

## Design of A Y-Junction Power Divider Using Substrate Integrated Waveguide

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**Abstract:** The substrate integrated waveguide (SIW) is mainly used in millimeter-wave and microwave integrated circuits. A Y-junction three-way power divider is proposed. Simulated and measured results show that the return loss of the input port is below -32dB at 13.57 GHz and -13.47dB at 12.26 GHz. The new power divider can be widely used in millimeter-wave and microwave circuits owing to its simple and small size structure.

**Keywords:** substrate integrated waveguide (SIW), Power divider, Return loss, etc.

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### I. Introduction

The substrate integrated waveguide (SIW) is a planar form of the traditional rectangular waveguide, compatible with printed circuit board (PCB) fabrication procedure. It is one of the most popular planar wave guiding structures because of its lower loss compared to other well-known planar guides such as microstrip line and CPW. The SIW technology, which is a compromise between both planar and waveguide technologies, features interesting characteristics in terms of ease of integration to other circuit components, while offering components with a high quality factor. Alternative solutions for efficient millimeter-wave antenna manufacturing processes have been studied, such as a “laminated waveguide” or a “substrate integrated waveguide” (SIW) with low conduction and radiation losses. SIW transmission lines are especially compatible with complex feeding networks compared to conventional microstrip transmission lines for millimeter-wave antenna systems due to their low radiation leakage. It is implemented by periodically arranging conductive via arrays in two parallel rows on a PCB substrate. The objective of this paper is to review the nature of these substrate integrated waveguide (SIW). Collection of most of the basic information for each substrate integrated waveguide has been attempted.

### II. Basic Of Power Divider

Power divider is a device to split the input power into a number of smaller amounts of power at multiple ports to feed N number of branching circuits with isolation between the output ports. Power divider provides equal amplitude and equal phase splitting. The main differences between resistive power divider and Wilkinson power divider are that Wilkinson power divider have 3 dB lower losses and possess the advantage of isolation between output ports. Fig 1 is representing the block diagram of Y-junction power divider.

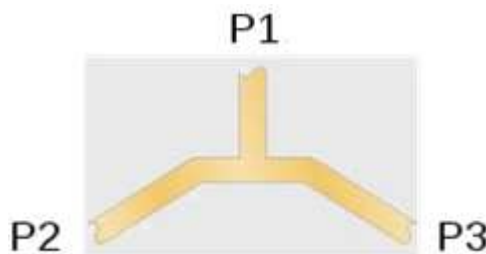


Fig1. Y-junction power divider

### III. Design Model

The microstrip line on an Fr<sub>4</sub> substrate with a relative permittivity of 4.4 and a height of 1.6 mm. The required frequencies are 5 - 15GHz and considering the dimensions of the power divider, the length of the power divider is generally chosen as the one fourth of the design wavelength. Fig2 is represents the Y-junction Power Divider.

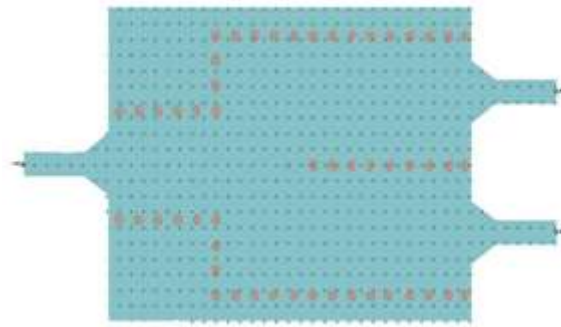


Fig.2 Y-junction Power Divider

**IV. Results And Discussions**

S-parameters describe the input-output relationship between ports (or terminals) in an electrical system. For instance, if we have 2 ports (intelligently called Port 1 and Port 2), then S12 represents the power transferred from Port 2 to Port 1. S21 represents the power transferred from Port 1 to Port 2. S11 then would be the reflected power ratio 1 is trying to deliver to antenna 1. S22 would be the reflected power ratio 2 is attempting to deliver to antenna 2.

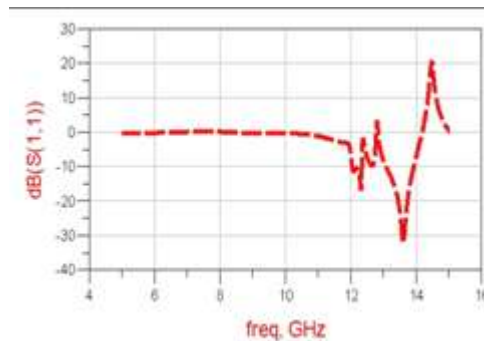


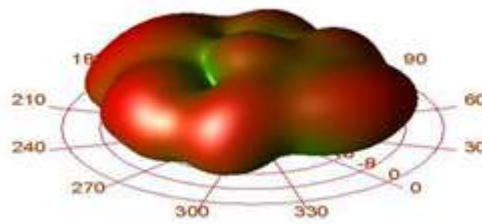
Fig.3 Simulated results of Power Divider

Fig 3 is representing the return loss and isolation loss of simulated results. A convenient way to characterize the input and output of signal sources is known as return loss. From this figure 3 at 5 GHz – 15GHz return loss is observed to -30.17 dB. S11 is observed as -3 dB. The frequency and return loss of Y-junction power divider is representing the following bands in table 1.

**Table 1.** Y-junction Power Divider

BAND	FREQUENCY (GHz)	RETURN LOSS (dB)
X - band	12.26	-13.472
Ku- band	13.57	-32.070

Radiation pattern is a graphical depiction of the relative field strength transmitted from or received by the antenna. It defines the variation of the power radiated by an antenna as a function of the direction away from the antenna. The patterns are usually presented in polar or rectilinear form with dB strength. Fig4 shows radiation pattern at X and Ku band.



**Fig.4 Simulated results of Radiation Pattern**

## **V. Conclusion**

In this paper, design of Y-junction power divider by using Substrate Integrated Waveguide technique for X-band and Ku band is designed. Simulated design illustrates improved divider performance and it uses Fr-4 substrate material because it is the lowest electrical loss of any reinforced PTFE material, low moisture absorption, are isotropic. Achieving a large bandwidth with excellent isolation loss. The Substrate Integrated Waveguide Y-junction power divider are reducing overall size. It is mostly suitable for various applications are, Monitoring

Making use of isolation

Radar

Terrestrial broadband

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