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(54) TRANSVERSE ELECTROMAGNETIC MODE DIELECTRIC FILTER, RADIO FREQUENCY MODULE AND BASE STATION

DIELEKTRISCHES TEM-FILTER, RADIOFREQUENZMODUL UND BASISSTATION

FILTRE DIÉLECTRIQUE À MODE ÉLECTROMAGNÉTIQUE TRANSVERSAL, MODULE DE RADIOFRÉQUENCE ET STATION DE BASE

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Description

TECHNICAL FIELD

[0001] Embodiments of the present invention relate to the field of communications technologies, and in particular, to a transverse electromagnetic mode dielectric filter, a radio frequency module, and a base station.

BACKGROUND

[0002] With development of wireless communications technologies, a wireless communications device increasingly strives for miniaturization and a low insertion loss. Compared with a conventional metal cavity filter, a dielectric filter has an advantage such as a small size, a low insertion loss, high bearing power, and low costs. A transverse electromagnetic mode (TEM, transverse electromagnetic mode) dielectric filter is an important dielectric filter type, and may be applied to a device such as a wireless base station, a radio frequency terminal, or a radio frequency or microwave transceiver component.

[0003] However, a transverse electromagnetic mode dielectric filter provided in the prior art has poor near-end rejection performance, and therefore, cannot be applied to a location, such as a radio frequency front-end or a microwave antenna feeder front-end, that has a relatively high requirement on filter performance. Consequently, an application scenario is limited. From US 2012/0326806 A1 RF monoblock filters comprising metallized filter structures on a dielectric lid are known. From WO2007/142786 A1 (CTS Corp [US]) ceramic monoblock filters comprising cross-coupling signal means at a top surface of a dielectric body are known. From US 5,537,085 ceramic filters comprising a magnetic coupling on a side surface of a dielectric body are known.

SUMMARY

[0004] Embodiments of the present invention provide a transverse electromagnetic mode dielectric filter that has good near-end rejection performance; and the embodiments of the present invention further provide a radio frequency module and a base station.

[0005] The present invention provides a transverse electromagnetic mode dielectric filter according to the subject-matter of the present claims.

[0006] According to technical solutions provided in the embodiments of the present invention, a near-end rejection structure is disposed inside a transverse electromagnetic mode dielectric filter. By flexibly designing a shape, a location, and a size of the near-end rejection structure, a transmission zero or zero cavity function is implemented, and a radio frequency signal on a high-frequency end or a low-frequency end out of a passband of the filter is rejected. The transverse electromagnetic mode dielectric filter provided in the embodiments of the present invention has good near-end rejection performance, and may be widely applied to a radio frequency module and a base station.

BRIEF DESCRIPTION OF DRAWINGS

[0007] To describe the technical solutions in the embodiments of the present invention more clearly, the following briefly describes the accompanying drawings required for describing the embodiments. Apparently, the accompanying drawings in the following description show merely some embodiments of the present invention, and persons of ordinary skill in the art may still derive other drawings from these accompanying drawings without creative efforts.

FIG. 1 is a schematic structural diagram of a transverse electromagnetic mode dielectric filter according to an embodiment of the present invention;
FIG. 2 is a front view of another transverse electromagnetic mode dielectric filter according to an embodiment of the present invention;
FIG. 3 is a top view of another transverse electromagnetic mode dielectric filter according to an embodiment of the present invention;
FIG. 4 is a schematic structural diagram of another transverse electromagnetic mode dielectric filter according to an embodiment of the present invention; and
FIG. 5 is a schematic structural diagram of a base station according to an embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0008] To make the objectives, technical solutions, and advantages of the present invention clearer, the following further describes implementations of the present invention in detail with reference to the accompanying drawings.

[0009] A filter is a necessary component in a device such as a base station or a radio frequency terminal. With an advantage in costs, size, and the like, a dielectric filter may be applied at a location such as a receive link of the base station, and is configured to perform filtering on a radio frequency signal. A transverse electromagnetic mode dielectric filter is a widely-used dielectric filter.

[0010] However, a radio frequency performance indicator of the transverse electromagnetic mode dielectric filter is relatively poor, and cannot be used at a location, such as a front-end of a radio frequency module, that is, a location between a transmit antenna and a power amplifier, that has a relatively high requirement on the performance of the filter. The radio frequency performance indicator of the filter includes multiple indicators such as an insertion loss, rejection, and inter-modulation. Therefore, an application scenario of the transverse electromagnetic mode dielectric filter is greatly limited.

[0011] A main reason causing the relatively poor radio frequency performance indicator of the transverse electromagnetic mode dielectric filter is that near-end rejection performance of this type of filter is poor. Near-end rejection is also referred to as sideband rejection or near band rejection (near band rejection), and means performing strong rejection on a signal on a high-frequency end or a low-frequency end near an outside area of a passband of the filter, so as to ensure a filtering effect. Currently, a design method for cross-coupling or resonance of the transverse electromagnetic mode dielectric filter is inflexible, a transmission zero or zero cavity structure cannot be formed effectively, and therefore, the filter does not have good near-end rejection performance.

[0012] FIG. 1 is a schematic diagram of a transverse electromagnetic mode dielectric filter according to an embodiment of the present invention.

[0013] As shown in FIG. 1, a transverse electromagnetic mode dielectric filter 1 ("filter 1" for short below) includes a resonator 11, a dielectric body 12, and a metal housing 13. The metal housing 13 is fastened above the dielectric body 12, and there is a gap between the metal housing 13 and the dielectric body 12.

[0014] An outer surface of the dielectric body 12 is covered with a conductive material. Optionally, a metal coating, such as a silver coating, may be used.

[0015] The gap between the metal housing 13 and the dielectric body 12 is filled with air.

[0016] The resonator 11 includes a resonant plate 101 and a resonant hole 102, and the resonant plate 101 is disposed on a top surface of the dielectric body 12.

[0017] Optionally, the resonant plate 101 may be a thin metal piece disposed on the top surface of the dielectric body 12, or may be a metal coating printed on the top surface of the dielectric body 12.

[0018] Optionally, a shape of the resonant plate 101 is not limited. For example, the shape may be a regular figure such as a rectangle or a circle, or may be modified on the basis of the regular figure according to specifications and a performance requirement of the filter, for example, a specific area is cut off to form an irregular figure. This is not particularly limited in this embodiment of the present invention.

[0019] The resonant hole 102 is a hollow cylindrical structure with openings on upper and lower ends, an upper opening of the resonant hole 102 is provided on the resonant plate 101, a lower opening of the resonant hole 102 is provided on a lower surface of the dielectric body 12, and an inner surface of the resonant hole 102 is covered with a conductive material.

[0020] Optionally, the conductive material covering the inner surface of the resonant hole 102 may be a metal coating, such as a silver coating.

[0021] Optionally, the resonant hole 102 and the resonant plate 101 may be integrally formed, or may be separately made and then formed by means of connection.

[0022] The filter 1 further includes a near-end rejection structure 14. The near-end rejection structure 14 is inside the dielectric body 12, and a shape, a location, and a size of the near-end rejection structure 14 are determined by a frequency of a signal that the filter is to filter out.

[0023] As shown in FIG. 1, two ends of the near-end rejection structure 14 are in contact with the lower surface of the dielectric body 12, and a remaining part of the near-end rejection structure 14 is within a magnetic field area inside the dielectric body 12. The magnetic field area refers to an area that is inside the dielectric body and that has a stronger magnetic field than that of another location.

[0024] A strong magnetic field area inside the dielectric body 12 is an area near the lower surface of the dielectric body 12.

[0025] Optionally, a height, a length, and a distance away from the resonant hole that are of the near-end rejection structure 14 may be determined according to a coupling coefficient (coupling coefficient) of the filter, and the coupling coefficient is corresponding to the frequency of the signal that the filter is to filter out.

[0026] The coupling coefficient is an important parameter during filter design. When the coupling coefficient is determined, a physical structure of the filter may be designed according to the coupling coefficient, and a corresponding performance indicator may be achieved. Generally, the coupling coefficient may be obtained by solving a coupling matrix (coupling matrix). The coupling matrix may be used to indicate a coupling energy relationship between resonant cavities, and the coupling coefficient is included in the coupling matrix.

[0027] Optionally, the coupling matrix may be obtained by means of calculation by using filter emulation software, or may be determined according to an experimental or empirical value. This is not particularly limited in this embodiment of the present invention.

[0028] Optionally, the near-end rejection structure 14 may be any one of a metalized through hole, a metalized strip line, a physical metal structure, a metalized conductor, or a thin metal piece.

[0029] Optionally, the near-end rejection structure 14 may be a strip structure with a specific radian. Specifically, the radian may be determined by means of debugging according to the performance requirement of the filter. This is not particularly limited in this embodiment of the present invention.

[0030] Optionally, in another embodiment of the present invention, in addition to the two ends, any other part of the near-end rejection structure 14 may also be in contact with the lower surface of the dielectric body 12, to play a grounding role.

[0031] In the embodiment shown in FIG. 1, the near-end rejection structure 14 plays an inductive transmission zero role, and can improve a rejection capability on a high-frequency end out of a passband of the filter, that is, can reject a signal on the high-frequency end out of the passband of the filter. It may be understood that the near-end rejection structure 14 may be designed for only one specific signal frequency, and when the filter has strong rejection over a specific frequency, the filter has good rejection over a frequency band neighboring to the frequency.

[0032] Optionally, the filter 1 may include more than three resonators 11, and the near-end rejection structure 14 is located between nonadjacent resonant cavities. As shown in FIG. 1, the filter 1 includes four resonators, successively marked as cavity 1, cavity 2, cavity 3, and cavity 4 from left to right. The two ends of the near-end rejection structure 14 are respectively located near the cavity 1 and cavity 3. Optionally, the near-end rejection structure 14 may be located between the cavity 1 and cavity 4, or between the cavity 2 and cavity 4.

[0033] The near-end rejection structure 14 located between nonadjacent resonant cavities forms a cross-coupling structure, that is, when signals pass through resonant cavities through different signal paths, phases of different signal paths are canceled, so as to form a transmission zero. For example, a signal path of cavity 1-cavity 2-cavity 3 may be considered as a positive phase path, and a signal path of cavity 1-cavity 3 is considered as a negative phase path. Phases of the two paths are canceled, and a transmission zero is formed at the near-end rejection structure 14. The zero is corresponding to the frequency of the signal that the filter is to filter out.

[0034] According to the transverse electromagnetic mode dielectric filter provided in this embodiment of the present invention, a near-end rejection structure is disposed inside the dielectric filter and near a lower surface of the dielectric filter, so as to implement an inductive transmission zero function, and reject a radio frequency signal on a high-frequency end out of a passband of the filter, thereby achieving good near-end rejection performance.

[0035] FIG. 2 and FIG. 3 are a front view and a top view of another transverse electromagnetic mode dielectric filter according to an embodiment of the present invention.

[0036] As shown in FIG. 2, a transverse electromagnetic mode dielectric filter 2 ("filter 2" for short below) includes a resonator 21, a dielectric body 22, a metal housing 23, and a near-end rejection structure 24. The metal housing 23 is fastened above the dielectric body 22, and there is a gap between the metal housing 23 and the dielectric body 22. As shown in FIG. 3, the resonator 21 includes a resonant plate 211 and a resonant hole 212.

[0037] Overall structures of the filter 2 and the filter 1 provided in the embodiment shown in FIG. 1 are similar, and what is different from the embodiment shown in FIG. 1 is that the near-end rejection structure 24 is located at an area near a top surface of the dielectric body 22. The area is an electric field area inside the dielectric body 22, and the electric field area refers to an area that is inside the dielectric body and that has a stronger electric field than that of another location. A specific shape, location, and size of the near-end rejection structure 24 may be determined according to a coupling coefficient of the filter. For a specific determining manner, reference may be made to the description in the embodiment shown in FIG. 1. This is not described herein.

[0038] In the embodiments shown in FIG. 2 and FIG. 3, the near-end rejection structure 24 plays a capacitive transmission zero role, and can improve a rejection capability on a low-frequency end out of a passband of the filter, that is, can reject a signal on the low-frequency end out of the passband of the filter.

[0039] It may be understood that for detailed description of another component in the filter 2, reference may be made to the content in the embodiment shown in FIG. 1. This is not described herein.

[0040] A transverse electromagnetic mode dielectric filter whose specification is 90*44*20 (mm, millimeter) is used as an example. A near-end rejection structure is disposed inside a dielectric body of the filter to serve as a capacitive zero. The structure is a metalized through hole whose specific size is as follows: A length is 23 mm, a width is 1 mm, a distance away from a resonant hole is 3 mm, and a distance away from a top surface of the dielectric body, that is, a resonant plate, is 3 mm. A passband of the filter is 1805 MHz to 1865 MHz, that is, a radio frequency signal whose frequency is beyond this frequency band can be effectively filtered out.

[0041] According to the transverse electromagnetic mode dielectric filter provided in this embodiment of the present invention, a near-end rejection structure is disposed inside the dielectric filter and near a top surface of a dielectric body, so as to implement a capacitive transmission zero function, and reject a radio frequency signal on a low-frequency end out of a passband of the filter, thereby achieving good near-end rejection performance.

[0042] FIG. 4 is a schematic diagram of another transverse electromagnetic mode dielectric filter according to an embodiment of the present invention.

[0043] As shown in FIG. 4, a transverse electromagnetic mode dielectric filter 3 ("filter 3" for short below) includes a resonator 31, a dielectric body 32, a metal housing 33, and a near-end rejection structure 34. The metal housing 33 is fastened above the dielectric body 32, there is a gap between the metal housing 33 and the dielectric body 32, and the resonator 31 includes a resonant plate 301 and a resonant hole 302.

[0044] Overall structures of the filter 3 and the transverse electromagnetic mode dielectric filter provided in the embodiment in FIG. 1 or FIG. 2 and FIG. 3 are similar, and what is different from the filter shown in FIG. 1 or FIG. 2 is that a shape, a location, and a size of the near-end rejection structure 34 are determined by an electrical wavelength corresponding to a frequency of a signal that the filter is to filter out. The electrical wavelength is an electromagnetic wave wavelength.

[0045] Specifically, the electrical wavelength may be calculated according to a formula: $c=\lambda*f$, where f is a signal frequency, λ is an electrical wavelength, and c is a constant.

[0046] It can be learned that a wavelength and a frequency of an electromagnetic wave waveform are in a one-to-one correspondence relationship. A height, a length, and a distance away from the resonant hole 302 that are of the near-end rejection structure 34 may be determined according to the electrical wavelength. Specifically, a size of the near-end rejection structure 34 may be determined by using filter emulation software, or may be determined according to an experiment or experience. This is not particularly limited in this embodiment of the present invention.

[0047] Optionally, as shown in FIG. 4, the near-end rejection structure 34 may be a strip structure with a bending angle, or may be a strip or tube structure with a radian in another embodiment.

[0048] As shown in FIG. 4, two ends of the near-end rejection structure 34 are contacted to a lower surface of the dielectric body 32. Optionally, in another embodiment, in addition to the two ends, any other parts of the near-end rejection structure 34 may also be contacted to the lower surface of the dielectric body 32.

[0049] In the embodiment shown in FIG. 4, the near-end rejection structure 34 may play a zero cavity role, and may improve a rejection capability on a high-frequency end or a low-frequency end out of a passband of the filter, that is, may reject a signal on the high-frequency end or the low-frequency end out of the passband of the filter.

[0050] Optionally, by changing a structure of the near-end rejection structure 34, such as changing a length, the electrical wavelength corresponding to the near-end rejection structure 34 may be changed, so as to control the frequency of the signal that the filter is to filter out. Specifically, the length of the near-end rejection structure 34 is inversely proportional to the signal frequency. A longer near-end rejection structure 34 indicates a lower corresponding signal frequency, and the filter 3 may be configured to filter out a signal on a low-frequency end. A shorter near-end rejection structure 34 indicates a higher corresponding signal frequency, and the filter 3 may be configured to filter out a signal on a high-frequency end.

[0051] It may be understood that for detailed description of another component in the filter 3, reference may be made to the content in the embodiment shown in FIG. 1 or FIG. 2 and FIG. 3. This is not described herein.

[0052] This embodiment of the present invention further provides a radio frequency module. The radio frequency module includes any transverse electromagnetic mode dielectric filter described in the foregoing embodiments.

[0053] Optionally, the radio frequency module may be a repeater, a remote radio unit (RRU, remote radio unit), a radio frequency unit (RFU, radio frequency unit), or another device. This is not particularly limited in this embodiment of the present invention.

[0054] According to the transverse electromagnetic mode dielectric filter or the radio frequency module provided in this embodiment of the present invention, when a size of the filter is not increased, a zero cavity function can be implemented by disposing a near-end rejection structure inside a dielectric body; and by using the structure, a signal on a high-frequency end or a low-frequency end out of a passband of the filter can be rejected, and near-end rejection performance of the filter can be improved, thereby improving a filtering effect.

[0055] FIG. 5 is an example diagram of a base station according to an embodiment of the present invention. The base station may include a radio frequency module, and the radio frequency module includes the transverse electromagnetic mode dielectric filter shown in any embodiment in FIG. 1 to FIG. 4.

[0056] The base station may further include a baseband processing unit (BBU, base band unit) 402, a power module 403, and the like. All modules or units may be connected by using a communications bus.

[0057] Optionally, the base station may be a small cell (small cell) device, such as an indoor small cell product.

[0058] The radio frequency module or the base station provided in this embodiment of the present invention uses a transverse electromagnetic mode dielectric filter with good near-end rejection performance, and therefore has low costs and a small size.

[0059] An embodiment of the present invention further provides a method for producing any transverse electromagnetic mode dielectric filter ("filter" for short below) according to FIG. 1 to FIG. 4.

[0060] The method includes: preparing two layers or multiple layers of dielectric blank raw materials; after a through hole or a blind hole is provided on the two layers or multiple layers of dielectric raw materials, separately sintering each layer of dielectric raw material; preparing a metalized structure and a punching on each layer of sintered dielectric; then forming a filter entirety by means of bonding; and forming the transverse electromagnetic mode dielectric filter provided in this embodiment of the present invention after metallization of a printed pattern of the filter is completed.

[0061] In another embodiment of the present invention, the method may be: preparing two layers or multiple layers of dielectric blank raw materials; obtaining a required metal structure, that is, a transmission zero or zero cavity structure in the present invention, by means of opening a hole, printing a circuit, and the like on each layer of dielectric raw material; then stacking prepared layers of dielectric raw materials together for sintering; and finally forming the transverse electromagnetic mode dielectric filter provided in this embodiment of the present invention after metallization of a printed pattern of the dielectric filter is completed.

Claims

1. A transverse electromagnetic mode dielectric filter (1, 2, 3), comprising:

   a resonator (11, 21, 31), a dielectric body (12, 22, 32), and a metal housing (13, 23, 33), wherein

- an outer surface of the dielectric body (12, 22, 32) is covered with a conductive material, the metal housing (13, 23, 33) is fastened above the dielectric body (12, 22, 32), and there is a gap between the metal housing (13, 23, 33) and the dielectric body (12, 22, 32);
- the resonator (11, 21, 31) comprises a resonant plate (101, 201, 301) and a resonant hole (102, 202, 302), wherein the resonant plate (102, 202, 302) is disposed on a top surface of the dielectric body (12, 22, 32), the resonant hole (102, 202, 302) is a hollow cylindrical structure with openings on upper and lower ends, an upper opening of the resonant hole (102, 202, 302) is provided on the resonant plate (101, 201, 301), a lower opening of the resonant hole is provided on a lower surface of the dielectric body (12, 22, 32), an inner surface of the resonant hole (102, 202, 302) is covered with a conductive material, and the resonant plate (101, 201, 301) is of a metal material; and
- the filter (1, 2, 3) further comprises a near-end rejection structure (14, 24, 34), wherein the near-end rejection structure (14, 24, 34) is inside the dielectric body (12, 22, 32), and a shape, a location, and a size of the near-end rejection structure (14, 24, 34) are configured according to a frequency of a signal that the filter (1, 2, 3) is to filter out;
- the near-end rejection structure is a near high-frequency end-rejection structure or a near low-frequency end-rejection structure;
- the near-end rejection structure (14, 24, 34) has at least two ends in contact with the lower surface of the dielectric body (12, 22, 32), and a remaining part of the near-end rejection structure (14, 24, 34) is within a magnetic field area inside the dielectric body
or
the near-end rejection structure (14, 24, 34) is within an electric field area inside the dielectric body (12, 22, 32); and
- the near-end rejection structure (14, 24, 34) is any one of a metalized through hole, a metalized strip line, a physical metal structure, a metalized conductor, or a thin metal piece.

2. The filter (1, 2, 3) according to claim 1, wherein a height, a length, and a distance away from the resonant hole (102, 202, 302) that are of the near-end rejection structure (14, 24, 34) are configured according to a coupling coefficient of the filter (1, 2, 3), wherein the coupling coefficient is corresponding to the frequency of the signal that the filter (1, 2, 3) is to filter out.

3. The filter (1, 2, 3) according to claim 1, wherein a height, a length, and a distance away from the resonant hole (102, 202, 302) that are of the near-end rejection structure (14, 24, 34) are configured according to an electrical wavelength corresponding to the frequency of the signal that the filter (1, 2, 3) is to filter out.

4. A radio frequency module, comprising the transverse electromagnetic mode dielectric filter according to any one of claims 1 to 3.

5. A base station, comprising the radio frequency module according to claim 4.

Patentansprüche

1. Dielektrisches Transversalelektromagnetischer-Modus-Filter (1, 2, 3), das Folgendes umfasst:

einen Resonator (11, 21, 31), einen dielektrischen Körper (12, 22, 23) und ein Metallgehäuse (13, 23, 33), wobei
eine Außenfläche des dielektrischen Körpers (12, 22, 23) mit einem leitfähigen Material bedeckt ist, das Metallgehäuse (13, 23, 33) über dem dielektrischen Körper (12, 22, 23) befestigt ist und es einen Spalt zwischen dem Metallgehäuse (13, 23, 33) und dem dielektrischen Körper (12, 22, 23) gibt;
der Resonator (11, 21, 31) eine Resonanzplatte (101, 201, 301) und ein Resonanzloch (102, 202, 302) umfasst, wobei die Resonanzplatte (102, 202, 302) auf einer oberen Oberfläche des dielektrischen Körpers (12, 22, 23) angeordnet ist, das Resonanzloch (102, 202, 302) eine hohle zylindrische Struktur mit Öffnungen an einem oberen und unteren Ende ist, eine obere Öffnung des Resonanzlochs (102, 202, 302) an der Resonanzplatte (101, 201, 301) bereitgestellt ist, eine untere Öffnung des Resonanzlochs an einer unteren Oberfläche des dielektrischen Körpers (12, 22, 23) bereitgestellt ist, eine Innenfläche des Resonanzlochs (102, 202, 302) mit einem leitfähigen Material bedeckt ist und die Resonanzplatte (101, 201, 301) aus einem Metallmaterial gebildet ist; und
das Filter (1, 2, 3) ferner eine Randbereich-Unterdrückungsstruktur (14, 24, 34) umfasst, wobei sich die Randbereich-Unterdrückungsstruktur (14, 24, 34) innerhalb des dielektrischen Körpers (12, 22, 23) befindet und eine Form, ein Ort und eine Größe der Randbereich-Unterdrückungsstruktur (14, 24, 34) gemäß einer Frequenz eines Signals, das das Filter (1, 2, 3) herausfiltern soll, konfiguriert sind;
die Randbereich-Unterdrückungsstruktur (14, 24, 34) eine Hochfrequenzrandbereich-Unterdrückungsstruktur oder eine Niederfrequenz-

randbereich-Unterdrückungsstruktur ist;
die Randbereich-Unterdrückungsstruktur (14, 24, 34) mindestens zwei Enden in Kontakt mit der unteren Oberfläche des dielektrischen Körpers (12, 22, 23) aufweist und ein verbleibender Teil der Randbereich-Unterdrückungsstruktur (14, 24, 34) in einem Magnetfeldbereich innerhalb des dielektrischen Körpers liegt,
oder
die Randbereich-Unterdrückungsstruktur (14, 24, 34) in einem Bereich eines elektrischen Feldes innerhalb des dielektrischen Körpers (12, 22, 23) liegt; und
die Randbereich-Unterdrückungsstruktur (14, 24, 34) ein beliebiges eines metallisierten Durchgangslochs, einer metallisierten Streifenleitung, einer physischen Metallstruktur, eines metallisierten Leiters oder eines dünnen Metallstücks ist.

2. Filter (1, 2, 3) nach Anspruch 1, wobei eine Höhe, eine Länge und ein Abstand vom Resonanzloch (102, 202, 302) der Randbereich-Unterdrückungsstruktur (14, 24, 34) gemäß einem Kopplungskoeffizienten des Filters (1, 2, 3) konfiguriert sind, wobei der Kopplungskoeffizient der Frequenz des Signals, das das Filter (1, 2, 3) herausfiltern soll, entspricht.

3. Filter (1, 2, 3) nach Anspruch 1, wobei eine Höhe, eine Länge und ein Abstand vom Resonanzloch (102, 202, 302) der Randbereich-Unterdrückungsstruktur (14, 24, 34) gemäß einer elektrischen Wellenlänge konfiguriert sind, die der Frequenz des Signals, das das Filter (1, 2, 3) herausfiltern soll, entspricht.

4. Hochfrequenzmodul, das das dielektrische Transversalelektromagnetischer-Modus-Filter nach einem der Ansprüche 1 bis 3 umfasst.

5. Basisstation, die das Hochfrequenzmodul nach Anspruch 4 umfasst.

Revendications

1. Filtre diélectrique à mode électromagnétique transversal (1, 2, 3), comprenant :
un résonateur (11, 21, 31), un corps diélectrique (12, 22, 32) et un boîtier métallique (13, 23, 33), dans lequel :

- une surface extérieure du corps diélectrique (12, 22, 32) est recouverte d'un matériau conducteur, le boîtier métallique (13, 23, 33) est fixé au-dessus du corps diélectrique (12, 22, 32) et il y a un espace entre le boîtier métallique (13, 23, 33) et le corps diélectrique (12, 22, 32) ;
- le résonateur (11, 21, 31) comprend une plaque résonante (101, 201, 301) et un trou résonant (102, 202, 302), la plaque résonante (102, 202, 302) étant disposée sur une surface supérieure du corps diélectrique (12, 22, 32), le trou résonant (102, 202, 302) étant une structure cylindrique creuse avec des ouvertures aux extrémités supérieure et inférieure, une ouverture supérieure du trou résonant (102, 202, 302) étant située sur la plaque résonante (101, 201, 301), une ouverture inférieure du trou résonant étant située sur une surface inférieure du corps diélectrique (12, 22, 32), une surface interne du trou résonant (102, 202, 302) étant recouverte d'un matériau conducteur et la plaque résonante (101, 201, 301) étant en un matériau métallique ; et
- le filtre (1, 2, 3) comprend en outre une structure de réjection proche (14, 24, 34), la structure de réjection proche (14, 24, 34) étant à l'intérieur du corps diélectrique (12, 22, 32) et une forme, un emplacement et une taille de la structure de réjection proche (14, 24, 34) étant configurés selon une fréquence d'un signal que le filtre (1, 2, 3) doit filtrer ;
- la structure de réjection proche est une structure de réjection proche des hautes fréquences ou une structure de réjection proche des basses fréquences ;
- la structure de réjection proche (14, 24, 34) a au moins deux extrémités en contact avec la surface inférieure du corps diélectrique (12, 22, 32), et une partie restante de la structure de réjection proche (14, 24, 34) est dans une zone de champ magnétique à l'intérieur du corps diélectrique,
ou
- la structure de réjection proche (14, 24, 34) est dans une zone de champ électrique à l'intérieur du corps diélectrique (12, 22, 32) ; et
- la structure de réjection proche (14, 24, 34) est une structure quelconque parmi un trou traversant métallisé, une ligne à rubans métallisée, une structure métallique physique, un conducteur métallisé et une pièce métallique fine.

2. Filtre (1, 2, 3) selon la revendication 1, dans lequel une hauteur, une longueur et une distance opposée au trou résonant (102, 202, 302), qui appartiennent à la structure de réjection proche (14, 24, 34), sont configurées selon un coefficient de couplage du filtre (1, 2, 3), le coefficient de couplage correspondant à la fréquence du signal que le filtre (1, 2, 3) doit filtrer.

3. Filtre (1, 2, 3) selon la revendication 1, dans lequel une hauteur, une longueur et une distance opposée au trou résonant (102, 202, 302), qui appartiennent à la structure de réjection proche (14, 24, 34), sont

configurées selon une longueur d'onde électrique correspondant à la fréquence du signal que le filtre (1, 2, 3) doit filtrer.

4. Module radioélectrique, comprenant le filtre diélectrique à mode électromagnétique transversal selon l'une quelconque des revendications 1 à 3.

5. Station de base, comprenant le module radioélectrique selon la revendication 4.

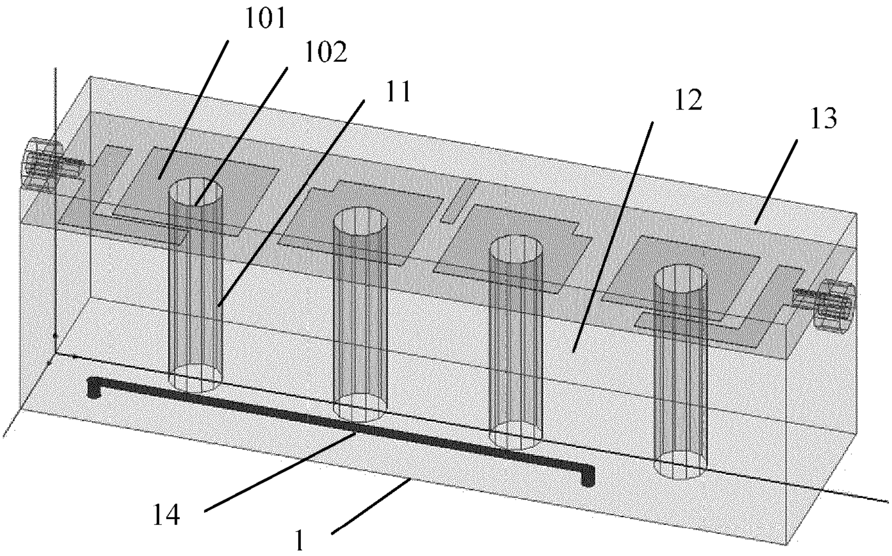

FIG. 1

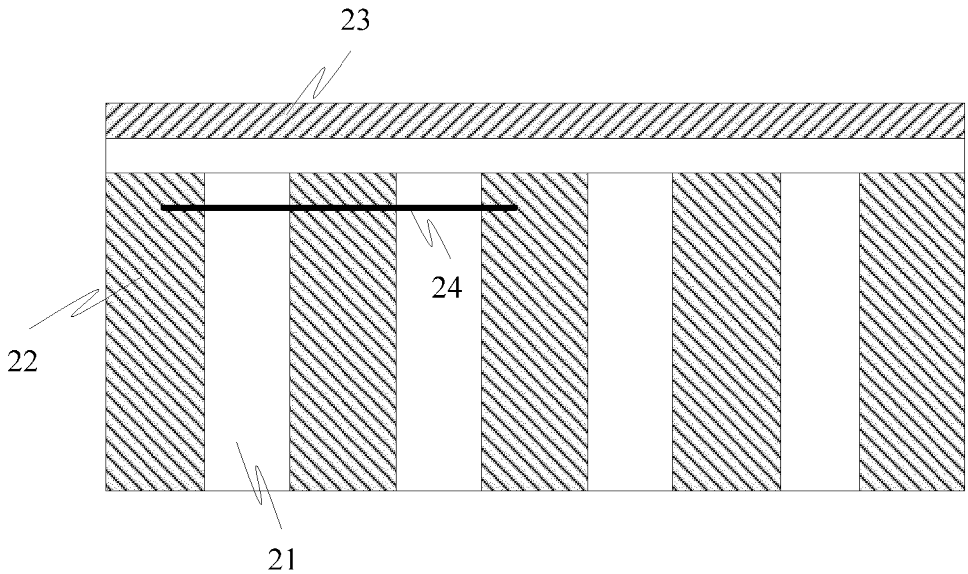

FIG. 2

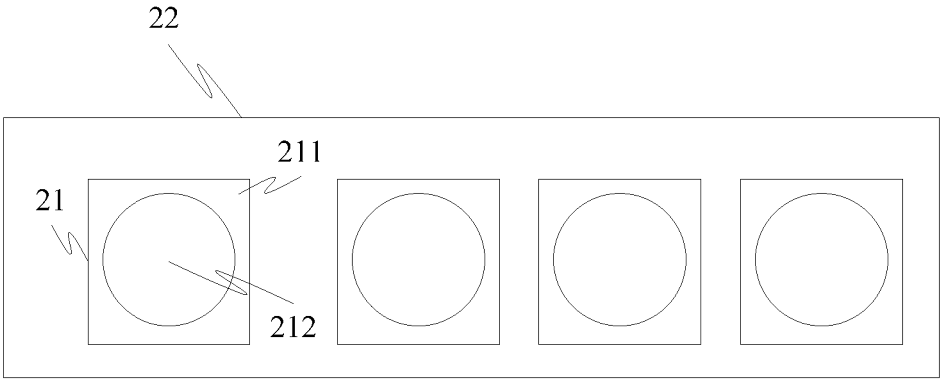

FIG. 3

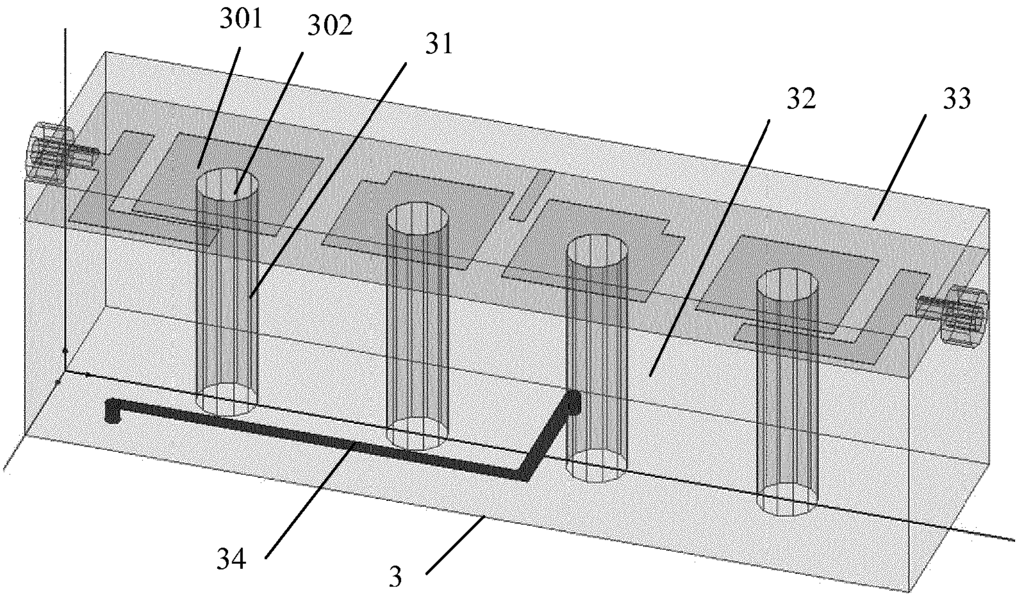

FIG. 4

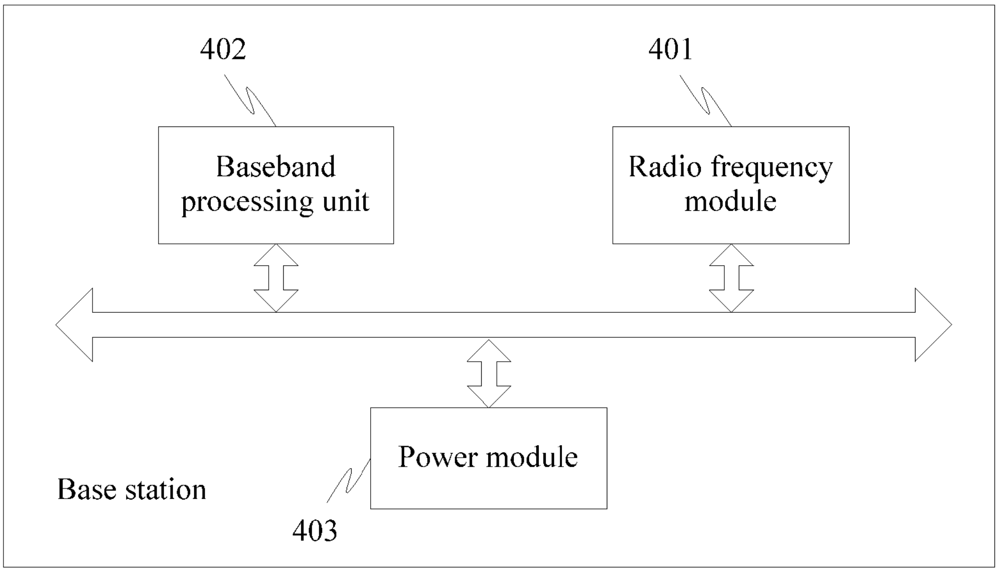
402
401
Baseband processing unit
Radio frequency module
Power module
Base station
403

FIG. 5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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