DESIGN AND ANALYSIS OF MICROSTRIP PATCH ANTENNA FOR WLAN APPLICATIONS USING EV ALGORITHM.

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ABSTRACT: *In recent days, many interesting microstrip patch antennas have been proposed. In this paper, we have designed and simulated a novel antenna structure with coaxial feed for wireless local area network (WLAN) applications using ANSYS HFSS software. Strip and patch are fabricated on the substrate type FR-4, of thickness 1.5mm and a relative permittivity of 4.4 respectively. The designed antenna offers a resonant frequency of 8GHz for WLAN applications. The paper provides information of all the parameters of the antenna including voltage standing-wave ratio (VSWR).*

Key Words: *Patch, Strip line, wireless local area network (WLAN), voltage standing-wave ratio (**VSWR**).*

I. INTRODUCTION

Antennas are used to utilize the electromagnetic spectrum which is of paramount importance to mankind. Antennas have become indispensable in present-day communication sector [1,5]. In wireless applications antennas are pre-requisite both at the sender's and receiver's side [5]. The attractive features of microstrip antennas are low-profile structure, compact, inexpensive, easy fabrication, rugged and so on [2,3,4,5,7,8]. Hence the microstrip antennas are being studied extensively to put them to use in wide range of applications such as satellites, missiles and aircrafts, radars, biomedical applications and mobile phones [1,6,10]. Abating the size and intensification of gain are however the prime design obstacles that we encounter on using microstrip antennas in the focus area i.e shrinking mobile units [2,6,9]. The design and simulation of a rectangular patch microstrip antenna using ANSYS HFSS is presented in this paper. The antenna is ascertained to operate at a center frequency of 8GHz. FR-4 substrate having a dielectric constant of 4.4 and thickness of 1.5mm was used in fabrication of the proposed antenna. A return loss of -15.2 decibels and VSWR of 2.43 decibels is provided by the antenna. This provided by the antenna. This work is ordered as follows: description of the design and performance of the antenna is provided in section II. Obtained results are given in section III and section IV concludes the work.

II. ANTENNA DESIGN AND PERFORMANCE

A rectangular patch antenna composed of FR4 substrate used in wireless communications is developed and experimented using ANSYS HFSS software. The 3D - geometry of the rectangular microstrip patch antenna with dimensions 6.849mm x 11.41mm is as shown in Fig1. A desirable response can be obtained with many substrates having dielectric constants ranging from 2.2 to 12 but for reasonable performance of the antenna, we employ thick substrates whose dielectric constant is less. Their characteristic parameters such as the return loss, VSWR and bandwidth have been figured out experimentally.

The antenna is modeled using the transmission line model and the measurements of the same are obtained theoretically using equations as given below. The notations used in the design of the antenna are $€_r$ being the dielectric constant of the FR4-substrate (4.4), f_r is the resonant frequency of the antenna (8GHz), c is the speed of light in vacuum (3 x 10^8 m/s), L and W are the length and width of the patch antenna respectively and Δl gives the normalized extension of the length of the patch.

$$W = \frac{C_0}{2f_r}\sqrt{\frac{2}{\varepsilon_r+1}} \qquad \text{-- (1)}$$

On substituting the values, we get **W = 11.41mm**

L_{eff} or the effective length of the microstrip antenna patch can be obtained as follows

$$\varepsilon_{eff} = \left(\frac{\varepsilon_r+1}{2}\right) + \left(\frac{\varepsilon_r-1}{2}\right)\left[1 + 10\,\frac{h}{W}\right]^{\frac{1}{2}} \qquad \text{-- (2)}$$

We obtain, $€_{eff}$ = 5.28

$$\frac{\Delta l}{h} = 0.412\,\frac{(\varepsilon_{eff}+0.300)(\frac{W}{h}+0.262)}{(\varepsilon_{eff}-0.258)(\frac{W}{h}+0.813)} \qquad \text{-- (3)}$$

Δl = 0.65mm

And length can be obtained using the equation,

$$L = \frac{c}{2f\sqrt{\varepsilon_{eff}}} - 2\,\Delta l \qquad \text{-- (4)}$$

On substituting the necessary values, we get **L = 6.849mm**

III. RESULTS AND DISCUSSIONS

A rectangular microstrip patch antenna was developed and experimented using the ANSYS high frequency structured simulator software with the specifications as discussed in the previous section.

Voltage standing wave ratio (VSWR) in RF electrical transmission can be described as the ratio of the transmitted standing voltage waves to the reflected standing voltage waves. The VSWR of the designed antenna is simulated to be 2.42dB at resonant frequency as shown in Fig.2. The simulation result of return loss against frequency of the microstrip antenna is shown in Fig.3. It shows a return loss being -15.2dB at the 7.8Ghz or operating frequency. Due to various losses in the antenna, the operating frequency is shifted to 7.8Ghz from 8Ghz. The simulated operating frequency has moved by about 2.5% from the measured frequency. Angular dependence of the strength of the radio waves from the antenna is referred to as radiation pattern. Fig.4 shows the radiation pattern of the designed antenna. We observe that the radiation increases as theta increases. Radiation is maximum along z- axis. The electric field plot or E-plot determines the orientation of the radio wave. E plot for various values of phi (Ø) ranging from 0 to 80^0 is shown in Fig.5. Rectangular contour plot of the radiations observed with an increase in the values of theta and phi along with gains in decibels are shown in Fig.6. The magnitude of the response in any direction is indicated by a polar plot. The polar plot is shown in Fig.7.

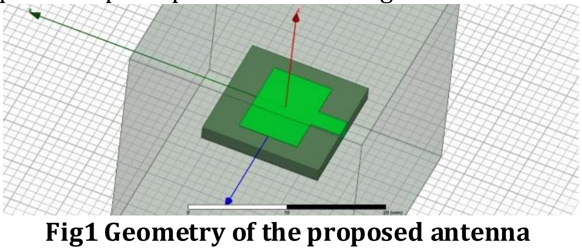

Fig1 Geometry of the proposed antenna

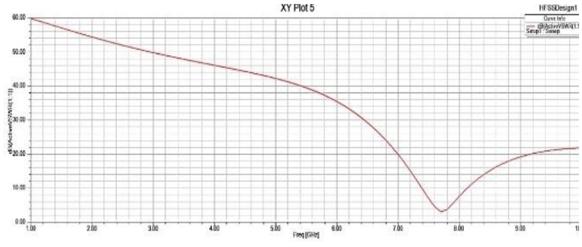

Fig.2: VSWR vs frequency

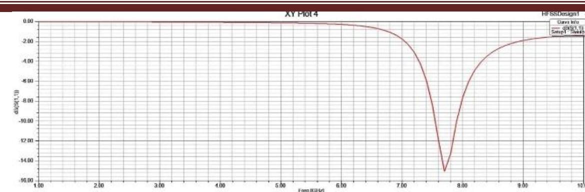

Fig.3: Return loss vs Frequency

Fig.4: Radiation Pattern

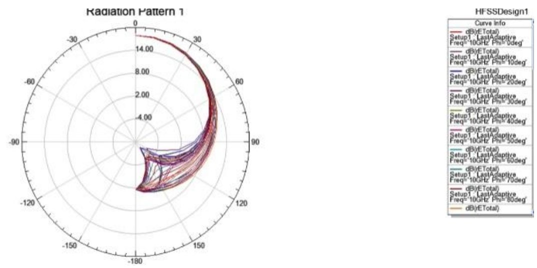

Fig.5: E-plot

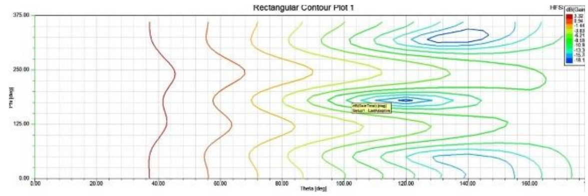

Fig.6: Rectangular contour plot

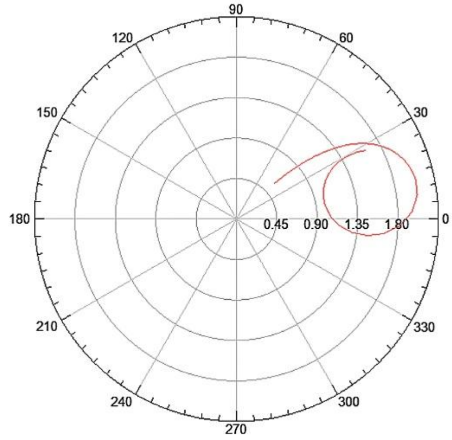

Fig.7: Polar plot

IV. CONCLUSION

A rectangular patch antenna with coaxial feed is fabricated on FR-4 substrate of dielectric constant 4.4 and thickness 1.5mm and simulated using ANSYS HFSS for a wide range of applications. The anticipated requirements of return loss and VSWR ae met by the proposed antenna. A return loss of -

15.2 decibels and VSWR of 2.42 decibels is attained at a center frequency of 7.8 GHz, which however has been shifted from the expected 8GHz due to various parameters affecting it such as the type of substrate used, substrate dimension, feeding technique, dielectric constant etc.

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