International Journal of Current Engineering and Technology
E-ISSN 2277 – 4106, P-ISSN 2347 – 5161
©2016 INPRESSCO®, All Rights Reserved
Available at http://inpressco.com/category/ijcet

*Research Article*

# Bandwidth Improvement using Slotted Triangular Microstrip Patch Antenna

**Abhishek Gautam*, Anil Kumar, A. K. Jaiswal and Ekta Singh Chauhan**

Department of Electronics and Communication Engg. Shepherd School of Engineering and Technology Sam Higginbottom Institute of Agriculture, Technology and Sciences Deemed-to-be-University Allahabad-211007, India

Accepted 30 May 2016, Available online 04 June 2016, **Vol.6, No.3 (June 2016)**

***Abstract***

*In this paper a Slotted Triangular Microstrip Patch Antenna (MPA) is proposed with improved Bandwidth from 4.32% to 4.43% at the range of 7.1281GHz to 7.4513GHz. The properties of traditionally triangular MPA and Slotted MPA are presented and compared to each other. It was found that for the extension of bandwidth, slots can be embedded on the patch and was more favorable. Due to this many advantages, MPAs have many applications like space technology, aircrafts, missiles, tracking, mobile communication, GPS systems, remote sensing and satellite broadcast.*

***Keywords:*** *Bandwidth, Triangular MPA, Slotted MPA, Return, Loss, Microstrip line feed and Gain.*

## 1. Introduction

Microstrip patch antenna (MPA) have the advantage of low cost, thin profile, light weight, ease of fabrication, conformable to mounting surface and being integrated in active devices.The size of the antenna is effectively reduced by cutting slot in proper position on the microstrip Patch [Chakraborty *et al.* 2010].The simpler method to realize broadband MSA is by fabricating the patch on lower dielectric constant thicker substrate [Deshmukh *et al.* 2010]. Also Inset fed microstrip antennas provide excellent isolation between the feed network and the radiating elements and yield very good front to back ratios [Surmeli *et al.*]. Due to this many advantages, MPAs have many applications like space technology, aircrafts, missiles, tracking, mobile communication, GPS systems, remote sensing and satellite broadcast [Jamro et al]. Triangular MPAs are found to provide radiation characteristics similar to those of Rectangular patches, but with a smaller size. The size of the antenna can be reduced by loading it with a shortor slot.

One of the most attractive features of the equilateral triangular microstrip antenna is that, the area necessary for the patch becomes about half as large as that of a nearly square microstrip antenna [Suzuki *et al.* 1987].The wide slot is selected, as it is more effective in enhancing the impedance bandwidth when compared to narrow slot [Bhal *et al.* 1981]. The technology to vary the resonant frequency is by the means of embedding perturbation (loading) elements into the radiating patch. These perturbation elements, such as slots [Shynu *et al.* 2006], [Xiao *et al*. 2003] and shorting strips [Sheta *et al.* 2008]–[Feldner *et al.* 2007], can affect the current distribution on the radiating patch, and the antenna resonant length is accordingly varied. The most important drawback of Triangular MPA is narrow bandwidth typically 1-5% [Constantine *et al.*]. To overcome this drawback, one of the methods is to cut slots in various shapes.

## 2. Placing the figures

The conventional Triangular MPA is considered the reference antenna to compare the results of that obtained from modified slotted MPA. The geometry of the conventional Triangular MPA is shown in Figure 1.

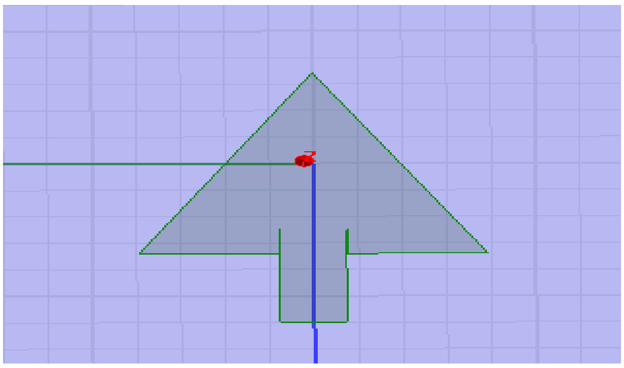

**Fig.1** Triangular MPA

*Corresponding author: **Abhishek Gautam**

The patch has the dimension of height = 13.632mm and base =15.74mm and is printed on FR4 epoxy of dielectric constant, $\varepsilon_r$ =4.4 and the thickness of the substrate, h = 2.82mm. A microstrip Inset fed is used to connect the microstrip patch and the position is made fixed for both the conventional and the Slotted Triangular MPA. The length of feed is 7mm & width 3mm, inset gap 0.5mm & inset distance 1.816mm.

The geometry of the proposed to extend the bandwidth Inset-fed patch antenna with embedding slots is shown in Fig. 2. Impedance bandwidth of about 4.43% can be obtained from the above geometry. Its main advantage of this structure is that it produces wider bandwidth than the conventional triangular patch with a single and simple topology.

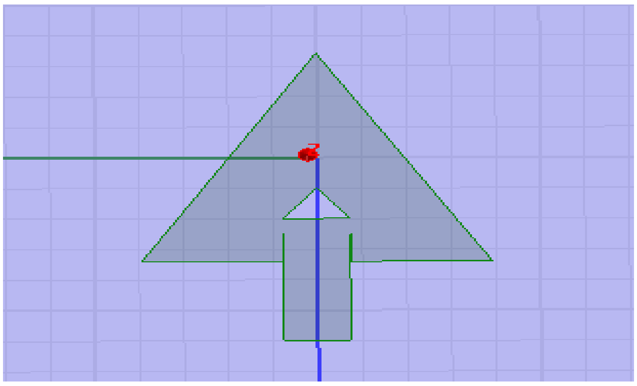

**Fig.2** Slotted Triangular MPA

## 3. Simulated results

### *3.1 Return Loss and Bandwidth*

The Return Loss shown in Fig.3.1 of the Triangular MPA is - 26.8117dB at Resonating frequency at 7.2727 GHz and the bandwidth obtained is 4.32%.

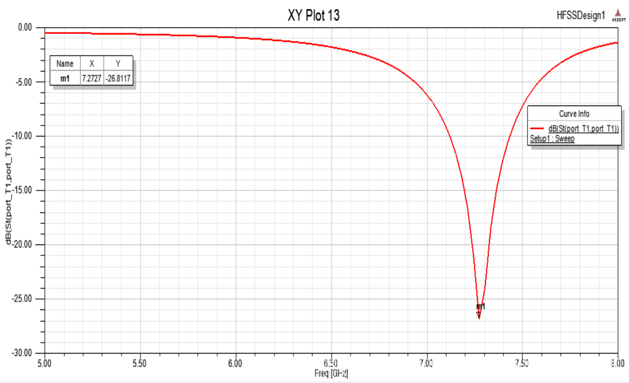


**Fig. 3.1**(a) Return loss of Triangular MPA

The Return Loss shown in Fig.4(b) of the Slotted Triangular MPA is -31.7460dB at Resonating frequency at 7.3030GHz and the bandwidth obtained is 4.43%.

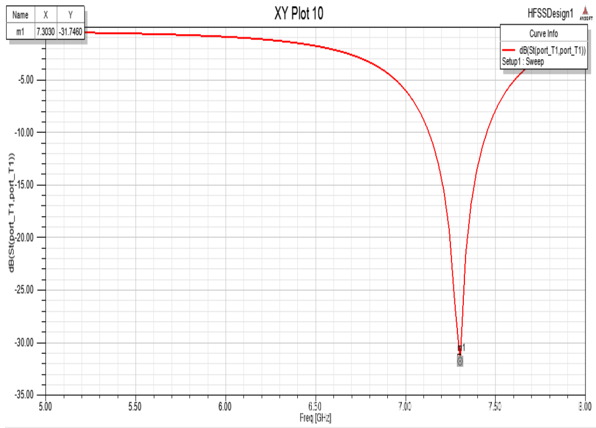


**Fig. 3.1** (b) Return loss of slotted Triangular MPA

### *3.2 Gain*

The Gain shown in Fig. 3.2(a) of the Triangular MPA is 7.8465dB at Resonating Frequency at 7.2727GHz.

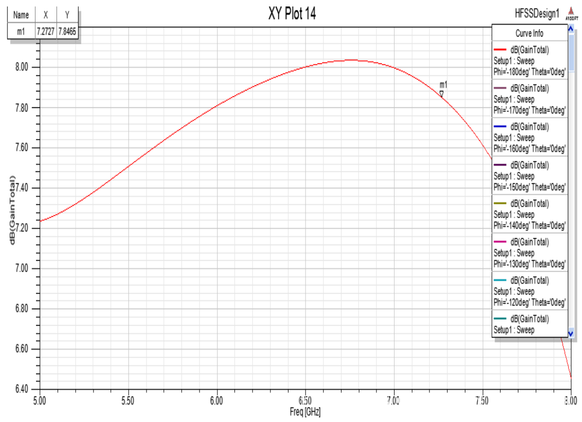


**Fig. 3.2** (a) Gain of Triangular MPA

Gain: The Gain shown in Fig. 3.2(b) of the Triangular MPA is 7.7271dB at Resonating frequency at 7.3030GHz.

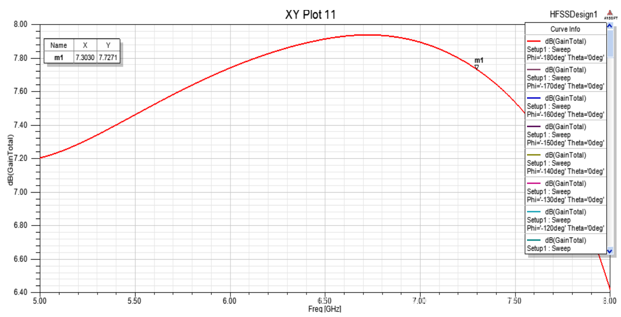


**Fig. 3.2** (b) gain of slotted Triangular MPA

### *3.3 Radiation Pattern*

The microstrip antenna radiates normal to its patch surface. So, the elevation pattern for = 0 and = 90 degrees are important for the measurement. The simulated E-plane and & H-plane pattern, 2D pattern view the conventional triangular patch and the modified triangular patch are illustrated in Fig.3.3(a) and 3.3(b).

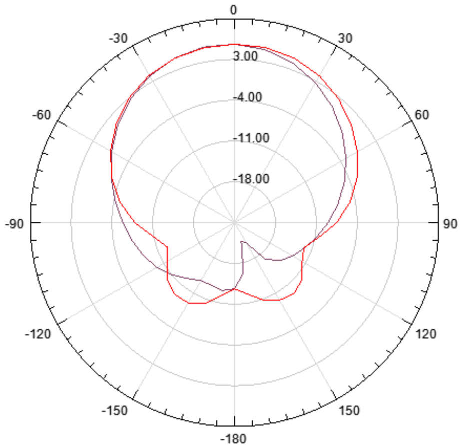


**Fig. 3.3** (a) 2D Radiation Pattern for Triangular MPA

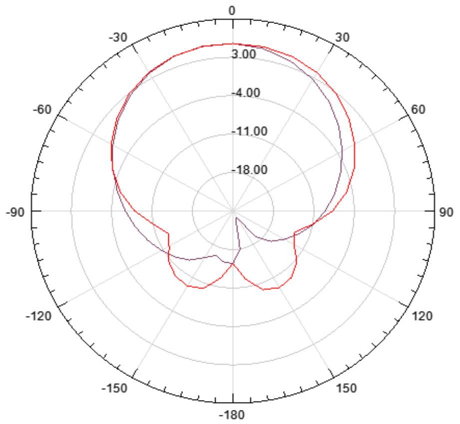


**Fig. 3.3** (b) 2D Radiation Pattern for Slotted Triangular MPA

**Table 1** Experimental procedure parameters

| Antenna | Frequency (GHz) | Return loss (dBi) | Gain (dBi) | Bandwidth (%) |
|---|---|---|---|---|
| Conventional MSA | 7.2727 | -26.8117 | 7.8465 | 4.32 |
| Slotted MSA | 7.3030 | -31.7460 | 7.7271 | 4.42 |

## Conclusions

In this paper, the new geometry proposed the better bandwidth of 4.43% was achieved by embedding slot in the antenna design. The radiation pattern of the antenna was stable over the entire bandwidth and minor improvement of gain, impedance and return loss were also achieved.

## References

Ujjal Chakraborty, Samiran Chatterjee, S.K. Chowdhury, P.P. Sarkar(2010)Triangular Slot Microstrip Patch Antenna for Wireless Communication *Annual IEEE India Conference* (INDICON).

Amit A. Deshmukh, Ankita R. Jain and K. P. Ray (2010)Analysis of Broadband Pair of slot cut Equilateral Triangular Microstrip Antenna,*International Journal of Microwave and Optical Technology* pp. (248 – 256).

Koray Surmeli, Bahattin Turetken,U-Slot Stacked Patch Antenna Using High and Low Dielectric Constant Material Combinations in S- BandAntenna Test and Research Center(ATAM).

Deedar Ali Jamro, Jing-Song Hong Member Ieee, MamadouHady Bah, Farman Ali Mangi Novel Triangular Patch Antenna With Reduced Radar Cross Section,IEEE

Suzuki Y, Miyano N and Chiba T (1987) Circularly polarized radiation from singly fed equilateral triangular microstrip antenna, IEEE. Proc., vol. 134, pp. 194-197.

Bhal I J and Bhartia P (1981) Microstrip Slot Antennas, Microstrip Antennas, Dedham, MA: Artech House, pp. 221-245

S. V. Shynu, G. Augustin, C. K. Aanandan, P. Mohanan, and K. Vasudevan (2006) C-shaped slot loaded reconfigurable microstrip antenna,*Electron. Lett.*, vol. 42, pp. 316–318.

S. Xiao, B. Z.Wang, and X. S.Yang (2003) A novel frequency reconfigurable patch antenna, *Microw. Opt. Technol. Lett.*, vol. 36, pp. 295–297.

A. F. Sheta and S. F. Mahmoud (2008) A widely tunable compact patch antenna,*IEEE Antennas Wireless Propag.Lett.*, vol. 7, pp. 40–42.

L. M. Feldner, C. T. Rodenbeck, C. G. Christodoulou, and N. Kinzie (2007) Electrically small frequency-agile PIFA-as-a-package for protablewireless devices, *IEEE Trans. Antennas Propag.*, vol. 55, no. 11, pp. 3310–3319

Constantine A. Balanis, Antenna Theory Analysis and Design, Third Edition, Wiley Publication.