



(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); Soenho Hwang, Suwon-si (KR); Jaebong Chun, Suwon-si (KR)**

(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.

(21) Appl. No.: **16/596,108**

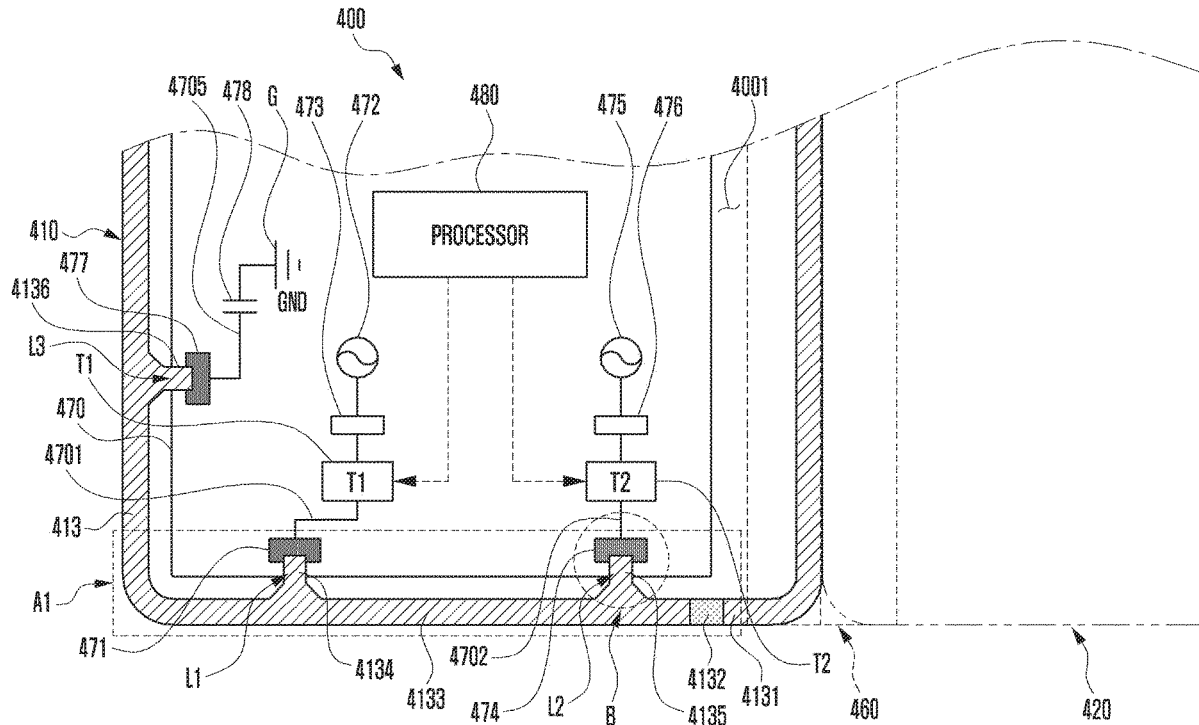
(22) Filed: **Oct. 8, 2019**

(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)





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)

(51) **Int. Cl.**  
*H01Q 1/24* (2006.01)  
*H01Q 1/22* (2006.01)  
*G06F 1/16* (2006.01)  
*H04B 7/0413* (2006.01)

(72) Inventors: **Ryuken Mizunuma**, Kyoto (JP);  
**Satoshi Tanaka**, Kyoto (JP); **Yasuhisa Yamamoto**, Kyoto (JP); **Akiko Itabashi**, Kyoto (JP)

(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**

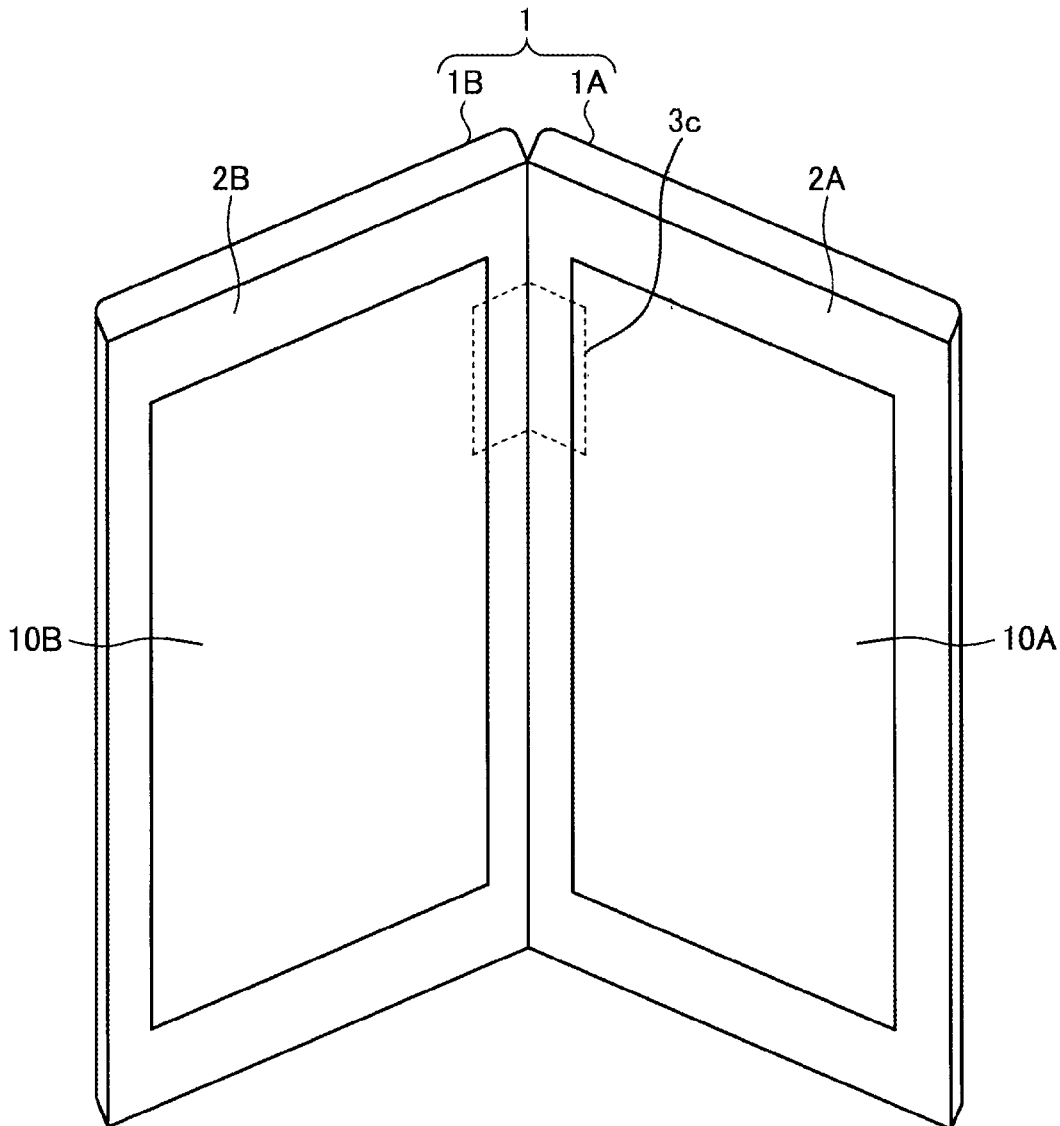
(22) Filed: **Oct. 15, 2019**

(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.

(30) **Foreign Application Priority Data**

Oct. 16, 2018 (JP) ..... 2018-195347  
Jul. 29, 2019 (JP) ..... 2019-139090





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)

(51) **Int. Cl.**  
*H01Q 1/38* (2006.01)  
*H01Q 1/48* (2006.01)

(72) Inventor: **Kuan-Jung Hung**, Taipei City (TW)

(52) **U.S. Cl.**  
CPC ..... *H01Q 1/38* (2013.01); *H01Q 1/2266* (2013.01); *H01Q 1/48* (2013.01)

(21) Appl. No.: **16/603,855**

(57) **ABSTRACT**

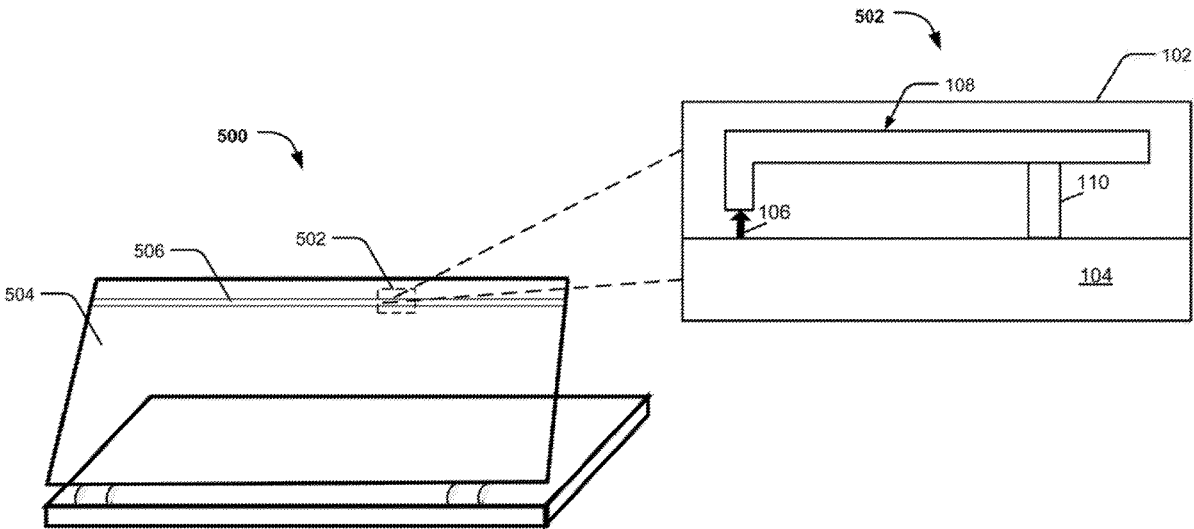
(22) PCT Filed: **Apr. 17, 2017**

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.

(86) PCT No.: **PCT/US2017/027947**

§ 371 (c)(1),

(2) Date: **Oct. 9, 2019**





(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)

(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.

(21) Appl. No.: **16/712,196**

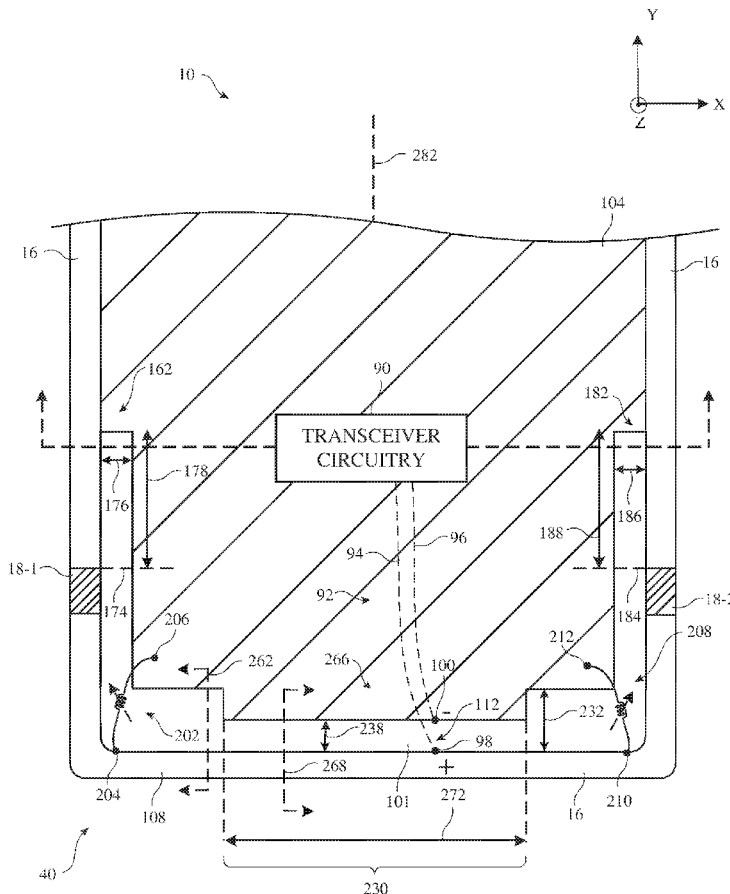
(22) Filed: **Dec. 12, 2019**

**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)





US 20200127365A1

(19) **United States**

(12) **Patent Application Publication**

**Hung et al.**

(10) **Pub. No.: US 2020/0127365 A1**

(43) **Pub. Date: Apr. 23, 2020**

(54) **BASE COVERS ALIGNED FOR SLOT ANTENNAS ON CONVERTIBLE COMPUTING DEVICES**

**Publication Classification**

(51) **Int. Cl.**  
*H01Q 1/22* (2006.01)  
*H01Q 13/10* (2006.01)  
*G06F 1/16* (2006.01)

(52) **U.S. Cl.**  
 CPC ..... *H01Q 1/2266* (2013.01); *G06F 1/1618* (2013.01); *H01Q 13/106* (2013.01)

(71) Applicant: **HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P.**,  
Spring, TX (US)

(72) Inventors: **Kuan-Jung Hung**, Taipei (TW); **Shih Huang Wu**, Houston, TX (US)

(21) Appl. No.: **16/481,495**

(22) PCT Filed: **Jul. 7, 2017**

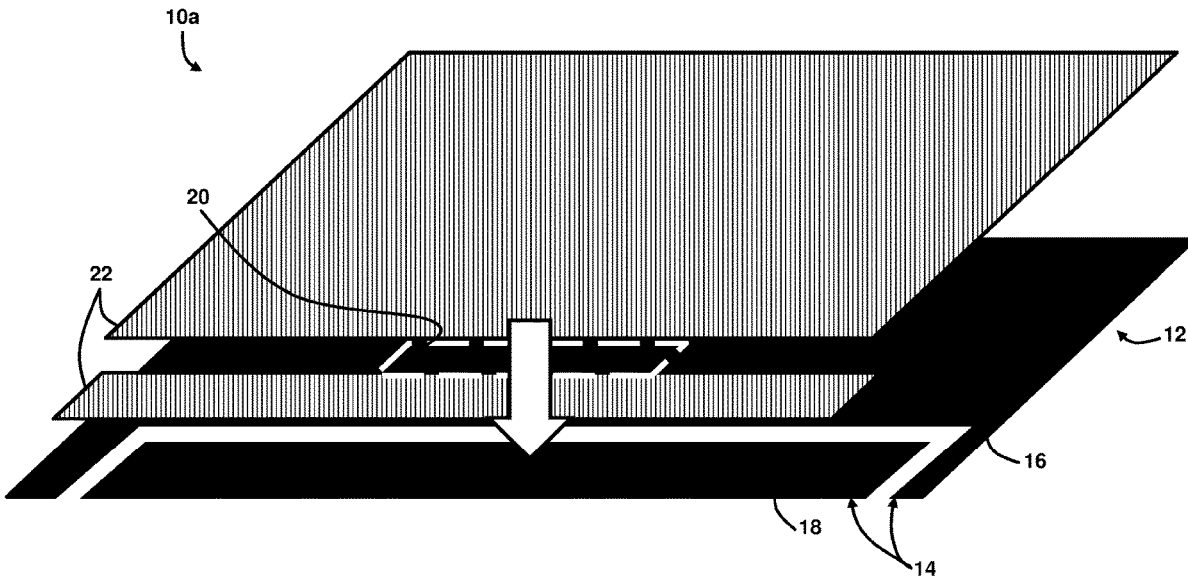
(86) PCT No.: **PCT/US2017/041235**

§ 371 (c)(1),

(2) Date: **Jul. 29, 2019**

(57) **ABSTRACT**

An example base cover for a lower housing of a convertible computing device includes a first metallic structure positioned in the lower housing, and a second metallic structure electrically isolated from the first metallic structure. The second metallic structure is positioned in the lower housing and directly below an antenna slot defined in an upper housing of the convertible computing device when the upper housing is positioned over and parallel to the lower housing.





(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**

(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)

(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)

(21) Appl. No.: **16/719,271**

(22) Filed: **Dec. 18, 2019**

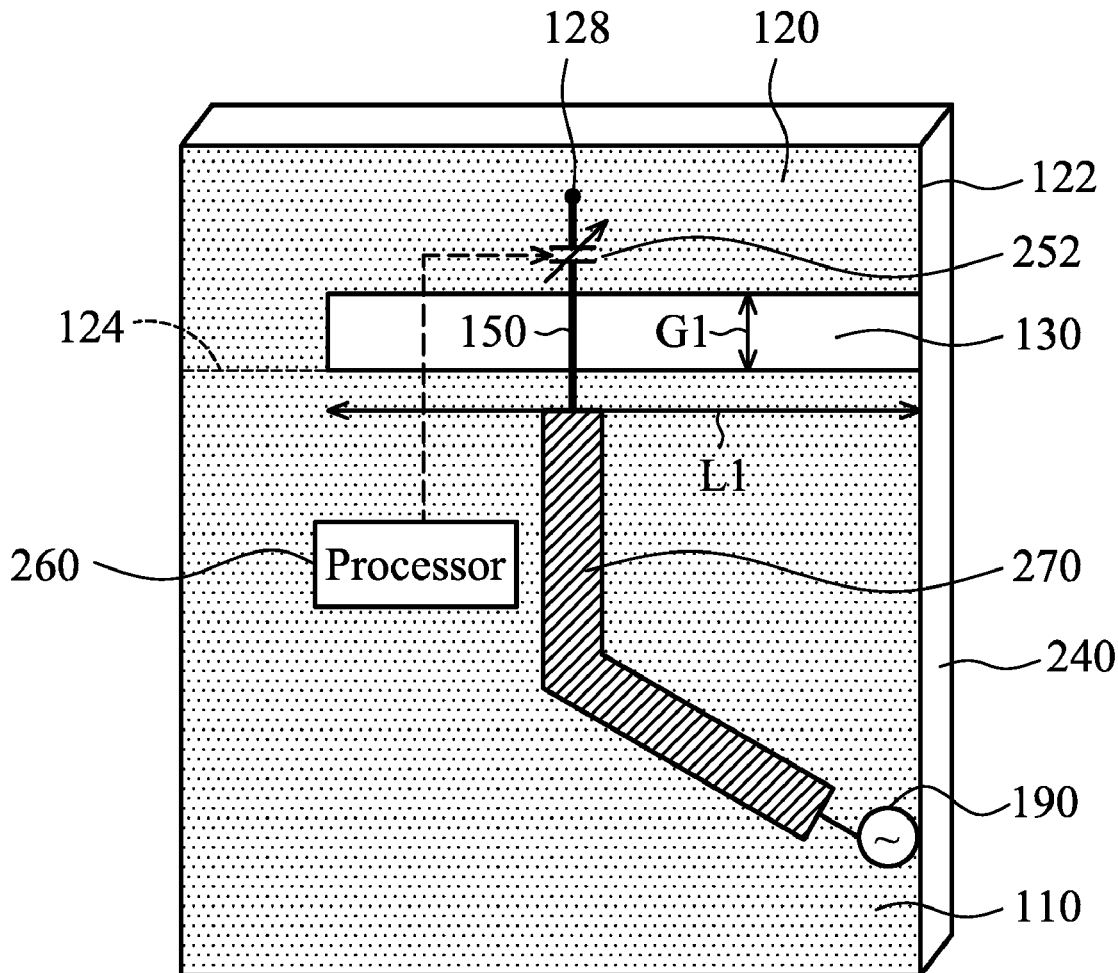
(57) **ABSTRACT**

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.

**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.

200





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**

(21) Appl. No.: **16/716,919**

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.

(22) Filed: **Dec. 17, 2019**

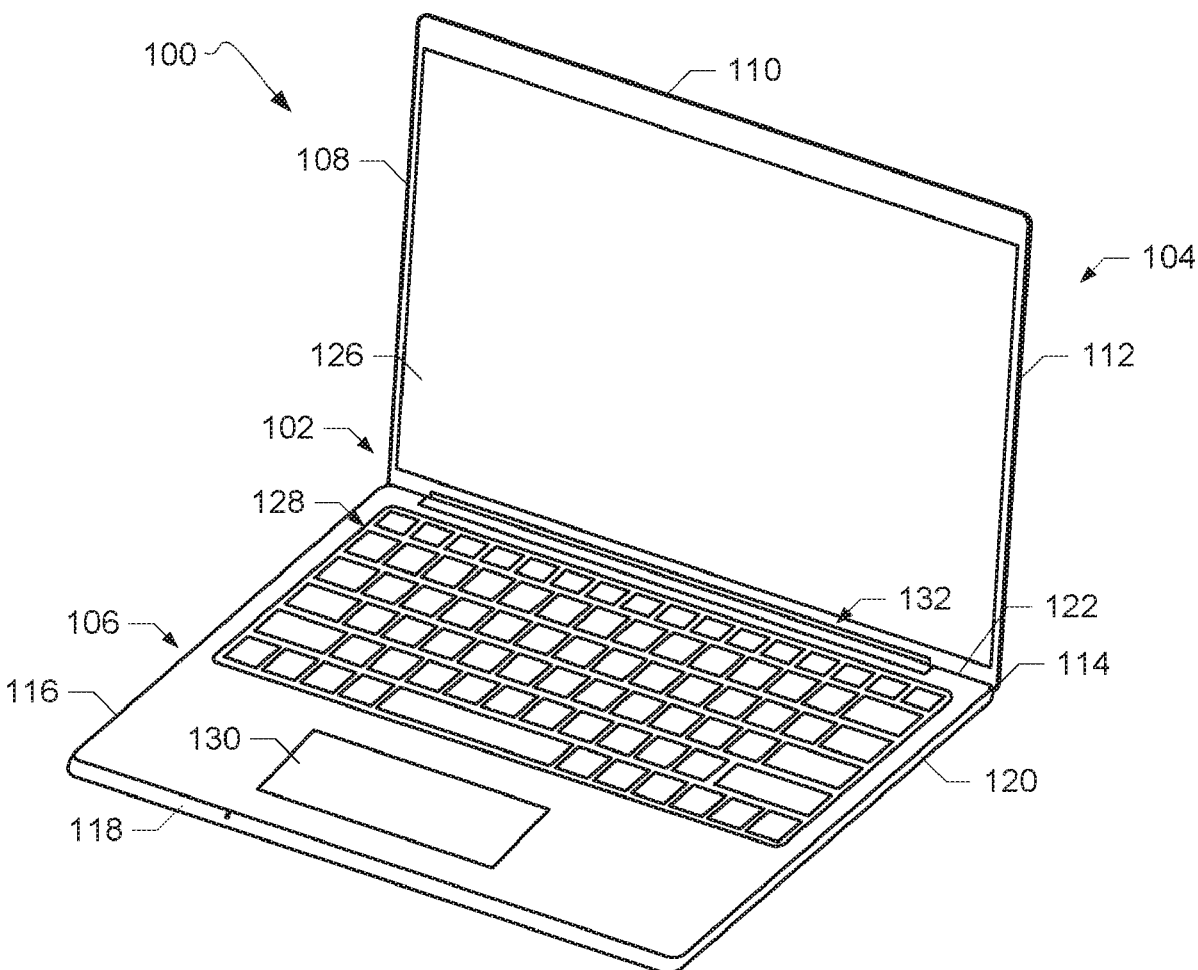
**Publication Classification**

(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**

*H01Q 13/12* (2006.01)

*H01Q 13/08* (2006.01)

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

*H01Q 1/24* (2006.01)

*H01Q 9/42* (2006.01)

*H01Q 1/48* (2006.01)

(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)

(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**

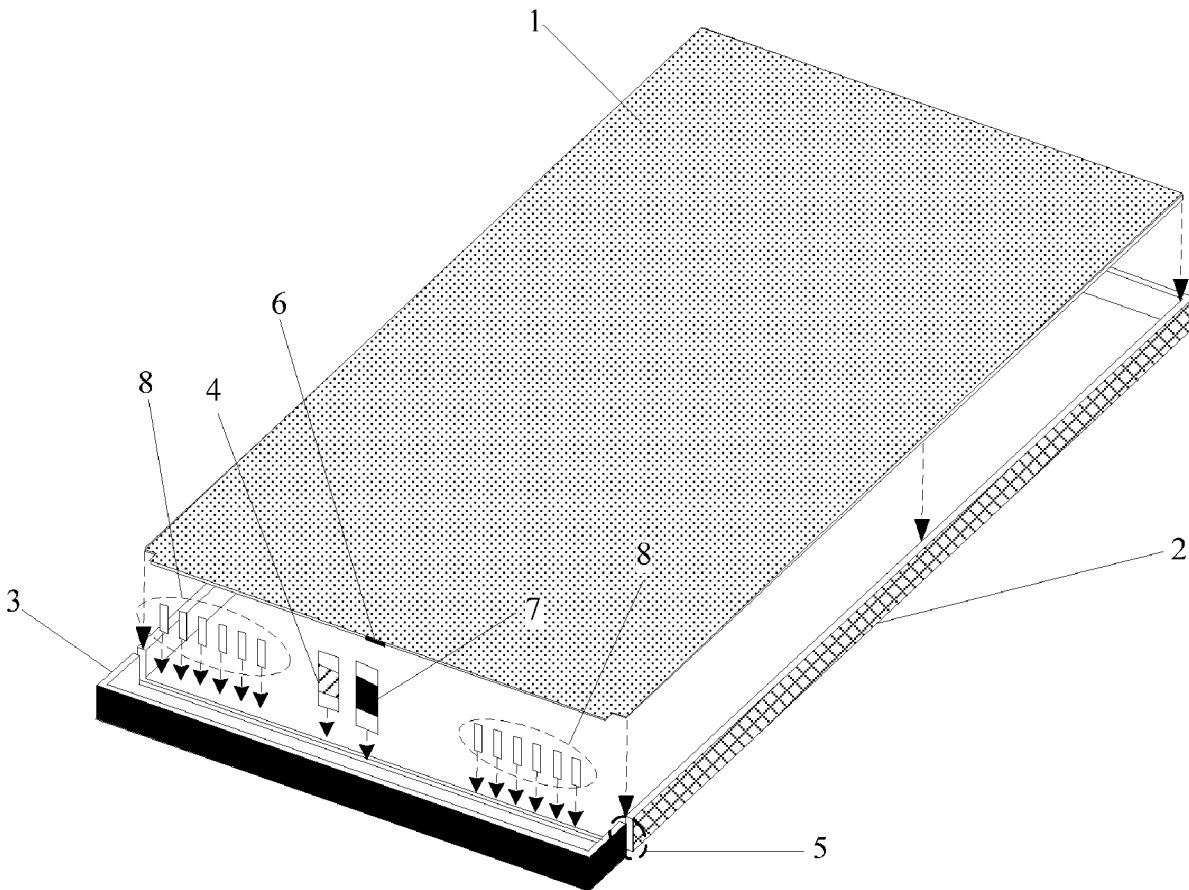
(51) **Int. Cl.**

*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**

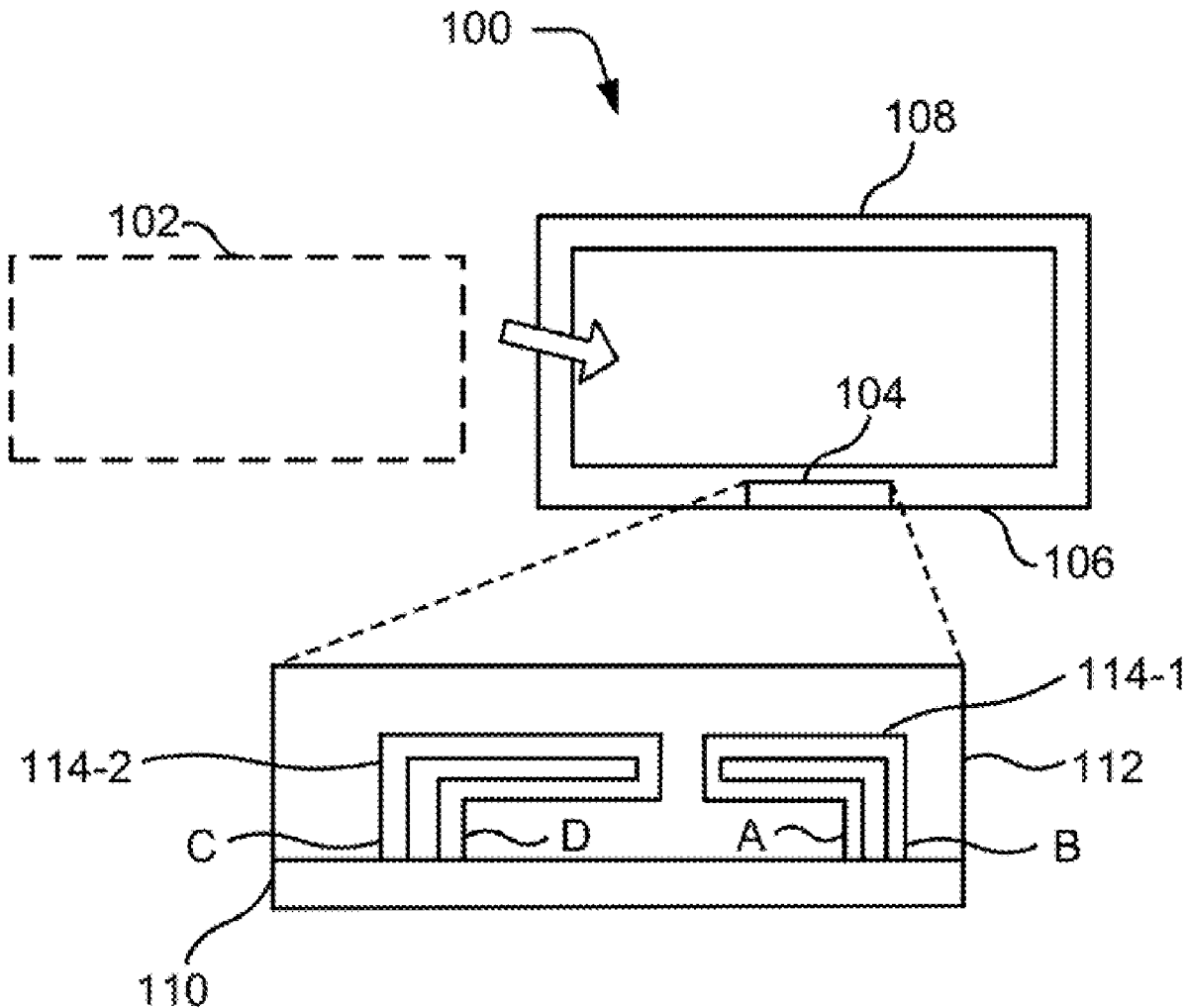
(86) PCT No.: **PCT/US2017/027008**

§ 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.





(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)

(57) **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**

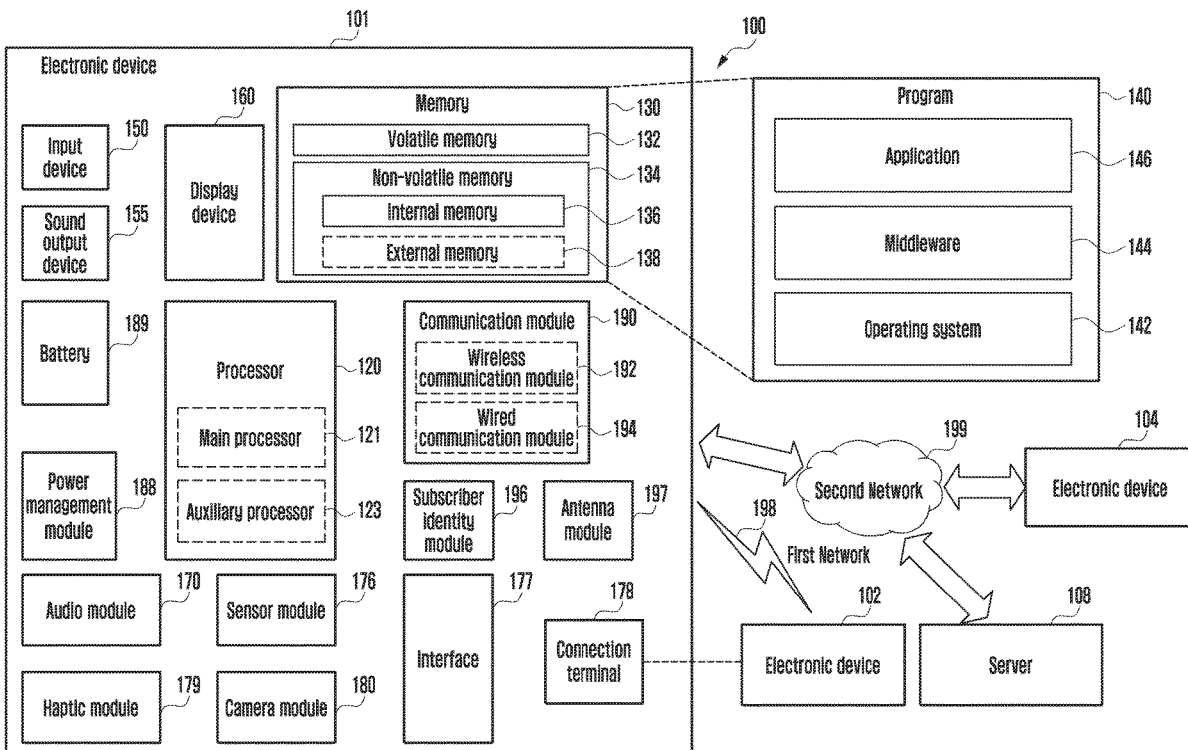
(22) Filed: **Oct. 17, 2019**

(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)





US 20200136235A1

(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)

(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)

(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)

(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)

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

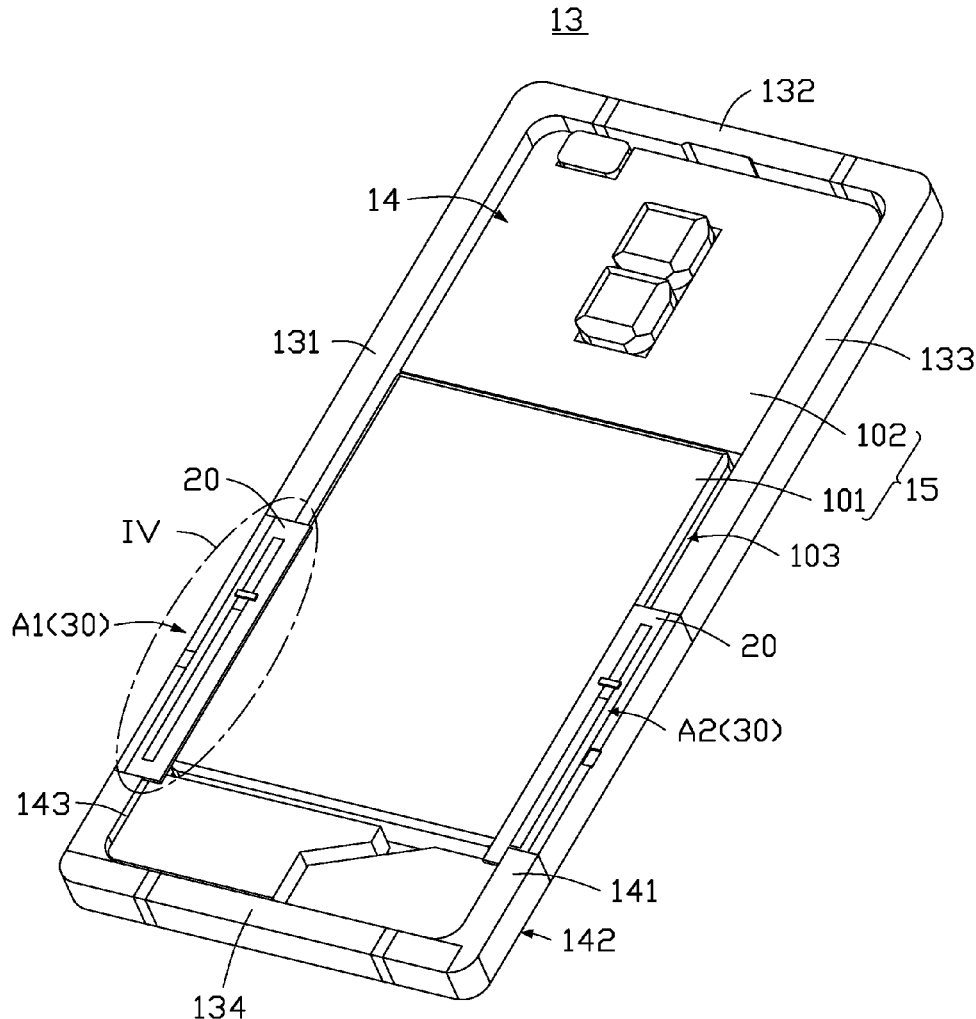
(57) **ABSTRACT**

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

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.

(30) **Foreign Application Priority Data**

Oct. 24, 2018 (CN) ..... 201811244525.4





(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**

(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)

(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)

(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 ( $1\lambda$ ,  $\frac{1}{2}\lambda$ ,  $\frac{1}{4}\lambda$  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.

(21) Appl. No.: **16/727,860**

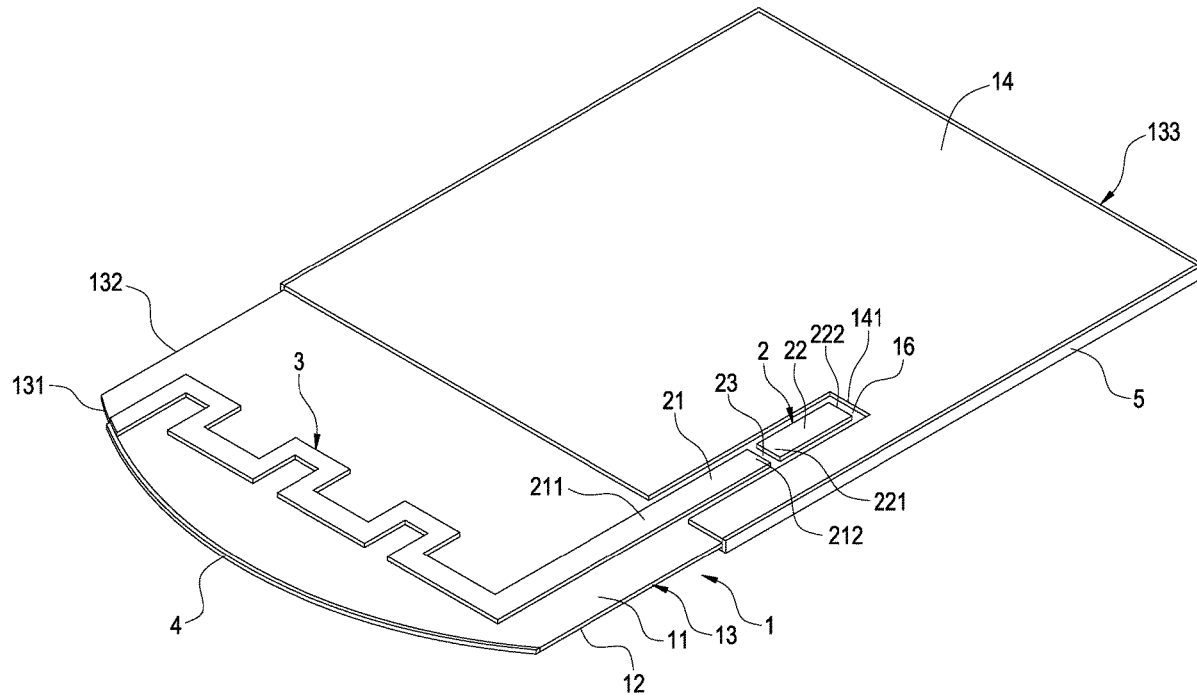
(22) Filed: **Dec. 26, 2019**

**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)





US 20200136261A1

(19) **United States**

(12) **Patent Application Publication**

**JAIN et al.**

(10) **Pub. No.: US 2020/0136261 A1**

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

(54) **STRUCTURAL SLOT ANTENNA WITH ISOLATING ELEMENT**

*H01Q 21/06* (2006.01)

*H04B 7/0413* (2006.01)

(71) Applicant: **Microsoft Technology Licensing, LLC**, Redmond, WA (US)

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

CPC ..... *H01Q 13/103* (2013.01); *H04B 7/0413* (2013.01); *H01Q 21/064* (2013.01); *H01Q 13/12* (2013.01)

(72) Inventors: **Sidharath JAIN**, Bellevue, WA (US); **Toby James MORRIS**, Seattle, WA (US); **Marc HARPER**, Snohomish, WA (US)

(57)

**ABSTRACT**

The disclosed technology provides an antenna structure located in the metal casing of a computing device. A first open slot radiating structure radiates at a radiating wavelength and is located on a surface of the metal casing of the computing device. A second open slot radiating structure radiates at the radiating wavelength and is located on the surface of the metal casing of the computing device. At least one closed slot radiator element is located between the first open slot radiating structure and the second open slot radiating structure on the surface of the metal casing of the computing device. The closed slot radiator element is approximately half the length of the radiating wavelength.

(21) Appl. No.: **16/172,437**

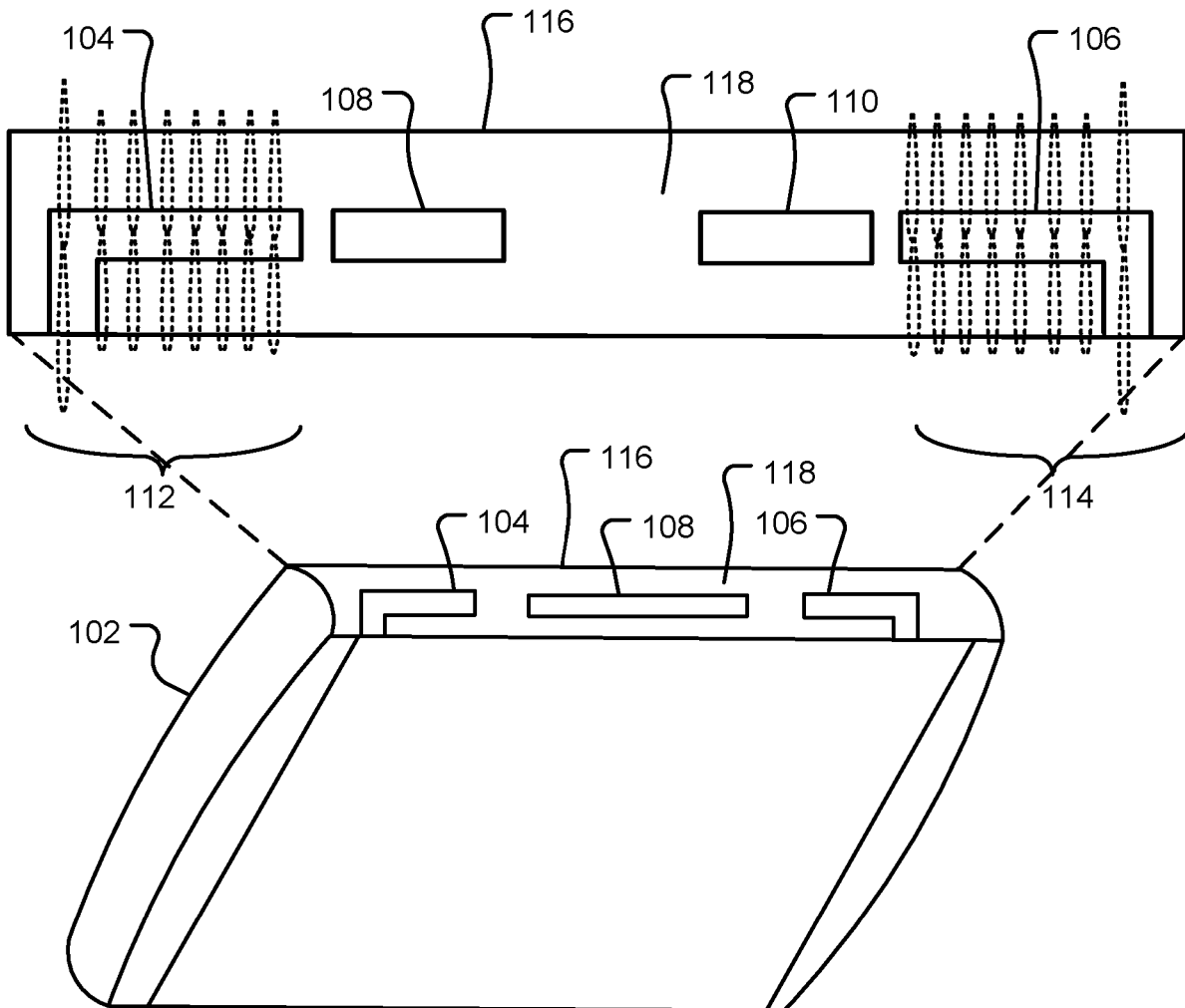
(22) Filed: **Oct. 26, 2018**

**Publication Classification**

(51) **Int. Cl.**

*H01Q 13/10* (2006.01)

*H01Q 13/12* (2006.01)





US 20200144699A1

(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**

*H01Q 9/04* (2006.01)

*H01Q 1/48* (2006.01)

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

(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)

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

(57) **ABSTRACT**

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

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.

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

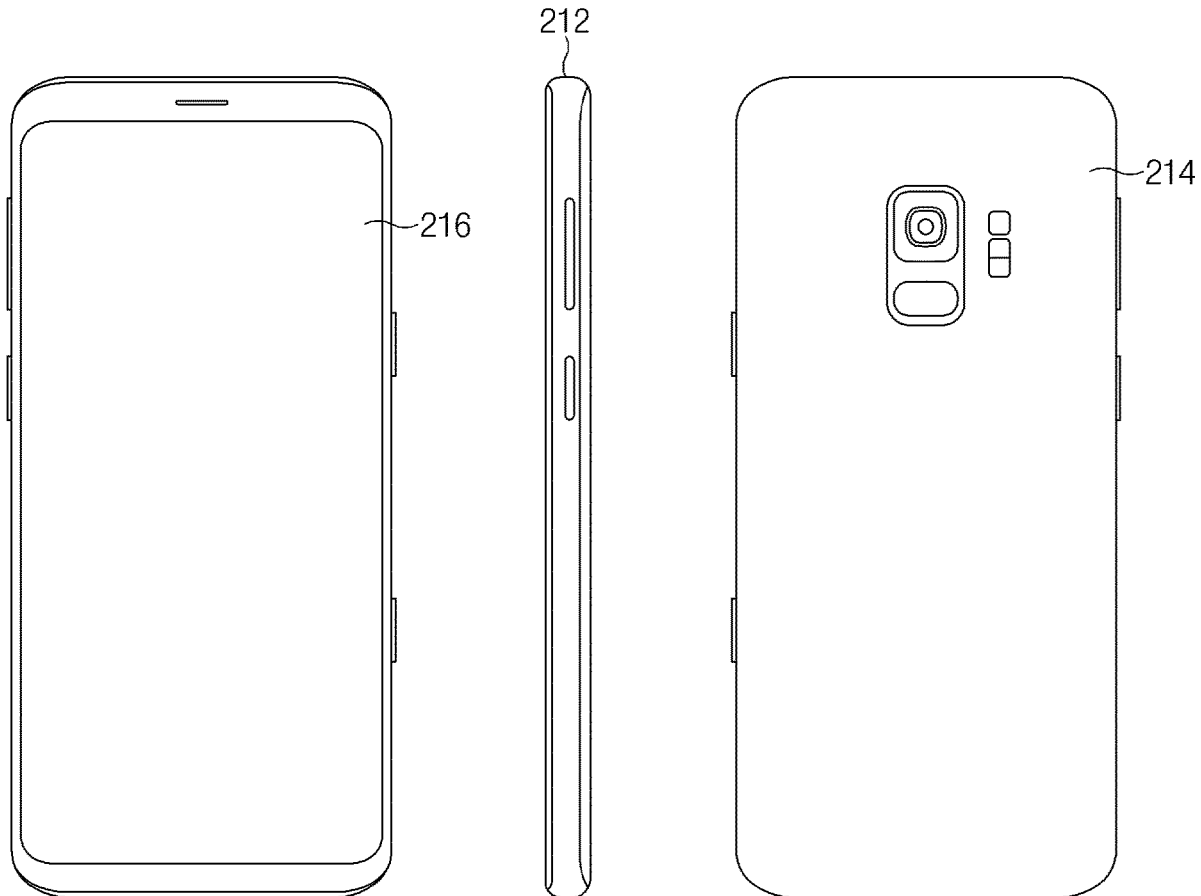
(30) **Foreign Application Priority Data**

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

**Publication Classification**

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

210  
↙





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**

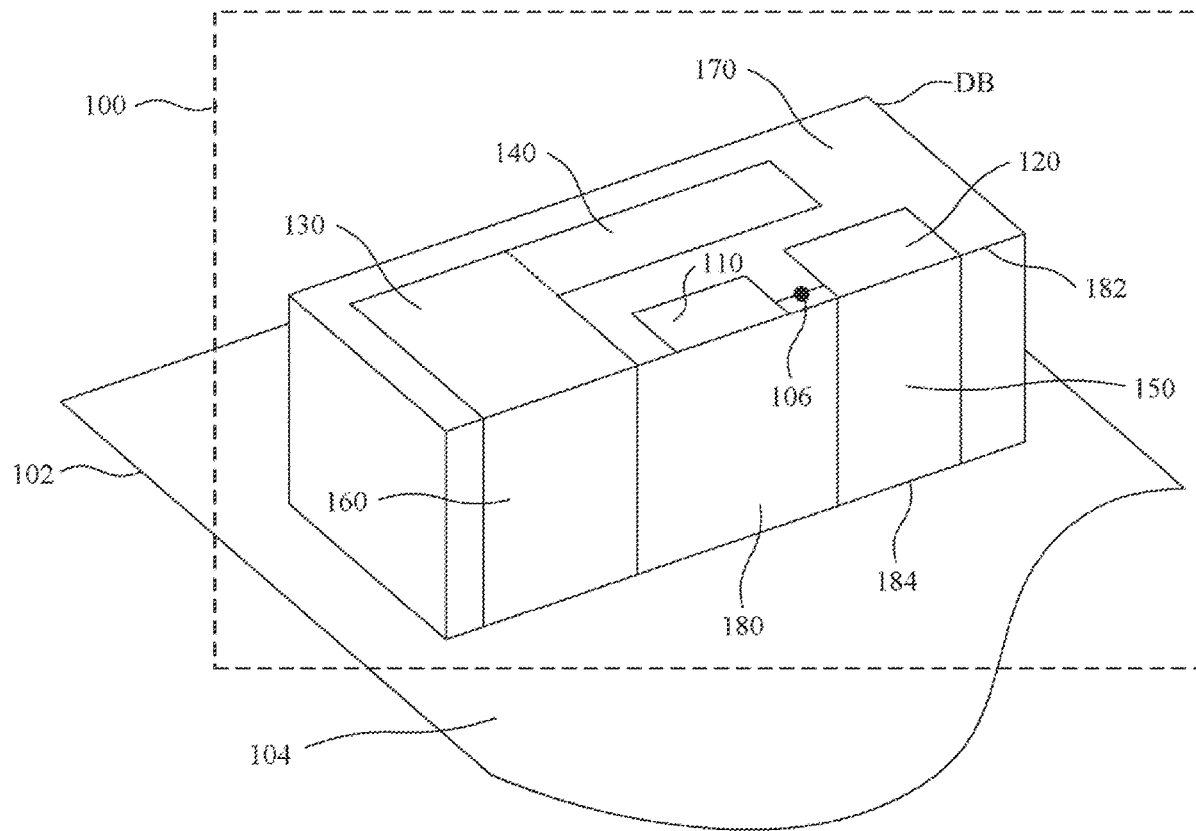
Nov. 7, 2018 (TW) ..... 107139548

**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**

*H01Q 5/30* (2006.01)

*H01Q 1/24* (2006.01)

*H01Q 1/22* (2006.01)

(71) Applicant: **PEGATRON CORPORATION,**  
TAIPEI CITY (TW)

(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)

(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)

(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.

(73) Assignee: **PEGATRON CORPORATION,**  
TAIPEI CITY (TW)

(21) Appl. No.: **16/595,141**

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

(30) **Foreign Application Priority Data**

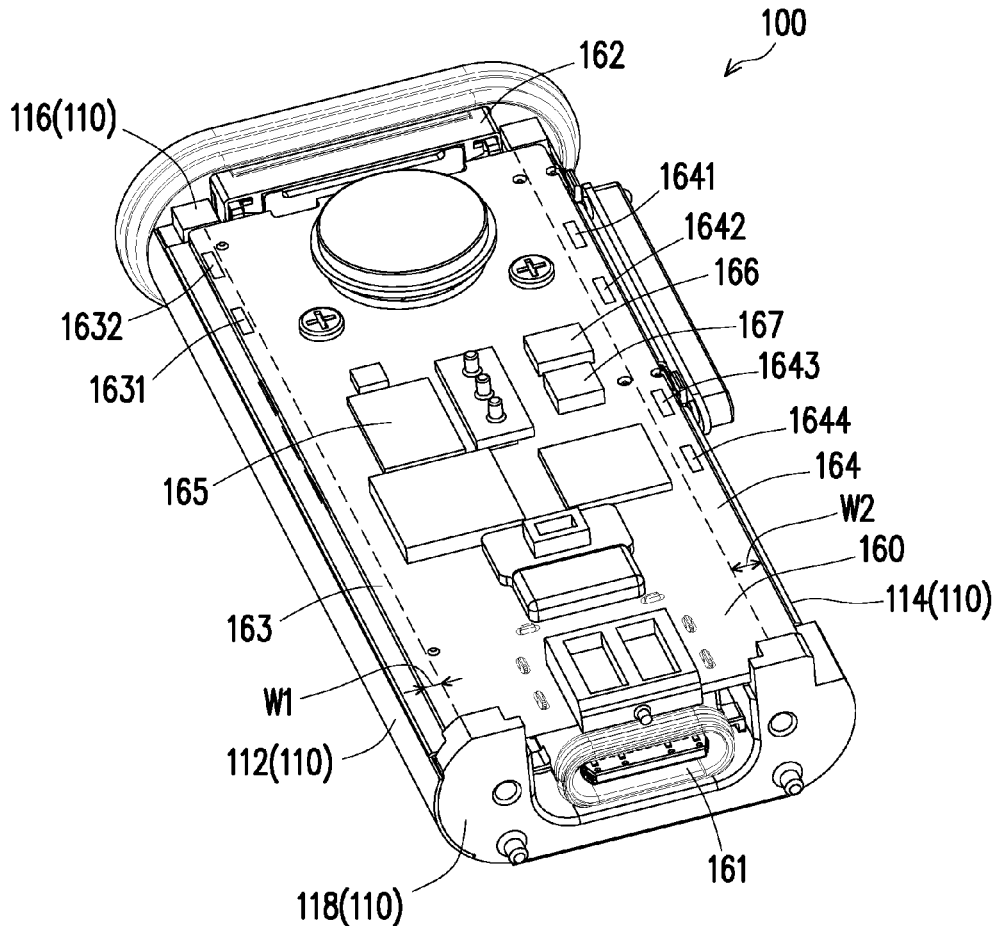
Nov. 2, 2018 (TW) ..... 107139068

**Publication Classification**

(51) **Int. Cl.**

*H01Q 1/52* (2006.01)

*H04M 1/03* (2006.01)







(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**

(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)

(71) Applicant: **Samsung Electronics Co., Ltd.**,  
Gyeonggi-do (KR)

(57) **ABSTRACT**

(72) Inventors: **Sangmin JUNG**, Gyeonggi-do (KR);  
**Geunwoo KIM**, Gyeonggi-do (KR)

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.

(21) Appl. No.: **16/571,544**

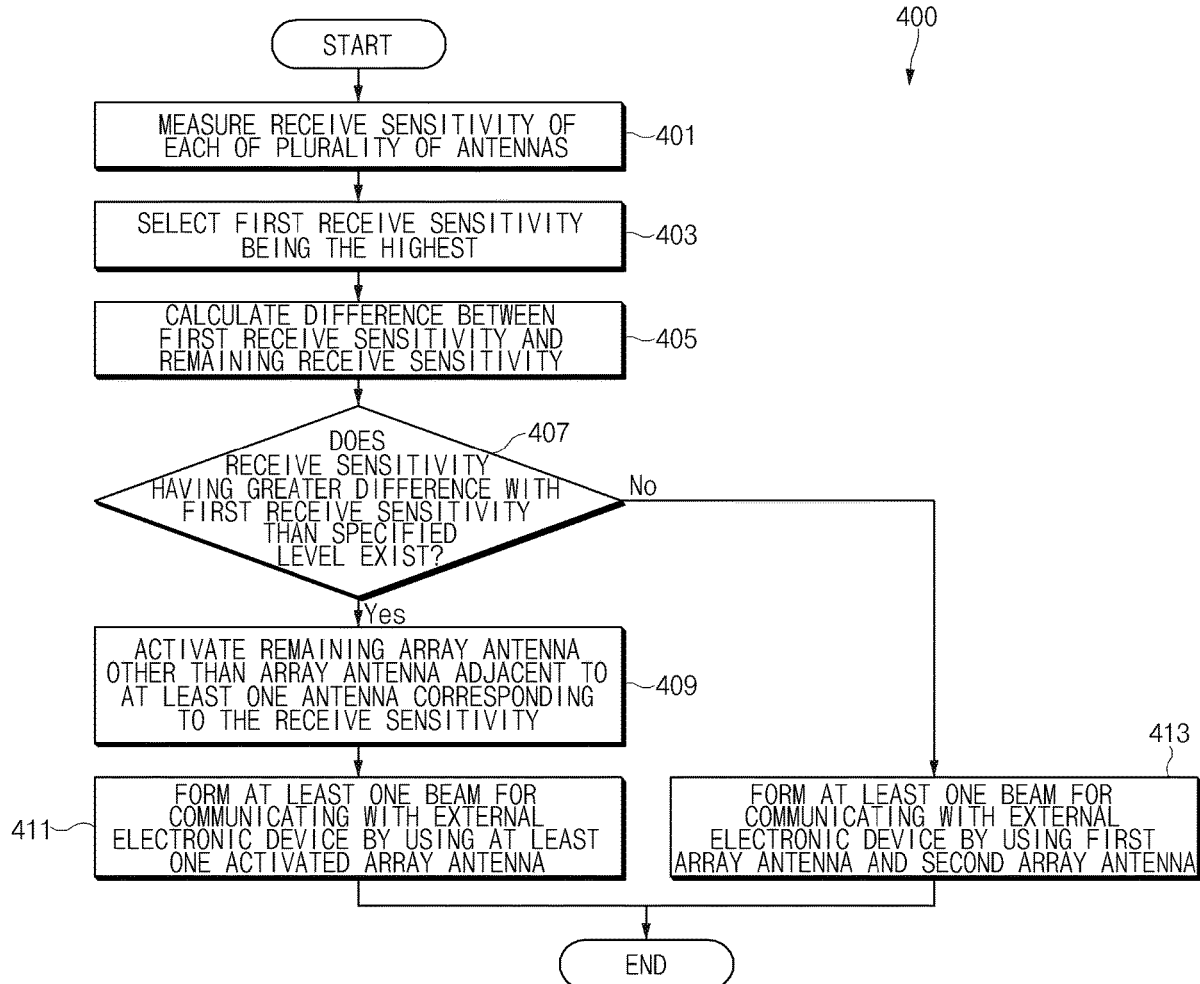
(22) Filed: **Sep. 16, 2019**

(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)





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**

(30) **Foreign Application Priority Data**

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

(71) Applicant: **Samsung Electronics Co., Ltd.**,  
Gyeonggi-do (KR)

**Publication Classification**

(72) Inventor: **Ju Hwan YUN**, Gyeongsangbuk-do  
(KR)

(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)

(21) Appl. No.: **16/745,554**

(22) Filed: **Jan. 17, 2020**

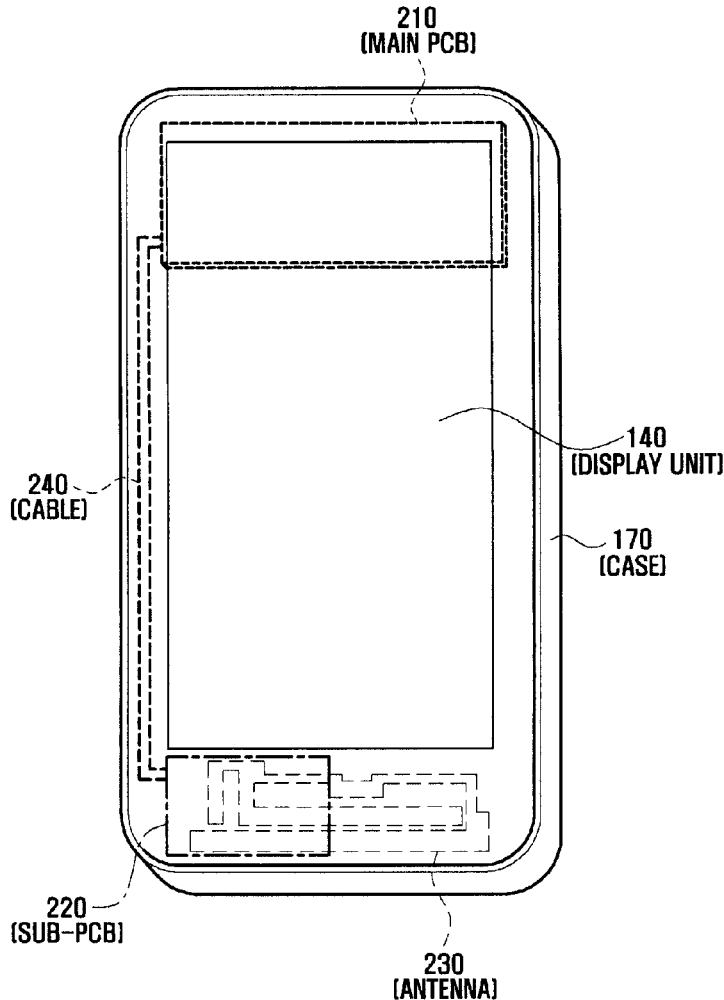
(57) **ABSTRACT**

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.

**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.

**100**





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**

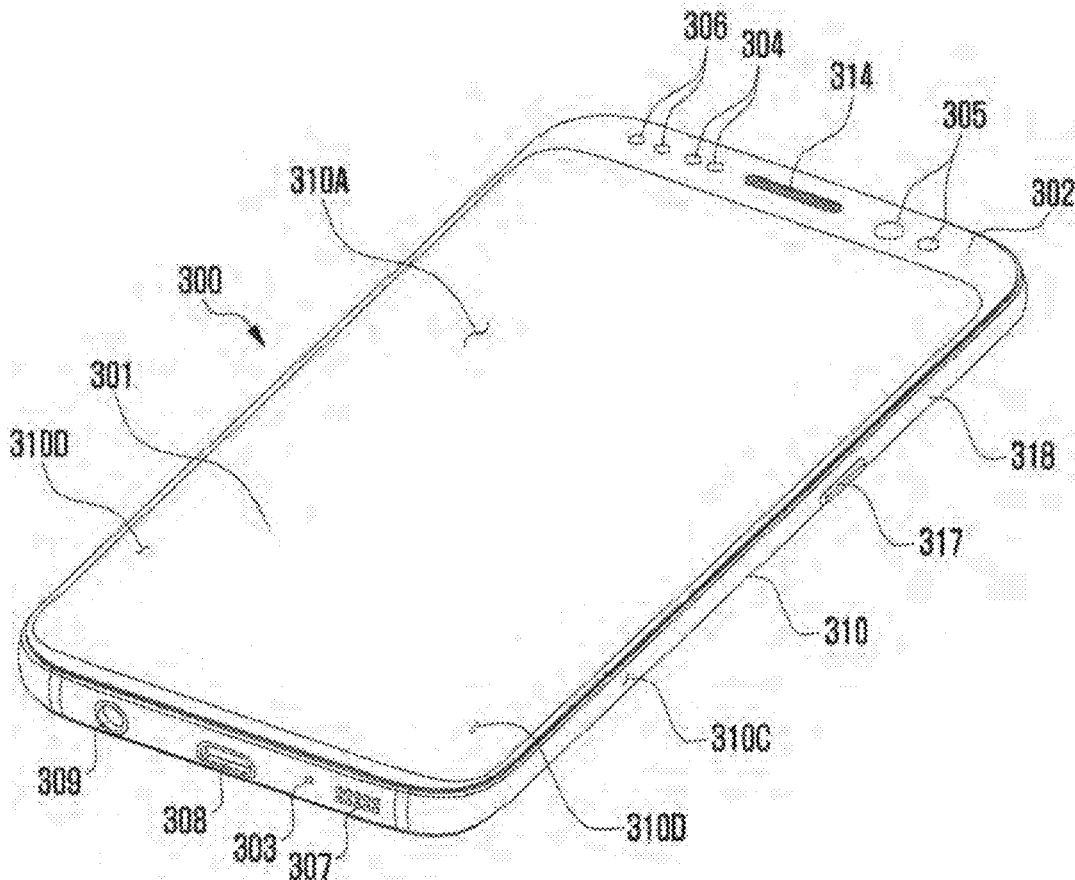
(22) Filed: **Nov. 7, 2019**

(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)





(19) **United States**

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

(10) **Pub. No.: US 2020/0153097 A1**

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

(54) **MULTIBAND COMPATIBLE ANTENNA AND RADIO COMMUNICATION DEVICE**

(71) Applicant: **Panasonic Intellectual Property Management Co., Ltd., Osaka (JP)**

(72) Inventors: **Masashi KOSHI, Ishikawa (JP); Takahiro OCHI, Miyagi (JP); Shingo SUMI, Miyagi (JP); Kenji NISHIKAWA, Hyogo (JP)**

(21) Appl. No.: **16/744,026**

(22) Filed: **Jan. 15, 2020**

**Related U.S. Application Data**

(63) Continuation of application No. PCT/JP2018/026682, filed on Jul. 17, 2018.

**Foreign Application Priority Data**

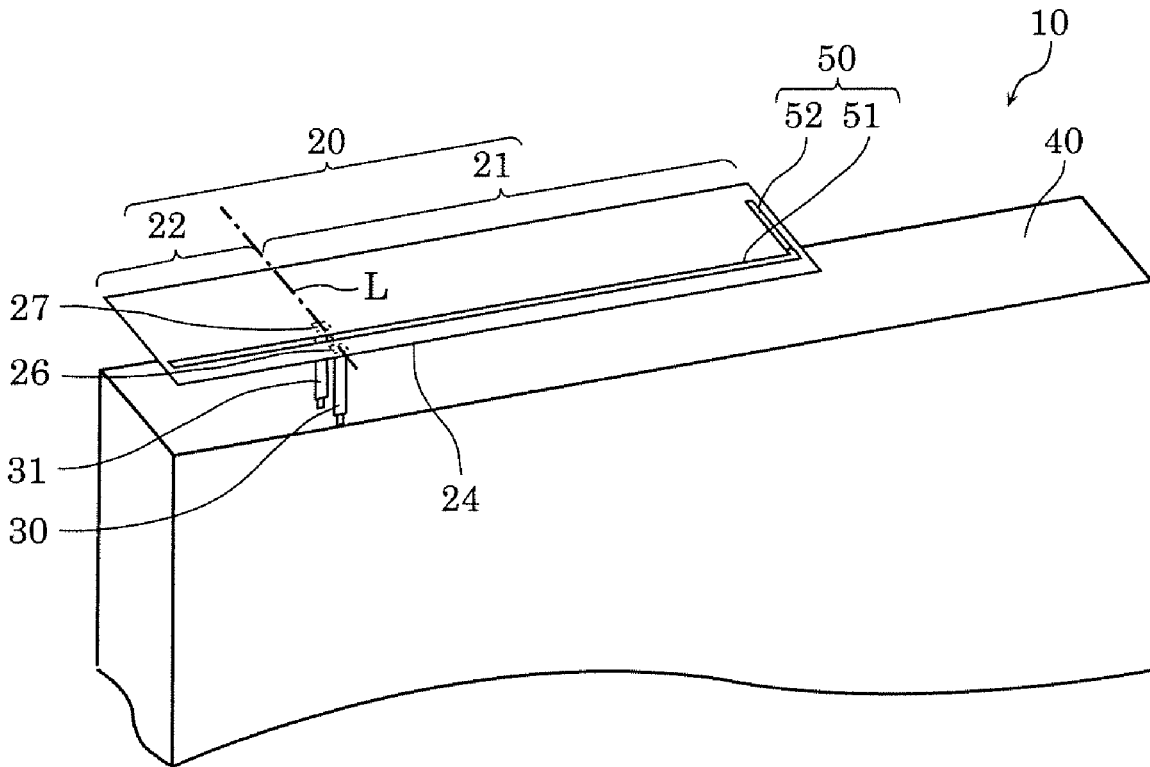
Jul. 20, 2017 (JP) ..... 2017-140847

**Publication Classification**

(51) **Int. Cl.**  
**H01Q 5/30** (2006.01)  
**H01Q 13/10** (2006.01)  
(52) **U.S. Cl.**  
CPC ..... **H01Q 5/30** (2015.01); **H01Q 1/48** (2013.01); **H01Q 13/10** (2013.01)

(57) **ABSTRACT**

A multiband compatible antenna that resonates at a first frequency and a second frequency includes: a planar conductor including a feeding portion to which a signal is supplied, a grounding portion, and a slit between the feeding portion and grounding portion. The slit includes a first slit portion extending in a first direction and a second slit portion extending in a second direction intersecting the first direction from an end of the first slit portion. The first slit portion is disposed closer to one edge than a center of the planar conductor in the second direction, and the feeding portion is disposed to a side of the first slit portion closer to the one edge. The planar conductor includes a first element portion and a second frequency portion that resonate at the first frequency and the second frequency, respectively. The second slit portion is disposed in the first element portion.





(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)

(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.

(21) Appl. No.: **16/744,226**

(22) Filed: **Jan. 16, 2020**

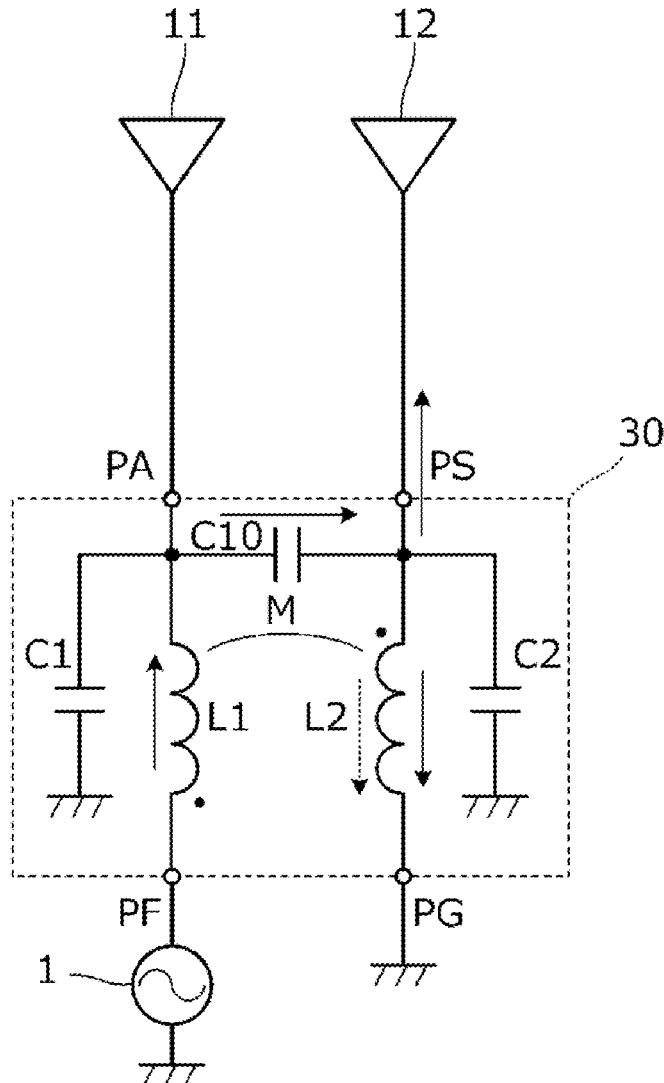
**Related U.S. Application Data**

(63) Continuation of application No. PCT/JP2018/  
021580, filed on Jun. 5, 2018.

(30) **Foreign Application Priority Data**

Jul. 21, 2017 (JP) ..... 2017-141549

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**

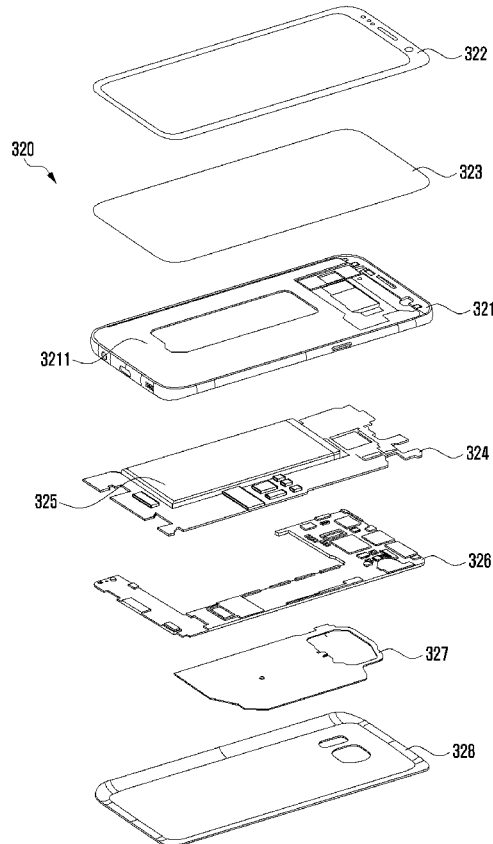
(22) Filed: **Nov. 7, 2019**

(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)
- (72) Inventors: **Kyoungsun HWANG**, Seoul (KR); **Moonsoo SONG**, Seoul (KR); **Yoonjae WON**, Seoul (KR); **Deuksu CHOI**, Seoul (KR); **Chisang YOU**, Seoul (KR)
- (73) Assignee: **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)
- (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)

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

**Foreign Application Priority Data**

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

(57) **ABSTRACT**

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.

