Design and Analysis of Dual Microstrip Patch Band Pass Filter

R. Rukmangathan
PG Student (M.E-Communication System)
Department of Electronics and Communication Engineering
Sri Venkateswara College of Engineering

Mr. S. Senthil Rajan
Assistant Professor
Department of Electronics and Communication Engineering
Sri Venkateswara College of Engineering

***Abstract*:- This paper proposes the design of the micro strip dual band pass filter by using slots. The dual-band BPF was simulated on Rogers 5880 substrate with a relative dielectric constant of 2.2, thickness of 0.508 mm, and loss tangent of 0.0009. And then simulated the proposed micro strip patch, we have get 1.7 GHZ and 2.4GHZ frequency. The dual-band response can be realised by embedding two CPW structures in the micro strip rectangular patch, which can not only disturb two fundamental degenerated modes. We can designed various frequency by changing the length and width of the slots. The designed micro strip patch dual band pass filter is very compact size compared to other model. The frequency can be used in communication field**

Keywords— Microstrip patch, band pass filter (BPF), cpw.

I. INTRODUCTION

Dual-pass band filters play an important role in modern wireless communication systems, among which the dual-band band pass filter (BPF) is one of the most key devices. In recent years, many methods on the design of dual-band BPF have been studied in [1–3]. Most of the dual-band BPFs using a single resonator were realised by a loop or patch resonator [2–5]. In [2], a square loop resonator with two loaded stubs was used to design a dual-band BPF. A dual-band BPF using a single patch resonator with two different loaded stubs and a cross slot was presented in [5]. However, few dual-band BPFs have been realised by using a hybrid structure of microstrip patch and coplanar waveguide (CPW). However, most of the afore mentioned dual band filters only regulate the central frequencies of two pass bands and they can hardly regulate the bandwidths of two bands simultaneously to fit the specification at each band, mainly due to the limited degrees of freedom in the design parameters. Dual-band filter is mainly used to allow two different signals to go through within two frequency ranges at the same time rather than common single frequency range filter. narrow bandpass filter can be used in application that passes narrow range of frequencies in a single spectrum. For instance, microstrip filters have been extensively applied to modern radio frequency and microwave system. Thus, filter size is one of the concerns in the filter design. The filter is design to ensure that it can fit into the electronic devices. Besides, the losses of the filter are playing an important role because they will affect the performance of the filters. Therefore, it is hard to put these filters into practical applications. In this letter, we present a dual band BPF with controllable fractional bandwidths and compact size, as shown in Fig. 1

II. ANALYSIS OF DUAL BAND FILTER

First, The layout of the proposed dual-band BPF is shown in Fig. 1. It is composed of one micro strip rectangular patch and two orthogonal embedded CPWs. The section of the CPW is inserted into the patch along the symmetric axis and separated by slots, and the patch in turn contains the whole CPW. The slots consist of two parts including the horizontal and the vertical slot with lengths L1 and L2, respectively. The input and output feed lines are tapped at the centre of the patch. Without perturbation, the two degenerated modes – TM100 and TM010 – of the conventional rectangular micro strip patch with the side length λg/2 cannot be slit. The TMmn0 mode resonant frequency of the micro strip rectangular patch can be calculated as follows,

fig 1.layout of the dual band pass filter

$$fmno = \frac{c}{2\pi\sqrt{\mu_{r\varepsilon_r}}}\sqrt{\left(\frac{m\pi}{w1}\right)^2 + \left(\frac{n\pi}{w1}\right)^2}$$

It can be seen that the embedded slots can perturb the two degenerated modes, which can be used to form the first pass band. By changing the size of the slots, the coupling between the degenerated modes can be controlled. Meanwhile, the slot can adjust the resonant frequency of the TM110 mode by reasonable location of the slot and resonate itself. The second pass band can be generated by using the TM110 mode and two slot resonators. That is to say, there are two and three poles in the first and the second pass band, respectively. Fig. 3 shows the frequency response of the dual-band BPF with varied lengths L1 and L2. It can be seen that the bandwidth of the second passband can be adjusted largely by altering L1 and L2, whereas that of the first pass band changes slightly. This is due to the slot mainly having an impact on the current distribution of the TM110 mode. To some extent, the resonant frequency of the TM110 mode can be adjusted by changing the size of the CPW. The resonant frequency can be shifted down by increasing the length of the CPW. Meanwhile, the resonance of the CPW is mainly dependent on its length. So it can also be shifted down by increasing the length.

III DESIGN OF PROPOSED FILTER

The proposed dual-band BPF shown in Fig. 1 was designed, simulated and optimised using the commercial software ADS simulator. The final dimensions are:W0 = 1.25 mm, W1 = 69.75 mm, L1 = 1.00mm, L2 = 11.00 mm L3=25.00 mm, g1 = 0.2 mm, and g2 = 0.1mm. The dual-band BPF was fabricated on Rogers 5880 substrate with a relative dielectric constant of 2.2, thickness of 0.508 mm, and loss tangent of 0.0009. The circuit area of the proposed dual-band BPF is only 0.19λg × 0.19λg, where λg is the guided wavelength at the centre frequency of the first.

Fig. 3 also shows the simulated and measured results of frequency response. The first and second pass bands of the measured results are centred at 1.7 and 2.4 GHz.

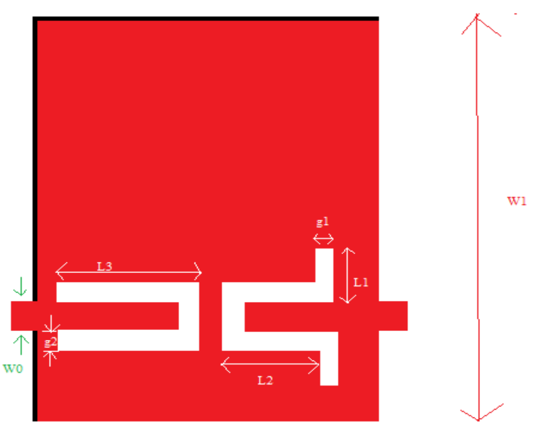

Fig 2. Configuration of proposed dual-band BPF

The measured minimum insertion losses of the two pass bands are 1.2 and 1.67 dB, respectively. The measured return losses are above 12 dB for both pass bands. Some slight differences between the simulated and measured results may be attributed to the fabrication tolerance and assembly errors in the design. In this letter, the hook feed line is introduced in the filter to satisfy the desired external coupling degrees for two bands simultaneously. When the width of the feed line and the coupled length are fixed, the coupling degree between the feed line and the resonator at the higher band is determined mainly by coupled spacing , but the coupling degree between the feed line and the resonator at lower band is determined mainly by the Substrate materials play an important role in antenna design, production and finished product performance. A simple method that can be employed to modify the different properties of the antenna is by changing the substrate; as height and dielectric constant of the substrate influence the antenna properties. The substrate in micro strip antenna is primarily required for giving mechanical strength to antenna. The dielectric used is also responsible for degraded electrical properties of antenna as the surface waves produced on the dielectric extract a part of total power available for direct radiation (space waves). The cost incurred in the production of micro strip antenna is closely affected by the Substrate used in its design. Therefore an intelligent decision has to be taken while selecting a substrate so as to satisfy both electrical and mechanical requirement for the antenna. The Choice of the substrate materials depends on the application. Conformal antennas require flexible substrates; low frequency antennas require high dielectric constant substrates to reduce the size of the antenna. The first design step is to choose a suitable dielectric substrate of appropriate thickness h and loss tangent. A thicker substrate, besides being mechanically strong, will increase the radiated power, reduce conductor loss.However, it will also increase the weight, dielectric loss.

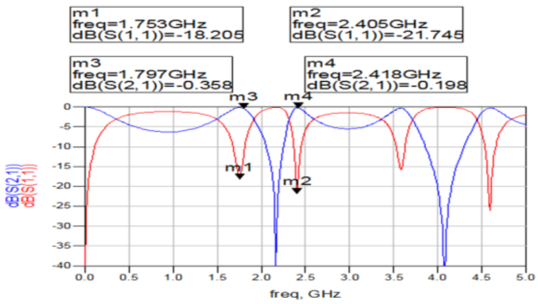

Fig 3 simulated results of the dual band pass filter

However, it will also increase the weight, dielectric loss, surface wave loss, and extraneous radiations from the probe feed. The substrate dielectric constant plays a role similar to that of substrate thickness. A low value of dielectric constant for the substrate will increase the fringing field at the patch periphery, and thus the radiated power. Therefore, substrates with dielectric constant less than 2.5 are preferred. An increase in the substrate thickness has a similar effect on antenna characteristics as a decrease in the value of dielectric constant. A high loss tangent increases dielectric loss and therefore reduces antenna efficiency.

A) PATCH WIDTH:

The width of the patch affects the resonant resistance of the antenna, with a wider patch giving a lower resistance. Square patches may result in the generation of high cross polarization levels, and thus should be avoided unless dual or circular polarization is required.

B) FEED LINE WIDTH:

Besides controlling the characteristic impedance of the feed line, the width of the feed line affects the coupling to the slot. To a certain degree, thinner feed lines couple more strongly to the slot.

For maximum coupling, the feed line should be positioned at right angles to the centre of the slot. Skewing the feed Line from the slot will reduce the coupling, as will positioning the feed line towards the edge of the slot.

The variation of only has a little impact on the external coupling degree at higher band. Meanwhile, the S parameters of 2.45 GHz pass band is varied in shape considerably.

IV.CONCLUSION

The main scope of this project is to design and develop a new approach of transforming the band pass filter. The filters were designed, simulated using Advanced Design Software (ADS). And then got the dual frequency of 1.7 Ghz and 2.4 Ghz. The proposed antenna will be fabricated and measured result will be compared with simulated results. After fabrication it will be operated in the given conditions and the radiation pattern will be analyzed.

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