International Journal of Electrical & Electronics Research (IJEER)
FOREX Publication
Multi-disciplinary | Open Access | ISSN: 2347-470X

Date of Publication: February 3, 2019 | Volume 7, Issue 1 | Pages: 1-3

Design of Microstrip Patch Antenna with DGS for GSM application

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ABSTRACT: In the present paper a micro strip patch antenna with DGS for GSM application is designed and simulated at 1.8 GHz frequency. DGS is applied in the shape of circular rings on the ground plane. Without DGS the return loss is -12 dB, which is further improved to -22dB by applying DGS. The simulated results such as impedance, bandwidth, directivity, gain and radiation pattern are analyzed and compared for with and without DGS.

Keywords: Defected Ground Structure (DGS), Microstrip Patch Antenna (MPA), Circular Ring Structure (CRS), Computer Simulation Technology (CST).

1. INTRODUCTION

Now a days, tremendous amount of spatio-temporal Now a day, in wireless communication system, the size of the micro strip patch, gain, bandwidth, efficiency and other parameter with good results is a research area. Several techniques have been proposed such as by using dielectric substrate of high permittivity, defected ground structure, slots on the patch etc. [1-2]. Defected ground structure is easy to implement and widely used to enhance the antenna performance parameters. Various types of slots such as circular ring, rectangular, triangular and shape of alphabet have been in literature proposed. [3].

Microstrip patch antenna has been designed in the frequency band 1.558 to 1.588GHz by applying the fractal geometry on the ground plane as a DGS and a circularly polarization is achieved [4].

A microstrip patch antenna is designed at frequency 5.7GHz by applying the slots of microstrip lines with various periodic structure on the ground plane is resonating at 3GHz.[5]

By introducing various circular slots with hexagonally shaped arrangement using genetic algorithm, higher order modes of proposed RMPA after 5.8 GHz is suppressed. [6]

Simple RMPA is designed and its performance parameter is compared with RMPA having a defected ground plane. The antenna is simulated at 2.4 GHz using CAD-FEKO simulation software. [7]

In this proposed paper, a rectangular microstrip patch antenna is designed at 1.8 GHz frequency. Bandwidth of 38 MHz (1.77 GHz to 1.8 GHz) is achieved with a return loss -12 dB. By applying the defected ground structure (DGS) of four circular rings shaped, the return loss, bandwidth, gain, directivity and efficiency is also improved. The proposed antenna is used for GSM application, wireless communication and radio frequency signal.

2. MICROSTRIP PATCH ANTENNA DESIGN

The geometry of proposed rectangular microstrip patch antenna with ground plane is shown in fig 1. In this design, the substrate FR 4 lossy is used due to its low cost and easy fabrication. The substrate height is 1.6 mm, dielectric constant 4.4 and the loss tangent is 0.021. The dimensions of proposed antenna are optimized by using CST microwave studio tool as shown in table 1.

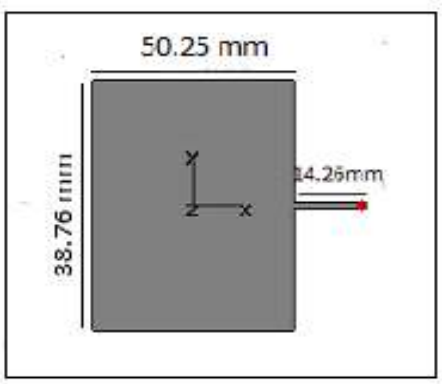

Fig.1 Geometry of proposed Micro strip patch antenna at 1.8 GHz

TABLE 1: Dimensions of proposed Micro Strip Rectangular Patch Antenna at 1.8 GHz

Parameter's	Dimensions (mm)
Length of Ground	74
Width of Ground	60
Length of Patch	38.76
Width of Patch	50.24
Length of Feed line	14.26
Width of Feed line	2

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Four circular rings were drawn on the left side of the ground plane. The inner and outer radius of the circular is 5mm and 7mm respectively. The distance between the circular rings is 2 mm to each other.

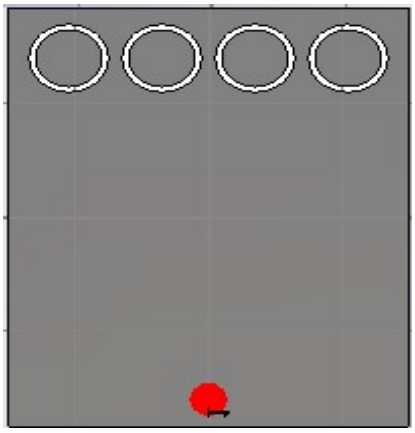


Fig.2 Micro strip patch antenna with DGS

In fig.3 the simulated return loss of proposed microstrip patch antenna with and without DGS is present. Bandwidth of the microstrip antenna without the DGS is 38 MHz while the antenna bandwidth with the DGS is expanded to 40MHz.

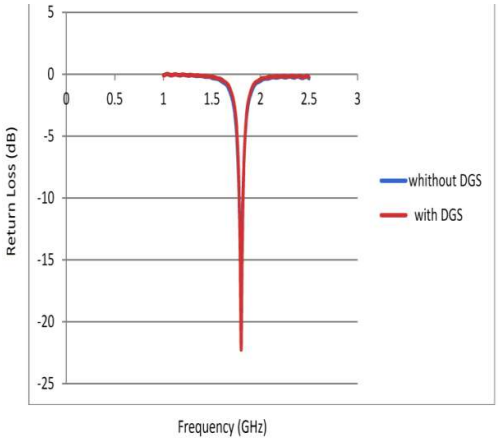
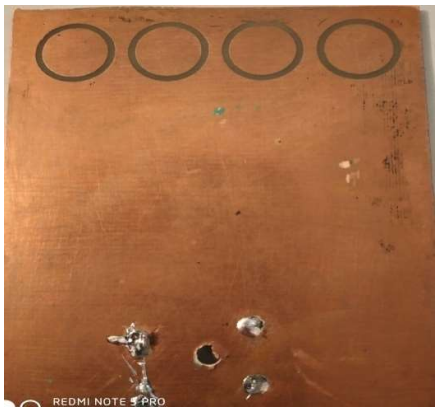


Fig.3 Simulation return loss of proposed antenna with DGS and without DGS

(a) Top View



(b) Bottom View

Fig 4 Fabrication of microstrip patch Antenna

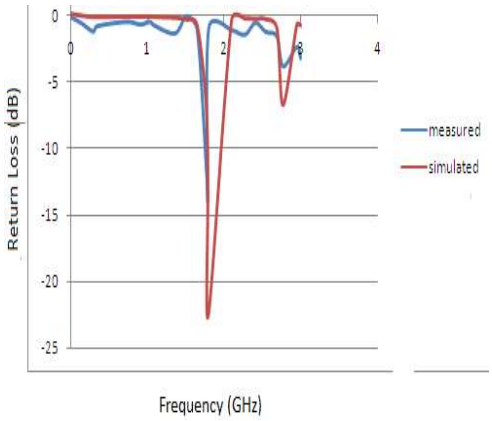


Fig 5 Simulated and measured return loss of the proposed antenna with DGS

The return losses of proposed antenna are measured with the help of spectrum analyzer. Fig.5 shows the simulated and measured result of proposed antenna.

Fig.6 shows the simulated radiation pattern of proposed antenna with DGS at a frequency of 1.8 GHz. It is clearly seen in the fig. 6, the half power beam width of the antenna is 106.6 deg.

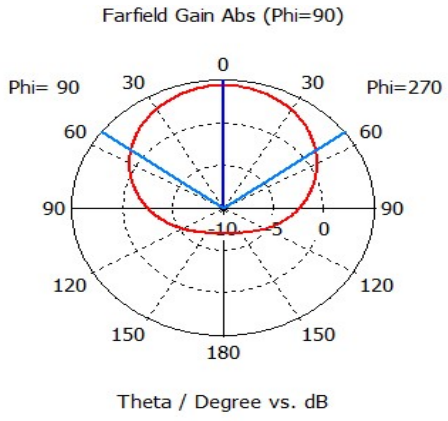


Fig.6 Radiation pattern for microstrip patch antenna with DGS.

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TABLE 2: Comparison between the proposed antenna parameters without DGS and with DGS at 1.8 GHz

S. no.	Parameters	Without DGS	With DGS	Implement ation of %
1	Return Loss	-14.78 dB	-22.26 dB	33%
2	Bandwidth	38 MHz	40 MHz	5%
3	Directivity	5.906 dBi	5.911 dBi	0.50%
4	Efficiency	43.95%	53.53%	17.80%
5	Gain	4.12	4.332	4%

All the above parameters in the table to an improved after applying the DGS on the antenna.

CONCLUSION

Proposed patch antenna is designed for the application GSM. Initially antenna parameters were not significantly fulfilling the requirement of the targeted applications but when slit ring shaped DGS is implemented in the opposite side of patch in ground plane, a significant improvement is achieved. Bandwidth and efficiency were highly improved. Modified patch can be used in GSM application.

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