



US009798906B2

(12) **United States Patent**
Yasutomi et al.

(10) **Patent No.:** **US 9,798,906 B2**
(45) **Date of Patent:** **Oct. 24, 2017**

(54) **TRANSACTION TERMINAL DEVICE**

(71) Applicant: **PANASONIC INTELLECTUAL
PROPERTY MANAGEMENT CO.,
LTD.**, Osaka (JP)

(72) Inventors: **Kenya Yasutomi**, Osaka (JP); **Tsutomu
Kojitani**, Osaka (JP)

(73) Assignee: **PANASONIC INTELLECTUAL
PROPERTY MANAGEMENT CO.,
LTD.**, Osaka (JP)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/366,388**

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

(65) **Prior Publication Data**
US 2017/0083726 A1 Mar. 23, 2017

Related U.S. Application Data

(63) Continuation of application No. 14/707,544, filed on
May 8, 2015, now Pat. No. 9,542,575.

(30) **Foreign Application Priority Data**

Jul. 31, 2014 (JP) 2014-155797

(51) **Int. Cl.**
G06K 5/00 (2006.01)
G06K 7/08 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC **G06K 7/084** (2013.01); **G07G 1/0018**
(2013.01); **G07G 1/12** (2013.01); **H01Q**
1/2216 (2013.01);
(Continued)

(58) **Field of Classification Search**

USPC 235/380, 383, 449, 475, 493, 440
See application file for complete search history.

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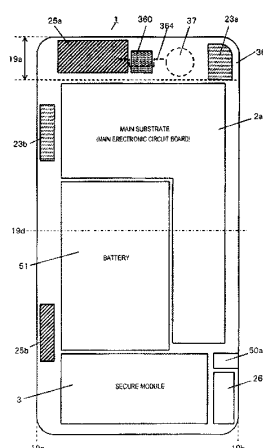
Primary Examiner — Tuyen K Vo

(74) *Attorney, Agent, or Firm* — Greenblum & Bernstein,
P.L.C.

(57) **ABSTRACT**

A transaction terminal device is provided. The device includes a magnetic head module that supports a magnetic head which reads a magnetic card. A plurality of communication antennas that communicate according to different standards are arranged at a same end of a housing as the magnetic head module. The magnetic head module includes a line-shaped metal urging member that exerts urging force to the magnetic head in a passing path direction of the magnetic card. The line-shaped metal urging member has a first straight portion exerting the urging force to the magnetic head in a direction perpendicular to the first straight portion when viewed from a side view of the transaction terminal device. Even though a communication antenna is arranged close to the magnetic head, a reradiated radio wave generated from the metal urging member of the magnetic head is reduced.

19 Claims, 6 Drawing Sheets





US009799946B2

(12) **United States Patent**
Nakano et al.

(10) **Patent No.:** **US 9,799,946 B2**

(45) **Date of Patent:** ***Oct. 24, 2017**

(54) **COMMUNICATION TERMINAL DEVICE**

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

(72) Inventors: **Shinichi Nakano**, Nagaokakyo (JP);
Hiroyuki Kubo, Nagaokakyo (JP);
Kuniaki Yosui, Nagaokakyo (JP)

(73) Assignee: **Murata Manufacturing Co., Ltd.**,
Kyoto (JP)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

This patent is subject to a terminal dis-
claimer.

(21) Appl. No.: **14/955,133**

(22) Filed: **Dec. 1, 2015**

(65) **Prior Publication Data**

US 2016/0086074 A1 Mar. 24, 2016

Related U.S. Application Data

(63) Continuation of application No. 13/760,196, filed on
Feb. 6, 2013, now Pat. No. 9,236,651, which is a
(Continued)

(30) **Foreign Application Priority Data**

Oct. 21, 2010 (JP) 2010-236127
Oct. 21, 2010 (JP) 2010-236141

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 7/06 (2006.01)

(Continued)

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

CPC **H01Q 1/243** (2013.01); **G06K 19/0723**
(2013.01); **G06K 19/07773** (2013.01);
(Continued)

(58) **Field of Classification Search**

None
See application file for complete search history.

(56) **References Cited**

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343/702
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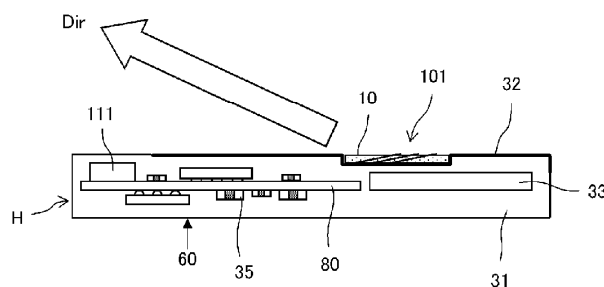
Primary Examiner — Robert Karacsony

(74) *Attorney, Agent, or Firm* — Keating & Bennett, LLP

(57) **ABSTRACT**

An RFID antenna is arranged in the vicinity of a metal
portion of and on an outer surface side of a casing of a
communication terminal device. The RFID antenna includes
a magnetic core, and a coil conductor that is wound around
the magnetic core. The coil conductor includes a first
conductor portion positioned on a first main surface side of
the magnetic core and a second conductor portion positioned
on the second main surface side of the magnetic core and
arranged at a different position than the first conductor
portion when viewed in plan from the direction of the first
and second main surfaces, and the coil conductor is arranged
such that the first main surface side of the magnetic core is
on the metal portion side and such that the first conductor
portion of the coil conductor faces a leading end portion of
the casing.

21 Claims, 8 Drawing Sheets





US009799947B1

(12) **United States Patent**
Lim et al.

(10) **Patent No.:** **US 9,799,947 B1**
(45) **Date of Patent:** ***Oct. 24, 2017**

(54) **MODULAR DEVICE SYSTEM DESENSE
REDUCTION**

- (71) Applicant: **Motorola Mobility LLC**, Chicago, IL (US)
- (72) Inventors: **David Lim**, Glenview, IL (US); **Paul L Fordham**, Wauconda, IL (US); **Mark Janninck**, Glen Ellyn, IL (US)
- (73) Assignee: **Motorola Mobility LLC**, Chicago, IL (US)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.
- This patent is subject to a terminal disclaimer.

(21) Appl. No.: **15/174,593**

(22) Filed: **Jun. 6, 2016**

(51) **Int. Cl.**
H04M 1/00 (2006.01)
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)
H01Q 13/10 (2006.01)
H04M 1/02 (2006.01)

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 1/48** (2013.01); **H01Q 13/10** (2013.01); **H04M 1/0266** (2013.01); **H04M 1/0274** (2013.01)

(58) **Field of Classification Search**
CPC H04M 1/00; H04M 1/02; H04M 1/725; H04B 15/02; H04B 1/10
USPC 455/347-349, 550.1, 575.1, 575.4, 575.8, 455/90.3

See application file for complete search history.

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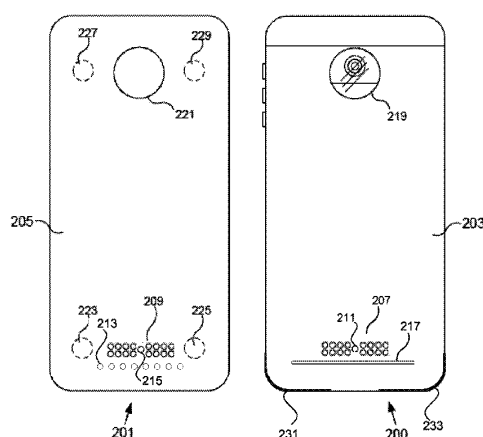
Primary Examiner — Dominic Rego

(74) *Attorney, Agent, or Firm* — Miller, Matthias & Hull LLP

(57) **ABSTRACT**

A modular device system is provided having a base portable electronic communication device. The base portable electronic communication device has a display side and a reverse side, and one or more antennas being located along one of the device edges. A ground element on the reverse side of the housing is adjacent to the antennas and is grounded to the chassis. A multi-pin connector array on the same side is located adjacent to the ground element and the ground element lies between the connector array and the antennas. The ground element is configured to contact a mating ground element on an add-on module when the module is mated to the base portable electronic communication device.

20 Claims, 7 Drawing Sheets





US009799951B2

(12) **United States Patent**
Sawaya et al.

(10) **Patent No.:** **US 9,799,951 B2**

(45) **Date of Patent:** **Oct. 24, 2017**

(54) **ANTENNA UNIT**

USPC 343/703, 894, 760, 872, 873, 713
See application file for complete search history.

(75) Inventors: **Takuma Sawaya**, Aichi (JP);
Tokumitsu Hanita, Aichi (JP); **Seiji Go**, Gunma (JP); **Atsushi Ubukata**, Gunma (JP)

(56) **References Cited**

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Primary Examiner — Jessica Han

Assistant Examiner — Bamidele A Jegede

(74) *Attorney, Agent, or Firm* — Leydig Voit and Mayer

(57) **ABSTRACT**

An antenna unit includes a base having a base-side fitting portion, antenna elements disposed on the base, an inner case fixed to the base and covering the antenna elements, and an outer case mounted on the base covering the inner case. The outer case 50 has an outer-case-side fitting portion fitted to the base-side fitting portion.

18 Claims, 7 Drawing Sheets

(73) Assignee: **Yokowo Co., Ltd.**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 487 days.

(21) Appl. No.: **13/877,698**

(22) PCT Filed: **Aug. 31, 2011**

(86) PCT No.: **PCT/JP2011/069789**

§ 371 (c)(1),

(2), (4) Date: **Jun. 12, 2013**

(87) PCT Pub. No.: **WO2012/046524**

PCT Pub. Date: **Apr. 12, 2012**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

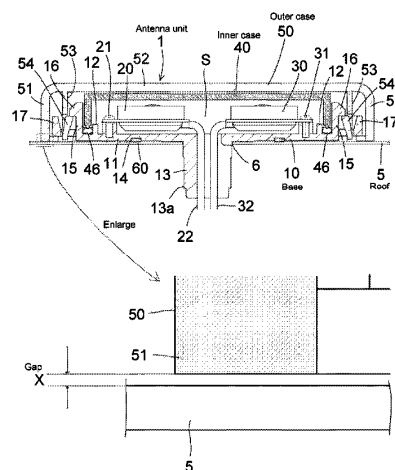
Oct. 8, 2010 (JP) 2010-228551

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

H01Q 1/32 (2006.01)

(52) **U.S. Cl.**
CPC **H01Q 1/422** (2013.01); **H01Q 1/3275** (2013.01); **H01Q 1/42** (2013.01)

(58) **Field of Classification Search**
CPC H01Q 1/42; H01Q 1/422; H01Q 1/3275





US009799964B2

(12) **United States Patent**
Jang et al.

(10) **Patent No.:** **US 9,799,964 B2**

(45) **Date of Patent:** **Oct. 24, 2017**

(54) **BUILT-IN ANTENNA DEVICE FOR ELECTRONIC COMMUNICATION DEVICE**

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

(72) Inventors: **Soo-Young Jang**, Gyeongsangbuk-do (KR); **Dong-Hwan Kim**, Gyeonggi-do (KR); **Austin Kim**, Gyeonggi-do (KR); **Se-Ho Kim**, Gyeongsangbuk-do (KR); **Kong-Min Sa**, Gyeonggi-do (KR); **Jae-Ho Lee**, Gyeonggi-do (KR); **Byung-Chan Jang**, Gyeongsangbuk-do (KR); **In-Jin Hwang**, Gyeongsangbuk-do (KR)

(73) Assignee: **Samsung Electronics Co., Ltd.**,
Yeongtong-gu, Suwon-si, Gyeonggi-do (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 638 days.

(21) Appl. No.: **13/768,499**

(22) Filed: **Feb. 15, 2013**

(65) **Prior Publication Data**
US 2013/0249744 A1 Sep. 26, 2013

(30) **Foreign Application Priority Data**
Mar. 26, 2012 (KR) 10-2012-0030432

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 21/30 (2006.01)
H01Q 9/42 (2006.01)

(52) **U.S. Cl.**
CPC **H01Q 21/30** (2013.01); **H01Q 1/243** (2013.01); **H01Q 9/42** (2013.01)

(58) **Field of Classification Search**

CPC H01Q 21/30; H01Q 9/42; H01Q 1/243; H01Q 5/307; H01Q 5/357; H01Q 5/364
USPC 343/702, 725, 826
See application file for complete search history.

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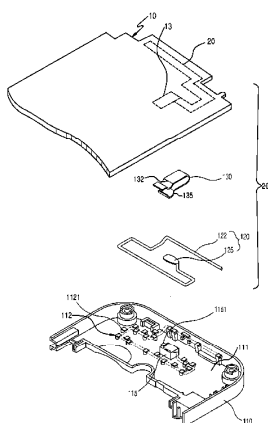
Primary Examiner — Dieu H Duong

(74) *Attorney, Agent, or Firm* — Cha & Reiter, LLC

(57) **ABSTRACT**

A built-in antenna device for an electronic device for communication used in a multi-band is provided. The built-in antenna device includes a PCB, a first antenna radiator disposed on the PCB, and a second antenna radiator which has the same power feeding point as the first antenna radiator and is disposed at a housing of the electronic device, wherein the first antenna radiator and the second antenna radiator are configured to operate at different frequency bands.

20 Claims, 5 Drawing Sheets





US009800300B2

(12) **United States Patent**
Caruana et al.

(10) **Patent No.:** **US 9,800,300 B2**

(45) **Date of Patent:** **Oct. 24, 2017**

(54) **METHOD, CIRCUIT AND CONTACTLESS COMMUNICATION DEVICE WITH ACTIVATED EMITTING**

(75) Inventors: **Jean-Paul Caruana**, La Seyne sur Mer (FR); **Christophe Buton**, Gemenos (FR); **Grégory Capomaggio**, Roquevaire (FR)

(73) Assignee: **GEMALTO SA**, Meudon (FR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 208 days.

(21) Appl. No.: **14/111,105**

(22) PCT Filed: **Apr. 12, 2012**

(86) PCT No.: **PCT/EP2012/056726**

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(2), (4) Date: **Oct. 10, 2013**

(87) PCT Pub. No.: **WO2012/140169**

PCT Pub. Date: **Oct. 18, 2012**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Apr. 15, 2011 (EP) 11305453
Apr. 6, 2012 (EP) 12305408

(51) **Int. Cl.**
H04B 7/02 (2017.01)
G06K 19/077 (2006.01)

(52) **U.S. Cl.**
CPC **H04B 7/028** (2013.01); **G06K 19/07773**
(2013.01)

(58) **Field of Classification Search**

CPC H04W 4/008; H04M 1/7253; H04M
2250/04

See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Andrew Wendell

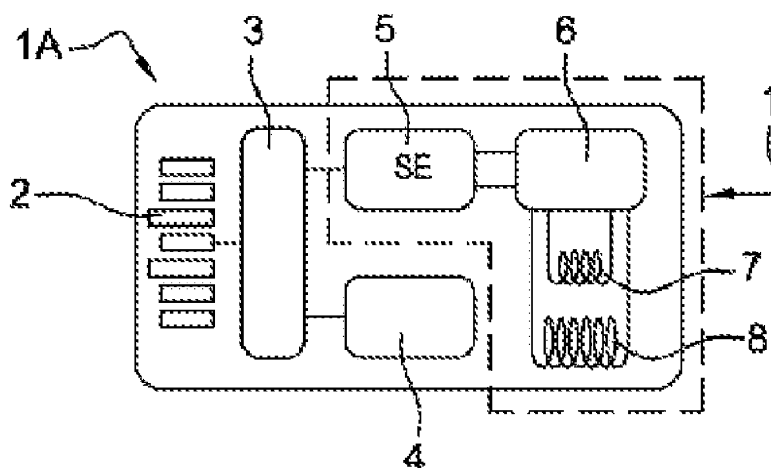
Assistant Examiner — Maryam Soltanzadeh

(74) *Attorney, Agent, or Firm* — Buchanan Ingersoll & Rooney PC

(57) **ABSTRACT**

An activated contactless communication circuit includes a device for receiving and transmitting a data-carrying electromagnetic field; a first circuit resonating with a first antenna for receiving data; and a second circuit resonating with a second antenna for transmitting data, the first and second resonating circuits being separate from each other. The transmission is carried out at a frequency phase-synchronized with the frequency of the electromagnetic field for reception.

16 Claims, 4 Drawing Sheets





US009800702B1

(12) **United States Patent**
Natarajan et al.

(10) **Patent No.:** **US 9,800,702 B1**

(45) **Date of Patent:** ***Oct. 24, 2017**

(54) **MODULAR DEVICE SYSTEM DESENSE
REDUCTION**

USPC 455/347-349, 550.1, 575.1, 575.4, 575.8,
455/90.3

See application file for complete search history.

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

(56) **References Cited**

(72) Inventors: **Vimalkaushik Natarajan**, Palatine, IL
(US); **Mubeen Ahmed**, Lindenhurst, IL
(US); **David Lim**, Glenview, IL (US);
Paul L Fordham, Wauconda, IL (US);
Mark Janninck, Glen Ellyn, IL (US)

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(Continued)

(73) Assignee: **Motorola Mobility LLC**, Chicago, IL
(US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

This patent is subject to a terminal dis-
claimer.

(21) Appl. No.: **15/277,719**

Primary Examiner — Dominic Rego

(22) Filed: **Sep. 27, 2016**

(74) *Attorney, Agent, or Firm* — Miller, Matthias & Hull
LLP

Related U.S. Application Data

(63) Continuation of application No. 15/174,593, filed on
Jun. 6, 2016.

(57) **ABSTRACT**

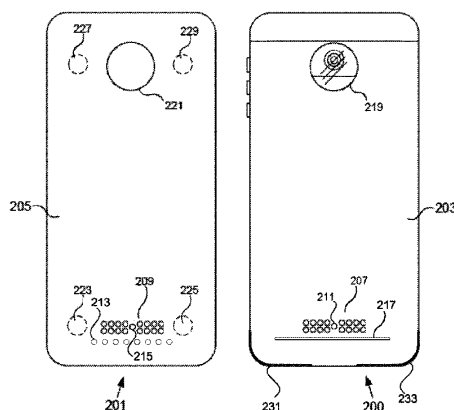
(51) **Int. Cl.**
H04M 1/00 (2006.01)
H04M 1/02 (2006.01)
H01Q 1/24 (2006.01)
H01Q 13/10 (2006.01)
H01Q 1/48 (2006.01)

A modular device system is provided having a base portable
electronic communication device. The base portable elec-
tronic communication device has a display side and a
reverse side, and one or more antennas being located along
one of the device edges. A ground element on the reverse
side of the housing is adjacent to the antennas and is
grounded to the chassis. A multi-pin connector array on the
same side is located adjacent to the ground element and the
ground element lies between the connector array and the
antennas. The ground element is configured to contact a
mating ground element on an add-on module when the
module is mated to the base portable electronic communi-
cation device.

(52) **U.S. Cl.**
CPC **H04M 1/0274** (2013.01); **H01Q 1/243**
(2013.01); **H01Q 1/48** (2013.01); **H01Q 13/10**
(2013.01); **H04M 1/0266** (2013.01)

(58) **Field of Classification Search**
CPC H04M 1/00; H04M 1/02; H04M 1/725;
H04B 15/02; H04B 1/10

15 Claims, 7 Drawing Sheets





US009806400B2

(12) **United States Patent**
Tseng et al.

(10) **Patent No.:** **US 9,806,400 B2**
(45) **Date of Patent:** **Oct. 31, 2017**

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

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

(72) Inventors: **Yen-Jung Tseng**, New Taipei (TW);
Yi-Ting Chen, New Taipei (TW);
Cho-Kang Hsu, New Taipei (TW)

(73) Assignee: **Chiun Mai Communication Systems, Inc.**, New Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 346 days.

(21) Appl. No.: **14/522,077**

(22) Filed: **Oct. 23, 2014**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Dec. 31, 2013 (CN) 2013 1 0749270

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 21/28 (2006.01)
H01Q 5/335 (2015.01)
H01Q 5/371 (2015.01)

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 5/335** (2015.01); **H01Q 5/371** (2015.01); **H01Q 21/28** (2013.01)

(58) **Field of Classification Search**

CPC H01Q 1/243; H01Q 5/335; H01Q 5/371; H01Q 21/28

USPC 343/702

See application file for complete search history.

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Primary Examiner — Dameon E Levi

Assistant Examiner — David Lotter

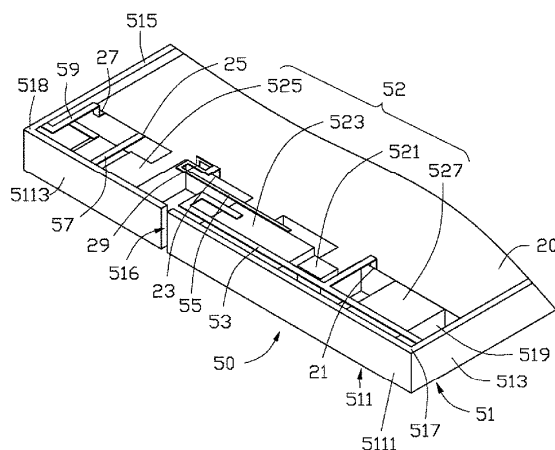
(74) *Attorney, Agent, or Firm* — Steven Reiss

(57) **ABSTRACT**

An antenna structure includes a metal member, a first antenna, a second antenna, a third antenna, and a fourth antenna. A gap is defined on the metal member to divide the metal member into a first frame assembly and a second frame assembly. The first frame assembly and the second frame assembly cooperatively form a receiving space for accommodating at least one electronic element. The first antenna, the second antenna, the third antenna, and the fourth antenna are received in the receiving space. The first antenna is electronically connected to the first frame assembly of the metal member. The third antenna and the fourth antenna are both electronically connected to the second frame assembly of the metal member.

16 Claims, 8 Drawing Sheets

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US009806401B2

(12) **United States Patent**
Caballero et al.

(10) **Patent No.:** **US 9,806,401 B2**

(45) **Date of Patent:** **Oct. 31, 2017**

(54) **ANTENNA SYSTEM WITH ANTENNA SWAPPING AND ANTENNA TUNING**

(56) **References Cited**

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Primary Examiner — Graham Smith

(74) Attorney, Agent, or Firm — Treyz Law Group, P.C.;
G. Victor Treyz; Michael H. Lyons

(57) **ABSTRACT**

Electronic devices may be provided that contain wireless communications circuitry. The wireless communications circuitry may include radio-frequency transceiver circuitry and first and second antennas. An electronic device may include a housing. The first antenna may be located at an upper end of the housing and the second antenna may be located at a lower end of the housing. A peripheral conductive member may run around the edges of the housing and may be used in forming the first and second antennas. The radio-frequency transceiver circuitry may have a transmit-receive port and a receive port. Switching circuitry may connect the first antenna to the transmit-receive port and the second antenna to the receiver port or may connect the first antenna to the receive port and the second antenna to the transmit-receive port.

20 Claims, 8 Drawing Sheets

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

(72) Inventors: **Ruben Caballero**, San Jose, CA (US);
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Mohit Narang, Cupertino, CA (US);
Matt A. Mow, Los Altos, CA (US);
Robert W. Schlub, Cupertino, CA (US)

(73) Assignee: **Apple Inc.**, Cupertino, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 464 days.

(21) Appl. No.: **14/608,048**

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

(65) **Prior Publication Data**

US 2015/0145734 A1 May 28, 2015

Related U.S. Application Data

(63) Continuation of application No. 12/941,011, filed on Nov. 5, 2010, now Pat. No. 8,947,302.

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

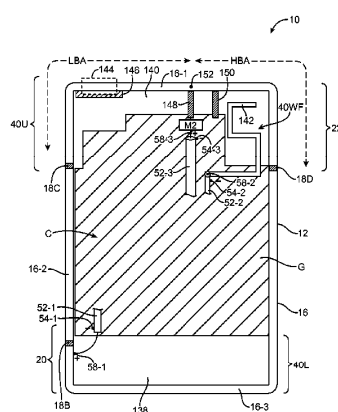
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(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 7/00** (2013.01); **H01Q 9/0421** (2013.01); **H01Q 9/42** (2013.01);

(Continued)

(58) **Field of Classification Search**
CPC H01Q 1/243; H01Q 1/38; H01Q 21/28; H01Q 1/44

(Continued)





US009806402B2

(12) **United States Patent**
Liu et al.

(10) **Patent No.:** **US 9,806,402 B2**
(45) **Date of Patent:** **Oct. 31, 2017**

(54) **ANTENNA MODULE**

(71) Applicants: **Shijie Liu**, Shenzhen (CN); **Yongli Chen**, Shenzhen (CN); **Xing Yuan**, Shenzhen (CN); **Xiaopu Wu**, Shenzhen (CN)

(72) Inventors: **Shijie Liu**, Shenzhen (CN); **Yongli Chen**, Shenzhen (CN); **Xing Yuan**, Shenzhen (CN); **Xiaopu Wu**, Shenzhen (CN)

(73) Assignee: **AAC TECHNOLOGIES PTE. LTD.**, Singapore (SG)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 111 days.

(21) Appl. No.: **14/832,895**

(22) Filed: **Aug. 21, 2015**

(65) **Prior Publication Data**
US 2016/0211572 A1 Jul. 21, 2016

(30) **Foreign Application Priority Data**
Jan. 20, 2015 (CN) 2015 2 0040079 U

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

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

(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

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			343/702

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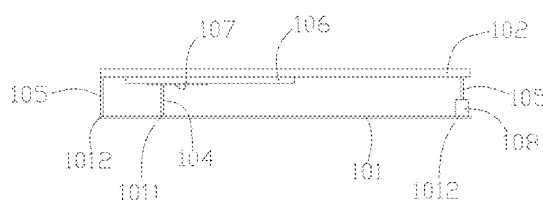
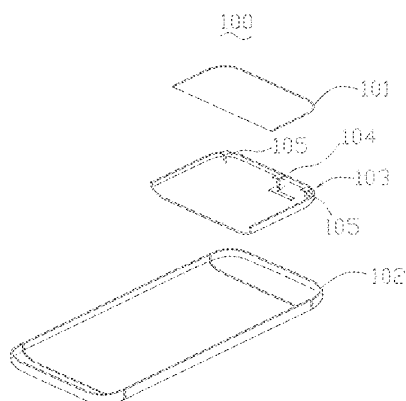
Primary Examiner — Trinh Dinh

(74) *Attorney, Agent, or Firm* — Na Xu; IPro, PLLC

(57) **ABSTRACT**

An antenna module for a mobile communication device is provided in the present disclosure. The antenna module includes a main board, a feed point and at least one ground point provided on the main board, a metal radiator opposite to the main board and electrically connected with the at least one ground point of the main board and a capacitive coupling feed part attached to a surface of the metal radiator and facing the main board, the capacitive coupling feed part being electrically connected to the feed point of the main board via a connecting member.

17 Claims, 2 Drawing Sheets





US009806409B2

(12) **United States Patent**
Yang et al.

(10) **Patent No.:** **US 9,806,409 B2**

(45) **Date of Patent:** **Oct. 31, 2017**

(54) **EMBEDDED ANTENNA DEVICE FOR
ELECTRONIC COMMUNICATION DEVICE**

(75) Inventors: **Tae-Sik Yang**, Suwon-si (KR);
Ju-Hyung Lee, Gwacheon-si (KR);
Hyeong-Dong Kim, Seoul (KR);
Sin-Hyung Jeon, Seoul (KR);
Joong-Ho Jeong, Seoul (KR)

(73) Assignees: **Samsung Electronics Co., Ltd.**,
Suwon-si (KR); **Industry-University
Cooperation Foundation Hanyang
University**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 216 days.

(21) Appl. No.: **14/005,694**

(22) PCT Filed: **Mar. 26, 2012**

(86) PCT No.: **PCT/KR2012/002187**

§ 371 (c)(1),
(2), (4) Date: **Sep. 17, 2013**

(87) PCT Pub. No.: **WO2012/128601**

PCT Pub. Date: **Sep. 27, 2012**

(65) **Prior Publication Data**

US 2014/0009358 A1 Jan. 9, 2014

(30) **Foreign Application Priority Data**

Mar. 24, 2011 (KR) 10-2011-0026177

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

(Continued)

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

CPC **H01Q 1/48** (2013.01); **H01Q 1/243**
(2013.01); **H01Q 1/38** (2013.01); **H01Q 9/42**
(2013.01)

(58) **Field of Classification Search**

CPC H01Q 1/48; H01Q 1/38; H01Q 1/243;
H01Q 9/42

See application file for complete search history.

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Primary Examiner — Graham Smith

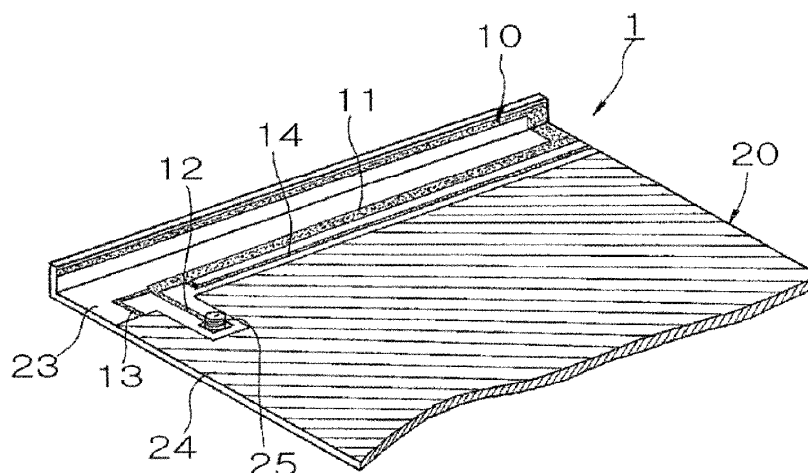
Assistant Examiner — Noel Maldonado

(74) *Attorney, Agent, or Firm* — Jefferson IP Law, LLP

(57) **ABSTRACT**

A built-in antenna device for an electronic device for communication is provided. The antenna device includes a substrate, an antenna radiator, and a transmission line. The substrate includes a grounding region and a non-grounding region. The antenna radiator is disposed in the non-grounding region of the substrate and fed from a feeding portion provided to the substrate. The transmission line branches from the antenna radiator and is disposed in vicinity of the grounding region to have a predetermined length and a predetermined width. The antenna device controls reactance by coupling the transmission line with the grounding region to allow the antenna radiator to operate in at least one desired band.

16 Claims, 13 Drawing Sheets





US009806411B2

(12) **United States Patent**
Hwang et al.

(10) **Patent No.:** **US 9,806,411 B2**
(45) **Date of Patent:** **Oct. 31, 2017**

(54) **ANTENNA WITH HIGH ISOLATION**

(56) **References Cited**

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

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(72) Inventors: **Tzu-Yao Hwang**, New Taipei (TW);
Lung-Sheng Tai, New Taipei (TW)

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			343/700 MS
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			343/700 MS

(73) Assignee: **FOXCONN INTERCONNECT TECHNOLOGY LIMITED**, Grand Cayman (KY)

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 361 days.

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(21) Appl. No.: **14/522,603**

(22) Filed: **Oct. 24, 2014**

(65) **Prior Publication Data**

US 2015/0123866 A1 May 7, 2015

(30) **Foreign Application Priority Data**

Nov. 6, 2013 (TW) 102140199 A

(51) **Int. Cl.**
H01Q 1/52 (2006.01)
H01Q 9/42 (2006.01)
H01Q 1/48 (2006.01)

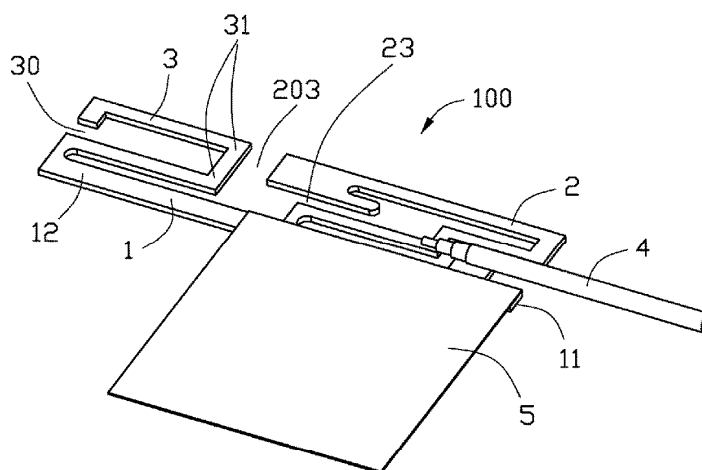
(52) **U.S. Cl.**
CPC **H01Q 1/526** (2013.01); **H01Q 9/42** (2013.01); **H01Q 1/48** (2013.01)

(58) **Field of Classification Search**
CPC H01Q 1/526; H01Q 9/42; H01Q 1/48
See application file for complete search history.

(57) **ABSTRACT**

An antenna includes a grounding portion extending in a longitudinal direction, a main body and an isolating portion extending from the grounding portion, a metal foil assembled on the grounding portion and a coaxial cable connecting the main body. The grounding portion includes a first section and a second section connecting with each other. The main body extends from the first section while the isolating portion extends from the second section. The isolating portion locates beside the main body in the longitudinal direction and defines a gap therebetween.

19 Claims, 4 Drawing Sheets





(12) **United States Patent**
Lin

(54) ANTENNA STRUCTURE FOR ELECTRONIC DEVICE

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

(72) Inventor: **Yen-Hui Lin**, New Taipei (TW)

(73) Assignee: **Chiun Mai Communication Systems, Inc., New Taipei (TW)**

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 6 days.

(21) Appl. No.: 14/923,631

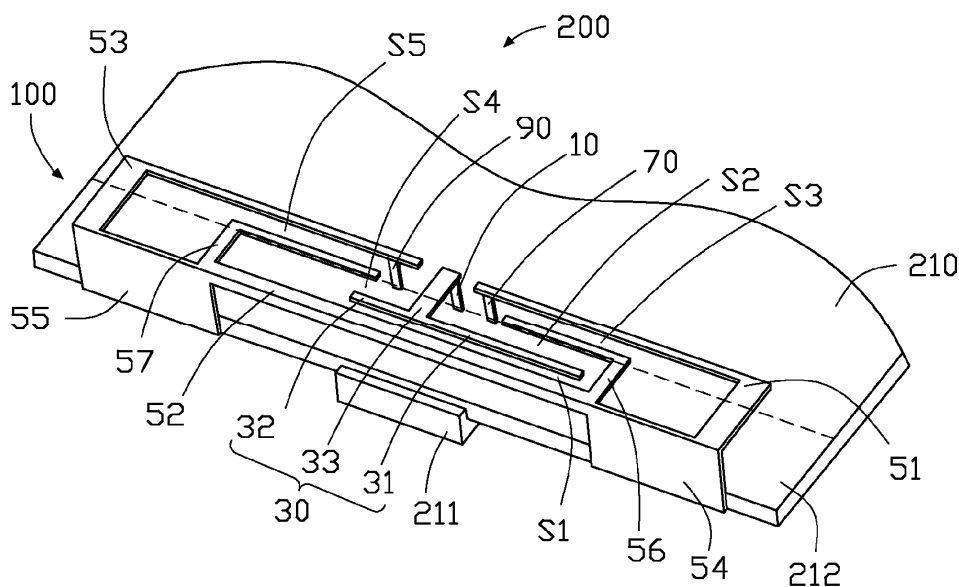
(22) Filed: **Oct. 27, 2015**

(65) **Prior Publication Data**

US 2016/0218421 A1 Jul. 28, 2016

(30) **Foreign Application Priority Data**

Jan. 23, 2015 (TW) 104102225 A





US009806786B2

(12) **United States Patent**
Hirabayashi

(10) **Patent No.:** **US 9,806,786 B2**

(45) **Date of Patent:** **Oct. 31, 2017**

(54) **COMMUNICATION DEVICE AND ANTENNA
DEVICE WITH FIRST AND SECOND
ANTENNAS HAVING POWER SUPPLY
SECTIONS SEPARATED BY $N\lambda/4$ ELECTRIC
PATH LENGTH**

(71) Applicant: **Sony Corporation**, Tokyo (JP)

(72) Inventor: **Takayuki Hirabayashi**, Tokyo (JP)

(73) Assignee: **Sony Corporation**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 89 days.

(21) Appl. No.: **14/097,790**

(22) Filed: **Dec. 5, 2013**

(65) **Prior Publication Data**

US 2014/0162572 A1 Jun. 12, 2014

(30) **Foreign Application Priority Data**

Dec. 12, 2012 (JP) 2012-271217

(51) **Int. Cl.**

H04B 7/06 (2006.01)

H04B 7/04 (2017.01)

H04B 7/08 (2006.01)

H01Q 1/52 (2006.01)

H01Q 9/42 (2006.01)

H01Q 21/28 (2006.01)

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

CPC **H04B 7/0697** (2013.01); **H01Q 1/521**
(2013.01); **H01Q 9/42** (2013.01); **H01Q 21/28**
(2013.01); **H04B 7/04** (2013.01); **H04B 7/08**
(2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

(56) **References Cited**

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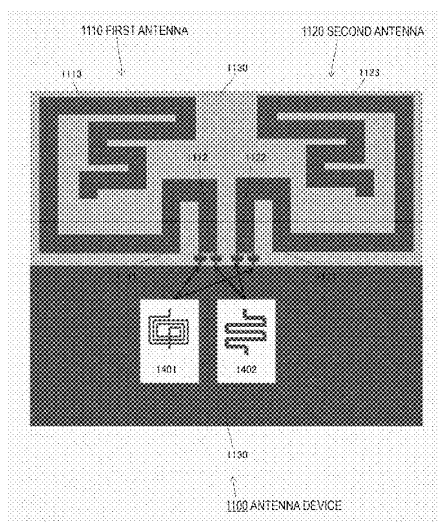
Primary Examiner — Alejandro Rivero

(74) *Attorney, Agent, or Firm* — Chip Law Group

(57) **ABSTRACT**

There is provided an antenna device including a first antenna including a first power supply section, a first short-circuited section connected to a bottom board, and a first open-circuited section, and a second antenna including a second power supply section separated from the first power supply section by an electric path length of about $n\lambda/4$, a second short-circuited section connected to the bottom board, and a second open-circuited section.

9 Claims, 20 Drawing Sheets





US009812765B2

(12) **United States Patent**
Hong et al.

(10) **Patent No.:** **US 9,812,765 B2**

(45) **Date of Patent:** **Nov. 7, 2017**

(54) **ANTENNA ASSEMBLY AND MOBILE
TERMINAL USING SAME**

USPC 343/702, 726, 728, 741, 742, 748, 789,
343/842, 855, 872

See application file for complete search history.

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

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701/36
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348/552

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Primary Examiner — Hoang Nguyen

Assistant Examiner — Jae Kim

(74) *Attorney, Agent, or Firm* — Na Xu; IPro, PLLC

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

(73) Assignee: **AAC TECHNOLOGIES PTE. LTD.**,
Singapore (SG)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 52 days.

(21) Appl. No.: **14/217,634**

(22) Filed: **Mar. 18, 2014**

(65) **Prior Publication Data**

US 2014/0285384 A1 Sep. 25, 2014

(30) **Foreign Application Priority Data**

Mar. 22, 2013 (CN) 2013 1 0096530

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 5/371 (2015.01)

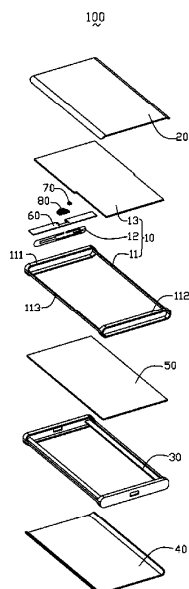
(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 5/371**
(2015.01)

(58) **Field of Classification Search**
CPC H01Q 5/371; H01Q 1/243

(57) **ABSTRACT**

An embodiment of the present invention provides an antenna assembly and a mobile terminal. The antenna assembly includes an antenna body provided with a grounding plate and a feeding portion. The antenna body includes a radiating portion provided with an unclosed loop structure. The antenna assembly further has a metal frame. The metal frame is provided with a closed first loop portion surrounding an outer periphery of the radiating portion. An annular gap is formed between the first loop portion and the radiating portion. The antenna assembly of the present disclosure improves the product performance and makes the product appearance more aesthetic.

4 Claims, 5 Drawing Sheets





US009812769B2

(12) **United States Patent**
Koga et al.

(10) **Patent No.:** **US 9,812,769 B2**
(45) **Date of Patent:** **Nov. 7, 2017**

(54) **ANTENNA APPARATUS**

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

(72) Inventors: **Yohei Koga**, Kawasaki (JP); **Hiroyuki**
Egawa, Fukuoka (JP)

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

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 1 day.

(21) Appl. No.: **15/189,436**

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

(65) **Prior Publication Data**

US 2017/0033453 A1 Feb. 2, 2017

(30) **Foreign Application Priority Data**

Jul. 27, 2015 (JP) 2015-148145

(51) **Int. Cl.**

H01Q 1/38 (2006.01)

H01Q 1/48 (2006.01)

H01Q 1/24 (2006.01)

H01Q 9/42 (2006.01)

H01Q 5/371 (2015.01)

H01Q 5/328 (2015.01)

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

CPC **H01Q 1/48** (2013.01); **H01Q 1/243**
(2013.01); **H01Q 5/328** (2015.01); **H01Q**
5/371 (2015.01); **H01Q 9/42** (2013.01)

(58) **Field of Classification Search**

CPC H01Q 1/38; H01Q 1/24

USPC 343/700 MS

See application file for complete search history.

(56) **References Cited**

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343/700 MS

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Primary Examiner — Huedung Mancuso

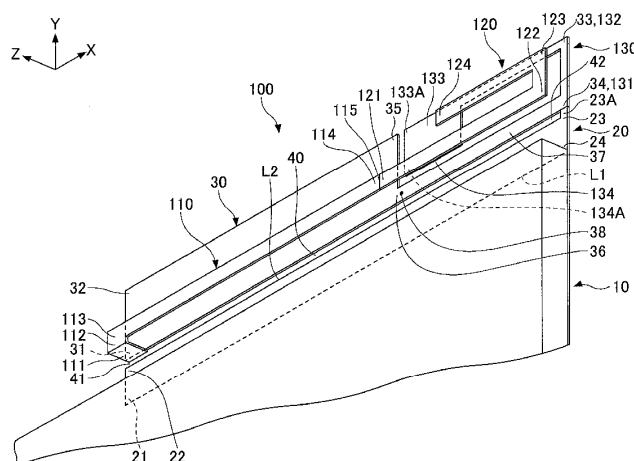
(74) Attorney, Agent, or Firm — Fujitsu Patent Center

(57)

ABSTRACT

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

8 Claims, 27 Drawing Sheets





US009812770B2

(12) **United States Patent**
Gavilan et al.

(10) **Patent No.:** **US 9,812,770 B2**
(45) **Date of Patent:** **Nov. 7, 2017**

(54) **ANTENNA INTEGRATED WITH METAL CHASSIS**

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

(72) Inventors: **Joselito Gavilan**, Santa Clara, CA (US); **Warren Lee**, Santa Clara, CA (US)

(73) Assignee: **Nvidia Corporation**, Santa Clara, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 236 days.

(21) Appl. No.: **13/711,951**

(22) Filed: **Dec. 12, 2012**

(65) **Prior Publication Data**

US 2014/0118204 A1 May 1, 2014

Related U.S. Application Data

(60) Provisional application No. 61/721,358, filed on Nov. 1, 2012.

(51) **Int. Cl.**
H01Q 9/00 (2006.01)
H01Q 1/50 (2006.01)
H01Q 1/24 (2006.01)
H01Q 9/42 (2006.01)
H01Q 5/371 (2015.01)
H01Q 5/378 (2015.01)

(52) **U.S. Cl.**
CPC **H01Q 1/50** (2013.01); **H01Q 1/243** (2013.01); **H01Q 5/371** (2015.01); **H01Q 5/378** (2015.01); **H01Q 9/42** (2013.01)

(58) **Field of Classification Search**

CPC H01Q 9/00; H01Q 1/38; H01Q 1/24
USPC 343/754, 700 MS, 702
See application file for complete search history.

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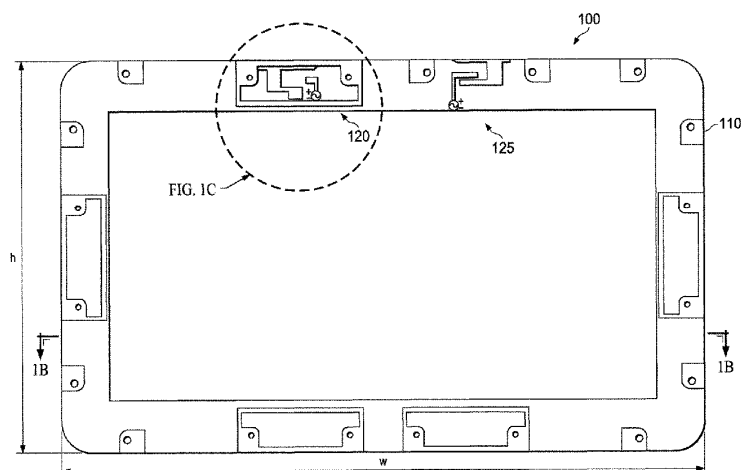
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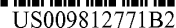
Primary Examiner — Huedung Mancuso

(57) **ABSTRACT**

One aspect provides an antenna. The antenna, in this aspect, includes a grounded segment extending from a metal chassis of an electronic device, and a feed portion coplanar with the grounded segment, the grounded segment and feed portion jointly tuned to cause the antenna to communicate in selected bands of frequencies.

18 Claims, 4 Drawing Sheets





(10) **Patent No.:** US 9,812,771 B2
(45) **Date of Patent:** Nov. 7, 2017

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Chinese Search Report dated Aug. 31, 2017.

- Primary Examiner — Jessica Han

- Assistant Examiner* — Noel Maldonado

- (74) *Attorney, Agent, or Firm* — Cha & Reiter, LLC.

- (57) **ABSTRACT**

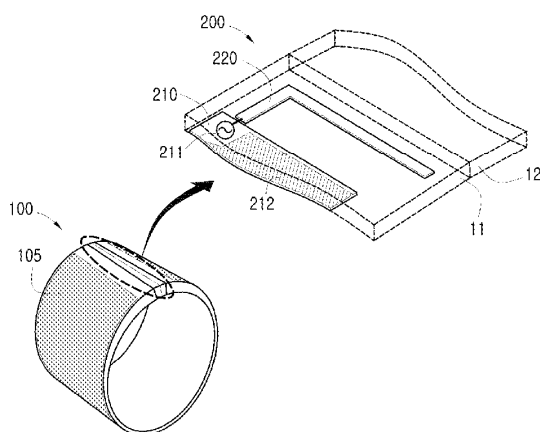
- A mobile terminal with an antenna apparatus is provided. The mobile terminal in one embodiment includes an antenna radiator disposed at a first end of the mobile terminal; at least one antenna modifying element disposed at a second, opposing end of the mobile terminal; and a coupling unit for fastening the first and second ends and electrically connecting the at least one antenna modifying element with the antenna device when the first and second ends are fastened. In another embodiment, a deformation detector detects at least one deformation of the mobile terminal, an antenna matching unit is electrically connectable to the first antenna radiator; and a controller is coupled to the deformation detector, for controlling an electrical connection between the antenna matching unit and the first antenna radiator when the at least one deformation is detected. The antenna matching unit may include a second antenna radiator.

- Mar. 19, 2012 (KR) 10-2012-0027701

- (51) **Int. Cl.**
H01Q 1/50 (2006.01)
H01Q 1/27 (2006.01)
H01Q 9/42 (2006.01)

- (52) **U.S. Cl.**
CPC *H01Q 1/50* (2013.01); *H01Q 1/273*
(2013.01); *H01Q 9/42* (2013.01)

- (58) **Field of Classification Search**
CPC .. H01Q 1/22; H01Q 1/27; H01Q 1/38; H01Q
1/50; H01Q 9/42; H01Q 1/273
See application file for complete search history.



7 Claims, 15 Drawing Sheets



US009812773B1

(12) **United States Patent**
Zheng

(10) **Patent No.:** **US 9,812,773 B1**
(45) **Date of Patent:** **Nov. 7, 2017**

- (54) **ANTENNA DESIGN FOR REDUCED SPECIFIC ABSORPTION RATE**
- (71) Applicant: **Amazon Technologies, Inc.**, Reno, NV (US)
- (72) Inventor: **Ming Zheng**, Cupertino, CA (US)
- (73) Assignee: **Amazon Technologies, Inc.**, Seattle, WA (US)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 841 days.
- (21) Appl. No.: **14/082,418**
- (22) Filed: **Nov. 18, 2013**
- (51) **Int. Cl.**
H01Q 1/52 (2006.01)
H01Q 1/24 (2006.01)
H01Q 21/00 (2006.01)
H01Q 5/392 (2015.01)
H01Q 5/378 (2015.01)
- (52) **U.S. Cl.**
CPC **H01Q 1/52** (2013.01); **H01Q 1/243** (2013.01); **H01Q 5/378** (2015.01); **H01Q 5/392** (2015.01); **H01Q 21/0006** (2013.01)
- (58) **Field of Classification Search**
CPC H01Q 1/52; H01Q 1/243; H01Q 5/378; H01Q 5/392; H01Q 21/0006
USPC 343/841
See application file for complete search history.

- (56) **References Cited**
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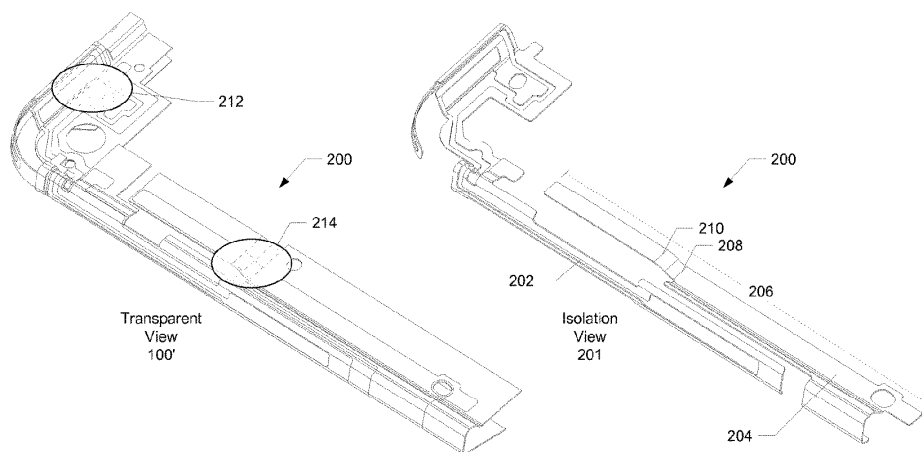
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Primary Examiner — Dameon E Levi
Assistant Examiner — Jennifer F Hu
(74) *Attorney, Agent, or Firm* — Weaver Austin Villeneuve & Sampson LLP

(57) **ABSTRACT**

An antenna for use in portable wireless devices is described for which SAR is significantly reduced relative to conventional antenna designs for the same transmit power. The antenna includes a primary antenna element and one or more parasitic antenna elements. Each parasitic antenna element is electromagnetically coupled to the primary antenna element so as to spread out the RF energy associated with SAR hotspots.

20 Claims, 4 Drawing Sheets





US009812780B2

(12) **United States Patent**
Gaddi et al.

(10) **Patent No.:** **US 9,812,780 B2**

(45) **Date of Patent:** **Nov. 7, 2017**

(54) **TECHNIQUES OF TUNING AN ANTENNA BY WEAK COUPLING OF A VARIABLE IMPEDANCE COMPONENT**

(71) Applicant: **CAVENDISH KINETICS, INC.**, San Jose, CA (US)

(72) Inventors: **Roberto Gaddi**, 's-Hertogenbosch (NL); **Paul Anthony Tornatta, Jr.**, Melbourne, FL (US); **Ramadan A. Alhalabi**, San Jose, CA (US)

(73) Assignee: **CAVENDISH KINETICS, INC.**, San Jose, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 77 days.

(21) Appl. No.: **14/916,015**

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

(86) PCT No.: **PCT/US2014/055987**

§ 371 (c)(1),

(2) Date: **Mar. 2, 2016**

(87) PCT Pub. No.: **WO2015/042092**

PCT Pub. Date: **Mar. 26, 2015**

(65) **Prior Publication Data**

US 2016/0218431 A1 Jul. 28, 2016

Related U.S. Application Data

(60) Provisional application No. 61/881,292, filed on Sep. 23, 2013, provisional application No. 61/910,484, filed on Dec. 2, 2013.

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 5/378 (2015.01)

H01Q 9/42 (2006.01)

H01Q 5/328 (2015.01)

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

CPC **H01Q 5/378** (2015.01); **H01Q 1/241** (2013.01); **H01Q 1/243** (2013.01); **H01Q 5/328** (2015.01); **H01Q 9/42** (2013.01)

(58) **Field of Classification Search**

CPC H01Q 1/241; H01Q 1/243; H01Q 5/378; H01Q 5/328; H01Q 9/42

See application file for complete search history.

(56) **References Cited**

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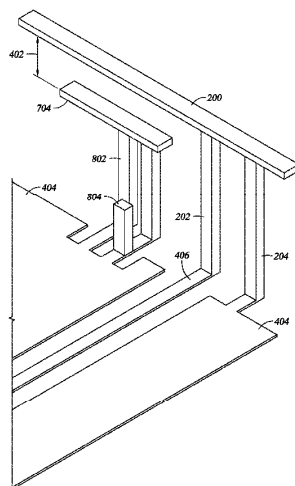
Primary Examiner — Hoang Nguyen

(74) *Attorney, Agent, or Firm* — Patterson & Sheridan, LLP

(57) **ABSTRACT**

The present invention generally relates to small antennas suitable for mobile devices operating in the high frequency and radio frequency bands in the range 100 MHz to 5 GHz. The antennas may be coupled to a DVC such as a MEMS DVC. The antenna may be coupled to a printed circuit board disposed inside of the mobile device, such as a mobile phone or smart phone.

30 Claims, 8 Drawing Sheets





US009813099B2

(12) **United States Patent**
Seol et al.

(10) **Patent No.:** **US 9,813,099 B2**
(45) **Date of Patent:** **Nov. 7, 2017**

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

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

(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)

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

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

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

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

(65) **Prior Publication Data**

US 2016/0344439 A1 Nov. 24, 2016

(30) **Foreign Application Priority Data**

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

(51) **Int. Cl.**
H04M 1/00 (2006.01)
H04B 1/3888 (2015.01)
(Continued)

(52) **U.S. Cl.**
CPC **H04B 1/3888** (2013.01); **G06F 1/1656**
(2013.01); **H01Q 1/243** (2013.01);
(Continued)

(58) **Field of Classification Search**

None

See application file for complete search history.

(56) **References Cited**

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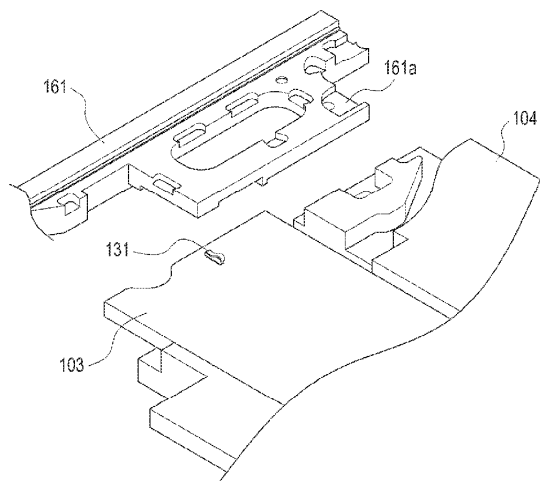
Primary Examiner — Idowu O Osifade

(74) *Attorney, Agent, or Firm* — The Farrell Law Firm,
P.C.

(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.

15 Claims, 12 Drawing Sheets





US009818056B2

(12) **United States Patent**
Forster

(10) **Patent No.:** **US 9,818,056 B2**

(45) **Date of Patent:** **Nov. 14, 2017**

(54) **ROBUST WASHABLE TAGS USING A
LARGE AREA ANTENNA CONDUCTOR**

(71) Applicant: **Avery Dennison Retail Information
Services, LLC**, Westborough, MA (US)

(72) Inventor: **Ian James Forster**, Chelmsford (GB)

(73) Assignee: **AVERY DENNISON RETAIL
INFORMATION SERVICES, LLC**,
Mentor, OH (US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/247,407**

(22) Filed: **Aug. 25, 2016**

(65) **Prior Publication Data**

US 2017/0083809 A1 Mar. 23, 2017

Related U.S. Application Data

(62) Division of application No. 14/313,427, filed on Jun.
24, 2014, now Pat. No. 9,436,904.

(60) Provisional application No. 61/838,668, filed on Jun.
24, 2013.

(51) **Int. Cl.**

G06K 19/06 (2006.01)

G06K 19/077 (2006.01)

H01Q 13/10 (2006.01)

H01Q 1/22 (2006.01)

H01Q 7/00 (2006.01)

H01Q 1/27 (2006.01)

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

CPC . **G06K 19/07777** (2013.01); **G06K 19/07728**
(2013.01); **G06K 19/07749** (2013.01); **G06K**
19/07762 (2013.01); **H01Q 1/2225** (2013.01);
H01Q 7/00 (2013.01); **H01Q 13/10** (2013.01);
H01Q 1/273 (2013.01)

(58) **Field of Classification Search**

USPC 235/492, 451; 340/572.1, 572.7, 572.8
See application file for complete search history.

(56) **References Cited**

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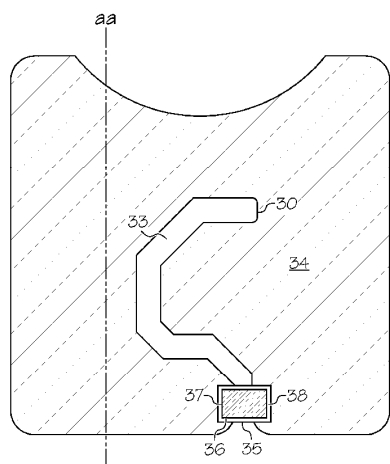
Primary Examiner — Ahshik Kim

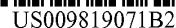
(74) *Attorney, Agent, or Firm* — Avery Dennison Retail
Information Services, LLC

(57) **ABSTRACT**

Robust merchandise tags, patches, inlays and labels are provided for mounting on garments, fabrics, apparel accessories and other flexible merchandising materials. These are robust enough to withstand processing during manufacturing, including steps such as machine washing, stone washing and chemical treatments, while being capable of remaining on the garment, fabric or the like during inventory handling, merchandising and consumer use. The robust merchandise tags combine a hybrid-slot loop antenna structure with an uncharacteristically large area conductor sheet in the nature of a foil or the like. Overlaminations and fold-over portions also can be included for robustness enhancement.

20 Claims, 11 Drawing Sheets





(10) **Patent No.:** US 9,819,071 B2
(45) **Date of Patent:** Nov. 14, 2017

- (56) **References Cited**

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- Primary Examiner — Linh Nguyen

- (74) *Attorney, Agent, or Firm* — Nokia Technologies Oy

- PCT Pub. Date:
- Feb. 27, 2014**

- (65) **Prior Publication Data**

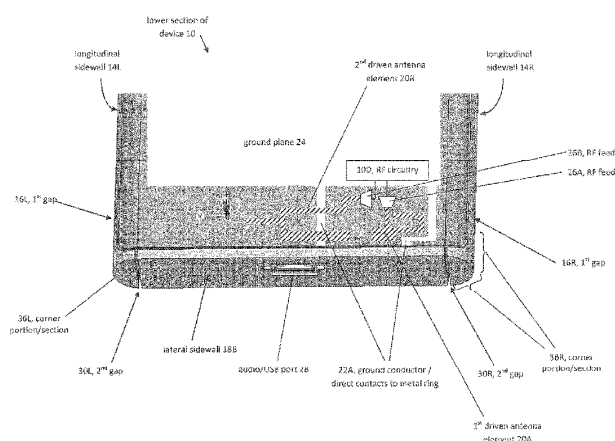
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- (51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 9/42 (2006.01)
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- (52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 9/42*
(2013.01); *H01Q 21/0087* (2013.01); *H01Q*
21/30 (2013.01)

- (58) **Field of Classification Search**
CPC H01Q 1/243; H01Q 1/38; H01Q 13/10;
H01Q 9/0421; H01Q 1/42; H01Q 1/36
(Continued)

20 Claims, 7 Drawing Sheets





US009819072B2

(12) **United States Patent**
Wu et al.

(10) **Patent No.:** **US 9,819,072 B2**

(45) **Date of Patent:** **Nov. 14, 2017**

(54) **WIRELESS COMMUNICATION APPARATUS
AND ANTENNA MODULE THEREOF**

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

(72) Inventors: **Chien-Yi Wu**, Taipei (TW); **Chao-Hsu
Wu**, Taipei (TW); **Cheng-Hsiung Wu**,
Taipei (TW); **Chun-Yen Huang**, Taipei
(TW)

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

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 31 days.

(21) Appl. No.: **15/182,617**

(22) Filed: **Jun. 15, 2016**

(65) **Prior Publication Data**
US 2016/0380336 A1 Dec. 29, 2016

(30) **Foreign Application Priority Data**
Jun. 26, 2015 (TW) 104120770 A

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)
H01Q 1/50 (2006.01)
H01Q 5/371 (2015.01)

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 1/48**
(2013.01); **H01Q 1/50** (2013.01); **H01Q 5/371**
(2015.01)

(58) **Field of Classification Search**

CPC H01Q 1/243; H01Q 5/371; H01Q 1/48;
H01Q 1/50

See application file for complete search history.

(56) **References Cited**

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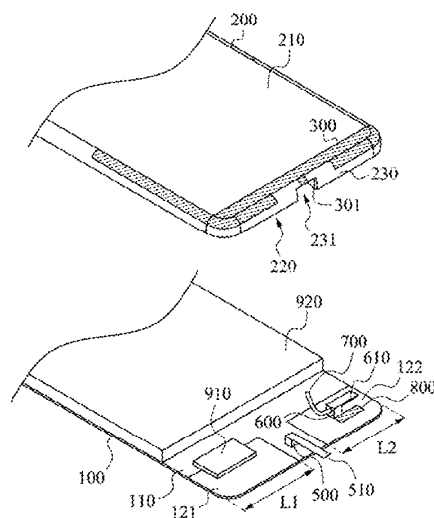
Primary Examiner — Hoang Nguyen

(74) *Attorney, Agent, or Firm* — CKC & Partners Co.,
Ltd.

(57) **ABSTRACT**

A wireless communication apparatus includes a substrate, an electrical insulation cover, a first antenna and a second antenna. The substrate has a ground surface. The electrical insulation cover covers the substrate. The electrical insulation cover has first and second surfaces. The first antenna is disposed on the first surface and is electrically connected to the ground surface. The second antenna is disposed on the second surface and includes first and second capacitive coupling portions, a signal feeding portion and a first slit. The signal feeding portion connects the first and second capacitive coupling portions. The first slit is located between the first and second capacitive coupling portions. The first antenna can generate first and second resonant modes with the first and second capacitive coupling portions in a manner of capacitive coupling, respectively. The first and second resonant modes have different frequency bands.

14 Claims, 4 Drawing Sheets





US009819073B2

(12) **United States Patent**
Park et al.

(10) **Patent No.:** **US 9,819,073 B2**

(45) **Date of Patent:** **Nov. 14, 2017**

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

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

(72) Inventors: **Hoon Park**, Seoul (KR); **Yeon-Woo Kim**, Seoul (KR); **Ho-Saeng Kim**,
Gyeonggi-do (KR)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/216,379**

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

(65) **Prior Publication Data**

US 2016/0329629 A1 Nov. 10, 2016

Related U.S. Application Data

(63) Continuation of application No. 14/532,235, filed on Nov. 4, 2014, now Pat. No. 9,413,080.

(30) **Foreign Application Priority Data**

Nov. 4, 2013 (KR) 10-2013-0133221

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/38 (2006.01)
H01Q 21/30 (2006.01)
H01Q 9/42 (2006.01)
H01Q 7/00 (2006.01)

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 7/00** (2013.01); **H01Q 9/42** (2013.01); **H01Q 21/30** (2013.01)

(58) **Field of Classification Search**

CPC H01Q 1/243; H01Q 21/30; H01Q 7/00; H01Q 9/42; H01Q 1/12; H01Q 1/38
See application file for complete search history.

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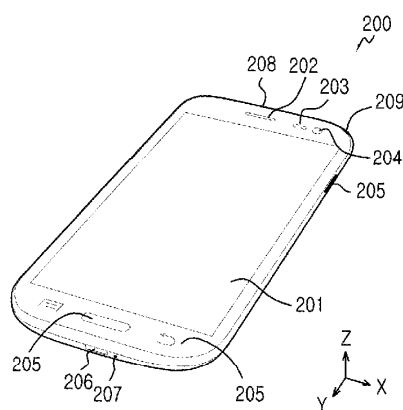
Primary Examiner — Tho G Phan

(74) *Attorney, Agent, or Firm* — The Farrell Law Firm, P.C.

(57) **ABSTRACT**

An electronic apparatus is provided. The electronic apparatus includes at least one first antenna radiator, a main board including a feed part that is spaced apart from at least one portion of the at least one first antenna radiator to overlap the at least one portion of the at least one first antenna radiator and feeds an electric current to the at least one first antenna radiator according to an indirect feed method, at least one second antenna radiator disposed on a housing of the electronic apparatus, at least one first connection member for electrically connecting the at least one first antenna radiator to the at least one second antenna radiator, and at least one second connection member for electrically connecting a ground part formed on the main board to the at least one second antenna radiator. Also, other various exemplary may be implemented.

18 Claims, 16 Drawing Sheets





US009819091B2

(12) **United States Patent**
Fan et al.

(10) **Patent No.:** **US 9,819,091 B2**

(45) **Date of Patent:** **Nov. 14, 2017**

(54) **PORTABLE TERMINAL AND SLOT ANTENNA THEREOF**

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

(72) Inventors: **Yi Fan**, Shenzhen (CN); **Yao Lan**, Shenzhen (CN)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 443 days.

(21) Appl. No.: **14/134,894**

(22) Filed: **Dec. 19, 2013**

(65) **Prior Publication Data**

US 2014/0104126 A1 Apr. 17, 2014

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2013/077400, filed on Jun. 18, 2013.

(30) **Foreign Application Priority Data**

Jun. 21, 2012 (CN) 2012 1 0208421

(51) **Int. Cl.**
H01Q 13/10 (2006.01)
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)
H01Q 5/385 (2015.01)

(52) **U.S. Cl.**
CPC **H01Q 13/10** (2013.01); **H01Q 1/243** (2013.01); **H01Q 1/48** (2013.01); **H01Q 5/385** (2015.01)

(58) **Field of Classification Search**

CPC H01Q 13/10; H01Q 5/385; H01Q 1/48; H01Q 1/243

USPC 343/702, 767
See application file for complete search history.

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Primary Examiner — Linh Nguyen

(74) *Attorney, Agent, or Firm* — Leydig, Voit & Mayer, Ltd.

(57) **ABSTRACT**

Embodiments of the present invention disclose a portable terminal and a slot antenna thereof, and relate to the field of mobile communications technologies, which can effectively reduce a space occupied by the antenna and at the same time meet various bandwidth requirements. The slot antenna of the portable terminal includes: a large-area conductor plane laid on a printed circuit board, a battery with a bulk conductor, and a first feeding part, where a slot is formed between the conductor plane and the battery, the conductor plane is radio-frequency coupled to the bulk conductor in the battery through the slot, and the first feeding part is located in the slot. The present invention is applied in designing the antenna of the portable terminal.

16 Claims, 3 Drawing Sheets

