



US009977528B2

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

(10) **Patent No.:** **US 9,977,528 B2**

(45) **Date of Patent:** **May 22, 2018**

(54) **ELECTRONIC DEVICE HAVING TOUCH SENSOR**

H04M 1/0254 (2013.01); *H04M 1/0262* (2013.01); *H04M 1/72575* (2013.01); *H04M 2250/22* (2013.01)

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

(58) **Field of Classification Search**
CPC combination set(s) only.
See application file for complete search history.

(72) Inventors: **Jeonghun Kim**, Gyeonggi-do (KR);
Kyungjung Kim, Gyeonggi-do (KR);
Changhyun Ahn, Gyeonggi-do (KR);
Hyejeon Jung, Seoul (KR); **Youngjoon Kim**, Gyeonggi-do (KR); **Gajin Song**,
Gyeonggi-do (KR); **Bongjae Rhee**,
Gyeonggi-do (KR); **Yujeong Jeon**,
Seoul (KR)

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Primary Examiner — Jennifer Mehmood

Assistant Examiner — Sosina Abebe

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 39 days.

(21) Appl. No.: **14/273,204**

(22) Filed: **May 8, 2014**

(65) **Prior Publication Data**

US 2014/0333554 A1 Nov. 13, 2014

(30) **Foreign Application Priority Data**

May 8, 2013 (KR) 10-2013-0052054

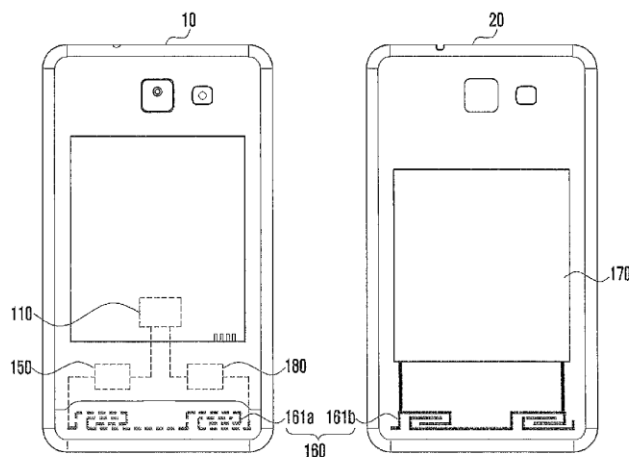
(51) **Int. Cl.**
G06F 3/041 (2006.01)
G06F 1/16 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC **G06F 3/0416** (2013.01); **G06F 1/169** (2013.01); **G06F 1/1656** (2013.01); **G06F 3/041** (2013.01); **G06F 3/0436** (2013.01);

(57) **ABSTRACT**

An electronic device with a touch sensor includes a body mounted with an electronic element, and a cover detachably coupled to the body. The body includes a signal generating circuitry that generates an electric signal, a first antenna that transmits the electric signal, and a touch processing circuitry that processes a touch signal received through the first antenna. The cover includes a touch sensor that is driven by the electric signal and recognizes a touch, and a second antenna connected with the touch sensor. The second antenna receives the electric signal and transmits a touch signal sensed through the touch sensor unit.

20 Claims, 4 Drawing Sheets





US009978007B2

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

(10) **Patent No.:** **US 9,978,007 B2**
(45) **Date of Patent:** **May 22, 2018**

(54) **THERMAL SCALE RADIO FREQUENCY LABEL**

(71) Applicant: **Synq Access + Security Technology Ltd.**, Victoria (CA)

(72) Inventors: **Nolan Wheeler**, Victoria (CA); **Vince Geisler**, Victoria (CA)

(73) Assignee: **Synq Access + Security Technology Ltd.**, Victoria, BC (CA)

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

(21) Appl. No.: **15/399,454**

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

(65) **Prior Publication Data**

US 2017/0193344 A1 Jul. 6, 2017

(30) **Foreign Application Priority Data**

Jan. 5, 2016 (CA) 2916700

(51) **Int. Cl.**
G08B 13/24 (2006.01)
G06K 19/02 (2006.01)
G06K 19/07 (2006.01)
G06K 19/077 (2006.01)

(52) **U.S. Cl.**
CPC **G06K 19/025** (2013.01); **G06K 19/0723** (2013.01); **G06K 19/07756** (2013.01); **G06K 19/07783** (2013.01); **G08B 13/2428** (2013.01); **G08B 13/2451** (2013.01); **G08B 13/2474** (2013.01)

(58) **Field of Classification Search**
CPC G08B 13/24-13/26
See application file for complete search history.

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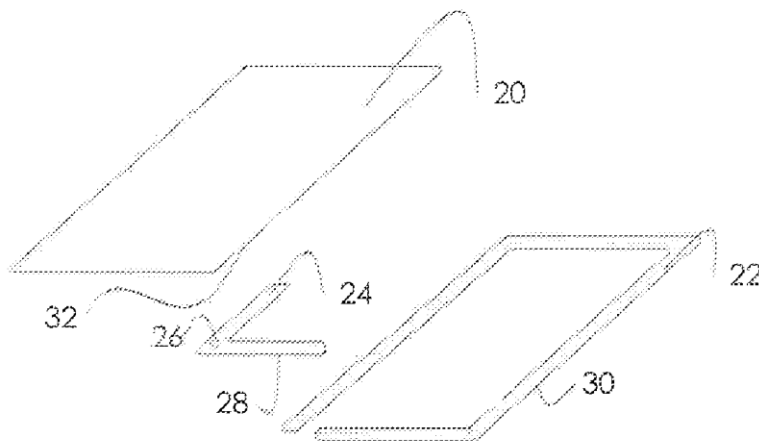
Primary Examiner — Christle I Marshall

(74) *Attorney, Agent, or Firm* — Davis & Bujold PLLC; Michael J. Bujold

(57) **ABSTRACT**

A thermal scale radio frequency label which includes a top layer of thermal paper of 20-60 lb weight with an RF antenna mounted on the thermal paper. The RF antenna includes a single turn inductor coil having a width of not less than 5 mm and not more than 13 mm. The inductor coil has a thickness in the range of 30-60 um and covers an area of at least 55×49 mm. A capacitive layer is provided having a thickness in the range of 30-60 um. A dielectric layer is positioned between the capacitive layer and the inductor coil. A plurality of electrical connections are provided between the capacitive layer and the inductor coil. The electrical connections are capable of being deactivated by RF energy.

4 Claims, 1 Drawing Sheet





US009979071B2

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

(10) **Patent No.:** **US 9,979,071 B2**
(45) **Date of Patent:** **May 22, 2018**

(54) **ELECTRONIC DEVICE**

USPC 343/700 MS, 702
See application file for complete search history.

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

(72) Inventors: **Cheng-Yu Hsieh**, New Taipei (TW);
Kun-Sheng Chang, New Taipei (TW);
Ching-Chi Lin, New Taipei (TW)

(73) Assignee: **Acer Incorporated**, 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 0 days.

(21) Appl. No.: **15/096,053**

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

(65) **Prior Publication Data**

US 2017/0141452 A1 May 18, 2017

(30) **Foreign Application Priority Data**

Nov. 13, 2015 (TW) 104137449 A

(51) **Int. Cl.**

H01Q 1/38 (2006.01)

H01Q 1/22 (2006.01)

H01Q 1/52 (2006.01)

H01Q 9/04 (2006.01)

H01Q 1/24 (2006.01)

H01Q 1/48 (2006.01)

H01Q 9/42 (2006.01)

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

CPC **H01Q 1/22** (2013.01); **H01Q 1/243** (2013.01); **H01Q 1/38** (2013.01); **H01Q 1/48** (2013.01); **H01Q 1/528** (2013.01); **H01Q 9/0414** (2013.01); **H01Q 9/0421** (2013.01); **H01Q 9/42** (2013.01)

(58) **Field of Classification Search**

CPC H01Q 1/22; H01Q 1/528; H01Q 9/0421; H01Q 9/0414

(56) **References Cited**

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343/700 MS

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Primary Examiner — Daniel J Munoz

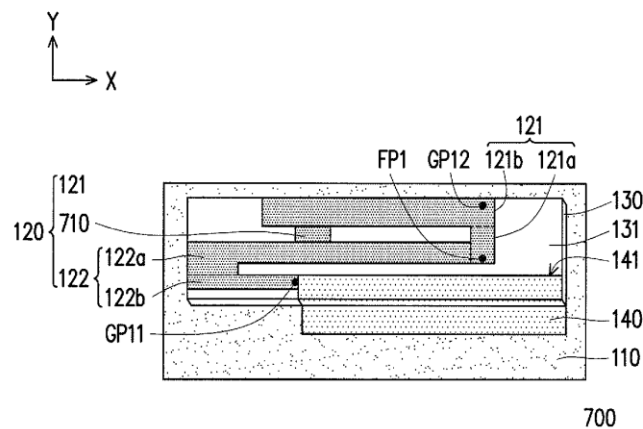
Assistant Examiner — Hai Tran

(74) *Attorney, Agent, or Firm* — J.C. Patents

(57) **ABSTRACT**

An electronic device including a metal element and an antenna element is provided. The antenna element is disposed on a substrate and includes a radiation portion and a connection portion. A first end of the radiation portion has a feeding point for receiving a feeding signal, and a second end of the radiation portion is an open end. A first end of the connection portion is electrically connected to the first end of the radiation portion. A second end of the connecting portion has a first ground point to be electrically connected the metal element. An orthogonal projection of the metal element on the substrate and an orthogonal projection of the antenna element on the substrate are overlapped with each other. The radiation portion is electrically connected the metal element through a second ground point.

12 Claims, 5 Drawing Sheets





US009979073B2

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

(10) **Patent No.:** **US 9,979,073 B2**
(45) **Date of Patent:** **May 22, 2018**

(54) **WIRELESS DEVICE**

(71) Applicant: **MEDIATEK INC.**, Hsin-Chu (TW)

(72) Inventors: **Min-Chung Wu**, Taoyuan (TW);
Shao-Chin Lo, Miaoli County (TW)

(73) Assignee: **MEDIATEK INC.**, Hsin-Chu (TW)

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

(21) Appl. No.: **15/202,587**

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

(65) **Prior Publication Data**

US 2016/0315374 A1 Oct. 27, 2016

Related U.S. Application Data

(62) Division of application No. 12/959,373, filed on Dec. 3, 2010.

(60) Provisional application No. 61/290,177, filed on Dec. 25, 2009.

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 9/40 (2006.01)
H01Q 1/38 (2006.01)
H01Q 1/48 (2006.01)

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 1/38** (2013.01); **H01Q 1/48** (2013.01); **H01Q 9/40** (2013.01)

(58) **Field of Classification Search**
CPC . H01Q 11/38; H01Q 1/48; H01Q 1/38; H01Q 1/243; H01Q 9/40
USPC 343/702
See application file for complete search history.

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Primary Examiner — Jessica Han

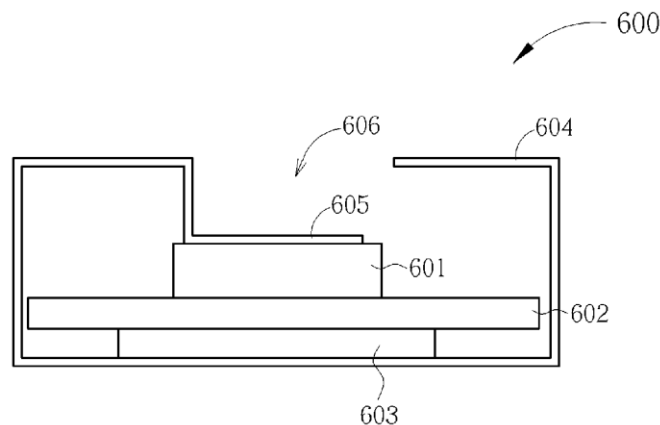
Assistant Examiner — Jae Kim

(74) *Attorney, Agent, or Firm* — McClure, Qualey & Rodack, LLP

(57) **ABSTRACT**

The present invention discloses a wireless device, which includes a substrate and an antenna. The antenna includes a printed antenna element and a 3-dimensional antenna element. The printed antenna element is printed on the substrate, while the 3-dimensional antenna element is disposed on the substrate and coupled to the printed antenna element. The printed antenna element and the 3-dimensional antenna element jointly have a physical length of a desired frequency.

7 Claims, 6 Drawing Sheets





US009979074B2

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

(10) **Patent No.:** **US 9,979,074 B2**
(45) **Date of Patent:** **May 22, 2018**

(54) **MOBILE DEVICE**

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

(72) Inventors: **Chun-I Chen**, Taoyuan (TW);
Chi-Hsuan Lee, Taoyuan (TW);
Chung-Ting Hung, Taoyuan (TW)

(73) Assignee: **QUANTA COMPUTER INC.**,
Guishan Dist., Taoyuan (TW)

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

(21) Appl. No.: **15/286,893**

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

(65) **Prior Publication Data**
US 2018/0013190 A1 Jan. 11, 2018

(30) **Foreign Application Priority Data**
Jul. 6, 2016 (TW) 105121329 A

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

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

(58) **Field of Classification Search**
CPC H01Q 1/243; H01Q 1/36; H01Q 1/48
See application file for complete search history.

(56) **References Cited**

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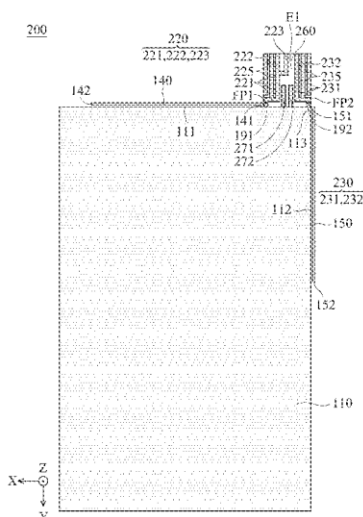
Primary Examiner — Graham Smith

(74) *Attorney, Agent, or Firm* — McClure, Qualey &
Rodack, LLP

(57) **ABSTRACT**

A mobile device includes a ground plane, a first antenna, a second antenna, a first metal element, and a second metal element. The first antenna has a first feeding point coupled to a first signal source. The second antenna has a second feeding point coupled to a second signal source. The first metal element has a connection end and an open end. The connection end of the first metal element is coupled to the ground plane, and is adjacent to the first feeding point. The second metal element has a connection end and an open end. The connection end of the second metal element is coupled to the ground plane, and is adjacent to the second feeding point.

8 Claims, 6 Drawing Sheets





US009979090B2

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

(10) **Patent No.:** **US 9,979,090 B2**

(45) **Date of Patent:** **May 22, 2018**

(54) **TOUCH SCREEN PANEL ANTENNA OF MOBILE TERMINAL**

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

(72) Inventors: **Kyung Jin Oh**, Hwaseong-si (KR); **Oh Hyuck Kwon**, Suwon-si (KR)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 228 days.

(21) Appl. No.: **15/090,115**

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

(65) **Prior Publication Data**

US 2016/0218435 A1 Jul. 28, 2016

Related U.S. Application Data

(63) Continuation of application No. 12/977,620, filed on Dec. 23, 2010, now Pat. No. 9,325,072.

(30) **Foreign Application Priority Data**

Dec. 28, 2009 (KR) 10-2009-0131636

(51) **Int. Cl.**
H01Q 9/42 (2006.01)
H01Q 9/40 (2006.01)
H01Q 1/24 (2006.01)

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

CPC **H01Q 9/42** (2013.01); **H01Q 1/24** (2013.01); **H01Q 9/40** (2013.01)

(58) **Field of Classification Search**

CPC H01Q 9/42; H01Q 1/24; H01Q 9/40
See application file for complete search history.

(56) **References Cited**

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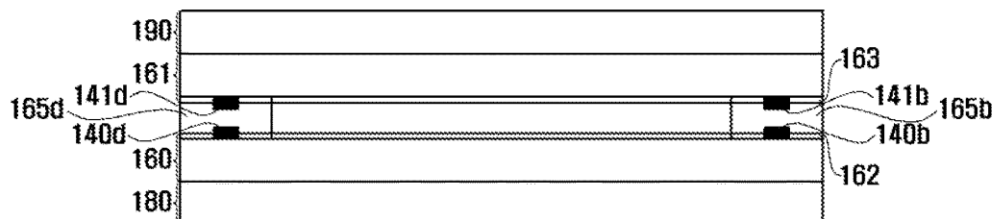
Primary Examiner — Graham Smith

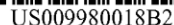
(74) *Attorney, Agent, or Firm* — Jefferson IP Law, LLP

(57) **ABSTRACT**

A touch screen panel (TSP) antenna of a mobile terminal is provided. The TSP antenna includes an ITO film stacked in a TSP, an upper electrode line, a lower electrode line, a left electrode line, and a right electrode line formed at an upper or lower surface of the ITO film, an external surface, and an antenna pattern formed in at least one of an upper surface, a lower surface, a left surface, and a right surface of the external surface.

20 Claims, 6 Drawing Sheets





(10) **Patent No.:** US 9,980,018 B2
(45) **Date of Patent:** May 22, 2018

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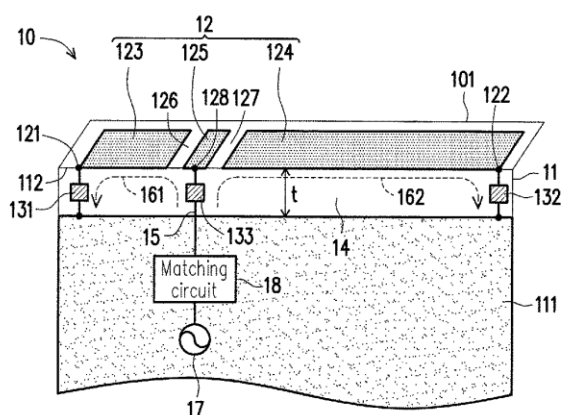
- Primary Examiner — Tho G Phan

- (74) *Attorney, Agent, or Firm* — J.C. Patents

- (57)
- ABSTRACT**

A communication device including a system circuit board and an antenna element is presented. A radiation metal strip of the antenna element does not lie on the same surface as the system circuit board. The radiation metal strip and a ground plane are separated by a clearance region. The radiation metal strip comprises a first metal strip, a second metal strip, and a coupling metal strip. A first end is located in the first metal strip and connected to the ground plane by a first inductive element. A second end is located in the second metal strip and connected to the ground plane by a second inductive element. A first gap is located between the coupling metal strip and the first metal strip. A second gap is located between the coupling metal strip and the second metal strip. The coupling metal strip is connected to a signal source.

11 Claims, 4 Drawing Sheets





US009985337B2

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

(10) **Patent No.:** **US 9,985,337 B2**
(45) **Date of Patent:** **May 29, 2018**

(54) **MOBILE TERMINAL**

(71) Applicant: **LG ELECTRONICS INC.**, Seoul
(KR)

(72) Inventors: **Yunmo Kang**, Seoul (KR); **Kangjae Jung**, Seoul (KR); **Sungjoon Hong**, Seoul (KR); **Byungwoon Jung**, Seoul (KR); **Sungjung Rho**, Seoul (KR)

(73) Assignee: **LG ELECTRONICS INC.**, Seoul
(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.: **15/346,505**

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

(65) **Prior Publication Data**

US 2017/0054200 A1 Feb. 23, 2017

Related U.S. Application Data

(63) Continuation of application No. 14/010,900, filed on Aug. 27, 2013, now Pat. No. 9,871,286.

(30) **Foreign Application Priority Data**

Sep. 19, 2012 (KR) 10-2012-0104152

(51) **Int. Cl.**

H01Q 1/24 (2006.01)
H01Q 21/30 (2006.01)
H01Q 9/26 (2006.01)
H01Q 13/10 (2006.01)
H01Q 5/35 (2015.01)
H01Q 5/50 (2015.01)
H01Q 1/38 (2006.01)
H01Q 1/48 (2006.01)

H01Q 1/50 (2006.01)

H01Q 7/00 (2006.01)

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

CPC **H01Q 1/243** (2013.01); **H01Q 1/38** (2013.01); **H01Q 1/48** (2013.01); **H01Q 1/50** (2013.01); **H01Q 5/35** (2015.01); **H01Q 5/50** (2015.01); **H01Q 7/00** (2013.01); **H01Q 9/26** (2013.01); **H01Q 13/10** (2013.01); **H01Q 21/30** (2013.01)

(58) **Field of Classification Search**

CPC H01Q 1/273; H01Q 1/243; H01Q 9/0421; H01Q 1/38; H01Q 7/00
USPC 343/702, 718, 700 MS, 872
See application file for complete search history.

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Primary Examiner — Dameon E Levi

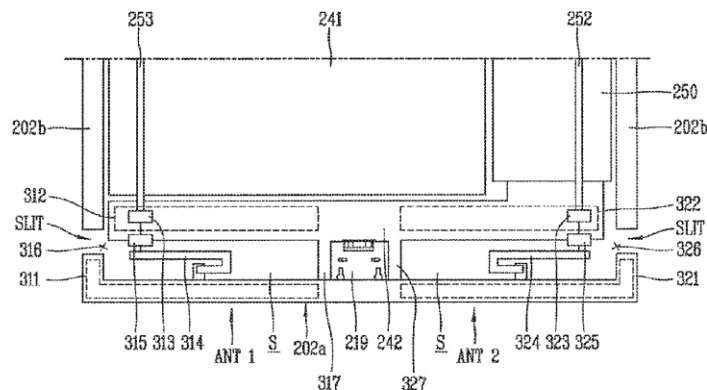
Assistant Examiner — Collin Dawkins

(74) *Attorney, Agent, or Firm* — Lee, Hong, Degerman, Kang & Waimey PC

(57) **ABSTRACT**

A mobile terminal comprises: a terminal body; and a first antenna device and a second antenna device disposed at one side of the terminal body in an adjacent manner, and formed to operate at different frequency bands, wherein the first antenna device and the second antenna device are provided with conductive members each having a slit at one side thereof, and wherein the conductive members form part of an appearance of the terminal body.

26 Claims, 13 Drawing Sheets





US009985338B2

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

(10) **Patent No.:** **US 9,985,338 B2**
(45) **Date of Patent:** **May 29, 2018**

(54) **MOBILE TERMINAL**

(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)

(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 22 days.

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

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(30) **Foreign Application Priority Data**
Sep. 22, 2016 (CN) 2016 1 0840545

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

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 1/48** (2013.01); **H04M 1/026** (2013.01)

(58) **Field of Classification Search**
CPC H01Q 1/24; H01Q 1/48–1/50
USPC 343/702
See application file for complete search history.

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Primary Examiner — Dameon E Levi

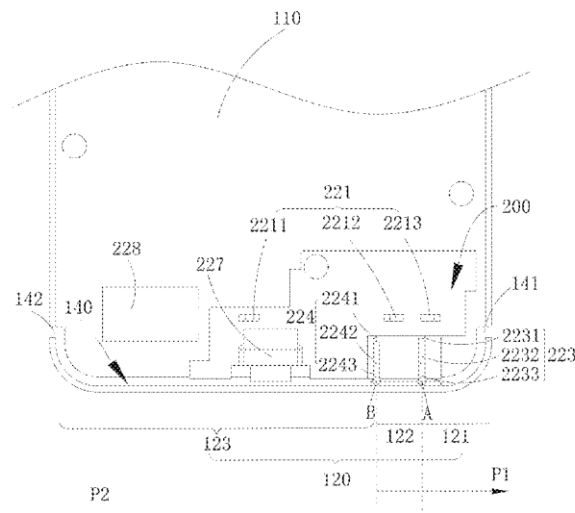
Assistant Examiner — Hasan Islam

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

(57) **ABSTRACT**

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.

10 Claims, 7 Drawing Sheets





US009985349B1

(12) **United States Patent**
He

(10) **Patent No.:** **US 9,985,349 B1**

(45) **Date of Patent:** ***May 29, 2018**

(54) **MULTI-BAND LTE ANTENNA**

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

(72) Inventor: **Ziming He**, Irvine, CA (US)

(73) Assignee: **Airgain Incorporated**, San Diego, CA (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. days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **15/161,060**

(22) Filed: **May 20, 2016**

Related U.S. Application Data

(63) Continuation of application No. 14/071,571, filed on Nov. 4, 2013, now Pat. No. 9,362,621, and a continuation-in-part of application No. 29/457,103, filed on Jun. 6, 2013, now Pat. No. Des. 692,870.

(60) Provisional application No. 61/826,981, filed on May 23, 2013.

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 5/10 (2015.01)
H01Q 1/48 (2006.01)
H01Q 15/14 (2006.01)
H01Q 1/50 (2006.01)

(52) **U.S. Cl.**
CPC **H01Q 5/10** (2015.01); **H01Q 1/242** (2013.01); **H01Q 1/48** (2013.01); **H01Q 1/50** (2013.01); **H01Q 15/14** (2013.01)

(58) **Field of Classification Search**

CPC H01Q 1/243; H01Q 1/242; H01Q 1/38; H01Q 1/48; H01Q 15/14; H01Q 1/50; H01Q 5/10
USPC 343/700 MS, 702
See application file for complete search history.

(56) **References Cited**

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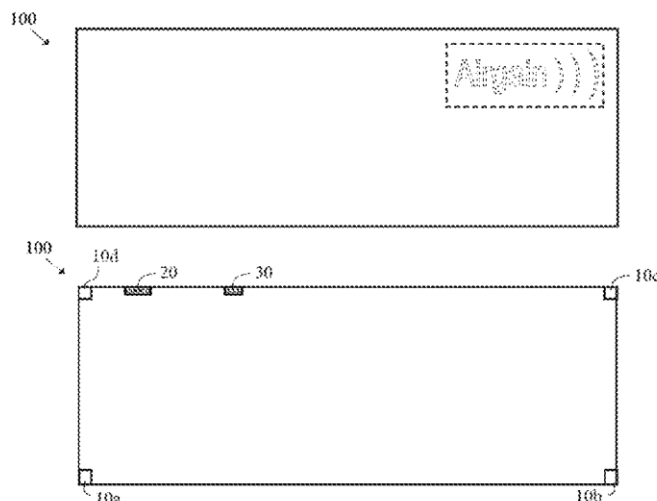
Primary Examiner — Dieu H Duong

(74) *Attorney, Agent, or Firm* — Clause Eight IPS; Michael Catania

(57) **ABSTRACT**

A surface-mounted multi-band LTE antenna that covers the frequency band of 698-960 MHz (LTE 700/800/900 bands) and 2400-2500 GHz (WLAN 2.4G band) is disclosed herein. The antenna preferably has high gain and high radiation efficiency, and is used for a variety of wireless communication devices applications. The surface-mounted multi-band LTE antenna has compact size, wide bandwidth, good return loss, high gain and high radiation efficiency, and no matching circuit is needed.

4 Claims, 8 Drawing Sheets





US009985351B2

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

(10) **Patent No.:** **US 9,985,351 B2**
(45) **Date of Patent:** **May 29, 2018**

(54) **MULTI-BAND ANTENNA AND ELECTRONIC DEVICE FOR SUPPORTING THE SAME**

USPC 343/852
See application file for complete search history.

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

(56) **References Cited**

U.S. PATENT DOCUMENTS

(72) Inventors: **Jong Suk Kim**, Gyeonggi-do (KR); **Jin Kyu Bang**, Gyeonggi-do (KR); **Kyung Bae Ko**, Gyeonggi-do (KR); **Dong Hwan Kim**, Gyeonggi-do (KR)

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343/702

(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 68 days.

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(21) Appl. No.: **14/808,667**

KR 10-2013-0053801 5/2013
KR 10-2013-0077362 7/2013

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

(65) **Prior Publication Data**

US 2016/0028157 A1 Jan. 28, 2016

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(30) **Foreign Application Priority Data**

Jul. 24, 2014 (KR) 10-2014-0094171

Primary Examiner — Dameon E Levi

Assistant Examiner — David Lotter

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

(51) **Int. Cl.**

H01Q 5/00 (2015.01)
H01Q 5/371 (2015.01)
H01Q 5/335 (2015.01)
H01Q 1/24 (2006.01)
H01Q 21/28 (2006.01)

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

CPC **H01Q 5/371** (2015.01); **H01Q 1/243** (2013.01); **H01Q 5/335** (2015.01); **H01Q 21/28** (2013.01)

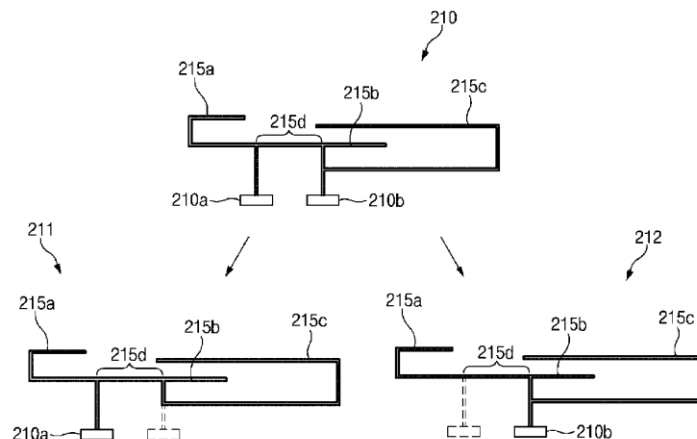
(58) **Field of Classification Search**

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

ABSTRACT

A multi-band antenna is provided. The multi-band antenna includes a plurality of radiator patterns that are configured to operate according to different frequency bands, a plurality of feeding units that are respectively connected to different contact points of the antenna radiator for connecting feeding units of the plurality of feeding units to at least one radiator pattern included in the plurality of radiator patterns, and a switching unit configured to switch between feeding units of the plurality of feeding units for connecting at least one radiator pattern included in the plurality of radiator patterns to the switched feeding unit.

13 Claims, 12 Drawing Sheets





US009985353B1

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

(10) **Patent No.:** **US 9,985,353 B1**
(45) **Date of Patent:** **May 29, 2018**

(54) **ANTENNA SYSTEM FOR METALLIZED DEVICES**

(56) **References Cited**

U.S. PATENT DOCUMENTS

(71) Applicants: **Olivier Pajona**, Nice (FR); **Laurent Desclos**, San Diego, CA (US);
Abhishek Singh, San Diego, CA (US)

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(72) Inventors: **Olivier Pajona**, Nice (FR); **Laurent Desclos**, San Diego, CA (US);
Abhishek Singh, San Diego, CA (US)

(73) Assignee: **Ethertronics, Inc.**, San Diego, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 13 days.

(21) Appl. No.: **14/503,272**

* cited by examiner

(22) Filed: **Sep. 30, 2014**

Primary Examiner — Dameon E Levi

Assistant Examiner — David Lotter

(74) *Attorney, Agent, or Firm* — Dority & Manning, P.A.

Related U.S. Application Data

(60) Provisional application No. 61/884,934, filed on Sep. 30, 2013.

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

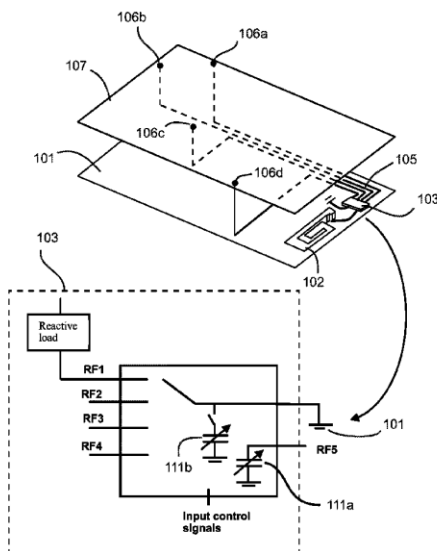
(52) **U.S. Cl.**
CPC **H01Q 9/0442** (2013.01); **H01Q 1/243** (2013.01)

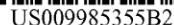
(58) **Field of Classification Search**
CPC H01Q 9/0442; H01Q 1/242
USPC 343/700 MS
See application file for complete search history.

ABSTRACT

An embedded antenna system is described for use with metallized enclosures and housings used with wireless communication devices. One or multiple radiators are coupled to a metal cover, with ground points established on the metal cover to improve radiation efficiency and control the frequency response of the antenna system. Dynamic tuning methods are described wherein detuning of the antenna system from sources such as body-loading are compensated by adjusting impedance properties of the combination of radiator and metallized cover.

15 Claims, 13 Drawing Sheets





(45) **Date of Patent:** **May 29, 2018**

[illegible]



US009991584B2

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

(10) **Patent No.:** **US 9,991,584 B2**
(45) **Date of Patent:** **Jun. 5, 2018**

(54) **PORTABLE ELECTRONIC DEVICE
HOUSING HAVING INSERT MOLDING
AROUND ANTENNA**

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

(72) Inventors: **Anthony S. Montevirgen**, San Francisco, CA (US); **Emery A. Sanford**, San Francisco, CA (US); **Stephen B. Lynch**, Portola Valley, 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 346 days.

(21) Appl. No.: **14/322,817**

(22) Filed: **Jul. 2, 2014**

(65) **Prior Publication Data**

US 2014/0313086 A1 Oct. 23, 2014

Related U.S. Application Data

(63) Continuation of application No. 13/250,668, filed on Sep. 30, 2011, now Pat. No. 9,001,002.

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/04 (2006.01)
B29C 70/68 (2006.01)
H01Q 1/40 (2006.01)

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **B29C 70/68** (2013.01); **H01Q 1/04** (2013.01); **H01Q 1/40** (2013.01)

(58) **Field of Classification Search**
USPC 343/702, 873
See application file for complete search history.

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Primary Examiner — Jessica Han

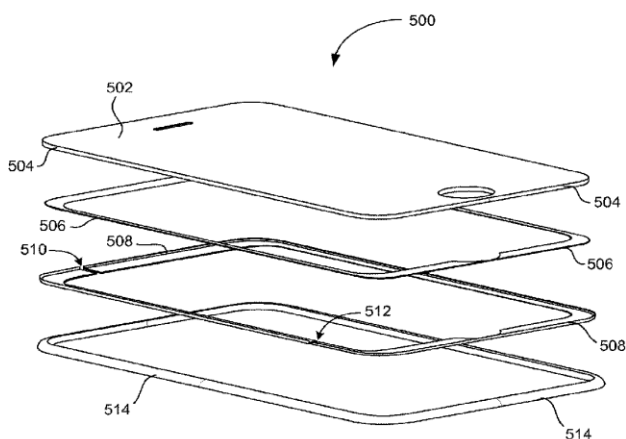
Assistant Examiner — Hai Tran

(74) *Attorney, Agent, or Firm* — Brownstein Hyatt Farber Schreck, LLP

(57) **ABSTRACT**

Embodiments are described herein in the context of housings for electronic devices. In one embodiment, a housing can make use of an outer member, which can be formed of glass. The outer member can be secured with respect to other portions of the housing for the electronic device. The output member can also be protected at its edges by a protective side member. Still further, one or more antenna can be provided at least partially internal to the protective side member. The electronic devices can be portable and in some cases handheld.

16 Claims, 10 Drawing Sheets





US009991586B2

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

(10) **Patent No.:** **US 9,991,586 B2**
(45) **Date of Patent:** **Jun. 5, 2018**

(54) **PORTABLE ELECTRONIC DEVICE**

(2013.01); **H01Q 1/48** (2013.01); **H01Q 9/42**
(2013.01); **H01Q 21/28** (2013.01)

(71) Applicant: **ASUSTeK COMPUTER INC.**, Taipei
(TW)

(58) **Field of Classification Search**

CPC **H01Q 1/24**; **H01Q 1/241**; **H01Q 1/242**;
H01Q 1/38; **H01Q 1/48**; **H01Q 9/42**;
H01Q 21/28

See application file for complete search history.

(72) Inventors: **Chien-Ming Hsu**, Taipei (TW);
Wang-Ta Hsieh, Taipei (TW);
Kuei-Shun Yeh, Taipei (TW);
Shih-Chia Chiu, Taipei (TW);
Chuan-Chien Huang, Taipei (TW)

(56) **References Cited**

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343/702
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343/702

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(21) Appl. No.: **15/376,677**

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

Primary Examiner — Hoang Nguyen

(74) *Attorney, Agent, or Firm* — JCIPRNET

(65) **Prior Publication Data**

US 2017/0179575 A1 Jun. 22, 2017

(57) **ABSTRACT**

A portable electronic device including a front cover, a back cover and a circuit board is provided. The circuit board is located between the front cover and the back cover. The back cover is combined with the front cover and includes a back section, a plurality of side sections and a separator, at least one of the side sections adjacent to the back cover includes a groove close to the back section and a slot far away from the back section, the slot is connected through to the groove, a first antenna unit and a second antenna unit are defined at the side section by the groove and the slot. The separator is located in the groove and the slot.

(30) **Foreign Application Priority Data**

Dec. 22, 2015 (CN) 2015 1 0991116

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 1/38 (2006.01)

H01Q 1/48 (2006.01)

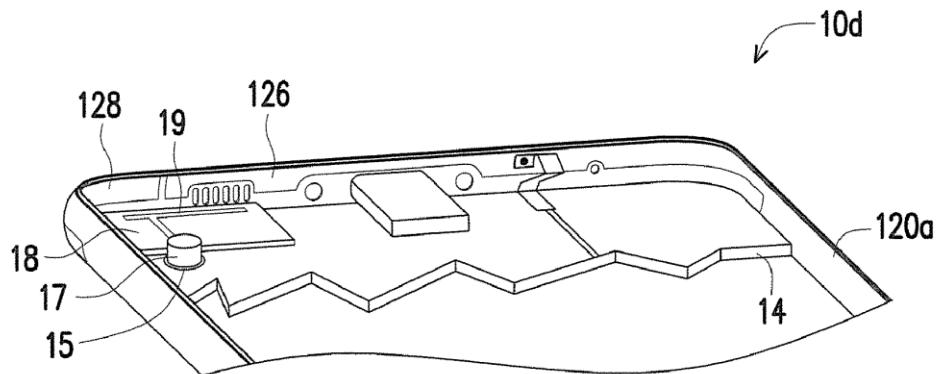
H01Q 9/42 (2006.01)

H01Q 21/28 (2006.01)

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

CPC **H01Q 1/243** (2013.01); **H01Q 1/241**
(2013.01); **H01Q 1/242** (2013.01); **H01Q 1/38**

10 Claims, 6 Drawing Sheets





US00992312B1

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

(10) **Patent No.:** **US 9,992,312 B1**
(45) **Date of Patent:** **Jun. 5, 2018**

(54) **MOBILE DEVICE**

USPC 455/90.3, 556.1, 557, 575.1, 575.8;
343/702, 741, 846

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

See application file for complete search history.

(72) Inventors: **Ying-Cong Deng**, Taoyuan (TW);
Chung-Ting Hung, Taoyuan (TW);
Chin-Lung Tsai, Taoyuan (TW);
Chung-Hung Lo, Taoyuan (TW);
Kuan-Hsien Lee, Taoyuan (TW);
Ching-Hai Chiang, Taoyuan (TW);
Yi-Ling Tseng, Taoyuan (TW)

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(73) Assignee: **QUANTA COMPUTER INC.**,
Guishan Dist., Taoyuan (TW)

Primary Examiner — Quochien B Vuong

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

(74) *Attorney, Agent, or Firm* — McClure, Qualey &
Rodack, LLP

(21) Appl. No.: **15/702,854**

(22) Filed: **Sep. 13, 2017**

(30) **Foreign Application Priority Data**

Jul. 4, 2017 (TW) 106122351 A

(51) **Int. Cl.**
H04M 1/00 (2006.01)
H04Q 1/24 (2006.01)
H04M 1/02 (2006.01)

(52) **U.S. Cl.**
CPC **H04M 1/026** (2013.01)

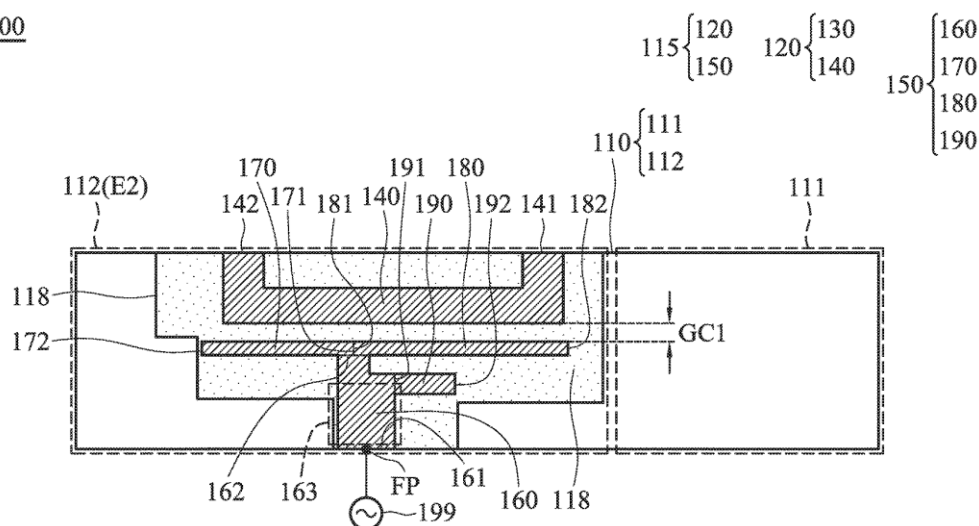
(58) **Field of Classification Search**
CPC H01Q 1/243; H01Q 1/2283; H01Q 1/36;
H01Q 9/06; H04M 1/0202; H04M 1/026

(57) **ABSTRACT**

A mobile device includes a speaker element and an antenna element. The speaker element includes a conductive portion and a nonconductive portion. The nonconductive portion has a first surface and a second surface which are opposite to each other. The antenna element is adjacent to the nonconductive portion. The antenna element includes a signal source, a first radiation element, and a second radiation element. The signal source is coupled to a feeding point. The first radiation element is coupled to the feeding point. The first radiation element extends from the first surface onto the second surface. The second radiation element is coupled to the feeding point. The second radiation element is disposed on the second surface. The second radiation element is separate from the first radiation element. A coupling gap is formed between the first radiation element and the second radiation element.

10 Claims, 7 Drawing Sheets

100





US00997828B2

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

(10) **Patent No.:** **US 9,997,828 B2**
(45) **Date of Patent:** ***Jun. 12, 2018**

(54) **ELECTRONIC DEVICE WITH SHARED ANTENNA STRUCTURES AND BALUN**

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

(72) Inventors: **Yuehui Ouyang**, Sunnyvale, CA (US); **Dean F. Darnell**, Durham, NC (US); **Enrique Ayala Vazquez**, Watsonville, CA (US); **Erica J. Tong**, Pacifica, CA (US); **Hongfei Hu**, Santa Clara, CA (US); **Matthew A. Mow**, Los Altos, CA (US); **Mattia Pascolini**, San Mateo, CA (US); **Ming-Ju Tsai**, Cupertino, CA (US); **Nanbo Jin**, Sunnyvale, 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 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **15/071,795**

(22) Filed: **Mar. 16, 2016**

(65) **Prior Publication Data**

US 2016/0197401 A1 Jul. 7, 2016

Related U.S. Application Data

(63) Continuation of application No. 14/195,130, filed on Mar. 3, 2014, now Pat. No. 9,325,080.

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 3/24 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC **H01Q 3/247** (2013.01); **H01Q 1/243** (2013.01); **H01Q 1/48** (2013.01); **H01Q 5/35** (2015.01);
(Continued)

(58) **Field of Classification Search**

CPC H01Q 1/243; H01Q 9/0421; H01Q 21/30;
H01Q 5/335; H01Q 5/371; H01Q 5/50;
H01Q 1/2283; H01Q 21/29
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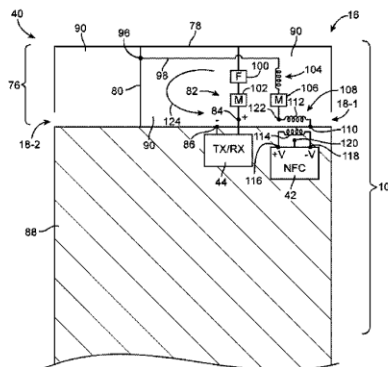
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Primary Examiner — Linh Nguyen

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

(57) **ABSTRACT**

An electronic device may be provided with shared antenna structures that can be used to form both a near-field-communications antenna such as a loop antenna and a non-near-field communications antenna such as an inverted-F antenna. The antenna structures may include conductive structures such as metal traces on printed circuits or other dielectric substrates, internal metal housing structures, or other conductive electronic device housing structures. A main resonating element arm may be separated from an antenna ground by an opening. A non-near-field communications antenna return path and antenna feed path may span the opening. A balun may have first and second electromagnetically coupled inductors. The second inductor may have terminals coupled across differential signal terminals in a near-field communications transceiver. The first
(Continued)





US009997833B2

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

(10) **Patent No.:** **US 9,997,833 B2**
(45) **Date of Patent:** **Jun. 12, 2018**

(54) **ANTENNA**

(71) Applicant: **EMW CO., LTD.**, Incheon (KR)

(72) Inventors: **Kyoung Ho Lee**, Gyeonggi-do (KR);
Young Tae Kim, Daegu (KR); **Won Mo Seong**, Gyeonggi-do (KR)

(73) Assignee: **EMW CO., LTD.**, Incheon (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 17 days.

(21) Appl. No.: **15/103,448**

(22) PCT Filed: **Dec. 8, 2014**

(86) PCT No.: **PCT/KR2014/012019**

§ 371 (c)(1),

(2) Date: **Jun. 10, 2016**

(87) PCT Pub. No.: **WO2015/088214**

PCT Pub. Date: **Jun. 18, 2015**

(65) **Prior Publication Data**

US 2016/0315387 A1 Oct. 27, 2016

(30) **Foreign Application Priority Data**

Dec. 11, 2013 (KR) 10-2013-0154213

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 5/371 (2015.01)

H01Q 9/14 (2006.01)

H01Q 13/10 (2006.01)

H01Q 1/36 (2006.01)

H01Q 1/48 (2006.01)

(Continued)

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

CPC **H01Q 5/371** (2015.01); **H01Q 1/243**
(2013.01); **H01Q 1/36** (2013.01); **H01Q 1/38**
(2013.01); **H01Q 1/48** (2013.01); **H01Q 7/00**
(2013.01); **H01Q 9/14** (2013.01); **H01Q 13/10**
(2013.01); **H01Q 13/106** (2013.01)

(58) **Field of Classification Search**

CPC H01Q 1/243; H01Q 13/10
USPC 343/702
See application file for complete search history.

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Primary Examiner — Dameon E Levi

Assistant Examiner — Hasan Islam

(74) *Attorney, Agent, or Firm* — The PL Law Group,
PLLC

(57)

ABSTRACT

An antenna using a length-adjustable slit includes a power supply line connected to a ground pad and a power supply pad for receiving a power supply signal from a PCB, the ground pad being connected to a case, a radiator formed on the case, the radiator including at least one slit having a dielectric embedded in the slit, and a plurality of switching terminals for controlling the resonant frequency of the slit.

8 Claims, 10 Drawing Sheets

