Design and Analysis of Microstrip Patch Antenna for Wireless Communication

S.NIRMALADEVI¹, S.RENUPRIYA², S.REVATHI³, G.SHANMUGAVALLI⁴, K.VINOBHA⁵

Assistant Professor¹, Department of Electronics & Communication Engineering
Dhirajlal Gandhi College of Technology

Abstract
As the technology in wireless communication field is advancing rapidly the need of an antenna with high accuracy is required. In this paper a compact microstrip patch antenna is designed using ADS Software which resonates at 2.4 GHz for Bluetooth application. The proposed antenna uses FR-4 epoxy substrate having thickness of 1.7mm and dielectric constant of 4.4 with dimensions 29.2mm x 29.2mm. The proposed antenna is capable to achieve return loss less than - 30. Antenna performance parameters such as antenna gain, return loss, VSWR, radiation pattern over the operating bands have been observed and found to be well within the expected range.

Keywords: Microstrip antenna(MSA), radiation pattern, directivity, Advanced Design System (ADS).

1. Introduction:
In any wireless communication field the antenna is a primary need. There are several types of antennas available as per application and requirement. Nowadays the integration in electronics and communication field tends to decrease size of communication devices due to which need of compact size of antennas are required. The microstrip patch antennas are most widely used antennas because of their small size, less weight, ease in manufacture and easy to implement in any system. A patch antenna is a narrowband, wide-beam antenna fabricated by etching the antenna element pattern in metal trace bonded to an insulating dielectric substrate, such as a printed circuit board, with a continuous metal layer bonded to the opposite side of the substrate which forms a ground plane. This unique property allows patch antennas to be used in many types of communications links that may have varied requirements. The patch antenna also provides high efficiency and its efficiency is based on the feed. Figure 1.1 shows the Microstrip antenna which contains the four elements, ground plane, dielectric substrate, patch and a feed which supplies the RF power. The patch shape may be either linear or non-linear, based on the applications it may vary. The patch is generally made of conducting material such as copper or gold and can take any possible shape. A rectangular patch is used as the main radiator. Some of the regular shapes are elliptical, circular, square and rectangular. Four types of feeding mechanisms are, microstrip line feed, coaxial feed, aperture coupled feed and proximity coupled feed. A simple feed is microstrip-line feed because, ease of fabrication and matching. The main feature of coaxial feed is its low spurious radiation. The above two mechanisms are commonly used for all type of applications.
2. Design procedure:
The proposed antenna is designed using FR-4_epoxy material. The substrate with this is drawn by taking the geometry of 29.2mm x 29.2mm (Length and Width). The relative permittivity is 4.4 and permeability is of the order of 1. The proposed antenna design is expected to operate in the frequencies of about 2.4GHz to 2.45GHz. These frequencies are used for Bluetooth applications. Figure (2.1) shows the proposed patch antenna geometry with simple feed. Here square patch geometry has been selected to achieve wideband characteristics. It has advantages of single layer with single feed structure. Simple microstrip-line feed is used to supply the RF power. The choice of substrate depends on dielectric constant (Permittivity), Loss tangent, Conductivity and cost. The selected substrate has low dielectric constant, loss tangent and thickness.

![Figure 1.1 Microstrip Patch Antenna](image)

![Figure 2.1 Flow Chart Of Design Procedure](image)
Figure 2.2 The Proposed Antenna With Feed

3. Simulation results:

3.1. Output Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resonant frequency</td>
<td>2.4GHz</td>
</tr>
<tr>
<td>Return loss</td>
<td>-33dB</td>
</tr>
<tr>
<td>Gain</td>
<td>5.22074</td>
</tr>
<tr>
<td>Directivity</td>
<td>6.20074</td>
</tr>
</tbody>
</table>

3.2 Resonant frequency: This antenna is resonating at 2.4 GHZ frequency. And this frequency is used for wireless communication as it is ISM band frequency and L band frequency.

3.3 Return loss: the return loss output of this microstrip patch antenna is shown in figure 3. Return loss of antenna at resonating frequency 2.4 GHz, which is below -10 dB and is equal to –34dB.

3.4 Gain: The ability of antenna can be measured through the antenna gain which is a ratio of radiated power to input power. Obtained gain is about 5.22 dBi for the designed frequency band.

3.5. Radiation Pattern: The radiation pattern provides how the antenna radiates the transmitting power with respect to direction. The users may be located anywhere, so the antenna should cover all the directions from 0° to 360°. Figure 3.3 shows the radiation pattern for proposed patch design. The red color from the figure shows the maximum radiation intensity to the user.
Conclusion and future scope

A superior performance is obtained through this proposed antenna configuration. It can be seen that the work demonstrated in this paper is mainly focused on designing the patch antenna for Bluetooth application. The geometrical shape can be also extended to other applications. In order to meet the needs of the fast developing wireless and mobile services, further design and optimization of the antenna system may be required to ensure high efficiency (low loss), low-power consumption, low profile, high speed tuning, and spurious free radiation in a particular application. The primary result shows that proposed may be useful for developing microstrip antennas with wide or multi band performance.

References


