International Journal of Engineering & Technology, 7 (4.6) (2018) 227-229

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

Novel Microstrip Band Pass Filter for C- Band Wireless Applications

Dr. S. Sreenath Kashyap [1]*, Kantipudi MVV Prasad [2], Dr. Vipul M Dabhi [3]

[1]*Associate Professor Department of Electronics and communication, Kommuri Pratap Reddy Institute of Technology, Hyderabad.*
[2]*Assistant Professor, R.K. University, Rajkot, Gujarat*
[3]*Professor, Kommuri Pratap Reddy Institute of Technology, Hyderabad*
**Corresponding author E-mail: sreenathkashyaps@gmail.com, prasadkmvv@gmail.com*

Abstract

In this paper, a novel approach for designing the parallel coupled microstrip bandpass filter operating at C-band frequency is numerically analyzed iteratively and simulated. The physical dimensions are being finalized using standard odd- even impedance method. Various electrical parameters such as insertion loss, reflection loss are being analyzed and practical results are being compared and found same as the predicted results. The proposed design is fabricated on FR4 dielectric substrate and the experimental result shows the scientifically acceptable for C-band Applications.

Keywords: *Microstrip line filters, C-band applications, Insertion loss, Reflection loss, Odd- Even Impedance method.*

1. Introduction

In this era of science and technology the recent advancements in wireless communication systems require compact structures with enhanced performance parameters to ensure mobility and high efficiency characteristics [1, 2]. Due to the technological innovations in the design and development of communication systems various researchers and aspirants started reconsidering the designs of the filters by considering various shapes, materials, size which has influenced the reformulation of various electrical and mechanical characteristics[3]. The development and progress has attracted more interest in the researchers. The challenge in this design of filters is mainly lies with the size and design modeling which influences the electrical behavior of the entire communication system[4,5]. Several techniques are being proposed in order to analyze the electrical performance parameters of the micro strip filters[6]. The progress in designing the microstrip line filters has attracted more and more interest of the researchers. In this letter, a novel approach for the design procedure of the microstrip line filter which comprises of analysis of attenuation characteristics, prototype values, odd even impedance method, separation of coupled lines is proposed[7,8]. Using this method the electrical performance parameters of the proposed filter structure are drastically enhanced[9,10]. The proposed filter design and performances are analysed and optimized using Computer Simulation Technology (CST microwave studio). The proposed structures are fabricated using FR4 Substrate with a thickness of 1.6mm and dielectric permittivity of 4.4.

2. Filter Design

The geometry of the proposed structures is shown in figure 1. The filter structure is designed on a FR-4 dielectric substrate with permittivity 4.4 and thickness of 1.6 mm.

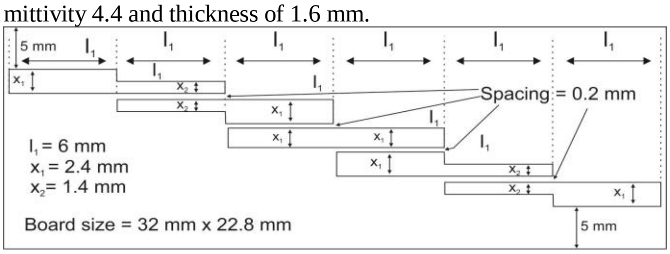

Fig1: Geometry of the Microstrip Parallel Coupled Filter operating at 6 GHz

The dimension of the filter is calculated using odd- even impedance method (Z_{0o}, Z_{0e}) and enlisted in table 1.

Table1: Calculations of Microstrip Parallel Coupled Filter operating at 6 GHz using odd even impedance method

Element Value N	Odd Impedance $Z_{0o}(\Omega)$	Even Impedance $Z_{0e}(\Omega)$	Width W (mm)	Length L (mm)	Space S (mm)
1	101.5	38.5	1.4	6	0.2
2	71	39	2.4	6	0.2
3	71	39	2.4	6	0.2
4	101.5	38.5	1.4	6	0.2

The table 1 specifies the dimensions of the filter namely length, width and spacing, odd impedance and even impedance values. The dimensions of the calculated values are rounded off to the nearest decimal value in order to avoid the errors in fabrication.

3. Simulation of the Parallel Coupled Band Pass Filter

The mechanical parameters of the filter are calculated and enlisted in table 1. The filter is designed and simulated in CST. The parameters such as insertion loss and reflection loss are analyzed in the simulation results obtained in CST software.

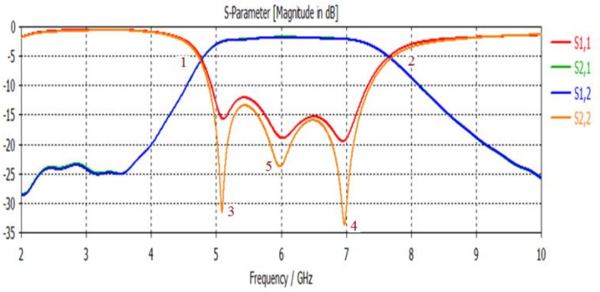

Fig. 2: Simulation results of the Microstrip Parallel Coupled Filter

The figure 2 shows the simulation results of the designed filter. The performance parameters of the filter are indicated by the markings for clear understanding and analysis. The marking 1 indicates lower cut off frequency, 2 indicates the upper cut off frequency, 3 indicates the reflection coefficient, 4 & 5 indicates the reflection loss respectively. It is observed that the reflection coefficient is about -30dB at 5 GHz frequency whereas the reflection loss at 7 GHz is -40dB and at 6 GHz is -25dB.the return loss at all these three frequencies is below -10dB whereas the transmission loss is greater than -10dB for the designed filter. Standing waves will be generated due to the mismatch in the impedance.

4. Fabrication, Test and Measurement of the Microstrip Filter at 6 GHz.

The designed filter in CST is fabricated on the FR4 substrate by considering the dimensions as enlisted in table 1. The figure 3 shows the fabricated filter structure on FR4 substrate. SMA connectors are connected on the either sides of the filter in order to connect to the scalar network analyzer. The physical dimension of the fabricated structure is 32 mm x 22.8 mm.

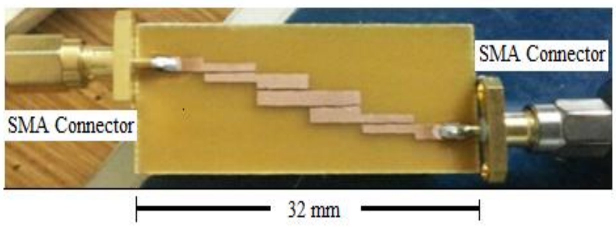

Fig3: Fabricated Microstrip Parallel Coupled Filter on FR4 substrate 3.4.2. Table captions

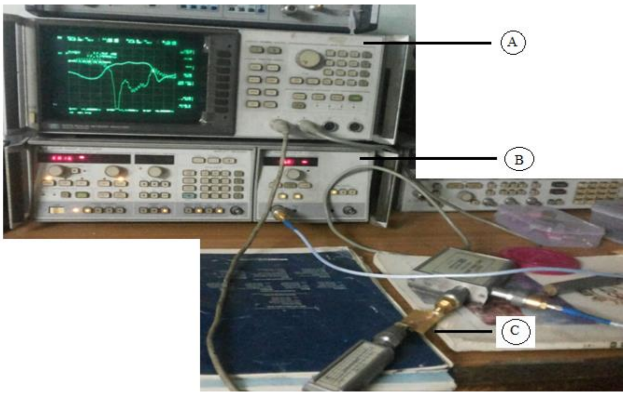

Fig4: Setup for measurement for microstrip line filter

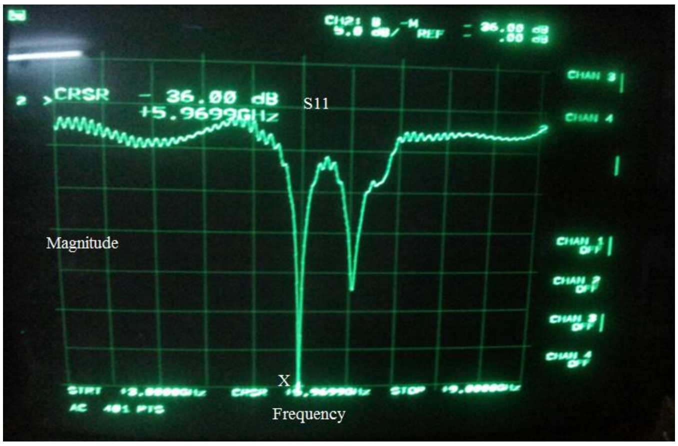

Fig5: Measured value of the reflection loss (S_{11}) for the fabricated microstrip line filter.

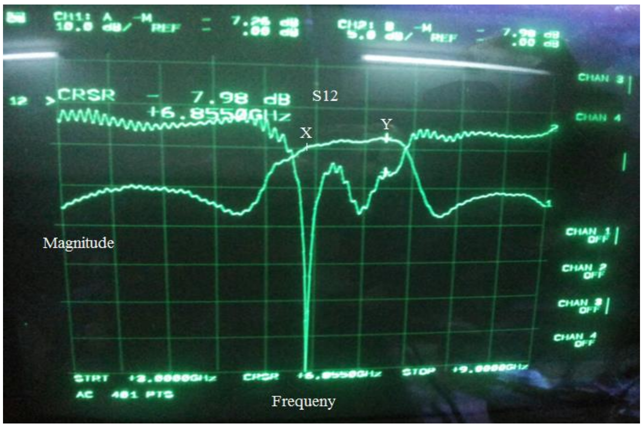

Fig6: Measured value of the Transmission loss (S_{12}) for the fabricated microstrip line filter.

The setup of the test and measurement, measured results are shown in above figures4, 5 & 6. The notations in the scalar network analyser is A- used for measuring the scattering parameter, B- used for the generation of sweep frequency, C- used for the device which is under the test in our case it will be the fabricated microstrip line filter. The simulation result shows the reflection loss of about -35 dB and transmission loss of about -10dB at frequency 6 GHz. The response of the fabricated filter is being determined by the scalar network analyser. The electrical performance parameters S_{11} is as shown in the figure 4 in which the X-axis indicates the operating frequency 6 GHz and the value of the magnitude is -36 dB. The figure 6 indicates the transmission loss S_{12} of the fabricated microstrip filter at 6 GHz. The value of the S_{12} is about -7 dB. Therefore, the test and measurement results when compared with the simulation and analysis results are found deviating in an acceptable range of less than 10% which is valid for microwave communication applications.

Table2: Comparison table of the electrical performance parameters the simulated and fabricated models

Model	Resonant Frequency	Reflection Loss (S_{11}) in dB		Transmission Loss (S_{12}) in dB	
		Simulated	Measured	Simulated	Measured
Microstrip Parallel coupled line filter	6 GHz	-30	-36	-10	-7

5. Conclusion

In this paper, we present a novel approach for the design of the microstrip line filter which consists of the parallel coupled lines and operates at 6 GHz frequency. The performance parameters of the filter structure are compared by considering the simulation and test and measured results. It is found that the reflection loss is and the transmission loss is for the designed microstrip line filter at 6 GHz operating frequency. The simulated and measured results show that the filter model can be used for mutli-frequency and wireless communication applications.

Acknowledgement

The authors sincerely thank to Kommuri Pratap Reddy Institute of Technology, Hyderabad & RK University, Rajkot for encouraging and supporting the research work.

References

[1] Girish Kumar, K.P.Ray "Broadband Microstrip Antennas," Artech House, CH.2, pp, 2-6, ISBN 1-58053-244-6,2003.
[2] Vedvyas Dwivedi. Y.P.Kosta, "Miniaturized and Compact Microstrip Patch Antenna designed on a Double negative metamaterial substrate," Proceedings of International symposium on Microwave and Optical Technology, December, 2009.
[3] Prachi Tyagi, "Design and Implementation of Low Pass filter using Microstrip line, International journal of Latest trends in Engineering and Technology, Vol.5 Issue 2, March2015.
[4] Sanae Azizi, Saida Ahyoud et.al, "Design of Ring Circle Microstrip Band Pass filter with wide stop Band characteristics for WLAN applications", Proc. Of 10th International interdisciplinary conference in Engineering INTER-ENG 2016.
[5] B.H. Ahmad, M.H. Mazlan, et.al, "Microstrip filter Design Techniques: An overview", ARPN Journal of Engineering and Applied Sciences, Vol. 10, No.2, February 2015, ISSN 1819-6608.
[6] Nikunj Parikh, Pragya Katare, et.al. "Design and Analysis of Hairpin Micro-Strip Line Band Pass Filter, International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering, Vol.3, Issue 5, May 2015.
[7] M. taghizadeh, Gh. Moloudian, A.R.Rouzbeh,"Design and Simulation of Band Pass Filter Using Microstrip Lines," International Journal of Computer Science and Mobile Computing, Vol.4, Issue11, November2015, pp 331-337.
[8] Islam Mansour, Hadia Elhennaway, Adly s. Tag El-dein, "Design of Stepped Impedance Microstrip Low pass Filter with DGS," International Journal of Engineering Research and Development, Vol.10, Issue 7, July 20144, PP 58-67.
[9] Arjun Kumar, M.V.Kartikeyan, "Design and Realization of Microstrip filters with new defected ground structures (DGS)," Engineering Science and Technology, an International Journal, Vol.20, Issue 2, April 2017, PP 679-686.
[10] A.K.Tiwary, N.Gupta, "Design of Compact Coupled Microstrip Line Band Pass Filter with Improved Stop Band Characteristics", Progress in Electromagnetic Research C Vol.24, PP 97-109, ISSN:1937-8718.