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Review Paper

Different Methods of Designing Ultra Wideband Filters in Various Applications-A Review

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ABSTRACT

This article presents the designing of ultra wideband filters are used in wireless technology systems to transmit data over spectrum of frequency bands for short distance with very low power and high data rates. The six different methods which can be used to design ultra wideband (UWB) filters are (1) Combined High Pass / LowPass Microstripline UWB Filters. (2)Ultra-Wideband Bandpass Filter Using Hybrid Microstrip Defected Ground Structures. (3) A Novel Compact Ultra Wideband Bandpass Filter Using Microstrip Stub Loaded Dual Mode Resonator Doublets. (4) Ultra-wide microstrip band pass filter using short circuited stubs. (5) Design Method for Ultra-Wideband Bandpass Filter with wide Stopband Using Parallel-Coupled Microstrip Lines. (6) UWB High-Q Bandpass Filter with Wide Rejection Band using Defected Ground Structures.This paper also discusses about the designing of filters and its various parameters. Various applications of the UWB filters are also being presented. The main objective of the paper is toprovide practicing engineers the information in this field to design UWB filters.
Keywords: Ultra wideband filter, Dielectric substrate, Coupled micro-strip line, Band pass Filters.

1. Introduction

The Federal Communications Commission (FCC)'s decision to permit the unlicensed operation band from 3.1 to 10.6 GHz in 2002 Ultra-Wideband (UWB) technology has drawn attention of researchers for high-speed wireless connectivity applications. UWB systems are very promising, because they provide higher transmission data rates than those of other wireless communication systems with low power dissipation.

1.1 Classification of UWB filters

There are four types of filters which used to reject the unwanted signal frequencies while permitting the required frequencies.

1.1.1 Low pass filter

This filter is to provide good transmission for the frequencies lower than the cutoff frequency and reject the other frequencies

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1.1.2 High pass filter

This filter rejects the frequencies lower than the cutoff frequency and provides a good transmission for high frequency.

1.1.3 Band pass filter

This filter provides good transmission for a certain frequency band and rejects the other frequencies.

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1.1.4 Band stop filter

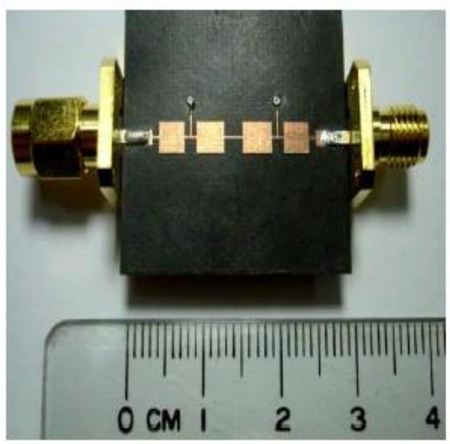
This filter provides rejection at certain frequency band and provides good transmission for all other frequencies [2-3] RF and microwave filters are also classified as active and passive filters based on the technology used. Active filters are realized by using active elements such as transistors, diodes and Op amplifiers. These filters are simple to realize as they provide high gain, high quality factor, and can be easily integrated with other system components. However, due to the active elements used in the filter, the filter requires a power supply, which may increase the complexity to the system. Moreover, the internal feedback is required that may increase the sensitivity of the filter [5]. Passive filters are realized by using passive elements such as capacitors and inductors. These kind of filters have many advantages over active filters, they are more stable than the active filters, no power supply is required, and are less expensive. UWB filters have low cost, high data transmission rate and low power consumption; it has become very attractive in local area networks, tracking and radar systems. As a key component of UWB communication system, UWB band pass filter should have low insertion loss over the operating band, good band rejection and flat group delay, which is important for impulse-radio systems. To meet these requirements, several methodologies have been adopted to design UWB BPFs in the recent years.

2. Uwb Filters Methods

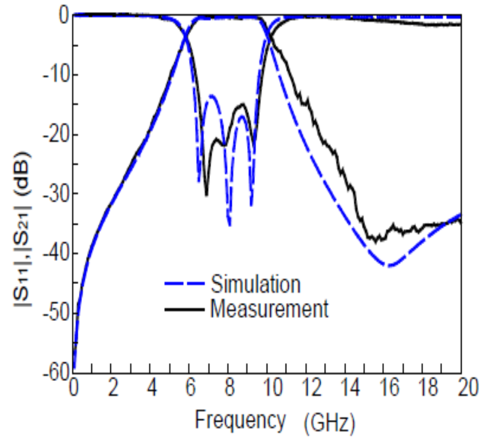
In this paper we have presented the methods used for designing of UWB filters.

2.1 Combined High Pass / Low Pass Micro-strip line UWB Filters.

The design proposes embedding of individually designed high pass structures and low pass filters (LPF). The combination of low pass filters and high pass filters into each other is thereafter optimized for a good in-band performance. The stepped-impedance low pass filter transmission line sections are employed to attenuate the upper stop band and the quarter-wave short-circuited stubs are used to realize the lower stop band [6]. The filter design is shown along with its performance in Fig. 1 below.



(a)

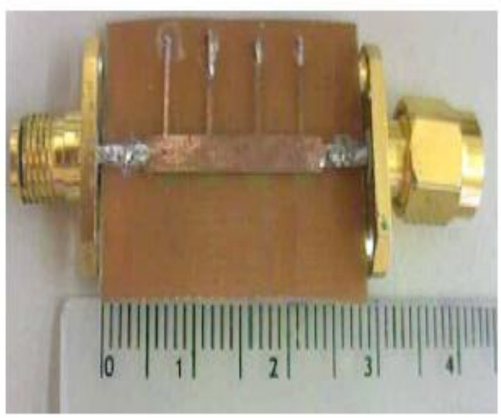


(b)

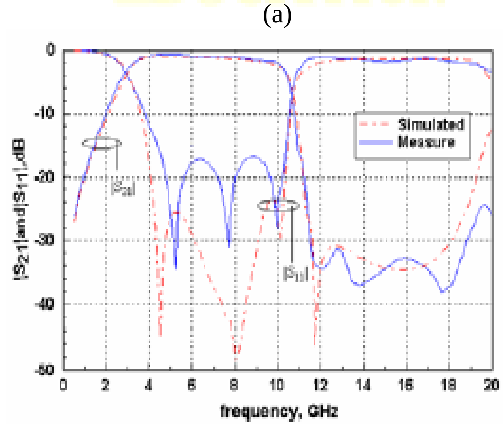
Fig1. Embedding high pass filter stubs into stepped impedance low pass filter: (a) Prototype, (b) Designed Filter Performance

2.2 Ultra-Wideband Bandpass Filter Using Hybrid Microstrip-Defected-Ground Structures.

This filter is designed by using a combination of hybrid microstrip-defected-ground structure lowpass filter (LPF) with typical quarter-wavelength short-circuited stubs highpass filter (HPF). Then it is followed by an optimization for tuning in-band performance. The filter comes with a good performance, including an ultra-wideband bandpass of 3.1 to10.6 GHz, sharp rejection, low insertion loss, flat group delay, high selectivity and excellent performance outside the bandpass [7]. The filter design is shown along with its performance in Fig.2 below.



(a)

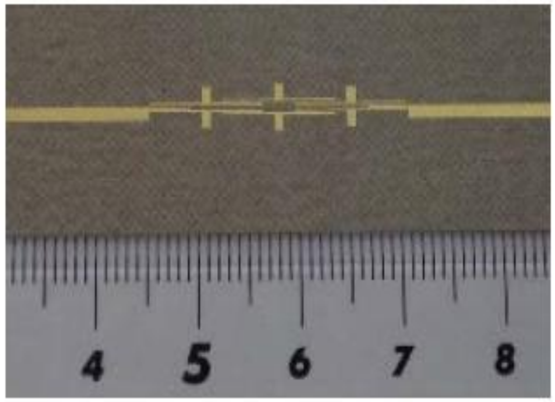


(b)

Fig. 2. Filter using Hybrid Microstrip DGS: (a) Prototype, (b) Filter Performance

2.3 A Novel Compact Ultra-Wideband Bandpass Filter Using Microstrip Stub Loaded Dual-Mode Resonator Doublets.

A novel compact ultra-wideband (UWB) bandpass filter is developed by using microstrip stub-loaded dual-mode resonator doublets. The doublet consists of two parallel but oppositely arranged stub-loaded resonators. The filter has a passband covering to 3.3 to 10.4 GHz, and exhibits sharp attenuations near its passband [8]. The filter design is shown along with its performance in Fig. 3 below.



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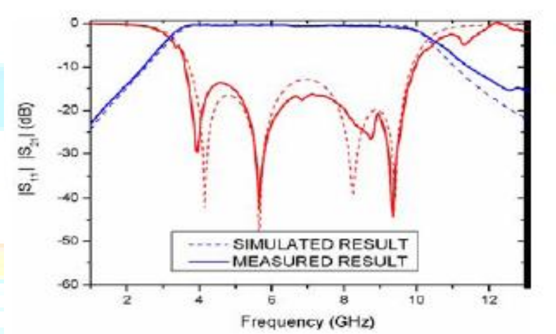
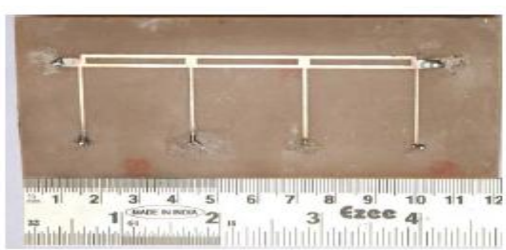


(b)

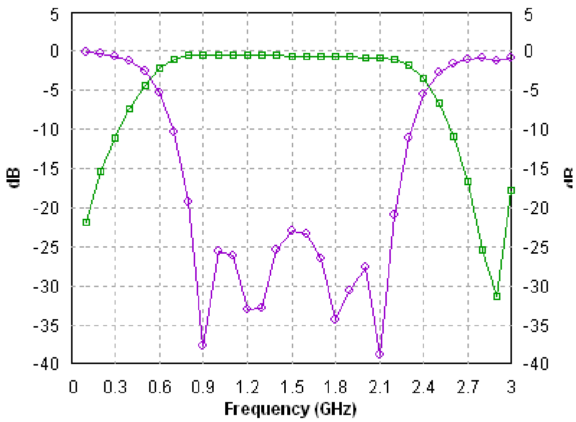
Fig. 3.Filter using Microstrip Stub-Loaded Dual-Mode Resonator Doublets: (a) Prototype, (b) Filter Performance

2.4 Ultra-wide microstrip band pass filter using Short Circuited Stubs.

A novel ultra-wideband microstrip filter is designed by employing short-circuited stubs with etched rectangular lattice.
The etching provides a better return loss. The band pass filter is proposed and physically implemented. The quarter-wavelength short-circuited stubs are used to realize the lower stop-band characteristics. This filter has a pass band covering to 0.6 to 2.3GHZ.[9].Second Harmonic-Suppressed Band stop and Band pass Filters Using Open Stubs with the equivalent T-shaped lines[10].The filter design is shown along with its performance in fig. 4 below.



(a)

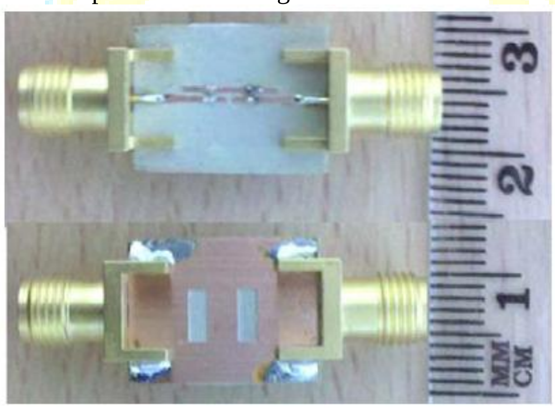


(b)

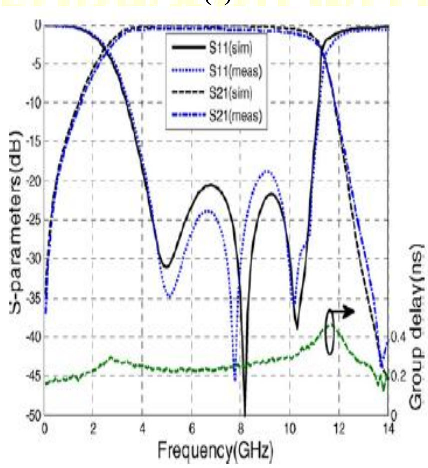
Fig. (4) . Filter using short circuited stubs: (a) Prototype (b) Filter Performance.

2.5 Design Method for Ultra-Wideband Bandpass Filter with wide Stopband Using Parallel-Coupled Microstrip Lines.

The structure of Ultra-Wideband Bandpass Filter is composed of a stepped impedance parallel coupled microstrip line structure. A theoretical model is derived and used to find the optimum length and coupling factor for each of those sub-sections for an UWB pass band and suppressed second and third harmonic responses in the stop band [11]. The filter design is shown along with its performance in fig. 5 below.



(a)



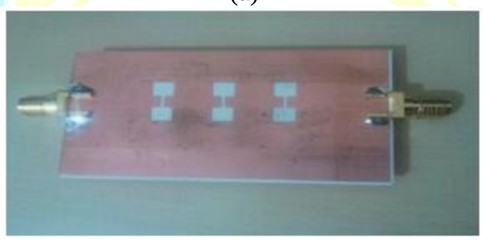
(b)

Fig (5): Filter using Parallel-Coupled Microstrip Lines: (a) Prototype, (b) Filter Performance

2.6 UWB High-Q Bandpass Filter with Wide Rejection Band using Defected Ground Structures.

An ultra-wideband microstrip bandpass filter (BPF) operating from 2GHz to 4.7 GHz, with high selectivity and wide rejection band is presented and experimentally verified. The filter is composed of microstrip lines with shorted stubs acting as a high pass filter (HPF) on top side and dumbbell shaped defected ground structures (DGSs) on bottom side acting as a band stop filter (BSF). The seventh order high pass filter structures and three dumbbell shaped DGS resonators combined on a single layer microstrip substrate are optimized using microwave circuit and electromagnetic simulation tools to obtain the ultra-wideband bandpass filter[12]. The filter design is shown along with its performance in fig. 6 below.

(a)



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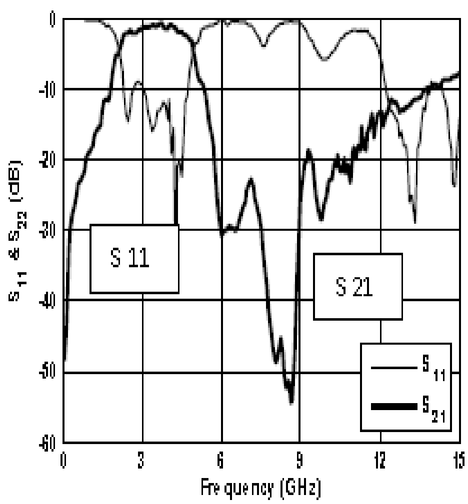

(c)

Fig. (6). Filter with Wide Rejection Band using Defected Ground Structures(a)Top-side view, (b) Bottom-side view, (c) Filter Performance

3. Application Of Uwb Filters

UWB Filters are used in diffierent application Such as radio and television broadcasting, mobile communications, satellite communications, traffic radar, air traffic radar, automotive radar and synthetic aperture radar. In many applications UWB filters are used to reduce harmonics and help in designing power amplifiers, mixers and voltage controlled oscillators. These are also used in removing the DC offsets and removal of low-frequency noise. UWB filters also help in separating different frequency bands like diplexers and multiplexers.[4]

4. Conclusion

In this paper, different methods being used to design ultra wideband filters have been presented. Various application of Ultra Wide Band such as suppress harmonics, removing the DC offsets, select & reject certain frequency has been highlighted. This will definitely help the new researchers to undertake the filter design work smoothly.

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