WIDEBAND ANTIPHASE POWER COMBINER/DIVIDER

Piltyay S.I.
Research supervisor: Dr. Sci., professor Dubrovka F.F.
National technical university of Ukraine «KPI», Ukraine
E-mail: crosspolar@ukr.net

Abstract — Results of development of a wideband antiphase power combiner/divider, which provides reflection coefficient less than −23 dB in the frequency band (3.4 … 5.4) GHz, are presented.

1. Introduction

In some microwave devices, namely, in orthomode transducers and antennas with difference patterns, there is the requirement of antiphase combining/dividing of electromagnetic waves power in wide operation frequency band (30% and more). The Y-shape junctions (also known as T-shape junctions) of rectangular waveguides are mostly used for these purposes [1].

The disadvantage of the Y-shape junctions at utilization in the orthomode transducers is its considerable transverse sizes compared with the common waveguide sizes. The rigidity of power combiners/dividers based on solid metal waveguides doesn't allow bending them in arbitrary directions. This is the essential disadvantage at their utilization in coaxial orthomode transducer [2], because the access to the inner circular waveguide is significantly limited.

The mentioned disadvantages are avoided in the antiphase power combiner/divider presented in [3]. It consists of two coaxial transmission lines RG-402/U and a rectangular waveguide short-circuited from one side. The probe-to-waveguide transition was roughly optimized in simulation. The operation frequency band of the antiphase power combiner/divider developed in [3] is (18 … 26) GHz. The measured reflection coefficient of the transition is less than −14 dB.

In this paper, a wideband antiphase power combiner/divider, which provides low reflection in the operation frequency band (3.4 … 5.4) GHz, has been developed. On the whole, the design developed is similar to the one presented in [3]. The main modification is the introduction of the pair of metal cylinders at the ends of coaxial probes to obtain good matching performance (fig. 1).

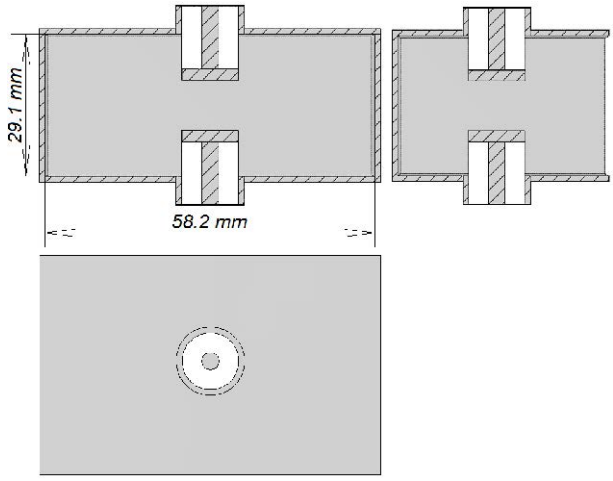

Fig. 1

2. The main part

The frequency dependence of minimized reflection coefficient is shown in fig. 2. As one can see, the reflection coefficient doesn't exceed −23 dB in the whole operation frequency band (3.4 … 5.4) GHz.

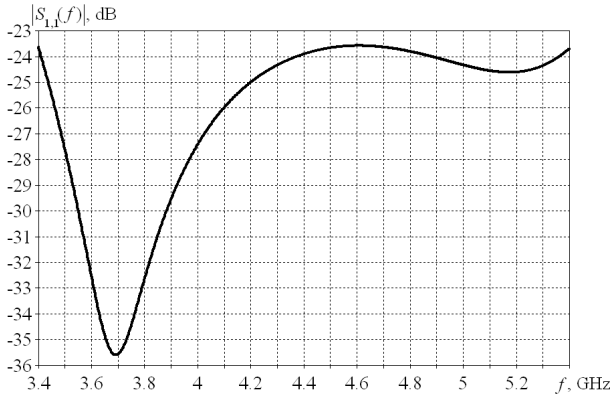

Fig. 2

The calculations of reflection coefficient have been performed in the operation frequency band (3.4 … 5.4) GHz at the alteration of construction sizes using CST Microwave Studio software. At numerical simulation, the sizes were varied by ±0.05 mm and ±0.10 mm.

The results of numerical simulations have shown, that for providing reflection coefficient less than −22 dB the tolerances are equal ±0.05 mm, and for providing reflection coefficient less than −21 dB – ±0.10 mm.

4. Conclusions

A wideband antiphase power combiner/divider, which provides low reflection in the operation frequency band (3.4 … 5.4) GHz, has been developed. On the whole the design developed is similar to the one presented in [3]. The main modification is the introduction of the pair of metal cylinders at the ends of coaxial probes to obtain good matching performance.

The reflection coefficient of optimized configuration has been decreased by 9 dB compared with the one presented in [3] and it is less than −23 dB.

The analysis of matching sensitivity to manufacturing inaccuracies has been performed. It has been defined that for providing reflection coefficient less than −22 dB the tolerances are equal ±0.05 mm, and for providing reflection coefficient less than −21 dB – ±0.10 mm.

The wideband antiphase power combiner/divider developed can be used in orthomode transducers and antennas with difference patterns.

5. References

[1] Navarrini A. A turnstile junction waveguide orthomode transducer / A. Navarrini, R.L. Plambeck // IEEE Trans. Microwave Theory Tech. — 2006. — Vol. 54, № 1. — P. 272 — 277.

[2] Granet C. The designing, manufacturing, and testing of a dual-band feed system for the Parkes radio telescope / C. Granet, H.Z. Zhang, A.R. Forsyth [et al.]// IEEE Antennas Propagat. Mag. — 2005. — Vol. 47, № 3. — P. 13 — 19.

[3] Engargiola G. K-band orthomode transducer with waveguide ports and balanced coaxial probes / G. Engargiola, A. Navarrini // IEEE Trans. Microwave Theory Tech. — 2005. — Vol. 53, № 5. — P. 1792 — 1801.