



US 20250097329A1

(19) **United States**

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

(10) **Pub. No.: US 2025/0097329 A1**

(43) **Pub. Date: Mar. 20, 2025**

(54) **FOLDABLE DEVICE WITH
HINGE-INTEGRATED ANTENNA**

(52) **U.S. Cl.**
CPC **H04M 1/0218** (2013.01); **H04B 1/1615**
(2013.01)

(71) Applicant: **QUALCOMM Incorporated**, San
Diego, CA (US)

(57) **ABSTRACT**

(72) Inventors: **Yi-Hsiang KUNG**, Taipei (TW);
Cheng-Fan WEI, New Taipei City
(TW); **Chao-Kuei CHANG**, Taipei City
(TW)

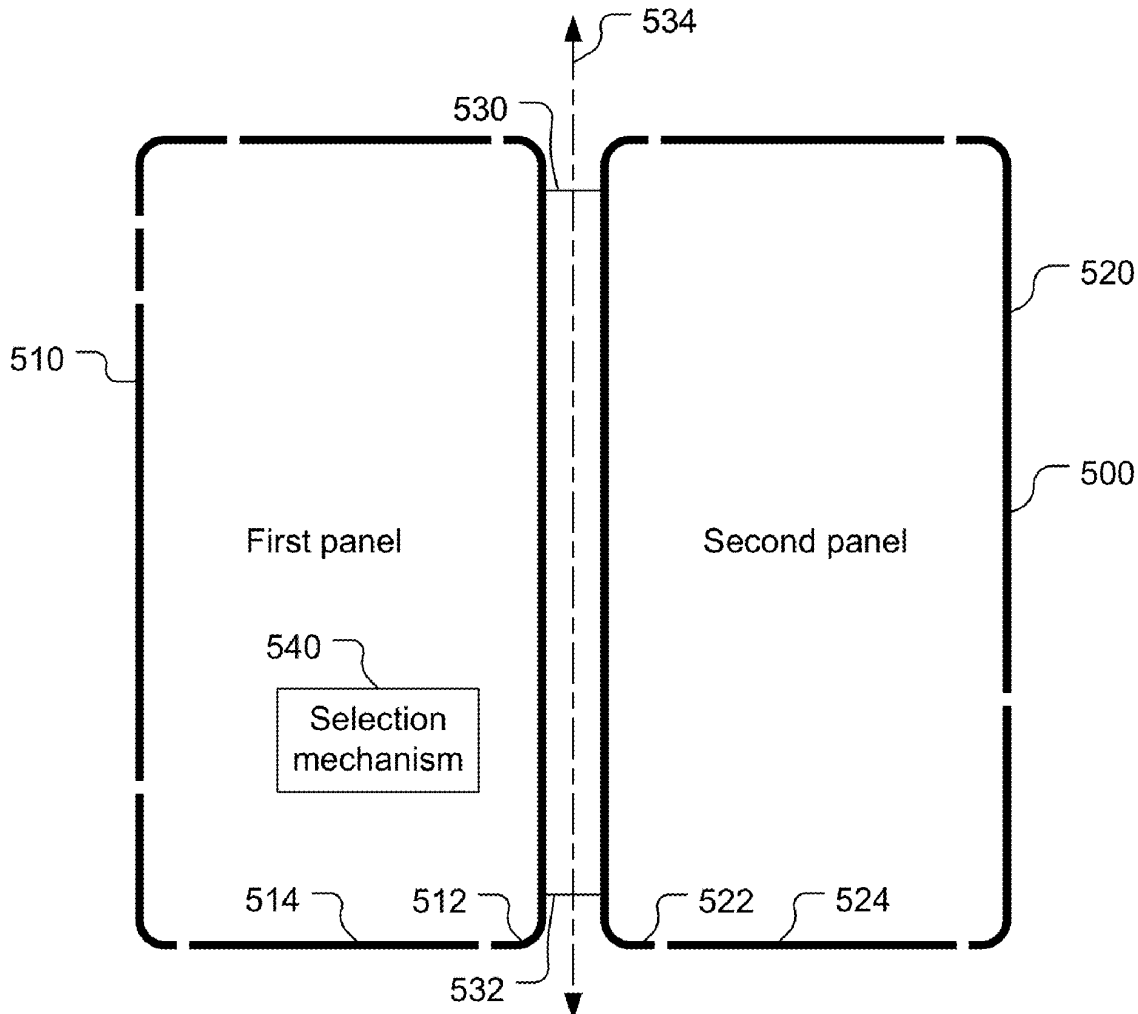
A method of configuring a signal transducer of a foldable UE includes: providing a first panel comprising a first conductor configured to provide a first portion of the signal transducer; providing a second panel comprising a second conductor configured to provide a second portion of the signal transducer; providing a hinge connected to the first panel and the second panel and configured to allow the first panel to rotate relative to the second panel about a pivot axis of the hinge, the hinge comprising a third conductor configured to provide a third portion of the signal transducer, the third conductor electrically coupling the first conductor to the second conductor; providing a fourth conductor that is physically separate from the first conductor, the second conductor, and the third conductor; and selectively causing the fourth conductor to provide a fourth portion of the signal transducer.

(21) Appl. No.: **18/470,739**

(22) Filed: **Sep. 20, 2023**

Publication Classification

(51) **Int. Cl.**
H04M 1/02 (2006.01)
H04B 1/16 (2006.01)





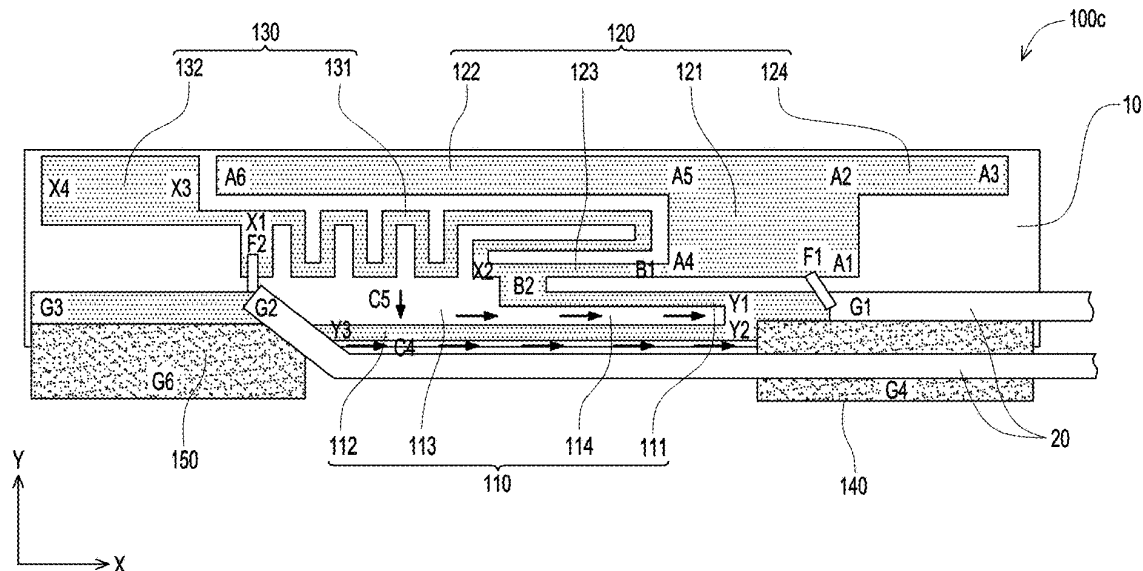
US 20250096476A1

(19) **United States**(12) **Patent Application Publication**
Wu et al.(10) **Pub. No.: US 2025/0096476 A1**(43) **Pub. Date: Mar. 20, 2025**(54) **ANTENNA MODULE****Publication Classification**(71) Applicant: **PEGATRON CORPORATION,**
TAIPEI CITY (TW)(51) **Int. Cl.**
H01Q 13/16 (2006.01)
H01Q 1/48 (2006.01)
H01Q 5/10 (2015.01)(72) Inventors: **Chien-Yi Wu**, Taipei City (TW);
Shao-Chi Wang, Taipei City (TW);
Hau Yuen Tan, Taipei City (TW);
Hung-Te Liao, Taipei City (TW);
Chao-Hsu Wu, Taipei City (TW);
Chih-Hung Cho, Taipei City (TW);
Tse-Hsuan Wang, Taipei City (TW);
I-Shu Lee, Taipei City (TW); **Jr-Wei Hsu**, Taipei City (TW)(52) **U.S. Cl.**
CPC **H01Q 13/16** (2013.01); **H01Q 1/48**
(2013.01); **H01Q 5/10** (2015.01)(73) Assignee: **PEGATRON CORPORATION,**
TAIPEI CITY (TW)(21) Appl. No.: **18/652,976**(22) Filed: **May 2, 2024**(30) **Foreign Application Priority Data**

Sep. 15, 2023 (TW) 112135280

(57) **ABSTRACT**

An antenna module includes a ground radiator, a first antenna, and a second antenna. The first antenna includes a first feeding end, a first segment, a second segment, a third segment, and a fourth segment. A first area of the first antenna and a second area including a part of the first antenna and a part of the ground radiator resonate at a first frequency band. A third area of the first antenna and the second area resonate at a second frequency band. An area including a part of the second antenna, the third segment, the first segment, and the second segment resonates at the first frequency band. An area of the second antenna and an area including the part of the second antenna, a part of the third segment, and another part of the ground radiator resonate at the second frequency band.





US 20250096472A1

(19) **United States**

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

(10) **Pub. No.: US 2025/0096472 A1**

(43) **Pub. Date: Mar. 20, 2025**

(54) **ANTENNA AND BASE STATION**

Publication Classification

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

(51) **Int. Cl.**
H01Q 9/04 (2006.01)
H01Q 1/24 (2006.01)
H01Q 21/06 (2006.01)

(72) Inventors: **Liangyong DENG**, Dongguan (CN);
Wen DUAN, Shenzhen (CN); **Dantao CAI**, Dongguan (CN); **Weihong XIAO**, Dongguan (CN); **Rui JIN**, Weilheim (DE)

(52) **U.S. Cl.**
CPC **H01Q 9/0485** (2013.01); **H01Q 1/246** (2013.01); **H01Q 21/06** (2013.01)

(21) Appl. No.: **18/961,843**

(57) **ABSTRACT**

(22) Filed: **Nov. 27, 2024**

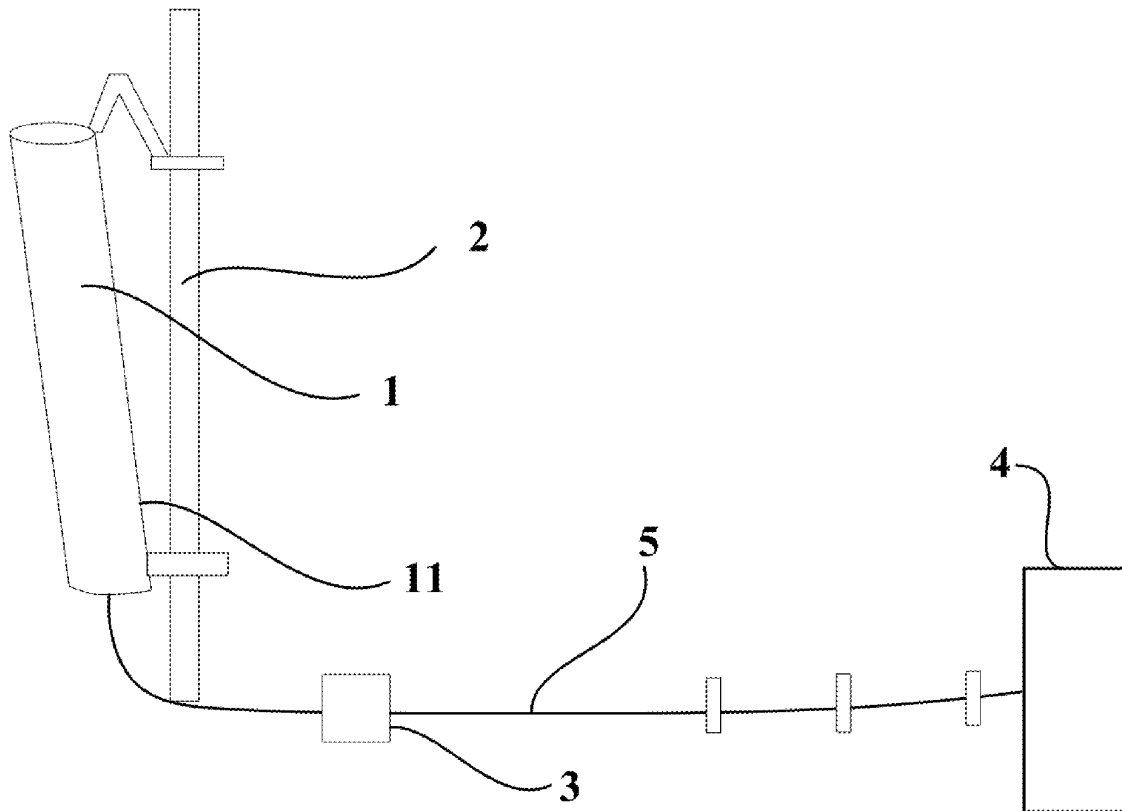
This application provides example antennas and example base stations. One example antenna includes a reflection panel, a radiating element, and a resonator group. The resonator group is disposed between the reflection panel and the radiating element. The resonator group includes a first resonator, a second resonator, and a third resonator. The third resonator has a first connection portion and a second connection portion that are located at at least one open-circuit end. The first resonator is coupled to the first connection portion. The second resonator is coupled to the second connection portion. The third resonator is further coupled to the radiating element, and a signal may be transmitted between the third resonator and the radiating element. The first resonator is configured to transmit a signal in a first frequency band. The second resonator is configured to transmit a signal in a second frequency band.

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2023/094153, filed on May 15, 2023.

(30) **Foreign Application Priority Data**

May 30, 2022 (CN) 202210604355.6

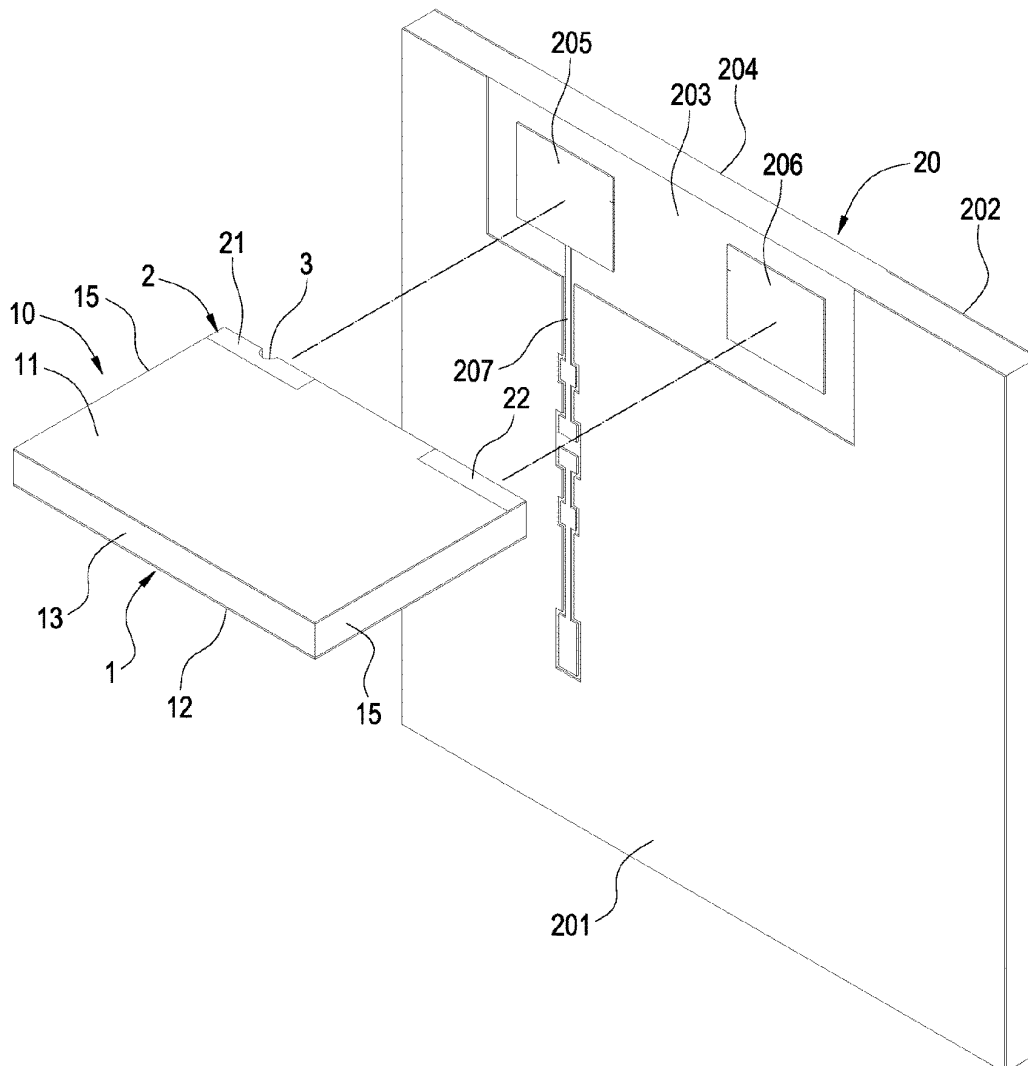




US 20250096471A1

(19) **United States**(12) **Patent Application Publication**
TSAI et al.(10) **Pub. No.: US 2025/0096471 A1**(43) **Pub. Date: Mar. 20, 2025**(54) **VERTICAL ANTENNA STRUCTURE**(52) **U.S. Cl.**CPC **H01Q 9/0442** (2013.01); **H01Q 1/22**
(2013.01); **H01Q 1/48** (2013.01)(71) Applicants: **Yun-Chan TSAI**, Taipei City (TW);
ONEWAVE TECHNOLOGY CO., LTD., Taipei City (TW)(72) Inventors: **Yun-Chan TSAI**, Taipei City (TW);
Shi-Yu CHIU, Taipei City (TW);
Po-Huai HUANG, Taipei City (TW);
Shi-Hong YANG, Taipei City (TW)(21) Appl. No.: **18/369,671**(22) Filed: **Sep. 18, 2023****Publication Classification**(51) **Int. Cl.**
H01Q 9/04 (2006.01)
H01Q 1/22 (2006.01)
H01Q 1/48 (2006.01)(57) **ABSTRACT**

A vertical antenna structure is electrically fixed and connected to a main board of an electronic apparatus. The vertical antenna structure includes a circuit board, an electrode layer, and a semi-hole electrode layer. The circuit board is a square body with a front surface, a back surface, a top surface, a bottom surface and two side surfaces. The electrode layer is arranged on the front surface and the back surface of the circuit board. The semi-hole electrode layer is arranged on the bottom surface of the circuit board. The semi-hole electrode layer is electrically fixed and connected to the electrode layer. Moreover, the electrode layer and the semi-hole electrode layer are electrically fixed and connected to the main board.





US 20250096467A1

(19) **United States**

(12) **Patent Application Publication**
KAJIKIYA

(10) **Pub. No.: US 2025/0096467 A1**

(43) **Pub. Date: Mar. 20, 2025**

(54) **ANTENNA DEVICE AND IC CARD HAVING
THE SAME**

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

CPC **H01Q 7/00** (2013.01); **G06K 19/07775**
(2013.01); **G06K 19/07777** (2013.01)

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

(72) Inventor: **Shoma KAJIKIYA**, Tokyo (JP)

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

(21) Appl. No.: **18/889,627**

(22) Filed: **Sep. 19, 2024**

(30) **Foreign Application Priority Data**

Sep. 20, 2023 (JP) 2023-151895

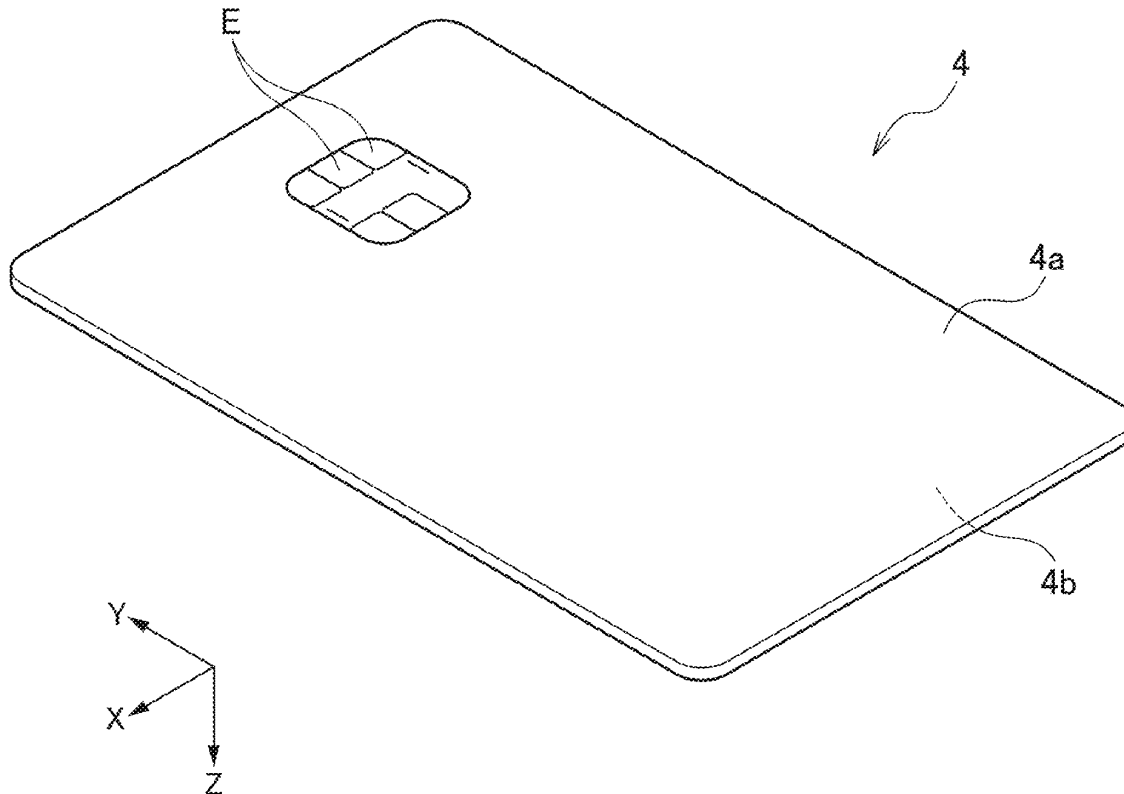
Publication Classification

(51) **Int. Cl.**

H01Q 7/00 (2006.01)
G06K 19/077 (2006.01)

(57) **ABSTRACT**

Disclosed herein is an antenna device that includes a coil pattern having first to third winding parts each having a plurality of turns. The first winding part has an outer peripheral end being opened and an inner peripheral end connected to an outer peripheral end of the second winding part. The second winding part has an inner peripheral end connected to an outer peripheral end of the third winding part. The third winding part has an inner peripheral end being opened. Each turn of the second winding part has a first partial winding part wound concentrically with the third winding part and a second partial winding part protruding radially outward from the first partial winding part and wound about a center axis positioned between the first partial winding part and the first winding part.





US 20250096466A1

(19) **United States**

(12) **Patent Application Publication**
Deng

(10) **Pub. No.: US 2025/0096466 A1**

(43) **Pub. Date: Mar. 20, 2025**

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

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

(72) Inventor: **Shaogang Deng, Shenzhen (CN)**

(21) Appl. No.: **18/696,132**

(22) PCT Filed: **Aug. 26, 2022**

(86) PCT No.: **PCT/CN2022/115221**

§ 371 (c)(1),

(2) Date: **Mar. 27, 2024**

(30) **Foreign Application Priority Data**

Sep. 29, 2021 (CN) 202111156219.7

Publication Classification

(51) **Int. Cl.**

H01Q 5/371 (2015.01)

H01Q 9/24 (2006.01)

H01Q 9/30 (2006.01)

H01Q 13/10 (2006.01)

H01Q 21/28 (2006.01)

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

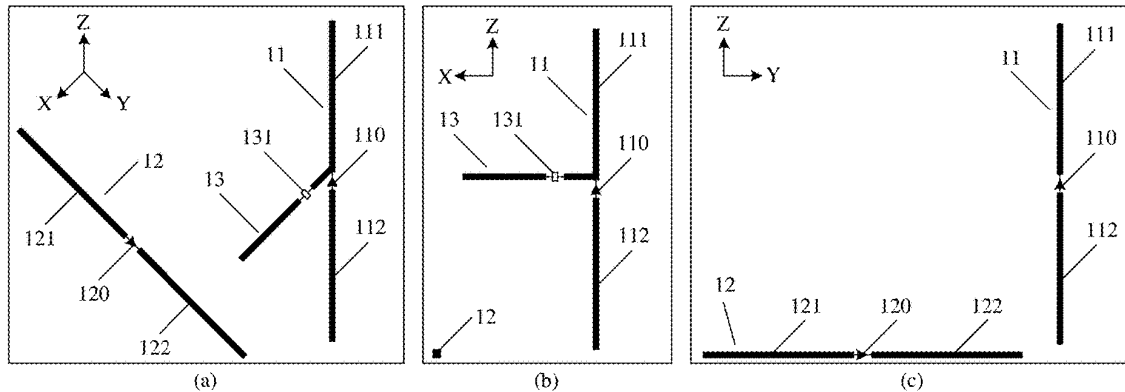
CPC **H01Q 5/371** (2015.01); **H01Q 9/24**

(2013.01); **H01Q 9/30** (2013.01); **H01Q 13/10**

(2013.01); **H01Q 21/28** (2013.01)

(57) **ABSTRACT**

An antenna system includes a first antenna, a second antenna, and a tuning stub, where the first antenna and the second antenna have a same first operating frequency band or similar first operating frequency bands. The tuning stub is electrically connected to the first antenna, and the tuning stub is configured to adjust an equivalent current path of the first antenna, so that a connection line between a projection point of a maximum equivalent current point of the first antenna and a projection point of a maximum equivalent current point of the second antenna on a first plane tends to be more perpendicular to a projection of the equivalent current path of the first antenna or of the second antenna on the first plane; or the equivalent current path of the first antenna and of the second antenna tend to be more perpendicular to each other.





US 20250096461A1

(19) **United States**

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

(10) **Pub. No.: US 2025/0096461 A1**

(43) **Pub. Date: Mar. 20, 2025**

(54) **PLANAR ANTENNA AND ANTENNA DEVICE**

Publication Classification

(71) Applicant: **NEC Corporation**, Tokyo (JP)

(51) **Int. Cl.**
H01Q 3/40 (2006.01)
H01Q 1/48 (2006.01)
H01Q 9/04 (2006.01)

(72) Inventors: **Kohei YOSHIDA**, Tokyo (JP); **Fujio OKUMURA**, Kanagawa (JP)

(52) **U.S. Cl.**
CPC **H01Q 3/40** (2013.01); **H01Q 1/48** (2013.01); **H01Q 9/0457** (2013.01)

(73) Assignee: **NEC Corporation**, Tokyo (JP)

(21) Appl. No.: **18/818,739**

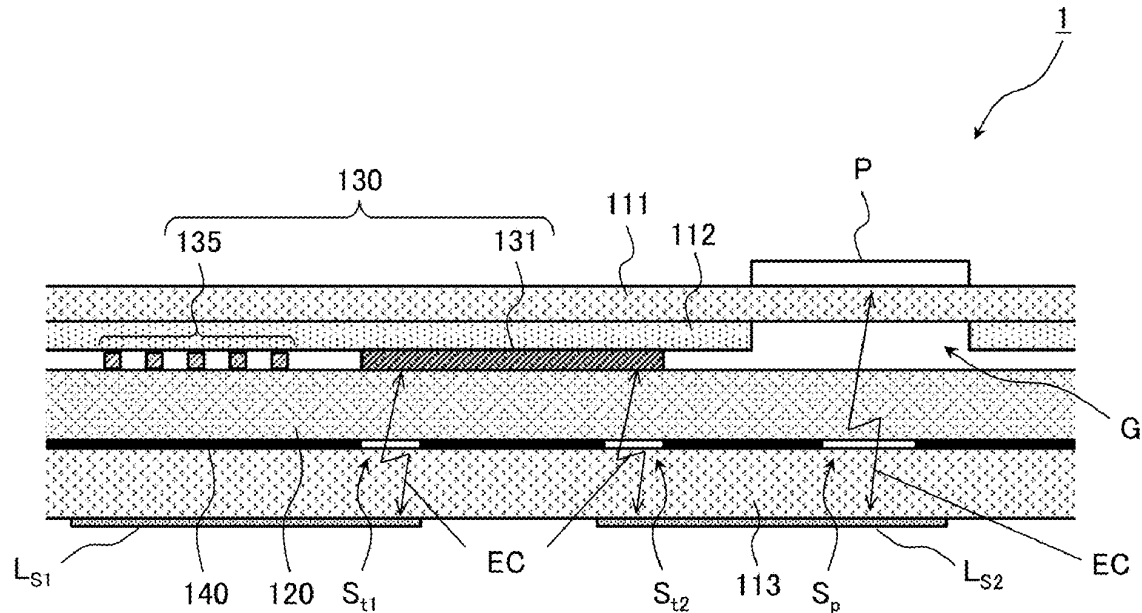
(22) Filed: **Aug. 29, 2024**

(30) **Foreign Application Priority Data**

Sep. 19, 2023 (JP) 2023-150693

(57) **ABSTRACT**

Provided is a planar antenna including an antenna array in which a plurality of patch antennas are disposed in a two-dimensional array; a substrate on which a phase shifter layer including a phase shifter associated with each of the plurality of patch antennas and wiring used for controlling the phase shifter is formed; a signal line through which a communication signal propagates; and a ground layer disposed between the phase shifter layer and the signal line, and having a slot formed at least between the signal line and the phase shifter.





US 20250094761A1

(19) **United States**

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

(10) **Pub. No.: US 2025/0094761 A1**

(43) **Pub. Date: Mar. 20, 2025**

(54) **ANTENNA DEVICE AND IC CARD HAVING
THE SAME**

(52) **U.S. Cl.**
CPC . G06K 19/07773 (2013.01); G06K 19/07747 (2013.01)

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

(72) Inventors: **Shoma KAJIKIYA**, Tokyo (JP); **Toshio TOMONARI**, Tokyo (JP); **Chris T. BURKET**, Lincolnshire, IL (US)

(57) **ABSTRACT**

(21) Appl. No.: **18/891,079**

(22) Filed: **Sep. 20, 2024**

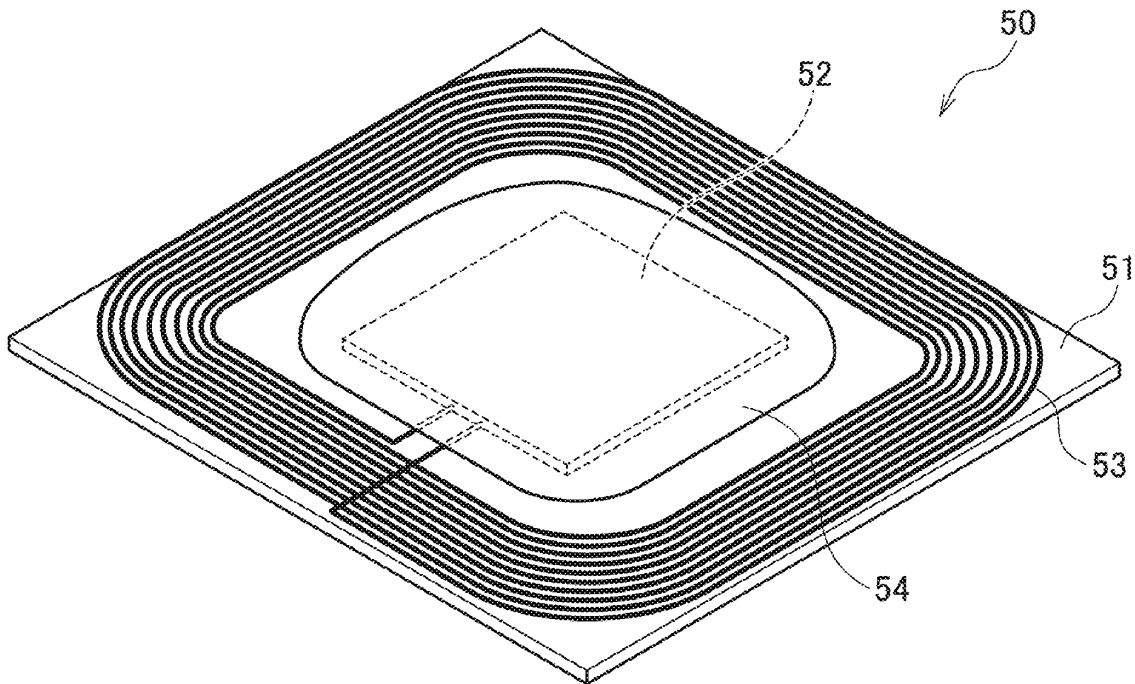
Related U.S. Application Data

(60) Provisional application No. 63/583,986, filed on Sep. 20, 2023.

Publication Classification

(51) **Int. Cl.**
G06K 19/077 (2006.01)

Disclosed herein is an antenna device that includes: a metal plate having a first slit extending in a long side direction thereof and a second slit extending in a short side direction thereof; a first coil disposed so as to overlap with the metal plate in a plan view and circling along an outer edge of the metal plate; and a second coil electrically connected to the first coil, disposed so as to be surrounded by the first coil, and disposed so as to overlap with the first slit. The first slit has a first end that is open to divide the outer edge and a second end terminating without reaching the outer edge. The second slit has a third end that is open to divide the outer edge and a fourth end terminating without reaching the outer edge.



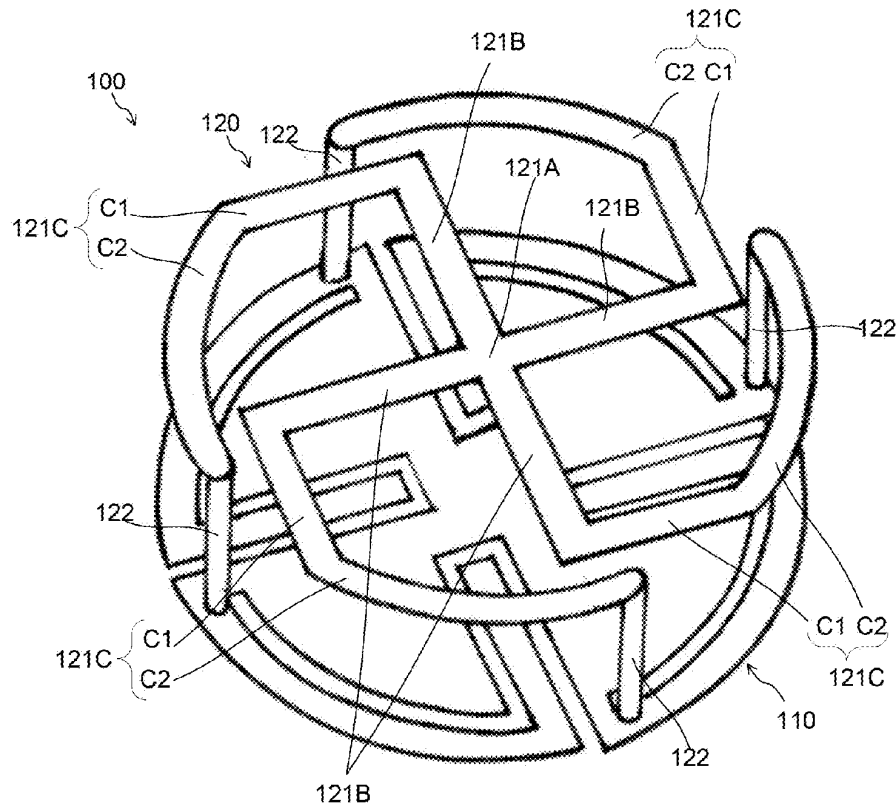


US 20250087904A1

(19) **United States**(12) **Patent Application Publication**
KUROKAWA et al.(10) **Pub. No.: US 2025/0087904 A1**(43) **Pub. Date: Mar. 13, 2025**(54) **ANTENNA APPARATUS****Publication Classification**(71) Applicant: **Panasonic Holdings Corporation,**
Osaka (JP)(51) **Int. Cl.**
H01Q 21/26 (2006.01)
H01Q 5/371 (2006.01)(72) Inventors: **Aya KUROKAWA,** Osaka (JP);
Hiroyuki Tani, Hyogo (JP); **Manabu**
Gokan, Hyogo (JP); **Takuma Ikeda,**
Osaka (JP); **Yuki Tanaka,** Tokyo (JP)(52) **U.S. Cl.**
CPC **H01Q 21/26** (2013.01); **H01Q 5/371**
(2015.01)(21) Appl. No.: **18/958,931**(57) **ABSTRACT**(22) Filed: **Nov. 25, 2024****Related U.S. Application Data**(63) Continuation of application No. PCT/JP2023/
014083, filed on Apr. 5, 2023.(30) **Foreign Application Priority Data**

Jun. 2, 2022 (JP) 2022-090204

Provided is an antenna apparatus that includes: a first element having a flat plate shape; and a second element that includes a plate-like portion provided parallel to the first element. The plate-like portion includes three or more power feeding paths each of which radially extends from a power feeder in a central portion; and three or more antenna portions which extend from ends of the three or more power feeding paths, respectively, and each of which is connected to a grounding portion of the first element.





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(19) **United States**

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

(10) **Pub. No.: US 2025/0087899 A1**

(43) **Pub. Date: Mar. 13, 2025**

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

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

CPC **H01Q 21/065** (2013.01); **H01Q 9/0414**
(2013.01); **H04B 7/0413** (2013.01)

(71) Applicant: **Nanning Fulian FuGui Precision
Industrial Co., Ltd., Nanning (CN)**

(72) Inventors: **JIN Hao**, Houston, TX (US); **Yu-Yuan
Guo**, New Taipei (TW); **Kai-Hao
Chen**, New Taipei (TW); **Liang-Hsien
Hung**, New Taipei (TW)

(57)

ABSTRACT

An antenna system, installed on a base, includes: a first group of MIMO antennas, including multiple first MIMO antennas, and each first MIMO antenna is provide with a grounding structure and a fence like structure perpendicular to the base; a second group of MIMO antennas, comprising multiple second MIMO antennas, and each second MIMO antenna is a planar structure, arranged on a substrate, and the substrate is fixed to the base through a support column and the substrate is parallel to the base; a third group of MIMO antennas, comprising multiple third MIMO antennas, and each third MIMO antenna includes a dielectric structure and a wire structure perpendicular to the base, and the wire structure excites the dielectric structure; an AUX antenna, provided with a T-shaped slot parallel to the base.

(21) Appl. No.: **18/646,599**

(22) Filed: **Apr. 25, 2024**

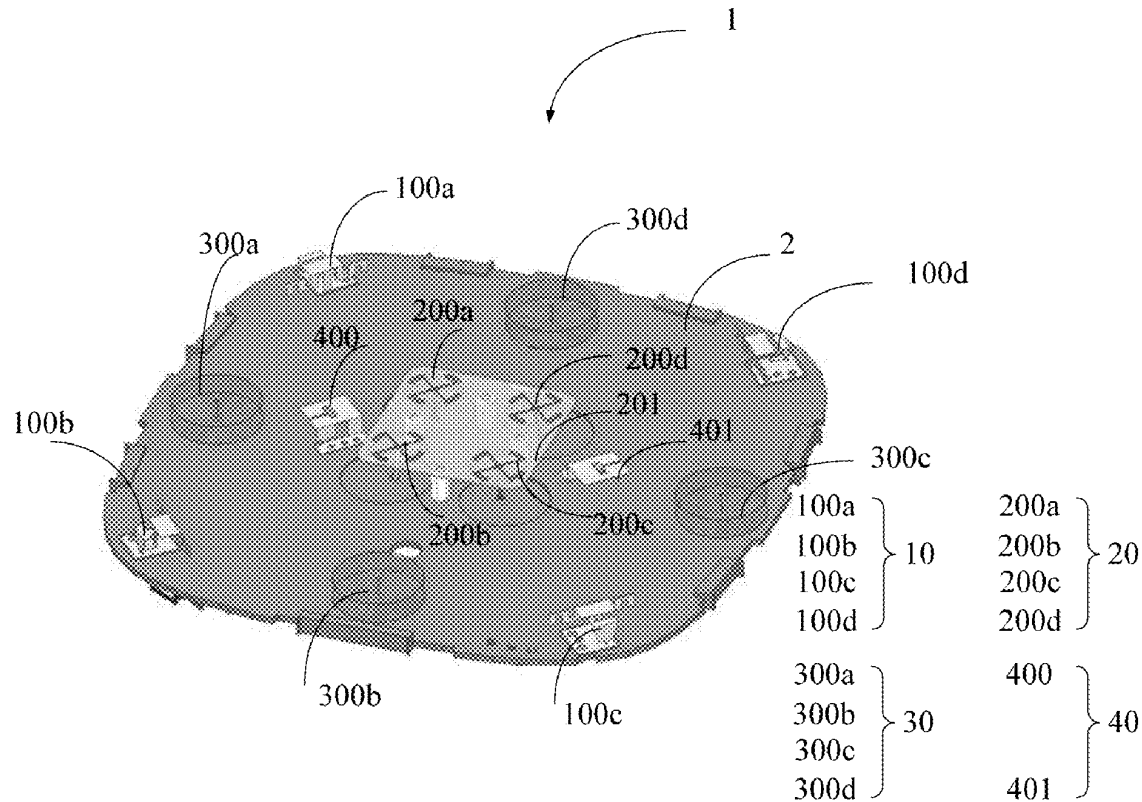
(30) **Foreign Application Priority Data**

Sep. 12, 2023 (CN) 202311171409.5

Publication Classification

(51) **Int. Cl.**

H01Q 21/06 (2006.01)
H01Q 9/04 (2006.01)
H04B 7/0413 (2006.01)





US 20250087896A1

(19) **United States**

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

(10) **Pub. No.: US 2025/0087896 A1**

(43) **Pub. Date: Mar. 13, 2025**

(54) **DUAL-POLARIZED MAGNETOELECTRIC
DIPOLE ANTENNA AND ELECTRONIC
DEVICE**

Publication Classification

(51) **Int. Cl.**
H01Q 19/10 (2006.01)
H01Q 21/24 (2006.01)

(71) Applicants: **Beijing BOE Technology Development
Co., Ltd.**, Beijing (CN); **BOE
Technology Group Co., Ltd.**, Beijing
(CN)

(52) **U.S. Cl.**
CPC **H01Q 19/108** (2013.01); **H01Q 21/24**
(2013.01)

(72) Inventors: **Dongdong ZHANG**, Beijing (CN);
Shihua WANG, Beijing (CN); **Youjian
HU**, Beijing (CN); **Yali WANG**, Beijing
(CN); **Feng QU**, Beijing (CN); **Biqi LI**,
Beijing (CN)

(57) **ABSTRACT**

A dual-polarized magnetoelectric dipole antenna, including a reflection plate, electric and magnetic dipoles, where the electric dipole includes four first electrodes; the magnetic dipole includes four second electrodes; the second electrodes are in one-to-one correspondence with the first electrodes, and each second electrode is connected between a corresponding first electrode and the reflection plate; each first electrode includes first and second sides connected to each other; the first side of the first electrode is adjacent to the first side of one adjacent first electrode, and the second side of the first electrode is adjacent to the second side of other one adjacent first electrode; each second electrode includes two sub-electrodes connected to the first and second sides of a corresponding first electrode, respectively; the sub-electrode has a slit opening therein, and an extending direction of the slit opening is parallel to a plane where the reflection plate is located.

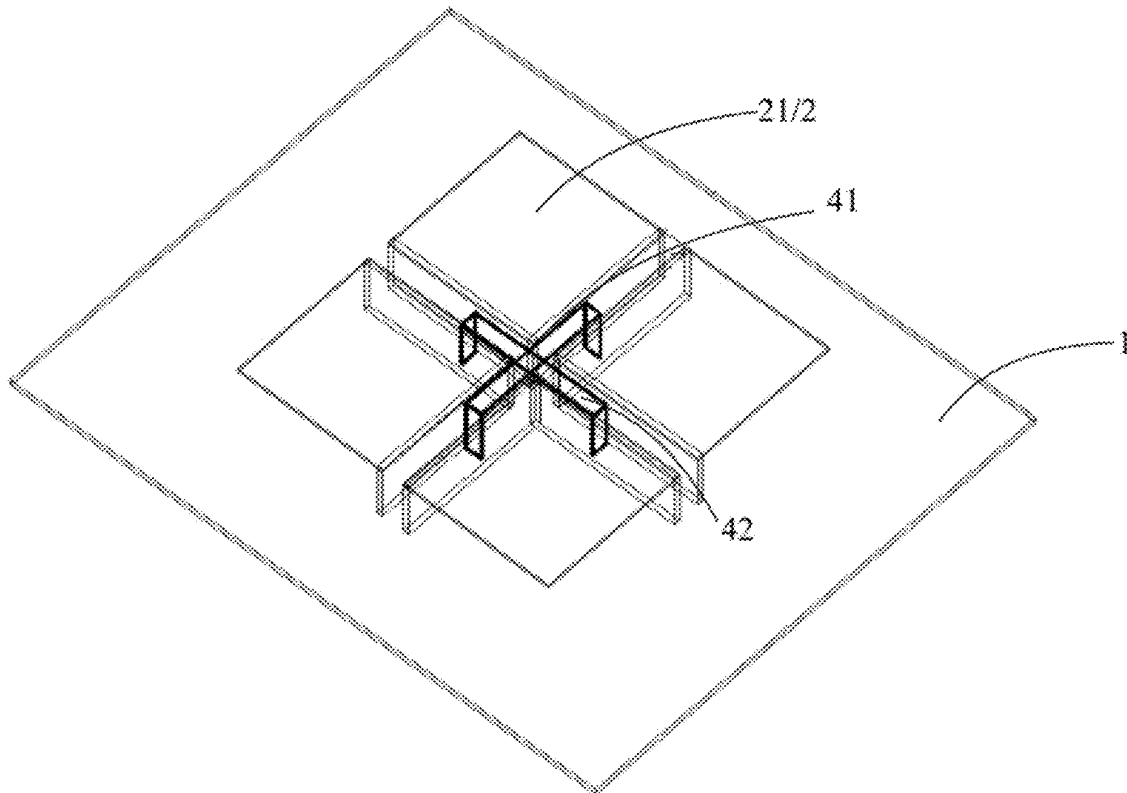
(21) Appl. No.: **18/579,334**

(22) PCT Filed: **Dec. 26, 2022**

(86) PCT No.: **PCT/CN2022/141915**

§ 371 (c)(1),

(2) Date: **Jan. 13, 2024**

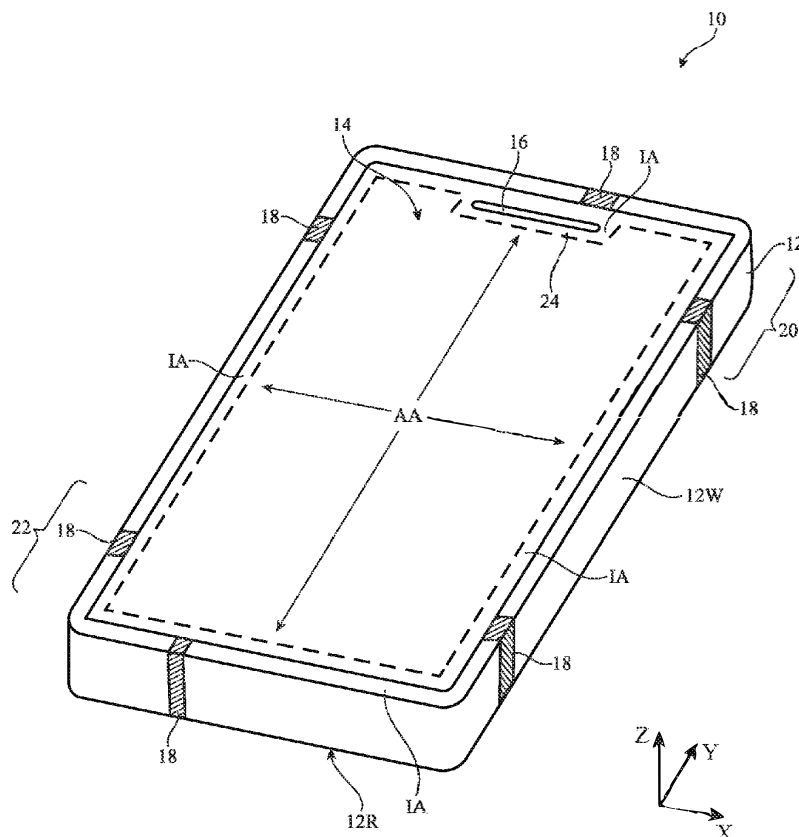




US 20250087890A1

(19) **United States**(12) **Patent Application Publication**
Nafe et al.(10) **Pub. No.: US 2025/0087890 A1**(43) **Pub. Date: Mar. 13, 2025**(54) **ELECTRONIC DEVICES WITH LOWER
ANTENNA SWITCHING**(22) Filed: **Sep. 11, 2023****Publication Classification**(71) Applicant: **Apple Inc.**, Cupertino, CA (US)(51) **Int. Cl.**
H01Q 9/04 (2006.01)
H01Q 3/24 (2006.01)(72) Inventors: **Ahmed Ali Abdelhalim Nafe**,
Cupertino, CA (US); **Ali Pourghorban
Saghati**, San Jose, CA (US); **Ana
Papio Toda**, San Jose, CA (US); **Carlo
Di Nallo**, Belmont, CA (US); **Enrique
Ayala Vazquez**, Watsonville, CA (US);
Erdinc Irci, Sunnyvale, CA (US); **Hao
Xu**, Cupertino, CA (US); **Hongfei Hu**,
Cupertino, CA (US); **Jingni Zhong**,
Santa Clara, CA (US); **Mattia
Pascolini**, San Francisco, CA (US);
Ming Chen, Cupertino, CA (US);
Mohsen Salehi, San Jose, CA (US);
Nikolaj P Kammergaard,
Copenhagen (DK); **Orbay Tuncay**, San
Jose, CA (US); **Salih Yarga**, San Jose,
CA (US); **Seyed Mohammad Amjadi**,
Santa Clara, CA (US); **Tiejun Yu**,
Fremont, CA (US); **Yiren Wang**,
Cupertino, CA (US); **Yuan Tao**, Santa
Clara, CA (US)(52) **U.S. Cl.**
CPC **H01Q 9/0485** (2013.01); **H01Q 3/24**
(2013.01)(57) **ABSTRACT**

An electronic device may be provided with wireless circuitry and a housing having peripheral conductive housing structures. The wireless circuitry may include first and second antennas. The first antenna may have a resonating element arm formed from a first segment of the peripheral conductive housing structures. The second antenna may have a resonating element arm formed from a second segment of the peripheral conductive housing structures separated from the first segment by a gap. Switchable short paths may be coupled between the second segment and ground on opposing sides of an antenna feed for the second antenna and/or may be coupled between the first and second segments and ground on opposing sides of the gap. Additionally or alternatively, a switch may be coupled between the first and second segments across the gap and a tuning component may couple the second segment to the ground structures.

(21) Appl. No.: **18/464,999**



US 20250087889A1

(19) **United States**

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

(10) **Pub. No.: US 2025/0087889 A1**

(43) **Pub. Date: Mar. 13, 2025**

(54) **TERMINAL ANTENNA**

Publication Classification

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

(51) **Int. Cl.**
H01Q 9/04 (2006.01)
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)

(72) Inventors: **Yiwu Hu**, Shenzhen (CN); **Kunpeng Wei**, Shenzhen (CN); **Shaojie Chu**, Shenzhen (CN); **Yang Lu**, Shenzhen (CN)

(52) **U.S. Cl.**
CPC **H01Q 9/0421** (2013.01); **H01Q 1/243** (2013.01); **H01Q 1/48** (2013.01)

(21) Appl. No.: **18/561,572**

(22) PCT Filed: **Apr. 28, 2023**

(86) PCT No.: **PCT/CN2023/091853**

§ 371 (c)(1),

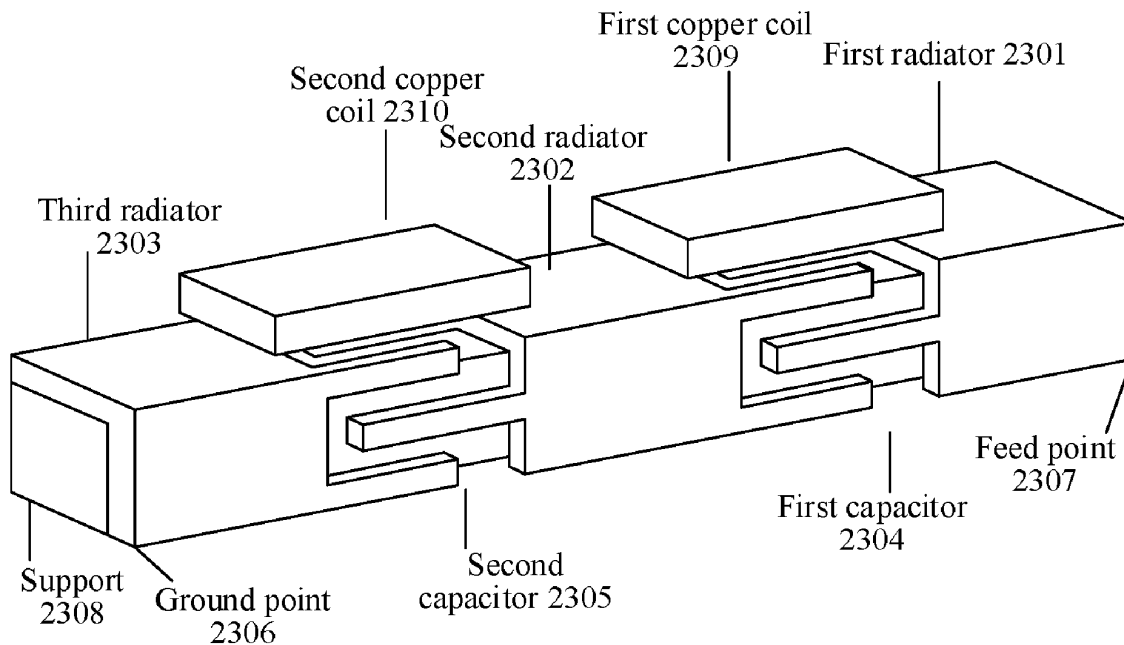
(2) Date: **Nov. 16, 2023**

(30) **Foreign Application Priority Data**

Jul. 8, 2022 (CN) 202210799849.4

(57) **ABSTRACT**

Embodiments of this application relate to the field of antennas, and provide a terminal antenna. The terminal antenna includes n radiators. The n radiators include a first radiator, a second radiator, and a third radiator. Lengths of the first radiator, the second radiator, and the third radiator form a descending arithmetic progression. The first radiator, the second radiator, and the third radiator are arranged in sequence to form two gaps. A coupling capacitance formed by the first radiator and the second radiator through the corresponding gap is greater than a coupling capacitance formed by the second radiator and the third radiator through the corresponding gap. The first radiator, the second radiator, and the third radiator are any three of the n radiators distributed in sequence.





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(19) **United States**

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

(10) **Pub. No.: US 2025/0087886 A1**

(43) **Pub. Date: Mar. 13, 2025**

(54) **ELECTRONIC DEVICE INCLUDING ANTENNA**

(30) **Foreign Application Priority Data**

Sep. 11, 2023 (KR) 10-2023-0120327

Nov. 7, 2023 (KR) 10-2023-0152907

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

Publication Classification

(72) Inventors: **Jaehyung KIM**, Suwon-si (KR);
Hongpyo BAE, Suwon-si (KR);
Seunghwan KIM, Suwon-si (KR);
Jongwon KIM, Suwon-si (KR);
Taegyu KIM, Suwon-si (KR); **Jesun MOON**, Suwon-si (KR); **Himchan YUN**, Suwon-si (KR); **Jaebong CHUN**, Suwon-si (KR); **Hochul HWANG**, Suwon-si (KR)

(51) **Int. Cl.**

H01Q 5/364 (2006.01)

H01Q 1/24 (2006.01)

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

CPC **H01Q 5/364** (2015.01); **H01Q 1/243**

(2013.01)

(57) **ABSTRACT**

An electronic device includes a display, a rear cover, a side member surrounding the space between the display and the rear cover, the side member having a groove formed therein, a side key disposed the groove and including a conductive portion, a wireless communication circuit, at least one processor, and a first conductive connection member electrically connecting the at least one processor to the side key. The wireless communication circuit is configured to feed power to a first portion of the side member surrounding an edge of the groove through the first conductive connection member electrically connecting the at least one processor to the side key, and transmit and/or receive radio frequency (RF) signals in a specified frequency band, based on an electrical path formed in the first portion of the side member and the conductive portion of the side key.

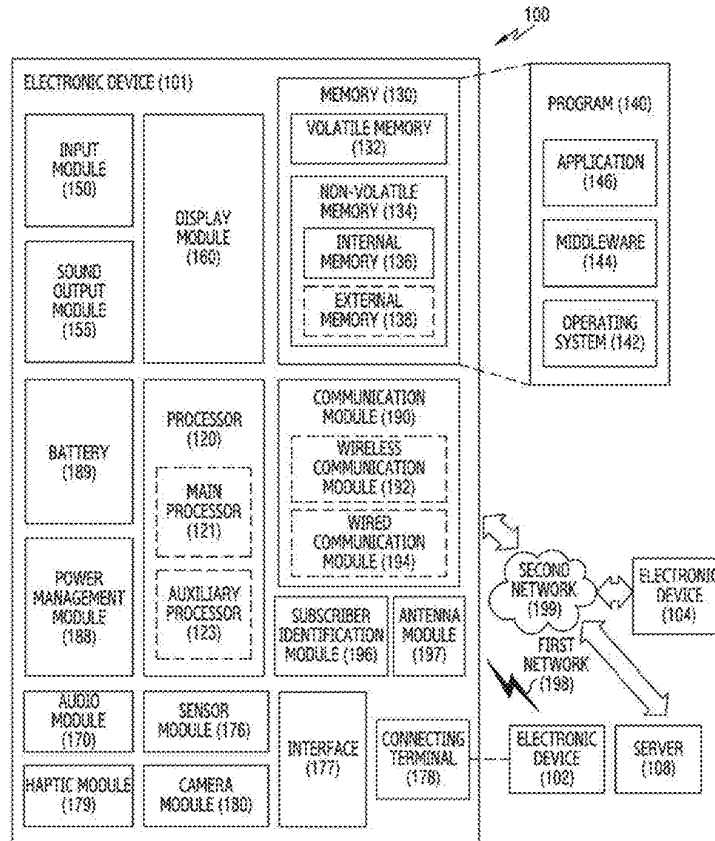
(73) Assignee: **SAMSUNG ELECTRONICS CO., LTD.**, Suwon-si (KR)

(21) Appl. No.: **18/943,407**

(22) Filed: **Nov. 11, 2024**

Related U.S. Application Data

(63) Continuation of application No. PCT/KR2024/013771, filed on Sep. 11, 2024.





US 20250087870A1

(19) **United States**

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

(10) **Pub. No.: US 2025/0087870 A1**

(43) **Pub. Date: Mar. 13, 2025**

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

Publication Classification

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

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/52 (2006.01)
H05K 1/02 (2006.01)

(72) Inventors: **Youngkon LIM**, Suwon-si (KR);
Kihyuk Han, Suwon-si (KR); **Hyoseok
Na**, Suwon-si (KR)

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 1/526*
(2013.01); *H05K 1/028* (2013.01); *H05K*
2201/10098 (2013.01)

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

(57) **ABSTRACT**

(21) Appl. No.: **18/957,050**

(22) Filed: **Nov. 22, 2024**

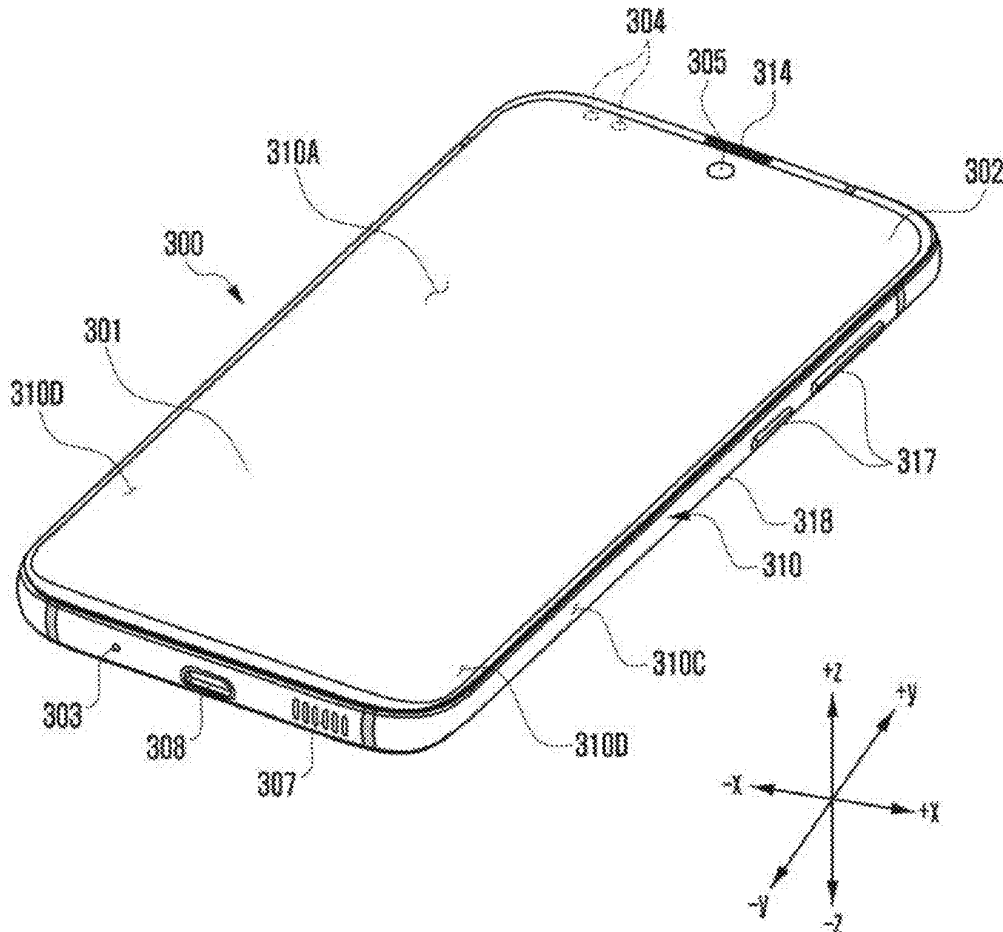
Related U.S. Application Data

(63) Continuation of application No. PCT/KR2023/
006979, filed on May 23, 2023.

(30) **Foreign Application Priority Data**

May 23, 2022 (KR) 10-2022-0063016
Jul. 5, 2022 (KR) 10-2022-0082237

An electronic device includes: a housing including a front surface and a rear surface; a display on the front surface of the housing; a shielding member being inside the housing; a printed circuit board on the shielding member, including: a first antenna area including a first pattern, a second antenna area including a second pattern, and a bending area, which is at least partially bent to interconnect the first antenna area and the second antenna area; and a rear surface plate on the rear surface of the housing to cover the printed circuit board, wherein the second pattern extends to outside of the first pattern and at least partially faces a portion of the first pattern.

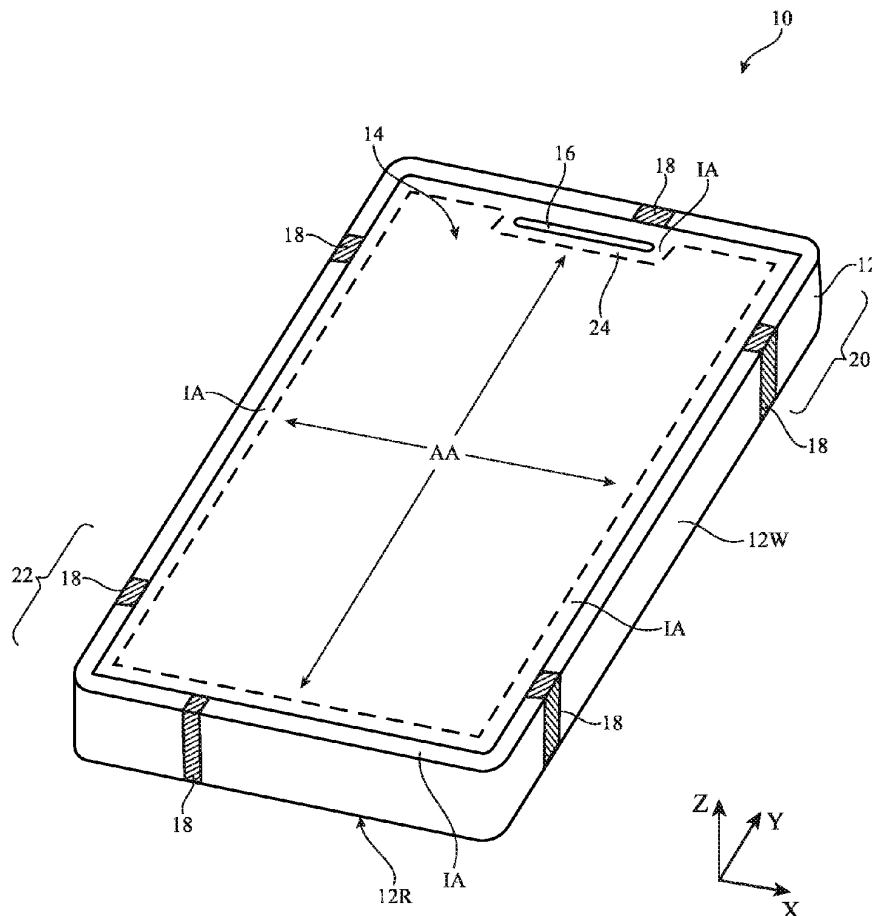




US 20250087869A1

(19) **United States**(12) **Patent Application Publication**
Chen et al.(10) **Pub. No.: US 2025/0087869 A1**(43) **Pub. Date: Mar. 13, 2025**(54) **ELECTRONIC DEVICE ANTENNAS WITH
NARROW BORDER DISPLAY****Publication Classification**(71) Applicant: **Apple Inc.**, Cupertino, CA (US)(72) Inventors: **Ming Chen**, Cupertino, CA (US);
Enrique Ayala Vazquez, Watsonville,
CA (US); **Joel Ravi**, San Francisco, CA
(US); **Woonyong Bae**, San Jose, CA
(US); **Laura M Burke**, Los Gatos, CA
(US); **Yuancheng Xu**, San Jose, CA
(US); **Bhaskara R Rupakula**, San Jose,
CA (US); **Haozhan Tian**, San Jose, CA
(US); **Salih Yarga**, San Jose, CA (US);
Erdinc Irci, Sunnyvale, CA (US);
Tiejun Yu, Fremont, CA (US); **Seyed
Mohammad Amjadi**, Santa Clara, CA
(US); **Ahmed Ali Abdelhalim Nafe**,
Cupertino, CA (US); **Hongfei Hu**,
Cupertino, CA (US); **Carlo Di Nallo**,
Belmont, CA (US); **Mattia Pascolini**,
San Francisco, CA (US)(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H05K 5/02 (2006.01)
(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H05K 5/0247**
(2013.01)(57) **ABSTRACT**

An electronic device may be provided with sidewalls and a conductive plate. A segment of the sidewalls may form a radiating arm of an antenna. A display may be mounted to the sidewalls. The display may include a conductive frame and a flexible printed circuit. The flexible circuit may have a bend. Conductive foam may short a conductive trace on the flexible circuit to the conductive frame near the bend. Low injection pressure overmolding (LIPO) may be molded over the flexible circuit, the foam, and the frame. A conductive spring may short the frame to the conductive plate. The spring may include a wider and/or thinner portion that optionally includes one or more notches for reducing its inductance. The conductive plate, the spring, the frame, the foam, and the conductive trace may form part of the antenna ground for the antenna.

(21) Appl. No.: **18/465,014**(22) Filed: **Sep. 11, 2023**



US 20250079711A1

(19) **United States**

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

(10) **Pub. No.: US 2025/0079711 A1**

(43) **Pub. Date: Mar. 6, 2025**

(54) **HYBRID ANTENNA STRUCTURE**

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

(72) Inventors: **Li-Kai KUO**, Hsinchu (TW); **Jun-Yan CHEN**, Hsinchu (TW)

(21) Appl. No.: **18/795,798**

(22) Filed: **Aug. 6, 2024**

(30) **Foreign Application Priority Data**

Sep. 1, 2023 (TW) 112133261

Publication Classification

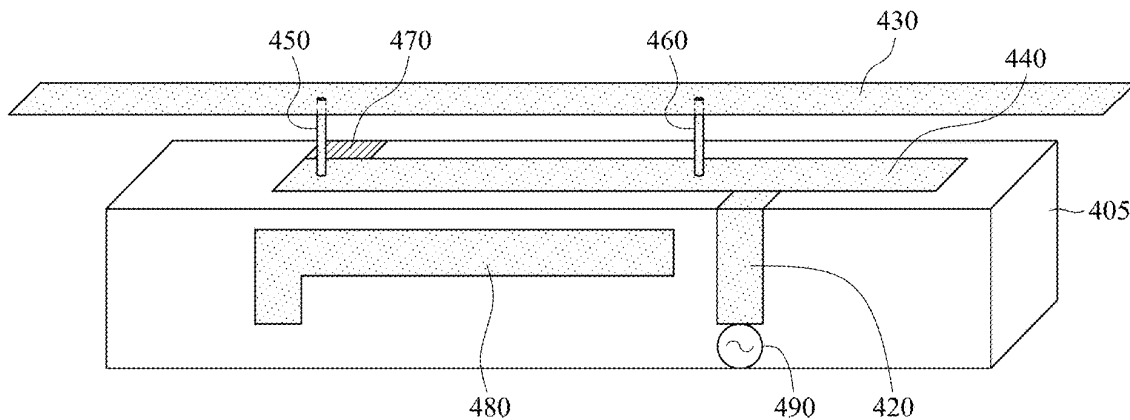
(51) **Int. Cl.**
H01Q 9/04 (2006.01)
H01Q 21/30 (2006.01)

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

CPC **H01Q 9/0442** (2013.01); **H01Q 9/0414**
(2013.01); **H01Q 9/0457** (2013.01); **H01Q**
21/30 (2013.01)

(57) **ABSTRACT**

A hybrid antenna structure includes a ground element, a feeding radiation element, a first radiation element, a second radiation element, a first connection radiation element, a second connection radiation element, a shorting radiation element, a third radiation element, and an integrated module. The ground element provides a ground voltage. The feeding radiation element has a feeding point. The second radiation element is coupled to the feeding radiation element. The first radiation element is coupled through the first connection radiation element and the second connection radiation element to the second radiation element. The second radiation element is also coupled through the shorting radiation element to the ground voltage. The third radiation element is adjacent to the second radiation element. The integrated module is coupled to the third radiation element. The integrated module has the functions of circuit adjustment and proximity sense.





US 20250079708A1

(19) **United States**

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

(10) **Pub. No.: US 2025/0079708 A1**

(43) **Pub. Date: Mar. 6, 2025**

(54) **FREQUENCY MODULATION ANTENNA AND ANTENNA DEVICE**

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

CPC **H01Q 7/005** (2013.01); **H01Q 1/3275** (2013.01); **H01Q 1/42** (2013.01)

(71) Applicant: **Wistron NeWeb Corporation**, Hsinchu (TW)

(72) Inventors: **Tzu-Min WU**, Hsinchu (TW); **Yu-Hsin YE**, Hsinchu (TW); **Kuang-Yuan KU**, Hsinchu (TW); **Kuo-Jen LAI**, Hsinchu (TW)

(57)

ABSTRACT

A frequency modulation antenna and an antenna device are proposed. The antenna device has an accommodating space, and the frequency modulation antenna is in the accommodating space and includes a main antenna structure and a first extending antenna structure. The main antenna structure includes a main substrate and a main loop radiator. The main substrate has a plane. The main loop radiator is disposed on the plane and has a first end and a second end in which the first end is coupled to a feeding point. The first extending antenna structure is vertically disposed on the plane and electrically connected to the second end. Therefore, the size of the frequency modulation antenna can be reduced and the performance of the frequency modulation antenna can be improved.

(21) Appl. No.: **18/679,939**

(22) Filed: **May 31, 2024**

(30) **Foreign Application Priority Data**

Sep. 5, 2023 (TW) 112133614

Publication Classification

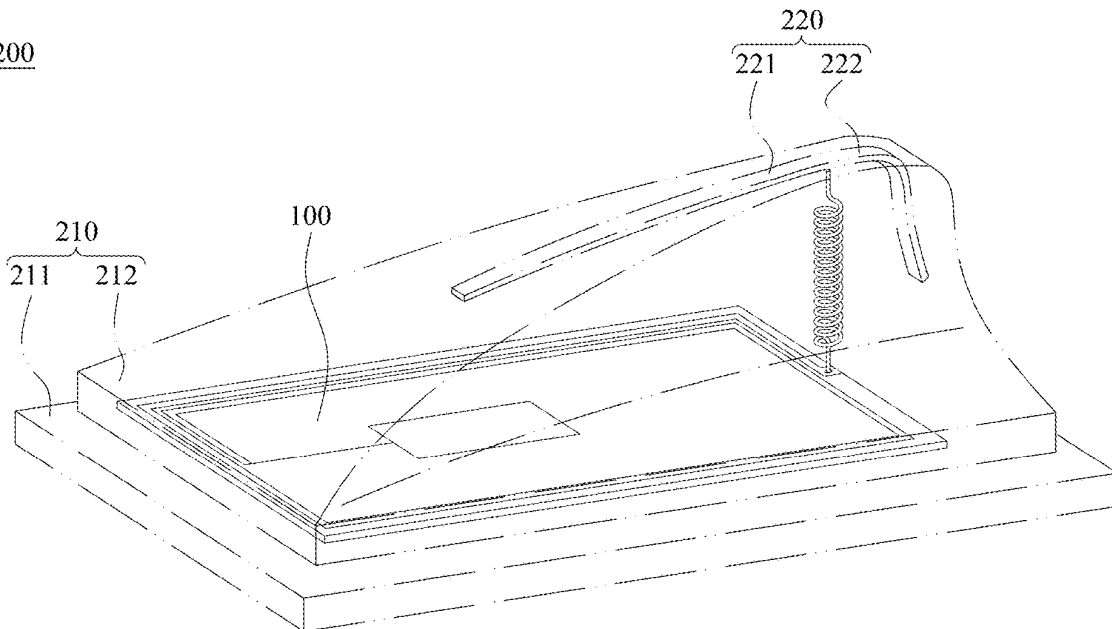
(51) **Int. Cl.**

H01Q 7/00 (2006.01)

H01Q 1/32 (2006.01)

H01Q 1/42 (2006.01)

200





US 20250079706A1

(19) **United States**

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

(10) **Pub. No.: US 2025/0079706 A1**

(43) **Pub. Date: Mar. 6, 2025**

(54) **ANTENNA STRUCTURE**

Publication Classification

(71) Applicant: **Qisda Corporation**, Taoyuan City (TW)

(51) **Int. Cl.**
H01Q 5/30 (2006.01)
H01Q 1/52 (2006.01)

(72) Inventors: **An-Chun LIU**, Taoyuan City (TW);
Chih-Hsuan WANG, Taoyuan City (TW)

(52) **U.S. Cl.**
CPC **H01Q 5/30** (2015.01); **H01Q 1/526** (2013.01)

(73) Assignee: **Qisda Corporation**, Taoyuan City (TW)

(57) **ABSTRACT**

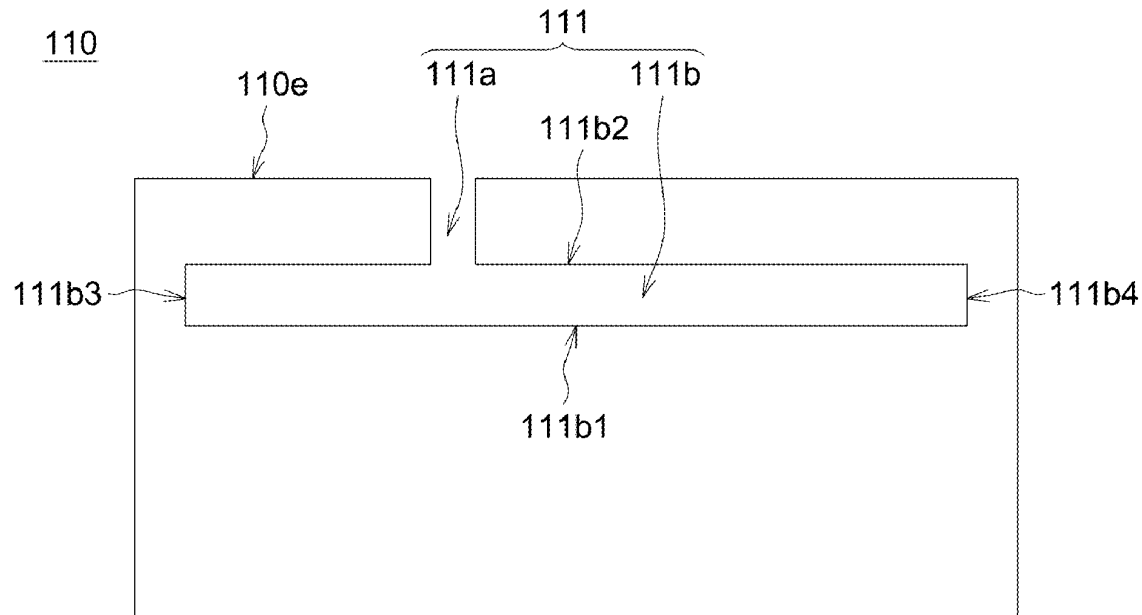
(21) Appl. No.: **18/800,221**

An antenna structure is provided. The antenna structure includes a conductor substrate, a coupling feed-in element and a shielding element. The conductor substrate has a slot. The coupling feed-in element, partly overlapping the slot, is disposed on the conductor substrate. The shielding element, partly overlapping the slot, is separated from the coupling feed-in element and disposed on the conductor substrate, wherein the shielding element is movable along the slot.

(22) Filed: **Aug. 12, 2024**

(30) **Foreign Application Priority Data**

Sep. 4, 2023 (CN) 202311130845.8





US 20250079319A1

(19) **United States**

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

(10) **Pub. No.: US 2025/0079319 A1**

(43) **Pub. Date: Mar. 6, 2025**

(54) **SEMICONDUCTOR PACKAGE AND
METHOD OF FABRICATING THE SAME**

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

(72) Inventors: **Jeongseok KIM**, Suwon-si (KR);
Jaeseong KIM, Suwon-si (KR); **Tae
Wook KIM**, Suwon-si (KR); **Yejin
LEE**, Suwon-si (KR); **Jooyoung
CHOI**, Suwon-si (KR); **Sangseok
HONG**, Suwon-si (KR)

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

(21) Appl. No.: **18/737,402**

(22) Filed: **Jun. 7, 2024**

(30) **Foreign Application Priority Data**

Aug. 31, 2023 (KR) 10-2023-0115252

Publication Classification

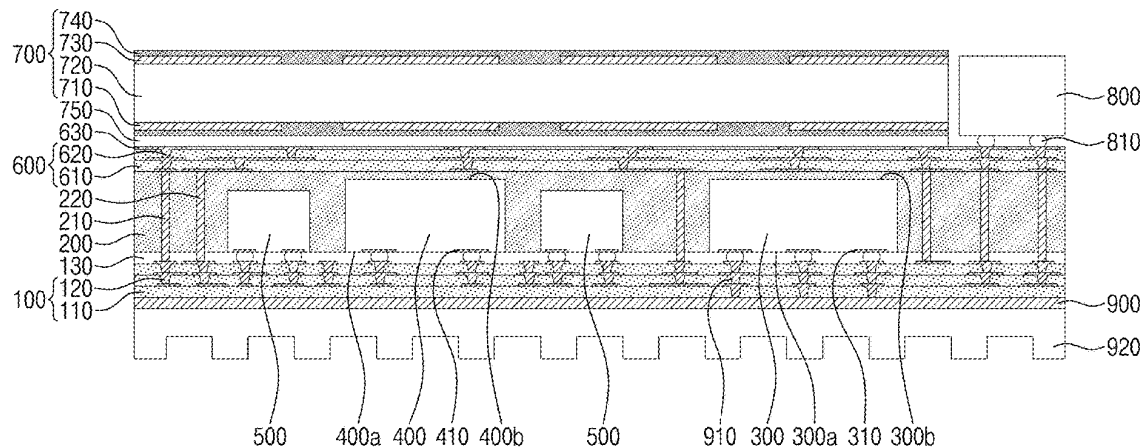
(51) **Int. Cl.**
H01L 23/538 (2006.01)
H01L 23/00 (2006.01)
H01L 23/31 (2006.01)
H01L 23/36 (2006.01)
H01L 23/49 (2006.01)

H01L 23/498 (2006.01)
H01L 25/16 (2006.01)
H01Q 1/22 (2006.01)

(52) **U.S. Cl.**
CPC **H01L 23/5383** (2013.01); **H01L 23/3107**
(2013.01); **H01L 23/36** (2013.01); **H01L 23/49**
(2013.01); **H01L 25/16** (2013.01); **H01Q**
1/2283 (2013.01); **H01L 23/49816** (2013.01);
H01L 24/16 (2013.01); **H01L 24/32** (2013.01);
H01L 24/73 (2013.01); **H01L 2224/16227**
(2013.01); **H01L 2224/32225** (2013.01); **H01L**
2224/73204 (2013.01); **H01L 2924/1421**
(2013.01); **H01L 2924/15174** (2013.01)

(57) **ABSTRACT**

A semiconductor package may include a first redistribution substrate, a first semiconductor chip disposed on the first redistribution substrate, a second semiconductor chip horizontally spaced apart from the first semiconductor chip, a mold layer provided on the first redistribution substrate to enclose the first and second semiconductor chips, a second redistribution substrate disposed on the mold layer, a connection member, which is provided at a side of the first and second semiconductor chips to connect the first redistribution substrate to the second redistribution substrate, and an antenna substrate attached to the second redistribution substrate using an adhesive layer. The antenna substrate may include a core portion, an antenna pattern provided on a top surface of the core portion, and a wiring pattern provided on a bottom surface of the core portion.





US 20250070473A1

(19) **United States**(12) **Patent Application Publication**
LIN et al.(10) **Pub. No.: US 2025/0070473 A1**(43) **Pub. Date: Feb. 27, 2025**(54) **ANTENNA STRUCTURE AND ELECTRONIC
DEVICE****Publication Classification**(51) **Int. Cl.***H01Q 13/16*

(2006.01)

H01Q 13/22

(2006.01)

H01Q 21/06

(2006.01)

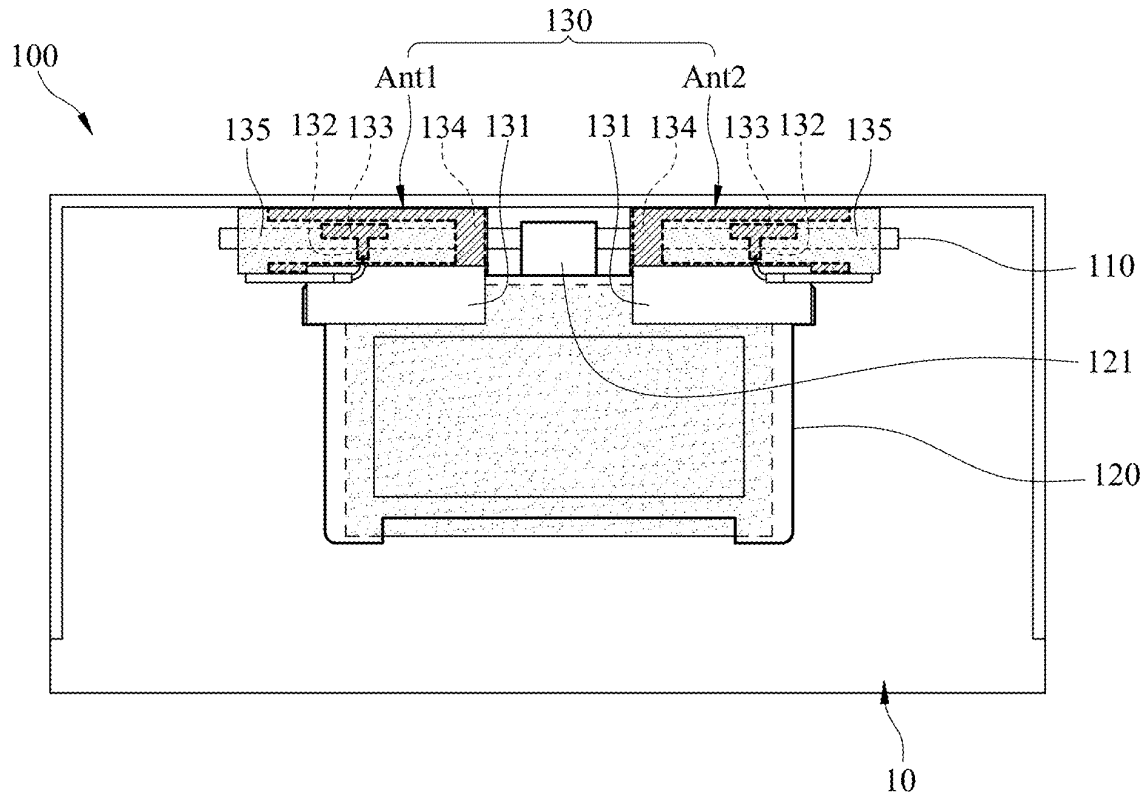
(52) **U.S. Cl.**CPC *H01Q 13/16* (2013.01); *H01Q 13/22*
(2013.01); *H01Q 21/064* (2013.01)(71) Applicant: **Wistron NeWeb Corporation**, Hsinchu
(TW)(72) Inventors: **Hsieh-Chih LIN**, Hsinchu (TW);
Guan-Ren SU, Hsinchu (TW);
Shih-Chiang WEI, Hsinchu (TW)(21) Appl. No.: **18/679,894**(22) Filed: **May 31, 2024**(30) **Foreign Application Priority Data**

Aug. 24, 2023 (TW) 112131877

(57)

ABSTRACT

An antenna structure is disposed on a metal case. The metal case includes a surface. The antenna structure includes a slot and a metal unit. The slot is formed on the surface along a direction. The metal unit is disposed on the metal case. The metal unit includes at least one blocking part. The at least one blocking part is in contact with the surface, extended toward and crossed over the slot to separate the slot into a plurality of slot paths.





US 20250070465A1

(19) **United States**

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

(10) **Pub. No.: US 2025/0070465 A1**

(43) **Pub. Date: Feb. 27, 2025**

(54) **ELECTRONIC DEVICE**

Publication Classification

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

(51) **Int. Cl.**
H01Q 5/25 (2006.01)
H01Q 9/04 (2006.01)
H01Q 21/22 (2006.01)

(72) Inventors: **Libin SUN**, Shanghai (CN); **Lishun KE**, Shanghai (CN); **Hanyang WANG**, Reading (GB)

(52) **U.S. Cl.**
CPC **H01Q 5/25** (2015.01); **H01Q 9/0428** (2013.01); **H01Q 21/22** (2013.01)

(21) Appl. No.: **18/941,628**

(57) **ABSTRACT**

(22) Filed: **Nov. 8, 2024**

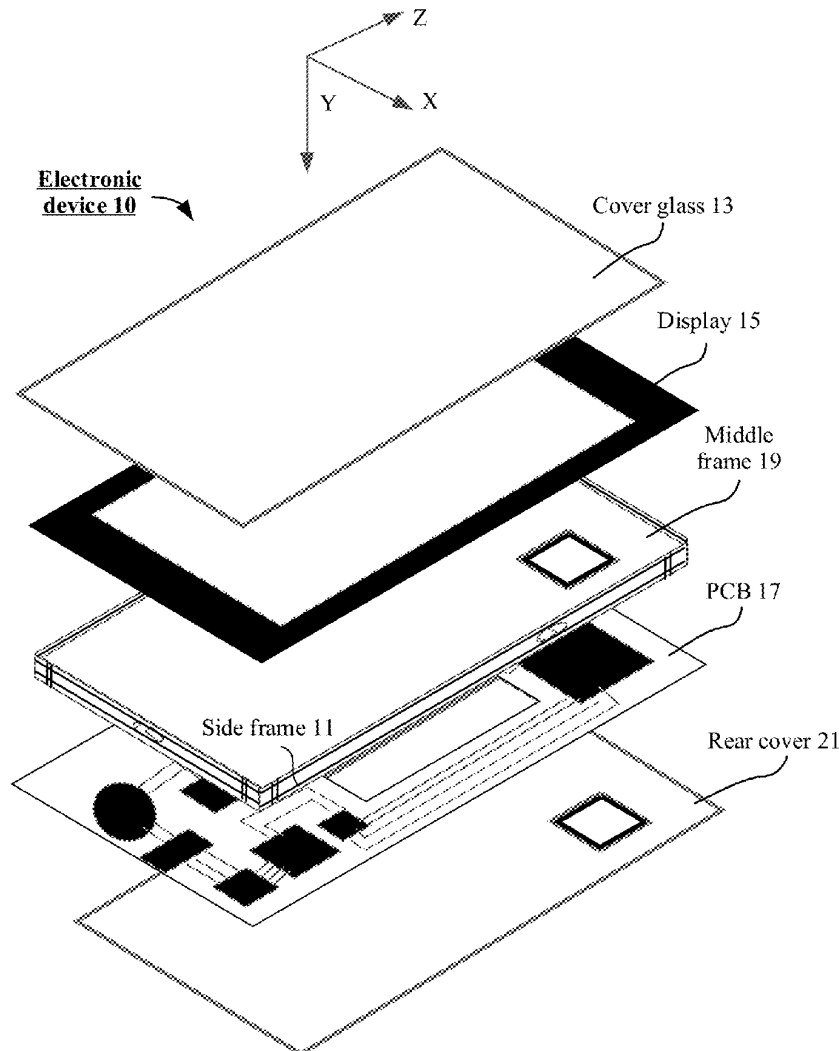
Related U.S. Application Data

(63) Continuation of application No. PCT/CN2023/093650, filed on May 11, 2023.

An electronic device includes a conductive frame and an antenna. A part of the frame is used as a radiator of the antenna. The antenna is used to generate a first resonance and a second resonance. A ratio of a frequency of the first resonance to a frequency of the second resonance is greater than 1 and less than or equal to 1.5. An operating frequency band of the antenna includes a first frequency band, and a frequency in the first frequency band is between the frequency of the first resonance and the frequency of the second resonance.

(30) **Foreign Application Priority Data**

May 17, 2022 (CN) 202210534097.9





US 20250070464A1

(19) **United States**

(12) **Patent Application Publication**
ZHANG

(10) **Pub. No.: US 2025/0070464 A1**

(43) **Pub. Date: Feb. 27, 2025**

(54) **TERMINAL REAR COVER AND
ELECTRONIC DEVICE**

Publication Classification

(71) Applicant: **BEIJING XIAOMI MOBILE
SOFTWARE CO., LTD.**, Beijing (CN)

(51) **Int. Cl.**
H01Q 5/25 (2006.01)
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)

(72) Inventor: **Lupeng ZHANG**, Beijing (CN)

(52) **U.S. Cl.**
CPC *H01Q 5/25* (2015.01); *H01Q 1/243*
(2013.01); *H01Q 1/48* (2013.01)

(21) Appl. No.: **18/719,601**

(22) PCT Filed: **Apr. 29, 2022**

(86) PCT No.: **PCT/CN2022/090798**

§ 371 (c)(1),

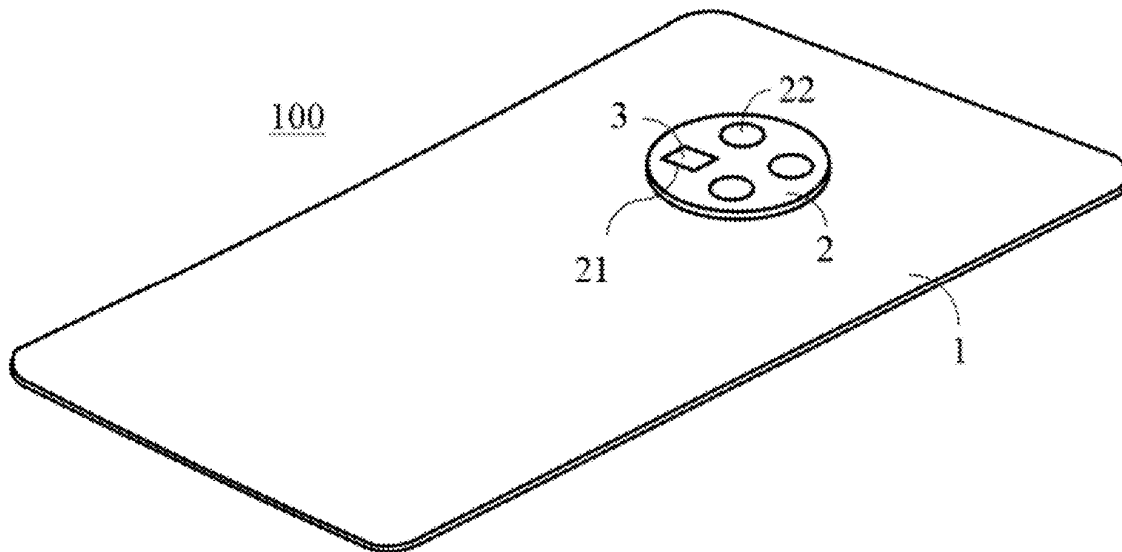
(2) Date: **Jun. 13, 2024**

(57) **ABSTRACT**

(30) **Foreign Application Priority Data**

Dec. 22, 2021 (CN) 202111608369.7

A terminal rear cover includes: a rear cover body including an opening; a metal decoration frame coupled to the rear cover body and covering the opening, the metal decoration frame including a groove and at least one light passing opening, the groove being spaced from each light passing opening; and a UWB antenna embedded in the groove.





US 20250070454A1

(19) **United States**

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

(10) **Pub. No.: US 2025/0070454 A1**

(43) **Pub. Date: Feb. 27, 2025**

(54) **ELECTRONIC DEVICE INCLUDING
FOLDABLE HOUSING AND ANTENNA**

Publication Classification

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

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/38 (2006.01)
H04M 1/02 (2006.01)

(72) Inventors: **Hojung NAM**, Suwon-si (KR);
Sungkoo PARK, Suwon-si (KR);
Kyungmoon SEOL, Suwon-si (KR);
Cheolhong SON, Suwon-si (KR);
Kookjoo LEE, Suwon-si (KR);
Donguk CHOI, Suwon-si (KR);
Jaewon CHOE, Suwon-si (KR);
Soonho HWANG, Suwon-si (KR)

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 1/38**
(2013.01); **H04M 1/0216** (2013.01)

(21) Appl. No.: **18/821,411**

(22) Filed: **Aug. 30, 2024**

Related U.S. Application Data

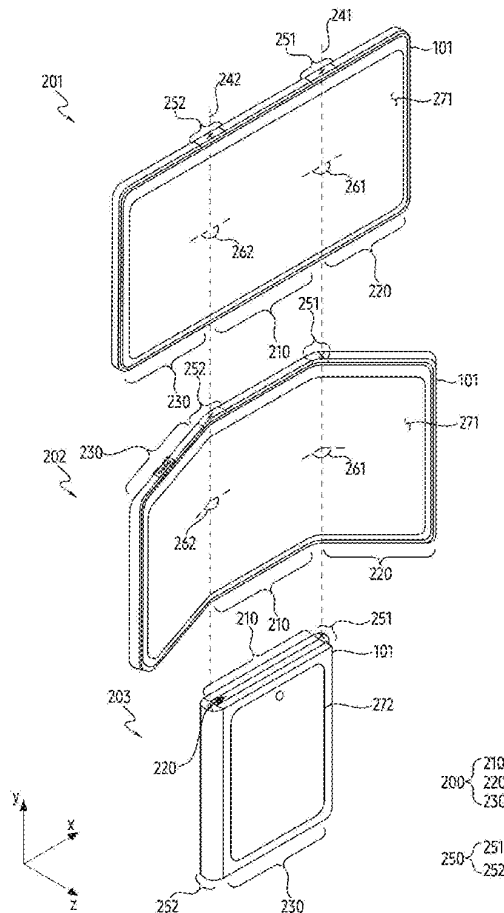
(63) Continuation of application No. PCT/KR2024/
012356, filed on Aug. 20, 2024.

(30) **Foreign Application Priority Data**

Aug. 23, 2023 (KR) 10-2023-0110870
Nov. 6, 2023 (KR) 10-2023-0152215

(57) **ABSTRACT**

An electronic device according to an embodiments includes a foldable housing including a first housing part, a second housing part and a third housing part, a wireless communication circuit, a first conductive portion formed along at least a portion of a first side exterior surface of the first housing part and including a feeding point and a ground point, and a filter circuit electrically connected to a portion of a second conductive portion in a second side exterior surface of the second housing part. The portion corresponds to a region between the feeding point of the first conductive portion and the ground point of the first conductive portion, in a folded state in which the first housing part and the second housing part are folded.





US 20250070451A1

(19) **United States**

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

(10) **Pub. No.: US 2025/0070451 A1**

(43) **Pub. Date: Feb. 27, 2025**

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

Publication Classification

(71) Applicants: **Yungu (Gu'an) Technology Co., Ltd.**,
Langfang (CN); **Hefei Visionox
Technology Co., Ltd.**, Hefei (CN)

(51) **Int. Cl.**
H01Q 1/22 (2006.01)
H01Q 1/50 (2006.01)
H01Q 21/06 (2006.01)

(72) Inventors: **Huan-Chu HUANG**, Taoyuan City
(CN); **Jie WU**, Langfang (CN); **Shuang
CUI**, Langfang (CN)

(52) **U.S. Cl.**
CPC **H01Q 1/2283** (2013.01); **H01Q 1/50**
(2013.01); **H01Q 21/06** (2013.01)

(73) Assignees: **Yungu (Gu'an) Technology Co., Ltd.**,
Langfang (CN); **Hefei Visionox
Technology Co., Ltd.**, Hefei (CN)

(57) **ABSTRACT**

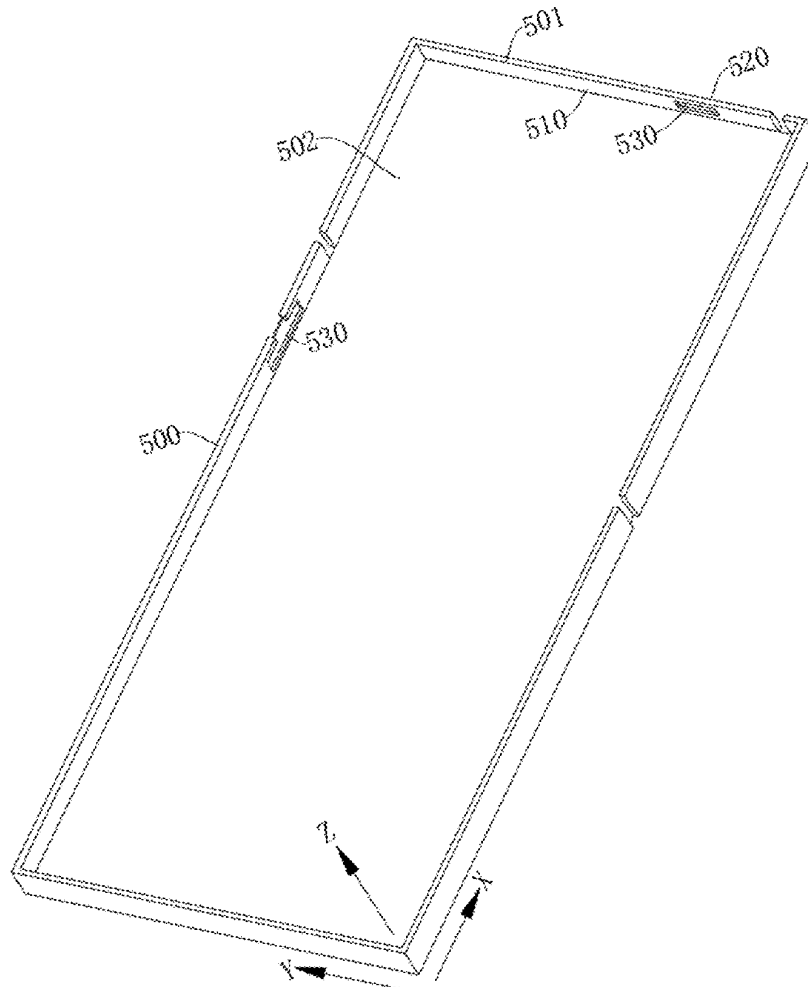
(21) Appl. No.: **18/945,859**

An antenna device, a housing and an electronic apparatus, the antenna device includes: a substrate, with a first section and a second section; an antenna module, provided in the first section and having two or more antenna units spaced apart on the first section; an integrated circuit, provided in the second section; a connecting portion, provided in the substrate and electrically connected the antenna unit and the integrated circuit; a metal shielding layer, provided in the substrate, and an orthographic projection of the plurality of antenna units in a thickness direction of the first section are located within an orthographic projection of the metal shielding layer in the thickness direction.

(22) Filed: **Nov. 13, 2024**

(30) **Foreign Application Priority Data**

Nov. 17, 2023 (CN) 202311542540.8





US 20250070448A1

(19) **United States**

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

(10) **Pub. No.: US 2025/0070448 A1**

(43) **Pub. Date: Feb. 27, 2025**

(54) **ANTENNA STRUCTURE AND BLUETOOTH
SENSOR INCLUDING THE ANTENNA
STRUCTURE IN TPMS**

Publication Classification

(51) **Int. Cl.**
H01Q 1/22 (2006.01)
H01Q 9/04 (2006.01)
(52) **U.S. Cl.**
CPC *H01Q 1/2241* (2013.01); *H01Q 9/0414*
(2013.01)

(71) Applicant: **Hamaton Automotive Technology
Co.,Ltd**, Hangzhou, Zhejiang (CN)

(72) Inventors: **Jianer ZHANG**, Hangzhou, Zhejiang
(CN); **Zenan HU**, Hangzhou, Zhejiang
(CN); **Mingguang YU**, Hangzhou,
Zhejiang (CN)

(73) Assignee: **Hamaton Automotive Technology
Co.,Ltd**, Hangzhou, Zhejiang (CN)

(21) Appl. No.: **18/553,057**

(22) PCT Filed: **Jul. 31, 2023**

(86) PCT No.: **PCT/CN2023/110239**

§ 371 (c)(1),

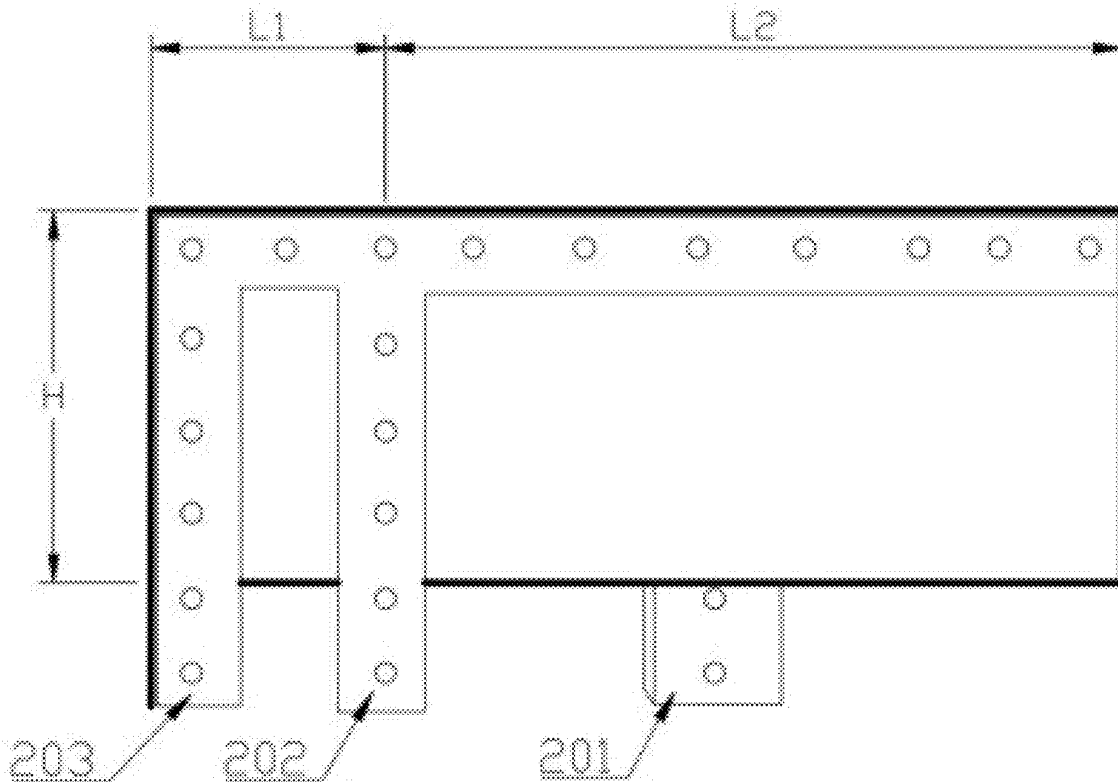
(2) Date: **Sep. 28, 2023**

(30) **Foreign Application Priority Data**

Jul. 6, 2022 (CN) 202221715895.3

(57) **ABSTRACT**

The application discloses an antenna structure for a Bluetooth sensor in a TPMS, including an antenna board and a Bluetooth antenna arranged on the antenna board, where the Bluetooth antenna is an IFA with a backbone distributed in a straight line or a backbone distributed in a serpentine shape; where the antenna board is a PCB, including a ground pin and a signal feed point protruded from an edge of the antenna board; and where the ground pin and the signal feed point are connected with the Bluetooth antenna. The present application further discloses a Bluetooth sensor in a TPMS, including a battery, a tire pressure sensor main board, and the antenna structure as described above, where the antenna structure is vertically installed on the tire pressure sensor main board.





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(54) **ELECTRONIC DEVICE**

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(57) **ABSTRACT**

An electronic device includes a radiator, a feed point, and a ground point. The plurality of radiators include a first radiator, a second radiator, and a third radiator. A first end of the first radiator and a first end of the second radiator are opposite to each other, and form a first gap. A second end of the first radiator and a first end of the third radiator are opposite to each other, and form a second gap. The feed point and the ground point are disposed on the first radiator. The ground point is disposed in a central region of the plurality of radiators or the first radiator, and the feed point is disposed between the central region and the first end of the first radiator. Gaps are formed between a plurality of radiators, so that a broadband antenna can be implemented.

