Design And Analysis Compact Microstrip Band Pass Filter at 2GHz

Brajesh Singh Yadav, P.K.Singhal
Department of Electronics Engineering, Madhav Institute of Technology and Science, Gwalior-474005, India
yadav.brajeshsingh@gmail.com

Abstract: In this paper, a microstrip band pass filter for wireless application is presented. The filter whose centre frequency is 2 GHz is fabricated on FR4 substrate. Tapped input/output lines and stepped impedance resonator are used in this filter. For the designed filter, return loss of 37 dB with a 3 dB fractional bandwidth of 330MHz is obtained. The simulated and experimental results are in good agreement. During the design and analysis of the proposed filter, MOM based IE3D software is used.

Keywords – Method of Moments, Microstrip band pass filter, Spectrum analyzer, Stepped impedance resonator.

I. INTRODUCTION
Due to the increasing requirement of devices which are smaller in size and compatible with the wireless communication systems, microstrip technology is getting a lot of attention these days. The microwave filter plays a very important role in wireless communication system with their high performance, low cost and compact size [1]. The telecommunication technology is advancing rapidly because of market demands and government regulations, which push the invention and lead to the development of new microwave applications. Band pass filter plays an important role in transmitting or receiving the desired band of frequencies. Band pass filter is a passive filter which passes a certain band of frequencies and rejects other. Planar band pass filter of compact size is very popular to implement the radio frequency front end in microwave communication system [2]. The performance of common planar filter decreases because of the existence of spurious frequencies. The spurious frequency of Stepped impedance resonator can be controlled by its impedance ratio and length ratio [3]. Stepped impedance resonator is used in tuning the harmonic frequency. The important factor in filter design is coupling coefficients [4]. Some question are introduced in designing of band pass filter, what is the maximum loss in pass region and how the filter characteristics look in transition region[5]. In the design of this planar band pass filter high quantity of spurious frequency has been suppressed, by tuning the impedance ratio and physical length of Stepped impedance resonators (SIRs), maximum suppression of spurious frequency has been achieved at upper stop band.

II. CIRCUIT DESIGN
The configuration of proposed filter is shown in figure 1. Two half wavelength Stepped impedance resonators and tapped input/output lines are used to implement this filter. The arrangement of the tapped input/output lines can further change the circuit size [6]. This band pass filter having centre frequency of 2 GHz and wide stop band is implemented on FR4 substrate having dielectric constant of 4.4, height 1.6mm and loss tangent 0.02. The dimensions of the proposed filter design are listed in Table 1. The overall size of the fabricated filter is 25mm X 20 mm. The filter was excited by using a port of characteristic impedance of 50Ω. The spurious frequency of both Stepped impedance resonators (SIRs) are suppressed by using this design. The fabricated band pass filter is shown in Fig.2.

![Fig.1 configuration of proposed filter](image)

Table1: Dimensions of Filter Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Dimensions (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>15.2</td>
</tr>
<tr>
<td>W2</td>
<td>4.473</td>
</tr>
<tr>
<td>W3</td>
<td>10.55</td>
</tr>
<tr>
<td>W4</td>
<td>4.67</td>
</tr>
<tr>
<td>W5</td>
<td>3.1</td>
</tr>
<tr>
<td>L1</td>
<td>3.83</td>
</tr>
<tr>
<td>L2</td>
<td>13.2</td>
</tr>
<tr>
<td>L3</td>
<td>11.71</td>
</tr>
<tr>
<td>L4</td>
<td>11.13</td>
</tr>
<tr>
<td>L5</td>
<td>3.3</td>
</tr>
</tbody>
</table>
III. RESULTS

On simulating the proposed filter design, a return loss (S11) of 37dB and bandwidth (3dB fractional bandwidth) of 0.33GHz. The graph between return loss versus insertion loss and simulated and measured insertion loss of compact band pass filter is given in fig.3 and fig. 4 respectively. The comparison of past literatures of band pass filter is given in table 2.

![Fig.2 Fabricated Filter](image)

![Fig.3 Comparison between Return Loss and Insertion Loss](image)

![Fig.4 (a) simulated and measured insertion loss comparison graph](image)

![Fig.4 (b) simulated and measured return loss comparison graph](image)

Table: 2 Comparison of past literatures.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Ref.[7]</th>
<th>Ref.[8]</th>
<th>Proposed filter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centre frequency f0 (GHz)</td>
<td>1.5</td>
<td>2.4</td>
<td>2.0</td>
</tr>
<tr>
<td>Return loss(dB)</td>
<td>20</td>
<td>25</td>
<td>37</td>
</tr>
<tr>
<td>3-dB FBW (%)</td>
<td>8.1</td>
<td>12</td>
<td>33</td>
</tr>
<tr>
<td>Circuit size(mm2)</td>
<td>45×15</td>
<td>13.4×8.4</td>
<td>25×20</td>
</tr>
</tbody>
</table>

IV. CONCLUSION:

The band pass filter which suppressed the spurious frequency of Stepped impedance resonators has proposed in this filter. By changing the impedance ratio and length ratio this band pass filter suppressed the spurious frequency. This band pass filter with compact size and effective insertion loss and well rejection level has achieved after the study of this paper.

REFERENCES


