MODIFIED PLANAR UWB ANTENNA WITH H TYPE SLOT IN PATCH PLANE

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Abstract: **A planar antenna with a multi-slotted patch plane has been proposed for UWB applications. The compact antenna have a total size of 30 mm* 22 mm consists of a square patch with H type slot and four slots provided at the corners and a partial ground plane. The rectangular slot on the top side of the ground plane helps to raise the bandwidth. The precise result shows that the proposed antenna achieves a bandwidth (VSWR <2) ranges from 2.4 to 16.72 GHz. Details of the planned antenna and measured results are presented and discussed.**

***Index Terms* – Planar antenna; Micro strip line; multi slot ground plane.**

I. INTRODUCTION

Ultra-wideband (UWB) skill has become the most talented candidate for future wireless communications due to its smart features, like low density and extremely elevated data transmitting rates. Here are many necessities such as wide bandwidth, low cost, tiny size, constant radiation patterns, and constant gain for UWB antennas. To achieve these, several compact antennas have been proposed for UWB applications in three dimensional [1], and planar form [2, 3]. Owing its low profile, low cost, ease of fabrication, broad bandwidth, and radiation property, the printed UWB planar antennas include received more and more attention with the progress of communication technologies. These antennas utilize the monopole configuration such as ring, elliptical, circular disc, annual ring, triangle, pentagon, and hexagonal antennas [4–9]; the dipole configuration [10] like bow-tie antennas. However, the bandwidth of conventional printed planar antenna is not yet sufficient to cover the entire UWB frequency band, and they are not compact in physical size.

Various techniques have been examined to enhance the antenna bandwidth, including the insertion of a modified trapezoid trapezoid-shaped slot in the patch [11], the use of trident-shaped feeding strip and a tapered impedance transformer [12] and embedding a pair of notches in the two lower corners of the patch and the notch structure in the upper edge of the ground plane [13]. The use of two bevel slots on the upper edge and two semicircle slots on the bottom edge of the ground plane [14], insertion of rectangular slot on the top side of the ground plane[15], and a half-bowtie radiating patch with staircase shape have been also reported for the bandwidth enhancement. Techniques such as adding steps to the lower edge of the patch [16], increasing the elasticity ratio of ellipse-shaped patch [17], the insertion of additional stub to the one side of circular patch and addition of the slit on one side of the radiating element have also been reported for bandwidth enhancement in planar monopole antennas.

In this article, compact printed antenna that achieves a physical planar profile, sufficient impedance bandwidth and stable radiation pattern is proposed. The proposed planar antenna consists of a square shaped radiating patch fed by a micro strip line and partial ground plane. To enhance the bandwidth, we optimize and improve the impedance matching by modifying the ground plane to form a multi-slotted ground. Measured VSWR, antenna gain, radiation efficiency, and radiation patterns are presented.

II. ANTENNA DESIGN

The geometry of the proposed antenna, which consists of a four-sided figure formed patch and a biased ground plane with rectangular slots, is given away in Figure 1. The antenna is in print on a low price FR4 substrate of width 1.6 mm, with relative permittivity 4.6

PHYSICAL DIMENSION PARAMETER OF PROPOSED ANTENNA DESIGN

S. no.	Parameters	Values of Design
1	Dielectric Material	FR4-epoxy
2	Substrate Height	1.60mm
3	Length of substrate(L)	30 mm
4	Width of substrate(W)	22 mm
5	Length of Patch (LP)	14.5 mm
6	Width of Patch (Wp)	14.75 mm
8	Length of feed(Lf)	7.25 mm

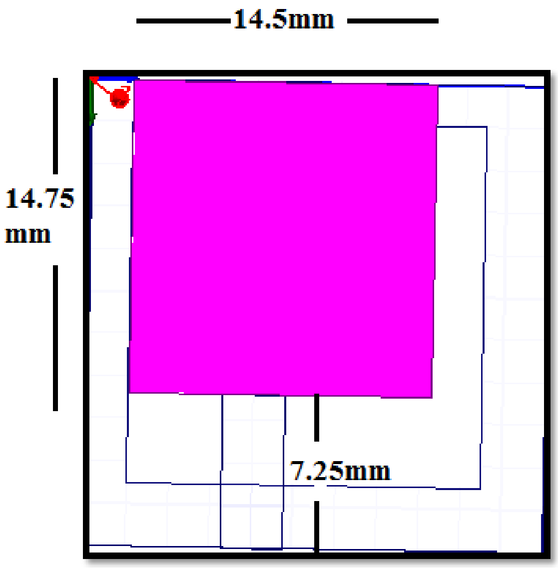


Fig 1.1 reference antenna design

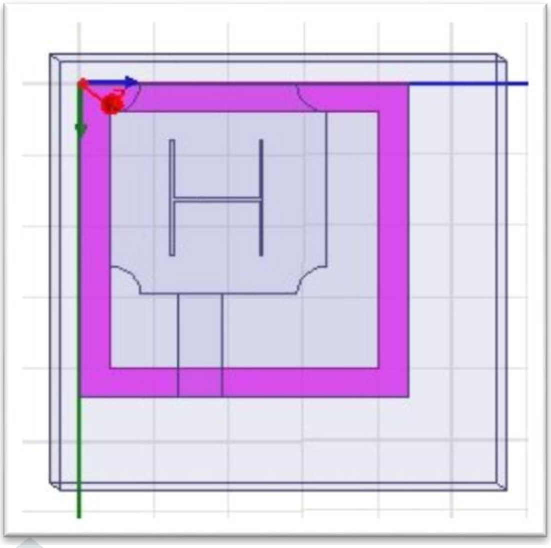


Fig 1.2 proposed antenna design

& loss tangent 0.02. The burning patch with a length of 14.5 * 14.75 mm2 fed by a micro strip feed line, is in print on one side of the substrate. The length and width of the micro strip feed line are set at 7.25 mm and 2.6 mm, correspondingly to get 50-X characteristics impedance. An SMA is coupled to the port of the feeding micro strip line. The partial ground plane having a length of 7.5 mm is printed on the other side of the substrate. Rectangular slots with two different sizes are introduced on the top side of the finite ground plane to change the input impedance characteristics. The antenna has a total dimension of 30 * 22 mm. The arithmetical parameter of this design can be accustomed to tune the VSWR and bandwidth over broad range of frequencies.

III. RESULTS AND DISCUSSION

The parameters of the antenna can be attained by using of formula which is given by:

$$\rho=\frac{Z_A-Z_0}{Z_A-Z_0}$$

$$ReturnLoss=-20\log|\rho|$$

$$VSWR=\frac{1+|\rho|}{1-|\rho|}$$

Where,

P= Reflection Coefficient.

Z_0= characteristic impedance

Zin= input impedance of antenna

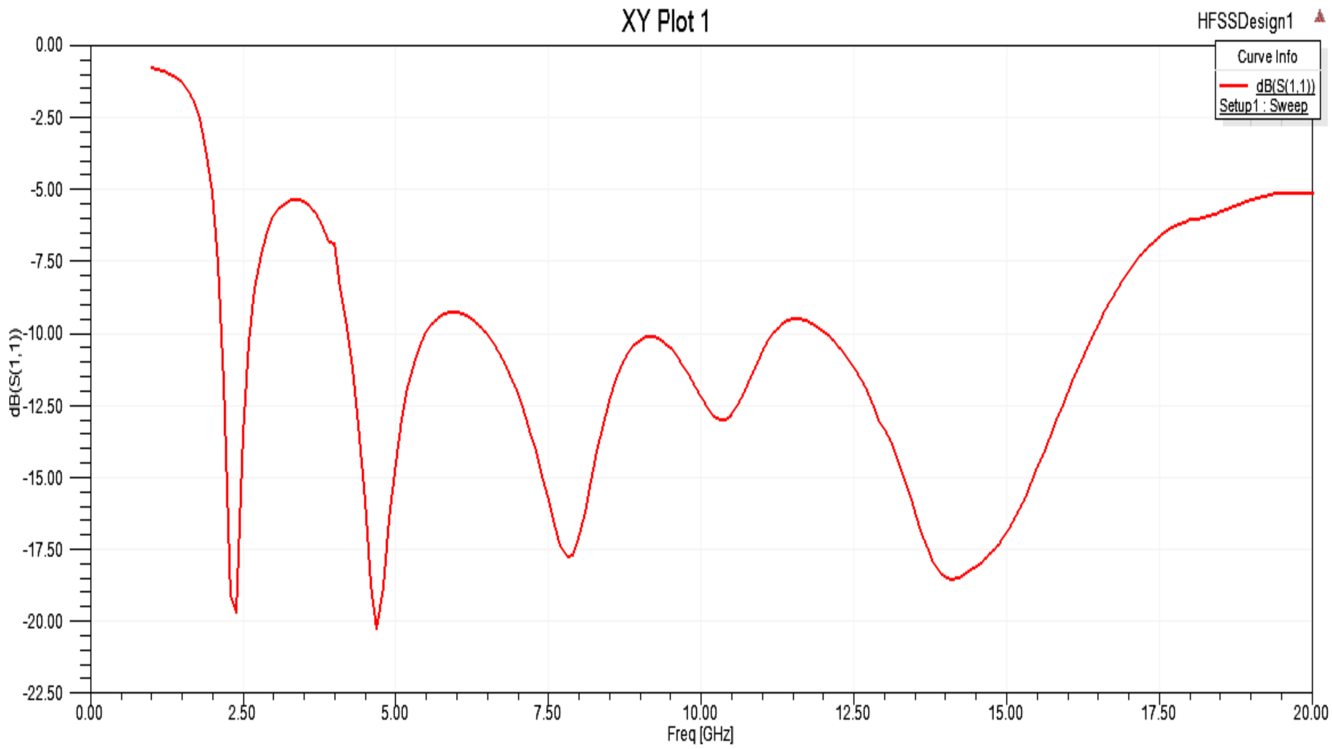
By using the above given formulas for proposed antennas parameters can be calculated.

Measured and simulated VSWR of the proposed antenna are shown in Figure 3.3 &3.4. The measured in use bandwidth is very close to the simulated results (2.85–16.5 GHz). The measured group of VSWR < 2 is from 2.57 to 16.72 GHz. The difference between measured and simulated results is typically due to the inaccuracy during manufacture of the antenna and high losses of FR4 substrate. It may also be due to the cause of the feeding cable, which has not been measured in simulation as the antenna is physically small.

1. RETURN LOSS

The return loss for the reference and proposed antenna is given in Figure 3.1 & 3.2

From fig 3.1, we can examine different resonant frequencies like 2.4 GHz, 4.9GHz, 7.4GHz and 14.5GHz having return loss less than -10db, because reflection are minor below -10db return loss [19].



.Fig 3.1 return loss for reference design

From proposed antennas return loss graph the resonating frequencies are 2.4 GHz, 4.9GHz, 7.5GHz and 14.5GHz at return loss -24db, -40db, -20db, -19db respectively.

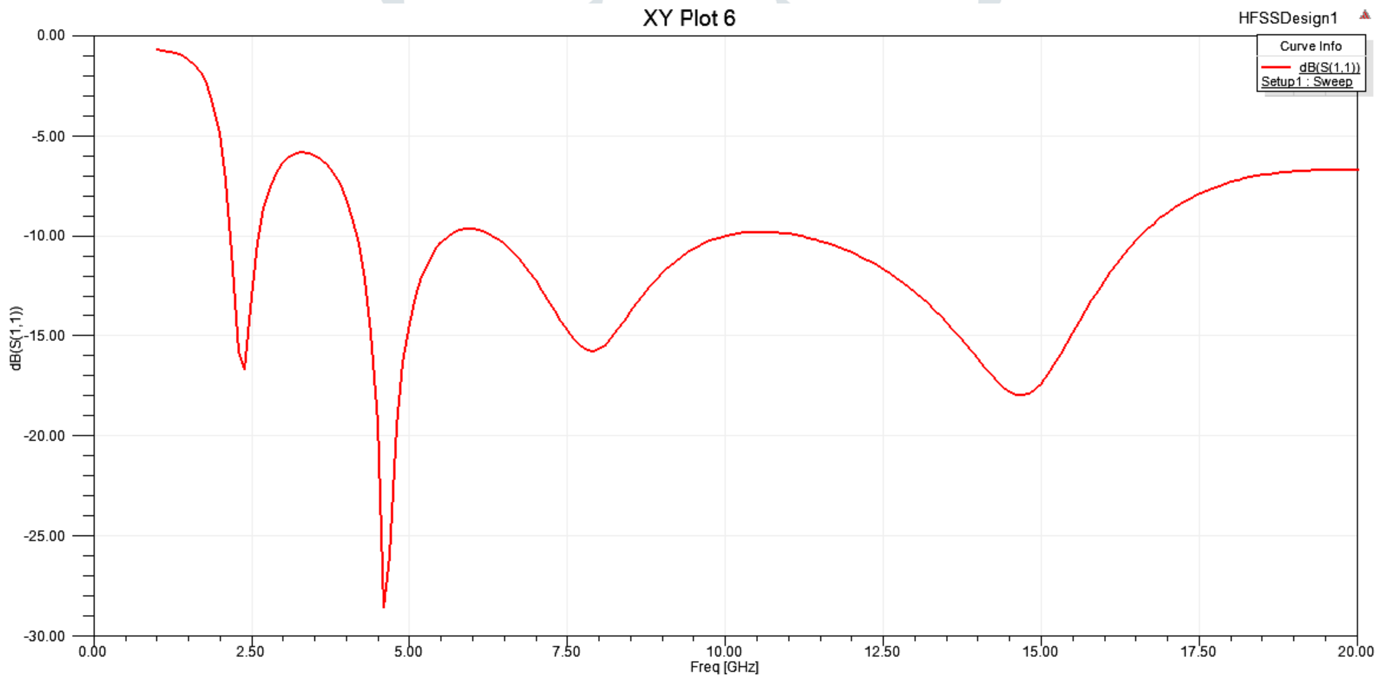


Fig 3.2 Return loss for proposed antenna design

Comparison of return loss at various resonant frequencies for reference and proposed designs return loss

TABLE II

Ref. no.	Resonating Frequency (GHZ)	Reference antennas Return Loss(db)	Proposed antennas Return Loss(db)
1	2.4	-20	-20
2	4.9	-22	-27
3	7.5	-19	-16
4	14.5	-18	-19

2. VSWR

The voltage standing wave ratio tells as regards the impedance variance. If VSWR is increases it indicates an increase in variance between the antenna and the transmission line. VSWR with less value means good matching with minimum VSWR is one. It is always advantageous for VSWR to be always less than 2. We can see that in the figure 3.3 &3.4 all the resonating frequency bands include VSWR below 2db [20, 21].

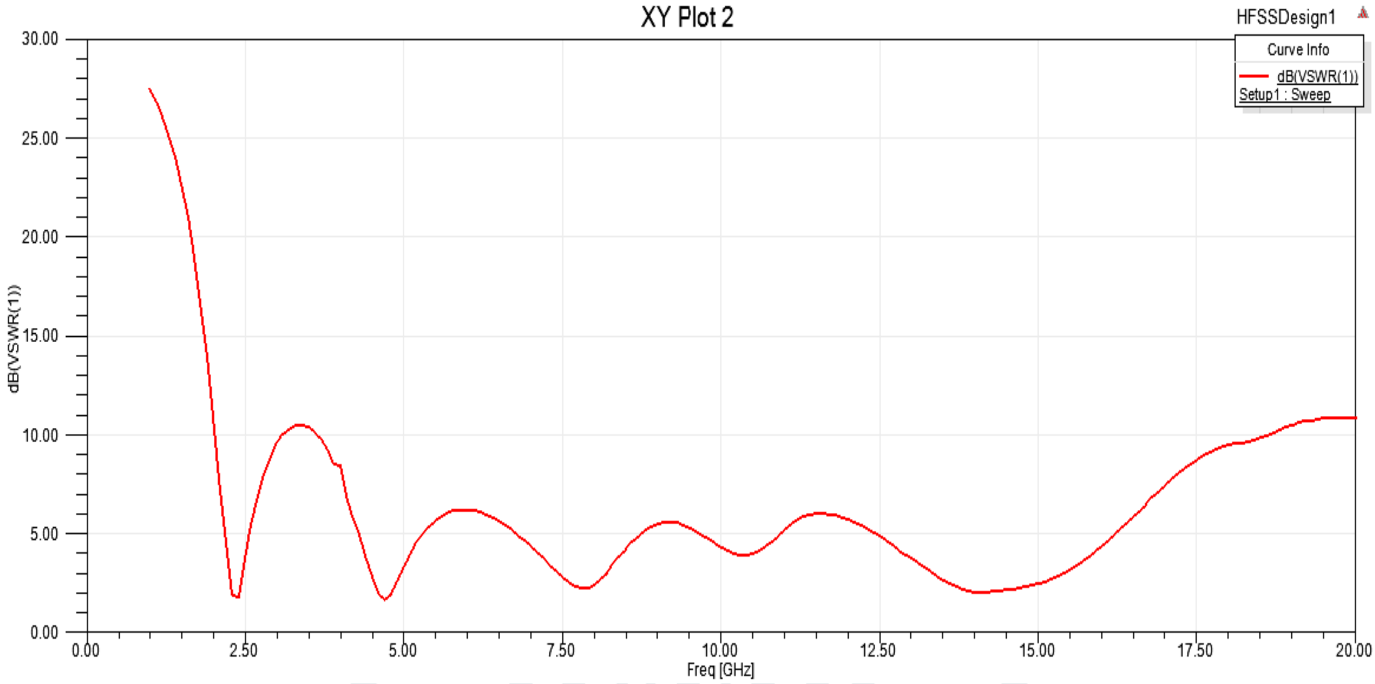


Fig 3.3 VSWR for reference antenna design

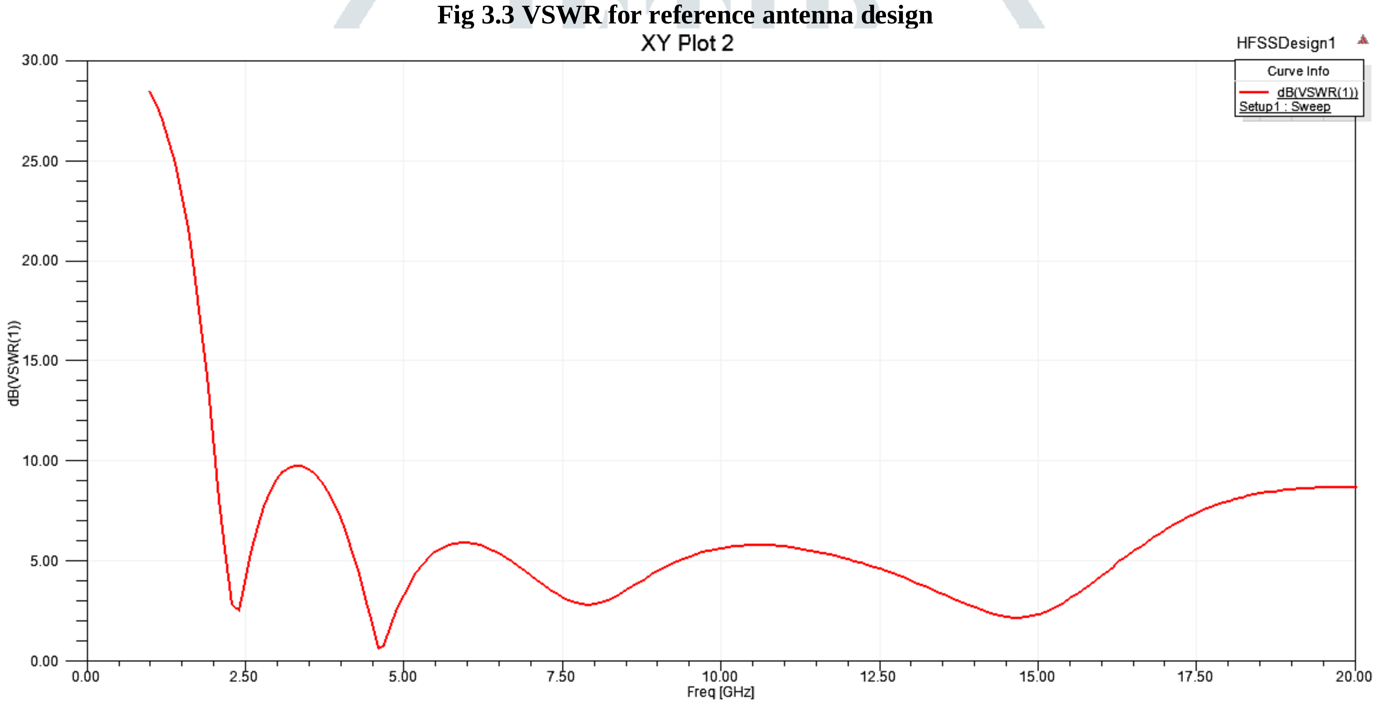


Fig 3.4 VSWR for proposed antenna design

The comparison table for frequency versus VSWR for reference and proposed antenna is given in table III is given below

TABLE III

Ref. no.	Resonating Frequency (GHZ)	Reference antennas VSWR (db)	Proposed antennas VSWR (db)
1	2.4	1	1
2	4.9	1.1	0.9
3	8	2	1.4
4	14.5	2.3	1.5

3. RADIATION PATTERN

The radiation patterns of the proposed and reference antenna at the significant frequencies 2.4 GHz are shown in Fig 3.5 &3.6. The results illustrate very monopole like radiation patterns with Omni directional radiation.

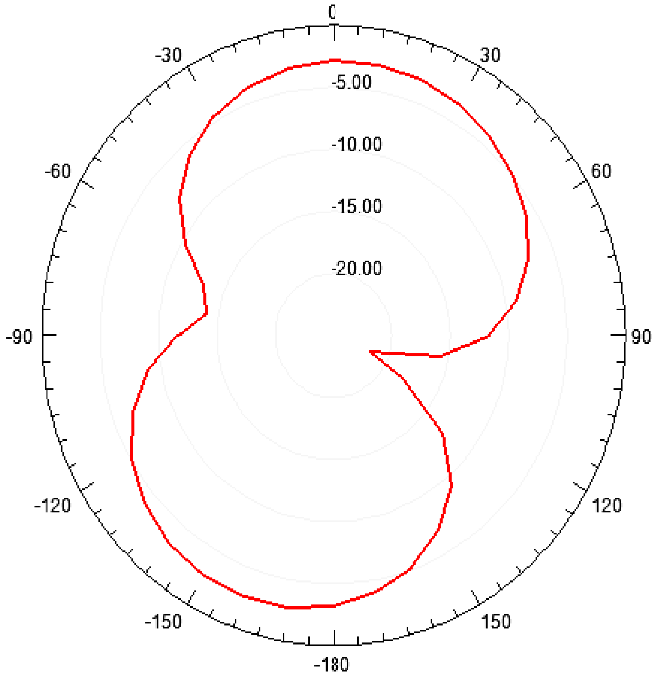


Fig 3.5 radiation pattern at 2.4 GHz for reference antenna design

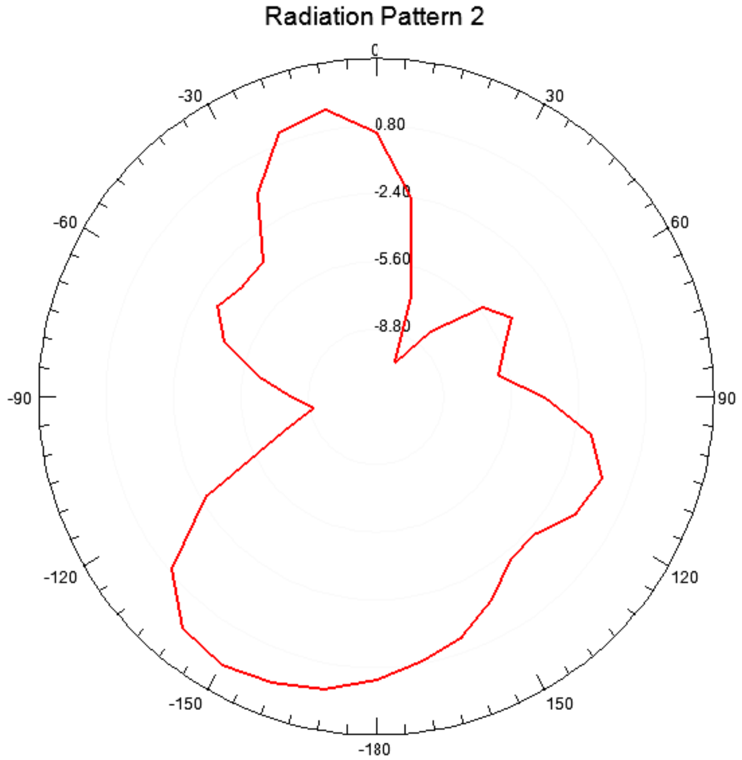


Fig 3.6 radiation pattern at 2.4 GHz for proposed antenna design

IV CONCLUSION

In this work a modified planar antenna with multi slot is proposed for ultra wideband applications. The proposed antenna designs can handle many frequencies by simply varying the patch shape and cover lot of challenging frequency bands used in daily communication systems. It is observed that the slots on the side of the patch plane can be used to get better the impedance bandwidth of printed planar antenna. The simulated result of the proposed antenna show minimum return loss,omini directional radiation pattern, large impedence bandwidth, VSWR<2, which cover the entire UWB band. This category of antenna is the best aspirant for wireless communications for multiband operation.

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