*International Journal of Latest Research in Engineering and Management" (IJLREM)*
*ISSN: 2456-0766*
*www.ijlrem.org Volume 2 Issue 3 ǁ March. 2018 ǁ PP 01-06*

# Design and Analysis Of Π Shape Microstrip Patch Antenna

[1,] Er. Nitin Agarwal, [2,]Beenu Kushwah[2], Km Kanchan[3], Mohit Sharma[4]
[1,2,3,4,] *(P.G. Department of ECE, RBS Engineering Technical Campus, Bichpuri Agra)*
[1,]agarwal_nitin88@rediffmail.com , [2,] beenukushwah14@gmail.com
[3,]kanchankumari.comss1996@gmail.com , [4,]mohitsha421@gmail.com

***ABSTRACT**: In this paper a π shape microstrip patch antenna is studied and analyzed. Here IE3D software is used for simulation and getting results for VSWR, Return losses, gain, and many other parameters for operating frequency of 5GHz. The return loss comes out to be -35dB for this designed antenna. Coaxial probe feeding technique is used to feed the designed antenna as it is easier to implement. IE3D simulation software V.14 was chosen to simulate the structures*

***KEYWORDS:** Coaxial probe feeding, π shape patch antenna.*

## I. INTRODUCTION

A communication system is usually required when the information is to be conveyed over a distance. Wireless communication is much more flexible way of communication and antenna is the most important part of it. In today's modern communication industry, antennas are the most important components required to create a communication link. . In resent year, the current trend in commercial and government communication system has been to develop low cost, minimal weight, low profile antennas that are capable of maintaining high performance over a large spectrum of frequencies. This technological trend has focused much effort in to the design of microstrip (Patch) antennas A Microstrip Antenna consists of a radiating patch on one side of a dielectric substrate and a ground plane on the other side. Radiation from the MSA can occur from the fringing fields between the periphery of the patch and the ground plane. A feeding technique is used in antenna to supply radio waves into the antenna structure. With a simple geometry, patch antenna offers many advantages not commonly exhibited in other antenna configurations

**MICROSTRIP PATCH ANTENNA:** 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. 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. Microstrip Patch Antennas (MPA) are extremely attractive candidates for use in many applications due to their interesting features such as low cost, light weight, thin profile and conformability. On the other side, the greatest disadvantage of MPA is its low bandwidth which can be as low as 1%. A Microstrip antenna consist of four parts like a very thin flat metallic region often called patch, a dielectric substrate, a ground plane and feed which supplies the element RF power. Rectangular and circular micro strip resonant patches have been used extensively in a variety of array configurations. Microstrip patch antennas radiate primarily because of the fringing fields between the patch edge and the ground plane.

## II. ANALYSIS OF MICROSTRIP PATCH ANTENNA

**Resonance Frequency:** The resonance frequency depends on the patch size, cavity dimensions, and the filling material dielectric constant. It is expressed as follows;

$$f_{mn} = \frac{K_{mn} c}{2\pi\sqrt{\varepsilon_r}}$$

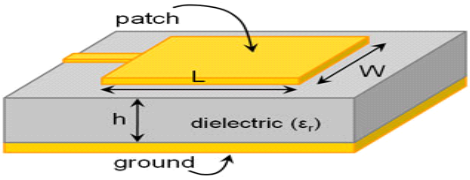


**Figure 1. Structure of a Microstrip Patch Antenna**

Where m, n = 0, 1, 2… $K_{Mn}$ = wave number at m, n mode, c is the velocity of light, is the dielectric constant of the substrate, and

$$K_{mn} = \sqrt{\left(\frac{m\pi}{W}\right)^2 + \left(\frac{n\pi}{L}\right)^2}$$

Length and width of non-radiating rectangular patch's edge at a certain resonance frequency and dielectric constant are given by:

$$L = \frac{c}{2f_r\sqrt{\varepsilon_r}}$$

and

$$W = \frac{c}{f_r}\sqrt{\frac{2}{\varepsilon_r+1}}$$

Where $f_r$ is the resonance frequency at which the rectangular microstrip antenna is to be designed. The radiating edge W, patch width is usually kept such that it lies within the range L<W>2L for efficient radiation.

The ratio W/L= 1.5 gives good performance according to the side lobe appearances.

By using the above equations, we can find the values of actual length of the patch as:

$$L = \frac{c}{2f_r\sqrt{\varepsilon_{eff}}} - 2\Delta l$$

where $e_{eff}$ is the effective dielectric constant and Δl is the line extension which is given as

$$\varepsilon_{eff} = \left(\frac{\varepsilon_r+1}{2}\right) + \left(\frac{\varepsilon_r+1}{2}\right) \cdot \frac{1}{\sqrt{1+12\frac{h}{W}}}$$

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

## 3 .DESIGN PARAMETERS

π shape Microstrip patch Antenna resonating at frequency 5GHZ have been simulated on Zealand Ie3d Ver.14.0 software. The design specifications for patch antenna are:

1. Substrate permittivity (εr) = 4.2
2. Substrate thickness (h) = 1.6 mm.
3. Loss Tangent = 0.0005
4. Length of patch (L) = 14.08mm.
5. Width of patch (W) = 18.08mm.
6. Feed point location= (4, 9).

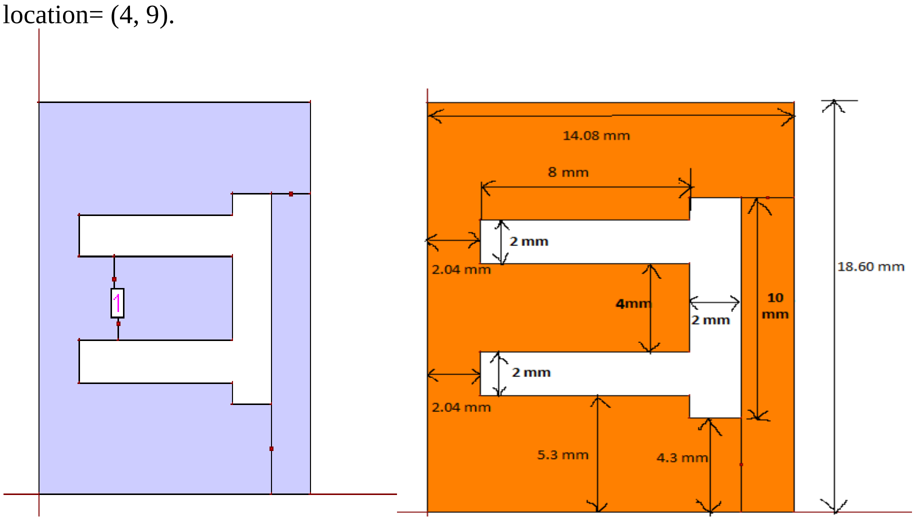


**Figure 2 Pie shape microstrip patch antenna with feed point at resonating freq. 5GHz**

## III. SIMULATED RESULTS

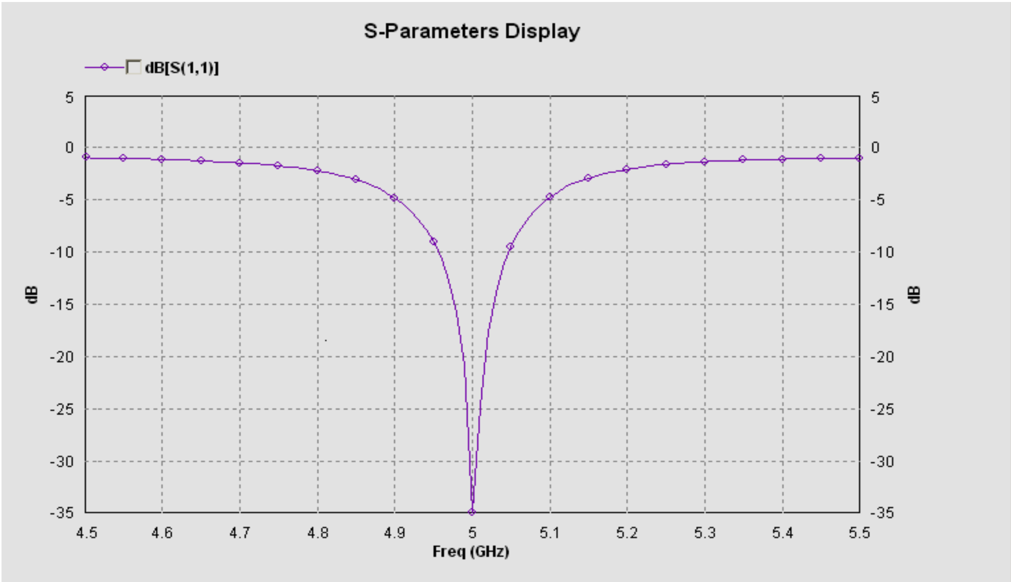


**Figure 3. Return Losses Vs Frequency plot for S parameter**

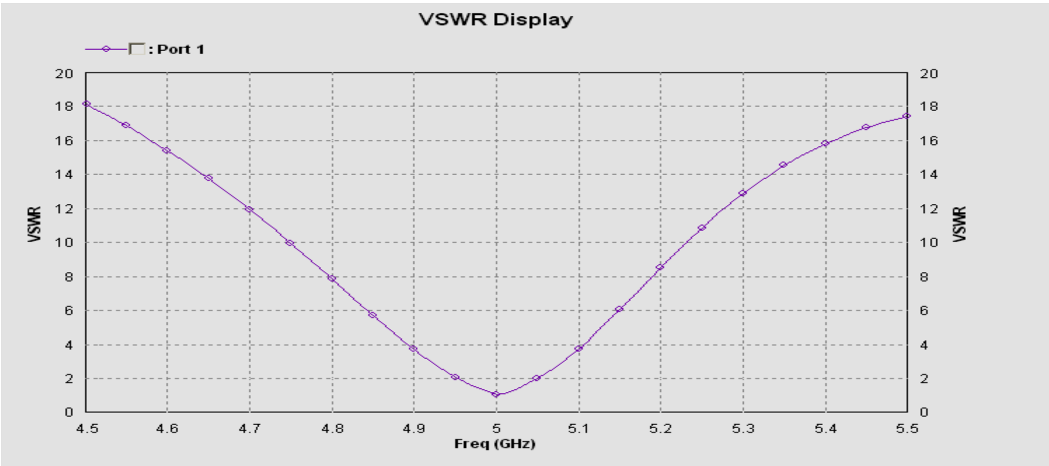


**Figure 4. VSWR graph**

From these graphs we found the two-frequency point where VSWR ≤ 2 and bandwidth is 170 MHz on operating frequency 5GHz ranges from 4.5 GHz to 5.5 GHz. The maximum return loss at the resonant frequency is -35dB.

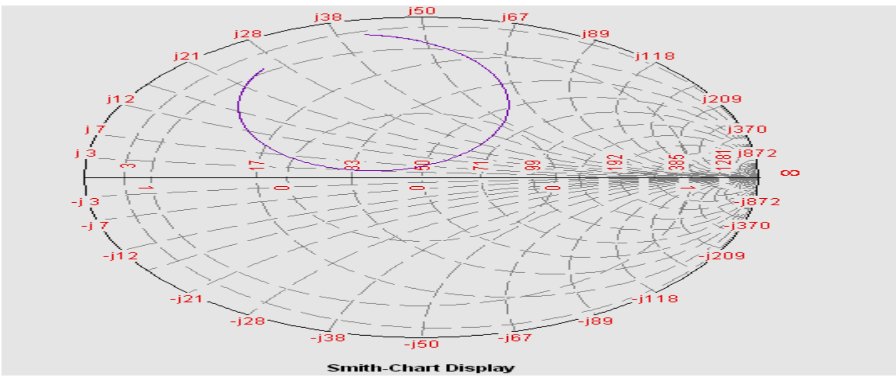


**Figure 5. Smith chart**

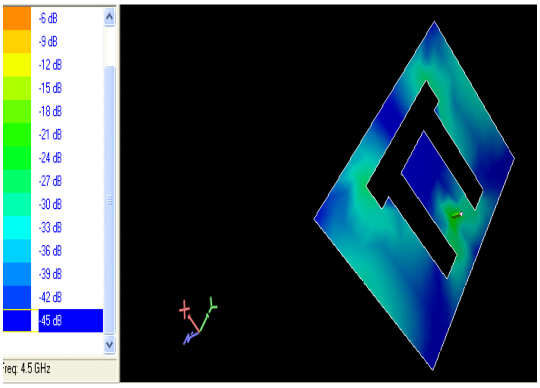


**Figure 6. Current distribution**

## IV. DESIGN OF ANTENNA HARDWARE USING PCB AND ITS TESTING

**5.1 π SHAPE ANTENNA :** The base of π shaped antenna structure designed is a simple rectangular microstrip patch antenna. The antenna structure is designed by cutting three rectangular slots in the rectangular microstrip patch antenna. The designed antenna structure along with its dimensions is shown in fig 8. The design parameters are same as in case rectangular microstrip patch antenna.

**Figure 7. π shape slotted Microstrip patch Antenna.**

## V. TESTED RESULTS:

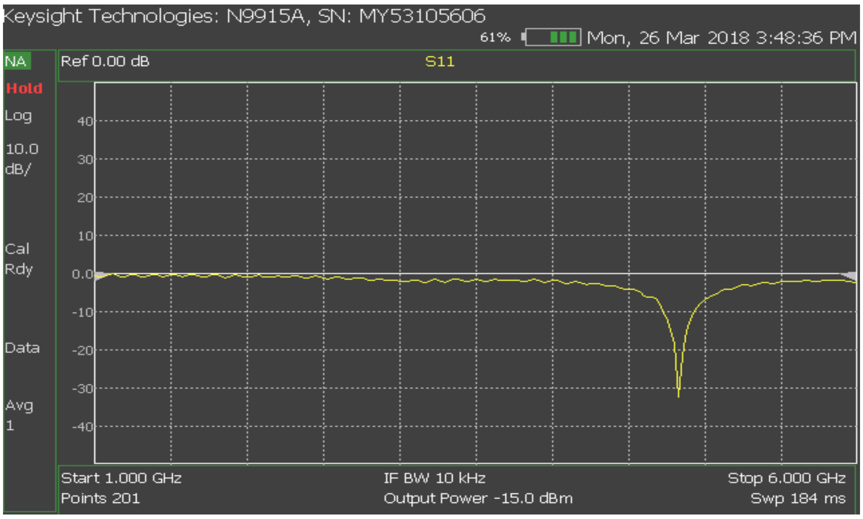


**Figure 8. S parameter Display**

In figure 8, 9 the bandwidth is 200MHz from operating frequency 4.8GHz ranges from 4.925GHz to 4.725GHz. The resonance frequency of that region is 4.8GHz where maximum return loss -32dB.

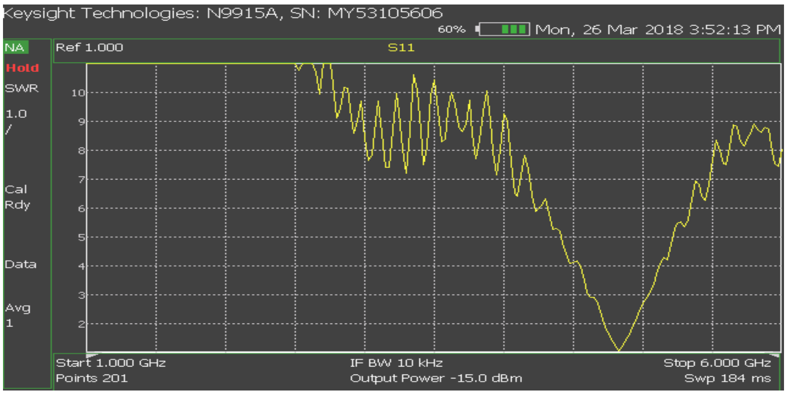


**Figure9. VSWR Display of S shape slotted antenna.**

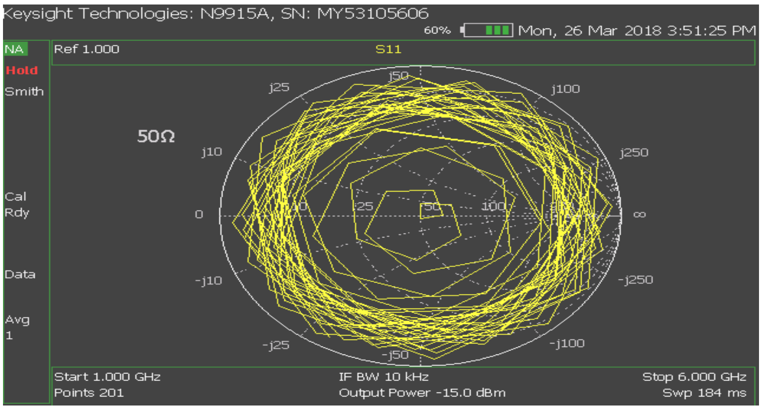


**Figure 10. Smith chart**

## VI. RESULT DISCUSSION

| | Simulated value | Tested value |
|---|---|---|
| Resonating frequency | 5 GHZ | 4.8 GHZ |
| Return loss | -35 dB | -32 dB |
| Z parameter | 49.72 Ohm | - |
| Starting frequency | 4.91GHZ | 4.725 GHZ |
| End frequency | 5.08 GHZ | 4.925 GHZ |
| Bandwidth | 170 MHZ | 200MHZ |

**Table1. Shows result comparison between simulated value and tested value**

Result comparison between simulated and tested values has done in the above table where there is slightly difference between both the values. This antenna exhibits the Return Loss of -35 dB during simulation whereas -32 dB while testing.

## VII. CONCLUSION

This paper demonstrates the π shape microstrip patch antenna for 5GHz frequency using IE3D software. There are still many problems and complications in antennas like distortion of radiation patterns, reduction of gain, complexity of structure etc. Hence, more distant research is earnestly needed in this area of research work.

## REFERENCES

[1] Patil V. P., "Enhancement of bandwidth of rectangular patch antenna using two square slots techniques" International Journal of Engineering Sciences & Emerging Technologies, ISSN: 2231 – 6604, Volume 3, Issue 2, pp: 1-12, Oct. 2012.

[2] R.Garg, P.Bhartia, I.Bahl, A.Itipiboon, "Microstrip antenna design handbook", Artech House, Boston – London, 2000.

[3] P. Pigin,‘’Emerging mobile WiMax antenna technologies", IET communication engineer, October/November 2006.
[4] C.A.Balanis,’’Antenna Theory Analysis and Design,’’ third edition, Wiley, New Jersey, 2005.
[5] Ashwini K. Arya, M.V.Kartikeyan, A.Patnaik ‘’Defected Ground Structure in the perpective of microstrip antenna : A Review’’ frequenz, Vol.64,pp.79-84,2010.m
[6] Kidre A, 2014- Widwe band dual beam U- slot Microstrip antenna’’, IEEE transaction of Antenna And Wireless propagation Letters, Vol.61 pp 1415-19.
[7] John .Volkakis , Antenna Engineering Handbook . The ohio state university 2007
[8] A.A.Abdelaziz. Bandwidth enhancement of microstrip antenna. Progress In Electromagnetics Research, 2006 PIER 63, 311–317.
[9] Er Nitin Agarwal, Dr.D.C.Dhubkarya, Er Rinkesh Mittal “Designing & Testing of Rectangular Micro strip antenna operating at 2.0 GHz using IE3D” Volume 11 Issue 1 Version 1.0 February 2011.
[10] Renuka Baban Singh, Er.Nitin Agarwal” Design And Analysis Of Circlehead Shape Microstrip Patch Antenna” Volume: 02 Issue: 02 | May-2015.
[11] Er.Nitin Agarwa,Dr.D.C.Dhubkarya,Dr. Sanjay Garg Pattern Analysis of Rectangular Microstrip Antenna for 3G Frequency. Vol. 1 Issue 4 Dec 2012
[12] Er. Nitin Agarwal, Lalit Mohan Sharma, Robin Singhal, Karan Kumar, “Design Of Broadband S Shape Microstrip patch Antenna Using Slotting Technique”, Progress In Science and Engineering Research Journal ISSN 2347-6680 (E).
[13] Er. Nitin Agarwal, Karnika Sharma, Kirti Rana, “Twin Slot Square Shaped Microstrip Patch Antenna”, International Journal of Current Trends in Engineering & Research (IJCTER) Volume 2 Issue 4, April 2016 pp. 431 – 438.