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Design of Broadband Microstrip Patch Antenna for RF Applications

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Abstract: Microstrip patch antenna was designed in this paper for Radio Frequency (RF) applications. The proposed patch antenna operates at frequency 1.8GHz to 2.4 GHz which obtained very sharp cut-off points. And also it obtained Return loss -22dB at 2GHz resonant frequency. Two L- shaped patch antenna was constructed using probe or coaxial feeding techniques. Loading slots on a rectangular patch antenna. Two parallel L-shaped antennas was used to achieved good or better impedance bandwidth. Microstrip antennas are made of a rectangular patch with dimensions length L and width W, above a ground plane with dielectric constants ε_r and substrate thickness h. Microstrip antenna is made of with the help of conducting patch over a ground plane isolated by a dielectric substrate the proposed antenna was simulating on HFSS software tool for commercial purposes.

Keywords: Microstrip Patch Antenna, IE3D EM Simulation, S-Parameters, Return-Loss and Defected Micro Strip Structure.

I.INTRODUCTION

Antenna is widely used now a day for high performance in space craft, missiles and satellite communication. There are many antenna used for commercial purposes but the most widely used antenna is Microstrip patch antenna is used for low weight, low cost and for good performance[1].To enhance the performance of the antenna a shunt antenna used.

The purpose of using two series Rectangular patches was to enhance Bandwidth broadening [2]. Two L- shaped patch antenna was constructed using probe or coaxial feeding techniques.

Loading slots on a rectangular patch antenna. Two parallel L-shaped antennas was used to achieved good or better impedance bandwidth [3].

In [4] Single-fed Broadband Square patch antenna was constructed for UHF RFID applications using meandered probe feeding techniques for good impedance matching.

In [5] M-shaped compact patch Antenna was constructed using coaxial feed technique, Bandwidth of the proposed antenna is 1.8 GHz ranging from 8.7 GHz to 10.5 GHz. Return loss of the proposed antenna was -24 dB.

II. DESIGN OF RECTANGULAR MICROSTRIP PATCH ANTENNA

The rectangular microstrip antennas are made of a rectangular patch with dimensions length L and width W, above a ground plane with dielectric constants ε_r. and substrate thickness h.

A microstrip antenna is made of with the help of conducting patch over a ground plane isolated by a dielectric substrate [1].

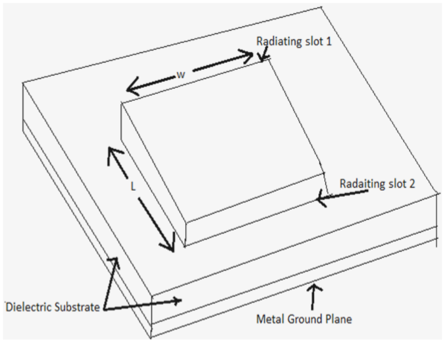
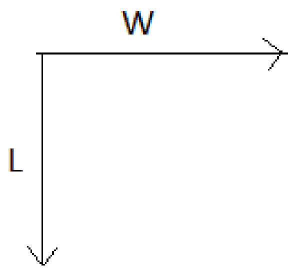


Figure 1: Layout of a Microstrip Patch Antenna



III. DESIGN OF MICROSTRIP PATCH ANTENNA

Antenna is designed at cut-off frequency 2GHz to 3.5GHz. Where 'h' is the height of the Patch here it is denoted by

$$h_e = \sqrt{\frac{\in_r}{\in_g}}\, h \qquad (1)$$

Where $\in_r$ dielectric is constant, $\in_g$ is geometric mean and h_e is effective spacing.

To calculate dielectric constant we use formula

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$$\epsilon_{eff} = \frac{\epsilon_g + 1}{2} + \frac{\epsilon_g - 1}{2}\left[1 + 12\frac{h_e}{W}\right]^{-\frac{1}{2}} \quad (2)$$

Now calculate Width of the patch

$$W = \frac{V_0}{2 f_o}\sqrt{\frac{2}{\epsilon_g + 1}} \quad (3)$$

Extended length is

$$\frac{\Delta L}{h} = 0.412\frac{(\epsilon_{eff} + 0.3)\left(\frac{W}{h} + 0.264\right)}{(\epsilon_{eff} - 0.250)\left(\frac{W}{h} + 0.8\right)} \quad (4)$$

Actual length can be calculated as

$$L = \frac{1}{2 f_r \sqrt{\epsilon_{eff}}\sqrt{\mu_o \epsilon_r}} - 2\Delta L \quad (5)$$

The design Patch Antenna was constructed using Line Feeding Techniques whose cut-off frequency (f_c) at 2GHz to 3.5GHz having thickness of substrate.

IV. IE3D LAYOUT OF MICROSTRIP PATCH ANTENNA

The length and the width of the proposed antenna is 35.4 and 45.6 using FR4 substrate. By using mathematical formulas we calculate antenna dimensions which having thickness 1.6mm and dielectric constant of 4.4 and terminating impedence $Z_o = 50ohm$

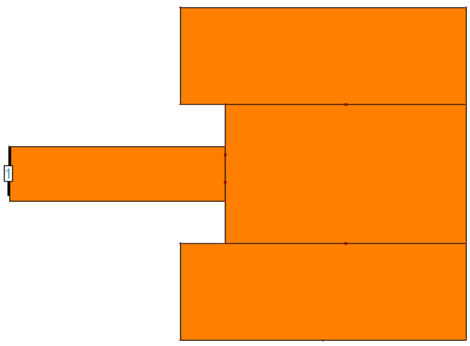

Figure 2: Layout of Microstrip Patch Antenna

V.IMPLEMENTATION AND RESULTS

The microstrip patch antenna is designed for 1.8 to 2.4GHz shown in fig.3 shows that the simulated patch antenna of proposed antenna at different frequencies. Hence the performance of the antenna increases. We obtained resonant frequency of 2 GHz having return loss is -22dB. We obtained this graph with the help of HFSS software simulation

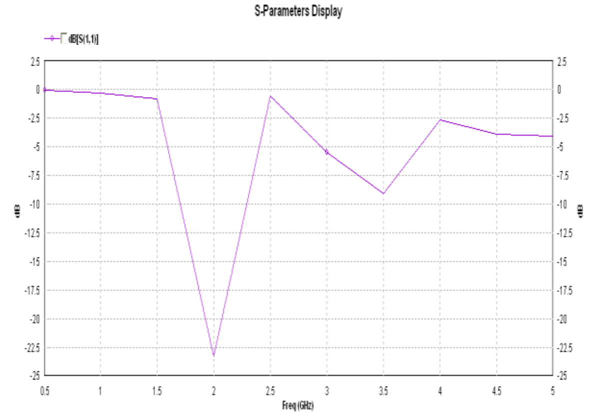

Figure 3: Simulated result of return-loss for proposed patch antenna.

In table 1 show return losses at different frequencies. At 2GHz frequency the antenna obtained 23.31 GHz and at 3.5GHz the antenna obtained 9.128 GHz shown in table below

Table 1: Results of Return loss at different frequency

dB(Sij) in dB and Ang(Sij) in degree.

Freq[GHz]	dB[S(1,1)]
0.5	-8.776e-002
1	-0.4056
1.5	-0.8527
2	-23.31
2.5	-0.6469
3	-5.522
3.5	-9.128
4	-2.745
4.5	-3.97
5	-4.125

VSWR in no unit.

Freq[GHz]	Port 1
0.5	197.9
1	42.84
1.5	20.39
2	1.147
2.5	26.86
3	3.251
3.5	2.075
4	6.382
4.5	4.452
5	4.29

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VI.SIMULATED 3-D GEOMETRY

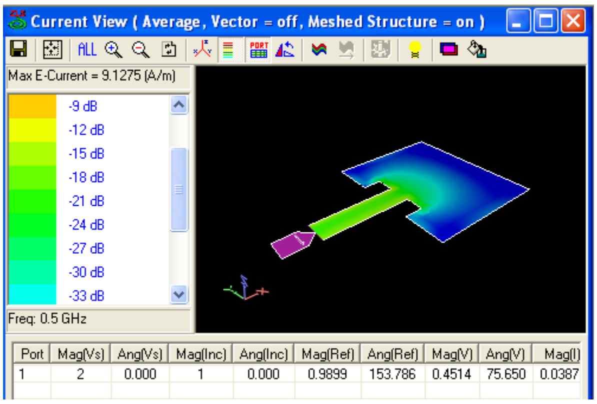

Figure 4: 3D current view of proposed antenna

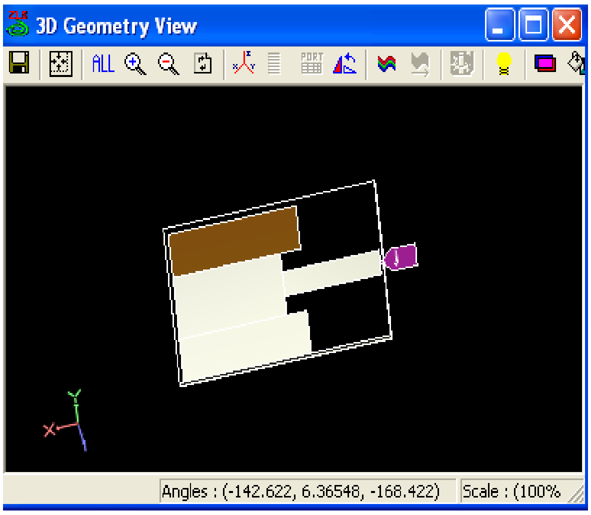

Figure 5: 3D Geometry of Antenna

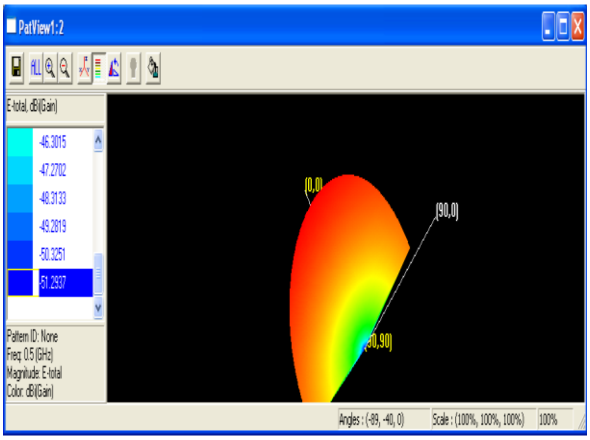

Figure 6: Radiation pattern of proposed antenna

VII.CONCLUSION

The main objective of this paper is to design Microstrip patch antenna for RF applications. The proposed antenna is designed at cut-off frequencies 1.8GHz to 2.4GHz and gives sharp cut-off frequency, which is easy to design. The antenna behaves like wideband microstrip patch antenna which is used for RFID applications.

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BIOGRAPHIES

Pratiksha Singh Gaur passed B.Tech degree in Electronics and Communication engineering form college of science, and engineering Jhansi, U.P, Uttar Pradesh technical university luck now. She has published 3 papers in International Journal and publishes 3 papers in national seminar. She has completed M.Tech from Amity University, Gwalior.

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