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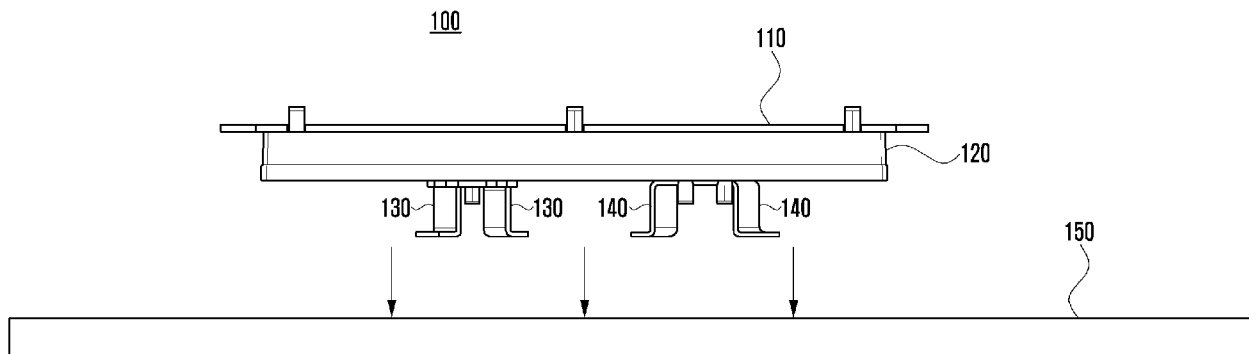
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(54) Title: ANTENNA MODULE INCLUDING DIELECTRIC MATERIAL AND ELECTRONIC DEVICE INCLUDING ANTENNA MODULE



(57) Abstract: An antenna module of a wireless communication system is provided. The antenna module includes a radiator comprising a top face to which a radio wave is radiated, a dielectric material disposed on a bottom face of the radiator, the bottom face of the radiator being opposite to the top face of the radiator, a feeding unit disposed on a bottom face of the dielectric material, the feeding unit being configured to supply an electric signal to the radiator through the dielectric material, and a support unit disposed on the bottom face of the dielectric material, the support unit comprising a metallic material.



Description

Title of Invention: ANTENNA MODULE INCLUDING DI-ELECTRIC MATERIAL AND ELECTRONIC DEVICE INCLUDING ANTENNA MODULE

Technical Field

- [1] The disclosure provides an antenna module capable of improving communication efficiency in a next-generation communication system and an electronic device including the antenna module.

Background Art

- [2] The above information is presented as background information only to assist with an understanding of the disclosure. No determination has been made, and no assertion is made, as to whether any of the above might be applicable as prior art with regard to the disclosure.
- [3] To meet the demand for wireless data traffic having increased since the deployment of 4th generation (4G) communication systems, efforts have been made to develop an improved 5th generation (5G) or pre-5G communication system. Therefore, the 5G or pre-5G communication system is also called a 'Beyond 4G Network' or a 'Post LTE System'. The 5G communication system is considered to be implemented in higher frequency (mm Wave) bands, e.g., 60 GHz bands, so as to accomplish higher data rates. To decrease propagation loss of the radio waves and increase the transmission distance, the beamforming, massive multiple-input multiple-output (MIMO), full dimensional MIMO (FD-MIMO), array antenna, an analog beam forming, large scale antenna techniques are discussed in 5G communication systems. In addition, in 5G communication systems, development for system network improvement is under way based on advanced small cells, cloud radio access networks (RANs), ultra-dense networks, device-to-device (D2D) communication, wireless backhaul, moving network, cooperative communication, coordinated multi-points (CoMP), reception-end interference cancellation and the like. In the 5G system, Hybrid frequency shift keying (FSK) and quadrature amplitude modulation (QAM) (FQAM) and sliding window superposition coding (SWSC) as an advanced coding modulation (ACM), and filter bank multi carrier (FBMC), non-orthogonal multiple access (NOMA), and sparse code multiple access (SCMA) as an advanced access technology have been developed.
- [4] The Internet, which is a human centered connectivity network where humans generate and consume information, is now evolving to the internet of things (IoT) where distributed entities, such as things, exchange and process information without human intervention. The internet of everything (IoE), which is a combination of the

IoT technology and the Big Data processing technology through connection with a cloud server, has emerged. As technology elements, such as "sensing technology," "wired/wireless communication and network infrastructure," "service interface technology," and "Security technology" have been demanded for IoT implementation, a sensor network, a machine-to-machine (M2M) communication, machine type communication (MTC), and so forth have been recently researched. Such an IoT environment may provide intelligent Internet technology services that create a new value to human life by collecting and analyzing data generated among connected things. IoT may be applied to a variety of fields including smart home, smart building, smart city, smart car or connected cars, smart grid, health care, smart appliances, and advanced medical services through convergence and combination between existing information technology (IT) and various industrial applications.

- [5] In line with this, various attempts have been made to apply 5G communication systems to IoT networks. For example, technologies such as a sensor network, machine type communication (MTC), and machine-to-machine (M2M) communication may be implemented by beamforming, MIMO, and array antennas. Application of a cloud radio access network (RAN) as the above-described Big Data processing technology may also be considered to be as an example of convergence between the 5G technology and the IoT technology.
- [6] The above information is presented as background information only to assist with an understanding of the disclosure. No determination has been made, and no assertion is made, as to whether any of the above might be applicable as prior art with regard to the disclosure.

Disclosure of Invention

Technical Problem

- [7] As described above, in the frequency band to which a next-generation mobile communication system is applied, the performance of the antenna module may be deteriorated due to the path loss of radio waves or the like. Therefore, in the next-generation mobile communication system, an antenna module structure for solving such a problem is required.
- [8] Aspects of the disclosure are to address at least the above-mentioned problems and/or disadvantages and to provide at least the advantages described below. Accordingly, an aspect of the disclosure is to provide an antenna module structure capable of implementing smooth communication even in a massive multiple-input multiple-output (MIMO) communication environment.
- [9] Additional aspects will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the

presented embodiments.

Solution to Problem

- [10] In accordance with an aspect of the disclosure, an antenna module is provided. The antenna module includes a radiator having a top face to which a radio wave is radiated, a dielectric material disposed on a bottom face of the radiator, the bottom face of the radiator being opposite to the top face of the radiator, a feeding unit disposed on a bottom face of the dielectric material, the feeding unit being configured to supply an electric signal to the radiator through the dielectric material, and a support unit disposed on the bottom face of the dielectric material, the support unit comprising a metallic material.
- [11] The antenna module may further include a printed circuit board (PCB) coupled to the feeding unit and the support unit to supply the electric signal to the feeding unit.
- [12] The feeding unit and the support unit may be disposed such that the bottom face of the dielectric material and a top face of the PCB are spaced apart from each other by a predetermined first length, and a frequency characteristic of the radio wave radiated through the radiator may be determined based on the predetermined first length.
- [13] Each of the feeding unit and the support unit may include a first segment disposed on the bottom face of the dielectric material, and a second segment extending from a first end of the first segment toward the PCB to be coupled to a top face of the PCB.
- [14] Each of the feeding unit and the support unit may further include a third segment extending from the second end of the first segment toward the PCB to be coupled to the top face of the PCB.
- [15] The dielectric material may be disposed to enclose the feeding unit and the support unit, and each of the first segment, the second segment, and the third segment may further include a protrusion so as not to be separated from the dielectric material.
- [16] The feeding unit may include a first feeding unit configured to supply an electric signal related to horizontal polarization to the radiator, and a second feeding unit configured to supply an electric signal related to vertical polarization to the radiator. On the bottom face of the dielectric material, an extension line of the first feeding unit and an extension line of the second feeding unit may be perpendicular to each other.
- [17] The support unit may include a first support unit disposed on the extension line of the first feeding unit on the bottom face of the dielectric material, and a second support unit disposed on the extension line of the second feeding unit on the bottom face of the dielectric material.
- [18] In accordance with another aspect of the disclosure, an antenna module is provided. The antenna module includes an insulator having a plate shape and comprising a conductive pattern formed thereon for an electric signal to flow therethrough, a metal

structure disposed on a top face of the insulator, the metal structure being configured to radiate a radio wave through a top face of the metal structure, the top face of the metal structure being spaced apart from the insulator by a predetermined first length, and a wireless communication chip disposed on a bottom face of the insulator, the wireless communication chip being configured to supply the electric signal to the metal structure through the conductive pattern to radiate the radio wave.

[19] The metal structure may include a first feeding unit having a first end electrically connected to a conductive pattern formed on the insulator and a second end electrically connected to the top face of the metal structure, the first feeding unit being disposed such that the top face of the metal structure is spaced apart from the top face of the insulator by the predetermined first length, a second feeding unit having a first end electrically connected to a conductive pattern formed on the insulator and a second end electrically connected to the top face of the metal structure, the second feeding unit being disposed such that the top face of the metal structure is spaced apart from the top face of the insulator by the predetermined first length and a support unit having a first end connected to the top face of the insulator and a second end connected to the top face of the metal structure, the support unit being disposed such that the top face of the metal structure is spaced apart from the top face of the insulator by the predetermined first length.

[20] On the top face of the insulator, an extension line of the first feeding unit and an extension line of the second feeding unit may be perpendicular to each other, and the support unit may be disposed in a region between the extension line of the first feeding unit and the extension line of the second feeding unit.

[21] In accordance with another aspect of the disclosure, an electronic device is provided. The electronic device includes an antenna module. The antenna module includes a radiator having a top face, a radio wave being radiated toward the top face of the radiator, a dielectric material disposed on a bottom face of the radiator, the bottom face of the radiator being opposite to the top face of the radiator, a feeding unit disposed on a bottom face of the dielectric material, the feeding unit being configured to supply an electric signal to the radiator through the dielectric material, and a support unit disposed on the bottom face of the dielectric material, the support unit comprising a metallic material.

[22] The electronic device may further include a printed circuit board (PCB) coupled to the feeding unit and the support unit to supply the electric signal to the feeding unit.

[23] The feeding unit and the support unit may be disposed such that the bottom face of the dielectric material and a top face of the PCB are spaced apart from each other by a predetermined first length, and a frequency characteristic of the radio wave radiated through the radiator may be determined on the basis of the predetermined first length.

- [24] Each of the feeding unit and the support unit may include a first segment disposed on the bottom face of the dielectric material, and a second segment extending from a first end of the first segment toward the PCB to be coupled to a top face of the PCB.
- [25] Each of the feeding unit and the support unit may further include a third segment extending from the second end of the first segment toward the PCB to be coupled to the top face of the PCB.
- [26] The dielectric material may be disposed to enclose the feeding unit and the support unit, and each of the first segment, the second segment, and the third segment may further include a protrusion so as not to be separated from the dielectric material.
- [27] The feeding unit may include a first feeding unit configured to supply an electric signal related to horizontal polarization to the radiator, and a second feeding unit configured to supply an electric signal related to vertical polarization to the radiator. On the bottom face of the dielectric material, an extension line of the first feeding unit and an extension line of the second feeding unit may be perpendicular to each other.
- [28] The support unit may include a first support unit disposed on the extension line of the first feeding unit on the bottom face of the dielectric material, and a second support unit disposed on the extension line of the second feeding unit on the bottom face of the dielectric material.
- [29] In accordance with another aspect of the disclosure, an electronic device is provided. The electronic device includes an antenna module. The antenna module includes an insulator having a plate shape and comprising a conductive pattern formed thereon for an electric signal to flow therethrough, a metal structure disposed on a top face of the insulator, the metal structure being configured to radiate a radio wave through a top face of the metal structure, the top face of the metal structure being spaced apart from the insulator by a predetermined first length, and a wireless communication chip disposed on a bottom face of the insulator, the wireless communication chip being configured to supply the electric signal to the metal structure through the conductive pattern to radiate the radio wave.
- [30] The metal structure may include a first feeding unit having a first end electrically connected to a conductive pattern formed on the insulator and a second end electrically connected to the top face of the metal structure, the first feeding unit being disposed such that the top face of the metal structure is spaced apart from the top face of the insulator by the first length, a second feeding unit having a first end electrically connected to a conductive pattern formed on the insulator and a second end electrically connected to the top face of the metal structure, the second feeding unit being disposed such that the top face of the metal structure is spaced apart from the top face of the insulator by the first length and a support unit having a first end connected to the top face of the insulator and a second end connected to the top face of the metal structure,

the support unit being disposed such that the top face of the metal structure is spaced apart from the top face of the insulator by the first length.

- [31] On the top face of the insulator, an extension line of the first feeding unit and an extension line of the second feeding unit are perpendicular to each other, and the support unit may be disposed in a region between the extension line of the first feeding unit and the extension line of the second feeding unit.

Advantageous Effects of Invention

- [32] According to an embodiment of the disclosure, it is possible to improve antenna performance in a super-high-frequency range used in the next-generation communication system. In addition, it is possible to reduce the defect rate and the manufacturing cost of antenna modules by simplifying the processes required for manufacturing the antenna modules.
- [33] Other aspects, advantages, and salient features of the disclosure will become apparent to those skilled in the art from the following detailed description, which, taken in conjunction with the annexed drawings, discloses various embodiments of the disclosure.

Brief Description of Drawings

- [34] The above and other aspects, features, and advantages of certain embodiments of the disclosure will be more apparent from the following description taken in conjunction with the accompanying drawings, in which:
- [35] FIG. 1 is a side view of a configuration of an antenna module according to a first embodiment of the disclosure;
- [36] FIG. 2 is a bottom view of a configuration of the antenna module according to the first embodiment of the disclosure;
- [37] FIG. 3A is a view illustrating a feeding unit or a support unit according to the first embodiment of the disclosure;
- [38] FIG. 3B is a view illustrating a feeding unit or a support unit connected to a dielectric material according to the first embodiment of the disclosure;
- [39] FIG. 3C is another view illustrating a feeding unit or a support unit connected to a dielectric material according to the first embodiment of the disclosure;
- [40] FIG. 4 is a view illustrating an antenna module including a metal structure according to a second embodiment of the disclosure; and
- [41] FIG. 5 is a view illustrating a metal structure according to the second embodiment of the disclosure.
- [42] Throughout the drawings, it should be noted that like reference numbers are used to depict the same or similar elements, features, and structures.

Mode for the Invention

- [43] The following description with reference to the accompanying drawings is provided

to assist in a comprehensive understanding of various embodiments of the disclosure as defined by the claims and their equivalents. . It includes various specific details to assist in that understanding but these are to be regarded as merely exemplary. Accordingly, those of ordinary skill in the art will recognize that various changes and modifications of the various embodiments described herein can be made without departing from the scope and spirit of the disclosure. In addition, descriptions of well-known functions and constructions may be omitted for clarity and conciseness.

[44] The terms and words used in the following description and claims are not limited to the bibliographical meanings, but, are merely used by the inventor to enable a clear and consistent understanding of the disclosure. Accordingly, it should be apparent to those skilled in the art that the following description of various embodiments of the disclosure is provided for illustration purpose only and not for the purpose of limiting the disclosure as defined by the appended claims and their equivalents.

[45] It is to be understood that the singular forms "a," "an," and "the" include plural referents unless the context clearly dictates otherwise. Thus, for example, reference to "a component surface" includes reference to one or more of such surfaces.

[46] The advantages and features of the disclosure and ways to achieve them will be apparent by making reference to embodiments as described below in detail in conjunction with the accompanying drawings. However, the disclosure is not limited to the embodiments set forth below, but may be implemented in various different forms. The following embodiments are provided only to completely disclose the disclosure and inform those skilled in the art of the scope of the disclosure, and the disclosure is defined only by the scope of the appended claims. Throughout the specification, the same or like reference numerals designate the same or like elements.

[47] Here, it will be understood that each block of the flowchart illustrations, and combinations of blocks in the flowchart illustrations, can be implemented by computer program instructions. These computer program instructions can be provided to a processor of a general purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the instructions, which execute via the processor of the computer or other programmable data processing apparatus, create means for implementing the functions specified in the flowchart block or blocks. These computer program instructions may also be stored in a computer usable or computer-readable memory that can direct a computer or other programmable data processing apparatus to function in a particular manner, such that the instructions stored in the computer usable or computer-readable memory produce an article of manufacture including instruction means that implement the function specified in the flowchart block or blocks. The computer program instructions may also be loaded onto a computer or other programmable data processing apparatus to

cause a series of operational steps to be performed on the computer or other programmable apparatus to produce a computer implemented process such that the instructions that execute on the computer or other programmable apparatus provide steps for implementing the functions specified in the flowchart block or blocks.

- [48] Additionally, each block of the flowchart illustrations may represent a module, segment, or portion of code, which includes one or more executable instructions for implementing the specified logical function(s). It should also be noted that in some alternative implementations, the functions noted in the blocks may occur out of the order. For example, two blocks shown in succession may in fact be executed substantially concurrently or the blocks may sometimes be executed in the reverse order, depending upon the functionality involved.
- [49] As used herein, the "unit" or "module" refers to a software element or a hardware element, such as a field programmable gate array (FPGA) or an application specific integrated circuit (ASIC), which performs a predetermined function. However, the "unit" or "module" does not always have a meaning limited to software or hardware. The "unit" may be configured either to be stored in an addressable storage medium or to execute one or more processors. Therefore, the "unit" includes, for example, software elements, object-oriented software elements, class elements or task elements, processes, functions, properties, procedures, sub-routines, segments of a program code, drivers, firmware, micro-codes, circuits, data, database, data structures, tables, arrays, and parameters. The elements and functions provided in the "units" may be either combined into a smaller number of elements and "units," or divided into a larger number of elements and "units." Moreover, the elements and "units" may be implemented to reproduce one or more central processing units (CPUs) within a device or a security multimedia card. Further, in the embodiments, the "unit" may include at least one processor.
- [50] The disclosure provides the configuration of an antenna module capable of improving the performance of an antenna module in a next-generation mobile communication system as described above. More specifically, the disclosure provides an antenna module including a dielectric material and a support unit configured to support the dielectric material as a first embodiment, and provides an antenna module using a metal structure as a second embodiment. Hereinafter, the configurations of antenna modules according to the first embodiment and the second embodiment will be described in more detail.
- [51] First Embodiment
- [52] FIG. 1 is a side view of a configuration of an antenna module according to a first embodiment of the disclosure.
- [53] Referring to FIG. 1, the configuration of an antenna module 100 according to the first

embodiment may include a radiator 110 configured to radiate a radio wave toward a top face, a dielectric material 120 disposed on the bottom face of the radiator 110, which is opposite the top face of the radiator 110, a feeding unit 130 disposed on a bottom face of the dielectric material 120 to supply an electric signal to the radiator 110 through the dielectric material 120, a support unit 140 disposed on the bottom face of the dielectric material 120 and including a metallic material, and a printed circuit board (PCB) 150 coupled to the feeding unit 130 and the support unit 140 to supply the electric signal to the feeding unit 130.

- [54] The feeding unit 130 and the support unit 140 may be coupled to the PCB 150 through various methods. According to an embodiment, the feeding unit 130 and the support unit 140 may be coupled to the PCB through a surface-mount technology (SMT) process.
- [55] According to an embodiment, the PCB 150 may have a conductive pattern formed thereon, and an electric signal supplied from a wireless communication chip (not illustrated) may be supplied to the feeding unit 130 through the conductive pattern. That is, according to an embodiment, a conductive pattern is disposed on one face of the PCB 150, and a first end of the feeding unit 130 may be electrically connected to the conductive pattern. A wireless communication chip is disposed on the other face of the PCB 150, and an electric signal supplied through the wireless communication chip may be supplied to the feeding unit 130 through the conductive pattern.
- [56] According to an embodiment, the feeding unit 130 and the support unit 140 may be disposed such that the bottom face of the dielectric material 120 and the top face of the PCB 150 are spaced apart from each other by a predetermined first length.
- [57] According to an embodiment, the feeding unit 130 and the support unit 140 may be formed in the same shape or may be formed in different shapes. Even if the feeding unit 130 and the support unit 140 are different in shape from each other, in order to maintain parallelism between the radiator 110 and the PCB 150, the heights of the feeding unit 130 and the support unit 140 may be the same.
- [58] According to an embodiment, the frequency characteristic of a radio wave radiated through the radiator 110 may be determined on the basis of the first length (that is, the distance between the bottom face of the dielectric material 120 and the top face of the PCB 150). For example, the gain value of the radio wave radiated through the radiator 110 may be changed depending on the first length.
- [59] According to an embodiment, a distance may be formed between the radiator 110 and the feeding unit 130 by a second length through the dielectric material 120. That is, the feeding unit 130 and the radiator 110 may have a gap-coupled structure. The feeding unit 130 and the radiator 110 are both made of a metallic material, the feeding unit 130 and the radiator 110 are spaced apart from each other by the second length,

and the dielectric material 120 is disposed in the space between the feeding unit 130 and the radiator 110. Therefore, with the above-described structure, it is possible to obtain an effect of disposing a capacitor or an inductor between the feeding unit 130 and the radiator 110, which makes it possible to improve the bandwidth of the radio wave radiated through the radiator 110.

- [60] FIG. 2 is a bottom view of a configuration of an antenna module according to the first embodiment of the disclosure.
- [61] Referring to FIG. 2, FIG. 2 is a view for describing the configurations of a first feeding unit 230, a second feeding unit 232, a first support unit 242, and a second support unit 240 disposed on the bottom face of a dielectric material 220 in the configuration of an antenna module 200 according to the disclosure.
- [62] According to an embodiment, the feeding units may include the first feeding unit 230 configured to supply an electric signal related to horizontal polarization to a radiator 210 disposed on the top face of the dielectric material 220, and the second feeding unit 232 configured to supply an electric signal related to vertical polarization to the radiator 210.
- [63] According to an embodiment, on the bottom face of the dielectric material 220, an extension line of the first feeding unit 230 and an extension line of the second feeding unit 232 may be perpendicular to each other. The extension line of the first feeding unit 230 and the extension line of the second feeding unit 232 may be perpendicular to each other to improve the isolation between the horizontal polarization and the vertical polarization.
- [64] According to an embodiment, on the bottom face of the dielectric material 220, the first support unit 242 disposed on the extension line of the first feeding unit 230 and the second support unit 240 disposed on the extension line of the second feeding unit 232 may be included.
- [65] According to an embodiment, the first support unit 242 and the second support unit 240 may include a metallic material. The distribution of an electromagnetic field generated by the electric signals flowing through the first feeding unit 230 or the second feeding unit 232 may be changed through the first support unit 242 and the second support unit 240. That is, the isolation performance of the antenna module 200 according to the disclosure may be improved by the metallic material included in the first support unit 242 and the second support unit 240.
- [66] According to an embodiment, the degree of improvement of the isolation performance of the antenna module 200 may be determined depending on the size of the contact area between the first and second support units 242 and 240 and the bottom face of the dielectric material 220.
- [67] Meanwhile, in the disclosure, it is disclosed that the first feeding unit 230 may supply

an electric signal related to the horizontal polarization and that the second feeding unit 232 may supply an electric signal related to the vertical polarization, but the scope of the disclosure should not be construed as being limited thereto. For example, the first feeding unit 230 may supply an electric signal related to the vertical polarization and the second feeding unit 232 may provide an electric signal related to the horizontal polarization.

[68] FIG. 3A is a view illustrating a feeding unit or a support unit according to the first embodiment of the disclosure.

[69] Referring to FIG. 3A, a feeding unit 330 according to the disclosure may include a first segment disposed on the bottom face of the dielectric material, a second segment extending from a first end of the first segment toward the PCB to be coupled to the top face of the PCB, and a third segment extending from a second end of the first segment toward the PCB to be coupled to the top face of the PCB.

[70] According to an embodiment, the first segment is a portion that is directly coupled to the bottom face of the dielectric material, and the first segment may supply an electric signal to the radiator disposed on the top face of the dielectric material through the bottom face of the dielectric material. According to an embodiment, the isolation performance of the antenna module including the first segment may be improved depending on the area size of the first segment.

[71] According to an embodiment, the second segment and the third segment may extend from the first end of the first segment such that the bottom face of the dielectric material and the top face of the PCB are spaced apart from each other by the predetermined first length. According to an embodiment, the frequency characteristic of a radio wave radiated through the radiator may be determined on the basis of the first length.

[72] According to an embodiment, the feeding unit 330 may be formed by being welded to the dielectric material, and the first segment may include a plurality of protrusions such that the feeding unit 330 is not separated from the dielectric material during injection molding. According to an embodiment, the first segment may include a first protrusion 333 and a second protrusion 334 so as not to be separated from the dielectric material, the second segment may include a third protrusion 331 so as not to be separated from the dielectric material, and the third segment may include a fourth protrusion 332 so as not to be separated from the dielectric material.

[73] Meanwhile, although FIG. 3A illustrates the case in which the feeding unit or the support unit includes the first segment, the second segment, and the third segment, this is merely an example and the scope of the disclosure is not limited thereto.

[74] According to an embodiment, the feeding unit may include only a first segment disposed on the bottom face of the dielectric material and a second segment extending

from the first end of the first segment toward the PCB and coupled to the top face of the PCB.

[75] That is, the feeding unit may receive an electric signal for radiating a radio wave from the PCB through the second segment, the electric signal may be transmitted to the first segment through the second segment, and the electric signal may be supplied from the first segment to the radiator through the bottom face of the dielectric material.

[76] According to an embodiment, the second segment may execute the function of supporting the dielectric material such that the distance between the dielectric material and the PCB is maintained, in addition to the function of transmitting an electric signal from the PCB.

[77] FIG. 3B is a view illustrating a feeding unit or a support unit connected to a dielectric material according to the first embodiment of the disclosure.

[78] FIG. 3C is another view illustrating a feeding unit or a support unit connected to a dielectric material according to the first embodiment of the disclosure.

[79] Referring to FIG. 3B, the third protrusion 331 and the fourth protrusion 332 disposed on the feeding unit 330 are connected to a dielectric material 320 and are able to prevent the feeding unit 330 from being separated in the horizontal direction.

[80] Referring to FIG. 3C, the first protrusion 333 and the second protrusion 334 disposed on the feeding unit 330 are connected to the dielectric material 320 and are able to prevent the feeding unit 330 from being separated in the vertical direction.

[81] Meanwhile, although FIGS. 3A to 3C illustrate only the shape of the feeding unit according to various embodiments of the disclosure, the support unit according to the disclosure may have a shape that is the same as or similar to that of the feeding unit. In addition, since the shape of the feeding unit disclosed in the disclosure is merely an embodiment, the scope of right of the disclosure should not be construed as being limited to the shape of the feeding unit or the support unit illustrated in FIGS. 3A to 3C.

[82] Second Embodiment

[83] FIG. 4 is a view illustrating an antenna module including a metal structure according to a second embodiment of the disclosure.

[84] Referring to FIG. 4, an antenna module 400 according to the disclosure may include an insulator 430 having a plate shape and including a conductive pattern 420 formed thereon to allow an electric signal to flow therethrough, metal structures 410 and 412 disposed on the top face of the insulator 430 and configured to radiate a radio wave through a top face spaced apart from the insulator 430 by a predetermined first length, and a wireless communication chip 440 disposed on the bottom face of the insulator 430 to supply an electric signal for radiating a radio wave to the metal structures 410 and 412 through the conductive pattern 420.

- [85] According to an embodiment, the wireless communication chip 440 may directly supply an electric signal to the metal structures 410 and 412 through the conductive pattern 420. That is, while the configuration of the antenna module according to the first embodiment is a configuration in which the feeding unit and the radiator are spaced apart from each other by a predetermined distance through the dielectric material (that is, a structure configured to indirectly supply an electric signal to the radiator), the configuration of the antenna module 400 disclosed in the second embodiment is a configuration in which the metal structures 410 and 412 are supplied with an electric signal directly from the wireless communication chip 440 through the conductive pattern 420.
- [86] In other words, the metal structures 410 and 412 according to the second embodiment include all of the feeding unit, the support unit, and the radiator of the antenna module disclosed in the first embodiment. The specific configurations of the metal structures 410 and 412 will be described later with reference to FIG. 5.
- [87] FIG. 5 is a view illustrating a metal structure according to the second embodiment of the disclosure.
- [88] Referring to FIG. 5, the metal structure according to the second embodiment may include a first feeding unit 520 having a first end electrically connected to a conductive pattern formed on the insulator and a second end electrically connected to a top face 510 of the metal structure, the first feeding unit 520 being disposed such that the top face 510 of the metal structure is spaced apart from the top face of the insulator by the first length, a second feeding unit 522 having a first end electrically connected to the conductive pattern formed on the insulator and a second end electrically connected to the top face 510 of the metal structure, the second feeding unit 522 being disposed such that the top face 510 of the metal structure is spaced apart from the top face of the insulator by the first length, and a support unit 524 having a first end connected to the top face of the insulator and a second end connected to the top face 510 of the metal structure, the support unit 524 being disposed such that the top face 510 of the metal structure is spaced apart from the top face of the insulator by the first length.
- [89] According to an embodiment, the first feeding unit 520 may supply an electric signal related to horizontal polarization to the top face 510 of the metal structure, and the second feeding unit 522 may supply an electric signal related to vertical polarization to the top face 510 of the metal structure. According to an embodiment, the top face 510 of the metal structure may receive electric signals from the first feeding unit 520 or the second feeding unit 522 to radiate radio waves. That is, the top face 510 of the metal structure may execute an operation, which is the same as or similar to that of the radiator.
- [90] According to an embodiment, on the top face of the insulator, an extension line of the

first feeding unit 520 and an extension line of the second feeding unit 522 may be perpendicular to each other. According to an embodiment, it is possible to improve the isolation performance of the antenna module by disposing the extension line of the first feeding unit 520 and the extension line of the second feeding unit 522 to be perpendicular to each other.

- [91] According to an embodiment, the support unit 524 may be disposed in a region between the extension line of the first feeding unit 520 and the extension line of the second feeding unit 522. That is, the extension line of the first feeding unit 520 and the extension line of the second feeding unit 522 may be perpendicular (90°) to each other when viewed from the top face 510 of the metal structure, and the support unit 524 may be disposed at a point of 135° in a 270° angular range formed on the top face 510 of the metal structure by the first feeding unit 520 and the second feeding unit 522.
- [92] According to an embodiment, it may be most advantageous in terms of isolation performance of the antenna module that the extension line of the first feeding unit 520 and the extension line of the second feeding unit 522 be perpendicular to each other and that the support unit 524 be disposed in the region between the extension line of the first feeding unit 520 and the extension line of the second feeding unit 522.
- [93] Meanwhile, in the disclosure, it is disclosed that the first feeding unit 520 may supply an electric signal related to the horizontal polarization and that the second feeding unit 522 may supply an electric signal related to the vertical polarization, but the scope of the disclosure should not be construed as being limited thereto. For example, the first feeding unit 520 may supply an electric signal related to the vertical polarization and the second feeding unit 522 may provide an electric signal related to the horizontal polarization.
- [94] In addition, since the metal structure illustrated in FIG. 5 is merely an embodiment of the metal structure disclosed in the disclosure, the scope of the disclosure should not be construed as being limited to the metal structure illustrated in FIG. 5.
- [95] While the disclosure has been shown and described with reference to various embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the disclosure as defined by the appended claims and their equivalents.

Claims

- [Claim 1] An antenna module of a wireless communication system, the antenna module comprising:
a radiator comprising a top face to which a radio wave is radiated;
a dielectric material disposed on a bottom face of the radiator, the bottom face of the radiator being opposite to the top face of the radiator;
a feeding unit disposed on a bottom face of the dielectric material, the feeding unit being configured to supply an electric signal to the radiator through the dielectric material; and
a support unit disposed on the bottom face of the dielectric material, the support unit comprising a metallic material.
- [Claim 2] The antenna module of claim 1, further comprising:
a printed circuit board (PCB) coupled to both of the feeding unit and the support unit,
wherein the PCB is configured to supply the electric signal to the feeding unit, and
wherein a height of the feeding unit is same as a height of the support unit.
- [Claim 3] The antenna module of claim 2,
wherein the feeding unit and the support unit are disposed such that the bottom face of the dielectric material and a top face of the PCB are spaced apart from each other by a predetermined first length,
wherein a frequency characteristic of the radio wave radiated through the radiator is determined based on the predetermined first length,
wherein the feeding unit and the radiator are spaced apart from each other by a second length, and
wherein the dielectric material is disposed in a space between the feeding unit and the radiator.
- [Claim 4] The antenna module of claim 2,
wherein each of the feeding unit and the support unit comprises:
a first segment disposed on the bottom face of the dielectric material;
and
a second segment extending from a first end of the first segment toward the PCB to be coupled to a top face of the PCB, and
wherein the second segment is configured to:
support the dielectric material such that a distance between the di-

electric material and the PCB is maintained; and
transmit the electric signal from the PCB to the radiator.

[Claim 5] The antenna module of claim 4, wherein each of the feeding unit and the support unit further comprises a third segment extending from a second end of the first segment toward the PCB to be coupled to the top face of the PCB.

[Claim 6] The antenna module of claim 5,
wherein the dielectric material is disposed to enclose the feeding unit and the support unit, and
wherein each of the first segment, the second segment, and the third segment comprises a protrusion so as not to be separated from the dielectric material.

[Claim 7] The antenna module of claim 1,
wherein the feeding unit comprises:
a first feeding unit configured to supply the electric signal related to horizontal polarization to the radiator; and
a second feeding unit configured to supply the electric signal related to vertical polarization to the radiator, and
wherein, on the bottom face of the dielectric material, an extension line of the first feeding unit and an extension line of the second feeding unit are perpendicular to each other.

[Claim 8] The antenna module of claim 7, wherein the support unit further comprises:
a first support unit disposed on the extension line of the first feeding unit on the bottom face of the dielectric material; and
a second support unit disposed on the extension line of the second feeding unit on the bottom face of the dielectric material.

[Claim 9] An antenna module of a wireless communication system, the antenna module comprising:
an insulator having a plate shape and comprising a conductive pattern formed thereon for an electric signal to flow therethrough;
a metal structure disposed on a top face of the insulator, the metal structure being configured to radiate a radio wave through a top face of the metal structure, the top face of the metal structure being spaced apart from the insulator by a predetermined first length; and
a wireless communication chip disposed on a bottom face of the insulator, the wireless communication chip being configured to supply the electric signal to the metal structure through the conductive pattern

to radiate the radio wave.

[Claim 10]

The antenna module of claim 9, wherein the metal structure comprises: a first feeding unit comprising a first end and a second end, the first end of the first feeding unit being electrically connected to a conductive pattern formed on the insulator and the second end of the first feeding unit being electrically connected to the top face of the metal structure, the first feeding unit being disposed such that the top face of the metal structure is spaced apart from the top face of the insulator by the predetermined first length;

a second feeding unit comprising a first end and a second end, the first end of the second feeding unit being electrically connected to a conductive pattern formed on the insulator and the second end of the second feeding unit being electrically connected to the top face of the metal structure, the second feeding unit being disposed such that the top face of the metal structure is spaced apart from the top face of the insulator by the predetermined first length; and

a support unit comprising a first end and a second end, the first end of the support unit being connected to the top face of the insulator and the second end of the support unit being connected to the top face of the metal structure, the support unit being disposed such that the top face of the metal structure is spaced apart from the top face of the insulator by the predetermined first length.

[Claim 11]

The antenna module of claim 10,

wherein, on the top face of the insulator, an extension line of the first feeding unit and an extension line of the second feeding unit are perpendicular to each other,

wherein the support unit is disposed in a region between the extension line of the first feeding unit and the extension line of the second feeding unit, and

wherein the wireless communication chip directly supplies the electric signal to the metal structures through the conductive pattern.

[Claim 12]

An electronic device comprising:

an antenna module,

wherein the antenna module comprises:

a radiator having a top face, a radio wave being radiated toward the top face of the radiator;

a dielectric material disposed on a bottom face of the radiator, the bottom face of the radiator being opposite to the top face of the

radiator;

a feeding unit disposed on a bottom face of the dielectric material, the feeding unit being configured to supply an electric signal to the radiator through the dielectric material; and

a support unit disposed on the bottom face of the dielectric material, the support unit comprising a metallic material.

[Claim 13]

The electronic device of claim 12, further comprising:

a printed circuit board (PCB) coupled to both of the feeding unit and the support unit,

wherein the PCB is configured to supply the electric signal to the feeding unit, and

wherein a height of the feeding unit is same as a height of the support unit.

[Claim 14]

The electronic device of claim 13,

wherein the feeding unit and the support unit are disposed such that the bottom face of the dielectric material and a top face of the PCB are spaced apart from each other by a predetermined first length,

wherein a frequency characteristic of the radio wave radiated through the radiator is determined based on the predetermined first length,

wherein the feeding unit and the radiator are spaced apart from each other by a second length, and

wherein the dielectric material is disposed in a space between the feeding unit and the radiator.

[Claim 15]

The electronic device of claim 13,

wherein each of the feeding unit and the support unit comprises:

a first segment disposed on the bottom face of the dielectric material; and

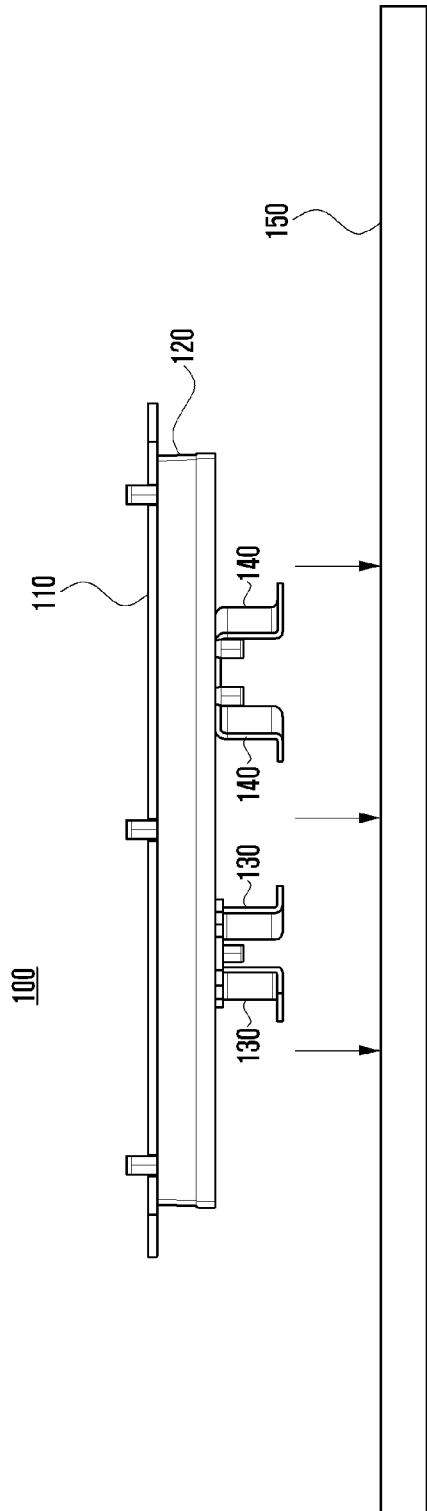
a second segment extending from a first end of the first segment toward the PCB to be coupled to a top face of the PCB, and

wherein the second segment is configured to:

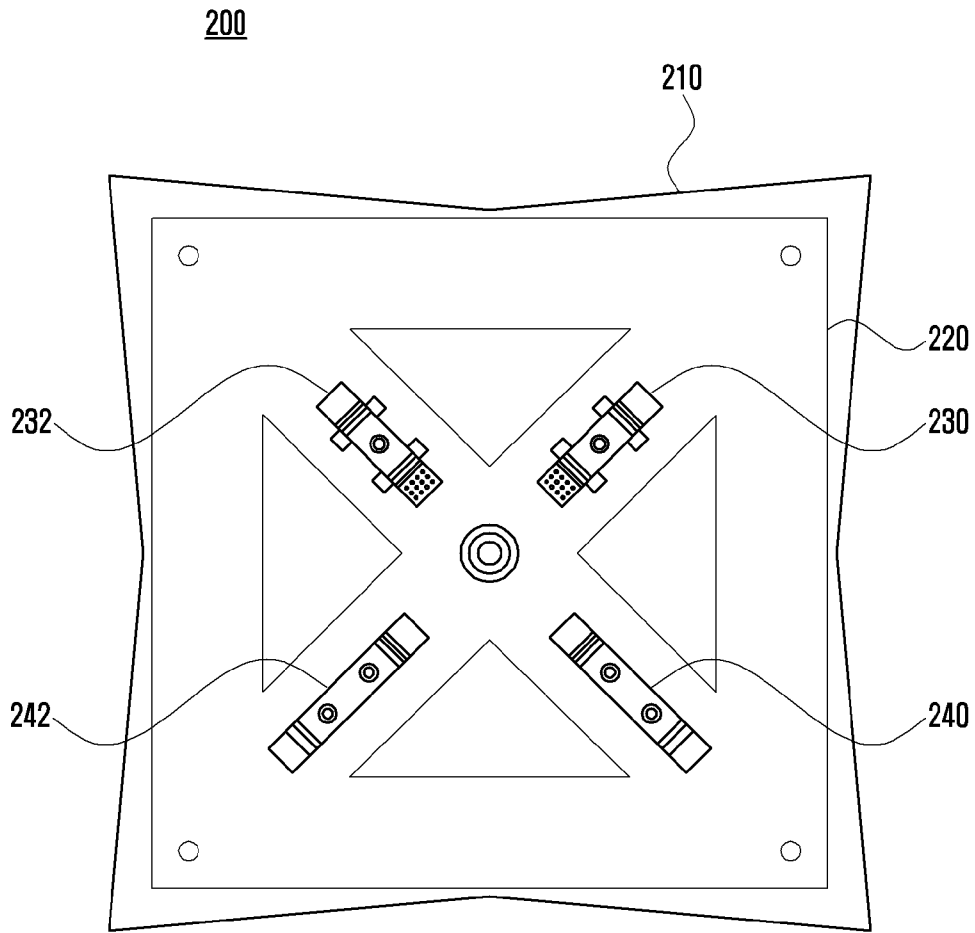
support the dielectric material such that a distance between the dielectric material and the PCB is maintained; and

transmit the electric signal from the PCB to the radiator.

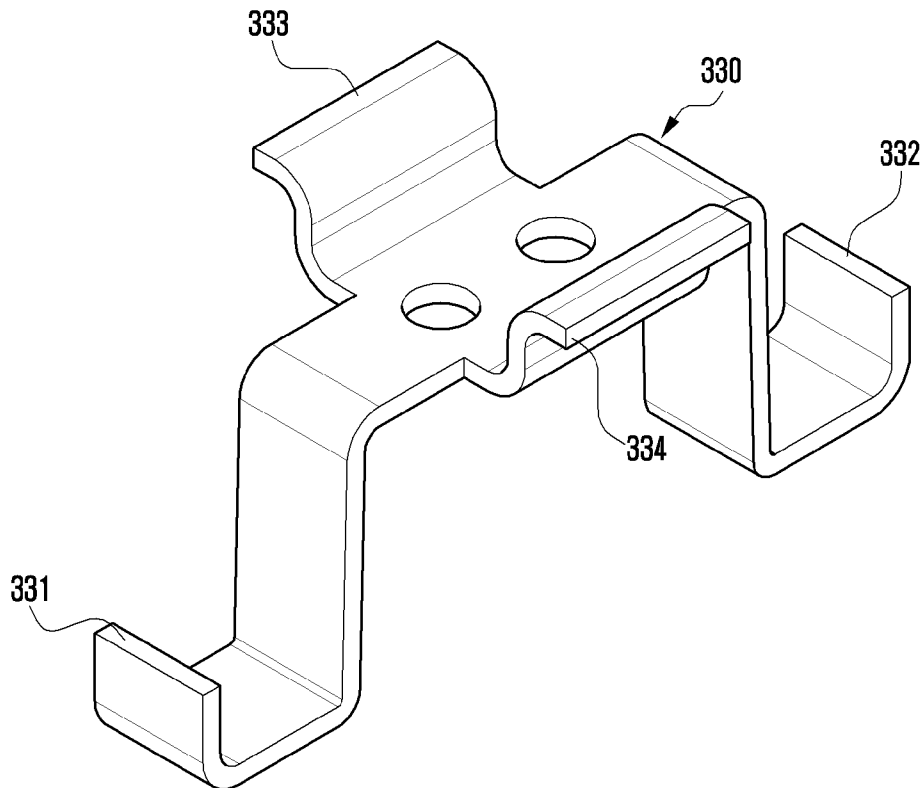
[Fig. 1]



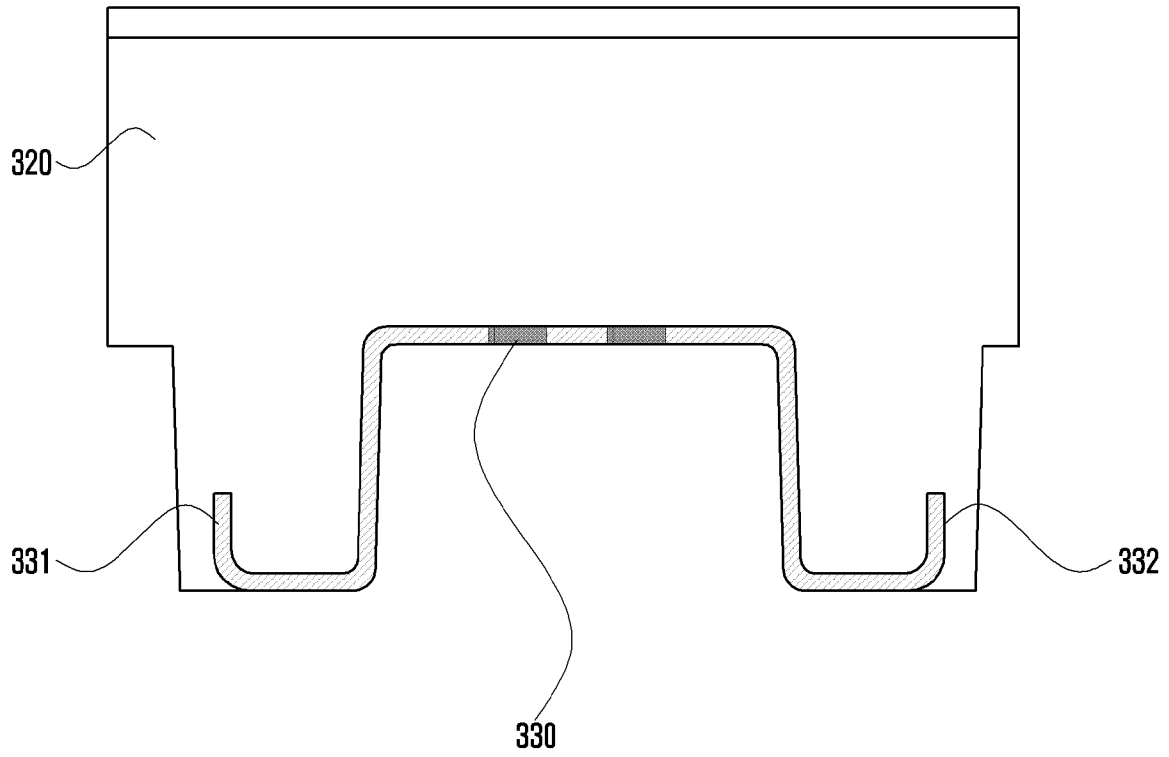
[Fig. 2]



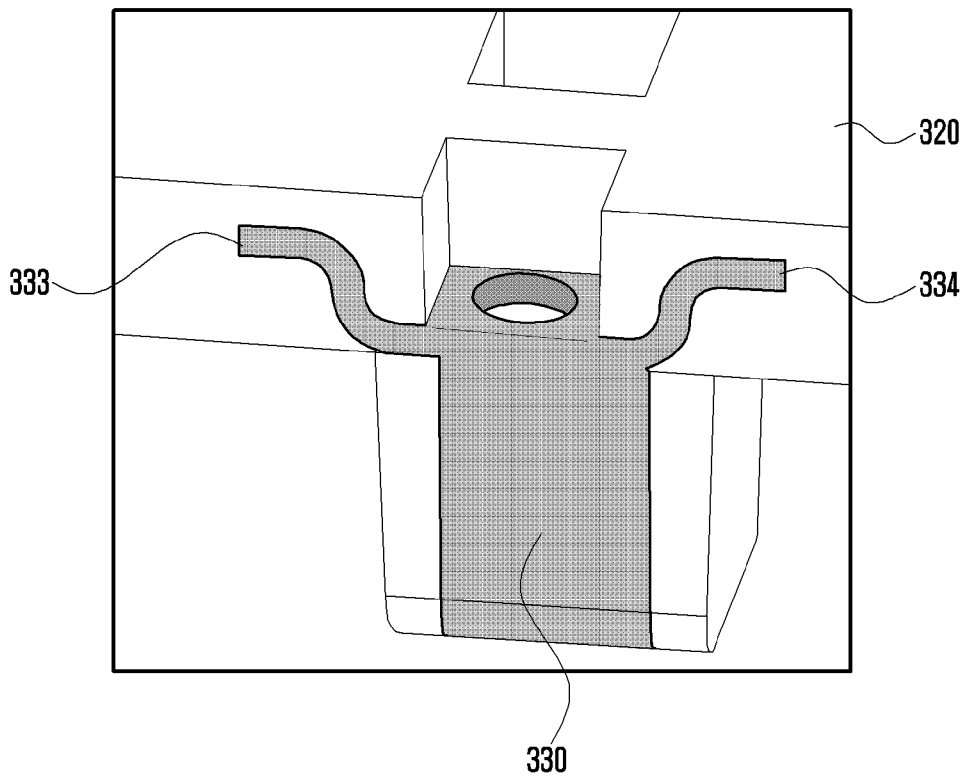
[Fig. 3a]



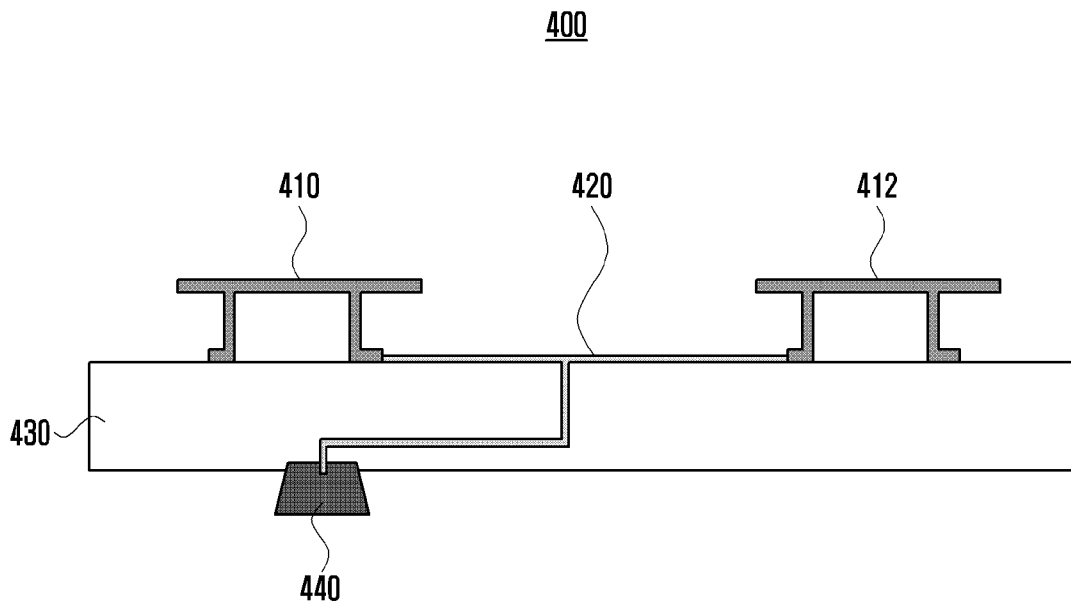
[Fig. 3b]



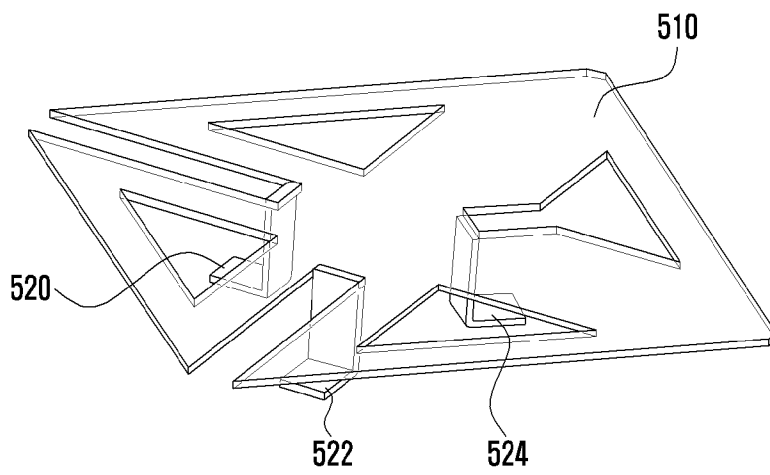
[Fig. 3c]



[Fig. 4]



[Fig. 5]



A. CLASSIFICATION OF SUBJECT MATTER**H01Q 1/38(2006.01)i, H01Q 9/04(2006.01)i, H01Q 1/46(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHEDMinimum documentation searched (classification system followed by classification symbols)
H01Q 1/38; H01Q 1/50; H01Q 21/12; H01Q 21/26; H01Q 9/26; H01Q 9/04; H01Q 1/46Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility modelsElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: antenna, dielectric, feed, support, metal**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2013-0050028 A1 (HIDEKATSU NOGAMI) 28 February 2013 See paragraphs [0005], [0028]-[0029], claim 1 and figures 1A-1B.	1-15
Y	US 2008-0030422 A1 (JOHN GEVARGIZ et al.) 07 February 2008 See paragraph [0096], claim 1 and figure 10A.	1-15
A	US 2006-0220976 A1 (JOHN L. SCHADLER et al.) 05 October 2006 See paragraphs [0027]-[0030] and figures 1-4.	1-15
A	US 2007-0132642 A1 (ZEEV ILUZ et al.) 14 June 2007 See paragraphs [0079]-[0080] and figure 5B.	1-15
A	US 2018-0034165 A1 (ZIMENG LI) 01 February 2018 See claims 1-4 and figures 2-3.	1-15

 Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:

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"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

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"&" document member of the same patent family

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2019/003705

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013-0050028 A1	28/02/2013	CN 102956964 A	06/03/2013
		CN 102956964 B	17/12/2014
		EP 2562872 A1	27/02/2013
		EP 2562872 B1	19/03/2014
		JP 2013-046335 A	04/03/2013
		JP 5786559 B2	30/09/2015
		US 8866693 B2	21/10/2014
		US 2008-0030422 A1	07/02/2008
EP 2044650 B1	24/04/2019		
US 2008-0012710 A1	17/01/2008		
US 2011-0090059 A1	21/04/2011		
US 2014-0292492 A1	02/10/2014		
US 2015-0326298 A1	12/11/2015		
US 2017-0177911 A1	22/06/2017		
US 2019-0102582 A1	04/04/2019		
US 7667652 B2	23/02/2010		
US 7873326 B2	18/01/2011		
US 8768248 B2	01/07/2014		
US 9014635 B2	21/04/2015		
US 9614604 B2	04/04/2017		
WO 2008-027650 A2	06/03/2008		
WO 2008-027650 A3	21/08/2008		
WO 2008-027650 B1	02/10/2008		
US 2006-0220976 A1	05/10/2006	US 7209091 B2	24/04/2007
US 2007-0132642 A1	14/06/2007	EP 1958290 A1	20/08/2008
		EP 1958290 B1	13/03/2019
		US 7298333 B2	20/11/2007
		WO 2007-066322 A1	14/06/2007
US 2018-0034165 A1	01/02/2018	None	