Analysis of Microstrip Antennas

Poojitha. S. Nayak
UG Student
Dept.ECE, VVCE, Mysuru

Prathima. U. S
UG Student
Dept.ECE, VVCE, Mysuru

Vivek. V
UG Student
Dept.ECE, VVCE, Mysuru

***Abstract*:- Wireless technology is one of the main areas of research in the world of communication systems today and a study of communication systems is incomplete without an understanding of the operation and fabrication of antennas.This was the main reason for our selecting a project focusing on this field.The goal of this project is to analyse the Microstrip Patch Antenna which covers the GSM Band 0.8 to 1.9 GHz. This project covers study of basics and fundamentals of microstrip patch antenna. A series of parametric study were done to find that how the characteristics of the antenna depends on its various geometrical and other parameters. The various geometrical parameters of the antenna are the dimensions of the patch and ground planes and the separation between them and it also includes the dielectric constant of the substrate material.The parametric study also contains the study of different techniques for optimizing the different parameters of antenna to get the optimum results and performance. This is a simulation based study. The simulation of the antenna is carried out using Antenna magus simulation software and verified through matlab code. The simulation results of antennas indicate that the proposed antenna fulfils the excellent band characteristics for various frequency bands and showing the good return loss and radiation patters in the interested GSM band.**

Keywords:- Microstrip; Patch; Antenna; gain; return; loss; bandwidth.

1. INTRODUCTION

Patch antennas play a very significant role in today's world of wireless communication systems. A Microstrip patch antenna (Fig 1) is very simple in the construction using a conventional Microstrip fabrication technique. The most commonly used Microstrip patch.These patch antennas are used as simple and for the widest and most demanding applications. Dual characteristics, circular polarizations, dual frequency operation, frequency agility, broad band width, feed line flexibility, beam scanning can be easilyobtained from these patch antennas .here we are doing the design of a microstrip patch antenna and we have to compare the differences between rectangular and circular patch antenna using matlab simulation software.

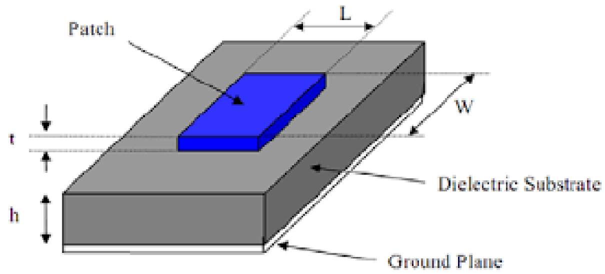


Figure1.1 a microstrip patch antenna

2. THEORY OF MICROSTRIP ANTENNA

The basic categories of these Microstrip antennas can be classified in to four which are:
- Microstrip patch antennas
- Microstrip dipoles
- Printed slot antennas
- Microstrip travelling wave antennas.

A Microstrip patch antenna is a thin square patch on one side of a dielectric substrate and the other side having a plane to the ground. The patch in the antenna is made of a conducting material Cu (Copper) or Au (Gold) and this can be in any shape rectangular, circular, triangular, elliptical or some other common shape.

3.ANTENNAS UNDER CONSIDERATION

- Circular patch antenna
- Archimedean spiral patch antenna

3.1Circular Patch Antenna

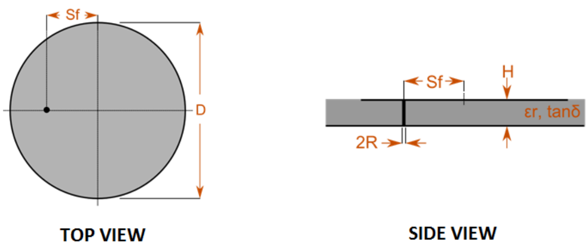


Figure 3.1.1 circular patch antenna

3.1.1 Design Parameters

NAME	DESCRIPTION	VALUE
D	Patch diameter	88.45mm
Sf	Feed offset	9.895mm
R	Feed pin radius	588.8mm
H	Substrate height	4.711mm
Ɛr	Relative permivitty	2

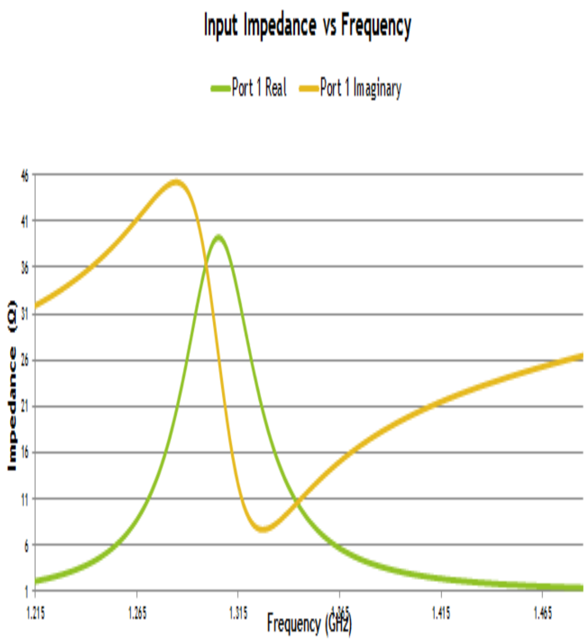
3.1.2 Input impedance

The input impedance of an antenna is defined as the impedance presentedby an antenna at its terminals or the ratio of the voltage to the current at thepair of terminals or the ratio of the appropriate components of the electricto magnetic fields at a point. Hence the impedance of the antenna can be
written as given below:

Zin = Rin + jXin (1.1)

where Zin is the antenna impedance at the terminals, Rin is the antennaresistance at the terminals,Xin is the antenna reactance at the terminalsThe imaginary part, Xin of the input impedance represents the powerstored in the near field of the antenna. The resistive part, Rin of the inputimpedance consists of two components, the radiation resistance Rr and theloss resistance RL. The power associated with the radiation resistance is thepower actually radiated by the antenna, while the power dissipated in the lossresistance is lost as heat in the antenna itself due to dielectric or conducting
losses.

The input impedance vs frequency characteristics is as shown below:



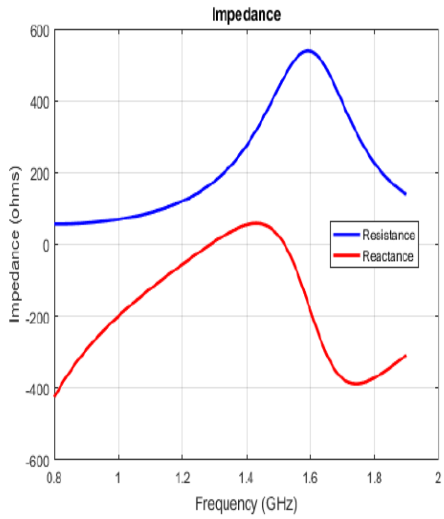
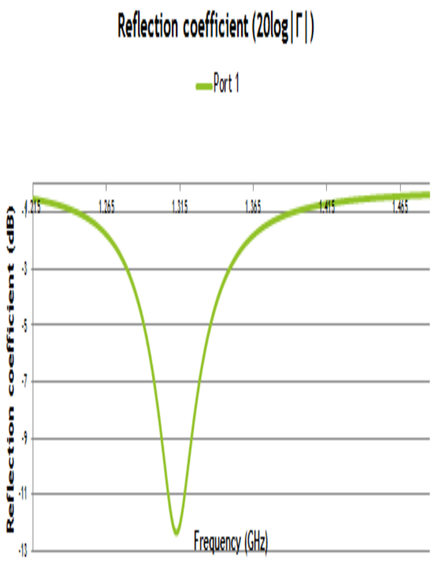


Fig 3.1.1 input impedance of circular patch antenna

3.1.3 Reflection Coefficient

The reflection coefficient is the ratio of the complex amplitude of the reflected wave to that of the incident wave. In particular, at a discontinuity in a transmission line, it is the complex ratio of the electric field strength of the reflected wave (E^+) to that of the incident wave (E^-). This is typically represented with a (capital gamma) and can be written as:

$$\Gamma = \frac{E^-}{E^+}$$



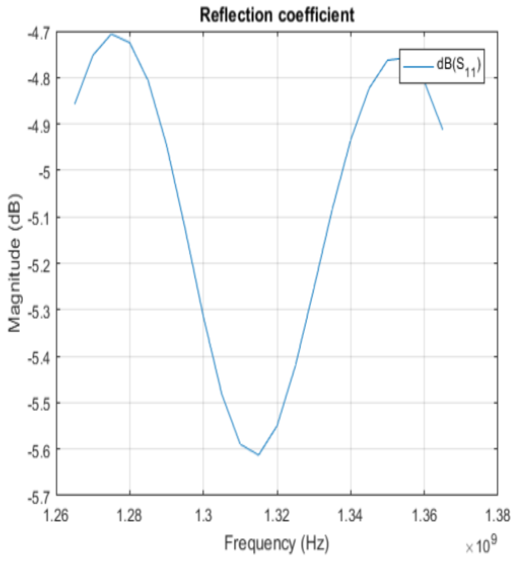


Fig 3.1.1 reflection coefficient of circular patch antenna

3.2 Archimedean Spiral Antenna

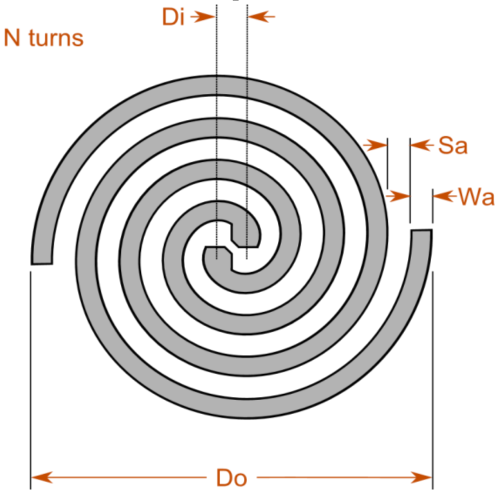


Figure 3.2.1 Archimedean spiral antenna

Spiral antennas belong to the class of ”frequency independent” antennas;these antennas are characterized as having a very large bandwidth. The fractionalBandwidth can be as high as 30:1. This means that if the lower frequencyis 1 GHz, the antenna would still be efficient at 30 GHz, and everyfrequency in between.Spiral antennas are usually circularly polarized. The spiral antenna'sradiation pattern typically has a peak radiation direction perpendicular tothe plane of the spiral (broadside radiation). The Half-Power Beamwidth(HPBW) is approximately 70-90 degrees.

Spiral antennas are widely used in the defense industry for sensing applications,where very wideband antennas that do not take up much spaceare needed. Spiral antenna arrays are used in military aircraft in the 1-18GHz range.Other applications of spiral antennas include GPS, where it is advantageous to have RHCP (right hand circularly polarized) antenn

3.2.1 Design parameters

NAME	DESCRIPTION	VALUE
Di	Inner diameter	14.35mm
Do	Outer diameter	268.4mm
N	Number of turns	3.5
h	Handedness	Left handed

3.2.2 Input impedance

Input impedance vs frequency curve for archimedes spiral antenna is asshownWe observe that the average impedance value is 200.2 ohms throughout the GSM band.

Reflection coefficient vs frequency curve is as obtained as below.

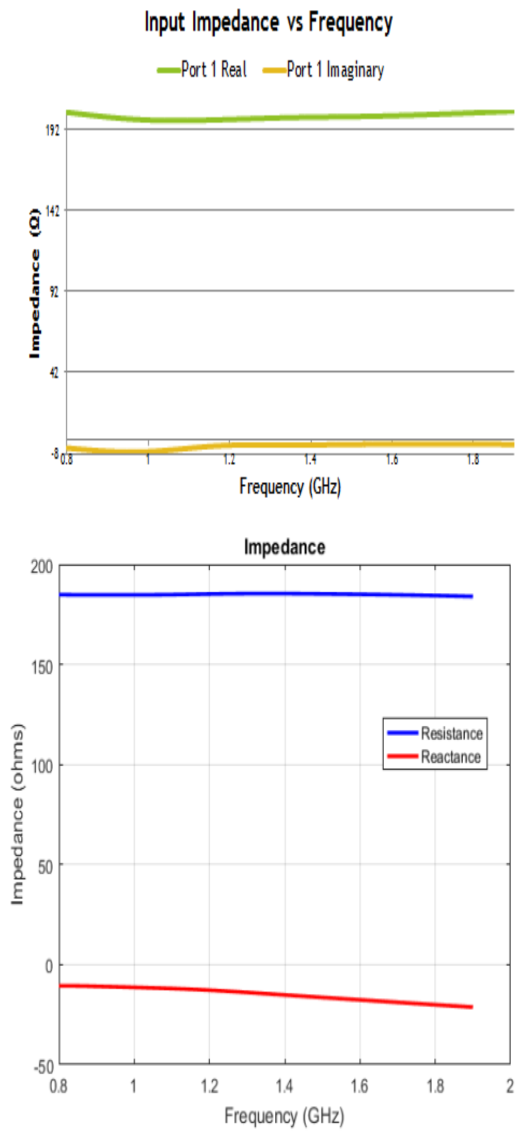
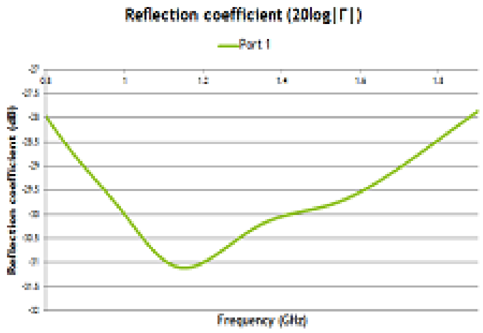


Fig 3.2.1 input impedance of Archimedean spiral antenna

3.2.3 Reflection Coefficient

Reflection coefficient vs frequency curve is as obtained as below



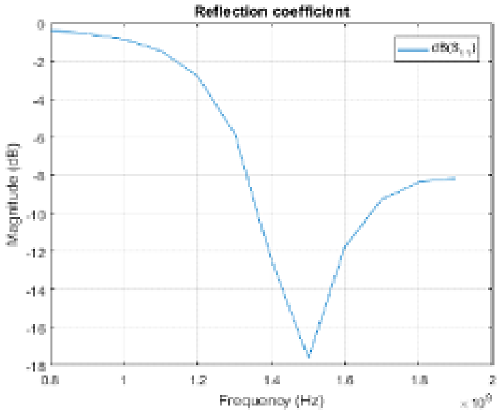


Fig 3.2.2 reflection coefficient of Archimedean spiral antenna

4.CONCLUSION

Types of antenna	**Input Impedance**	**Reflection coefficient**	**Gain**
Circular patch antenna	11.02Ω	-13.49db	8dbi
Archimedean spiral antenna	200.2Ω	-31.11db	6dbi

5.ACKNOWLEDGMENT

We express our sincere thanks to our guides Dr. T.P. Surekha, Professor,Dept of ECE, VVCE, and Prof. Sharath Kumar A J, Assistant Professor,Dept of ECE, VVCE, for their constant co-operation, support, and invaluable suggestions.

6.REFERENCES

1. Arnab.De, C.K.Chosh, A.K.Bhattcherjee, "Design and performance analysis of micro strippatch array antennas with different configurations",International journal of future generation and networking,Vol.9,No.3(2016),pp.97-110.
2. R.Garg, P.Bhartia, I.Bahl and A.Ittipiboon, "Micro strip Antenna Design Handbook", Artech House, (2000).
3. D.M. Pozar and D.H. Schaubert, "Microstrip Antennas: The Analysis and Design of Microstrip Antennas and Arrays", IEEE Press, (1995).
4. H. Pues and A Van de Capelle, "Accurate transmission-line model for the rectangular microstrip antenna", Proceeding IEEE, vol. 131, pt. H, no. 6, Dec. (1984), pp. 334-340.
5. W.F. Richards, Y.T. Lo, and D.D. Harrison, "An improved theory ofmicrostrip antennas", IEEE Transaction Antennas and Propagation, vol. AP-29, (1981), pp, 38-46