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THE QUASI-YAGI ANTENNA SUBARRAY FED BY AN ORTHOGONAL T JUNCTION

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Abstract—A 2×2 quasi-Yagi antenna array fed by a novel orthogonal T junction is presented. The orthogonal T junction is constructed with a traditional microstrip T junction, two planar microstrip to CPW transitions and two orthogonal microstrip to CPW transitions. The orthogonal T junction can be integrated with the quasi-Yagi array element directly. A 2×2 prototype operated from 7.6 GHz to 12 GHz is fabricated and measured.

1. INTRODUCTION

The quasi-Yagi antenna is a plane antenna type and is used widely not only singly but also as array elements [1–3]. The quasi-Yagi planar array is usually fed by external feeding networks, and connected with them by cables. The arrangement of all the array elements are often the same, as shown in Fig. 1 [3], all the elements are pointing to the same direction in H plane. The paper presented a novel orthogonal T junction, which includes a planar microstrip T junction, two planar MS to CPW transitions and two orthogonal MS to CPW transitions. The novel T junction can be integrated directly with quasi-Yagi array elements without the use of any RF cables and RF connectors. This makes the array system compact and with a low cost. The array elements must be arranged face to face in the case. A 2×2 quasi-Yagi antenna array fed by the new orthogonal junction is fabricated and measured.

2. CONFIGURATION OF NOVEL ORTHOGONAL T JUNCTION

The configuration of the novel orthogonal T junction is shown in Fig. 2. It constructed with a microstrip T-junction, two MS-to-CPW planar transitions and two CPW-to-MS vertical transitions.

As the impedances of two dividing arms are 50 Ω, to get wide band matching, the main arm of microstrip T-junction is multi-sections-quarter-wavelength impedance transformer from 50 Ω to 100 Ω.

The MS-to-CPW planar transition presents the connection between the top microstrip line and the CPW in the ground plane by via holes [5]. The impedances of MS and CPW are 50 Ω.

Figure 1. 2D quasi-Yagi antenna array with elements all pointing forward [3].

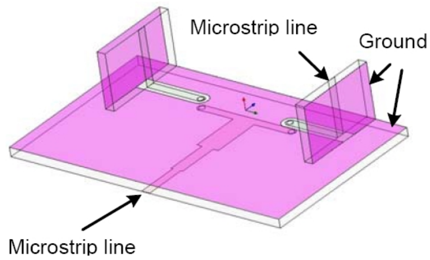

Figure 2. Configuration of novel orthogonal T junction.

The CPW-to-MS vertical transition presents the connection between the vertical microstrip line and the horizontal CPW by connecting the conducting strips and the ground planes, for the conducting strip and the ground plane of CPW are on the same plane of the substrate, so the connecting is easy to be achieved. The impedances of MS and CPW are also 50 Ω. To get a better matching, the microstrip line and the CPW are all tapered at the connection point [4]. Both MS and CPW tapers end at the same characteristic impedance, 60 Ω.

Both bandwidth of 50 Ω to 100 Ω impedance transformer and the distribution effects of the via holes and the vertical connection of strips in both types of MS-CPW transition influence the total band width.

3. 2×2 QUASI-YAGI ARRAY FED BY NOVEL ORTHOGONAL T JUNCTION

The X-band orthogonal T junction is designed and simulated by Ansoft ensemble and HFSS. The Rogers 6010 ($\varepsilon r = 10.2$, $h = 0.635$ mm) is chosen. At X-band, as for the impedance of 50 Ω, microstrip width, CPW strip width and slot width are $w_{MS} = 0.62$ mm, $w_{CPW} = 0.62$ mm, $G_{CPW} = 0.25$ mm respectively.

A 2×2 quasi-Yagi array is fabricated as Fig. 3 shows, the coplanar elements are fed by planar microstrip T-junction, as for two 1×2 quasi-Yagi arrays, the novel orthogonal T junction is used. The array elements must be arranged face to face other than pointing forward as shown in Fig. 1. The measurements have been performed with a Vector Network Analyzer (VNA) in the frequency range 7–13 GHz. Fig. 3 shows the measured return loss for the input port of the 2×2 quasi-Yagi array. As can be shown, the return loss is less than -10 dB from $7.6 \sim 12$ GHz.

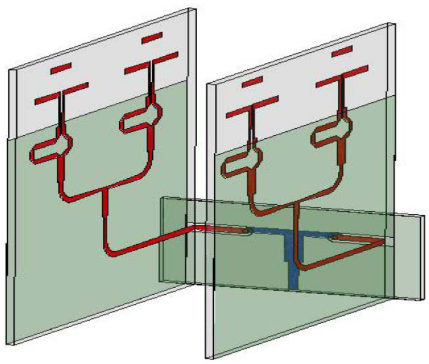

Figure 3. A 2×2 quasi-Yagi array fed by novel orthogonal T junction with elements face to face.

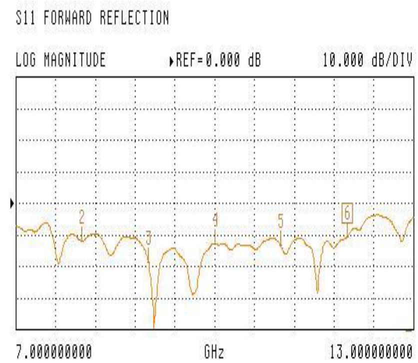

Figure 4. Measured return loss of the 2×2 quasi-Yagi array fed by novel orthogonal T junction.

4. CONCLUSION

A novel orthogonal T junction is presented, and the example in the X band 2×2 quasi-Yagi array is constructed and fabricated. The measured results show that the T junction can be used in a wideband (54 %) feeding system of the microstrip array. The novel T junction presents a new compact and cheap way in array feeding networks and can be used in other types of microstrip arrays and other frequency bands.

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