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Design of a Micro-strip Patch antenna for 2.4 GHz resonance frequency

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Abstract: ***The design and simulation done on the rectangular micro-strip patch antenna for the ISM band of frequencies is studied in this paper. Micro-strip line feed is used in this paper. The resonance frequency is found between 2.4-2.5 GHz. This band of frequencies is ISM band of wireless applications. The design and simulation are done in Computer Simulation Technology (CST) software with FR4 substrate. By using the length and width expressions, the size of the antenna is calculated. Then the antenna is simulated for the radiation parameters obtained through optimizing and matching to meet the requirements. The parameters of antenna such as Reflection coefficient, Gain, VSWR and Band width are measured.***

Keywords – CST, FR4, ISM Band, Micro-strip patch antenna, Simulation

1.INTRODUCTION

An antenna is a device used to transform an RF signal, traveling on a conductor, into an electromagnetic guided wave in free space. Printed circuit techniques can be utilized to design the antennas on low frequency substrates to produce low cost and reconfigurable antennas in a low profile. The antennas are generally used in wireless application due to their higher performance, less cost, small weight, reduced size, appropriate shape, and easy to construct. A microstrip antenna consists of a sandwich of two parallel conducting layers separated by a single dielectric substrate. The lower conductor is called ground plane and upper conductor is known as patch. Antennas are frequency dependent devices. Each antenna is designed for a certain frequency band, and it rejects signals beyond the operating band.[1] The Industrial, Scientific, and Medical (ISM) frequency bands are designated radio frequency bands as defined by the ITU (International Telecommunication Union). In a typical wireless communication system increasing the gain of antennas used for transmission increases the wireless coverage range, decreases errors, increases achievable bitrates, and decreases the battery consumption of wireless communication devices. Microstrip patch antenna used to send onboard parameters of article to the ground while under operating conditions. [2]

2.LITERATURE SURVEY

By surveying it is planned to design and implement Rectangular microstrip Patch Antenna resonating at ISM Band of 2.46 GHz frequency. Design features were taken from Prakash Bhartia [Prakash Bhartia, 2018]. S Sreenath Kashyap contribution on ISM band are noted [3] Based on the above inputs the proposed antenna is designed using CST software and tested its antenna parameters using network analyzer. Microstrip patches are popular by their less weight, small space, and work with components with minimum cost. These antennas can be interconnected by networks and active devices with printed microstrip line fed.[4] A patch antenna comprises of a radiation part as colored on dielectrics substrate top side and bottom side as ground shown in Figure 1. Both sides are made by copper material. The radiating patch and the microstrip feed lines are designed on the dielectric substrates. The radiating patch structure is usually square, rectangular, circular, triangular, elliptical and/or some common design. A rectangular geometry is planned here.[5]

3.DESIGN AND ANALYSIS

Micro-strip patch antennas can be powered by a variety of techniques by two main types of contacting type and non- contacting type. The RF current is given to the radiating patch by connecting a micro-strip line and probe in contacting type. Coupling of electromagnetic fields is done by the non- contacting type. The common feeding

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techniques utilized are the coaxial probe, micro-strip line, through aperture coupling and by proximity coupling. Antenna is simulated using CST software.

4.FIGURES AND TABLES

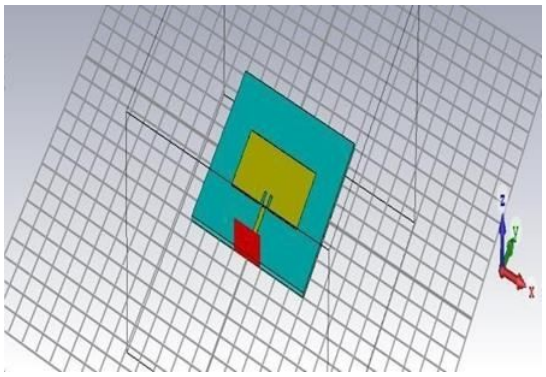

Fig 1: Structure of a Micro-strip Patch Antenna with micro-strip line

The layout overview of patch antenna is following below. Designing the antenna with appropriate dimensions, Simulate the antenna, Analyze the design in layout view, Evaluate the performance measure of frequency, return loss, power, gain, Fabrication, Measuring. To have the desired resonance at more than one frequency generally we can go for multi band techniques.

TABLE 1 -DIMENSIONS OF ANTENNA

Name	Dimension	Measurement values(mm)
Radiating patch	W	36.50
Length	L	23.55
Ground plane	W_g	46.10
Length	L_g	33.15

Simulation is done by the CST software by following the procedures in that software. FR4 substrate is selected.

The Simulation Frequency range is set as 2.1 GHz – 2.7 GHz and added a new Single Point of 2.46 GHz as below. Simulate option is selected and observed the simulation results in the data display. Simulated results are shown in figure 2.

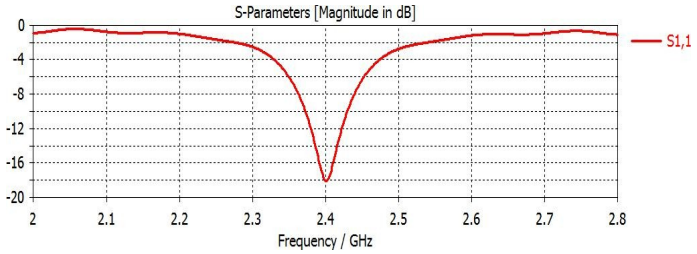

Fig 2. Simulation results S_{11} Vs Frequency (GHz)

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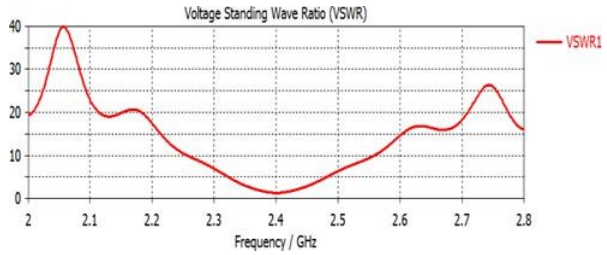

Fig 5 VSWR

The simulated reflection coefficient is -18 dB

5. Conclusion

Rectangular micro-strip patch antenna fed by micro-strip Line is developed. The results are simulated using CST software. The designed micro-strip rectangular patch antenna efficiently propagates at 2.46 GHz frequency and gives the return loss of 18 dB directivity as 5.64 dB, VSWR is 1.45. Antenna Radiation Efficiency comes out to be 97.05% at 2.46 GHz. The antenna results are found to be satisfactory, and it may be suitable at ISM frequency band applications like Bluetooth, WLAN etc. This research can be further developed on high frequency substrates to increase the gain value.

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