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Design & Analysis of H-Shape Microstrip Patch Antenna

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Abstract: ***Our proposed research is about designing and analysis of H shape microstrip patch antenna. Operating frequency of H shape micro strip antenna is 5 Ghz. The design and simulation are done in High-frequency structure simulator (HFSS) software with FR4 substrate. According to its real application, shape, and the type the H- shape microstrip antenna is designed. The size of the antenna is calculated by its length, width. Then the H-shape is stimulated for the radiation parameters obtained through optimizing and matching to meet the requirement. The parameter of antenna such as Return Loss, Gain, VSWR are measured.***

Keywords: Return Loss, Gain, VSWR.

I. INTRODUCTION

Microstrip antennas are mostly used for aerospace applications because of their low weight, low volume and conformal nature. The most commonly used microstrip antennas are rectangular and circular disc antennas. However, other microstrip antennas has also been considered, depending on the application. Here we report two alternativesto the rectangular patch antenna.

On the other hand, the rectangular ring antenna has smaller size, larger bandwidth and narrow beam-width. The H- shaped microstrip patch antenna, can be considered because of it's smaller size, it could replace the rectangular patch at UHF frequencies. It is used in transport of electromagnetic energy from the transmitting source to the antenna or from the antenna to the receiver, the antenna can be in a form of microstrip.

II. DESIGN OF H-SHAPE MICROSTRIP PATCHANTENNA

The H-shaped microstrip antenna has patch supported on a grounded dielectric sheet of thickness h and dielectric constant εr, and the physical dimensions of the H-shaped microstrip patch antenna are shown in Fig 1.In this techniquea conducting microstrip line is attached directly to the centeredge of the microstrip patch as shown in the figure 1.

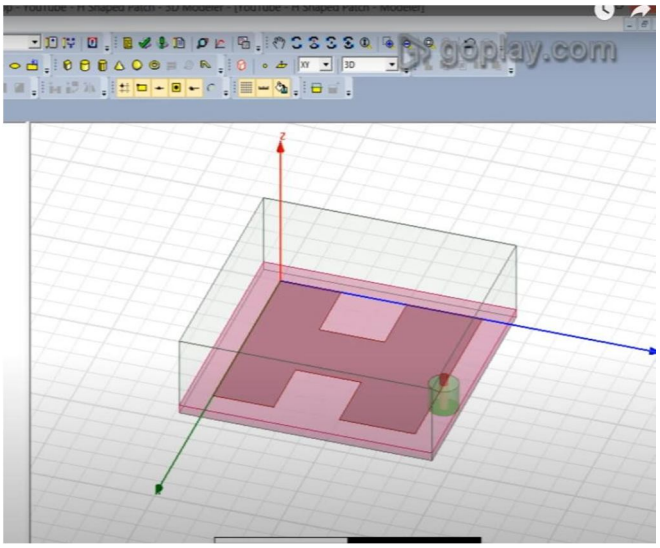

Fig.1. H-shaped Patch Antenna with Parameters L=40 mm,W=40mm, Frequency f=5 GHz, ε_r =4.2, h=1.6mm

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III. GEOMETRY OF MICROSTRIP PATCH ANTENNA

Resonant frequency and dielectric medium are selected for designing the microstrip patch antenna. The parameters can becalculated by.

Width(w): The width can be calculated by the given equation.

$$W = \frac{C}{2f_0\sqrt{\frac{(\varepsilon r+1)}{2}}} \quad (1)$$

Were, W = Width of the patchCo = Speed of light
Ɛr = value of the dielectric substrate

The effective refractive index (ERI) value of a patch is an important parameter in the designing procedure of a microstrip patch antenna. The radiations travelling from thepatch towards the ground passes through the air and some through the substrate. Both the air and substrate have different dielectric values, therefore in order to account thiswe find the value of effective dielectric constant,

The valueof the effective dielectric constant(Ɛreff) is calculated usingthe following equation.

$$W/h \geq 1$$
$$= \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{W}\right]^{-/} \quad (2)$$

Length, Due to fringing electrically the size of the antennais increased by an antenna of (delL) of the patch is to be calculated using the following equation

$$\Delta L = 0.412h\frac{(\varepsilon_{reff}+0.3)\frac{W}{H}+0.264}{(\varepsilon_{reff}-0.258)\frac{W}{H}+0.8} \quad (3)$$

Where h=height of the substrate
The length(L) of the patch is now can be calculated usingthe below mentioned equation.

$$L = \frac{C_0}{2f_r\sqrt{\varepsilon_{reff}}} - 2\Delta L \quad (4)$$

Length (L) and width (W) of ground plane:
Now the dimension of a patch is known. The length and width of substrate is equal to that of the ground plane. Thelength of a ground plane (Wg) is calculated using the following equation

$$L_g = 6h + L$$
$$W_g = 6h + W$$

For feeding of the microstrip patch antenna there are different methods for example, feed line method, coaxial probe feeding method etc. But mainly coaxial probe methodis used.

IV. ANTENNA DESIGN PARAMETERS

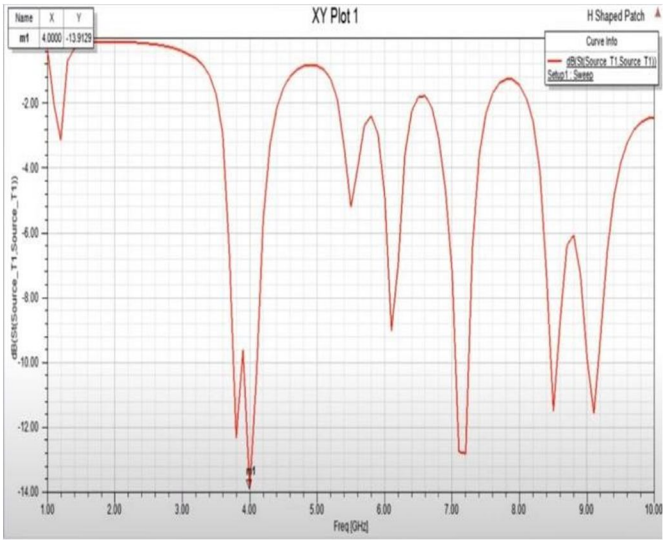
The size and the bandwidth of the H – Shape microstrip patch antenna is related to dielectric constant of the substrate. Larger bandwidth is produced by low dielectric constant of the substrate , while the high dielectric constant of the substrate results is smaller size of antenna

Dielectric Substrate (FR4)	Ɛ=4.4
Substrate Height (h)	1.6m m
Patch Width (W)	40 mm
Patch Length (L)	40 mm

V. SIMULATION RESULTS

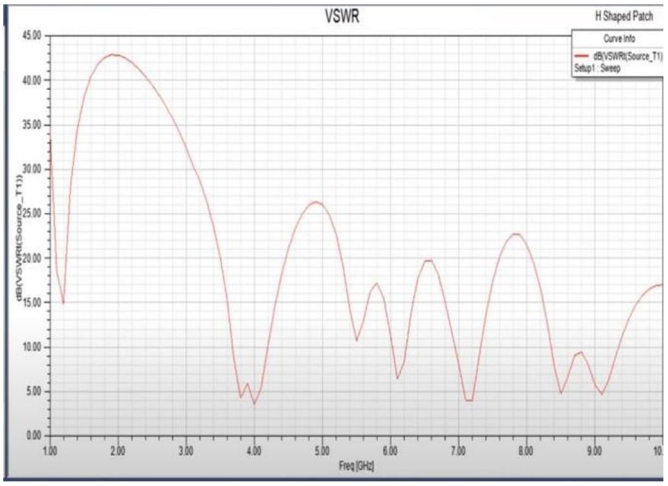
A. Return Loss

Return loss versus frequency plot of H Slotted RectangularMicrostrip Patch Antennas are shown in figure respectively.



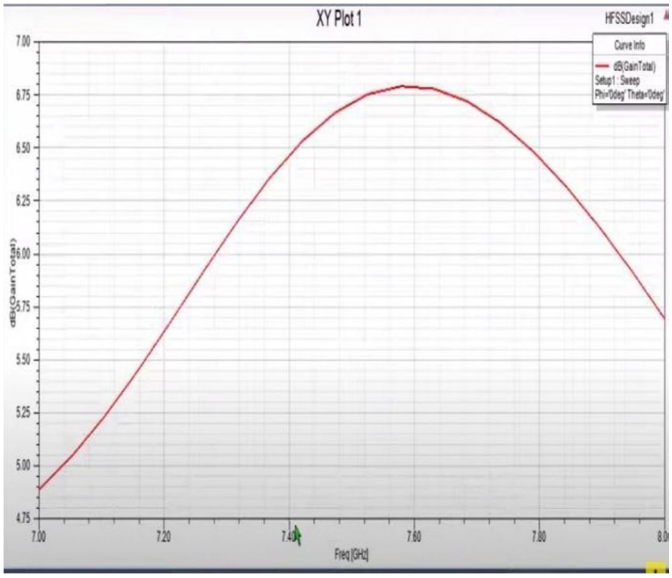
B. VSWR

Voltage Standing Wave Ratio (VSWR) verses frequency plot for H Rectangular Microstrip Patch Antennas are shown in figure respectively. The values of VSWR for boththe antennas are shown in Table.



C. Gain

Three-dimension radiation pattern of H Rectangular Microstrip Patch Antennas at 5 GHz are shown in figure respectively. From Fig(6) it is clear that H- slot RectangularMicrostrip Patch Antenna has a gain of 7.16 db.



VI. RESULT TABLE

Designed Antenna	VSWR	Return Loss	Gain
H-Shape	2.1db	-13.91db	7.16db

VII. CONCLUSION

In this paper, H Rectangular Microstrip Patch is 5 Ghz thatH – slot antenna has 7.16 dB gain, - 13.91 dB of return lossand 2.1 dB of vswr are the evaluated from our simulation.

VIII. APPLICATION

A. The Microstrip antennas, for its low-profile planarconfiguration, in which ease of fabrication andintegration with RF devices, are being used for many applications due to key advantages overconventional antenna.

B. It can be used in mobile phones, wirelesscommunication, etc.

C. H-shaped patch antenna contributed betterperformance and hence is best suitable for 5Gapplications.

D. It is used in GPS (Satellite Navigation System) Technology.

E. Can function as a antenna for wireless batterycharging at 5.5 GHz and data telemetry in the 5.15–5.35 GHz WLAN band.

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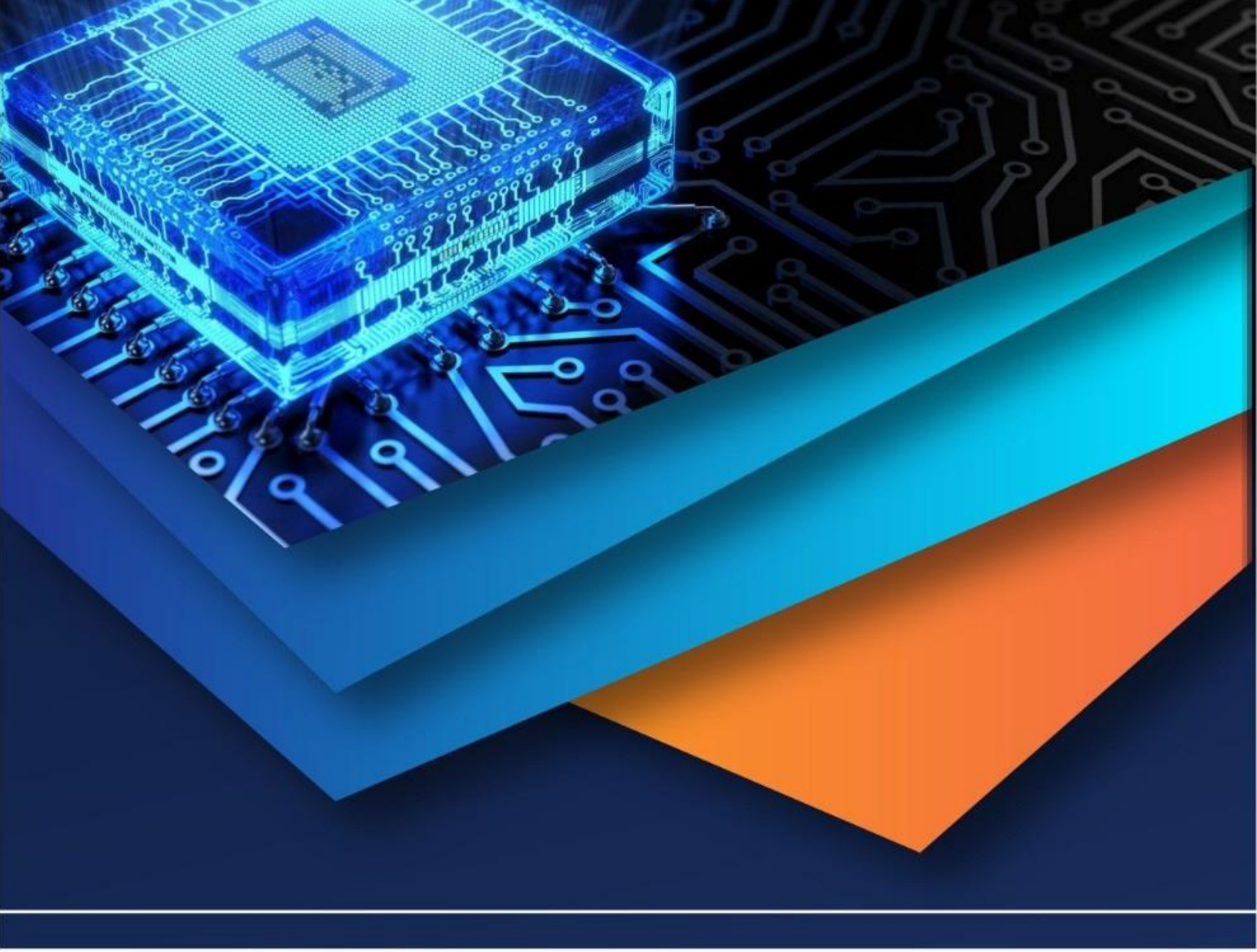

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