*International Journal on Emerging Technologies* (Special Issue NCETST-2017) **8**(1): 205-208(2017)
*(Published by Research Trend, Website:* www.researchtrend.net*)*

**ISSN No. (Print) : 0975-8364**
**ISSN No. (Online) : 2249-3255**

# Single Layer Microstrip Antenna with S shape patch

***Upendra Kumar Singh*[1] *and Monika Nanda*[2]**
*1Assistant Professor, Amrapali Institute of Technology & Sciences,*
*Shiksa Nagar, Lamachaur, Haldwani, Nainital, (U.K.), India*
[2]*Assistant Professor, Birla Institute of Applied Sciences, Bhimtal, Nainital, (U.K.), India*

**ABSTRACT: Now a days microstrip patch antenna is one of the most preferably used antenna because of its small structure size and ease of manufacturing. A single layer microstrip antenna with S shape patch is designed and thoroughly simulated on HFSS software in this paper. The designed antenna is worked at Resonant frequency of 1.58GHz, which lies in L band and that can be used in GPS antenna and various other Communication related applications. It is shown that the simulated results are in acceptable agreement.**

**Keywords:** Compact, high frequency structural simulator (HFSS), Patch, Global Positioning System (GPS), Resonant frequency.

## I. INTRODUCTION

In recent years, demand for small antennas on wireless communication has increased the interest of research work on compact microstrip antenna design among microwave and wireless engineers [1-6]. Because of their simplicity and compatibility with printed-circuit technology microstrip antennas are widely used in the microwave frequency spectrum. Simply a microstrip antenna is a rectangular or other shape, patch of metal on top of a grounded dielectric substrate. Microstrip patch antennas are attractive in antenna applications for many reasons. They are easy and cheap to manufacture, lightweight, and planar to list just a few advantages. Also they can be manufactured either as a stand-alone element or as part of an array[11-12]. However, these advantages are offset by low efficiency and limited bandwidth. In recent years much research and testing has been done to increase both the bandwidth and radiation efficiency of microstrip antennas [7-8]. Due to the recent interest in broadband antennas a microstrip patch antenna was developed to meet the need for a cheap, low profile, broadband antenna.

This antenna could be used in a wide range of applications such as in the communications industry for cell phones or satellite communication. Our aim is to reduce the size of the antenna as well as increase the operating bandwidth. The proposed antenna (substrate with $\varepsilon r$ = 4.4) has a gain of 6.24 dBi. The simulation has been carried out by HFSS software. Due to the small size, low cost and low weight this antenna is a good entrant for the application of L-Band microwave communication and RADAR communication & satellite communication.

The L band defined by an IEEE standard for radio waves and radar engineering with frequencies that ranges from 1.0 to 2.0 GHz [10]. The L band is used for short range tracking, missile guidance, marine, radar and air bone intercept. Especially it is used for radar communication and GPS. The GPS (Global Positioning System) has revolutionized modern day navigation and position location. GPS is now the most common means of tracking and location mapping in most of the ships, aircraft carriers and even in automobiles. With advancement in technology and science, GPS applications are even used by common public for the knowledge of updating location, tracking purposes and even travelling from one place to another. Most of the GPS Antennas require circular polarization and this is achieved by microstrip antennas which satisfy criteria like low cost (economically feasible), ease of fabrication, miniaturization along with high precision and reliability.

## II. FEEDING TECHNIQUE

Microstrip patch antennas can be served by a different feeding methods [8]. These methods can be divided into two parts- contacting and non-contacting. In the contacting method, the radio power is fed directly to the radiating patch by using a connecting element such as a microstrip line. In the non-contacting scheme, electromagnetic field link is completed by transferring radio power between the microstrip line and the radiating patch.

The most four most popular feeding techniques used are microstrip line feeding and coaxial probe feeding, examples of contacting schemes feeding, aperture coupling and proximity coupling, examples of non-contacting schemes feeding. These techniques have several advantages and disadvantages. These are used according to their applications. In this paper we use the microstrip line feeding technique for proposed antenna.

*A. Microstrip Line Feeding*

This type of feeding technique has a conducting strip that is associated directly to the edge of the Microstrip patch.

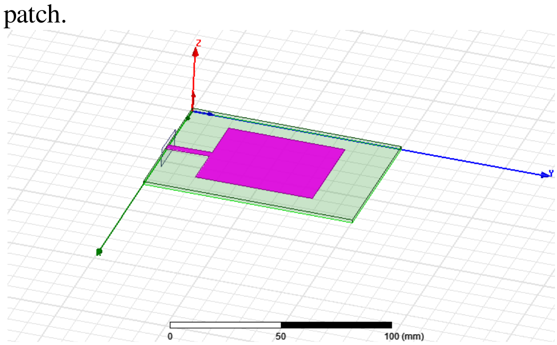



**Fig. 1.** Side view of line feeding.

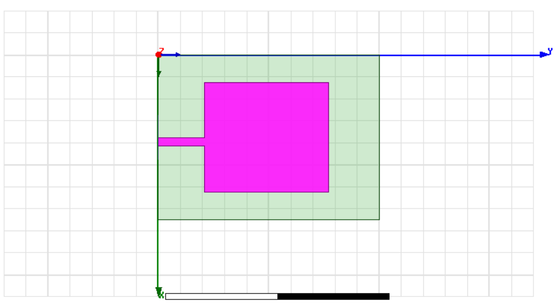



**Fig. 2.** Top view of line feeding.

The width of conducting strip is smaller as compared to the patch. This category of feeding arrangement has the advantage that this type of feeding can be removed on the same substrate to transport a planar structure.This method has many advantages due to its simple planar structure. Though as the thickness of the dielectric substrate being used, increases, surface waves and spurious feed radiation also increases, which offers the bandwidth 1.5-5% of the antenna. This feed radiation also leads to undesired cross polarized radiation. The side view and top view is shown in fig.1 and fig.2.

## III. ANTENNA DESIGN

The configuration of the designed antenna is shown in Figure 1 where a rectangular patch of dimensions L=56 mm, W=50 mm, lies above the substrate (FR4 Epoxy) thickness h = 1.6 mm, dielectric constant εr = 4.4.

The feeding of the antenna is done by line feeding method. Assuming practical patch width W= 50 mm for efficient radiation and using the equation [9],

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

Where, c = velocity of light in free space. Using the following equation [9] we determined the practical length L (=6mm).

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

$$\text{Where, } \frac{\Delta L}{h} = \left[0.412 \times \frac{(\varepsilon_{reff}+0.3)\times(W/h+0.264)}{(\varepsilon_{reff}-0.258)\times(W/h+0.8)}\right]$$

$$\varepsilon_{reff} = \left|\left(\frac{\varepsilon_r+1}{2}\right) + \frac{\varepsilon_r - 1}{\left(2\times\sqrt{\left(1+12\times\frac{h}{W}\right)}\right)}\right|$$

$$\text{and} \quad L_{eff} = \left[\frac{c}{2\times f_r \times \sqrt{\varepsilon_{eff}}}\right]$$

Where, Leff = Effective length of the patch, ΔL/h =Normalized extension of the patch length, εreff = Effective dielectric constant. The given table shows the different parameters of designed antenna.

| Sr.No. | AntennaParameter | Value |
|---|---|---|
| 1 | Length of patch (Lp) | 56 mm |
| 2 | Width of Patch (Wp) | 50mm |
| 3 | Dielectric Constant of Substrate($\varepsilon_r$) | 4.4 |
| 4 | Thickness of Substrate | 1.6mm |
| 5 | Substrate Length | 100mm |
| 6 | Substrate Width | 75mm |
| 7 | Dimensions of slit on patch | 10mm*40mm |

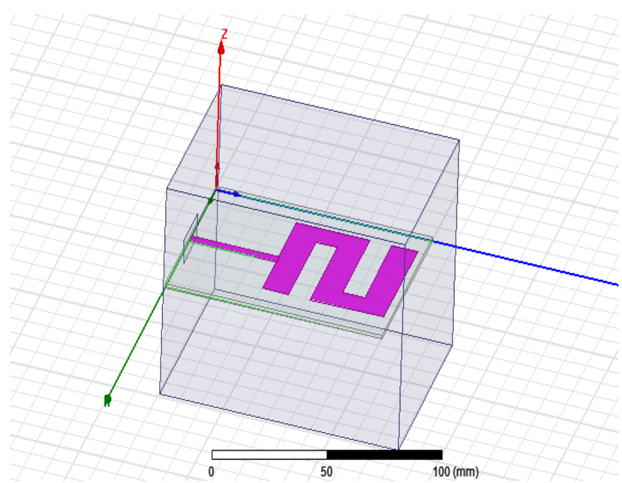



**Fig. 3.** Proposed Antenna configuration.

## IV. RESULTS AND DISCUSSION

The designed antenna is Simulated thoroughly (using HFSS [13]).The results for the simulated antenna structure are shown in Figure 4 to Figure 10.

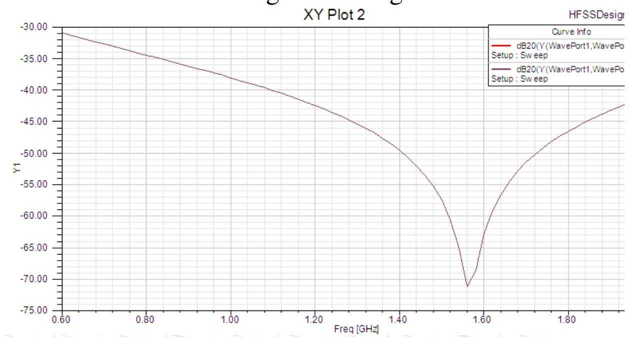



**Fig. 4.** Return Loss vs. Frequency plot.

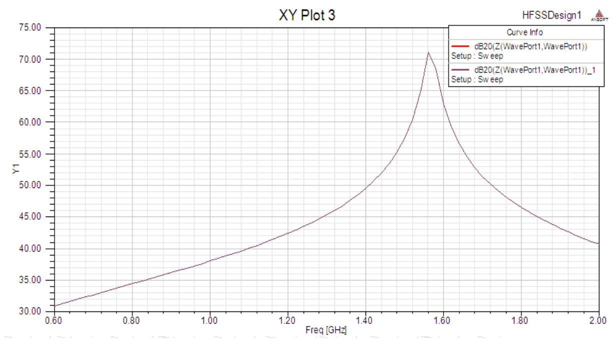



**Fig. 5.** VSWR Vs Frequency plot.

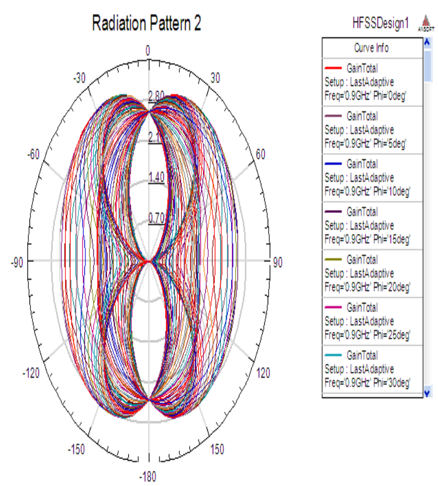



**Fig. 6.** Polarization ratio for the antenna at f=10.24 GHz.

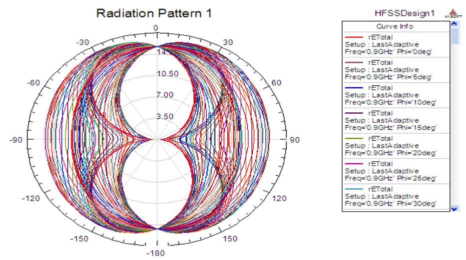



**Fig. 7.** Total Directivity for the antenna at f=10.24 GHz.

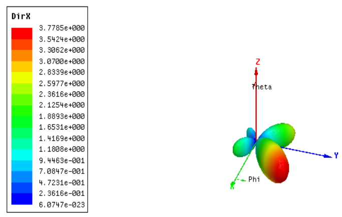
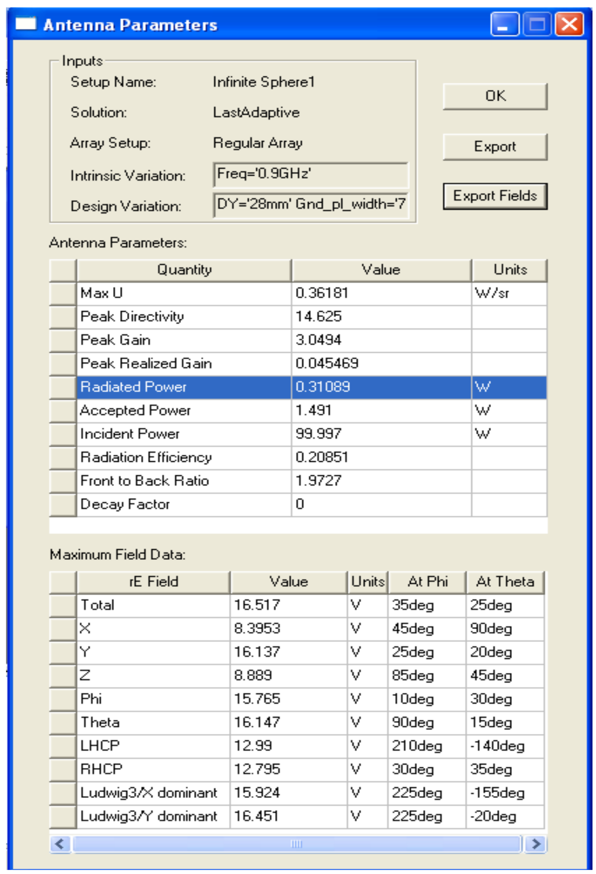


**Fig. 8.** 3D plot of Directivity for simulated antenna.



Antenna Parameters

Inputs

| | |
|---|---|
| Setup Name: | Infinite Sphere1 |
| Solution: | LastAdaptive |
| Array Setup: | Regular Array |
| Intrinsic Variation: | Freq='0.9GHz' |
| Design Variation: | DY='28mm' Gnd_pl_width='7 |

OK
Export
Export Fields

Antenna Parameters:

| Quantity | Value | Units |
|---|---|---|
| Max U | 0.36181 | W/sr |
| Peak Directivity | 14.625 | |
| Peak Gain | 3.0494 | |
| Peak Realized Gain | 0.045469 | |
| Radiated Power | 0.31089 | W |
| Accepted Power | 1.491 | W |
| Incident Power | 99.997 | W |
| Radiation Efficiency | 0.20851 | |
| Front to Back Ratio | 1.9727 | |
| Decay Factor | 0 | |

Maximum Field Data:

| rE Field | Value | Units | At Phi | At Theta |
|---|---|---|---|---|
| Total | 16.517 | V | 35deg | 25deg |
| X | 8.3953 | V | 45deg | 90deg |
| Y | 16.137 | V | 25deg | 20deg |
| Z | 8.889 | V | 85deg | 45deg |
| Phi | 15.765 | V | 10deg | 30deg |
| Theta | 16.147 | V | 90deg | 15deg |
| LHCP | 12.99 | V | 210deg | -140deg |
| RHCP | 12.795 | V | 30deg | 35deg |
| Ludwig3/X dominant | 15.924 | V | 225deg | -155deg |
| Ludwig3/Y dominant | 16.451 | V | 225deg | -20deg |

**Fig. 9.** Antenna Parameters.

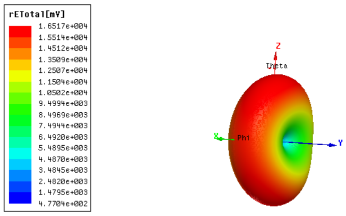



**Fig. 10.** E total 3D plot for simulated antenna.

The Designed Antenna parameters are shown in figure 10.Designed antenna is resonating at the frequency Introducing f=1.58 GHz which comes in L band with good percentage bandwidth, gain, return loss and efficiency.

## V. CONCLUSION

This paper focused on the simulated design on differentially-driven microstrip antenna. Simulation studies of a single layer monopole microstrip patch antenna have been carried out using HFSS software. Designed antenna is resonating at the frequency Introducing f=1.58 GHz. The proposed antenna covers the L band with good percentage bandwidth, gain, return loss and efficiency. Therefore the proposed antenna has many applications such as GPS, mobile service, satellite navigation, telecommunication uses such as GSM phones, aircraft surveillance such as Automatic dependent surveillance-broadcast, amateur radio, digital audio broadcasting used by military for telemetry and astronomy.

## REFERENCES

[1] Sarkar, I., P. P. Sarkar, and S. K. Chowdhury. "A new compact printed antenna for mobile communication." *Antennas & Propagation Conference, 2009. LAPC 2009. Loughborough*. IEEE, 2009.

[2] Chatterjee, Samiran, et al. "Compact microstrip antenna for mobile communication." *Microwave and Optical Technology Letters* **55.5** (2013): 954-957.

[3] Wu, J-W., et al. "Dual broadband design of rectangular slot antenna for 2.4 and 5 GHz wireless communication." *Electronics Letters* **40.23** (2004): 1461-1463.

[4] Chakraborty, Ujjal, et al. "A comact microstrip patch antenna for wireless communication." *Progress In Electromagnetics Research C* **18** (2011): 211-220.

[5] Raj, Rohith K., et al. "A new compact microstrip-fed dual-band coplanar antenna for WLAN applications." *IEEE Transactions on Antennas and Propagation* **54.12** (2006): 3755-3762.

[6] Zhang, Zhijun, et al. "Dual-band WLAN dipole antenna using an internal matching circuit." *IEEE Transactions on Antennas and Propagation* **53.5** (2005): 1813-1818.

[7] Chatterjee, Samiran, *et al.* "A printed patch antenna for mobile communication." *Convergence of Optics and Electronics conference*. 2011.

[8] Balanis, Constantine A. *Antenna theory: analysis and design*. John Wiley & Sons, 2016.

[9] Jana, Supriya, et al. "Single Layer Monopole Hexagonal Microstrip Patch Antenna for Microwave Communication." *International Refereed Journal of Engineering and Science (IRJES), ISSN (Online)* (2012): 2319-1821.

[10] Das, Arnab, et al. "Multi-band microstrip slotted patch antenna for application in microwave communication." *International Journal of Science and Advanced Technology,(ISSN 2221-8386)* **2.9** (2012): 91-95.

[11] Singh, Upendra Kumar, and Monika Nanda. "Single Layer Monopole Slotted Microstrip Antenna for Ku-Band Applications."

[12] Singh, Upendra Kumar, and Monika Nanda. "Single Layer Monopole Microstrip Antenna for X-Band Application." *IJRECE* **1.3** (2013): 68-70.

[13] Ansoft Software Inc. HFSS. Web: http://www.ansoft.com /