



US 20170018839A1

(19) **United States**(12) **Patent Application Publication**
Harper et al.(10) **Pub. No.: US 2017/0018839 A1**(43) **Pub. Date: Jan. 19, 2017**(54) **LOOP ANTENNA FOR MOBILE HANDSET
AND OTHER APPLICATIONS**(71) Applicant: **Microsoft Technology Licensing, LLC,**
Redmond, WA (US)(72) Inventors: **Marc Harper,** Issaquah, WA (US);
Devis Iellici, Cambridge (GB);
Christopher Tomlin, Redmond, WA
(US)(21) Appl. No.: **15/282,100**(22) Filed: **Sep. 30, 2016****Related U.S. Application Data**(60) Continuation of application No. 14/789,817, filed on
Jul. 1, 2015, which is a division of application No.
13/878,971, filed on Apr. 11, 2013, now Pat. No.
9,502,771, filed as application No. PCT/GB2011/
051837 on Sep. 28, 2011.(30) **Foreign Application Priority Data**

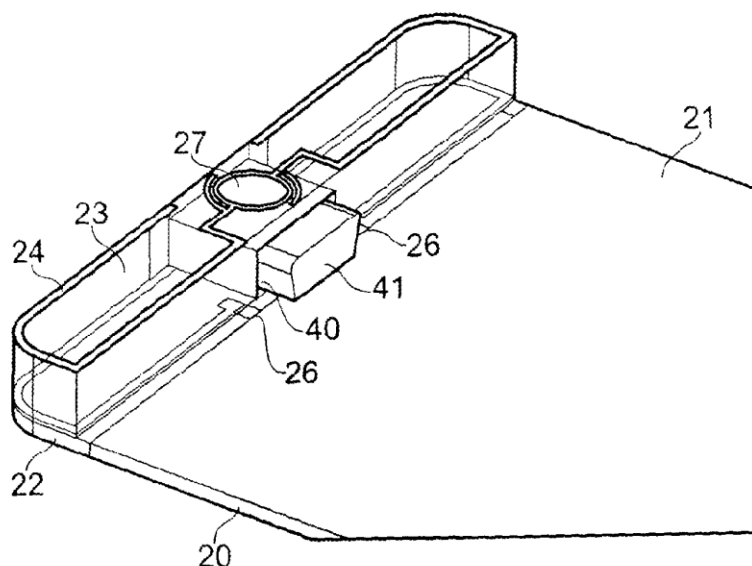
Oct. 15, 2010 (GB) 1017472.0

Publication Classification(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 5/378 (2006.01)**H01Q 1/48** (2006.01)
H01Q 5/392 (2006.01)
H01Q 9/26 (2006.01)
H01Q 7/00 (2006.01)
H01Q 1/38 (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/243** (2013.01); **H01Q 7/005**
(2013.01); **H01Q 5/378** (2015.01); **H01Q 1/38**
(2013.01); **H01Q 5/392** (2015.01); **H01Q 9/26**
(2013.01); **H01Q 1/48** (2013.01)

(57)

ABSTRACT

There is disclosed an antenna system for mobile handsets and other devices. The antenna system comprises a dielectric substrate having first and second opposed surfaces, a conductive track on the substrate, and a separate, directly driven antenna to drive the parasitic loop antenna formed by the conductive track. Two grounding points are provided adjacent to each other on the first surface of the substrate, with the arms of the conductive track extending in generally opposite directions from the grounding points. The conductive tracks then extend towards an edge of the dielectric substrate, before passing to the second surface of the dielectric substrate and then passing across the second surface of the dielectric substrate following a path generally following the path taken on the first surface of the dielectric substrate. The conductive tracks then connect to respective sides of a conductive arrangement formed on the second surface of the dielectric substrate that extends into a central part of a loop formed by the conductive track on the second surface of the dielectric substrate.

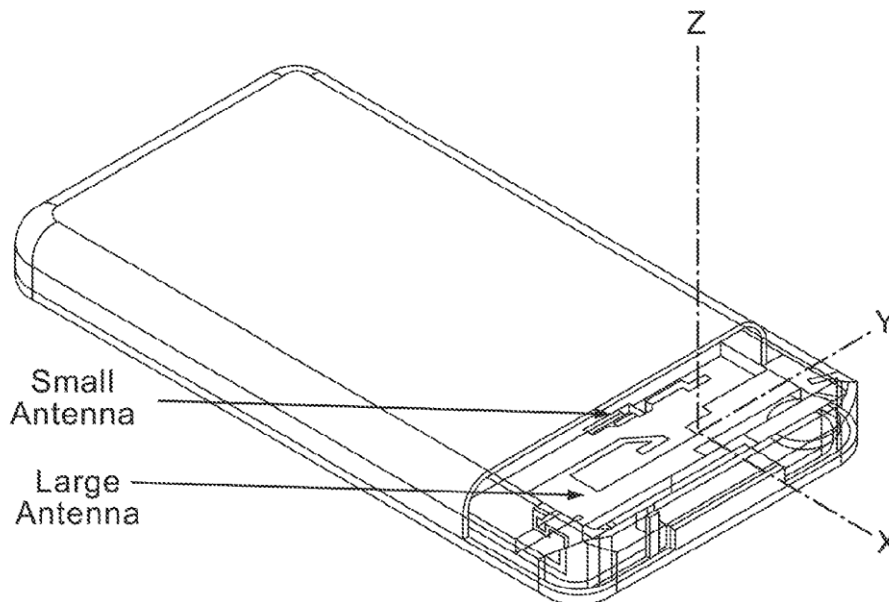




US 20170018840A1

(19) **United States**(12) **Patent Application Publication**
WONG et al.(10) **Pub. No.: US 2017/0018840 A1**(43) **Pub. Date: Jan. 19, 2017**(54) **RF RADIATION REDIRECTION AWAY
FROM PORTABLE COMMUNICATION
DEVICE USER**(71) Applicant: **Antenna79, Inc.**, Encinitas, CA (US)(72) Inventors: **Alfred Y. WONG**, Los Angeles, CA
(US); **Robert MORENO**, Acton, CA
(US); **Karl Richard SHIELDS**, North
Hills, CA (US); **Rong WANG**, Sherman
Oaks, CA (US)(73) Assignee: **Antenna79, Inc.**, Encinitas, CA (US)(21) Appl. No.: **15/281,827**(22) Filed: **Sep. 30, 2016****Related U.S. Application Data**(63) Continuation of application No. 14/551,775, filed on
Nov. 24, 2014, now Pat. No. 9,472,841, which is a
continuation of application No. 13/492,518, filed on
Jun. 8, 2012, now Pat. No. 8,897,843, which is a
continuation of application No. 12/724,290, filed on
Mar. 15, 2010, now Pat. No. 8,214,003, which is a
continuation-in-part of application No. 12/614,132,
filed on Nov. 6, 2009, now Pat. No. 8,208,980.(60) Provisional application No. 61/160,282, filed on Mar.
13, 2009, provisional application No. 61/112,141,
filed on Nov. 6, 2008, provisional application No.
61/158,551, filed on Mar. 9, 2009.**Publication Classification**(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 7/00 (2006.01)
H01Q 9/04 (2006.01)
(52) **U.S. Cl.**
CPC **H01Q 1/245** (2013.01); **H01Q 9/0407**
(2013.01); **H01Q 7/00** (2013.01)(57) **ABSTRACT**

A case for a wireless device includes a number of RF coupling elements mounted in the case and configured such that RF radiation is coupled from an internal antenna of the wireless device out of the device to a first RF coupling element, and from the first RF coupling element to a RF redirector coupling element that redirects the RF radiation in a direction outward from said wireless device that is opposite to a user side of the wireless device. A corrugated metallic shield is optionally provided on an opposite side of the case, facing a user of the device.

Reference - iPhone Model



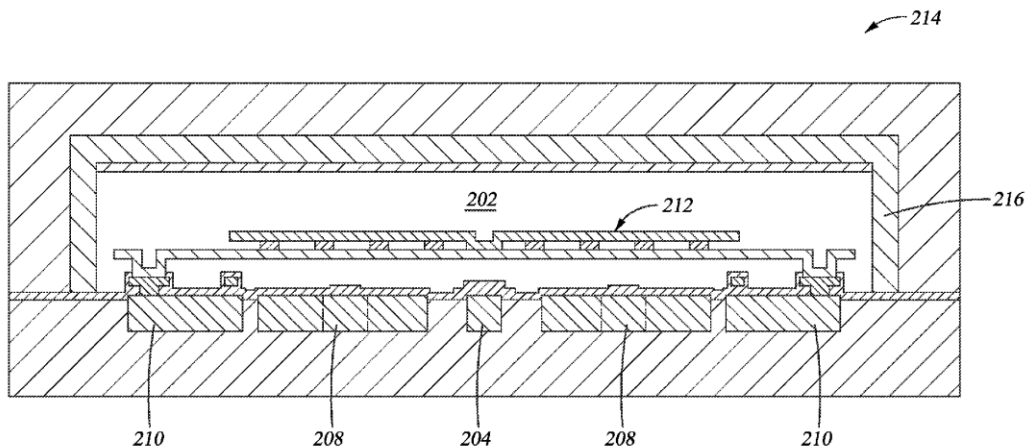
US 20170018841A1

(19) **United States**(12) **Patent Application Publication**
PARKHURST et al.(10) **Pub. No.: US 2017/0018841 A1**(43) **Pub. Date: Jan. 19, 2017**(54) **HEAD-HAND CAPACITANCE
COMPENSATION WITH DIGITAL
VARIABLE CAPACITOR****Publication Classification**(51) **Int. Cl.****H01Q 1/24** (2006.01)**H01Q 7/00** (2006.01)**H01Q 1/48** (2006.01)**H01Q 9/42** (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/245** (2013.01); **H01Q 9/42**
(2013.01); **H01Q 7/005** (2013.01); **H01Q 1/48**
(2013.01)(71) Applicant: **CAVENDISH KINETICS, INC.**, San
Jose, CA (US)(72) Inventors: **Ray PARKHURST**, Santa Clara, CA
(US); **Paul Anthony TORNATTA, Jr.**,
Melbourne, FL (US)(21) Appl. No.: **15/301,277**(22) PCT Filed: **Apr. 2, 2015**(86) PCT No.: **PCT/US2015/024107**

§ 371 (c)(1),

(2) Date: **Sep. 30, 2016****Related U.S. Application Data**(60) Provisional application No. 61/976,469, filed on Apr.
7, 2014.(57) **ABSTRACT**

The present disclosure generally relates to a device having a capacitance sensor that detects a change in capacitance that occurs in the antenna whenever the antenna is in close proximity to a user's hand and/or head. Following detection of the capacitance change, the capacitance of the antenna may be changed by using a variable capacitor that is coupled to the sensor through a controller.





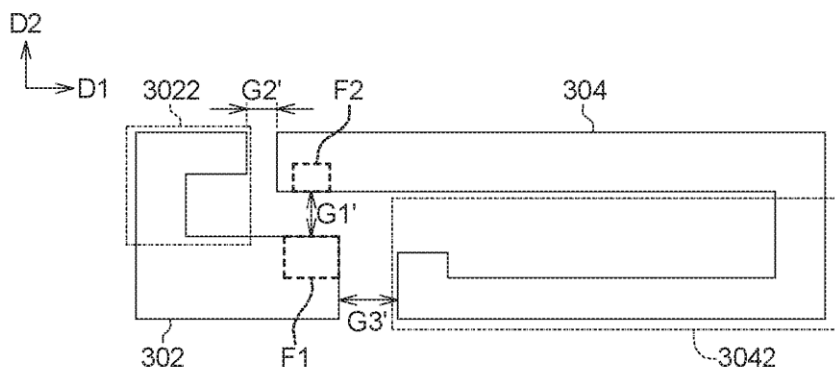
US 20170018857A1

(19) **United States**(12) **Patent Application Publication**
LO et al.(10) **Pub. No.: US 2017/0018857 A1**(43) **Pub. Date: Jan. 19, 2017**(54) **DUAL-BAND ANTENNA**(52) **U.S. CL.**(71) Applicant: **Arcadyan Technology Corporation,**
Hsinchu City (TW)CPC **H01Q 21/30** (2013.01); **H01Q 9/0407**
(2013.01)(72) Inventors: **Kuo-Chang LO**, Miaoli County (TW);
Chih-Yung HUANG, Taichung City
(TW)(57) **ABSTRACT**(73) Assignee: **Arcadyan Technology Corporation,**
Hsinchu City (TW)(21) Appl. No.: **15/174,484**(22) Filed: **Jun. 6, 2016**(30) **Foreign Application Priority Data**

Jul. 14, 2015 (TW) 104122717

Publication Classification(51) **Int. Cl.**
H01Q 21/30 (2006.01)
H01Q 9/04 (2006.01)

A dual-band antenna including a first radiation part and a second radiation part is provided. The first radiation part is arranged along a first direction. One end of the first radiation part includes a first feeding part. The other end of the first radiation part extends along a second direction and accordingly forms a first bending part. The second radiation part is arranged along the first direction. One end of the second radiation part includes a second feeding part. The projection of the one end of the second radiation part in the second direction is partially overlapped with the first radiation part. The second feeding part and the first feeding part are separated by a first gap. The first bending part and the second radiation part are separated by a second gap which is different from the first gap.

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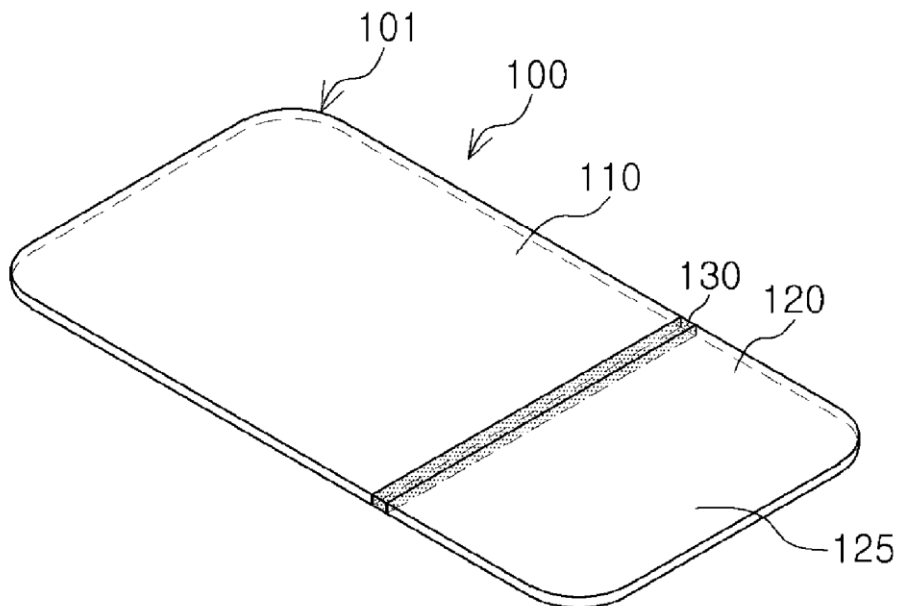
US 20170019510A1

(19) **United States**(12) **Patent Application Publication**
JEON et al.(10) **Pub. No.: US 2017/0019510 A1**(43) **Pub. Date: Jan. 19, 2017**(54) **COVER FOR ELECTRONIC DEVICE,
ANTENNA ASSEMBLY, ELECTRONIC
DEVICE, AND METHOD FOR
MANUFACTURING THE SAME**(30) **Foreign Application Priority Data**Aug. 14, 2013 (KR) 10-2013-0096933
Jan. 29, 2014 (KR) 10-2014-0011684(71) Applicant: **SAMSUNG
ELECTRO-MECHANICS CO., LTD.,**
Suwon-si (KR)**Publication Classification**(72) Inventors: **Dae Seong JEON**, Suwon-si (KR);
Jong Lae KIM, Suwon-si (KR); **Kang
Ryong CHOI**, Suwon-si (KR)(51) **Int. Cl.**
H04M 1/02 (2006.01)
C25D 11/02 (2006.01)
C25D 11/04 (2006.01)
C25D 11/26 (2006.01)
H01Q 1/24 (2006.01)
C25D 11/30 (2006.01)(73) Assignee: **SAMSUNG
ELECTRO-MECHANICS CO., LTD.,**
Suwon-si (KR)(52) **U.S. Cl.**
CPC **H04M 1/0249** (2013.01); **H01Q 1/243**
(2013.01); **C25D 11/30** (2013.01); **C25D 11/04**
(2013.01); **C25D 11/26** (2013.01); **C25D**
11/022 (2013.01)(21) Appl. No.: **15/281,541**(57) **ABSTRACT**(22) Filed: **Sep. 30, 2016**

A cover for an electronic device may include a metal plate having a first metal region formed of a metal; a through-hole formed in a portion of the first metal region of the metal plate; and an electrical open path extending from the through-hole to an end portion on one side of the first metal region through metal oxidation.

Related U.S. Application Data

(62) Division of application No. 14/459,194, filed on Aug. 13, 2014, now Pat. No. 9,516,150.





US 20170025738A1

(19) **United States**(12) **Patent Application Publication****LEE et al.**(10) **Pub. No.: US 2017/0025738 A1**(43) **Pub. Date: Jan. 26, 2017**(54) **MOBILE DEVICE**(71) Applicant: **Quanta Computer Inc.**, Taoyuan City (TW)(72) Inventors: **Chi-Hsuan LEE**, Taoyuan City (TW);
Chung-Ting HUNG, Taoyuan City (TW); **Tsung-Ying HSIEH**, Taoyuan City (TW)(21) Appl. No.: **14/880,496**(22) Filed: **Oct. 12, 2015**(30) **Foreign Application Priority Data**

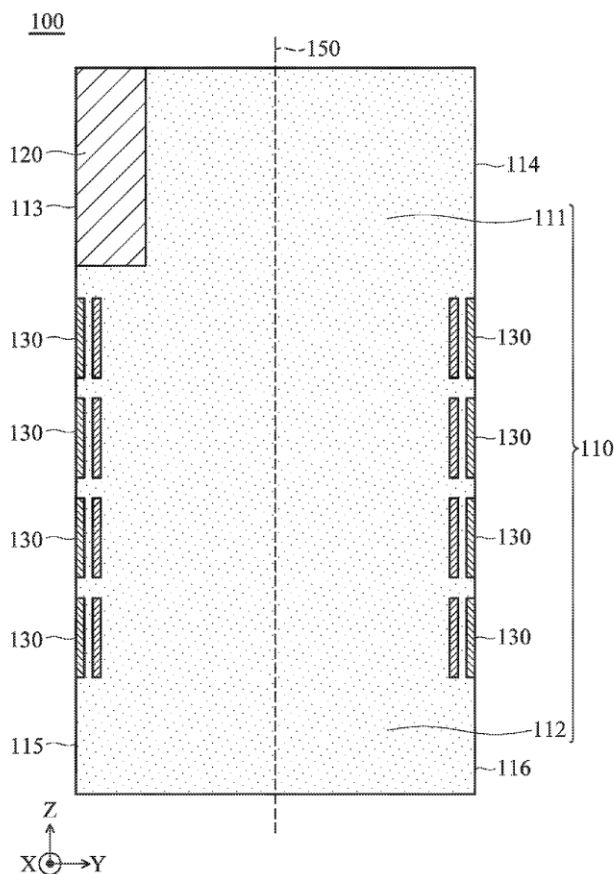
Jul. 20, 2015 (TW) 104123371

Publication Classification(51) **Int. Cl.****H01Q 1/24** (2006.01)**H01Q 9/04** (2006.01)**H04M 1/02** (2006.01)**H01Q 1/48** (2006.01)**H01Q 7/00** (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/243** (2013.01); **H01Q 1/48** (2013.01); **H01Q 7/00** (2013.01); **H04M 1/026** (2013.01); **H01Q 9/0407** (2013.01)

(57)

ABSTRACT

A mobile device includes a ground plane, an antenna element, and one or more ring resonators. The ground plane has a first region and a second region. The antenna element is disposed on the first region. The ring resonators are disposed on the second region. Each of the ring resonators includes a first loop structure and a second loop structure. The ring resonators are configured to enhance the radiation gain of the antenna element in a zenith direction.





US 20170025739A1

(19) **United States**

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

(10) **Pub. No.: US 2017/0025739 A1**

(43) **Pub. Date: Jan. 26, 2017**

(54) **ANTENNA MODULE, ANTENNA AND
MOBILE DEVICE COMPRISING SUCH AN
ANTENNA MODULE**

(71) Applicant: **THE ANTENNA COMPANY
INTERNATIONAL N.V.**, Netherlands
Antilles (NL)

(72) Inventors: **Diego CARATELLI**, Duizel (NL);
Francesco GIUPPI, The Hague (NL)

(21) Appl. No.: **15/113,547**

(22) PCT Filed: **Jan. 22, 2015**

(86) PCT No.: **PCT/NL2015/050039**

§ 371 (c)(1),

(2) Date: **Jul. 22, 2016**

(30) **Foreign Application Priority Data**

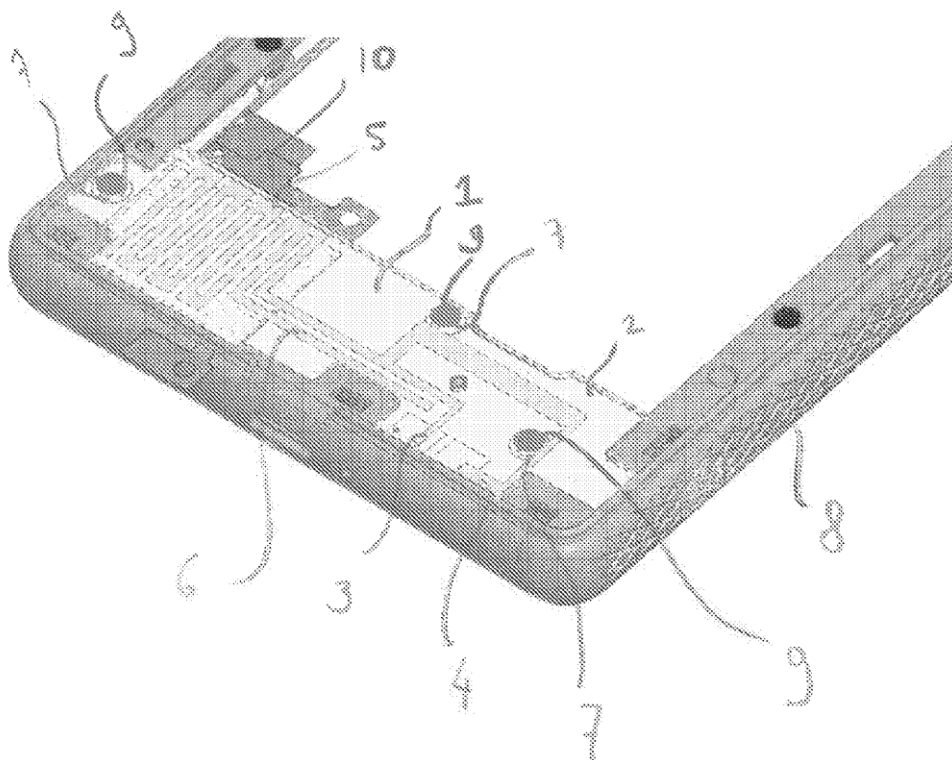
Jan. 24, 2014	(NL)	2012131
Dec. 10, 2014	(NL)	2013951

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)
H01Q 1/38 (2006.01)
(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 1/38**
(2013.01); **H01Q 1/48** (2013.01)

(57) **ABSTRACT**

The invention relates to an antenna module, in particular for use in a mobile device, such as a phone. The invention relates to an antenna, in particular for use in a mobile device, such as a phone, comprising at least one antenna module according to the invention. The invention also relates to a mobile device comprising at least one antenna according to the invention. The invention further relates to a method for manufacturing of an antenna according to the invention.





US 20170025740A1

(19) **United States**(12) **Patent Application Publication****LI et al.**(10) **Pub. No.: US 2017/0025740 A1**(43) **Pub. Date: Jan. 26, 2017**(54) **ELECTRONIC DEVICE**(71) Applicant: **HUAWEI DEVICE CO., LTD.**,
Shenzhen (CN)(72) Inventors: **Jianming LI**, Taipei (TW); **Kun FENG**, Shanghai (CN); **Xuefei ZHANG**, Shenzhen (CN); **Hanyang WANG**, Reading (GB)(21) Appl. No.: **15/124,449**(22) PCT Filed: **Mar. 4, 2015**(86) PCT No.: **PCT/CN2015/073649**

§ 371 (c)(1),

(2) Date: **Sep. 8, 2016**(30) **Foreign Application Priority Data**

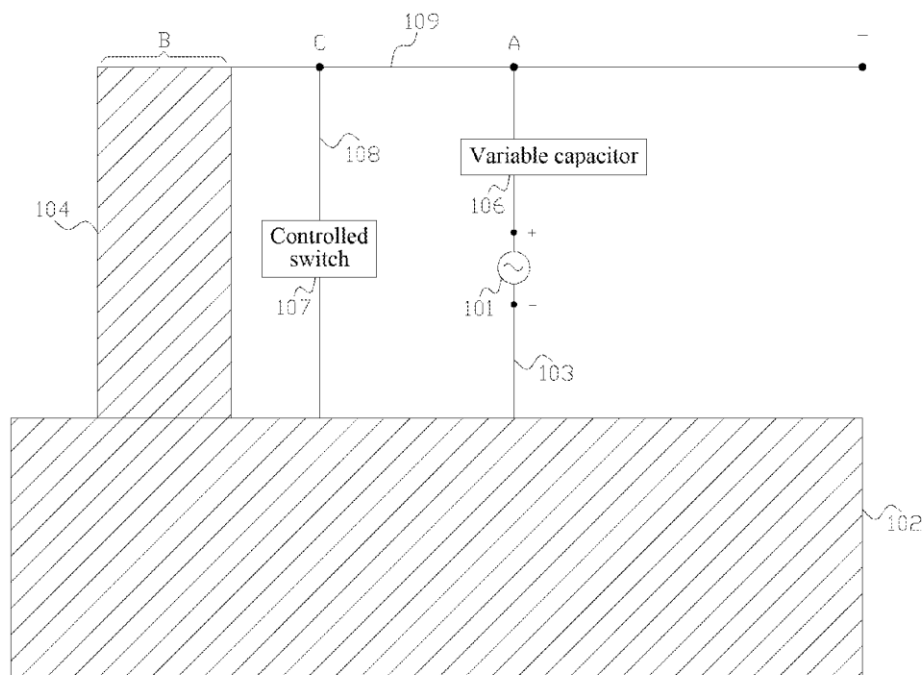
Mar. 21, 2014 (CN) 201410109571.9

Publication Classification(51) **Int. Cl.****H01Q 1/24** (2006.01)**H01Q 1/50** (2006.01)**H01Q 1/48** (2006.01)**H01Q 5/328** (2006.01)**H01Q 9/42** (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/243** (2013.01); **H01Q 5/328**(2015.01); **H01Q 9/42** (2013.01); **H01Q 1/48**(2013.01); **H01Q 1/50** (2013.01)

(57)

ABSTRACT

An electronic device is disclosed, where the electronic device is provided with a metal frame, the electronic device further includes an antenna feeding point, an antenna ground, a feeding branch, a grounding branch, an antenna resonance arm, a variable capacitor, and a control circuit. The antenna resonance arm is a part of the metal frame after segmentation, the antenna feeding point is disposed on the feeding branch, a first connection portion and a second connection portion are disposed on the antenna resonance arm, the feeding branch is disposed between the second connection portion and the antenna ground, the grounding branch is disposed between the first connection portion and the antenna ground, the variable capacitor is disposed on the feeding branch, the variable capacitor is disposed between the antenna feeding point and the second connection portion, and the control circuit is configured to adjust a capacitance of the variable capacitor.





US 20170025759A1

(19) **United States**(12) **Patent Application Publication****LEE et al.**(10) **Pub. No.: US 2017/0025759 A1**(43) **Pub. Date: Jan. 26, 2017**(54) **MOBILE DEVICE**(71) Applicant: **Quanta Computer Inc.**, Taoyuan City (TW)(72) Inventors: **Chi-Hsuan LEE**, Taoyuan City (TW);
Chung-Ting HUNG, Taoyuan City (TW); **Tsung-Ying HSIEH**, Taoyuan City (TW)(21) Appl. No.: **14/880,479**(22) Filed: **Oct. 12, 2015**(30) **Foreign Application Priority Data**

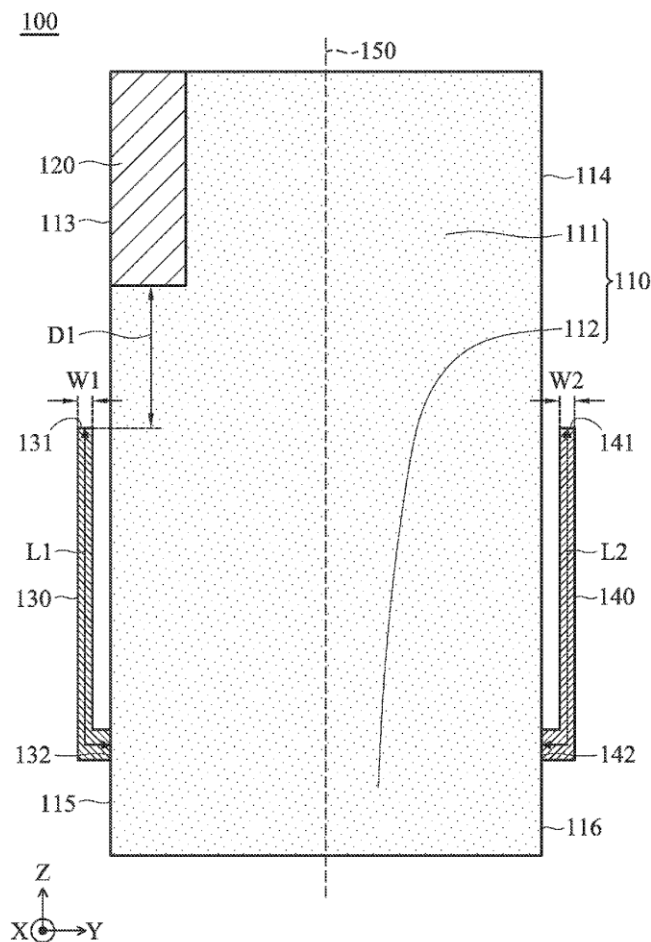
Jul. 20, 2015 (TW) 104123370

Publication Classification(51) **Int. Cl.****H01Q 9/04** (2006.01)**H01Q 1/38** (2006.01)(52) **U.S. Cl.**CPC . **H01Q 9/04** (2013.01); **H01Q 1/38** (2013.01)

(57)

ABSTRACT

A mobile device includes a ground plane, an antenna element, and at least one extension element. The ground plane has a first region and a second region. The antenna element is disposed on the first region. The extension element has an open end and a connection end. The connection end of the extension element is coupled to a side of the second region. The extension element is configured to enhance the radiation gain of the antenna element in a zenith direction.

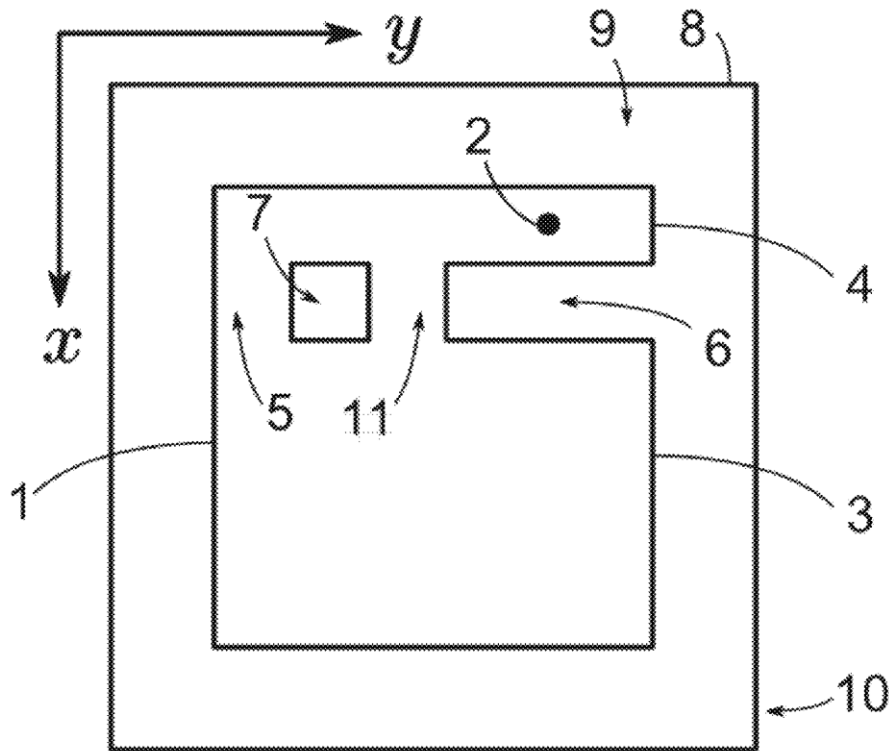




US 20170025762A1

(19) **United States**(12) **Patent Application Publication**
Rahmat-Samii et al.(10) **Pub. No.: US 2017/0025762 A1**(43) **Pub. Date: Jan. 26, 2017**(54) **LOW-PROFILE CIRCULARLY-POLARIZED
SINGLE-PROBE BROADBAND ANTENNA****Publication Classification**(51) **Int. Cl.****H01Q 9/04** (2006.01)**H01Q 13/10** (2006.01)**H01Q 1/48** (2006.01)(52) **U.S. Cl.****CPC** **H01Q 9/0428** (2013.01); **H01Q 1/48**
(2013.01); **H01Q 13/106** (2013.01)(71) Applicant: **The Regents of the University of
California**, Oakland, CA (US)(72) Inventors: **Yahya Rahmat-Samii**, Los Angeles,
CA (US); **Harish Rajagopalan**, Los
Angeles, CA (US); **Joshua M. Kovitz**,
Los Angeles, CA (US); **Jean Paul
Santos**, Los Angeles, CA (US)(73) Assignee: **The Regents of the University of
California**, Oakland, CA (US)(21) Appl. No.: **15/214,892**(22) Filed: **Jul. 20, 2016****Related U.S. Application Data**(60) Provisional application No. 62/194,584, filed on Jul.
20, 2015.(57) **ABSTRACT**

Low-profile broadband patch antennas capable of radiating circularly polarized (CP) signals utilizing a single probe in accordance with embodiments of the invention are disclosed. In many embodiments, the patch antenna includes a ground plane, a patch plate, at least one dielectric or foam substrate, and a feed probe. In several embodiments, the patch plate includes a first plate and a second plate that can be connected via first and second connecting bars. In various embodiments, the connection of the first and second plates can expose first and second slots as further discussed below. In a variety of embodiments, the feed probe can be a coaxial cable having an inner and outer conductor where the inner conductor connects to the first plate and the outer conductor connects to the ground plane.





US 20170033434A1

(19) **United States**

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

(10) **Pub. No.: US 2017/0033434 A1**

(43) **Pub. Date: Feb. 2, 2017**

(54) **AUXILIARY APPARATUS FOR
ELECTRONIC DEVICE INCLUDING
ANTENNA**

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

(72) Inventors: **Won-Bin HONG**, Seoul (KR); **Jun-Sig
KUM**, Yongin-si (KR); **Young-Ju LEE**,
Seoul (KR); **Jung-Yub LEE**, Yongin-si
(KR)

(21) Appl. No.: **15/302,385**

(22) PCT Filed: **Apr. 7, 2015**

(86) PCT No.: **PCT/KR2015/003468**

§ 371 (c)(1),

(2) Date: **Oct. 6, 2016**

(30) **Foreign Application Priority Data**

Apr. 7, 2014 (KR) 10-2014-0041193

Apr. 6, 2015 (KR) 10-2015-0048642

Publication Classification

(51) **Int. Cl.**

H01Q 1/22 (2006.01)

H01Q 5/371 (2006.01)

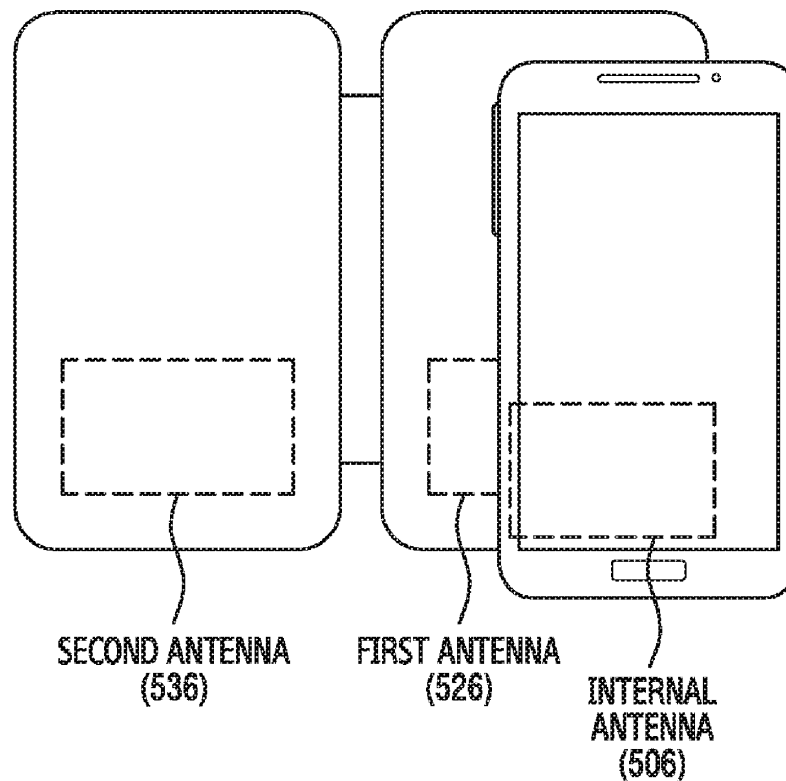
H01Q 1/24 (2006.01)

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

CPC **H01Q 1/22** (2013.01); **H01Q 1/243**
(2013.01); **H01Q 5/371** (2015.01)

(57) **ABSTRACT**

The present disclosure relates to a pre-5th-Generation (5G) or 5G communication system to be provided for supporting higher data rates Beyond 4th-Generation (4G) communication system such as Long Term Evolution (LTE). The present invention relates to an assist device for an electronic device including an antenna, wherein the assist device includes a second unit including a second antenna, wherein the second antenna configured to generate capacitance with at least one of a first antenna in a first unit and an internal antenna of the electronic device. Further, the present invention also includes embodiments different from the above-described embodiment.





US 20170033436A1

(19) **United States**

(12) **Patent Application Publication**
Yan

(10) **Pub. No.: US 2017/0033436 A1**

(43) **Pub. Date: Feb. 2, 2017**

(54) **MOBILE TERMINAL**

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

CPC **H01Q 1/241** (2013.01)

(71) Applicant: **Wei Yan**, Shenzhen (CN)

(72) Inventor: **Wei Yan**, Shenzhen (CN)

(57)

ABSTRACT

(73) Assignee: **AAC Technologies Pte. Ltd.**,
Singapore city (SG)

(21) Appl. No.: **15/061,646**

(22) Filed: **Mar. 4, 2016**

(30) **Foreign Application Priority Data**

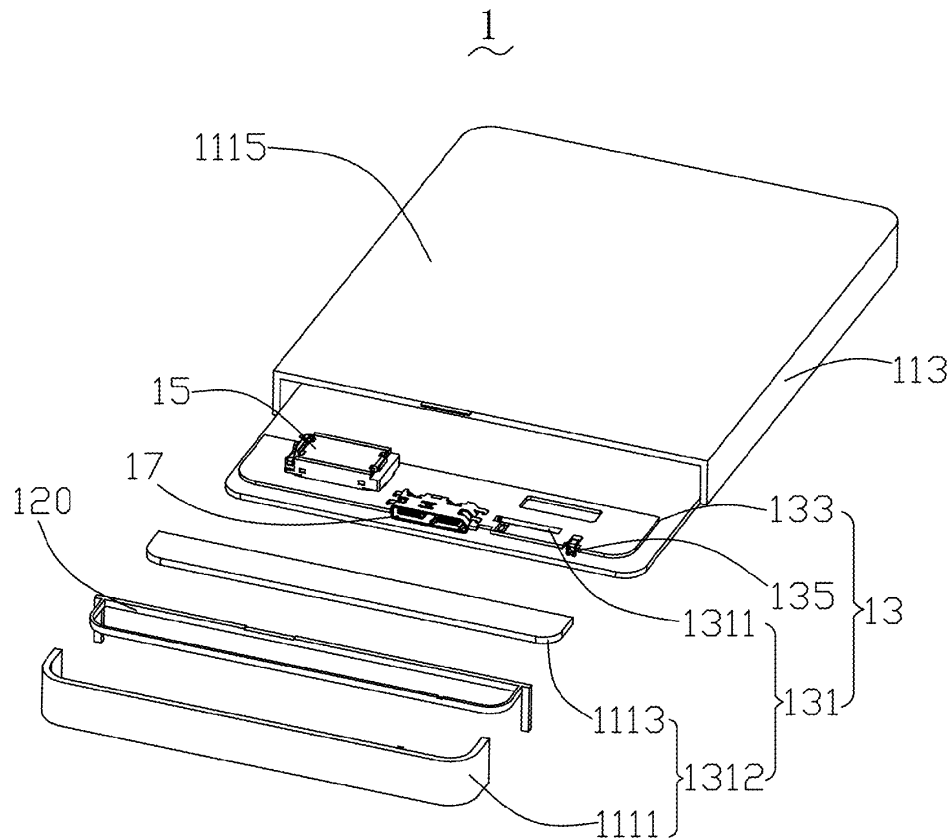
Jul. 31, 2015 (CN) 201510460533.2

Publication Classification

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

(2006.01)

A mobile terminal is disclosed. The mobile terminal includes a metal housing with an accommodation space, the metal shell including a metal housing having a metal cover, a metal ring disposed outside of the metal cover, and a metal rear housing; an antenna module received in the accommodation space. The antenna module includes a main board with a grounding terminal, the main board including a switching circuit connected with the grounding end of the main board electrically and an LDS antenna controlled by the switching circuit. The main board is connected with the metal cover and the metal ring electrically, the metal cover and the metal ring is coupled with the LDS antenna.





US 20170033438A1

(19) **United States**

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

(10) **Pub. No.: US 2017/0033438 A1**

(43) **Pub. Date: Feb. 2, 2017**

(54) **MOBILE TERMINAL DEVICE**

Publication Classification

(71) Applicants: **Chan Yun Ghit**, Shenzhen (CN); **Ng Guan Hong**, Shenzhen (CN); **Tay Yew Siow**, Shenzhen (CN)

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

(52) **U.S. Cl.**
CPC **H01Q 1/241** (2013.01)

(72) Inventors: **Chan Yun Ghit**, Shenzhen (CN); **Ng Guan Hong**, Shenzhen (CN); **Tay Yew Siow**, Shenzhen (CN)

(57) **ABSTRACT**

A mobile terminal device is provided in the present disclosure. The mobile terminal device includes a metal back cover with a groove, a printed circuit board with a groove opening corresponding to the groove, and an antenna module. The antenna module includes a radiator body and a groove adaptor member, at least part of the metal back cover serves as the radiator body of the antenna module. The groove adaptor member includes a groove adapting part and a supporting part for supporting the groove adapting part, the groove adapting part includes a main body, a first extending piece and a second extending piece. The main body is received in the groove opening and aligned with the groove; the first extending piece and the second extending piece respectively extend from two opposite edges of the main body and are connected to the printed circuit board.

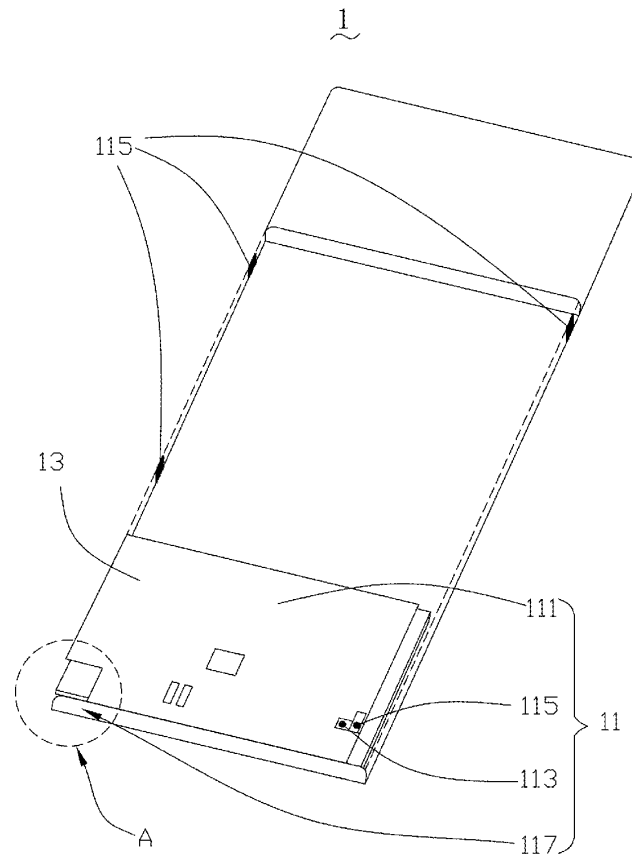
(73) Assignee: **AAC Technologies Pte. Ltd.**,
Singapore City (SG)

(21) Appl. No.: **15/062,100**

(22) Filed: **Mar. 5, 2016**

(30) **Foreign Application Priority Data**

Jul. 31, 2015 (CN) 201510465475.2





US 20170033440A1

(19) **United States**

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

(10) **Pub. No.: US 2017/0033440 A1**

(43) **Pub. Date: Feb. 2, 2017**

(54) **ELECTRONIC DEVICE WITH MULTI-BAND ANTENNA FOR SUPPORTING CARRIER AGGREGATION USING NON-SEGMENTED CONDUCTIVE BORDER MEMBER**

H01Q 1/52 (2006.01)

H01Q 9/04 (2006.01)

H01Q 5/50 (2006.01)

H01Q 1/48 (2006.01)

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

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

CPC *H01Q 1/243* (2013.01); *H01Q 5/50*

(2015.01); *H01Q 1/48* (2013.01); *H01Q 1/523*

(2013.01); *H01Q 9/04* (2013.01); *H03H 7/38* (2013.01)

(72) Inventors: **Nam Ki KIM**, Suwon-si (KR); **Dae Seong JEON**, Suwon-si (KR); **Young Min CHEON**, Suwon-si (KR); **Hyun Do PARK**, Suwon-si (KR); **Dae Ki LIM**, Suwon-si (KR)

(57) **ABSTRACT**

(73) Assignee: **SAMSUNG ELECTRO-MECHANICS CO., LTD.**, Suwon-si (KR)

An electronic device including a multi-band antenna, a cover, a substrate, and a conductive border member is disclosed, where the device includes a first feed terminal connected to a circuit of a substrate embedded in the device, a second feed terminal connected to the circuit and insulated from the first feed terminal, a ground disposed on the substrate, a conductive border member continuously disposed along a periphery of the electronic device, a first antenna connected to the first feed terminal and the conductive border member, and the first antenna forming a multiple resonance for covering a first multi-band having a plurality of bands, a second antenna connected to the second feed terminal and the conductive border member and the second antenna forming a multiple resonance for covering a second multi-band, and a bypass conductor to bypass interference signals generated by the first antenna and the second antenna to the ground.

(21) Appl. No.: **15/158,845**

(22) Filed: **May 19, 2016**

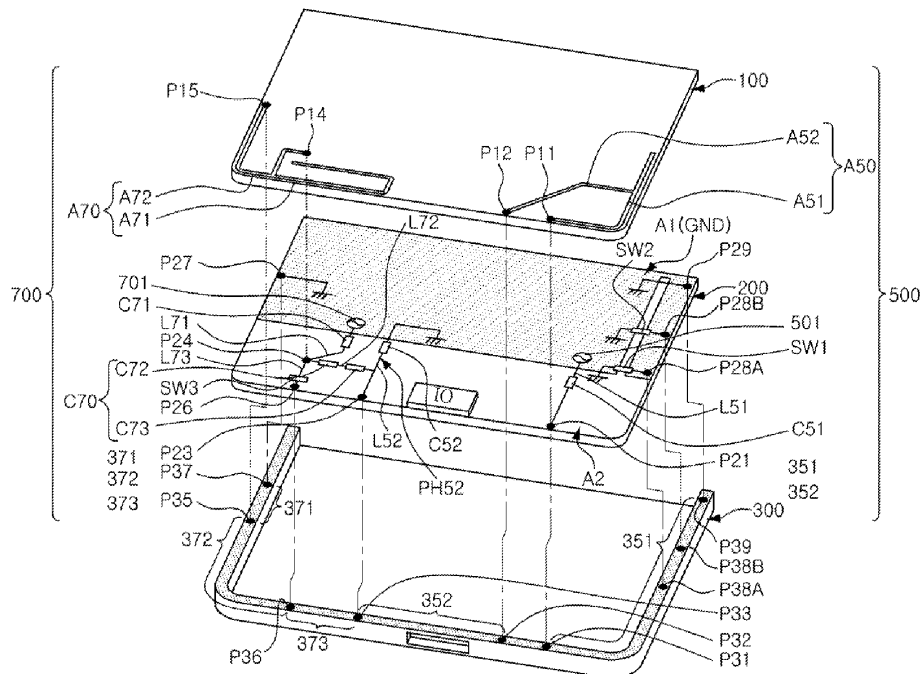
(30) **Foreign Application Priority Data**

Jul. 30, 2015 (KR) 10-2015-0108246

Dec. 30, 2015 (KR) 10-2015-0189250

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H03H 7/38 (2006.01)





US 20170033441A1

(19) **United States**

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

(10) **Pub. No.: US 2017/0033441 A1**

(43) **Pub. Date: Feb. 2, 2017**

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

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

CPC **H01Q 1/243** (2013.01); **H01Q 1/48**
(2013.01); **H04B 1/385** (2013.01)

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

(57) **ABSTRACT**

(72) Inventors: **Gunhee SON**, Gyeongsangbuk-do
(KR); **Minsuk KIM**,
Gyeongsangbuk-do (KR); **Soon-Sang
PARK**, Daegu (KR)

One embodiment disclosed in the present disclosure may provide an antenna device that includes: a metal member that forms at least a part of an external housing for the electronic device; a printed circuit board (PCB) coupled to a feed connector of the metal member, such that the metal member is configured to operate as an antenna radiator for the PCB; and the metal member further including at least two grounding connectors that are coupled to ground through the PCB, wherein the feed connector and the two grounding connectors are located at different positions on the metal member, and may provide an electronic device that includes the same. Accordingly, it is possible to easily design an antenna that operates in a desired frequency band, to reduce the cost, to make the exterior of the device appealing due to the advantage of design, and to maximize the efficient use of space for the design of a multiband antenna.

(21) Appl. No.: **15/185,171**

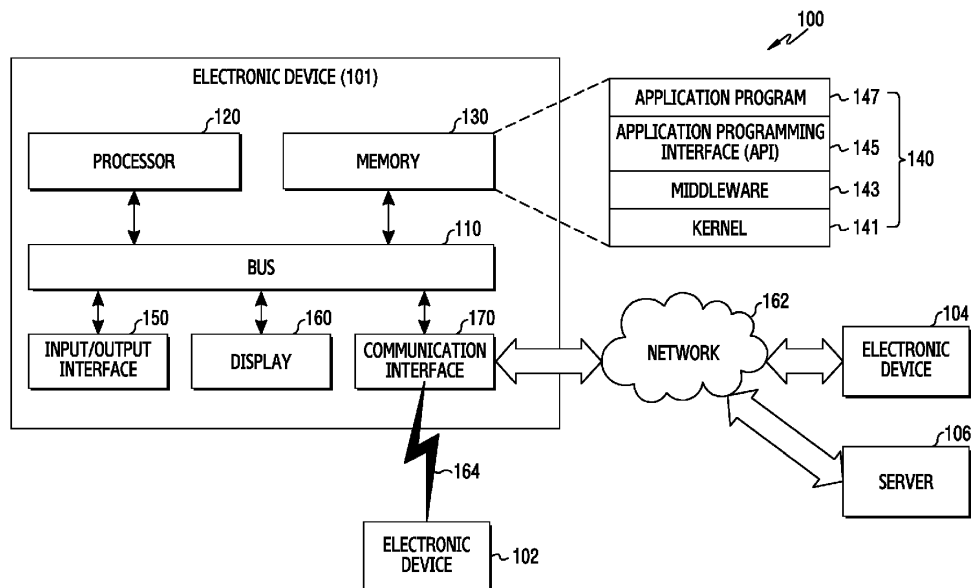
(22) Filed: **Jun. 17, 2016**

(30) **Foreign Application Priority Data**

Jul. 28, 2015 (KR) 10-2015-0106677

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H04B 1/3827 (2006.01)
H01Q 1/48 (2006.01)





US 20170033442A1

(19) **United States**

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

(10) **Pub. No.: US 2017/0033442 A1**

(43) **Pub. Date: Feb. 2, 2017**

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

H01Q 1/38 (2006.01)

G06F 3/044 (2006.01)

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

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

CPC **H01Q 1/243** (2013.01); **G06F 3/044**
(2013.01); **H01Q 1/48** (2013.01); **H01Q 1/38**
(2013.01)

(72) Inventors: **Dong-Uk CHOI**, Gyeonggi-do (KR);
Sang-Pil Lee, Gyeonggi-do (KR);
Jangje Park, Gyeonggi-do (KR); **Jinu Kim**, Seoul (KR); **Bumjin Cho**,
Gyeonggi-do (KR); **Inyong Hwang**,
Gyeonggi-do (KR)

(57)

ABSTRACT

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

(21) Appl. No.: **15/217,411**

(22) Filed: **Jul. 22, 2016**

(30) **Foreign Application Priority Data**

Jul. 31, 2015 (KR) 10-2015-0109186

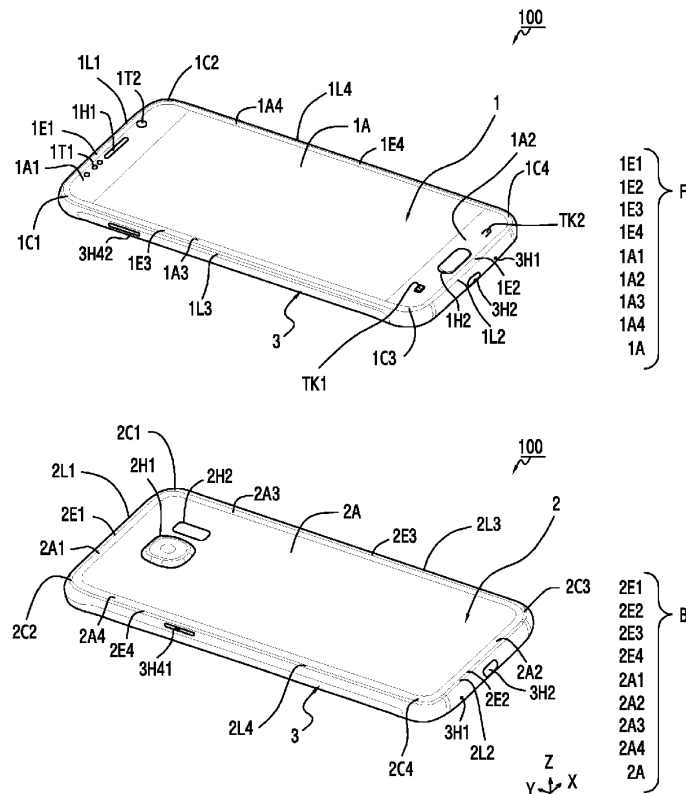
Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 1/48 (2006.01)

An electronic device is provided. The electronic device includes a housing including a window that forms a first side of the electronic device, and a second side that is disposed opposite to the first side, a touch sensor disposed adjacent to the window and configured to generate a capacitance, an input circuit operably connected to the touch sensor and configured to detect an input based on a variation in the capacitance, an antenna radiator at least one of partially disposed inside the housing and a part of the housing, a ground operably disposed between the first side and the second side, a communication circuit operably connected to the antenna radiator and the ground, and an antenna matching circuit operably connected to the touch sensor and the input circuit.





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

(43) **Pub. Date:** **Feb. 2, 2017**

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 13/10 (2006.01)
H01Q 1/36 (2006.01)
H01Q 1/48 (2006.01)

(52) **U.S. Cl.**
CPC ***H01Q 1/243*** (2013.01); ***H01Q 1/48***
(2013.01); ***H01Q 13/10*** (2013.01); ***H01Q 1/36***
(2013.01)

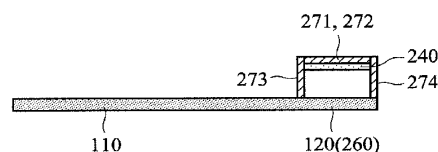
(57) **ABSTRACT**

A mobile device includes a metal housing and an antenna structure. A ground plane and a ground branch form at least a portion of the metal housing. The ground branch is coupled to the ground plane. A slot is formed between the ground branch and the ground plane. A circuit element is coupled to the ground branch and the ground plane. The antenna structure is formed by the ground branch. The antenna structure is excited by a signal source.

A mobile device includes a metal housing and an antenna structure. A ground plane and a ground branch form at least a portion of the metal housing. The ground branch is coupled to the ground plane. A slot is formed between the ground branch and the ground plane. A circuit element is coupled to the ground branch and the ground plane. The antenna structure is formed by the ground branch. The antenna structure is excited by a signal source.

A mobile device includes a metal housing and an antenna structure. A ground plane and a ground branch form at least a portion of the metal housing. The ground branch is coupled to the ground plane. A slot is formed between the ground branch and the ground plane. A circuit element is coupled to the ground branch and the ground plane. The antenna structure is formed by the ground branch. The antenna structure is excited by a signal source.

A mobile device includes a metal housing and an antenna structure. A ground plane and a ground branch form at least a portion of the metal housing. The ground branch is coupled to the ground plane. A slot is formed between the ground branch and the ground plane. A circuit element is coupled to the ground branch and the ground plane. The antenna structure is formed by the ground branch. The antenna structure is excited by a signal source.





US 20170033445A1

(19) **United States**

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

(10) **Pub. No.: US 2017/0033445 A1**

(43) **Pub. Date: Feb. 2, 2017**

(54) **TERMINAL DEVICE**

Publication Classification

(71) Applicant: **SHARP KABUSHIKI KAISHA**, Sakai City (JP)

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H04B 1/3818 (2006.01)

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

CPC **H01Q 1/243** (2013.01); **H04B 1/3818** (2015.01)

(72) Inventors: **Yusuke OKAJIMA**, Sakai City (JP);
Hiroyuki TAKEBE, Sakai City (JP)

(21) Appl. No.: **15/303,565**

(22) PCT Filed: **Apr. 14, 2015**

(86) PCT No.: **PCT/JP2015/061455**

§ 371 (c)(1),

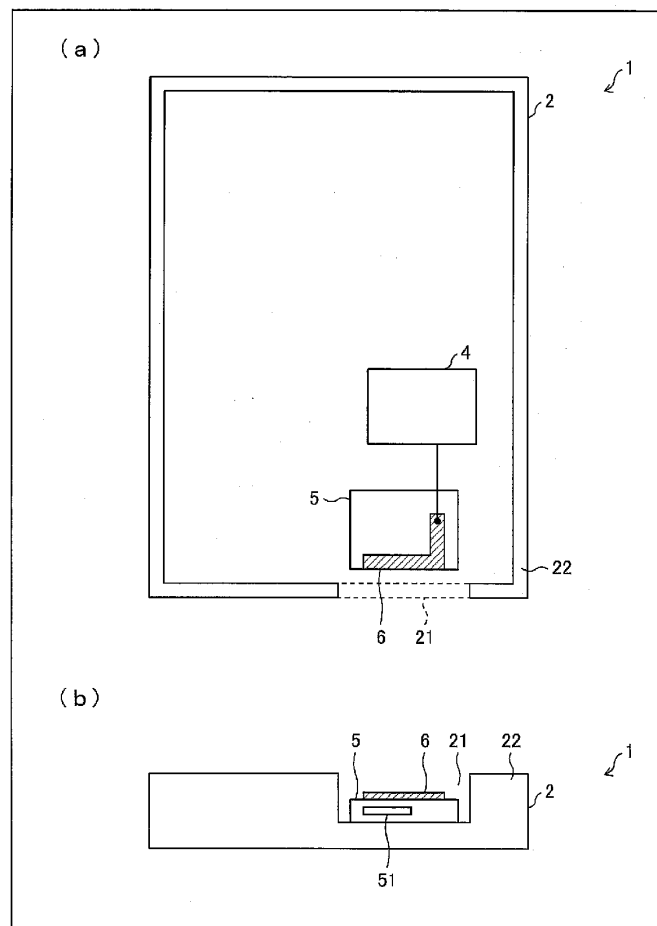
(2) Date: **Oct. 12, 2016**

(30) **Foreign Application Priority Data**

Apr. 30, 2014 (JP) 2014-093835

ABSTRACT

In the present invention, a metallic section (22) has an opening (21). An antenna 6 is provided in a terminal device 1, in a location overlapped with the opening 21 when the opening (21) is viewed from an opening surface of the opening (21). The metallic section (22) has the opening (21) such that the metallic section (22) includes a notch-like shape when the opening (21) is viewed from the opening surface, the notch-like shape being cut out from a side of the metallic section which side is closer to the antenna (6). This ensures body rigidity while also enabling the antenna to exhibit favorable properties during use of the terminal device (1) by a user.





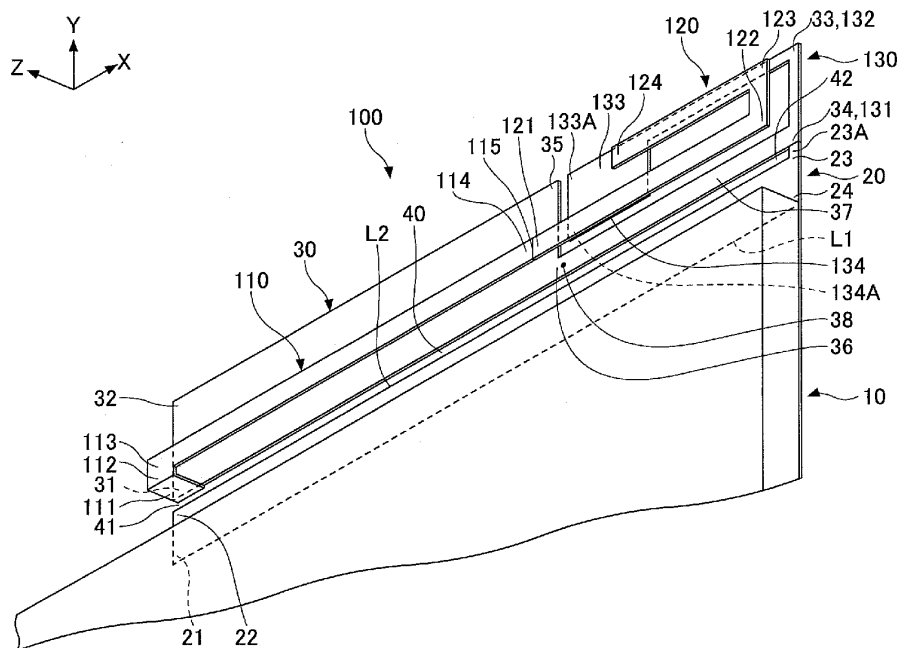
US 20170033453A1

(19) **United States**(12) **Patent Application Publication**
Koga et al.(10) **Pub. No.: US 2017/0033453 A1**(43) **Pub. Date: Feb. 2, 2017**(54) **ANTENNA APPARATUS**(71) Applicant: **FUJITSU LIMITED**, Kawasaki-shi
(JP)(72) Inventors: **Yohei Koga**, Kawasaki (JP);
HIROYUKI EGAWA, Fukuoka (JP)(73) Assignee: **FUJITSU LIMITED**, Kawasaki-shi
(JP)(21) Appl. No.: **15/189,436**(22) Filed: **Jun. 22, 2016**(30) **Foreign Application Priority Data**

Jul. 27, 2015 (JP) 2015-148145

Publication Classification(51) **Int. Cl.**
H01Q 1/48 (2006.01)
H01Q 5/328 (2006.01)
H01Q 1/24 (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/48** (2013.01); **H01Q 1/243**
(2013.01); **H01Q 5/328** (2015.01)(57) **ABSTRACT**

An antenna apparatus includes a first ground plane; a second ground plane having first, second, third and fourth sides, a cutout part, and a slit having an open end; a first radiating element having first and second lines, and a feeding point; a second radiating element having a third line; and a parasitic element having first and second parasitic lines. A length from the feeding point to an end part of the slit is set to one-half wavelength at a first communication frequency, a total length of a length from an end part of the fourth line to the feeding point, and a length from a ground potential point to an end part of the second parasitic line is set to one-half wavelength at a second communication frequency, and a length of the third line and the fourth line is set to one-quarter wavelength at a third communication frequency.



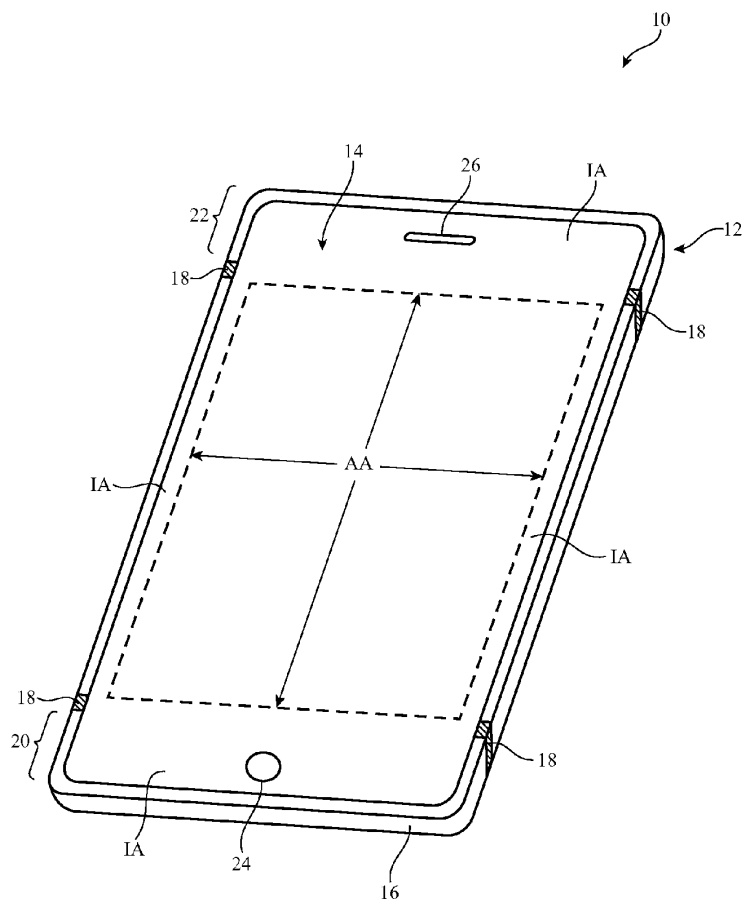


Ayala Vazquez et al.

(43) **Pub. Date:** **Feb. 2, 2017**

An electronic device may have wireless circuitry with antennas. An antenna resonating element arm for an antenna may be formed from conductive housing structures running along the edges of a device. The antenna may have a pair of switchable return paths that bridge a slot between the antenna resonating element and an antenna ground. An adjustable component and a feed may be coupled in parallel across the slot. The adjustable component may switch a capacitor into use or out of use and the return paths may be selectively opened and closed to compensate for antenna loading due to the presence of external objects near the electronic device.

(22) Filed: **Jul. 28, 2015**





US 20170033467A1

(19) **United States**

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

(10) **Pub. No.: US 2017/0033467 A1**

(43) **Pub. Date: Feb. 2, 2017**

(54) **ANTENNA FOR MOBILE COMMUNICATION
DEVICE**

Publication Classification

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

(51) **Int. Cl.**
H01Q 13/10 (2006.01)
H01Q 1/24 (2006.01)

(72) Inventors: **Shih-Ting Huang**, New Taipei City
(TW); **Kun-Sheng Chang**, New Taipei
City (TW); **Ching-Chi Lin**, New Taipei
City (TW)

(52) **U.S. Cl.**
CPC **H01Q 13/106** (2013.01); **H01Q 1/243**
(2013.01)

(21) Appl. No.: **14/927,808**

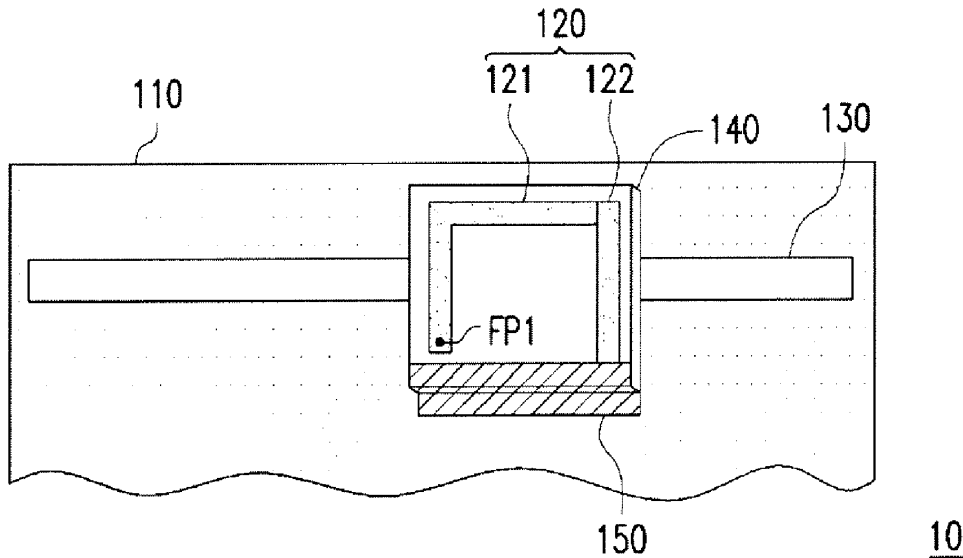
(57) **ABSTRACT**

(22) Filed: **Oct. 30, 2015**

An antenna includes a metal member, a closed slot disposed in the metal member, and a feed element having a first feed portion and a second feed portion, the first and second feed portions crossing the closed slot, and being electrically connected to each other. The feed element enables the closed slot to resonate at two different frequency bands and enables both bands to be individually tunable. The antenna can be incorporated into a metal cover or case of a mobile communication device.

(30) **Foreign Application Priority Data**

Jul. 31, 2015 (TW) 104125035





US 20170033812A1

(19) **United States**

(12) **Patent Application Publication**

Son et al.

(10) **Pub. No.: US 2017/0033812 A1**

(43) **Pub. Date:**

Feb. 2, 2017

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

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

CPC **H04B 1/0483** (2013.01); **H04W 88/06**
(2013.01)

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

(57)

ABSTRACT

(72) Inventors: **Gunhee Son**, Gyeongsangbuk-do (KR);
Hyeongwoo Kim, Busan (KR);
Soon-Sang Park, Daegu (KR);
Seunghyun Yeo, Daegu (KR)

Various embodiments provide an antenna device that includes: a metal member configured to have a length that contributes to at least a part of an electronic device; a printed circuit board (PCB) configured to be feed-connected to a preset position of the metal member in order to apply the metal member as an antenna radiator; and at least one electronic component electrically connected to a position different from the feeding position of the metal member and grounded to the PCB, and provide an electronic device that includes the same. Accordingly, the antenna device is grounded to the PCB in a desired position of the metal member by using the basically provided electronic component so that it is possible to exclude a separate electrical connection member, thereby reducing the cost, increasing the use of space, enhancing the degree of freedom of the design of the antenna radiator.

(21) Appl. No.: **15/222,899**

(22) Filed: **Jul. 28, 2016**

(30) **Foreign Application Priority Data**

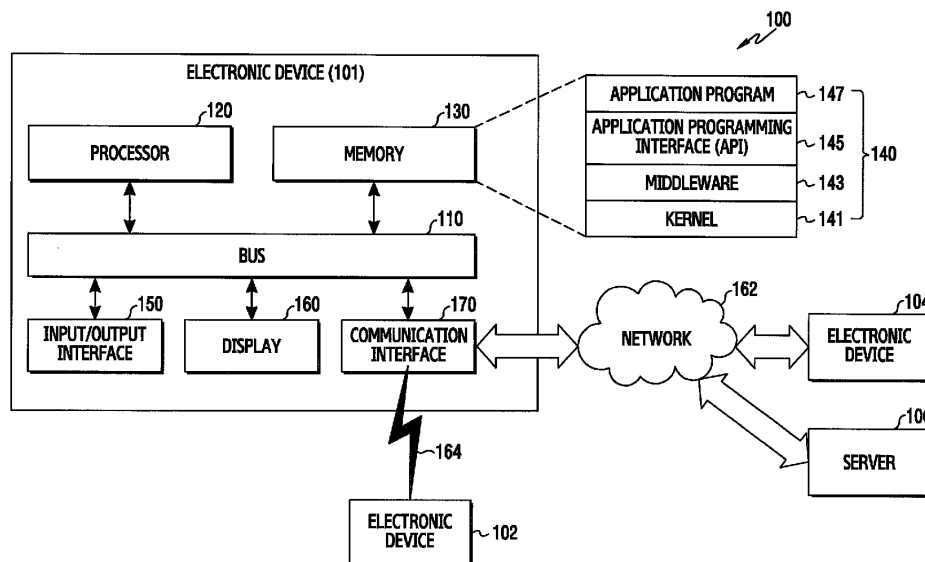
Jul. 28, 2015 (KR) 10-2015-0106687

Publication Classification

(51) **Int. Cl.**

H04B 1/04

(2006.01)

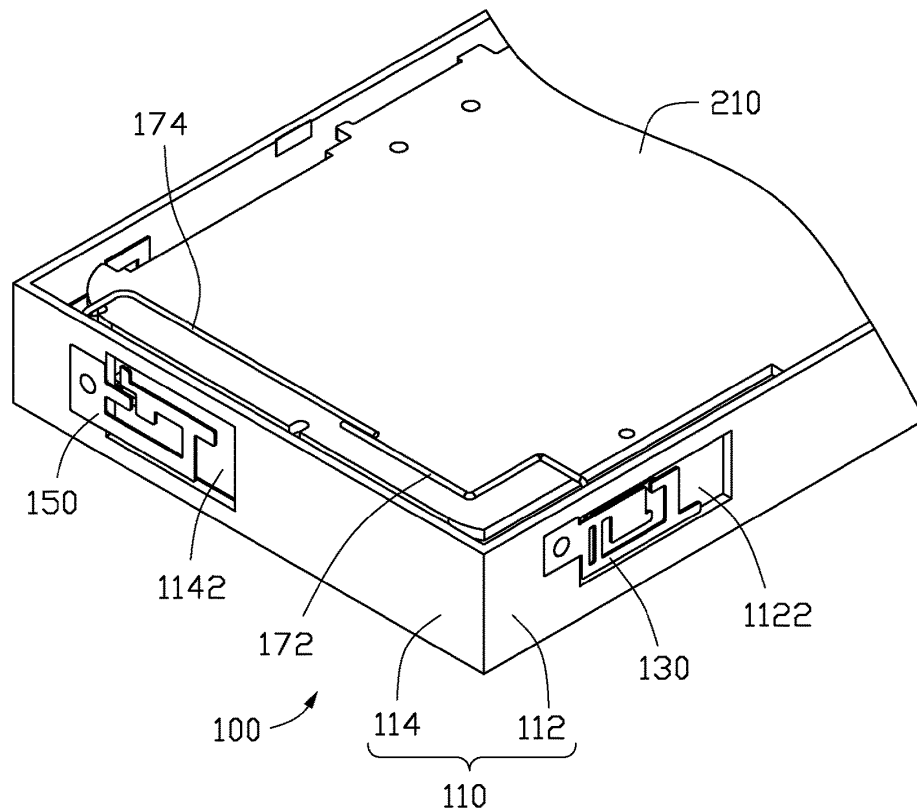




US 20170040667A1

(19) **United States**(12) **Patent Application Publication**
LEE(10) **Pub. No.: US 2017/0040667 A1**(43) **Pub. Date: Feb. 9, 2017**(54) **ANTENNA ASSEMBLY AND WIRELESS
COMMUNICATION DEVICE USING THE
SAME**(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01)(71) Applicant: **Chiun Mai Communication Systems,
Inc.**, New Taipei (TW)(57) **ABSTRACT**(72) Inventor: **CHIH-HO LEE**, New Taipei (TW)(21) Appl. No.: **14/816,566**(22) Filed: **Aug. 3, 2015****Publication Classification**(51) **Int. Cl.**
H01Q 1/24 (2006.01)

A wireless communication device includes a housing and an antenna assembly. The housing including a metallic frame having a first side plate and a second side plate connected to the first side plate, the first side plate defines a first opening, and the second side plate defines a second opening. The antenna assembly includes a first antenna and a second antenna. The first antenna is received in the first opening, secured on the first side plate and grounded by the first side plate. The second antenna is received in the second opening and is secured on the second side plate and grounded by the second side plate.

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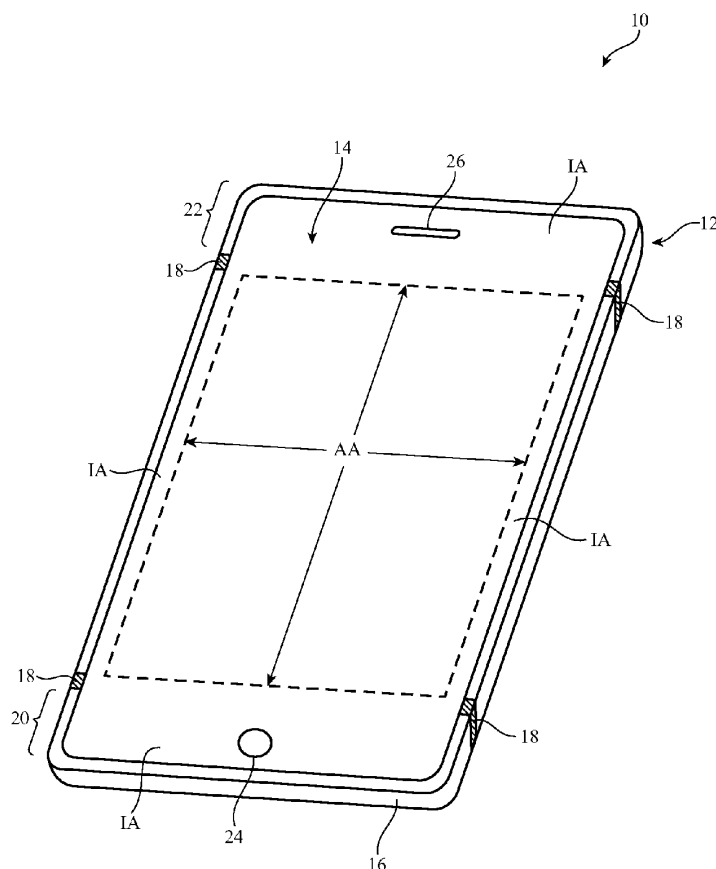
US 20170040668A1

(19) **United States**(12) **Patent Application Publication****Ayala Vazquez et al.**(10) **Pub. No.: US 2017/0040668 A1**(43) **Pub. Date: Feb. 9, 2017**(54) **ELECTRONIC DEVICE ANTENNA WITH ISOLATION MODE**(52) **U.S. CL.**CPC **H01Q 1/243** (2013.01); **H01Q 21/28** (2013.01); **H01Q 9/0442** (2013.01); **H01Q 5/20** (2015.01)(71) Applicant: **Apple Inc.**, Cupertino, CA (US)(72) Inventors: **Enrique Ayala Vazquez**, Watsonville, CA (US); **Hongfei Hu**, Santa Clara, CA (US); **Nanbo Jin**, Milpitas, CA (US); **Matthew A. Mow**, Los Altos, CA (US); **Liang Han**, Sunnyvale, CA (US); **Mattia Pascolini**, San Francisco, CA (US)

(57)

ABSTRACT

An electronic device may have wireless circuitry with antennas. An antenna resonating element arm for a given antenna may be formed from metal structures supported by a plastic carrier. The antenna resonating element arm may be coupled to switching circuitry to isolate the antenna resonating element arm when the antenna resonating element arm is not being used to handle communications in a communications band. The electronic device may have a metal housing. A slot may separate a peripheral portion of the housing such as a sidewall portion from a planar rear portion. The sidewall portion and the planar rear portion may form an additional antenna that operates at communications frequencies outside of the communications band handled by the given antenna. A parasitic antenna resonating element arm may be formed in the slot to enhance the frequency response of the additional antenna.

(21) Appl. No.: **14/819,280**(22) Filed: **Aug. 5, 2015****Publication Classification**(51) **Int. Cl.****H01Q 1/24** (2006.01)**H01Q 9/04** (2006.01)**H01Q 5/20** (2006.01)**H01Q 21/28** (2006.01)



US 20170040669A1

(19) **United States**

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

(10) **Pub. No.: US 2017/0040669 A1**

(43) **Pub. Date: Feb. 9, 2017**

(54) **MOBILE DISPLAY TERMINAL**

(30) **Foreign Application Priority Data**

(71) Applicant: **BOE TECHNOLOGY GROUP CO., LTD.**, Beijing (CN)

Apr. 3, 2015 (CN) 201520200997.5

Publication Classification

(72) Inventors: **Yongchun Lu**, Beijing (CN); **Jian Xu**, Beijing (CN); **Xinyin Wu**, Beijing (CN); **Yong Qiao**, Beijing (CN); **Jianbo Xian**, Beijing (CN)

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

(73) Assignee: **BOE TECHNOLOGY GROUP CO., LTD.**, Beijing (CN)

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

(21) Appl. No.: **14/915,613**

(57) **ABSTRACT**

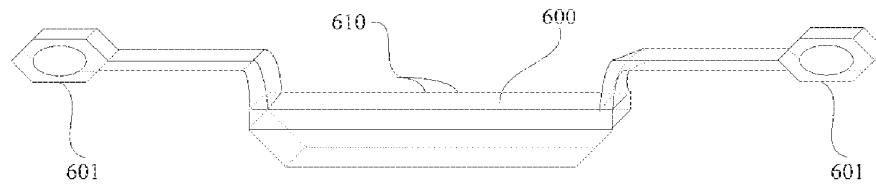
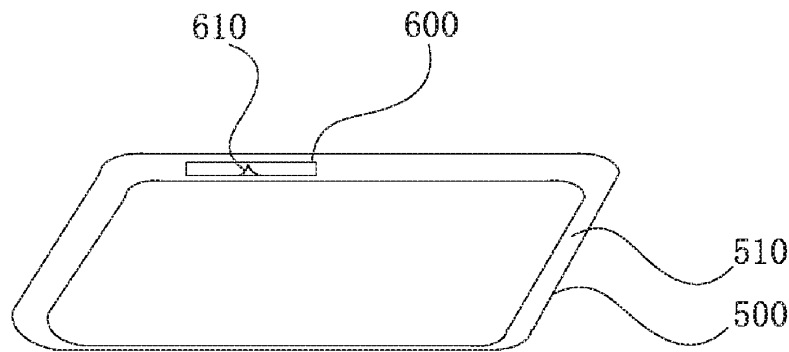
(22) PCT Filed: **Sep. 29, 2015**

The present disclosure provides a mobile display terminal, including a case, a main board and an antenna. The main board is arranged inside the case, a circuit board is arranged on the main board, and the antenna is arranged on the case. The mobile display terminal further includes a connector configured to electrically connect the antenna to the circuit board.

(86) PCT No.: **PCT/CN2015/091078**

§ 371 (c)(1),

(2) Date: **Feb. 29, 2016**





US 20170040670A1

(19) **United States**

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

(10) **Pub. No.: US 2017/0040670 A1**

(43) **Pub. Date: Feb. 9, 2017**

(54) **ANTENNA STRUCTURES AND METHODS**

Publication Classification

(71) Applicant: **Achilles Technology Management Co II, Inc.**, Palo Alto, CA (US)

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 21/00 (2006.01)
H01Q 13/10 (2006.01)

(72) Inventors: **Li Chen**, Melbourne, FL (US); **Frank M. Caimi**, Vero Beach, FL (US); **Mark T. Montgomery**, Melbourne Beach, FL (US); **Mark W. Kishler**, Rockledge, FL (US)

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 13/10** (2013.01); **H01Q 21/00** (2013.01)

(21) Appl. No.: **15/155,193**

(57) **ABSTRACT**

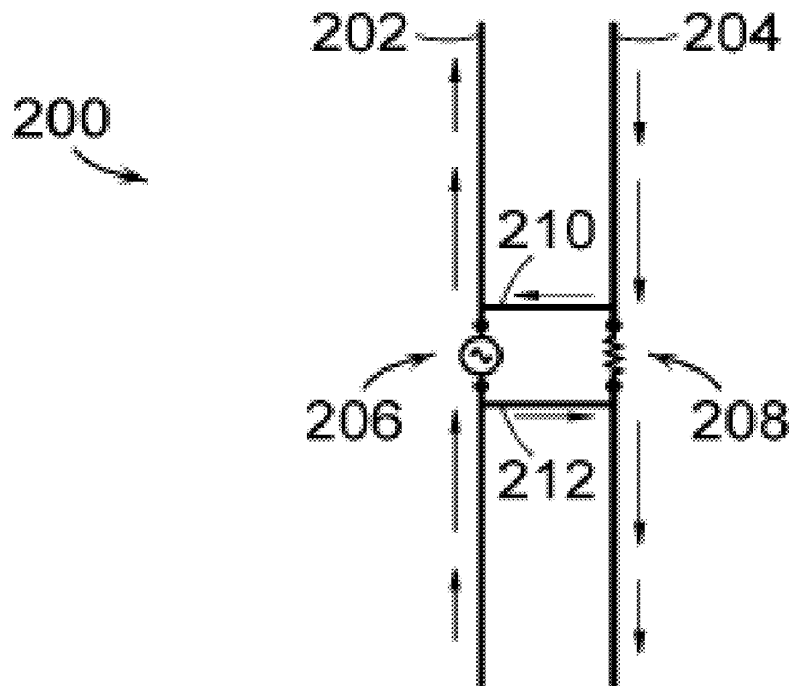
(22) Filed: **May 16, 2016**

A communication device that incorporates the subject disclosure may include, for example, a conductive cover, an antenna structure, and a circuit. The antenna structure can comprise a first portion of the conductive cover having a first slot formed therein. The first portion can form a first antenna element for converting between first electromagnetic signals and first electrical signals. The first slot can define a shape of a trade dress design in the conductive cover. The circuit can be communicatively coupled to first edges of the first slot to define a first port. The circuit can perform operations comprising transmitting the first electronic signals into the first antenna element. Other embodiments are disclosed.

Related U.S. Application Data

(63) Continuation of application No. 14/449,498, filed on Aug. 1, 2014, now Pat. No. 9,368,869.

(60) Provisional application No. 61/896,233, filed on Oct. 28, 2013, provisional application No. 61/932,831, filed on Jan. 29, 2014, provisional application No. 61/941,888, filed on Feb. 19, 2014.





US 20170040676A1

(19) **United States**

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

(10) **Pub. No.: US 2017/0040676 A1**

(43) **Pub. Date: Feb. 9, 2017**

(54) **WIRELESS DEVICE INCLUDING A
MULTIBAND ANTENNA SYSTEM**

Publication Classification

(71) Applicant: **Fractus Antennas, S.L.**, Sant Cugat del
Valles (ES)

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 5/335 (2006.01)
H01Q 5/50 (2006.01)
H01Q 1/48 (2006.01)

(72) Inventors: **Jaume ANGUERA PROS**, Castellon
(ES); **Ivan SANZ**, Barcelona (ES);
Carles PUENTE BALLARDA,
Barcelona (ES); **Josep MUMBRU**,
Asnieres-sur-Seine (FR)

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 1/48**
(2013.01); **H01Q 5/335** (2015.01); **H01Q 5/50**
(2015.01)

(21) Appl. No.: **15/331,390**

(22) Filed: **Oct. 21, 2016**

Related U.S. Application Data

(63) Continuation of application No. 14/807,302, filed on
Jul. 23, 2015, now abandoned, which is a continua-
tion of application No. 12/593,290, filed on Sep. 26,
2009, now Pat. No. 9,130,267, filed as application
No. PCT/EP2008/053526 on Mar. 26, 2008.

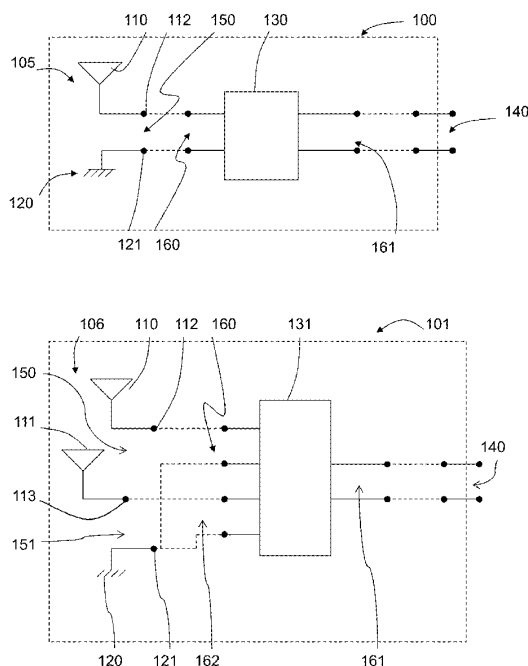
(60) Provisional application No. 60/910,113, filed on Apr.
4, 2007.

(30) **Foreign Application Priority Data**

Mar. 30, 2007 (EP) 07105364.9

(57) **ABSTRACT**

A wireless handheld or portable device includes an antenna system operable in a first frequency region and a higher, second frequency region. The antenna system comprises an antenna structure, a matching and tuning system, and an external input/output (I/O) port. The antenna structure comprises at least one radiating element including a connection point, a ground plane layer including at least one connection point, and at least one internal I/O port. At least one radiating element of the antenna structure protrudes beyond the ground plane layer. The antenna structure features at any of its internal I/O ports when disconnected from the matching and tuning system an input return loss curve having a minimum at a frequency outside the first frequency region of the antenna system. The matching and tuning system modifies the impedance of the antenna structure and provides impedance matching to the antenna system in the first and second regions.





US 20170040712A1

(19) **United States**

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

(10) **Pub. No.: US 2017/0040712 A1**

(43) **Pub. Date: Feb. 9, 2017**

(54) **ELECTRONIC DEVICE, COMMUNICATION
DEVICE, AND ANTENNA GAIN
ENHANCEMENT METHOD FOR A
DETACHABLE WIRELESS
COMMUNICATION MODULE**

Publication Classification

(51) **Int. Cl.**
H01Q 21/29 (2006.01)
(52) **U.S. Cl.**
CPC **H01Q 21/29** (2013.01)

(71) Applicant: **Quanta Computer Inc.**, Taoyuan City
(TW)

(72) Inventors: **Tsung-Ying HSIEH**, Taoyuan City
(TW); **Li-Cheng SHEN**, Taoyuan City
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City (TW)

(21) Appl. No.: **14/883,936**

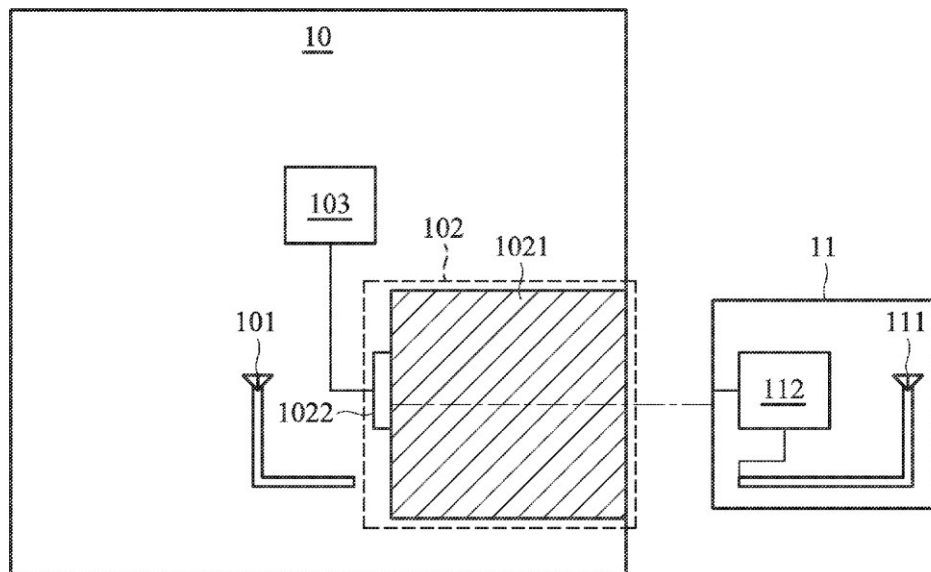
(22) Filed: **Oct. 15, 2015**

(30) **Foreign Application Priority Data**

Aug. 6, 2015 (TW) 104125562

ABSTRACT

The present invention presents an electronic device. The electronic device includes a socket and a supplementary antenna. The socket is disposed on the electronic device, wherein the socket includes an accommodating portion for accommodating an external wireless communication module inserted from the outside. The supplementary antenna is disposed in the electronic device, wherein when the wireless communication module is completely inserted into the accommodating portion, the main antenna of the wireless communication module and the supplementary antenna become electromagnetically coupled; and wherein when the wireless communication module is completely inserted into the accommodating portion, the electronic device transmits/receives wireless signals using the main antenna and the supplementary antenna together.





US 20170048366A1

(19) **United States**

(12) **Patent Application Publication**
JEONG

(10) **Pub. No.: US 2017/0048366 A1**

(43) **Pub. Date: Feb. 16, 2017**

(54) **ELECTRONIC DEVICE WITH EXTERIOR
METAL FRAME ANTENNA**

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

CPC *H04M 1/0272* (2013.01); *H04M 1/0277*
(2013.01); *H04M 1/0264* (2013.01); *H04M*
1/03 (2013.01)

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

(72) Inventor: **Woo-Young JEONG**, Seoul (KR)

(57)

ABSTRACT

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

(21) Appl. No.: **15/205,341**

(22) Filed: **Jul. 8, 2016**

Disclosed is an electronic device that includes a housing; a printed circuit board disposed within the housing; a communication circuit disposed on the printed circuit board; at least one exterior metal frame forming at least a part of the housing, and is electrically connected with the communication circuit; a first electric path that electrically connecting the at least one exterior metal frame and the printed circuit board with each other; a support structure including a metal region and a non-metal region, and supporting the printed circuit board and/or the at least one exterior metal frame; and a second electric path disposed between the printed circuit board and the metal region of the support structure and is electrically connected with the first electric path.

(30) **Foreign Application Priority Data**

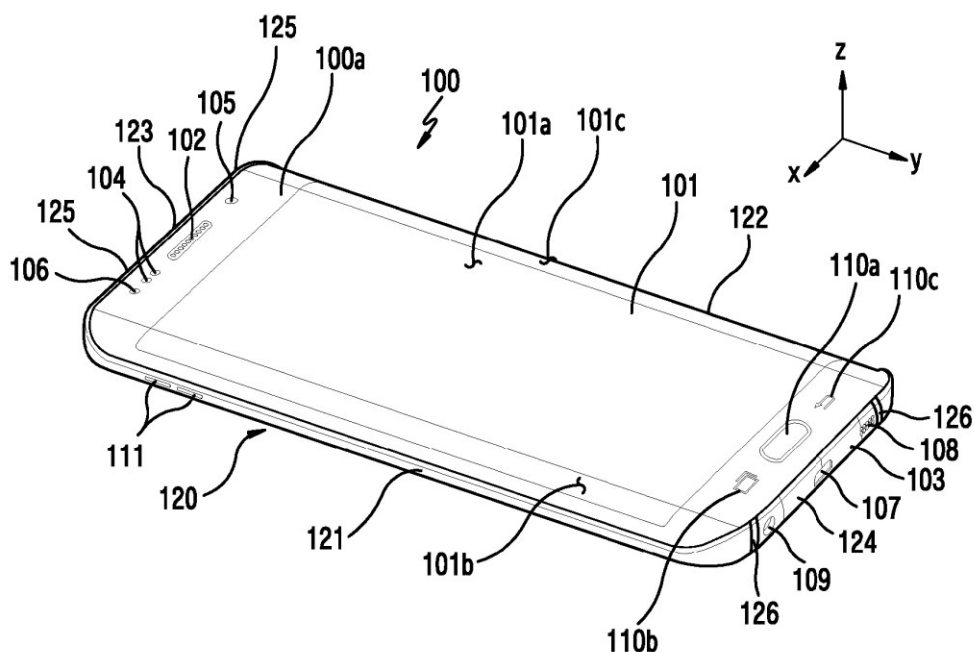
Aug. 13, 2015 (KR) 10-2015-0114557

Publication Classification

(51) **Int. Cl.**

H04M 1/02 (2006.01)

H04M 1/03 (2006.01)





US 20170047637A1

(19) **United States**(12) **Patent Application Publication**
KIM et al.(10) **Pub. No.: US 2017/0047637 A1**(43) **Pub. Date: Feb. 16, 2017**(54) **ANTENNA DEVICE AND ELECTRONIC
DEVICE INCLUDING THE SAME****H04W 72/04** (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); **H04W 4/005** (2013.01); **H04W**
72/0453 (2013.01)(72) Inventors: **Ki-Man KIM**, Gumi-si (KR); **Jaehwan**
KIM, Gyeongju-si (KR); **Min-Soo**
KIM, Gumi-si (KR); **Chulhyung**
YANG, Gumi-si (KR); **Ji-Woo LEE**,
Gumi-si (KR)

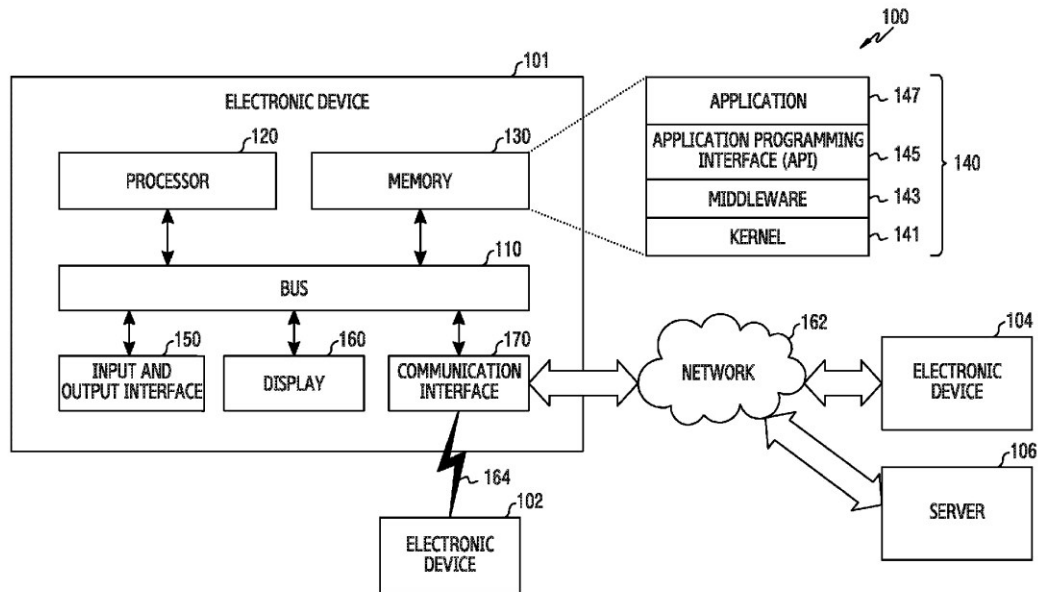
(57)

ABSTRACT

An electronic device is provided. The electronic device includes a housing that includes a first face, a second face that is directed opposite to the first face, and a side face that at least partially enclose a space between the first face and the second face, a first metallic member, a second metallic member, and a third metallic member that form a side face, a sensor configured to detect whether an external object comes in contact with at least one of the first metallic member, the second metallic member, and the third metallic member, and to generate a signal, and a circuit configured to change an electric path between at least one of the first metallic member, the second metallic member, and the third metallic member, and the ground member, at least partially based on the generated signal.

(21) Appl. No.: **15/211,653**(22) Filed: **Jul. 15, 2016**(30) **Foreign Application Priority Data**

Aug. 13, 2015 (KR) 10-2015-0114240

Publication Classification(51) **Int. Cl.****H01Q 1/24** (2006.01)**H04W 4/00** (2006.01)



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

(43) **Pub. Date:** Feb. 16, 2017

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 1/48*
(2013.01); *H04B 1/40* (2013.01)

(72) Inventors: **Bomyoung KIM**, Gyeonggi-do (KR);
Jungho Park, Gyeonggi-do (KR);
Byungman Lim, Seoul (KR);
Young-Jun Cho, Seoul (KR)

(57) **ABSTRACT**

(22) Filed: **Jul. 22, 2016**

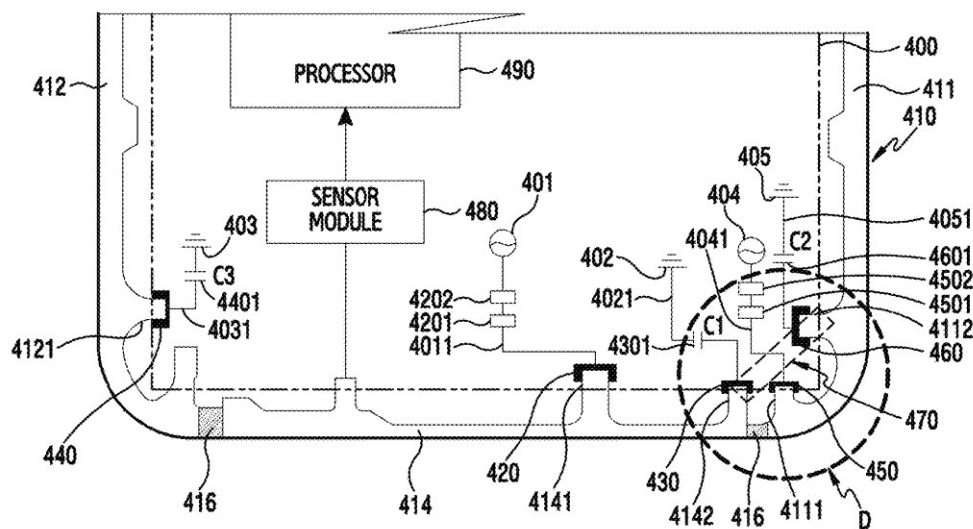
(30) **Foreign Application Priority Data**

Aug. 13, 2015 (KR) 10-2015-0114620

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H04B 1/40 (2006.01)
H01Q 1/48 (2006.01)

An electronic device is provided that includes a housing, a first conductive member configured to form a part of the housing, or be partially disposed within the housing, wherein the first conductive member includes a first conductive protrusion disposed toward the inside of the housing, a second conductive member configured to form another part of the housing, wherein the second conductive member includes a portion disposed adjacent to a portion of the first conductive member and a second conductive protrusion disposed toward the inside of the housing, a non-conductive member disposed between the portion of the first conductive member and the portion of the second conductive member, a coupling structure that includes a conductor and is connected between the first conductive protrusion and the second conductive protrusion, and at least one communication circuit electrically connected to the second conductive member.





US 20170047639A1

(19) **United States**(12) **Patent Application Publication****LEE et al.**(10) **Pub. No.: US 2017/0047639 A1**(43) **Pub. Date: Feb. 16, 2017**(54) **ANTENNA DEVICE AND ELECTRONIC DEVICE INCLUDING THE SAME**(52) **U.S. CL.**CPC **H01Q 1/243** (2013.01); **H01Q 1/48** (2013.01); **H01Q 7/00** (2013.01)(71) Applicant: **Samsung Electronics Co., Ltd.**,
Suwon-si (KR)(72) Inventors: **Kyung-Jae LEE**, Seoul (KR);
Kyung-Jong LEE, Hwaseong-si (KR);
Sewoong KIM, Gimhae-si (KR);
Soo-Young JANG, Daegu (KR);
Seunghwan KIM, Seoul (KR);
Hosaeng KIM, Anyang-si (KR);
Jinwoo JUNG, Seoul (KR)

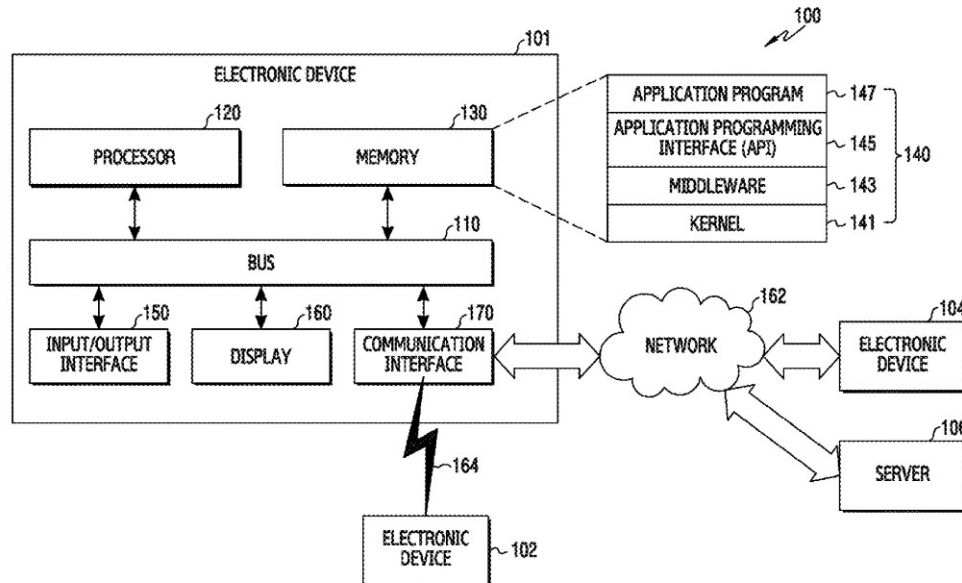
(57)

ABSTRACT

An electronic device is provided. The electronic device includes a housing including a first face, a second face, and a side face that at least partially encloses a space between the first face and the second face, a conductive member configured to form at least a portion of the side face, a ground member, at least one communication circuit, and a conductive pattern positioned within the housing, the conductive pattern electrically connected to the communication circuit and the ground member, a first electric path positioned within the housing, and configured to electrically interconnect another end of the conductive member and the communication circuit, a second electric path configured to electrically interconnect the first electric path or the conductive member and the ground member, and a third electric path configured to electrically interconnect the first electric path or the conductive member and the ground member, and including a switching circuit.

(21) Appl. No.: **15/217,516**(22) Filed: **Jul. 22, 2016**(30) **Foreign Application Priority Data**

Aug. 10, 2015 (KR) 10-2015-0112620

Publication Classification(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 7/00 (2006.01)
H01Q 1/48 (2006.01)



US 20170047640A1

(19) **United States**(12) **Patent Application Publication**
Choi et al.(10) **Pub. No.: US 2017/0047640 A1**(43) **Pub. Date: Feb. 16, 2017**(54) **ELECTRONIC DEVICE AND METHOD OF
IMPROVING ANTENNA PERFORMANCE
THEREOF**(52) **U.S. CL.**CPC **H01Q 1/243** (2013.01); **H01Q 1/48**
(2013.01); **H01Q 1/50** (2013.01)(71) Applicant: **Samsung Electronics Co., Ltd.**,
Gyeonggi-do (KR)

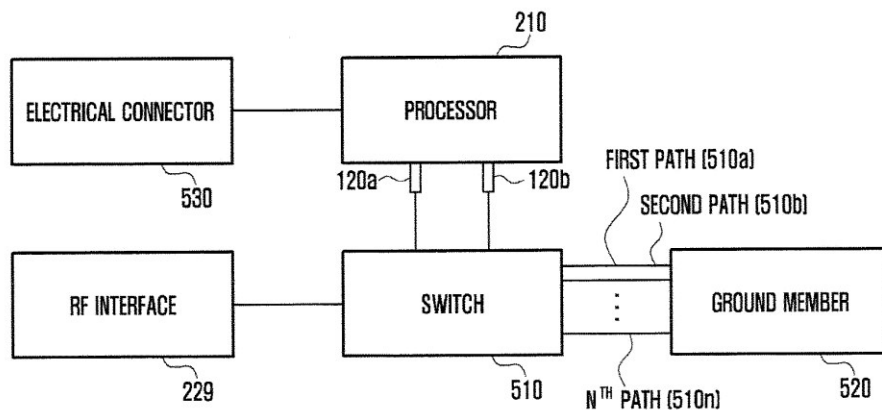
(57)

ABSTRACT(72) Inventors: **Hoon Choi**, Gyeonggi-do (KR);
Myungjin Kang, Gyeonggi-do (KR);
Kyoungho Kim, Gyeonggi-do (KR);
Kihun Lee, Gyeonggi-do (KR);
Hanjin Yi, Gyeonggi-do (KR);
Jongwook Choi, Gyeonggi-do (KR)

A method of improving antenna performance and an electronic device configured to improve the antenna performance are provided. The electronic device include: a housing; an antenna located inside the housing or formed as part of the housing; a radio frequency (RF) interface configured to transmit/receive wireless signals via the antenna; a groove formed inside an opening in part of the housing; an electrical connector placed inside the groove; a ground member placed inside the housing; a processor electrically connected to the RF interface and the electrical connector; and a memory electrically connected to the processor. The memory stores instructions which enable the processor to detect an external electrical connector inserted into the electrical connector, and select at least one of a plurality of electrical paths between the RF interface and the ground member, in response to at least part of the inserted external electrical connector. Various embodiments are provided.

(21) Appl. No.: **15/236,367**(22) Filed: **Aug. 12, 2016**(30) **Foreign Application Priority Data**

Aug. 12, 2015 (KR) 10-2015-0113941

Publication Classification(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/50 (2006.01)
H01Q 1/48 (2006.01)



US 20170047642A1

(19) **United States**

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

(10) **Pub. No.: US 2017/0047642 A1**

(43) **Pub. Date: Feb. 16, 2017**

(54) **ANTENNA APPARATUS AND TERMINAL**

(71) Applicant: **HUAWEI DEVICE CO., LTD.**,
Shenzhen (CN)

(72) Inventors: **Yuanpeng LI**, Beijing (CN); **Yafang YU**, Beijing (CN); **Meng HOU**,
Shanghai (CN)

(21) Appl. No.: **15/307,316**

(22) PCT Filed: **Apr. 28, 2014**

(86) PCT No.: **PCT/CN2014/076386**

§ 371 (c)(1),

(2) Date: **Oct. 27, 2016**

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 9/04 (2006.01)
H01Q 5/364 (2006.01)

H01Q 1/38 (2006.01)

H01Q 1/48 (2006.01)

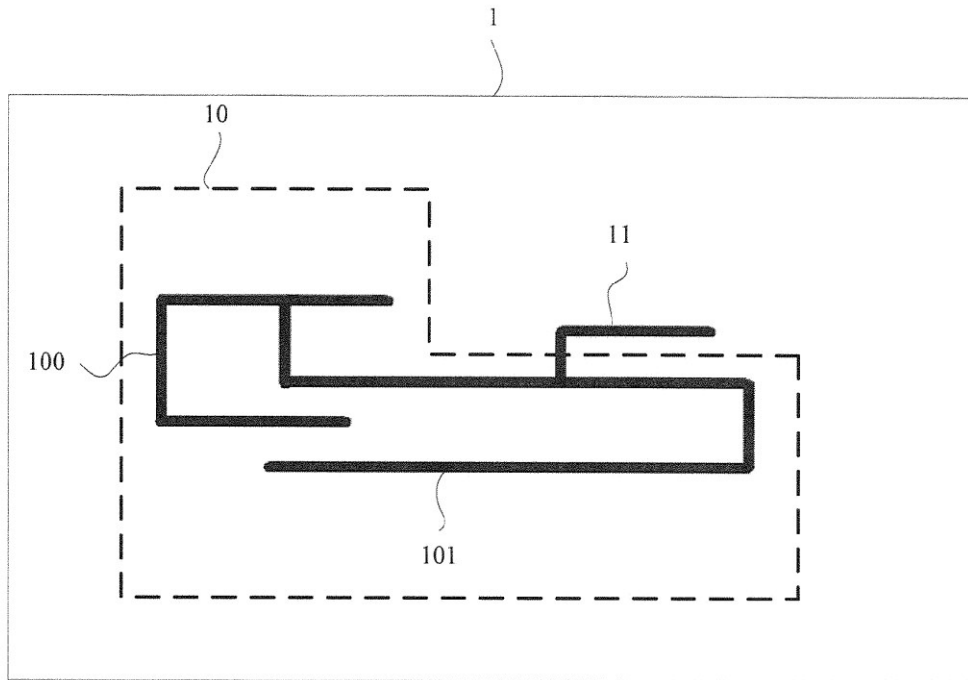
(52) **U.S. Cl.**

CPC **H01Q 1/243** (2013.01); **H01Q 1/38**
(2013.01); **H01Q 1/48** (2013.01); **H01Q 5/364**
(2015.01); **H01Q 9/0421** (2013.01)

(57)

ABSTRACT

An antenna apparatus and a terminal. The antenna apparatus includes an antenna body and at least one stub. The antenna body includes a first branch used to radiate a high-frequency signal and a second branch used to radiate a low-frequency signal. One end of the stub is connected to a connection point of the second branch, and the other end of the stub is a free end. The connection point is a position with a maximum value of current distribution on the second branch of an electromagnetic wave having a wavelength. The wavelength corresponds to a specified high frequency at which the antenna apparatus works. The length of the stub is determined according to the wavelength corresponding to the specified high frequency.





US 20170047644A1

(19) **United States**

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

(10) **Pub. No.: US 2017/0047644 A1**

(43) **Pub. Date: Feb. 16, 2017**

(54) **ANTENNA DEVICE OF MOBILE TERMINAL**

Publication Classification

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

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 9/04 (2006.01)

H01Q 1/38 (2006.01)

H04M 1/02 (2006.01)

H01Q 1/48 (2006.01)

(72) Inventors: **Sang Bong SUNG**, Gyeongsangbuk-do
(KR); **In Jin Hwang**,
Gyeongsangbuk-do (KR); **Seung Hwan**
Kim, Gyeonggi-do (KR); **Jae Ho Lee**,
Gyeonggi-do (KR)

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

CPC **H01Q 1/243** (2013.01); **H04M 1/0262**

(2013.01); **H01Q 1/48** (2013.01); **H01Q 1/38**

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

(21) Appl. No.: **15/337,961**

(22) Filed: **Oct. 28, 2016**

(57)

ABSTRACT

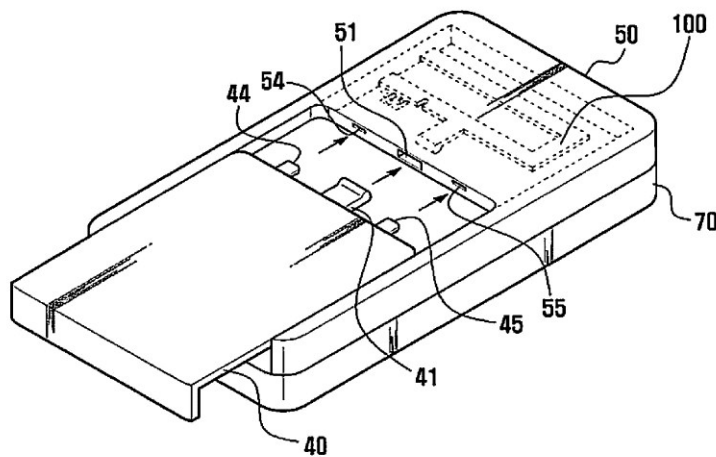
Related U.S. Application Data

(63) Continuation of application No. 14/731,801, filed on Jun. 5, 2015, now Pat. No. 9,484,623, which is a continuation of application No. 13/962,483, filed on Aug. 8, 2013, now Pat. No. 9,054,419, which is a continuation of application No. 13/458,453, filed on Apr. 27, 2012, now Pat. No. 8,531,342, which is a continuation of application No. 12/489,044, filed on Jun. 22, 2009, now Pat. No. 8,188,930.

Various mobile communication terminals, apparatuses, and methods having antenna improvements are discussed. An apparatus is described which includes an outer front side having a display disposed therein; an outer rear side a conductive part and a non-conductive part; a battery disposed between the outer front side and the outer rear side; and an antenna including a radiation unit capable of receiving a signal, at least a portion of the radiation unit being disposed between the outer front side and the non-conductive part of the outer rear side, a feeding unit which electrically connects the radiation unit to a circuit board, and a ground part which electrically connects the radiation unit to the conductive part of the outer rear side.

(30) **Foreign Application Priority Data**

Jun. 20, 2008 (KR) 10-2008-0058619





US 20170047643A1

(19) **United States**

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

(10) **Pub. No.: US 2017/0047643 A1**

(43) **Pub. Date: Feb. 16, 2017**

(54) **ANTENNA CIRCUIT, TERMINAL DEVICE,
AND METHOD FOR DISPOSING ANTENNA
CIRCUIT**

(71) Applicant: **HUAWEI DEVICE CO., LTD.**,
Shenzhen (CN)

(72) Inventors: **Xikui ZHANG**, Shenzhen (CN);
Tiezhu LIANG, Beijing (CN); **Yukun
GUO**, Beijing (CN); **Hui LI**, Shenzhen
(CN)

(73) Assignee: **Huawei Device Co., Ltd.**

(21) Appl. No.: **15/307,328**

(22) PCT Filed: **Apr. 29, 2014**

(86) PCT No.: **PCT/CN2014/076519**

§ 371 (c)(1),

(2) Date: **Oct. 27, 2016**

Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 1/50 (2006.01)

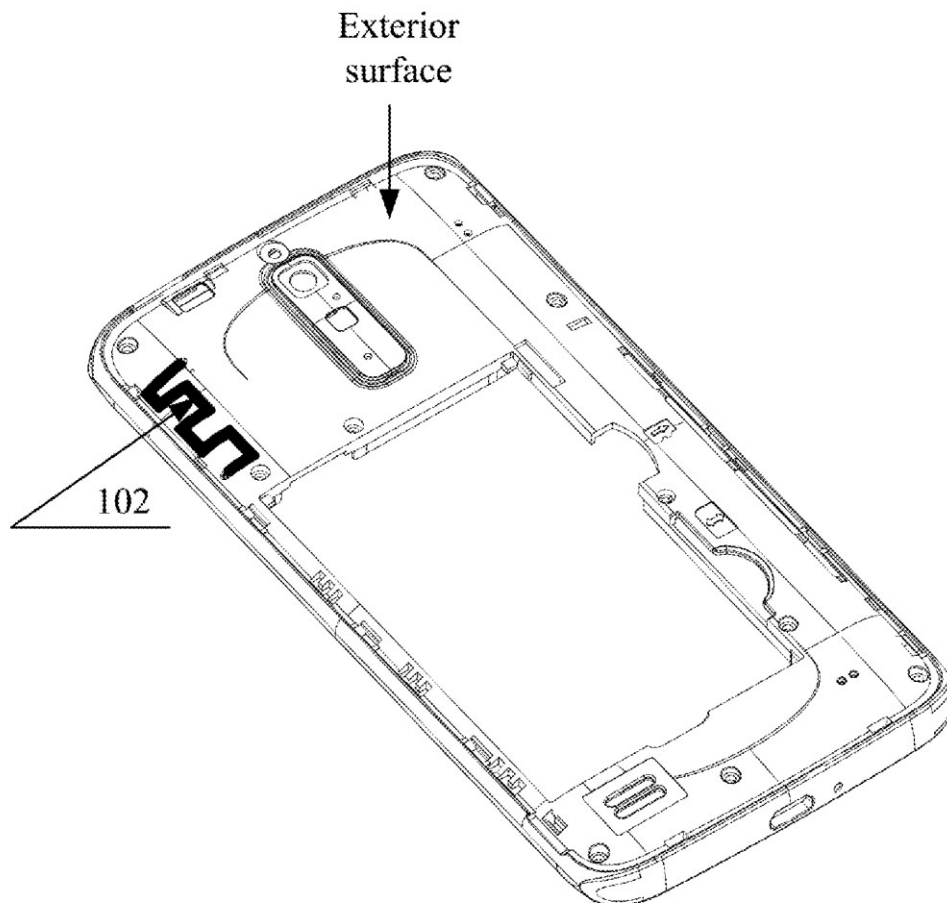
(52) **U.S. Cl.**

CPC **H01Q 1/243** (2013.01); **H01Q 1/50**
(2013.01)

(57)

ABSTRACT

An antenna circuit includes a first antenna circuit, a second antenna circuit, and a connection hole. The first antenna circuit is disposed on a non-exterior surface of a terminal device; the second antenna circuit is disposed on an exterior surface of the terminal device, where the exterior surface is a surface of the terminal device visible to a user, and the non-exterior surface is disposed opposite to the exterior surface; and the connection hole penetrates through the non-exterior surface and the exterior surface, where the first antenna circuit and the second antenna circuit are electrically connected by using the connection hole.





US 20170047950A1

(19) **United States**(12) **Patent Application Publication**
CHEN et al.(10) **Pub. No.: US 2017/0047950 A1**(43) **Pub. Date: Feb. 16, 2017**(54) **ELECTRONIC DEVICE AND MULTI-BAND ANTENNA**(71) Applicant: **HON HAI PRECISION INDUSTRY CO., LTD.**, New Taipei (TW)(72) Inventors: **WEI-YU CHEN**, New Taipei (TW);
YUEH-CHU LIN, New Taipei (TW)(21) Appl. No.: **14/886,615**(22) Filed: **Oct. 19, 2015**(30) **Foreign Application Priority Data**

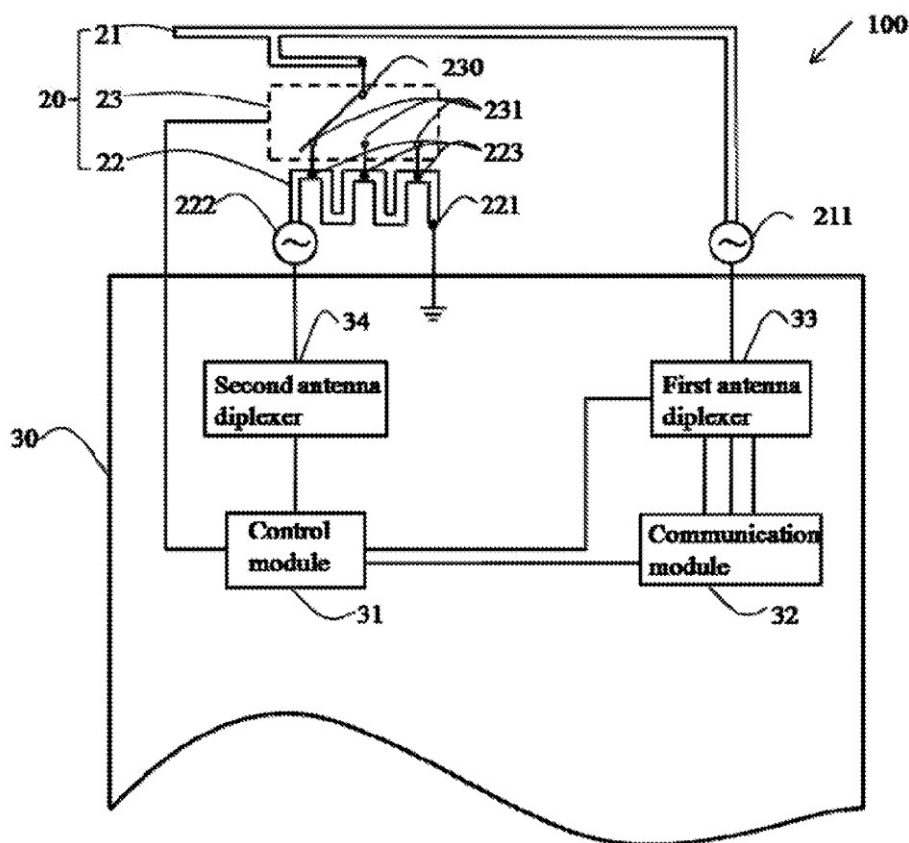
Aug. 11, 2015 (CN) 201510488121.X

Publication Classification(51) **Int. Cl.**
H04B 1/00 (2006.01)
H04W 72/04 (2006.01)(52) **U.S. CL.**CPC **H04B 1/0057** (2013.01); **H04B 1/006**
(2013.01); **H04W 72/0453** (2013.01)

(57)

ABSTRACT

An electronic device with multi-band antenna includes a first antenna frame, a second antenna frame, and a switching unit being electrically coupled between the first antenna frame and the second antenna frame. A first feed point only is located on the first antenna frame and multiple electrical connection points, a second feed point, and a ground point are located on the second antenna frame. One end of the first antenna frame can be connected to one of the electrical connection points by controlling the switching unit, and multiple radiating elements, able to radiate signals in different frequency bands, are formed on the multi-band antenna. Radiating elements are formed between the first feed point and the second feed point and the ground point.





US 20170048363A1

(19) **United States**

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

(10) **Pub. No.: US 2017/0048363 A1**

(43) **Pub. Date: Feb. 16, 2017**

(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.: **15/234,547**

(22) Filed: **Aug. 11, 2016**

(30) **Foreign Application Priority Data**

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

Publication Classification

(51) **Int. Cl.**
H04M 1/02 (2006.01)
H04B 1/48 (2006.01)
H04B 1/3827 (2006.01)

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

CPC **H04M 1/0202** (2013.01); **H04B 1/3833**
(2013.01); **H04B 1/48** (2013.01); **H04B**
2001/485 (2013.01); **H04W 4/008** (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.

