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Irregular Hexagonal shaped antenna for UWB Applications

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Abstract*: This paper presents the design of a microstrip line fed irregular hexagonal shaped monopole antenna. The antenna consists of a sliced semi-circular ground plane with a square slit below the feed line which exhibits an Ultra Wide Band (UWB) of 7.5GHz. A frequency notch band (5.1GHz – 5.57GHz) is obtained by introducing 'U' shaped slot on to the proposed antenna. The proposed monopole is fabricated, measured for reflection coefficient, radiation pattern and peak gain to validate the performance of the antenna.

***Index Terms*: Defected ground structure, Hexagonal shaped antenna, Modified ground plane, Monopole antenna, UWB antenna.**

I. INTRODUCTION

In modern wireless communication systems, it is required to design antenna with wide band characteristics. Microstrip antennas are widely used in wireless communication systems because of small size, low cost and light weight. These antennas suffer from narrow bandwidth [1]. So many researchers attempted to design various broad band antennas. Patch antennas with a defected ground structure improves its performance in terms of various parameters [2]. A triangular shaped antenna with truncating ground plane and slits in the patch is designed to achieve UWB characteristics [3]. Introducing parasitic elements to a patch antenna enhances its bandwidth [4] and techniques to enhance bandwidth of a microstrip antenna are available in the open literature [5-10]. In this paper a simple irregular hexagonal (all angles and all sides are not equal) shaped Microstrip antenna with UWB is designed, fabricated and measured for return loss, radiation pattern and peak gain.

II. PROPOSED ANTENNA DESIGN

The proposed antenna is a modification to the basic square monopole antenna; the two opposite corners of a square patch are truncated to form an irregular hexagon. Modification is also introduced in the ground plane and it is fed with a microstrip line at one of its corners as shown in fig. 1. The geometrical aspects are mentioned in table I.

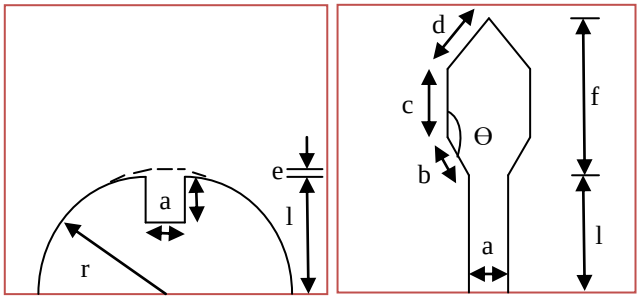

Fig. 1. Rear and front view of proposed antenna

Consider a sliced semi-circular ground plane (peak of the semicircle is clipped off) with a square slit exactly below the feed line. The diameter of the semicircle is less than the width and length of the substrate (60mm and 65mm) and the radius of semicircle after slicing is equal to the length of the feed line. This modification in the ground plane exhibits UWB characteristics. Based on the simulated results, a corner fed irregular hexagonal monopole with sliced semi-circular ground plane and a square slit can act as an ultra wide band antenna. The proposed antenna is designed on an FR4 epoxy substrate with ε_r=4.4 and thickness of 1.6mm. The rear view and front view of irregular hexagonal shaped monopole are shown in figure 2.

Table I. Parameters of the monopole

S No.	Parameter	Dimensions
1	a	4mm
2	b	8.485mm
3	c	22mm
4	d	11.384mm
5	e	3mm
6	f	36mm
7	l	20mm
8	r	23mm
9	Θ	135^0

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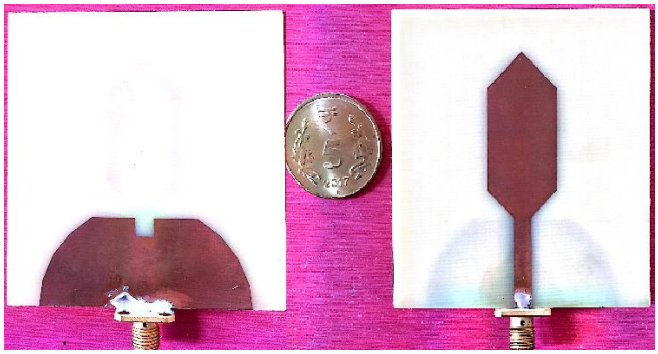


Fig. 2. Rear and front view of hexagonal monopole

III. RESULTS & DISCUSSION

The proposed antenna was simulated using HFSS 18.0 software, from the simulated results, return loss of irregular hexagonal antenna with sliced semi-circular ground plane and a slit exhibits wide band characteristics as shown in figure 3.

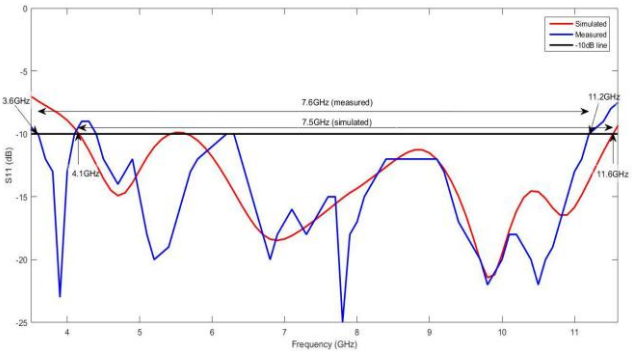
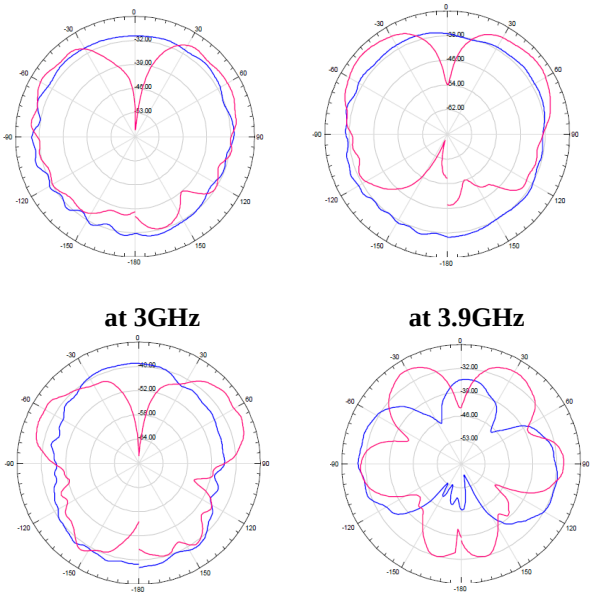


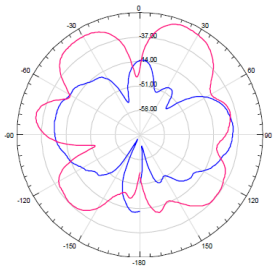
Fig. 3. S_{11} of the irregular hexagonal monopole.

The measured radiation pattern at frequencies 3GHz, 3.9GHz, 5.2GHz, 7.7GHz and 9.8GHz are shown in figure 4.



at 3GHz **at 3.9GHz**

at 5.2GHz **at 7.7GHz**



at 9.8GHz

Fig. 4. Measured E-plane (red), H- Plane (blue) pattern

E-plane radiation has directional pattern and H-plane radiation has nearly Omni-directional pattern. At higher frequencies there is a deviation in the radiation pattern. The peak gain of irregular monopole antenna is given in fig. 5.

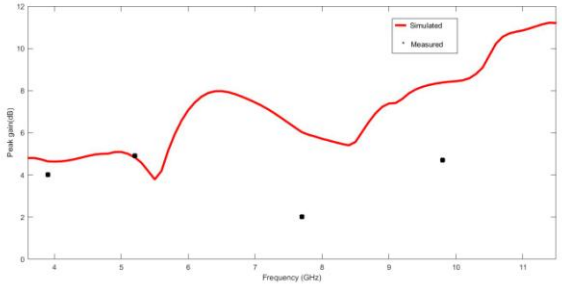


Fig. 5. Peak gain of the monopole antenna.

Frequency notch band is obtained when a 'U' shaped slot is introduced on the hexagonal shaped monopole as shown in fig. 6 and fig. 7 shows its reflection coefficient with respect to the proposed antenna. The geometry of the slot on the hexagonal monopole is given in table II.

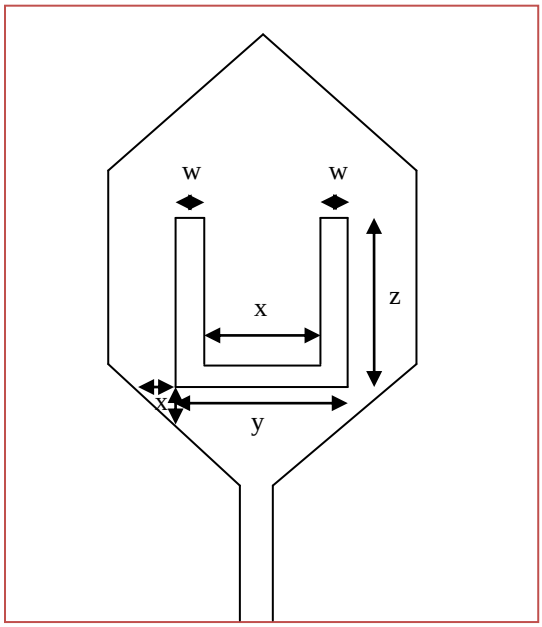


Fig. 6. Geometry of slot introduced on the patch

Table II. Parameters of the slot

S No.	Parameter	Dimensions
1	w	1mm
2	x	2mm
3	y	4mm
4	z	8mm

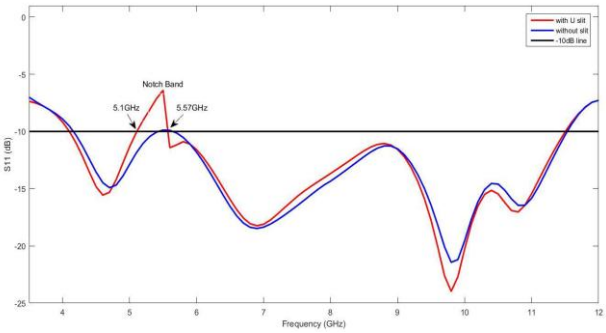


Fig. 7. Measured S_{11} of monopole without and with slot.

IV. CONCLUSION

A simple irregular hexagonal shaped patch antenna with modified ground plane is designed, simulated, fabricated and measured for return loss, radiation pattern and peak gain. The measured results proved that the proposed antenna exhibits UWB characteristics over a band of frequencies from 3.6GHz to 11.2GHz. Hence it is suitable for UWB applications. The proposed antenna can be used to control interference in the frequency band from 5.1GHz to 5.57GHz.

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