A Novel Shape Patch Antenna for Wi-Max Band

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Abstract - The High-Frequency Structure Simulator (HFSS) is used in this paper for design of proposed broadband microstrip patch antenna. The broadband microstrip patch antenna is designed in a novel shape and analyzed. The result of a planned antenna is discussed in expressions of return loss, bandwidth and gain. FR-4 substrate is use in antenna configuration having dielectric constant 4.4. The designed antenna gives the result as return loss of rectangular patch is -22.71 dB & -13.82 dB at 1.5 GHz & 2 GHz frequency band and gain of the rectangular patch is 9.06 dB correspondingly.

Keywords – *Rectangular Patch antenna, High Frequency Structured Simulator, gain directivity*

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I. Introduction

Microstrip antennas have developed into more and more well-liked for microwave and millimeter wave application, for the reason that they put forward a number of divergent rewards in excess of conservative microwave antennas. These advantages consist of miniature size, simple fabrication, light mass, and uniformity by the present surface of vehicles, aircraft, missiles, and straight incorporation through the developing electronics. Microstrip antennas are known with many name, for example, imprint antennas (can be printed directly onto a circuit board), planar antennas, microstrip patch antennas or else basically microstrip antennas (MSA). MSA commonly consists of conducting patch, a conducting ground plane, a dielectric substrate sandwiched between the two, and a feed connected to the patch through the substrate [1-10].

In recent years, there is a requirement for additional compact antennas as a result of fast reduce in the dimension of individual communication devices. As communication devices develop into lesser because of better incorporation of electronics, the antenna becomes an appreciably big fraction in generally enclose capacity. These grades a command for alike reductions in antenna dimension. In totalling, small shape antenna designs are also significant for the permanent wireless request. The microstrip antennas used in an extensive range of applications as of message systems to satellite and biomedical applications [11-20].

II. Microstrip Patch Antenna Design

The rectangular patch antenna is made by "FR4_EPOXY" the dielectric substrate which has dielectric constant of 4.4 and height of dielectric substrate is 1.6mm. The Width and length of the patch are 38.5mm and 28 mm respectively. There are many rectangular slits with width of 1mm (L_a, L_b, L_c, L_d, L_e, L_f, L_g, L_h, L_e, L_f) and circular slots (R) are designed in the antenna which shows in figure1 for giving the better result. . The patch is feed with coaxial probe (50Ω) which is easy to formulate and have simulated radiation. In proposed feeding method, the coaxial connector with the inside conductor extend as of ground from end to end the substrate and is soldered to the radiating patch, whereas the external conductor extend from ground up towards substrate.

The propose mathematical design of the practical antenna is given below

11. Effective Dielectric Constant:

$$\epsilon_{reff} = \frac{\epsilon_r+1}{2} + \frac{\epsilon_r-1}{2}\left[1+12\frac{h}{W}\right]^{-0.5} \quad (1)$$

b. Fringes Factor:

$$\Delta L = 0.412h\frac{(\epsilon_{reff}+0.3)(\frac{W}{h}+0.264)}{(\epsilon_{reff}-0.258)(\frac{W}{h}+0.8)} \quad (2)$$

c. Calculation of Length:

$$L = L_{eff} - 2\Delta L \quad (3)$$

Where

$$L_{eff} = \frac{c}{2f_r\sqrt{\epsilon_{reff}}} \quad (4)$$

d. Calculation of Width:

$$W = \frac{c}{2f_r\sqrt{\frac{\epsilon_r+1}{2}}} \quad (5)$$

e. Calculation of Ground Plane Dimensions:

$$L_g = L + 6h, \quad W_g = W + 6h \quad (6)$$

Where W is width of patch and h is the height of substrate, L is length of patch ΔL is extension in length due to fringing effect and c is speed of light in free space f_r is resonant frequency [5].

Resonance frequency(fr)	2.4GHz
Dielectric constant(ε_r)	4.4
Thickness of the substrate(h)	0.5mm
Length of patch(L)	38.5mm
Width of patch(W)	28mm
Dimension of L_a	21X1mm
Dimension of L_b	21X1mm
Dimension of L_c	11.5X1mm
Dimension of L_d	11.5X1mm

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Dimension of L_e	11.5X1mm
Dimension of L_f	11.5X1mm
Dimension of L_g	3X1mm
Dimension of L_h	3X1mm
Radius of circular slot R	3mm

Table: 1 Dimension Of Antenna

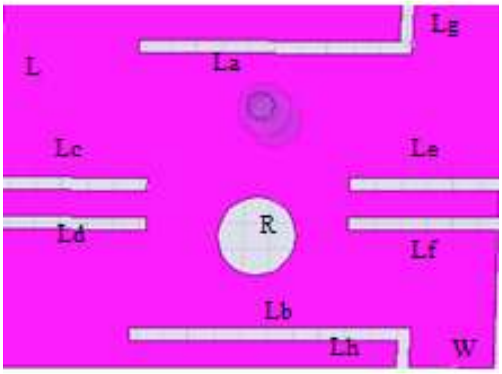

Fig: 1 Image of patch antenna

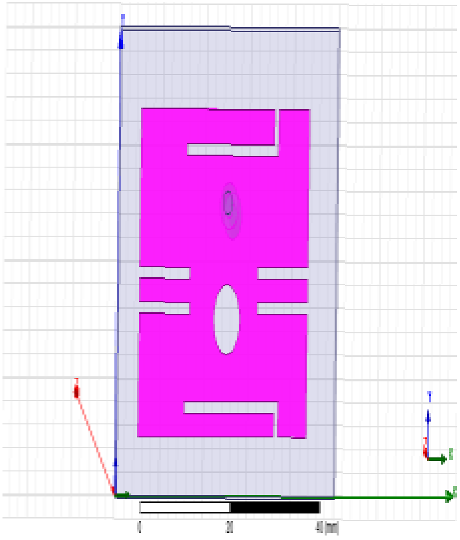
Fig: 2 Antenna design in software

III. RESULT AND DISCUSSION

Figure 3 shows the return loss of antenna which is -22.71 at 2 GHz frequency and -13.82 at 1.5 GHz frequency. There is a band of frequency from 1.5 GHz to 2 GHz and figure 4 shows the VSWR of the antenna which is below than 2 for this frequency band which shows that antenna gives a good wide band response for this frequency band. Figure 5 and 6 shows gain and directivity of the antenna those are 9.06 and 1.79. Figure 7 shows the smith chart and figure 8 shows the radiation pattern in E plane.

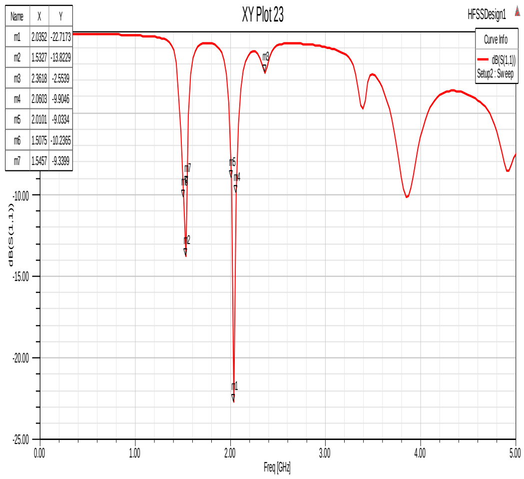

Fig: 3 Return Loss Of Antenna

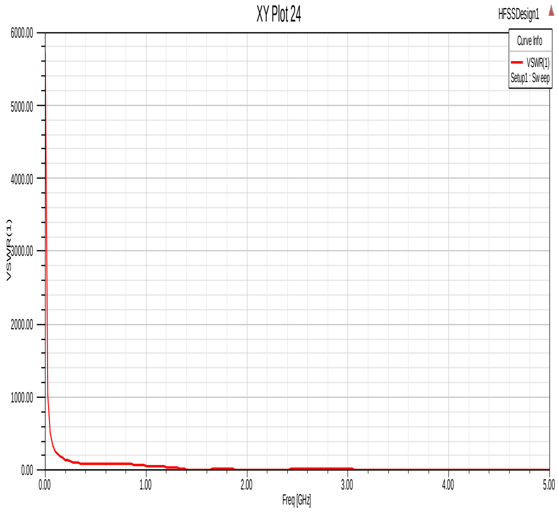

Fig: 4 VSWR Of Antenna

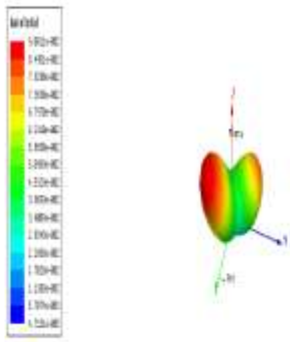
Fig: 5 Gain Of Antenna

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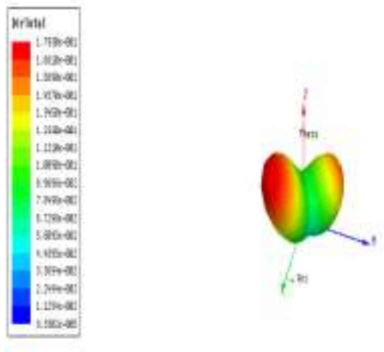

Fig: 6 Directivity of Antenna

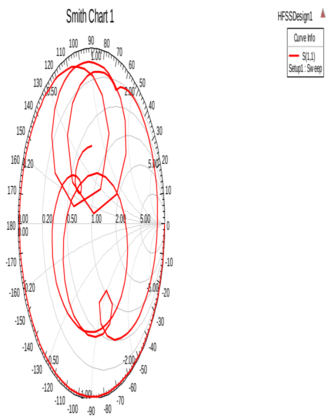

Fig: 7 Smith chart representation of Antenna

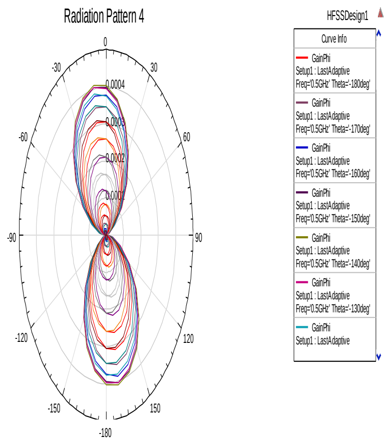

Fig: 8 radiation pattern of Antenna

IV. CONCLUSION

It was shown that the technique is use by HFSS be capable of to efficiently model microstrip antennas. The quick expansion of wireless communications strain that antennas should be small shape and permit process at many frequency band, eliminate the requirement for separate antennas for every function. The proposed antenna design of the method of a moment with a compacted, multi-use and small built-up price of microstrip patch antenna which is premeditated via this software and the simulation results are given. The considered antenna design carries high directivity and peak gain. The proposed antenna have to find make use for a number of wireless application according to their high-quality electrical performance over the frequency range of interest, like Wi-MAX, WLAN, searching and automotive radar, wireless sensors, and various ground-based and airborne applications in C-band.

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