International Journal of Pure and Applied Mathematics
Volume 117 No. 16 2017, 51-56
ISSN: 1311-8080 (printed version); ISSN: 1314-3395 (on-line version)
url: http://www.ijpam.eu
Special Issue
ijpam.eu

A REVIEW OF ANTENNA PARAMETERS OF RECTANGULAR MICRO STRIP PATCH ANTENNAS AT 9-15GHZ AND 20-32GHZ

[1]A.Vimala, [2]S.Manikandan, [3]P.Karthigaikumar
[1,2]Assistant Professors, [3]Professor
Karpagam College of Engineering, Coimbatore, India
[1]tel2vimala@gmail.com

Abstract: In this paper two different configurations of rectangular micro strip patch antenna parameters are analysed at 9- 15 GHz and 20- 32GHz frequency ranges for 5G applications. The simulated S11 radiation pattern, return loss, gain, directivity, efficiency and power radiated are measured in millimetre wave spectrum in the range of 9 – 15 GHz and 20 – 32 GHz using FR4 substrate and Rogger Substrate.

Key Terms: 5G; millimeter wave; 9- 15 GHz and 20- 32GHz ; microstrip patch antenna.

1. Introduction

The developing 5G technology include vast features in antenna parameters like bandwidth, radiation pattern and beam forming, gain, directivity etc. 5G technology is introduced to reduce the global bandwidth shortage in mobile communication and also 5G technologies provide low latency, real time response and high reliability communication. The movement of user during call progress changes the radiation pattern, gain and input impedance. So micro strip patch antennas are used in 5G technology. This requirement raises numerous design challenges to achieve a reasonable trade-off between technological design issues and commercial criteria – low cost, small size, radiation efficiency, antenna gain, broadband performance, and so on – mainly at millimetre wave bands. The upcoming fifth generation network is introduced to exhibit uniform Giga bits per second experience across a wide range of user scenarios. The recent wireless communication systems require a low profile, light weight, high gain, and simple antenna structures to ensure reliability and high efficiency to achieve these parameters Rectangular Micro strip patch antennas are used.

1.1 Rectangular Micro strip patch antenna Configuration:

Micro strip antennas are usually printed antennas fabricated using micro strip techniques on printed Circuit Board. Micro strip line feed is one of the easiest methods to fabricate in which a conducting strip is connected to the patch. Generally a conducting material is used for fabricating Patch such as gold and copper. The Radiating Patch may be Square, Rectangle, Circular, and Elliptical, Triangle or any other configuration. A conducting strip is connected directly to the edge of the Micro strip Patch. Also it is simple and easy to match by controlling the inset position.

A Feed Line is provided which is photo etched with patch. Micro strip Line Feed technique is used for feeding.

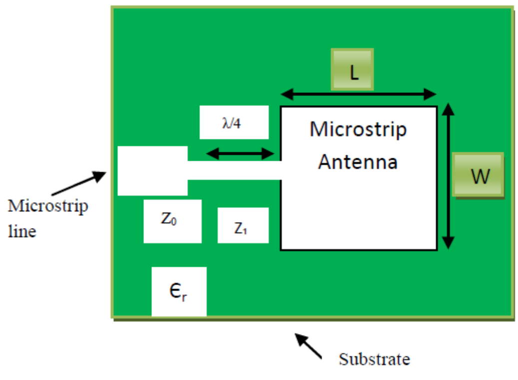

Figure 1. Micro strip line feed patch antenna

1.2 Design Methodology:

For a rectangular micro strip patch antenna, the length l of the element is usually $\lambda_0/3<L<\lambda_0/2$. There are numerous substrates that can be used for the design of micro strip antenna and their dielectric constant is usually in the range of $2.2 \leq \varepsilon_r \leq 12$. The performance of antenna depends on its dimension, operating frequency, radiation efficiency, return loss and some other parameters.

For efficient radiation, the practical width (W) and length (L) of the patch can be given as

$$W = \frac{c}{\left(2f\sqrt{(\epsilon_r + 1)}\right)}$$

$$L = L_{eff} - 2\Delta L$$

Where

c = velocity of light

f = resonant frequency

ε_r = dielectric constant

Leff = effective length of patch

ΔL = Length extension

The height of the feed line can be calculated by

H=0.822*(L/2)

The other dimensions for design of patch can be given as

Y = (W/5)

X = Z = (2W/5)

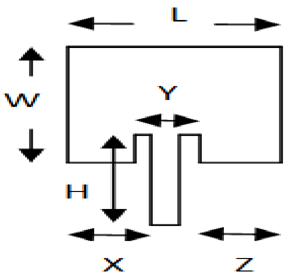

Figure 2. Dimensions of Rectangular Patch

1.3 Layout Design:

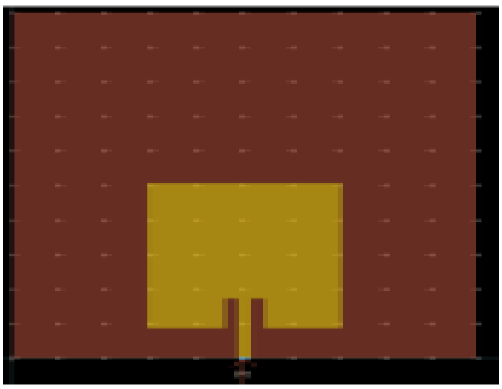

Figure 3. Layout design of Rectangular Patch Antenna for 9 -15 GHz.

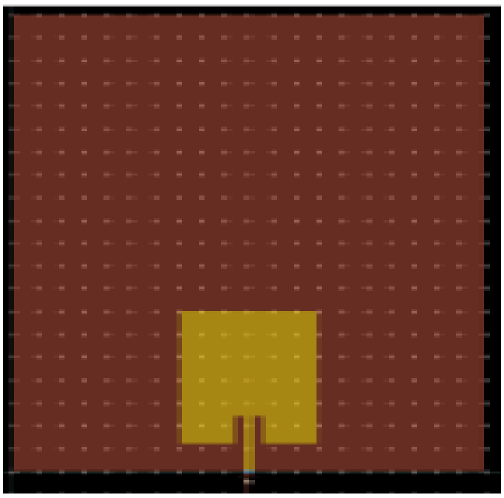

Figure 4. Layout design of Rectangular Patch Antenna for 20 -32 GHz.

Figure 3 and 4 shows the layout design view of rectangular Micro strip patch antenna at frequency ranges 9 -15 GHz and 20 – 32GHz.

1.4 Substrate Design:

The FR4 substrate is used for simulation in 9-15GHz and Rogger substrate is used for 20 -32GHz frequency range.

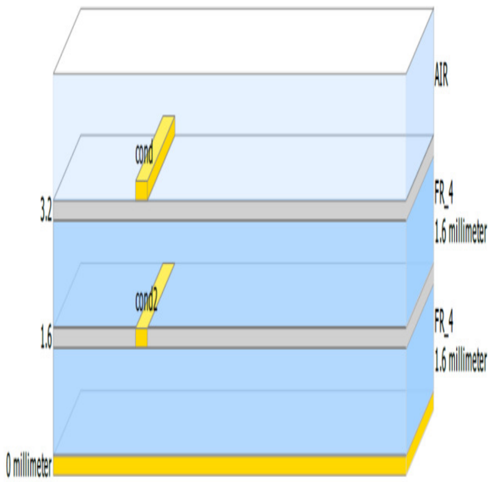

Figure 5. FR4 Substrate Design

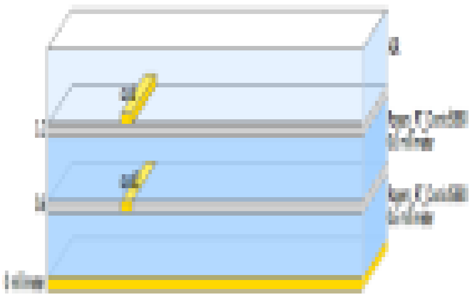

Figure 6. Rogger Substrate Design

2. Simulation Results

2.1 Return Loss:

Return loss is the amount of power lost in the load and does not return as reflection. Larger return loss indicates higher power being radiated by the antenna which eventually increases the gain

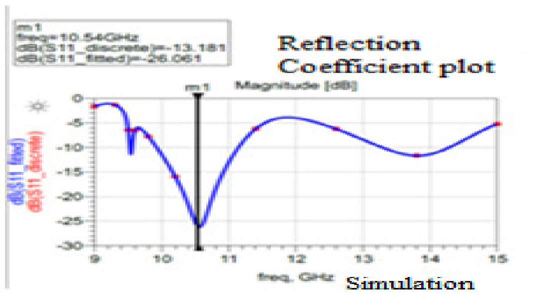

Figure 7. Return loss (9-15) GHz with FR4 Substrate

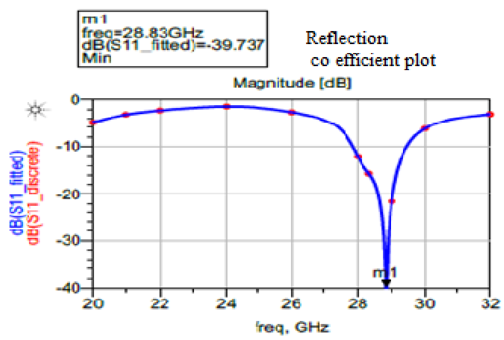

Figure 8. Return loss (20-32) GHz with Rogger Substrate

2.2 Radiation Pattern:

The radiation pattern of microstrip antenna is the power radiated or received by the antenna. It is the function of radial distribution and angular position from the antenna. The radiation pattern for the proposed rectangular micro strip patch antenna at 9 – 15 GHz and 20 – 32GHz is show in Figure.

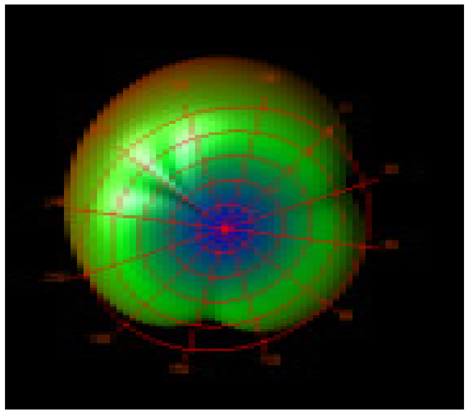

Figure 9. Radiation Pattern for 9 -15GHz

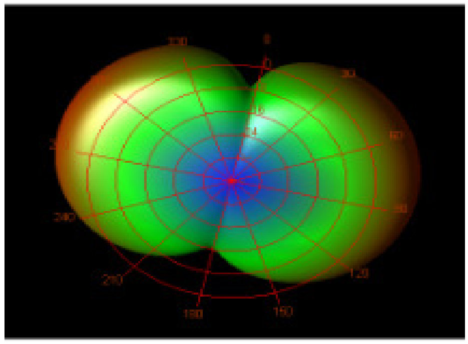

Figure 10. Radiation Pattern for 20 – 32 GHz

2.3 Antenna Parameters Vs Frequency:

2.3.1 Gain:

The important parameter of antenna is Gain, which determines the performance of the antenna or the capability to concentrate energy through a direction to give a better picture of the radiation performance.

2.3.2 Directivity:

The fundamental antenna parameter is Directivity, which determines the direction of radiation pattern of antenna.

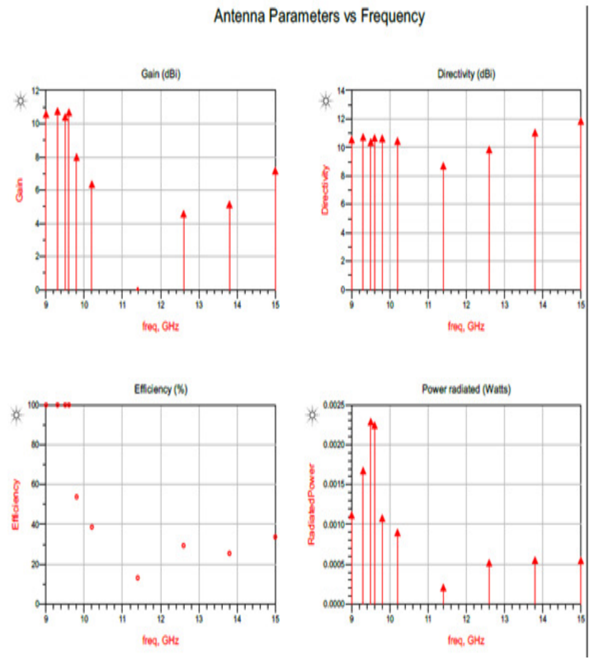

Figure 13. Antenna Parameters Vs Frequency (9-15 GHz)

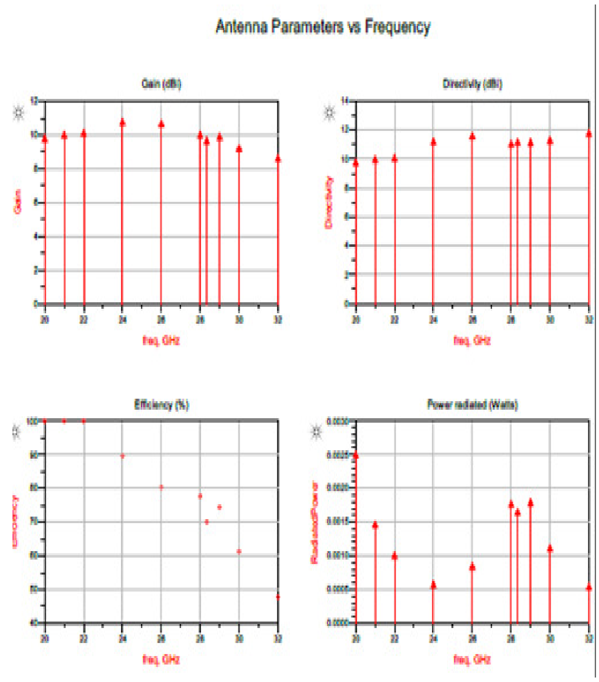

Figure 14. Antenna Parameters Vs Frequency (20-32 GHz)

Table 1. Parameters of antenna at different frequency range

Sl.No	Parameters	Frequency Range	
		9 – 15 (GHz)	20 - 32 (GHz)
1	Gain (dB)	10.025	10.025
2	Directivity (dB)	10.025	10.025
3	Efficiency (%)	100	100
4	Power radiated (Watts)	0.00255	0.00255

3. Results And Discussion

The rectangular patch array antennas operating at 9 - 15GHz and 20 - 32 GHz frequency ranges are simulated using Advanced Design Systems Software. The radiation patterns are analyzed. The Reflection Coefficient $|S_{11}|$ at frequency range 9 – 15 GHz 20 – 32 GHz are measured. The Fig :13 shows the simulation results of antenna parameters like gain, Directivity, efficiency and power radiated at 9 -15 GHz range, and also Fig : 14 shows the simulation results of antenna parameters at 20 -32 GHz range of frequencies.

References

[1] Yu, Low Ching, and Muhammad Ramlee Kamarudin. "Investigation of Patch Phase Array Antenna Orientation at 28GHz for 5G Applications."Procedia Computer Science 86 (2016): 47-50.

[2] Sharma, P. C., and K. C. Gupta. "Analysis and optimized design of single feed circularly polarized microstrip antennas."IEEE Transactions on Antennas and Propagation 31.6 (1983): 949-955.

[3] Tang, Chia-Luan, Jyh-Ying Chiou, and Kin-Lu Wong. "Beamwidth enhancement of a circularly polarized microstrip antenna mounted on a three-dimensional ground structure."Microwave and optical technology letters 32.2 (2002): 149-153.

[4] Rappaport, Theodore S., et al. "Millimeter wave mobile communications for 5G cellular: It will work!."IEEE access 1 (2013): 335-349.

[5] Malisuwan, Settapong, et al. "Design of Microstrip Patch Antenna for Ku-Band Satellite Communication Applications."International Journal of Computer and Communication Engineering 3.6 (2014): 413.

[6] Garg, Payal, et al. "Transformation of Rectangular Patch into a Circular Patch in a Microstrip

Patch Antenna for LAN Application." (2014).

[7] Mak, Ka Ming, et al. "Circularly polarized patch antenna for future 5G mobile phones."IEEE Access 2 (2014): 1521-1529.

[8] Rishishwar, Dharmendra, and Laxmi Shrivastava. "Rectangular microstrip patch antenna with FSS and slotted patch to enhance bandwidth at 2.4 GHz for WLAN applications."Int J Technol Enhancem Emerg Eng Res 2.4 (2014).

[9] Dehos, Cedric, et al. "Millimeter-wave access and backhauling: the solution to the exponential data traffic increase in 5G mobile communications systems?."IEEE Communications Magazine 52.9 (2014): 88-95.

[10] Tran, Gia Khanh, et al. "Dynamic cell activation and user association for green 5G heterogeneous cellular networks."Personal, Indoor, and Mobile Radio Communications (PIMRC), 2015 IEEE 26th Annual International Symposium on. IEEE, 2015.

[11] Ojaroudiparchin, Naser, Ming Shen, and Gert Frolund Pedersen. "A 28 GHz FR-4 compatible phased array antenna for 5G mobile phone applications."Antennas and Propagation (ISAP), 2015 International Symposium. IEEE, 2015.

[12] Outerelo, David Alvarez, et al. "Microstrip antenna for 5G broadband communications: Overview of design issues."Antennas and Propagation & USNC/URSI National Radio Science Meeting, 2015 IEEE International Symposium on. IEEE, 2015.

[13] Mitra, Rupendra Nath, and Dharma P. Agrawal. "5G mobile technology: A survey."ICT Express 1.3 (2015): 132-137

[14] Ban, Yong-Ling, et al. "4G/5G multiple antennas for future multi-mode smartphone applications."IEEE Access 4 (2016): 2981-2988.

[15] Singh, Jaspreet, Gurnoor Singh Brar, and Ekambir Sidhu. "High Gain Rectangular Microstrip Patch Antenna Employing Polystyrene Substrate For Satellite Communication Applications.",2016.

[16] T. Padmapriya and V. Saminadan, “Inter-cell Load Balancing technique for multi-class traffic in MIMO-LTE-A Networks”, International Journal of Electrical, Electronics and Data Communication (IJEEDC), ISSN: 2320- 2084, vol.3, no.8, pp. 22-26, Aug 2015.

[17] S.V.Manikanthan and K.srividhya "An Android based secure access control using ARM and cloud computing", Published in: Electronics and Communication Systems (ICECS), 2015 2nd International Conference on 26-27 Feb. 2015,Publisher: IEEE,DOI: 10.1109/ECS.2015.7124833.

[18] S.Shakeela “Agribot: An Agriculture Robot” International Innovative Research Journal of Engineering and Technology ISSN NO: 2456-1983.Volume 2, Issue 4 June 2017.129-131.