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(19) **United States**

(12) **Patent Application Publication**

Rowson et al.

(10) **Pub. No.: US 2020/0161746 A1**

(43) **Pub. Date: May 21, 2020**

(54) **ANTENNA AND METHOD FOR STEERING ANTENNA BEAM DIRECTION FOR WIFI APPLICATIONS**

477, filed on Dec. 24, 2012, now Pat. No. 8,648,755, which is a continuation of application No. 13/029,564, filed on Feb. 17, 2011, now Pat. No. 8,362,962, which is a continuation of application No. 12/043,090, filed on Mar. 5, 2008, now Pat. No. 7,911,402.

(71) Applicant: **Ethertronic, Inc.**, San Diego, CA (US)

(72) Inventors: **Sebastian Rowson**, San Diego, CA (US); **Laurent Desclos**, San Diego, CA (US); **Jeffrey Shamblin**, San Marcos, CA (US)

(21) Appl. No.: **16/751,903**

(22) Filed: **Jan. 24, 2020**

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 9/04 (2006.01)
H01Q 3/00 (2006.01)

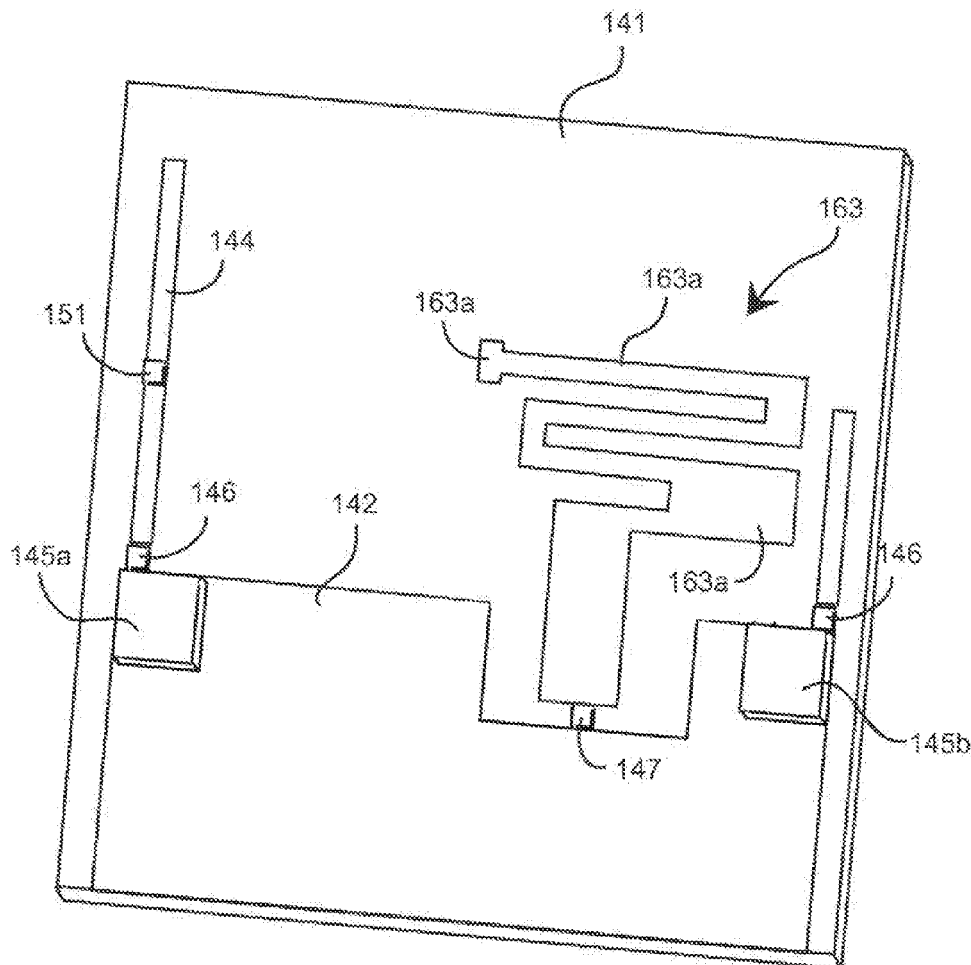
(52) **U.S. Cl.**
 CPC *H01Q 1/243* (2013.01); *H01Q 3/00* (2013.01); *H01Q 9/0421* (2013.01)

Related U.S. Application Data

(63) Continuation of application No. 16/048,987, filed on Jul. 30, 2018, now Pat. No. 10,547,102, which is a continuation of application No. 15/660,907, filed on Jul. 26, 2017, now Pat. No. 10,056,679, which is a continuation of application No. 14/965,881, filed on Dec. 10, 2015, now Pat. No. 9,748,637, which is a continuation-in-part of application No. 14/144,461, filed on Dec. 30, 2013, now Pat. No. 9,240,634, which is a continuation of application No. 13/726,

(57) **ABSTRACT**

An antenna comprising an IMD element and one or more parasitic and active tuning elements is disclosed. The IMD element, when used in combination with the active tuning and parasitic elements, allows antenna operation at multiple resonant frequencies. In addition, the direction of antenna radiation pattern may be arbitrarily rotated in accordance with the parasitic and active tuning elements. Unique antenna architectures for beam steering in Wi-Fi band applications is further described.





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(19) **United States**

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

(10) **Pub. No.: US 2020/0161747 A1**

(43) **Pub. Date: May 21, 2020**

(54) **MOBILE TERMINAL**

Publication Classification

- (71) Applicant: **LG ELECTRONICS INC.**, Seoul (KR)
- (72) Inventors: **Yunmo KANG**, Seoul (KR); **Kangjae JUNG**, Seoul (KR); **Sungjoon HONG**, Seoul (KR); **Byungwoon JUNG**, Seoul (KR); **Sungjung RHO**, Seoul (KR)
- (73) Assignee: **LG ELECTRONICS INC.**, Seoul (KR)

- (51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 7/00 (2006.01)
H01Q 1/50 (2006.01)
H01Q 1/48 (2006.01)
H01Q 1/38 (2006.01)
H01Q 13/10 (2006.01)
H01Q 9/26 (2006.01)
H01Q 5/50 (2006.01)
H01Q 5/35 (2006.01)
H01Q 21/30 (2006.01)
- (52) **U.S. Cl.**
 CPC *H01Q 1/243* (2013.01); *H01Q 7/00* (2013.01); *H01Q 1/50* (2013.01); *H01Q 1/48* (2013.01); *H01Q 21/30* (2013.01); *H01Q 13/10* (2013.01); *H01Q 9/26* (2013.01); *H01Q 5/50* (2015.01); *H01Q 5/35* (2015.01); *H01Q 1/38* (2013.01)

(21) Appl. No.: **16/752,485**

(22) Filed: **Jan. 24, 2020**

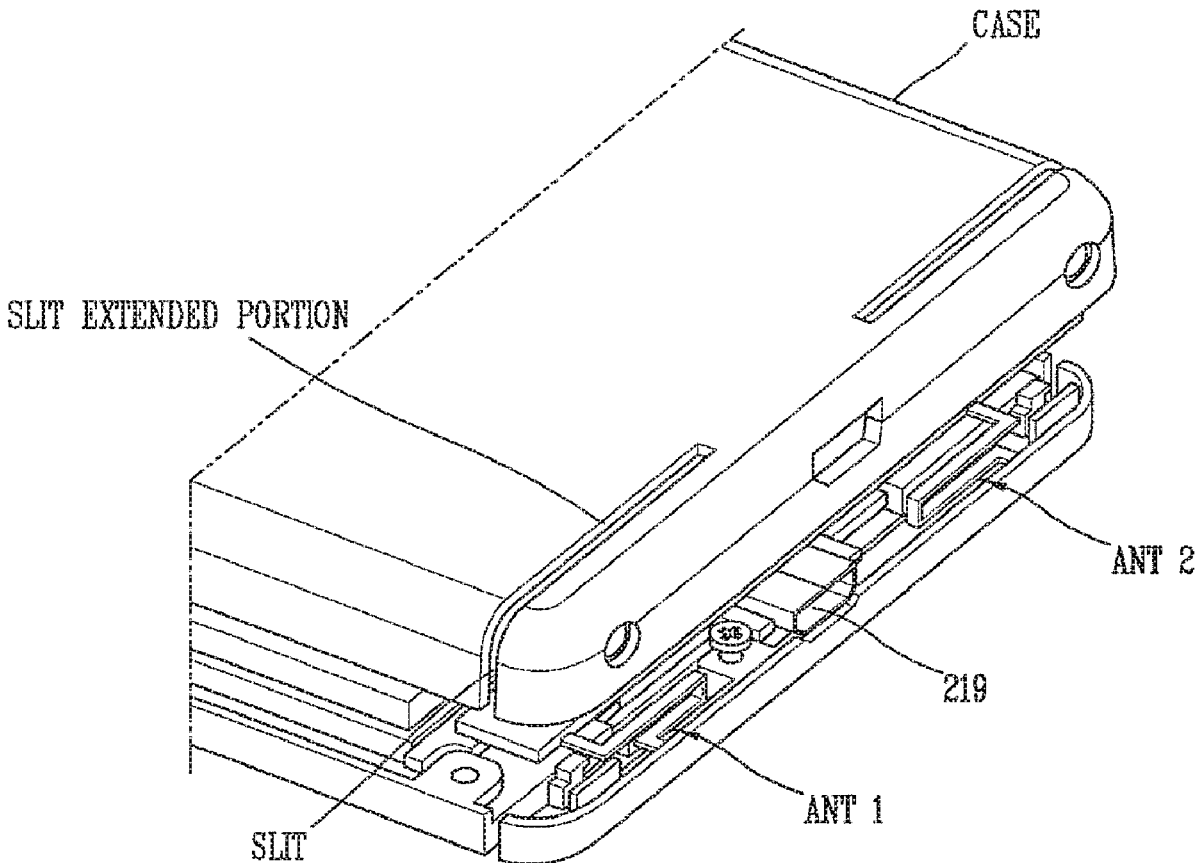
Related U.S. Application Data

(63) Continuation of application No. 16/033,083, filed on Jul. 11, 2018, now Pat. No. 10,573,957, which is a continuation of application No. 15/860,427, filed on Jan. 2, 2018, now Pat. No. 10,056,680, which is a continuation of application No. 14/010,900, filed on Aug. 27, 2013, now Pat. No. 9,871,286.

Foreign Application Priority Data

Sep. 19, 2012 (KR) 10-2012-0104152

(57) **ABSTRACT**
 A mobile terminal comprises: a terminal body; and a first antenna device and a second antenna device disposed at one side of the terminal body in an adjacent manner, and formed to operate at different frequency bands, wherein the first antenna device and the second antenna device are provided with conductive members each having a slit at one side thereof, and wherein the conductive members form part of an appearance of the terminal body.





(19) **United States**

(12) **Patent Application Publication**

LEE et al.

(10) **Pub. No.: US 2020/0161763 A1**

(43) **Pub. Date: May 21, 2020**

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

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

(72) Inventors: **Jongpil LEE**, Gyeonggi-do (KR); **Byungjoon KIM**, Gyeonggi-do (KR); **Wonseob KIM**, Gyeonggi-do (KR); **Heejin PARK**, Gyeonggi-do (KR); **Hyunchul HONG**, Gyeonggi-do (KR); **Sungchul PARK**, Gyeonggi-do (KR)

(21) Appl. No.: **16/687,881**

(22) Filed: **Nov. 19, 2019**

(30) **Foreign Application Priority Data**

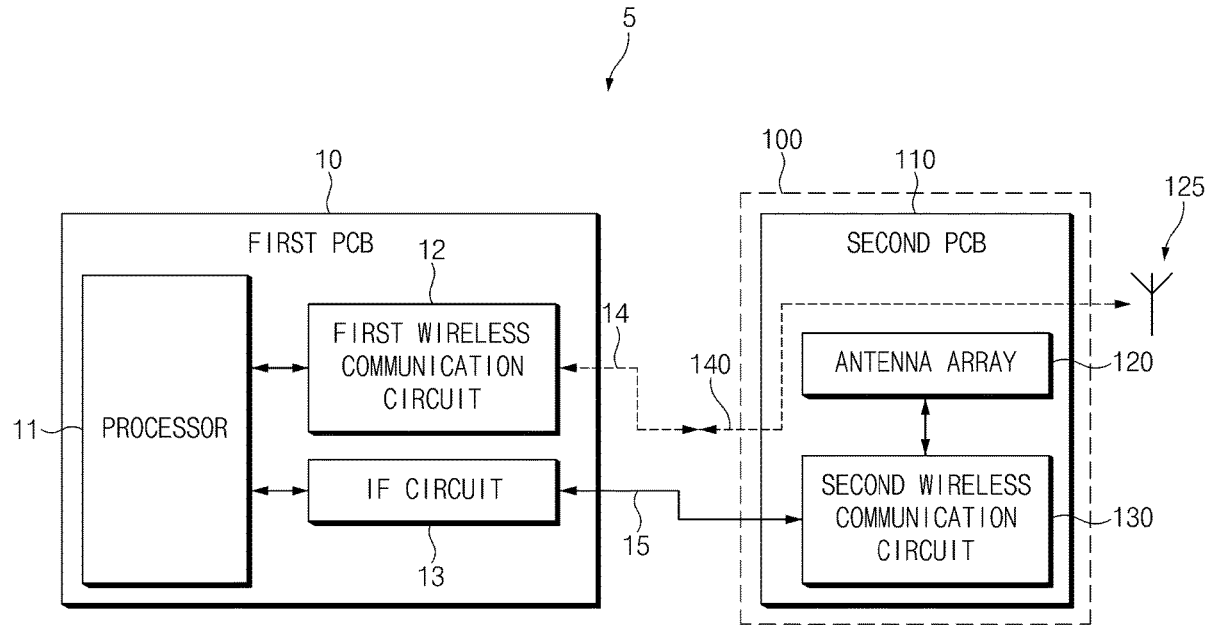
Nov. 19, 2018 (KR) 10-2018-0142801

Publication Classification

(51) **Int. Cl.**
H01Q 5/314 (2006.01)
H04B 1/40 (2006.01)
H01Q 21/06 (2006.01)
(52) **U.S. Cl.**
CPC *H01Q 5/314* (2015.01); *H01Q 21/06* (2013.01); *H04B 1/40* (2013.01)

(57) **ABSTRACT**

Disclosed herein is an electronic device. The electronic device may include an electronic device may comprising a housing, a first PCB disposed inside the housing, a first wireless communication circuit disposed on the first PCB to transmit and receive signals of a first frequency band, a second PCB disposed inside the housing, wherein the second PCB includes a signal line, an antenna array disposed on the second PCB, a second wireless communication circuit disposed on the second PCB to transmit and receive a signal of a second frequency band using the antenna array, and a conductive member electrically connected to the first wireless communication circuit by the signal line of the second PCB via a feed point for the conductive member.





(19) **United States**

(12) **Patent Application Publication**

Liao et al.

(10) **Pub. No.: US 2020/0161764 A1**

(43) **Pub. Date: May 21, 2020**

(54) **DUAL-BAND ANTENNA**

Publication Classification

(71) Applicants: **Wen-Jiao Liao**, Taipei City (TW);
Jhin-Ciang Chen, Taipei City (TW);
Shih-Chia Liu, Taipei City (TW);
Liang-Che Chou, Taipei City (TW);
Yen-Hao Yu, Taipei City (TW);
Li-Chun Lee, Taipei City (TW)

(51) **Int. Cl.**
H01Q 5/328 (2006.01)
H01Q 5/45 (2006.01)
H01Q 5/50 (2006.01)
H01Q 1/24 (2006.01)
H01Q 21/24 (2006.01)

(72) Inventors: **Wen-Jiao Liao**, Taipei City (TW);
Jhin-Ciang Chen, Taipei City (TW);
Shih-Chia Liu, Taipei City (TW);
Liang-Che Chou, Taipei City (TW);
Yen-Hao Yu, Taipei City (TW);
Li-Chun Lee, Taipei City (TW)

(52) **U.S. Cl.**
CPC **H01Q 5/328** (2015.01); **H01Q 5/45**
(2015.01); **H01Q 21/24** (2013.01); **H01Q**
1/241 (2013.01); **H01Q 5/50** (2015.01)

(73) Assignee: **COMPAL ELECTRONICS, INC.**,
Taipei City (TW)

(57) **ABSTRACT**

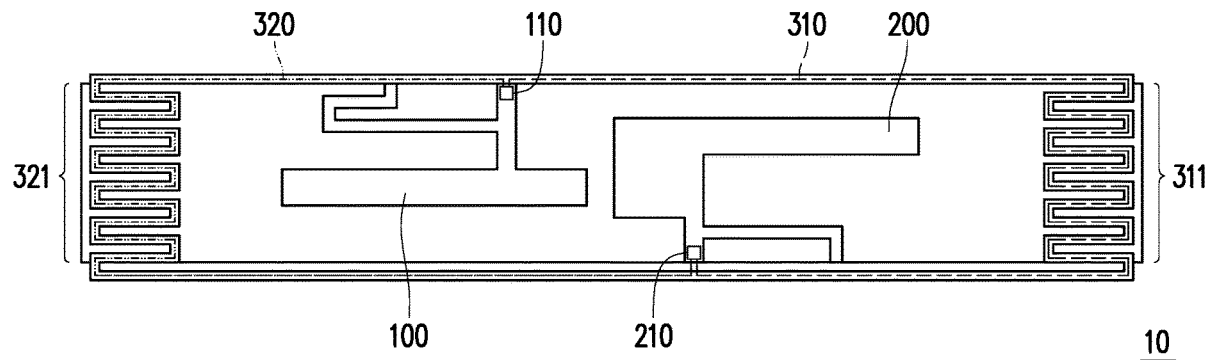
A dual-band antenna is provided. The dual-band antenna includes a first antenna, a second antenna, and a grounding component. The first antenna has a first feed point for transceiving a first signal. The second antenna has a second feed point. The grounding component is electrically coupled to the first feed point and the second feed point, wherein the grounding component forms a first path and a second path between the first feed point and the second feed point, wherein a first path length of the first path and a second path length of the second path are integer multiples of a first wavelength of the first signal.

(21) Appl. No.: **16/683,172**

(22) Filed: **Nov. 13, 2019**

Related U.S. Application Data

(60) Provisional application No. 62/767,518, filed on Nov. 15, 2018.





(19) **United States**

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

(10) **Pub. No.: US 2020/0161765 A1**

(43) **Pub. Date: May 21, 2020**

(54) **5G WIDEBAND MIMO ANTENNA SYSTEM
BASED ON COUPLED LOOP ANTENNAS
AND MOBILE TERMINAL**

Publication Classification

(51) **Int. Cl.**
H01Q 7/00 (2006.01)
H04B 7/0413 (2006.01)
H01Q 21/06 (2006.01)
(52) **U.S. Cl.**
CPC *H01Q 7/00* (2013.01); *H01Q 21/062*
(2013.01); *H04B 7/0413* (2013.01)

(71) Applicant: **SHENZHEN SUNWAY
COMMUNICATION CO LTD.,**
Shenzhen (CN)

(72) Inventors: **Anping ZHAO,** Shenzhen (CN);
Zhouyou REN, Shenzhen (CN)

(73) Assignee: **SHENZHEN SUNWAY
COMMUNICATION CO LTD.,**
Shenzhen (CN)

(57) **ABSTRACT**

A 5G wideband MIMO antenna system based on coupled loop antennas and a mobile terminal are disclosed. The antenna system comprises at least four antenna units comprising an antenna frame, a first coupling branch, a second coupling branch, a feed branch and an ground branch, wherein one end of the first coupling branch and one end of the ground branch are overlapped in the thickness or length direction of the frame, one end of the second coupling branch and one end of the feed branch are overlapped in the thickness or length direction of the frame. A traditional loop antenna is converted into a coupled loop antenna with three coupling regions. The coupled loop antenna system is high in antenna efficiency, good in isolation, simple in structure and easy to manufacture and has a small height when placed vertically, thereby making the mobile terminal lighter and thinner.

(21) Appl. No.: **16/276,123**

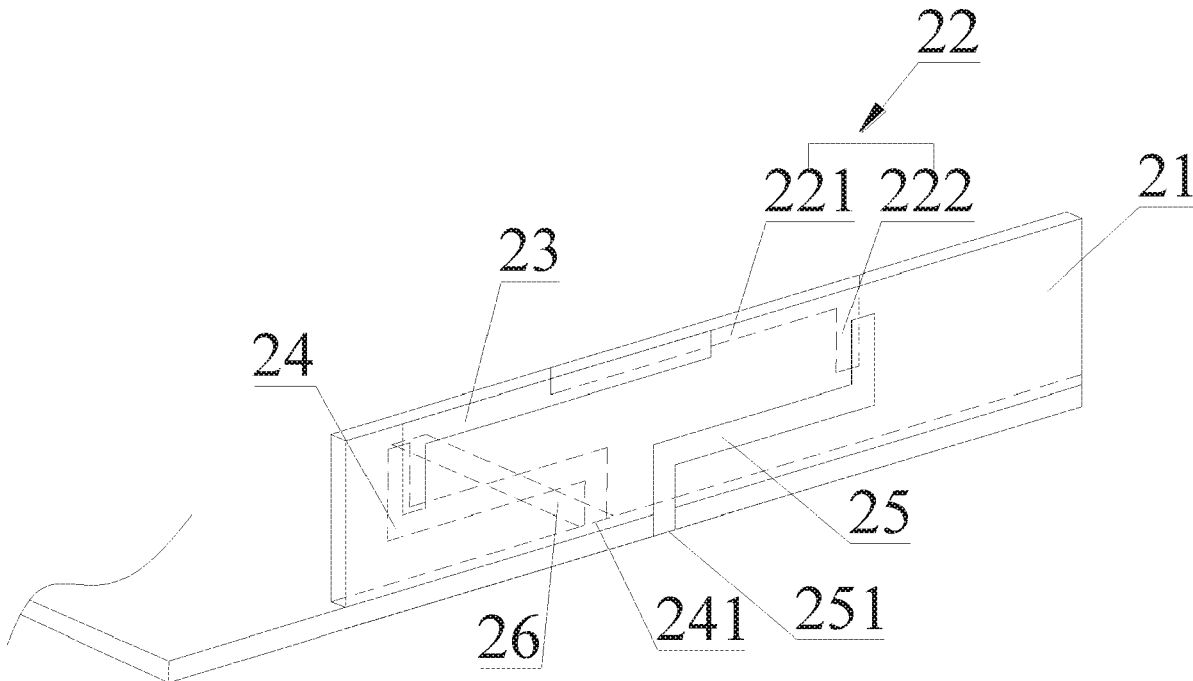
(22) Filed: **Feb. 14, 2019**

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2019/
070602, filed on Jan. 7, 2019.

Foreign Application Priority Data

Nov. 19, 2018 (CN) 201811374186.1





US 20200161769A1

(19) **United States**

(12) **Patent Application Publication**

Hu et al.

(10) **Pub. No.: US 2020/0161769 A1**

(43) **Pub. Date: May 21, 2020**

(54) **TRIPLE WIDEBAND HYBRID LTE SLOT ANTENNA**

H01Q 1/48 (2006.01)

H01Q 9/42 (2006.01)

H01Q 1/24 (2006.01)

(71) Applicant: **SMART ANTENNA TECHNOLOGIES LTD**, Birmingham (GB)

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

CPC *H01Q 13/10* (2013.01); *H01Q 9/0407* (2013.01); *H01Q 1/241* (2013.01); *H01Q 1/48* (2013.01); *H01Q 9/42* (2013.01); *H01Q 1/38* (2013.01)

(72) Inventors: **Sampson Hu**, Birmingham (GB); **Jinsong Song**, Birmingham (GB); **Qing Liu**, Birmingham (GB); **Liang Wan**, Birmingham (GB)

(57) **ABSTRACT**

There is disclosed an antenna arrangement for a portable electronic device. The antenna arrangement comprises a conductive ground plane having an edge and a substantially rectangular recess formed in the edge of the ground plane. The recess has a base, an open edge opposed to the base, and at least a first side extending from the base. A first conductor element extends across the open edge of the recess, a first end of the first conductor element being connected to the ground plane at the first side of the recess. The first conductor element leaves at least one gap at the edge of the recess, such that the first conductor element, the first side of the recess and the base of the recess together define a slot in the ground plane and the at least one gap defines at least one notch in the slot. A second conductor element is disposed within the recess and connected to or configured to couple with the ground plane. The antenna arrangement further comprises a feed arm for connection to an RF feed, the feed arm being disposed substantially within a footprint of the slot.

(21) Appl. No.: **16/487,058**

(22) PCT Filed: **Feb. 19, 2018**

(86) PCT No.: **PCT/GB2018/050434**

§ 371 (c)(1),

(2) Date: **Aug. 19, 2019**

(30) **Foreign Application Priority Data**

Feb. 20, 2017 (GB) 1702748.3

Jul. 24, 2017 (GB) 1711909.0

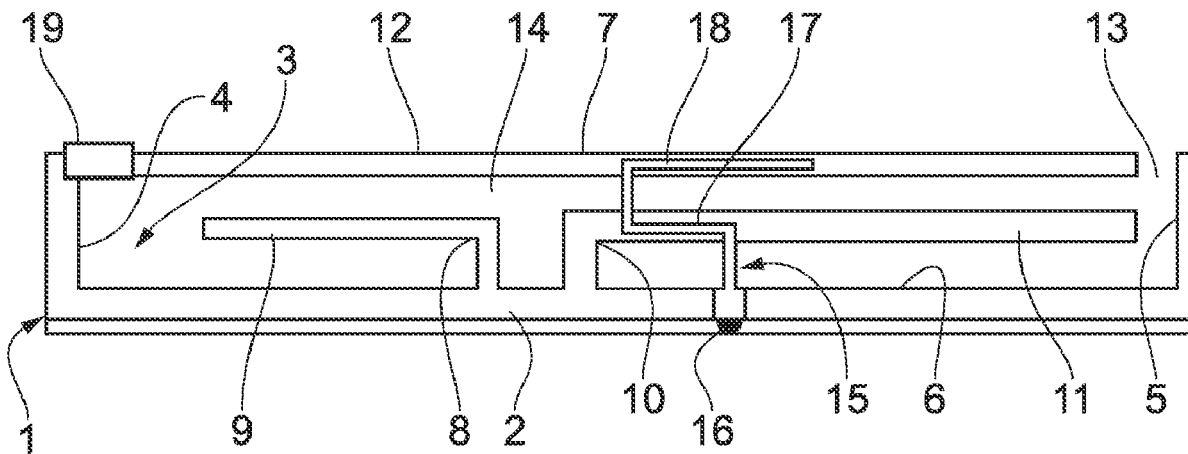
Publication Classification

(51) **Int. Cl.**

H01Q 13/10 (2006.01)

H01Q 9/04 (2006.01)

H01Q 1/38 (2006.01)





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(19) **United States**

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

(10) **Pub. No.: US 2020/0162591 A1**

(43) **Pub. Date: May 21, 2020**

(54) **ELECTRONIC DEVICE**

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

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

CPC **H04M 1/02** (2013.01); **H01Q 1/243** (2013.01); **H01Q 5/371** (2015.01); **H01Q 1/38** (2013.01)

(72) Inventors: **Byungwoon JUNG**, Seoul (KR);
Soyeon LEE, Seoul (KR)

(57) **ABSTRACT**

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

(21) Appl. No.: **16/623,190**

(22) PCT Filed: **Jul. 4, 2017**

(86) PCT No.: **PCT/KR2017/007089**

§ 371 (c)(1),

(2) Date: **Dec. 16, 2019**

An electronic device of the present disclosure comprises: a housing including a metal frame; and a first antenna unit which is arranged at one side of the housing and transmits and receives a signal at a specific frequency band, wherein: the first antenna unit includes a first metal member which is connected to the metal frame, receives power by a power feeding unit, and has a length set to be radiated at the specific frequency band, and a second metal member which is arranged at a spaced gap of a preset interval from the first metal member and has one end coming into contact with the metal frame; a current, which is induced through the second metal member coupled with the first metal member, moves to the metal frame by means of the spaced gap; the first metal member, the second metal member and the metal frame are arranged to be separated from one another; and the first and second metal members are formed to resonate at the specific frequency band.

Publication Classification

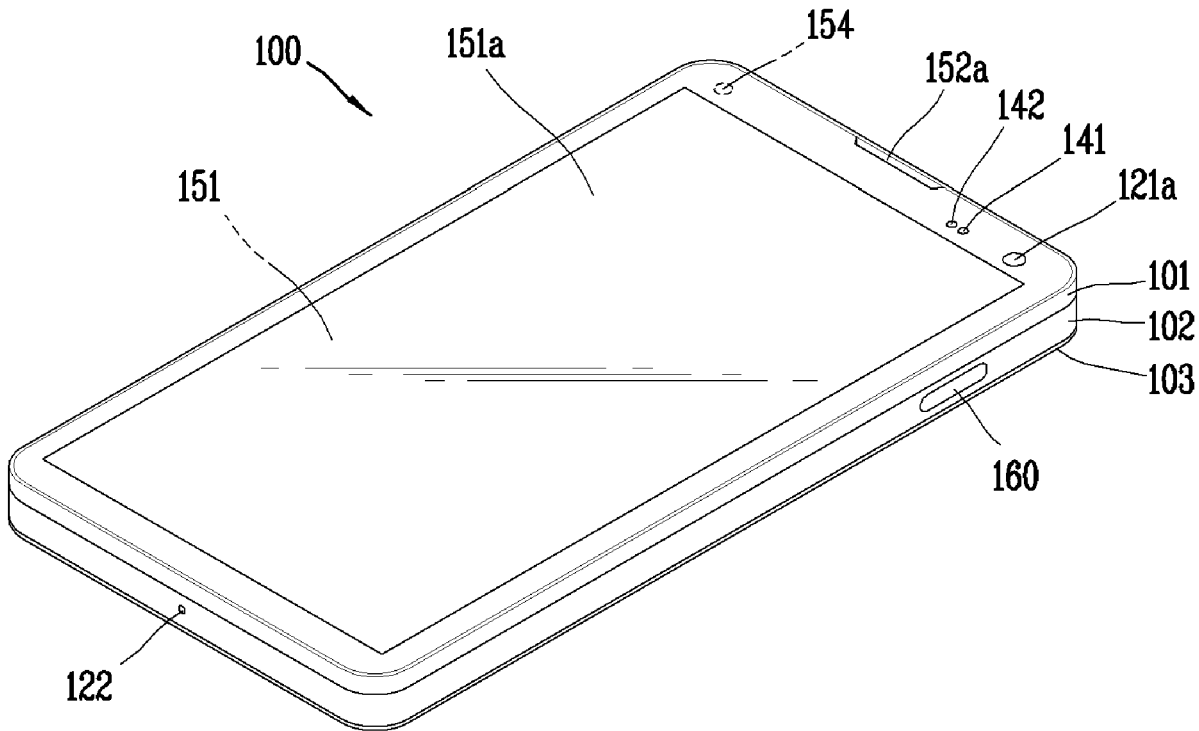
(51) **Int. Cl.**

H04M 1/02 (2006.01)

H01Q 1/38 (2006.01)

H01Q 5/371 (2006.01)

H01Q 1/24 (2006.01)





(19) **United States**

(12) **Patent Application Publication**
LI

(10) **Pub. No.: US 2020/0168988 A1**

(43) **Pub. Date: May 28, 2020**

(54) **MULTI-FEED ANTENNA**

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

(71) Applicants: **Inventec (Pudong) Technology Corporation**, Shanghai (CN);
INVENTEC CORPORATION, Taipei (TW)

CPC **H01Q 1/521** (2013.01); **H01Q 1/243** (2013.01); **H01Q 5/35** (2015.01); **H01Q 9/30** (2013.01); **H01Q 7/00** (2013.01)

(72) Inventor: **Chih-Cheng LI**, Taipei (TW)

(57) **ABSTRACT**

(21) Appl. No.: **16/214,350**

(22) Filed: **Dec. 10, 2018**

A multi-feed antenna comprises a first antenna component, a second antenna component, a metal board and an isolation assembly. The first antenna component comprises a first signal feed-in terminal and a first free end, with the first signal feed-in terminal configured for receiving a first feed-in signal. The second antenna component comprises a second signal feed-in terminal and a second free end, with the second signal feed-in terminal configured for receiving a second feed-in signal. The metal board comprises a first section, a second section and a third section between the first and second sections. The first section and the first free end define a first gap therebetween, and the second section and the second free end define a second gap therebetween. The isolation assembly is electrically connected with the third section, comprises a ground terminal, and is configured for isolating the first and second feed-in signals.

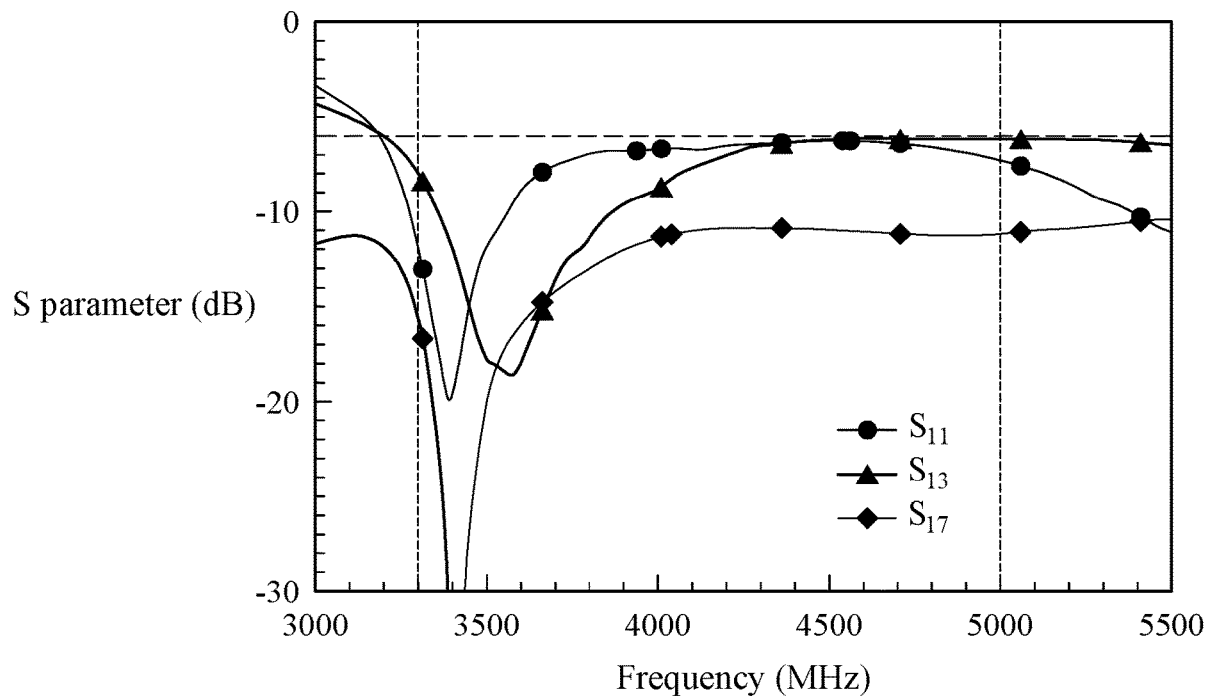
(30) **Foreign Application Priority Data**

Nov. 28, 2018 (CN) 201811433065.X

Publication Classification

(51) **Int. Cl.**

H01Q 1/52 (2006.01)
H01Q 1/24 (2006.01)
H01Q 7/00 (2006.01)
H01Q 9/30 (2006.01)





(19) **United States**

(12) **Patent Application Publication**
Chang

(10) **Pub. No.: US 2020/0168991 A1**

(43) **Pub. Date: May 28, 2020**

(54) **MULTI-BAND ANTENNA**

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

(71) Applicant: **Acer Incorporated**, New Taipei City (TW)

CPC **H01Q 5/328** (2015.01); **H01Q 1/36** (2013.01); **H01Q 5/50** (2015.01)

(72) Inventor: **Kun-Sheng Chang**, New Taipei City (TW)

(57) **ABSTRACT**

(73) Assignee: **Acer Incorporated**, New Taipei City (TW)

(21) Appl. No.: **16/396,743**

(22) Filed: **Apr. 28, 2019**

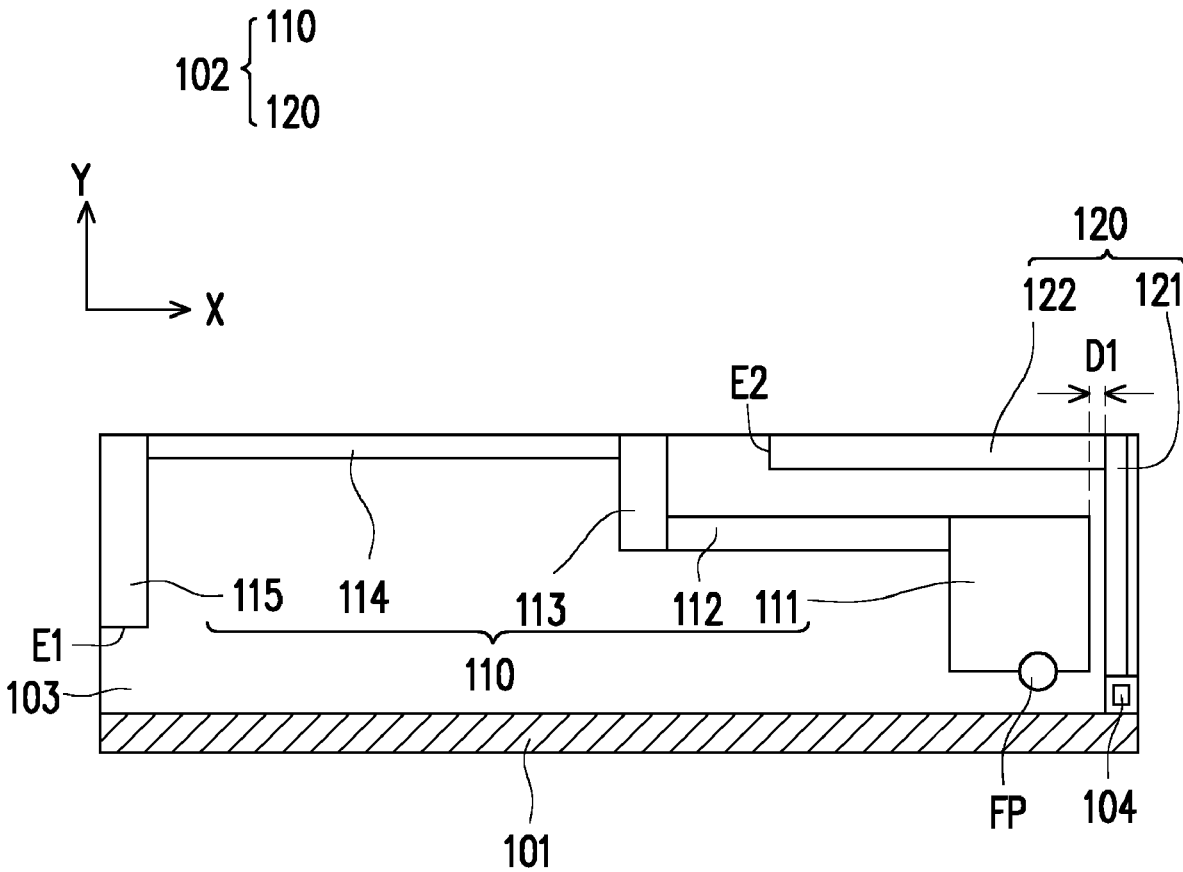
(30) **Foreign Application Priority Data**

Nov. 23, 2018 (TW) 107141762

Publication Classification

(51) **Int. Cl.**
H01Q 5/328 (2006.01)
H01Q 5/50 (2006.01)
H01Q 1/36 (2006.01)

A multi-band antenna includes a ground plane and an antenna element. The antenna element includes a first radiation portion and a second radiation portion. A first end of the first radiation portion is coupled to a feeding point, and a second end of the first radiation portion is a first open end. A first end of the second radiation portion is coupled to a ground plane, and a second end of the second radiation portion is a second open end. The second radiation portion is not electrically connected to the first radiation portion, and a coupling distance exists between the second radiation portion and the first radiation portion. The antenna element operates in a first band through the first radiation portion and operates in a second band through the second radiation portion. The frequency in the first band is lower than the frequency in the second band.





(19) **United States**

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

(10) **Pub. No.: US 2020/0168992 A1**

(43) **Pub. Date: May 28, 2020**

(54) **COMMUNICATION DEVICE AND
NOTEBOOK COMPUTER DEVICE**

H01Q 5/45 (2006.01)

H01Q 1/24 (2006.01)

H01Q 9/42 (2006.01)

(71) Applicant: **Wistron NeWeb Corp.**, Hsinchu (TW)

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

CPC *H01Q 5/371* (2015.01); *H01Q 5/328*
(2015.01); *H01Q 9/42* (2013.01); *H01Q 5/45*
(2015.01); *H01Q 1/244* (2013.01); *H01Q 5/28*
(2015.01)

(72) Inventors: **Huang-Tse PENG**, Hsinchu (TW);
Hsiang-Feng HSIEH, Hsinchu (TW);
Wan-Ju HUANG, Hsinchu (TW)

(21) Appl. No.: **16/595,937**

(57) **ABSTRACT**

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

A communication device includes a ground element, an antenna structure, a first reflector, a second reflector, a first tuning element, and a switch element. The first reflector is disposed adjacent to the antenna structure. The second reflector is disposed adjacent to the antenna structure. The second reflector is separate from the first reflector. The switch element is coupled to the first tuning element. When the switch element is enabled, the switch element couples the first tuning element to the first reflector or the second reflector. When the switch element is disabled, the first tuning element is separate from the first reflector and the second reflector.

(30) **Foreign Application Priority Data**

Nov. 23, 2018 (TW) 107141861

Publication Classification

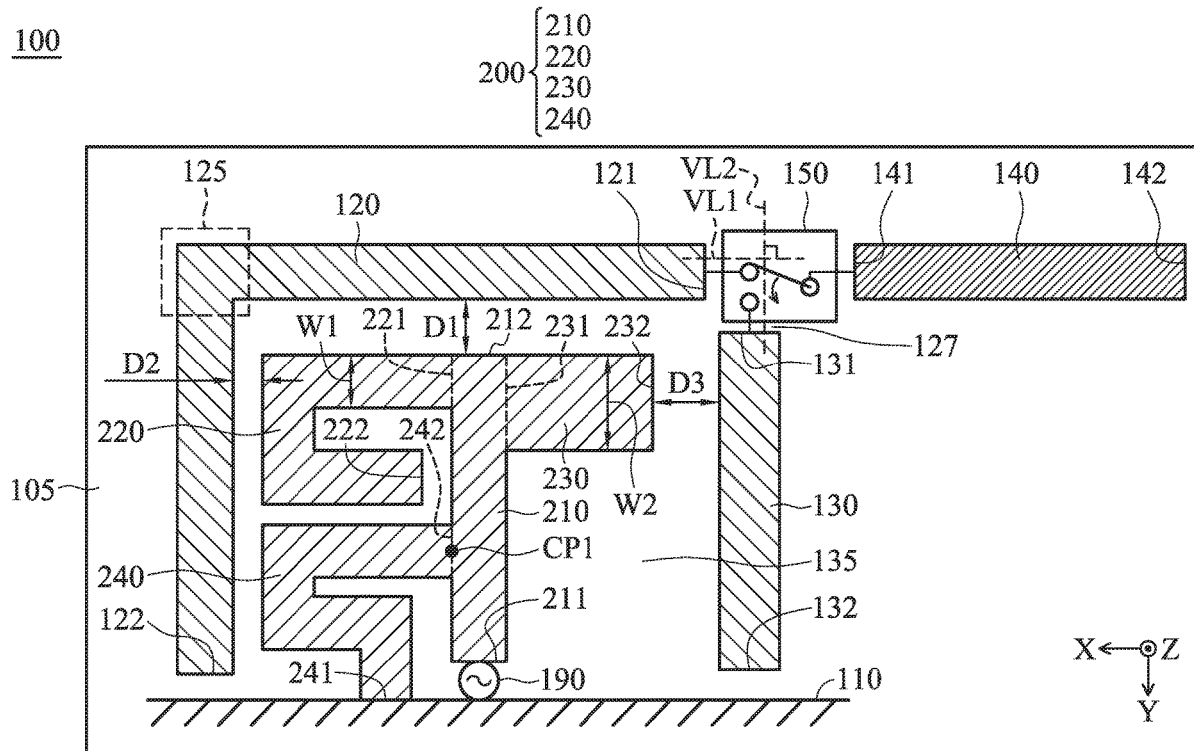
(51) **Int. Cl.**

H01Q 5/371 (2006.01)

H01Q 5/328 (2006.01)

H01Q 5/28 (2006.01)

100





(19) **United States**

(12) **Patent Application Publication**
WEI

(10) **Pub. No.: US 2020/0168993 A1**

(43) **Pub. Date: May 28, 2020**

(54) **MOBILE DEVICE**

(71) Applicant: **Wistron NeWeb Corp.**, Hsinchu (TW)

(72) Inventor: **Shih-Chiang WEI**, Hsinchu (TW)

(21) Appl. No.: **16/655,926**

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

(30) **Foreign Application Priority Data**

Nov. 28, 2018 (TW) 107142393

Publication Classification

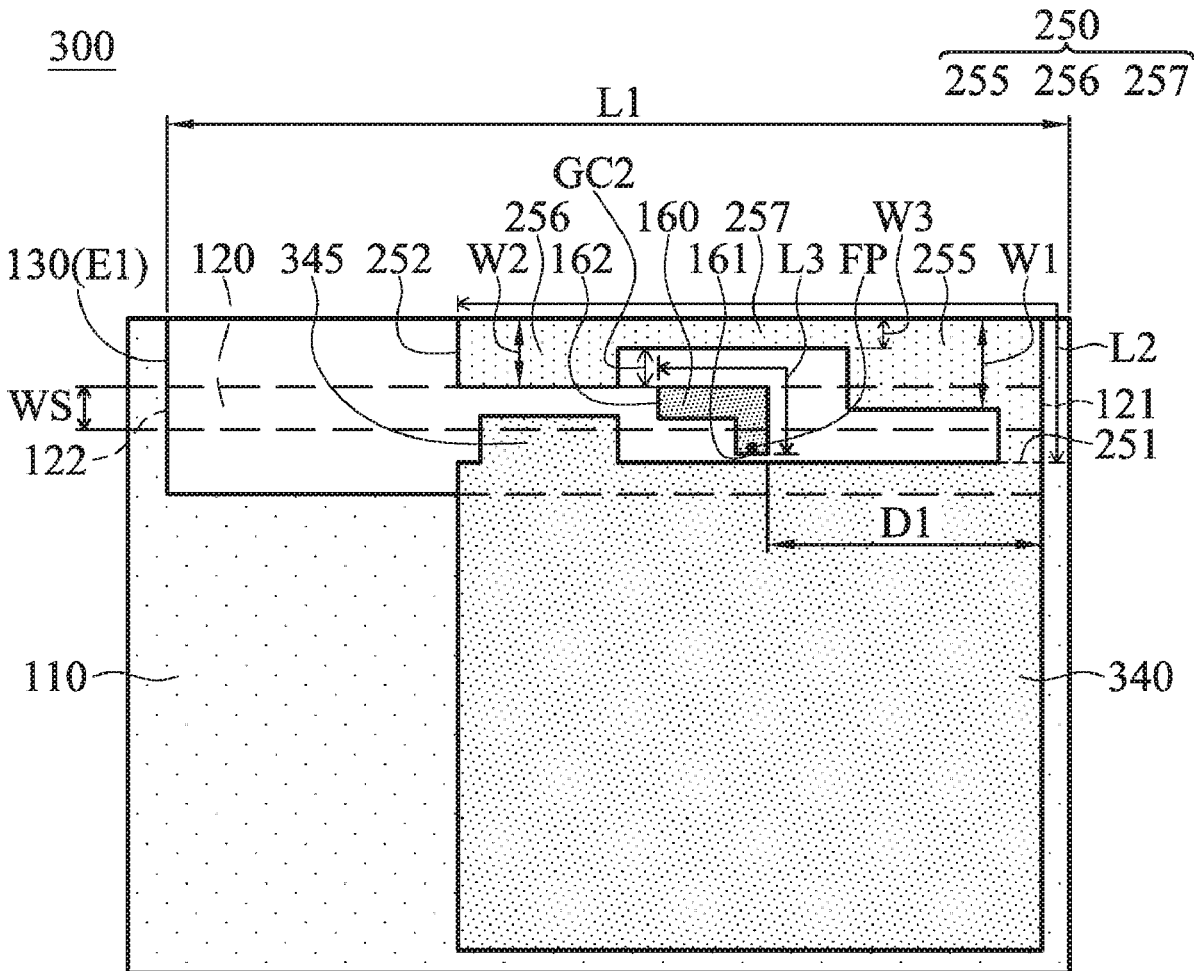
- (51) **Int. Cl.**
- H01Q 5/392* (2006.01)
- H01Q 5/15* (2006.01)
- H01Q 1/24* (2006.01)
- H01Q 1/48* (2006.01)
- H01Q 1/38* (2006.01)
- H01Q 13/10* (2006.01)

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

CPC *H01Q 5/392* (2015.01); *H01Q 5/15* (2015.01); *H01Q 13/106* (2013.01); *H01Q 1/48* (2013.01); *H01Q 1/38* (2013.01); *H01Q 1/243* (2013.01)

(57) **ABSTRACT**

A mobile device includes a metal mechanism element, a dielectric substrate, a ground plane, a parasitic radiation element, and a feeding radiation element. A connection end of the parasitic radiation element is coupled to the ground plane. The parasitic radiation element includes a first widening portion, which is positioned at a bend of the parasitic radiation element. The parasitic radiation element has a vertical projection on the metal mechanism element. The vertical projection at least partially overlaps a first closed end of the slot. The feeding radiation element is disposed between the parasitic radiation element and the ground plane. The dielectric substrate is adjacent to the metal mechanism element. The parasitic radiation element and the feeding radiation element are disposed on the dielectric substrate. An antenna structure is formed by the parasitic radiation element, the feeding radiation element, and the slot of the metal mechanism element.





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(19) **United States**

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

(10) **Pub. No.: US 2020/0169007 A1**

(43) **Pub. Date: May 28, 2020**

(54) **ANTENNA AND ELECTRONIC DEVICE INCLUDING THE SAME**

(52) **U.S. CI.**
CPC **H01Q 21/293** (2013.01); **H01Q 21/0006** (2013.01); **H01Q 1/22** (2013.01)

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

(72) Inventors: **Youngman SONG**, Gyeonggi-do (KR);
Wooyoung Jeong, Gyeonggi-do (KR);
Gwangun Oh, Gyeonggi-do (KR);
Youngmoon Park, Gyeonggi-do (KR);
Jongmin Lee, Gyeonggi-do (KR)

(57) **ABSTRACT**

An electronic device is provided. The electronic device includes a housing, and a printed circuit board (PCB) disposed in an inner space of the housing and includes at least one first conductive contact exposed at least partially and electrically connected to a wireless communication circuit; and an antenna structure disposed on the PCB, including at least one first antenna element and at least one second conductive contact exposed at least partially and electrically connected to the at least one first antenna element. The at least one first conductive contact is electrically connected to the at least one second conductive contact when the antenna structure is combined with the PCB. The wireless communication circuit is configured to form a directional beam through the at least one first antenna element.

(21) Appl. No.: **16/682,852**

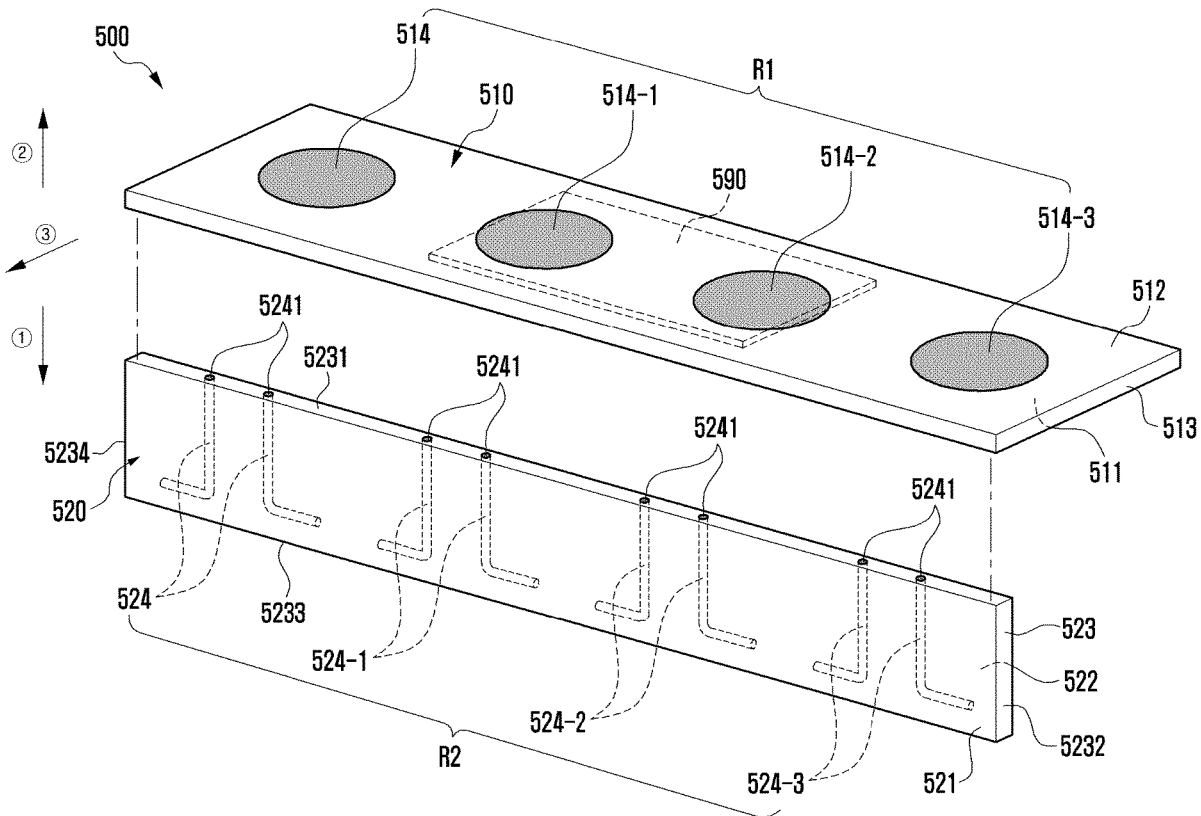
(22) Filed: **Nov. 13, 2019**

(30) **Foreign Application Priority Data**

Nov. 26, 2018 (KR) 10-2018-0147802

Publication Classification

(51) **Int. Cl.**
H01Q 21/29 (2006.01)
H01Q 1/22 (2006.01)





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(19) **United States**

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

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(43) **Pub. Date: Jun. 4, 2020**

(54) **MODULAR MULTI-STAGE ANTENNA SYSTEM AND COMPONENT FOR WIRELESS COMMUNICATIONS**

Publication Classification

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(51) **Int. Cl.**
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H01Q 5/335 (2006.01)
H01Q 1/48 (2006.01)
H01Q 21/00 (2006.01)
H01Q 1/38 (2006.01)

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(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 5/335*
(2015.01); *H01Q 1/38* (2013.01); *H01Q 21/0025* (2013.01); *H01Q 1/48* (2013.01)

(21) Appl. No.: **16/731,755**

(57) **ABSTRACT**

(22) Filed: **Dec. 31, 2019**

A wireless device comprises a radiating system that comprises: an antenna system, a ground plane, and a matching network. The antenna system comprises an antenna component including a first multi-section antenna component comprising two sections, each comprising a conductive element. The matching network connected to the antenna system for impedance matching to a first frequency range. The radiating system operates in a frequency range of operation including the first frequency range, the first frequency range comprising a first highest frequency and a first lowest frequency. The first antenna component has a maximum size larger than $\frac{1}{30}$ times and smaller than $\frac{1}{5}$ times a free-space wavelength corresponding to the lowest frequency of operation. The conductive elements in the different sections of the first antenna component are spaced apart from each other.

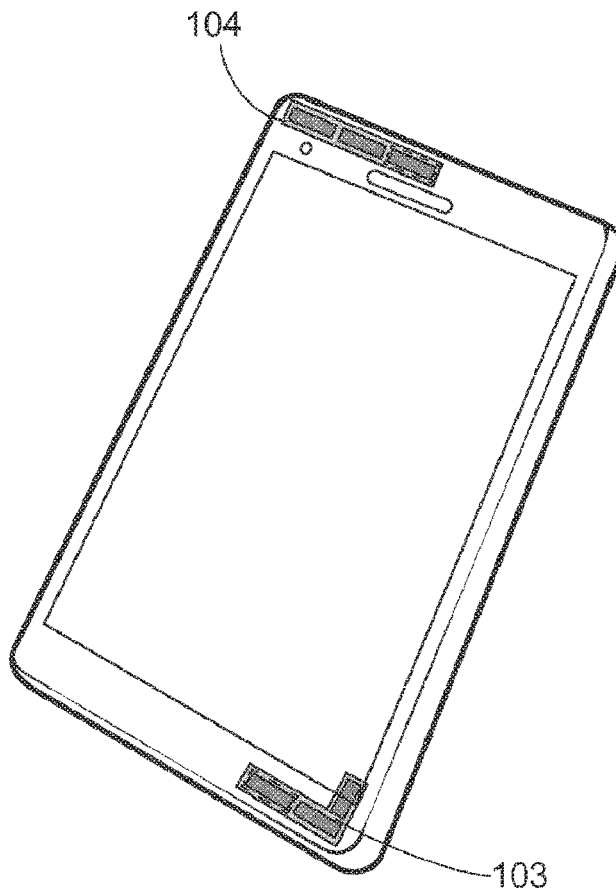
Related U.S. Application Data

(63) Continuation of application No. PCT/EP2018/068436, filed on Jul. 6, 2018.

(60) Provisional application No. 62/529,032, filed on Jul. 6, 2017, provisional application No. 62/634,943, filed on Feb. 26, 2018.

Foreign Application Priority Data

(30) Feb. 26, 2018 (EP) 18158695.9





(19) **United States**

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

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(43) **Pub. Date: Jun. 4, 2020**

(54) **ANTENNA DEVICE**

Publication Classification

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(51) **Int. Cl.**
H01Q 3/01 (2006.01)
H01Q 13/10 (2006.01)
H01Q 3/46 (2006.01)
H01Q 9/04 (2006.01)
H01Q 19/30 (2006.01)
(52) **U.S. Cl.**
CPC **H01Q 3/01** (2013.01); **H01Q 13/10**
(2013.01); **H01Q 1/2291** (2013.01); **H01Q**
9/0442 (2013.01); **H01Q 19/30** (2013.01);
H01Q 3/46 (2013.01)

(21) Appl. No.: **16/786,449**

(22) Filed: **Feb. 10, 2020**

Related U.S. Application Data

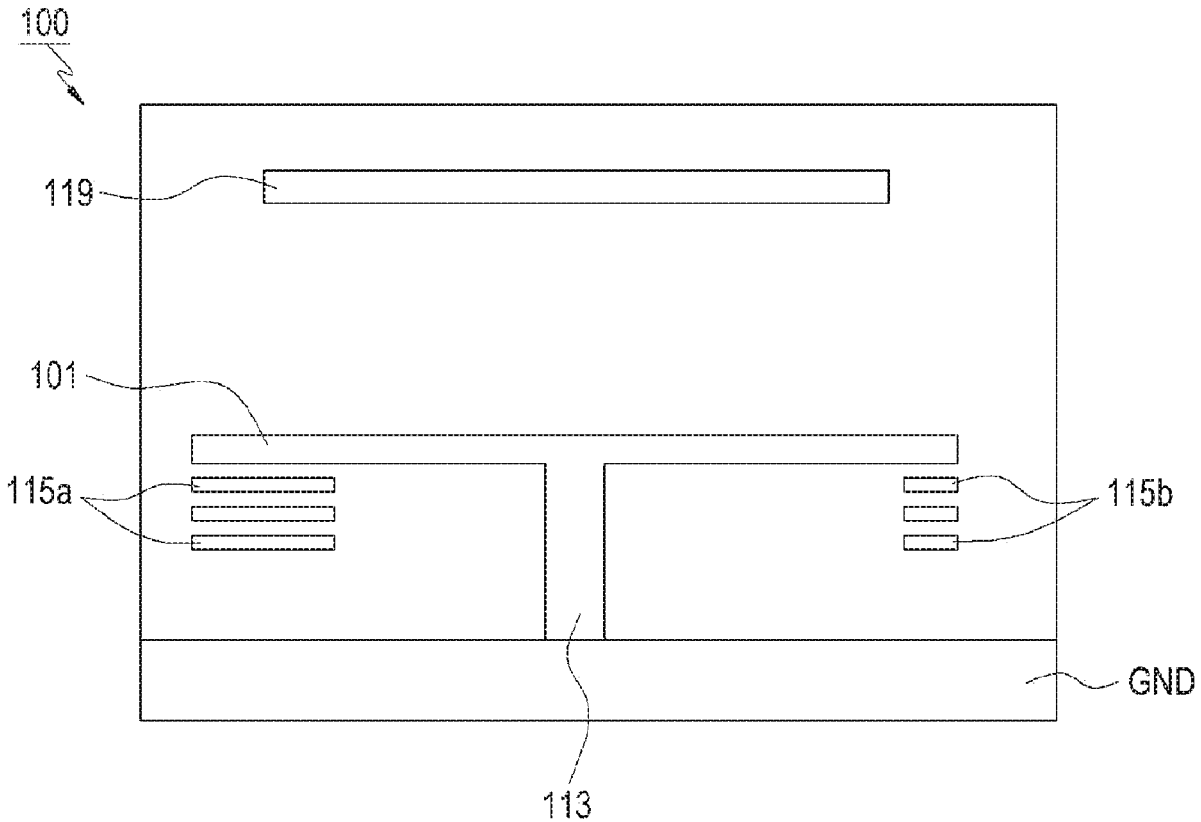
(62) Division of application No. 15/038,334, filed on May
20, 2016, now abandoned, filed as application No.
PCT/KR2015/001989 on Mar. 2, 2015.

Foreign Application Priority Data

May 13, 2014 (KR) 10-2014-0057077

(57) **ABSTRACT**

Various embodiments of the present disclosure provide an antenna device, which comprises: a radiator for receiving a power supply signal; multiple tuning units disposed adjacently to or on the radiator, wherein the tuning units are short-circuited to the radiator or adjacent tuning units are selectively short-circuited to each other. The antenna device as described above can be variously implemented according to embodiments.





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Huang et al.

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(54) **FINGER TYPE ANTENNA**

H01Q 1/38 (2006.01)

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H01Q 9/30 (2006.01)

(52) **U.S. CL.**
CPC *H01Q 5/335* (2015.01); *H01Q 9/30* (2013.01); *H01Q 1/38* (2013.01); *H01Q 9/42* (2013.01)

(72) Inventors: **Chi-Fang Huang**, Taipei (TW);
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(57) **ABSTRACT**

The disclosure provides a finger type antenna, including a short-circuit portion, a feeding portion, an open-circuit portion, a ground portion, and a coplanar waveguide. The short-circuit portion has a first end and a second end. The feeding portion has a first end and a second end, wherein the first end of the feeding portion is coupled to the first end of the short-circuit portion. The open-circuit portion includes at least three antenna elements, wherein each antenna element has a first end and a second end, and the first ends of the antenna elements are coupled to each other via the feeding portion. The coplanar waveguide is connected to the second end of the short-circuit portion, the second end of the feeding portion, and the ground portion.

(21) Appl. No.: **16/449,481**

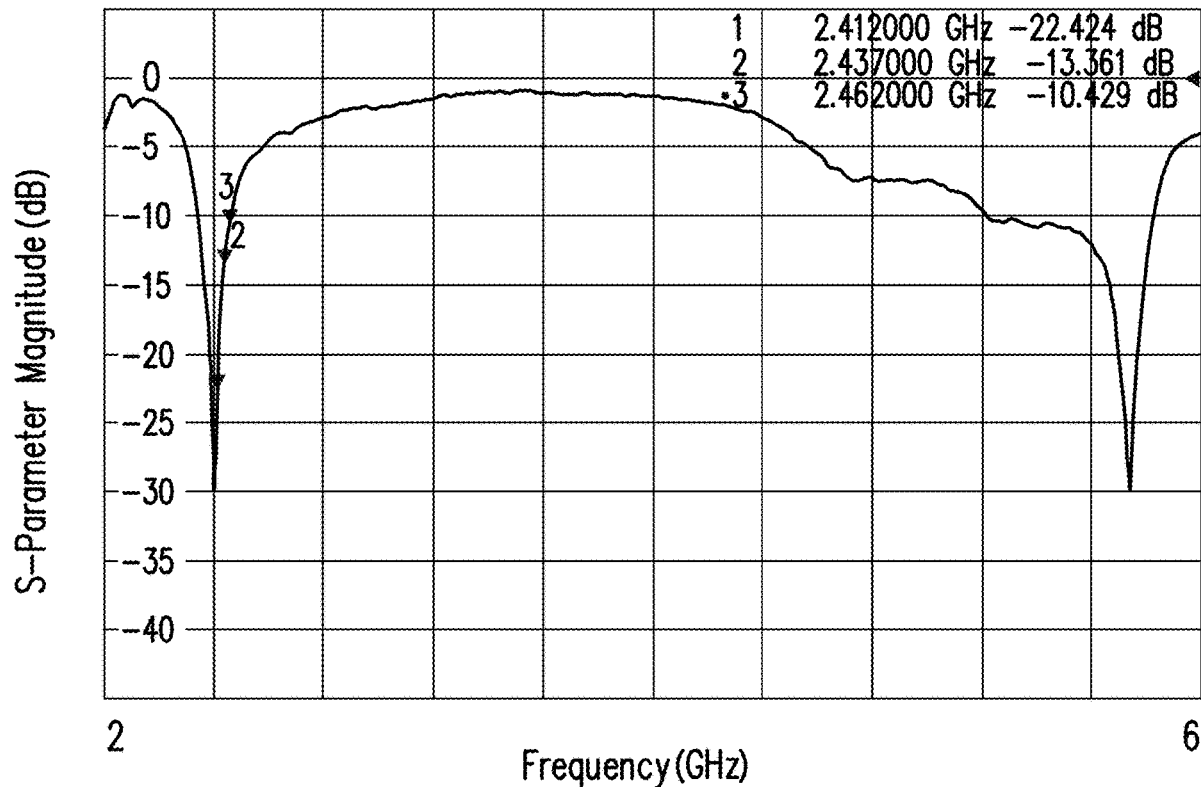
(22) Filed: **Jun. 24, 2019**

(30) **Foreign Application Priority Data**

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Publication Classification

(51) **Int. Cl.**
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H01Q 9/42 (2006.01)





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(19) **United States**

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

(10) **Pub. No.: US 2020/0176870 A1**

(43) **Pub. Date: Jun. 4, 2020**

(54) **ANTENNA STRUCTURE AND WIRELESS COMMUNICATION DEVICE USING THE SAME**

H01Q 1/22 (2006.01)

H04B 1/00 (2006.01)

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

CPC *H01Q 5/335* (2015.01); *H04B 1/0064* (2013.01); *H01Q 1/2291* (2013.01); *H01Q 1/243* (2013.01)

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(57) **ABSTRACT**

An antenna structure of few components and reduced size which functions by switching between components to achieve radiation in three different frequency bands includes two radiating portions, a feeding portion, a matching circuit, and a first switching circuit. With the first switching circuit closed, current flows along a first radiating portion to activate a first frequency band. A second radiating portion obtains the current from the first switching circuit by coupling with the first radiating portion, to activate a second frequency band. Current in the first radiating portion can activate a third frequency band. With the first switching circuit open, current in the first radiating portion activates radiation in the first frequency band. The second radiating portion can radiate in second frequency band by coupling current from the first radiating portion. Frequency multiplication of the first frequency band can activate the third frequency band.

(21) Appl. No.: **16/684,981**

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

(30) **Foreign Application Priority Data**

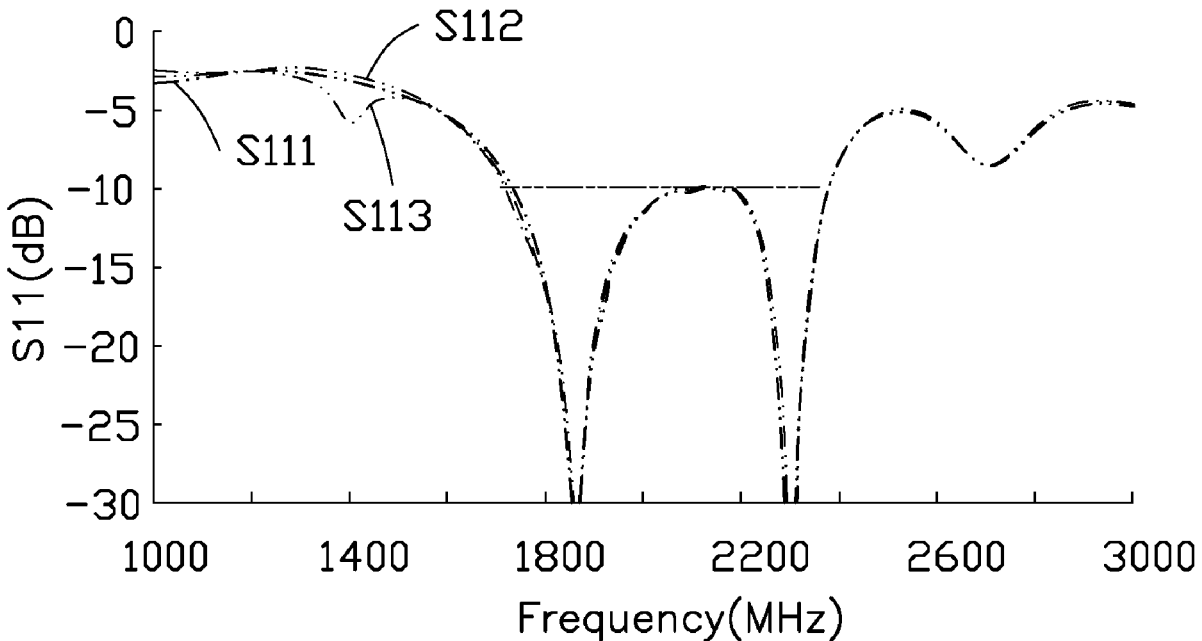
Nov. 30, 2018 (CN) 201811455055.6

Publication Classification

(51) **Int. Cl.**

H01Q 5/335 (2006.01)

H01Q 1/24 (2006.01)





(19) **United States**

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

(10) **Pub. No.: US 2020/0185813 A1**
(43) **Pub. Date: Jun. 11, 2020**

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

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(72) Inventors: **Cheng-Pang CHANG**, Hsinchu (TW);
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(21) Appl. No.: **16/658,353**

(22) Filed: **Oct. 21, 2019**

(30) **Foreign Application Priority Data**

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Publication Classification

(51) **Int. Cl.**

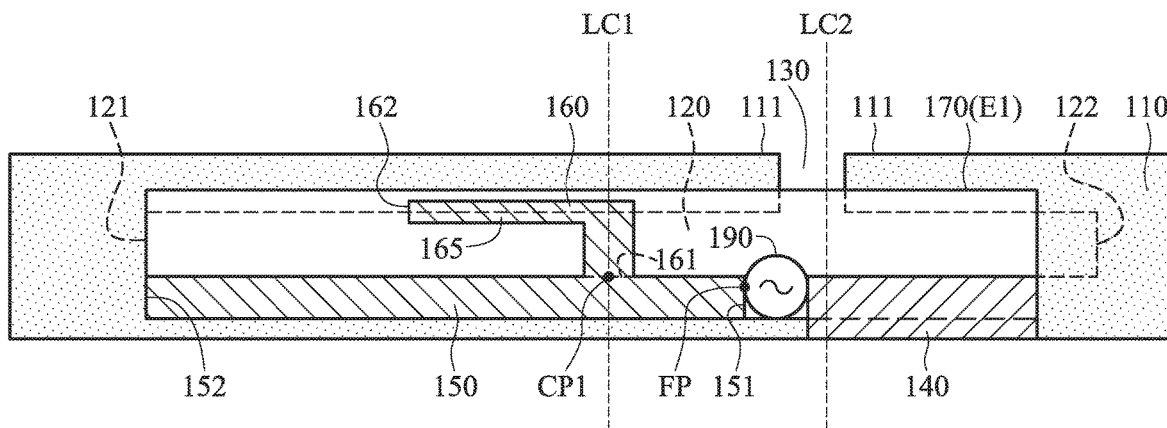
<i>H01Q 1/22</i>	(2006.01)
<i>H01Q 1/48</i>	(2006.01)
<i>H01Q 9/40</i>	(2006.01)
<i>H01Q 9/42</i>	(2006.01)

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

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(57) **ABSTRACT**

An antenna structure includes a metal mechanism element, a ground element, a first radiation element, a second radiation element, and a dielectric substrate. The metal mechanism element has a slot. A notch is formed on an edge of the metal mechanism element. The notch and the slot are connected to each other. The ground element is coupled to the metal mechanism element. The first radiation element has a feeding point. The second radiation element is coupled to the first radiation element and includes a first extension portion. The second radiation element extends across the slot. The first extension portion is parallel to the slot. A vertical projection of the first extension portion at least partially overlaps the slot. The dielectric substrate is adjacent to the metal mechanism element. The first radiation element and the second radiation element are disposed on the dielectric substrate.





(19) **United States**

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CHEN et al.

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(43) **Pub. Date: Jun. 11, 2020**

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

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

CPC **H01Q 5/328** (2015.01); **H01Q 1/243** (2013.01); **H01Q 5/335** (2015.01); **H01Q 9/30** (2013.01); **H01Q 13/10** (2013.01)

(71) Applicant: **Wistron NeWeb Corp., Hsinchu (TW)**

(72) Inventors: **Wei-Chen CHEN, Hsinchu (TW); Cheng-Wei CHANG, Hsinchu (TW)**

(57) **ABSTRACT**

An antenna structure includes a metal mechanism element, a ground element, a feeding radiation element, a coupling element, a dielectric substrate, and a switchable circuit. The metal mechanism element has a slot. The feeding radiation element extends across the slot. A coupling gap is formed between the feeding radiation element and the coupling element. The feeding radiation element and the coupling element are disposed on the dielectric substrate. The switchable circuit includes a first metal element, a second metal element, a reactance element, a capacitor, and a diode. The first metal element is coupled to the coupling element. The reactance element is embedded in the first metal element. The second metal element is coupled through the capacitor to the ground element. The diode is coupled between the first metal element and the second metal element. The diode is turned on or off according to the control voltage difference.

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

(30) **Foreign Application Priority Data**

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H01Q 13/10 (2006.01)
H01Q 9/30 (2006.01)
H01Q 5/335 (2006.01)

