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MICROSTRIP ANTENNA WITH DEFECTED GROUND STRUCTURE FOR MULTIBAND APPLICATIONS

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ABSTRACT

Two different antenna designs have been designed , analyzed & compared in this paper. First one (antenna 1) is without DGS (defected ground structure). And the other one(antenna 2) is with DGS (defected ground structure). All structures are analyzed using Ansoft HFSS v.13.0 & measured results satisfy the simulated results. Antenna 1 without defected ground resonates at 7GHz & 8.3 GHz. Antenna 2 with defected ground resonates at 1.9GHz(applications in phones), 2.4GHz(Wi-Fi standard), 4.4GHz (INSAT & Radio altimeters), 4.9GHz(Public safety), 6.8GHz & 7.7GHz.Antenna 2 is more efficient for multiband application as compared to antenna 1.Hence antenna 2 having wide range of operating frequency application have been fabricated .

Keywords: Coaxial feeding technique, Defected ground structure, Microstrip patch antenna, MMIC, PCB.

I. INTRODUCTION:

In telecommunication field, a microstrip antenna is an antenna fabricated on PCB using microstrip technique, which are mostly used at microwave frequencies.Microstrip antennas have become very popular in recent times because of their thin planar profile, light weight, ease of fabrication, ease of integration, MMIC (Monolithic Microwave Integrated Circuit) compatibility, and the possibility of adding active devices. Moreover, these are relatively cheap to manufacture and design. The conventional microstrip patch antenna (MPA) have number of deficiencies such as narrow bandwidth, single operating frequency, low gain, cross-polarized radiation, etc. Several designs have been proposed as multiband antennas [3–7].Multiband has been achieved using defected ground structure (DGS). DGS has been gained a lot of attraction of researchers for improving the deficiencies of conventional microstrip patch antenna (MPA). A trapezoidal ground plane also has been used for the WLAN/WiMAX applications [5].

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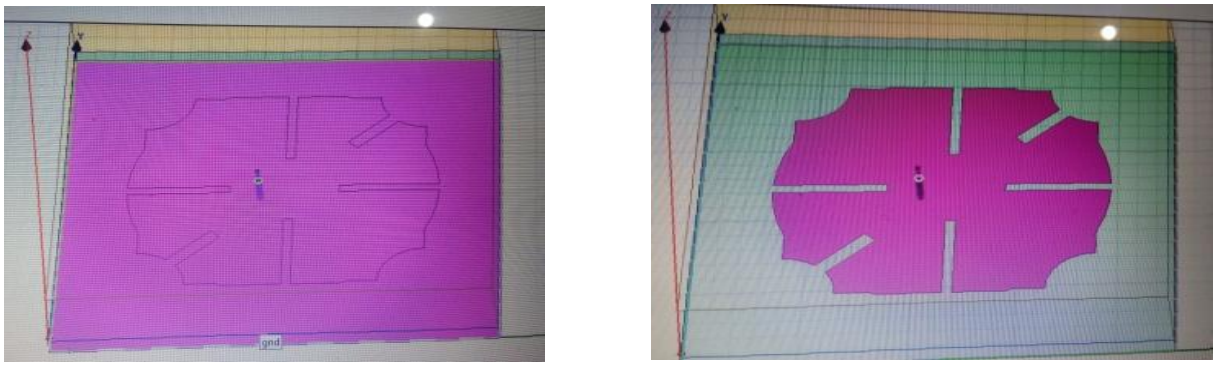
In this paper we have proposed two antenna structures: antenna1 without DGS & antenna 2 with DGS. Antenna1 have limited number of frequency bands (only at 7GHz & 8.3GHz).While antenna 2 shows multiband frequencies. Figures shows ground & patch structures of both the antennas. Fig.1 shows bottom view, top view, ground structure and patch structure for antenna1 (without defected ground). Fig.2. shows bottom view, top view, ground structure and patch structure for antenna 2(with defected ground).

For antenna 1.(without defected ground structure)

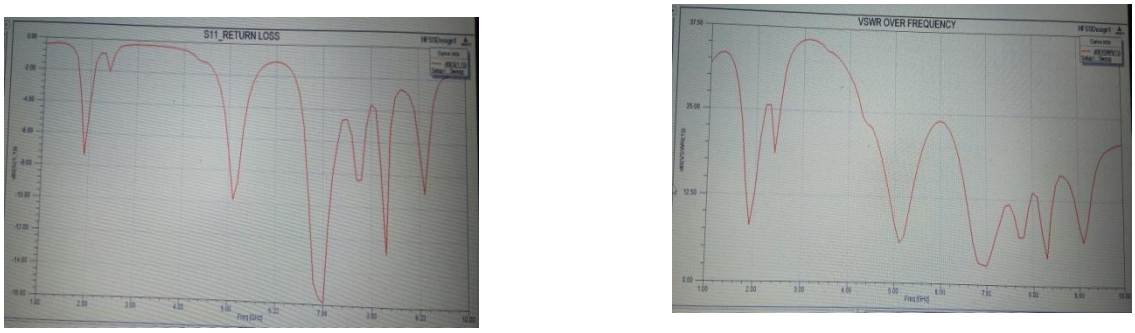


(a) **(b)**

Fig.1: (a) Ground for antenna1, (b) patch for antenna 1

In this design for antenna 1 the ground have dimension of 46 × 46 without defected structure and the circular patch of radius R_e is combined with square patch which have dimensions 2ls × 2ls.The centers of square and circular are concluding and all four corners of the square are circularly truncated with arc of radius S.Circular patch is further truncated with two rectangles of the distance of W from horizontal sides of square patch. Six slots of width W_x are embedded in the structure. L_x, l_y and l_d is the length of the horizontal, vertical and diagonal slits. Antenna is fed with a coaxial probe at the location of A.

Antenna 1. (Results)



(a) (b)

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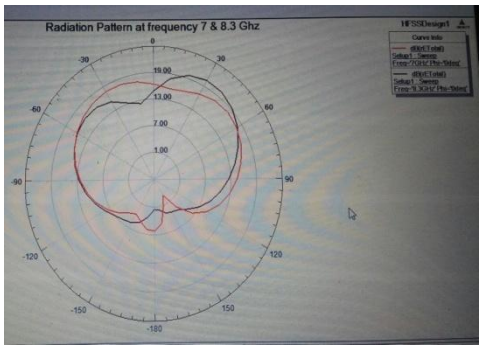
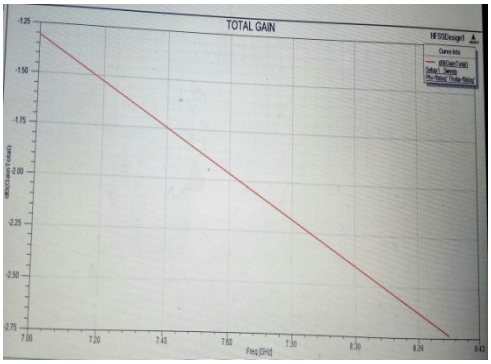


(c)

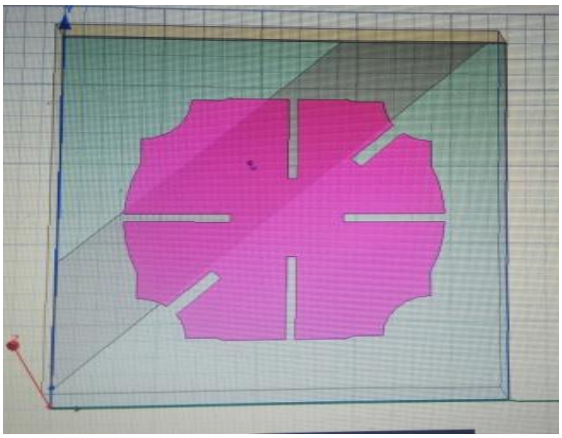


(d)

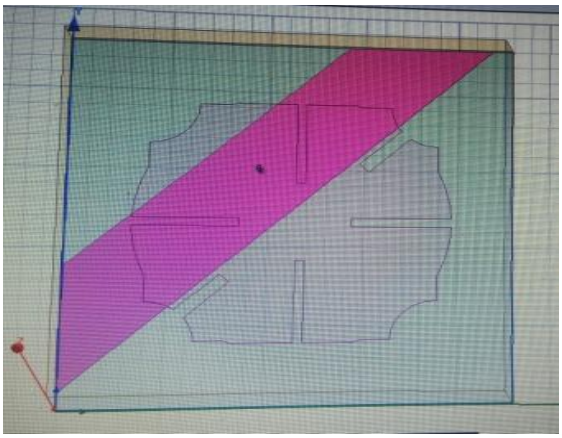
Fig.2: (a) Return loss, (b)VSWR, (c)Radiation Pattern, (d)Total Gain of antenna 1

In the Antenna 1 results analysis, the two frequencies have gotten, the first one is 7GHz and another is 8.3GHz. At the frequency 7GHz the return loss is -15.8dB, and -13dB at frequency 8.3GHz.And the VSWR at frequency 7GHz is 3dB, and 7.5dB at the frequency 8.3GHz.In the figure c &d shows the radiation pattern and total gain of the antenna 1 with no defected ground structure.

For Antenna 2.(with defected ground structure)



(a)



(b)

Fig.3: (a) patch for antenna 2, (b) defected ground for antenna 2

In this design for antenna 2 the ground have dimension of 46 × 46 with defected structure and the circular patch of radius R_e is combined with square patch which have dimensions 2ls × 2ls.The centers of square and circular are concluding and all four corners of the square are circularly truncated with arc of radius S.Circular patch is further truncated with two rectangles of the distance of W from horizontal sides of square patch. Six slots of width W_x are embedded in the structure. L_x, l_y and l_d is the length of the horizontal, vertical and diagonal slits. Antenna is fed with a coaxial probe at the location of A.

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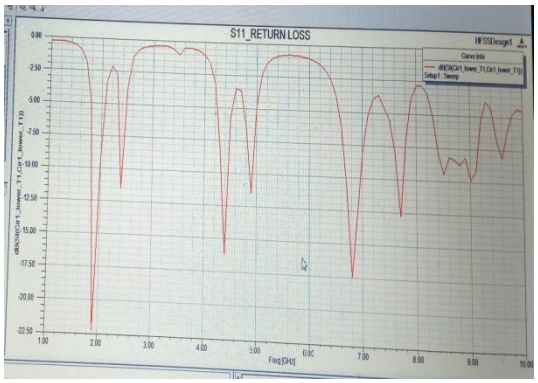
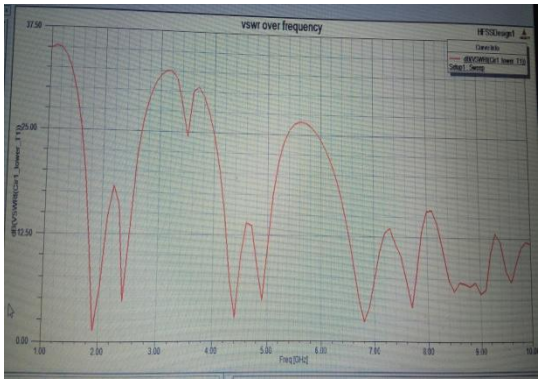
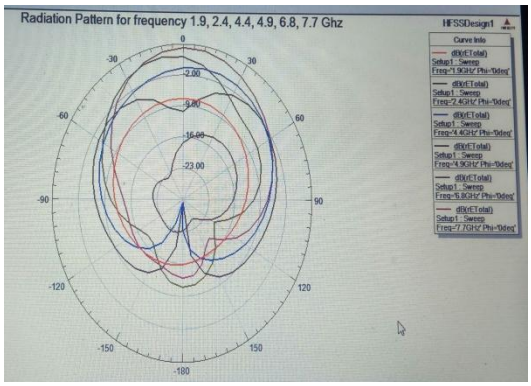
Antenna 2.(Results)



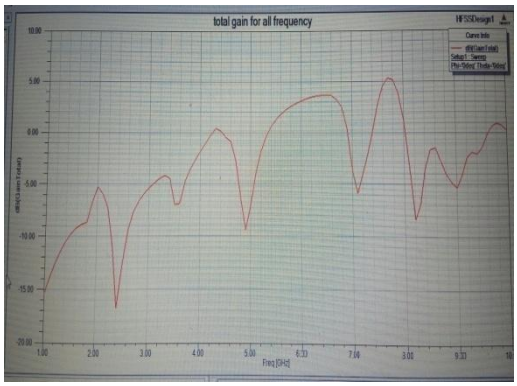
(a)



(b)



(c)



(d)

Fig.4: (a) Return loss, (b) VSWR, (c)Radiation Pattern, (d)Total Gain of antenna 2

In the Antenna 2 results analysis, six frequencies have gotten, which are 1.9GHz, 2.4GHz, 4.4GHz, 4.9GHz, 6.8GHz, 7.7GHz. At the frequency 1.9GHz the return loss is -22.25dB, -11.50dB at frequency 2.4GHz, -16.20dB at the frequency 4.4GHz, -11.50dB at the frequency 4.9GHz, -17.50dB at the frequency 6.8GHz and at the frequency 7.7GHz the return loss is -12.75dB.And the VSWR at frequencies 1.9GHz, 2.4GHz, 4.4GHz, 4.9GHz, 6.8GHz, and 7.7GHz are 1.31dB, 4.75dB, 2.75dB, 4.75dB, 2.36dB, 4.08dB at the frequency 8.3GHz.In the figure c &d shows the radiation pattern for the six frequencies and total gain of the antenna 2 with defected ground structure.

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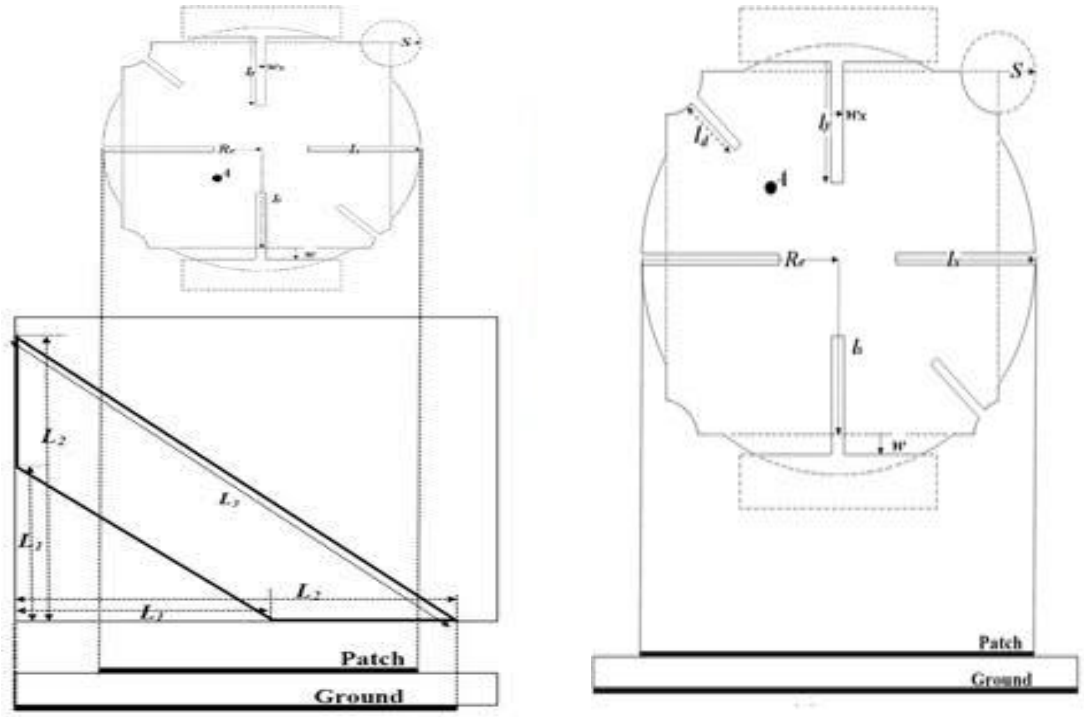
II. ANTENNA CONFIGURATION AND DESIGN:



(a) **(b)**

Fig.5. (a) Structure of proposed antenna 2 with DGS, (b) Structure of antenna 1 without DGS.

Table 1: Design Specifications

Parameter	(mm)
l_x	*10.69*
l_y	*10.30*
l_d	*6.23*
l_s	*15*
w_x	*1*
S	*5*
w	*0.3*
R_e	*16.50*
L_1	*28.27*
L_2	*43.73*
L_3	61.85

In this section, the designs of proposed antennas are described. Figure.5. shows the schematic diagram of the proposed antenna with regular shaped ground plane and with defected ground and antenna is referred as antenna 1& antenna 2 respectively. A circular patch of radius Re is combined with a square patch of dimension 2ls × 2ls. Antenna is fed with coaxial probe at the location A. A FR-$_4$ epoxy substrate of dimension 46 × 46 × 1.6 mm^3 is used to fabricate all the two antennas. Fabrication is done by standard photolithography process. The dielectric

constant and height of the substrate are 4.4 and 1.6mm respectively. And all other dimensions of proposed antenna's structures are listed in the table 1.

III. COMPARATIVE ANALYSIS OF TWO PROPOSED ANTENNNAS:

Table.2 Result analysis of Antenna 1

Freq(GHz)	S11(dB)	VSWR(dB)	Gain(dB)
7	-15.8	3	-1.30
8.3	-13	7.5	-2.74

Table.3 Result analysis of Antenna 2

Freq(GHz)	S11(dB)	VSWR(dB)	Gain(dB)
1.9	-22.25	1.31	-6.8
2.4	-11.50	4.75	-16.8
4.4	-16.20	2.75	0.20
4.9	-11.50	4.75	-9.50
6.8	-17.50	2.36	2.50
7.7	-12.75	4.08	5.40

The table 2 & 3 shows comparative analysis of antenna 1 and antenna 2.The tables show that antenna 2 has maximum number of frequencies band in compare to the antenna 1, which has limited application of frequency band .Antenna2 have six frequency resonating peaks at 1.9GHz, 2.4GHz, 4.4GHz, 4.9GHz, 6.8GHz & 7.7GHz.And other comparisons have been shown in the table 1and 2. Hence antenna 2 with greater multiband application has been fabricated. The proposed antennas are analyzed using An soft HFSS v.13.0 based on FEM. Following figures shows radiation patterns of agglomerated frequency bands.

IV.CONCLUSION:

Asymmetric slits loaded and corner truncated irregular shaped MPA with and without DGS is designed and antenna with DGS has been fabricated. All structures are analyzed using Ansoft HFSS v.13.0 & measured results satisfy the simulated results. Antenna 1 without defected ground resonates at 7GHz & 8.3 GHz which have gain -1.3 and -2.4dB respectively. Antenna 2 with defected ground resonates at 1.9GHz(applications in phones), 2.4GHz(Wi-Fi standard), 4.4GHz(INSAT & Radio altimeters), 4.9GHz(Public safety), 6.8GHz & 7.7GHz which have gain -6.8, -16.8, .2, -9.5, 2.5 and 5.4 dB respectively. Thus antenna 2 is more efficient for multiband application as compared to antenna 1.Hence antenna 2 having wide range of operating frequency application have been fabricated .

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