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REVIEW ARTICLE

DESIGN OF AN INTEGRATED S-BAND ANTENNA AND FILTER USING IEEE 802.11 APPLICATIONS

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ABSTRACT

Design and measurement of a new compact filter and a microstrip antenna is proposed for IEEE 802.11 applications. Here the size of the three pole hair pin BPF is approximately reduced from 6.83 cm to 5.81 cm, The three pole hair pin BPF designed at center frequency 1.97 GHz achieves an impedance bandwidth of 5.16 % (over 1.6 – 2.4 GHz) at a reflection coefficient $|S_{11}| < -20$ dB and has a gain of 0.44 dB. Also the size of the designed antenna is nearly 45 mm x 35 mm on TRF substrate with relative permittivity of 4.1 dB. The antenna has a resonance frequency of 2.14 GHz with a gain of 0.15 dB.

INTRODUCTION

Due to the increasing trend towards miniaturization and simplicity the integration among components has become a significant issue. In a wireless communication system, the antenna is an essential component for transmitting and receiving signals. The characteristics of antenna is closely concerned with its dimension, a small antenna is sensitive to the conductor resistance. The antennas have been analyzed in different forms including inverted-L antenna (Abunjaileh *et al.,* 2008), slot dipole (Chuang and Chung, 2009), Yagi antenna (Chuang and Chung, 2011), monopole antenna (Lim and Leung, 2008), ∏-shaped antenna (Lin and Chung, 2011), circular patch (Oda *et al.,* 2007), patch array (Queudet *et al.,* 2002), waveguide slot antenna (Wang *et al.,* 2012), dielectric resonator antennas (Wu *et al.,* 2011), and rectangular patch (Yang Lancaster, 2010).

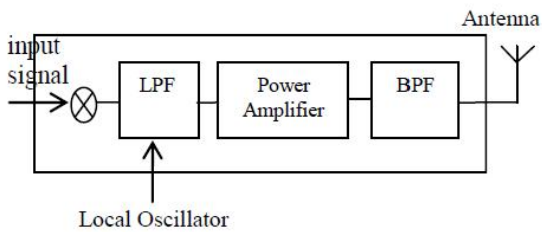

Fig.1. Layout of antenna and filter

In this paper, we designed a rectangular antenna whose dimension is 45 mm x 35 mm with a dielectric constant of 4.1 and loss tangent of 0.01 mm. The filtering function is developed using the synthesis process of the band pass filter. The filtering antenna consists of a feed line, two hairpin resonator, rectangular patch. The proposed structure functions as a band pass filter having bandwidth of 10% with a dielectric constant of 4.1 and loss tangent of 0.0035 mm with a gain of 0.15 dB with the frequency range from 1.6-2.4 GHz.

Design of the filter

The three pole Hair-pin filter is shown in the Fig.2 with the following configuration, where the S_1=1mm, S_2=0.3 mm and g1=0.3mm, g=1mm with a fractional bandwidth of 10%(FBW=0.010) at a mid frequency f_0=2.1 GHz.

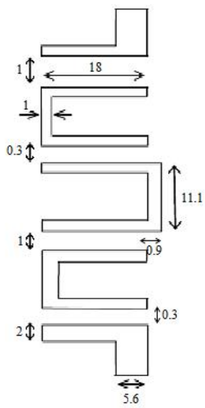

Fig. 2. Layout of three-pole hairpin microstrip BPF

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The lowpass prototype parameters, given for a normalized cut off frequency Ω_c=1, can be found in the literature (Yang and Lancaster, 2010) as follow: g_0=$g_4$1.0, g_1=g_3=0.8516, and g_2= 1.1032. For microstrip implementation, a dielectric substrate TRF4 from Taconic ® was used. The dielectric constant of the material is 4.1 and the loss tangent is 0.0035. The dielectric thickness is h = 3.04 mm. The ground plane has a width of W_g = 80 mm, and length of L_g= 85 mm.

Design of the antenna

The proposed antenna in Fig 4., it is a rectangular microstrip patch antenna with a dimension of 45mm x 35 mm on TRF substrate, with a L=35 mm and w= 45 mm

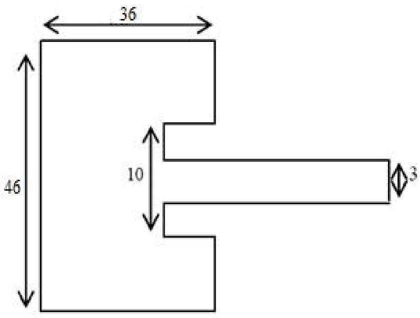

Fig.5. Structure of microstrip patch antenna

With a feed length L= 32mm and w= 10mm. a rectangular patch is used as a radiating element. The energy radiated by the patch0.0003 watts

Simulated result

Simulations were performed using the commercially available ADS Software where the parameters of the proposed structure is simulated

A. Antenna

Antenna ranges from 1.9-2.3 GHz where power radiated 0.00036 watts, with effective angle of 3.11 steradian of 6.055 directivity and obtain a gain of 1.054 dB.

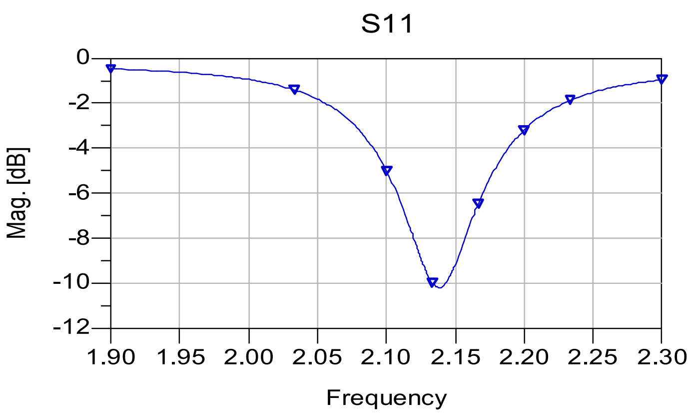

Fig 6. Field based simulation results of magnitude of s_{21}.

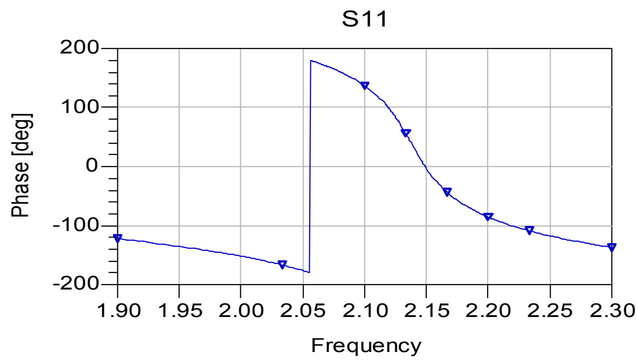

Fig 7. Simulation results of phase of s_{22}.

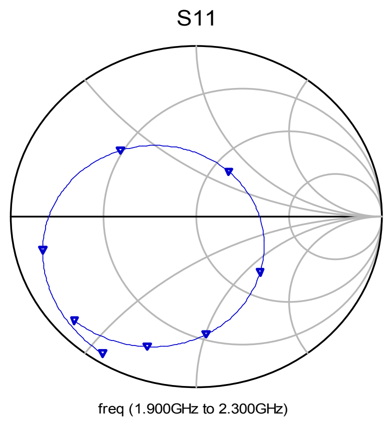

Fig 8. Simulated and measured radiation pattern of antenna

B. Filter

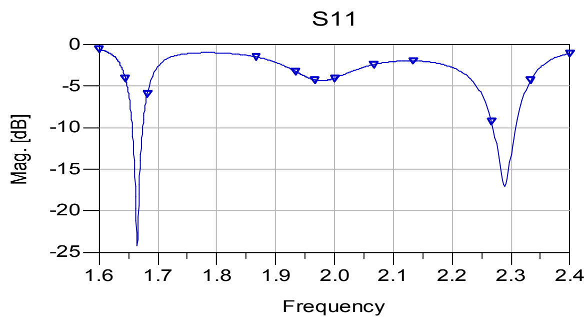

Fig 3. Field based simulation results of magnitude of s_{21}

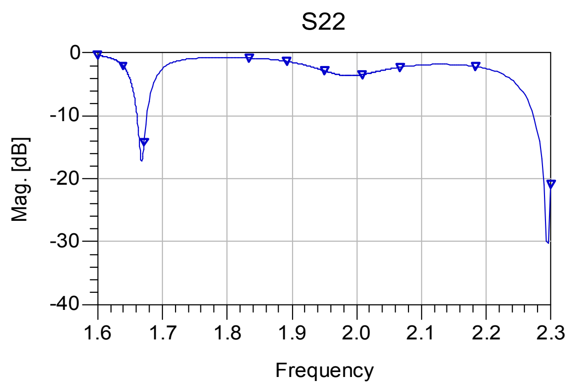

Fig. 4. Simulation results of phase of s_{22}.

Conclusion

The separate Rectangular microstrip antenna and microstrip bandpass filter is designed. The size of the three pole hairpin microstrip bandpass filter is also reduced by 1.02 cm. The simulated filter has bandwidth of 10% in the 1.6-2.4 GHz range. The simulated antenna has the performance has a gain of 1.05 db has a resonance frequency of 2.14 GHz.

Future work

In order to achieve simplicity and miniaturization, it is desirable to integrate the filter with antenna structure. The proposed integrated structure will operate in the required frequency band with desirable performance. The integrated design will have smaller dimension than the existing design.

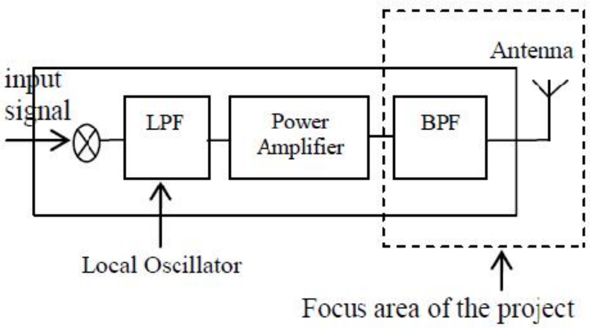

Fig. 9. Layout of antenna with filter

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