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# A Review of Design & Simulation of S Band Planar Microwave Filter for Wireless Application

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## Abstract

Reducing the size of today's wireless communication systems has become an important criterion in filter design with higher performance parameters. Conventional filters are very important for modern wireless communication systems as they do not provide the desired miniaturization and results. Recently, using metamaterials and dielectric resonators, the filter size has been drastically reduced to a very small size for practical applications. This paper provides the review on planar microwave filter. In this paper the design geometry, size, B.W. and other important parameters are compared with various references. This paper provides clear idea and information about SRRs and metamaterial with various references.

**Key words – Planar microwave filter, Metamaterial, Square Split ring resonator (SSRR), Wi - Fi range, Wireless LAN application.**

## 1. Introduction

Now, in recent year wireless communication requires compact, less complex and easy to fabricated devices which necessitated the use of microstrip structures. Microstrip filters are inevitable part of communication system. Various filters are design according to this structure. Now a day's many people have focused on filter design with square split ring resonator (SSRR) or improved SRR structures. The split-ring resonator presented by Pendry can have a negative permeability and is used for the realization of left-handed materials (LHM) with a negative refractive index. The SRRs are made up of concentric rings of non-magnetic metal such as copper. When they are generated by a magnetic field, their real part of permeability can be very positive to negative near their resonance frequency. This resonance frequency is a narrow band that can be explained by analogy with the LC resonator, where the inductance L is the length of the ring and the capacitance C is the size of the cut. Because of their properties, the SRRs are used to reduce the size of the microwave filter. And these filters are also narrow-band. [8] The position and the width of the stop band filters are depend on the size, number and position of SRRs. SRRs with different size and position gives the dual frequency response with reduced structure of SRRs in S – band. By varying the size of SRRs we can varies the frequencies for desired frequency of response. And also by varying the distance between SRRs we can achieve good frequency of response.

Square split ring resonators are used to improve the parametric response of filters. A resonator is a device or system that exhibits a resonance or resonance effect. In other words, it has greater amplitude at some frequencies, called resonant frequencies, than others. The resonator vibration can be electromagnetic or mechanical (including acoustic). Resonators are used to generate a wave of a specific frequency or to select a specific frequency in a signal.

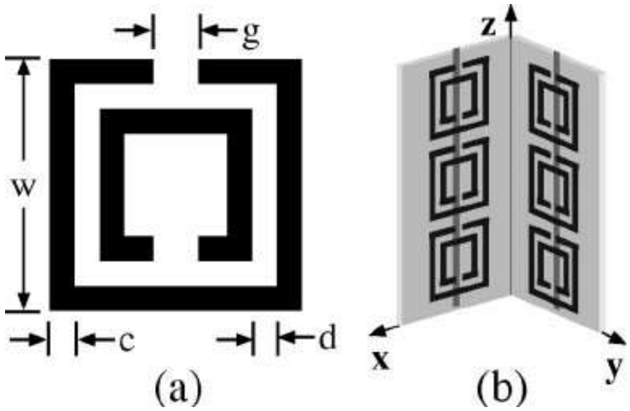


Fig: (1) Diagram of split ring resonator

Metamaterial property is become beneficial to design this filter. A properly designed metamaterial can create waves. Electromagnetic radiation or Dream this is a possibility that you cannot see with bulk solids. People showing negative things Refractive index it has become the focus of much research on specific wavelengths. These ingredients are known as: Negative index metamaterial.

## 2. Literature review

In previous researches there are many stop band filter design using metamaterial property but it gives one frequency of response and higher filter size. Here my main motive is to reduce the size of filter and get dual frequency of response. To design this filter I take huge reference of earlier researches which consists many different design and methodology which explained bellow.

The authors of those researches have uses different techniques like, Moore fractal geometry method, Using property of MTM resonators, Defected ground structure (DGS) method, Advanced coupling matrix synthesis technique, Von Koch snowflake fractals etc to improve their results and parameters. They use different geometries of design to satisfy their applications. Many paper consist comparative analysis of different papers and journals where many parameters are compared with each other and get good parametric response.

Now a day's many people have focused on the filter design with SRRs. Split ring resonator have a negative permeability and is used for the realization of left-handed materials (LHM) with a negative refractive index. Especially square split ring resonator is used to get good frequency of response and higher parametric response. By using the geometry of square split ring resonator we can achieve the compact size of filters. The geometry of SRRs are easy to design and fabricate. The complexity of overall circuitry is reduced by using this structure.

Now a day's many filters have designed using property of metamaterial. Metamaterials are the material which have combine property of all material used to design the structure of filter. The metamaterial generates their own property from different materials and used to get better frequency of response at less complex design with compact size. The materials are usually arranged in a repeating pattern. Exactly shape, geometry, Size, orientation Arrays offer intelligent manipulation properties. Electromagnetic: Blocks, absorbs, reinforces or bends waves to achieve benefits beyond what is possible with conventional materials.

There are some notable advantages by using microwave metamaterial filter like, filters can be flat and light in weight, less complex design, compatible for flat integration with other component, law power consumption etc. These advantages lead the metamaterial microwave filter at a certain stages. By these advantages of microwave filter it becomes real discovery in communication world. Now a day's for digitalization craze of miniaturized circuits has becomes extremely high. And here by sing metamaterial property we can achieve compact sized circuitry with good parametric response.

## 3. Comparative analysis of planar microwave filter

Table: 1 Comparison analysis of planar microwave filter with review paper methods, frequencies and applications

| Paper/Year | Methodology | $f_0$(GHz) | Application |
|---|---|---|---|
| **[7]2020** | Moore fractal geometry | 5.8 GHz | Wireless application |
| **[2]2020** | Property of MTM resonators | 3.24 GHz | Wireless application |
| **[4]2020** | Defected ground structure (DGS) method | 3.65 & 5.67 GHz | Wireless communication application |
| **[5]2019** | Advanced coupling matrix synthesis technique | 0.24 GHz | Wi – Fi and WLAN application |
| **[3]2019** | Von Koch snow flake fractals | Filter:- 3 GHz & Filter:- 3.4 GHz | Wireless application |
| **Proposed work** | Property of MTM resonator | 2.45 & 3.65 GHz | Wireless communication application |

Table: 2 Comparison analysis of planar microwave filter with different review paper parameters

| Paper/Year | Insertion loss | Fractional B.W. | Size |
|---|---|---|---|
| **[7]2020** | 1.5 dB | 12.8% | $8.83 \times 6$ mm$^2$ |
| **[2]2020** | 0.95 dB | 4.32% | $14 \times 14 \times 1$ mm$^3$ |
| **[4]2020** | <0.62 dB<br><0.45 dB | 12.3% and 127.67% | 0.0546 $\lambda^2$g |
| **[5]2019** | 0.4 dB | 4.9% | $0.049\ \lambda_0 \times 0.026\ \lambda_0 \times 0.047\lambda_0$ |
| **[3]2019** | 1, 1.2 dB | 29% and 143% | - |
| **Proposed work** | 0.9, 0.8 dB | 3.47% and 2.76% | $40 \times 28$ mm$^2$ |

## 4. Conclusion

Various method of designing planar microwave stop band filter at various applications is reviewed. This review paper is based on effect of metamaterial component on stop band filter using SRRs. In this paper various reviews are taken in to consideration for good performance of microwave planar filter. Finally narrow band filter is designed and simulated by referring various review papers for WLAN application. To design this filter simple geometry is used. This filter is compact in size and lighter in weight.

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