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Microstrip H-Shape Patch Antenna's Analysis and Layout

R.Durga Bhavani, J.L.Narayana

Abstract: ***Microstrip Patch Antenna gives low contour and size, so it is utilized in specialized gadgets. It is engraved on a dielectric substrate, supported by a metal board, and directly sustained from a 50Ω coaxial link. By utilizing HFSS software design, it will be replicated. The complex impact of incorporating various methods and by presenting a novel H-shape patch provides truncated contour, extensive bandwidth and returns loss, intense gain and minimized antenna components. This sort of miniature antenna has application in cell phone for Wi-Max, Bluetooth, C-band, S-band and furthermore for different remote applications. The parameters of antenna, for example, bandwidth, return loss, VSWR, directivity and gain are examined and compared with the square patch microstrip antenna. Outcome demonstrates that the antenna has accomplished a good match of impedance, bandwidth, return loss, VSWR, Gain and Directivity.***

Index Terms: ***Multi band, H-shape Microstrip patch antenna, HFSS.***

I. INTRODUCTION

1. OVERVIEW

The rapid improvement of wireless technology has expanded the interest for microstrip patch antenna with high gain and multiband working frequencies. The utilization of multiband microstrip patch antennas in versatile gadget like cell phone, electronic gadgets like laptops and gaming. Some microstrip patch antenna has different position, for example, low profile, conformal light weight, extensive bandwidth, high gain and similarity with standard assembling process. In general, a microstrip patch antenna has some drawbacks, for example, narrow bandwidth, low gain, interference and so forth. The execution to cover the bandwidth is the fundamental task. There are various and surely understood strategies to expand the data transmission of antennas includes incrementing the thickness of substrate, utilization of low dielectric constant substrate, utilization of different impedance matching, feeding procedure and the utilization of numerous resonators. The antenna can transmit the data as well as receives the data. So, it is the basic segment of the microwave correspondence. It is a gadget that is made to effectively transmit and accept the electromagnetic waves. In this paper a multiband antenna reinforced by a coaxial probe is utilized. The antenna is pretended by utilizing HFSS software.

II. ANTENNA DESIGN

This portion examines the outline of the desired micro-strip patch antenna. The antenna is outlined on FR-4_Epoxy substrate width of 1.6 mm with dielectric constant 4.4. First a square patch is structured on FR-4_Epoxy with measurements characterized as shown in the figure1.

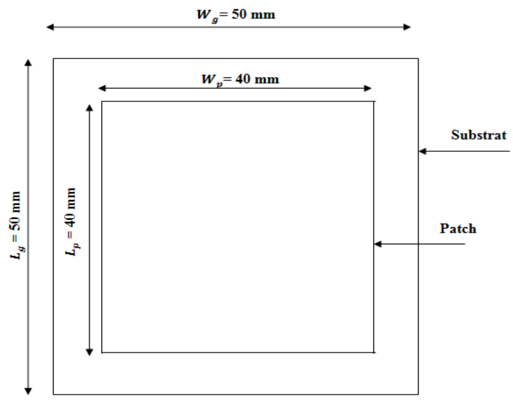

Fig.1: Dimensions of the square patch antenna.

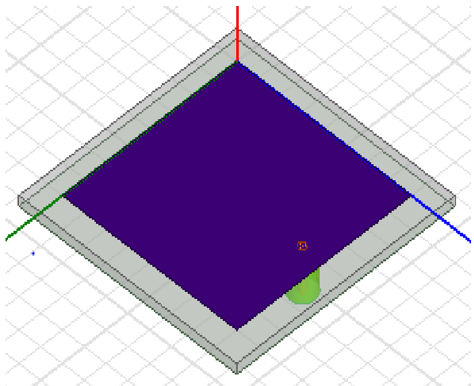

Fig.2: HFSS software design for square patch antenna.

The length of the square patch is characterized as

$$L = \frac{1}{2f_r\sqrt{\varepsilon_{reff}}\sqrt{\mu_0\varepsilon_0}} - 2\Delta L \quad (1)$$

where effective dielectric constant is characterized as

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

and ΔL is expansion length caused by fringing impact and by examine length and width of patch it can easily overlooked.

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

h - Substrates thickness.
The width of patch is characterized as

$$W = \frac{v_0}{2f_r}\sqrt{\frac{2}{(\varepsilon_r+1)}} \quad (4)$$

v_0 - Speed of light in a vacuum,
f_r - Resonant frequency,
ε_r - Substrate Dielectric constant.

Figure2 shows the square microstrip patch antenna design in HFSS software, from this square patch the H-shaped microstrip patch antenna is outlined by creating two slots at top and bottom of the square patch as shown in figure3. Figure4 shows the diverse layers incorporated into the formation of H-shape patch antenna. Figure5 demonstrates measurements of H-shape patch utilized in the planned H-shape patch antenna.

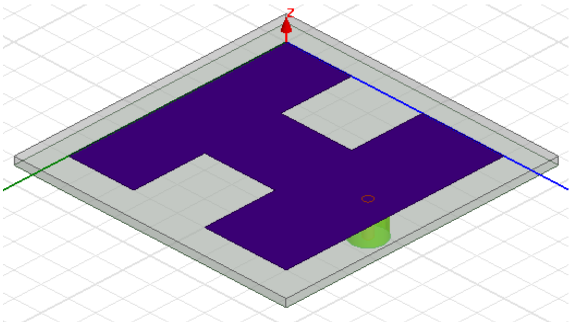

Fig.3: 3D geometry of the proposed H-shape microstrip patch antenna.

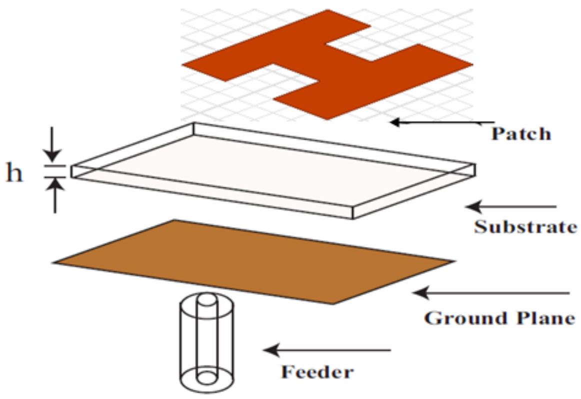

Fig.4: Sheets elaborated in H-shape patch antenna.

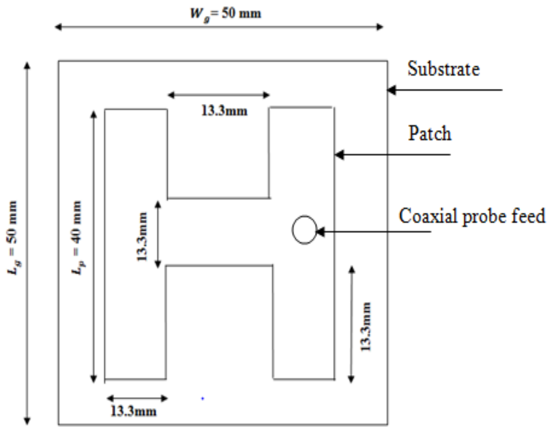

Fig.5: Measurements of square patch antenna.

III. RESULTS

It is obvious from Figure6 that the H-shaped patch antenna got tri-band qualities having resonant frequencies 3.8, 4&7.3GHz. All the 3 peaks encounter adequate range vital for return loss i.e., greater than 10dB.

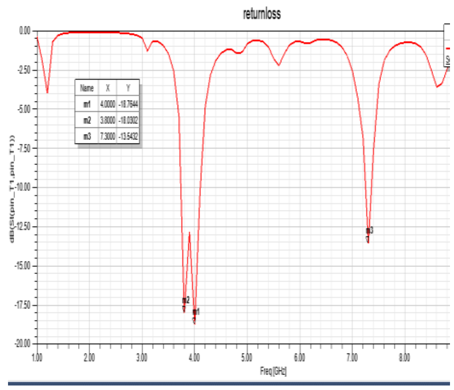

Fig.6: Return Loss for H-shape patch antenna.

Figure7 demonstrates VSWR of planned antenna with satisfactory edges.

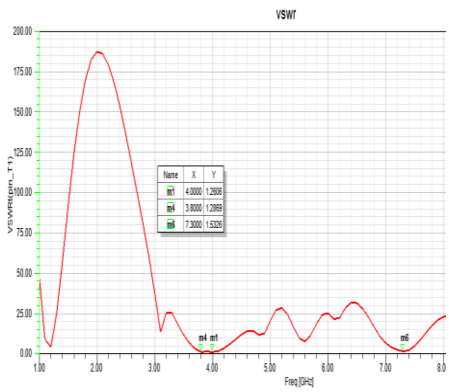

Fig.7: VSWR of planned H-shape patch antenna.

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The radiation pattern of planned antenna is appeared in figure8.

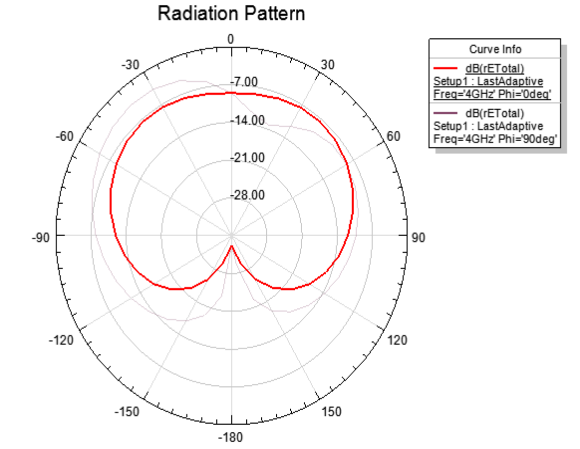

Fig.8: Radiation pattern of planned antenna.

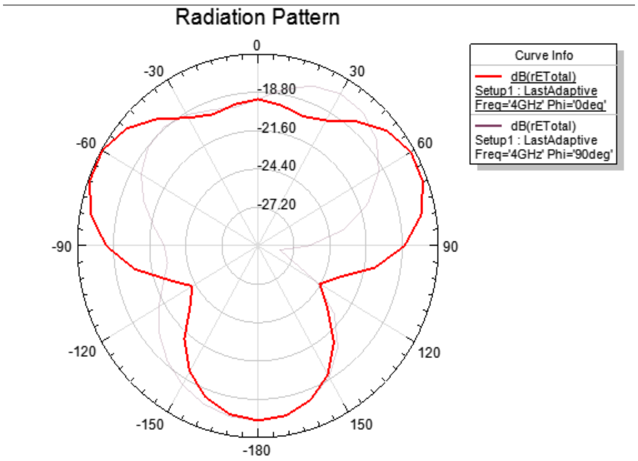

Fig.9: Radiation pattern of square patch antenna.

The radiation pattern, gain and directivity of the H-shaped microstrip patch antenna are better compared to the square patch antenna. Figure10 and figure11 shows H-shape patch antenna's gain & directivity in 3D polar plot.

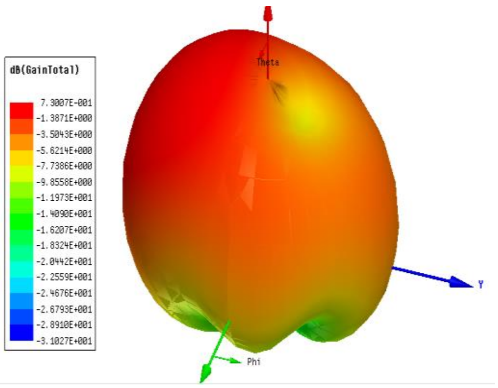

Fig.10: Gain of planned antenna- 7.30dB.

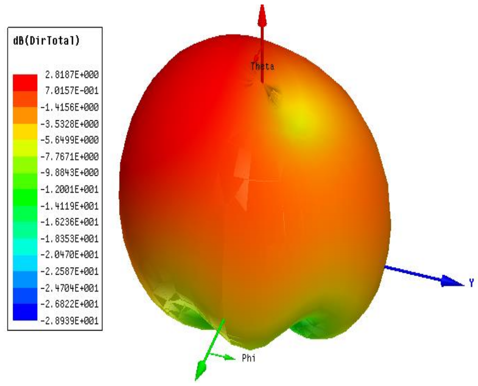

Fig.11: Directivity of H-shaped antenna-7.015dB.

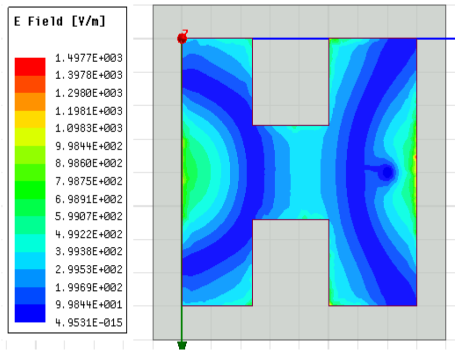

Fig.12: Electric field distribution of planned antenna.

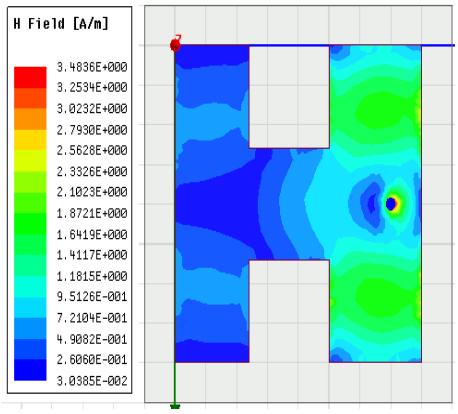

Fig.13: Magnetic field distribution of planned antenna.

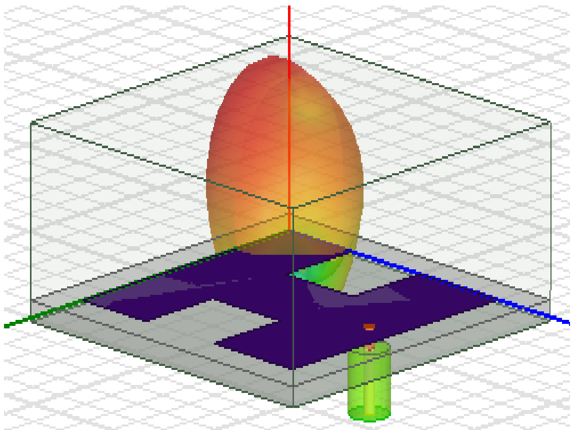

Fig.14: Overlaying Polar Plot on Geometry of designed antenna.

The electric and magnetic field distribution of the H-shaped antenna achieved high voltage 9.98 V/m and current 9.512 A/m as shown in figure12 and figure13. Figure14 demonstrates the polar plot on geometry of H-shape microstrip patch antenna. Comparison for parameters of square patch antenna and H-shaped patch antenna is demonstrated in table 1.

Parameter	Square patch antenna	Planned H-shaped patch antenna
Resonant frequencies	3.5GHz & 4.0GHz	3.8GHz, 4.0GHz & 7.3GHz
Return Loss	-12.56dB &-17.80dB	-18.03dB, -18.76& -13.54
Gain	-1.17dB	7.3007dB
Directivity	-1.044dB	7.015dB
VSWR	1.6155,1.2954	1.2869,1.2606,1.5326
Bandwidth	5%	9%

Table1: Comparison table between square patch and planned H-shaped patch antenna.

IV. CONCLUSION

H-shape microstrip patch antenna is simulated at 3.8GHz, 4GHz and 7.3GHz frequency. From the results it is concluded that H-shaped patch antenna contributed better performance and hence is best suitable for 5G applications. It gives the greatest bandwidth of 9%, gain of 7.30 dB, directivity of 7.0157dB, Return Loss of -18.0302dB,-18.7644 dB, -13.5432 dB and VSWR of 1.2869, 1.2606 & 1.526 at 3.8 GHz 4.0 GHz and 7.3 GHz.

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