Impact Factor (SJIF): 3.632

International Journal of Advance Research in Engineering, Science & Technology

e-ISSN: 2393-9877, p-ISSN: 2394-2444

Volume 3, Issue 5, May-2016

Design And Analysis Of Compact Circularly polarized asymmetric V-shaped slits patch antenna for S-band Applications

[1]Miss.Shubhangi Pawale, [2]Prof.Dhede V M
[1]P.G student,JCOE,Kuran
[2]Assistant professor,JCOE,kuran

Abstract—***In this paper, a circularly polarized asymmetric slits, high gain, a small patch antenna with low axial ratio dedicated for S band satellite communications is presented. Four asymmetric V-shaped slits in the diagonal directions on the square patches and a parasitic element are added to create circularly polarized (CP) radiation having large axial ratio beamwidth. A proposed of the antenna has been design with a 1.6 mm thick single layer FR4 substrate with a relative permittivity of 4.4. The simulated 3-dB axial ratio (AR) bandwidth of the proposed antenna is 41 MHz (2.41–2.46 GHz) having a 3-dB AR beamwidth of nearly 180◦ across the bandwidth and a 10-dB return loss bandwidth is about 60.0 MHz (2.43–2.49 GHz) with a gain of more than 6.2 dB. The overall size of the antenna is 56mmx56mmx1.6mm. In addition, effects of with parasitic element to improve more gain are examined and discussed in detail. All the simulations results are carry out using HFSS software package and Simulation results are given, indicating that this S band antenna realizes the required satellite specifications in terms of frequency bandwidth, gain, circular polarization bandwidth, and axial ratio (AR) beamwidth.***

Keywords— *Circular polarization, axial ratio, patch antennas,Nanosatellite, satellite communication*

I. Introduction

Nowadays,the microstrip patch antenna is popularly used and various research work has done on this antenna.The microstrip patch antennas has more advantages like greater reliability, low cost,small size and better prospects than conventional antennas.Now,the speed and the size of the device are the two important factors for the evolution of wireless or wifi which is popularly used.Hence,we need a compact and efficient antenna for success of all these wireless applications as wireless technologies is getting more and more important in our life.Along with mobile and cellular technologies ,portale antenna technology has grown. Microstrip antennas (MSA) have various features like low cost and low profile which has showed that Microstrip antennas (MSA) to be well suited for WLAN application systems. A Microstrip patch has dielectric substrate sandwitched in between the radiating patch and the ground plane.The overview of MSA shown in fig 1. The patch is generally consists of conducting material like copper or gold and has any shape like rectangular,circular,triangular and irregular shown in fig 2.The patch and the feed lines are generally photo etched on the dielectric substrate. The Electromagnetic waves fringing off from the top patch into the substrate and are radiated into the air after reflecting off the ground plane. For best performance of the antenna,a thick dielectric substrate having a low dielectric constant value is required.since this provides better efficiency, greater bandwidth and best radiation effects.

.

Here, we construct a rectangular micro-strip patch antenna in which asymmetric v slots are cut in micro-strip patch to increase its axial ratio bandwidth and frequency response.And the one parasitic element is added for the circular polarization.

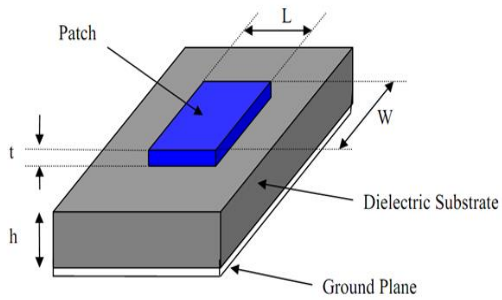

Fig: 1 Structure of Microstrip patch Antenna.

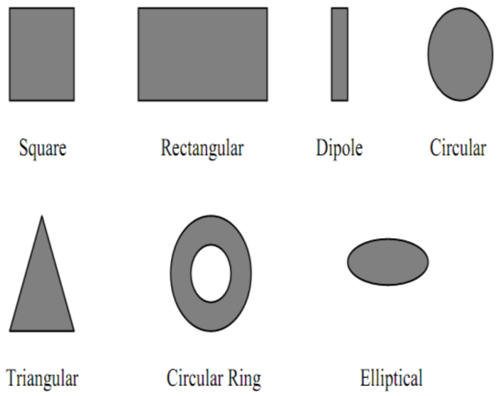

Fig: 2 Common shapes of Microstrip patch elements

II. MICROSTRIP ANTENNA DESIGN

The initial design was chosen based on the literature that provided circularly polarized radiation in the broadside direction. A square patch antenna designs are one of the earliest examples of microstrip patch antenna. Various techniques, like offset feeds, truncated corners and diagonal slits were used to produce circular polarization from square or rectangular patch antennas.Fig. 1 shows the top view and cross-sectional view of the proposed asymmetric V shape slits microstrip antenna with parasitic element. One parasitic strip has been added to the downside of the radiating patch. The parasitic strips are ensured to be longer than the radiating element so that they may act as reflectors of a Yagi antenna. The size of the antenna is limited to 56 mm × 56 mm at most. Thus the initial design was chosen of dimensions 56 mm × 56 mm. A probe feed from the bottom is attached to the patch through a hole drilled into the substrate. The coaxial feed location is along the orthogonal X-axis from the center of a patch. Fig 1 b introduces the asymmetric V-shaped slits square patch for CP radiation and rectangular strips for wide axial ratio beamwidth.

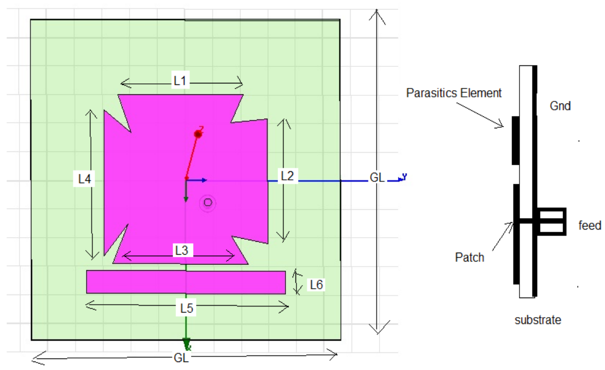

Figure 1: Proposed antenna geometry (a) top view
(b) cross-sectional view

The dimensions of the strips and the corner of the V-shaped asymmetric slits are optimized to create the resonance and circular polarization at 2.45 GHz. The optimized dimension is as follows:
G_L=56 mm, *L1*=22.6 mm, *L2*=21.8mm, *L3*=24.4mm, *L4*=25.5 mm, *L5*=36 mm and *L6*=4mm..

III.METHODOLOGY

The formulas for calculating the length, width and value of air gap are taken from [8]. The value of resonant frequency (Fr) is 2.44 GHz and dielectric constant of the substrate (εr) is 4.4 and Height of dielectric substrate (h) is 1.6mm.

Next step is to calculate the other parameters like length and width of micro strip patch is given as follows:

Step 1:

Width of micro strip patch is given below:

$$w = \frac{c}{2 f_0 \sqrt{\frac{\varepsilon_r + 1}{2}}} \qquad (1)$$

Step 2:

Length of micro strip patch is given below:

$$\Delta L = (0.412 * h)\frac{(\varepsilon_{reff} + 0.3)\left(\frac{w}{h} + 0.264\right)}{(\varepsilon_{reff} - 0.258)\left(\frac{w}{h} + 0.813\right)} \qquad (2)$$

Step 3:

The resonant frequency for any mode is given by:

$$f_0 = \frac{c}{2\sqrt{\varepsilon_{reff}}}\left[\left(\frac{m}{l}\right)^2 + \left(\frac{n}{m}\right)^2\right]^{1/2} \qquad (3)$$

IV. RESULTS AND DISCUSSION

The designed V-shaped asymmetric slit square patch with rectangular slit was simulated for validate the design. The simulated reflection coefficient of The proposed antenna design is simulated in Ansoft hfss software. Simulated and 10-dB return loss bandwidth are 60 (2.43-2.49GHz)

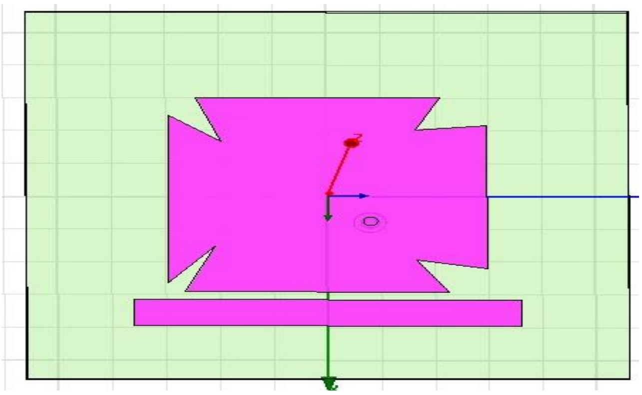

Fig.2 Proposed antenna geometry

Fig.3 shows the return loss of the antenna.it shows that return loss is -20.47 at resonant frequency 2.46 Ghz.

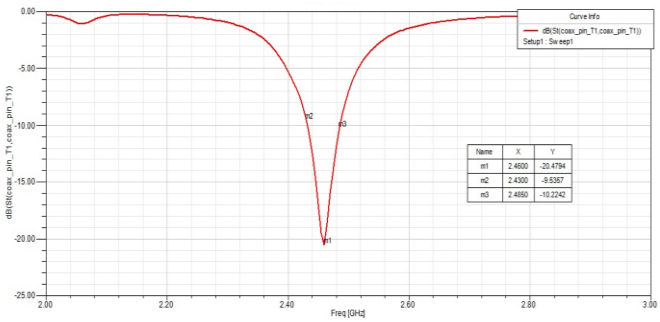

Fig.3 return loss

Fig.4 a and b shows the 3-D plot of radiation pattern and polar plot of radiation pattern.it shows the maximum gain of 6.1dbi.

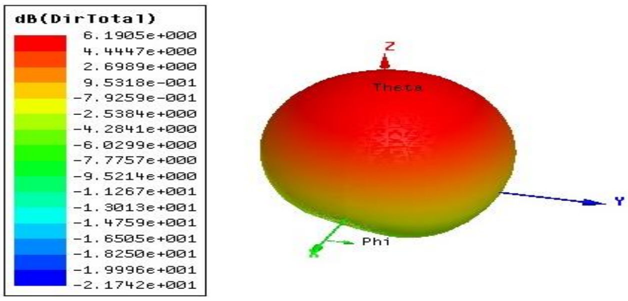

Fig.4 a)3-D plot of radiation pattern

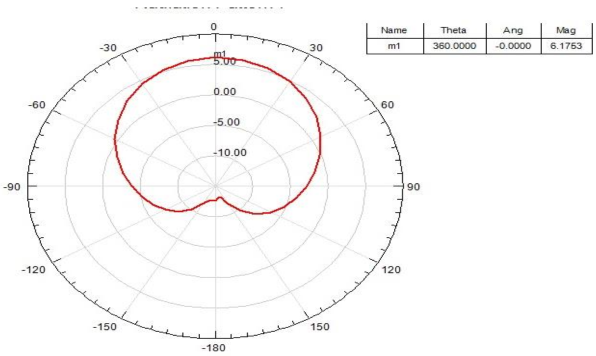

Fig 4.b) Radiation pattern of antenna

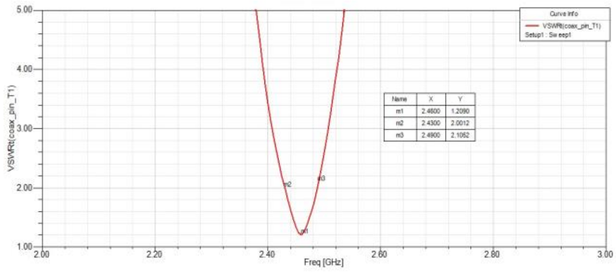

Fig.5.VSWR

Fig.5 shows the VSWR of the antenna.it shows the less than <2 at 2.46ghz frequency and the fig.6 shows the axial ratio of 1.48db at 2.46ghz frequency

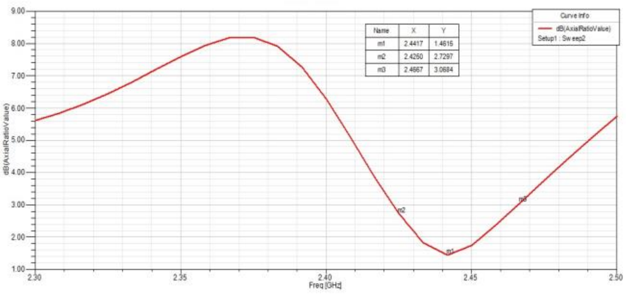

Fig.6 Axial ratio

Figure 6 depicts the simulated AR value is 1.4db at resonant freq of the antenna. The simulated 3-dB AR bandwidth is also near about 41 MHz.

Sr .No.	Shape of MSA	Freq (GHZ)	Return Loss(dB)	VSWR	Bandwidth (MHZ)	Axial ratio (BW)	Axial Ratio (dB)	Directivity (dB)
1.	V-shaped asymmetric slit square patch	2.46	-22.49	1.16	65	31	2.50	5.1
2.	V-shaped asymmetric slit square patch with parasitic1	2.46	-20.47	1.20	60	41	1.46	6.1

Table 1: Comparison table

In addition, effects of with parasitic element and without parasitic element to improve gain are examined and discussed in detail .Table 1 shows with parasitics element the gain is increased upto 6.2dB instead of 5db.

V. CONCLUSION

A compact high gain Circular polarized V-shaped asymmetric slit MSP antenna was proposed. Slits are inserted on four corners of the patch. the antenna exhibits an effective bandwidth of 60MHz from 2.43-2.49 GHz for 10-dB return loss and AR<3 dB at 41 MHz. The simulated gain of the antenna is around 6.2 dBi and the 3-dB axial ratio beamwidth is about 180deg. The overall dimension of the antenna is 56mm×56mm×1.6mm at 2.45GHz and thus can be considered as a suitable for various like WLAN applications, ISM-band(2.43-2.49Ghz) and S-band satellite applications.

VI. REFERENCES

[1] S. P. Neeck, T. J. Magner, and G. E. Paules, "NASA's smalsatellite missions for Earth observation," *Acta Astronautica*, vol.56, pp. 187-192, 2005.

[2] Y. Zhen and Y. Ruliang, "Feasibility study of using small satellite synthetic aperture radar for global 3D imaging," in *Geoscience and Remote Sensing Symposium, 2002. IGARSS'02. 2002 IEEE International*, 2002, pp. 3162-3164.

[3] A. Wicks, A. da Silva Curiel, J. Ward, and M. Fouquet,"Advancing small satellite earth observation: operational spacecraft, planned missions and future concepts," 2000.

[4] C. A. Balanis, Antenna Theory, 2nd ed. New York: Wiley, 1997.

[5] E. Arnieri, L. Boccia, G. Amendola, and G. Di Massa, "A compact high gain antenna for small satellite applications," IEEE Transactions on Antennas and Propagation, vol. 55, pp. 277-282, Feb 2007.

[6] P. Khotso, R. Lehmensiek, and R. R. van Zyl, "Circularly polarized circular microstrip patch antenna loaded with four shorting posts for nanosatellite applications," Microwave and Optical Technology Letters, vol. 54, pp. 8-11, 2012.

[7] L. H. Abderrahmane, M. Benyettou, and M. Sweeting, "An S band antenna system used for communication on earth observation microsatellite," in Aerospace Conference, 2006 IEEE, 2006, p. 6 pp.