# Design of Broadside Coupled UWB Bandpass Filter with DGS

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## Abstract

*Ultra wide band is a wireless technology with very low power used for transmitting data. It consists of a wide spectrum and thus has a variety of applications. It ranges from 3.1GHz to 10.6GHz.The UWB bandpass filter is an essential component in the UWB systems. In this paper a UWB band pass filter is designed using broadside coupling structure with Defective Ground Structure(DGS). It has a pass band from 3to 11 GHz. It has a minimum return loss of 15 dB of about 4 KHz and an insertion loss of 0.5 dB. The modified coupling structure is designed by using a dual-line parallel coupled line which is taper -connected to two folded open stubs. DGS is etched over the stubs to obtain better selectivity.*



**Keywords: Ultra Wide band (UWB), Defected Ground Structure (DGS),Band Pass filter (BPF),Folded Open stub (FOS).**

## 1. Introduction

UWB technology is promising for local area networks, position location, tracking and radar systems because of low power consumption and because it offers a wide spectrum. UWB filters must have a fractional bandwidth of more than 110 % and it is one of the difficulties experienced while designing [1][5]. Here three different designs have been compared in order to attain a filter which has very low return loss and insertion loss and a wide passband.

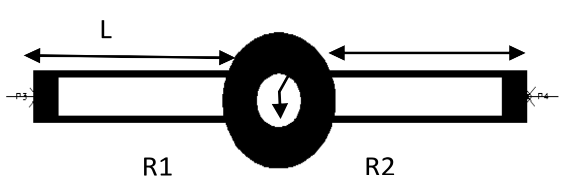


**Figure 1**: UWB BPF using Ring resonator with two coupled lines (F7)

R1= inner radius=0.7 mm
R2=outer radius=1.8mm
L=length=6.2 mm
The above dimensions are used for the remaining designs.
A UWB BPF is designed using a circular ring resonator [3] with two coupled lines. The first two resonant frequencies are allocated using this methodology [5].

**Figure 2**: UWB BPF using Ring resonator with three coupled lines (F8)

The above figure represents the same resonator structure with three coupled lines. This is introduced to enhance the return loss and insertion loss.

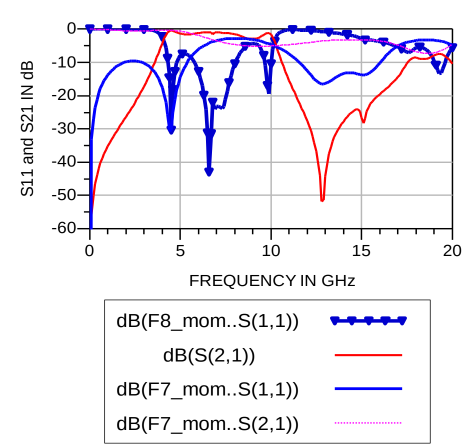


**Figure 3**: Comparison of UWB BPF using Ring resonator with two and three coupled lines

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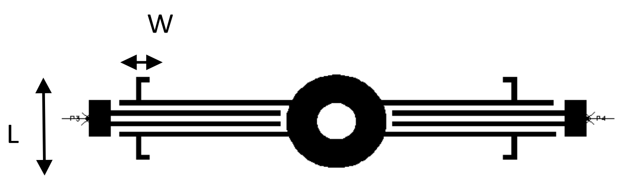
The above simulated result is a comparison of the ring resonator with two and three coupled lines. The return loss in the first case is poor and is found to be improved in the latter.For obtaining a wider passband broadside coupling is introduced as shown in figure.4.

**Figure 4**: UWB BPF using Ring resonator with broadside coupled lines (F5)

The broadside coupled line structure is used to provide better or tighter coupling. Though it provides a better return loss and insertion loss it lacks in selectivity which is attained by using the ring resonator with broadside coupled lines with folded stubs as shown in fig 5.




W=width of the stub=1.1 mm , L=length of the folded stub=3.2mm

**Figure 5**: UWB BPF using Ring resonator with broadside coupled lines and folded stubs (F6)

The width of each coupled line should be a minimum of 0.2mm. If not, fabrication would not be possible. If it is greater than 0.2mm then tighter coupling will not be achievable.

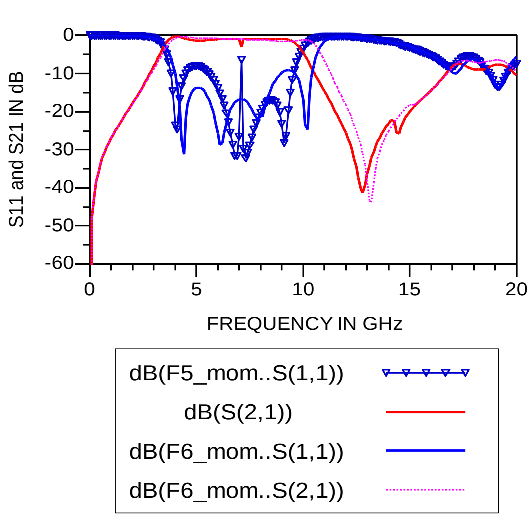



**Figure6**: Comparison of UWB BPF using Ring resonator with broadside coupled lines and broadside coupled lines and folded stubs

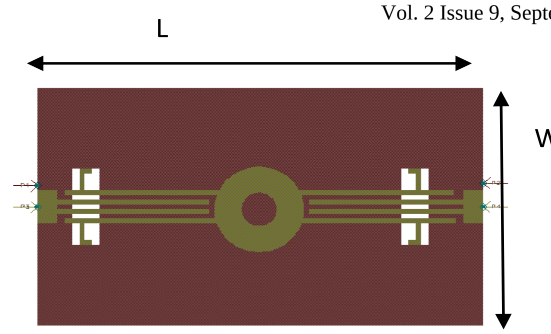



**Figure 7**: UWB BPF using Ring resonator with broadside coupled lines and folded stubs with DGS L=10mm, W=18mm

The UWB band pass filter is designed using broadside coupling structure with Defective Ground Structure (DGS). It has a pass band from 3 to 11GHz. It has a minimum return loss of 15 dB of about 4 KHz and an insertion loss of 0.5 dB. The modified coupling structure is designed by using a dual-line parallel coupled structure which is taper -connected to two folded open stubs. DGS is etched over the stubs to obtain better selectivity as shown in fig.7.The insertion loss performance of the filter is improved by introducing DGS.



### 2. Design of compact UWB BPF using Broadside coupled coupling structure and DGS

In this design a Broadside coupled structure is constructed by connecting four parallel lines with taper -connecting two folded open stubs to the parallel coupled lines. It provides much better coupling which is an essential requirement for UWB BPF. It is implemented to provide a stronger coupling between the input/output port and the resonator .Two folded open stubs are provided to improve selectivity at both lower and upper cut-off frequencies. The designed filter has a length of 10 mm and breadth of 18 mm as shown in figure 7. It has a thickness of 1.6 mm.

Defected ground structure (DGS) is realized by etching rectangular defects in the back side of the metallic ground plane[9]. DGS introduces higher impedance and band rejection for a good out- of band performance. Also it reduces the size of the microstrip design and eliminates spurious response in the stopband. The simulated results (using ADS) shows that a passband of 3 to11 GHz with a better return loss and insertion loss compared to the other two designs of about 15 dB and 0.5 dB respectively.

## 3. Comparison of UWB Topologies

**Table 1**: Comparison of UWB topologies

| Filter topology | Bandwidth | Return loss | Insertion loss |
|---|---|---|---|
| **UWB BPF using Ring resonator with broadside coupled lines and folded stubs** | 3 to 9 GHz | 10 dB | 0.3 dB |
| **UWB BPF using Ring resonator with broadside coupled lines and folded stubs with DGS** | 3 to 11 GHz | 15 dB | 0.5 dB |

The comparison of the two UWB topologies indicates that the broadside coupling structure with folded lines combined with a circular ring resonator using DGS is preferred.

## 4. CONCLUSION

Initially a circular ring resonator is designed with two coupled lines followed by the same ring resonator with three coupled lines. Their passband and return loss were poor so broadside coupling was introduced with the same design parameters. It lacked in selectivity though it had a wider passband. So a broadside coupling structure with folded stubs was proposed for designing a UWB BPF using DGS and its passband, return loss, insertion loss were found to be much better than the previous designs. The designs were simulated using ADS.



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