

### Design and Simulation of Dual U Shaped Slot Patch Antenna for C Band Using IE3D Software

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**Abstract:** The aim of this paper is to design a Slot Patch Antenna with enhanced gain and bandwidth and study the effect of antenna dimensions Length (L), Width (W) and substrate parameters relative Dielectric constant( $\epsilon_r$ ), substrate thickness on antenna gain and bandwidth. In this paper a proposed structure of Dual U shape slot patch antenna for high frequency application is design and simulated. The antenna is designed for operating frequency 8 GHz and dielectric constant 2.6 by using IE3D simulation software. Proposed antenna is designed for satellite communication.

**Keywords:** Slot Patch Antenna, Return Loss, Dual U shaped patch antenna, VSWR, IE3D.

#### I. INTRODUCTION

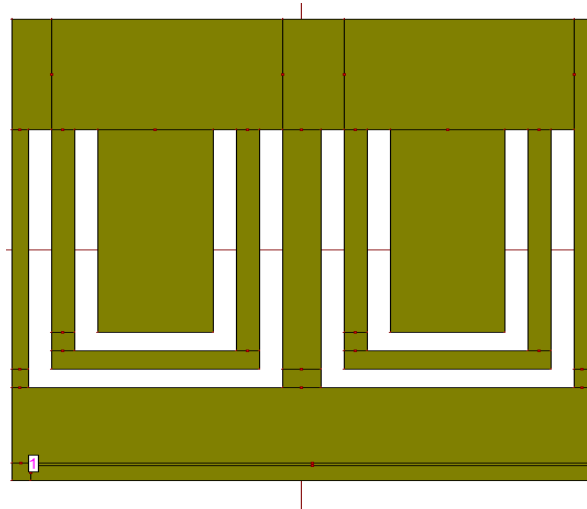
The parameters design and results in this paper for a Dual U shaped slot patch antenna in IE3D software is explained and the results obtained from the simulations .The slot patch design is achieved by using Coaxial Feed technique. After done simulation that there is increase in bandwidth using propose antenna and using Coaxial Feed at position where maximum matching is obtained. The proposed antenna is designed and simulated using IE3D full wave electromagnetic simulation software from Zeland. To increase antenna efficiency and gain a low loss material should be used to fabricate the patch.

#### II. ANTENNA DESIGN PROCEDURE

The geometry of dual u shape microstrip patch antenna with different parameters. The antenna is designed and fabricated on a substrate with a dielectric constant( $\epsilon_r$ ) 2.6, a thickness(h) 1.524 mm and loss tangent ( $\tan\delta$ ) 0.0025. The dielectric material which is used here is epoxy resin material because of its value of tangent loss and dielectric constant. The properties which are considered are dielectric constant, loss tangent, frequency, stability, thickness etc.



**Figure 1. Proposed antenna geometry with Coaxial Feed at x,y(-17.5,-17.5)**



**Figure 2. Proposed antenna geometry with Coaxial Feed at x,y(-17.5,-17.5)**

### III. DIMENSION OF ANTENNA

The calculated values of the antenna geometry

Dual U slot patch antenna	Dimension	Unit
Height	1.524	mm
Loss tangent	0.0025	-
Dielectric constant	2.6	-
Length(L) of horizontal slot	16.5	mm
Length(L) of horizontal slot	10.5	
Width(W) of horizontal slot	1.5	mm
Width(W ) of horizontal slot	1.5	
Length(L) of vertical slot	19.5	mm
Length(L) of vertical slot	16.5	
Width(W) of vertical slot	1.5	mm
Width(W) of vertical slot	1.5	mm
Radius of feed	.1524	mm
Feed Point	-17.5,-17.5	-

Width of the patch:

$$W = \frac{c}{2f_o} \sqrt{\frac{2}{\epsilon_r + 1}}$$

Effective dielectric constant:

$$\epsilon_{eff} = \frac{\epsilon_r + 1}{2} - \frac{\epsilon_r - 1}{2} \left( 1 - 12 \frac{h}{W} \right)^{-\frac{1}{2}}$$

Effective length of the patch:

$$L = \frac{c}{2f_o \sqrt{\epsilon_{eff}}}$$

Delta length or length extension:

$$\Delta L = 0.412h \frac{(\epsilon_{eff} + 0.3) \left( \frac{W}{h} + 0.264 \right)}{(\epsilon_{eff} - 0.258) \left( \frac{W}{h} - 0.8 \right)}$$

Actual length of patch :

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

Where parameter:

$c = 3 \times 10^8$  m/s and  $h$  is the thickness of the substrate characteristic impedance in terms of height.

#### IV. SIMULATED RESULT

The feature of the proposed antenna is analyzed using the Zeland IE3D software. The IE3D is an integrated full wave electromagnetic simulator and optimization package for the analysis and design of the patch antenna. The simulated results are shown in the figures below.

##### 4.1 U- shape slot patch antenna

The VSWR is 1.02 at the frequency 8 GHz which is in the C band. The ideal value of the VSWR is 1. My simulated VSWR is under the acceptance level and can be used in various applications in the C-band region such as for large ships that traverse the oceans, terrestrial microwave links. VSWR shows good impedance matching between the feed line and antenna in fig. 3 shows the VSWR curve.

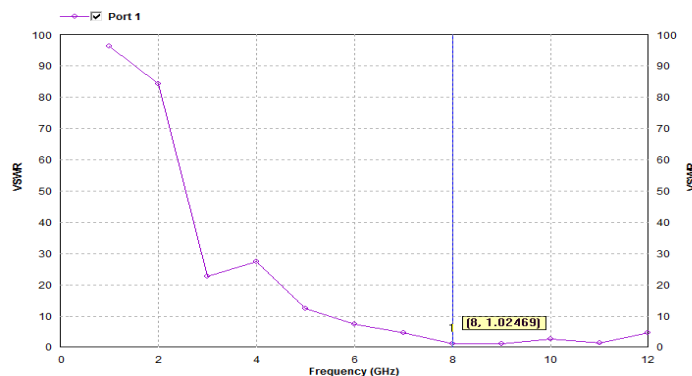
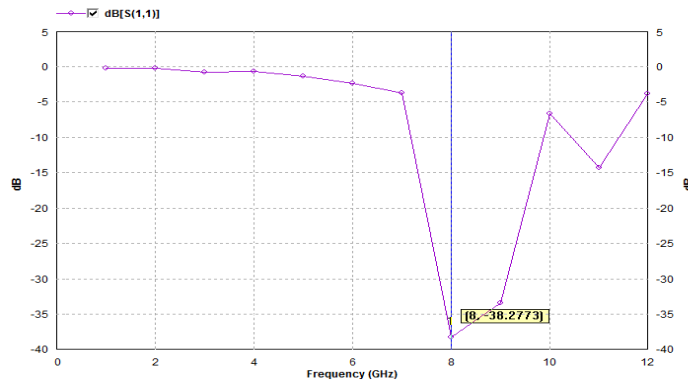


Figure 3. Simulated VSWR Curve

The VSWR is obtained in this design is 1.11 at the frequency of 8. Return loss is related to both standing wave ratio and reflection coefficient. Increasing return loss corresponds to lower VSWR. Return loss is a measure of how well devices or lines are matched. A match is good if the return loss is high.

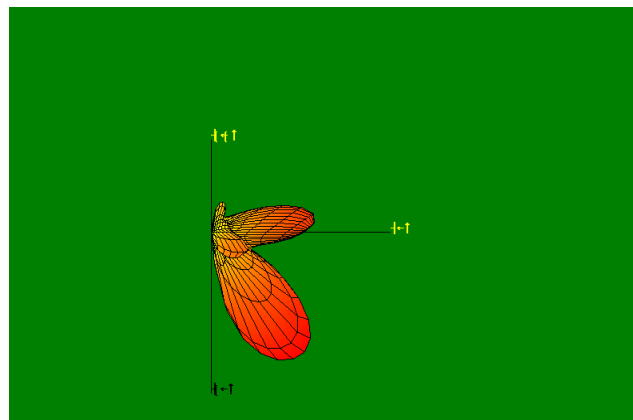
$$RL = -20 \log_{10} |\Gamma|$$

The value of return loss is -38.4 dB at 8 GHz. It shows the amount of power which is lost to load and doesn't return after reflection. In fig. 4 shows the return loss curve. Bandwidth of antenna is range of frequencies within which performance of antenna with respect to different characteristics conforms to specific standard. The calculated bandwidth from return loss versus frequency plot at frequencies 8 GHz is 2.8 GHz.



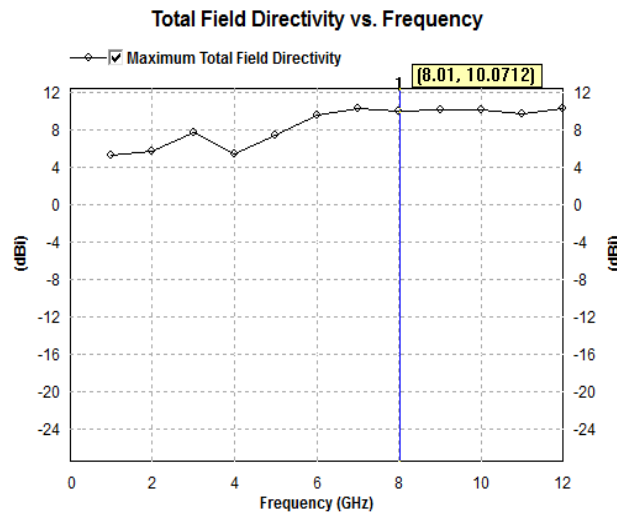
**Figure 4. Simulated Return Loss Curve**

In fig.5 shows the radiation pattern of Dual U shaped slot patch antenna. Antenna radiation pattern is defined as “spatial distribution of quantity which characterize electromagnetic field generated by an antenna 3D radiation pattern of Single Four H band slot patch antenna at frequency resonates at 8 GHz.



**Figure 5. Simulated Radiation pattern Curve**

In fig 6 shows the directivity of dual U shaped slot patch antenna..Directivity of proposed antenna resonates at frequency 8 GHz and simulated value for directivity is 10 dB.



**Figure 6. Simulated Directivity Curve**

## V. CONCLUSION AND RESULT

Using a coaxial feed technique design for U shape slot patch antenna. Analysed dual U shape slot patch antenna with return loss is -38.4 dB & bandwidth is 2.8GHz. The return loss of the dual U shape slot patch antenna is -38.4 dB that is good for analysed the different properties of slot patch antenna. In case of Dual U slot antenna 49.6% radiation efficiency. This antenna find application in C band spectrum like in military communication satellites, Terrestrial communications, terrestrial microwave links.

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