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Design of 'V' Shape Microstrip Patch Antenna

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ABSTRACT: The main aim of this paper is to invistigate the performance of the antenna which depends on various parameters.The antenna parameters such as Radiation pattern,Input Impedance,Gain,VSWR,Return loss are considered for performance evaluation.Antenna is also designed for WIFI(2.4 GHz frequency range) application.
For this purpose we designed the model of V shape Microstrip patch antenna.The antenna is designed at 2.4 GHz frequency using the basic concept of electromagnetics.

KEYWORDS:Return loss,Gain,Bandwidth,VSWR,Radiation pattern of antenna

I. INTRODUCTION

An antenna is a device which is used to for radiating or receiving the Electromagnetic waves.Wired communications are replaced by wireless communication in which antenna place an important role in present and future.Microstrip antennas are widely used in communication field because of several attractive properties such as light weight,low profile, low production cost,reliability and ease in fabrication and integration with solid state devices.

At home and work has also neccesited the demand for antennas that are compact and inexpensive .patch antennas are planar antennas used in wireless links and other microwave applications.Microstrip can be fabricated using photolithographic techniques.it is easily fabricated into linear or planar arrays and readily integrated with microwave integrated circuits.Microstrip antennas can be designed to produce a wide variety patterns and polarizations.Additionaly the planar structure of a microstrip antenna permitts the microstrip antenna to be conformed to a variety of surfaces having different shapes.

The simulation Of V shape patch antenna is carried out with HFSS software.The proposed antenna are compact,has a patch area less than that of a conventional square patch microstrip patch antenna fabricated on the same substrate and resonating at the same frequency.that antenna can find application in the WLAN (802.11) communication standard operating at 2.4 GHz.

II. RELATED WORK

In recent years the rapid decrease in size of personal communication devices has lead to the need for more compact antennas.This results in a demand for similar reductions in antenna size.the size of a conventional microstrip antenna is somewhat large when designed at lower microwave frequency spectrum.The proposed antennas are compact,having a patch area less than that of a conventional square microstrip patch antenna fabricated on the same substrate and resonating at the same frequency.these antennas can find application in the WLAN 802.11communication standard operating at 2.4 GHz. For that purpose we refer three different papers like,Simulation and modelling of different shapes of microstrip patch,Design of V-slotted microstrip patch antenna for yielding improved gain bandwidth product etc.

III. GEOMETRY OF V SHAPE MICROSTRIP PATCH ANTENNA

In this paper Microstrip patch antenna in V shape is designed for having substrate material as Copper. While designing the V shape Microstrip patch antenna on HFSS software we need to select firstly Material which is FR4 and by taking some standard values of dielectric constants we have to select Rectangular edge feed technique for better results. Standard value of dielectric constant is 4.4, loss tangent is 0.02, substrate thickness is 1.6 and all dimensions are in mm. after drawing the geometry of antenna we have to check the results. The geometry of V shape patch antenna is as follows

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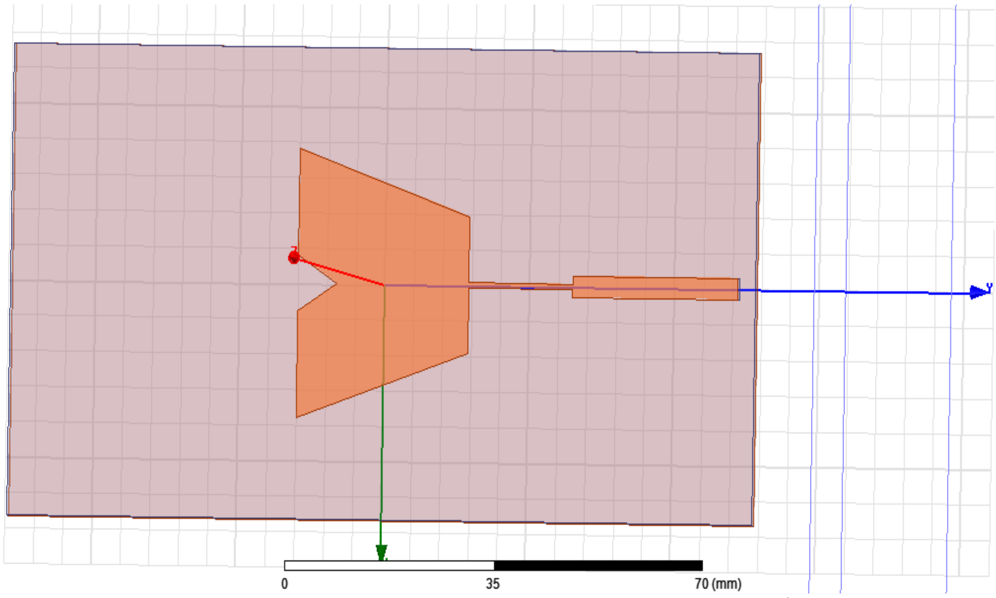

Fig 1: V-shape Microstrip patch antenna design on HFSS software

IV. MATHEMATICAL CALCULATIONS

For design of Microstrip patch antenna, the standard formula to calculate width and length of antenna at particular operating frequency as given below.
Step 1: for an efficiency radiator practical width that leads to good efficiency is given:

$$W = \frac{1}{2Fr\sqrt{\mu 0\varepsilon 0}}\sqrt{\frac{2}{\varepsilon r + 1}}$$

Step 2: calculation of effective dielectric coefficient is given ($\varepsilon reff$:

$$\varepsilon reff = \frac{\varepsilon r + 1}{2} + \frac{\varepsilon r - 1}{2}\left[1 + 12\frac{h}{w}\right] power^{1/2}$$

Step 3: calculation of effective length is given as:

$$Leff = \frac{c}{2f0\sqrt{\varepsilon reff}}$$

Step 4: calculation of length extension is given as:

$$\frac{wL}{h}0.472\frac{(\varepsilon reff + 0.3)\left(\frac{w}{h} + 0.264\right)}{(\varepsilon reff - 0.3)\left(\frac{w}{L} + 0.8\right)}$$

Step 5: Calculation of actual length of patch is given as:

$$L = Leff - 2\Delta L$$

V. EXPERIMENTAL RESULTS

The antenna start working from 2.3755GHz which mark as (m2) and stop working at 24284.GHz which mark as (m3).the centre frequency is 2.4060GHz.The return loss is -15.0844The return loss is shown below in fig 2:
It is a parameter which indicates the amount of power that is "lost" to the load and does not return as a reflection. Hence the RL is a parameter to indicate how well the matching between the transmitter and antenna has taken place. Simply put it is the S11 of an antenna. A graph of s11 of an antenna vs. frequency is called its return loss curve. For optimum working such a graph must show a dip at the operating frequency and have a minimum dB value at this

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frequency. This parameter was found to be of crucial importance to our project as we sought to adjust the antenna dimensions for a fixed operating frequency.

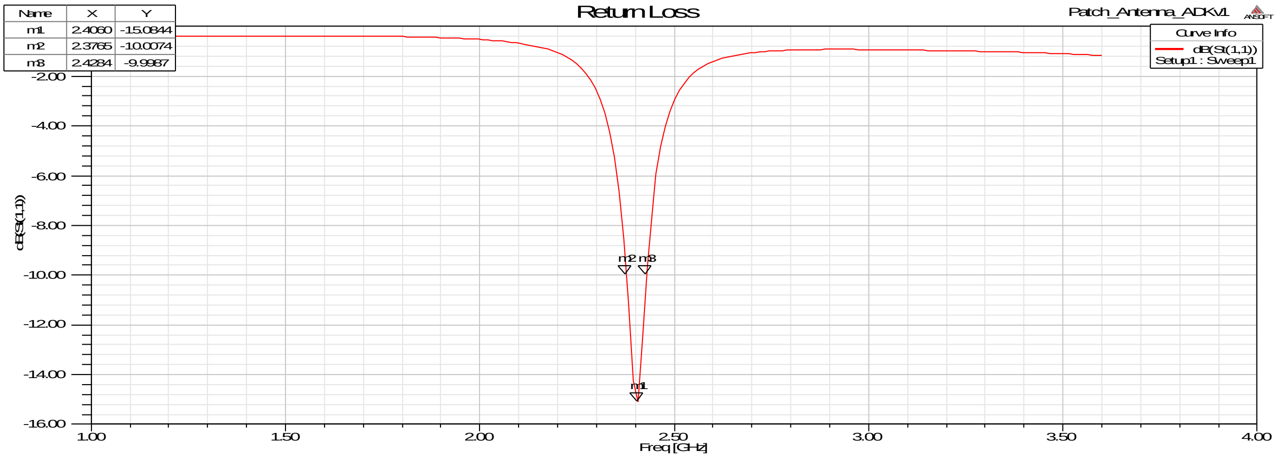

Fig 2: Return loss

The fig.3 shows the simulated result of gain of the proposed antenna. The maximum achievable gain is 1.7121db.
Gain is a measure of the ability of the antenna to direct the input power into radiation in a particular direction and is measured at the peak radiation intensity. Consider the power density radiated by an isotropic antenna with input power P_0 at a distance R which is given by(S = $P_0/4\pi R^{2)}$. An isotropic antenna radiates equally in all directions, and its radiated power density S is found by dividing the radiated power by the area of the sphere $4\pi R^2$. An isotropic radiator is considered to be 100% efficient. The gain of an actual antenna increases the power density in the direction of the peak radiation.

$$S = \frac{PoG}{4\pi R^2} = \frac{|E|^2}{\eta}$$

Gain is achieved by directing the radiation away from other parts of the radiation sphere. In general, gain is defined as the gain-biased pattern of the antenna.

$$S(\theta, \emptyset) = \frac{PoG(\theta,\emptyset)}{4\pi R^2} \quad \text{power density}$$
$$U(\theta, \emptyset) = \frac{PoG(\theta,\emptyset)}{4\pi} \quad \text{radiation intensity}$$

Fig 3: Gain of Antenna

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At the 2.40GHz frequency the VSWR is 1.4275which has shown in fig 4:
The Voltage Standing Wave ratio (VSWR) is an indication of the amount of mismatch between an antenna and the feed line connecting to it, The range of values if VSWR is from 1 to infinity VSWR value under 2 is considered suitable for most antenna applications. The Antenna can be described as having a good match. so, when someone says that the antenna is poorly matched, very often it means that the VSWR value exceeds 2 for a frequency of interest.

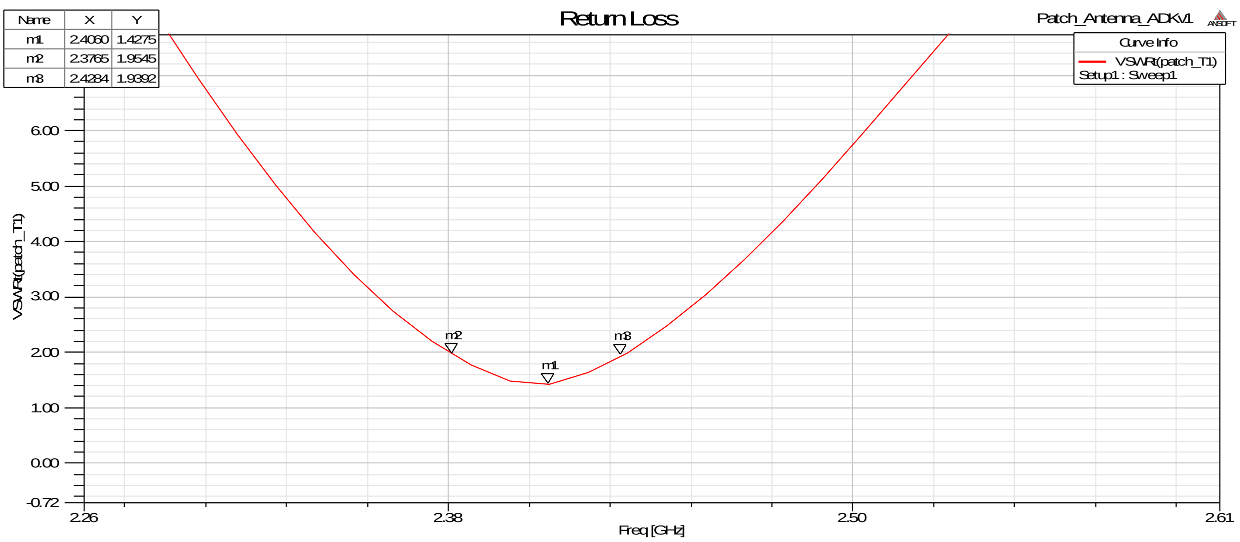

Fig 4: VSWR

The current distribution of simulated V-shape Microstrip patch antenna is shown in fig.5; the maximum value of current is 3.180 A/m, at 2.4GHz frequency.

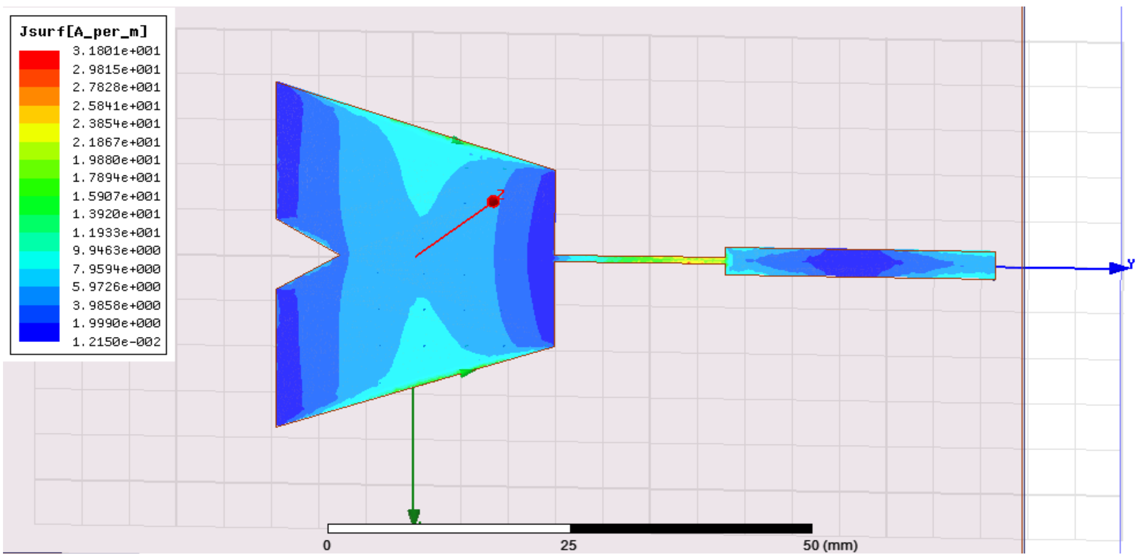

Fig 5: Current distribution

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Fig.6 shows Input Impedance of Antenna

The input impedance of an antenna is defined as "the impedance presented by an antenna at its terminals or the ratio of the voltage to the current at the pair of terminals or the ratio of the appropriate components of the electric to magnetic fields at a point". Hence the impedance of the antenna can be written as given below.

$$Zin = Rin + jXin$$

Where Zin is the antenna impedance at the terminals

R_{in} is the antenna resistance at the terminals

X_{in} is the antenna reactance at the terminals

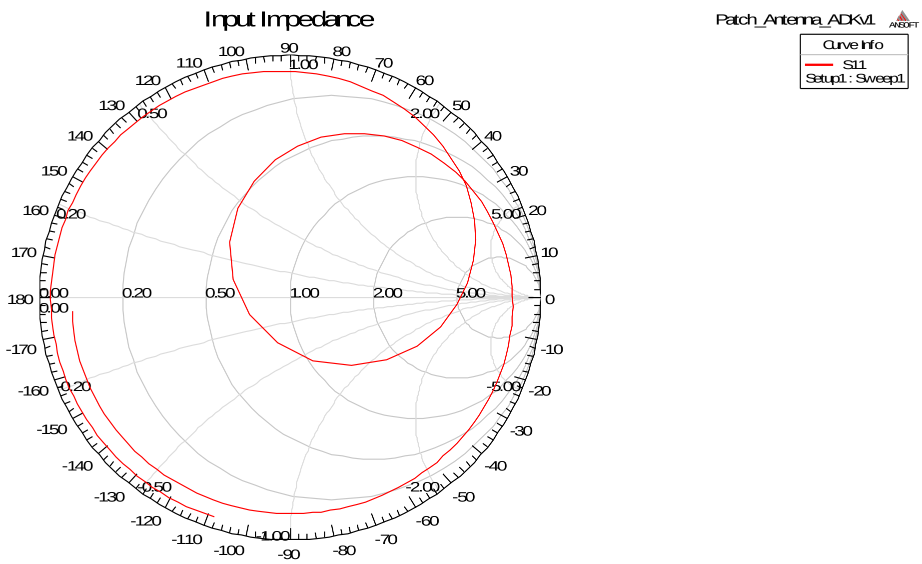

Fig.6 Radiation pattern of the antenna

VI. CONCLUSION

By designing this antenna, we observed the different parameters of antenna, how the performance of antenna depends on different parameters and we designed the antenna for WI-FI application. In this paper we have simulated Microstrip patch antenna in V-shape at range of frequency 2.4GHz with the help of HFFS software .in that project we are using 2 material, one is FR4 material for substrate and other is copper material for patch. So, in that we have design and simulated Microstrip patch antenna at particular range of frequency at 2.4GHz and also calculated the parameter such as return loss, gain, bandwidth, current distribution and VSWR of antenna.

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