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Design of Wireless Antenna for LAN Communication

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***Abstract**: In this paper we have design and analyzed the performance of microstrip patch antenna using the spectrum analyzer. The return loss of a normal patch antenna designed at the resonant frequency of 2.47 GHz has been obtained. This paper shows the faithful frequency for the wireless LAN communication network with a very good practically value of VSWR, antenna gain and return loss at the 2.47 GHz resonant frequency. These structures are simulated using IE3D Electromagnetic simulator of Zeland software incorporation.*

Keywords: *Rectangular Microstrip Patch Antenna, Return Loss, VSWR, Gain*.

1. INTRODUCTION

Presently there is in government and commercial applications, such as mobile radio and wireless communications that have similar specifications. In modern wireless communication systems, the microstrip patch antennas are commonly used in the wireless devices. Therefore, the miniaturization of the antenna has become an important issue in reducing the volume of entire communication system [1]. To meet these requirements, microstrip antennas can be used. Microstrip antennas are largely used in many wireless communication systems because of their low profile and lightweight [2].

These antennas is conformable to planar and nonplanar surfaces, simple and inexpensive to manufacture using modern printed-circuit technology, mechanically robust when mounted on rigid surfaces, compatible designs, and when the particular patch shape and mode are selected, they are very versatile in terms of resonant frequency. The currently popular antenna designs suitable for the applications of wireless local area network (WLAN) and world-wide interoperability for microwave access (Wi-MAX) have been reported [3].

2. DESIGN SPECIFICATION

The RMPA parameters are calculated from the following formulas. Desired Parametric Analysis [4][5].

Step 1: Calculation of the Width (W):

$$W = \frac{c}{2f_o\sqrt{\frac{(\varepsilon_r + 1)}{2}}}$$

Step 2: Calculation of Effective dielectric constant (ε_{reff}):

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{W}\right]^{-\frac{1}{2}}$$

Step 3: Calculation of the Effective length (L_{eff}):

$$L_{eff} = \frac{c}{2f_o\sqrt{\varepsilon_{reff}}}$$

Step 4: Calculation of the length extension (ΔL):

$$\Delta L = 0.412h\frac{(\varepsilon_{reff} + 0.3)\left(\frac{W}{h} + 0.264\right)}{(\varepsilon_{reff} - 0.258)\left(\frac{W}{h} + 0.8\right)}$$

Step 5: Calculation of actual length of patch (L):

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

ISSN 2320-6802

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3. DESIGN & SIMULATION OF RECTANGULAR MICROSTRIP PATCH ANTENNA

For simplicity, the length and the width of the patch and the ground plane have been rounded off to the following values: L = 28.8984 ≈ 29 mm, W = 37.214 ≈ 37 mm. Rectangular Resonant Microstrip Patch Antenna is etched on FR4 (Lossy) substrate of thickness h = 1.6mm, and dielectric constant ε_r =4.4 by using PEC [6] (Perfect Electric conductor) as the conducting plane. Hence, the essential parameters for the design are resonant frequency f_o=2.47 GHz, dielectric constant of the substrate ε_r= 4.4 & height of dielectric substrate h = 1.6 mm.

Feed point in the figure is represent by probe feed and feed point location (X_f , Y_f) is X_f = 8.5 mm and Y_f = 19 mm and the center coordinate is: X = 14.4492 mm , Y = 18.6052 mm.From the simulation by IE3D software the normal microstrip rectangular patch antenna shown in Figure 1.

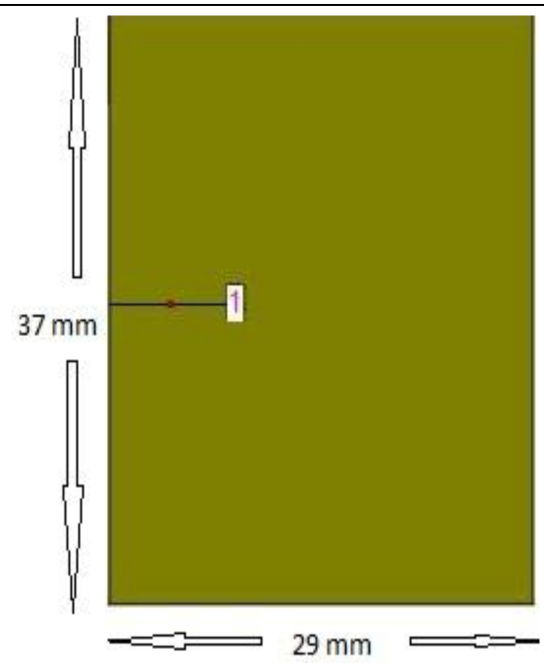

Figure 1: Normal rectangular microstrip patch

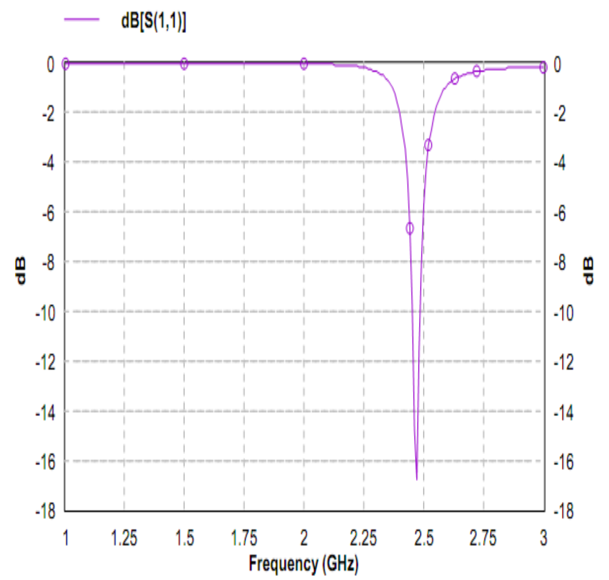

Figure 2: Return loss curve of Normal RMPA

The above Figure-2 is showing the result of return loss -16.76 dB at a resonant frequency 2.47 GHz.

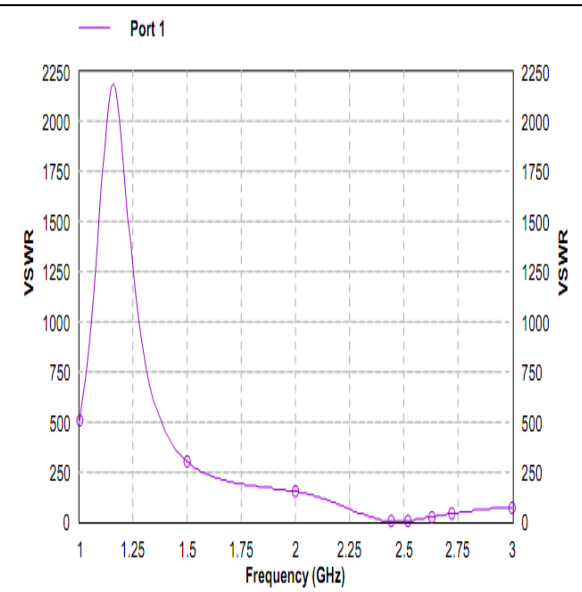

Figure 3: VSWR vs frequency of Normal RMPA

ISSN 2320-6802

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The above Figure-3 is showing the result of Voltage standing wave ratio 1.34 at a resonant frequency 2.47 GHz.

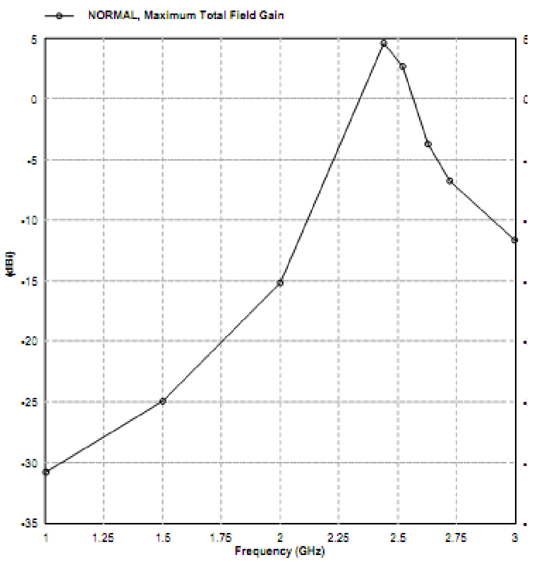

Figure 4: Gain vs. frequency curve of Normal RMPA

The above Figure-4 is showing the result of gain 3.2 at a resonant frequency 2.47 GHz.

However, the difficulty in impedance matching or increasing of surface wave in the Substrate could decline the radiation efficiency and the radiation pattern. Bandwidth of the antenna may be considerably becomes worse [7][8].

4. RESULT AND DISCUSSIONS

The simulated result of rectangular microstrip patch antenna is shown in figure 1 and Return loss -16.76 dB at 2.47 GHz. 2.47 GHz frequency simulated exhibits rectangular microstrip patch antenna alone the VSWR 1.34 at 2.47 GHz that is practically faithfull when it is designed for the LAN communication. The Gain in (dB) is 3.2 which ultimately improve the quality of communication.

The other result is as follows:

S.no.	Parameter	Rectangular patch
1	Return loss	-16.76 dB at 2.47 GHz
2	VSWR	1.34 at 2.47 GHz
3	% B.W.	0.44
4	Gain (dB)	3.2
5	Directivity	6.55

Table 1: Results of RMPA at 2.47 GHz

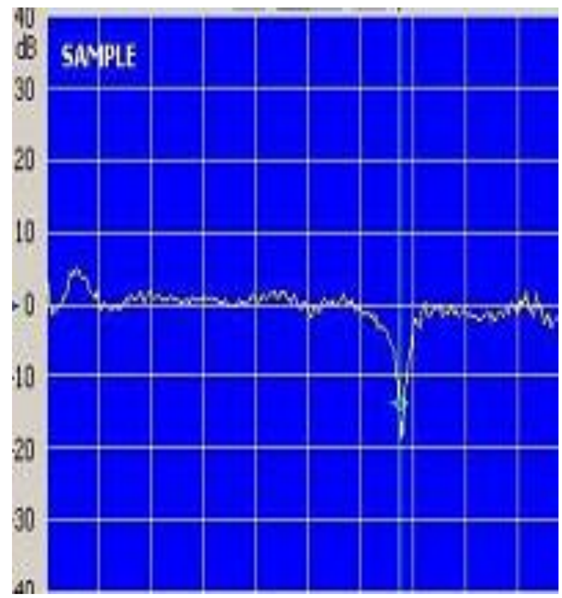

Figure 5: Experimental figure of RMPA by Spectrum analyzer

The above Figure-5 is showing the Experimental result of return loss which is similar to simulated result at a resonant frequency 2.47 GHz.

5. CONCLUSION

As we know that the frequency range of LAN communication lie between 2.2 to 5.8 GHz. Hence here Rectangular microstrip patch antenna has been designed at frequency 2.47 GHz for LAN communication in this paper. The simulated results provide better gain & return loss as well as good VSWR. That encourages fabricating the structure. On making, some variations in antenna parameter gain can be improved up to desired limit but some practical limitation should be taken care while fabricating the structure on IE3D education software.

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