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Design and Implementation of Wideband Microstrip Patch Antenna for Wlan Application

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ABSTRACT

A novel 2x2 electromagnetically coupled wideband antenna has been proposed in this paper. The proposed antenna resonates at 2.4GHz and operates from 2.1GHz to 2.52GHz covering a bandwidth of 0.42GHz. Simulation Results shows that the return loss is -24.17dB, peak Gain is 10.49dBi, and VSWR is 1.13. The proposed antenna finds application for WLAN, Wi-Fi.

Keywords : Aperture Coupled, Wlan applications, Wideband.

I. INTRODUCTION

The MSPAs have less bandwidth of around 2% to 5% and hence Vivaldi antennas or yagi-uda antennas are used for wideband applications. Due to their large size researchers were interested in making microstrip wide band antennas, [1] using log periodic technique and a microstrip stacked technique on a single layer dielectric and achieved a return loss bandwidth of 30% but still the size of the MSPA was larger as compared to the single patch.

After five years i.e. in 1985, A novel concept of multilayer dielectric technique [2], co-axial feeding method was used to excitethe antenna and they obtained a bandwidth of around 10%. The main advantage was in the reduction of antenna. Later i.e. in 1990 a technique of dual feeding [3] the antenna and exciting simultaneously in two modes was proposed to achieve bandwidth of 25%.

At the same time a technique of gap in patches [4] to increase the bandwidth by obstructing the current flow in the patch was proposed. They achieved more than 10% bandwidth with good gain and compact size.

New feeding technique called capacitive feeding was proposed [5] in which a single layer suspended dielectric substrate was used with a small feeding patch and a radiating patch. A bandwidth of 25% was obtained with a gain of more than 5dBi over the bandwidth

A combination of square slotted patch fed by a stacked patch [6] was proposed which was providing a bandwidth of 15% with a gain of 6.5dBi over the bandwidth and the proposed structure was providing circular polarization with axial ratio of less than 3dB over the bandwidth.

A novel wideband square ring patch feed by using the electromagnetic coupling by a microstrip line [7] was proposed to achieve a bandwidth of 80% and gain of around 4dBi over the resonating bandwidth.

II. DESIGN OF WIDEBAND PATCH ANTENNA

Design and optimization of the antenna by using Ansoft HFSS software. At first design starts with the normal rectangular patch on a low dielectric, low loss and low cost polyguide material. Then the antenna is fed with different feeding methods as well as optimized for those feeding methods. After which the height between the ground plane and the substrate are varied to analyze the bandwidth.

The dimensions of rectangular patch are calculated by using following equations

- Width (W):

$$W = \frac{v0}{2fr}\sqrt{\frac{2}{\varepsilon r+1}} \quad .....1$$

- Effective dielectric constant (ε_{reff}):

$$\varepsilon reff = \frac{\varepsilon r+1}{2} + \frac{\varepsilon r-1}{2} + \left[1 + 12\,\frac{h}{w}\right]^{-1/2} \quad ....\ 2$$

- Effective length(L_{eff}):

$$L = \frac{v0}{2fr\sqrt{\varepsilon reff}} \quad .....3$$

- Calculation of length extension:

$$\frac{\Delta L}{h} = 0.412\,\frac{(\varepsilon reff+0.3)(w/h+0.264)}{(\varepsilon reff-0.258)(w/h+0.8)} \quad ....4$$

- The actual length (L) of patch:

$$L = Leff - 2\Delta L \quad .....5$$

The impedance along the length of the patch is given by

$R_{in} = R_e\,\{\mathrm{Sin}(\pi x/L)\}^2$ where $0 \le x \le L/2$

And edge impedance of rectangular MSPA is given by

$$Z = 90 * \left(\frac{\varepsilon r2}{\varepsilon r-1} * i\right)^2 \quad .....7$$

The rectangular patch antenna is designed and simulated for 2.4GHz as centre frequency.

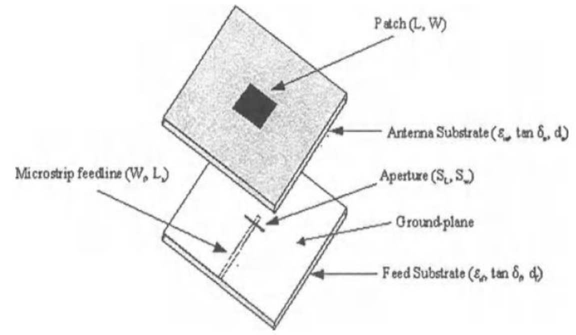

Figure 1. simple aperture coupled patch antenna

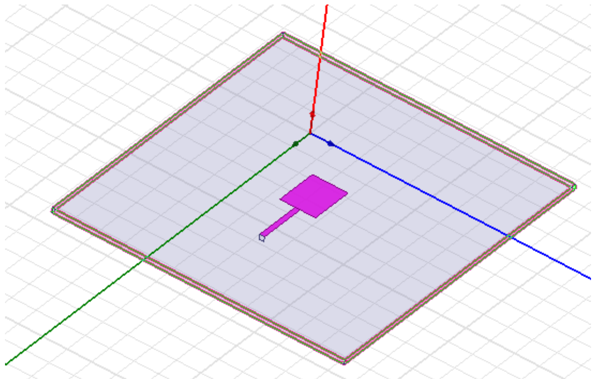

Figure 2. simple patch antenna with an edge feed

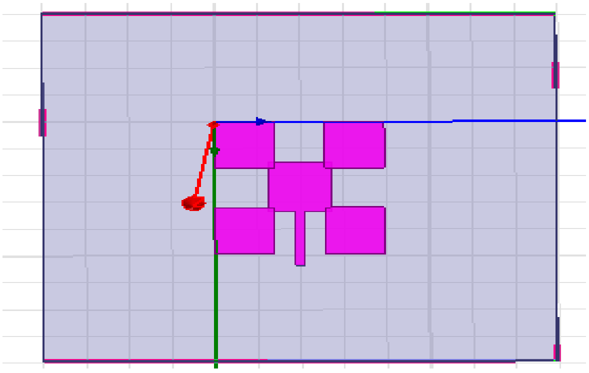

Figure 3. patches constructed above substrate 2.

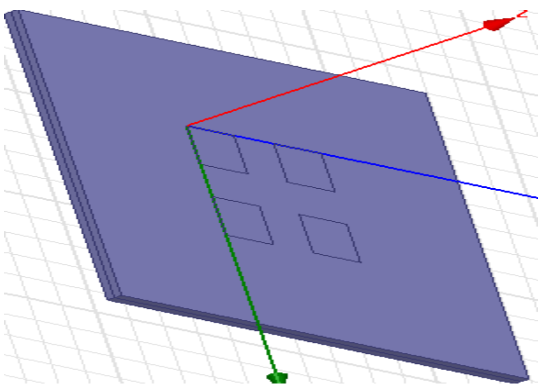

Figure 4. overview of complete antenna

The design and simulation of antenna is carried out in Ansys HFSS and results are provided accordingly.

III. SIMULATION RESULTS

Return loss

The return loss of the antenna at 2.4 GHz is -24.17.

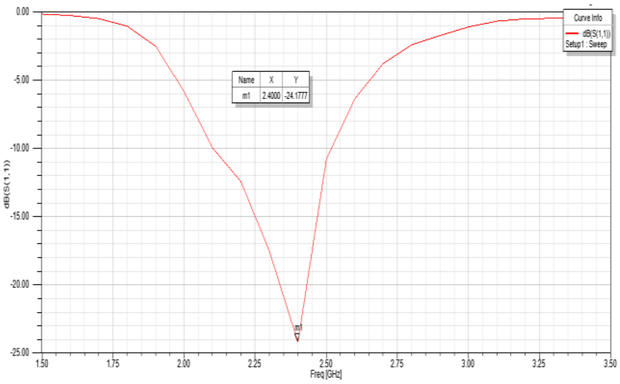

Figure 5. Shows return loss of the antenna.

Gain

The gain obtained by this antenna is 10.49dB.

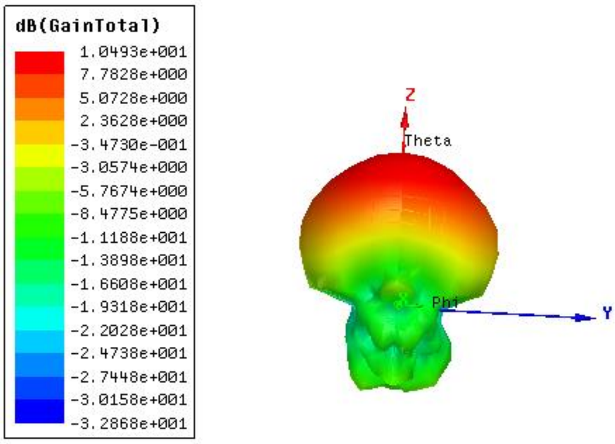

Figure 6. Shows 3D gain of antenna.

VSWR

The VSWR obtained for 2.4 GHz is 1.13.

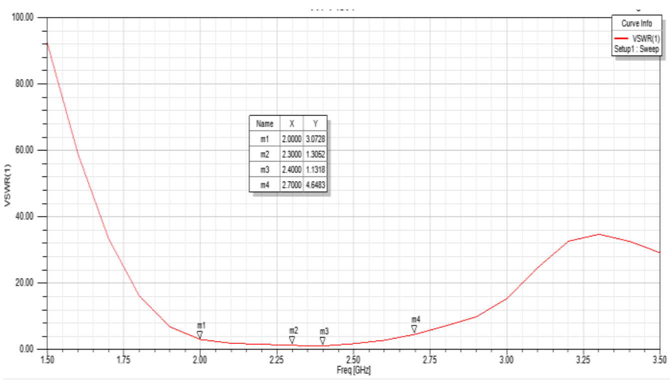

Figure 6. Shows VSWR at 2.4 GHz.

Radiation Pattern

This explains about directivity ,beamwidth and beam pattern.

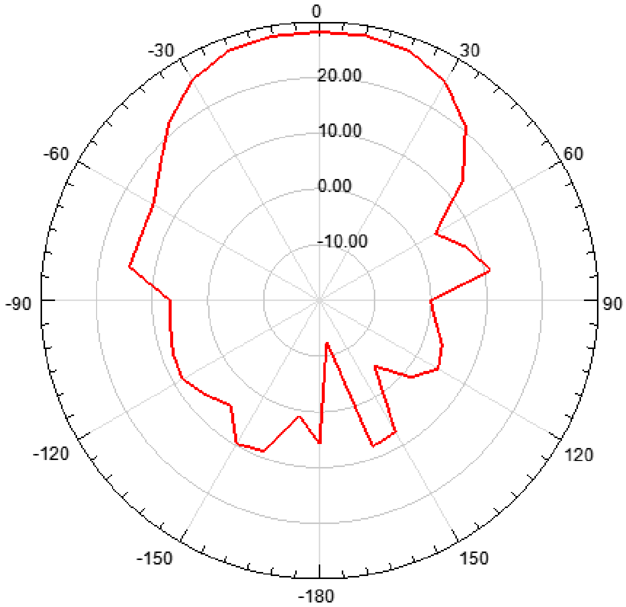

Figure 8. Shows gain polar plot.

IV. CONCLUSION

The proposed novel 2x2 aperture coupled wideband antenna has been designed and optimized using HFSS. Antenna shows good results in resemblance with desired antenna characteristics. The return loss of proposed antenna is -24.17dB, Gain is around 10.49dBi for center frequency and measured VSWR is 1.13. The above antenna resonates between the frequencies 2.1GHz to 2.52GHz. Above antenna finds application in WLAN, Wi-Fi etc. The bandwidth can be further increased by using techniques of slots on the patches.

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