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Development of Cross Cut Shape Rectangular Microstrip Patch Antenna & Compare with Normal Microstrip Patch Antenna

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----------**ABSTRACT**----------
In this paper, we developed a cross cut shape microstrip patch antenna for the performance comparison with the normal microstrip patch antenna using the spectrum analyzer. The return loss of cross cut shape microstrip patch antenna designed at the resonant frequency of 2.47 GHz has been compared with the normal microstrip patch antenna at a substrate height of 1.6 mm. We get improvement in return loss. This paper shows the faithful return loss means we get dual band operation for the cross cut shape on the patch side and a very good practically value of VSWR obtain at the 2.47 GHz resonant frequency. These structures are simulated using IE3D version 12.29 Electromagnetic simulator of Zeland software incorporation.

Keywords: *Cross cut shape Rectangular Microstrip Patch Antenna, Return Loss, VSWR.*

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I. INTRODUCTION

In the present era of wireless communication systems, RMPA plays a very important role. 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 light weight [2]. In spite of having a lot of advantages (low profile, low cost and Omni directional radiation patterns etc.), it has some drawbacks like narrow bandwidth and low gain [9].These antennas is conformable to planar and non-planar 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 [3].

II. DESIGN SPECIFICATION

The Rectangular microstrip patch antenna 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):

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

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

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

Where, ε_r = relative permittivity
c = speed of light
W = width of antenna patch
h = height of antenna patch
f_o = resonant frequency of antenna

III. DESIGN & SIMULATION

For simplicity, the length and width of the patch, the ground plane has been rounded off to the following values: L = 28.8984 ≈ 29 mm, W = 37.214 ≈ 37 mm. Rectangular 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.

Case 1: In normal RMPA Feed point is obtained by probe feed and feed point location (X_f , Y_f) is X_f = 8.5 mm and Y_f = 19 mm by the simulation through IE3D software and the result of return loss & VSWR given in the below table:

S. no.	Parameter	Normal rectangular patch
1	Return loss	-16.76 dB at 2.47 GHz
2	VSWR	1.34 at 2.47 GHz

Table 1: Shows return loss & VSWR for the normal RMPA

Case 2: In Cross cut shape Feed point in the figure is represent by probe feed and feed point location (X_f, Y_f). X_f = 9.5 mm and Y_f = 15 mm by the simulation through IE3D software shown in figure 1.

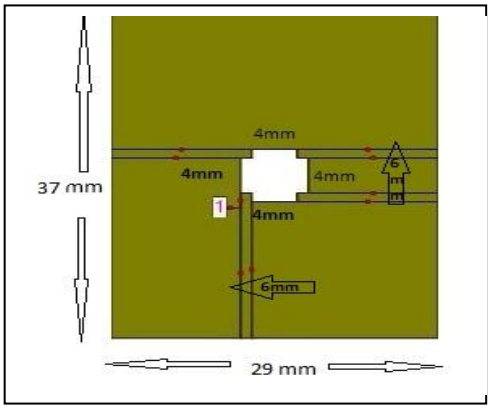

Fig.1. Cross cut shape of rectangular microstrip patch antenna

After the fabrication of proposed antenna the antenna parameters like return loss and Voltage standing wave ratio are measured on the spectrum analyzer. Dual band operation of the proposed antenna can be verified from the Graph given in Fig.2.This graph has been plotted by taking the values of return loss (in dB) within the operating frequency range obtained from the Frequency analyzer.

FIGURES AND TABLES

The simulated result of Cross cut shape of rectangular microstrip patch antenna is shown in Fig.1 and their graph of Return loss is -28.79 dB at 2.47 GHz & -14.11 dB at 2.47 GHz shown in Fig.2. While in case of normal RMPA the return loss was -16.76 dB at a 2.47 GHz resonant frequency, simulated result of VSWR for

the cross cut shape RMPA is 1.075 at a frequency & 1.491 at a frequency 2.47 GHz shown in Fig.3. While in case of normal rectangular microstrip patch antenna VSWR was 1.34 at 2.47 GHz resonant frequency. Therefore both the above result shows the improvement in the return loss as well as in VSWR when we use cross cut shape RMPA instead of normal RMPA.

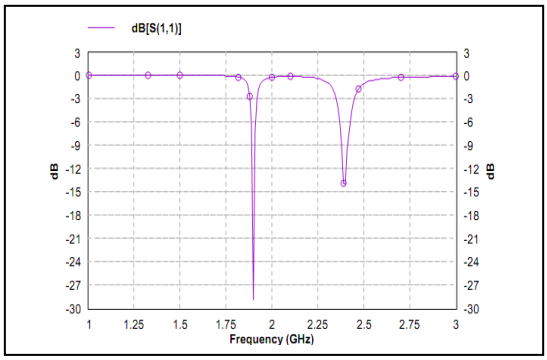

Fig.2. Graph between Return loss & frequency

Dual band operation of the proposed antenna can be verified from the Graph given in Fig.2. This graph has been plotted by taking the values of return loss (in dB) within the operating frequency range obtained from the Frequency analyzer. It has also been seen that with these improvements this structure also possesses double negative properties within the operating frequency ranges.

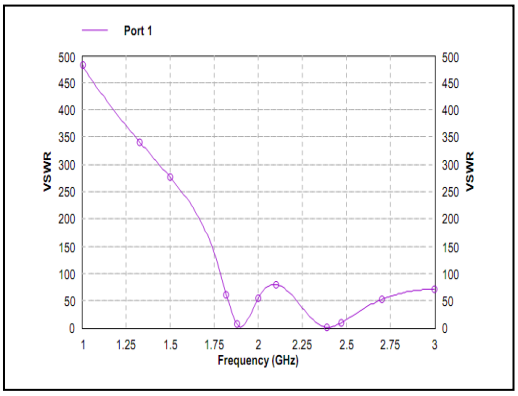

Fig.3. Graph between VSWR & frequency

The Fig.3 shows the Voltage standing wave ratio at dual band frequency which gives the good practically result less than 2.2D-Radiation pattern shows the impedance variation within the simulated frequency range and on the basis of smith chart information about impedance matching can be easily obtained.

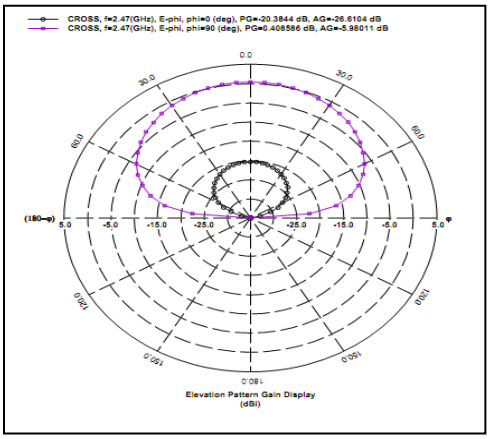

Fig.4. Radiation pattern at a resonant frequency 2.47 GHz

The results for the Cross cut shape rectangular microstrip patch antenna as follows:

S. No.	Parameter	Cross rectangular slot on patch
1	Return loss	-28.79 dB at 1.9 GHz & -14.11 db at 2.47GHz
2	VSWR	1.075 at 1.9 GHz & 1.491 at 2.47 GHz

Table 2: Shows return loss & VSWR for the Cross cut shape RMPA

IV. CONCLUSION

We compare Cross cut shape rectangular microstrip patch antenna to normal rectangular microstrip patch antenna at an operating frequency 2.47 GHz. The cross cut shape RMPA provide dual band operation at 2.47 GHz. At 2.47 GHz the values of Return loss are -28.79 dB at 1.9 GHz & -14.11 db at 2.47GHz.we know that the dual band operating frequency improves the gain of antenna. Hence here Cross cut shape rectangular microstrip patch antenna has been designed at frequency 2.47 GHz for Aircraft & mobile communication. 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.

REFERENCES

[1] H.A. Jang, D.O. Kim and C.Y. Kim, Size reduction of patch antenna array using CSRRS loaded ground Plane, *progress in electromagnetics research symposium proceedings*, Kl Malaysia, march 2012, 27-30.

[2] H.W. Douglas, R.L. Haupt and P.L. Werner, Fractal antenna engineering: The theory and design of fractal antenna arrays, *IEEE Antennas and Propagation Magazine*, 41(5), 1999, 37-59.

[3] Y.L. Kuo and K.L Wong, Printed double-T monopole antenna for 2.4/5.2 GHz dual band WLAN operations, *IEEE Trans.Antennas Propagation*, 51(9), 2187-2192.

[4] Constantine A. Balanis, Antenna Theory and Design, *John Wiley & Sons*, Inc., 1997.

[5] L. Stutzman and G.A. Thiele, Antenna theory and design, *John Wiley & Sons* 2nd Ed., New York, 1998.

[6] J.B. Pendry, A.J. Holden, D.J. Robbins and W.J. Stewart, Magnetism from conductors and enhanced nonlinear phenomena, *IEEE Transaction. Micro Tech*. 47(11), 1999, 2075-2081.

[7] J.S. Colburn and Y. Rahmat-Samii, Patch antennas on externally perforated high dielectric constant Substrates, *IEEE Trans. Antennas Propagation*, 47(12), 1999, 1785–1794.

[8] H. Oraizi and R. Pazoki, Radiation bandwidth enhancement of aperture stacked microstrip antenna, antennas and propagation, *IEEE Transaction*, 59(12), 2011, 4445-4453.

[9] Vikas Gupta and B.S.Dhaliwal, Performance enhancement of rectangular microstrip patch antenna by loading complementary split ring resonator in the patch, *International Journal of Electronics Engineering*, 3(1), 2011, 141–143.

[10] Tushar & Pooja jaiswal, Design of wireless antenna for LAN Communication, *International Journal for Advance Research in Engineering and Technology*,2(1), 2014,75-78.

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