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DESIGN & SIMULATION OF C–SHAPED COAXIAL FEED PATCH ANTENNA

Nitin Halkara[1], Ashish Verma[2]
[1,2]ECE, RGPV, Mahakal Institute of Technology, Ujjain, India

Abstract: In this paper, a C–shaped microstrip patch antenna with parametric study of the antenna parameters is presented. The proposed antenna is simulated in Ansoft's High Frequency Structure Simulator (HFSS) V11.1.To design the proposed antenna 5.72-5.85GHz frequency band is chosen because this frequency band is being developed for various commercial and non-commercial applications. This frequency band is referred as C-band or 3-cm band
Keywords: I- Shaped, Coaxial feed, HFSS, WLAN and WiMAX

I. INTRODUCTION

In this paper, a coaxial fed C–shaped microstrip patch antenna is presented. The FR4 epoxy dielectric material of relative permittivity 4.4 and loss tangent of 0.019. With the thickness of 1.6mm is used as a substrate of the antenna. The proposed antenna is excited by microstrip coaxial probe feeding technique and probe is located at (-2mm, 0mm,-3mm). A rectangular shape slot of the dimension of 1 x 8.5 mm is removed from right edge of the base shape (simple rectangular) to make a C–shaped patch antenna shown in Fig.2.

The antenna is simulated upon completion of the design and various results are obtained. The return loss plot for simple base shape, C-shape. Table1 shows the results of return loss plots for the steps in development of the antenna design. Where fl, fh and fr are frequency at lower return loss, frequency at higher return loss, and resonant frequency respectively. From the table, it can be seen that, the bandwidth percentage of base shape is 3.98, but in final step it has increased to 4.46%.Which covers the frequency band from 5.92GHz to 6.19GHz with return loss -32.66dB. The resonating frequency and return loss are also increased as moved from base shape to I – shaped patch antenna.

II. ANTENNA DESIGN

The development of microstrip antenna technology started in the 1970s. By the early 1980s basic microstrip antenna elements were fairly well established in terms of design and modeling. The side view of the proposed antenna structure has been shown in Fig.1 .The broad banding technique of slotting technique is used to improve bandwidth.

In the first step a simple rectangular microstrip patch antenna has been taken. Size of the antenna is calculated from the basic patch antenna equation(C.A.Balanis,2007) and appropriate changes have been done to make an C- shape patch antenna. Coaxial feeding is chosen for the excitation of the proposed antenna.

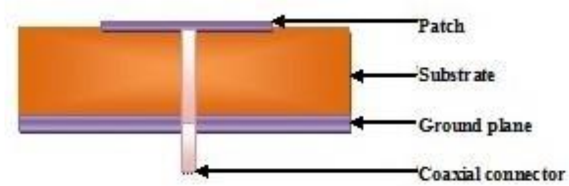

Fig.1 Side view proposed antenna structure

In the first step a simple rectangular microstrip patch antenna has been taken as shown in the Fig.1. Size of the antenna is calculated from the basic patch antenna equations [1] and appropriate changes have been done for the desired result. Coaxial feeding is chosen for the excitation of the proposed antenna.

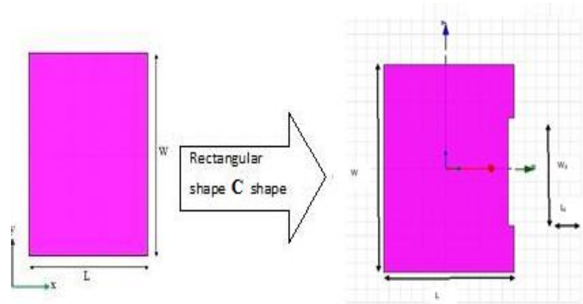

Fig.2 Development of C from Base rectangular shape

A rectangular shape slot of the dimension of 1 x 8.5 mm is removed from right edge of the base shape (simple rectangular) to make an C–shaped patch antenna shown in Fig.2.

TABLE 4.1 RESULTS OF RETURN LOSS PLOTS FOR DEVELOPMENT OF THE DESIGN

Antenna Design	f_l (GHz)	f_h (GHz)	f_r (GHz)	Return Loss (dB)	Bandwidth %
Base Shape	5.007	5.210	5.10	-17.89	3.98
C-Shape	5.611	5.875	5.72	-43.10	4.61

Table 2 Parameters of the optimized c–shaped patch antenna

Parameters	Dimensions(mm)
L	11.5
W	15.5
L1	0.5
W1	8

Ground	L x W = 21.46 x 25.47
Height	1.6

III. RESULTS

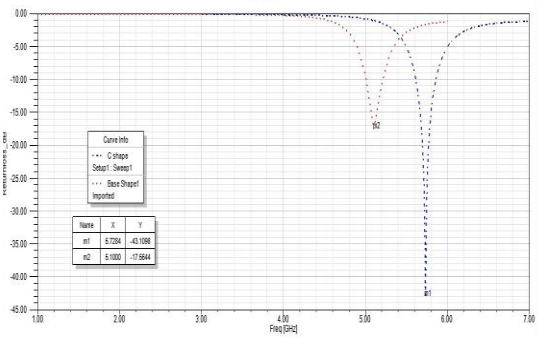

Fig.3 Return loss plot for base shape and C–shaped

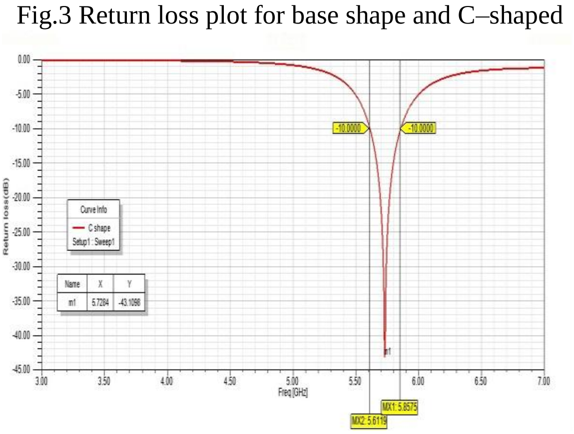

Fig.4 Return loss and bandwidth plot

Return losses is the measure of the effectiveness of electrical energy delivery from feed to an antenna. For maximum energy transfer the return loss should be minimum Fig. 5 shows the S11 parameters (Return loss) for the proposed antenna. The Fig. 4 shows that the antenna starts resonant from 5.85GHz to 5.61GHz which covers the range of Mobile Communication applications. The bandwidth of the proposed antenna is 245 MHz and the Return loss of -43.10dB.

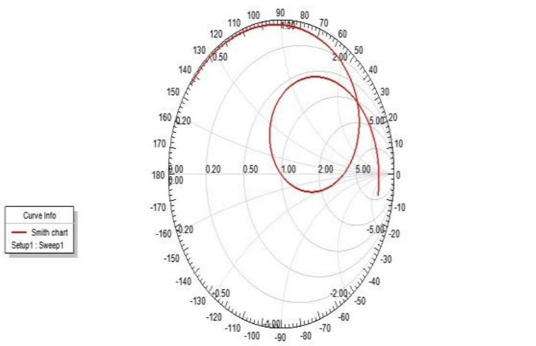

Fig.5 Smith chart of C–shaped patch antenna

A Smith chart was developed by Phillip H. Smith in 1940s. Smith chart is a method that graphs the reflection coefficient and impedance and is also used to examine the relationship between them. Since smith chart is defined only for the input and output reflection coefficient parameters (S11, S22), it represents that how the antenna impedance varies with frequency. It shows the complex reflection coefficient in polar form for arbitrary impedance. The center of the smith chart circle corresponds to reflection coefficient (Γ) which when equals to zero means a perfect impedance match. Thus the plot of Γ should be as close as possible to center of the smith chart. Fig.5.Shows that the circle cut the resistive part at 1 circle which means the proposed antenna is perfectly matched.

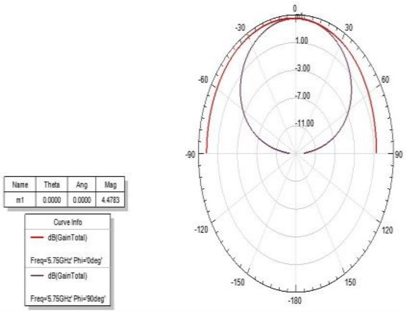

Fig.6 Radiation pattern of C-shaped patch antenna at 5.72GHz

The radiation pattern is a graphical representation of the relative field strength transmitted from or received by the antenna. The radiation pattern is shown in Fig. 6 at the 5.72GHz frequency. The radiation pattern shows that the antenna radiates more power in a certain direction than another direction

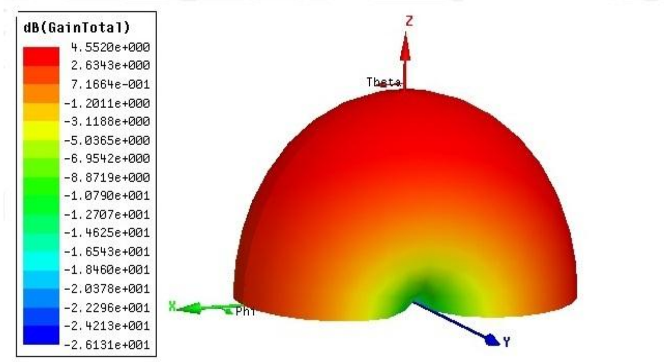

Fig.7 3D Polar plot of C–shaped patch antenna

The radiation pattern is a graphical representation of the relative field strength transmitted from or received by the antenna. The radiation pattern is shown in Fig. 7 at the 5.72GHz frequency. The radiation pattern shows that the antenna radiates more power in a certain direction than another direction

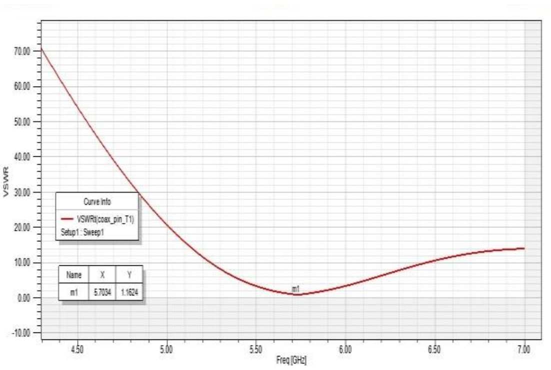

Fig.8 VSWR of C–shaped patch antenna

When a transmitter is connected to an antenna which is fed by any one of the feeding techniques, then the impedance between the antenna and feed must be exactly same or equal for maximum energy transfer from feed to antenna. When the matching between the antenna and feed is not achieved, then some of the electrical energy can to be transferred from feed to antenna. Electrical energy that is not transferred to antenna is reflected back to transmitter. The reflected waves get encountered with the forward waves (incoming waves) which cause standing wave patterns. The smaller value of VSWR describes that the antenna and feed both are well matched and more electrical energy is delivered to antenna. The VSWR is always positive and a real number. Since the VSWR is an absolute function of reflection coefficient (Γ).

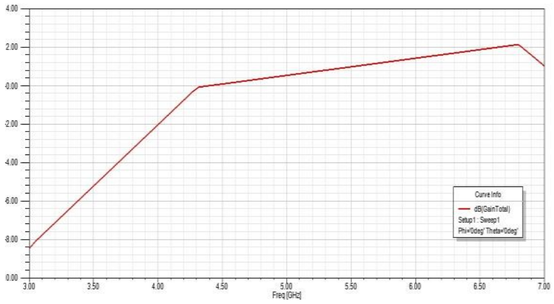

Fig.9 Gain V/s Frequency of C–shaped patch antenna

Fig. 9. shows, the variations in the gain with respect to frequency. It has revealed that the gain performance of the proposed antenna is satisfactory within the desired frequency range. Fig.4.11. shows that in the desired frequency band, value of gain of the proposed antenna lies in positive range.

IV. CONCLUSIONS

In this paper, a C-shaped patch antenna has been designed with coaxial feeding technique used. Initially rectangular shape patch is simulated and return loss curve is traced, then a rectangular shape of particular dimension is detached from the base shape such a way that base shape converted into C-shape then a defected ground structure is created. After accomplishment of the design it is retained beneath simulation to get desired result. Here we get better return loss than base shape, and then parametric study of various parameters of the proposed antenna has also been presented. We concluded that return loss increases to some value. The return loss plot of the proposed antenna has been shown that the antenna is resonated from 5.611GHz to 5.811GHz with the return loss of -43.10dB. So, the proposed antenna can be used for amateur radio and satellite communications. The proposed antenna shows the satisfactory gain in the desired frequency range. In this shape we improved BW% up to 4.61% from 3.98%.

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