

A Novel Design of a Low Cost Wideband Wilkinson Power Divider

A. Sardi, J. Zbitou, A. Errkik, L. El Abdellaoui, A. Tajmouati, M. Latrach.

Abstract—This paper presents analysis and design of a wideband Wilkinson power divider for wireless applications. The design is accomplished by transforming the lengths and impedances of the quarter wavelength sections of the conventional Wilkinson power divider into U-shaped sections. The designed power divider is simulated by using ADS Agilent technologies and CST microwave studio software. It is shown that the proposed power divider has simple topology and good performances in terms of insertion loss, port matching and isolation at all operating frequencies (1.8 GHz, 2.45 GHz and 3.55 GHz).

Keywords—ADS Agilent technologies, CST microwave Studio, Microstrip, Wideband, Wilkinson power divider.

I. INTRODUCTION

POWER dividers and combiners are the key components in microwave and millimeter-wave system [1]-[22]. A conventional Wilkinson power divider is implemented with quarter-wave transmission line and has narrow bandwidth around a single frequency [6]-[12], [17]-[19]. In recent years, many dual-band power dividers have been reported due to the development of multiband technologies. However, they don't involve the issue of unequal power dividing ratio, which has been proposed for single band operation [13]-[15].

In this paper, we propose a new design for Wilkinson power dividers that can be used to miniaturize a size and to get wideband. This Wilkinson power divider is design by converting each quarter wavelength section of the conventional power divider to its equivalent π -shaped transmission line section. The details of the procedures are described in the following sections.

The purpose of the Wilkinson Power Divider is to split the power of the input equally between two output ports, ideally without loss. It can also be used in the reverse direction – as a power combiner. Other properties of the Wilkinson power divider is that all ports are matched, the two output terminals are isolated from one another, and that it is reciprocal.

Reciprocity means that you get the same result if you send the signal from one port to another in either direction.

Three-port networks cannot be reciprocal and matched without being lossy. The solution to this, in the Wilkinson Power Divider, is to add a resistor between the two outputs. This resistor absorbs energy if there is a mismatch between the

outputs. It also helps isolating the two outputs when the circuit functions as a power combiner.

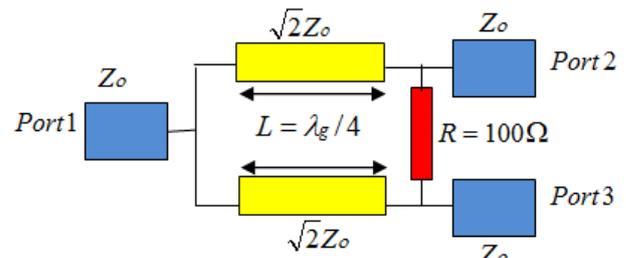


Fig. 1 The conventional Wilkinson power divider

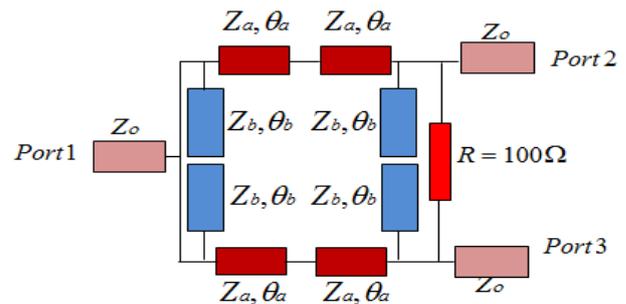


Fig. 2 The circuit of the proposed power divider

II. DESIGN OF PROPOSED WIDEBAND POWER DIVIDER

One of the biggest drawbacks of the Wilkinson Power Divider is that it has a quite narrow bandwidth. This can be improved by adding stubs sections in a quarter-wavelength sections of the conventional Wilkinson power divider. Simple design equations for basic design geometry are discussed:

A. Quarter-Wavelength of Line Transmission Stage

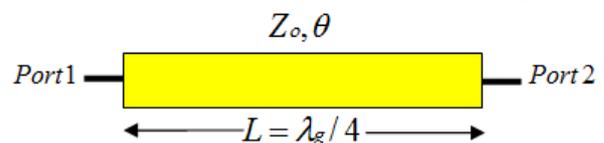


Fig. 3 The quarter wave-length transmission line

The ABCD matrix for the original transmission line, which is $(\lambda_g/4)$ in length shown in Fig. 2 will be [6]:

$$M = \begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} 0 & jZ_0 \\ jY_0 & 0 \end{bmatrix} \quad (1)$$

A.Sardi and A.Errkik are with the LITEN Laboratory, FST of Settat, Hassan 1st University of Settat-Morocco (e-mail: azzeddine;sardi@gmail.com, ahmed.errkik@uhp.ac.ma..

J.Zbitou is with the FPK LITEN Laboratory, Hassan 1st University of Settat- Morocco (e-mail: jazbitou@gmail.com).

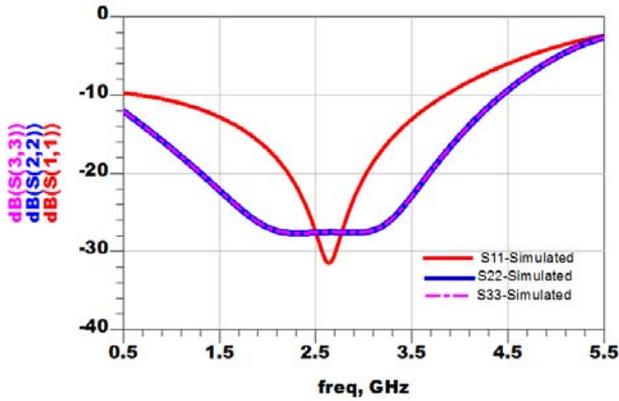


Fig. 7 Simulated return loss

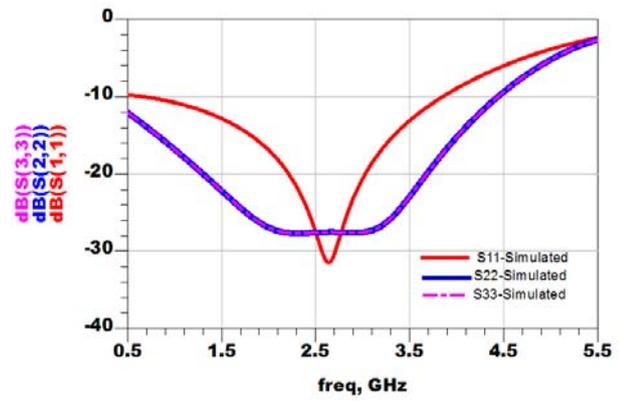


Fig. 8 Simulated transmission and isolation

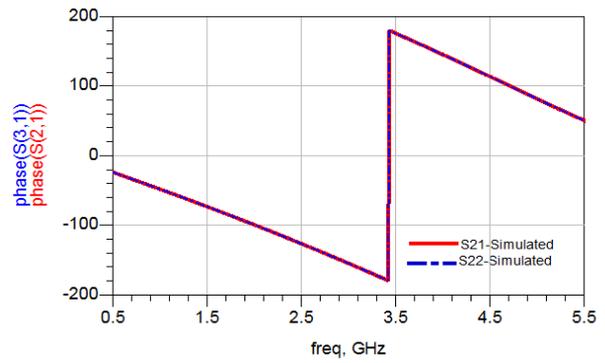


Fig. 9 Phase versus frequency

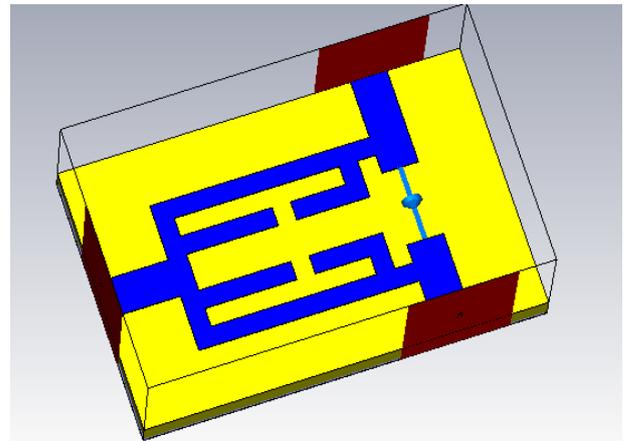


Fig. 10 The 3D coupler structure in CST-MW

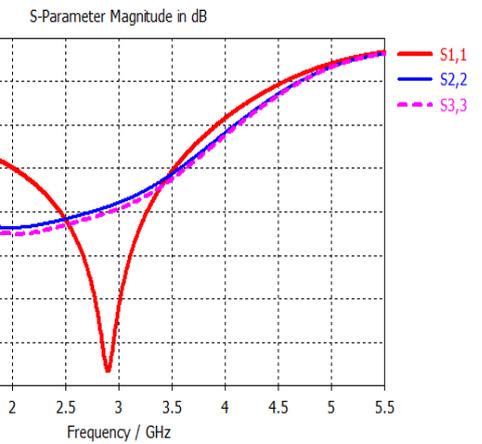
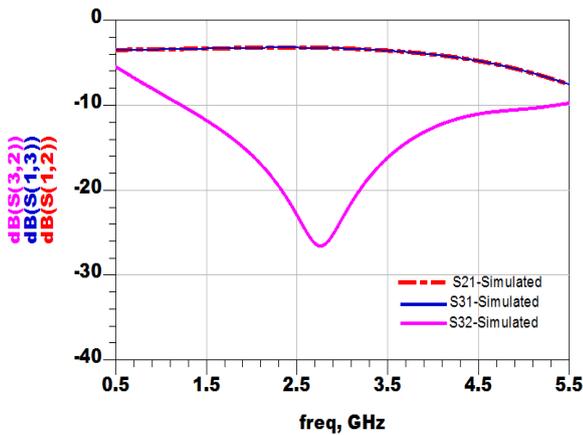


Fig. 11 Simulated return loss

According to the Fig. 11, it is observed that we have a good matching of the input impedance over the frequency range from 1 to 3.8 GHz.

As shown in Fig. 12, the isolation between the two output ports was found to be good with the resistor connected between the two arms.

As shown in Fig. 13, ports 2 and 3 exhibit phase balance in the entire frequency band.

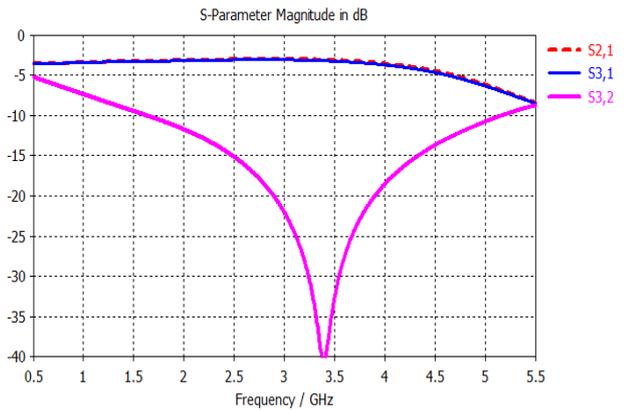


Fig. 12 Simulated return loss

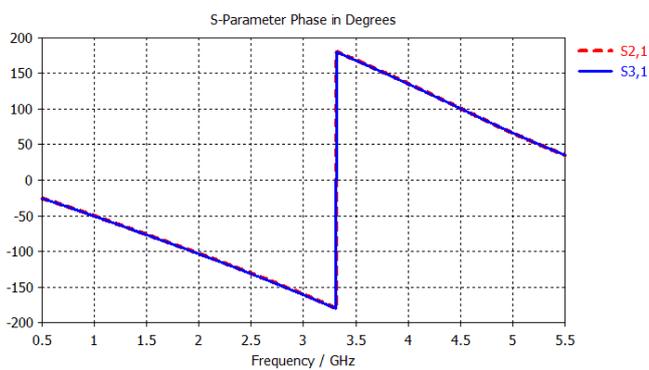


Fig. 13 Simulated return loss

After have shown the simulated the proposed design in two different softwares, we can deduce that there is found a good agreement between the simulated ADS Schematic and CST.

IV. CONCLUSION

This paper presents a novel design wideband equal Wilkinson power divider which can operate without reactive components. The proposed power divider can be fabricated easily and the parasitic effect can be greatly reduced. The formulas used to determine the design parameters have been validated into simulation. The wide band achieved permits the use of this power divider for telecommunication applications.

ACKNOWLEDGMENT

Thanks to Mr. Mohamed LATRACH Professor in ESEO, Engineering Institute in Angers, France, for allowing us to use all the equipments and software available in his laboratory.

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