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# Rectangular Microstrip Patch Antenna For WLAN Application

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***Abstract***— *The aim of this paper is to design a rectangular microstrip patch antennas suitable for WLAN application centered at 5.2 GHz. There are various standards for simultaneous running of different applications. WLAN (Wireless Local Area Network) is a common wireless communication standard. Among the five bands announced by IEEE in 802.11 standards for wireless LAN, two most common bands are 2.4 GHz and 5.2 GHz. The requirement of impedance matching, gain and bandwidth are studied and performance of the proposed antenna is analysed on the HFSS (High Field Structural Simulator). The proposed antenna has the bandwidth of 223 MHz (5.100-5.323 GHz) at -10 dB reflection coefficient and the maximum gain achievable is 5.2626dB. Soft-computing technique is used to optimize the best impedance match at 5.2 GHz. The antenna was designed with FR4 Epoxy material as substrate, that had a relative dielectric constant, εr = 4.4, a loss tangent tan δ = 0.009 and thickness, h of 1.6 mm.*

***Keywords-component: WLAN; Bandwidth; microstrip antenna; soft-computing; HFSS, Impedance matching.***

## INTRODUCTION

Antennas enable wireless communications between two or more stations by directing signals toward the stations. a means for radiating or receiving radio waves.[1]"A usually metallic device (as a rod or wire) for radiating or receiving radio waves." Microstrip antennas have attracted a lot of attenuation due to rapid growth in wireless communication area.

IEEE 802.11 wireless LAN (WLAN) [1] is one of the most deployed wireless technologies all over the world and is likely to play a major role in next-generation wireless communication networks. The main characteristics of the 802.11 WLAN technology are simplicity, flexibility and cost effectiveness. This technology provides people with a ubiquitous communication and computing environment in offices, hospitals, campuses, factories, airports, stock markets, etc. Simultaneously, multimedia applications have experienced an explosive growth. People are now requiring to receive high-speed video, audio, voice and Web services even when they are moving in offices or travelling around campuses. However, multimedia applications require some quality of service (QoS) support such as guaranteed bandwidth, delay, jitter and error rate.

Microstrip patch antennas are increasing in popularly for use in wireless applications due to their low-profile structure [2]. However, the antenna inherent narrow bandwidth and low gain is one of their major drawbacks [3, 4, and 5]. These problems can be solved by introducing Microstrip patch antenna. The Microstrip Patch antennas are light in weight, small size, low cost, simplicity of manufacture and easy integration to circuits.

Designing of micro strip patch antenna depends on three parameters. In this paper, a micro-strip patch antenna for solution frequency 5.2 GHz with FR4 Epoxy material as substrate is designed and observing return loss, s-parameter, and Gain and field animations.

## RECTANGULAR PATCH ANTENNA DESIGN WITH ANALYTIC APPROCH

The performance of the microstrip patch antenna depends on its resonant frequency, dimension. Depending on the dimension, the operating frequency, radiation efficiency, directivity, return loss are influenced. In this paper, selected Resonance frequency at 5.2 GHz FR4 Epoxy substrate which has a dielectric constant (   ) of 4.4 and height of the substrate is 1.6mm. For an

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efficient radiation, the practical width of the patch can be calculated by using the following.

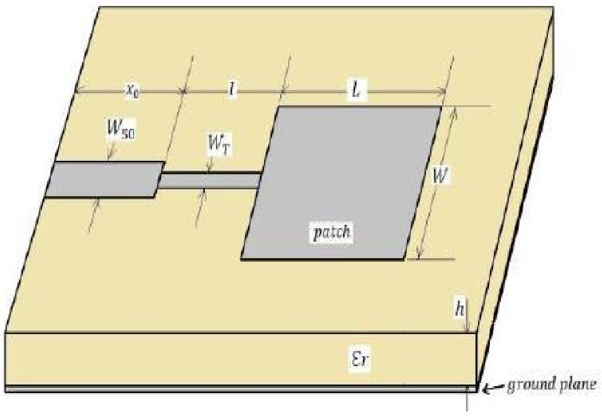


Figure 1: Rectangular Patch

$$w = \frac{1}{2f_r\sqrt{\mu_0\epsilon_0}}\sqrt{\frac{2}{\epsilon_{r+1}}}$$

$$L = \frac{}{2f_r}$$

Where,

$$\epsilon_{eff} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2\sqrt{1 + 12\frac{h}{w}}}$$

$$\Delta L = \frac{(\epsilon_{eff} + 0.3)\left(\frac{w}{h} + 0.264\right)}{(\epsilon_{eff} - 0.258)\left(\frac{w}{h} + 0.8\right)} * 0.412h$$

Where,

λ - Wave length,

fr - Resonant frequency,

L - Length of the patch element ,

W - Width of the patch element ,

εr - Dielectric constant.

Characteristic impedance of the patch can be found by

$$Z_a = 90\frac{{\epsilon_r}^2}{\epsilon_{r-1}}\left(\frac{L}{W}\right)^2$$

Impedance of transition section:

$$Z_t = \sqrt{50 * Z_a}$$

Width of transmission line $W_T$

$$z_T = \frac{60}{\sqrt{\epsilon_r}}\ln\left(\frac{8d}{w_T} + \frac{w_T}{4d}\right)$$

Length of transmission line

$$l = \frac{\lambda}{4} = \frac{\lambda_0}{\sqrt{\epsilon_{eff}}}$$

Length of the microstrip transmission line

$$R_{in(x=0)} = \frac{Z_0}{Z_T} = cos^2\left(\frac{\pi}{L}\right)x_0$$

Width of 50Ω microstrip transmission line

$$Z_0 = \frac{120\pi}{\sqrt{\epsilon_{eff}\left(1.393 + \frac{w}{h} + \frac{2}{3}ln\left(\frac{w}{h} + 1.44\right)\right)}}$$

Where Z0= 50Ω

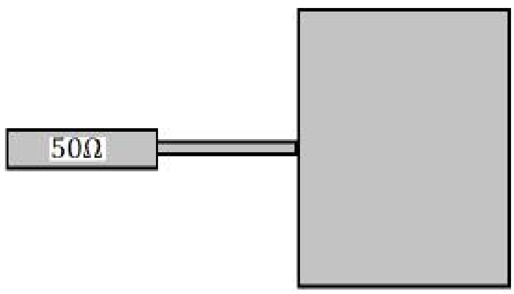


Figure 2: Patch with feed

**FEEDING TECHNIQUE**

Microstrip antennas have radiating elements on one side of dielectric substrate and were fed by microstrip line or coaxial probe through ground plane. Different factors to be considered for selecting feeding techniques are as follows

1. Impedance matching radiating structure and feed structure
2. Minimization of spurious radiation

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3. Suitability of feed for array applications

Different feeding techniques used in antennas are

1. Inset feed
2. Fed by quarter wavelength transmission line
3. Co-axial Probe feed
4. Microstrip (Coplanar)feeds
5. Gap- coupled feed
6. Proximity Coupled microstrip feed
7. Aperture Coupled microstrip feed
8. Coplanar Waveguide feed

## METHODOLOGY

The simple patch antenna is simulated using HFSS. HFSS is an interactive software package for calculating the electromagnetic behavior of a structure. The software includes post-processing commands for analyzing this behavior in detail. HFSS helps to compute

1. Basic electromagnetic field quantities and, for open boundary problems, radiated near and far fields.
2. Characteristic port impedances and propagation constants.
3. Generalized S-parameters and S-parameters renormalized to specific port impedances.
4. The eigenmodes, or resonances, of a structure.

## RESULTS

The rectangular patch antenna is simulated using HFSS software. Following are the results obtained for peak gain and return loss.

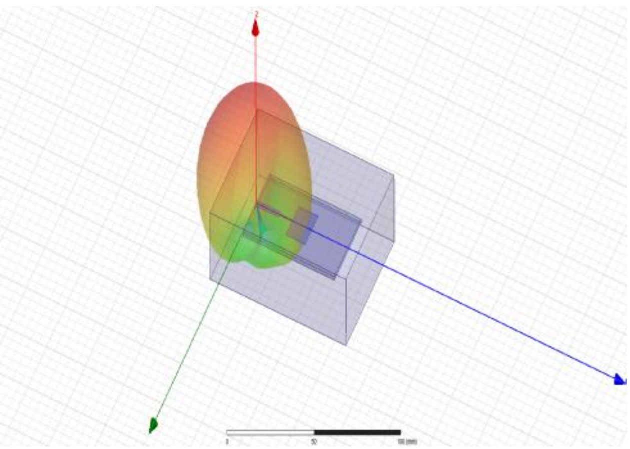

Figure 3: Rectangular Patch with radiation on HFSS software

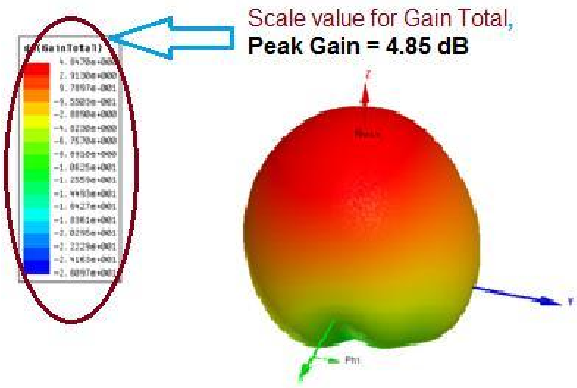


Figure 4: Rectangular Patch with peak gain


Figure 5: Rectangular Patch with return loss


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