International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 12, pp: 100-114 www.ijaem.net ISSN: 2395-5252

Design of a L-Wide band Micro strip patch Antenna for Global Navigation Satellite System

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Date of Submission: 14-11-2021 Date of Acceptance: 29-11-2021

ABSTRACT:
In the recent year's antenna design appears as a mature field of research. It really is not the fact because as the technology grows with new ideas, fitting expectations in the antenna design are always coming up GNSS (Global Navigation Satellite System) is a satellite system that is used to pinpoint the geographic location of a user's receiver anywhere in the world. Two GNSS systems are currently in operation: the United States' Global Positioning System (GPS) and the Russian Federation's Global Orbiting Navigation Satellite System (GLONASS). A variety of forms of antenna can be used for transmitting to and receiving from satellites... In this work L-band patch antenna loaded with notches and slit has been designed and simulated using CST studio tool. Single frequency band operation is obtained from the proposed microstrip antenna. The design was carried out using air as the substrate and copper as antenna material. The designed antennas resonate at 1.567GHz with return loss over -12dB & VSWR 1.66. Such designed band is used in the satellite application for Global Navigation Satellite System (GNSS), non- geostationary orbit (NGSO) and fixed-satellite services (FSS) providers to operate in various segments of the L-band.

KEYWORDS – GNSS , GPS, HPBW , CST, VSWR

I. INTRODUCTION

GNSS (Global Navigation Satellite System) is a satellite system that is utilized to pinpoint the geographic area of a client's recipient anyplace on the planet. Two GNSS systems are as of now in operation: the Assembled States' Global Situating System (GPS) and the Russian Federation's Global Circling Navigation Satellite System (GLONASS). A third, Europe's Galileo, is slated to achieve full operational limit in 2008. Every one of the GNSS systems utilizes a group of stars of circling satellites working related to a system of ground stations.

Satellite-based navigation systems utilize an adaptation of triangulation to find the client, through computations including data from various satellites. Each satellite transmits coded signals at exact interims. The beneficiary believers flag data into position, speed, and time gauges. Utilizing this data, any beneficiary on or close to the world's surface can figure the correct position of the transmitting satellite and the separation (from the transmission time delay) among it and the recipient. Organizing current flag information from at least four satellites empowers the collector to decide its position.

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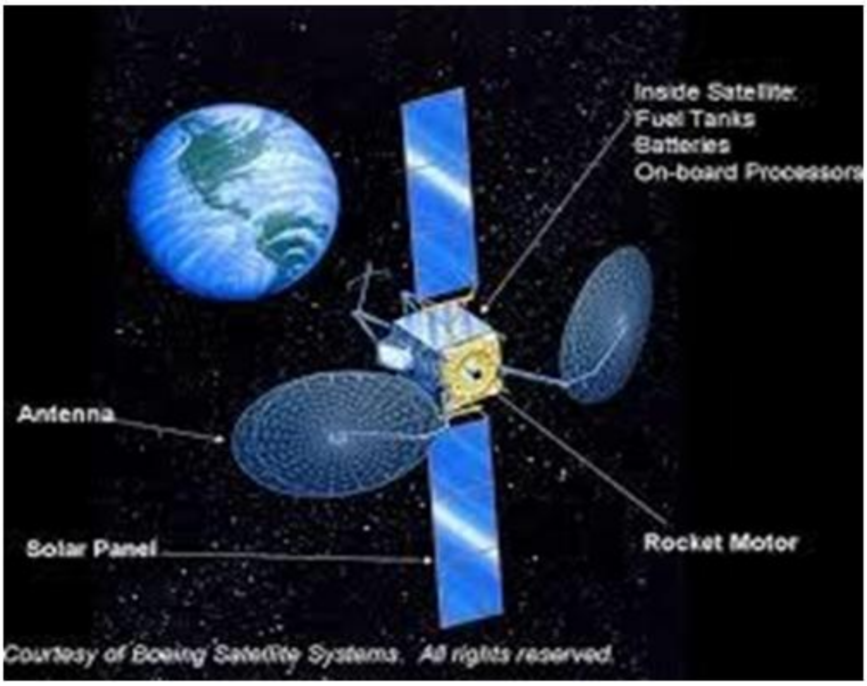


Contingent upon the specific advancements utilized, GNSS exactness differs. For instance, the Unified States Bureau of Guard initially utilized a deliberate debasement (known as "Particular Accessibility," or "SA") of GPS signs to keep potential military foes from utilizing the situating information. On account of SA, GPS precision was constrained to a 100-meter run for non military personnel clients, albeit military hardware empowered exactness to inside a solitary meter. In May 2000, a presidential request commanded that SA be ceased.

SATELLITE ANTENNA

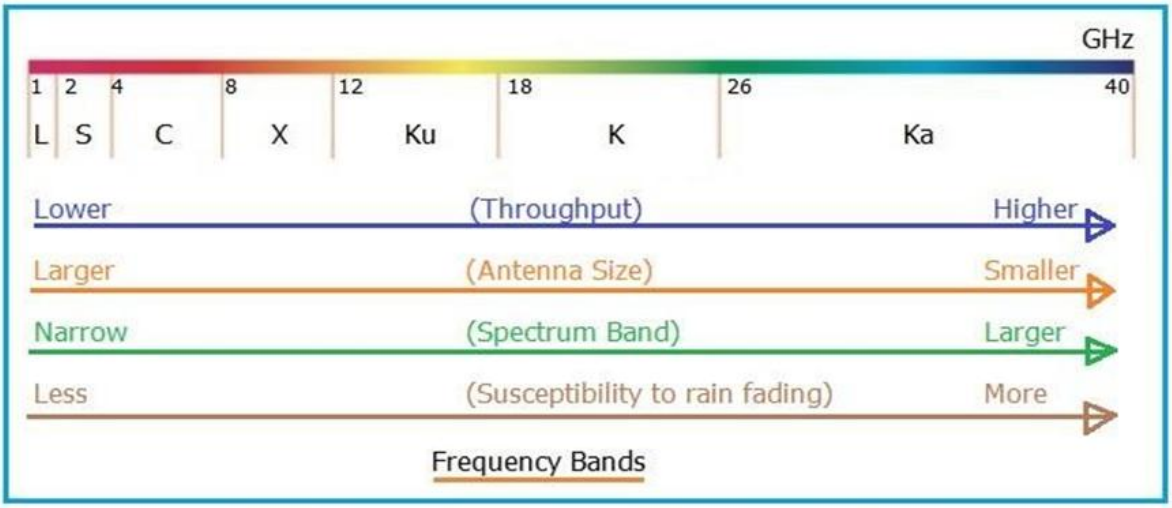
An assortment of types of antenna can be utilized for transmitting to and getting from satellites. The most widely recognized sort of satellite antenna is the illustrative reflector, anyway this isn't the main kind of antenna that can be utilized. The real sort of antenna will rely on what the general application and the necessities. The separations over which signals travel to a few satellites is extensive. Geostationary ones are a specific case. This implies way losses are high and as needs be flag levels are low. Notwithstanding this the power levels that can be transmitted by satellites are restricted by the way that all the power has be produced from sun oriented boards. Thus the antennas that are utilized are frequently high increase directional assortments. In spite of the fact that there is on a very basic level no distinction between the antennas on satellites and those on the ground there are various diverse necessities that should be considered. In the primary example the ecological conditions are altogether different. As conditions in space are especially brutal the antennas should be worked to withstand this. Temperatures change extensively among light and dull and this will cause development and compression. The materials that are sued in the conduction should be cautiously picked.

The gain and directivity of the antenna should be addressed the necessities of the satellite. For most geostationary satellites the utilization of directional antennas with gain is obligatory in perspective of the way losses brought about. These satellites are bound to cover a give region of the Earth, and as they stay similarly situated this is typically not an issue. Anyway the frame of mind of the satellite and its antenna must be cautiously kept up to guarantee the antenna is adjusted in the right heading. The antennas on board the satellite are normally constrained in size to around 2 - 3 meters by the space that is accessible on the satellite structure.

SATELLITE FREQUENCY BANDS

Because of lower frequencies, L-Band is most effortless to execute for marine satellite balanced out systems. There isn't much L-Band bandwidth accessible. The higher you go in frequency, the more bandwidth is accessible, however the hardware should be progressively modern On the off chance that one could liken the expense and accessibility of L-Band space fragment to state, city land, C-Band may be suburbia, Ku band the farmland, and Ka-Band the prairies of the wild west. Possibly somewhat more hard to get to, however a great deal of it accessible at a sensible cost.

L-Band (1-2 GHz) | C-Band (4-8 GHz) | Ku-Band (12-18 GHz) | Ka-Band (26.5-40 GHz)



II. LITERATUR-SURVEY

C. Sun, Z. Wu and B. Bai [1] the bandwidth of antenna will diminish with the decline of antenna size and this component constrains the structure of smaller Global Navigation Satellite System (GNSS) patch antenna (1.1-1.6 GHz). In this correspondence, a novel wideband strategy dependent on the mode examination on the shorting load patch antenna is proposed. By changing the position and the extent of the shorting load structure, the overwhelming thunderous method of patch antenna(TM 10) is isolated into two auxiliary modes and these two modes are consolidated together to frame a wide working band. It is demonstrated this new strategy has preferred bandwidth improvement impact over the customary strategies. By using this proposed strategy, a minimized circularly polarization wideband patch antenna is intendedfor GNSS application, which has a little electrical size of just 0.2λ 0 × 0.2λ 0 × 0.05λ 0 .(λ 0 is the wavelength of low band in free space.) The reproduced and estimated results demonstrate that the proposed antenna has great and stable execution over the entire working band, which implies that it is a significant perfect conservative antenna utilized for GNSS satellite navigation applications.

A. S. W. Ghattas and E. E. M. Khaled [2] A vicinity feed ultra-wide band (UWB) patch antennas with a smaller size (millimeters estimate) for Ku/K band applications is introduced. Deserted ground structure (DGS) strategy is utilized to expand the bandwidth of the antenna. The proposed antenna presents UWB execution in the frequency scope of 16 GHz to 29 GHz with a minimal size of 7 × 10 mm 2 , which is reasonable for some applications. The examination and structure of the proposed antenna are researched with the industrially accessible programming CST microwave studio (MWS) test system. The proposed structure is created and tried. The deliberate information of the created antenna exhibits a decent concurrence with the mimicked outcomes. The proposed antenna indicates omnidirectional radiation design with a normal gain of 3.5 dBi and great radiation productivity over the workingband.

K. K. In this way, K. M. Luk and C. H. Chan [3] Patch antennas are generally connected in current remote correspondence systems. In any case, customary patch antennas have the drawback of limited bandwidth and are not appropriate for Ku-band satellite communicate gathering. Numerous analysts have proposed different systems to upgrade the bandwidth of test encouraged patch antennas, e.g., utilizing thick substrate, including parasitic patches either in a similar layer (coplanar) or in another layer (stacked) , and utilizing capacitor-stacked patches. With the main procedure, the substrate thickness increments and initiates the excitation of surface waves. Aside from lessening the radiation productivity, these surface waves diffract at the substrate edges and fall apart the radiation designs. The nearness of coplanar and stacked geometry has the inconvenience of expanding the territory and thickness of the antenna, individually. Extra capacitors cause antenna gain decrease due to the ohmic loss of the stackingchip resistor.

H. Al-Saedi, W. M. Abdel-Wahab [4] This letter introduces the structure of a wideband circularly spellbound antenna, working at Ka band. The proposed antenna contains a round microstrip patch antenna that is coupled to a microstrip feedline through a changed L-formed opening space. The antenna transmits a wideband right-hand circularly energized wave with high polarization immaculateness and a wide pivotal ratio (AR) rakish beamwidth. A 4 × 4 antenna subarray has been structured, created, and estimated to approve the proposed idea. The cluster shows a reflection coefficient S11 <; - 10 dB over the frequency band 27-31 GHz. In addition, the 4 × 4 antenna subarray yields an abnormal state of polarization immaculateness, and also a level estimated AR ≤ 1.15 dB over the frequency go 27.55-30.45 GHz (10% bandwidth).

L. Wang, Z. Weng, Y. Jiao, W. Zhang [5] A position of safety broadband circularly spellbound (CP) microstrip antenna with a wide beamwidth is proposed for a global navigation satellite system. Four hook molded parasitic branches are put on the sides of the ground to augment the impedance bandwidth (IBW) and half-control beamwidth (HPBW) all the while. A few openings are scratched on the radiation patch to acquire impedance coordinating. The proposedantenna is manufactured and estimated. The trial results demonstrate that the IBW for VSWR

≤ 2 is 72.5% from 1.02 to 2.18 GHz, and the 3 dB pivotal ratio bandwidth is 54% from 1.15 to 2 GHz. The HPBW is past 100° by and large CP bandwidth. Its measurements are 70 mm × 70 mm × 12 mm, (0.35 × 0.35 × 0.06) λ 0 3 , where λ 0 is the wavelength of the middle frequency.

Refer. No	Year of Publication	Frequency Range	Multi-band	FeedingPoint	Objective
Reference paper [1]	Dec 2017	1.1- 1.6 GHz	Single Band	1	Circularly polarization wideband patch antennais designed for GNSS application
Reference paper [2]	Nov 2017	16 GHz to 29 GHz	Single Band	1	Omnidirectional radiation pattern with anaverage gain of 3.5 dBi
Reference paper [5]	July 2018	1.02 to 2.18 GHz	Single Band	1	Microstrip antenna witha wide beamwidth is proposed for a global navigation satellite
Reference paper [7]	Nov 2017	1.73 and 2.75 GHz	Single Band	1	Circularly polarised diversity antenna consisting of closely spaced monopole radiators
Reference paper [12]	Nov 2015	1.492-1.518 GHz	Single Band	1	Microstrip antenna formobile satellite communication

PROBLEM FORMULATION

From the above literature review we can conclude that the main issue with the microstrip patch antenna is Narrow bandwidth, lower gain (6 dB), large ohmic loss in the feed structure of array, polarization purity is difficult to achieve, lower power handling capability etc. in the light of literature study we can formulate a problem of lower bandwidth is one of the main disadvantage network).

PROPOSED DESIGN

At the point when the transmitter supplies an electric flow swaying at radio frequency (i.e. a high frequency exchanging current (air conditioning)) to the antenna's terminals, and the antenna transmits the vitality from the present as electromagnetic waves (radio waves). At gathering, an antenna catches a portion of the intensity of an electromagnetic wave so as todeliver a small voltage at its terminals. The attractive field that the antenna puts out will create an electric flow on any metal surface that it strikes, notwithstanding if the metal surface that the flag strikes has a length connection to itself the initiated flow will be especially more grounded on the article. As we expressed before that as a flag goes through the air, finishes a cycle in around 36 feet. For illustration, if the item that the attractive wave strikes is 18 feet long (λ/2), 9 feet long (λ/4) or 36 feet long (λ), at that point the initiated current will be considerably more than if the flag struck a metal article which was not some obvious division of the wavelength of the flag. The tuned frequency for an antenna is known as antenna reverberation. Each antenna has something like one correct reverberation point. Antenna reverberation is where, the antenna is in a condition of electrical equalization as far as impedance coordinating, which is dictated by the length of an antenna.

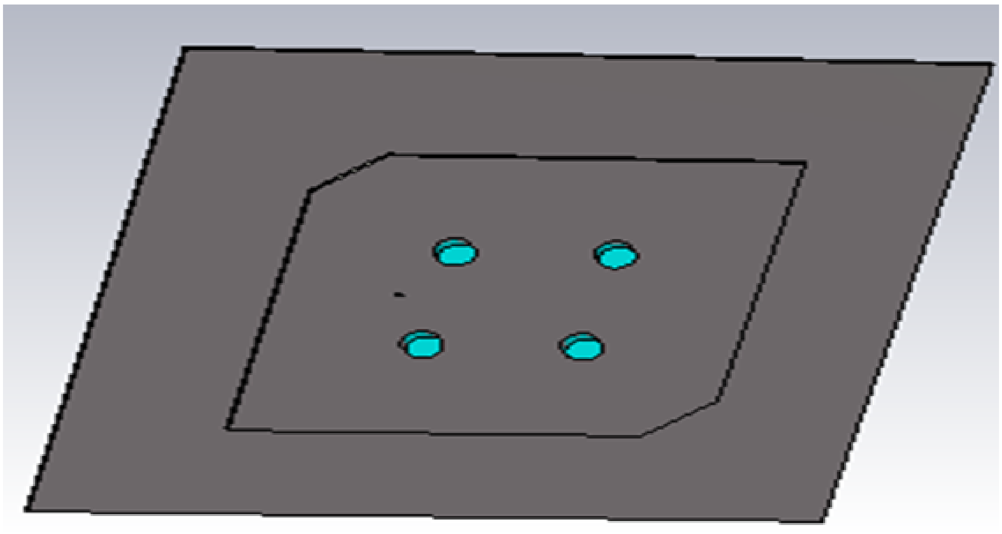
In the structure strategy of round patch antenna, a fundamental parameters are:

1) Dielectric steady of the substrate (εr): The dielectric consistent of substrate material assumes a vital job in the patch antenna plan. A substrate with a higher dielectric steady diminishes the elements of the antenna yet it likewise influences the antenna execution. In this way, there is dependably an exchange off among size and execution of patch antenna. For planning diverse reverberating structures, the dielectric consistent is taken to be 4.4.

2) Stature of dielectric substrate (h): For the microstrip patch antenna to be utilized in correspondence systems, it is fundamental that the antenna isn't cumbersome. Subsequently, the tallness of the dielectric substrate ought to be less. In this thesis, tallness of the substrate is characterized as 1.6 mm for every resounding structure.

The gain of a patch antenna decides the inclusion separation of the radio at which it is worked. Utilizing the Friis equation, the separation for inclusion can be effortlessly determined given the base got flag level to keep up correspondence connection of the radiosystem utilized.

PROPOSED MICROSTRIP ANTENNA VIEW



Top view of Proposed antenna

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SIMULATION AND RESULT

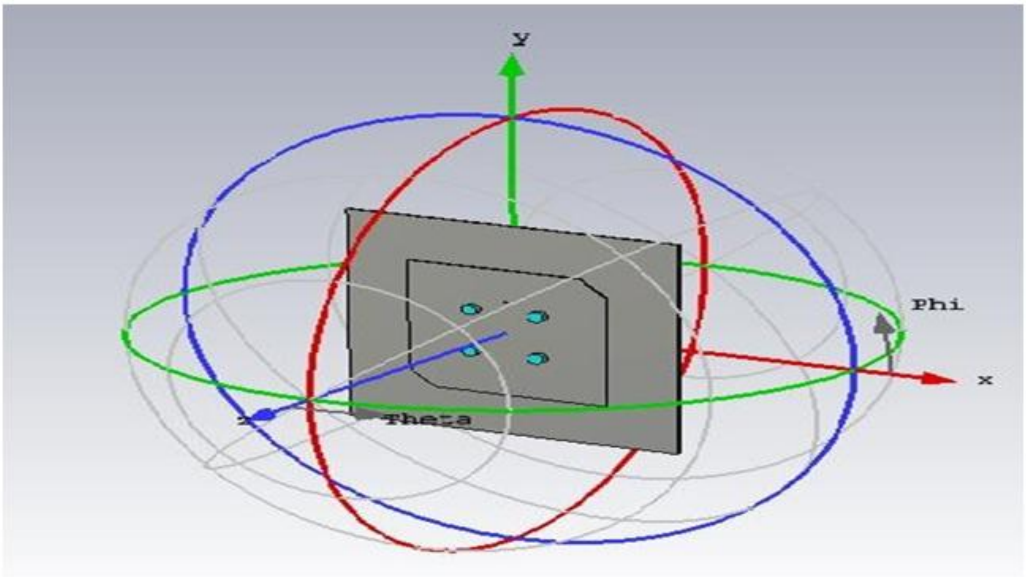
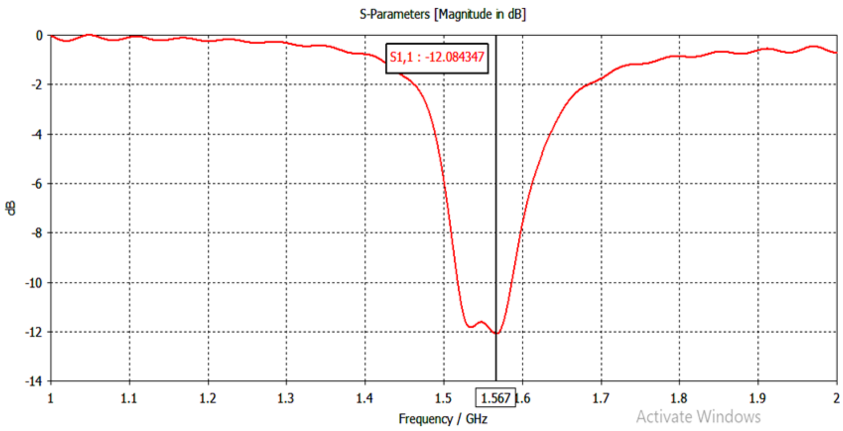


Figure , indicating recreated antenna in CST microwave studio, it is a specific apparatus for the quick and exact 3D EM reenactment of high frequency issues. Alongside an expansive application run, it offers significant item to-advertise points of interest: shorter improvement cycles; virtual prototyping before physical preliminaries; advancement rather than experimentation. It is a simple to-utilize apparatus for the investigation and plan of static and low frequency structures. Applications include: actuators, brakes, EMC, generators, estimation, engines, sensors and protecting. It is a particular apparatus for the quick and exact structure and examination of 3D electron firearms.

RETURN LOSS

Return loss is the distinction, in dB, among forward and reflected power estimated at some random point in a RF system and, as SWR, does not change with the power level at which it is estimated. Figure demonstrates the Return Loss (S11) parameters for the proposed antenna, which speaks to the multiband bands of frequency for which the antenna planned is upgraded i.e. frequencies going from 1 GHz to 2 GHz with S11 esteem past - 10 dB and the scope of frequencies according to the outcomes demonstrates that it has a decent bandwidth when contrasted with other microstrip antenna. The got estimation of S11 for 1.567 GHz is - 12.08db dB.



BANDWIDTH

The bandwidth of an antenna is characterized as "the scope of frequencies inside which the execution of the antenna, as for some trademark, fits in with a predetermined standard." The bandwidth can be viewed as the scope of frequencies, on either side of a middle frequency (typically the reverberation frequency for a dipole), where the antenna attributes, (for example, input impedance, design, bar width, polarization, side projection level, gain, pillar course, radiation effectiveness) are inside an adequate estimation of those at the middle frequency. For broadband antennas, the bandwidth is generally communicated as the ratio of the upper-to-bring down frequencies of adequate operation.

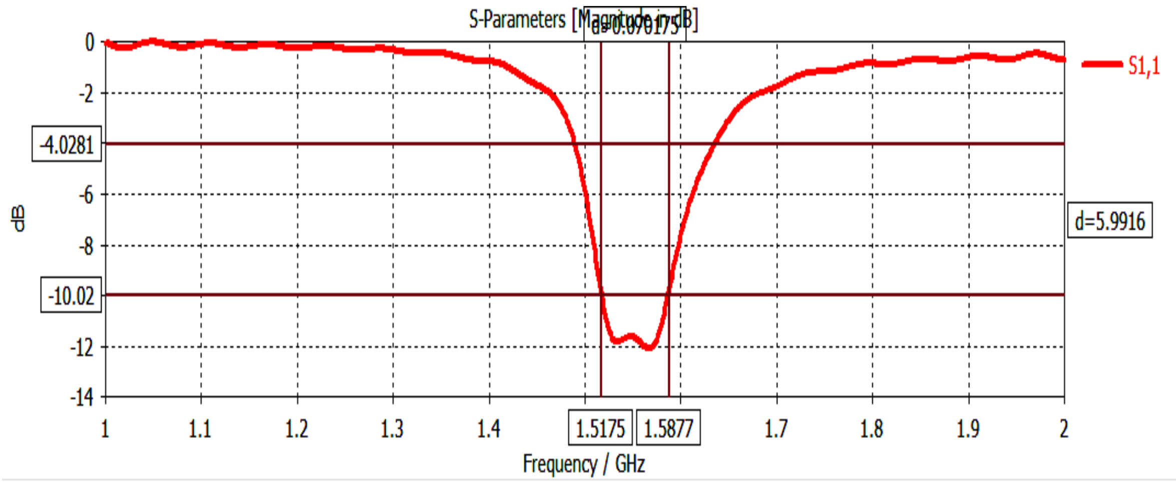


Figure : Bandwidth calculation

For narrowband antennas, the bandwidth is communicated as a level of the frequency contrast (upper short lower) over the middle frequency of the bandwidth. The bandwidth of proposed antenna is 70.2 MHz, (1.5877GHz-1.5175GHz).

S11 PARAMETER

S11 speaks to how much power is reflected from the antenna, and henceforth is known as the reflection coefficient (now and then composed as gamma: or return loss. In the event that S11=0 dB, all the power is reflected from the antenna and nothing is emanated.
So here s11 parameter is -12.08db.

VOLTAGE STANDING WAVE RATIO (VSWR)

The most widely recognized case for estimating and looking at VSWR is when introducing and tuning transmitting antennas. At the point when a transmitter is associated with an antenna by a feed line, the impedance of the antenna and feed line must match precisely for most extreme vitality exchange from the feed line to the antenna to be conceivable. At the point when an antenna and feed line don't have coordinating impedances, a portion of the electrical vitality can't be exchanged from the feed line to the antenna. Vitality not exchanged to the antenna is reflected back towards the transmitter. It is the communication of these reflected waves with forward waves which causes standing wave designs.

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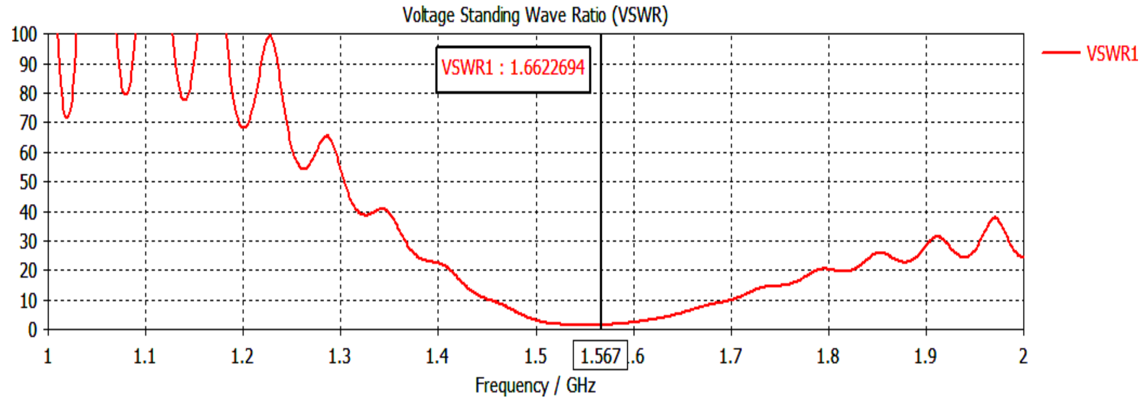
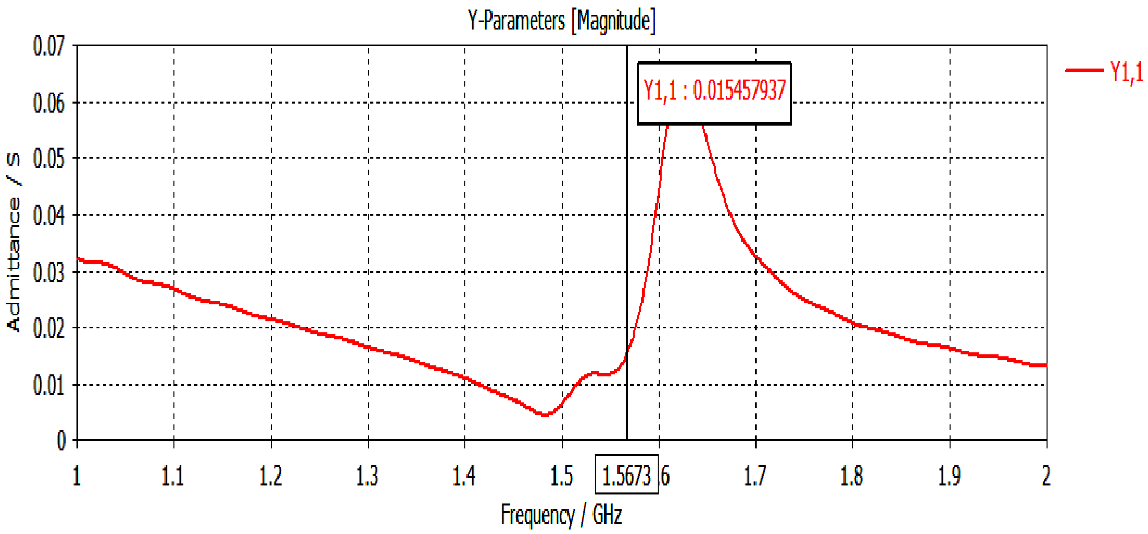


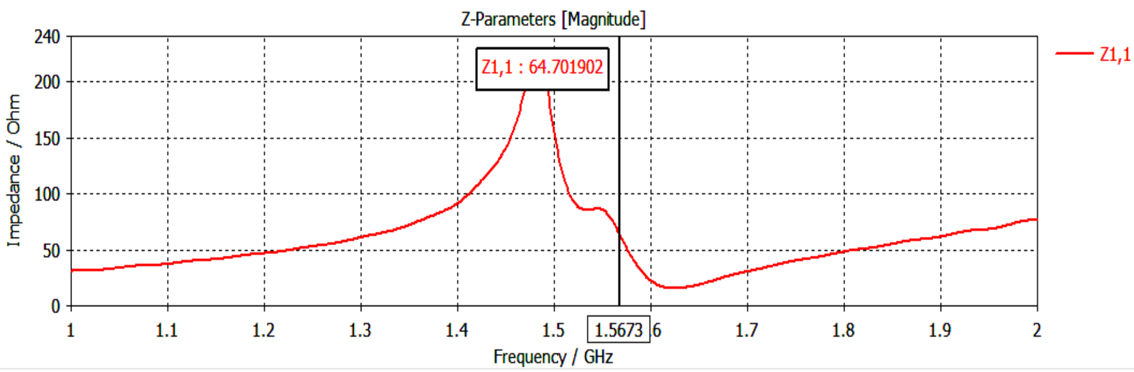
Figure :VSWR

The VSWR plot for L-band antenna with customary ground plane is appeared in Figure In a perfect world, VSWR must lie in the scope of 1-2 which has been accomplished for the frequencies 1.567GHz. The incentive for VSWR is 1.66.

ADMITTANCE AND IMPEDANCE



(a)



(a) (b)

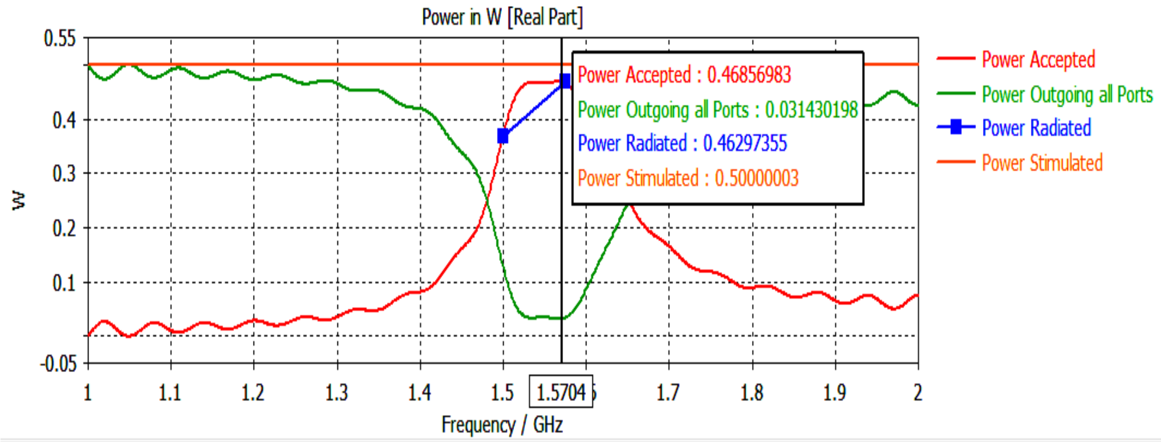
Figure (a) Y parameter (b) Z- parameter

Figure , appearing of induction of antenna and impendence of proposed antenna. A Y-parameter lattice portrays the conduct of any straight electrical system that can be viewed as a black box with various ports. Z parameter is utilized to decide the quality factor of an antenna which can give an understanding about the feasible bandwidth. Z(ant)=R+jX, where R=R(rad)+R(Loss), so ie can anticipated in some way or another the losses and the effectiveness.

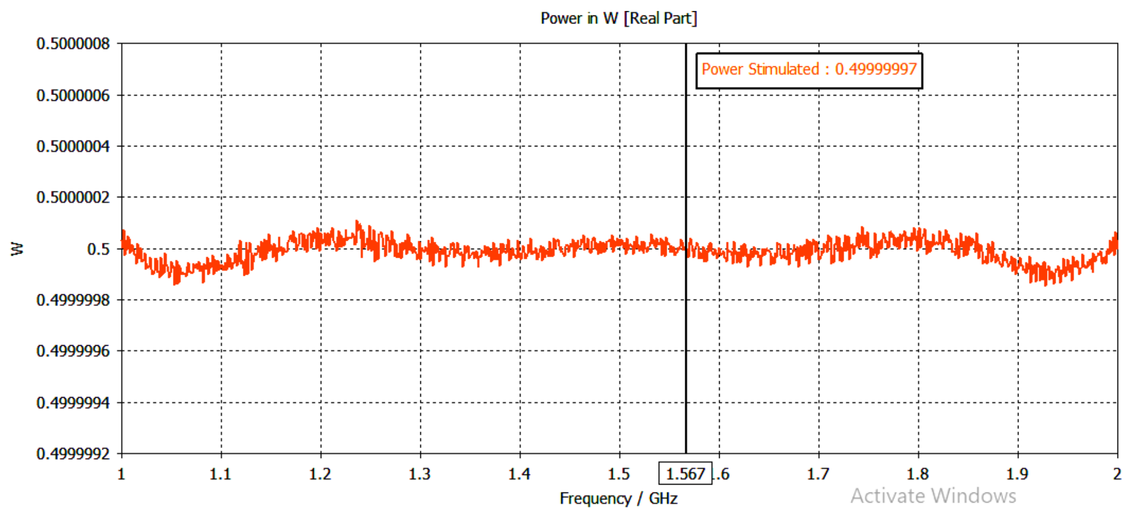
So estimations of induction and impedance of antenna is-

Y parameter= 0.0154s (siemens) , perfect esteem lies on approx zero in this way is huge documented.
Z parameter= 68.70 ohm, basic esteem approx 50 to 70 ohm.

POWER



(a)



(b)

Figure : (a) Power in different port (b) Real power for stimulated (For working)

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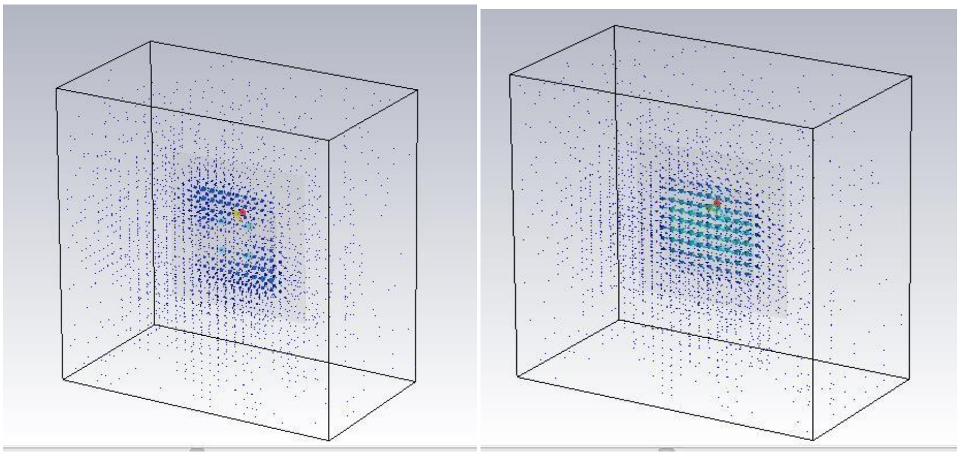
E AND H FIELD



(a) (b)

Figure : (a) E field (b) H field

For a straightly enraptured antenna, this is the plane containing the electric field vector (now and then called the E opening) and the bearing of most extreme radiation. The electric field or "E" plane decides the polarization or introduction of the radio wave. On account of the equivalent straightly enraptured antenna, this is the plane containing the attractive field vector (at times called the H opening) and the bearing of greatest radiation. The polarizing field or "H" plane lies at a correct point to the "E" plane.

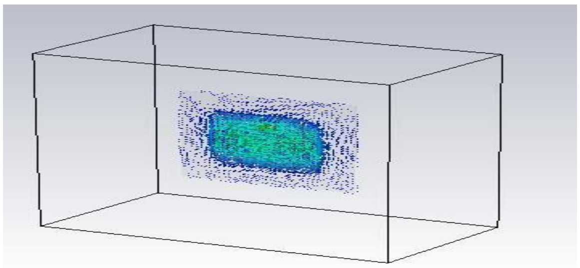


Figure : Surface Current

A surface current is a guess. Extremely, just volume flows exist. In metallic antennas, the surface flow is a real electric flow that is prompted by a connected electromagnetic field. The electric field drives charges around. Basically any reproduction bundle that handles metals will have the capacity to envision the surface current.

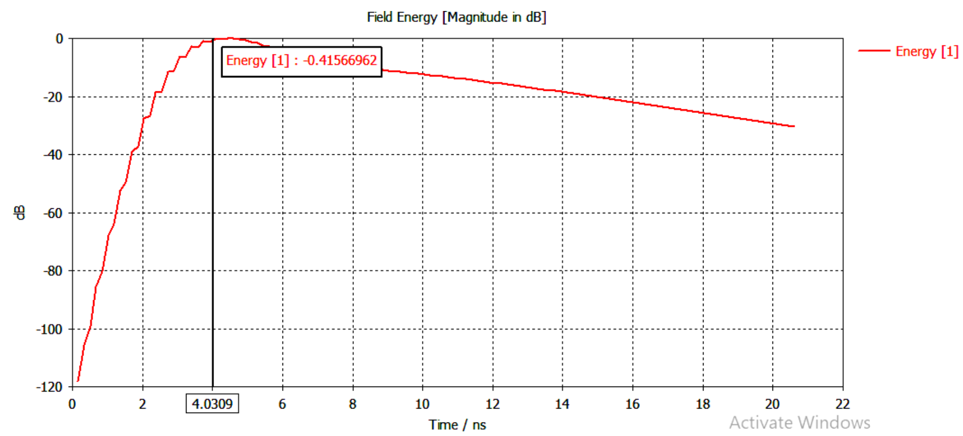


Figure : Field Energy

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RADIATION PATTERN

An antenna radiation example or antenna design is characterized as "a scientific capacity or a graphical portrayal of the radiation properties of the antenna as a component of room facilitates. By and large, the radiation design is resolved in the far field area and is spoken to as an element of the directional directions. Radiation properties incorporate power transition thickness, radiation force, field quality, directivity, stage or polarization." The radiation property of most concern is the a few dimensional spatial dispersion of transmitted vitality as an element of the eyewitness' situation along a way or surface of consistent range. A hint of the got electric (attractive) field at a steady range is known as the adequacy field design. Then again, a diagram of the spatial variety of the power thickness along a consistent range is called an adequacy control design .

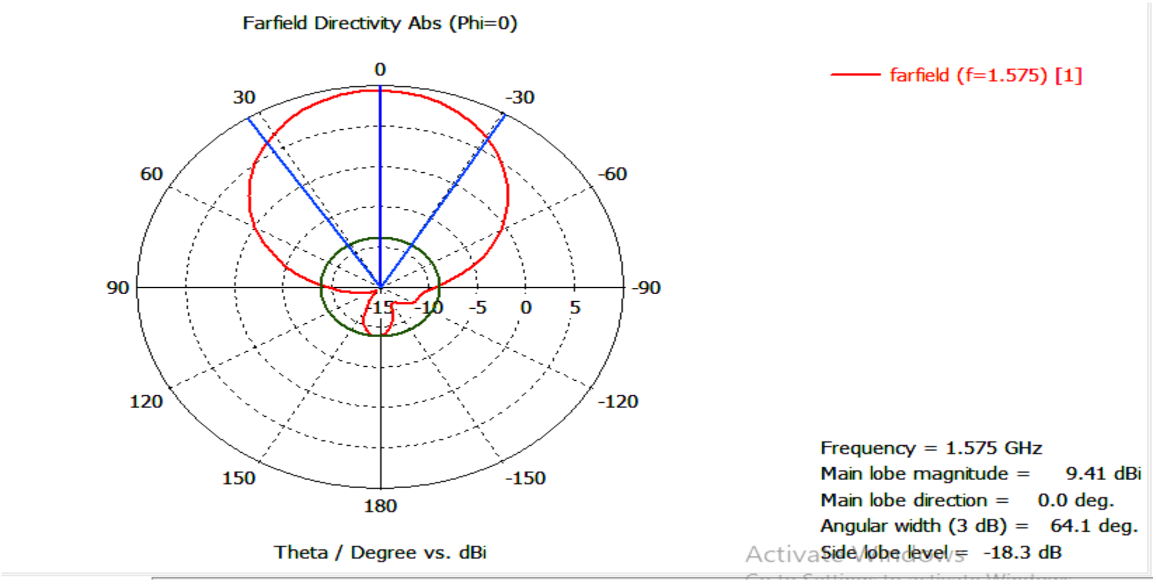

Figure : Far field

The reenacted radiation designs for the proposed microstrip antenna are plotted in Fig. , Fig. and Fig . With the acquired gain design for E plane, the antenna has radiation example of omnidirectional which has wide assortment of use in satellite correspondence.

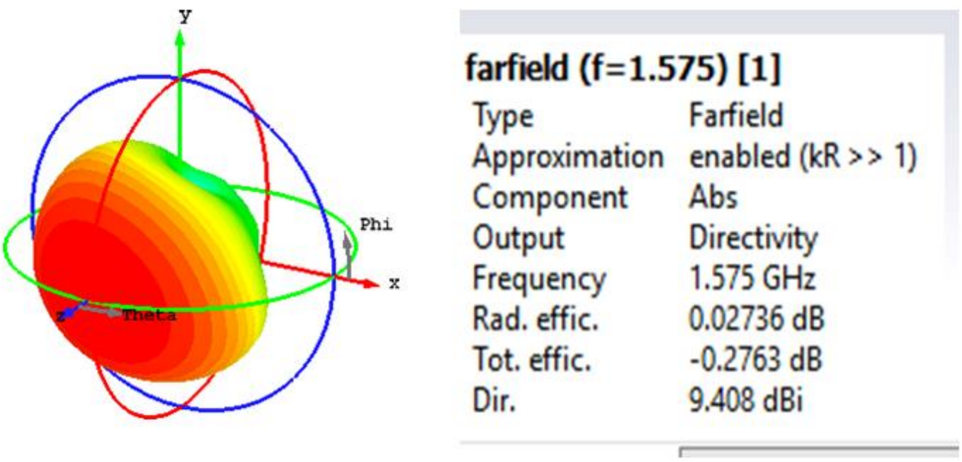

Figure : Specific absorption rate (SAR)

The deliberate radiation designs for the two frequencies incorporating the polarization the azimuthal way (xy-plane) and the rise bearing (xz and yz-planes) while working at 1.567 frequencies for GNSS/GPS/GSM, WiMax, Bluetooth and WLAN/Wi-Fi applications.

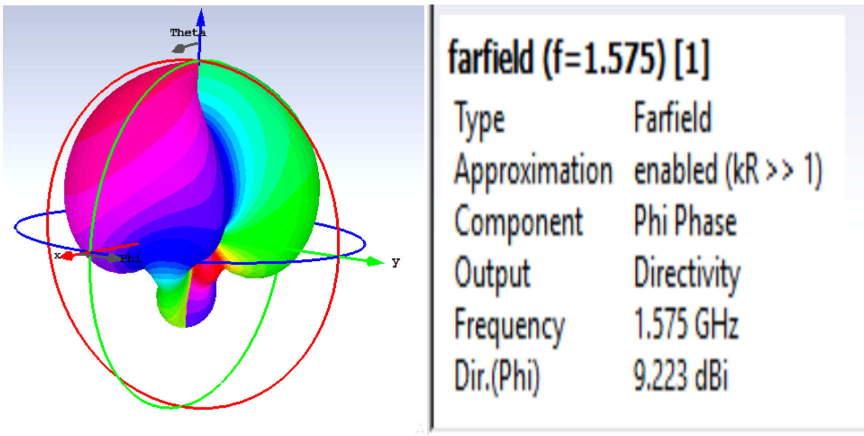

Figure : Specific absorption rate (SAR) pattern

The radiation effectiveness of the patch antenna is influenced by transmitter and dielectric losses, as well as by surface-wave excitation - since the overwhelming TM10 method of the grounded substrate will be energized by the patch. As the substrate thickness diminishes, the impact of the channel and dielectric losses turns out to be increasingly serious, restricting the productivity.

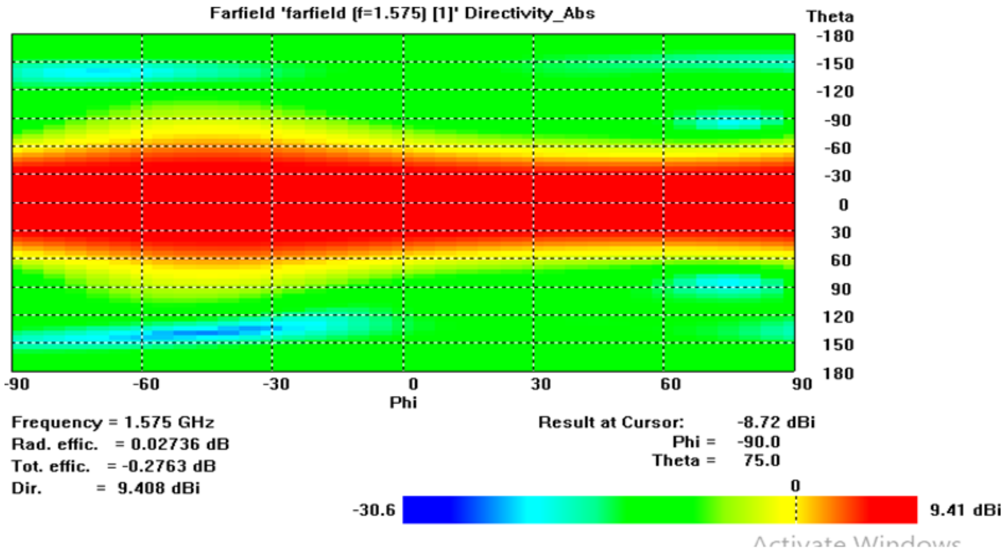

Figure : Far field

Then again, as the substrate thickness builds, the surface-wave control expands, consequently constraining the productivity. Surface-wave excitation is unwanted for different reasons too, since surface waves add to common coupling between components in a cluster, and furthermore cause unfortunate edge diffraction at the edges of the ground plane or substrate, which regularly adds to twists in the example and to back radiation. For an air (or froth) substrate there is no surface-wave excitation.

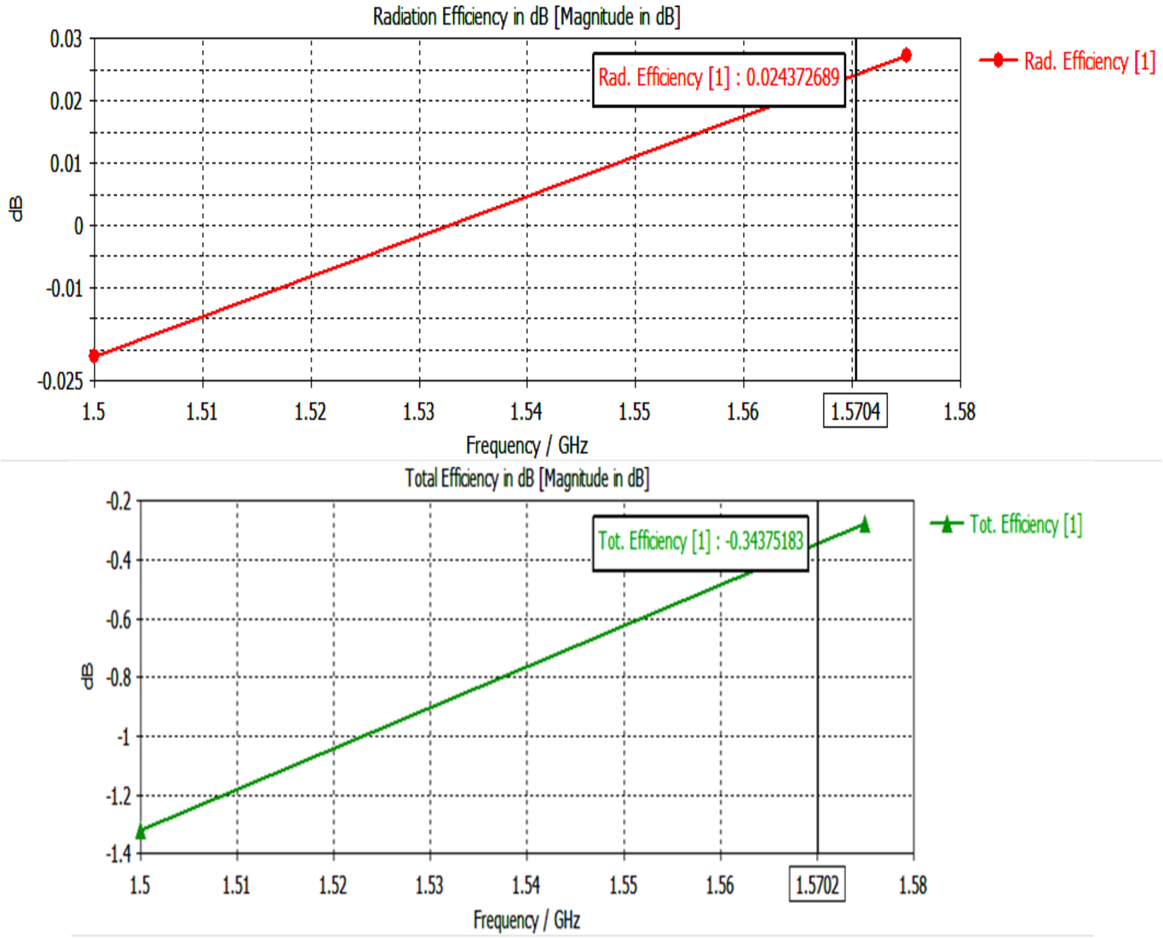

Figure : Radiation Efficiency

The effectiveness of an antenna is a ratio of the power conveyed to the antenna with respect to the power emanated from the antenna. A high proficiency antenna has the vast majority of the power present at the antenna's information transmitted away. Being a ratio, antenna productivity is a number somewhere in the range of 0 and 1. In this antenna productivity is
0.343 Along these lines we have accomplished great effectiveness of proposed antenna.

III. RESULT SUMMARY

Be that as it may, as of late impressive exertion has been spent to enhance the bandwidth of the microstrip antenna, to a limited extent by utilizing elective encouraging plans to beat the issue of test inductance, at the expense of expanded intricacy.

Table shows the simulated results of return loss, VSWR, gain, impedance andbandwidth.

Table : Result summary of proposed Antenna

Sr. No.	Parameter	Value
1	S11	< -10 db
2	Return Loss	-12.08db
3	Band Width	70.2MHz
4	VSWR	1.662
5	Total Efficiency	0.343

6	Resonant Frequency	1.567GHz
7	Y parameter	0.0154s (siemens)
8	Z parameter	68.70 ohm
9	Accepted power	- 0.4685 W
10	Radiated power	- 0.4629 W
11	Power stimulated.	0.5 W

IV. CONCLUSION

In this exposition, we proposed an adjusted single band microstrip antenna which works proficiently in GNSS and remote application. As an outcomes a proposed antenna was recreated with fitting parameters for better working antenna. The cutting of rectangular opening brought about wide multiband microstrip antenna for GNSS/GSM/GPS applications. The last outcomes fulfill every one of the parameters of a productive antenna. The planned antenna works effectively under all conditions with low return loss and legitimate impedance coordinating. This wide antenna has wide application in GNSS/GPS/GSM, WiMax, Wi-Fi/WLAN of remote correspondence. The essential work is done in this paper is to plan and actualize this structures of single band Microstrip antenna utilizing CST reenactment programming. Frequency go from 1-2 GHz utilized in remote correspondence can be accomplished by utilizing structured antenna.

'With the improvement of development advancements, single band and wideband antennas working at extra frequency bands, for example, L and S are required. In this exposition, it is at first exhibited the principal parameters of the antenna to be considered while structuring an antenna and deciding the working frequency bands. In the last, the new sorts of proposed antenna (microstrip patch antenna, reverberating structures), which are increasingly suitable for base station or passageway applications, are exhibited.

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