International Journal For Advanced Research In Science & Technology
A peer reviewed international journal www.ijarst.in
IJARST
ISSN: 2457-0362

MULTI-BAND MICROSTRIP CIRCULAR PATCH ANTENNA DESIGN FOR TERAHERTZ APPLICATIONS

[1]Mrs. S. Manjula, [2]A. Naveena, [3]D. Laxmi Prasanna, [4]M. Naga Bhargavi,

[1]Assistant Professor, Department of Electronics and Communication Engineering, Sridevi Women's Engineering College, Telangana, India.

[2,3,4]Student, Department of Electronics and Communication Engineering, Sridevi Women's Engineering College, Telangana, India.

naveena.akula02@gmail.com,laxmiprasannadiddi06@gmail.com, mnagabhargavi.2018@gmail.com

Abstract:

The goal of this study is to assess a circular patch antenna design for 6G applications in the 2.0723 THz and 4.1058 THz range. Our goal is to use a microstrip line feed to mimic the performance of a circular patch antenna. The FR4 substrate, which has a 1.6mm thickness, was used to make the antennas. The circular microstrip line feed antenna has high performance. It also has a 1.4276 THz and 0.80908 THz bandwidth. The antenna's axial ratio, surface current, directivity, gain, return loss, and other characteristics have all been studied. The circular microstrip antenna may be utilized for advanced wireless communication applications since it is made to resonate at 10 separate frequency bands. Small portable devices supporting communication protocols can use thesuggested antenna.

Keywords: Microstrip line, Circular patch antenna, FR4 substrate, Return loss.

1. INTRODUCTION

The process of converting electrical power into radio waves using an electrical equipment known as an antenna. Often, it works in conjunction with a radio transmitter or receiver. To broadcast a signal, a transmitter feeds the antenna's terminals with a high frequency AC current that oscillates at radio frequencies. Then, to amplify it, this voltage is applied toa receiver. They are used in a wide range of devices, such as small monitor, cordless microphone, WIFI devices, cordless computer network, multiple radio, messaging receivers, radar, cell phones, and Radio - frequency identification on goods, in furthermore to systems like broadcasting, commercial television, and multiple radio. An antenna is a grouping of copper wires that are directly coupled to the wireless broadcast or the receivers. The oscillation electrons current of a transmission will create a rotating magnetic field around the antenna arrays, and the charge of the oscillating particles will create an induced electromagnetic field along the elements. In the latter case, an antenna could also incorporate extra parts or faces like horns, spherical reflections, or parasites features that are employed toconcentrate wireless signals into a beam or other desirable radiation pattern but have no electronic signal between the transmission or the

International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
ISSN: 2457-0362
www.ijarst.in
IJARST

receivers. An electrical apparatus known as an antenna converts power generation into electrical signals and back again. Sometimes, antenna is used to refer to it. It accepts a signal from a twisted pair or other power cable and transforms it into radiant waves before transmitting it into space. It makes radio wave transmission and reception possible. A receiving antenna, as contrast to a transmitting antenna, takes in radio waves from space, converts them into electrical impulses, and then transmits those signals toa transmission line.

2. MICROSTRIP CIRCULAR PATCH ANTENNA

In essence, a polymeric substrate with a beam and a buffer layer on either side makes up microstrip patch transmitters. The conducting elements copper and gold are frequently used to make patches. The patch isa mere wavelength above the ground plane and is very thin (between 0.003 and 0.05). (t,where t represents the wavelength in freespace. The microstrip patch is made to have a pattern that is as uniform as feasible. This is achieved by carefully selecting the stimulation mode beneath the patch. Withtypical dielectric constants ranging from 2.2 to 12 r, a variety of substrates can be used tocreate microstrip patch antennas. Even though they result in bigger generate value, thick surfaces with low electrical constant are chosen for antenna parameters because they provide superior efficiency, a wider bandwidth, and freely confined beams for transmission into space. Here between patch edge and the side of the substrate, fringing fields are the primary source of patch antennamicrostrip emission. As frequencies, depth ofpenetration, and permeability are increased, the radiation generally arises from defects (Lewin, 1960) Good antenna quality and circuitry must be sacrificed since microchips are frequently linked with other microwave devices. Applying the photo-etched feed lines and radiating components to the dielectric substrate. Any form, including square, rectangle, thin strip (dipole), circular, elliptical, triangular, and more, can be used for the radiating patch. Using different polarizations, resonance frequencies, andimpedances, a tiny strip antenna may be employed. It is appropriate for use in cellular and public surveillance equipment where restricted spectrum is required due to its operational features, which include limited capability, power dissipation, better quality factor, poor polarization purity, bad scanning performance, and severely limited frequencies bandwidth.

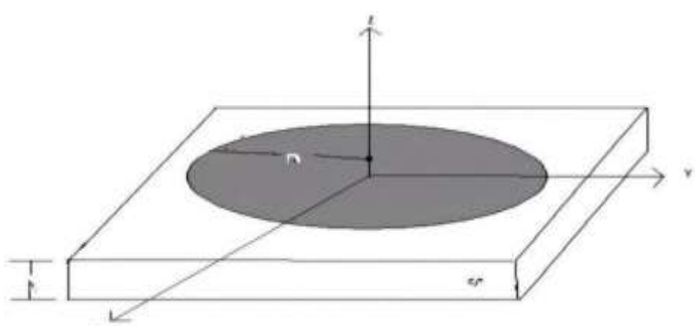

Figure. 1. Circular Patch Antenna

International Journal For Advanced Research In Science & Technology
A peer reviewed international journal www.ijarst.in
IJARST
ISSN: 2457-0362

3. THEORY

3.1 EXISTING SYSTEM

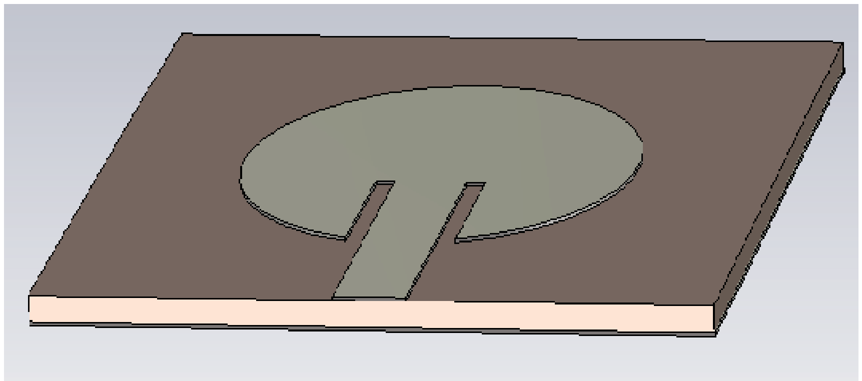

Figure. 2. The geometry of Microstrip Linefed Circular Patch Antenna

For 5G applications, the present technology employs a patch antenna with a circular form that resonates in the 28 GHz band. The structure of the antenna is made of RT/Duroid 5880. RT/Duroid 5880 has a thickness that ranges from 5.00 to 125mm and a dielectric constant of 2.2. A circular patch antenna with coaxial feedingtechnology provides fair return loss, directivity, and gain. Coaxial feed bandwidth for the patch antenna is 0.792 GHz at 28 GHz.

In the GHz was utilized in the current system because it had good return loss with microstrip line feeding, but it only provides asmall bandwidth and is only appropriate for aparticular application.

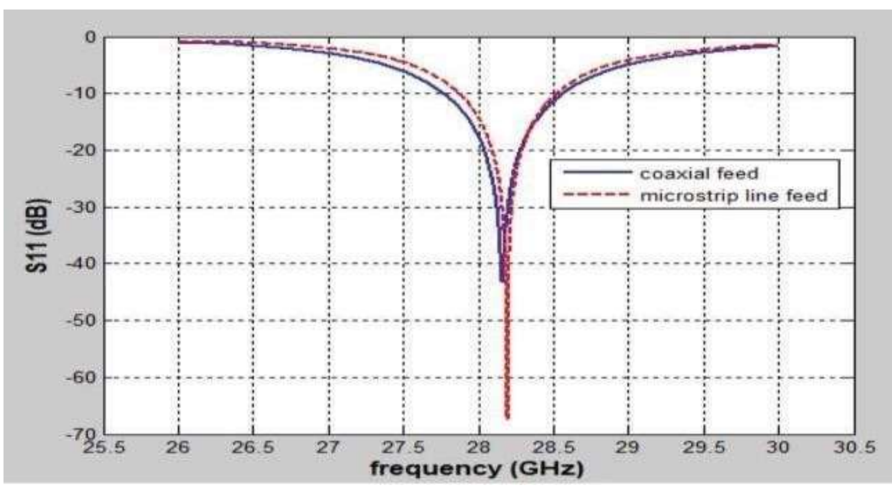

Figure. 3. Simulated return loss parameter

3.2 PROPOSED SYSTEM

The antenna designs we show in this research have properties that make them more suitable for THz transmission across short distances. Terahertz (THz) lines will be crucial for high data rate transmission over a few meters. Theproposed concepts are strong contenders for high-speed and short-range wireless communication systems because of the findings attained. Terahertz communication is suited to both stationary and moving users in both indoor and outdoor settings. Terahertz communication is carried out at the same pace through wired and wireless networks. THz and sub-THz frequencies have a few benefits, including antenna sizes that are reduced to around sub-millimeter sizes. It is less expensive, lighter, and smaller in size. Improved bandwidth, improved gain, directivity, and multi-frequency performance are among its features. It was proposed to employ THz for effective input impedance matching.

Design: Circular Shaped Patch Antenna

Ground: Truncated corners of Rectangular shaped partial ground

Here, we can see the dimensions and the shape of the rectangular shape circular patch antenna.

It is less expensive, lighter, and smaller in size. Improved bandwidth, improved gain, directivity, and multi-frequency performance are among its features. It was proposed to employ THz for effective input impedance matching.

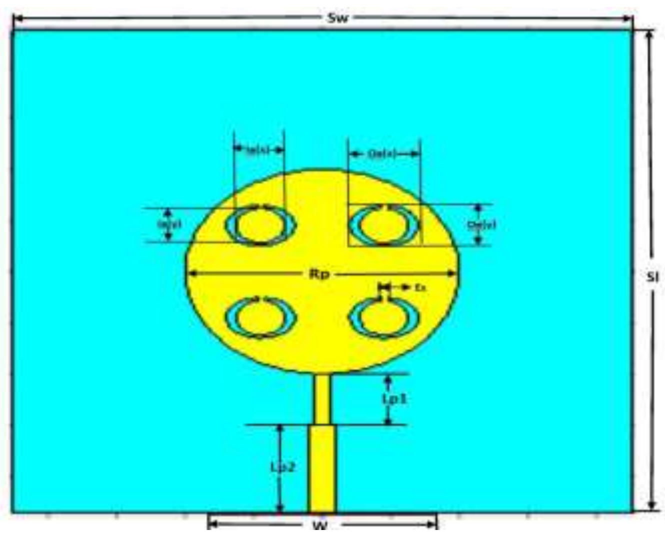

Figure. 4. Circular Patch antenna

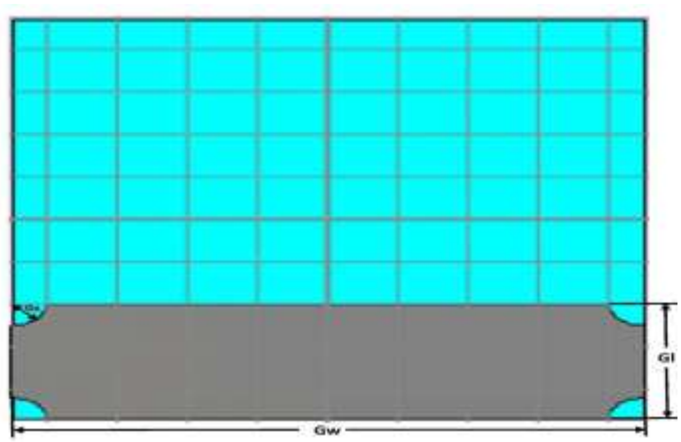

Figure. 5. Rectangular Partial Ground

Dimensions:

Parameter	Description	Value (μm)
Gl	Length of the ground	135
Gw	Width of the ground	450
Gs	Slot radius of ground	20
Sl	Length of the substrate	470
Sw	Width of the substrate	450
Rp	Radius of patch	100
Lp1	Length of the patch 1	10
Lp2	Length of the patch 2	20
Ie(x)	Elliptical major axis 1	25
Ie(y)	Elliptical minor axis 1	20
Oe(x)	Elliptical major axis 2	20
Oe(y)	Elliptical minor axis 2	18
Es	Split over the ellipse	4
Wf	Width of the feed	10

Table: 1 Dimensions of Circular shape patch antenna.

International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
www.ijarst.in
IJARST
ISSN: 2457-0362

4. RESULTS AND CONCLUSION

4.1 RESULT

Return Loss: In this Result the designed circular patch antenna shows return loss value well below

S11 Results:

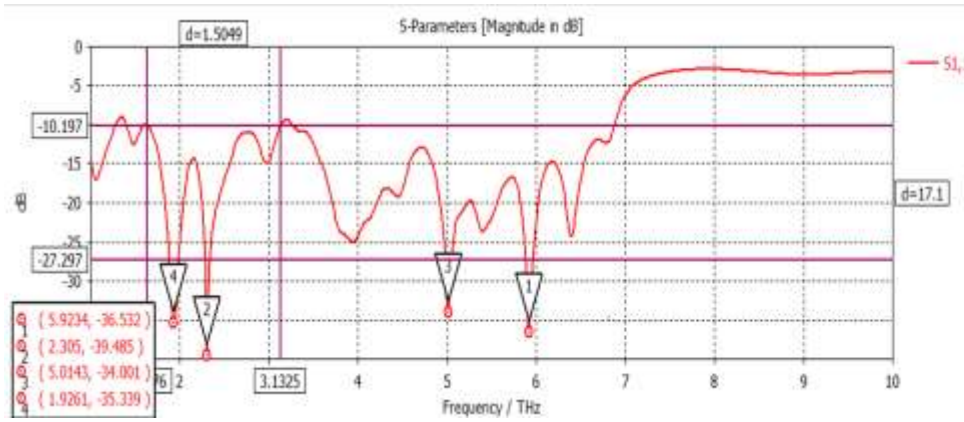

Figure. 6. Return loss at 5.9234 THz, S11 value is -36.5532dB, at 2.305 THz, S11 value is - 39.485dB, at 5.0143 THz, S11 value is -34.001dB and at 1.9261 THz, S11 value is -35.339dB.

VSWR:

It is defined as ratio between transmitted and reflected voltage standing waves in a radio frequency (RF) electrical transmission system. It is a measure of how efficiently RF power is transmitted from the power source, through a transmission line, and into the load.

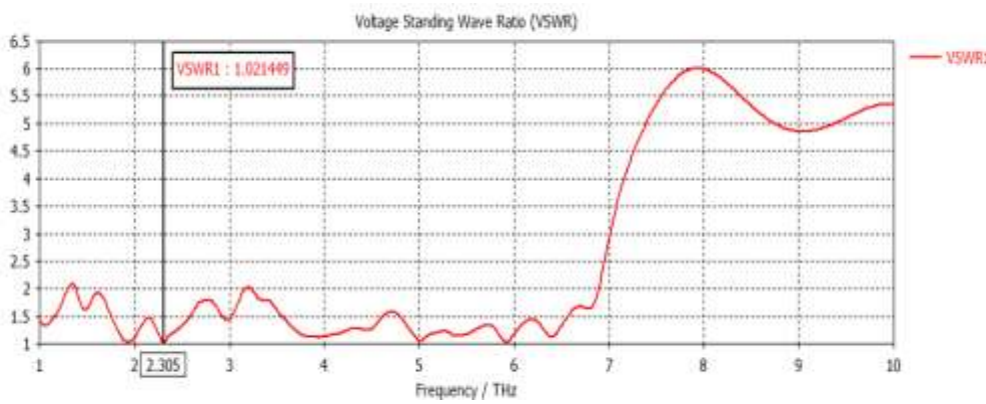

Figure. 7. VSWR at 2.305 is 1.02

Applications: Building and Factory automation.

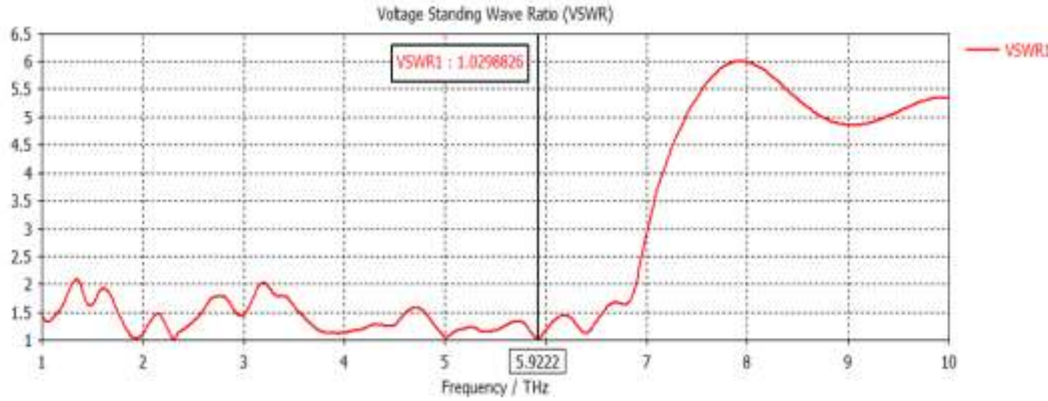

Figure. 8. VSWR at 5.922 is 1.02

Applications: Production and E-health.

GAIN:

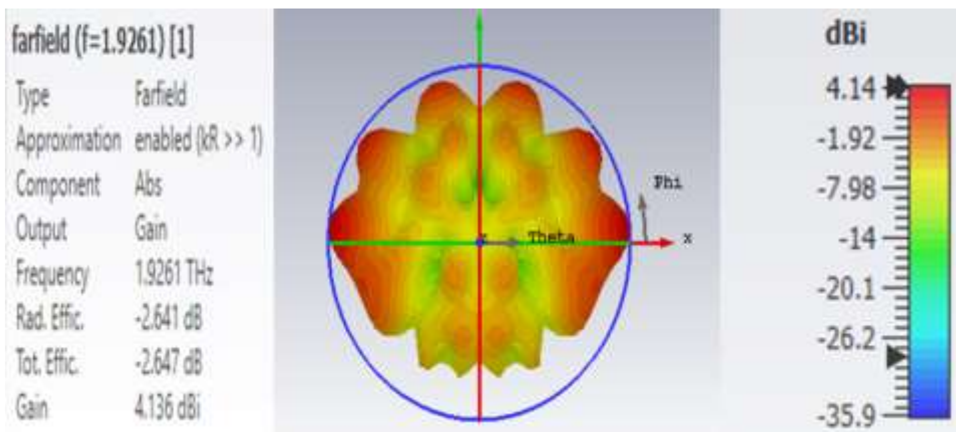

Figure. 11. Gain at f = 1.9261 is 4.136dBi

Applications: Remote patient monitoring and Wearable medical devices.

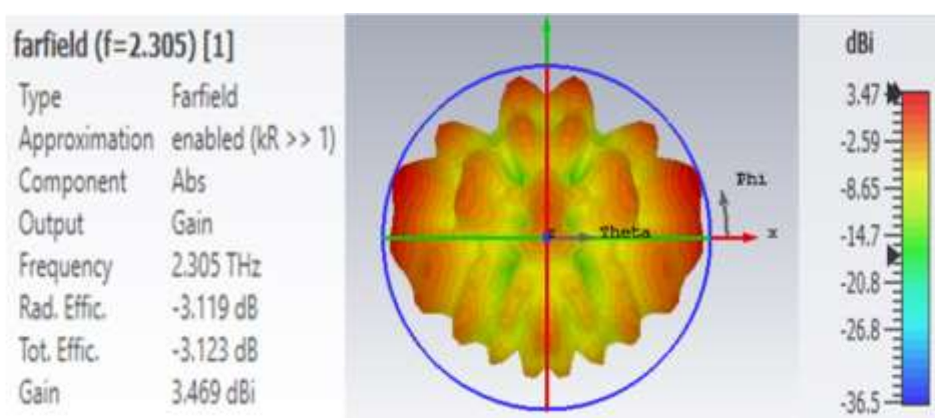

Figure. 12. Gain at f = 2.305 is 3.469dBi

Applications: Robotics and Telemedicine solutions.

International Journal For Advanced Research In Science & Technology
A peer reviewed international journal www.ijarst.in
IJARST
ISSN: 2457-0362

BANDWIDTH:

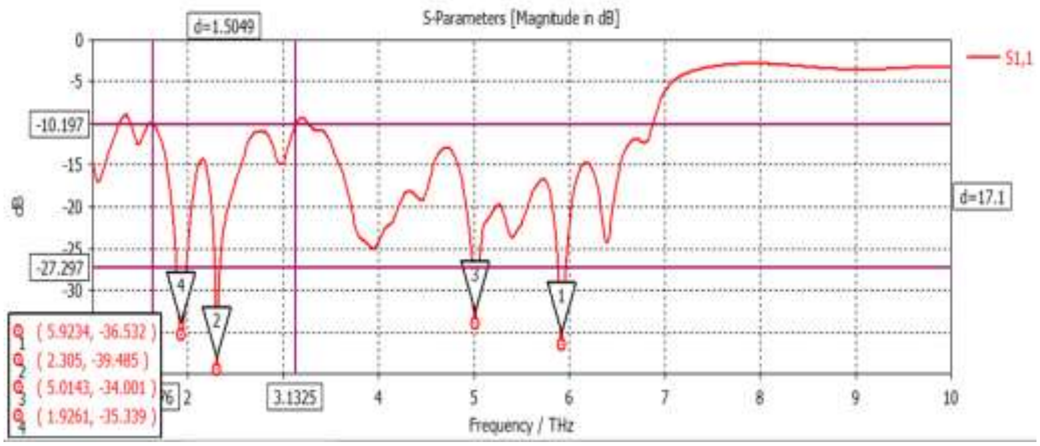

Figure. 13. Bandwidth at f = 2.305 is 1.5049 THz

Applications: Waste management and Water treatment.

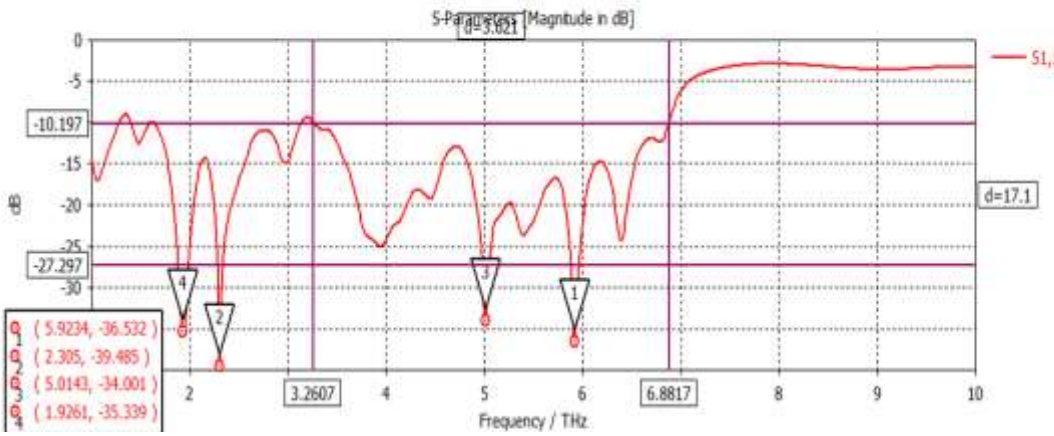

Figure. 14. Bandwidth at f = 5.9234 is 3.621THz

Applications: Precision health care and Earth monitor.

DIRECTIVITY:

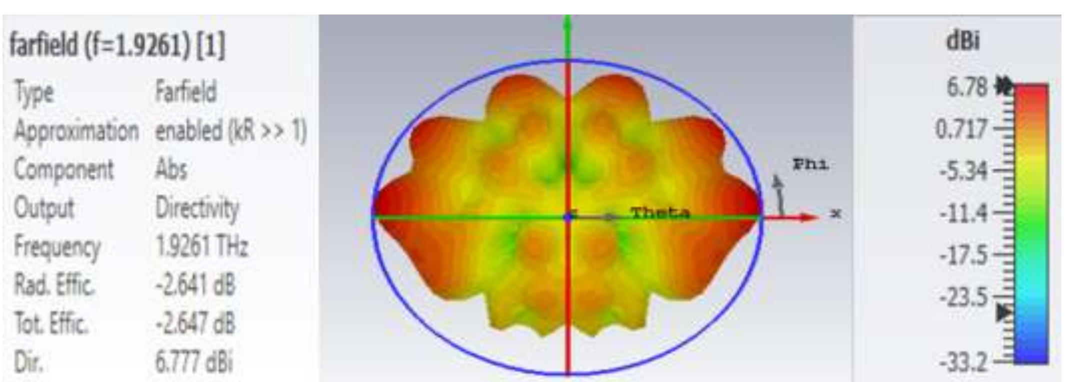

Figure. 17. Directivity at f = 1.9261 is 6.777dBi

IJARST
International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
www.ijarst.in
ISSN: 2457-0362

Applications: Broadband cellular networks.

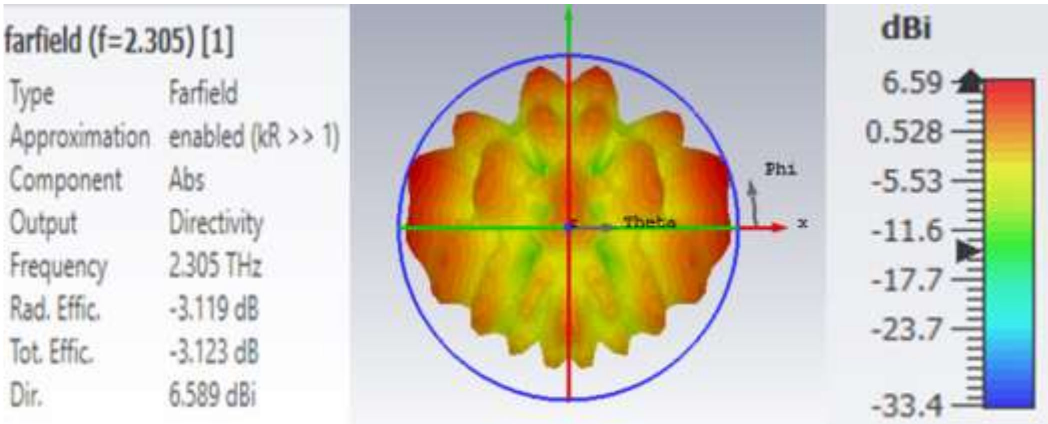

Figure. 18. Directivity at f = 2.305 is 6.589dBi

Applications: Assistive Technology and Immersive AR/VR.

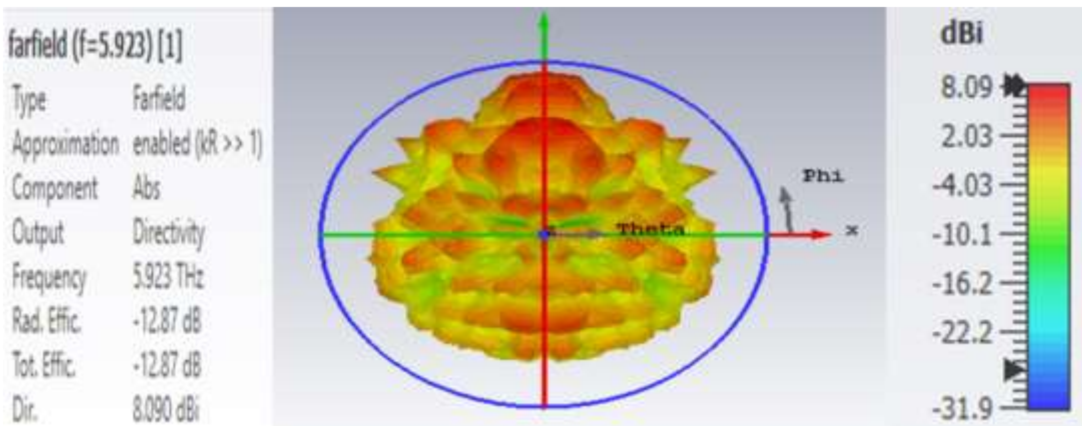

Figure. 20. Directivity at f = 5.923 is 8.090dBi

Applications: Decentralized Businesses.

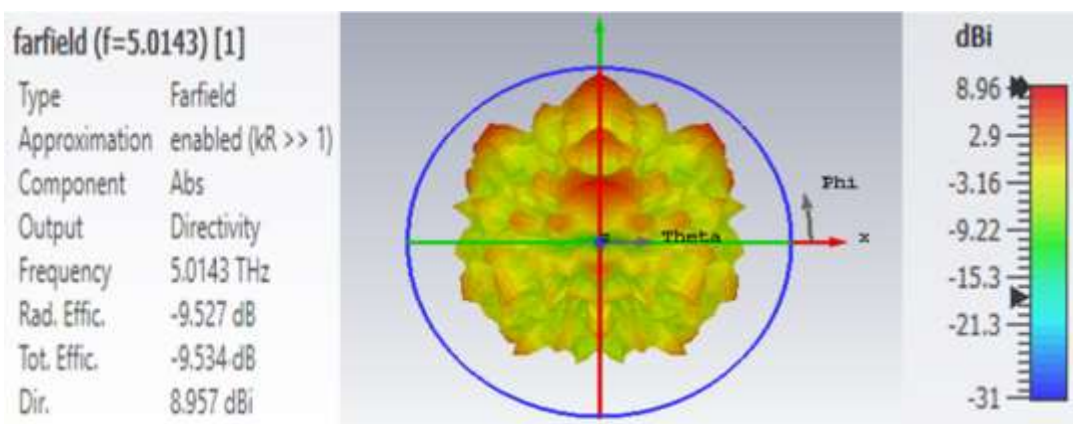

Figure. 19. Directivity at f = 5.0143 is 8.957dBi

Applications: Advanced AI and Autonomous vehicles.

International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
www.ijarst.in
ISSN: 2457-0362

Parameter	Resonance Frequency f = 5.9234 THz	Resonance Frequency f = 2.305 THz	Resonance Frequency f = 5.0143 THz	Resonance Frequency f = 1.9261 THz
S11(dB)	-36.532	-39.485	-34.001	-35.339
Directivity(dBi)	8.090	6.589	8.957	6.777
Gain (dBi)	-4.778	3.469	-0.5698	4.136
VSWR	1.0298	1.0214	1.0419	1.0357
Bandwidth (THz)	3.621	1.5049	3.6112	1.5115

Table 2. Analysis of radiation characteristics for the proposed antenna designs

5. CONCLUSION

This study built and tested a recommended microstrip circular patch antenna for upcoming 6G applications at resonance frequencies of 2.07 THz and 4.105 THz. Using the outcomes of the proposed antenna, the performance of the suggested antenna for wireless applications is also assessed. The designed antenna has a higher gain for strong signal reception, more bandwidth for accessing, sharing, or downloading data, good return loss of - 33.172dB and -28.313dB, and the necessary voltage standing wave ratio is effective for transmitting radio frequency power, which isessential for 6G applications and devices supporting 6G, such as smartphones. These traits are clearly visible in the outcomes of our simulation, which are displayed above.

FUTURE SCOPE

Wideband width is needed in wireless scenarios to increase data rates, which could be achieved by defining: Slots, Fractals,various feeding mechanisms, Size of the portand the antenna.

6. REFERENCES

[1] Deschamps, G.A., “Microstrip Microwave Antennas”, Third symposium on the USAF Antenna Research anddevelopment program, University of IIIinois, Moticello, IIIinois, October 18-22, 1953.

[2] Bernhard, J.T., Mayes, P.E., Schaubert, D., and Mailoux, R.J.,” A commemoration of Deschamps’ and Sichak’s ‘Microstrip Microwave Antennas’: 50 years of Development, divergence,and new directions,” Proceedings of the 2003 Antenna Applications Symposium, Moticello,

[3] IIIinois,september 2003, pp. 189-230 Randy Bancroft, 2nd edition,”

[4] Circuits-a historical survey," IEEE Transactions on microwave Theory and techniques, vol.3, No.2, pp. 1-9.

[5] Denlinger, E.J., "Radiation from Microstrip Radiators" IEEE Transactions onmicrowave Theory and techniques, April1969, vol.17, No. 4, pp. 235-236.