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# DESIGN OF RECTANGULAR MICROSTRIP PATCH ANTENNA FOR WI-FI APPLICATIONS

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## ABSTRACT

An antenna is used to receive RF/microwave signals, while a rectifier converts these signals into DC power. In this work, the design and simulation of a rectangular microstrip patch antenna and its array are carried out at a frequency of 2.45 GHz for low-profile wireless applications. Initially, a single rectangular microstrip patch antenna is designed at 2.45 GHz using an electromagnetic solver, and its design parameters are optimized accordingly. A 1×2 rectangular microstrip array is then developed using a feed network, maintaining the same frequency. The inter-element spacing is set at $0.75\lambda_0$. Key antenna radiation characteristics—including return loss, gain, directivity, efficiency, and 3D radiation patterns—are obtained for both the single patch and the array configuration. A comparative analysis reveals that, with an increased number of elements in the array, the gain improves while the beamwidth narrows, as observed in the simulation results.

**Keywords:** Microstrip antenna, Wireless communication Directivity, Efficiency, Gain

## 1. INTRODUCTION

Microstrip antennas are commonly used in low-profile applications due to their compact size, low profile, ease of integration with circuits and arrays, but they typically exhibit low radiation efficiency and narrow bandwidth. In this work, a rectangular microstrip patch antenna is designed and simulated at a frequency of 2.4 GHz. The antenna's design parameters are optimized using electromagnetic simulation software. Key performance metrics such as return loss, gain, efficiency, directivity, and radiation pattern are obtained through the simulator for the designed antenna.

### Rectangular Patch Antenna

The design of a single microstrip antenna includes a patch, a quarter-wave transformer, and a feed line. A rectangular patch antenna is designed to operate at 2.45 GHz. A 50 Ω surface-mount connector is used to link the feed line to a coaxial cable. The feed line connects to the patch through a matching network implemented using a quarter-wave transformer. The patch antenna integrated with the quarter-wave transformer is illustrated in Fig. 1. The antenna dimensions are determined based on the transmission line model, with the length and width of the patch calculated using below equations.

$$W=\sqrt{\frac{90\frac{\varepsilon_r^2}{\varepsilon_r-1}}{Z_A}}\quad L$$

$$Z_1=\sqrt{Z_0 R_{in}} \qquad ($$

The impedance of the quarter wave line is calculated using the above equation. $Z_1$ is the transformer characteristic impedance. $Z_0$ is the characteristic impedance of the transmission line and $R_{in}$ is the edge resistance at resonance. The obtained values for the parameters are given in Table 1.

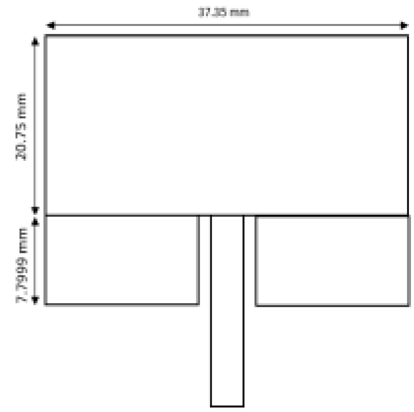


**Fig.1** Patch Antenna Design Layout

**Table 1** Dimensions of Rectangular Patch Antenna

| Patch | |
|---|---|
| Width W | 13.3 mm |
| Length L | 19.97 mm |
| 50 Ω Feedline | |
| Width W | 2.95 mm |
| Length L | 6.35 mm |
| 35 Ω Feedline | |
| Width W | 1.55 mm |
| Length L | 18.173 mm |

The array antenna is used to increase the directivity. So the received power will be increased. In this proposed work, 1X2 patch antenna array is designed at 2.45 GHz frequency. The array calculation consists of two parts. The first is the patch calculation and the second is for 50 Ω, and 35 Ω transmission lines. Similarly the patch antenna dimensions are obtained from above mentioned equations. The impedance of the quarter wave line transformer is also calculated using the equation. The obtained values for the line parameters are given in the Table 2.

## 2. RESULTS AND DISCUSSION

**Table 3** Antenna Parameters

| Parameters | Single Patch Antenna | 1X2 Patch Antenna Array |
|---|---|---|
| Gain | 6.8 dBi | 7.8 dBi |
| Directivity | 6.3 dBi | 8.4 dBi |
| Efficiency | 87 % | 89 % |
| Effective Angle | 2.9 Steradians | 1.8 Steradians |

## 3. CONCLUSION

The comparison of antenna parameters for single rectangular patch antenna and 1X2 rectangular patch antenna array at 2.45 GHz frequency is given in Table 3. From the tabulation values, it is observed that directivity, gain and efficiency are increased and also effective angle, is decreased for the array. So the simulated array obeys the antenna theory. The designed array may be suitable for Wi-Fi application.

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