

Rectangular Microstrip Patch Antenna Design

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ABSTRACT

This article presents the design of Rectangular Microstrip Patch antenna for communication. The simple patch antenna can be designed by varying the substrate and the thickness of the substrate. In Microstrip patch antenna (MPA) design, choosing the substrate is difficult task because, the designer should select the proper substrate material, to get the proper Gain value, Radiation pattern, Return loss and Impedance bandwidth. This paper presents how the rectangular Microstrip patch antenna can be designed and the performance of patch antenna varies when we are changing the substrate thickness and substrate materials. The proposed antenna operates at a band of WiMAX, Wi-Fi and ISM.

Key words: Rectangular MPA, Wi-Fi and ISM.,

I. INTRODUCTION

The Microstrip patch antenna contains very compact in size, it requires less power, fast data transmission and better return loss. The challenging task in the antenna design is Electromagnetic Interference and Compatibility (EMI/EMC). So we need to analyse the performance of the proposed antenna by varying the substrate materials. The proposed antenna is used for most of the ISM and ultra-wide band applications. In this article we study about the different substrate materials used in Microstrip patch antenna design and the thickness of the substrate. The simple patch antenna is shown in the figure (1)

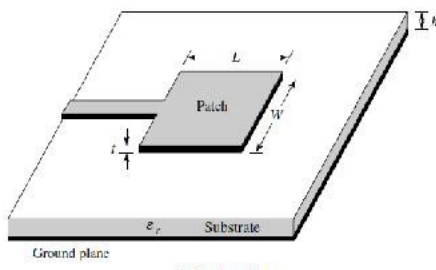


Figure 1

The Patch antenna consists of Ground plane, substrate, Patch and Feed line. It gives the different Antenna parameters, Metamaterial as a composite material structure that exhibits a special property like negative refractive index or left-handed materials. It gives a polarization in negative direction because of negative μ and negative ϵ . The Metamaterial can enhance the directivity, gain of the patch antenna and reduce the return loss. The variation in gap size of Split ring resonator (SRR) improves the Bandwidth of patch antenna. These Metamaterial structures miniaturize the antenna, inducing the resonator.

Antenna design

The Microstrip patch antenna can be designed using the theoretical calculation using the steps.

Step1: The width of the patch can be calculated using,

$$W = \frac{c}{2f_0} \sqrt{\frac{2}{\epsilon_r + 1}}$$

Step 2: The effective dielectric constant,

$$\epsilon_{reff} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2} \left[1 + 12 \frac{h}{w} \right]^{-\frac{1}{2}}$$

Step 3: The length of the patch,

$$\Delta L = 0.412h \left[\frac{(\epsilon_{reff} + 0.3) \left(\frac{w}{h} + 0.264 \right)}{(\epsilon_{reff} - 0.258) \left(\frac{w}{h} + 0.8 \right)} \right]$$

Step4: Effective length of the patch,

$$L_{eff} = \frac{c}{2f_0 \sqrt{\epsilon_{reff}}}$$

Step5: Final length of the patch and ground plane

$$L = L_{eff} - 2\Delta L$$

$$W_g = 6h + W$$

$$L_g = 6h + W$$

The patch design is shown in the figure (2),

The calculated width and length of the patch can be used to simulate the two rectangular patch connected one with other.

II. RESULT AND ANALYSIS

The rectangular patch can be created for the width $W=25.2\text{mm}$, Length $L=18.2\text{mm}$, thickness 1.6mm , FR4 substrate and the gain -0.25dB is obtained.

The antenna gain value changes to -1.2dB for the substrate material RT Duroid 5880 of thickness 1.6mm . The result of rectangular patch can be analyzed using the patch simulation. From the above analysis the FR4 substrate gives the gain value minimum at the frequency 5.1GHz , when the thickness increases the return loss increases and the frequency decreases also the antenna performance can be increased. The gain, S-parameter and Magnitude analysis can be shown in the graph given below.

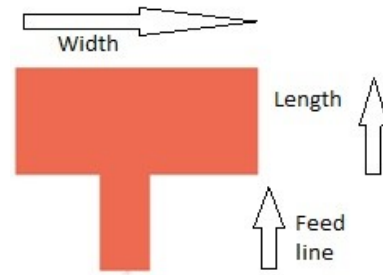


Figure 2

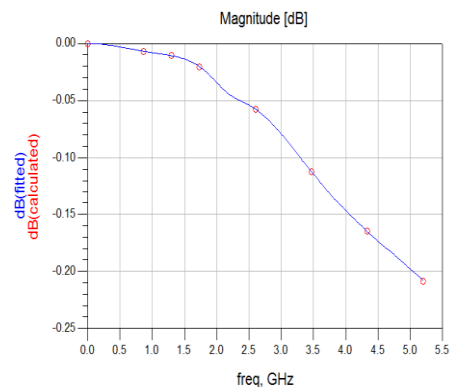


Figure 3

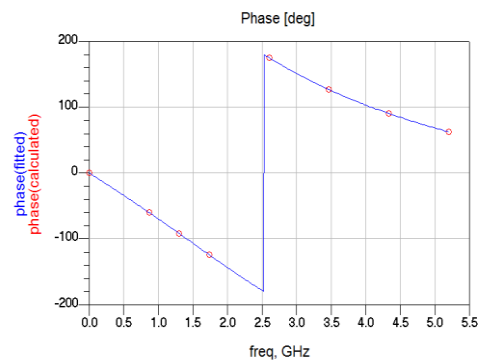


Figure 4

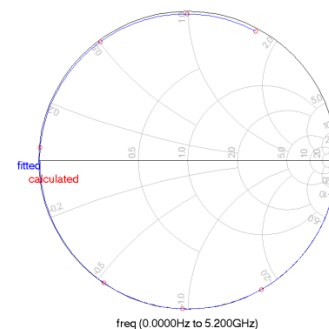


Figure 5

III. CONCLUSION

The proposed design was simulated using the advanced design system (ADS), the substrate materials

used for the design are FR4 and RT duroid5880. The rectangular patch gives the better radiation for different frequency band. The thickness of the substrate can be 1.6mm,2.2mm,4.4mm etc., are used for the patch design, Most of the patch antennas are designed using the FR4 substrate but in this design RT duroid5880 is also used for patch design, it is observed that the gain varies when we are varying the substrate material, it gives a better radiation pattern and Return loss. The antenna is used in WiMAX, Wi-Fi and ISM band applications.

IV. REFERENCES

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