QUAD BAND CIRCULAR MICROSTRIP ANTENNA WITH DGS

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Abstract - The paper presents a novel design of a circular patch antenna with a defected ground structure (DGS) for multi band operation. The antenna is fed with coaxial probe. A comparative study of antenna without DGS and with DGS is presented. Simulation is carried out with CST studio suite 2013. Return loss VSWR and radiation patterns are also presented.

Index Terms— Circular patch antenna, Defected ground structure, Multi band.

I. INTRODUCTION

Microstrip antennas have been rapidly developed in recent years. These are very useful because of the advantages like light weight, low-cost, low profile and planar structure [1-2]. But the inherent limitation is its narrow band width. To improve the impedance bandwidth and radiation effiencies the circular patch is used [4]. Efforts have been devoted to improve the bandwidth. Recently many defected ground structure patch antennas have been rapidly developed for multiband and broadband operation [3-5]. DGS is realized by introducing a defected shape on a ground plane. They may disturb the shielded current distribution depending on shape and dimensions of defect. The DGS is equivalent to an LC resonator circuit. The value of inductance and capacitance depends on the area and size of the defect [3]. By varying different dimensions of the defect, the desired resonance frequency can be achieved [5-7]. DGS is basically used in microstrip antenna design for different applications such as antenna size reduction, cross polarization reduction, mutual coupling reduction in antenna arrays; harmonic suppression etc. [8-11].The paper proposes a novel design of a circular patch antenna with triangular DGS for multiband operation. The proposed design is fed with coaxial probe feeding. The main advantage with this type of feeding technique is easy to vary the probe location.

II. ANTENNA DESIGN

The geometry of a circular patch antenna without the defected ground plane is shown in fig.1 and the dimensions are tabulated in table-1. The circular patch is designed on a commercially available substrate Rogers RT 5880 having a dielectric constant of 2.2 and height of the substrate is 0.79m. Radius of the circular patch is 9mm. Initially the probe location was kept at (4, 0).

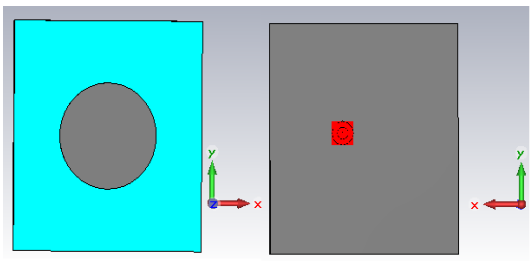

Fig.1.Top view and bottom view of the proposed antenna without DGS.

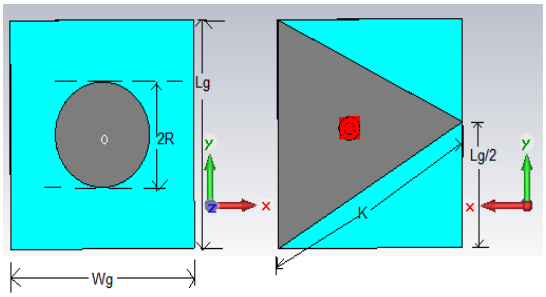

Fig.2.Top view and bottom view of the proposed antenna with DGS

Table-1 Dimensions of proposed Antenna

Parameter	Lg	Wg	R	K
Value(mm)	39	35	9	40.06

The probe location is optimized to improve the performance to double band.To get the double band operation the probe location is fixed at (4,-1). Then, the ground plane is defected with symmetric triangular structure as shown in fig.2.By defecting the ground plane the quad band operation is achieved.

III. SIMULATION AND RESULTS

Results are compared for both the antenna structures, structure without ground plane and structure with defected ground plane. When the ground plane is not defected, it considers the entire substrate; the simulated return loss is shown in fig (3). From the graph, antenna shows a good return loss of -15dB at 8.55GHz and another band with return loss of -17.5dB at 10.4GHz.When a triangular symmetric DGS is introduced, the simulated plot is shown in fig (4). The antenna exhibits multiband characteristics. The resonance frequencies are 5.1GHz, 8.5GHz, 10.4GHz, 15.3GHz With return loss of -16dB ,-30dB ,-22dB , and –29dB respectively. Fig.5. represents the VSWR plot of the antenna with DGS. Figs.6-8 Show 3D radiation at different resonant frequencies.

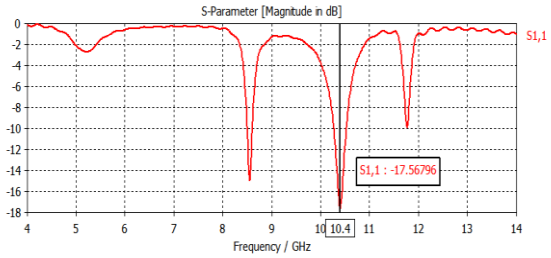

Fig.3.Return loss plot of the proposed antenna without DGS.

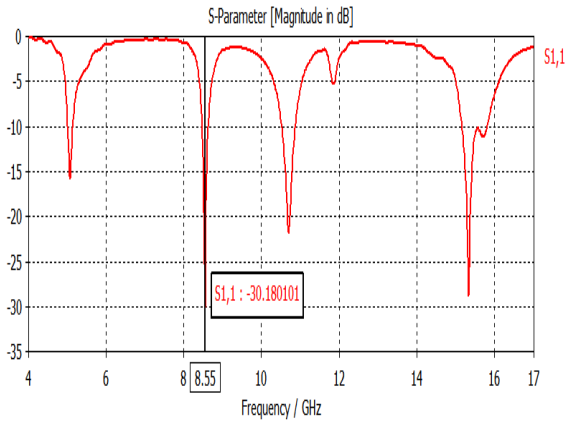

Fig.4.Return loss plot of the proposed antenna with DGS

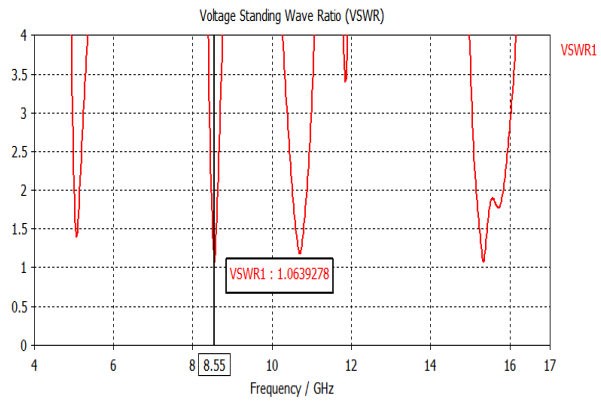

Fig.5.VSWR plot of the proposed antenna with DGS

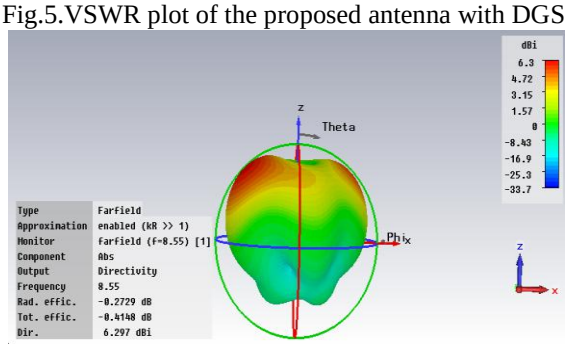

Fig.6. Radiation pattern of the proposed antenna at 8.55GHz

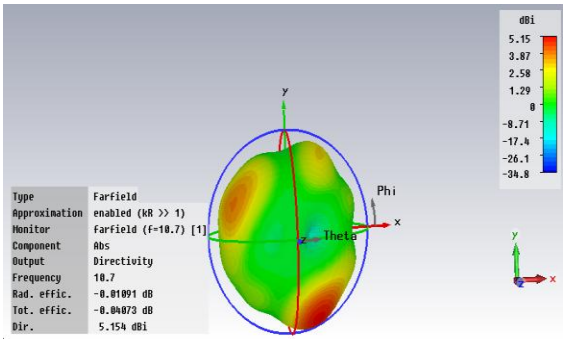

Fig.7. Radiation pattern of the proposed antenna at 10.7GHz

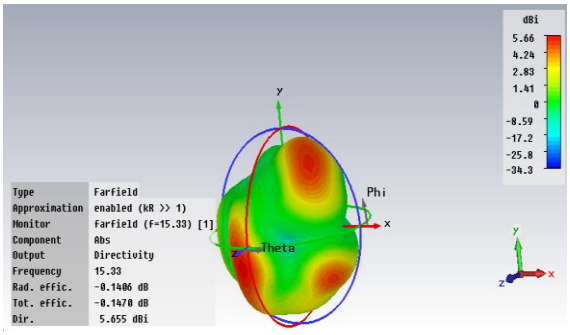

Fig.8. Radiation pattern of the proposed antenna at 15.33GHz

IV. CONCLUSION

A novel symmetric triangular shaped defected ground structure is employed in a circular Microstrip patch antenna. It is therefore observed that by introducing the defected structure, the performance has been improved. Quad band characteristics are observed at 5.1GHz, 8.5GHz, 10.4GHz and 15.3GHz**.** The maximum directivity of 6.3dBi is achieved.

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