

Designing and Performance Evaluation of Wilkinson Power Divider

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Abstract

The requirement to achieve a desired gain using antenna can be met by using antenna arrays. For feeding the elements in antenna array we need a power divider circuit that can feed the antenna elements without mutual coupling between antenna elements. Wilkinson power divider can be used to feed antenna elements in antenna array in order to reduce mutual coupling between the elements. This research presents the design and analysis of Wilkinson power divider to operate on 2.4 GHz. Wilkinson power divider is designed and simulated by using High Frequency structure simulator.

Index Terms— Wilkinson Power Divider, Isolation, High Frequency Structure Simulator.

1. Introduction

The purpose of Wilkinson power divider is to split input power equally between output ports with minimum mutual coupling between the output ports. In order to achieve isolation between output ports all ports of Wilkinson power divider are perfectly matched with their characteristic's impedance. The structure of Wilkinson power divider is as shown in Fig (1). Wilkinson power divider is designed using microstrip lines [1-5].

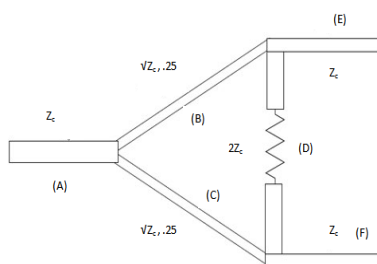


Figure 1 Wilkinson power divider

Here section A, section E and section F of power divider is microstrip line having characteristics impedance of 50Ω , Section B & section C of microstrip line is having characteristics impedance of 70.7Ω with $.25\lambda$ length. Section D is having resistance of 100Ω .

We can use design equations provided in [6-8] to decide the length and width of microstrip lines required to construct Wilkinson power divider. For 2.4 GHz frequency and by using substrate having dielectric constant 2.2 and height of substrate as .508 mm the calculated length and width of various sections of Wilkinson power divider is provided in Table 1.

Table 1. Dimensions of Microstrip line

Section –A, D, E	
Length	22.84 mm
Width	1.56 mm
Section –B, C	
Length	.91 mm
Width	23.18 mm

2. Results and Discussion

The structure of Wilkinson power divider designed using HFSS is as shown in Fig (2).

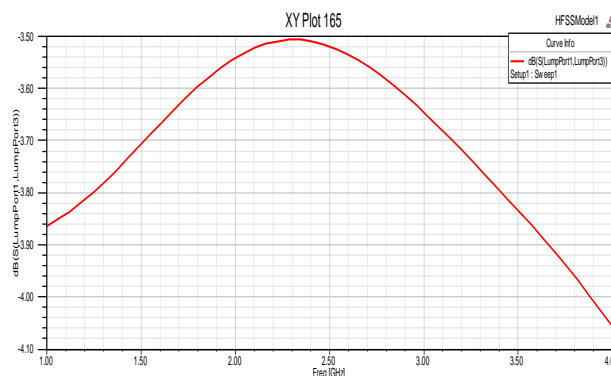


Fig 2 Wilkinson power divider using HFSS

Transmission Parameters S_{12} and S_{13} of designed Wilkinson power divider are shown in Fig (3, 4). Transmission parameters represent the attenuation of signal when signal propagates from Port 1 to port 2 or from port 1 to port 3.

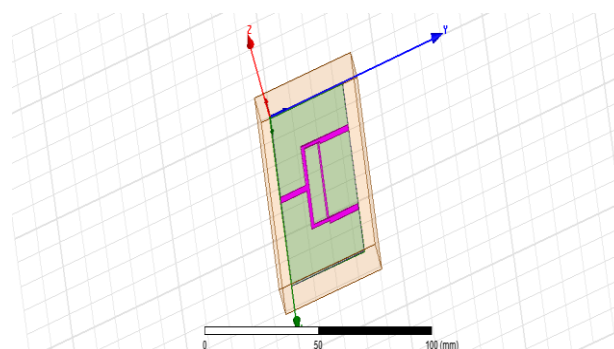


Figure 3 Transmission parameter S_{12}

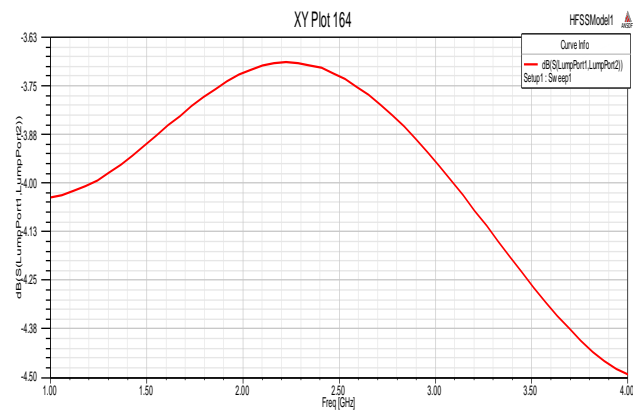


Figure 4 Transmission parameter S_{13}

From the Transmission parameters it can be concluded that power is equally divided between output ports and is half of the input power.

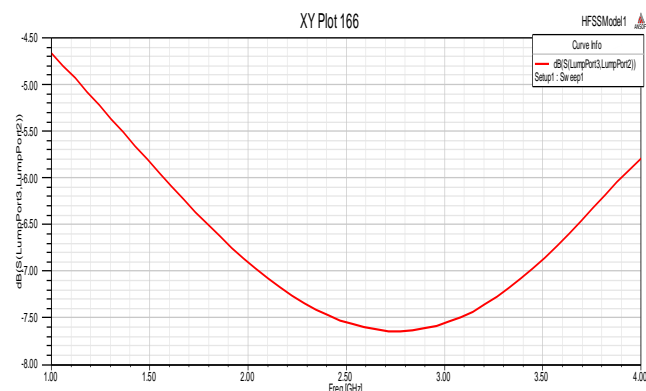


Figure 5 Transmission parameter S_{23}

From the Transmission parameters S_{23} it can be concluded that there is high attenuation of signal when signal propagates from Port 2 to Port3. Transmission parameters S_{23} indicates high isolation between output ports.

The Transmission parameters S_{11} , S_{22} , S_{33} of designed Wilkinson son power divider are plotted in Fig (6). These parameters represent impedance matching of respective ports. Transmission parameters clearly indicates that there is perfect matching of ports with negligible small reflected power.

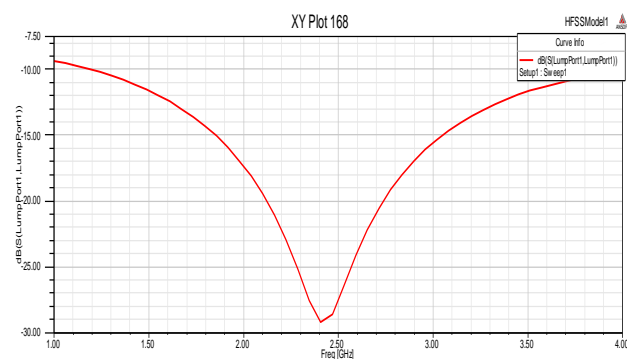


Figure 6 Transmission parameter S_{11}

Conclusion

A Wilkinson Power Divider for 2.4 GHz is designed and analyzed in this research. High frequency structure simulator is used to simulate the design. Transmission scattering parameters clearly illustrates that input power is equally divided among output ports and is half of input power. Further reflective scattering parameters represents that there are minimum reflections on each port. I.e. each port is perfectly matched. Further as is evident from scattering parameters output ports are perfectly isolated from each other.

References

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