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(19) **United States**

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

(10) **Pub. No.: US 2016/0344099 A1**

(43) **Pub. Date: Nov. 24, 2016**

(54) **FEEDING MATCHING APPARATUS OF MULTIBAND ANTENNA, MULTIBAND ANTENNA, AND RADIO COMMUNICATION DEVICE**

*H01Q 13/08* (2006.01)  
*H01Q 1/24* (2006.01)

(52) **U.S. Cl.**  
CPC ..... *H01Q 5/328* (2015.01); *H01Q 1/241* (2013.01); *H01Q 1/48* (2013.01); *H01Q 13/08* (2013.01)

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

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

(57) **ABSTRACT**

(21) Appl. No.: **15/229,829**

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

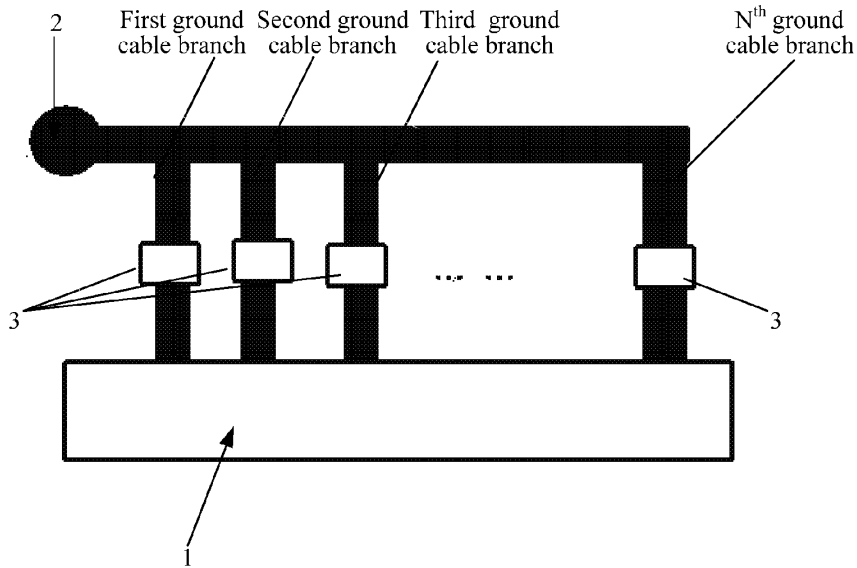
**Related U.S. Application Data**

(63) Continuation of application No. 14/143,367, filed on Dec. 30, 2013, now Pat. No. 9,437,928, which is a continuation of application No. PCT/CN2013/070557, filed on Jan. 16, 2013.

**Publication Classification**

(51) **Int. Cl.**  
*H01Q 5/328* (2006.01)  
*H01Q 1/48* (2006.01)

The present disclosure relates to the field of antenna technologies and discloses a feeding matching apparatus of a multiband antenna, a multiband antenna, and a radio communication device to improve a bandwidth and efficiency of a lower frequency band. The feeding matching apparatus of a multiband antenna includes: a grounding portion; a feeding portion connected to a signal source, where a signal of the signal source is input into the feeding portion; and two or more ground cable branches with different lengths, where one end of each ground cable branch is electrically connected to the feeding portion, the other end is electrically connected to the grounding portion, at least one ground cable branch is connected in series to a signal filtering component, and the signal filtering component is capable of preventing a signal lower than a frequency point corresponding to the signal filtering component from passing through it.





US 20160344439A1

(19) **United States**

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

(10) **Pub. No.: US 2016/0344439 A1**

(43) **Pub. Date: Nov. 24, 2016**

(54) **ELECTRONIC DEVICE WITH ANTENNA DEVICE**

**H01Q 1/24** (2006.01)

**H01Q 7/00** (2006.01)

**G06F 1/16** (2006.01)

**H05K 5/02** (2006.01)

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

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

CPC ..... **H04B 1/3888** (2013.01); **G06F 1/1656**

(2013.01); **H05K 5/0247** (2013.01); **H01Q**

**1/243** (2013.01); **H01Q 7/00** (2013.01); **H01Q**

**9/0421** (2013.01); **H01Q 9/0407** (2013.01)

(72) Inventors: **Kyung-Moon SEOL**, Seoul (KR);  
**Ji-Ho KIM**, Gyeonggi-do (KR);  
**Jae-Won CHOE**, Gyeonggi-do (KR);  
**Gyu-Bok PARK**, Gyeonggi-do (KR);  
**Jae-Moon LEE**, Seoul (KR)

(57)

**ABSTRACT**

An electronic device with an antenna device is provided. The electronic device includes a case member that includes a first face, a second face disposed opposite to the first face, and side walls that enclose a space between the first face and the second face, a first metallic member that forms at least a portion of the side walls of the case member or is formed adjacent to the side walls, a metal pattern disposed within the case member and extends from a portion of the first metallic member to another portion of the first metallic member, the first metallic member and the metal pattern electrically forming at least a portion of a closed loop, a wireless communication circuit electrically connected to a portion of the metal pattern, a ground member positioned within the case member, and a portion of the metal pattern disposed adjacent to the ground member.

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

(21) Appl. No.: **15/148,385**

(22) Filed: **May 6, 2016**

(30) **Foreign Application Priority Data**

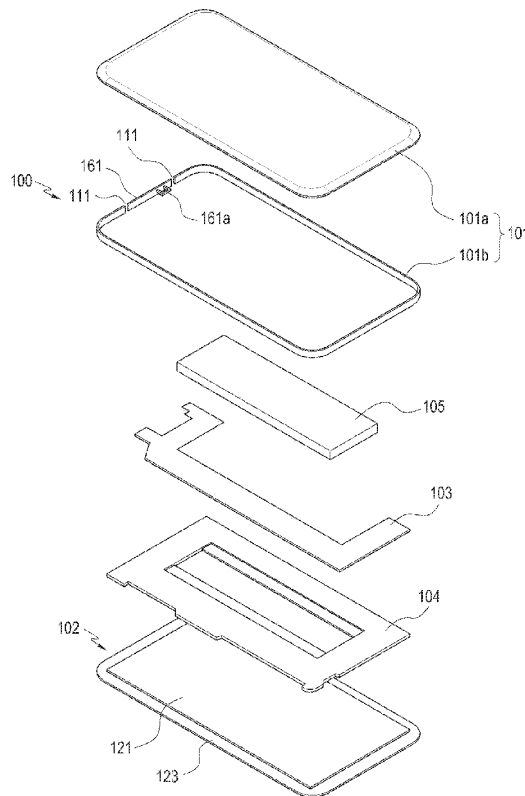
May 19, 2015 (KR) ..... 10-2015-0069476

**Publication Classification**

(51) **Int. Cl.**

**H04B 1/3888** (2006.01)

**H01Q 9/04** (2006.01)





US 20160352013A1

(19) **United States**

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

(10) **Pub. No.: US 2016/0352013 A1**

(43) **Pub. Date: Dec. 1, 2016**

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

**Publication Classification**

(51) **Int. Cl.**  
*H01Q 5/10* (2006.01)  
*H01Q 1/38* (2006.01)  
*H01Q 5/50* (2006.01)

(52) **U.S. Cl.**  
 CPC ..... *H01Q 5/10* (2015.01); *H01Q 5/50* (2015.01); *H01Q 1/38* (2013.01)

(71) Applicant: **Chiun Mai Communication Systems, Inc.**, New Taipei (TW)

(72) Inventors: **SZU-CHI FAN**, New Taipei (TW);  
**YEN-HUI LIN**, New Taipei (TW)

(57) **ABSTRACT**

An antenna structure includes a matching portion, a first radiator, and a second radiator. The matching portion includes a first edge and a second edge. The first radiator and the second radiator extend from the first edge of the matching portion. The matching portion defines a slot splitting the second edge into two prongs. The second radiator and the matching portion resonate a first mode. The first radiator and the matching portion resonate a second mode. The slot, the first radiator, and the matching portion resonate a third mode.

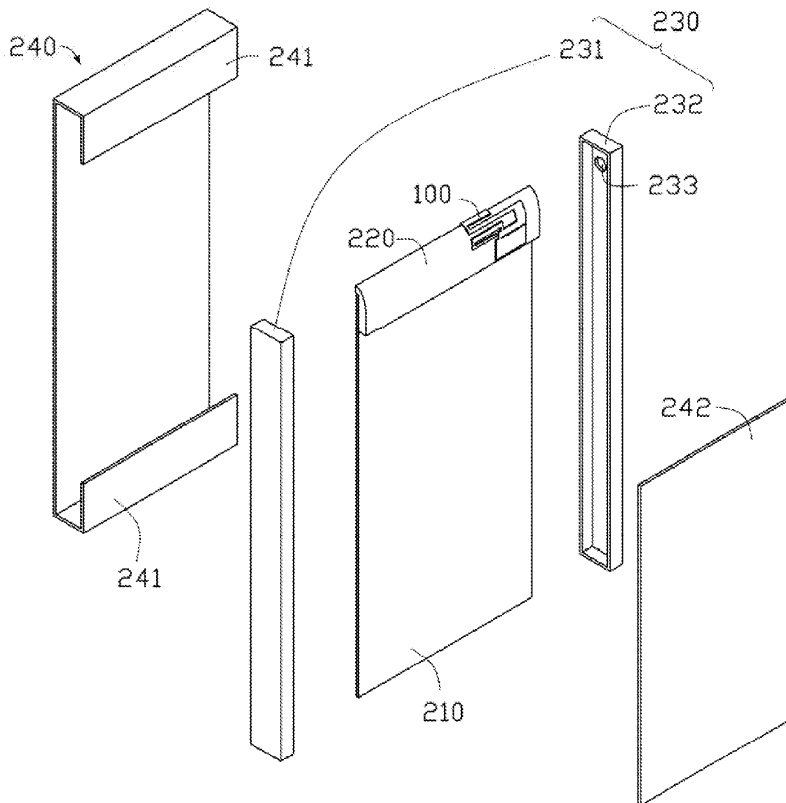
(21) Appl. No.: **14/980,737**

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

(30) **Foreign Application Priority Data**

May 29, 2015 (CN) ..... 201510285623.2

200





US 20160352014A1

(19) **United States**

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

(10) **Pub. No.: US 2016/0352014 A1**

(43) **Pub. Date: Dec. 1, 2016**

(54) **ELECTRONIC DEVICE AND MULTI-BAND ANTENNA**

(52) **U.S. Cl.**  
CPC ..... **H01Q 5/50** (2015.01)

(71) Applicant: **HON HAI PRECISION INDUSTRY CO., LTD.**, New Taipei (TW)

(57) **ABSTRACT**

(72) Inventors: **WEI-YU CHEN**, New Taipei (TW);  
**YUEH-CHU LIN**, New Taipei (TW)

An electronic device has a multi-band antenna which includes an antenna frame and multiple feed points and multiple ground points located on the antenna frame. The multiple feed points include a first feed point located at one end portion of the antenna frame and a second feed point located between two end portions of the antenna frame. The multiple ground points include a first ground point located between the two end portions of the antenna frame and a second ground point located at the other end portion of the antenna frame. The multiple feed points and the multiple ground points are alternately located on the antenna frame, and multiple radiating elements are formed on the antenna frame and are configured to radiate signals having different frequency bands. Each radiating element is formed between a feed point and a ground point.

(21) Appl. No.: **14/797,831**

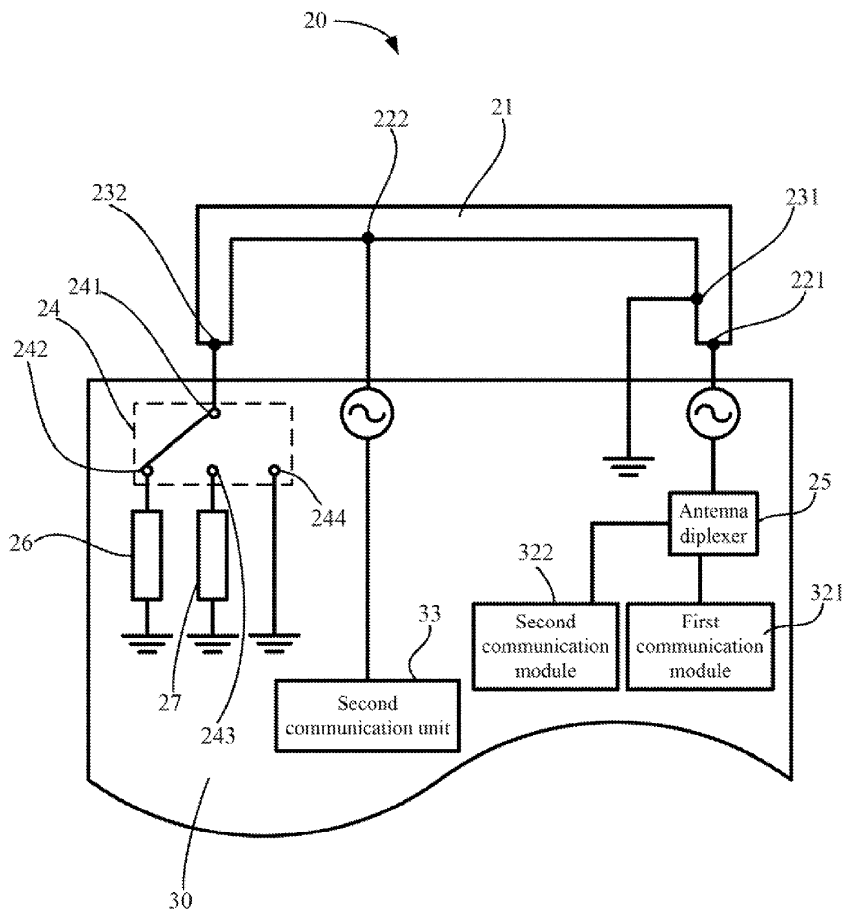
(22) Filed: **Jul. 13, 2015**

(30) **Foreign Application Priority Data**

May 27, 2015 (CN) ..... 201510276463.5

**Publication Classification**

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





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(19) **United States**

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

(10) **Pub. No.: US 2016/0352015 A1**

(43) **Pub. Date: Dec. 1, 2016**

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

*H01Q 1/24* (2006.01)

*H01Q 1/48* (2006.01)

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

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

CPC ..... *H01Q 5/50* (2015.01); *H01Q 1/243*  
(2013.01); *H01Q 1/48* (2013.01); *H04W 4/008*  
(2013.01); *H01Q 9/04* (2013.01)

(72) Inventors: **Hyun Seock ROH**, Gyeonggi-do (KR);  
**Sang Bong SUNG**, Gyeonggi-do (KR);  
**Seong Yong AN**, Gyeonggi-do (KR); **Se**  
**Woong KIM**, Gyeongsangnam-do  
(KR); **Ji Ho KIM**, Gyeonggi-do (KR);  
**Gyu Bok PARK**, Gyeonggi-do (KR);  
**Kyung Moon SEOL**, Seoul (KR); **Shin**  
**Ho YOON**, Gyeonggi-do (KR)

(57)

**ABSTRACT**

An electronic device is provided. The electronic device includes a housing including a first surface, a second surface facing the first surface, and side surfaces surrounding a space between the first surface and the second surface, a first conductive member and a second conductive member forming at least part of the side surfaces, being parallel to the first surface, and extending parallel to each other, a first nonconductive member disposed between the first conductive member and the second conductive member to electrically isolate the first conductive member and the second conductive member from each other, and a communication circuit that performs wireless communication by using the first conductive member and the second conductive member as radiators.

(21) Appl. No.: **15/165,415**

(22) Filed: **May 26, 2016**

(30) **Foreign Application Priority Data**

May 27, 2015 (KR) ..... 10-2015-0074261

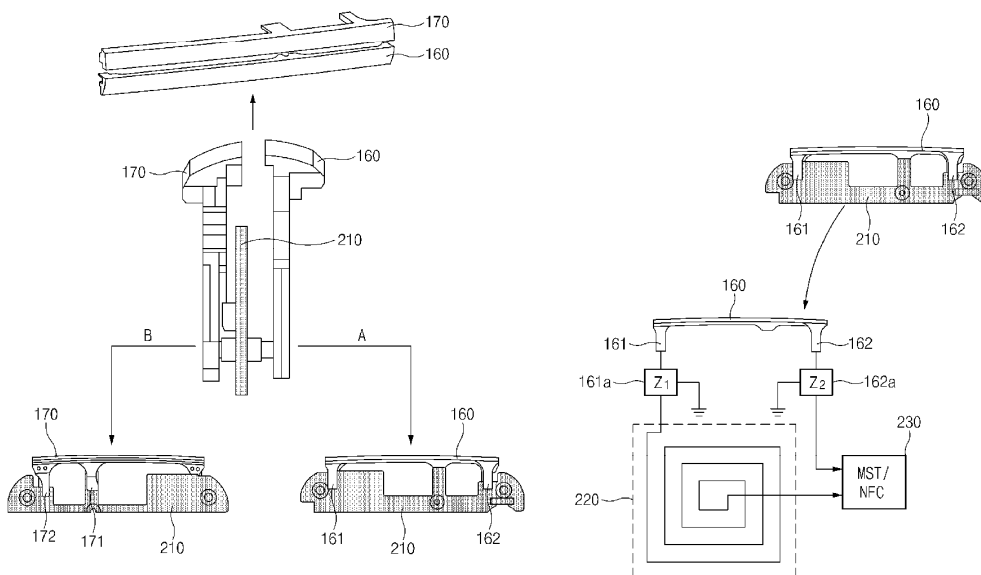
**Publication Classification**

(51) **Int. Cl.**

*H01Q 5/50* (2006.01)

*H01Q 9/04* (2006.01)

*H04W 4/00* (2006.01)





US 20160352025A1

(19) **United States**

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

(10) **Pub. No.: US 2016/0352025 A1**

(43) **Pub. Date: Dec. 1, 2016**

(54) **ANTENNA AND RADIO FREQUENCY  
SIGNAL TRANSCEIVING DEVICE**

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

CPC ..... *H01Q 21/30* (2013.01); *H01Q 5/10*  
(2015.01); *H01Q 1/38* (2013.01)

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

(57)

**ABSTRACT**

(72) Inventors: **Jun-Fu Chen**, Hsinchu (TW); **Yu-Yu Chiang**, Hsinchu (TW)

An antenna including an antenna structure disposed on a substrate is provided. The antenna structure includes a first radiation part, a second radiation part, a metal coupling part, a third radiation part and a feeding point. The first radiation part has a first bend, a second bend and an opening end. The first radiation part extends from a grounding point of a grounding plane and the opening end thereof is nearing the grounding plane. The second radiation part extends from a section between the first bend of the first radiation part and the grounding point. The metal coupling part is nearing the first radiation part and the second radiation part. The third radiation part is disposed between the second radiation part and the grounding plane, and extends from the metal coupling part. The feeding point is coupled to where the third radiation part and the metal coupling part connected.

(21) Appl. No.: **14/938,858**

(22) Filed: **Nov. 12, 2015**

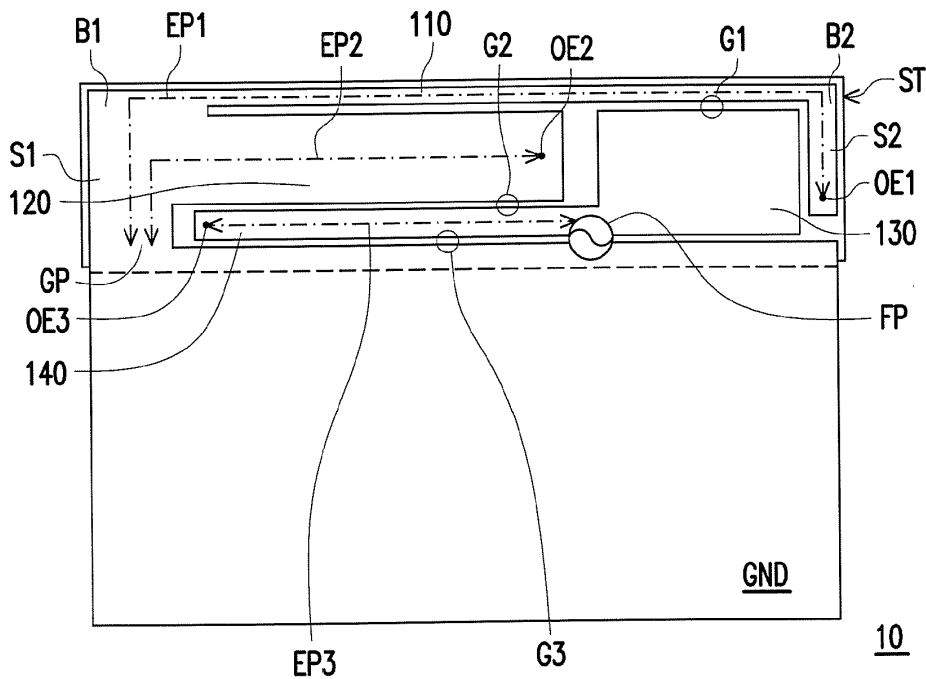
(30) **Foreign Application Priority Data**

Jun. 1, 2015 (TW) ..... 104117655

**Publication Classification**

(51) **Int. Cl.**

*H01Q 21/30* (2006.01)  
*H01Q 1/38* (2006.01)  
*H01Q 5/10* (2006.01)





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(19) **United States**

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

(10) **Pub. No.: US 2016/0359227 A1**

(43) **Pub. Date: Dec. 8, 2016**

(54) **MOBILE DEVICE**

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

CPC . **H01Q 1/50** (2013.01); **H01Q 5/20** (2015.01)

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

(72) Inventors: **Kun-Sheng CHANG**, New Taipei City (TW); **Ching-Chi LIN**, New Taipei City (TW)

(57) **ABSTRACT**

(21) Appl. No.: **14/986,129**

(22) Filed: **Dec. 31, 2015**

(30) **Foreign Application Priority Data**

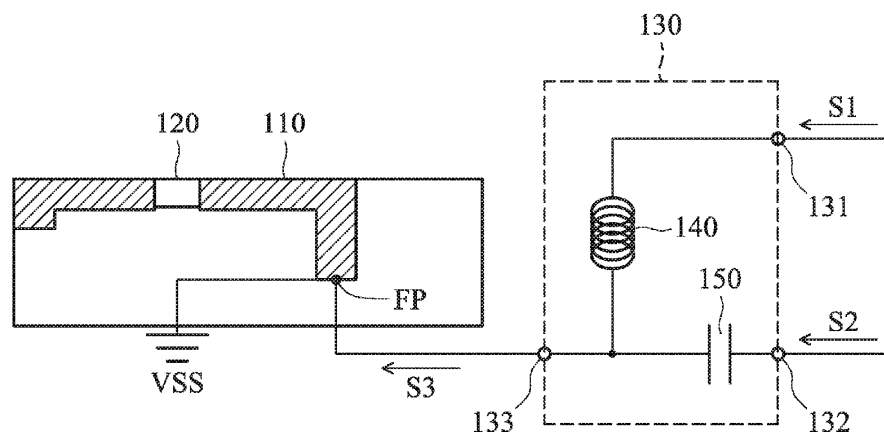
Jun. 8, 2015 (TW) ..... 104118459

**Publication Classification**

(51) **Int. Cl.**  
**H01Q 1/50** (2006.01)  
**H01Q 5/20** (2006.01)

A mobile device includes an antenna structure, a tunable circuit element, a bias tee element, an inductive element, and a capacitive element. The tunable circuit element is in the antenna structure. The bias tee element has a first input terminal for receiving a power signal, a second input terminal for receiving an RF (Radio Frequency) signal, and an output terminal for outputting a mixed signal. The inductive element is configured to remove high-frequency noise from the power signal. The capacitive element is configured to remove low-frequency noise from the RF signal. The output terminal of the bias tee element is coupled to a feeding point on the antenna structure. The antenna structure is excited by the mixed signal. The tunable circuit element generates different impedance values according to the mixed signal.

100





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(19) **United States**

(12) **Patent Application Publication**  
**YANG**

(10) **Pub. No.: US 2016/0359231 A1**

(43) **Pub. Date: Dec. 8, 2016**

(54) **ANTENNA STRUCTURE**

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

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

CPC ..... **H01Q 5/371** (2015.01); **H01Q 1/48** (2013.01); **H01Q 7/00** (2013.01)

(72) Inventor: **Chung-Wen YANG**, New Taipei City (TW)

(57) **ABSTRACT**

(21) Appl. No.: **14/828,797**

(22) Filed: **Aug. 18, 2015**

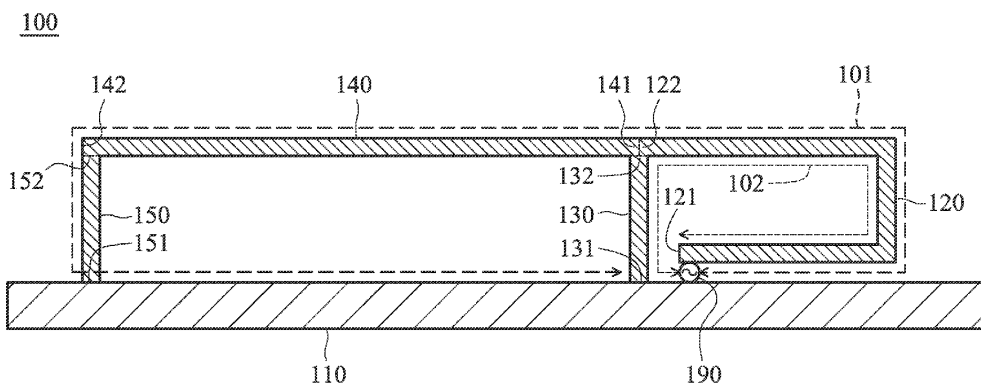
(30) **Foreign Application Priority Data**

Jun. 3, 2015 (TW) ..... 104117909

**Publication Classification**

(51) **Int. Cl.**  
**H01Q 5/371** (2006.01)  
**H01Q 7/00** (2006.01)  
**H01Q 1/48** (2006.01)

An antenna structure includes a ground element, a first radiation branch, a first ground branch, a second radiation branch, and a second ground branch. A first end of the first radiation branch is coupled to a signal source. A first end of the first ground branch is coupled to the ground element. A second end of the first ground branch is coupled to a second end of the first radiation branch. A first end of the second radiation branch is coupled to the second end of the first radiation branch. A first end of the second ground branch is coupled to the ground element. A second end of the second ground branch is coupled to a second end of the second radiation branch.







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(19) **United States**

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

(10) **Pub. No.: US 2016/0365622 A1**

(43) **Pub. Date: Dec. 15, 2016**

(54) **MULTI-FEED ANTENNA ASSEMBLY**

*H01Q 9/04* (2006.01)

(71) Applicant: **GALTRONICS CORPOATION LTD.**,  
Tiberias (IL)

*H01Q 1/48* (2006.01)

*H01Q 1/50* (2006.01)

(72) Inventors: **Jongmin NA**, Gyeong-gi-do (KR);  
**Taihong KIM**, Gyeong-gi-do (KR);  
**Eungyu BAE**, Gyeong-gi-do (KR);  
**Matti MARTISKAINEN**, Tiberias (IL)

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

CPC ..... *H01Q 1/243* (2013.01); *H01Q 1/48*  
(2013.01); *H01Q 1/50* (2013.01); *H01Q*  
*9/0407* (2013.01); *H01Q 7/00* (2013.01)

(21) Appl. No.: **15/121,711**

(57)

**ABSTRACT**

(22) PCT Filed: **Feb. 26, 2014**

(86) PCT No.: **PCT/IL2014/050199**

§ 371 (c)(1),

(2) Date: **Aug. 25, 2016**

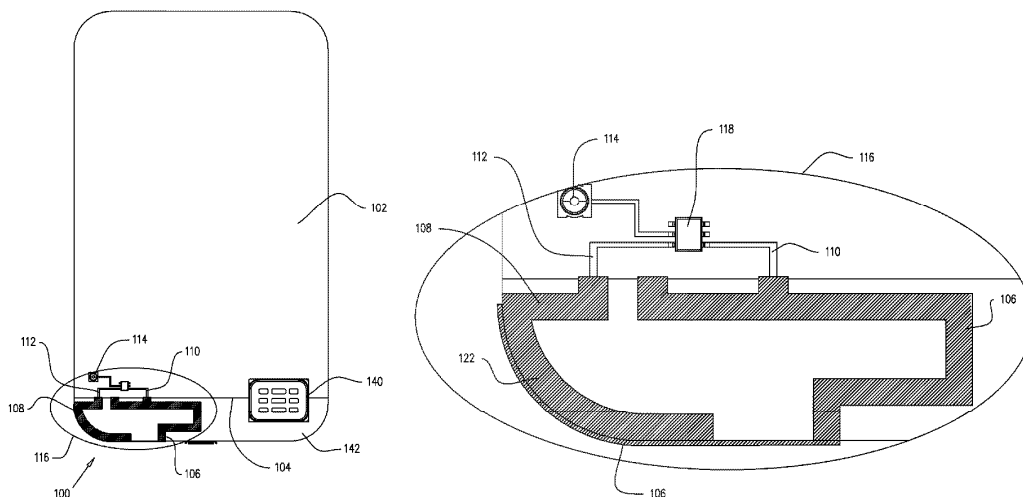
**Publication Classification**

(51) **Int. Cl.**

*H01Q 1/24* (2006.01)

*H01Q 7/00* (2006.01)

A multi-feed antenna assembly including a ground element lying in a plane, a first antenna element coupled to the ground element and having a projection on the plane, a first feed for feeding the first antenna element, a second antenna element coupled to the ground element and having a projection on the plane, the projection of the second antenna element being at least partially encompassed by the projection of the first antenna element and a second feed for feeding the second antenna element.





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(19) **United States**

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

(10) **Pub. No.: US 2016/0365623 A1**

(43) **Pub. Date: Dec. 15, 2016**

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

*H01Q 1/38* (2006.01)

*H01Q 1/48* (2006.01)

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

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

CPC ..... *H01Q 1/243* (2013.01); *H01Q 1/48*  
(2013.01); *H01Q 1/50* (2013.01); *H01Q 1/38*  
(2013.01)

(72) Inventors: **Jae Hyung KIM**, Seoul (KR); **Jin Li KIM**, Daejeon (KR); **Jin Kyu BANG**, Gyeonggi-do (KR); **Dong Hwan KIM**, Gyeonggi-do (KR); **Tae Gyu KIM**, Gyeonggi-do (KR); **Ki Young CHANG**, Seoul (KR); **Sung Yeul HONG**, Gyeonggi-do (KR)

(57)

**ABSTRACT**

An electronic device including a plurality of antennas is provided. The electronic device includes a first radiator including at least one matching block that is connected with a ground area and at least one side of the first radiator. The first radiator is configured to transmit and receive a first frequency signal through a first antenna resonance length corresponding to a first area of the first radiator, and to transmit and receive a second frequency signal through a second antenna resonance length corresponding to a second area opposite to the first area. A second radiator is connected with the ground area and is configured to transmit and receive a third frequency signal through a third antenna resonance length corresponding to a third area adjacent to the first radiator.

(21) Appl. No.: **15/180,890**

(22) Filed: **Jun. 13, 2016**

(30) **Foreign Application Priority Data**

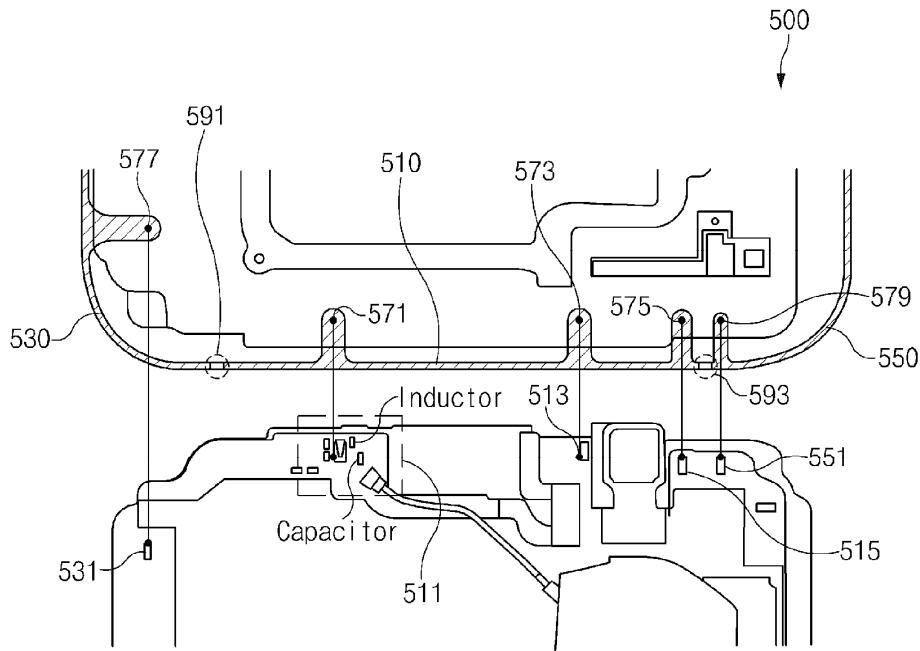
Jun. 11, 2015 (KR) ..... 10-2015-0082840

**Publication Classification**

(51) **Int. Cl.**

*H01Q 1/24* (2006.01)

*H01Q 1/50* (2006.01)





US 20160365639A1

(19) **United States**

(12) **Patent Application Publication**  
**Huang**

(10) **Pub. No.: US 2016/0365639 A1**

(43) **Pub. Date: Dec. 15, 2016**

(54) **ANTENNA STRUCTURE**

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

CPC ..... **H01Q 9/18** (2013.01); **H01Q 1/52**  
(2013.01); **H01Q 9/145** (2013.01)

(71) Applicant: **ARCADYAN TECHNOLOGY CORPORATION**, Hsinchu (TW)

(72) Inventor: **Chih-Yung Huang**, Hsinchu (TW)

(57) **ABSTRACT**

(21) Appl. No.: **15/004,452**

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

An antenna structure is disclosed. The antenna structure includes a reference axis having a first direction; a signal-feeding terminal; and a radiating portion, including a first conductor extending from the signal-feeding terminal along the first direction to a first turning point; a second conductor extending from the first turning point across the longitudinal reference axis to a second turning point; a third conductor extending from the second turning point along the first direction to a third turning point; a fourth conductor extending from the third turning point across the reference axis to a fourth turning point; and a fifth conductor extending from the fourth turning point along a second direction opposite to the first direction.

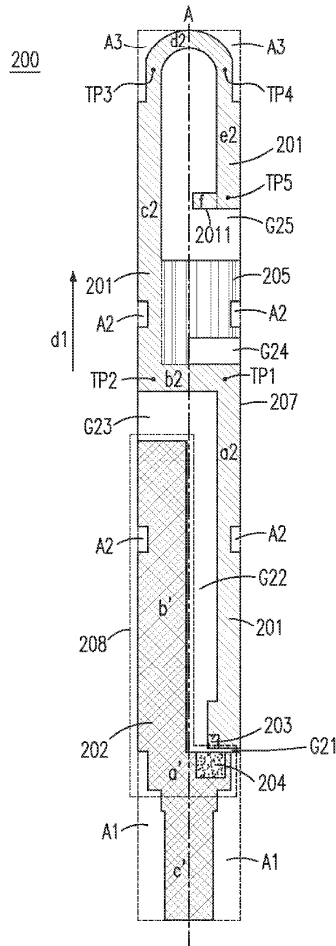
(30) **Foreign Application Priority Data**

Jun. 12, 2015 (TW) ..... 104119185

**Publication Classification**

(51) **Int. Cl.**

**H01Q 9/18** (2006.01)  
**H01Q 9/14** (2006.01)  
**H01Q 1/52** (2006.01)





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(19) **United States**

(12) **Patent Application Publication**  
**NAKANO**

(10) **Pub. No.: US 2016/0372817 A1**

(43) **Pub. Date: Dec. 22, 2016**

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

**Publication Classification**

(71) Applicant: **Murata Manufacturing Co., Ltd.**,  
Nagaokakyo-shi (JP)

(51) **Int. Cl.**  
*H01Q 1/24* (2006.01)  
*H01Q 1/38* (2006.01)  
*H01Q 7/00* (2006.01)

(72) Inventor: **Shinichi NAKANO**, Nagaokakyo-shi (JP)

(52) **U.S. Cl.**  
CPC ..... *H01Q 1/243* (2013.01); *H01Q 7/00* (2013.01); *H01Q 1/38* (2013.01)

(21) Appl. No.: **15/253,985**

(57) **ABSTRACT**

(22) Filed: **Sep. 1, 2016**

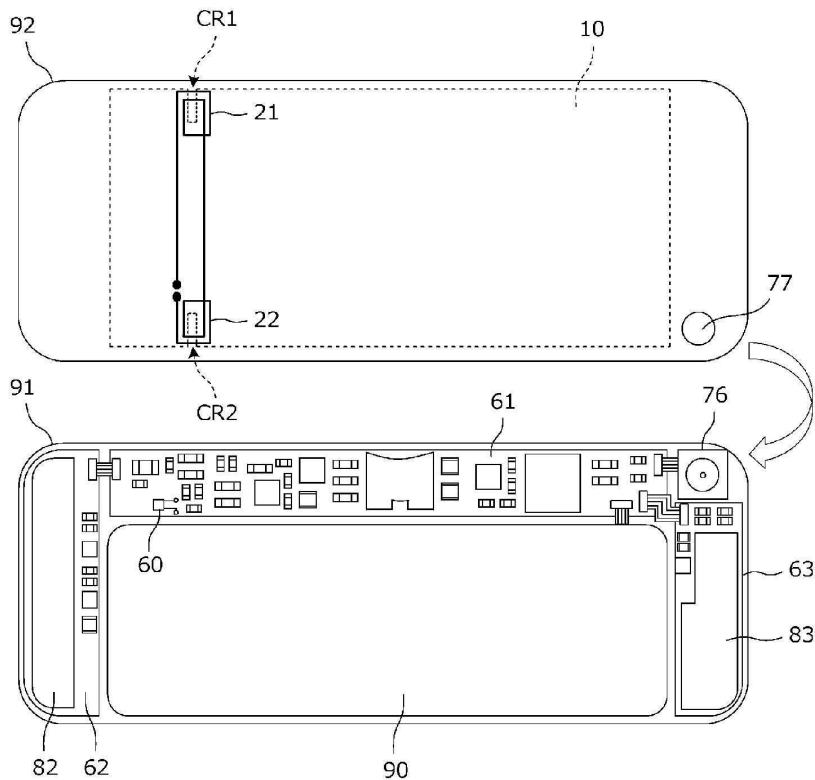
Coil conductors each including a coil opening, and a planar conductor are included in an antenna device. The coil conductors are disposed at edge portions of the planar conductor such that winding axes of the coil conductors extend in a normal direction of the planar conductor. The coil conductors are connected such that magnetic fluxes generated at the respective coil conductors are in phase with each other. In a plan view, portions of the plurality of coil conductors overlap the planar conductor and portions of the coil openings do not overlap the planar conductor.

**Related U.S. Application Data**

(63) Continuation of application No. PCT/JP2015/056292, filed on Mar. 4, 2015.

(30) **Foreign Application Priority Data**

Mar. 7, 2014 (JP) ..... 2014-044808





US 20160372825A1

(19) **United States**

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

(10) **Pub. No.: US 2016/0372825 A1**

(43) **Pub. Date: Dec. 22, 2016**

(54) **ANTENNA ON SAPPHIRE STRUCTURE**

**H01Q 7/00** (2006.01)

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

**H01Q 1/24** (2006.01)

**H01Q 3/44** (2006.01)

(72) Inventors: **Benjamin J. Pope**, Cupertino, CA (US); **Scott A. Myers**, Cupertino, CA (US)

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

CPC ..... **H01Q 1/38** (2013.01); **H01Q 1/243** (2013.01); **H01Q 3/44** (2013.01); **H01Q 7/00** (2013.01); **H01Q 1/48** (2013.01)

(21) Appl. No.: **15/251,913**

(22) Filed: **Aug. 30, 2016**

(57)

**ABSTRACT**

**Related U.S. Application Data**

(63) Continuation of application No. 14/956,799, filed on Dec. 2, 2015, now Pat. No. 9,461,357, which is a continuation of application No. 14/178,623, filed on Feb. 12, 2014, now Pat. No. 9,225,056.

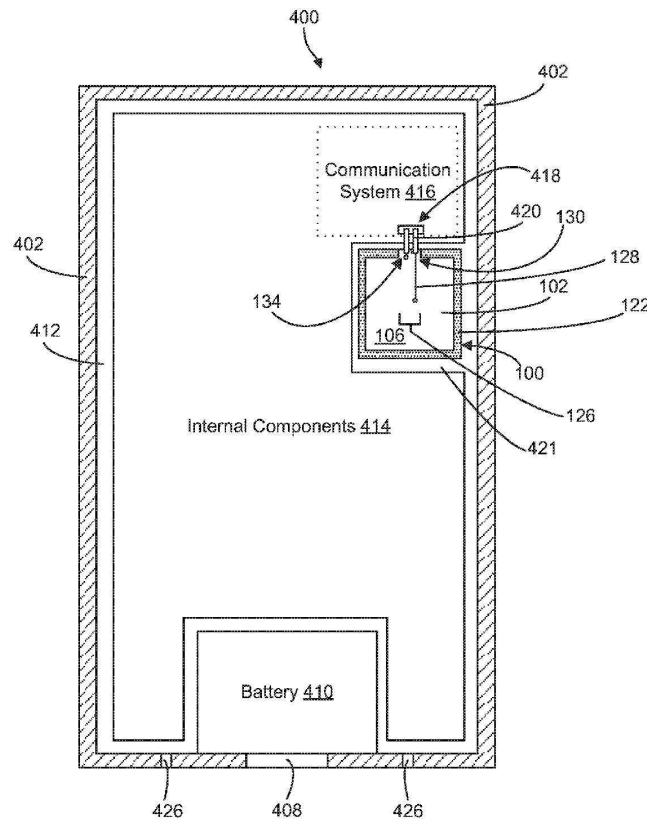
**Publication Classification**

(51) **Int. Cl.**

**H01Q 1/38** (2006.01)

**H01Q 1/48** (2006.01)

An antenna on a sapphire structure. The antenna includes a sapphire structure having a first side, and a second side positioned opposite the first side. The antenna also includes a first antenna trace positioned on the first side of the sapphire structure, and a second antenna trace positioned on the second side of the sapphire structure. Additionally, the antenna includes at least one via formed through the sapphire structure. The at least one via electrically connects the first antenna trace to the second antenna trace.





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(54) **WIRELESS COMMUNICATION MODULE AND PORTABLE TERMINAL INCLUDING THE SAME**

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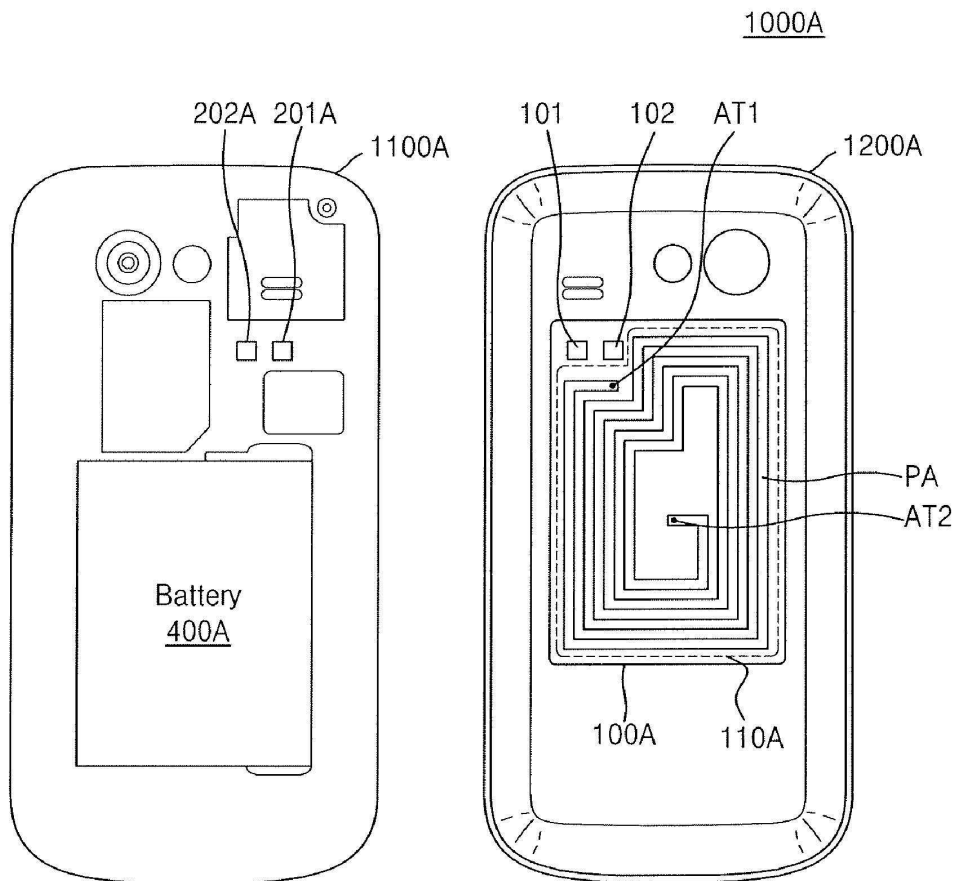
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(57) **ABSTRACT**

A wireless communication module includes a controller configured to control wireless communication operations, an antenna module that includes a first antenna device, and a matching circuit configured to perform impedance matching between the controller and the antenna module, wherein the first antenna device includes a heat dissipating sheet with a first pattern that transceives wireless signals by detecting a surrounding magnetic flux.





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(54) **MOBILE COMMUNICATION DEVICE**

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(57) **ABSTRACT**

A mobile communication device includes an antenna element, a low-frequency blocking element, an isolation circuit, a first high-frequency blocking element and a second high-frequency blocking element. The antenna element converts a radio-frequency signal into an electromagnetic wave and includes a radiation portion and a parasitic portion. The parasitic portion and the radiation portion generate a first sensing signal and a second sensing signal in response to a proximity of an object. The low-frequency blocking element transmits the radio-frequency signal to the radiation portion. The isolation circuit is connected between the parasitic portion and a ground plane, and the isolation circuit blocks the first sensing signal and transmits the radio-frequency signal. The first high-frequency blocking element transmits the first sensing signal to a first sensing controller through a first metal line. The second high-frequency blocking element transmits the second sensing signal to a second sensing controller through a second metal line.

