A Wideband 1:2 T-Junction Power Divider for Antenna Array with Optimum Results

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***Abstract*— In this paper, a symmetrical T-junction power divider has been proposed for 2.45 GHz application. This is used to split the total incident power equally by using quarter wave transformer, stepped impedance transformer and mitered corners. It is a generalized wideband power divider with optimum reflection and transmission characteristics and VSWR of 1.006, simulated using a commercial electromagnetic 3-D simulator CST Microwave Studio.**

***Keywords*— T-junction power divider, Quarter Wave Transformer, Mitered bends.**

I. INTRODUCTION

Microwave circuits employs passive devices like power dividers which couples predefined amount of electromagnetic power in a transmission line to port enabling the signal to be used in another circuit such as antenna arrays, power amplifiers [1], etc. Power divider is frequently used as a feeding network for planar antenna arrays to control the power distribution of each element and provide required transmission and reflection characteristics [2]. Micro strip power dividers are used because of its low cost of fabrication, light weight, low volume and are simple to design with fine performance. Amongst several topologies we have used T-junction as a 3-dB power divider that provides equal amplitude and equal phase splitting [3]. Mismatch occurs in T-junction port impedances so to compensate it resistors can be added to match port impedances or impedance transformers, e.g. quarter wavelength transmission lines, can be added to transform the mismatched port impedance to the desired port impedance [4]. T-junction networks employ right-angled bends that causes reflections due to generation of capacitance. Hence by chamfering the edges by 50% it can be avoided [5].

II. POWER DIVIDER DESIGN

A 1: 2 power divider has been designed for the operating frequency (f_o) of 2.45 GHz by using a 1.6 mm thick FR-4 substrate of size 60 mm × 40 mm and dielectric constant (ε_r) 4.4 as shown in Fig. 1. Stepped impedance on the splitted arms and quarter wave transformers of length are used for impedance matching.

Optimized parameters of power divider are (all dimensions in millimeter) W1 = 3.2, W2 = 4.4, W3 = 1.8, W4 = 2.6, W5 = 3.4, W6 = 3.2, L1 = 13, L2 = 14, L3 = 22, L4 = 2.5, L5 = 4.5, L6 = 24.6, L7 = 5.6468, t = 0.035, z = 38 where is the width and is the length of the sections of transmission lines with thickness t and z is the spacing between two output ports.

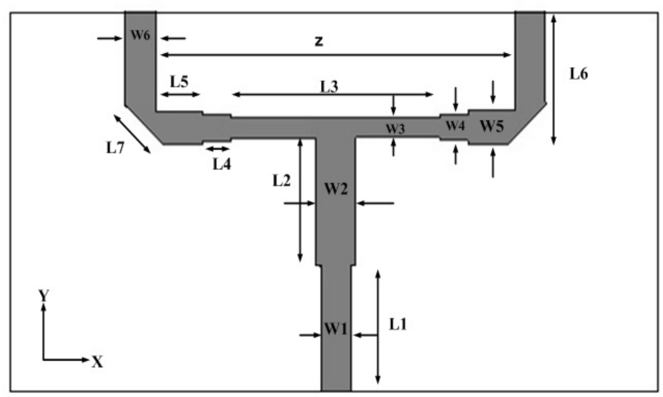

Fig. 1. Proposed Power divider

III. ANALYSIS AND METHODOLOGY

A power divider has a 50 ohm (Z_0) feed line that has to be splitted into two arms of 100 ohm (Z_1) ideally, as per 3-dB power divider $Z_1=2Z_0$ that would be connected again to a load of 50 ohm (Z_L) at each end. Though we know that these two arms are parallel to each other so impedance at the junction will be 50 ohms ($Z_{junc.}$), 100 ||100 = 50 ohm that would be matched to the feed line, i.e. $Z_{junc} = Z_0$ but practically due to mismatch, reflections occur so to circumvent it, we have used a quarter wave transformer of length ($\lambda g/4$) with impedance Z_2.

$$\text{Where} \quad Z_2 = \sqrt{Z_0 \times Z_{junc}}$$

Due to transmission line discontinuities of 90° bend in a T-junction some parasitic reactance are introduced, so we have used mitered bends that compensates the excess capacitance and reduce reflections, to regain the original characteristic impedance of line.

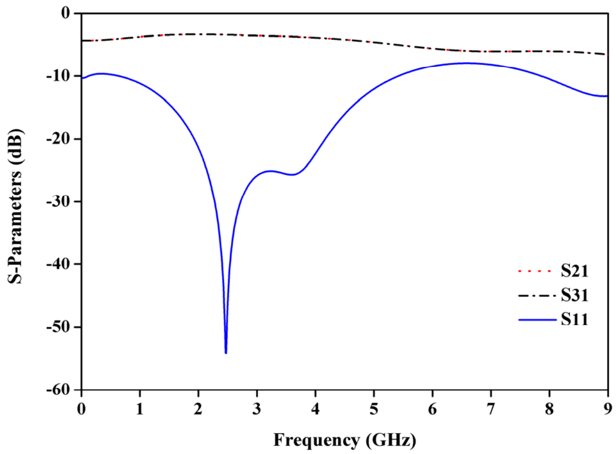

Fig. 2. Simulated Return Loss of the proposed power divider

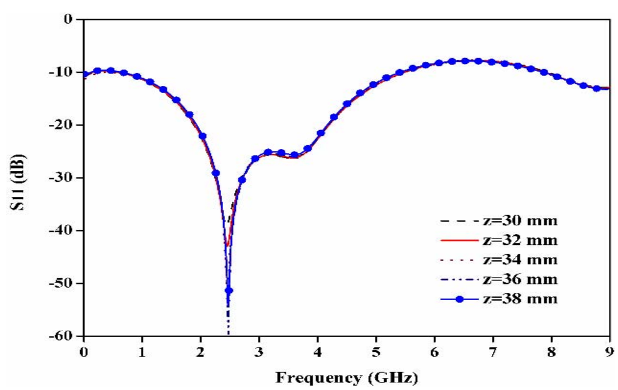

Fig. 3. Parametric analysis for different spacing between output ports

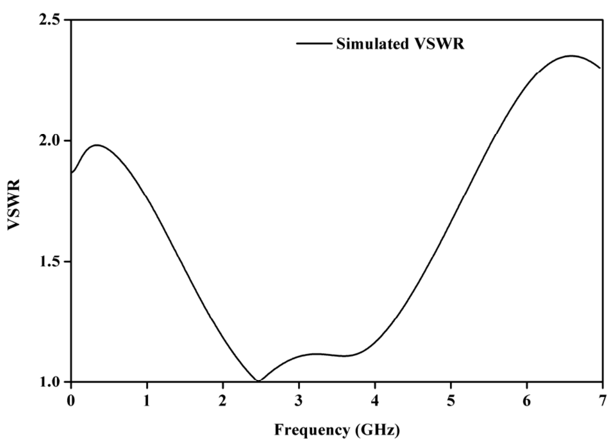

Fig.4. VSWR plot of presented power divider

IV. Simulation Results And Discussion

The proposed design for the power divider has been simulated using a commercial electromagnetic 3-D simulator CST Microwave Studio. The simulation results of the 1:2 T-junction power divider for 2.45 GHz frequency is shown in Fig. 2. The from the figure it reveals that the return loss (S_{11}) of designed power divider is –52 dB that shows that the input terminal is matched and the insertion loss (S_{21}) is -3.35 dB and so the S_{31}that shows equal split of power in both the ports. The VSWR obtained is 1.006 as shown in Fig. 4. Hence the simulated results satisfied all the stipulated constraints of power divider [6].

V. Conclusion

A 1:2 T-junction power divider for antenna arrays working at frequency of 2.45 GHz is presented in this paper with wideband characteristics working in frequency range of 0.8GHz to 5.3GHz. This proposed circuit provides better reflection and transmission characteristics as well as the constant by changing the spacing between its output ports as shown in fig (3). Hence the frequency response of the proposed design validates the stipulated concepts. This power divider will be further used for feeding of planar antenna arrays.

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