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Bandwidth Improvement of RMPA using DGS

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Abstract – In this research paper we proposed a new DGS design to improve the bandwidth of RMPA designed for 2.2GHz operating frequency. In this paper, author proposed a RMPA with DGS to enhance its parameters and mainly bandwidth and directivity of the antenna. To achieve a very important bandwidth and directivity enhancement author proposed a table shaped unsymmetrical DGS in the ground plane. This unsymmetrical DGS on the other side of the patch increases the fringing field which consequently increased the parasitic capacitance. This coupling of patch and ground made the bandwidth and directivity enhanced from the RMPA without DGS.

Keywords – Defected ground structure, patch, bandwidth, directivity.

1. INTRODUCTION

An antenna is defined as a transducer, which works as a part of a transmitting or receiving system designed to radiate or to receive electromagnetic waves. Application of a conventional antenna always limited since they are governed by the 'right hand rule' which determine how electromagnetic wave should behave. Many theories were presented over rectangular microstrip patch antenna and for their parameter improvement. Some of them were use of parasitic elements [1], different feeding techniques [2], metamaterial incorporation [3], and one of the major setback was use of defected ground structure technique [4], it is not only easy to design and cheap in fabrication as well. Not too much calculation required while going through this process.
In recent years various applications of microstrip antenna came into existence like microwave and wireless communication system. Therefore, microstrip antenna is very suitable to apply at various fields like satellite, military, medical application and telecommunication system. Here in this paper authors are interested in studying the performance of a rectangular patch when DGS is introduced in the ground plane of the patch antenna.
This research was conducted on the frequency of 2.2 GHz by designing a RMPA and then a highly inspirational parameter improvement technique which is defected ground structure technique was used. After using DGS technique in RMPA and applying a table shaped structure in ground plane, bandwidth has been improved and directivity too.
DGS is an etched symmetrical or non-symmetrical cascaded configuration defect in ground of a planar transmission line (e.g., microstrip, coplanar and conductor backed coplanar wave guide) which disturbs the shield current distribution in the ground plane cause of the defect in the ground.

2. CALCULATION

A new RMPA has been proposed for the operating frequency of 2.2 GHz. Parameters were calculated by formulas listed in [5] and then a RMPA was designed in CST simulation software and the simulation result were analyzed. Designed RMPA is shown in figure 1 and then in corresponding figures 2 and 3 simulation result were presented of RMPA shown in figure 1.

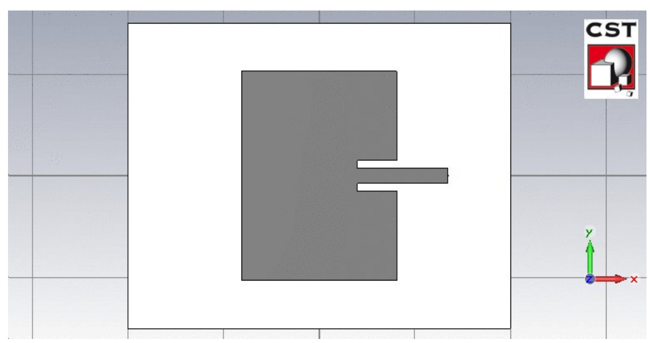

Fig. 1. RMPA at 2.2 GHz

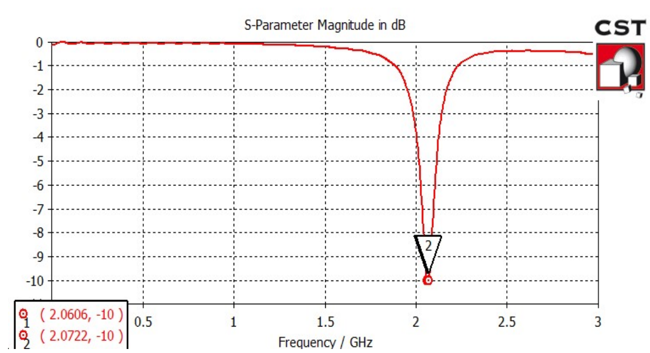

Fig. 2. Simulated result of RMPA shown in Fig. 1 with return loss -10.1dB

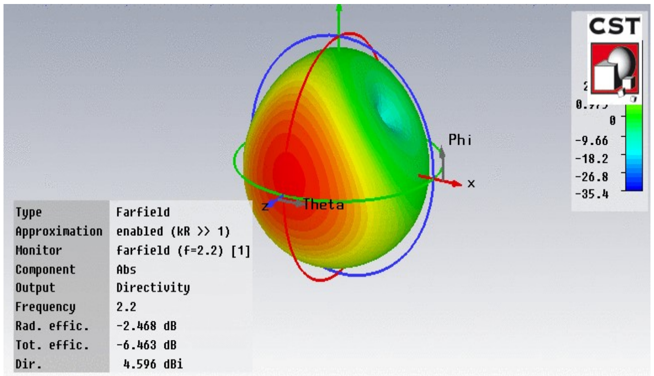

Fig. 3. Simulation result shows directivity, efficiency and radiation pattern.

Designed RMPA was simulated and its result was presented in figure 1, 2 and 3 respectively. Simulated result shows return loss of -10 dB and directivity of 4.596dBi whereas the bandwidth was around 12MHz. These parameters are not fulfilling the requirement so parameter improvement is desirable. To fulfill demand DGS technique was implemented, following is proposed DGS structure in figure 4 and corresponding figure shows its simulated results.

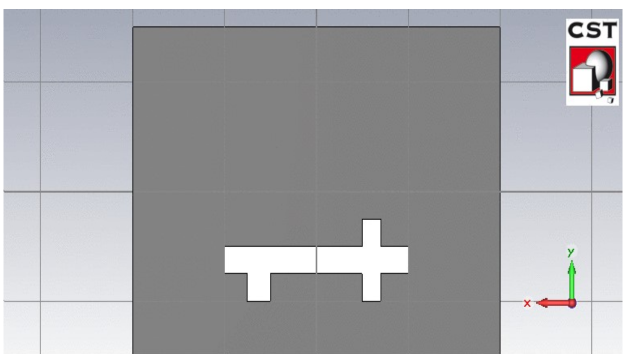

Fig. 4. Proposed DGS on the ground plane.

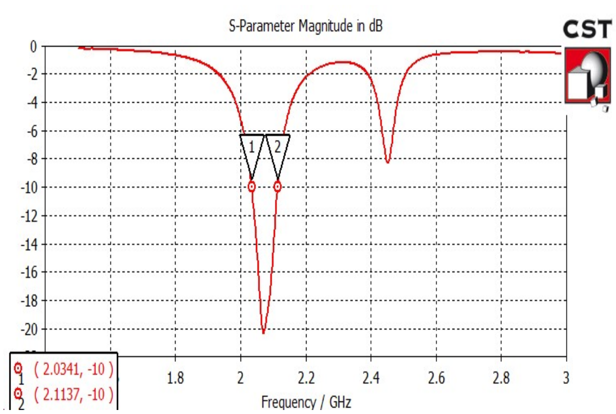

Fig. 5. This is the simulated result of design proposed on ground plane in figure 4, dip at 2.2 GHz.

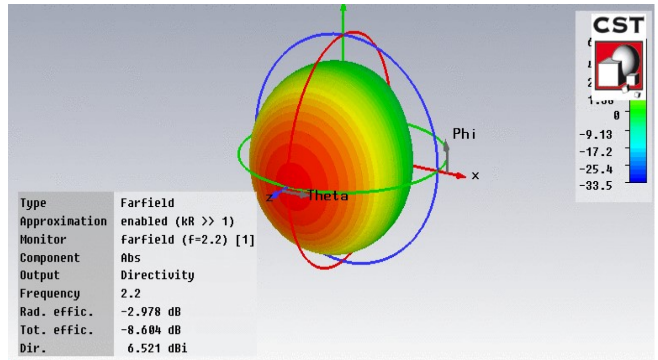

Fig. 6. This is the simulated result of design in figure 4, showing radiation pattern with efficiency and directivity.

3. RESULT

It has been observed by comparing the simulated results shown in fig. 2 & 3 (simulated result of RMPA alone) & in fig. 5 & 6 (simulated result after incorporating DGS) that there is significant improvement is achieved in Return loss, directivity, bandwidth. Efficiency is merely gets affected. These results are compared w.r.t the parameter variation. Comparative chart is shown below in table 1.

TABLE I: COMPARISON CHART

S. no.	Parameters	Parameters of RMPA alone at 2.2 GHz	After DGS introduction At 2.2 GHz
1	Return loss	-10.1 dB	-20 dB
2	Bandwidth	12 MHz	81 MHz
3	Directivity	6.059 dB	5.896 dB

After the comparison it has been observed that the proposed DGS structure ameliorate the parameters up to a great extent, the proposed DGS method improves the return loss and increased the bandwidth above six times the bandwidth of RMPA alone.

4. CONCLUSION

This proposed RMPA was designed for the applications of S band. Initially only RMPA parameters were not significantly fulfilling the requirement of the targeted applications but when a table shaped DGS is implemented in the opposite side of patch in ground plane, a significant improvement is achieved. Bandwidth and directivity was highly improved. Modified patch can be used in S band applications like WLAN and Satellite applications. Bandwidth has been modified up to 600% and so was the directivity which has been modified above 50 %.

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