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Bandwidth Enhancement of Rectangular Shaped DGS Strip Antenna for 5.8GHz Communication

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Abstract

Antennas is the essential part of the wireless communications. Most of them are Microstrip Patch Antennas, Monopole antenna, and Folded Dipole Antennas. Each antenna is good in their own properties and usage. It can be said that antennas are the backbone and almost everything in the wireless communication without which the one cannot imagine wireless communication. This paper presents the designs of Rectangular microstrip patch antenna for 5.8 GHz communication. One of the antennas is Rectangular Microstrip Patch Antenna (RMPA) and Second Rectangular Microstrip Patch Antenna with defect ground structure. Basic property of both the antenna like simulated design, Return loss, directivity, Radiation Pattern and bandwidth are discussed. This work shows that bandwidth of Antenna in RMPA with DGS is increased about 39.57% which is great deal in antenna designing system, return losses of designed antenna is also decreased by 25.923%, gain and directivity of the proposed antenna is almost same. Rectangular Microstrip Patch Antenna with DGS also reduces the size of antenna which is always a basic need of Patch antenna design system.
Keywords: Rectangular Microstrip Patch Antenna (RMPA), Defect ground structure (DGS), gain, return loss, directivity

I. INTRODUCTION

A microstrip antenna has become the essential part of Satellite Communication System. Microstrip antennas for commercial systems require low-cost materials, simple and inexpensive fabrication techniques. Antennas are the essential communication link for aircrafts and ships. Antennas for cellular phones and all types of wireless devices link us to everyone and everything. With mankind's activities expanding into space the need for antennas will grow to an unprecedented degree. Antennas will provide the vital links to and from everything out there space the need for antennas will grow to an unprecedented degree. Antennas will provide the vital links to and from everything out there. [1]

Author presented, quad band U-slot microstrip patch antenna for GPS/Bluetooth/WiMAX/WLAN

Application is presented. In the paper, a tetra band U-slot microstrip patch antenna is designed, optimized and simulated. The antenna covers three frequency bands of 1.43-1.5 GHz, 2.4-2.55 GHz, 3.8-3.98 GHz and 5.2-5.4 GHz [2].

The paper proposes the use of a patch antenna with U-shaped slot to achieve wideband application with very low return loss. The objective of the paper is to design, construct and fabricate microstrip antennas suitable for Wi-Max application that centered at frequency 5.25GHz.The proposed antenna reduced the return loss as well as increases the bandwidth of the antenna. [3]

Paper is to design a different microstrip patch antenna with Defect Ground Structure (DGS) for efficient rectenna design. This antenna having the property of high harmonics rejection at unwanted frequencies at 2.0131GHz, and 2.457GHz, 2.565GHz as the designed frequency is 1.3 GHz and return loss is decreased about 43.17%by the DGS structure.[4]

An I-shaped microstrip line is used to excite the square slot. The rotated square slot is embedded in the middle of the ground plane, and its diagonal points are implanted in the middle of the strip line and ground plane. To increase the gain, four L-shaped slots are etched in the ground plane. The measured results show that the proposed structure retains a wide impedance bandwidth of 88.07%, which is 20%better than the reference antenna. The average gain is also increased, which is about 4.17 dBi with a stable radiation pattern in the entire operating band. [5],

The proposed antenna has small in size and operates at 2.25GHz, 3.76GHz and 5.23GHz suitable for mobile satellite service (MSS) network, WiMAX and WLAN applications ,In the paper, the design of a coaxial feed single layer rectangular microstrip patch antenna for three different wireless communication band applications is presented. The proposed antenna is designed by using substrate Roger RT/duroid 5880 having permittivity of about 2.2 and tangent loss of 0.0009. The characteristics of the substrate are designed and to evaluate the performance of modeled antenna using HFSS v.11 EM simulator, from Ansoft.[6]

The maximum achievable gain is 9.41 dBi. The achievable experimental 3-dB beam width (HPBW) in the azimuth and elevation are 60.88± and 39± respectively at centre frequency, the proposed antenna design consists of inverted patch structure with air-filled dielectric, direct coaxial probe feed technique and the novel slotted shaped patch. The composite effect of integrating these techniques and by introducing the new multi-slotted patch, offer a low profile, high gain, broadband, and compact antenna element. A wide impedance bandwidth of 27.62% at 10 dB return loss is achieved. [7]

Novel, compact, probe-fed microstrip patch antenna for operation in dual-polarization mode is proposed.Reduction in patch size of up to 51% with respect to a traditional dual-polarized square patch operating at the same frequency is obtained. Results show linear polarizations in the +45 and 45 with a high isolation of 38 dB between the two ports. Moreover, the 50- feed position can be achieved by moving the feed point along the diagonal of the square patch, leading to ease in fabrication [8].

The paper presents the design a triple band h-slot antenna by using feed line technique. These bands cover GSM mobile phone system (0.9 and 1.8 GHz) and ISM band which is used for Bluetooth and wireless local area network bands applications. The CST microwave studio software is used as a tool for simulation [9]

A very good return loss of -46.75 dB is obtained for I-Shaped Defected Ground Structure (DGS). Also I-shaped DGS in the ground plane found to give a size reduction of about 5%.A comparison is also shown for the proposed antenna with the antenna structure without defect. The proposed antenna resonates in C-band at frequency of 6.0718 GHz with bandwidth of 132.3 MHz [10].

The properties of antenna such as reflection co-efficient, bandwidth and gain are determined and compared with the properties of single element square patch antenna and dimension of DGS The simulation process has been done through Finite Element Machine (FEM) based software High Frequency Structure Simulator (HFSS) software.. Further it‘s also observed that proposed antenna finds its most of application in the lower band like IEEE 802.11 and ISM Bands.[11]

II. ANTENNA DESIGNS

Designing of antenna is done using CST-Microwave Studio simulation software and the parameters are displayed by the figures. Designing of the patch has to be taken into consideration the antenna physical sizes are an important factor in the design process owing to the miniaturization of the modern mobile terminals [12]. Any technique to miniaturize the size of the MPA has received much attention. Designing requires selection of suitable dielectric constant and substrate height of an antenna as these are basics to design an antenna; these are chosen according to the design frequency our designed frequency band is 5.8GHz, here the chosen material is FR4 lossy .the dielectric constant of the FR4 material is 4.3.

1) Substrate Height =1.6mm
2) Dielectric Constant=4.3
3) Loss Tangent=.02

Designing of two antennas RMPA and Rectangular Microstrip patch antenna with DGS is done and their respective results are shown by Graph or figure. The Length and Width of Microstrip Patch Antenna has been calculated by the formula given in References books [12],and all other parameter like cut width, cut depth, continue straight path length and width are calculated by iteration on simulation software and dimensions are stored for best simulation results. Antenna Designed by simulation Software, its return loss graph, Directivity Graph, Electric field Distribution, Radiation pattern is shown for two antenna design [13].

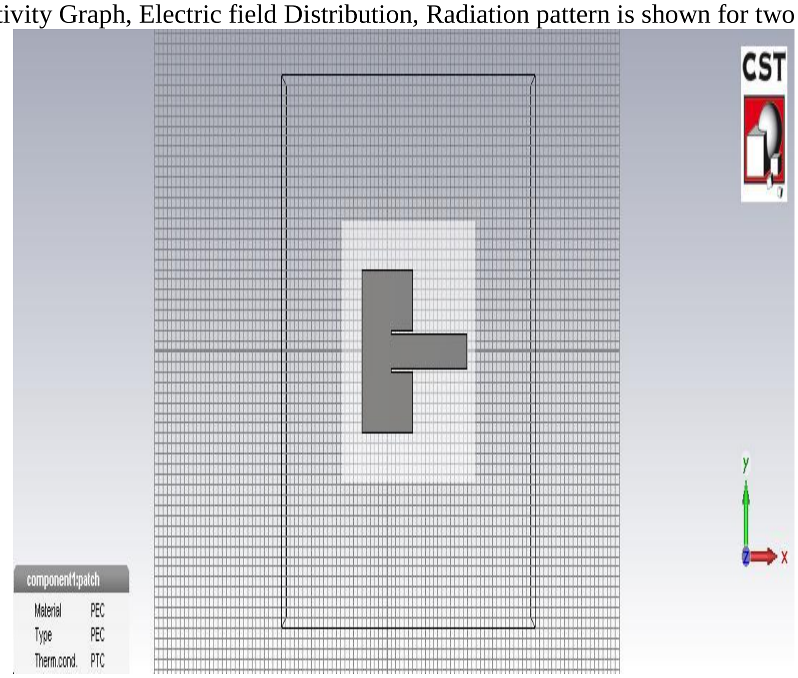

Fig. 1: Simple RMPA for 5.8ghz Communication

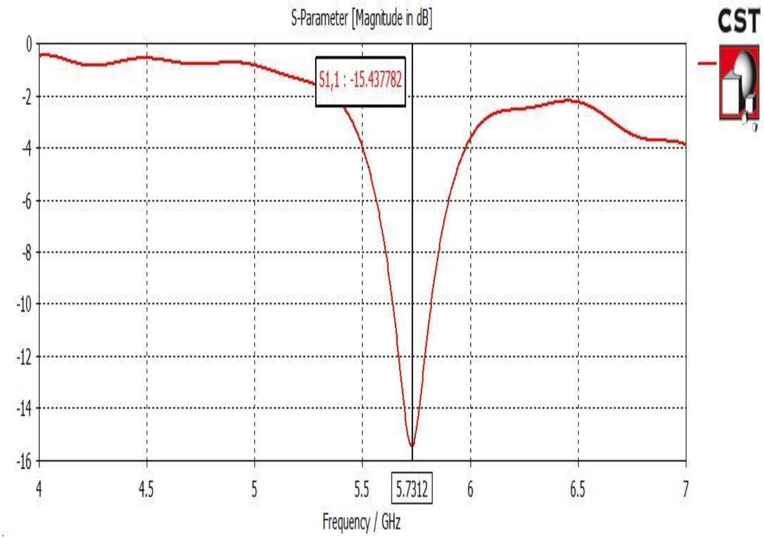

Fig. 2: Simulated Return Loss vs. Frequency of Simple RMPA is-15.43dB at 5.7312GHz

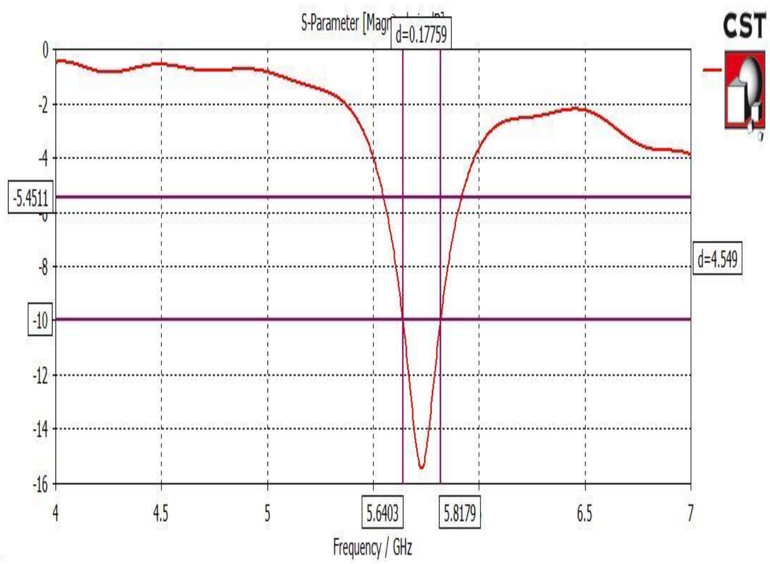

Fig. 3: Bandwidth of Simple RMPA is 177.59MHz

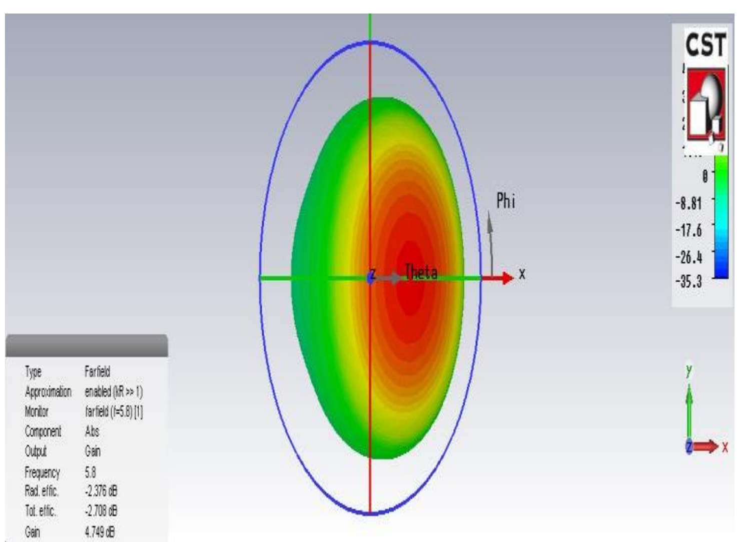

Fig. 4: Total Gain of Simple RMPA is 4.749dB

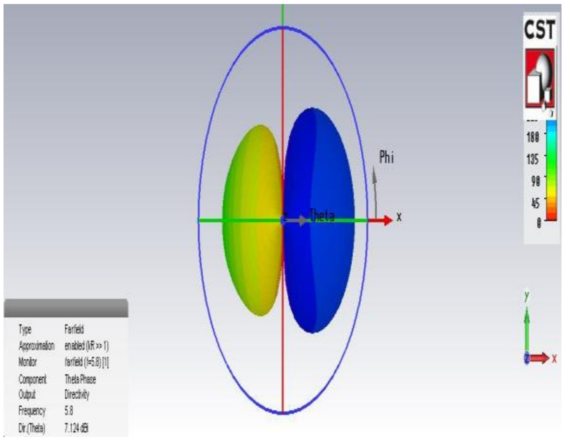

Fig. 5: Total Directivity and radiation pattern of the Simple RMPA is 7.124dB

Table - 1
Parameter of Simple Rmpa for 5.8ghz Communication

Frequency(GHz)	*Return loss(dB)*	*Gain(dB)*	*Bandwidth(MHz)*	*Total Directivity(dBi)*
5.8	*15.43*	*4.749*	*177.59*	*7.124*

As it is very clear from the Fig. 1, Fig. 2, Fig. 3, Fig. 4, Fig. 5 and Table I that, antenna is working on 5.7312 GHz and giving return loss 15.43, Directivity 7.124dbi, bandwidth of 177.59 MHz which is good enough for working of an antenna. Now two Rectangular types parallel DGS has been introduced into the simple microstrip patch antenna in the in Fig. 6.

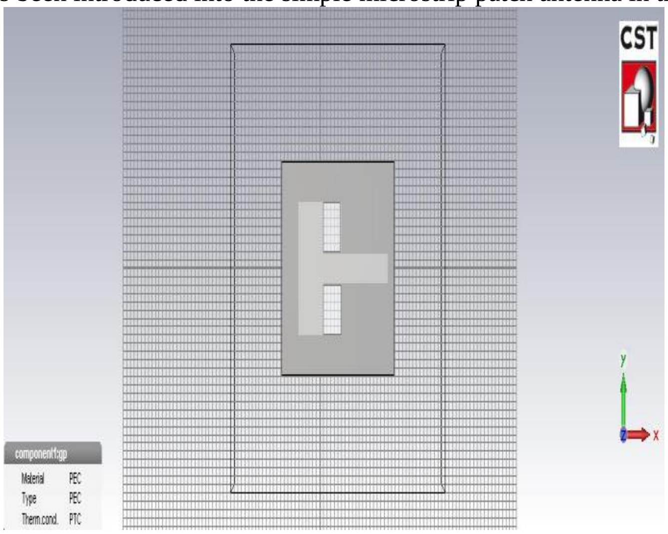

Fig. 6: RMPA with Rectangular DGS for L-band Communication

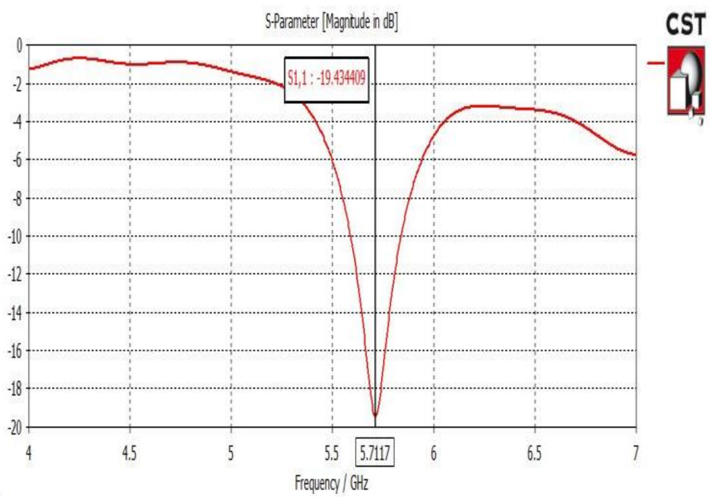

Fig. 7: Simulated Return-loss of RMPA with rectangular DGS is -19.43dB at 5.717 GHz

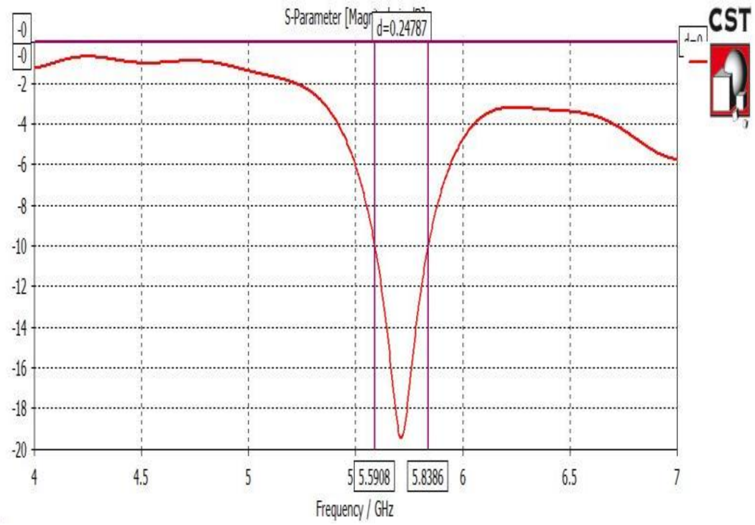

Fig. 8: Bandwidth of RMPA with DGS is 247.87MHz

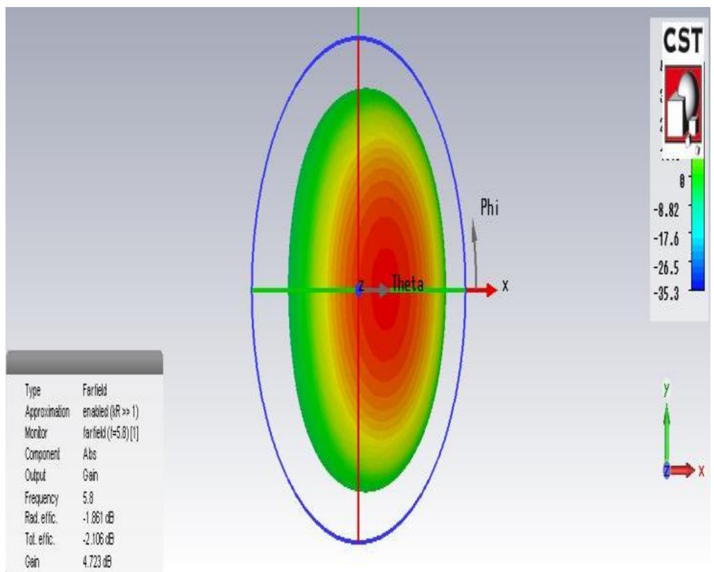

Fig. 9: Total Gain of RMPA with DGS is 4.723dB

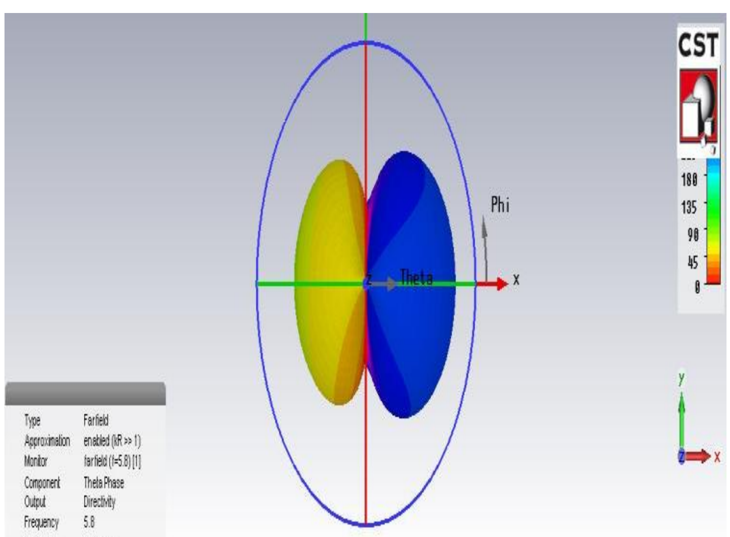

Fig. 10: Total Directivity and radiation pattern of the Simple RMPA is 6.583dBi

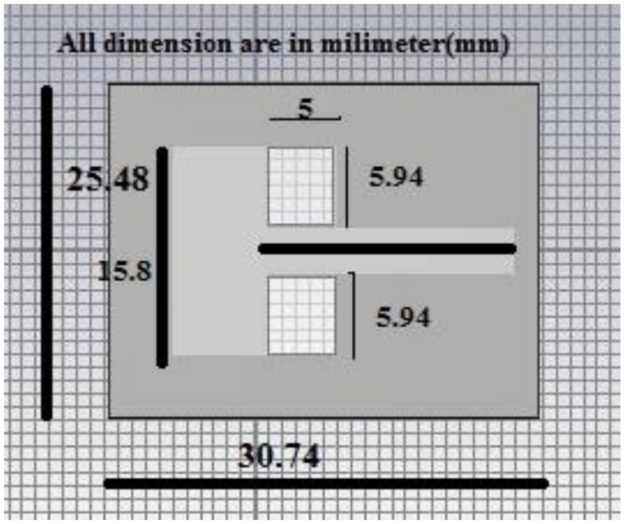

Fig. 11: Dimension of the proposed strip antenna with DGS

Table - 2
Parameter of Slit -Slot Rmpa for Ism-Band Communication

Frequency(5.8GHz)	*Return loss(dB)*	*Gain(dB)*	*Bandwidth(MHz)*	*Total Directivity(dBi)*
5.717	*-19.43*	*4.723*	*247.87*	*6.583*

III. CONCLUSION

The paper concludes from above figures and tables that the DGS Structure of Antenna has improved characteristics like return loss, bandwidth and, due to this improvement in parameters maximum output is achieved. In this paper improvement in bandwidth in great amount this will give the maximum output and gain is also increases in, size of patch antenna is also reduced by defect ground structure gives the great achievement in patch antenna designing system.

IV. RESULT

Comparative study of both the antenna is done as shown, in Fig. 6 and Fig. 1 the size is reduced. From Fig. 2 and Fig. 7 the Return-loss of antenna is decreased about 25.293% Antenna directivity is almost same clear from Fig. 5 and Fig. 10.antenna gain are also almost same shown in figure 4 and 9, bandwidth is increased from 177.59MHz to 247.87MHz as shown in Fig. 3 and Fig. 8 all these results can be justified from Table I and Table II, Dimension of DGS of Patch antenna is also shown in fig 11.

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