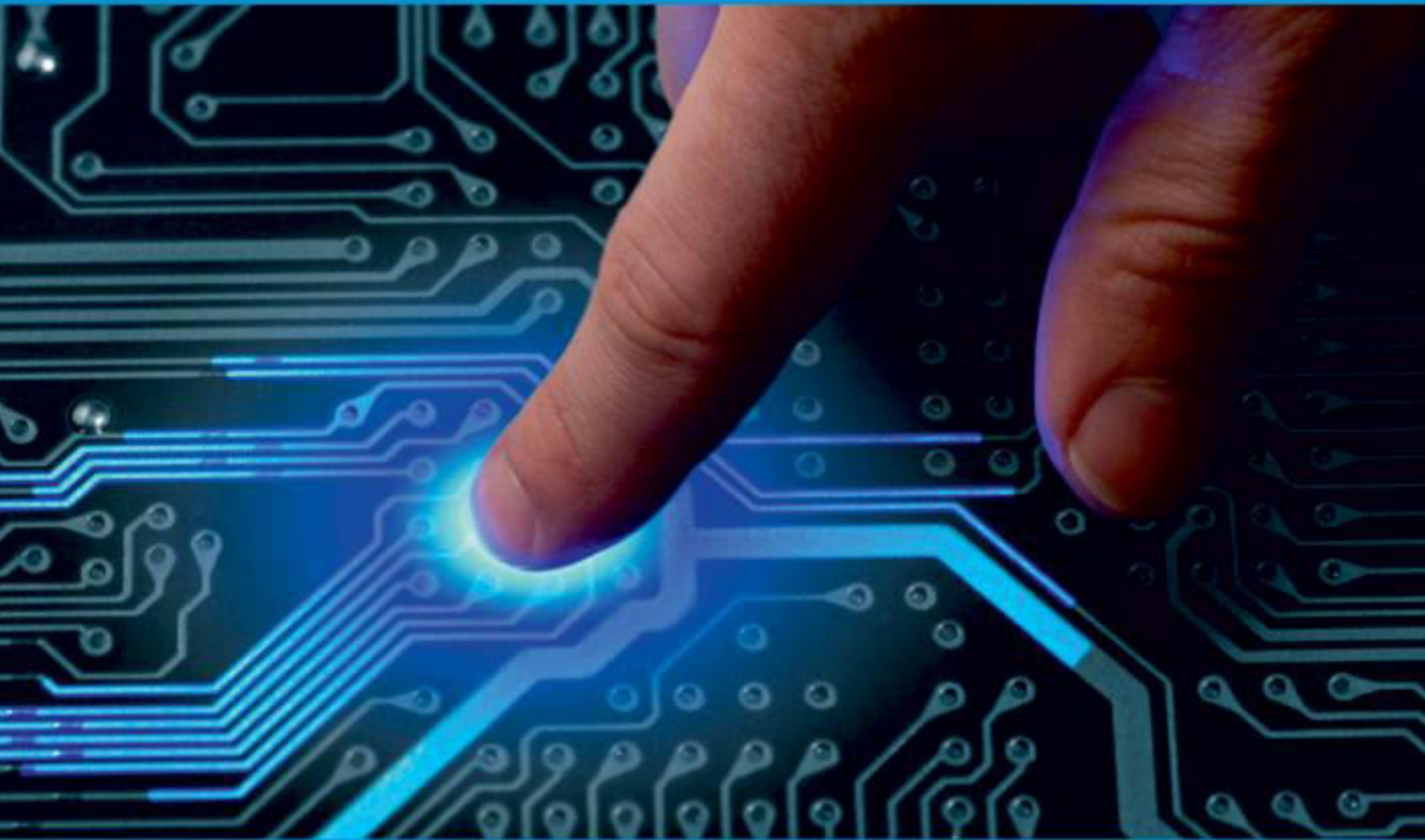
IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 10, Issue 5, May 2022

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.165

Design and Implementation of U- Slot Microstrip Patch Antenna Using Switchable Shorting Pins

S. ANUPRIYA [1], N.PAVITHRA [1], R.K.SAI.SUPRAJA [1], K.BALAJI [2]

UG Student, Department of ECE, GRT Institute of Engineering and Technology, Tiruttani, India[1]

Assistant professor, Department of ECE, GRT Institute of Engineering and Technology, Tiruttani, India[2]

ABSTRACT: The antenna design and implementation of 5G application which will use U-slot microstrip patch antenna and to adopting switchable shorting pins. Switchable shorting pins are realized by employing p-i-n diodes with biasing circuits. By adjusting the ON/OFF state of these p-i-n diodes. And also loaded on the radiating patch to improve the performance of antenna in terms of gain, polarization, radiation pattern and bandwidth at 5-12GHz spectrum. Microstrip antennas have several advantages like low profile, low cost and ease of fabrication. By loading some specific slot in the radiating patch of microstrip antennas, compact or reduced size microstrip antennas can be obtained. Loading the slots in the radiating patch can be the excited surface current paths and result in lowering of the antenna's fundamental resonant frequency, which corresponds to the reduced antenna size for such an antenna. Then then antenna parameters are obtained by high frequency structure simulator (HFSS)

KEYWORDS: U-Slot Microstrip patch antenna, return loss, VSWR, gain, polarization and radiation pattern

I.INTRODUCTION

The design, fabricate and testing of microstrip patch antenna by using high frequency structure simulator Software. Aim of this Project is to design reconfigurable microstrip patch antenna by transmission line technique. A patch typically wider than a strip and it shape and dimensions are important features of the antenna. Microstrip patch antennas have attracted much attention due to their low profile, light weight and easy fabrication. They are usually designed for single mode operation that radiates mainly linear polarization. In some applications such as satellite communication systems, however, this system is more suitable because of its insensitivity to transmitter and receiver orientations. Fabricating patch antennas on high dielectric substrates is of growing interest. Patch antennas on high dielectric constant substrates have the benefit of reduced element size due to the shorter wavelengths in such materials and resonant nature of the patch radiator. Besides the main drive of reduced element size, being able to integrate a patch antenna directly on a monolithic microwave integrated circuit (MMIC) substrate simplifies interconnection of the antenna with the circuitry and fabrication.

The development of a 5G system has been begun recently to obtain higher data rates. The standardization activity of 5G is expected to be available in the early 2020s. Compared with a 4G system, the 5G system uses millimeter-wave bands, which are a challenging requirement in the design of an antenna in 5G mobile systems. As the mobile industry looks toward scaling up into the millimeter-wave spectrum, carriers are likely to use the 28, 38, and 73 GHz bands that will become available for future technologies . Microstrip antennas have become attractive for use in mobile applications. This antenna has attracted much interest because of its low profile (i.e., compact size), light weight, low cost mass production, and ease of installation. However a major limitation in its application is its narrow bandwidth. The technique that has been used extensively for increasing bandwidth is stacked patches, in which a parasitic element is placed vertically over the lower patch. A microwave antenna that introduces a U-slot or slit into a rectangular radiating patch is a simple and efficient method for obtaining the desired compactness and multiband and broadband properties, as this shape radiates electromagnetic energy efficiently. This design avoids the use of stacked or parasitic patches, and etching U-slot on the patch is simple . It is derive that the resonant frequency is inversely

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 5, May 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1005332 |

proportional to the slot length and feed point and at the same time as it increases with increasing the coaxial probe feed radius and slot width . In recent years, some papers were reported for Dual/triple band operation by using single/double U slot in the microstrip antenna. It is seen that the applications which require dual frequency operation with small frequency ratio were designed by using the U slot in a wideband micro strip antenna . Micro strip antennas are suffer from low impedance bandwidth characteristics to increase 5G system applications. To avoid this suffering of antennas, there have been various bandwidth enhancement techniques like coplanar parasitic patches, stacked patches, or novel shapes patches such as the U and H -shaped patches. Here in this design one method is used, called as special feed networks or feeding techniques, to compensate for the natural impedance variation of the patch. To avoid the use of coplanar or stacked parasitic patches we can do the etching process on the patch with U -slot, which increases either the lateral size or the thickness of the antenna.

II. RELATED WORK

Now a day, the wearable textile materials of the antenna seems to be a great extent in the miniaturization of wireless devices. The demand of the wearable antennas in rise because of their use in smart clothes in wireless communications. Basic requirements for wearable antennas are a planar structure and flexible construction materials. A novel wearable reconfigurable antenna is designed to provide optimal on-body performance at 1.53 GHz and 4.39 GHz in S band communication.

This wideband antenna is constructed in the area of 12mm and it is based on the micro strip feeding connection that depends on switch for providing two frequency bands. The copper and flexible polyurethane foam respectively makes the conductive and ground planes. Here, copper acts as a conductor and polyurethane foam provides isolation between the human body and the antenna. Here micro strip feeding is provided for enhancing the reliability of the O-shaped antenna. The O-shaped antenna has two kinds of steps, those are, step 1 (OFF mode) and step 2 (On mode). In ON mode the O-shaped antenna gives the frequency of 1.48 – 1.53 GHz and OFF mode gives 4 – 4.39 GHz. additionally, the performance of the O-shaped antenna is analyzed by reflection coefficient and radiation pattern. The step 1 and step 2 antennas achieved the reflection coefficient of -26.9 dB and -19.96 dB respectively.

III. PROPOSED SYSTEM

Designs a vertically polarized, horizontal, Bidirectional vehicle antenna for the mobile communication band, covering the available frequency bands of the wireless sensor network and 5G. The antenna is composed of semi-Monopole and semi cone monopole, which are placed vertically on the metal plate, especially suitable for being mounted on top of a car. E-branch mainly works at low frequency, and cone branch mainly works at high frequency. The cone branch adopts tapered structure in order to improve the impedance matching of antenna and increase the bandwidth of antenna. The antenna can be miniaturized by cutting the antenna in half. The operating frequencies of the antenna are 5GHz–12GHz which can cover multiple wireless system bands, including GSM, LTE, and 5G.

The U-slot rectangular microstrip patch antenna for 5G Applications is proposed. The U slot antenna concept has been used in patch antenna designed to reduce antenna size. The U-slot patch antenna structure consists of a patch, U-shaped slot, a ground plane and coaxial feed lines. The proposed antenna is designed and fabricated to meet the best possible result using a simulation software: Ansoft HFSS (High Frequency Structure Simulator) software version 15.0. Microstrip patch antennas are widely used because of their several advantages such as light .weight, low volume, small size and low fabrication cost. The proposed antenna was measured and compared with the simulation results to prove the reliability of the design. The performance of the designed antenna was analyzed in term of gain, return loss, VSWR, and radiation pattern at frequency.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |
|| Volume 10, Issue 5, May 2022 ||
| DOI: 10.15680/IJIRCCE.2022.1005332 |

a. BLOCK DIAGRAM

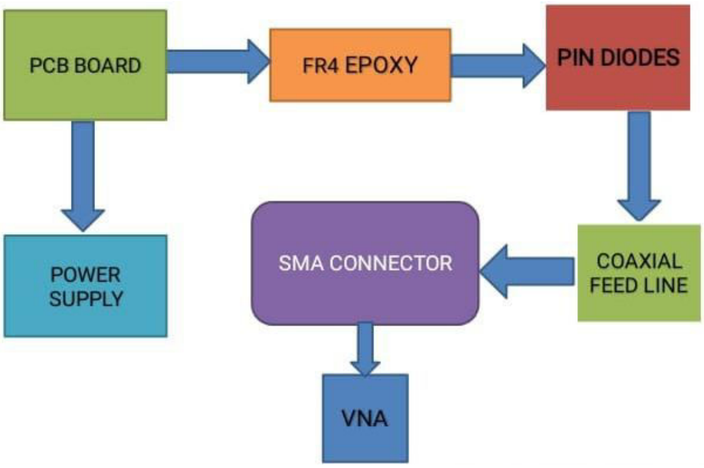


Fig 1. Fabrication and Testing antenna

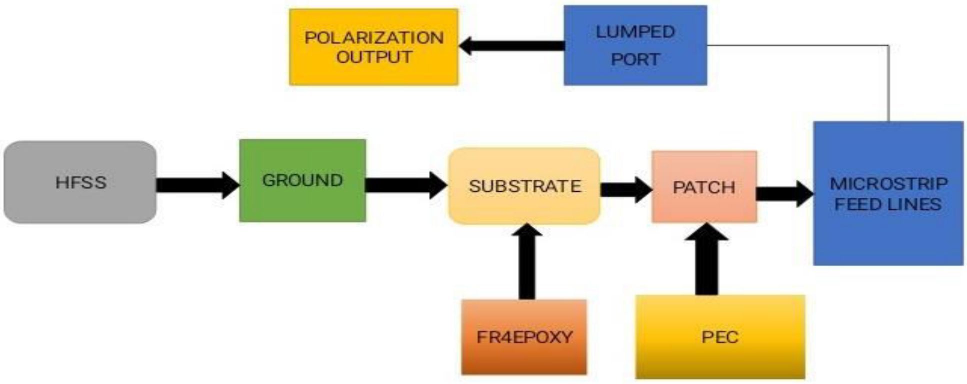


Fig 2. software design antenna

IV. FABRICATION AND TESTING OF ANTENNA

Design and simulation of dual-band Microstrip patch antenna is carried out in this work and methods of resonant frequency control are also studied. A U-shape slot in the radiating patch makes an antenna operating at two resonant frequencies. All the new designs with U-shape slotted patch are suitable for C-Band and X- Band applications. A U-slot antenna is a wide band antenna. These antennas are fairly directive, cheap and simple to make. A U-slot is nothing but two single turn loop antennas forming an array where each one is a driven component. The array improves the directivity and bandwidth .The working of a U-slot is the same as a folded dipole antenna.

It generates the same radiation pattern as a dipole with more directivity and bandwidth. A U-slot antenna can be considered as a modified form of a folded dipole antenna. More specifically its elements come under the category of small loop single turn antennas.

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 5, May 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1005332 |

a. **DESIGN OF U-SLOT ANTENNA**

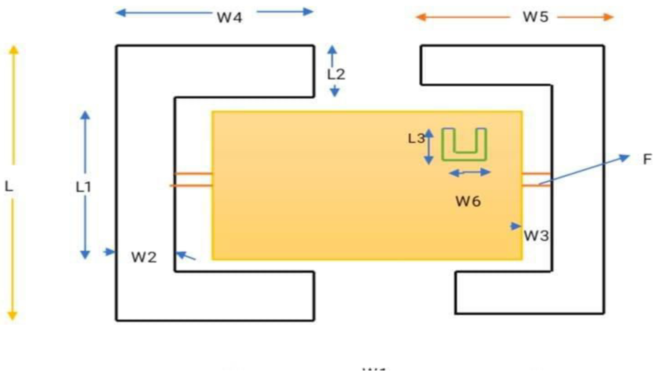


Fig 3. Design of U- Slot antenna

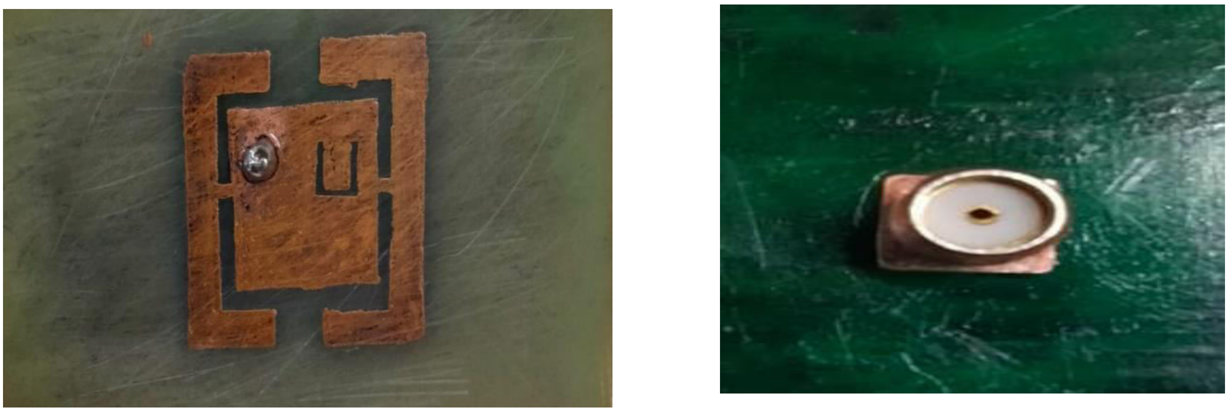
PARAMETER	UNIT(mm)
WIDTH(W6)	2
LENGTH(L3)	2

TABLE 1. U- SLOT PAREMETER

PARAMETER	UNIT(mm)
WIDTH(W)	**22**
W1	**14**
W2	**3**
W3	**1**
W4	**6.5**
W5	**5**
LENGTH(L)	**18**
L1	**12**
L2	**3**
FEED LINE (F)	**1.3**

TABLE 2. Normal parameter Antenna

b. **FABRICATION DESIGN**



(a) **(b)**

Fig 4. Fabrication of U-Slot Patch Antenna

Implementation of U-slot patch antenna on FR4 with co-axial feeding and compact size.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 5, May 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1005332 |

C. TESTING OF ANTENNA

For testing our antennas we used the equipment available in our lab. Equipment like network analyzer, spectrum analyzer and signal generator, which are recent additions to our lab, were studied and then used to determine s11 (insertion loss), transmitting power, received power etc.,

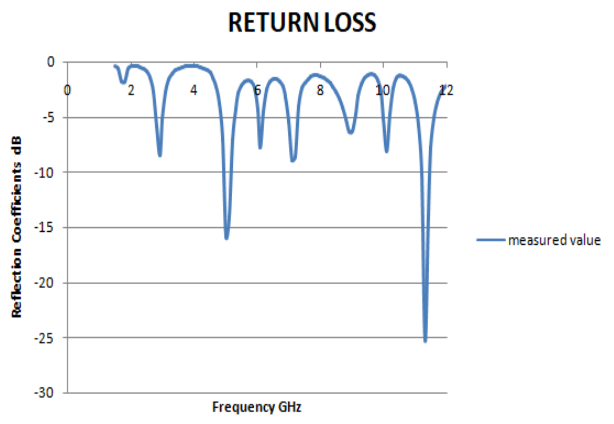


Fig 5. Testing of return loss

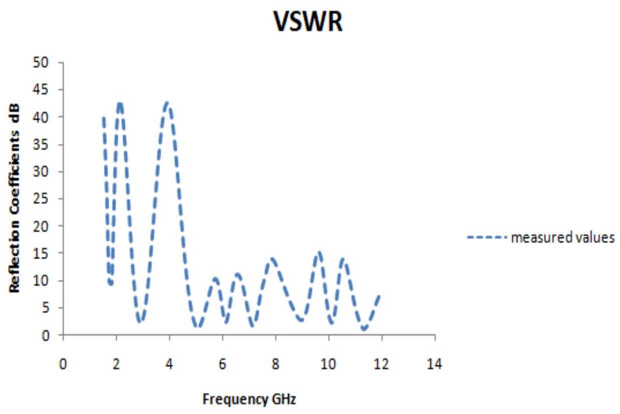


Fig 6. Testing of VSWR

d. S PARAMETER

The dip is the central operating frequency of the antenna. The operating frequency of the antenna was found to be 5.04 GHz and 11.30GHz. The S11 measured at this frequency was -21 dB and -49dB.

V. DESIGN ANTENNA IN SOFTWARE

A description of the proposed rectangular U- Slot microstrip patch antenna design simulation is discussed. Simulation of the improved rectangular microstrip patch antenna design is carried out using a 3-D full wave electromagnetic simulator Ansoft HFSS.

a. DESIGN OF U-SLOT MICROSTRIP PATCH ANTENNA

The design of rectangular microstrip patch antenna consist of a conductive strip width (W) and thickness "t" and a wider ground plane, separated by a dielectric layer (FR4 the "substrate") of thickness "H" as shown the figure 7.

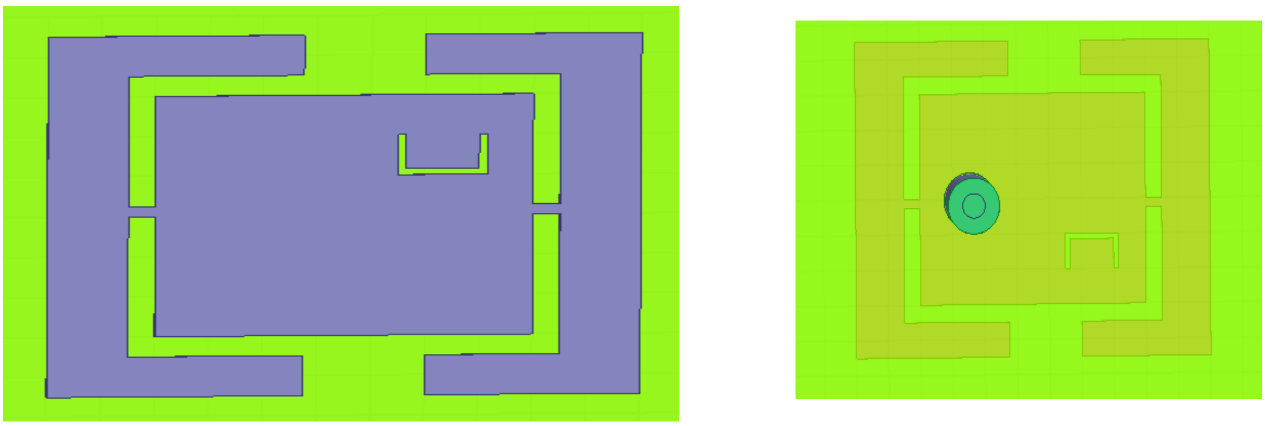


Fig 7. U- slot Microstrip Patch Antenna

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 5, May 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1005332 |

VI. RESULT AND DISCUSSION

a. RETURN LOSS

The return loss is another way of expressing mismatch. It is a logarithmic ratio measured in dB which compares the power reflected by the antenna to the power that is fed into the antenna from the transmission line. Return loss more than -10db in the frequency getting best signal or return loss. Also Return loss is defined as the difference, in db, between the forward and reflected power measured at a given point in an RF system. The achieved Return Loss of dual band antenna (-21 dB at 5.04 GHz, -49 dB at 11.3 GHz).

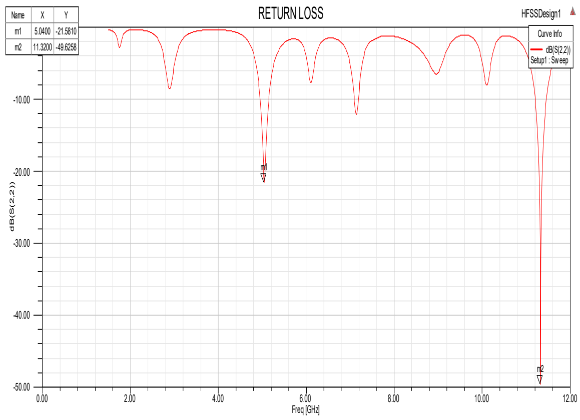
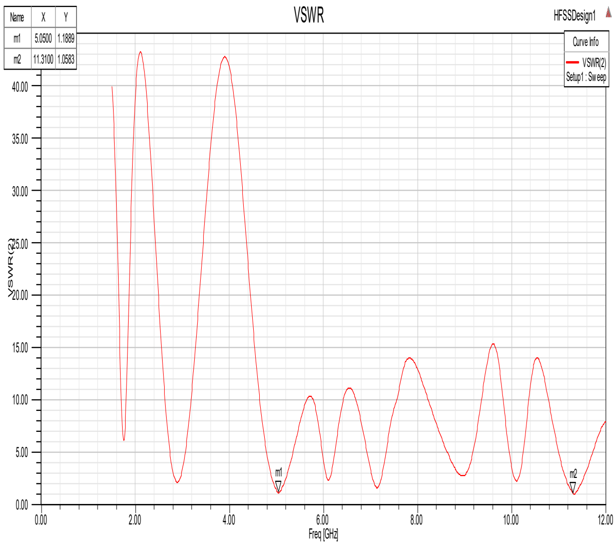


Fig 8. Return loss

b. GAIN AND VSWR

Voltage Standing Wave Ratio (VSWR) or sometimes just Standing Wave Ratio (SWR) is a measure of how well matched an antenna is Less than 2.

Gain is a measure of the ability of the antenna to direct the input power into radiation in a particular direction and is measure the peak intensity.



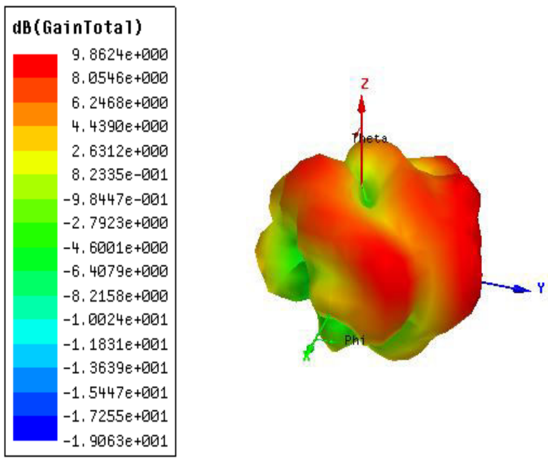


Fig 9. VSWR **Fig 10. Total radiation gain**

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 5, May 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1005332 |

c. RADIATION PATTERN

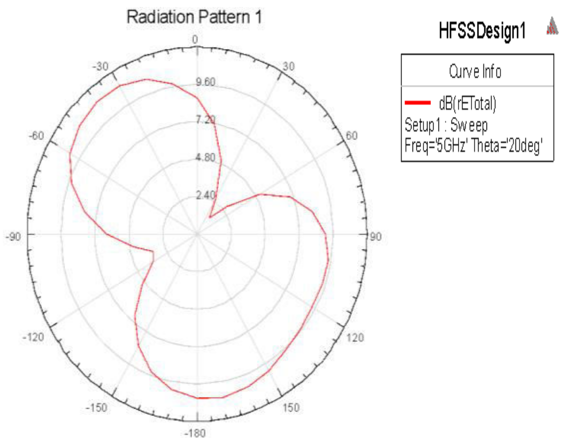


Fig 11. Radiation pattern

d. RADIATION ENERGY

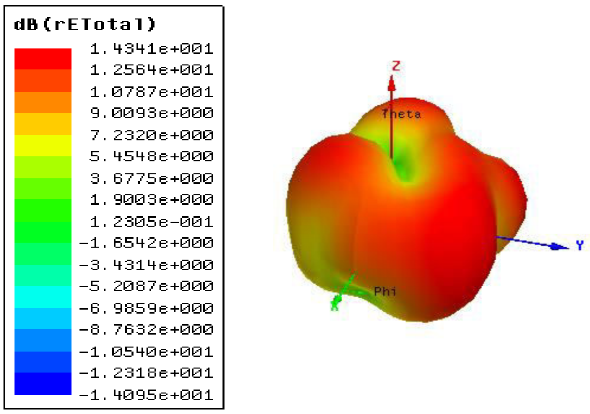


Fig 12. Total Radiation energy

e. POLARIZATION

- Linear polarization is horizontal and vertical polarization,
- Circular polarization is LSCP and RSCP.
- A horizontal antenna receives or emits horizontally polarized waves. Some wireless antennas transmit and receive EM.
- The best short-range communications is obtained when the transmitting and receiving (source and destination) antennas have the same polarization.

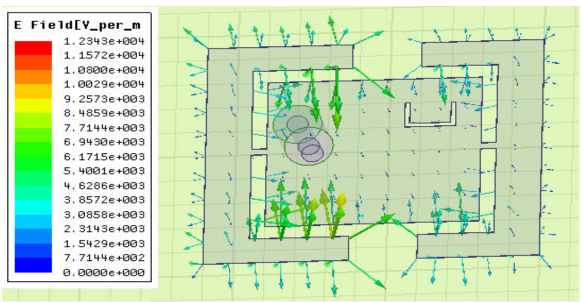


Fig 13. Polarization Vector distribution

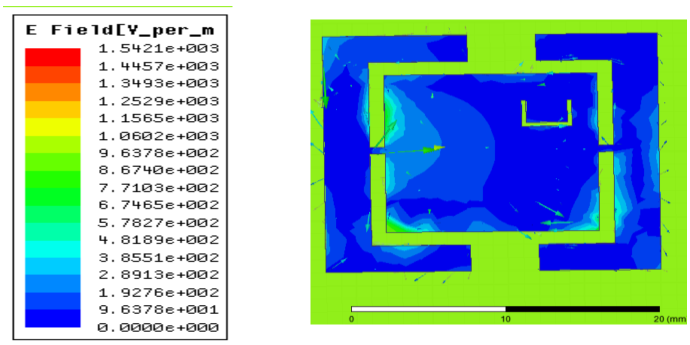


Fig 14. Polarization current distribution

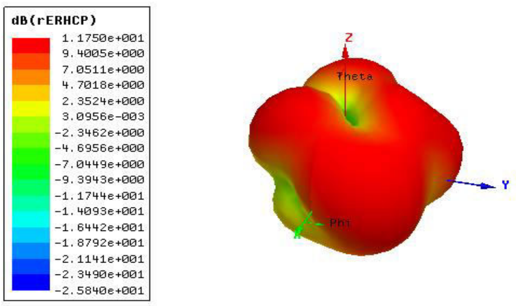


Fig 15. Polarization of RHCP

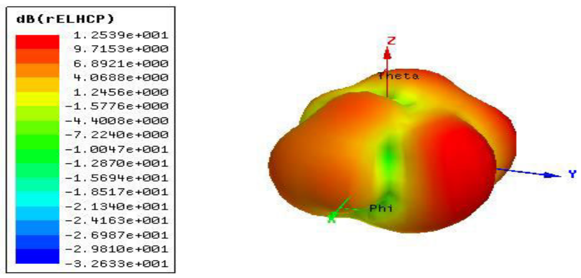


Fig 16. Polarization of LHCP

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 5, May 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1005332 |

VIII CONCLUSION

The proposed microstrip patch using U-slot antenna suitable 5G application with C-Band and X-band (Dual band communication) communication with higher performance. This antenna's have a good efficiency in transmission and reception. We operate this antenna in 5.04 GHz and 11.32GHz.This frequency will not cause any damage to the internal and external skin when it is implanted. This antenna will provide greater safety for the patients. This antenna's are designed with an input impendence of 50 Ohms. This antenna has been developed with a gain of 9dB.After fabricating

FUTURE WORK

In future, to design different shape antenna and also we are going to test and analyze patch antenna by using signal generator, network analyzers and etc.

APPLICATION

- Mobile Applications.
- Defense tracking.
- Radar application.
- Weather monitoring.
- Bio medical applications

REFERENCES

[1] Sivabalan, A. Jothilakshmi. P, "Micro Strip Wearable O-Shaped Reconfigurable antenna for medical Applications, "ISSN: 2277- 3878, Volume-8, Issue-1, and May 2019.

[2] Muhammad Asad Rahman*, Eisuke Nishiyama, and Ichihiko Toyoda," A Polarization Reconfigurable Microstrip antenna employing Dual- Perturbation Technique, "In Electromagnetic Research M,Vol.69, 2019.

[3] M.Anto Bennet, Himaya. R, V.Deepa. K, Divya.V, Aarthi.V, " Design And Implementation of Rectangular Microstrip patch antenna for biomedical Applications,"ISSN, Volume-7, Issue-6S3 April, 2019.

[4] CH. S. Srinivas1, Damaraju Sri Sai Satyanarayana2," Microstrip Patch Antenna Design For Military Application,"ISSN:2277-3878, Volume-7 Issue-6S3 April,2019.

[5] Ali Ramadan, Mohammed Al-Hussein, Karim Y. Kabalan and Ali ElHajjGeorgios, Atmatzakis and Christos G. Christodoulou," A Directional Polarization Reconfigurable Microstrip Antenna," 978-1-61284-383- 4/11/$26.00 ©2018 IEEE \ 62

[6] Jorge A. Ruiz-Cruz, Senior Member, IEEE, Mohamed M. Fahmi, Member, IEEE, Siamak A. Fouladi, Member, IEEE, and Raafat R. Mansour, Fellow, IEEE," Waveguide Antenna Feeders With Integrated Reconfigurable Dual Circular Polarization," IEEE transactions on microwave theory and techniques, vol. 59, no. 12, December 2018

[7] Xue-Xia Yang, Member, IEEE, Bing-Cheng Shao, Fan Yang, Senior Member, IEEE, Atef Z. Elsherbeni, Fellow, IEEE, and Bo Gong," A Polarization Reconfigurable Patch Antenna With Loop Slots on the Ground Plane," IEEE antennas and wireless propagation letters, vol. 11, 2017

[8] Wenquan Cao, Bangning Zhang, Aijun Liu, Tongbin Yu, Daosheng Guo, and Kegang Pan," A Reconfigurable Microstrip Antenna With Radiation Pattern Selectivity and Polarization Diversity," IEEE antennas and wireless propagation letters, vol. 11, 2017

[9] Y.J. Sung Department of Electronic Engineering, Kyonggi University, Suwon, Korea," Frequency and polarization reconfigurability from an open-loop square ring antenna," IET Microw. Antennas Propag., 2017, Vol. 6, Iss. 5, pp. 505–509 509 doi: 10.1049/iet-map.2010.0591

[10] Hossein Emami, Niusha Sarkhosh, Elias Roberto Lopez Lara, and Arnan MitchellA," Reconfigurable Photonic Feed for Sinuous Antenna," JOURNAL OF LIGHTWAVE TECHNOLOGY, VOL. 30, NO. 16, AUGUST 15, 2017 63

BIOGRAPHY

K.Balaji has received his B.E., degree in Electronics and Communication from Priyadarshini Engineering College, Anna University, India and received his Master of Engineering in communication Systems from Ranippettai Engineering College, Anna University, India. in 2011. Presently he is working as a Assistant professor in GRT

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 5, May 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1005332 |

Institute of engineering and technology India. His research interest includes wireless communication, Digital Image Processing.

S.ANUPRIYA B.E.,degree in Electronics and Communication from GRT Institute of engineering and technology.

N.PAVITHRA B.E.,degree in Electronics and Communication from GRT Institute of engineering and technology.

R.K.SAI.SUPRAJA B.E., degree in Electronics and Communication from GRT Institute of engineering and technology.

INNO SPACE

SJIF Scientific Journal Impact Factor

Impact Factor: 8.165

doi crossref

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

निस्केयर NISCAIR

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

9940 572 462 6381 907 438 ijircce@gmail.com