USB BPF based on Folded λ/4 Resonator with Shorted End using Patch Via

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Abstract— UWB BPF is required for short range high speed communication systems. In this paper we have proposed a UWB BPF. The filter consists of a folded λ/4 resonator with shorted end using patch via. The center frequency is chosen to be 5GHz.The folded λ/4 resonator is of the size 11.6 mm which is half of the wavelength of the center frequency. This folded λ/4 resonator is shorted at the one end. The filter attains a bandwidth of 6.5 GHz. The proposed filter is having an insertion loss of 0.545dB and return loss greater than 12dB. The structure has been simulated with full wave simulator.

Key words: Ultra-Wideband, Band Pass Filter, Micro-Strip, Stubs

I. Introduction

The UWB technology came into existence in year 2002 when US FCC (U.S. Federal Communications Commission) allotted, ultra-wide frequency band (UWB 3.1–10.6 GHz) for industrial and commercial purposes. The UWB technology is best suited for short range high speed communication systems. There are various methods for implementation of the UBW filter in which parallel coupled line based stub loaded filter is very common. These filters are easy to implement, easy to fabricate, low cost, having controllable bandwidth, better selectivity and can be designed to have re-configurability which gives additional advantage of operation in other band with very less design changes.

The proposed filter consists of a folded λ/4 resonator is loaded with a short ended stub at one end. The folded resonator is of the length 11.6 mm, half of the length of the wavelength at 5GHz. To short the end, a path via is used. The proposed filter is designed on the FR-4 substrate with thickness 1.6 mm. FR-4 epoxy is having a relative dielectric constant of 4.4. The designed structure is simulated using HFSS full wave simulation tool.

II. Filter Structure

The proposed filter has been displayed in Fig.1 and Table. I show the dimensions of the proposed filter. The filter consists of a λ/4 resonator which is 11.6 mm (Length L2), which have been shorted at one end using a patch via of length 0.8 mm and width 1.0 mm (Length L1 and Width W1).

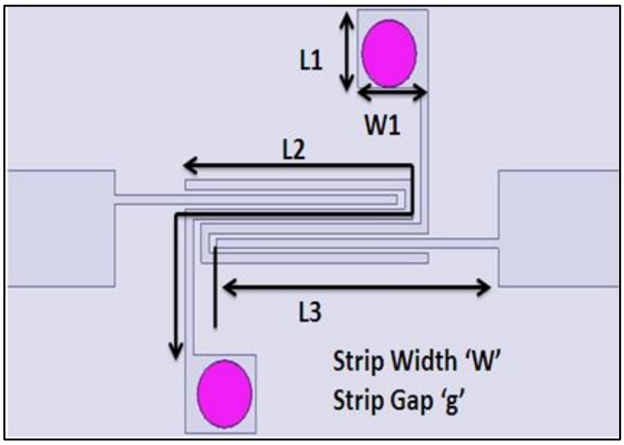

Fig. 1: Schematic of proposed filter- Front View. Substrate: εr =4.4, t=1.6mm.

Dimensions of purposed filter	
Parameter	Values (in mm)
L1	0.7
L2	12.2
L3	5.3
W1	0.7
W	0.2
g	0.05

Table 1: Dimensions of Proposed Filter.

The strip width has been chosen 0.2 mm (Strip Width- W) and the gap between the strips has been chosen 0.05mm to provide maximum coupling between the coupled feed length and the λ/4 resonator. The proposed filter is being feed by 50 ohm feed line using loose coupling method. The proposed filter is designed using FR-4 with a relative dielectric constant of 4.4 and thickness of 1.6mm.

III. Result and Discussions

Fig. 2 shows the design of the filter using a folded stub which has been coupled using loose coupling from the 50 ohm feed line.

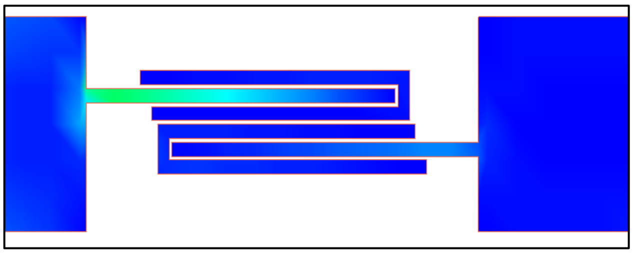

Fig. 2: Schematic of Filter without Short ended stubs.

Fig. 3 shows the simulated result of the filter without loading of the short ended stub, it achieves a BW of 2 GHz and one resonating mode frequency at 7.6GHz.

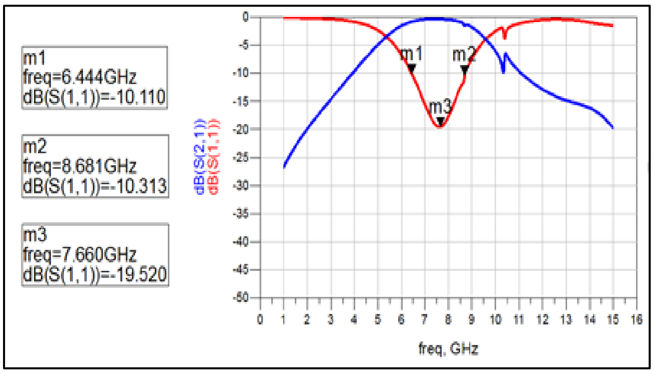

Fig. 3: Simulated result of the Filter without Short ended stubs

The simulated result of the proposed filter is shown in the Fig. 4. This filter is having a bandwidth of 5.67 GHz, from 4.1GHz to9.9GHz. The proposed filter structure attains a total of four resonances at 4.6GHz, 6GHz, 8.6GHz and 9.9GHz. Insertion loss (S21) of investigated filter is 0.54dB and return loss (S11) is greater than 12dB.

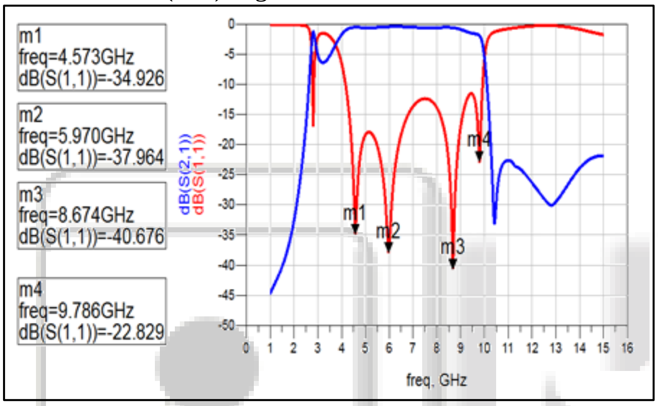

Fig. 4: Simulated result of the Proposed Filter

The proposed filter is having sharp transmission zeros at the out of band, it also shows good out o band performance.

IV. CONCLUSIONS

An ultra-wideband (UWB) band pass filter (BPF) using folded λ/4 resonator is loaded with a short ended stub at one end have been investigated. The proposed filter structure attains a total of four resonances at 4.6GHz, 6GHz, 8.6GHz and 9.9GHz. The bandwidth of investigated filter is 5.67 GHz (4.1GHz – 9.9GHz). This filter operates with 110% fractional bandwidth with notches at frequencies 5.7GHz and 8 GHz. The size of the proposed filter is 0.64 λg x0.95λg (4.6 x 6.85 mm2). Insertion loss (S21) of investigated filter is 0.54dB and return loss (S11) is greater than 12dB.

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