Design of H-Shaped Micro Strip Antenna for Satellite Application with Comparatively Simulation for Different Ground Plane Techniques

[1]Dheeraj Garg, [2]Roma Rewani
[1] Research Scholar [2] Assistant Professor
[1][2] Jaipur National University
[1]allen.dheerajgarg@gmail.com, [2] romarewani@gmail.com

***Abstract*— The object of this Paper is design a micro strip patch antenna for satellite communication .This complete dissertation is software based. The satellite frequency bands which was commonly used for communication are the C-band, Ka-band, and Ku-band. C-band and Ku-band are the commonly used frequency spectrums by today's satellites. The Ku band is the 12GHz to 18 GHz portion of the electromagnetic spectrum in the microwave frequency band. The Ku band offers a user more flexibility. A smaller antenna size and a Ku band system's freedom from terrestrial operations simplify finding a suitable antenna site. For the final users Ku band is generally cheaper and enables smaller antennas (both because of the higher frequency and a more concentrated beam).Ku band is less vulnerable to rain fade than the Ka band frequency spectrum. The proposed antenna have good return loss parameter, VSWR and radiation pattern.**

***Index Terms*—FR4 dielectric material, Return Loss, VSWR, Defected Ground Structure, Partial Ground Structure, HFSS.**

I. INTRODUCTION

Wireless systems are placing a greater role on antenna designs for future development in communication technology because antenna is a key element in the whole communication system. An antenna is a device that is made to efficiently radiate and receive electromagnetic waves. An antenna is an electrical conductor in which transmitter is used to radiate electromagnetic energy into space and receiver is used to collect electromagnetic energy from space. In communication technology, various types of antennas are used such as Wire antenna, Aperture antenna, Array antenna, Reflector antenna and Micro strip antenna.

Wireless technology is one of the main areas of research in the world of communication systems. Earlier systems were narrowband, long range systems but in order to extend the use of available spectrum we are now using Broadband systems. The broadband antenna is a specific component whose transmitting and receiving properties differ from conventional narrowband antenna. The micro strip patch antennas are required because of compact size, light weight, low cost and high efficiency [1]. Due to these well met requirements, micro strip patch antennas are very well suited for Broadband wireless applications such as mobile phones, laptops and personal digital assistants. Micro strip patch antennas are also increasing in popularity for use in wireless applications due to their low profile structure. Therefore they are more compatible for embedded antennas in wireless devices such as cellular phones, pagers etc.

II. DESIGN EQUATIONS

The dimensions of the patch along its length have now been extended on each end by a distance ΔL, which is a function of εreff and W/h (Width-to-Height Ratio). It is given as:

$$\Delta L = 0.412h\frac{\varepsilon_{reff} + 0.3}{\varepsilon_{reff} - 0.258}\left(\frac{W/_h + 0.264}{W/_h + 0.813}\right)$$

The effective length of the patch L_{eff} becomes

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

For a given resonant frequency f_0, the effective length is

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

For a rectangular micro strip patch antenna, the resonance frequency for any TM mn mode is given by James and Hall [2] as:

$$f_0 = \frac{c}{2\sqrt{\varepsilon_{reff}}}\left[\left(\frac{m}{L}\right)^2 + \left(\frac{n}{W}\right)^2\right]^{0.5}$$

Where m and n are modes along L and W respectively

The width W is [3]

$$W = \frac{C}{2f_0}\left(\frac{\varepsilon_r + 1}{2}\right)^{-0.5}$$

Where f_0 = Resonant frequency C =speed of light in free-space

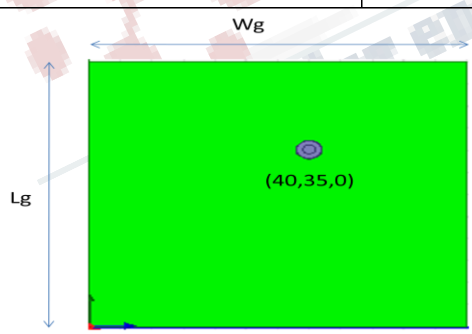
Proposed antenna Design With Dimensions

(a) Antenna Design For Full Ground Plane

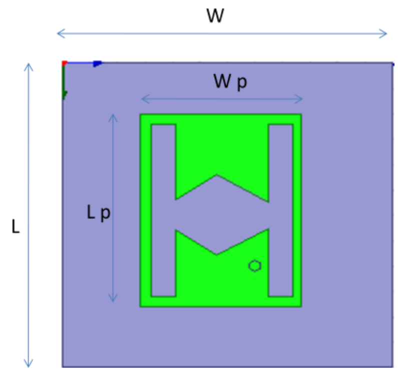
First design the antenna for full ground plane .The complete project is software based . The dimension of antenna is

TABLE 1
DIMENSIONS OF H SHAPED MICRO STRIP PATCH ANTENNA

Parameters	**Dimension (mm)**
Substrate length ,L	60
Substrate width, W	60
Patch length,L_p	38.03628871
Patch width,W_p	29.44314253
Ground plane length, L_g	40
Width of the strip W_g	40



(a) Bottom view



(b) Top view

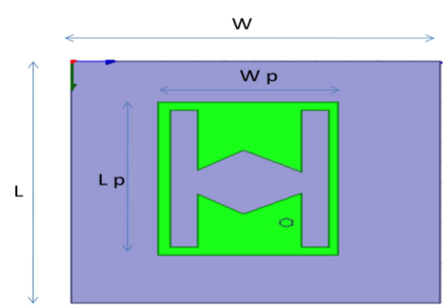
Fig.1 Geometry of Full ground plane micro strip patch antenna

(a) Antenna Design For Full Ground Plane

In this process first design the antenna for partial

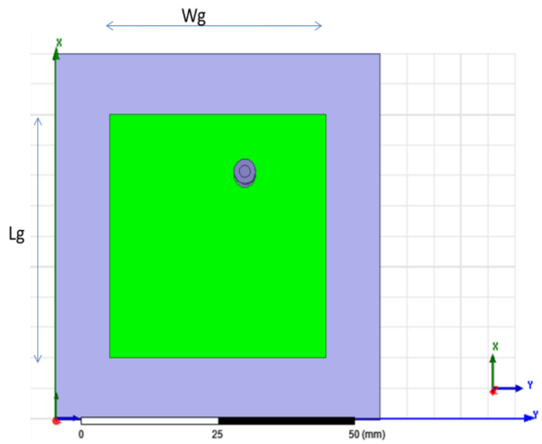
Parameters	**Dimension (mm)**
Substrate length ,L	60
Substrate width, W	60
Patch length,L_p	38.03628871
Patch width,W_p	29.44314253
Ground plane length, L_g	60
Width of the strip W_g	60

ground plane. For this take a box of size 60mmx60mmx1.6mm. FR4 matrial is used as substrtae. Ground size reduces to40mmx40mm. Coaxial feeding is used. 2.4GHZ frequency is used as reference frequency. The antenna parameter is mentioned in table 2. Geometry of micro strip patch antenna for partial ground is presented in fig 2.



(a) Top view
(b) Bottom view

Fig.2. Geometry of partial ground plane micro strip patch antenna



(c) Antenna Design For Defected Ground Plane

Firstly a simple micro strip square patch antenna is designed with low cost FR4 epoxy dielectric substrate with relative permittivity ε_r = 4.4 and thickness h = 1.6 mm as shown in Fig. 3.4. The full ground plane is used at the bottom of the substrate and ground plane size is 40mmx40mm with a rectangular cut at the corner.

Parameter	**Dimension**
Substrate width, Ws	**60mm**
Substrate length, Ls	**60 mm**
Ground width	**40mm**
Ground length	**40mm**
Ground length	**40mm**
Rectangular cut width	**5 mm**
Rectangular cut length	**5 mm**

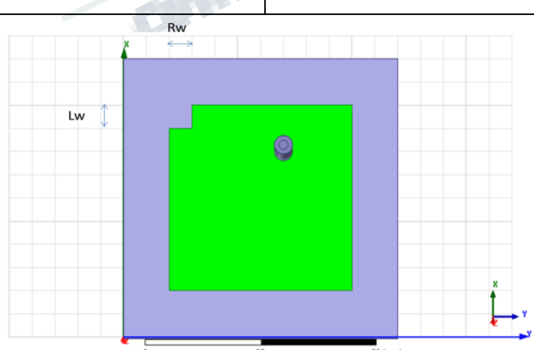


Fig. 3 Geometry of micro strip patch antenna with defected ground plane

Simulation Results

(a) Results for full ground plane antenna

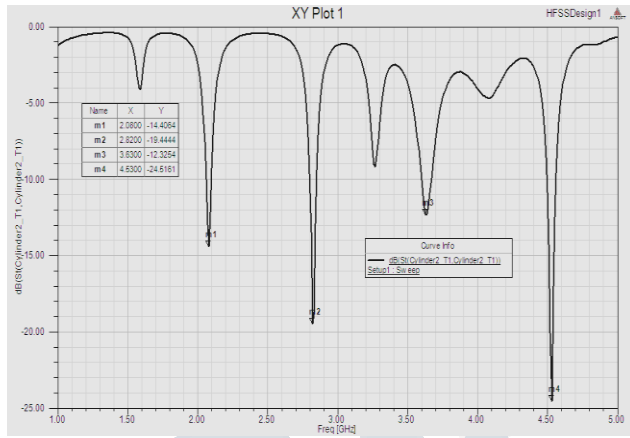


Fig. 4. Return Loss vs. frequency graph of antenna for full ground plane

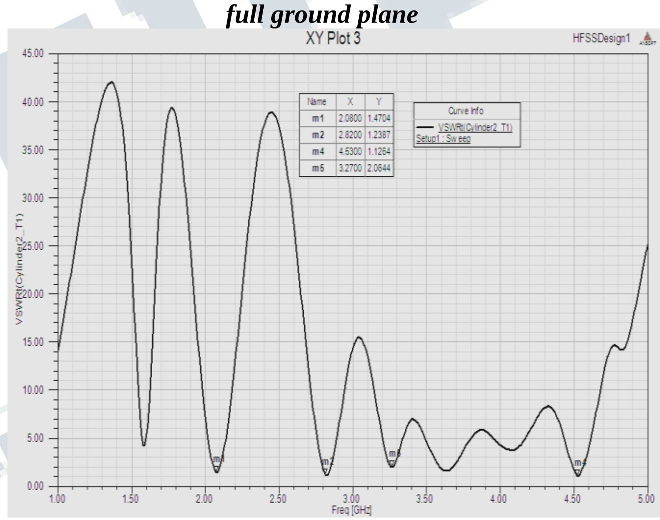


Fig. 5 VSWR vs. frequency graph of antenna for full ground plane

S. No	**Frequency(GHz)**	**Return loss**	**VSWR**
1	**2.08**	**-14dB**	**1.47**
2	**2.82**	**-19.44dB**	**1.23**
3	**3.63**	**-12.32dB**	**2.06**
4	**4.53**	**-24.51dB**	**1.12**

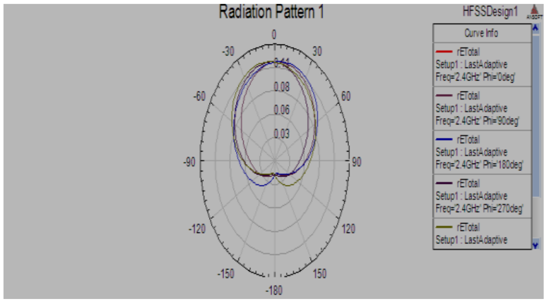


Fig. 6 Radiation Pattern of antenna for full ground plane

(b) Simulation Result for Partial Ground Plane

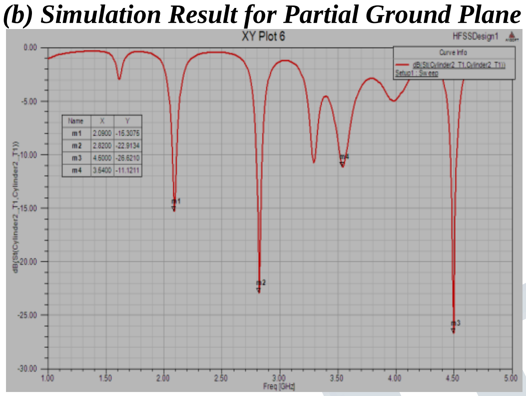


Fig. 7 Return Loss vs. frequency graph of antenna for partial ground plane

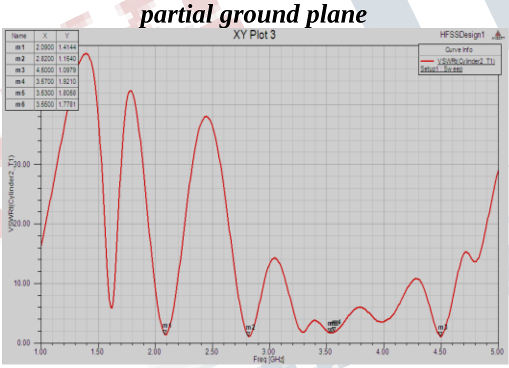
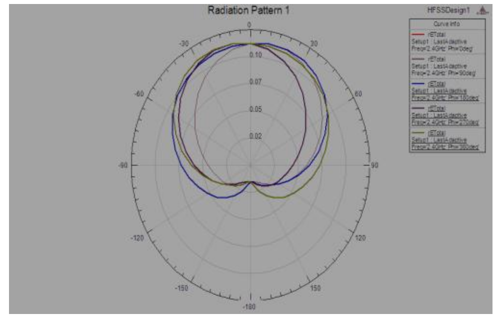


Fig. 8 VSWR vs. frequency graph of antenna for partial ground plane

S . No	Frequency(GHz)	Return loss	VSWR
1	2.09	-15.30dB	1.414
2	2.82	-22.91dB	1.15
3	3.54	-11.12dB	1.7
4	4.54	-26.62dB	1.09



(c) Simulation Result for Defected Ground Plane

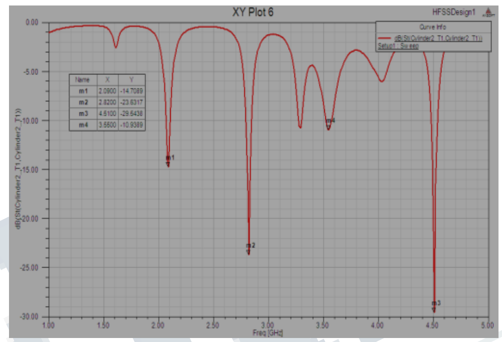


Fig. 9 Return Loss vs. frequency graph of antenna for Defected ground plane

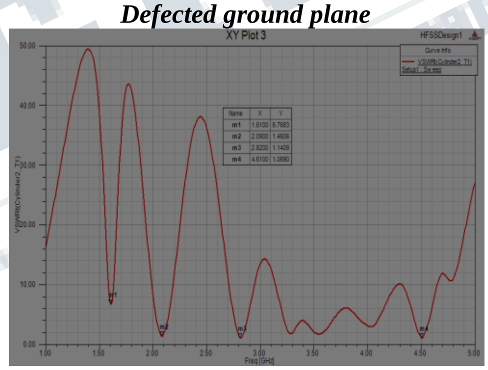


Fig. 10 VSWR vs. frequency graph of antenna for partial ground plane

S. No	Frequency(GHz)	Return loss	VSWR
1	2.09	-14.70dB	1.4
2	2.82	-23.63dB	1.14
3	3.54	-10dB	1.7
4	4.54	-29.54dB	1.06

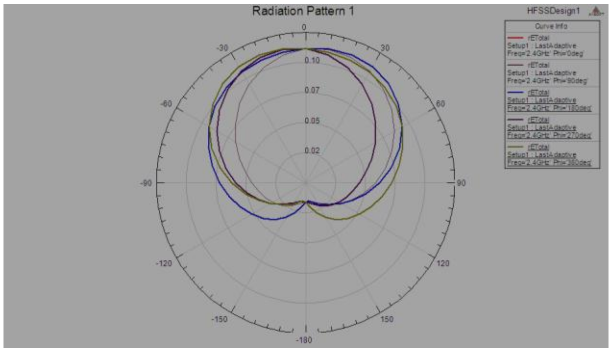


Fig. 11 Radiation Pattern of antenna for Defected ground plane

III. CONCLUSION

This Paper is for design a micro strip patch antenna for satellite application(specially for s and c band.This complete dissertation is software based. The satellite frequency bands which was commonly used for communication are the L, S, C, and Ku-band. The propose antenna is work in s and c band frequencies. The S band is the 2GHz to 4 GHz portion of the electromagnetic spectrum in the microwave frequency band. Similarly C band is the 4GHz to 8GHz portion of the electromagnetic spectrum in the microwave frequency band. The complete dessetation is based on theanalysis of H shaped antenna for three different ground plane structure. The three ground plane structure are full ground plane , partial ground plane and defected ground plane .The proposed antenna have good return loss parameter, VSWR and radiation pattern.

REFERENCES

[1] Anil kumar Agrawal, Shyam Sundar Pattnaik, S .Devi & J G Joshi "Broadband and high gain micro strip patch antenna for WLAN", Indian Journal of Radio & space Physics, vol. 40, October 2011,pp 282 - 286.

[2] Kumar, G., and K. C. Gupta, ''Nonradiating Edges and Four Edges Gap-Coupled Multiple Resonator, Broadband Micro strip Antennas,'' IEEE Trans. Antennas Propagation,Vol. AP-33, , pp. 173–178, February 1985.

[3] Kumar, G., and K. C. Gupta, ''Directly Coupled Multiple Resonator Wideband Micro strip Antennas,'' IEEE Trans. Antennas Propagation, Vol. AP-33, pp. 588–593, June 1985.