BANDWIDTH ENHANCED STACKED PATCH ANTENNA FOR MULTIBAND APPLICATIONS

[1]M. Eswari Bhavana, [2]M. V. S. Prasad

[1]M. Tech Student, [2]Professor of ECE,
[1]Electronics And Communication Engineering,
[1]R V. R & J.C College of Engineering, Guntur, India

Abstract : A microstrip stacked patch antenna with a rectangular patch and dumbell patch is presented in this paper. The antenna is fed by 50Ω microstrip line feed to the first patch. The proposed antenna is designed by using CST microwave studio suite. The antenna consists two patches in which driven patch is rectangular and parasitic patch has dumbbell shape, each patch is placed on different substrates of two different relative permittivities. The simulated results show that antenna can be operated in C-band and X-band. The proposed antenna is suitable for Wifi, remote sensing, satellite communication, mobile networking etc

***IndexTerms* - Microstrip patch antenna, stacked configuration, dumbbell shaped patch, rectangular patch.**

I. INTRODUCTION

In wireless communication now-a-days microstrip antenna play very important role because high performance applications like aircraft, spacecraft, satellite and mobile communication where size, weight, cost, ease of installation and performance have great effect on design particularly. on the other hand microstrip antennas have advantages such as small size, light weight, simple and cost effective manufacture using modern printed circuit technology [1-3].

The main drawback of microstrip antenna is narrow bandwidth. Several techniques have been proposed to overcome this drawback, Among them stacking has showed better results mainly to improve bandwidth and other characteristics. stacked configuration with a uniform ground plane can achieve broad bandwidth with a unidirectional radiation pattern and thickness of the substrate also has its effect on bandwidth of the antenna i.e as the thickness of substrate increases there is increase in operating bandwidth [4-5].

Principle of stacking involves placing the substrate and patches one above the other above the ground plane. The bottom patch is called driven patch for which feeding is given, upper patch is called parasitic patch. The bottom patch radiates signals to the upper patch and radiates energy [6].

Substrate gives mechanical strength to the antenna. Deciding the different substrates also plays major role in designing stacked patch antenna. If two substrates are needed the bottom substrate should have higher relative permittivity compared to the upper patch to produce broader response. The selection of substrates is important as the current distribution on lower patch has effect on bandwidth of antenna [7].

In present paper antenna has two layers of dielectric substrates and two respective patches. Driven patch is rectangular and parasitic patch is dumbbell shaped.

II. ANTENNA DESIGN

The proposed antenna involves the concept of stacking. It is fed by using microstrip feed line having characteristic impedance of 50Ω to the fed patch. The design consists of two substrates of 30 mm wide and 30 mm long and two microstrip patches. Above the ground plane first substrate is placed of thickness 1.6mm and then respective rectangular patch of the substrate is placed as shown in fig 1. Dielectric material of first substrate is FR4(4.4) and second substrate is RT Duriod(2.2).

Table 2.1: Dimensions of antenna

S No	Parameters	Dimensions	Material
1	Substrate 1	L_G=30mm W_G=30mm H_1=1.6mm	FR4(4.4)
2	Patch 1	Lp= 16mm W_p=12mm	copper
3	Substrate 2	L_G=30mm W_G=30mm H_2=0.5mm	RT Duriod(2.2)
4	Patch 2	R_1=5mm R_2=5mm L_1=4mm L_2=7mm	copper
5	Ground	L_G=30mm W_G=30mm	copper
6	Feed	L_F=3mm W_F=8mm	copper

Above the first rectangular patch second substrate of 0.5mm thickness is placed and then, on the parasitic substrate second patch which is in the shape of dumbbell is placed. It is designed by using two circular patches joined by strip.
A circular microstrip patch antenna designing is easier than other patch configuration as we need only one design parameter i.e. radius of the patch. The radius of the patch is the only degree of freedom to control the modes of the antenna.

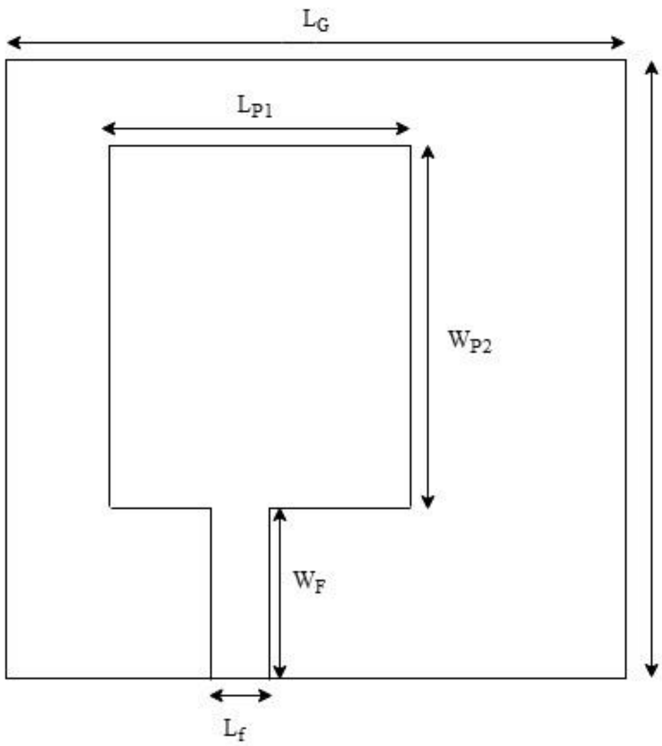

Fig 1: Front view of first patch

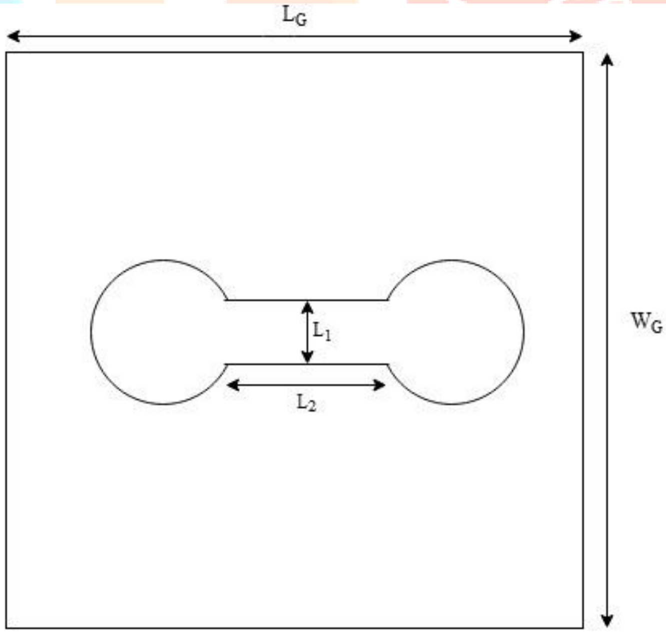

Fig 2: Front view of second patch

Second layer is stacked above the first patch, second set of layers consist of a substrate and patch. Material used for substrate is RT Duriod having relative permittivity of 2.2, 30 mm long and 30 mm wide of height 1.6 mm.

Above the second substrate second patch is placed which consists of two circular patches of 5mm radius each which are joined by using a strip of 4 mm long and 7 mm wide as shown in fig 2.

The front view of the designed antenna are shown in fig 3 and fig 4.

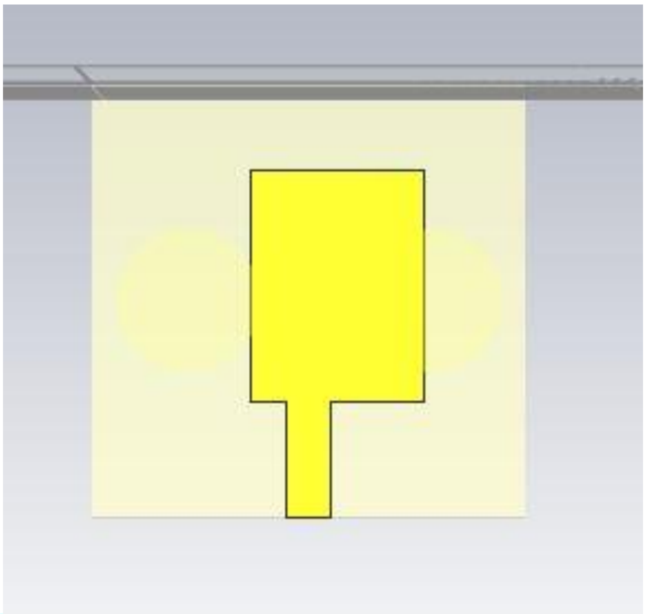

Fig 3: Front view design of first patch

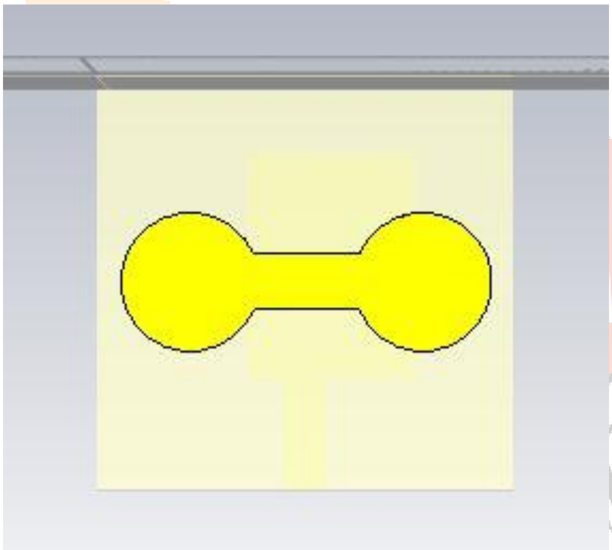

Fig 4: Front view of design of second patch

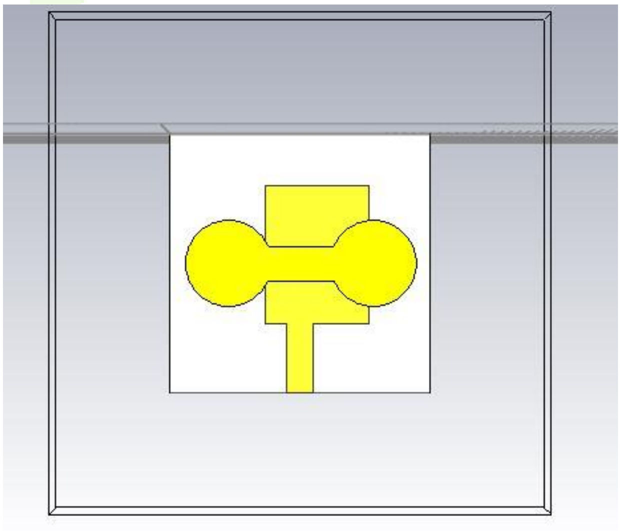

Fig 5: Front view of the stacked antenna

III. RESULTS

The Return loss (RL), VSWR and Radiation Patterns are investigated using .CST studio the return loss, VSWR and Radiation patterns of the circular antenna are shown from fig 3 and fig 4. The operating range of antenna 6.6 GHz – 6.9GHz (0.2 GHz

Bandwidth) and 8.1 GHz – 9.4GHz (1.26 GHz Bandwidth) in these frequency band the stacked antenna is in good agreement in terms of return loss, VSWR and radiation patterns. The proposed antenna is shown in fig 5 with results are shown from fig 6 to fig 11. The strength of the radio waves from the antenna is referred as the radiation pattern shown in fig 8 and fig 9 shows the proposed 3D radiation patterns. The gain of the antenna is 5.8 dBi at 8.5 GHz.

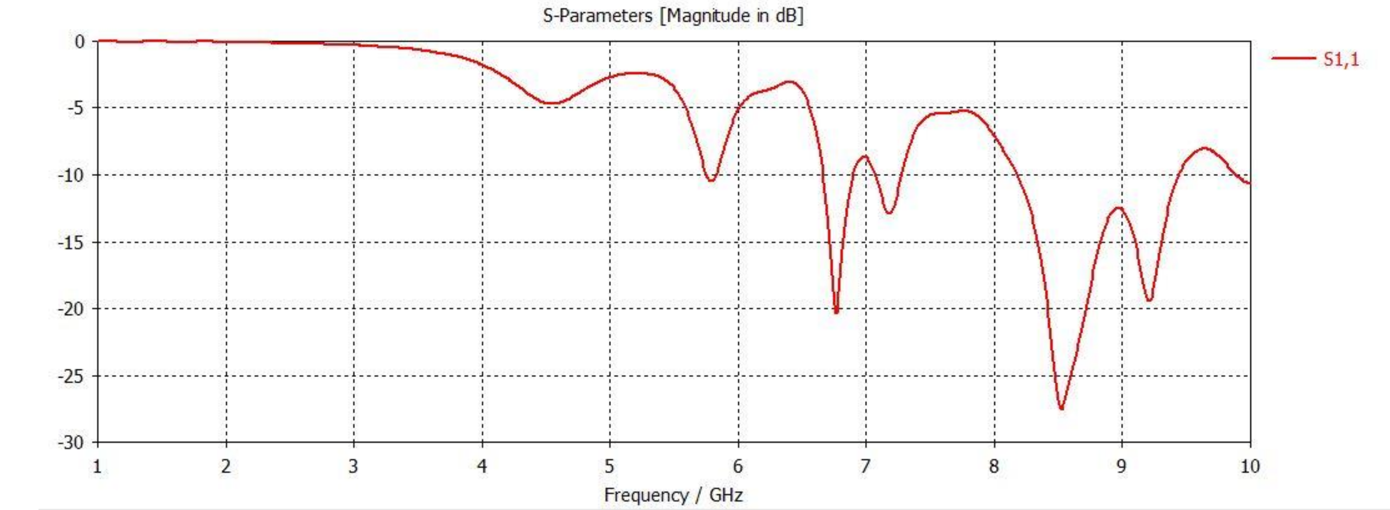

Fig 6: S parameters of antenna

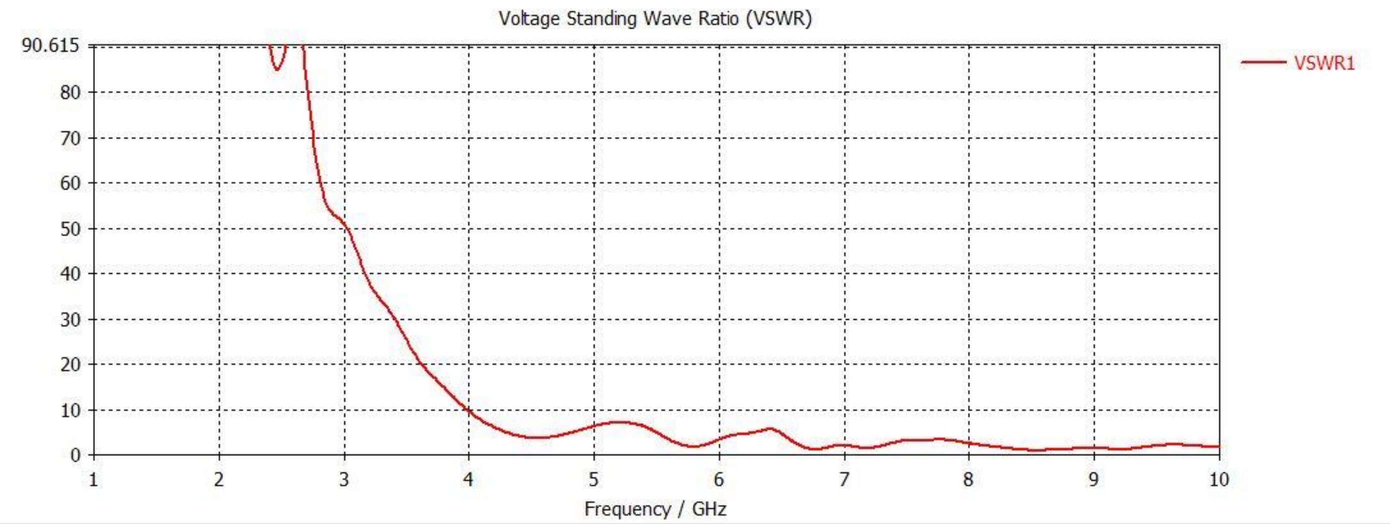

Fig 7: VSWR of antenna

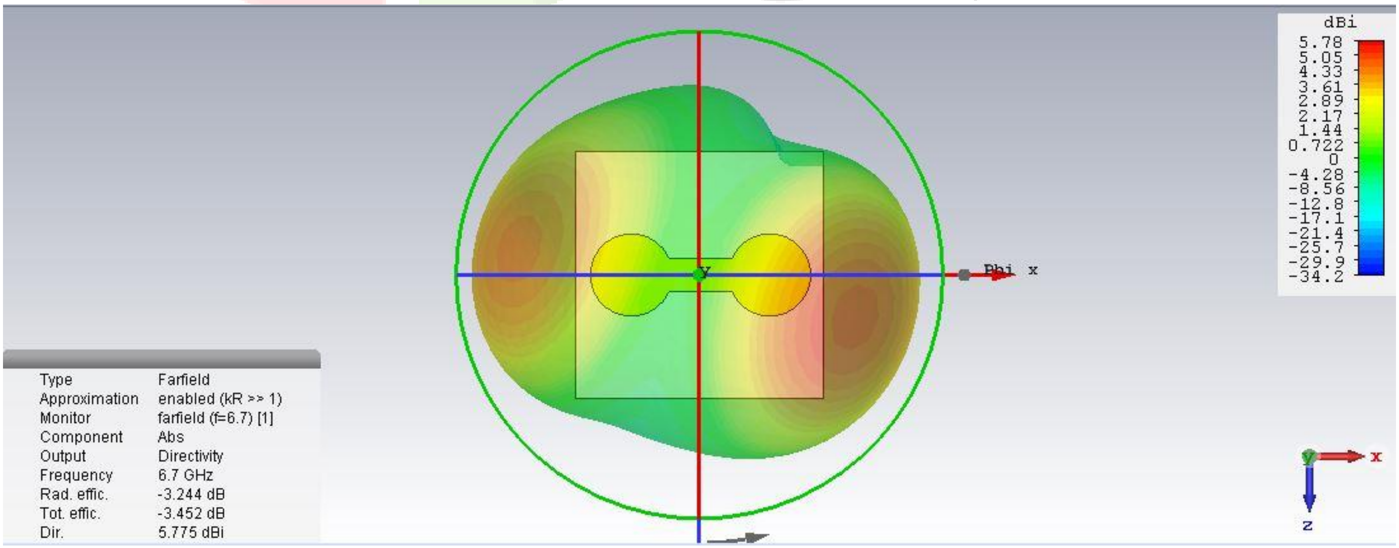

Fig 8: 3D plot of antenna at 6.7 GHz

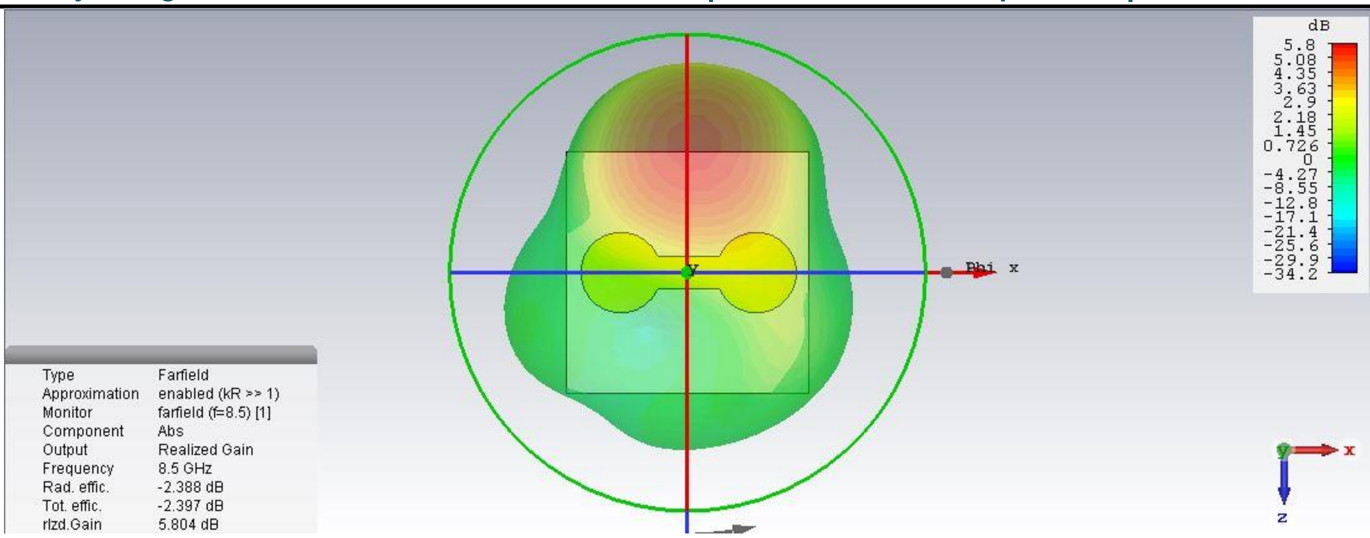

Fig 9: 3D plot of antenna at 8.5 GHz

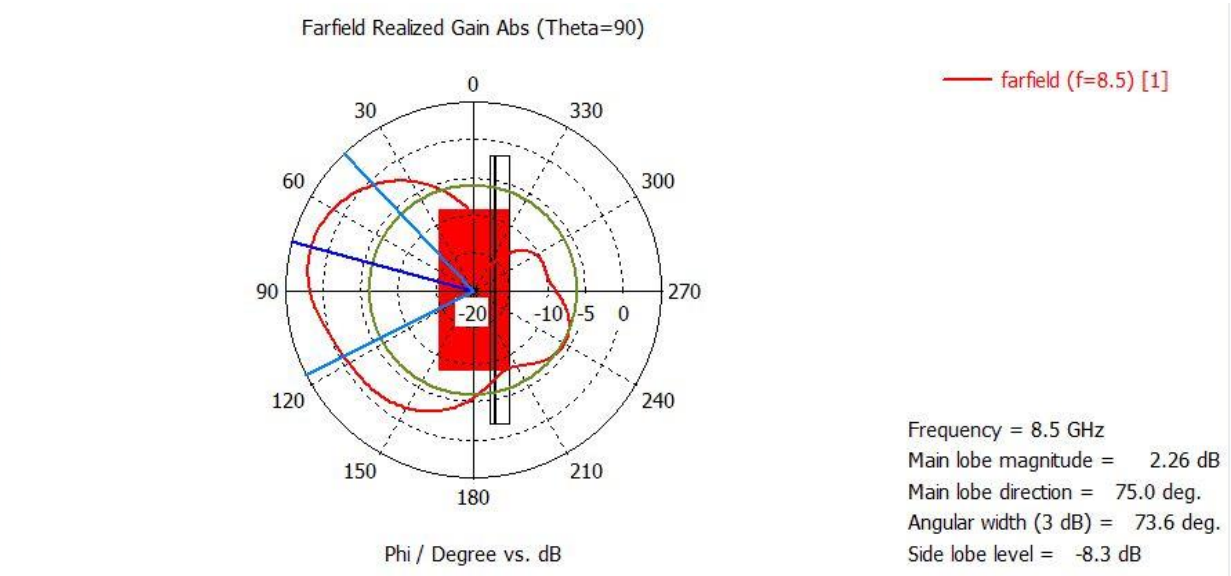

Fig 10: Polar plot of antenna at 6.7 GHz

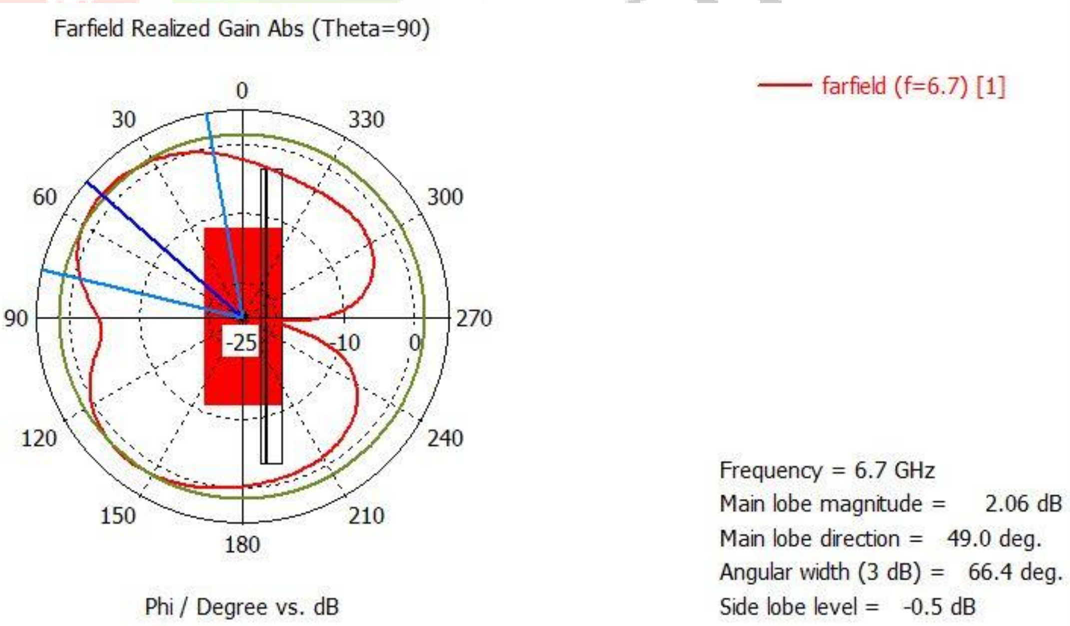

Fig 11: Polar plot of antenna at 8.5 GHz

IV. CONCLUSION

A novel multi band antenna with enhanced bandwidth operating at 6.7 GHz and 8.5 GHz has been designed and its performance has been optimized using CST microwave Studio. The enhanced bandwidth is achieved by using a stacked configuration with dumbbell shaped patch. The proposed antenna can be used for multiband applications in the field of wireless communication(C-band, X-band). The proposed antenna depicts improved results with band widths of 0.2 GHz and 1.26 GHz at 6.76 GHz and 8.5 GHz respectively with return loss of -27.49dB and gain of 5.8 dB.

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