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(19) **United States**

(12) **Patent Application Publication**
Wu

(10) **Pub. No.: US 2024/0063527 A1**

(43) **Pub. Date: Feb. 22, 2024**

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

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

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

(21) Appl. No.: **18/385,051**

(22) Filed: **Oct. 30, 2023**

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2022/
080623, filed on Mar. 14, 2022.

(30) **Foreign Application Priority Data**

Apr. 30, 2021 (CN) 202110484710.6

Publication Classification

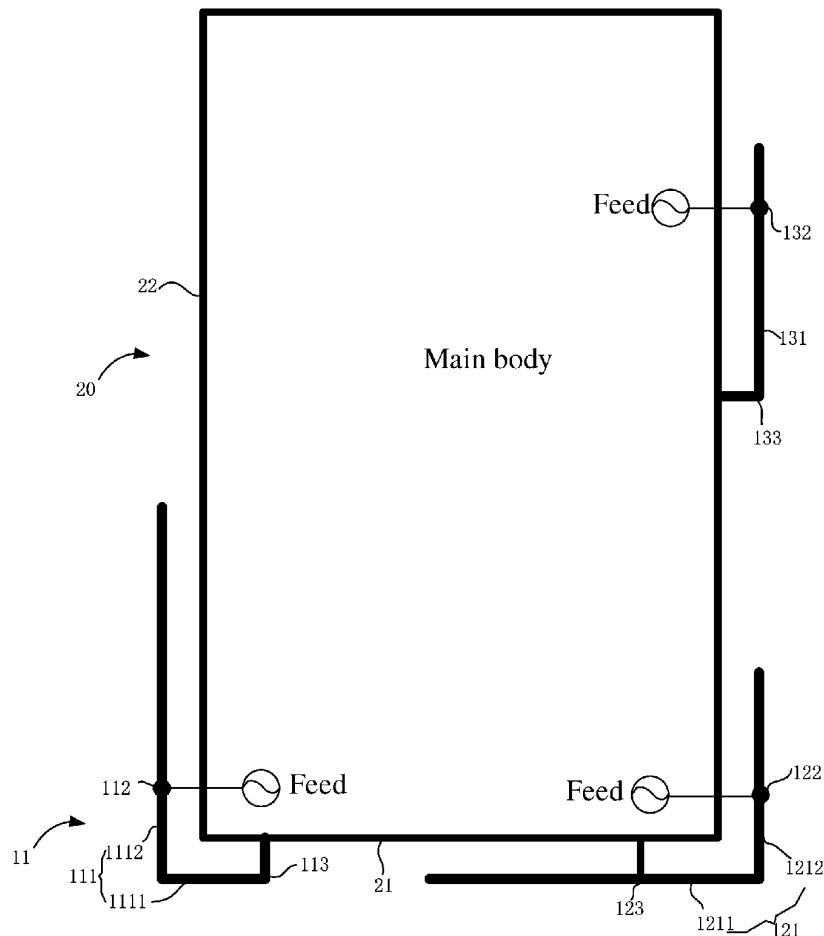
(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 5/35 (2006.01)
H01Q 1/48 (2006.01)

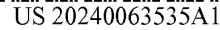
(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 5/35**
(2015.01); **H01Q 1/48** (2013.01)

(57) **ABSTRACT**

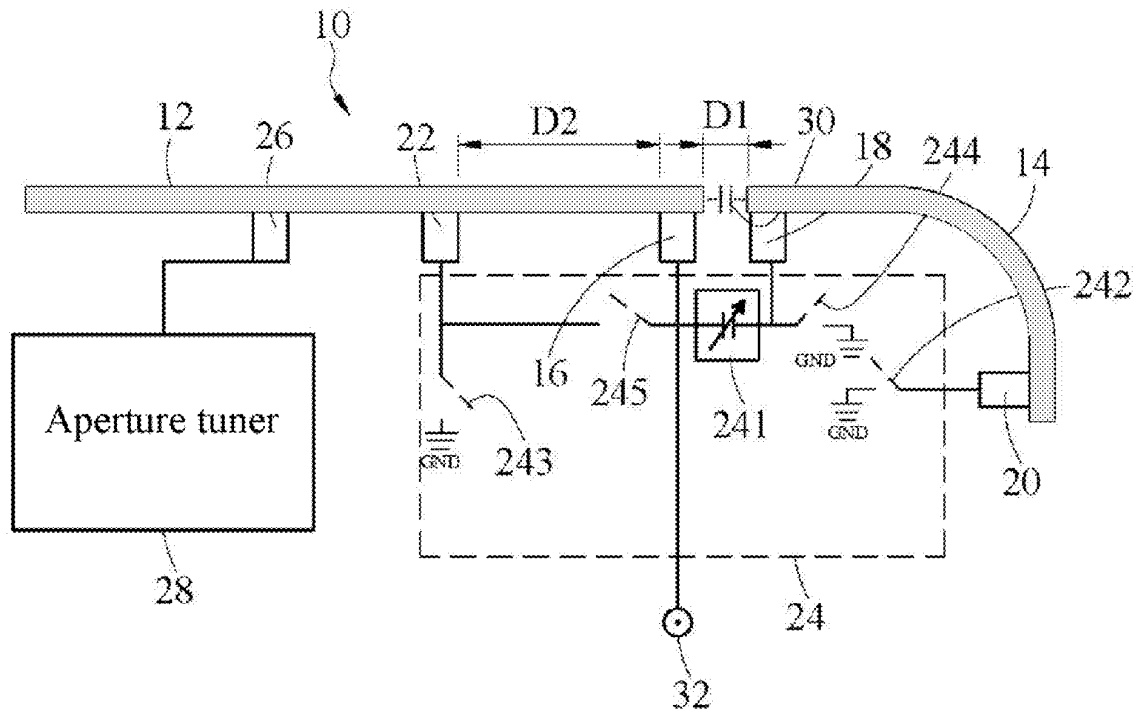
Provided is an antenna device. The antenna device includes a first antenna. The first antenna includes a first radiator. The first radiator includes a first branch and a second branch that are connected to each other. The second branch bends and extends from an end of the first branch. The first antenna supports both a first operation mode and a second operation mode. The first antenna covers a bandwidth greater than 190 MHz by using the first operation mode and the second operation mode together. In addition, a mobile terminal is provided.

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

(10) **Pub. No.: US 2024/0063543 A1**

(43) **Pub. Date: Feb. 22, 2024**

(54) **OPEN LOOP ANTENNA AND ELECTRONIC
DEVICE**

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

(71) Applicant: **Wistron NeWeb Corporation**, Hsinchu
(TW)

(72) Inventors: **Hao-Yu WANG**, Hsinchu (TW); **Pei
Siou LUO**, Hsinchu (TW)

(21) Appl. No.: **18/151,499**

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

(30) **Foreign Application Priority Data**

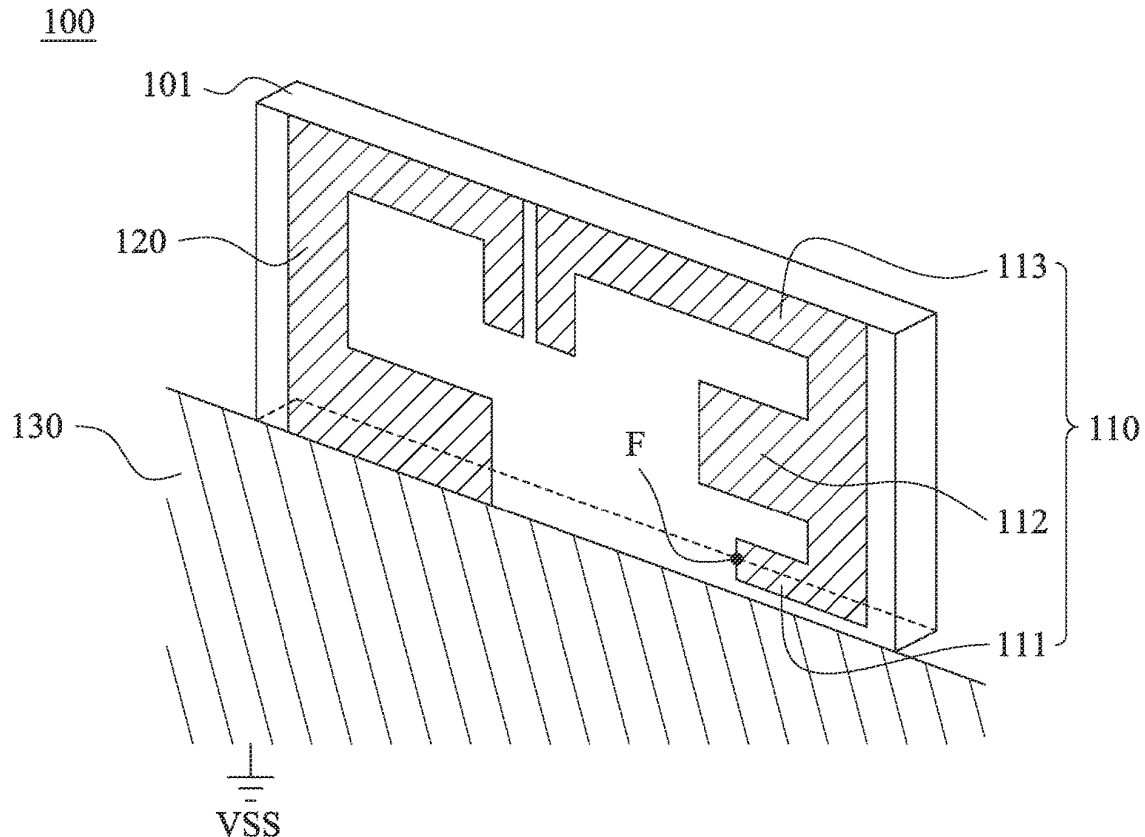
Aug. 17, 2022 (TW) 111131016

Publication Classification

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

(57) **ABSTRACT**

An open loop antenna includes a base, a first radiating section disposed on the base, a second radiating section spaced apart from the first radiating section to form an open loop, and a grounding section spaced apart from the first radiating section and connected to the second radiating section and a ground voltage. The first radiating section includes a feeding segment connected to a feeding point, an extending segment connected to the feeding segment and excited to generate a first frequency band, and a high-frequency coupling segment connected to the extending segment and excited to generate a second frequency band. The second radiating section is coupled with the first radiating section to generate a third frequency band. The first frequency band is higher than the second frequency band. The second frequency band is higher than the third frequency band.





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

(10) **Pub. No.: US 2024/0072416 A1**

(43) **Pub. Date: Feb. 29, 2024**

(54) **ELECTRONIC DEVICE INCLUDING ANTENNA**

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

(72) Inventors: **Soonho HWANG**, Suwon-si (KR);
Kyungjae LEE, Suwon-si (KR);
Sungkoo PARK, Suwon-si (KR);
Himchan YUN, Suwon-si (KR);
Kookjoo LEE, Suwon-si (KR);
Donguk CHOI, Suwon-si (KR);
Seunghwan KIM, Suwon-si (KR);
Jaebong CHUN, Suwon-si (KR)

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

(21) Appl. No.: **18/381,741**

(22) Filed: **Oct. 19, 2023**

Related U.S. Application Data

(63) Continuation of application No. PCT/KR2023/010751, filed on Jul. 25, 2023.

(30) **Foreign Application Priority Data**

Jul. 29, 2022 (KR) 10-2022-0094349

Aug. 9, 2022 (KR) 10-2022-0099540

Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 1/50 (2006.01)

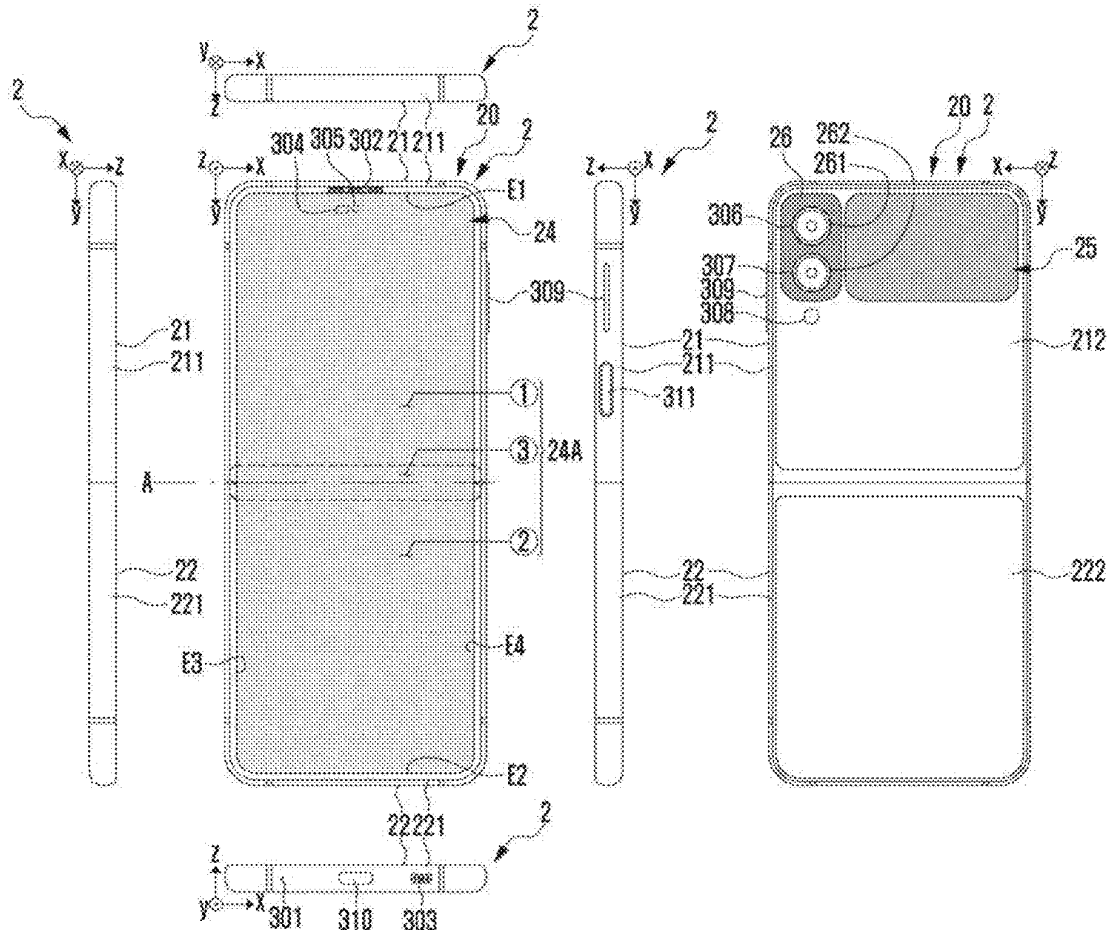
H01Q 1/52 (2006.01)

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

CPC **H01Q 1/243** (2013.01); **H01Q 1/50**
(2013.01); **H01Q 1/526** (2013.01); **H04M**
1/0214 (2013.01)

(57) **ABSTRACT**

An electronic device includes: a housing forming an exterior of the electronic device; a first display; a second display facing in a direction different from that of the first display, wherein the second display may include a conductive pattern; a metal part electrically connected to the conductive pattern; and a wireless communication circuit electrically connected to at least one of the metal part or the conductive pattern.





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(19) **United States**

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

(10) **Pub. No.: US 2024/0072417 A1**

(43) **Pub. Date: Feb. 29, 2024**

(54) **ELECTRONIC DEVICE ANTENNA ARRAYS
MOUNTED AGAINST A DIELECTRIC
LAYER**

H01Q 3/26 (2006.01)

H01Q 9/04 (2006.01)

H01Q 21/06 (2006.01)

H01Q 21/22 (2006.01)

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

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

CPC *H01Q 1/243* (2013.01); *H01Q 1/38*
(2013.01); *H01Q 3/26* (2013.01); *H01Q*
3/2605 (2013.01); *H01Q 3/2658* (2013.01);
H01Q 9/0414 (2013.01); *H01Q 21/061*
(2013.01); *H01Q 21/065* (2013.01); *H01Q*
21/22 (2013.01)

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

(57)

ABSTRACT

An electronic device may be provided with a dielectric cover layer, a dielectric substrate, and a phased antenna array on the dielectric substrate for conveying millimeter wave signals through the dielectric cover layer. The array may include conductive traces mounted against the dielectric layer. The conductive traces may form patch elements or parasitic elements for the phased antenna array. The dielectric layer may have a dielectric constant and a thickness selected to form a quarter wave impedance transformer for the array at a wavelength of operation of the array. The substrate may include fences of conductive vias that laterally surround each of the antennas within the array. When configured in this way, signal attenuation, destructive interference, and surface wave generation associated with the presence of the dielectric layer over the phased antenna array may be minimized.

(21) Appl. No.: **18/502,979**

(22) Filed: **Nov. 6, 2023**

Related U.S. Application Data

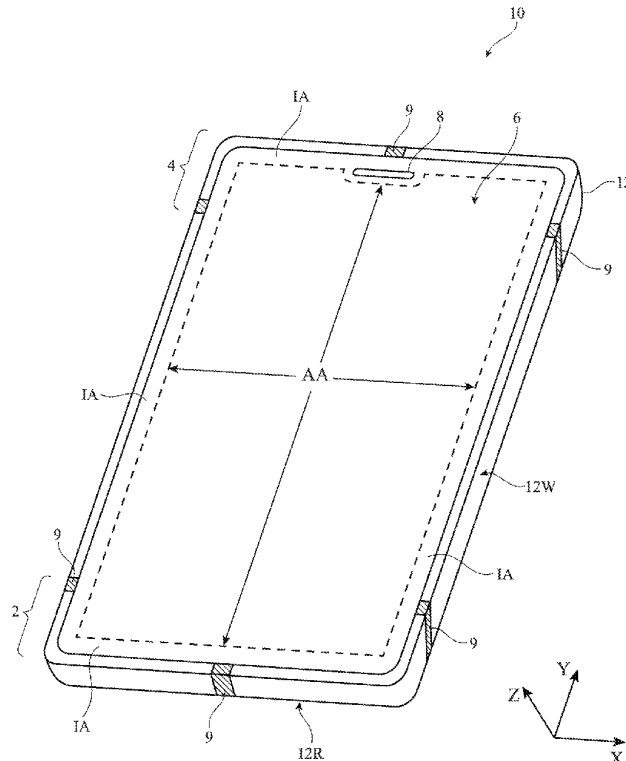
(63) Continuation of application No. 17/314,740, filed on May 7, 2021, now Pat. No. 11,811,133, which is a continuation of application No. 15/950,677, filed on Apr. 11, 2018, now Pat. No. 11,139,588.

Publication Classification

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 1/38 (2006.01)





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(19) **United States**

(12) **Patent Application Publication**
WU

(10) **Pub. No.: US 2024/0072418 A1**

(43) **Pub. Date: Feb. 29, 2024**

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

H03H 7/38 (2006.01)

H04B 1/00 (2006.01)

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

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 5/335**
(2015.01); **H03H 7/38** (2013.01); **H04B**
1/0064 (2013.01)

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

(21) Appl. No.: **18/503,330**

(22) Filed: **Nov. 7, 2023**

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2022/
086365, filed on Apr. 12, 2022.

(30) **Foreign Application Priority Data**

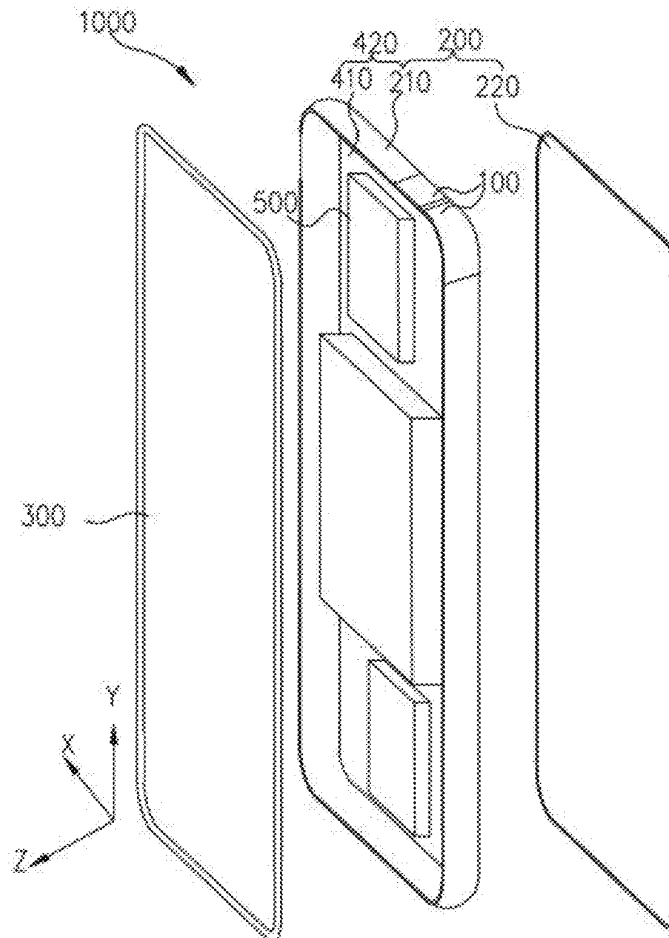
May 26, 2021 (CN) 202110582433.2

Publication Classification

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 5/335 (2006.01)

(57) **ABSTRACT**

Provided are an antenna assembly and an electronic device. The antenna assembly includes a first radiator, a second radiator, a first matching module, a first feeding module, a second matching module, and a second feeding module. The first radiator has a first ground end, a first coupling end, and a first feeding point. The second radiator has a second coupling end, a second ground end, and a second feed point. A first coupling gap is defined between the second coupling end and the first coupling end. The first matching module is electrically connected between the first feeding point and the first feeding module. The second matching module is electrically connected between the second feeding point and the second feeding module. The first radiator and the second radiator support multiple resonant modes, where at least one resonant mode is a $\frac{1}{8}$ to $\frac{1}{4}$ wavelength mode.





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(19) **United States**

(12) **Patent Application Publication**
HWANG

(10) **Pub. No.: US 2024/0072444 A1**

(43) **Pub. Date: Feb. 29, 2024**

(54) **MULTIBAND PATCH ANTENNA**

Publication Classification

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

(51) **Int. Cl.**
H01Q 9/04 (2006.01)
H01Q 5/25 (2006.01)

(72) Inventor: **Chul HWANG**, Incheon (KR)

(52) **U.S. Cl.**
CPC **H01Q 9/0407** (2013.01); **H01Q 5/25** (2015.01)

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

(21) Appl. No.: **18/272,487**

(22) PCT Filed: **Jan. 13, 2022**

(86) PCT No.: **PCT/KR2022/000636**

§ 371 (c)(1),

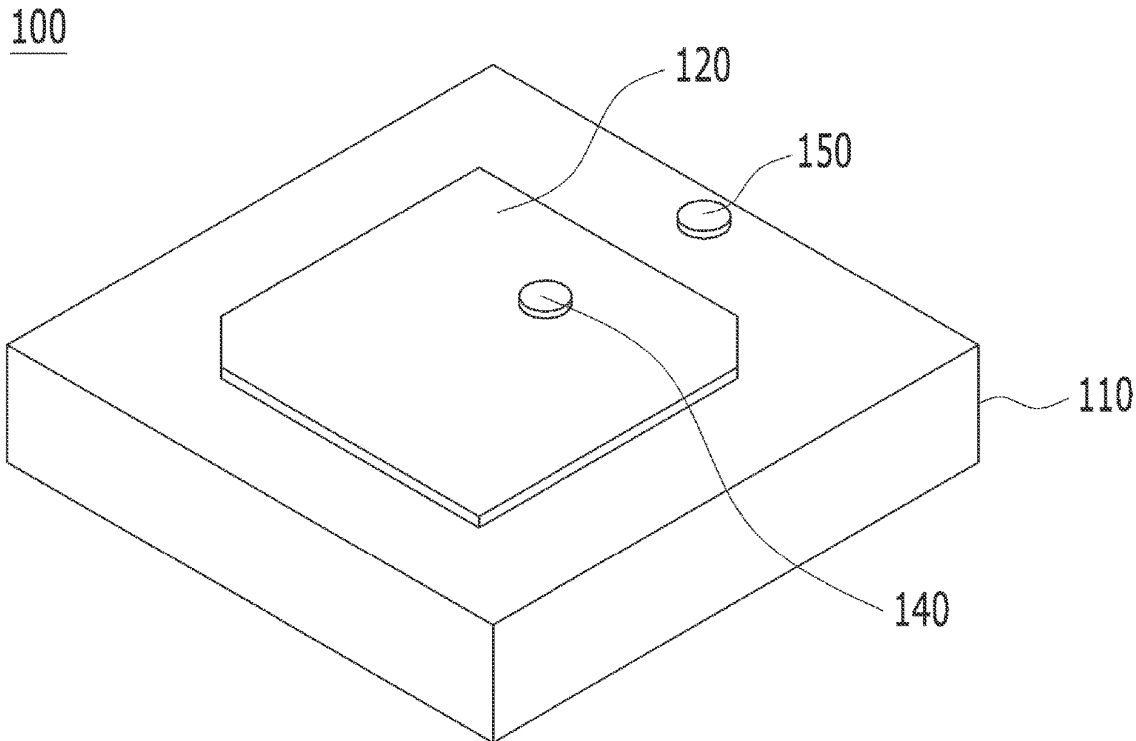
(2) Date: **Jul. 14, 2023**

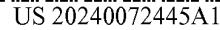
(30) **Foreign Application Priority Data**

Jan. 15, 2021 (KR) 10-2021-0005908

(57) **ABSTRACT**

This disclosure presents a multiband patch antenna which resonates in a second frequency band as well as in a first frequency band, i.e., a GNSS frequency band, by adding an antenna pin to a patch antenna. The presented multiband patch antenna includes a base substrate, an upper patch disposed on an upper surface of the base substrate, a lower patch disposed on a lower surface of the base substrate, a feed pin which passes through the base substrate, the upper patch, and the lower patch, and an antenna pin which is spaced apart from the feed pin and passes through the base substrate and the lower patch.





(43) **Pub. Date:** **Feb. 29, 2024**

An antenna structure 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 dielectric substrate. The first radiation element has a feeding point. The first radiation element is coupled through the second radiation element to the ground element. The third radiation element is coupled to the first radiation element and the second radiation element. The fourth radiation element is coupled to the first radiation element and the third radiation element. The fifth radiation element is coupled to the ground element. The fifth radiation element is adjacent to the fourth radiation element. The ground element, the first radiation element, the second radiation element, the third radiation element, the fourth radiation element, and the fifth radiation element are disposed on the dielectric substrate.

A detailed cross-sectional diagram of a semiconductor device. The device has a total length LT and width WT. It consists of several stacked layers: a top layer 130 (containing sub-layers 134 and 135), a middle layer 120 (containing sub-layer 126), and a bottom layer 110. Within these layers are various patterns and features: a central rectangular region 122, a horizontal strip 121, and a circular feature 190 labeled FP. Below the main body, there's a base layer 170 with a patterned region 150 containing sub-regions 154 and 155. Other labels include 140, 141, 142, 146, 160, 162, 161, 131, W1, L1, L2, W2, L3, W3, W4, D1, GC1, and GC2, which define specific dimensions, widths, lengths, and gaps within the structure.



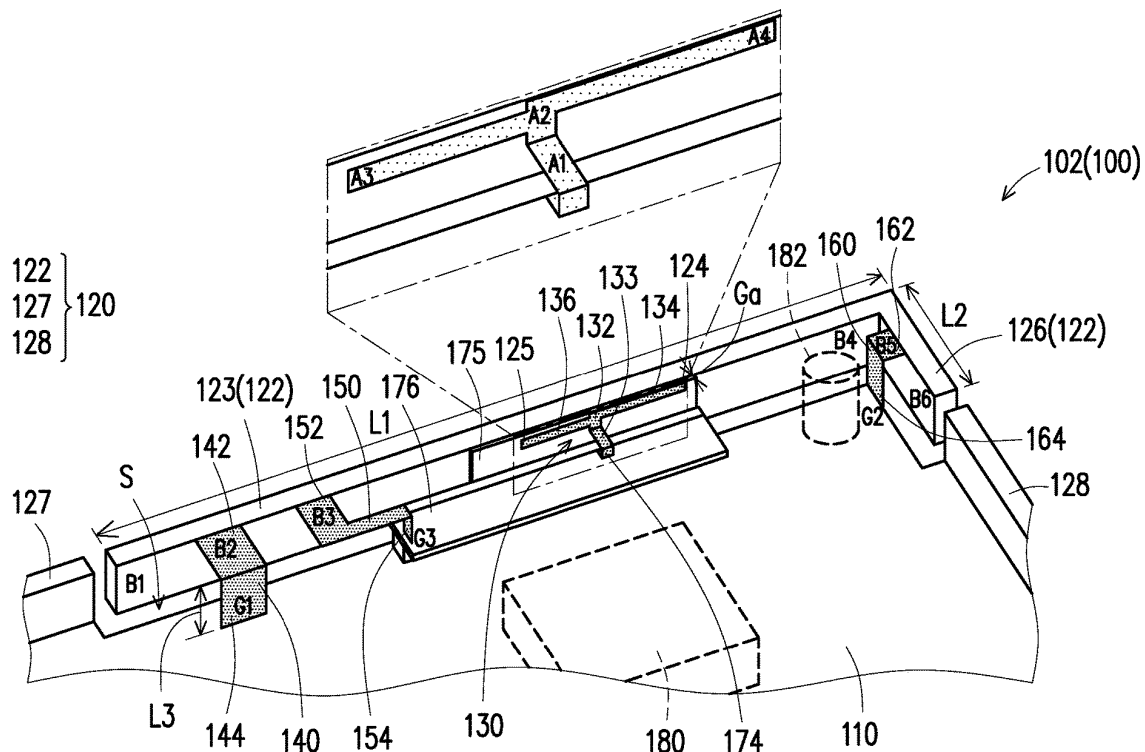
US 20240079758A1

(19) **United States**(12) **Patent Application Publication**
Wu et al.(10) **Pub. No.: US 2024/0079758 A1**(43) **Pub. Date: Mar. 7, 2024**(54) **ELECTRONIC DEVICE****Publication Classification**(71) Applicant: **PEGATRON CORPORATION,**
TAIPEI CITY (TW)(51) **Int. Cl.**
H01Q 1/22 (2006.01)
H01Q 9/04 (2006.01)
H01Q 21/28 (2006.01)(72) Inventors: **Chien-Yi Wu,** Taipei City (TW);
Chao-Hsu Wu, Taipei City (TW);
Chih-Wei Liao, Taipei City (TW); **Hau**
Yuen Tan, Taipei City (TW);
Shih-Keng Huang, Taipei City (TW);
Wen-Hgin Chuang, Taipei City (TW);
Lin-Hsu Chiang, Taipei City (TW);
Chang-Hua Wu, Taipei City (TW);
Han-Wei Wang, Taipei City (TW);
Chun-Jung Hu, Taipei City (TW)(52) **U.S. Cl.**
CPC **H01Q 1/2266** (2013.01); **H01Q 9/0407**
(2013.01); **H01Q 21/28** (2013.01)(73) Assignee: **PEGATRON CORPORATION,**
TAIPEI CITY (TW)(21) Appl. No.: **18/364,362**(22) Filed: **Aug. 2, 2023**(30) **Foreign Application Priority Data**

Sep. 2, 2022 (TW) 111133432

(57) **ABSTRACT**

An electronic device includes a metal back cover, a metal frame, and a first, second, third, and fourth radiators. The metal frame includes a discrete part and two connection parts. The connection parts are located by two sides of the discrete part, separated from the discrete part, and connected to the metal back cover. A U-shaped slot is formed between the discrete part and the metal back cover and between the discrete part and the connection parts. The first radiator is separated from the discrete part and includes a feed end. The second, third, and fourth radiators are connected to the discrete part and the metal back cover. The third radiator is located between the first and second radiators. The first radiator is located between the third and fourth radiators. The discrete part and the first, second, third, and fourth radiators form an antenna module together.





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(19) **United States**

(12) **Patent Application Publication**

Li et al.

(10) **Pub. No.: US 2024/0088541 A1**

(43) **Pub. Date: Mar. 14, 2024**

(54)	ELECTRONIC DEVICE		Publication Classification
(71)	Applicant: Huawei Technologies Co., Ltd. , Shenzhen (CN)	(51)	Int. Cl. H01Q 1/24 (2006.01) H01Q 5/321 (2006.01) H01Q 5/335 (2006.01)
(72)	Inventors: Yuanpeng Li , Shenzhen (CN); Hanyang Wang , Reading (GB); Dawei Zhou , Shenzhen (CN)	(52)	U.S. Cl. CPC H01Q 1/243 (2013.01); H01Q 5/321 (2015.01); H01Q 5/335 (2015.01)
(21)	Appl. No.: 18/259,909	(57)	ABSTRACT
(22)	PCT Filed: Dec. 22, 2021		An electronic device includes an antenna structure having an antenna radiator, a first circuit, a first feeding element, and a second feeding element. The first circuit comprises feeding input ports configured to input electrical signals of the first feeding element and the second feeding element, and feeding output ports configured to feed processed electrical signals to the antenna radiator. The electrical signal of the first feeding element has a same phase on the feeding input ports. The electrical signal of the second feeding element has opposite phases on the feeding input ports.
(86)	PCT No.: PCT/CN2021/140289		
	§ 371 (c)(1), (2) Date: Jun. 29, 2023		
(30)	Foreign Application Priority Data		
	Dec. 30, 2020 (CN) 202011611722.2		
	Mar. 19, 2021 (CN) 202110296431.7		



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(19) **United States**

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

(10) **Pub. No.: US 2024/0088543 A1**

(43) **Pub. Date: Mar. 14, 2024**

(54) **CONFORMAL ANTENNA MODULE WITH
3D-PRINTED RADOME**

Publication Classification

(71) Applicant: **Synergy Microwave Corporation**,
Paterson, NJ (US)

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/42 (2006.01)
H01Q 3/30 (2006.01)
H01Q 9/04 (2006.01)

(72) Inventors: **Shiban K. Koul**, Delhi (IN); **Ajay
Kumar Poddar**, Elmwood Park, NJ
(US); **Karthikeya Gulur Sadananda**,
New Delhi (IN); **Ulrich L. Rohde**,
Upper Saddle River, NJ (US)

(52) **U.S. Cl.**
CPC *H01Q 1/243* (2013.01); *H01Q 1/42*
(2013.01); *H01Q 3/30* (2013.01); *H01Q*
9/0407 (2013.01)

(73) Assignee: **Synergy Microwave Corporation**,
Paterson, NJ (US)

(57) **ABSTRACT**

(21) Appl. No.: **18/508,553**

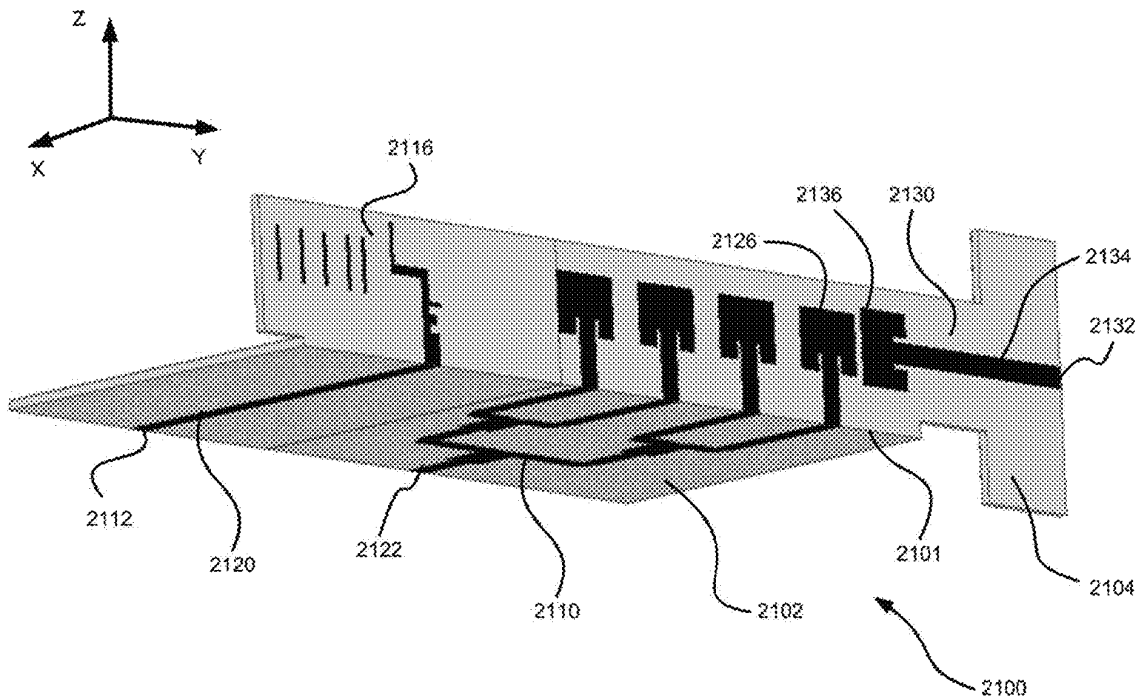
(22) Filed: **Nov. 14, 2023**

Related U.S. Application Data

(62) Division of application No. 17/221,965, filed on Apr.
5, 2021, now Pat. No. 11,876,284.

(60) Provisional application No. 63/033,884, filed on Jun.
3, 2020.

The present disclosure provides several embodiments of integrated conformal antennas that are designed to be integrated into handheld devices and support operation at millimeter-wave operating frequency band that includes 28 GHz. The antennas have low mutual coupling despite close proximity, and maintain a front-to-back radiation ratio of 10 dB or better within the operating frequency band. The integrated conformal antennas are further capable of supporting operation of the device in different orientations, different forward gains, or a combination thereof.





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(19) **United States**(12) **Patent Application Publication**
SU et al.(10) **Pub. No.: US 2024/0088562 A1**(43) **Pub. Date: Mar. 14, 2024**(54) **ANTENNA STRUCTURE AND MOBILE
DEVICE**(52) **U.S. Cl.**
CPC **H01Q 5/328** (2015.01); **H01Q 9/0442**
(2013.01)(71) Applicant: **Wistron NeWeb Corp.**, Hsinchu (TW)(72) Inventors: **Guan-Ren SU**, Hsinchu (TW);
Meng-Kai WU, Hsinchu (TW);
Hsieh-Chih LIN, Hsinchu (TW)(21) Appl. No.: **18/451,391**(22) Filed: **Aug. 17, 2023**(30) **Foreign Application Priority Data**

Sep. 14, 2022 (TW) 111134673

Publication Classification(51) **Int. Cl.**
H01Q 5/328 (2006.01)
H01Q 9/04 (2006.01)(57) **ABSTRACT**

An antenna structure includes a metal mechanism element, a feeding radiation element, a first radiation element, a second radiation element, a third radiation element, a fourth radiation element, a fifth radiation element, a sixth radiation element, and a tuning circuit. A slot is formed in the metal mechanism element. The first radiation element is coupled to the feeding radiation element. The tuning circuit is coupled to the first radiation element. The second radiation element is coupled to the feeding radiation element. The third radiation element is coupled to a first grounding point on the metal mechanism element. The fourth radiation element is coupled to a second grounding point on the metal mechanism element. The fifth radiation element is coupled to a third grounding point on the metal mechanism element.

