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 (12) **Patent Application Publication** (10) **Pub. No.: US 2023/0268639 A1**
PARK et al. (43) **Pub. Date: Aug. 24, 2023**

(54) **ELECTRONIC DEVICE COMPRISING ANTENNA**

Publication Classification

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

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)
H01Q 5/30 (2006.01)

(72) Inventors: **Jeongwan PARK**, Suwon-si (KR); **Gyubok PARK**, Suwon-si (KR); **Min SAKONG**, Suwon-si (KR); **Moonsoo SON**, Suwon-si (KR); **Kwanseok LEE**, Suwon-si (KR); **Injin HWANG**, Suwon-si (KR)

(52) **U.S. Cl.**
 CPC *H01Q 1/243* (2013.01); *H01Q 1/48* (2013.01); *H01Q 5/30* (2015.01)

(57) **ABSTRACT**

An electronic device according to an embodiment may include an antenna radiator, a conductive member, a wireless communication circuit configured to feed power to a first point of the conductive member and a second point spaced apart from the first point, and a ground electrically connected to a third point between the first point and the second point of the conductive member, at least a portion of one region of the conductive member including the third point may overlap the antenna radiator, and the wireless communication circuit may be configured to transmit and/or receive a signal of a first frequency band based on a first electrical path formed by feeding power to the first point of the conductive member; and transmit and/or receive the signal of the first frequency band based on a second electrical path formed by feeding power to the second point of the conductive member.

(21) Appl. No.: **18/141,146**

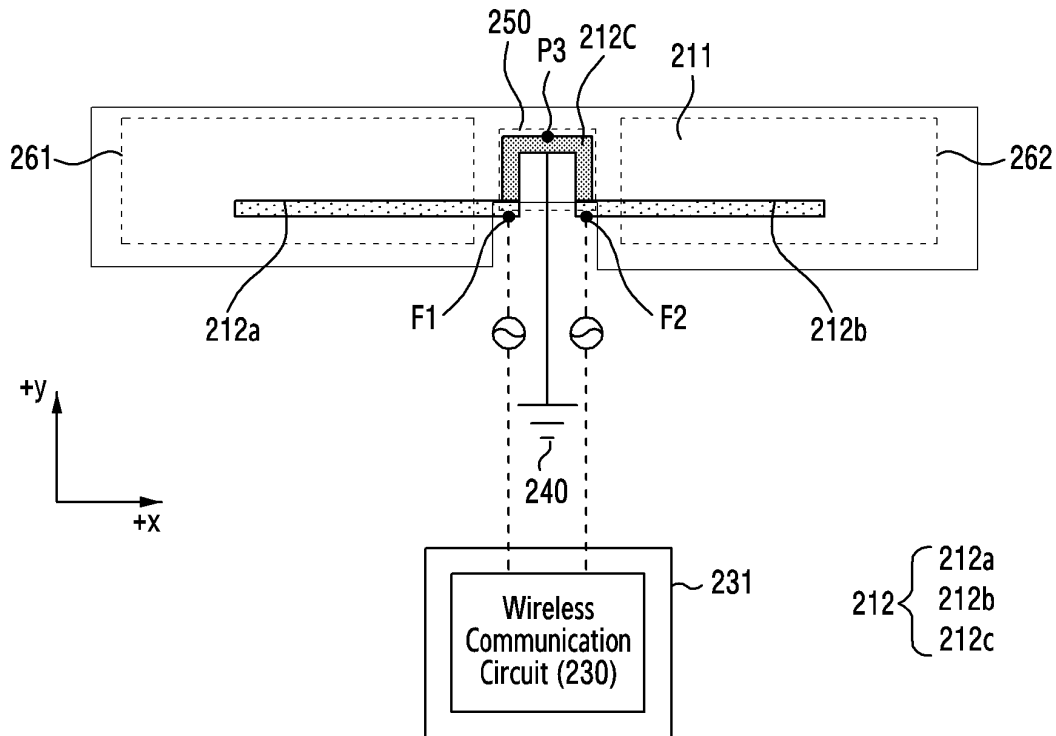
(22) Filed: **Apr. 28, 2023**

Related U.S. Application Data

(63) Continuation of application No. PCT/KR2022/012916, filed on Aug. 30, 2022.

Foreign Application Priority Data

(30) Sep. 6, 2021 (KR) 10-2021-0118384





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(19) **United States**

(12) **Patent Application Publication**
YANG

(10) **Pub. No.: US 2023/0268658 A1**

(43) **Pub. Date: Aug. 24, 2023**

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

H01Q 1/24 (2006.01)

H01Q 21/00 (2006.01)

H01Q 1/50 (2006.01)

(71) Applicant: **ZTE CORPORATION**, Shenzhen, Guangdong (CN)

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

CPC *H01Q 13/106* (2013.01); *H01Q 1/48* (2013.01); *H01Q 1/243* (2013.01); *H01Q 21/00* (2013.01); *H01Q 1/50* (2013.01)

(72) Inventor: **Shirong YANG**, Shenzhen, Guangdong (CN)

(21) Appl. No.: **18/012,918**

(57) **ABSTRACT**

(22) PCT Filed: **Jun. 25, 2021**

(86) PCT No.: **PCT/CN2021/102356**

§ 371 (c)(1),

(2) Date: **Dec. 24, 2022**

(30) **Foreign Application Priority Data**

Jun. 30, 2020 (CN) 202010630513.6

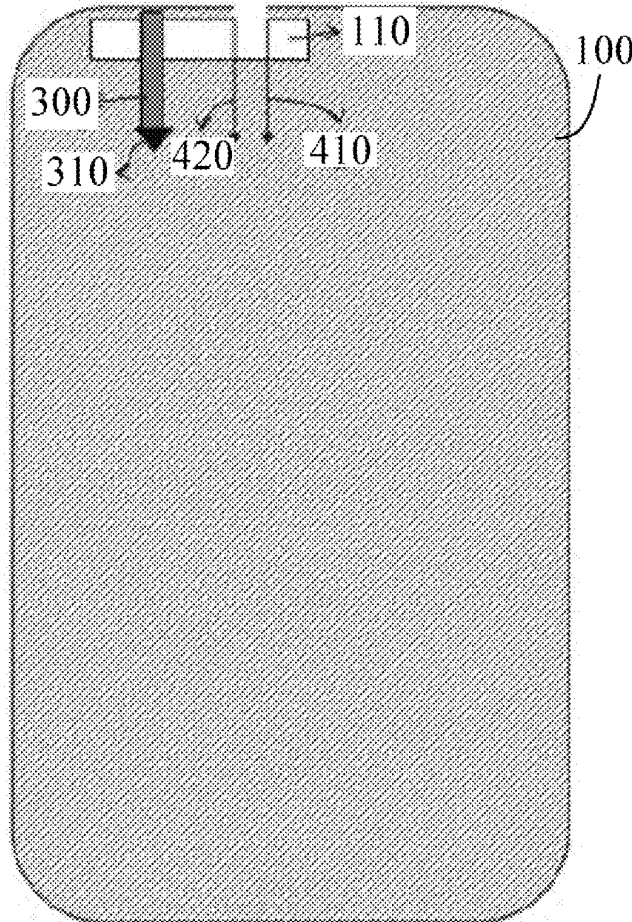
Publication Classification

(51) **Int. Cl.**

H01Q 13/10 (2006.01)

H01Q 1/48 (2006.01)

An antenna assembly and a terminal device are provided. The antenna assembly includes a circuit board, and at least one antenna structure arranged on the circuit board; the circuit board includes a conductive ground plate, and at least one emission slit hole penetrating through the conductive ground plate along a direction in which a thickness of the conductive ground plate extends is formed in the conductive ground plate; and any one of the at least one antenna structure includes a feed branch and a feed part; a position of the feed branch is matched with one of the at least one emission slit hole, and the feed branch is configured to excite the emission slit hole to generate slot antenna radiation; and the feed part is arranged at an edge of the emission slit hole, and is configured to drive the emission slit hole to generate loop antenna radiation.





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

(10) **Pub. No.: US 2023/0268669 A1**

(43) **Pub. Date: Aug. 24, 2023**

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

H01Q 9/40 (2006.01)

H01Q 3/36 (2006.01)

H01Q 9/28 (2006.01)

H01Q 13/10 (2006.01)

H01Q 1/24 (2006.01)

H04M 1/02 (2006.01)

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

(72) Inventors: **Byeongyong PARK**, Seoul (KR); **Ilnam CHO**, Seoul (KR); **Kangjae JUNG**, Seoul (KR); **Kukheon CHOI**, Seoul (KR); **Uisheon KIM**, Seoul (KR)

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

CPC *H01Q 21/24* (2013.01); *H01Q 19/10*

(2013.01); *H01Q 9/40* (2013.01); *H01Q 3/36*

(2013.01); *H01Q 9/28* (2013.01); *H01Q 13/10*

(2013.01); *H01Q 1/243* (2013.01); *H04M*

1/026 (2013.01)

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

(21) Appl. No.: **18/006,686**

(22) PCT Filed: **Jul. 27, 2020**

(86) PCT No.: **PCT/KR2020/009832**

§ 371 (c)(1),

(2) Date: **Jan. 24, 2023**

(57)

ABSTRACT

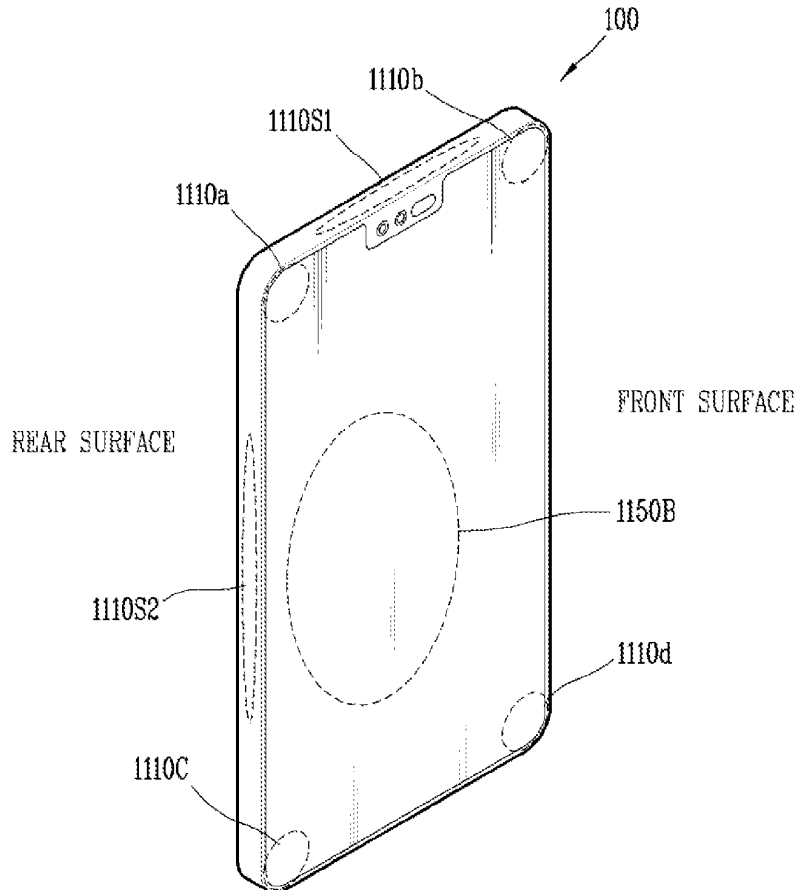
An electronic device having an antenna, according to one embodiment, is provided. The electronic device can include an antenna module which is disposed at the lower portion of a display region and which radiates a vertically polarized signal to the front surface of the electronic device. The antenna module can comprise: a slot array antenna disposed in a first region of a flexible substrate to radiate the vertically polarized signal in a millimeter-wave band; and a feeding portion disposed in a second region bent from the first region and in a third region bent from the second region, so as to apply a signal to each slot radiation element of the slot array antenna.

Publication Classification

(51) **Int. Cl.**

H01Q 21/24 (2006.01)

H01Q 19/10 (2006.01)





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(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2023/0269315 A1**

LEE et al.

(43) **Pub. Date: Aug. 24, 2023**

(54) **STRUCTURE HAVING ANTENNA MODULE APPLIED IN FOLDABLE ELECTRONIC DEVICE**

Publication Classification

(51) **Int. Cl.**
H04M 1/02 (2006.01)
H01Q 1/24 (2006.01)
H01Q 21/06 (2006.01)

(52) **U.S. Cl.**
 CPC *H04M 1/0216* (2013.01); *H01Q 1/243* (2013.01); *H01Q 21/065* (2013.01); *H04M 1/0268* (2013.01); *H04M 1/0262* (2013.01)

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

(72) Inventors: **Sangha LEE**, Suwon-si (KR); **Soonho HWANG**, Suwon-si (KR); **Seongjin PARK**, Suwon-si (KR); **Hyeonuk KANG**, Suwon-si (KR); **Youngjoon LIM**, Suwon-si (KR)

(21) Appl. No.: **18/310,096**

(22) Filed: **May 1, 2023**

Related U.S. Application Data

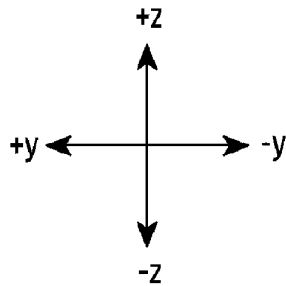
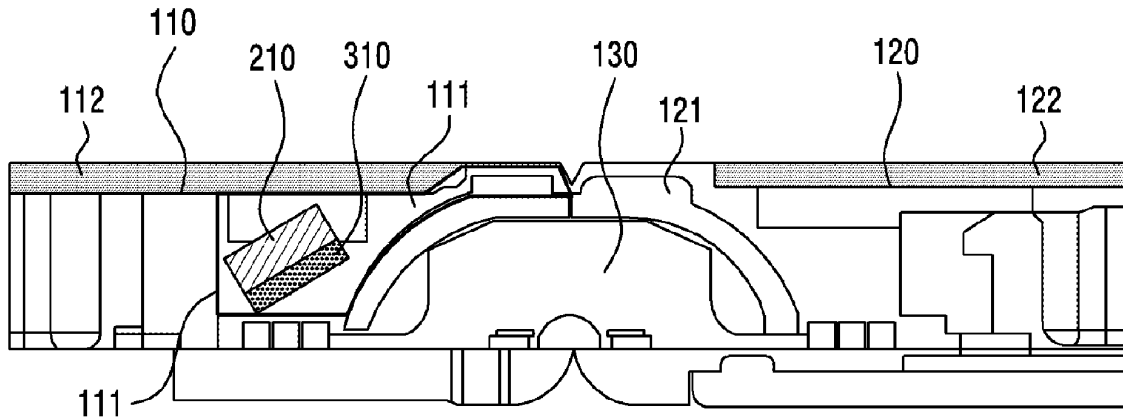
(63) Continuation of application No. PCT/KR2021/015332, filed on Oct. 28, 2021.

Foreign Application Priority Data

Oct. 30, 2020 (KR) 10-2020-0143765

(57) **ABSTRACT**

An electronic device may include: a first housing; a second housing coupled to the first housing through a hinge; an antenna module; and at least one processor electrically coupled to the antenna module, wherein the hinge is arranged about a first axis in an area having a first width in a third direction which is perpendicular to each of a first direction and to a second direction, which is perpendicular to the first direction and is faced by the rear side of the first housing, and the first housing has a first structure, and an arrangement portion is provided in the first structure, and the at least one processor may be configured to transmit and/or receive a signal having a frequency between 3 GHz and 100 GHz in the first direction or in a direction between the second direction and the third direction, by using the antenna module.





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(19) **United States**

(12) **Patent Application Publication**
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(10) **Pub. No.: US 2023/0275340 A1**

(43) **Pub. Date: Aug. 31, 2023**

(54) **ELECTRONIC DEVICE COMPRISING ANTENNA**

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

(72) Inventors: **Soonho HWANG**, Suwon-si (KR); **Kyungjae LEE**, Suwon-si (KR); **Kyungil SEO**, Suwon-si (KR); **Shinho YOON**, Suwon-si (KR); **Seunghwan KIM**, Suwon-si (KR)

(21) Appl. No.: **18/313,812**

(22) Filed: **May 8, 2023**

Related U.S. Application Data

(63) Continuation of application No. PCT/KR2022/011478, filed on Aug. 3, 2022.

Foreign Application Priority Data

Aug. 10, 2021 (KR) 10-2021-0105677
Dec. 16, 2021 (KR) 10-2021-0180895

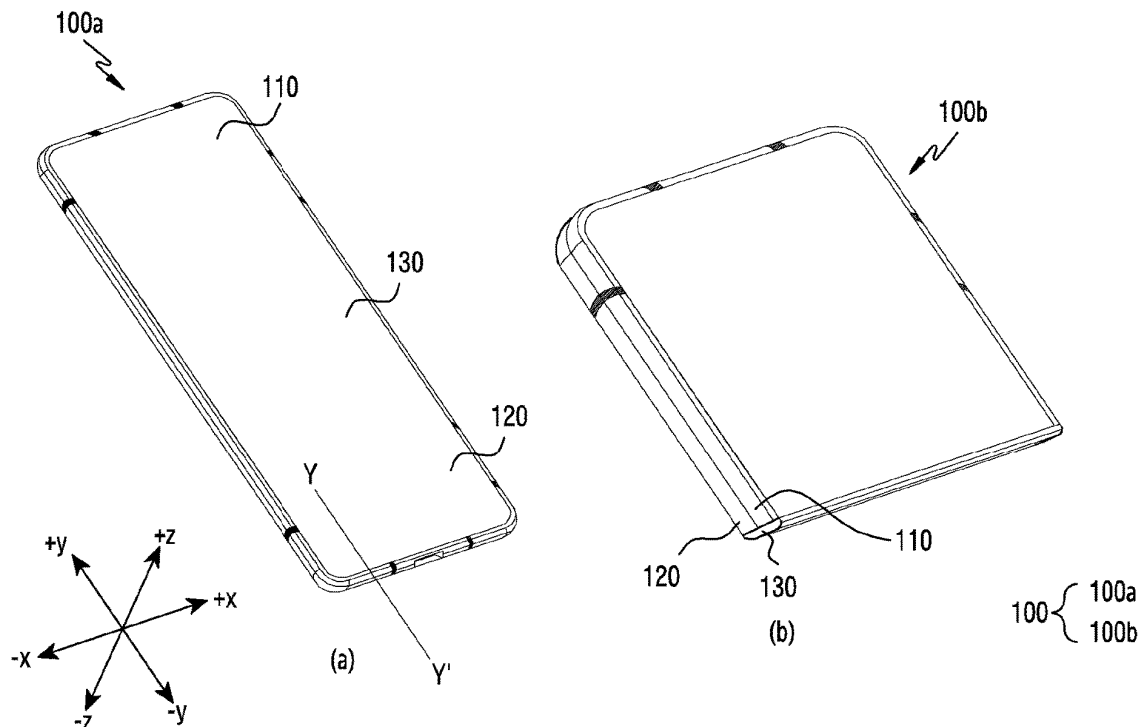
Publication Classification

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

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 9/0407** (2013.01); **H04B 1/3827** (2013.01)

(57) **ABSTRACT**

An electronic device according to an embodiment may include: a first housing including a first edge oriented in a first direction and a second edge oriented in a second direction perpendicular to the first direction; a second housing rotatably connected to the first housing, wherein the second housing includes a third edge corresponding to the first edge and a fourth edge corresponding to the second edge when the first housing and the second housing face each other; a flexible display defining a front surface of the electronic device and disposed over the first housing and the second housing; a dielectric material at least partially disposed between the flexible display and the fourth edge of the second housing and at least partially surrounding a perimeter of the flexible display; a conductive member comprising a conductive material located between the dielectric material and the flexible display; and a wireless communication circuit disposed within the first housing or the second housing, wherein the fourth edge may include a first conductive portion, a first non-conductive portion, a second conductive portion, a second non-conductive portion, and a third conductive portion, the conductive member may include a first split portion and a second split portion corresponding to the first non-conductive portion and the second non-conductive portion of the fourth edge of the second housing, respectively, and the wireless communication circuit may be configured to transmit and/or receive a radio signal using at least one of the first conductive portion, the second conductive portion, or the third conductive portion of the second housing.





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(19) **United States**

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Wang et al.

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(43) **Pub. Date: Sep. 7, 2023**

(54) **ELECTRONIC DEVICE**

H01Q 19/17 (2006.01)

H01Q 13/10 (2006.01)

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

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

CPC *H04M 1/026* (2013.01); *H01Q 1/22* (2013.01); *H01Q 19/17* (2013.01); *H01Q 13/10* (2013.01)

(72) Inventors: **Hanyang Wang**, Reading (GB); **Kexin Liu**, Shanghai (CN); **Dong Yu**, Shanghai (CN)

(21) Appl. No.: **18/008,385**

(57)

ABSTRACT

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

Electronic devices and antenna structures are described. An example electronic device includes an antenna structure, wherein the antenna structure includes: a first radiator and a second radiator, wherein the first radiator includes a first end and a second end, and the second radiator includes a first end and a second end. The first end of the first radiator and the first end of the second radiator face each other and are not in contact with each other, and a slot is formed between the first end of the first radiator and the first end of the second radiator. The first radiator and the second radiator are disposed in a bent manner, and a spatial region formed between the first radiator, the second radiator, and the slot is T-shaped; and the second end of the first radiator is grounded, and the second end of the second radiator is grounded.

(86) PCT No.: **PCT/CN2021/094633**

§ 371 (c)(1),

(2) Date: **Dec. 5, 2022**

(30) **Foreign Application Priority Data**

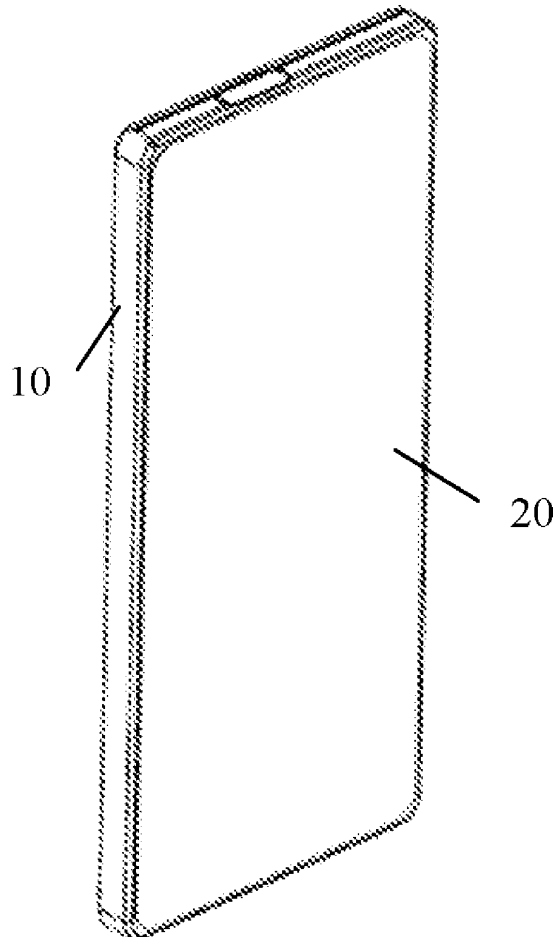
Jun. 5, 2020 (CN) 202010504820.X

Publication Classification

(51) **Int. Cl.**

H04M 1/02 (2006.01)

H01Q 1/22 (2006.01)





(19) **United States**

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LEE et al.

(43) **Pub. Date: Sep. 14, 2023**

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

(52) **U.S. Cl.**
CPC **H01Q 5/357** (2015.01); **H01Q 1/241** (2013.01)

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

(72) Inventors: **Yoonjae LEE**, Suwon-si (KR); **Seongyong AN**, Suwon-si (KR); **Sangha LEE**, Suwon-si (KR); **Jinwoo JUNG**, Suwon-si (KR); **Youngjun CHO**, Suwon-si (KR); **Jaebong CHUN**, Suwon-si (KR); **Sangmin HAN**, Suwon-si (KR)

(57) **ABSTRACT**

An electronic device according to various embodiments of the present disclosure may comprise: a first housing; a second housing configured to accommodate at least a portion of the first housing and to guide a sliding motion of the first housing; a flexible display including a first display area connected to the first housing, and a second display area extending from the first display area and capable of bending or rolling; a circuit board disposed in the first housing and movable in response to the sliding motion of the first housing; an antenna structure formed on an outer surface of the second structure, and including a first part and a second part that are symmetrical about a first axis perpendicular to the sliding motion direction; and a feeding structure disposed on the circuit board configured to feed power to the antenna structure. The feeding structure is electrically connected to a first point of the first part in a state in which the flexible display slides in, and the feeding structure is electrically connected to a second point of the second part in a state in which the flexible display slides out. The first point and the second point may be spaced apart from each other by the same distance as the first axis.

(21) Appl. No.: **18/320,552**

(22) Filed: **May 19, 2023**

Related U.S. Application Data

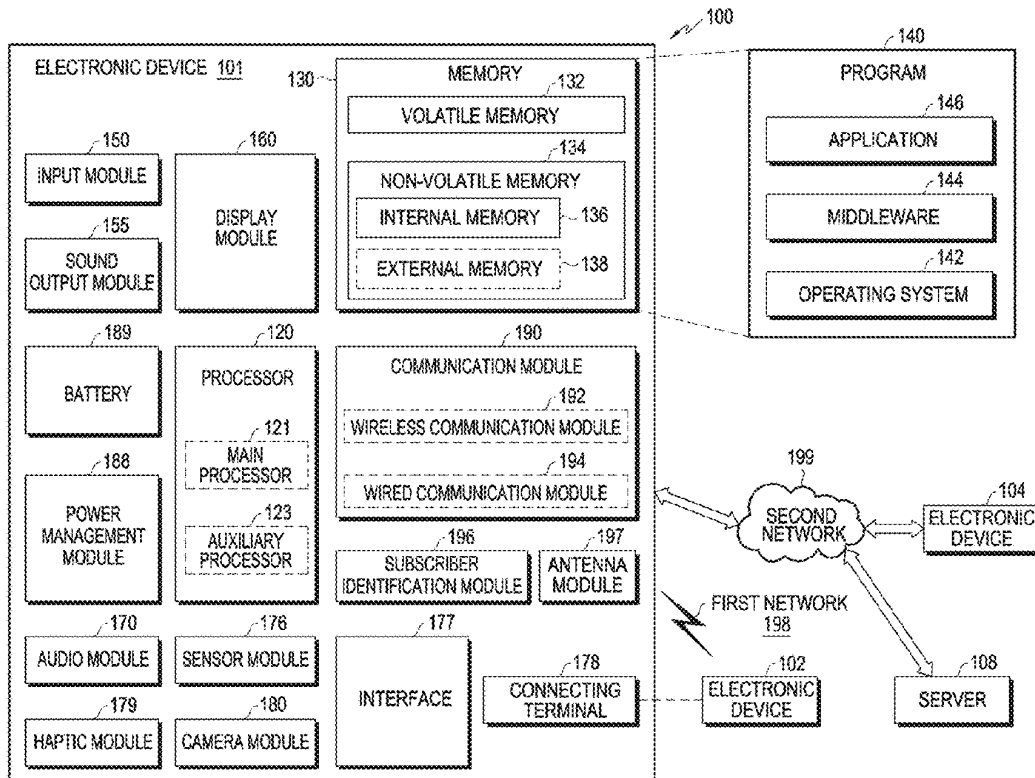
(63) Continuation of application No. PCT/KR2021/017067, filed on Nov. 19, 2021.

(30) **Foreign Application Priority Data**

Nov. 19, 2020 (KR) 10-2020-0155503
Apr. 29, 2021 (KR) 10-2021-0055445

Publication Classification

(51) **Int. Cl.**
H01Q 5/357 (2006.01)
H01Q 1/24 (2006.01)





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(19) **United States**

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

(10) **Pub. No.: US 2023/0291102 A1**

(43) **Pub. Date: Sep. 14, 2023**

(54) **ANTENNA AND MOBILE TERMINAL**

Publication Classification

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

(51) **Int. Cl.**
H01Q 5/385 (2006.01)
H01Q 1/48 (2006.01)
H01Q 1/24 (2006.01)

(72) Inventors: **Liang Xue**, Shanghai (CN); **Hanyang Wang**, Reading (GB); **Chuanbo Shi**, Shanghai (CN); **Yiwen Gong**, Shanghai (CN); **Jikang Wang**, Shanghai (CN); **Xiaowei Zhang**, Shenzhen (CN); **Dong Yu**, Shanghai (CN)

(52) **U.S. Cl.**
CPC *H01Q 5/385* (2015.01); *H01Q 1/48* (2013.01); *H01Q 1/243* (2013.01)

(57) **ABSTRACT**

(21) Appl. No.: **18/003,656**

An antenna is provided, which includes: a main stub, a first parasitic stub, and a second parasitic stub. The first parasitic stub and the second parasitic stub are respectively arranged on two sides of the main stub. The first parasitic stub and the second parasitic stub are configured to excite resonances to improve main resonance efficiency or expand bandwidth. A frequency of the resonance excited by the first parasitic stub is greater than a frequency of a resonance excited by the main stub. A frequency of the resonance excited by the second parasitic stub is less than the frequency of the resonance excited by the main stub.

(22) PCT Filed: **Jun. 30, 2021**

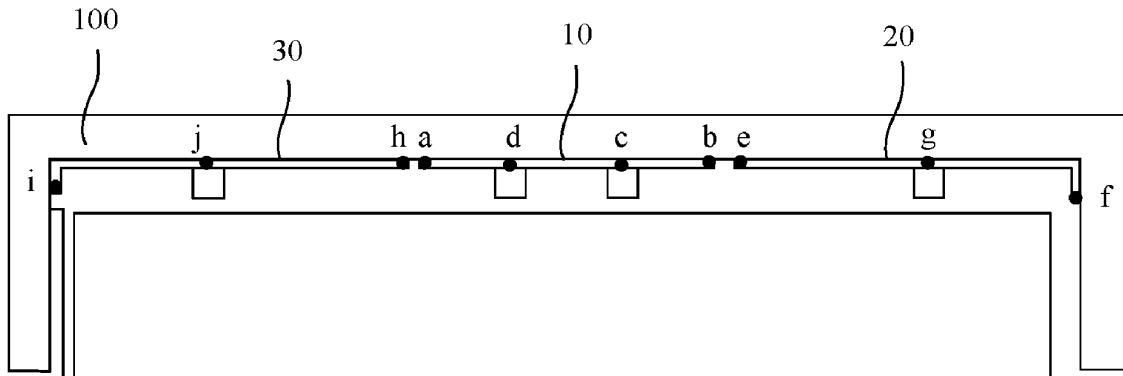
(86) PCT No.: **PCT/CN2021/103880**

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(2) Date: **Dec. 28, 2022**

(30) **Foreign Application Priority Data**

Jun. 30, 2020 (CN) 202010615049.3





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(19) **United States**

(12) **Patent Application Publication**

Ayala Vazquez et al.

(10) **Pub. No.: US 2023/0291124 A1**

(43) **Pub. Date: Sep. 14, 2023**

(54) **ELECTRONIC DEVICES WITH MULTIPLE LOW BAND ANTENNAS**

(52) **U.S. Cl.**
CPC **H01Q 21/28** (2013.01); **H01Q 1/241** (2013.01); **H01Q 1/38** (2013.01)

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

(72) Inventors: **Enrique Ayala Vazquez**, Watsonville, CA (US); **Xu Han**, Santa Clara, 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)

(57) **ABSTRACT**

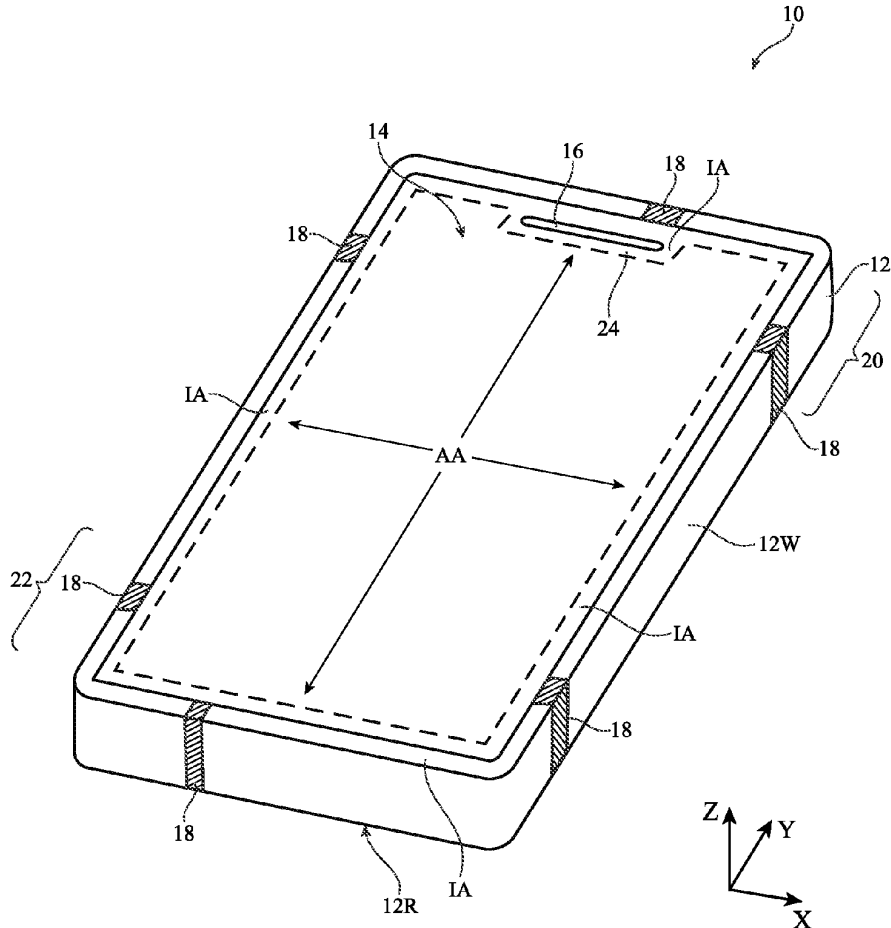
An electronic device may include first and second antennas formed from respective first and second segments of a housing. The first antenna may have a first feed coupled to the first segment by a first switch and coupled to the first segment by a first conductive trace. The second antenna may have a 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.

(21) Appl. No.: **17/694,486**

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

Publication Classification

(51) **Int. Cl.**
H01Q 21/28 (2006.01)
H01Q 1/24 (2006.01)
H01Q 1/38 (2006.01)





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(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**

(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

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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)

(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.

