



US 20200335853A1

(19) **United States**

(12) **Patent Application Publication**
ZHANG

(10) **Pub. No.: US 2020/0335853 A1**

(43) **Pub. Date: Oct. 22, 2020**

(54) **VERTICALLY POLARIZED MIMO
ANTENNA AND TERMINAL HAVING SAME**

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(21) Appl. No.: **16/954,104**

(22) PCT Filed: **Sep. 10, 2018**

(86) PCT No.: **PCT/CN2018/104756**

§ 371 (c)(1),

(2) Date: **Jun. 16, 2020**

(30) **Foreign Application Priority Data**

Dec. 15, 2017 (CN) 201711351032.6

Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H04B 7/0413 (2006.01)

H01Q 1/36 (2006.01)

H01Q 1/38 (2006.01)

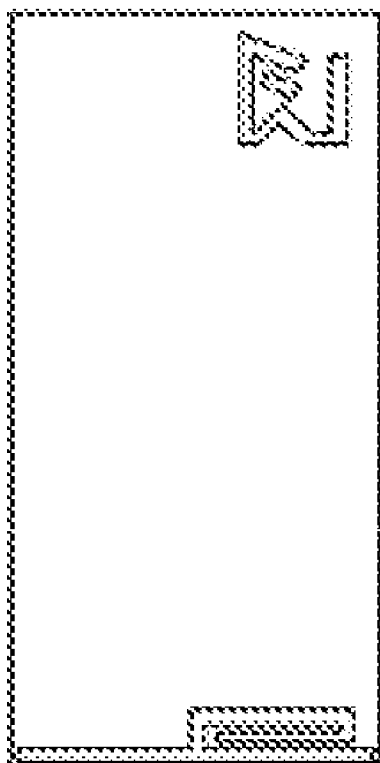
(52) **U.S. Cl.**

CPC **H01Q 1/243** (2013.01); **H01Q 1/38**
(2013.01); **H01Q 1/36** (2013.01); **H04B**
7/0413 (2013.01)

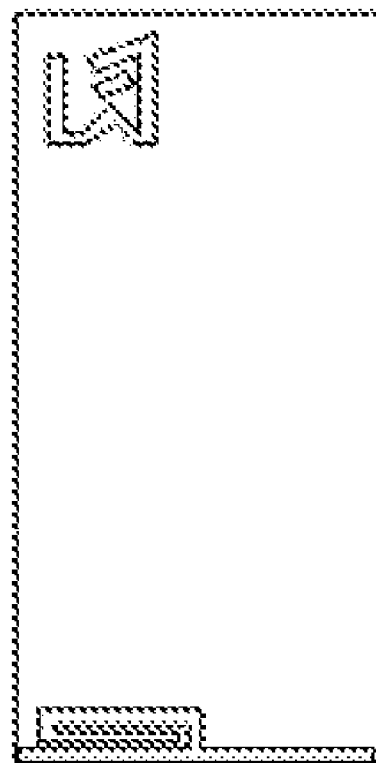
(57)

ABSTRACT

Provided are a vertically polarized MIMO antenna and a terminal having an MIMO antenna. The antenna includes a primary antenna and a diversity antenna, where a radiation end of the diversity antenna is disposed vertically to a radiation end of the primary antenna. The terminal includes the above-mentioned antenna.



(a)



(b)



US 20200335854A1

(19) **United States**(12) **Patent Application Publication** (10) **Pub. No.: US 2020/0335854 A1**
(43) **Pub. Date: Oct. 22, 2020**(54) **MOBILE TERMINAL AND MOBILE
TERMINAL ANTENNA PRODUCTION
METHOD**(71) Applicant: **HUAWEI TECHNOLOGIES CO.,
LTD.**, Shenzhen (CN)(72) Inventors: **Yu Chan YANG**, Shenzhen (CN);
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Dong YU, Shanghai (CN); **YiHsiang
LIAO**, Shenzhen (CN); **Xiaoli YANG**,
Shanghai (CN); **Jiaqing YOU**,
Shanghai (CN)(73) Assignee: **HUAWEI TECHNOLOGIES CO.,
LTD.**, Shenzhen (CN)(21) Appl. No.: **16/954,591**(22) PCT Filed: **Jul. 30, 2019**(86) PCT No.: **PCT/CN2019/098310**

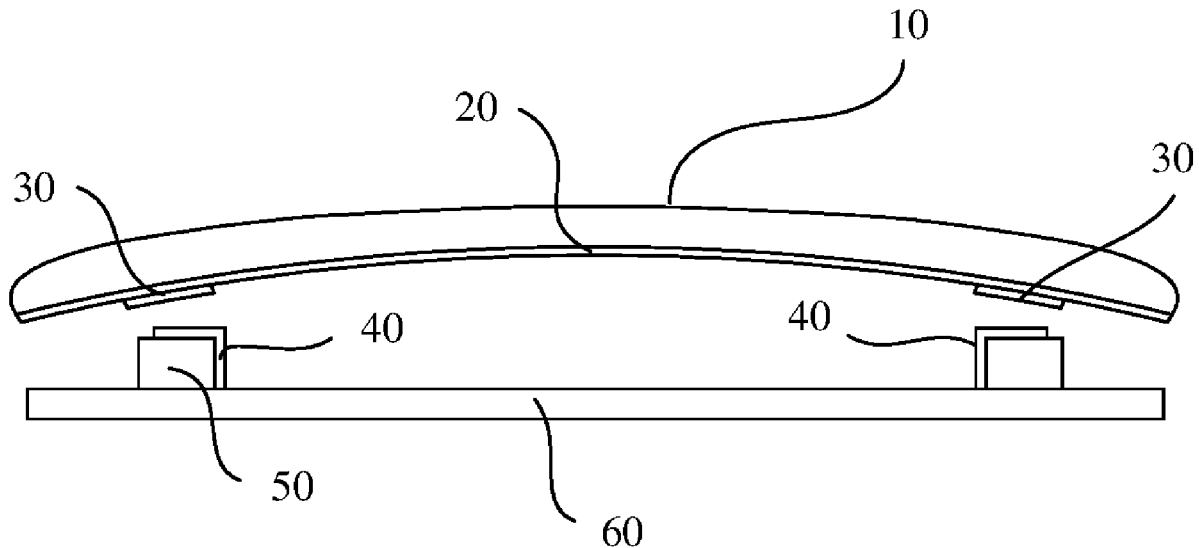
§ 371 (c)(1),

(2) Date: **Jun. 17, 2020**(30) **Foreign Application Priority Data**

Jul. 31, 2018 (CN) 201810858567.0

Publication Classification(51) **Int. Cl.**
H01Q 1/24 (2006.01)**H04M 1/02** (2006.01)(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H04M 1/026**
(2013.01)(57) **ABSTRACT**

A mobile terminal and a mobile terminal antenna production method. The mobile terminal uses an insulation film layer on an insulation rear housing as a carrier of a radiating element of an antenna, and the radiating element is located within the entire mobile terminal, thereby effectively increasing a height of the radiating element of the antenna relative to a circuit board with the antenna not affecting an appearance of the mobile terminal. Compared with a conventional support solution, this manner can increase a height of about 0.2 mm to 0.6 mm. This reduces an impact caused by a metal component on the circuit board on antenna radiation, and further increases a bandwidth and efficiency of the antenna so that the antenna can cover a frequency band used in a handheld communications system.





US 20200335869A1

(19) **United States**

(12) **Patent Application Publication**
JIA

(10) **Pub. No.: US 2020/0335869 A1**

(43) **Pub. Date: Oct. 22, 2020**

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

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(21) Appl. No.: **16/833,216**

(22) Filed: **Mar. 27, 2020**

(30) **Foreign Application Priority Data**

Apr. 19, 2019 (CN) 201910316178.X

Publication Classification

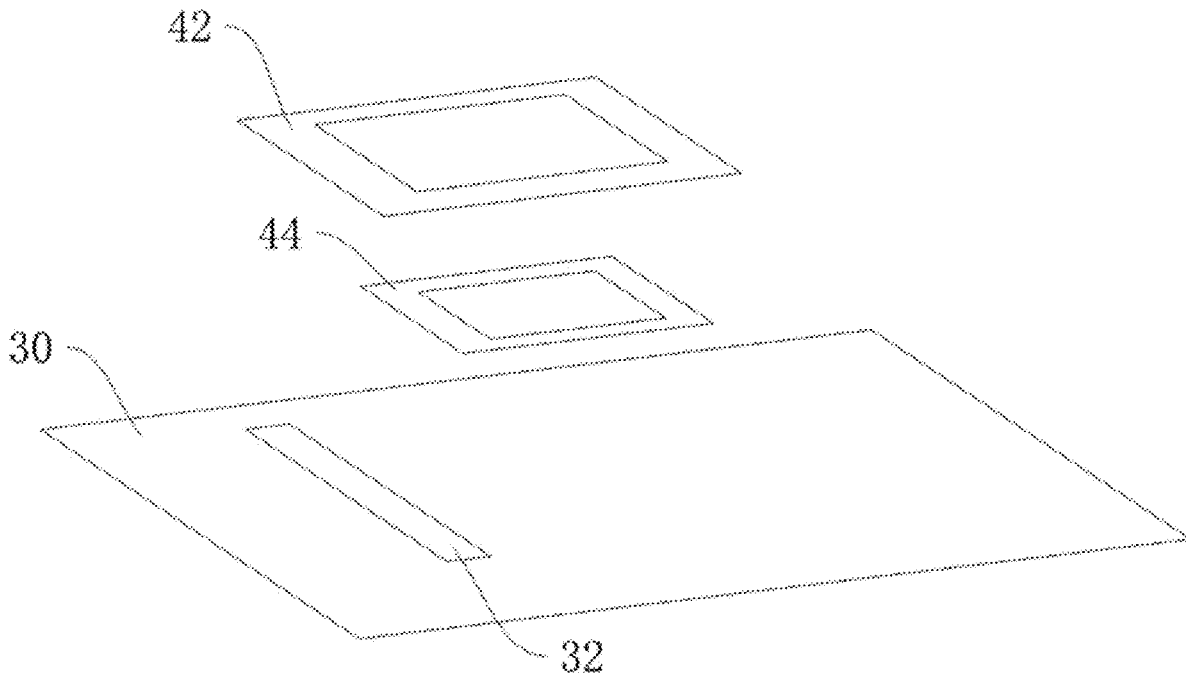
(51) **Int. Cl.**
H01Q 9/04 (2006.01)
H01Q 1/38 (2006.01)
H01Q 5/30 (2006.01)

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

CPC **H01Q 9/045** (2013.01); **H01Q 5/30**
(2015.01); **H01Q 9/0414** (2013.01); **H01Q**
1/38 (2013.01)

(57) **ABSTRACT**

An antenna module is provided. The antenna module includes a dielectric substrate, a first insulating layer, a stacked patch antenna, a ground layer, a second insulating layer, and a feeding structure. The dielectric substrate includes a first surface and a second surface opposite the first surface. The first insulating layer is disposed on the first surface of the dielectric substrate. The stacked patch antenna includes a first antenna radiator disposed on a side of the first insulating layer away from the dielectric substrate and a second antenna radiator disposed between the first insulating layer and the dielectric substrate. A projection of the first antenna radiator on the dielectric substrate at least partially overlaps with a projection of the second antenna radiator on the dielectric substrate. The ground layer is disposed on the second surface of the dielectric substrate, and the ground layer defines at least one slot.





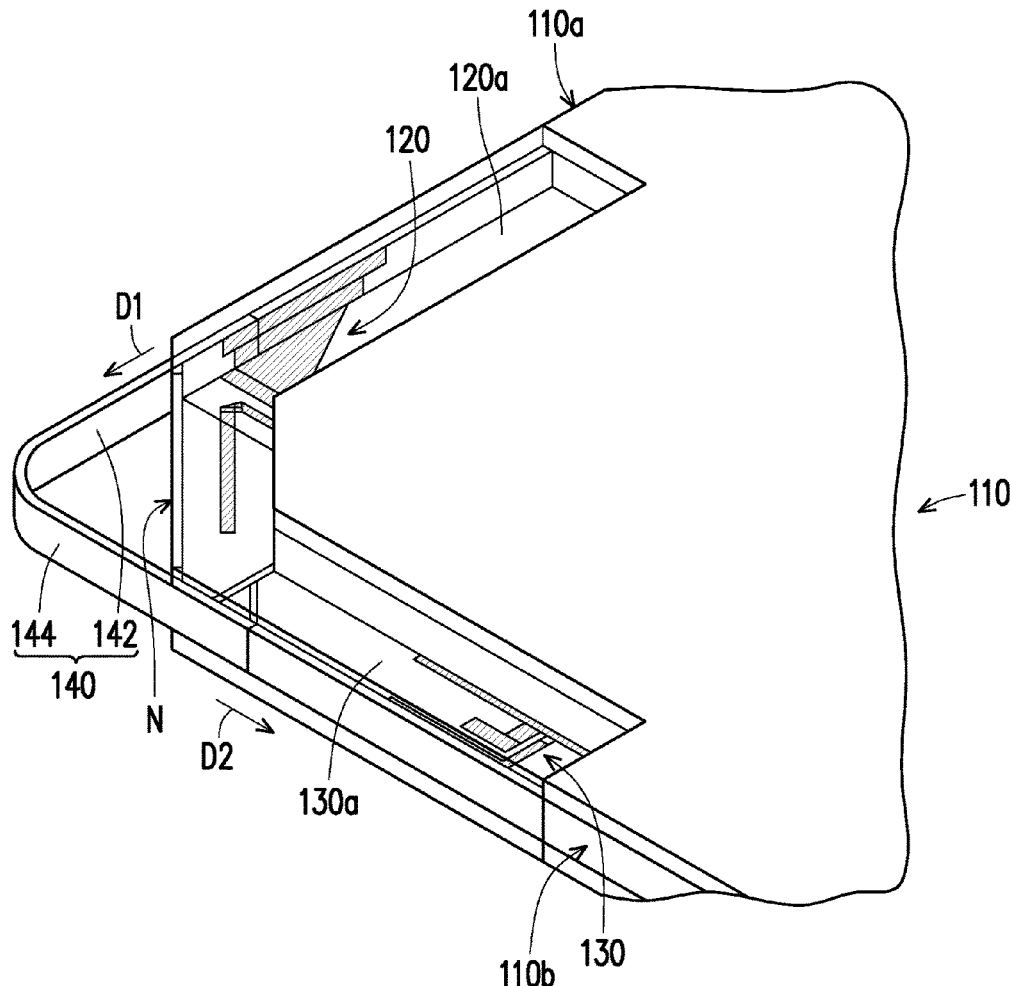
US 20200341520A1

(19) **United States**(12) **Patent Application Publication**
Chen et al.(10) **Pub. No.: US 2020/0341520 A1**(43) **Pub. Date: Oct. 29, 2020**(54) **ELECTRONIC DEVICE****Publication Classification**(71) Applicants: **I-Lung Chen**, Taipei City (TW);
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Hsiao-Ching Hung, Taipei City (TW);
Li-Chun Lee, Taipei City (TW);
Shih-Chia Liu, Taipei City (TW);
Kun-Rong Lin, Taipei City (TW)(51) **Int. Cl.**
G06F 1/16 (2006.01)
H01Q 1/22 (2006.01)
(52) **U.S. Cl.**
CPC **G06F 1/1656** (2013.01); **G06F 1/1616**
(2013.01); **G06F 1/1637** (2013.01); **H01Q**
1/2266 (2013.01)(72) Inventors: **I-Lung Chen**, Taipei City (TW);
Wang-Hung Yeh, Taipei City (TW);
Hsiao-Ching Hung, Taipei City (TW);
Li-Chun Lee, Taipei City (TW);
Shih-Chia Liu, Taipei City (TW);
Kun-Rong Lin, Taipei City (TW)(57) **ABSTRACT**

An electronic device including a device body, a first antenna module, a second antenna module, and an electrically conductive structure is provided. The first antenna module is disposed on the device body, and the second antenna module is disposed on the device body. The electrically conductive structure includes a first section and a second section, and the first section is connected between the first antenna module and the second section. The first section is extended along a first direction, the second section is extended toward the second antenna module along a second direction not parallel to the first direction, and the second section and the second antenna module have a gap therebetween.

(73) Assignee: **COMPAL ELECTRONICS, INC.**,
Taipei City (TW)(21) Appl. No.: **16/856,041**(22) Filed: **Apr. 23, 2020****Related U.S. Application Data**

(60) Provisional application No. 62/838,316, filed on Apr. 25, 2019.





US 20200343624A1

(19) **United States**

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

(10) **Pub. No.: US 2020/0343624 A1**

(43) **Pub. Date: Oct. 29, 2020**

(54) **ELECTRONIC DEVICE INCLUDING COVER
HAVING ANTENNA MODULE COUPLED
THERE TO**

Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 21/06 (2006.01)

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

CPC **H01Q 1/243** (2013.01); **H01R 13/2442**
(2013.01); **H01Q 21/065** (2013.01)

(71) Applicant: **Samsung Electronics Co., Ltd.,**
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(72) Inventors: **Dongho YU**, Suwon-si (KR); **Kucheol**
AHN, Suwon-si (KR)

(21) Appl. No.: **16/927,282**

(57)

ABSTRACT

(22) Filed: **Jul. 13, 2020**

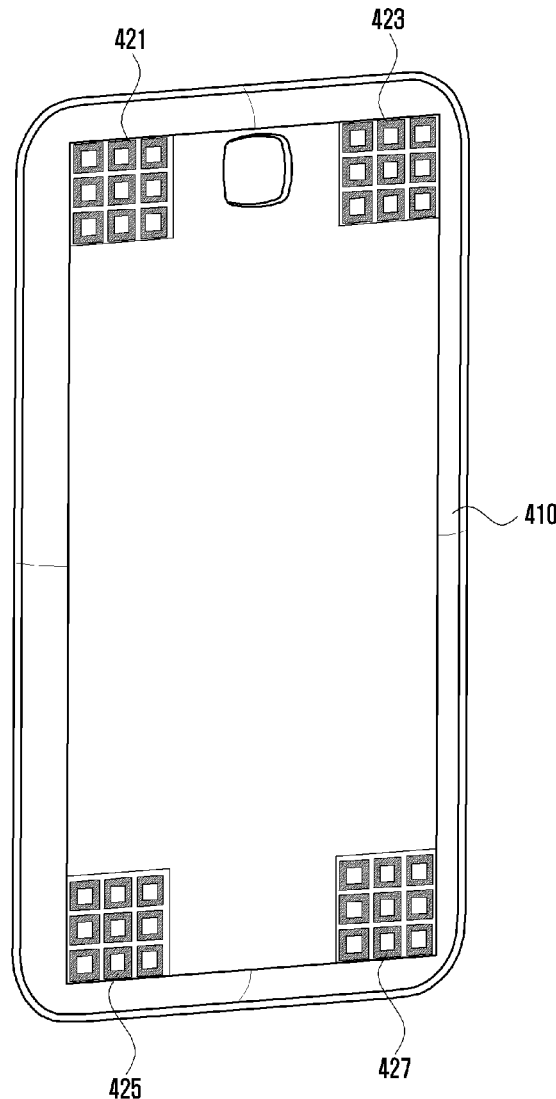
Related U.S. Application Data

(63) Continuation of application No. 16/367,634, filed on
Mar. 28, 2019, now Pat. No. 10,714,813.

(30) **Foreign Application Priority Data**

Apr. 11, 2018 (KR) 10-2018-0042078

An electronic device having a space formed between a front face and a rear face thereof is provided. The electronic device includes a first cover disposed on the front face, a second cover disposed on the rear face, a frame surrounding a periphery of the first cover and a periphery of the second cover, at least one antenna module coupled to a first face of the second cover, and a printed circuit board disposed in the space and having a front face electrically connected to the at least one antenna module.





US 20200350660A1

(19) **United States**(12) **Patent Application Publication**
KIM et al.(10) **Pub. No.: US 2020/0350660 A1**(43) **Pub. Date: Nov. 5, 2020**(54) **WIDE-BAND ANTENNA AND ELECTRONIC
DEVICE INCLUDING THE SAME**(52) **U.S. Cl.**CPC **H01Q 1/242** (2013.01); **H05K 5/0017**
(2013.01); **H05K 5/0217** (2013.01); **H05K**
7/1427 (2013.01); **H05K 1/0243** (2013.01);
H01Q 1/50 (2013.01); **H05K 2201/10121**
(2013.01); **H01Q 9/045** (2013.01); **H01Q 1/48**
(2013.01); **H05K 2201/10098** (2013.01); **H05K**
2201/10151 (2013.01); **H05K 2201/10083**
(2013.01); **H05K 2201/10189** (2013.01);
H01Q 5/20 (2015.01)(71) Applicant: **Samsung Electronics Co., Ltd.**,
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Kyungbae KO, Gyeonggi-do (KR); **Un**
KIM, Gyeonggi-do (KR); **Sanguk**
KIM, Gyeonggi-do (KR); **Donghwan**
KIM, Gyeonggi-do (KR); **Yongsub**
LEE, Gyeonggi-do (KR)(73) Assignee: **Samsung Electronics Co., Ltd.**(21) Appl. No.: **16/861,800**(22) Filed: **Apr. 29, 2020**(30) **Foreign Application Priority Data**

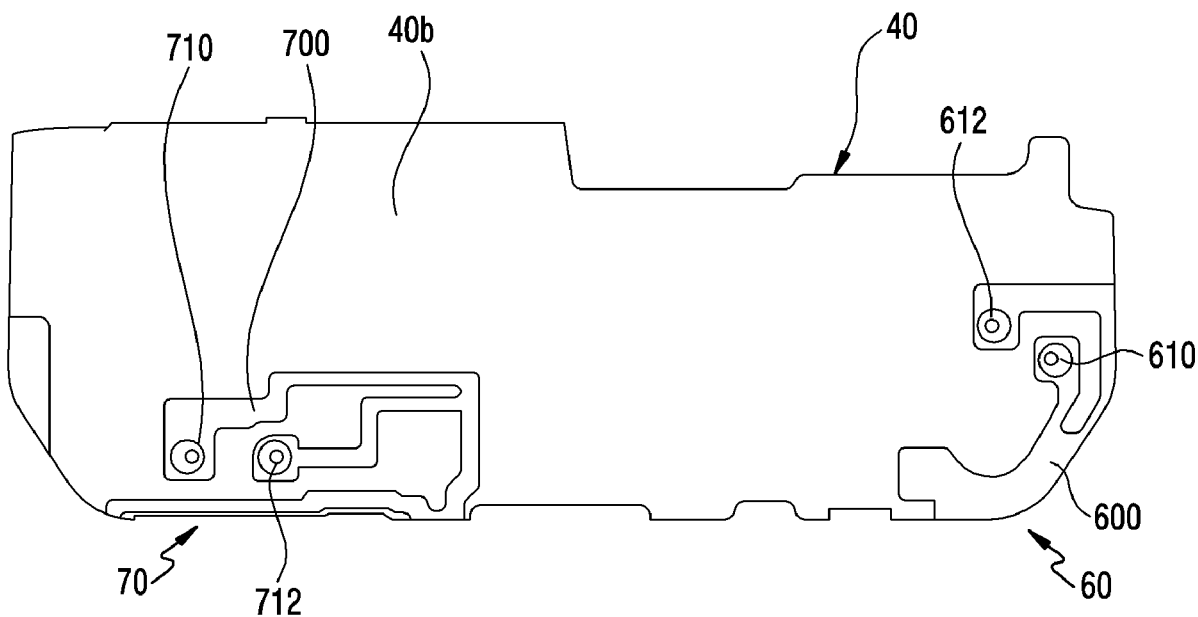
May 3, 2019 (KR) 10-2019-0052637

Publication Classification(51) **Int. Cl.****H01Q 1/24** (2006.01)
H05K 5/00 (2006.01)
H05K 5/02 (2006.01)
H05K 7/14 (2006.01)
H05K 1/02 (2006.01)
H01Q 1/50 (2006.01)
H01Q 5/20 (2006.01)
H01Q 9/04 (2006.01)
H01Q 1/48 (2006.01)

(57)

ABSTRACT

An electronic device includes a housing including a first plate disposed to be oriented in a first direction, a second plate disposed to be oriented in a second direction opposite the first direction, and a side member surrounding a space between the first plate and the second plate and coupled to or integrally formed with the second plate; a display visible through at least part of the first plate; a printed circuit board (PCB) disposed in the space and including a ground; a first conductive pattern disposed between the PCB and the second plate and including a first portion and a second portion spaced apart from the first portion; a second conductive connection member disposed between the second portion and the PCB; and a radio frequency (RF) communication circuit electrically connected with the first conductive connection member and configured to transmit or receive at least one signal having a predetermined frequency. The PCB may include a first conductive path electrically connecting the RF communication circuit and the first portion; a second conductive path electrically connecting a first position of the ground and the second portion; a third conductive path electrically connecting the first portion and a second position of the ground; and a fourth conductive path electrically connecting the first portion and a third position of the ground.





US 20200350669A1

(19) **United States**(12) **Patent Application Publication** (10) **Pub. No.: US 2020/0350669 A1**
(43) **Pub. Date:** **Nov. 5, 2020**(54) **SUBSTRATE FOR PREVENTING
DETERIORATION OF ANTENNA
PERFORMANCE AND ELECTRONIC
DEVICE COMPRISING SAME**(71) Applicant: **Samsung Electronics Co., Ltd.,**
Gyeonggi-do (KR)(72) Inventors: **Mincheol SEO**, Gyeonggi-do (KR);
Dongyeon KIM, Gyeonggi-do (KR);
Hojung NAM, Gyeonggi-do (KR);
Jeongwan PARK, Gyeonggi-do (KR);
Chankyu AN, Gyeonggi-do (KR);
Sungjun LEE, Gyeonggi-do (KR);
Nakchung CHOI, Gyeonggi-do (KR);
Yoonjae LEE, Gyeonggi-do (KR)(21) Appl. No.: **16/964,680**(22) PCT Filed: **Dec. 17, 2018**(86) PCT No.: **PCT/KR2018/015993**

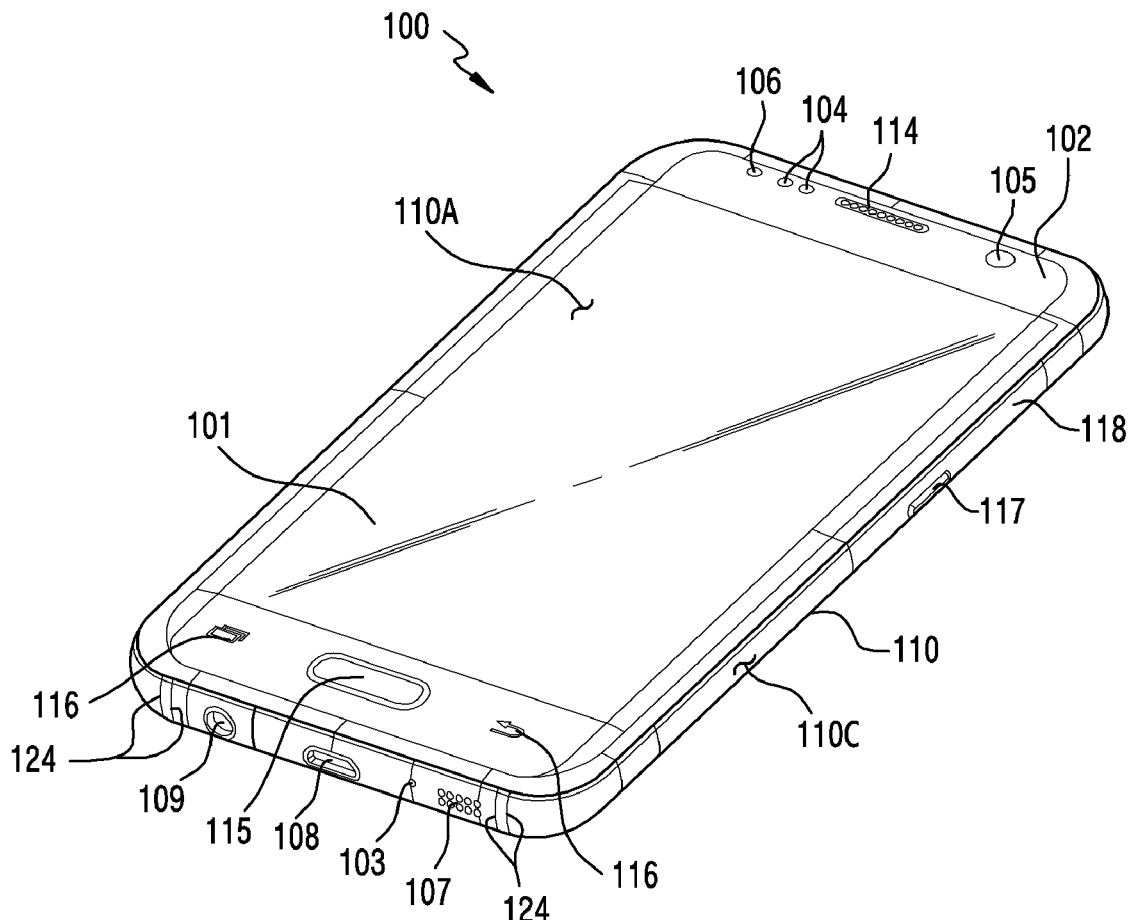
§ 371 (c)(1),

(2) Date: **Jul. 24, 2020**(30) **Foreign Application Priority Data**

Jan. 26, 2018 (KR) 10-2018-0010065

Publication Classification(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H05K 1/11 (2006.01)
H01Q 1/22 (2006.01)
H01Q 1/00 (2006.01)
(52) **U.S. Cl.**
CPC **H01Q 1/38** (2013.01); **H01Q 1/002**
(2013.01); **H01Q 1/22** (2013.01); **H05K 1/11**
(2013.01)(57) **ABSTRACT**

According to one embodiment of the disclosure, an electronic device comprises: a printed circuit board including a conductive pattern; and a tuner mounted on the conductive pattern and electrically connected to the conductive pattern, wherein the tuner comprises: a ground; a first conductive pad; a first switching element electrically connected between the ground and the first conductive pad; and a second conductive pad electrically disconnected with the ground, wherein the conductive pattern may comprise: a first electrical path in electrical contact with the first conductive pad; and a second electrical path in electrical contact with the second conductive pad and electrically shorted to the first electrical path. Various other embodiments are possible.





US 20200350939A1

(19) **United States**(12) **Patent Application Publication****LEE et al.**(10) **Pub. No.: US 2020/0350939 A1**(43) **Pub. Date: Nov. 5, 2020**(54) **ANTENNA AND FOLDABLE ELECTRONIC
DEVICE INCLUDING THE SAME**(71) Applicant: **Samsung Electronics Co., Ltd.,**
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Yongyoun KIM, Gyeonggi-do (KR);
Haeyeon KIM, Gyeonggi-do (KR);
Taekyung LEE, Gyeonggi-do (KR);
Dongil YANG, Gyeonggi-do (KR);
Hyoseok NA, Gyeonggi-do (KR);
Soyoung LEE, Gyeonggi-do (KR)(21) Appl. No.: **16/847,869**(22) Filed: **Apr. 14, 2020**(30) **Foreign Application Priority Data**

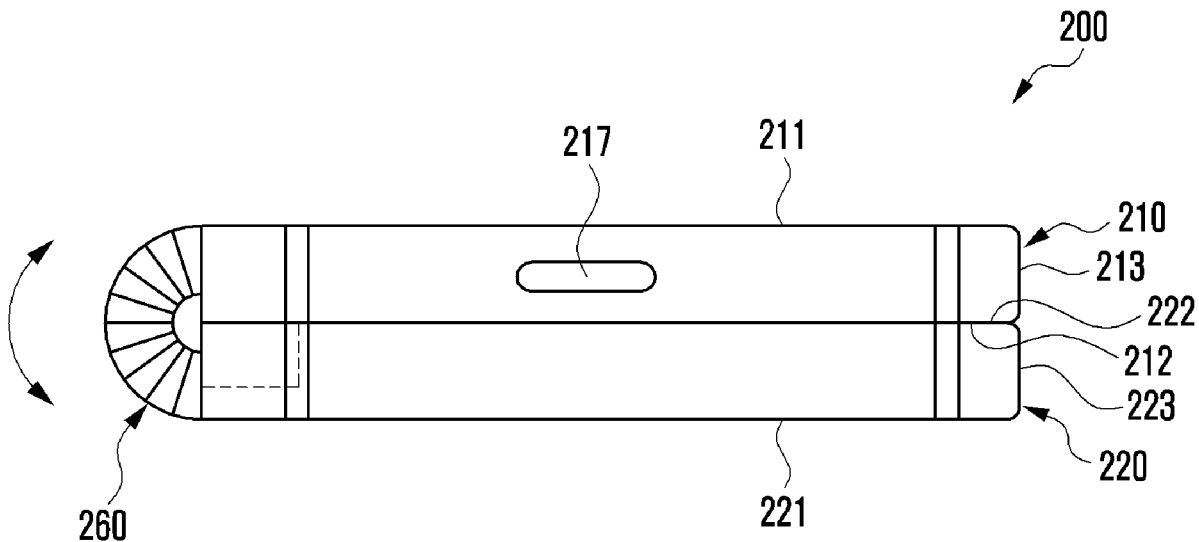
Apr. 16, 2019 (KR) 10-2019-0044160

Publication Classification(51) **Int. Cl.**
H04B 1/16 (2006.01)
H05K 5/00 (2006.01)
H05K 5/02 (2006.01)**H05K 1/11** (2006.01)**H05K 1/02** (2006.01)**H05K 7/14** (2006.01)(52) **U.S. Cl.**CPC **H04B 1/16** (2013.01); **H05K 5/0017**
(2013.01); **H05K 5/0226** (2013.01); **H05K**
1/111 (2013.01); **H05K 2201/10098** (2013.01);
H05K 1/0277 (2013.01); **H05K 7/1427**
(2013.01); **H05K 2201/1003** (2013.01); **H05K**
1/0237 (2013.01)

(57)

ABSTRACT

In an embodiment, an electronic device may include a housing including a hinge module, a first housing, and second housing. The first and second housings are rotatably coupled to each other via the hinge module to be in a folded state or an unfolded state. The electronic device may further include a flexible display, at least one conductive pattern disposed in the first housing, at least one conductor disposed at a position in the second housing corresponding to the at least one conductive pattern such that the at least one conductor is capacitively coupled to the conductive pattern when the electronic device is in the folded state, and a wireless communication circuit electrically connected to the at least one conductive pattern in the first housing. Other embodiments are also possible.





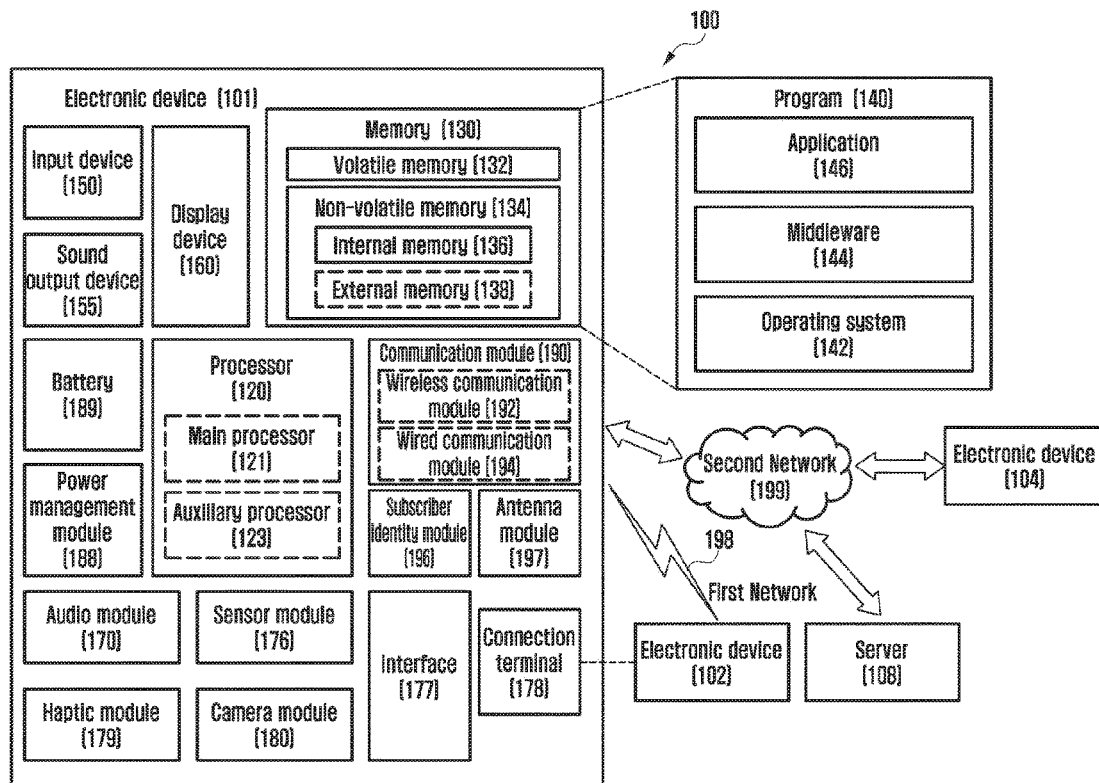
US 20200358165A1

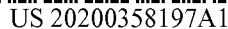
(19) **United States**(12) **Patent Application Publication**
JEONG et al.(10) **Pub. No.: US 2020/0358165 A1**(43) **Pub. Date: Nov. 12, 2020**(54) **DUAL POLARIZED ANTENNA AND
ELECTRONIC DEVICE INCLUDING THE
SAME****H01Q 9/04** (2006.01)**H01Q 1/22** (2006.01)(52) **U.S. Cl.****CPC** **H01Q 1/243** (2013.01); **H01Q 1/2283**
(2013.01); **H01Q 9/0407** (2013.01); **H04M**
1/0266 (2013.01)(71) Applicant: **Samsung Electronics Co., Ltd.**,
Suwon-si (KR)(72) Inventors: **Myunghun JEONG**, Suwon-si (KR);
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Dongyeon KIM, Suwon-si (KR);
Hosaeng KIM, Suwon-si (KR);
Seongjin PARK, Suwon-si (KR);
Sumin YUN, Suwon-si (KR); **Woomin**
JANG, Suwon-si (KR); **Jehun JONG**,
Suwon-si (KR); **Jaebong CHUN**,
Suwon-si (KR)(21) Appl. No.: **16/936,757**(22) Filed: **Jul. 23, 2020****Related U.S. Application Data**(63) Continuation of application No. 16/788,822, filed on
Feb. 12, 2020.(30) **Foreign Application Priority Data**

Feb. 15, 2019 (KR) 10-2019-0017915

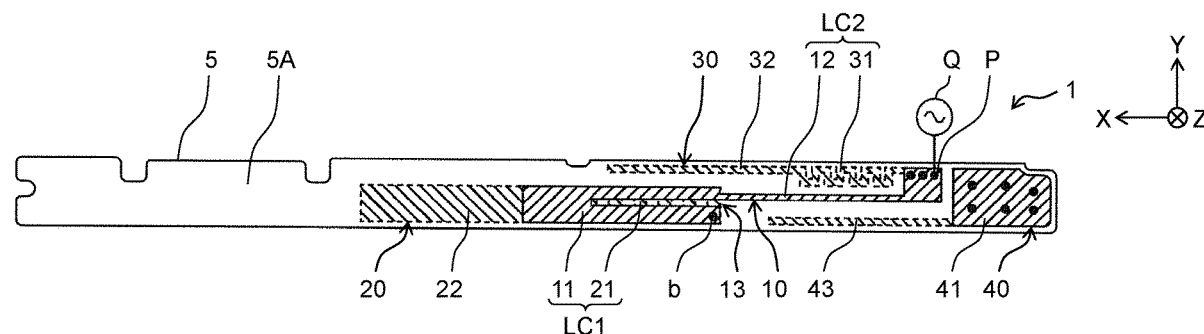
Publication Classification(51) **Int. Cl.****H01Q 1/24** (2006.01)**H04M 1/02** (2006.01)(57) **ABSTRACT**

An electronic device is provided. The electronic device includes a housing and an antenna structure. The housing includes a front plate, a rear plate, and a lateral member surrounding a space between the front and rear plates. The antenna structure is disposed in the space includes a printed circuit board (PCB) disposed in the space and includes a ground layer at least in part. The antenna structure further includes at least one conductive patch disposed on the PCB in a second direction and configured to transmit and/or receive first and second signals having a frequency between about 3 GHz and about 100 GHz. The conductive patch includes a first feeder and a second feeder. The first feeder is disposed on a first virtual line passing through a center of the conductive patch and forming a first angle with respect to a virtual axis passing through the center and perpendicular to the second direction, and configured to transmit and/or receive the first signal having a first polarization. The second feeder is disposed on a second virtual line passing through the center and forming a second angle with respect to the virtual axis, and configured to transmit and/or receive the second signal having a second polarization perpendicular to the first polarization. A sum of the first and second angles is substantially 90 degrees.





(43) **Pub. Date:** **Nov. 12, 2020**





US 20200358198A1

(19) **United States**(12) **Patent Application Publication**
HSU et al.(10) **Pub. No.: US 2020/0358198 A1**(43) **Pub. Date: Nov. 12, 2020**(54) **ANTENNA STRUCTURE AND WIRELESS
COMMUNICATION DEVICE USING THE
SAME****H01Q 5/335** (2006.01)**H01Q 1/24** (2006.01)(52) **U.S. Cl.**CPC **H01Q 13/10** (2013.01); **H01Q 1/243**
(2013.01); **H01Q 5/335** (2015.01); **H01Q 1/48**
(2013.01)(71) Applicant: **Chiun Mai Communication Systems,
Inc.**, New Taipei (TW)(72) Inventors: **CHO-KANG HSU**, New Taipei (TW);
MIN-HUI HO, New Taipei (TW)(21) Appl. No.: **16/868,394**(22) Filed: **May 6, 2020**(30) **Foreign Application Priority Data**

May 9, 2019 (CN) 201910385886.9

Publication Classification(51) **Int. Cl.****H01Q 13/10** (2006.01)**H01Q 1/48** (2006.01)(57) **ABSTRACT**

An antenna structure with wide bandwidth in a reduced physical space includes a housing, a side wall, and a first feed portion. The housing includes a metal side frame, a metal middle frame, and a metal back board. The side wall is made of metal material. The metal middle frame and the metal back board are coupled to two sides of the side wall, and the metal middle frame is parallel to the metal back board. The metal side frame surrounds the metal back board. The metal side frame defines at least one gap. The metal back board defines a slot. The slot and the at least one gap cooperatively divide at least two radiation portions from the metal side frame. A wireless communication device employing the antenna structure is also provided.

