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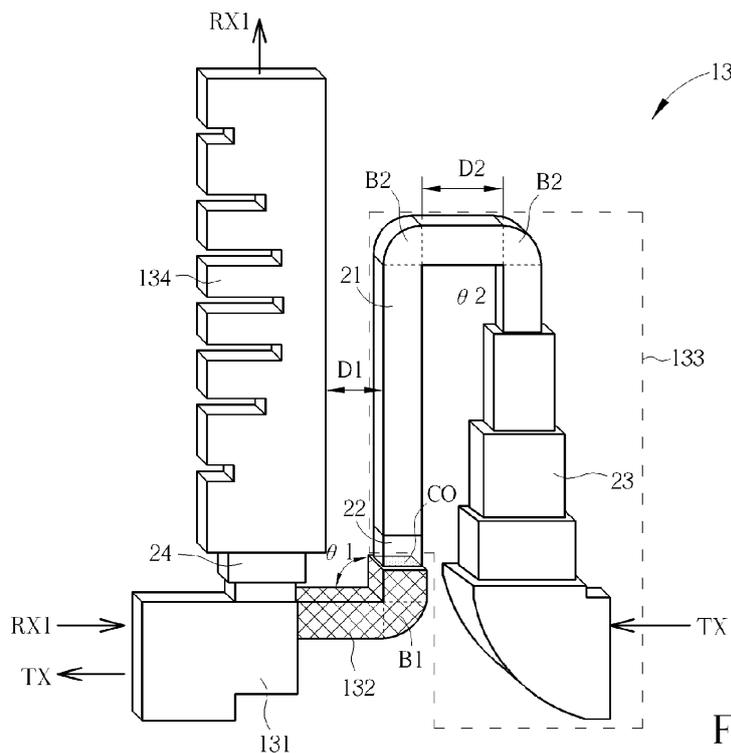
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(54) **Diplexer and waveguide**

(57) A diplexer (13) for a waveguide (10) includes a power divider (131) for transmitting a transmitting signal (TX) and a first ortho-polarized receiving signal (RX1), a first lowpass filter (134) coupled to the power divider (131) for filtering out the transmitting signal (TX) and transmitting the first ortho-polarized receiving signal (RX1) a con-

necting port (132) coupled to the power divider (131) and having a first bend (B1) for transmitting the transmitting signal (TX), and a highpass filter (133) coupled to the connecting port (132) for filtering out the first ortho-polarized receiving signal (RX1) and transmitting the transmitting signal (TX).



**FIG. 2**

**Description**

Field of the Invention

5 **[0001]** The present invention relates to a diplexer, and more particularly, to a diplexer whose highpass filter is bended to reduce a dimension of the diplexer.

Background of the Invention

10 **[0002]** Satellite communication has advantages such as a wide communication coverage and free from interference from ground environment, and is widely used for military communication, exploration and business communication services, e.g. satellite navigation, satellite voice broadcast or satellite television broadcast.

**[0003]** A waveguide is widely used in a satellite communication transceiver. In operation, the waveguide may transmit satellite wireless signals and separate received satellite wireless signals into horizontally polarized and vertically polarized signals to output to different output ports. Thus, a backend processor may generate the transmitting satellite wireless signals or perform further signal processing on the received horizontally and vertically polarized signals simultaneously.

15 **[0004]** However, the satellite communication transceiver is usually installed on a roof or an exterior wall of a building to facilitate signal transmission and reception. Therefore, a dimension and a weight of the satellite communication transceiver are expected to be as small as possible to enhance convenience for installing the satellite communication transceiver and ensure durability and safety as well, which may avoid the satellite communication transceiver falling from the roof or the wall due to strong winds. Thus, reducing the dimension and weight of the satellite communication transceiver has become a goal to be achieved in the industry.

Summary of the Invention

25 **[0005]** This in mind, the application aims at providing a diplexer in a waveguide in order to solve the abovementioned problems.

**[0006]** This is achieved by a diplexer and a waveguide according to claims 1 and 6. The dependent claims pertain to corresponding further developments and improvements.

30 **[0007]** As will be seen more clearly from the detailed description following below, the claimed diplexer for a waveguide includes a power divider for transmitting a transmitting signal and a first ortho-polarized reception signal, a first lowpass filter coupled to the power divider for filtering out the transmitting signal and transmitting the first ortho-polarized reception signal, a connecting port coupled to the power divider and having a first bend for transmitting the transmitting signal, and a highpass filter coupled to the connecting port for filtering out the first ortho-polarized reception signal and transmitting the transmitting signal.

Brief Description of the Drawings

**[0008]**

40 FIG. 1 is a schematic diagram of a waveguide according to an embodiment of the present invention.  
FIG. 2 is a structural diagram of the diplexer shown in FIG. 1 according to an embodiment of the present invention.  
FIG. 3 illustrates an insertion loss, a return loss of the transmitting port shown in FIG. 1, and an isolation between the transmitting port and the receiving port shown in FIG. 1.  
45 FIG. 4 illustrates an insertion loss, a return loss of the receiving port shown in FIG. 1, and an isolation between the receiving port and the transmitting port shown in FIG. 1.

Detailed Description

50 **[0009]** Please refer to FIG. 1, which is a schematic diagram of a waveguide 10 according to an embodiment of the present invention. The waveguide 10 may be utilized in a satellite transceiver. The waveguide 10 includes an orthomode transducer 11, a lowpass filter 12, a diplexer 13, a common port CMP, a receiving port RP2 and RP1 and a transmitting port TP. In detail, the common port CMP is used for outputting a transmitting signal TX and inputting a receiving signal RX. The orthomode transducer 11 is coupled to the common port CMP, the lowpass filter 12 and the diplexer 13. The orthomode transducer 11 is used for transmitting the transmitting signal TX and cooperating with the lowpass filter 12 to separate the receiving signal RX into ortho-polarized receiving signals RX2 and RX1. For example, the ortho-polarized receiving signal RX2 may be a horizontally polarized signal, the ortho-polarized receiving signal RX1 may be a vertically polarized signal, and the transmitting signal TX may be a vertically polarized signal. The lowpass filter 12 is coupled

between the orthomode transducer 11 and the receiving port RP2, and used for filtering out the transmitting signal TX and the ortho-polarized receiving signal RX1 to transmit the ortho-polarized receiving signal RX2 to the receiving port RP2. The diplexer 13 is coupled to the orthomode transducer 11, and used for cooperating with the lowpass filter 134 to separate the transmitting signal TX and the signal ortho-polarized receiving signal RX1, such that the transmitting signal TX may be transmitted from the transmitting port TP and the ortho-polarized receiving signal RX1 may be transmitted to the receiving port RP1.

**[0010]** The diplexer 13 includes a power divider 131, a connecting port 132, a highpass filter 133 and a lowpass filter 134. The power divider 131 is coupled to the orthomode transducer 11 for transmitting the transmitting signal TX and cooperating with the lowpass filter 134 to separate the ortho-polarized receiving signal RX1. The lowpass filter 134 is coupled to the power divider 131, and used for filtering out the transmitting signal TX and transmitting the ortho-polarized receiving signal RX1 to the receiving port RP1. The connecting port 132 is coupled to the power divider 131, and used for transmitting the transmitting signal TX. The highpass filter 133 is coupled to the connecting port 132, and used for filtering out the ortho-polarized receiving signal RX1 such that the transmitting signal TX may be transmitted from the transmitting port TP.

**[0011]** In such a structure, the waveguide 10 may be utilized in a satellite communication transceiver to transmit wireless signals (the transmitting signal TX and receiving signal RX), and may separate the receiving signal RX into the ortho-polarized receiving signals RX2 and RX1 to respectively output from the receiving ports RP2 and RP1.

**[0012]** Specifically, please refer to FIG. 2, which is a structural diagram of the diplexer 13 according to an embodiment of the present invention. The connecting port 132 includes a bend B1, which may be effectively viewed as a signal reflecting plane for reflecting part of the ortho-polarized receiving signal RX1, and thus an isolation between the receiving port RP1 and the transmitting port TP may be improved. The highpass filter 133 may be a double corrugated filter, which includes a propagator 21 and corrugated transformers 22 and 23. The propagator 21 includes a plurality of bends B2 such that the highpass filter 133 has a meandering shape. The corrugated transformer 22 is formed between an end of the propagator 21 and the bend B1. The corrugated transformer 22 is used for transmitting the transmitting signal TX and being a cut-off reflecting plane CO of the ortho-polarized receiving signal RX1 to prevent the ortho-polarized receiving signal RX1 from flowing into the highpass filter 133. The corrugated transformer 23 is formed on another end of the propagator 21, and used for transmitting the transmitting signal TX from the transmitting port TP. The lowpass filter 134 includes a corrugated transformer 24 formed between the lowpass filter 134 and the power divider 131. The lowpass filter 134 is used for transmitting the ortho-polarized receiving signal RX1.

**[0013]** A corrugated transformer may be viewed as a matching element to be disposed at an interface between two elements for matching characteristic impedances between the two elements to reduce signal attenuation during signal transmission. A number of corrugations of the corrugated transformer may be adjustable, and a shape of the corrugated transformer may be modified as well; for example, an open mouth of the corrugated transformer may be narrowed or broadened. Specifically, the corrugated transformer 22 has two corrugations, and an open mouth of the corrugated transformer 22 narrows to the propagator 21 from the connecting port 132. The corrugated transformer 23 has four corrugations, and an open mouth of the corrugated transformer 23 broadens to the transmitting port TP (not shown in FIG. 2) from the propagator 21. The corrugated transformer 24 has two corrugations, and an open mouth of the corrugated transformer 24 broadens to the lowpass filter 134 from the power divider 131. A designer may design one corrugated transformer 22, 23 or 24 or multiple corrugated transformers on the diplexer 13 according to practical requirements. For example, the designer may design the corrugated transformers 22 and 23, the corrugated transformers 22 and 24, or the corrugated transformers 23 and 24 on the diplexer 13.

**[0014]** In the structure of the diplexer 13, the highpass filter 133 may have a meandering shape due to the bends B1 and B2, which may reduce an area of the highpass filter 133 and also dimensions and weights of the diplexer 13 and the waveguide 10, so as to reduce production cost of the waveguide 10. Besides, the bend B1 of the corrugated transformer 22 may form the cut-off reflecting plane CO to reflect the ortho-polarized receiving signal RX1, which may improve the isolation between the receiving port RP1 and the transmitting port TP.

**[0015]** In short, the present invention couples the connecting port 132 having the bend B1 between the highpass filter 133 and the power divider 131, which may reduce the area and the dimension of the diplexer 13. The diplexer 13 having the corrugated transformer 22 may reduce the isolation between the receiving port RP1 and the transmitting port TP. Those skilled in the art may make modifications accordingly.

**[0016]** For example, an angle  $\theta_1$  of the bend B1 may be adjustable. A number of the plurality of bends B2 may be adjustable, as shown in FIG. 2, the highpass filter 133 may have two or more bends B2. An angle  $\theta_2$  of the bend B2 may adjustable. There is a gap D1 between the highpass filter 133 and the lowpass filter 134, and there is a gap D2 between any two adjacent bends B2. The gaps D1 and D2 may be adjustable to adjust the area and the dimension of the diplexer 13 to meet practical requirements.

**[0017]** On the other hand, the waveguide 10 may be a T-junction-type waveguide for separating wireless signals respectively propagating along an E-plane (electric field plane) and an H-plane (magnetizing field plane), i.e. the ortho-polarized receiving signals RX1 and RX2. Besides, since the bend B1 of the present invention may reflect part of a low

frequency signal, i.e. the ortho-polarized receiving signal RX1, such that the diplexer 13 may separate wireless signals having a same polarization but different frequencies, i.e. the ortho-polarized receiving signal RX1 and the transmitting signal TX.

**[0018]** Please refer to FIG. 3, which illustrates a schematic diagram of insertion loss, return loss of the transmitting port TP, and isolation between the transmitting port TP and the receiving port RP1. The insertion loss is denoted with a solid line, the return loss is denoted with a dashed line, the isolation is denoted with a dotted line. Operating frequencies of the transmitting port TP are 13.75-14.5GHz. Table 1 includes measurement data shown in FIG. 3:

Table 1

Frequency(GHz)	Insertion loss (dB/%)	Return loss (dB/%)	Isolation (dB)
13.75	-0.24/94.6	-29.08/0.12	-56.17
14.5	-0.23/94.8	-19.37/1.16	<-56.17

**[0019]** As can be seen from Table 1, the transmitting port TP may operate in the operating frequencies 13.75-14.5GHz, the insertion loss indicates that there are at least 94.6% of the transmitting signal TX is transmitted from the transmitting port TP to the common port CMP. The return loss indicates that less than 1.16% of the transmitting signal TX is reflected back to the transmitting port TP. The isolation between the transmitting port TP and the receiving port RP1 is nearly 0%, which indicates there is almost no signal transmission between the transmitting port TP and the receiving port RP1.

**[0020]** Please refer to FIG. 4, which illustrates a schematic diagram of insertion loss, return loss of the receiving port RP1, and isolation between the receiving port RP1 and the transmitting port TP. The insertion loss is denoted with a solid line, the return loss is denoted with a dashed line, the isolation is denoted with a dotted line. Operating frequencies of the transmitting port TP are 10.7-12.75GHz. Table 2 includes measurement data shown in FIG. 4:

Table 2

Frequency(GHz)	Insertion loss (dB/%)	Return loss (dB/%)	Isolation (dB)
10.7	-0.14/96.8	-25.34/0.29	<-25.22
12.25	-0.21/95.3	-20.72/0.85	<-25.22
12.75	-0.34/92.5	-26.10/0.25	-25.22

**[0021]** As can be seen from Table 2, the receiving port RP1 may operate in the operating frequencies 10.7-12.75GHz, the insertion loss indicates that at least 92.5% of ortho-polarized receiving signal RX1 is transmitted from the common port CMP to the receiving port RP1. The return loss indicates that less than 0.85% of the ortho-polarized receiving signal RX1 is reflected back to the receiving port RP1. The isolation between the receiving port RP1 and the transmitting port TP is nearly 0%, which indicates that there is almost no signal transmission between the receiving port RP1 and the transmitting port TP.

**[0022]** To sum up, the present invention couples the connecting port 132 having the bend B1 between the highpass filter 133 and the power divider 131, which may reduce the area and the dimension of the diplexer 13. The diplexer 13 having the corrugated transformer 22 may reduce the isolation between the receiving port RP1 and the transmitting port TP. The highpass filter 133 includes multiple bends B1 and B2 such that the dimension of the highpass filter 133 may be reduced, which may reduce the areas and the dimensions of the diplexer 13 and waveguide 10 as well. Therefore, since the present invention may reduce the weights and production costs of the diplexer 13 and the waveguide 10, installing the satellite communication transceiver may be more convenient, which may ensure durability and safety of the satellite communication transceiver.

**Claims**

1. A diplexer (13) for a waveguide (10), **characterized by:**

- a power divider (131) for transmitting a transmitting signal (TX) and a first ortho-polarized receiving signal (RX1);
- a first lowpass filter (134) coupled to the power divider (131) for filtering out the transmitting signal (TX) and transmitting the first ortho-polarized receiving signal (RX1);
- a connecting port (132) coupled to the power divider (131) and having a first bend (B1) for transmitting the transmitting signal (TX); and

a highpass filter (133) coupled to the connecting port (132) for filtering out the first ortho-polarized receiving signal (RX1) and transmitting the transmitting signal (TX).

2. The diplexer of claim 1, **characterized in that** the highpass filter (133) comprises:

a propagator (21) including a plurality of second bends (B2) such that the highpass filter (133) has a meandering shape;  
 a first corrugated transformer (22) formed between an end of the propagator (21) and the first bend (B1) for transmitting the transmitting signal (TX), and for being a cut-off reflecting plane (CO) of the first ortho-polarized receiving signal (RX1); and  
 a second corrugated transformer (23) formed on another end of the propagator (21) for transmitting the transmitting signal (TX).

3. The diplexer of claim 2, **characterized in that** there is a gap (D2) between any two adjacent second bends (B2) among the plurality of second bends (B2).

4. The diplexer of claim 1, **characterized in that** the first lowpass filter (134) comprises a third corrugated transformer (24) formed between the first lowpass filter (134) and the power divider (131) for transmitting the first ortho-polarized receiving signal (RX1).

5. The diplexer of claim 1, **characterized in that** there is a gap (D1) between the highpass filter (133) and the first lowpass filter (134).

6. A waveguide (10), **characterized by:**

a diplexer (13) comprising:

a power divider (131) for transmitting a transmitting signal (TX) and a first ortho-polarized receiving signal (RX1);

a first lowpass filter (134) coupled to the power divider (131) for filtering out the transmitting signal (TX) and transmitting the first ortho-polarized receiving signal (RX1);

a connecting port (132) coupled to the power divider (131) and having a first bend (B1) for transmitting the transmitting signal (TX); and

a highpass filter (133) coupled to the connecting port (132) for filtering out the first ortho-polarized receiving signal (RX1) and transmitting the transmitting signal (TX);

a transmitting port (TP) coupled to the highpass filter (133) for inputting the transmitting signal (TX);

a first receiving port (RP1) for receiving the first ortho-polarized receiving signal (RX1);

a second receiving port (RP2) for receiving a second ortho-polarized receiving signal (RX2);

a common port (CMP) for outputting the transmitting signal (TX) and inputting a receiving signal (RX);

a second lowpass filter (12) coupled to the second receiving port (RP2) for filtering out the transmitting signal (TX) and the first ortho-polarized receiving signal (RX1) and transmitting the second ortho-polarized receiving signal (RX2) to the second receiving port (RP2); and

an orthomode transducer (11) coupled to the common port (CMP), the second lowpass filter (12) and the diplexer (13) for transmitting the transmitting signal (TX) and cooperating with the second lowpass filter (12) to separate the receiving signal (RX) into the first ortho-polarized receiving signal (RX1) and the second ortho-polarized receiving signal (RX2).

7. The waveguide of claim 6, **characterized in that** the highpass filter (133) comprises:

a propagator (21) including a plurality of second bends (B2) such that the highpass filter (133) has a meandering shape;

a first corrugated transformer (22) formed between an end of the propagator (21) and the first bend (B1) for transmitting the transmitting signal (TX), and for being a cut-off reflecting plane (CO) of the first ortho-polarized receiving signal (RX1); and

a second corrugated transformer (23) formed on another end of the propagator (21) for transmitting the transmitting signal (TX).

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8. The waveguide of claim 7, **characterized in that** there is a gap (D2) between any two adjacent second bends (B2) among the plurality of second bends (B2).

5 9. The waveguide of claim 6, **characterized in that** the first lowpass filter (134) comprises a third corrugated transformer (24) formed between the first lowpass filter (134) and the power divider (131) for transmitting the first ortho-polarized receiving signal (RX1).

10 10. The waveguide of claim 6, **characterized in that** there is a gap (D1) between the highpass filter (133) and the first lowpass filter (134).

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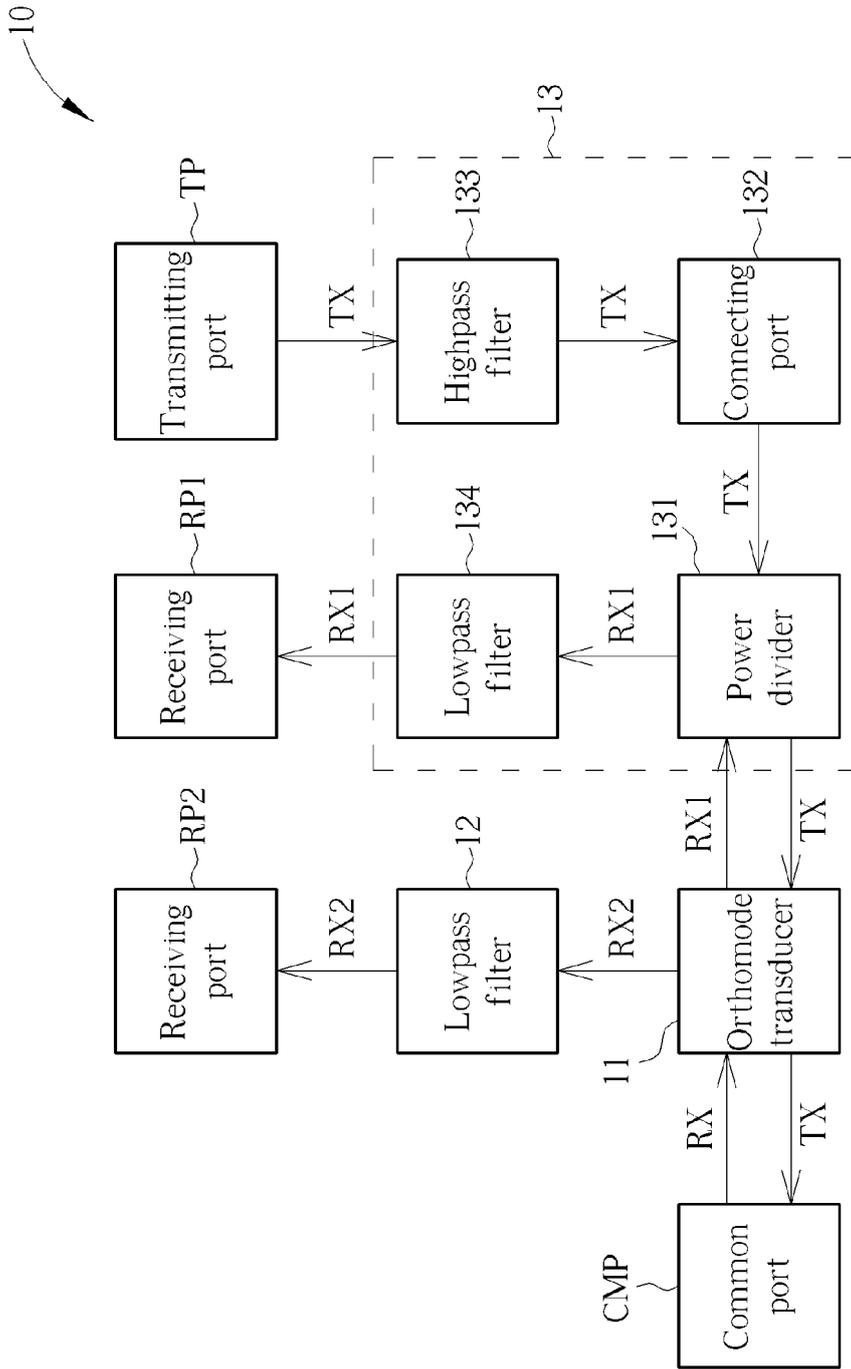
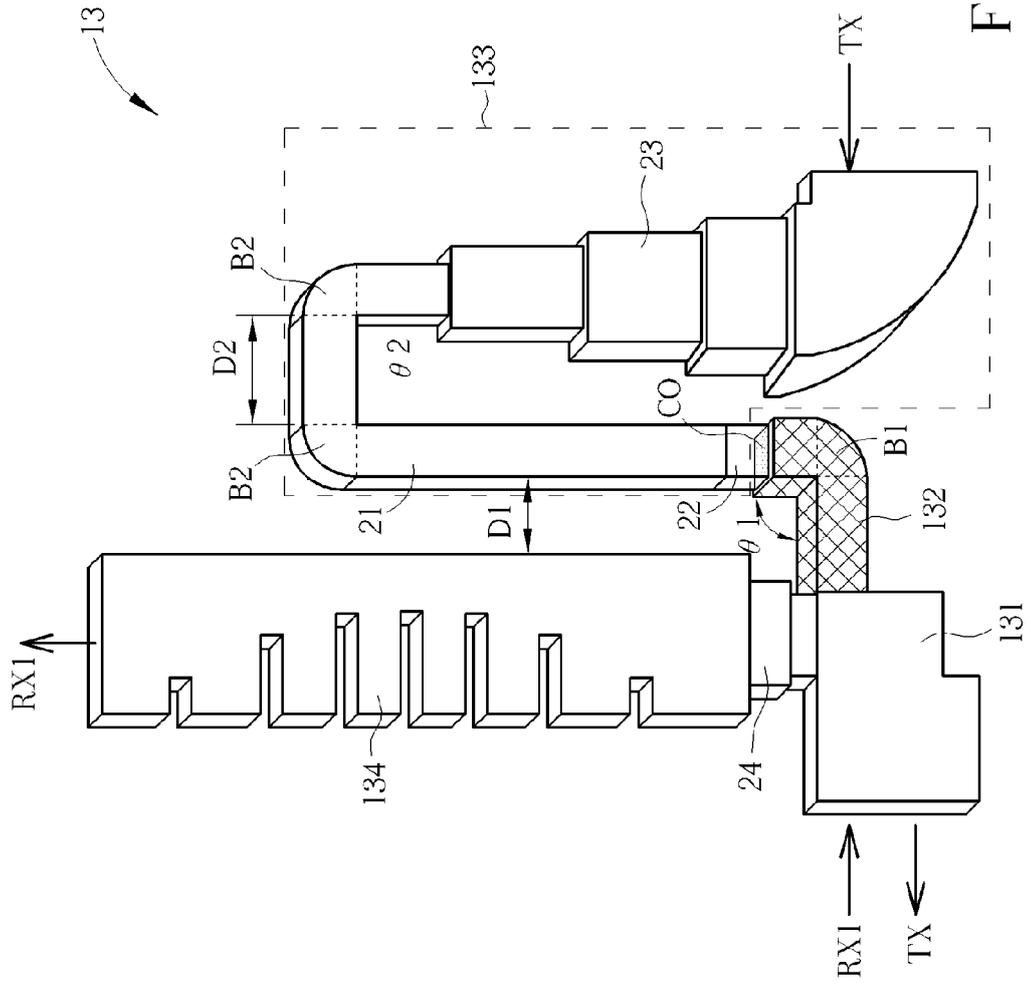


FIG. 1



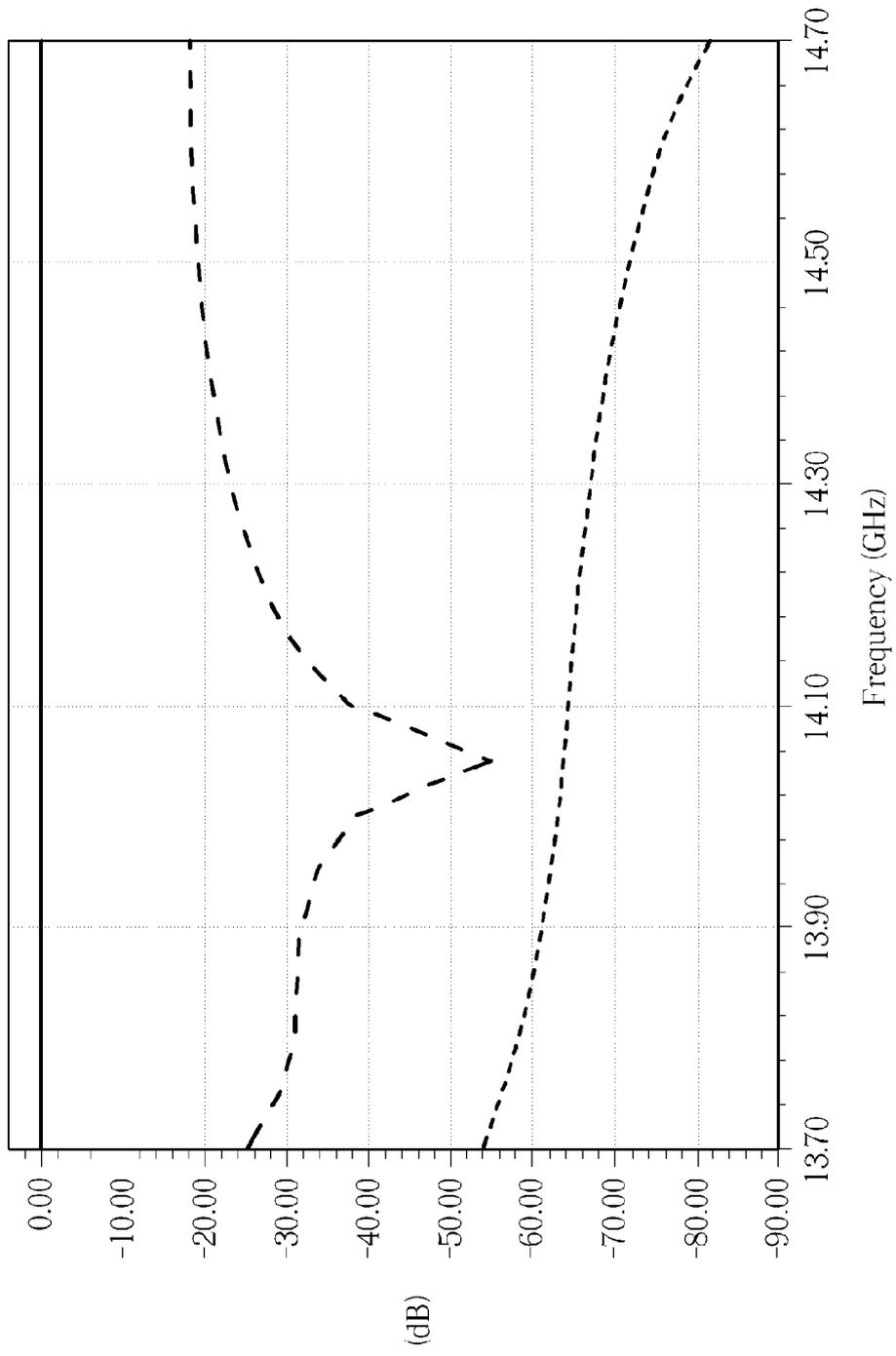


FIG. 3

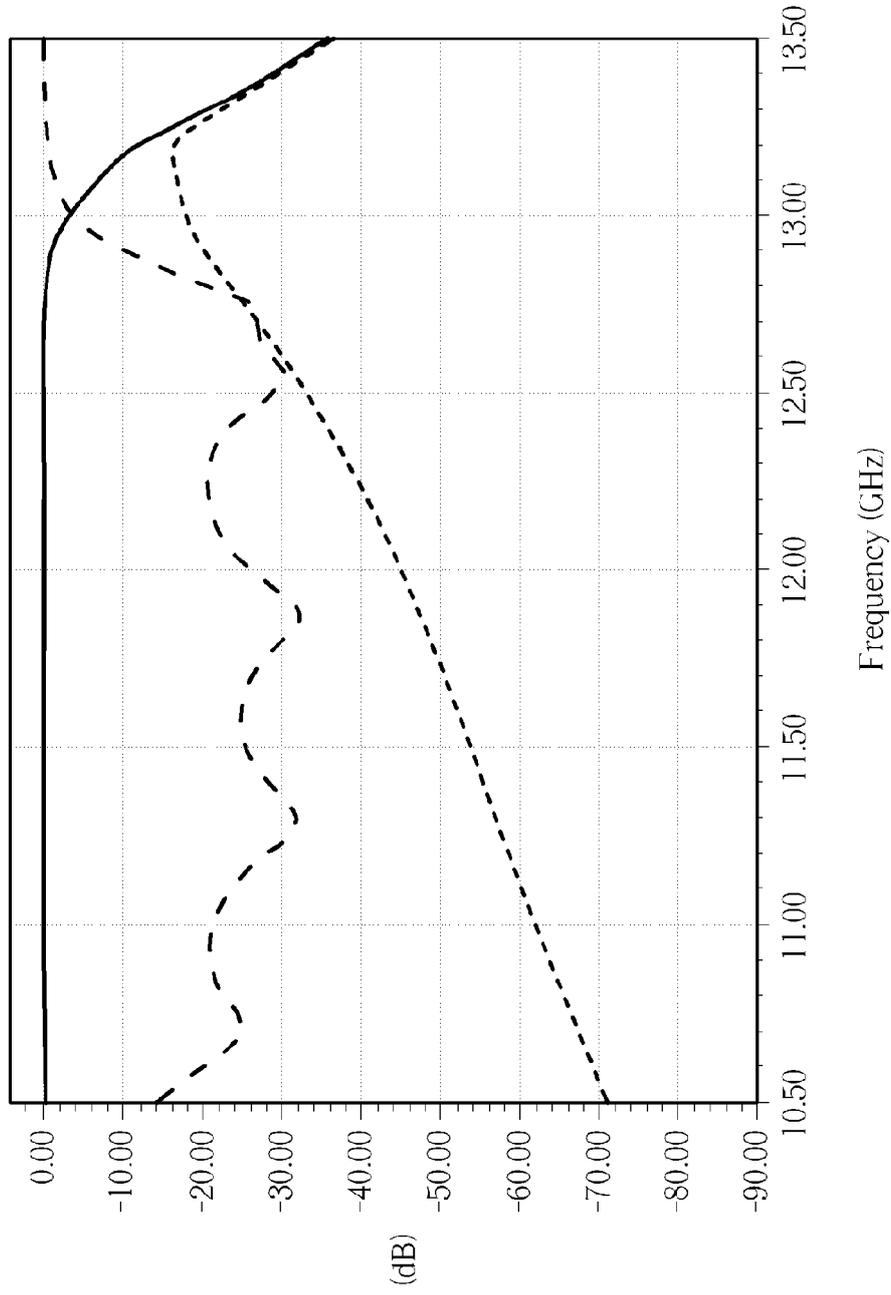


FIG. 4



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Application Number  
EP 13 15 7832

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 4 April 2014	Examiner Pastor Jiménez, J
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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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