IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

DESIGN AND IMPLEMENTATION RECTANGULAR MICROSTRIP PATCH -ANTENNA AT 5GHZ FOR WIRELESS APPLICATIONS

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Abstract: The demand for wireless network access dramatically increasing due to the automation of all appliances. The need for high performance wireless transceivers is also warrants more. The successful operation of various electronic gadgets under strong electromagnetic environment is a challenging. The EMI disturbance is not that much sensitive in consumer electronics. But it has strong influence in the military electronic equipment. Radar, Satellites, commercial communication equipment and other medical equipment. They need accurate tracking and faithful operation even at the worst natural and manmade environmental pollutions.

ISM band is used in the applications such as medical, industrial wireless environment and mobile communications etc., these applications require high gain, more directional and low return loss antennas. Antennas are front-end component in the transceiver. Antenna needs to be selective and sensitive. In this work, a microstrip patch antenna has been design and analysed at 5 GHz frequency. The design methodology adopts analytical approach to find the dimensions of the antenna and to fix the location of the feeding point. The patch is a distributed planar structure of microstrip line.

Index Terms **– Patch Antenna, Wireless Network, Beam width, VSWR, Return Loss**

I. INTRODUCTION

In high-performance like aircraft, spacecraft, satellite and missile application, where sizes, weight, cost, performance, ease of installation, and aerodynamic profile are constraints, low profile antenna may be required. Presently there are many other government and commercial application, such as mobile and radio and wireless communications, which have similar specifications. Microstrip patch antenna can be used based on these requirements. This antenna has low profile, conformable to planar and non- planar surface, simple and low cost to manufacture by using a modern printed- circuit technology. Microstrip antennas consist of a patch of metallization on a grounded substrate. These are low-profile, lightweight antennas, most suitable for aerospace and mobile applications because of their low-power handling capability, this antenna can be used in low-power transmitting and receiving applications.

One types of wireless communication is wireless fidelity (Wi-Fi) it enable the devices such as Smartphone, personal computer, video game console or digital audio player can connect to the internet if within range of a wireless network connected to the internet. The micro strip antenna was drawn the maximum attention of the antenna community in recent year. A micro strip antenna is very simple in construction using a conventional micro strip fabrication technique. The conducting patch can be any shape but the most commonly used configurations are circular and rectangular configurations. Descamps first proposed the concept of micro strip antennas in 1953 but practical antennas were developed by Munson and Howell in 1970's. Increasing requirements for personal and mobile communications has made the micro strip antennas very important.

Microstrip antennas are becoming a popular choice for portable wireless system since they are light weight, low cost and easily manufacture. These 802.11 wireless local area network (WLAN) systems may operate at 2.4Ghz microstrip patch antenna can take a variety of forms, but the basic element consists of a single patch of conductor on the upper surface of a grounded dielectric substrate. The patch radiates efficiently when it is resonant, which generally means that some characteristic dimension of the patch is nearly equal to one-half wavelength in the substrate medium.

The shape of the patch can be rather arbitrary, but rectangular and circular patches have several desirable characteristics and more often used in practice. Figure 1.1 shows the side view of simple microstrip patch antenna and this antenna consists of three layers which are substrate, patch layer and ground layer.

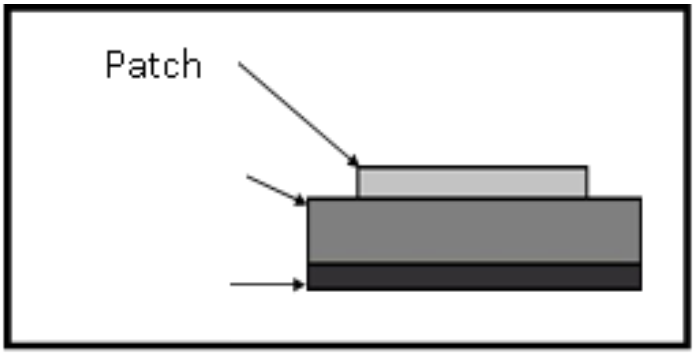

Fig .1: Side view of micro strip patch antenna.

Antenna was developed in order to full fill the problem occurs and upgraded the antenna for the advanced technologies. A conventional antenna is very hard to design compared to micro strip antenna. A conventional antenna is very costly and quite heavy but the micro strip patch antenna has a simple structure and quite easy to fabricate. There are many shape of micro strip patch antenna such as rectangular, circular, triangular and other types of geometries. The most popular configuration is rectangular micro strip patch antenna. The main purpose of this project is to design a rectangular micro strip patch antenna using the Flame retardant 4 (FR4) and Roger4350 as a dielectric substrate in fabrication of the antenna.

II. IMPLEMENTATION

Microstrip antenna is becoming beneficial due to their mild weight and coffee value, they may be maximum use microwave frequencies, and can be revealed without delay onto a circuit board. The maximum microstrip patch antenna typically includes 12 a steel foil "patch" on floor on pinnacle of board, with a metallic foil ground plane on the opposite facet of the board, and the patch is typically made of any viable shape consisting of rectangular, square, round and elliptical. Usually we continually use inset feed and coaxial feed techniques, as it is simple to understand and obtain input in shape. The patch antenna is a low profile antenna, because structure, it has proper radiation potential, we can see that the radiation of microstrip antenna is as a result of the threshold of the open facet of the patch. Because the length of the radiation patch is ready half of wavelength, the electric subject is opposite in vertical aspect of open facet, however the electric field is distributed in the equal course horizontal thing shown in fig 2.

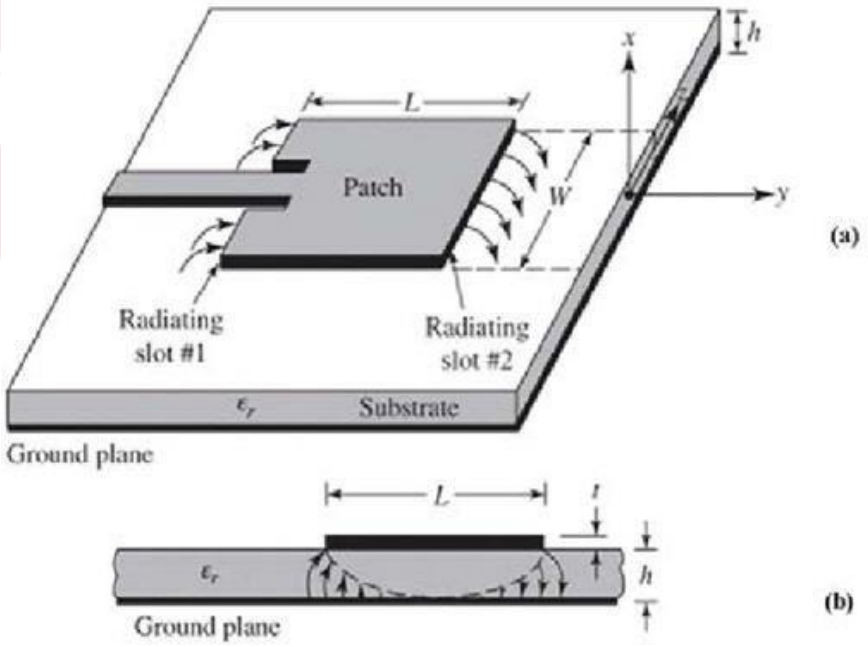

Fig. 2 (a): Microstrip antenna. (b): Side view of microstrip antenna.

This type of microstrip antenna is straightforward to fabricate, due to the easy 2-dimensional physical geometry parent 1. Rectangular antenna is implemented in ultra-high frequency (300 GHz - 3 GHz), because the dimensions of antenna results the wave length at the resonant frequency. For the most important e plane, the scale of the patch alongside its period was prolonged on every give up by using a distance ΔL that is function of the effective dielectric consistent is shown.

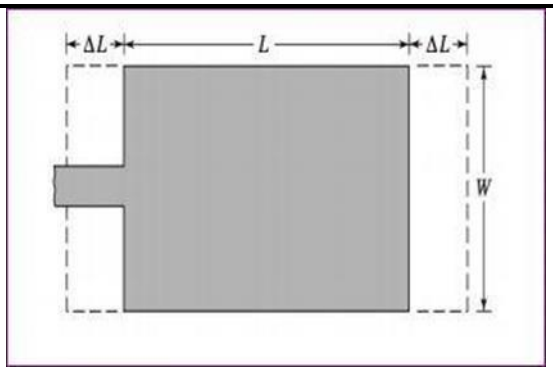

Fig .2 (c): Rectangular patch antenna without gap.

III. RESULTS

This analysis helps to finalize the design and the improvement of the antenna performance in the terms of input impedance, VSWR, radiation pattern, beam width. EM Structure Layout of Rectangular Microstrip Patch Antenna – 2D View

The software part of our project revolved around determination of the several parameters like radiation pattern, directivity, gain, half-power beam width , bandwidth, input impedance, polarization, reflection coefficient, voltage standing wave ratio (VSWR) and return loss ect.

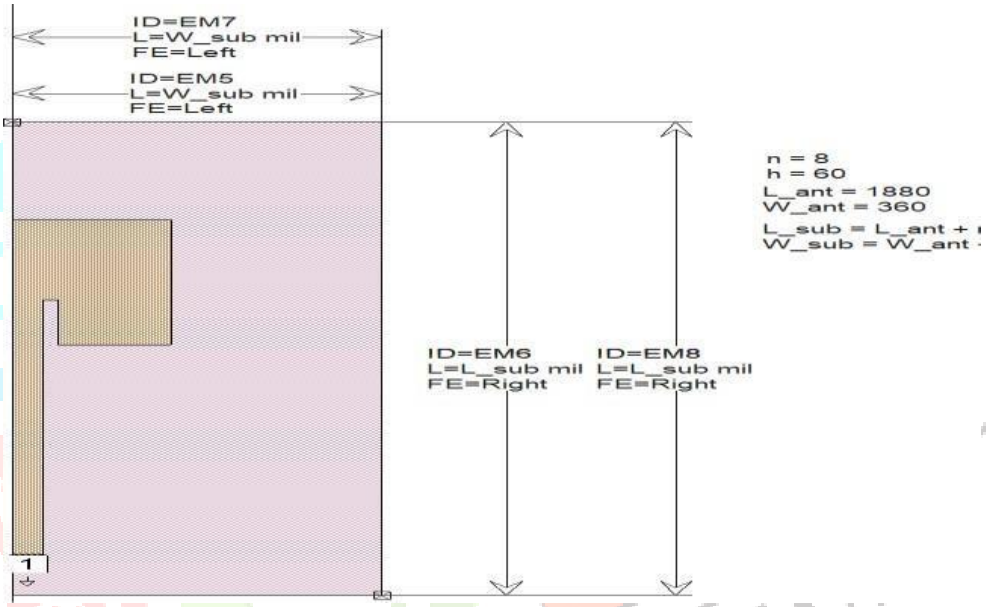

Fig .3: EM layout 2D view.

Rectangular micro strip patch antenna – 3D top view

A simple microstrip patch antenna consists of a conducting patch and ground plane between them is a dielectric medium called the substrate having a particular value of dielectric constant of 3.38.The below diagram shows that Rectangular micro strip patch antenna 3D view.

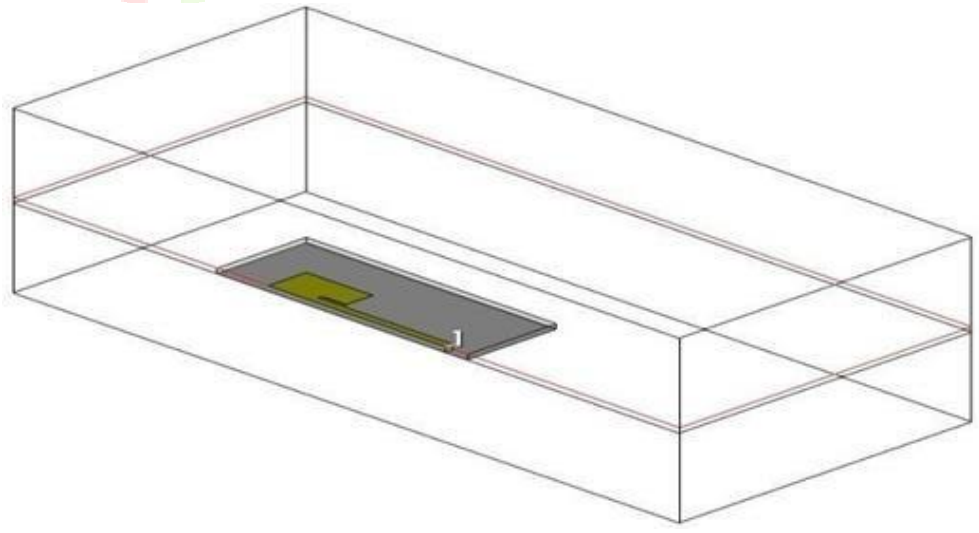

Fig. 4: RMPA 3D view.

Radiation pattern:

In the style of antenna the term radiation diagram or far field pattern refers to the directional dependence of the radio waves strength from the antenna or alternative supply. Particularly in the sides of fiber optics, lasers and integrated circuits the term radiation pattern may also be used as a synonym for the very near field pattern and resonant field pattern. From the radiation pattern plot antennas can be calculated.

3D Radiation Pattern

The radiation pattern is a three-dimensional figure and represented in spherical coordinates (r, θ, Φ) assuming its origin at the center of spherical coordinate system. It looks like the following figure.

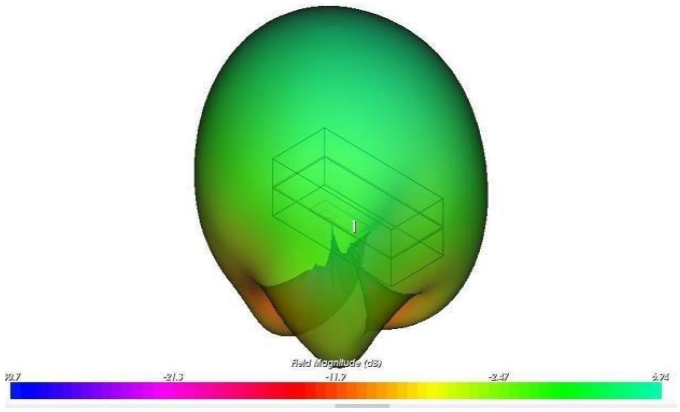

Fig .5: 3D vertical radiation pattern.

The given figure is a three dimensional radiation pattern for an Omni directional pattern. This clearly indicates the three co-ordinates (x, y, z).

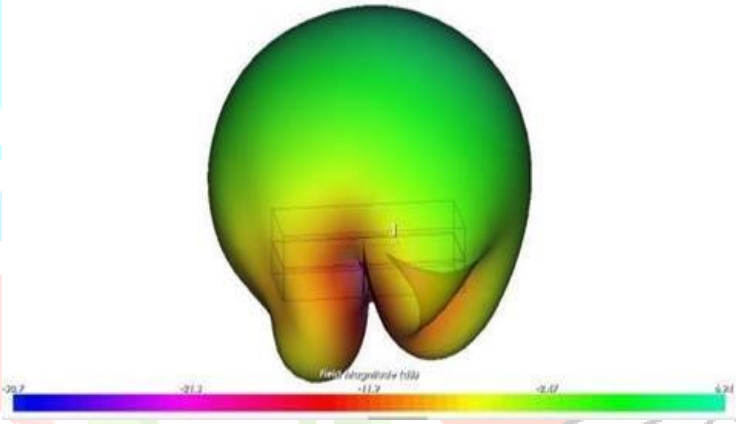

Fig .6: 3D horizontal radiation pattern **E-Plane**

Radiation:

For a linearly polarized antenna, this is the plane containing the electric field vector (sometimes called the E aperture) and the direction of maximum radiation. The electric field or "E" plane determines the polarization or orientation of the radio wave.

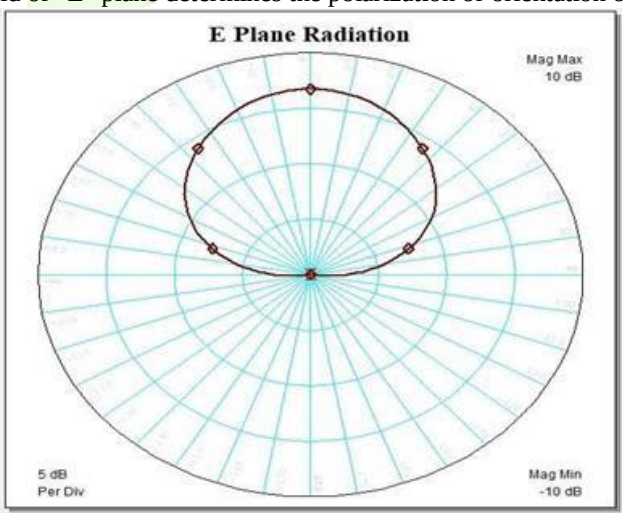

Fig .7: Electric field radiation **H-Plane**

Radiation:

In the case of the same linearly polarized antenna, this is the plane containing the magnetic field vector (sometimes called the H aperture) and the direction of maximum radiation. The magnetizing field or "H" plane lies at a right angle to the "E" plane.

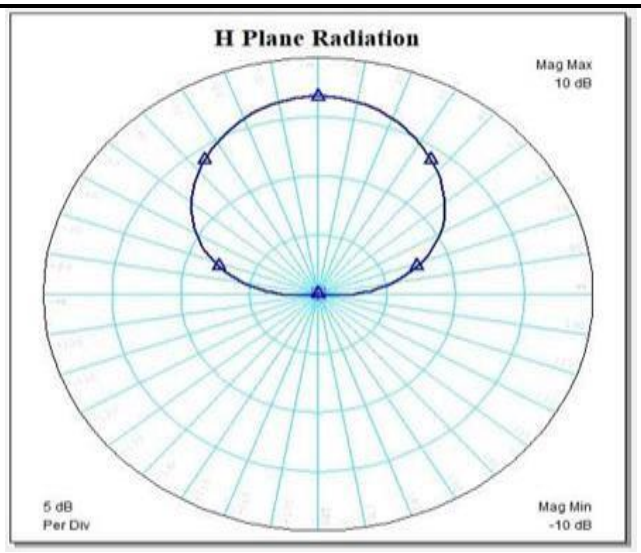

Fig .8: Horizontal field radiation

Beam Width:

Beam width is the aperture angle from where most of the power is radiated. The two main considerations of this beam width are half power beam width (HPBW) and first null beam width (FNBW).

Half Power Beam Width (HPBW) =3.721 dB
First Null Beam Width (FNBW) =3.721 dB
Total beam width=6.721 dB

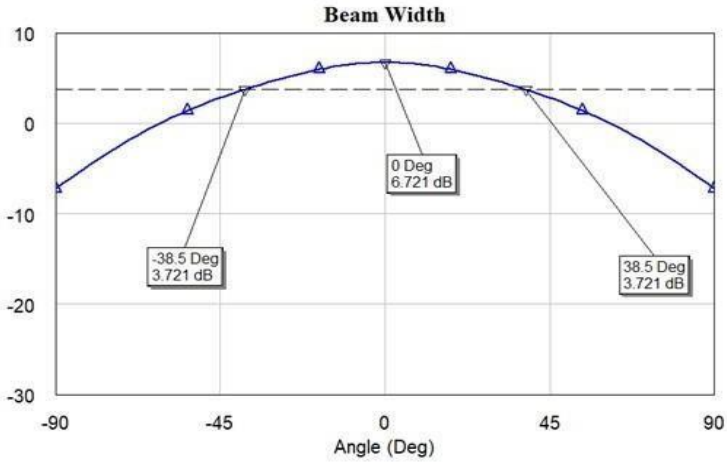

Fig .9: Beam width **Beam**

Width – Polar:

Beam width of antenna is easily determined from its 2D radiation pattern and is also a very important parameter. Beam width is the angular separation of the half-power points of the radiated pattern

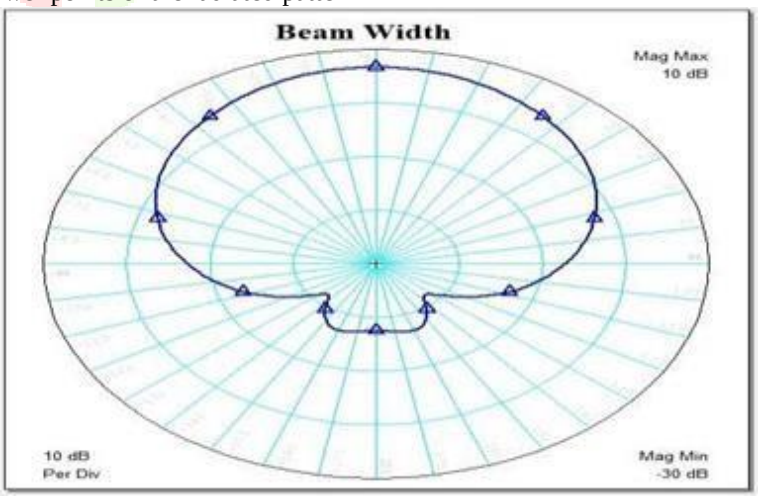

Fig.10: Polar beam width.

Input impedance:

An input impedance of Antenna relates the voltage to the current at the input to the antenna. The real part of the antenna impedance represents power that is either radiated away or absorbed within the antenna.

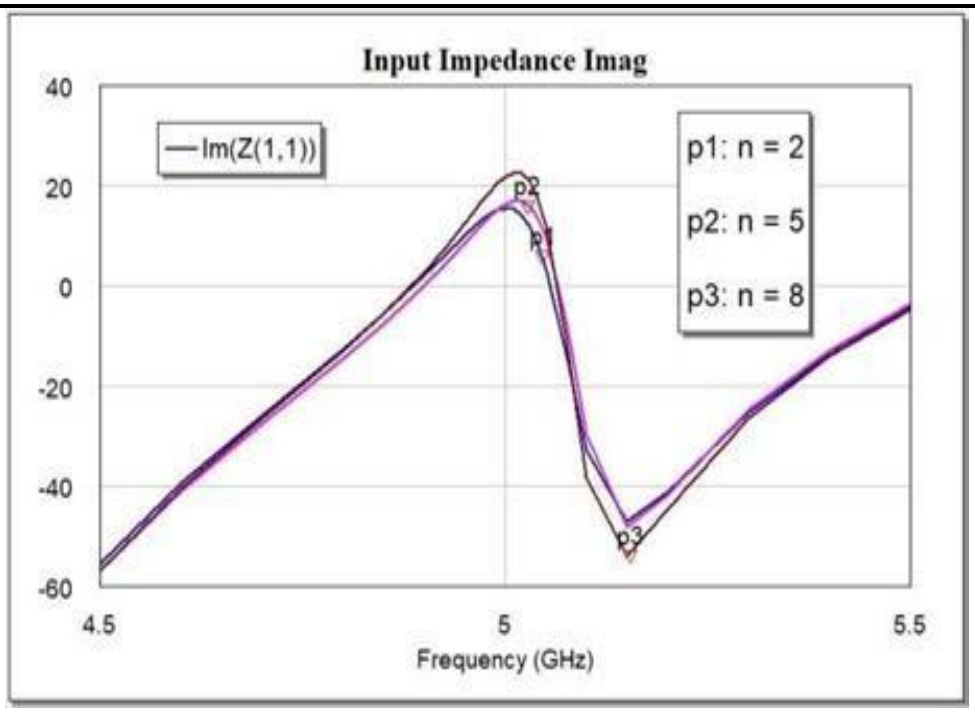

Fig .11: Input impedance **Input**

return loss:

The return loss indicates the mismatch in the load. Hence this loss is measured in the terms of power delivered. The loss of power in reflected signal due to the mismatch in the load impedance is measure as return loss. The brown colored line in the graph indicates that the antenna performance when slot is introduced on the center of the patch. The return loss provided by this structure is very less when compared to the other structures with other position from left to right. From the analysis, it is found that the structure performs well when slot is made at the center of the rectangular patch. Hence the structure is retained for rest of the parametric analysis.

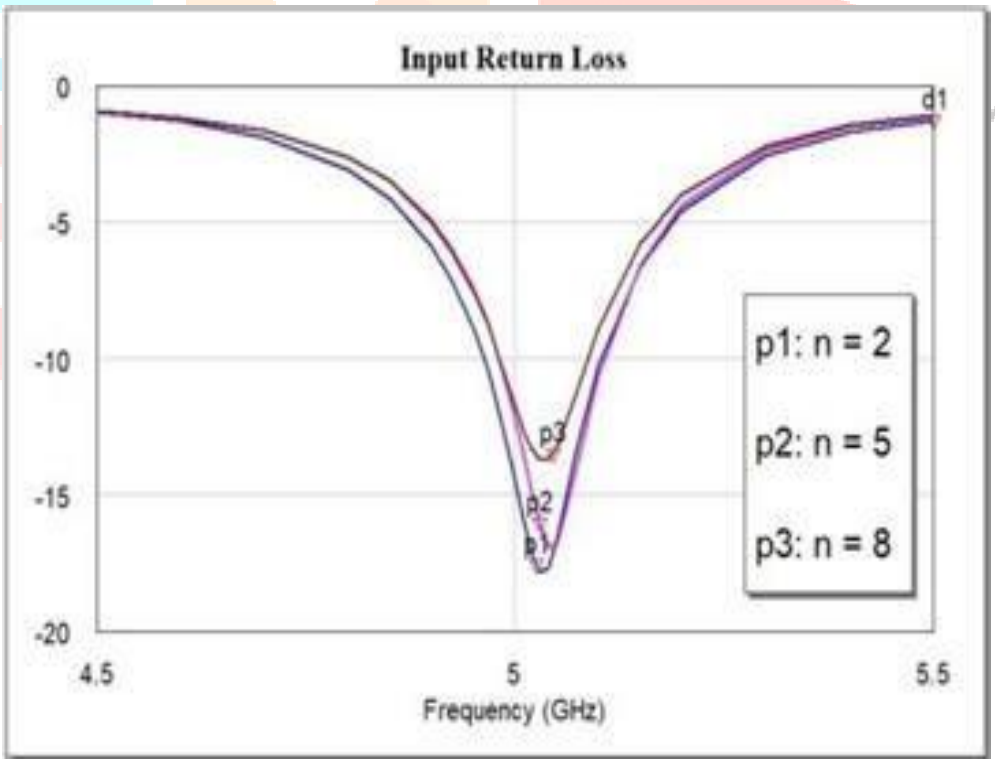

Fig .12: Return loss

VSWR:

For the communication device VSWR is an important parameter. It tells as how perfectly the antenna is matched to the cable impedance without any reflection. The simulation result for VSWR characteristics is shown in figure. From the obtained result it is found that the VSWR value is 1.705dB.

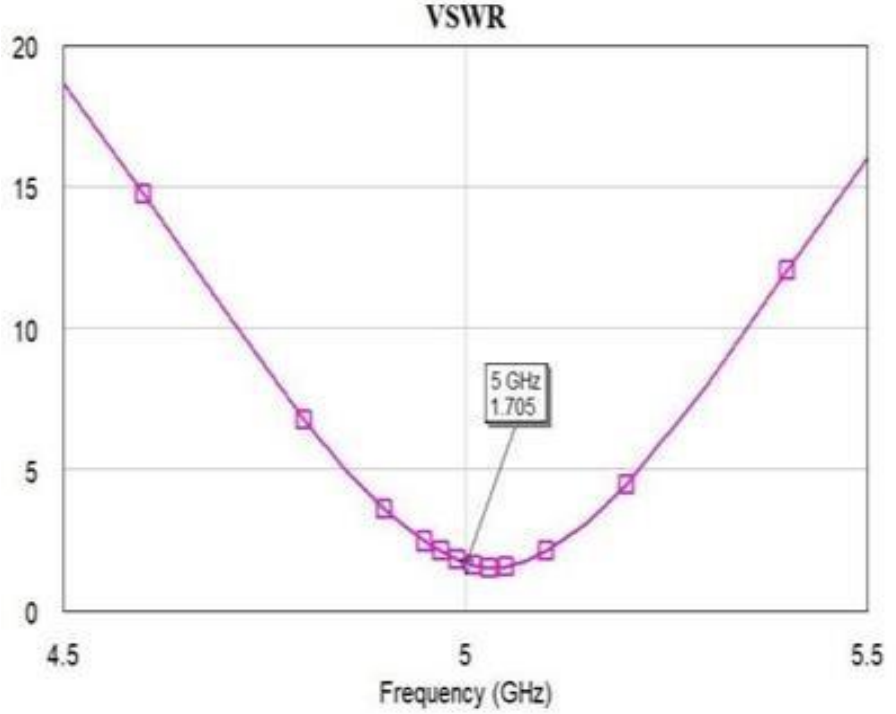

Fig. 13: VSWR

Table 6.1:Parameter values of rectangular microstrip patch antenna

Parameter Name	Parameter Description	Parameter Value
F	Frequency of operation	5GHZ
ε_r	Dielectric constant of the substrate	3.38
W	Width of the patch	70 mil
L	Physical length of patch	1050 mil
H	Height of dielectric substrate	60 mil
T	Conductor thickness	1.38 mil
VSWR	Voltage standing wave ratio	1.705
Γ	Reflection co-efficient	0.260
RL	Return loss	11.70 dB
L_{eff}	Effective length of the patch	2.77
ε_{reff}	Effective dielectric constant	3.81
ΔL	Length due to fringing effects.	0.05
BW	Beam width	6.721

IV. CONCLUSION AND FUTURE SCOPE

Finally, we designed micro strip rectangular patch antenna resonating at 5GHZ frequency with improved return loss, gain, directivity and VSWR. This design exhibits a good impedance matching at the center frequency. This antenna can be easily fabricated on FR4 Epoxy Substrate material due to its small size and thickness. Hence this antenna is recommended in WLAN and other wireless application. The gain of the antenna can be further increased by introducing slots on the patch. The future plan is to fabricate the antenna and verify the results using network analyzer.By utilizing this structure we can fabricate patch antennas for various applications such as radar, cell phone and satellites to achieve high gain, high data rate and speedy communication.

Future Scope

The explosive growth in the demand for wireless communication and information transfer using handsets and personal communications (PCS) devices has created the need for major advancements of antenna designs as a fundamental part of any wireless system. One type of antennas that fulfils most of the wireless systems requirements is the micro strip antennas. These antennas are widely used on base stations as well as handheld devices. Microstrip antennas have a variety of configurations and are currently the most active field in antenna research and development. The micro strip antennas, due to their great advantages, have increasingly wide range of applications in wireless communication systems as handheld mobile devices, satellite communication systems, and biomedical applications.

This special issue contains different topics about micro strip antennas. New designs are investigated for several wireless communication applications. Papers are classified from survey about most literature publications in several topics as RF energy harvesting to new designs in UWB antennas, reconfigurable antennas. We hope the readers and researches of micro strip antenna systems will find in this special issue not only new designs about different micro strip antenna characteristics but also valuable information about numerical analysis and fabrications.

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