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A Novel Hexa-triangle Dual-Band Antenna

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ABSTRACT: In this paper , a dual band antenna designed using a novel slot formed by merging the alternate sides of hexagon with the triangles is inserted in the circular patch to obtain the dual band operation. The antenna is designed on FR4 with overall size of 53x36x1.6mm and the dielectric substrate is εr=4.4. The performance is analyzed using High Frequency Structure Simulator (HFSS). The proposed CPW fed, low profile antenna offers good performance in 2.09GHz -2.27GHz and 4.01GHz- 4.45GHz

I.INTRODUCTION

In recent days, UWB is widely renowned short range wireless communication technology that will provide high data rate with lower power consumption. UWB provides the ease and flexibility of wireless communication to high speed interconnects in WPAN and WBAN.UWB communication is different from other architectures, personal communication devices are required to operate at multiple frequency to enhance different applications. In addition to multiband operation, it is necessary that the antenna is small with light weight, low profile and easy integration with other devices. According to Federal Communication Commission (FCC) the unlicensed band allotted for UWB communication or Detection is 3.1GHz-10.6GHz.[1]. There are various studies on UWB micro strip antenna. In [2] , a printed monopole micro strip patch antenna with a sharp triangular patch of five steps has been introduced to increase the large bandwidth and to get constant radiation characteristics over the wide frequency range. In[3], the dual band antenna is obtained with the radiation efficiency of 83.5%. Co-planar waveguide feed antennas are very eager in rapid development of wireless communication due to their wideband characteristics.[4]-[6]. The dual band characteristics are obtained by single tri-arm resonator[7] In this paper a dual band antenna with CPW feed is introduced for various applications. The antenna designed to enhance at the frequency of 2.09GHz -2.27GHz and 4.01GHz- 4.45GHz mainly used in mobile applications. The basic structure behind this antenna is a circular monopole antenna, in which the dual band is obtained by framing the opposite sides of hexagon is connected to the circular patch by means of triangles. In this paper the section II discuss about the basic of dual band antenna design . Section III discuss about the obtained results. Section IV discuss about the result and conclusion. Section V discuss about the future work.

II. DUAL BAND ANTENNA DESIGN

The antenna is fed by CPW on a substrate of size WxL. The substrate used is of h=1.6mm thickness and the relative dielectric constant is εr=4.4. with the loss tangent of 0.02.the feeding is given at a distance “g” from the ground plane of length Lg and width of the ground plane is Wg. The width of the CPW feed line is Wf. The basic patch is shown in the figure1.

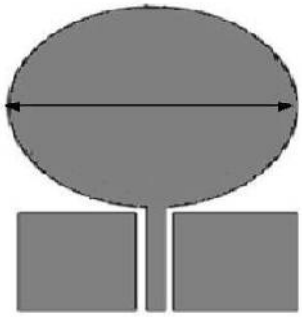

Figure1: Basic Patch

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The proposed antenna is developed by following method, first a circular patch is designed with the diameter of 17mm which is to cover UWB range and which is spaced at a distance of 1mm from the ground conductor. The dimensions of patch is given in the table1.

Table1: Dimension of Patch

Parameter	Dimensions (mm)
L	51
W	34
D	34
L_s	16.7
g_s	1
W_f	3

Then the hexagonal slot is inserted in the patch, the slot inserted in the patch has a perimeter that is an integer multiple of quarter wavelength evaluated as

$$n\frac{\lambda_g}{4} = \frac{nc}{4 f_r \sqrt{\varepsilon_{reff}}}$$

Where c is the free space velocity, fr is the resonant frequency and the εreff is the effective dielectric constant of the substrate given by the approximate formula

$$\varepsilon_{reff} = \frac{\varepsilon_r}{2} + \frac{1}{2}$$

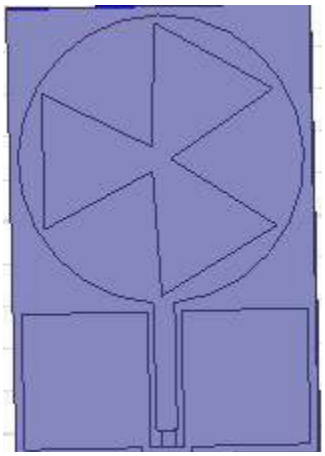

Figure2 : Structure of designed antenna

The parameters Lg, Wg, Wf, g and s affects the impedance matching in the UWB range, but they are optimized for wideband response in the initial circular patch itself. The dimensions of ground surface is given in the table2.

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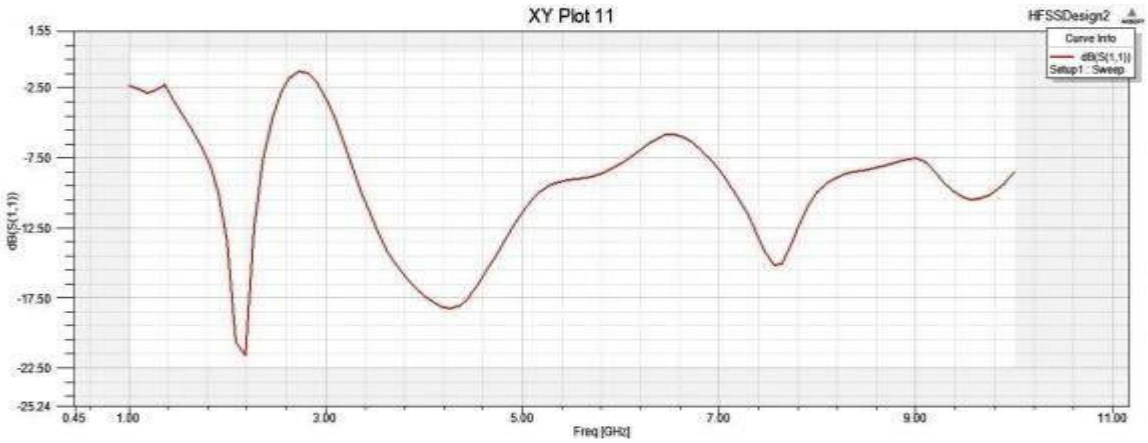
Table2: Dimensions of Ground Plane

Parameter	Dimensions (mm)
Lg	16
Wg	15
g	0.5
s	1

The designed antenna is shown in figure2

III. RESULTS

The experimental results are listed below with the following figures. The Figure 3 shows that the dual band operation is at frequency range of 2.09GHz -2.27GHz and 4.01GHz-4.45GHz.



Figue3: Frequency Vs Return Loss

The table3 describes the return loss for the various frequency range in the two different bands. Lower return loss value will increase the performance of the antenna. The maximum gain of the antenna is around 4.2073dB, which is shown in the figure4. The VSWR measurement for this antenna is shown in the figure5 , which explains that at which frequency the minimum VSWR is obtained.

Table3: Frequency Vs Return Loss

Frequency in GHz	S_{11} in dB
2.09	-20.63
2.18	-21.63
2.27	-12.44
4.01	-17.28
4.09	-17.76
4.18	-18.09
4.27	-18.18
4.36	-17.95
4.45	-17.38

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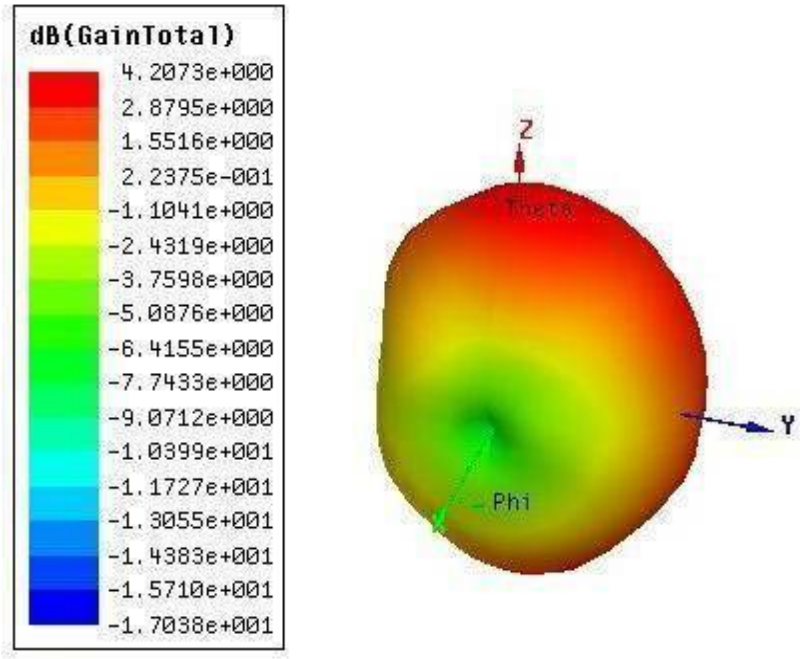
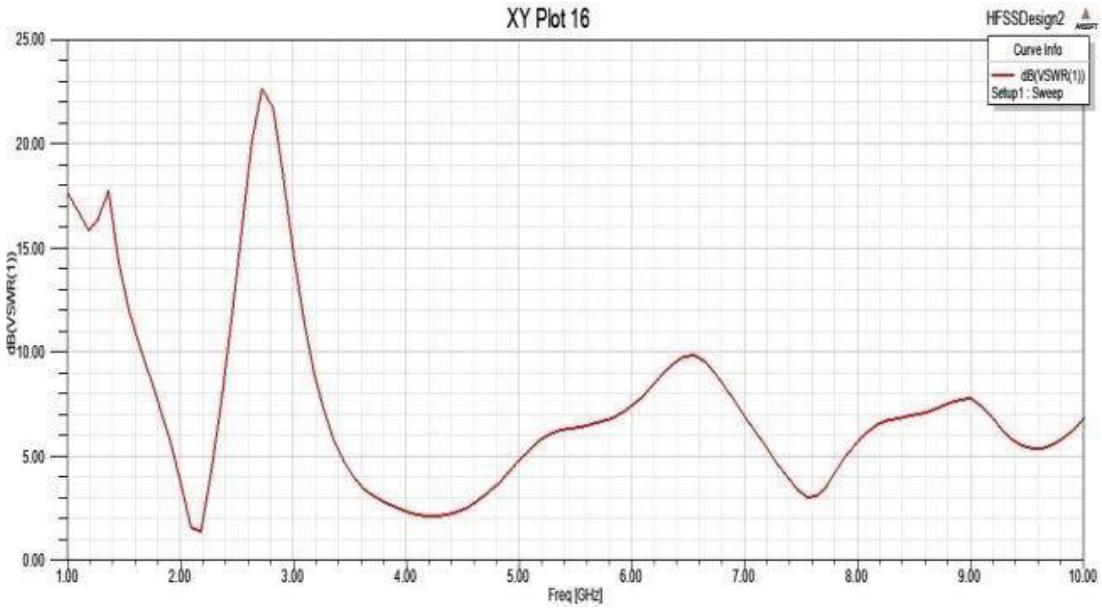


Figure 4 : Gain measurement in dB



Figue 3: Frequency Vs Return Loss Figure5: Frequency Vs VSWR

IV. CONCLUSION

A conventional circular monopole is used to obtain the UWB range, in which a novel method is used with hexagonal slot in which triangles are merged in the opposite direction, a dual band operation is obtained. The antenna produces the maximum gain of 4.2073dB and produces good return loss and suitable for dual band operation.

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V. FUTURE WORK

In future this may be developed for multiband operation by including the different slots or varying the structures and gain is to be increased but size , weight is further reduced by using fractal technologies

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