



US 20160056522A1

(19) **United States**(12) **Patent Application Publication**
KIM et al.(10) **Pub. No.: US 2016/0056522 A1**(43) **Pub. Date: Feb. 25, 2016**(54) **ELECTRICITY FEEDING STRUCTURE****Publication Classification**(71) Applicant: **LG INNOTEK CO., LTD.**, Seoul (KR)(51) **Int. Cl.**
H01P 7/08 (2006.01)(72) Inventors: **Chang Wook KIM**, Seoul (KR); **Do Gyun KIM**, Seoul (KR); **Byung Youl MOON**, Seoul (KR)(52) **U.S. Cl.**
CPC **H01P 7/088** (2013.01)(21) Appl. No.: **14/780,863**(57) **ABSTRACT**(22) PCT Filed: **Mar. 26, 2014**(86) PCT No.: **PCT/KR2014/002574**

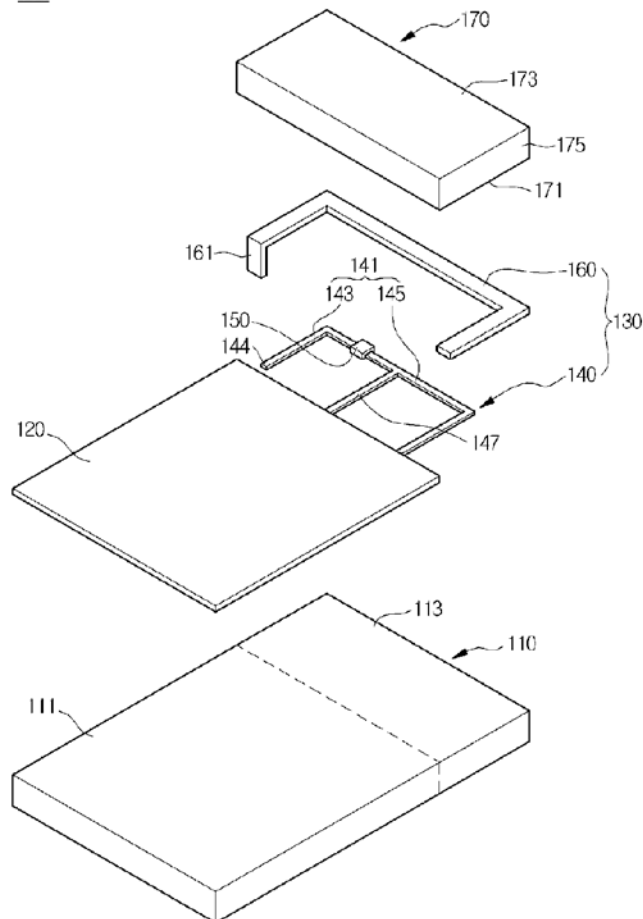
§ 371 (c)(1),

(2) Date: **Sep. 28, 2015**

The present invention relates to an electricity feeding structure, comprising: a resonator including an electricity feeding part and a ground part connected to the electricity feeding part; a resonance adding part disposed between the electricity feeding part and the ground part; and a controlling part disposed in at least one of the electricity feeding part, the resonance adding part and the ground part. According to the present invention, since the electricity feeding structure includes the controlling part, it is possible to easily control the resonant frequency band of an antenna device.

(30) **Foreign Application Priority Data**

Mar. 26, 2013 (KR) 10-2013-0032091

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(19) **United States**(12) **Patent Application Publication****Li et al.**(10) **Pub. No.: US 2016/0056526 A1**(43) **Pub. Date: Feb. 25, 2016**(54) **ELECTRONIC DEVICE WITH PERIPHERAL DISPLAY ANTENNA**(52) **U.S. CL.**CPC ... **H01Q 1/24** (2013.01); **H01Q 9/42** (2013.01)(71) Applicant: **Apple Inc.**, Cupertino, CA (US)(72) Inventors: **Qingxiang Li**, Mountain View, CA (US);
Robert W. Schub, Cupertino, CA (US);
Erik G. de Jong, San Francisco, CA (US);
Yuehui Ouyang, Sunnyvale, CA (US);
Siwen Yong, Santa Clara, CA (US);
Miroslav Samardzija, Mountain View, CA (US);
Yiren Wang, San Jose, CA (US);
Jiang Zhu, Mountain View, CA (US)

(57)

ABSTRACT

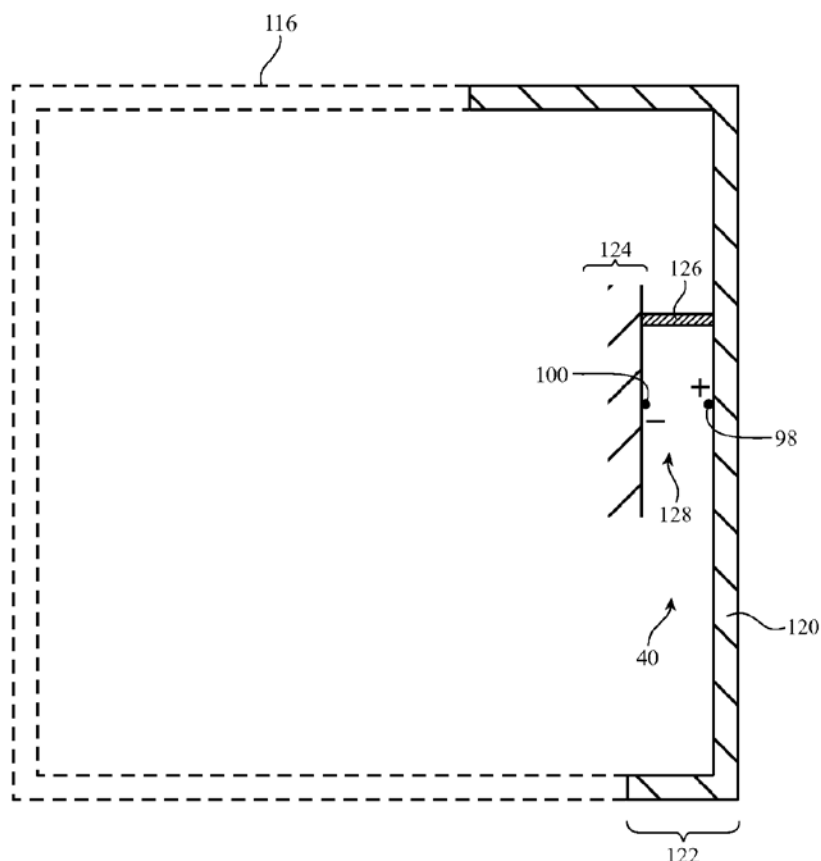
An electronic device may be provided with electrical components mounted in a housing. The electronic device may include wireless transceiver circuitry and antenna structures. A display may be mounted in the housing. The display may have a transparent layer such as display cover layer. The display cover layer may have an inner surface with a recess. The recess may be a groove that runs along a peripheral edge of the display cover layer. An antenna structure such as an inverted-F antenna resonating element may be formed from a metal trace on a plastic support structure. The metal trace and support structure may be mounted in the groove with adhesive. The housing may be a metal housing that forms an antenna ground. Springs may be used in forming an antenna feed and an antenna return path that couples the antenna resonating element to ground.

(21) Appl. No.: **14/468,217**(22) Filed: **Aug. 25, 2014****Publication Classification**(51) **Int. Cl.****H01Q 1/24**

(2006.01)

H01Q 9/42

(2006.01)





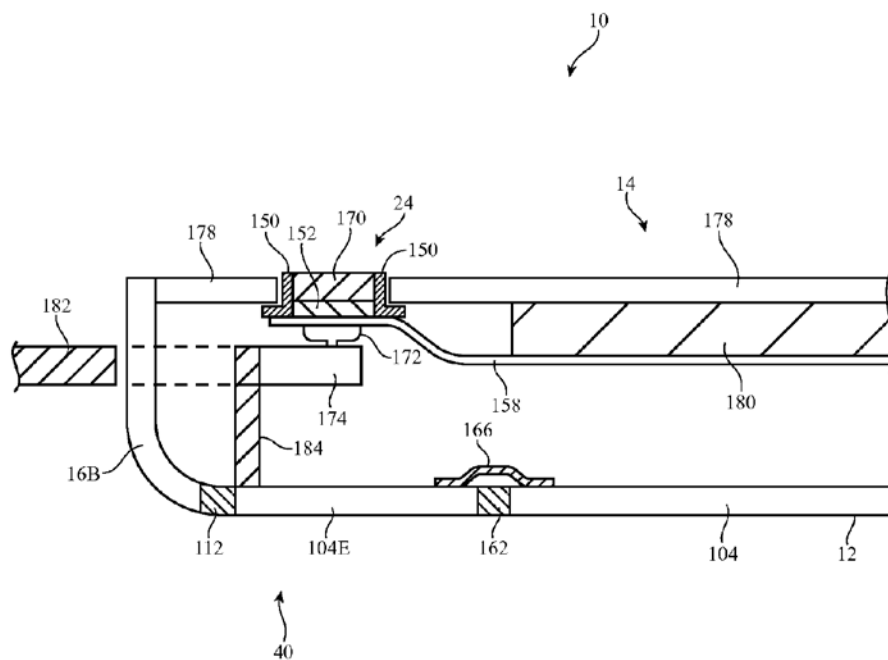
US 20160056527A1

(19) **United States**(12) **Patent Application Publication****Pascolini et al.**(10) **Pub. No.: US 2016/0056527 A1**(43) **Pub. Date: Feb. 25, 2016**(54) **ELECTRONIC DEVICE WITH FINGERPRINT SENSOR AND TUNABLE HYBRID ANTENNA**(71) Applicant: **Apple Inc.**, Cupertino, CA (US)(72) Inventors: **Mattia Pascolini**, San Francisco, CA (US); **Nanbo Jin**, Milpitas, CA (US)(21) Appl. No.: **14/463,299**(22) Filed: **Aug. 19, 2014****Publication Classification**(51) **Int. Cl.**
H01Q 1/24 (2006.01)
G06K 9/00 (2006.01)
H01Q 13/10 (2006.01)(52) **U.S. CL.**CPC **H01Q 1/243** (2013.01); **H01Q 13/10** (2013.01); **G06K 9/00006** (2013.01)

(57)

ABSTRACT

An electronic device may have wireless circuitry and components such as sensors. The electronic device may have a metal housing having first and second planar rear wall portions separated by a gap. Conductive structures may bridge the gap to electrically couple the first and second rear wall portions. The wireless circuitry may include a hybrid slot inverted-F antenna. The antenna may have an inverted-F antenna resonating element formed from peripheral housing structures that are separated from the second rear wall portion by an opening. The opening may form a C-shaped slot antenna resonating element for the antenna. The sensors may include a fingerprint sensor. The fingerprint sensor may be coupled to a button member in a button. The fingerprint sensor and other portions of the button may overlap the second planar rear wall portion to minimize interference with antenna operation.





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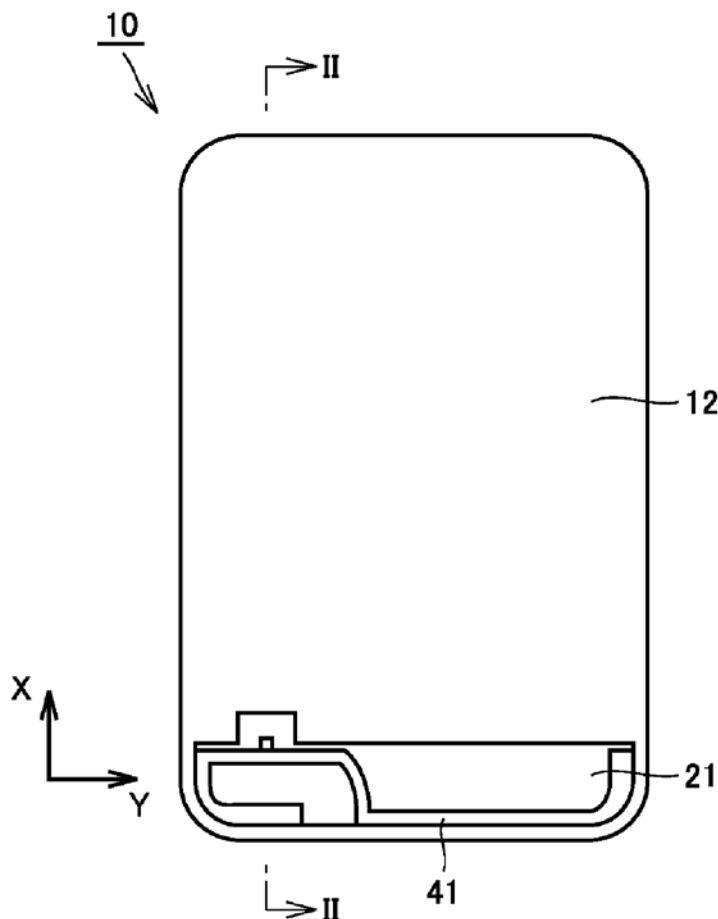
(19) **United States**(12) **Patent Application Publication**
YAMASHITA et al.(10) **Pub. No.: US 2016/0056528 A1**(43) **Pub. Date: Feb. 25, 2016**(54) **MOBILE DEVICE****Publication Classification**(71) Applicant: **SHARP KABUSHIKI KAISHA**,
Osaka-shi, Osaka (JP)(51) **Int. Cl.**
H01Q 1/24 (2006.01)(72) Inventors: **Tetsuya YAMASHITA**, Osaka-shi (JP);
Kohichi MUROTA, Osaka-shi (JP);
Keijiroh HIGASHI, Osaka-shi (JP)(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01)(21) Appl. No.: **14/778,728**(57) **ABSTRACT**(22) PCT Filed: **Jan. 21, 2014**(86) PCT No.: **PCT/JP2014/051056**

§ 371 (c)(1),

(2) Date: **Sep. 21, 2015**(30) **Foreign Application Priority Data**

Mar. 22, 2013 (JP) 2013-060207

A mobile phone includes an antenna housing made of a resin, an insert metal plate being insert molded into the antenna housing and having a connecting portion exposed from an outer surface of the antenna housing, and a thin film-shaped antenna element being provided on the outer surface of the antenna housing and brought into contact with the connecting portion. The mobile device having this structure provides excellent waterproof performance.

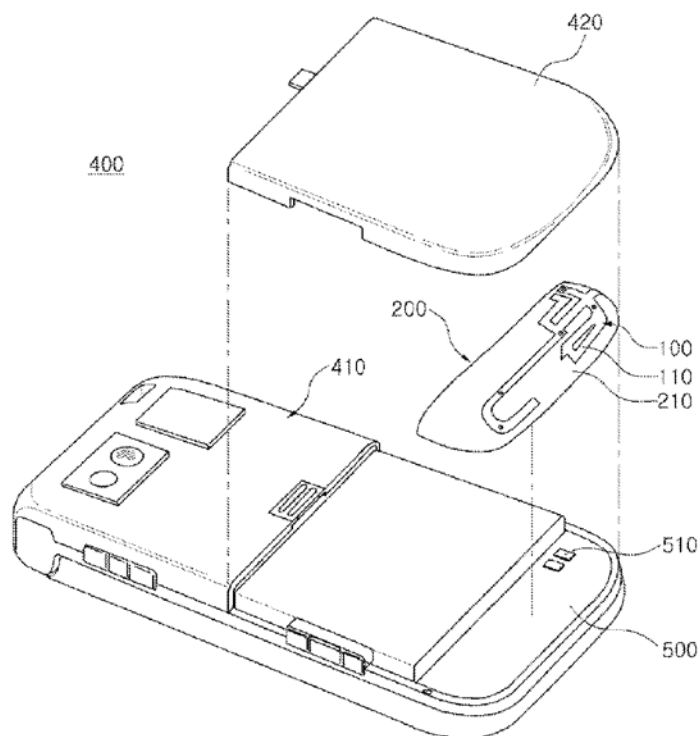




US 20160056529A1

(19) **United States**(12) **Patent Application Publication****YI et al.**(10) **Pub. No.: US 2016/0056529 A1**(43) **Pub. Date: Feb. 25, 2016**(54) **RADIATOR FRAME HAVING ANTENNA
PATTERN EMBEDDED THEREIN AND
METHOD OF MANUFACTURING THE SAME****Publication Classification**(71) Applicant: **Samsung Electro-Mechanics Co., Ltd.**,
Suwon-si (KR)(51) **Int. Cl.**
H01Q 1/24 (2006.01)
B29C 45/14 (2006.01)(72) Inventors: **Jun Seung YI**, Suwon-si (KR); **Ye Ji
PARK**, Suwon-si (KR); **Sun Hee LEE**,
Suwon-si (KR); **Hyeon Gil NAM**,
Suwon-si (KR); **Nam Ki KIM**, Suwon-si
(KR); **Su Hyun KIM**, Suwon-si (KR);
Ha Ryong HONG, Suwon-si (KR);
Sung Eun CHO, Suwon-si (KR); **Dae
Seong JEON**, Suwon-si (KR); **Ho Jin
LEE**, Suwon-si (KR)(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **B29C 45/14**
(2013.01); **B29L 2031/3481** (2013.01)(73) Assignee: **SAMSUNG ELECTRO-MECHANICS
CO., LTD.**, Suwon-si (KR)(57) **ABSTRACT**(21) Appl. No.: **14/830,192**(22) Filed: **Aug. 19, 2015**(30) **Foreign Application Priority Data**Aug. 21, 2014 (KR) 10-2014-0109104
Jan. 21, 2015 (KR) 10-2015-0009849

A radiator frame having an antenna radiator formed on a surface thereof and a method of manufacturing the same are provided. The radiator frame includes: a radiator including an antenna pattern portion configured to transmit or receive a signal, and a connection terminal portion configured to electrically connect the antenna pattern portion and a circuit board; and a molding frame connected to the radiator such that the antenna pattern portion is exposed at one surface of the molding frame and the connection terminal portion is exposed at another surface of the molding frame opposing the one surface of the molding frame. The connection terminal portion may include a plated layer exposed at the other surface of the molding frame to contact the circuit board.





US 20160056530A1

(19) **United States**

(12) **Patent Application Publication**

LEE et al.

(10) **Pub. No.: US 2016/0056530 A1**

(43) **Pub. Date: Feb. 25, 2016**

(54) **ANTENNA APPARATUS AND ELECTRONIC DEVICE HAVING THE SAME**

Publication Classification

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

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

(72) Inventors: **Jong-Hyuck LEE**, Gyeonggi-do (KR);
Se-Hyun PARK, Gyeonggi-do (KR);
Gyu-Sub KIM, Seoul (KR); **Yong-Eui HONG**, Seoul (KR)

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 9/0407* (2013.01)

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

(57) **ABSTRACT**

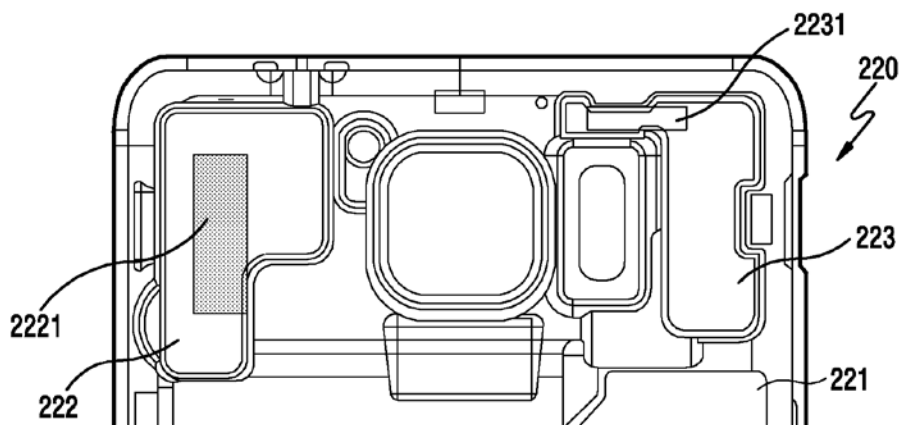
(21) Appl. No.: **14/830,237**

(22) Filed: **Aug. 19, 2015**

(30) **Foreign Application Priority Data**

Aug. 19, 2014 (KR) 10-2014-0107666

An antenna apparatus and an electronic device are provided. The electronic device includes a plurality of metal parts, an antenna radiator arranged around the plurality of metal parts, and at least one sub antenna radiator arranged to electrically connect with the antenna radiator around the antenna radiator, and prevent deterioration of radiation efficiency of the antenna radiator caused by the plurality of metal parts.





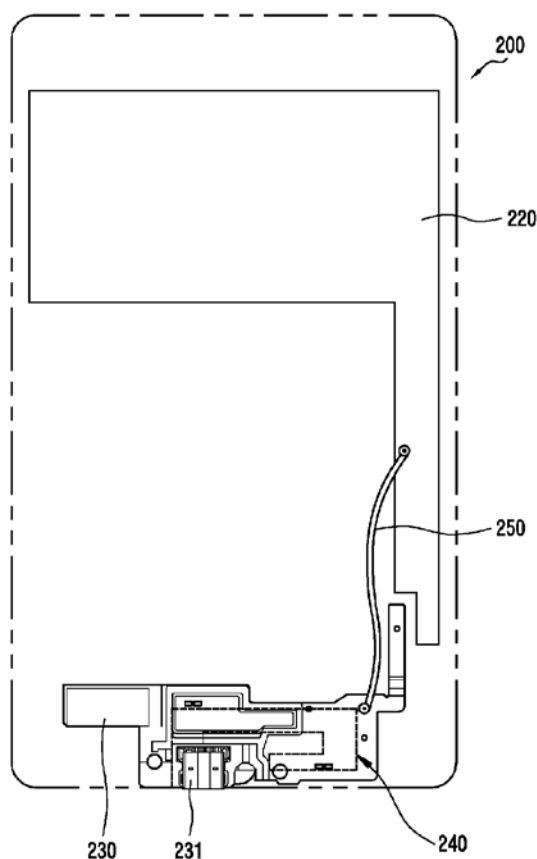
US 20160056531A1

(19) **United States**(12) **Patent Application Publication****LEE et al.**(10) **Pub. No.: US 2016/0056531 A1**(43) **Pub. Date: Feb. 25, 2016**(54) **ANTENNA APPARATUS AND ELECTRONIC
DEVICE HAVING THE SAME****Publication Classification**(71) Applicant: **Samsung Electronics Co., Ltd.**,
Gyeonggi-do (KR)(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 21/30 (2006.01)
H01Q 7/00 (2006.01)(72) Inventors: **Kyung-Jong LEE**, Gyeonggi-do (KR);
Se-Woong KIM, Gyeongsangnam-do
(KR); **Jung-Ho PARK**, Gyeonggi-do
(KR); **Kyung-Jae LEE**, Seoul (KR);
Soo-Young JANG, Daegu (KR); **Austin
KIM**, Gyeonggi-do (KR); **Seung-Hwan
KIM**, Seoul (KR); **Joon-Ho BYUN**,
Gyeonggi-do (KR)(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 7/00*
(2013.01); *H01Q 21/30* (2013.01)(57) **ABSTRACT**

An antenna apparatus and an electronic device having the same is provided. The electronic device includes an antenna radiator formed in a loop shape having at least one opening end part opened by a slit, at least a portion of the at least one opening end part is fed, at least one electronic component of metal material electrically connected with the antenna radiator, and at least one metal member arranged around the antenna radiator, where the at least one opening end part is formed in a reverse direction from the direction of the metal member.

(21) Appl. No.: **14/831,355**(22) Filed: **Aug. 20, 2015**(30) **Foreign Application Priority Data**

Aug. 21, 2014 (KR) 10-2014-0109086

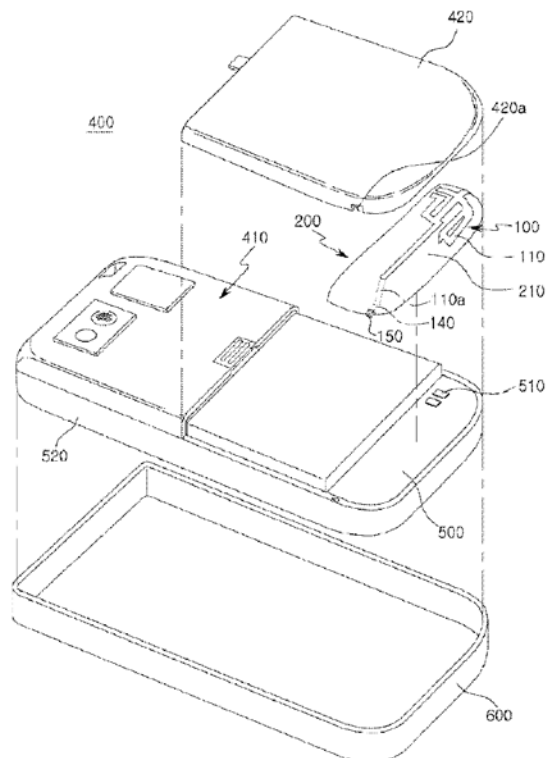




US 20160056532A1

(19) **United States**(12) **Patent Application Publication**
HONG et al.(10) **Pub. No.: US 2016/0056532 A1**(43) **Pub. Date: Feb. 25, 2016**(54) **RADIATOR FRAME HAVING ANTENNA
PATTERN EMBEDDED THEREIN AND
ELECTRONIC DEVICE INCLUDING THE
SAME**(71) Applicant: **Samsung Electro-Mechanics Co., Ltd.,**
Suwon-si (KR)(72) Inventors: **Ha Ryong HONG**, Suwon-si (KR); **Sun
Hee LEE**, Suwon-si (KR); **Chan Gwang
AN**, Suwon-si (KR); **Dae Ki LIM**,
Suwon-si (KR); **Hyeon Gil NAM**,
Suwon-si (KR); **Sung Eun CHO**,
Suwon-si (KR); **Dae Kyu LEE**,
Suwon-si (KR); **Dae Seong JEON**,
Suwon-si (KR); **Hyun Do PARK**,
Suwon-si (KR)(73) Assignee: **SAMSUNG ELECTRO-MECHANICS
CO., LTD.**, Suwon-si (KR)(21) Appl. No.: **14/834,063**(22) Filed: **Aug. 24, 2015**(30) **Foreign Application Priority Data**Aug. 25, 2014 (KR) 10-2014-0110977
Dec. 11, 2014 (KR) 10-2014-0178231**Publication Classification**(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/36 (2006.01)(52) **U.S. Cl.**
CPC . **H01Q 1/243** (2013.01); **H01Q 1/36** (2013.01)(57) **ABSTRACT**

A radiator frame includes: a main radiator including an antenna pattern part configured to transmit or receive a signal, an internal terminal part provided on one end of the antenna pattern part and configured to electrically connect the antenna pattern part and a circuit substrate, and an external terminal part provided on another end of the antenna pattern part and configured to be connected to an auxiliary radiator to improve radiation performance of the antenna pattern part; and a molded frame molded around the radiator, the molded frame allowing the internal terminal part to be exposed at a first surface of the molded frame, and allowing the external terminal part to be exposed at a second surface of the molded frame.





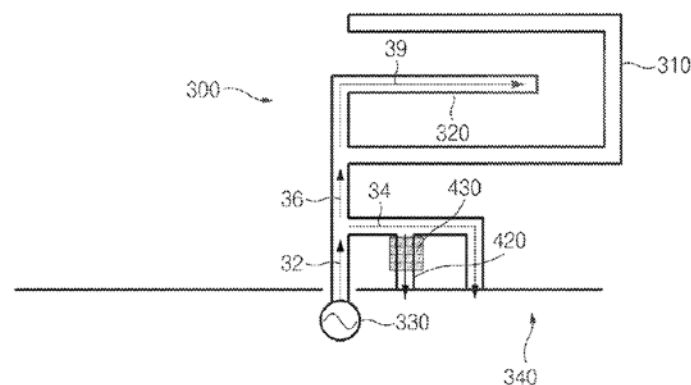
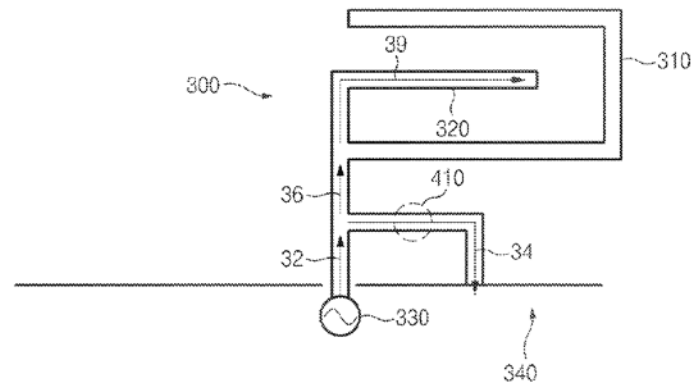
US 20160056535A1

(19) **United States**(12) **Patent Application Publication**
SAKONG et al.(10) **Pub. No.: US 2016/0056535 A1**(43) **Pub. Date: Feb. 25, 2016**(54) **MULTIBAND ANTENNA****Publication Classification**(71) Applicant: **Samsung Electronics Co., Ltd.**,
Suwon-si (KR)(51) **Int. Cl.**
H01Q 1/50 (2006.01)
H01Q 1/38 (2006.01)
H01Q 9/26 (2006.01)(72) Inventors: **Min SAKONG**, Gumi-si (KR); **Dong Ryul SHIN**, Daegu (KR); **Eun Jin LEE**, Gumi-si (KR); **Joon Bo PARK**, Busan (KR); **Byung Chan JANG**, Gumi-si (KR); **Jin Woo JUNG**, Seoul (KR)(52) **U.S. Cl.**
CPC . *H01Q 1/50* (2013.01); *H01Q 9/26* (2013.01);
H01Q 1/38 (2013.01)(21) Appl. No.: **14/832,353**(22) Filed: **Aug. 21, 2015**(30) **Foreign Application Priority Data**

Aug. 22, 2014 (KR) 10-2014-0109437

(57) **ABSTRACT**

A multiband antenna is provided. The multiband antenna includes a feeding unit, a first radiator including a first path, a second radiator including a second path sharing at least a portion of the first path, a current dispersion path extending to a ground from one end of the first path, and a switch configured to open and short-circuit the current dispersion path.





US 20160056545A1

(19) **United States**

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

(10) **Pub. No.: US 2016/0056545 A1**

(43) **Pub. Date: Feb. 25, 2016**

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

Publication Classification

(51) **Int. Cl.**
H01Q 21/30 (2006.01)
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)
(52) **U.S. Cl.**
CPC *H01Q 21/30* (2013.01); *H01Q 1/48*
(2013.01); *H01Q 1/243* (2013.01)

(71) Applicant: **Samsung Electronics Co., Ltd.**,
Suwon-si (KR)
(72) Inventors: **Sung Koo PARK**, Suwon-si (KR); **Soon
Ho HWANG**, Seoul (KR); **Joon Ho
BYUN**, Yongin-si (KR); **Chan Kyu AN**,
Incheon (KR); **Jun Hwa OH**, Seoul
(KR)

(57) **ABSTRACT**

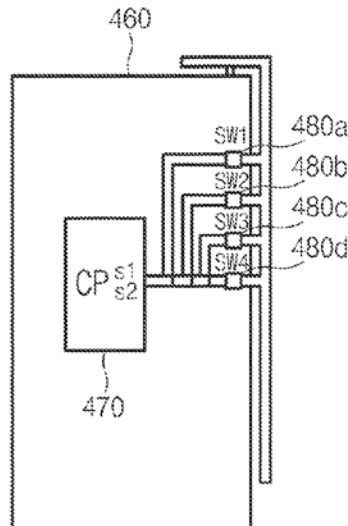
(21) Appl. No.: **14/833,307**

(22) Filed: **Aug. 24, 2015**

(30) **Foreign Application Priority Data**

Aug. 25, 2014 (KR) 10-2014-0111074

An antenna for transmitting and receiving a multi-band signal is provided. The antenna includes a feeding unit, a first radiator connected to the feeding unit, a second radiator coupled with the first radiator, such that the first radiator and the second radiator are spaced apart from each other by a specific distance, and a ground unit connected to the second radiator.



control table				
S1	0	0	1	1
S2	0	1	0	1
s/w on	SW1	SW2	SW3	SW4



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(19) **United States**(12) **Patent Application Publication**
JEON et al.(10) **Pub. No.: US 2016/0064799 A1**(43) **Pub. Date: Mar. 3, 2016**(54) **RADIATOR FRAME HAVING ANTENNA
PATTERN AND METHOD OF
MANUFACTURING THE SAME****Publication Classification**

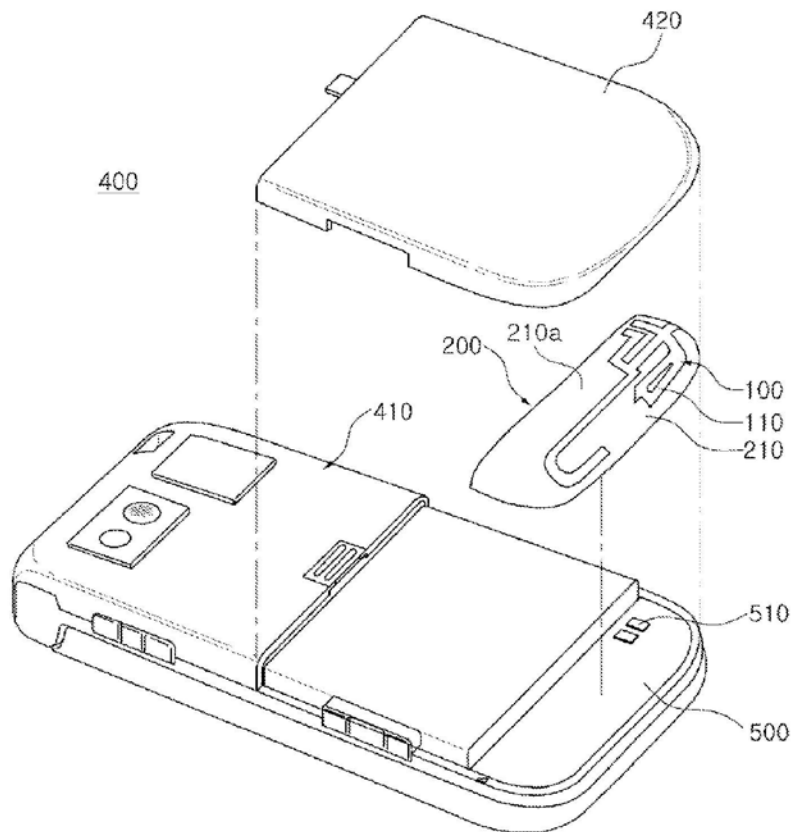
(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 9/04 (2006.01)
(52) **U.S. Cl.**
CPC . *H01Q 1/241* (2013.01); *H01Q 9/04* (2013.01)

(71) Applicant: **Samsung Electro-Mechanics Co., Ltd.**,
Suwon-si (KR)(72) Inventors: **Dae Seong JEON**, Suwon-si (KR); **Sung
Eun CHO**, Suwon-si (KR); **Hyun Sam
MUN**, Suwon-si (KR)(73) Assignee: **SAMSUNG ELECTRO-MECHANICS
CO., LTD.**, Suwon-si (KR)(21) Appl. No.: **14/837,013**(22) Filed: **Aug. 27, 2015**(30) **Foreign Application Priority Data**

Sep. 3, 2014 (KR) 10-2014-0117285

ABSTRACT

A radiator frame having an antenna pattern and a method of manufacturing the same are provided. The radiator frame includes a molded frame having a connection terminal part extending therethrough, the connection terminal part being exposed on a first surface of the molded frame and a second surface of the molded frame, and an antenna pattern portion patterned on the first surface of the molded frame and connected to the connection terminal part. The connection terminal part includes a contact expansion part extending along the first surface of the molded frame, a connection portion extending through the molded frame from one end of the contact expansion part to the second surface of the molded frame, and a terminal portion extending along the second surface of the molded frame from one end of the connection portion.





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(19) **United States**(12) **Patent Application Publication****Han et al.**(10) **Pub. No.: US 2016/0064801 A1**(43) **Pub. Date: Mar. 3, 2016**(54) **ELECTRONIC DEVICE ANTENNA WITH
REDUCED LOSSY MODE****Publication Classification**(51) **Int. Cl.****H01Q 1/24** (2006.01)**H01Q 13/10** (2006.01)**H01Q 9/04** (2006.01)(52) **U.S. Cl.**CPC **H01Q 1/243** (2013.01); **H01Q 9/0442**
(2013.01); **H01Q 13/103** (2013.01)

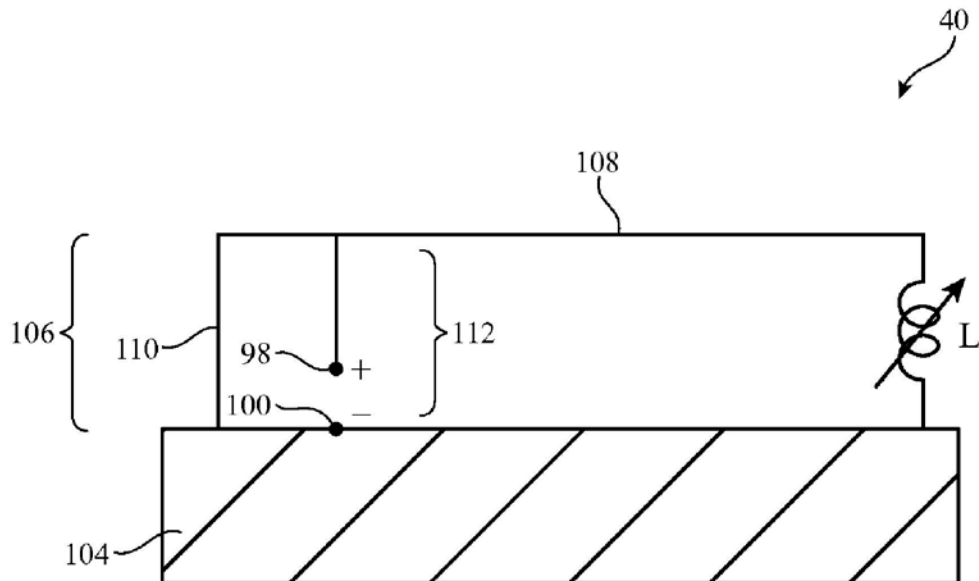
(57)

ABSTRACT

An electronic device may be provided with an antenna. The antenna may have an antenna resonating element and an antenna ground. An adjustable inductor may be coupled between the antenna resonating element and the antenna ground. An antenna feed may have a positive feed terminal coupled to the antenna resonating element and a ground antenna feed coupled to the antenna ground. The adjustable inductor may have first and second inductors coupled to respective first and second ports of a switch. The switch may have a third port coupled to the antenna ground. A capacitor may have a first terminal coupled to ground and a second terminal coupled to the first inductor at the first port of the switch. An inductor may be coupled between the antenna resonating element and antenna ground at a location between the adjustable inductor and the antenna feed.

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

(72) Inventors: **Liang Han**, Sunnyvale, CA (US);
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Ming-Ju Tsai, Cupertino, CA (US);
Yijun Zhou, Sunnyvale, CA (US);
Hongfei Hu, Santa Clara, CA (US);
Salih Yarga, Sunnyvale, CA (US);
Mattia Pascolini, San Francisco, CA
(US); **Yuehui Ouyang**, Sunnyvale, CA
(US); **Erdinc Irci**, Sunnyvale, CA (US);
Enrique Ayala Vazquez, Watsonville,
CA (US); **Robert W. Schlub**, Cupertino,
CA (US)

(21) Appl. No.: **14/476,490**(22) Filed: **Sep. 3, 2014**



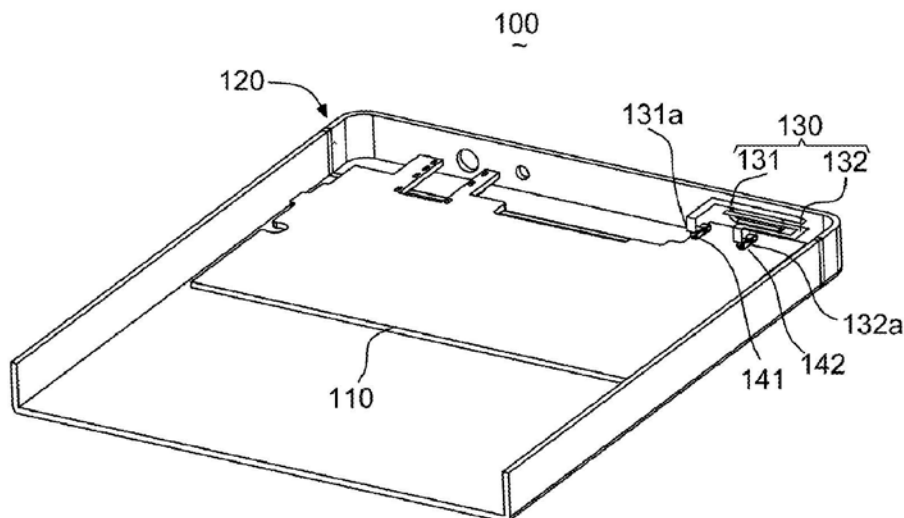
US 20160064802A1

(19) **United States**(12) **Patent Application Publication**
JIANG(10) **Pub. No.: US 2016/0064802 A1**(43) **Pub. Date: Mar. 3, 2016**(54) **MULTIBAND ANTENNA ARRANGEMENT**(52) **U.S. CL.**(71) Applicant: **Hua JIANG**, Shenzhen (CN)CPC *H01Q 1/243* (2013.01); *H01Q 5/307*
(2015.01); *H01Q 5/20* (2015.01)(72) Inventor: **Hua JIANG**, Shenzhen (CN)(73) Assignee: **AAC TECHNOLOGIES PTE. LTD.**,
Singapore (SG)(57) **ABSTRACT**(21) Appl. No.: **14/597,379**(22) Filed: **Jan. 15, 2015**(30) **Foreign Application Priority Data**

Aug. 26, 2014 (CN) 201420484886.7

Publication Classification(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 5/20 (2006.01)
H01Q 5/307 (2006.01)

A multiband antenna arrangement is disclosed. The multiband antenna arrangement includes a metallic shell forming an rectangular outer appearance and including a metallic top shell acting as a radiating element of antenna, a printed circuit board, a WIFI antenna, a diversity antenna having a grounded point and a feeding point electrically connecting the radiating element of the metallic top shell, a GPS antenna far away from the diversity antenna and having a grounded point and a feeding point electrically connecting the radiating element of the metallic top shell, the grounded point of the diversity antenna and the grounded point of the GPS antenna both positioned between the feeding point of the diversity antenna and the feeding point of the GPS antenna.





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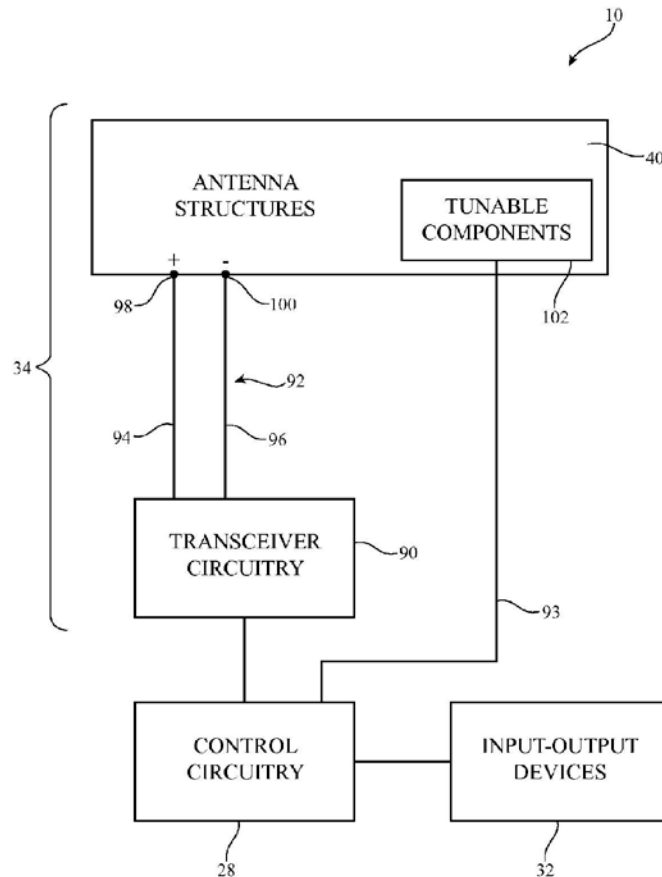
(19) **United States**(12) **Patent Application Publication****Han et al.**(10) **Pub. No.: US 2016/0064812 A1**(43) **Pub. Date: Mar. 3, 2016**(54) **ELECTRONIC DEVICE ANTENNA WITH INTERFERENCE MITIGATION CIRCUITRY****Publication Classification**(51) **Int. Cl.****H01Q 1/52** (2006.01)**H01Q 1/50** (2006.01)**H01Q 1/22** (2006.01)(52) **U.S. Cl.**CPC . **H01Q 1/52** (2013.01); **H01Q 1/22** (2013.01);**H01Q 1/50** (2013.01)(71) Applicant: **Apple Inc.**, Cupertino, CA (US)

(72) Inventors: **Liang Han**, Sunnyvale, CA (US);
Ming-Ju Tsai, Cupertino, CA (US);
Matthew A. Mow, Los Altos, CA (US);
Yijun Zhou, Sunnyvale, CA (US);
Mattia Pascolini, San Francisco, CA (US);
Salih Yarga, Sunnyvale, CA (US);
Enrique Ayala Vazquez, Watsonville, CA (US);
Hongfei Hu, Santa Clara, CA (US);
Xu Han, San Jose, CA (US);
Robert W. Schlub, Cupertino, CA (US)

(57)

ABSTRACT

An electronic device may be provided with an antenna. The antenna may have an antenna resonating element and an antenna ground. The antenna resonating element may be formed from peripheral conductive housing structures. An audio jack or other connector may be mounted in an opening in the peripheral conductive housing structures. The audio jack may overlap the antenna ground. Contacts in the audio jack may be coupled to an interference mitigation circuit. The interference mitigation circuit may include capacitors coupled to the ground and inductors coupled between the contacts and the capacitors. Radio-frequency signal blocking inductors may be coupled between the interference mitigation circuit and respective ports in an audio circuit.

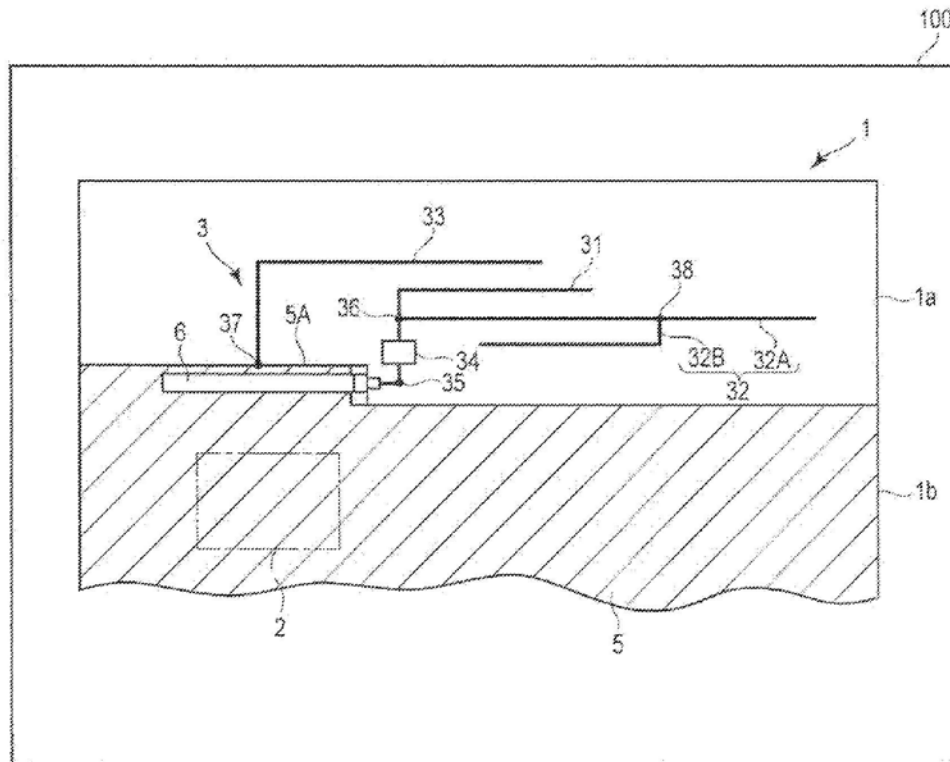
(21) Appl. No.: **14/476,453**(22) Filed: **Sep. 3, 2014**



US 20160064818A1

(19) **United States**(12) **Patent Application Publication**
KASHIWAGI(10) **Pub. No.: US 2016/0064818 A1**(43) **Pub. Date: Mar. 3, 2016**(54) **ANTENNA APPARATUS AND ELECTRONIC
DEVICE INCLUDING THE ANTENNA
APPARATUS**(71) Applicant: **KABUSHIKI KAISHA TOSHIBA,**
Tokyo (JP)(72) Inventor: **Ipppei KASHIWAGI,** Tokyo (JP)(73) Assignee: **KABUSHIKI KAISHA TOSHIBA,**
Tokyo (JP)(21) Appl. No.: **14/726,970**(22) Filed: **Jun. 1, 2015****Related U.S. Application Data**(60) Provisional application No. 62/043,280, filed on Aug.
28, 2014.**Publication Classification**(51) **Int. Cl.**
H01Q 5/10 (2006.01)
H01Q 1/38 (2006.01)(52) **U.S. Cl.**
CPC ... **H01Q 5/10** (2015.01); **H01Q 1/38** (2013.01)(57) **ABSTRACT**

According to one embodiment, an antenna includes a second element that has an end connected to a first point of a first element, and first and second ends kept open, and includes a first portion extending from a feed terminal to the first end, and a second portion extending from the feed terminal and bifurcated at a second point between the first point and the first end. The lengths of the first and second portions are set to substantially $\frac{1}{4}$ of a resonance frequency, and substantially $\frac{3}{4}$ of a resonance frequency, severally. The second portion includes a portion extending from the feed terminal to the second point, and a portion extending from the second point to the second end and interposed between the portion and a ground.





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

(43) **Pub. Date:** Mar. 3, 2016

Publication Classification

(51) Int. Cl.
H01Q 5/50 (2006.01)
H01Q 13/10 (2006.01)
H01Q 5/10 (2006.01)
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)
H01Q 1/50 (2006.01)
H01Q 9/04 (2006.01)
H01Q 7/00 (2006.01)

(52) U.S. CL. (2000.01)
CPC *H01Q 5/50* (2015.01); *H01Q 9/045*
(2013.01); *H01Q 9/04* (2013.01); *H01Q 13/10*
(2013.01); *H01Q 7/00* (2013.01); *H01Q 1/24*
(2013.01); *H01Q 1/48* (2013.01); *H01Q 1/50*
(2013.01); *H01Q 5/10* (2015.01)

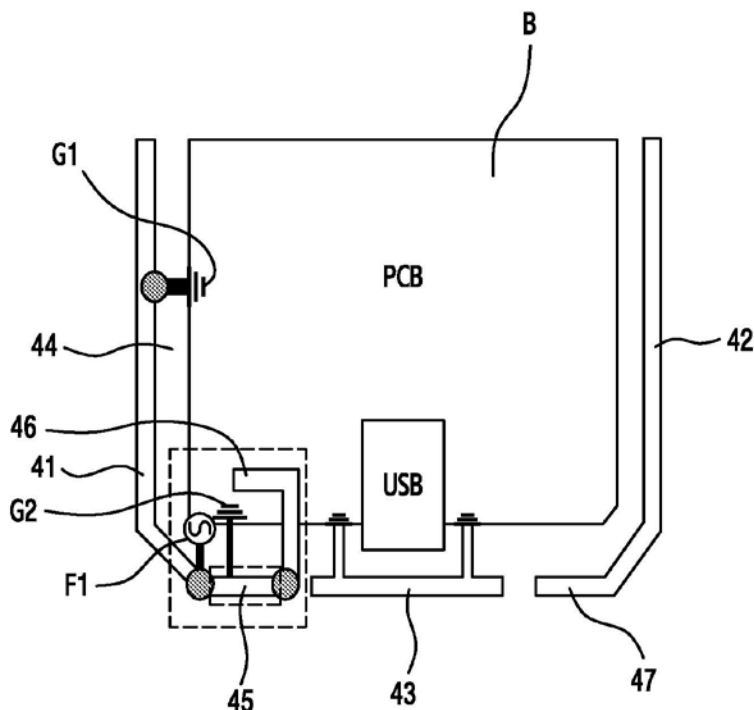
(57) **ABSTRACT**

An antenna device that uses an exterior metal frame is provided. The antenna includes a Printed Circuit Board (PCB); a plurality of segment-type exterior metal frames spaced apart from the PCB; a feeding portion connected to one metal frame of the plurality of segment-type exterior metal frames; and a slit located between the PCB and the one metal frame, wherein the one metal frame fed through the feeding portion operates with radiation, or the slit operates with radiator, or another exterior metal frame fed through the feeding portion operates with radiation.

operates with radiation.

operates with radiation.

Sep. 2, 2014 (KR) 10-2014-0116104





US 20160064823A1

(19) **United States**(12) **Patent Application Publication****Tsukuda et al.**(10) **Pub. No.: US 2016/0064823 A1**(43) **Pub. Date: Mar. 3, 2016**(54) **ELECTRONIC DEVICE FOR COMMUNICATION**(52) **U.S. CL.**CPC **H01Q 7/06** (2013.01); **H01Q 1/243** (2013.01); **H02J 5/005** (2013.01)(71) Applicant: **Renesas Electronics Corporation,**
Tokyo (JP)

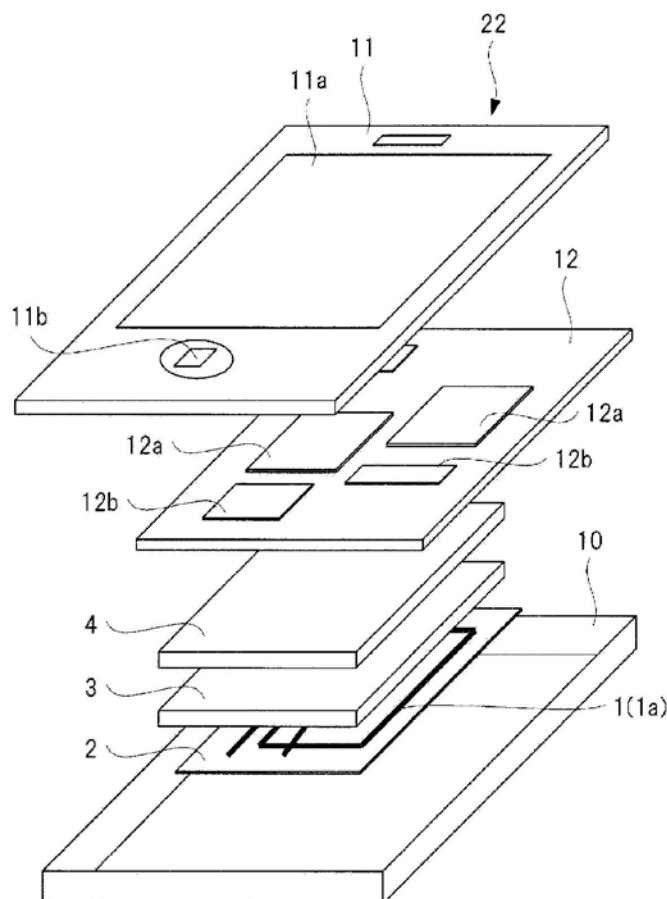
(57)

ABSTRACT(72) Inventors: **Tatsuaki Tsukuda,** Tokyo (JP); **Hideki Sasaki,** Tokyo (JP)(21) Appl. No.: **14/838,147**(22) Filed: **Aug. 27, 2015**(30) **Foreign Application Priority Data**

Aug. 29, 2014 (JP) 2014-175192

Publication Classification(51) **Int. Cl.****H01Q 7/06** (2006.01)**H02J 5/00** (2006.01)**H01Q 1/24** (2006.01)

To achieve a reduction of noise in a wireless system of an electronic device for communication. The electronic device for communication includes: a bottom lid; a loop antenna that forms an electromagnetic field; a communication circuit coupled to the loop antenna; a battery pack that is a metallic part; a magnetic sheet arranged between the loop antenna and the metallic part, the magnetic sheet including a protruding portion that protrudes outside an outer peripheral portion of the loop antenna; a wiring substrate arranged over the battery pack and having an IC and the like mounted thereon; and a lid with a display arranged over the wiring substrate, in which, with the outer peripheral portion of the loop antenna as a base point, a protruding amount from the base point of the protruding portion of the magnetic sheet is twice or more a wiring width of the loop antenna.





US 20160064824A1

(19) **United States**

(12) **Patent Application Publication**
MONTEIX

(10) **Pub. No.: US 2016/0064824 A1**

(43) **Pub. Date: Mar. 3, 2016**

(54) **ANTENNA CONSISTING OF AT LEAST TWO
RADIATING TURNS AND AN EARTH PLANE**

Publication Classification

(71) Applicant: **AVIWEST, SAINT GREGOIRE Cedex**
9 (FR)

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

(72) Inventor: **Jean-Michel MONTEIX, CESSON**
SEVIGNE (FR)

(52) **U.S. CL.**
CPC **H01Q 9/0414** (2013.01); **H01Q 1/48**
(2013.01)

(21) Appl. No.: **14/778,319**

(22) PCT Filed: **Mar. 17, 2014**

(57) **ABSTRACT**

(86) PCT No.: **PCT/EP2014/055308**

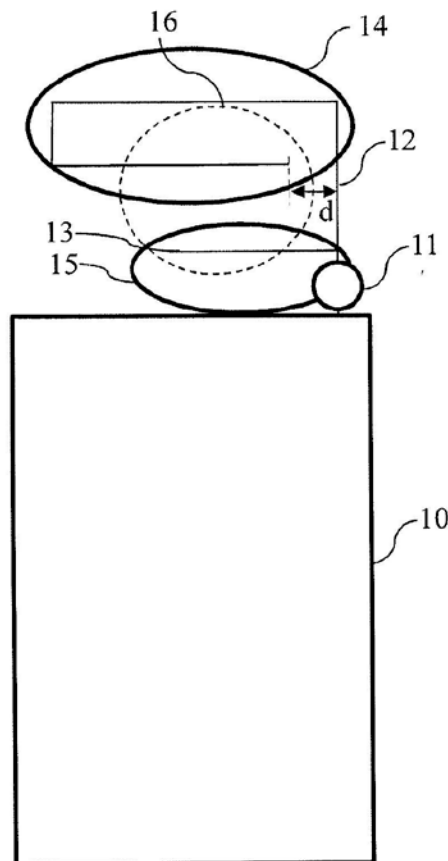
§ 371 (c)(1),

(2) Date: **Sep. 18, 2015**

(30) **Foreign Application Priority Data**

Mar. 20, 2013 (FR) 13/52499

An antenna may include at least two radiating turns and an earth plane, wherein a first turn is placed opposite the earth plane so as to create a first resonant cavity, a second turn is folded several times so as to create at least one U shape forming at least one second resonant cavity and in that the resonant cavities are coupled to each other.





US 20160064832A1

(19) **United States**(12) **Patent Application Publication**
SHIN et al.(10) **Pub. No.: US 2016/0064832 A1**(43) **Pub. Date: Mar. 3, 2016**(54) **MULTI-BAND LOOP ANTENNA AND
ELECTRONIC DEVICE UTILIZING THE
SAME****Publication Classification**

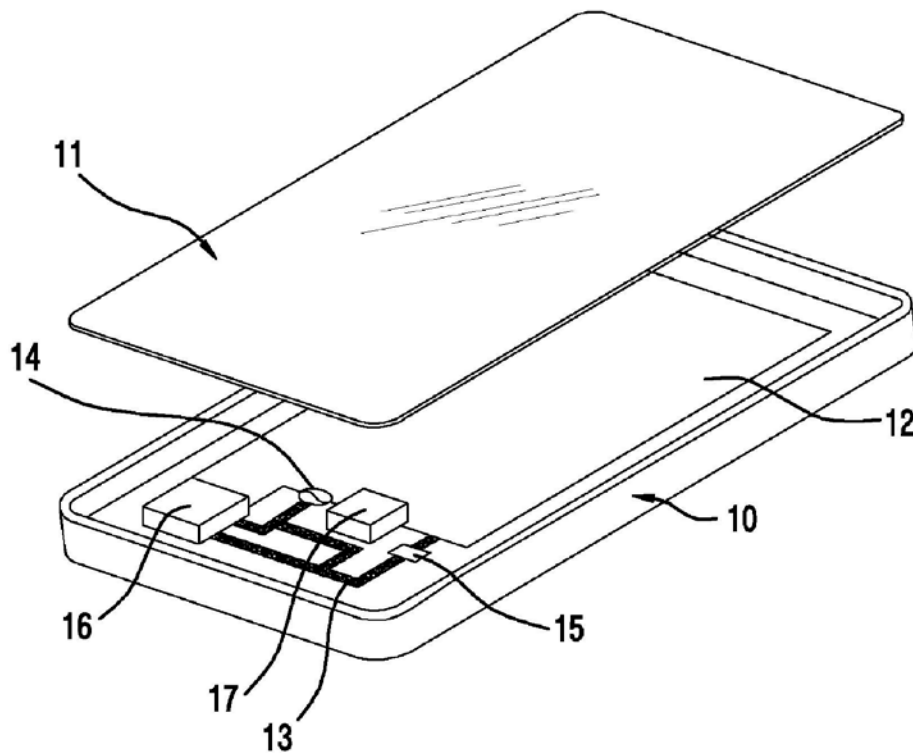
- (51) **Int. Cl.**
H01Q 21/30 (2006.01)
H01Q 7/00 (2006.01)
H01Q 1/24 (2006.01)
- (52) **U.S. Cl.**
CPC *H01Q 21/30* (2013.01); *H01Q 1/243*
(2013.01); *H01Q 7/00* (2013.01); *H01Q 7/005*
(2013.01)

(71) Applicant: **Samsung Electronics Co., Ltd.**,
Gyeonggi-do (KR)(72) Inventors: **Dong-Ryul SHIN**, Daegu (KR); **Min
SAKONG**, Gyeongsangbuk-do (KR);
Byung-Chan JANG,
Gyeongsangbuk-do (KR); **Jin-Woo
JUNG**, Seoul (KR); **Joon-Bo PARK**,
Busan (KR)(73) Assignee: **Samsung Electronics Co., Ltd.**(21) Appl. No.: **14/836,401**(22) Filed: **Aug. 26, 2015**(30) **Foreign Application Priority Data**

Aug. 26, 2014 (KR) 10-2014-0111689

(57) **ABSTRACT**

A multi-band loop antenna is provided. The antenna includes a loop radiator that operates in a low frequency band, and at least two loop radiators that operate in a high frequency band and are inserted into an inner area of the low frequency band loop radiator. Each of the radiators independently operates according to an operating frequency band, to provide a multi-band characteristic.





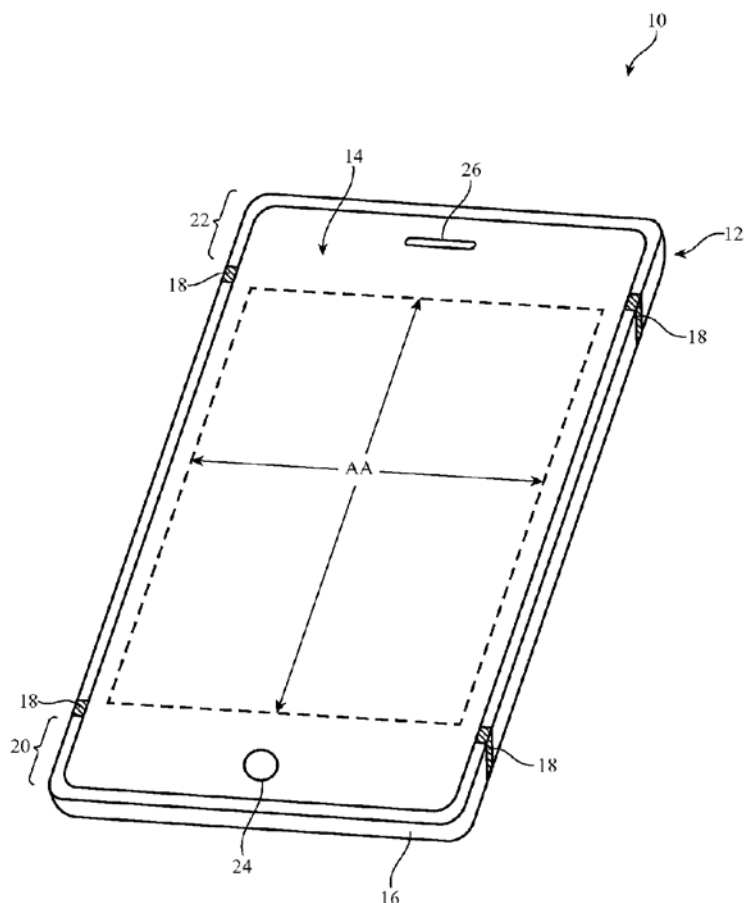
US 20160072178A1

(19) **United States**(12) **Patent Application Publication****Khalifa et al.**(10) **Pub. No.: US 2016/0072178 A1**(43) **Pub. Date: Mar. 10, 2016**(54) **ELECTRONIC DEVICE ANTENNA FEED AND RETURN PATH STRUCTURES****Publication Classification**(71) Applicant: **Apple Inc.**, Cupertino, CA (US)(51) **Int. Cl.**
H01Q 1/24 (2006.01)(72) Inventors: **Sammy M. Khalifa**, Mountain View, CA (US); **Daniel Lau**, Santa Clara, CA (US); **Scott A. Myers**, San Francisco (SU); **Richard A. Besen**, San Francisco, CA (US); **Gregory N. Stephens**, Sunnyvale, CA (US)(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01)(57) **ABSTRACT**

An antenna may be formed from a peripheral conductive housing structure in an electronic device that is separated from an antenna ground by a gap. An antenna feed may be formed from a metal trace on a flexible printed circuit that spans the gap. The metal trace may have a line segment that joins a wider pad portion of the trace at a junction. A stiffener on the flexible printed circuit may have a protrusion that overlaps the junction. A metal bracket attached to the peripheral housing structure may be soldered to the pad. A metal member with meandering paths may form a return path in the antenna. The meandering path may have parallel segments that extend along an inner surface of the peripheral conductive housing structure to prevent the metal member from rotating when a screw is used to screw the metal member to the peripheral conductive housing structure.

(21) Appl. No.: **14/822,091**(22) Filed: **Aug. 10, 2015****Related U.S. Application Data**

(60) Provisional application No. 62/047,547, filed on Sep. 8, 2014.





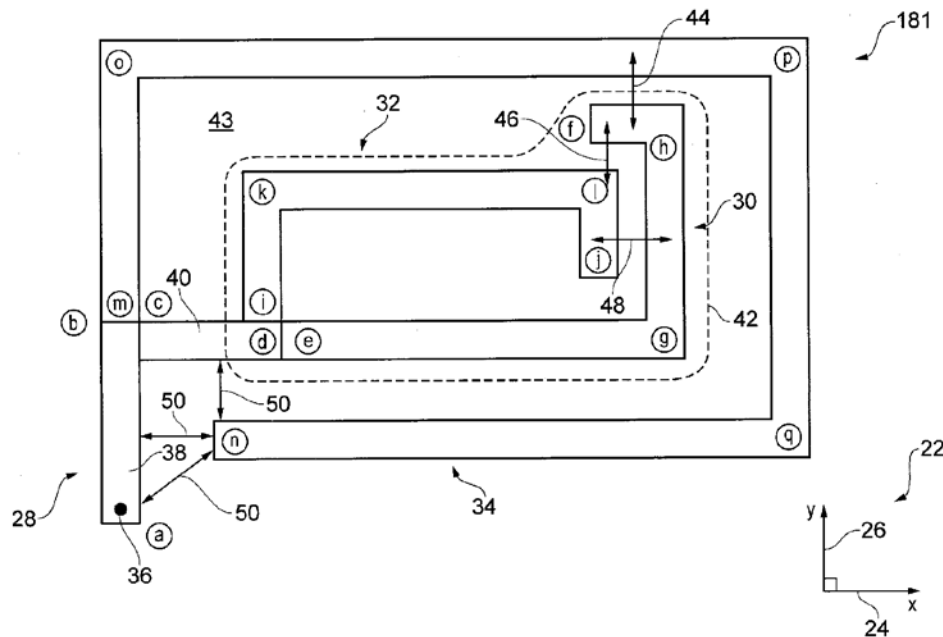
US 20160072187A1

(19) **United States**(12) **Patent Application Publication**
Arkko(10) **Pub. No.: US 2016/0072187 A1**(43) **Pub. Date: Mar. 10, 2016**(54) **APPARATUS AND METHODS FOR WIRELESS COMMUNICATION**(52) **U.S. CL.**CPC *H01Q 5/371* (2015.01); *H01Q 21/06* (2013.01); *H01Q 21/30* (2013.01)(71) Applicant: **NOKIA TECHNOLOGIES OY**, Espoo (FI)(72) Inventor: **Aimo Arkko**, Ruutana (FI)(21) Appl. No.: **14/785,716**(22) PCT Filed: **Apr. 22, 2013**(86) PCT No.: **PCT/FI2013/050442**

§ 371 (c)(1),

(2) Date: **Oct. 20, 2015****Publication Classification**(51) **Int. Cl.***H01Q 5/371* (2006.01)*H01Q 21/30* (2006.01)*H01Q 21/06* (2006.01)(57) **ABSTRACT**

An apparatus comprising: a feed portion (28) configured to couple to radio frequency circuitry; a first antenna portion (30) coupled to the feed portion (28) and configured to resonate in a first operational frequency band; a second antenna portion (32) coupled to the feed portion (28) and configured to resonate in a second operational frequency band, the first antenna portion (30) and the second antenna portion (32) defining a perimeter (42); and a third antenna portion (34) coupled to the feed portion (28) at a first end and extending around the perimeter (42) defined by the first and second antenna portions, the third antenna portion (34) being configured to electromagnetically couple to the feed portion (28) at a second end and resonate in a third operational frequency band.





US 20160072189A1

(19) **United States**

(12) **Patent Application Publication**
Lo Hine Tong et al.

(10) **Pub. No.: US 2016/0072189 A1**

(43) **Pub. Date: Mar. 10, 2016**

(54) **ANTENNA ASSEMBLY AND ELECTRONIC
DEVICE COMPRISING SAID ANTENNA
ASSEMBLY**

Publication Classification

(51) **Int. Cl.**
H01Q 9/20 (2006.01)
(52) **U.S. Cl.**
CPC **H01Q 9/20** (2013.01)

(71) Applicant: **THOMSON LICENSING**, Issy de
Moulinaux (FR)

(72) Inventors: **Dominique Lo Hine Tong**, Rennes (FR);
Philippe Minard, Saint Medard Sur Ille
(FR); **Pierre-Marie Morin**, Sainte
Gemmes Sur Loire (FR); **Jean-Marc Le
Foulgoc**, Bourgbarre (FR)

(57) **ABSTRACT**

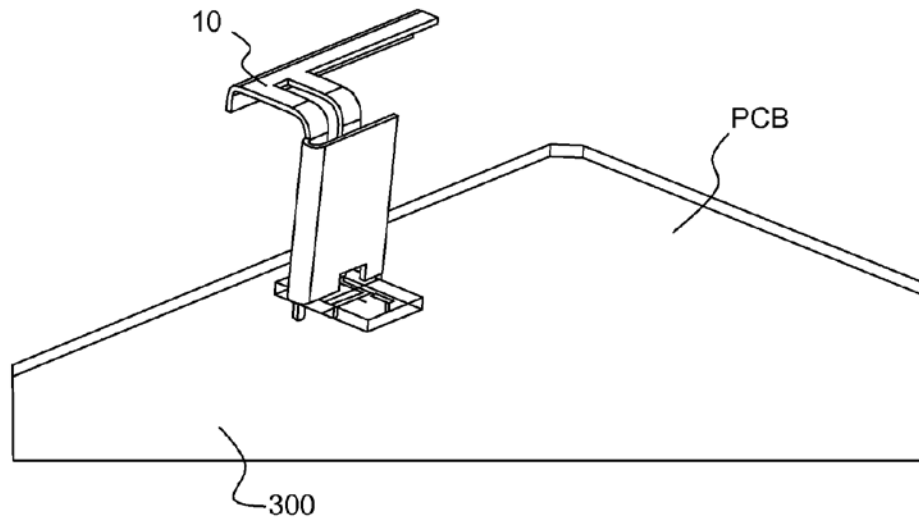
An antenna assembly mountable on a circuit board, the antenna assembly comprising a radiating part; a transmission part for feeding the radiating part the transmission part comprising a signal feed element and a ground element connectable to the circuit board; wherein: the ground element comprises an extension ground portion, folded away from a first ground portion such that it extends over the signal feed element and the first ground portion to form a ground plane cover spaced apart from the signal feed element and connectable to a ground connection of the circuit board.

(21) Appl. No.: **14/845,630**

(22) Filed: **Sep. 4, 2015**

(30) **Foreign Application Priority Data**

Sep. 5, 2014 (EP) 14306372.5
Nov. 3, 2014 (EP) 14306755.1





US 20160072194A1

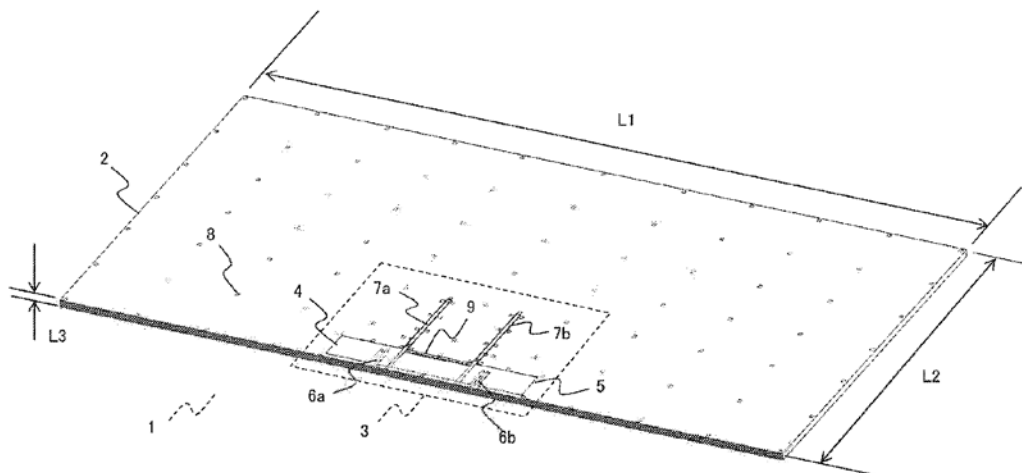
(19) **United States**(12) **Patent Application Publication**
YOSHIDA et al.(10) **Pub. No.: US 2016/0072194 A1**(43) **Pub. Date: Mar. 10, 2016**(54) **MIMO ANTENNA DEVICE****Publication Classification**(71) Applicant: **NEC CORPORATION**, Tokyo (JP)(51) **Int. Cl.**
H01Q 21/00 (2006.01)(72) Inventors: **Takahide YOSHIDA**, Tokyo (JP);
Hiroshi TOYAO, Tokyo (JP)(52) **U.S. Cl.**
CPC **H01Q 21/0075** (2013.01)(73) Assignee: **NEC CORPORATION**, Tokyo (JP)(57) **ABSTRACT**(21) Appl. No.: **14/888,234**(22) PCT Filed: **May 23, 2014**(86) PCT No.: **PCT/JP2014/002722**

§ 371 (c)(1),

(2) Date: **Oct. 30, 2015**(30) **Foreign Application Priority Data**

May 28, 2013 (JP) 2013-111867

The MIMO antenna device of the present invention includes a first conductor layer having a first opening portion, a first feed line and a second feed line. Each of the first feed line and the second feed line crosses the first opening portion, has a connection point with a first opening edge of the first opening portion, and feeds power to the first conductor layer at the connection point, wherein the first conductor layer includes a first split portion and a second split portion at the first opening edge. The first split portion and the second split portion are cut up to a conductor edge of the first conductor layer. Thus, the MIMO antenna device which is small in size and securing isolation between antenna ports is realized.





US 20160072195A1

(19) **United States**

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

(10) **Pub. No.: US 2016/0072195 A1**

(43) **Pub. Date: Mar. 10, 2016**

(54) **DIVERSITY ANTENNA ARRANGEMENT FOR WLAN, AND WLAN COMMUNICATION UNIT HAVING SUCH A DIVERSITY ANTENNA ARRANGEMENT, AND DEVICE HAVING SUCH A WLAN COMMUNICATION UNIT**

(71) Applicant: **DLoG Gesellschaft für elektronische Datentechnik mbH**, Germering (DE)

(72) Inventors: **Dejan Milankovic**, München (DE);
Rolf-Gunter Hauk, Frankfurt (DE)

(21) Appl. No.: **14/819,290**

(22) Filed: **Aug. 5, 2015**

(30) **Foreign Application Priority Data**

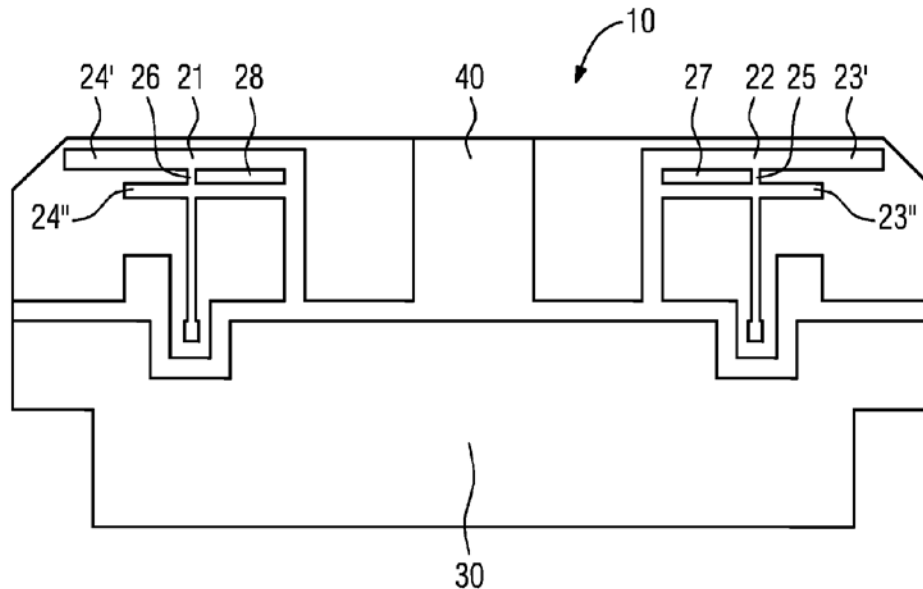
Aug. 6, 2014 (DE) 20 2014 103 657.1

Publication Classification

(51) **Int. Cl.**
H01Q 21/06 (2006.01)
H01Q 21/30 (2006.01)
H01Q 1/42 (2006.01)
H01Q 1/52 (2006.01)
(52) **U.S. Cl.**
CPC *H01Q 21/06* (2013.01); *H01Q 1/521* (2013.01); *H01Q 21/30* (2013.01); *H01Q 1/42* (2013.01); *H01Q 1/526* (2013.01)

(57) **ABSTRACT**

A diversity antenna arrangement, in particular a diversity radio antenna arrangement, for WLAN can have two or more antenna elements. In at least one implementation, the antenna elements are arranged in a manner spatially separate from one another on a printed circuit board.

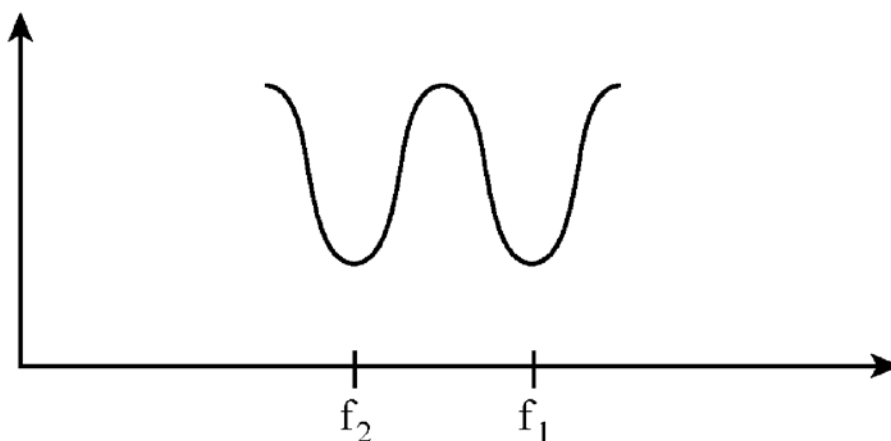




US 20160072539A1

(19) **United States**(12) **Patent Application Publication****Hu et al.**(10) **Pub. No.: US 2016/0072539 A1**(43) **Pub. Date: Mar. 10, 2016**(54) **REMOVABLE ELECTRONIC DEVICE CASE
WITH SUPPLEMENTAL ANTENNA
ELEMENT**(52) **U.S. CL.**CPC **H04B 1/3888** (2013.01)(71) Applicant: **Apple Inc.**, Cupertino, CA (US)(57) **ABSTRACT**(72) Inventors: **Hongfei Hu**, Santa Clara, CA (US);
Enrique Ayala Vazquez, Watsonville,
CA (US); **Hao Xu**, Cupertino, CA (US);
Mattia Pascolini, San Francisco, CA
(US); **Ruben Caballero**, San Jose, CA
(US); **Erdinc Irci**, Sunnyvale, CA (US)

A removable case may receive an electronic device. A male connector in the case may mate with a female connector in the device. A battery in the case may supply power to the device through the male connector. The electronic device may have an antenna formed from peripheral conductive housing structures and an antenna ground. The case may have a supplemental antenna that restores antenna performance when the device is received within the case. The supplemental antenna may be formed from a monopole antenna resonating element coupled to the antenna ground through the power pin. The monopole element may have a portion that runs parallel to the peripheral conductive housing structures. During operation of the antenna in the electronic device, the supplemental antenna in the case may be indirectly fed by near-field coupling between the supplemental antenna and the antenna of the electronic device.

(21) Appl. No.: **14/477,596**(22) Filed: **Sep. 4, 2014****Publication Classification**(51) **Int. Cl.**
H04B 1/3888 (2006.01)



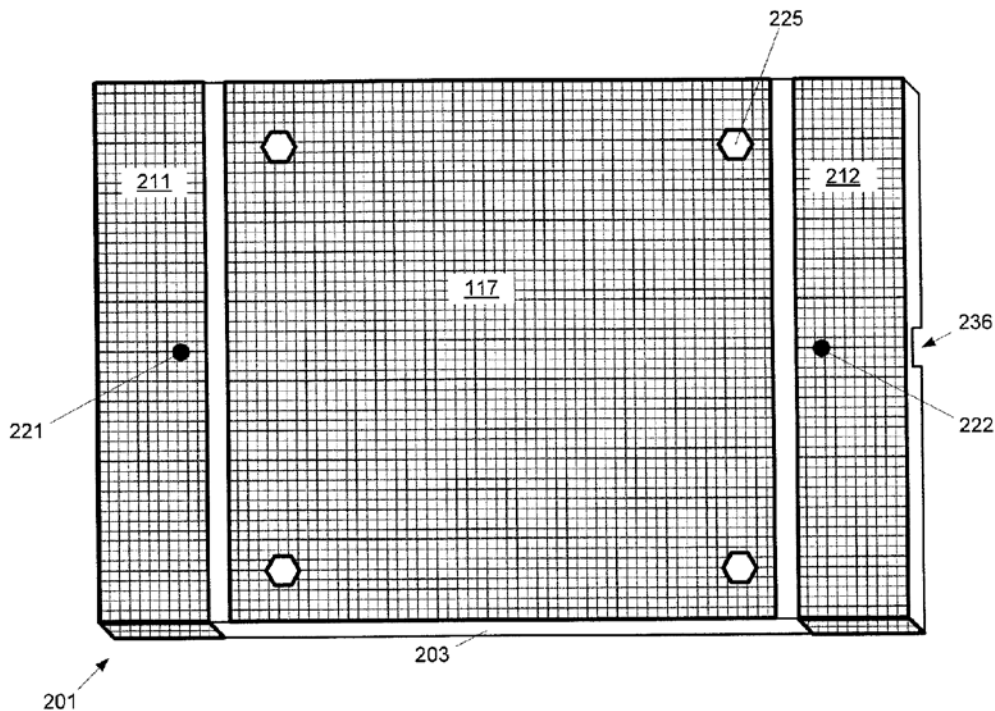
US 20160079653A1

(19) **United States**(12) **Patent Application Publication**
KANJ et al.(10) **Pub. No.: US 2016/0079653 A1**(43) **Pub. Date: Mar. 17, 2016**(54) **MULTI-ANTENNA SYSTEM FOR MOBILE
HANDSETS WITH A PREDOMINANTLY
METAL BACK SIDE**(71) Applicant: **BLACKBERRY LIMITED**, Waterloo
(CA)(72) Inventors: **Houssam KANJ**, Waterloo (CA);
Shirook M. ALI, Waterloo (CA)(21) Appl. No.: **14/486,685**(22) Filed: **Sep. 15, 2014****Publication Classification**(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 5/364 (2006.01)
H01Q 1/48 (2006.01)(52) **U.S. CL.**CPC **H01Q 1/243** (2013.01); **H01Q 1/48**
(2013.01); **H01Q 5/364** (2015.01)

(57)

ABSTRACT

A device with a predominantly metal back side is provided. The device comprises: a non-conducting chassis having an interior and an exterior; at least one exterior radiating arm on the exterior of the chassis and a respective microstrip line located on the interior of the chassis, the exterior radiating arm and the microstrip electrically connected through the chassis, the exterior radiating arm and microstrip configured to resonate together in a first frequency range; and, at least one interior radiating arm located, and configured to resonate in one or more second frequency ranges higher than the first frequency range; a ground plane located on the exterior of the chassis, each of the exterior radiating arms and the ground plane being electrically separated from each other on the exterior of the chassis; and, one or more antenna feeds configured to connect to each of the microstrips and interior radiating arms.

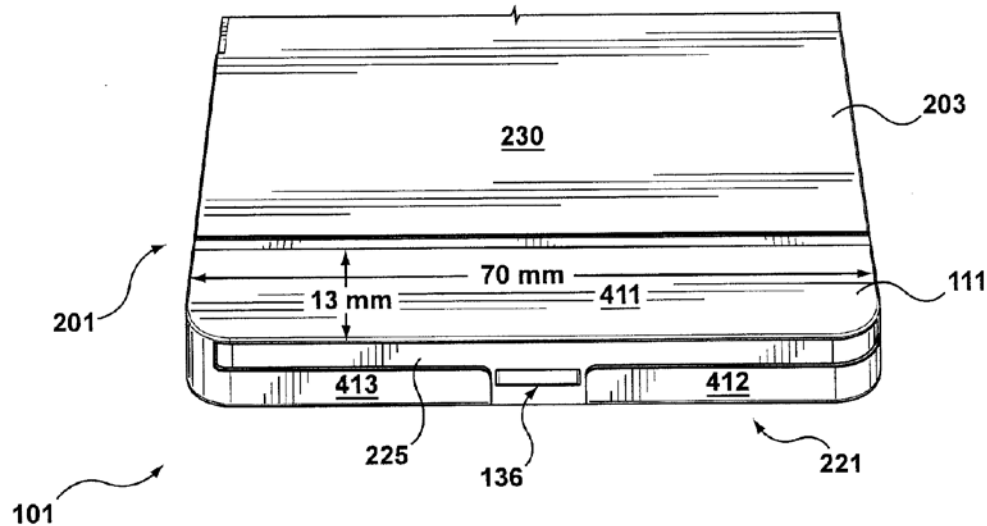




US 20160079652A1

(19) **United States**(12) **Patent Application Publication**
GU et al.(10) **Pub. No.: US 2016/0079652 A1**(43) **Pub. Date: Mar. 17, 2016**(54) **MOBILE DEVICE WITH TRI-BAND
ANTENNAS INCORPORATED INTO A
METAL BACK SIDE**(52) **U.S. CL**CPC *H01Q 1/243* (2013.01); *H01Q 21/30*
(2013.01); *H01Q 21/0006* (2013.01)(71) Applicant: **BLACKBERRY LIMITED**, Waterloo,
CA (US)(57) **ABSTRACT**(72) Inventors: **Huanhuan GU**, Kitchener (CA);
Shirook M. ALI, Milton (CA)(21) Appl. No.: **14/486,632**(22) Filed: **Sep. 15, 2014****Publication Classification**(51) **Int. Cl.***H01Q 1/24* (2006.01)*H01Q 21/00* (2006.01)*H01Q 21/30* (2006.01)

A mobile device with tri-band antennas incorporated into a metal back side thereof is provided. The device comprises: a back side comprising a face and opposing ends; an edge extending from the face: a conducting central portion; antennas located at the opposing ends, each of the antennas electrically separated from the conducting central portion, and each comprising: a first respective radiating arm located at least partially on the face, and at least two further respective radiating arms extending from the first respective radiating arm, the at least two further respective radiating arms located on the edge, the radiating arms configured to resonate in at least three frequency ranges; one or more antenna feeds connected to each of the antennas; and, a switch configured to select one or more of the antennas for operation.





US 20160079653A1

(19) **United States**

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

(10) **Pub. No.: US 2016/0079653 A1**

(43) **Pub. Date: Mar. 17, 2016**

(54) **MULTI-ANTENNA SYSTEM FOR MOBILE
HANDSETS WITH A PREDOMINANTLY
METAL BACK SIDE**

(71) Applicant: **BLACKBERRY LIMITED**, Waterloo
(CA)

(72) Inventors: **Houssam KANJ**, Waterloo (CA);
Shirook M. ALI, Waterloo (CA)

(21) Appl. No.: **14/486,685**

(22) Filed: **Sep. 15, 2014**

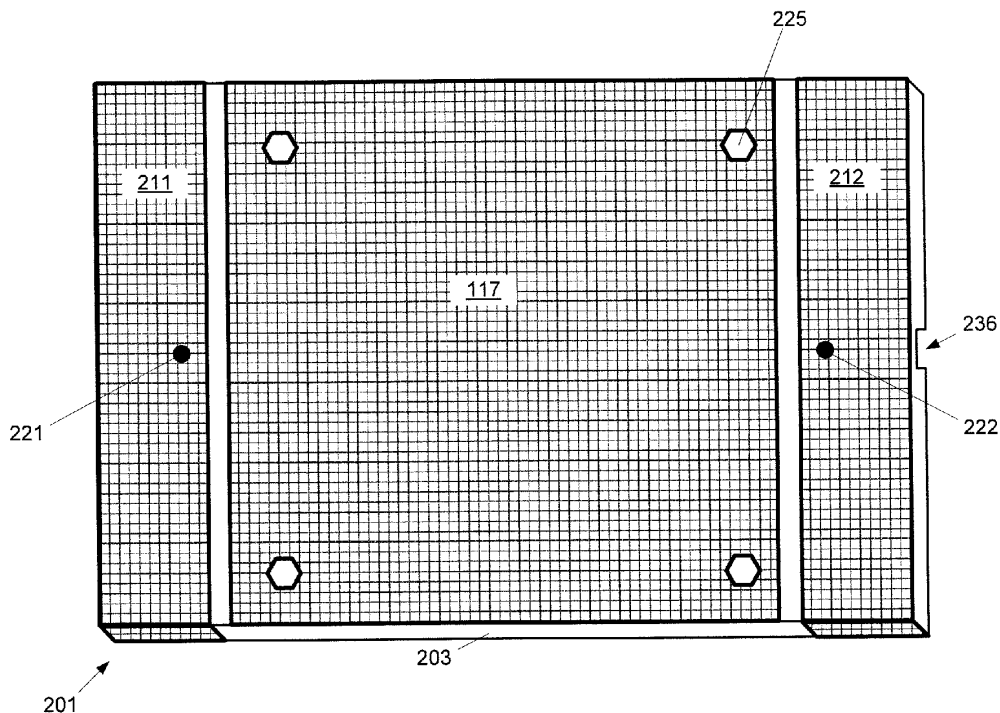
Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 5/364 (2006.01)
H01Q 1/48 (2006.01)

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 1/48**
(2013.01); **H01Q 5/364** (2015.01)

(57) **ABSTRACT**

A device with a predominantly metal back side is provided. The device comprises: a non-conducting chassis having an interior and an exterior; at least one exterior radiating arm on the exterior of the chassis and a respective microstrip line located on the interior of the chassis, the exterior radiating arm and the microstrip electrically connected through the chassis, the exterior radiating arm and microstrip configured to resonate together in a first frequency range; and, at least one interior radiating arm located, and configured to resonate in one or more second frequency ranges higher than the first frequency range; a ground plane located on the exterior of the chassis, each of the exterior radiating arms and the ground plane being electrically separated from each other on the exterior of the chassis; and, one or more antenna feeds configured to connect to each of the microstrips and interior radiating arms.





US 20160079654A1

(19) **United States**

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

(10) **Pub. No.: US 2016/0079654 A1**

(43) **Pub. Date: Mar. 17, 2016**

(54) **MOBILE DEVICE HAVING AN INTERIOR
MULTIBAND ANTENNA AND A PARTIALLY
METAL BACK**

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

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

(71) Applicant: **BLACKBERRY LIMITED**, Waterloo
(CA)

(57)

ABSTRACT

(72) Inventors: **Dong Wang**, Waterloo (CA); **Shirook
M. ALI**, Milton (CA)

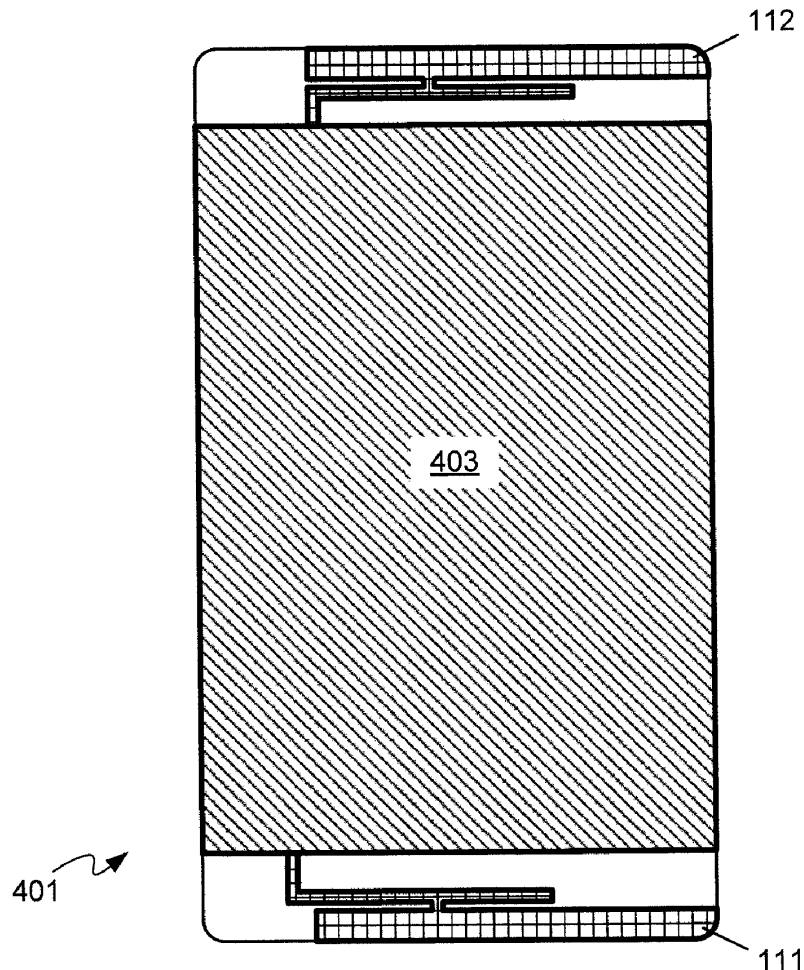
A mobile device having an interior multiband antenna and a partially metal back is provided. The device comprises: a back side comprising: a conducting central portion; non-conducting portions comprising respective widths from respective end edges of the back side to the conducting central portion, the conducting central portion separating the non-conducting portions; an interior chassis covered by the back side; antennas located on the interior chassis behind each of the non-conducting portions, each of the antennas comprising at least two respective radiating arms configured to resonate in at least three frequency ranges; one or more antenna feeds connected to each of the antennas; and, a switch configured to select one or more of the antennas for operation.

(21) Appl. No.: **14/486,724**

(22) Filed: **Sep. 15, 2014**

Publication Classification

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





US 20160079655A1

(19) **United States**

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

(10) **Pub. No.: US 2016/0079655 A1**

(43) **Pub. Date: Mar. 17, 2016**

(54) **WIDEBAND ANTENNA FOR MOBILE
SYSTEM WITH METAL BACK COVER**

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

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

(71) Applicant: **Blackberry Limited**, Waterloo (CA)

(57)

ABSTRACT

(72) Inventors: **Huanhuan GU**, Kitchener (CA);
Houssam KANJ, Waterloo (CA);
Shirook M. ALI, Milton (CA)

A device is set forth, comprising: a metallic back cover having interior and exterior portions; a chassis disposed on the interior portion of said metallic back cover for mounting components; a metallic edge ring surrounding said metallic back cover and said chassis; a gap extending through the exterior portion of the back cover and through the edge, for defining one dimension of an antenna conducting plane; a ground plane covering the chassis such that said antenna conducting plane and ground plane wrap around the chassis and components mounted thereon; an antenna feed extending through the ground plane to the antenna conducting plane; and a shorting pin connecting the ground plane to the antenna conducting plane.

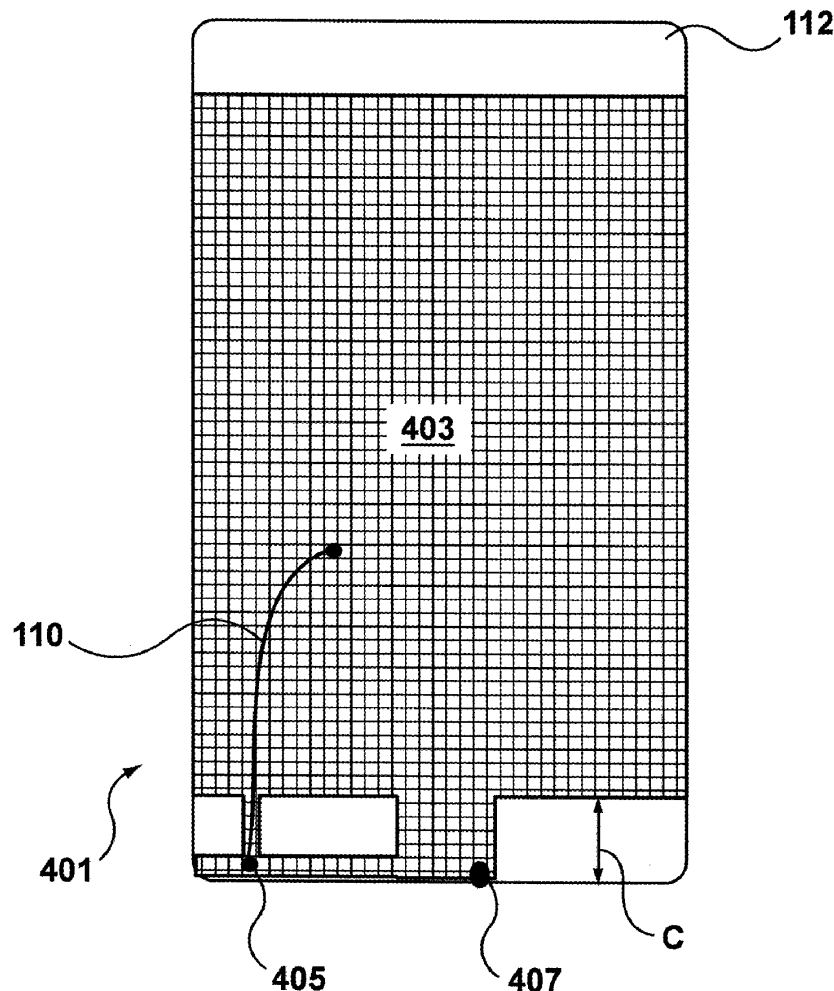
(21) Appl. No.: **14/486,772**

(22) Filed: **Sep. 15, 2014**

Publication Classification

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

(2006.01)





US 20160079656A1

(19) **United States**

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

(10) **Pub. No.: US 2016/0079656 A1**

(43) **Pub. Date: Mar. 17, 2016**

(54) **MOBILE DEVICE AND MANUFACTURING METHOD THEREOF**

Publication Classification

(71) Applicant: **HTC Corporation**, Taoyuan City (TW)

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 3/44 (2006.01)

(72) Inventors: **Tiao-Hsing TSAI**, Taoyuan City (TW);
Chien-Pin CHIU, Taoyuan City (TW);
Li-Yuan FANG, Taoyuan City (TW);
Hsiao-Wei WU, Taoyuan City (TW)

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

CPC . **H01Q 1/243** (2013.01); **H01Q 3/44** (2013.01)

(73) Assignee: **HTC CORPORATION**, Taoyuan City (TW)

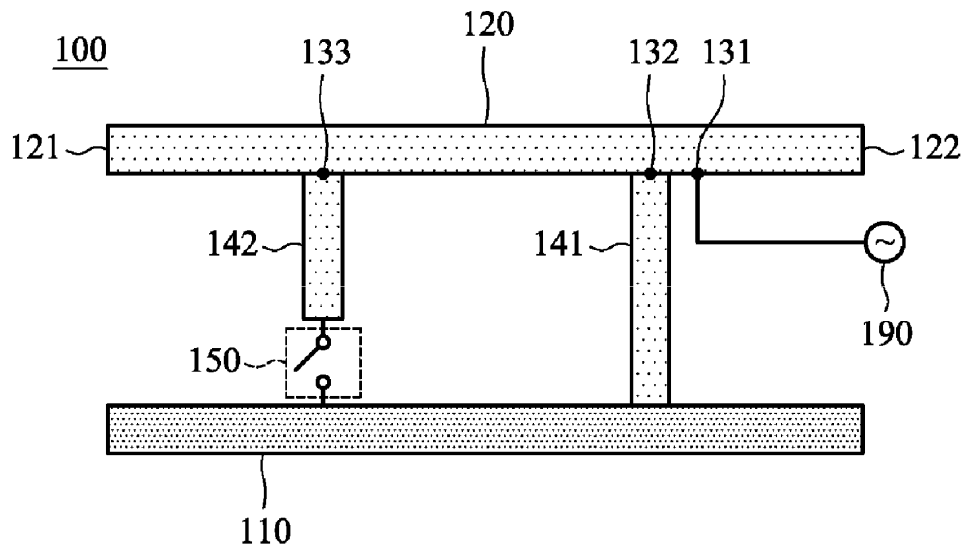
(57)

ABSTRACT

A mobile device includes a ground element, a radiation element, a first short-circuited element, a second short-circuited element, and a switch element. The radiation element has a feeding point, a fixed grounding point, and a switchable grounding point. The fixed grounding point is coupled through the first short-circuited element to the ground element. The switchable grounding point is coupled through the second short-circuited element and the switch element to the ground element. An antenna structure is formed by the radiation element, the first short-circuited element, the second short-circuited element, and the switch element.

(21) Appl. No.: **14/487,958**

(22) Filed: **Sep. 16, 2014**





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(19) **United States**

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

(10) **Pub. No.: US 2016/0079657 A1**

(43) **Pub. Date: Mar. 17, 2016**

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

Publication Classification

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

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

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

(72) Inventors: **Chan Gwang AN**, Suwon-Si (KR);
Hyun Sam MUN, Suwon-Si (KR); **Dae
Kyu LEE**, Suwon-Si (KR); **Ha Ryong
HONG**, Suwon-Si (KR); **Sung Eun
CHO**, Suwon-Si (KR); **Dae Seong
JEON**, Suwon-Si (KR)

(57) **ABSTRACT**

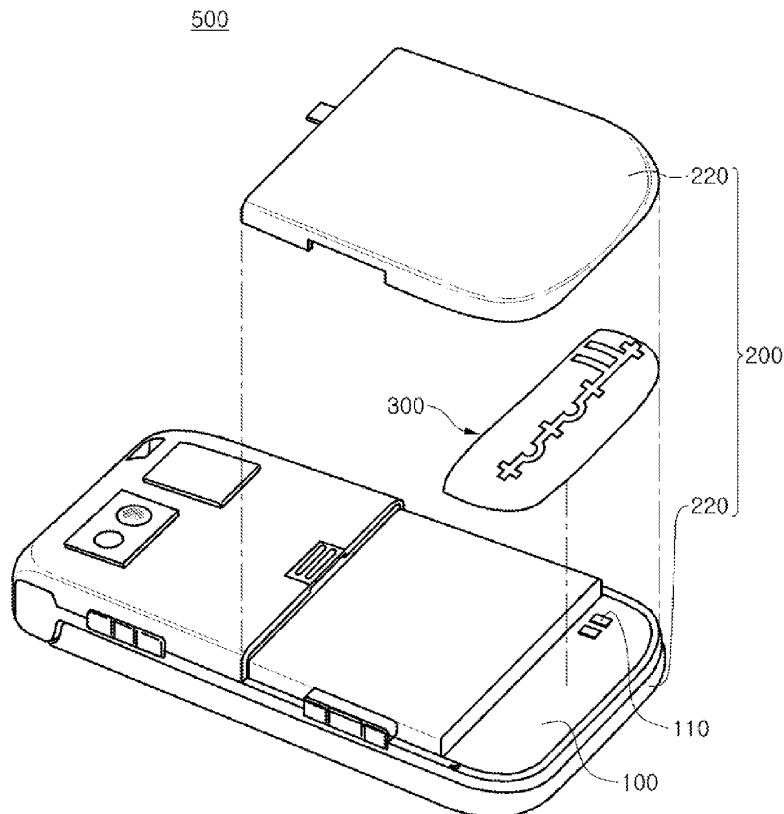
There is provided an antenna pattern frame including: a radiator including an antenna pattern part transmitting and receiving signals and a connection terminal part electrically connecting the antenna pattern part and a circuit board to each other; and a radiator frame provided by performing injection molding on the radiator while allowing the antenna pattern part to be exposed to one surface thereof and allowing the connection terminal part to be exposed to the other surface thereof, wherein the antenna pattern part is provided with a support part protruding outwardly from the antenna pattern part and bent in a direction toward the radiator frame to be disposed inwardly of the radiator frame.

(21) Appl. No.: **14/717,940**

(22) Filed: **May 20, 2015**

(30) **Foreign Application Priority Data**

Sep. 11, 2014 (KR) 10-2014-0120460





US 20160079659A1

(19) **United States**

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

(10) **Pub. No.: US 2016/0079659 A1**

(43) **Pub. Date: Mar. 17, 2016**

(54) **MOBILE TERMINAL**

(30) **Foreign Application Priority Data**

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

May 22, 2013 (CN) 201310196497.4

Publication Classification

(72) Inventors: **Hongyu WANG**, Shenzhen (CN); **Yufei SUN**, Shanghai (CN); **Huimin ZHANG**,
Shenzhen (CN); **Dongjian ZHANG**,
Shenzhen (CN); **Kun FENG**, Shanghai
(CN)

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

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

(73) Assignee: **HUAWEI DEVICE CO., LTD.**,
Shenzhen (CN)

(57) **ABSTRACT**

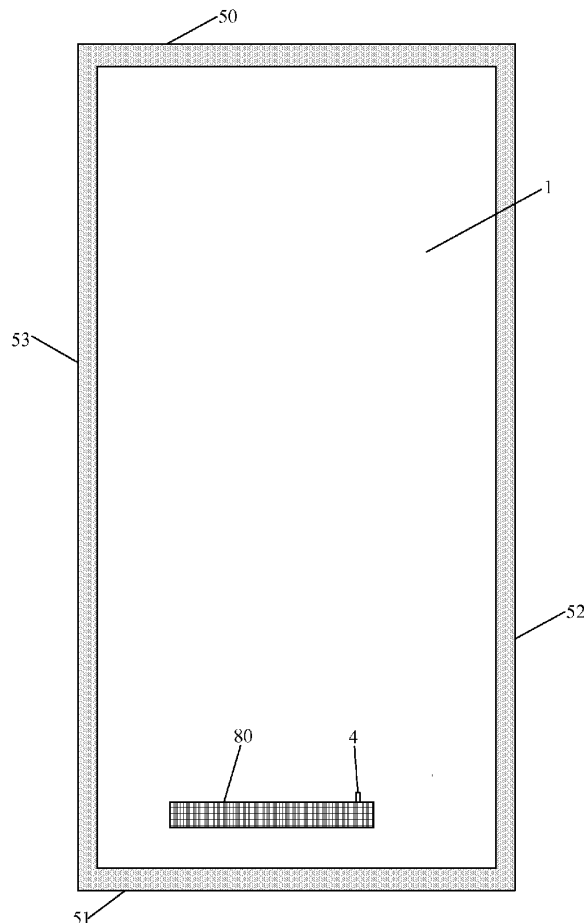
(21) Appl. No.: **14/947,042**

(22) Filed: **Nov. 20, 2015**

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2014/
077949, filed on May 21, 2014.

An embodiment of the present invention discloses a mobile terminal, which relates to the field of communications technologies and is invented to enable the mobile terminal to have relatively good metal texture and appearance. The mobile terminal includes a metal rear cover used as a grounding component and at least one antenna, where the antenna includes a grounding pin, and the grounding pin is electrically connected to the metal rear cover. The present invention is mainly applicable to mobile terminal products.





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

(43) **Pub. Date:** **Mar. 17, 2016**

- (2013.01); **B29C 45/1671** (2013.01); **B29C 45/1657** (2013.01); **B29C 37/0025** (2013.01); **B29C 45/17** (2013.01); **B29K 2069/00** (2013.01)

- ## ABSTRACT

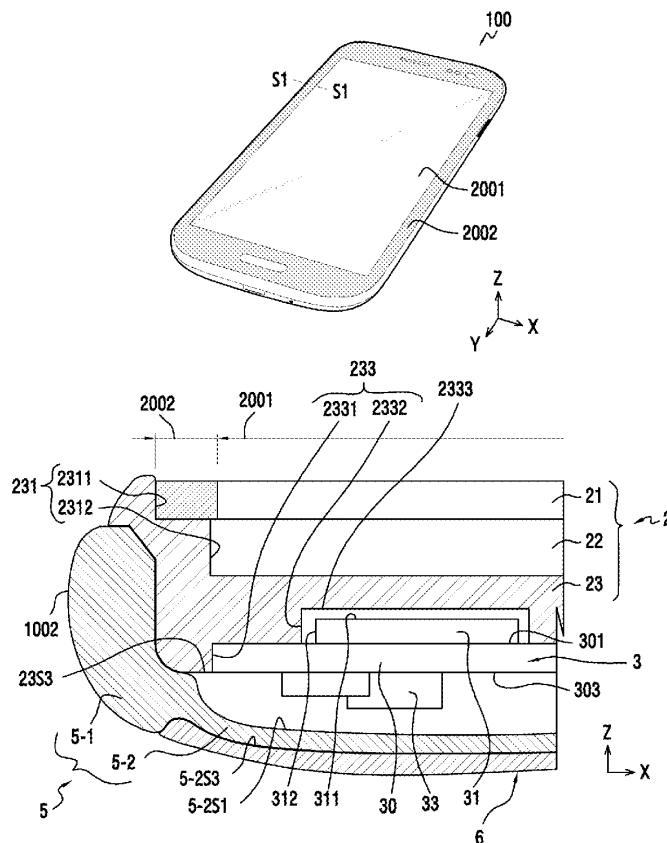
- (30) **Foreign Application Priority Data**

Sep. 12, 2014 (KR) 10-2014-0121215

Publication Classification

- (51) **Int. Cl.**
H01Q 1/40 (2006.01)
B29C 45/17 (2006.01)

An example antenna device may include a base member, an antenna that is attached to the base member, and a cover member that is attached to surround at least a part of the base member and at least a part of the antenna. A first part of the base member that is attached to the cover member has a melting temperature equal to or lower than that of the cover member. A second part of the base member to which the antenna is attached has a higher melting temperature than the cover member.





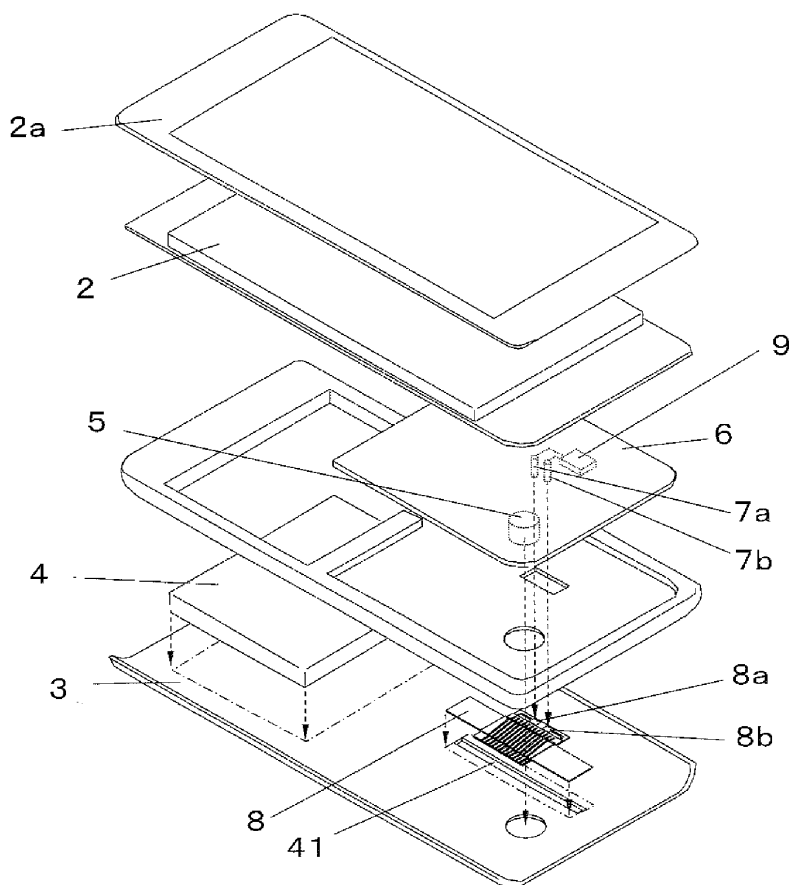
US 20160079671A1

(19) **United States**(12) **Patent Application Publication****Yamaguchi et al.**(10) **Pub. No.: US 2016/0079671 A1**(43) **Pub. Date: Mar. 17, 2016**(54) **ANTENNA, ANTENNA DEVICE AND COMMUNICATION DEVICE****Publication Classification**(71) Applicant: **PANASONIC INTELLECTUAL PROPERTY MANAGEMENT CO., LTD.**, Osaka-shi, Osaka (JP)(51) **Int. Cl.**
H01Q 7/08 (2006.01)
H01Q 1/24 (2006.01)(72) Inventors: **Shuichiro Yamaguchi**, Osaka (JP);
Masaaki Sano, Osaka (JP)(52) **U.S. Cl.**
CPC . **H01Q 7/08** (2013.01); **H01Q 1/243** (2013.01)(21) Appl. No.: **14/783,796**(57) **ABSTRACT**(22) PCT Filed: **Apr. 3, 2014**(86) PCT No.: **PCT/JP2014/001956**

§ 371 (c)(1),

(2) Date: **Oct. 9, 2015**

Provided is an antenna that can facilitate favorable communications even if no metal body is located near the antenna and even if the antenna is located within a metal body. An antenna is characterized in that the antenna comprises: a core (11) having a plane; a coil winding part (area B) of the plane about which a coil is wound; and no-coil winding parts (areas A, C) of the plane about which no coil is wound, wherein the coil winding part is sandwiched between the no-coil winding parts in the axial direction of the coil on the plane, and the width of the plane in the axial direction of the coil is equal to or greater than the width of the plane in the winding direction of the coil.

(30) **Foreign Application Priority Data**Apr. 12, 2013 (JP) 2013-083534
May 17, 2013 (JP) 2013-104718



US 20160079683A1

(19) **United States**(12) **Patent Application Publication****LEE et al.**(10) **Pub. No.: US 2016/0079683 A1**(43) **Pub. Date: Mar. 17, 2016**(54) **BUILT-IN ANTENNA FOR ELECTRONIC DEVICE**(30) **Foreign Application Priority Data**

Mar. 19, 2012 (KR) 10-2012-0027681

(71) Applicant: **Samsung Electronics Co., Ltd.**,
Gyeonggi-do (KR)**Publication Classification**(72) Inventors: **Kyung-Jong LEE**, Gyeonggi-do (KR);
Seung-Hwan KIM, Seoul (KR);
Dong-Hwan KIM, Gyeonggi-do (KR);
Austin KIM, Gyeonggi-do (KR);
Young-Sung LEE, Gyeonggi-do (KR);
Jae-Ho LEE, Gyeonggi-do (KR);
Jae-Bong CHUN, Gyeonggi-do (KR)(51) **Int. Cl.**
H01Q 21/30 (2006.01)(52) **U.S. Cl.**
CPC **H01Q 21/30** (2013.01)(57) **ABSTRACT**

A built-in antenna for an electronic device is provided. The built-in antenna includes a substrate, a 1st antenna radiator with at least two radiating portions, a 2nd antenna radiator, and a switching means. The substrate has a conductive area and a non-conductive area. The 2nd antenna radiator is arranged within the non-conductive area of the substrate and fed by a Radio Frequency (RF) end of the substrate. The 2nd antenna radiator is configured to operate at a band different from at least one operating band of the 1st antenna radiator, and is fed by the RF end in a position adjacent the 1st antenna radiator. The switching means switches to selectively feed the 1st antenna radiator and the 2nd antenna radiator.

(21) Appl. No.: **14/947,188**(22) Filed: **Nov. 20, 2015****Related U.S. Application Data**

(63) Continuation of application No. 13/761,289, filed on Feb. 7, 2013, now Pat. No. 9,219,305.

