



(19) **United States**

(12) **Patent Application Publication**

Kim et al.

(10) **Pub. No.: US 2018/0269561 A1**

(43) **Pub. Date: Sep. 20, 2018**

(54) **ANTENNA DEVICE HAVING SLIT STRUCTURE AND ELECTRONIC DEVICE INCLUDING THE SAME**

H01Q 1/36 (2006.01)

H01Q 1/44 (2006.01)

H03K 17/96 (2006.01)

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

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 1/085* (2013.01); *H03K 17/96* (2013.01); *H01Q 1/44* (2013.01); *H01Q 1/36* (2013.01)

(72) Inventors: **Jaehyung Kim**, Gyeonggi-do (KR);
Sang-Min Han, Gyeonggi-do (KR);
Kyung-Bae Ko, Gyeonggi-do (KR);
Youngjung Kim, Seoul (KR);
Jong-Suk Kim, Gyeonggi-do (KR);
Taegyu Kim, Gyeonggi-do (KR);
Jinkyu Bang, Gyeonggi-do (KR);
Changha Yu, Gyeonggi-do (KR);
Young-Sung Lee, Gyeonggi-do (KR)

(57) **ABSTRACT**

An electronic device includes housing including first plate, second plate, and side member, wherein side member includes first side face in first direction having first length, second side face having second length greater than first length, third side face extending parallel to first side face having first length, and fourth side face; touch screen display disposed within housing, and exposed through portion of first plate; a PCB between first plate and second plate to be parallel to second plate, wherein PCB includes ground plane and first L-shaped ground extension between first conductive region of second plate and first plate, and first L-shaped ground extension includes first portion extending in second direction from ground plane and second portion extending in first direction from first portion; and at least one first wireless communication circuit disposed on PCB and electrically connected to first point in second portion of first L-shaped ground extension.

(73) Assignee: **Samsung Electronics Co., Ltd.**

(21) Appl. No.: **15/922,466**

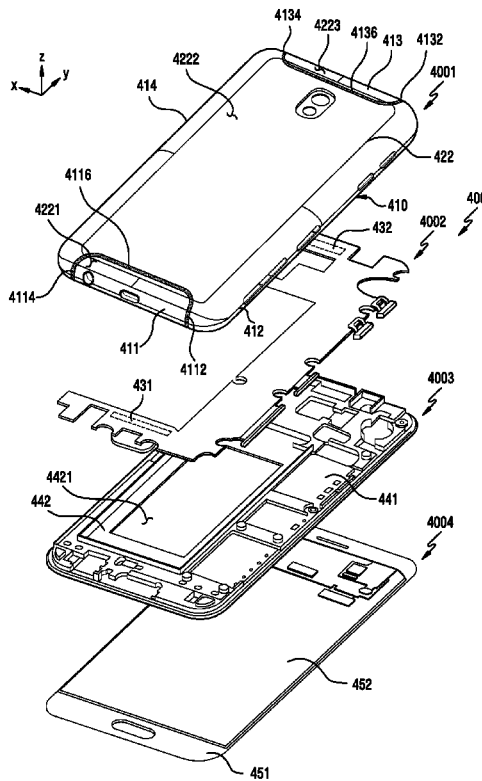
(22) Filed: **Mar. 15, 2018**

(30) **Foreign Application Priority Data**

Mar. 15, 2017 (KR) 10-2017-0032324

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/08 (2006.01)





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(19) **United States**

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

(10) **Pub. No.: US 2018/0269562 A1**

(43) **Pub. Date: Sep. 20, 2018**

(54) **WIRELESS DEVICE**

(71) Applicant: **MEDIATEK INC.**, Hsin-Chu (TW)

(72) Inventors: **Min-Chung WU**, Hsinchu (TW);
Shao-Chin LO, Hsinchu (TW)

(21) Appl. No.: **15/984,531**

(22) Filed: **May 21, 2018**

Related U.S. Application Data

(60) Continuation-in-part of application No. 15/202,587, filed on Jul. 6, 2016, now Pat. No. 9,979,073, which is a division of application No. 12/959,373, filed on Dec. 3, 2010, now abandoned.

(60) Provisional application No. 61/290,177, filed on Dec. 25, 2009.

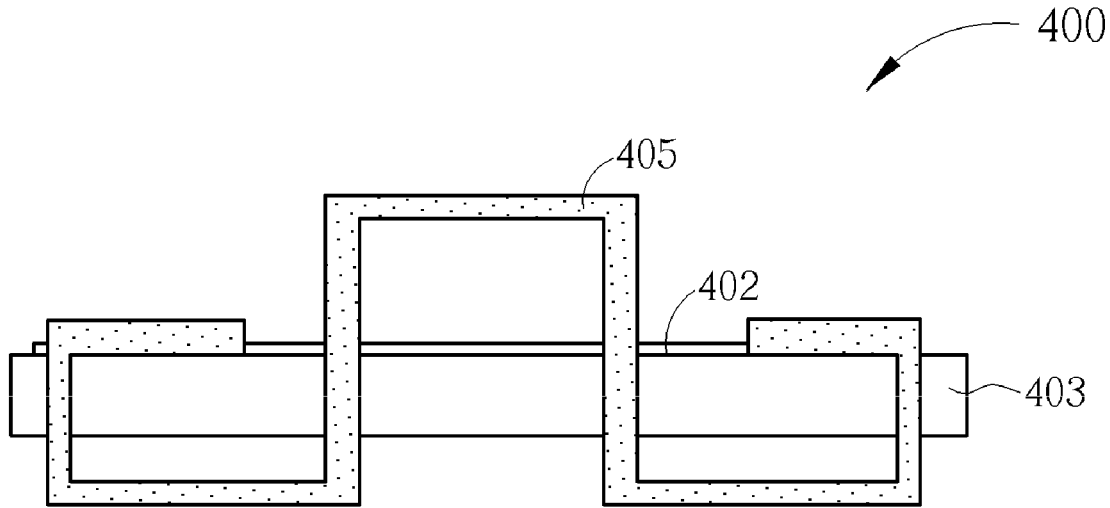
Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)
H01Q 9/40 (2006.01)
H01Q 1/38 (2006.01)

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 1/48* (2013.01); *H01Q 1/38* (2013.01); *H01Q 9/40* (2013.01)

(57) **ABSTRACT**

The present invention discloses a wireless device, which includes a substrate and an antenna. The antenna includes a printed antenna element and a 3-dimensional antenna element. The printed antenna element is printed on the substrate, while the 3-dimensional antenna element is disposed on the substrate and coupled to the printed antenna element. The printed antenna element and the 3-dimensional antenna element jointly have a physical length of a desired frequency.





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(19) **United States**

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

(10) **Pub. No.: US 2018/0269568 A1**

(43) **Pub. Date: Sep. 20, 2018**

(54) **ELECTRONIC DEVICE AND SUBSTRATE WITH LDS ANTENNAS AND MANUFACTURING METHOD THEREOF**

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

(71) Applicant: **FOXCONN INTERCONNECT TECHNOLOGY LIMITED**, Grand Cayman (KY)

(57) **ABSTRACT**

(72) Inventors: **XUAN XU**, Kunshan (CN); **Ye Xiong**, Kunshan (CN); **YUAN-ZI DUAN**, Kunshan (CN)

An electronic device includes a substrate with a plurality of LDS antennas and a conductive member, the substrate defines a first surface and a second surface opposite to the first surface. A decorative ink layer coats to the first surface of the substrate facing the interior of the electronic device, several LDS ink layers coat to the decorative ink layer, the LDS antennas are disposed on the corresponding LDS ink layers. The LDS antenna defines feed-in portion connecting with the conductive member, the conductive member comprises a flexible printed circuit and an anisotropic conductive adhesive connecting the flexible printed circuit and feed-in portion. Therefore, the transmission and reception of signal data can be realized through the connection between the flexible print circuit and the LDS antenna thereby enhance the effect of signal transmission and meet the needs of flexibility and miniaturization.

(21) Appl. No.: **15/922,933**

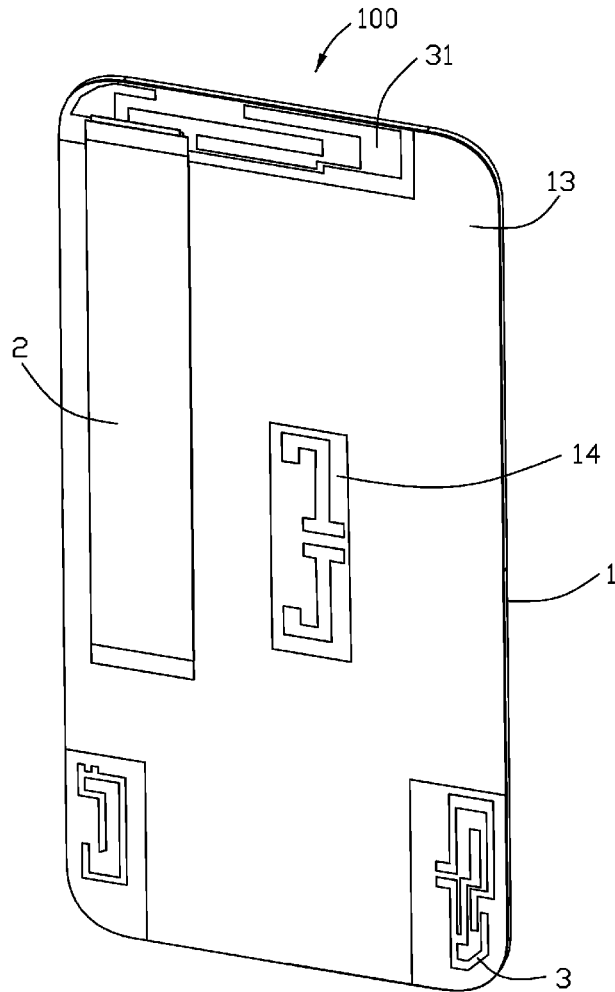
(22) Filed: **Mar. 16, 2018**

(30) **Foreign Application Priority Data**

Mar. 16, 2017 (CN) 201710156418.5

Publication Classification

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





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(19) **United States**

(12) **Patent Application Publication**

Wu et al.

(10) **Pub. No.: US 2018/0269578 A1**

(43) **Pub. Date: Sep. 20, 2018**

(54) **ANTENNA STRUCTURE**

(52) **U.S. CL.**

(71) Applicant: **Arcadyan Technology Corporation**,
Hsinchu City (TW)

CPC **H01Q 5/40** (2015.01); **H01Q 1/521**
(2013.01); **H01Q 5/328** (2015.01); **H01Q**
21/28 (2013.01); **H01Q 1/243** (2013.01)

(72) Inventors: **Min-Chi Wu**, Zhubei City (TW); **I-Min**
Chen, Kaohsiung City (TW)

(57) **ABSTRACT**

(21) Appl. No.: **15/673,113**

An antenna structure including a substrate, a grounding layer, a first antenna layer, a second antenna layer, an inductance element and a capacitance element is provided. The substrate has a surface. The grounding layer is formed on the surface of the substrate. The first antenna layer includes a first radiating portion and a second radiating portion. The second antenna layer includes a third radiating portion and a fourth radiating portion. The third radiating portion is connected to the first radiating portion at a connection portion. The connection portion is separated from the grounding layer, and the fourth radiating portion and the second radiating portion are disposed oppositely and separated from each other. The inductance element bridges the grounding layer and the connection portion. The capacitance element bridges the fourth radiating portion and the second radiating portion.

(22) Filed: **Aug. 9, 2017**

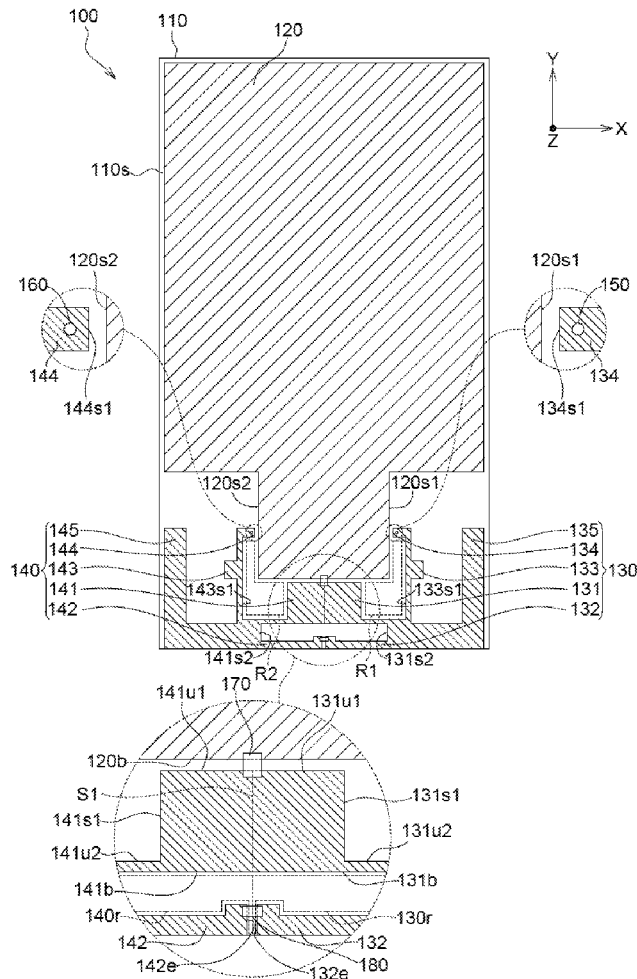
(30) **Foreign Application Priority Data**

Mar. 15, 2017 (TW) 106108590

Publication Classification

(51) **Int. Cl.**

H01Q 5/40 (2006.01)
H01Q 1/52 (2006.01)
H01Q 1/24 (2006.01)
H01Q 21/28 (2006.01)
H01Q 5/328 (2006.01)





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(19) **United States**

(12) **Patent Application Publication**

Lai et al.

(10) **Pub. No.: US 2018/0269595 A1**

(43) **Pub. Date: Sep. 20, 2018**

(54) **SYSTEM AND METHOD FOR A MOBILE ANTENNA WITH ADJUSTABLE RESONANT FREQUENCIES AND RADIATION PATTERN**

H01Q 9/04 (2006.01)

H01Q 9/42 (2006.01)

H01Q 5/378 (2006.01)

H01Q 21/28 (2006.01)

(71) Applicant: **Futurewei Technologies, Inc.**, Plano, TX (US)

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

CPC *H01Q 21/30* (2013.01); *H01Q 1/243*

(2013.01); *H01Q 1/38* (2013.01); *H01Q 3/24*

(2013.01); *H01Q 21/28* (2013.01); *H01Q*

9/0442 (2013.01); *H01Q 9/42* (2013.01);

H01Q 5/378 (2015.01); *H01Q 21/29* (2013.01)

(72) Inventors: **Chun Kit Lai**, LaJolla, CA (US); **Wee Kian Toh**, San Diego, CA (US); **Ning Ma**, San Diego, CA (US)

(21) Appl. No.: **15/986,096**

(57)

ABSTRACT

(22) Filed: **May 22, 2018**

Embodiments are provided for an efficient antenna design and operation method to adjust or add frequency bands at mobile devices using the available limited antenna size. The embodiments include electrically coupling to the antenna elements at a mobile or radio device a tuning stub or element through a printed circuit board (PCB) or a metal chassis. The PCB is placed between the antenna elements and the tuning stub and is connected to the antenna elements. The tuning stub, e.g., at a corner of the PCB, is connected or disconnected via a switch from the PCB, and hence the antenna elements, to shift the radiation of the antenna at different frequencies and also provide an additional mode of radiation. The tuning stub can also be switched to vary the radiation pattern of the antenna.

Related U.S. Application Data

(63) Continuation of application No. 13/971,628, filed on Aug. 20, 2013, now Pat. No. 9,979,096.

Publication Classification

(51) **Int. Cl.**

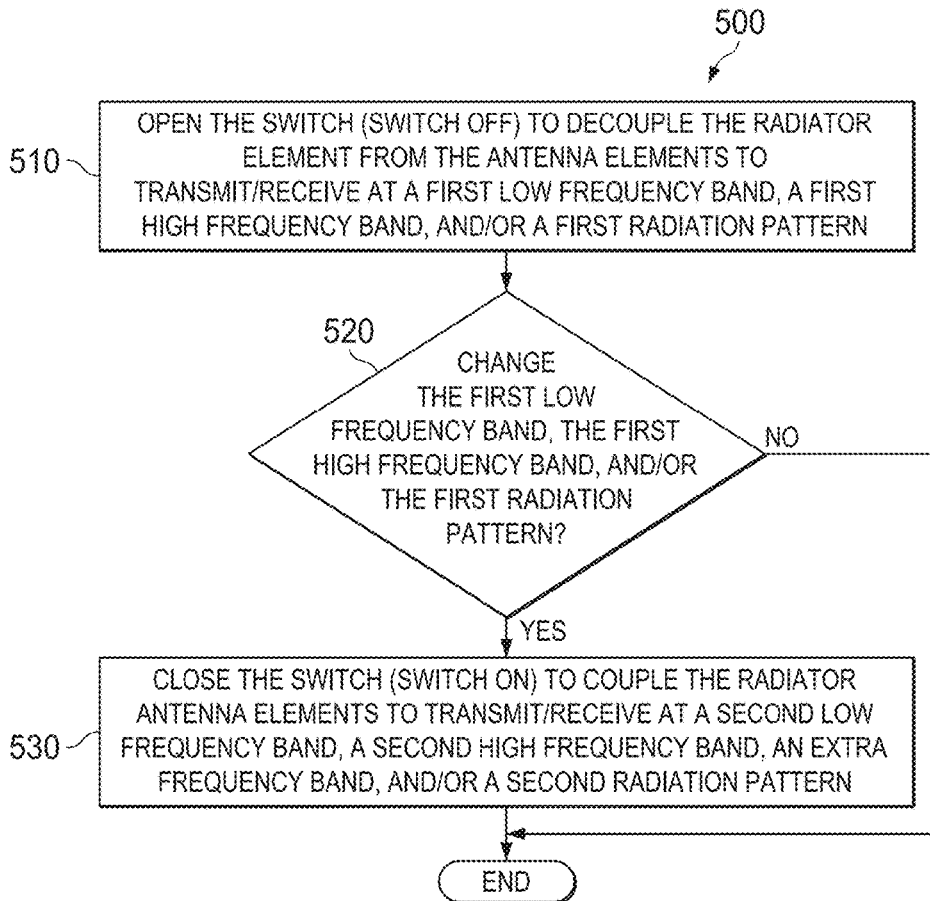
H01Q 21/30 (2006.01)

H01Q 1/24 (2006.01)

H01Q 1/38 (2006.01)

H01Q 3/24 (2006.01)

H01Q 21/29 (2006.01)





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(19) **United States**

(12) **Patent Application Publication**

Wu et al.

(10) **Pub. No.: US 2018/0277925 A1**

(43) **Pub. Date: Sep. 27, 2018**

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

H01Q 9/04 (2006.01)

H01Q 1/48 (2006.01)

H01Q 5/307 (2006.01)

(71) Applicant: **PEGATRON CORPORATION**, Taipei City (TW)

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

CPC *H01Q 1/2266* (2013.01); *H01Q 21/065*

(2013.01); *H01Q 5/307* (2015.01); *H01Q 1/48*

(2013.01); *H01Q 9/0421* (2013.01)

(72) Inventors: **Chien-Yi Wu**, Taipei City (TW);
Chao-Hsu Wu, Taipei City (TW);
Ching-Hsiang Ko, Taipei City (TW);
Shih-Keng Huang, Taipei City (TW);
Cheng-Hsiung Wu, Taipei City (TW);
Ya-Jyun Li, Taipei City (TW)

(57)

ABSTRACT

An antenna structure including a grounding portion, a feeding portion, a first radiating portion, a second radiating portion, and a third radiating portion is provided. The first radiating portion is connected to the feeding portion, wherein the first radiating portion is adapted to generate a low-frequency resonant mode. The second radiating portion is connected to the feeding portion, wherein a first gap is formed between the first radiating portion and the second radiating portion, and the second radiating portion is adapted to generate a first high-frequency resonant mode. The third radiating portion is connected to the feeding portion, wherein a second gap is formed between the third radiating portion and the grounding portion, and the third radiating portion is adapted to generate a second high-frequency resonant mode. In addition, an electronic device including the antenna structure is also provided.

(73) Assignee: **PEGATRON CORPORATION**, Taipei City (TW)

(21) Appl. No.: **15/833,884**

(22) Filed: **Dec. 6, 2017**

(30) **Foreign Application Priority Data**

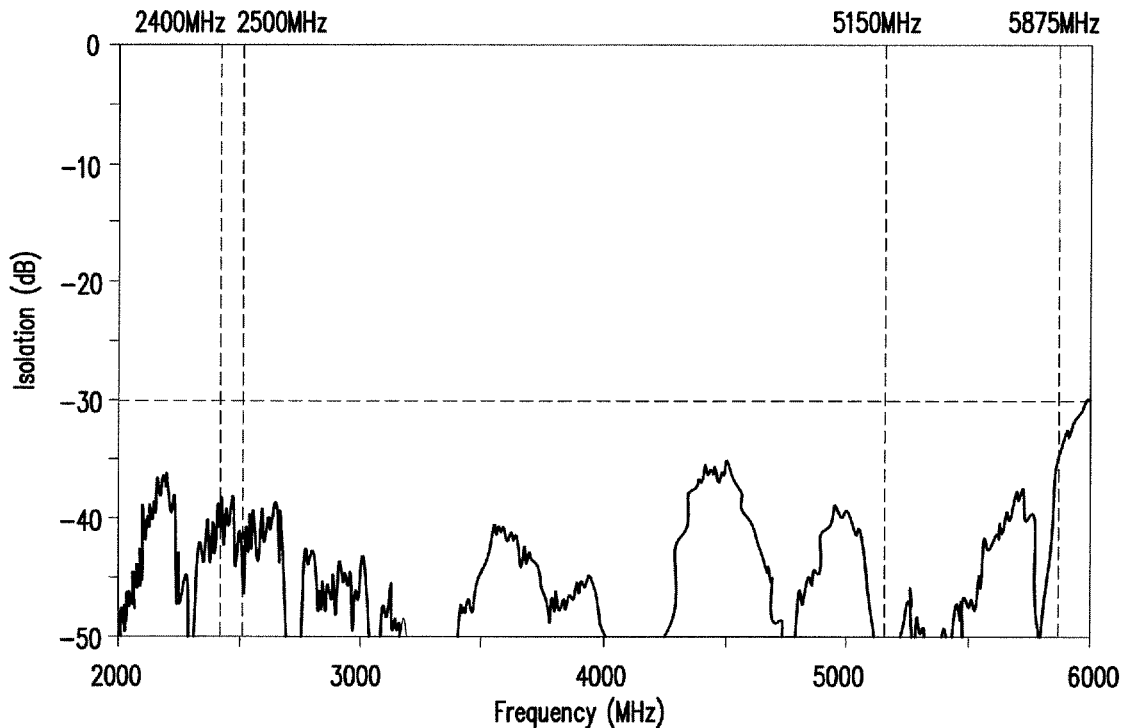
Mar. 24, 2017 (TW) 106109884

Publication Classification

(51) **Int. Cl.**

H01Q 1/22 (2006.01)

H01Q 21/06 (2006.01)





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(19) **United States**

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

(10) **Pub. No.: US 2018/0277929 A1**

(43) **Pub. Date: Sep. 27, 2018**

(54) **ELECTRONIC DEVICE INCLUDING ANTENNA**

H04B 1/40 (2006.01)

H01Q 5/40 (2006.01)

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

(52) **U.S. Cl.**
CPC *H01Q 1/241* (2013.01); *H01Q 5/40*
(2015.01); *H04B 1/40* (2013.01); *H01Q 5/20*
(2015.01)

(72) Inventors: **Jung Hoon SEO**, Hwaseong-si (KR);
Kyung Gu KIM, Suwon-si (KR);
Kyung Il SEO, Suwon-si (KR); **Young Jun CHO**, Seoul (KR)

(57) **ABSTRACT**

An electronic device including an antenna is provided. The electronic device includes a first antenna radiator that resonates in a first band, a second antenna radiator that resonates in second and third bands higher than the first band, a third antenna radiator that resonates in the second and third bands, a communication circuit, a first feeding part electrically connecting the communication circuit and the first antenna radiator, a second feeding part electrically connecting the communication circuit and the second antenna radiator, and a third feeding part electrically connecting the communication circuit and the third antenna radiator. The communication circuit receives a signal in the second band while transmitting and receiving a signal in the second band by using the second antenna radiator and receives a signal in the third band while transmitting and receiving a signal in the third band using the third antenna radiator.

(21) Appl. No.: **15/928,567**

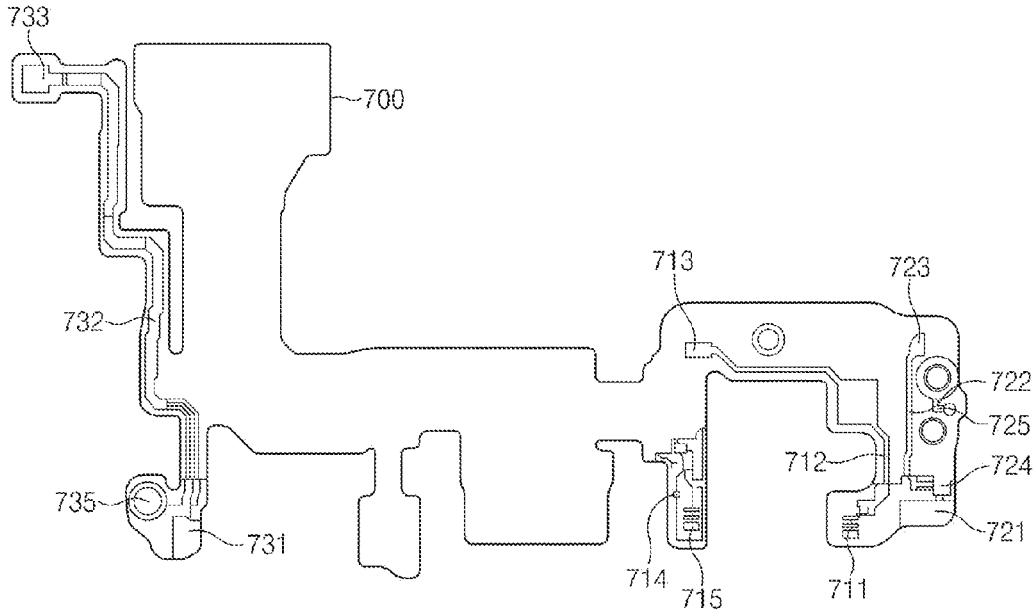
(22) Filed: **Mar. 22, 2018**

(30) **Foreign Application Priority Data**

Mar. 24, 2017 (KR) 10-2017-0037775

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 5/20 (2006.01)





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(19) **United States**

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

(10) **Pub. No.: US 2018/0277934 A1**

(43) **Pub. Date: Sep. 27, 2018**

(54) **ELECTRONIC DEVICE COMPRISING ANTENNA**

Publication Classification

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

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/38 (2006.01)
H04M 1/02 (2006.01)

(72) Inventors: **Dong Yeon KIM**, Gyeonggi-do (KR);
Jun Hwa OH, Seoul (KR); **Hyung Joo LEE**,
Gyeonggi-do (KR); **Soon Ho HWANG**, Seoul (KR);
Sung Hyup LEE, Gyeonggi-do (KR); **Yoon Jae LEE**,
Gyeonggi-do (KR)

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H04M 1/026*
(2013.01); *H01Q 1/38* (2013.01)

(73) Assignee: **Samsung Electronics Co., Ltd.**

(57) **ABSTRACT**

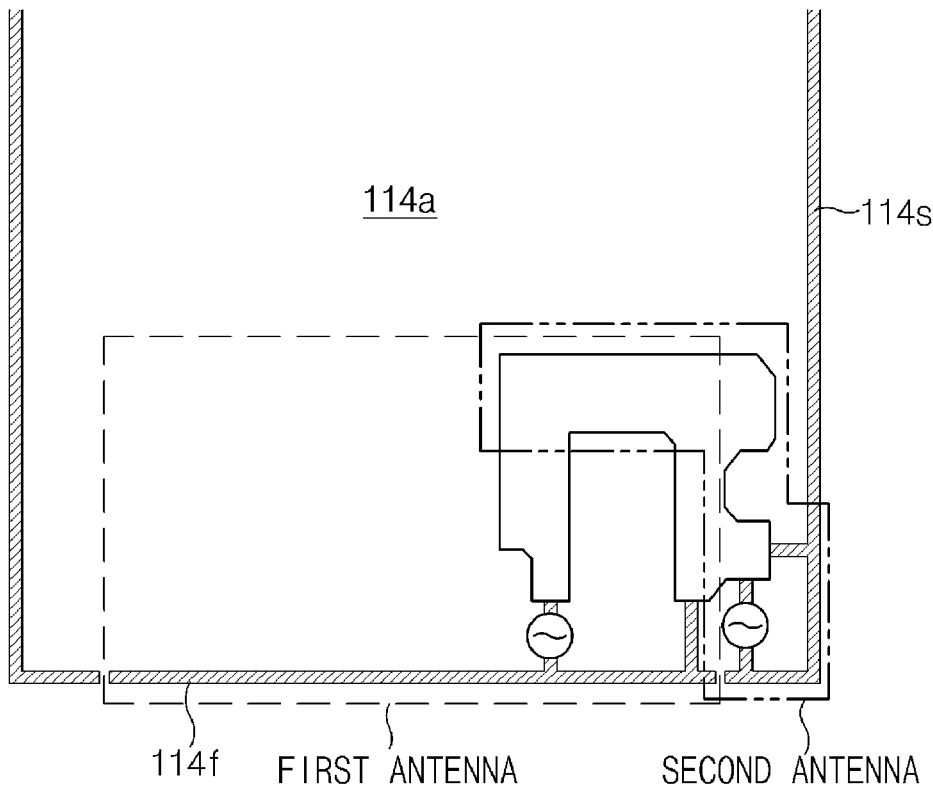
(21) Appl. No.: **15/935,504**

An electronic device includes a cover glass, a display exposed through the cover glass, a housing for mounting the display, a first printed circuit board (PCB) and a second PCB that are disposed inside the housing, a back cover coupled to the housing, a first antenna element electrically connected to a ground area through the first PCB, and a communication circuit feeding the first antenna element and transmitting or receiving a signal through the first antenna element. A spaced distance between the first PCB and the display is longer than a spaced distance between the second PCB and the display.

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

(30) **Foreign Application Priority Data**

Mar. 24, 2017 (KR) 10-2017-0037523





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(19) **United States**

(12) **Patent Application Publication**

Dinh et al.

(10) **Pub. No.: US 2018/0277936 A1**

(43) **Pub. Date: Sep. 27, 2018**

(54) **HYBRID ANTENNA FOR A PERSONAL ELECTRONIC DEVICE**

Publication Classification

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

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/08 (2006.01)
H01Q 1/44 (2006.01)

(72) Inventors: **Richard Hung Minh Dinh**, Saratoga, CA (US); **Hao Xu**, Cupertino, CA (US); **Jayesh Nath**, Milpitas, CA (US); **Peter I. Bevelacqua**, Sunnyvale, CA (US); **Jennifer M. Edwards**, San Francisco, CA (US); **Daniel W. Jarvis**, Sunnyvale, CA (US); **Jared M. Kole**, San Jose, CA (US); **Mattia Pascolini**, San Francisco, CA (US); **Robert W. Schlub**, Cupertino, CA (US); **Ruben Caballero**, San Jose, CA (US)

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 1/085* (2013.01); *Y10T 29/49016* (2015.01); *H01Q 1/44* (2013.01)

(21) Appl. No.: **15/994,853**

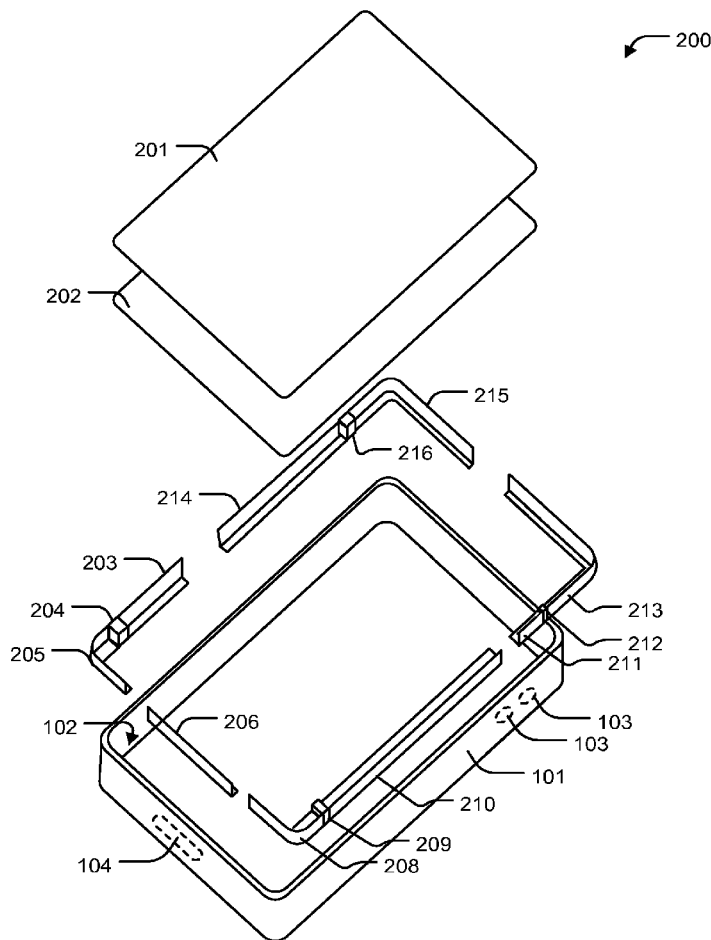
(57) **ABSTRACT**

(22) Filed: **May 31, 2018**

A housing for a personal electronic device is described herein. The housing may include at least one modular subassembly configured to be arranged within an internal cavity of the housing. The at least one modular subassembly is aligned with a feature external to the housing, is affixed to an interior surface of the internal cavity, and is configured to function both as an antenna and as an internal support member of the housing. A hybrid antenna is also described herein. The hybrid antenna can include first and second flexible members capable of facilitating wireless communication, where the first and second flexible members are affixed to one another via a metal member.

Related U.S. Application Data

(63) Continuation of application No. 14/020,687, filed on Sep. 6, 2013.





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(19) **United States**

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

(10) **Pub. No.: US 2018/0277951 A1**

(43) **Pub. Date: Sep. 27, 2018**

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

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

(72) Inventors: **Kenji NISHIKAWA, Hyogo (JP); Shingo SUMI, Miyagi (JP); Yasunori KOMUKAI, Miyagi (JP); Yukinari TAKAHASHI, Miyagi (JP); Yu ONO, Miyagi (JP)**

(21) Appl. No.: **15/990,006**

(22) Filed: **May 25, 2018**

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2017/001159, filed on Jan. 16, 2017.

Foreign Application Priority Data

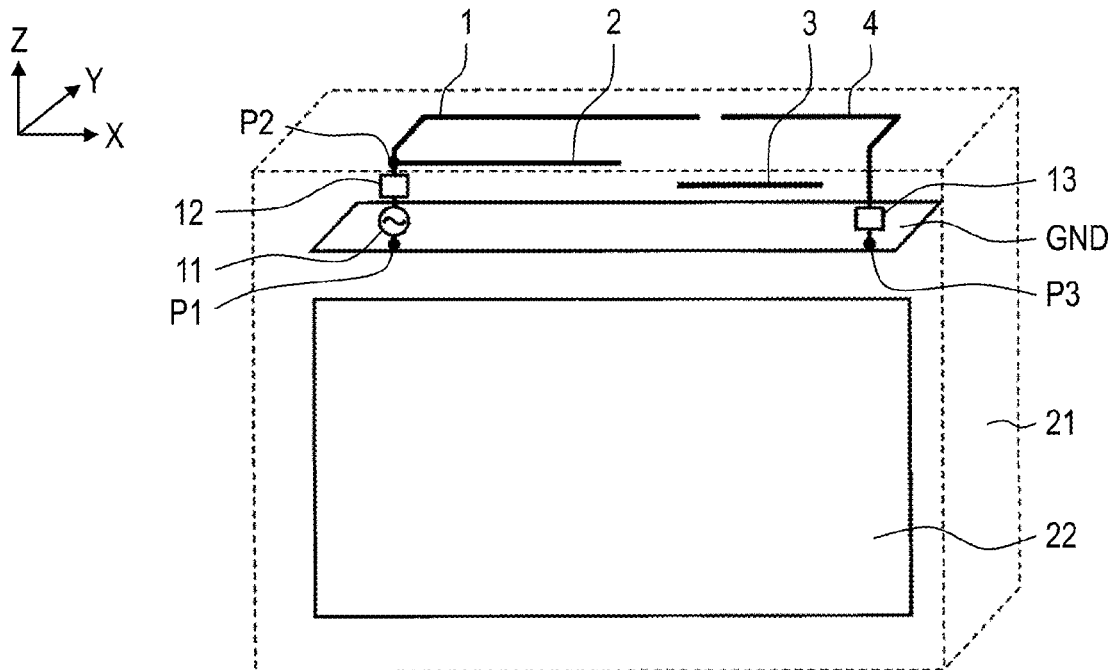
Feb. 18, 2016 (JP) 2016-029294

Publication Classification

(51) **Int. Cl.**
H01Q 5/307 (2006.01)
H01Q 1/48 (2006.01)
H04B 1/3827 (2006.01)
(52) **U.S. Cl.**
CPC *H01Q 5/307* (2015.01); *H01Q 9/30* (2013.01); *H04B 1/3838* (2013.01); *H01Q 1/48* (2013.01)

(57) **ABSTRACT**

An antenna unit includes a conductive ground plate, a first antenna element, and a second antenna element. The first antenna element includes a first end connected to a feedpoint and a second end containing an open end. A part of the first antenna element is disposed along the conductive ground plate. The second antenna element branches off the first antenna element at a branch point on the first antenna element. The second antenna element is disposed between the part of the first antenna element disposed along the conductive ground plate and the conductive ground plate. The first antenna element resonates at a first frequency. The second antenna element and a segment between the first end and the branch point of the first antenna element resonate at a second frequency that is higher than the first frequency.





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(19) **United States**

(12) **Patent Application Publication**
YOO

(10) **Pub. No.: US 2018/0277955 A1**

(43) **Pub. Date: Sep. 27, 2018**

(54) **MULTI-BAND ANTENNA**

(30) **Foreign Application Priority Data**

(71) Applicant: **UNIVERSITY OF ULSAN
FOUNDATION FOR INDUSTRY
COOPERATION, Ulsan (KR)**

Nov. 20, 2015 (KR) 10-2015-0163559

Publication Classification

(72) Inventor: **HYOUNG SUK YOO, Daegu (KR)**

(51) **Int. Cl.**
H01Q 9/04 (2006.01)
H01Q 5/50 (2006.01)
H01Q 1/48 (2006.01)

(73) Assignee: **Univerity of Ulsan Foundation for
Industry Cooperation, Ulsan (KR)**

(52) **U.S. Cl.**
CPC *H01Q 9/045* (2013.01); *H01Q 1/48*
(2013.01); *H01Q 5/50* (2015.01)

(21) Appl. No.: **15/541,349**

(57) **ABSTRACT**

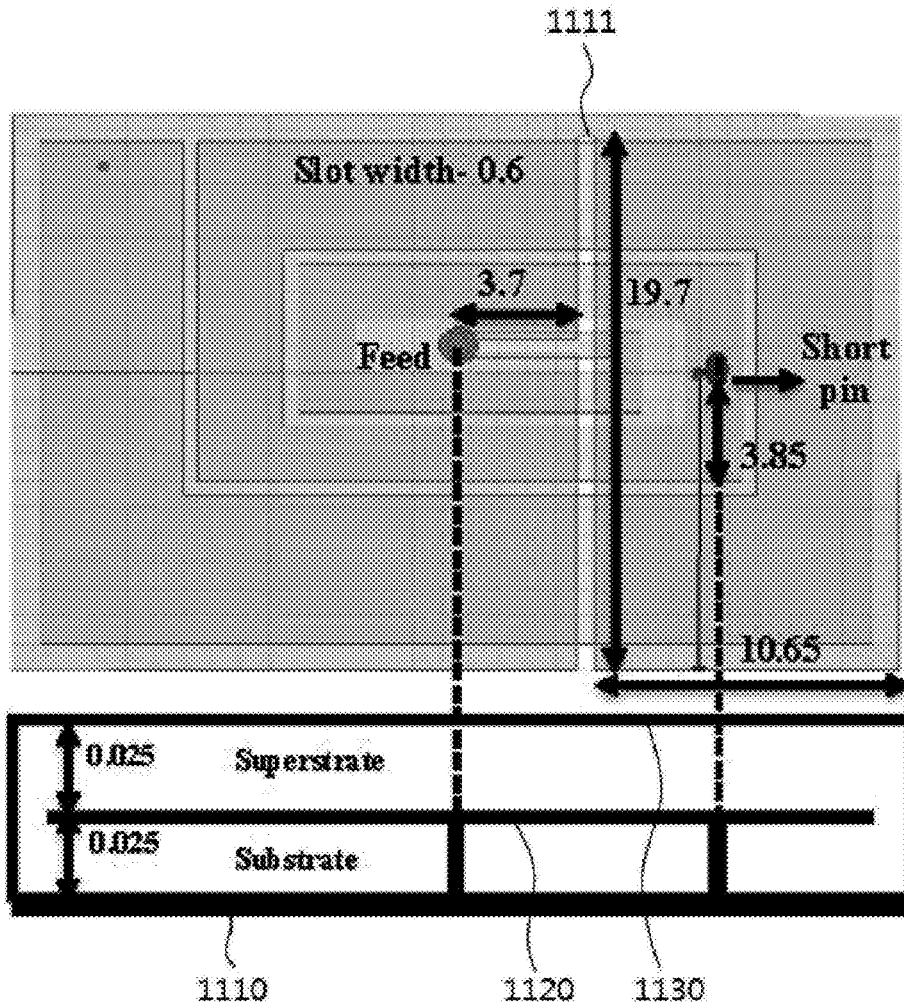
(22) PCT Filed: **Nov. 2, 2016**

A multi-band antenna according to an embodiment of the present invention comprises a first ground surface having a first slot; an antenna body placed above the first ground surface and having a second slot, a feed pin and a ground surface pin; and a second ground surface formed above the antenna body.

(86) PCT No.: **PCT/KR2016/012505**

§ 371 (c)(1),

(2) Date: **Oct. 24, 2017**





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(19) **United States**

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

(10) **Pub. No.: US 2018/0277957 A1**

(43) **Pub. Date: Sep. 27, 2018**

(54) **RFID ANTENNA STRUCTURE FOR INCREASED RANGE WHEN COUPLED WITH A MOBILE DEVICE**

H01Q 7/08 (2006.01)

H01Q 1/22 (2006.01)

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

CPC *H01Q 9/065* (2013.01); *H01Q 1/2208*

(2013.01); *H01Q 7/08* (2013.01); *H01Q 21/28*

(2013.01)

(71) Applicant: **GEOTOLL, INC.**, Cooper City, FL (US)

(72) Inventors: **Wyatt Drake Geist**, Davie, FL (US);
JAIME ANDRES BORRAS,
PEMBROKE PINES, FL (US)

(57)

ABSTRACT

An RFID tag device with an RFID antenna assembly that increases transmission range of the RFID tag device when adhesively coupled to a mobile device. The RFID tag device includes a RF interface that operates at a first RF frequency, a controller coupled to the RF interfaces, and the RFID antenna assembly. The RFID antenna assembly includes a first and a second dipole elements, each shaped as a half rectangle with an additional segment joining the respective element to a tuning element. The RFID antenna also includes a tuning element, which is a loop antenna, connecting the RF interface to the controller and a ferrite dielectric on the back of one of the dipole elements. A structure of the RF antennal assembly, when the RFID tag device is coupled to a mobile device, causes the mobile device to function as a reflector to increase gain of the RFID antenna assembly thereby improving transmission range.

(21) Appl. No.: **15/985,134**

(22) Filed: **May 21, 2018**

Related U.S. Application Data

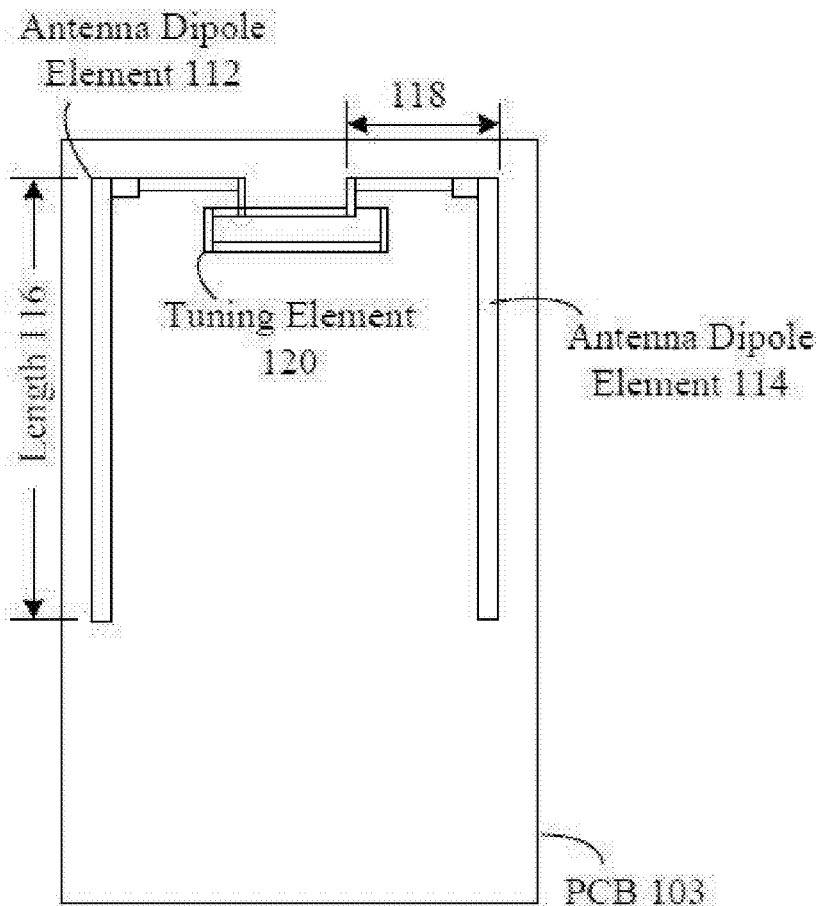
(63) Continuation-in-part of application No. 14/713,145, filed on May 15, 2015, now Pat. No. 9,978,009, Continuation-in-part of application No. 13/945,990, filed on Jul. 19, 2013, now Pat. No. 9,633,243.

Publication Classification

(51) **Int. Cl.**

H01Q 9/06 (2006.01)

H01Q 21/28 (2006.01)





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(19) **United States**

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

(10) **Pub. No.: US 2018/0278287 A1**

(43) **Pub. Date: Sep. 27, 2018**

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

H01Q 1/48 (2006.01)

H01Q 5/314 (2006.01)

H01Q 5/392 (2006.01)

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

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

CPC *H04B 1/3838* (2013.01); *H01Q 9/42* (2013.01); *H01Q 5/392* (2015.01); *H01Q 5/314* (2015.01); *H01Q 1/48* (2013.01)

(72) Inventors: **Kenji NISHIKAWA**, Hyogo (JP); **Shingo SUMI**, Miyagi (JP); **Hiroaki OHMORI**, Miyagi (JP); **Toshiharu ISHIMURA**, Miyagi (JP)

(57) **ABSTRACT**

(21) Appl. No.: **15/990,098**

(22) Filed: **May 25, 2018**

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2017/001160, filed on Jan. 16, 2017.

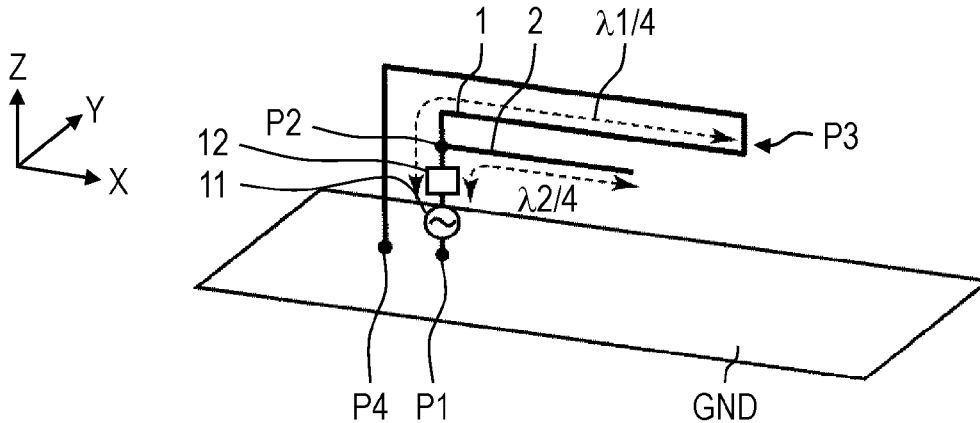
Foreign Application Priority Data

Feb. 18, 2016 (JP) 2016-029296

Publication Classification

(51) **Int. Cl.**
H04B 1/3827 (2006.01)
H01Q 9/42 (2006.01)

A first antenna element includes a first end connected to a feedpoint, a second end connected to a connection point on a ground conductor, and a fold disposed between the first and the second ends. A part of a segment between the first end and the fold of the first antenna element is disposed along the ground conductor. A second antenna element branches off the first antenna element. The second antenna element is disposed between the part of the first antenna element disposed along the ground conductor and the ground conductor. The segment between the first end and the fold of the first antenna element resonates at a first frequency. The second antenna element and a segment between the first end and a branch point of the first antenna element resonate at a second frequency that is higher than the first frequency.





US 20180278731A1

(19) **United States**

(12) **Patent Application Publication**

LEE et al.

(10) **Pub. No.: US 2018/0278731 A1**

(43) **Pub. Date: Sep. 27, 2018**

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

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

(72) Inventors: **Hyung Joo LEE**, Seongnam-si (KR); **Gyu Sub KIM**, Seoul (KR); **Dong Yeon KIM**, Suwon-si (KR); **Chae Up YOO**, Seoul (KR)

(21) Appl. No.: **15/991,568**

(22) Filed: **May 29, 2018**

Related U.S. Application Data

(63) Continuation of application No. 15/673,097, filed on Aug. 9, 2017, now Pat. No. 10,015,294, which is a continuation of application No. 15/234,547, filed on Aug. 11, 2016, now Pat. No. 9,762,710.

Foreign Application Priority Data

Aug. 13, 2015 (KR) 10-2015-0114638

Publication Classification

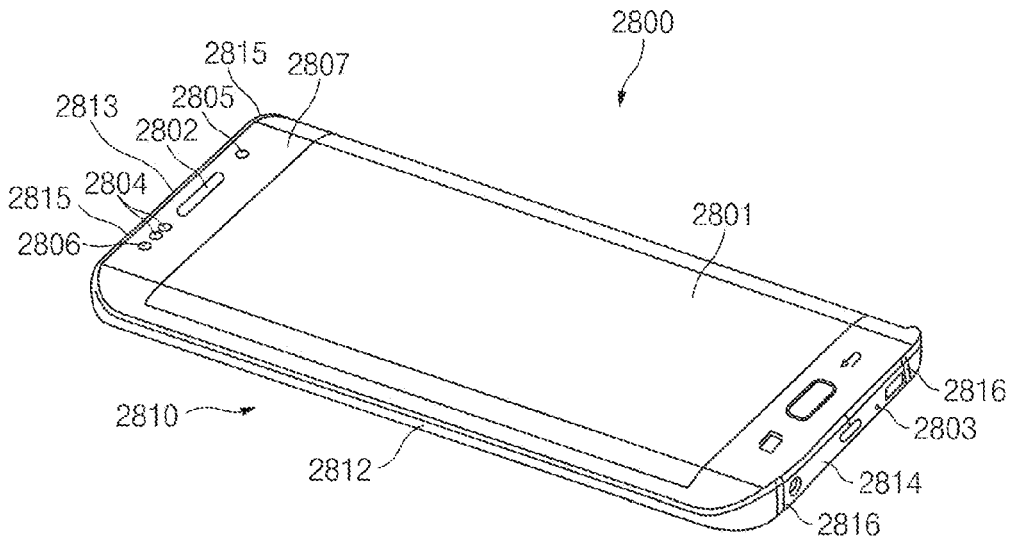
(51) **Int. Cl.**
H04M 1/02 (2006.01)
H01Q 1/52 (2006.01)
H01Q 5/328 (2015.01)
H01Q 5/35 (2015.01)
H01Q 1/24 (2006.01)
H04B 1/48 (2006.01)

H04B 1/3827 (2015.01)
H01Q 5/314 (2015.01)
H01Q 1/48 (2006.01)
H04W 4/80 (2018.01)
H04W 84/04 (2009.01)
H04W 84/12 (2009.01)

(52) **U.S. Cl.**
CPC **H04M 1/0202** (2013.01); **H01Q 1/521** (2013.01); **H01Q 5/328** (2015.01); **H01Q 5/35** (2015.01); **H01Q 1/243** (2013.01); **H04B 1/48** (2013.01); **H04W 84/12** (2013.01); **H01Q 5/314** (2015.01); **H01Q 1/48** (2013.01); **H04W 4/80** (2018.02); **H04B 2001/485** (2013.01); **H04W 84/042** (2013.01); **H04B 1/3833** (2013.01)

(57) **ABSTRACT**

An electronic device is provided. The electronic device includes a housing including a first surface, a second surface disposed facing an opposite side of the first surface, and a side surface configured to surround at least a portion of a space between the first surface and the second surface, a first elongated metal member configured to form a first portion of the side surface and including a first end and a second end, at least one communication circuit electrically connected to a first point of the first elongated metal member through a capacitive element, at least one ground member disposed in an interior of the housing, and a first conductive member configured to electrically connect a second point of the first elongated metal member to the ground member. The second point of the first elongated metal member is disposed closer to the second end than to the first point.





(19) **United States**

(12) **Patent Application Publication**
Kumar

(10) **Pub. No.: US 2018/0287241 A1**

(43) **Pub. Date: Oct. 4, 2018**

(54) **ANTENNA INCORPORATED INTO DEVICE HINGE AND METHOD**

(52) **U.S. CL.**
CPC *H01Q 1/2266* (2013.01); *G06F 1/1681* (2013.01); *H01Q 1/50* (2013.01)

(71) Applicant: **Intel Corporation**, Santa Clara, CA (US)

(57) **ABSTRACT**

(72) Inventor: **Praveen Kumar**, Bangalore (IN)

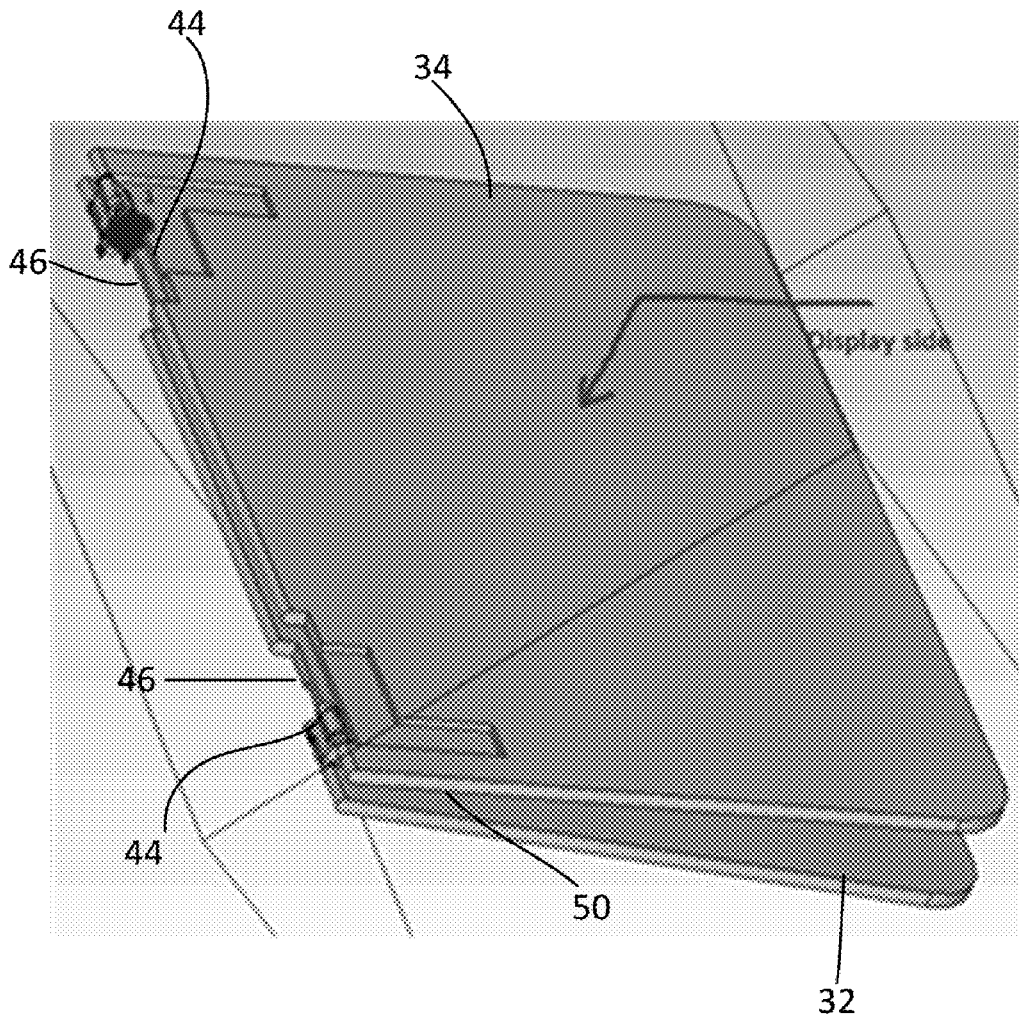
A method and apparatus for switching between two antenna elements in an electronic device having a hinge. A rotating element within the hinge has a coupling or contact brush that extends into contact with a first contact element connected to a first antenna element. Rotation of the hinge moves the coupling of coupled communication with the first contact element and into coupled communication with a second contact element, that connects to a second antenna element. The first and second antenna elements are provided on a hinge of an electronic device that may be moved from a closed position to a 360 degree open position or tablet position. The movement of the hinge switches between the two antenna elements to avoid blocking of the connected antenna(s) by the body of the electronic device.

(21) Appl. No.: **15/477,054**

(22) Filed: **Apr. 1, 2017**

Publication Classification

(51) **Int. Cl.**
H01Q 1/22 (2006.01)
H01Q 1/50 (2006.01)
G06F 1/16 (2006.01)





US 20180287246A1

(19) **United States**

(12) **Patent Application Publication**

KIM et al.

(10) **Pub. No.: US 2018/0287246 A1**

(43) **Pub. Date: Oct. 4, 2018**

(54) **MOBILE TERMINAL**

Publication Classification

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

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H04M 1/02 (2006.01)
H01Q 1/46 (2006.01)

(72) Inventors: **Dongjin KIM**, Seoul (KR); **Moonsoo SONG**, Seoul (KR); **Namyong KIM**, Seoul (KR); **Byungeun JEON**, Seoul (KR); **Kyongsun HWANG**, Seoul (KR); **Changil KIM**, Seoul (KR)

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H04M 1/0266* (2013.01); *H05F 1/00* (2013.01); *H01Q 1/46* (2013.01); *H04M 1/0277* (2013.01)

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

(57) **ABSTRACT**

(21) Appl. No.: **15/762,974**

The present invention relates to a mobile terminal which comprises: a display unit; a frame for supporting the display unit; a printed circuit board formed on one side of the frame; a case formed on one side of the printed circuit board; first and second beam-shaped metal members arranged on both sides of the frame while being spaced apart from the frame and exposed to the outside; and a first antenna which is formed adjacent to the frame and implements a first frequency band, wherein the first antenna comprises: a first radiator including at least one end of the first metal member or the second metal member; a first power supply unit for supplying power to the first radiator; and a first ground unit for grounding the first radiator.

(22) PCT Filed: **Mar. 22, 2016**

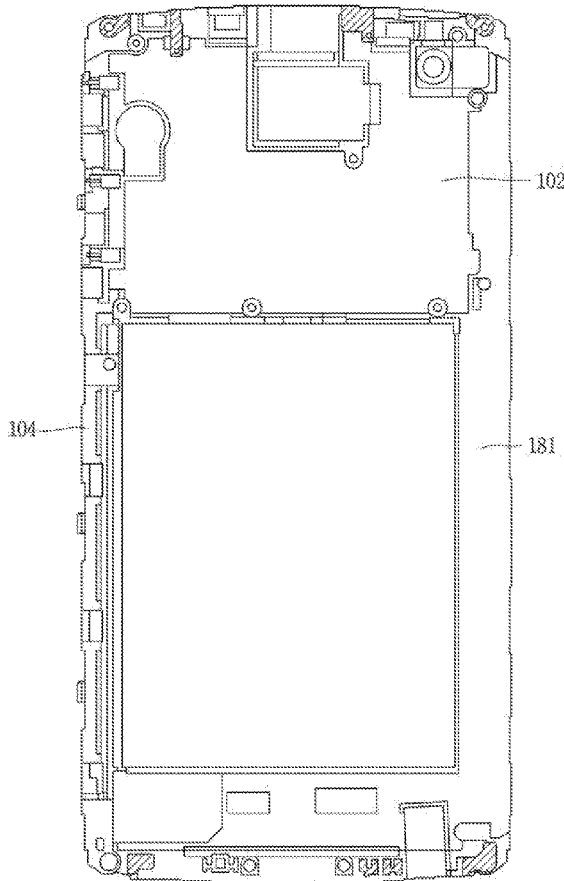
(86) PCT No.: **PCT/KR2016/002883**

§ 371 (c)(1),

(2) Date: **Mar. 23, 2018**

(30) **Foreign Application Priority Data**

Sep. 25, 2015 (KR) 10-2015-0137121





US 20180287249A1

(19) **United States**

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

(10) **Pub. No.: US 2018/0287249 A1**
(43) **Pub. Date: Oct. 4, 2018**

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

H01Q 21/06 (2006.01)

H01Q 9/42 (2006.01)

H01Q 21/00 (2006.01)

H01Q 1/52 (2006.01)

(71) Applicant: **FUJITSU LIMITED**, Kawasaki-shi (JP)

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

CPC *H01Q 1/3275* (2013.01); *H01Q 1/48*

(2013.01); *H01Q 1/523* (2013.01); *H01Q 9/42*

(2013.01); *H01Q 21/0025* (2013.01); *H01Q*

21/064 (2013.01)

(72) Inventors: **Takashi YAMAGAJO**, Yokosuka (JP); **Yohei Koga**, Kawasaki (JP); **Manabu Kai**, Yokohama (JP); **Masatomo Mori**, Kawasaki (JP); **Tabito Tonooka**, Kawasaki (JP); **Mitsuharu Hoshino**, Kawasaki (JP)

(57)

ABSTRACT

(73) Assignee: **FUJITSU LIMITED**, Kawasaki-shi (JP)

An antenna apparatus includes: a ground plane having a slit extending from an edge to an inside first point and extending, along the edge, to a second point; a first antenna element having a first feed point and a first open end, the first feed point being arranged at an opposite side of an area surrounded by the slit and the edge with respect to the slit, the first antennae element extending from the first feed point to a first bend part at a first height position and extending to the first open end; and a second antenna element having a second feed point, arranged in the area, and a second open end, and extending from the second feed point to a second bend part at a second height position, extending to the second open end, and crossing, at a second open end side, the slit.

(21) Appl. No.: **15/913,561**

(22) Filed: **Mar. 6, 2018**

(30) **Foreign Application Priority Data**

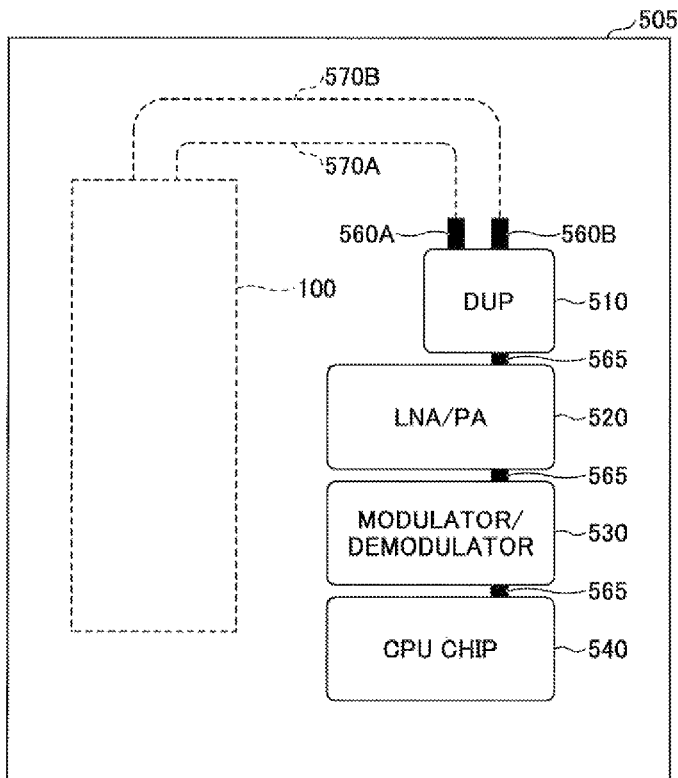
Mar. 29, 2017 (JP) 2017-065428

Publication Classification

(51) **Int. Cl.**

H01Q 1/32 (2006.01)

H01Q 1/48 (2006.01)





US 20180288203A1

(19) **United States**

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

(10) **Pub. No.: US 2018/0288203 A1**

(43) **Pub. Date: Oct. 4, 2018**

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

Publication Classification

(51) **Int. Cl.**
H04M 1/02 (2006.01)
H05K 7/14 (2006.01)
H05K 1/02 (2006.01)
H01Q 9/04 (2006.01)
H01Q 5/50 (2006.01)
H01Q 1/24 (2006.01)

(52) **U.S. Cl.**
 CPC *H04M 1/0277* (2013.01); *H05K 7/1427*
 (2013.01); *H01Q 1/242* (2013.01); *H01Q*
9/045 (2013.01); *H01Q 5/50* (2015.01); *H05K*
1/0243 (2013.01)

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

(72) Inventors: **Jae-Woong JEON**, Gyeonggi-do (KR);
Dong-Hun PARK, Gyeonggi-do (KR);
Siyoul JANG, Gyeonggi-do (KR);
Changtae KIM, Gyeonggi-do (KR)

(73) Assignee: **Samsung Electronics Co., Ltd.**

(21) Appl. No.: **15/938,531**

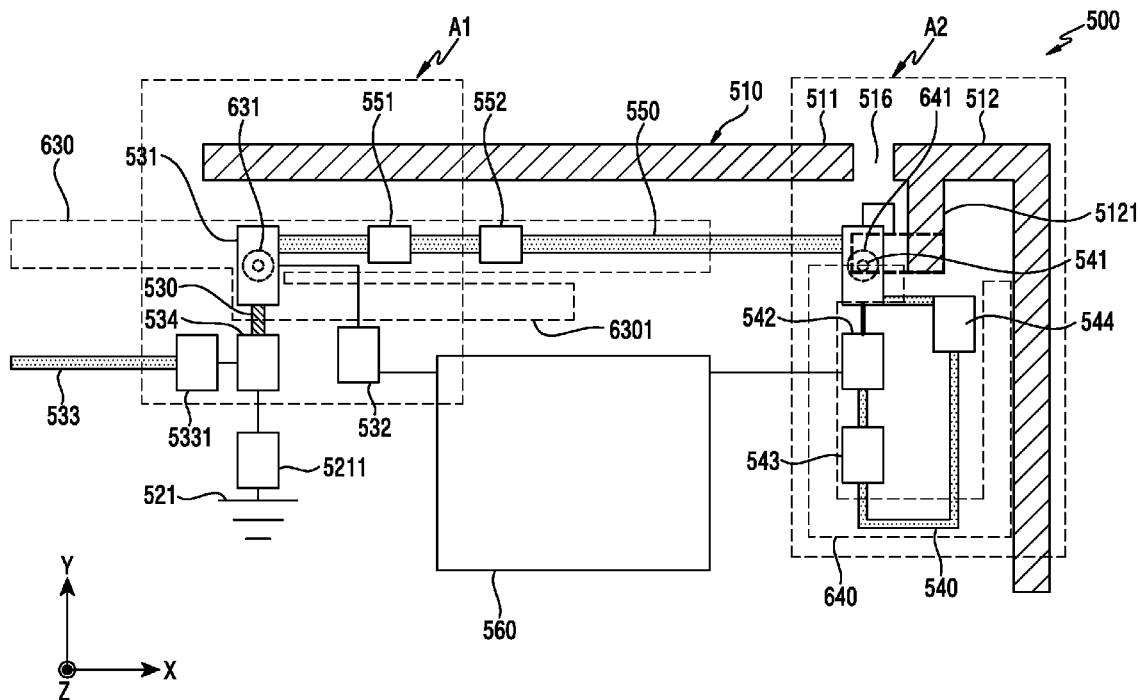
(22) Filed: **Mar. 28, 2018**

(30) **Foreign Application Priority Data**

Mar. 28, 2017 (KR) 10-2017-0039326

(57) **ABSTRACT**

Disclosed is an electronic device which may provide a multi-feeding antenna operating in multiple frequency bands by reducing performance degradation, and can contribute to slimness by implementing at least a portion of the patterns in a printed circuit board.





(19) **United States**

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

(10) **Pub. No.: US 2018/0294548 A1**

(43) **Pub. Date: Oct. 11, 2018**

(54) **ELECTRONIC DEVICE COMPRISING AN ANTENNA WHICH IS USING AN ELECTRICALLY CONDUCTIVE MATERIAL INCLUDED IN A HOUSING OF THE ELECTRONIC DEVICE**

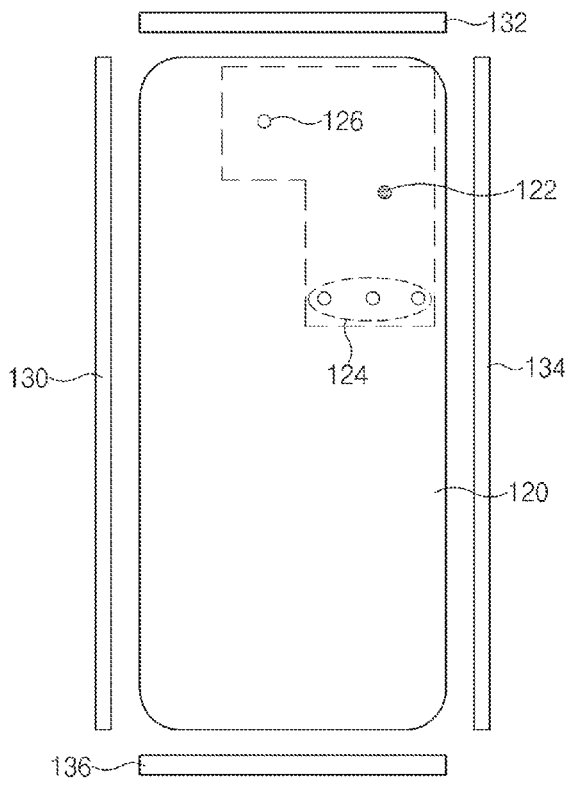
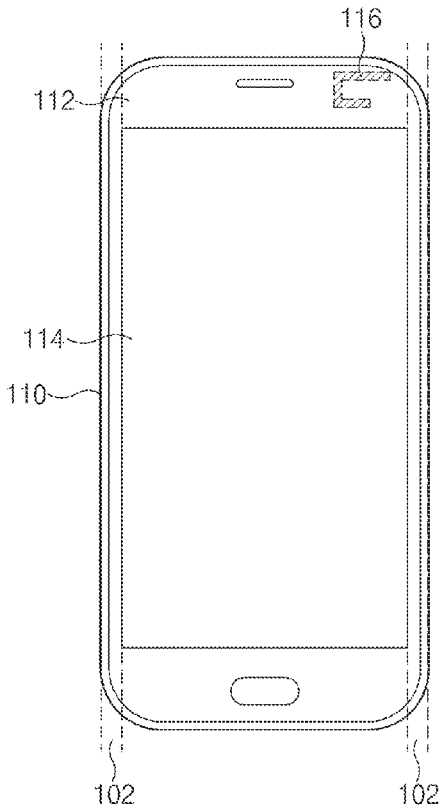
Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/42 (2006.01)
H01Q 1/48 (2006.01)
H01Q 9/04 (2006.01)
(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 9/0407* (2013.01); *H01Q 1/48* (2013.01); *H01Q 1/422* (2013.01)

(71) Applicant: **Samsung Electronics Co., Ltd.**, Suwon-si (KR)
(72) Inventors: **Kyung Kyun KANG**, Suwon-si (KR); **Ji Ho KIM**, Anyang-si (KR); **Kyung Moon SEOL**, Yongin-si (KR); **Gyu Bok PARK**, Suwon-si (KR); **Hyun Jeong LEE**, Suwon-si (KR); **Kyi Hyun JANG**, Seoul (KR); **Hyo Seok NA**, Yongin-si (KR); **So Young LEE**, Gwacheon-si (KR); **Jae Bong CHUN**, Suwon-si (KR)

(57) **ABSTRACT**
An electronic device is provided. The electronic device includes a housing comprising a first plate, a second plate, and a side member surrounding a space between the first and second plates, a wireless communication circuit that feeds a first feeding point in the second plate, a ground plane electrically coupled to a first ground point and a second ground point in the second plate, and a processor. The side member includes a first side, a second side, a third side, and a fourth side. The first feeding point is between the second side and the first ground point, the first feeding point being closer to the second side than the first ground point is to the second side, and the second ground point being closer to the second side than the first feeding point and the first ground point is to the second side, and is outside the region.

(21) Appl. No.: **15/944,116**
(22) Filed: **Apr. 3, 2018**
(30) **Foreign Application Priority Data**
Apr. 10, 2017 (KR) 10-2017-0046244





US 20180301787A1

(19) **United States**

(12) **Patent Application Publication**

Han et al.

(10) **Pub. No.: US 2018/0301787 A1**

(43) **Pub. Date: Oct. 18, 2018**

(54) **THREE-SLOTTED ANTENNA APPARATUS AND METHOD**

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

CPC *H01Q 1/243* (2013.01); *H01Q 13/18* (2013.01); *H04B 7/0413* (2013.01); *H01Q 1/48* (2013.01); *H04B 7/0404* (2013.01); *H01Q 5/50* (2015.01)

(71) Applicant: **Futurewei Technologies, Inc.**, Plano, TX (US)

(72) Inventors: **Chulmin Han**, San Diego, CA (US); **Wee Kian Toh**, San Diego, CA (US); **Wei Huang**, San Diego, CA (US); **Hongwei Liu**, San Diego, CA (US)

(57)

ABSTRACT

An apparatus and associated method are provided involving a housing having a periphery configured to operate as a second antenna, a third antenna, and a fourth antenna. The periphery includes a top wall having a first slot formed therein, a first side wall having a second slot formed therein, and a second side wall having a third slot formed therein. The top wall is arranged between the first side wall and the second side wall, and a top portion of the periphery is defined between the second slot and the third slot. The top portion is divided into a first top side portion and a second top side portion via the first slot. Further, the first top side portion operates as the second antenna, and the second top side portion operates as both the third antenna and the fourth antenna.

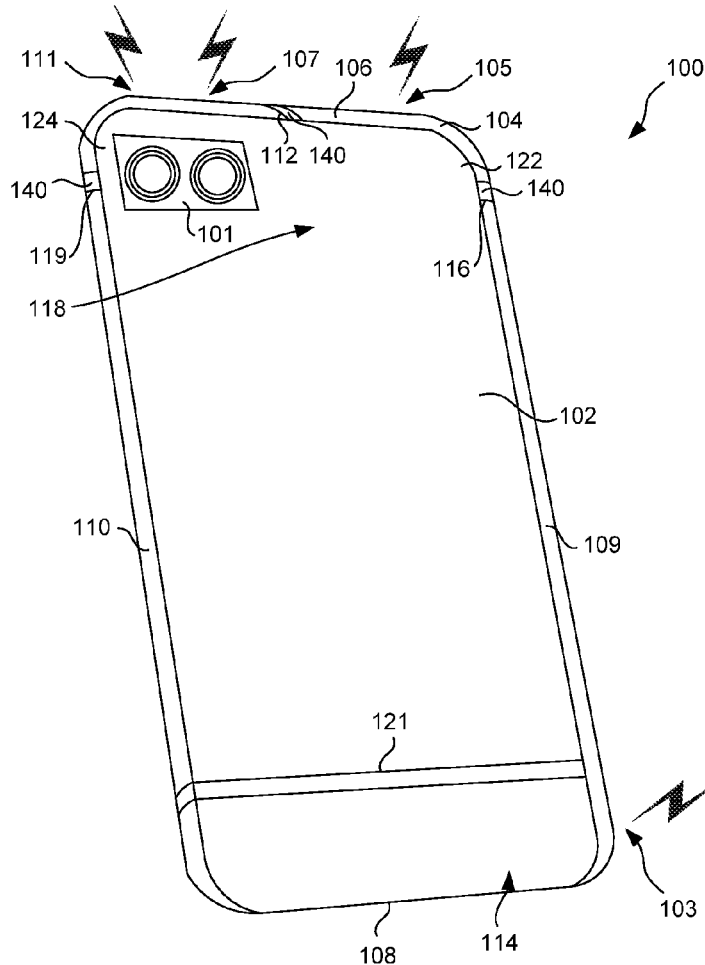
(21) Appl. No.: **15/488,308**

(22) Filed: **Apr. 14, 2017**

Publication Classification

(51) **Int. Cl.**

<i>H01Q 1/24</i>	(2006.01)
<i>H01Q 13/18</i>	(2006.01)
<i>H01Q 5/50</i>	(2006.01)
<i>H01Q 1/48</i>	(2006.01)
<i>H04B 7/0404</i>	(2006.01)
<i>H04B 7/0413</i>	(2006.01)





US 20180301788A1

(19) **United States**

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

(10) **Pub. No.: US 2018/0301788 A1**

(43) **Pub. Date: Oct. 18, 2018**

(54) **OPTICALLY TRANSMISSIVE ANTENNA
BREAK STRUCTURES FOR WIRELESS
DEVICES, AND ASSOCIATED SYSTEMS AND
PROCESSES**

(71) Applicant: **Essential Products, Inc.**, Palo Alto, CA
(US)

(72) Inventors: **ANDREW E. RUBIN**, Los Altos, CA
(US); **Mathew Hershenson**, Los Altos,
CA (US); **David John Evans, V**, Palo
Alto, CA (US); **Xinrui Jiang**, San Jose,
CA (US); **Xiaoyu Miao**, Palo Alto, CA
(US)

(21) Appl. No.: **15/791,003**

(22) Filed: **Oct. 23, 2017**

Related U.S. Application Data

(63) Continuation of application No. 15/336,742, filed on
Oct. 27, 2016, now Pat. No. 9,799,948.

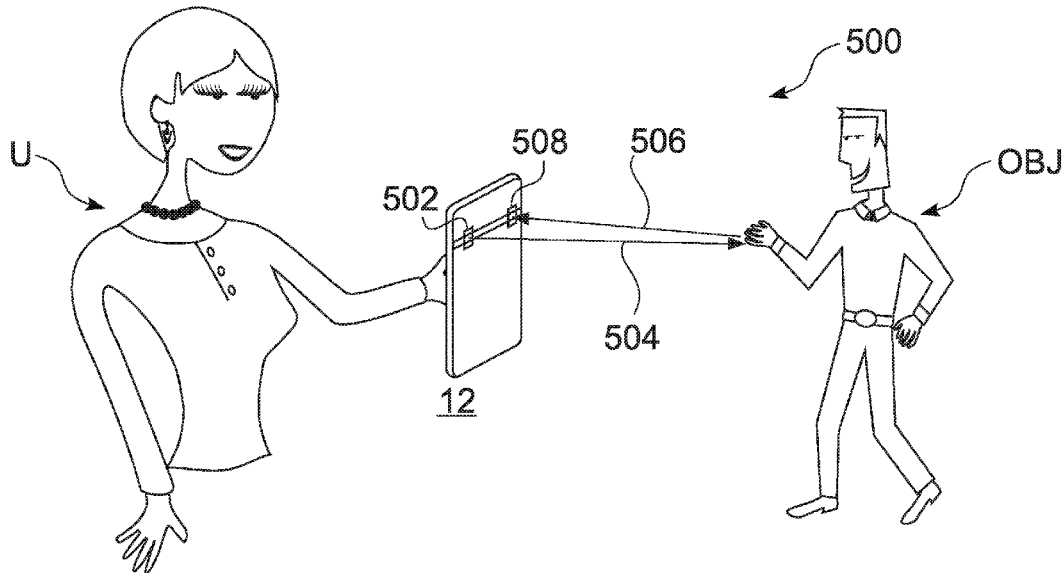
(60) Provisional application No. 62/249,130, filed on Oct.
30, 2015, provisional application No. 62/317,775,
filed on Apr. 4, 2016.

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/44 (2006.01)
H01Q 5/22 (2006.01)
H01Q 1/50 (2006.01)
H01Q 1/42 (2006.01)
(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 1/44*
(2013.01); *H01Q 1/42* (2013.01); *H01Q 1/50*
(2013.01); *H01Q 5/22* (2015.01)

(57) **ABSTRACT**

Disclosed are structures, methods and systems for wireless devices that are configured to allow the transmission of light through an enhanced antenna break for a wide variety of purposes. In an illustrative embodiment, an antenna break is configured to allow the passage of both wireless communication signals and light, such as to notify the user of one or more conditions. The light transmission can be integrated with other functions of the wireless device, such as to provide a flash for operation of a camera, to provide a light source for scanning or 3D sensing, to provide light in conjunction to acoustic or vibration output, or to sense light for other integrated functions.





US 20180301789A1

(19) **United States**

(12) **Patent Application Publication**

Lee et al.

(10) **Pub. No.: US 2018/0301789 A1**

(43) **Pub. Date: Oct. 18, 2018**

(54) **ANTENNA ELEMENT**

(71) Applicant: **ASUSTeK COMPUTER INC.**, Taipei (TW)

(72) Inventors: **Cheng-Tse Lee**, Taipei (TW);
Saou-Wen Su, Taipei (TW)

(21) Appl. No.: **15/950,309**

(22) Filed: **Apr. 11, 2018**

(30) **Foreign Application Priority Data**

Apr. 18, 2017 (TW) 106112998

Publication Classification

(51) **Int. Cl.**

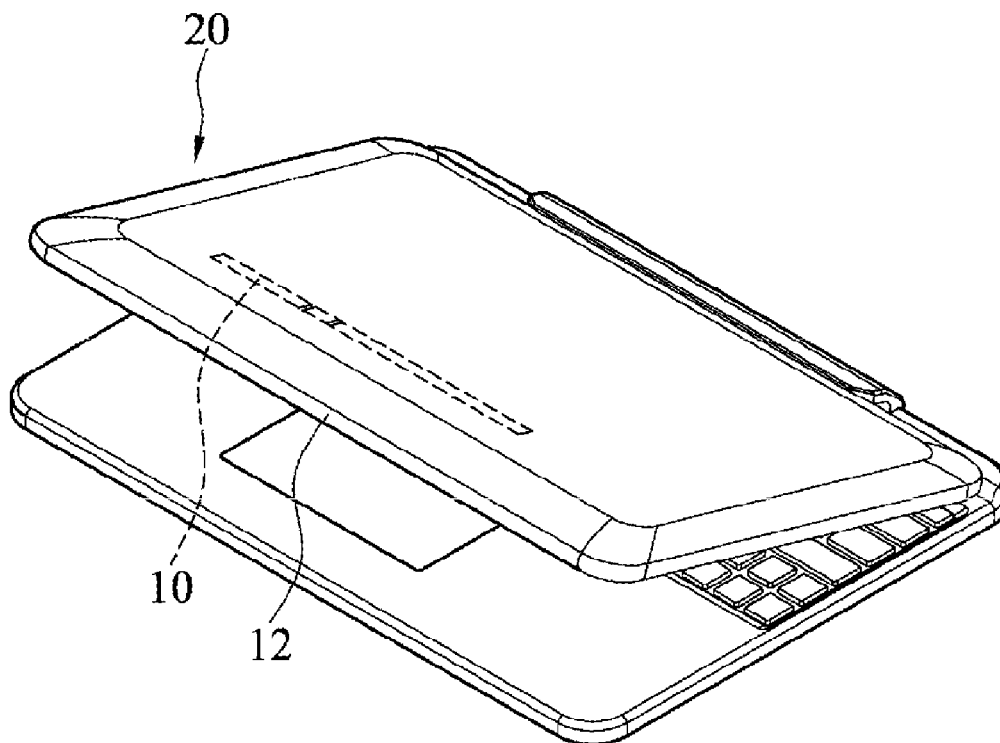
<i>H01Q 1/24</i>	(2006.01)
<i>H01Q 13/10</i>	(2006.01)
<i>H01Q 21/06</i>	(2006.01)
<i>H04M 1/02</i>	(2006.01)
<i>H01Q 5/335</i>	(2006.01)

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

CPC *H01Q 1/243* (2013.01); *H01Q 13/10* (2013.01); *H01Q 1/2266* (2013.01); *H04M 1/0283* (2013.01); *H01Q 5/335* (2015.01); *H01Q 21/064* (2013.01)

(57) **ABSTRACT**

The disclosure provides an antenna element. The antenna element comprises a metal substrate, a first closed slot, a feed part and a first matching part. The first closed slot is formed in the metal substrate, and comprises a first slot section and a second slot section, wherein the length of the first slot section is greater than the length of the second slot section. The feed part spans across the closed slot, the closed slot is divided into the first slot section and the second slot section by the feed part, the feed part is used for exciting the first slot section to generate a resonant mode in a first frequency band and generate a resonant mode in a second frequency band, and exciting the second slot section to generate a resonant mode in a third frequency band. The first matching part is formed on the first slot section, and is connected to parts of the metal substrate, which are positioned on two sides of the first slot section.





US 20180301814A1

(19) **United States**

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

(10) **Pub. No.: US 2018/0301814 A1**

(43) **Pub. Date: Oct. 18, 2018**

(54) **PLANAR-SHAPED ANTENNA DEVICES,
ANTENNA ARRAYS, AND FABRICATION**

(52) **U.S. Cl.**
CPC *H01Q 19/005* (2013.01); *H01Q 25/005*
(2013.01); *H01Q 15/14* (2013.01)

(71) Applicant: **University of Massachusetts**, Boston,
MA (US)

(57) **ABSTRACT**

(72) Inventors: **Hualiang Zhang**, Arlington, MA (US);
Bowen Zheng, Dracut, MA (US)

An antenna device as described herein includes a first metal layer and a second metal layer. The second metal layer is spaced apart from the first metal layer. The first metal layer includes an opening through which to transmit RF (Radio Frequency) energy to the second metal layer. The second metal layer is operable to reflect the RF energy received through the opening back to a surface of the first metal layer. The first metal layer is operable to reflect the RF energy (received from the reflection off the second metal layer) in a direction past the second metal layer through a communication medium. The surface area of the first metal layer is sufficiently larger than a surface area of the second metal layer to reflect the RF energy past the second metal layer into the communication medium. This ensures that the antenna device operates in a reflective mode as opposed to a resonant mode, resulting in high gain.

(21) Appl. No.: **15/953,739**

(22) Filed: **Apr. 16, 2018**

Related U.S. Application Data

(60) Provisional application No. 62/486,133, filed on Apr. 17, 2017.

Publication Classification

(51) **Int. Cl.**
H01Q 19/00 (2006.01)
H01Q 15/14 (2006.01)
H01Q 25/00 (2006.01)

