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Modified Rectangular Microstrip Patch Antenna for 5G Application at 28GHz

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Abstract: *Microstrip patch antenna is used in modern communication device. A modified rectangular patch antenna is designed and probed at 28 GHz in this paper. The designed antenna has resonating frequency of 28 GHz which is pertinent for 5G antenna. The blueprint is contrived on Fr4-Eproxy material used as a dielectric material. Its dielectric constant (εr) is 4.4 and thickness is of 1.6mm. For optimum performance the no. of elements and component spacing are studied. Thus it has potential for 5G applications.*

Keywords: *Patch, HFSS, Slot, Resonating frequency, 5G.*

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I. Introduction

Microstrip antenna was first introduced in 1950s. The progress of mobile phone technology growing rapidly and tremendously. Series it was made acquainted in early 1990's [1]. The technology advanced all over the world. The 5th generation of technology started from 1G, 2G (GSM), 3G (WCDMA), 4G (LTE) and now going to flourish 5G all over the world [2]. Every generation are accomplished with some innovations and several disparities. The fifth generation (5G) technology is extended to outright the fourth generation. Such as limited bandwidth and speed. To have 5G, the antenna must have at least gain of 28 GHz [3] and band width more than 1GHz. Microstrip patch antenna are widely used in satellite communication, military purpose, GPS, etc., due to its compact shape and light weight it is easy to implement [4]. A patch antenna is a narrow band, wide team antenna fabricated by etching the antenna element pattern in Meta traces bended to an insulting dielectric substrate. The microstrip rectangular patch antenna which looks like a truncated microstrip transmission line. The upcoming 5th generation cellular network is anticipated to exhibit a uniform GBps data throughout experiences across a vast range of user scenario. In association with advanced modulation schematics, employment of the millimetre wave spectrum will be highly instrumental in enhancing the data throughout by more than a hundredfold in comparison to the legacy rate's [5]. A 28Ghz Pico-cellular network is conceived and study based on real world. Work has been evaluated and stimulated by the software HFSS12. HFSS stand for High Frequency Structure Stimulator tool for 3D- Full wave electromagnetic field stimulation Software [6].

II. The Designed Antenna

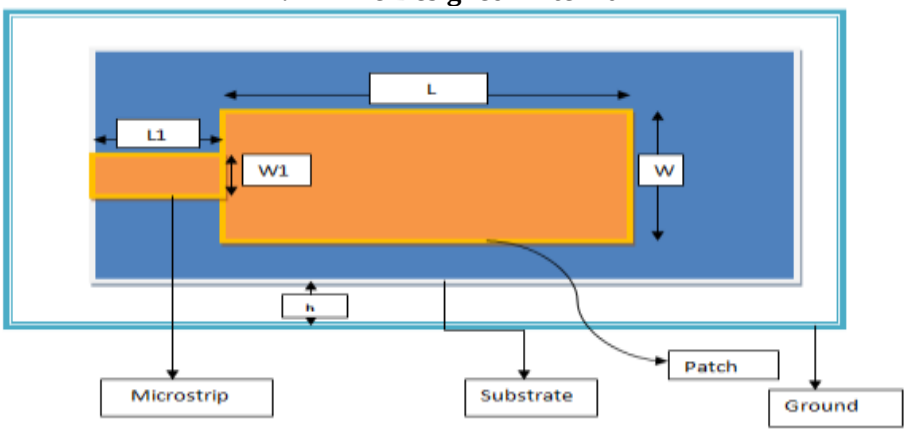

Fig-1 Antenna Geometry

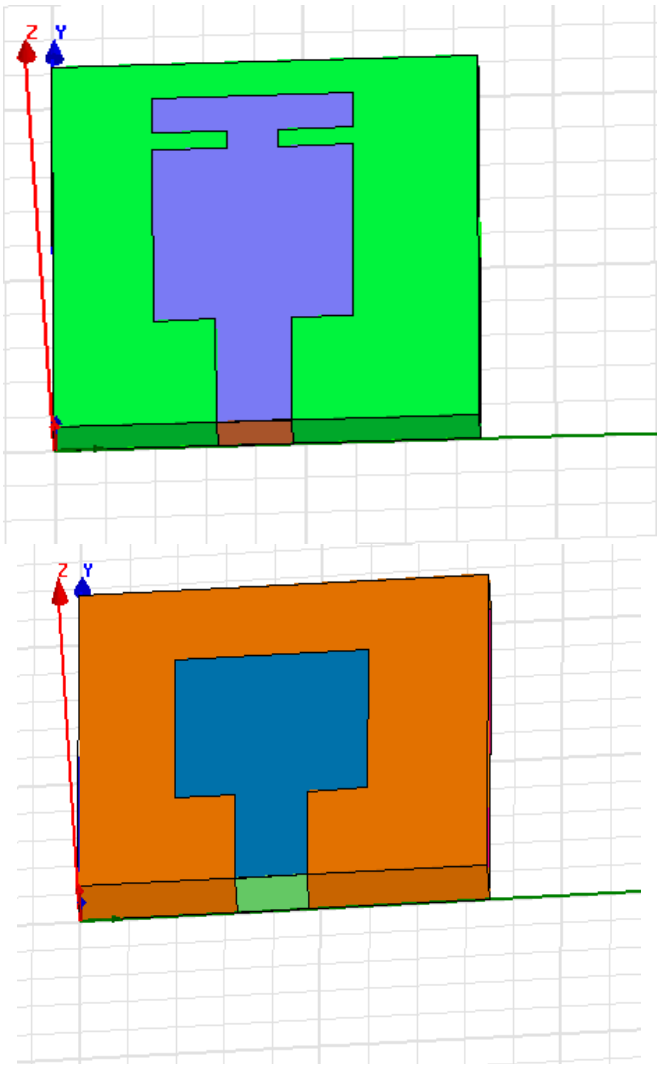

Fig-2 Perspective view of the modified rectangular Patch antenna
Fig-3 Perspective view of the rectangular patch Rectangular Patch antenna

In this paper, to design a rectangular patch antenna suitable methods are used. In fig- 2, a box "ground" that we made by using the material vacuum and assigned boundary condition "Perfect E1". We made Substrate in box by using the material "FR4-Eproxy". The height of the substrate box is 1.6mm above the ground plane. Above of the substrate we designed patch and two rectangular boxes. Patch and Microstrip are in "unite" condition and are rectangular in Z-axis that is equal to substrate height and the width is equal to the rectangular. We made the patch and rectangular is assigned to boundary condition "Perfect E2". At last a Rectangular box is designed by considering air material and then assigned the radiation. In fig- 3,the modified rectangular antenna is designed . By forming the rectangular box and patch we completed the modified antenna and they are assigned by the boundary condition "Perfect E" .

III. Mathematical Formulation Of Patch Antenna

Microstrip patch antennas have many method of simulation. The rectangular patch is far the most widely used configuration. It is very easy to analysis using the cavity and transmission line model. Since the dimension of the rectangular patch and substrate is given by[7] :

$$W = \frac{C}{2f_r\sqrt{\frac{(\varepsilon_r+1)}{2}}} \quad \text{.... (1)}$$

Where C is speed of light that is 3×10^8, f_r is the resonant frequency that is 28Ghz for 5G application and ε_r is the dielectric constant of substrate that is for "FR4-Eproxy" is 4.4
The effective dielectric constant ε_{eff} is given by ;

$$\varepsilon_{eff} = \frac{(\varepsilon_r+1)}{2} + \frac{(\varepsilon_r-1)}{2}\left[1+12\frac{h}{W}\right]^{\frac{-1}{2}} \quad \text{....(2)}$$

Here h is the height of the substrate that is 1.6 mm .

$$L_{eff} = \frac{C}{2f_r\sqrt{\varepsilon_{eff}}} \quad \text{.... (3)}$$

Based on the simplified formulation that has been described, a design procedure is out lined which leads to practical design of rectangular microstrip antennas [8].

$$\Delta L = 0.412h\frac{(\varepsilon_{eff}+0.3)\left(\frac{W}{h}+0.264\right)}{(\varepsilon_{eff}-0.258)\left(\frac{W}{h}+0.8\right)} \quad \text{.... (4)}$$

$$L = L_{eff} - 2\Delta L \quad \text{.....(5)}$$

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TABLE-1 . Rectangular Patch Antenna

Sl.No	Parameters	Dimension (mm)
1	W	3.26
2	L	1.67
3	*Leff*	2.93
4	ε_{eff}	3.34
5	ε_r*(FR4-Eproxy)*	4.4

TABLE-2. Comparison Table

Parameters	Rectangular Patch antenna	Modified Rectangular Patch Antenna
Resonant Frequency	27.35 GHz	27.16 GHz
VSWR	27.46 GHz	27.16 GHz
Gain	-2.0 dB	-1.20 dB

IV. Simulation Result

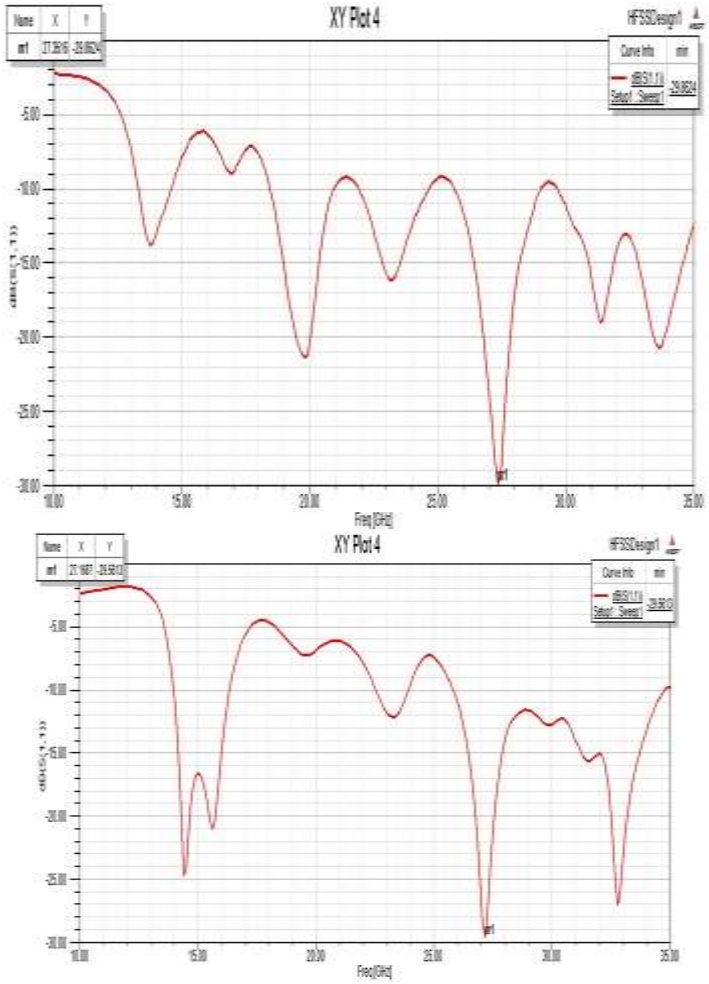
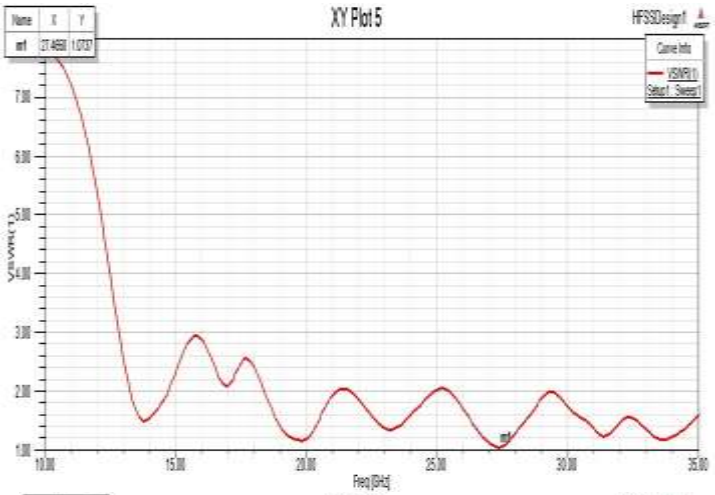


Fig- 4 S-Parameter in Rectangular Patch antenna
Fig- 5 S-Parameter in modified Rectangular Patch antenna



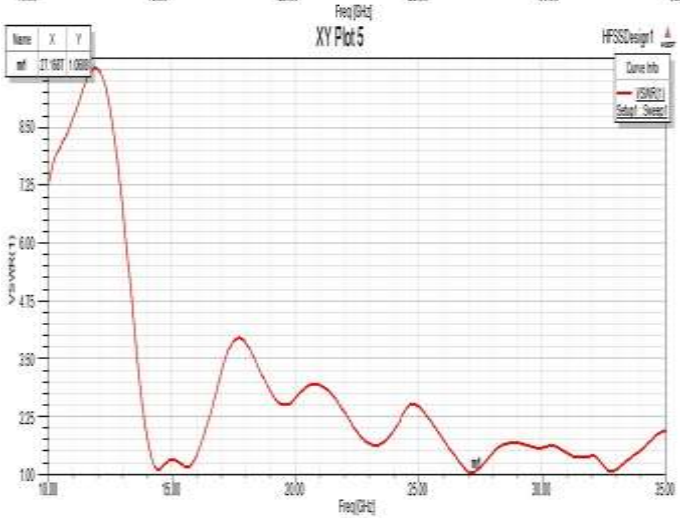


Fig- 6 VSWR in Rectangular Patch antenna
Fig- 7 VSWR in modified Rectangular Patch antenna

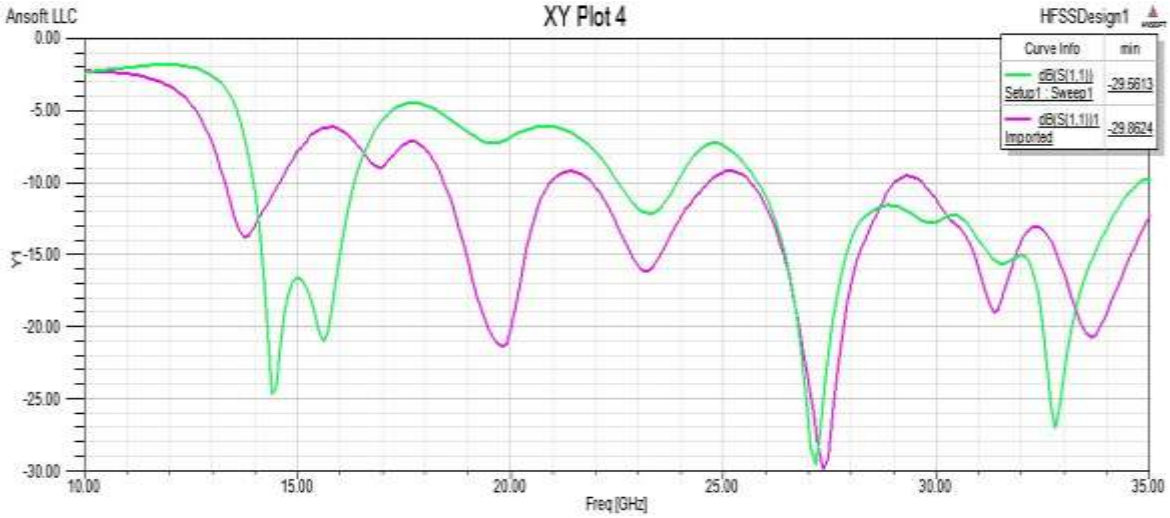


Fig- 8 Comparison between S-Parameter in both the antenna pink shows rectangular patch antenna and green curve shows the modified antenna

In fig- 8 there is comparison between the S-Parameter in rectangular patch antenna and modified antenna. The pink colour graph shows the curve of rectangular patch antenna and the green colour graph shows the curve of modified antenna. The Maximum Resonant frequency, VSWR and Gain for without modified is 27.35GHz, 27.46GHz and -2.0 dB and for modified antenna 27.16GHz Maximum Resonant frequency, 27.46GHz for VSWR and -1.20 dB for Gain.

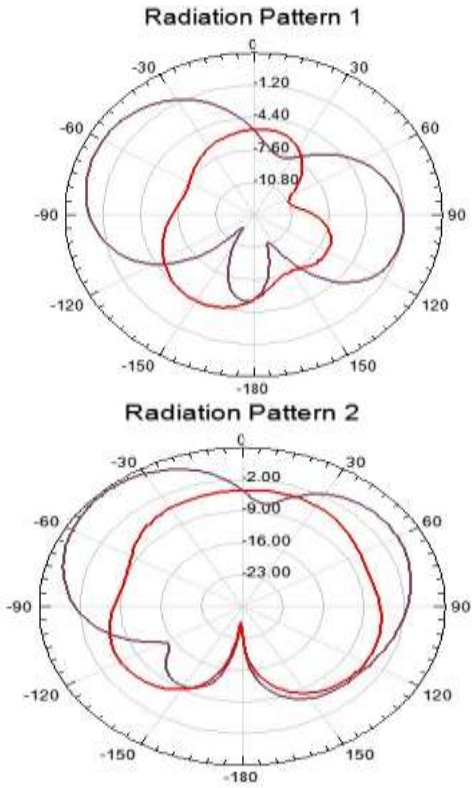


Fig-9 2D- Gain Radiation in Rectangular Patch antenna
Fig-10 2D-Gain Radiation in modified Rectangular Patch antenna

V. Conclusion

In this paper the comparison between the Rectangular Patch Antenna and Modified Rectangular Patch Antenna has been done for 5G application. The results have been found out to be in the desired range of frequency 28 GHz. In this course of the project, we concluded that the Modified Rectangular Patch antenna gives the better result than the rectangular patch antenna.

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References

[1] Tanish Narang; Shubhangi jain; "Microstrip Patch Antenna- A Historical Perspective of the Development", Conference on Advance in Communication and Control Systems2013 (CAC2S 2013).
[2] Z.Ying, Antennas in Cellular Phones for Mobile Communications," in Proceedings of the IEEE, Vol..No. 100, pp. 2286-2296, July 2012.
[3] www.wikipedia.com : "5G"
[4] ^Lel, Kai Forg,Luk Kwai-Mann: Microstrip patch Antenna, (World scientific, ISBN-184816453X,PP- 8-12)
[5] Wonbin Hoklg : DMC R&D Centre,(Samsung electron,Suwon,South Korea)
[6] Ansoft HFSS. Ver 12 Ansys Corporation. Available At WWW.ansoft.com.
[7] C.A.Balanis,Antenna Theory: Analysis and Design,(3rd edition Wiley, New York ,2005)
[8] Nandini Ammanagi, Rahul Khadilkar, Akash Harwani, Disha Budhlani, Disha Dembla; "Comparison of the performance of Microstrip Antenna at 2.4 GHz Using Different Substrate Materials", International Journal of Engineering and Advanced Technology(IJEAT) ISSN:2249-8958, Volume-3,Issue-4,April 2014 .

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