Microstrip Patch Antenna with High Impedance Surface

Bhor Priyanka, Bhor Rajashree, Kawade Shaila,Prof. Dhede V.M.

***Abstract*— This paper encapsulates the properties and implementation areas of high impedance surface. A rectangular microstrip patch antenna simulated using HFSS software at an operating frequency 2.4GHz. Rectangular Microstrip patch antenna are low profile antennas, conformable to planar and non-planar surfaces, simple and easy to manufacture using printed circuit technology.**

***Keywords*— Rectangular Microstrip patch antenna, high impedance surface, Artificial Magnetic Conductor.**

I. INTRODUCTION

Antenna is one type of transducer that converts the electrical energy into the electromagnetic energy in the form of electromagnetic waves. A patch antenna is called as a rectangular microstrip antenna. The high impedance ground planes (also called artificial magnetic conductors) gained a sufficient attention in recent years. Improve the performance of this antenna for short distance wireless communication Artificial Magnetic Conductor as ground plane is preferred. It consists of a radiating patch on one side of a dielectric substrate which has a ground plane on the other side. The most commonly employed microstrip antenna is a rectangular patch which looks like a microstrip transmission line.

The microstrip patch antennas are more accurate and efficient, High Frequency Structure Simulator software HFSS's is used for the optimization of the antenna design. The various parameters of antenna such as radiation pattern, input impedance, return loss bandwidth directivity and gain, beam width, etc. [1].

This antenna is implemented on FR4 Epoxy dielectric substrate with relative permittivity of εr =4.4. An artificial magnetic conductor consisting of grounded dielectric slab loaded by metallic patches. Microstrip patch antenna is designed using substrate, Bluetooth, wireless LAN and Wi-Fi. There various type of antenna used for communication like horn, dipole, slot, parabolic antenna. Microstrip antennas are one type antenna which are low-profile, low weight, low cost, easy to fabricate and installation, and integral with other microwave devices. Microstrip patch antenna have some important advantages like having small size, easy to manufacturing, low profile, easy in integration with microwave integration circuit [2]-[4].

The resonant frequency is high then directivity of microstrip antenna increases. A rectangular microstrip patch antenna with High Impedance Surface the ground plane to reduce the antenna size and decreases the RF [5]-[6].

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II. DIAGRAM

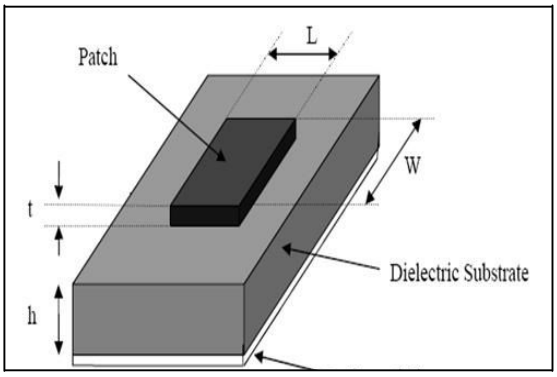


Fig-1: Construction of microstrip patch antenna

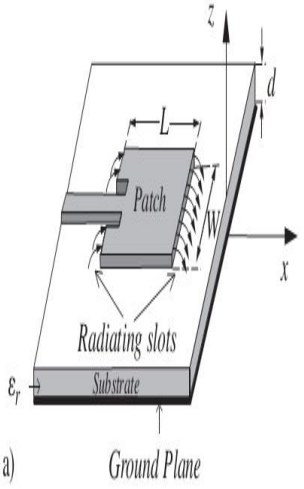


Fig-2: Structure of microstrip patch antenna

For a rectangular patch, the length L of the patch in the range of $0.3333\ \lambda 0 < L < 0.5\ \lambda 0$. Where, λ0 is the free space wavelength. The patch is chosen or selected to be thin such that $t << \lambda 0$ where, t is the patch thickness. The height h of the dielectric substrate is typically $0.003\lambda 0 \leq h \leq 0.005\lambda 0$. The dielectric constants of the substrate is should be of $2.2 \leq \varepsilon r \leq 12$.

III. DESIGN

frequency	2.4 GHz
Patch shape	rectangular
Dielectric constant	4.4
Height substrate	1.6mm
Feeding method	Line feeding
Polarization	Linear

Table -1:Element of MPA

A. Theoretical design

Step 1: Calculation of the Width (W):

$$W = \frac{C}{2f_r\sqrt{\left(\frac{\varepsilon_r + 1}{2}\right)}}$$

Where;

c - Free space velocity of light, 3 x 10^8 m/s
fr - Frequency of operation
ε_r - Dielectric constant

Step 2: Calculation of Effective dielectric constant (ε_{reff}):

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

Where;

ε_r - Dielectric constant
h - Height of dielectric substrate
W - Width of the patch

Step 3: Calculation of the Effective length (L_{eff}):

$$L_{eff} = \frac{C}{2f_r\sqrt{\varepsilon_{reff}}}$$

Where;

c - Free space velocity of light, 3 x 10^8 m/s
f_r - Frequency of operation
ε_{reff} - Effective dielectric constant

Step 4: Calculation of actual length of patch (L):

$L = L_{eff} - 2\Delta L$

Where,

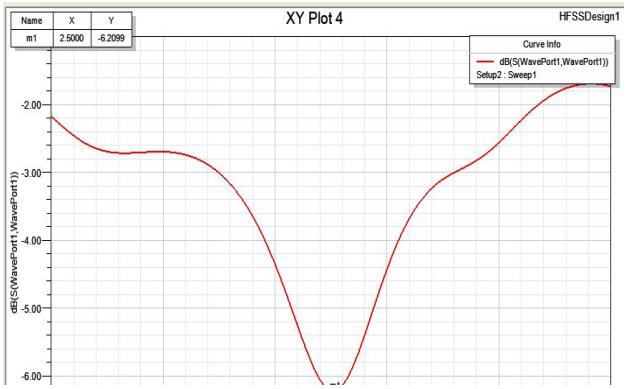
L-Actual length of patch.
L_{eff}-Effective length.
ΔL-Small difference between length.

IV. SIMULATION RESULTS

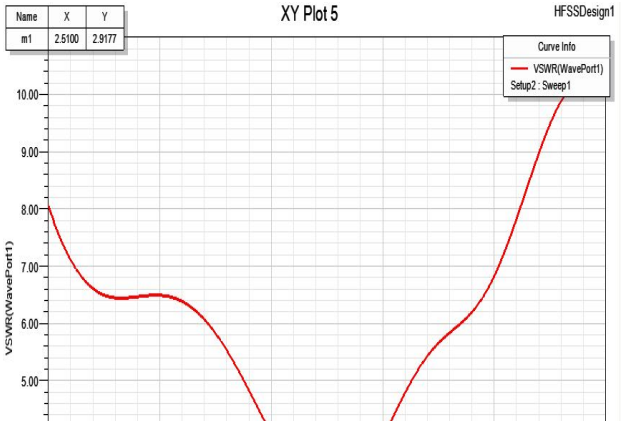
The design of rectangular microstrip patch antenna is simulated by using HFSS version 11. For proper transmission of signal by antenna, the return loss of antenna should be less than -10dB and VSWR Should be less than 2.

1. Simulation result –

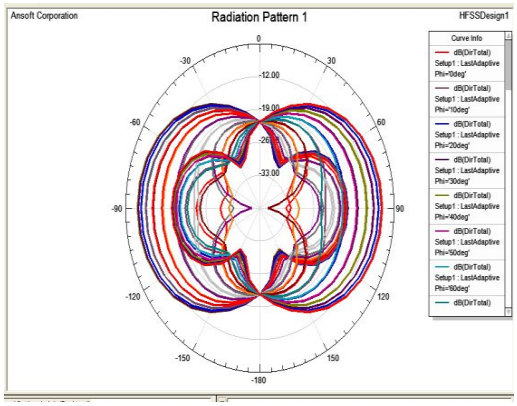
A) Return loss-



B) VSWR -



C) Radiation Pattern –



V. APPLICATION

The main application of rectangular microstrip patch antenna is wireless LAN's. The Microstrip patch antenna used for GPS technology. It is also used in mobile satellite communication system, Wi-Fi applications. In satellite and aircraft communication it is widely used. It also used in Bluetooth communication. Microstrip patch antenna are increasing in popularity for use in wireless application due to their low profile application.

VI. CONCLUSION

A microstrip patch antenna was designed at frequency 2.4GHz.This project is design of Microstrip patch antenna which is based on microstrip feed line technique.

VII. REFERANCES

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