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UWB BPF With Uncoupled Symmetric loaded Stubs For Notch Implementation

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Abstract

In the proposed paper a miniature micro-strip ultra-wideband (UWB) band pass filter (BPF) structure is introduced. The structure consists of two symmetrical placed resonator, quarter wavelength long parallel-coupled line stubs (at the mid-band frequency), short ended stubs and symmetrically loaded stubs for notch implementation. It forms a compact size BPF and has better selectivity at the resonance frequency. The resonance frequency of the BPF is optimized by adjusting the width and length of symmetry-loaded stub. The size of compact size filter is 4.7x3.2mm^2, which attains S_{21} of 0.1 dB and S_{11} greater than 18 dB. This filter having compact size of the EM simulation of designed structure has been executed with the help full-wave simulator software.

Keywords—Ultra wide bandpass filter, micro-strip, stubs.

1. INTRODUCTION

In year 2002, U.S. Federal Communications Commission (FCC) publicized, ultra-wide frequency band (UWB 3.1–10.6 GHz) spectrum for industrial and mercantile applications [1]. Ultra-wideband (UWB) microwave structures have been developed for different applications. There are different UWB band pass filters have been developed. New methods and structures have been developing to foster the need to confine UWB band pass filter (BPF) to it frequency band [2]-[4].MMR (multi-mode resonators) and coupled line methods are the most common to obtain the wide band spectrum [5]-[7].

In this paper resonator based dual band BPF is designed. The designed structure can be flexibly shifted to different frequencies by varying the coupled line resonator sections, also the notched frequencies can shifted to other frequencies by varying the symmetrically loaded stubs. Here an additional pair of parallel-coupled stub is added to gain a better selectivity advantage at the upper and the lower pass band. Consequently, the structure attains high selectivity at both the upper and lower sides of pass band. The desired bandwidth is achieved by adjusting the length coupled section line stubs. The center frequency of designed structure is 6.5 GHz and Roger TMM substrate with ε_r = 9.2 (relative dielectric permittivity constant) and t = 1.0 mm (thickness) is utilized. The size of the proposed BPF is 4.7X3.2mm^2. The EM simulation of designed structure has been executed with the help full-wave simulator ADS [8]. The rest of the paper is organized as, Section II gives the details of the filter structure. In Section III, contain the simulation results obtained and section IV contain the conclusion.

2. FILTER STRUCTURE

The proposed UWB band pass filter is shown in Fig.1 and its dimensions are categorized in Table-I. In the filter 50Ω characteristic impedance is used at the feed ports and achieves 2.0 GHz to 10.0 GHz bandwidth, which covers most of usable frequency and UWB range from 3.1GHz to 10.6GHz.

The UWB BPF is designed by two symmetrical placed resonators, quarter wavelength long parallel-coupled line stubs, short ended stubs and symmetrically loaded stubs. And the bandwidth of filter can comfortably adjusted by varying the coupling length of the parallel-coupled section stub line (L1) and location of notch can be adjusted by modification of L6 and L7. Here the separation gap between each of parallel-coupled section line stubs is kept 0.20 mm and width of each of parallel-coupled section line stub is kept 0.20 mm. The short ended stub line are placed symmetrically with the length of 4.7 mm, which is connected to the patch via and the length of shorted stub is decides the selection transmission zero position.

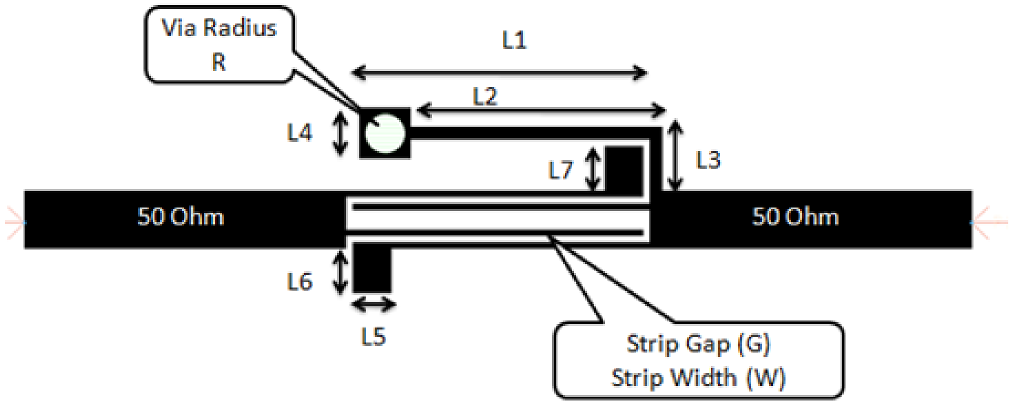


Fig. 1. Schematic of proposed filter. Substrate: ε_r =9.2, t=1mm

Table I. Dimensions of Proposed Filter

S/No.	Dimensions of the Proposed filter	
	Parameters	*Values (mm)*
1	L_1	4.6
2	L_2	3.7
3	L_3	1
4	L_4	0.8
5	L_5	0.6
6	L_6	1
7	L7	0.7
8	W	0.2
9	W_1	0.8
10	g	0.2

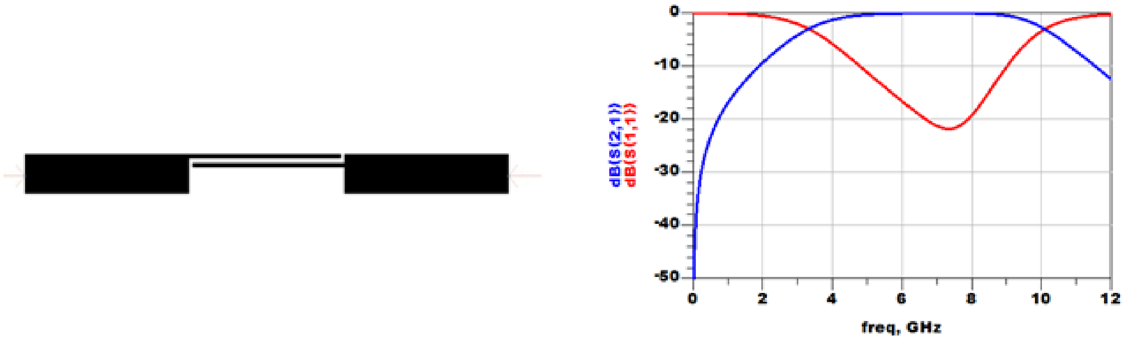
The symmetrically loaded stub lines is used to achieve the notches at the frequencies of 5.1GHz and 8.0GHz. The notches at these frequencies can be re-located at different frequencies by changing the length of the symmetrically loaded stub lines (L6 and L7). The insertion loss and return loss of the UWB BPF is ~ 18dB and 0.1db, respectively.

3. RESULT AND DISCUSION

The performance of UWB BPF is understood with the help of S_{11} and S_{21} parameter. In this section Fig.2 to 5, indicates the UWB band pass filter design hierarchical structures. Fig.2 (a) indicates the layout of the BPF and its performance results are given in Fig. 2(b).

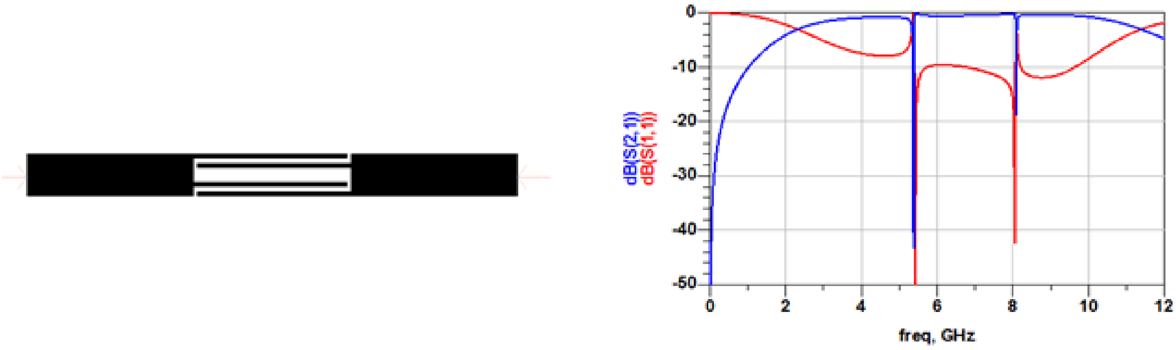
In the previous BPF (See Fig 2(a)), if two parallel coupled line are intruduced then in the combined structure twonotchs are obtained. The dual notches wide band BPF is shown in Fig.3(a). The S_{11} and S_{21} parameters of the dual notch BPF is shown in Fig.3(b). In the filter two notches are at frequency 5.8 GHz and 8.0 GHz. The location of notech can adjusted by varing the length of couled line section.

In above (See Fig.3) analysis the transmission (S_{21}) is zero. For sharp cut off or creating transmission zero via is introduced in asymmetric manner. The location of via is found by the quarter wavelength stub of desire frequency. The structure of filter with via is shown in Fig.4 (a) and its response is shown in Fig.4 (b).



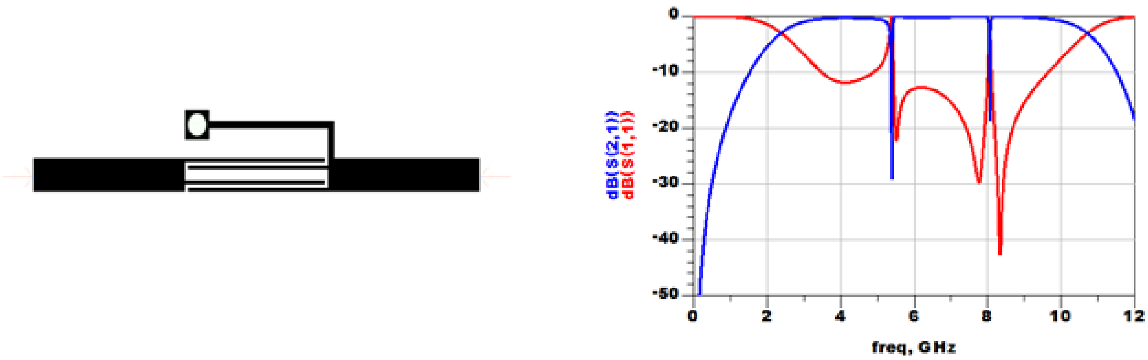
(a) (b)

Fig. 2.Parallel coupled section resonator simulated result (a) Structure of coupled line (b) S_{11} and S_{21} parameter for coupled line



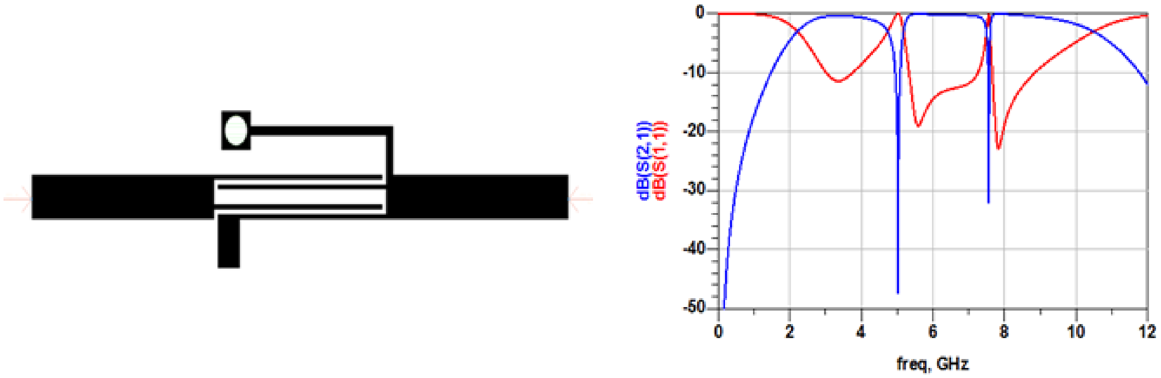
(a) (b)

Fig. 3.Notch creation (a)Parallel coupled section resonator (b) S11 and S21 parameter



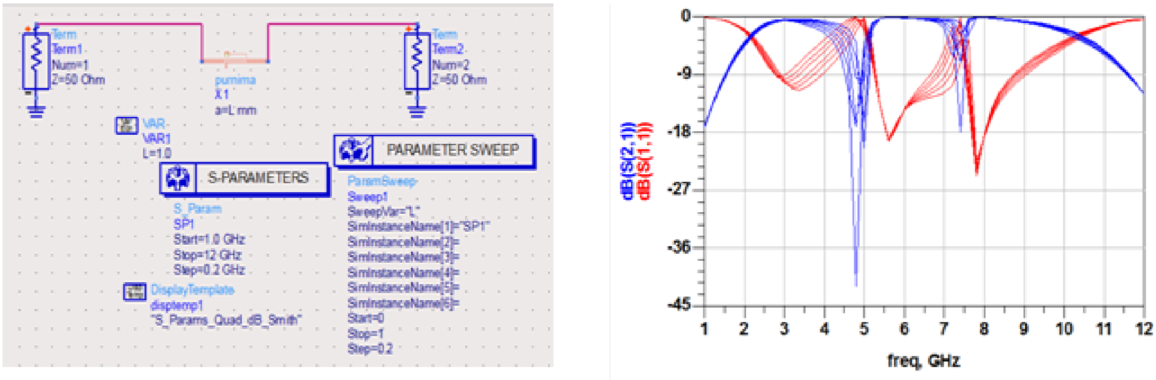
(a) (b)

Fig. 4.Transmission Zero (a) Structure with Via (b)S_{11} and S_{21} Vs Frequency



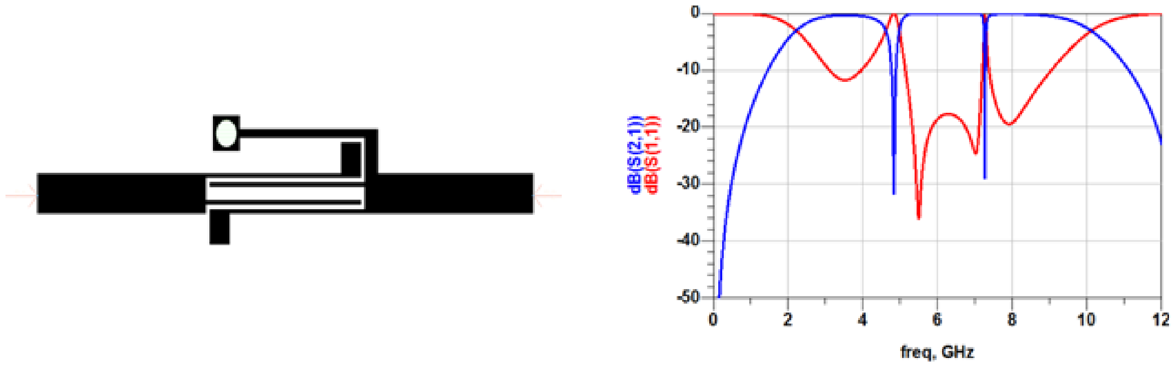
(a) (b)

Fig.5 Location of notch form passband (a) Structure of uncoupled stub (b) S_{11} and S_{21} parameter of uncoupled stub.



(a) (b)

Fig.6 Parametric analysis for different L6 (a) Parametric setup (b) S_{11} and S_{21} parameter.



(a) (b)

Fig.7 Symmetric unclouped (a) Structure symmetric uncoupled stub (b) S_{11} and S_{21} parameter.

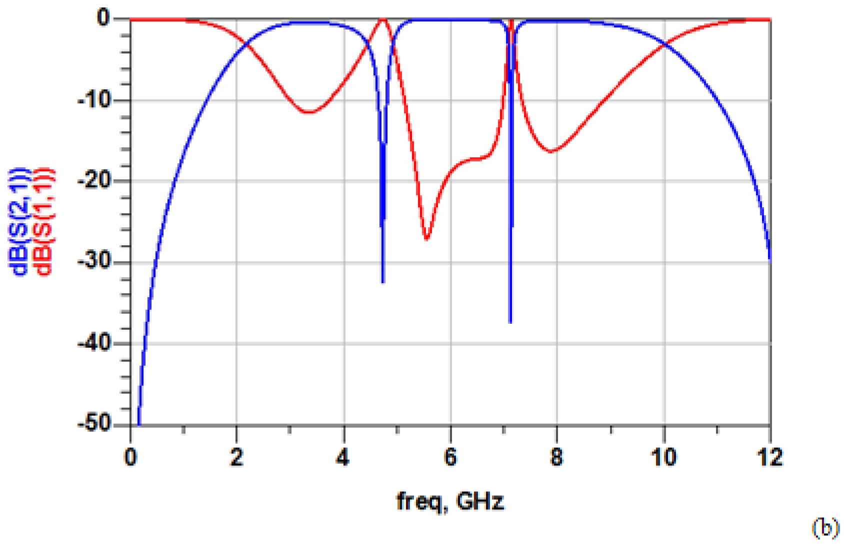


Fig 8 S_{11} and S_{21} of Proposed Filter.

In Fig.4 zero transmission is obtain only for desire frequency (10.6GHz) and it will not disturbed the previous frequency analysis. In this case, the location of notch in pass band can be obtained by introducing uncoupled line structure. Which will change the length of parallel-coupled line structure and therefore selected frequency will not pass to output side and some of the frequency is notch form the pass band side. The filter with uncoupled stub structure is shown in Fig.5 (a) and the S-parameters of the coupled line BPF structure is shown in Fig.5 (b).

The performance of BPF is optimized by changing the length of uncoupled line section. For selection of proper length prametric analysis has been done. In the parametric analysis its length is move from L6=1.0 mm to 2.0 mm for the step of 0.2 mmas shown in Fig.6(a) then the S_{11} and S_{21} performance is shown in Fig.6 (b), The length L6=1.0 mm gives the best results in term of S11 and S21. From the results it is observed that by changing length of uncoupled line section, the notch bandwidth is slightly shifted. Therefore, for slightly changing of notch frequecncy is obtain by changing it length.

In Fig. 5(a) is asymmetric structure. For symetric analysis, introcduce one additional stub to check the performance of filter. By intruducing this S_{11} parameter performance is improve but S_{21} performance is reduced as previous analysis. Symmetric stucture width L6= L7= 0.7 mm is shown in Fig.7(a). Its S_{11} and S_{21} parameter is shown in Fig.7(b). It is quite clear that S_{11} is better than 18dB but S_{21} is reduced and reached upto 31db which touched 49dB in previous analysis.

In both analysis symeetric uncoupled structure result is best form the preious analysis. S_{21} is reduced but getting good S_{11} performance. This is proposed Ultera Wide Band filter having two notch is obtain with selecting best performance which is L6=1mm and L7= 0.7 mm. Final proposed structure is shown in Fig.1 and its S_{11} and S_{21} parameter is shown in Fig 8.

4. CONCLUSION

An ultra-wideband band pass filter with short-ended stubs with dual feed, parallel-coupled lines stubs and symmetrically loaded stubs for notch implementation is introduced. This filter has sharply cut off on both edges. It covers UWB range from 3.1GHz to 10.6GHz. It has two sharp edge notches at 4.5 GHz and 7.2 GHz. This filter is suitable for microwave application belonging to S-band, C-band & X-band:WLAN (2.4 GHz), Wi-MAX (3.5 GHz) and in Satellites communication (4.5 GHz). Insertion loss of introduced filter is 0.1dBand return loss is 18.0 dB.

5. REFERENCE

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