



RESEARCH ARTICLE

Design and Simulation of Band-Pass Filter using Micro-Strip Lines

M.Taghizadeh¹, Gh.Moloudian², A.R.Rouzbeh³

^{1,3}Department of Electrical Engineering, Islamic Azad University, Kazeroun Branch, Kazeroun, Iran

²Sama Technical and Vocational Training College, Islamic Azad University, Kazeroun Branch, Kazeroun, Iran

Abstract— In this paper, we have designed and simulated a filter. We have used micro-strip lines for designs in both even and odd coupling. It is possible to understand the coupling between two micro-strip lines and input and output impedance that are part of bipolar cascade matrix. Band-pass filters are obtained through cascading these elements which are designed simply using circuit simulation packs RF (ADS). The results, guarantee designed filter performance.

keyword: filter, band-pass, microstrip, ADS software

I. INTRODUCTION

Filters are circuits through which we can select certain frequency or frequency band among other frequencies. Each filter has a frequency range including a set of frequencies that can pass through filter. The frequency range is called bandwidth or filter frequency response. Ideally, when a filter is placed in RF signal path, it must not have loss; that is, replacement loss must be zero. In fact, we must consider a certain amount of losses for filter. Replacement loss is power which falls below 0, DC. Attenuation curve of band-pass filter is as follows.

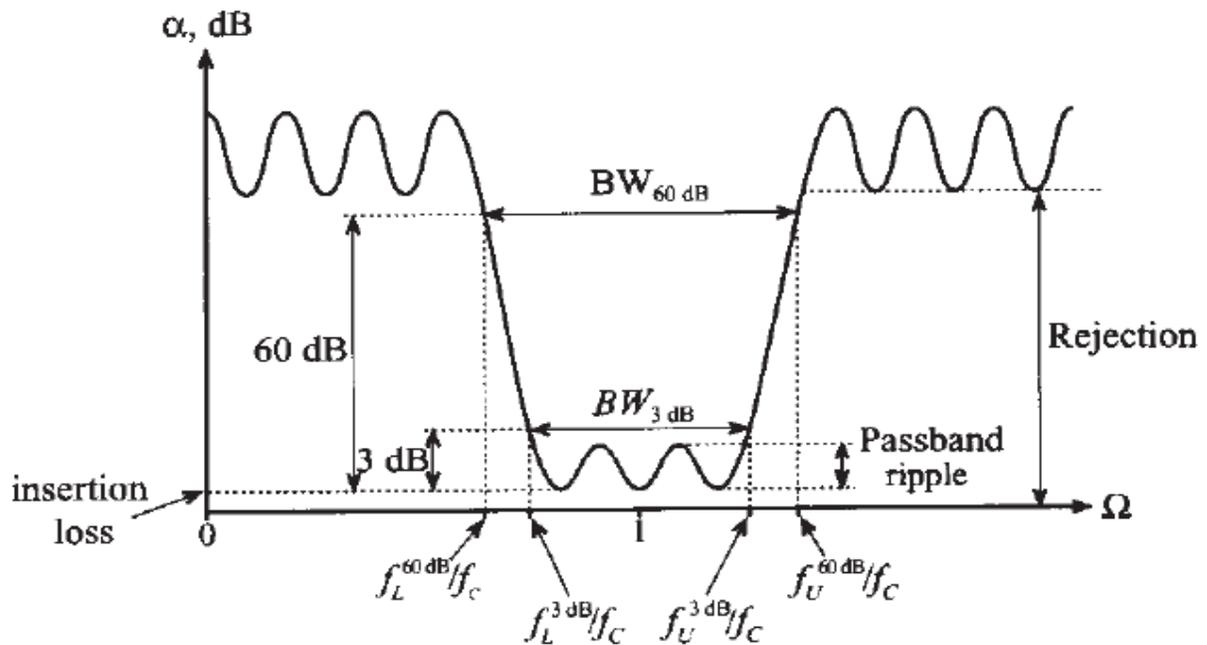


Fig.1: attenuation curve of band-pass filter

Here, we will review several papers in this field. A microwave filter has 2 ports that are used in a communication system in order to control frequency response [1]. In this paper, micro strip lines are used in order to design filter that work in coupled even and odd mode. This paper designs, simulates and manufactures filter on FR4 substrate and receives good results [1]. In [2] we design and simulate a band-pass filter with a central frequency of 5.8 GHz. The designed filter can be used for wireless telecommunications applications. In 2010, a paper entitled “designing a band-pass filter with central frequency of 3.2 GHz. was published. In this paper, micro-strip lines were used in parallel couple with odd and even impedance [3]. We can design filters based on micro-strip lines with open loop resonators. This type of resonator is completed version of bent transmission line resonator and is similar to ring which is open on one side. More researches and books have been done on filter design that can be referred to the following references [4-9].

II. FILTER DESIGN

The figure shows geometric structure of input and output terminals, open circuit conditions and related transmission path.

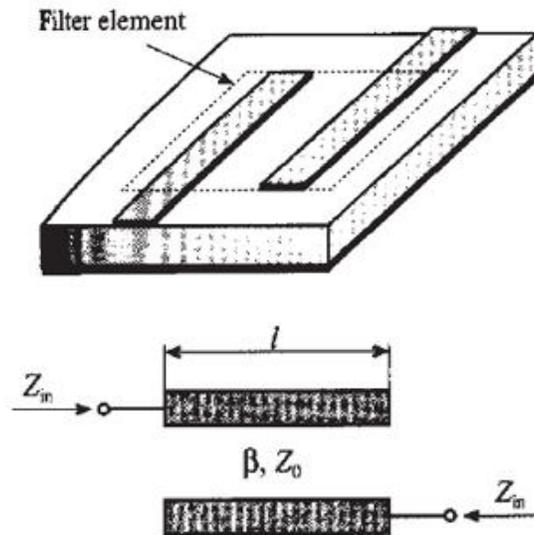


Fig.2: A schematic of a filter with micro-strip lines

When we connect block structures in cascade form, it is desirable to adapt poles of adjacent elements. In fact, we find the image impedance. We can write for input impedance at port one and load impedance at port two as:

$$Z_{in} = \frac{V_1}{I_1} = \frac{AZ_L + B}{CZ_L + D}$$

$$Z_L = \frac{-V_2}{I_2} = \frac{DZ_{in} + B}{CZ_{in} + A}$$

We must use multi-element band-pass instead of one element band-pass in cascade form in order to have effective band-pass filter. The figure below shows the state.

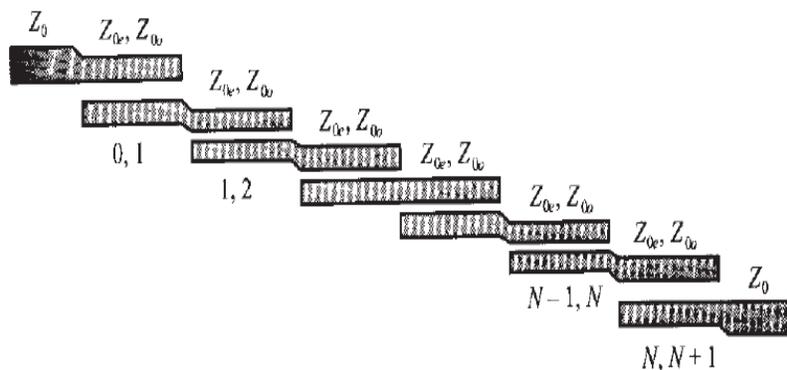


Fig. 3: Design a band-pass with micro strip lines as cascade

The following equations are used in order to design filters.

$$\Omega = \frac{\omega_c}{\omega_u - \omega_l} \left(\frac{\omega}{\omega_c} - \frac{\omega_c}{\omega} \right)$$

We must obtain filter order after calculating Ω using Chebyshev table and then we use the following equations:

Now, we calculate J_i s using the following equations (it has 3 modes)

Mode 1: We use the following equation in order to calculate $Z_0 J_{0,1}$:

$$Z_0 J_{0,1} = \sqrt{\frac{\pi BW}{2g_0 g_1}}$$

Mode 2: We use the following equation in order to calculate $Z_0 J_{i,i+1}$:

$$Z_0 J_{i,i+1} = \frac{\pi BW}{2\sqrt{g_i g_{i+1}}}$$

Mode 3: We use the following equation in order to calculate $Z_0 J_{N,N+1}$:

$$Z_0 J_{N,N+1} = \sqrt{\frac{\pi BW}{2g_N g_{N+1}}}$$

After calculations, the results were obtained as following table:

Table.1. calculate of $Z_0 J_i$ s

i	$Z_0 J_{i,i+1}$
0	0.2882
1	0.1780
2	0.1583
3	0.1780
4	0.2882

Now we must calculate even and odd impedance by the following equations:

$$Z_{0o}|_{i,i+1} = Z_0[1 - Z_0J_{i,i+1} + (Z_0J_{i,i+1})^2]$$

$$Z_{0e}|_{i,i+1} = Z_0[1 + Z_0J_{i,i+1} + (Z_0J_{i,i+1})^2]$$

The following table is completed through calculating even and odd impedance.

Table.2. calculate of even Z , odd Z

i	even- Z	odd- Z
0	68.56	39.74
1	60.485	42.685
2	59.17	43.34
3	60.465	42.685
4	68.56	39.74

We must enter odd and even impedance in ADS in order to get transmission line dimensions. The following results are obtained.

Table.2. calculate parameters of transmission lines

parameters	Transmission line 1,5	Transmission line 2,4	Transmission line 3
W (mil)	5.5341	7.0163	7.0900
S (mil)	6.0622	8.3993	9.4558
L (mil)	972.51	960.70	959.09

III.SIMULATION RESULTS:

The proposed filter is shown below.

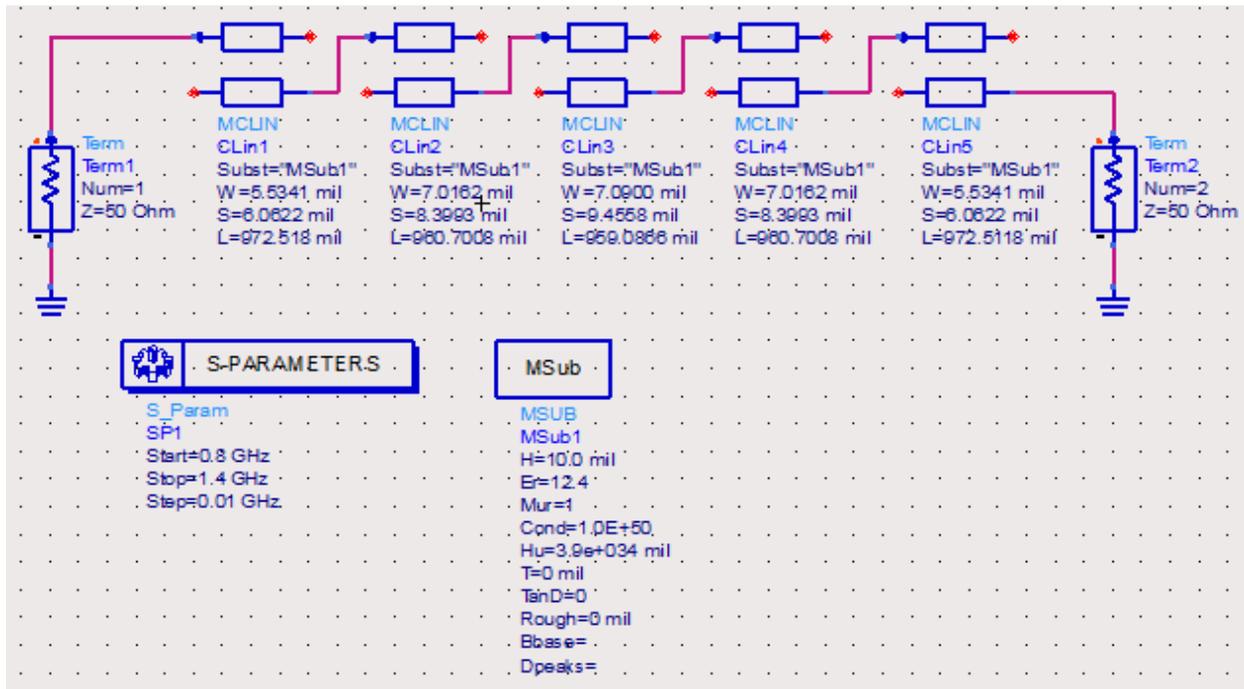


Fig.4: schematic of proposed band-pass filters

We must obtain filter scattering parameters after performing the program which determines the amount of losses and transmissions. It must be noted that 3% ripple is needed for pass band during design. The results are as follows.

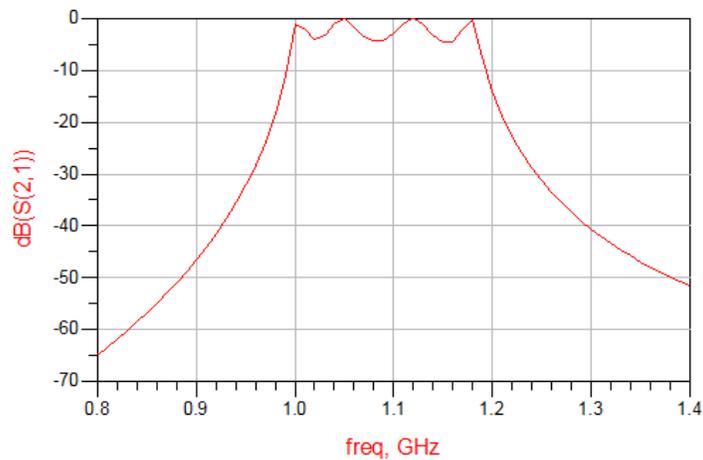


Fig. 5: Frequency response of designed filter

According to filter frequency response curve, the results are optimal. We must prepare filter substitution map using ADS software momentum.

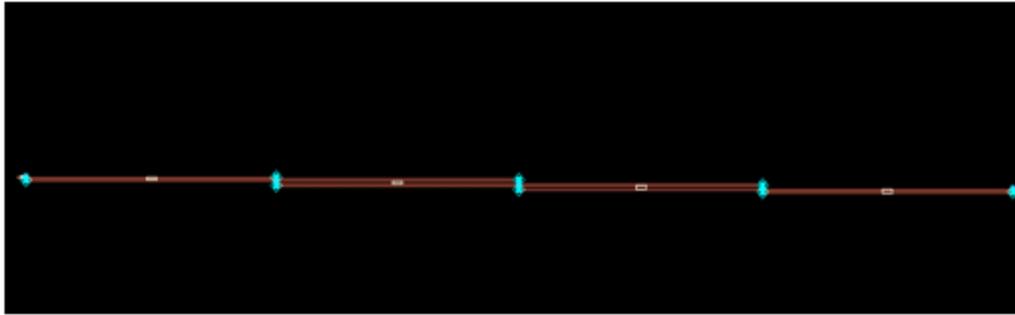


Fig. 6: Layout of proposed filter

IV. CONCLUSIONS

Designing micro strip filters with good performance is new technology and human science and has wide applications in various fields such as: Physics, chemistry, mechanics, and electricity. In this paper, we have designed and simulated a band-pass filter with central frequency of 1.1 GHz. We used micro strip lines with odd and even impedance in order to design such a filter; the results ensure the performance of filter. We draw filter substitution map in order to improve the work.

REFERENCES

- [1] Shreyasi Srivastava, R.K.Manjunath, Shanthi P., “Design, Simulation and Fabrication of a Microstrip Bandpass Filter” , International Journal of Science and Engineering Applications, Volume 3 Issue 5, 2014, ISSN-2319-7560 (Online)
- [2] M.A. Othman, M. Sinnappa, M.N. Hussain, M.Z.A. Abd. Aziz, M.M. Ismail, “Development of 5.8 GHz Microstrip Parallel Coupled Line Bandpass Filter for Wireless Communication System” , International Journal of Engineering and Technology (IJET), Vol 5 No 4 Aug-Sep 2013.
- [3] Mudrik Alaydrus, “Designing Microstrip Bandpass Filter at 3.2 GHz”, International Journal on Electrical Engineering and Informatics - Volume 2, Number 2, 2010
- [4] Man&Tel Co., Ltd., “MW-2000 Microwave Communication Trainer”, Man&Tel Co., Ltd., 2005.
- [5] David M. Pozar, “Microwave Engineering”, John Willey and Sons, Inc, Third edition, pp. 370 – 421, 2005.
- [6] S. B. Cohn, “Parallel-Coupled Transmission-Line-Resonator Filters,” Microwave Theory and Techniques, IRE Transactions on , vol. 6, no. 2, pp. 223-231, April 1958.
- [7] Jia-Sheng Hong, “Microstrip Filter For RF/Microwave Application”, John Willey and Sons, Inc, Second edition, pp. 112– 160, 2011.
- [8] C. A Balanis, “Antenna Theory: Analysis and Design”, 3rd edition, Wiley, 2005.
- [9] A. R Othman, I.M. Ibrahim, M. F. M. Selamat, M. S. A. S. Samingan, A. A. A. Aziz, H. C. Halim, “5.75 GHz microstrip bandpass filter for ISM band”, Applied Electromagnetics, APACE Asia-Pacific Conference on , pp. 1-5, 4-6 Dec. 2007.