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].

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,
The dielectric constant is 4.4 and the loss tangent is 0.021.

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

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

<table>
<thead>
<tr>
<th>Parameter's</th>
<th>Dimensions (mm)</th>
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<tbody>
<tr>
<td>Length of Ground</td>
<td>73</td>
</tr>
<tr>
<td>Width of Ground</td>
<td>59</td>
</tr>
<tr>
<td>Length of Patch</td>
<td>38</td>
</tr>
</tbody>
</table>

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.

In fig.4, the microstrip patch antenna S11 (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.
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.
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 4.17 dB. 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.

### References


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