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# MULTIBAND LOW PASS FILTER: A REVIEW

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## ABSTRACT

Here we are going to design multiband low pass filter with the help of HFSS software and stimulate design with different parameters and make it wrathful for real life implementation. Filters are the basic part in wired, and wireless telecommunications and radar system circuits and they play an important role in determining the cost and performance of a system. All these have made a vital contribution to both the required performance specifications for filters and other commercial requirements in terms of low cost, large storage capacity and high-speed performance. This review paper presents several design examples for multi-band, multi-mode micro strip filter resonators to satisfy RF, WLAN, WiMAX, UWB and other wireless communication frequency bands. To analyse the resonant frequencies odd-mode and even -modes can be used for the symmetrical structure. In general, the multi-mode resonators can be designed by using different methods like cross-coupling resonators Structure, and the allocation of the fundamental resonant frequencies of the resonator as stated by the Chebyshev's insertion loss function. We will also discuss about the low pass filter and how this filter can be used to build Multiband filter. We planned to reduce the no of components for lightweight design and low power consume to provide efficient used and also try to use high frequency modern components to provide better gain.

**KEYWORDS:** Satellite Communication, WLAN & FM, High Frequency Modulating Device, UWB (Ultra-Wideband Filter).

## INTRODUCTION

We all know about filters and their works but sometimes filtering a very high or very low frequency leads to a complicated filter structure. To avoid this problem Multiband low pass filter been introduced to provide high accurate output with lesser loss. We use microstrip liens to have compact design of circuit and less chance of burning or damage of circuit. An ideal filter is a linear 2-port network that provides perfect transmission of signal for frequencies in a certain passband region, infinite attenuation for frequencies in the stop

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band region and a linear phase response in the passband (to reduce signal distortion) [1]. The goal of filter design is to approximate the ideal requirements within acceptable tolerance with circuits or systems consisting of real components. The increasing demand for high performance in the fields of RF, WLAN, WiMAX and other wireless communications led to the great revolution in the advancement of the development of a compact micro strip resonator filter design.

Low-pass filter (LPF), High-pass filter (HPF), Bandpass filter (BPF), Band stop filter (BSF), arbitrary type etc. In each category, the filter can be further divided into active and passive types. In active filter, there can be amplification of the of the signal power in the passband region, passive filter do not provide power amplification in the passband. Multiband filter was first introduced to reproduced higher band of frequencies to pass[2]. It contains several bands for passing different type of desired frequencies for different purposes. The principle of stepped impedance resonators helps to create building block of MULTIBAND filter[4,6].The faster development of wideband wireless communication, bandpass filter with high performance low cost insertion loss and compact BPF are highly desirable[5].There is also a concept of UBW(ultra-wideband filter) which is specifically design to eliminate the interference causes by WLAN tech.This UBW filter made with the process of Quadruple-mode ring resonator which has an excellent in-band performance and allows controlling resonant frequencies sensitively, thus achieves low return loss and insertion loss[6].This type of filter could be useful in radar, measurement, test system, sat communication. The filter can be designed with help of stepped impedance method. Lumped elements are converted into microstrip line with the help of Richards transformation method. Third order stepped impedance low pass microstrip filter has been designed and analysed using Ansoft HFSS software at 1GHz frequency on Droid substrate [8,9] Ideal filter has no loss with the pass band. Th ease of the microstrip line is to transport microwave signal with better gain. In medical and military application the wearable systems like HUD, VR really takes the innovation into a next level where microwave link works as a major part [10].The distribution of the microwave filter components over the entire circuit, microwave filters still occupies a lot of space. For the coupled transmission line through the broad bandwidth property [11]. There is also a concept of dual-band filter which are often used in wireless communication system [12]. For the high frequency satellite communication to control the interference, it is indispensable to use some kind of filter in the antenna system [13].

## HISTORICAL BACKGROUND

Previously filters were not so much used widely like nowadays. The scope of using filters were not so much widespread because of the components used in the filters were so big and it takes more space and costly, but the concept was same just like now. Filter is very essential component in wireless communication system. Since need of compact devices is increasing day by day, Filter plays very important role in developments of such devices [1]. Despite the increasing importance and critical needs, reconfigurable radio frequency (RF) multiband filters are currently underdeveloped even both RF electronics and photonics technologies are being explored. Although RF multiband filters with large numbers of simultaneous passbands and wide frequency tuning range are extremely desired, achieving such functionality is extremely challenging. Previously filters were used only in FM and AM widely but now a days it's been used for high rated communication system. In recent years UBW band pass filter creates a major change in modern communication process [2, 3,5].

 

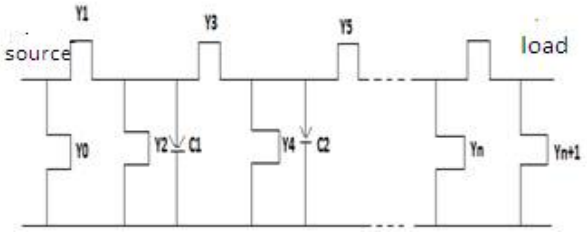


**Figure 1.Each node represents a resonator. (a)inline topology(b)Folded topology [5]**

## LITERATURE SURVEY

In this paper a pure semiconductor substrate is used to design low pass filter and its characteristics and has a defect ground structure in the use of high dopant semiconductor substrate that increases the sharpness factor of a filter. In the above paper the proposed low pass filter makes use of a defected ground structure which is planar in nature and makes use of an anisotropic substrate. Here a defected ground structure is created by introducing discontinuities in the ground plane of micro strip line [1, 2]. In this paper we designed an equivalent circuit of Multiband low pass filter with the help of coupled circuit and analysis it by mesh analogy. The results obtained are studied and further improved using iteration. In the referred paper, a defected ground structure having dumbbell shaped slot is included in a low pass filter. The hybrid microtrap t-STUB/ DEFECTED ground structure cell is designed, which is composed of a micro strip T-stub and inter digital DGS with the broadside couplet transition [3]. Various filters working in microwave frequency range are discussed as per the designing purposes and applications. The various filters used are- 5$^{th}$order Chebyshev filter for dimension scaling and tuning of microwave filters using formulation of feature-based optimization algorithms and construction of inverse surrogate model [4,5]. Band pass filter is one of the essential passive components in the UWB technologies. In recent years various UWB band pass filters have been reported based on numerous design techniques. Multiple mode resonator (MMR) was originally proposed in the form of a stepped impedance resonator (SIR)[6].In this paper there is also discussed about stepped impedance method to design filter, with the help of two steps we can design filter [8].The use of Ansoft HFSS software is also useful to have a conception of the overall structure of filter. As it's an electromagnetic software package to create 3-D structure of the filter so it's easy to use [9,10,11,13,17]. In addition, high speed local area networks and other services such as WiMAX and ISM operate between 2 to 6 GHz frequency with band rate 100 MHz [12]. There also a concept come which is quad band microstrip where the filter is designed and its low insertion loss makes it suitable for design multiband filter [14]. In this year's mobile and wireless technologies are adopting more than one communication technologies and for that multiband radio frequency and microwave module plays an important role[15].

## WORKING PRINCIPLE

A micro strip filter has a planner structure and T shaped microtrap feed line both are printed on dielectric substrate. A gap is kept between feed line and middle resonator to provide coupling electromagnetic energy to the ports to the centre micro strip section T shaped feed line is used [1,2]. Unique resonator designs reduce overall size and increase peak power handling. Using silver plating on our resonators and internal cavity surfaces reduces loss and offers higher Q than other less expensive plating methods. The unique low dielectric constant stabilizing structure helps to diminish overall sensitivity to shock and vibration [3]. The

 

various filters used are 5$^{th}$order Chebyshev filter for dimension scaling and tuning of microwave filters using formulation of feature-based optimization algorithms and construction of inverse surrogate model [5]. Chebyshev BPF using cavity combine filter- prototype conversion into combine and presented low pass using HFSS. There are such few algorithms by which a filter can be designed, one of them is:

## DIMENSION SCALING ALGORITHM

The proposed procedure has two stages: (i) obtaining the reference designs and constructing the inverse model, (ii) filter scaling. Stage (i) is executed only once for a given filter structure and scaling range. Then, the results can be reused at essentially no cost. The second stage has two steps. By valuating the inverse model, we can obtain geometry of the scaled filterwith a feature model surrogate we can tune the filter [5].

## LOW PASS PROTYPE CONVERSION AND STIMULATE USING HFSS

It is presented how to derive the L, C resonator starting from a low-pass prototype coupling matrix, which consists of a unity capacitance and frequency invariant susceptance. After L &C values are obtained then the next step is to combine them in equivalent circuit, shown in figure 1[4,5]. Where Y0, t refers to the admittance introduced through any cross-coupling between the resonators.

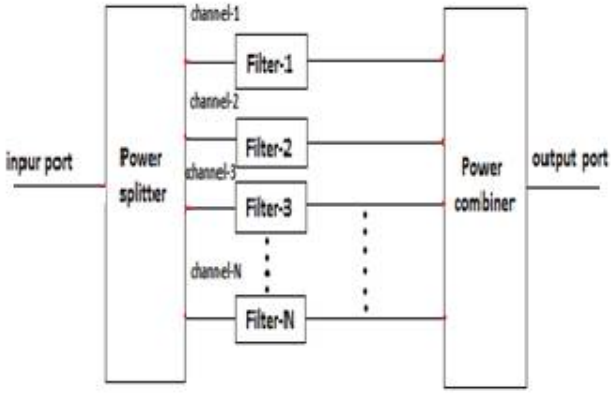


**Figure 2.Multiband filter power transformation with the help of LPF**

Now for before designing Multiband filter we have to design the separate filters, like wise low pass filter. The two basic steps of designing the stepped impedance low pass filter are to select an appropriate low pass prototype and find an appropriate micro strip realization that approximates the lumped element filter. For proposed design work, Chebyshev approximation is assumed which exhibits the equal ripple pass-band and maximally flat stop-band. The general structure and LC ladder type stepped impedance low pass micro strip line filter [6, 7, 8, 10]. HFSS software is widely used to have an overview of the filter and work on its characteristics individually so we have a conception of Innovation. The example of HFSS software and utility has been shown in paper [8,9,11,12]. The microwave filters were designed with four parallel coupled lines, and LaAlO3 substrate is assigned to act a as a dielectric material. The data of dimension of such as height, width and radius are put in a command dialogue window to get desired high performance result [9,10,11]. A concept of new generation BPF with tri band property using short stubs and there is also a concept of six band BPF filter invented for high performance[15]. For the wearable low pass filter tech we use jeans as a substrate and copper adhesive tape for micro strip line

 

structure and ground surface[8,18].But above all the main problem of losses comes across which are insertion loss and return loss which can be obtained using ABCD parameters to the overall circuit. The ABCD parameters are nothing but cascade condition of the filters and the matrix representation of major parameters like resistance, inductance, capacitance etc[20]. The advantage of using ABCD parameters is that two or more ports can be analysed and also helpful to create low loss Multiband filter.

## ADVANTAGES

- These filters are used in microwave system like radar measurement and test system and in satellite communication [1, 2, 9,10].
- This microwave filters are cost efficient, higher selectivity and uncomplicated structure [10].
- The use of Micro strip line helps to decrease noise in the channel and faster communication with higher efficiency and it's also cheaper, lighter [10].
- It can access different services with single multiport terminal, in addition HIGH SPEED WIRELESS LOCAL AREA NETWORK (WLAN) and other services like WIMAX and ISM operator [12].
- Multiband reduces the size of band using compressor circuit for reducing size, cost and components [11,12].
- The wide stop band is a main advantage of rejecting unwanted frequencies of multiband filter [18,19,21].

## DISADVANTAGES

- The passband control is limited which is kind of difficult for low frequencies [11].
- The microstrip has a great loss compared to other transmitters [12].
- Electromagnetic spectrum is limited.
- Using of same antenna creates more complex when it comes about band pass filter.
- Design is far more complex than other filters as for parameter calculation [12].
- The insertion loss and return loss creates a major problem in this multiband filter [10,12,15,18].

## PRESENT RESEARCH

Nowadays filters are designed perform multiple operations on few gigahertz about 200-330GHz.Now researchers can handle complex designs like the 50 watt diplexer which required isolation of 80 dB and insertion loss of less than 1 dB from 880-910 MHz and 928-960 MHz. This military requirement was made even more complicated with both height and width restrictions. Utilizing sophisticated software like Sonnet EM Simulator and SolidWorks and creative layouts can be realized to optimize package size and electrical performance that is so helpful for consumers and real time application. Now a days researcher look for the current densities and heat dissipation for high power handling low packet density which is now used in sat communication for better seamless and distortion less communication . Developers look for few physical things like: API tubular filters have inherently broad the stopbands with very high rejection levels. With low recorded insertion the loss performance decreases to less than 0.1 dB, the latest tubular filters consist of a series of semi-lumped capacitive coupled low pass sections, using low loss dielectric spacers [3, 4]. Providing both excellent harmonic suppression and rejection of out of band noise, these designs answer many quick turn-around time requirements as well as handling high power applications [10]. Wearable low pass filter is the latest tech[12] which is about to use and the tri state BPF is invented to provide high performance filtering system and later to be extended into six state BPF[15,19,20] which is great invention for wireless, mobile and satellite communication.

 

## FUTURE SCOPE

In order to control the interference in the satellite communication, it is Indispensable to use some kind of filter in the antenna system which provides the band stop and bandpass filtering characteristics. To reduce this indispensability FSS structures are potential candidates. Bandstop/ bandpass filtering behaviour and scattering characteristics particularly, the frequency response, bandwidth, and angular/ polarization stability of the structures. The process of computation of different geometrical parameters is presented and achieved by this synthesis technique are supported by the experimental as well as simulation results.

At every frequency the filters should work of their own perfectly, parameters are analysis so. HFSS software is so needed now for better output of the filters. The proposed synthesis technique is used to design bandstop SSLFSS at different frequencies (3 GHz, 22 GHz and 26 GHz) and further extended to design the bandpass SSLFSS structure. Moreover, a way to control the reflection at any chosen frequency is discussed, which may find potential applications in controlling the reflection coefficient at various frequencies of the electromagnetic spectrum.At each frequency of interest, the resonance responses are discussed in terms of the significant angular (up to 50) stability, polarization (perpendicular and parallel) stability and bandwidth, which signifies that the simple proposed geometry of FSS structure provides significantly better angular and polarization stability as compared to that of the various reported FSS structures[13].

## CONCLUSION

A multiband band pass filter has been designed in this paper. For miniature of the filter 3 or 4 slots are designed to give quad band response [1]. Due to the compact size and multiband operation, these filters are predictable to be useful in a horde of wireless applications where multiband operation is necessary. The simulation in HFSS software causes insertion loss, return loss, VSWR and group delay of the proposed BPF [4]. Reference paper results that by using the Chebyshev filter of fifth order for dimension scaling and tuning of microwave filter has inaccuracies due to high sensitivity of filter characteristics. The filter example with different parameters shown in paper [8,10,11]. The simulation result of the designed filter has been investigated using HFSS and found it depends on the circuit physical dimensions such as, line width, line height, line coupling long, and the distance between the lines. The microwave filter is designed to have low RF loss and small area of LaAlO3 substrate[11].Here also a cascaded ladder filter configuration has been discussed which is capable of generating multiple pass-bands at desired frequencies, suitable for wireless communication[12].The quad band filter is used for a wireless system that can support GSM, WLAN, Bluetooth and WiMAX wireless standard which has been designed, tested and is found to perform well under complex circumstances ,so the multiband filter also useful for the mobile communication [14].Due to the chance of cable loss and substrate soldering to the ports the reference cut-off frequency has been set up to 5-10MHz[12,16].The other purpose is this filter not only shows superior harmonic suppressor but also saves size due to its compact micro size[19].

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