



(11)

EP 4 325 881 A1

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:

21.02.2024 Bulletin 2024/08

(51) International Patent Classification (IPC):

H04Q 1/38 (2006.01)

(21) Application number: **22810351.1**

(86) International application number:

PCT/CN2022/091741

(22) Date of filing: **09.05.2022**

(87) International publication number:

WO 2022/247624 (01.12.2022 Gazette 2022/48)

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

Designated Extension States:

BA ME

Designated Validation States:

KH MA MD TN

(72) Inventors:

- **WU, Zubing**
Chengdu, Sichuan 610002 (CN)
- **ZHAO, Guohua**
Chengdu, Sichuan 610002 (CN)
- **GUO, Fanyu**
Chengdu, Sichuan 610002 (CN)
- **XU, Fengkai**
Chengdu, Sichuan 610002 (CN)

(30) Priority: **26.05.2021 CN 202110574673**

(71) Applicant: **Chengdu T-Ray Technology Co., Ltd.**
Chengdu, Sichuan 610015 (CN)

(74) Representative: **Caspary, Karsten et al**

Kroher-Strobel
Rechts- und Patentanwälte PartmbB
Bavariaring 20
80336 München (DE)

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

(57) The present disclosure provides a microstrip antenna structure and a communication device, which relate to the technical field of microwave communications. In the present disclosure, an antenna feed assembly and a coupling patch in an antenna radiation assembly are mutually communicatively provided on a side surface of a second dielectric plate, and an antenna ground is provided on the other side surface of the second dielectric plate; then, a radiation patch in the antenna radiation assembly is provided on a side surface of a first dielectric plate, and the other side surface of the first dielectric plate is laminated over the second dielectric plate and spaced by the coupling patch and the antenna feed assembly; the radiation patch has on the second dielectric plate a patch projection area that at least partially overlaps with the coupling patch, and the antenna feed assembly is distributed outside of the patch projection area of the radiation patch. Therefore, while the communication function of the antenna structure is realized, the feed assembly and the antenna radiation assembly are integrally arranged on a same layer of physical structure, which decreases the overall height of the antenna structure, reduces the space occupied thereby, and facilitates its use.

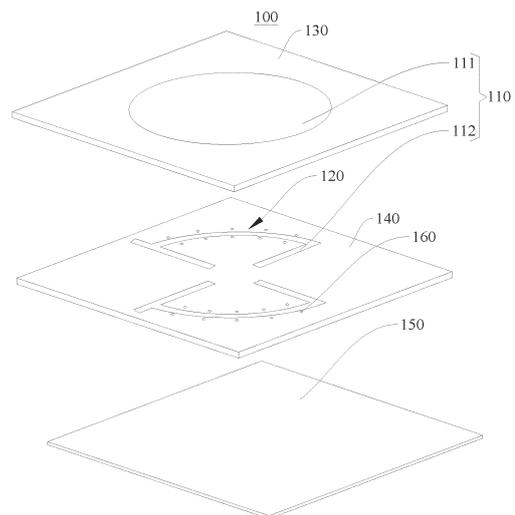


Fig. 1

EP 4 325 881 A1

Description**FIELD OF THE DISCLOSURE**

[0001] The present disclosure relates to the field of microwave communications, and in particular, to a microstrip antenna structure and a communication device.

BACKGROUND OF THE DISCLOSURE

[0002] With the constant advancement of science and technology, microwave communications have been increasingly applied across various major industries, and people have put forward higher requirements for hardware performance of antennas. Microstrip antennas, with their small size, simple structure, easy manufacture, and low profile, are attracting extensive attention in the field of microwave communications.

[0003] For a conventional microstrip antenna, it is generally necessary to design a corresponding feed circuit as a separate layer of physical structure, which in turn greatly increases the overall antenna thickness, raises the level of difficulty in designing a communication system, and is not conducive to integration with other communication hardware units.

SUMMARY OF THE DISCLOSURE

[0004] In view of the above, it is an object of the present disclosure to provide a microstrip antenna structure and a communication device, which can integrally arrange a feed assembly and an antenna radiation assembly on a same layer of physical structure, thereby decreasing the overall height of the antenna structure, reducing the space occupied thereby, and facilitating its use.

[0005] In order to attain the object above, the technical solutions employed in the embodiments of the present disclosure are as follows.

[0006] According to a first aspect, the present disclosure provides a microstrip antenna structure, comprising an antenna radiation assembly, an antenna feed assembly, a first dielectric plate, a second dielectric plate, and an antenna ground, wherein the antenna radiation assembly comprises a radiation patch and a coupling patch;

The coupling patch and the antenna feed assembly are mutually communicatively provided on a side surface of the second dielectric plate, and the antenna ground is provided on the other side surface of the second dielectric plate;

The radiation patch is provided on a side surface of the first dielectric plate, and the other side surface of the first dielectric plate is laminated over the second dielectric plate and spaced by the coupling patch and the antenna feed assembly; the radiation patch has on the second dielectric plate a patch projection area that at least partially overlaps with the coupling patch, and the antenna feed assembly is located out-

side of the patch projection area.

[0007] In an optional implementation, the coupling patch comprises a first strip-shaped patch, a second strip-shaped patch, a third strip-shaped patch, and a fourth strip-shaped patch that are distributed annularly, and the first strip-shaped patch has a length extension direction that is perpendicular to that of the second strip-shaped patch;

The first strip-shaped patch is spaced apart from the third strip-shaped patch, and the length extension direction of the first strip-shaped patch coincides with that of the third strip-shaped patch;

The second strip-shaped patch is spaced apart from the fourth strip-shaped patch, and the length extension direction of the second strip-shaped patch coincides with that of the fourth strip-shaped patch;

In the implementation, an interval space between the first strip-shaped patch and the third strip-shaped patch merges with an interval space between the second strip-shaped patch and the fourth strip-shaped patch.

[0008] In an optional implementation, the first strip-shaped patch and the second strip-shaped patch have an identical patch size, the first strip-shaped patch and the third strip-shaped patch are centrally symmetrically distributed, and the second strip-shaped patch and the fourth strip-shaped patch are centrally symmetrically distributed.

[0009] In an optional implementation, a symmetric center between the first strip-shaped patch and the third strip-shaped patch coincides with that between the second strip-shaped patch and the fourth strip-shaped patch; In the implementation, the first strip-shaped patch, the second strip-shaped patch, the third strip-shaped patch, and the fourth strip-shaped patch each are at an equal distance from the symmetric center.

[0010] In an optional implementation, the antenna feed assembly comprises a signal transmission strip and a plurality of feed connection strips, and the feed connection strips have a total number of less than four;

The signal transmission strip is in communication with the first strip-shaped patch, the second strip-shaped patch, the third strip-shaped patch, and the fourth strip-shaped patch through the plurality of feed connection strips, and each of the feed connection strips is configured to communicate respective end portions of any pair of adjacent strip-shaped patches among the first strip-shaped patch, the second strip-shaped patch, the third strip-shaped patch, and the fourth strip-shaped patch, which end portions are distal from the interval space.

[0011] In an optional implementation, where the feed connection strips have a total number of two, the plurality of feed connection strips comprise a first connection strip and a second connection strip, and the signal transmission strip comprises a first transmission strip and a sec-

ond transmission strip;

The first connection strip has one end in communication with an end portion of the first strip-shaped patch distal from the interval space, and the other end in communication with an end portion of the second strip-shaped patch distal from the interval space; The second connection strip has one end in communication with an end portion of the third strip-shaped patch distal from the interval space, and the other end in communication with an end portion of the fourth strip-shaped patch distal from the interval space;

In the implementation, the first transmission strip is in communication with an end portion of the first strip-shaped patch distal from the interval space, and the second transmission strip is in communication with an end portion of the fourth strip-shaped patch distal from the interval space;

Or, the first transmission strip is in communication with an end portion of the second strip-shaped patch distal from the interval space, and the second transmission strip is in communication with an end portion of the third strip-shaped patch distal from the interval space;

Or, the first transmission strip is in direct communication with the first connection strip, and the second transmission strip in direct communication with the second connection strip.

[0012] In an optional implementation, where the feed connection strips have a total number of three, the plurality of feed connection strips comprise a first connection strip, a second connection strip, and a third connection strip;

The first connection strip has one end in communication with an end portion of the first strip-shaped patch distal from the interval space, and the other end in communication with an end portion of the second strip-shaped patch distal from the interval space; The second connection strip has one end in communication with an end portion of the third strip-shaped patch distal from the interval space, and the other end in communication with an end portion of the fourth strip-shaped patch distal from the interval space;

The third connection strip has one end in communication with an end portion of the second strip-shaped patch distal from the interval space, and the other end in communication with an end portion of the third strip-shaped patch distal from the interval space; The signal transmission strip is in communication with an end portion of the first strip-shaped patch or the fourth strip-shaped patch distal from the interval space; or the signal transmission strip is in direct communication with one of the first connection strip, the second connection strip, and the third connection

strip.

[0013] In an optional implementation, where the feed connection strips has a total number of three, the plurality of feed connection strips comprise a first connection strip, a second connection strip, and a fourth connection strip;

The first connection strip has one end in communication with an end portion of the first strip-shaped patch distal from the interval space, and the other end in communication with an end portion of the second strip-shaped patch distal from the interval space; The second connection strip has one end in communication with an end portion of the third strip-shaped patch distal from the interval space, and the other end in communication with an end portion of the fourth strip-shaped patch distal from the interval space;

The fourth connection strip has one end in communication with an end portion of the first strip-shaped patch distal from the interval space, and the other end in communication with an end portion of the fourth strip-shaped patch distal from the interval space;

The signal transmission strip is in direct communication with one of the first connection strip, the second connection strip, and the fourth connection strip.

[0014] In an optional implementation, the second dielectric plate is provided with a plurality of isolation holes that run through the second dielectric plate, wherein the plurality of isolation holes are distributed around the antenna feed assembly and are in communication with the antenna ground.

[0015] According to a second aspect, the present disclosure provides a communication device, comprising at least one microstrip antenna structure according to any one of the foregoing implementations.

[0016] In this case, the beneficial effects of the embodiments of the present disclosure include the following.

[0017] In the present disclosure, the antenna feed assembly and the coupling patch in the antenna radiation assembly are mutually communicatively provided on a side surface of the second dielectric plate, and the antenna ground is provided on the other side surface of the second dielectric plate; then, the radiation patch in the antenna radiation assembly is provided on a side surface of the first dielectric plate, and the other side surface of the first dielectric plate is laminated over the second dielectric plate and spaced by the coupling patch and the antenna feed assembly; the radiation patch has on the second dielectric plate a patch projection area that at least partially overlaps with the coupling patch, and the antenna feed assembly is distributed outside of the patch projection area of the radiation patch, so as to form an antenna feed point in the patch projection area of the radiation patch through the coupling patch, ensuring that the antenna feed assembly can perform signal coupling and

transmission through the coupling patch and the radiation patch. Therefore, while the communication function of the antenna structure is realized, the feed assembly and the antenna radiation assembly are integrally arranged on a same layer of physical structure, which decreases the overall height of the antenna structure, reduces the space occupied thereby, and facilitates its use.

[0018] In order to make the above objects, features and advantages of the present disclosure more apparent, preferred embodiments are exemplified below, and are described in detail as follows in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] In order to more clearly illustrate the technical solutions of the embodiments of the present disclosure, the accompanying drawings to be used in the embodiments will be briefly introduced below. It should be understood that the following figures are only illustrative of certain embodiments of the present disclosure, and therefore should not be regarded as limiting to its scope. For those skilled in the art, other related drawings could also be obtained from these drawings without exercise of any ingenuity.

FIG. 1 is a diagram of composition of a microstrip antenna structure according to an embodiment of the present disclosure;

FIG. 2 is a first diagram of communication between an antenna feed assembly and a coupling patch according to an embodiment of the present disclosure; FIG. 3 is a second diagram of communication between an antenna feed assembly and a coupling patch according to an embodiment of the present disclosure;

FIG. 4 is a third diagram of communication between an antenna feed assembly and a coupling patch according to an embodiment of the present disclosure; and

FIG. 5 is a fourth diagram of communication between an antenna feed assembly and a coupling patch according to an embodiment of the present disclosure.

[0020] Reference numbers in the figures include: 100-microstrip antenna structure; 110-antenna radiation assembly; 111-radiation patch; 112-coupling patch; 113-first strip-shaped patch; 114-second strip-shaped patch; 115-third strip-shaped patch; 116-fourth strip-shaped patch; 120-antenna feed assembly; 130-first dielectric plate; 140-second dielectric plate; 150-antenna ground; 121-feed connection strip; 122-signal transmission strip; 123-first connection strip; 124-second connection strip; 125-third connection strip; 126-fourth connection strip; 127-first transmission strip; 128-second transmission strip; 160-isolation hole.

DETAILED IMPLEMENTATION OF THE DISCLOSURE

[0021] In order to make the objects, technical solutions and advantages of the embodiments of the present disclosure clearer, the technical solutions in the embodiments of the present disclosure will be clearly and completely described below in conjunction with the accompanying drawings. Apparently, the embodiments described herein are some, but not all, embodiments of the present disclosure. The components in the embodiments of the present disclosure described and illustrated herein may generally be arranged and designed in a variety of different configurations.

[0022] Accordingly, the following detailed description of the embodiments of the present disclosure as provided in the accompanying drawings is not intended to limit the scope of the present disclosure, but merely to indicate selected embodiments of the present disclosure. Based on the embodiments in the present disclosure, all other embodiments obtained without exercise of ingenuity by a person of ordinary skill in the art fall within the scope of protection of the present disclosure.

[0023] It should be noted that like reference numerals and letters refer to like items in the following figures, and thus, once an item is defined in one figure, it need not be further defined and explained in subsequent ones.

[0024] In the description of the present disclosure, it should be noted that an orientation or a positional relationship indicated by the terms "central", "upper", "lower", "left", "right", "vertical", "horizontal", "inner", "outer" and the like, if any, is based on that shown in the drawings, or that of the product of the present disclosure as it is in use. This is only for ease and simplicity of description, without indicating or implying that the device or the element referred to must have a specific orientation, or be constructed and operated in a particular orientation, and thus it should not be construed as limiting to the present disclosure.

[0025] In addition, the terms "first", "second" and the like are merely used to distinguish one entity or operation from another, and do not necessarily require or imply that any such actual relationship or order exists between these entities or operations. Moreover, the terms "including", "comprising", or any other variant thereof, are intended to cover non-exclusive inclusion, such that a process, method, article, or apparatus comprising a set of elements includes not only those elements, but also other elements not expressly listed, or elements that are inherent to such process, method, article or apparatus. Without further limitation, the fact that an element is defined by the phrase "comprising a" does not preclude the existence of additional identical elements in the process, method, article or apparatus that comprises the element.

[0026] In the description of the present disclosure, it should also be noted that, unless otherwise expressly specified or defined, the terms "provided", "mounted", "coupled" and "connected" and the like are to be under-

stood in a broad sense. For example, it may be a fixed connection, a detachable connection, or an integral connection; it may be a mechanical connection or an electrical connection; it may be a direct connection, or an indirect connection through an intermediary, or an internal communication of two elements. For a person of ordinary skill in the art, the specific meanings of these terms in the present disclosure may be understood in specific contexts.

[0027] Some embodiments of the present disclosure are described in detail below in conjunction with the accompanying drawings. The following embodiments and features therein may be combined with each other in the absence of conflicts.

[0028] Referring to FIG. 1, FIG. 1 is a diagram of composition of a microstrip antenna 100 structure according to an embodiment of the present disclosure. In this embodiment of the present disclosure, the microstrip antenna structure 100 is capable of integrally arranging a feed assembly and an antenna radiation assembly on a same layer of physical structure while realizing its own antenna communication function, thereby decreasing the overall height of the antenna structure, reducing the space occupied thereby, and facilitating its use. The microstrip antenna structure 100 may comprise an antenna radiation assembly 110, an antenna feed assembly 120, a first dielectric plate 130, a second dielectric plate 140, and an antenna ground 150.

[0029] In this embodiment, the antenna radiation assembly 110 comprises a radiation patch 111 and a coupling patch 112, wherein the radiation patch 111 is configured to implement a signal transceiving function, and the coupling patch 112 is configured to establish a signal coupling relationship with the radiation patch 111, such that on the one hand, a hardware structure having an antenna feed function uses the coupling patch 112 to transmit, by means of signal coupling, a to-be-transmitted electromagnetic wave signal to the radiation patch 111 for signal transmission processing, and on the other hand, the radiation patch 111 transmits, by means of signal coupling, the received electromagnetic wave signal to the coupling patch 112, which coupling patch 112 transmits the received electromagnetic wave signal to the hardware structure having an antenna feed function. The radiation patch 111 may have a patch shape that is, but not limited to, any one of a circle, an ellipse, a square, a polygon, and the like.

[0030] In this embodiment, the antenna feed assembly 120 is configured to implement an antenna feed function of the microstrip antenna structure 100, and the antenna ground 150 is configured to implement a grounding function of the microstrip antenna structure 100. The coupling patch 112 and the antenna feed assembly 120 are provided on a same side surface of the second dielectric plate 140, and the coupling patch 112 is in communication with the antenna feed assembly 120, so that the antenna feed assembly 120 performs signal coupling and transmission through the coupling patch

112 and the radiation patch 111. The antenna ground 150 is provided on the other side surface of the second dielectric plate 140.

[0031] In this embodiment, the radiation patch 111 is provided on a side surface of the first dielectric plate 130, and the other side surface of the first dielectric plate 130 is laminated over the second dielectric plate 140 and spaced by the coupling patch 112 and the antenna feed assembly 120; the radiation patch 111 has on the second dielectric plate 140 a patch projection area that at least partially overlaps with the coupling patch 112, so as to form an antenna feed point in the patch projection area of the radiation patch 111 through the coupling patch 112, which facilitates establishing a signal transmission relationship between the antenna feed assembly 120 and the radiation patch 111; meanwhile, the antenna feed assembly 120 is distributed outside of the patch projection area of the radiation patch 111, so as to prevent the antenna feed assembly 120 from interfering with the signal coupling performance of the coupling patch 112 as much as possible, thereby ensuring that the antenna feed assembly 120 can perform signal coupling and transmission through the coupling patch 112 and the radiation patch 111.

[0032] As such, while the present disclosure realizes the communication function of the microstrip antenna structure 100, the antenna feed assembly 120 and the antenna radiation assembly 110 are integrally arranged on a same layer of physical structure, which decreases the overall height of the antenna structure, reduces the space occupied thereby, and facilitates its use.

[0033] In this embodiment of the present disclosure, the coupling patch 112 may comprise a plurality of strip-shaped patches, and the coupling patch 112 forms a plurality of antenna feed points in the patch projection area of the radiation patch 111 through the plurality of strip-shaped patches, so as to extend the microstrip antenna structure 100 to a multi-feed-point antenna. The strip-shaped patches may have a number of two, three, four, or more, each strip-shaped patch correspondingly forming one antenna feed point. Taking two strip-shaped patches for example, the two strip-shaped patches may be distributed in a manner that their length extension directions are perpendicular to each other; taking three strip-shaped patches for example, the three strip-shaped patches may be distributed in a manner that their length extension directions form 120° angles relative to each other. The specific implementation of the coupling patch 112 is illustrated below by taking four strip-shaped patches for example.

[0034] Referring to FIG. 2, FIG. 2 is a first diagram of communication between the antenna feed assembly 120 and the coupling patch 112 according to an embodiment of the present disclosure. In this embodiment, the four strip-shaped patches comprised in the coupling patch 112 may be represented as a first strip-shaped patch 113, a second strip-shaped patch 114, a third strip-shaped patch 115, and a fourth strip-shaped patch 116,

respectively.

[0035] In this embodiment, the first strip-shaped patch 113, the second strip-shaped patch 114, the third strip-shaped patch 115, and the fourth strip-shaped patch 116 are annularly distributed on the second dielectric plate 140, and the first strip-shaped patch 113 has a length extension direction that is perpendicular to that of the second strip-shaped patch 114. The first strip-shaped patch 113 is spaced apart from the third strip-shaped patch 115, and the first strip-shaped patch 113 has a length extension direction that coincides with that of the third strip-shaped patch 115, so as to arrange the first strip-shaped patch 113 and the third strip-shaped patch 115 on a same straight line in a spaced manner. The second strip-shaped patch 114 is spaced apart from the fourth strip-shaped patch 116, and the second strip-shaped patch 114 has a length extension direction that coincides with that of the fourth strip-shaped patch 116, so as to arrange the second strip-shaped patch 114 and the fourth strip-shaped patch 116 on a same straight line in a spaced manner. An interval space between the first strip-shaped patch 113 and the third strip-shaped patch 115 merges with that between the second strip-shaped patch 114 and the fourth strip-shaped patch 116. Accordingly, the first strip-shaped patch 113, the second strip-shaped patch 114, the third strip-shaped patch 115, and the fourth strip-shaped patch 116 present a cross-like distribution as a whole (the respective length extension directions of adjacent strip-shaped patches are perpendicular to each other), so that each of the first strip-shaped patch 113, the second strip-shaped patch 114, the third strip-shaped patch 115, and the fourth strip-shaped patch 116 uses an end portion proximate to the interval space as one antenna feed point of the microstrip antenna structure 100, making electromagnetic wave signals transmitted through the four strip-shaped patches exhibit a phase difference that is a multiple of 90° .

[0036] In this embodiment, the first strip-shaped patch 113, the second strip-shaped patch 114, the third strip-shaped patch 115, and the fourth strip-shaped patch 116 each may have identical, partially identical, or completely different patch sizes, and the specific patch size may be configured differently by an antenna designer according to needs of antenna communication performances. In an implementation of this embodiment, the first strip-shaped patch 113 and the second strip-shaped patch 114 have an identical patch size, the first strip-shaped patch 113 and the third strip-shaped patch 115 are centrally symmetrically distributed, and the second strip-shaped patch 114 and the fourth strip-shaped patch 116 are centrally symmetrically distributed; at this time, the first strip-shaped patch 113, the second strip-shaped patch 114, the third strip-shaped patch 115, and the fourth strip-shaped patch 116 each have an identical patch size.

[0037] In this embodiment, if the first strip-shaped patch 113 and the second strip-shaped patch 114 have an identical patch size, the first strip-shaped patch 113 and

the third strip-shaped patch 115 are centrally symmetrically distributed, and the second strip-shaped patch 114 and the fourth strip-shaped patch 116 are centrally symmetrically distributed, then a symmetric center between the first strip-shaped patch 113 and the third strip-shaped patch 115 may coincide with that between the second strip-shaped patch 114 and the fourth strip-shaped patch 116, or may not coincide therewith, and the distance from the first strip-shaped patch 113 and the third strip-shaped patch 115 to a corresponding symmetric center may be the same as or different from that from the second strip-shaped patch 114 and the fourth strip-shaped patch 116 to a corresponding symmetric center. The specific coincidence of the symmetric center(s) and/or the distance(s) to the corresponding symmetric center(s) may also be differently configured by antenna designers according to requirements for antenna communication performance.

[0038] In an implementation of this embodiment, to stabilize the signal coupling performance of the coupling patch 112, where the first strip-shaped patch 113, the second strip-shaped patch 114, the third strip-shaped patch 115, and the fourth strip-shaped patch 116 each have an identical patch size, the symmetric center between the first strip-shaped patch 113 and the third strip-shaped patch 115 may be designed to be in a state of coinciding with that between the second strip-shaped patch 114 and the fourth strip-shaped patch 116, and the first strip-shaped patch 113, the second strip-shaped patch 114, the third strip-shaped patch 115, and the fourth strip-shaped patch 116 each are at an equal distance from the symmetric center.

[0039] In this embodiment of the present disclosure, when the coupling patch 112 comprises the first strip-shaped patch 113, the second strip-shaped patch 114, the third strip-shaped patch 115, and the fourth strip-shaped patch 116, to ensure that the antenna feed assembly 120 can cooperate with the four strip-shaped patches to express a specific antenna polarization mode of the microstrip antenna structure 100, the antenna feed assembly 120 may construct the antenna polarization of the microstrip antenna structure 100 through a signal transmission strip 122 and a plurality of feed connection strips 121 as comprised therein, where the antenna polarization mode of the microstrip antenna structure 100 may be any one of a dual circular polarization mode, a left-hand circular polarization mode, a right-hand circular polarization mode, and a linear polarization mode.

[0040] In this embodiment, the signal transmission strip 122 is configured to serve as an electromagnetic wave signal input/output port of the antenna feed assembly 120, and the signal transmission strip 122 needs to communicate with the first strip-shaped patch 113, the second strip-shaped patch 114, the third strip-shaped patch 115, and the fourth strip-shaped patch 116 through the plurality of feed connection strips 121, so as to construct the specific antenna polarization mode of the microstrip antenna structure 100. In this process, each of

the feed connection strips 121 is configured to communicate respective end portions of any pair of adjacent strip-shaped patches among the first strip-shaped patch 113, the second strip-shaped patch 114, the third strip-shaped patch 115, and the fourth strip-shaped patches 116, which end portions are distal from the interval space. In addition, the feed connection strips 121 need to have a total number of less than four to prevent the plurality of feed connection strips 121 from communicating with each other to form a closed-loop structure, thereby preventing the antenna feed assembly 120 from being short-circuited, and avoiding the phenomenon that the antenna polarization mode cannot be realized.

[0041] Optionally, referring to FIG. 2, in this embodiment, if the antenna polarization of the microstrip antenna structure 100 needs to be constructed as a dual circular one, it is necessary to have two feed connection strips 121 and divide the signal transmission strip 122 into two transmission strips that operate independently. At this time, it is necessary to communicate each of the four strip-shaped patches comprised in the coupling patch 112 with only one strip-shaped patch by adopting the two feed connection strips 121, to have the two feed connection strips 121 diagonally distributed, and then to mount the two transmission strips on respective end portions of a pair of uncommunicated adjacent strip-shaped patches, which end portions are distal from the interval space, or to mount the two transmission strips on one feed connection strip 121 respectively, so that a dual circular polarization of the antenna is achieved through such communication between the antenna feed assembly 120 and the four strip-shaped patches.

[0042] For example, the first strip-shaped patch 113 is communicated with the second strip-shaped patch 114 through one feed connection strip 121, and the third strip-shaped patch 115 is communicated with the fourth strip-shaped patch 116 through the other feed connection strip 121. At this time, one transmission strip may be mounted on the first strip-shaped patch 113, and the other transmission strip on the fourth strip-shaped patch 116, so as to realize dual circular polarization of the antenna; or, one transmission strip may be mounted on the second strip-shaped patch 114, and the other transmission strip on the third strip-shaped patch 115, so as to realize the dual circular polarization of the antenna; or, one transmission strip may be mounted directly on the feed connection strip 121 between the first strip-shaped patch 113 and the second strip-shaped patch 114, and the other transmission strip directly on the feed connection strip 121 between the third strip-shaped patch 115 and the fourth strip-shaped patch 116, so as to realize dual circular polarization of the antenna.

[0043] Or, the first strip-shaped patch 113 is communicated with the fourth strip-shaped patch 116 through one feed connection strip 121, and the third strip-shaped patch 115 is communicated with the second strip-shaped patch 114 through the other feed connection strip 121. At this time, one transmission strip may be mounted on the

first strip-shaped patch 113, and the other transmission strip on the second strip-shaped patch 114, so as to realize dual circular polarization of the antenna; or, one transmission strip may be mounted on the third strip-shaped patch 115, and the other transmission strip on the fourth strip-shaped patch 116, so as to realize dual circular polarization of the antenna; or, one transmission strip may be mounted directly on the feed connection strip 121 between the first strip-shaped patch 113 and the fourth strip-shaped patch 116, and the other transmission strip directly on the feed connection strip 121 between the third strip-shaped patch 115 and the second strip-shaped patch 114, so as to realize dual circular polarization of the antenna.

[0044] In an implementation of this embodiment, where the feed connection strips 121 has a total number of two, the plurality of feed connection strips 121 comprise a first connection strip 123 and a second connection strip 124, and the signal transmission strip 122 comprises a first transmission strip 127 and a second transmission strip 128. At this time, the first connection strip 123 has one end in communication with an end portion of the first strip-shaped patch 113 distal from the interval space, and the other end in communication with an end portion of the second strip-shaped patch 114 distal from the interval space, while the second connection strip 124 has one end in communication with an end portion of the third strip-shaped patch 115 distal from the interval space, and the other end in communication with an end portion of the fourth strip-shaped patch 116 distal from the interval space. Then, the first transmission strip 127 may be communicated with an end portion of the first strip-shaped patch 113 distal from the interval space, and the second transmission strip 128 with an end portion of the fourth strip-shaped patch 116 distal from the interval space; or, the first transmission strip 127 may be communicated with an end portion of the second strip-shaped patch 114 distal from the interval space, and the second transmission strip 128 with an end portion of the third strip-shaped patch 115 distal from the interval space; or, the first transmission strip 127 is directly communicated with the first connection strip 123, and the second transmission strip 128 is directly communicated with the second connection strip 124. In so doing, a dual circular polarization effect of the antenna is achieved.

[0045] Referring to FIG. 2, the dual circular polarization conditions of the microstrip antenna structure 100 are briefly described below by taking it as an example that the first transmission strip 127 is in communication with an end portion of the first strip-shaped patch 113 distal from the interval space, and the second transmission strip 128 is in communication with an end portion of the fourth strip-shaped patch 116 distal from the interval space. Assuming that an electromagnetic wave signal transmitted by the first transmission strip 127 and the first strip-shaped patch 113 has a signal amplitude of M_1 and a signal phase of P_1 , and an electromagnetic wave signal transmitted by the first transmission strip 127 and the sec-

ond strip-shaped patch 114 has a signal amplitude of M_2 and a signal phase of P_2 , then the two electromagnetic wave signals generally satisfy that $M_1 = M_2$, and $P_1 - P_2 = 90^\circ$. Assuming that an electromagnetic wave signal transmitted by the second transmission strip 128 and the third strip-shaped patch 115 has a signal amplitude of M_3 and a signal phase of P_3 , and an electromagnetic wave signal transmitted by the second transmission strip 128 and the fourth strip-shaped patch 116 has a signal amplitude of M_4 and a signal phase of P_4 , then the two electromagnetic wave signals generally satisfy that $M_3 = M_4$, and $P_3 - P_4 = -90^\circ$.

[0046] Optionally, referring to FIG. 3 and FIG. 4, FIG. 3 is a second diagram of communication between the antenna feed assembly 120 and the coupling patch 112 according to an embodiment of the present disclosure, and FIG. 4 is a third diagram of communication between the antenna feed assembly 120 and the coupling patch 112 according to an embodiment of the present disclosure. In this embodiment, if the antenna polarization of the microstrip antenna structure 100 needs to be constructed as a single circular one (a left-hand circular polarization or a right-hand circular polarization), it is necessary to have three feed connection strips 121 in cooperation with the signal transmission strip 122. At this time, the four strip-shaped patches comprised in the coupling patch 112 need to be rendered in communication by adopting the three feed connection strips 121; then, the signal transmission strip 122 is mounted on an end portion of one of a pair of adjacent strip-shaped patches that are not directly communicated with a feed connection strip 121, which end portion is distal from the interval space; or, the signal transmission strip 122 is mounted on any one of the three feed connection strips 121. In so doing, a single circular polarization effect of the antenna is achieved through such communication between the antenna feed assembly 120 and the four strip-shaped patches.

[0047] For example, the first strip-shaped patch 113, the second strip-shaped patch 114, the third strip-shaped patch 115, and the fourth strip-shaped patch 116 are rendered in communication through three feed connection strips 121; at this time, if the second strip-shaped patch 114 is not directly communicated with the third strip-shaped patch 115 with a feed connection strip 121, the signal transmission strip 122 may be directly mounted on the second strip-shaped patch 114 to realize left-hand circular polarization; or, the signal transmission strip 122 is directly mounted on the third strip-shaped patch 115 to realize right-hand circular polarization; or, the signal transmission strip 122 is directly mounted on one of the three feed connection strips 121 to realize left-hand/right-hand circular polarization.

[0048] If the first strip-shaped patch 113 is not directly communicated with the fourth strip-shaped patch 116 with a feed connection strip 121, the signal transmission strip 122 may be directly mounted on the fourth strip-shaped patch 116 to realize the left-hand circular polariza-

tion mode; or, the signal transmission strip 122 is directly mounted on the first strip-shaped patch 113 to realize the right-hand circular polarization mode; or, the signal transmission strip 122 is directly mounted on one of the three feed connection strips 121 to realize the left-hand/right-hand circular polarization mode.

[0049] If the first strip-shaped patch 113 is not directly communicated with the second strip-shaped patch 114 with a feed connection strip 121, the signal transmission strip 122 may be directly mounted on the first strip-shaped patch 113 to realize the left-hand circular polarization mode; or, the signal transmission strip 122 is directly mounted on the second strip-shaped patch 114 to realize the right-hand circular polarization mode; or, the signal transmission strip 122 is directly mounted on one of the three feed connection strips 121 to realize the left-hand/right-hand circular polarization mode.

[0050] If the third strip-shaped patch 115 is not directly communicated with the fourth strip-shaped patch 116 with a feed connection strip 121, the signal transmission strip 122 may be directly mounted on the third strip-shaped patch 115 to realize the left-hand circular polarization mode; or, the signal transmission strip 122 is directly mounted on the fourth strip-shaped patch 116 to realize the right-hand circular polarization mode; or, the signal transmission strip 122 is directly mounted on one of the three feed connection strips 121 to realize the left-hand/right-hand circular polarization mode.

[0051] In an implementation of this embodiment, where the feed connection strips 121 have a total number of three, the plurality of feed connection strips 121 comprise a first connection strip 123, a second connection strip 124, and a third connection strip 125. The first connection strip 123 has one end in communication with an end portion of the first strip-shaped patch 113 distal from the interval space, and the other end in communication with an end portion of the second strip-shaped patch 114 distal from the interval space. The second connection strip 124 has one end in communication with an end portion of the third strip-shaped patch 115 distal from the interval space, and the other end in communication with an end portion of the fourth strip-shaped patch 116 distal from the interval space. The third connection strip 125 has one end in communication with an end portion of the second strip-shaped patch 114 distal from the interval space, and the other end in communication with an end portion of the third strip-shaped patch 115 distal from the interval space. At this time, the signal transmission strip 122 may be communicated with an end portion of the first strip-shaped patch 113 distal from the interval space, so as to realize the right-hand circular polarization mode; or, the signal transmission strip 122 may be communicated with an end portion of the fourth strip-shaped patch 116 distal from the interval space, so as to realize the left-hand circular polarization mode; or, the signal transmission strip 122 may be directly communicated with any one of the first connection strip 123, the second connection strip 124, and the third connection strip 125 to

realize the left-hand/right-hand circular polarization mode. In so doing, a single circular polarization effect of the antenna is achieved.

[0052] Referring to FIG. 3, the right-hand circular polarization conditions of the microstrip antenna structure 100 are briefly described below by taking it as an example that the signal transmission strip 122 is in communication with an end portion of the first strip-shaped patch 113 distal from the interval space. Assuming that an electromagnetic wave signal transmitted by the signal transmission strip 122 and the first strip-shaped patch 113 has a signal amplitude of M1 and a signal phase of P1, an electromagnetic wave signal transmitted by the signal transmission strip 122 and the second strip-shaped patch 114 has a signal amplitude of M2 and a signal phase of P2, an electromagnetic wave signal transmitted by the signal transmission strip 122 and the third strip-shaped patch 115 has a signal amplitude of M3 and a signal phase of P3, and an electromagnetic wave signal transmitted by the signal transmission strip 122 and the fourth strip-shaped patch 116 has a signal amplitude of M4 and a signal phase of P4, then the four electromagnetic wave signals generally satisfy that $M1 = M2 = M3 = M4$, and $P1 = P2 + 90^\circ = P3 + 180^\circ = P4 + 270^\circ$.

[0053] Referring to FIG. 4, the left-hand circular polarization conditions of the microstrip antenna structure 100 are briefly described below by taking it as an example that the signal transmission strip 122 is in communication with an end portion of the fourth strip-shaped patch 116 distal from the interval space. Assuming that an electromagnetic wave signal transmitted by the signal transmission strip 122 and the first strip-shaped patch 113 has a signal amplitude of M1 and a signal phase of P1, an electromagnetic wave signal transmitted by the signal transmission strip 122 and the second strip-shaped patch 114 has a signal amplitude of M2 and a signal phase of P2, an electromagnetic wave signal transmitted by the signal transmission strip 122 and the third strip-shaped patch 115 has a signal amplitude of M3 and a signal phase of P3, and an electromagnetic wave signal transmitted by the signal transmission strip 122 and the fourth strip-shaped patch 116 has a signal amplitude of M4 and a signal phase of P4, then the four electromagnetic wave signals generally satisfy that $M1 = M2 = M3 = M4$, and $P1 = P2 - 90^\circ = P3 - 180^\circ = P4 - 270^\circ$.

[0054] Optionally, referring to FIG. 5, FIG. 5 is a fourth diagram of communication between the antenna feed assembly 120 and the coupling patch 112 according to an embodiment of the present disclosure. In this embodiment, if the antenna polarization mode of the microstrip antenna structure 100 needs to be constructed as a linear one, it may also be realized through three feed connection strips 121 in cooperation with the signal transmission strip 122; at this time, the four strip-shaped patches comprised in the coupling patch 112 need to be rendered in communication with the three feed connection strips 121, and then, the signal transmission strip 122 is mounted on any one of the three feed connection strips 121, such that

a linear polarization effect of the antenna is achieved through such communication between the antenna feed assembly 120 and the four strip-shaped patches.

[0055] For example, the first strip-shaped patch 113, the second strip-shaped patch 114, the third strip-shaped patch 115, and the fourth strip-shaped patch 116 are rendered in communication through three feed connection strips 121, where the signal transmission strip 122 may be directly mounted on any one of the three feed connection strips 121 to construct linear polarization meeting a polarization angle desired by antenna designers.

[0056] In an implementation of this embodiment, where the feed connection strips 121 has a total number of three, the plurality of feed connection strips 121 comprise a first connection strip 123, a second connection strip 124, and a fourth connection strip 126. The first connection strip 123 has one end in communication with an end portion of the first strip-shaped patch 113 distal from the interval space, and the other end in communication with an end portion of the second strip-shaped patch 114 distal from the interval space. The second connection strip 124 has one end in communication with an end portion of the third strip-shaped patch 115 distal from the interval space, and the other end in communication with an end portion of the fourth strip-shaped patch 116 distal from the interval space. The fourth connection strip 126 has one end in communication with an end portion of the first strip-shaped patch 113 distal from the interval space, and the other end in communication with an end portion of the fourth strip-shaped patch 116 distal from the interval space. At this time, the signal transmission strip 122 may be directly communicated with any one of the first connection strip 123, the second connection strip 124, and the fourth connection strip 126, so as to achieve a linear polarization effect of the antenna.

[0057] Referring to FIG. 5, the linear polarization conditions of the microstrip antenna structure 100 are briefly described below by taking it as an example that the signal transmission strip 122 is directly communicated with the fourth connection strip 126. Assuming that an electromagnetic wave signal transmitted by the signal transmission strip 122 and the first strip-shaped patch 113 has a signal amplitude of M1 and a signal phase of P1, an electromagnetic wave signal transmitted by the signal transmission strip 122 and the second strip-shaped patch 114 has a signal amplitude of M2 and a signal phase of P2, an electromagnetic wave signal transmitted by the signal transmission strip 122 and the third strip-shaped patch 115 has a signal amplitude of M3 and a signal phase of P3, an electromagnetic wave signal transmitted by the signal transmission strip 122 and the fourth strip-shaped patch 116 has a signal amplitude of M4 and a signal phase of P4, an electromagnetic wave signal transmitted by the signal transmission strip 122 and the communicated end portion of the first strip-shaped patch 113 has a signal amplitude of M5 and a signal phase of P5, and an electromagnetic wave signal transmitted by the signal trans-

mission strip 122 and the communicated end portion of the fourth strip-shaped patch 116 has a signal amplitude of M6 and a signal phase of P6, then the six electromagnetic wave signals generally satisfy that $M1 = M2 = M3 = M4$, $P1 - P2 = 90^\circ$, $P4 - P3 = 90^\circ$, and $M5 = M6$; at this time, the microstrip antenna structure 100 has a linear polarization angle of $P7 = (P5 - P6)/2$; the value of P7 may be adjusted by changing the connection positions of the signal transmission strip 122 on the first connection strip 123, the second connection strip 124, and the fourth connection strip 126, so as to construct linear polarization meeting a polarization angle desired by antenna designers.

[0058] Accordingly, the present disclosure may construct a matched antenna polarization mode according to requirements of antenna designers by means of the signal transmission strip 122 and the plurality of feed connection strips 121 in cooperation with four strip-shaped patches comprised in the coupling patch 112. The feed connection strips 121 may have a shape that is, but not limited to, an arc shape, an elongated shape, or any curved shape having a curved portion.

[0059] Optionally, referring again to FIG. 1 to FIG. 5, in the embodiments of the present disclosure, to further reduce the signal radiation interference of the antenna feed assembly 120 with the antenna radiation assembly 110, a plurality of isolation holes 160 that run through the second dielectric plate 140 may be provided on the second dielectric plate 140; the plurality of isolation holes 160 are distributed around the antenna feed assembly 120 and are in communication with the antenna ground 150, thereby reducing the signal radiation interference of the antenna feed assembly 120 with the antenna radiation assembly 110. In an implementation of the embodiments, the plurality of isolation holes 160 may be provided on two sides of each feed connection strip 121 comprised in the antenna feed assembly 120.

[0060] The present disclosure may further provide a communication device, which uses at least one microstrip antenna structure 100 to realize its own communication function. In an implementation of this embodiment, a plurality of the microstrip antenna structures 100 may be arrayed to form an antenna array to be integrated with other communication hardware units.

[0061] In summary, in the microstrip antenna structure and the communication device according to the embodiments of the present disclosure, the antenna feed assembly and the coupling patch in the antenna radiation assembly are mutually communicatively provided on a side surface of the second dielectric plate, and the antenna ground is provided on the other side surface of the second dielectric plate; then, the radiation patch in the antenna radiation assembly is provided on a side surface of the first dielectric plate, and the other side surface of the first dielectric plate is laminated over the second dielectric plate and spaced by the coupling patch and the antenna feed assembly; the radiation patch on the second dielectric plate has a patch projection area that at

least partially overlaps with the coupling patch, and the antenna feed assembly is distributed outside of the patch projection area of the radiation patch, so as to form an antenna feed point in the patch projection area of the radiation patch through the coupling patch, and to ensure that the antenna feed assembly can perform signal coupling and transmission through the coupling patch and the radiation patch. Therefore, while the communication function of the antenna structure is realized, the feed assembly and the antenna radiation assembly are integrally arranged on a same layer of physical structure, which decreases the overall height of the antenna structure, reduces the space occupied thereby, and facilitates its use.

[0062] The foregoing are only various embodiments of the present disclosure, but the scope of the present disclosure is not limited thereto, and any skilled person in the art could readily conceive of changes or substitutions within the technical scope disclosed herein, which should all be covered by the scope of the present disclosure. Therefore, the scope of the present disclosure shall be defined by the appending claims.

Claims

1. A microstrip antenna structure, wherein the microstrip antenna structure comprises an antenna radiation assembly, an antenna feed assembly, a first dielectric plate, a second dielectric plate, and an antenna ground, the antenna radiation assembly comprising a radiation patch and a coupling patch;

the coupling patch and the antenna feed assembly being mutually communicatively provided on a side surface of the second dielectric plate, and the antenna ground being provided on the other side surface of the second dielectric plate; the radiation patch being provided on a side surface of the first dielectric plate, and the other side surface of the first dielectric plate being laminated over the second dielectric plate and spaced by the coupling patch and the antenna feed assembly, wherein the radiation patch has on the second dielectric plate a patch projection area that at least partially overlaps with the coupling patch, the antenna feed assembly being located outside of the patch projection area; wherein the coupling patch comprises a first strip-shaped patch, a second strip-shaped patch, a third strip-shaped patch, and a fourth strip-shaped patch that are annularly distributed, the first strip-shaped patch having a length extension direction that is perpendicular to that of the second strip-shaped patch; wherein the first strip-shaped patch is spaced apart from the third strip-shaped patch, the length extension direction of the first strip-

- shaped patch coinciding with that of the third strip-shaped patch;
 wherein the second strip-shaped patch is spaced apart from the fourth strip-shaped patch, the length extension direction of the second strip-shaped patch coinciding with that of the fourth strip-shaped patch;
 and wherein an interval space between the first strip-shaped patch and the third strip-shaped patch merges with that between the second strip-shaped patch and the fourth strip-shaped patch.
2. The microstrip antenna structure according to claim 1, wherein the first strip-shaped patch and the second strip-shaped patch have an identical patch size, wherein the first strip-shaped patch and the third strip-shaped patch are centrally symmetrically distributed, and wherein the second strip-shaped patch and the fourth strip-shaped patch are centrally symmetrically distributed.
 3. The microstrip antenna structure according to claim 2, wherein a symmetric center between the first strip-shaped patch and the third strip-shaped patch coincides with that between the second strip-shaped patch and the fourth strip-shaped patch, and wherein the first strip-shaped patch, the second strip-shaped patch, the third strip-shaped patch, and the fourth strip-shaped patch each are at an equal distance from the symmetric center.
 4. The microstrip antenna structure according to any one of claims 1-3, wherein the antenna feed assembly comprises a signal transmission strip and a plurality of feed connection strips, the feed connection strips having a total number of less than four; wherein the signal transmission strip is in communication with the first strip-shaped patch, the second strip-shaped patch, the third strip-shaped patch, and the fourth strip-shaped patch through the plurality of feed connection strips, wherein each of the feed connection strips is configured to communicate respective end portions of any pair of adjacent strip-shaped patches among the first strip-shaped patch, the second strip-shaped patch, the third strip-shaped patch and the fourth strip-shaped patch, which end portions are distal from the interval space.
 5. The microstrip antenna structure according to claim 4, wherein where the feed connection strips have a total number of two, the plurality of feed connection strips comprise a first connection strip and a second connection strip, and the signal transmission strip comprises a first transmission strip and a second transmission strip;

wherein the first connection strip has one end in

communication with an end portion of the first strip-shaped patch distal from the interval space, and the other end in communication with an end portion of the second strip-shaped patch distal from the interval space;
 wherein the second connection strip has one end in communication with an end portion of the third strip-shaped patch distal from the interval space, and the other end in communication with an end portion of the fourth strip-shaped patch distal from the interval space;
 wherein the first transmission strip is in communication with an end portion of the first strip-shaped patch distal from the interval space, and wherein the second transmission strip is in communication with an end portion of the fourth strip-shaped patch distal from the interval space;
 or, wherein the first transmission strip is in communication with an end portion of the second strip-shaped patch distal from the interval space, and the second transmission strip in communication with an end portion of the third strip-shaped patch distal from the interval space;
 or, wherein the first transmission strip is in direct communication with the first connection strip, and the second transmission strip in direct communication with the second connection strip.

6. The microstrip antenna structure according to claim 4, wherein where the feed connection strips have a total number of three, the plurality of feed connection strips comprise a first connection strip, a second connection strip, and a third connection strip;

wherein the first connection strip has one end in communication with an end portion of the first strip-shaped patch distal from the interval space, and the other end in communication with an end portion of the second strip-shaped patch distal from the interval space;
 wherein the second connection strip has one end in communication with an end portion of the third strip-shaped patch distal from the interval space, and the other end in communication with an end portion of the fourth strip-shaped patch distal from the interval space;
 wherein the third connection strip has one end in communication with an end portion of the second strip-shaped patch distal from the interval space, and the other end in communication with an end portion of the third strip-shaped patch distal from the interval space;
 and wherein the signal transmission strip is in communication with an end portion of the first strip-shaped patch or the fourth strip-shaped patch distal from the interval space, or the signal transmission strip is in direct communication

with one of the first connection strip, the second connection strip, and the third connection strip.

- 7. The microstrip antenna structure according to claim 4, wherein where the feed connection strips have a total number of three, the plurality of feed connection strips comprise a first connection strip, a second connection strip, and a fourth connection strip; 5

wherein the first connection strip has one end in communication with an end portion of the first strip-shaped patch distal from the interval space, and the other end in communication with an end portion of the second strip-shaped patch distal from the interval space; 10

wherein the second connection strip has one end in communication with an end portion of the third strip-shaped patch distal from the interval space, and the other end in communication with an end portion of the fourth strip-shaped patch distal from the interval space; 15

wherein the fourth connection strip has one end in communication with an end portion of the first strip-shaped patch distal from the interval space, and the other end in communication with an end portion of the fourth strip-shaped patch distal from the interval space; 20

and wherein the signal transmission strip is in direct communication with one of the first connection strip, the second connection strip, and the fourth connection strip. 25 30

- 8. The microstrip antenna structure according to claim 1, wherein the second dielectric plate is provided with a plurality of isolation holes that run through the second dielectric plate, and wherein the plurality of isolation holes are distributed around the antenna feed assembly and are in communication with the antenna ground. 35 40

- 9. A communication device, wherein the communication device comprises at least one microstrip antenna structure according to any one of claims 1-8. 45

50

55

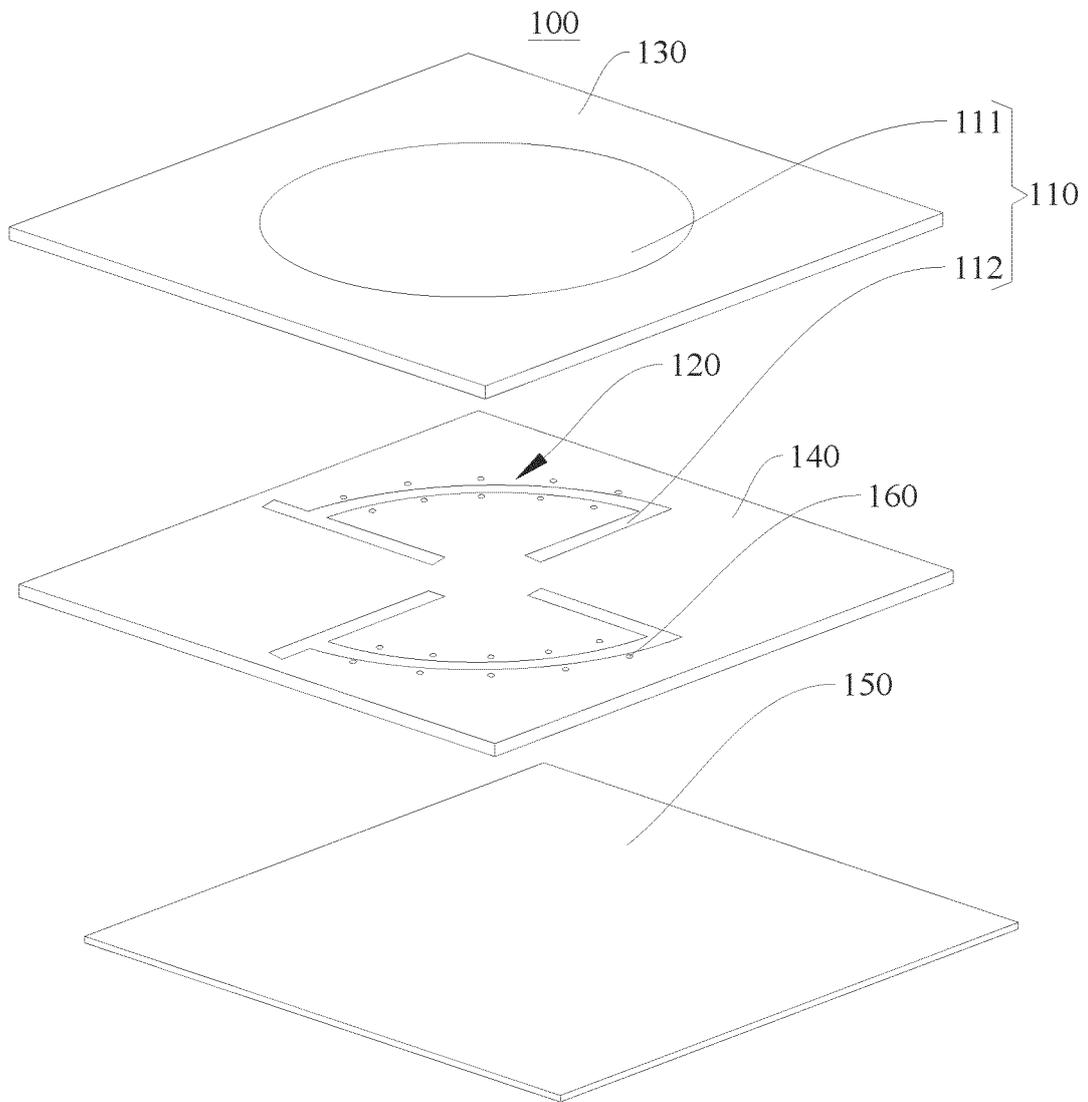


Fig. 1

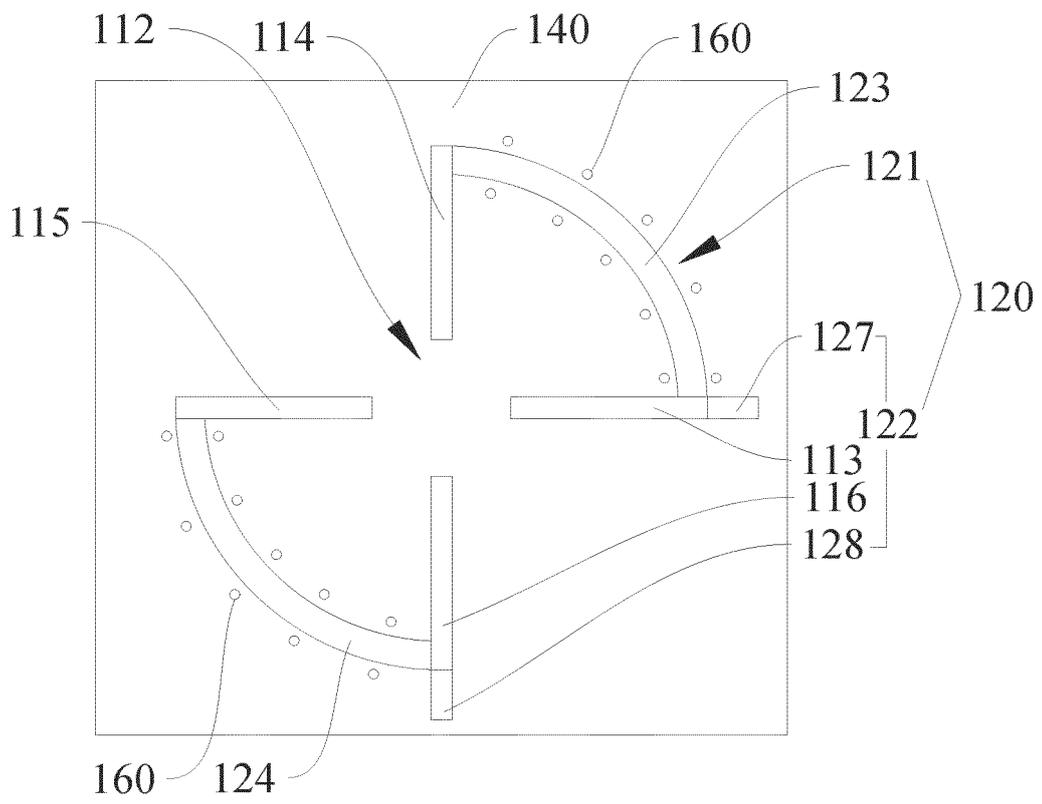


Fig.2

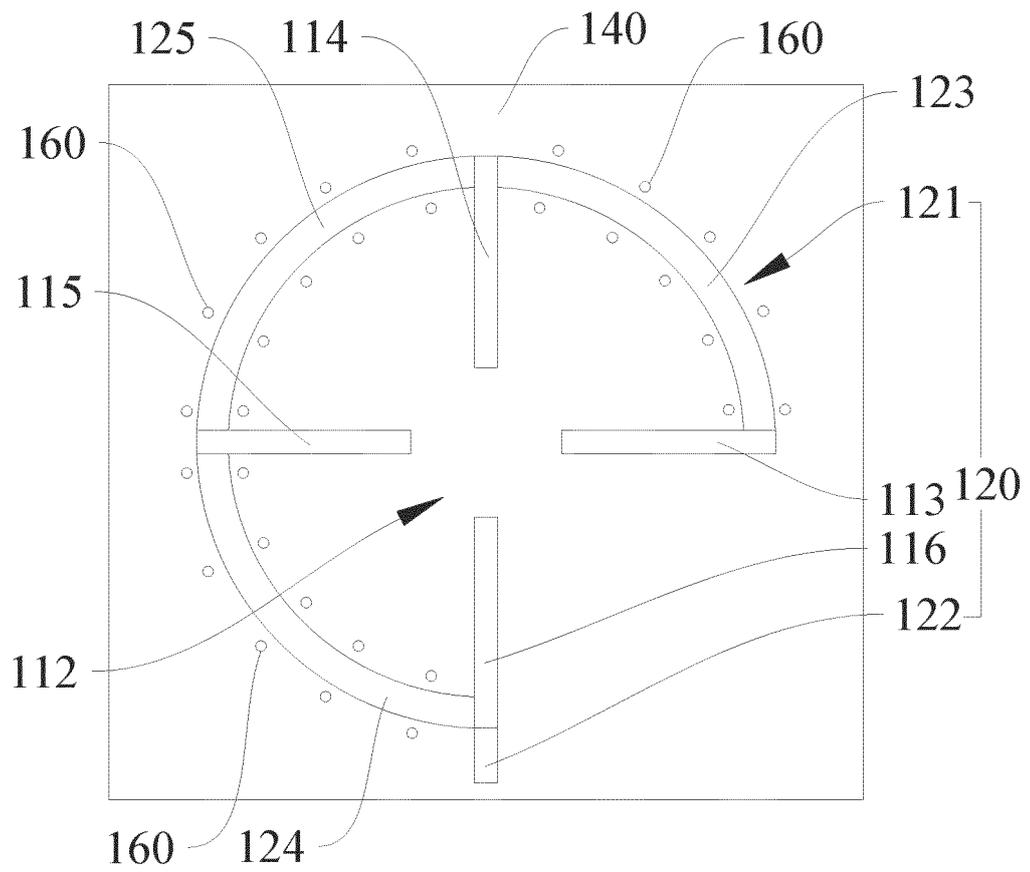


Fig.4

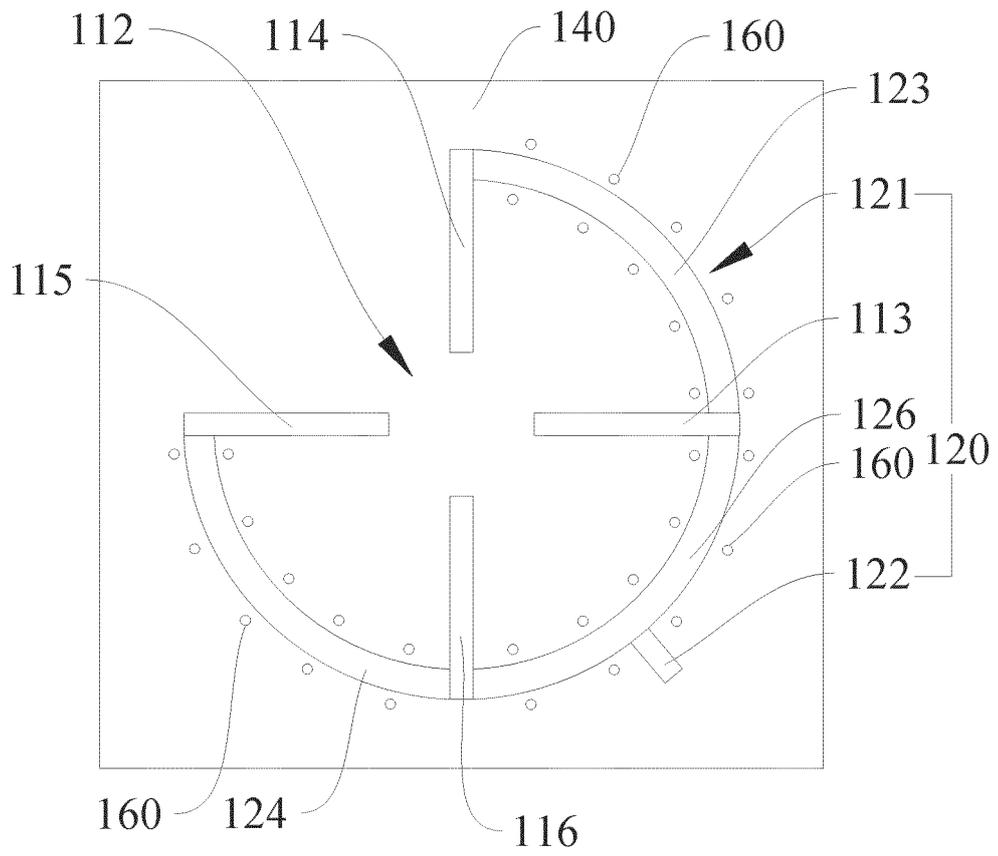


Fig.5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2022/091741

5

A. CLASSIFICATION OF SUBJECT MATTER		
H04Q 1/38(2006.01)i		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
H04Q		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
CCNPAT, WPI, EPODOC, CNKI, GOOGLE: 微带, 天线, 辐射, 馈电, 耦合, 投影, 重叠, 区域, 集成, 高度, 减小, 降低, 缩减, microstrip, antenna, radiation, feed, projection, overlap, area, integration, height, reduce		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 113036439 A (CHENGDU T-RAY TECHNOLOGY CO., LTD.) 25 June 2021 (2021-06-25) claims 1-10	1-9
A	CN 207409650 U (ZTE CORP.) 25 May 2018 (2018-05-25) description, paragraphs [0005]-[0018]	1-9
A	CN 111355027 A (ZHONGTIAN BROADBAND TECHNOLOGY CO., LTD. et al.) 30 June 2020 (2020-06-30) entire document	1-9
A	CN 111740217 A (VIVO COMMUNICATION TECHNOLOGY CO., LTD.) 02 October 2020 (2020-10-02) entire document	1-9
A	WO 2011031174 A1 (FERT, P.) 17 March 2011 (2011-03-17) entire document	1-9
A	US 2013241794 A1 (CHAKRAVARTY, T. et al.) 19 September 2013 (2013-09-19) entire document	1-9
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search		Date of mailing of the international search report
06 July 2022		29 July 2022
Name and mailing address of the ISA/CN		Authorized officer
China National Intellectual Property Administration (ISA/CN) No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China		
Facsimile No. (86-10)62019451		Telephone No.

55

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2022/091741

5
10
15
20
25
30
35
40
45
50
55

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	113036439	A	25 June 2021	None			
CN	207409650	U	25 May 2018	WO	2019080535	A1	02 May 2019
CN	111355027	A	30 June 2020	None			
CN	111740217	A	02 October 2020	WO	2022002138	A1	06 January 2022
WO	2011031174	A1	17 March 2011	PL	389027	A1	28 March 2011
US	2013241794	A1	19 September 2013	EP	2631991	A1	28 August 2013
				IN	201200511	I3	06 December 2013

Form PCT/ISA/210 (patent family annex) (January 2015)