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Sharp Skirt Dual-Mode Bandpass Filter with Overlay Plate to Control Upper Passband Edge

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Abstract: *This paper presents design and analytical model for Sharp Skirt Dual-Mode Bandpass Filter for RF receivers. Proposed filter is designed using open stub loaded H shaped resonator. Based on analytical model insertion loss* S_{21} *and return loss* S_{11} *for proposed filter are demonstrated. Inductive Overlaying plate is proposed to control upper passband edge of proposed filter to improve frequency selectivity with fixed center frequency. The proposed filter has sharp frequency selective range from 5.1GHz to 9.2GHz. With overlay plate, frequency selective range is tuned to 5.1GHz-8.6GHz. Without overlaying plate the proposed filter has return loss greater than 10dB and insertion loss of 0.7dB. Lower and upper passband edges are at 5.1GHz and 9.2GHz with attenuation level of 52dB and 54dB respectively. With overlaying plate, the filter has same* S_{11} *and* S_{21} *parameters, but upper passband edge is shifted from 9.2GHz to 8.6GHz.*

Keywords: *Dual-Mode, Overlayplate, Passband edge, Printed Circuit Board Technology*

I. INTRODUCTION

The performance of RF receivers is measured in terms of its selectivity to receive desired range of frequencies and reject undesired frequencies to eliminate interferences from other channels. High performance miniaturized sharp frequency selectivity Microstrip Bandpass filters play a vital role in RF receivers. Since these filters are cost effective and easily fabricated by Printed circuit Board Technology (PCB) they have gathered more attention in satellite and mobile communications. In literature, Star shaped resonator with triangular perturbation, triangular patch with vertical and horizontal slots, symmetrical fractal structure etched on meander loop resonator have been proposed to design Dual-Mode filters [1-3]. Parallel coupled stepped impedance resonator with proper tapping at input and output resonators has been proposed [4] and tunable transmission zeros in stopband have been achieved with tapping at input and output. An "extended doublet" coupling schematic [5] has been proposed to create one pair of transmission zeros near passband to improve the selectivity of the filter. This paper demonstrates design and analytical model for proposed filter. The proposed filter comprises of Dual-mode H shaped resonator as depicted in fig 1.

Symmetrical frequency response with two transmission zeros in lower and upper passband edges are achieved with source load coupling which enhances frequency selectivity of the filter. Proposed filter configuration is depicted in fig.2.

Fig.1. Proposed H shaped Dual-mode Resonator.

The paper is organized as follows. In Section II, Based on Analytical model, Insertion loss and Return loss for proposed filter are demonstrated. In Section III, controlling upper passband edge and tuning the frequency selective range of proposed filter with Overlaying plate is discussed. Section IV concludes the work presented in this paper.

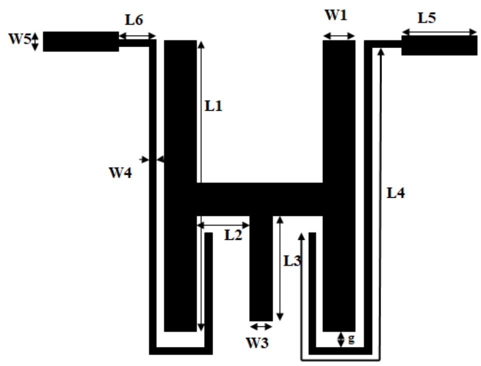

Fig.2 Proposed Filter Configuration

The proposed filter is designed for center frequency 7.45 GHz and flat passband between 7.2GHz to 7.9GHz, lower rejection band up to 100MHz with attenuation level of 20dB and upper rejection band up to 10GHz with attenuation level of 44.5dB.

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The proposed filter is designed using Dielectric material having Dielectric constant 10.2 and thickness 25mil and tangential loss of 0.0023.

II. ANALYTICAL MODEL OF PROPOSED FILTER

Circuit model for proposed filter is shown in Fig.3. H shaped resonator is modeled as uniform impedance resonator Z_1 and Z_2 is impedance of open stub and Z_o impedance of 50Ω transmission line.

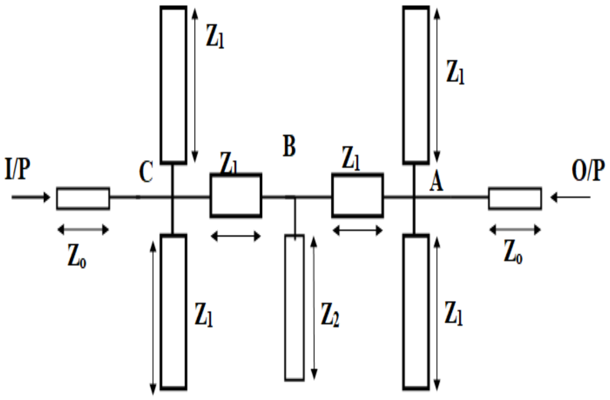

Fig.3. Circuit Model of proposed filter.

The complete circuit model consists of three nodes A, B and C. Equivalent impedance at each node is analyzed in following steps.

Step1:

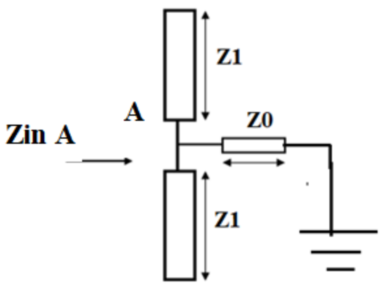

Fig.4. Input impedance looking in to node A.

$$Z_{inA} = 0.5Z_1 \,||\, Z_o \quad (1)$$

Step2:

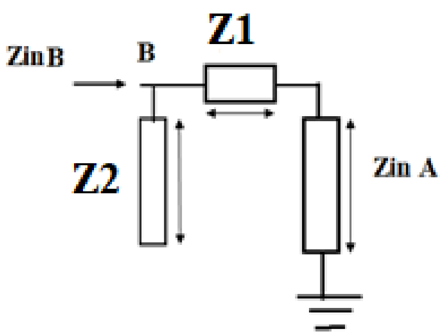

Fig.5. Input Impedance looking in to node B.

$$Z_{inB} = Z_2 \,||\, \left(Z_1 + Z_{inA}\right) \quad (2)$$

Step3:

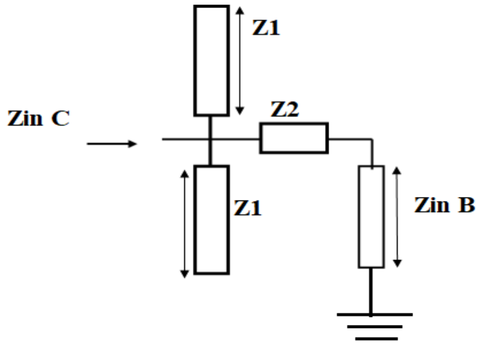

Fig.5 Input Impedance looking in to node C.

$$Z_{inC} = 0.5Z_1 \,||\, \left(Z_2 + Z_{inB}\right) \quad (3)$$

Step4:

Reflection coefficient of proposed filter is:

$$\tau = \frac{\left(Zinc - Zo\right)}{\left(Zinc + Zo\right)} \quad (4)$$

Return loss is given by

$$S_{11}\left(dB\right) = 20Log_{10}\left(\tau\right) \quad (5)$$

Transmission Coefficient is given by

$$\Gamma = \left[1 - \left(\tau\right)^2\right]^{\frac{1}{2}} \quad (6)$$

Insertion loss is given by

$$S_{12}\left(dB\right) = 20Log_{10}\left(\Gamma\right) \quad (7)$$

Table-I: Dimensions of proposed filter.

Sno	*Length in mm*	*Width in mm*
1	L1=5.9	W_1=0.9
2	L_2=1	W_2=0.9
3	L_3=2.9	W_3=0.8
4	L_4=11	W_4=0.2
5	L_5=2.5	W_5=0.5
6	L_6=0.3	W_6= W_4
7	g =0.3	

Simulation results of proposed filter is shown in Fig 6.The proposed filter has symmetrical frequency response with center frequency 7.45GHz and frequency selective range from 5.1GHz to 9.2GH.

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Lower and Upper passband edges are at 5.1GHz and 9.2GHz with attenuation level of 52dB and 54dB respectively. Lower rejection band is up to 100MHz with minimum attenuation level of 20dB and upper rejection band is up to 10 GHz with attenuation level of 44dB. Return loss S_{11} >10dB and Insertion loss S_{21} is 0.7 dB.

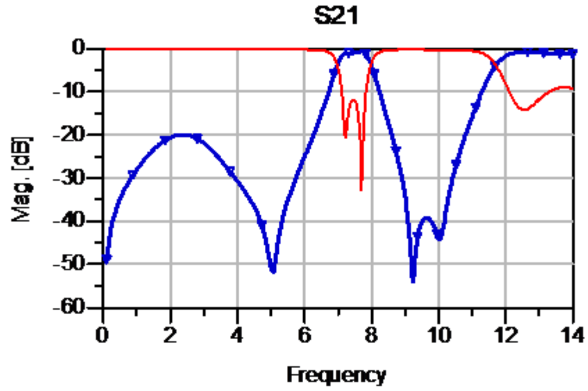


Fig. 6 Simulation results of Proposed filter.

III. FILTER WITH INDUCTIVE OVERLAYING PLATE.

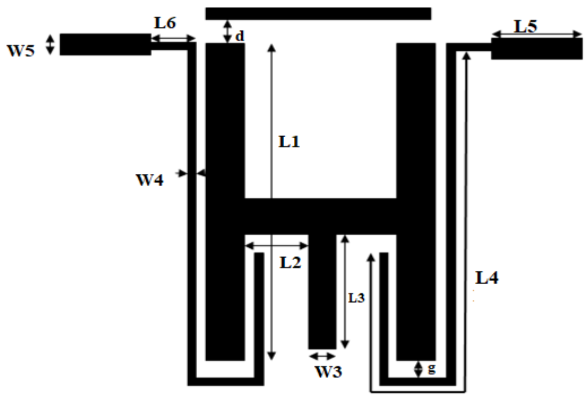
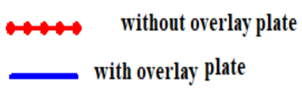
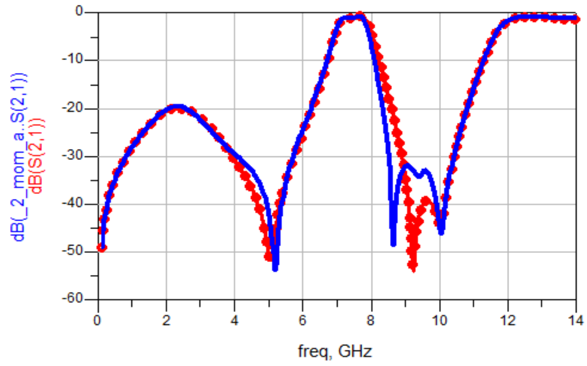


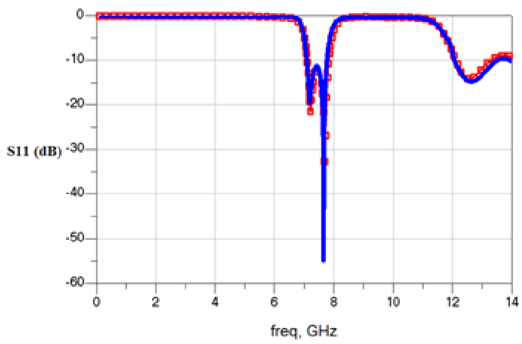
Fig.7. Proposed filter configuration with overlaying plate.

An inductive overlay plate is incorporated in proposed filter configuration as shown in fig .7 to control location of upper passband edge. An overlay plate of dimension 4.7mm*0.2mm at a distance d=0.2mm relocates the passband edge from 9.2GHz to 8.6GHz thereby changing frequency selective range from (5.1GHz-9.2Ghz) to (5.1GHz-8.6GHz) without changing odd and even mode frequencies of the filter as depicted in figs.8 (a) and (b) respectively.





(a)



(b)

Fig.8 (a) Shift in location of upper passband edge (b) Unchanged odd and even mode frequencies

III. CONCLUSION

Sharp frequency selective dual mode BPF is proposed using open stub loaded H shaped resonator.Based on analytical model Insertion loss and return loss for proposed filter are demonstrated.Frequency selective range for proposed filter is tuned by shifting location of upper passband edge using overlaying plates without changing center frequency of the proposed filter.

REFERENCES

1. Kenganahalli G. Avinash and Inabathini Srinivasa Rao “Compact Dual-Mode Microstrip Bandpass Filters with Transmission Zeros Using Modified Star Shaped Resonator,” Progress In Electromagnetic Research C, vol. 71, 2017, pp.177–187.
2. K.G. Avinash, I. Srinivasa Rao “Highly Selective Dual-Mode Microstrip Bandpass Filters Using Triangular Patch Resonators,” Advanced Electromagnetics, vol. 6, No. 1, March 2017.
3. Hongshu Lu, Tao Xie, Jingjian Huang, NaichangYuan, Qian Li “Design of compact dual-mode bandpass filter based on a new fractal resonator,” Proceedings of 7th IEEE International Symposium on Microwave, Antenna, Propagation, and EMC Technologies, 2017.
4. Jen-Tsai Kuo, Eric Shih “Microstrip Stepped Impedance Resonator Bandpass Filter with an Extended Optimal Rejection Bandwidth,” IEEE Transactions on Microwave Theory and Techniques, vol. 51, No. 5, May 2003.
5. Mingqi Zhou, Xiaohong Tang, Fei Xiao “Miniature Microstrip Bandpass Filter Using Resonator-Embedded Dual-Mode Resonator Based on Source-Load Coupling,” IEEE Microwave And Wireless Components Letters, vol. 20, No. 3, March 2010.

6. Hongshu LU, Wei WU, Jingjian HUANG, Xiaofa ZHANG, Naichang YUAN "Compact Dual-mode Microstrip Bandpass Filter Based on Greek-cross Fractal Resonator," Radio Engineering, vol. 26, No. 1, April 2017.
7. Ravee Phromloungsria, Nopparat Thammawongsaa, Krissanapong Somsuka, and Pichai Arunvipasb "Design of Compact Microstrip Stepped-impedance Resonator Bandpass Filters," Engineering Science and Management journal, 2010.
8. T Y Xiang, T Lie, M.Peng "Miniature dual-mode bandpass filter based on meander loop resonator with source-load coupling," Proceedings of Asia-Pacific Microwave Conference (APMC), 2015.