# Parameter Enhancement and Size Reduction using DGS of L Band Antenna

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***Abstract–*** Proposed research is the outcome of the detailed literature review and intensive research carried out in the field of parameter improvement of antenna using defected ground structure. In this paper a patch antenna is proposed with the introduction of a slit ring DGS structure to modify its parameters and reduce the size of antenna. Antenna was designed and simulated at 1.95GHz initially but after implementing DGS its radiation efficiency is shifted to 1.58GHz which theoretically a sign of size reduction of antenna. DGS is actually a cut made in the ground plane of the antenna which create a disturbance in radiating power, this disturbance in the ground basically distributes the radiating frequency and make antenna more efficient than ever before.

***Keywords-*** *microstrip patch, DGS, return loss, bandwidth.*

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## I. INTRODUCTION

The MPR is very popular and useful radiator for small charge and solid design for RF uses and Wi-Fi systems. In Wi-Fi cellular phone call and satellite uses, MPR has magnetized a lot interest because of less dimension, cheap on mass production, less burden, short profile and simple incorporation with other parts. Though MPR have extremely attractive characteristics, they usually endure from inadequate bandwidth. Consequently, the very essential drawback of MPR is their narrow bandwidth. To conquer this difficulty without troubling their main benefit (for instance plain structure of printed circuit, less burden and economical), numerous schemes and configurations have just been examined. Presented a novel paper called MPR using Defected Micro-Strip Structure & DGS which reduces the dimension of MPR and do not degrade the performance characteristics as bandwidth and efficiency etc. [1,2]. It has also another application of suppressing the harmonics without establishment of huge attenuation in the base frequency [3].

Proposed a radiator in which there is improvement in efficiency and reduction in size. Mutual coupling reduction and cross polarization decrement etc. are also some of the advantages of using DGS. It is considered as an identical LC resonator circuit. The size and area of the defect determines the value of capacitance and inductance. The effectiveness of MPR is enhanced by 10% using a cavity backed structure, where patch is surrounded by the electric walls [4].Presented a paper in which a series of MPR with DGS for multiband applications have been discussed. These radiators have wide radiation beam and are much lesser size and are suitable in different conditions for WLAN applications. The DGS which is made in the ground plane of the MPR is utilized to achieve small size, gain enhancement and useful multiband [5].

In recent year requirement of having small, compatible and affordable antennas has grown tremendously. As such antennas are versatile, they received very much interest of the researchers and they get attracted to its vast applications and many other advantages. This interest was due to many reasons which cannot be overlooked, like such antennas are able to support more than single wireless standard, cost is very nominal, isolation is very perfect among wireless frequencies. Along with these many advantages it sure has some disadvantages also like having low bandwidth, very low gain but these problems can be overcome by the help of techniques available. In sequence to improve the efficiency and decrease the size which are the basic disadvantages of such antenna any of the available technique can be implemented. Various researchers have worked over the antennas to improve the characteristic of them using DGS to improve the characteristics in order to improve the efficiency and reduce its size.

## II.CALCULATION

In this paper a novel design for miniaturization of patch antenna is presented. In the last few years, the microstrip antenna have been in tremendous use for applications such as radars, satellite, Radio frequency identifications (RFIDs), telemetry, aerospace etc. The microstrip antennas in their conventional form have certain limitations like narrow bandwidth, polarization impurity and large size for better performance. Primarily, the microstrip antennas need to have high gain, compact size, broad bandwidth, flexibility, easyto be fabricated, etc. In particular, bandwidths, polarization, radiation patterns are becoming the most important factors that affect the application of antennas in modern wireless communication systems. Microstrip antenna for applications such as mobile and other portable devices must be small in physical size so that they can be embedded in devices and broadband in nature. The bandwidth enhancements in compact antennas have become a very critical design issue. Researchers in academia and industry have been working in this direction for development of a variety of techniques to build up small broadband antenna designs for different frequency bands.

Several techniques have been illustrated in past to obtain broad bandwidth like use of thick substrate, stacked patches, shorting pins, use of active and passive devices, different feeding arrangement and using impedance matching network. Recently a new technique of defected ground structure (DGS) is being used to enhance the bandwidth of microstrip antennas. In DGS intentional defects are introduced in the ground plane or slots of different shapes.

After calculating required dimensions to design the patch antenna, following patch antenna was proposed at 2.14GHz.

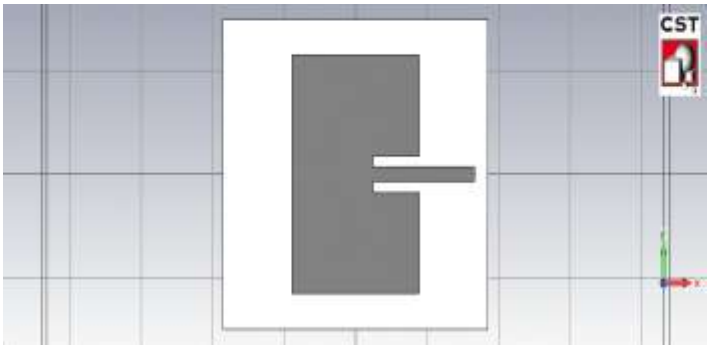


Fig. 1: Patch at 2.14 GHz.

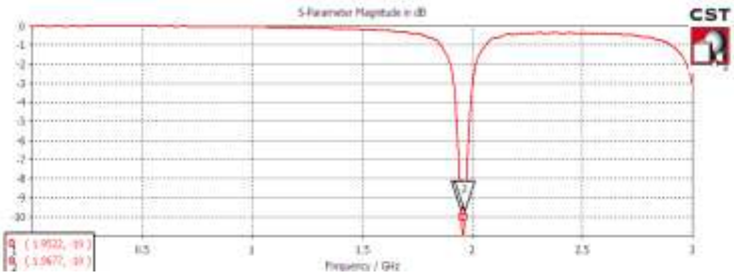


Fig. 2. Simulated result of patch shown in Fig. 1

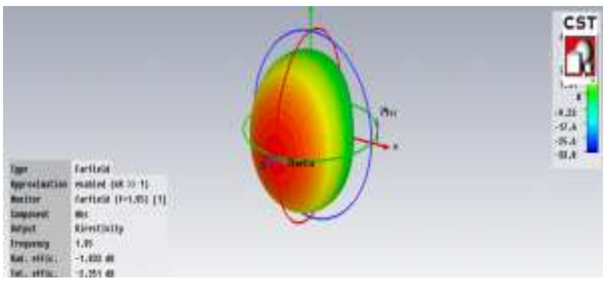


Fig. 3. Simulation result shows directivity, efficiency and radiation pattern.

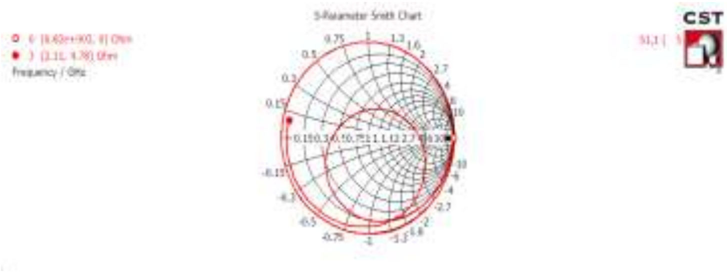


Fig. 4. Smith Chart of the proposed patch without DGS introduction.

These simulated results indicate the characteristic and major parameters of the antenna that are not significantly usable. So, some changes and modification in this antenna is required. This implementation modifies the antenna parameters to a great extent e.g. size [6], efficiency after implementation of defect also increased than later. All the results after implementation of this change are shown in fig. 6 to 8. And the implemented defected structure is shown in fig. 5.

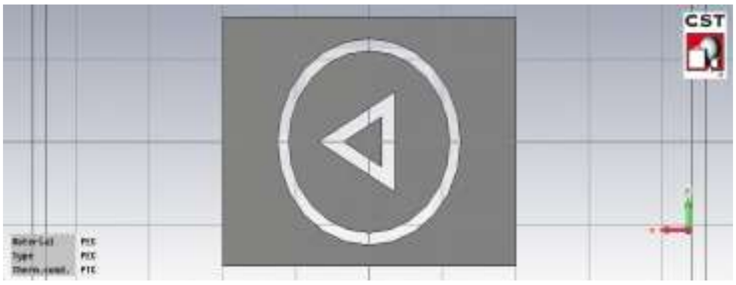


Fig. 5: DGS

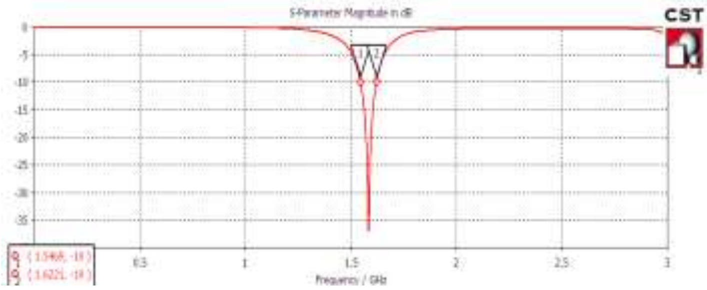


Fig. 6. This is the simulated result of design in figure 5, dip at 1.71GHz.

After introduction of defected ground structure size of the patch reduced as it can be analyzed from the above figure that frequency has been shifted from 2.14GHz to 1.71GHz.The parameters of patch modify drastically, efficiency modifies of the antenna. Radiation pattern results are listed follows.

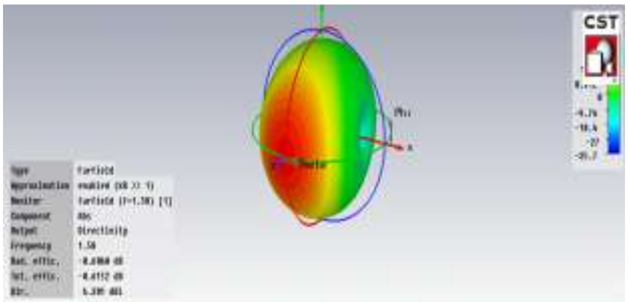


Fig. 7. This is the simulated result of design in figure 5, showing radiation pattern with efficiency and directivity.

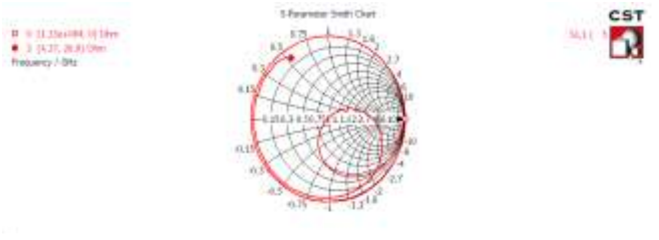

Fig. 8. Smith Chart of the proposed patch after modification.

Fig. 9. Polar plot of the proposed patch after modification.

## III.RESULT

After simulation of patch alone and after modification it has been observed that the antenna performance parameters have been increased drastically after introducing defect on the lower plane. These results are compared w.r.t the parameter variation. Comparative chart is shown below in table 1.

TABLE I: COMPARISON CHART (Size)

| S. no. | Parameters | Parameters of patch at 1.95 GHz | If antenna were designed at 1.58GHz | Reduced size is |
|---|---|---|---|---|
| 1 | Length | 36.7787mm | 45.5054mm | 8.7267mm |
| 2 | Width | 47.2534mm | 58.3191mm | 11.0657mm |

TABLE II: COMPARISON CHART (Parameters)

| S. no. | Parameters | Parameters of patch at 1.95 GHz | After DGS introduction frequency shifted to 1.58GHz |
|---|---|---|---|
| 1 | Return Loss | -11dB | -38dB |
| 2 | Bandwidth | 15 MHz | 75MHz |
| 3 | Directivity | 6.172dBi | 6.381dBi |
| 4 | Efficiency | 65% | 86% |

After the comparison, it has been observed that after modification or applying defect on the ground plane of the antenna frequency of the antenna has been shifted [13] from 1.95GHz to 1.58GHz but along with that all the parameters were improved and antenna is functioning way better than before.

## IV.CONCLUSION

After the comparison it has been examined that the projected DGS structure ameliorate the parameters up to a great level, the proposed DGS method improves the return loss and increased the bandwidth 5 times, and size was also reduced of the patch antenna.

This proposed patch antenna was designed for the applications of L band. Initially antenna parameters were not significantly fulfilling the requirement of the targeted applications but when a slit ring shaped DGS is implemented in the opposite side of patch in ground plane, a significant improvement is achieved. Bandwidth and efficiency were highly improved. Modified patch can be used in L band applications. Size was significantly reduced.

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