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# Irregular Pentagonal Patch Antenna For L Band Application

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***Abstract-*** *In this paper, we designed a Irregular pentagonal shape patch antenna for L-band application. The designed antenna simulate on IE3d software at 1.8 GHz (L-band) frequency calculated the bandwidth 63.68 % and maximum return loss is -17dB . And the gain is near about to 4dBi ,the design is best suited for L band application.*

***Keywords- Irregular, pentagonal, microstrip patch, cutting slot, coaxial feed.***

## 1. INTRODUCTION

Microstrip patch antennas are very popular for modern communication system due to their compact size, low cost and ease of fabrication[1]. Microstrip antennas geometries are rectangular, circular , triangular and many more shaped structures have been reported [2]. The advantages of patch antennas are that they radiate with high gain in a direction perpendicular to the substrate. Efficiency and bandwidth of a patch antenna depends upon many factors like as patch size, substrate thickness, dielectric constant of substrate, feed point type and its location, etc. For good antenna performance, a thick dielectric substrate having a low dielectric constant is desirable for higher bandwidth, better efficiency and better radiation [3-5]. Circular or rectangular microstrip patch has been modified for some applications to other shapes. Irregular Pentagonal shape microstrip antenna has smaller size for a given frequency. The small size is an important requirement for portable communication equipments [6-9]. Coaxial probe feed is used for the antenna feeding . IE3d simulation software is used for simulation of antenna . IE3d software is a fully featured software package for electromagnetic analysis and design in the high frequency range.

## 2. ANTENNA DESIGN USING IE3d

The length and width of rectangular patch antenna are calculated from below equations. Where c is the speed of light, $\varepsilon_r$ is the dielectric constant of substrate. First we calculate the width of patch ($W_p$) by using specified formula than calculate length of patch ($L_p$) by using some specified formulas. The calculated Wp and Lp are 50.6mm and 39.4mm respectively at 1.8 GHz.

**Ground plane dimensions**

Ideally the ground plane is assumed of infinite size in length and width but it is practically impossible to make a such infinite size ground plane, so to calculate the length and width of a ground plane followings equations are given as:

$$L_g = L_p + 6h(mm) = 49.0mm$$
$$W_g = W_p + 6h(mm) = 60.2mm$$

**Determination of feed point location**

**($X_f$ , $Y_f$):** A coaxial probe type feed is to be used in this design. The center of the patch is taken as the origin and the feed point location is given by the co-ordinates ($X_f$ , $Y_f$) from the origin. The feed point must be located at that point on the patch, where the input impedance is 50 ohms for the resonant frequency. Hence, a trial and error method is used to locate the feed point. For different locations of the feed point, the return loss (R.L) is compared and that feed point is selected where the R.L is most negative . The feed point of the proposed geometry is $X_f$ =44.2mm and $Y_f$ =30.1mm.

**Table 1.** Proposed antenna Design parameters

| Design of Micro strip patch antenna | Design 1. Software base |
|---|---|
| Pattern | Irregular pentagonal |
| Frequency $f_o$ (GHz) | 1.8 GHz |
| Dielectric constant | 4.4 |
| Loss tangent § | .0012 |
| Height of the dielectric material h (mm) | 1.6mm |
| Width of the ground ($W_g$) | 60.2mm |
| Length of the ground ($L_g$) | 49.0mm |
| Width of the patch ($W_p$) | 50.6mm |
| Length of the patch ($L_p$) | 39.4mm |

**Proposed Antenna Design**

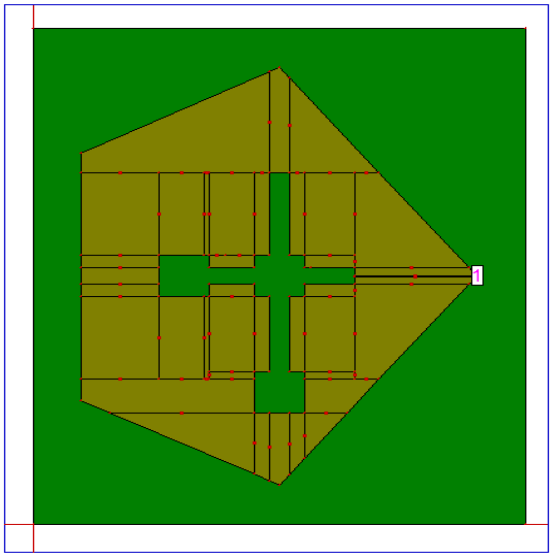

**Fig.1**- proposed antenna geometory

The proposed geometry coordinates on X,Y planes are(mm) 4.8,4.8 ;24.5,4.8 ;44.2,30.1 ;24.5,55.4 ;4.8,45 ;4.8,15,and the first cut slot on 24.5,30.1(cut 15,2mm) ,second slot on 24.5,30.1(2,25 mm),third slot on 24.5,30.1(5,5mm),fourth slot 24.5,16(5,5mm),fifth slot 15,17(5,5mm) and the feed point is 44.2,30.1mm.

## 3.IE3D SIMULATED RESULTS

After simulation the proposed antenna we get various results. All these various results are shown in figure.

**Frequency Vs Return Loss**

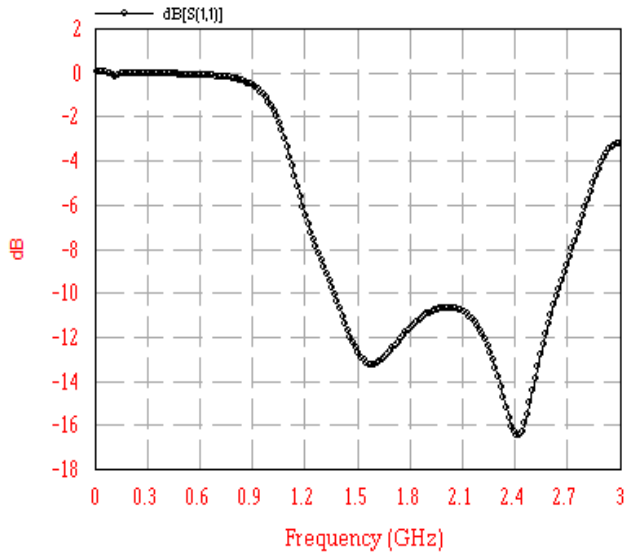


**Fig.2**- Frequency Vs Return Loss

**Frequency Vs VSWR**

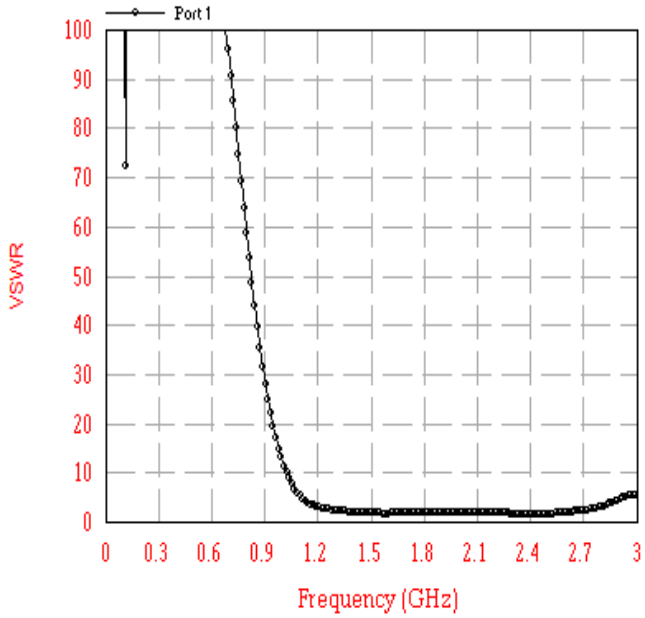


**Fig.3**- Frequency Vs VSWR

**Gain Vs Frequency**

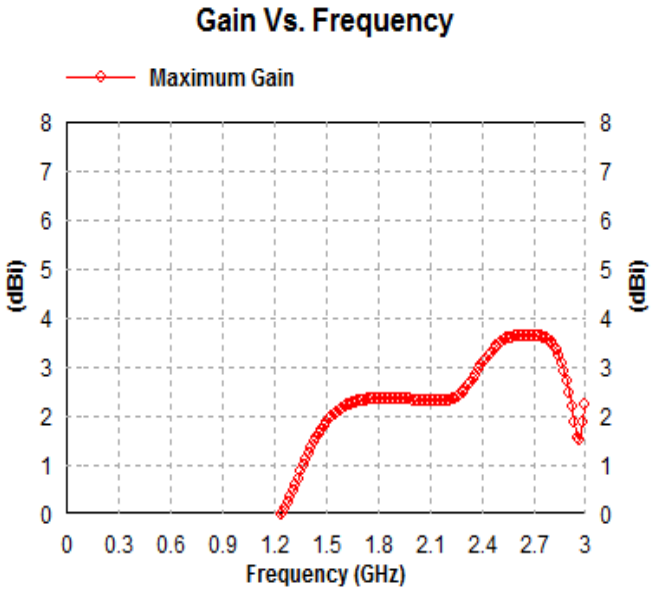


**Fig.4** - Gain Vs Frequency

**Directivity Vs Frequency**

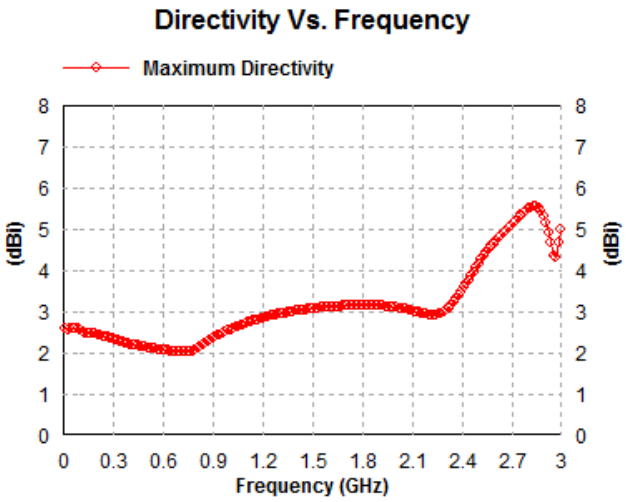


**Fig.5**- Directivity Vs Frequency

**Efficiency Vs Frequency**

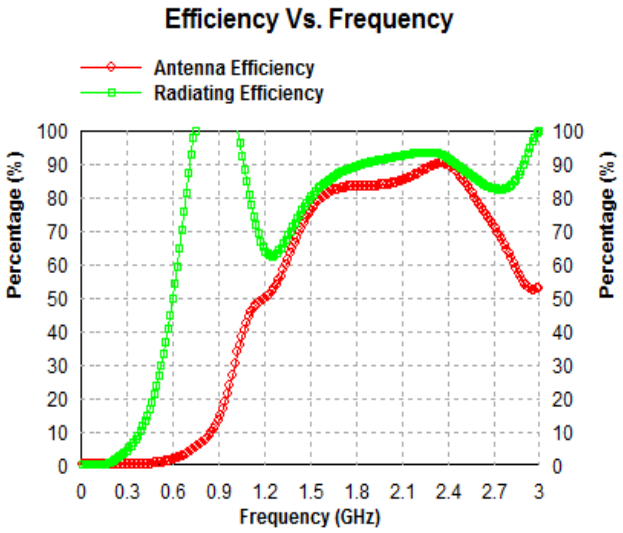


**Fig.6**- Efficiency Vs Frequency

### 3D View of proposed geometry

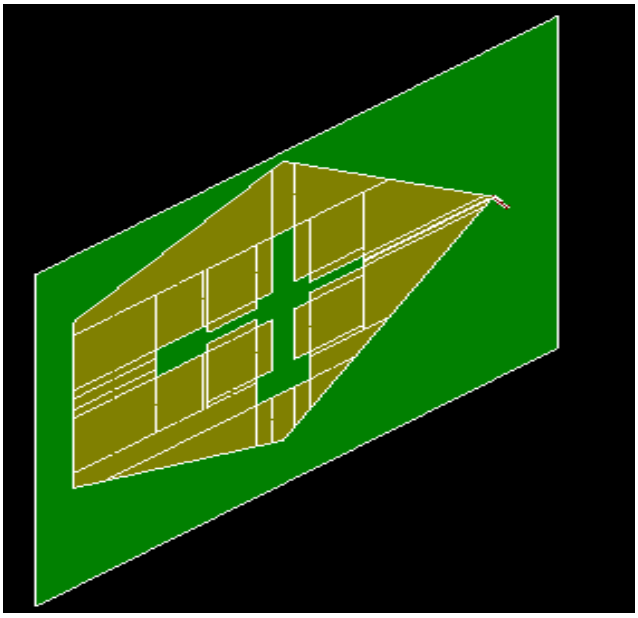

**Fig.8**-3D View of proposed geometry

### Radiation Pattern

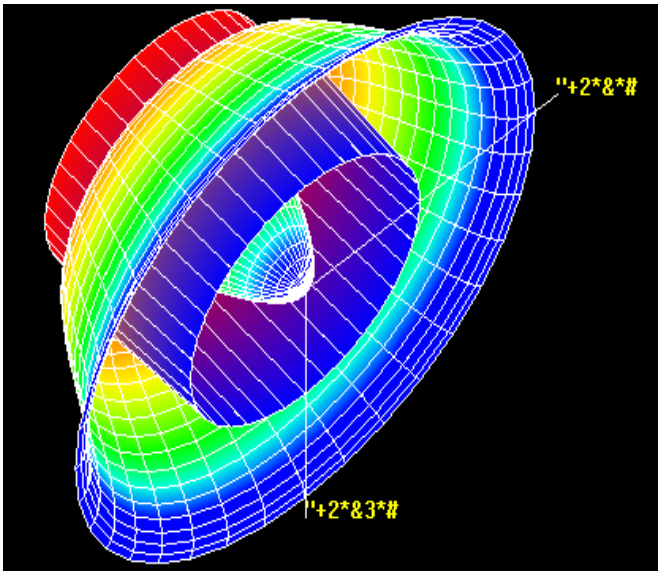


**Fig.7**- 3D View of radiation pattern

### SmithChart

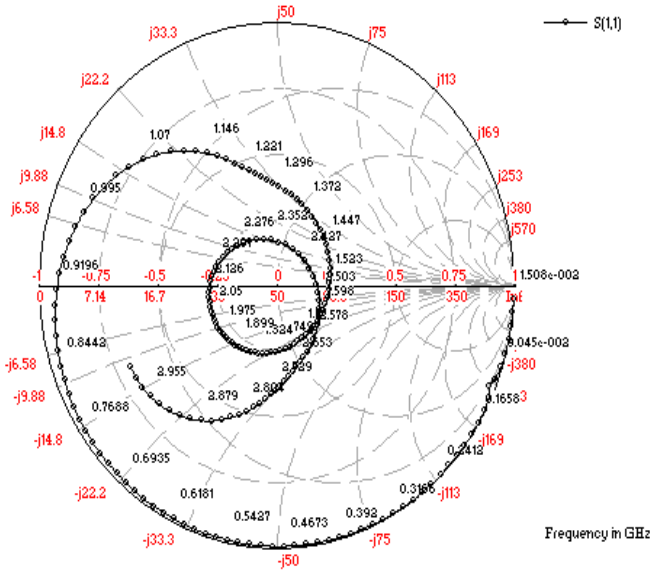


**Fig.9**- Smith Chart

## 2D radiation pattern

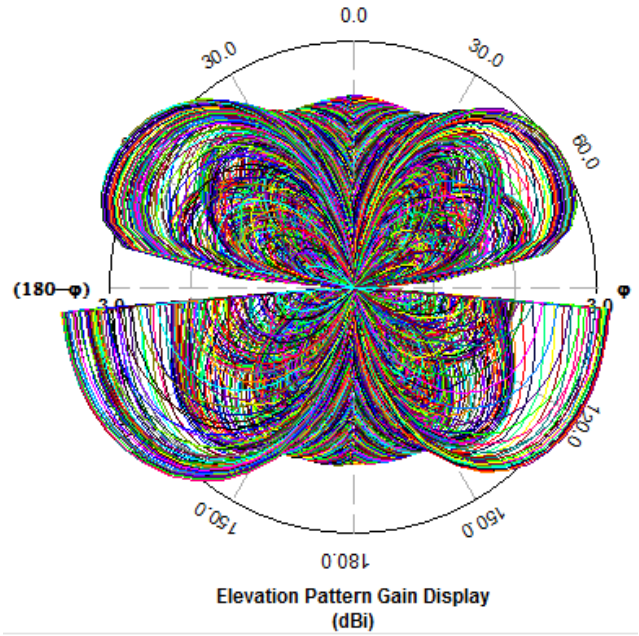


**Fig.10**- 2D radiation pattern

**Table 2.** In the table explore the output results

| IRREGULAR PANTAGONAL MICROSTRIP PATCH | BAND WIDTH | RETURN LOSS |
|---|---|---|
| | 63.68% | -17dB |

## CONCLUSION

In the paper, we have design an irregular pentagonal Shape Microstrip Patch antenna on 1.8GHz ( for L-band) . The proposed antenna is designed on a GLASS EPOXY Substrate dielectric constant 4.4 and we got a bandwidth of 63.68% which is very high and also measured high antenna and radiation efficiency of 90% to 95% . The antenna applicable for the satellite and navigation .

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