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Comparative Study of UWB BPF to Enhance Bandwidth using Defected Ground

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Abstract: ***First we designed a band pass filter at the center frequency of 6.85 GHz using the increased Parallel coupled lines. After that for enhancing the bandwidth of the filter defected ground is proposed on the same structure for that we introduced rectangular aperture on ground plane. Size of the filter is 24.1 mm and The passband of the proposed filter is from 3.2GHz to 11.6GHz with center frequency 7.7GHz.***

Key Words: parallel coupled microstripline (PCML), Bandpass filter, Backside Aperture, Defected ground

I.INTRODUCTION

There has been considerable research going on developing ultra-wideband (UWB) technology for high-speed wireless connectivity The Federal Communications Commission (FCC) in the USA has permitted unlicensed use of UWB band from 3.1–10.6 GHz with 110% fractional bandwidth at 7.5 GHz for Indoor and handheld systems in 2002 [1][4].Small size and low cost are the most fundamental demands in today's printed circuit board technology. Generally filter are considered as the critical components in reducing the whole size of the RF Front design. We are trying to develop a new kind of filter structure that have wideband property and good in-band and out-band performance, so the proposed designs are compact, planar, simpler, all the simulation done on the HFSS tool [5]. The substrate is Gilgml1032 used which has thickness h = 0.762mm and relative permittivity ϵ_r = 3.2.

II. FILTER DESIGNING

The schematic diagram of the parallel coupled line wideband bandpass filter with center frequency 6.85 GHz is shown in fig.1. At the central frequency of the proposed passband, the first and third line are selected equal to one quarter wavelength while the central line is selected equal to one half-wavelength ($\lambda g_0/2$). The width and length of transmission line having the characteristic impedance of 50Ω and Gap and width of the coupled line can be calculated [3][4][1] taking a substrate with relative permittivity ε_r = 3.2, and thickness h = 0.762mm.The ground plane aperture width is approximately $\lambda g_0/8$ and the length of aperture is $\lambda g_0/2$ + 2 G1 [2]. width of the 50 ohm transmission line is 1.8mm and length of the line is 5 mm.

Optimized Filter dimensions	$\lambda_{g0}/4$	W1	G_1	G_2
	6.85mm	0.5mm	0.2mm	0.15mm

Table 1: Dimensions of the Parallel coupled microstrip line filter

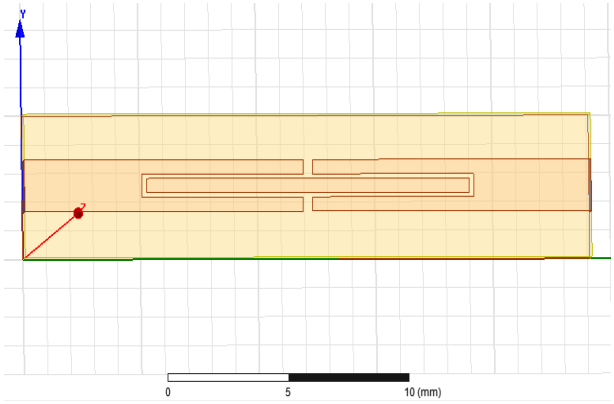

Fig.1 : PCML filter

The optimized parameters are listed in Table 1, and the design of PCML filter is shown in figure 1. The design of PCML filter was analyzed on HFSS tool, and the simulation result is shown in fig.2. That shows insertion loss is almost -0.12dB. The maximum return loss is -40.55dB at 6.85GHz and bandwidth is approximately 4.57GHz to 9.12GHz and having the single pole.

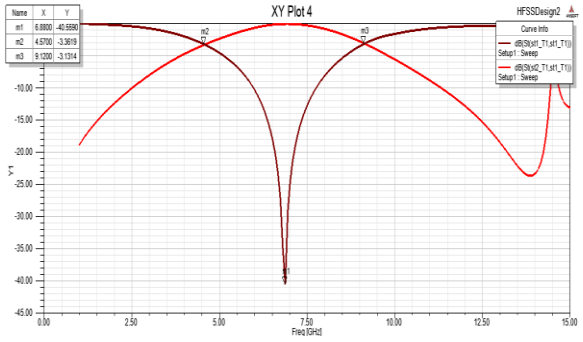

Fig. 2: Simulated result without defected ground

But this result is not satisfying the UWB bandwidth and total band is only 4.5 GHz whereas UWB bandwidth should be 7.5 GHz. So this filter is not fulfilling the requirement of bandwidth of FCC, but it shows a good wideband property. For increasing the width of the band, I am using the defected ground technique and no. of coupled line also increased.

III. DESIGNINING OF FILTER WITH DEFECTED GROUND

The design layout of PLMC filter with defected ground [6]is shown in fig3. The back side aperture on the ground plane is

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1 Feb. 2016

created for coupling enhancement between the coupled lines [1][2]. The aperture slot is formed on the ground of width approximately λgo/8 and its length is onehalf wave lengths long(Fig.4(a)). All the dimensions are same except the width of slot on ground is calculated and shown in table 2.

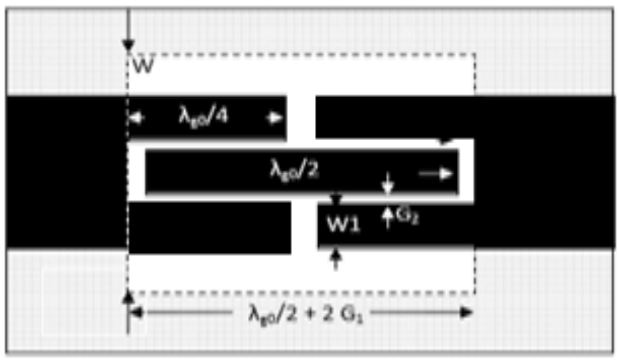
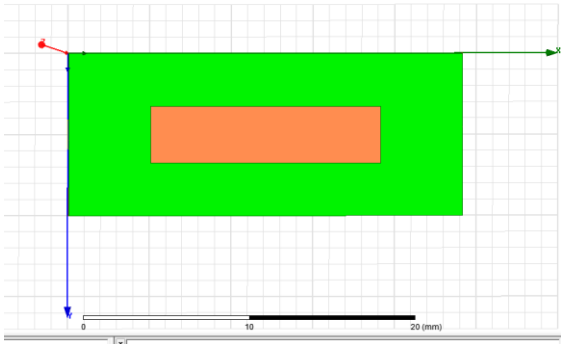


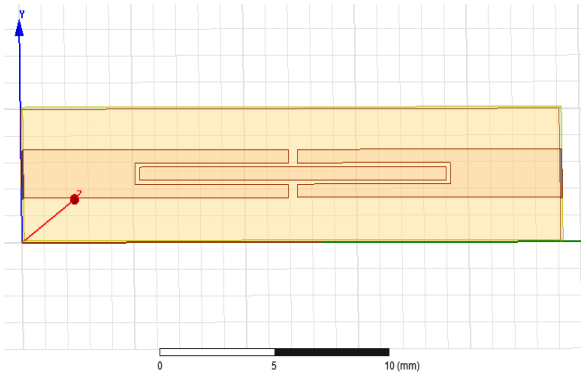
Fig. 3: Parallel coupled line filter with defected ground

Optimized Filter dimensions (mm)	$\lambda_{g0}/4$	W1	W	G_1	G_2
	6.85	0.5	3.5	0.2	0.15

Table 2: Dimensions of filter with defected ground



(a)



(b)

Fig. 4: PCML filter with defected ground
(a)Bottom view (b) Top view

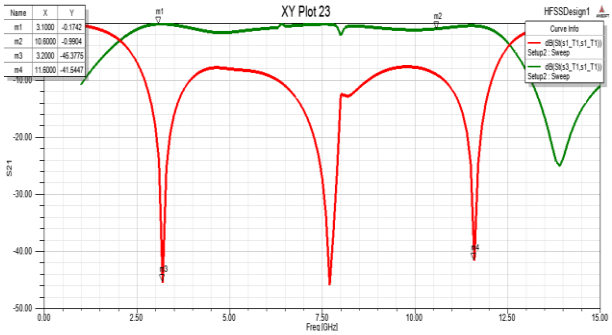


Fig 4(c) : Simulated result with defected ground

A simulated result of this filter with slot at the ground is shown in figure 4(c), from the simulation result we can easily conclude the effect of change in band by using of back aperture. The maximum return loss of PCML filter with defected ground is -45.798dB at 7.7GHz.The simulated band width of the filter is from 2.2GHz to 12.3GHz. We got bandwidth only 10.4 GHz whereas UWB bandwidth should be 7.5 GHz

IV RESULT

The comparison of simulated results of Parallel coupled line BPF without and with defected ground is shown in fig 5 and 6.

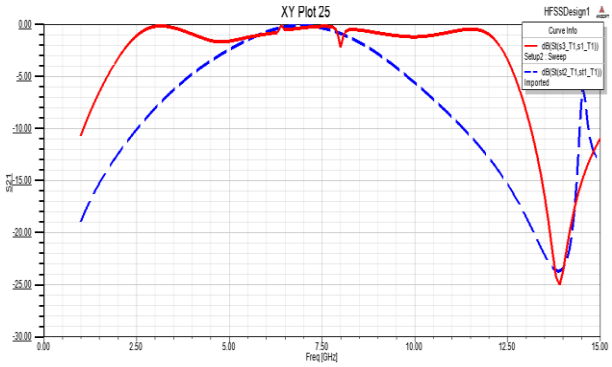


Fig. 5: Comparison result of transmission co-efficient (S21)

It has been seen that the performance of defected ground filter is better than without defected ground filter. The simulated bandwidth of the defected ground filter is from 2.2 GHz to 12.3 GHz. The simulated results are found to have regionally good agreement accept the cutoff frequency.

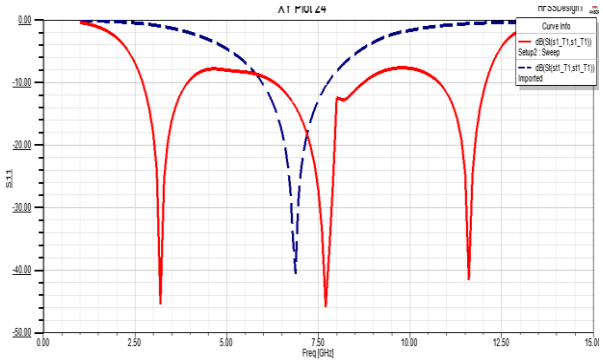


Fig. 6: Comparison result of reflection coefficients(S11)

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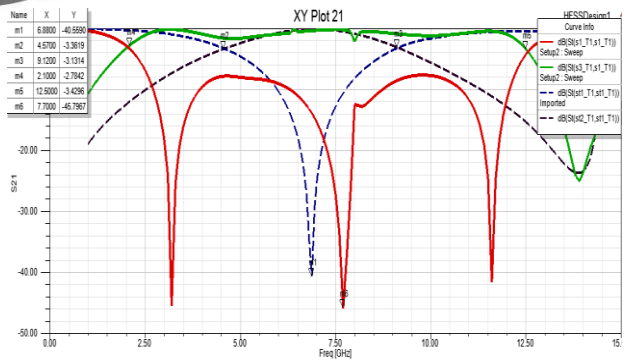

Fig 7: Comparison Result of S11 and S21

V. CONCULISION

In this paper the comparative study of the parallel coupled line band pass filter with and without defected ground is proposed. it has been observed that filter bandwidth has been enhanced by using defected ground technique. The main key feature of the filter is the filter structure that is very compact i.e.24.1mm in size. The proposed filter exhibited very good passband performance as compare with basic filter structure.

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