

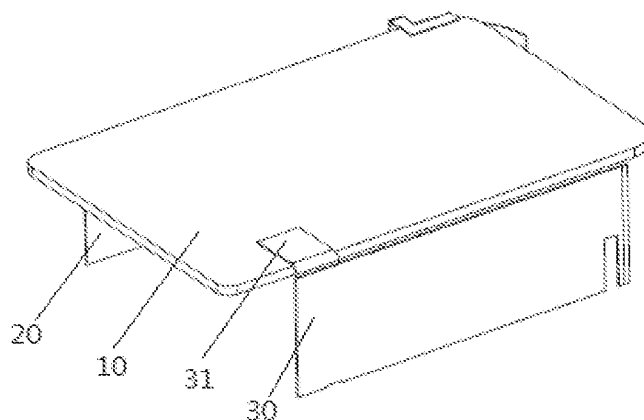


US 20230053514A1

(19) **United States**(12) **Patent Application Publication** (10) **Pub. No.: US 2023/0053514 A1****Lin et al.**(43) **Pub. Date: Feb. 23, 2023**(54) **ANTENNA EQUIPMENT****Publication Classification**(71) Applicants: **Tyco Electronics Holdings (Bermuda) No. 7 Limited**, Hamilton (BM); **Tyco Electronics Japan G.K.**, Kawasaki-shi (JP)(51) **Int. Cl.**
H01Q 9/04 (2006.01)
H01Q 23/00 (2006.01)(72) Inventors: **Yu Ching (Jimmy) Lin**, Taipei (CN); **Sin-Hooi Cheah**, Taipei (CN); **Hiroaki Kikuchi**, Kawawaki (JP); **Kuei Hsu Hsiang**, Taipei (CN)(52) **U.S. Cl.**
CPC **H01Q 9/0414** (2013.01);
H01Q 23/00 (2013.01)(73) Assignees: **Tyco Electronics Holdings (Bermuda) No. 7 Limited**, Hamilton (BM); **Tyco Electronics Japan G.K.**, Kawasaki-shi (JP)(57) **ABSTRACT**(21) Appl. No.: **17/888,953**(22) Filed: **Aug. 16, 2022**(30) **Foreign Application Priority Data**

Aug. 17, 2021 (CN) 202110941986.2

An antenna device includes a main circuit board, a first-type antenna ground-coupled to the main circuit board, and a second-type antenna ground-coupled to the main circuit board. The first-type antenna has a ground structure. The second-type antenna is spaced apart from the first-type antenna and an operating bandwidth of the second-type antenna is greater than an operating bandwidth of the first-type antenna.





US 20230055236A1

(19) **United States**

(12) **Patent Application Publication**
ODES

(10) **Pub. No.: US 2023/0055236 A1**

(43) **Pub. Date: Feb. 23, 2023**

(54) **SIMPLE ULTRA WIDE BAND VERY LOW
PROFILE ANTENNA**

(71) Applicant: **GM GLOBAL TECHNOLOGY
OPERATIONS LLC**, Detroit, MI (US)

(72) Inventor: **Uriel Zvi ODES**, Givaat Shmuel (IL)

(21) Appl. No.: **17/409,543**

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

Publication Classification

(51) **Int. Cl.**
H01Q 9/40 (2006.01)
H01Q 9/42 (2006.01)
H01Q 5/25 (2006.01)
H01Q 1/38 (2006.01)
H01Q 1/48 (2006.01)

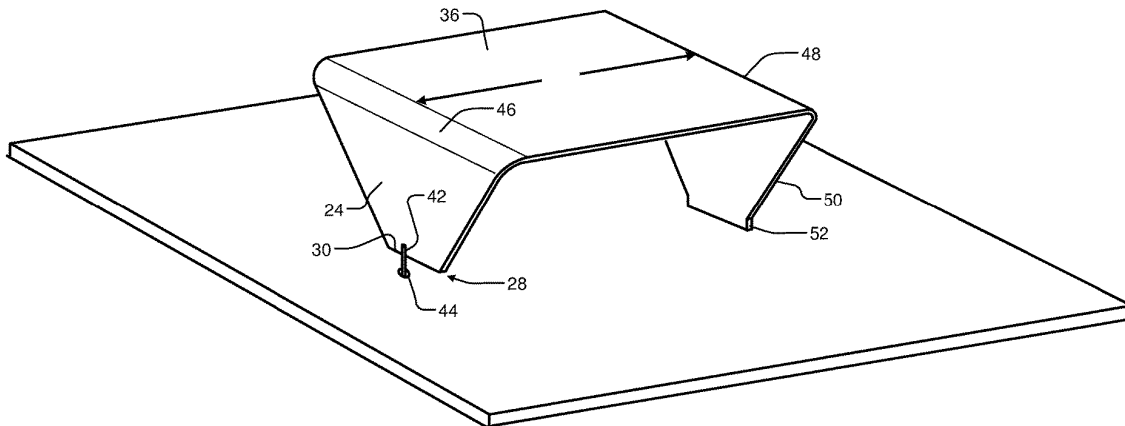
(52) **U.S. Cl.**

CPC **H01Q 9/40** (2013.01); **H01Q 9/42**
(2013.01); **H01Q 5/25** (2015.01); **H01Q 1/38**
(2013.01); **H01Q 1/48** (2013.01)

(57) **ABSTRACT**

An ultra wide band antenna includes a ground plane and an antenna body.

The antenna body includes a planar portion arranged above and parallel to the ground plane. A first tapered portion extends in a perpendicular direction from a first edge of the planar portion towards the ground plane. A lower edge of the first tapered portion is spaced from the ground plane by a predetermined gap. A second tapered portion extends in a perpendicular direction from a second edge of the planar portion towards the ground plane and includes a first portion that is connected to the ground plane.

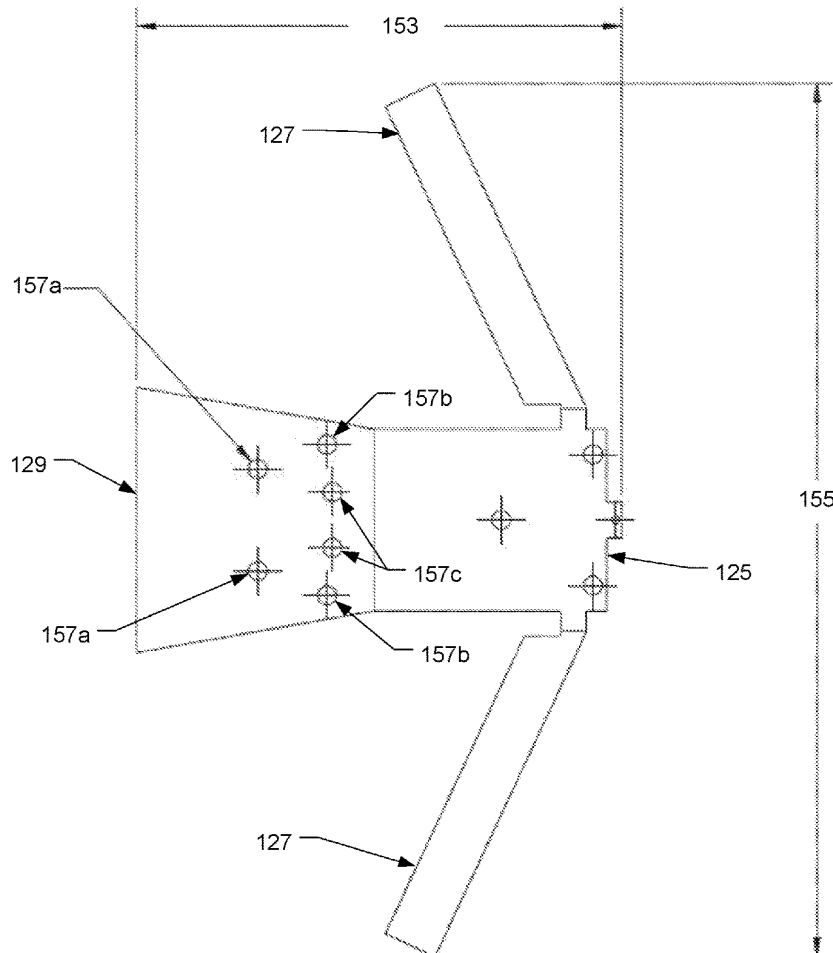




US 20230055367A1

(19) **United States**(12) **Patent Application Publication**
Neenan et al.(10) **Pub. No.: US 2023/0055367 A1**(43) **Pub. Date: Feb. 23, 2023**(54) **ANTENNA SYSTEM**(71) Applicant: **Parsec Technologies, Inc.**, Plano, TX
(US)(72) Inventors: **Michael A. Neenan**, Plano, TX (US);
Richard Loy Smith, JR., Dallas, TX
(US); **George Alexander Bednekoff**,
Plano, TX (US)(21) Appl. No.: **17/712,000**(22) Filed: **Apr. 1, 2022****Related U.S. Application Data**(63) Continuation-in-part of application No. 17/699,578,
filed on Mar. 21, 2022, which is a continuation of
application No. 16/588,732, filed on Sep. 30, 2019,
now Pat. No. 11,283,149.**Publication Classification**(51) **Int. Cl.**
H01Q 1/08 (2006.01)
H01Q 1/24 (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/08** (2013.01); **H01Q 1/243**
(2013.01); **H01Q 9/0421** (2013.01)(57) **ABSTRACT**

A multi-band antenna has a feed point, a grounding location, a first portion for low band operation, a second portion for high band operation, and one or more portions for high band operation. The ground reference of the feed point for the multi-band antenna is connected to a separate object that may provide a base for the multi-band antenna. The feed point of the multi-band antenna may be spaced above the base and have a space between the feed point and a location for the ground point. The low band portion has multiple resonances that are often odd multiples of the lowest resonant response. The portions that resonant most dominantly in the high band often have multiple resonances that are even multiples of the lowest high band resonance. The multi-band antenna has resonances spaced closely enough to appear to be a wide band antenna above the fundamental high band resonance.





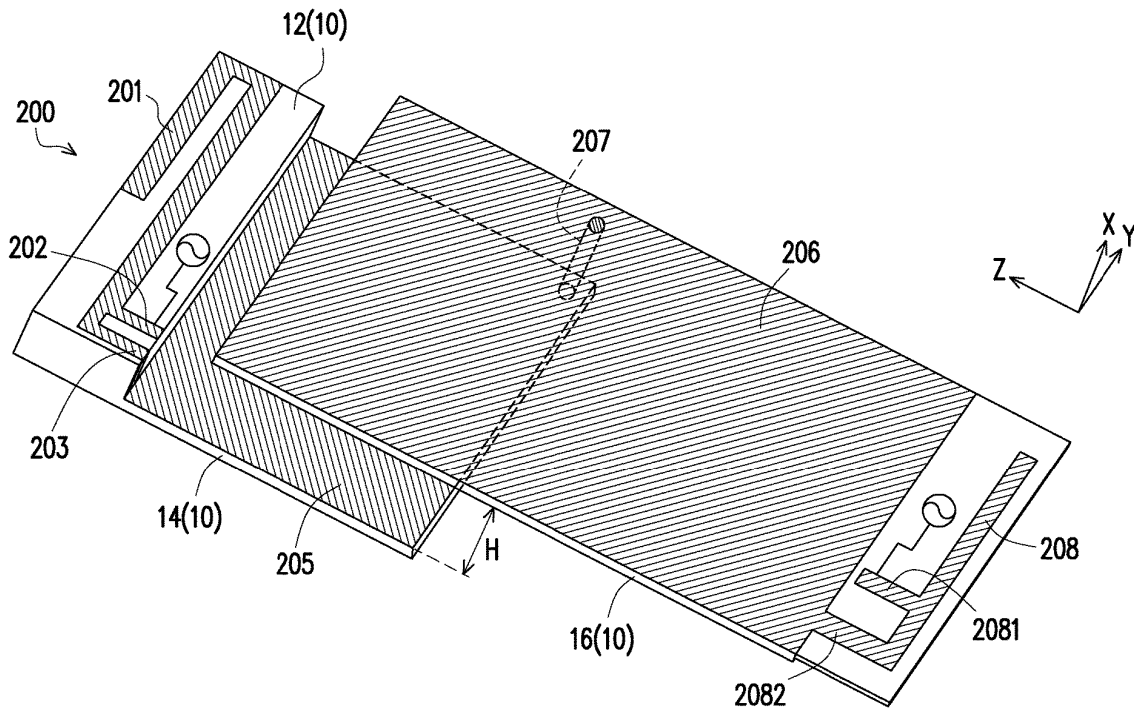
US 20230057270A1

(19) **United States**(12) **Patent Application Publication**
Huang et al.(10) **Pub. No.: US 2023/0057270 A1**(43) **Pub. Date: Feb. 23, 2023**(54) **ANTENNA MODULE****Publication Classification**(71) Applicant: **PEGATRON CORPORATION,**
TAIPEI CITY (TW)(51) **Int. Cl.**
H01Q 9/04 (2006.01)
H01Q 1/22 (2006.01)(72) Inventors: **Chin-Ting Huang**, Taipei City (TW);
Chun-Kai Wang, Taipei City (TW);
Hsi-Kai Hung, Taipei City (TW); **Sony**
Chayadi, Taipei City (TW)(52) **U.S. Cl.**
CPC **H01Q 9/0414** (2013.01); **H01Q 9/0421**
(2013.01); **H01Q 1/2291** (2013.01)(73) Assignee: **PEGATRON CORPORATION,**
TAIPEI CITY (TW)(21) Appl. No.: **17/862,216**(22) Filed: **Jul. 11, 2022**(30) **Foreign Application Priority Data**

Aug. 19, 2021 (TW) 110130731

(57) **ABSTRACT**

Provided is an antenna module including a first planar inverted-F antenna radiator, a first ground plane, a second ground plane, and a conductor. The first planar inverted-F antenna radiator includes a first feeding terminal and a first ground terminal. The first ground terminal is connected to the first ground plane. The second ground plane is located on one side of the first ground plane. A gap exists between the first ground plane and the second ground plane. The conductor is located between the first ground plane and the second ground plane and connects the first ground plane with the second ground plane.





US 20230058737A1

(19) **United States**

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

(10) **Pub. No.: US 2023/0058737 A1**

(43) **Pub. Date: Feb. 23, 2023**

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

Publication Classification

(71) Applicant: **REALTEK SEMICONDUCTOR
CORPORATION, HSINCHU (TW)**

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 9/04 (2006.01)
H01Q 1/52 (2006.01)

(72) Inventors: **CHING-WEI LING, HSINCHU (TW);
CHIH-PAO LIN, HSINCHU (TW)**

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 9/0421**
(2013.01); **H01Q 1/521** (2013.01)

(21) Appl. No.: **17/549,344**

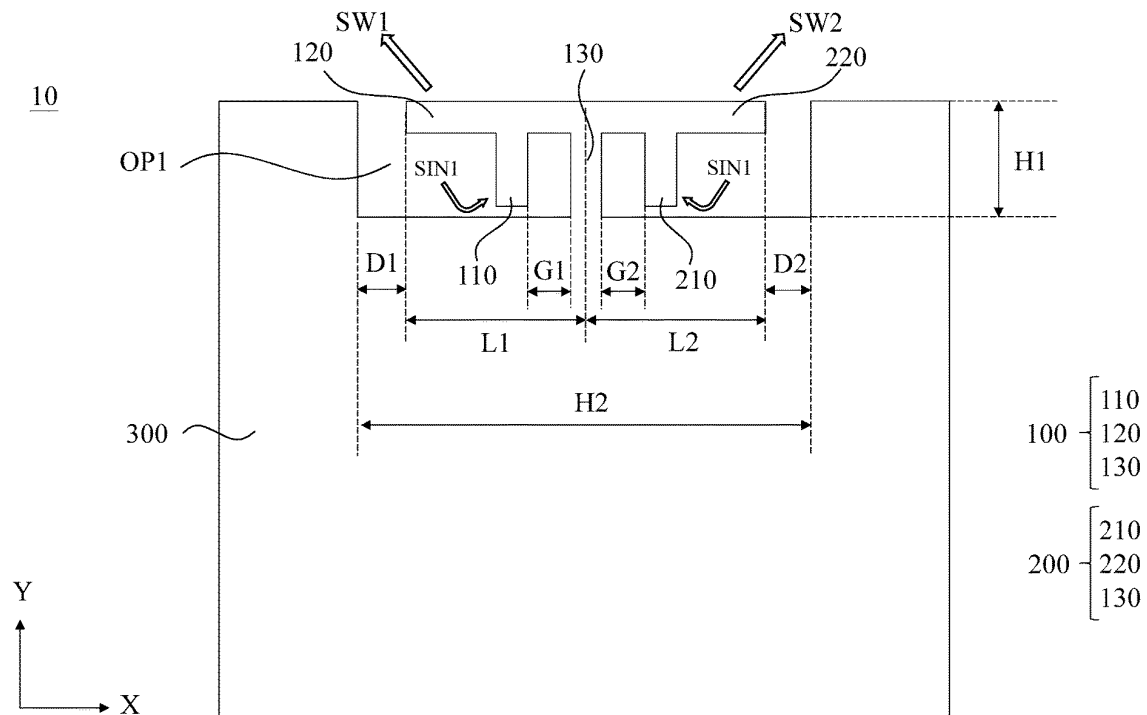
(57) **ABSTRACT**

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

An antenna structure includes a first resonant unit and a second resonant unit. The first resonant unit is configured to transmit an input signal as a first wireless signal. The second resonant unit is configured to transmit the input signal as a second wireless signal. The first resonant unit and the second resonant unit have a substantially identical operating band, and the first resonant unit and the second resonant unit are a single continuous metal structure.

(30) **Foreign Application Priority Data**

Aug. 23, 2021 (TW) 110131145

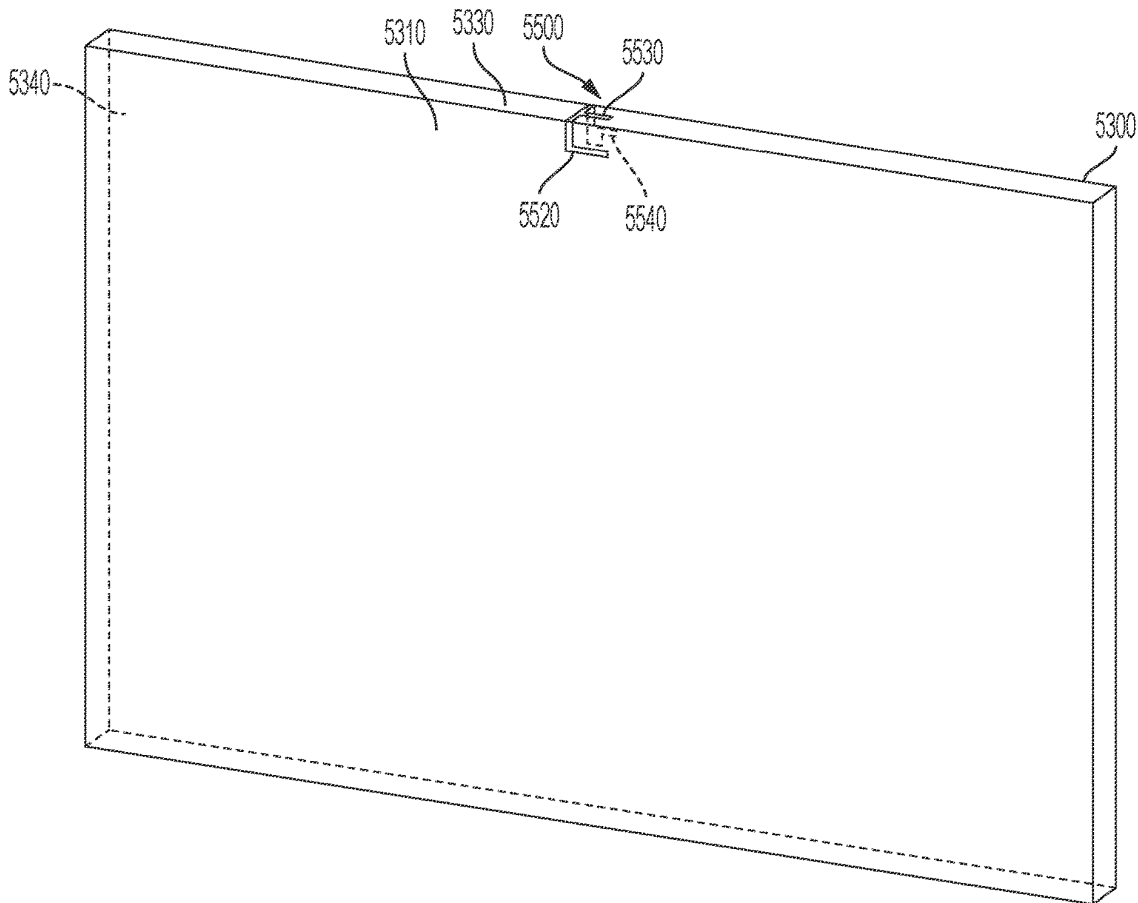




US 20230060719A1

(19) **United States**(12) **Patent Application Publication**
Willing et al.(10) **Pub. No.: US 2023/0060719 A1**(43) **Pub. Date: Mar. 2, 2023**(54) **FOLDABLE ANTENNA**(52) **U.S. Cl.**(71) Applicant: **Dell Products L.P.**, Round Rock, TX
(US)CPC **H01Q 1/2258** (2013.01); **G06F 1/1601**
(2013.01); **H01Q 1/085** (2013.01)(72) Inventors: **Austin Willing**, Austin, TX (US);
Deeder M. Aurongzeb, Austin, TX
(US); **Johnny Gutierrez**, Lake Hills,
TX (US)(57) **ABSTRACT**(73) Assignee: **Dell Products L.P.**, Round Rock, TX
(US)

A flexible antenna may be used to transmit information from and receive information to an information handling system by folding the antenna into contact with an inside surface of a display chassis of the information handling system, an outside surface of the display chassis and the surface connecting them. The folded antenna configuration may permit the antenna to receive and transmit signals in any or almost any direction when the chassis (e.g., a laptop) is in an open position even though the antenna occupies only a very small space of the inside surface of the display chassis (i.e., permitting the screen to occupy nearly all of the inside surface of the display chassis without interference from the antenna) or in a closed position.

(21) Appl. No.: **17/446,275**(22) Filed: **Aug. 27, 2021****Publication Classification**(51) **Int. Cl.**
H01Q 1/22 (2006.01)
G06F 1/16 (2006.01)
H01Q 1/08 (2006.01)



US 20230061101A1

(19) **United States**

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

(10) **Pub. No.: US 2023/0061101 A1**
(43) **Pub. Date: Mar. 2, 2023**

(54) **ELECTRONIC DEVICE COMPRISING ANTENNA**

H01Q 21/08 (2006.01)
H01Q 7/00 (2006.01)
H01Q 9/04 (2006.01)

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

(52) **U.S. Cl.**
CPC *H01Q 1/2291* (2013.01); *H01Q 25/002* (2013.01); *H01Q 21/08* (2013.01); *H01Q 7/00* (2013.01); *H01Q 9/0407* (2013.01)

(72) Inventors: **Seongjin PARK**, Suwon-si (KR); **Kiwon KIM**, Suwon-si (KR); **Hyunkee MIN**, Suwon-si (KR); **Jaebong CHUN**, Suwon-si (KR); **ILPYO HONG**, Suwon-si (KR)

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

(21) Appl. No.: **17/982,143**

(22) Filed: **Nov. 7, 2022**

Related U.S. Application Data

(63) Continuation of application No. PCT/KR2021/005151, filed on Apr. 23, 2021.

(30) **Foreign Application Priority Data**

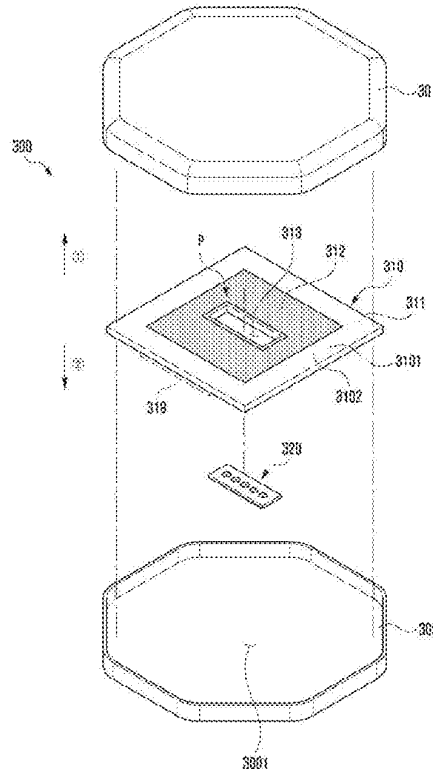
May 7, 2020 (KR) 10-2020-0054528

Publication Classification

(51) **Int. Cl.**
H01Q 1/22 (2006.01)
H01Q 25/00 (2006.01)

(57) **ABSTRACT**

An electronic device includes: an electronic device includes: a housing; a first antenna structure provided in an inner space of the housing, the first antenna structure including: a first substrate having a first substrate surface facing a first direction and a second substrate surface facing a second direction opposite to the first direction, the first substrate including a plurality of first insulating layers and a first ground layer disposed on at least one of the plurality of first insulating layers; and a conductive patch disposed on one of the plurality of first insulating layers and overlapping the first ground layer; and a second antenna structure disposed in an opening of the first substrate in the inner space of the housing, the second antenna structure including: a second substrate having a third substrate surface facing the first direction and a fourth substrate surface facing the second direction, the second substrate including a plurality of second insulating layers that are stacked and a second ground layer; and at least two antenna elements disposed on a second insulating layer, among the plurality of second insulating layers, that is closer to the third substrate surface than the fourth substrate surface, wherein the conductive patch at least partly surrounds the second antenna structure.





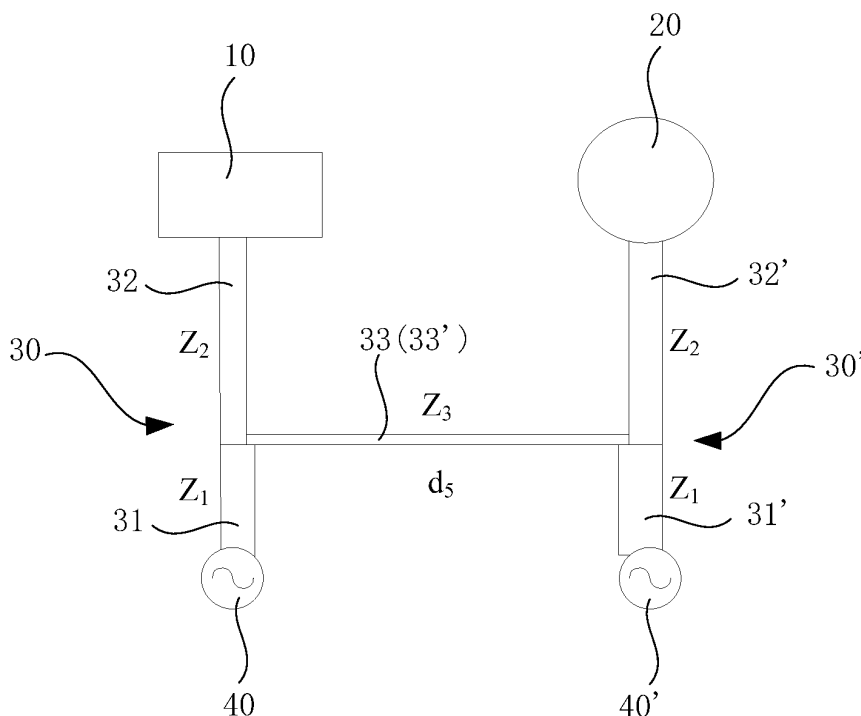
US 20230062082A1

(19) **United States**(12) **Patent Application Publication****Zhang et al.**(10) **Pub. No.: US 2023/0062082 A1**(43) **Pub. Date:****Mar. 2, 2023**(54) **ANTENNA APPARATUS AND ELECTRONIC DEVICE****Publication Classification**(71) Applicants: **XIDIAN UNIVERSITY**, Xi'an (CN);
GUANGDONG OPPO MOBILE TELECOMMUNICATIONS CORP., LTD., Dongguan (CN)(72) Inventors: **Shuai Zhang**, Dongguan (CN); **Nan Huang**, Dongguan (CN); **Zhengdong Yong**, Dongguan (CN); **Bao Lu**, Dongguan (CN)(21) Appl. No.: **17/985,551**(22) Filed: **Nov. 11, 2022****Related U.S. Application Data**

(63) Continuation of application No. PCT/CN2021/088833, filed on Apr. 22, 2021.

(30) **Foreign Application Priority Data**May 12, 2020 (CN) 202010399374.0
May 12, 2020 (CN) 202020781746.1(51) **Int. Cl.**
H01Q 13/20 (2006.01)
H01Q 1/24 (2006.01)
H01Q 1/52 (2006.01)(52) **U.S. Cl.**
CPC **H01Q 13/206** (2013.01); **H01Q 1/52** (2013.01); **H01Q 1/241** (2013.01)(57) **ABSTRACT**

Provided are an antenna apparatus and an electronic device. The antenna apparatus comprises a plurality of antenna units, spaced from each other; a plurality of decoupling networks, corresponding to the plurality of antenna units one to one; and a decoupling transmission line. Each of the decoupling networks comprises a first transmission line and a second transmission line; an end of the first transmission line is configured to be connected to a radio-frequency chip, the other end of the first transmission line is connected to an end of the second transmission line, a decoupling port is formed at a joint between the other end of the first transmission line and the end of the second transmission line, and the other end of the second transmission line is connected to a corresponding antenna unit; and the decoupling transmission line is connected between adjacent decoupling ports. The electronic device comprises the antenna apparatus.





US 20230062765A1

(19) **United States**

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

(10) **Pub. No.: US 2023/0062765 A1**

(43) **Pub. Date: Mar. 2, 2023**

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

Publication Classification

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

(51) **Int. Cl.**
H01Q 5/10 (2006.01)
H01Q 1/24 (2006.01)
H01Q 9/04 (2006.01)
H01Q 21/08 (2006.01)

(72) Inventors: **Jaehoon JO**, Suwon-si (KR); **Hosaeng KIM**, Suwon-si (KR); **Seongjin PARK**, Suwon-si (KR); **Sumin YUN**, Suwon-si (KR); **Woomin JANG**, Suwon-si (KR); **Jehun JONG**, Suwon-si (KR)

(52) **U.S. Cl.**
CPC **H01Q 5/10** (2015.01); **H01Q 1/243** (2013.01); **H01Q 9/045** (2013.01); **H01Q 21/08** (2013.01); **H04M 1/026** (2013.01)

(21) Appl. No.: **17/899,136**

(22) Filed: **Aug. 30, 2022**

Related U.S. Application Data

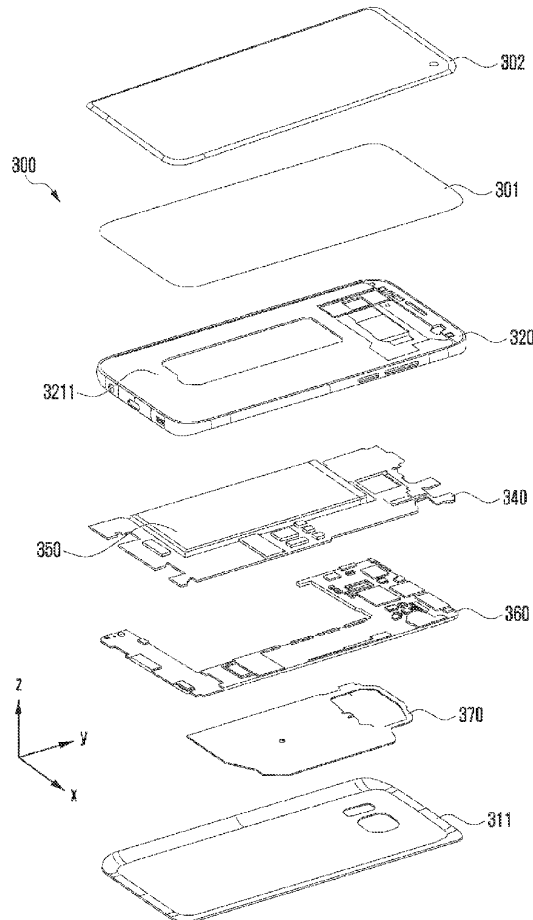
(63) Continuation of application No. PCT/KR2022/011937, filed on Aug. 10, 2022.

Foreign Application Priority Data

Aug. 26, 2021 (KR) 10-2021-0112933

(57) **ABSTRACT**

An electronic device is provided. The electronic device includes a housing, an antenna structure disposed in an inner space of the housing and including a substrate having a first substrate surface and a second substrate surface facing a direction opposite the first substrate surface, and configured to have a first dielectric constant, a plurality of antenna elements disposed on the substrate at a designated interval and forming a directional beam in a direction toward which the first substrate surface faces, and at least one dielectric disposed on the first substrate surface and configured to have a second dielectric constant, and a wireless communication circuit disposed in the inner space and configured to at least one of transmit or receive a wireless signal in at least one frequency band through the plurality of antenna elements.





US 20230063968A1

(19) **United States**

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

(10) **Pub. No.: US 2023/0063968 A1**

(43) **Pub. Date: Mar. 2, 2023**

(54) **TRANSPARENT ANTENNA, ANTENNA
ARRAY, AND DISPLAY MODULE**

(71) Applicant: **AGC Inc.**, Tokyo (JP)

(72) Inventors: **Yasuo MORIMOTO**, Tokyo (JP);
Nobuhiro NAKAMURA, Tokyo (JP);
Masanobu ISSHIKI, Tokyo (JP)

(73) Assignee: **AGC Inc.**, Tokyo (JP)

(21) Appl. No.: **18/045,269**

(22) Filed: **Oct. 10, 2022**

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2021/
015048, filed on Apr. 9, 2021.

(30) **Foreign Application Priority Data**

Apr. 27, 2020 (JP) 2020-078662

Publication Classification

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

H01Q 1/42 (2006.01)

(52) **U.S. Cl.**
CPC **H01Q 1/38** (2013.01); **H01Q 1/42**
(2013.01)

(57) **ABSTRACT**

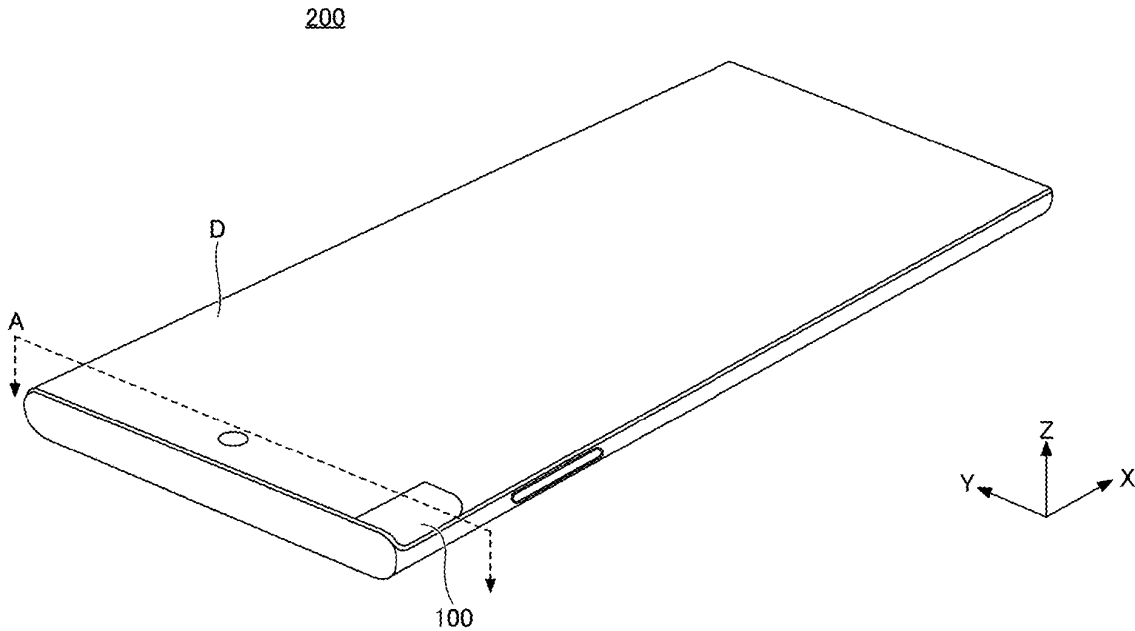
A transparent antenna includes a transparent substrate; and a metal thin wire layer on an upper side of the transparent substrate. The transparent substrate has a thickness of 300 μm or less. The metal thin wire layer has an opening ratio of 80% or more. When a metal conductor having a surface resistivity ρ Ω/sq is placed parallel to the transparent antenna 0.15 mm apart, an input reflection coefficient $S_{11}(\rho, f)$ and a radiation efficiency $\text{Eff}(\rho, f)$ at a frequency f satisfy relations

$$S_{11}(0.1 \text{ } \Omega/\text{sq}, f_1 \text{ GHz}) < -3 \text{ dB},$$

$$S_{11}(0.1 \text{ } \Omega/\text{sq}, f_2 \text{ GHz}) < -3 \text{ dB}, \text{ and}$$

$$|\text{Eff}(0.1 \text{ } \Omega/\text{sq}, f_1 \text{ GHz}) - \text{Eff}(0.1 \text{ } \Omega/\text{sq}, f_2 \text{ GHz})| < 25\%$$

at two frequencies f_1 and f_2 that are between 2 GHz and 50 GHz.





US 20230067193A1

(19) **United States**

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

(10) **Pub. No.: US 2023/0067193 A1**

(43) **Pub. Date: Mar. 2, 2023**

(54) **CWG FILTER, AND RU, AU OR BS HAVING
THE SAME**

Publication Classification

(71) Applicant: **Telefonaktiebolaget LM Ericsson**
(publ), Stockholm (SE)

(51) **Int. Cl.**
H01P 1/212 (2006.01)
H01P 5/04 (2006.01)

(72) Inventors: **Yongbin Liu**, Beijing (CN); **Jianlan Li**,
Beijing (CN); **Mengyang Jia**, Beijing
(CN); **Ying Li**, Beijing (CN)

(52) **U.S. Cl.**
CPC **H01P 1/212** (2013.01); **H01P 5/04**
(2013.01)

(21) Appl. No.: **17/789,416**

(57) **ABSTRACT**

(22) PCT Filed: **Dec. 30, 2020**

(86) PCT No.: **PCT/CN2020/141458**

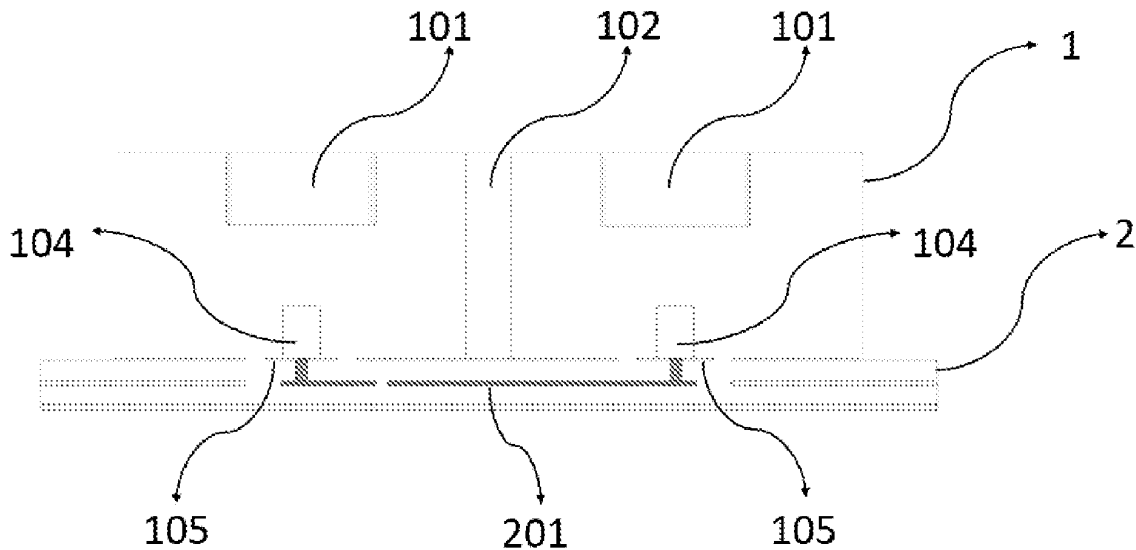
§ 371 (c)(1),

(2) Date: **Jun. 27, 2022**

A ceramic waveguide filter, a radio unit, an antenna unit and a base station are disclosed. According to an embodiment, a ceramic waveguide filter comprises a body (1) that is made of a ceramic material and that has a plurality of resonators each including a blind hole (101). The blind holes (101) of two of the resonators open at a first surface of the body (1) and extend toward an opposite second surface of the body (1). Capacitive coupling between the two resonators is achieved by a coupling structure (201) on/in a substrate (2), to which the body (1) is attached at the side of the second surface.

(30) **Foreign Application Priority Data**

Dec. 31, 2019 (CN) PCT/CN2019/130526





US 20230067595A1

(19) **United States**

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

(10) **Pub. No.: US 2023/0067595 A1**

(43) **Pub. Date: Mar. 2, 2023**

(54) **PACKAGE STRUCTURE WITH ANTENNA CIRCUIT**

Publication Classification

(71) Applicant: **Jabil Circuit (Singapore) Pte. Ltd.**,
Singapore (SG)

(51) **Int. Cl.**
H05K 1/02 (2006.01)
H05K 1/11 (2006.01)
H01Q 9/04 (2006.01)
H01Q 1/22 (2006.01)

(72) Inventors: **Chi-Neng Ho**, Taichung City (TW);
Sheng-Wen Ni, Taichung City (TW);
Yu-Cheng Lin, Taichung City (TW);
Yen-Chou Chen, Taichung City (TW)

(52) **U.S. Cl.**
CPC **H05K 1/0243** (2013.01); **H05K 1/0277**
(2013.01); **H05K 1/11** (2013.01); **H01Q**
9/0407 (2013.01); **H01Q 1/22** (2013.01);
H05K 2201/10098 (2013.01)

(73) Assignee: **Jabil Circuit (Singapore) Pte. Ltd.**,
Singapore (SG)

(21) Appl. No.: **17/897,635**

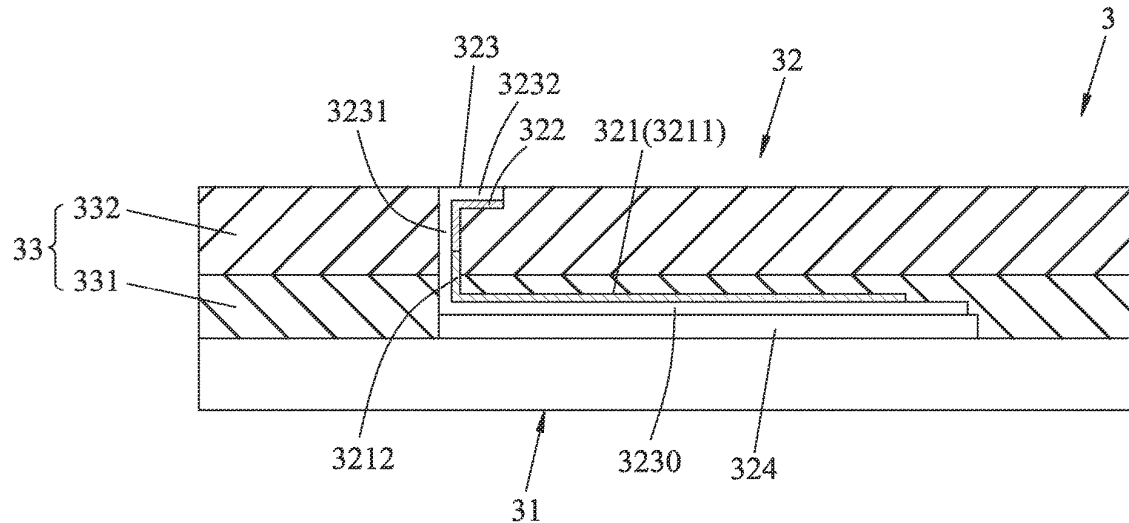
(22) Filed: **Aug. 29, 2022**

(30) **Foreign Application Priority Data**

Sep. 2, 2021 (TW) 110210356

(57) **ABSTRACT**

A package structure includes a carrier substrate, a circuit unit, and a packaging unit. The circuit unit includes an antenna circuit, and a conducting circuit that is flexible and that is electrically connected to the antenna circuit. At least a portion of the antenna circuit is disposed on the carrier substrate. The packaging unit is disposed on the carrier substrate by molding and encapsulates the circuit unit such that a portion of the circuit unit is exposed to permit said conducting circuit for electrical connection with the outside.





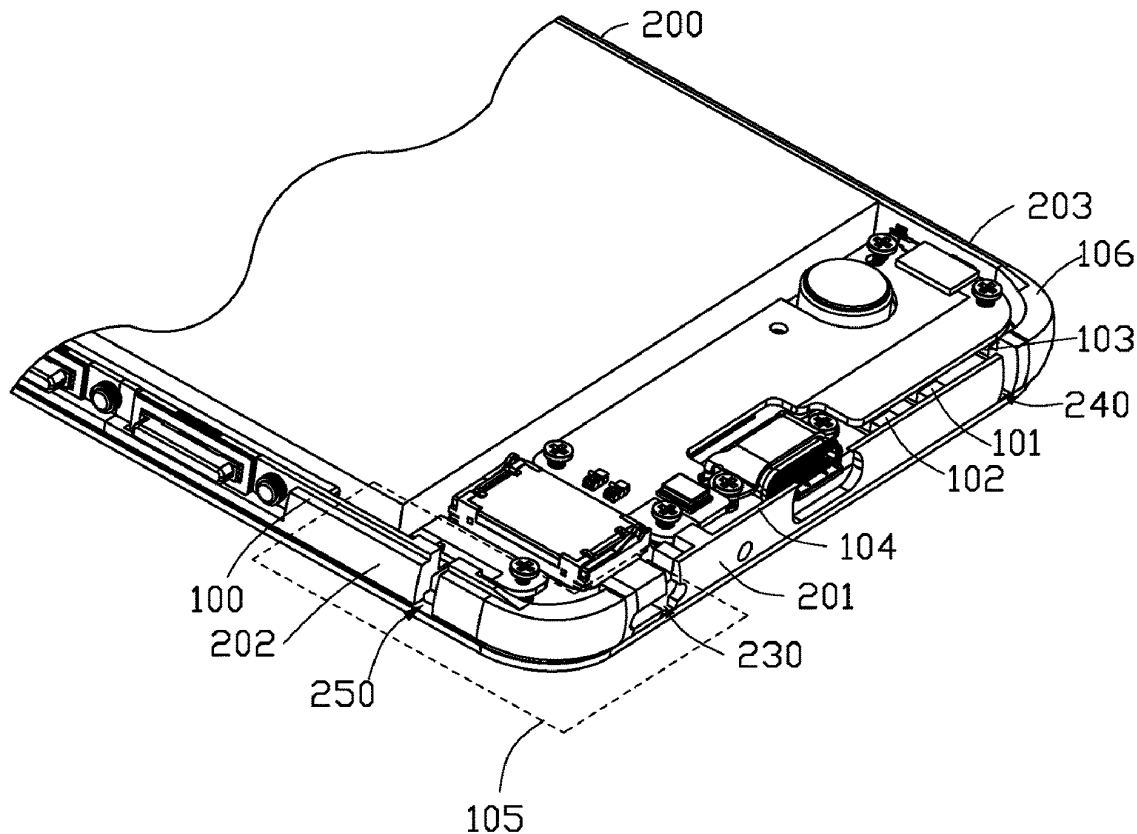
US 20230070301A1

(19) **United States**(12) **Patent Application Publication**
XIE et al.(10) **Pub. No.: US 2023/0070301 A1**(43) **Pub. Date: Mar. 9, 2023**(54) **ANTENNA STRUCTURE AND WIRELESS
COMMUNICATION DEVICE HAVING SAME**(52) **U.S. Cl.**
CPC **H01Q 5/335** (2015.01); **H01Q 1/243**
(2013.01)(71) Applicants: **Futaijing Precision Electronics
(Yantai) Co., Ltd.**, Yantai (CN); **HON
HAI PRECISION INDUSTRY CO.,
LTD.**, New Taipei (TW)(57) **ABSTRACT**(72) Inventors: **JIA-YING XIE**, New Taipei (TW);
JIA-HUNG HSIAO, New Taipei (TW)(21) Appl. No.: **17/868,237**(22) Filed: **Jul. 19, 2022**(30) **Foreign Application Priority Data**

Sep. 7, 2021 (CN) 202111045974.8

Publication Classification(51) **Int. Cl.**
H01Q 5/335 (2006.01)
H01Q 1/24 (2006.01)

An antenna structure and a wireless communication device having the antenna structure are provided, the antenna structure includes a metal frame, a feeding portion, a first ground portion, and a second ground portion. The metal frame defines a first gap, a second gap, and a third gap, the metal frame between the first gap and the second gap forms a first radiating portion, the metal frame between the first gap and the third gap and the metal frame on a side of the third gap cooperatively form a second radiating portion, the metal frame on a side of the second gap forms a third radiating portion. The feeding portion is connected to the first radiating portion. The first ground portion is apart from the feeding portion and connected to the first radiating portion. The second ground portion closes to the second gap and is connected to the third radiating portion.





US 20230072518A1

(19) **United States**

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

(10) **Pub. No.: US 2023/0072518 A1**

(43) **Pub. Date: Mar. 9, 2023**

(54) **ELECTRONIC DEVICE HOUSING WITH
INTEGRATED ANTENNA**

Publication Classification

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

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/42 (2006.01)
H01Q 13/10 (2006.01)

(72) Inventors: **Nicholas A. Renda**, San Francisco, CA (US); **Carlo Catalano**, Cupertino, CA (US); **Chen Wang**, Cupertino, CA (US); **David R. Cramer**, Cupertino, CA (US); **Kellen M. Atom**, Cupertino, CA (US); **Lindsay D. Corbet**, Cupertino, CA (US); **Melody L. Kuna**, Palo Alto, CA (US); **Robert J. Durand**, Cupertino, CA (US); **Stephanie L. Ternullo**, Cupertino, CA (US); **Sunita Venkatesh**, Cupertino, CA (US); **Suvrat Lele**, Cupertino, CA (US); **Wang Chung Alston Cheung**, Cupertino, CA (US)

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 1/42* (2013.01); *H01Q 13/10* (2013.01)

(21) Appl. No.: **17/544,837**

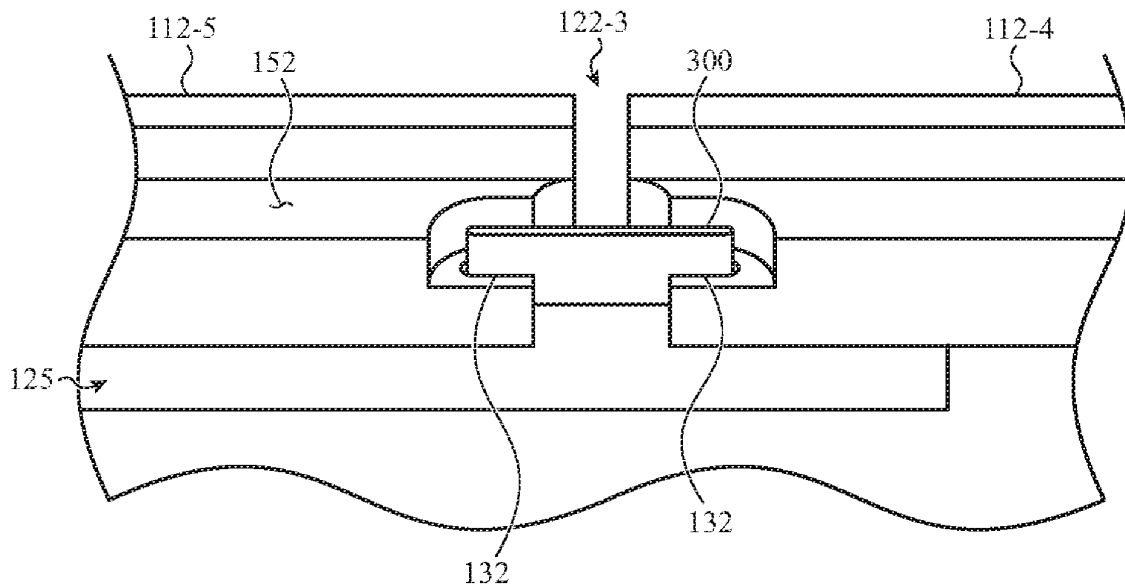
(22) Filed: **Dec. 7, 2021**

Related U.S. Application Data

(60) Provisional application No. 63/242,252, filed on Sep. 9, 2021.

(57) **ABSTRACT**

An electronic device includes a display, and a housing at least partially surrounding the display and comprising a first housing member defining a first portion of an exterior surface of the electronic device and a second housing member defining a second portion of the exterior surface of the electronic device and configured to function as an antenna. The electronic device also includes a joining structure positioned between the first housing member and the second housing member including a reinforcement plate and a molded element at least partially encapsulating the reinforcement plate and engaged with the first housing member and the second housing member, thereby retaining the first housing member to the second housing member.





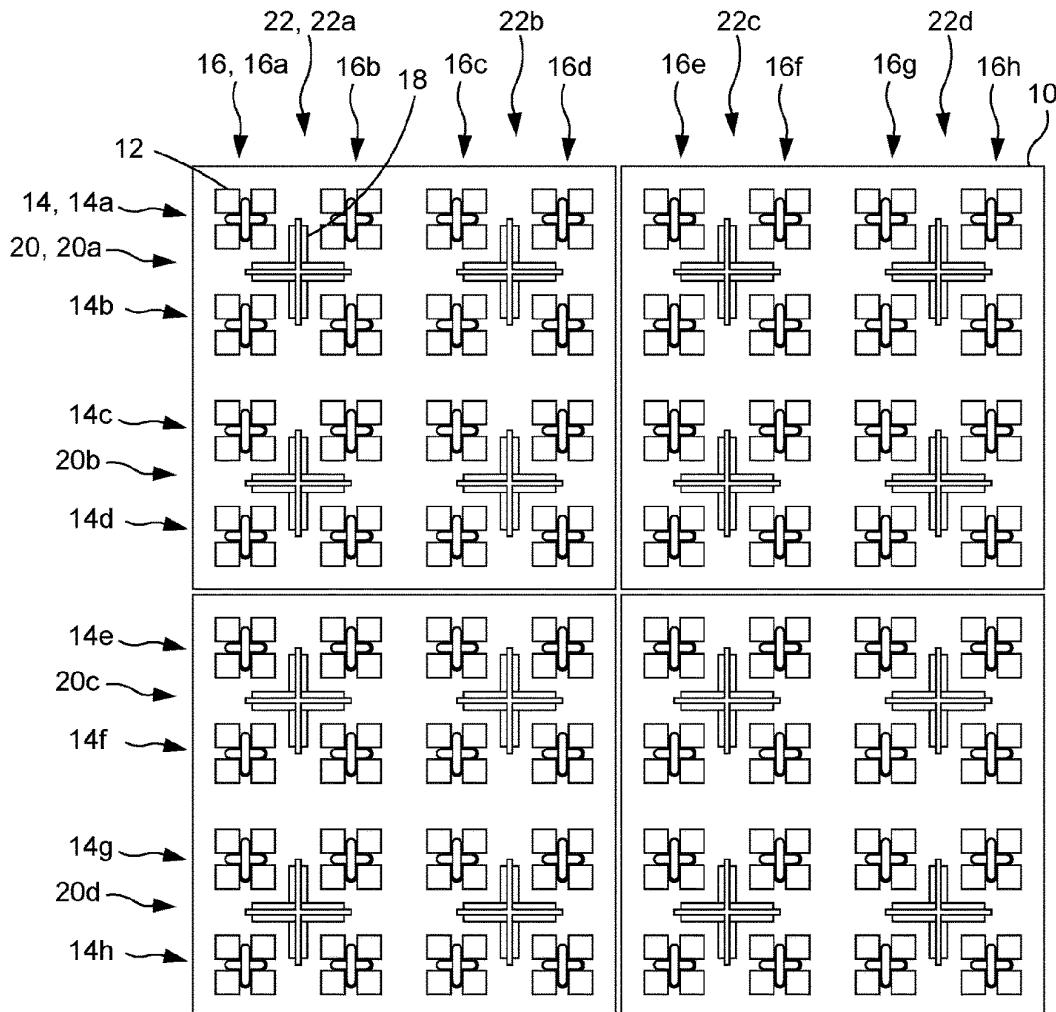
US 20230076013A1

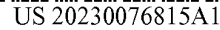
(19) **United States**(12) **Patent Application Publication**
Moallem et al.(10) **Pub. No.: US 2023/0076013 A1**(43) **Pub. Date: Mar. 9, 2023**(54) **DUAL/TRI-BAND ANTENNA ARRAY ON A
SHARED APERTURE**(52) **U.S. Cl.**CPC *H01Q 21/065* (2013.01); *H01Q 21/062*
(2013.01); *H01Q 9/0414* (2013.01); *H01Q*
21/26 (2013.01)(71) Applicant: **Mobix Labs, Inc.**, Irvine, CA (US)(72) Inventors: **Meysam Moallem**, Irvine, CA (US);
Saeideh Shad, Irvine, CA (US)

(57)

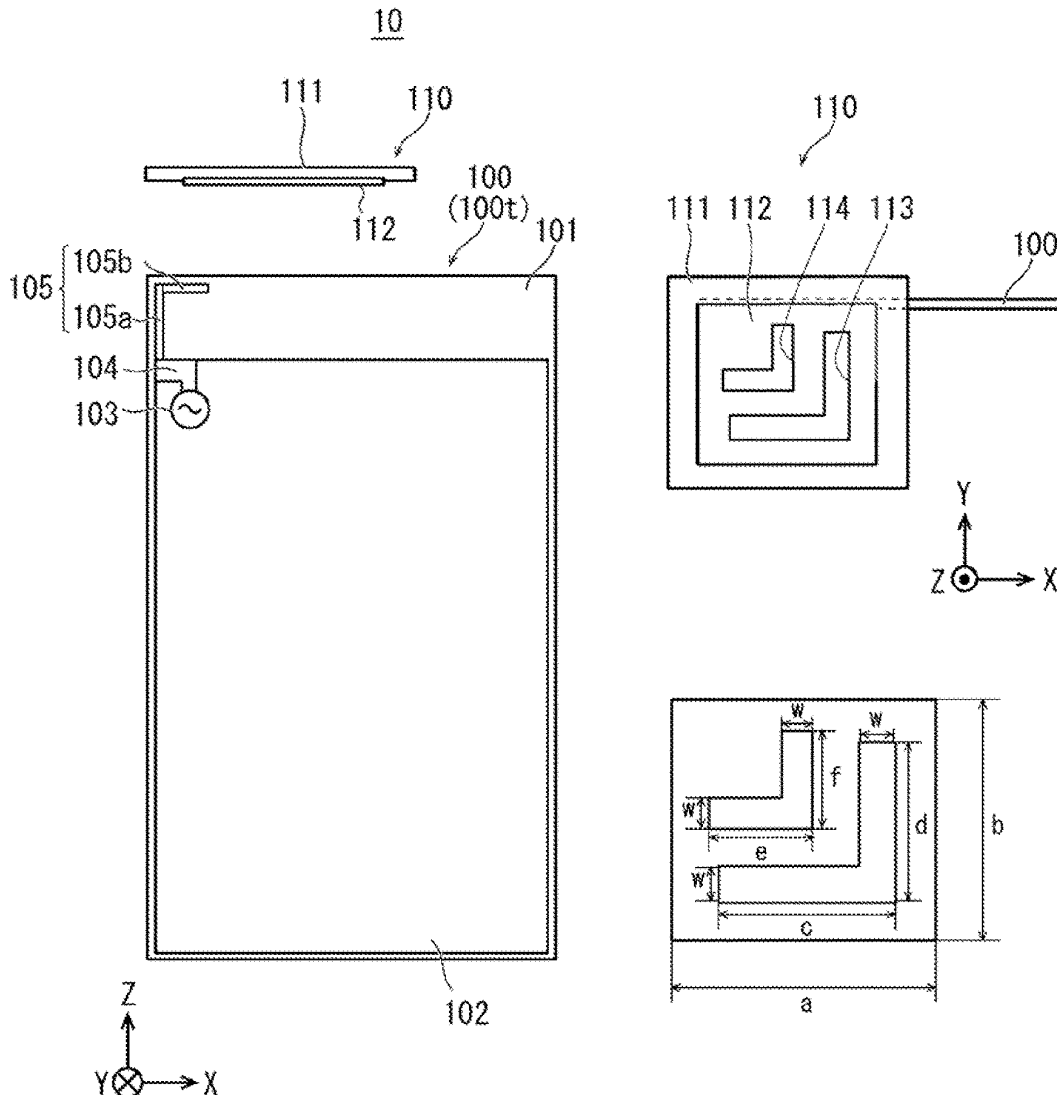
ABSTRACT(21) Appl. No.: **17/931,025**(22) Filed: **Sep. 9, 2022****Related U.S. Application Data**(60) Provisional application No. 63/242,374, filed on Sep.
9, 2021, provisional application No. 63/242,376, filed
on Sep. 9, 2021.**Publication Classification**(51) **Int. Cl.**
H01Q 21/06 (2006.01)
H01Q 9/04 (2006.01)
H01Q 21/26 (2006.01)

A dual/tri-band array antenna for multiple frequency bands has one or more shared aperture unit cells, and a plurality of dual-polarized magneto-electric dipole antennas or aperture-fed stacked patch antennas configured for signals of the high band(s). A given set of the dual-polarized magneto-electric dipole antennas or aperture-fed stacked patch antennas are positioned on a given one of the shared aperture unit cells in a spaced apart relationship. The array antenna has one or more dual-polarized crossed dipole patch antennas configured for the low band. A given one of the dual-polarized crossed dipole patch antennas are centered on the given one of the shared aperture unit cells and spaced apart from the dual-polarized magneto-electric dipole antennas or aperture-fed stacked patch antennas.





(43) **Pub. Date:** **Mar. 9, 2023**





US 20230079082A1

(19) **United States**

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

(10) **Pub. No.: US 2023/0079082 A1**

(43) **Pub. Date: Mar. 16, 2023**

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

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

(72) Inventors: **Gunbae LIM**, Suwon-si (KR);
Yongsang YUN, Suwon-si (KR);
Seongjin PARK, Suwon-si (KR);
Jaebong CHUN, Suwon-si (KR)

(21) Appl. No.: **17/941,218**

(22) Filed: **Sep. 9, 2022**

Related U.S. Application Data

(63) Continuation of application No. PCT/KR2022/
012866, filed on Aug. 29, 2022.

(30) **Foreign Application Priority Data**

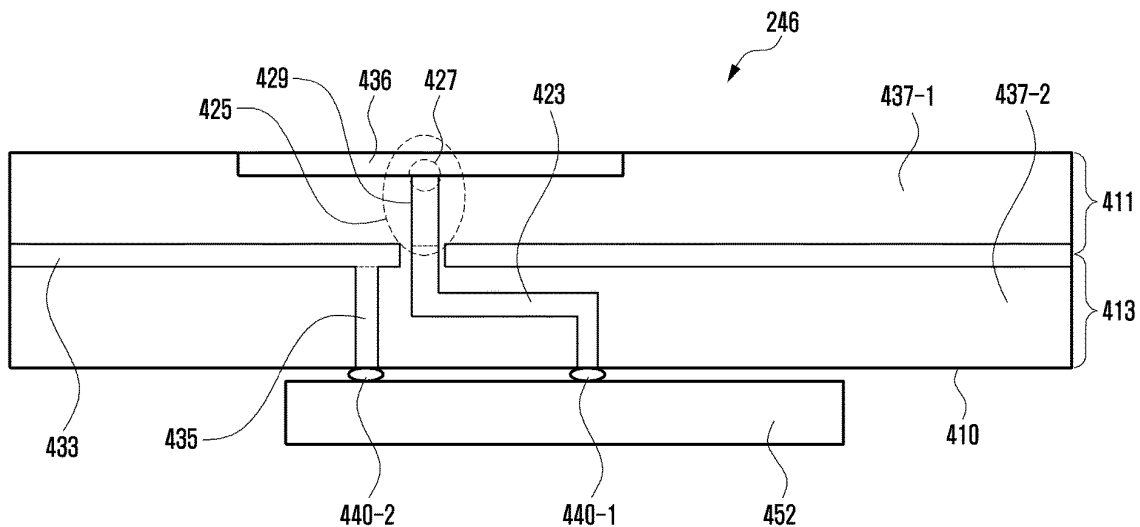
Sep. 15, 2021 (KR) 10-2021-0123049

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 9/04 (2006.01)
H01Q 21/08 (2006.01)
(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 9/0407**
(2013.01); **H01Q 21/08** (2013.01)

(57) **ABSTRACT**

Electronic devices including an antenna module and the antenna module are presented. The electronic devices may include a housing, a wireless communication module, a plurality of slits provided in the housing, and an antenna module disposed inside the housing to correspond to the plurality of slits and operatively connected to the wireless communication module. The antenna module may include a printed circuit board, a plurality of conductive patches disposed on a first surface of the printed circuit board, and an RFIC disposed on a second surface of the printed circuit board. The plurality of conductive patches are configured to be disposed in the plurality of slits. As a result, it is possible to secure a space for disposing different electronic components included in the electronic device.

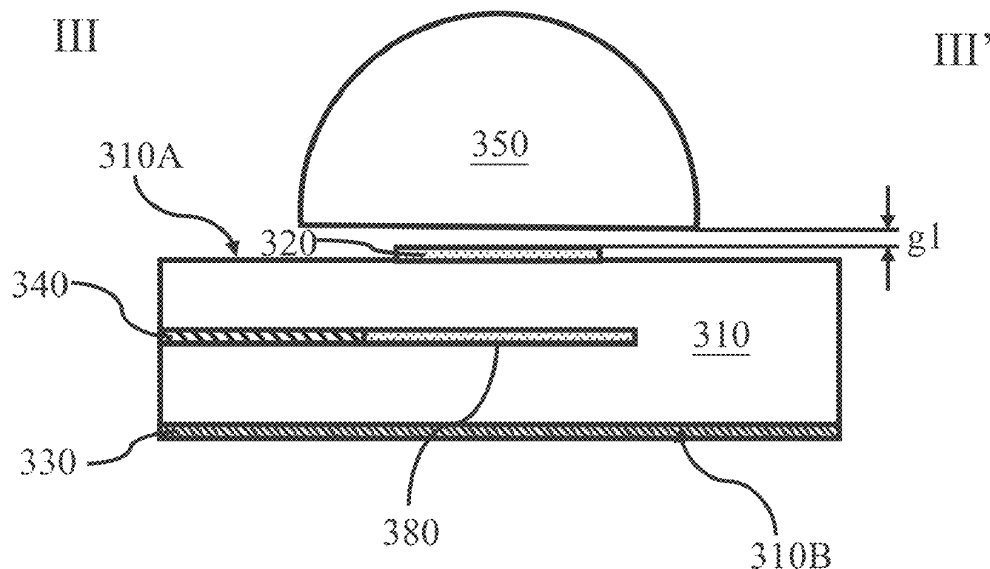




US 20230080502A1

(19) **United States**(12) **Patent Application Publication**
WANG et al.(10) **Pub. No.: US 2023/0080502 A1**(43) **Pub. Date: Mar. 16, 2023**(54) **ANTENNA ASSEMBLY EQUIPPED WITH A
SUB-WAVELENGTH STRUCTURED
ENHANCER**(71) Applicant: **AuthenX Inc.**, Hsinchu County (TW)(72) Inventors: **YU-CHUN WANG**, Hsinchu County
(TW); **PO-KUAN SHEN**, Hsinchu
County (TW); **SHENG-FU LIN**,
Hsinchu County (TW); **JENQ-YANG
CHANG**, Hsinchu County (TW);
MAO-JEN WU, Hsinchu County (TW)(73) Assignee: **AuthenX Inc.**, Hsinchu County (TW)(21) Appl. No.: **17/944,254**(22) Filed: **Sep. 14, 2022****Related U.S. Application Data**(60) Provisional application No. 63/243,782, filed on Sep.
14, 2021.**Publication Classification**(51) **Int. Cl.**
H01Q 19/06 (2006.01)
H01Q 21/06 (2006.01)**H01Q 1/48** (2006.01)**H01Q 9/04** (2006.01)(52) **U.S. Cl.**CPC **H01Q 19/06** (2013.01); **H01Q 21/06**
(2013.01); **H01Q 1/48** (2013.01); **H01Q 9/045**
(2013.01); **H01Q 9/0414** (2013.01)(57) **ABSTRACT**

This invention provides an antenna assembly equipped with a sub-wavelength structured enhancer, comprising an antenna supporting substrate with a top surface and a bottom surface opposite to each other; a first patch antenna is disposed on the top surface of the antenna supporting substrate or inside of the antenna supporting substrate; a ground layer is disposed under the bottom surface of the antenna supporting substrate; a signal feeding layer for transmitting satellite communicating signals is disposed on one of surfaces of the antenna supporting substrate, or inside of the antenna supporting substrate, or under the first patch antenna, or under a side of the ground layer back to the antenna supporting substrate; and a solid sub-wavelength structured enhancer is disposed above the first patch antenna and spaced with each other by an air gap ranging between 7 mm and 47 mm.

300



US 20230083196A1

(19) **United States**

(12) **Patent Application Publication**
YOO

(10) **Pub. No.: US 2023/0083196 A1**

(43) **Pub. Date: Mar. 16, 2023**

(54) **ANTENNA STRUCTURE WITH REDUCED
ANGLE ERROR**

(71) Applicant: **HJWAVE Co., Ltd.**, Incheon (KR)

(72) Inventor: **Tae Hwan YOO**, Incheon (KR)

(21) Appl. No.: **17/987,942**

(22) Filed: **Nov. 16, 2022**

Related U.S. Application Data

(63) Continuation-in-part of application No. 17/741,225,
filed on May 10, 2022.

(30) **Foreign Application Priority Data**

May 17, 2021	(KR)	10-2021-0063506
May 17, 2021	(KR)	10-2021-0063674
Jul. 30, 2021	(KR)	10-2021-0100845
Nov. 2, 2021	(KR)	10-2021-0148966

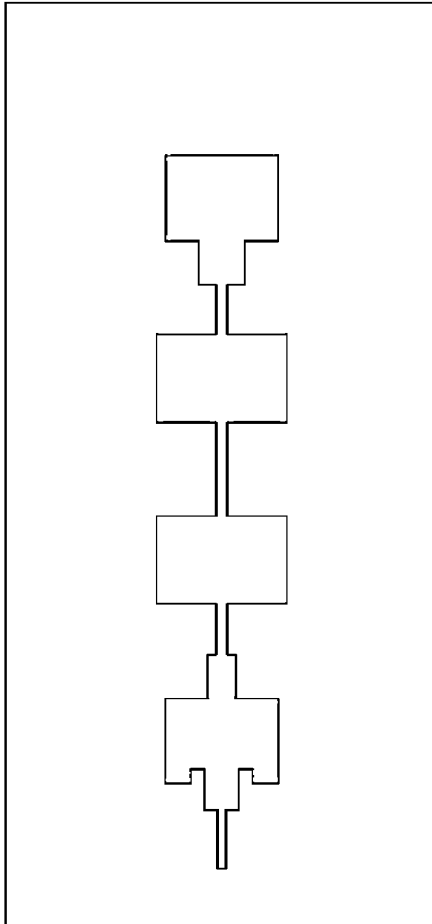
Publication Classification

(51) **Int. Cl.**
H01Q 13/10 (2006.01)
H01Q 1/22 (2006.01)
(52) **U.S. Cl.**
CPC **H01Q 13/106** (2013.01); **H01Q 1/2283**
(2013.01)

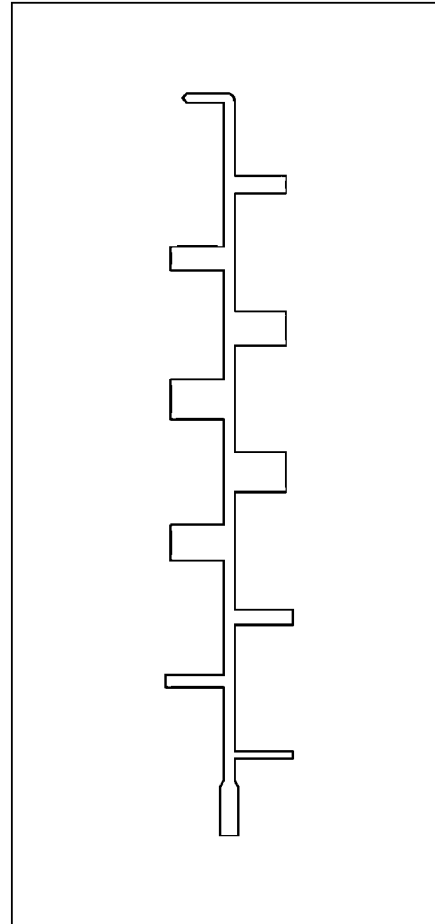
(57) **ABSTRACT**

According to an embodiment, an antenna structure comprises a printed circuit board including an integrated circuit processing a radio frequency (RF) signal, a feeding line connected to the integrated circuit, and a feeding pad connected to the feeding line to transfer the RF signal and a conductive upper layer including an antenna slot pattern connected with the feeding pad through a waveguide and vertically opened to radiate or receive the RF signal. The conductive upper layer further includes an adjacent slot pattern around the antenna slot pattern.

**Conventional vertical
polarization antenna**



**Conventional horizontal
polarization antenna**





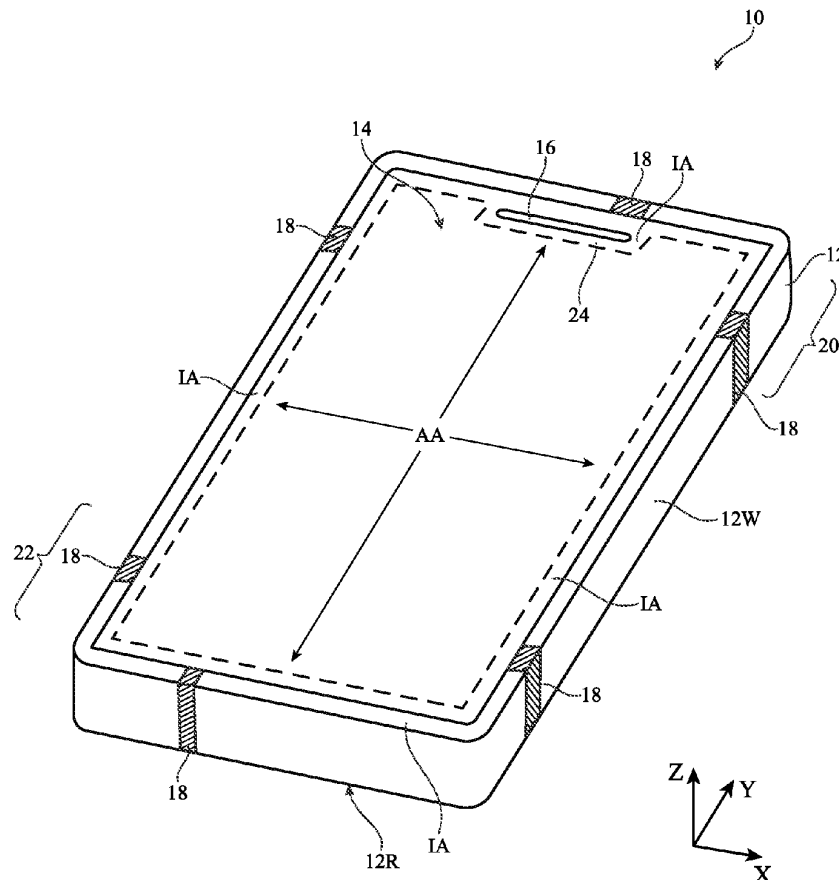
US 20230083466A1

(19) **United States**(12) **Patent Application Publication**
Li et al.(10) **Pub. No.: US 2023/0083466 A1**(43) **Pub. Date: Mar. 16, 2023**(54) **ELECTRONIC DEVICES WITH
DISTRIBUTED SLOT ANTENNA
STRUCTURES**(71) Applicant: **Apple Inc.**, Cupertino, CA (US)(72) Inventors: **Aobo Li**, Saratoga, CA (US); **Erdinc Irci**, Sunnyvale, CA (US); **Carlo Di Nallo**, Belmont, CA (US); **Enrique Ayala Vazquez**, Watsonville, CA (US); **Haozhan Tian**, San Jose, CA (US); **Hongfei Hu**, Cupertino, CA (US); **Liang Han**, Sunnyvale, CA (US); **Ming Chen**, Cupertino, CA (US); **Ming-Ju Tsai**, Sunnyvale, CA (US); **Salih Yarga**, Sunnyvale, CA (US); **Tiejun Yu**, Fremont, CA (US); **Victor C Lee**, Santa Clara, CA (US); **Xu Han**, Cupertino, CA (US)(21) Appl. No.: **17/728,737**(22) Filed: **Apr. 25, 2022****Related U.S. Application Data**

(60) Provisional application No. 63/243,547, filed on Sep. 13, 2021.

Publication Classification(51) **Int. Cl.**
H01Q 21/06 (2006.01)
H04M 1/02 (2006.01)
H04B 1/00 (2006.01)(52) **U.S. Cl.**
CPC **H01Q 21/064** (2013.01); **H04M 1/0266**
(2013.01); **H04B 1/0064** (2013.01)(57) **ABSTRACT**

An electronic device may have peripheral conductive housing structures, a display frame, a support plate, a logic board, and an antenna. The antenna may have a resonating element that includes a first slot between the logic board and a segment of the peripheral conductive housing structures, a second slot between the display frame and the segment, and optionally a third slot between the between the support plate and the segment. The slots may be at least partially overlapping, may have respective lengths, may be located at respective distances from a cover layer for the display, and may collectively receive radio-frequency signals in a frequency band such as the L5 GPS band. Switching circuitry and filter circuitry may be coupled to the antenna feed and/or to the antenna feed(s) of one or more adjacent antennas in the electronic device to help to isolate the antennas from each other.





US 20230083590A1

(19) **United States**

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

(10) **Pub. No.: US 2023/0083590 A1**

(43) **Pub. Date: Mar. 16, 2023**

(54) **ANTENNA CONNECTION APPARATUS,
ANTENNA ASSEMBLY, AND ELECTRONIC
DEVICE**

(30) **Foreign Application Priority Data**

Feb. 25, 2020 (CN) 202010117356.9

(71) Applicant: **Honor Device Co., Ltd.**, Futian
District, Shenzhen, Guangdong (CN)

Publication Classification

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

(72) Inventors: **Qiao SUN**, Shenzhen (CN); **Kun LI**,
Shenzhen (CN); **Silei HUYAN**,
Shenzhen (CN); **Wukui DU**, Shenzhen
(CN); **Chaoliang YANG**, Shenzhen
(CN); **Zhengmiao WANG**, Shenzhen
(CN)

(52) **U.S. Cl.**
CPC **H01Q 1/50** (2013.01); **H01Q 1/48**
(2013.01); **H01Q 1/243** (2013.01)

(73) Assignee: **Honor Device Co., Ltd.**, Futian
District, Shenzhen, Guangdong (CN)

ABSTRACT

Disclosed are an antenna connection apparatus, an antenna assembly, and an electronic device. The electronic device may be a mobile or fixed terminal with an antenna. A non-contact coupling connection between an antenna and a feed point or a ground point is implemented by using the antenna connection apparatus, to avoid arranging an elastic bonding pad or a flexible metal buffer material on the antenna and arranging an elastic pin and the flexible metal buffer material on the feed point or the ground point, thereby reducing connection cost of the antenna and a space occupied by the antenna connection apparatus in a mobile phone.

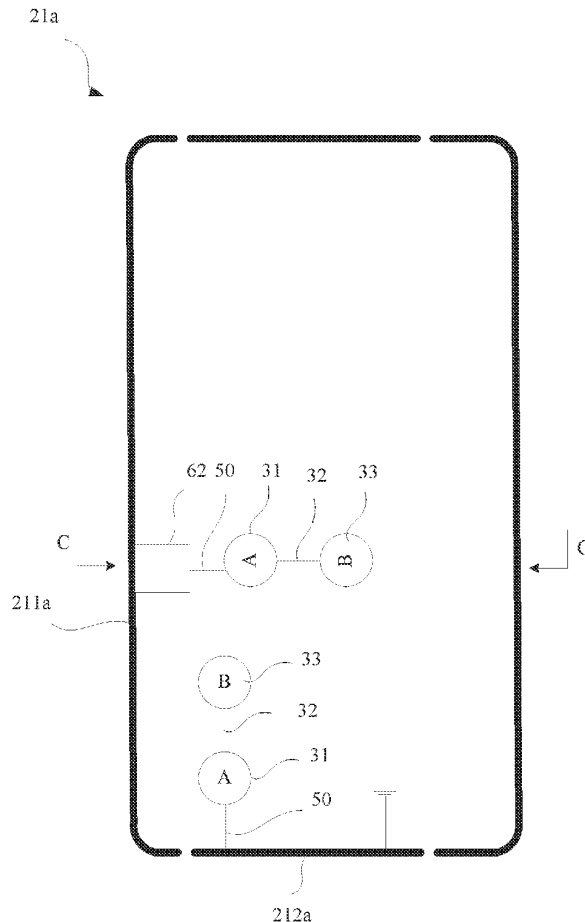
(21) Appl. No.: **17/801,613**

(22) PCT Filed: **Feb. 18, 2021**

(86) PCT No.: **PCT/CN2021/076678**

§ 371 (c)(1),

(2) Date: **Aug. 23, 2022**





US 20230084229A1

(19) **United States**

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

(10) **Pub. No.: US 2023/0084229 A1**

(43) **Pub. Date: Mar. 16, 2023**

(54) **STEALTH ANTENNA HAVING
ELECTROMAGNETIC WAVE ABSORBER
WITH SANDWICH STRUCTURE**

Publication Classification

(51) **Int. Cl.**
H01Q 17/00 (2006.01)
H01Q 9/04 (2006.01)
(52) **U.S. Cl.**
CPC **H01Q 17/00** (2013.01); **H01Q 9/0407**
(2013.01)

(71) Applicant: **Korea Advanced Institute of Science
and Technology, Daejeon (KR)**

(72) Inventors: **Chun-Gon KIM, Daejeon (KR);
Woo-Hyeok JANG, Daejeon (KR);
Min-Su JANG, Daejeon (KR);
Do-Hyeon JIN, Daejeon (KR)**

(73) Assignee: **Korea Advanced Institute of Science
and Technology, Daejeon (KR)**

(21) Appl. No.: **17/931,966**

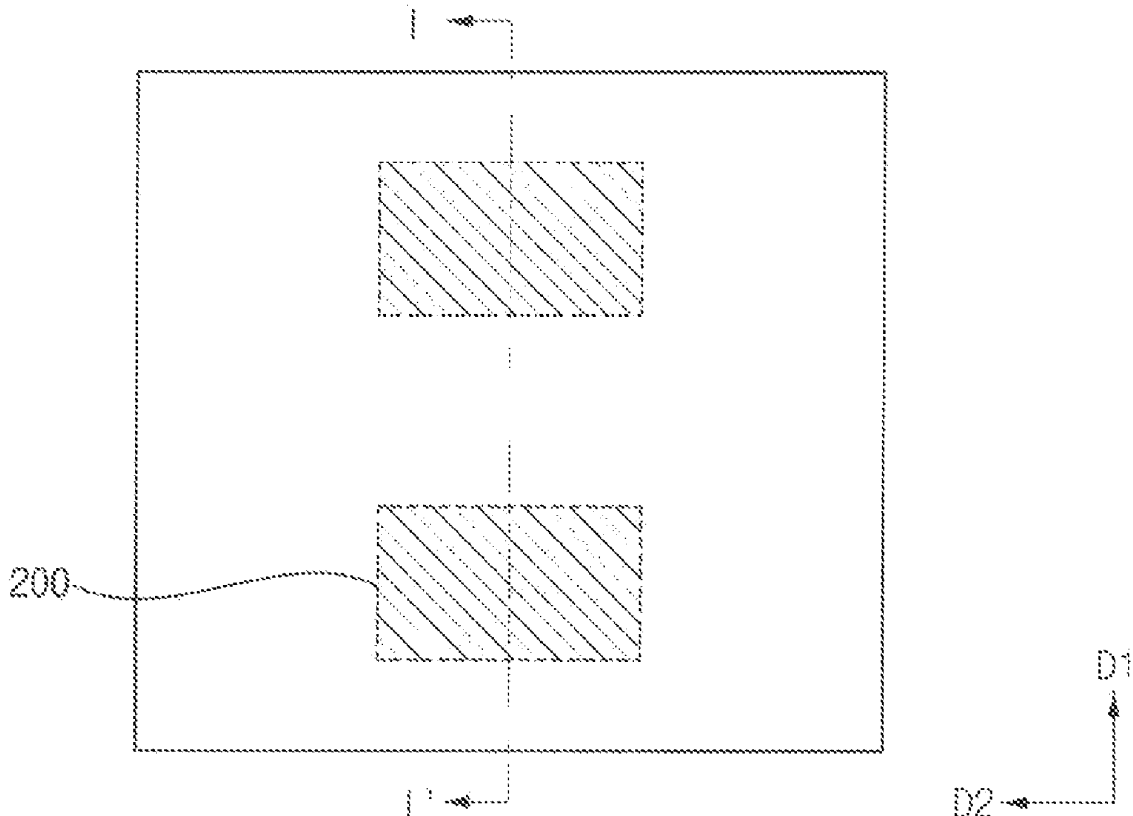
(22) Filed: **Sep. 14, 2022**

(30) **Foreign Application Priority Data**

Sep. 14, 2021 (KR) 10-2021-0122684

(57) **ABSTRACT**

A stealth antenna includes an electromagnetic wave absorbing structure and an antenna patch embedded in the electromagnetic wave absorbing structure. The electromagnetic wave absorbing structure includes an upper dielectric layer, a lower dielectric layer and a spacer disposed between the upper dielectric layer and the lower dielectric layer. The upper dielectric layer includes a dielectric fabric and a conductive coating layer combined with at least a portion of the dielectric fabric. The lower dielectric layer includes a dielectric fabric and has a dielectric constant lower than that of the upper dielectric layer. The antenna patch is disposed between the spacer and the lower dielectric layer.





US 20230084643A1

(19) **United States**
(12) **Patent Application Publication** (10) **Pub. No.: US 2023/0084643 A1**
WANG et al. (43) **Pub. Date: Mar. 16, 2023**

(54) **ANTENNA HAVING HIGH ISOLATION AND LOW CROSS-POLARIZATION LEVEL, BASE STATION, AND TERMINAL**

H01Q 1/38 (2006.01)
H01Q 1/48 (2006.01)
H01Q 1/52 (2006.01)
H01Q 13/10 (2006.01)

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

(72) Inventors: **Yongchao WANG**, Xi'an (CN);
Xiaoqiang YANG, Shenzhen (CN);
Cheng GOU, Xi'an (CN); **Jie PENG**,
Xi'an (CN)

(52) **U.S. Cl.**
CPC *H01Q 9/0407* (2013.01); *H01Q 1/38*
(2013.01); *H01Q 1/48* (2013.01); *H01Q 1/52*
(2013.01); *H01Q 1/246* (2013.01); *H01Q 13/10*
(2013.01); *H01Q 15/24* (2013.01)

(21) Appl. No.: **17/794,535**

(22) PCT Filed: **Oct. 30, 2020**

(86) PCT No.: **PCT/CN2020/125207**

§ 371 (c)(1),

(2) Date: **Jul. 21, 2022**

(30) **Foreign Application Priority Data**

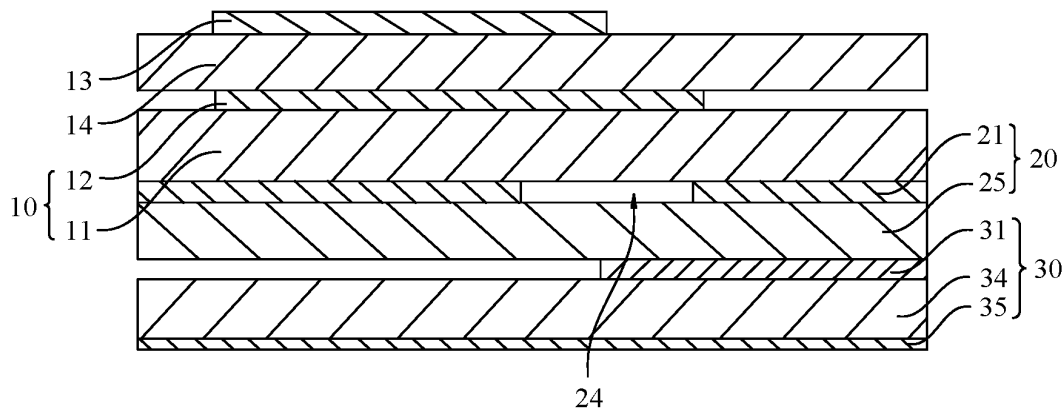
Jan. 22, 2020 (CN) 202010074376.2

Publication Classification

(51) **Int. Cl.**
H01Q 9/04 (2006.01)
H01Q 1/24 (2006.01)

(57) **ABSTRACT**

An antenna having high isolation and a low cross-polarization level, a base station, and a terminal are provided. The antenna includes a radiation layer, a feed layer, and an aperture coupling layer disposed between the radiation layer and the feed layer. The aperture coupling layer includes a metal sheet. A first feeding slot, a second feeding slot, and a middle slot are configured in the metal sheet. The middle slot is located between the first feeding slot and the second feeding slot, and is located in a weak electric field region of the metal sheet. The middle slot is configured between the first feeding slot and the second feeding slot of the metal sheet.





US 20230085200A1

(19) **United States**(12) **Patent Application Publication**
OH et al.(10) **Pub. No.: US 2023/0085200 A1**(43) **Pub. Date: Mar. 16, 2023**(54) **ANTENNA AND ELECTRONIC DEVICE**
INCLUDING THE SAME(71) Applicant: **Samsung Electronics Co., Ltd.**,
Gyeonggi-do (KR)(72) Inventors: **Dongjun OH**, Gyeonggi-do (KR);
Shinho YOON, Gyeonggi-do (KR);
Myeongjun KONG, Gyeonggi-do
(KR); **Jaebong CHUN**, Gyeonggi-do
(KR); **Soonho HWANG**, Gyeonggi-do
(KR)**H01Q 5/335** (2006.01)**H01Q 13/10** (2006.01)**H01Q 21/30** (2006.01)**H04M 1/02** (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/243** (2013.01); **H01Q 1/38**
(2013.01); **H01Q 1/48** (2013.01); **H01Q 5/10**
(2015.01); **H01Q 5/335** (2015.01); **H01Q**
13/10 (2013.01); **H01Q 21/30** (2013.01);
H04M 1/0277 (2013.01); **H04M 1/0268**
(2013.01); **H04M 1/0235** (2013.01); **H04M**
2201/38 (2013.01)(21) Appl. No.: **17/965,201**(22) Filed: **Oct. 13, 2022****Related U.S. Application Data**(63) Continuation of application No. PCT/KR2022/
013096, filed on Sep. 1, 2022.(30) **Foreign Application Priority Data**

Sep. 7, 2021 (KR) 10-2021-0119285

Publication Classification(51) **Int. Cl.****H01Q 1/24** (2006.01)**H01Q 1/38** (2006.01)**H01Q 1/48** (2006.01)**H01Q 5/10** (2006.01)(57) **ABSTRACT**

According to certain embodiments, an electronic device comprises: a first housing including a plurality of conductive portions electrically separated from each other and disposed on at least a portion of a side surface of the first housing; a second housing slidably coupled to the first housing; a flexible display supported by the first housing and the second housing and having a display area that is changable by sliding the second housing; and a wireless communication circuit disposed in the first housing and configured to transmit and receive wireless signals in a plurality of frequency bands via the plurality of conductive portions, wherein the plurality of conductive portions includes a first conductive portion and a second conductive portion, wherein the first conductive portion and the second conductive portion have a U shape or C shape and are electrically separated from each other, and wherein the first conductive portion is spaced apart from the first housing.

