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Rectangular Patch Antenna for 7.5 GHz Wireless Communications

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Abstract*: A small Microstrip patch antenna is introduced. The antenna is designed to function in 7.5 GHz wireless radio band. It achieves return loss below -10 dB by the using fr4 substrate under the patch. The antenna has many practical applications like in WLAN, WIFI, etc. The patch design is simulated in An Soft HFSS software .The result showed satisfactory performance.*

Keywords: Microstrip patch antenna, HFSS simulation software, Feed, Wireless communication

1. Introduction

Wireless communication systems are becoming more popular now-a-days, and have been developed rapidly over the last decade. As with new developments, there has been an increased demand for high data rate and reduced sized antennas. The study on microstrip patch antennas has made a great progress in the recent years. Compared with the conventional antennas, microstrip patch antennas have more advantages and better prospects. There are two important standards are Wi-Fi (WLAN) and Wi-MAX. For success of all these wireless applications we need efficient and small antenna as wireless is getting more and more important in our life. This being the case, portable antenna technology has grown along with mobile and cellular technologies. Microstrip antennas (MSA) have characteristics like low cost and low profile which proves Microstrip antennas (MSA) to be well suited for WLAN/Wi MAX application systems

A Microstrip patch antenna consists of a radiating patch on one side of a dielectric substrate which has a ground plane on the other side and overview of MSA. The patch is generally made of conducting material such as copper or gold and can take any possible shape. The radiating patch and the feed lines are usually photo etched on the dielectric substrate. For better antenna performance, a thick dielectric substrate having a low dielectric constant is desirable since this provides better efficiency, larger bandwidth and better radiation. Microstrip patch antenna has several advantages over conventional microwave antenna. The various advantages and disadvantages are given in table:

S.No.	Advantages	Disadvantages
1	Low Weight	Low Efficiency
2	Low Profile	Low Gain
3	Thin Profile	Large Ohmic Loss
4	Linear and Circular Polarization	Low power handling capacity
5	Capable of multi frequency operation	Complex Feed Structure

In this paper, we demonstrate a novel and simple rectangular patch antenna. Details of the antenna design are described, and prototypes of the proposed antenna for WLAN operations in the 7.5 GHz bands have been constructed and tested.

2. Design Procedure

The basic structure of the proposed antenna consists of three layers. The middle substrate, which is made of FR4 epoxy resin, has a relative dielectric constant 2.2 and height 0.8 mm. The lower layer, which constitutes the ground plane, covers the partial rectangular shaped substrate with a side of 28.1 X 32 mm. The upper layer, which is the patch, covers the rectangular top surface. The rectangular patch has sides 12.45×16 mm that covers the middle portion of the substrate. The patch is fed by a Microstrip line with 50ohm input impedance. To design a rectangular microstrip patch antenna following parameters such as dielectric constant (€r), resonant frequency (fo), and height (h) are considered.

2.1 The width of the Microstrip patch antenna is given as:

$$W = \frac{c}{2 f_0 \sqrt{\frac{(\varepsilon_r + 1)}{2}}}$$

2.2 Effective dielectric constant (ε*eff*) is given as:

$$\varepsilon_{re} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{W}\right]^{-1/2}$$

2.3 The effective length is given as:

$$L_{eff} = \frac{c}{2 f_0 \sqrt{\varepsilon_{re}}}$$

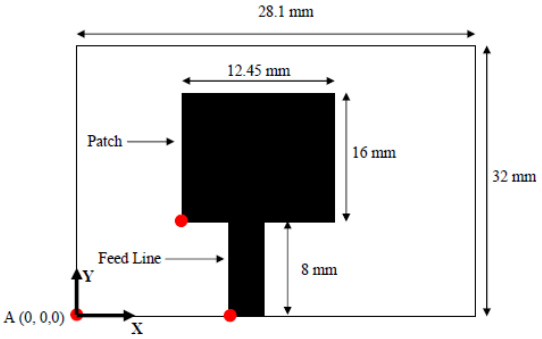
2.4 Length Extension (ΔL) is given as:

$$\Delta L = 0.412h\frac{\left(\varepsilon_{re} + 0.3\right)\left(\frac{W}{h} + 0.264\right)}{\left(\varepsilon_{re} - 0.258\right)\left(\frac{W}{h} + 0.8\right)}$$

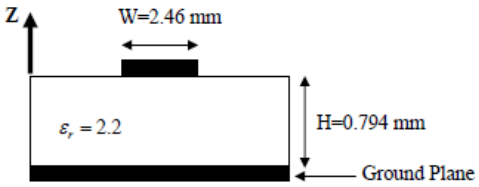
2.5 The actual length is given as:

$$Leff = L + 2\Delta L$$

3. Geometry of Proposed Antenna

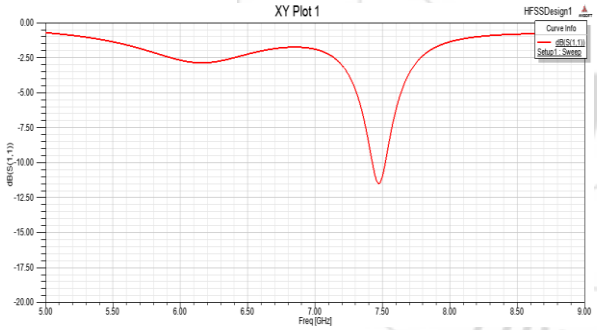


Top View

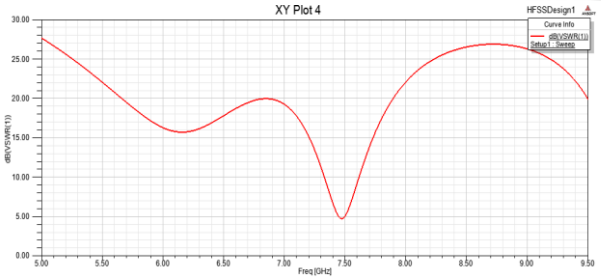


Side View

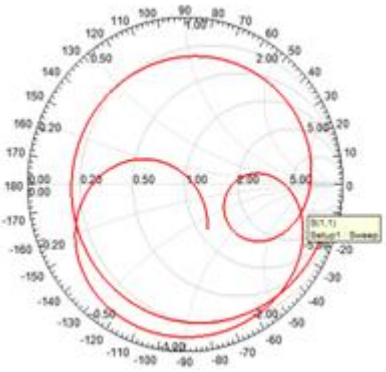
4. Simulation Results



Return Loss



VSWR



Smith Chart

5. Conclusion

A simple microstrip patch antenna for 7.5 GHz wireless communications systems has been simulated. The simulation result obtained by HFSS shows good results. The input impedance is 94.6 ohm at 7.5 GHz. It achieves return loss -11.48 dB by the using fr4 substrate under the patch.

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