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Reconfigurable Compact Bandpass Microstrip Filter of Bandwidth 1.54GHz

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Abstract: A new compact Bandpass Microstrip filter with very wide band is presented using Reconfigurable Bandpass Microstrip Filter, it is reconfigured and simulated to Reconfigured Compact Bandpass Microstrip (RCBM) Filter to minimize the size of the filter and to enhance its bandwidth (BW). The achieved BW is 1.54GHz with minimum amount of insertion loss of -0.5dB and compactness of 1/3rd size reduction in the filter compared to its original filter size. In this methodology- varying the spacing, length and width of transmission lines of this RCBM is done. Hence by the variation of its dimensions the size of the filter is reduced with enhanced BW. These filters are used in handheld communication systems- here the size of each component, size of overall system and incorporating more number of features to that system is the main goal in recent research of handheld communication and these are the most important parameters. For this purpose compact filters are required, hence the proposed work is to achieve the compactness of the Microstrip Bandpass Filter by reconfiguring the compact Bandpass micro strip filter and increasing their performance. The proposed RCBM Filter is successfully realised in theory and verified by full wave electromagnetic simulation and the experiment. The simulated and measured results are in excellent agreement.

Keywords: Reconfigured Compact Bandpass Microstrip (RCBM) Filter, Bandwidth (BW), Size

1. Introduction

Microstrip filters have lot of scope and popularity due to its compact size, less cost, low weight and easy fabrication techniques. It has found many real-time applications in low power and medium power RF transceivers. This bandpass filters have low insertion loss, compact size, wide stop band and high selectivity. These are the most important parameters for modern wireless communication systems [1-3]. Analog circuits for wireless communication in the giga-hertz (GHz) range and ever increasing clock speeds of computer circuits in high performance mainframes, workstations and of course personal computers exemplify this trend. In general, due to the rapid expansion of wireless communication, more compact amplifier, filter, oscillator and mixer circuits are being designed and placed in service at frequencies generally above 1GHz [13].

This proposed work gives a way to reduce the size of the filter and increase the bandwidth of Reconfigured Compact Band-pass Microstrip Filters for RF and microwave applications of bandwidth 1.54GHz and compactness of 1/3rd size reduction compare to the original hairpin filter.

2. Proposed Work

The goal of the proposed work is designing and implementation of RCBM filters, these are useful in handheld communications. In these types of communication systems the most important requirements are reduced size, less cost and compact blocks along with high performance. In Microwave filters the micro strip filters plays an important role for frequency selecting and filtering. And in developing and designing of various wireless components that operate at frequency range above 300 MHz, these filters acts as an active component in effectively transmitting the required signals in pass-band region and attenuating the unwanted signals in the band-stop region. In the Latest advances in communications applications demand reconfigured, higher bandwidth and compact RF subsystems. Therefore, much attention has been given to the research on compact reconfigurable microwave devices. Hence here the filter structures and shapes are selected from the already existing filters that could be electronically reconfigured to achieve

good bandwidth and compactness of the filter compare to its original structure [1-4], will be studied through this research.

Design Flow

Reconfigurable Microstrip Filter	to Reconfigured Compact Microstrip Filter

1. Analysis of the compact band-pass Microstrip filters.
2. Selection of appropriate configurations that could be reconfigured.
3. Analysis and design of the selected Configurations.
4. Simulation of the designed band-pass Microstrip filters using Advanced Design system (ADS) 2016.01
5. Comparison between theoretical and Experimental result

End

3. Design and Simulation Analysis

3.1. Basic Hairpin Filter

After the process of the literature survey the selected reconfigurable structure is the basic Hairpin filter (HF) and its dimensions are W=27.2112mm, H=5.0464mm as shown in the figure 1, it consist of six Microstrip coupling lines placed one after the other in a horizontal line with vertical alignment as shown in the figure 1, hence the structure and shape of this filter is like a straight line.

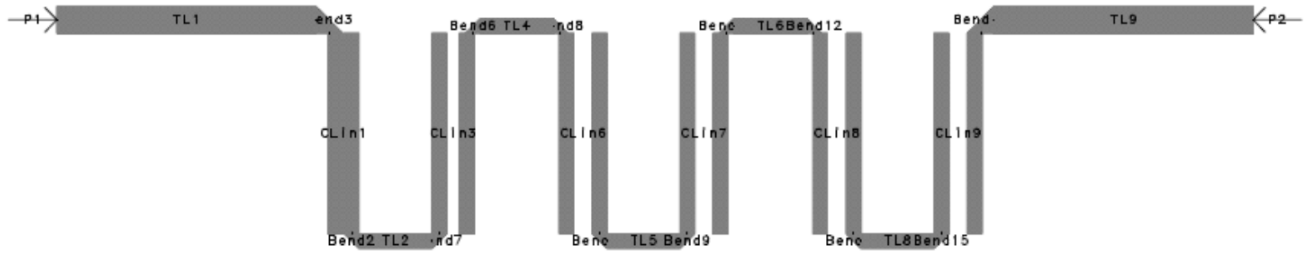


Figure 1. *Basic Hairpin Filter.*

3.2. Schematic Structure of Hairpin Filter

The equivalent schematic circuit of hairpin filter is designed and simulated using Advanced Design System (ADS) 2016.01 Software keeping all the coupling lines and designing parameters same as the original basic Hairpin filter as shown in the figure 2 below, here we can see that the size of the filter is very large.

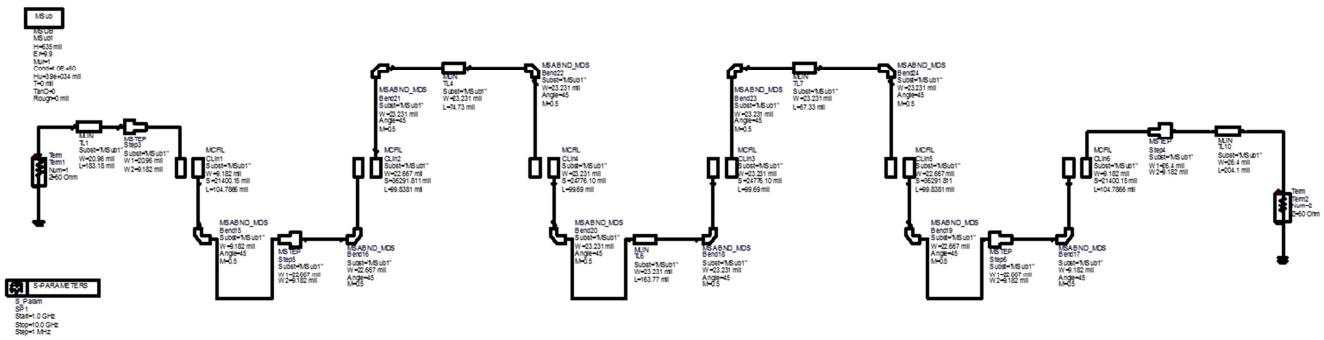
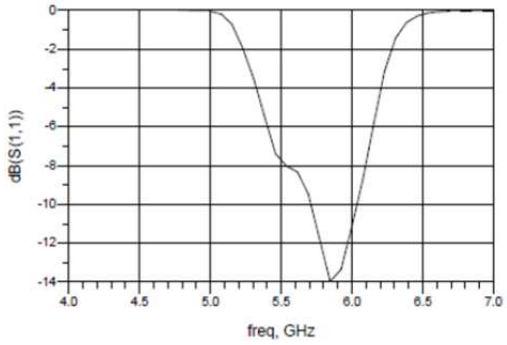


Figure 2. *Schematic structure of Hairpin Filter (HP).*

Simulation Results of Hairpin Filter

The simulation of the designed hairpin filter is done and measured the bandwidth; as this hairpin filter is a band pass Microstrip filter having the bandwidth of 0.4GHz at below -10dB in S11 and insertion loss of -5dB in S12 and S21 as shown in the figure 3 below.



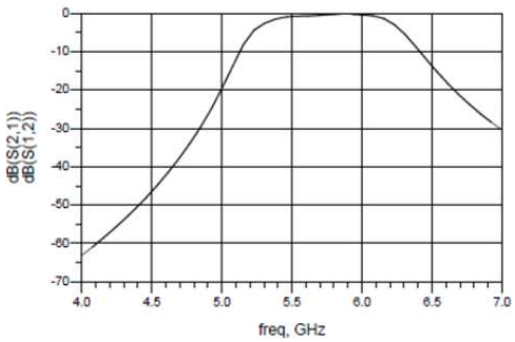


Figure 3. *Simulation results of hairpin filter.*

3.3. Reconfigured Compact Bandpass Microstrip Filter (RCBM)

The selected reconfigurable straight line hairpin

bandpass Microstrip filter is reconfigured into cured shape structure with reduced in size, with dimensions of width: 8.35mm and Height: 12.00mm as shown in the figure 4 below.

By this cured shape structure in figure 4 we can see that the filter size has been reduced compare to its original structure i.e. hairpin filter.

3.3.1. Equivalent Layout Design of Reconfigured Compact Bandpass Microstrip Filter

Reconfigured Compact Bandpass Microstrip Filter illustrated in figure 5 constructed using six Microstrip coupled lines called as Lines from 1 to 6, five connectors from c1 to c5 to connect these components and two ports. Its specifications are the substrate thickness is 725µm and dielectric constant of 9.9.

The Dimensions of the figure 5 are L1: W=4, S=2.5, L=96, W1=11, W2=6.

L2: W=9, S=14, L=125, W1=0, W2=0.

L3: W=8, S=18, L=118, W1=0, W2=0.

L4: W=18, S=18, L=118, W1=0, W2=0.

L 5: W=4, S=19, L=123, W1=0, W2=0.

L6: W=9, S=2.5, L=106, W1=5, W2=10.

Input and output ports W=10 and L=25,

All the connectors from C_1 toC_5 are of W=11.99 and L=60.13,

Hence the size of the filter is reduced to 1/3rd of its original size.

3.3.2. Simulation Results

The simulation of the designed Reconfigured Compact Bandpass Microstrip Filter, having the bandwidth of 1.54GHz with less insertion loss of - 0.5 to - 0.8 dB in S12 & S21. This is achieved by varying the spacing between the coupling lines; this enhances the coupling effect effectively between the coupling lines and enhances BW with less loss of -0.5dB as shown in the figure 6 below.

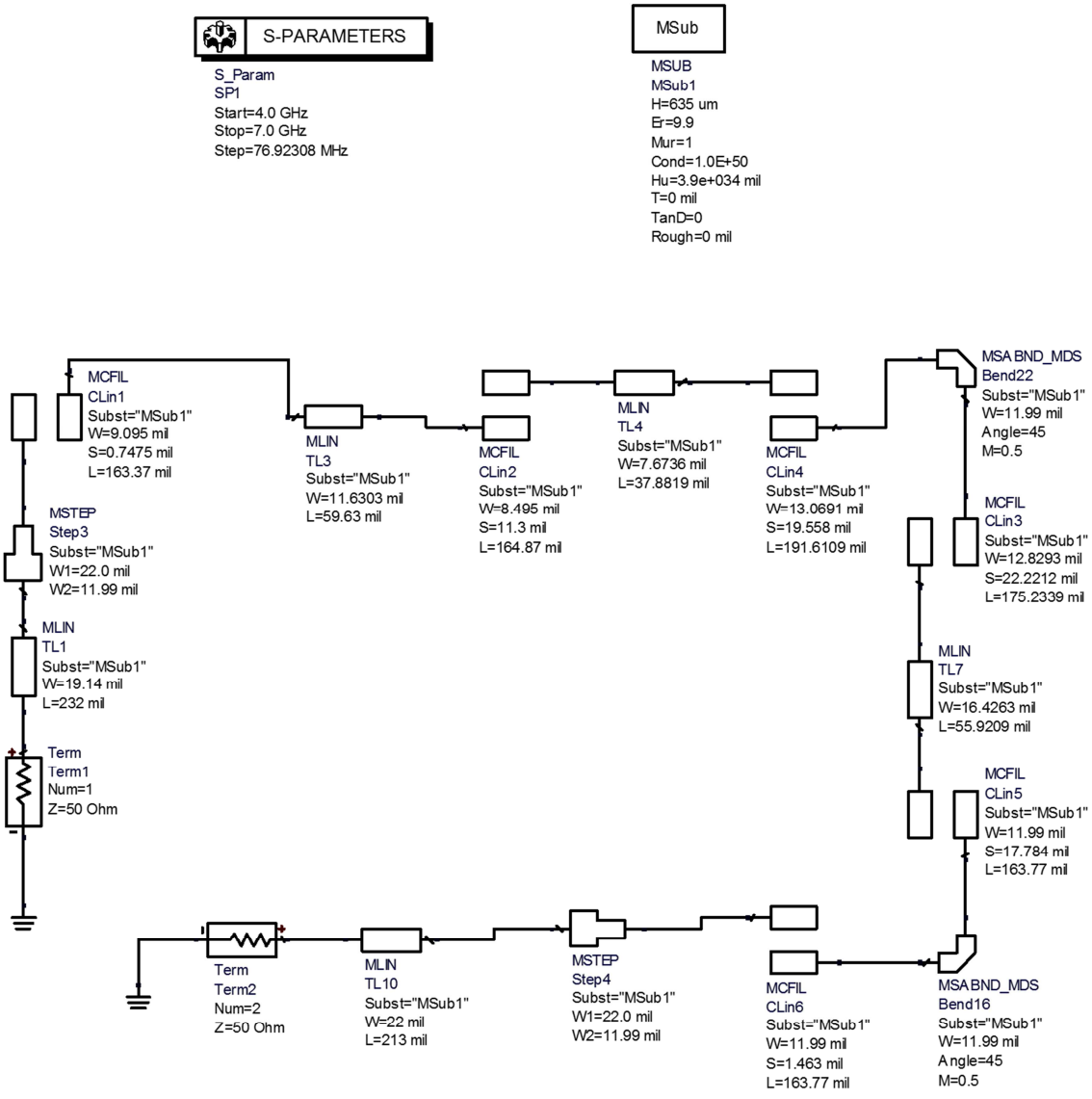


Figure 4. *Reconfigured Compact bandpass Microstrip Filter.*

The S parameter of Reconfigured Compact Bandpass Microstrip Filter is illustrated in figure 6 with 1/3rd reduced in size of original structure. Hence band width is increased to 1.54GHz more than the original structure at below -10dB in S11 and S22.

3.4. Comparative Study

The comparison between the previous work reconfigurable hairpin filter and the research work (Authors work) reconfigured compact bandpass Microstrip filter is done with two parameters size and bandwidth as shown in the table 1 as follows:

Table 1. *Comparative Study.*

	Type of Filter	Bandwidth GHz	Dimensions mm^2
1	Previous work: Hairpin Filter	0.4	27.7x5.85
2	Authors Work: Reconfigured Compact Bandpass Microstrip Filter with 1/3rd reduced in size of original structure.	1.54	8.85x11.00

The comparative Study table 1 depicts how the Reconfigurable Compact Microstrip Filter has miniaturized & the compactness of the Reconfigured Compact Bandpass Microstrip Filter is achieved with 1/3rd reduction in size and with three times increase in bandwidth compared to original hairpin structure with 1.54GHz.

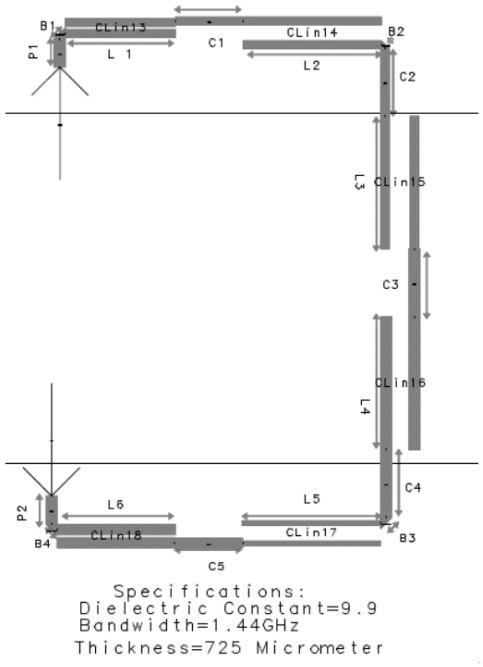


Figure 5. *Reconfigured Compact Bandpass Microstrip Filter with 1/3rd reduced in size of original structure.*

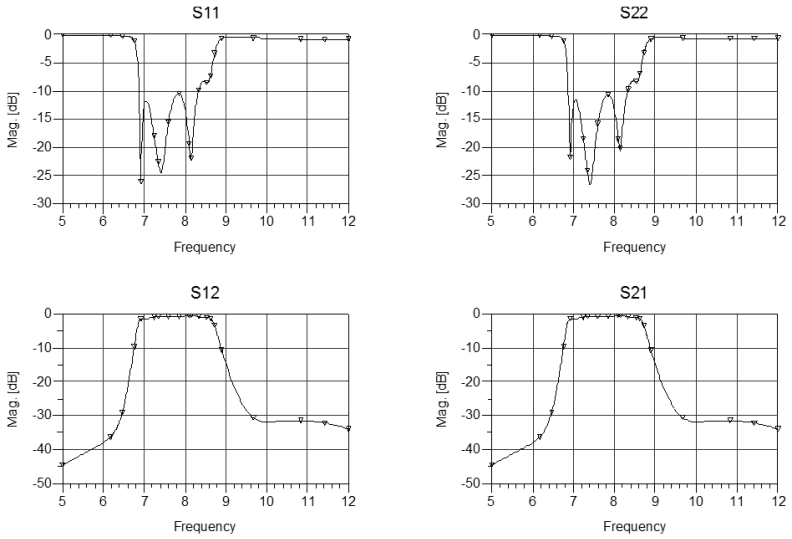


Figure 6. *Simulation Results of layout design of Reconfigured Compact bandpass Microstrip Filter.*

4. Conclusion

The purposed Reconfigurable compact Bandpass Microstrip filter is reconfigured to achieve the compactness of the Microstrip Bandpass Filter by increasing its performance. In this work the size of the Filter is reduced to $1/3^{rd}$ of its original size and increased the bandwidth to 1.54GHz of the original filter i.e. hairpin filter with little shift in the band. This reconfigured compact bandpass Microstrip filters are attractive due to increased bandwidth and compact size. These filters have more scope in many communication application systems due to the rapid expansion of wireless communication, more compact amplifier, filter, oscillator and mixer circuits are being designed and placed in service at frequencies generally above 1GHz.

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