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UWB BPF with Short Ended Stubs and Uncoupled loaded Stubs For Notch Implementation

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ABSTRACT

An UWB BPF is presented with two notch implementations. The UWB BPF is formed by using the coupled lines. Two notches are introduced at frequencies 5.2 GHz and 8 GHz respectively by using two coupled lines. An open stub is loaded in the structure to make the notch better which is obtained at 8 GHz. To make the transmission zero better a λ/4 short ended stub is added in the structure. The structure is simple and asymmetric. The designed structure is compact and do have better selectivity at the resonant corner frequencies. Position of notched frequency can be varied at different desired frequencies by making adjustments to the width and length of the coupled lines. Designed structure attains S_{21} of approximately 0 dB and S_{11} greater than 30 dB. The EM simulation of designed structure has been executed with the help full-wave simulator HFSS based on FEM method of simulation.

Keywords—Ultra wide bandpass filter; micro-strip; stubs;

I. INTRODUCTION

In year 2002, U.S. Federal Communications Commission (FCC) publicized, ultra-wide frequency band (UWB 3.1–10.6 GHz) frequency spectrum for industrial and mercantile purposes [1]. Ultra-wideband (UWB) microwave structures have been developing for different applications and implementations ever since the release of ultra wide band (UWB) spectrum. Notches are required in the UWB to reject certain bands of frequencies for different applications.

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 the followingresearch paper a UWB BPF with two notch frequencies is implemented. To implement the UWB BPF coupled lines are used. Two coupled lines are added in the structure to obtain the two notch frequencies at 5.2 GHz and 8 GHz respectively. Both the notch frequencies can be varied by varying the length and width of the coupled lines. A λ/4 short ended stub is added to gain a better selectivity advantage at the upper side of the passband. To make the notch better which is obtained at 8 GHz, an open stub is loaded in the structure.The center frequency of designed structure is 7 GHz and Rogger TMM substrate with ε_r = 9.2 (relative dielectric permittivity constant) and t = 1 mm (thickness). Size of new proposed resonator is about 4.7X2.9mm^2.The EM simulation of designed structure has been executed with the help full-wave simulator HFSS based on FEM method of simulation [8].

II. FILTER STRUCTURE

Fig.1 shown below is the proposed ultra-wideband(UWB) band pass filter(BPF) schematic for notch implementation and Table-I show dimensions of the proposed filter. Characteristic impedance of each of the feed ports is 50 ohm. An ultra-wideband is achieved by using the coupled lines of length L1. Then two coupled lines are introduced in the structure to obtain two notches. To make the second notch better an open stub is loaded in the structure and to make the selectivity better at the upper side of the passband, a λ/4 short ended stub with radius of via 0.3 mm is used.

. The bandwidth of ultra-wide band(UWB) band pass filter(BPF) can comfortably adjusted by varying the coupling length of the parallel-coupled section stub line (L1). Here the separation gap between each of parallel-coupled section line stubs is kept 0.1 mm and width of each of parallel-coupled section line stub is also kept 0.1 mm.

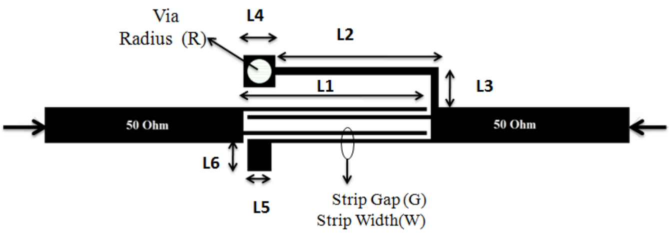

Fig. 1. Schematic of proposed filter. Substrate: ε_r =9.2, t=1 mm.

The coupled lines are being used to achieve the notches at the frequencies 5.2 GHz and 8 GHz also the frequency at which notches are achieved can be located at different frequencies by changing the length of the coupled lines (L1).

Performance of this ultra-wide band (UWB) BPF isS_{21} (approximately) 0 dB and S_{11} is greater than 30dB.

Table I. Dimensions of Proposed Filter

S/No.	Dimensions of the Proposed filter		
	Parameters	***Values***	***Unit***
1	L_1	4.6	millimeter
2	L_2	3.9	millimeter
3	L_3	1	millimeter
4	L_4	0.8	millimeter
5	L_5	0.6	millimeter
6	L_6	0.7	millimeter
7	W	0.1	millimeter
8	W_1	0.2	millimeter
9	R	0.3	millimeter

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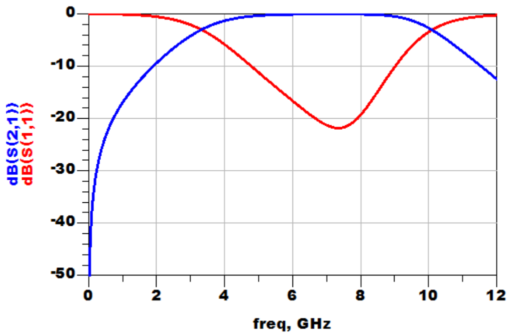
III. RESULT AND DISCUSSION

Simulation result of the introduced ultra-wideband (UWB) band pass filter (BPF), which is λ/4 coupled line structure Shown in Fig.2 (a). Length of coupled line structure is adjusted for central frequency approx 5.2 GHz. S_{11} and $S_{21}$of coupled lines Structure is shown in Fig.2 (b). It shows the response from frequency response cover UWB range 3.1 GHz to 10.6 GHz. But structure produces poor selectivity and not having any notch.

(a)



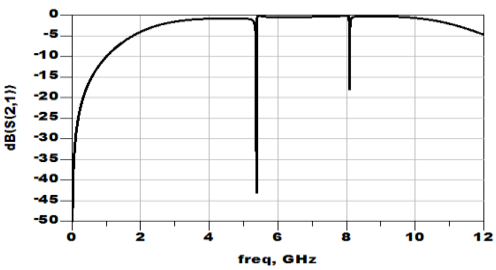
(b)

Fig.2 (a) λ/4 coupled line structure (b) S_{11} & S_{21} of coupled line structure.

To intruduce notch in the range of UWB, two coupled lines structure of λ/4 are added.The notch frequencies can be varied by adjusting the length and width of these coupled lines. Structure for introducing notch is given in Fig3.(a). and there response in S_{11} and S_{21} term is shown in Fig3 (b).

It shows that two notch frequecies are obtained using the coupled lines at frequencies 5.2 GHz and 8 GHz. Rejection is good in first notched frequency, but having poor response in second notched frequecny.

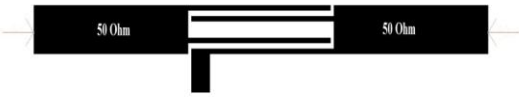
(a)



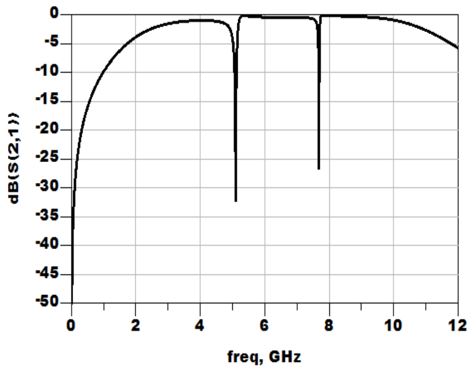
(b)

Fig3(a) λ/4 coupled line structure for notch (b) S_{11} & S_{21} of coupled line structure.

To improve selectivity of second notch, extra uncoupled open stub is added at the end of coupled line structure as shown in Fig.4 (a). The response of this structure $S_{11}$and S_{21} in shown in Fig4. (b). As clear from figure selectivity of second notch is better from Fig.3 (b).



(a)



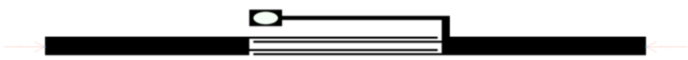
(b)

Fig.4 (a)Uncoupled open stub added in coupled line structure (b) S_{11} & S_{21} of uncoupled open stub .

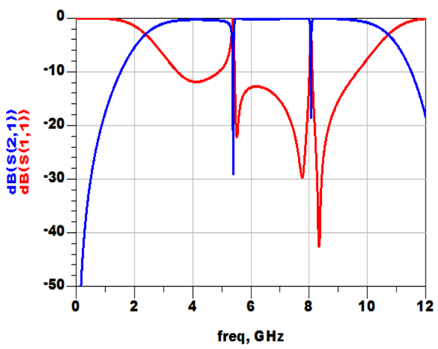
Still, overall selectivity at upper pass of filter is not good. To improve selectivity or create transmission zero, one λ/4 short ended stub is added in the filter structure as shown in Fig.5(a).

Response of short ended stub in term S11 and S21 is shown in

Fig.5(b). Which shown upper pass band selectivity is improved.



(a)



(b)

Fig.4 (a)λ/4 Short ended stub structure (b) S_{11} & S_{21} on short ended stub.

Over all result, after adding coupled line, open stub and short stub as in Fig1.is shown in Fig.5.

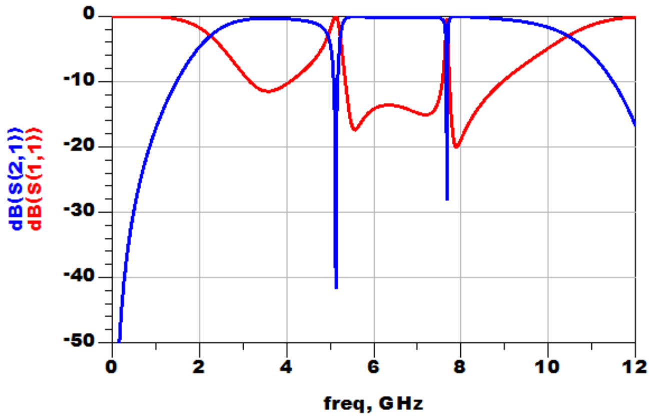


Fig.5S_{11} & S_{21} of Proposed Filter

IV. CONCLUSIONS

An ultra-wideband(UWB) band pass filter (BPF) using coupled lines with added coupled lines is used to implement the two notch frequencies. The notch frequencies are obtained at 5.2 GHz and 8 GHz to reject the interference at these frequencies. The notch frequencies can be varied by adjusting the length and width of the coupled lines. Size of filter is very compact 4.7x2.9mm^2.The bandwidth of introduced filter is 8 GHz(approx.) ,notches at frequencies 5.2GHz and 8GHz. Insertion loss (S_{21}) of introduced filter is 0dB(approx.) and return loss (S_{11}) is 30 dB (approx.).

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