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IMPLEMENTATION OF INDOOR POSITIONING AND TRACKING SYSTEM USING WSN IN MICROSTRIP WIDE STOPBAND LOWPASS FILTER

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Abstract - A microstrip lowpass filter is created using a stepped impedance resonator. Compact structure, low insertion loss, and a wide stopband were proposed for this filter. The substrate of this filter is FR-4 Epoxy, which measures 18mm x 15.5mm in length and width. This filter is constructed on a lowpass T-shaped resonator with a wide stopband, which produces in a convenience size and low insertion loss LPF. The most common frequency bands are L band range (1-2 GHz), S band range (2-4 GHz), C band range (4-8 GHz), and so on. This study focuses on the S band frequency since the LPF is a key element in wireless communication systems. The passband bandwidth of the LPF is 2.78 GHz to 3GHz, while its cut-off frequency is 3GHz. It has a reflection coefficient of less than 16.5 dB and an transmission coefficient compared with fewer than 0.9 dB. This technique can be used to create a WSN (wireless sensor network) for indoor positioning and tracking. The simulation and measurement results are presented.

Key Words: lowpass filter, T-shaped resonator, wireless communication, passband, wireless sensor network

1.INTRODUCTION

Small lowpass filters (LPF) with fine performance are in great supply for communication systems to minimize overtones and false signals. Traditional open-stub and stepping impedance LPFs feature a narrow stopband bandwidth and a gradual cut-off. [1] There are various key characteristics of frequency at microstrip low pass filters that help to improve frequency responses, such as quick cut-off frequency responses and low ripple, which correspond to low passband return loss. [2] The suggested filter, which employs numerous cascaded hairpin resonators, has a highly sharp cut-off frequency response in each state, as well as a wide and deep stopband [3]. it proposes and realise a meander transmission line with uniformly packed resonant patches. All these triangular patchwork and radial patchwork resonators are used in the design to obtain modest size and ultra-wide band rejection. The filter design incorporates meander transmission lines more to minimize its circuit size. [4-5]. Stopband attenuation rate and maximum attenuation level in relation to insertion and return loss values [6-7] The proposed structure has good characteristics; however, it is large and has a high insertion loss when compared to other LPFs. To construct a wide stopband LPF, radial stubs featuring stepped impedance hairpin resonant frequencies were used [8-9]. It is proposed to use a T-shaped resonator with something like a reasonably wide stopband LPF. The eighth harmonic can be removed since LPF has a low insertion loss. [10-11]. In this paper design and study a small microstrip LPF with moderate insertion loss, decent return loss, and a huge stopband. The recommended LPF size is 18mm x 15.5mm. The prototype is built on FR4 Epoxy microwave dielectric board ($\varepsilon_{\gamma} = 4.4$ *and* tan δ = 0.02), with a central frequency 'f_0' is 3 GHz.

2.DESIGN METHODOLOGY

The design and dimension of the microstrip lowpass filter is shown in fig 1 and 2 diagrams. The ground plane like the substrate, is (18mm x 15.5mm) length and width in size. The substrate is made of FR4 epoxy, a popular and scalable high-pressure thermoset plastic laminate material with high quality to weight ratios. The patch's dimensions are listed below and are designated as A, B, C, D, and E for a rectangular patch. Radiation is produced by two edges that have two equivalent slots. As long as the feedline is near the centre of the radiating edges, the other two opposing edges that are W apart do not radiate. Figure 2 shows the filter's corresponding circuit diagram. The equivalent capacitance of the open stub is s Coi = lieff/CZsi, where Zsi is the characteristic impedance and li is the distance of each sequence, g is the guided wavelength, and C is the velocity of light in free space, where Li = Zsi sin(2li/g) and CiZsi = tan(li/g) are the values of inductors and capacitors. In this design Chebyshev filter prototype is used. The layout's frequency response and Chebyshev prototype are obtained. The proposed resonator, in relation to the Chebyshev prototype, may produce a finite transmission zero. F_z with good selectivity

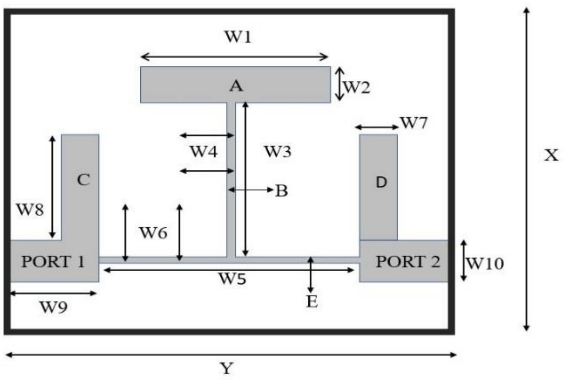

Fig -1: Design and Dimension of wide stop band lowpass filter

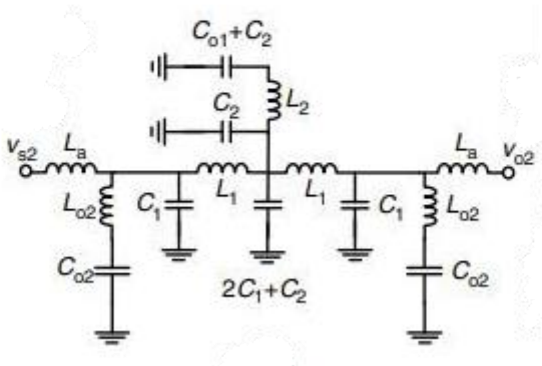

Fig-2: Equivalent circuit of wide strop band lowpass filter

Figure 1 and 2 shows the Schematic and equivalent circuit. It Show the suggested resonator's LC equivalent circuit, as well as the EM and equivalent circuit simulation results.

Table -1: DESIGN PARAMETER AND DIMENSION

DESIGN PARAMETER	**DIMENSION**
Length of the substrate X	18mm
Width of the substrate Y	15.5mm
Length of the port 1,2 (W9)	3mm
Width of the port 1,2 (W10)	5mm
Length of the patch C, D (W8)	6mm
Width of the patch C, D (W7)	3mm
Length of the patch A (W1)	0.9mm
Width of the patch A (W2)	5mm
Length of the patch B (W3)	7.9mm
Width of the patch B (W4)	0.15mm
Length of the patch E (W5)	0.1mm
Width of the patch E (W6)	5.5mm

3. RESULTS AND DISCUSSION

The above table shows the parameters of the filter design. It shows the length and width of the substrate of X is same as Y (18mm X 15.5mm). The length of the port 1 length and width (3mm x 5mm) is similar to the opposite port 1 length and width. The measured S-parameter is plotted in below figure along with the simulated result using Ansys HFSS for comparison

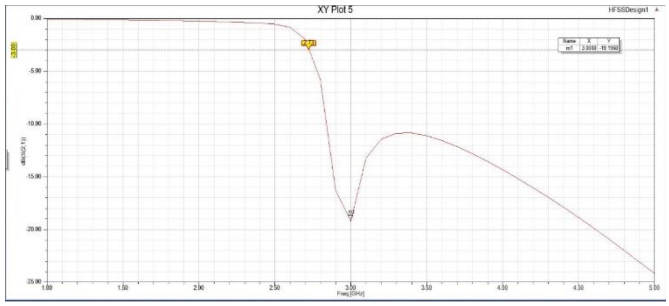

Fig-3: S11 parameter or insertion loss

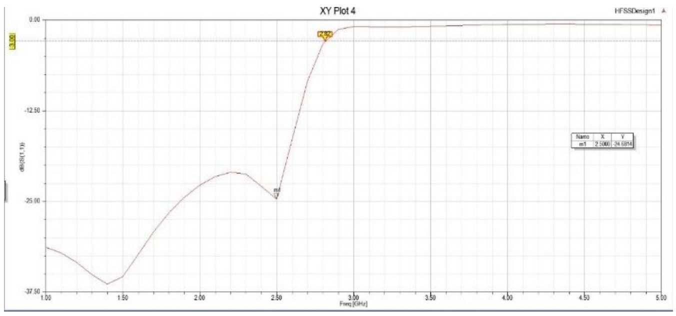

Fig-4: S21 parameter or return loss

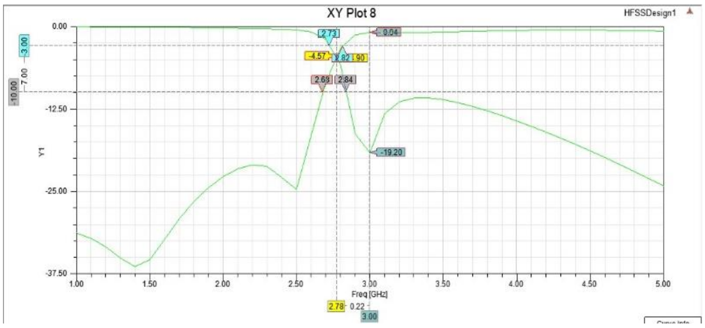

Fig-5: Combination of both insertion loss and return loss

The outputs of the design, simulation, and measurement are provided. The prototype is designed and constructed on FR4 Epoxy microwave dielectric board (ε_γ=4.4 and tanδ = 0.02), with the prototype's centre frequency 'f_0' being 3 GHz. After the final designing in the software, more modification and optimization in the HFSS is required to account for open ports and the dissipation effect of microstrip lines. The substrate's physical dimensions are 18mm x 15.5mm x 1.6mm, and the passband of this lowpass filter is 0.22 GHz, with a frequency range of 2.78 GHz to 3 GHz and a passband of 0.22 GHz. It is utilised for wireless communication in this WSN application. The rectangular slot is filled with FR4 epoxy substrate in the first case, and another substrate is placed on top. The above figure 3, 4 and 5 shows the observed S-parameter with the calculated result using Ansys HFSS for comparison.

The simulated and measured findings are very similar. The return loss is better than 15 dB across the specified passband, while the insertion loss is 0.7 dB

In this paper discussed about the incorporates of microstrip wide stopband lowpass filter and wireless sensor network for indoor positioning and tracking application. The frequency range of WSN is 2.78 GHz- 3GHz. In this design the output S11 parameter shows the reflection coefficient and it reflect towards that time output S21 shows the transmission coefficient and it transmits that time the S11 parameter falls down in that particular frequency (2.78 GHz – 3GHz). The output attains the desired frequency then it transmits to the WSN and so the WSN will perform the indoor positioning and tracking operation. It will help to tracks the people or object in building / office when the GPS or other satellite fails.

4. CONCLUSIONS

The microstrip LPF unit with a large stopband is shown. A 3-dB cut-off frequency was used to design, construct, and test the prototype LPF. The obtained findings reveal that the proposed LPF has high performance characteristics, such as a wide stopband, minimal insertion and return loss, and a small size. For these desirable features, the filter will be an excellent choice for implementing an indoor location and tracking system employing WSN.

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