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DESIGN OF X BAND RECTANGULAR MICROSTRIP PATCH ANTENNA

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Abstract - The antenna is used to transmit or receive RF/Microwave signal. In this work, the design and simulation of the rectangular microstrip patch antenna are carried out at 10 GHz frequency for low- profile wireless applications. A rectangular microstrip patch antenna is designed in RT Duroid 5880 substrate at 10 GHz frequency using an electromagnetic solver. The antenna design parameters are optimized using an electromagnetic solver. The antenna radiation parameters such as return loss, gain, directivity, and efficiency and radiation patterns are obtained for the designed rectangular microstrip patch antenna. From the simulation results, it is observed that the gain and beamwidth of the antenna may be increased and decreased respectively for the increase in antenna elements.

Key Words: Microstrip antenna, Wireless communication, Directivity, Efficiency, Gain.

1. INTRODUCTION

In low-profile application, microstrip antenna was used for wireless communication application. The characteristics of microstrip antenna are small size, low profile, ease of integration with circuits and arrays, low radiating efficiency and narrow bandwidth. In this work, a rectangular microstrip patch antenna is designed and simulated at 10 GHz frequency in RT Duroid 5880 substrate. The design parameters of antenna are optimized using an electromagnetic software. The antenna parameters such as return loss, gain, efficiency, directivity, and radiation pattern are obtained using the electromagnetic simulator for the antenna.

2. RECTANGULAR PATCH ANTENNA DESIGN

The rectangular microstrip patch antenna is designed in RT Duroid 5880 substrate. The substrate dielectric constant and thickness are 2.2 and 0.254 mm. The loss tangent of the substrate is 0.0009. The conductor thickness is 17 μm. The design specifications are shown in the Table.1.

Frequency	10 GHz
Substrate	RT Duroid 5880
Dielectric constant	2.2
Loss Tangent	0.0009
Substrate Height	0.254 mm
Conductor Thickness	17μm

Table -1: Design Specifications

Design section of a single microstrip antenna consists of patch, quarter wave transformer and feed line. A rectangular patch antenna is designed at 10 GHz frequency. A 50 Ω surface mount connector is used to connect the feed line to the coaxial cable. The feed line is fed to the patch through a matching network which is a quarter-wave transformer. The patch antenna with quarter-wave transformer and feeder line is shown in Fig.1. The dimensions are calculated based on the transmission line model. The length and width of the patch are calculated using equations (1) and (2).

$$L = 0.49\frac{\lambda}{\sqrt{\varepsilon_r}} \quad (1)$$

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

$$Z_1 = \sqrt{Z_0 R_{in}} \quad (3)$$

The impedance of the quarter wave line is calculated using equation (3). Z_1 is the transformer characteristic impedance. Z_0 is the characteristic impedance of the transmission line and R_{in} is the edge resistance of the antenna at resonance. The obtained values for the parameters are given in Table 2. The layout of the antenna is shown in the Fig.1.

Patch	
Width W	10.2 mm
Length L	6.5 mm
98 Ω Quarter Wave Line	
Width W	1 mm
Length L	4.3 mm
50 Ω Feeder Line	
Width W	2 mm
Length L	10 mm

Table -2: Dimensions of Rectangular Patch Antenna

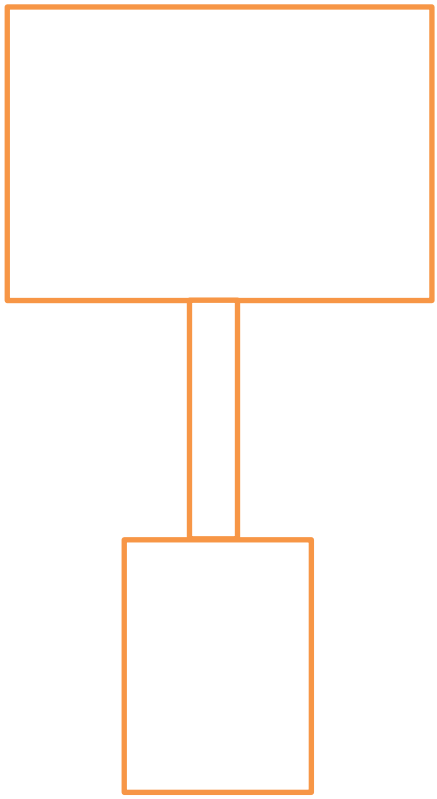

Fig.1 Patch Antenna Design Layout

3. RESULTS AND DISCUSSION

The return loss of the designed antenna at 10 GHz frequency in RT Duroid 5880 substrate is -23 dB. The directivity of the antenna is 7.2 dBi. Gain of the antenna is 6.5 dBi. Efficiency of the antenna is 85 %. Effective angle of the antenna is 2.44 steradians. The antenna parameters are shown in the Table 3.

Parameters	Value
Gain	6.5 dBi
Directivity	7.2 dBi
Efficiency	85 %
Effective Angle	2.44 Steradians
Return Loss	-23 dB

Table -3: Antenna Parameters

4. CONCLUSION

The antenna parameters for the designed single rectangular patch antenna at 10 GHz frequency in the RT Duroid substrate are given in the Table 2. From the tabulation values, it is observed that directivity, gain and efficiency may be increased and also effective angle, may be decreased for the array. The designed antenna may be suitable for X- Band application.

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