Microstrip Antenna with Split Circular Ring Shaped DGS Structure for WLAN Applications

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Abstract – Paper is outcome of DGS inspired antenna which was proposed for the WLAN applications of S band. Proposed antenna is designed at 1.8GHz frequency. DGS of split ring shaped structure was implemented later to modify the antenna characteristics. Modified results increases the return loss up to -37dB from -12dB and increased the bandwidth to 41.4MHz from 38MMHz.

Keywords- Defected Ground Structure (DGS), Microstrip Patch Antenna (MPA), Split Ring Structure (SRS), Computer Simulation Technology (CST).

I. Introduction

The patch behaves like a transducer which contains resonant like cavity having its barriers like short circuit elements on front and back of the substrate. In a confined space or cavity there is only assured forms are permitted to be present, at unusual radiating frequencies. If frequency is applied to the radiator, a powerful ground is set up within cavity and a powerful current on the (base) ground of the patch. This generates important radiation (perfect radiator). These types of radiator are of very low cost and easy to fabricate and possess very large number of qualities. Microstrip patch antenna converts the electromagnetic waved into the electrical signal at the time of receiving and do vice versa at the time of transmission of the signal. Many theories were presented over rectangular microstrip patch antenna and for their parameter improvement [1-2].

A defected ground structure [3] was used to design the antenna for radiolocation application of radar. Four rectangular slots and one circular slot was etched in the ground plane to modify the characteristics.

In view of the multiband characteristic an antenna is designed comprising 4 bands at L band and above [4]. Asymmetrical DGS structure was implemented in the ground plane to enhance the characteristics of the antenna. Operating frequencies were 2.58, 3.02, 5.58, 6.44GHz.

Defected ground structures of U and H shape, and their combination [5] was used in this proposed design to reduce the size of the antenna. 86% size reduction was achieved and bandwidth was achieved in the range of 105MHz to 1700MHz. This antenna is proposed for the applications of Laptop and cellphones.

The proposed rectangular microstrip patch antenna is designed at 1.8 GHz frequency. Bandwidth of 41.4 MHz (1.78 GHz to 1.82 GHz) is achieved with a return loss -39 dB. By applying the defected ground structure (DGS) of four circular rings shaped, the return loss, bandwidth, gain, and efficiency has been improved. The proposed frequency is used for WLAN application.

II. Microstrip Patch Antenna Design

The geometry of proposed rectangular microstrip patch antenna with ground plane is shown in fig 1. In proposed design, the substrate FR 4 lossy is used due to its low cost and easy fabrication. The substrate height is 1.6 mm,

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dielectric constant 4.4 and the loss tangent is 0.021.

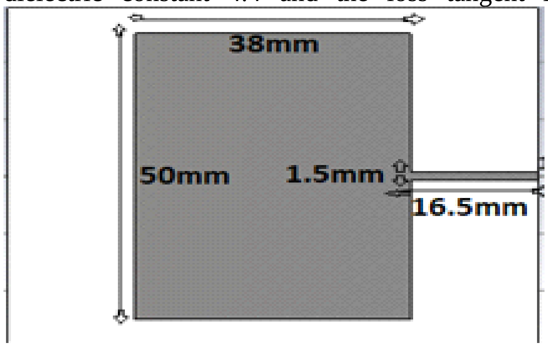

Fig.1 Micro Strip Patch Antenna

Simulated result of this designed antenna is shown in figure 2 below, indicating return loss of -14.2dB at 1.8MHz.

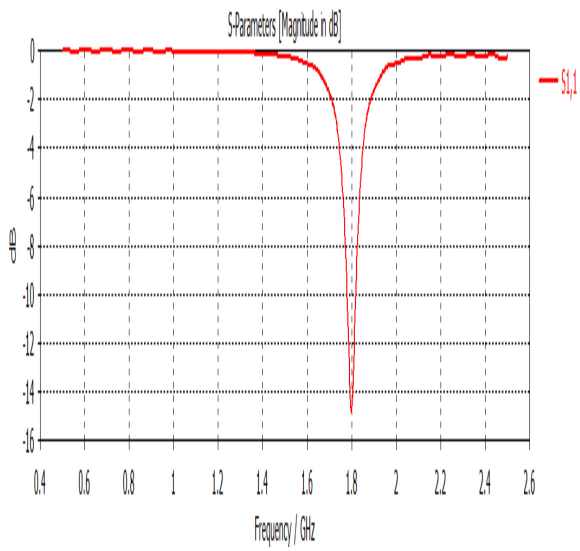

Fig. 2 Simulated Result of Antenna Shown In Fig. 1.

The dimensions of proposed antenna are optimized by using CST microwave studio tool as shown in table 1

Table 1
Dimensions of Micro Strip Rectangular Patch Antenna

Parameter's	**Dimensions (mm)**
Length of Ground	73
Width of Ground	59
Length of Patch	38
Width of Patch	50
Length of Feed line	16.5
Width of Feed line	1.5

Nine circular rings were drawn on the ground plane. The inner and outer radius of the circular is 4.5mm and 2.5mm respectively. The distance between the circular rings is 19 mm to each other.

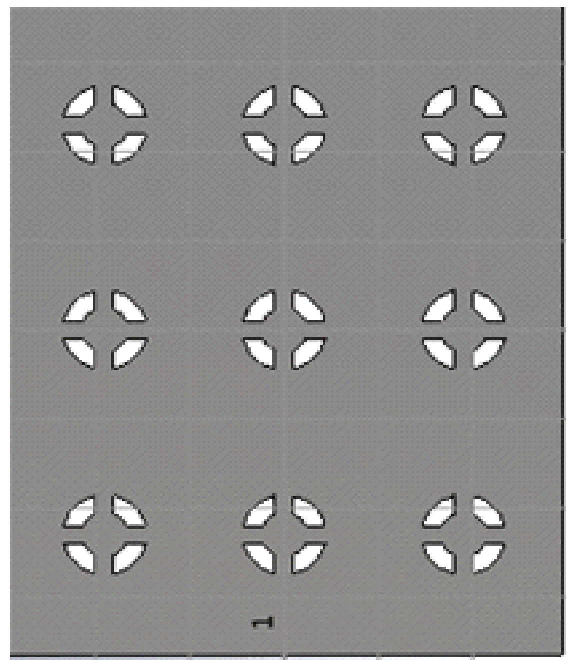

Fig.3 Micro Strip Patch Antenna With DGS

In fig.4, the microstrip patch antenna S_{11} (return loss) with DGS is presented for comparison. Bandwidth of the microstrip antenna without the DGS was quite low while the antenna bandwidth with the DGS is expanded to 41.4MHz.

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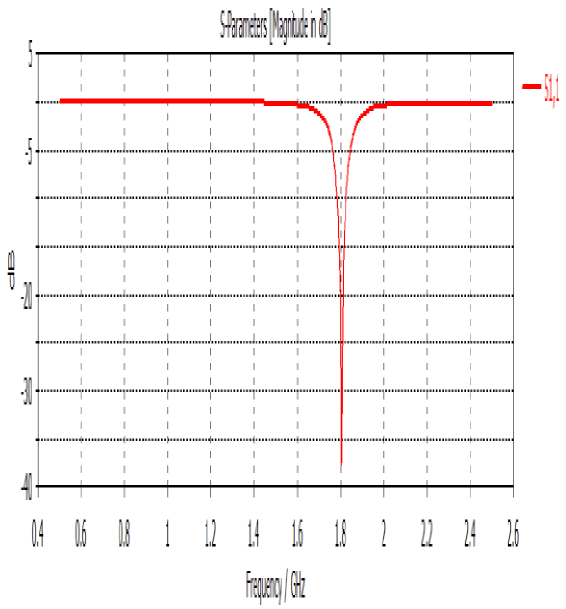
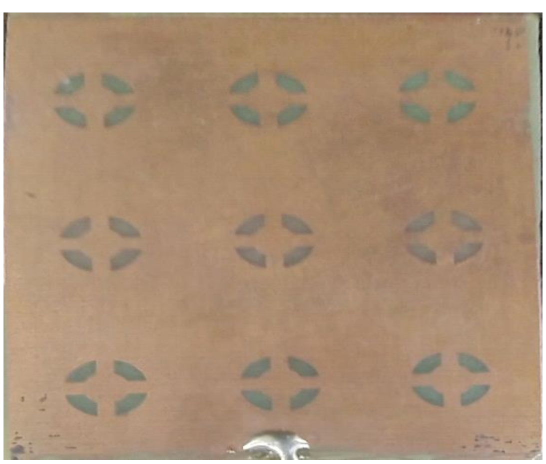


Fig 4 Simulation of Return Loss For The Antenna With DGS

- Top View



(b) Bottom View

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Fig 5 Fabrication of Microstrip Patch Antenna

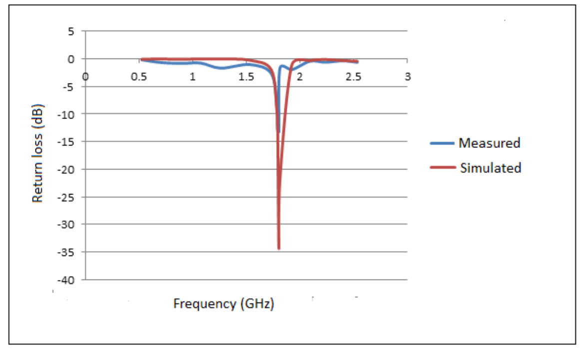

Fig 6 Simulation and Measured S_{11} Of The Microstrip Patch Antenna With DGS

In order to measure the scattering parameters of the proposed antenna, the employing spectrum analyzer, which frequency range is 3 GHz. Thus, the S_{11} parameter was measured and compared to the simulated results.

Fig.5 (a) shown a micro strip antenna without DGS and (b) represent the applied DGS on the ground plane. Both the antennas are resonating at 1.8 GHz. The defected ground plane on microstrip patch antenna allows us to improve the return loss, band width, gain, directivity, efficiency etc.

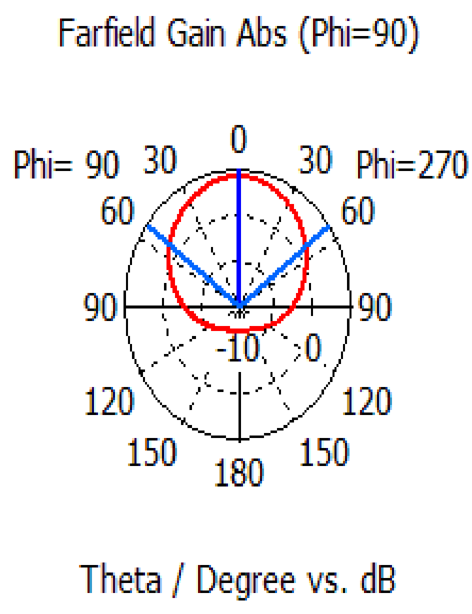

Fig.7 Radiation Pattern For Micro Strip Patch Antenna Without DGS

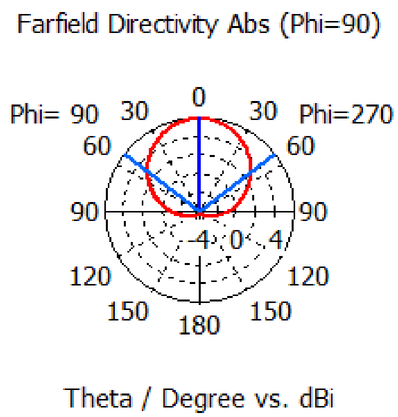

Fig.8 Radiation Pattern For Microstrip Patch Antenna With DGS

Table 3
Comparison between Microstrip Patch Antenna Without Dgs And With Dgs At 1.8 Ghz

S. no.	Parameters	without DGS	With DGS	Implementation of %
1	Return Loss	-14.78	-37.26 dB	60.3
2	Bandwidth	38 MHz	41.4 MHz	8.2
3	Directivity	5.906 dBi	5.96 dBi	1
4	Efficiency	43.95%	66%	33
5	Gain	4.12	4.17	1

The radiation patterns present in fig. 7 and 8 are obtained for our DGS microstrip patch antenna and for a proposed microstrip patch antenna at 1.8 GHz, respectively. Gain achieved after DGS implementation is 4.17dB. It was found that after implementing DGS on the ground plane of the antenna the parameter was modified efficiently.

III. Conclusion

By observing table 3 it is clearly indicating the demarcating achievement in the parameter modification achieved. Proposed 9 split ring shaped DGS, implemented on the ground plane significantly improved the bandwidth & return loss. Antenna was designed on the 1.8GHz frequency and simulation results indicated that it is not best suited for the WLAN applications, so to create the antenna for S band applications in WLAN DGS was implemented and significant improvement was achieved.

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