

**Design of UWB MIMO Antenna with DGS Structure****Komal**GGGI, Kurukshetra University
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Abstract— An ultra wideband multiple-input-multiple-output antenna having compact size of only $22 \times 36 \text{ mm}^2$ is proposed for portable ultra wideband (UWB) applications in this paper. The antenna consists of two square monopole-antenna elements, a T-shaped ground stub to improve matching of antenna, a vertical slot cut on the T-shaped ground stub is used for better isolation. Simulations and measurements are used to study the antenna performance in terms of radiation efficiency, gain, return loss and directivity. Zealand IE3D software is used to perform simulations. The objective of this paper is to design a UWB MIMO antenna with DGS structure and compare performance characteristics with MIMO antenna without DGS.

Keywords— IE3D Software, DGS Structure, UWB (Ultra wideband), MIMO, Mutual Coupling

I. INTRODUCTION

The demand for high data rate and good channel capacity is always the primary area of concern in the modern era of wireless communication systems. The race for this contributes to the popularity of multiple-input multiple-output (MIMO) systems [1], which can utilize the diversity technique to improve the reliability of the communication systems by mitigating the vulnerable multipath fading problem. Researches show that incorporating MIMO technique with ultra wideband (UWB) provides a viable solution to many drawbacks of UWB communications [2]. This will help to achieve data rate of more than 1 Gbps for wireless communication. But researches on compact UWB MIMO antennas are very scant in the literature. The main difficulty in UWB MIMO system is to achieve isolation between the radiating elements. An ultra wideband multiple-input-multiple-output antenna having compact size of only $22 \times 36 \text{ mm}^2$ is proposed for portable ultra wideband (UWB) applications in this paper. The antenna consists of two square monopole-antenna elements, a T-shaped ground stub to improve matching of antenna, a vertical slot cut on the T-shaped ground stub is used for better isolation. In this we implement DGS structure for the improvement of characteristics of antenna.

A. DGS Structure

In this for the improvement we implement DGS structures in the design of the antenna. A Defected Ground Structure (DGS) is an etched lattice shape, which is located on the ground plane. DGS has arbitrary shapes and is located on the backside metallic ground plane. DGS is realized on the bottom plane with one island placed at both sides of the microstrip line on the upper plane. The characteristics of the defected ground structure are:

- Disturbs shielding fields on the ground plane.
- Increases effective permittivity.
- Has one-pole LPF characteristics (3dB cutoff and resonance frequency).
- Size reduction for the component.

II. ANTENNA DESIGN

The geometry of proposed MIMO antenna is shown in Fig. 1 which has two planar monopole antennas with a very compact size of $22 \times 36 \text{ mm}^2$. In our MIMO antenna shown in Fig. 1, for simplicity, we use square-shaped radiators for the planar monopole elements. In Fig. 1, the T-shaped ground stub protruding vertically between the monopole elements is used to improve matching of the antenna. A long ground slot is cut vertically on the T-shaped ground for better isolation between the two input ports.

Table I Parameters of Antenna

W	L	a	b	c	d
36	22	8	6	3	3.5
e	f	g	h	i	
8	20	4	1	17	

The MIMO antenna is designed using the IE3D tool on a Rogers R4 substrate with a dielectric constant ϵ_r of 3.5, a loss tangent of 0.004, and a thickness of 1.6 mm. The dimensions for the final design are listed in Table I. All dimensions are in mm.

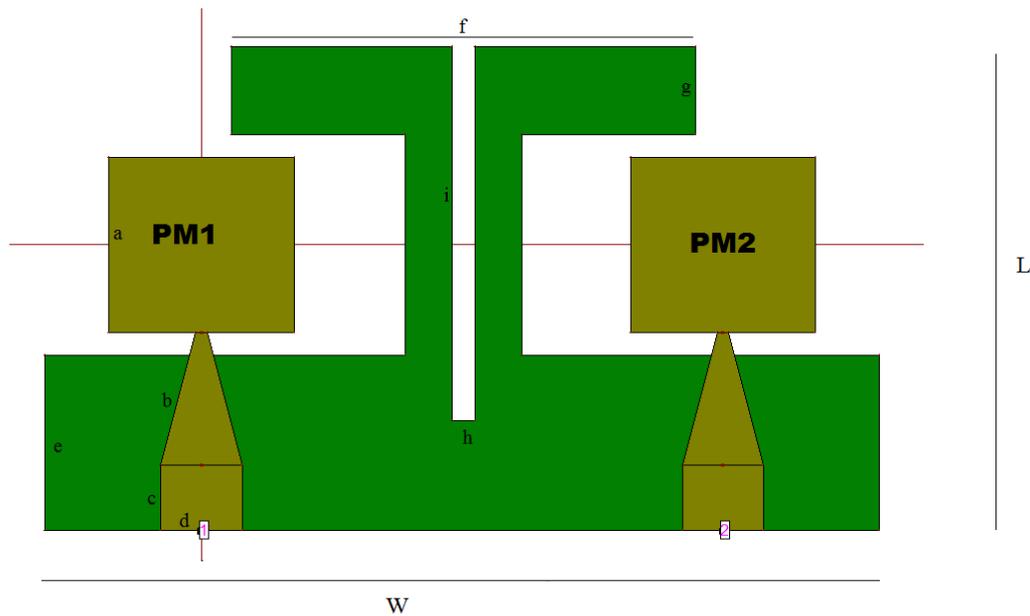


Fig.1 UWB MIMO antenna without DGS

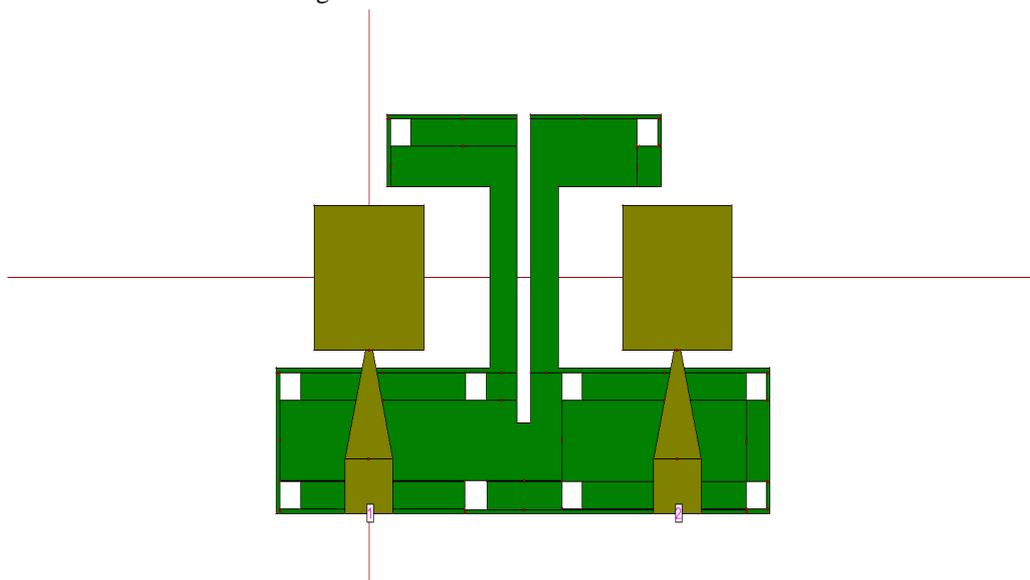


Fig. 2 UWB MIMO antenna with DGS

III. RESULTS

The antenna is designed using Zealand IE3D software. Various results such as return loss, radiation efficiency, directivity etc. are presented in this section. The comparison of above mentioned two structures is given in Table II.

Table II Comparison of Two Antenna Structures

Antenna Type	Return Loss (dB)	Directivity (dBi)	Gain (dBi)	Efficiency (%)
UWB MIMO antenna without DGS	-26	5.7	3	81
UWB MIMO antenna with DGS	-30	11.2	8	76

From Table II it is clear that the performance of UWB MIMO antenna with DGS is better than the antenna without DGS. Return loss has been decreased from -26dB to -30dB when DGS is applied. Directivity has also been improved very much with DGS structure i.e. from 5.7dBi to 11.2dBi. Gain is increased from 3dBi to 8dBi while efficiency is decreased from 81% to 76%. Thus the use of DGS structure in antenna has many advantages over wireless communications.

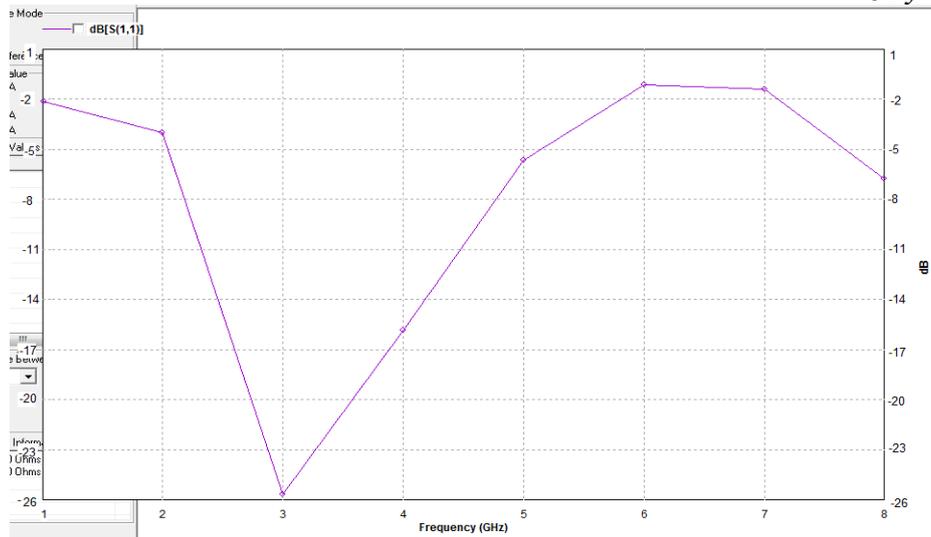


Fig.3 Return loss of UWB MIMO antenna without DGS

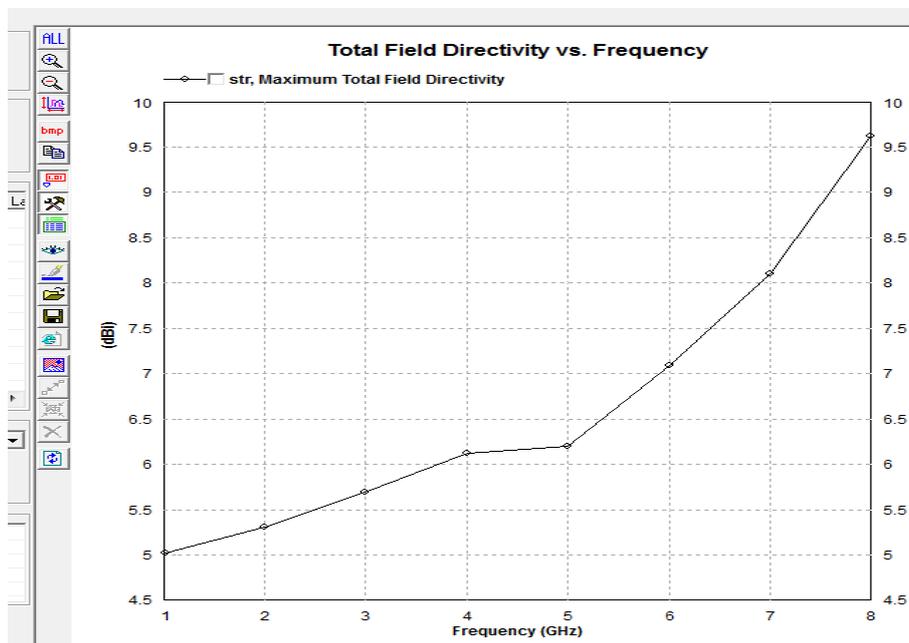


Fig.4 Directivity of UWB MIMO antenna without DGS

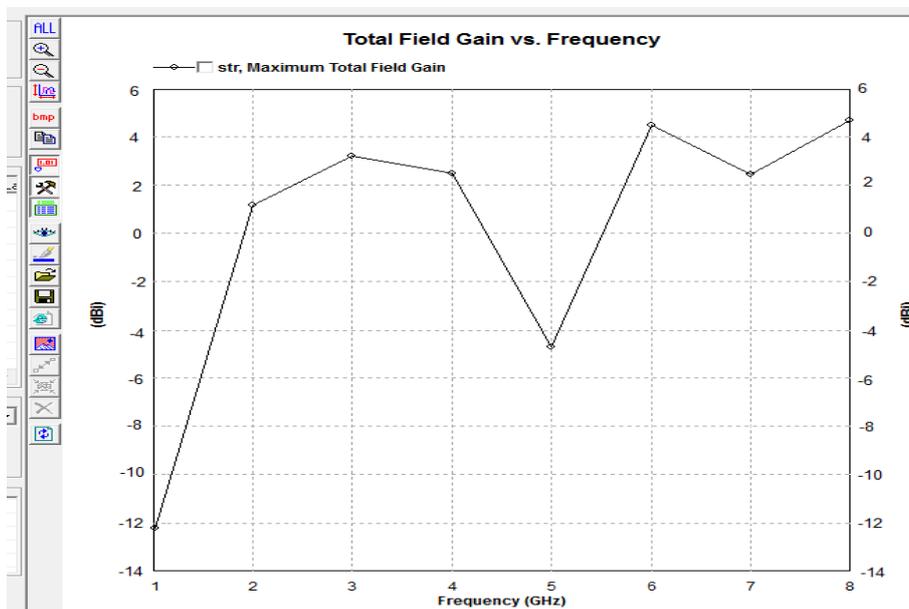


Fig.5 Gain of UWB MIMO antenna without DGS

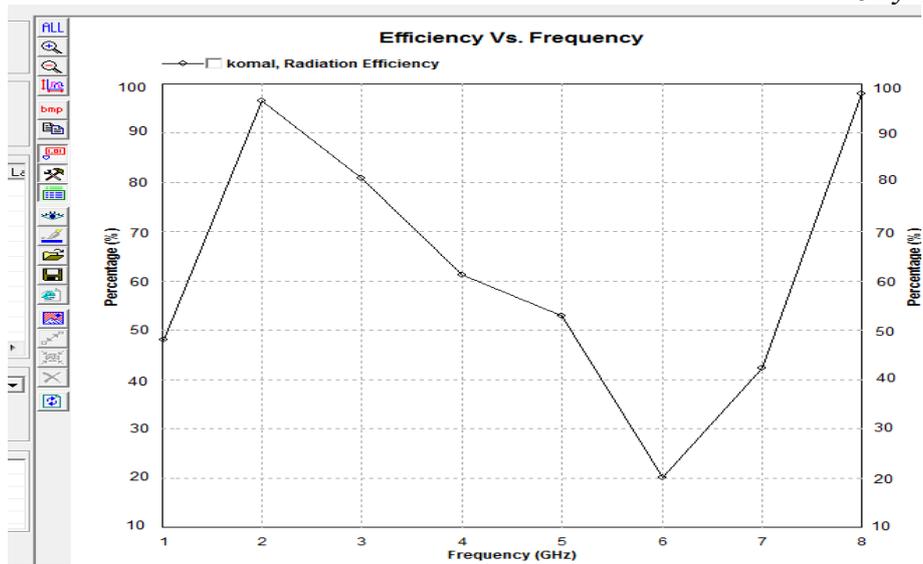


Fig.6 Efficiency of UWB MIMO antenna without DGS

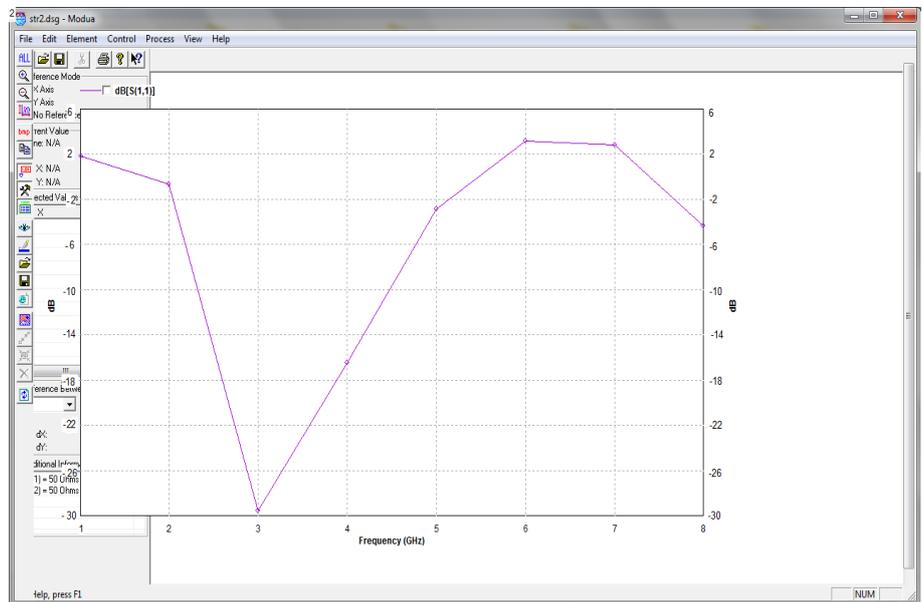


Fig.7 Return loss of UWB MIMO antenna with DGS

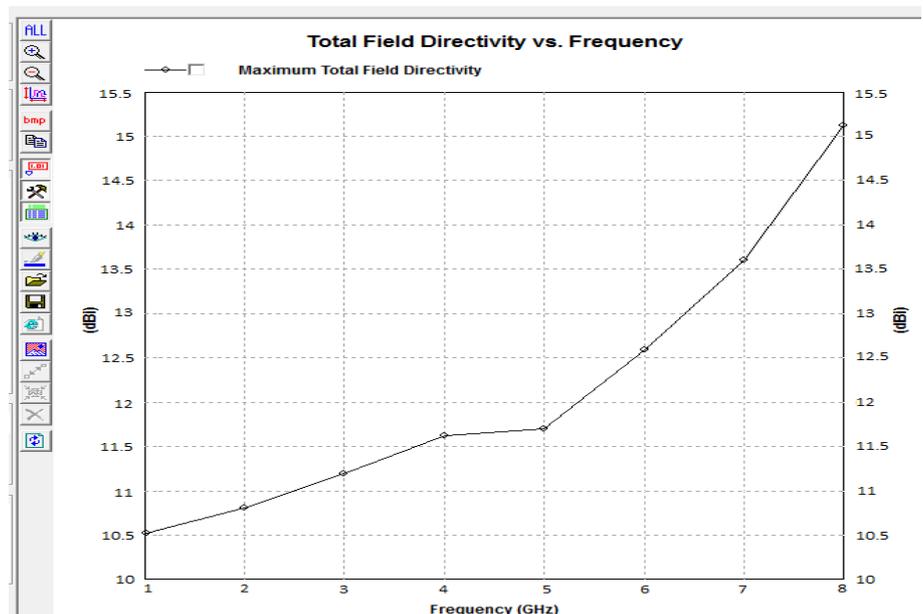


Fig.8 Directivity of UWB MIMO antenna with DGS

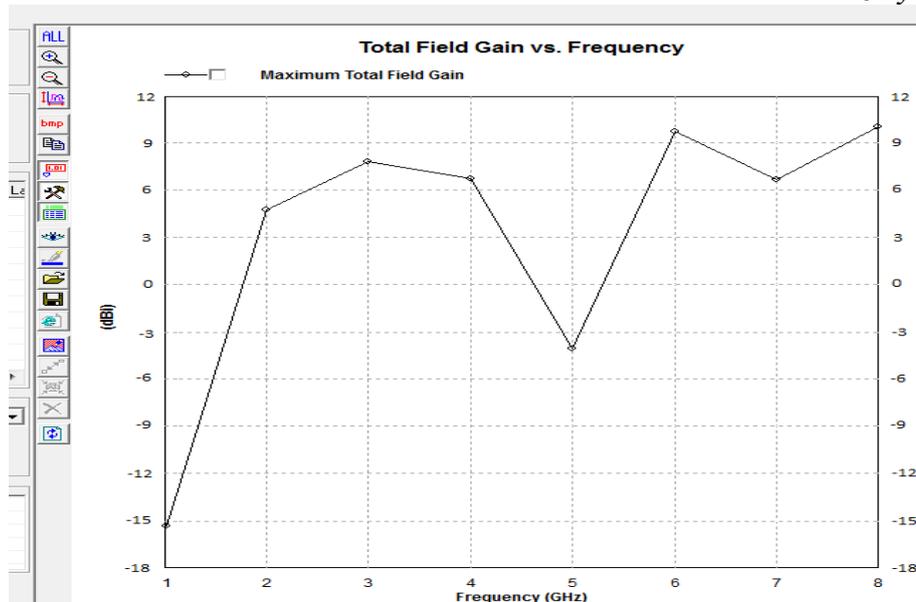


Fig.9 Gain of UWB MIMO antenna with DGS

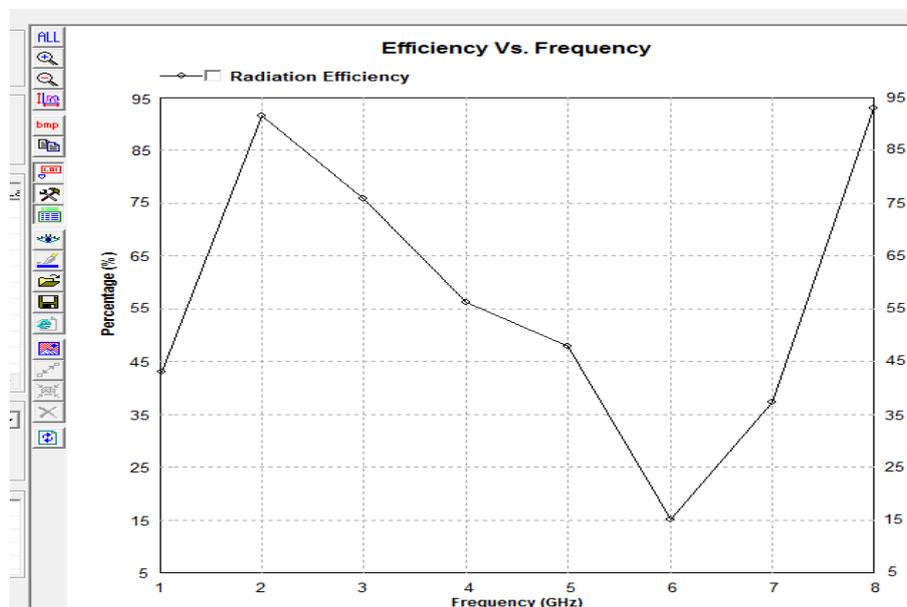


Fig.10 Efficiency of UWB MIMO antenna with DGS

IV. CONCLUSIONS

A UWB MIMO antenna with DGS structure has been presented in this paper. MIMO technique has been considered one of the best solutions to improve reliability and capacity of UWB systems. While designing UWB MIMO antenna the problem of mutual coupling arises. High isolation between two ports is achieved by etching ground slot in the antenna structure. Furthermore, antenna performance is increased by implementing DGS structure in UWB MIMO antenna.

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