



(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2023/0378631 A1**

LEE et al.

(43) **Pub. Date: Nov. 23, 2023**

(54) **SELF-ALIGNING MAGNETIC ANTENNA FEED CONNECTION**

(57) **ABSTRACT**

(71) Applicant: **Microsoft Technology Licensing, LLC**, Redmond, WA (US)

An electronic communication device communicates a radiofrequency communication signal between wireless communication circuitry and an antenna structure. The antenna structure may be mounted on a first component support structure and configured to communicate wireless radiofrequency signals. A first connector may be connected to the antenna structure. A second component support structure may be mechanically coupled to the first component support structure and capable of movement with respect to the first component support structure. Wireless communication circuitry may be mounted on the second component support structure configured to communicate with the antenna structure using radiofrequency carrier signals. A second connector may be connected to the wireless communication circuitry. The first connector and the second connector may be mechanically connected and resiliently aligned by magnetic attraction therebetween and communicatively coupled to communicate the radiofrequency carrier signal between the wireless communication circuitry and the antenna structure.

(72) Inventors: **Jaejin LEE**, Beaverton, OR (US); **Marc HARPER**, Snohomish, WA (US)

(21) Appl. No.: **17/748,135**

(22) Filed: **May 19, 2022**

Publication Classification

(51) **Int. Cl.**

H01Q 1/12 (2006.01)

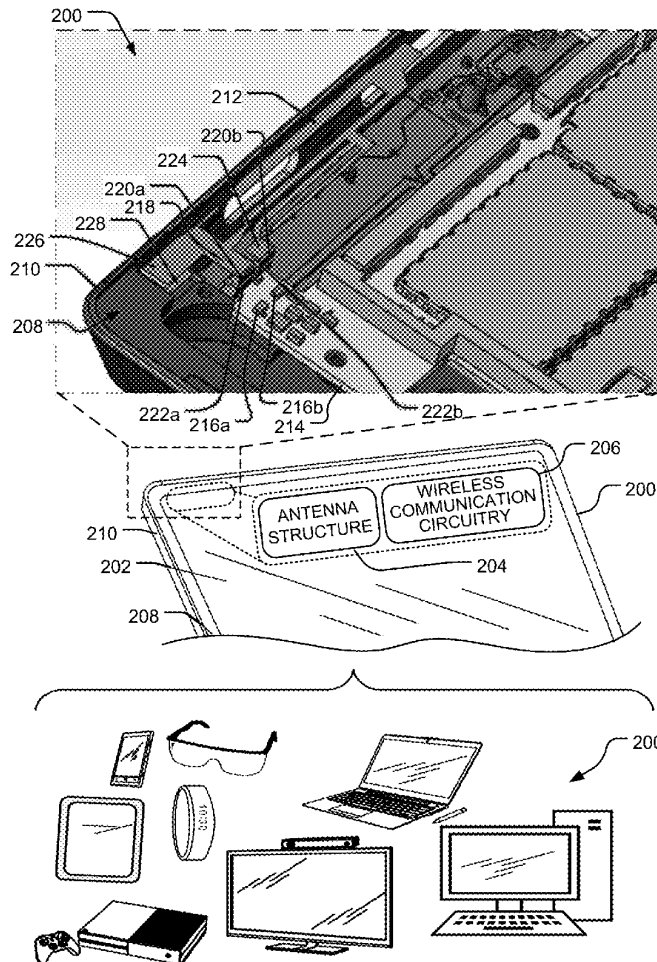
H01Q 1/24 (2006.01)

H01Q 21/28 (2006.01)

H01Q 9/04 (2006.01)

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

CPC **H01Q 1/1207** (2013.01); **H01Q 1/241** (2013.01); **H01Q 21/28** (2013.01); **H01Q 9/0414** (2013.01)





US 20230378635A1

(19) **United States**

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

(10) **Pub. No.: US 2023/0378635 A1**

(43) **Pub. Date: Nov. 23, 2023**

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

(52) **U.S. Cl.**
CPC **H01Q 1/2283** (2013.01); **H01Q 1/38** (2013.01); **H01Q 1/50** (2013.01)

(71) Applicant: **WISTRON NEWEB CORPORATION, HSINCHU (TW)**

(57) **ABSTRACT**

(72) Inventors: **LI-KAI KUO, HSINCHU (TW); CHUN-HSIANG CHUANG, HSINCHU (TW); RI-CHANG WANG, HSINCHU (TW)**

An antenna module and an electronic device including the antenna module are provided. The antenna module includes a radiating element, a first inductive element, a first capacitive element, a first feeding radiating element and a second feeding radiating element. The radiating element includes a first radiating branch, a second radiating branch and a third radiating branch, and the third radiating branch is connected between the first and second radiating branches. The first inductive element is connected between the second radiating branch and the third radiating branch. One end of the first capacitive element connected to the third radiating branch, and another end thereof is grounded. The first feeding radiation element is adjacent to the first radiating branch. The second feeding radiation element is adjacent to the second radiating branch. The first feeding radiation element and the first radiating branch are used to generate the first operating frequency band.

(21) Appl. No.: **18/066,376**

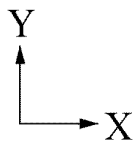
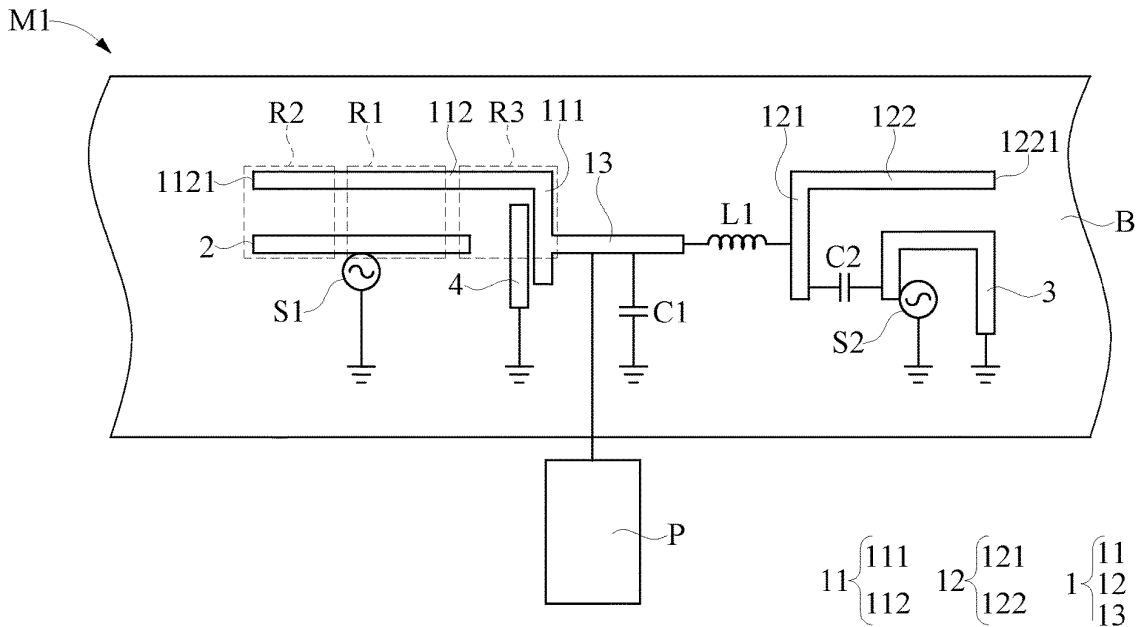
(22) Filed: **Dec. 15, 2022**

(30) **Foreign Application Priority Data**

May 18, 2022 (TW) 111118488

Publication Classification

(51) **Int. Cl.**
H01Q 1/22 (2006.01)
H01Q 1/38 (2006.01)
H01Q 1/50 (2006.01)





US 20230378654A1

(19) **United States**

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

(10) **Pub. No.: US 2023/0378654 A1**

(43) **Pub. Date: Nov. 23, 2023**

(54) **MULTI-FEED ANTENNA ARRANGEMENT FOR ELECTRONIC APPARATUS**

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

(72) Inventors: **Janne Iivonen**, Helsinki (FI); **Rasmus Luomaniemi**, Espoo (FI); **Anu Lehtovuori**, Espoo (FI); **Ville Viikari**, Espoo (FI); **Alexander Khripkov**, Helsinki (FI); **Joonas Krogerus**, Helsinki (FI); **Riku Kormilainen**, Espoo (FI)

(21) Appl. No.: **18/362,577**

(22) Filed: **Jul. 31, 2023**

Related U.S. Application Data

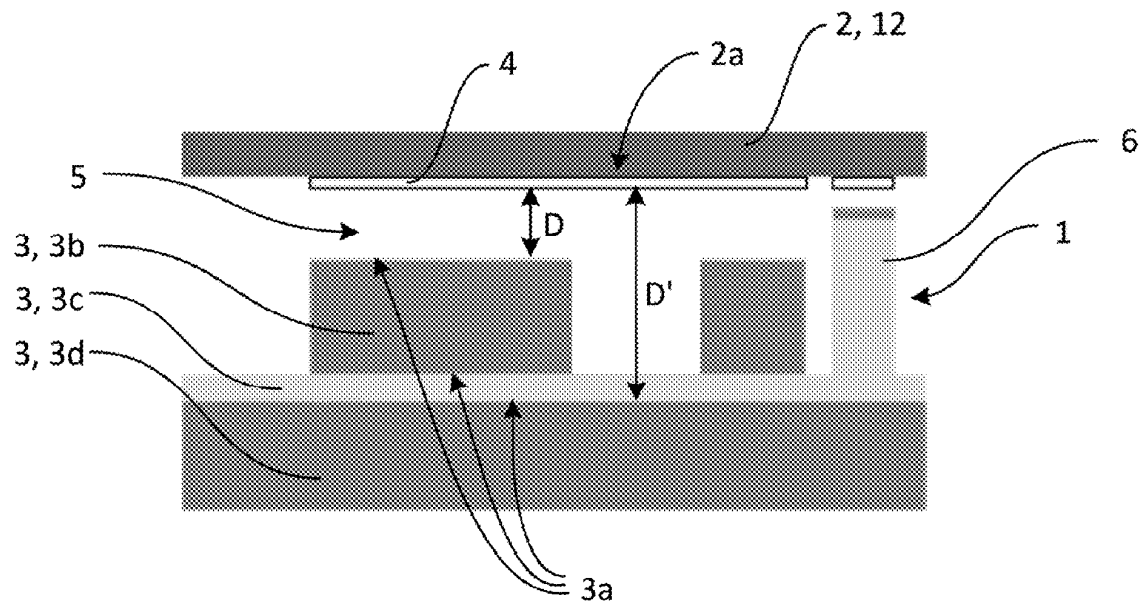
(63) Continuation of application No. PCT/EP2021/052058, filed on Jan. 29, 2021.

Publication Classification

(51) **Int. Cl.**
H01Q 9/04 (2006.01)
H01Q 1/50 (2006.01)
H01Q 1/24 (2006.01)
(52) **U.S. Cl.**
CPC **H01Q 9/045** (2013.01); **H01Q 1/50** (2013.01); **H01Q 9/0442** (2013.01); **H01Q 1/243** (2013.01)

(57) **ABSTRACT**

An antenna arrangement comprising a dielectric element, at least one conductive element, an antenna radiator, and a plurality of exciter elements. The antenna radiator arranged at a first surface of the dielectric element and at a distance from the conductive element such that a gap is formed between the antenna radiator and a first surface of the conductive element. The exciter elements extend at least partially through a gap and are arranged on or adjacent to the conductive element. The antenna radiator may comprise a conductive material and be printed, sintered, painted, laminated, or deposited onto the first surface of the dielectric element, or molded into the dielectric element.





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(19) **United States**

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

(10) **Pub. No.: US 2023/0387571 A1**

(43) **Pub. Date: Nov. 30, 2023**

(54) **ELECTRONIC DEVICE**

Publication Classification

(71) Applicant: **Panasonic Intellectual Property Management Co., Ltd., Osaka (JP)**

(51) **Int. Cl.**
H01Q 1/22 (2006.01)
H01Q 1/38 (2006.01)
G06F 1/16 (2006.01)

(72) Inventors: **Riho FUKAGAWA, Osaka (JP); Junichi HASEGAWA, Osaka (JP); Junpei KOHARA, Osaka (JP); Hiroki KAMEZAKI, Osaka (JP); Koki YAMAMOTO, Osaka (JP); Kyota YAMAMOTO, Osaka (JP)**

(52) **U.S. Cl.**
CPC *H01Q 1/2266* (2013.01); *H01Q 1/38* (2013.01); *G06F 1/1698* (2013.01)

(73) Assignee: **Panasonic Intellectual Property Management Co., Ltd., Osaka (JP)**

(57) **ABSTRACT**

(21) Appl. No.: **18/231,813**

An electronic device includes a first housing including a display unit, and a second housing that includes an input unit and an antenna unit, is rotatably connected to the first housing via a connection part, and is made of a metal material. The first housing includes a support plate that constitutes a back surface of the first housing, supports the display, and is made of a metal material, and a communication path member that is provided on the support plate and is made of a resin material. The communication path member is disposed in a region facing at least a part of the antenna unit of the second housing in a closed state where the first housing and the second housing are disposed to face each other.

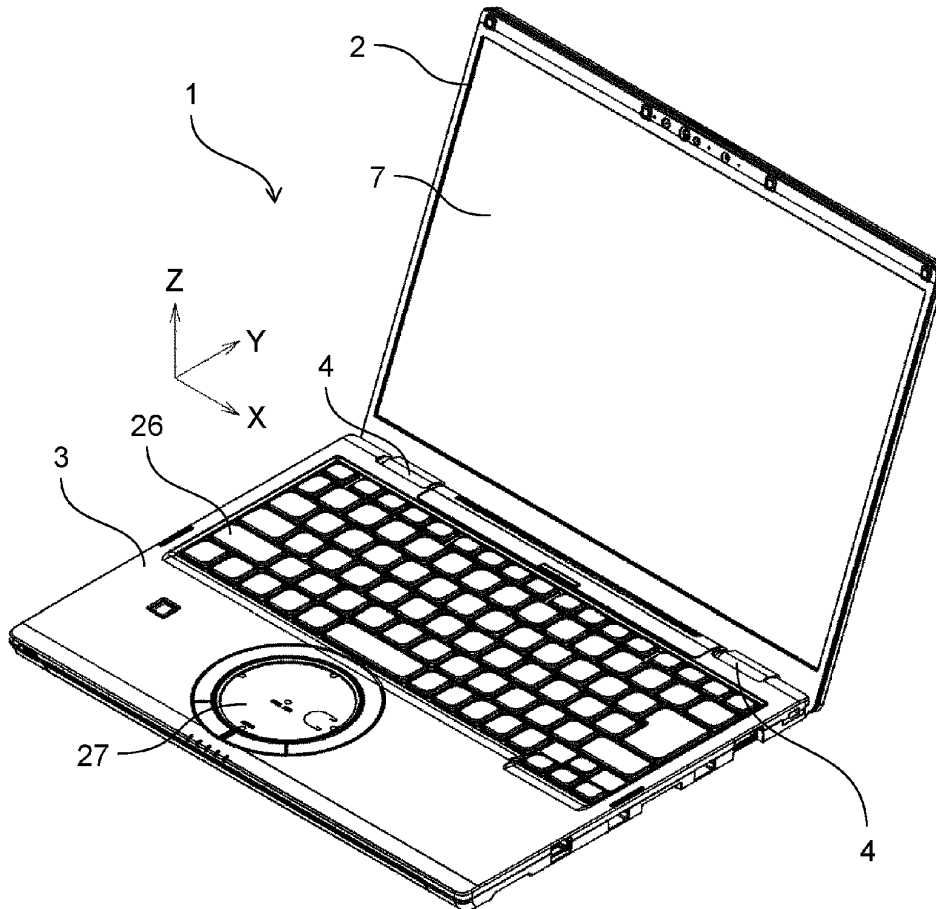
(22) Filed: **Aug. 9, 2023**

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2022/002321, filed on Jan. 24, 2022.

(30) **Foreign Application Priority Data**

Feb. 26, 2021 (JP) 2021-029941





US 20230387594A1

(19) **United States**

(12) **Patent Application Publication**
WU

(10) **Pub. No.: US 2023/0387594 A1**

(43) **Pub. Date: Nov. 30, 2023**

(54) **ANTENNA ASSEMBLY AND ELECTRONIC DEVICE**

Publication Classification

(71) Applicant: **GUANGDONG OPPO MOBILE TELECOMMUNICATIONS CORP., LTD.**, Dongguan (CN)

(51) **Int. Cl.**
H01Q 5/50 (2006.01)
H01Q 5/335 (2006.01)
H04B 1/04 (2006.01)

(72) Inventor: **Xiaopu WU**, Dongguan (CN)

(52) **U.S. Cl.**
CPC *H01Q 5/50* (2015.01); *H01Q 5/335* (2015.01); *H04B 1/0458* (2013.01)

(73) Assignee: **GUANGDONG OPPO MOBILE TELECOMMUNICATIONS CORP., LTD.**, Dongguan (CN)

(57) **ABSTRACT**

An antenna assembly includes a radiator, a first matching circuit and a signal source. The radiator includes a first sub-radiator and a second sub-radiator, wherein a coupling gap is present between the first sub-radiator and the second sub-radiator, and the first sub-radiator and the second sub-radiator are coupled to each other by means of the coupling gap; the first sub-radiator includes a free end, a first coupling end, and a grounding point and a feeding point, which are arranged between the free end and the first coupling end, the grounding point is grounded, and the feeding point is located between the grounding point and the first coupling end; and the second sub-radiator includes a second coupling end and a grounding end, a coupling gap is present between the first coupling end and the second coupling end, and the grounding end is grounded.

(21) Appl. No.: **18/446,163**

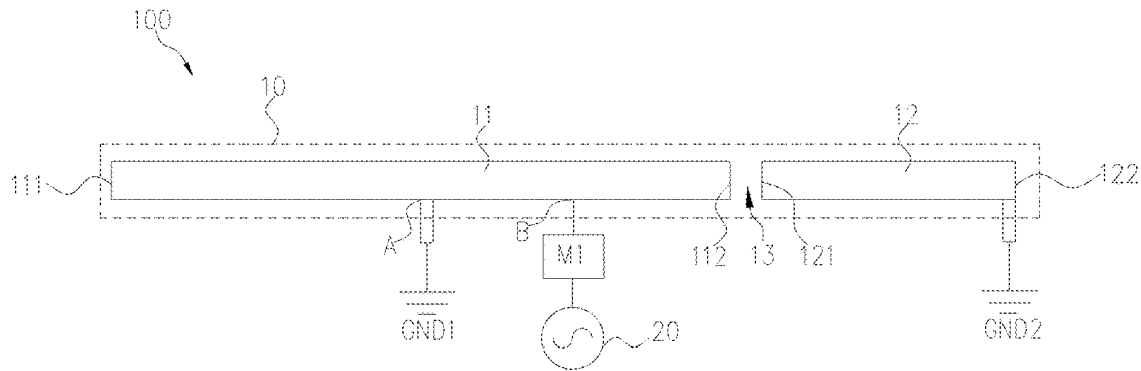
(22) Filed: **Aug. 8, 2023**

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2022/075871, filed on Feb. 10, 2022.

(30) **Foreign Application Priority Data**

Mar. 3, 2021 (CN) 202110237419.9





US 20230387603A1

(19) **United States**

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

(10) **Pub. No.: US 2023/0387603 A1**

(43) **Pub. Date: Nov. 30, 2023**

(54) **ANTENNA DEVICE AND ANTENNA UNIT**

H01Q 1/48 (2006.01)

H01Q 1/22 (2006.01)

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

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

CPC *H01Q 19/02* (2013.01); *H01Q 1/2291*

(2013.01); *H01Q 1/48* (2013.01); *H01Q 1/085*

(2013.01)

(72) Inventors: **Ryo KOMURA**, Kyoto (JP); **Masahiro**
IZAWA, Kyoto (JP)

(21) Appl. No.: **18/448,506**

(57)

ABSTRACT

(22) Filed: **Aug. 11, 2023**

An antenna device includes: a ground electrode plate; one or more first radiating electrode plates which face the ground electrode plate; a second radiating electrode plate which lies between the ground electrode plate and the one or more first radiating electrode plates; one or more first feeder lines which are connected to the one or more first radiating electrode plates; a second feeder line which is not connected to the one or more first feeder lines but is connected to the second radiating electrode plate; and a ground line which does not connect the one or more first radiating electrode plates to the ground electrode plate but connects the second radiating electrode plate to the ground electrode plate. The one or more first radiating electrode plates lie inside the second radiating electrode plate as viewed from a thickness direction of the ground electrode plate.

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2022/
004870, filed on Feb. 8, 2022.

(30) **Foreign Application Priority Data**

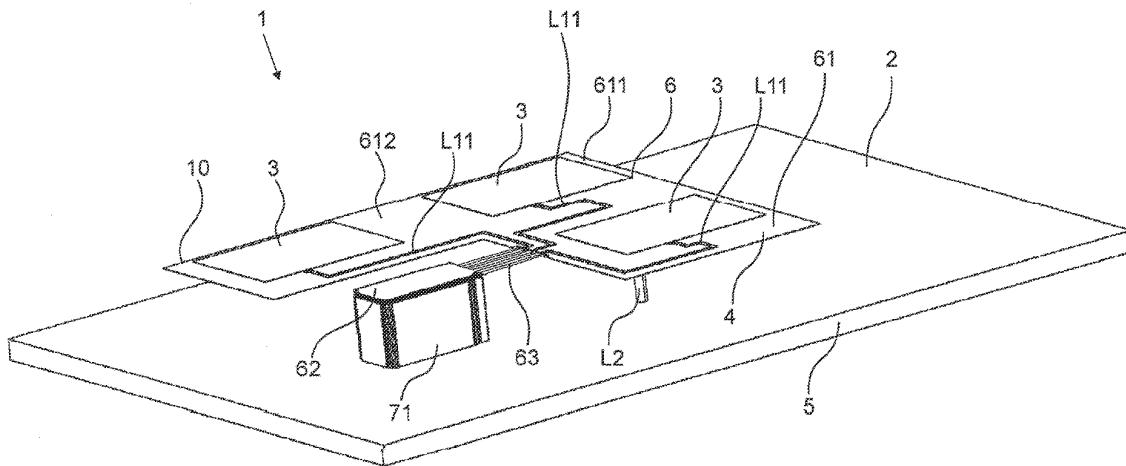
Mar. 5, 2021 (JP) 2021-035559

Publication Classification

(51) **Int. Cl.**

H01Q 19/02 (2006.01)

H01Q 1/08 (2006.01)





US 20230387609A1

(19) **United States**

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

(10) **Pub. No.: US 2023/0387609 A1**

(43) **Pub. Date: Nov. 30, 2023**

(54) **ELECTRONIC DEVICE**

Publication Classification

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

(51) **Int. Cl.**
H01Q 21/28 (2006.01)
H01Q 1/38 (2006.01)
H01Q 1/50 (2006.01)
H01Q 1/24 (2006.01)
H01Q 9/42 (2006.01)

(72) Inventors: **Hanyang Wang**, Reading (GB);
Yuanpeng Li, Shenzhen (CN); **Dawei Zhou**, Shenzhen (CN); **Chuanbo Shi**,
Shanghai (CN); **Xiaowei Zhang**,
Shenzhen (CN)

(52) **U.S. Cl.**
CPC **H01Q 21/28** (2013.01); **H01Q 1/38**
(2013.01); **H01Q 1/50** (2013.01); **H01Q 1/243**
(2013.01); **H01Q 9/42** (2013.01)

(21) Appl. No.: **18/249,444**

(22) PCT Filed: **Sep. 23, 2021**

(57) **ABSTRACT**

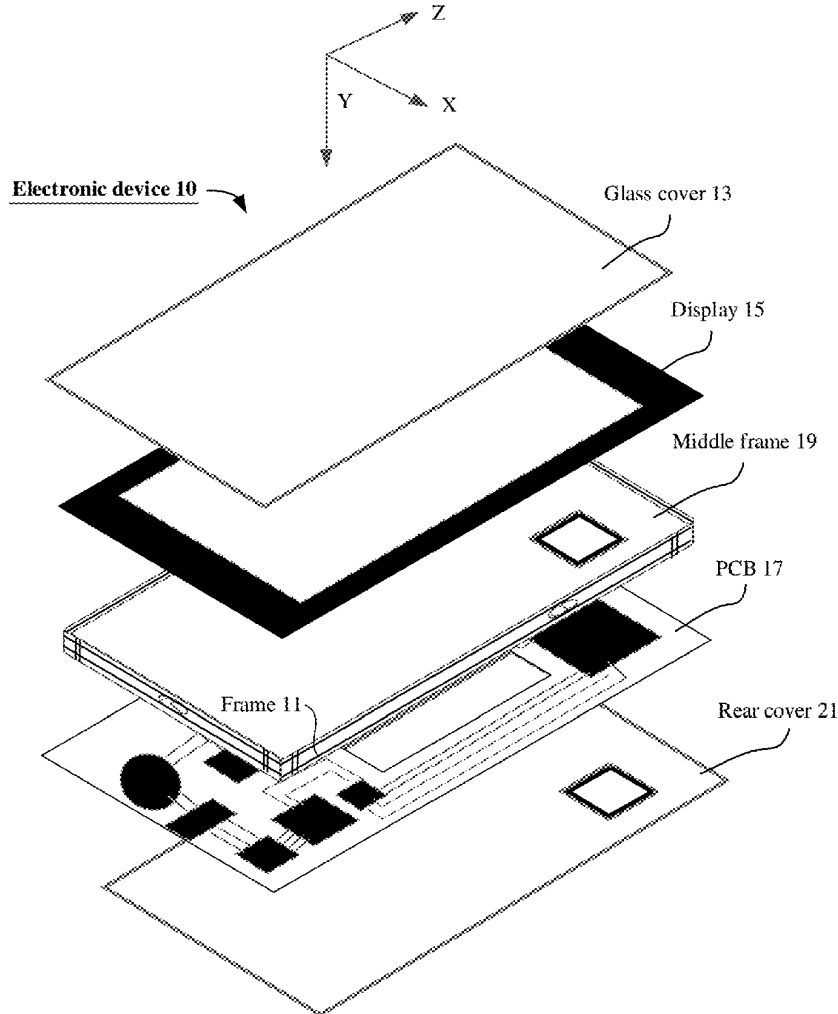
(86) PCT No.: **PCT/CN2021/119918**

§ 371 (c)(1),
(2) Date: **Apr. 18, 2023**

Embodiments of this application provide an electronic device. The electronic device includes an antenna structure, the antenna structure includes a plurality of antenna units, and the plurality of antenna units are electrically connected to a ground. When a feed unit feeds the antenna units, the ground bears a part of a mode current.

(30) **Foreign Application Priority Data**

Oct. 19, 2020 (CN) 202011120282.0





US 20230395970A1

(19) **United States**

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

(10) **Pub. No.: US 2023/0395970 A1**

(43) **Pub. Date: Dec. 7, 2023**

(54) **ANTENNA AND ELECTRONIC APPARATUS INCLUDING SAME**

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

(72) Inventors: **Junwoo KIM**, Suwon-si (KR);
Himchan YUN, Suwon-si (KR);
Cheolhong SON, Suwon-si (KR);
Sangha LEE, Suwon-si (KR); **Soonho HWANG**, Suwon-si (KR)

(21) Appl. No.: **18/451,840**

(22) Filed: **Aug. 18, 2023**

Related U.S. Application Data

(63) Continuation of application No. PCT/KR2022/002248, filed on Feb. 16, 2022.

Foreign Application Priority Data

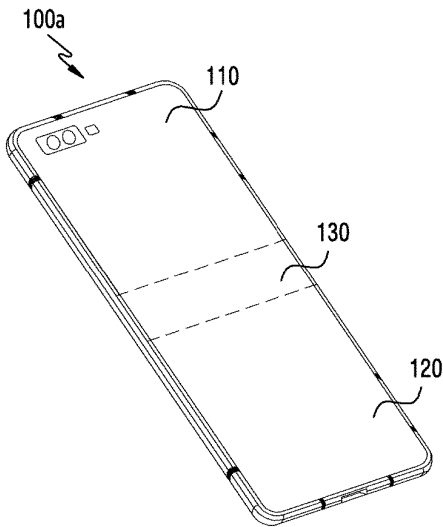
Feb. 18, 2021 (KR) 10-2021-0022056

Publication Classification

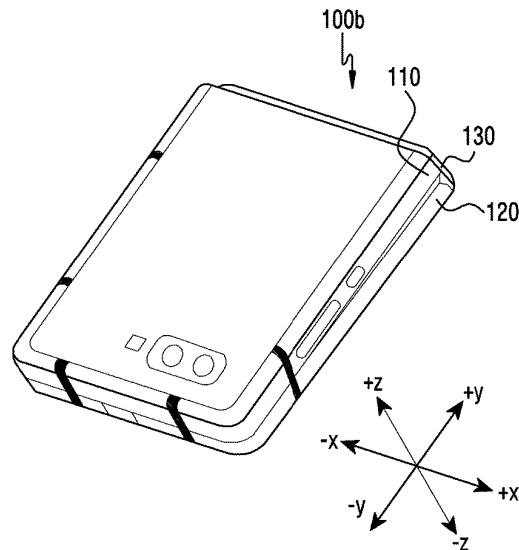
(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H04M 1/02 (2006.01)
(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H04M 1/026** (2013.01)

(57) **ABSTRACT**

An electronic apparatus includes: a first housing; a second housing rotatably connected to the first housing; an opening formed along a third edge of the second housing; a switch located on a path that connects the opening and a ground region; and a wireless communication circuit. The first housing includes a first edge extending in a first direction and a second edge extending in a second direction. The second housing includes the third edge corresponding to the first edge and a fourth edge corresponding to the second edge when the first and second housings face each other. Parts of the first and second edge are made of a conductive material. When the first housing and the second housing face each other, the wireless communication circuit feeds power to the conductive material and controls the switch to electrically short-circuit the third edge and the ground region.



(a)



(b)

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100b



US 20230395981A1

(19) **United States**

(12) **Patent Application Publication**
CONTOPANAGOS

(10) **Pub. No.: US 2023/0395981 A1**

(43) **Pub. Date: Dec. 7, 2023**

(54) **MULTILAYER PRINTED ANTENNA ARRANGEMENTS**

Publication Classification

(71) Applicant: **Argo Semiconductors SA**, Hellinikon (GR)

(51) **Int. Cl.**
H01Q 13/10 (2006.01)
H01Q 1/38 (2006.01)

(72) Inventor: **Charalampos (Harry) CONTOPANAGOS**, Kifissia (GR)

(52) **U.S. Cl.**
CPC **H01Q 13/106** (2013.01); **H01Q 1/38** (2013.01)

(73) Assignee: **Argo Semiconductors SA**, Hellinikon (GR)

(57) **ABSTRACT**

A monolithic antenna structure, comprising: a first metal layer; a second metal layer; a third metal layer arranged as a ground plane; a first dielectric layer between the first metal layer and the second metal layer; a second dielectric layer between the second metal layer and the third metal layer; a via feeding a signal for transmission by the antenna structure through the second dielectric layer to the second metal layer; wherein the first metal layer and the second metal layer are not electrically connected; and wherein the first metal layer acts primarily as the radiating element of the monolithic antenna structure.

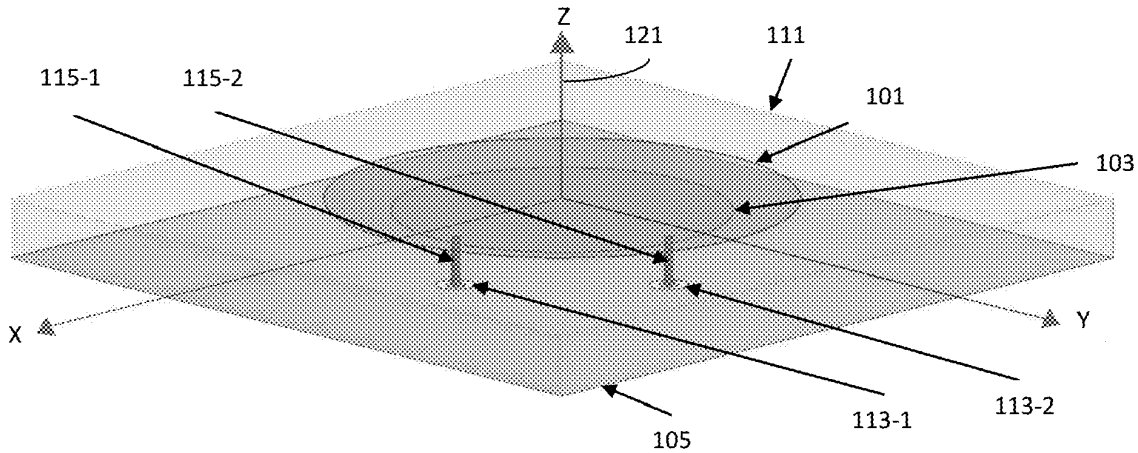
(21) Appl. No.: **17/807,046**

(22) Filed: **Jun. 15, 2022**

(30) **Foreign Application Priority Data**

Jun. 2, 2022 (EP) 22386034.7

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US 20230395984A1

(19) **United States**

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

(10) **Pub. No.: US 2023/0395984 A1**

(43) **Pub. Date: Dec. 7, 2023**

(54) **ELECTRONIC DEVICE ANTENNAS IN ACOUSTIC CAVITIES**

(52) **U.S. Cl.**
CPC **H01Q 13/18** (2013.01); **H01Q 1/22** (2013.01); **H04R 1/02** (2013.01)

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

(72) Inventors: **Joel D. Barrera**, Cedar Park, TX (US); **Nikolaos Chiotellis**, San Jose, CA (US); **Michael J. Williams**, Saratoga, CA (US); **Jerzy S. Guterman**, Sunnyvale, CA (US); **Trevor J. Edmonds**, San Francisco, CA (US); **Joshua P. Song**, Cupertino, CA (US); **Richard D. Kosoglow**, San Jose, CA (US)

(57) **ABSTRACT**

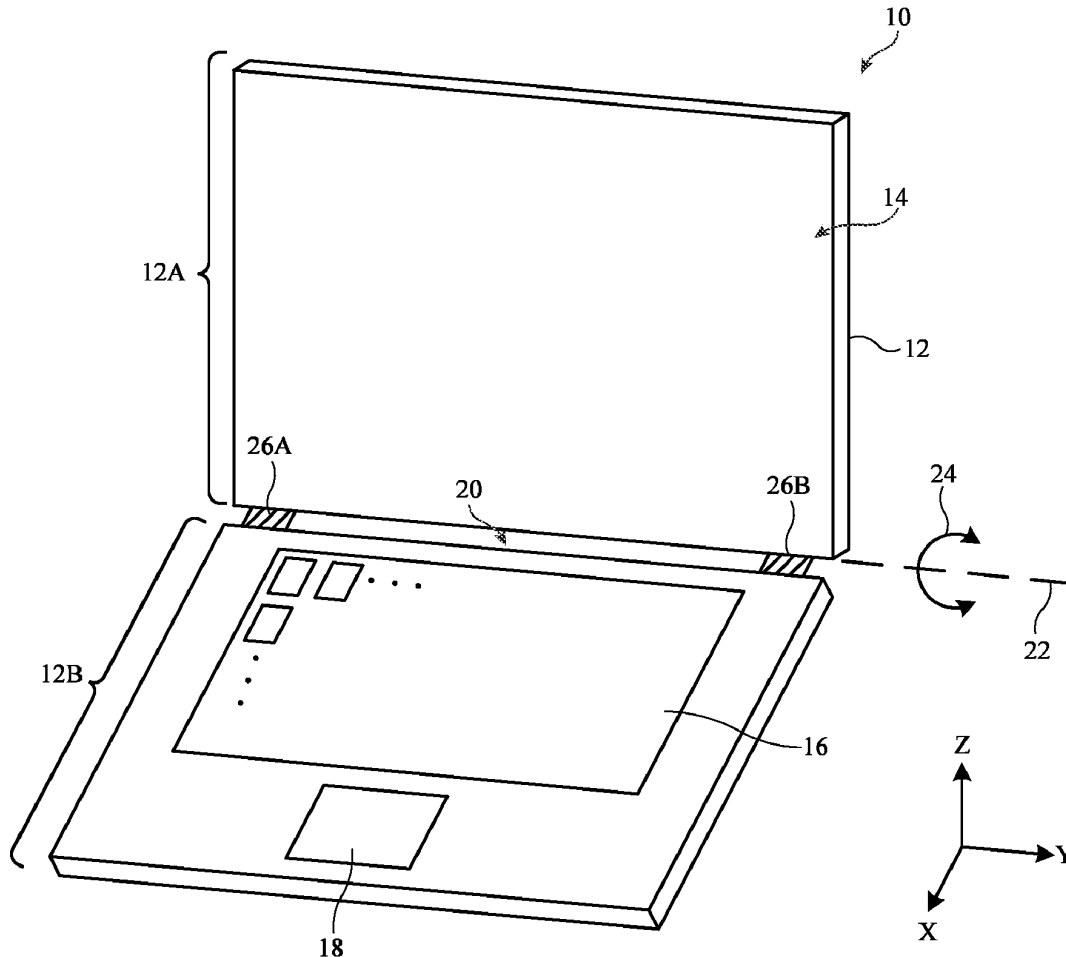
An electronic device may have an upper housing and a lower housing separated by a slot. An antenna module may be mounted in the lower housing and may include a cavity. An antenna element may be disposed within the cavity. Grounded traces may be patterned onto walls of the module and may be coupled to conductive walls of the lower housing by conductive gaskets. The antenna element may have a high band arm displaced farther into the cavity than a low band arm by a shim. The antenna module may have an acoustic port aligned with a speaker port. The acoustic port may allow sound waves from a speaker to pass into the cavity from the speaker port. The cavity may be configured to optimize an audio response of the speaker while concurrently optimizing radio-frequency performance of the antenna element.

(21) Appl. No.: **17/832,465**

(22) Filed: **Jun. 3, 2022**

Publication Classification

(51) **Int. Cl.**
H01Q 13/18 (2006.01)
H01Q 1/22 (2006.01)
H04R 1/02 (2006.01)





US 20230395991A1

(19) **United States**

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

(10) **Pub. No.: US 2023/0395991 A1**

(43) **Pub. Date: Dec. 7, 2023**

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

H01Q 5/28 (2006.01)

H01Q 21/06 (2006.01)

(71) Applicant: **TCL COMMUNICATION (NINGBO) CO., LTD.**, Ningbo, Zhejiang (CN)

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

CPC *H01Q 21/0006* (2013.01); *H01Q 5/50* (2015.01); *H01Q 5/28* (2015.01); *H01Q 21/065* (2013.01)

(72) Inventors: **Hongjuan XING**, Ningbo, Zhejiang (CN); **Hai CAI**, Ningbo, Zhejiang (CN)

(73) Assignee: **TCL COMMUNICATION (NINGBO) CO., LTD.**, Ningbo, Zhejiang (CN)

(57)

ABSTRACT

(21) Appl. No.: **18/249,544**

(22) PCT Filed: **Dec. 9, 2020**

(86) PCT No.: **PCT/CN2020/134928**

§ 371 (c)(1),

(2) Date: **Apr. 19, 2023**

(30) **Foreign Application Priority Data**

Oct. 19, 2020 (CN) 202011120353.7

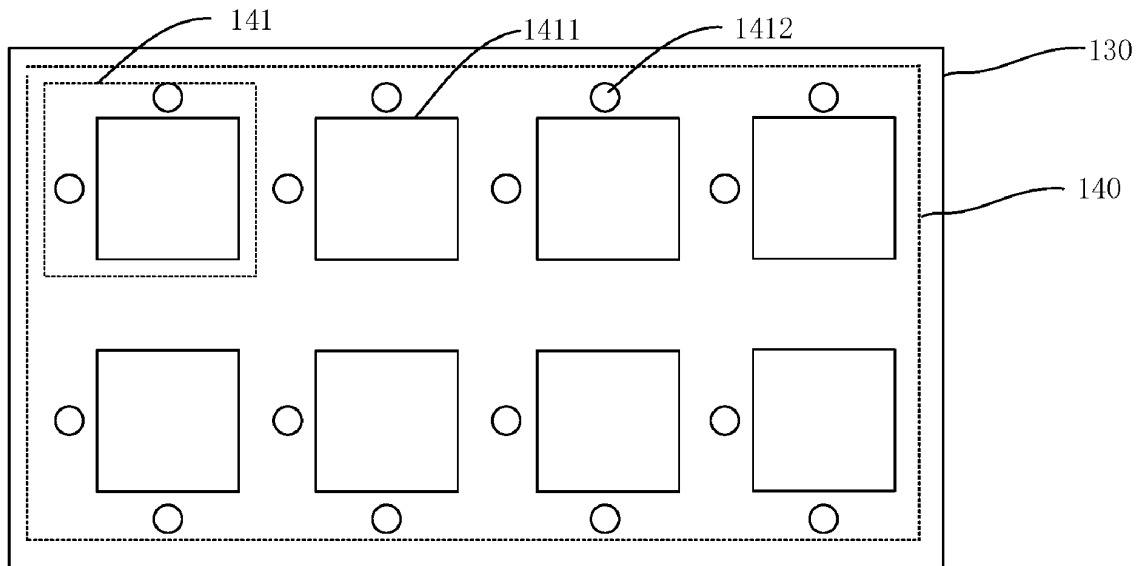
Publication Classification

(51) **Int. Cl.**

H01Q 21/00 (2006.01)

H01Q 5/50 (2006.01)

The present application provides an array antenna and a mobile terminal. This application increases the number of array elements through the arrangement of the plurality of rows of array elements, thereby reducing the maximum gain reduction of the array antenna in the maximum scan area, and by the arrangement, each feeding network supports the 28 GHz frequency band and the 39 GHz frequency band such that 2*2 MIMO signal differential communication is realized for each array element, thereby achieving support of dual-frequency and dual-polarization signals by the array antenna. Meanwhile, it can automatically adjust the antenna array form according to the strength of signals, thereby reducing the input power, improving the energy efficiency of the system and dynamically adjusting chip operating temperature.





US 20230395992A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2023/0395992 A1**
XING (43) **Pub. Date: Dec. 7, 2023**

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

(30) **Foreign Application Priority Data**

Oct. 23, 2020 (CN) 202011146031.X

(71) Applicant: **JRD COMMUNICATION (SHENZHEN) LTD.**, Shenzhen, Guangdong (CN)

Publication Classification

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

(72) Inventor: **Hongjuan XING**, Shenzhen, Guangdong (CN)

(52) **U.S. Cl.**
CPC **H01Q 21/061** (2013.01); **H01Q 1/242** (2013.01)

(73) Assignee: **JRD COMMUNICATION (SHENZHEN) LTD.**, Shenzhen, Guangdong (CN)

(57) **ABSTRACT**

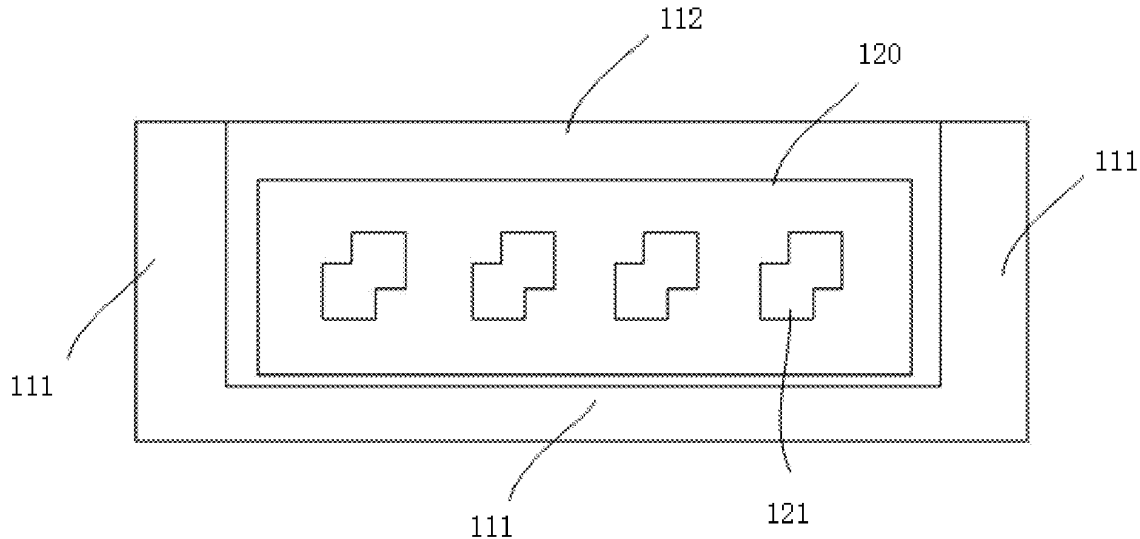
The present application discloses an antenna structure and a mobile terminal. In the antenna structure of the present application, a radome corresponding to a region between adjacent antenna elements is made of a metal material, and a radome corresponding to a radiation region of the antenna elements is made of a low dielectric constant material, and a fence-type radome structure is formed. Such a design can ensure the performance of an array antenna in the antenna structure, and can improve the product firmness of the antenna structure.

(21) Appl. No.: **18/250,191**

(22) PCT Filed: **Dec. 9, 2020**

(86) PCT No.: **PCT/CN2020/134742**

§ 371 (c)(1),
(2) Date: **Apr. 21, 2023**





US 20230402741A1

(19) **United States**

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

(10) **Pub. No.: US 2023/0402741 A1**

(43) **Pub. Date: Dec. 14, 2023**

(54) **WEARABLE DEVICE**

H01Q 1/52 (2006.01)

G02B 27/01 (2006.01)

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

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

CPC *H01Q 1/273* (2013.01); *H01Q 1/48* (2013.01); *H01Q 1/528* (2013.01); *G02B 27/0176* (2013.01); *G02B 2027/0178* (2013.01)

(72) Inventors: **Kai-Hsiang CHANG**, Taoyuan City (TW); **Chung-Ting HUNG**, Taoyuan City (TW); **Chin-Lung TSAI**, Taoyuan City (TW); **Kuan-Hsien LEE**, Taoyuan City (TW); **Yu-Chen ZHAO**, Taoyuan City (TW); **Chun-I CHENG**, Taoyuan City (TW)

(57) **ABSTRACT**

A wearable device includes a ground element, a first radiation element, a second radiation element, a third radiation element, a fourth radiation element, a fifth radiation element, and a sixth radiation element. The first radiation element is coupled to the ground element. The third radiation element is coupled through the second radiation element to the first radiation element. The fourth radiation element is coupled through the second radiation element to the first radiation element. The fifth radiation element is coupled to the first radiation element. The sixth radiation element is coupled to the ground element. The sixth radiation element is adjacent to the fourth radiation element. An antenna structure is formed by the first radiation element, the second radiation element, the third radiation element, the fourth radiation element, the fifth radiation element, and the sixth radiation element.

(21) Appl. No.: **17/814,312**

(22) Filed: **Jul. 22, 2022**

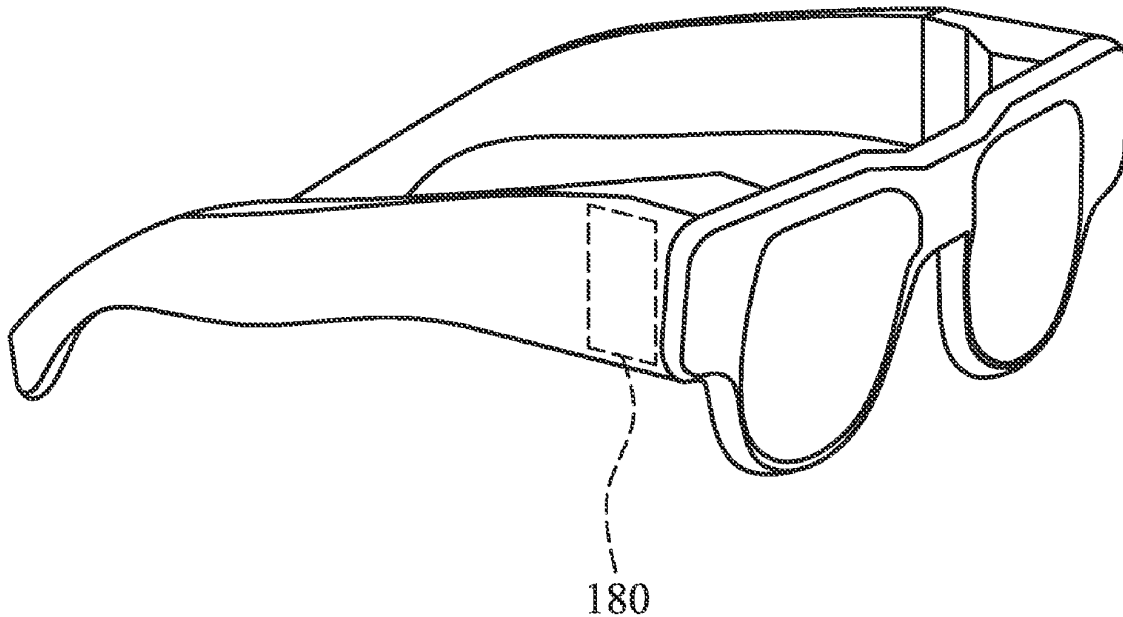
(30) **Foreign Application Priority Data**

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(43) **Pub. Date: Dec. 14, 2023**

(54) **ANTENNA STRUCTURE**

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

(72) Inventor: **Tsung-Jung TSAI**, Hsinchu (TW)

(21) Appl. No.: **18/313,443**

(22) Filed: **May 8, 2023**

(30) **Foreign Application Priority Data**

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Publication Classification

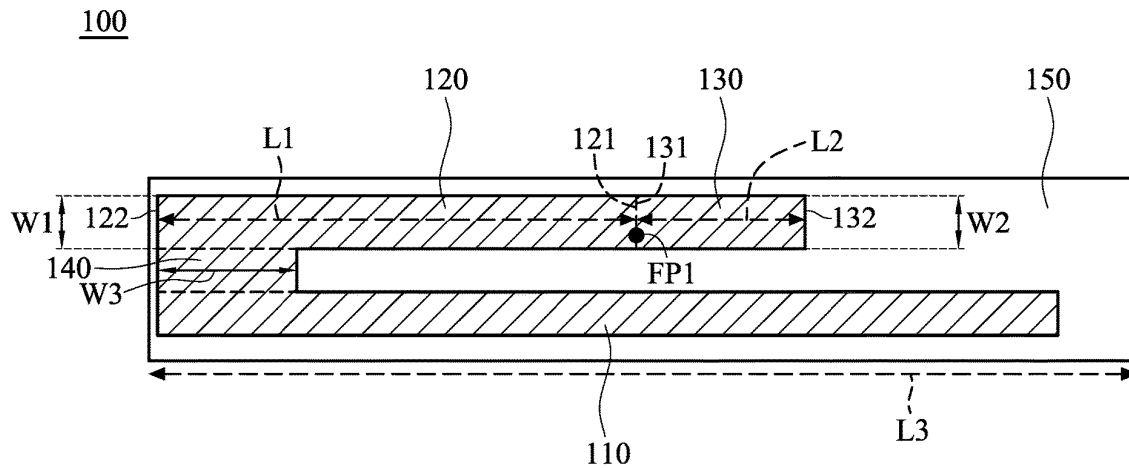
(51) **Int. Cl.**
H01Q 5/307 (2006.01)
H01Q 1/48 (2006.01)
H01Q 1/22 (2006.01)
H01Q 9/04 (2006.01)
H01Q 13/10 (2006.01)

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

CPC *H01Q 5/307* (2015.01); *H01Q 1/48* (2013.01); *H01Q 1/2266* (2013.01); *H01Q 9/0421* (2013.01); *H01Q 13/106* (2013.01)

(57) **ABSTRACT**

An antenna structure includes a ground element, a first radiation element, a second radiation element, a nonconductive support element, and a metal cavity. The first radiation element has a feeding point. The first radiation element is coupled to the ground element. The second radiation element is coupled to the feeding point. The second radiation element and the first radiation element substantially extend in opposite directions. The ground element, the first radiation element, and the second radiation element are disposed on the nonconductive support element. The metal cavity includes a coupling metal plate with a slot. The ground element, the first radiation element, the second radiation element, and the nonconductive support element are disposed inside the metal cavity. The first radiation element and the second radiation element are adjacent to the coupling metal plate. The feeding point is covered by the coupling metal plate.





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

Publication Classification

(71) Applicant: **Panasonic Intellectual Property Management Co., Ltd., Osaka (JP)**

(51) **Int. Cl.**
H01Q 5/35 (2006.01)
H01Q 7/00 (2006.01)
H01Q 1/50 (2006.01)

(72) Inventor: **Taichi HAMABE, Osaka (JP)**

(52) **U.S. Cl.**
CPC **H01Q 5/35** (2015.01); **H01Q 7/00** (2013.01); **H01Q 1/50** (2013.01)

(21) Appl. No.: **18/207,867**

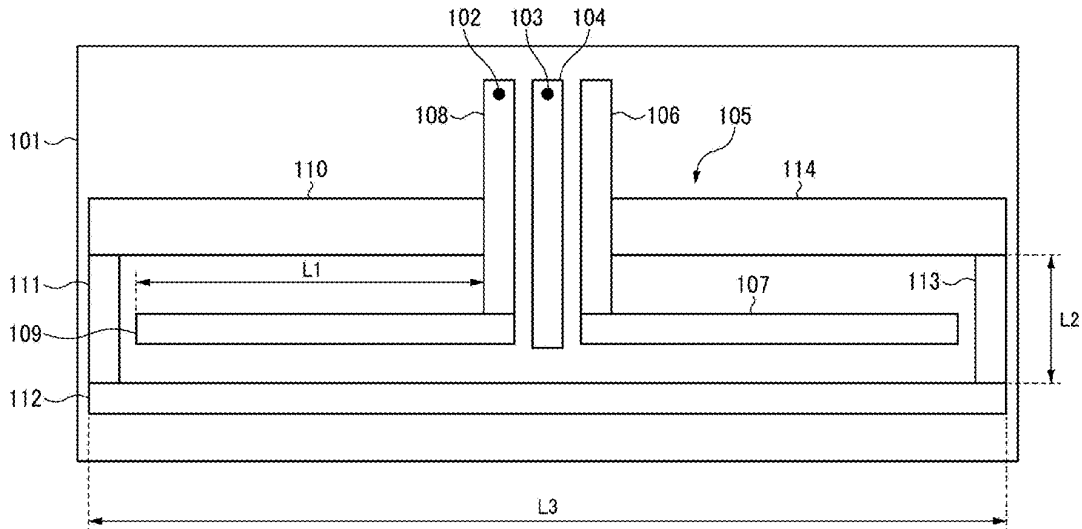
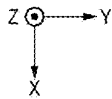
(57) **ABSTRACT**

(22) Filed: **Jun. 9, 2023**

There are provided an antenna device and a communication device including: a feed antenna connected to a feed point; a loop antenna connected to ground and arranged to surround the feed antenna; and two resonators provided inside the loop antenna and on both sides of the feed antenna in a short direction of the feed antenna. Each of the two resonators is connected to the loop antenna and has an L shape.

(30) **Foreign Application Priority Data**

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(19) **United States**

(12) **Patent Application Publication**
HAMABE

(10) **Pub. No.: US 2023/0402753 A1**

(43) **Pub. Date: Dec. 14, 2023**

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

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

(71) Applicant: **Panasonic Intellectual Property Management Co., Ltd.**, Osaka (JP)

(57) **ABSTRACT**

(72) Inventor: **Taichi HAMABE**, Osaka (JP)

There are provided an antenna device and a communication device including: a feed antenna connected to a feed point and extending from the feed point, the feed antenna corresponding to a first frequency; a loop antenna connected to a ground and arranged to surround the feed antenna, the loop antenna corresponding to a second frequency lower than the first frequency; and a resonator arranged outside the loop antenna in a direction in which the feed antenna extends, the resonator corresponding to the second frequency. The loop antenna includes an extending portion that extends to protrude outward on a side where the resonator is arranged with respect to the feed point.

(21) Appl. No.: **18/207,863**

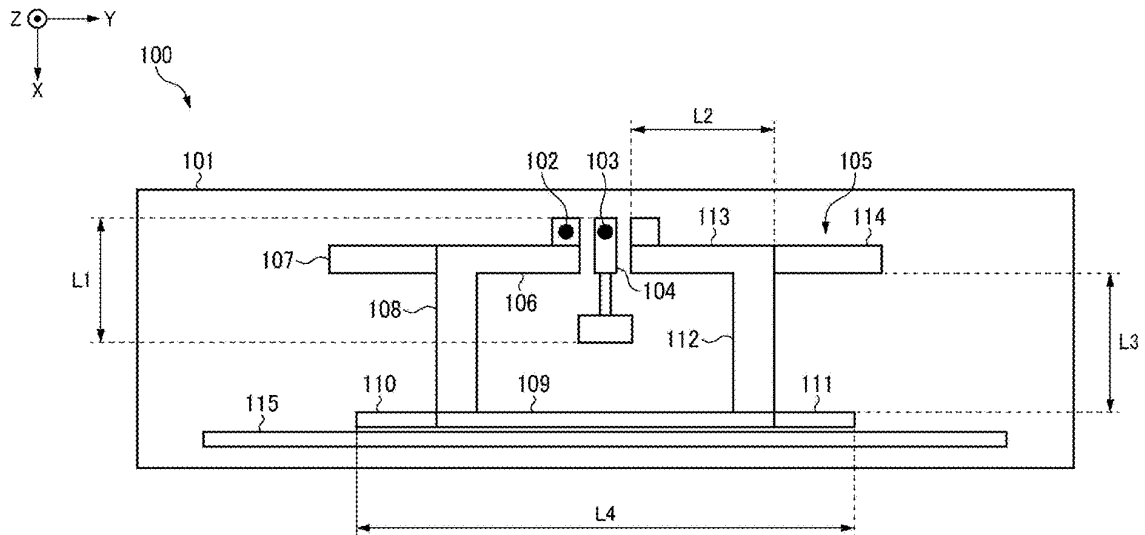
(22) Filed: **Jun. 9, 2023**

(30) **Foreign Application Priority Data**

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Publication Classification

(51) **Int. Cl.**
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(19) **United States**

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

(10) **Pub. No.: US 2023/0402757 A1**

(43) **Pub. Date: Dec. 14, 2023**

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

(52) **U.S. Cl.**
CPC **H01Q 9/0421** (2013.01); **H01Q 1/2291** (2013.01); **H01Q 9/30** (2013.01)

(71) Applicant: **WISTRON NEWEB CORPORATION, HSINCHU (TW)**

(57) **ABSTRACT**

(72) Inventors: **HSIEH-CHIH LIN, HSINCHU (TW); MENG-KAI WU, HSINCHU (TW)**

An antenna module and an electronic device are provided. The antenna module is disposed in a housing of the electronic device. The antenna module includes a first radiating element, a second radiating element, and a feeding element. The first radiating element includes a first radiating portion, a second radiating portion, and a feeding portion. The feeding portion is connected between the first radiating portion and the second radiating portion. A length of the first radiating portion is greater than a length of the second radiating portion. The second radiating element includes a connecting portion, a third radiating portion, and a fourth radiating portion. The connecting portion is connected between the third radiating portion and the fourth radiating portion. A length of the third radiating portion and a length of the fourth radiating portion are not equal to each other.

(21) Appl. No.: **18/314,846**

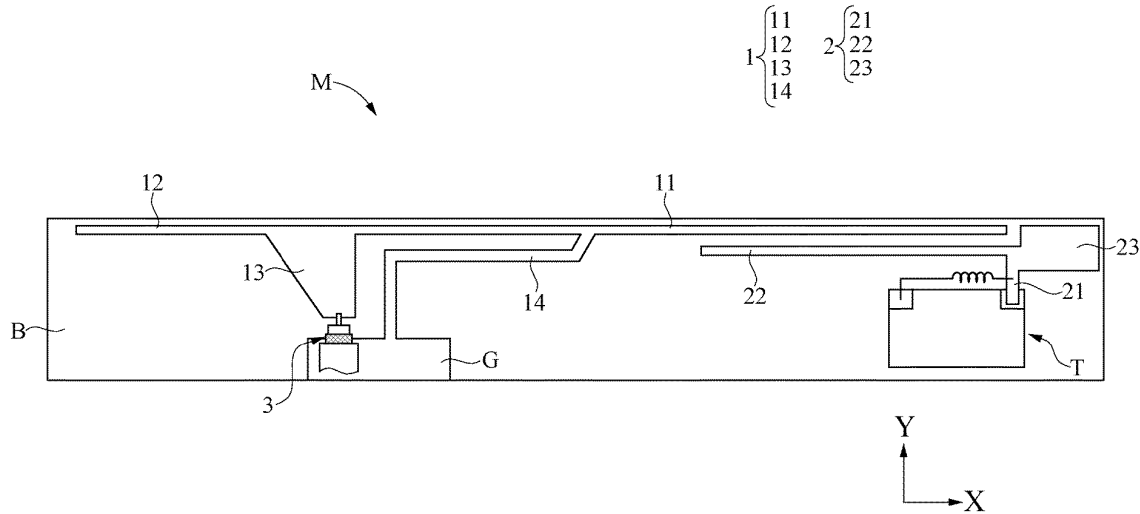
(22) Filed: **May 10, 2023**

(30) **Foreign Application Priority Data**

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Publication Classification

(51) **Int. Cl.**
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H01Q 1/22 (2006.01)
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(19) **United States**

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KANG et al.

(10) **Pub. No.: US 2023/0402765 A1**

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(54) **PATCH ANTENNA UNIT AND ANTENNA ARRAY IN PACKAGE**

Publication Classification

(71) Applicant: **SPREADTRUM COMMUNICATIONS (SHANGHAI) CO., LTD.**, Shanghai (CN)

(51) **Int. Cl.**
H01Q 21/06 (2006.01)
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H01Q 21/20 (2006.01)

(72) Inventors: **Kai KANG**, Pudong New Area, Shanghai (CN); **Shusheng GUO**, Pudong New Area, Shanghai (CN); **Hongyu TIAN**, Pudong New Area, Shanghai (CN); **Jikang HUANG**, Pudong New Area, Shanghai (CN)

(52) **U.S. Cl.**
CPC *H01Q 21/065* (2013.01); *H01Q 9/0414* (2013.01); *H01Q 21/20* (2013.01)

(57) **ABSTRACT**

(21) Appl. No.: **18/033,217**

A patch antenna unit and an antenna array in package are provided. The patch antenna unit includes: a substrate; and two groups of stacked patches which respectively stack on the substrate, geometric axes of the two groups of stacked patches being perpendicular to each other, wherein a radiating edge of each patch in the stacked patches is shaped as a function curve, the radiating edges of the patches in different layers are shaped as integrally orthogonal function curves, and a function curve corresponding to a shape of a non-radiating edge of each patch includes a ripple function curve.

(22) PCT Filed: **May 8, 2021**

(86) PCT No.: **PCT/CN2021/092247**

§ 371 (c)(1),
(2) Date: **Apr. 21, 2023**

(30) **Foreign Application Priority Data**

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