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DESIGN OF MICROSTRIP MULTIBAND BANDPASS FILTERS AND IMPLEMENTATION USING SIRS

T. Asiyabi

Electrical Engineering Department, Dezful Branch, Islamic Azad University, Dezful, Iran, t_asiyabi@yahoo.com

Abstract- In this paper a simplified technique is used to design multiband bandpass filters using a compact Ultra Wide Band (UWB) microstrip. Analysis in a typical dispersion diagram is convenient for distinguishing unbalanced mode and balanced mode from transmission line. This filter is on the base of the design of the dualband filter of 2.4 GHz, 3.7 GHz and then dualband filter 2.4 GHz and 5 GHz. In the proposed filter the double coupling technique has been used to increase bandwidth, the low impedance piece is surveyed because of the creating double zero in this area, and the stopband profile is improved. These transmission frequencies show us that the intended plan is effective for all plans.

Keywords: Dualband Filter, Stepped Impedance Resonator (SIR), Low Impedance, Additional Coupling.

I. INTRODUCTION

Bandpass filter has great potentials in the development of modern communication systems, worldwide the bandpass filter in multiband communication systems is used as a key component for selecting the frequency in the specified range. Another type of filter is the Transition Filter that passes through itself a certain range of frequency components and weakens another components of the frequency. This filter is used for retrieving of useful information in a noise signal. In parts, which we have the input, output signals and communication buses, the important terms are according to physical structure and classification.

Microstrip filters play various roles in communication systems. The dimensions of a microstrip filter compared to other structures that operate in the frequency range are smaller. For most applications, including factors that reduce the size initial matter, the microstrip filters are optimizer. Minimal microstrip may be supplied with using of dielectric constant or the compressed elements. However, often for the specified substrata, for minimizing filter, it is required to change the dimensions of the filter. Therefore, using this method, many filters are designed and built. This paper is dealt with design, and optimization of dualband microstrip bandpass filter with use of direct engineering according to IEEE standards. There are numerous articles on the technology of the dual-band filter.

In the study [1] a dualband filter has been proposed that with use of a piece of impedance, frequency range of the filter in pass band is settling between 2.5 GHz and 3.5 GHz. In this part, the three-part microstrip band is designed using bandpass filter and the effect of pairing each of resonators and the characteristics of the filter such as bandwidth will be analyzed [2]. In addition, a new design of a dual-band bandpass filter with wide bandwidth and low loss at frequencies of 2.40 GHz and 5.20 GHz center for wireless communication networks is presented. [3] dualband filter using stepped impedance is designed in which the second bandpass is flexible while the first bandpass is fixed and function of this filter is in working frequency 2.4 GHz and 5.25 GHz that in compare with its previous studies has a smaller structure [4].

A new topology is suggested, using impedance Stepped Impedance Resonator (SIR) to improve the response [5, 6]. With placing the transmission zeros in the bandpass and use of the resonator impedance ring, designs the dualband filter [7]. In this paper, three bandpass filter is designed using electromagnetic simulator is simulated with connection between Stepped Impedance Resonator, optimizes the three bandpass filter [9]. In [10] the idea of three-part Stepped Impedance Resonator filter is discussed, to improve the performance of the filter.

II. PROCESS DESIGN AND SIMULATION

A. Resonator Proposed Structure

Figure 1(a) shows the basic structure of the Resonator. As this figure shows, the Resonator is composed of the connection of the low impedance piece (Z_1) to two high impedance (Z_2) that has the electrical length θ_1 and θ_2. Figure 1(b) has a structure in contrary to resonator shown in Figure 1(a). Of course, the extent of the impedance and balance, this connection brings a different resonant frequency. The following relations can achieve the resonator. Resonator filter can be used to realize bandpass of the filters with high performance by the suppression of additional harmonics that the resonant frequency can be achieved by adjusting the impedance ratio. Figure 1 shows the used basic resonator structure. It can be seen that by proper choice of impedance, the frequency range can become wide for stopband.

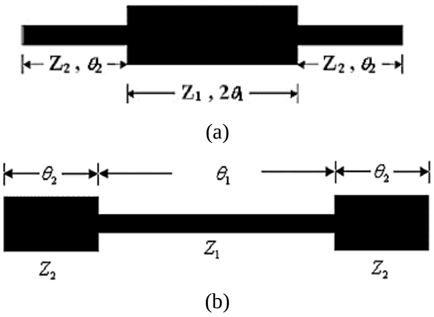

Figure 1. (a) Connecting a low impedance in the middle
(b) Connection low impedance piece with the sides

where, F_1 and F_2 are the resonance frequencies.

$$Y_I = JY_2 \frac{Y_2 \tan\theta_1 \times \tan\theta_2 - Y_1}{Y_2 \tan\theta_1 + Y_1 \tan\theta_2} \quad (1)$$

The impedance ratio is:

$$R_Z = \frac{Y_1}{Y_2} = \frac{Z_2}{Z_1} \quad (2)$$

Resonance analysis where $Y_i = 0$,

$$R_Z = \frac{Z_2}{Z_1} = \tan\theta_1 \times \tan\theta_2 \quad (3)$$

where, R_Z is the impedance ratio. Fundamental frequency (F_0) and first spurious frequencies F_{SB1} derived by the following equation:

$$\frac{F_{SB1}}{F_0} = \frac{\pi}{2\tan\sqrt{R_Z}} \quad (4)$$

Resonant frequencies associated with the impedance ratio, based on filters that are designed with dualband bandpass.

$$\begin{cases} \frac{F_2}{F_1} < 2 \quad \Rightarrow \quad R_Z > 1 \\ \frac{F_2}{F_1} = 2 \quad \Rightarrow \quad R_Z = 1 \\ \frac{F_2}{F_1} > 2 \quad \Rightarrow \quad R_Z < 1 \end{cases} \quad (5)$$

The filter is designed so that there is $R_Z < 1$ and where, Y_I is characteristic admittance, Z_I is the characteristic impedance, θ_1 is electrical length, R_Z is impedance ratio and F_I is resonant frequency.

B. Filter Design

This lower than -20 dB cut for the band to reach the shape extend below the low impedance of the other two pieces on the previous form, and we cut the band profile due to a zero-double in this area, to improve. Figure 2 shows the dimensions of the proposed first filtered using a combination of both the proposed resonator optimized..

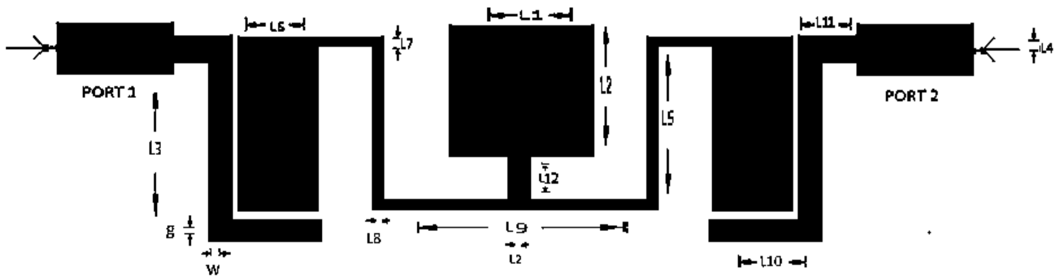

Figure 2. Dimensions of the first dual bandpass filter between the proposed

The dimensions of this filter are named in the following way, L_1 = 3.7, L_2 = 3, L_3 = 3.59, L_4 = 0.6, L_5 = 3.96, L_6 = 2, L_7 = 0.61, L_8 = 0.28, L_9 = 6.77, L_{10} = 0.51, L_{11} = 1.49, g = 0.51, w = 0.59 (all dimensions are in mm). Parametric study yielding a spacing of 0.11 mm is a low impedance between the input and output to improve the stopband profile takes. Its central frequency is 2.4 GHz and 3.7 GHz, respectively. Bandwidths of the first and second passes are 0.04 and 0.03 MHz, respectively. In addition, the insertion loss (S_{21}), respectively -1.2 dB and -1.8 dB and return loss (S_{11}) is the -16.62 dB and -13.1 dB. The distance created is 0.11 mm. As seen in Figure 5 the simulated bandwidth filter is small, this amount does not suffer from the disadvantages of the optimal filter is the desired frequency.

So to increase the bandwidth to pass, and filtering techniques are utilized in accordance with Figure 4 double coupling is used. The filter design is L_1 = 1.35, L_2 = 0.4, L_3 = 0.98, L_4 = 1.43, L_5 = 3.74, L_6 = 2.59, L_7 = 0.22, L_8 = 0.19, L_9 = 2.35, L_{11} = 4.73, L_{10} = 0.55, L_{12} = 1.1, L_{13} = 4.41, L_{14} = 3.73, L_{15} = 0.73, w = 0.48, g = 0.27 (all dimensions are in mm). Bandwidths of the first and second passes are 0.12 and 0.11 MHz respectively. In addition, the insertion losses are -0.18 and -0.4 dB and return loss is -32 dB and -20 dB and the distance created is 0.12 mm.

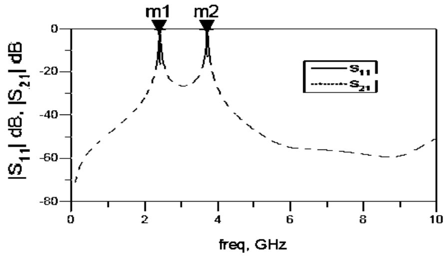

Figure 3. Simulated filter response in Figure 2 without the binary coupling

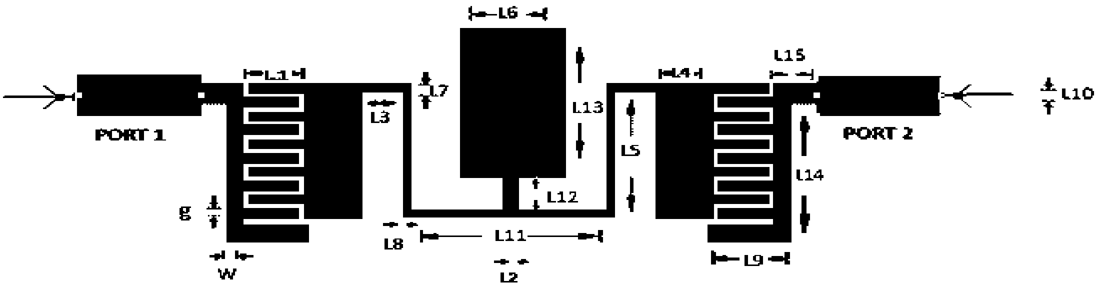

Figure 4. Dimensions of the dualband bandpass filter with double coupling

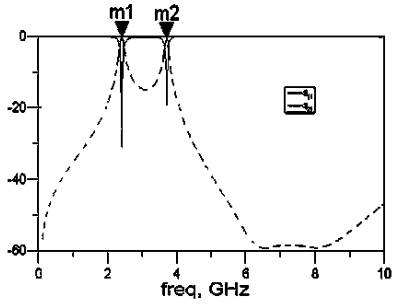

Figure 5. Simulated response of the double coupling

III. RESULTS AND DISCUSSION

As seen with the design of two bandpass filter of bandwidth is also enhanced with a double coupling to 0.27 MHz. These filters are more efficient than similar filters that are used in the communications industry is having, therewith a low impedance device on the filter with the stopband profile due to a double zero in this area improves. Dimensional two-band filter is also designed so that its shape is shown in Figure 6.

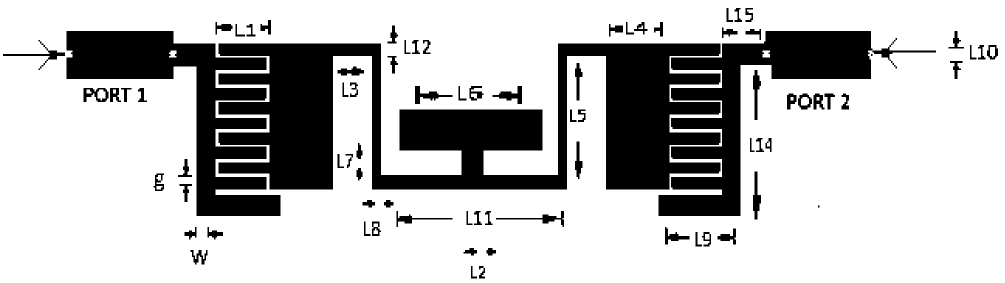

Figure 6. Dimensions of the efficient dualband bandpass filter with double coupling

The filter design in Figure 6 is L_1 = 1.48, L_2 = 0.59, L_3 = 1.14, L_4 = 1.79, L_5 = 3.32, l_6 = 4, L_7 = 0.7, L_8 = 0.23, L_9 = 2.35, L_{10} = 0.55, L_{11} = 5.1, L_{12} = 0.27, L_{13} = 0.99, L_{14} = 3.73, L_{15} = 0.73, w = 0.48, g = 0.25 (all dimensions are in mm) is the bandwidth through the first and second, 0.14 and 0.13 MHz respectively. The insertion losses are -0.37 dB and -0.67 dB and return loss are the -30 dB and -22 dB. Applying technique of double coupling to increase bandwidth that design of two bandpass filter of bandwidth is also enhanced with a double coupling to 0.37 MHz.

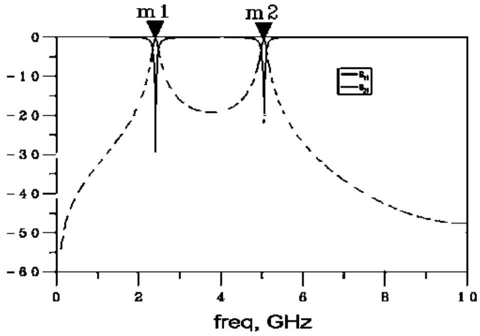

Figure 7. A simulator developed at working frequency

IV. RESULTS

Two dualband bandpass filter design on the paper passing between the circuits in accordance with IEEE standards and the results are fully described.

This filter with dielectric constant 3.38 and the thickness of 20 mm is designed by applying techniques double coupling increase bandwidth through and the piece impedance low-profile band interrupted due to a zero-double in this area, improving performance the communications industry has more.

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BIOGRAPHY

Tayebeh Asiyabi was born in Iran, 1983. She received the B.Sc. degree from Electrical Engineering Department, Shariaty University, Tehran, Iran and M.Sc. degree from Kermanshah Branch, Islamic Azad University, Kermanshah, Iran. Currently, she is a Lecturer of Power Electrical Engineering at Dezful Branch, Islamic Azad University, Dezful, Iran. Her research interests are in the area of power quality, energy management systems, ICT in power engineering and in the areas of microstrip multiband bandpass filters. She has published several papers and research reports in the mentioned areas.