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RECTANGULAR MICROSTRIP ANTENNA WITH ISM BAND

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Abstract-This paper represents the work done on anmicrostrip antenna such as designing, simulation and parameter for the ISM band of frequencies. A microstrip line feed powers the rectangular antenna.Resonant frequency performance is investigated on 2.4GHz. 2.4GHz is also known for ISM Band for wireless systems. Design and simulation were performed in high frequency structural simulation software (HFSS) with FR4 substrates. Microstrip antenna is designed according to the application. Antenna's length, width is calculated by theexpression. Antenna parameters such as gain, VSWR and bandwidth are measured by HFSS and shown to be satisfactory with the simulation results.Compared with the previous antenna design, theproposed antenna has a larger gain.

Keywords— Antenna, Loss less substrate; microstrip antenna; simulation; fabrication.

1. INTRODUCTION

Antennas are an essential part of a communication system. According to the requirements, differenttypes of antennas are designed. Fabricating a singleantenna that can operate on multiple frequency bands with a compact size is today's world need. Microstrip antennas serve this purpose. Recent technologies have made it possible to createextremely useful restrained antennas. Microstrip antennas perform this function. Recent technologieshave made extremely useful low-profile antennas. Microstrip technology can be used to designfrequency-based antennas (2.4 GHz) to createaffordable and recompose antennas in a lie low [1]. Antennas are main part of wireless applications because outstanding performance, cheapness, low weight, compact, handy and ease of construction. Designing microstrip antennas using simulation program has proven to be the famous in this decade.The dielectric constant is in range of 2.2 <x>3.7 formicrostrip antennas [2]. If the bandwidth is reduced then dielectric constant can be increased. If there is increase in height of substrate, the efficiency and bandwidth are improved. Surface waves can occur if the height of the substrate is increased, which isnot acceptable [6]. if there is surface waves loss, then antenna may not able to transmit all the EM waves. Dielectric loss and conductor loss are few more loss. This can be due to the useful processing of many parameters that plays important role in the design of high-end antennas. This article focuses onthe design of a microstrip antenna which is rectangular that depends on few basic terms: operating frequency (fo), board thickness (h), and board dielectric constant (εr) [5]. The plan is to design and manufacture a rectangular antenna with an improved gain. The amount of reflection attenuation is assumed to be the power consumed during radiation, from difference b/w the feed powerand the diverted power in dB tells the reflectedpower.

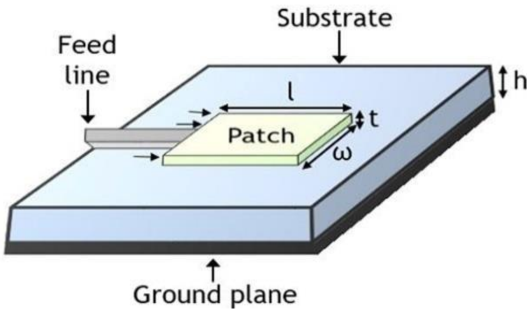

Fig 1. Structure of Microstrip Antenna

A way to inject Radio Frequency power directly into the purpose is to scatter the antenna using a line feed technique. HFSS software tools areused in antenna design and simulation.

2. LITERATURE SURVEY

Through research, it is discussed that rectangular microstrip antenna which works at 2.4Ghzfrequency is to be designed. The design features are **well given by Salai Thillai Thilagam.J, Ganesh BabuT.R** (Department of ECE,2018) [6]. This is a relatively new domain of antenna technology. Popular for its light weight and small footprint, microstrip patches work with components at minimal cost. The network can interconnect these antennas to power active devices with printed microstrip lines. Powering techniques such as microstrip lines, coaxial probes, aperture probes, aperture couplings, and proximity couplings can be used to power the antenna [3].

The heatsink andmicrostrip feeds are made above substrates. Thepatch structure is can be of any geometry shape as per the requirement, here a rectangular shape isintended.

3. DESIGN AND ANALYSIS

Techniques that can power microstrip antennas:

(1) Contacting type

(2) Non-contacting type

A contacting type microstrip line and probe are usedto supply current to the radiating patch. The non- contacting kind is used to couple electromagnetic fields. Few feeding mechanisms are coaxial probe, microstrip line, though. Microstrip Line Feeding: This technique, Microstrip Leads Lead: This technique connects the conductive microstrip drivesthe microstrip patch directly to the center, as illustrated in Figure 1. The width of the feed strip issmaller than the width dimension [4]. This feed has a planar structure due to the concentration of connections. This facilitates manufacturing and simplifies modelling and impedance matching. This includes design, simulation, fabrication and measuring. The Rectangular Patch coil design has the following settings:

(i) Operating Frequency (fo):

The operating frequency of the antenna is very stressful. Therefore, resonant frequency of this antenna is chosen as 2.4GHz in this simulation.

(ii) Dielectric Substrate (εr):

FR4 is selected for dielectric substrate with a permittivity of 4.6. This is a ready-to-use, low-cost,high-loss board.

(iii) Dielectric board thickness or height (h): Theheight of dielectric board is assumed to be 1.5 mm.

$$W = \frac{C_0}{2f_r}\sqrt{\frac{2}{\varepsilon_r + 1}}$$

Where, W = Width

C_0= Speed of light

Designing: To design a microstrip antenna, you needto select the frequency and medium for which you

Designing antenna. The parameters to

εr= value of the dielectric substrate.

By putting c = $3x10^8$ m/s, εr = 4.6 & fo = 2.4 GHz, width (W) as 36.6 millimeter.

Refractive index:

The value of the effective index of refraction of the patch is important parameter in designing process ofantennas. The scattering that travels from the patch to ground goes through the air & partly through the substrate (called the edge). Since the permittivity ofair and the substrate are different, to explain this, theeffective permittivity is calculated using the following formula, which is also known as effectivepermittivity.

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{W}\right]^{-1/2}, W/_h > 1$$

Length: Due to fringes, the size of the antenna is electrically (ΔL) larger. Therefore, the particularincrease in patch length (ΔL) is calculated exploitation the subsequent equation:

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

Where 'h'= height of the substrate. Then calculate the patch length (L) by formula:

$$L = \frac{C_0}{2f_r\sqrt{\varepsilon_{reff}}} - 2\Delta L$$

Length (Lg) and width (Wg) of ground plane: You know dimensions of the patch. The length & width of the board is the same as the ground plan. The baselength (Lg) and base width (Wg) are calculatedusing the following formulas:

$$Lg = 6h + L$$

$$Wg = 6h + W$$

There are several ways to power a microstrip patch antenna. B. Feeding line method, coaxial probe feeding method [2], etc. Microstrip line calculations:

$$Zo = \frac{87.0}{\sqrt{\varepsilon_r + 1.41}} x \ln\left(\frac{5.98h}{0.8W + t}\right)$$

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It is calculated that W=2.95 mm and L 5.22 mm forZ0=50-ohm, Electrical length =28.1mm Dimensions for this are calculated [3].

TABLE 1. DIMENSIONS OF ANTENNA

Plane	Dimension	Measurement values(mm)
Radiating plane	W	37.35
Length	L	28.83
Ground Plane	Wg	46.35
Length	Lg	34.25

4. RESULTS & DISCUSSION

Simulation is completed by HFSS software system & FR4 substrate is selected. mistreatment the equations mentioned above, microstrip antenna is intended at a frequency of 2.4GHz. The breadth (W)& length (L) of the patch at resonant frequency of 2.4Ghz is found to be 37.35mm, whereas 2mm is thefeeding position in the microstrip antenna, the peak of the substrate is1.5mm, for the bottom plane, the length (Lg) and width (Wg) of the bottom plane is found to be.

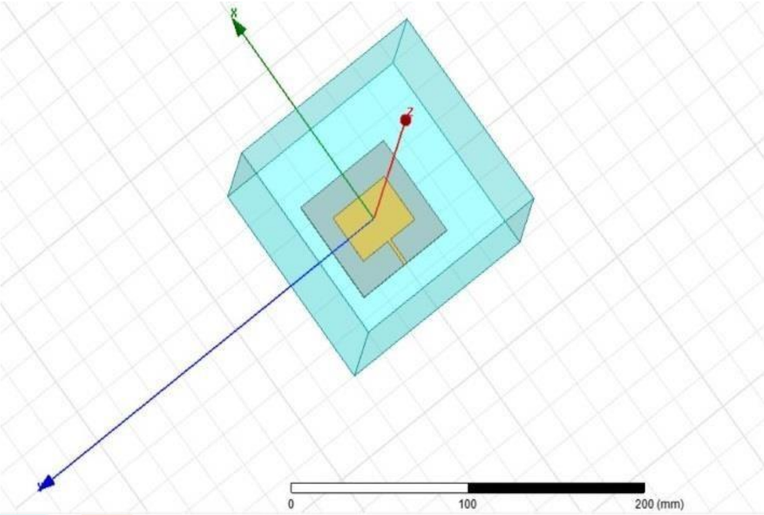

Figure 1: Microstrip patch antenna design using HFSS

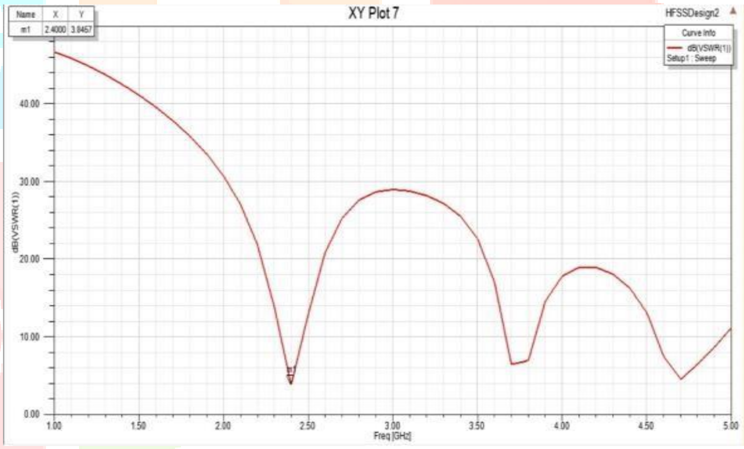

Figure 2: S (1,1) parameter of microstrip antenna.

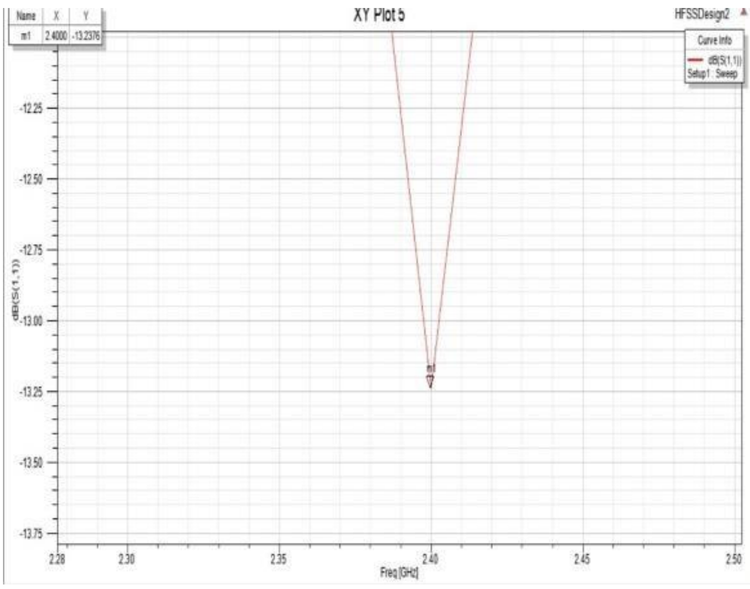

Figure 3: Gain of microstrip antenna

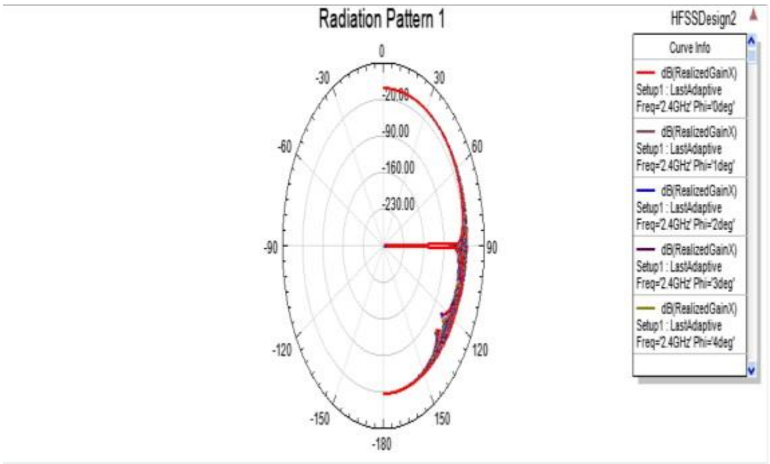

Figure 4: Radiation pattern of Microstripantenna

5. CONCLUSIONS

A rectangular microstrip patch antenna, resonant at frequency fo = 2.4 GHz, is designed and simulated on glass epoxy FR-4 substrate. The microstrip patchantenna is fabricated as per the calculated and simulated result. The simulation of rectangular Microstrip Patch antenna with microstrip linefeeding technique is performed by using HFSS software for the specific frequency of 2.4 GHz [5]. TheS11 value of -27.439 db. The result of the proposed antenna model is better than the base paper.

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