



US009455491B2

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

(10) **Patent No.:** **US 9,455,491 B2**
(45) **Date of Patent:** ***Sep. 27, 2016**

(54) **WIRELESS DEVICE**

9/0421 (2013.01); **H01Q 9/30** (2013.01);
H01Q 9/42 (2013.01); **H01Q 21/28** (2013.01)

(71) Applicant: **KABUSHIKI KAISHA TOSHIBA**,
Minato-ku, Tokyo (JP)

(58) **Field of Classification Search**

None

See application file for complete search history.

(72) Inventors: **Koichi Sato**, Tachikawa (JP); **Makoto**
Tabata, Fuchu (JP)

(56) **References Cited**

(73) Assignee: **KABUSHIKI KAISHA TOSHIBA**,
Tokyo (JP)

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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 59 days.

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This patent is subject to a terminal dis-
claimer.

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(21) Appl. No.: **14/488,687**

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

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(65) **Prior Publication Data**

US 2015/0005045 A1 Jan. 1, 2015

Advisory Action dated May 7, 2014, issued in parent U.S. Appl. No.
13/654,145.

(Continued)

Related U.S. Application Data

(63) Continuation of application No. 13/654,145, filed on
Oct. 17, 2012, now Pat. No. 9,088,070, which is a
continuation of application No. 12/556,766, filed on
Sep. 10, 2009, now abandoned.

Primary Examiner — Christopher R Lamb

(74) *Attorney, Agent, or Firm* — Holtz, Holtz & Volek PC

(30) **Foreign Application Priority Data**

Mar. 30, 2009 (JP) 2009-082341

(57) **ABSTRACT**

A wireless device includes: a casing having a first face; a
display configured to be visible from the first face; a touch
sensor formed by a transparent material and mounted in the
casing with respect to the display as a part of the first face;
a substrate mounted to a side opposite to the first face with
respect to the display; and an antenna element including: a
first portion built in the casing, connected to a feeding point
included in the substrate, and located within a first range
occupied by the touch sensor when viewed from a direction
perpendicular to the first face; and a second portion located
within a second range other than the first range.

(51) **Int. Cl.**

G06F 3/041 (2006.01)

H01Q 1/24 (2006.01)

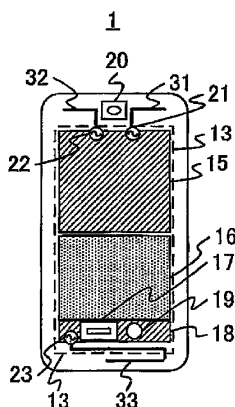
G06F 1/16 (2006.01)

(Continued)

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

CPC **H01Q 1/243** (2013.01); **G06F 1/1626**
(2013.01); **G06F 1/1698** (2013.01); **H01Q**

20 Claims, 6 Drawing Sheets





US009455492B2

(12) **United States Patent**
Jiang

(10) **Patent No.:** **US 9,455,492 B2**
(45) **Date of Patent:** **Sep. 27, 2016**

(54) **MULTIBAND ANTENNA ARRANGEMENT**

(56) **References Cited**

(71) Applicant: **Hua Jiang**, Shenzhen (CN)

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(72) Inventor: **Hua Jiang**, Shenzhen (CN)

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

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343/700 MS

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 85 days.

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343/700 MS

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343/700 MS

(21) Appl. No.: **14/597,379**

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343/702

(22) Filed: **Jan. 15, 2015**

2014/0354487 A1 * 12/2014 Liang H01Q 1/243
343/702

(65) **Prior Publication Data**

US 2016/0064802 A1 Mar. 3, 2016

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Primary Examiner — Tho G Phan

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

(30) **Foreign Application Priority Data**

Aug. 26, 2014 (CN) 2014 2 0484886 U

(57) **ABSTRACT**

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

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 5/307 (2015.01)

H01Q 5/20 (2015.01)

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

CPC **H01Q 1/243** (2013.01); **H01Q 5/20**
(2015.01); **H01Q 5/307** (2015.01)

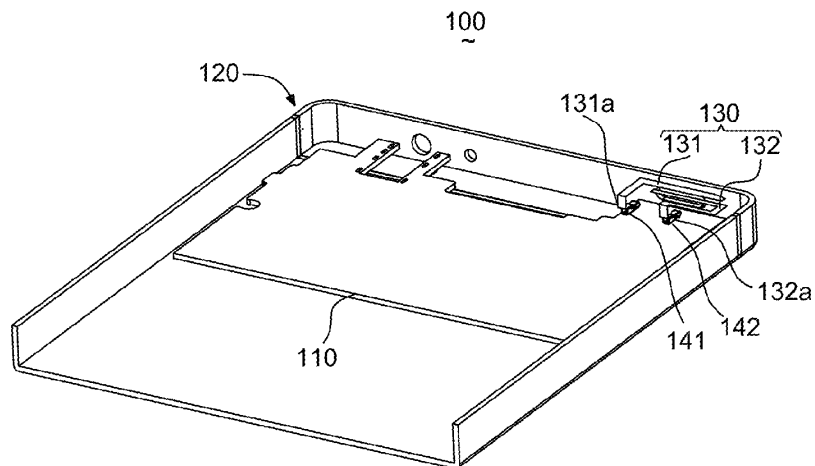
(58) **Field of Classification Search**

CPC H01Q 1/243; H01Q 5/20; H01Q 5/307

USPC 343/700 MS, 702, 725, 727, 829, 846

See application file for complete search history.

16 Claims, 3 Drawing Sheets





US009455493B2

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

(10) **Patent No.:** **US 9,455,493 B2**
(45) **Date of Patent:** **Sep. 27, 2016**

(54) **DUAL BRANCH COMMON CONDUCTOR ANTENNA**

(71) Applicant: **Galtronics Corporation Ltd.**, Tempe, AZ (US)

(72) Inventors: **Matti Martiskainen**, Tiberias (IL); **Jongmin Na**, Suwon-si (KR); **Eeungyu Bae**, Suwon-si (KR)

(73) Assignee: **GALTRONICS CORPORATION, LTD.**, Tiberias (IL)

(*) 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.: **14/601,778**

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

(65) **Prior Publication Data**

US 2015/0207210 A1 Jul. 23, 2015

Related U.S. Application Data

(60) Provisional application No. 61/954,685, filed on Mar. 18, 2014, provisional application No. 61/944,638, filed on Feb. 26, 2014, provisional application No. 61/930,029, filed on Jan. 22, 2014, provisional application No. 61/971,650, filed on Mar. 28, 2014.

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 5/371 (2015.01)
H01Q 21/30 (2006.01)
H01Q 7/00 (2006.01)
H01Q 5/307 (2015.01)
H01Q 13/10 (2006.01)
H01Q 9/42 (2006.01)

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 5/307** (2015.01); **H01Q 5/371** (2015.01); **H01Q 7/00** (2013.01); **H01Q 9/42** (2013.01); **H01Q 13/10** (2013.01); **H01Q 21/30** (2013.01)

(58) **Field of Classification Search**

CPC H01Q 1/24; H01Q 1/241; H01Q 1/242; H01Q 1/243; H01Q 5/30; H01Q 21/30
USPC 343/702
See application file for complete search history.

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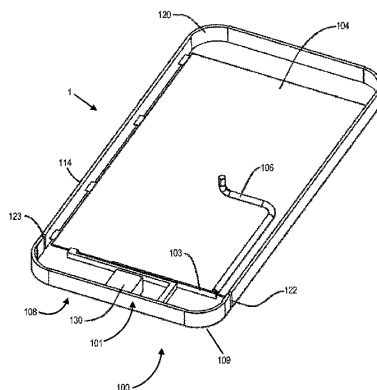
Primary Examiner — Dameon E Levi
Assistant Examiner — Collin Dawkins

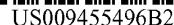
(74) *Attorney, Agent, or Firm* — Lorenz & Kopf, LLP.

(57) **ABSTRACT**

A dual branch antenna is provided. The dual branch antenna may include a continuous conductive element divided into first and second branches. Each branch may be configured to form at least a portion of an antenna structure. Antenna structures thus formed may be configured to radiate in at least two different frequencies.

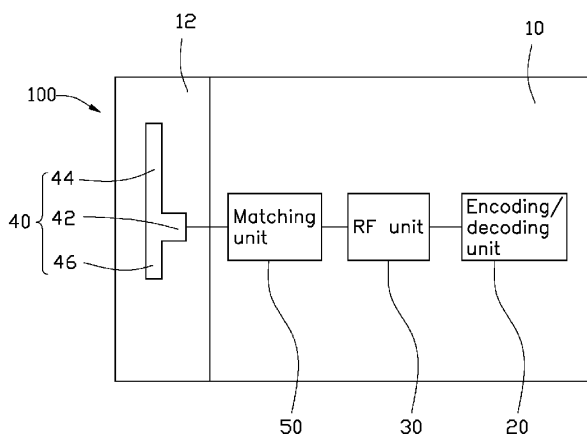
19 Claims, 7 Drawing Sheets





(10) **Patent No.:** US 9,455,496 B2
(45) **Date of Patent:** Sep. 27, 2016

14 Claims, 3 Drawing Sheets





US009455497B2

(12) **United States Patent**
Wu

(10) **Patent No.:** **US 9,455,497 B2**
(45) **Date of Patent:** **Sep. 27, 2016**

(54) **MULTI-BAND ANTENNA**

(71) Applicant: **Jing Wu**, Shenzhen (CN)

(72) Inventor: **Jing 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 83 days.

(21) Appl. No.: **14/597,362**

(22) Filed: **Jan. 15, 2015**

(65) **Prior Publication Data**

US 2016/0134018 A1 May 12, 2016

(30) **Foreign Application Priority Data**

Nov. 10, 2014 (CN) 2014 2 0668356 U

(51) **Int. Cl.**

H01Q 1/38 (2006.01)

H01Q 5/385 (2015.01)

H01Q 19/00 (2006.01)

H01Q 5/392 (2015.01)

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

CPC **H01Q 5/385** (2015.01); **H01Q 5/392**
(2015.01); **H01Q 19/005** (2013.01)

(58) **Field of Classification Search**

CPC H01Q 19/005; H01Q 5/385; H01Q 5/392
USPC 343/700 MS, 817, 818, 834, 846
See application file for complete search history.

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2016/0134017 A1 *	5/2016	Lin		H01Q 5/335
				343/861

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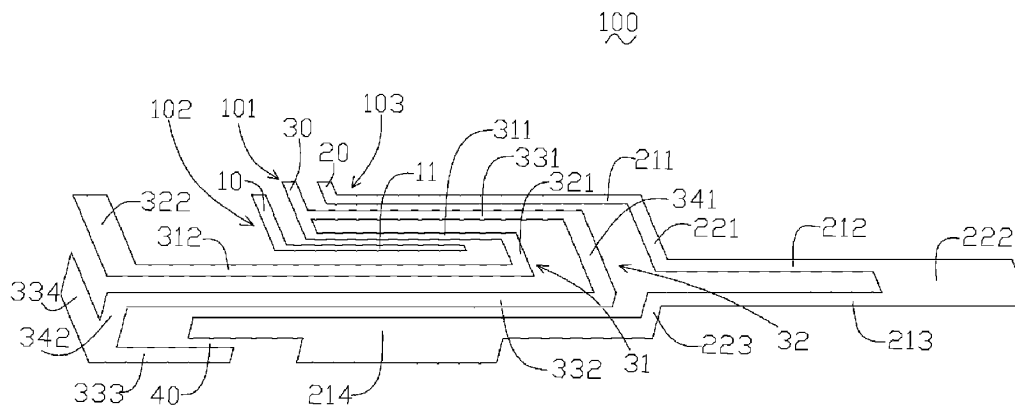
Primary Examiner — Tho G Phan

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

(57) **ABSTRACT**

A multi-band antenna includes a radiating antenna member, a first parasitic antenna member, and a second parasitic antenna member. The radiating antenna member includes a feeding unit, a high frequency (HF) radiating unit and a low frequency (LF) radiating unit, the HF radiating unit and the LF radiating unit extend from the feeding unit. The first parasitic antenna member includes an HF grounding part, and an HF parasitic unit extending from the HF grounding part and adjacent to the HF radiating unit. The second parasitic antenna member includes an LF grounding part, and an LF parasitic unit extending from the LF grounding part and electromagnetically coupled to the LF radiating unit. The feeding unit is arranged between the HF grounding part and the LF grounding part; the feeding unit and the HF radiating unit define a receiving slot, and the HF parasitic unit is arranged in the receiving slot.

20 Claims, 2 Drawing Sheets





US009455499B2

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

(10) **Patent No.:** **US 9,455,499 B2**
(45) **Date of Patent:** **Sep. 27, 2016**

(54) **COMMUNICATION DEVICE AND ANTENNA ELEMENT THEREIN**

FOREIGN PATENT DOCUMENTS

- (71) Applicant: **Acер Incorporated**, New Taipei (TW)
(72) Inventors: **Kin-Lu Wong**, New Taipei (TW);
Meng-Ting Chen, New Taipei (TW)
(73) Assignee: **ACER INCORPORATED**, New Taipei (TW)

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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 317 days.

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Chinese language office action dated Apr. 5, 2016, issued in application No. CN 201310155557.8.

(21) Appl. No.: **13/963,415**

(22) Filed: **Aug. 9, 2013**

(65) **Prior Publication Data**
US 2014/0320359 A1 Oct. 30, 2014

Primary Examiner — Graham Smith

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

(30) **Foreign Application Priority Data**

Apr. 25, 2013 (TW) 102114762 A

(57) **ABSTRACT**

- (51) **Int. Cl.**
H01Q 1/50 (2006.01)
H01Q 9/30 (2006.01)
H01Q 9/42 (2006.01)
H01Q 5/35 (2015.01)
(52) **U.S. Cl.**
CPC **H01Q 9/30** (2013.01); **H01Q 5/35** (2015.01); **H01Q 9/42** (2013.01)
(58) **Field of Classification Search**
USPC 343/852, 857, 858
See application file for complete search history.

A communication device including a ground element and an antenna element is provided. The antenna element includes a metal element. The metal element is disposed at or adjacent to an edge of the ground element. The metal element is substantially perpendicular to the ground element. The metal element has a projection on the ground element, and the whole projection is in the internal of the ground element. The antenna element has a first feeding point and a second feeding point. The first and second feeding points are away from each other. The first and second feeding points are substantially positioned at two ends of the metal element, respectively. The first feeding point is coupled through a first switch and a first matching circuit to a communication module. The second feeding point is coupled through a second switch and a second matching circuit to the communication module.

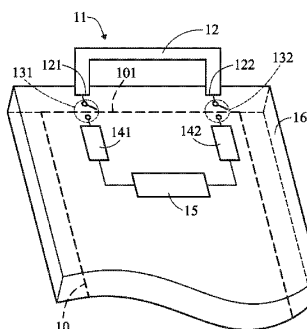
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11 Claims, 7 Drawing Sheets

100





US009461354B2

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

(10) **Patent No.:** **US 9,461,354 B2**
(45) **Date of Patent:** **Oct. 4, 2016**

(54) **SINGLE PIECE ANTENNA DEVICE**

(56) **References Cited**

(71) Applicant: **Checkpoint Systems, Inc.**, Thorofare,
NJ (US)

U.S. PATENT DOCUMENTS

(72) Inventors: **Harald Günter**, Heppenheim (DE);
Peter Schneider, Neckargemuend (DE)

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439/472

(73) Assignee: **CHECKPOINT SYSTEMS, INC.**,
Thorofare, NJ (US)

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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 295 days.

DE 2823191 11/1978
DE 68921745 8/1995

(Continued)

(21) Appl. No.: **14/020,017**

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(22) Filed: **Sep. 6, 2013**

Ketec, Inc. Shoplifting Prevention Systems; Jan. 15, 2012.*

(Continued)

(65) **Prior Publication Data**

US 2014/0078015 A1 Mar. 20, 2014

(30) **Foreign Application Priority Data**

Sep. 17, 2012 (DE) 20 2012 008 852 U

Primary Examiner — Dameon E Levi

Assistant Examiner — Ab Salam Alkassim, Jr.

(74) *Attorney, Agent, or Firm* — Nelson Mullins Riley &
Scarborough, LLP

(57) **ABSTRACT**

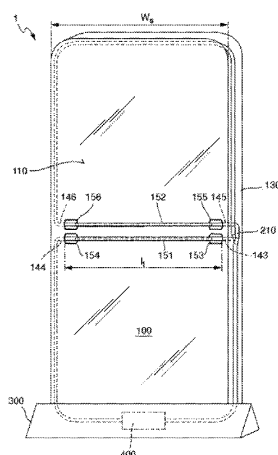
(51) **Int. Cl.**
H01Q 1/22 (2006.01)
H01Q 7/00 (2006.01)
H01Q 1/40 (2006.01)

(52) **U.S. Cl.**
CPC **H01Q 1/22** (2013.01); **H01Q 1/2216**
(2013.01); **H01Q 1/40** (2013.01); **H01Q 7/00**
(2013.01)

(58) **Field of Classification Search**
CPC H01Q 1/2216; H01Q 1/22; H01Q 1/40;
H01Q 7/00
USPC 340/572.7; 343/742, 687, 870, 871,
343/873, 878, 879, 905
See application file for complete search history.

An antenna device and supports for an antenna. The antenna device includes a plate-like support, having a front, back, and surrounding side face. The surrounding side face has a first groove. The front of the support has at least one second groove. The first antenna cable is located in the first groove and in the second groove. The first and second end regions of the second groove are spaced apart from the surrounding side face. The first end region of the second groove has a first opening to the first groove, and the second end region of the second groove has a second opening to the first groove. The first antenna cable is routed through the first and second openings.

9 Claims, 7 Drawing Sheets





US009461356B2

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

(10) **Patent No.:** **US 9,461,356 B2**

(45) **Date of Patent:** ***Oct. 4, 2016**

(54) **DUAL-BAND INVERTED-F ANTENNA APPARATUS PROVIDED WITH AT LEAST ONE ANTENNA ELEMENT HAVING ELEMENT PORTION OF HEIGHT FROM DIELECTRIC SUBSTRATE**

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

(72) Inventors: **Hiroyuki Yurugi**, Osaka (JP); **Wataru Noguchi**, Hyogo (JP); **Masahiko Nagoshi**, 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 537 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/669,829**

(22) Filed: **Nov. 6, 2012**

(65) **Prior Publication Data**

US 2013/0063318 A1 Mar. 14, 2013

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2012/001500, filed on Mar. 5, 2012.

(30) **Foreign Application Priority Data**

Jun. 2, 2011 (JP) 2011-123933

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

(Continued)

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 5/371** (2015.01); **H01Q 9/42** (2013.01); **H01Q 21/28** (2013.01)

(58) **Field of Classification Search**

CPC H01Q 9/42; H01Q 5/357; H01Q 5/364; H01Q 5/371; H01Q 1/24; H01Q 1/241; H01Q 1/242; H01Q 1/245; H01Q 21/28
See application file for complete search history.

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Primary Examiner — Hoang V Nguyen

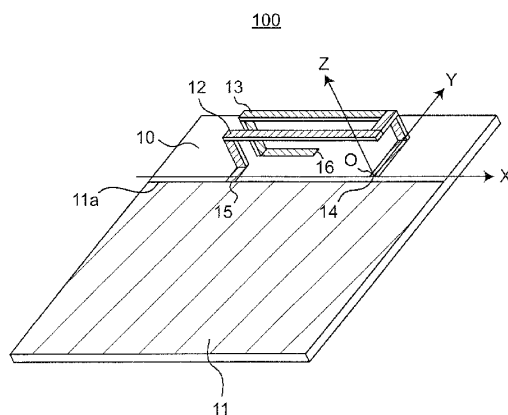
Assistant Examiner — Daniel J Munoz

(74) *Attorney, Agent, or Firm* — Wenderoth, Lind & Ponack, L.L.P.

(57) **ABSTRACT**

An antenna apparatus includes first and second antenna elements. The first antenna element operates as a loop antenna that resonates at a first wavelength, and the antenna apparatus operates as an inverted-F antenna that resonates at a second wavelength. The first antenna elements includes a first element portion formed to have a predetermined height from a surface of a dielectric substrate, and the second antenna element includes a second element portion which is formed to be substantially parallel to the first element portion at least at a predetermined distance apart from the first antenna element.

4 Claims, 13 Drawing Sheets





US00D767542S

(12) **United States Design Patent** (10) **Patent No.:** **US D767,542 S**
Chang et al. (45) **Date of Patent:** **** Sep. 27, 2016**

(54) **ANTENNA**(71) Applicant: **Airgain, Incorporated**, San Diego, CA
(US)(72) Inventors: **Wei Chang**, Zhang Jia Gang (CN);
Jindan Zhao, Zhang Jia Gang (CN);
Xiaowei Wu, Zhang Jia Gang (CN)(73) Assignee: **Airgain Incorporated**, San Diego, CA
(US)(**) Term: **14 Years**(21) Appl. No.: **29/504,610**(22) Filed: **Oct. 8, 2014**(51) **LOC (10) Cl.** **14-03**(52) **U.S. Cl.**
USPC **D14/230**(58) **Field of Classification Search**USPC D14/230, 299, 358, 427, 459–460, 344,
D14/203.5CPC H01Q 1/38; H01Q 1/24; H01Q 9/04;
H01Q 9/24; H01Q 9/16; H01Q 5/00; H01Q
9/28; H01Q 1/50

See application file for complete search history.

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The ornamental design for an antenna, as shown and described.

DESCRIPTION

FIG. 1 is a front elevational view of an antenna with a cover in broken lines.

FIG. 2 is a side elevational view of the antenna of FIG. 1 with a cover in broken lines.

FIG. 3 is a bottom plan view of the antenna of FIG. 1 with a cover in broken lines;

FIG. 4 is a rear elevational view of the antenna of FIG. 1 with a cover in broken lines.

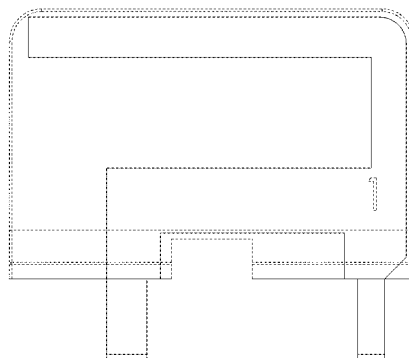
FIG. 5 is a top perspective view of the antenna of FIG. 1 with a cover in broken lines.

FIG. 6 is a front elevational view of the antenna of FIG. 1.

FIG. 7 is a side elevational view of the antenna of FIG. 1; and,

FIG. 8 is a bottom plan view of the antenna of FIG. 1.

The broken lines are for illustration purposes only and form no part of the claimed invention.

1 Claim, 8 Drawing Sheets



US00D767543S

(12) **United States Design Patent** (10) **Patent No.:** **US D767,543 S**
Chang (45) **Date of Patent:** **** Sep. 27, 2016**

(54) **ANTENNA**
(71) Applicant: **Airgain, Incorporated**, San Diego, CA
(US)
(72) Inventor: **Wei Chang**, Zhang Jia Gang (CN)
(73) Assignee: **Airgain Incorporated**, San Diego, CA
(US)

(**) Term: **14 Years**

(21) Appl. No.: **29/523,748**

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

(51) **LOC (10) Cl.** **14-03**

(52) **U.S. Cl.**
USPC **D14/230**

(58) **Field of Classification Search**
USPC D14/138, 230–238.1, 299, 358;
D13/182

CPC H01L 33/48; H01L 33/486; H01L 23/02;
H05K 5/00; H01Q 13/10

See application file for complete search history.

(56) **References Cited**

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D607,442 S	1/2010	Su et al.
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Primary Examiner — Manpreet Matharu

Assistant Examiner — Mojtaba Tehrani

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

(57) **CLAIM**

The ornamental design for an antenna, as shown and described.

DESCRIPTION

FIG. 1 is a front elevation view of an antenna, showing our new design;

FIG. 2 is a side plan view thereof;

FIG. 3 is a bottom plan view thereof;

FIG. 4 is a rear elevation view thereof;

FIG. 5 is a top perspective view thereof;

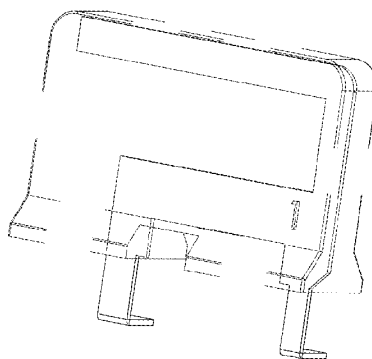
FIG. 6 is a front elevation view thereof, with unclaimed environment not shown;

FIG. 7 is a side elevation view thereof, with unclaimed environment not shown; and,

FIG. 8 is a bottom plan view thereof, with unclaimed environment not shown.

The broken line in the figure drawings represents unclaimed environment only and forms no part of the claimed design.

1 Claim, 2 Drawing Sheets





US00D767544S

(12) **United States Design Patent** (10) **Patent No.:** **US D767,544 S**
Yang et al. (45) **Date of Patent:** **** Sep. 27, 2016**

(54) **ANTENNA**
(71) Applicant: **Airgain, Incorporated**, San Diego, CA (US)
(72) Inventors: **Simon Yang**, Carlsbad, CA (US); **Wei Chang**, Zhang Jia Gang (CN); **Qun Li**, Zhang Jia Gang (CN)
(73) Assignee: **Airgain Incorporated**, San Diego, CA (US)
(**) Term: **14 Years**

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D608,769 S	1/2010	Bufe
D612,368 S	3/2010	Yang et al.
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7,729,662 B2	6/2010	Abramov et al.
D621,819 S	8/2010	Tsai et al.
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(21) Appl. No.: **29/524,273**

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

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(51) **LOC (10) CL.** **14-03**

(52) **U.S. Cl.** **D14/230**
USPC **D14/230**

(58) **Field of Classification Search**
USPC D14/138, 230–238.1, 299, 358; D13/182
CPC H01L 33/48; H01L 33/486; H01L 23/02; H05K 5/00; H01Q 13/10
See application file for complete search history.

Primary Examiner — Manpreet Matharu

Assistant Examiner — Mojtaba Tehrani

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

(57) **CLAIM**

The ornamental design for an antenna, as shown and described.

(56) **References Cited**

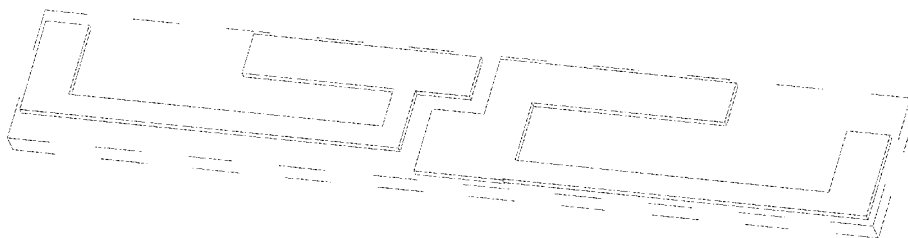
DESCRIPTION

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D549,696 S	8/2007	Oshima et al.
7,268,737 B1 *	9/2007	Ai H01Q 1/38 343/700 MS
7,333,067 B2	2/2008	Hung et al.
7,336,959 B2	2/2008	Khitrik et al.
D573,589 S	7/2008	Montgomery et al.
7,405,704 B1	7/2008	Lin et al.
7,477,195 B2	1/2009	Vance
D592,195 S	5/2009	Wu et al.
7,570,215 B2	8/2009	Abramov et al.
D599,334 S	9/2009	Chiang

FIG. 1 is a front elevation view of an antenna, showing our new design;
FIG. 2 is a side plan view thereof;
FIG. 3 is a top plan view thereof;
FIG. 4 is a rear elevation view thereof;
FIG. 5 is a top perspective view thereof;
FIG. 6 is a front elevation view thereof, with unclaimed environment not shown; and,
FIG. 7 is a top elevation view thereof, with unclaimed environment not shown.
The broken line in the figure drawings represents unclaimed environment only and forms no part of the claimed design.

1 Claim, 2 Drawing Sheets





US009461362B2

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

(10) **Patent No.:** **US 9,461,362 B2**
(45) **Date of Patent:** **Oct. 4, 2016**

(54) **MULTI-BAND ANTENNA**

(71) Applicants: **UNIVERSAL SCIENTIFIC INDUSTRIAL (SHANGHAI) CO., LTD.**, Shanghai (CN); **UNIVERSAL GLOBAL SCIENTIFIC INDUSTRIAL CO., LTD.**, Nantou County (TW)

(72) Inventors: **Chao-An Lyu**, Nantou County (TW); **Jui-Chih Chien**, Nantou County (TW); **Hung-Wei Chiu**, Nantou County (TW)

(73) Assignees: **UNIVERSAL SCIENTIFIC INDUSTRIAL (SHANGHAI) CO., LTD.**, Shanghai (CN); **UNIVERSAL GLOBAL SCIENTIFIC INDUSTRIAL CO., LTD.**, Nantou County (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 95 days.

(21) Appl. No.: **14/532,090**

(22) Filed: **Nov. 4, 2014**

(65) **Prior Publication Data**
US 2015/0325915 A1 Nov. 12, 2015

(30) **Foreign Application Priority Data**
May 9, 2014 (TW) 103116536 A

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 5/371 (2015.01)
H01Q 7/00 (2006.01)
H01Q 9/04 (2006.01)
H01Q 5/378 (2015.01)

(52) **U.S. Cl.**
CPC **H01Q 5/371** (2015.01); **H01Q 7/00** (2013.01); **H01Q 9/0421** (2013.01); **H01Q 5/378** (2015.01)

(58) **Field of Classification Search**

CPC H01Q 5/371; H01Q 7/00
USPC 343/700 MS, 725, 726, 728, 729, 741, 343/842, 843, 866
See application file for complete search history.

(56) **References Cited**

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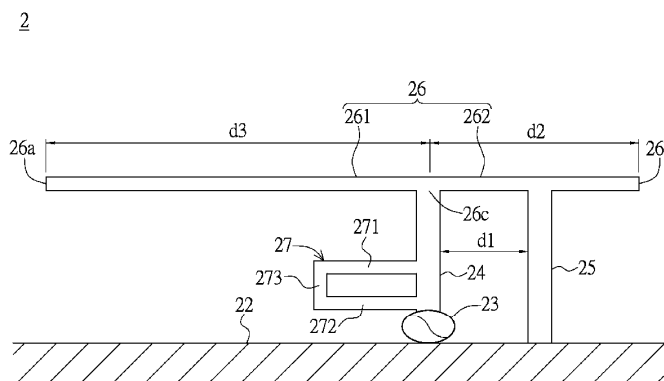
Primary Examiner — Tho G Phan

(74) *Attorney, Agent, or Firm* — Li & Cai Intellectual Property (USA) Office

(57) **ABSTRACT**

A multi-band antenna and electronic device are provided. The multi-frequency antenna includes a feeding portion, a shorting portion, a radiating portion and a loop radiating portion. One end of the feeding portion is electrically connected to a signal source. One end of the shorting portion is electrically connected to a ground plane. The radiating portion is electrically connected to another end of the shorting portion and another end of the feeding portion. The loop radiating portion is electrically connected to the radiating portion.

8 Claims, 8 Drawing Sheets





US009461371B2

(12) **United States Patent**
Kuonanoja

(10) **Patent No.:** **US 9,461,371 B2**
(45) **Date of Patent:** **Oct. 4, 2016**

(54) **MIMO ANTENNA AND METHODS**

USPC 343/810, 702, 700 MS, 846
See application file for complete search history.

(75) Inventor: **Reetta Kuonanoja**, Oulu (FI)

(73) Assignee: **Pulse Finland OY** (FI)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 953 days.

(21) Appl. No.: **13/511,643**

(22) PCT Filed: **Nov. 16, 2010**

(86) PCT No.: **PCT/FI2010/050926**

§ 371 (c)(1),
(2), (4) Date: **Sep. 25, 2012**

(87) PCT Pub. No.: **WO2011/064444**

PCT Pub. Date: **Jun. 3, 2011**

(65) **Prior Publication Data**

US 2013/0044036 A1 Feb. 21, 2013

(30) **Foreign Application Priority Data**

Nov. 27, 2009 (FI) 20096251

(51) **Int. Cl.**

H01Q 21/00 (2006.01)

H01Q 21/28 (2006.01)

H01Q 1/24 (2006.01)

H01Q 1/38 (2006.01)

H01Q 9/40 (2006.01)

(Continued)

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

CPC **H01Q 21/28** (2013.01); **H01Q 1/243**
(2013.01); **H01Q 1/38** (2013.01); **H01Q 9/40**
(2013.01); **H01Q 9/42** (2013.01); **H01Q 21/29**
(2013.01)

(58) **Field of Classification Search**

CPC H01Q 21/00; H01Q 1/38; H01Q 1/24

(56) **References Cited**

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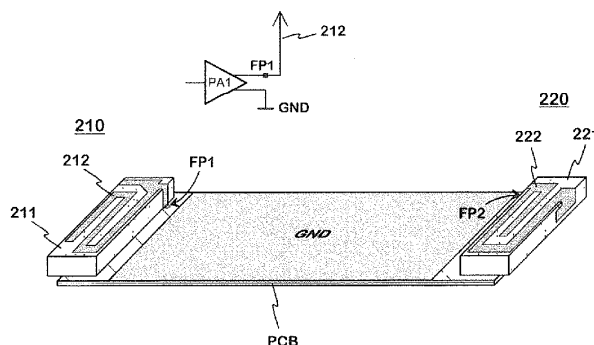
Primary Examiner — Huedung Mancuso

(74) *Attorney, Agent, or Firm* — Gazdzinski & Associates, PC

(57) **ABSTRACT**

An antenna structure that provides spatial multiplexing capabilities. In one embodiment, the antenna comprises two antenna components with a substrate and radiator, the components being located on opposite sides of the circuit board of a radio device. Each antenna component operates in combination with the ground plane of the radio device to form a partial antenna, the operating band of which is below the frequency of 1 GHz. The ground plane and the feed points of the partial antennas are arranged so that the 'dipole axes' of the partial antennas have clearly different directions at the frequencies of said operating band.

17 Claims, 4 Drawing Sheets





US009461686B2

(12) **United States Patent**
Yang

(10) **Patent No.:** **US 9,461,686 B2**
(45) **Date of Patent:** **Oct. 4, 2016**

(54) **MOBILE COMMUNICATION DEVICE**

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

(72) Inventor: **Chung-Wen Yang**, 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.: **14/571,309**

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

(65) **Prior Publication Data**

US 2015/0171911 A1 Jun. 18, 2015

(30) **Foreign Application Priority Data**

Dec. 18, 2013 (TW) 102146904 A

(51) **Int. Cl.**
H04B 1/18 (2006.01)
H04B 1/3827 (2015.01)

(52) **U.S. Cl.**
CPC **H04B 1/3838** (2013.01)

(58) **Field of Classification Search**
CPC H04B 1/3838
USPC 455/78, 280, 550.1; 343/720
See application file for complete search history.

(56) **References Cited**

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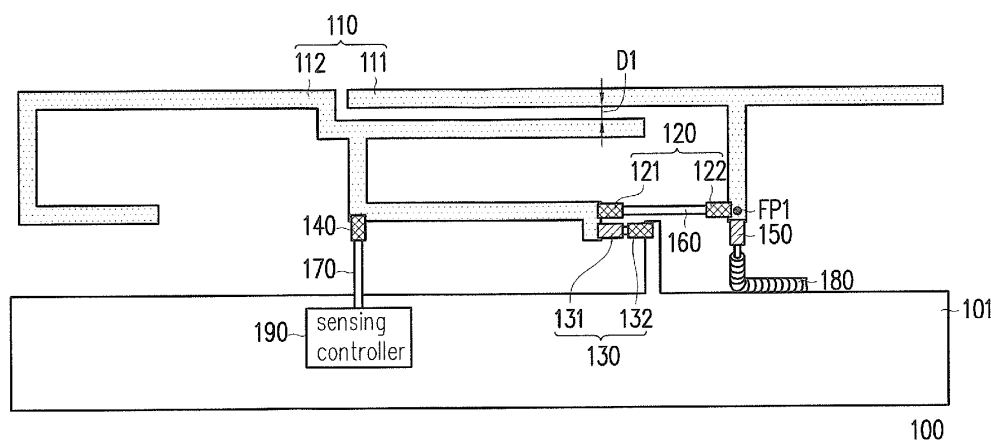
Primary Examiner — Hsin-Chun Liao

(74) *Attorney, Agent, or Firm* — Jianq Chyun IP Office

(57) **ABSTRACT**

A mobile communication device including an antenna element, a low-frequency blocking element, a first isolation circuit, a second isolation circuit and a high-frequency blocking element is provided. The antenna element converts a radio-frequency signal into an electromagnetic wave and generates a sensing signal in response to a proximity of an object. The antenna element includes a radiation portion and a parasitic portion which are spaced by a coupling gap. The low-frequency blocking element transmits the radio-frequency signal to the radiation portion. The first isolation circuit and a connection element are connected in series between the radiation portion and the parasitic portion, and the first isolation circuit blocks the radio-frequency signal. The second isolation circuit is electrically connected between the parasitic portion and a ground plane, and blocks the sensing signal. The high-frequency blocking element transmits the sensing signal from the antenna element to a sensing controller through a metal line.

7 Claims, 3 Drawing Sheets





US009462094B2

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

(10) **Patent No.:** **US 9,462,094 B2**
(45) **Date of Patent:** **Oct. 4, 2016**

(54) **DEVICE HOUSING AND PORTABLE
ELECTRONIC DEVICE USING SAME**

(71) Applicants: **SHENZHEN FUTAIHONG
PRECISION INDUSTRY CO., LTD.,**
Shenzhen (CN); **FIH (Hong Kong)
Limited**, Kowloon (HK)

(72) Inventors: **Xu Liu**, Shenzhen (CN); **Yi Yang**,
Shenzhen (CN)

(73) Assignees: **SHENZHEN FUTAIHONG
PRECISION INDUSTRY CO., LTD.,**
Shenzhen (CN); **FIH (HONG KONG)
LIMITED**, Kowloon (HK)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 65 days.

(21) Appl. No.: **14/522,108**

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

(65) **Prior Publication Data**

US 2015/0189049 A1 Jul. 2, 2015

(30) **Foreign Application Priority Data**

Dec. 31, 2013 (CN) 2013 1 0747943

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

(52) **U.S. Cl.**
CPC **H04M 1/026** (2013.01); **H01Q 1/243**
(2013.01); **H01Q 13/10** (2013.01)

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

(56) **References Cited**

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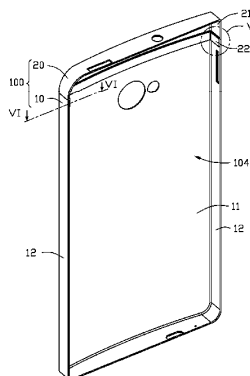
Primary Examiner — Dominic Rego

(74) *Attorney, Agent, or Firm* — Zhigang Ma

(57) **ABSTRACT**

A housing for a portable electronic device is provided. The housing includes a first section made of metal and a second section made of dielectric ceramic. The second section is coupled to the first section to cooperatively define an accommodating space. When an antenna is coupled to an inner surface of the second section facing the accommodating space, the antenna can transmit and receive signals through the second section. A portable electronic device incorporating the housing is also provided.

18 Claims, 7 Drawing Sheets





US009462096B2

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

(10) **Patent No.:** **US 9,462,096 B2**

(45) **Date of Patent:** **Oct. 4, 2016**

(54) **WIRELESS COMMUNICATION DEVICE
WITH AN ANTENNA ADJACENT TO AN
EDGE OF THE DEVICE**

(71) Applicant: **Futurewei Technologies, Inc.**, Plano,
TX (US)

(72) Inventors: **Chul Min Han**, San Diego, CA (US);
Jorge Fabrega Sanchez, San Diego,
CA (US)

(73) Assignee: **Futurewei Technologies, Inc.**, Plano,
TX (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.: **15/059,588**

(22) Filed: **Mar. 3, 2016**

(65) **Prior Publication Data**

US 2016/0191681 A1 Jun. 30, 2016

Related U.S. Application Data

(63) Continuation of application No. 13/278,836, filed on
Oct. 21, 2011, now Pat. No. 9,300,033.

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H04M 1/02 (2006.01)
H01Q 13/10 (2006.01)
H01Q 21/29 (2006.01)
H04B 1/3827 (2015.01)

(52) **U.S. Cl.**
CPC **H04M 1/026** (2013.01); **H01Q 1/243**
(2013.01); **H01Q 13/10** (2013.01); **H01Q**
21/293 (2013.01); **H04B 1/3827** (2013.01)

(58) **Field of Classification Search**
USPC 343/700 MS, 702
See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Hoang V Nguyen

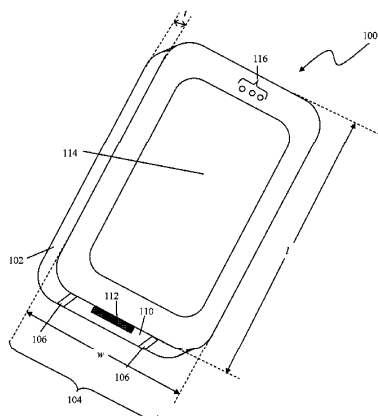
Assistant Examiner — Hai Tran

(74) *Attorney, Agent, or Firm* — Futurewei Technologies, Inc.

(57) **ABSTRACT**

A wireless communication device comprising a housing comprising a plurality of edges and configured to serve as an external surface for the wireless communication device, and an antenna adjacent to at least a first edge of the housing, wherein the antenna comprises at least a conductive strip and at least one slot and wherein the antenna is configured to receive and transmit wireless signals, wherein the first edge of the housing is one of an edge of the housing nearest an ear piece and an edge of the housing that is opposite the edge of the housing nearest the ear piece, and wherein the conductive strip and the slot are adjacent to at least the first edge of the housing.

12 Claims, 10 Drawing Sheets





US009466872B2

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

(10) **Patent No.:** **US 9,466,872 B2**
(45) **Date of Patent:** **Oct. 11, 2016**

(54) **TUNABLE DUAL LOOP ANTENNA SYSTEM**

(56) **References Cited**

(71) Applicant: **Futurewei Technologies, Inc.**, Plano, TX (US)

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(72) Inventors: **Jorge Fabrega Sanchez**, San Diego, CA (US); **Kiran Vanjani**, San Diego, CA (US)

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(73) Assignee: **Futurewei Technologies, Inc.**, Plano, TX (US)

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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 302 days.

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(21) Appl. No.: **13/907,120**

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(65) **Prior Publication Data**

US 2014/0132465 A1 May 15, 2014

(Continued)

Related U.S. Application Data

(63) Continuation-in-part of application No. 13/673,862, filed on Nov. 9, 2012, now abandoned.

(60) Provisional application No. 61/780,081, filed on Mar. 13, 2013.

(51) **Int. Cl.**
H01Q 7/00 (2006.01)
H01Q 21/28 (2006.01)
H01Q 21/30 (2006.01)
H01Q 1/24 (2006.01)
H01Q 1/36 (2006.01)

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 1/36** (2013.01); **H01Q 7/00** (2013.01); **H01Q 21/28** (2013.01); **H01Q 21/30** (2013.01)

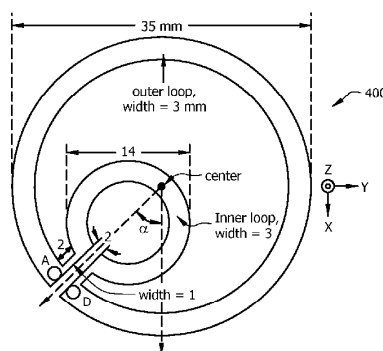
(58) **Field of Classification Search**
None

See application file for complete search history.

(57) **ABSTRACT**

An apparatus comprising a first antenna, a second antenna, wherein the first antenna and the second antenna comprise a common conductor, a variable load connected between the common conductor and a ground connection, wherein an impedance of the variable load is variable, and wherein an operating frequency of the first antenna and the second antenna depends on the impedance, and a selection switch coupled to the first antenna and the second antenna, wherein the selection switch is configured to activate the first antenna and deactivate the second antenna in a first state, and wherein the selection switch is configured to activate the second antenna and deactivate the first antenna in a second state.

20 Claims, 16 Drawing Sheets





US009466873B2

(12) **United States Patent**
Lin

(10) **Patent No.:** **US 9,466,873 B2**

(45) **Date of Patent:** **Oct. 11, 2016**

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

USPC 343/700 MS, 702, 860, 861
See application file for complete search history.

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

(56) **References Cited**

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

U.S. PATENT DOCUMENTS

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

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343/700 MS
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343/700 MS
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343/702

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 257 days.

(21) Appl. No.: **14/068,251**

* cited by examiner

(22) Filed: **Oct. 31, 2013**

(65) **Prior Publication Data**

US 2014/0375522 A1 Dec. 25, 2014

Primary Examiner — Dieu H Duong

(74) *Attorney, Agent, or Firm* — Zhigang Ma

(30) **Foreign Application Priority Data**

Jun. 20, 2013 (TW) 102121840 A

(57) **ABSTRACT**

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 9/04 (2006.01)
H01Q 5/378 (2015.01)

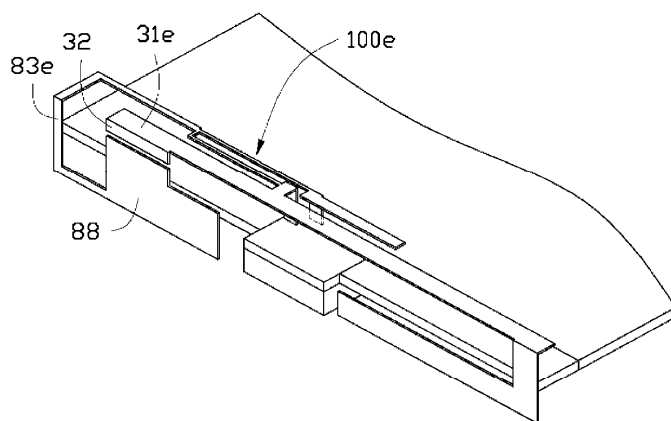
An antenna structure includes a feed portion, a ground
portion, a first antenna, a second antenna, and a microstrip
line. The first antenna includes a first radiating body and a
second radiating body. The first radiating body and the
second radiating body are both connected to the feed por-
tion. The second antenna is connected to the ground portion
and spaced from the second radiating body. The microstrip
line is connected between the feed portion and the ground
portion to adjust a matching impedance of the antenna
structure.

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 5/378**
(2015.01); **H01Q 9/0421** (2013.01)

(58) **Field of Classification Search**
CPC H01Q 1/38; H01Q 1/243; H01Q 9/0421

10 Claims, 7 Drawing Sheets

200e





US009466874B2

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

(10) **Patent No.:** **US 9,466,874 B2**
(45) **Date of Patent:** **Oct. 11, 2016**

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

(71) Applicants: **Chao Wang**, Shenzhen (CN); **Yongli
Chen**, Shen (CN)

(72) Inventors: **Chao Wang**, Shenzhen (CN); **Yongli
Chen**, Shen (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 95 days.

(21) Appl. No.: **14/269,296**

(22) Filed: **May 5, 2014**

(65) **Prior Publication Data**

US 2014/0333488 A1 Nov. 13, 2014

(30) **Foreign Application Priority Data**

May 7, 2013 (CN) 2013 1 0165181

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 9/04 (2006.01)
H01Q 5/371 (2015.01)

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 5/371**
(2015.01); **H01Q 9/0421** (2013.01)

(58) **Field of Classification Search**
CPC H01Q 1/243; H01Q 5/371; H01Q 9/0421
USPC 343/702
See application file for complete search history.

(56) **References Cited**

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2005/0057400 A1 *	3/2005	Yuanzhu		H01Q 5/378 343/700 MS
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Primary Examiner — Dameon E Levi

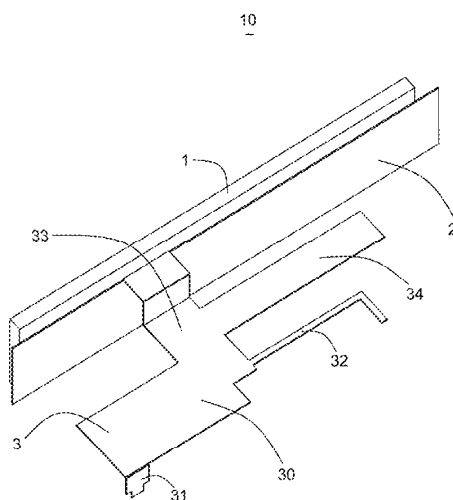
Assistant Examiner — Hasan Islam

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

(57) **ABSTRACT**

The present disclosure provides an antenna and an electronic device using same. The antenna includes an antenna radiating element for radiating signals, a capacitive feed plate separated from and substantially parallel to the antenna radiating element for carrying out capacitive feed on the antenna radiating element, and a FPC antenna electrically connecting with the capacitive feed plate for feeding for the capacitive feed plate. The FPC antenna includes a plate-shaped main body, a feeding end, a ground end, an extending portion for being electrically connected with the capacitive feed plate, and a feeding strip extending vertically from the extending portion for improving the low-frequency performance of the antenna.

7 Claims, 5 Drawing Sheets





US009466875B2

(12) **United States Patent**
Wang

(10) **Patent No.:** **US 9,466,875 B2**
(45) **Date of Patent:** **Oct. 11, 2016**

(54) **ANTENNA SYSTEM**

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

(71) Applicant: **Jianan Wang**, Shenzhen (CN)

(72) Inventor: **Jianan Wang**, Shenzhen (CN)

(73) Assignee: **AAC Acoustic Technologies (Suzhou) Co., Ltd.**, Suzhou (CN)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 33 days.

(21) Appl. No.: **14/559,297**

(22) Filed: **Dec. 3, 2014**

(65) **Prior Publication Data**

US 2015/0349404 A1 Dec. 3, 2015

(30) **Foreign Application Priority Data**

May 28, 2014 (CN) 2014 2 0280453 U

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 21/30 (2006.01)

H01Q 21/28 (2006.01)

H01Q 5/314 (2015.01)

H01Q 5/35 (2015.01)

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

CPC **H01Q 1/243** (2013.01); **H01Q 5/314** (2015.01); **H01Q 5/35** (2015.01); **H01Q 21/28** (2013.01); **H01Q 21/30** (2013.01)

(58) **Field of Classification Search**

CPC H01Q 1/241-1/243; H01Q 5/30; H01Q 21/30

(56) **References Cited**

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343/702
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343/700 MS
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343/872

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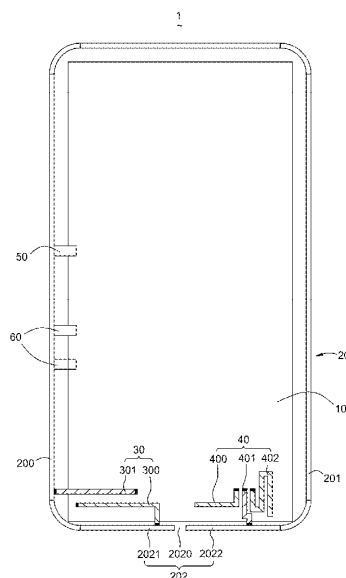
Primary Examiner — Iloang V Nguyen

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

(57) **ABSTRACT**

An antenna system is disclosed. The antenna system includes a printed circuit board, a metallic frame surrounding and electrically connecting with the printed circuit board, a low frequency antenna unit electrically connecting to the metallic frame and an antenna feed, a high frequency antenna unit electrically connecting to the metallic frame and the antenna feed, a ground terminal disposed on the metallic frame for grounding the metallic frame, and an adjusting terminal for being grounded via a matching component for adjusting the low frequency performance of the antenna system. The antenna system enables covering the operational frequency bands of 791 MHz~960 MHz, and 1710 MHz~2690 MHz. By virtue of the adjusting terminal, ultra wide low frequency of dual-resonance is accordingly performed.

6 Claims, 3 Drawing Sheets





US009466878B2

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

(10) **Patent No.:** **US 9,466,878 B2**
(45) **Date of Patent:** **Oct. 11, 2016**

(54) **MULTI-BAND ANTENNA**

(56) **References Cited**

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

U.S. PATENT DOCUMENTS

(72) Inventors: **Cheng-Fan Wei**, New Taipei (TW);
Lung-Sheng Tai, New Taipei (TW);
Wen-Fong Su, New Taipei (TW)

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(73) Assignee: **HON HAI PRECISION INDUSTRY CO., LTD.**, 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 299 days.

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(21) Appl. No.: **13/964,127**

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TW	555177		9/2003

(22) Filed: **Aug. 12, 2013**

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(65) **Prior Publication Data**
US 2014/0043200 A1 Feb. 13, 2014

Primary Examiner — Robert Karacsony

(74) *Attorney, Agent, or Firm* — Wei Te Chung; Ming Chieh Chang

(30) **Foreign Application Priority Data**

Aug. 10, 2012 (TW) 101128889 A

(57) **ABSTRACT**

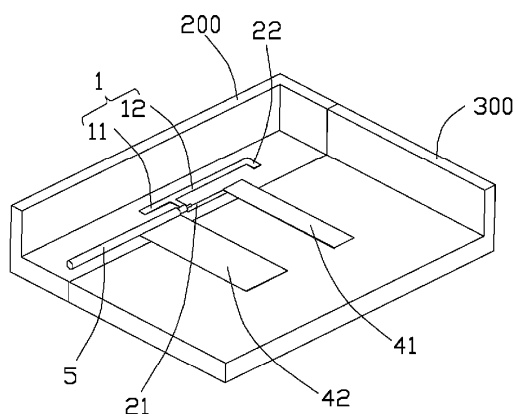
(51) **Int. Cl.**
H01Q 1/48 (2006.01)
H01Q 5/364 (2015.01)
H01Q 9/04 (2006.01)
H01Q 1/24 (2006.01)
H01Q 5/378 (2015.01)

A multi-band antenna for assembling to an insulation base and metal base of an electronic device comprises: a radiating element; a first connecting element; a second connecting element; a grounding element; and a first grounding foil and a second grounding foil respectively electrically connected to the second connecting element and the grounding element along a longitudinal direction perpendicular to the transversal direction and extending to the metal base. The first grounding foil and the second grounding foil has a first part respectively extending from the second connecting and grounding element to a joint line between the insulation and the metal base and a second part attached to the metal base. A slot is formed among the first part of the first grounding foil, the first part of the second grounding foil, the second connecting element, and the joint line between the insulation base and the metal base.

(52) **U.S. Cl.**
CPC **H01Q 1/48** (2013.01); **H01Q 1/243** (2013.01); **H01Q 5/364** (2015.01); **H01Q 5/378** (2015.01); **H01Q 9/0421** (2013.01)

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

10 Claims, 8 Drawing Sheets





US009472841B2

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

(10) **Patent No.:** **US 9,472,841 B2**

(45) **Date of Patent:** ***Oct. 18, 2016**

(54) **RF RADIATION REDIRECTION AWAY FROM PORTABLE COMMUNICATION DEVICE USER**

(2013.01); **H01Q 7/00** (2013.01); **H01Q 9/0407** (2013.01); **H01Q 19/005** (2013.01); **H01Q 19/28** (2013.01)

(71) Applicant: **ANTENNA79, INC.**, Encinitas, CA (US)

(58) **Field of Classification Search**

CPC **H01Q 19/005**; **H01Q 19/28**; **H01Q 1/243**; **H01Q 1/245**; **H01Q 7/00**; **H01Q 9/0407**
USPC 455/575.7, 289, 280, 575, 90, 129, 455/562.1, 97, 550.1, 90.3, 19, 66.1, 558; 343/702, 700, 814, 815, 841, 745; 434/702, 841, 790

See application file for complete search history.

(72) Inventors: **Alfred Y. Wong**, Los Angeles, CA (US); **Robert Moreno**, Acton, CA (US); **Karl Richard Shields**, North Hills, CA (US); **Rong Wang**, Sherman Oaks, CA (US)

(56) **References Cited**

(73) Assignee: **Antenna79, Inc.**, Encinitas, CA (US)

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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 0 days.

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This patent is subject to a terminal disclaimer.

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(21) Appl. No.: **14/551,775**

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

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(65) **Prior Publication Data**

US 2015/0077295 A1 Mar. 19, 2015

First Office Action for Chinese Application No. 201280064893.5, mailed Jun. 3, 2015.

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Related U.S. Application Data

(63) Continuation of application No. 13/492,518, filed on Jun. 8, 2012, now Pat. No. 8,897,843, which is a continuation of application No. 12/724,290, filed on Mar. 15, 2010, now Pat. No. 8,214,003, which is a

Primary Examiner — Tan H Trinh

(57) **ABSTRACT**

(Continued)

(51) **Int. Cl.**
H04M 1/00 (2006.01)
H01Q 1/24 (2006.01)

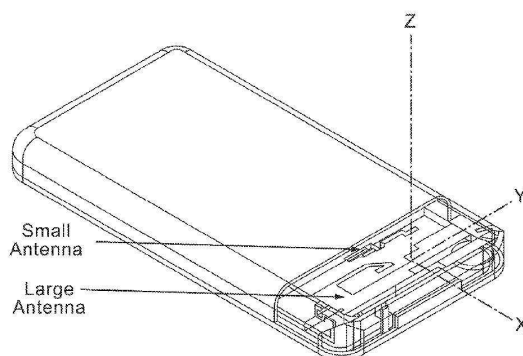
(Continued)

A case for a wireless device includes a number of RF coupling elements mounted in the case and configured such that RF radiation is coupled from an internal antenna of the wireless device out of the device to a first RF coupling element, and from the first RF coupling element to a RF redirector coupling element that redirects the RF radiation in a direction outward from said wireless device that is opposite to a user side of the wireless device. A corrugated metallic shield is optionally provided on an opposite side of the case, facing a user of the device.

20 Claims, 11 Drawing Sheets

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 1/245**

Reference - iPhone Model





US009472847B2

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

(10) **Patent No.:** **US 9,472,847 B2**

(45) **Date of Patent:** **Oct. 18, 2016**

(54) **ANTENNA STRUCTURE AND WIRELESS COMMUNICATION DEVICE EMPLOYING SAME**

(2013.01); *H01Q 9/0421* (2013.01); *H01Q 9/42* (2013.01); *H01Q 21/30* (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

(56) **References Cited**

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2012/0212390	A1 *	8/2012	Lan	343/860
2013/0050026	A1 *	2/2013	Vin et al.	343/700 MS

* cited by examiner

Primary Examiner — Robert Karacsony

(74) *Attorney, Agent, or Firm* — Zhigang Ma

(57) **ABSTRACT**

An antenna structure is electronically connected to a connector of a wireless communication device. The connector includes a power terminal and a ground terminal. The antenna structure includes a main antenna, a secondary antenna, and two posts. The main antenna includes a feed portion and a ground portion. The secondary antenna extends from the main antenna. One post electronically connects the power terminal of the connector to the feed portion, and the other post electronically connects the ground terminal of the connector to the ground portion. A wireless communication device employing the antenna structure is also described.

6 Claims, 5 Drawing Sheets

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

(72) Inventors: **Yi-Chieh Lee**, New Taipei (TW);
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 110 days.

(21) Appl. No.: **14/066,859**

(22) Filed: **Oct. 30, 2013**

(65) **Prior Publication Data**

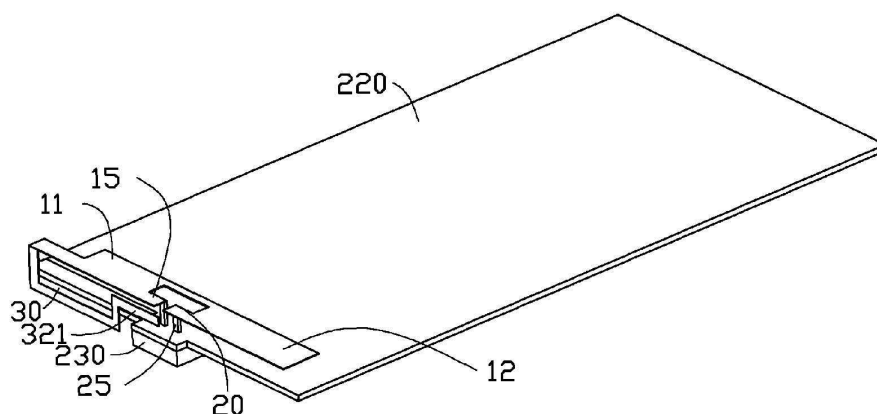
US 2014/0354488 A1 Dec. 4, 2014

(30) **Foreign Application Priority Data**

Jun. 3, 2013 (TW) 102119655 A

(51) **Int. Cl.**
H01Q 5/371 (2015.01)
H01Q 21/30 (2006.01)
H01Q 9/04 (2006.01)
H01Q 9/42 (2006.01)
H01Q 1/24 (2006.01)

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





US009472848B2

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

(10) **Patent No.:** **US 9,472,848 B2**

(45) **Date of Patent:** **Oct. 18, 2016**

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

(71) Applicants: **Olivier Pajona**, Nice (FR); **Laurent Desclos**, San Diego, CA (US); **Seng Thail Sron**, Nice (FR)

(72) Inventors: **Olivier Pajona**, Nice (FR); **Laurent Desclos**, San Diego, CA (US); **Seng Thail Sron**, Nice (FR)

(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 0 days.

(21) Appl. No.: **14/145,769**

(22) Filed: **Dec. 31, 2013**

(65) **Prior Publication Data**
US 2015/0048991 A1 Feb. 19, 2015

Related U.S. Application Data
(63) Continuation-in-part of application No. 13/868,093, filed on Apr. 22, 2013.
(60) Provisional application No. 61/636,553, filed on Apr. 20, 2012.

(51) **Int. Cl.**
H01Q 1/50 (2006.01)
H01Q 7/00 (2006.01)

H01Q 1/24 (2006.01)

H01Q 21/28 (2006.01)

H01Q 5/307 (2015.01)

(52) **U.S. Cl.**
CPC **H01Q 7/00** (2013.01); **H01Q 1/243** (2013.01); **H01Q 5/307** (2015.01); **H01Q 21/28** (2013.01)

(58) **Field of Classification Search**
CPC H01Q 1/50; H01Q 7/00; H01Q 5/307; H01Q 21/28
See application file for complete search history.

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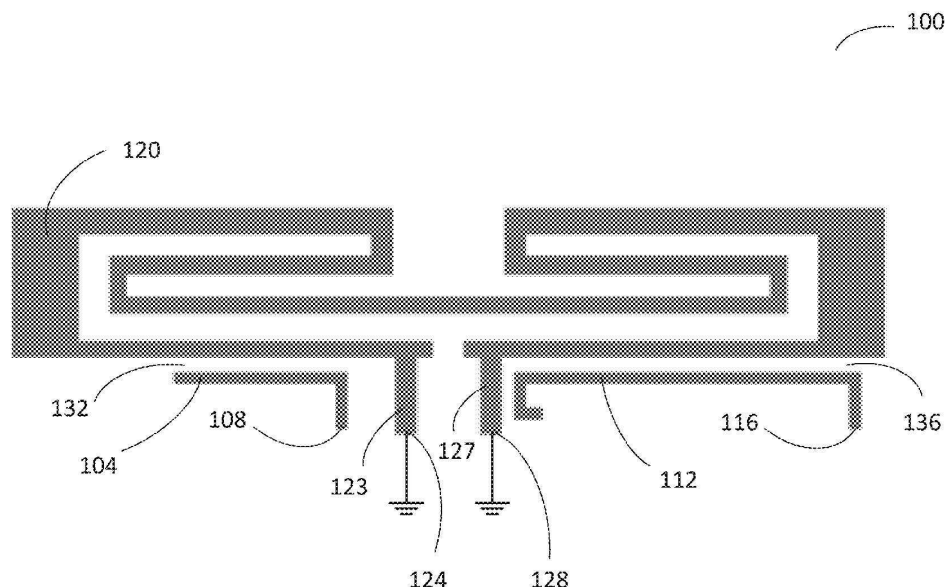
Primary Examiner — Hoang V Nguyen

(74) *Attorney, Agent, or Firm* — Coastal Patent Law Group, P.C.

(57) **ABSTRACT**

A multi-feed antenna is provided, including multiple feed elements associated with multiple frequency regions, respectively, and a folded loop element for radiating energy. Each of the multiple feed elements is capacitively coupled to the folded loop element.

8 Claims, 11 Drawing Sheets





US009472850B2

(12) **United States Patent**
Chiu

(10) **Patent No.:** **US 9,472,850 B2**

(45) **Date of Patent:** **Oct. 18, 2016**

(54) **ANTENNA APPARATUS**

(71) Applicant: **GETAC TECHNOLOGY CORPORATION**, Hsinchu County (TW)

(72) Inventor: **Shang-Ming Chiu**, Taipei (TW)

(73) Assignee: **Getac Technology Corporation**, Hsinchu County (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 65 days.

(21) Appl. No.: **14/474,066**

(22) Filed: **Aug. 29, 2014**

(65) **Prior Publication Data**

US 2015/0295318 A1 Oct. 15, 2015

(30) **Foreign Application Priority Data**

Apr. 10, 2014 (CN) 2014 1 0141349

(51) **Int. Cl.**
H01Q 9/00 (2006.01)
H01Q 9/04 (2006.01)

H01Q 1/24 (2006.01)

H01Q 9/42 (2006.01)

H01Q 19/00 (2006.01)

(52) **U.S. Cl.**
CPC **H01Q 9/0442** (2013.01); **H01Q 1/245** (2013.01); **H01Q 9/42** (2013.01); **H01Q 19/005** (2013.01)

(58) **Field of Classification Search**
CPC H01Q 1/243
USPC 343/745
See application file for complete search history.

(56) **References Cited**

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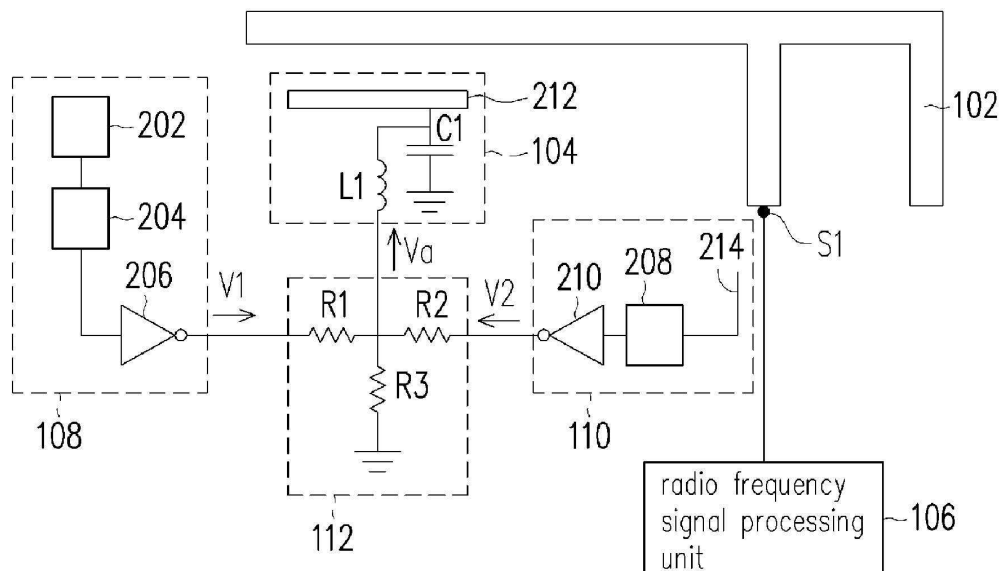
TW M456027 6/2013

Primary Examiner — Graham Smith

(57) **ABSTRACT**

An antenna apparatus is provided. A control unit adjusts an adjustment voltage outputted to a parasitic ground antenna unit according to a first voltage generated by a sensing unit and a second voltage generated by a frequency detecting unit.

10 Claims, 2 Drawing Sheets





US009472852B2

(12) **United States Patent**
O'Shea et al.

(10) **Patent No.:** **US 9,472,852 B2**
(45) **Date of Patent:** **Oct. 18, 2016**

(54) **INTEGRATED MIMO ANTENNA SYSTEM**

(75) Inventors: **Dermot O'Shea**, San Diego, CA (US);
Ronan Quinlan, Zhongli (TW)

(73) Assignee: **TAOGLAS GROUP HOLDINGS LIMITED**, Wexford (IE)

(*) 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.: **13/485,857**

(22) Filed: **May 31, 2012**

(65) **Prior Publication Data**

US 2013/0321240 A1 Dec. 5, 2013

(51) **Int. Cl.**
H01Q 21/00 (2006.01)
H01Q 9/28 (2006.01)
H01Q 21/28 (2006.01)

(52) **U.S. Cl.**
CPC **H01Q 9/285** (2013.01); **H01Q 21/28** (2013.01)

(58) **Field of Classification Search**
CPC H01Q 1/243; H01Q 1/38; H01Q 9/285; H01Q 21/28
USPC 343/893, 824, 795, 700 MS
See application file for complete search history.

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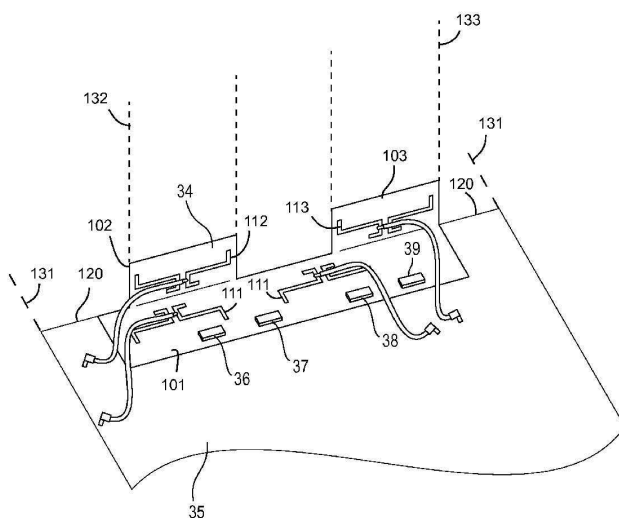
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(57) **ABSTRACT**

An integrated MIMO antenna system is described wherein multiple antennas are fabricated on a single substrate. Antenna spacing and alignment is enhanced and controlled to a finer degree than with conventional discrete antenna fabrication techniques. Rotation of one or multiple antennas in relation to the other antennas in the system can be performed to within the accuracy of current photo-etching techniques. Metalized traces can be designed and etched on the single substrate and positioned between antenna elements to enhance inter-element isolation. The integrated MIMO antenna system can be fabricated on flexible printed circuit (FPC) material, or can be fabricated on rigid metalized substrate such as common FR4 materials. Portions of one or multiple antenna elements can be photo-etched on opposite sides of the substrate to provide an additional degree of freedom in terms of antenna placement, spacing, and rotation angle.

11 Claims, 8 Drawing Sheets





US009472855B2

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

(10) **Patent No.:** **US 9,472,855 B2**

(45) **Date of Patent:** **Oct. 18, 2016**

(54) **ANTENNA DEVICE**

USPC 343/700 MS, 702, 767, 770
See application file for complete search history.

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(73) Assignee: **NEC CORPORATION**, Tokyo (JP)

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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 107 days.

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(22) PCT Filed: **Feb. 23, 2012**

(86) PCT No.: **PCT/JP2012/001243**

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(65) **Prior Publication Data**

US 2015/0029068 A1 Jan. 29, 2015

Japanese Office Action for JP Application No. 2011-132508 mailed on Oct. 21, 2014 with English Translation.

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(51) **Int. Cl.**

H01Q 13/10 (2006.01)
H01Q 1/22 (2006.01)
H01Q 1/24 (2006.01)
H01Q 1/38 (2006.01)
H01Q 21/28 (2006.01)
H01Q 5/385 (2015.01)

Primary Examiner — Tho G Phan

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ABSTRACT

An antenna device **10** includes at least one dielectric substrate **2**, a conductor plate **3** arranged in the dielectric substrate **2**, at least one slot **4** formed in the conductor plate **3**, at least one stub **5**, and at least one via **6**. The stub **5** is formed on a surface of the dielectric substrate **2** different from a surface where the slot is formed, the stub **5** being formed to cross the slot **4**. The via **6** has one end connected to a periphery of the slot **4** of the conductor plate **3** and another end connected to the stub **5**.

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

CPC **H01Q 13/106** (2013.01); **H01Q 1/2266** (2013.01); **H01Q 1/243** (2013.01); **H01Q 1/38** (2013.01); **H01Q 5/385** (2015.01); **H01Q 21/28** (2013.01)

(58) **Field of Classification Search**

CPC H01Q 13/106; H01Q 1/38; H01Q 13/10

10 Claims, 16 Drawing Sheets

