CPW FED Planner Monopole Square Antenna with Fractal Stub

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Abstract— In this paper a multi band planner monopole square antenna is presented with fractal stub. This antenna is designed on 1.6mm thick FR4 substrate using CPW (coplanar waveguide) feed technique. CPW feed technique is used to feed the antenna. The simulated multi bandwidth of the antenna is from (0.91- 1.05), (1.64-1.83) and (1.98-2.23) GHz for return loss < -10dB. Proposed antenna finds the application in CDMA, GSM900, GSM1800 and 3G bands. A stable omnidirectional radiation pattern is obtained for this multiband structure. The maximum gain of the designed antenna is 4.6dBi.

Keywords- Multilband antenna, stable radiation pattern, planar monopole antenna, fractal stub.

I. INTRODUCTION

A rectangular patch antenna with fractal stud is designed and fabricated with CPW feeding technique reported in [1], in which pattern stability is not good at higher side. A UWB antenna with Single Notch-Band for WLAN environment is designed in which the pattern is bad which is reported in [2]. A Compact Multiband Gasket Enable Rectangular Fractal Antenna is reported with CPW feed technique in which the radiation pattern is very bad at higher side [3]. A multiband triangular antenna is presented using CPW feed technique but the pattern stability is bad [4]. One-dimensional Fractal Broadband Antenna for Demand Expansion in RFID Systems is designed and fabricated with broadband bandwidth in [5] but there is no mention about the radiation pattern stability. Design and simulation of miniaturized multiband fractal antennas for microwave applications are designed with multiband structure but the pattern stability is very bad which is reported in [6].

A CPW fed slot loop minkowski fractal antenna with enhanced channel selectivity is reported in [7], where multiband bandwidth is obtained but the pattern stability is very bad. A multiband behavioural analysis of the higher order fractal patch antenna is reported in [8], in which multiband bandwidth is occurred but there is no mention about the pattern stability. Design of Broadband Dual-Frequency micro strip patch antenna with modified sierpinski fractal geometry is reported in [8], in which a multiband bandwidth is occurred but pattern stability is very bad.

In this paper a square patch antenna is designed with fractal stub. Total two iterations are done to achieve the required bandwidth. This antenna covers the application areas in CDMA GSM900, GSM1800 and 3G bands. CPW feed technique is used in which ground plane and radiating patch are in the same plane. All the simulations have been carried out by using IE3D software based on method of moments [9].

II. ANTENNA DESIGN

A planar monopole square patch antenna is first designed as the zeroth iteration of the proposed antenna. The planar monopole square antenna (zero iteration) is shown in Fig.1 (a).

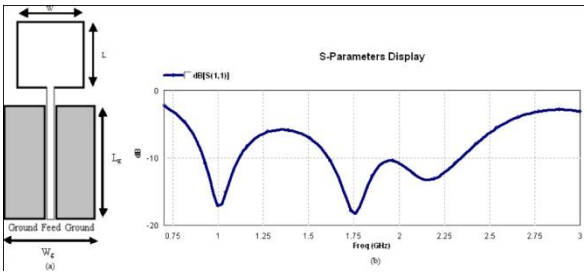

Fig. 1. (a) Multi band square antenna (zero iteration) and (b) its S11

The antenna is designed and simulated using FR4 substrate (h = 1.6mm, dielectric constant εr = 4.4 and tanδ = 0.02). The length of the patch (L) = 44mm and width of the patch (W) = 44mm. The dimensions of the ground plane are Wg = 66mm, Lg= 75mm. The feed has a width (Wf) of 5mm and length (Lf) of 87mm.The gap between the feed line and the ground planes is 0.5mm. The simulated S11 of zero iteration is shown in Fig. 1 (b). Bandwidth of the dual band antenna is between (0.92-1.11) GHz and (1.61-2.34) GHz.

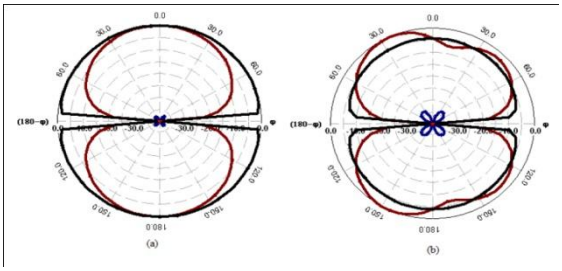

Fig. 2. Simulated Radiation pattern of the zeroth iteration (a) 960MHz (b) 2.1 GHz

The simulated radiation pattern at 960MHz and 2.1GHz is shown in Fig. 2 (a) and (b), respectively. At 960MHz the pattern is stable in E plane and as well as in H plane. The cross polar level is less than -40 dB in H plane and less than -35dB in E plane. Radiation pattern at 2.1 GHz is unstable and tilted from the broadside by more than 300. Cross polar level is more than -30dB in E plane. The variation in H plane is approximately 10dB and cross polar level is less than -40dB.

In the first level iteration, fractal cut is added in the two sides of the rectangle to improve the bandwidth and reduce the tilt present in radiation pattern at higher band side. Final level iteration of the proposed antenna design is shown in Fig.3 (a). In this iteration a small fractal cut of length (L1 = 14.6mm) are added to the zeroth iteration of the proposed antenna. After cutting this cut inside the square patch the effective length of the radiating patch is increased. After increasing the patch length the more current will flow from the patch. The simulated S11 of the final iteration of the proposed antenna is shown in Fig.3 (b). Simulated S11 Bandwidth of the final iteration for return loss less than -10 dB range is from (0.91-1.05), (1.64- 1.83) and (1.98-2.23) GHz.

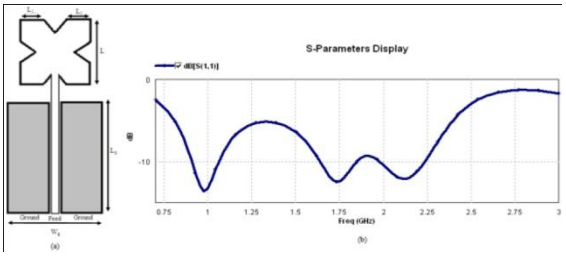

Fig. 3. (a) Multi band square antenna with fractal stub (final iteration) of the proposed fractal antenna and (b) its S11

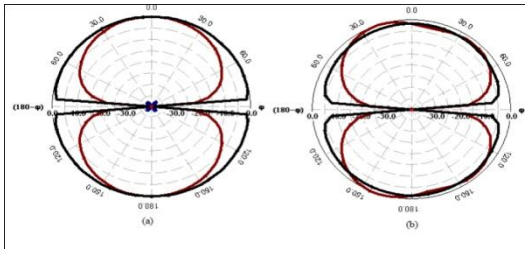

Fig. 4. Simulated radiation pattern of the proposed multi band square antenna with fractal stub (final iteration) (a) 880MHz (b) 2.1 GHz

The simulated radiation patterns of the final iteration at 880MHz and 2.1 GHz are shown in Fig.4 (a) and (b) respectively. Radiation pattern at 880 MHz is good in E as well as in H plane. Cross polar level in E plane is less than -35dB and less than -40dB in H plane. At higher band side (2.1 GHz) pattern is improved from the previous result and it is good. At E-plane there is no tilt from broadside and variation in H plane is also less than 10dB. The cross polar level is less than -40 dB in E plane as well as in H plane.

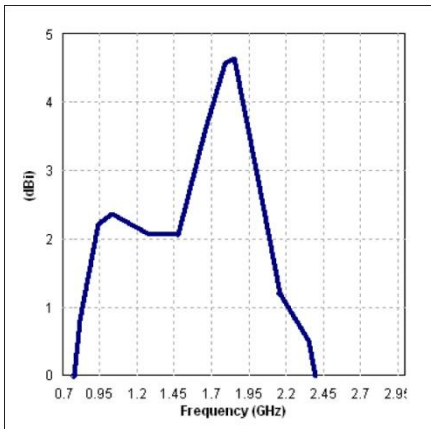

Fig. 5. Gain Vs. frequency plot of proposed antenna (final iteration)

Gain Vs. frequency plot is shown in Fig.5 for final iteration of the proposed antenna. The maximum gain of the proposed antenna is 4.6 dBi

III. CONCLUSION

In this paper a multi band planar monopole square patch antenna with fractal stub is designed. The antenna has multi bandwidth range from (0.91-1.05) GHz, (1.64-1.83) GHz and (1.98-2.23) GHz. Bandwidth range of the proposed antenna covers the application areas in CDMA, GSM900 and also covers the GSM1800 and 3G band area. The radiation pattern is also good. In this proposed antenna the overall size of the antenna is big because of the large ground plane, so the size of the antenna can be further reduced.

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[9] IE3D software from Mentor Graphics

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