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(54) **5G ANTENNA AND RADIATION UNIT THEREOF**

5G-ANTENNE UND STRAHLUNGSEINHEIT DAFÜR

ANTENNE 5G ET SON UNITÉ DE RAYONNEMENT

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Description

TECHNICAL FIELD

[0001] The present invention relates to the field of communication technologies, and in particular, to a 5G antenna and a radiation unit thereof.

BACKGROUND

[0002] With the increasing sophistication and advancement of the 5G communication technology, the 5G network is also gradually entering the commercial stage. Due to higher requirements on antennas by the 5G technology, the antennas are required to have high-rate transmission, larger system capacity, miniaturization, and dual-polarization characteristic simultaneously.

[0003] Conventional radiation units have bandwidth ranging from low frequencies to high frequencies. Since the wave length with respect to the low frequencies is longer than the wave length with respect to the frequencies, for a radiation unit having fixed size, when the low frequencies and the high frequencies are operated simultaneously, they will be influenced by each other, thereby affecting the frequency band extension of the radiation units and affecting the radiation performance of the antennas.

[0004] In the related art, several patents or patent applications have provided radiation units for 5G communication. For example, Japanese patent publication No. JP5872018B1, Chinese patent publication No. CN110233343A, CN209516000U, and CN103647140A, American patent publication No. 7688271B2, and PCT application publication No. WO2017003374A1.

SUMMARY

[0005] As the low frequency wavelength is longer than the high frequency wavelength, for fixed size radiation unit, when the low frequency and high frequency work at the same time, they tend to interact with each other, thus affecting the radiation unit's frequency band expansion and affecting the radiation performance of the antenna.

[0006] The technical solution is as follows:

[0007] According to an aspect, there is provided a radiation unit, including: two groups of dipoles the polarizations of which are orthogonal, each group of the dipoles includes two radiation arms which are disposed to be spaced apart relative to each other, and each of the radiation arms is provided with a first extension branch and a second extension branch which are disposed to be spaced apart from each other; wherein the surface area of the first extension branch is greater than the surface area of the second extension branch; wherein an outer sidewall of each of the radiation arms is provided with a cut-off corner; wherein each of the radiation arms is provided with a first hollowed groove, each of one end of the first extension branch and one end of the second extension branch is connected with the outer sidewall of each of the radiation arms, a first spacer groove in communication with the first hollowed groove is provided between the first extension branch and the second extension branch, and each of the first extension branch and the second extension branch is disposed towards the inside of the first hollowed groove; wherein a second spacer groove and a current-conducting part for connecting two adjacent radiation arms are provided between the two adjacent radiation arms, and each of the two adjacent radiation arms is provided with a second hollowed groove in communication with the second spacer groove.

[0008] The radiation unit of the above embodiment includes four radiation arms of the same shape and size, wherein two radiation arms which are disposed to be spaced apart and diagonal relative to each other fit to form a first group of dipoles, the other two radiation arms which are disposed to be spaced apart and diagonal relative to each other fit to form a second group of dipoles, and the two groups of dipoles the polarizations of which are orthogonal to each other are utilized to form dual-polarization radiation. Meanwhile, the first extension branches and the second extension branches which are disposed to be spaced apart from each other are disposed on respective radiation arms, so that the first extension branches and the second extension branches can be utilized to adjust the electrical lengths of the high frequencies and low frequencies of the radiation unit, thereby being able to achieve extension of the operating frequency band which is more than 20% of the bandwidth, good radiation performance, and fulfil the use requirements of 5G antennas. Moreover, the radiation unit has a simple structure and is easy to produce, and the manufacturing cost is lowered.

[0009] The technical solution will be described further below.

[0010] In one of these embodiments, each of the radiation arms is provided with a first connecting portion for coupling feed with a feeding balun.

[0011] In one of these embodiments, a distance between a sidewall of the first hollowed groove and a sidewall of the second spacer groove ranges from 5.5 mm to 6mm; and a width of the second hollowed groove ranges from 11.9 mm to 12.7 mm.

[0012] According to another aspect, there is provided a 5G antenna, including: the radiation unit; and feeding baluns which are in coupling feed with the radiation arms.

[0013] The 5G antenna in the above embodiments, when in use, performs coupling feed on the radiation arms by using the feeding baluns, so that it can be ensured that the radiation unit can radiate signals with good radiation performance in a stable and reliable manner. Meanwhile, the first extension branches and the second extension branches which are disposed to be spaced apart from each other are disposed on respective radiation arms of the radiation unit, thus the first extension branches and the second extension branches can be utilized to adjust the electrical lengths of the high frequencies and low frequencies of the radiation unit, thereby being able to achieve extension of the operating frequency band, achieve a very wide operating frequency band, and fulfil the use requirements of 5G antennas. The 5G antenna of the above embodiment, in the case of ultra-wideband being implemented, also has good impedance characteristics and cross-polarization ratio, and the production cost is low, which is suitable for the use requirements of 5G technology.

[0014] In one of these embodiments, the radiation unit further includes a substrate which is provided between the radiation arms and the feeding baluns, and the radiation arms are disposed on a surface of the substrate.

[0015] In one of these embodiments, each of the feeding baluns includes a first feeding component for the coupling feed with the first group of dipoles and a second feeding component for the coupling feed with the second group of dipoles, the first feeding component and the second feeding component being disposed to have an angle therebetween.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

Fig. 1 is a structural schematic diagram of a radiation unit according to one embodiment;
Fig. 2 is a structural schematic diagram of a side of a first media of the radiation unit of Fig. 1;
Fig. 3 is a structural schematic diagram of other side of the first media of the radiation unit of Fig. 1;
Fig. 4 is a structural schematic diagram of a side of a second media of the radiation unit of Fig. 1;
Fig. 5 is a structural schematic diagram of other side of the second media of the radiation unit of Fig. 1;
Fig. 6 is a simulation diagram of the standing waves of the radiation unit of Fig. 1; and
Fig. 7 is a horizontal radiation pattern of a 5G antenna according to one embodiment.

DESCRIPTION OF REFERENCE SYMBOLS:

[0017] 10, radiation unit, 110, radiation arm, 120, first extension branch, 130, second extension branch, 140, first hollowed groove, 150, first spacer groove, 160, second spacer groove, 170, second hollowed groove, 180, current-conducting part, 190, cut-off corner, 1000, feeding socket, 210, first feeding component, 211, first media, 2111, first socket, 2112, third bump, 212, first balun microstrip line, 2121, first branch, 2122, second branch, 213, first microstrip ground piece, 2131, first bump, 220, second feeding component, 221, second media, 2211, second socket, 2212, fourth bump, 222, second balun microstrip line, 2221, third branch, 2222, fourth branch, 223, second microstrip ground piece, 2231, second bump, 300, substrate.

DETAILED DESCRIPTION

[0018] In order to make the objectives, technical solutions and advantages of present invention clearer, hereafter, the present invention will be further described in detail with reference to the accompanying drawings and the detailed description. It should be understood that the detailed description here is only for explaining the present invention and does not define the protection scope of the present invention.

[0019] It should be noted that when an element is referred to as being "disposed on" or "fixed to" another element, it can be directly on another element or intervening elements may be present.

[0020] When an element is "fixed to" another element or "fixedly connected to" another element, they are fixed in a detachable manner or they are fixed in a non-removable manner. When an element is considered to be "connected with", "rotately connected with" another element, it can be directly connected to another element or there are intervening elements present. The terms such as "perpendicular", "horizontal", "left", "right", "upper" and "lower" as well as similar expressions as used herein are for illustration purposes only, and do not represent the unique implementation.

[0021] Unless otherwise defined, all technical and scientific terms as used herein have the same meaning as meanings that are generally understood to one of ordinary skill in the art. The terms as used in the description of the invention herein are for the purpose of description only and are not intended to limit the present invention. The term " and/or" as used herein includes any and all combinations of one or more of the associated listed items.

[0022] Similar words such as "first", ""second" and "third" in the present invention do not represent specific number or order, and are used merely to distinguish between names.

[0023] It should also be understood that when explaining an element, the element should be construed as including a error range although not explicitly described, the error range should be within an acceptable deviation from the specified value as determined by those skilled in the art. For example, "about", "approximately" or "substantially" may mean that it is in one or more standard derivations, which is not limited herein.

[0024] As shown in Fig. 1, in one embodiment, there is provided a radiation unit 10 including two groups of dipoles the polarizations of which are orthogonal, each group of the dipoles includes two radiation arms 110 which are disposed to be spaced apart relative to each other, each of the radiation arms 110 is provided with a first extension branch 120 and a second extension branch 130 which are disposed to be spaced apart from each other.

[0025] The radiation unit 10 of the above embodiment includes four radiation arms 110 of the same shape and size, wherein two radiation arms 110 which are disposed to be spaced apart and diagonal relative to each other fit to form a first group of dipoles, the other two radiation arms 110 which are disposed to be spaced apart and diagonal relative to each other fit to form a second group of dipoles, and the two groups of dipoles the polarizations of which are orthogonal to each other are utilized to form dual-polarization radiation.

[0026] Meanwhile, the first extension branches 120 and the second extension branches 130 which are disposed to be spaced apart from each other are disposed on respective radiation arms 110, so that the first extension branches 120 and the second extension branches 130 can be utilized to adjust the electrical lengths of the high frequencies and low frequencies of the radiation unit 10, thereby being able to achieve extension of the operating frequency band which is more than 20% of the bandwidth, good radiation performance, and fulfil the use requirements of 5G antennas. Moreover, the radiation unit 10 has a simple structure and is easy to produce, and the manufacturing cost is lowered.

[0027] It should be noted that the connecting end of the first extension branches 120 and the connecting end of the second extension branches 130 may be connected with outer sidewalls of respective radiation arms 110, so that the first extension branches 120 and the second extension branches 130 can flexibly extend towards the outer sides or inner sides of the radiation arms 110. The first extension branch 120 and the second extension branch 130 can be formed with the radiation arm 110 in an all-in-one manner or they can be formed separately to be assembled; the all-in-one manufacturing manner is preferred, which is simple and convenient, and lowers the manufacturing cost. The first extension branch 120 and the second extension branch 130 can be provided in structures of sheets, strips, etc. As shown in Fig. 1, the radiation arm 110a and the radiation arm 110b form the first group of dipoles, and the radiation arm 110c and the radiation arm 110d form the second group of dipoles.

[0028] The surface area of the first extension branch 120 and the surface area of the second extension branch 130 can be flexibly adjusted simultaneously or separately according to the actual use cases, as long as the first extension branch 120 and the second extension branch 130 are enabled to extend the operating frequency band of the radiation unit 10.

[0029] In one embodiment, the length (Li as shown in Fig. 1) of the first extension branch 120 is adjustable. As such, by flexibly adjusting the length of the first extension branch 120, the surface area of the first extension branch 120 is adjusted, the electrical length of the radiation unit 10 is adjusted, and in turn the operating frequency band of the radiation unit 10 is adjusted.

[0030] In one embodiment, the width (D_1 as shown in Fig. 1) of the first extension branch 120 is adjustable. As such, by flexibly adjusting the width of the first extension branch 120, the surface area of the first extension branch 120 is adjusted, the electrical length of the radiation unit 10 is adjusted, and in turn the operating frequency band of the radiation unit 10 is adjusted.

[0031] In one embodiment, the length (L_2 as shown in Fig. 1) of second extension branch 130 is adjustable. As such, by flexibly adjusting the length of second extension branch 130, the surface area of the second extension branch 130 is adjusted, the electrical length of the radiation unit 10 is adjusted, and in turn the operating frequency band of the radiation unit 10 is adjusted.

[0032] In one embodiment, the width (D_2 as shown in Fig. 1) of second extension branch 130 is adjustable. As such, by flexibly adjusting the width of second extension branch 130, the surface area of the second extension branch 130 is adjusted, the electrical length of the radiation unit 10 is adjusted, and in turn the operating frequency band of the radiation unit 10 is adjusted.

[0033] It should be noted that flexible adjustment can be at least made to one of the parameters including the length of the first extension branch 120, the width of the first extension branch 120, the length of the second extension branch 130 and the width of the second extension branch 130, so that the electrical length of the radiation unit 10 can be adjusted, and in turn the operating frequency band of the radiation unit 10 can be adjusted.

[0034] As shown in Fig. 1, in one embodiment, the surface area of the first extension branch 120 is greater than the surface area of the second extension branch 130. As such, the first extension branch 120 can be utilized to extend the bandwidth of low frequencies, and the second extension branch 130 can be utilized to extend the bandwidth of the high frequencies. When adjusting the surface area of the first extension branch 120 by adjusting the length of the first extension branch 120 and adjusting the surface area of the second extension branch 130 by adjusting the length of the second extension branch 130, it is preferred that the difference in length between the first extension branch 120 and the second extension branch 130 is within 1 mm in order not to affect the radiation performance of the radiation unit 10.

[0035] In one embodiment, the surface area of the first extension branch 120 is equal to the surface area of the second extension branch 130.

[0036] As such, when adjusting the surface area of the first extension branch 120 and the surface area of the second extension branch 130, the electrical length of the radiation unit 10 can be adjusted to a greater extent, and in turn the operating frequency band of the radiation unit 10 can be adjusted to a greater extent.

[0037] On the basis of any of the above embodiments, each of the radiation arms 110 is provided with a first connecting portion for coupling feed with a feeding balun. As such, the use of the first connecting portions enables the easy and reliable connection of the feeding baluns to the radiation arms 110, which in turn enables the coupling feed to the radiation arms 110 and ensures the radiation performance of the radiation unit 10. Each of the first connecting portions can be provided as a feed jack or feeding socket 1000 for ease of pluggable fitting.

[0038] As shown in Fig. 1, on the basis of any of the above embodiments, an outer sidewall of each of the radiation arms 110 is provided with a cut-off corner 190. As such, the cut-off corner 190 is effective in improving the influence between operating frequencies and enhancing the radiation performance of the radiation unit 10. The size of the cut-off corner 190 can be flexibly adjusted according to the actual use requirements. The cut-off corner 190 can be disposed on a portion corresponding to the first extension branch 120 and the second extension branch 130.

[0039] As shown in Fig. 1, on the basis of any of the above embodiments, each of the radiation arms 110 is provided with a first hollowed groove 140, each of one end of the first extension branch 120 and one end of the second extension branch 130 is connected with the outer sidewall of each of the radiation arms 110. A first spacer groove 150 in communication with the first hollowed groove 140 is provided between the first extension branch 120 and the second extension branch 130. In this way, the weights of the radiation arms 110 can be reduced, and light-weight antennas can be achieved. Moreover, the arrangement of the first hollowed groove 140 on the inner surface of the radiation arm 110 also improves the cross-polarization ratio of the radiation unit 10 and also increases the electrical lengths of the radiation arms 110, extending the operating bandwidths of the radiation unit 10.

[0040] Each of the first extension branch 120 and the second extension branch 130 is disposed towards the inside of the first hollowed groove 140. As such, the structure of the radiation unit 10 can be made more compact, the projection area of the radiation unit 10 on the base plate is reduced, and the miniaturization of antenna can be achieved.

[0041] Of course, in other embodiments, it may be that the first extension branch 120 extends towards the interior of the first hollowed groove 140 and the second extension branch 130 extends towards the outer side of a respective radiation arm 110; or it may be that the second extension branch 130 extends towards the interior of the first hollowed groove 140 and the first extension branch 120 extends towards the outer side of a respective radiation arm 110; or it may be that each of the first extension branch 120 and the second extension branch 130 extends towards the exterior of the first hollowed groove 140. It is only necessary to meet the requirement of enabling the first extension branch 120 and the second extension branch 130 to extend the operating frequency band of the radiation unit 10.

[0042] Further, a hollowed area of the first hollowed groove 140 is adjustable. As such, the cross-polarization ratio of the radiation unit 10 can be adjusted by adjusting the hollowed area of the first hollowed groove 140. The hollowed area refers to the size of the first hollowed groove 140. For example, as shown in Fig. 1, when the outline of the first hollowed groove 140 is a square, the side length of the square is adjusted, i.e., the hollowed area is adjustable.

[0043] As shown in Fig. 1, in one embodiment, a second spacer groove 160 and a current-conducting part 180 for connecting two adjacent radiation arms 110 are provided between the two adjacent radiation arms 110, and each of the two adjacent radiation arms 110 is provided with a second hollowed groove 170 in communication with the second spacer groove 160. In this way, the use of the current-conducting part 180, together with the second spacer groove 160 and the second hollowed groove 170, enables the formation of a slow wave structure, thereby increasing the electrical lengths of the radiation arms 110 and thus broadening the operating frequency bands of the radiation unit 10. Wherein the current-conducting part 180 can be provided as a sidewall in the width direction of the second hollowed groove 170 for easy of machining. The current-conducting part 180 can be provided in the form of a strip or sheet.

[0044] Further, a hollowed area of the second hollowed groove 170 is adjustable. As such, the electrical lengths of the radiation arms 110 can be adjusted by adjusting the widths of the second hollowed grooves 170, thus the operating frequency band of the radiation unit 10 is adjusted. Wherein the adjustment of the hollowed area of the second hollowed groove 170 can be achieved by adjusting the width (H_2 as shown in Fig. 1) or length (H_3 as shown in Fig. 1) of the second hollowed groove 170.

[0045] In one embodiment, the hollowed area of the first hollowed groove 140 is adjustable, and the hollowed area of the second hollowed groove 170 is adjustable accordingly. As such, the hollowed area of the first hollowed groove 140 is changed, the hollowed area of the second hollowed groove 170 can be adjusted accordingly, thus the radiation performance of the radiation unit 10 can be ensured.

[0046] In one embodiment, when the hollowed area of the first hollowed groove 140 becomes larger so that the distance (H_1, as shown in Fig. 1) between the sidewall of the first hollowed groove 140 and the sidewall of the second spacer groove 160 becomes narrower, the width of the second hollowed groove 170 is made smaller accordingly, thereby reducing the hollowed area of the second hollowed groove 170 and thereby improving the radiation performance of the radiation unit 10. Preferably, the variation in distance between a sidewall of the first hollowed groove 140 and a sidewall of the second spacer groove 160 ranges from 5.5 mm to 6mm, the variable in width of the second hollowed groove 170 ranges from 11.9 mm to 12.7 mm, and the radiation performance of the radiation unit 10 is ensured.

[0047] Of course, the adjustment of the hollowed area of the first hollowed groove 140, the adjustment of the width of the second hollowed groove 170, the adjustment of the surface area of the first extension branch 120 and the adjustment of the surface area of the second extension branch 130 can be chosen flexibly according to the actual use requirements; these adjustments can be conducted simultaneously, separately or in combination, as long as the radiation performance of the radiation unit 10 is ensured. Preferably, respective adjustments to the hollowed area of the first hollowed groove 140, the hollowed area of the second hollowed groove 170, the surface area of the first extension branch 120 and the surface area of the second extension branch 130 are conducted simultaneously, so that a relative bandwidth up to 49.2% can be achieved and the range of the operating frequency band may be 2.3GHz~3.8 GHz.

[0048] As shown in Figs. 1 through 5, in one embodiment, there is also provided a 5G antenna including the radiation unit 10 according to any of the above embodiments and feeding baluns which are in coupling feed with the radiation arms 110.

[0049] The 5G antenna in the above embodiments, when in use, performs coupling feed on the radiation arms 110 by using the feeding baluns, so that it can be ensured that the radiation unit 10 can radiate signals with good radiation performance in a stable and reliable manner. Meanwhile, the first extension branches 120 and the second extension branches 130 which are disposed to be spaced apart from each other are disposed on respective radiation arms 110 of the radiation unit 10, thus the first extension branches 120 and the second extension branches 130 can be utilized to adjust the electrical lengths of the high frequencies and low frequencies of the radiation unit 10, thereby being able to achieve extension of the operating frequency band, achieve a very wide operating frequency band, and fulfil the use requirements of 5G antennas. The 5G antenna of the above embodiment, in the case of ultra-wideband being implemented, also has good impedance characteristics and cross-polarization ratio, and the production cost is low, which is suitable for the use requirements of 5G technology.

[0050] As shown in Fig. 1, in one embodiment, the radiation unit 10 also include a substrate 300 which is provided between the radiation arms 110 and the feeding baluns, the radiation arms 110 being disposed on the surface of the substrate 300.

[0051] As such, the radiation arms 110 can be disposed on the substrate 300 in form of patches, thus the volume of the radiation unit 10 can be reduced. The substrate 300 can be provided as a printed circuit board (PCB) media board.

[0052] As shown in Figs. 2 through 5, based on the above embodiments, each of the feeding baluns includes a first feeding component 210 for the coupling feed with the first group of dipoles and a second feeding component 200 for the coupling feed with the second group of dipoles, the first feeding component 210 and the second feeding component 220 being disposed to have an angle therebetween. As such, the first feeding component 210 is utilized to perform feeding on the two radiation arms 110 of a group of dipoles, and the second feeding component 220 is utilized to perform feeding on the two radiation arms 110 of another group of dipoles, thus the transmission of energy can be achieved, and it can be ensured that the radiation unit 10 can radiate signals in a stable and reliable manner.

[0053] As shown in Figs. 2 and 3, in one embodiment, the first feeding component 210 includes a first media 211, a first feeding member and two first grounding members. The first feeding member is disposed on one side of the first media 211 by means such as engaging or bonding, the two first grounding members are disposed on the other side of the first media 211 by means such as engaging or bonding, and the two first grounding members are disposed to be spaced apart relative to each other. The first feeding member is coupled and connected with the two first grounding members, and the two first grounding members are connected with the two radiation arms 110 of the first group of dipoles in one-to-one correspondence. As such, the first feeding member is coupled and connected with each of the two first grounding members, and the two first grounding members are connected with the two radiation arms 110 of the first group of dipoles in one-to-one correspondence, thus the first feed can be utilized to perform coupling feed on the first group of dipoles, so that the radiation unit meets good impedance characteristics.

[0054] It should be noted that the first media 211 can be provided as a plate made of insulating materials. The first feeding member can be provided as a first balun microstrip line 212, as shown in Fig. 2. For example, the first balun microstrip line 212 includes a first branch 2121 and a second branch 2122 which are electrically connected, one end of the first branch 2121 is electrically connected with an external feed network, and the second branch 212 has one end hanging in the air, and the first branch 2121 and the second branch 2122 are respectively disposed in correspondence with the two first grounding members and coupled and connected with them. As shown in Fig. 3, the first grounding member can be provided as a first microstrip ground piece 213, one end of the first microstrip ground piece 213 is electrically connected with a corresponding radiation arm 110 by means such as welding, and the other end of the first microstrip ground piece 213 is connected with ground base plate by means such as welding. The number of the first grounding members can be flexibly adjusted as required, as long as the coupling feed to the radiation arms 110 can be enabled.

[0055] As shown in Figs. 4 and 5, in one embodiment, the second feeding component 220 includes a second media 221 disposed at an angle to the first media 211, a second feeding member and two second grounding members. The second feeding member is disposed on one side of the second media 221 by means such as engaging or bonding, the second grounding member is disposed on the other side of the second media 221 by means such as engaging or bonding, and the two second grounding members are disposed to be spaced apart from each other. The second feeding member is coupled and connected with the two second grounding members, and the two second grounding members are connected with the two radiation arms 110 of second group of dipoles in one-to-one correspondence. As such, the second feeding member is coupled and connected with each of the two second grounding members, and the two second grounding members are connected with the two radiation arms 110 of second group of dipoles in one-to-one correspondence, thus the second feeding member can be utilized to perform coupling feed on second group of dipoles, so that the radiation unit meets good impedance characteristics.

[0056] It should be noted that second media 221 can be provided as a plate made of insulating materials. The second feeding member can be provided as a second balun microstrip line 222, as shown in Fig. 4. For example, the second balun microstrip line 222 includes a third branch 2221 and a fourth branch 2222 which are electrically connected, one end of the third branch 2221 is electrically connected with an external feed network, and the fourth branch 2222 has one end hanging in the air, and the third branch 2221 and the fourth branch 2222 are respectively disposed in correspondence with the two first grounding members and coupled and connected with them. As shown in Fig.5, the second feeding member can be provided as a second microstrip ground piece 223, one end of the second microstrip ground piece 223 is electrically connected with a corresponding radiation arm 110 by means such as welding, and the other end of the second microstrip ground piece 223 is connected with ground base plate by means such as welding. The number of the two grounding members can be flexibly adjusted as required, as long as the coupling feed to the radiation arms 110 can be enabled.

[0057] The first media 211 and the second media 221 which are disposed to have an angle therebetween can be implemented by means of pluggable fitting, are easy for disassembly and assembly, and are of high assembling efficiency. Preferably, the first media 211 is disposed perpendicular to the second media 221 in a compact layout.

[0058] As shown in Figs. 2 to 5, in one embodiment, the first media 211 is provided with a first socket 2111, and the second media 221 is provided with a second socket 2211 which is disposed corresponding to the first socket 2111. In this way, the first media 211 is above the second media 221, so that the second socket 2211 corresponds to the first socket 2111, and then the second media 221 is inserted into the first socket 2111 until the first media 211 is inserted into the second socket 2211, and then the first media 211 and the second media 221 can be stably and reliably connected together to form a support structure for providing stable support for the radiation unit 10.

[0059] The width of the first socket 2111 and the width of the second socket 2211 can be flexibly adjusted according to the thicknesses of the second media 221 and the first media 211.

[0060] As shown in Figs. 2 and 3, in one embodiment, one end of the first grounding member is provided with a first bump 2131 for pluggable fitting with a respective radiation arm 110. As shown in Figs. 4 and 5, one end of the second grounding member is provided with a second bump 2231 for pluggable fitting with a respective radiation arm 110. As such, a corresponding feeding socket 1000 can be provided on a radiation arm 110 for plugging the first bump 2131 and the second bump 2231 into the feeding socket 1000, thus the electrical connection between the first grounding member and the second grounding member and the radiation arm 110 can be implement in a simple and convenient manner. Of course, in order to improve the stability and reliability of the pluggable fitting, as shown in Fig. 3, the first media 211 may also be provided with a third bump 2112 which is disposed corresponding to the first bump 2131; as shown in Fig. 5, the second media 221 may also be provided with a fourth bump 2212 which is disposed corresponding to the second bump 2231; thus the plugging strength of the first bump 2131 and the second bump 2231 are increased. Jacks corresponding to the feeding sockets 1000 also need to be opened on the substrate 300.

[0061] In one embodiment, the 5G antenna includes at least three radiation units 10 which are disposed to be equally spaced apart from each other in a preset distance. As such, three radiation units 10 are utilized to constitute a subarray, and the spacing between two adjacent radiation units 10 is preferably 62.5 mm. Further, four subarrays can constitute a 5G antenna array, and the spacing between adjacent subarrays is preferably 52 mm. Therefore, the sizes of the radiation units 10 can be adjusted according to actual frequency requirements to meet the different operating frequency requirements, and the radiation units 10 are used in combination to meet 5G antenna requirements, so that as compared with other array antennas, the pattern of the 5G array antenna are improved significantly and have good standing waves, as shown in Fig. 6; the beam widths in the horizontal plane all reach 60° or more, as shown in Fig. 7.

[0062] The various technical features in the above embodiments may be combined arbitrarily. For brevity of description, not all possible combinations of various technical features in the above embodiments have been described. However, as long as the combinations of these technical features are not contradictory, they shall be regarded as falling within the scope of the specification.

[0063] The above embodiments represent only several embodiments of the present invention, which have been described concretely and in detail, but should not be construed as limiting the protection scope of the invention.

[0064] Therefore, the protection scope of the present invention should be defined by the appended claims.

Claims

1. A radiation unit (10), comprising:

two groups of dipoles the polarizations of which are orthogonal, each group of the dipoles comprises two radiation arms (110) which are disposed to be spaced apart relative to each other, and each of the radiation arms (110) is provided with a first extension branch (120) and a second extension branch (130) which are disposed to be spaced apart from each other;
wherein the surface area of the first extension branch (120) is greater than the surface area of the second extension branch (130);
wherein an outer sidewall of each of the radiation arms (110) is provided with a cut-off corner (190);
wherein each of the radiation arms (110) is provided with a first hollowed groove (140), each of one end of the first extension branch (120) and one end of the second extension branch (130) is connected with the outer sidewall of each of the radiation arms (110), a first spacer groove (150) in communication with the first hollowed groove (140) is provided between the first extension branch (120) and the second extension branch (130), and each of the first extension branch (120) and the second extension branch (130) is disposed towards the inside of the first hollowed groove (140);
wherein a second spacer groove (160) and a current-conducting part (180) for connecting two adjacent radiation arms (110) are provided between the two adjacent radiation arms (110), and each of the two adjacent radiation arms (110) is provided with a second hollowed groove (170) in communication with the second spacer groove (160).

2. The radiation unit (10) according to claim 1, wherein each of the radiation arms (110) is provided with a first connecting portion for coupling feed with a feeding balun.

3. The radiation unit (10) according to claim 1, wherein a distance between a sidewall of the first hollowed groove (140) and a sidewall of the second spacer groove (160) ranges from 5.5 mm to 6mm; and a width of the second hollowed groove (170) ranges from 11.9 mm to 12.7 mm.

4. A 5G antenna, comprising:

the radiation unit (10) according to any one of claims 1-3, and
feeding baluns which are in coupling feed with the radiation arms (110).

5. The 5G antenna according to claim 4, wherein the radiation unit (10) further comprises a substrate (300) which is provided between the radiation arms (110) and the feeding baluns, and the radiation arms (110) are disposed on a surface of the substrate (300).

6. The 5G antenna according to claims 4 or 5, wherein each of the feeding baluns comprises a first feeding component (210) for the coupling feed with the first group of dipoles and a second feeding component (220) for the coupling feed with the second group of dipoles, the first feeding component and the second feeding component being disposed to have an angle therebetween.

Patentansprüche

1. Strahlungseinheit (10), umfassend:

zwei Gruppen von Dipolen, deren Polarisationen orthogonal sind, wobei jede Gruppe der Dipole zwei Strahlungsarme (110) umfasst, die angeordnet sind, um relativ zueinander beabstandet zu sein, und jeder der Strahlungsarme (110) mit einem ersten Verlängerungszweig (120) und einem zweiten Verlängerungszweig (130) versehen ist, die angeordnet sind, um voneinander beabstandet zu sein;
wobei die Fläche des ersten Verlängerungszweigs (120) größer ist als die Fläche des zweiten Verlängerungszweigs (130);
wobei eine äußere Seitenwand jedes der Strahlungsarme (110) mit einer abgeschnittenen Ecke (190) versehen ist;
wobei jeder der Strahlungsarme (110) mit einer ersten ausgehöhlten Nut (140) versehen ist, wobei jeweils ein Ende des ersten Verlängerungszweigs (120) und ein Ende des zweiten Verlängerungszweigs (130) mit der äußeren Seitenwand jedes der Strahlungsarme (110) verbunden ist, eine erste Abstandhalter-Nut (150), die mit der ersten ausgehöhlten Nut (140) kommuniziert, zwischen dem ersten Verlängerungszweig (120) und dem zweiten Verlängerungszweig (130) vorgesehen ist, und jeder des ersten Verlängerungszweigs (120) und des zweiten Verlängerungszweigs (130) zur Innenseite der ersten ausgehöhlten Nut (140) hin angeordnet ist;
wobei zwischen den zwei benachbarten Strahlungsarmen (110) eine zweite Abstandhalter-Nut (160) und ein stromleitender Teil (180) zum Verbinden zweier benachbarter Strahlungsarme (110) vorgesehen sind, und jeder der zwei benachbarten Strahlungsarme (110) mit einer zweiten ausgehöhlten Nut (170) ver-

sehen ist, die mit der zweiten Abstandhalter-Nut (160) kommuniziert.

2. Strahlungseinheit (10) nach Anspruch 1, wobei jeder der Strahlungsarme (110) mit einem ersten Kopplungsabschnitt zum Koppeln der Einspeisung mit einem Einspeisebalun versehen ist.

3. Strahlungseinheit (10) nach Anspruch 1, wobei ein Abstand zwischen einer Seitenwand der ersten ausgehöhlten Nut (140) und einer Seitenwand der zweiten Abstandhalter-Nut (160) im Bereich von 5,5 mm bis 6 mm liegt; und eine Breite der zweiten ausgehöhlten Nut (170) im Bereich von 11,9 mm bis 12,7 mm liegt.

4. 5-G-Antenne, umfassend:

   die Strahlungseinheit (10) nach einem der Ansprüche 1-3, und
   Einspeisebaluns, die mit den Strahlungsarmen (110) in Kopplungs-Einspeisung stehen.

5. 5G-Antenne nach Anspruch 4, wobei die Strahlungseinheit (10) ferner ein Substrat (300) umfasst, das zwischen den Strahlungsarmen (110) und den Einspeisebaluns vorgesehen ist, und die Strahlungsarme (110) auf einer Oberfläche des Substrats (300) angeordnet sind.

6. 5G-Antenne nach Anspruch 4 oder 5, wobei jeder der Einspeisebaluns eine erste Einspeisekomponente (210) für die Kopplungs-Einspeisung mit der ersten Gruppe von Dipolen und eine zweite Einspeisekomponente (220) für die Kopplungs-Einspeisung mit der zweiten Gruppe von Dipolen umfasst, wobei die erste Einspeisekomponente und die zweite Einspeisekomponente so angeordnet sind, dass sie einen Winkel dazwischen aufweisen.

Revendications

1. Unité de rayonnement (10), comprenant :

   deux groupes de dipôles dont les polarisations sont orthogonales, chaque groupe de dipôles comprenant deux bras de rayonnement (110) disposés de manière à être espacés l'un par rapport à l'autre, et chacun des bras de rayonnement (110) étant pourvu d'une première branche d'extension (120) et d'une deuxième branche d'extension (130) disposées de manière à être espacées l'une par rapport à l'autre ;
   dans laquelle la surface de la première branche d'extension (120) est supérieure à la surface de la deuxième branche d'extension (130) ;
   dans laquelle une paroi latérale extérieure de chacun des bras de rayonnement (110) est pourvue d'un coin coupé (190) ;
   dans laquelle chacun des bras de rayonnement (110) est pourvu d'une première rainure creusée (140), chacune d'une extrémité de la première branche d'extension (120) et d'une extrémité de la deuxième branche d'extension (130) est reliée à la paroi latérale extérieure de chacun des bras de rayonnement (110), une première rainure d'espacement (150) en communication avec la première rainure creusée (140) est prévue entre la première branche d'extension (120) et la deuxième branche d'extension (130), et chacune de la première branche d'extension (120) et de la deuxième branche d'extension (130) est disposée vers l'intérieur de la première rainure creusée (140) ;
   dans laquelle une deuxième rainure d'espacement (160) et une partie conductrice de courant (180) pour connecter deux bras de rayonnement adjacents (110) sont prévues entre les deux bras de rayonnement adjacents (110), et chacun des deux bras de rayonnement adjacents (110) est pourvu d'une deuxième rainure creusée (170) en communication avec la deuxième rainure d'espacement (160).

2. Unité de rayonnement (10) selon la revendication 1, dans laquelle chacun des bras de rayonnement (110) est pourvu d'une première partie d'alimentation pour coupler l'alimentation avec un balun d'alimentation.

3. Unité de rayonnement (10) selon la revendication 1, dans laquelle une distance entre une paroi latérale de la première rainure creusée (140) et une paroi latérale de la deuxième rainure d'espacement (160) est comprise entre 5,5 mm et 6 mm ; et une largeur de la deuxième rainure creusée (170) est comprise entre 11,9 mm et 12,7 mm.

4. Antenne 5G, comprenant :

   une unité de rayonnement (10) selon une quelconque des revendications 1-3, et
   des baluns d'alimentation qui sont en alimentation de couplage avec les bras de rayonnement (110).

5. Antenne 5G selon la revendication 4, dans laquelle l'unité de rayonnement (10) comprend en outre un substrat (300) qui est prévu entre les bras de rayonnement (110) et les baluns d'alimentation de couplage, et les bras de rayonnement (110) sont disposés sur une surface du substrat (300).

6. Antenne 5G selon les revendications 4 ou 5, dans laquelle chacun des baluns d'alimentation

comprend un premier composant d'alimentation (210) pour l'alimentation de couplage avec le premier groupe de dipôles et un deuxième composant d'alimentation (220) pour l'alimentation de couplage avec le deuxième groupe de dipôles, le premier composant d'alimentation et le deuxième composant d'alimentation étant disposés de manière à présenter un angle entre eux.

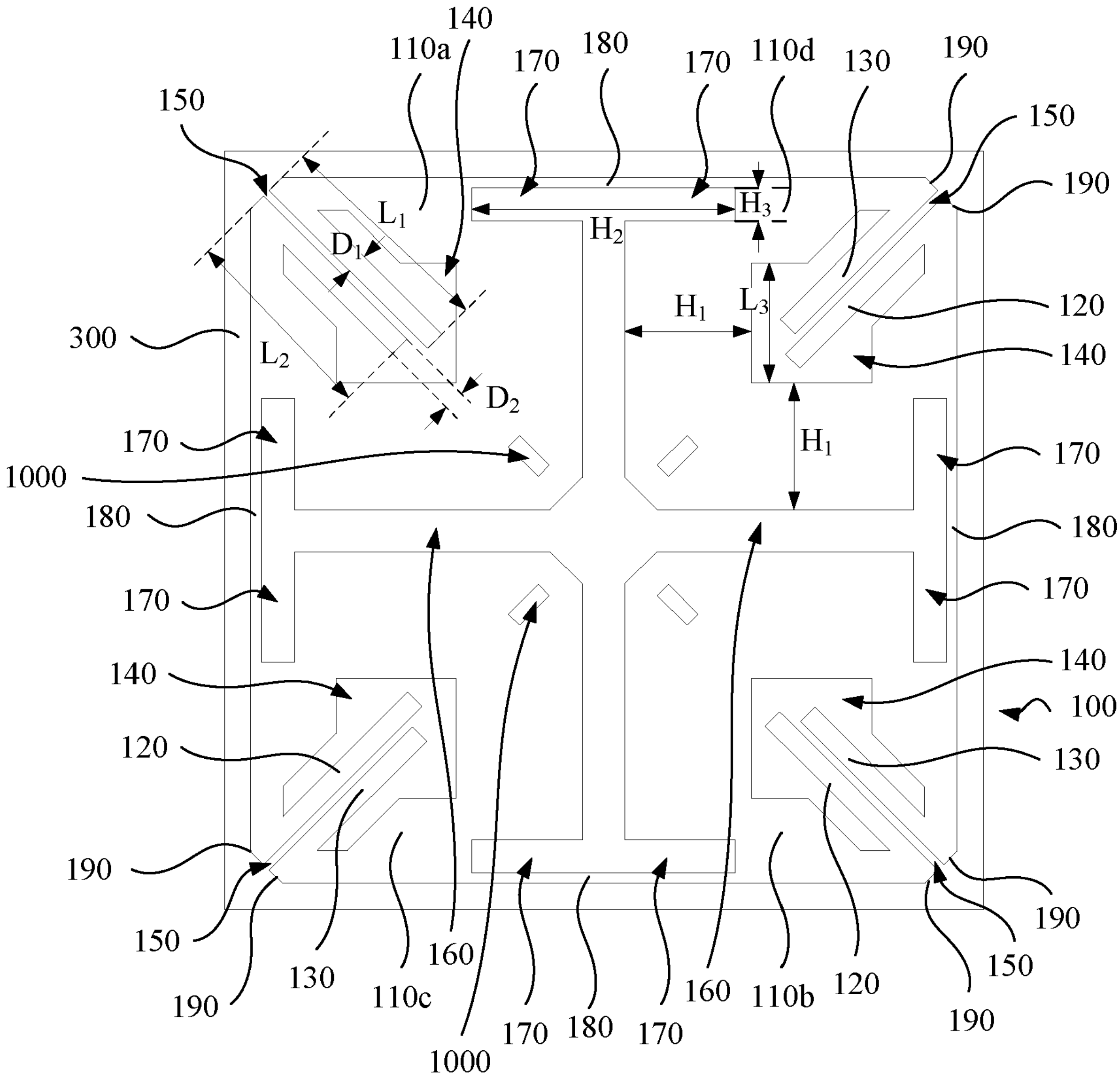

140
110a
170
180
170
110d
130
190
150
150
190
L_1
H_3
H_2
D_1
H_1
L_3
120
300
L_2
140
D_2
H_1
170
170
1000
180
180
170
170
140
140
100
120
130
190
190
150
190
150
130
110c
160
170
180
170
160
110b
120
190
1000

Figure 1

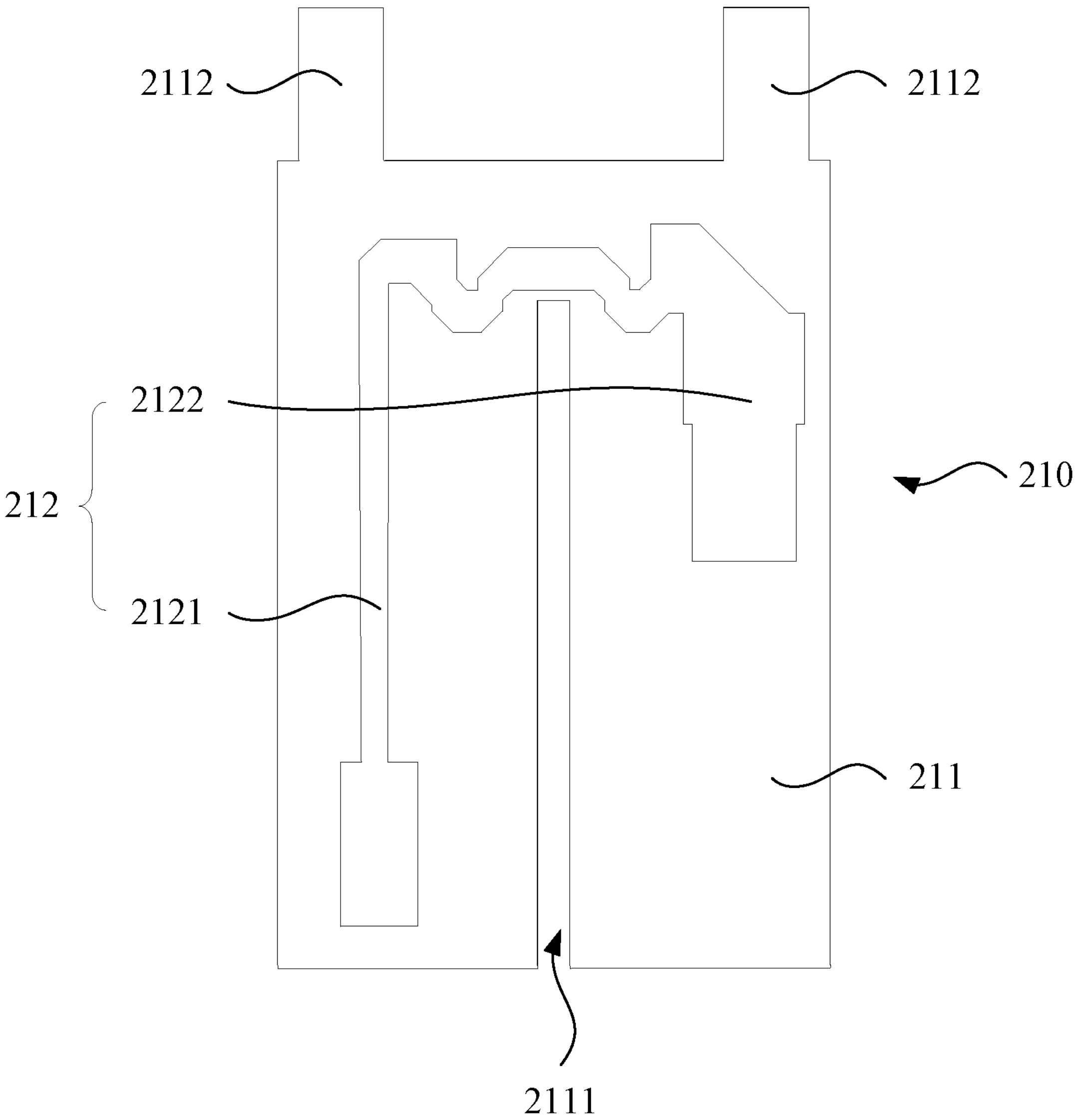


Figure 2

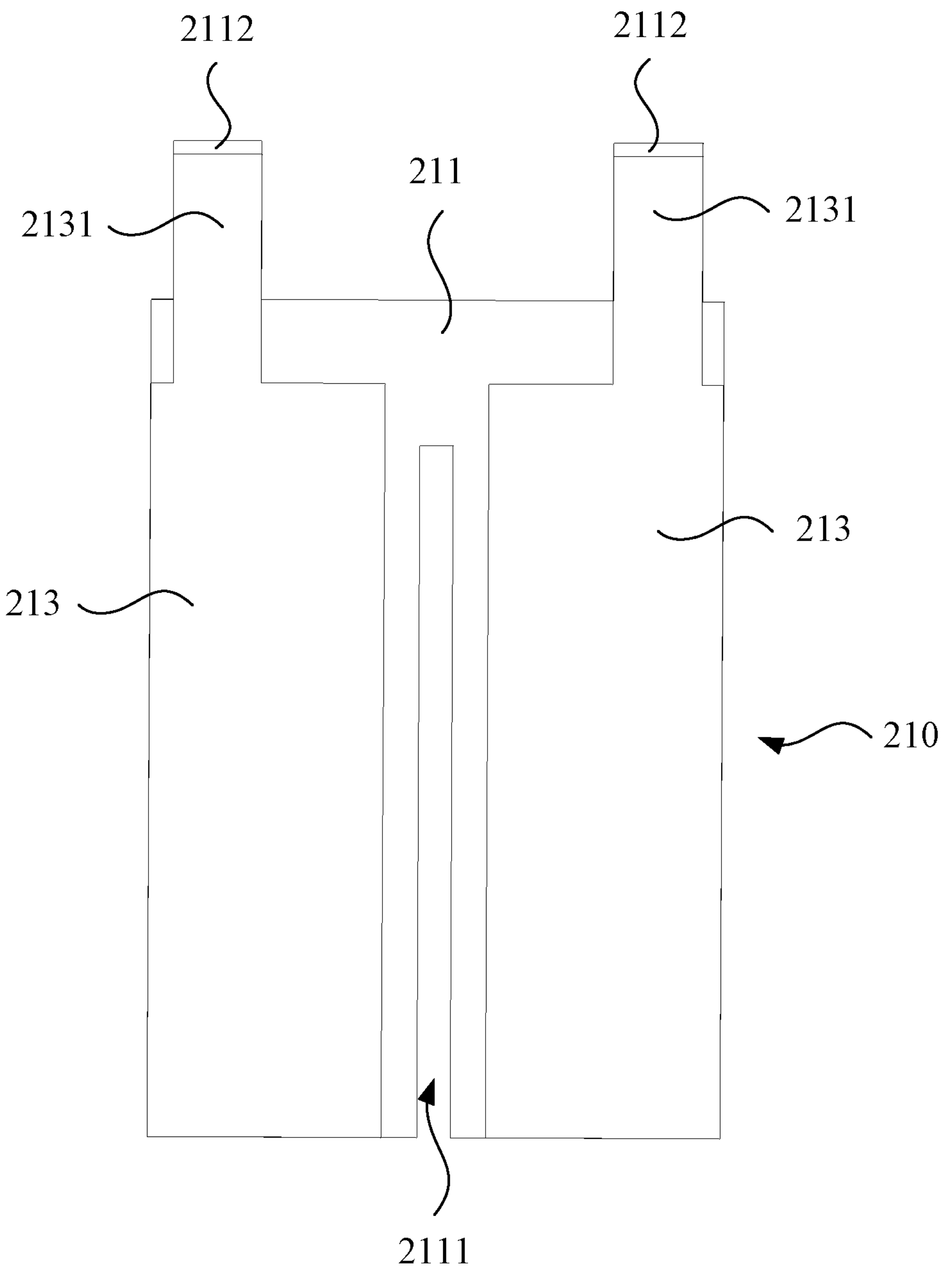


Figure 3

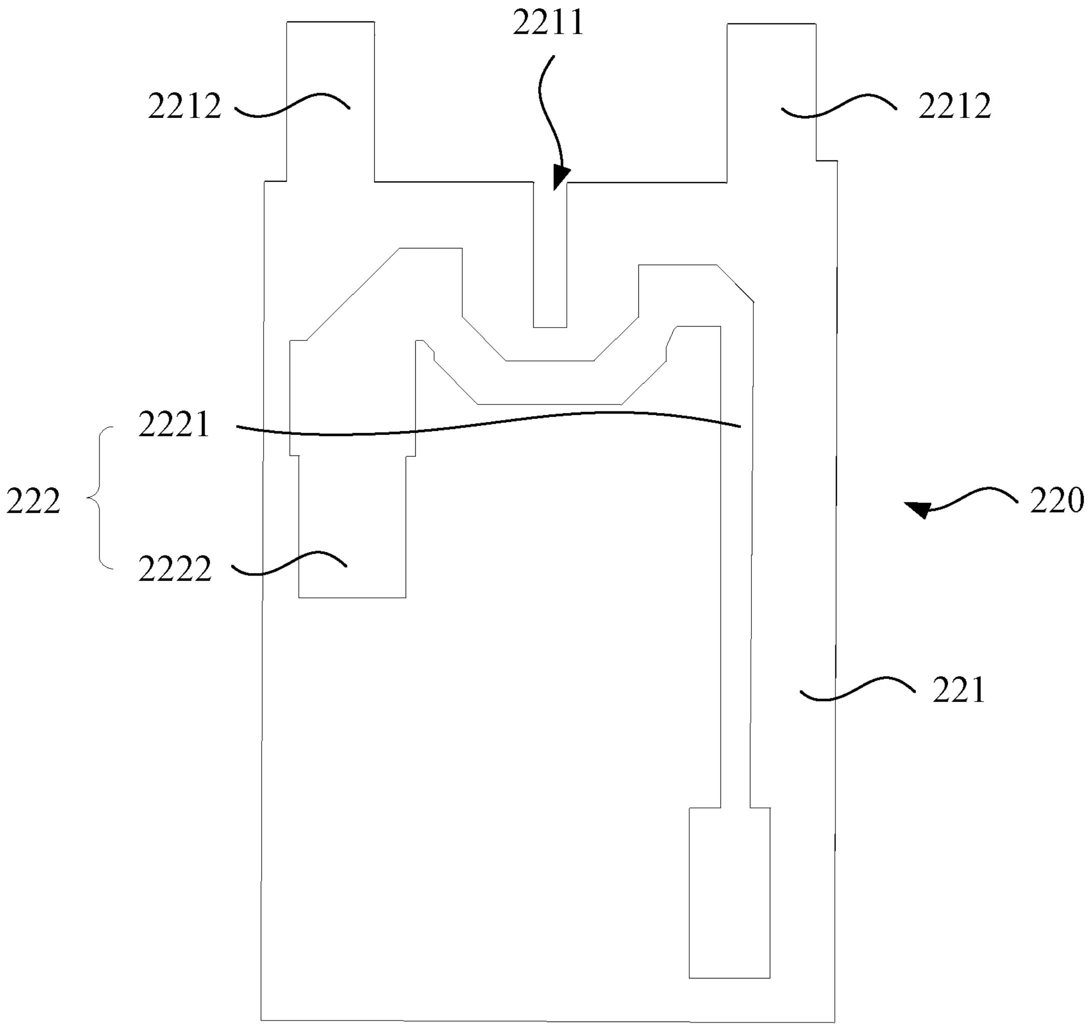


Figure 4

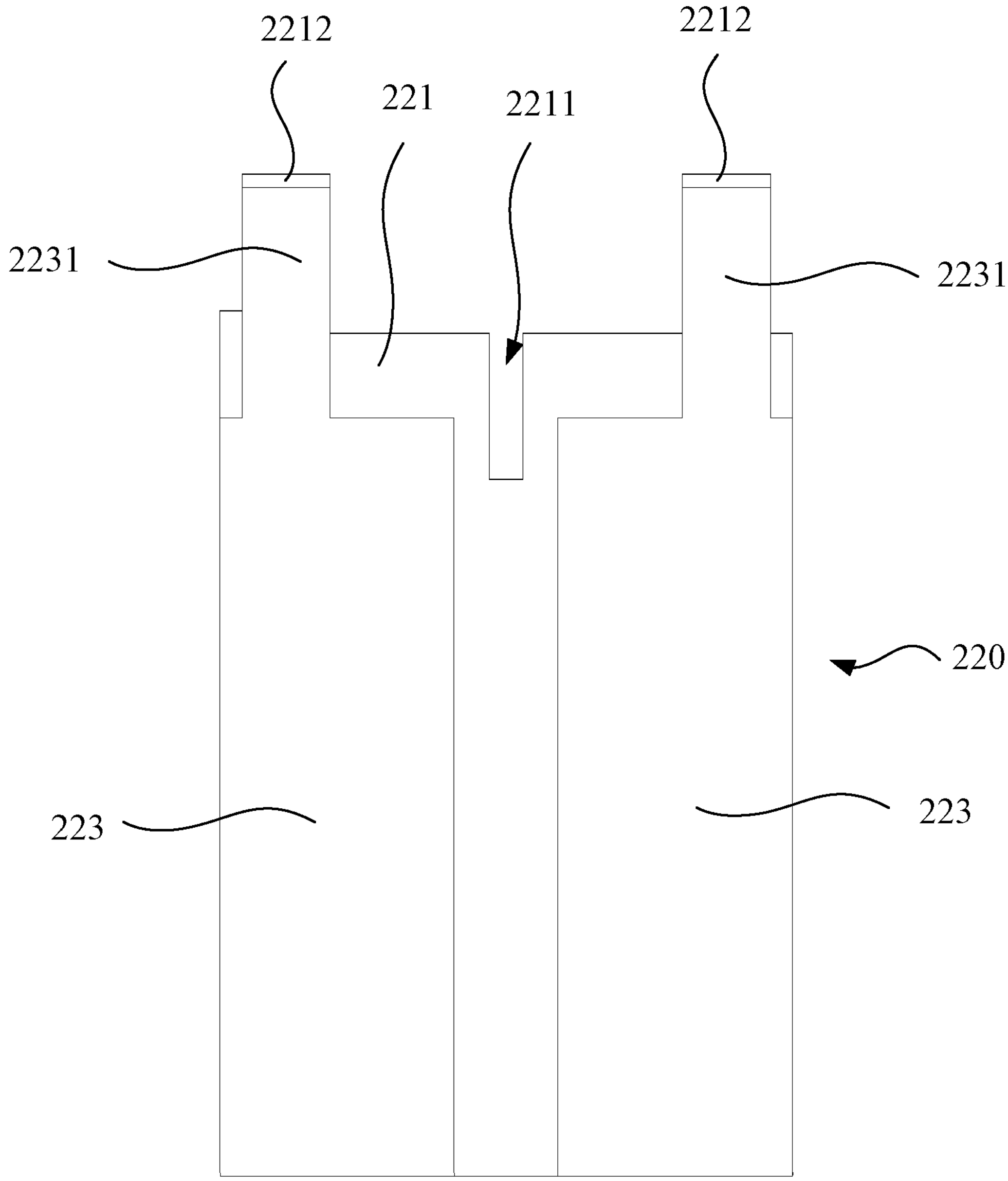
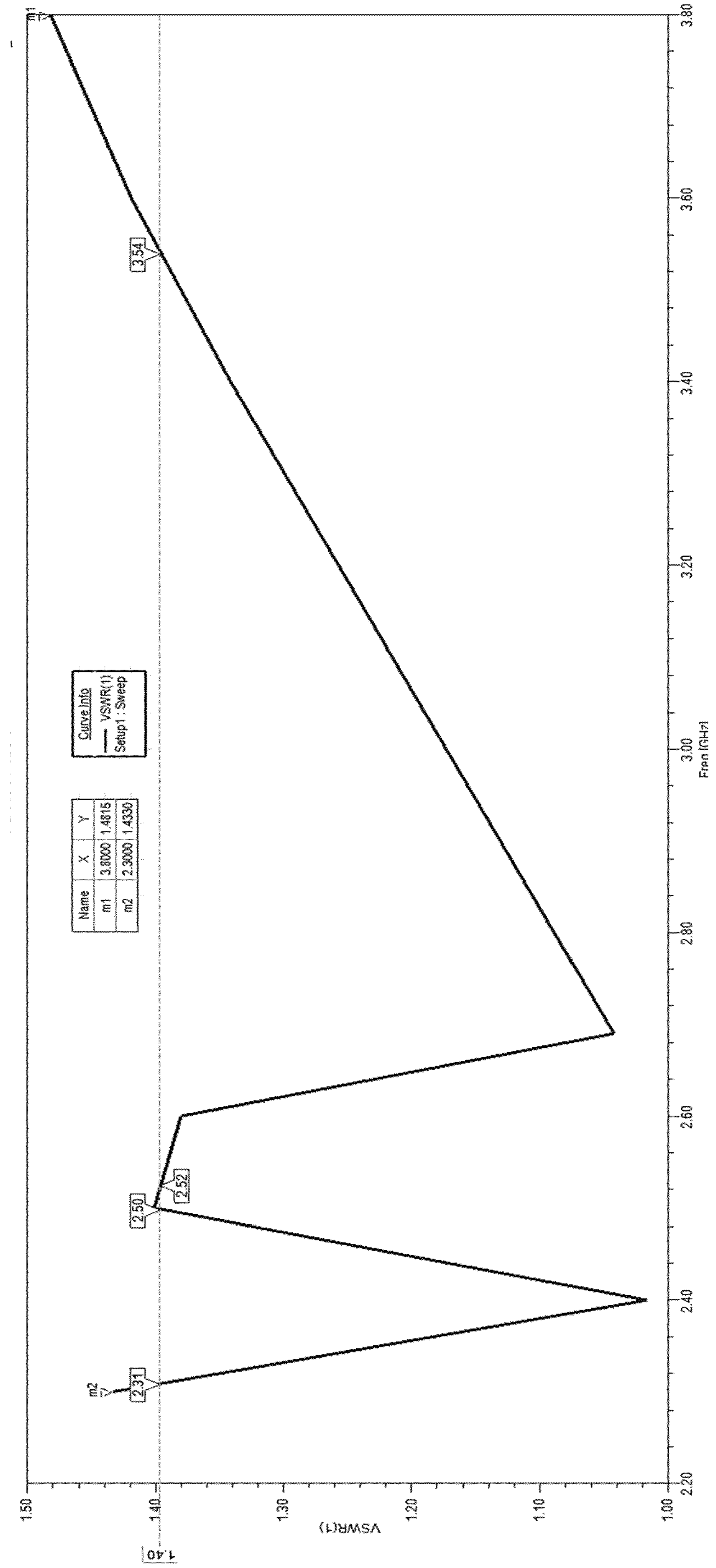


Figure 5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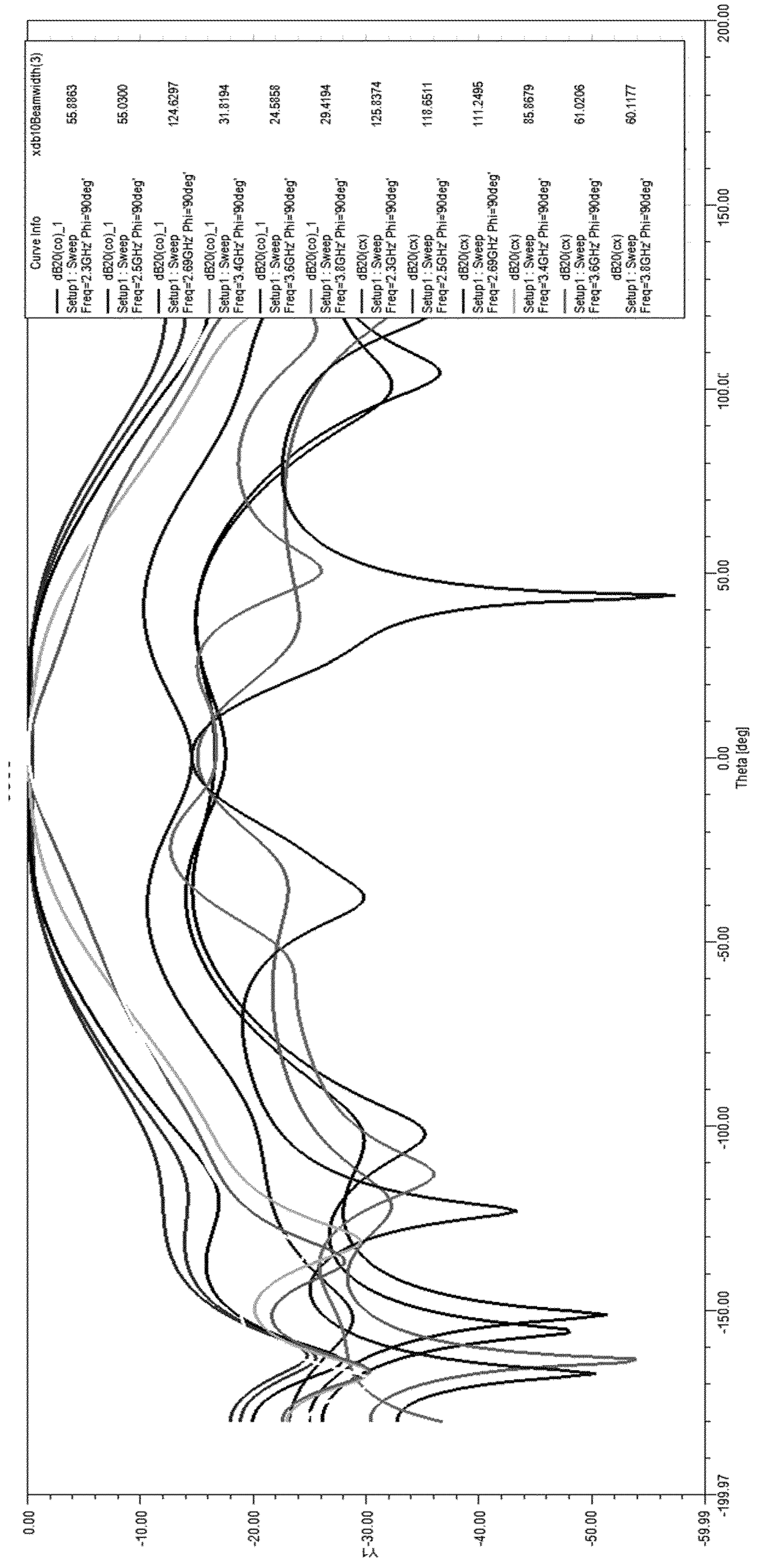
m2 2.3000 1.4330
m1
m2
3.54
2.52
2.50
2.31
1.40
VSWR(1)
Freq [GHz]
1.50
1.40
1.30
1.20
1.10
1.00
2.20
2.40
2.60
2.80
3.00
3.20
3.40
3.60
3.80

Figure 6


Curve Info
xdb10Beamwidth(3)
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55.8863
dB20(co)_1 Setup1 : Sweep Freq='2.5GHz' Phi='90deg'
55.0300
dB20(co)_1 Setup1 : Sweep Freq='2.69GHz' Phi='90deg'
124.6297
dB20(co)_1 Setup1 : Sweep Freq='3.4GHz' Phi='90deg'
31.8194
dB20(co)_1 Setup1 : Sweep Freq='3.6GHz' Phi='90deg'
24.5858
dB20(co)_1 Setup1 : Sweep Freq='3.8GHz' Phi='90deg'
29.4194
dB20(cx) Setup1 : Sweep Freq='2.3GHz' Phi='90deg'
125.8374
dB20(cx) Setup1 : Sweep Freq='2.5GHz' Phi='90deg'
118.6511
dB20(cx) Setup1 : Sweep Freq='2.69GHz' Phi='90deg'
111.2495
dB20(cx) Setup1 : Sweep Freq='3.4GHz' Phi='90deg'
85.8679
dB20(cx) Setup1 : Sweep Freq='3.6GHz' Phi='90deg'
61.0206
dB20(cx) Setup1 : Sweep Freq='3.8GHz' Phi='90deg'
60.1177
200.00
150.00
100.00
50.00
0.00
Theta [deg]
-50.00
-100.00
-150.00
-199.97
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-59.99
Y1

Figure 7

REFERENCES CITED IN THE DESCRIPTION

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