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Design of Dual U Slotted Printed Antenna with DGS

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***Abstract*—In this paper, presents the compact dual U slot microstrip patch antenna for mobile communication devices has been proposed.The antenna designed of a main patch with dual U slot and a ground plane to generate two frequency bands at 1.65 and 2.75 GHz.The bandwidth of two frequency bands 1.65 and 2.75 GHz are 46 MHz and160 MHz respectively. The system may include GSM/ DCS/PCS/IMT frequency bands.Defected ground structure (DGS) is used in this antenna,which has a rectangular slot truncated on ground plane for achieving additional resonances and bandwidth enhancements.The simulated results of the presented antenna exhibit good refelection coefficient, stable gain and radiation pattern at the operating frequencies. This monopole antenna is very popular in wireless communication systems for dualband applications.**

Keywords - Dual band, DGS, Printed Antenna, U slot

I. INTRODUCTION

The micro strip antennas are low profile, conformable to planar and non planar surfaces, simple and inexpensive to fabricate using modern printed-circuit technology, mechanically robust when mounted on rigid surfaces, compatible with MMIC designs, and very versatile in terms of resonant frequency, polarization, pattern, and impedance. [11].The generation of different frequency with a good radiation pattern and stable gain has been proposed by the U and L slot micro strip antenna[1]-[3],[10]. There are several method has been used by the improvement of radiation pattern and gain[10]. Defected ground structure (DGS) is used for the harmonic reduction and has been found that the performance of antenna parameters is also enhanced[6],[7],[9]. The miniaturization of antenna is used by the various slot technique[4],[8].The sizes of antenna fabricated on substrates with high permittivity can also be reduced[5]. In this paper we have to designed the one patch printed antenna with a dual U slot for wireless communication systems. The presented antenna is simple in structure and generate two resonant frequency at 1.65GHz and 2.75GHz simulated results of the presented antenna with a bandwidth 46 MHz and 160 MHz respectively. The exhibit good reflection coefficient, stable gain and radiation pattern which are very suitable for mobile handsets devices.

II. ANTENNA CONFIGURATION

Fig 2.1(a) &2.2(b) shows the schematic diagram of presented antenna, having two frequency patch elements of dual U slot works at 1.65, 2.75 GHz frequency bands . Table 1 and 2 lists the key parameters of antenna. The antenna consists of one patch element of dual U slot with a microstrip line feeding. The complete antenna is designed using the, HFSS V.11.2 on a FR-4 substrate with a thickness of 1.57mm and a relative permittivity of 4.4, and occupying an area of 50x50 mm^2 on one side of the substrate and an area of 50x45 mm^2 for the ground plane .

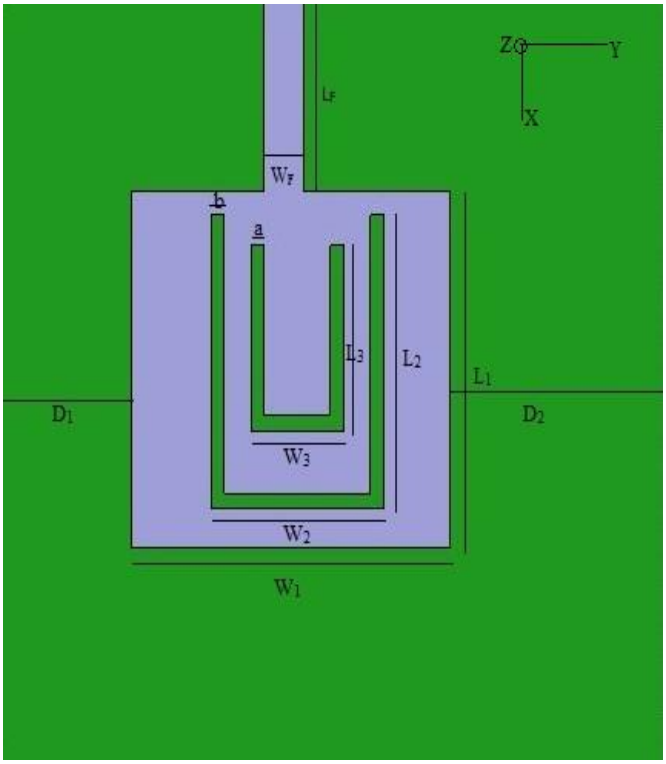

Fig-2.1(a)Structure of front view of antenna

TABLE 1:- Dimensions Of Front View Of Antenna (mm)

L_f	L_1	W_f	L_2	L_3
12.6	23	3	13	12
W_2	W_3	W_1	D_2	D_1
13	6	24	10	16
a	b	Total Volume 50x50x1.57		
1	1			

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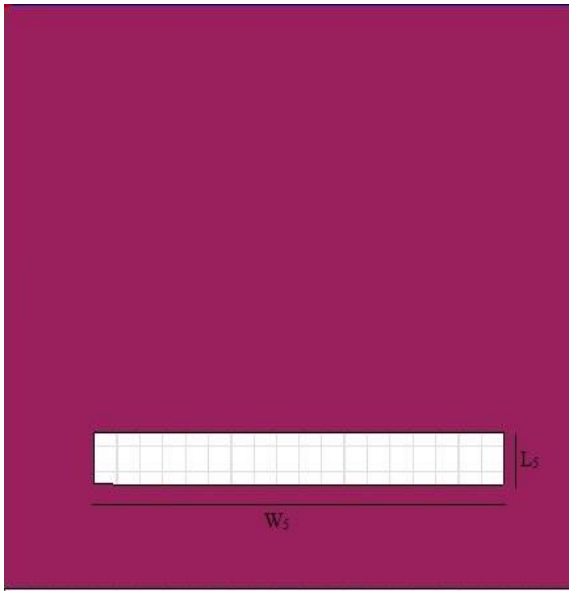

Fig-2.2(b) Structure of back View of antenna

Table 2 :- Dimensions Of Back View Of Antenna (Mm)

W_5	L_5	Total volume 50x45
36	4	

A. Design Procedure

The dimensions of patch elements describe to operate to mobile devices andtwo U-Slots are employed on the main patch elements for excitation of the dual-band and wideband modes.Since cutting the rectangular slot on the ground plane can change the current distribution and the current path, and hence improve the impedance matching especially at higher frequencies.The antenna for wireless applications such as theGSM/ DCS/ PCS/IMT wireless standards. The various geometries of defected ground structure(DGS) has been reported in the literature, such as rectangular, circular, square, dumbbell, spiral, L-shaped, concentric ring, U-shaped and V-shaped, hairpin DGS, hexagonal, cross shaped, arrow head slot, interdigital DGS etc [9]. The shape and dimensions has been affected the defect of ground plane is disturbed resulting in a controlled excitation and propagation of the electromagnetic waves through the substrate layer. The work presented in this paper mainly focuses on the rectangular shaped DGS for high frequency applications. The figure 2.3 shows the simulated graph of return loss of antenna that shows the effect of DGS.

B. Current Distribution

The operation of antenna at the resonant frequency using surface current distribution. Fig 2.4 and 2.5 shows the simulated results of current direction . The dual U slot cutting on main patch is changed the surface current distribution and

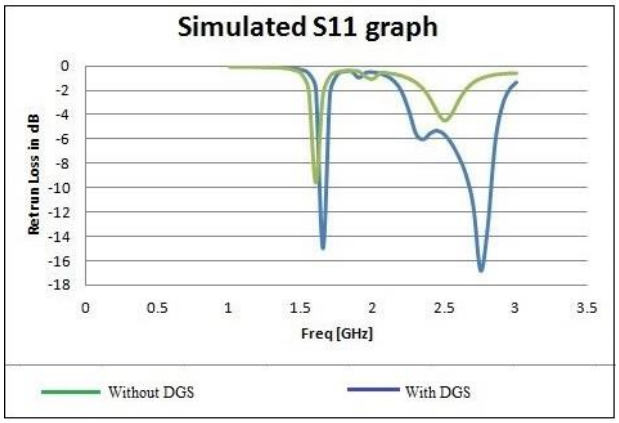

Fig-2.3Simulated return loss with and without DGS of antenna

to generate the dual and multiband resonant frequencies. The current mainly locate the nearest of U slot of patch elements. This shows that the maximum current flows the near the U slot.

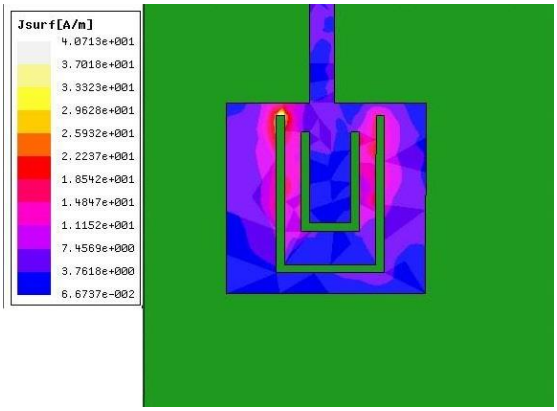

Fig 2.4 Simulated surface current distribution at (a) 1.65 GHz.

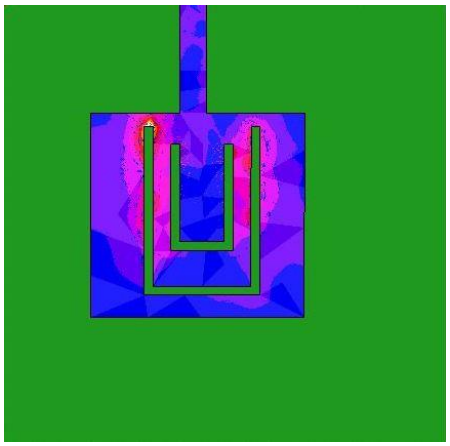

Fig 2.5 Simulated surface current distribution at (a) 2.75 GHz

III. SIMULATION AND RESULT

The simulated result has been performed by using the HFSS software. The presented antenna works at dual band at 1.65

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GHz and 2.75 GHz and the performance of antenna parameter has been analyzed .

A. Return Loss

The final simulated return loss graph is shown in fig 3. Followed by defected ground structure. The simulated impedance bandwidth (S11<-10dB) cover 1.65 GHz and 2.75 GHz which are applicable wireless communication devices. The first resonance frequency obtained at 1.65 GHz with the return loss value of -15.5 dB. The second resonance frequency of 2.5 GHz with the return loss value of -16.83dB.

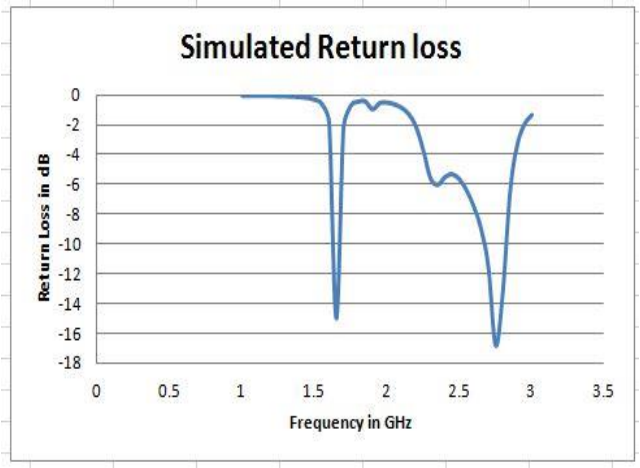

Fig 3.1 Final Simulated return Loss

B. Radiation Pattern

The simulated radiation pattern shown in Fig 3.2(a),3.2(b) at frequency 1.65, 2.75 GHz . The presented antenna has been omni directional radiation pattern which will demand for wireless communication devices or mobile terminal as well. The radiation pattern of frequency 1.65 and 2.75 GHz at E plane and H plane shown by individual line with a different value of φ(phi).

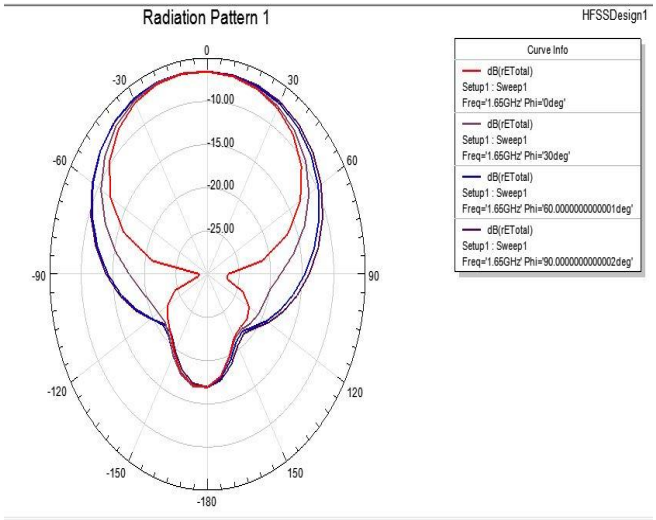

Fig. 3.2(a) Simulated Radiation pattern at 1.65 GHz

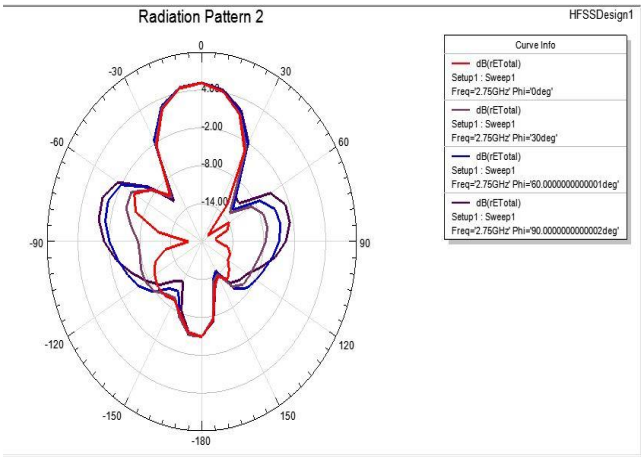

Fig. 3.2 (b) Simulated Radiation pattern at 2.75 GHz

C. Gain And Efficiency

The simulated gain and radiation efficiency of presented antenna has been shown by Fig 4 and 5. At frequency 1.65 GHz gain is -3.3dB and at 2.75 GHz gain is 4dB and the efficiency which shows the pretty good result of presented antenna .

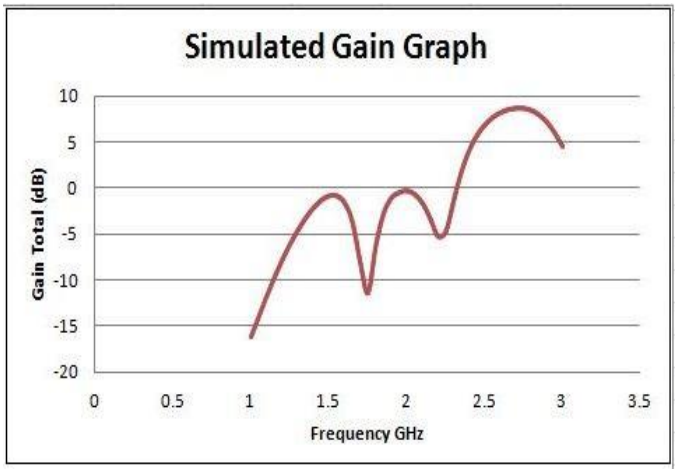

Fig 3.3(a) Simulated Graph of Gain

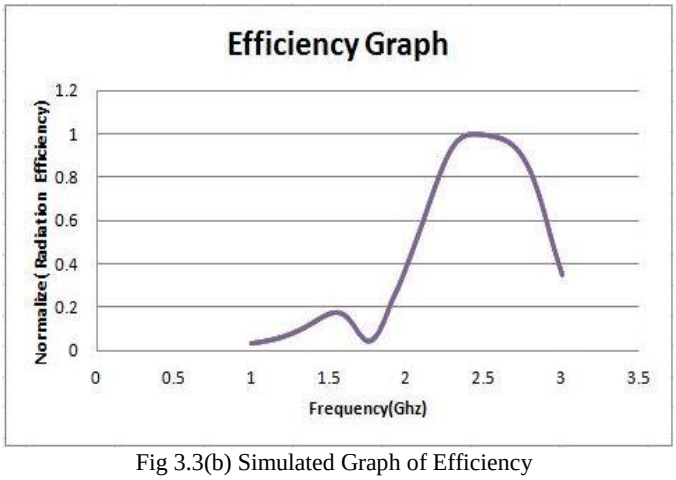

Fig 3.3(b) Simulated Graph of Efficiency

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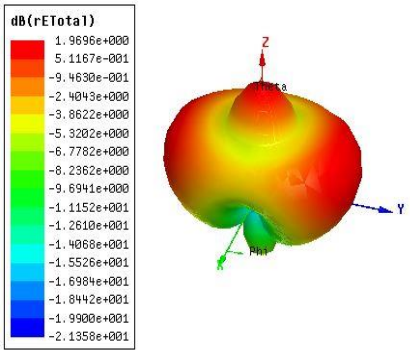

Fig 4. Simulated Graph of 3D Radiation Plot

IV. CONCLUSION

In this paper a presented antenna is applicable for the 1.65 GHz and 2.75 GHz with a wide bandwidth resonant frequency and suitable for GSM/DCS/PCS/IMT frequency standards. The simulated results shows the verygood impedance matchingby the value of reflection coefficient and give better gain of antenna. The ground plane of the antenna is carefully demonstrated for the better result in terms of return loss and radiation pattern . The results showed that the performance of the presented antenna is very well for the wireless communication systems.

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