



US 20230291125A1

(19) **United States**(12) **Patent Application Publication****Ayala Vazquez et al.**(10) **Pub. No.: US 2023/0291125 A1**(43) **Pub. Date: Sep. 14, 2023**(54) **ELECTRONIC DEVICES WITH MULTIPLE
LOW BAND ANTENNAS****Publication Classification**

- (51) **Int. Cl.**
H01Q 21/28 (2006.01)
H01Q 1/38 (2006.01)
H01Q 1/24 (2006.01)
- (52) **U.S. Cl.**
CPC *H01Q 21/28* (2013.01); *H01Q 1/38*
(2013.01); *H01Q 1/241* (2013.01)

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

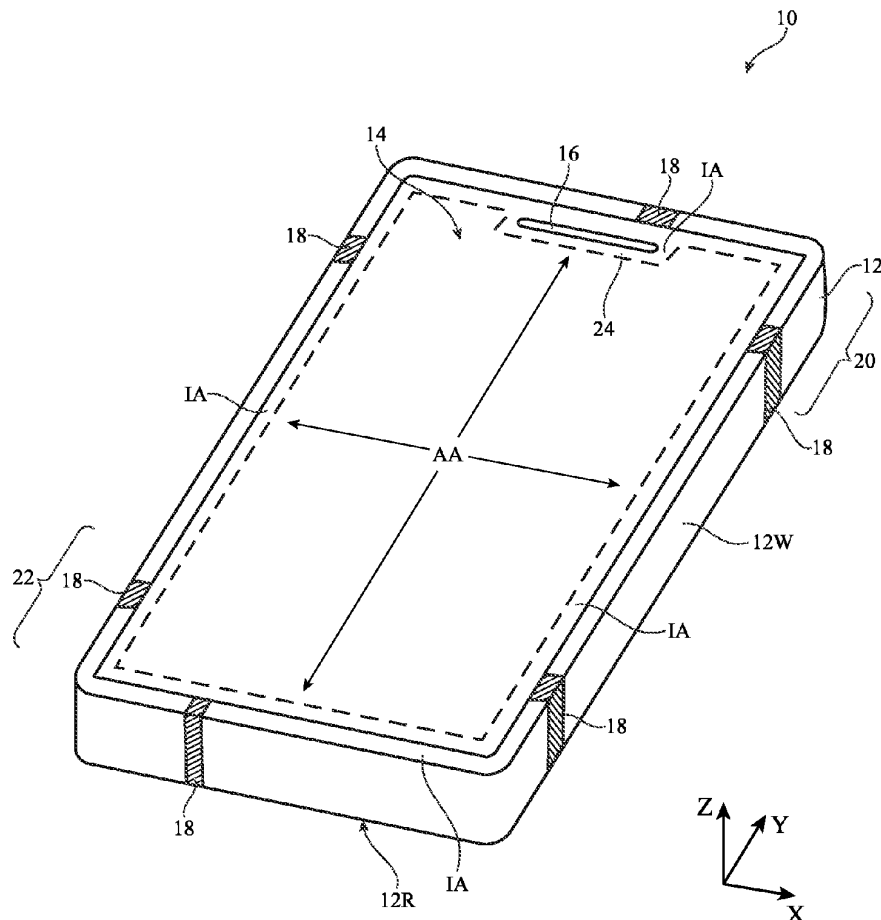
(72) Inventors: **Enrique Ayala Vazquez**, Watsonville, CA (US); **Xu Han**, Cupertino, CA (US); **Hongfei Hu**, Cupertino, CA (US); **Ming Chen**, Cupertino, CA (US); **Jingni Zhong**, Santa Clara, CA (US); **Erdinc Irci**, Sunnyvale, CA (US); **Salih Yarga**, Sunnyvale, CA (US); **Mohsen Salehi**, San Jose, CA (US); **Carlo Di Nallo**, Belmont, CA (US); **Ming-Ju Tsai**, Sunnyvale, CA (US); **Mattia Pascolini**, San Francisco, CA (US)

(21) Appl. No.: **17/832,427**(22) Filed: **Jun. 3, 2022****Related U.S. Application Data**

(63) Continuation of application No. 17/694,486, filed on Mar. 14, 2022.

(57) **ABSTRACT**

An electronic device may include first and second antennas formed from respective first and second segments of a housing. The first antenna may have a first feed coupled to the first segment by a first switch and coupled to the first segment by a first conductive trace. The second antenna may have a second feed coupled to the second segment by a second switch and coupled to the second segment by a second conductive trace. The first segment may be separated from the second segment by a single gap, a data connector may pass through the second segment, and the antennas may selectively cover a low band. Alternatively, the first segment may be separated from the second segment by a third segment and two gaps, the data connector may pass through the third segment, and the first and second antennas may concurrently cover the low band.





US 20230297792A1

(19) **United States**

(12) **Patent Application Publication**
KOIKE

(10) **Pub. No.: US 2023/0297792 A1**

(43) **Pub. Date: Sep. 21, 2023**

(54) **WIRELESS TAG COMMUNICATION DEVICE
AND SHEET PROCESSING APPARATUS**

(71) Applicant: **Toshiba Tec Kabushiki Kaisha**, Tokyo
(JP)

(72) Inventor: **Yuki KOIKE**, Sunto Shizuoka (JP)

(21) Appl. No.: **18/321,665**

(22) Filed: **May 22, 2023**

Related U.S. Application Data

(63) Continuation of application No. 17/325,121, filed on
May 19, 2021, now Pat. No. 11,699,049.

(30) **Foreign Application Priority Data**

Jul. 16, 2020 (JP) 2020-122404

Publication Classification

(51) **Int. Cl.**
G06K 7/10 (2006.01)
G06K 19/077 (2006.01)

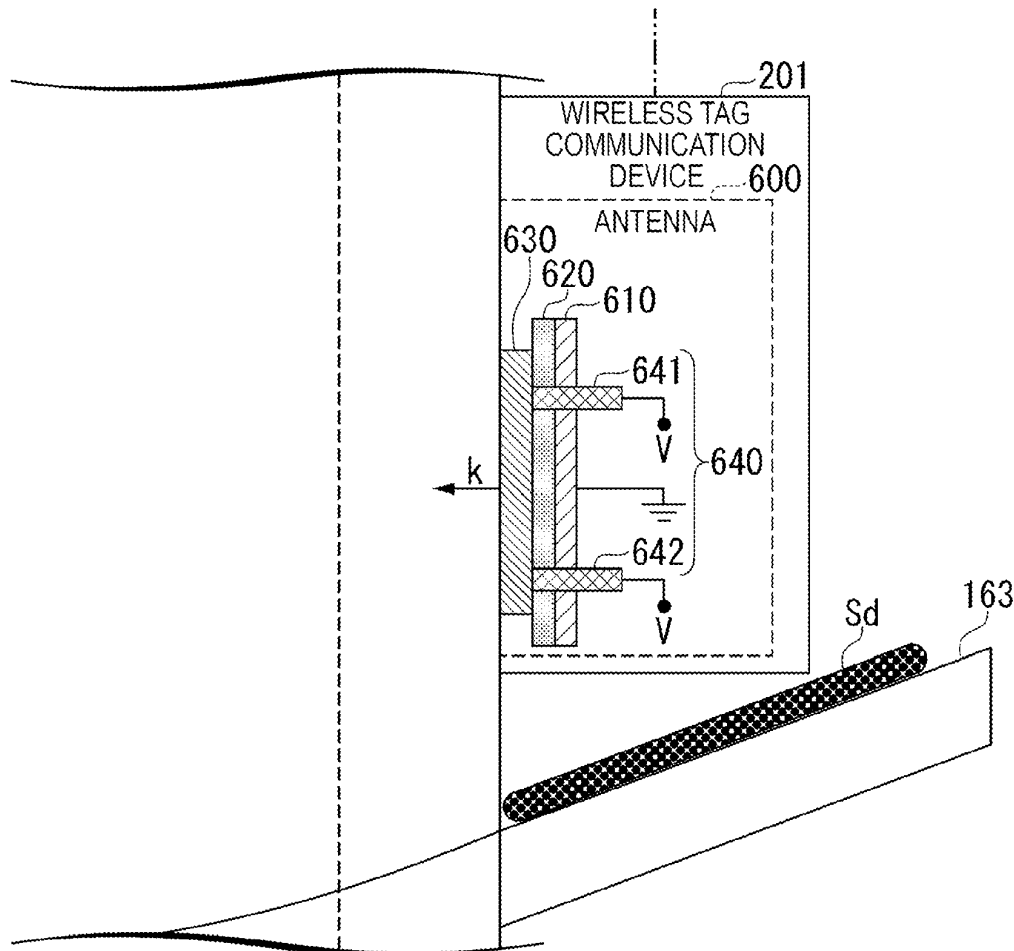
(52) **U.S. Cl.**

CPC **G06K 7/10435** (2013.01); **G06K 7/10366**
(2013.01); **G06K 19/07773** (2013.01); **G06K**
7/10356 (2013.01); **G06K 7/10316** (2013.01);
H04N 1/02472 (2013.01)

(57)

ABSTRACT

A wireless tag communication device for communicating with a wireless tag conveyed in a conveyance direction includes an antenna with a plurality of radiation regions from which a polarized radio wave is emitted and including a first radiation region extending along a first direction crossing the conveyance direction and having a first length in the first direction, and a second radiation region extending parallel to the first radiation region and having a second length that is different from the first length in the first direction, and a controller configured to cause at least one of the first and second radiation regions to emit a polarized wave towards the wireless tag.





US 20230299466A1

(19) **United States**(12) **Patent Application Publication**
AN et al.(10) **Pub. No.: US 2023/0299466 A1**(43) **Pub. Date: Sep. 21, 2023**(54) **ELECTRONIC DEVICE COMPRISING
ANTENNA**(71) Applicant: **Samsung Electronics Co., Ltd.,**
Suwon-si (KR)(72) Inventors: **Chankyu AN**, Suwon-si (KR);
Sungkoo PARK, Suwon-si (KR);
Himchan YUN, Suwon-si (KR);
Nakchung CHOI, Suwon-si (KR);
Soonho HWANG, Suwon-si (KR);
Jaebong CHUN, Suwon-si (KR)(21) Appl. No.: **18/322,080**(22) Filed: **May 23, 2023****Related U.S. Application Data**(63) Continuation of application No. PCT/KR2021/
015571, filed on Nov. 1, 2021.(30) **Foreign Application Priority Data**

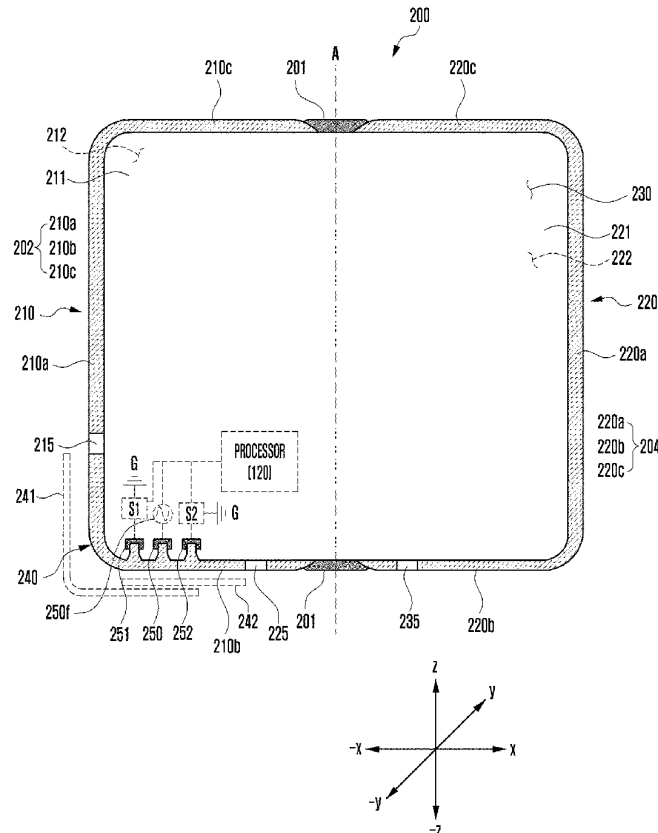
Dec. 2, 2020 (KR) 10-2020-0166365

Publication Classification(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 9/04 (2006.01)**H01Q 1/48** (2006.01)**H05K 5/02** (2006.01)**H03H 11/28** (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/243** (2013.01); **H01Q 9/0414**
(2013.01); **H01Q 1/48** (2013.01); **H05K**
5/0226 (2013.01); **H03H 11/28** (2013.01)

(57)

ABSTRACT

A foldable electronic device comprising an antenna is provided. The foldable electronic device includes a processor, hinge module, a first housing and a second housing each having at least a portion thereof coupled to either side of the hinge module and adapted to rotate about the hinge module to form an unfolded state or a folded state, and a flexible display disposed in a space formed by the first housing and the second housing. The first housing comprises a first lateral member, the first lateral member comprising a first side surface disposed in parallel to a folding axis of the hinge module, a second side surface extending from one end of the first side surface in a direction perpendicular to the folding axis, and a third side surface extending in the direction perpendicular to the folding axis from another end of the first side surface. The second housing comprises a second lateral member, the second lateral member comprising a fourth side surface disposed in parallel to the folding axis, and a fifth side surface extending in the direction perpendicular to the folding axis from one end of the fourth side surface.





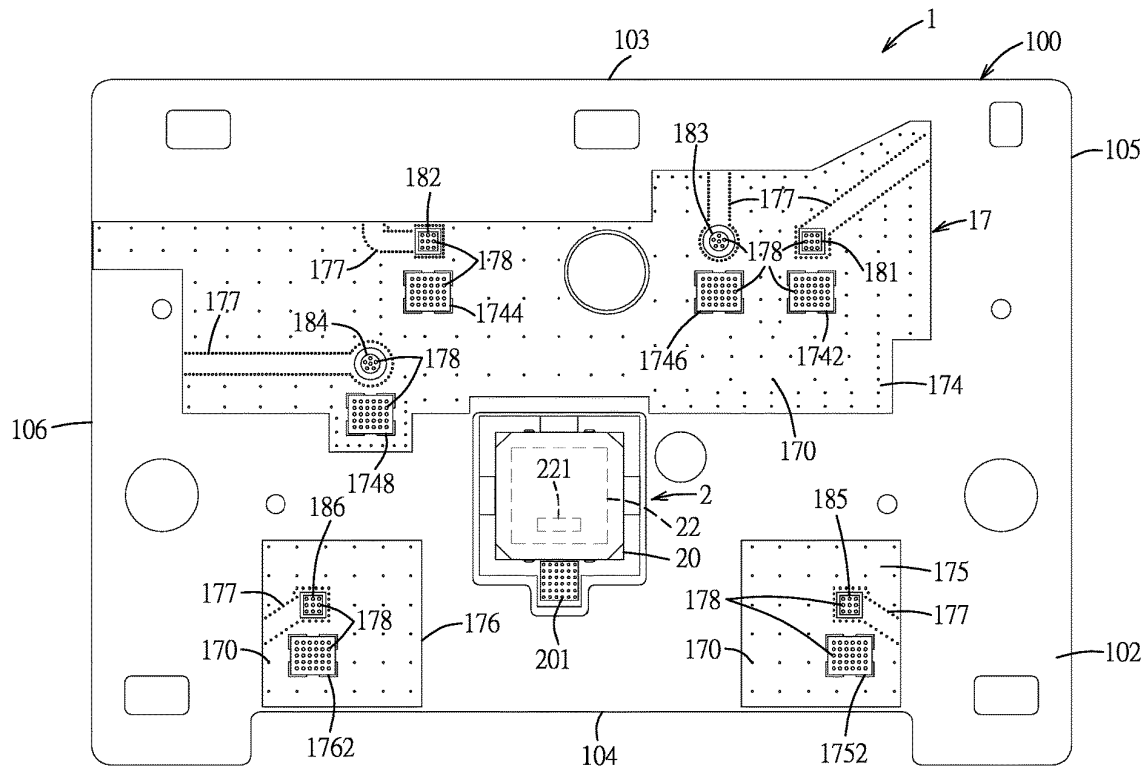
US 20230299482A1

(19) **United States**(12) **Patent Application Publication**
Liu et al.(10) **Pub. No.: US 2023/0299482 A1**(43) **Pub. Date: Sep. 21, 2023**(54) **ANTENNA DEVICE**(71) Applicant: **Molex, LLC**, Lisle, IL (US)(72) Inventors: **Hai Liu**, Shanghai (CN); **Guang-Yong Zhong**, Shanghai (CN); **Ping Zhang**, Shanghai (CN); **Chun-Xia Zhang**, Shanghai (CN); **Kang Cheng**, Shanghai (CN)(21) Appl. No.: **18/116,858**(22) Filed: **Mar. 3, 2023**(30) **Foreign Application Priority Data**

Mar. 16, 2022 (CN) 202210259312.9

Publication Classification(51) **Int. Cl.**
H01Q 5/20 (2006.01)
H01Q 1/48 (2006.01)
H01Q 9/30 (2006.01)(52) **U.S. Cl.**CPC **H01Q 5/20** (2015.01); **H01Q 1/48** (2013.01); **H01Q 9/30** (2013.01)(57) **ABSTRACT**

An antenna device includes: a dielectric substrate; a first grounding face, a second grounding face and a third grounding face which are provided on a first face of the dielectric substrate and are isolated from each other; a first primary antenna and a first auxiliary antenna which are provided on the first face, cooperatively act with the first grounding face to operate at a first frequency range and are isolated from each other; a second primary antenna and a second auxiliary antenna which cooperatively act with the first grounding face to operate at a second frequency range and are isolated from each other; a third primary antenna which cooperatively acts with the second grounding face to operate at a third frequency range; and a third auxiliary antenna which cooperatively acts with the third grounding face to operate at the third frequency range.





US 20230299487A1

(19) **United States**

(12) **Patent Application Publication**
HWANG

(10) **Pub. No.: US 2023/0299487 A1**

(43) **Pub. Date: Sep. 21, 2023**

(54) **LIGHTWEIGHT PATCH ANTENNA**

Publication Classification

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

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

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

(52) **U.S. Cl.**
CPC **H01Q 9/0414** (2013.01); **H01Q 21/065** (2013.01)

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

(21) Appl. No.: **18/013,881**

(22) PCT Filed: **Jun. 21, 2021**

(86) PCT No.: **PCT/KR2021/007749**

§ 371 (c)(1),

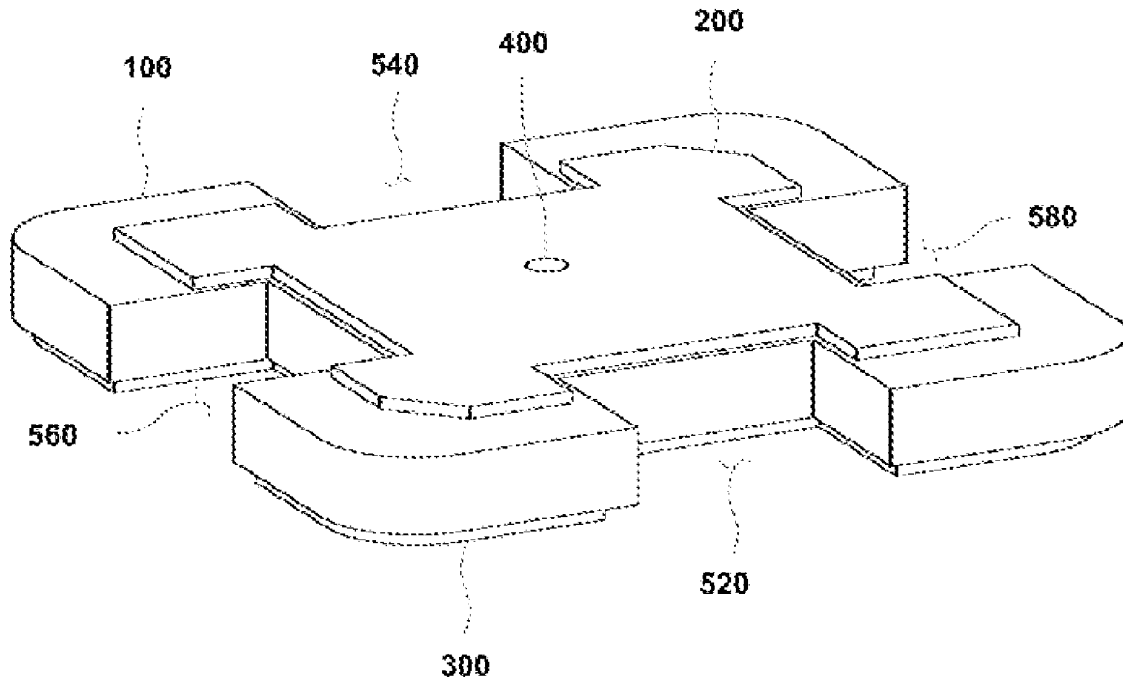
(2) Date: **Dec. 29, 2022**

(57) **ABSTRACT**

Disclosed is a lightweight patch antenna having grooves formed in a dielectric, an upper patch, and a lower patch so as to maintain antenna performance while being lightweight. The disclosed lightweight patch antenna comprises: a dielectric; an upper patch layered on the dielectric; a lower patch layered under the dielectric; and a plurality of lightweight grooves formed by removing a portion of a stack from the outside of the stack in which the dielectric, the upper patch, and the lower patch are stacked.

(30) **Foreign Application Priority Data**

Jun. 30, 2020 (KR) 10-2020-0080000





US 20230299496A1

(19) **United States**

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

(10) **Pub. No.: US 2023/0299496 A1**

(43) **Pub. Date: Sep. 21, 2023**

(54) **ANTENNA DEVICE**

Publication Classification

(71) Applicant: **DONGWOO FINE-CHEM CO., LTD.**, Jeollabuk-do (KR)

(51) **Int. Cl.**
H01Q 15/16 (2006.01)
H01Q 1/22 (2006.01)
H01Q 1/42 (2006.01)

(72) Inventors: **Young Ju KIM**, Gyeonggi-do (KR);
Sung Hoe KIM, Seoul (KR); **Hee Jun PARK**, Gyeonggi-do (KR); **Young Sub SON**, Seoul (KR)

(52) **U.S. Cl.**
CPC **H01Q 15/168** (2013.01); **H01Q 1/2283** (2013.01); **H01Q 1/422** (2013.01)

(21) Appl. No.: **18/118,868**

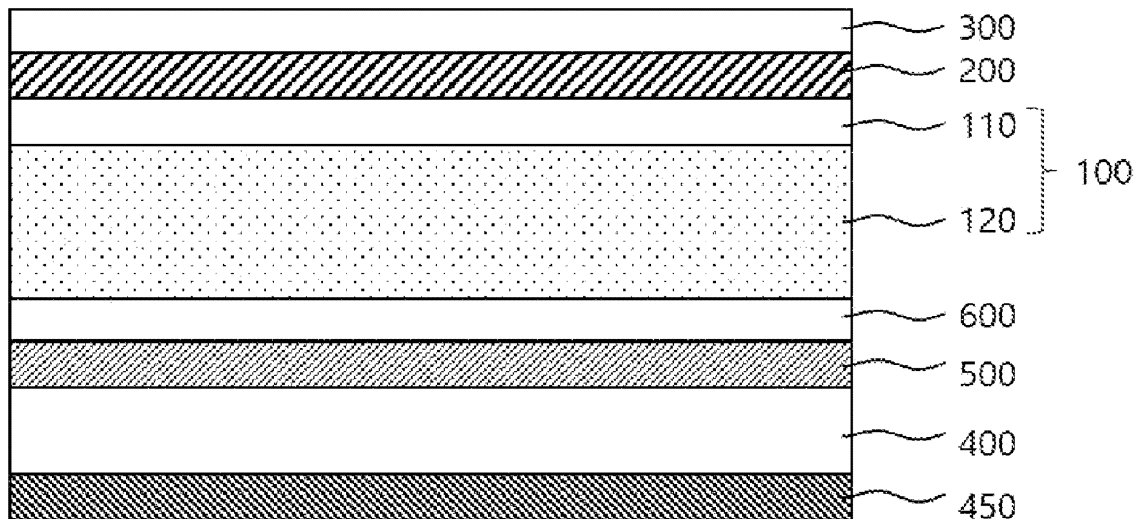
(22) Filed: **Mar. 8, 2023**

(30) **Foreign Application Priority Data**

Mar. 15, 2022 (KR) 10-2022-0031973

(57) **ABSTRACT**

An antenna device according to an embodiments of the present invention includes a substrate layer, a ground layer disposed on a bottom surface of the substrate layer, a radiation control layer disposed on a top surface of the substrate layer, the radiation control layer including a plurality of radiation control patterns formed of a conductive mesh structure, each of the radiation control patterns having a hollow portion, an antenna dielectric layer disposed on the radiation control layer, and an antenna unit disposed on the antenna dielectric layer.





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(19) **United States**

(12) **Patent Application Publication**
CHEN

(10) **Pub. No.: US 2023/0305605 A1**

(43) **Pub. Date: Sep. 28, 2023**

(54) **ELECTRONIC DEVICE**

Publication Classification

(71) Applicant: **Advanced Semiconductor Engineering, Inc.**, Kaohsiung (TW)

(51) **Int. Cl.**
G06F 1/16 (2006.01)

(72) Inventor: **Yi CHEN**, Kaohsiung (TW)

(52) **U.S. Cl.**
CPC **G06F 1/1698** (2013.01); **G06F 1/1681** (2013.01)

(73) Assignee: **Advanced Semiconductor Engineering, Inc.**, Kaohsiung (TW)

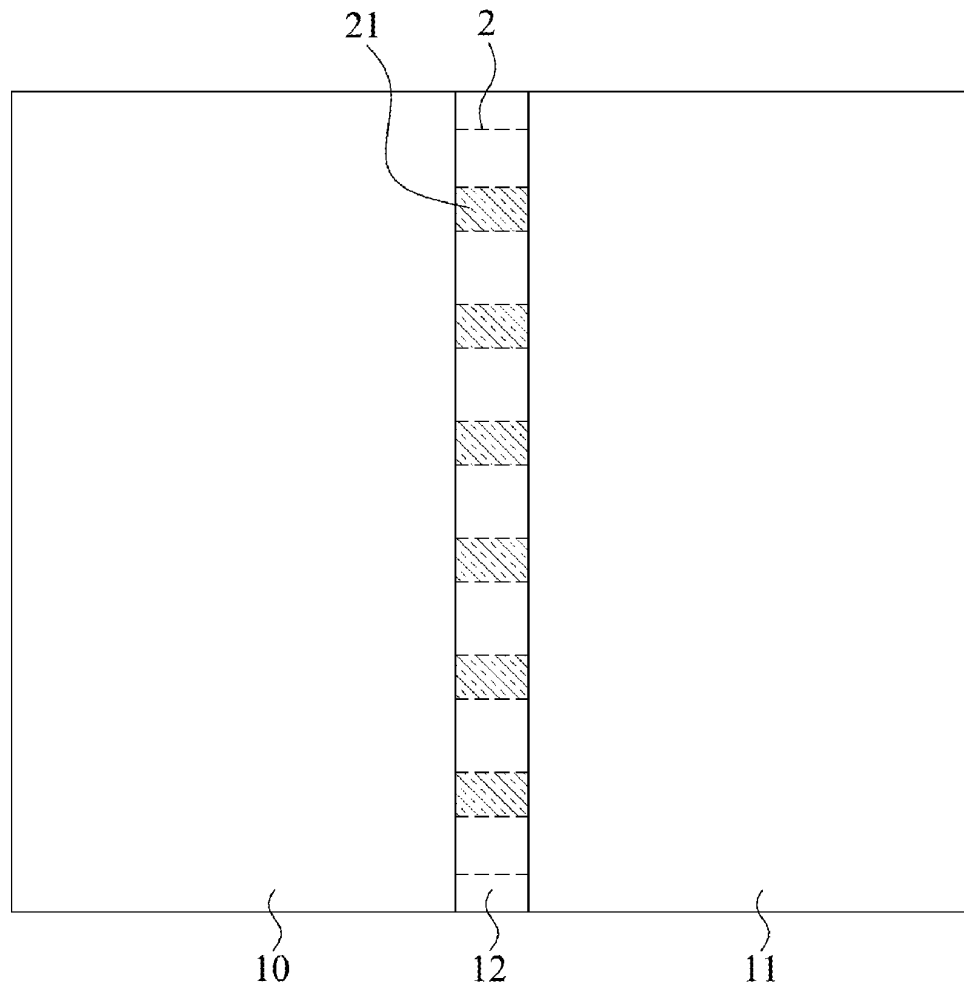
(57) **ABSTRACT**

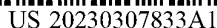
An electronic device is disclosed. The electronic device includes a first part, a second part adjacent to the first part and a rotational shaft. The rotational shaft includes an antenna and configured to allow the first part and the second part to rotate about a rotation axis defined by the rotational shaft.

(21) Appl. No.: **17/703,834**

(22) Filed: **Mar. 24, 2022**

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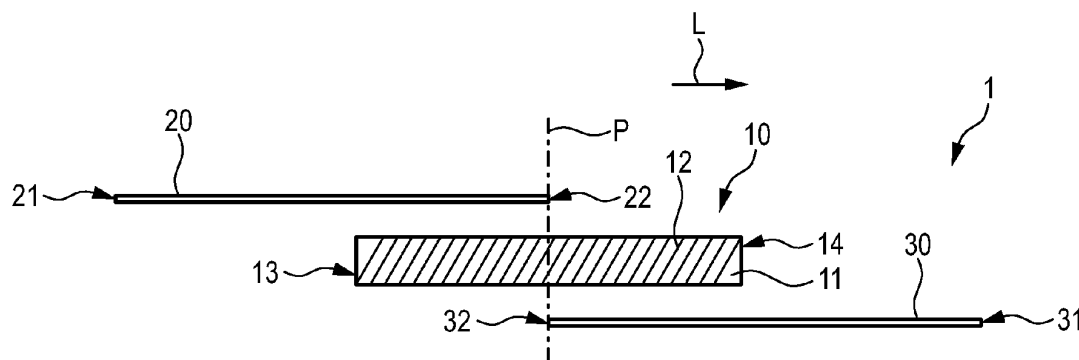


(43) **Pub. Date:** Sep. 28, 2023

Publication Classification

(30) **Foreign Application Priority Data**

Aug. 7, 2020 (EP) 20189988.7





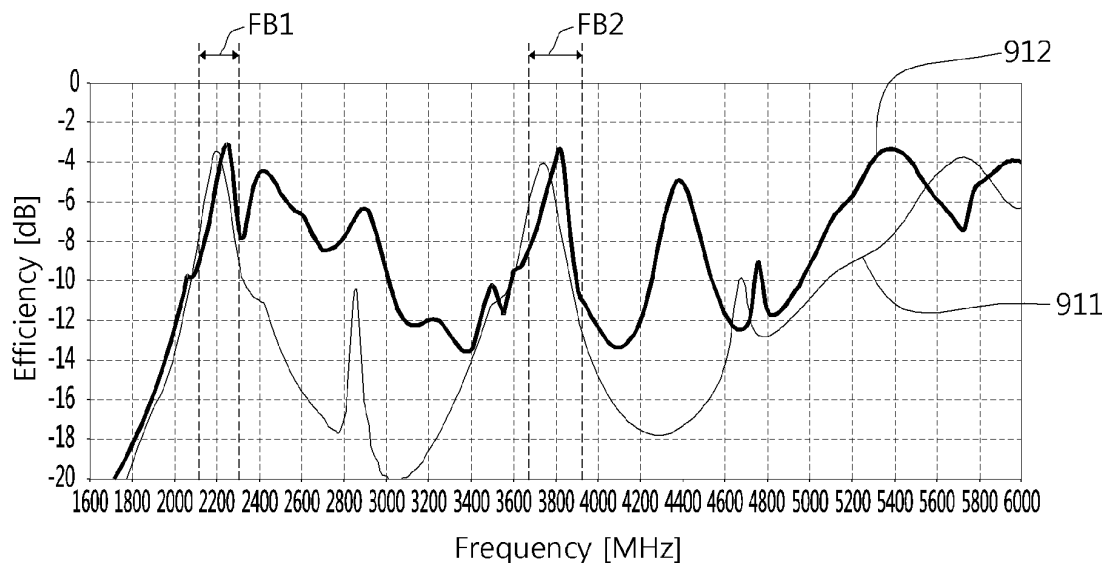
US 20230318168A1

(19) **United States**(12) **Patent Application Publication**

AN et al.

(10) **Pub. No.: US 2023/0318168 A1**(43) **Pub. Date: Oct. 5, 2023**(54) **ELECTRONIC DEVICE INCLUDING
SLIDING STRUCTURE, FLEXIBLE DISPLAY,
AND ANTENNA****Publication Classification**(71) Applicant: **SAMSUNG ELECTRONICS CO.,
LTD.**, Suwon-si (KR)(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H04B 1/00 (2006.01)
H04M 1/02 (2006.01)(72) Inventors: **Seongyong AN**, Suwon-si (KR); **Jiho
KIM**, Suwon-si (KR); **Kyihyun JANG**,
Suwon-si (KR); **Yoonjae LEE**, Suwon-si
(KR); **Jaebong CHUN**, Suwon-si (KR);
Sangmin HAN, Suwon-si (KR)(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H04B 1/0053*
(2013.01); *H04M 1/0268* (2013.01);
H04M 1/0274 (2013.01)(21) Appl. No.: **18/205,482**(22) Filed: **Jun. 2, 2023****Related U.S. Application Data**(63) Continuation of application No. PCT/KR2021/
018268, filed on Dec. 3, 2021.(30) **Foreign Application Priority Data**Dec. 4, 2020 (KR) 10-2020-0168918
Feb. 3, 2021 (KR) 10-2021-0015506**ABSTRACT**

An electronic device including a housing including a first housing and a second housing that can slide with respect to the first housing, a flexible display arranged to be supported by the housing, the flexible display including a first area exposed to the outside of the electronic device and a second area, which extends from the first area and is withdrawn from the housing and is drawn into the housing according to the sliding of the second housing, a cavity structure positioned in the second housing and a wireless communication circuit configured to transmit and/or receive a signal of a selected or designated frequency band through the cavity structure.





US 20230318172A1

(19) **United States**(12) **Patent Application Publication**
Liu et al.(10) **Pub. No.: US 2023/0318172 A1**(43) **Pub. Date: Oct. 5, 2023**(54) **ANTENNA APPARATUS AND ELECTRONIC
DEVICE**(71) Applicant: **Huawei Technologies Co., Ltd.**,
Shenzhen (CN)(72) Inventors: **Kexin Liu**, Shanghai (CN); **Dong Yu**,
Shanghai (CN); **Pengfei Wu**, Shanghai
(CN); **Hanyang Wang**, Reading (GB)(21) Appl. No.: **18/007,899**(22) PCT Filed: **Mar. 30, 2021**(86) PCT No.: **PCT/CN2021/084156**

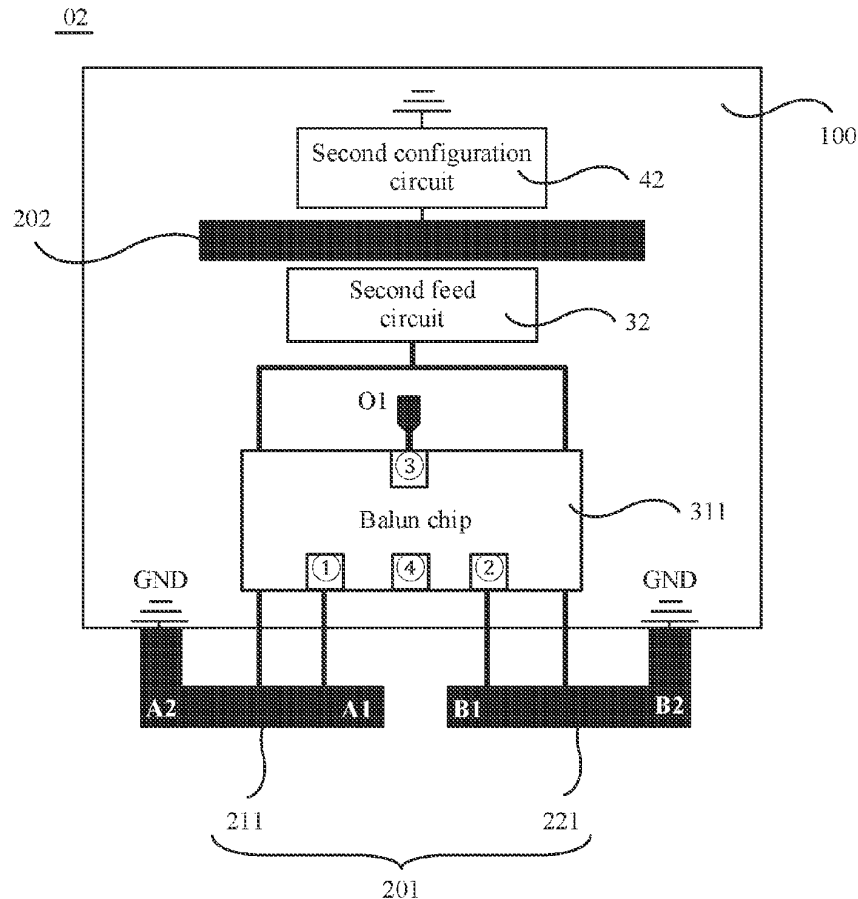
§ 371 (c)(1),

(2) Date: **Dec. 2, 2022**(30) **Foreign Application Priority Data**

Jun. 3, 2020 (CN) 202010495093.5

Publication Classification(51) **Int. Cl.****H01Q 1/52** (2006.01)**H01Q 5/28** (2006.01)**H01Q 5/328** (2006.01)**H01Q 5/335** (2006.01)**H01Q 5/378** (2006.01)**H01Q 5/50** (2006.01)**H01Q 9/42** (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/521** (2013.01); **H01Q 5/28**
(2015.01); **H01Q 5/328** (2015.01); **H01Q**
5/335 (2015.01); **H01Q 5/378** (2015.01);
H01Q 5/50 (2015.01); **H01Q 9/42** (2013.01)(57) **ABSTRACT**

An antenna apparatus includes a circuit board and an antenna body. The antenna body includes a first radiator and a second radiator that are indirectly coupled. The first radiator comprises a first stub and a second stub that are opposite to, but do not touch each other to form a first gap, the first stub and the second stub are located on a first side edge of the circuit board, a second gap is configured between the first stub and the first side edge, and also between the second stub and the first side edge. The second radiator is located on the circuit board to form a third gap in-between. A vertical projection of the second radiator is located on the first surface. The first stub and the second stub are electrically connected to reference ground of the circuit board separately.





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(19) **United States**

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

(10) **Pub. No.: US 2023/0318180 A1**

(43) **Pub. Date: Oct. 5, 2023**

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

Publication Classification

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

(51) **Int. Cl.**
H01Q 5/385 (2006.01)
H01Q 5/15 (2006.01)
H01Q 1/27 (2006.01)

(72) Inventors: **Yao Lan**, Dongguan (CN); **Hanyang Wang**, Reading (GB); **Zhongying Long**, Dongguan (CN)

(52) **U.S. Cl.**
CPC **H01Q 5/385** (2015.01); **H01Q 5/15** (2015.01); **H01Q 1/273** (2013.01)

(21) Appl. No.: **18/043,213**

(57) **ABSTRACT**

(22) PCT Filed: **Jul. 21, 2021**

(86) PCT No.: **PCT/CN2021/107650**

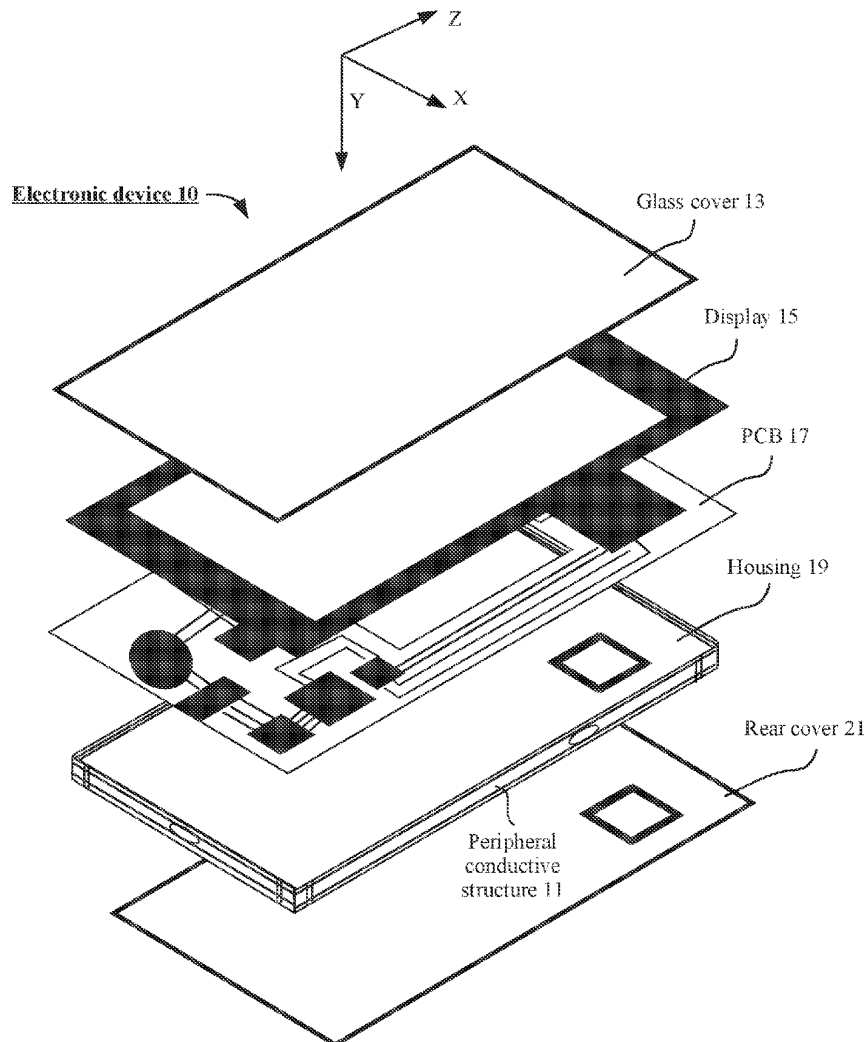
§ 371 (c)(1),

(2) Date: **Feb. 27, 2023**

(30) **Foreign Application Priority Data**

Aug. 28, 2020 (CN) 202010882369.5

An antenna structure includes a first radiator, a first feed unit, and a second feed unit. The first radiator includes a first feed point and a second feed point. The first feed unit feeds the antenna structure at the first feed point, and the second feed unit feeds the antenna structure at the second feed point. The first feed point is disposed in a central region. The second feed point is disposed between the central region and an end of the first radiator.





US 20230318185A1

(19) **United States**(12) **Patent Application Publication**
WANG et al.(10) **Pub. No.: US 2023/0318185 A1**(43) **Pub. Date: Oct. 5, 2023**(54) **ANTENNA STRUCTURE AND ELECTRONIC
DEVICE***H01Q 1/50* (2006.01)*H01Q 1/22* (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 9/0421* (2013.01); *H01Q 1/48*
(2013.01); *H01Q 1/50* (2013.01); *H01Q 1/22*
(2013.01)(72) Inventors: **Yali WANG**, Beijing (CN); **Feng QU**,
Beijing (CN); **Biqi LI**, Beijing (CN)

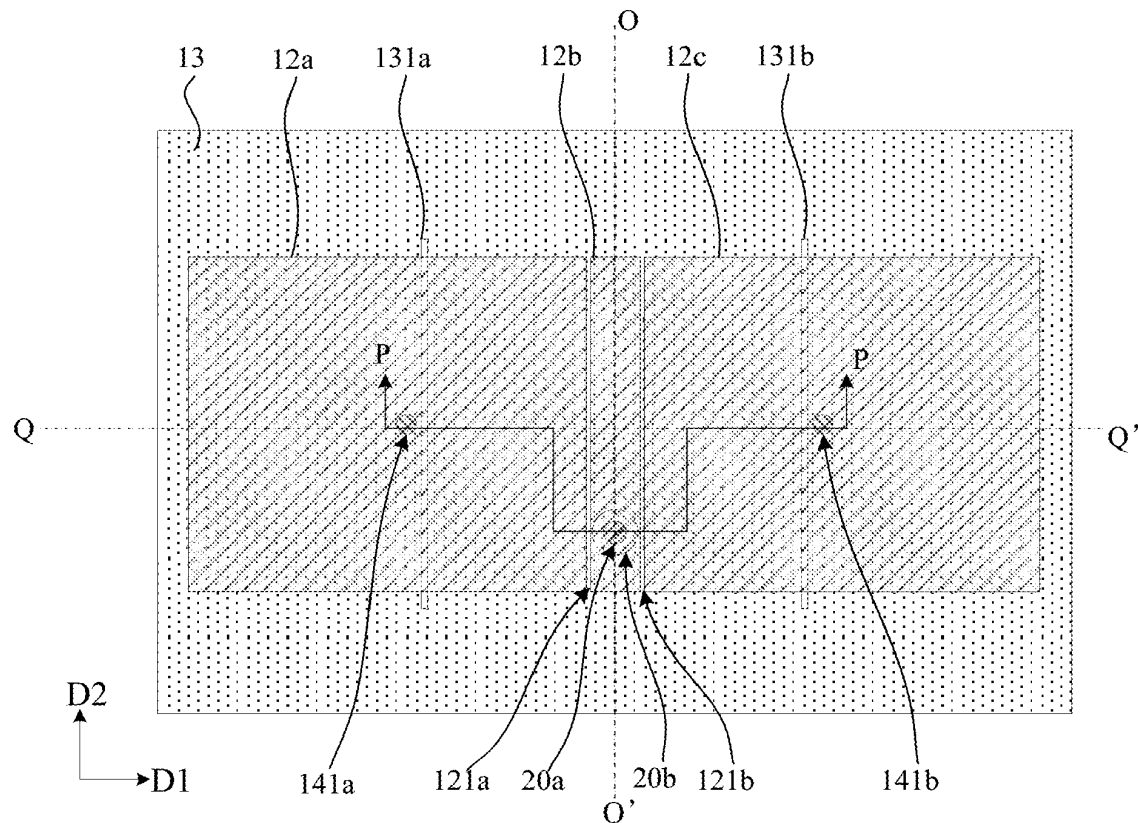
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ABSTRACT(21) Appl. No.: **17/629,417**(22) PCT Filed: **Apr. 12, 2021**(86) PCT No.: **PCT/CN2021/086406**

§ 371 (c)(1),

(2) Date: **Jan. 24, 2022****Publication Classification**(51) **Int. Cl.***H01Q 9/04* (2006.01)*H01Q 1/48* (2006.01)

An antenna structure includes a dielectric substrate, a ground layer and a radiation layer located at two opposite sides of the dielectric substrate. The ground layer has two first gaps which are symmetrical about a central axis of the antenna structure in a first direction to introduce a radiation zero. The radiation layer has two second gaps which are symmetrical about the central axis, edges of the two second gaps are aligned with edges of the radiation layer in a second direction to introduce another radiation zero. The second direction is perpendicular to the first direction.





US 20230327323A1

(19) **United States**

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

(10) **Pub. No.: US 2023/0327323 A1**

(43) **Pub. Date: Oct. 12, 2023**

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

Publication Classification

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

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H04N 23/57 (2006.01)
H01Q 5/314 (2006.01)

(72) Inventors: **Jongmin KIM**, Suwon-si (KR); **Sangho HONG**, Suwon-si (KR); **Hyoseok NA**, Suwon-si (KR); **Gunhee PARK**, Suwon-si (KR); **Yongam SON**, Suwon-si (KR); **Jongkwan LEE**, Suwon-si (KR); **Hanyeop LEE**, Suwon-si (KR); **Taihwon CHOI**, Suwon-si (KR)

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H04N 23/57** (2023.01); **H01Q 5/314** (2015.01)

(21) Appl. No.: **18/210,975**

(22) Filed: **Jun. 16, 2023**

Related U.S. Application Data

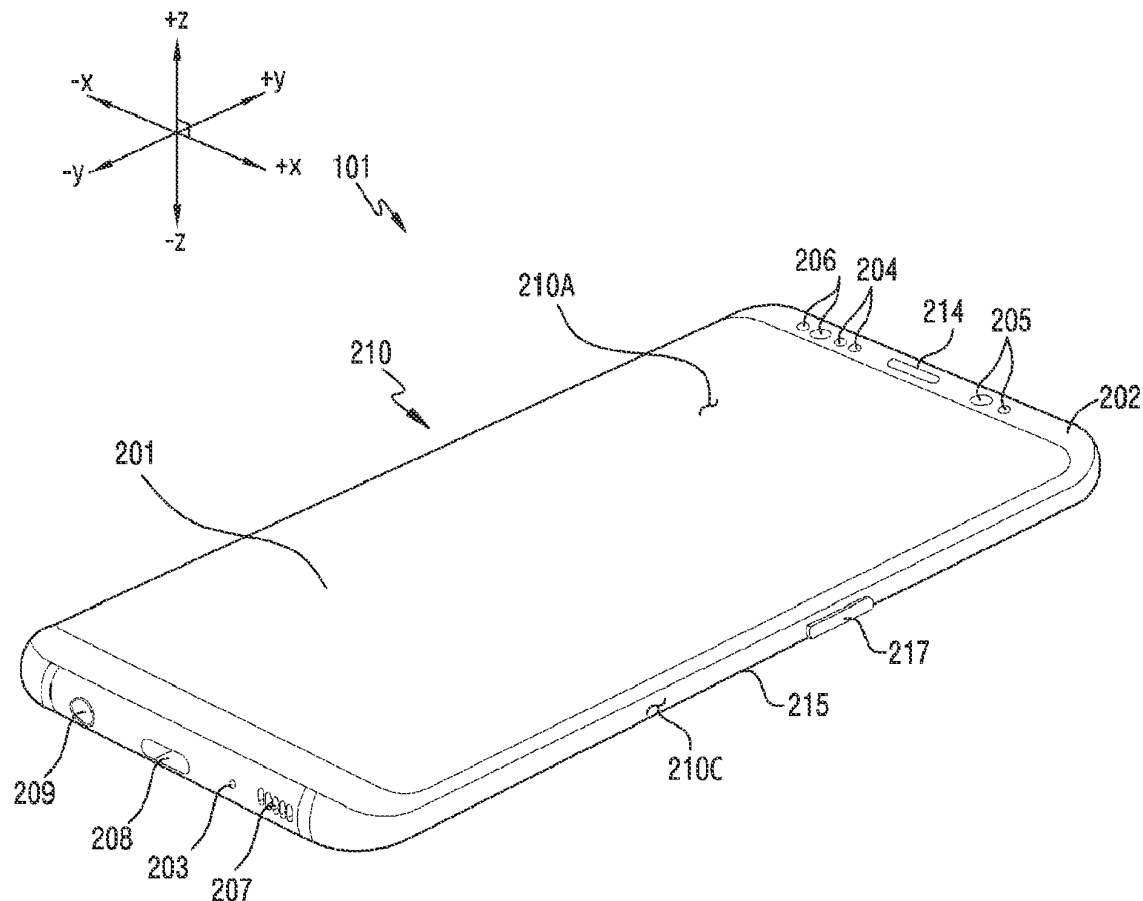
(63) Continuation of application No. PCT/KR2022/012734, filed on Aug. 25, 2022.

Foreign Application Priority Data

Sep. 28, 2021 (KR) 2021-0128308

(57) **ABSTRACT**

An electronic device according to an embodiment may include a camera module, a metal structure, a first antenna adjacent to the camera module, a second antenna spaced from the camera module, a switching module electrically connected to the metal structure, including at least one lumped element, and adjusting an impedance by using the at least one lumped element, and at least one processor. The at least one processor is configured to transmit a signal in a first frequency band by feeding the first antenna and control the switching module such that the switching module has a first impedance corresponding to the first frequency band and electrically connects the metal structure and the ground when the transmission power of the first antenna is equal to or more than the designated value.





US 20230327337A1

(19) **United States**
(12) **Patent Application Publication** (10) **Pub. No.: US 2023/0327337 A1**
KIM et al. (43) **Pub. Date: Oct. 12, 2023**

(54) **ELECTRONIC APPARATUS COMPRISING ANTENNA**

Publication Classification

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

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

(72) Inventors: **Sungsoo KIM**, Suwon-si (KR); **Seyoon BAE**, Suwon-si (KR); **Byoungryoul SONG**, Suwon-si (KR); **Seungbum CHOI**, Suwon-si (KR); **Wonjoon CHOI**, Suwon-si (KR); **Joon HEO**, Suwon-si (KR); **Seongjin PARK**, Suwon-si (KR); **Sumin YUN**, Suwon-si (KR); **Jaehoon JO**, Suwon-si (KR); **Woosung CHUN**, Suwon-si (KR)

(52) **U.S. Cl.**
CPC *H01Q 9/0407* (2013.01); *H01Q 1/241* (2013.01); *H01Q 21/065* (2013.01)

(57) **ABSTRACT**

An electronic apparatus having a housing, a flexible display, and a key button which is arranged in a first area on a side of a first part is provided. The key button includes at least one protrusion extending toward the inside of the first part and an antenna structure arranged on the inside of the first part with respect to the first area. The housing includes the first part, a second part, and a connection part arranged between the first part and the second part, the second part being rotatably coupled to the first part through the connection part. The antenna structure includes a dome switch arranged above a substrate at a position corresponding to the at least one protrusion, and a plurality of conductive patches provided on a conductive layer of the substrate. The dome switch may be arranged at the corresponding position between the plurality of conductive patches.

(21) Appl. No.: **18/201,382**

(22) Filed: **May 24, 2023**

Related U.S. Application Data

(63) Continuation of application No. PCT/KR2021/016182, filed on Nov. 9, 2021.

(30) **Foreign Application Priority Data**

Nov. 24, 2020 (KR) 10-2020-0159059

