# Bandwidth Improvement Using Slotted Triangular MPA

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***Abstract*— In this paper a new geometry of Slotted Triangular MPA (Microstrip Patch Antenna) is proposed with improved Bandwidth from 2.69% to 10.27% at the range of 4.9GHz to 5.4GHz which can be used for WLAN applications. The designs equations with polynomial fitting are also obtained.**

***Keywords*— Bandwidth, Triangular MPA, Slotted MPA, Return Loss, Coaxial probe feed, Gain.**

## I. INTRODUCTION

MPA have the advantage of low cost, thin profile, light weight, ease of fabrication, conformable to mounting surface and being integrated in active devices [1]. Also Coaxial probe fed microstrip antennas provide excellent isolation between the feed network and the radiating elements and yield very good front to back ratios [1]. Due to this many advantages, MPAs have many applications like space technology, aircrafts, missiles, tracking, mobile communication, GPS systems, remote sensing and satellite broadcast [2][3]. 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 short or slot. The most important drawback of Triangular MPA is narrow bandwidth typically 1-5% [2]. To overcome this drawback, one of the methods is to cut slots in various shapes. For example, by embedding U-slots in stacked patch the bandwidth was improved to 2 times as compared to the conventional Rectangular MPA [1]. And also the wideband characteristics of the Triangular patch is achieved by using the by embedding slots and arrays [5], the use of series slots (H-shaped) and another pair of parallel slots (E-shaped) lead to the improvement of bandwidth of 21.79%[6]. So, by embedding suitable slots in the radiating patch, compact operation with enhanced impedance bandwidth can be obtained [4].

In this study, the properties of traditionally triangular MPA and Slotted MPA are presented and compared to each other. The designs were simulated using electromagnetic simulator, Zealand IE3D software. It was found that for the extension of bandwidth, slots can be embedded on the patch and was more favorable (about 3.8 times the bandwidth of the conventional Triangular MPA).

## II. ANTENNA DESIGN

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. The patch has the dimension of height = 30mm and base = 30mm and is printed on FR4 of dielectric constant, $\varepsilon_r$= 4.4 and the thickness of the substrate, h = 1.59 mm. A coaxial probe is used to connect the microstrip patch and the position is made fixed for both the conventional and the Slotted Triangular MPA.

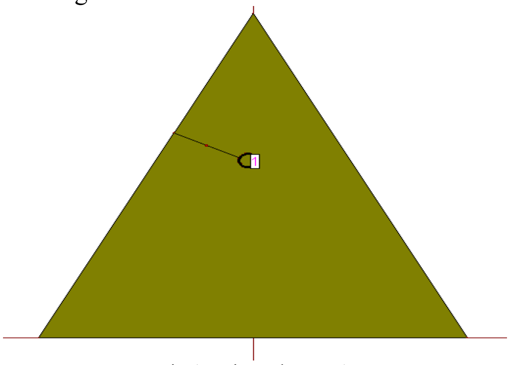

Fig.1. Triangular MPA

The geometry of the proposed to extend the bandwidth probe-fed patch antenna with embedding slots is shown in Fig. 2. Impedance bandwidth of about 10.27% 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.

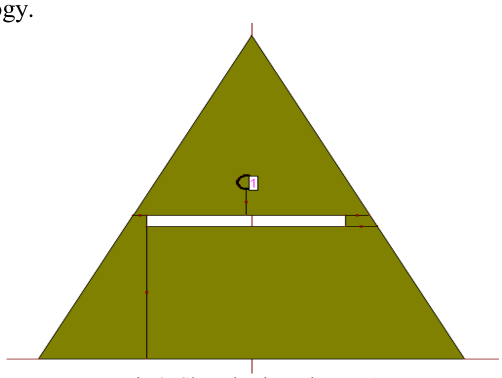

Fig.2. Slotted Triangular MPA

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## III. SIMULATED RESULTS

1) Radiation Pattern: The microstrip antenna radiates normal to its patch surface. So, the elevation pattern for φ= 0 and φ= 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(a) and 3(b).

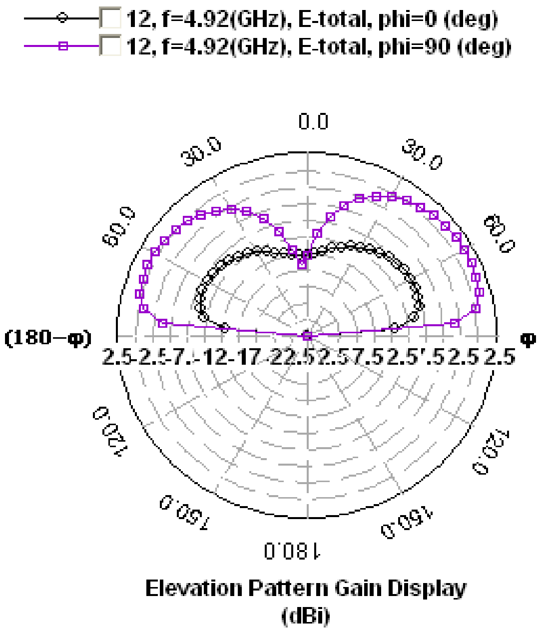


Fig.3 (a): 2D Radiation Pattern for Triangular MPA

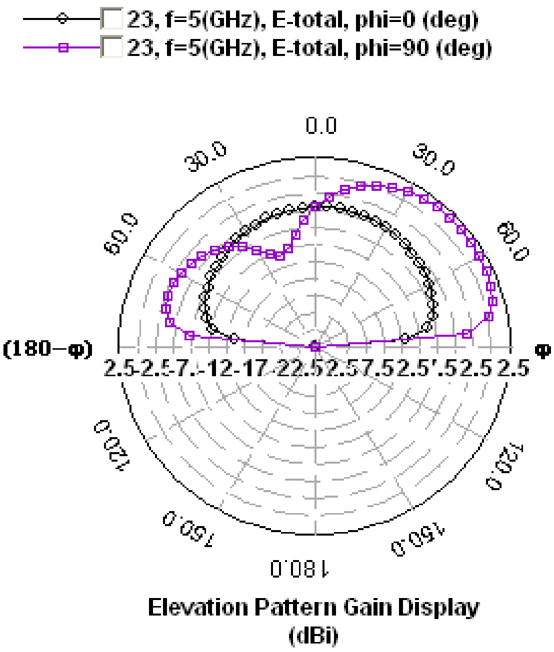


Fig.3 (b): 2D Radiation Pattern for Slotted Triangular MPA

2) Return Loss and Bandwidth: The Return Loss shown in Fig. 4(a) of the Triangular MPA is -36.9848 dB at Resonating frequency at 4.92 GHz and the bandwidth obtained is 2.69%.

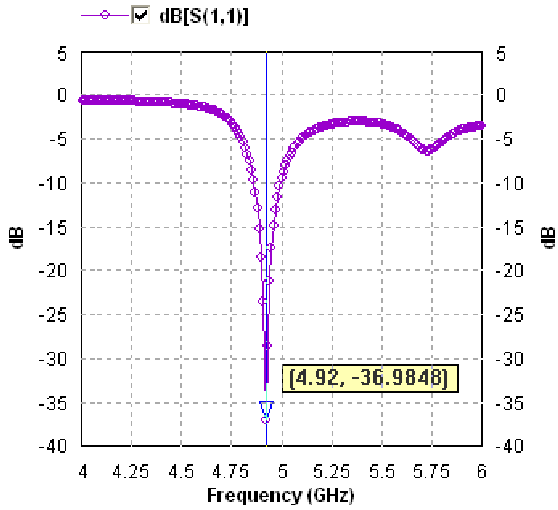


Fig.4 (a): Simulated Return Loss for Triangular MPA

The Return Loss shown in Fig.4 (b) of the Slotted Triangular MPA is -40.009dB at Resonating frequency at 4.976GHz and the bandwidth obtained is 10.05%.

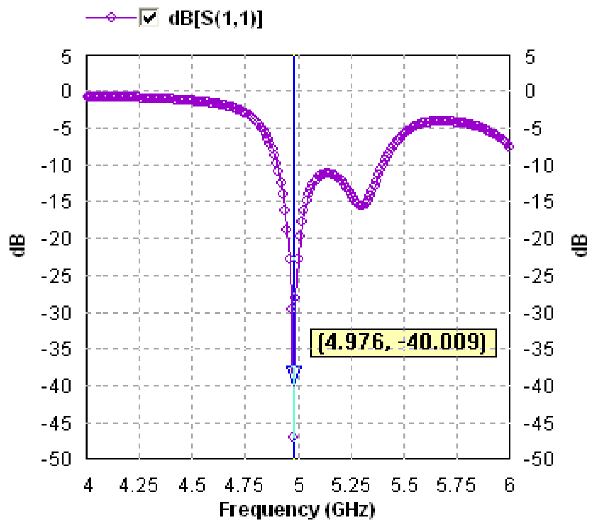


Fig.4 (b): Simulated Return Loss for Slotted Triangular MPA

3) Smith Chart: The loops in the Smith Chart show where the antenna and feed structure were resonant and the nearer the loop to the centre of the chart the better the impedance match. Smith Chart also provides the information about polarization. The

Smith chart for the conventional Triangular MPA is given in Fig.5 (a).

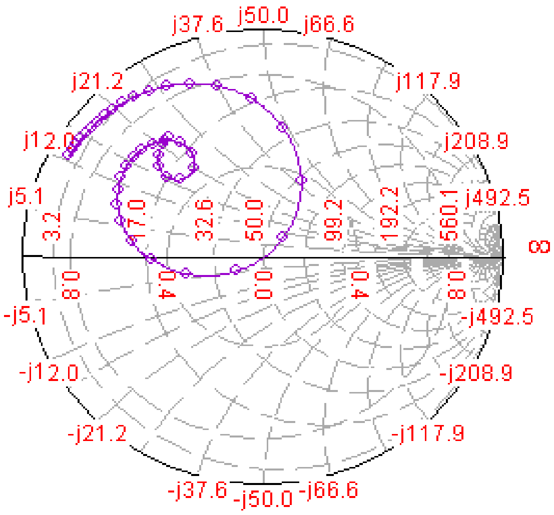


Fig.5 (a): Smith Chart for Triangular MPA

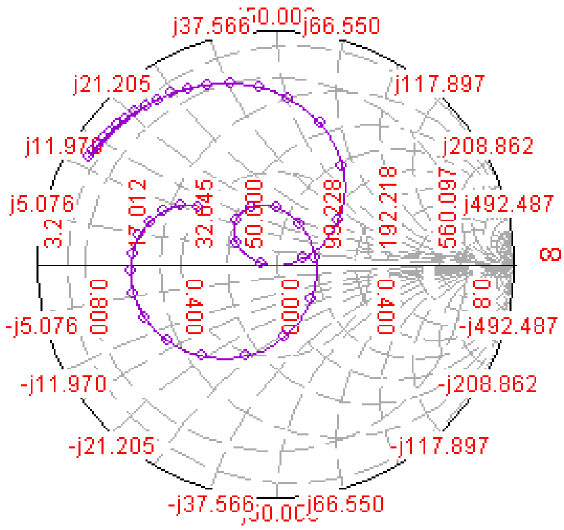


Fig.5 (b): Smith Chart for Slotted Triangular MPA.

4) Others characteristics of Triangular MPA and the Slotted Triangular MPA after simulation is given in TABLE I:

TABLE I
Others characteristics of the Triangular MPA and the slotted Triangular MPA

| Characteristics | Triangular MPA | Slotted Triangular MPA |
|---|---|---|
| Impedance (Ω) | 51.6376+j1.10642 | 49.9833+j0.161498 |
| Gain (dBi) | 1.04264 | 1.81972 |

5) Graphs with the variation of width of slotted Triangular MPA

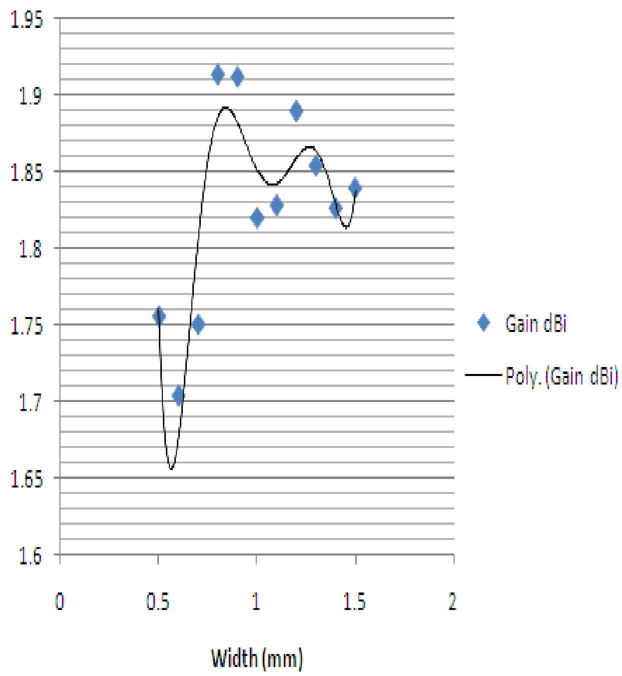


Fig.6: Plot of Gain (Y-axis) vs Width (X-axis) of the slot.

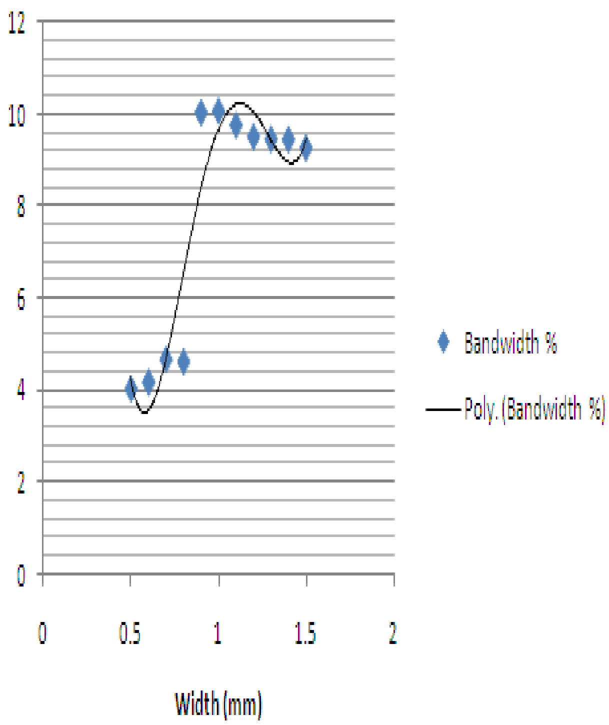


Fig.7: Plot of Bandwidth (Y-axis) vs Width (X-axis) of the slot

The polynomial fitting design equations for the slotted Rectangular MPA are mentioned below:

The length of the slot is kept constant; the width (W) of the slot depends on gain (G), bandwidth (BW), as per the following relation

$$G = 67.11W^6 - 418.9W^5 + 1065W^4 - 1408W^3 + 1017W^2 -379.3W + 58.55$$

$$BW = 112.1W^4 - 465.5W^3 + 684.7W^2 - 411.7W + 90.14$$

## IV. CONCLUSION

In this paper, the new geometry proposed the better bandwidth of 10.27% 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. It can be used for WLAN applications.

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