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(54) DUAL-BAND ANTENNA

DUALBANDANTENNE

ANTENNE DOUBLE BANDE

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(73) Proprietor: **Arcadyan Technology Corporation**
Hsinchu City 30071 (TW)

(72) Inventors:
- **HUANG, CHIH-YUNG**
  423 Taichung County (TW)
- **LO, KUO-CHANG**
  351 Miaoli County (TW)

(74) Representative: **Lermer, Christoph**
LermerRaible Patent- u. Rechtsanwalts PartGmbB
Lessingstrasse 6
80336 München (DE)

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Description

BACKGROUND OF THE INVENTION

(1) Field of the Invention

[0001] The invention relates to a dual-band antenna, and more particularly to the dual-band antenna that is featured in a small size, less occupation, less cost and an independent design, that can be constructed on an insulated base plate such as a printed circuit board, whose frequency of resonance mode can be easily adjusted, and upon which a demanding frequency band of a wireless local network system can be obtained.

(2) Description of the Prior Art

[0002] With progress in technology, various types and sizes of antennas have been developed for handheld electronic devices (such as mobile phones or notebook computers) and wireless communication devices (such as USB Dongles, Wireless LAN Cards, or APs). For example, a printed antenna featured in lightweight, simple structure and well communicative efficiency, and already proved to be adequate to be constructed on an inner wall of an electronic device, has been widely applied to perform wireless communication for various handheld electronic devices or notebook computers.

[0003] US 2014/0085145 A1 describes an antenna structure for a wireless communication device including a feed end, a grounding end, at least one main radiator, and at least one coupling radiator.

[0004] According to the US 2014/0132469 A1 a dipole antenna includes a feed-in terminal, a balun, a first radiator and a second radiator.

[0005] Nevertheless, the conventional antenna does have some shortcomings anyway. By having a conventional dual-band antenna as an example, this type of antenna is featured in broader planar area, larger space occupation and higher cost, but needs a specific ground leg. With the limitation of having the ground leg to connect with a ground of the system, the dual-band antenna is not suitable to be used for a miniaturized electronic device.

[0006] Thus, the present invention provides a dual-band antenna featured in a small size, less cost, and independent design. This design can be disposed on an insulated base plate such as a printed circuit board, wherein a demanding frequency band of a wireless device can be acheived.

SUMMARY OF THE INVENTION

[0007] The invention is set out in the independent claim. Preferred embodiments are defined by the dependent claims.

[0008] All these objects are achieved by the dual-band antenna described below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The present invention will now be specified with reference to its preferred embodiment illustrated in the drawings, in which:

FIG.1 is a schematic view of an embodiment of the dual-band antenna in accordance with the present invention;

FIG.2 is a schematic top view of the dual-band antenna of FIG.1 printed on a base plate;

FIG.3 shows schematically a plot of return loss for the dual-band antenna of FIG. 1; and

FIG.4 shows schematically a plot of radiation efficiency for the dual-band antenna of FIG.1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0010] The invention disclosed herein is directed to a dual-band antenna. In the following description, numerous details are outlined to provide a thorough understanding of the present invention. It will be appreciated by one skilled in the art that variations of these specific details are possible while still achieving the results of the present invention. In other instances, well-known components are not described in detail as not to unnecessarily obscure the present invention.

[0011] Referring now to FIG.1, an embodiment of the present invention is shown. The dual-band antenna 1 mainly includes a first radiation part 10 and a second radiation part 20, serving respectively two separate radiation divisions of the same dipole-antenna structure. Both the first radiation part 10 and the second radiation part 20 are made of conductive materials, such as metal plates. Alternatively, the first radiation part 10 and the second radiation part 20 can be two separate metallic patterns printed on the same surface of a base plate such as a printed circuit board. The base plate may be an insulating material. In the embodiment shown in FIG.1, the first radiation part 10 and the second radiation part 20 are two metal plates.

[0012] The first radiation part 10 as a unique piece includes a first main block 11, a first extension part 12, a second extension part 13, a first bending part 14 and a second bending part 15. The first extension part 12 extending from the first main block 11 is disposed at one side of the first main block 11. The second extension part 13, extending from the first main block 11, is disposed at the side of the first main block 11 having the first extension part 12 but extending in different directions from the first extension part 12 to form an angle $\theta 1$, which the angle $\theta 1$ is approximately ninety degrees (90 °). An arc-shaped side of the dual-band antenna 1 is formed along the adjacent sides of the first extension part 12, the first main block 11, and the other adjacent parts on the same cor-

responding sides, so that the dual-band antenna 1 may be installed in a device which has an arc-shaped side; for example, a wireless device which has a curved shape. An angle formed between the second extension part 13 and the first extension part 12 may be in a range from more than 80 degrees to less than 90 degrees, not limited to ninety degrees (90°); so that the width difference between two ends of the first extension part 12 may maintain the desired range, to form the arc-shaped side of the dual-band antenna 1.

[0013] The first bending part 14, extending from the first extension part 12, is disposed at one end of the first extension part 12 opposing to the first main block 11. A longitudinal direction of the first bending part 14 is intersected by another longitudinal direction of the first extension part 12. For example, an angle $\theta 2$ formed by the two longitudinal directions of the first bending part 14 and the first extension part 12 is approximately ninety degrees (90°). The second bending part 15 extending from the second extension part 13 is disposed at one end of the second extension part 13 by opposing to the first main block 11 with respect to the second extension part 13. A longitudinal direction of the second bending part 15 is intersected by another longitudinal direction of the second extension part 13. For example, an angle $\theta 3$ formed by the two longitudinal directions of the second bending part 15 and the second extension part 13 is approximately ninety degrees (90°).

[0014] The second radiation part 20 is configured for grounding and matching. The second radiation part 20 includes a second main block 21, a connecting block 22 and a matching part 23. The connecting block 22, extending from the second main block 21, is disposed at one side of the second main block 21. The matching part 23, extending from the connecting block 22, is disposed at one side of the connecting block 22 opposing to the second main block 21. The matching part 23 is to adjust the antenna impedance matching.

[0015] The first main block 11 is disposed adjacent to the second main block 21 by a first gap G1. The connecting block 22 is disposed adjacent to the first main block 11 by a second gap G2. The second main block 21 is disposed adjacent to the second extension part 13 by a third gap G3. A signal line 30 has a protrusive soldering section 31, and the soldering section 31 has one end 311 soldered onto the first main block 11 for feeding signals while another end 312 is soldered onto the second main block 21 for grounding the feed signals. The signal line 30 other than the soldering section 31 is led to connect with a signal module (not shown in the figure). A middle portion of the soldering section 31 that crosses the first gap G1 to bridge the end 311 for feeding signals and the end 312 for grounding the feed signals is formed as an intermediate isolation layer. In the present invention, determinations of the first gap G1, the second gap G2, and the third gap G3 are up to practical requirements.

[0016] The first main block 11, the first extension part 12, the second bending part 15 and the second main block 21 are all extended longitudinally in a first direction F1, while the second extension part 13 and the first bending part 14 are both extended longitudinally in a second direction F2.

[0017] The first main block 11 and the first extension part 12 are used for emitting and receiving signals with a first frequency. The signal of the first frequency has a first wavelength $\lambda 1$. A total length from the first main block 11 (at the connection point with the end 311 of the soldering section 31 of the signal line 30) to the first extension part 12 is defined as a first length L1. Then, the first length L1 and the first wavelength $\lambda 1$ fulfill the following equation:

$$L1=(\lambda 1)/4;$$

in which both the first length L1 and the first wavelength $\lambda 1$ are measured in centimeters. For example, as the first frequency = 2450MHz and the first wavelength $\lambda 1$ = 12.2cm, then the total length (i,e., the first length L1) from the first main body 11 to the first extension part 12 is 12.2/4=3.05cm.

[0018] The first main block 11 and the second extension part 13 are used for emitting and receiving signals with a second frequency. The signal of the second frequency has a second wavelength $\lambda 2$. A total length from the first main block 11 (at the connection point with the end 311 of the soldering section 31 of the signal line 30) to the second extension part 13 is defined as a second length L2. Then, the second length L2 and the second wavelength $\lambda 2$ fulfill the following equation:

$$L2=(\lambda 2)/4;$$

in which both the second length L2 and the second wavelength λ 2 are measured in centimeters. For example, as the second frequency = 5000MHz and the second wavelength $\lambda 2$ = 6.0cm, then the total length (i,e., the second length L2) from the first main body 11 to the second extension part 13 is 6.0/4=1.5cm.

[0019] The first extension part 12 has a first width W1, the second bending part 15 has a second width W2, and the spacing between the first extension part 12 and the second bending part 15 is defined as a fourth width G4. Then, the first width W1, the second width W2, and the fourth width G4 fulfill the following equation:

$$G4>(W1+W2)/2;$$

in which the first width W1, the second width W2, and the fourth width G4 are all measured in the same unit. Upon such an arrangement, the dual-frequency structure

can be established by a pair of the first main block 11 and the first extension part 12, and another pair of the first main block 11 and the second extension part 13.

[0020] It shall be explained that, in the embodiment of FIG.1, the first extension part 12 is not absolutely parallel to the first direction F1, but forms an arc with the connecting block 22 and the matching part 23 (an arc-shaped side of the dual-band antenna 1 is formed along the adjacent sides of the first extension part 12, the first main block 11, the connecting block 22, and the matching part 23). However, it shall be understood as well that the aforesaid arc-shaped profile is simply one of many embodiments in accordance with the present invention, and will not limit the ranges of the aforesaid numbers. Namely, while in determining the first length L1, the second length L2, the first width W1, the second width W2 and/or the fourth width G4, the foregoing three equations are the only limitations, and profiles of the first radiation part 10 and the second radiation part 20 is practically arbitrarily determined. Also, determination of lengths of the first bending part 14 and the second bending part 15 is not particularly limited, but up to the frequency in the application.

[0021] Referring now to FIG.2, a schematic top view of the dual-band antenna 2 of FIG.1 printed on a base plate is shown. As mentioned above, the first radiation part 10 and the second radiation part 20 can be printed on an insulated base plate 40. In addition, a first bare copper zone 111 can be furnished on the first main block 11, while a second bare copper zone 211 is furnished on the second main block 21. The first and second bare copper zones 111, 211 are to solder thereon the ends 311, 312 of the soldering section 31 of the signal line 30, for forming a signal-feeding end and a ground for feed signals, respectively.

[0022] Referring now to FIG.3 and FIG.4, the practical effect of a device equipped with the dual-band antenna having operational frequency bands 802.11b/g [2400MHz~2500MHz] + 802.11ac [4900MHz~5850MHz] is demonstrated. In FIG.3, in two different operational frequency bands around 2.4GHz and 5GHz, the minimum return loss can be achieved. In FIG.4, for all the operational frequency bands, the resulted radiation efficiency can be always kept at a stable level.

[0023] It shall be explained that the dual-band antenna provided by the present invention can be adjusted arbitrarily to meet system requirements. For example, the operational frequency band can be adjusted to 802.11a(5150~5850MHz), 802.11b(2400~2500MHz), 802.11g(2400~2500MHz), and 802.11n(2.4GHz or 5GHz Band), or can be further adjusted to meet a wider frequency-band requirement for the antenna of a wireless communication system.

[0024] In summary, the dual-band antenna provided by the present invention, featured in a small size, less occupation, less cost and an independent design, can be constructed on an insulated base plate such as a printed circuit board, and can have a frequency of resonance mode easily to be adjusted for obtaining an operational frequency band meeting requirements of a wireless local network system. In comparison with the conventional dual-band antenna, the dual-band antenna of the present invention can be produced with a reduced width (by removing at least 25-50% original width), and can save the cost significantly in materials for the printed antenna. In addition, in the circumstance of a reduced antenna surface area, the antenna efficiency is not sacrificed. Further, by introducing the present invention, expensive tooling and assembly cost for the conventional 3D antenna can be waived, and the risk in distorted products can be reduced. The dual-band antenna of the present invention can be furnished to any place in the system without considering the need for grounding.

[0025] While the present invention has been particularly shown and described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes in form and detail may be within the scope of the appended claims.

Claims

1. A dual-band antenna (1), comprising:

a first radiation part (10), made of conductive materials, including:

a first main block (11);
a first extension part (12), extending from one side of the first main block (11);
a second extension part (13), extending from said side of the first main block (11) but in a different direction from the first extension part (12);
a first bending part (14) extending from one end of the first extension part (12), opposing to the first main block (11), but in a different direction from a longitudinal direction of said first extension part (12); and
a second bending part (15) disposed at one end of the second extension part (13), opposing to the first main block (11), wherein a longitudinal direction of the second bending part (15) is different to a longitudinal direction of said second extension part (13); and

a second radiation part (20), made of conductive materials, including:

a second main block (21);
a connecting block (22) extending from the second main block (21); and
a matching part (23) disposed at one side of the connecting block (22) opposing to the

second main block (21);

wherein the first main block (11) is spaced from the second main block (21) by a first gap (G1), the connecting block (22) is spaced from the first main block (11) by a second gap (G2), the second main block (21) is spaced from the second extension part (13) by a third gap (G3), one end of a soldering section (31) of a signal line (30) is soldered onto the first main block (11) as a signal-feeding end, and another end of the soldering section (31) of the signal line (30) is soldered onto the second main block (21) as a ground for feed signals;
wherein the first main block (11), the first extension part (12), the second bending part (15) and the second main block (21) are all extended approximately in a first direction (F1), the second extension part (13) and the first bending part (14) are all extended in a second direction (F2), and an angle formed between the first direction (F1) and the second direction (F2) is approximately 90 degrees;
wherein the first extension part (12) has a first width W1, the second bending part (15) has a second width W2, the first extension part (12) and the second bending part (15) are spaced by a fourth width G4,
characterized in that:

the first width W1, the second width W2 and the fourth width G4 fulfill the following equation:

$$G4>(W1+W2)/2;$$

wherein the first width W1, the second width W2 and the fourth width G4 are all measured in the same unit, and wherein an arc-shaped side of the dual-band antenna (1) is formed along adjacent sides of the first extension part (12), the first main block (11), the connecting block (22), and the matching part (23).

2. The dual-band antenna (1) of claim 1, wherein the first main block (11) and the first extension part (12) are used for emitting and receiving signals with a first frequency, the signal of the first frequency has a first wavelength λ 1, a total length from the first main block (11) to the first extension part (12) is defined as a first length L1, and the first length L1 and the first wavelength λ 1 fulfill the following equation:

$$L1=(\lambda 1)/4;$$

wherein the first main block (11) and the second extension part (13) are used for emitting and receiving signals with a second frequency, the signal of the second frequency has a second wavelength λ 2, a total length from the first main block (11) to the second extension part (13) is defined as a second length L2, and the second length L2 and the second wavelength λ 2 fulfill the following equation:

$$L2=(\lambda 2)/4;$$

wherein the first length L1, the first wavelength λ 1, the second length L2 and the second wavelength λ 2 are all measured in centimeters.

3. The dual-band antenna (1) of claim 1, wherein the longitudinal direction of the first bending part (14) intersects that of the first extension part (12) by an angle which is approximately 90 degrees.

4. The dual-band antenna (1) of claim 1, wherein the longitudinal direction of the second bending part (15) intersects that of the second extension part (13) by an angle which is approximately 90 degrees.

5. The dual-band antenna (1) of claim 1, wherein an angle formed between the second extension part (13) and the first extension part (12) is in a range from more than 80 degrees to less than 90 degrees.

Patentansprüche

1. Dualbandantenne (1), umfassend:
einen ersten Strahlungsteil (10), der aus leitenden Materialien besteht, umfassend:

einen ersten Hauptblock (11);
einen ersten Verlängerungsteil (12), der sich von einer Seite des ersten Hauptblocks (11) aus erstreckt;
einen zweiten Verlängerungsteil (13), der sich von der genannten Seite des ersten Hauptblocks (11) aus erstreckt, jedoch in einer anderen Richtung als der erste Verlängerungsteil (12);
einen ersten Biegeteil (14), der sich von einem Ende des ersten Verlängerungsteils (12) gegenüber dem ersten Hauptblock (11), aber in einer anderen Richtung als eine Längsrichtung des ersten Verlängerungsteils (12) erstreckt; und
einen zweiten Biegeteil (15), der an einem Ende des zweiten Verlängerungsteils (13) angeordnet ist, das dem ersten Hauptblock (11) gegenüberliegt, wobei eine Längsrichtung des zweiten Biegeteils (15) von einer Längsrichtung des zweiten Verlängerungsteils (13) verschieden

ist; und
einen zweiten Strahlungsteil (20), der aus leitenden Materialien besteht und umfasst:

einen zweiten Hauptblock (21);
einen Verbindungsblock (22), der sich von dem zweiten Hauptblock (21) aus erstreckt; und
einen Anpassungsteil (23), der an einer Seite des Verbindungsblocks (22) gegenüber dem zweiten Hauptblock (21) angeordnet ist;
wobei der erste Hauptblock (11) von dem zweiten Hauptblock (21) durch einen ersten Spalt (G1) beabstandet ist, der Verbindungsblock (22) von dem ersten Hauptblock (11) durch einen zweiten Spalt (G2) beabstandet ist, der zweite Hauptblock (21) von dem zweiten Verlängerungsteil (13) durch einen dritten Spalt (G3) beabstandet ist, ein Ende eines Lötabschnitts (31) einer Signalleitung (30) auf den ersten Hauptblock (11) als ein Signalzuführungsende aufgelötet ist, und ein anderes Ende des Lötabschnitts (31) der Signalleitung (30) auf den zweiten Hauptblock (21) als Masse für Zuführungssignale aufgelötet ist;
wobei der erste Hauptblock (11), der erste Verlängerungsteil (12), der zweite Biegeteil (15) und der zweite Hauptblock (21) sich alle ungefähr in einer ersten Richtung (F1) erstrecken, der zweite Verlängerungsteil (13) und der erste Biegeteil (14) sich alle in einer zweiten Richtung (F2) erstrecken, und ein zwischen der ersten Richtung (F1) und der zweiten Richtung (F2) gebildeter Winkel ungefähr 90 Grad beträgt;
wobei der erste Verlängerungsteil (12) eine erste Breite W1 hat, der zweite Biegeteil (15) eine zweite Breite W2 hat, der erste Verlängerungsteil (12) und der zweite Biegeteil (15) durch eine vierte Breite G4 beabstandet sind,
dadurch gekennzeichnet, dass:

die erste Breite W1, die zweite Breite W2 und die vierte Breite G4 die folgende Gleichung erfüllen:

$$G4>(W1+W2)/2;$$

wobei die erste Breite W1, die zweite Breite W2 und die vierte Breite G4 alle in der gleichen Einheit gemessen werden, und wobei eine bogenförmige Seite der Dualbandantenne (1) entlang benachbarter Seiten des ersten Verlängerungsteils (12), des ersten Hauptblocks (11), des Verbindungsblocks (22) und des Anpassungsteils (23) gebildet wird.

2. Dualbandantenne (1) nach Anspruch 1, wobei der erste Hauptblock (11) und der erste Verlängerungsteil (12) zum Senden und Empfangen von Signalen mit einer ersten Frequenz verwendet werden, das Signal der ersten Frequenz eine erste Wellenlänge $\lambda 1$ hat, eine Gesamtlänge von dem ersten Hauptblock (11) zu dem ersten Verlängerungsteil (12) als eine erste Länge L1 definiert ist, und die erste Länge L1 und die erste Wellenlänge $\lambda 1$ die folgende Gleichung erfüllen:

$$L1=(\lambda 1)/4;$$

wobei der erste Hauptblock (11) und der zweite Verlängerungsteil (13) zum Senden und Empfangen von Signalen mit einer zweiten Frequenz verwendet werden, das Signal der zweiten Frequenz eine zweite Wellenlänge $\lambda 2$ hat, eine Gesamtlänge von dem ersten Hauptblock (11) zu dem zweiten Verlängerungsteil (13) als eine zweite Länge L2 definiert ist, und die zweite Länge L2 und die zweite Wellenlänge $\lambda 2$ die folgende Gleichung erfüllen:

$$L2=(\lambda 2)/4;$$

wobei die erste Länge L1, die erste Wellenlänge $\lambda 1$, die zweite Länge L2 und die zweite Wellenlänge $\lambda 2$ alle in Zentimetern gemessen werden.

3. Dualbandantenne (1) nach Anspruch 1, wobei die Längsrichtung des ersten Biegeteils (14) diejenige des ersten Verlängerungsteils (12) in einem Winkel von etwa 90 Grad schneidet.

4. Dualbandantenne (1) nach Anspruch 1, wobei die Längsrichtung des zweiten Biegeteils (15) diejenige des zweiten Verlängerungsteils (13) in einem Winkel von etwa 90 Grad schneidet.

5. Dualbandantenne (1) nach Anspruch 1, wobei ein zwischen dem zweiten Verlängerungsteil (13) und dem ersten Verlängerungsteil (12) gebildeter Winkel in einem Bereich von mehr als 80 Grad bis weniger als 90 Grad liegt.

Revendications

1. Antenne double bande (1), comprenant :

une première partie de rayonnement (10), cons-

tituée de matériaux conducteurs, incluant :

un premier bloc principal (11) ;
une première partie d'extension (12), s'étendant depuis un côté du premier bloc principal (11) ;
une deuxième partie d'extension (13), s'étendant depuis ledit côté du premier bloc principal (11) mais dans une direction différente de la première partie d'extension (12) ;
une première partie de courbure (14) s'étendant depuis une extrémité de la première partie d'extension (12), à l'opposé du premier bloc principal (11), mais dans une direction différente d'une direction longitudinale de ladite première partie d'extension (12) ; et
une deuxième partie de courbure (15) disposée à une extrémité de la deuxième partie d'extension (13), à l'opposé du premier bloc principal (11), dans laquelle une direction longitudinale de la deuxième partie de courbure (15) est différente d'une direction longitudinale de ladite deuxième partie d'extension (13) ; et

une deuxième partie de rayonnement (20), constituée de matériaux conducteurs, incluant :

un deuxième bloc principal (21) ;
un bloc de liaison (22) s'étendant depuis le deuxième bloc principal (21) ; et
une partie de correspondance (23) disposée à un côté du bloc de liaison (22) à l'opposé du deuxième bloc principal (21) ;

dans laquelle le premier bloc principal (11) est espacé du deuxième bloc principal (21) d'un premier espacement (G1), le bloc de liaison (22) est espacé du premier bloc principal (11) d'un deuxième espacement (G2), le deuxième bloc principal (21) est espacé de la deuxième partie d'extension (13) d'un troisième espacement (G3),
une extrémité d'une section de soudage (31) d'une ligne de signal (30) est soudée sur le premier bloc principal (11) en tant qu'une extrémité d'alimentation de signal, et une autre extrémité de la section de soudage (31) de la ligne de signal (30) est soudée sur le deuxième bloc principal (21) en tant qu'une masse pour alimenter des signaux ;
dans laquelle le premier bloc principal (11), la première partie d'extension (12), la deuxième partie de courbure (15) et le deuxième bloc principal (21) sont tous étendus approximativement dans une première direction (F1), la deuxième partie d'extension (13) et la première partie de courbure (14) sont toutes étendues dans une deuxième direction (F2), et un angle formé entre la première direction (F1) et la deuxième direction (F2) est approximativement 90 degrés ;
dans laquelle la première partie d'extension (12) présente une première largeur W1, la deuxième partie de courbure (15) présente une deuxième largeur W2, la première partie d'extension (12) et la deuxième partie de courbure (15) sont espacées d'une quatrième largeur G4,
caractérisée en ce que :
la première largeur W1, la deuxième largeur W2 et la quatrième largeur G4 satisfont l'équation suivante :

$$G4>(W1+W2)/2 ;$$

dans laquelle la première largeur W1, la deuxième largeur W2 et la quatrième largeur G4 sont toutes mesurées dans la même unité, et
dans laquelle un côté arqué de l'antenne double bande (1) est formé le long de côtés adjacents de la première partie d'extension (12), du premier bloc principal (11), du bloc de liaison (22), et de la partie de correspondance (23).

2. Antenne double bande (1) selon la revendication 1, dans laquelle le premier bloc principal (11) et la première partie d'extension (12) sont utilisées pour émettre et recevoir des signaux avec une première fréquence, le signal de la première fréquence présente une première longueur d'onde $\lambda 1$, une longueur totale depuis le premier bloc principal (11) jusqu'à la première partie d'extension (12) est définie en tant qu'une première longueur L1, et la première longueur L1 et la première longueur d'onde $\lambda 1$ satisfont l'équation suivante :

$$L1=(\lambda 1)/4 ;$$

dans laquelle le premier bloc principal (11) et la deuxième partie d'extension (13) sont utilisés pour émettre et recevoir des signaux avec une deuxième fréquence, le signal de la deuxième fréquence présente une deuxième longueur d'onde $\lambda 2$, une longueur totale depuis le premier bloc principal (11) jusqu'à la deuxième partie d'extension (13) est définie en tant qu'une deuxième longueur L2, et la deuxième longueur L2 et la deuxième longueur d'onde $\lambda 2$ satisfont l'équation suivante :

$$L2=(\lambda 2)/4 ;$$

dans laquelle la première longueur L1, la première longueur d'onde $\lambda 1$, la deuxième longueur L2 et la deuxième longueur d'onde $\lambda 2$ sont toutes mesurées en centimètres.

3. Antenne double bande (1) selon la revendication 1, dans laquelle la direction longitudinale de la première partie de courbure (14) est en intersection avec celle de la première partie d'extension (12) à un angle qui est approximativement 90 degrés.

4. Antenne double bande (1) selon la revendication 1, dans laquelle la direction longitudinale de la deuxième partie de courbure (15) est en intersection avec celle de la deuxième partie d'extension (13) à un angle qui est approximativement 90 degrés.

5. Antenne double bande (1) selon la revendication 1, dans laquelle un angle formé entre la deuxième partie d'extension (13) et la première partie d'extension (12) est dans une plage de plus de 80 degrés à moins de 90 degrés.

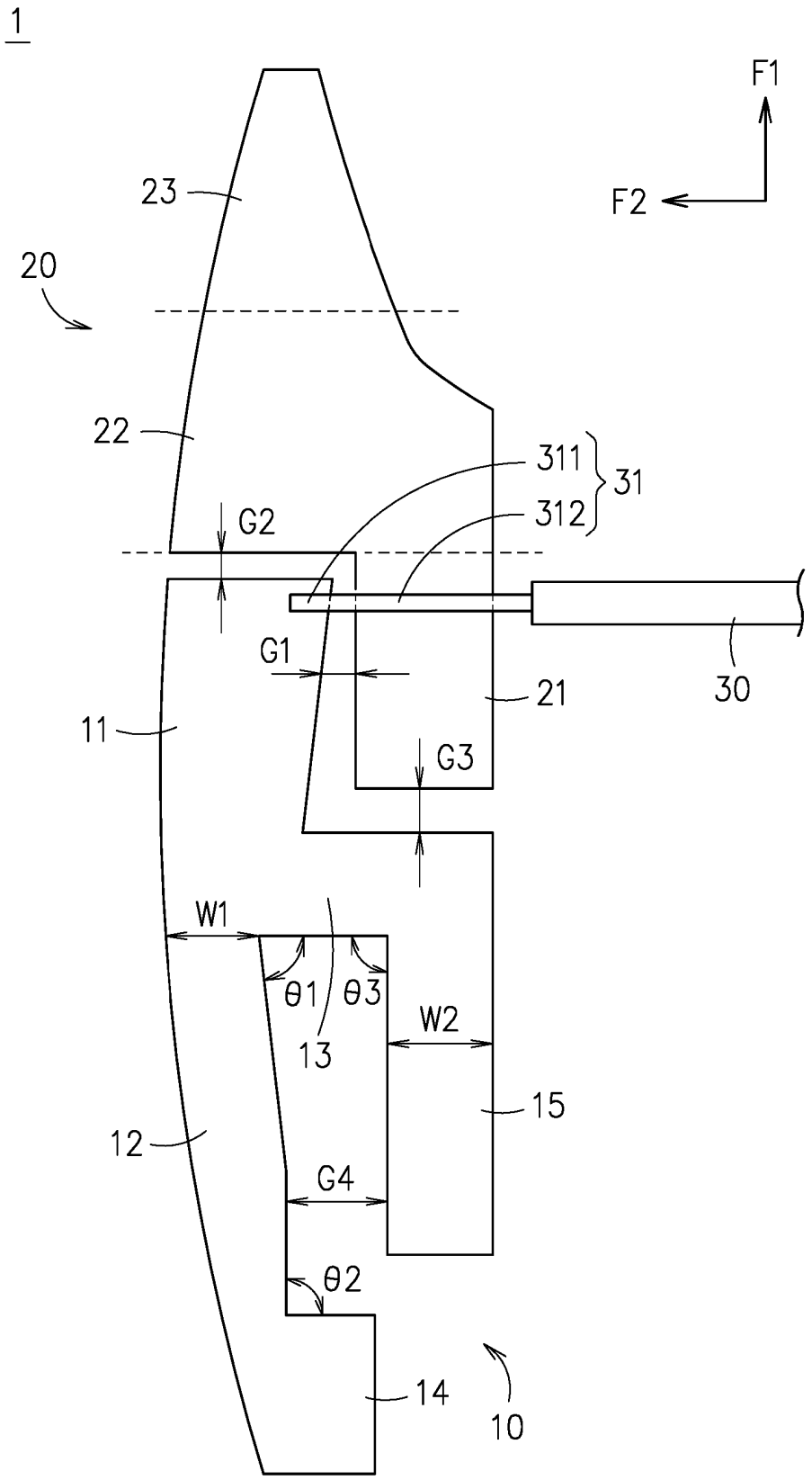

1
F1
F2
23
20
22
311
312
31
G2
G1
21
30
11
G3
W1
θ1
θ3
W2
13
15
12
G4
θ2
14
10

FIG. 1

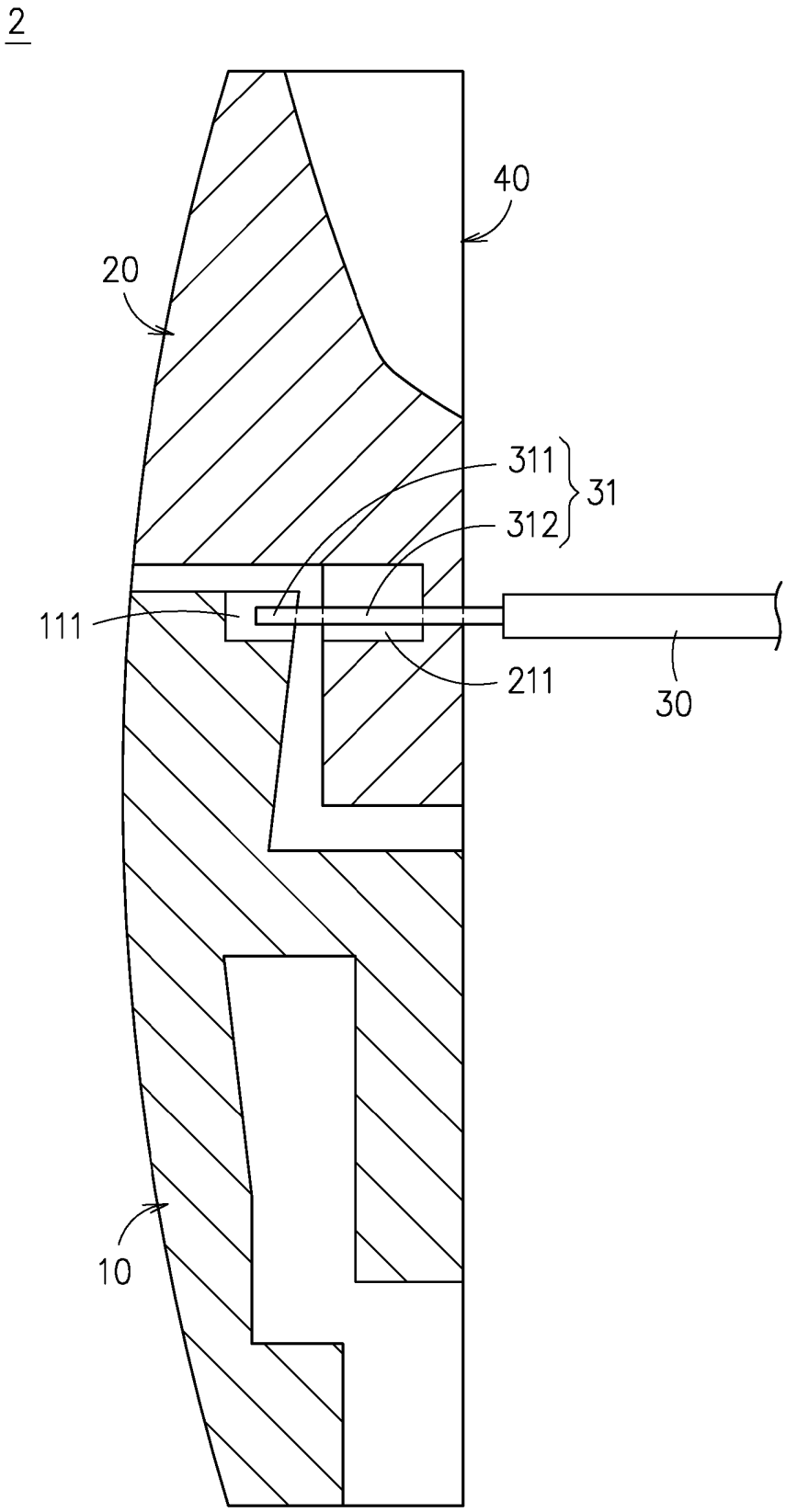


FIG. 2

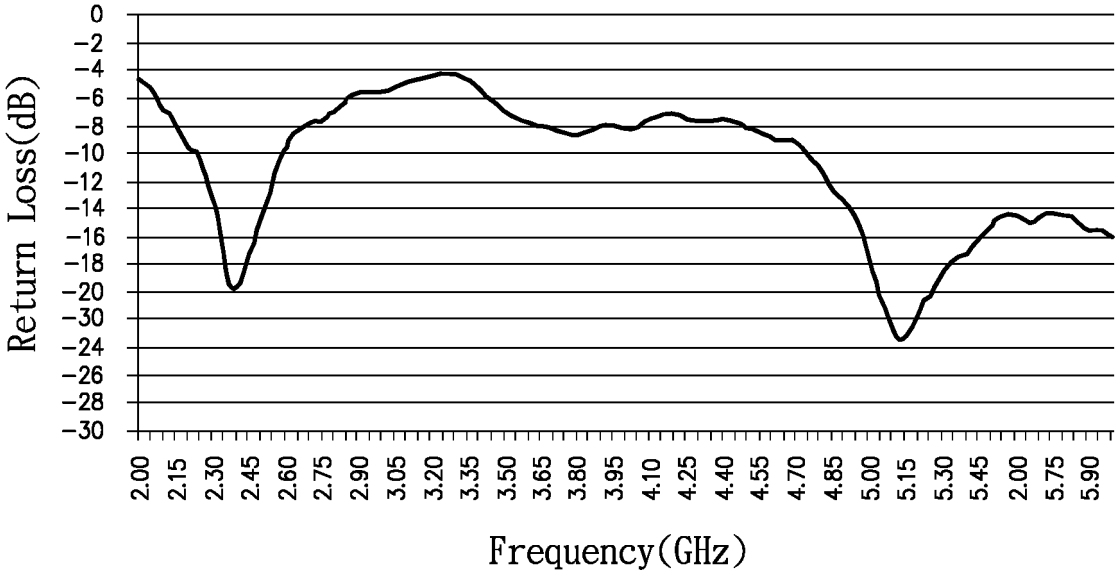

Return Loss(dB)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-30
-24
-26
-28
-30
2.00
2.15
2.30
2.45
2.60
2.75
2.90
3.05
3.20
3.35
3.50
3.65
3.80
3.95
4.10
4.25
4.40
4.55
4.70
4.85
5.00
5.15
5.30
5.45
2.00
5.75
5.90
Frequency(GHz)

FIG. 3

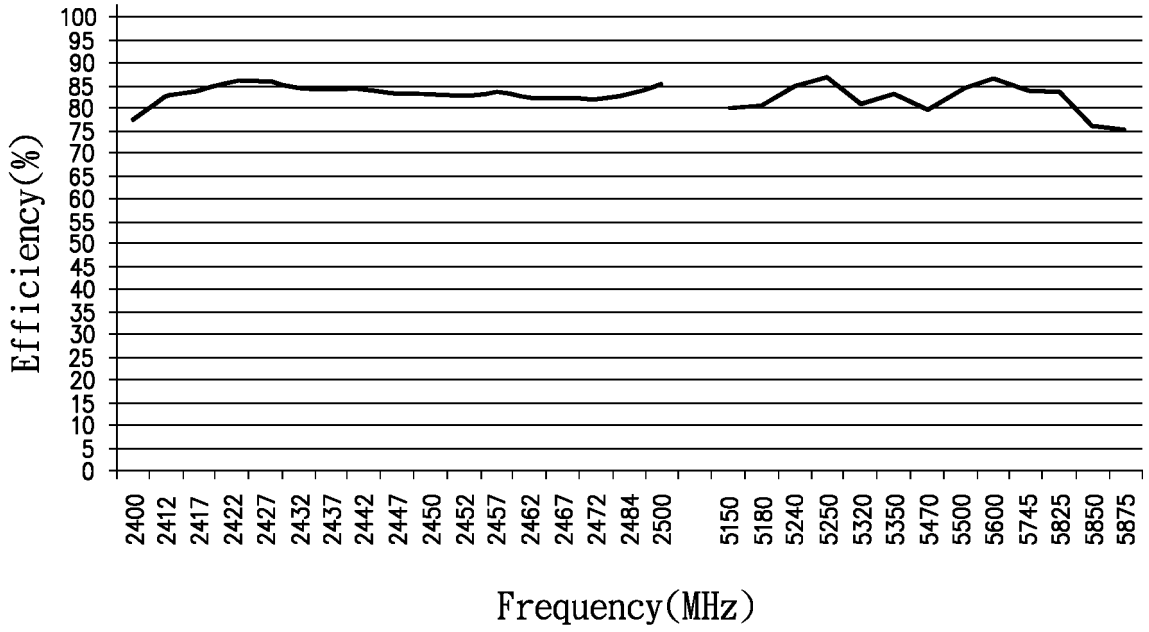

Efficiency(%)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
2400
2412
2417
2422
2427
2432
2437
2442
2447
2450
2452
2457
2462
2467
2472
2484
2500
5150
5180
5240
5250
5320
5350
5470
5500
5600
5745
5825
5850
5875
Frequency(MHz)

FIG. 4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20140085145 A1 **[0003]**
- US 20140132469 A1 **[0004]**