclosed. The electronic device includes a first antenna configured to communicate using a first frequency band group, a ground switch coupled to the first antenna, a second antenna configured to communicate using a second frequency band group, wherein the second antenna overlaps the first antenna, a band selection switch configured to select one of multiple radio frequency (RF) paths for the second frequency band group, and a processor. The processor implements the method, including determining a communication frequency band, when the communication frequency band is unsupported by the second antenna, identifying an RF path corresponding to the communication frequency band from among the multiple RF paths, and controlling the band selection switch to select the identified RF path for operative connection to the second antenna.





US 20220102841A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2022/0102841 A1

JIA (43) Pub. Date: Mar. 31, 2022

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

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

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

(21) Appl. No.: **17/643,365**

(22) Filed: **Dec. 8, 2021**

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2020/098115, filed on Jun. 24, 2020.

(30) **Foreign Application Priority Data**

Jun. 30, 2019 (CN) 201910588862.3

Publication Classification

(51) **Int. Cl.**

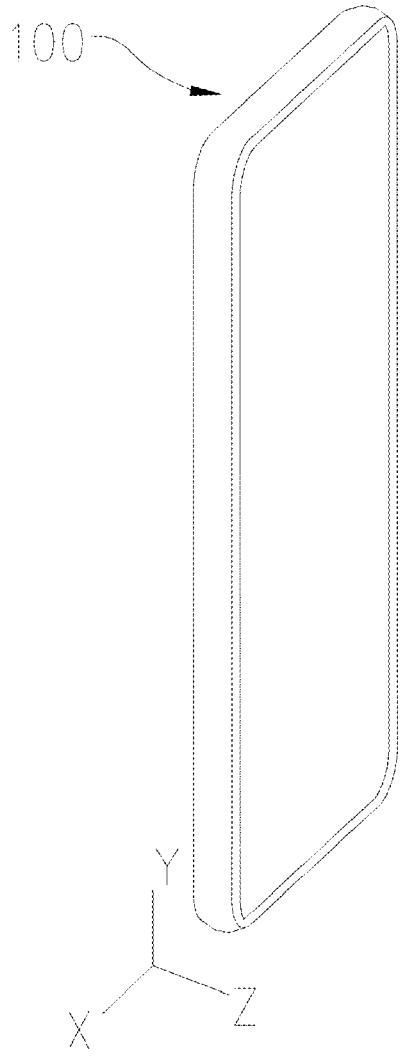
H01Q 1/24	(2006.01)
H01Q 1/38	(2006.01)
H01Q 9/04	(2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H01Q 9/0407*** (2013.01); ***H01Q 1/38*** (2013.01)

(57) **ABSTRACT**

An antenna assembly is provided. The antenna assembly includes a dielectric structure and an antenna module. The dielectric has a first region, a second region, and a third region connected in sequence. The antenna module faces the second region, the antenna module is configured to emit a radio frequency (RF) signal, the first region is configured to bring a first phase variation to the RF signal, the second region is configured to bring a second phase variation to the RF signal, the third region is configured to bring a third phase variation to the RF signal, and the second phase variation is different from the first phase variation and the third phase variation. An electronic device is further provided.



US 20220102853A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0102853 A1**

Shen et al. (43) **Pub. Date: Mar. 31, 2022**

(54) **ANTENNA SYSTEM**

(71) Applicant: **Askey Computer Corp.**, NEW TAIPEI CITY (TW)

(72) Inventors: **Su-Mei Shen**, New Taipei City (TW); **Xing-Jia Chen**, New Taipei City (TW); **Han-Lin Jhan**, New Taipei City (TW); **Chih-Chung Lin**, New Taipei City (TW)

(21) Appl. No.: **17/301,991**

(22) Filed: **Apr. 21, 2021**

(30) **Foreign Application Priority Data**

Sep. 25, 2020 (CN) 202011019561.8

Publication Classification

(51) **Int. Cl.**

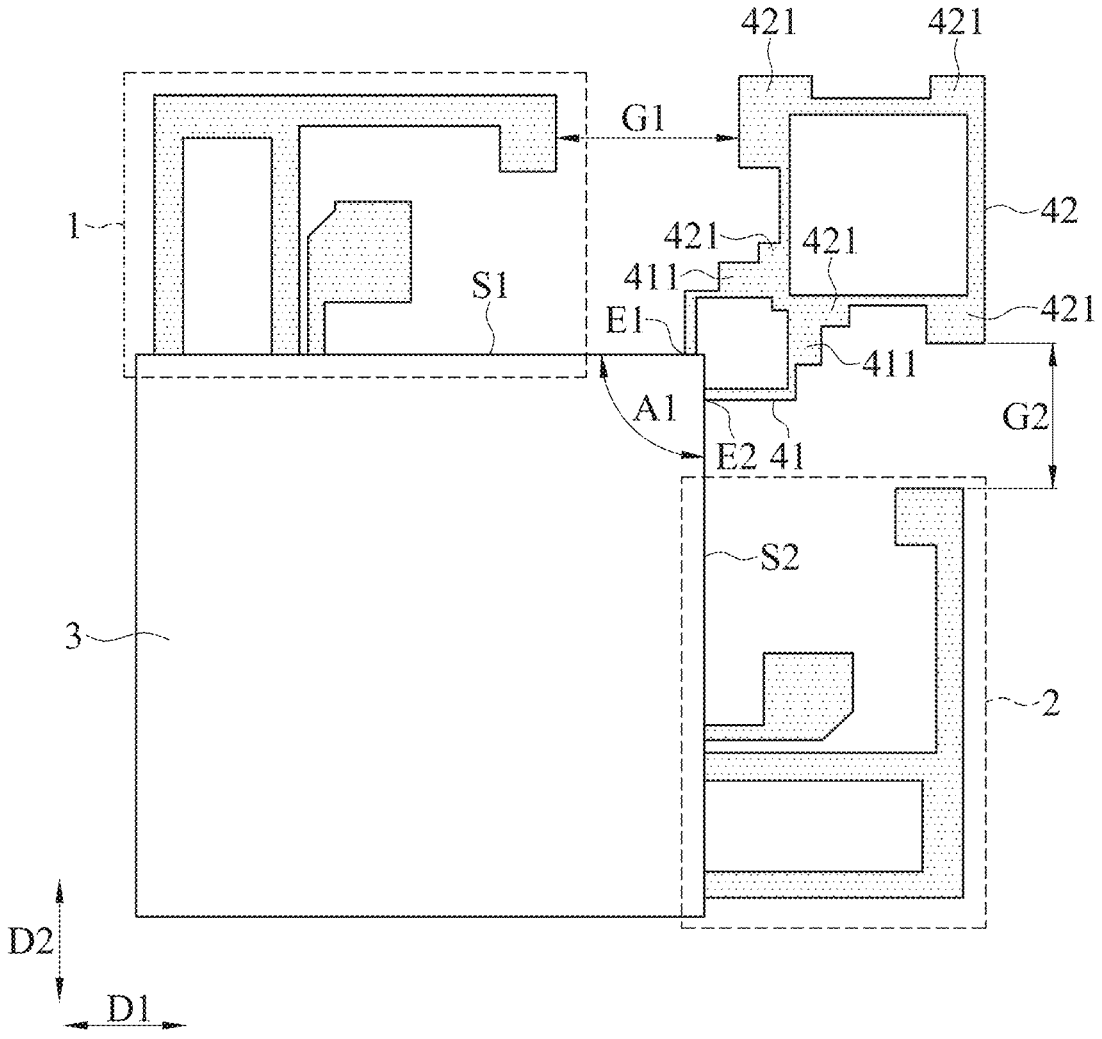
H01Q 1/52	(2006.01)
H01Q 21/30	(2006.01)
H01Q 1/48	(2006.01)

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

CPC ***H01Q 1/523*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 21/30*** (2013.01)

(57) **ABSTRACT**

An antenna system is provided, including a ground plane, a first antenna unit, a second antenna unit, a first ground unit and a second ground unit. The ground plane includes a first side and a second side. The first ground unit and the ground plane jointly form a first closed loop, and a length of the first ground unit matches the first high-frequency signal and the second high-frequency signal to provide grounding of the high-frequency signals. The second ground unit forms a second closed loop and is connected to the first ground unit, and a length of the second ground unit is greater than the length of the first ground unit. A sum of the length of the second ground unit and the length of the first ground unit matches the first low-frequency signal and the second low-frequency signal, to jointly provide the grounding of the low-frequency signals.



US 20220102861A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2022/0102861 A1

HWANG (43) Pub. Date: Mar. 31, 2022

(54) **PATCH ANTENNA**

(71) Applicant: **AMOTECH CO., LTD.**, Incheon (KR)

(72) Inventor: **Chul HWANG**, Incheon (KR)

(73) Assignee: **AMOTECH CO., LTD.**, Incheon (KR)

(21) Appl. No.: **17/275,589**

(22) PCT Filed: **Sep. 9, 2019**

(86) PCT No.: **PCT/KR2019/011644**

§ 371 (c)(1),
(2) Date: **Mar. 11, 2021**

(30) **Foreign Application Priority Data**

Sep. 12, 2018 (KR) 10-2018-0109188

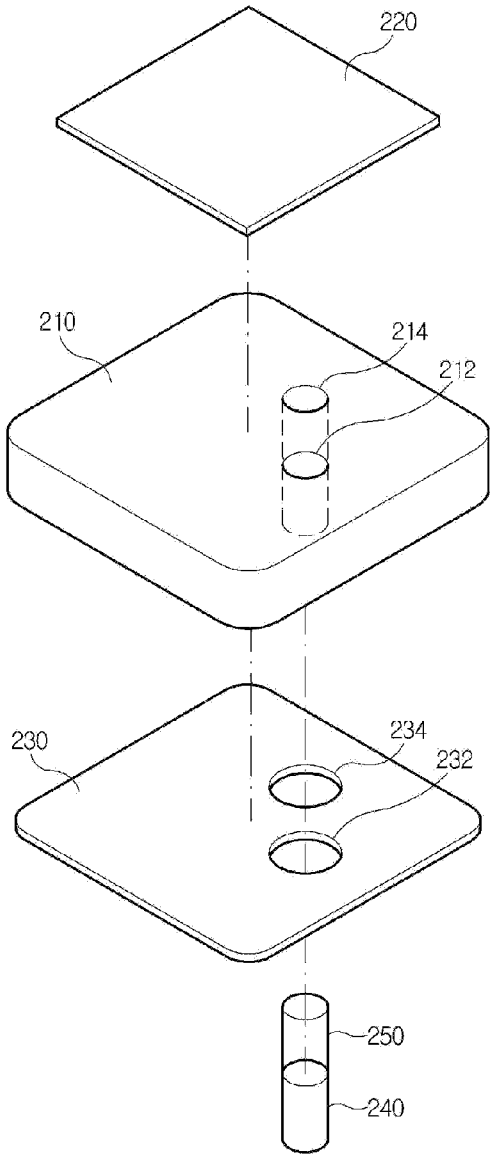
Publication Classification

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

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

(57) **ABSTRACT**

Disclosed is a patch antenna in which coupling gaps are formed between a lower patch and feed pins so as to maximize the performance of the antenna. The disclosed patch antenna comprises: a base layer; an upper patch disposed on the upper surface of the base layer; a lower patch disposed on the lower surface of the base layer; and feed pins passing through the base layer, upper patch, and lower patch, wherein the feed pins are spaced from the upper patch and thereby form coupling gaps.



US 20220102862A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2022/0102862 A1

Feng et al. (43) Pub. Date: Mar. 31, 2022

(54) **THREE-DIMENSIONAL ELECTRONIC COMPONENT AND ELECTRONIC DEVICE**

(71) Applicant: **ASUSTeK COMPUTER INC.**, Taipei (TW)

(72) Inventors: **Zhi-Hua Feng**, Taipei (TW); **Chia-Ho Lin**, Taipei (TW); **Pin-Tang Chiu**, Taipei (TW); **Zhen-De Jiang**, Taipei (TW)

(21) Appl. No.: **17/476,544**

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

(30) **Foreign Application Priority Data**

Sep. 30, 2020 (TW) 109134311

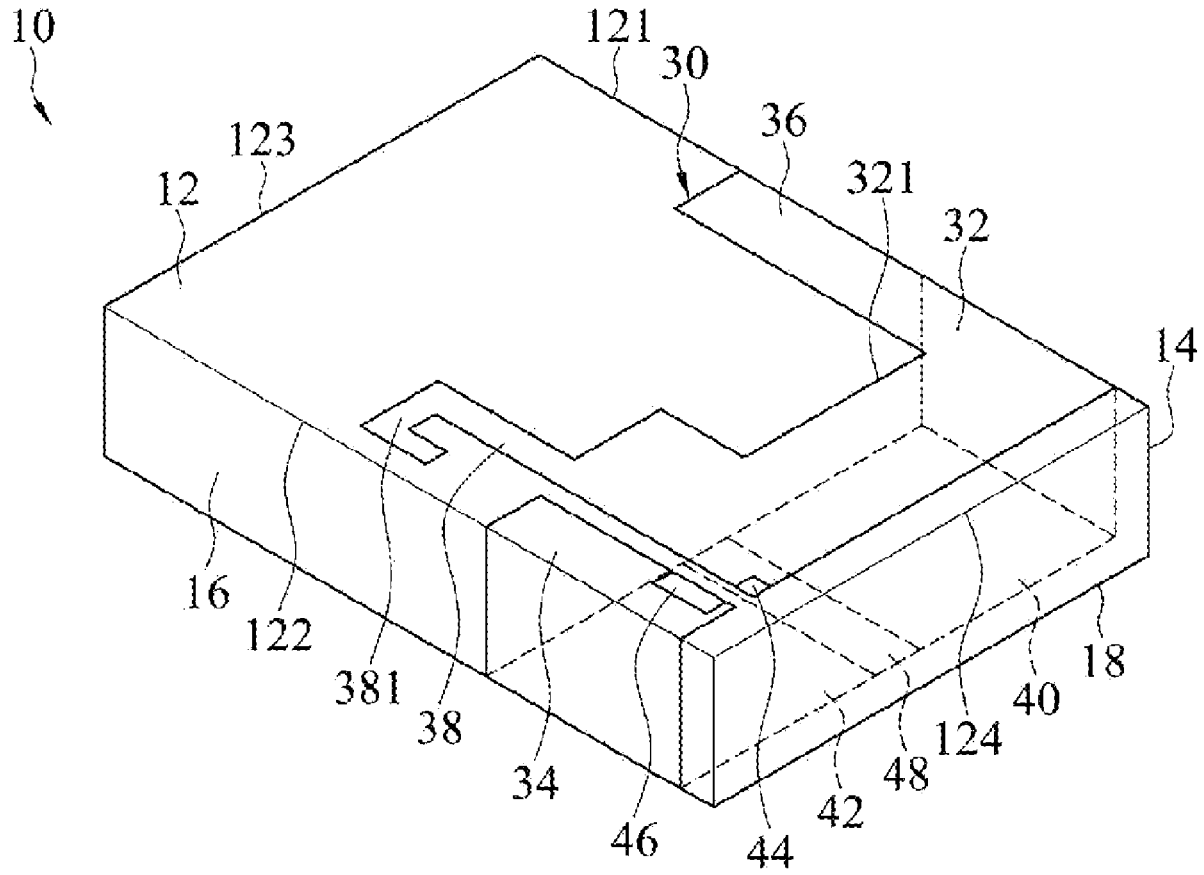
Publication Classification

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

(52) **U.S. Cl.**
CPC ***H01Q 9/0457*** (2013.01); ***H01Q 1/48*** (2013.01)

(57) **ABSTRACT**

A three-dimensional electronic component includes a first surface, a second surface, a third surface, and a fourth surface, and an antenna structure. The antenna structure includes a first radiating metal portion, a second radiating metal portion, an adjusting metal branch, a first ground connection portion, a second ground connection portion, a feed point, and a ground point. The first radiating metal portion on the first surface extends to the second surface. The second radiating metal portion on the first surface extends to the third surface. A gap is between the first radiating metal portion and the second radiating metal portion. The adjusting metal branch on the first surface is connected to the first radiating metal portion. The feed point on the first radiating metal portion is close to the gap. The ground point on the second radiating metal portion is close to the gap.



US 20220102869A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2022/0102869 A1

PARK (43) Pub. Date: Mar. 31, 2022

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

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

(72) Inventor: **Sungchul PARK**, Suwon-si (KR)

(21) Appl. No.: **17/643,884**

(22) Filed: **Dec. 13, 2021**

Related U.S. Application Data

(63) Continuation of application No. PCT/KR2020/006697, filed on May 22, 2020.

(30) **Foreign Application Priority Data**

Jun. 13, 2019 (KR) 10-2019-0070126

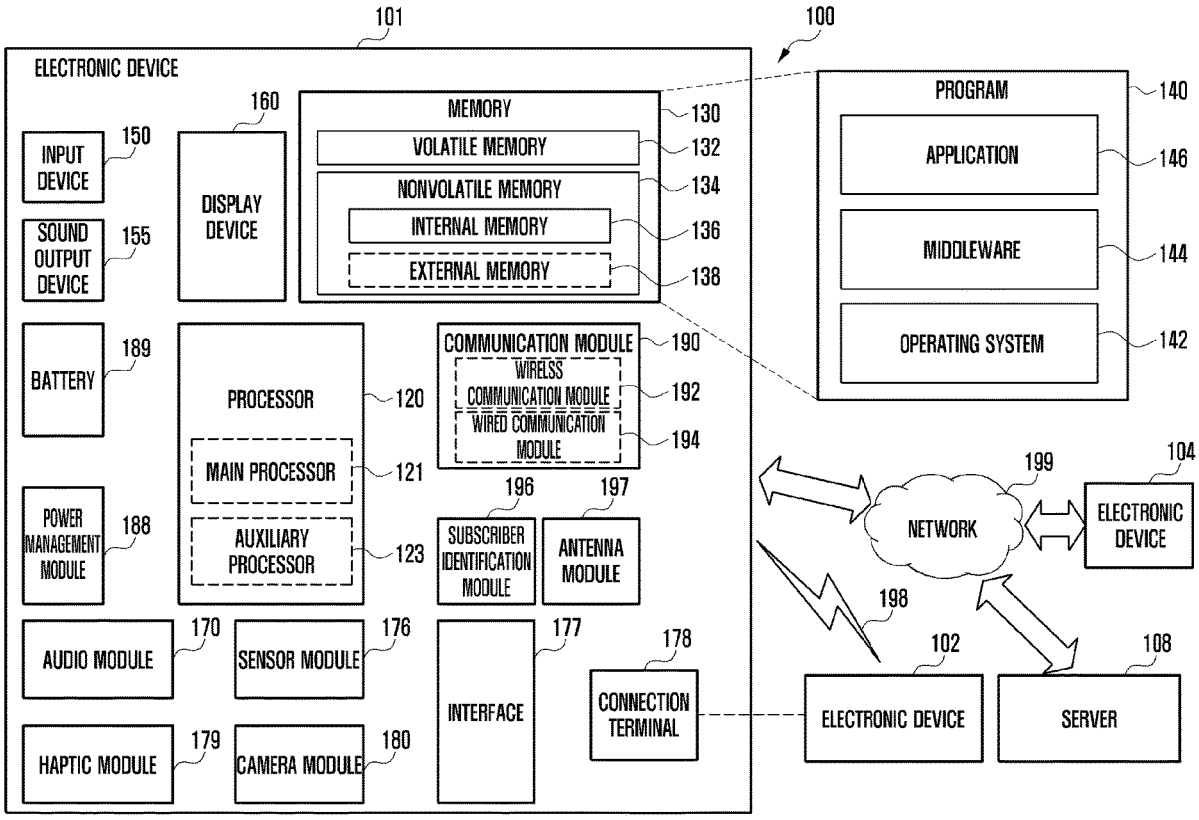
Publication Classification

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

(52) **U.S. Cl.**
CPC ***H01Q 17/004*** (2013.01); ***H01Q 1/243*** (2013.01)

(57) **ABSTRACT**

According to various embodiments, an electronic device may comprise: a housing; an antenna structure disposed in an inner space of the housing, the antenna structure including a substrate having a first surface and a second surface oriented toward a direction opposite to the first surface, and at least one first antenna element disposed in a space between the first surface and the second surface and having a beam pattern formed toward a conductive part; an electric wave absorbing member disposed between the conductive part and the at least one first antenna element so as to be disposed in a path in which the beam pattern is formed; and a first wireless communication circuit disposed in the inner space of the housing and configured to transmit or receive a wireless signal of a first frequency band through the at least one first antenna element.



US 20220102872A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2022/0102872 A1

PARK et al. (43) Pub. Date: Mar. 31, 2022

(54) **CHIP ANTENNA AND CHIP ANTENNA MODULE INCLUDING THE SAME**

(71) Applicant: **SAMSUNG ELECTRO-MECHANICS CO., LTD.**, Suwon-si (KR)

(72) Inventors: **Ju Hyoung PARK**, Suwon-si (KR); **Kyu Bum HAN**, Suwon-si (KR); **Jae Yeong KIM**, Suwon-si (KR); **Jeong Ki RYOO**, Suwon-si (KR); **Sung Nam CHO**, Suwon-si (KR); **Sung Yong AN**, Suwon-si (KR)

(73) Assignee: **SAMSUNG ELECTRO-MECHANICS CO., LTD.**, Suwon-si (KR)

(21) Appl. No.: **17/547,633**

(22) Filed: **Dec. 10, 2021**

Related U.S. Application Data

(63) Continuation of application No. 16/670,139, filed on Oct. 31, 2019, now Pat. No. 11,233,336.

(30) **Foreign Application Priority Data**

Feb. 8, 2019 (KR) 10-2019-0015001
Jul. 5, 2019 (KR) 10-2019-0081483

Publication Classification

(51) **Int. Cl.**

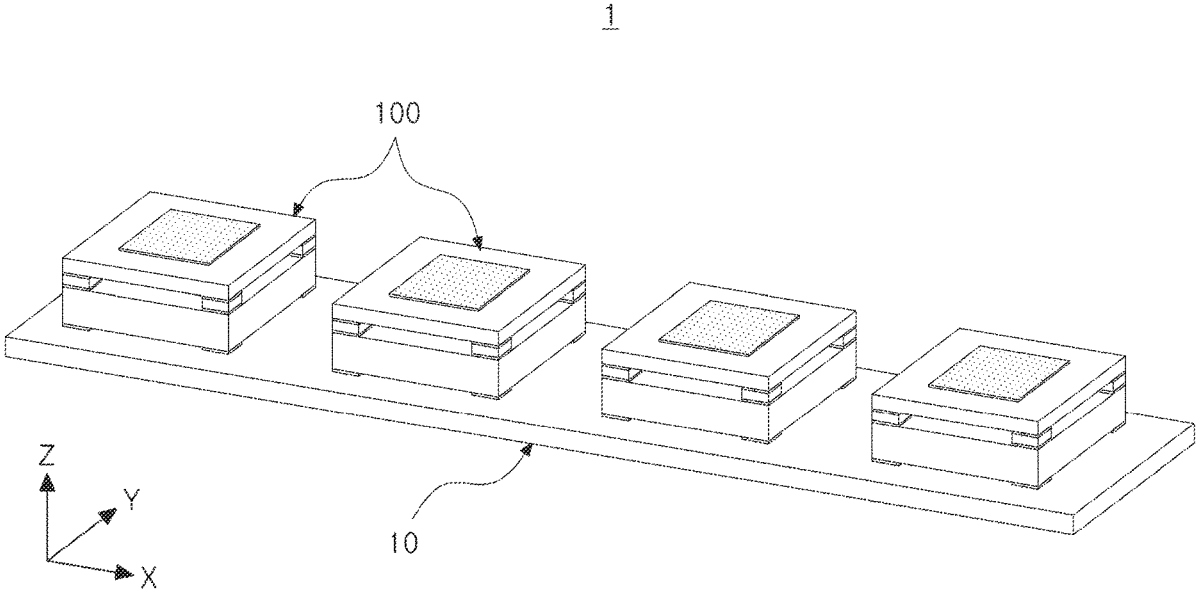
H01Q 21/00	(2006.01)
H01Q 21/06	(2006.01)
H01Q 1/24	(2006.01)
H01Q 1/48	(2006.01)
H01Q 19/10	(2006.01)
H01Q 9/04	(2006.01)

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

CPC ***H01Q 21/0025*** (2013.01); ***H01Q 21/065*** (2013.01); ***H01Q 9/045*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 19/10*** (2013.01); ***H01Q 1/243*** (2013.01)

(57) **ABSTRACT**

A chip antenna includes a first ceramic substrate, a second ceramic substrate disposed to face the first ceramic substrate, a first patch disposed on one surface of the first ceramic substrate to operate as a feeding patch, a second patch disposed on the second ceramic substrate to operate as a radiation patch, at least one feed via penetrating through the first ceramic substrate in a thickness direction to provide a feed signal to the first patch, and a bonding pad disposed on a second surface of the first ceramic substrate opposite the first surface. A thickness of the first ceramic substrate is greater than a thickness of the second ceramic substrate.



US 20220103668A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2022/0103668 A1

(43) Pub. Date: Mar. 31, 2022

KIM et al.

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

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

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

(21) Appl. No.: **17/426,892**

(22) PCT Filed: **Jan. 2, 2020**

(86) PCT No.: **PCT/KR2020/000028**

§ 371 (c)(1),
(2) Date: **Jul. 29, 2021**

(30) **Foreign Application Priority Data**

Feb. 13, 2019 (KR) 10-2019-0016491

Publication Classification

(51) **Int. Cl.**

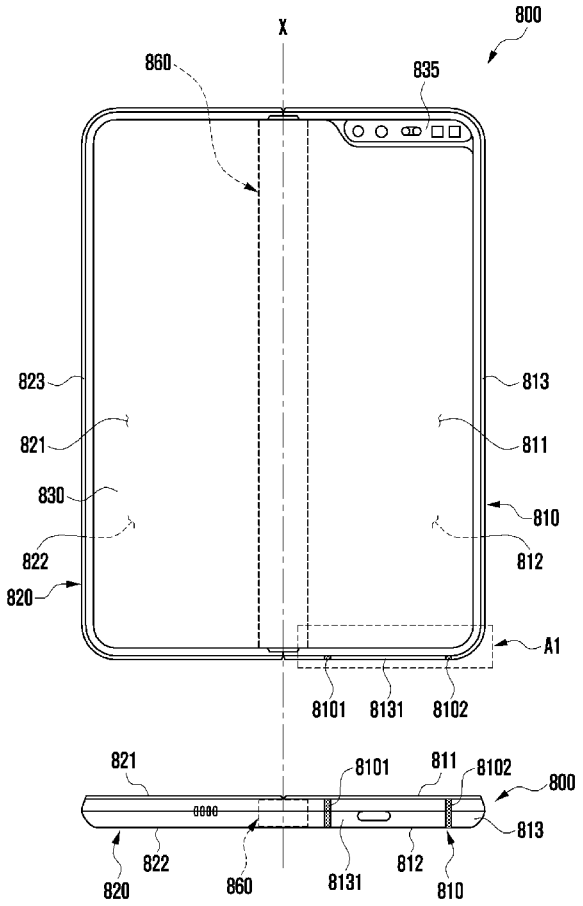
H04M 1/02	(2006.01)
H05K 5/00	(2006.01)
H05K 5/02	(2006.01)
H05K 7/14	(2006.01)
H05K 1/02	(2006.01)

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

CPC ***H04M 1/0214*** (2013.01); ***H05K 5/0017*** (2013.01); ***H05K 1/0213*** (2013.01); ***H05K 7/1427*** (2013.01); ***H05K 5/0217*** (2013.01)

(57) **ABSTRACT**

An electronic apparatus is provided. The electronic apparatus includes a housing which comprises a front surface plate, a rear surface plate oriented in the opposite direction to the front surface plate, and a side surface member surrounding the space between the front surface plate and the rear surface plate, at least a portion of the side surface member including at least one conductive section positioned between a first non-conductive section and a second non-conductive section which are spaced apart from each other, a conductive extended portion part extending from at least a partial area of the conductive section to the space, a printed circuit board disposed in the space, and a wireless communication circuit disposed on the printed circuit board and electrically connected a point which is in the conductive section and spaced toward a first location from the first non-conductive section.



US 20220109250A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0109250 A1**

TSAI (43) **Pub. Date: Apr. 7, 2022**

(54) **ANTENNA SYSTEM**

(71) Applicant: **Quanta Computer Inc.**, Taoyuan City (TW)

(72) Inventor: **Ming-Che TSAI**, Taoyuan City (TW)

(21) Appl. No.: **17/093,742**

(22) Filed: **Nov. 10, 2020**

(30) **Foreign Application Priority Data**

Oct. 5, 2020 (TW) 109134329

Publication Classification

(51) **Int. Cl.**

H01Q 21/28 (2006.01)

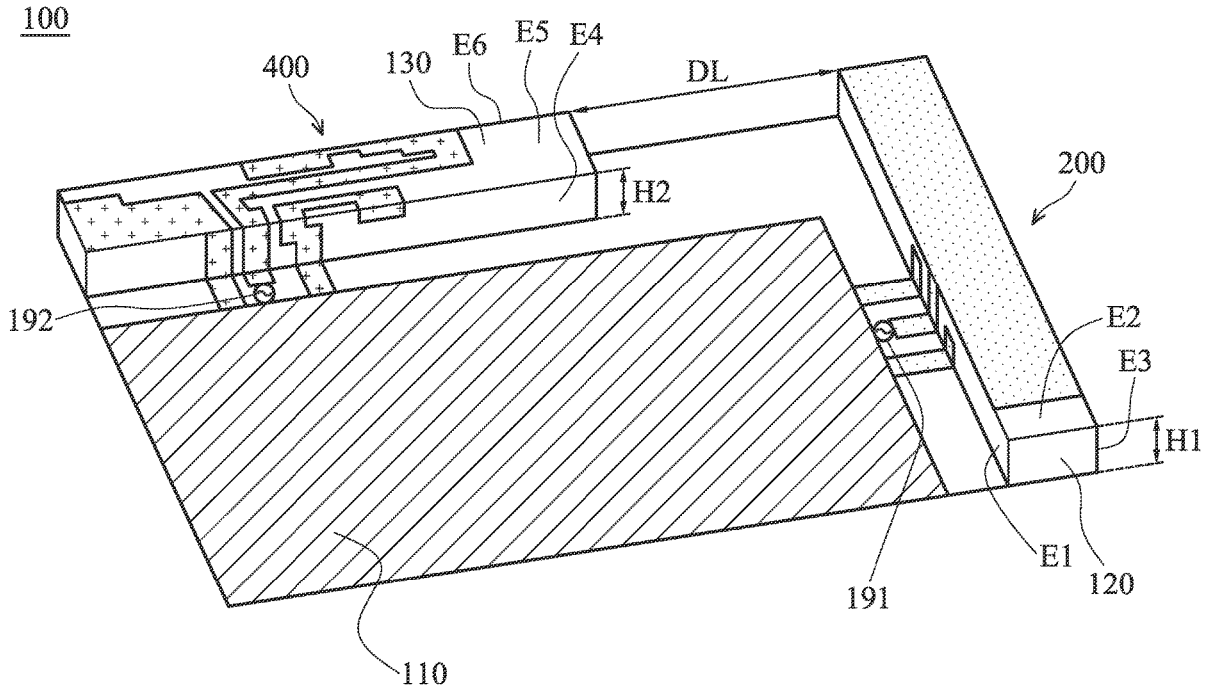
H01Q 5/35 (2006.01)

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

CPC ***H01Q 21/28*** (2013.01); ***H01Q 5/35*** (2015.01)

(57) **ABSTRACT**

An antenna system includes a ground plane, a first nonconductive support element, a first antenna element, a second nonconductive support element, and a second antenna element. The first nonconductive support element is adjacent to the ground plane. The first antenna element is distributed over the first nonconductive support element. The first antenna element is excited by a first signal source. The second nonconductive support element is adjacent to the ground plane. The second antenna element is distributed over the second nonconductive support element. The second antenna element is excited by a second signal source. Both the first antenna element and the second antenna element can cover a wide operation frequency band of LTE/5G.



US 20220115771A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0115771 A1**

KANG et al. (43) **Pub. Date: Apr. 14, 2022**

(54) **MOBILE TERMINAL**

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

(72) Inventors: **Yunmo KANG**, Seoul (KR); **Kangjae JUNG**, Seoul (KR); **Sungjoon HONG**, Seoul (KR); **Byungwoon JUNG**, Seoul (KR); **Sungjung RHO**, Seoul (KR)

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

(21) Appl. No.: **17/557,489**

(22) Filed: **Dec. 21, 2021**

Related U.S. Application Data

(63) Continuation of application No. 17/004,681, filed on Aug. 27, 2020, now Pat. No. 11,233,314, which is a continuation of application No. 16/752,485, filed on Jan. 24, 2020, now Pat. No. 10,790,575, which is a continuation of application No. 16/033,083, filed on Jul. 11, 2018, now Pat. No. 10,573,957, which is a continuation of application No. 15/860,427, filed on Jan. 2, 2018, now Pat. No. 10,056,680, which is a continuation of application No. 14/010,900, filed on Aug. 27, 2013, now Pat. No. 9,871,286.

(30) **Foreign Application Priority Data**

Sep. 19, 2012 (KR) 10-2012-0104152

Publication Classification

(51) **Int. Cl.**

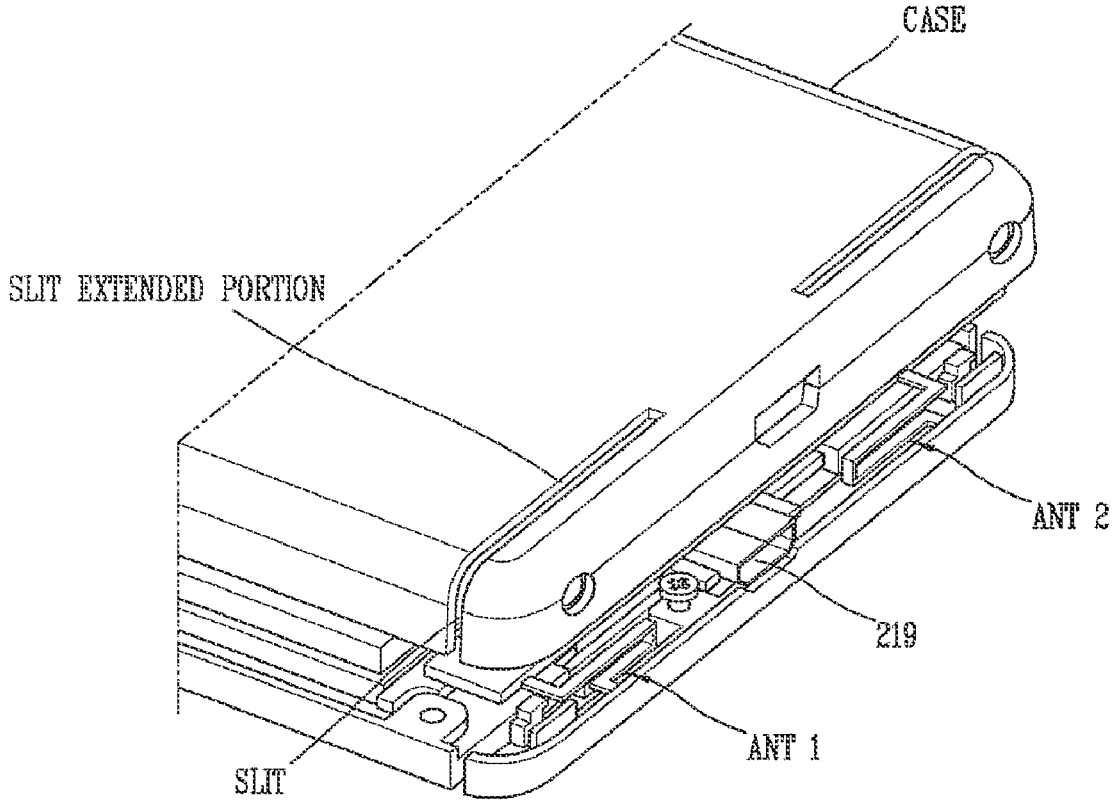
H01Q 1/24	(2006.01)
H01Q 21/30	(2006.01)
H01Q 5/35	(2006.01)
H01Q 5/50	(2006.01)
H01Q 9/26	(2006.01)
H01Q 13/10	(2006.01)
H01Q 1/38	(2006.01)
H01Q 1/48	(2006.01)
H01Q 1/50	(2006.01)
H01Q 7/00	(2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H01Q 21/30*** (2013.01); ***H01Q 5/35*** (2015.01); ***H01Q 5/50*** (2015.01); ***H01Q 7/00*** (2013.01); ***H01Q 13/10*** (2013.01); ***H01Q 1/38*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 1/50*** (2013.01); ***H01Q 9/26*** (2013.01)

(57) **ABSTRACT**

A mobile terminal comprises: a terminal body; and a first antenna device and a second antenna device disposed at one side of the terminal body in an adjacent manner, and formed to operate at different frequency bands, wherein the first antenna device and the second antenna device are provided with conductive members each having a slit at one side thereof, and wherein the conductive members form part of an appearance of the terminal body.



US 20220115778A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0115778 A1**

LI (43) **Pub. Date: Apr. 14, 2022**

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

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

(72) Inventor: **Si LI**, Dongguan (CN)

(21) Appl. No.: **17/559,639**

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

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2020/110840, filed on Aug. 24, 2020.

(30) **Foreign Application Priority Data**

Aug. 30, 2019 (CN) 201910818037.8

Publication Classification

(51) **Int. Cl.**

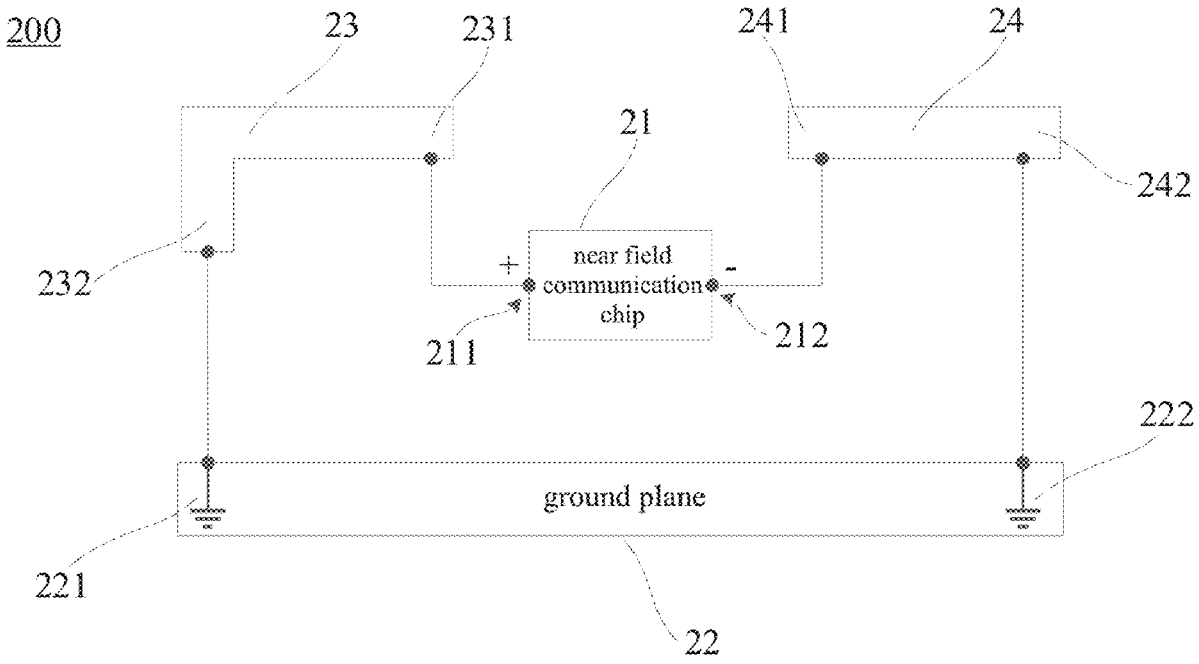
H01Q 1/36	(2006.01)
H01Q 1/48	(2006.01)
H01Q 1/44	(2006.01)
H01Q 1/24	(2006.01)
H01Q 21/00	(2006.01)
H04B 5/00	(2006.01)

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

CPC ***H01Q 1/36*** (2013.01); ***H01Q 1/48*** (2013.01); ***H04B 5/0025*** (2013.01); ***H01Q 1/243*** (2013.01); ***H01Q 21/0006*** (2013.01); ***H01Q 1/44*** (2013.01)

(57) **ABSTRACT**

An antenna device and an electronic device are provided. The antenna device includes a near field communication chip for supplying a differential excitation current, a ground plane forming a conductive path, a first conductor structure, and a second conductor structure. The first conductor structure, conductive path, and second conductor structure collectively form a conductive loop for transmission of the differential excitation current.



US 20220117081A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0117081 A1**

Jiang et al. (43) **Pub. Date: Apr. 14, 2022**

(54) **CIRCUIT BOARD**

(71) Applicant: **ASUSTeK COMPUTER INC.**, Taipei (TW)

(72) Inventors: **Zhen-De Jiang**, Taipei (TW); **Pin-Tang Chiu**, Taipei (TW); **Chia-Ho Lin**, Taipei (TW); **Zhi-Hua Feng**, Taipei (TW)

(21) Appl. No.: **17/489,927**

(22) Filed: **Sep. 30, 2021**

(30) **Foreign Application Priority Data**

Oct. 8, 2020 (TW) 109135055

Publication Classification

(51) **Int. Cl.**

H05K 1/02 (2006.01)

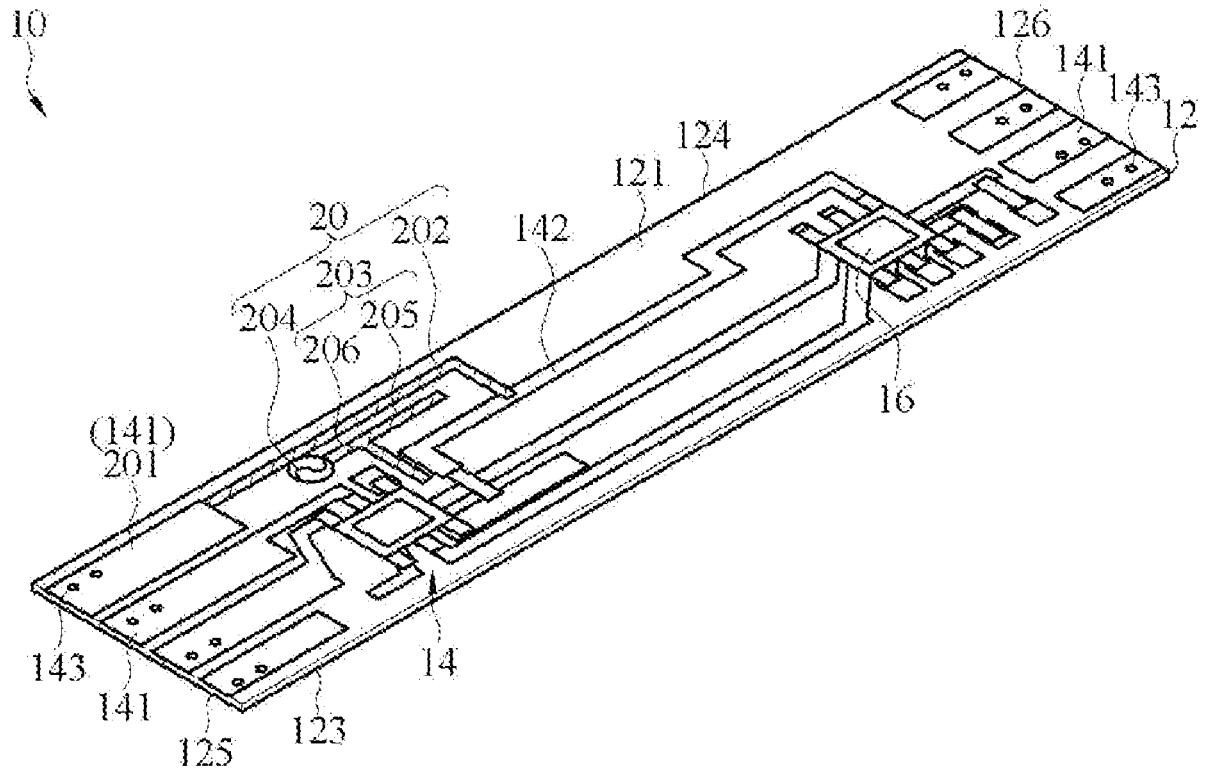
H01Q 1/48 (2006.01)

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

CPC ***H05K 1/0274*** (2013.01); *H01Q 23/00* (2013.01); ***H01Q 1/48*** (2013.01); ***H05K 1/0243*** (2013.01)

(57) **ABSTRACT**

A circuit board includes a substrate, a driver circuit, at least one light-emitting element, a grounding circuit, and an antenna unit. The substrate includes a first circuit layer and a second circuit layer. The driver circuit is located on the first circuit layer. The light-emitting element is located on the first circuit layer and is electrically connected to the driver circuit, so that the driver circuit controls the light-emitting element to emit light. The grounding circuit is located on the second circuit layer and is electrically connected to the driver circuit. The grounding circuit includes a plurality of conductive traces, and the conductive traces are arranged toward one side to form a clearance area on the second circuit layer. The antenna unit is located on the first circuit layer and corresponds to the clearance area to receive and transmit a radio frequency signal.



US 20220109234A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2022/0109234 A1**

Yang et al. (43) **Pub. Date: Apr. 7, 2022**

(54) **TERMINAL DEVICE**

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

(72) Inventors: **Yu Chan Yang**, Shenzhen (CN); **Chien-Ming Lee**, Shenzhen (CN); **Hanyang Wang**, Reading (GB); **Yi-Hsiang Liao**, Shenzhen (CN); **Lizhong Huang**, Dongguan (CN); **Guangxiang Zhu**, Shanghai (CN); **Bin Yu**, Shanghai (CN)

(21) Appl. No.: **17/421,870**

(22) PCT Filed: **Jan. 9, 2020**

(86) PCT No.: **PCT/CN2020/071207**

§ 371 (c)(1),
(2) Date: **Jul. 9, 2021**

(30) **Foreign Application Priority Data**

Jan. 9, 2019 (CN) 201910019373.6
Feb. 3, 2019 (CN) 201910108932.0

Publication Classification

(51) **Int. Cl.**
H01Q 1/40 (2006.01)
H01Q 1/38 (2006.01)
H01Q 1/24 (2006.01)
H01Q 1/52 (2006.01)

(52) **U.S. Cl.**
CPC ***H01Q 1/40*** (2013.01); ***H01Q 1/52*** (2013.01); ***H01Q 1/243*** (2013.01); ***H01Q 1/38*** (2013.01)

(57) **ABSTRACT**

This application provides a terminal device which includes a housing and a metal line. The metal line is disposed on an outer surface of the housing or embedded in the housing, and the metal line is configured to receive or send an electromagnetic wave signal. In the terminal device provided in this application, the metal line (an antenna) of the terminal device is disposed on the outer surface of the housing of the terminal device or embedded in the housing. This can increase a distance from the metal line to a circuit board of the terminal device, thereby reducing interference of a metal component on the circuit board to radiation of the metal line (radiation of the antenna) and improving operating bandwidth and efficiency of the antenna. This improves operating efficiency of the antenna of the terminal device, thereby improving signal receiving and signal sending quality of the terminal device.