iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** IX **Month of publication:** September 2017

DOI: http://doi.org/10.22214/ijraset.2017.9199

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue IX, September 2017- Available at www.ijraset.com

Dual Band Modified E-Shaped Microstrip Patch Antenna for 5g Application and Space Communication

Ribhu Abhusan Panda[1] Nabaneet Patnaik[2] Chinmayee Dash[3] Bandana Kumari[4]
[1]*Assistant Professor, ECE Department, Gandhi Institute Of Engineering And Technology, Gunupur (765022), India*
[2, 3, 4] *B.Tech, ECE Department, Gandhi Institute Of Engineering And Technology, Gunupur, India,*

Abstract: With the accelerating advancement in the field of science and technology, the mobile industry has experienced a dramatic growth from including all features to higher speed. This paper describes the design and simulation of modified E-shaped microstrip patch antenna by HFSS which deals with dual band, wider range of frequency which comes under Ka-band. The result shows that the dual band function at 26-30GHz includes the 5G application and space communication. The patch is made of conducting material having specific dimensions and the substrate is made of FR4 EPOXY a dielectric material having dielectric constant 4.4 and slots are used to increase the band width[2]. The designed antenna can be operated at multi-range of frequency
Keyboard: HFSS, E-Shaped patch antenna, 5G, space communication, Ka-band

I. INTRODUCTION

The wireless telecommunications industry has seen incredible advances in recent years, based on new inventions and practical implementation which brought a revolutionary change. Antennas play an essential role in the field of wireless communication. It includes slot antennas, patch antennas, folded dipole antennas having own properties and importance. Microstrip antenna developed rapidly in 1970's . The proposed design comes under dual frequency range[26-30 GHz] i.e, the Ka-band. Ka-band at 26GHz,is now considered the spectrum of the future for NASA communication. In Ka-band the data transmission rates are hundred times faster as compared to other bands. The higher frequency bands give access to wider bandwidths. This band is mainly used for radar and experimental communications[8]. NASA'S KEPLER spacecraft is the first NASA mission to use Ka band DSN communication. Due to the increase in use of satellites now a days congestion has became a typical issue in lower range of frequency bands[6]. As k_a band provides wider frequency range and high speed data transmission compared to other bands. The modern day world is planning to implement Ka-band for future space communication[3]. Work has been constructed and simulated using the HFSS 12 software. HFSS stands for high frequency structure stimulator . It is essential for the design of High frequency and High speed component design. 26-30GHz Pico-cellular network is conceived and studied based on real world[4].

II. THE DESIGNED ANTENNA

To design the E-shaped microstrip patch antenna, first rectangular patch has been constructed[7]. The length and width parameter of the antenna dimensions are determined by the following equations[1].

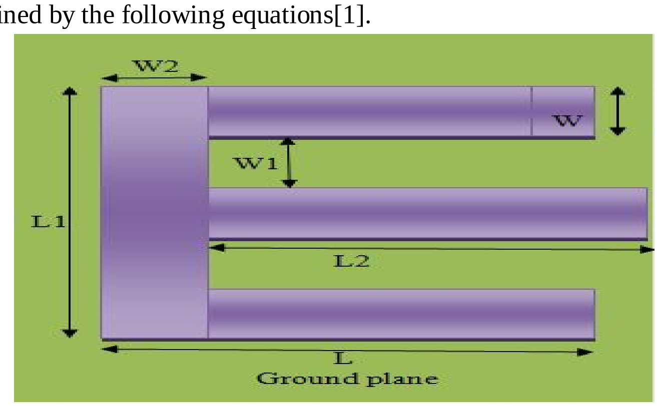

Fig- A Design Antenna

A. Formulae

1) $W = \frac{V_0}{2f_r}\sqrt{\frac{2}{\sqrt{\varepsilon_r+1}}}$

2) $\varepsilon_{eff} = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2}\left[1+12\frac{h}{w}\right]^{\frac{-1}{2}}$

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

4) $L = \frac{1}{2f_r\sqrt{\varepsilon_{eff}}\sqrt{\mu_0\varepsilon_0}} - 2\Delta L$

5) Here W is the width of the patch, h is the thickness of the substrate, L is the length of the patch, V_0 is the velocity of light, ε_r is the dielectric constant of the substrate, ε_{eff} is the effective dielectric constant of the material, f_r is the target frequency and ΔL is the extension in length.

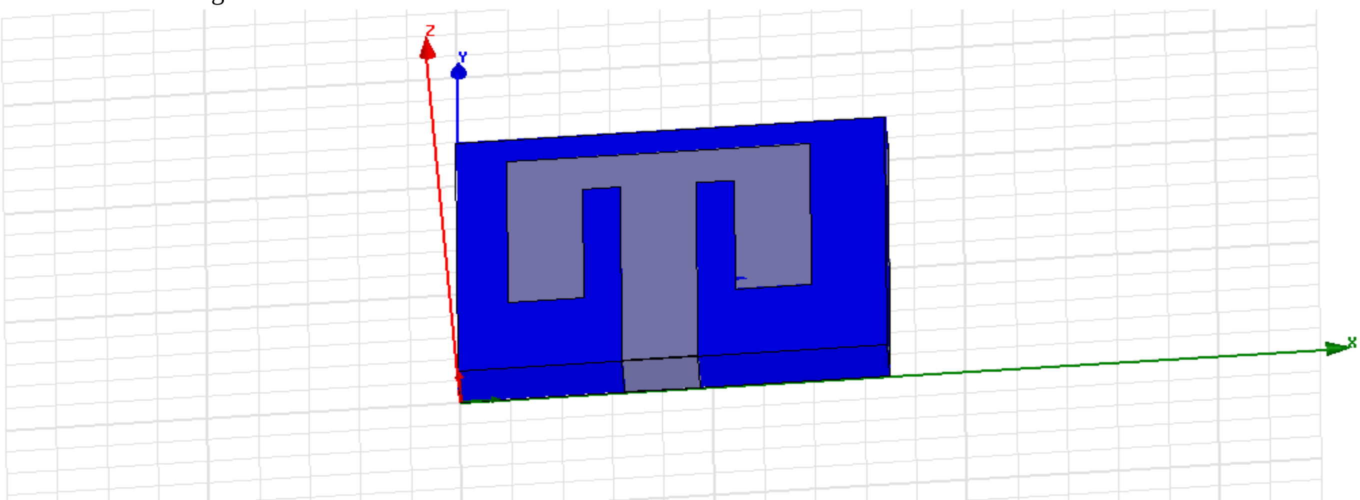

Fig-B E-shaped microstrip patch antenna

6)

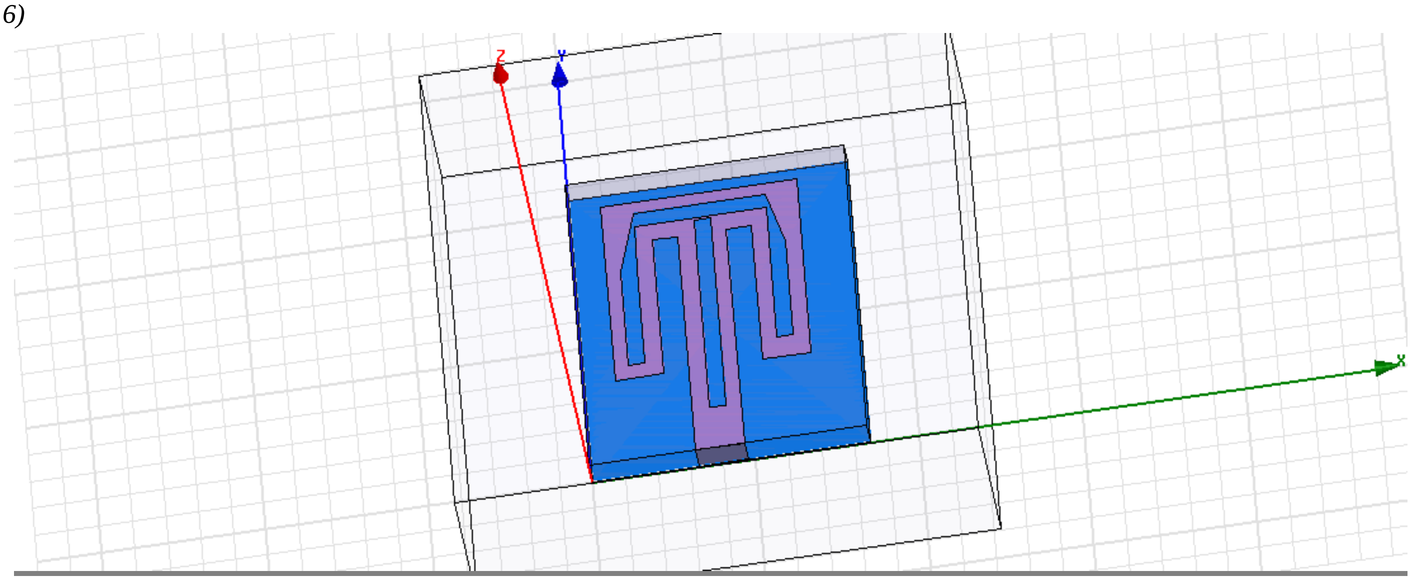

Fig-C Modified microstrip patch antenna

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue IX, September 2017- Available at www.ijraset.com

7) The patch is designed using conducting material. Substrate is designed using a dielectric material i.e FR4 EPOXY. The height of the substrate is 1.6mm with respect to z-axis. The ground plane is made up of same conducting material as the patch. The outer box is designed using air material and assigned the radiation. Patch and microstrip are united and are rectangular in z-axis that is equal to the height of the substrate. Boundary conditions are assigned to the patch and ground plane. In Fig C some slots are implemented on the patch to increase the band width.

TABLE-1: Dimensions of Patch Antenna

SL No.	Parameters	Dimension (mm)
1	W	3.28
2	L	1.69
3	H	1.6
4	ΔL	0.63
5	ε_{eff}	3.35
6	ε_r	4.4

By implementing the slots we get dual band which also results in better band width. It happens so because when the plate is driven as an antenna by a driven frequency the cut out slot radiates electromagnetic waves. The radiation distribution is determined by the shape and size of the slot made on patch.

III. RESULT AND SIMULATION

The performance of the designed antenna is simulated and analysed by using the High Frequency Structure Simulator (HFSS). The result parameters are plotted that is S-parameter, VSWR curve and Gain.

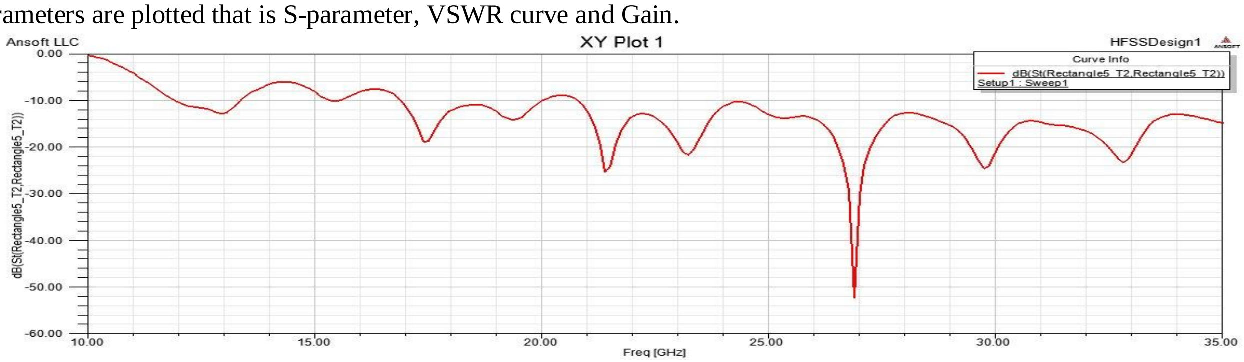

Fig-1.S-parameter Of E-shaped Patch Antenna

This plot shows the S-parameter resulting in frequency 27.82GHz

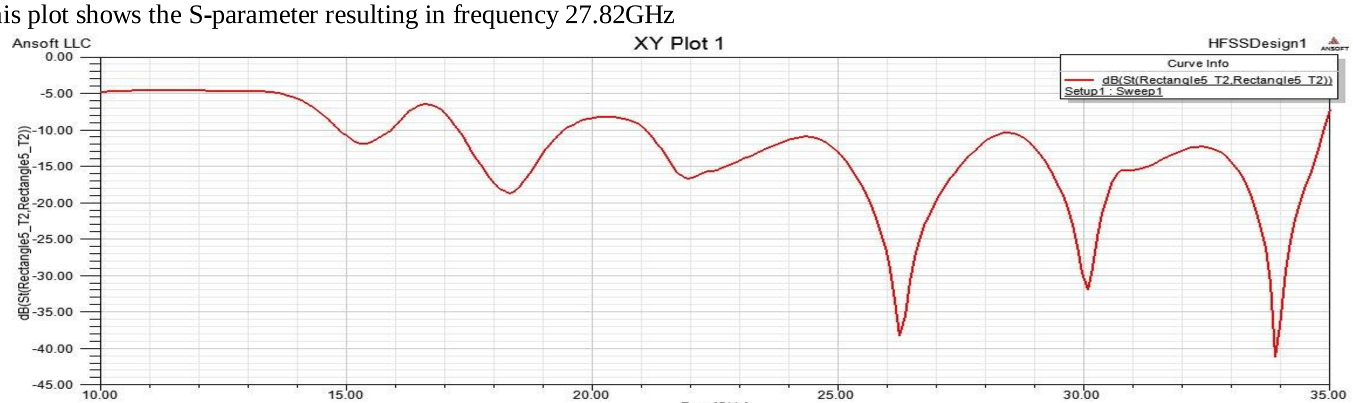

Fig-2.S-parameter Of Modified Patch Antenna

This plot shows the dual band nature resulting frequency 26.2-30GHz

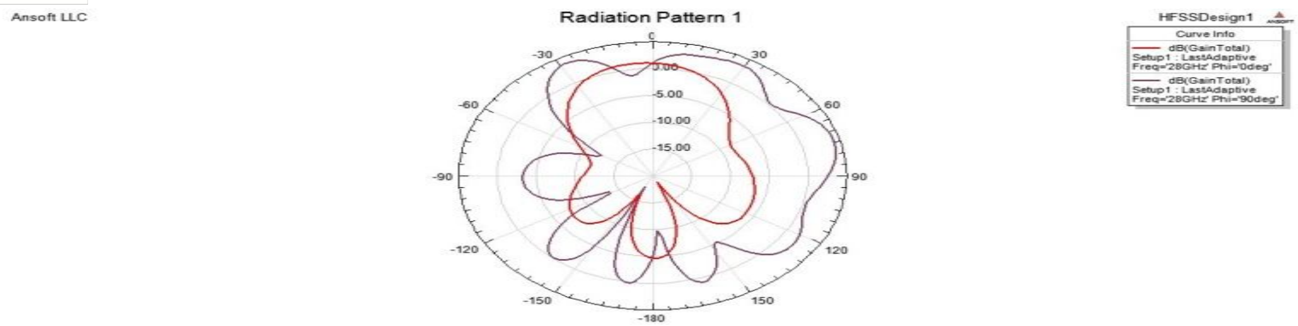

Fig-3.Radiation Pattern Of E-shaped Patch Antenna

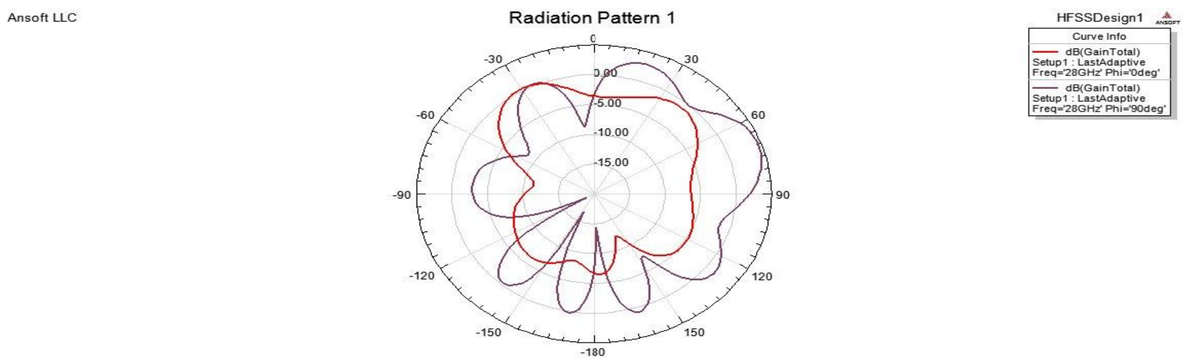

Fig-4.Radiation Pattern Of Modified Patch Antenna

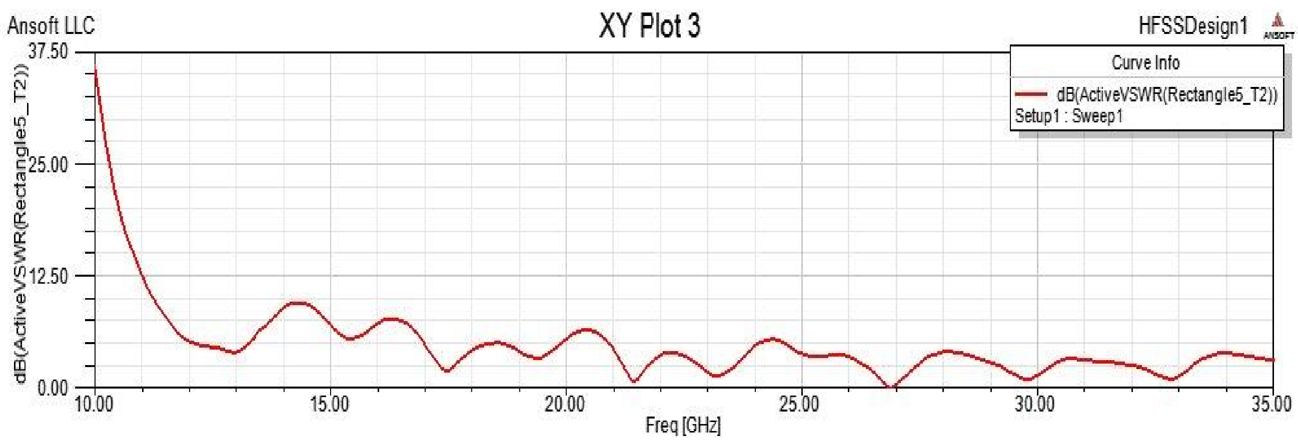

Fig-5.VSWR E-shaped Patch Antenna

Fig-6.VSWR Modified Patch Antenna

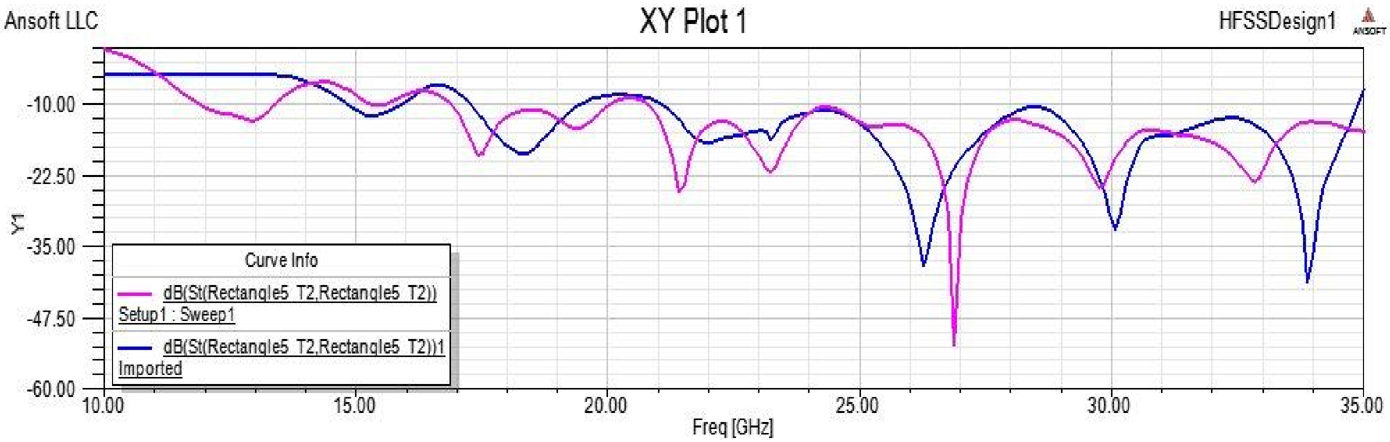

Fig-7.Comarision Between S-parameter Of E-shaped patch Antenna With Modified E-shaped Patch Antenna

TABLE-2. Comparison Table

Parameters	E-shaped Patch Antenna	Modified E-shaped Patch Antenna
Resonant Frequency	26.89GHz	26.26-30.08GHz
Gain	-8.40dB	-3.57dB

IV. CONCLUSION

This project was aimed to study the comparison between the E-shaped patch antenna with the modified E-shaped patch antenna and the various parameters related to it. We have witnessed that the modified patch antenna provides better bandwidth and wide range of frequency.

V. APPLICATION

1) It can be used in space communication.
2) Military application[5].
3) It is perfect for 5G communication.

VI. ACKNOWLEDGEMENT

It is very complicated to acknowledge the precious depth of knowledge. We can only repay it through our gratitude and convey our sincere thanks to Mr.Ribhu Abhusan Panda who had given their most valuable time and knowledge to reach our aim.

REFERENCES

[1] C.A.Balanis,Antenna Theory:Analysis and Dersign,(3rd edition Wiley,New York ,2005)
[2] D.Peroulis, K.Sarabandi and L.B.P.Katehi. 2005.Design of reconfigurable slot antennas. IEEE Trans.Antennas Propag.,vol.53,no.7,pp.645-654.
[3] www.wikipedia.com: 5G , Ka-band
[4] Ansoft HFSS. Ver 12 Ansys Corporation. WWW.ansoft.com
[5] Nandini Ammanagi, Rahul Khadilkar, Akash Harwani, Disha Budhlani, Disha Dembla; "Comparison of the performance of Microstrip Antenna at 2.4GHz Using Different Substrate Materials",International Journal of Engineering and Advanced Technology(IJEAT) ISSN:2249-8958,Volume-3,Issue-4,april 2014.
[6] B.K Ang and B.K Chung. 2007. A Wideband E-shaped Microstrip patch antenna for 5-6GHz wireless communication. Progress In Electromagnetics Research, PIER 75,pp.397-407.
[7] ^Lel,Kai Forg,Luk Kwai-Mann:Microstrip patch Antenna,(World scientific,ISBN-184816453X,PP-8-12)
[8] Dr.Sandhya Rajasekhar,impact of advertising on brand preference of high involvement products. ISSN-2319-2828,Vol-2,no.4,pg no.202-211.
[9] Ribhu Abhusan Panda,Harihar Panda, Debasis Mishra, Log Periodic Implementation of Biconvex Patch antenna",Internation journal of emerging Research in management &Technology ISSN: 2278-9359(Volume-5,Issue-3).