# A Circular Slotted Microstrip Antenna for Wide Band Application

George Vikas Likithapudi[1], K. Lakshmi Bhavani[2], Dr. S Nagakishore Bhavanam[3]
[1]*PG Scholar, University College of Engineering & Technology, Acharya Nagarjuna University, India*
[2,3]*Assitant Professor, Centre of Excellence in VLSI Design and Antennas University College of Engineering & Technology, Acharya Nagarjuna University, India*

***Abstract*- Many communication systems which have applications in like Aerospace, Radio Astronomy, Defense systems etc., needs wideband antennas. Here we are designing an antenna which can support wide band at different range of frequencies i.e. at multi frequency bands. This antenna can be operated at three different bands like K, Ka, U bands and bandwidth ranges from 3 to 24.3 GHz. The Gain and return loss of the antenna will be superior to that of recently reported one. The Performance of this antenna is Analyzed by various parameters like Return loss, Gain and VSWR etc. HFFS Software is used to Design and Simulate. The corresponding Design and simulation results have been presented in this paper.**

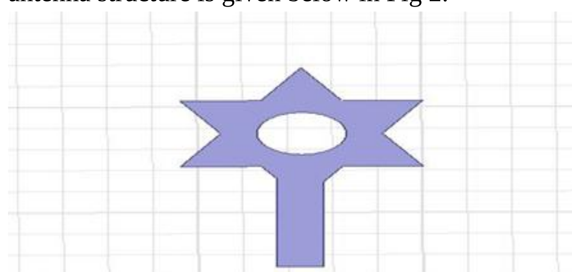
**Index terms- Gain, VSWR, HFSS, Return loss**

## I. INTRODUCTION

These days' communication is going beyond our imaginations due great Research. This is in context to wireless communications we use this as the best way of communication as it has high data carrying capacity with more reliability. We know that an antenna is characterized by factors like input impedance, radiation pattern, gain, VSWR etc. There are different feeding techniques available for design of an antenna there are line feed, coaxial feed, micro strip feed etc. Here we use micro strip feeding due to its less cost and more efficient as well as it uses less space. Wide band antennas show up their importance in many applications like Radio Astronomy, Aerospace Communications etc. This will carry huge amount of data. Now we are designing and simulating an antenna for showing its wide band applications with better gain and return loss.

## II.ANTENNA DESIGN

Microstrip Triangular patch antenna is modelled by using the below considerations. Then proposed antenna structure is given below in Fig 2.



Design Explanation:
Firstly Take a Circle and change it as three segments then we will get a triangle. After that take the second circle and take it as three segments and mirror it onto the axis of first circle then rotate it 180 degrees .Now we will get this structure. Then take third circle and place it in the middle of the isotoxal structure and just subtract it from the first and second triangle. Then after uniting the feed line to the structure then we will get this shape. The calculations have been done and the approximated values have been considered for better results. As we are design in this antenna for wide band applications we should select which structure has the most radiation capability.

Table 2.1 Antenna design parameters:

| Parameter | Notation | Value |
|---|---|---|
| Relative Permittivity | $\varepsilon_r$ | 3 |
| Operating Frequency(GHz) | $f_r$ | 22.8 |
| Height of Substrate (mm) | H | 1.43 |
| Width of Substrate (mm) | W | 14.662 |
| Length of Substrate(mm) | L | 12.638 |

2.1 Operating frequency: The frequency at which the total bandwidth fall under it. Here the operating frequency is 22.8 GHz.

2.2 Substrate Material and Height: The substrate material Rogers Duroid 3003 with $\in_r$ =3 this was taken for better efficiency may be the cost may increase but stability will be more. The height of the substrate is taken as 1.43mm and length=12.638, width=14.662.

2.3 Design Equations:
For patch:
Width of the patch is given as:

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

Change in length is given as:

$$VL = 0.412h \frac{(\varepsilon_{reff} + 0.3)[\frac{w}{h} + 0.264]}{(\varepsilon_{reff - 0.258})[\frac{w}{h} + 0.8]}$$

$$\varepsilon_r = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}[1 + 12\frac{h}{w}]^{\frac{-1}{2}}$$

Where
Effective length of patch is given as:

$$L_{eff} = \frac{c}{2 f_r \sqrt{\varepsilon_{reff}}}$$

Length of the patch is given as:

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

Radius of the two triangles is given as:

$$a = \frac{F}{[1 + \{\frac{2h}{\pi \varepsilon_r F}\}\{\ln(\frac{\pi F}{2h}) + 1.7726\}]^{\frac{1}{2}}}$$

$$F = \frac{8.791 * 10^9}{f_r \sqrt{\varepsilon_r}}$$
,

Effective Radius is given as:

$$a_e = a[1 + (\frac{2h}{\pi a \varepsilon_r})(\ln(\frac{\pi a}{2h}) + 1.7726)]^{\frac{1}{2}}$$

## III.SIMULATION RESULTS

3.1 : - Return loss:
The phenomenon of propagation of signal reflected back when impedance mismatch occurs. The better the return loss the better output can be obtained. The return loss is calculated as

$$RL = -20\log_{10}^{|\Gamma|}(dB)$$

The Simulated results $s_{11}$ of the designed antenna are -37.28(dB),-25.6418(dB) and -15.3152(dB) at 22.8 GHz, 34.1 GHz and 56.4 GHz Respectively

3.2 : -VSWR
It shows how much power is reflected back from the antenna. It is a function of .It is Expressed as

$$VSWR = \frac{1 + \Gamma}{1 - \Gamma}$$

The Simulated results of VSWR are 1.0272,1,1102 and 1.414 at 22.8 GHz, 34.1 GHz and 56.4 GHz.

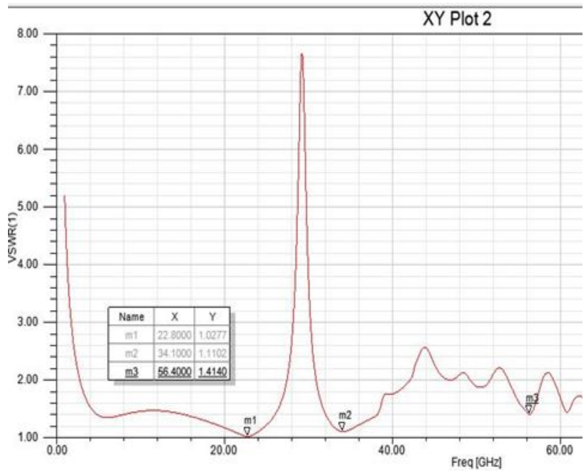



Figure 3.2: Voltage Wave Standing Ratio

3.3: - Gain:
It is nothing but amount of power transferred in that direction. Here we got a gain of total 7.0326dB.

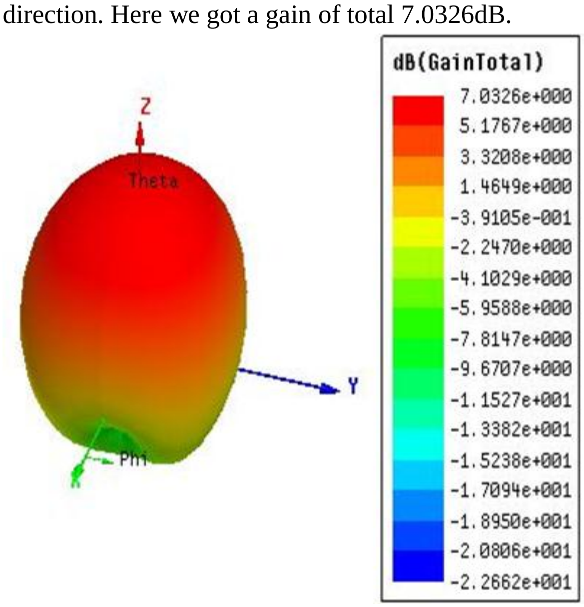



Figure 3.3: Total Gain of this Antenna

## IV.CONCLUSION

The designed Wide Band antenna occupies less volume and has better gain and return loss compared to other recently designed antennas. These are capable of operating at K band, Ka band and U band which is millimeter band with bandwidth ranging 24.3 GHz, 10.5 GHz and 3.5 GHz with Operating frequencies at 22.8GHz, 34.1GHz and 56.4GHz Respectively. The designed antenna is mostly preferred for Space Research, Mobile services, Radio Astronomy, Earth exploration satellite etc.

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