



US 20180083341A1

(19) **United States**

(12) **Patent Application Publication**
YEN

(10) **Pub. No.: US 2018/0083341 A1**
(43) **Pub. Date: Mar. 22, 2018**

(54) **SEMICONDUCTOR PACKAGE INCLUDING ANTENNA SUBSTRATE AND MANUFACTURING METHOD THEREOF**

H01L 25/16 (2006.01)
H01Q 9/04 (2006.01)
H01L 21/56 (2006.01)

(71) Applicant: **Advanced Semiconductor Engineering, Inc.**, Kaohsiung (TW)

(52) **U.S. Cl.**
CPC . *H01Q 1/2283* (2013.01); *H01L 2924/19107* (2013.01); *H01L 23/66* (2013.01); *H01L 24/97* (2013.01); *H01L 25/16* (2013.01); *H01Q 9/0407* (2013.01); *H01L 2924/00014* (2013.01); *H01L 2924/00012* (2013.01); *H01L 2924/00* (2013.01); *H01L 2224/73257* (2013.01); *H01L 2224/48227* (2013.01); *H01L 2224/48091* (2013.01); *H01L 2224/16225* (2013.01); *H01L 2224/16145* (2013.01); *H01L 2223/6677* (2013.01); *H01L 2924/12042* (2013.01); *H01L 2924/15787* (2013.01); *H01L 2924/181* (2013.01); *H01L 2924/19105* (2013.01); *H01L 21/561* (2013.01); *H01L 23/3128* (2013.01)

(72) Inventor: **Han-Chee YEN**, Kaohsiung (TW)

(73) Assignee: **Advanced Semiconductor Engineering, Inc.**, Kaohsiung (TW)

(21) Appl. No.: **15/826,543**

(22) Filed: **Nov. 29, 2017**

Related U.S. Application Data

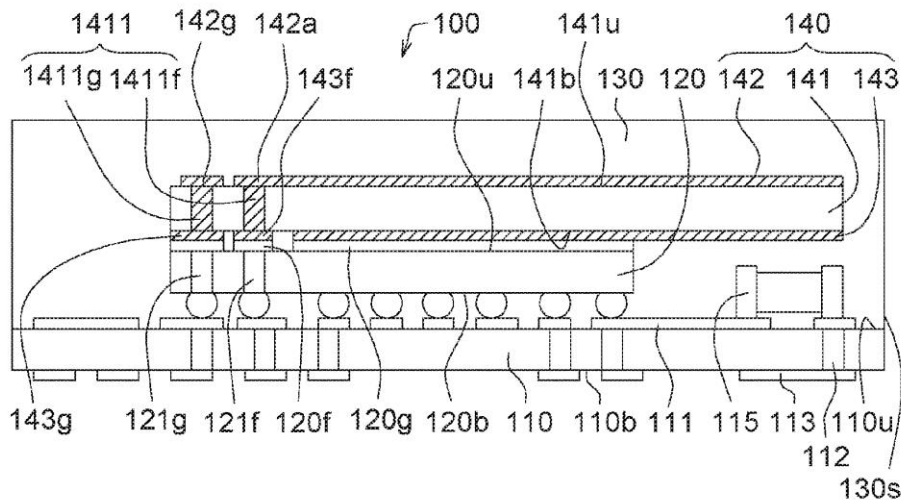
(63) Continuation of application No. 13/783,840, filed on Mar. 4, 2013, now Pat. No. 9,837,701.

Publication Classification

(51) **Int. Cl.**
H01Q 1/22 (2006.01)
H01L 23/31 (2006.01)
H01L 23/66 (2006.01)
H01L 23/00 (2006.01)

(57) **ABSTRACT**

A semiconductor package includes: (1) a package substrate including an upper surface; (2) a semiconductor device disposed adjacent to the upper surface of the package substrate, the semiconductor device including an inactive surface; and (3) an antenna substrate disposed on the inactive surface of the semiconductor device.





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(19) **United States**

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

(10) **Pub. No.: US 2018/0083343 A1**

(43) **Pub. Date: Mar. 22, 2018**

(54) **MOBILE TERMINAL**

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

CPC *H01Q 1/243* (2013.01); *H01Q 1/48* (2013.01); *H04M 1/026* (2013.01)

(71) Applicants: **Tan Yew Choon**, Singapore (SG); **NG Guan Hong**, Singapore (SG); **TAY Yew Siow**, Singapore (SG)

(72) Inventors: **Tan Yew Choon**, Singapore (SG); **NG Guan Hong**, Singapore (SG); **TAY Yew Siow**, Singapore (SG)

(57) **ABSTRACT**

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

A mobile terminal, including metal back cover including metal cover plate, first and second metal frames respectively arranged at two opposite sides thereof for forming first gap, first metal frame comprising first, second and third radiating portions; antenna module fixed on metal back cover close to first metal frame, antenna module comprising system ground connected with metal cover plate, and antenna circuit board connected with system ground and first metal frame, antenna circuit board including grounding, feeding, matching circuit and tuner; grounding circuit comprises grounding point and grounding pin and going across first gap; the feeding circuit comprises feeding point and feeding pin and going across first gap; first, second and third radiating portions are configured that when tuning in middle-high frequency, first and second radiating portions serve as radiator of antenna module, and when tuning in low frequency, second and third radiating portions serve as radiator.

(21) Appl. No.: **15/416,747**

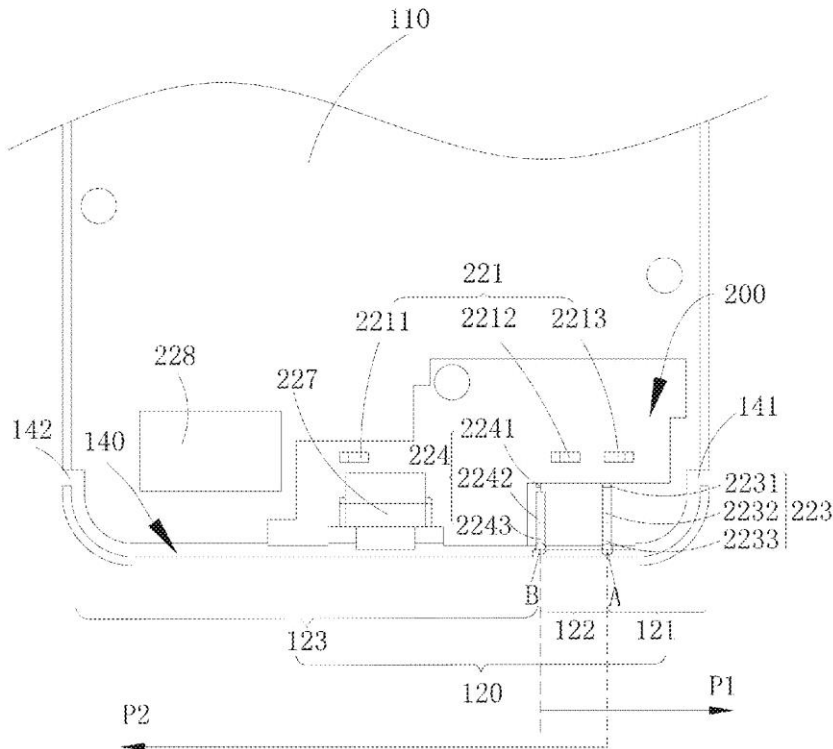
(22) Filed: **Jan. 26, 2017**

(30) **Foreign Application Priority Data**

Sep. 22, 2016 (CN) 201610840545.2

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H04M 1/02 (2006.01)
H01Q 1/48 (2006.01)





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(19) **United States**

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

(10) **Pub. No.: US 2018/0083345 A1**

(43) **Pub. Date: Mar. 22, 2018**

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

H01Q 5/50 (2006.01)

H01Q 7/00 (2006.01)

H01Q 1/48 (2006.01)

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

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

CPC *H01Q 1/243* (2013.01); *H01Q 9/0421*
(2013.01); *H01Q 1/48* (2013.01); *H01Q 7/00*
(2013.01); *H01Q 5/50* (2015.01)

(72) Inventors: **Chongfeng Zhao**, Xi'an (CN); **Silei Huyan**, Xi'an (CN); **Bao Lu**, Xi'an (CN); **Shiqiang Lu**, Xi'an (CN); **Yi Wang**, Xi'an (CN); **Kun Li**, Xi'an (CN)

(57)

ABSTRACT

Embodiments of the present disclosure provide a multi-band antenna and a terminal device. The multi-band antenna includes a feedpoint, a matching network, a capacitor assembly, a radiation portion, and a grounding portion. The feedpoint, the matching network, the capacitor assembly, the radiation portion, and the grounding portion are connected in sequence. The matching network includes at least a serially-connected inductor and a grounded capacitor or inductor. The grounding portion is electrically connected to a ground plane. A first resonant circuit is formed from the feedpoint to the grounding portion. The first resonant circuit generates a first resonance frequency and a second resonance frequency. The first resonance frequency is used in a CRLH mode, and the second resonance frequency is used in a half-wavelength loop mode.

(21) Appl. No.: **15/564,611**

(22) PCT Filed: **Apr. 10, 2015**

(86) PCT No.: **PCT/CN2015/076367**

§ 371 (c)(1),

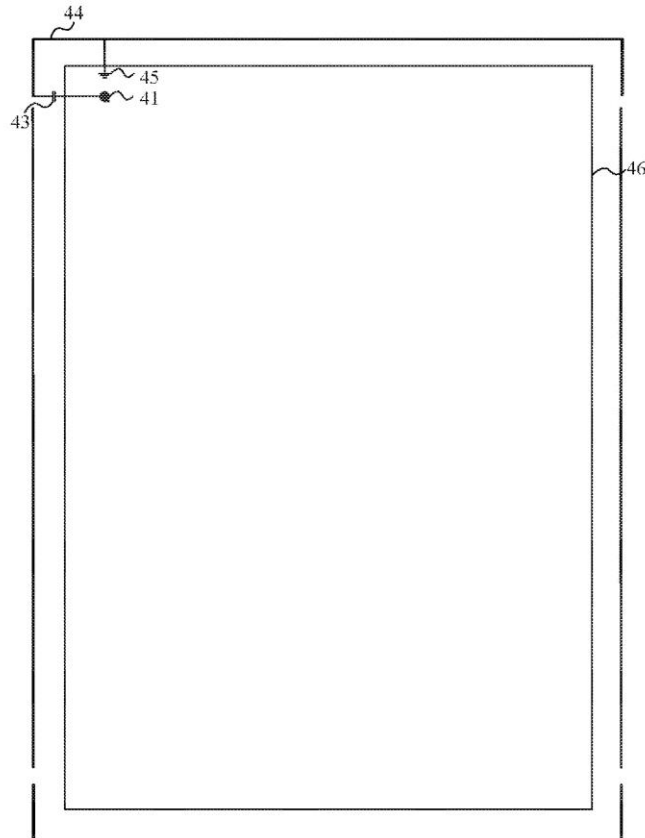
(2) Date: **Oct. 5, 2017**

Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 9/04 (2006.01)





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(19) **United States**

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

(10) **Pub. No.: US 2018/0083353 A1**

(43) **Pub. Date: Mar. 22, 2018**

(54) **ANTENNA SYSTEM AND ANTENNA STRUCTURE THEREOF**

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

CPC **H01Q 1/422** (2013.01); **H01Q 5/392** (2015.01); **H01Q 5/364** (2015.01)

(71) Applicant: **WISTRON NEWEB CORPORATION, HSINCHU (TW)**

(57)

ABSTRACT

(72) Inventors: **SHIH-HSIEN TSENG, HSINCHU (TW); CHIH-MING WANG, HSINCHU (TW)**

The instant disclosure provides an antenna system and an antenna structure thereof. The antenna structure includes a substrate, a radiation element, a coupling element, a grounding element, a conducting element, and a feeding element. The radiation element is disposed on the substrate and includes a first radiation portion for providing a first operating band, a second radiation portion for providing a second operating band, and a coupling portion connected between the first and the second radiation portion. The coupling element is disposed on the substrate. The coupling element and the coupling portion are separated from each other and coupling to each other. The feeding element is coupled between the coupling element and the grounding element and for feeding a signal. The conducting element is used to transmit a signal to the grounding element.

(21) Appl. No.: **15/689,228**

(22) Filed: **Aug. 29, 2017**

(30) **Foreign Application Priority Data**

Sep. 19, 2016 (TW) 105130164
Apr. 26, 2017 (TW) 106113968

Publication Classification

(51) **Int. Cl.**
H01Q 1/42 (2006.01)
H01Q 5/364 (2006.01)

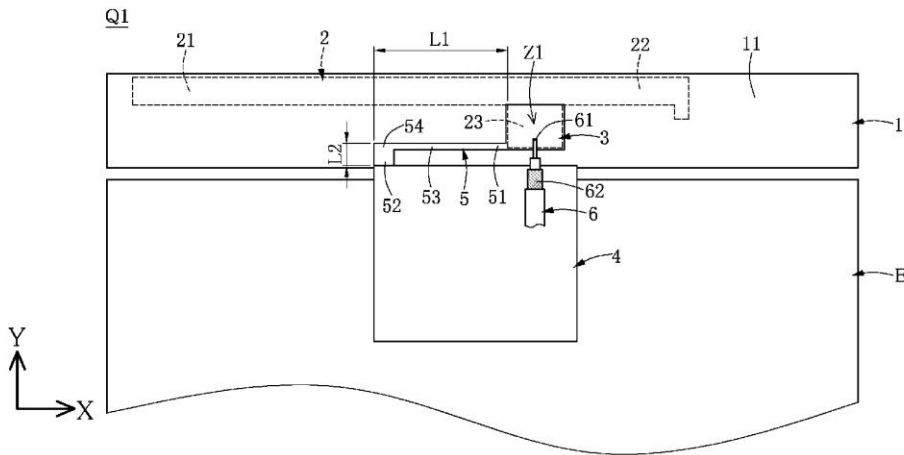


FIG. 1



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(19) **United States**

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

(10) **Pub. No.: US 2018/0083367 A1**

(43) **Pub. Date: Mar. 22, 2018**

(54) **COMMON-GROUND-PLANE ANTENNAS**

(71) Applicant: **QUALCOMM Incorporated**, San Diego, CA (US)

(72) Inventors: **Young Jun SONG**, San Diego, CA (US); **Guining SHI**, San Diego, CA (US); **Allen TRAN**, San Diego, CA (US)

(21) Appl. No.: **15/272,815**

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

Publication Classification

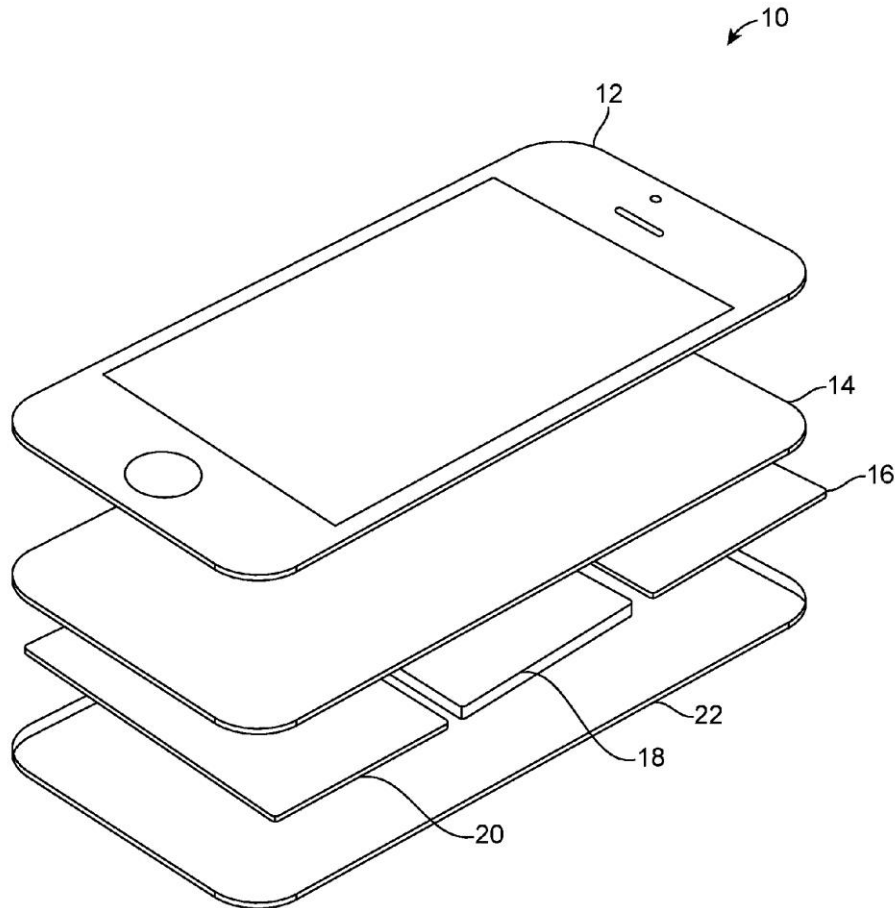
(51) **Int. Cl.**
H01Q 21/00 (2006.01)
H01Q 1/48 (2006.01)
H01Q 1/38 (2006.01)
H01Q 1/24 (2006.01)

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

CPC **H01Q 21/005** (2013.01); **H01Q 1/241** (2013.01); **H01Q 1/38** (2013.01); **H01Q 1/48** (2013.01)

(57) **ABSTRACT**

A multi-antenna structure includes: a substrate; a ground plane disposed on the substrate; a signal feed mechanism; a first antenna coupled to the ground plane via the signal feed mechanism; a second antenna coupled to the ground plane via the signal feed mechanism; and an isolator electrically coupled to the ground plane and disposed between the first antenna and the second antenna, the isolator including: a first side wall and a second side wall that define a slot; a short coupled to the first side wall and to the second side wall to define a first end of the slot; and a capacitor configured and disposed to be coupled to the first side wall and to the second side wall to define a second end of the slot.





US 20180090818A1

(19) **United States**

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

(10) **Pub. No.: US 2018/0090818 A1**

(43) **Pub. Date: Mar. 29, 2018**

(54) **LOOP ANTENNA STRUCTURE WITH ONE OR MORE AUXILIARY ELECTRONIC ELEMENTS FOR USE IN AN ELECTRONIC DEVICE**

(71) Applicant: **Motorola Mobility LLC**, Chicago, IL (US)

(72) Inventors: **Joshua Boerman**, Lake Zurich, IL (US); **Junsheng Zhao**, Vernon Hills, IL (US); **Md Rashidul Islam**, Lombard, IL (US); **Young Hun Kim**, Buffalo Grove, IL (US)

(21) Appl. No.: **15/279,369**

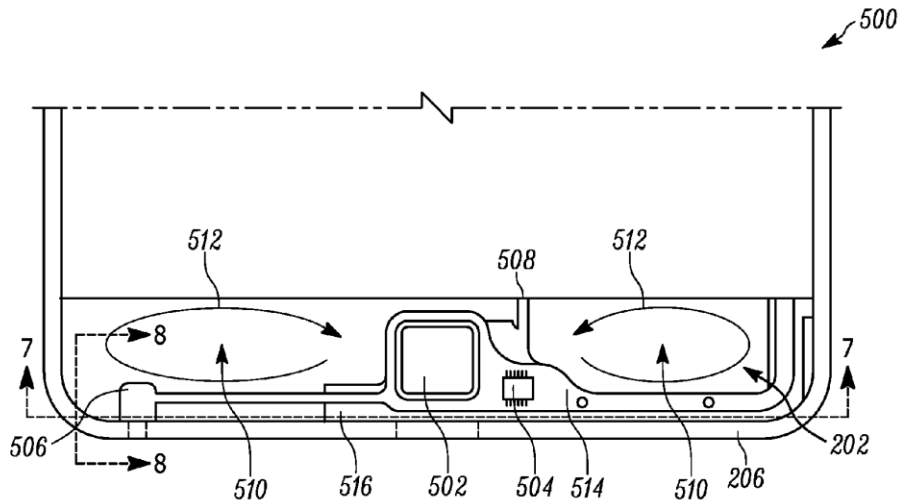
(22) Filed: **Sep. 28, 2016**

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 7/00 (2006.01)
H01Q 1/50 (2006.01)
(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 1/50** (2013.01); **H01Q 7/00** (2013.01)

(57) **ABSTRACT**

The present application provides a housing for an electronic device sub-assembly for use in an electronic device having wireless communication capabilities. The electronic device sub-assembly includes a loop antenna structure having a conductive ground structure, and a conductive loop element separate from the conductive ground structure. The conductive loop element has two ends and a conductive path, which extends between the two ends a distance away from the conductive ground structure. The conductive loop element is coupled to the conductive ground structure at each of the two ends, and the distance that the conductive path of the conductive loop element extends away from the conductive ground structure encloses an area forming a loop which is internal to the loop antenna structure. The electronic device sub-assembly further includes a signal source coupled between the conductive loop element and the conductive ground structure across the loop for applying a drive signal. The electronic device sub-assembly still further includes one or more auxiliary electronic elements, where the one or more auxiliary electronic elements each have a primary purpose that is separate from the loop antenna structure. The one or more auxiliary electronic elements each include a ground which is coupled to the conductive ground structure via the conductive loop element.





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(19) **United States**

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

(10) **Pub. No.: US 2018/0090819 A1**

(43) **Pub. Date: Mar. 29, 2018**

(54) **ANTENNA AND MOBILE TERMINAL HAVING THE SAME**

H01Q 13/10 (2006.01)

H01Q 1/52 (2006.01)

H04M 1/02 (2006.01)

(71) Applicant: **BYD COMPANY LIMITED**,
Shenzhen (CN)

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

CPC *H01Q 1/243* (2013.01); *H01Q 5/371*
(2015.01); *H04M 1/0283* (2013.01); *H01Q*
1/521 (2013.01); *H01Q 13/10* (2013.01)

(72) Inventors: **Yijin Wang**, Shenzhen (CN); **Lianhua Li**, Shenzhen (CN); **Faping Wang**, Shenzhen (CN)

(73) Assignee: **BYD COMPANY LIMITED**,
Shenzhen (CN)

(57)

ABSTRACT

(21) Appl. No.: **15/561,577**

(22) PCT Filed: **Mar. 28, 2016**

(86) PCT No.: **PCT/CN2016/077488**

§ 371 (e)(1),

(2) Date: **Sep. 26, 2017**

(30) **Foreign Application Priority Data**

Mar. 31, 2015 (CN) 201510145639.3

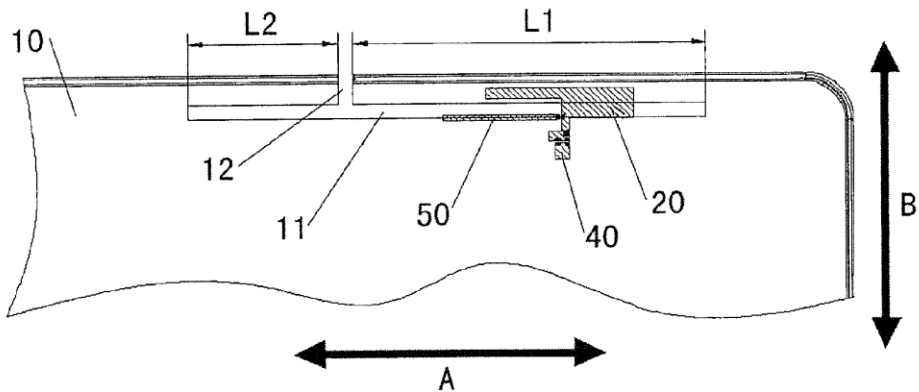
Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 5/371 (2006.01)

An antenna and a mobile terminal having the same are provided. The antenna includes: a metal shell having a first slot, penetrated through the metal shell, extending in a transverse direction of the metal shell, having two ends which are closed; and a second slot, penetrated through the metal shell, extending in a longitudinal direction of the metal shell, having a first end communicated with the first slot and a second end extending to an edge of the metal shell and opened thereat; an exciting sheet disposed at an inner side of the metal shell, covering the first slot in a width direction thereof; a dielectric filling layer disposed between the exciting sheet and the metal shell, configured to fill the first and second slots; and an expanding resonance branch, disposed on a surface of the dielectric filling layer facing away from the metal shell, connected to the exciting sheet.





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(19) **United States**

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

(10) **Pub. No.: US 2018/0090821 A1**
(43) **Pub. Date: Mar. 29, 2018**

(54) **ELECTRONIC DEVICE COMPRISING ANTENNA**

Publication Classification

(71) Applicant: **Samsung Electronics Co., Ltd.**,
Gyeonggi-do (KR)
(72) Inventors: **Sang Ha LEE**, Gyeonggi-do (KR);
Kyung Jae LEE, Seoul (KR); **Jae Ho LIM**,
Gyeonggi-do (KR); **Dong Hwan KIM**,
Gyeonggi-do (KR); **Young Jun KIM**,
Gwangju (KR); **Un KIM**, Gyeonggi-do (KR);
Jong Hoon KIM, Gyeonggi-do (KR); **Min Seok PARK**,
Seoul (KR)

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 13/10 (2006.01)
H01Q 1/38 (2006.01)
H01Q 5/328 (2006.01)
H01Q 9/04 (2006.01)
(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 13/10**
(2013.01); **H01Q 9/04** (2013.01); **H01Q 5/328**
(2015.01); **H01Q 1/38** (2013.01)

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

(21) Appl. No.: **15/720,872**

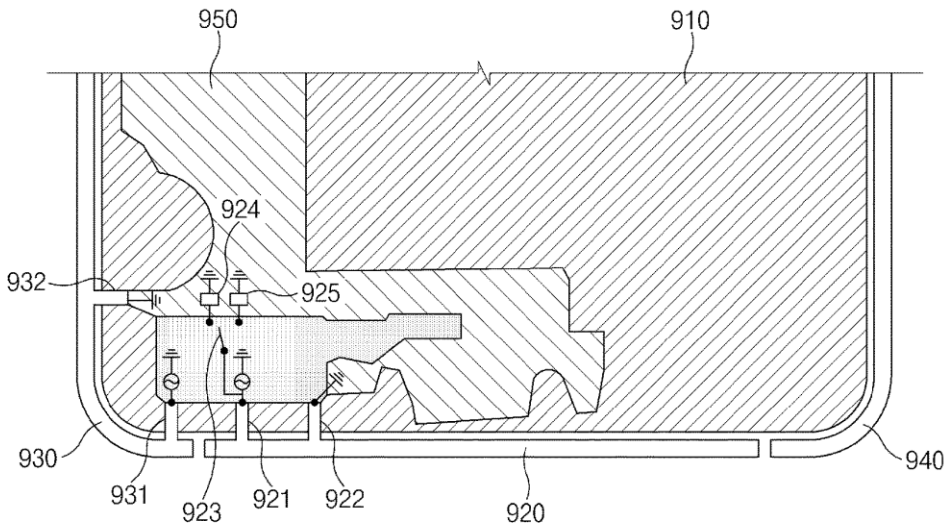
(22) Filed: **Sep. 29, 2017**

(30) **Foreign Application Priority Data**

Sep. 29, 2016 (KR) 10-2016-0125917

(57) **ABSTRACT**

An electronic device includes a metal housing, a conductive member disposed adjacent to the metal housing, a plurality of ground parts including a first ground part electrically connected with a first point of the conductive member and a second ground part electrically connected with a second point of the conductive member, a ground plate electrically connected with the metal housing and electrically connected with the conductive member via the plurality of ground parts, and a feeding part electrically connected with the conductive member.





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(19) **United States**

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

(10) **Pub. No.: US 2018/0090822 A1**

(43) **Pub. Date: Mar. 29, 2018**

(54) **COMMUNICATION DEVICE WITH METAL-FRAME HALF-LOOP ANTENNA ELEMENT**

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)
H01Q 7/00 (2006.01)
(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 7/00* (2013.01); *H01Q 1/48* (2013.01)

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

(72) Inventors: **Kin-Lu Wong**, New Taipei City (TW);
Hsuan-Jui Chang, New Taipei City (TW)

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

(21) Appl. No.: **15/807,591**

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

Related U.S. Application Data

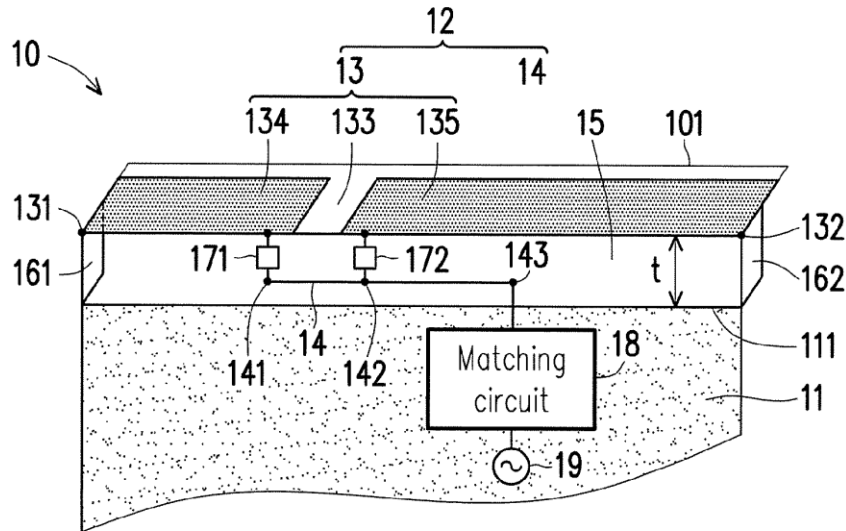
(63) Continuation of application No. 15/216,424, filed on Jul. 21, 2016, now Pat. No. 9,853,351.

(30) **Foreign Application Priority Data**

May 23, 2016 (TW) 105115954

(57) **ABSTRACT**

A communication device includes a ground plane and an antenna element. The antenna element includes a radiation metal strip and a feed metal line. The radiation metal strip is divided into a first metal strip and a second metal strip by a gap. The first metal strip is electrically connected to the ground plane by a first metal section. The second metal strip is electrically connected to the ground plane by a second metal section. The feed metal line has a first to a third connection points. The first connection point is coupled to the first metal strip through a first capacitive element. The second connection point is coupled to the second metal strip through a second capacitive element. The third connection point is a feeding point of the antenna element. The second connection point is located between the first connection point and the third connection point.





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(19) **United States**

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

(10) **Pub. No.: US 2018/0090823 A1**

(43) **Pub. Date: Mar. 29, 2018**

(54) **ANTENNA OF ELECTRONIC DEVICE**

(30) **Foreign Application Priority Data**

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

Aug. 18, 2014 (KR) 10-2014-0106730

Publication Classification

(72) Inventors: **Soon Ho Hwang**, Seoul (KR); **Ui Chul Jeong**, Gyeonggi-do (KR); **Sung Koo Park**, Gyeonggi-do (KR); **Chan Kyu An**, Incheon (KR); **Joon Ho Byun**, Gyeonggi-do (KR); **Sang Keun Yoo**, Gyeonggi-do (KR); **Yoon Jae Lee**, Gyeonggi-do (KR); **Jin Woo Jung**, Seoul (KR); **Jae Bong Chun**, Gyeonggi-do (KR)

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)
H01Q 9/14 (2006.01)
H01Q 9/42 (2006.01)

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 1/48* (2013.01); *H01Q 9/42* (2013.01); *H01Q 9/145* (2013.01)

(21) Appl. No.: **15/822,755**

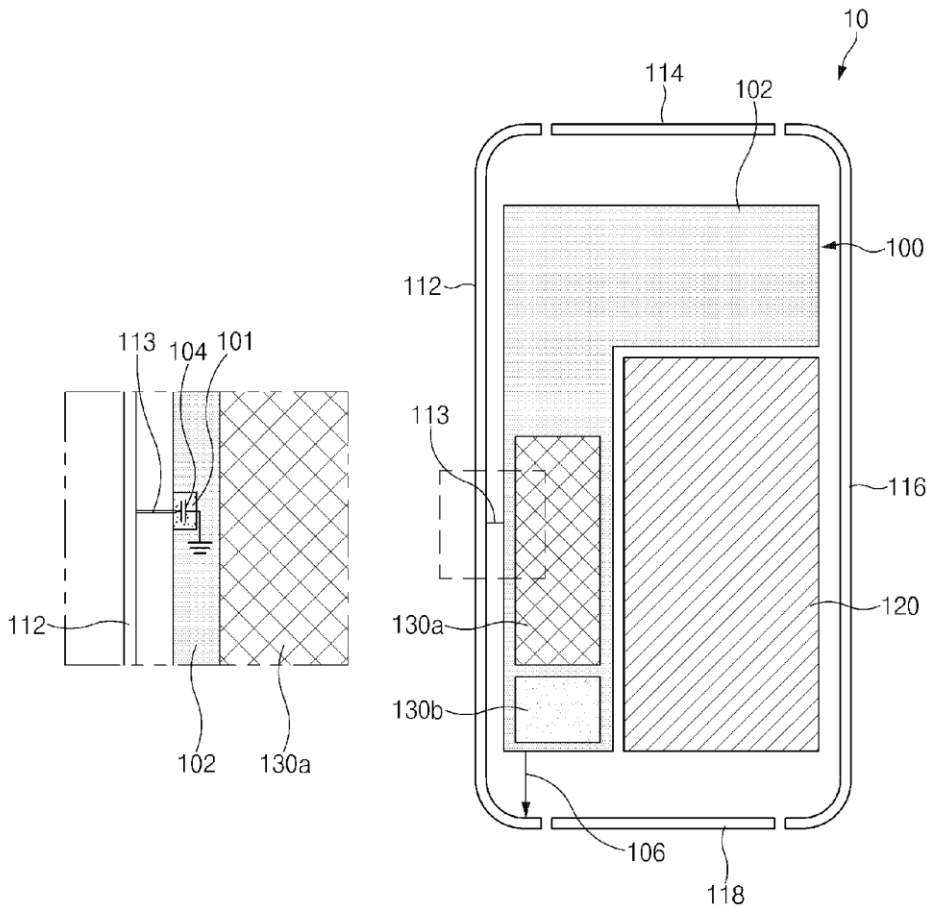
(57) **ABSTRACT**

(22) Filed: **Nov. 27, 2017**

An antenna of an electronic device is provided, which includes a radiator including at least part of a metal housing of the electronic device; a capacitor connected to the radiator; a feeding part connected to the radiator; and a ground part connected to the capacitor.

Related U.S. Application Data

(63) Continuation of application No. 14/829,305, filed on Aug. 18, 2015, now Pat. No. 9,859,607.





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(19) **United States**

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

(10) **Pub. No.: US 2018/0090840 A1**

(43) **Pub. Date: Mar. 29, 2018**

(54) **ANTENNA STRUCTURE**

H01Q 9/04 (2006.01)

H01Q 13/10 (2006.01)

H01Q 1/52 (2006.01)

H01Q 1/22 (2006.01)

(71) Applicants: **Yen-Hao Yu**, Taipei City (TW);
Li-Chun Lee, Taipei City (TW);
Jui-Hung Lai, Taipei City (TW);
Shih-Chia Liu, Taipei City (TW);
Jhin-Ciang Chen, Taipei City (TW);
Chao-Lin Wu, Taipei City (TW)

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

CPC **H01Q 5/371** (2015.01); **H01Q 1/243**
(2013.01); **H01Q 9/0421** (2013.01); **H04L**
69/18 (2013.01); **H01Q 1/52** (2013.01); **H01Q**
1/2266 (2013.01); **H01Q 13/106** (2013.01)

(72) Inventors: **Yen-Hao Yu**, Taipei City (TW);
Li-Chun Lee, Taipei City (TW);
Jui-Hung Lai, Taipei City (TW);
Shih-Chia Liu, Taipei City (TW);
Jhin-Ciang Chen, Taipei City (TW);
Chao-Lin Wu, Taipei City (TW)

(57)

ABSTRACT

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

An antenna structure includes a substrate, a metal element, and a feeding element. The metal element has an open slot. The open slot forms a first resonant path. The substrate is disposed on the metal element. The feeding element is disposed on the substrate, and the metal element and the feeding element are respectively disposed on two opposite sides of the substrate. The feeding element includes a feeding end and a shorting end electrically connected to the metal element. An orthogonal projection of the feeding element on the metal element is partially overlapped with the open slot. The feeding element forms a second resonant path extending from the feeding end to the shorting end. The antenna structure operates in a first band through the first resonant path and operates in a second band through the second resonant path.

(21) Appl. No.: **15/716,481**

(22) Filed: **Sep. 26, 2017**

Related U.S. Application Data

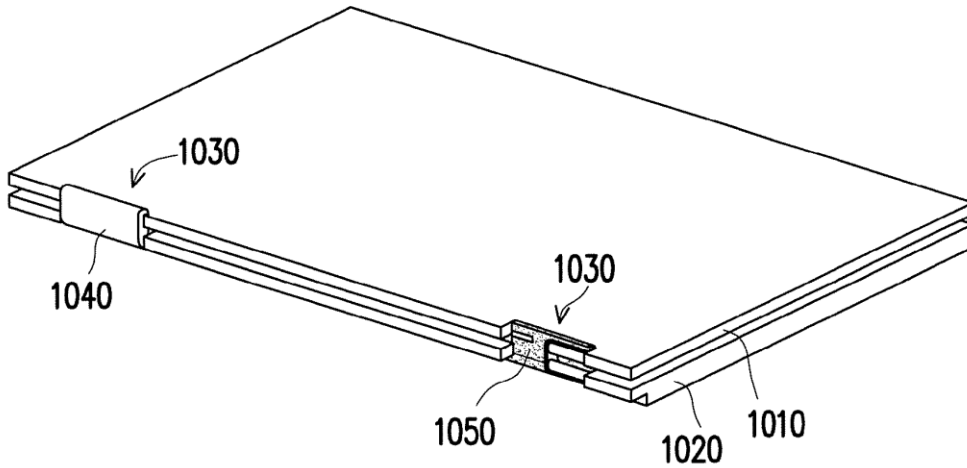
(60) Provisional application No. 62/401,831, filed on Sep. 29, 2016.

Publication Classification

(51) **Int. Cl.**

H01Q 5/371 (2006.01)

H01Q 1/24 (2006.01)



1000



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(19) **United States**

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

(10) **Pub. No.: US 2018/0090847 A1**

(43) **Pub. Date: Mar. 29, 2018**

(54) **HYBRID ELECTRONIC DEVICE ANTENNAS HAVING PARASITIC RESONATING ELEMENTS**

H01Q 1/48 (2006.01)

H01Q 9/28 (2006.01)

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

CPC *H01Q 13/10* (2013.01); *H01Q 9/285* (2013.01); *H01Q 1/48* (2013.01); *H01Q 1/241* (2013.01)

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

(72) Inventors: **Pietro Romano**, Mountain View, CA (US); **Harish Rajagopalan**, San Jose, CA (US); **Umar Azad**, San Jose, CA (US); **Lu Zhang**, West Lafayette, IN (US); **Rodney A. Gomez Angulo**, Sunnyvale, CA (US); **Mattia Pascolini**, San Francisco, CA (US)

(21) Appl. No.: **15/274,328**

(22) Filed: **Sep. 23, 2016**

Publication Classification

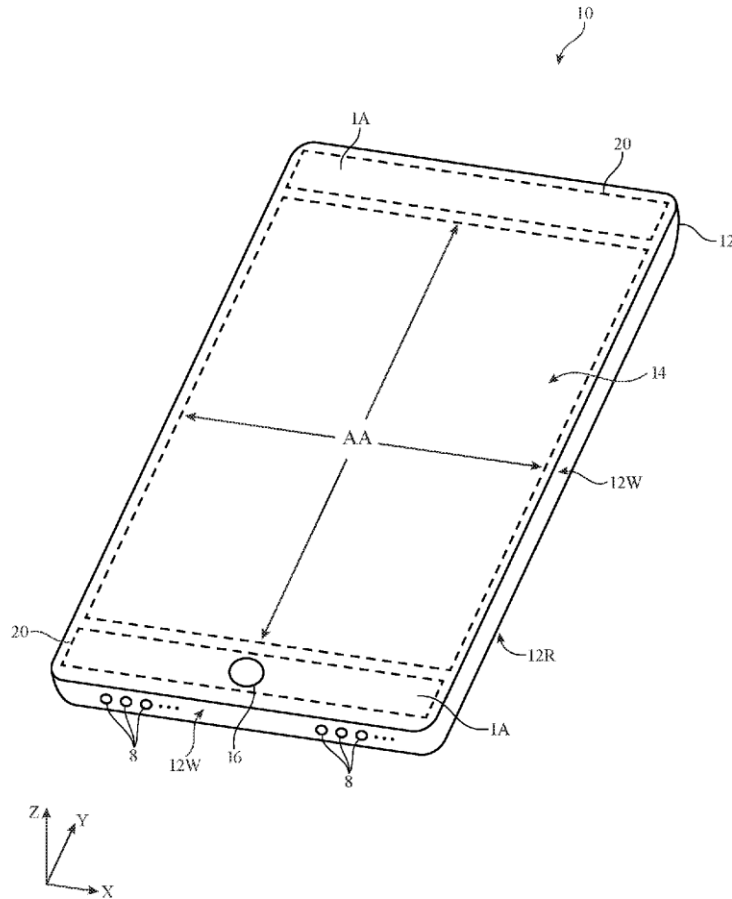
(51) **Int. Cl.**

H01Q 13/10 (2006.01)

H01Q 1/24 (2006.01)

(57) **ABSTRACT**

An electronic device may have a hybrid antenna that includes a slot resonating element formed from a slot in a ground plane and a planar resonating element formed over the slot. A parasitic element may be disposed over the planar element. A switch may couple the parasitic element to the ground. A tunable circuit may couple the planar element to the ground. The switch and tunable circuit may be placed in different tuning states. In a first state, the tunable circuit and switch form open circuits. In a second state, the tunable circuit may an open circuit and the switch is closed. In a third state, the tunable circuit forms a return path and the switch forms an open circuit. This may allow the antenna to operate with satisfactory efficiency in low, mid, and high bands despite volume constraints imposed on the antenna.





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(19) **United States**

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

(10) **Pub. No.: US 2018/0090850 A1**

(43) **Pub. Date: Mar. 29, 2018**

(54) **ANTENNA STRUCTURE**

Publication Classification

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(51) **Int. Cl.**
H01Q 21/06 (2006.01)
H01Q 13/10 (2006.01)
H01Q 9/04 (2006.01)
H01Q 5/50 (2006.01)

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(52) **U.S. Cl.**
CPC **H01Q 21/064** (2013.01); **H01Q 5/50**
(2015.01); **H01Q 9/0457** (2013.01); **H01Q**
13/10 (2013.01)

(57) **ABSTRACT**

An antenna structure including a metal element, a first capacitor, a second capacitor, a feeding element and an adjustment element is provided. The metal element has an open slot, and the open slot has an open end, a first slot and a second slot. The first slot and the second slot are respectively disposed on two opposite sides of the open end. The feeding element crosses the first slot. A first end of the feeding element has a feeding point, and a second end of the feeding element is electrically connected to the metal element through the first capacitor. The adjustment element is disposed in the second slot. A first end of the adjustment element is electrically connected to the metal element, and a second end of the adjustment element is electrically connected to the metal element through the second capacitor.

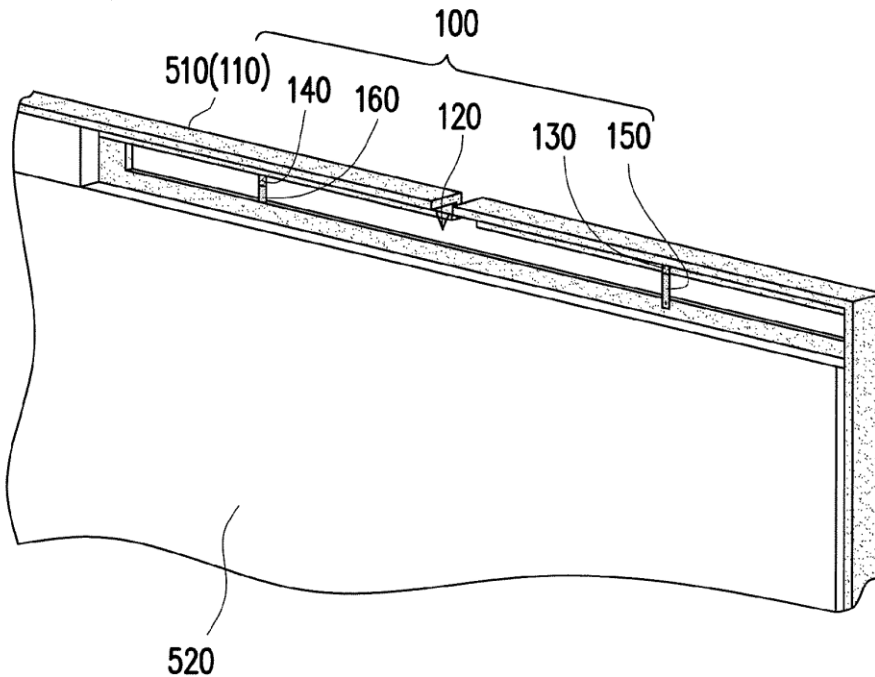
(73) Assignee: **COMPAL ELECTRONICS, INC.**,
Taipei City (TW)

(21) Appl. No.: **15/719,567**

(22) Filed: **Sep. 29, 2017**

Related U.S. Application Data

(60) Provisional application No. 62/401,831, filed on Sep. 29, 2016.





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(19) **United States**

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

(10) **Pub. No.: US 2018/0097276 A1**

(43) **Pub. Date: Apr. 5, 2018**

(54) **ANTENNA APPARATUS**

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

(72) Inventors: **Takashi Yamagajo**, Yokosuka (JP);
Manabu Kai, Yokohama (JP)

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

(21) Appl. No.: **15/706,568**

(22) Filed: **Sep. 15, 2017**

(30) **Foreign Application Priority Data**

Oct. 4, 2016 (JP) 2016-196592

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
G06K 19/077 (2006.01)
H01Q 1/48 (2006.01)
H01Q 9/42 (2006.01)

H01Q 1/38 (2006.01)

H01Q 13/08 (2006.01)

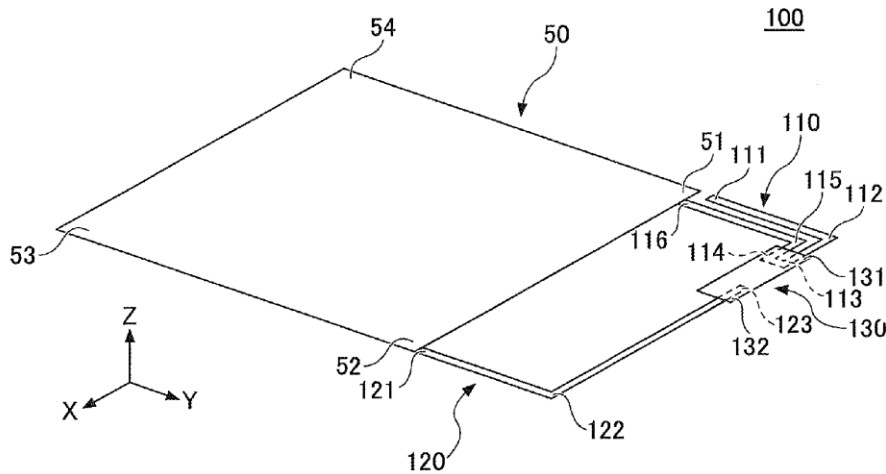
(52) **U.S. Cl.**

CPC **H01Q 1/24** (2013.01); **G06K 19/077** (2013.01); **H01Q 1/48** (2013.01); **H01Q 5/364** (2015.01); **H01Q 1/38** (2013.01); **H01Q 13/08** (2013.01); **H01Q 9/42** (2013.01)

(57)

ABSTRACT

An antenna apparatus includes a ground plane having an edge; a feed element having a feed point located close to the edge and a first open end, the feed element extending from the feed point to the first open end and serving as an inductor; a parasitic element having a second open end disposed a predetermined distance away from the first open end and a connection end connected to the edge, the parasitic element extending from the connection end to the second open end, a length from the connection end to the second open end being set to be a quarter wavelength of an electrical length of a wavelength in a communication frequency; and a metal member disposed between the first and second open ends via a predetermined interval to cover the first and second open ends to constitute a predetermined capacity between the first and second open ends.





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(19) **United States**

(12) **Patent Application Publication**
Koga

(10) **Pub. No.: US 2018/0097277 A1**

(43) **Pub. Date: Apr. 5, 2018**

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

H01Q 1/22 (2006.01)

H01Q 9/04 (2006.01)

H01Q 9/42 (2006.01)

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

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

CPC *H01Q 1/243* (2013.01); *H01Q 1/38*

(2013.01); *H01Q 5/357* (2015.01); *H01L*

2223/6677 (2013.01); *H01Q 1/2283* (2013.01);

H01Q 9/0407 (2013.01); *H01Q 9/42*

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

(72) Inventor: **Yohei Koga**, Kawasaki (JP)

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

(21) Appl. No.: **15/702,295**

(57) **ABSTRACT**

An antenna device includes a ground plane configured to have an end side; a ground element configured to have a first end and a second end; a first radiation element configured to have a first line extending upright with respect to the ground element from a grounded end, a second line coupled to the first line, and a feed point; a second radiation element configured to have a third line, and a fourth line coupled to the third line; a first parasitic element configured to have a first parasitic line, and a second parasitic line coupled to the first parasitic line and extending along the ground element toward the first end; and a second parasitic element configured to have a fifth line located close to a tip of the second parasitic line, and a sixth line extending along the ground element from a tip of the fifth line.

(22) Filed: **Sep. 12, 2017**

(30) **Foreign Application Priority Data**

Oct. 3, 2016 (JP) 2016-195947

Publication Classification

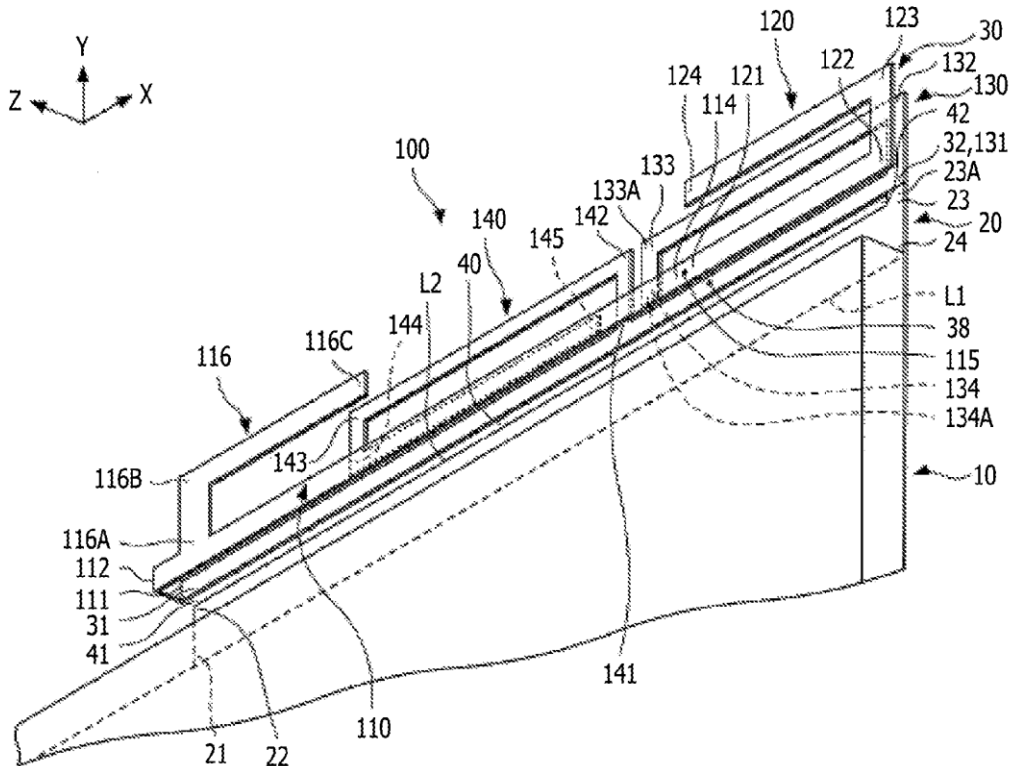
(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 1/38 (2006.01)

H01Q 5/357 (2006.01)

H01Q 1/52 (2006.01)





US 20180097287A1

(19) **United States**

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

(10) **Pub. No.: US 2018/0097287 A1**

(43) **Pub. Date: Apr. 5, 2018**

(54) **ELECTRONIC APPARATUS**

Publication Classification

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

(72) Inventors: **Yasuharu MATSUOKA**, Osaka (JP); **Kazuya Nakano**, Osaka (JP); **Kenji Nishikawa**, Hyogo (JP); **Keita Endo**, Osaka (JP); **Shintarou Tanaka**, Osaka (JP); **Ryo Yonezawa**, Kyoto (JP); **Kazuki Zusho**, Osaka (JP)

(51) **Int. Cl.**
H01Q 5/35 (2006.01)
H01Q 1/24 (2006.01)
H01Q 5/10 (2006.01)
H01Q 21/28 (2006.01)
H01Q 1/22 (2006.01)
(52) **U.S. Cl.**
CPC *H01Q 5/35* (2015.01); *H01Q 1/24* (2013.01); *H01Q 1/2266* (2013.01); *H01Q 21/28* (2013.01); *H01Q 5/10* (2015.01)

(21) Appl. No.: **15/820,228**

(22) Filed: **Nov. 21, 2017**

Related U.S. Application Data

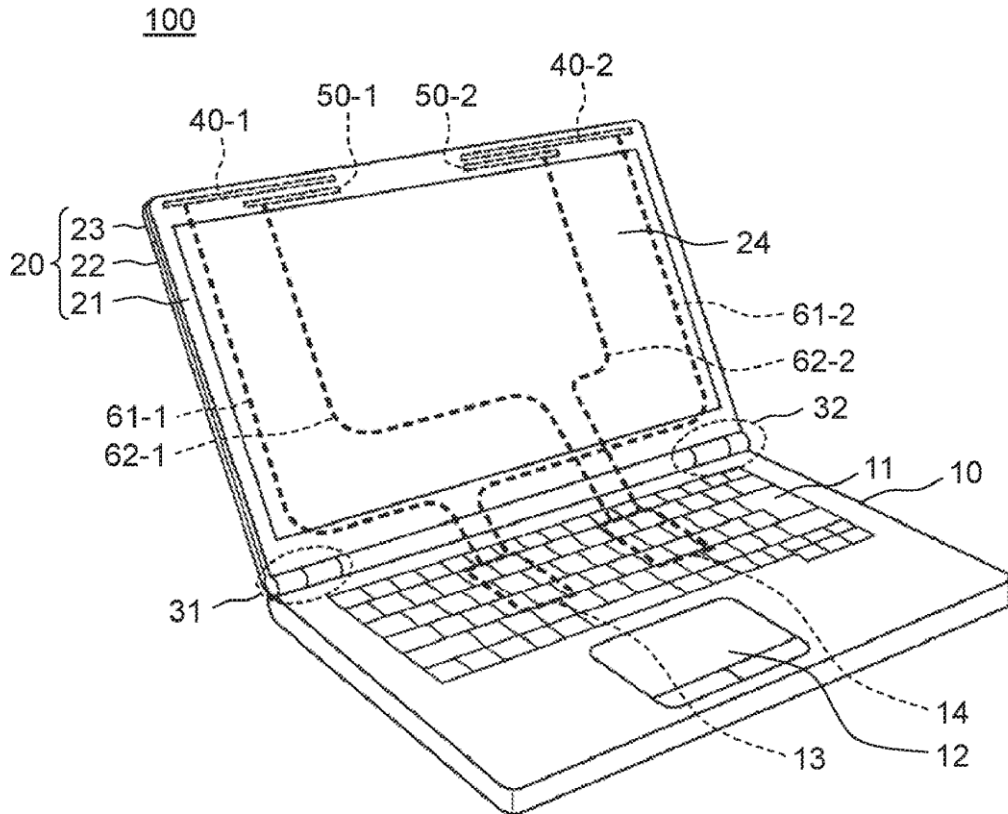
(63) Continuation of application No. PCT/JP2016/004512, filed on Oct. 7, 2016.

Foreign Application Priority Data

Oct. 30, 2015 (JP) 2015-214879

(57) **ABSTRACT**

An electronic apparatus includes: a first antenna board having a plate shape and extending with a first length; a second antenna board having a plate shape and extending with a second length; and a rectangular parallelepiped upper casing for accommodating the first antenna board and the second antenna board. The first antenna board and the second antenna board are arranged such that a longitudinal direction of the first antenna board and a longitudinal direction of the second antenna board are parallel to one side of one main surface of the rectangular parallelepiped upper casing. The first antenna board and the second antenna board are arranged parallel to each other.





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(19) **United States**

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

(10) **Pub. No.: US 2018/0102212 A1**

(43) **Pub. Date: Apr. 12, 2018**

(54) **ELECTRONIC DEVICE FOR REDUCING INTERFERENCE BETWEEN A CHARGING COIL AND AN ANTENNA**

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

(72) Inventors: **Woo-Ram LEE**, Gyeonggi-do (KR);
Ki-Hyun Kim, Gyeonggi-do (KR);
Jin-Hyoung Park, Gangwon-do (KR);
Kil-Soo Ko, Gyeonggi-do (KR);
Joon-Il Kim, Seoul (KR); **Sung-Kweon Park**,
Gyeonggi-do (KR); **Se-Ho Park**,
Gyeonggi-do (KR)

(21) Appl. No.: **15/837,429**

(22) Filed: **Dec. 11, 2017**

Related U.S. Application Data

(63) Continuation of application No. 14/920,299, filed on Oct. 22, 2015, now Pat. No. 9,859,053, which is a continuation of application No. 13/733,667, filed on Jan. 3, 2013, now Pat. No. 9,172,263.

(30) **Foreign Application Priority Data**

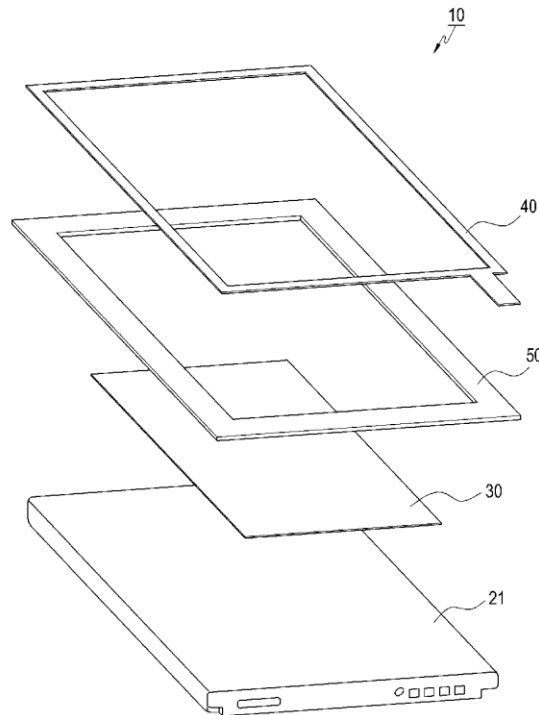
Jan. 4, 2012 (KR) 10-2012-0000879

Publication Classification

(51) **Int. Cl.**
H01F 38/14 (2006.01)
H01M 2/10 (2006.01)
H01M 10/42 (2006.01)
H01M 10/44 (2006.01)
H04B 15/02 (2006.01)
H02J 5/00 (2006.01)
H02J 7/00 (2006.01)
H02J 7/02 (2006.01)
H01Q 7/00 (2006.01)
(52) **U.S. Cl.**
CPC *H01F 38/14* (2013.01); *H01M 2/1066*
(2013.01); *H01M 10/4257* (2013.01); *H01M*
10/44 (2013.01); *H01Q 7/00* (2013.01); *H02J*
5/005 (2013.01); *H02J 7/0042* (2013.01);
H02J 7/025 (2013.01); *H04B 15/02* (2013.01)

(57) **ABSTRACT**

Disclosed is an electronic device including a battery, a case covering the battery, a wireless charging coil positioned between the battery and the case; and a communication antenna positioned between the battery and the wireless charging coil, wherein one of the communication antenna and the wireless charging coil is positioned to surround the other one of the communication antenna and the wireless charging coil, and wherein the communication antenna is spaced from the wireless charging coil by a predetermined distance and prevents interference between the communication antenna and the wireless charging coil.





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(19) **United States**

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

(10) **Pub. No.: US 2018/0102589 A1**

(43) **Pub. Date: Apr. 12, 2018**

(54) **ANTENNA SYSTEM**

(71) Applicant: **PEGATRON CORPORATION,**
TAIPEI CITY (TW)

(72) Inventors: **Chien-Yi WU,** TAIPEI CITY (TW);
Chao-Hsu WU, TAIPEI CITY (TW);
Shih-Keng HUANG, TAIPEI CITY
(TW); **Yu-Yi CHU,** TAIPEI CITY
(TW); **Ya-Jyun LI,** TAIPEI CITY (TW)

H01Q 1/24 (2006.01)

H01Q 1/38 (2006.01)

H01Q 5/357 (2006.01)

H01Q 21/08 (2006.01)

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

CPC **H01Q 1/523** (2013.01); **H01Q 5/335**

(2015.01); **H01Q 21/08** (2013.01); **H01Q 1/38**

(2013.01); **H01Q 5/357** (2015.01); **H01Q 1/24**

(2013.01)

(21) Appl. No.: **15/641,335**

(22) Filed: **Jul. 5, 2017**

(30) **Foreign Application Priority Data**

Oct. 6, 2016 (TW) 105132400

Publication Classification

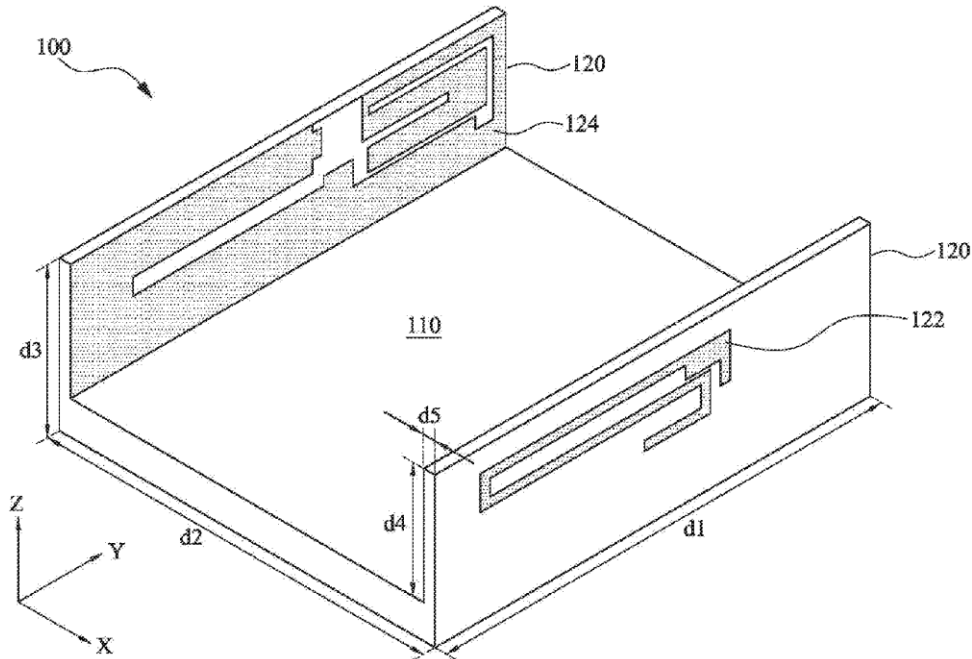
(51) **Int. Cl.**

H01Q 1/52 (2006.01)

H01Q 5/335 (2006.01)

(57) **ABSTRACT**

An antenna system includes a system ground and two antenna units. The two antenna units are individually disposed on two opposite sides of the system ground and symmetrically mirrored with each other. Each antenna unit includes a circuit board, a first antenna pattern and a second antenna pattern. The first antenna pattern is disposed at one side of the circuit board. The first antenna pattern resonates to generate a first high resonant frequency. The second antenna pattern is disposed at the other side of the circuit board. The first antenna pattern resonates with part of the second antenna pattern to generate a low resonant frequency.





US 20180102596A1

(19) **United States**

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

(10) **Pub. No.: US 2018/0102596 A1**

(43) **Pub. Date: Apr. 12, 2018**

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

Publication Classification

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

(51) **Int. Cl.**
H01Q 21/30 (2006.01)
H01Q 13/10 (2006.01)
H01Q 1/24 (2006.01)
H01Q 5/364 (2006.01)
H01Q 1/38 (2006.01)

(72) Inventors: **Dong-Ryul SHIN**, Daegu (KR); **Min SAKONG**, Gumi-si (KR); **Joon-Bo PARK**, Busan (KR); **Byung-Chan JANG**, Gumi-si (KR); **Soo-Young JANG**, Daegu (KR); **Jin-Woo JUNG**, Seoul (KR)

(52) **U.S. Cl.**
CPC *H01Q 21/30* (2013.01); *H01Q 13/10* (2013.01); *H01Q 1/38* (2013.01); *H01Q 5/364* (2015.01); *H01Q 1/243* (2013.01)

(21) Appl. No.: **15/836,123**

(57) **ABSTRACT**

(22) Filed: **Dec. 8, 2017**

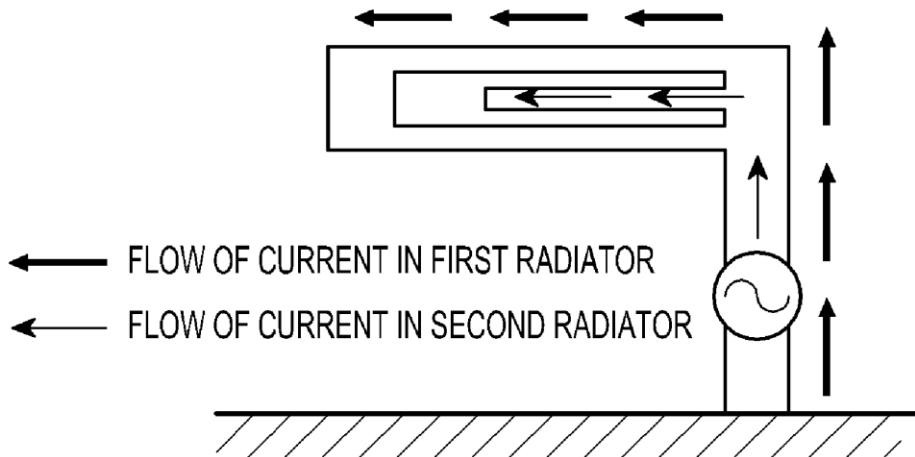
An antenna device and an electronic device including the same are provided. The antenna device includes a first radiator in which a slot is formed, a second radiator, at least a portion of which is disposed in the slot, and a feeder configured to feed the same electricity to the first radiator and the second radiator. The antenna device may have many resonance frequencies in the same installation space, allowing efficient use of the internal space of the electronic device. Moreover, the antenna device and the electronic device including the same may be implemented variously according to various embodiments.

Related U.S. Application Data

(63) Continuation of application No. 14/878,468, filed on Oct. 8, 2015, now Pat. No. 9,871,304.

Foreign Application Priority Data

(30) Oct. 17, 2014 (KR) 10-2014-0140649





US 20180108984A1

(19) **United States**

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

(10) **Pub. No.: US 2018/0108984 A1**

(43) **Pub. Date: Apr. 19, 2018**

(54) **ANTENNA ASSEMBLY AND SELF-CURING DECOUPLING METHOD FOR REDUCING MUTUAL COUPLING OF COUPLED ANTENNAS**

(52) **U.S. Cl.**
CPC **H01Q 1/52** (2013.01); **H01Q 9/0421** (2013.01); **H01Q 5/392** (2015.01)

(71) Applicant: **The Chinese University of Hong Kong, Shantin (CN)**

(57) **ABSTRACT**

(72) Inventors: **Ke-Li Wu, Shatin (CN); Jiangwei SUI, Nanyang (CN); Dacheng WEI, Guangzhou (CN)**

The disclosure provides antenna assemblies and methods for reducing mutual coupling of coupled antennas. According to an embodiment, the antenna assembly, comprises: a first antenna; and a second antenna coupled with the first antenna; wherein a first capacitive load is provided to the first antenna at a first position of the first antenna so that a mutual coupling between the first antenna and the second antenna is reduced. According to the present disclosure, at least some of the following advantages may be achieved: 1) no any component that connects or structure between coupled antennas is required; 2) the capacitive load is very little frequency dependent so that the method is highly suitable for antenna decoupling at low frequencies; 3) the required capacitive load takes almost no space in the circuit layout; and 4) the load does not noticeably change antenna radiation patterns.

(21) Appl. No.: **15/295,552**

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

Publication Classification

(51) **Int. Cl.**
H01Q 1/52 (2006.01)
H01Q 5/392 (2006.01)
H01Q 9/04 (2006.01)

