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(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2020/0091583 A1**

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

CHOI et al.

(54) **CHIP ANTENNA MODULE**

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

(72) Inventors: **Seong Hee CHOI**, Suwon-si (KR); **Sang Jong LEE**, Suwon-si (KR)

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

(21) Appl. No.: **16/506,289**

(22) Filed: **Jul. 9, 2019**

(30) **Foreign Application Priority Data**

Sep. 18, 2018 (KR) 10-2018-0111749
Nov. 7, 2018 (KR) 10-2018-0136072

Publication Classification

(51) **Int. Cl.**

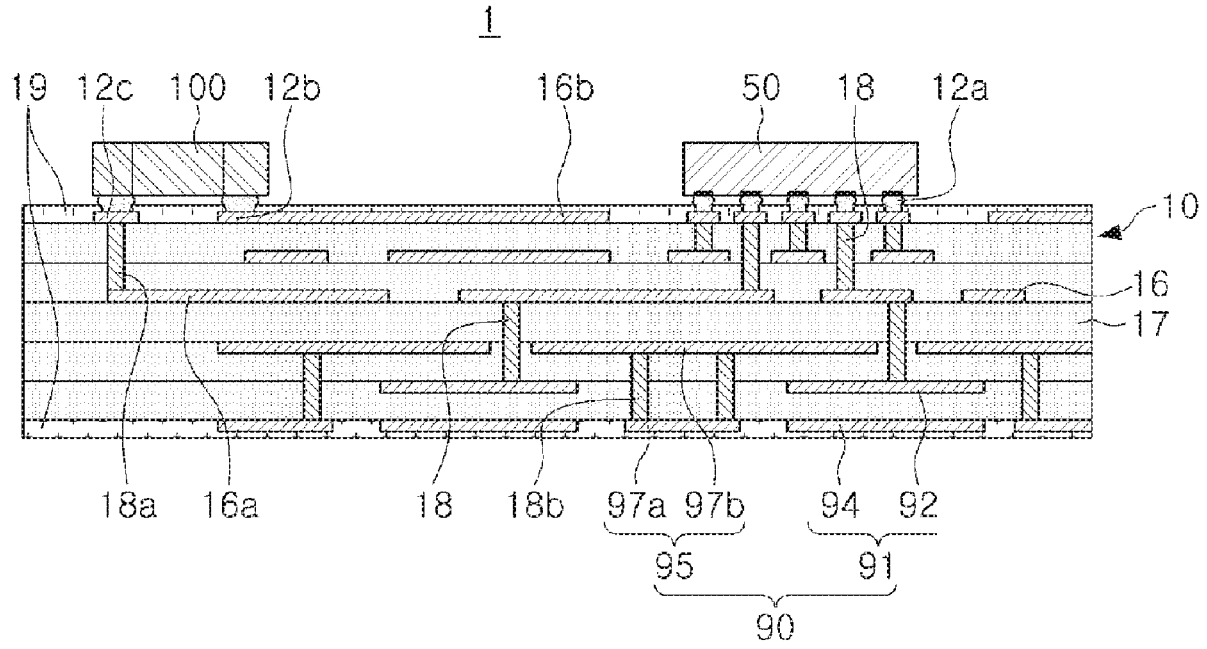
H01Q 1/22	(2006.01)
H01Q 1/24	(2006.01)
H01Q 1/38	(2006.01)
H01Q 1/48	(2006.01)
H01Q 9/40	(2006.01)
H01Q 5/10	(2006.01)
H01Q 9/04	(2006.01)

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

CPC ***H01Q 1/2283*** (2013.01); ***H01Q 1/243*** (2013.01); ***H01Q 1/38*** (2013.01); ***H01Q 9/045*** (2013.01); ***H01Q 9/40*** (2013.01); ***H01Q 5/10*** (2015.01); ***H01Q 9/0421*** (2013.01); ***H01Q 1/48*** (2013.01)

(57) **ABSTRACT**

A chip antenna module includes: a substrate including a feed wiring layer to provide a feed signal, a feeding via connected to the feed wiring layer, and a dummy via separated from the feed wiring layer; and a chip antenna disposed on a first surface of the substrate and including a body portion formed of a dielectric substance, a radiating portion that extends from a first surface of the body portion and is connected to the feeding via and the dummy via, and a grounding portion that extends from a second surface of the body portion opposite the first surface of the body portion.



US 20200091589A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2020/0091589 A1**

CHEN et al. (43) **Pub. Date: Mar. 19, 2020**

(54) **ANTENNA STRUCTURE**

(71) Applicant: **Shenzhen Next Generation Communications Limited**, Shenzhen (CN)

(72) Inventors: **JIA CHEN**, Shenzhen (CN); **KUO-CHENG CHEN**, New Taipei (TW); **JIAN-WEI CHANG**, New Taipei (TW); **ZHEN-CHANG TANG**, Shenzhen (CN); **BO PENG**, Shenzhen (CN); **WEI-YU YE**, Shenzhen (CN); **CHUN-SHENG WU**, New Taipei (TW)

(21) Appl. No.: **16/568,981**

(22) Filed: **Sep. 12, 2019**

(30) **Foreign Application Priority Data**

Sep. 13, 2018 (CN) 201811070579.3

Publication Classification

(51) **Int. Cl.**

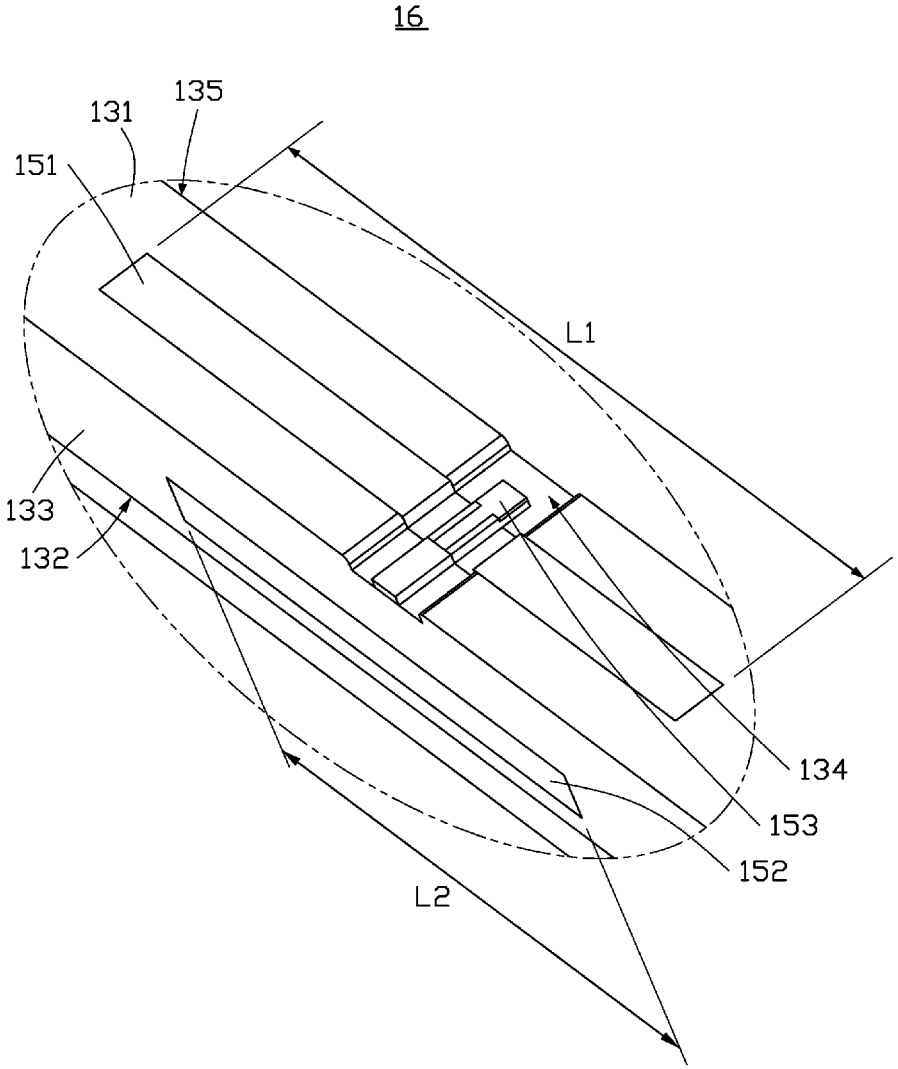
H01Q 1/24 (2006.01)
H01Q 5/10 (2006.01)
H01Q 5/30 (2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H01Q 5/30*** (2015.01); ***H01Q 5/10*** (2015.01)

(57) **ABSTRACT**

An antenna structure includes a metal frame. The metal frame includes a first surface, a second surface, and a third surface. The third surface is located between the first surface and the second surface. The metal frame includes at least one antenna. The at least one antenna includes a first gap, a second gap, and a feed portion. The first gap is disposed between the first surface and the second surface. The second gap is disposed in the third surface. The feed portion is mounted on the first surface and spans the first gap. When the feed portion supplies an electric current, the electric current is coupled to the first gap and the second gap.



US 20200091595A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2020/0091595 A1**

LEE (43) **Pub. Date: Mar. 19, 2020**

(54) **ANTENNA STRUCTURE**

(71) Applicant: **Wistron NeWeb Corp.**, Hsinchu (TW)

(72) Inventor: **Yun-Tsan LEE**, Hsinchu (TW)

(21) Appl. No.: **16/562,682**

(22) Filed: **Sep. 6, 2019**

(30) **Foreign Application Priority Data**

Sep. 19, 2018 (TW) 107132949

Publication Classification

(51) **Int. Cl.**

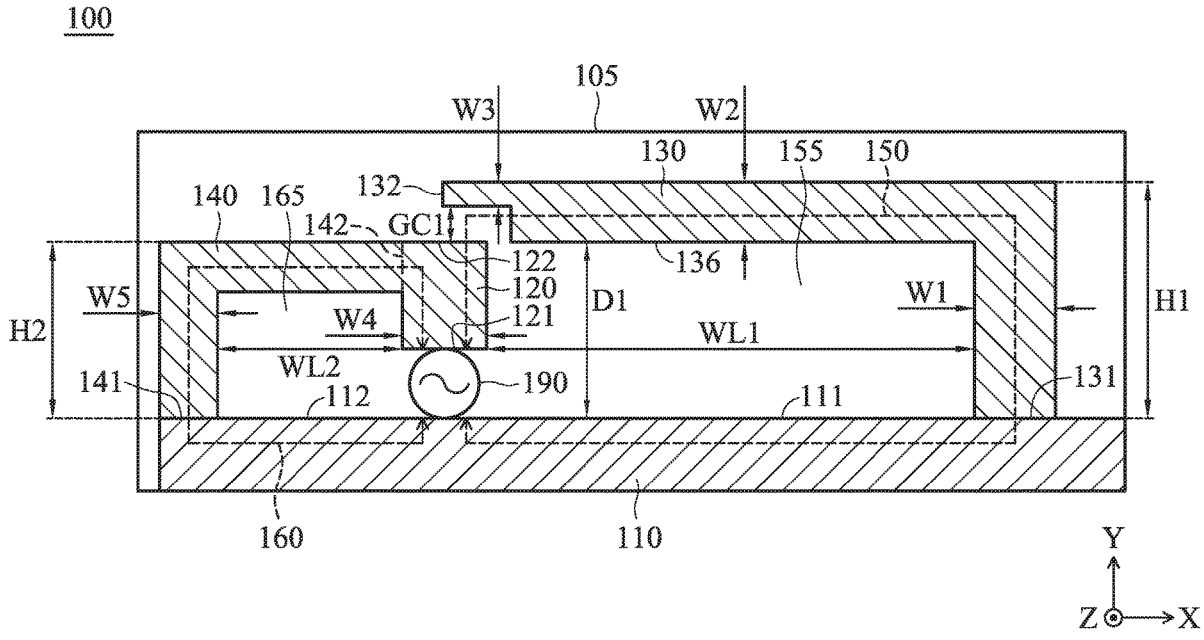
H01Q 1/36	(2006.01)
H01Q 1/48	(2006.01)
H01Q 1/52	(2006.01)
H01Q 1/22	(2006.01)

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

CPC ***H01Q 1/36*** (2013.01); ***H01Q 1/22*** (2013.01); ***H01Q 1/52*** (2013.01); ***H01Q 1/48*** (2013.01)

(57) **ABSTRACT**

An antenna structure includes a ground element, a feeding radiation element, a first radiation element, and a second radiation element. The feeding radiation element is coupled to a signal source. The first radiation element is coupled to the ground element. The first radiation element is adjacent to the feeding radiation element. The feeding radiation element is coupled through the second radiation element to the ground element. A first loop structure is formed by the feeding radiation element, the first radiation element, and the ground element. A second loop structure is formed by the feeding radiation element, the second radiation element, and the ground element. The second loop structure includes neither any branching portion nor any protruding portion.



US 20200099125A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2020/0099125 A1**

YING et al. (43) **Pub. Date: Mar. 26, 2020**

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

(71) Applicant: **HUAWEI TECHNOLOGIES CO., LTD.**, SHENZHEN, GUANGDONG (CN)

(72) Inventors: **Lijun YING**, Shanghai (CN); **Hanyang WANG**, Reading (GB); **Liang XUE**, Shanghai (CN); **Jiaqing YOU**, Shanghai (CN); **Chien-Ming LEE**, Shanghai (CN); **Xiaoli YANG**, Shanghai (CN); **Dong YU**, Shanghai (CN); **Lei WANG**, Shanghai (CN)

(21) Appl. No.: **16/495,806**

(22) PCT Filed: **Sep. 16, 2017**

(86) PCT No.: **PCT/CN2017/088683**

§ 371 (c)(1),
(2) Date: **Sep. 19, 2019**

(30) **Foreign Application Priority Data**

Mar. 20, 2017 (CN) 201710166832.4

Publication Classification

(51) **Int. Cl.**

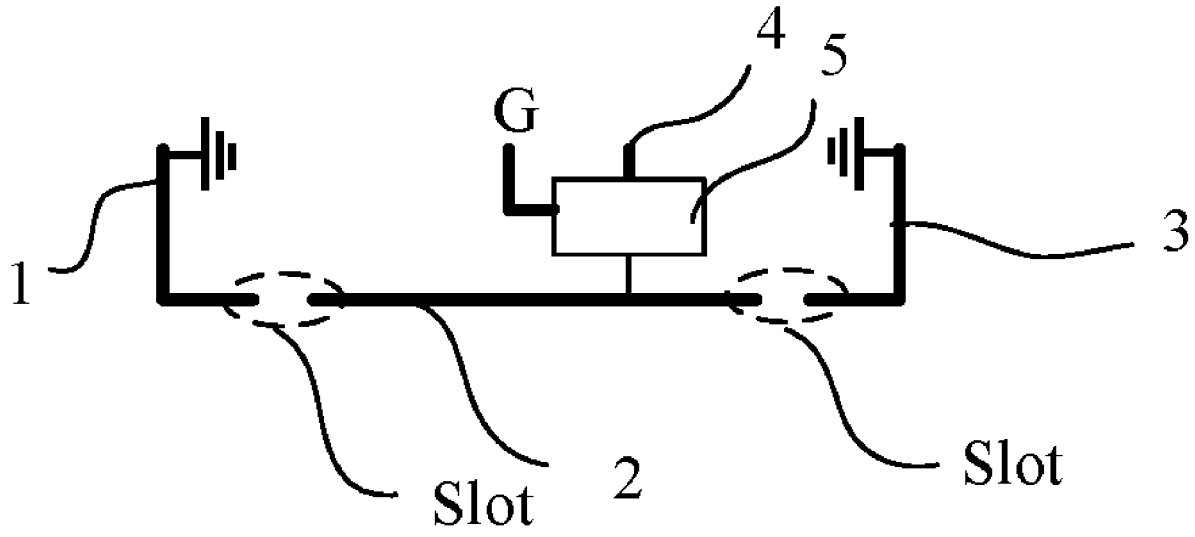
H01Q 1/24	(2006.01)
H01Q 5/378	(2006.01)
H01Q 5/371	(2006.01)
H01Q 9/04	(2006.01)
H01Q 1/48	(2006.01)
H01Q 1/50	(2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H01Q 5/378*** (2015.01); ***H01Q 1/50*** (2013.01); ***H01Q 9/045*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 5/371*** (2015.01)

(57) **ABSTRACT**

An antenna and a mobile terminal are provided. At least two slots are disposed in a metal bezel of the mobile terminal, and the two slots divide the metal bezel into three metal sections. A radiating element of the antenna includes a second metal section located between the two slots, a first conductor, and a second conductor. The first conductor and the second conductor are separately connected to the second metal section. A feed point is connected to the first conductor by using a matching network. A ground point is connected to the second conductor to form a loop antenna. An electrical length path of a current from the feed point to the second metal section is not equal to an electrical length path of a current from the ground point to the second metal section.



US 20200099126A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2020/0099126 A1**

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

MA et al.

(54) **ANTENNA ARRANGEMENT FOR AN ELECTRONIC DEVICE**

(71) Applicant: **MICROSOFT TECHNOLOGY LICENSING, LLC**, Redmond, WA (US)

(72) Inventors: **Guozhong MA**, Beijing (CN); **Anrong ZHANG**, Beijing (CN); **Jie ZHANG**, Beijing, WA (US); **Wei WANG**, Beijing, WA (US)

(21) Appl. No.: **16/696,445**

(22) Filed: **Nov. 26, 2019**

Related U.S. Application Data

(63) Continuation of application No. 15/751,149, filed on Feb. 7, 2018, now Pat. No. 10,498,013, filed as application No. PCT/US2016/042698 on Jul. 18, 2016.

(30) **Foreign Application Priority Data**

Aug. 7, 2015 (CN) 201510484994.3

Publication Classification

(51) **Int. Cl.**

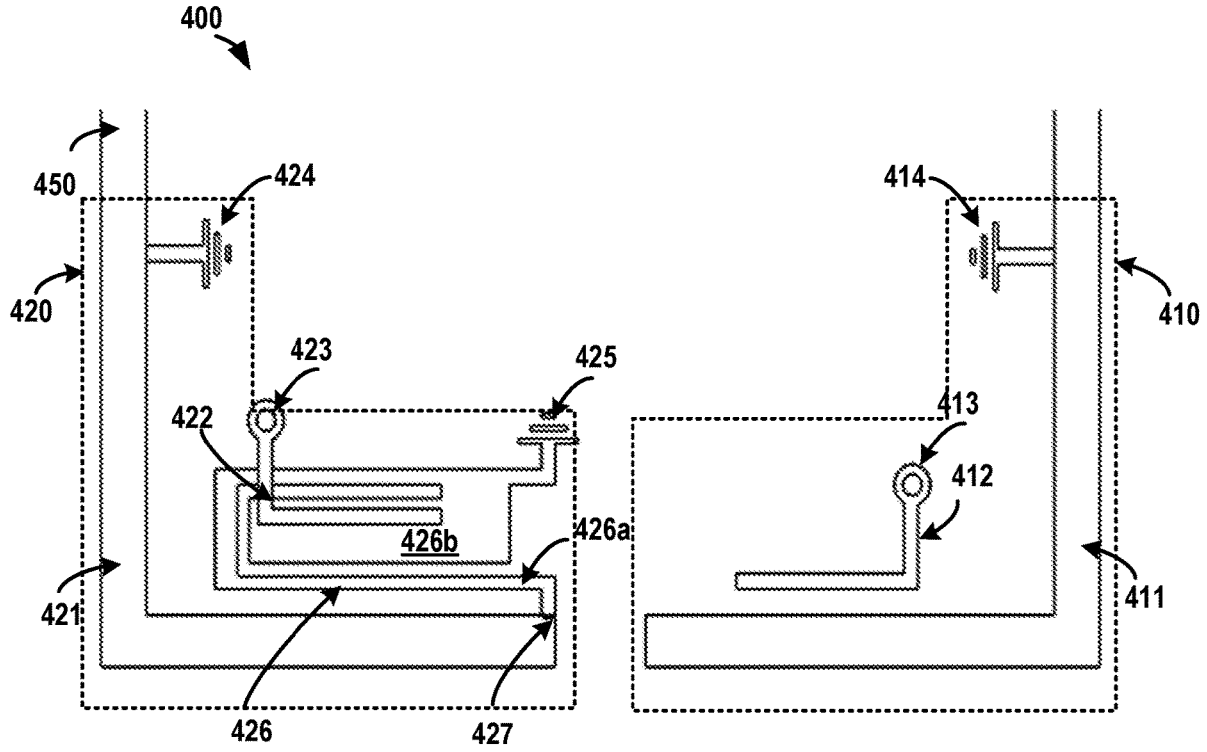
H01Q 1/24	(2006.01)
H01Q 1/48	(2006.01)
H01Q 1/52	(2006.01)
H01Q 21/00	(2006.01)
H01Q 9/42	(2006.01)
H01Q 21/28	(2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 1/523*** (2013.01); ***H01Q 21/28*** (2013.01); ***H01Q 21/0087*** (2013.01); ***H01Q 9/42*** (2013.01); ***H01Q 1/521*** (2013.01); ***H01Q 21/0075*** (2013.01)

(57) **ABSTRACT**

The subject matter described herein relates to an antenna arrangement, an electronic device and a method for manufacturing the antenna arrangement. In one implementation, the antenna arrangement comprises a first antenna and a second antenna. The first antenna includes a first metal section connected to a first grounding point and a first initial radiator for feeding first radiations to the first metal section. The second antenna includes a second metal section connected to a second grounding point and a second initial radiator for feeding second radiations to the second metal section. The first and second metal sections are integral parts of a housing of the electronic device and separated by an opening. The second metal section is further connected to a third grounding point to provide isolation between the two antennae. Thus, a pair of antennae with a good antenna performance can be built with the same one structure.



US 20200099138A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2020/0099138 A1**

Garrido Lopez et al. (43) **Pub. Date: Mar. 26, 2020**

(54) **ELECTRONIC DEVICE SLOT ANTENNAS**

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

(72) Inventors: **David Garrido Lopez**, Campbell, CA (US); **Harish Rajagopalan**, San Jose, CA (US); **Umar Azad**, Santa Clara, CA (US); **Rodney A. Gomez Angulo**, Santa Clara, CA (US)

(21) Appl. No.: **16/141,793**

(22) Filed: **Sep. 25, 2018**

Publication Classification

(51) **Int. Cl.**

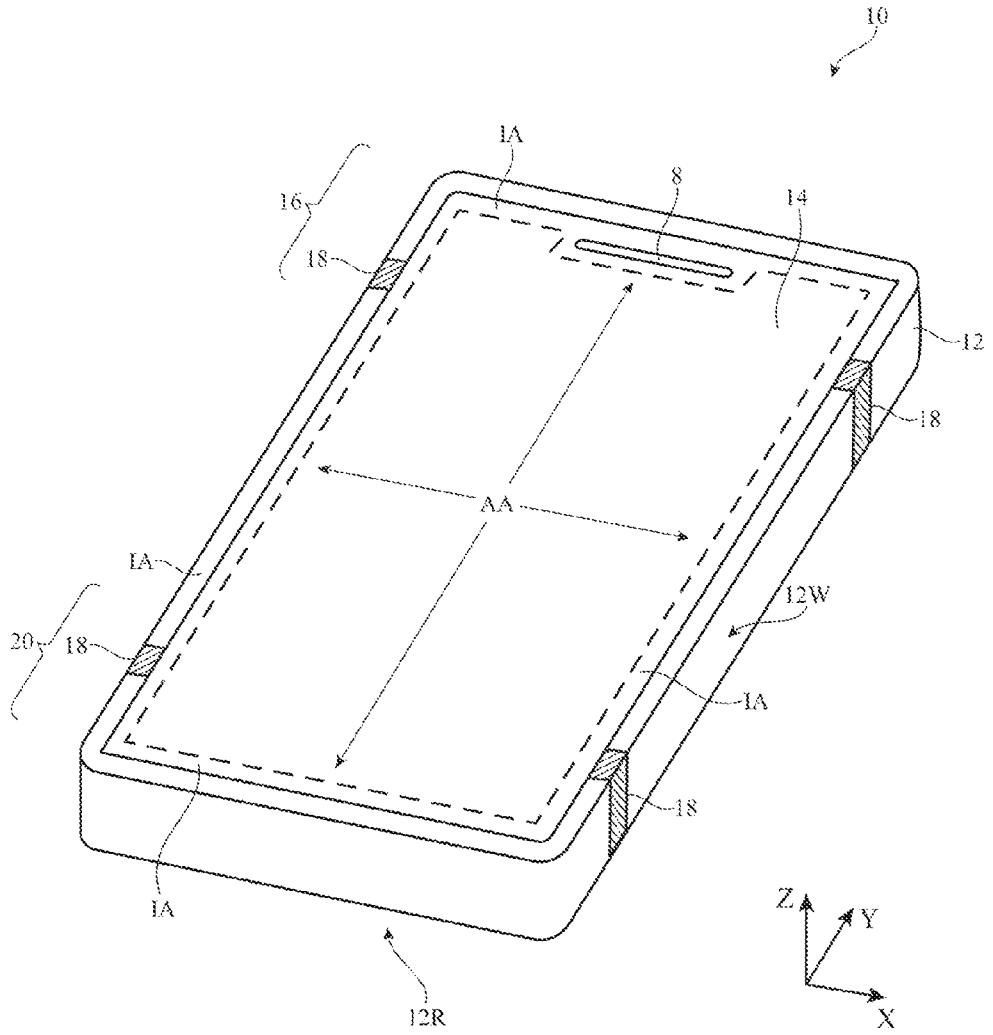
H01Q 13/10	(2006.01)
H01Q 1/24	(2006.01)
H01Q 21/30	(2006.01)
H01Q 9/42	(2006.01)
H01Q 21/28	(2006.01)
H01Q 9/04	(2006.01)

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

CPC ***H01Q 13/103*** (2013.01); ***H01Q 1/243*** (2013.01); ***H01Q 9/0407*** (2013.01); ***H01Q 9/42*** (2013.01); ***H01Q 21/28*** (2013.01); ***H01Q 21/30*** (2013.01)

(57) **ABSTRACT**

An electronic device may be provided an antenna, a display, and a housing. The display may include a conductive display structure and a cover layer. The housing may include peripheral conductive structures and a conductive rear wall. The peripheral structures may include a ledge separated from the conductive display structure by a gap. The peripheral structures and the rear wall may define opposing edges of a slot element for the antenna. Conductive bridging structures may be coupled between the conductive display structure and the ledge across the gap. The bridging structures may at least partially overlap locations along the length of the slot element where antenna currents around the slot element exhibit a maximum magnitude. The bridging structures may align the phase of current induced on the ledge with the phase of the current induced on the conductive display structure to maximize antenna efficiency through the cover layer.



US 20200106155A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2020/0106155 A1**

Huang et al. (43) **Pub. Date: Apr. 2, 2020**

(54) **BACK COVER FOR ELECTRONIC DEVICE AND ELECTRONIC DEVICE**

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

(72) Inventors: **Shih-Ting Huang**, New Taipei City (TW); **Ching-Chi Lin**, New Taipei City (TW); **Chien-Wen Chen**, New Taipei City (TW); **Chuan-Chun Wang**, New Taipei City (TW)

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

(21) Appl. No.: **16/221,616**

(22) Filed: **Dec. 17, 2018**

(30) **Foreign Application Priority Data**

Sep. 27, 2018 (TW) 107134186

Publication Classification

(51) **Int. Cl.**

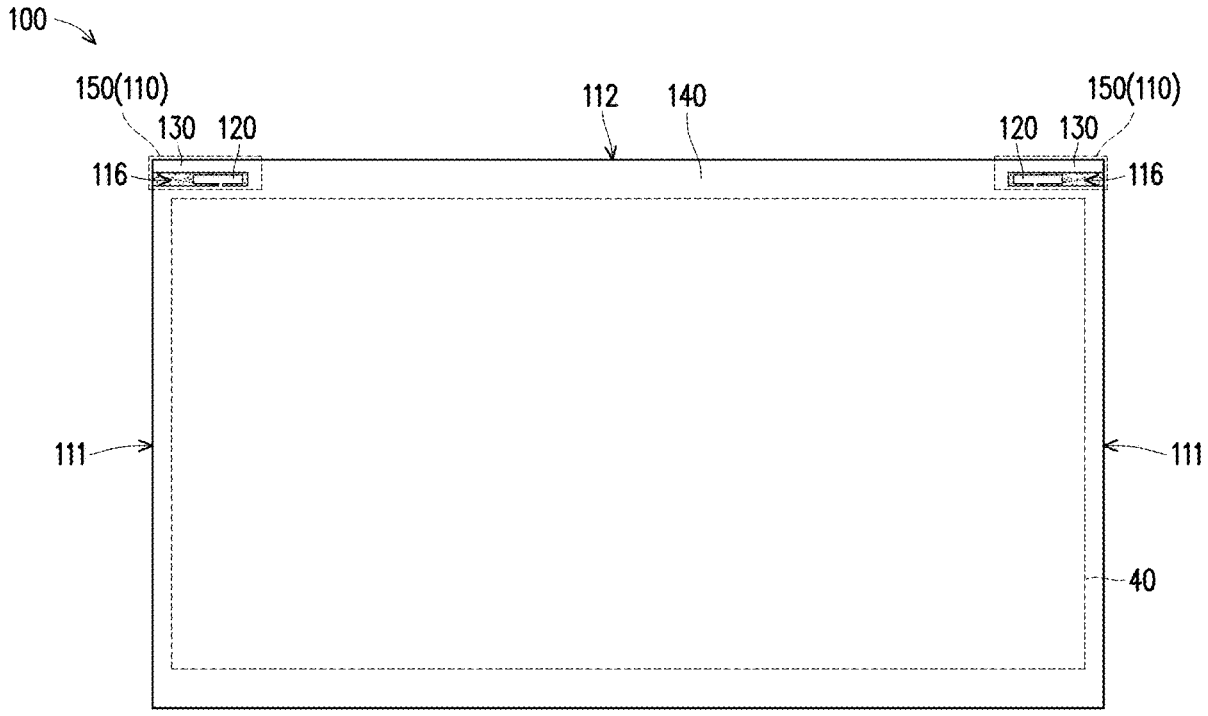
H01Q 1/22	(2006.01)
G06F 1/16	(2006.01)
H01Q 1/24	(2006.01)

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

CPC ***H01Q 1/2266*** (2013.01); *H01Q 5/30* (2015.01); ***H01Q 1/24*** (2013.01); ***G06F 1/1698*** (2013.01)

(57) **ABSTRACT**

A back cover includes a metal body having a first side, a second side, and a groove that is formed at the first side. The metal body further has a first radiator, a second radiator, and a ground radiator. The first radiator is disposed in the groove, and has a main portion and a support portion that cooperatively form a T-shape. The main portion includes a feeding end adjacent to a closed end of the groove. The second radiator is adjacently connected to the groove and is defined by the first and second sides, and an edge of the groove. The ground radiator is formed by a portion of the metal body excluding the first and second radiators. The second radiator and the support portion are connected to the ground radiator. The first and second radiators, and the ground radiator are serve as an antenna structure.



US 20200106157A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2020/0106157 A1**

TRAN (43) **Pub. Date: Apr. 2, 2020**

(54) **COMMON-RADIATOR MULTI-BAND ANTENNA SYSTEM**

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

(72) Inventor: **Allen Minh-Triet TRAN**, San Diego, CA (US)

(21) Appl. No.: **16/145,880**

(22) Filed: **Sep. 28, 2018**

Publication Classification

(51) **Int. Cl.**

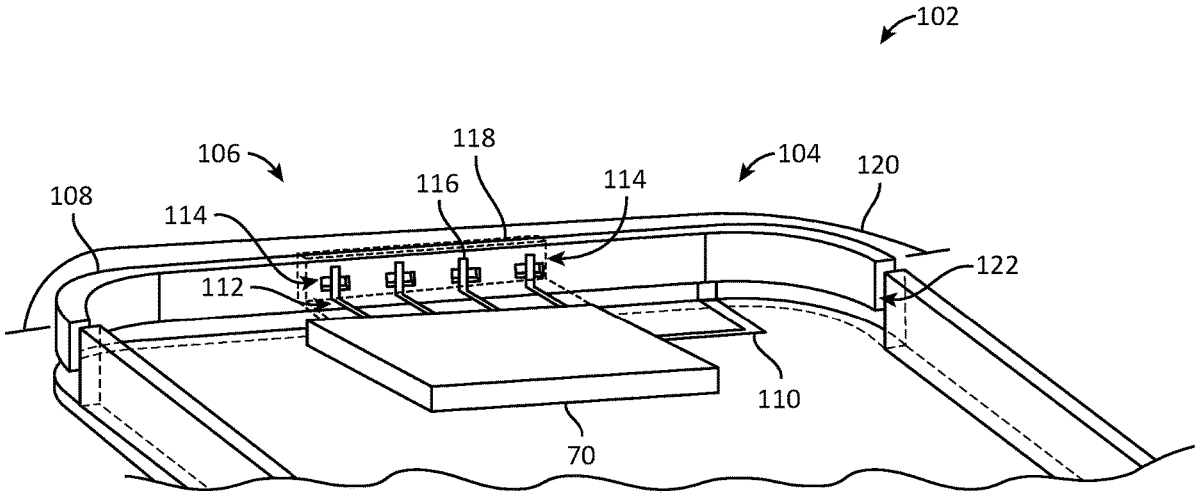
H01Q 1/24	(2006.01)
G06F 1/16	(2006.01)
H01Q 1/22	(2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H01Q 1/2291*** (2013.01); ***G06F 1/1698*** (2013.01)

(57) **ABSTRACT**

An example of a wireless communication antenna system includes: a sub-6 antenna including a radiator configured to radiate or receive first energy having a first frequency, the first frequency being below 6 GHz, the radiator being electrically conductive; a first feed configured and disposed to electrically couple the first energy to or from the radiator; and a second feed configured and disposed to electrically couple second energy to or from the radiator, the second energy having a second frequency, the second frequency being above 23 GHz; where the radiator is configured to radiate or receive the second energy.



US 20200106160A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2020/0106160 A1**

(43) **Pub. Date: Apr. 2, 2020**

CHEN et al.

(54) **ANTENNA STRUCTURE**

(71) Applicant: **Shenzhen Next Generation Communications Limited**, Shenzhen (CN)

(72) Inventors: **JIA CHEN**, Shenzhen (CN); **KUO-CHENG CHEN**, New Taipei (TW); **JIAN-WEI CHANG**, New Taipei (TW); **ZHEN-CHANG TANG**, Shenzhen (CN); **BO PENG**, Shenzhen (CN); **WEI-YU YE**, Shenzhen (CN); **CHUN-SHENG WU**, New Taipei (TW); **YI-LING JIANG**, Shenzhen (CN)

(21) Appl. No.: **16/571,476**

(22) Filed: **Sep. 16, 2019**

(30) **Foreign Application Priority Data**

Sep. 29, 2018 (CN) 201811150057.4

Publication Classification

(51) **Int. Cl.**

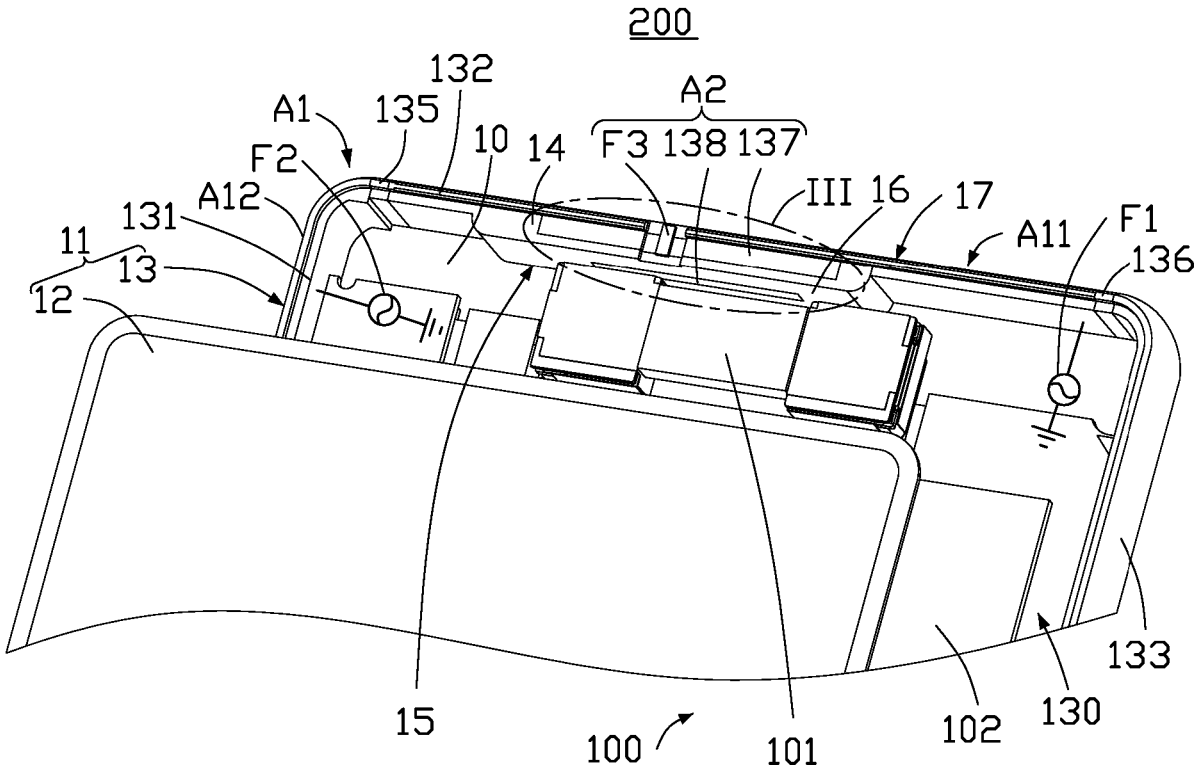
H01Q 1/24	(2006.01)
H01Q 1/36	(2006.01)
H01Q 5/328	(2006.01)
H01Q 5/10	(2006.01)
H01Q 9/04	(2006.01)
H01Q 9/40	(2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H01Q 1/36*** (2013.01); ***H01Q 9/40*** (2013.01); ***H01Q 5/10*** (2015.01); ***H01Q 9/0407*** (2013.01); ***H01Q 5/328*** (2015.01)

(57) **ABSTRACT**

An antenna structure includes a metal frame, at least one feed source, and a feed portion. The metal frame includes at least one radiating portion and at least one slot. The at least one slot is disposed in the at least one radiating portion or adjacent to the at least one radiating portion. The at least one feed source and the at least one radiating portion form a first antenna. The feed portion and the at least one slot form a second antenna. The at least one feed source supplies an electric current for the first antenna, thereby exciting a first working mode and generating a radiation signal in a first frequency band. The feed portion spans the at least one slot to supply the electric current for the second antenna, thereby exciting a second working mode and generating a radiation signal in a second frequency band.



US 20200106164A1

(19) **United States**

(12) **Patent Application Publication**

WANG et al.

(10) **Pub. No.: US 2020/0106164 A1**

(43) **Pub. Date: Apr. 2, 2020**

(54) **ELECTRONIC DEVICE**

(71) Applicant: **Lenovo (Beijing) Co., Ltd.**, Beijing (CN)

(72) Inventors: **Wei WANG**, Beijing (CN); **Jian REN**, Beijing (CN); **Zhiyuan DUAN**, Beijing (CN); **Shuangjie WU**, Beijing (CN)

(21) Appl. No.: **16/581,123**

(22) Filed: **Sep. 24, 2019**

(30) **Foreign Application Priority Data**

Sep. 30, 2018 (CN) 201811162946.2

Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

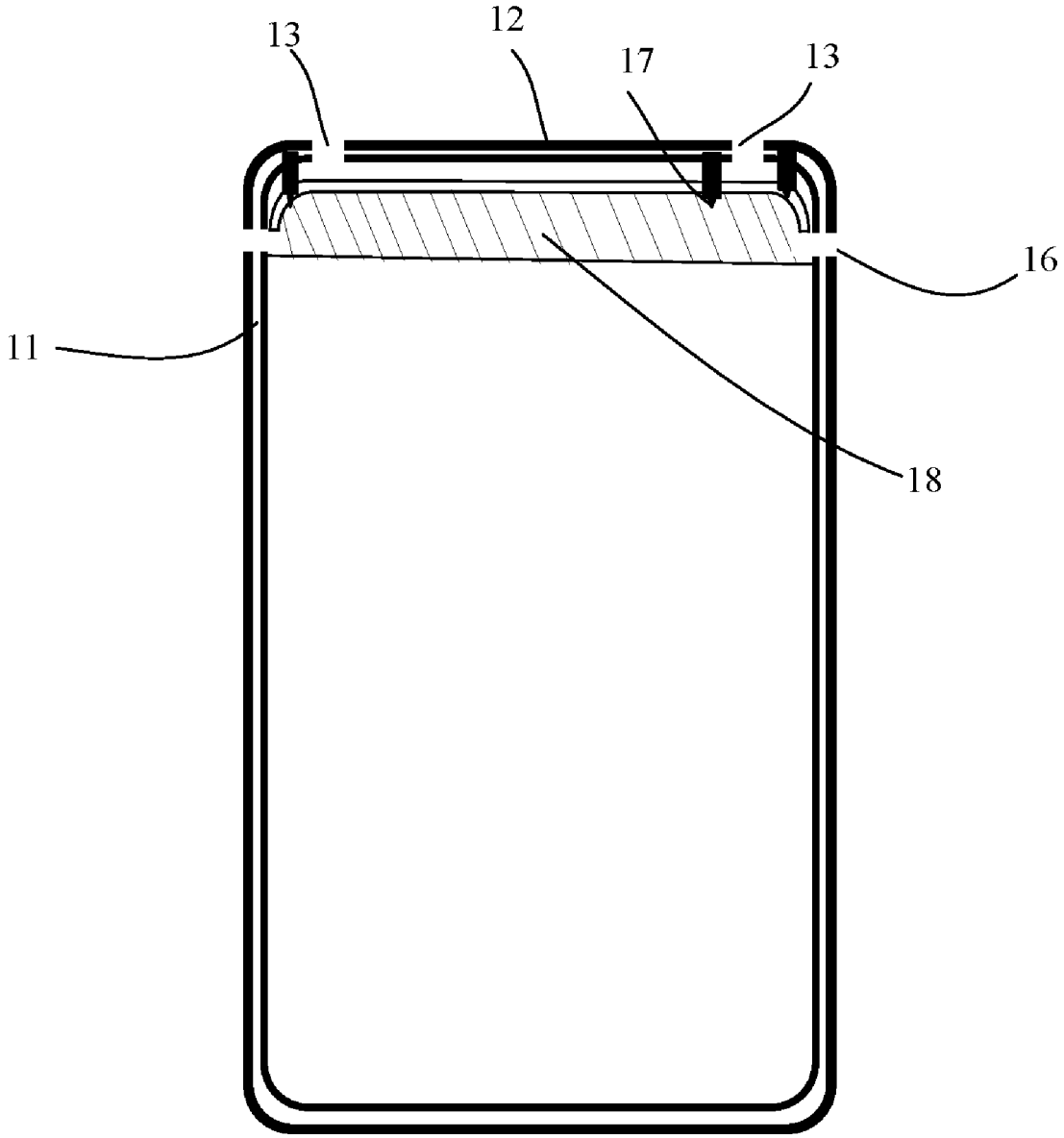
H04M 1/02 (2006.01)

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

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

(57) **ABSTRACT**

An electronic device is provided. The device includes a metal frame. The metal frame includes a first side and the first side includes three metal segments separated by two first gaps. The three metal segments include a first metal segment and the first metal segment is used to realize a first antenna. An operating frequency band of the first antenna at least includes 5 GHz to enable the electronic device to support a fifth-generation mobile communication network.



US 20200106165A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2020/0106165 A1**

WANG et al. (43) **Pub. Date: Apr. 2, 2020**

(54) **ELECTRONIC DEVICE**

(71) Applicant: **Lenovo (Beijing) Co., Ltd.**, Beijing (CN)

(72) Inventors: **Wei WANG**, Beijing (CN); **Jian REN**, Beijing (CN); **Zhiyuan DUAN**, Beijing (CN); **Shuangjie WU**, Beijing (CN)

(21) Appl. No.: **16/581,731**

(22) Filed: **Sep. 24, 2019**

(30) **Foreign Application Priority Data**

Sep. 30, 2018 (CN) 201811162945.8

Publication Classification

(51) **Int. Cl.**

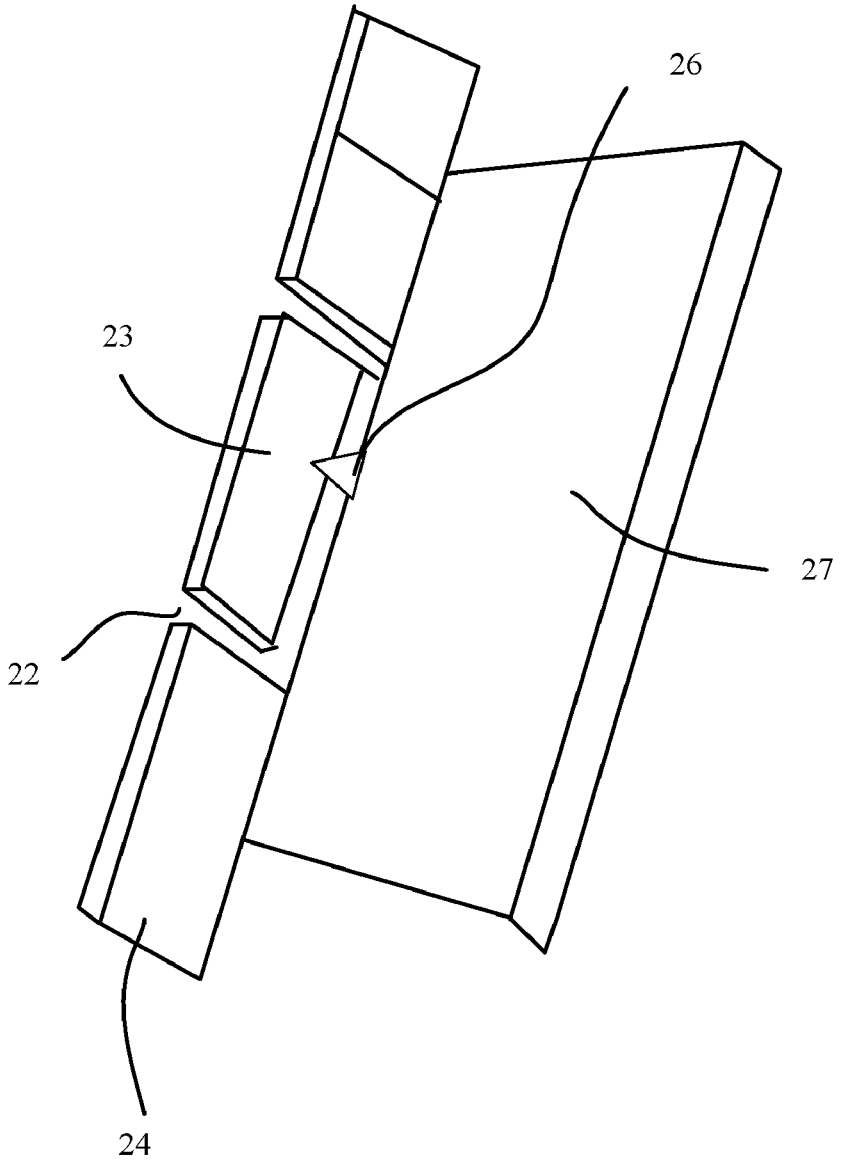
H01Q 1/24	(2006.01)
H01Q 21/06	(2006.01)
H01Q 5/50	(2006.01)
H01Q 13/10	(2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H01Q 13/10*** (2013.01); ***H01Q 5/50*** (2015.01); ***H01Q 21/064*** (2013.01)

(57) **ABSTRACT**

The present disclosure provides an electronic device including: a metal housing having four antenna slots, which correspond to four antennas that enable the electronic device to support a fifth generation mobile communication network. The present disclosure can realize antennas that enable an electronic device having a metal back housing to support a fifth generation mobile communication network.



US 20200106167A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2020/0106167 A1**

MOON et al. (43) **Pub. Date: Apr. 2, 2020**

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

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

(72) Inventors: **Heecheul MOON**, Suwon-si (KR); **Sangyoup SEOK**, Suwon-si (KR); **Kwonho SON**, Suwon-si (KR)

(21) Appl. No.: **16/591,552**

(22) Filed: **Oct. 2, 2019**

(30) **Foreign Application Priority Data**

Oct. 2, 2018 (KR) 10-2018-0117623

Publication Classification

(51) **Int. Cl.**

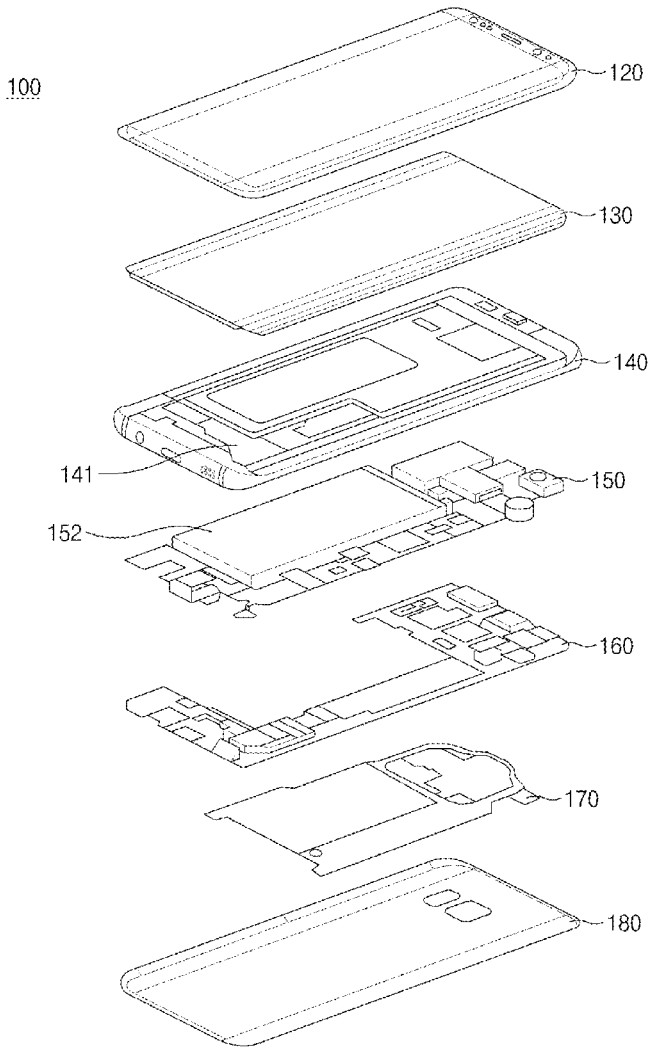
H01Q 1/24	(2006.01)
H01Q 23/00	(2006.01)
H01Q 9/16	(2006.01)
H04M 1/02	(2006.01)

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

CPC ***H01Q 1/243*** (2013.01); ***H04M 1/026*** (2013.01); ***H01Q 9/16*** (2013.01); ***H01Q 23/00*** (2013.01)

(57) **ABSTRACT**

An electronic device includes a housing that includes a front plate facing a first direction, a back plate facing a second direction opposite to the first direction, and a side member surrounding a space between the front plate and the back plate and at least a portion of which is formed of a metal material. A display is viewable through the front plate, and an antenna module is positioned in the space and includes a first surface facing a third direction different from the first direction and the second direction, a second surface facing a fourth direction different from the third direction, and at least one conductive element extended in a fifth direction, which is perpendicular to the third direction and the fourth direction and faces a first portion of the side member, adjacent to the side member, and between the first surface and the second surface.



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(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2020/0106177 A1**

Zhou et al. (43) **Pub. Date: Apr. 2, 2020**

(54) **ANTENNA AND MOBILE TERMINAL**

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(21) Appl. No.: **16/620,359**

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(2) Date: **Dec. 6, 2019**

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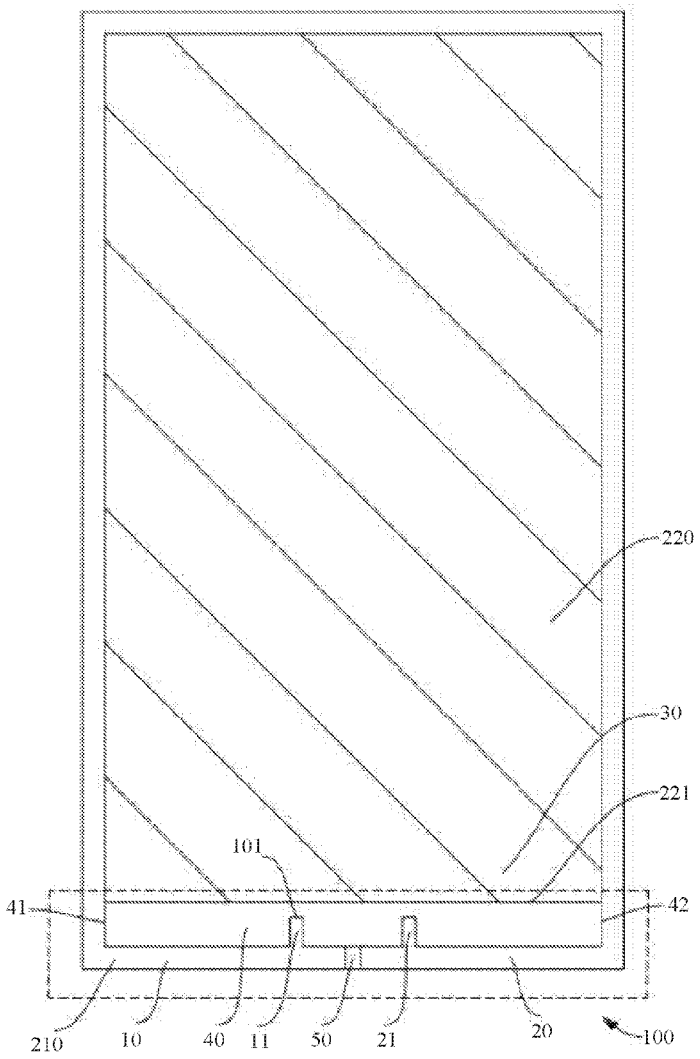
H01Q 1/48	(2006.01)

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

CPC ***H01Q 5/10*** (2015.01); ***H01Q 1/48*** (2013.01); ***H01Q 1/24*** (2013.01)

(57) **ABSTRACT**

This application relates to an antenna disposed on a mobile terminal. The mobile terminal includes a radiation portion and a circuit board, the circuit board includes a lateral side and a grounding layer, and an insulating slot divides the radiation portion into a feed stub and a parasitic stub. A gap is encompassed by the circuit board and the radiation portion. There is a first branch that extends from the feed stub to the gap for feeding the antenna, and there is a second branch that extends from the parasitic stub to the gap and that is electrically connected to a grounding portion. The antenna excites a current loop winding around the gap on the grounding portion, the feed stub, and the parasitic stub.



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(19) **United States**

(12) **Patent Application Publication**

CHOU

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(43) **Pub. Date: Apr. 2, 2020**

(54) **ANTENNA SYSTEM**

(71) Applicant: **Wistron Corp.**, New Taipei City (TW)

(72) Inventor: **Chen-Yu CHOU**, New Taipei City (TW)

(21) Appl. No.: **16/186,434**

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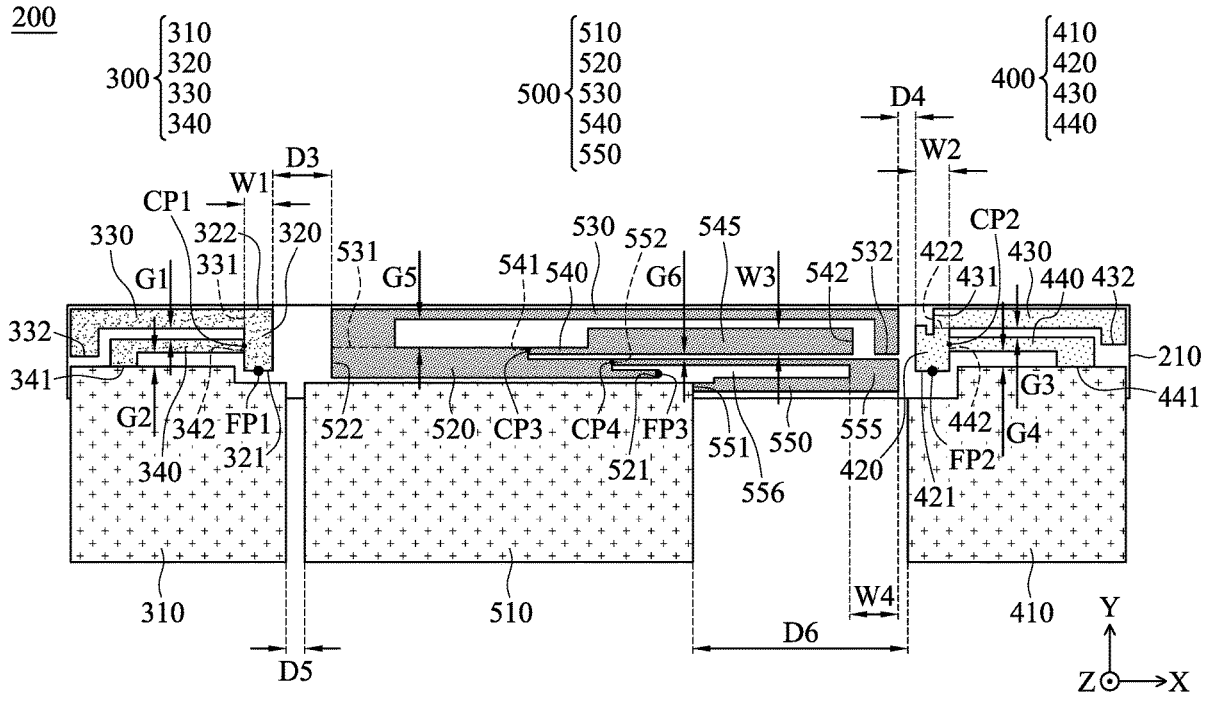
H01Q 1/24 (2006.01)
H01Q 1/22 (2006.01)
H01Q 21/00 (2006.01)

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

CPC ***H01Q 5/20*** (2015.01); ***H01Q 21/0006*** (2013.01); ***H01Q 1/2291*** (2013.01); ***H01Q 1/243*** (2013.01)

(57) **ABSTRACT**

An antenna system includes a first antenna, a second antenna, and a third antenna. The third antenna is disposed between the first antenna and the second antenna. Both the first antenna and the second antenna operate in a first frequency band. The third antenna operates in a second frequency band which is different from the first frequency band. The first antenna, the second antenna, and the third antenna are all disposed on the same plane.



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(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2020/0106181 A1**

Avser et al. (43) **Pub. Date: Apr. 2, 2020**

(54) **ELECTRONIC DEVICES HAVING ANTENNAS WITH SYMMETRIC FEEDING**

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

(72) Inventors: **Bilgehan Avser**, Mountain View, CA (US); **Jennifer M. Edwards**, San Francisco, CA (US); **Simone Paulotto**, Redwood City, CA (US); **Harish Rajagopalan**, San Jose, CA (US); **Hao Xu**, Cupertino, CA (US); **Rodney A. Gomez Angulo**, Santa Clara, CA (US); **Matthew A. Mow**, Los Altos, CA (US); **Mattia Pascolini**, San Francisco, CA (US)

(21) Appl. No.: **16/146,705**

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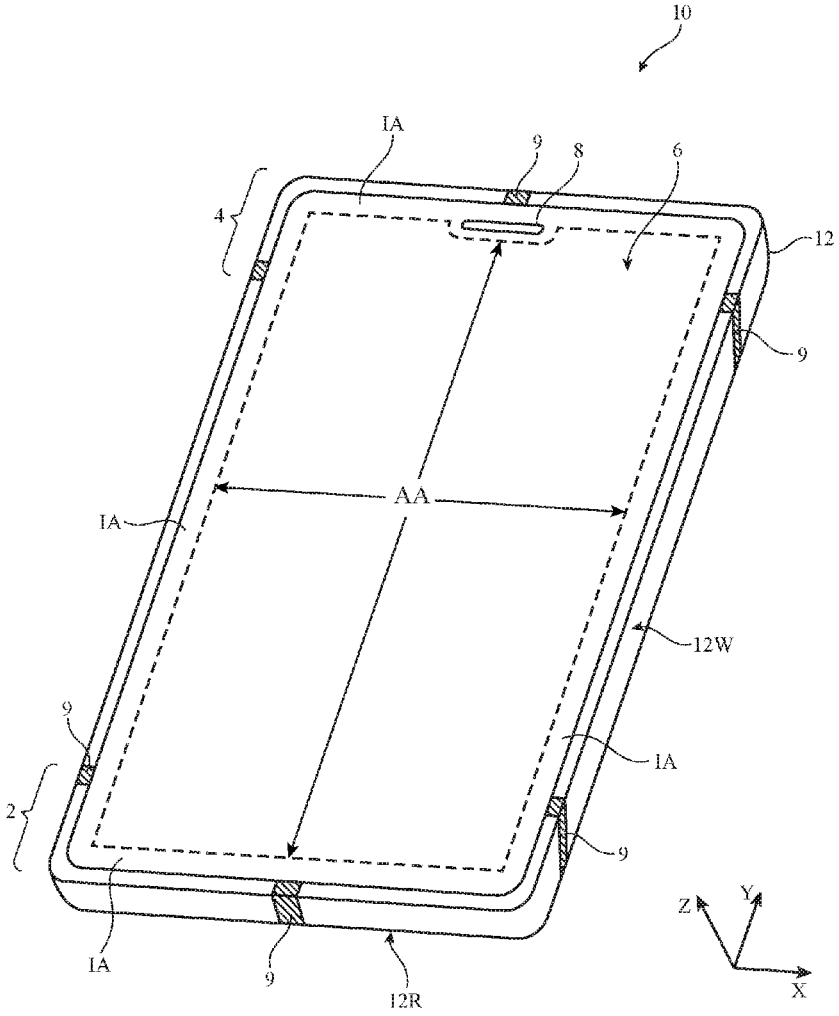
H01Q 21/06	(2006.01)

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

CPC ***H01Q 9/045*** (2013.01); ***H01Q 21/065*** (2013.01); ***H01Q 1/24*** (2013.01)

(57) **ABSTRACT**

An electronic device may be provided with a phased antenna array. Each antenna in the array may include a patch element having first, second, third, and fourth positive antenna feed terminals. The first and second terminals may convey first signals with a first polarization. The third and fourth terminals may convey second signals with a second polarization. Phase shifting components such as phase shifting transmission line segments or phase shifter circuits may ensure that the first signals at the first terminal are out of phase with respect to the first signals at the second terminal and may ensure that the second signals at the third terminal are out of phase with respect to the second signals at the fourth terminal. This may allow antenna current density for both polarizations to be symmetrically distributed about a normal axis of the patch element.



US 20200106184A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2020/0106184 A1**

FABREGA SANCHEZ et al. (43) **Pub. Date: Apr. 2, 2020**

(54) **WIDE-BAND DIPOLE ANTENNA**

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

(72) Inventors: **Jorge FABREGA SANCHEZ**, San Diego, CA (US); **Mohammad Ali TASSOUDJI**, San Diego, CA (US)

(21) Appl. No.: **16/146,742**

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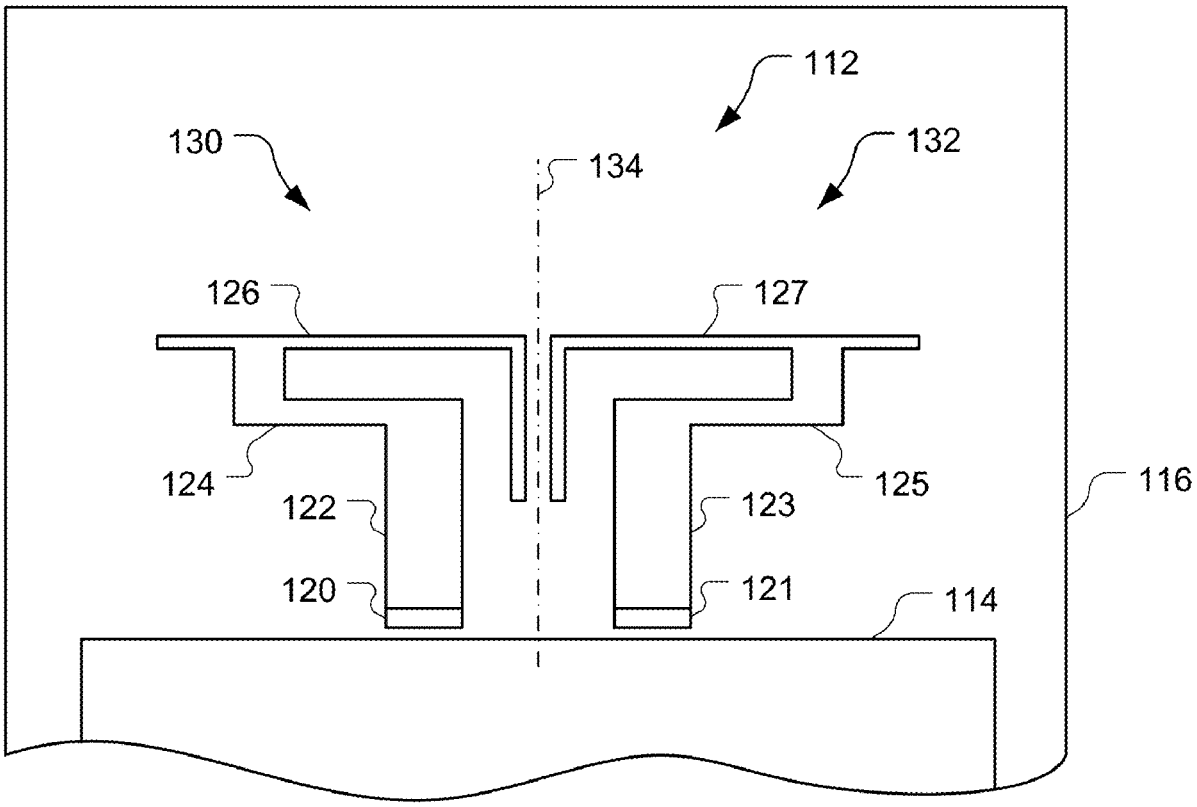
H01Q 1/38	(2006.01)
H01Q 5/364	(2006.01)
H01Q 21/06	(2006.01)

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

CPC ***H01Q 9/26*** (2013.01); ***H01Q 1/243*** (2013.01); ***H01Q 21/062*** (2013.01); ***H01Q 5/364*** (2015.01); ***H01Q 1/38*** (2013.01)

(57) **ABSTRACT**

A millimeter-wave antenna system includes: a ground plane; and a folded dipole radiator including: a plurality of feeds each extending away from the ground plane from a proximal feed end to a distal end; a plurality of radiating arms each coupled to and extending away from the distal feed end of a respective one of the plurality of feeds; and a plurality of folded conductors each coupled to a respective one of the plurality of radiating arms and each having a distal portion extending toward the ground plane to a distal conductor end; where each of the plurality of feeds and each of the plurality of radiating arms comprises an electrical conductor; and where the folded dipole radiator is discontinuous, without a conductive connection between the plurality of feeds via the plurality of radiating arms.



US 20200106185A1

(19) United States

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Paulotto et al. (43) Pub. Date: Apr. 2, 2020

(54) ELECTRONIC DEVICES HAVING ANTENNA MODULE ISOLATION STRUCTURES

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

(72) Inventors: **Simone Paulotto**, Redwood City, CA (US); **Qishan Yu**, San Jose, CA (US); **Harish Rajagopalan**, San Jose, CA (US); **Berke Cetinoneri**, Santa Clara, CA (US)

(21) Appl. No.: **16/146,488**

(22) Filed: **Sep. 28, 2018**

Publication Classification

(51) **Int. Cl.**

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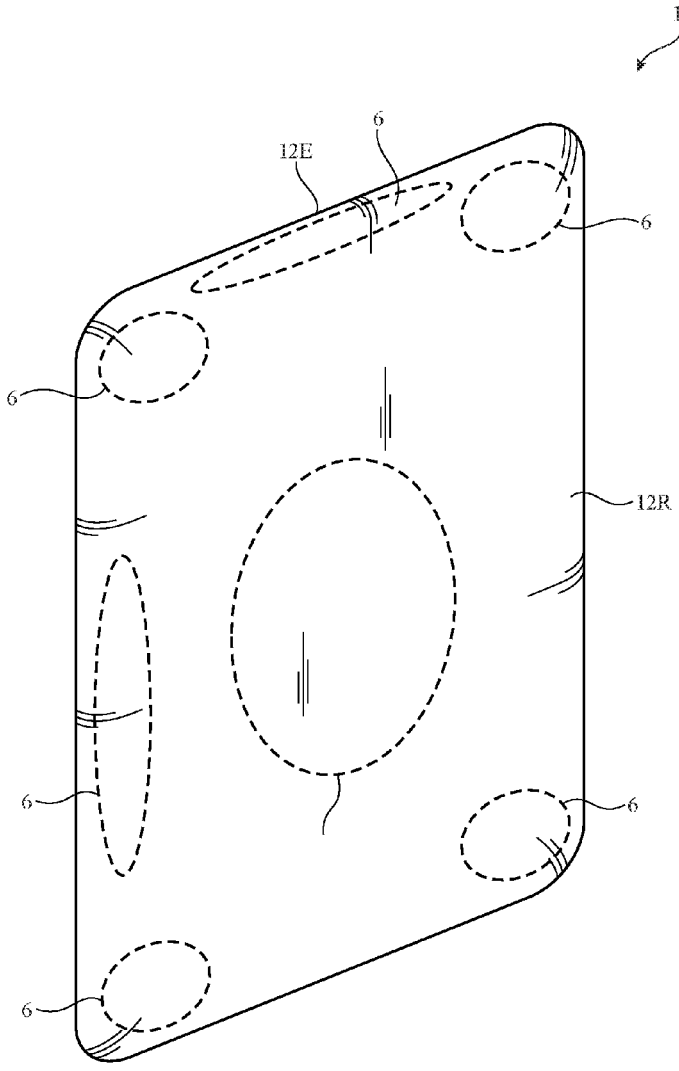
H01Q 1/38	(2006.01)
H01Q 3/44	(2006.01)

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

CPC ***H01Q 11/14*** (2013.01); ***H01Q 3/443*** (2013.01); ***H01Q 1/38*** (2013.01); ***H01Q 1/422*** (2013.01)

(57) **ABSTRACT**

An electronic device may be provided with a phased antenna array controlled by phase and magnitude controllers within an integrated circuit. The array may be formed on antenna layers and the integrated circuit may be mounted to transmission line layers of a dielectric substrate. A ground plane may separate the transmission line layers from the antenna layers. A connector may be mounted to the surface of the transmission line layers and may be coupled to the integrated circuit using conductive traces. A passive resonator may be formed in the antenna layers and may include conductive structures that resonate at one-quarter of the effective wavelength of operation of the array to form an open circuit impedance for surface currents generated on the ground plane by the array. This may serve to block the surface currents from scattering at an edge of the ground plane and leaking onto the integrated circuit.



US 20200106192A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2020/0106192 A1**

Avser et al. (43) **Pub. Date: Apr. 2, 2020**

(54) **ELECTRONIC DEVICE HAVING DUAL-BAND ANTENNAS MOUNTED AGAINST A DIELECTRIC LAYER**

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

(72) Inventors: **Bilgehan Avser**, Mountain View, CA (US); **Harish Rajagopalan**, San Jose, CA (US); **Simone Paulotto**, Redwood City, CA (US); **Jennifer M. Edwards**, San Francisco, CA (US); **Hao Xu**, Cupertino, CA (US); **Rodney A. Gomez Angulo**, Santa Clara, CA (US); **Matthew A. Mow**, Los Altos, CA (US); **Mattia Pascolini**, San Francisco, CA (US)

(21) Appl. No.: **16/146,649**

(22) Filed: **Sep. 28, 2018**

Publication Classification

(51) **Int. Cl.**

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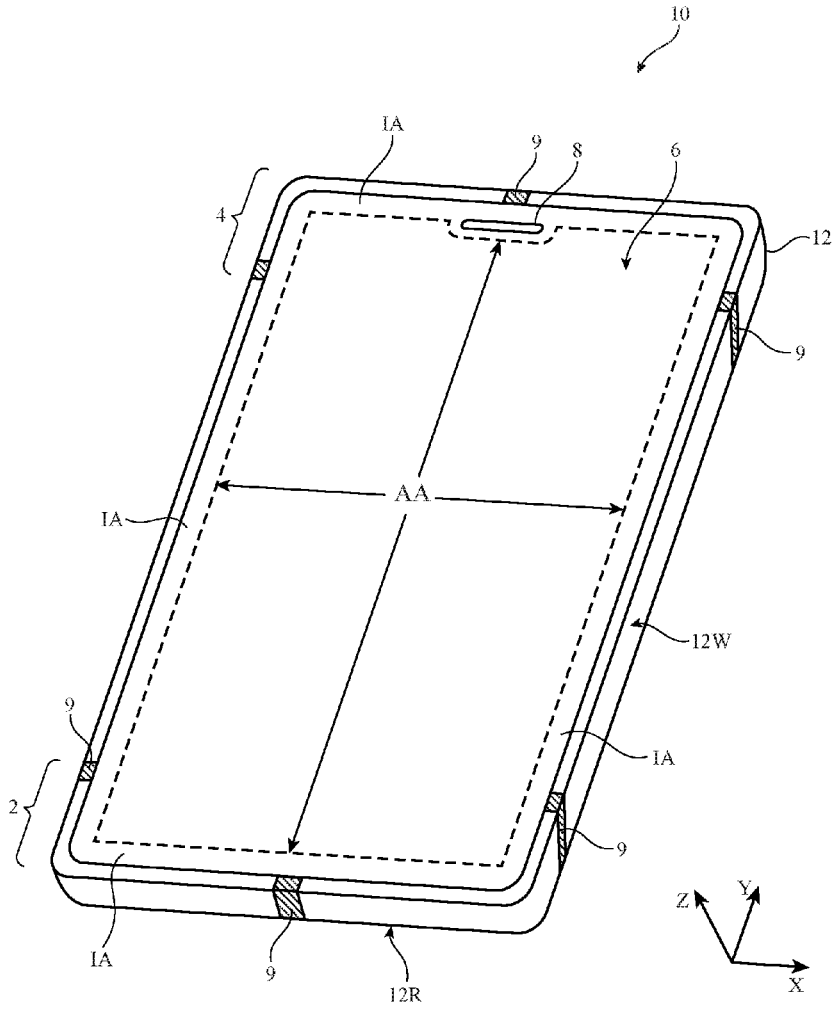
H01Q 1/38	(2006.01)

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

CPC ***H01Q 21/065*** (2013.01); ***H01Q 21/064*** (2013.01); ***H01Q 1/38*** (2013.01); ***H01Q 5/357*** (2015.01); ***H01Q 5/28*** (2015.01)

(57) **ABSTRACT**

An electronic device may be provided with a cover layer and a phased antenna array mounted against the cover layer. Each antenna in the array may include a first patch element that is directly fed using first and second feeds and a second patch element that is directly fed using third and fourth feeds. A slot element may be formed in the first patch element. The first patch element may radiate in a first frequency band through the cover layer. The slot element may radiate in a second frequency band that is higher than the first frequency band through the cover layer. The second patch element may indirectly feed the slot element. Locating the radiating elements for each frequency band in the same plane may allow the antenna to radiate through the cover layer in both frequency bands with satisfactory antenna efficiency.



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(19) **United States**

(12) **Patent Application Publication**

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(43) **Pub. Date: Apr. 9, 2020**

WU et al.

(54) **ANTENNA MODULE AND COMMUNICATION DEVICE**

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

(72) Inventors: **Chien-Yi WU**, TAIPEI CITY (TW); **Cheng-Hsiung WU**, TAIPEI CITY (TW); **Chao-Hsu WU**, TAIPEI CITY (TW); **Ching-Hsiang KO**, TAIPEI CITY (TW); **Shih-Keng HUANG**, TAIPEI CITY (TW); **Yu-Yi CHU**, TAIPEI CITY (TW)

(21) Appl. No.: **16/502,209**

(22) Filed: **Jul. 3, 2019**

(30) **Foreign Application Priority Data**

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H01Q 5/357	(2006.01)
H01Q 5/50	(2006.01)

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

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(57) **ABSTRACT**

An antenna module includes a metal board, an inverted F metal plate and an antenna unit. A slot is provided between the inverted F metal plate and the metal board, the inverted F metal plate and the metal board are integrally formed, and the inverted F metal plate is disposed perpendicular to the metal board. The antenna unit is disposed corresponding to the slot and the inverted F metal plate, and includes a radiation part and a ground part. The radiation part is coupled to a signal feeding point and includes a first radiation body and a second radiation body. The first radiation body, the slot and the inverted F metal plate operate cooperatively to generate a wireless signal at a first operating frequency. The second radiation body, the slot and the inverted F metal plate operate cooperatively to generate a wireless signal at a second operating frequency.