Third International Conference on "Materials, Computing and Communication Technologies"
in association with International Journal of Scientific Research in Science, Engineering and Technology
Print ISSN: 2395-1990 | Online ISSN : 2394-4099 (www.ijsrset.com)

Design of Compact Internal Antenna for Sub-6 GHz 5G Radio Application

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ABSTRACT

This paper is about the designing the compact internal antenna for radio applications in 5G which operates in sub 6GHz band and it is made up by circular patch antenna. We have gone through so many changes for antenna design to bring the novelty and made as the circular patch antenna with FR4 substrate which holds dielectric permittivity of 4.4 and height 1.6mm is used to design a circular patch antenna. This antenna design is made up of the complexity solver software Hfss used for high resonant frequency and obtained VSWR of 1.08. Return loss of -28.29dB with gain of 4.77dbi at the resonant frequency of 3.5 GHz.

KEYWORDS: Circular patch Antenna, Sub 6GHz, HFSS, Compact internal Antenna.

I. INTRODUCTION

Now-a-days the communication playing as vital role in everywhere but this communication is depending on the antenna design. There are so many bands are there for carrying the information by using this in that one of the band called sub 6GHz used in this paper for our antenna design. This is a band that which useful for the 5G cellular Network/communication purpose that supports Two frequency ranges FR1 & FR2 but we are using FR1 because of the Indian government rules it's about of range from 410 MHz to 7125 MHz. This Band mostly useful for our Radio application purpose.

5G radio appliances is a stable mobile technology that gives more advanced functionalities. It is designed to meet the exponential demand for connectivity and covers new applications to very high data speeds, high responsiveness and strong Reliability. The main purpose is the most and accurate and also from starting onwards the 5G development takes place mainly in the 3.5GHz frequency bandwidth.

Therefore, In this paper circular patch antenna is required for the radio application in 5G which operates in sub 6GHz band. This circular antenna has to developed and designed according to the operating functionalities of sub 6 GHz band and must have the resonant frequency of 3.5 GHz that which presented to Radio application.

In this paper maximum Novelty of the design has been tried on the circular patch and ground. This antenna design is made up on the software called HFSS. It is the software that finite element method solves for electromagnetic structure from it and also it is a 3D EM simulating High frequency antenna designs. The main purpose of using this circular patch antenna is the circularly polarized in a specific orientation and good immunity of signals in the multiple path and also low cost , less weight. The main advantage is it countless antenna features like return loss, radiation adjustment, bandwidth, directivity, antenna gain.

II. LITERATURE REVIEW

The main User effects on the circular polarization of 5G mobile Terminal Antenna is proposed by Igor syrystin, shuai Zhang, Zhinong Ying published in IEEE gives the information about the coverage efficiency and slan pattern by talk & data mode[1].The wide band dual polarized end time Antenna Based on Compact Open Ended cavity for 5G mm wave mobile phones proposed by Libin Sun, Yue Li, Zhijun Zhong. Published in IEEE give the information about compactness and construction of antenna in vertical polarization by integrating[2].Size reduction of self-Isolated MIMO antenna system for 5G mobile phone Applications has proposed by Anping Zhao, Zhouyou Reu published in IEEE given the information on Reduction the size of antenna that improves the gain and return loss in a accurate values in 5G applications[3].

III. ANTENNA DESIGN

Now coming to antenna design it has been divided into two parts front view and back view. Coming to front view it has the one circular patch antenna having 1.6 mm thickness and having electric conductivity 5.e+007. The back view consists of rectangular ground.

The electric antenna is designed of with FR4 material of having 1.6mm height & 4.4 of permittivity and loss tangent of 0.02 and input feeding with 50 ohm.

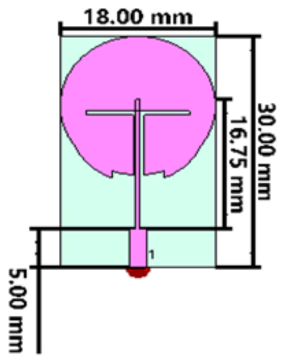

Fig: 4.1 Front view

The front view which consists of circular antenna shoped copper has been given as feeding by using excitation. Inset feeding given more/better impedence than the often feeding method. The circular patch having diameter 5mm and feeding having length 16.75 mm and Probe strip length 5.00 mm and height 1.6mm.

Table-1:Front-view parameters

Parameter	**Dimension**
Strip length	16.75mm
Probe length	5.00mm

Height	1.6mm

The back view is having the main purpose that giving proper ground that have the connection between patch and ground. And in between the substrate also place a major role for the design.

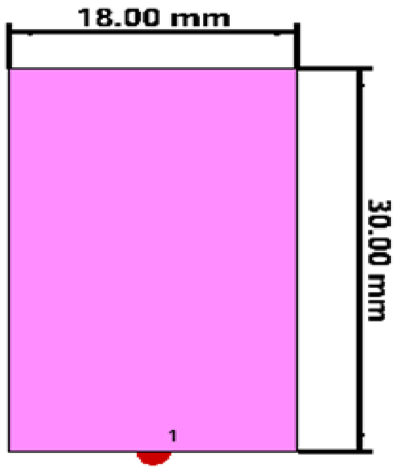

Fig:4.2 Back view

Table-2:Back-View parameters

Parameter	**Dimension**
Length	30.00mm
Breadth	18.00mm

IV. RESULTS

The proposed antenna design is simulated in HFSS and we got the results has been discussed below.

1. RETURN LOSS:

We have obtained a minimum return loss of -28.29dB around 3.5GHz as shown in the below fig.

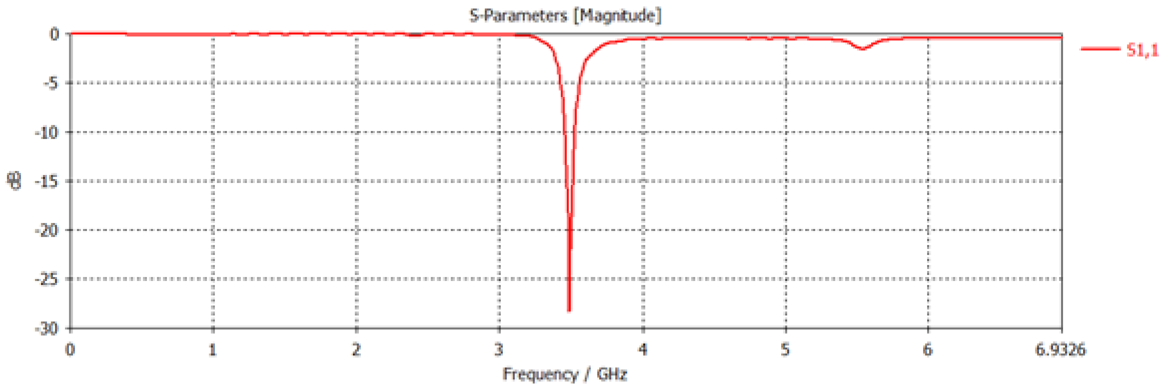

Fig:5.1 Return loss

2. VSWR:

We have obtained Voltage Standing Wave Ratio (VSWR) around 1.08 around 3.5 GHz shown in the below fig.

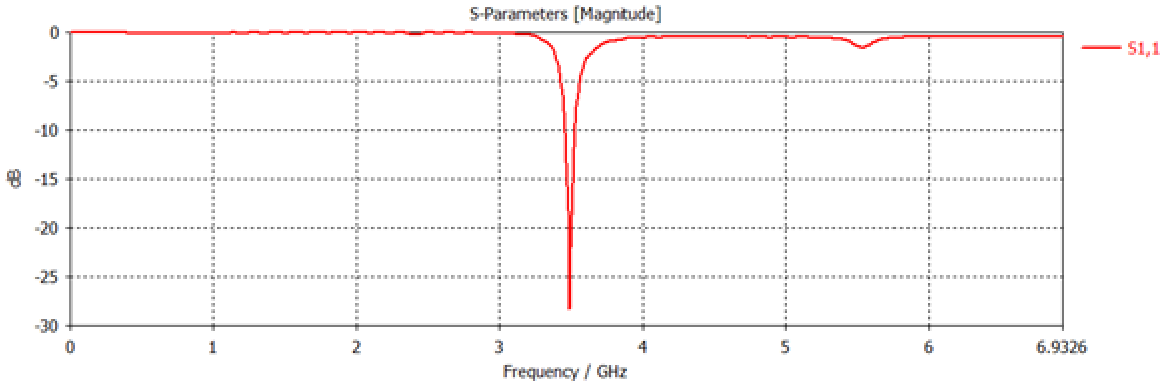

Fig:5.2 Voltage Standing Wave Ratio (VSWR)

3. GAIN :

We have obtained total gain of about 4.77dB around 3 .5 GHz as shown in below fig.

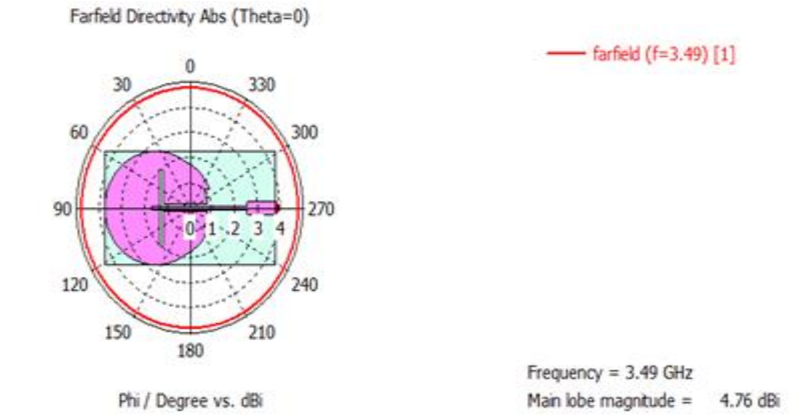

Fig:5.3.1 Theta 0

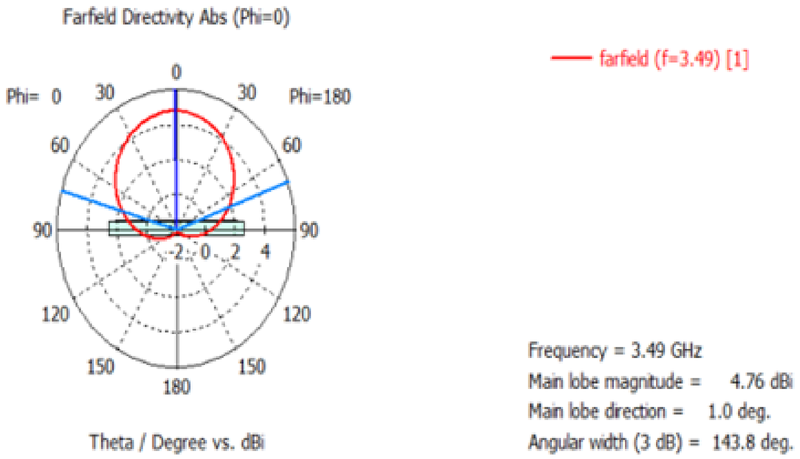

Fig:5.3.2 Phi 0

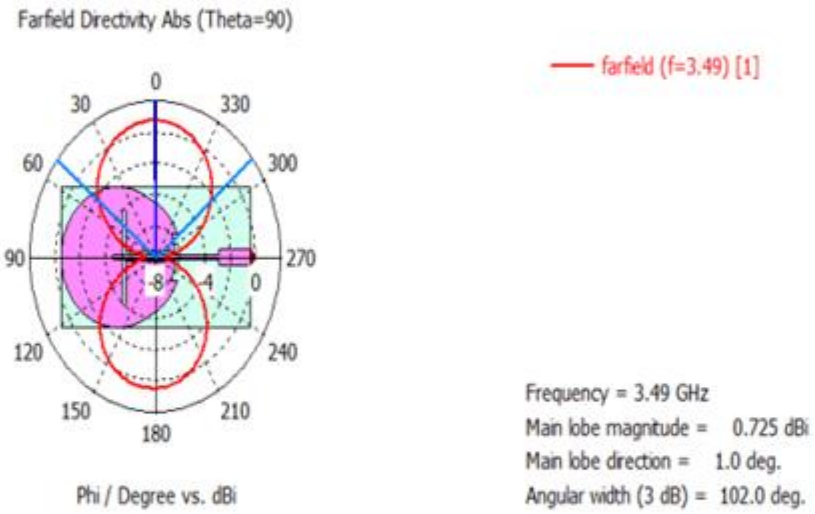

Fig:5.3.3 Theta 90

V. OVER ALL RESULTS

Parameter	Value
FREQUENCY BAND	SUB 6 GHZ
OPERATING FREQUENCY	3.5GHZ
WAVE LENGTH	85.7mm
RADIUS OF CIRCULAR PATH	5mm
SUBSTRATE DIELECTRIC USED	Fr4
SUBSTRATE DIELECTRIC CONSTANT	4.4
SUBSTRATE THICKNESS	1.6mm
FEEDING TECHNIQUE	PROBE FEEDING
GROUND PLANE	FULL GROUND
RETURN LOSS	-28.29dB
GAIN	4.77dbi
BANDWIDTH	70MHZ
EFFICIENCY	85%
VSWR	1.08

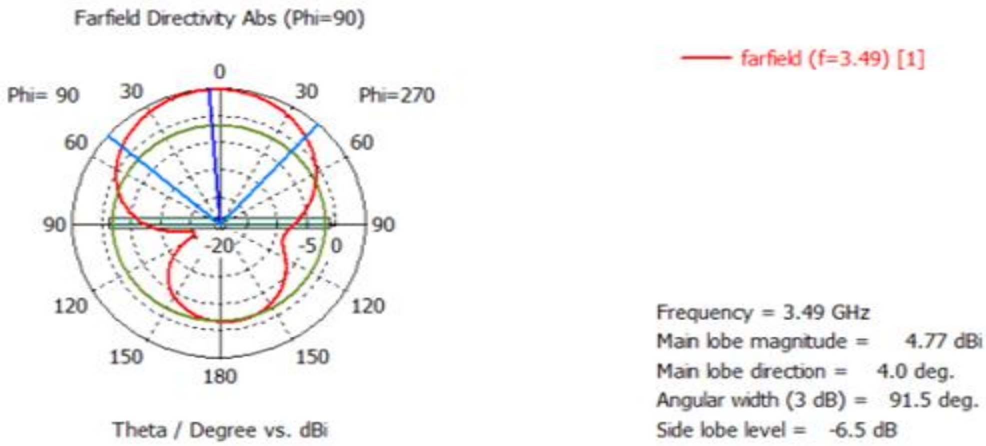

Fig:5.3.4 Phi 90

VI. CONCLUSION

By this paper we are concluding is we got the return loss of 28.29dB for 3.5GHZ frequency which is used for the 5g application with an efficiency of 85%and vswr of 1.08 and gain of 4.77dBi and bandwidth of 70MHZ for the antenna design we made .But in future we can make this antenna design for same application by changing the frequency , bands and also size which reduces space and cost of antenna.

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