

DGS Technique for Parameter Enhancement of MSA

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ABSTRACT

In this paper parameters of the micro strip patch antenna (MSA) which is feed by co-axial feed technique is enhanced by using the DGS technique, and comparing the results of different DGS shapes with the original MSA antenna using the HFSS (High Frequency Structure Simulator), which is a commercially available electromagnetic simulator based on finite element method and adaptive meshing technique to achieve the desired specification.

Keywords-HFSS, DGS, MSA and Co-axial feed

1.INTRODUCTION

A Micro strip Patch antenna consists of a radiating patch on one side of a dielectric substrate which has a ground plane on the other side as shown in Figure 1. The patch is generally made of conducting material such as copper or gold. The radiating patch and the feed lines are usually photo etched on the dielectric substrate. Micro strip patch antennas radiate primarily because of the fringing fields between the patch edge and the ground plane. Micro strip antennas are characterized by a larger number of physical parameters than conventional microwave antennas. They can be designed to have many geometrical shapes and dimensions but rectangular and circular Micro strip resonant patches have been used extensively in many applications. In this paper, the design of probe feed rectangular micro strip antenna is for satellite applications is presented and is expected to operate within 2GHz - 2.5GHz frequency span. This antenna is designed on a double sided Fibre Reinforced (FR-4) epoxy and its performance characteristics which include Return Loss, VSWR, and input impedance are obtained from the simulation results, these parameters of the MSA is enhanced using the DGS technique in this paper.

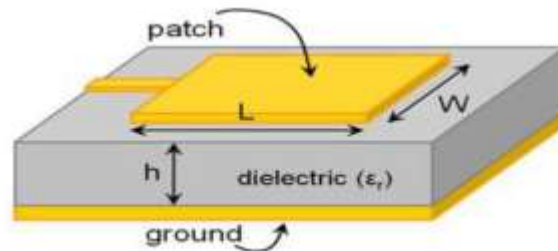


FIGURE 1:Micro strip patch antenna

1.1 Overview of DGS technique

DGS is an etched periodic or non-periodic cascaded configuration defect in ground of a planar transmission line (e.g., micro strip, coplanar and conductor backed coplanar wave guide) which disturbs the shield current distribution in the ground plane cause of the defect in the ground. This disturbance will change characteristics of a transmission line such as line capacitance and inductance. In a word, any defect etched in the ground plane of the micro strip can give rise to increasing effective capacitance and inductance. There are many shapes of DGS available but in this paper we are using Dumbbell shape shown in figure 2.

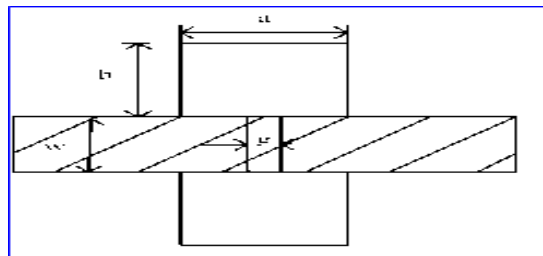


FIGURE 2 dumbbell shape DGS

1.2 ANTENNA DESIGN

Figure 3(a) and 3(b) shows the geometry of proposed coaxial fed micro strip patch antennas with single band operation for WLAN application. The antenna is excited by coaxial feed line designed for a 50 ohm characteristic impedance and is printed on substrate with a thickness of 1.6mm, relative permittivity 4.4 and loss tangent of 0.0009. The dimensions of the proposed antenna are written below:

Variable	Value
Width of the patch (Wp)	40.57mm
Length of the patch (Lp)	31.43mm
Height of the patch (Hp)	1.6mm
Width of the ground (Wg)	50.32mm
Length of the ground (Lg)	41.19mm
Feed Inner Core radius (r1)	.3mm
Feed Outer Core radius (r2)	.68mm

Table 1 Dimensions of the Patch Antenna Design for 2.25 GHz frequency

The proposed antenna is fed by coaxial cable with a characteristic impedance of 50 ohm. So, the outer conductor (from bottom of ground to top of ground) is made of substrate material and inner conductor (from bottom of ground to top of patch) is made of PEC material. The feed point for the proposed antenna is found to be (30.9, 16.66) where the best impedance matching of 46.48 ohm has been achieved which is very much close to 50 ohm. This has been done by applying parametric sweep for locating the feed point in the full range of x-axis in the window of transient solver. Proper impedance matching always yields the best desired result. Location of the DGS shapes and dimensions are explained in the below table for the proposed antenna design.

Variable	Value
Width of the patch (Wp)	40.57mm
Length of the patch (Lp)	31.43mm
Height of the patch (Hp)	1.6mm
Width of the ground (Wg)	50.32mm
Length of the ground (Lg)	41.19mm
Feed Inner Core radius (r1)	.3mm
Feed Outer Core radius (r2)	.68mm
Dimensions of dumbbell shaped slot on the ground	.2mm,3mm and 3mm,7mm

Table 2 Dimensions of the MSA Antennas Resonating at 2.25 GHz Frequencies with DGS technique.

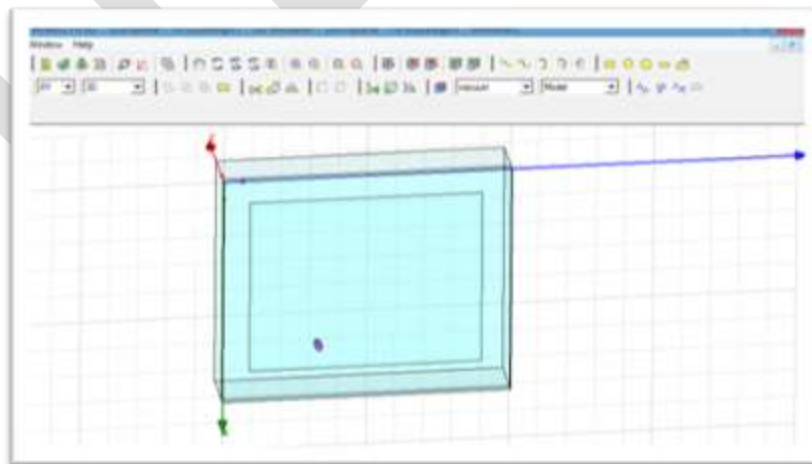


FIGURE 3(a) Designed Structure of MSA on HFSS resonating at 2.25 GHz

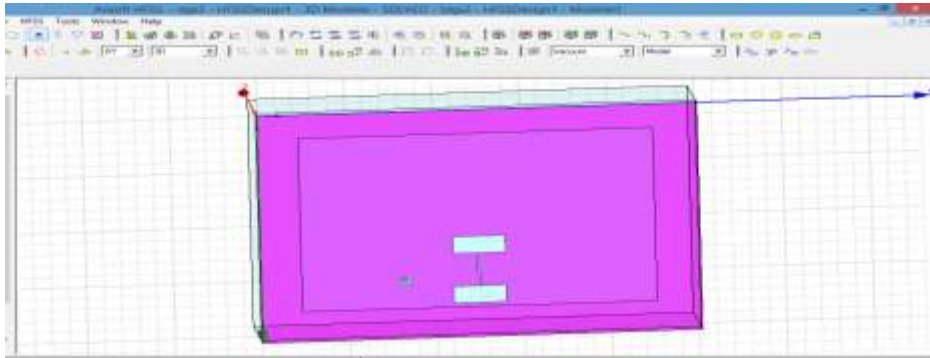


FIGURE 3(b) Simulated Design of MSA with Dumbbell shape DGS

2. SIMULATIONS AND RESULTS

The simulation results of the above designed antenna of various parameters like return loss, impedance, directivity and VSWR are given by using HFSS.

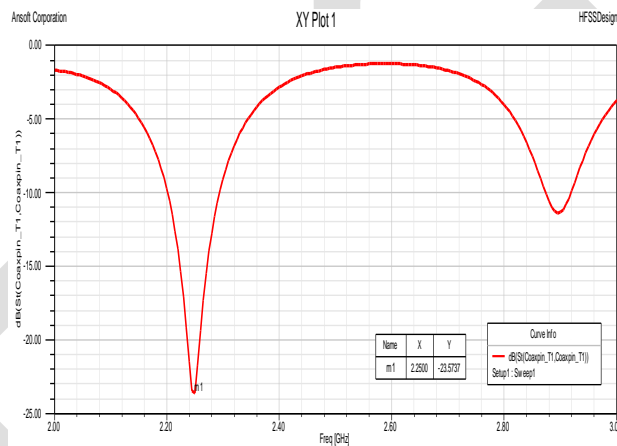


Figure 4 Simulated Return Loss of MSA Resonating at 2.25 GHz

The above designed antenna shows good return loss approximately -24dB which is an excellent result. This antenna resonates at 2.25 GHz frequencies which is applicable for Wireless Local Area Network (WLAN standards- 2.2-2.483 GHz for IEEE 802.11 b/g) applications and gives a bandwidth of approximately 90 MHz. The bandwidth is calculated by subtracting lower frequency from the upper frequency at -10dB. The proposed antenna design gives good impedance of approximately 45 ohms which shows that the antenna is perfectly matched and the power loss is minimum. The result of the designed antenna is given below.

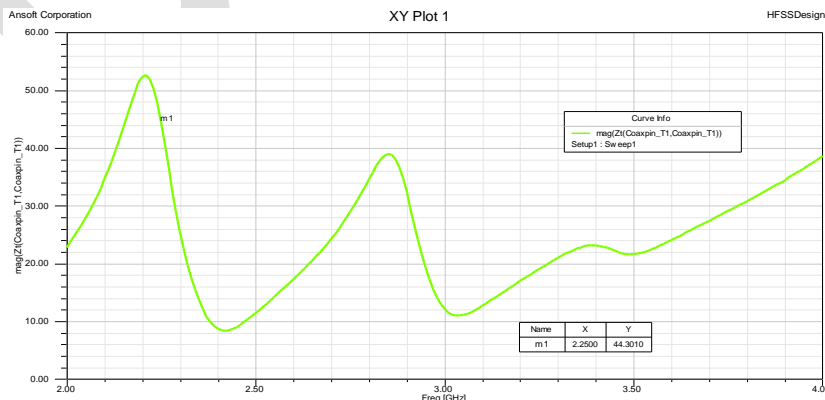


Figure 5 Simulated impedance of MSA Resonating at 2.25 GHz

The designed antenna shows the VSWR of 1.1421 at 2.25 GHz frequency

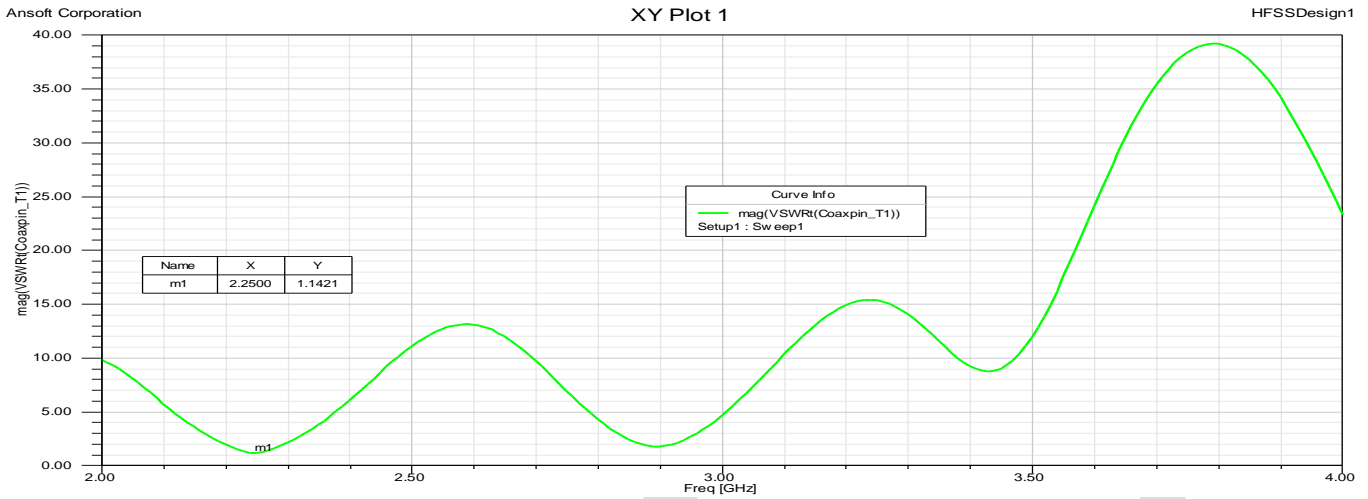


Figure 6 Simulated VSWR of MSA at 2.25 GHz

The results of the above designed

Parameters	Values
Operating frequency	2.25GHz
Return loss	-23.5
Impedance	45
VSWR	1.1421
Bandwidth	90

antenna are summarized in the following table.

Table 3 Summary of Parameter Values of Designed Antenna at 2.25 GHz frequency

2.1 Simulation Result for dumbbell shape

The above designed antenna gives return loss of -28.13dB and bandwidth 90MHz of at 2.25GHz. The simulated results of the proposed antenna are given below

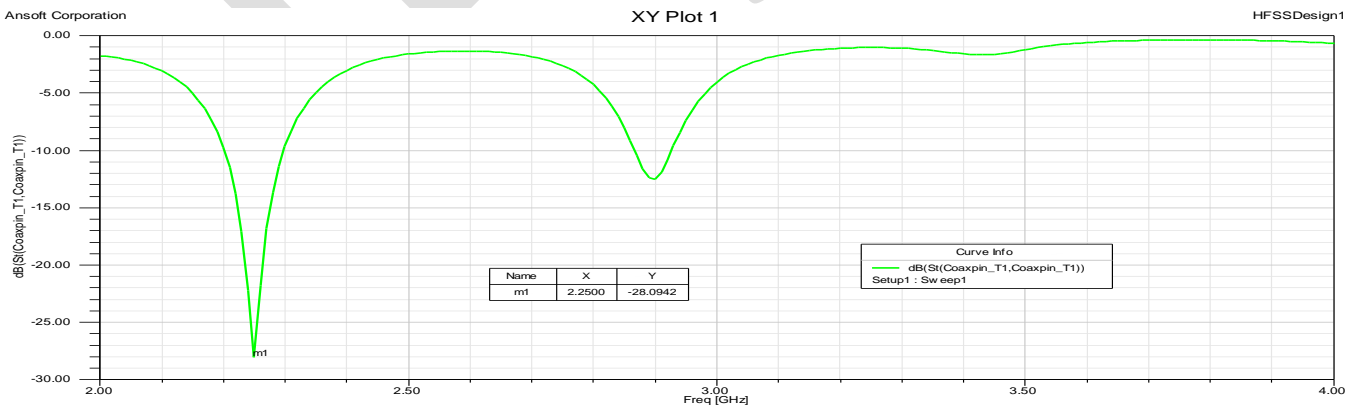
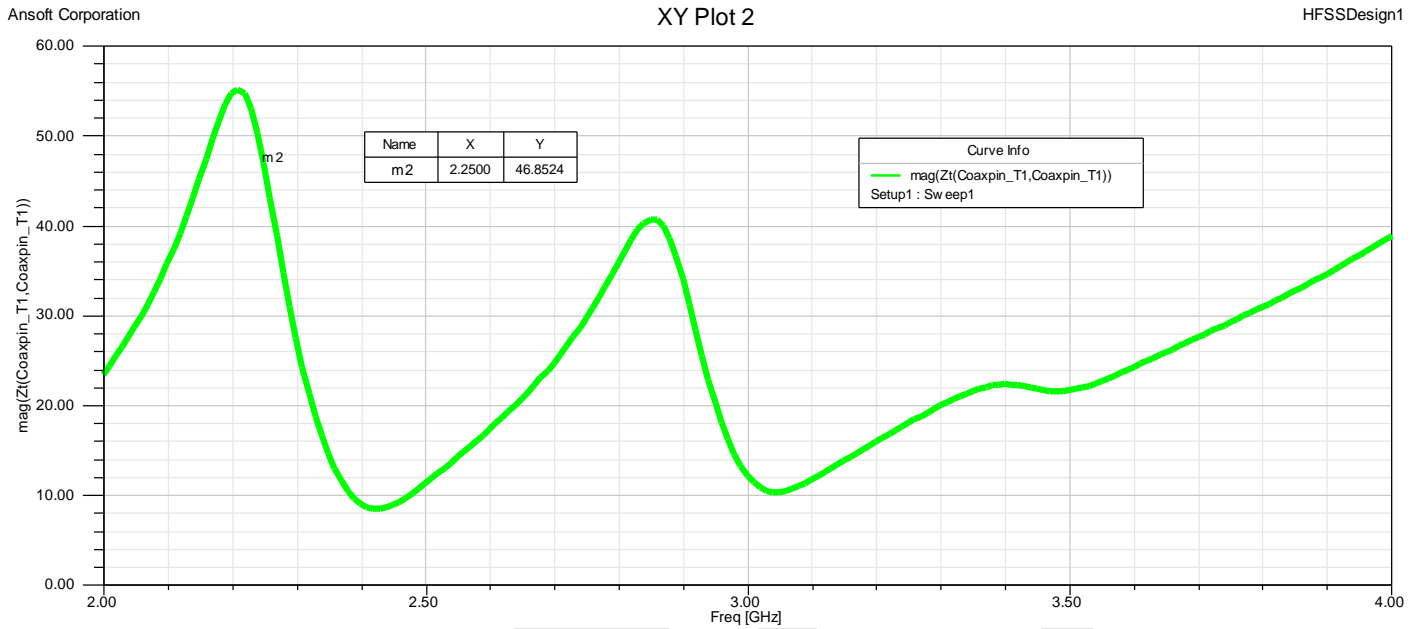


Figure 7 Simulated Return Loss of MSA Resonating at 2.25 GHz with dumbbell DGS

The designed antenna gives an impedance of around 47 ohms which is nearby 50 ohms so it is acceptable. The simulated result of impedance is given below

Figure 8 Simulated impedance of MSA Resonating at 2.25 GHz with dumbbell DGS



The simulated antenna gives VSWR of 1.08 at 2.25GHz. The simulation results of VSWR at 2.25 resonating frequency are given as follows.

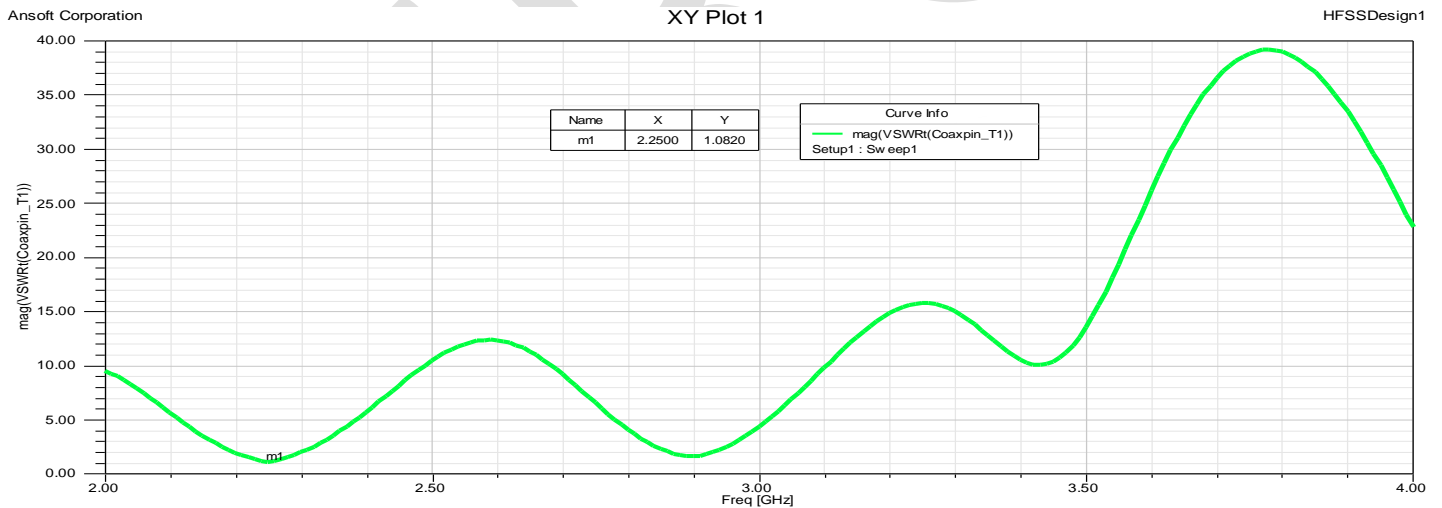


Figure 9 Simulated VSWR of MSA Resonating at 2.25 GHz with dumbbell DGS

The results of the above designed antenna are summarized in the following table

Parameters	Values
Operating frequency	2.25Ghz
Return loss	-28.09
Impedance	46.85
VSWR	1.08
Bandwidth	90

Table 4 Summary of Parameter Values of Designed Antenna at 2.25 GHz frequency

3. CONCLUSION

In this paper, we presented the design of a rectangular patch antenna covering the 2GHz–2.5 GHz frequency spectrum. It has been shown that this design of the rectangular patch antenna produces a bandwidth of approximately 4% with a stable radiation pattern within the frequency range. The design antenna exhibits a good impedance matching of approximately 50 Ohms at the centre frequency. The parameters of the antenna is enhanced by the DGS technique used above, a comparison table between the MSA antenna and the antenna with DGS is shown below which conclude that DGS improves the Overall efficiency of the MSA.

Parameters	MSA without DGS	MSA with Dumbbell DGS
Operating frequency	2.25 GHz	2.25 GHz
Return loss	-23.5	-28.09
Impedance	45	46.85
VSWR	1.1421	1.08
Bandwidth	90	90

Table 5 Comparison of Parameter Values of different Antennas at 2.25 GHz frequency

The table above shows that the antenna is acceptable, for various applications. The return loss, VSWR is minimum in dumbbell shape DGS technique and higher line impedance compare to other antenna which is very good for the communication.

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REFERENCES:

- 1) Balanis, C.A., "Antenna Theory Analysis and Design", 3rd Edition. New Jersey, John Wiley and Sons, 2005.
- 2) Theodore S. Rappaport, "Wireless Communication and Practice", Second Edition, 2002.
- 3) Lee, H. F., and W. Chen, "Advances in Microstrip and Printed Antennas", New York, John Wiley & Sons, 1997
- 4) RajeshwarLalDua, Himanshu Singh and NehaGambhir, International Journal of Soft Computing and Engineering (IJSCE) ISSN: 2231-2307, Volume-1, Issue-6, January 2012.
- 5) Ashwini K. Arya, M.V. Kartikeyan and A.Patnaik, Frequenz 64 (2010) 5–6.
- 6) J. P. Geng, J. J. Li, R. H. Jin, S. Ye, X. L. Liang and M. Z. Li, "The Development of Curved Microstrip Antenna with Defected Ground Structure" Progress In Electromagnetic Research,PIER, vol. 98, pp 53-73, 2009.
- 7) JaswinderKaur and Rajesh Khanna, "Co-axial Fed Rectangular Microstrip Patch Antenna for 5.2 GHz WLAN Application", Universal Journal of Electrical and Electronic Engineering 1(3):94-98, 2013.
- 8) Ansoft HFSS for SI –3rd Edition HFSS Release: 11.1, Published Dat