# A Rectangular Ring Shaped Ultra-Wide Band Pass Filter Design

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## Abstract

*A rectangular ring type band pass filter with U-shaped geometries kept in ring is proposed in this paper. Feed are connected at the end of open ended stubs. Presented filter is suitable for the application of wlan or the application using frequencies in L-band range. A flat passband response can be achieved when it is employed to implement a bandpass filter. The resonator also exhibits attenuation poles close to the edges of the passband, thereby offering sharp rejection in the bandpass filter response. Moreover, since the signal applied at the input port is effectively forced to travel mainly through the transmission line path over the passband frequency, the loss incurred by the coupled lines is minimized. Extensive theoretical analysis of the rectangular ring and design example of the bandpass filter prototypes based on the ring structure is given. The proposed geometry is simulated through ie3d software, and results are purely based on the simulation results.*



## 1. Introduction

Ultra-wideband (UWB) technology was ever investigated in the propagation of time-domain electromagnetic signals in the early 1960s rapid evolution of various wireless services, the demand of multi-band microwave communication systems capable of adapting multiple wireless communication platforms have greatly increased. The BPFs possessing tunable multi-band characteristics are one of the key components in multi-service wireless communication systems. The stub loaded resonators are widely used in the design of BPFs [1,2]. Recently, multi-mode resonators, such as stepped impedance resonators (SIRs) , and stub loaded open loop resonators have been used in the design of multi-band BPFs. It is also of great importance to design tunable dual-band BPFs. A centrally loaded varactor diode in a half-wavelength resonator [5] and a capacitor loaded SIR was presented in the design of a tunable BPF. However, these techniques are mostly focused on the use of variable reactance elements in order to tune the center frequency of the BPFs. Transmission lines with modified ground structure such as a photonic band gap and a DGS, have been actively studied and applied successfully in the design of various microwave circuits [7]. In this letter, a square ring type band pass filter is proposed.

A square ring shape with U shaped geometries is used to achieve ultrawide bandwidth band pass characteristics. The passing band for proposed structure is staring from 1.02 GHz to 1.49GHz which is a ultrawide band pass band.

Most RF filters are narrowband filters, with bandwidths less than 10% of the centre frequency and are designed as coupled resonator filters using a wide variety of filter topologies [1,2], the most common forms being:

### 1.1. Parallel Coupled Line Filters [3],

Use half wavelength long resonators, with electromagnetic coupling between quarter wavelength sections to produce the filtering. They are often made using microstrip or stripline circuits resulting in a low cost filter.

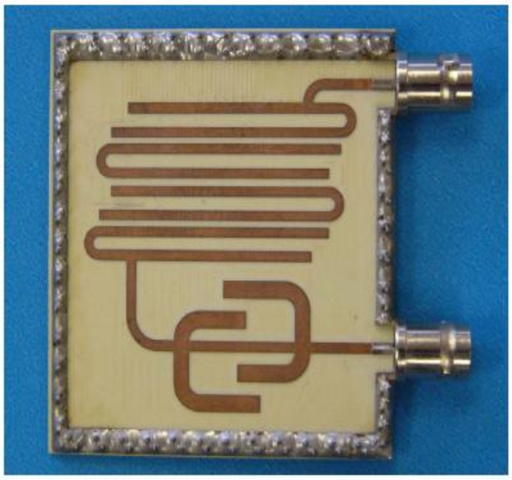

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**Figure 1. Bandwidth Parallel Coupled Line Filter**

### 1.2. Inter-digital Filters [3]

Use quarter wavelength resonators, grounded on opposite ends for adjacent resonators, with electromagnetic coupling between the resonators. Fig. 2 shows a 1 GHz, 70 MHz bandwidth inter digital filter designed by the author. Often these filters are made using round rods in a rectangular cavity. Dishal [6] and Martin have presented design equations for such filters with bandwidths up to 10%. Some commercial manufacturers [6] make inter digital filters with bandwidths up to 33% BW.

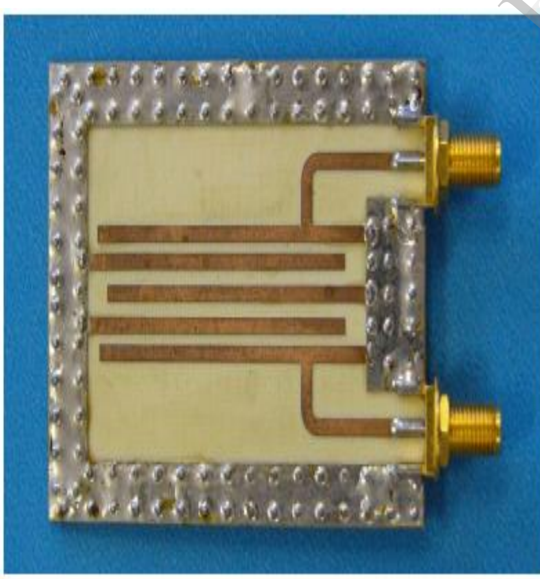


**Figure 2. Bandwidth Inter-digital Filter**

### 1.3. Coupled Coaxial Line Cavity Filters

Use quarter wavelength coaxial lines, located inside a cavity. Adjacent cavities are coupled by apertures in adjoining walls. Such filters are commonly used in narrowband high power applications. Helical Filters [7] are a variation of this type of filter. The bandwidth of these filters is limited by the size of the coupling apertures, which has to be less than the size of the wall joining the two cavities to be coupled. In some Coaxial Line Cavity filters, the cavities are coupled using coupling loops and sometimes these coupling loops are connected using transmission lines.

### 1.4. LC filters

Since Inductors and Capacitors have relatively high losses at RF frequencies, LC filters are not normally used for RF bandpass filters above 100 MHz. At UHF frequencies LC filters are used for low pass or high pass filters.

## 2. Filter design & result analysis

This paper describes a new design technique for the design of band pass filters with large bandwidths. In this filters quarter wavelength resonators are direct coupled using quarter wavelength transmission lines. Fig. shows a microstrip layout for a band pass filter, used for determining the coupling coefficients.

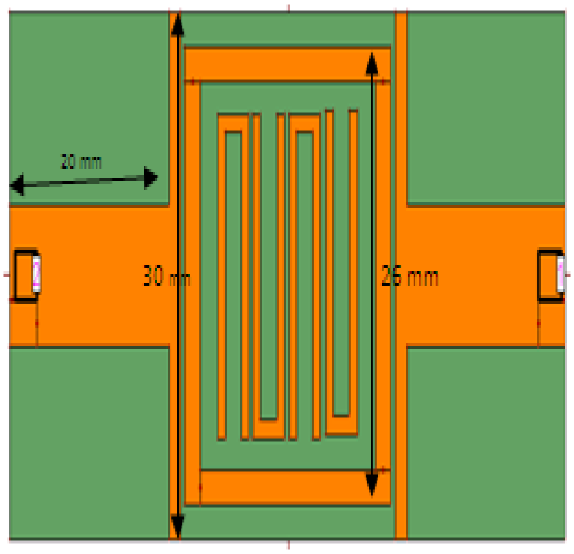
To use this type of filter in a design, the coupling coefficients must be determined as the tapping point is varied. This can be done using computer simulation using IE3D.

The present geometry is combination of three different shapes. The inner most geometry is a series of U shaped geometries with for and back side faces. This series is placed in a rectangular ring which is placed between two T shaped geometries as shown in fig.

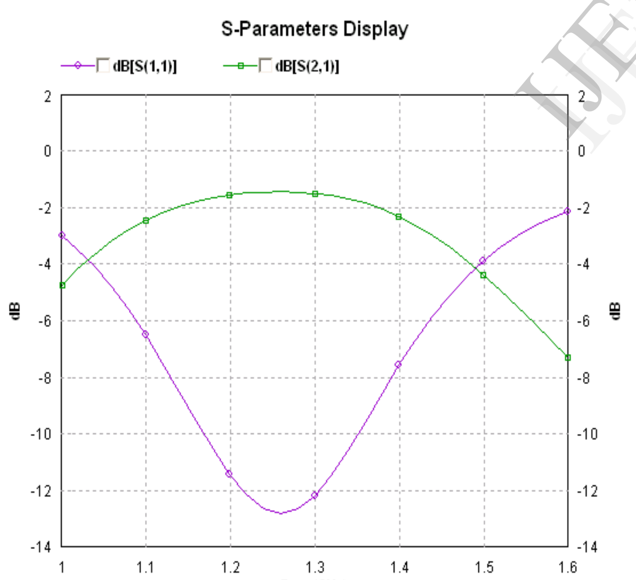
The length of feed stub is been calculated by following relation

$$L = \frac{C}{f_c * 10}$$

Where
C = speed of light in mm
$f_c$ = center frequency of desired band
which comes 20 mm and width of end of stub is been taken 1.5 times of L.




The simulated results of proposed geometries shows that pass band for proposed filter is from 1.02 GHz to 1.48 GHz, which is a band of 460 MHz with center frequency of 1.25 GHz. The bandwidth of pass band for proposed filter is 36.8% of center frequency, which makes this filter suitable for the category of ultra-wide band pass filter.




## 3. Conclusion

A recantangular ring resonator core and its applications to bandpass filters have been proposed and successfully simulated in a microstrip technology using IE3D software a product of Zeland software company. The introduction of a pair of identical open-ended coupled lines with a shunt open stub, into a transmission line branch of a conventional ring resonator, has led to the band-pass filter application. When the rectangular ring resonator is employed to implement a bandpass filter, the ultrawide passband resonance frequencies is achieved.

The presented filter is having more than 36% of passband with center frequency at 1.25 GHz. This filter will be suitable for WLAN application and in mobile applications.



## 4. References

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