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DESIGN AND SIMULATION OF SINGLE BAND RECTANGULAR MICROSTRIP PATCH ANTENNA FOR 5G APPLICATION

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Abstract - *The motive of this paper is to design a single band microstrip patch antenna for 5G wireless communication. The resonant frequency of the antenna is 30 GHZ. The antenna has a compressed structure of 6.0429x6.9528x0.5mm . This rectangular patch antenna is designed using Roger RT5880 substrate with dielectric constant 2.2 and of thickness h=0.5mm. The patch antenna was simulated on CST Microwave Studio Simulation Software. This antenna provides gain of 5.938 dB and it is used for wireless communication and mobile equipment.*

Key Words*: *Microstrip patch antenna, CST Studio, 5G communication, 30 GHz.

1. INTRODUCTION

In today's digital era the demand for Internet usage is increasing rapidly. Users demand fast data speeds, more reliability, massive network capacity in order to fulfill their needs, and we have come across 5G technology. Mostly the frequency range used for 5G research is in the range of 24 GHz to 60 GHz. So we have designed a single band. It is a rectangular patch antenna having a resonant frequency 30 Ghz. This antenna consists of ground, substrate, patch and feedlineThe dimensions of the ground are 6.0429mm x 6.9528mm. The antenna is designed with Rogers RT 5880 substrate with dimensions 6.0429mm x 6.9528mm. The structure of the patch has a measurement of 3.0429 mm x 3.9528 mm.

The wide use and considerable decrease in the size of mobile phones led to immediate requirement to develop small sized antennas that could fit in those devices. This gave rise to microstrip patch antennas in the 20th century. It consists of a thin metal foil also called a patch mounted on a substrate, beneath the substrate there is a ground layer. Mostly these antennas are used in microwave frequency bands. This future 5G technology can also be used in smart cities, smart transportation and robotics applications.

2. ANTENNA AND ITS PARAMETERS

An antenna is a metallic device which transmits or receives the radio signal. They are basically the transducers which convert voltage to radio signal at transmitter end and pass the signal to receiver through air .At receiver side, the antenna converts that radio signal into voltage from. Antenna parameters play a vital role in the Design and Development phase. The different antenna parameters are S-Parameter, VSWR, Directivity, Gain, Bandwidth, Radiation pattern, Antenna efficiency etc.

S11 parameter defines the return loss of an antenna. Less is the return loss, more is the efficiency of the antenna. VSWR is correlated to the reflection coefficient. Matter-of-factly it should be between 1 to 3. In a perfect world the value of VSWR is 1. Radiation is an important antenna parameter which decides how good the antenna is in matter of directivity of the antenna. Most of the radiation should be on the broadside perpendicular to the plane of paper. It is minimum at the bottom and maximum at the top because of the fringing field. Antenna radiation consists of a major lobe and side lobe. The side lobe represents the loss. The loss happens due to power being transmitted back to the source. Power is returned back to the source or transmitter; those losses are called return loss.

3. ANTENNA DESIGN

The designed model of Rectangular Microstrip Patch antenna works at a frequency of 30 Ghz. This rectangular patch antenna is fed by a 50 ohm microstrip feedline. This antenna is made up of three components namely ground ,substrate and patch as shown in figure no. 1. The measurement of ground is 6.0429mm x 6.9528mm as shown in the figure no. 2.1. The measurements of the substrate which is made up of Rogers RT 5880 are 6.0429mm x 6.9528mm as shown in the figure no. 2.2. The measurements of the rectangular patch are3.0429 mm x 3.9528 mm as shown in the figure no. 2.3. The precise values of the input parameter of the rectangular microstrip patch antenna is shown in Table no 1.

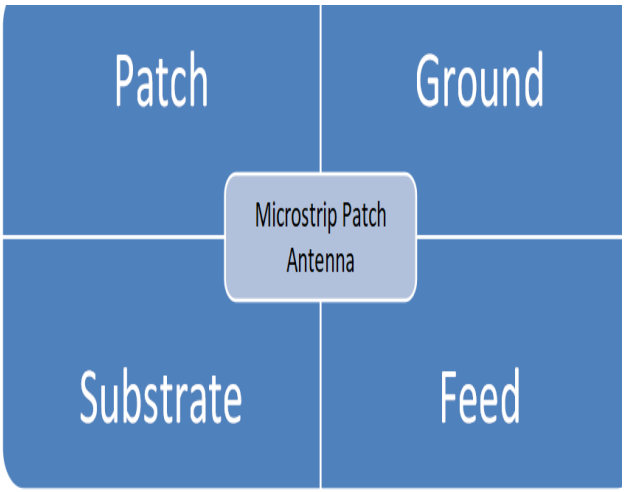

Figure no. 1 - Components of patch antenna

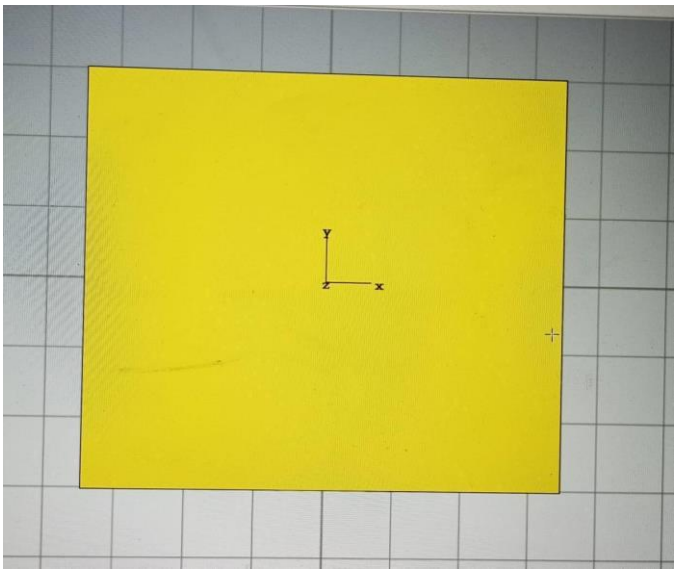

Figure no. 2.1 - Ground of Microstrip Patch Antenna

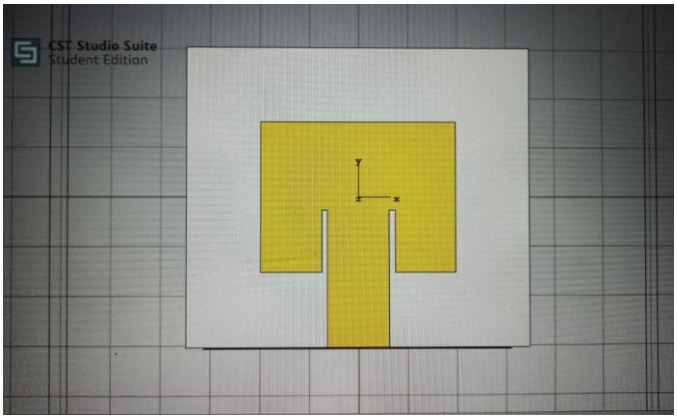

Figure no. 2.2 - Substrate of Microstrip Patch Antenna

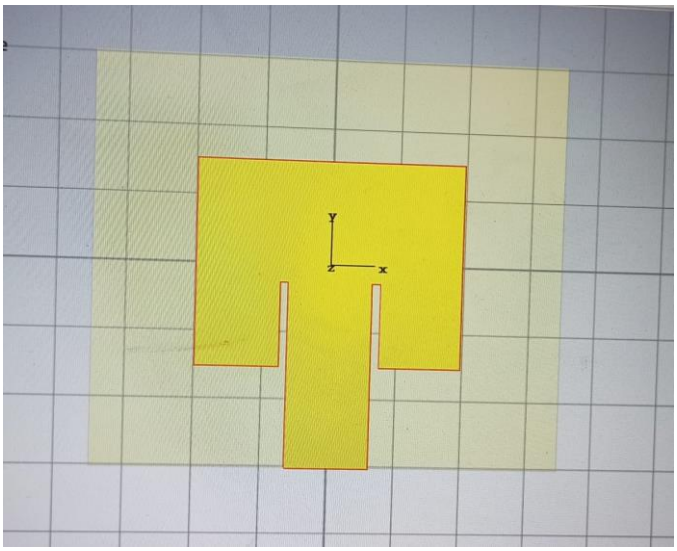

Figure no. 2.3 - Patch of Microstrip Patch Antenna

4. FIGURES AND TABLES

Table no. 1 - Input Parameters of Patch Antenna

Sr. No.	Parameter	Value	Description
1.	L	6.0429	Length of ground and substrate
2.	W	6.9528	Width of ground and substrate
3.	Lp	3.0429	Length of patch
4.	Wp	3.9528	Width of patch
5.	h	0.5	Height of substrate
6.	t	0.035	Thickness of ground
7.	wf	1.25	Width of feedline
8.	Lf	1.25	Length of feedline
9.	s	0.12	Width of slot

5. SIMULATION RESULTS

5.1 S-Parameter Plot

The S11 parameters are examined as antenna return loss parameters. Figure no. 3.1 shows the plot of S-Parameter. In this figure, considering -10 dB to be the base value, the return loss obtained at 30 GHz is 18 dB. -10 db cites that only 1/10 of the power is lost and 9/10 of the power is successfully transferred.

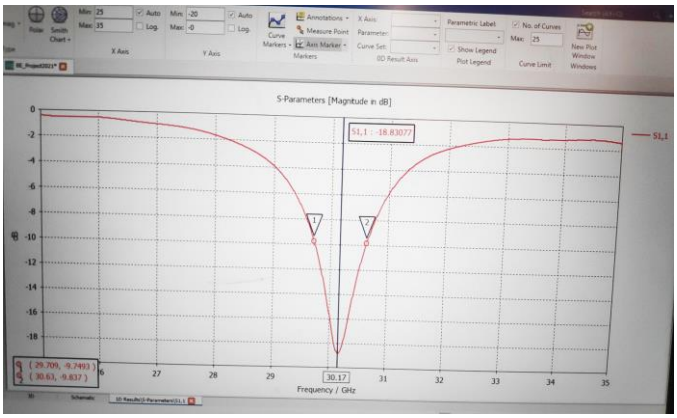

Figure no. 3.1 - S-parameter plot

5.2 VSWR Plot

The Voltage Standing Wave Ratio (VSWR) plot is shown in the figure no. 3.2.Preferably the value of VSWR should be 1 and matter of factly the value should be not more than 2.5 dB for a good antenna. In figure no. 3.2 we have obtained VSWR of 1.58 dB at 30 GHz which satisfies the condition of an acceptable antenna.

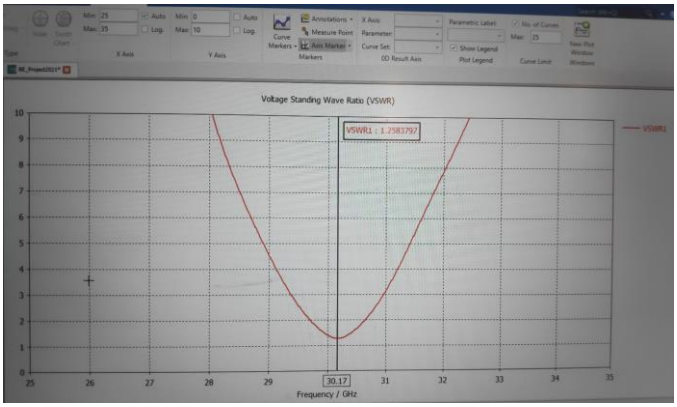

Figure no. 3.2 - VSWR plot

5.3 Gain Plot

Figure no. 3.3 shows the 1D plot of the gain of the antenna whereas Figure no. 3.4 shows the 3D plot of the gain of the antenna. In figure no 3.3 the outer circle shows angular direction of the radiation whereas the inner circle represents the axis that represents power gain. We have achieved power gain of 5.938 dB which lies between the required range.

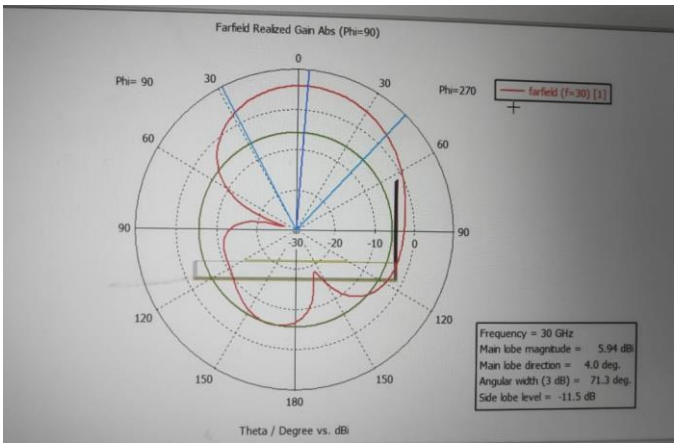

Figure no. 3.3 - Simulated 1D Farfield radiation pattern at 30 GHz

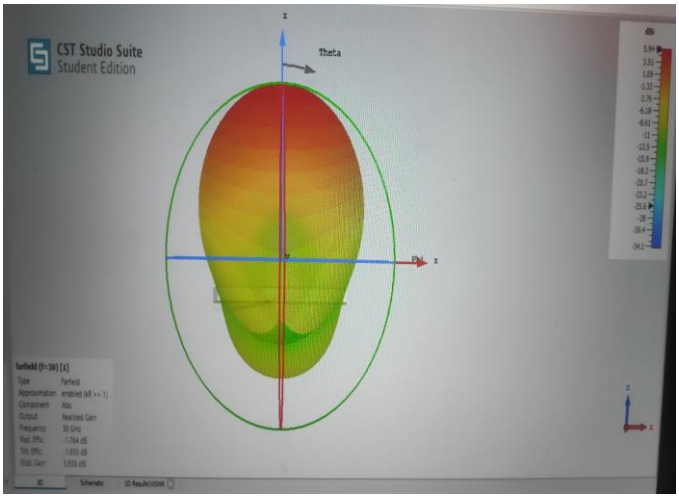

Figure no. 3.4 - Simulated 3D Farfield radiation pattern at 30 GHz

The Table no. 2 shows the output parameters of the single band rectangular microstrip patch antenna which we have obtained by simulation at the frequency at 30 GHz by using CST Studio software.

Table no. 2 - Output Parameters of Patch Antenna

Sr. No.	Parameter	Result
1.	S-Parameter	18 dB
2.	VSWR	1.58 dB
3.	Gain	5.938 dB

6. CONCLUSIONS

In this, a single band antenna has been proposed for 5G wireless communications which propagates at a frequency of 30 Ghz. The patch is excited by a 50 ohm feedline. The microstrip patch antenna has a compressed structure of 6.0429mm x 6.9528mm x 0.55mm. The antenna has a substrate of material Rogers RT5880(lossy). From practical results, the antenna provides the gain of 5.938dB and due to less VSWR and less return loss antenna, this antenna can be used for 5G communication systems and mobile equipment.

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