



US 20200365536A1

(19) **United States**

(12) **Patent Application Publication**

KIM et al.

(10) **Pub. No.: US 2020/0365536 A1**

(43) **Pub. Date: Nov. 19, 2020**

(54) **ANTENNA MODULE**

H01L 23/538 (2006.01)

H01L 23/00 (2006.01)

(71) Applicant: **SAMSUNG ELECTRONICS CO., LTD**, Suwon-Si (KR)

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

CPC *H01L 23/66* (2013.01); *H01L 23/3114* (2013.01); *H01L 23/5383* (2013.01); *H01Q 9/0407* (2013.01); *H01L 24/20* (2013.01); *H01L 23/5389* (2013.01); *H01L 23/5386* (2013.01)

(72) Inventors: **Doo II KIM**, Suwon-Si (KR); **Dae Kwon JUNG**, Suwon-Si (KR); **Young Sik HUR**, Suwon-Si (KR); **Yong Ho BAEK**, Suwon-Si (KR)

(73) Assignee: **SAMSUNG ELECTRONICS CO., LTD**, Suwon-Si (KR)

(57)

ABSTRACT

(21) Appl. No.: **16/983,771**

(22) Filed: **Aug. 3, 2020**

Related U.S. Application Data

(63) Continuation of application No. 16/009,732, filed on Jun. 15, 2018, now Pat. No. 10,741,509.

Foreign Application Priority Data

Mar. 12, 2018 (KR) 10-2018-0028803

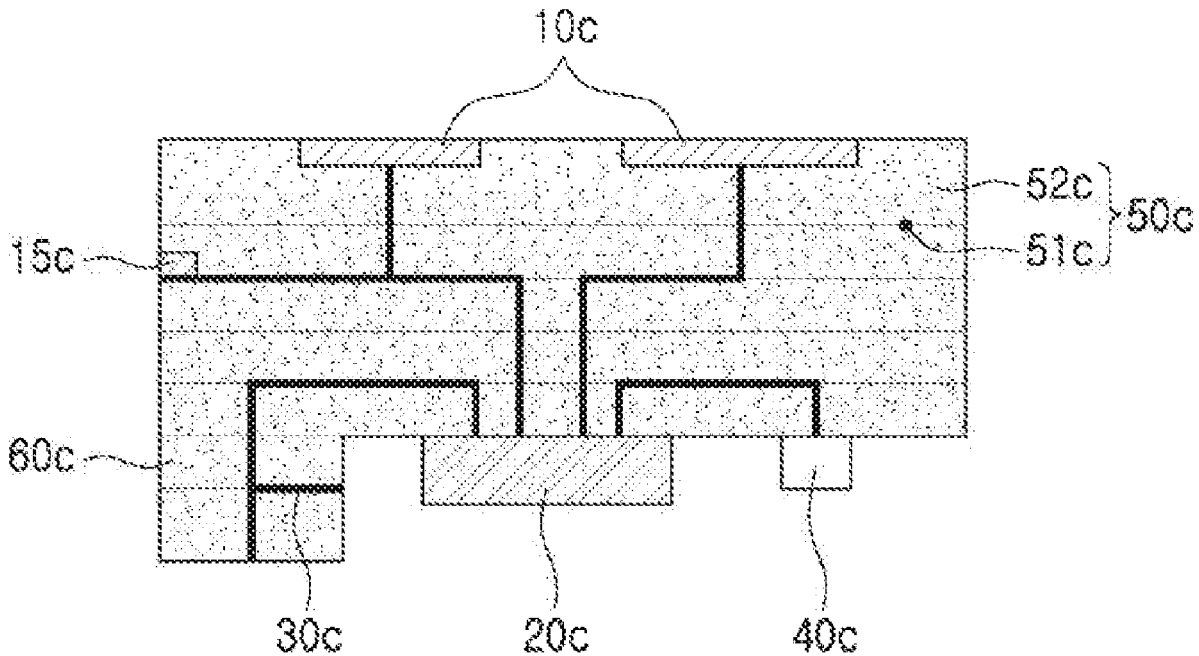
Publication Classification

(51) **Int. Cl.**

H01L 23/66 (2006.01)

H01L 23/31 (2006.01)

An antenna module includes a connection member including at least one wiring layer and at least one insulating layer, an antenna package including a plurality of antenna members transmitting or receiving a radio frequency (RF) signal and a plurality of feed vias respectively electrically connected to the plurality of antenna members at one end and respectively electrically connected to a wiring corresponding to the at least one wiring layer at the other end, and positioned on a first surface of the connection member, an integrated circuit (IC) disposed on a second surface of the connection member and electrically connected to the wiring corresponding to the at least one wiring layer to receive an intermediate frequency (IF) signal or baseband signal and transfer an RF signal or receive an RF signal and transfer an IF signal or baseband signal, and a filter filtering an IF signal or a baseband signal.





US 2020036592A1

(19) **United States**

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

(10) **Pub. No.: US 2020/036592 A1**

(43) **Pub. Date: Nov. 19, 2020**

(54) **ANTENNA AND MOBILE TERMINAL**

Publication Classification

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

(51) **Int. Cl.**
H01Q 9/04 (2006.01)
H01Q 7/00 (2006.01)
H01Q 9/30 (2006.01)

(72) Inventors: **Chongfeng Zhao**, Xi'an (CN); **Kun Li**,
Xi'an (CN); **Bao Lu**, Shenzhen (CN);
Yu Wang, Shenzhen (CN)

(52) **U.S. Cl.**
CPC **H01Q 9/045** (2013.01); **H04W 88/02**
(2013.01); **H01Q 9/30** (2013.01); **H01Q 7/00**
(2013.01)

(21) Appl. No.: **16/640,517**

(57) **ABSTRACT**

(22) PCT Filed: **Aug. 23, 2018**

A mobile terminal and an antenna that includes a feeder and a radiating element. The radiating element includes a first radiating patch and a second radiating patch. The first radiating patch and the second radiating patch are located on one side of the feeder and form a loop together with the feeder. An adjustable component configured to control the feeder and the second radiating patch is disposed on the feeder between the first radiating patch and the second radiating patch. The first radiating patch has a first extension part extending to an opposing side of the feeder.

(86) PCT No.: **PCT/CN2018/101947**

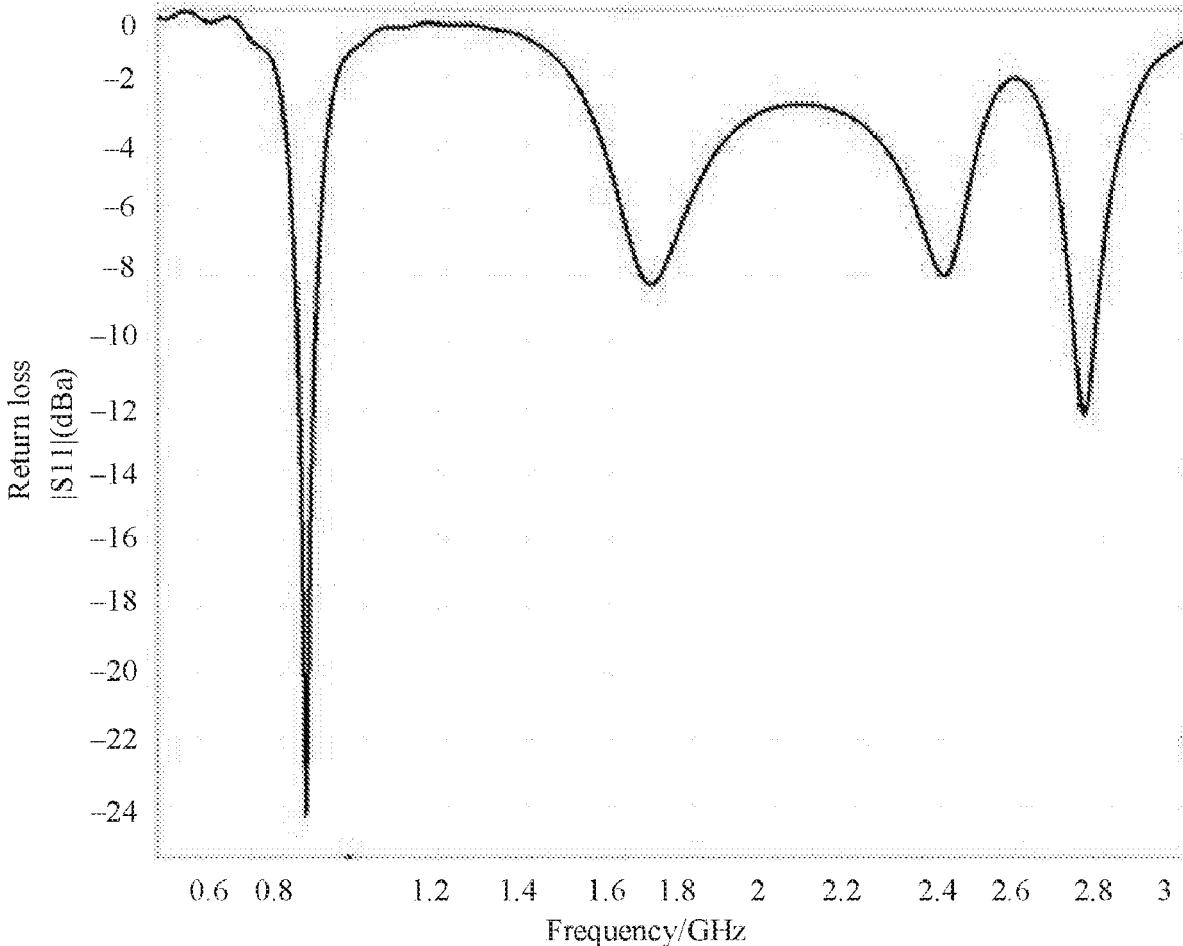
§ 371 (c)(1),

(2) Date: **Feb. 20, 2020**

(30) **Foreign Application Priority Data**

Oct. 31, 2017 (CN) 201711046227.X

Relationship between a return loss and a frequency





US 20200371223A1

(19) **United States**

(12) **Patent Application Publication**

Baheti et al.

(10) **Pub. No.: US 2020/0371223 A1**

(43) **Pub. Date: Nov. 26, 2020**

(54) **RADIO FREQUENCY SYSTEMS
INTEGRATED WITH DISPLAYS AND
METHODS OF FORMATION THEREOF**

G01S 7/04 (2006.01)

G01S 13/88 (2006.01)

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

CPC **G01S 13/34** (2013.01); **H01Q 1/40**

(2013.01); **H01Q 1/2283** (2013.01); **G01S**

7/02 (2013.01); **H01Q 1/38** (2013.01); **H01Q**

21/065 (2013.01); **H01Q 9/045** (2013.01);

H01Q 1/243 (2013.01); **H01Q 9/0457**

(2013.01); **G01S 7/04** (2013.01); **G01S 13/88**

(2013.01); **G01S 13/44** (2013.01)

(71) Applicant: **Infineon Technologies AG**, Neubiberg (DE)

(72) Inventors: **Ashutosh Baheti**, München (DE);
Saverio Trotta, München (DE)

(21) Appl. No.: **16/991,568**

(22) Filed: **Aug. 12, 2020**

(57)

ABSTRACT

Related U.S. Application Data

(63) Continuation of application No. 15/782,288, filed on Oct. 12, 2017, now Pat. No. 10,775,490.

Publication Classification

(51) **Int. Cl.**

G01S 13/34 (2006.01)

H01Q 1/40 (2006.01)

H01Q 1/22 (2006.01)

G01S 7/02 (2006.01)

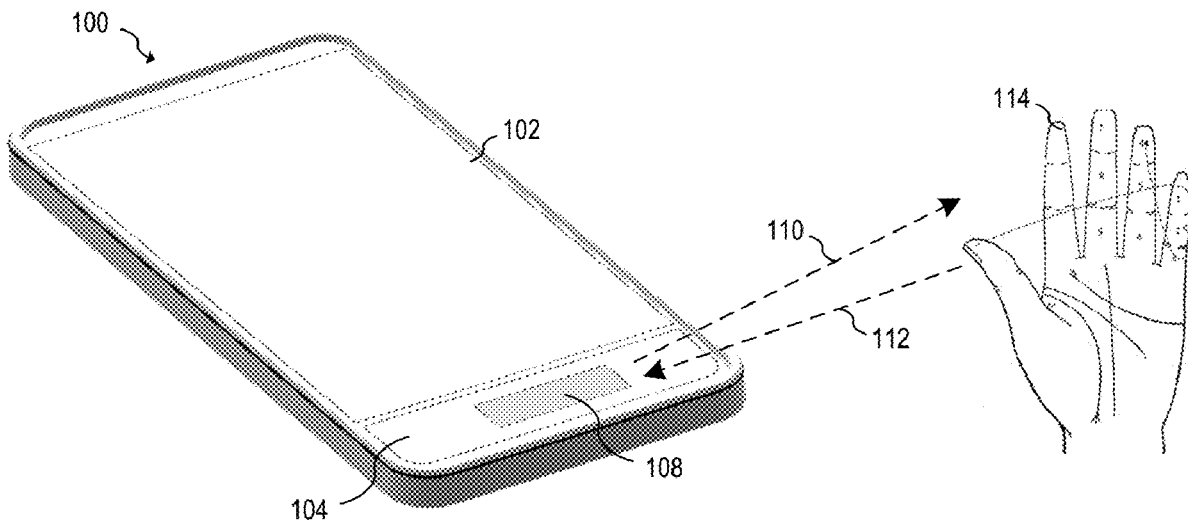
H01Q 1/38 (2006.01)

G01S 13/44 (2006.01)

H01Q 9/04 (2006.01)

H01Q 1/24 (2006.01)

A radio frequency (RF) device includes a display screen and a flexible substrate. The display screen is configured to transmit visible light at a first side of the display screen. The flexible substrate includes a first portion overlapping the first side, and a second portion overlapping an opposite second side of the display screen. The RF device further includes a plurality of antennas disposed over the first portion of the flexible substrate and the first side, and a transmission line disposed on a bent region of the flexible substrate between the first and second portions. The plurality of antennas is configured to transmit/receive RF signals on the first side of the display screen. The display screen is opaque to the RF signals. The transmission line is configured to propagate the RF signals between the first portion and the second portion on the opposite second side of the display screen.





US 20200373648A1

(19) **United States**

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

(10) **Pub. No.: US 2020/0373648 A1**

(43) **Pub. Date: Nov. 26, 2020**

(54) **COMMUNICATION DEVICE**

Publication Classification

(71) Applicant: **HTC Corporation**, Taoyuan City (TW)

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 5/307 (2006.01)

(72) Inventors: **Cheng-Hung LIN**, Taoyuan City (TW);
Chia-Te CHIEN, Taoyuan City (TW);
Kang-Ling LI, Taoyuan City (TW);
Chun-Hsien LEE, Taoyuan City (TW);
Yu-Chieh CHIU, Taoyuan City (TW);
Ching-Chih SU, Taoyuan City (TW)

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

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

(73) Assignee: **HTC Corporation**, Taoyuan City (TW)

(57)

ABSTRACT

(21) Appl. No.: **16/860,816**

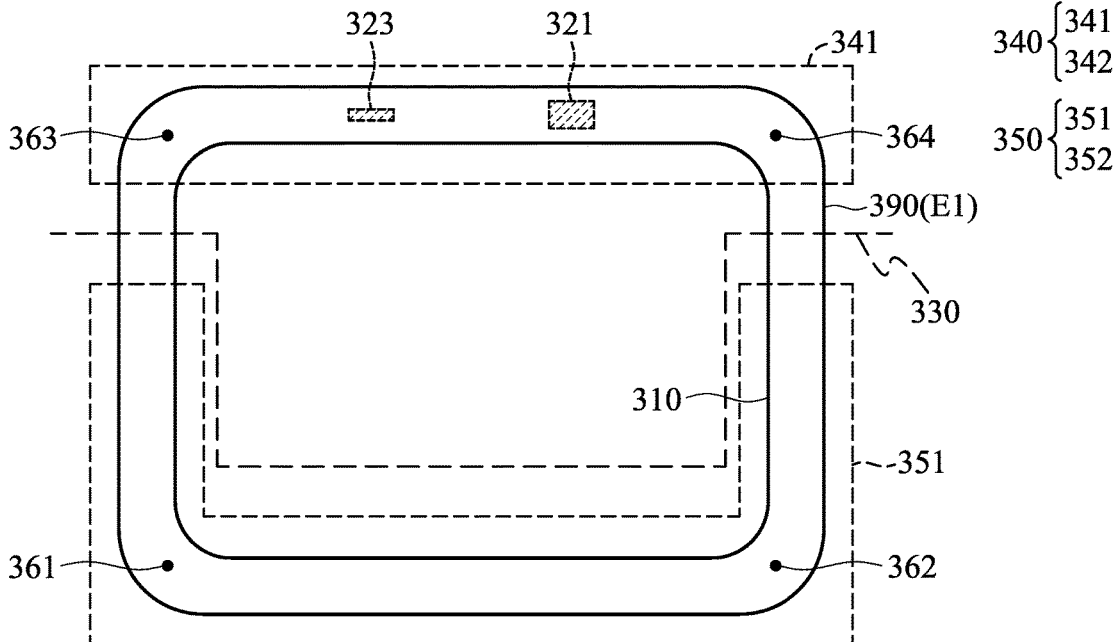
(22) Filed: **Apr. 28, 2020**

Related U.S. Application Data

(60) Provisional application No. 62/851,675, filed on May 23, 2019.

A communication device includes one or more mmWave (Millimeter Wave) antenna elements and a display device. The display device has a partition line. A first region is formed above the partition line, and a second region is formed below the partition line. The mmWave antenna elements are disposed in the first region. There is no mmWave antenna element disposed in the second region.

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(19) **United States**

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

(10) **Pub. No.: US 2020/0373649 A1**
(43) **Pub. Date: Nov. 26, 2020**

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

H01Q 21/29 (2006.01)
H04M 1/02 (2006.01)
H04B 1/3827 (2006.01)
H01Q 1/50 (2006.01)

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

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 13/10* (2013.01); *H01Q 21/293* (2013.01); *H01Q 1/24* (2013.01); *H01Q 1/50* (2013.01); *H04M 1/02* (2013.01); *H04B 1/3827* (2013.01); *H04M 1/026* (2013.01); *H01Q 21/29* (2013.01)

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

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

(21) Appl. No.: **16/875,580**

(57) **ABSTRACT**

(22) Filed: **May 15, 2020**

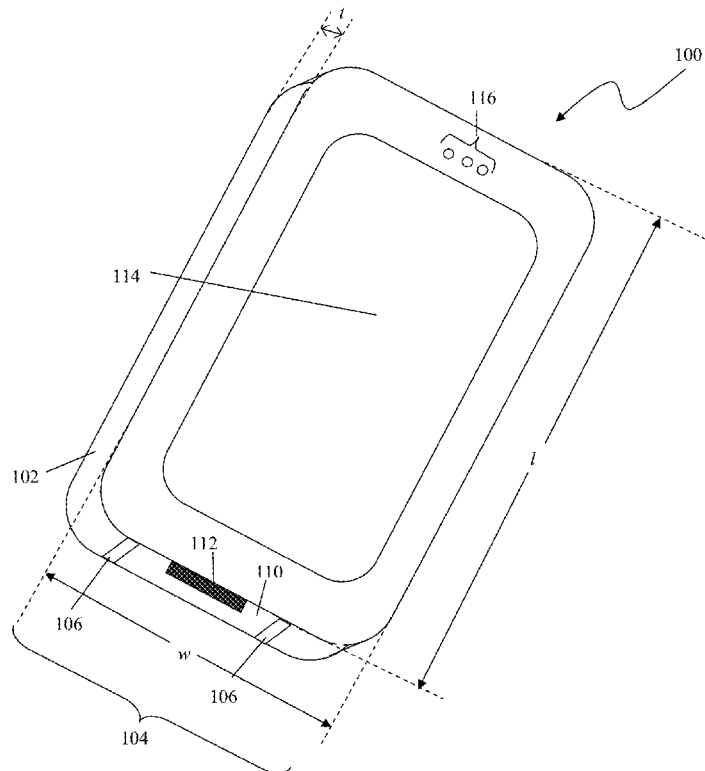
Related U.S. Application Data

(63) Continuation of application No. 16/005,086, filed on Jun. 11, 2018, which is a continuation of application No. 15/263,559, filed on Sep. 13, 2016, now Pat. No. 9,997,822, which is a continuation of application No. 15/059,588, filed on Mar. 3, 2016, now Pat. No. 9,462,096, which is a continuation of application No. 13/278,836, filed on Oct. 21, 2011, now Pat. No. 9,300,033.

Publication Classification

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

A method for a wireless communication device including configuring an antenna including antenna circuitry to receive or transmit wireless signals; feeding a radio frequency signal into the antenna circuitry; providing a housing comprising a plurality of edges, wherein the edges comprise a top edge, a bottom edge, and two side edges, wherein a first edge of the housing comprises a conductive strip, a first slot, and a second slot, and wherein the first edge is the top or bottom edge; providing an input/output port adjacent to the first edge of the housing; and locating the conductive strip, which comprises a portion of the antenna, entirely between the first slot and the second slot, wherein a length of each of the first slot and the second slot extends across the first edge of the housing and is oriented perpendicular to a major axis of the conductive strip.





(19) **United States**

(12) **Patent Application Publication**
NASU

(10) **Pub. No.: US 2020/0373650 A1**

(43) **Pub. Date: Nov. 26, 2020**

(54) **ANTENNA DEVICE AND COMMUNICATION TERMINAL APPARATUS**

H01Q 1/50 (2006.01)

H01Q 21/30 (2006.01)

H01Q 5/378 (2006.01)

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

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

CPC *H01Q 1/243* (2013.01); *H01Q 1/38*
(2013.01); *H01Q 5/378* (2015.01); *H01Q*
21/30 (2013.01); *H01Q 1/50* (2013.01)

(72) Inventor: **Takafumi NASU**, Nagaokakyo-shi (JP)

(21) Appl. No.: **16/992,197**

(22) Filed: **Aug. 13, 2020**

(57)

ABSTRACT

An antenna device includes first and second radiating elements, a first coil coupled to the first radiating element or a feeding circuit, and a second coil coupled to the second radiating element and coupled to the first coil via an electromagnetic field. The first and second radiating elements are coupled to each other via an electric field. At a resonant frequency defined by the antenna coupling element and the second radiating element, the absolute value of the phase difference between a current flowing into the second radiating element due to the electromagnetic field of the first coil and the second coil and a current flowing into the second radiating element due to the electric field is equal to or less than about 90 degrees.

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2019/012058, filed on Mar. 22, 2019.

Foreign Application Priority Data

Apr. 25, 2018 (JP) 2018-084210

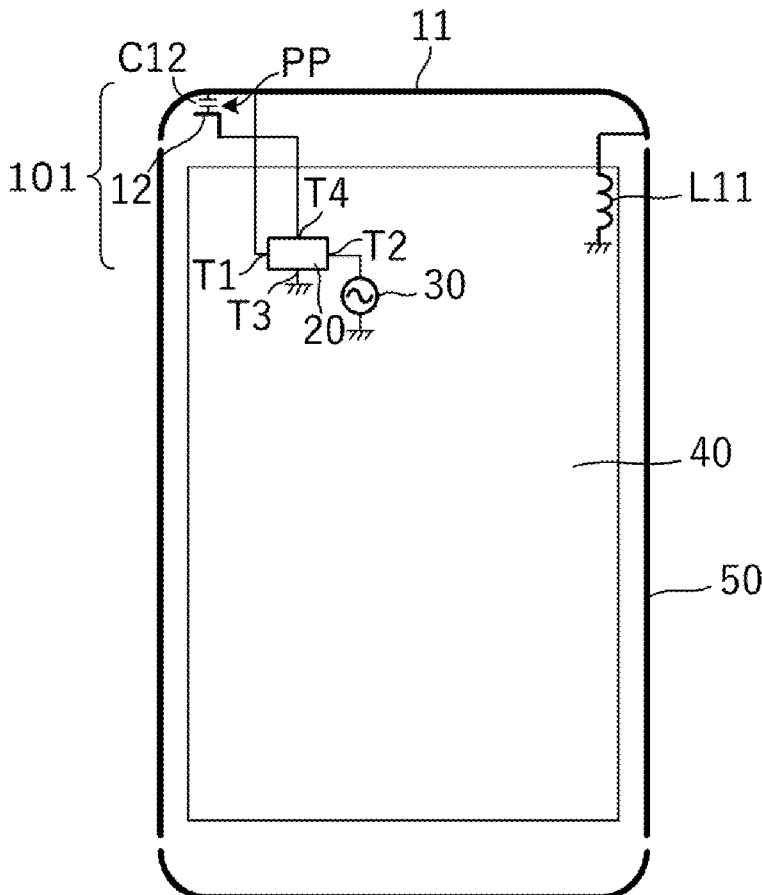
Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 1/38 (2006.01)

111





US 20200373666A1

(19) **United States**

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

(10) **Pub. No.: US 2020/0373666 A1**

(43) **Pub. Date: Nov. 26, 2020**

(54) **MULTIBAND ANTENNA, WIRELESS COMMUNICATION MODULE, AND WIRELESS COMMUNICATION DEVICE**

Publication Classification

(51) **Int. Cl.**
H01Q 5/307 (2006.01)
H01Q 13/10 (2006.01)
H01Q 1/48 (2006.01)

(52) **U.S. Cl.**
 CPC *H01Q 5/307* (2015.01); *H01Q 1/48* (2013.01); *H01Q 13/106* (2013.01)

(71) Applicant: **HITACHI METALS, LTD.**,
Minato-ku, Tokyo (JP)

(72) Inventors: **Yasunori TAKAKI**, Minato-ku, Tokyo (JP); **Kenji HAYASHI**, Minato-ku, Tokyo (JP)

(21) Appl. No.: **16/967,798**

(22) PCT Filed: **Feb. 12, 2019**

(86) PCT No.: **PCT/JP2019/004890**

§ 371 (c)(1),

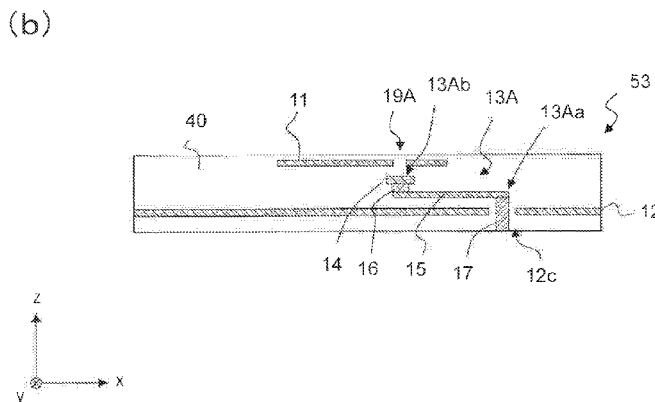
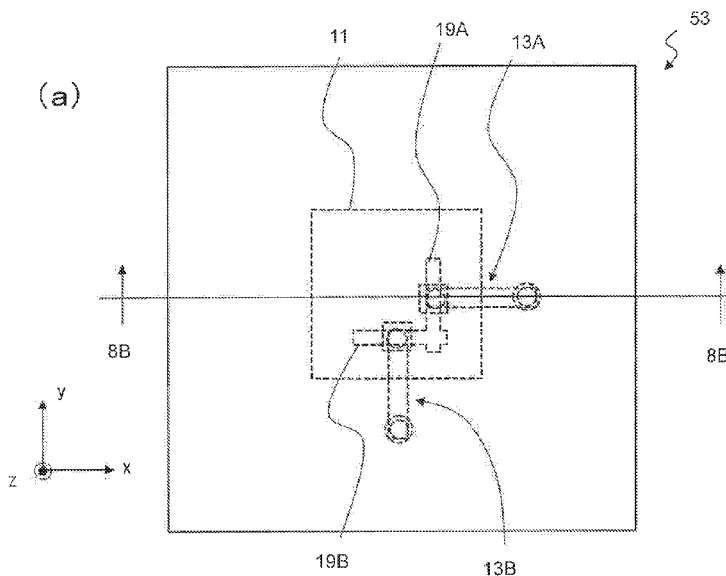
(2) Date: **Aug. 6, 2020**

(30) **Foreign Application Priority Data**

Feb. 14, 2018 (JP) 2018-024103

(57) **ABSTRACT**

A multiband antenna includes: a radiating conductor including a rectangular-shaped first slit extending along a second axis direction of a first right-hand orthogonal coordinate system having a first axis direction, the second axis direction, and a third axis direction; a ground conductor which is spaced apart from the radiating conductor by a predetermined interval along the third axis direction; and a first strip conductor being positioned between the radiating conductor and the ground conductor, and extending along the first axis direction. An end portion of the first strip conductor overlaps the first slit when viewed along the third axis direction.





US 20200373669A1

(19) **United States**

(12) **Patent Application Publication**

Xue et al.

(10) **Pub. No.: US 2020/0373669 A1**

(43) **Pub. Date: Nov. 26, 2020**

(54) **MOBILE TERMINAL AND ANTENNA OF MOBILE TERMINAL**

H01Q 1/52 (2006.01)

H01Q 5/328 (2006.01)

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

(52) **U.S. Cl.**
CPC *H01Q 5/35* (2015.01); *H01Q 5/328*
(2015.01); *H01Q 1/52* (2013.01); *H01Q 1/243*
(2013.01)

(72) Inventors: **Liang Xue**, Shanghai (CN); **Pengfei Wu**, Shanghai (CN); **Laiwei Shen**, Shanghai (CN); **Zhiyuan Xie**, Shanghai (CN); **Jiaqing You**, Shanghai (CN); **Dong Yu**, Shanghai (CN)

(57) **ABSTRACT**

An antenna includes a radiator, where the radiator includes three parts separated by a gap, an end of a second part proximate to a first part is a first end, and an end of the second part proximate to a third part is a second end, a medium-high frequency feeder, electrically coupled to the radiator at a first coupling point, a low frequency feeder electrically coupled to the radiator at a second coupling point, where an adjustable component for controlling conduction of the first ground cable is disposed on the first ground cable, a length from the second coupling point to an end that is in the first end and the second end and that is further from the first coupling point is a quarter of a wavelength corresponding to a resonance frequency.

(21) Appl. No.: **16/637,185**

(22) PCT Filed: **Nov. 10, 2017**

(86) PCT No.: **PCT/CN2017/110440**

§ 371 (c)(1),

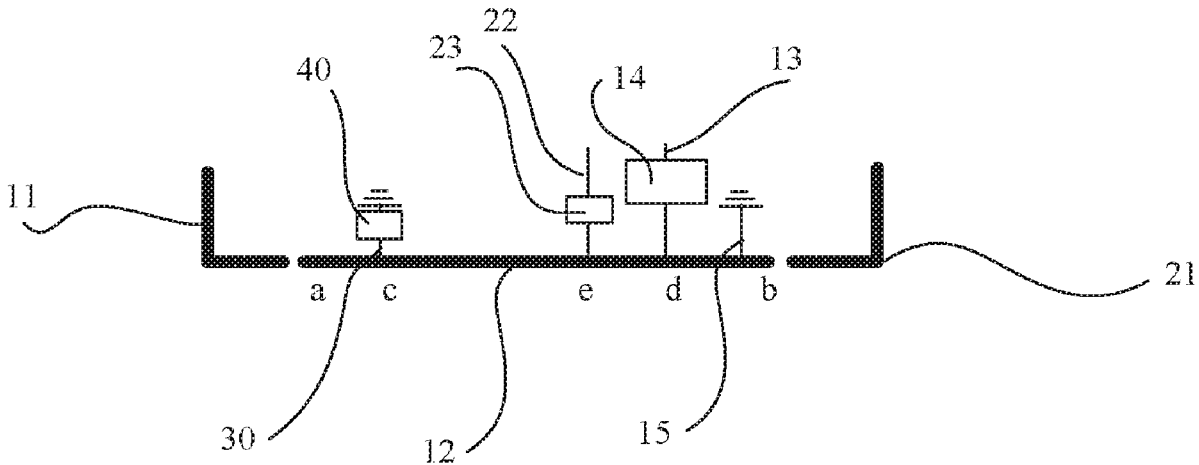
(2) Date: **Feb. 6, 2020**

Publication Classification

(51) **Int. Cl.**

H01Q 5/35 (2006.01)

H01Q 1/24 (2006.01)





(19) **United States**

(12) **Patent Application Publication**

Paulotto et al.

(10) **Pub. No.: US 2020/0373672 A1**

(43) **Pub. Date: Nov. 26, 2020**

(54) **MILLIMETER WAVE PATCH ANTENNAS**

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

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

CPC **H01Q 9/0442** (2013.01); **H01Q 5/378** (2015.01); **H01Q 9/40** (2013.01); **H01Q 5/40** (2015.01); **H01Q 1/521** (2013.01)

(72) Inventors: **Simone Paulotto**, Redwood City, CA (US); **Basim H. Noori**, Scotts Valley, CA (US); **Matthew A. Mow**, Los Altos, CA (US)

(57) **ABSTRACT**

(21) Appl. No.: **16/990,821**

An electronic device may include a millimeter wave antenna having a ground plane, resonating element, feed, and parasitic element. The resonating element may include first, second, and third layer of traces that are shorted together. The second traces may be interposed between the first and third traces and the third traces may be interposed between the second traces and the parasitic. The third traces may have a width that is less than the widths of the second and third traces. The third traces and the parasitic may define a constrained volume having an associated cavity resonance that lies outside of a frequency band of interest. If desired, the resonating element may include a single layer of conductive traces having a grid of openings that disrupt impedance in a transverse direction, thereby mitigating the trapping of energy within the frequency band of interest between the resonating element and the parasitic.

(22) Filed: **Aug. 11, 2020**

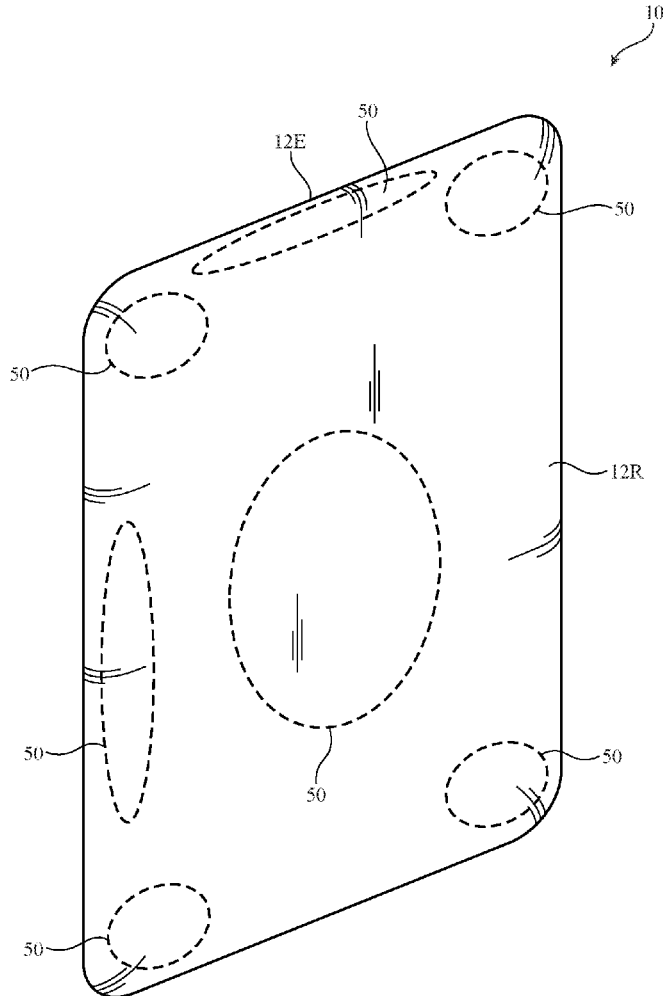
Related U.S. Application Data

(62) Division of application No. 15/650,689, filed on Jul. 14, 2017, now Pat. No. 10,777,895.

Publication Classification

(51) **Int. Cl.**

H01Q 9/04 (2006.01)
H01Q 5/378 (2006.01)
H01Q 1/52 (2006.01)
H01Q 5/40 (2006.01)
H01Q 9/40 (2006.01)





(19) **United States**

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

(10) **Pub. No.: US 2020/0373673 A1**

(43) **Pub. Date: Nov. 26, 2020**

(54) **ULTRA-LIGHT WEIGHT FLEXIBLE,
COLLAPSIBLE AND DEPLOYABLE
ANTENNAS AND ANTENNA ARRAYS**

H01Q 21/06 (2006.01)

H01Q 21/00 (2006.01)

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

CPC *H01Q 9/0457* (2013.01); *H01Q 1/48*
(2013.01); *H01Q 21/0025* (2013.01); *H01Q*
21/065 (2013.01); *H01Q 21/0087* (2013.01);
H01Q 1/08 (2013.01)

(71) Applicant: **California Institute of Technology,**
Pasadena, CA (US)

(72) Inventors: **Mohammed Reza M Hashemi,**
Pasadena, CA (US); **Seyed Ali**
Hajimiri, Pasadena, CA (US)

(21) Appl. No.: **16/869,441**

(22) Filed: **May 7, 2020**

Related U.S. Application Data

(60) Provisional application No. 62/844,542, filed on May
7, 2019.

Publication Classification

(51) **Int. Cl.**

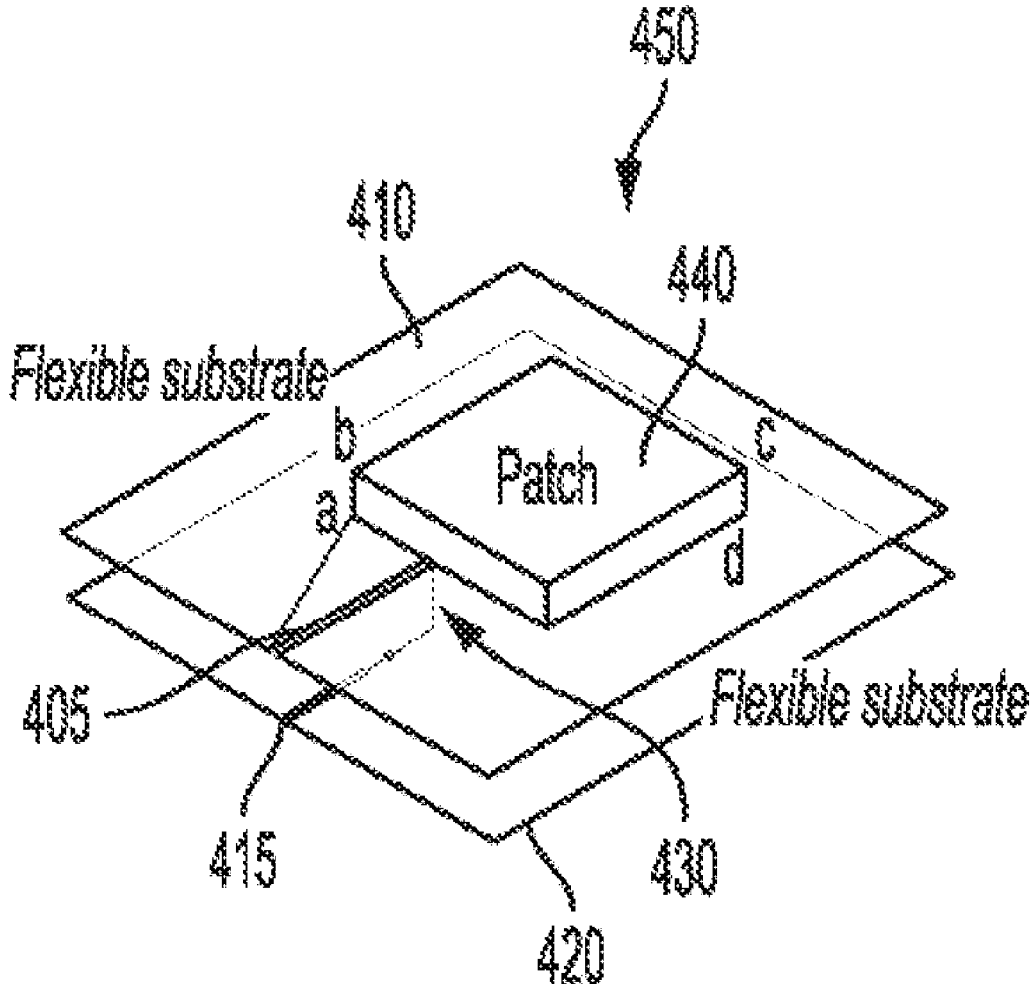
H01Q 9/04 (2006.01)

H01Q 1/48 (2006.01)

H01Q 1/08 (2006.01)

(57) **ABSTRACT**

An antenna includes, in part, first and second flexible boards separated from one another by air/vacuum gap dielectric. The first flexible board includes a radiating patch and a foldable, collapsible, and deployable feed transition. The second flexible board includes a ground layer and a transmission line. The feed transition is adapted to deliver an RF signal to the radiating patch from the transmission line. By pressing forward the first flexible board, the feed transition folds towards the second flexible board thereby causing the first flexible board to collapse onto the second flexible board. The feed transition may be tapered. The antenna may further include an interdigital capacitor having a first multitude of metal fingers connected to the radiating patch and a second multitude of metal fingers connected to the tapered section of the feed transition.





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(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2020/0388906 A1**

KIM et al.

(43) **Pub. Date: Dec. 10, 2020**

(54) **ANTENNA MODULE AND ANTENNA APPARATUS**

Publication Classification

(71) Applicant: **SAMSUNG ELECTRO-MECHANICS CO., LTD.**, Suwon-si (KR)

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 21/06 (2006.01)
H01Q 9/06 (2006.01)
H01Q 1/38 (2006.01)
H01Q 1/22 (2006.01)

(72) Inventors: **Nam Ki KIM**, Suwon-si (KR); **Jeong Ki RYOO**, Suwon-si (KR); **Seung Goo JANG**, Suwon-si (KR); **Sang Hyun KIM**, Suwon-si (KR)

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 21/062* (2013.01); *H01Q 9/065* (2013.01); *H01Q 5/48* (2015.01); *H01Q 21/065* (2013.01); *H01Q 1/2283* (2013.01); *H01Q 1/38* (2013.01)

(73) Assignee: **SAMSUNG ELECTRO-MECHANICS CO., LTD.**, Suwon-si (KR)

(57) **ABSTRACT**

An antenna module includes a connection member, an integrated circuit (IC) on a first surface thereof, and an antenna package on a second surface thereof. The connection member includes a wiring layer and an insulating layer. The IC is electrically connected to the wiring layer. The antenna package includes first antenna members and feed vias each electrically connected to a corresponding one of the first antenna members and a corresponding wire of the wiring layer. A feed line is electrically connected to a wire of the wiring layer and extends in a side direction of the second surface, a second antenna member is electrically connected to the feed line and is configured to transmit and/or receive an RF signal in the side direction, and a director member is spaced apart from the second antenna member in the side direction and has an inside boundary oblique to the second antenna member.

(21) Appl. No.: **17/000,679**

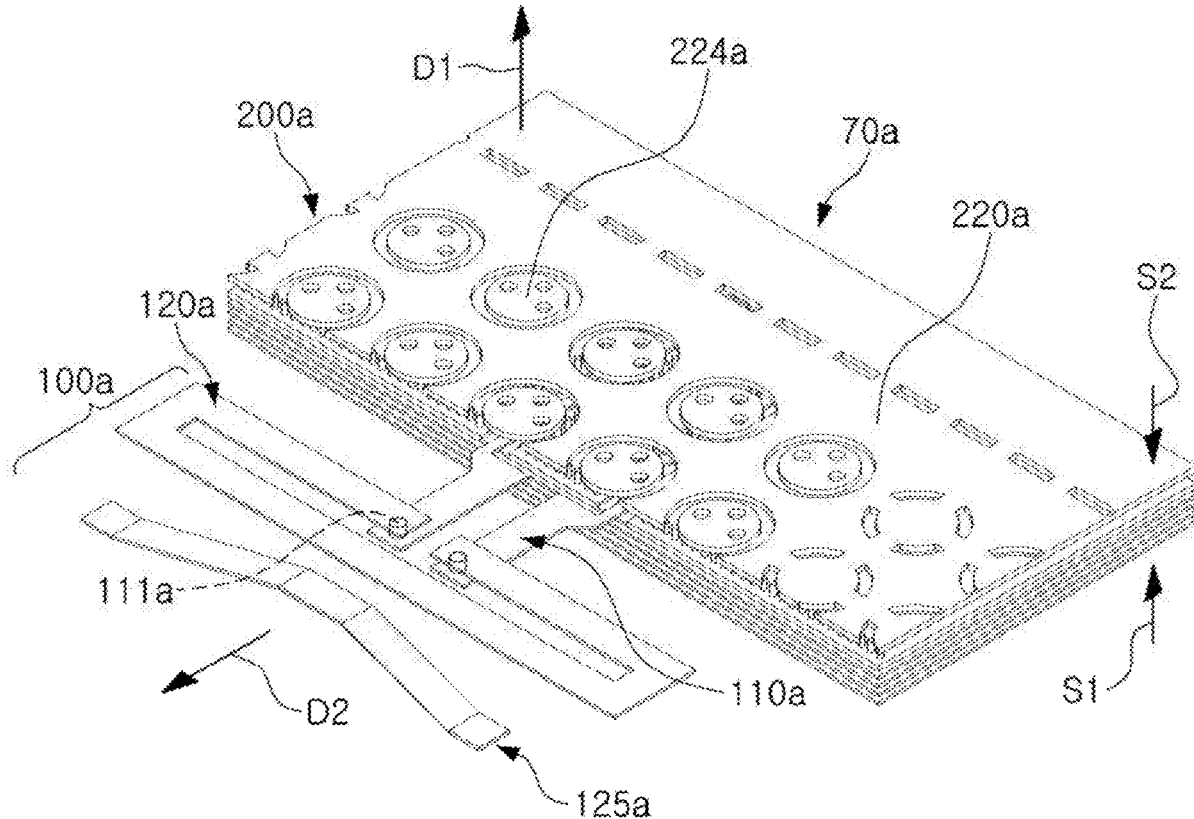
(22) Filed: **Aug. 24, 2020**

Related U.S. Application Data

(63) Continuation of application No. 15/994,350, filed on May 31, 2018, now Pat. No. 10,790,573.

Foreign Application Priority Data

Dec. 26, 2017 (KR) 10-2017-0179223





(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2020/0388911 A1**

KIM et al. (43) **Pub. Date: Dec. 10, 2020**

(54) **ELECTRONIC DEVICE COMPRISING ANTENNA DEVICE**

H01Q 1/12 (2013.01); *H05K 3/4644* (2013.01); *H05K 3/4038* (2013.01); *H05K 1/181* (2013.01)

(71) Applicant: **SAMSUNG ELECTRONICS CO., LTD.**, Gyeonggi-do (KR)

(72) Inventors: **Kyung-Bin KIM**, Gyeonggi-do (KR); **Yong-Eui HONG**, Seoul (KR); **Jin-U KIM**, Seoul (KR)

(21) Appl. No.: **16/772,600**

(22) PCT Filed: **Aug. 20, 2018**

(86) PCT No.: **PCT/KR2018/009525**

§ 371 (c)(1),

(2) Date: **Jun. 12, 2020**

(30) **Foreign Application Priority Data**

Dec. 19, 2017 (KR) 10-2017-0174877

Publication Classification

(51) **Int. Cl.**

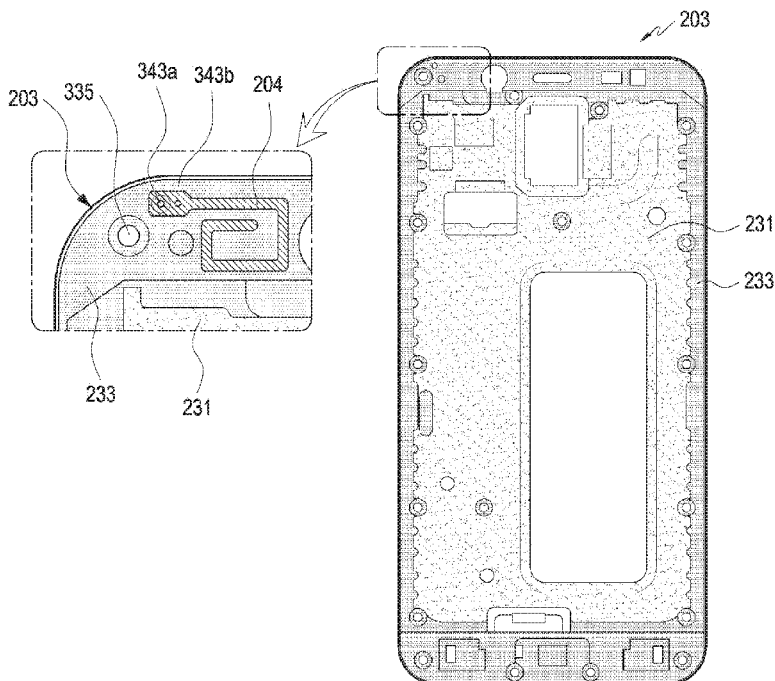
- H01Q 1/38* (2006.01)
- H05K 7/14* (2006.01)
- H05K 1/11* (2006.01)
- H05K 3/28* (2006.01)
- H05K 1/18* (2006.01)
- H01Q 1/12* (2006.01)
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- H05K 3/40* (2006.01)

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CPC *H01Q 1/38* (2013.01); *H05K 7/1427* (2013.01); *H05K 1/115* (2013.01); *H05K 3/282* (2013.01); *H05K 2201/10098* (2013.01);

(57) **ABSTRACT**

An electronic device according to various embodiments of the present invention may comprise a housing; an inner plate which is built into the housing, at least a portion of which is made of a synthetic resin material, and which comprises a first surface, a second surface facing the opposite direction to the first surface, a first through-hole formed in a cone-shaped cross-section the diameter of which gradually decreases the closer to the second surface from the first surface, and a second through-hole formed in a cone-shaped cross-section, which is disposed adjacent to the first through-hole and the diameter of which gradually decreases the closer to the first surface from the second surface; a first conductive line which is formed on the first surface and is formed to overlap with the first through-hole at least partially when viewed from the first surface, a second conductive line which is formed on the second surface and is formed to overlap with the second through-hole at least partially when viewed from the second surface, a first conductive layer which is deposited conformally on an inner wall of the first through-hole and electrically connected to at least one of the first conductive line and the second conductive line, a second conductive layer which is deposited conformally on an inner wall of the second through-hole and electrically connected to at least one of the first conductive line and the first conductive line, and a wireless communication module which is electrically connected to at least one of the first conductive line and the second conductive line, wherein the first conductive line, the second conductive line, the first conductive layer, and the second conductive layer may comprise the same composition of materials. Such an electronic device may vary according to the embodiment.





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SUDO et al.

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(54) **ANTENNA MODULE AND COMMUNICATION DEVICE PROVIDED WITH THE SAME**

H01Q 3/26 (2006.01)
H01Q 21/06 (2006.01)
H01Q 13/08 (2006.01)
H01Q 9/04 (2006.01)

(71) Applicant: **Murata Manufacturing Co., Ltd.**,
Kyoto (JP)

(52) **U.S. Cl.**
CPC *H01Q 1/38* (2013.01); *H01Q 5/378*
(2015.01); *H01Q 9/0421* (2013.01); *H01Q*
21/06 (2013.01); *H01Q 13/08* (2013.01);
H01Q 3/26 (2013.01)

(72) Inventors: **Kaoru SUDO**, Kyoto (JP); **Hirotsugu MORI**, Kyoto (JP)

(21) Appl. No.: **17/002,319**

(57) **ABSTRACT**

(22) Filed: **Aug. 25, 2020**

Related U.S. Application Data

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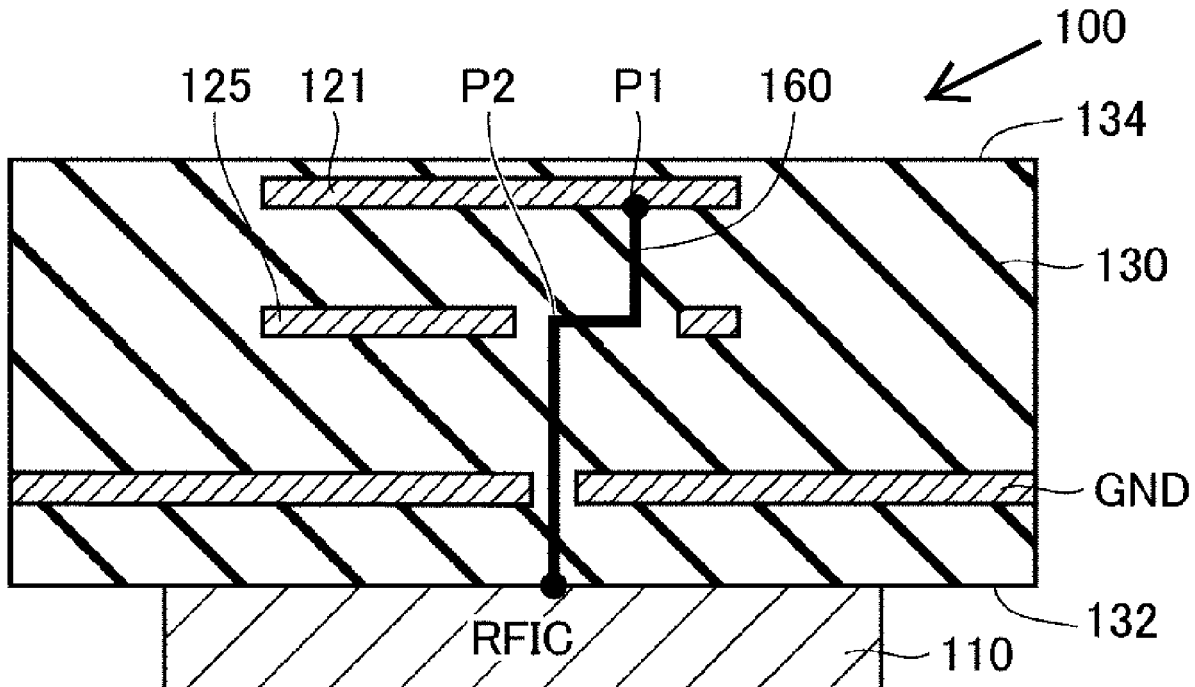
The antenna module includes a dielectric substrate having a multilayer structure, a feed element to which radio frequency power is supplied, a ground electrode (GND), a parasitic element disposed in a layer between the feed element and the ground electrode (GND), and a feed wire. The feed wire penetrates through the parasitic element, and supplies radio frequency power to the feed element. When the antenna module is viewed in a plan view from a normal direction of the dielectric substrate, at least part of the feed element overlaps with the parasitic element, and a first position (P1) at which the feed wire is connected to the feed element is different from a second position (P2) at which the feed wire reaches the layer in which the parasitic element is disposed from a side of the ground electrode (GND).

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Publication Classification

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Télez

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(54) **DUAL-BAND ANTENNA TOPOLOGY**

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

(71) Applicant: **Sonos, Inc.**, Santa Barbara, CA (US)

CPC **H01Q 5/378** (2015.01); **H01Q 13/103** (2013.01); **H01Q 1/38** (2013.01); **H01Q 1/48** (2013.01)

(72) Inventor: **Gregorio Télez**, Goleta, CA (US)

(57)

ABSTRACT

(21) Appl. No.: **16/435,024**

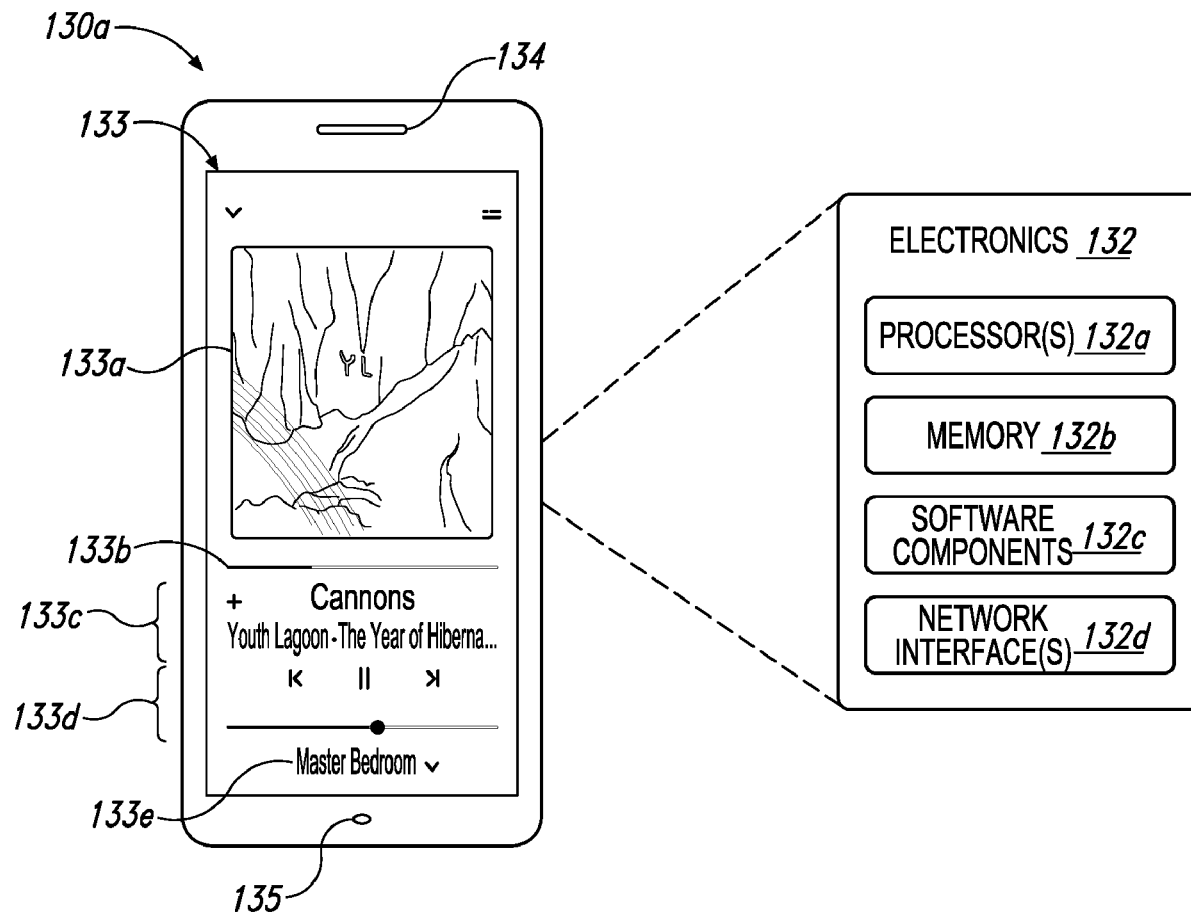
An example dual-band antenna includes a substrate and a primary radiator disposed on the substrate and connected to a transmission line for driving the primary radiator, where the primary radiator, when driven via the transmission line, has a first resonant frequency. The dual-band antenna also includes a secondary radiator disposed on the substrate and unconnected to the primary radiator, where the primary radiator, when driven via the transmission line, induces a current in the secondary radiator such that the secondary radiator has a second resonant frequency different from the first resonant frequency.

(22) Filed: **Jun. 7, 2019**

Publication Classification

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- H01Q 13/10** (2006.01)





(19) **United States**

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TANBO et al.

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(43) **Pub. Date: Dec. 10, 2020**

(54) **ANTENNA DEVICE**

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

(71) Applicant: **Murata Manufacturing Co., Ltd.**,
Kyoto (JP)

CPC **H01Q 11/14** (2013.01); **H01Q 5/45**
(2015.01); **H01Q 5/335** (2015.01)

(72) Inventors: **Yasuo TANBO**, Kyoto (JP); **Masahiro**
IZAWA, Kyoto (JP)

(57) **ABSTRACT**

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Related U.S. Application Data

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013263, filed on Mar. 27, 2019.

Foreign Application Priority Data

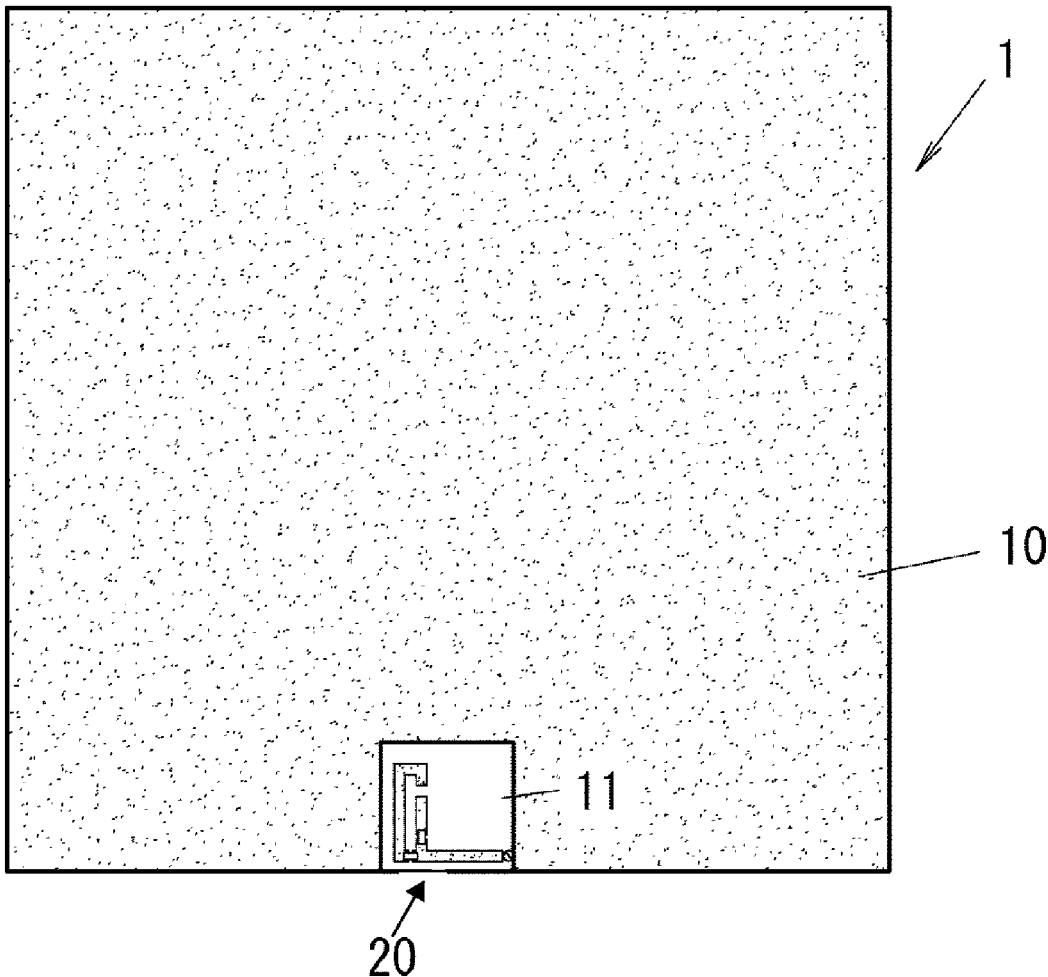
Apr. 13, 2018 (JP) 2018078023

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(51) **Int. Cl.**

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H01Q 5/45 (2006.01)

A conductor pattern of an antenna device is provided in a notch and includes a common conductor, a first conductor, and a second conductor. A power supply unit is disposed at a connection portion between a conductor plate and the conductor pattern. Each of the first conductor and the second conductor is connected to the power supply unit with the common conductor interposed therebetween. The power supply unit is positioned at a position at which a distance to an opening end is shorter than a distance to a closed end at a side end. A first partial conductor of the first conductor is positioned between the second conductor and a side end. A length of the first conductor in a direction along the side end is longer than a length of the second conductor in the direction along the side end.





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(19) **United States**

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Koo et al.

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(54) **ELECTRONIC DEVICE HAVING CONDUCTIVE STRUCTURE OF SUPPORTING MEMBER**

(52) **U.S. Cl.**
CPC **H05K 1/0243** (2013.01); **H01Q 1/1207** (2013.01); **H01Q 1/243** (2013.01); **H05K 3/305** (2013.01); **H05K 3/308** (2013.01)

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

(72) Inventors: **Jamyong Koo**, Suwon-si (KR); **Jaedeok Lim**, Suwon-si (KR); **Hyein Park**, Suwon-si (KR); **Gyuyeong Cho**, Suwon-si (KR)

(57) **ABSTRACT**

An electronic device is provided. The electronic device includes an electronic device including a housing including a front plate, a rear plate, and a member surrounding at least part of a space between the front plate and the rear plate and operating as an antenna radiator by being formed of a metal material at least in part, a support member including a first face and a second face, disposed between a display and the rear plate, supporting the display on the first face, and bonded to part of the side member, a printed circuit board, a housing groove formed on a first portion of the member, a conductive body bonded to the housing groove through a press-fit process, and a connection terminal disposed on the printed circuit board and electrically coupling the press-fitted conductive body to the printed circuit board.

(21) Appl. No.: **16/894,094**

(22) Filed: **Jun. 5, 2020**

(30) **Foreign Application Priority Data**

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H05K 3/30 (2006.01)

