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A COMPACT MICROSTRIP BANDPASS FILTER USING VARIOUS COUPLING TOPOLOGY FOR UWB APPLICATION

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ABSTRACT

This paper presents the design of Microstrip bandpass filter with Hairpin structure, Comb line structure, and tree coupled structure and cross coupled hairpin filter configurations with the center frequency of 4.8 GHz. The simulation of these configurations is performed using the ADS Simulation Tool. The four coupling topology filter is designed for the substrate FR4 (Flame Retardant) with the dielectric constant 4.4. The simulated results show that the coupling topology filters designed here are operating well for their desired specifications with good dielectric constants provides the highest return loss and lower insertion loss for filter configurations.

Keywords: microstrip, bandpass, hairpin, combline, cross coupled tree coupled, dielectric constant, insertion loss, return loss.

1. INTRODUCTION

A new, separate out is created to the extent which it enables transmitting transmission frequency inside passband region and it also rejects in the stopband. Probably the toughest areas of UWB engineering the structure connected with RF separates out. Your UWB separates out needs your adequate bandwidth and also adequate preventing qualities beyond the applicable band [2]. The design connected with instant and also mobile communication methods, will need top quality and also the tiny size RF/microwave filtration systems. Advancement in space decline is manufactured with the streamlined miniaturized resonator filtration systems, the location where the two biceps and triceps of the U-shaped microstrip are further folded to some tightly paired collections. Consequence of the idea minimal 'Q' value. Increased Q suggests a lesser rate of energy reduction relative to your saved vitality of the resonator.

$Q = 3/f_r$ (energy stored/power loss)

The Helical filtration system is classified as the finest since they present superb negativity account. That they endure massive dimension in addition to tunning problem [5].

For virtually any high filtration system pattern goes back reduction in addition to insertion reduction is usually regarded as being your functionality description details. Each of our planned performs targets on pattern in addition to effect functionality associated with microstrip bandpass filtration system topologies. To design this filtration system and to execute simulation effects, EM simulation instruments can be utilized. For any high filter design return loss and insertion loss are considered to be the performance measurement parameters.

2. FILTER DESIGN METHOD

Lumped element filters are used in many of applications as the transmission line distributive components. Inductor and capacitor are used to construct conventional filters for reliable wireless communication in the RF Domain. The circuit built describes the lumped element model to be the "Lumped element Together".

Inductor and capacitor are used to concern the filter design and due to this element mixing lumped capacitor and inductor cannot be treated separately.

Lumped element analogue filtering had well before been recently developed, nevertheless most of these fresh armed service devices operated on microwave frequencies in addition to fresh filtering designs ended up necessary.

Attachment burning procedure is used here because doing so provides substantial stage management over passband along with stopband amplitude step characteristics [2]. Hairpin- line bandpass filtration system tends to be lightweight structures. Additionally both the arms regarding hairpin resonator tend to be directly positioned this coupling collections possess powerful coupling [3].

3. FILTER DESIGN STEPS

A. Design equations

Inverters are utilized to help transfer impedance or even admission, degrees, that has the option associated with impedance inverter 'K' or even admission inverter 'J' parameters [2]. Then your comparable was created while using respected size and duration of the actual coupling come up with a hassle-free structure with the UWB app.

Table-1. Design specifications.

Filter type	Chebyshev
Order of filter	5
Center frequency	4.8GHZ
Fractional bandwidth	0.1%
Dielectric constants	4.4-FR4.

Table-2. Lowpass prototype element value. for filter type 5.

g0	g1	g2	g3	g4	g5	g6
1	1.146	1.371	1.975	1.371	1.146	1

The even and the odd mode equations are used to find the spacing parameters for the filters which are given below,

$Z_0J_1=\sqrt{(\pi\Delta/2g_1)}$

$Z_0J_n=\pi\Delta/2\sqrt{(g_{n-1}g_n)}$ (1)

$Z_{0e}=z_0[1+Jz_0+(JZ_0)^2]$ (2)

$Z_{0O}=Z_0[1-JZ_0+(JZ_0)^2]$ (3)

4. HAIRPIN FILTER

Hairpin filter is created in the ADS Software using the distributed components and the coupling lines. Thus the shape of the hairpin is like the folded with the parallel ends and it becomes as 'U' shape. The filter is adjusted in the spacing parameters for compact size and grounding in not necessary in the coupling resonator. This makes the design simpler. The design equations are written below,

$Q_{e1}=g_0g_1/FBW$ (4)

$Q_{en}=g_0g_{n+1}/FBW$ (5)

$M_{i,i+1}=FBW/\sqrt{(g_ig_{i+1})}$

for i=1 to n-1 (6)

5. COMBLINE FILTER

Combline filtration systems will be the most in-demand varieties of coaxial filter. This specific parallel design allows reasonably big coupling for a provided space among resonators, therefore, this filter structure is especially handy pertaining to developing filtration systems having a wider bandwidth as compared with this structure from the end coupled microstrip filter. Each and every resonator features a one on one floor relationship with one end and grounded, having a capacitor using some other end.

Consequently the size of this resonators might be kept tiny which provides using superb stopband overall performance. Consequently the length of the actual resonators is usually stored modest which provides along with exceptional stopband efficiency.

6. TREE COUPLED FILTER

The tree coupled filter has the microstrip transmission line and the coupling line which are constructed together to structure required. The parallel coupling in the ADS Software is designed by the microstrip transmission lines of the conductive drawing components. This filter has the better transmission zeroes and attenuation zeroes.

7. CROSS COUPLED HAIRPIN FILTER

The cross coupled hairpin filter has the coupling line has been changed to the mirror image method to get the cross coupling in the filter. The inter coupling of the microstrip line will give the passband to be applied within the lower order UWB band. The shape of the cross coupling is achieved.

8. DESIGN AND LAYOUT

Let us see the design of various coupling topologies for the UWB application which operates on 4.8 GHz as their center frequency. The filter designed has the characteristics depend on insertion loss and return loss is calculated using the S-Parameter of the transmission line. The designs are drawn below.

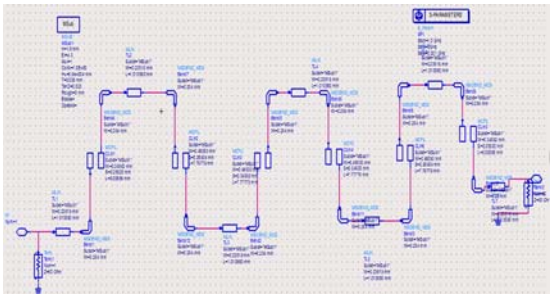

Figure-1. Schematic view of hairpin filter.

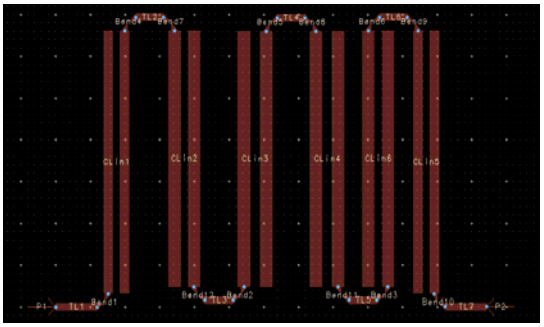

Figure-2. Layout view of hairpin filter.

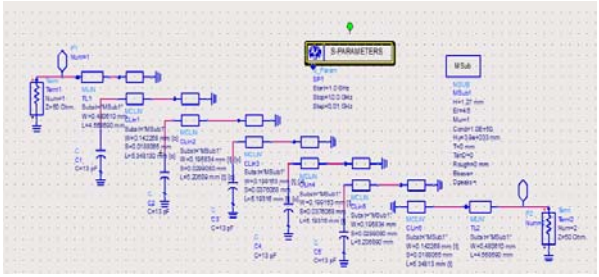

Figure-3. schematic view of combline filter.

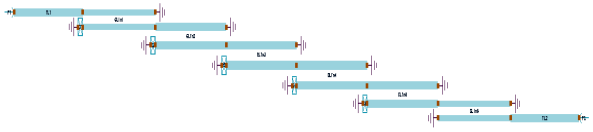

Figure-4. Layout view of combline filter.

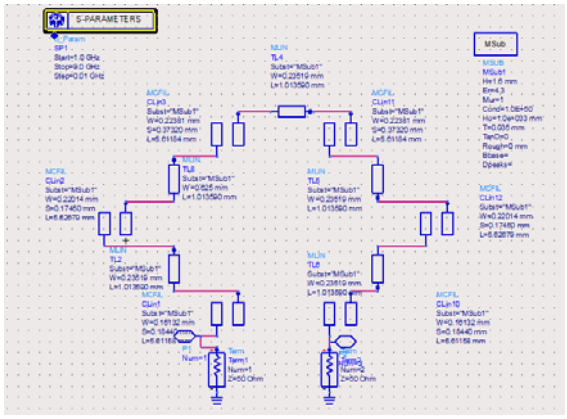

Figure-5. schematic view of Tree coupled filter.

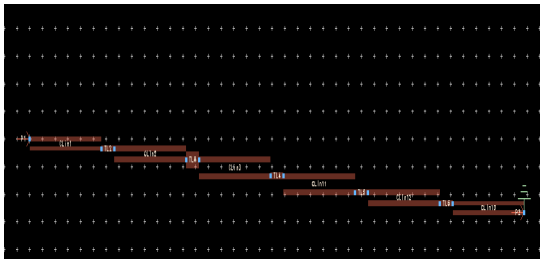

Figure-6. Layout view of Tree coupled filter.

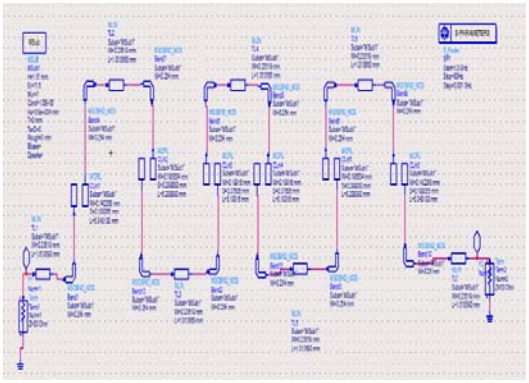

Figure-7. Schematic view of the cross coupled hairpin filter.

9. SIMULATION RESULTS

ADS Simulation Tool is the efficient software to design the antenna and filters for the wireless communication purpose. Then the simulated results of the Hairpin filter, Combline filter, Tree coupled filter, cross coupling filter in the FR4 substrate is shown below.

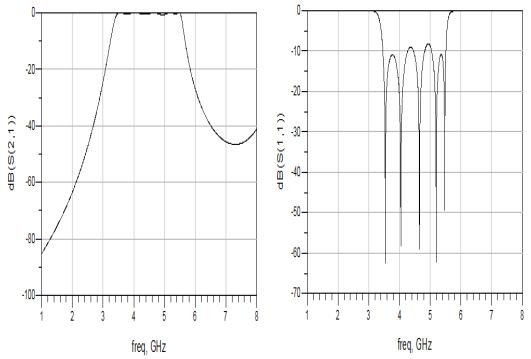

Figure-8. Simulated output for hairpin filter.

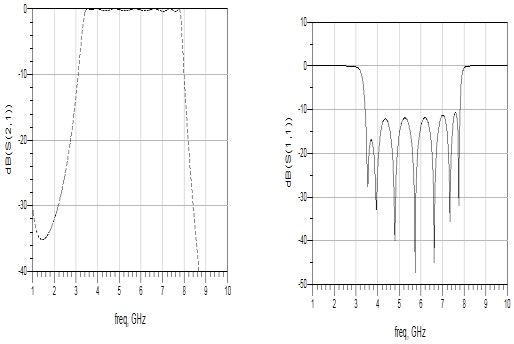

Figure-9. Simulated performance for combline filter.

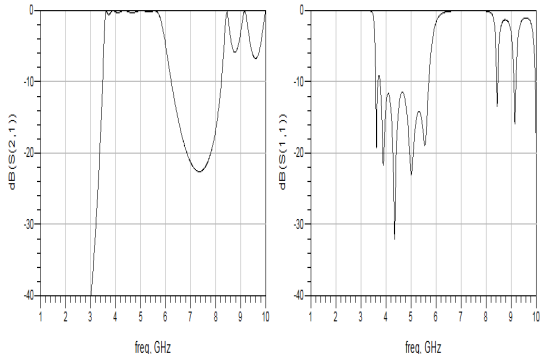

Figure-10. Simulated performance for tree coupled filter.

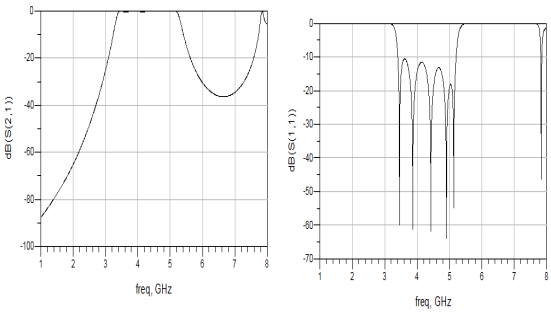

Figure-11. Simulated performance for cross coupled hairpin filter.

10. CONCLUSIONS

Thus the BPF coupling topologies for UWB application have been designed. Filters are achieving their passband at their center frequency of 4.8 GHz. In the future work the notch or the stub can be introduced in the designed filter for the higher range UWB application. Further optimization can be done with the designed filters to get the exact values and by closing the end ports that will give better coupling between the resonators.

REFERENCES

[1] Performance comparison of Microstrip bandpass filters topologies on different substrates by N. priyanga, M. Monica, S. Karthie in 2014.

[2] Double slit complementary split ring resonator based UWB filter by H. Umma Habiba, K. Malathi, M. H. Masood in 2009.

[3] Design method for ultra -wideeband bandpass filter with wide stopband using parallel coupled microstrip lines by Amin M abbosh in 2012.

[4] Jia-sheng Hong and M. J. Lancaster, “Microstrip filters for RF/Microwave Applications,” John Wiley and sons, 2001.

[5] http://defenseelectronicsmag.com/sitefiles/defenseelectronicsmag.com/combline.pdf.

[6] David M Pozar, “Microwave and RF design of wireless systems,”John Wiley and sons, 2001.

[7] A Overview of Microwave Bandpass Filters Wit Capacitive Couples Resonator", Sinisa p. Jovanovic in December 2010.