



US 20200119429A1

(19) **United States**(12) **Patent Application Publication****Park et al.**(10) **Pub. No.: US 2020/0119429 A1**(43) **Pub. Date: Apr. 16, 2020**

(54) **ANTENNA HAVING SINGLE
NON-CONDUCTIVE PORTION AND
ELECTRONIC DEVICE INCLUDING THE
SAME**

H05K 1/18 (2006.01)**H01Q 1/38** (2006.01)(52) **U.S. Cl.**

CPC **H01Q 1/2266** (2013.01); **G06F 1/1616**
(2013.01); **H05K 2201/1031** (2013.01); **H05K**
1/181 (2013.01); **H01Q 1/38** (2013.01); **G06F**
1/1626 (2013.01)

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

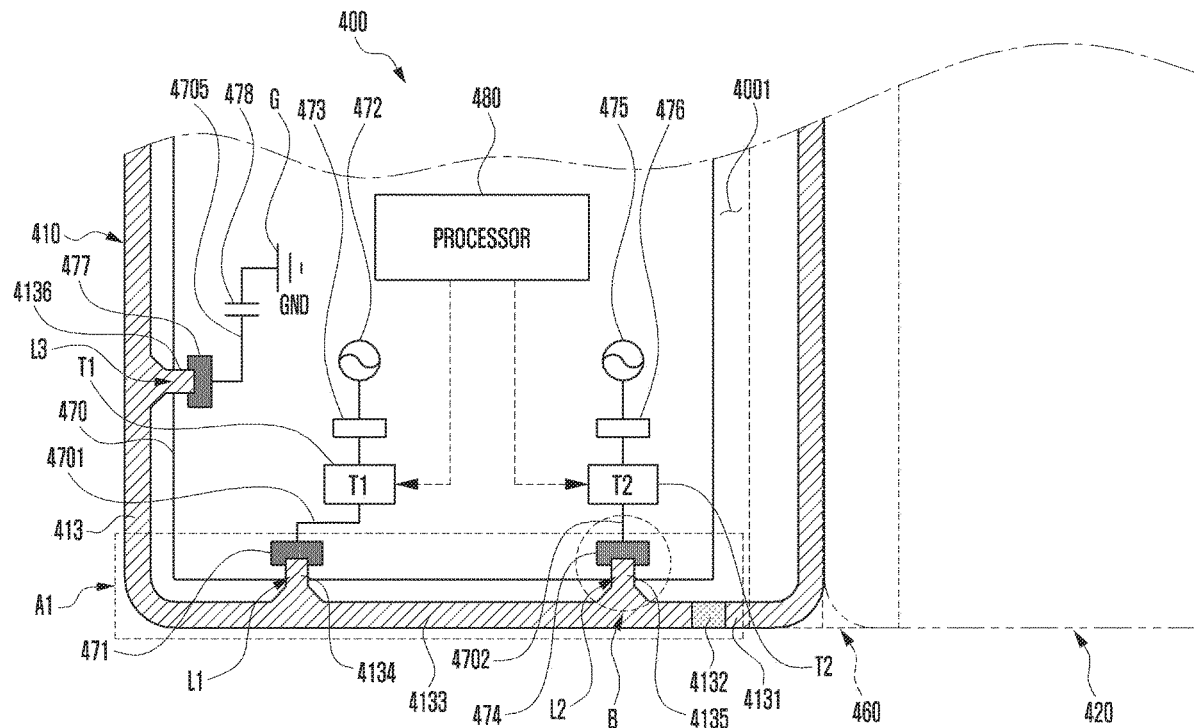
(72) Inventors: **Sungkoo Park**, Suwon-si (KR);
Hyungjoo Lee, Suwon-si (KR); **Shinho**
Yoon, Suwon-si (KR); **Himchan Yun**,
Suwon-si (KR); **Soonho Hwang**,
Suwon-si (KR); **Jaebong Chun**,
Suwon-si (KR)

(21) Appl. No.: **16/596,108**(22) Filed: **Oct. 8, 2019**(30) **Foreign Application Priority Data**

Oct. 16, 2018 (KR) 10-2018-0122922

Publication Classification(51) **Int. Cl.****H01Q 1/22** (2006.01)**G06F 1/16** (2006.01)(57) **ABSTRACT**

An electronic device is provided. The electronic device includes a foldable housing including, a hinge structure, a first housing structure including a first surface, a second surface, and a first side member, wherein the first side member encloses at least a portion of a space between the first surface and the second surface and includes a first conductive portion, a first non-conductive portion, and a second conductive portion, and a second housing structure including a third surface, a fourth surface, and a second side member, a printed circuit board, at least one wireless communication circuit including a first electrical path and a second electrical path, a first variable element including a first terminal, a second terminal, and a third terminal, and a second variable element including a fourth terminal, a fifth terminal, and a sixth terminal.





US 20200119432A1

(19) **United States**(12) **Patent Application Publication**
Mizunuma et al.(10) **Pub. No.: US 2020/0119432 A1**(43) **Pub. Date: Apr. 16, 2020**(54) **COMMUNICATION DEVICE****Publication Classification**(71) Applicant: **Murata Manufacturing Co., Ltd.**,
Kyoto (JP)(72) Inventors: **Ryukun Mizunuma**, Kyoto (JP);
Satoshi Tanaka, Kyoto (JP); **Yasuhisa**
Yamamoto, Kyoto (JP); **Akiko**
Itabashi, Kyoto (JP)(51) **Int. Cl.****H01Q 1/24** (2006.01)**H01Q 1/22** (2006.01)**G06F 1/16** (2006.01)**H04B 7/0413** (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/243** (2013.01); **H01Q 1/2266**(2013.01); **H04B 7/0413** (2013.01); **G06F****1/1616** (2013.01); **G06F 1/1647** (2013.01);**G06F 1/1641** (2013.01)(21) Appl. No.: **16/601,875**(22) Filed: **Oct. 15, 2019**(30) **Foreign Application Priority Data**

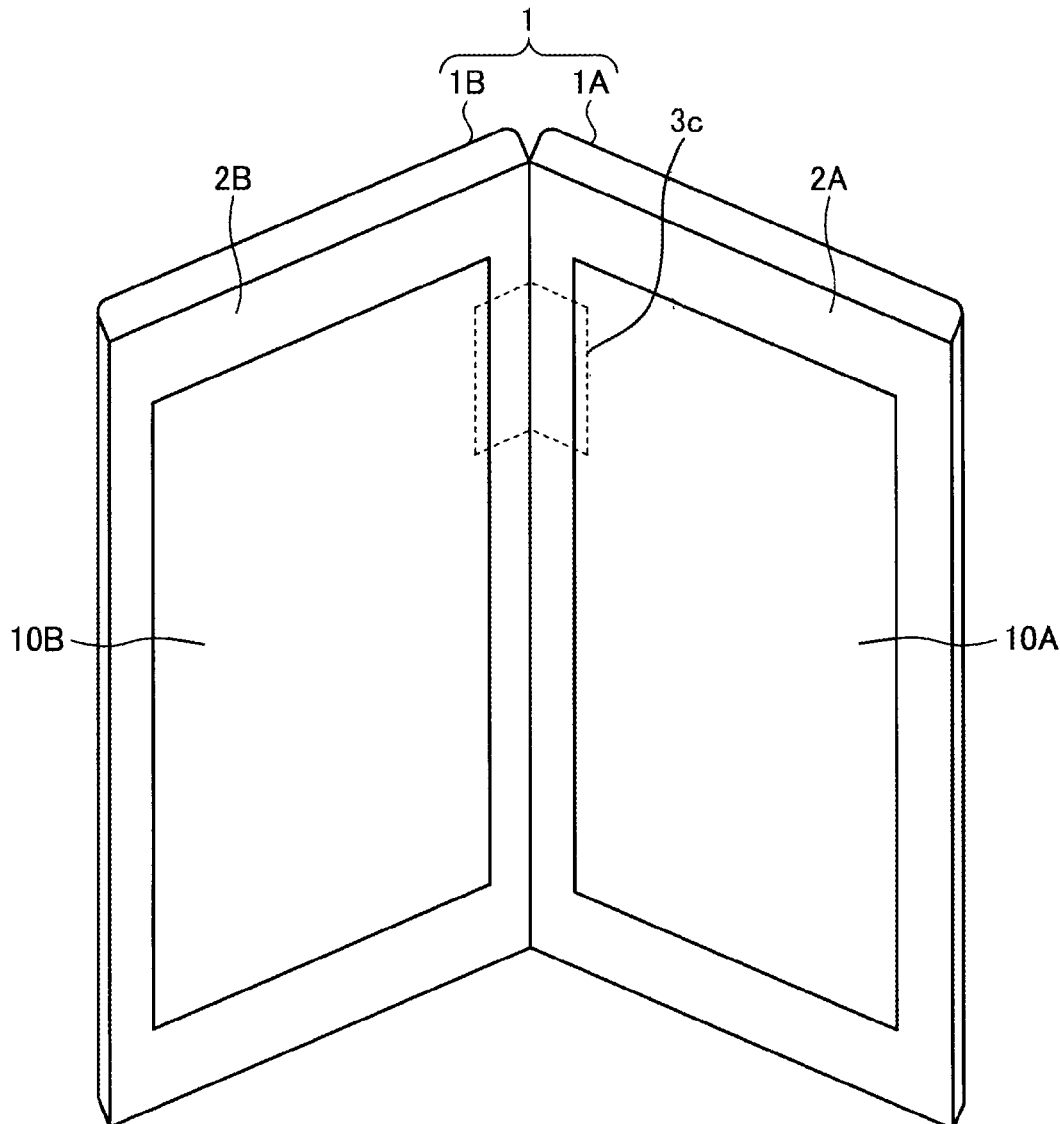
Oct. 16, 2018 (JP) 2018-195347

Jul. 29, 2019 (JP) 2019-139090

(57)

ABSTRACT

A communication device includes: a first body including a first display portion; a second body including a second display portion; a communication circuit that carries out millimeter-wave band communication; and one or more millimeter-wave band communication antennas provided in at least one of the first body and the second body.





US 20200119436A1

(19) **United States**(12) **Patent Application Publication**
Hung(10) **Pub. No.: US 2020/0119436 A1**(43) **Pub. Date: Apr. 16, 2020**(54) **ANTENNA ELEMENTS****Publication Classification**(71) Applicant: **Hewlett-Packard Development
Company, L.P.**, Spring, TX (US)(72) Inventor: **Kuan-Jung Hung**, Taipei City (TW)(21) Appl. No.: **16/603,855**(22) PCT Filed: **Apr. 17, 2017**(86) PCT No.: **PCT/US2017/027947**

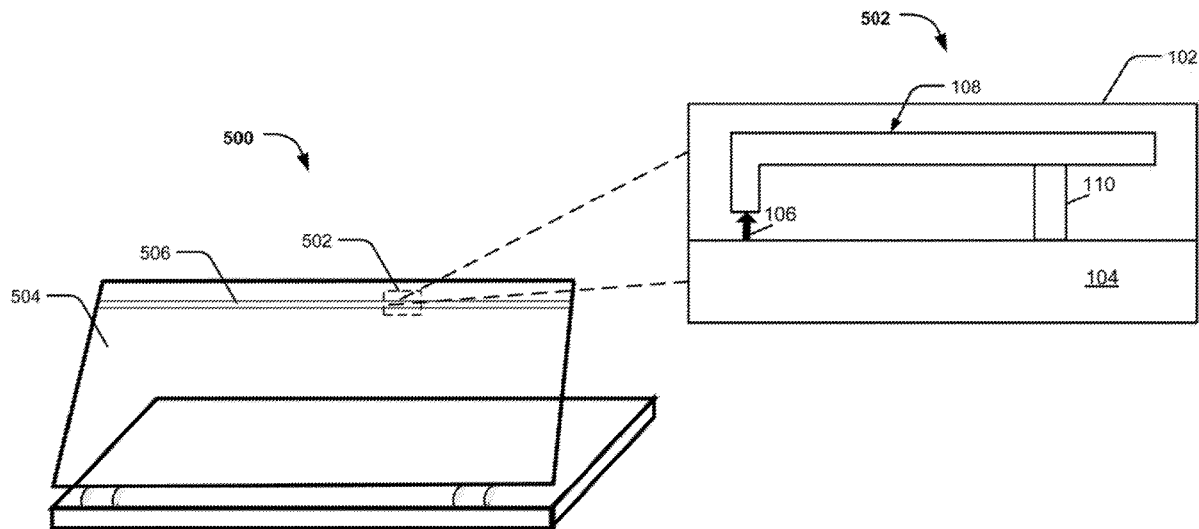
§ 371 (c)(1),

(2) Date: **Oct. 9, 2019**(51) **Int. Cl.****H01Q 1/38** (2006.01)**H01Q 1/48** (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/38** (2013.01); **H01Q 1/2266**
(2013.01); **H01Q 1/48** (2013.01)

(57)

ABSTRACT

Examples of antenna elements are described herein. In an example, the antenna element may include a substrate for being disposed on an enclosure. The substrate may include a ground plane. Further, the antenna element may include an antenna feeder that may be electrically coupled to the ground plane. The antenna element may also include a radiator. The radiator may be electrically coupled to the antenna feeder. In addition, the antenna element may include a lump component connected to the radiator.

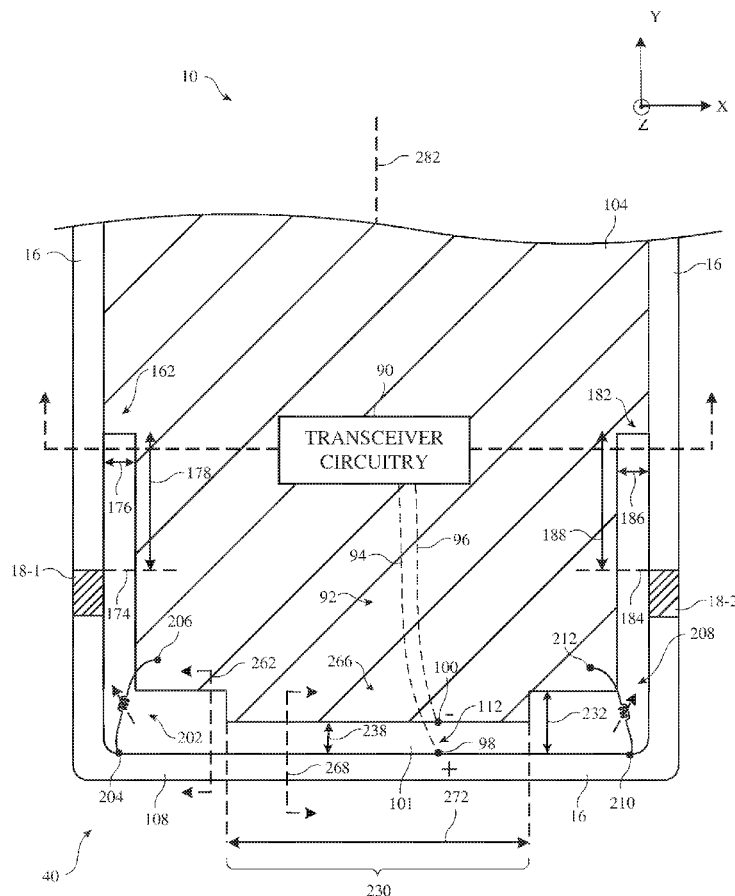




US 20200119439A1

(19) **United States**(12) **Patent Application Publication**
Edwards et al.(10) **Pub. No.: US 2020/0119439 A1**(43) **Pub. Date: Apr. 16, 2020**(54) **ELECTRONIC DEVICE ANTENNAS
INCLUDING CONDUCTIVE DISPLAY
STRUCTURES****H01Q 1/44** (2006.01)**H01Q 9/42** (2006.01)**H01Q 1/24** (2006.01)**H04M 1/02** (2006.01)(71) Applicant: **Apple Inc.**, Cupertino, CA (US)(52) **U.S. Cl.**CPC **H01Q 1/48** (2013.01); **H05K 5/0017**
(2013.01); **H05K 5/0247** (2013.01); **H01Q**
23/00 (2013.01); **H04M 1/02** (2013.01); **H01Q**
9/42 (2013.01); **H01Q 1/243** (2013.01); **H04M**
1/0266 (2013.01); **H01Q 1/44** (2013.01)(72) Inventors: **Jennifer M. Edwards**, San Francisco,
CA (US); **Yijun Zhou**, Mountain View,
CA (US); **Yiren Wang**, Santa Clara,
CA (US); **Hao Xu**, Cupertino, CA (US);
Ming-Ju Tsai, Sunnyvale, CA (US);
Mattia Pascolini, San Francisco, CA
(US)(21) Appl. No.: **16/712,196**(22) Filed: **Dec. 12, 2019****Related U.S. Application Data**(63) Continuation of application No. 15/701,250, filed on
Sep. 11, 2017, now Pat. No. 10,581,153.**Publication Classification**(51) **Int. Cl.****H01Q 1/48** (2006.01)**H05K 5/00** (2006.01)**H05K 5/02** (2006.01)**H01Q 23/00** (2006.01)(57) **ABSTRACT**

An electronic device may be provided with wireless circuitry and control circuitry. The wireless circuitry may include multiple antennas and transceiver circuitry. An antenna in the electronic device may have an inverted-F antenna resonating element formed from portions of a peripheral conductive electronic device housing structure and may have an antenna ground that is separated from the antenna resonating element by a gap. The antenna ground for the antenna may include a conductive frame for the display. The conductive frame may have a first portion that is separated from the antenna resonating element arm by a first distance and a second portion that is separated from the antenna resonating element arm by a second distance that is less than the first distance. The second portion may be configured to form a distributed impedance matching capacitance with the antenna resonating element arm.





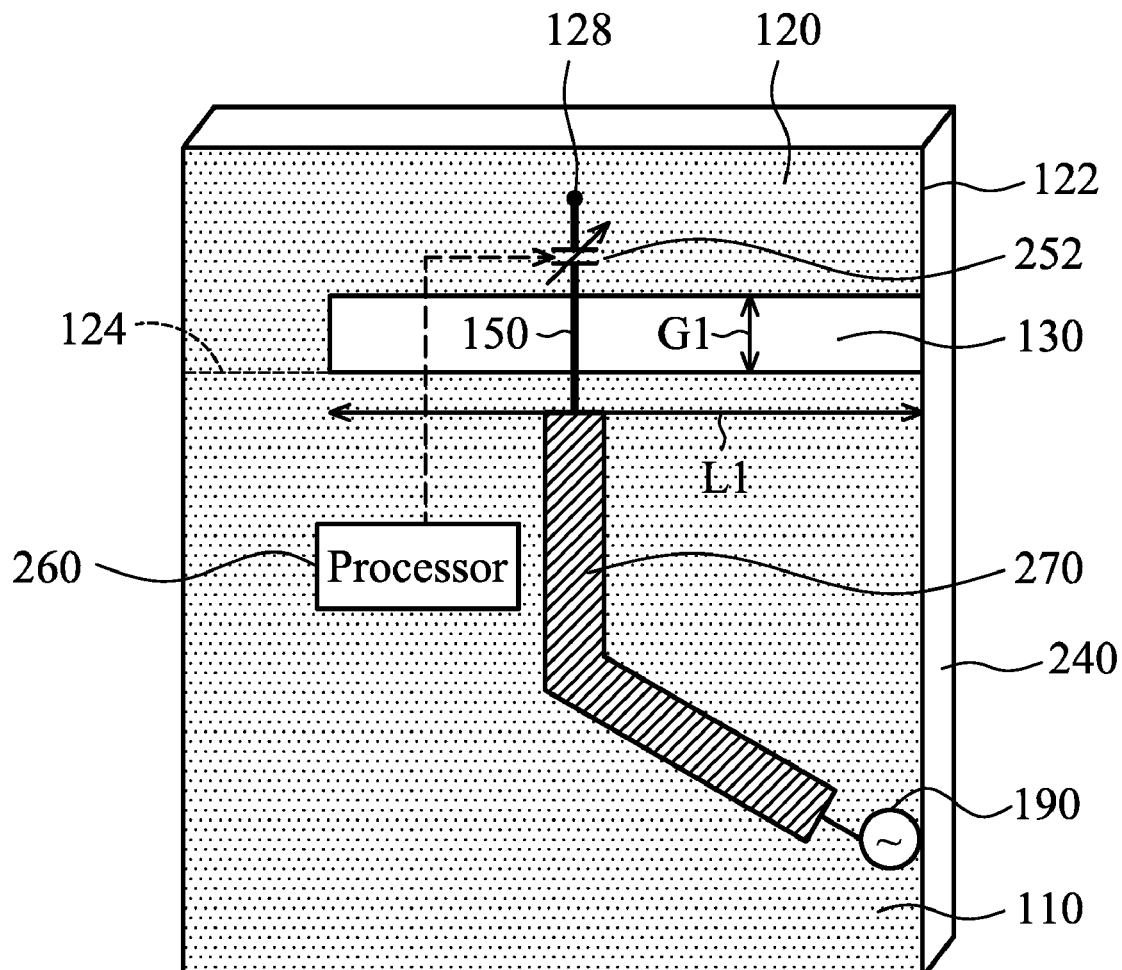
US 20200127368A1

(19) **United States**(12) **Patent Application Publication**
TSAI et al.(10) **Pub. No.: US 2020/0127368 A1**(43) **Pub. Date: Apr. 23, 2020**(54) **MOBILE DEVICE AND ANTENNA
STRUCTURE****Publication Classification**(51) **Int. Cl.***H01Q 1/24* (2006.01)*H01Q 9/42* (2006.01)*H01Q 5/378* (2006.01)*H01Q 5/335* (2006.01)(52) **U.S. Cl.**CPC *H01Q 1/243* (2013.01); *H01Q 5/335*
(2015.01); *H01Q 5/378* (2015.01); *H01Q 9/42*
(2013.01)(71) Applicant: **HTC Corporation**, Taoyuan City (TW)(72) Inventors: **Tiao-Hsing TSAI**, Taoyuan City (TW);
Chien-Pin CHIU, Taoyuan City (TW);
Hsiao-Wei WU, Taoyuan City (TW);
Ying-Chih WANG, Taoyuan City (TW)(73) Assignee: **HTC Corporation**, Taoyuan City (TW)(21) Appl. No.: **16/719,271**(22) Filed: **Dec. 18, 2019****Related U.S. Application Data**(63) Continuation of application No. 16/432,748, filed on
Jun. 5, 2019, now Pat. No. 10,553,932, which is a
continuation of application No. 15/943,067, filed on
Apr. 2, 2018, now Pat. No. 10,355,341, which is a
continuation of application No. 13/598,317, filed on
Aug. 29, 2012, now Pat. No. 10,003,121.

(57)

ABSTRACT

A mobile device including a ground plane, a grounding branch, wherein a slot is formed between the ground plane and the grounding branch, a connecting element, wherein the grounding branch is electrically coupled through the connecting element to the ground plane and a feeding element, extending across the slot, and electrically coupled between the grounding branch and a signal source, wherein an antenna structure is formed by the grounding branch and the feeding element.

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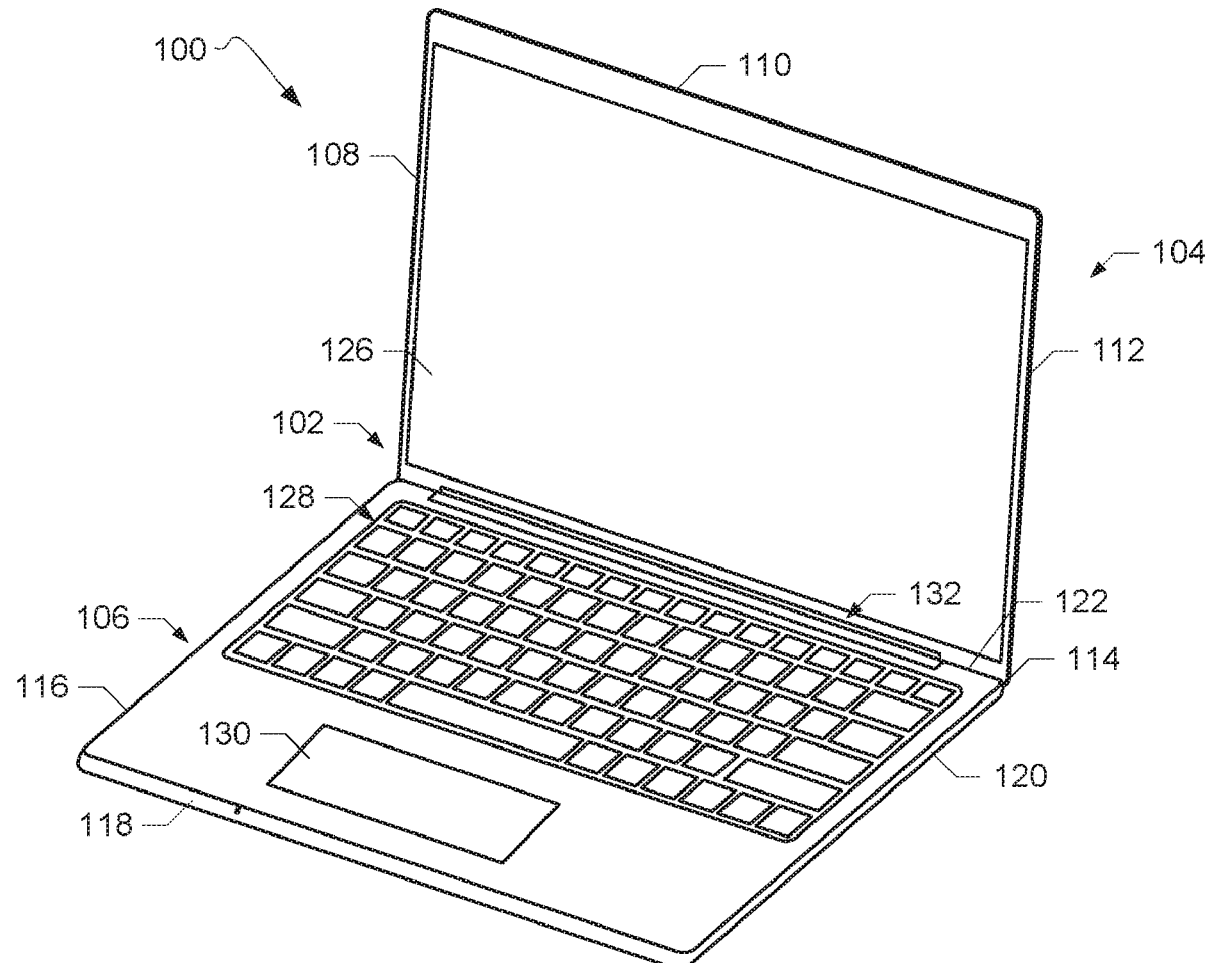
US 20200127384A1

(19) **United States**(12) **Patent Application Publication****Thakur et al.**(10) **Pub. No.: US 2020/0127384 A1**(43) **Pub. Date: Apr. 23, 2020**(54) **SLOT ANTENNAS FOR ELECTRONIC USER DEVICES AND RELATED METHODS****H01Q 21/06** (2006.01)**H01Q 1/22** (2006.01)(71) Applicant: **Intel Corporation**, Santa Clara, CA (US)(52) **U.S. Cl.**CPC **H01Q 13/10** (2013.01); **H01Q 1/44** (2013.01); **G06F 1/1616** (2013.01); **H01Q 21/064** (2013.01); **H01Q 1/2266** (2013.01); **H01Q 5/00** (2013.01)(72) Inventors: **Jayprakash Thakur**, Bangalore (IN);
Prakash Kurma Raju, Bangalore (IN);
Gustavo Fricke, San Jose, CA (US)

(57)

ABSTRACT

Example slot antennas for electronic user device and related methods are disclosed herein. An example electronic user device including at least one of a lid or a base. The at least one of the lid or the base have a first surface and a second surface spaced apart from the second surface. The example electronic user device includes an antenna including a first aperture in the first surface and a second aperture in the second surface. The example user device includes a first cover at least partially disposed in the first aperture and a second cover at least partially disposed in the second aperture.

(21) Appl. No.: **16/716,919**(22) Filed: **Dec. 17, 2019****Publication Classification**(51) **Int. Cl.****H01Q 13/10** (2006.01)**H01Q 1/44** (2006.01)**H01Q 5/00** (2006.01)



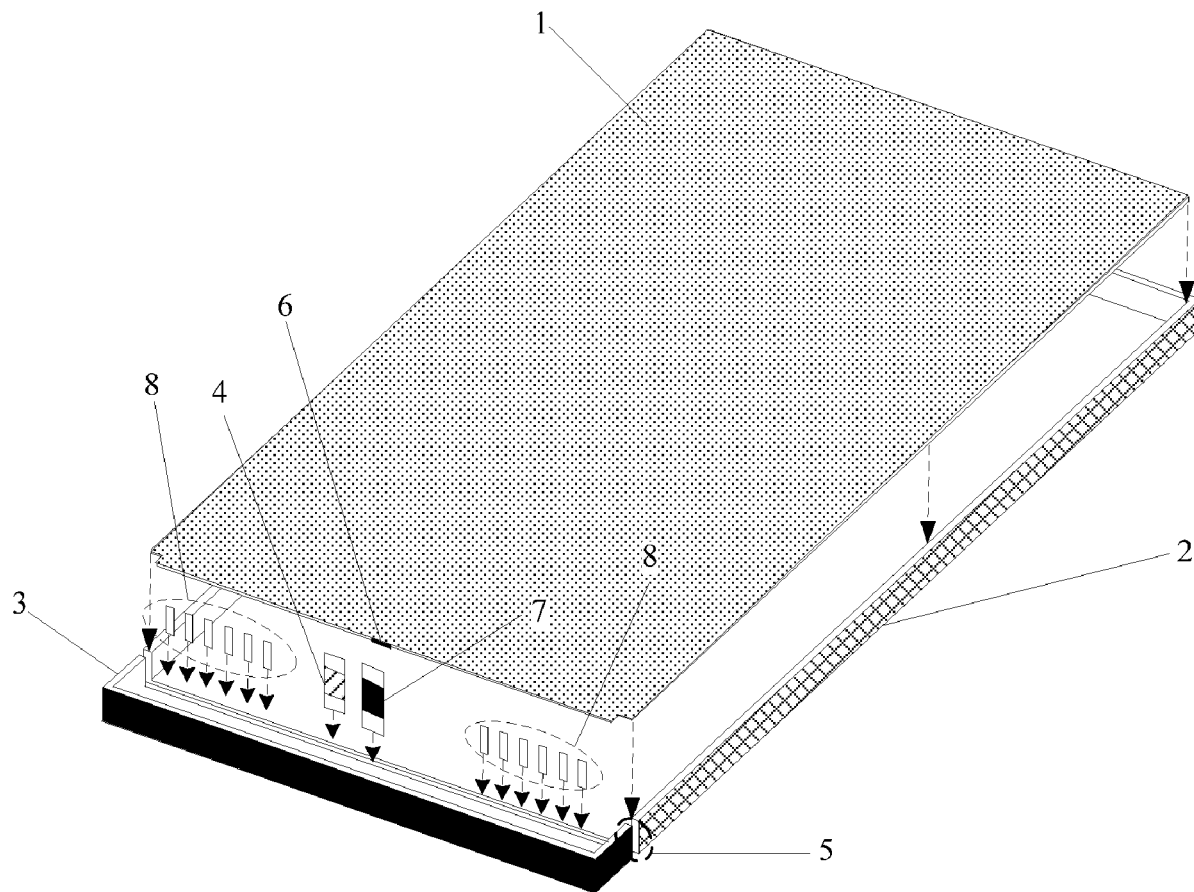
US 20200127385A1

(19) **United States**(12) **Patent Application Publication**
Wang et al.(10) **Pub. No.: US 2020/0127385 A1**(43) **Pub. Date: Apr. 23, 2020**(54) **SLOT ANTENNA AND MOBILE TERMINAL**(71) Applicant: **Huawei Technologies Co., Ltd.**,
Shenzhen (CN)(72) Inventors: **Hanyang Wang**, Reading (GB); **Lijun Ying**, Shanghai (CN); **Xuefei Zhang**,
Shenzhen (CN); **Chien-Ming Lee**,
Shanghai (CN); **Dong Yu**, Shanghai
(CN); **Liang Xue**, Shanghai (CN); **Lei Wang**,
Shanghai (CN); **Chih-Hua Chang**, Taipei (TW)*H01Q 13/12* (2006.01)*H01Q 13/08* (2006.01)*H01Q 1/24* (2006.01)*H01Q 9/42* (2006.01)*H01Q 1/48* (2006.01)(52) **U.S. Cl.**CPC *H01Q 13/103* (2013.01); *H01Q 13/26*
(2013.01); *H01Q 13/12* (2013.01); *H01Q*
13/106 (2013.01); *H01Q 1/48* (2013.01);
H01Q 1/242 (2013.01); *H01Q 1/243*
(2013.01); *H01Q 9/42* (2013.01); *H01Q*
13/085 (2013.01)(21) Appl. No.: **16/716,728**(22) Filed: **Dec. 17, 2019****Related U.S. Application Data**(63) Continuation of application No. 15/566,518, filed on
Oct. 13, 2017, now Pat. No. 10,547,114, filed as
application No. PCT/CN2015/076786 on Apr. 16,
2015.**Publication Classification**(51) **Int. Cl.***H01Q 13/10* (2006.01)*H01Q 13/26* (2006.01)

(57)

ABSTRACT

Embodiments of the present invention relate to the field of antenna technologies, and provide a mobile terminal, to generate different resonance frequencies. The slot antenna includes a system circuit board, a radiator, and a first adjustable unit. The radiator is opposite to the electric conductor to form a slot. A feeding end is disposed on the system circuit board, the feeding end is electrically connected to the radiator, one end of the first adjustable unit is connected to the system circuit board, the other end of the first adjustable unit is connected to the radiator, and the first adjustable unit is configured to adjust a resonance frequency of the slot antenna.





US 20200136230A1

(19) **United States**(12) **Patent Application Publication****Hung et al.**(10) **Pub. No.: US 2020/0136230 A1**(43) **Pub. Date: Apr. 30, 2020**(54) **ANTENNAS IN FRAMES FOR DISPLAY PANELS****Publication Classification**(71) Applicant: **Hewlett-Packard Development Company, L.P.**, Spring, TX (US)(72) Inventors: **Kuan-Jung Hung**, Taipei City (TW);
Chun-Chih Liu, Taipei City (TW)(73) Assignee: **Hewlett-Packard Development Company, L.P.**, Spring, TX (US)(51) **Int. Cl.***H01Q 1/22* (2006.01)*H01Q 5/385* (2006.01)*H01Q 7/00* (2006.01)*H01Q 9/42* (2006.01)*H01Q 1/48* (2006.01)*G06F 1/16* (2006.01)(52) **U.S. Cl.**CPC *H01Q 1/2266* (2013.01); *H01Q 5/385*(2015.01); *G06F 1/1681* (2013.01); *H01Q**9/42* (2013.01); *H01Q 1/48* (2013.01); *H01Q**7/00* (2013.01)(21) Appl. No.: **16/603,612**(22) PCT Filed: **Apr. 11, 2017**(86) PCT No.: **PCT/US2017/027008**

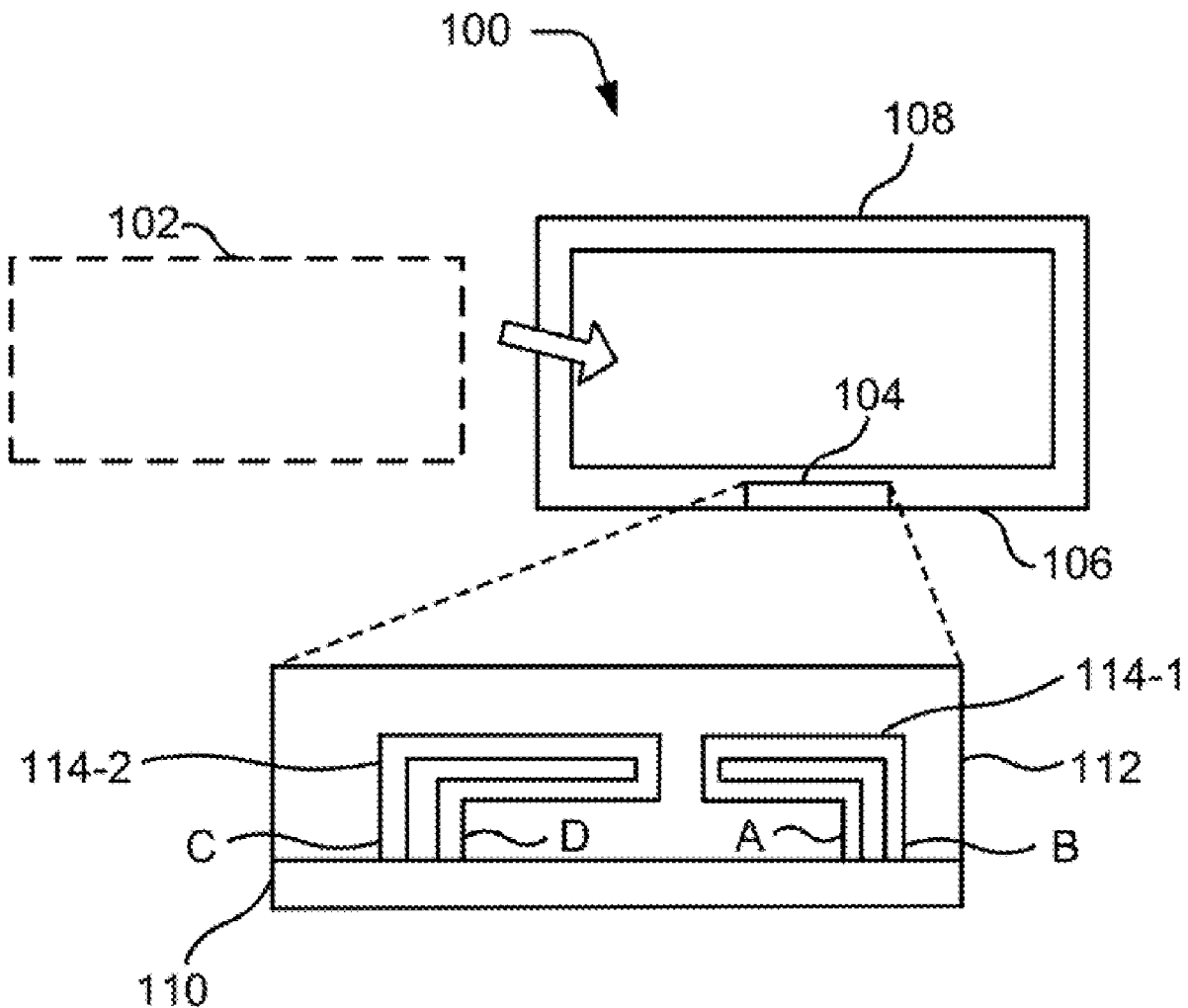
§ 371 (c)(1),

(2) Date: **Oct. 8, 2019**

(57)

ABSTRACT

The present subject matter describes positioning of an antenna inside a frame for a display panel of an electronic device. The antenna comprises a ground plate extending along a side of the frame, a substrate positioned on the ground plate, and two loop antenna elements formed on the substrate, both ends of each of the two loop antenna elements being connected to the ground plate.





US 20200136231A1

(19) **United States**(12) **Patent Application Publication**
LEE et al.(10) **Pub. No.: US 2020/0136231 A1**(43) **Pub. Date: Apr. 30, 2020**(54) **ANTENNA AND ELECTRONIC DEVICE
INCLUDING THE SAME****H04M 1/02** (2006.01)**H05K 1/11** (2006.01)(71) Applicant: **Samsung Electronics Co., Ltd.**,
Suwon-si (KR)(52) **U.S. Cl.****CPC** **H01Q 1/2266** (2013.01); **G06F 1/1616**
(2013.01); **H05K 1/118** (2013.01); **H04M**
1/0216 (2013.01); **H01Q 1/2291** (2013.01)(72) Inventors: **Jonghyuck LEE**, Suwon-si (KR);
Taeik KIM, Suwon-si (KR); **Haeyeon**
KIM, Suwon-si (KR); **Sehyun PARK**,
Suwon-si (KR); **Dongjun OH**,
Suwon-si (KR); **Shinho YOON**,
Suwon-si (KR); **Myeongsu OH**,
Suwon-si (KR)

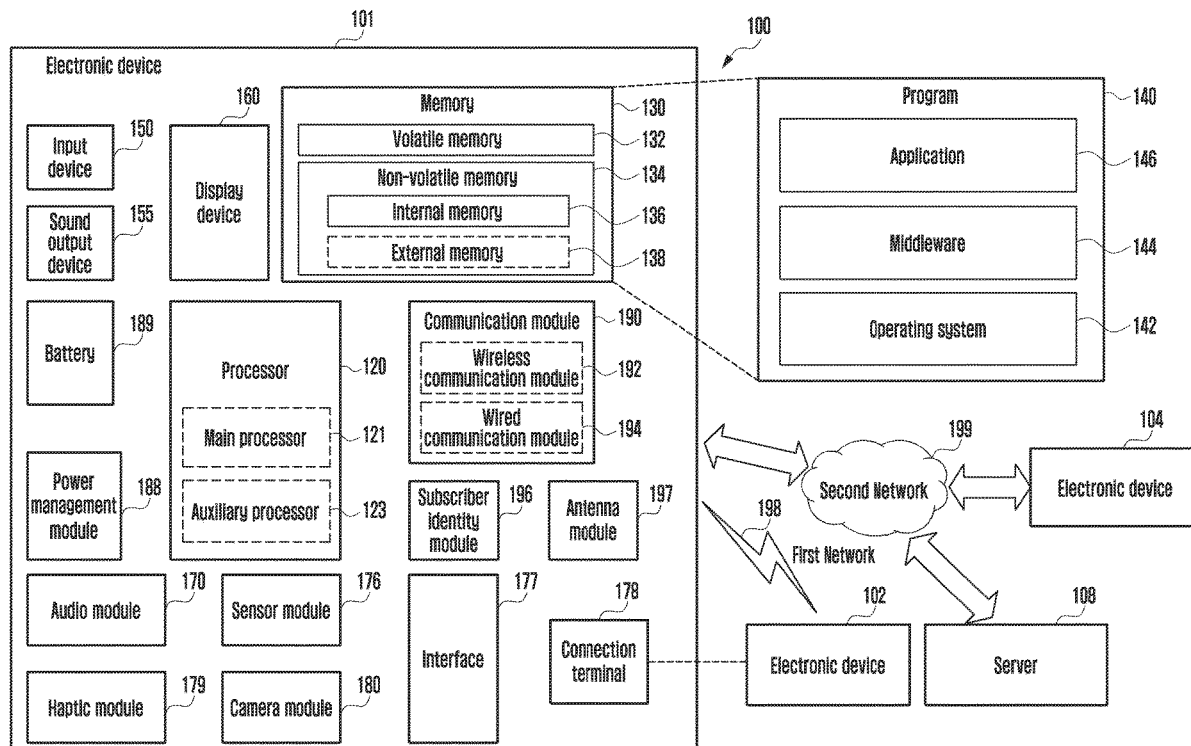
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ABSTRACT

An electronic device is provided. The electronic device includes a foldable housing, a flexible display, at least one printed circuit board (PCB), and a wireless communication circuit. The foldable housing includes a hinge structure, a first housing structure connected to the hinge structure and including a first surface facing in a first direction, a second surface facing in a direction opposite to the first direction, and a first lateral member surrounding a first space between the first surface and the second surface, and a second housing structure connected to the hinge structure and including a third surface facing in a second direction, a fourth surface facing in a direction opposite to the second direction, and a second lateral member surrounding a second space between the third surface and the fourth surface.

(21) Appl. No.: **16/655,969**(22) Filed: **Oct. 17, 2019**(30) **Foreign Application Priority Data**

Oct. 24, 2018 (KR) 10-2018-0127259

Publication Classification(51) **Int. Cl.****H01Q 1/22** (2006.01)**G06F 1/16** (2006.01)



(19) **United States**

(12) **Patent Application Publication**
CHEN et al.(10) **Pub. No.: US 2020/0136235 A1**

(43) **Pub. Date:** **Apr. 30, 2020**

(54) ANTENNA STRUCTURE

Publication Classification

(71) Applicant: **Shenzhen Next Generation Communications Limited**, Shenzhen (CN)

(72) Inventors: **JIA CHEN**, Shenzhen (CN); **KUO-CHENG CHEN**, New Taipei (TW); **JIAN-WEI CHANG**, New Taipei (TW); **ZHEN-CHANG TANG**, Shenzhen (CN); **YI-LING JIANG**, Shenzhen (CN); **WEI-YU YE**, Shenzhen (CN); **BO PENG**, Shenzhen (CN); **CHUN-SHENG WU**, New Taipei (TW)

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 5/371 (2006.01)

H01Q 9/04 (2006.01)

H01Q 9/30 (2006.01)

H01Q 13/10 (2006.01)

H01Q 1/36 (2006.01)

(52) U.S. Cl.

CPC *H01Q 1/243* (2013.01); *H01Q 5/371*
(2015.01); *H01Q 1/36* (2013.01); *H01Q 9/30*
(2013.01); *H01Q 13/10* (2013.01); *H01Q*
9/0442 (2013.01)

(57)

ABSTRACT

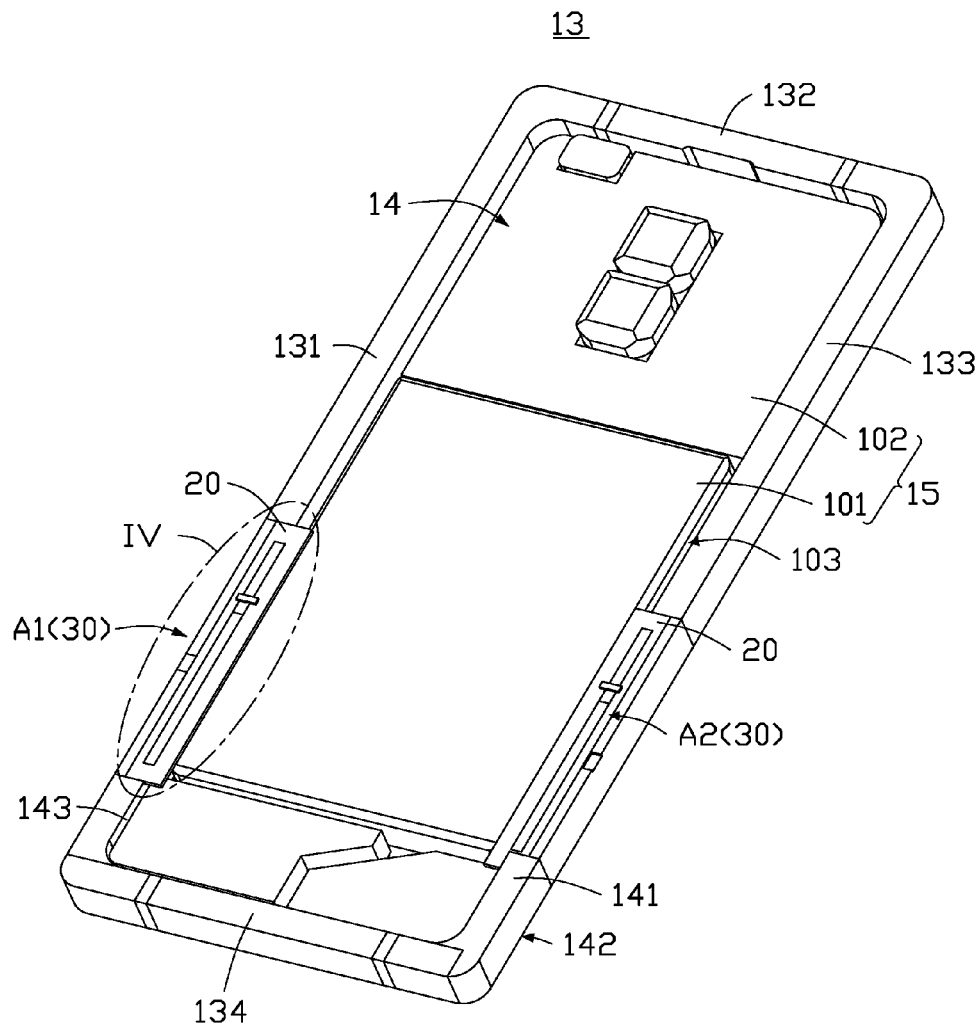
An antenna structure applied in a wireless communication device includes a metal frame. The wireless communication device includes at least one electronic component. The metal frame includes a substrate. The substrate includes an antenna. The antenna includes a feed portion and a gap. The feed portion spans the gap. The metal frame is spaced from the electronic component. A clearance is formed between the metal frame and the electronic component.

(21) Appl. No.: 16/654,872

(22) Filed: **Oct. 16, 2019**

(30) **Foreign Application Priority Data**

Oct. 24, 2018 (CN) 201811244525.4





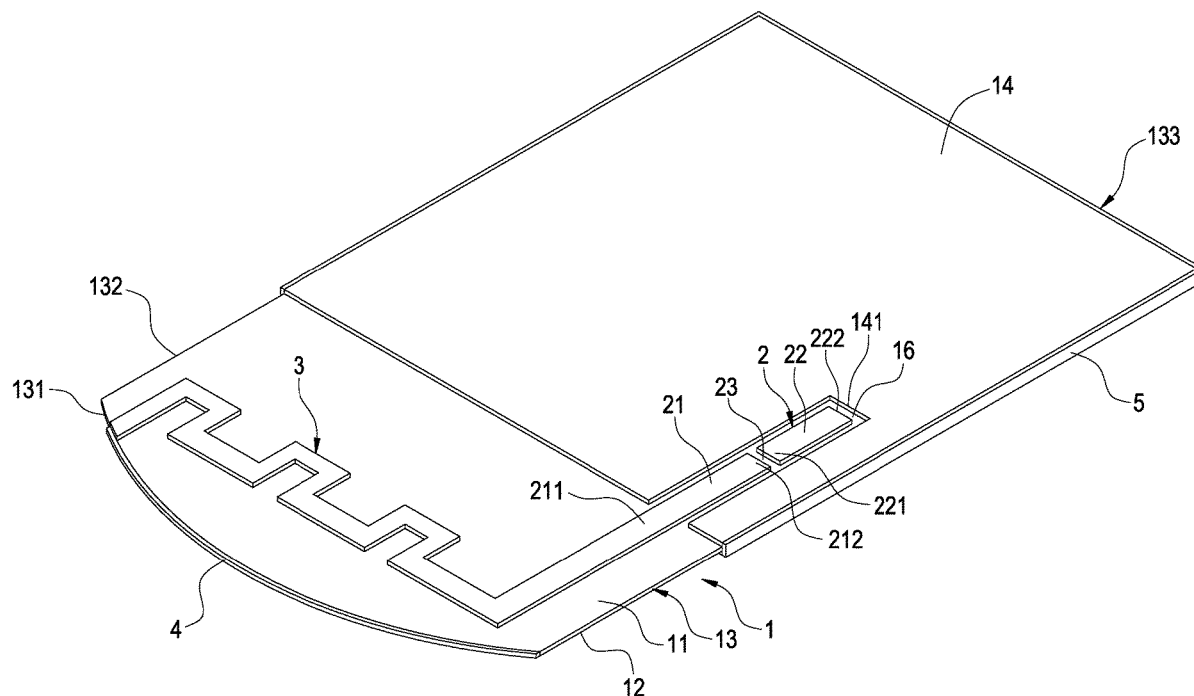
US 20200136252A1

(19) **United States**(12) **Patent Application Publication****Liao et al.**(10) **Pub. No.: US 2020/0136252 A1**(43) **Pub. Date: Apr. 30, 2020**(54) **ENHANCED PRINTED CIRCUIT BOARD
MONOPOLE ANTENNA**(71) Applicant: **Power Wave Electronic Co., Ltd.**,
Taipei City (TW)(72) Inventors: **Wen-Jiao Liao**, Taipei City (TW);
Wei-Hong Tsai, Taipei City (TW);
Yun-Chan Tsai, Taipei City (TW)(21) Appl. No.: **16/727,860**(22) Filed: **Dec. 26, 2019****Related U.S. Application Data**(62) Division of application No. 15/614,593, filed on Jun.
5, 2017.**Publication Classification**(51) **Int. Cl.**
H01Q 5/357 (2006.01)
H01Q 1/24 (2006.01)
H01Q 1/38 (2006.01)
H01Q 9/42 (2006.01)(52) **U.S. Cl.**CPC **H01Q 5/357** (2015.01); **H01Q 9/42**
(2013.01); **H01Q 1/38** (2013.01); **H01Q 1/243**
(2013.01)

(57)

ABSTRACT

An enhanced printed circuit board monopole antenna includes a baseplate, a signal feed-in unit, a first-radiation unit, a second-radiation unit and an auxiliary ground unit. The first-radiation unit and the second-radiation unit are arranged on a front side and an edge side of the baseplate. The auxiliary ground unit is arranged on the edge side and electrically connected to a first ground unit and a second ground unit on the baseplate. Adjusting the first-radiation unit controls 88 MHZ-60 GHZ frequency range impedance, resonant frequency, bandwidth and radiation effect. According to the frequency wave length (1λ , $\frac{1}{2}\lambda$, $\frac{1}{4}\lambda$ or $\frac{1}{8}\lambda$) formed by the first-radiation unit and the second-radiation unit cooperating with each other, controlling 88 MHZ-60 GHZ frequency range achieves the predetermined target impedance, resonant frequency, bandwidth and radiation efficiency. The antenna radiation efficiency can be increased effectively.





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(19) **United States**

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

(10) **Pub. No.: US 2020/0144699 A1**

(43) **Pub. Date: May 7, 2020**

(54) **ELECTRONIC DEVICE COMPRISING
ANTENNA**

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

(72) Inventors: **Seunggil JEON**, Suwon-si (KR);
Kyungwoo LEE, Suwon-si (KR);
Joohyun AHN, Suwon-si (KR)

(21) Appl. No.: **16/661,033**

(22) Filed: **Oct. 23, 2019**

(30) **Foreign Application Priority Data**

Nov. 5, 2018 (KR) 10-2018-0134740

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 5/50 (2006.01)

H01Q 9/04 (2006.01)

H01Q 1/48 (2006.01)

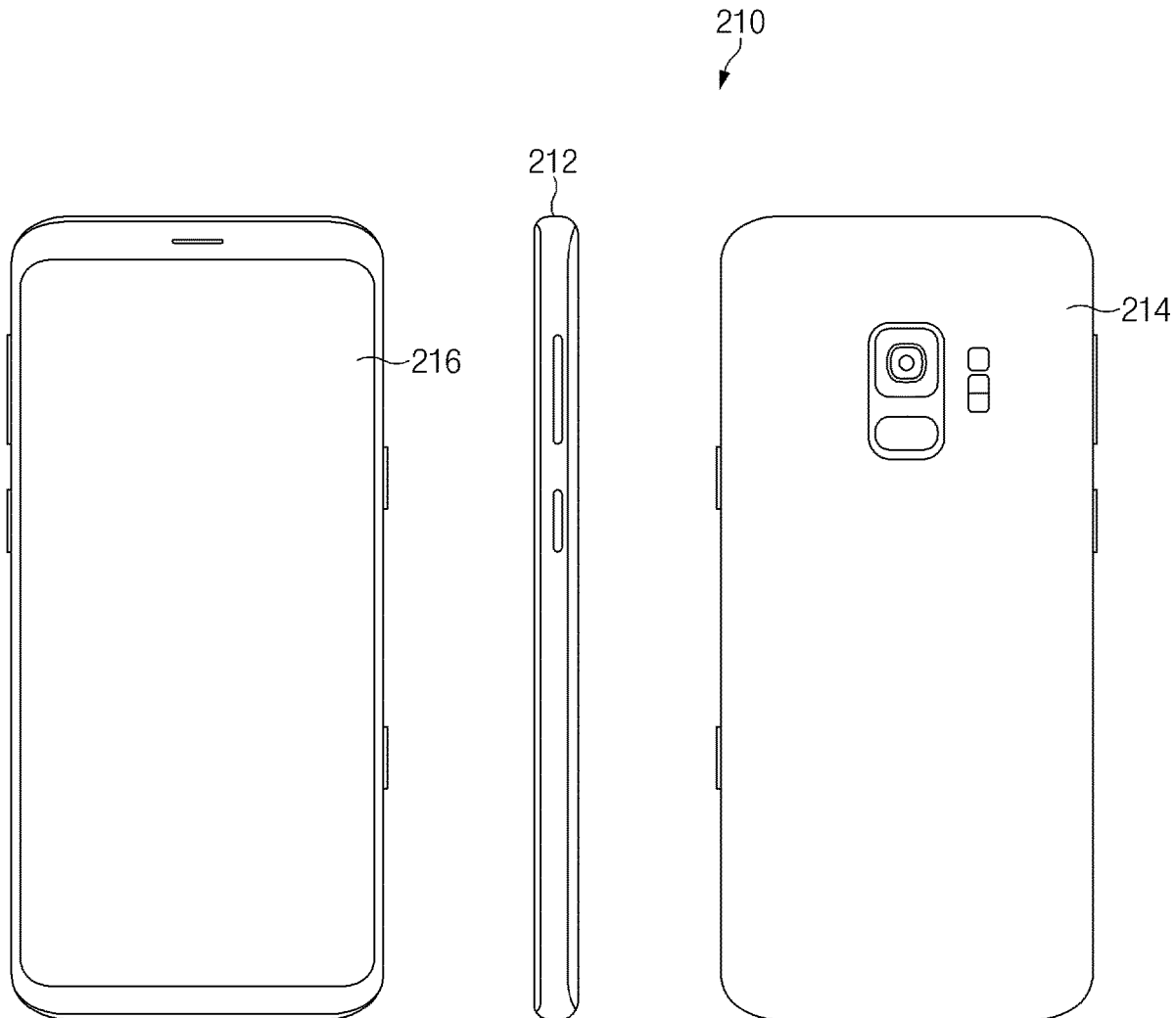
(52) **U.S. Cl.**

CPC **H01Q 1/243** (2013.01); **H01Q 1/48**
(2013.01); **H01Q 9/0421** (2013.01); **H01Q**
5/50 (2015.01)

(57)

ABSTRACT

An electronic device may include a housing including a conductive area, a first conductive member comprising a conductive material in electrical contact with the conductive area, a first wireless communication circuit electrically connected to the conductive area, and a second wireless communication circuit electrically connected to the first conductive member. The first wireless communication circuit transmits and/or receives a first signal having a frequency of 6 GHz or less using the conductive area, and the second wireless communication circuit transmits and/or receives a second signal having a frequency of 20 GHz or more using at least part of the first conductive member and the conductive area.





US 20200144707A1

(19) **United States**(12) **Patent Application Publication**
CHANG et al.(10) **Pub. No.: US 2020/0144707 A1**(43) **Pub. Date: May 7, 2020**(54) **THREE-DIMENSIONAL ANTENNA
ELEMENT**(52) **U.S. Cl.**CPC *H01Q 1/36* (2013.01); *H01Q 1/243*
(2013.01)(71) Applicant: **ASUSTeK COMPUTER INC.**, Taipei
(TW)(72) Inventors: **Wei-Hsuan CHANG**, TAIPEI (TW);
Fang-Hsien CHU, TAIPEI (TW)(21) Appl. No.: **16/669,749**(22) Filed: **Oct. 31, 2019**(30) **Foreign Application Priority Data**

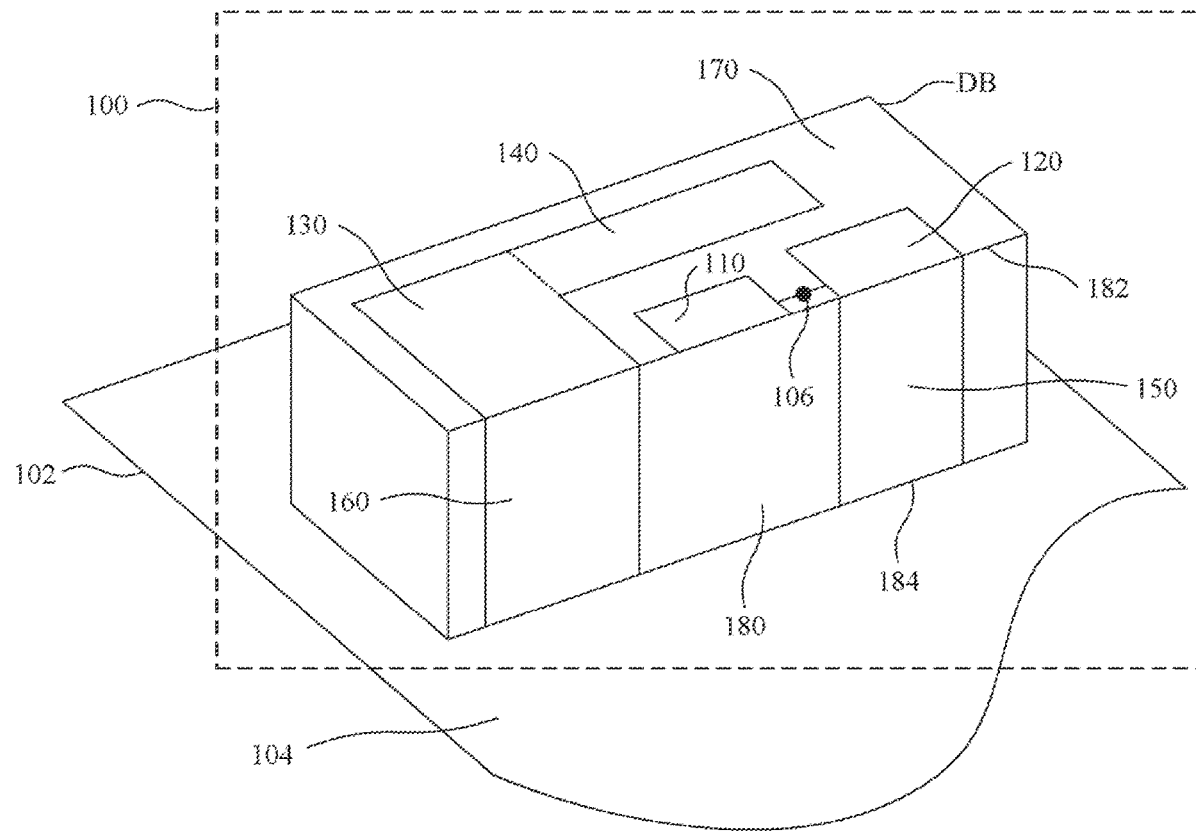
Nov. 7, 2018 (TW) 107139548

Publication Classification(51) **Int. Cl.***H01Q 1/36* (2006.01)*H01Q 1/24* (2006.01)

(57)

ABSTRACT

A three-dimensional antenna element is provided. The three-dimensional antenna element is configured to be disposed on a surface of a conductive substrate, and includes a dielectric base, a first radiation part, a second radiation part, a third radiation part, a fourth radiation part, a first shorting element, and a second shorting element. The dielectric base includes a first plane and a second plane, where the second plane includes a first side and a second side, the first side is opposite to the second side and configured to be joined to the first plane, and the second side is configured to be joined to the surface of the conductive substrate. A signal feed-in point is coupled between the first radiation part and the second radiation part.





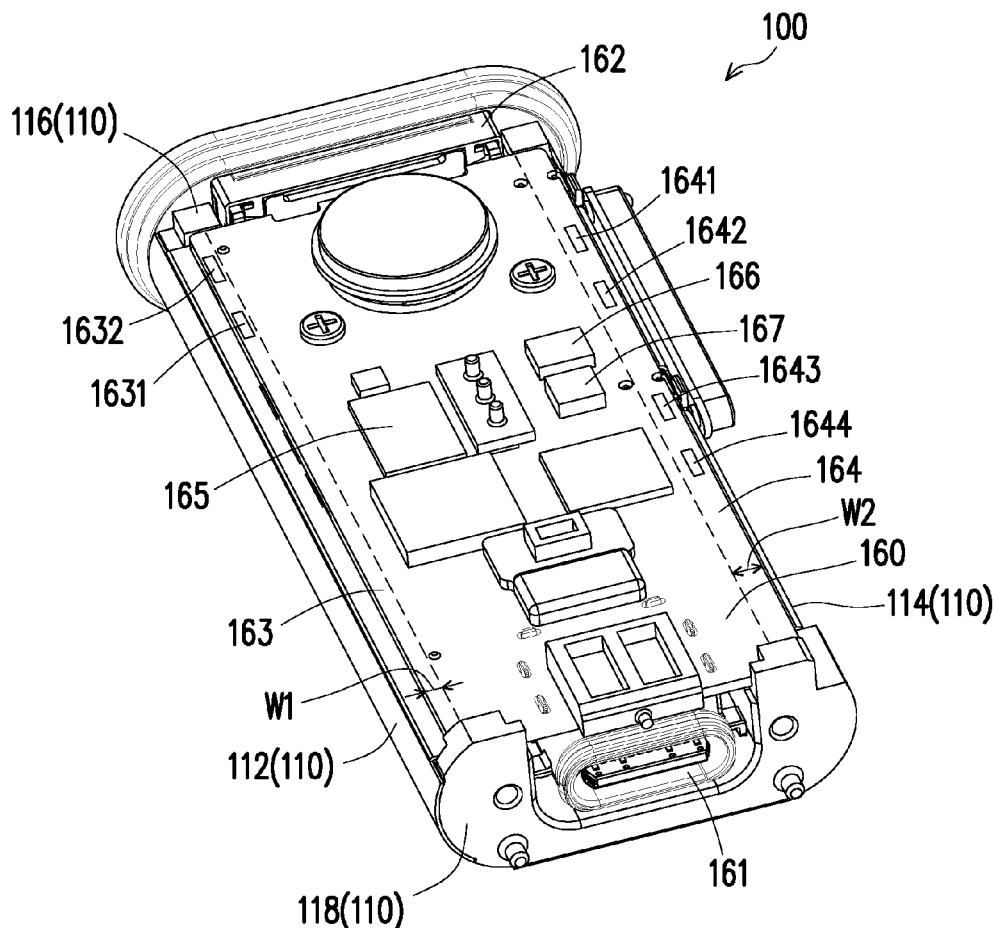
US 20200144712A1

(19) **United States**(12) **Patent Application Publication****Wu et al.**(10) **Pub. No.: US 2020/0144712 A1**(43) **Pub. Date: May 7, 2020**(54) **ELECTRONIC DEVICE**(71) Applicant: **PEGATRON CORPORATION,**
TAIPEI CITY (TW)(72) Inventors: **Chien-Yi Wu**, Taipei City (TW);
Chao-Hsu Wu, Taipei City (TW);
Cheng-Hsiung Wu, Taipei City (TW);
Yi-Ru Yang, Taipei City (TW);
Ching-Hsiang Ko, Taipei City (TW);
Shih-Keng Huang, Taipei City (TW);
Sheng-Chin Hsu, Taipei City (TW)(73) Assignee: **PEGATRON CORPORATION,**
TAIPEI CITY (TW)(21) Appl. No.: **16/595,141**(22) Filed: **Oct. 7, 2019**(30) **Foreign Application Priority Data**

Nov. 2, 2018 (TW) 107139068

Publication Classification(51) **Int. Cl.**
H01Q 1/52 (2006.01)
H04M 1/03 (2006.01)(52) **U.S. Cl.**
CPC **H01Q 1/521** (2013.01); **H01Q 1/526**
(2013.01); **H01Q 1/2291** (2013.01); **H01Q**
5/30 (2015.01); **H01Q 1/243** (2013.01); **H04M**
1/03 (2013.01)(57) **ABSTRACT**

The disclosure provides an electronic device including a carrier, a first antenna, a second antenna, a third antenna, and a shielding structure. The carrier includes a first side and a second side opposite to each other, and a third side and a fourth side opposite to each other. The first antenna is disposed at the first side of the carrier. The second antenna and the third antenna are disposed at the second side of the carrier. The first, second, and third antennas are used for transmitting and receiving wireless signals at first, second, and third frequency bands, respectively. The shielding structure is disposed between the first antenna and the second antenna, and between the first antenna and the third antenna, so that the shielding structure shields interference signals between the first antenna and the second antenna, and interference signals between the first antenna and the third antenna.





US 20200144713A1

(19) **United States**(12) **Patent Application Publication**
JUNG et al.(10) **Pub. No.: US 2020/0144713 A1**(43) **Pub. Date: May 7, 2020**(54) **ELECTRONIC DEVICE INCLUDING
ANTENNA MODULE**(71) Applicant: **Samsung Electronics Co., Ltd.**,
Gyeonggi-do (KR)(72) Inventors: **Sangmin JUNG**, Gyeonggi-do (KR);
Geunwoo KIM, Gyeonggi-do (KR)(21) Appl. No.: **16/571,544**(22) Filed: **Sep. 16, 2019**(30) **Foreign Application Priority Data**

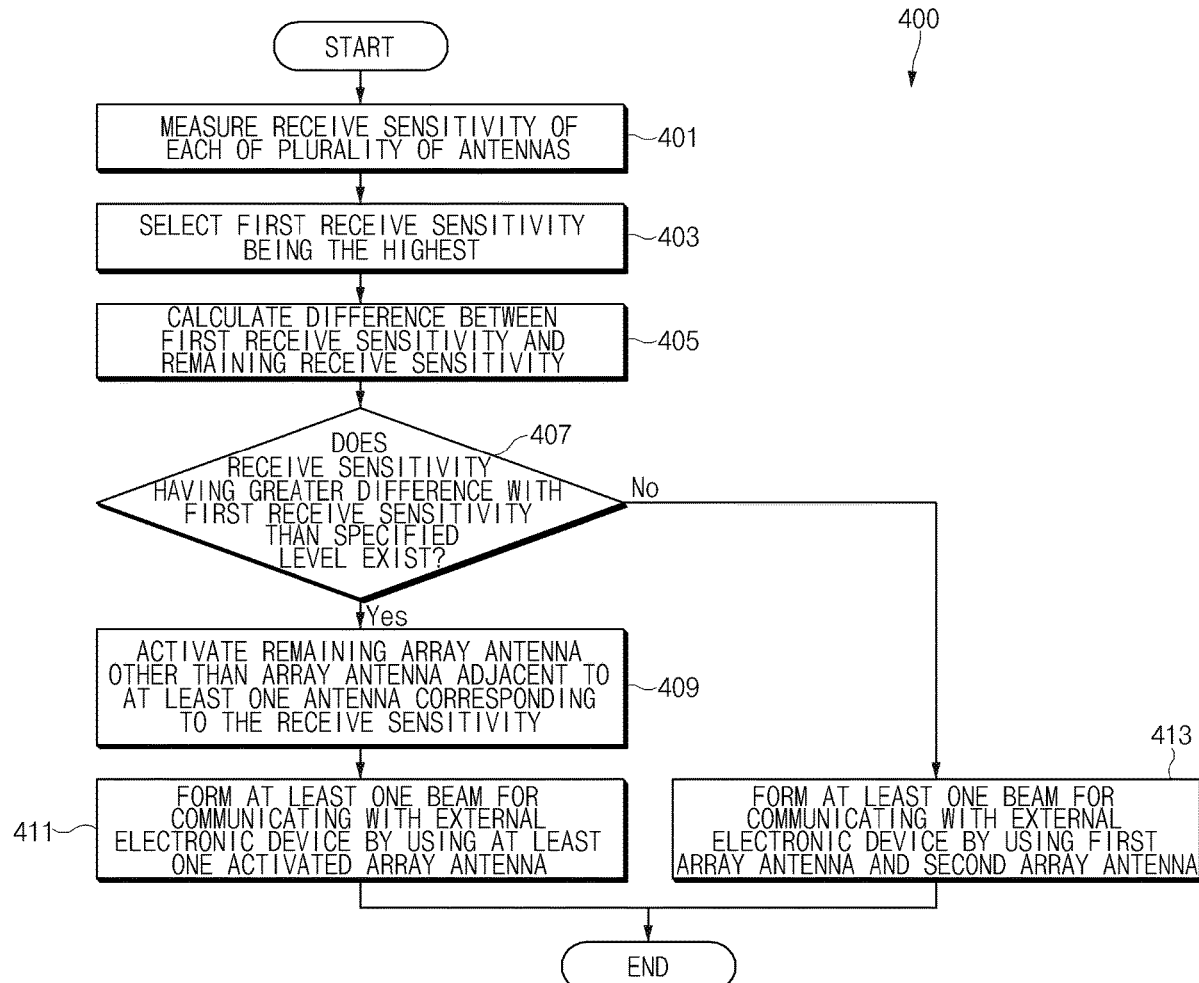
Nov. 7, 2018 (KR) 10-2018-0135770

Publication Classification(51) **Int. Cl.****H01Q 1/52** (2006.01)**H04W 76/10** (2006.01)**G06F 13/38** (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/523** (2013.01); **H04W 36/0072**
(2013.01); **G06F 13/385** (2013.01); **H04W**
76/10 (2018.02)

(57)

ABSTRACT

An electronic device comprises a plurality of antennas, wherein each of the plurality of antennas are spaced apart from each other, a first communication circuit electrically connected with the plurality of antennas, a plurality of array antennas comprising a first array antenna disposed adjacent to at least one of the plurality of antennas, and a second array antenna disposed adjacent to another antenna different from the at least one antenna of the plurality of antennas, a second communication circuit electrically connected with the first array antenna and the second array antenna, and at least one control circuit electrically connected with the first communication circuit and the second communication circuit, wherein the at least one control circuit is configured to obtain receive sensitivities of the plurality of antennas through the first communication circuit; activate at least one array antenna of the first array antenna and the second array antenna through the second communication circuit based at least on the receive sensitivities; and control the activated at least one array antenna to form at least one beam for communication with an external electronic device.





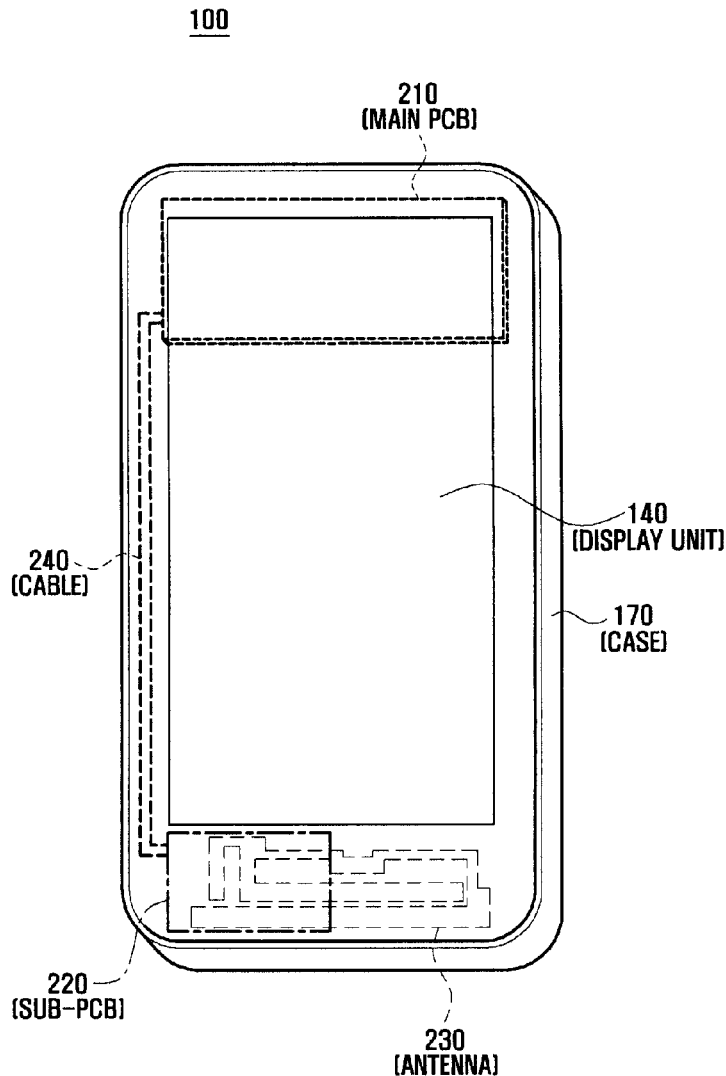
US 20200153084A1

(19) **United States**(12) **Patent Application Publication**
YUN(10) **Pub. No.: US 2020/0153084 A1**(43) **Pub. Date: May 14, 2020**(54) **ANTENNA APPARATUS OF MOBILE
TERMINAL**(71) Applicant: **Samsung Electronics Co., Ltd.**,
Gyeonggi-do (KR)(72) Inventor: **Ju Hwan YUN**, Gyeongsangbuk-do
(KR)(21) Appl. No.: **16/745,554**(22) Filed: **Jan. 17, 2020****Related U.S. Application Data**(63) Continuation of application No. 16/291,097, filed on
Mar. 4, 2019, now Pat. No. 10,541,466, which is a
continuation of application No. 14/559,072, filed on
Dec. 3, 2014, now Pat. No. 10,224,600, which is a
continuation of application No. 12/782,775, filed on
May 19, 2010, now Pat. No. 8,929,946.(30) **Foreign Application Priority Data**

May 21, 2009 (KR) 10-2009-0044377

Publication Classification(51) **Int. Cl.**
H01Q 1/24 (2006.01)(52) **U.S. Cl.**
CPC **H01Q 1/24** (2013.01); **H04M 1/0274**
(2013.01); **H01Q 1/243** (2013.01)(57) **ABSTRACT**

A mobile terminal and manufacture of same are provided. The mobile terminal includes: an antenna; a first case at which the antenna is disposed; a second case coupled to the first case; a main PCB disposed at one side of the second case; and a sub-PCB disposed at an opposite side of the second case, the sub-PCB being connected to the main PCB through a cable, wherein the sub-PCB is electrically coupled with the antenna when the first case and the second case are coupled together.





US 20200153086A1

(19) **United States**(12) **Patent Application Publication**
PARK et al.(10) **Pub. No.: US 2020/0153086 A1**(43) **Pub. Date: May 14, 2020**(54) **ANTENNA USING SLOT AND ELECTRONIC
DEVICE INCLUDING THE SAME****H01Q 21/30** (2006.01)**H01Q 13/16** (2006.01)(71) Applicant: **Samsung Electronics Co., Ltd.**,
Suwon-si (KR)(52) **U.S. Cl.**CPC **H01Q 1/243** (2013.01); **H01Q 13/16**
(2013.01); **H01Q 21/30** (2013.01); **H01Q**
21/064 (2013.01)(72) Inventors: **Seongjin PARK**, Suwon-si (KR);
Dongyeon KIM, Suwon-si (KR);
Sehyun PARK, Suwon-si (KR); **Sumin**
YUN, Suwon-si (KR); **Woomin JANG**,
Suwon-si (KR); **Myunghun JEONG**,
Suwon-si (KR); **Jehun JONG**,
Suwon-si (KR); **Jinwoo JUNG**,
Suwon-si (KR); **Jaehoon JO**, Suwon-si
(KR)

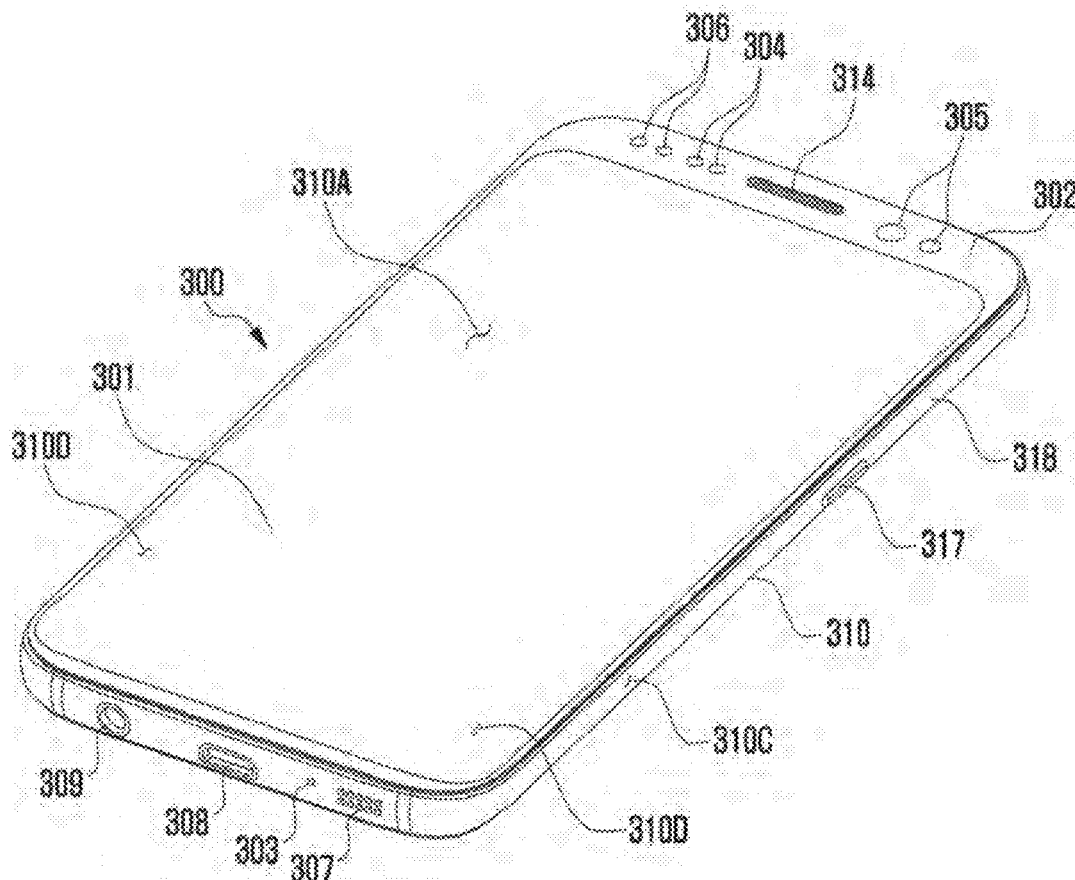
(57)

ABSTRACT

An electronic device is provided. The electronic device includes a housing including a first plate, a second plate directed in an opposite direction to the first plate, and a side member surrounding a space between the first plate and the second plate and being combined with or being integrally formed with the second plate, a display configured to be seen through at least a part of the first plate, an antenna structure arranged inside the housing, the antenna structure including a first conductive layer including a first region including a first U-shaped slot and a second region coming in contact with the first region, and a second conductive layer facing the first conductive layer to be spaced apart from the first conductive layer, and including a third region including a second U-shaped slot facing the first U-shaped slot and a fourth region coming in contact with the third region and facing the second region, and at least one wireless communication circuitry electrically connected to the first conductive layer or the second conductive layer and configured to transmit and/or receive a signal having a frequency in a range of 3 GHz to 100 GHz. Other various embodiments are possible.

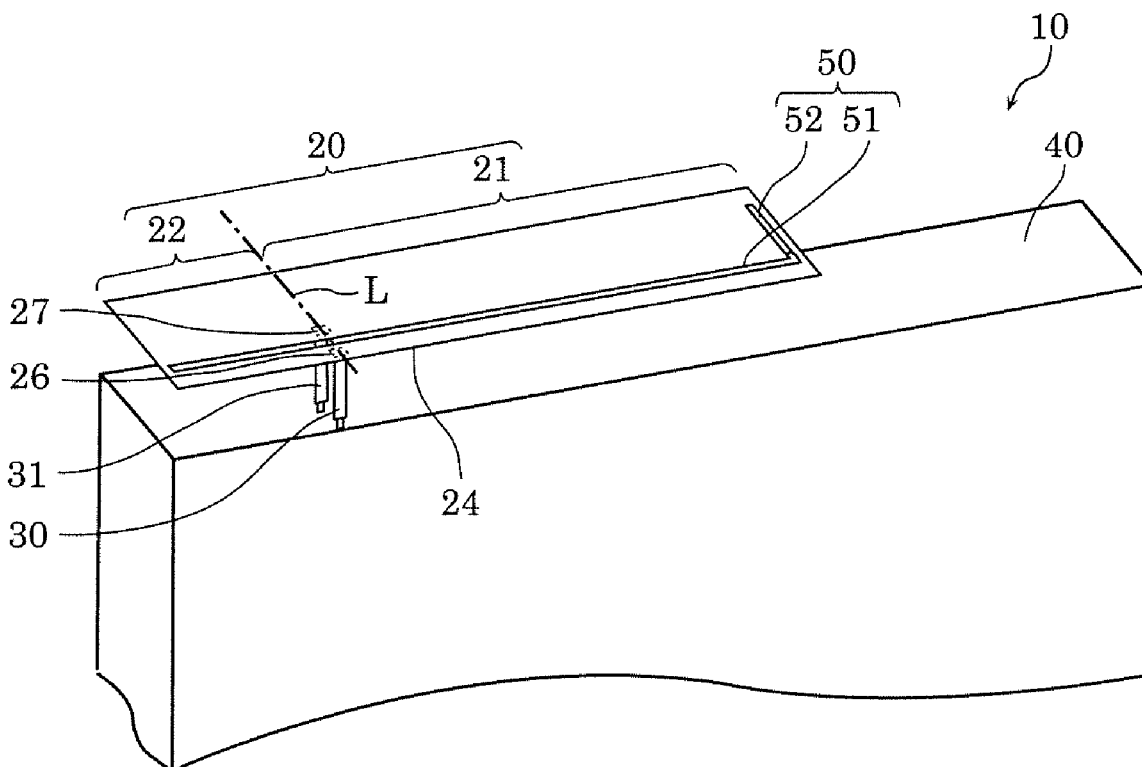
(21) Appl. No.: **16/676,824**(22) Filed: **Nov. 7, 2019**(30) **Foreign Application Priority Data**

Nov. 14, 2018 (KR) 10-2018-0139558

Publication Classification(51) **Int. Cl.****H01Q 1/24** (2006.01)**H01Q 21/06** (2006.01)



(43) **Pub. Date:** **May 14, 2020**





US 20200153099A1

(19) **United States**(12) **Patent Application Publication**
ISHIZUKA(10) **Pub. No.: US 2020/0153099 A1**(43) **Pub. Date: May 14, 2020**(54) **ANTENNA COUPLING ELEMENT,
ANTENNA DEVICE, AND ELECTRONIC
DEVICE****Publication Classification**

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

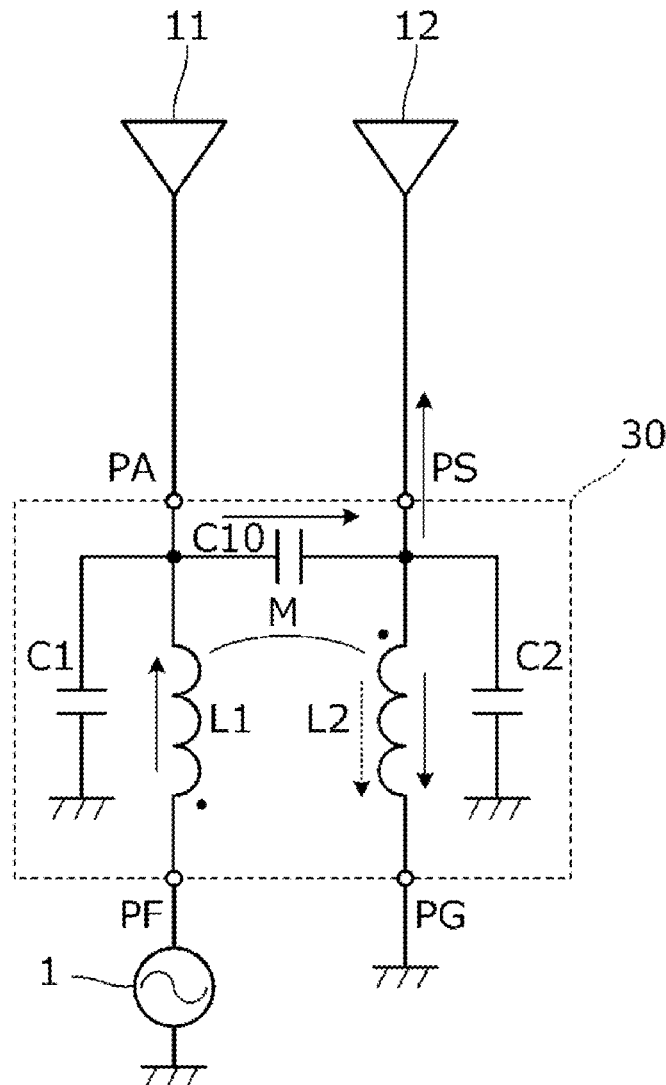
(52) **U.S. Cl.**
CPC **H01Q 9/045** (2013.01); **H01Q 1/48**
(2013.01)

(71) Applicant: **Murata Manufacturing Co., Ltd.**,
Nagaokakyo-shi (JP)(72) Inventor: **Kenichi ISHIZUKA**, Nagaokakyo-shi
(JP)(21) Appl. No.: **16/744,226**(22) Filed: **Jan. 16, 2020****Related U.S. Application Data**(63) Continuation of application No. PCT/JP2018/
021580, filed on Jun. 5, 2018.(30) **Foreign Application Priority Data**

Jul. 21, 2017 (JP) 2017-141549

(57) **ABSTRACT**

An antenna device includes first and second radiating elements, and an antenna coupling element. The antenna coupling element includes a primary coil electrically connected between the first radiating element and a feed circuit and a secondary coil inductively coupled to the primary coil and electrically connected between the second radiating element and a ground. A capacitor is provided between the primary coil and the secondary coil, thus causing current to flow from the primary coil to the secondary coil or the second radiating element via the capacitor even at an anti-resonant frequency of the first radiating element.

100



US 20200153115A1

(19) **United States**

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

(10) **Pub. No.: US 2020/0153115 A1**

(43) **Pub. Date: May 14, 2020**

(54) **ANTENNA HAVING RADIATION
STRUCTURE OF GIVEN DIRECTION AND
ELECTRONIC DEVICE INCLUDING SAME**

(52) **U.S. Cl.**
CPC *H01Q 21/065* (2013.01); *H01Q 5/30*
(2015.01); *H01Q 3/36* (2013.01); *G06F*
3/0412 (2013.01)

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

(57) **ABSTRACT**

(72) Inventors: **Sumin YUN**, Suwon-si (KR);
Dongyeon KIM, Suwon-si (KR);
Yoonjung KIM, Suwon-si (KR);
Seongjin PARK, Suwon-si (KR);
Sehyun PARK, Suwon-si (KR);
Myunghun JEONG, Suwon-si (KR);
Jehun JONG, Suwon-si (KR); **Jaehoon**
JO, Suwon-si (KR)

An electronic device may include a housing including a first plate facing a first direction, a second plate facing a second direction opposite the first direction, and a side housing surrounding a space between the first plate and the second plate, wherein the side housing includes a first portion, including an external metal portion having a first face facing an outside and a second face facing the space and an internal polymer portion having a third face contacting the second face and a fourth face facing the space, a touch screen display positioned within the space to be viewable through the first plate, wherein an edge of the touch screen display is spaced apart from the first portion of the side housing and when the first plate is viewed from above, the gap is covered by a peripheral portion of the first glass plate, an antenna structure comprising at least one antenna and configured to include a substrate having a fifth face substantially parallel to the second face and a sixth face facing a direction opposite the fifth face and at least one conductive pattern positioned between the fifth face and the sixth face and extending toward the peripheral portion of the first plate, and wireless communication circuitry operatively connected to the at least one conductive pattern and configured to form a directivity beam using at least a part of the at least one conductive pattern.

(21) Appl. No.: **16/676,691**

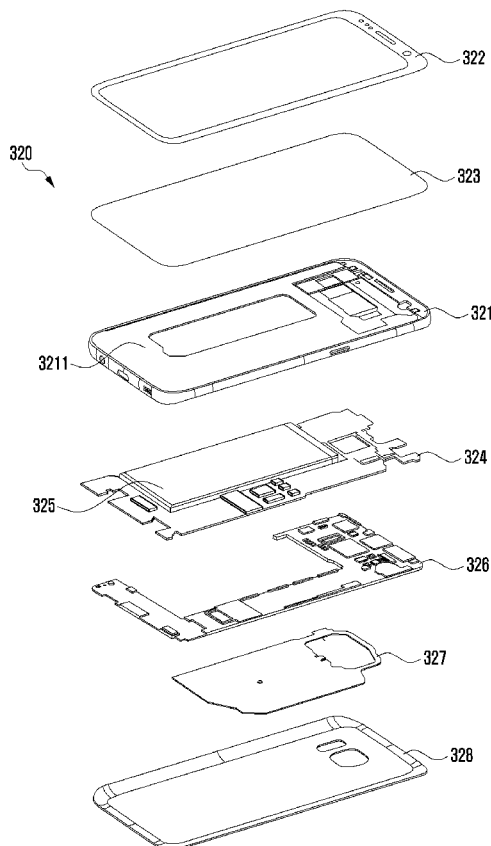
(22) Filed: **Nov. 7, 2019**

(30) **Foreign Application Priority Data**

Nov. 9, 2018 (KR) 10-2018-0137020

Publication Classification

(51) **Int. Cl.**
H01Q 21/06 (2006.01)
G06F 3/041 (2006.01)
H01Q 3/36 (2006.01)
H01Q 5/30 (2006.01)





US 20200153947A1

(19) **United States**

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

(10) **Pub. No.: US 2020/0153947 A1**

(43) **Pub. Date: May 14, 2020**

(54) **MOBILE TERMINAL**

Publication Classification

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

(51) **Int. Cl.**
H04M 1/02 (2006.01)
H01Q 1/24 (2006.01)
H01Q 13/10 (2006.01)
H04B 1/3827 (2006.01)

(72) Inventors: **Kyongsun HWANG**, Seoul (KR); **Moonsoo SONG**, Seoul (KR); **Yoonjae WON**, Seoul (KR); **Deuksu CHOI**, Seoul (KR); **Chisang YOU**, Seoul (KR)

(52) **U.S. Cl.**
CPC *H04M 1/0202* (2013.01); *H01Q 1/243* (2013.01); *H01Q 1/44* (2013.01); *H04B 1/3833* (2013.01); *H04M 1/026* (2013.01); *H01Q 13/10* (2013.01)

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

(57) **ABSTRACT**

(21) Appl. No.: **16/742,785**

There is disclosed a mobile terminal including: a display; a middle frame including a supporting portion and a side portion provided around the supporting portion to define a lateral external appearance; a main board including a ground; a first wireless communication unit configured to transceive a first signal; a second wireless communication unit configured to transceive a second signal; and a rear case configured to cover a rear surface of the main board, wherein the side portion includes a plurality of conductive members of which ends are divided into slits, and the plurality of the conductive members includes a common antenna electrically connectable with the first wireless communication unit and the second wireless communication unit and configured to receive the first signal and the second signal; and an independent antenna electrically connectable with the first wireless communication unit and configured to receive the first signal.

(22) Filed: **Jan. 14, 2020**

Related U.S. Application Data

(63) Continuation of application No. 16/383,399, filed on Apr. 12, 2019, now Pat. No. 10,560,557, which is a continuation of application No. 16/022,512, filed on Jun. 28, 2018, now Pat. No. 10,306,029.

(60) Provisional application No. 62/653,550, filed on Apr. 5, 2018.

(30) **Foreign Application Priority Data**

May 3, 2018 (KR) 10-2018-0051314

