

Analysis Of Patch Antenna With Defected Ground Structure For Wireless Applications

M.Sumathi, P.Chitra , K.Srilatha

Abstract : Microstrip fix receiving wire finds a superior decision in remote correspondences in view of their less cost, light weight and simplicity of creation. Small size wide band reception apparatuses are of awesome request in future advances with the fast development of remote correspondence innovation. Notwithstanding innate impediment like thin transfer speed and low pick up, microstrip fix receiving wires have various preferences. Be that as it may, different strategies have been examined for the improvement of both transfer speed and gain. This paper proposes a novel outline with deserted ground structure so as to get better data transfer capacity. The structure is designed at 8.5 GHz using FR4-epoxy as substrate material that has relative permittivity 4.4 and loss tangent 0.02. HFSS (High Frequency Structure Simulator) software is used for simulating the proposed design. This antenna obtained the return loss -12.87 dB, -14.36 dB at 5.5 GHz and 10.5 GHz with a VSWR of less than 2. In order to enhance the bandwidth of the antenna, defected partial ground has been used which truncate at the edges so, that bandwidth of more than 1 GHz has been achieved at both resonating frequencies. Gain of 4.24 dB and 6.27 dB has been obtained at 5.5 GHz and 10.5 GHz. The efficiency of antenna is also found to be good and proposed design has suitable characteristics so that it can be used in WiMax and Radar applications.

Keywords: Patch antenna, Microstrip, FR4-epoxy, HFSS, VSWR, DGS

I INTRODUCTION

The quick headway in microwave and remote correspondence has pulled in the interests in microstrip receiving wires. With the boundless multiplication of remote correspondence innovation as of late, the interest for smaller, low profile, simplicity of similarity with microwave circuits and less cost has expanded fundamentally [17]. Be that as it may, despite these favorable circumstances microstrip radio wires experiences constraints, for example, limit data transfer capacity and low pick up. To maintain a strategic distance from utilization of two separate receiving wires for two recurrence groups and to satisfy the request of driving business sector there is a need to build up the double band radio wires. Numerous outlines are accounted for in writing, for various correspondence groups, which utilizes diverse procedures, for example, opening, abandoned ground structure and so on to upgrade the execution of Microstrip fix radio wires likewise assortments of fix structures are planned. Presently a day defected ground structure (DGS) microstrip fix receiving wires have been quickly created for multi-band and wide band in wideband correspondence frameworks. M.HaroonTaria et.al recommended that the prerequisite of fast remote neighborhood (IEEE 802.11a standard) and other correspondence systems.Bandwidth increments because of bigger width of microstrip antenna. [7]. In recent years, specialists have been examined distinctive strategies to upgrade the transfer speed. It is watched that proficiency of radio wire get increments by expanding transfer speed and pick up diminishes in like manner. J.A. Ansari et.al portrayed that substrate thickness and openings length have huge impact on recurrence proportion [11]. Garima et.al suggested that by expanding the measure of jewel molded opening compelling range of circle get abatements and fix current increments. So that, impedance data transmission and pick up of radio wire get increments.

Enhanced transfer speed is of 13.58% for C-band application [12]. C. J. Wang et.al introduced that a Z-like opening get stacked on a fix which increments full recurrence as number of spaces increments without expanding involved space territory [14]. Srijita Chakraborty et.al watched that by changing crisscross formed DGS, reception apparatus reverberate at Bluetooth, WiMAX and IMT groups individually [17]. A.K.Arya et.al proposed distinctive absconded ground structures in detail. It has been watched that from single Skew-F molded deformity in ground plane,the recurrence proportion is diminishes by expanding the length of center arm of F. It has been watched that great impedance coordinating is accomplished by expanding the quantity of openings [18]. U. Chakraborty et.al portrayed that a double band microstrip fix reception apparatus for WLAN application is dependable to move down the resounding recurrence to bring down esteems. Opening impedance is specifically corresponding to length of the space is step by step expanded [19]. Regular microstrip radio wires had a few constraints, that is, single working recurrence, low impedance transmission capacity, low increase, bigger size, and polarization issues. There are number of methods which have been accounted for upgrading the parameters of traditional microstrip radio wires, that is, utilizing stacking, diverse sustaining strategies, Frequency Selective Surfaces (FSS), Electromagnetic Band Gap (EBG), Photonic Band Gap (PBG), Metamaterial, et cetera. Microwave segment with Defected Ground Structure (DGS) has been picked up ubiquity among every one of the strategies detailed for improving the parameters because of its basic plan. Scratched openings or deformities on the ground plane of microstrip circuits are alluded to as Defected Ground Structure. Single or various deformities on the ground plane might be considered as DGS. At first DGS was accounted for channels underneath the microstrip line. DGS has been utilized underneath the microstrip line to accomplish band-stop qualities and to smother higher mode sounds and common coupling. After effective usage of DGS in the field of channels, these days DGS shown in Fig.1 is popular broadly for different applications. The Rare side DGS Structure is in Fig.3. Minimal effort, superior, conservative size, wideband, and low profile radio wires regularly meet the stringent prerequisites of present day remote correspondence

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frameworks. Present day correspondence requests the accessibility of productive, smaller, and versatile gadgets that can be worked at high information rates and at low flag powers. Scientists have been working towards improvement and headway of RF front finishes to meet the most recent prerequisites. The goal of the venture is to outline double band micro strip fix reception apparatus for remote applications by utilizing abandoned ground structure (DGS). To dissect execution of radio wire in schematic. The fix that is utilized for the proposed configuration is combinational 'E' and 'U' fix so as to acquire double recurrence band. To execute receiving wire progressively.

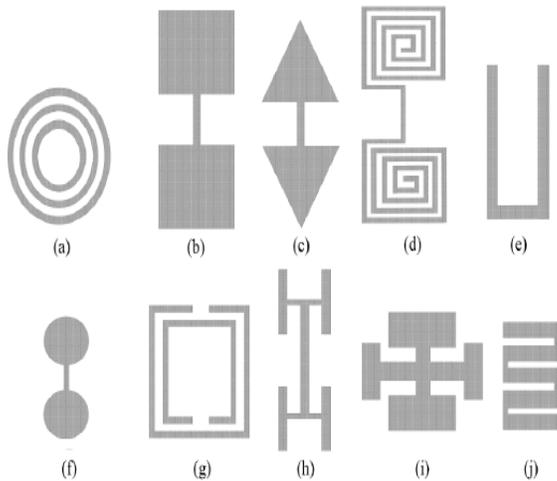


Fig. 1: DGS structures

II RELATED WORK

Chirag Garg, Magandeep Kaur has completed a concise survey on DGS and portrayed that Electromagnetic band gap (EBG) or on the other hand called photonic band hole (PBG) structures have been alluring to acquire the capacity of undesirable recurrence dismissal and circuit measure diminishment. Looks into on the PBG had been initially done in the optical recurrence. As of late, there has been an expanding enthusiasm for microwave and millimeter wave utilizations of PBG circuits. This paper displays an instructional exercise review of the new approach for planning smaller channels like low pass, band stop and band pass having a few favorable circumstances than Photonic Band Gap (PBG). This system is named as Defected Ground Structure (DGS). The fundamental originations and transmission qualities with identical circuit models of assortments of DGS units are introduced. Finally, the primary uses of DGS in microwave innovation field have been portrayed. Anju Verma, Debajit De, Nanda, Tripathy actualized a novel fix radio wire outline for double band. They have proposed a Slotted Microstrip Patch Antenna shown in Fig.2 with a Defected Ground Here, we have coordinated the idea of DGS and Slotted Patch Antenna keeping in mind the end goal to get upgraded transmission capacity and pick up The proposed radio wire comprises of a microstrip bolstered opened rectangular fix with E-molded cut in the ground plane. The execution of this receiving wire is talked about and broke down with execution of this radio wire is examined and various spaces. The varieties in Return Loss (S11), Radiation Pattern and Gain The reception apparatus demonstrates a double band attributes having a return loss of beneath - 20 dB

at 3.2-3.5 GHz and be 5.6-5.8 GHz, which is reasonable for IEEE 802.16 IEEE 802.11p WLAN applications. CST MWS 2015 simulate the receiving wire structure. Mohamed Aboulalaa, Abdel-Rahman, Ahmed Allam, Hala Elsadek examined about a double band round fix reception apparatus is presented. The receiving wire comprises of a round fix with an immediate sustain through microstrip bolster line, that intended to emanate at 2.45 GHz with fragmentary data transfer capacity of 4.5%. A round space is embedded into the ground plane that emanates by capacitive coupling between the fix and the ground plane. This space emanates at 1.95 GHz with partial impedance data transmission of 5%. The radio wire accomplishes great radiation qualities by embeddings a reflecting plane at ideal position behind it. The reception apparatus has pick up of 8.3 and 7.8 dB at 1.95 and 2.45 GHz, separately. This receiving wire is proposed for the rectenna; at that point it is intended to coordinate the primary shaft in a specific bearing by expanding Front to Back (F/B) proportion with low cross polarization levels by utilizing Defected Reflector Structure (DRS) in reflecting plane. The comparable circuit of the proposed radio wire is acquainted with display the electrical conduct of the receiving wire. The proposed reception apparatus can be utilized to gather the vitality from Wi-Fi and generally spread versatile systems. The proposed reception apparatus was outlined utilizing CST Microwave Studio. The reenacted and estimated comes about show great understanding. Pragma Shilpi, Dharmendra Upadhyay, Harish Parthasarathy talked about double recurrence microstrip line-sustained planar microstrip reception apparatus for multiband task is proposed utilizing surrendered ground structure (DGS). This receiving wire has a rectangular fix with rectangular-formed strips cut in ground and is nourished by a microstrip line, for accomplishing extra resonances and transfer speed upgrades. The composed reception apparatus has general size of 32x32 mm², and reverberates at 6.1 GHz and 8.9 GHz frequencies. Pick up upgrade of 3db and 10 db is accomplished at 6.1 GHz and 8.9 GHz separately and 95% transmission capacity improvement is achieved at 8.9 GHz. Thusly proposed dualband receiving wire can be successfully utilized for C-band and X-band remote applications. Jogesh Chandra Dash, Guru Prasad Mishra, Biswa Binayak Mangaraj executed another and extremely basic method for actualizing abandoned ground structure (DGS) in a microstrip fix receiving wire is exhibited. The measurement of DGS is precisely same as the measurement of transmitting component. There are two diverse DGSs executed in this paper. The DGSs are supplement of each other as for their structures. The receiving wires with these correlative DGSs indicate four distinct frequencies of task (10 GHz, 12 GHz, 16 GHz and 16.6 GHz) with improved data transmission greatest of 22% as for the reception apparatus without DGS. The proposed radio wire can be executed for X-band and Ku-band application Monika Tanwani¹, Ravindra Singh Chauhan², Kiran P. Singh³ introduced a changed fix receiving wire for 3 GHz working recurrence. Here various methodologies are considered by fluctuating space sizes, abandoned ground measure and furthermore changing food position. Reenactment is finished utilizing IE3D programming for different parameters. Return loss of definite plan was - 11.75 dB for 3 GHz recurrence and VSWR of 1.68 and - 17.86 dB and VSWR of 1.28 for 5GHz recurrence. Proposed receiving wire gives double band task and shows great

reenacted comes about for two recurrence groups. R. Kiruthika, Dr. T. Shanmuganatham, Rupak Kumar Gupta executed An opened fan molded microstrip fix receiving wire with three working frequencies for radar application is displayed. The plan display is made to resound at three frequencies in Xband. The X-band recurrence go falls between 8 to 12 Gigahertz and are broadly utilized as a part of radar applications. The dielectric substrate material utilized by the reception apparatus is of minimal effort FR4 (Flame Retardant – Grade 4) Epoxy. To enhance the reception apparatus execution, the radio wire configuration is incorporated with Defected Ground Structure (DGS). The Ansoft High Frequency Structural Simulator (HFSS) Version 12 programming is utilized to break down the outcomes. With 9.93 GHz, 10.81 GHz and 11.56 GHz as the full frequencies, an arrival loss of - 18.47 dB, - 42.23 dB and - 19.74 dB are acquired with 470 MHz, 590 MHz and 420 MHz as the data transmission separately. The parameters like pick up, transfer speed, return misfortune and directivity are talked about in the paper. FitriYuliZulkifli, Susy Tri Lomorti, EkoTjptoRahardjo executed a Novel isosceles-triangular deserted ground structure (DGS) is actualized on Triangular Patch Linear Array microstrip radio wires to suppress surface waves and enhance the outline. The radiation execution of the receiving wire is described by the measurement of the DGS and by finding the DGS at particular position which is discovered tentatively. Estimated comes about demonstrates that the reception apparatus with DGS can enhance impedance coordinating with better return loss of - 45.48 dB from - 30.33 dB, data transfer capacity improvement (2.87 MHz), pick up upgrade upto 0.5 dB and smother cross polarization. R.Er-rebyiy, J.Zbitou1, A.Tajmouati, M.Latrach, A.Errkik, L.EIAbdellaoui talked about the idea of Defected Ground Structures (DGS) has been created to enhance the qualities of numerous microwave gadgets. For this reason the DGS is additionally utilized as a part of the microstrip radio wire for a few favorable circumstances, for example, reception apparatus estimate lessening, common coupling diminishment in receiving wire exhibits and so on... In this paper the abandoned ground structure (DGS) has been utilized to scale down a microstrip fix receiving wire and to move the reverberation recurrence from an underlying estimation of 10 GHz to a last and incentive at 3.5 GHz, with no adjustment in the measurements of the first microstrip fix reception apparatus. This receiving wire is outlined on a FR-4 substrate with dielectric consistent 4.4 and thickness 1.6 mm and its size is 27 X 30 mm². The receiving wire is composed, streamlined, and scaled down by utilizing CST MW. R. Kiruthika, Rupak Kumar Gupta actualized a Microstrip Patch reception apparatus with two working frequencies for radar application is displayed. The reception apparatus is demonstrated to resound at two frequencies in X-band. The X-band recurrence extend lies between 8 to 12 Gigahertz and are for the most part utilized as a part of radar applications. The outline comprises of Defected Ground Structure (DGS) gave to enhance the receiving wire execution. The dielectric substrate utilized by the radio wire is of minimal effort FR4 (Flame Retardant) Epoxy. The Ansoft High Frequency Structural Simulator (HFSS) Version 12 programming is utilized to break down the outcomes. The parameters like pick up, return misfortune, directivity and transfer speed are examined in the paper. With 9.19 GHz and 10.82 GHz as the resounding frequencies, an arrival loss of - 22.91 dB and -

40.99 dB is acquired with 540 MHz and 1600 MHz as the data transmission separately.

III EXISTING SYSTEM

In existing framework, have proposed an opened fix Antenna with a Defected Ground structure, they have presented the idea of DGS fix. Radio wire keeping in mind the end goal to get upgraded transfer speed and gain. The proposed receiving wire comprise of a microstrip encouraged opened rectangular fix with

Table 1: Design Specification of MSPA

SL.No.	Parameters	Values
1	Patch dimension (L*W)	45*45
2	Feed length (L)	0.3mm
3	Feed width (W)	2mm
4	Relative Permittivity (ϵ_r)	4.4
5	Substrate Material	FR- 4

E-formed cut in the ground plane. The execution of this radio wire is talked about and examined with the varieties in the fix width and number of openings. The varieties in the arrival misfortune (s11), Radiation example and Gain of the planned reception apparatus are examined for various contextual investigations. The radio wire demonstrates a double band attributes having an arrival loss of beneath - 20 dB at 3.2 – 3.5 GHz and underneath - 10 db at 5.6 - 5.8 GHz, which is appropriate for IEEE 802.16 WiMAX and IEEE11p WLAN applications. Material they have utilized as dielectric medium is the Roger RO4003. The substrate tallness is 1mm.

3.1 DRAWBACKS OF EXISTING WORK

- They planned a radio wire which is primarily engaged keeping data transmission and Gain.
- They outlined a receiving wire with less pick up and less application recurrence groups.
- The outline of the reception apparatus is complicated plan.
- The manufacture of the receiving wire is Expensive

IV PROPOSED WORK

Proposed work manages the plan of 'E' and 'U' formed combinational fix with deserted ground structure. E and U combinational fix is utilized to get double recurrence band. Investigation with different deserted ground structures to acquire better execution attributes is done. For different parameters like return misfortune, pick up, transmission capacity and radiation design ,the proposed configuration is dissected.

4.1 DESIGN PARAMETERS AND SPECIFICATION OF PATCH ANTENNA

The proposed double band fix exhibit receiving wire is planned and mimicked over the HFSS programming. The plan structure and parameters are recorded beneath in table 1. The proposed microstrip fix cluster radio wire is worked over a scope of 5-6 GHz. The thunderous recurrence is 5.56 GHz with the utilization of regular remote correspondence frameworks. The FR 4 Substrate material is utilized with dielectric consistent of 4.4 and misfortune digression of 0.00018. As like a plan strategy the proposed fix exhibit reception apparatus is reverberate at 30 GHz and gets the most extreme wanted yield. The sustain width is 2mm.

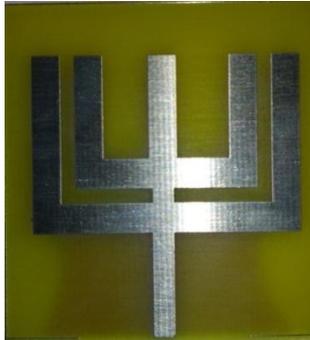


Fig. 2: Front side of Patch antenna

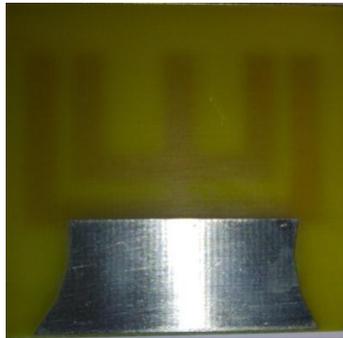


Fig.3: Rare side DGS Structure

V RESULTS AND DISCUSSION

5.1 RETURN LOSS

The down to earth circuit acknowledgment endures with the befuddle between the accessible source control and the power conveyed. This is known as return misfortune. Return misfortune = $-20\log(\Gamma_{in})$ of the radio wire is gotten as - 21 dB at 5.71 GHz, - 11.54 dB. So the composed reception apparatus offers great pick up and least misfortunes at the predefined recurrence. Fig.4 demonstrates the reflection coefficient of the Microstrip fix exhibit radio wire, got from the reenactment utilizing the HFSS programming. The reception apparatus is working at one reverberation frequencies 5.71GHz.

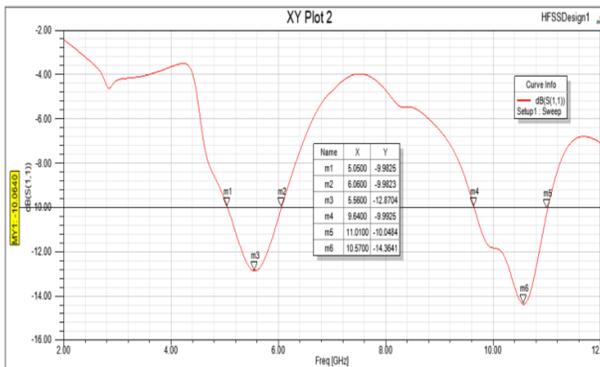


Fig.4: Return loss for Rectangular DGS

5.2VSWR

The proposed reception apparatus is having the VSWR esteem under the 2 is viewed as appropriate for the most receiving wire applications. The radio wire can be portrayed

as having a decent match. So when somebody say that the reception apparatus is inadequately coordinated, exceptionally often it implies that the VSWR esteem Exceeds 2 for a recurrence of intrigue. The plan has VSWR esteem as Fig. 5

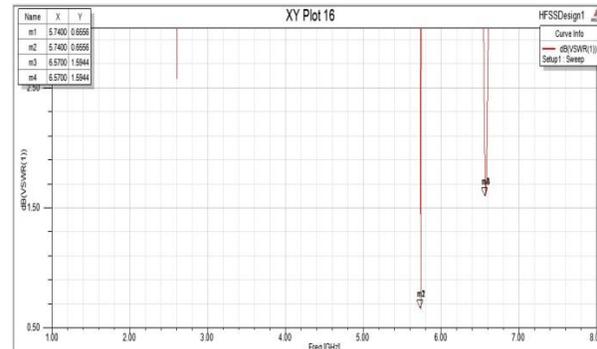


Fig.5: VSWR for Rectangular DGS structure

5.3 RADIATION PATTERN

The term radiation design alludes to the directional (rakish) reliance of the quality of the radio waves from the reception apparatus or other source. The radiation design for the Microstrip fix receiving wire without DGS structure is appeared in Fig. 6

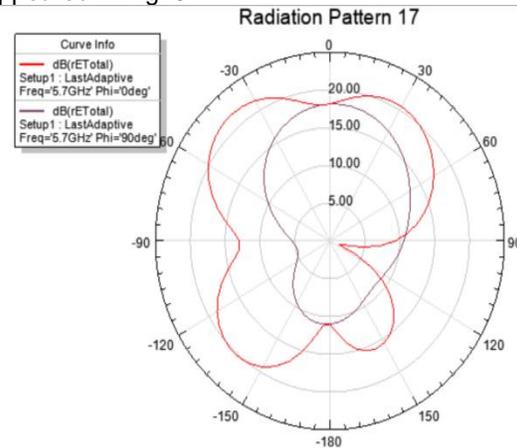


Fig.6: Radiation pattern for Rectangular DGS structure

5.4 BANDWIDTH

Transfer speed of the data transmission of an antenna alludes to the scope of frequencies over which the receiving wire can work effectively. The receiving wire's data transmission is the quantity of Hz for which the radio wire will show a SWR under 2:1. Transfer speed for without DGS is 1GHz and 1.65GHz is appeared in Fig. 7

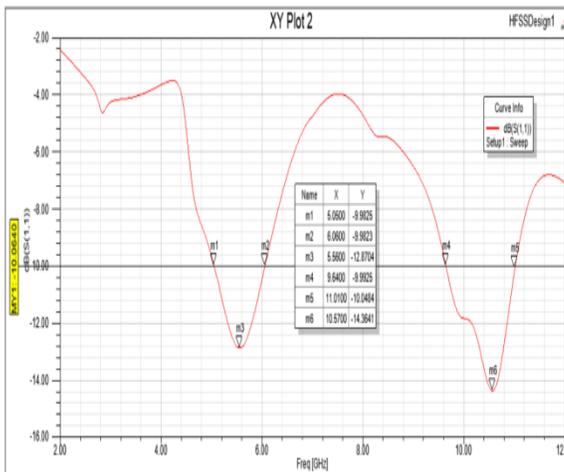


Fig.7: Bandwidth for without DGS structure

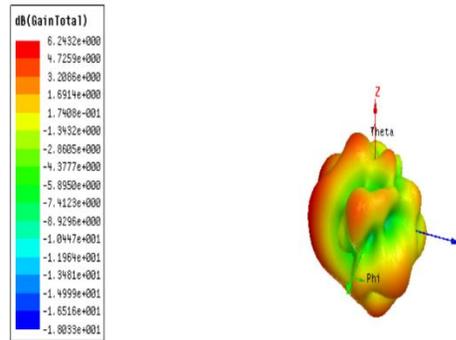


Fig.9: Gain for Rectangular DGS structure at 10.5GHZ

5.5 GAIN

Pick up is a helpful estimation portraying the receiving wire execution. Despite the fact that the pickup of the receiving wire is firmly identified with directivity, it is a measure that considers the effectiveness of the radio wire and in addition its directional capacities. Reception apparatus pick up is typically communicated in dB, essentially alludes to the heading of most extreme radiation. Pick up of any reception apparatus ought to dependably have positive incentive as far as Db. The gain for rectangular DGS Structure is shown in Fig.8 and Fig.9 at 5.56 GHz and 10.5 GHz.

VI CONCLUSION

A novel microstrip radio wire utilizing twofold E-molded fix has been planned with the middle recurrence of 5GHz. The proposed configuration acquired an arrival loss of - 12.87 dB, - 14.36 dB at 5.5 GHz and 10.5 GHz with a VSWR of under 2. With a specific end goal to build the data transmission of the receiving wire absconded halfway ground has been accomplished so transfer speed of in excess of 1 GHz has been accomplished at both of the resounding Frequencies. Pick up of 4.24 dB and 6.27 dB has been acquired at 5.5 GHz and 10.5 GHz. The proficiency of receiving wire is additionally found to great and proposed configuration has reasonable attributes so it can utilized as a part of WiMax and Radar applications.

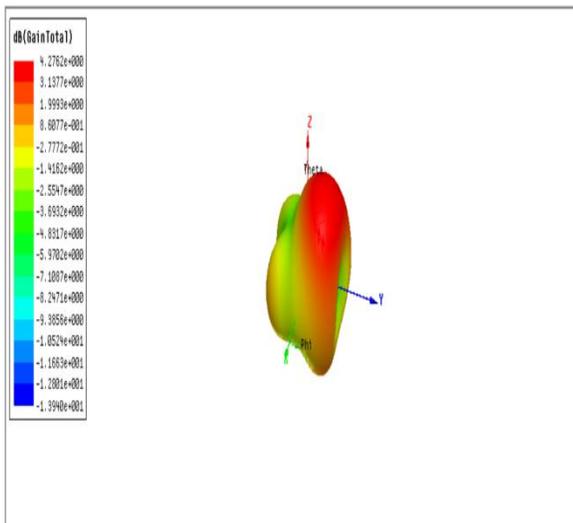


Fig.8: Gain for Rectangular DGS structure at 5.56GHz

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