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COMPACT DESIGN OF HEXAGONAL MONOPOLE ANTENNA FOR UWB APPLICATIONS

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ABSTRACT
In this paper, we are presenting a compact design of planar Hexagonal micro-strip patch antenna connected to an offset micro-strip feed line for ultra wideband applications. A rectangle shaped slot on the ground plane increase the impedance bandwidth. The proposed antenna designed on FR4 substrate with dielectric constant of 4.4 and loss tangent is 0.02. The antenna is designed on a 3D EM simulator and the overall size of the antenna is 33x35.5x1.6 mm^3.

I. INTRODUCTION

In 2002, FCC permits a 3.1-10.6 GHz frequency as unlicensed band of transmission [1]. The bandwidth of unlicensed band is 7.5 GHz. This UWB mainly used for short range communication up to few tens of meters with high data rate without influence on other systems. UWB system commonly used due to bits features like as low cost, low spectral power density and channel capacity. Due to the extremely large bandwidth of UWB, the interference between the narrow band and UWB system is major challenge in UWB. Different shapes of slot such as rectangle, circle, elliptical, bevelled, tapered has been used for enhancing wide impedance bandwidth.

In [2-4] several experiments have been carried out by the researchers to achieve wide impedance bandwidth of small planar antenna. .In [5], an inverted T shaped conductor backed plane was used inside rectangular shaped slot on bottom layer which achieved UWB span from 3.04-10.87 GHz. CPW fed corners of rectangular tuning stub with two semi circular slots were etched to improve the bandwidth [6]. A rectangular radiating patch was etched on front side of substrate [7] and tapered slot was cut from bottom side of substrate on ground plane, achieved an over -10 dB frequency bandwidth from 3.04-10.87 GHz. An inverted T shaped slot was cut in the square radiating patch and inverted T shaped conductor backed plane was used for enhancing wide impedance bandwidth in [8].

In our paper, a hexagonal patch antenna is proposed for UWB applications. Bandwidth of this proposed antenna is effectively improved by taking hexagonal patch and DGS (Defected Ground Structure) based ground. The rectangular ground is etched with rectangular slot then this ground plane like 'L' shaped ground. The proposed design is best suitable for different UWB applications. The paper organizes that the second chapter deals with the antenna design and in third chapter includes the simulation results and analysis and in the fourth chapter deals with conclusion and future scope.

II. ANTENNA DESIGN

The rectangular patch antenna with defected ground structure shown in fig 1 is taken as the basic antenna. The substrate used for designing the antenna is FR4 with dielectric constant 4.4 and loss tangent 0.02. The overall size of the antenna is 33 x 35.5 x 1.6 mm^3. The antenna design dimensions are tabulated in table 1. In the basic design of the fig 1 the rectangular patch is replaced with the hexagonal patch antenna and is shown in fig.2 as a proposed antenna. The rectangular patch is replaced with hexagonal patch due to increase in the bandwidth. For proposed antenna the ground is DGS based ground shown in fig.1 and the size of the each side of the patch is 9 mm.

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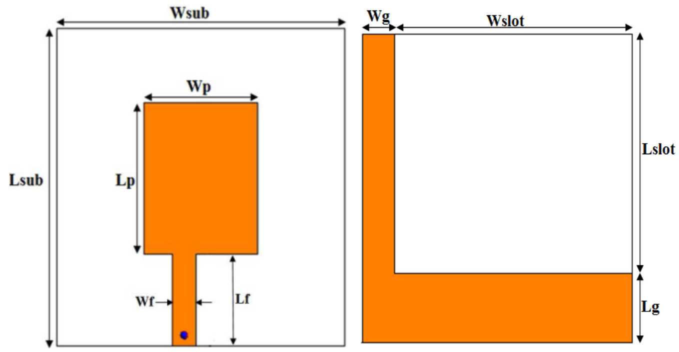

(a) Front view (b) Back View

Fig 1: Geometry of the basic design of rectangular patch antenna

Table 1: dimensions of the antenna

S.No	Parameter	Dimensions(mm)
1	Wsub	33
2	Lsub	35.5
3	Wp	12
4	Lp	16
5	Wf	2.8
6	Lf	10.25
7	Wslot	31.5
8	Lslot	26.5
9	Wg	1.5
10	Lg	9

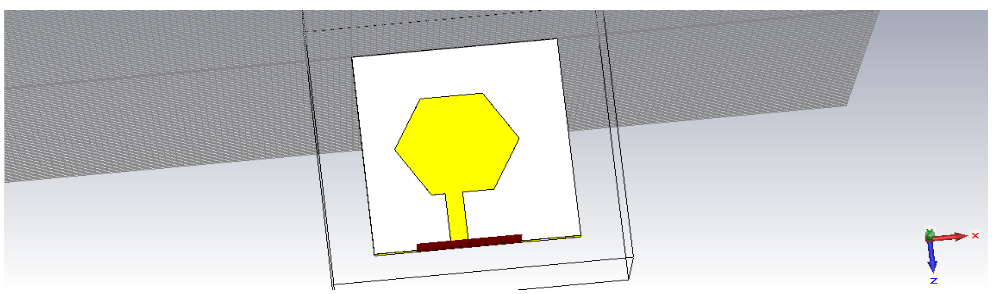

Fig 2: proposed Antenna design

III. ANTENNA ANALYSIS AND RESULTS

The fig 3 and fig 4 shows the basic rectangular patch antenna with L = 16 mm and W = 12 mm and the substrate is FR4 and the full ground plane is used with dimensions 35.5 x 33 mm^2. The designed antenna is simulated using the 3D EM Simulator. The fig 5 and 6 shows the return loss and vswr parameter of the simulated antenna. The results are not suitable for any uwb antenna applications for enhancing the bandwidth we introduce the DGS based ground structures. The rectangle is etched

In the ground plane is shown in fig 7. For this resultant the design is simulated get the return loss value of less than -10 db from frequencies 5.5 GHz-10 GHz. The operating band is not suitable for UWB applications. fig 8 and 9 shows the return losss and VSWR of the Rectgular patch with U shaped ground plane antenna .

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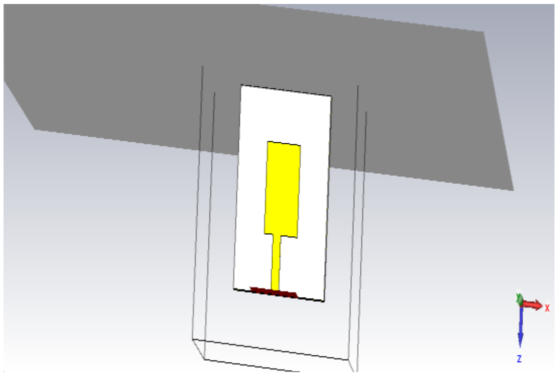

Fig 3: Front View of the designed antenna

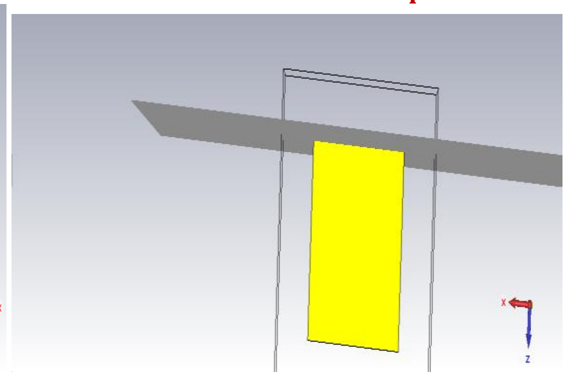

Fig 4: Full ground plane

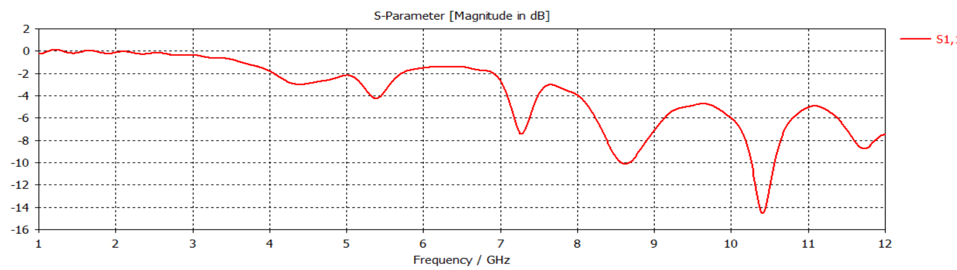

Fig 5: Return loss rectangular patch with full ground

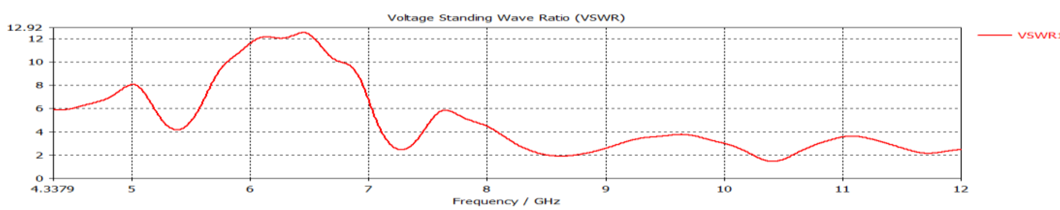

Fig 6: VSWR of rectangular patch with full ground

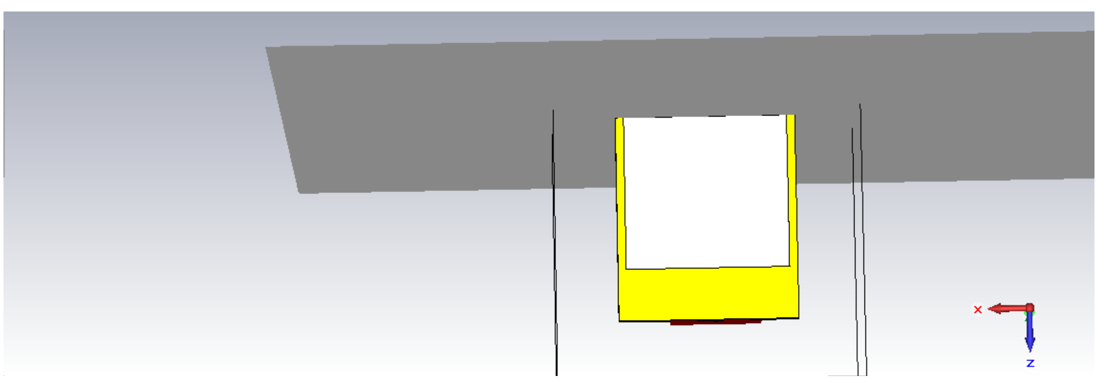

Fig 7: removing U slot in the ground plane

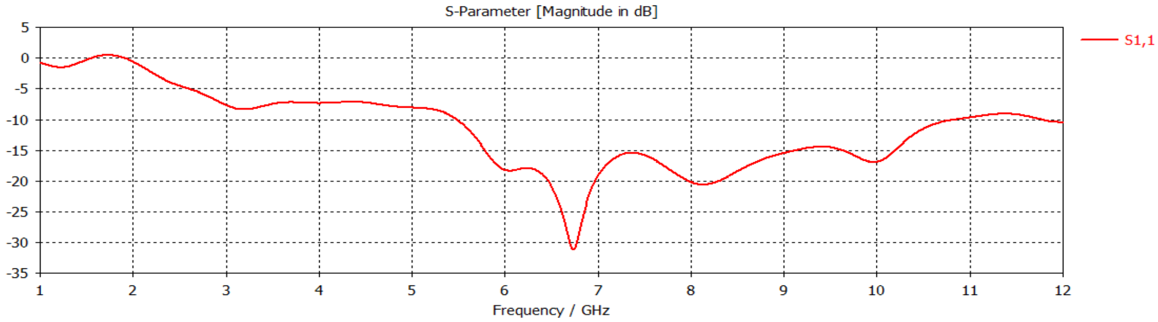

Fig 8: Return loss of U slot ground plane rectangular patch antenna

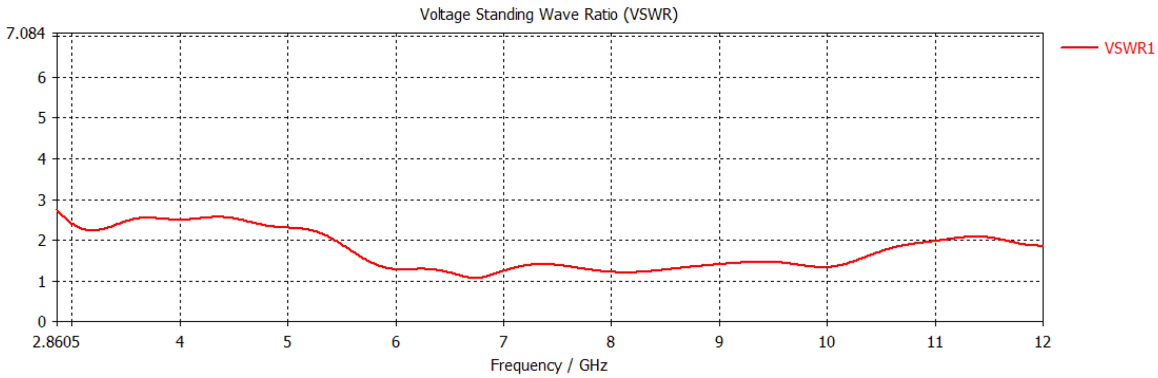

Fig 9: vswr of U slot ground plane rectangular patch antenna

The fig 10 shows the replacing the one strip in the ground and it will named as inverted L strip ground plane. And the patch is rectangular patch shown in fig 1. The simulated retunloss and vswr of inverted L strip ground plane are shown in fig 11 and 12. The simulated results show that the good antenna bandwidth from 5.4-11 GHz frequency.

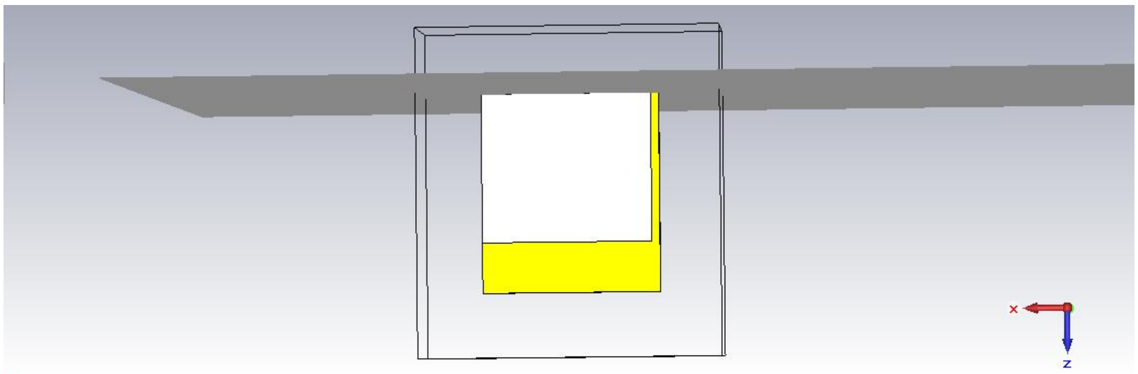
Fig 10: inverted L strip ground

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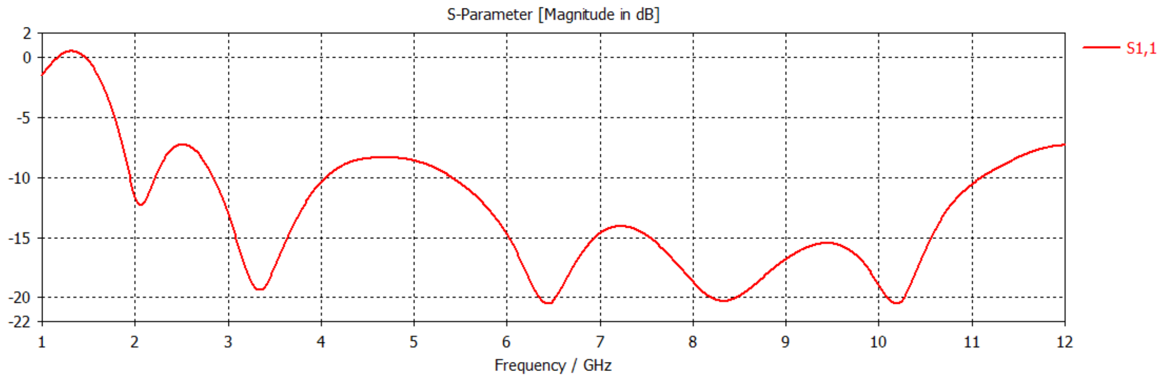

Fig 11: Return loss

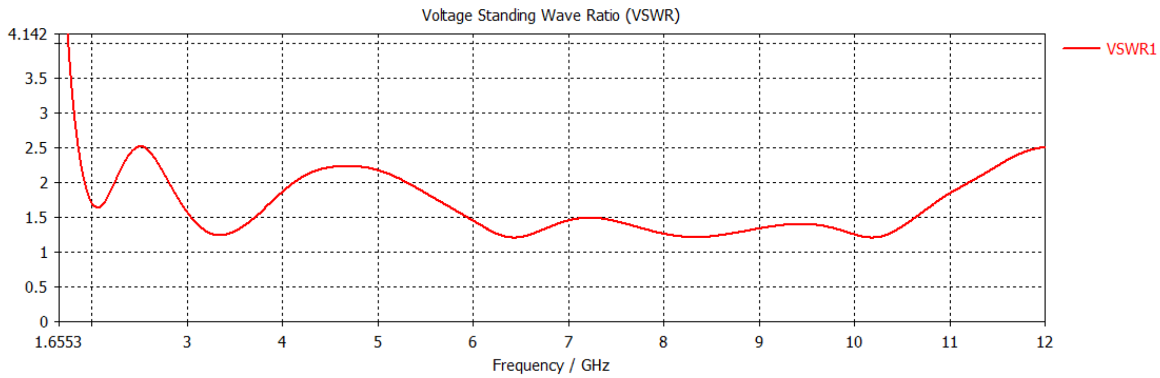

Fig 12: vswr

By replacing another strip in the ground of fig 10 then it becomes the fig 13. The etching the grounds the ground structure is decreases then it called the defected ground structure. The proposed ground is shown in fig 13. By using the rectangular patch and the defected ground structure the antenna is simulated in 3D EM simulator then the fig 14 and 15 shows the return loss and VSWR parameters of the existing antenna [9]. The simulation result shows the getting good bandwidth from 3- 11 GHz frequency. The fig 16 and 17 shows the radiation patterns of the existing antenna.

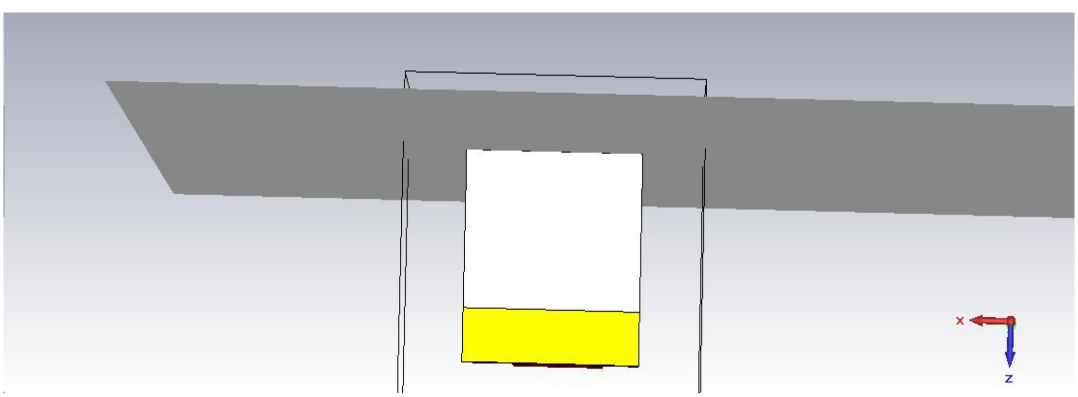

Fig 13: DGS (Defected ground structure) ground plane

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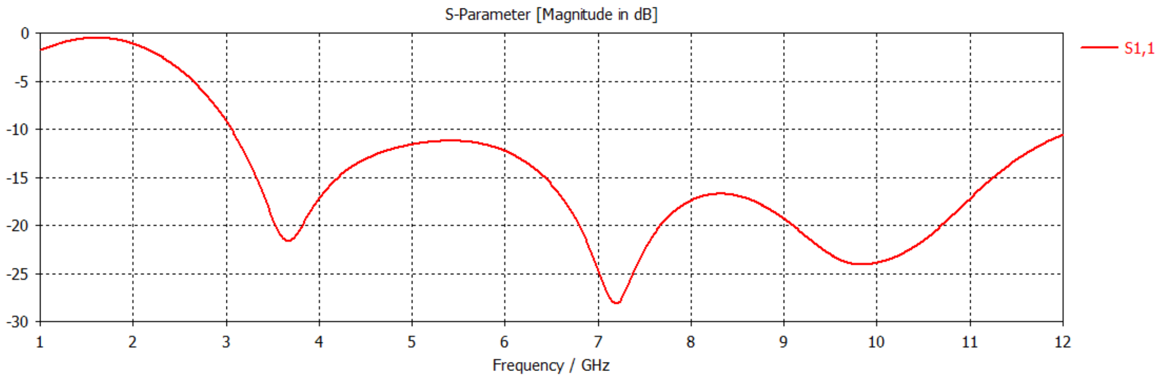

Fig 14: return loss of rectangular patch with DGS ground

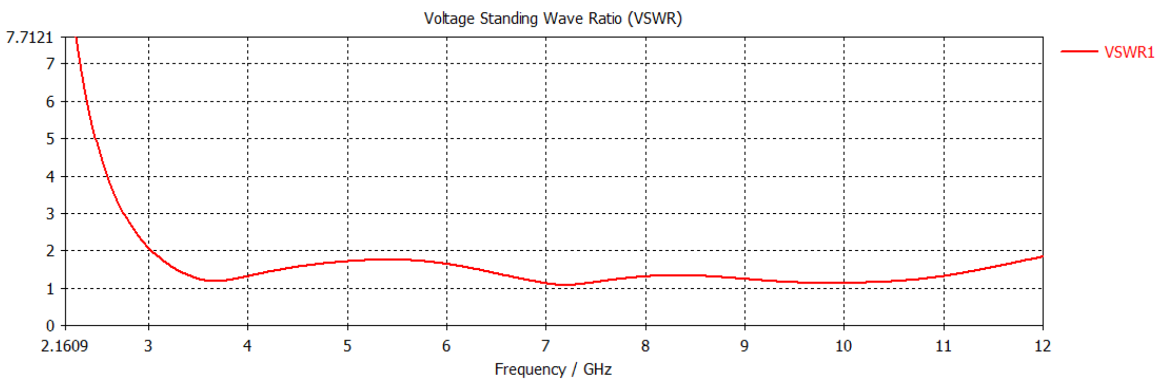

Fig 15: vswr of rectangular patch with DGS ground

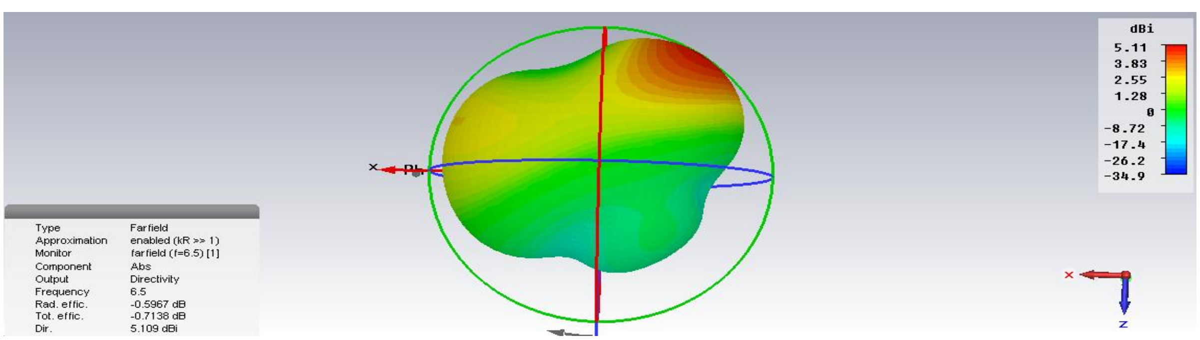

Fig 16: 3D radiation pattern of rectangular patch with DGS

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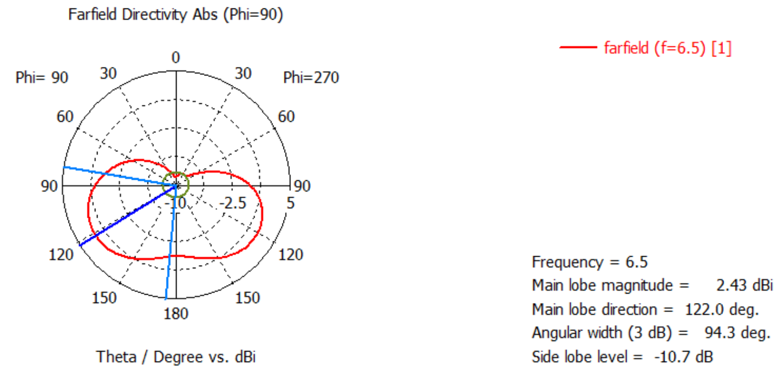

Fig 17: 2D radiation pattern of rectangular patch with DGS

The fig 18 shows the proposed antenna design with the DGS ground. The antenna is simulated then the fig 19 and 20 shows the return loss and vswr of the proposed antenna. the proposed antenna gets the good return loss and vswr from freq 3-18 GHz which have band width of 15 GHz. The fig 21 and 22 shows the 3D and 2D radiation patterns.

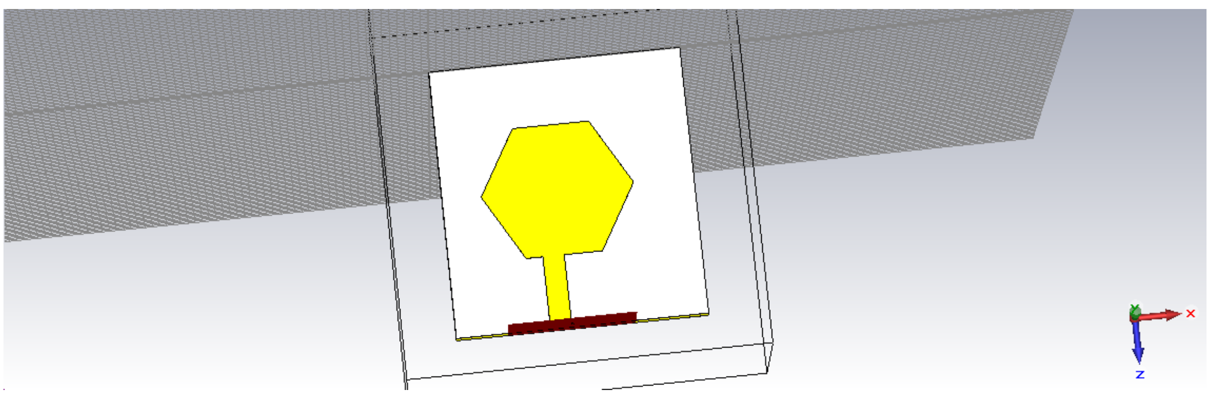

Fig 18: proposed antenna design

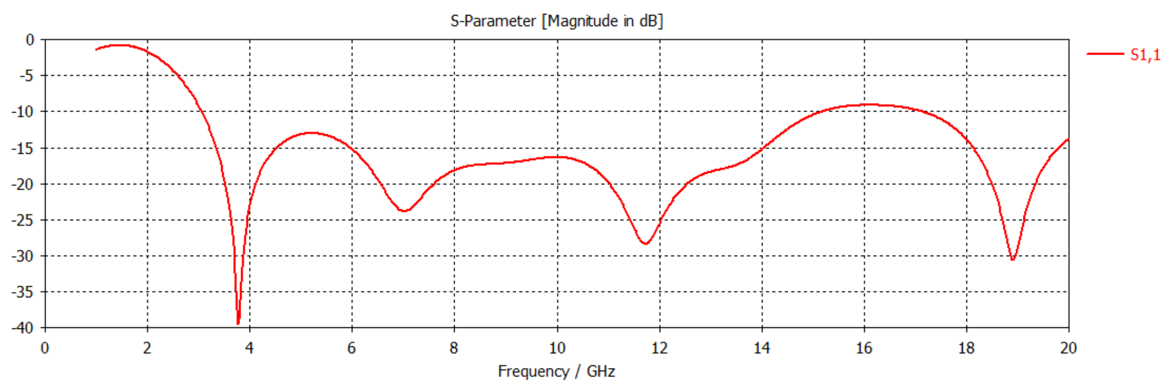

Fig 19: return loss of proposed design

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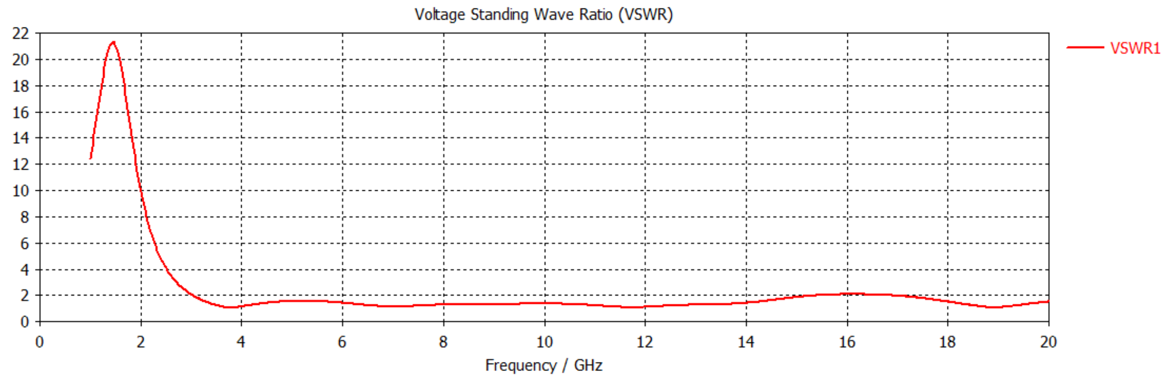

Fig 20: vswr of proposed design

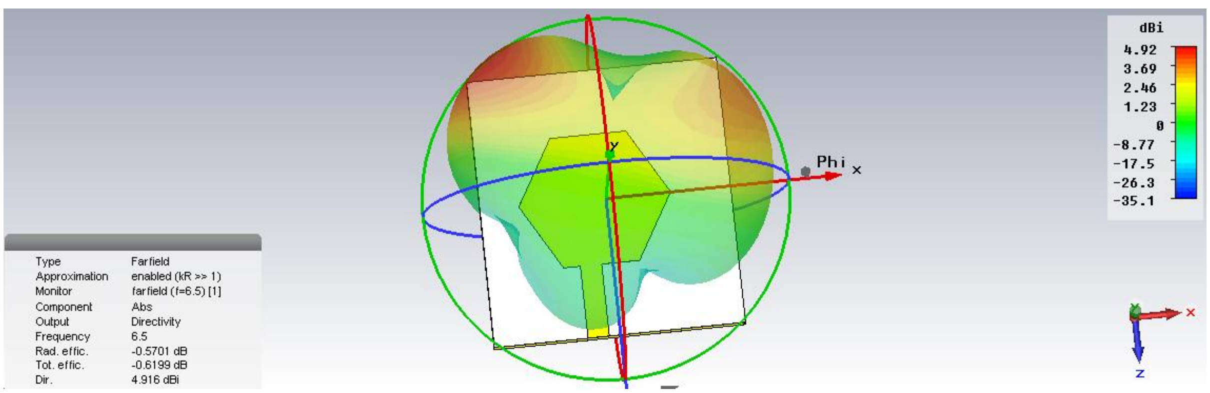

Fig 21: 3D radiation pattern of proposed design

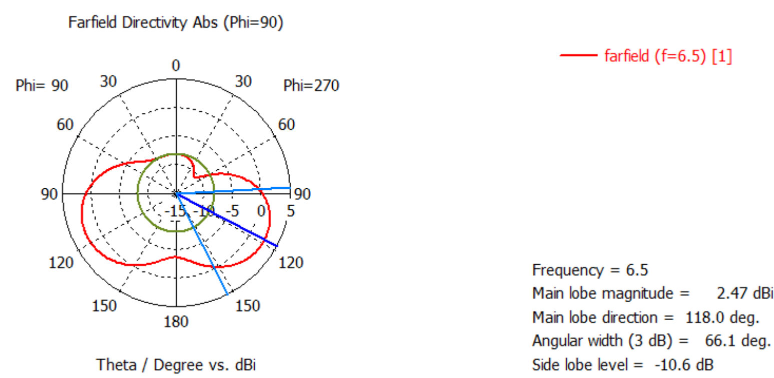

Fig 22: 2D radiation pattern of proposed design

IV. CONCLUSION

The novel compact hexagonal patch antenna is proposed for UWB applications. by introducing the DGS ground plane and Hexagonal patch the impedance bandwidth from 3-18 GHz with return loss less than -10 dB and VSWR less 2 is achieved. The proposed antenna is exhibited the good return loss, vswr, radiation pattern and gain based on their simulation results.

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