Southeast Europe Journal of Soft Computing
Available online: http://scjournal.ius.edu.ba

ISSN 2233 – 1859

Vol 11, No. 1, March 2022, pp. 33-36

High Frequency Dualband Microstrip Bandstop Filter

[1*]Harun Fazlagić, [1*]Aladin Mujagić, [1]Şehabeddin Taha İmeci, [2]Ahmet Fehim Uslu

[1]Faculty of Engineering and Natural Sciences, International University of Sarajevo,
Hrasnička Cesta 15, Ilidža 71210 Sarajevo, Bosnia and Herzegovina
[2]Faculty of Electrical and Electronics Engineering, Department of Electronics and Communication Engineering, Yıldız Technical University Davutpaşa Mah. Davutpaşa Cad. 34220 Esenler İstanbul, TÜRKİYE

**Corresponding Author*: hafzlagic@student.ius.edu.ba, amujagic@student.ius.edu.ba

Article Info

Article history: none

Article received on: 14 January 2022

Received in revised form 08 March 2022

Keywords:

Power divider; Bandstop filter; microstrip; simulation software; Sonnet

ABSTRACT: In this paper the task is to make a bandstop filter, we used Sonnet as is most supported in simulating bandpass filter projects. The project was designed to have two ports that are located at the left and the right side of the project. The geometry of the project consists of small thin metal lines that are almost symmetrical in position, with the main part of the design that consists of two horizontal parts connected by two vertical parts creating a 'L' shaped design. It operates at 8.5 to 11.7 GHz with a minimum S12 at -37,34 dB and on S11 at almost 0 dB. Overall features of the design are presented in the tables. Complete design and simulation were performed in Sonnet software. This design has benefits over the other designs since it is smaller in size but is performing as other bandpass filters on market.

1. INTRODUCTION

Engineers often encounter problems when designing bandstop filters especially due to complex nature of the design and the overall size of it. There is ever growing demand for wideband bandpass filters, especially those used for UWB [1]. By implementing already existing ideas and designs and using parallel coupled microstrip concepts [2]. Main problem in designing bandstop filters is coupling this happened then UWB>80% Conventional techniques for building these designs has been deemed impossible by already existing technology that is why FWB is more favorable than UWB [3]. Ring filters can also be utilized for this purpose of achieving attenuation poles [4]. New techniques were utilized for designing bandstop filters based on basic circuit theory and circuit model [5, 6]. To successfully design a bandstop filter other techniques where used these wideband microstrip filters are based on different circuits models making it easier to achieve optimized stub filter where all elements are nonredundant [7]. Due to their IN-PHASE responses, they are not suited for balanced circuits such as balanced mixers, multipliers, and push-pull amplifiers.

Using the FR4 substrate of dielectric constant εr = 4.4 and thickness of 1.55 mm allowed us to obtain the desired design of our wideband microstrip filter and further on, the simulation results. The thickness of air is 15.0 mm. All of our work was done in a box, dimensions of which are 6.6 mm and 8.0 mm by x and y axis respectively. The cell size is adjusted to 0.1 $mm * 0.1\ mm$ due to such compact size.

2. FIGURES

The following figure shows the layout of the top view of the filter containing all the determined dimensions. Along with the design, analysis was done as well in Sonnet Suites which came in as a very handy and practical tool, thanks to its simplicity and variations of options.

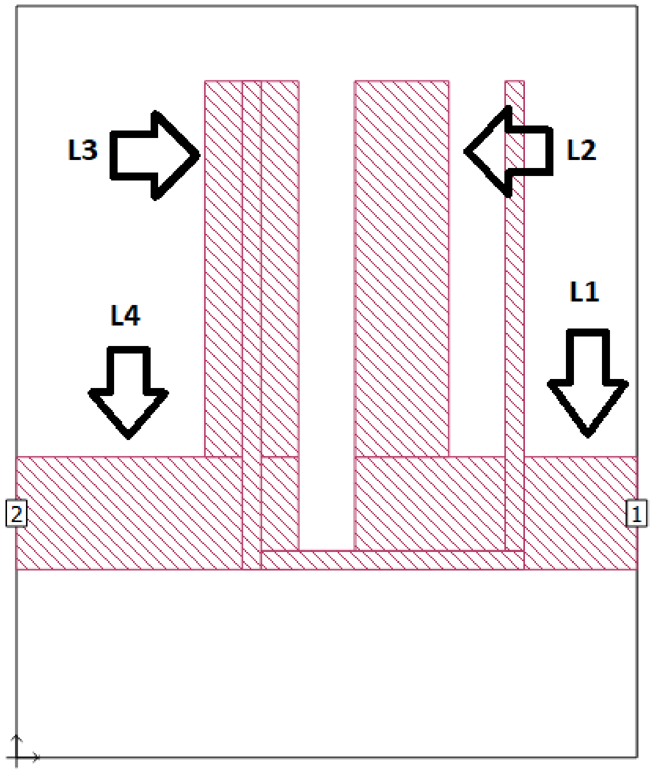

Figure 1. Top view of the filter

Figure 1 is representing the top view of metal plates with ports 1 and 2 on each side.

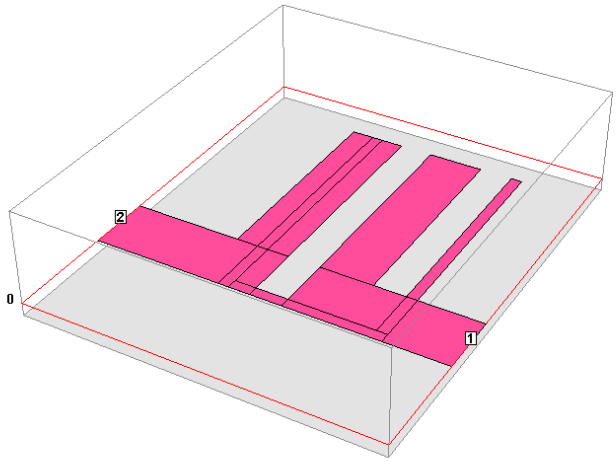

Figure 2. 3D view

It can be observed from the Figure 2 which shows how our graph appears, that this power divider passes frequencies between 6 and 11 GHz [8]. The minimum of S12 is the value of -35 dB at 5.25 GHz and the value of S11 is near 0 dB 5.25 and 7 GHz [9]. Creating alterations in the process of making allowed the obtaining of high value of S11 and low value of S12.

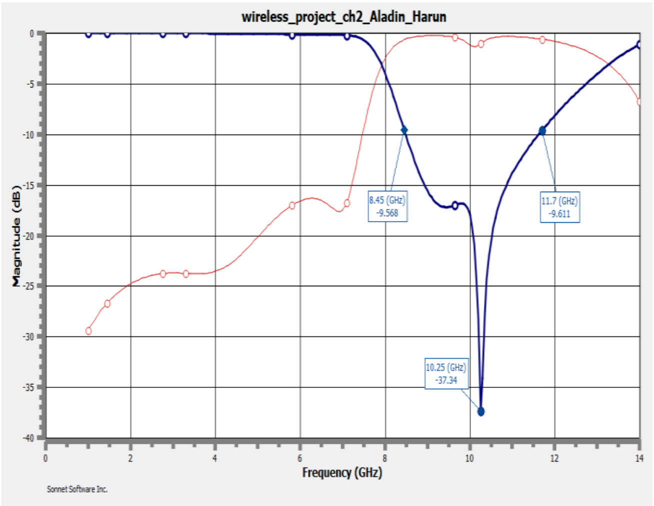

Figure 3. Filter response graph (S11 RED, S12 GREEN)

In Figure 3, it’s shown in the graph the values of the S12 and S11 reaching from 8 to 11.5 GHz, with S parameteres values from (-35) to (-1.258) dB. Figure 4 has the current distribution.

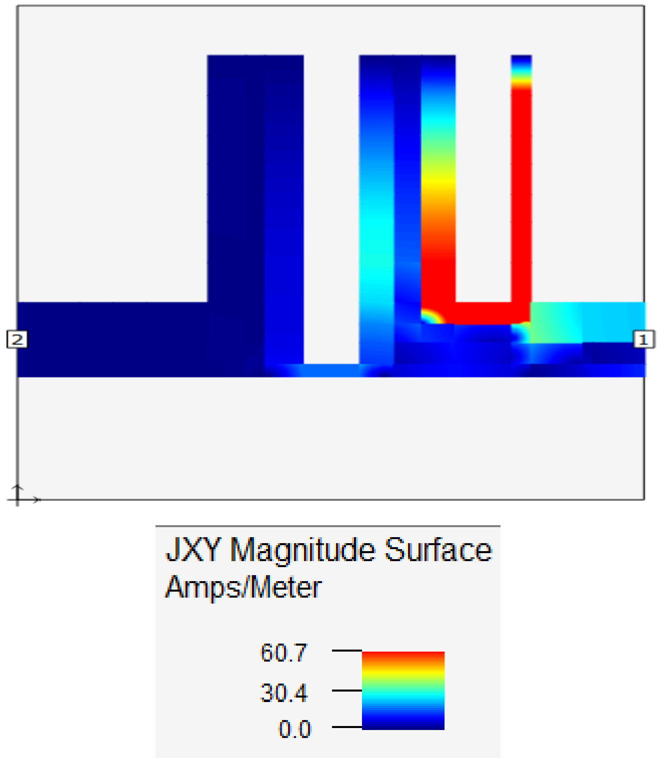

Figure 4. the current distribution

3. DESIGN DETAILS

In the first part of the paper, introduction was presented with figures 1, 2 and 3. Showing the data from top view, 3D view and Filter response graph from the Sonnet software data [10]. The design of the 'Top view' was influenced by the results that were needed to acchieved to have working band-stop filter. The data was analyezed by the Filter response graph. The simulation was repeated doesens of times to get the valid data and have response for band-stop filter, meaning that aftery every simulation, one plate was added or its shape was altered in some geometric way to get it operating from 8 to 11.5 GHz, with S parameters values reaching from (-29) to (-1.258) dB.

4. PARAMETRIC STUDY

In order to examine the output, physical parameters of the power divider were altered [11]. Altering the size of the L1 and L2 parts of our design we were able to examine the changes in frequency in the S11 and S12 curves. In the tables below you can see our recorded data for the given changes. Both of the elements had the original width of 2.0 mm and we expanded that size by small increments and looked at the changes in the curve.

1) Changing the dielectric thickness

[12] By increasing the dielectric thickness, S11 decreases at Frequency of 10GHz. Under the same conditions, S12 initially decreases and then begins to increase again. In the table below it is apparent how the S11 and S12 curve behave in the 10GHz frequency [13]. It is important to note how the changes in dielectric thickness impact the curves.

Table 1: Changing the dielectric thickness

DIELECTRIC THICKNESS	MAGNITUDE (dB)		FREQUENCY (GHz)
	S12	S11	
1,50	-21,1069	-1,21221	10
1,53	-21,103	-1,20718	10
1,55	-21,1356	-1,20408	10
1,57	-21,1649	-1,20104	10
1,60	-21,2556	-1,19506	10

2) Changing the ε_r

With a decrease in ε_r and a frequency of 10GHZ, S11 decreases, while S12 increases.

Table 2: Changing the ε_r

ε_r	MAGNITUDE (dB)		FREQUENCY (GHz)
	S12	S11	
4,5	-27,4093	-1,03465	10
4,45	-23,6301	-1,1463	10
4,40	-21,1069	-1,21221	10
4,35	-19,3376	-1,22292	10
4,30	-18,1958	-1,1846	10

3) Changing the length of L1 and L2

In the following table you can see how changing element L1 and L2 from 1,2 to 1,4 affects S11 and S12.

Table 3: Changing the length of L1 and L2

CHANGE IN L1 AND L2'S WIDTH	MAGNITUDE (dB)		FREQUENCY (GHz)
	S12	S11	
1,2	-21,1069	-1,21221	10
1,25	-21,069	-1,21221	10
1,3	-19,7804	-1,21344	10
1,35	-19,2062	-1,22779	10
1,40	-18,6561	-1,22338	10

4) Changing the length of L3

In the following table you can see how changing element L3 from 0,8 to 1,0 affects S11 and S12 [14].

Table 4: Changing the length of L2

CHANGE IN L3 WIDTH	MAGNITUDE (dB)		FREQUENCY (GHz)
	S12	S11	
0,8	-20,662	-1,2572	10
0,85	-20,535	-1,24035	10
0,9	-19,5809	-1,24323	10
0,95	-18,6602	-1,21544	10
1,0	-17,9714	-1,1597	10

5) Changing the length of L4

In the following table you can see the effects of changing the size of the L4 element on S11 and S12 curve

Table 5: Changing the length of L4

CHANGE IN L4 WIDTH	MAGNITUDE (dB)		FREQUENCY (GHz)
	S12	S11	
0,2	-20,5872	-1,2675	10
0,25	-20,5547	-1,2547	10
0,3	-19,5920	-1,24377	10
0,35	-18,7245	-1,2215	10
0,4	-17,9924	-1,1874	10

5. CONCLUSION

The band-stop filter is a filter that made big impact on electrical industry since it passes most of the frequencies unaltered, but attenuates the frequency that are present in specific range and is performing the work completely opposite of the band-pass filter. Band-stop filter is very important in music industry where it is used in instrument amplifiers, especially acoustic instruments like guitar to prevent audio feedback and as output it will give clear sound. This product is different from the other designs on the market since it's distinguished by its small size and weight, but with the performance of other designs available. Achievement of these proportions of the band-stop filter wouldn't be possible without Sonnet software. It operates at 8.5 to 11.7 GHz with S12 at -37.34 dB and on S11 with almost 0 dB. Overall features of the design are presented in the tables. Complete design and simulation was performed in Sonnet software [15]. This design has benefits over the other designs since it smaller in size, but is performing as other bandpass filters on market.

REFERENCES

[1] A. Podell. (1970). A high Directivity Microstrip Coupler Technique.

[2] Annapurna, D. (n.d.). Microwave Engineering. Tata Mc.Graw-Hill Publication.

[3] J., K. C. (November 2005). Designing Low Cost Wideband Microstirp Bandpass Filters". Melbourne.

[4] Kalialakis, C. (2013). Feasibility of Microstrip Wilkinson Power Dividers on FR4 Substrates for L-Band (1-2 GHz) Applications".

[5] Kim, J., & Park, W. S. (July, 2002). Novel configurations of planar multilayer magic-T using microstrip slotlines transistions.

[6] Lei, Z., Sun, S., & Li, R. (2011). Microwave bandpass filters for wideband communications.

[7] Maktoomi, M., Hashmi, M., & Ghannouchi, F. (2017). A Dual-Band Port-Extended Branch-Line Coupler and Mitigation of the Band-Ratio and Power Divison Limitations.

[8] Podell, A. (1970). A High Directivity Microstrip Coupler Technique.

[9] Pozar, & M., D. (1998). Microwave Engineering Second Edition. New York.

[10] Takao, M. (1992). Wideband low loss double mode SAW Filters.

[11] W., Z., N., Z., X., W. B., & Z., M. (2020). A Dual-Band Wilkinson Power Divider Using Dual Coupled Lines and Open Stubs. Shanghai.

[12] Wilkinson, E. (1960). An N-Way Hybrid Power Divider.

[13] Wu, Y., Liu, Y., & Li, S. (2009). An unequal dual-frequency Wilkinson power divider with optional isolation structure .

[14] Zhu Lei, S. S., & Menzel, W. (August 2012). Ultra-Wideband (UWB) bandpass filters using multiple-mode resonator.". Moscow, Russia.

[15] Sonnet Software Inc.; 126 N Sallina St. Syracuse N.Y. 13202;