

DESIGN AND ANALYSIS OF DUMBBELL ARRAY ANTENNA FOR AIR TRAFFIC MANAGEMENT SYSTEM

Submitted in partial fulfilment of the requirements for the award of Bachelor of
Engineering Degree in Electronics and Communication Engineering

By

Aakash. M (37130001)



**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
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**SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY (DEEMED TO BE UNIVERSITY)**

Accredited with Grade “A” by NAAC

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APRIL 2021



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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **AAKASH. M (37130001)** who carried out the project entitled **“Design and Analysis of Dumbbell Array Antenna for Air Traffic Management System”** under our supervision from September 2020 to April 2021.

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DECLARATION

I, AAKASH. M (37130001) hereby declare that the Project Report entitled “**DESIGN AND ANALYSIS OF DUMBBELL ARRAY ANTENNA FOR AIR TRAFFIC MANAGEMENT SYSTEM**” done by me under the guidance of **Mr. L. JEGAN ANTONY MARCILIN, M.Tech.**, is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

1)

DATE:

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ABSTRACT

It is important to design a Linear integrated dumbbell shaped antenna that will be used for future air traffic management applications. To achieve integration in the micro-strip patch antenna, we will use a variety of techniques such as DGS (Low-Level Disability Structure), Meta-material and to get the best benefit from re-loss of the antenna. Items used in compact multiband antenna on FR-4 with allowable value of 4.4. The structure has been updated and analysed using HFSS, which provides a high degree of accuracy in the updated results and the updated antenna will be performed. The field antenna is suitable for synthetic Spindle Radar, internal loss is taken in consideration.

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CHAPTER – 1

INTRODUCTION

1.1 ANTENNA

The device used for transmitting and receiving signals is called an Antenna. Electric waves are frequently referred to as radio waves. The antenna must be connected in a common band to a radio programme to which it is connected, or the reception and/or transmission may be disabled. Most of the antennas work better in small frequency bands because most of them are sound devices.

Antenna is an instrument that changes electrical force into radio waves and has a huge occupation in the correspondence systems (the opposite way around). It is used in radio recipient and transmitter transmission. Besides, it applies to radios, TV gathering, radio, satellite correspondences, radar, RFID marks, PDAs, biomedical gadgets, etc

1.1.1 Microstrip Patch Antenna

Micro strip antenna is a kind of inside antenna in which Microwave frequencies make extensive use of them. Micro strip antennas have a low profile. A metal fix mounted at ground level with a di-electric material in the middle is a miniature strip or a fix receiving wire. These are tiny radio wires with low radiation.

1.1.2 Frequency Range Of Patch Antennas

For low-profile applications in frequencies above 100MHz, patch antennas are mainstream.

1.1.3 Working Of Microstrip Patch Antennas

The Microstrip Antenna comprises of a slim metal strip set in the ground of a plane with a halfway dielectrical material. By photo-etching on the di-electrical material the emanating component and feed lines are put. The square, round or rectangular type of the fix or miniature strip for simple break down and fabricate is typically picked. A micro stripe or patch antenna is shown in the following image. The metal patch is $\lambda/2$ in length. The waves created in the dielectric are reflected when the radio wires are stimulated and the energy is sent by the edges of the metal fix, which is astoundingly low.

ADVANTAGES

- Light weight.
- Low cost.
- Ease of installation.

DISADVANTAGES

- Inefficient radiation.
- Narrow frequency bandwidth.

APPLICATIONS

- Used in Space craft applications
- Used in Air craft applications
- Used in Low profile antenna applications

These dielectric components have various dielectrical properties which are helpful when the antenna is built and operated. The dielectric substratum should be larger and have a continuous dielectric to achieve antenna efficiency, greater bandwidth and better radiation. A range of methods of feeding are used to supply the patch antenna of the microstrip. Different microstrip Patch Signaling Methods are used to achieve the best results, such as different shapes and patches and cutting areas.

1.2 FEEDING TECHNIQUE

A feedline is used for quick or unusual contact radiation. There are a couple of different dealing with procedures and four most fundamental methods consolidate microstrip line dealing with, coaxial test, opening affiliation and area.

Dealing with is isolated into two groupings. Dealing with cycles One grants and diverse doesn't pass on. Four sorts of dealing with techniques are available and the coaxial test is composed with the microstrip line, fused opening and area. Line Feed Microstrip: The push string is clearly connected with the edge of the fragment of the microstrip. The scene is more broad than the line of the pioneer. Feeds can consequently be taken care of with a planetary plan on a comparative substrate. A broke recieving wire is a fractal radio wire, a plan like the working length of a thing

that can ingest or send electric radiation in full (on the inside or outside parts). Typical microstrip receiving wires have a single working repeat, a low impedance, a little increment, an immense size, and separating issues. The DGS is known as the concentrated ground spaces or deformations of the microstrip circuit. A fractal receiving wire is a trademark answer for the radio wire issue that works at various frequencies and a diminished size, gotten from the Geometry limit of Benoit Mandelbrot. Nathan Cohen, the originator and CEO of Fractal Antenna Systems, created electric power supply advancement during the 1980s and set up the association in 1995. A destroyed receiving wire is a mechanical contraption that uses a similar arrangement to addition or augmentation the amazing length or line of things which can get or send radiation inside a given domain or volume (in inside parts or outside structures). The first is A defective ground structure is depicted as a hand weight formed plan mounted on a ground plane under a microstrip fix. The DGS unit and the DGS sporadic unit are two pieces of using the DGS work. Numerical conditions of various sorts are embedded on the planet's plane. There are square shape free weight shapes, round free weight shapes, winding shapes, "U", "V", "H", cross and focus rings among the properties. Other problematic species that have been represented join meander lines shape, split resonator and fractal. A bit of these are referred to in this paper including showing procedures.

1.3 OVERVIEW OF WIRELESS COMMUNICATION SYSTEM

Wireless communication, Communication System that transmits signals or data by means of radiofrequency, infrarouge, microwaves or other types of electromagnetic or acoustic waves. Cell phones, bidirectional radios, remote door garage openers, TV remote controls and GPS receivers are included in the Wireless Devices. Wireless modems, microwave and satellite transmitters provide worldwide access to the Internet. A Wireless XML mark-up (WML) is intended as a transmitter and display for mobile and payment devices for use on such narrow-band devices as cell phones. At the point when the setting permits, remote correspondence focuses don't utilize an electrical conduit as a medium to play out the exchange. Radio waves are utilized by the most continuous remote advancements. The proposed distances for radio waves can go from a wide scope of fixed, different utilizations of

radio remote innovation. Other electromagnetic remote frameworks, like are undeniably more uncommon strategies for accomplishing remote correspondences. All through the entire presence of correspondences, the explanation "far away" has been utilized twice, each time with a potentially this changed into the standard application. Far away activities draw in associations like adaptable and interplanetary exchanges that would be incomprehensible or senseless to do with is transmission correspondences broadcast exchanges structures that send data without the utilization of wires by utilizing a type of energy (e.g., radio waves, acoustic energy). This technique for data move is utilized for both short and basic distances.

1.3.1 Block Diagram Of A Wireless Communications

A typical Wireless Communication System consists of three components: the Transmitter, the Channel, and the Receiver. The square outline of a remote specialized gadget is appeared in fig. 1.1.

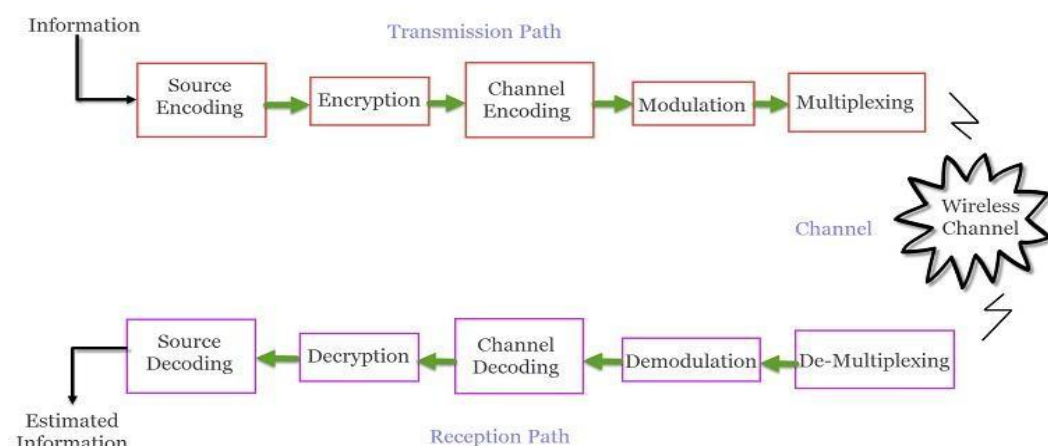


Fig:1.1 : Block diagram of Wireless Communication

THE TRANSMISSION PATH

In this process, redundant signal information is removed to maximise the use of resources. This sign is then encoded utilizing an Encryption Standard to guarantee

that the sign and data are shielded from unapproved access. Channel encoding is a signal processing technique that eliminates signal weaknesses such as noise and interference. During this cycle, a modest quantity of excess is acquainted into the sign with make it more commotion safe. The sign is then tweaked utilizing a reasonable recieving wire.

THE CHANNEL.

To share the significant data transmission, the changed sign is multiplexed with different signs utilizing Time Division Multiplexing (TDM) or Frequency Division Multiplexing (FDM).

In Wireless Communication, the channel denotes the signal's transmitting medium, which is open space. A wireless channel is unpredictably unpredictable, as well as highly variable and random in nature.

THE RECEPTION PATH

The recipient has the task of collecting and reproducing the signal on the channel as its source signal. The collector's job is clearly opposite to that of the transmitter, as proven by the parts of the gathering way.

The Channel Decoder is utilized to eliminate excess pieces from the message. The decoding of the sign eliminates the security and converts it to a basic grouping of pieces on the grounds that the message is encoded. At long last, the Source Decoder gets this sign to recover the first sent message or sign.

1.3.2 Characteristics Of Wireless Communication

Talk viability and the district got by a base station are the two critical assortments between the two systems. The fundamental for high talk quality in the cordless application is a result of the receptiveness of got consent in the home and office, comparably as the following direct rivalry with wire-line telephone utilities. The client has no option rather than far off access for a flexible cell application and can be content with the possibility of association that is lower yet satisfactory. Since the base station can be migrated to a steady wire-line section (divider jack) to give distant

affiliation access where required, the transmission range in cordless phone applications is limited. The versatile cell base station, then again, should give clients access all through a gigantic geographical space of up to 30 km (20 miles) around the base station. This wide consolidation locale is vital for meet the confirmation of enduring meandering clients financially.

The assorted show up at necessities sway unmistakably the transmission force of the two frameworks and the receiving wire height. High power transmitters found in convenient cell customer sets eat up certainly more power than even the most bewildering sign getting ready gear. As needs be, advanced sign taking care of, similar to talk pressure, voice lead area, botch cure and acknowledgment, and adaptable change, can be used in minimal handsets without basically reducing battery life. Also, such strategies are as per the objectives of expanded region and the help of endless customers with a singular, excessive base station. The high versatile cell base station receiving wires, obviously, present concede spreads that a few enormous degrees more prominent than those seen in cordless phone applications.

The two developments audited above are at farthest edges of the difficult to reach trades range. The instigating PCS structures, explicitly, fall some spot in the two. Regardless, the above relationship shows a piece of the device attributes that should be thought of while looking out for far away correspondence structure access frameworks.

1.3.3 Application For Wireless Antenna

Protection systems, TV remote controls, Wi-Fi, cell phones, wireless power transfer, computer interface interfaces, and other wireless communication-based ventures are examples of wireless communication applications.

CHAPTER-2

LITERATURE SURVEY

Horng-Dean Chen, Yuan-Chung Tsai, Chow-Yen-Desmond Sim and Colin Kuo.(2020). “Broadband 8-Antenna Array Design for Sub-6GHz 5G NR Bands Metal-Frame Smartphone Applications”

A broadband 5G New Radio (5G NR) receiving wire structure is proposed for PDA metal bundling applications. The MIMO receiving wire display is molded by embeddings eight unclear radio wires (Ant1Ant8) into the PDA's metal edge, achieving a 8-radio wire bunch for the sub-6GHz 8-receiving wire structure. Each radio wire part is a space receiving wire with a L-molded open opening and a 50 with phenomenal arranging recurrent band accomplished by stacking a tuning stub onto the feed line. The proposed 8-receiving wire show's 10-dB impedance move speed . comparatively as the band. Near showing a 50–82 percent receiving wire productivity, The partitions between associating bundle fragments are additionally > 12-dB, with an ECC of 0.11. The proposed 8-receiving wire bundle applied to a 8 x 8 MIMO gadget has a deliberate zenith channel limit of 43.93 bps/Hz at 20 dB SNR.

Rezaul Azim , AKM Moinul H. Meaze, Adnan Affandi, Md Mottahir Alam , Rumi Aktar, Md S. Mia, Touhidul Alam, Md Samsuzzaman and Mohammad T. Islam. (2020) “A multi-slotted antenna for LTE/5G Sub-6 GHz wireless communication applications”

A position of safety multi-opened fix radio wire for long haul advancement (LTE) and fifth-age (5G) network applications is introduced in this paper. A ventured fix and a ground plane were utilized in the investigation. Three spaces have been embedded inside the fix to accomplish the necessary working band. The expansion of the spaces improves the capacitive impact and permits the model radio wire to work in the range. The receiving wire introduced has omnidirectional designs, great increases, and execution, and is sufficiently little to be utilized for remote constancy (WiFi), remote neighborhood correspondence.

Naser Ojaroudi Parchin, Yasir I. A. Al-Yasir, Ahmed M. Abdulkhaleq, Haleh jahanbakhsh Basherlou , Atta Ullah , and Raed A. Abd-Alhameed.(2020).

“A New Broadband MIMO Antenna System for Sub 6 GHz 5G Cellular Communications”.

The proposed design provides ample efficiencies, strong isolation, and dual-polarized maximum radiation coverage. Accordingly, the proposed 5G radio wire engineering comprises of a sum of four evenly energized and four vertically enraptured recieving wire segments. The mainboard substrate is made of a minimal effort FR-4 substrate with a surface space of 75150 mm².

Demos Serghiou, Mohsen Khalily, Vikrant Singh, Ali Araghi, Rahim Tafazolli. (2020). “Sub-6 GHz Dual-Band 8×8 MIMO Antenna for 5G Smartphones”.

we present a dual-band 8x MIMO antenna for future 5G multiple-input multiple-output (MIMO) smartphones application is shown. The plan comprises of a completely grounded plane with firmly separated symmetrical sets of radio wires put evenly along the cell phone's long edges and corners. The symmetrical sets unbiased to lessen common in the two groups. Every recieving wire unit is comprised of a 17.855 mm² collapsed monopole that can work in the low band . The recieving wire model was tried and found to have great all out exhibition. At long last, the recieving wire's buyer impacts

Sheng-Jie Guo, Lin-Sheng Wu and Jun-Fa Mao.(2019).

“A Wideband Microstrip-Fed Dielectric Resonator Antenna Array With Defected Ground Structure”.

A wideband microstrip-took care of dielectric resonator Antenna(DRA) cluster with surrendered ground structure (DGS) is exhibited in this paper. The impedance transfer speed of a 22 DRA cluster took care of by equal microstrip lines is additionally expanded by adding four hand weight formed DGS units on the ground plane. The exhibit with DGS has a more extensive impedance transmission capacity

of 30.4 percent, which is around 11.5 percent more noteworthy than the broadening the array's bandwidth is investigated. Furthermore, the DGS's effects.

Ashkan Abolfathi and Pejman Rezaei.(2018).

“Dual Beam Leaky Wave Antenna Using Dumbbell-Shaped Slots based On substrate integrated”.

This paper plans and investigates a two fold column defective wave antenna (LWA) group at X-band using substrate composed waveguide (SIW) advancement subject to TE₂₀ mode. SIW has hand weight shaped openings scratched into it on the different sides. Utilizing these kinds of spaces has expanded the recieving wire's data transfer capacity, with the goal that the proposed radio wire data transfer capacity is somewhere in the range of 9.4 and 14 GHz. Another benefit of this construction is its acceptable increase, appropriate directivity, and radiation productivity, with the radio wire top addition arriving at 12.6 dB at 12 GHz. The CST Microwave Studio software is used to analyse and simulate this antenna.

Abdessamad Jarrar and Youssef Balouki.(2018).

“Formal modeling of a complex adaptive air traffic control system”.

Inferable from the giant number of models, the aeronautics authority framework in air terminals is perhaps the most confusing plans the heads. We recommend joins the chance of air terminal rule and the standard decisions to help engineers in masterminding a particularly unusual system. This model is built system, which relies upon set speculation and thinks about the check of theories. furthermore established on refinement, which includes beginning with a hypothetical model and consistently improving it. It has completed in different transportation systems and has been found to be without bug. This helps us with using it in this crucial construction to ensure that bugs are missing and that the model is right.

Debdeep Sarkar and Kumar Vaibhav Srivastava. (2018).

“Four Element Dual-band Sub-6 GHz 5G MIMO Antenna Using SRR-loaded Slot-Loops”.

To achieve miniaturisation, Multiband efficiency refers to the combining of two narrow bands to gain increased bandwidth in the higher frequency range. The proposed receiving wire's arrangement technique is explained using Ansys HFSS reenactments, which look at its impedance move speed, equivalent coupling, replicated 3D radiation models, and surface current scattering features. In a uniform multiplication circumstance, the proposed MIMO receiving wire has amazing assortment profitability extent of under In the indoor Gaussian inducing environment a wide extent of circumstance limits is furthermore checked for the generosity of the proposed MIMO radio wire.

Rinkee Chopra and Girish Kumar. (2017).

“Compact Dumbbell Shaped Microstrip Antenna with Suppressed harmonics”.

A circular compact dumbbell shaped microstrip antenna in normal mode suspended configuration is built in this paper at 2.25 GHz. To restrict the receiving wire's size, two symmetric spaces in the round fix are taken out. To update space estimations, an estimation examination of opening length and width is performed. Maybe than a standard traffic circle microstrip radio wire, the size of the developed receiving wire is diminished by 72%. Different output parameters are compared and evaluated, including gain and bandwidth. Higher order harmonics are suppressed by a small, dumbbell-shaped microstrip antenna. To shield the antenna from the atmosphere and unwanted interference, a radome and cavity are used. The masterminded decreased arrangement achieves 225 MHz information move limit at 2.25 GHz. This arrangement achieves an apex gain of 7 dBi. With a fundamental side and stable radiation plan in the information move limit, a half-power column width of 90 is cultivated. The antenna is built and the results are measured to ensure that the definition is right.

Subhradeep Chakraborty, Abhijyoti Ghosh, Sudipta Chattopadhyay and L. Lolit Kumar Singh.(2016).

“Improved Cross Polarized Radiation and Wide Impedance Bandwidth from Rectangular Microstrip Antenna with Dumbbell Shaped Defected Patch Surface”.

Hypothetically and tentatively, a rectangular fix with an abandoned fix surface as a free weight has been concentrated to expand polarization immaculateness over a huge precise reach and impedance transfer speed. Over the of more than 30 dB is obtained with a high impedance bandwidth. Furthermore, current structure is free of back radiation and can effectively suppress. The current framework and straightforward to build. With the current framework, the current investigation offers an informative, visualization-based interpretation of parallel changes.

Ang Yu and Xuexia Zhang.(2013).

“A novel method to improve the performance of microstrip antenna arrays using a dumbbell EBG structure”.

In this letter, the transmission coefficient S_{21} between the components of a twofold component microstrip Antenna exhibit embedded with a recently framed electromagnetic band hole (EBG) structure is decreased by around 4 dB, and the addition was expanded by 1 dB, with no improvement in different qualities. It has been exhibited that utilizing the EBG construction to improve the productivity of a radio wire cluster is a basic and viable strategy.

Ang YU and Xuexia Zhang.(2009).

“A Low Profile Monopole Antenna Using A Dumbbell Ebg Structure”.

It was feasible to make a position of safety monopole recieving wire with a novel DEBG structure. Around 5.2 GHz, the DEBG structure is like an attractive divider. While working at 4.9-5.15 GHz, the recieving wire can be arranged basically 1.5 mm over the DEBG field. In the H plane and E plane, the expansion has been extended by 6.5 dB and 5.7 dB, separately. By embeddings a superstrate, as far as possible can be extended while the expansion improvement is kept up.

Ajay K Sharma*, Shyam K Agrawal, Dharmendra S Rajpurohit, Raghvendra Singh and Ashok Mittal.(2006).

“A wideband microstrip array antenna with unique dumbbell shaped aperture coupled radiating elements”.

For versatile satellite interchanges, a wideband 2x2 planar microstrip radio antenna cluster with double round polarization is introduced. For improved pivotal proportion and impedance transfer speed execution, the essential cluster component is a streamlined askew opened precious stone formed hand weight gap took care of fix radio wire. The enhanced cluster structure accomplishes a 2:1 impedance transmission capacity of 23%, a 3 dB pivotal proportion transfer speed of 19.2%, and a round directivity of 14.2 dBi. Because of the foregoing characteristics.

CHAPTER-3

EXISTING METHODOLOGY

The Existing Methodology is about a low-profile, Wideband, dipole-Patch antenna with a printed dipole and four coupled microstrip patch. Which is housed in a Single-Substrate integrated-wavelength cavity, is two vias located on opposite side of a dumbbell shaped aperture. It operates from 22.3 to 32.1 GHz for SWR 2 with a peak gain of 9.6 dBi, a low crosspolarisation level of less than -25dB. Its thickness is just $0.071\lambda_0$, λ_0 free-space wavelength at the 27.2 GHz centre frequency. To validate the elements's property. The antenna is designed, fabricated and measured With sidelobe and cross-polarization levels below -17 dB and -22 dB, the measured E- and H-plane radiation patterns are stable across the operating band.

DRAWBACKS

- Dual-substrate.
- Size and thickness is more.
- Return loss is less.

CHAPTER-4

PROPOSED METHODOLOGY

The proposed methodology is about to design an antenna for air trafficking management system with high gain and efficiency, using ANSYS Software and will be fabricated in FR4 epoxy Material.

- A monopole microstrip rectangular patch with dumbbell shape slotted on ground for multiple band, enhance the bandwidth.
- The antenna is fabricated on FR 4 epoxy material with electrical permittivity of 4.4 and magnetic permeability 1.
- The reflection coefficient (S_{11}), radiation characteristics, peak gain and VSWR of designed antenna are described.
- The antenna structure is going to be stimulated and analyzed using ANSYS HFSS v19.2 which gives high accuracy rate in stimulated results and is going to be fabricated once stimulation gets over.

ADVANTAGES

- Single-substrate.
- Size and thickness is less.
- Return loss is more.
- Communication without any loss.
- High gain and high directivity capability.
- Low power consumption in real time.
- High system gain and efficiency.
- Low cost.

4. 1 HARDWARE REQUIRED:

- Substrate Material (FR-4 epoxy material)
- SMA connector (50 Ohm impedance)
- Copper (for patch and ground)
- Vector Network Analyser.

4.1.1 Substrate Material

For most PCB applications, FR4 epoxy glass substrates are the preferred material. With creation of more microwave frameworks focused on shopper markets, there is a developing revenue in bringing down the expense of these frameworks. Utilizing FR4 rather than costly PTFE-based substrates for microwave circuits and receiving wires could bring about tremendous expense investment funds. This paper portrays a program of work did at ERA Technology as a feature of its Membership Research Program to assess the properties of this material at microwave frequencies going from 1 GHz to 15 GHz. Because of its high misfortunes, it is inferred that the utilization of FR4 for radio wire taking care of designs is probably not going to be reasonable. Nonetheless, for high thickness microwave circuits with short way lengths and broadband radio wire components with lower misfortunes and supreme dielectric consistent qualities, the material could be utilized instead of more conventional microwave substrate materials, bringing about massive expense reserve funds. A multi-facet PCB fit for moving advanced signs at high rates in the high recurrence area is needed to give a high velocity network climate fit for dealing with an enormous volume of information.

4.1.2 SMA Connector

The SMA connector is a semi-precision sub-more modest than ordinary RF and microwave connector that is comprehensively used, particularly for RF relationship inside electronic structures at frequencies up to 18 GHz and now and again higher. The SMA connector is open in an arrangement of setups, including male, female, straight, right-determined, bulkhead fitting, and various others, allowing it to meet the greater part of necessities. Its sub-smaller than expected size additionally permits it to be utilized in moderately little electronic hardware. Albeit the SMA connector is currently grounded, its utilization is probably going to grow as numerous new RF frameworks see their working frequencies broaden all the way into the microwave locale. SMA connectors are intended to have a consistent impedance of 50 ohms across the connector. Albeit a few renditions have top frequencies of 12.4 GHz, a few less and some are determined up to 24 or 26.5 GHz, SMA connectors were initially planned and indicated for activity up to 18 GHz. Higher recurrence top cutoff points may require a better yield misfortune.

The SMA connector utilizes a 1/4-inch distance across, a day and a half for each inch strung barrel. It is appeared in fig 4.1.

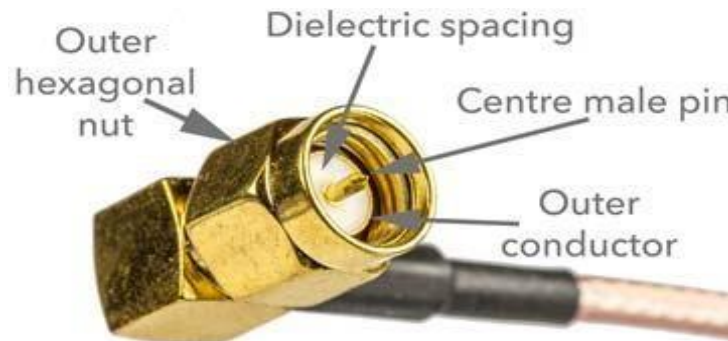


Fig:4.1 : SMA Connector

Different Connectors:



Fig:4.2 : Different Connectors

4.1.3 Vector Network Analyzer

A Vector Network Analyzer has a source that creates a realized upgrade signal and a bunch of collectors that recognize changes in this boost brought about by the gadget under-test or DUT.

The improvement signal is infused into the DUT, and the Vector Network Analyzer estimates both the reflected sign from the info side and the sign that goes through to the DUT's yield side. The subsequent signs are estimated and contrasted with the realized boost signal by the Vector Network Analyzer collectors. The deliberate outcomes are then handled by an inside or outer PC and showed on a screen.

Vector Network Analyzers take two sorts of estimations: transmission and reflection. Transmission estimations send the Vector Network Analyzer boost signal through the gadget under test, where it is estimated by the Vector Network Analyzer recipients on the opposite end. S21 and S12 are the most usually estimated transmission S-boundaries (Sxy for more than 2-ports). Transmission estimations, for example, cleared force estimations, are a kind of transmission estimation. Gain, addition misfortune/stage, electrical length/deferral, and gathering delay are some other transmission estimations. Reflection estimations, then again, measure the segment of the VNA upgrade signal that strikes the DUT however doesn't go through it. The reflection estimation, then again, measures the sign that movements back towards the source because of reflections.



Fig:4.3 : Vector Network Analyzer

4.1.4 Antenna Design

Antenna can be intended to communicate and get radio waves in all level ways similarly (omnidirectional recieving wires), or specially a specific way (directional, or high-gain, or "shaft" recieving wires). It is appeared in fig 4.3 and 4.4

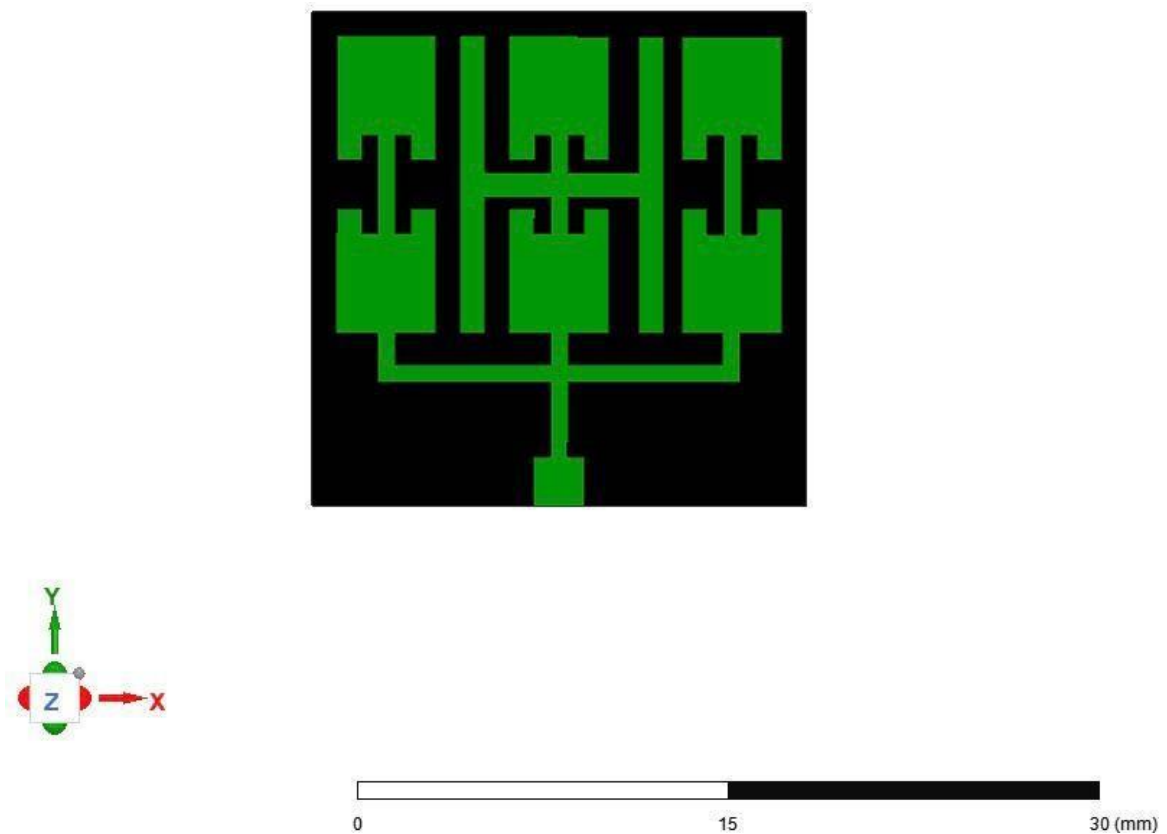


Fig:4.4 : Design of Antenna

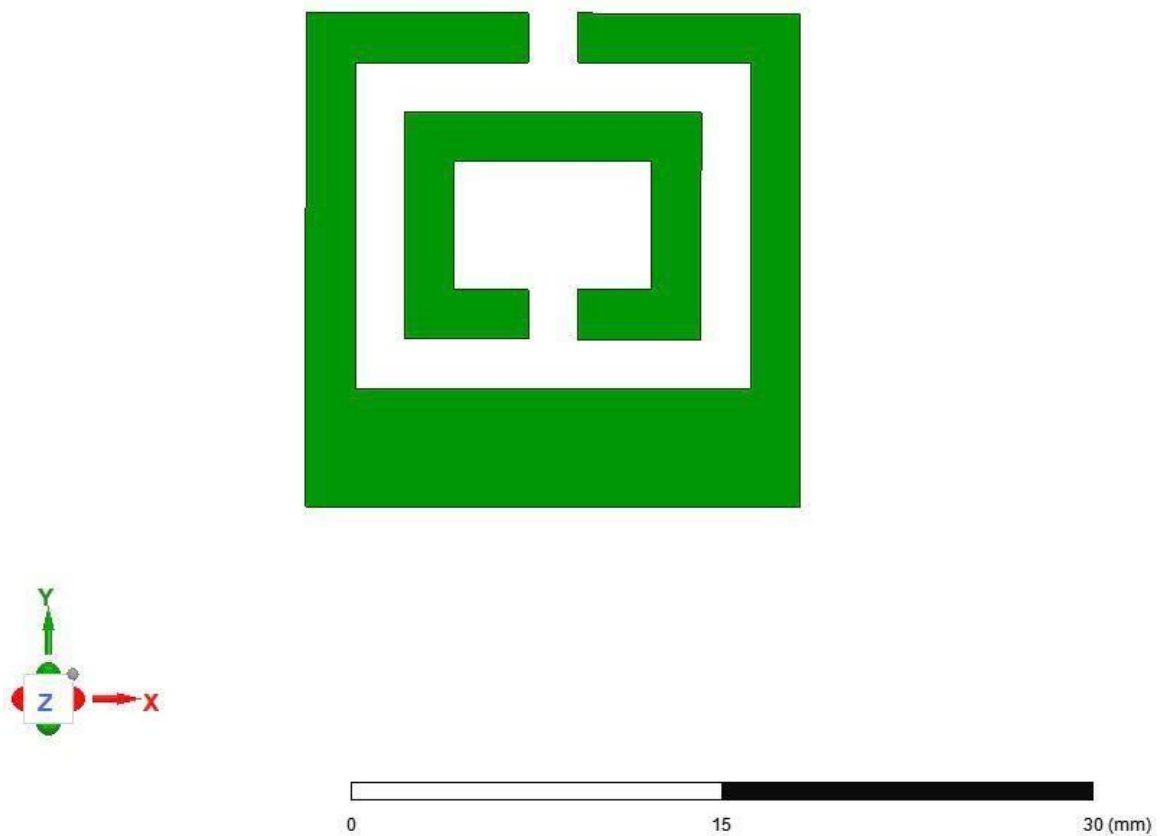


Fig:4.5 : Ground design of Antenna

DGS refers to the combined geometric spaces embedded in the ground structure of a microwave circuit. As a result, DGS refers to the periodic and/or aperiodic paralysis that is concentrated in the ground structure of the plane microwave circuit. Previously, PBG, EBG, and DGS comparisons are shown. A plane transmission line, such as a microstrip or a coplanar wave guide, is used to incorporate the DGS into the earth's surface. Flight errors disrupt the aircraft's current distribution; interference changes the feature of the transmission line by adding other components slots. On the other hand, any deformity recorded on the plane below the microstrip line changes the power and efficiency of the microstrip line by increasing the slot resistance and strength of the line. Capacitance and inductance are terms used to explain the sum of capacitance and inductance Occasional Defective Ground Structure planar microwave circuits are very appealing to microwave researchers. Microstrip lines with DGS: bandpass filters and low passar filters were implemented on a regular basis. A high degree of slow motion with high levels of miniaturisation is achieved by using the events of a temporary structure.

The status of the Defective Ground Structure unit, the distance between two Defective Ground Structure units, and the dispensation of different DGS are all important factors that affect how the DGS appears over time. An intermittent DGS (HPDGS) and an intermittent DGS (IDGS) are generated by combining two DGS sessions (VPDGS).

4.1.5 Software

The Software we use of simulation is ANSYS HFSS simulation tool as its accuracy rate is ~98%. HFSS (High Frequency Structure Simulator) utilizes adaptable solvers and an instinctive GUI to give you unrivaled effectiveness and profound knowledge into the entirety of your 3D EM issues. HFSS gives an amazing and complete Multiphysics examination of electronic items through mix with Ansys warm, underlying, and liquid elements instruments, guaranteeing their warm and primary unwavering quality. In view of its programmed versatile lattice strategy and modern solvers, HFSS is inseparable from best quality level exactness and dependability for handling 3D EM challenges, which can be sped up by elite processing (HPC) innovation.

CHAPTER-5

RESULTS AND DISCUSSION

In this chapter Various parameters of the proposed fractal antenna are discussed and analyzed by simulating it with the help of HFSS software.

- Return Loss.
- Voltage Standing Wave Ratio.
- Impedance Plot.
- Antenna Gain.
- Directivity.
- Peak Gain.
- Radiated Power.
- Front to Back Ratio.
- Accepted Power.
- Radiation Efficiency.
- Radiation Intensity.
- Specific Absorption Rate (SAR)
- Surface Current.
- Radiation Pattern.

5.1 RETURN LOSS

The Antenna's Return Loss is a number that addresses the quantity of waves that arrive at the antenna establishment yet are dismissed as an action when contrasted with the satisfactory ones. Determined in decibels (dB) in contrast with a short out. Investigate the receiving wire utilized in transmission mode. Figure 5.1. Therefore, some radio waves will be shown and sent down the transmission line from the receiving wire input spine association. The rest of be taken care of into the framework. Notwithstanding, any blemishes in the feed framework will bring about few occasion radio waves being reflected back to the info side.

The animated outcome from the proposed radio wire for 6 distinctive recurrence are 6.66 GHz - 23.6655, 9.68 GHz - 11.4434, 12.98 GHz - 15.3875, 15.53 GHz - 24.9507, it tends to be appeared in fig 5.1.

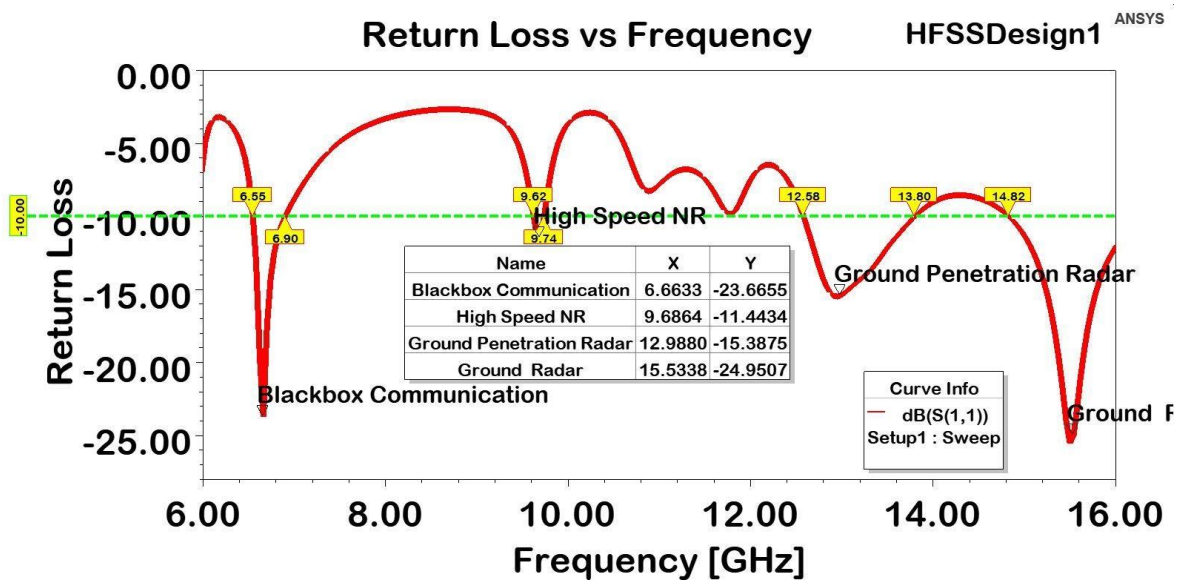


Fig:5.1 : Return Loss

5.2 VOLTAGE STANDING WAVE RATIO (VSWR)

The Voltage Standing Wave Ratio (VSWR) is an alternate method of portraying Return Loss. The genuine voltages created inside the transmission framework where radio waves are voyaging and showing simultaneously are alluded to as VSWR. Albeit static waves and VSWR are significant, VSWR hypotheses and insights can frequently cloud what is really going on. Luckily, it is feasible to acquire a decent comprehension of the subject without diving too profoundly into the idea of VSWR. For most receiving wire frameworks, a VSWR estimation of under 2 years is suitable. Figure 5.2 shows it.

The animated Voltage Standing Wave Ratio result from the proposed Antenna are 6.62 GHz - 1.2360, 9.68 GHz - 1.7315, 12.86 GHz – 1.4203, 15.45 GHz – 1.1341. it is appeared in fig 5.2.

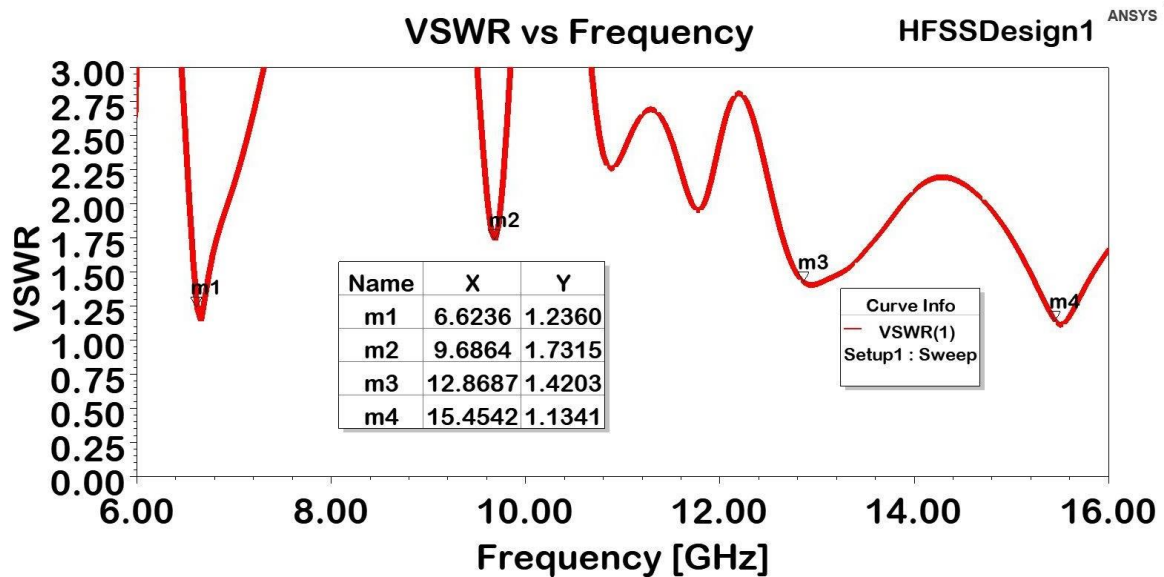


Fig:5.2 : Voltage Standing Wave Ratio

5.3 IMPEDANCE PLOT

The impedance connects the voltage and current of the Antenna's info. The energy transmitted from a good ways or implanted inside the Antenna is addressed by the radio wire's genuine impedance divide. The energy put away in the closest radio wire field is addressed by the theoretical bit of the impedance. Figure 3.3 portrays this. The impedance of surveying the port's flow electrical force. The recieving wire impedance is dictated by contrasting the current in the port with the phasor voltage, which is 1V at a 0 deg point.

The size of the Antenna establishment impedance is dictated by the recurrence. Over the recurrence scope of 20-120 MHz, the construction portrays the info impedance of a dipole radio wire. The recurrence of reaction opposition shifts. As far as reverberation, contrasts can be precisely portrayed.

The impedance plot of the proposed Antenna are 6.62 GHz – 0.8382+0.1076i, 9.68 GHz – 0.9861-0.5519i, 12.86 GHz – 0.7042-0.0070i, 15.45 GHz – 0.9122+0.0822i. The referenced invigorated outcomes are appeared in a smith outline in fig 5.3

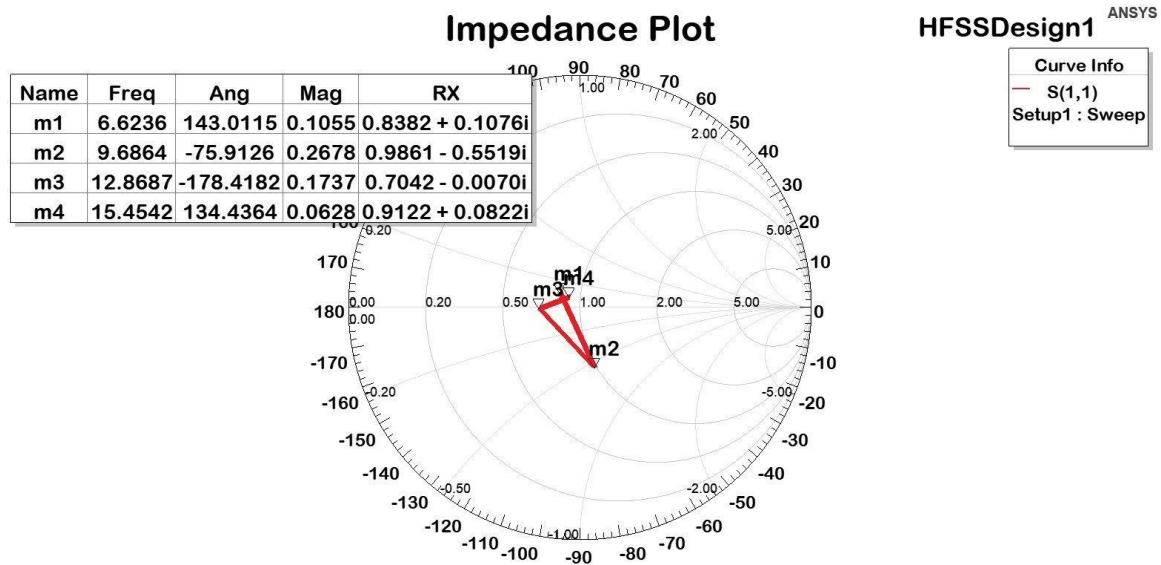


Fig 5.3 Impedance Plot.

5.4 ANTENNA GAIN

Antenna acquire is regularly characterized as the proportion of radio wire produced power from a distant field source to the Antenna hub pivot to the force created by isotropic Antenna, which is similarly delicate to signals from all markers. first Decibel-isotropic units are utilized to address this estimation, which is normally communicated in decibels (dBi). An alternate depiction stands out the force got from the force acquired from a non-lost dipole Antenna, with the units composed as dB. Antenna acquire indicates how incredible a Antenna sign will send or get a particular way. The advantage is controlled by looking at the appraised power communicated or got by the Antenna a specific way to the force moved or got by an appropriate Antenna in a similar condition. Figure 5.4

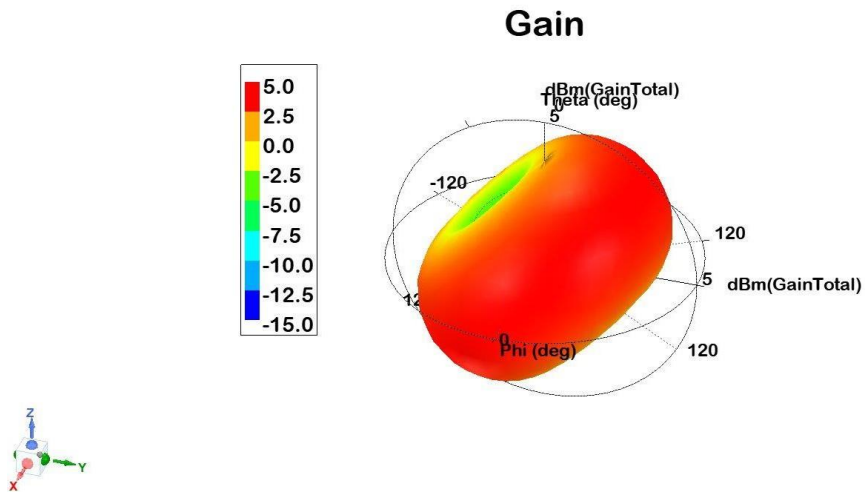


Figure:5.4 : Gain

5.5 DIRECTIVITY

The centralization of An Antenna radiation design on one side is estimated by directivity. In db, the way is appeared. The heading's tallness is extremely fixated or zeroed in on a wooden bar. The shaft will keep on voyaging if the way is solid It is the constraint of the greatness of the radiation on a given side of the Antenna every which way to the restricted radiation potential (IEEE 1993). The complete force delivered by the Antenna partitioned by 4π is the same radiation power. In db, the way is appeared. The heading's stature is exceptionally fixated or zeroed in on a wooden pillar. The pillar will keep on voyaging if the way is solid. An Antenna that is consistently enlightened every which way can act naturally coordinated and have just a single course (0 dB). The directivity of the proposed Antenna is 2.5dB. It is appeared in fig 5.5.

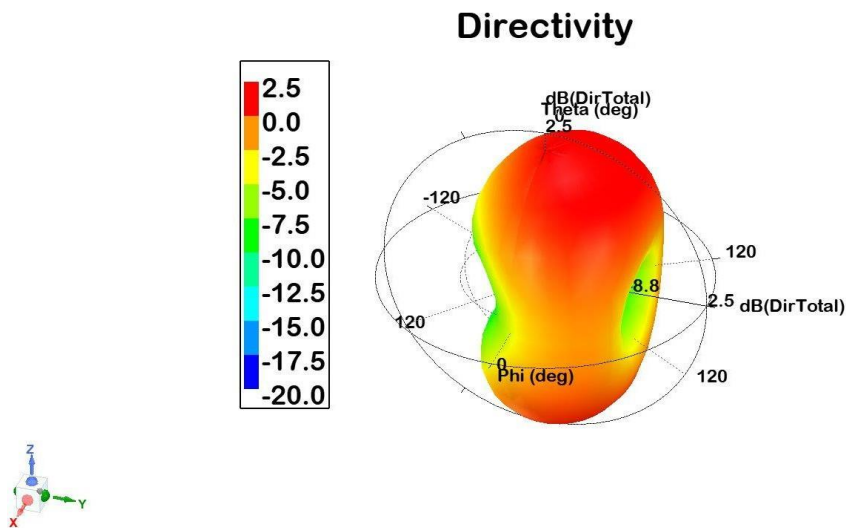


Fig:5.5 : Directivity

5.7 RADIATED POWER

The measure of force that would need to be provided to the satellite's Antenna on the off chance that it emanated correspondingly every which way. A standard satellite transmitter yield force would be marginally in excess of 3,000 watts if the satellite's Antenna emanated uniformly every which way. This is not really reasonable, however the satellite doesn't have to communicate its sign every which way. Everything necessary is to convey a message toward the segment of the earth that will get it. The force required on the satellite is drastically decreased by gathering power around there. The transmitted force of the proposed Antenna are appeared in fig 5.7.

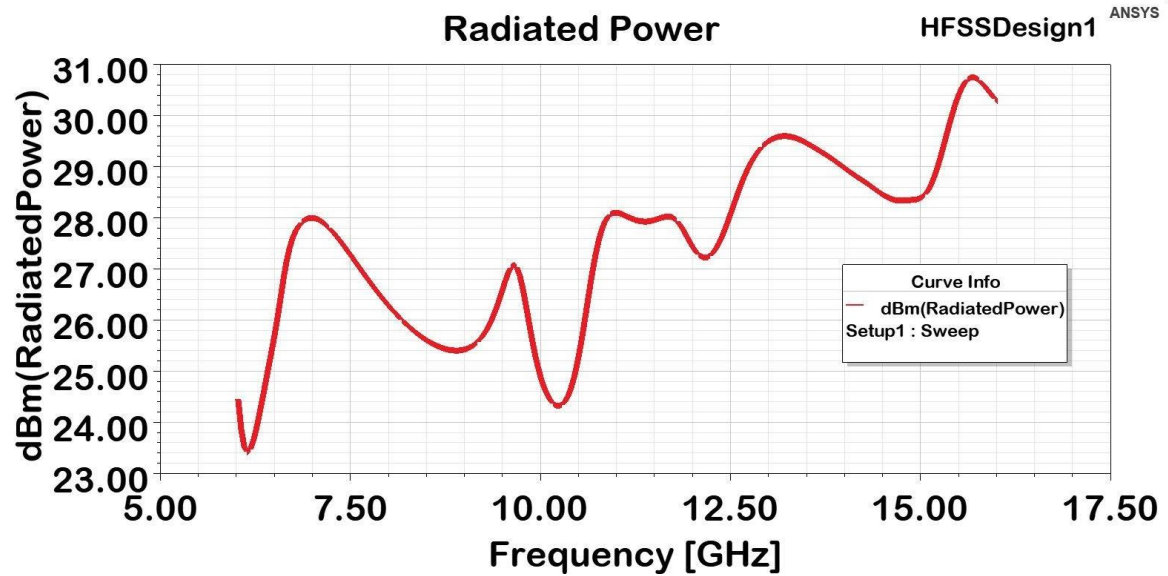


Fig:5.7 : Radiated Power

5.8 FRONT TO BACK RATIO

Antenna's Front to Back Ratio (F/B Ratio) is the extent of force emanated in the front/fundamental radiation flap to control transmitted the other way (180 degrees from the principle shaft).

$$\text{Front to Back ratio} = \frac{\text{Fordward Power (F)}}{\text{Backward Power (B)}} \quad \text{Equ 5.1}$$

This proportion, which is normally communicated in decibels, advises us how much in reverse radiation there is. In circumstances where obstruction or inclusion the converse way should be decreased, this boundary is basic. Figure 5.8 depicts it

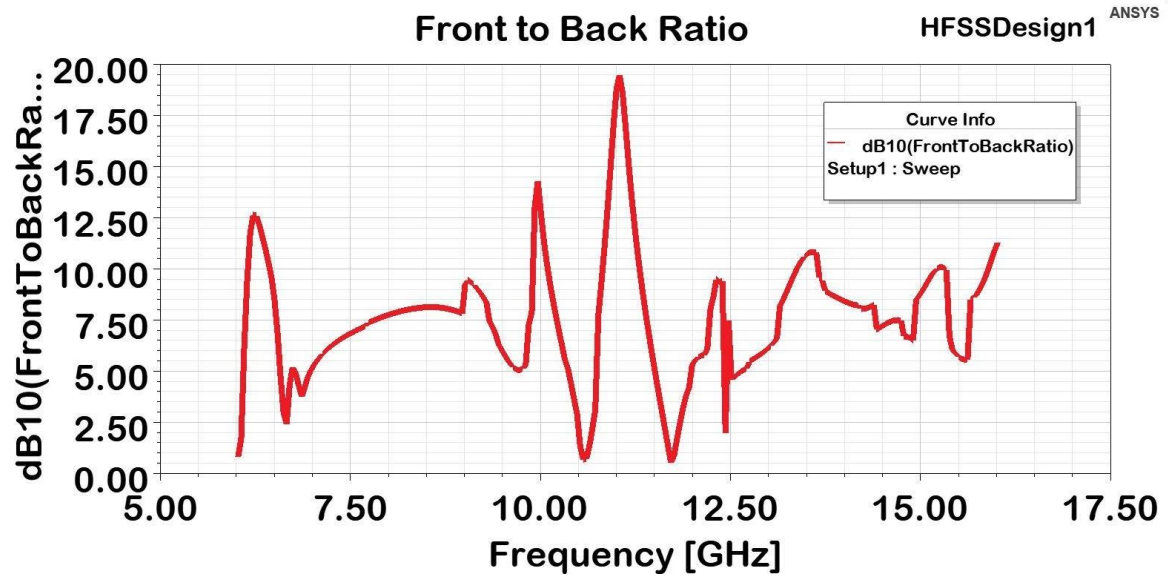


Fig:5.8 : Front to Back Ratio

5.9 ACCEPTED POWER

There would be no reflections and therefore no mismatch loss on a transmission line that is correctly terminated, that is, terminated with the same impedance as the transmission line's characteristic. The amount of power lost in the system is referred to as mismatch failure. It's also the amount of power obtained if the system's components were perfectly balanced. Impedance matching is an important part of RF device design, but there will almost certainly be some mismatch failure in practise. Mismatch loss causes relatively little loss in real systems, usually on the order of 1dB. It is shown in fig 5.9.

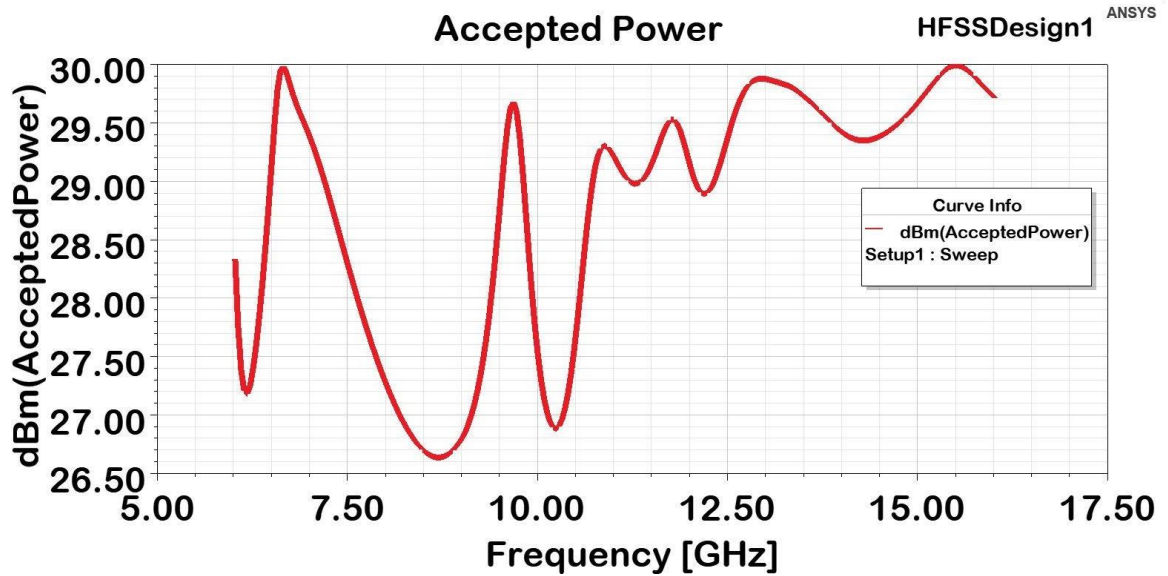


Fig:5.9 : Accepted power

5.10 RADIATION EFFICIENCY

The expression "Antenna proficiency" is frequently utilized in radio wire hypothesis to allude to radiation productivity. With regards to Antenna, the expression "proficiency" is frequently utilized. It is a computation of a radio Antenna's electrical effectiveness in changing the radio-recurrence power got at its terminals into transmitted force. Likewise, it characterizes the extent of the radio wave's force caught by Antenna that is eventually communicated as an electrical sign in a getting Antenna. It ought not be mistaken for gap quality, which alludes to Antenna with gaps, like the illustrative reflector. It is appeared in fig 5.10.:

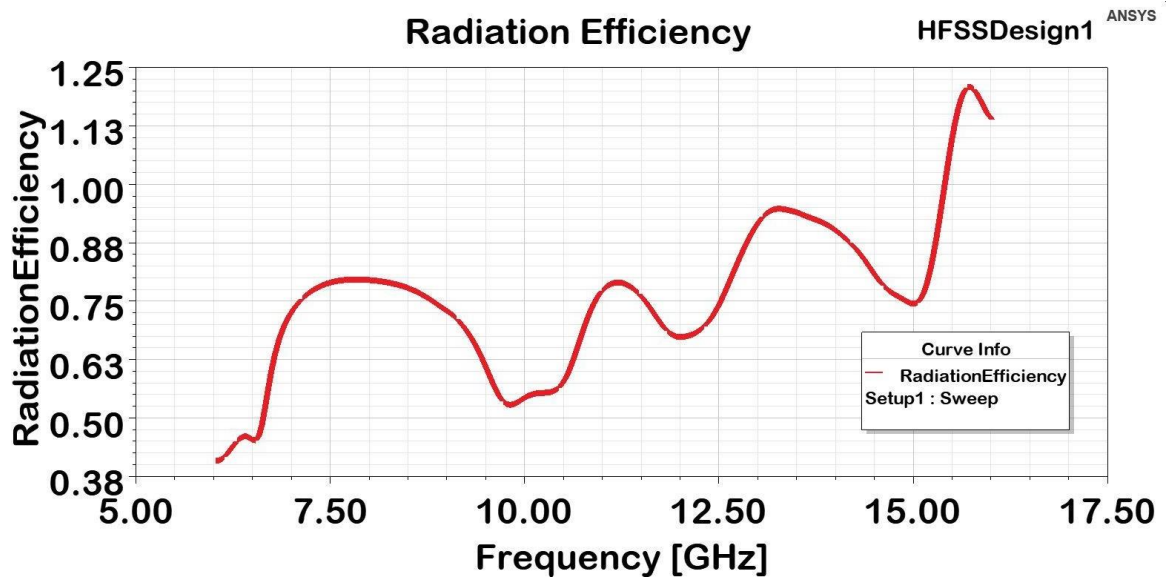


Fig:5.10 : Radiation Efficiency

5.11 RADIATION INTENSITY

The power radiated from an antenna for each unit strong point is known as the radiation power, or Antenna power design, in a provided guidance. Radiation force is a far-field boundary that is determined by increasing the radiation power thickness by the square size. It is shown in fig 5.11.

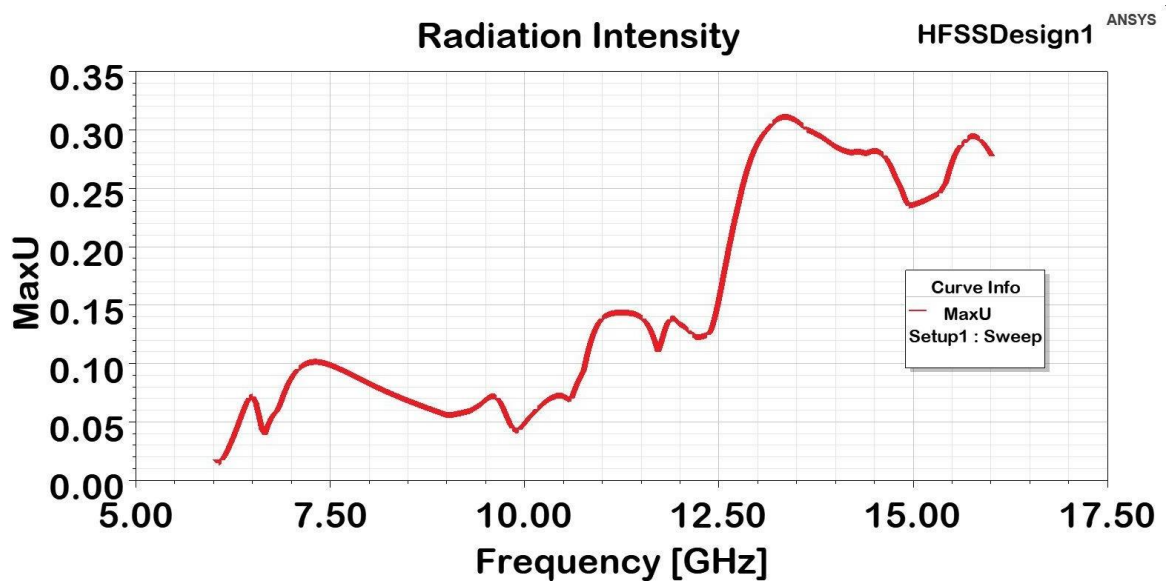


Fig:5.11 : Radiation Intensity

5.12 SPECIFIC ABSORPTION RATE (SAR)

The particular retention rate (SAR) is an estimation of the most extreme measure of EM radiation that a correspondence Antenna in a remote framework can transmit. At the point when SAR is excessively high, Antenna communicate power is decreased. When exposed to a radio recurrence electromagnetic field, it is a proportion of the rate at which energy is consumed by the human body. It is estimated in watts per kilogram (W/kg) and is characterized as the force assimilate per mass of tissue. It is appeared in fig 5.12.

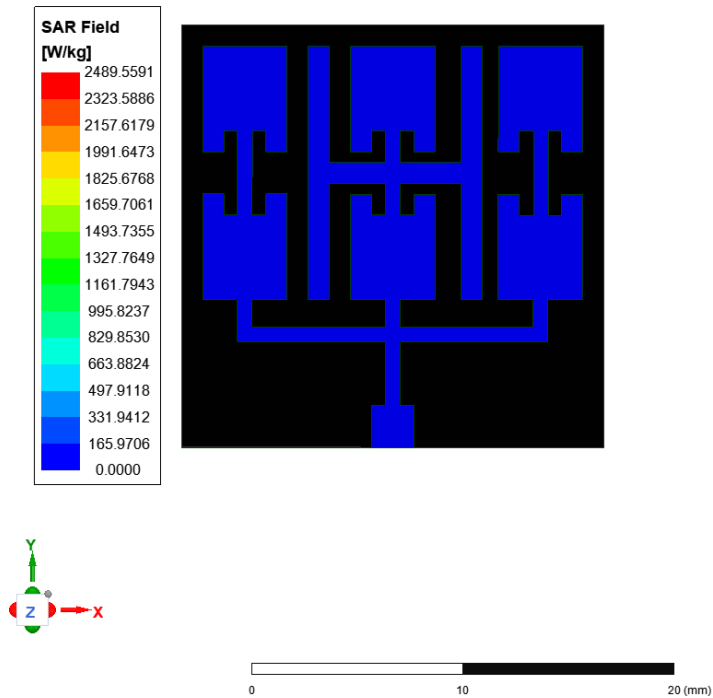


Fig:5.12 : SAR

5.13 SURFACE CURRENT

An applied electromagnetic field generates an actual electric current in the surface current antenna. The letter J is used to represent the surface current. The electric flow per cross sectional territory at a given point in space is characterized as the greatness of the surface flow thickness. The current thickness is the volume of charge coursing through a unit space of a picked cross area for each unit time. The surface current density is measured in amperes per square metre, which is a SI unit. It is shown in fig 5.13.

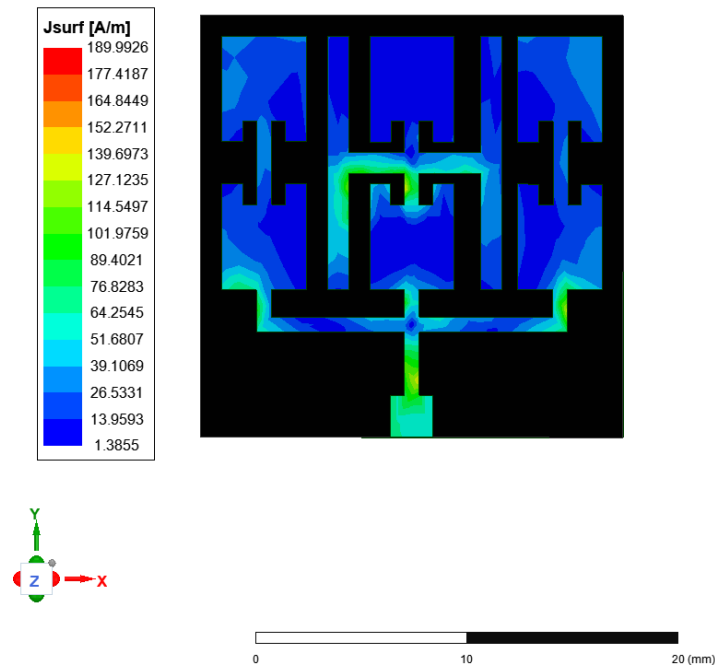


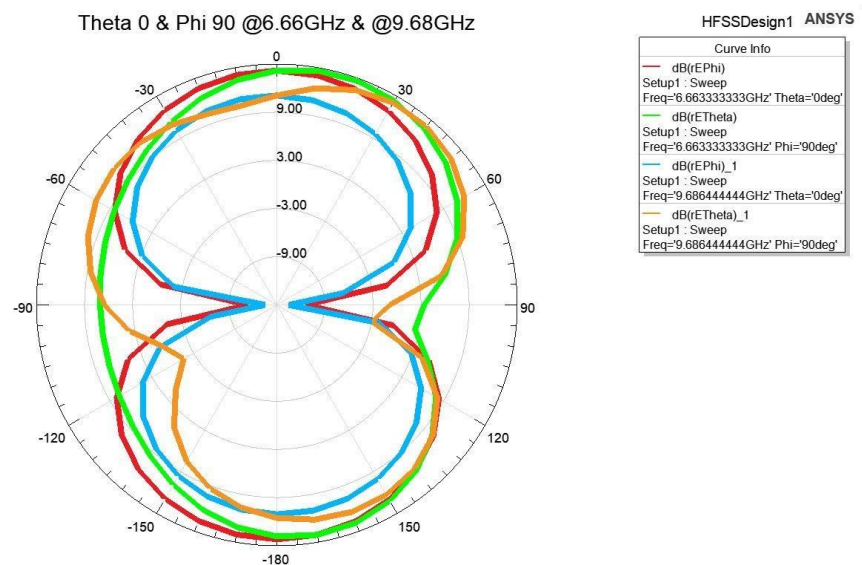
Fig:5.13 : Surface Current

5.14 RADIATION PATTERN

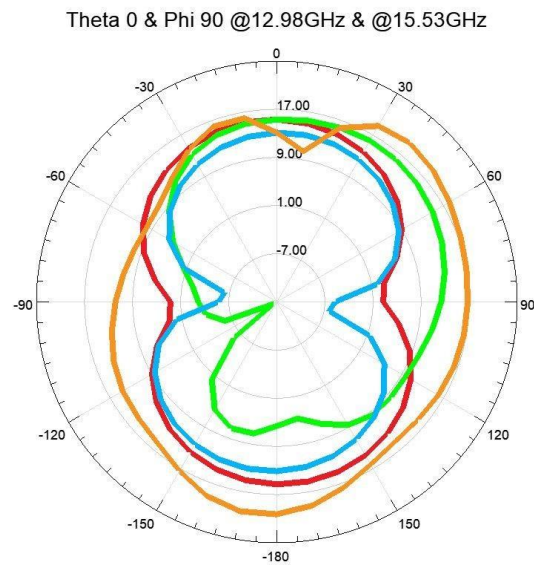
The radio frequency energy from an antenna to another source that is directly dependent is referred to as the solar radiation pattern in the field antenna design (either an antenna pattern or a remote field pattern).

Radiation pattern can be used interchangeably with nearby field pattern or Fresnel pattern, particularly in the fields of fibre optics, lasers, and composite optics. [number four] This implies that it is based on the state of the electromagnetic field in a neighbouring field or in the source's Fresnel region. A plane positioned in front of the well, or over a circular or circular region that encircles it, is the best way to describe a nearby field pattern.

The proximity field pattern, as well as the radiation pattern derived from it, can be identified using a nearby field scanner, or the remote field antenna pattern can be calculated by experimenting with the antenna range. EM Software such as HFSS can also measure the remote radiation pattern from the antenna configuration.



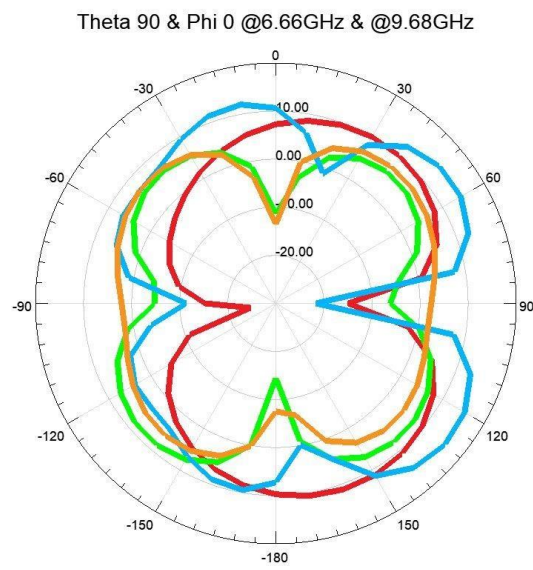
(a)



HFSSDesign1 ANSYS

Curve Info
dB(rEPhi)
Setup1 : Sweep
Freq='12.988GHz' Theta='0deg'
dB(rETheta)
Setup1 : Sweep
Freq='12.988GHz' Phi='90deg'
dB(rEPhi)
Setup1 : Sweep
Freq='15.5377778GHz' Theta='0deg'
dB(rETheta)
Setup1 : Sweep
Freq='15.5377778GHz' Phi='90deg'

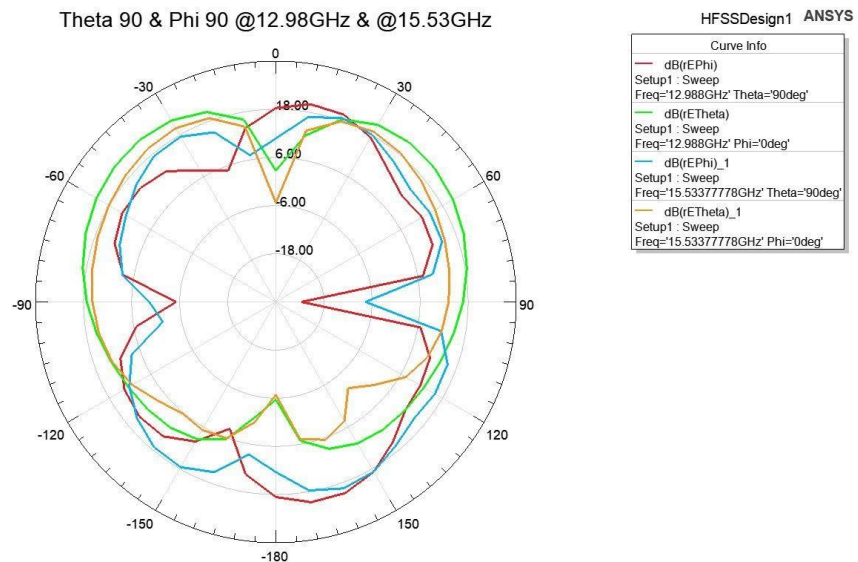
(b)



HFSSDesign1 ANSYS

Curve Info
dB(rEPhi)
Setup1 : Sweep
Freq='6.663333333GHz' Theta='90deg'
dB(rETheta)
Setup1 : Sweep
Freq='6.663333333GHz' Phi='0deg'
dB(rEPhi)_1
Setup1 : Sweep
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dB(rETheta)_1
Setup1 : Sweep
Freq='9.686444444GHz' Phi='0deg'

(c)

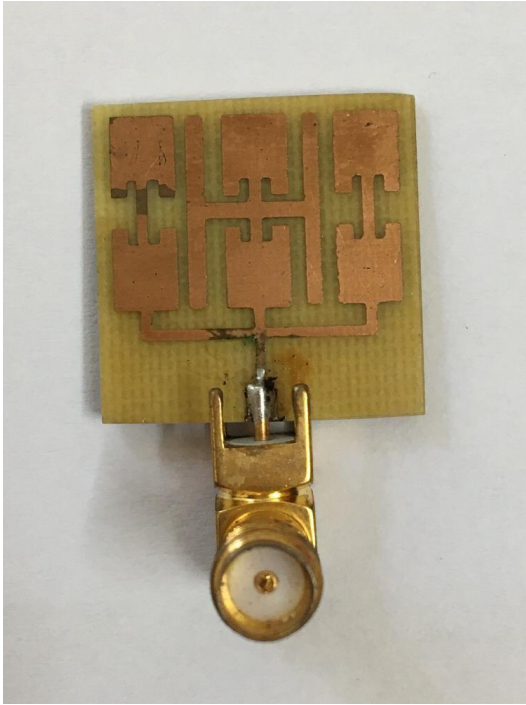


(d)

Fig:5.14 : Radiation Pattern

5.15 FABRICATED ANTENNA DESIGN IMAGES

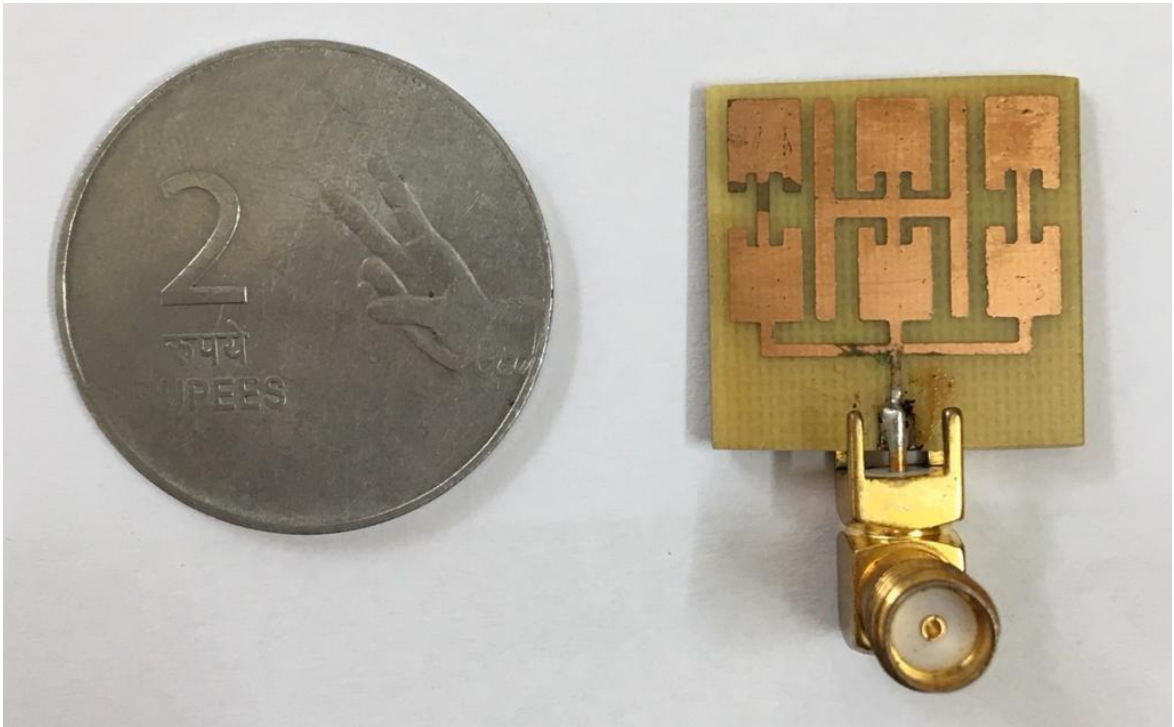
Linear integrated dumbbell shaped antenna have been designed and simulated. Compared to array antenna the efficiency, directivity and gain of triangular antenna have produced much increased value. So we fabricated the dumbbell shaped antenna which is shown in the fig 5.15



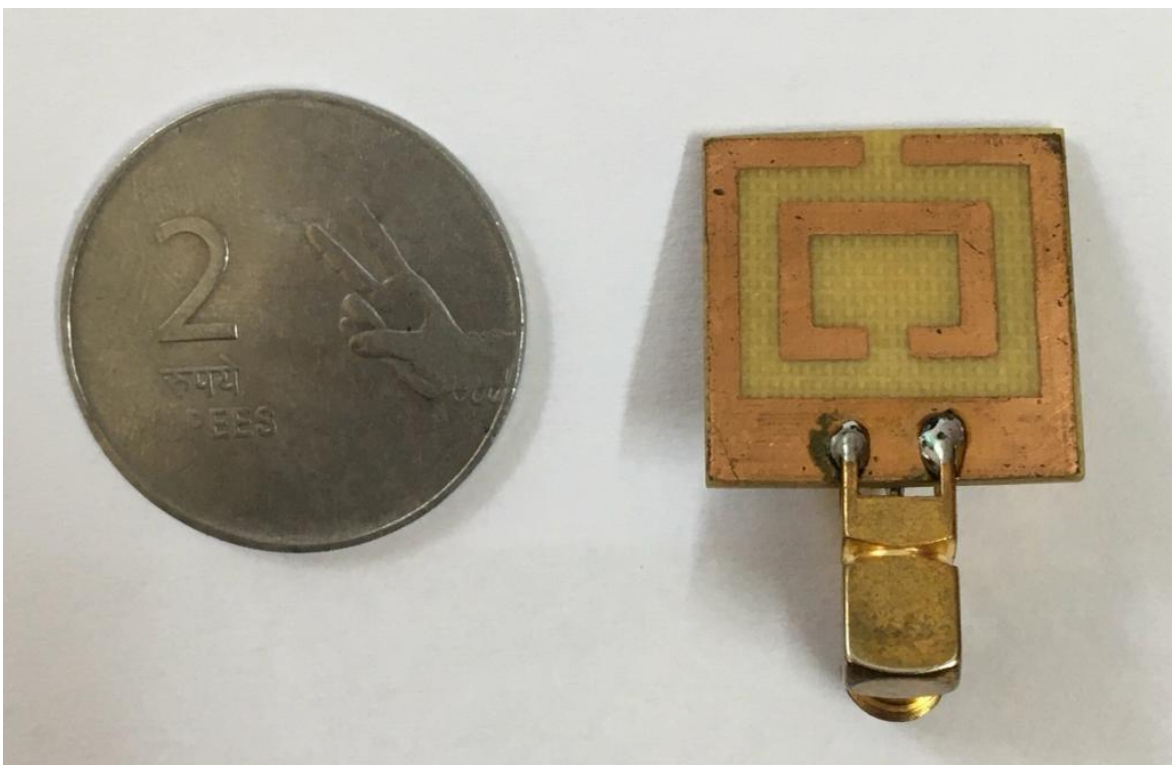
(a)



(b)



(c)



(d)

Figure:5.15 : Front and back of the fabricated design

5.16 TESTING RESULTS

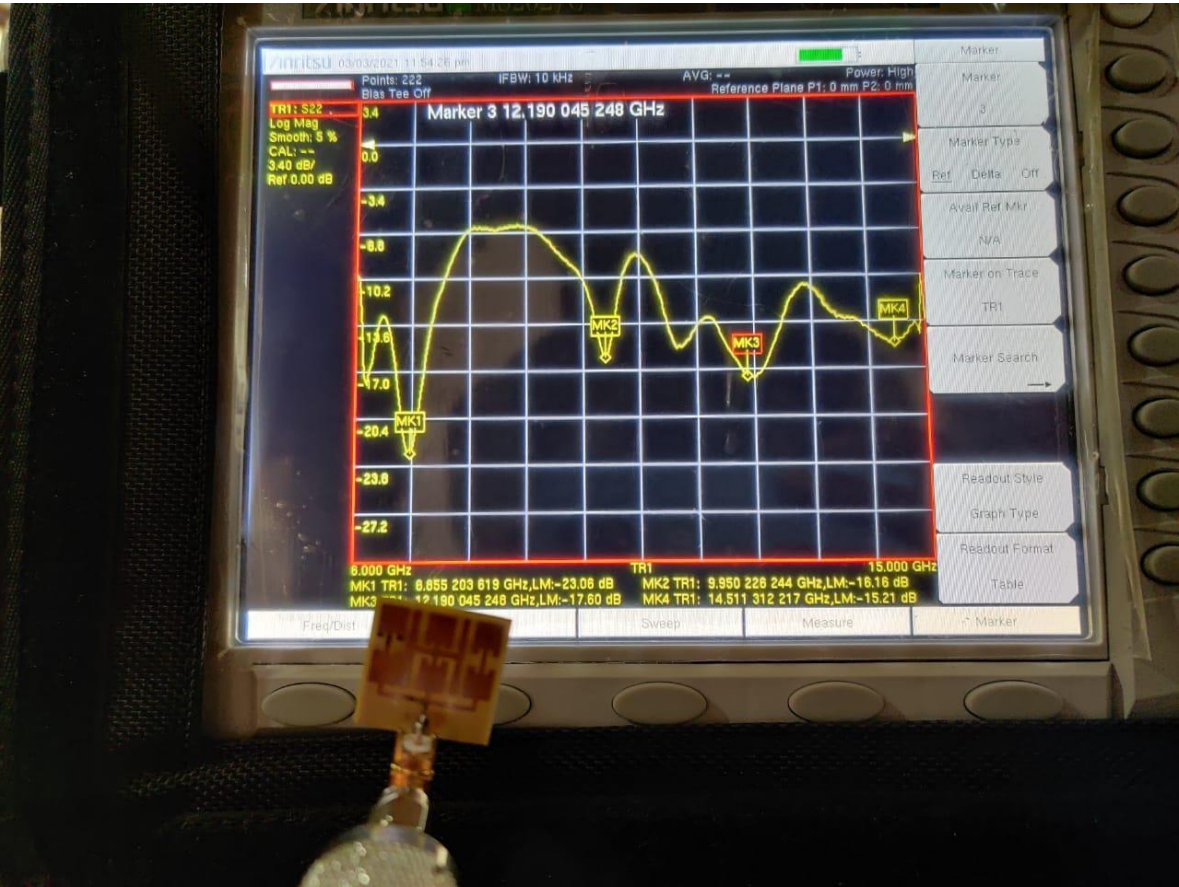


Fig:5.16 : Testing Results

5.17 TESTING VS SIMULATED RESULTS

Table 5.1: Tesiting Vs Simulated Results

TESTING RESULTS	SIMULATED RESULTS
-22.97 GHz	-23.66 GHz
-16.18 GHz	-11.44 GHZ
-17.63 GHz	-15.38 GHz
-15.09 GHz	-24.95 GHz

CHAPTER-6

CONCLUSION

A Microstrip rectangular patch antenna is designed for Air Traffic Management System. The H shaped slots are defected in ground and all this technique contributed for the resonance of frequency at 6.66 GHz, 9.68GHz, 12.98GHz, 15.53GHz respectively. The proposed fractal-based antenna is fabricated and its S11 parameters are measured in Anritsu VNA. The simulated results are closer to that of the measured results so in real time it can transmit the data most efficiently in all the resonated frequency. The existing antenna works in different frequency simultaneously yet does not provide with high gain, directivity, efficiency, VSWR, low loss, and since the stimulated value are closer to the result of real time value, The proposed methodology revealed better performance rate from the analysis. the proposed antenna can be used in all future Air traffic applications.

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DESIGN AND ANALYSIS OF DUMBBELL ARRAY ANTENNA FOR AIR TRAFFIC MANAGEMENT SYSTEM

Submitted in partial fulfilment of the requirements for the award of Bachelor of
Engineering Degree in Electronics and Communication Engineering

By

Aakash. M (37130001)
Augustine. G (37130037)



DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of AAKASH. M (37130001) and AUGUSTINE. G (37130001) who carried out the project entitled “Design and Analysis of Dumbbell Array Antenna for Air Traffic Management System” under our supervision from September 2020 to April 2021.

Internal Guide

Mr. L. Jegan Antony Marcilin, M.Tech.,
Assistant Professor, Department of ECE

Head of the Department

Dr. T. RAVI, M.E., Ph.D.

Submitted for Viva voce examination held on _____

Internal Examiner

External Examiner

DECLARATION

We, **AAKASH. M (37130001)** and **AUGUSTINE.G (37130037)** hereby declare that the Project Report entitled **“DESIGN AND ANALYSIS OF DUMBBELL ARRAY ANTENNA FOR AIR TRAFFIC MANAGEMENT SYSTEM”** done by us under the guidance of **Mr. L. JEGAN ANTONY MARCILIN, M.Tech.,** is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

1)

2)

DATE:

PLACE:

SIGNATURE OF THE CANDIDATES

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We express our gratitude to our parents for their constant encouragement and support for the completion of the project.

ABSTRACT

It is important to design a Linear integrated dumbbell shaped antenna that will be used for future air traffic management applications. To achieve integration in the micro-strip patch antenna, we will use a variety of techniques such as DGS (Low-Level Disability Structure), Meta-material and to get the best benefit from re-loss of the antenna. Items used in compact multiband antenna on FR-4 with allowable value of 4.4. The structure has been updated and analysed using HFSS, which provides a high degree of accuracy in the updated results and the updated antenna will be performed. The field antenna is suitable for synthetic Spindle Radar, internal loss is taken in consideration.

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CHAPTER – 1

INTRODUCTION

1.1 ANTENNA

The device used for transmitting and receiving signals is called an Antenna. Electric waves are frequently referred to as radio waves. The antenna must be connected in a common band to a radio programme to which it is connected, or the reception and/or transmission may be disabled. Most of the antennas work better in small frequency bands because most of them are sound devices.

Receiving wire is an instrument that changes electrical force into radio waves and has a huge occupation in the correspondence systems (the opposite way around). It is used in radio recipient and transmitter transmission. Besides, it applies to radios, TV gathering, radio, satellite correspondences, radar, RFID marks, PDAs, biomedical gadgets, etc

1.1.1 Microstrip Patch Antenna

Micro strip antenna is a kind of inside antenna in which Microwave frequencies make extensive use of them. Micro strip antennas have a low profile. A metal fix mounted at ground level with a di-electric material in the middle is a miniature strip or a fix receiving wire. These are tiny radio wires with low radiation.

1.1.2 Frequency Range Of Patch Antennas

For low-profile applications in frequencies above 100MHz, patch antennas are mainstream.

1.1.3 Working Of Microstrip Patch Antennas

The Microstrip receiving wire comprises of a slim metal strip set in the ground of a plane with a halfway dielectrical material. By photo-etching on the di-electrical material the emanating component and feed lines are put. The square, round or rectangular type of the fix or miniature strip for simple break down and fabricate is typically picked. A micro stripe or patch antenna is shown in the following image. The metal patch is $\lambda/2$ in length. The waves created in the dielectric are reflected

when the radio waves are stimulated and the energy is sent by the edges of the metal fix, which is astoundingly low.

ADVANTAGES

- Light weight.
- Low cost.
- Ease of installation.

DISADVANTAGES

- Inefficient radiation.
- Narrow frequency bandwidth.

APPLICATIONS

- Used in Space craft applications
- Used in Air craft applications
- Used in Low profile antenna applications

These dielectric components have various dielectrical properties which are helpful when the antenna is built and operated. The dielectric substratum should be larger and have a continuous dielectric to achieve antenna efficiency, greater bandwidth and better radiation. A range of methods of feeding are used to supply the patch antenna of the microstrip.

Different microstrip Patch Signaling Methods are used to achieve the best results, such as different shapes and patches and cutting areas.

1.2 FEEDING TECHNIQUE

A feedline is used for quick or unusual contact radiation. There are a couple of different dealing with procedures and four most fundamental methods consolidate microstrip line dealing with, coaxial test, opening affiliation and area.

Dealing with is isolated into two groupings. Dealing with cycles One grants and diverse doesn't pass on. Four sorts of dealing with techniques are available and the coaxial test is composed with the microstrip line, fused opening and area. Line Feed Microstrip: The push string is clearly connected with the edge of the fragment of the

microstrip. The scene is more broad than the line of the pioneer. Feeds can consequently be taken care of with a planetary plan on a comparative substrate. A broke receiving wire is a fractal radio wire, a plan like the working length of a thing that can ingest or send electric radiation in full (on the inside or outside parts). Typical microstrip receiving wires have a single working repeat, a low impedance, a little increment, an immense size, and separating issues. The DGS is known as the concentrated ground spaces or deformations of the microstrip circuit. A fractal receiving wire is a trademark answer for the radio wire issue that works at various frequencies and a diminished size, gotten from the Geometry limit of Benoit Mandelbrot. Nathan Cohen, the originator and CEO of Fractal Antenna Systems, created electric power supply advancement during the 1980s and set up the association in 1995. A destroyed receiving wire is a mechanical contraption that uses a similar arrangement to addition or augmentation the amazing length or line of things which can get or send radiation inside a given domain or volume (in inside parts or outside structures). The first is A defective ground structure is depicted as a hand weight formed plan mounted on a ground plane under a microstrip fix. The DGS unit and the DGS sporadic unit are two pieces of using the DGS work. Numerical conditions of various sorts are embedded on the planet's plane. There are square shape free weight shapes, round free weight shapes, winding shapes, "U", "V", "H", cross and focus rings among the properties. Other problematic species that have been represented join meander lines shape, split resonator and fractal. A bit of these are referred to in this paper including showing procedures.

1.3 OVERVIEW OF WIRELESS COMMUNICATION SYSTEM

Wireless communication, Communication System that transmits signals or data by means of radiofrequency, infrared, microwaves or other types of electromagnetic or acoustic waves. Cell phones, bidirectional radios, remote door garage openers, TV remote controls and GPS receivers are included in the Wireless Devices. Wireless modems, microwave and satellite transmitters provide worldwide access to the Internet. A Wireless XML mark-up (WML) is intended as a transmitter and display for mobile and payment devices for use on such narrow-band devices as cell phones. At the point when the setting permits, remote correspondence focuses don't utilize an electrical conduit as a medium to play out the exchange. Radio

waves are utilized by the most continuous remote advancements. The proposed distances for radio waves can go from a wide scope of fixed, different utilizations of radio remote innovation. Other electromagnetic remote frameworks, like are undeniably more uncommon strategies for accomplishing remote correspondences.

All through the entire presence of correspondences, the explanation "far away" has been utilized twice, each time with a potentially this changed into the standard application. Far away activities draw in associations like adaptable and interplanetary exchanges that would be incomprehensible or senseless to do with is transmission correspondences broadcast exchanges structures that send data without the utilization of wires by utilizing a type of energy (e.g., radio waves, acoustic energy). This technique for data move is utilized for both short and basic distances.

1.3.1 Block Diagram Of A Wireless Communications

A typical Wireless Communication System consists of three components: the Transmitter, the Channel, and the Receiver. The square outline of a remote specialized gadget is appeared in fig. 1.1.

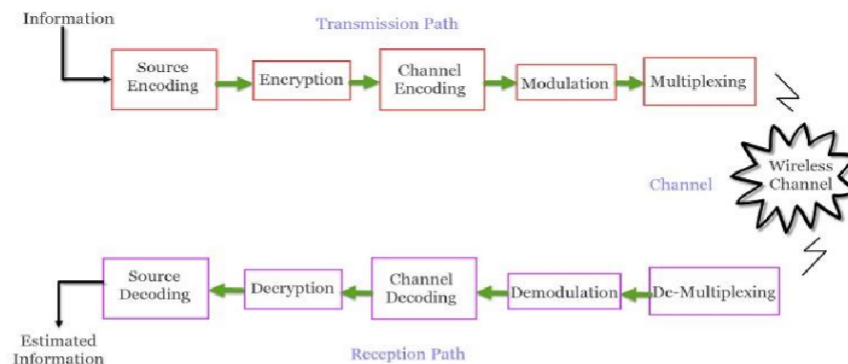


Fig:1.1 : Block diagram of Wireless Communication

THE TRANSMISSION PATH

In this process, redundant signal information is removed to maximise the use of resources. This sign is then encoded utilizing an Encryption Standard to guarantee that the sign and data are shielded from unapproved access. Channel encoding is a signal processing technique that eliminates signal weaknesses such as noise and interference. During this cycle, a modest quantity of excess is acquainted into the sign with make it more commotion safe. The sign is then tweaked utilizing a reasonable receiving wire.

THE CHANNEL.

To share the significant data transmission, the changed sign is multiplexed with different signs utilizing Time Division Multiplexing (TDM) or Frequency Division Multiplexing (FDM).

In Wireless Communication, the channel denotes the signal's transmitting medium, which is open space. A wireless channel is unpredictably unpredictable, as well as highly variable and random in nature.

THE RECEPTION PATH

The recipient has the task of collecting and reproducing the signal on the channel as its source signal. The collector's job is clearly opposite to that of the transmitter, as proven by the parts of the gathering way.

The Channel Decoder is utilized to eliminate excess pieces from the message. The decoding of the sign eliminates the security and converts it to a basic grouping of pieces on the grounds that the message is encoded. At long last, the Source Decoder gets this sign to recover the first sent message or sign.

1.3.2 Characteristics Of Wireless Communication

Talk viability and the district got by a base station are the two critical assortments between the two systems. The fundamental for high talk quality in the cordless application is a result of the receptiveness of got consent in the home and office, comparably as the following direct rivalry with wire-line telephone utilities. The client has no option rather than far off access for a flexible cell application and can be content with the possibility of association that is lower yet satisfactory. Since the base station can be migrated to a steady wire-line section (divider jack) to give distant affiliation access where required, the transmission range in cordless phone applications is limited. The versatile cell base station, then again, should give clients access all through a gigantic geographical space of up to 30 km (20 miles) around the base station. This wide consolidation locale is vital for meet the confirmation of enduring meandering clients financially.

The assorted show up at necessities sway unmistakably the transmission force of the two frameworks and the receiving wire height. High power transmitters found in convenient cell customer sets eat up certainly more power than even the most bewildering sign getting ready gear. As needs be, advanced sign taking care of, similar to talk pressure, voice lead area, botch cure and acknowledgment, and adaptable change, can be used in minimal handsets without basically reducing battery life. Also, such strategies are as per the objectives of expanded region and the help of endless customers with a singular, excessive base station. The high versatile cell base station receiving wires, obviously, present concede spreads that a few enormous degrees more prominent than those seen in cordless phone applications.

The two developments audited above are at farthest edges of the difficult to reach trades range. The instigating PCS structures, explicitly, fall some spot in the two. Regardless, the above relationship shows a piece of the device attributes that should be thought of while looking out for far away correspondence structure access frameworks.

1.3.3 Application For Wireless Antenna

Protection systems, TV remote controls, Wi-Fi, cell phones, wireless power transfer, computer interface interfaces, and other wireless communication-based ventures are examples of wireless communication applications.

CHAPTER-2

LITERATURE SURVEY

Ashkan Abolfathi and Pejman Rezaei.(2018).

This paper plans and investigates a twofold column defective wave radio antenna (LWA) group at X-band using substrate composed waveguide (SIW) advancement subject to TE₂₀ mode. SIW has hand weight shaped openings scratched into it on the different sides. Utilizing these kinds of spaces has expanded the receiving wire's data transfer capacity, with the goal that the proposed radio wire data transfer capacity is somewhere in the range of 9.4 and 14 GHz. Another benefit of this construction is its acceptable increase, appropriate directivity, and radiation productivity, with the radio wire top addition arriving at 12.6 dB at 12 GHz. The CST Microwave Studio software is used to analyse and simulate this antenna.

Ajay K Sharma*, Shyam K Agrawal, Dharmendra S Rajpurohit, Raghvendra Singh and Ashok Mittal.(2006).

For versatile satellite interchanges, a wideband 2x2 planar microstrip radio antenna cluster with double round polarization is introduced. For improved pivotal proportion and impedance transfer speed execution, the essential cluster component is a streamlined askew opened precious stone formed hand weight gap took care of fix radio wire. The enhanced cluster structure accomplishes a 2:1 impedance transmission capacity of 23%, a 3 dB pivotal proportion transfer speed of 19.2%, and a round directivity of 14.2 dBi. Because of the foregoing characteristics.

Rinke Chopra and Girish Kumar. (2017).

A circular compact dumbbell shaped microstrip antenna in normal mode suspended configuration is built in this paper at 2.25 GHz. To restrict the receiving wire's size, two symmetric spaces in the round fix are taken out. To update space estimations, an estimation examination of opening length and width is performed. Maybe than a standard traffic circle microstrip radio wire, the size of the developed receiving wire is diminished by 72%. Different output parameters are compared and evaluated, including gain and bandwidth. Higher order harmonics are suppressed by a small, dumbbell-shaped microstrip antenna. To shield the antenna from the atmosphere

and unwanted interference, a radome and cavity are used. The masterminded decreased arrangement achieves 225 MHz information move limit at 2.25 GHz. This arrangement achieves an apex gain of 7 dBi. With a fundamental side and stable radiation plan in the information move limit, a half-power column width of 90 is cultivated. The antenna is built and the results are measured to ensure that the definition is right.

Debdeep Sarkar and Kumar Vaibhav Srivastava. (2018).

To achieve miniaturisation, Multiband efficiency refers to the combining of two narrow bands to gain increased bandwidth in the higher frequency range. The proposed receiving wire's arrangement technique is explained using Ansys HFSS reenactments, which look at its impedance move speed, equivalent coupling, replicated 3D radiation models, and surface current scattering features. In a uniform multiplication circumstance, the proposed MIMO receiving wire has amazing assortment profitability extent of under . In the indoor Gaussian inducing environment a wide extent of circumstance limits is furthermore checked for the generosity of the proposed MIMO radio wire

Hong-Dean Chen, Yuan-Chung Tsai, Chow-Yen-Desmond Sim and Colin Kuo.(2020).

A broadband 5G New Radio (5G NR) receiving wire show is proposed for PDA metal bundling applications. The MIMO receiving wire display is molded by embeddings eight unclear radio wires (Ant1Ant8) into the PDA's metal edge, achieving a 8-radio wire bunch for the sub-6GHz 8-receiving wire structure. Each radio wire part is a space receiving wire with a L-molded open opening and a 50 with phenomenal arranging recurrent band accomplished by stacking a tuning stub onto the feed line. The proposed 8-receiving wire show's 10-dB impedance move speed . comparatively as the band. Near showing a 50–82 percent receiving wire productivity, The partitions between associating bundle fragments are additionally > 12-dB, with an ECC of 0.11. The proposed 8-receiving wire bundle applied to a 8 x 8 MIMO gadget has a deliberate zenith channel limit of 43.93 bps/Hz at 20 dB SNR.

Demos Serghiou, Mohsen Khalily, Vikrant Singh, Ali Araghi, Rahim Tafazolli. (2020).

we present a dual-band 8x MIMO antenna for future 5G multiple-input multiple-output (MIMO) smartphones application is shown. The plan comprises of a completely grounded plane with firmly separated symmetrical sets of radio wires put evenly along the cell phone's long edges and corners. The symmetrical sets unbiased to lessen common in the two groups. Every receiving wire unit is comprised of a 17.855 mm² collapsed monopole that can work in the low band . The receiving wire model was tried and found to have great all out exhibition. At long last, the receiving wire's buyer impacts

Naser Ojaroudi Parchin, Yasir I. A. Al-Yasir, Ahmed M. Abdulkhaleq, Haleh jahanbakhsh Basherlou , Atta Ullah , and Raed A. Abd-Alhameed.(2020).

The proposed design provides ample efficiencies, strong isolation, and dual-polarized maximum radiation coverage. Accordingly, the proposed 5G radio wire engineering comprises of a sum of four evenly energized and four vertically enraptured receiving wire segments. The mainboard substrate is made of a minimal effort FR-4 substrate with a surface space of 75150 mm².

Rezaul Azim , AKM Moinul H. Meaze, Adnan Affandi, Md Mottahir Alam , Rumi Aktar, Md S. Mia, Touhidul Alam, Md Samsuzzaman and Mohammad T. Islam. (2020).

A position of safety multi-opened fix radio wire for long haul advancement (LTE) and fifth-age (5G) network applications is introduced in this paper. A ventured fix and a ground plane were utilized in the investigation. Three spaces have been embedded inside the fix to accomplish the necessary working band. The expansion of the spaces improves the capacitive impact and permits the model radio wire to work in the range. The receiving wire introduced has omnidirectional designs, great increases, and execution, and is sufficiently little to be utilized for remote constancy (WiFi), remote neighborhood correspondence.

Ang Yu and Xuexia Zhang.(2013).

In this letter, the transmission coefficient S_{21} between the components of a twofold component microstrip receiving wire exhibit embedded with a recently framed electromagnetic band hole (EBG) structure is decreased by around 4 dB, and the addition was expanded by 1 dB, with no improvement in different qualities. It has been exhibited that utilizing the EBG construction to improve the productivity of a radio wire cluster is a basic and viable strategy.

Sheng-Jie Guo, Lin-Sheng Wu and Jun-Fa Mao.(2019).

A wideband microstrip-tuned dielectric resonator antenna (DRA) cluster with surrendered ground structure (DGS) is exhibited in this paper. The impedance transfer speed of a 22 DRA cluster tuned by equal microstrip lines is additionally expanded by adding four hand weight formed DGS units on the ground plane. The exhibit with DGS has a more extensive impedance transmission capacity of 30.4 percent, which is around 11.5 percent more noteworthy than the broadening the array's bandwidth is investigated. Furthermore, the DGS's effects.

Subhradeep Chakraborty, Abhijyoti Ghosh, Sudipta Chattopadhyay and L. Lolit Kumar Singh.(2016).

Hypothetically and tentatively, a rectangular fix with an abandoned fix surface as a free weight has been concentrated to expand polarization immaculateness over a huge precise reach and impedance transfer speed. Over the of more than 30 dB is obtained with a high impedance bandwidth. Furthermore, current structure is free of back radiation and can effectively suppress. The current framework and straightforward to build. With the current framework, the current investigation offers an informative, visualization-based interpretation of parallel changes.

Ang YU and Xuexia Zhang.(2009).

It was feasible to make a position of safety monopole receiving wire with a novel DEBG structure. Around 5.2 GHz, the DEBG structure is like an attractive divider. While working at 4.9-5.15 GHz, the receiving wire can be arranged basically 1.5 mm over the DEBG field. In the H plane and E plane, the expansion has been

extended by 6.5 dB and 5.7 dB, separately. By embeddings a superstrate, as far as possible can be extended while the expansion improvement is kept up.

Abdessamad Jarrar and Youssef Balouki.(2018).

Inferable from the giant number of models, the aeronautics authority framework in air terminals is perhaps the most confusing plans the heads. We recommend joins the chance of air terminal rule and the standard decisions to help engineers in masterminding a particularly unusual system. This model is built system, which relies upon set speculation and thinks about the check of theories. furthermore established on refinement, which includes beginning with a hypothetical model and consistently improving it. It has completed in different transportation systems and has been found to be without bug. This helps us with using it in this crucial construction to ensure that bugs are missing and that the model is right.

CHAPTER-3

EXISTING METHODOLOGY

The Existing Methodology is about a low-profile, Wideband, dipole-Patch antenna with a printed dipole and four coupled microstrip patch. Which is housed in a Single-Substrate integrated-wavelength cavity, is two vias located on opposite side of a dumbbell shaped aperture. It operates from 22.3 to 32.1 GHz for SWR 2 with a peak gain of 9.6 dBi, a low crosspolarisation level of less than -25dB. Its thickness is just $0.071\lambda_0$, λ_0 free-space wavelength at the 27.2 GHz centre frequency. To validate the elements's property. The antenna is designed, fabricated and measured With sidelobe and cross-polarization levels below -17 dB and -22 dB, the measured E- and H-plane radiation patterns are stable across the operating band.

DRAWBACKS

- Dual-substrate.
- Size and thickness is more.
- Return loss is less.

CHAPTER-4

PROPOSED METHODOLOGY

The proposed methodology is about to design an antenna for air trafficking management system with high gain and efficiency, using ANSYS Software and will be fabricated in FR4 epoxy Material.

- A monopole microstrip rectangular patch with dumbbell shape slotted on ground for multiple band, enhance the bandwidth.
- The antenna is fabricated on FR 4 epoxy material with electrical permittivity of 4.4 and magnetic permeability 1.
- The reflection coefficient (S_{11}), radiation characteristics, peak gain and VSWR of designed antenna are described.
- The antenna structure is going to be stimulated and analyzed using ANSYS HFSS v19.2 which gives high accuracy rate in stimulated results and is going to be fabricated once stimulation gets over.

ADVANTAGES

- Single-substrate.
- Size and thickness is less.
- Return loss is more.
- Communication without any loss.
- High gain and high directivity capability.
- Low power consumption in real time.
- High system gain and efficiency.
- Low cost.

4. 1 HARDWARE REQUIRED:

- Substrate Material (FR-4 epoxy material)
- SMA connector (50 Ohm impedance)
- Copper (for patch and ground)
- Vector Network Analyser.

4.1.1 Substrate Material

For most PCB applications, FR4 epoxy glass substrates are the preferred material. With creation of more microwave frameworks focused on shopper markets, there is a developing revenue in bringing down the expense of these frameworks. Utilizing FR4 rather than costly PTFE-based substrates for microwave circuits and receiving wires could bring about tremendous expense investment funds. This paper portrays a program of work did at ERA Technology as a feature of its Membership Research Program to assess the properties of this material at microwave frequencies going from 1 GHz to 15 GHz. Because of its high misfortunes, it is inferred that the utilization of FR4 for radio wire taking care of designs is probably not going to be reasonable. Nonetheless, for high thickness microwave circuits with short way lengths and broadband radio wire components with lower misfortunes and supreme dielectric consistent qualities, the material could be utilized instead of more conventional microwave substrate materials, bringing about massive expense reserve funds. A multi-facet PCB fit for moving advanced signs at high rates in the high recurrence area is needed to give a high velocity network climate fit for dealing with an enormous volume of information.

4.1.2 SMA Connector

The SMA connector is a semi-precision sub-more modest than ordinary RF and microwave connector that is comprehensively used, particularly for RF relationship inside electronic structures at frequencies up to 18 GHz and now and again higher. The SMA connector is open in an arrangement of setups, including male, female, straight, right-determined, bulkhead fitting, and various others, allowing it to meet the greater part of necessities. Its sub-smaller than expected size additionally permits it to be utilized in moderately little electronic hardware. Albeit the SMA connector is currently grounded, its utilization is probably going to grow as numerous new RF frameworks see their working frequencies broaden all the way into the microwave locale. SMA connectors are intended to have a consistent impedance of 50 ohms across the connector. Albeit a few renditions have top frequencies of 12.4 GHz, a few less and some are determined up to 24 or 26.5 GHz,

SMA connectors were initially planned and indicated for activity up to 18 GHz. Higher recurrence top cutoff points may require a better yield misfortune.

The SMA connector utilizes a 1/4-inch distance across, a day and a half for each inch strung barrel. It is appeared in fig 4.1.

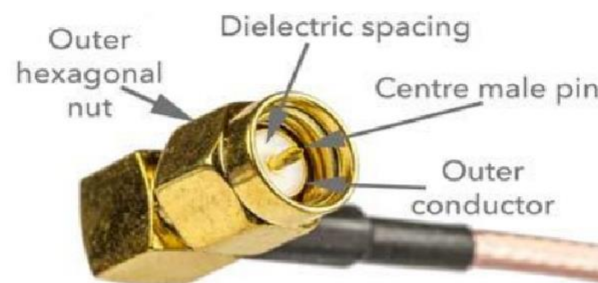


Fig:4.1 : SMA Connector

Different Connectors:



Fig:4.2 : Different Connectors

4.1.3 Vector Network Analyzer

A Vector Network Analyzer has a source that creates a realized upgrade signal and a bunch of collectors that recognize changes in this boost brought about by the gadget under-test or DUT.

The improvement signal is infused into the DUT, and the Vector Network Analyzer estimates both the reflected sign from the info side and the sign that goes through to the DUT's yield side. The subsequent signs are estimated and contrasted with the realized boost signal by the Vector Network Analyzer collectors. The deliberate outcomes are then handled by an inside or outer PC and showed on a screen. Vector Network Analyzers take two sorts of estimations: transmission and reflection. Transmission estimations send the Vector Network Analyzer boost signal through the gadget under test, where it is estimated by the Vector Network Analyzer recipients on the opposite end. S_{21} and S_{12} are the most usually estimated transmission S-boundaries (S_{xy} for more than 2-ports). Transmission estimations, for example, cleared force estimations, are a kind of transmission estimation. Gain, addition misfortune/stage, electrical length/deferral, and gathering delay are some other transmission estimations. Reflection estimations, then again, measure the segment of the VNA upgrade signal that strikes the DUT however doesn't go through it. The reflection estimation, then again, measures the sign that movements back towards the source because of reflections.



Fig:4.3 : Vector Network Analyzer

4.1.4 Antenna Design

Receiving wires can be intended to communicate and get radio waves in all level ways similarly (omnidirectional receiving wires), or specially a specific way (directional, or high-gain, or "shaft" receiving wires). It is appeared in fig 4.3 and 4.4

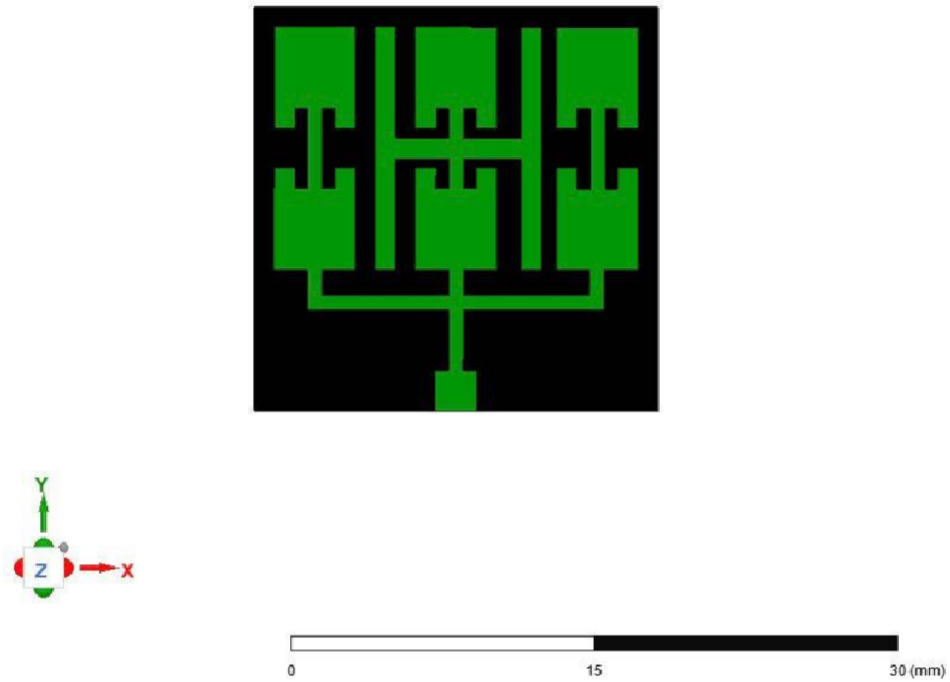


Fig:4.4 : Design of Antenna

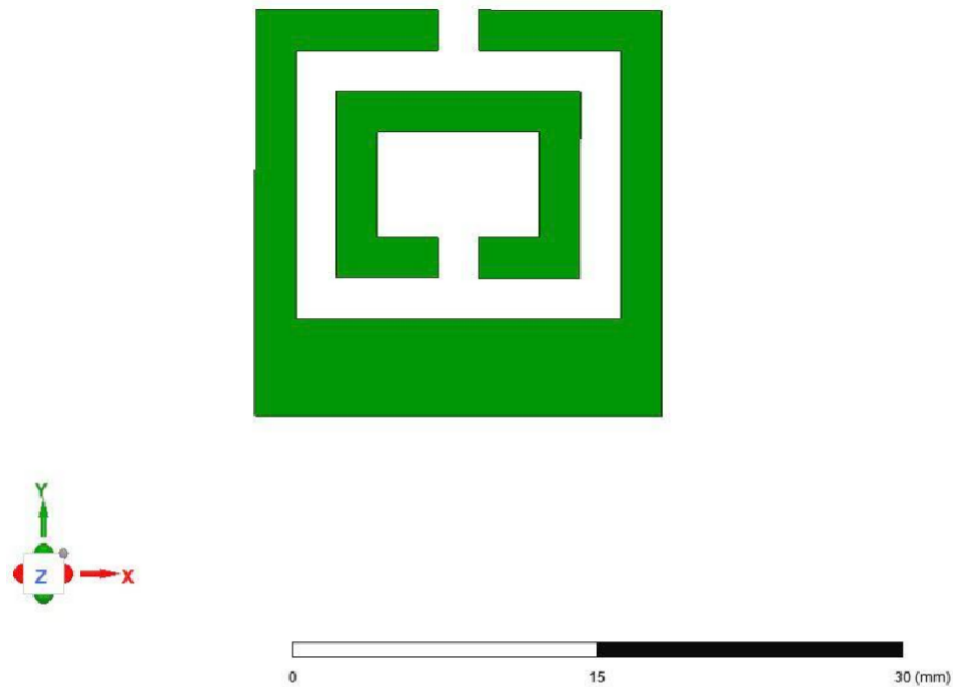


Fig:4.5 : Ground design of Antenna

DGS refers to the combined geometric spaces embedded in the ground structure of a microwave circuit. As a result, DGS refers to the periodic and/or aperiodic paralysis that is concentrated in the ground structure of the plane microwave circuit. Previously, PBG, EBG, and DGS comparisons are shown. A plane transmission line, such as a microstrip or a coplanar wave guide, is used to incorporate the DGS into the earth's surface. Flight errors disrupt the aircraft's current distribution; interference changes the feature of the transmission line by adding other components slots. On the other hand, any deformity recorded on the plane below the microstrip line changes the power and efficiency of the microstrip line by increasing the slot resistance and strength of the line. Capacitance and inductance are terms used to explain the sum of capacitance and inductance Occasional Defective Ground Structure planar microwave circuits are very appealing to microwave researchers. Microstrip lines with DGS: bandpass filters and low passar

filters were implemented on a regular basis. A high degree of slow motion with high levels of miniaturisation is achieved by using the events of a temporary structure. The status of the Defective Ground Structure unit, the distance between two Defective Ground Structure units, and the dispensation of different DGS are all important factors that affect how the DGS appears over time. An intermittent DGS (HPDGS) and an intermittent DGS (IDGS) are generated by combining two DGS sessions (VPDGS).

4.1.5 Software

The Software we use of simulation is ANSYS HFSS simulation tool as its accuracy rate is is ~98%. HFSS (High Frequency Structure Simulator) utilizes adaptable solvers and an instinctive GUI to give you unrivaled effectiveness and profound knowledge into the entirety of your 3D EM issues. HFSS gives an amazing and complete Multiphysics examination of electronic items through mix with Ansys warm, underlying, and liquid elements instruments, guaranteeing their warm and primary unwavering quality. In view of its programmed versatile lattice strategy and modern solvers, HFSS is inseparable from best quality level exactness and dependability for handling 3D EM challenges, which can be sped up by elite processing (HPC) innovation.

CHAPTER-5

RESULT & ANALYSIS

In this chapter Various parameters of the proposed fractal antenna are discussed and analyzed by simulating it with the help of HFSS software.

- Return Loss.
- Voltage Standing Wave Ratio.
- Impedance Plot.
- Antenna Gain.
- Directivity.
- Peak Gain.
- Radiated Power.
- Front to Back Ratio.
- Accepted Power.
- Radiation Efficiency.
- Radiation Intensity.
- Specific Absorption Rate (SAR)
- Surface Current.
- Radiation Pattern.

5.1 RETURN LOSS

The receiving wire's Return Loss is a number that addresses the quantity of radio waves that arrive at the radio wire establishment yet are dismissed as an action when contrasted with the satisfactory ones. Determined in decibels (dB) in contrast with a short out. Investigate the receiving wire utilized in transmission mode. Figure 5.1. Therefore, some radio waves will be shown and sent down the transmission line from the receiving wire input spine association. The rest of be taken care of into the framework. Notwithstanding, any blemishes in the feed framework will bring about few occasion radio waves being reflected back to the info side.

The animated outcome from the proposed radio wire for 6 distinctive recurrence are 6.66 GHz - 23.6655, 9.68 GHz - 11.4434, 12.98 GHz - 15.3875, 15.53 GHz - 24.9507, it tends to be appeared in fig 5.1.

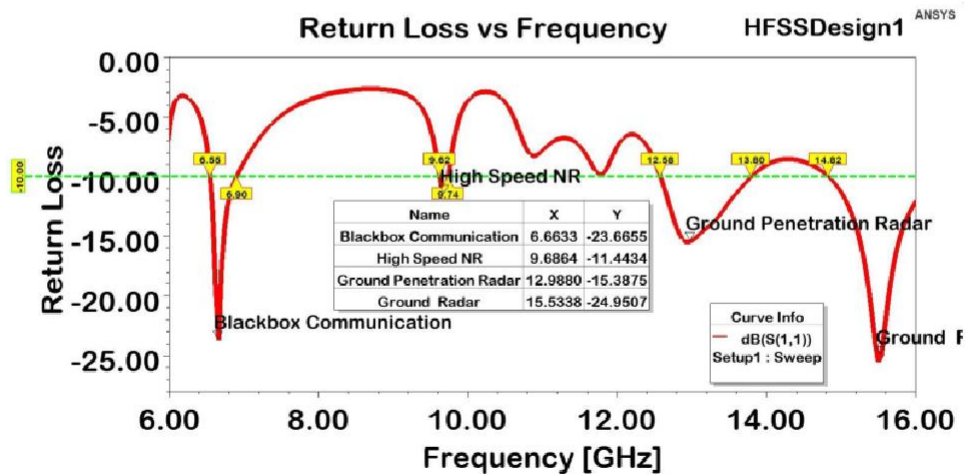


Fig:5.1 : Return Loss

5.2 VOLTAGE STANDING WAVE RATIO (VSWR)

The Voltage Standing Wave Ratio (VSWR) is an alternate method of portraying Return Loss. The genuine voltages created inside the transmission framework where radio waves are voyaging and showing simultaneously are alluded to as VSWR. Albeit static waves and VSWR are significant, VSWR hypotheses and insights can frequently cloud what is really going on. Luckily, it is feasible to acquire a decent comprehension of the subject without diving too profoundly into the idea of VSWR. For most receiving wire frameworks, a VSWR estimation of under 2 years is suitable. Figure 5.2 shows it.

The animated Voltage Standing Wave Ratio result from the proposed radio wire are 6.62 GHz - 1.2360, 9.68 GHz - 1.7315, 12.86 GHz – 1.4203, 15.45 GHz – 1.1341. it is appeared in fig 5.2.

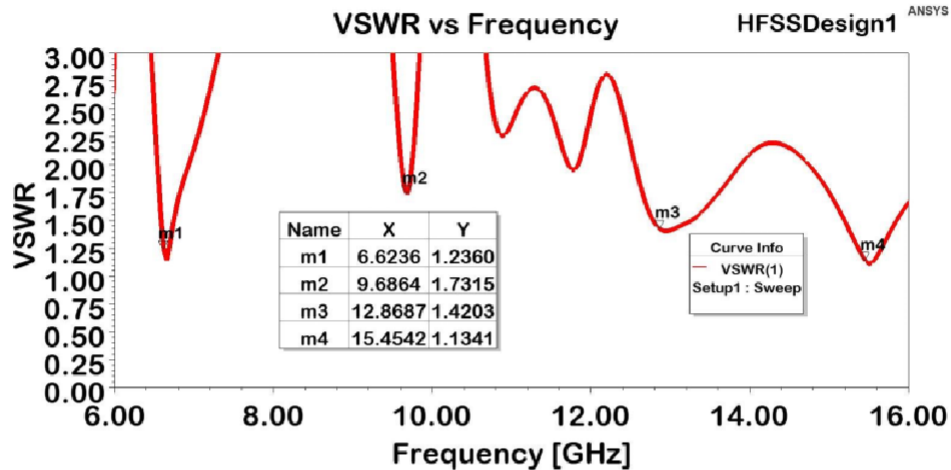


Fig:5.2 : Voltage Standing Wave Ratio

5.3 IMPEDANCE PLOT

The impedance connects the voltage and current of the receiving wire's info. The energy transmitted from a good ways or implanted inside the receiving wire is addressed by the radio wire's genuine impedance divide. The energy put away in the closest radio wire field is addressed by the theoretical bit of the impedance. Figure 3.3 portrays this. The impedance of surveying the port's flow electrical force. The receiving wire impedance is dictated by contrasting the current in the port with the phasor voltage, which is 1V at a 0 deg point.

The size of the radio wire establishment impedance is dictated by the recurrence. Over the recurrence scope of 20-120 MHz, the construction portrays the info impedance of a dipole radio wire. The recurrence of reaction opposition shifts. As far as reverberation, contrasts can be precisely portrayed.

The impedance plot of the proposed radio wire are 6.62 GHz – 0.8382+0.1076i, 9.68 GHz – 0.9861-0.5519i, 12.86 GHz – 0.7042-0.0070i, 15.45 GHz – 0.9122+0.0822i. The referenced invigorated outcomes are appeared in a smith outline in fig 5.3

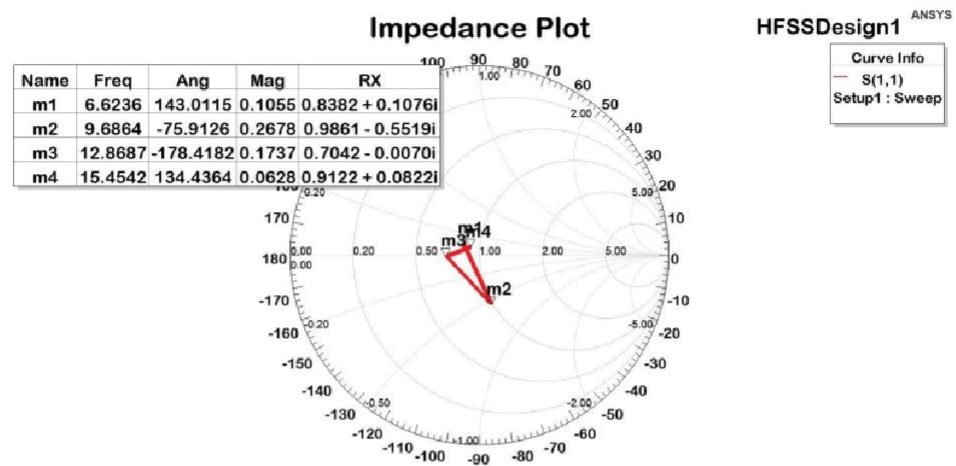


Fig 5.3 Impedance Plot.

5.4 ANTENNA GAIN

The receiving wire acquire is regularly characterized as the proportion of radio wire produced power from a distant field source to the radio wire hub pivot to the force created by isotropic receiving wires, which is similarly delicate to signals from all markers. first Decibel-isotropic units are utilized to address this estimation, which is normally communicated in decibels (dBi). An alternate depiction stands out the force got from the force acquired from a non-lost dipole receiving wire, with the units composed as dB. Radio wire acquire indicates how incredible a receiving wire sign will send or get a particular way. The advantage is controlled by looking at the appraised power communicated or got by the receiving wire a specific way to the force moved or got by an appropriate radio wire in a similar condition. Figure 5.4

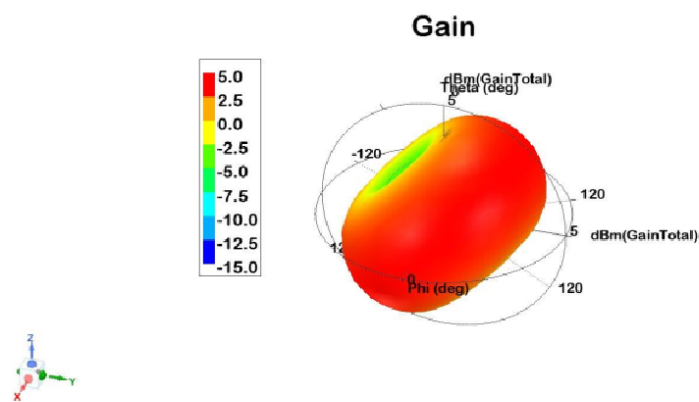


Figure:5.4 : Gain

5.5 DIRECTIVITY

The centralization of the receiving wire radiation design on one side is estimated by directivity. In db, the way is appeared. The heading's tallness is extremely fixated or zeroed in on a wooden bar. The shaft will keep on voyaging if the way is solid It is the constraint of the greatness of the radiation on a given side of the receiving wire every which way to the restricted radiation potential (IEEE 1993). The complete force delivered by the radio wire partitioned by 4π is the same radiation power. In db, the way is appeared. The heading's stature is exceptionally fixated or zeroed in on a wooden pillar. The pillar will keep on voyaging if the way is solid. A receiving wire that is consistently enlightened every which way can act naturally coordinated and have just a single course (0 dB). The directivity of the proposed radio wire is 2.5dB. It is appeared in fig 5.5.

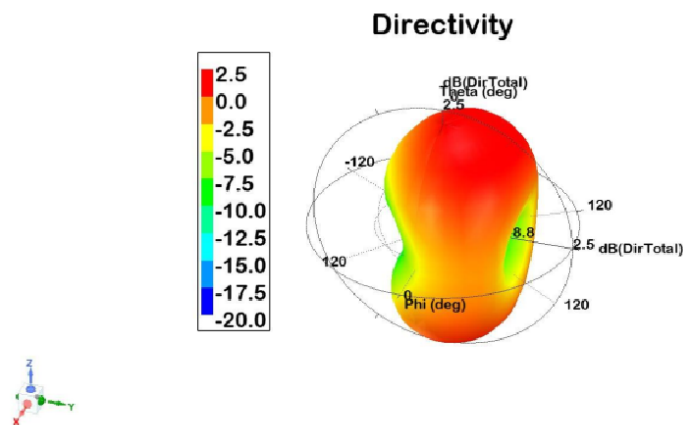


Fig:5.5 : Directivity

5.7 RADIATED POWER

The measure of force that would need to be provided to the satellite's radio wire on the off chance that it emanated correspondingly every which way. A standard satellite transmitter yield force would be marginally in excess of 3,000 watts if the satellite's recieving wire emanated uniformly every which way. This is not really reasonable, however the satellite doesn't have to communicate its sign every which way. Everything necessary is to convey a message toward the segment of the earth that will get it. The force required on the satellite is drastically decreased by gathering power around there. The transmitted force of the proposed radio wire are appeared in fig 5.7.

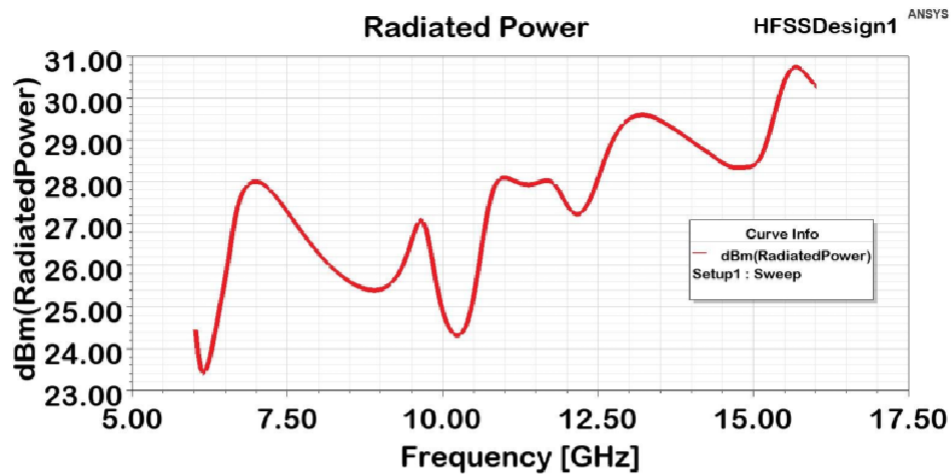


Fig:5.7 : Radiated Power

5.8 FRONT TO BACK RATIO

A receiving wire's Front to Back Ratio (F/B Ratio) is the extent of force emanated in the front/fundamental radiation flap to control transmitted the other way (180 degrees from the principle shaft).

$$\text{Front to Back ratio} = \frac{\text{Fordward Power (F)}}{\text{Backward Power (B)}}$$

This proportion, which is normally communicated in decibels, advises us how much in reverse radiation there is. In circumstances where obstruction or inclusion the converse way should be decreased, this boundary is basic. Figure 5.8 depicts it

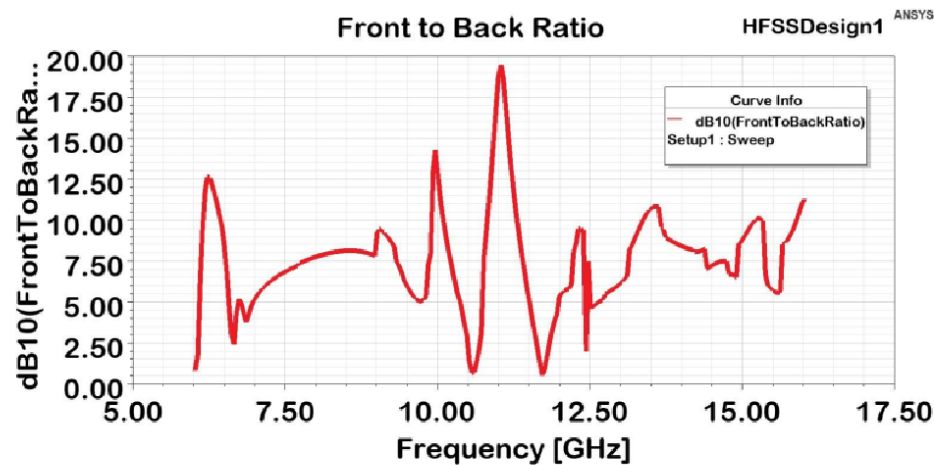


Fig:5.8 : Front to Back Ratio

5.9 ACCEPTED POWER

There would be no reflections and therefore no mismatch loss on a transmission line that is correctly terminated, that is, terminated with the same impedance as the transmission line's characteristic. The amount of power lost in the system is referred to as mismatch failure. It's also the amount of power obtained if the system's components were perfectly balanced. Impedance matching is an important part of RF device design, but there will almost certainly be some mismatch failure in practise. Mismatch loss causes relatively little loss in real systems, usually on the order of 1dB. It is shown in fig 5.9.

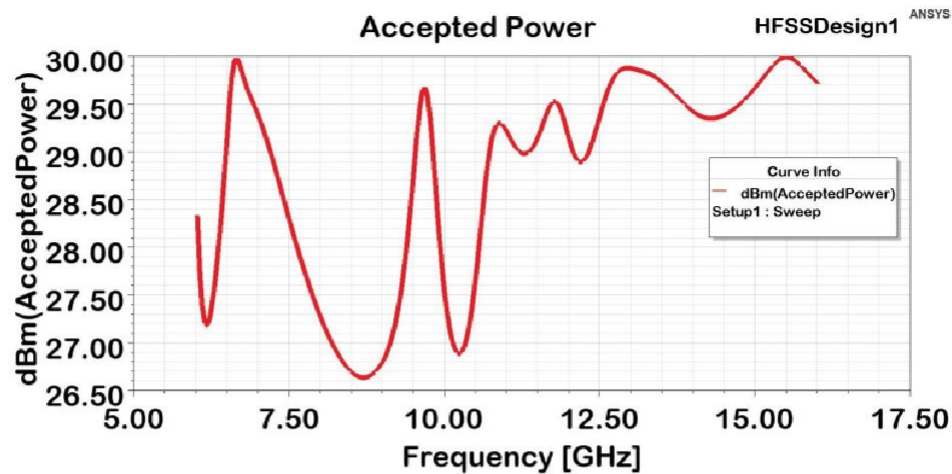


Fig:5.9 : Accepted power

5.10 RADIATION EFFICIENCY

The expression "receiving wire proficiency" is frequently utilized in radio wire hypothesis to allude to radiation productivity. With regards to radio wires, the expression "proficiency" is frequently utilized. It is a computation of a radio receiving wire's electrical effectiveness in changing the radio-recurrence power got at its terminals into transmitted force. Likewise, it characterizes the extent of the radio wave's force caught by the receiving wire that is eventually communicated as an electrical sign in a getting radio wire. It ought not be mistaken for gap quality, which alludes to radio wires with gaps, like the illustrative reflector. It is appeared in fig 5.10.

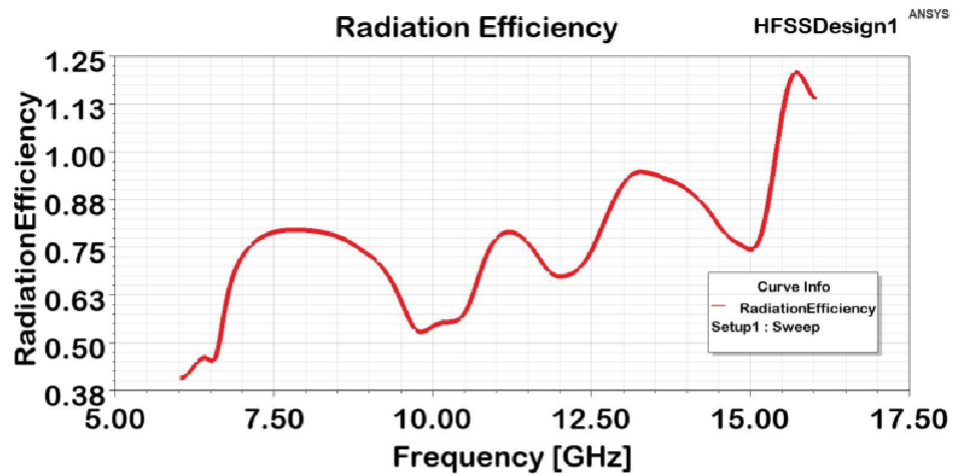


Fig:5.10 : Radiation Efficiency

5.11 RADIATION INTENSITY

The power radiated from an antenna for each unit strong point is known as the radiation power, or receiving wire power design, in a provided guidance. Radiation force is a far-field boundary that is determined by increasing the radiation power thickness by the square size. It is shown in fig 5.11.

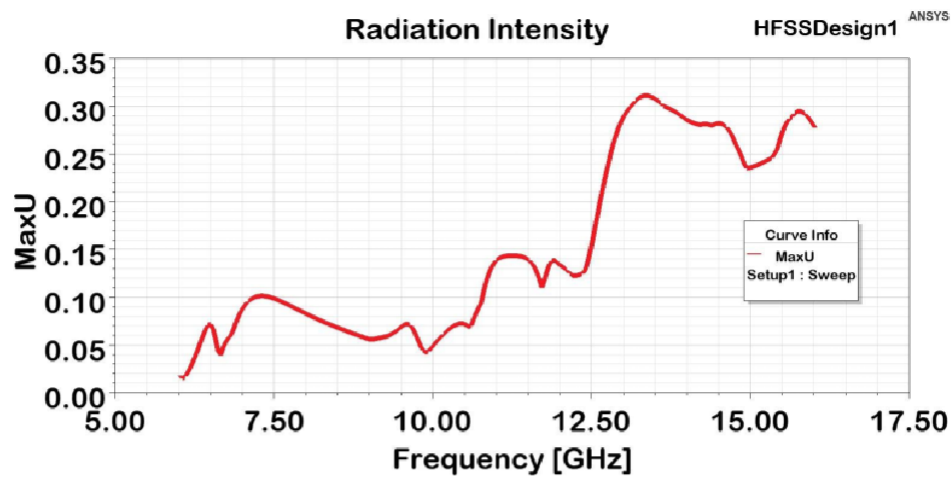


Fig.5.11 : Radiation Intensity

5.12 SPECIFIC ABSORPTION RATE (SAR)

The particular retention rate (SAR) is an estimation of the most extreme measure of EM radiation that a correspondence radio wire in a remote framework can transmit. At the point when SAR is excessively high, recieving wire communicate power is decreased. When exposed to a radio recurrence electromagnetic field, it is a proportion of the rate at which energy is consumed by the human body. It is estimated in watts per kilogram (W/kg) and is characterized as the force assimilate

per mass of tissue. It is appeared in fig 5.12.

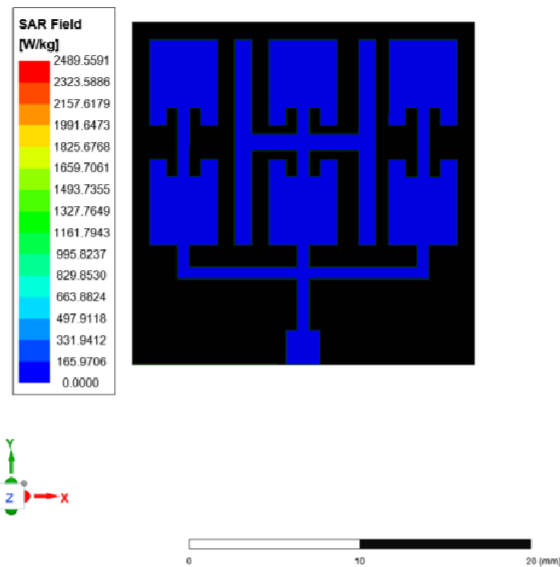


Fig:5.12 : SAR

5.13 SURFACE CURRENT

An applied electromagnetic field generates an actual electric current in the surface current antenna. The letter J is used to represent the surface current. The electric flow per cross sectional territory at a given point in space is characterized as the greatness of the surface flow thickness. The current thickness is the volume of charge coursing through a unit space of a picked cross area for each unit time. The surface current density is measured in amperes per square metre, which is a SI unit. It is shown in fig 5.13.

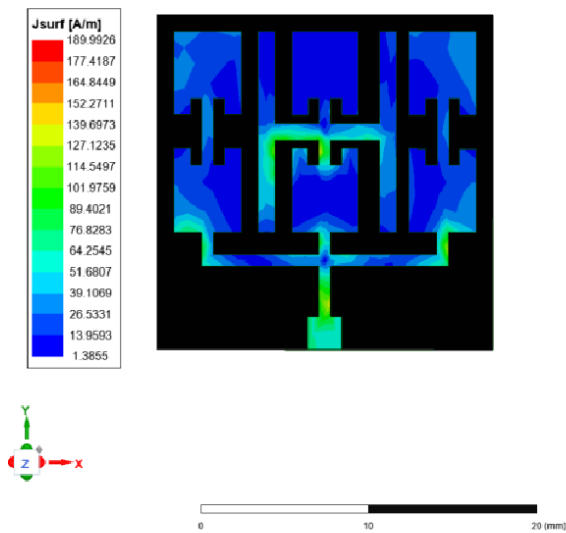


Fig:5.13 : Surface Current

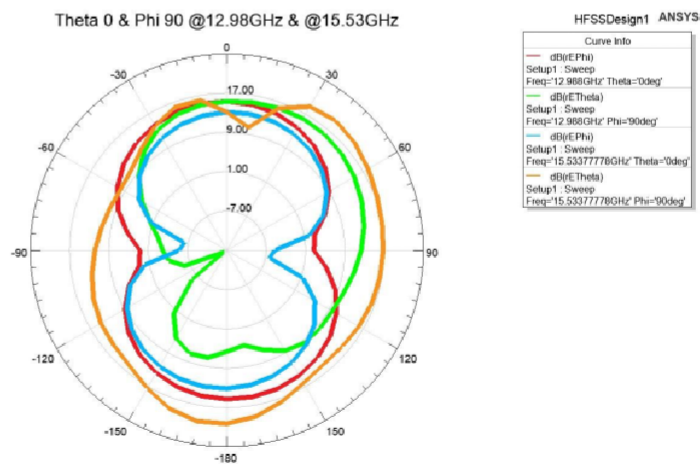
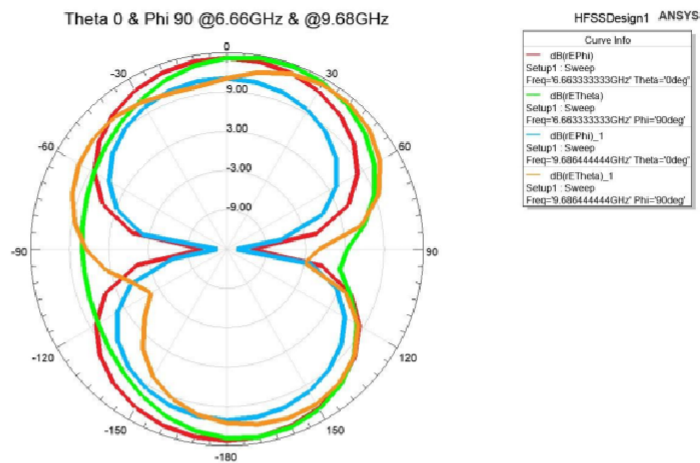
5.14 RADIATION PATTERN

The radio frequency energy from an antenna to another source that is directly dependent is referred to as the solar radiation pattern in the field antenna design (either an antenna pattern or a remote field pattern).

Radiation pattern can be used interchangeably with nearby field pattern or Fresnel pattern, particularly in the fields of fibre optics, lasers, and composite optics. [number four] This implies that it is based on the state of the electromagnetic field in a neighbouring field or in the source's Fresnel region. A plane positioned in front of the well, or over a circular or circular region that encircles it, is the best way to describe a nearby field pattern.

The proximity field pattern, as well as the radiation pattern derived from it, can be identified using a nearby field scanner, or the remote field antenna pattern can be

calculated by experimenting with the antenna range. EM Software such as HFSS can also measure the remote radiation pattern from the antenna configuration.



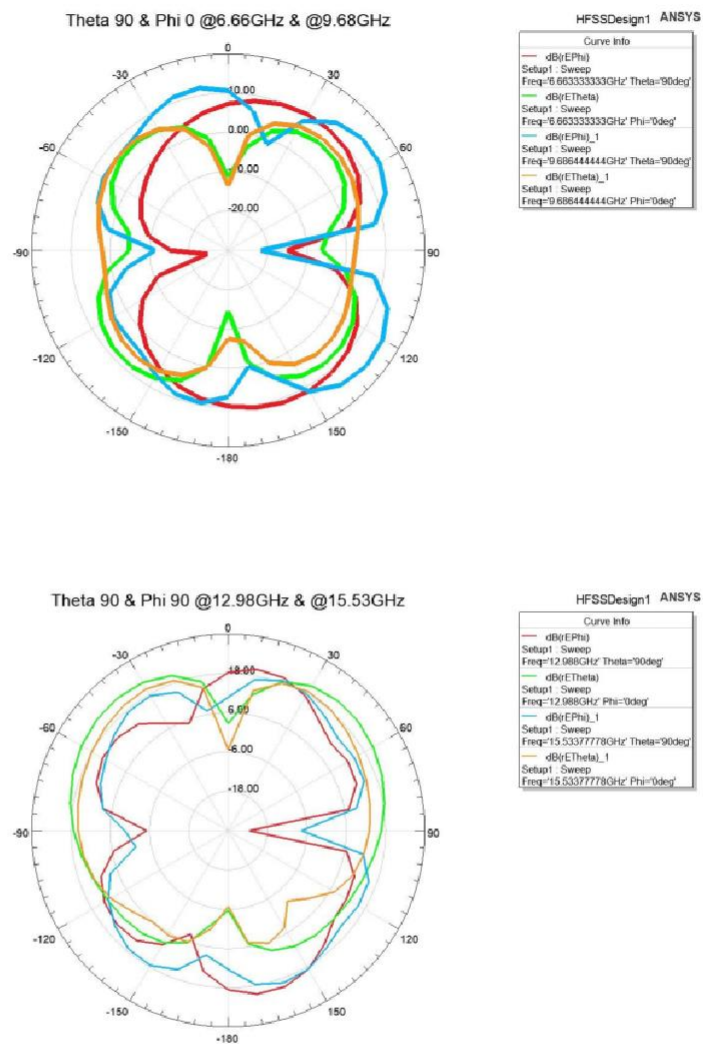


Fig.5.14 : Radiation Pattern

5.15 FABRICATED ANTENNA DESIGN IMAGES

Linear integrated dumbbell shaped antenna have been designed and simulated. Compared to array antenna the efficiency, directivity and gain of triangular antenna have produced much increased value. So we fabricated the dumbbell shaped antenna which is shown in the fig 5.15.

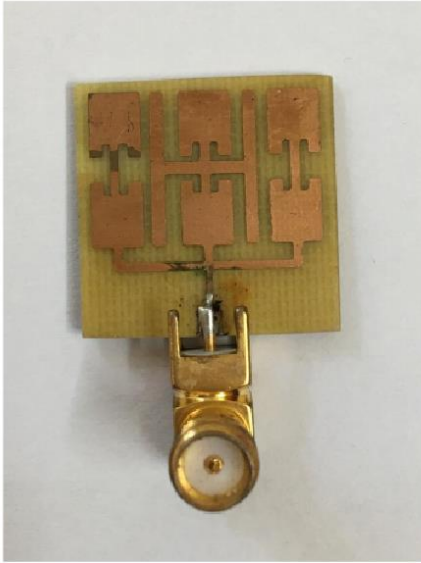
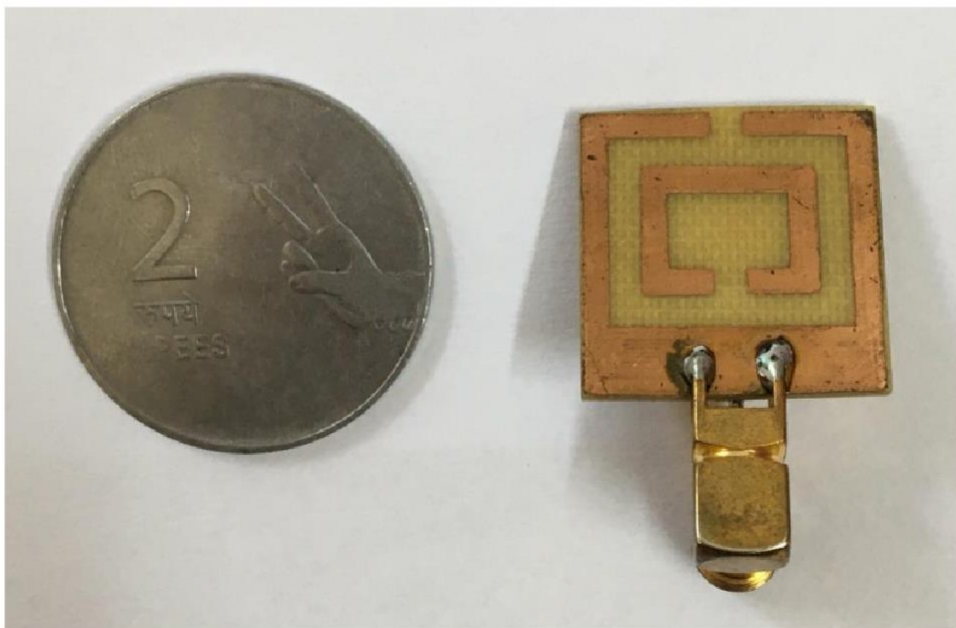
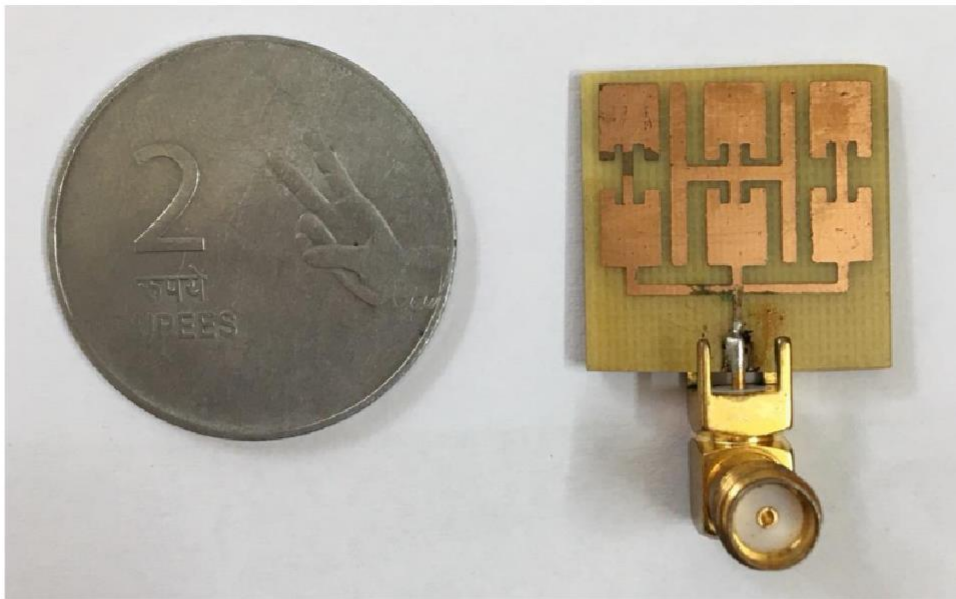


Figure:5.15 : Front and back of the fabricated design





5.16 TESTING RESULTS

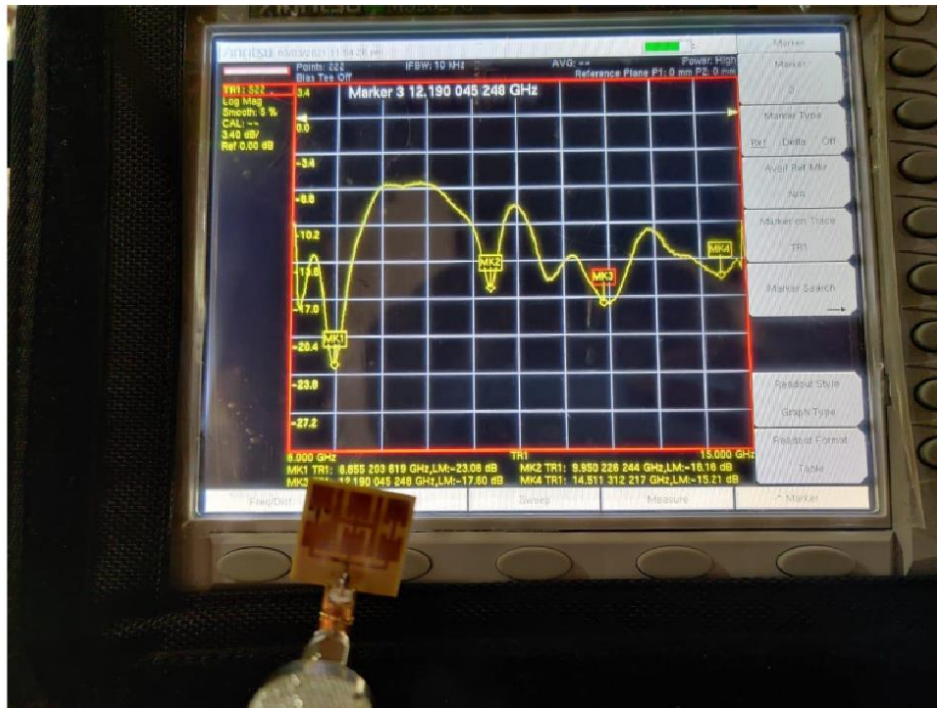


Fig:5.16 : Testing Results

5.17 TESTING VS SIMULATED RESULTS

Table 5.1 Tesiting Vs Simulated Results

TESTING RESULTS	SIMULATED RESULTS
-22.97 GHz	-23.66 GHz
-16.18 GHz	-11.44 GHZ
-17.63 GHz	-15.38 GHz
-15.09 GHz	-24.95 GHz

CHAPTER-6

CONCLUSION & SUMMARY

A Microstrip rectangular patch antenna is designed for Air Traffic Management System. The H shaped slots are defected in ground and all this technique contributed for the resonance of frequency at 6.66 GHz, 9.68GHz, 12.98GHz, 15.53GHz respectively. The proposed fractal-based antenna is fabricated and its S11 parameters are measured in Anritsu VNA. The simulated results are closer to that of the measured results so in real time it can transmit the data most efficiently in all the resonated frequency. The existing antenna works in different frequency simultaneously yet does not provide with high gain, directivity, efficiency, VSWR, low loss, and since the stimulated value are closer to the result of real time value, The proposed methodology revealed better performance rate from the analysis. the proposed antenna can be used in all future Air traffic applications.

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