Design and Analysis of a CPW Fed Planar Elliptical Shaped Antenna with Incomplete C-shaped Slot and Minkowski Fractal

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Abstract— This paper present the design of a compact split ring resonator [SRR] loaded coplanar monopole antenna with two symmetrical band notches and two minkowski fractal, having frequency notch characteristics. The electromagnetic coupling of the SRR with the CPW yields the frequency notch. The proposed antenna could potentially minimize frequency interference from many underlying technologies for example: WLAN, WiMAX and aeronautical mobile band. The impedance band width of proposed antenna covers the frequency ranges from 2.45GHz to 13.89 GHz. The group delay is obtained 1ns expected at the notches frequency.

Key words: Bandwidth, Ultra Wide Band, Elliptical Shaped Antenna, Compact Planner Resonator, Characteristic Mode

I. INTRODUCTION

The interest of using coplanar wave guide fed for ultra wide band monopole antenna has been increasing over recent years. The coplanar fed in ultra wide band antenna have many attractive features like low radiation loss, less dispersion, ease of fabrication, etc. For UBW system, printed monopole antenna with various design have been studied which meet the frequency range specified for UWB communication. Printed monopole antenna with enhanced bandwidths for multiple wireless systems have been proposed recently. However, it is also necessary to avoid potential interference with carious narrow band communication systems which are within UWB frequency range. In this paper an elliptical shaped printed monopole antenna with two symmetrical incomplete C shape slot and minkowski fractal is proposed. The Microstrip fed antenna with an in-complete C shape slot is introduced in ground has been presented for Wlan and UWB and minkowski fractal is introduced in patch has been presented in Wimax and aeronautical. A printed elliptical antenna with a tapered and modified feed design to support a number of wireless communication frequency bands. On the other side,the designed notch band for ultra wide band system, there exist various narrow frequency bands used by other wireless system such as Wimax(3.3GHz to 3.7 GHz), Wlan (5.15GHz to 5.825GHz), satellite communication(7.25GHz to 7.75GHz). The paper is arranged such section 2 describes the details of the design and parametric study, which is followed by result and discussion and conclusion in section 3 and section 4 respectively.

II. ANTENNA DESIGN

The simulation for the antenna study is carried out in the CST microwave studio software. The proposed antenna is perceived on FR material substrate. The die-electric constant of substrate is 4.3, and the thickness of proposed antenna is 1.6mm. The dimension of proposed antenna is 40mm * 40mm * 1.6mm. All the dimension of proposed antenna is taken in mm. the radiator patch consists of an elliptical feed by a 50 ohm coplanar waveguide line. Figure 1 shows the geometry of proposed antenna.

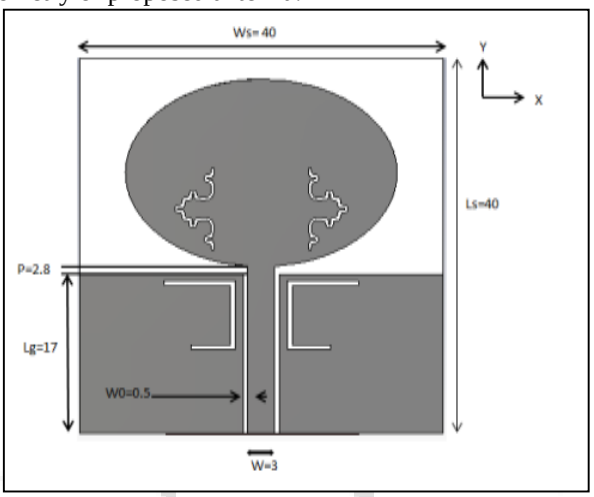
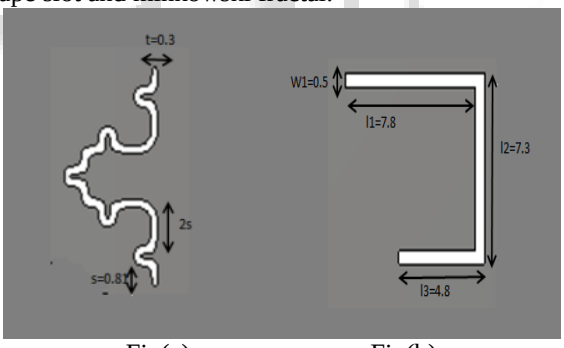


Fig. 1: Geometry of antenna

The two symmetrical in complete C shape slot is cut in ground plane. The two symmetrical minkowski fractal is cut in patch. Figure 2 shows the symmetrical in complete c shape slot and minkowski fractal.



Fig(a) Fig(b)

Fig. 2: Geometry of slot (a) minkowski fractal (b) C- shape slot

The length of incomplete C shape slot is calculated by using given equation.

$$L = \frac{c}{2*f*\sqrt{Ereff}} \qquad \text{eq(1)}$$

The gap between the patch and the ground plane, 'Wp', and the gap between the feed line and the ground plane is 'g', are the two most important parameters the antenna is made to cover the entire UWB ranges from 3.1GHz to 10.6 GHz. It is observed that the bandwidth of the antenna increase as the gap, 'g' decreases. So the optimized value of the gap is fixed at 0.5mm.

The optimized antenna parameters are listed in table 1.

Antenna Parameter	L_{sub}	W_{sub}	L_g	Rx	Ry	W0	W	W1							
Value(mm)	40	40	17	15	10	0.5	3	18							
Slot parameters	W1	L1	L2	L3	P										
Value(mm)	0.5	7	6.8	4.8	2.8										

Table 1:

III. RESULT AND DISCUSSION

One of these technologies recently proposed is a wide band notched technique. In this paper, we proposed a compact ultra wide band Microstrip patch antenna with double band notch and minkowski fractal. The dimension of proposed antenna is 40mm * 40mm. The simulation of proposed antenna is done in CST studio microwave software. The VSWR of the proposed antenna is plotted in figure 3. This shows the wide impedance bandwidth range from 2.658GHz to 14.2GHz.

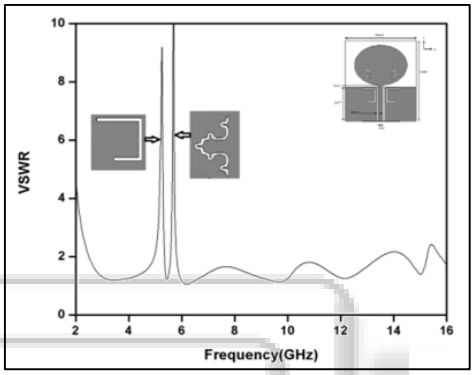


Fig. 3: Simulated VSWR of antenna

Figure 4 shows the current distribution of proposed antenna. Resonance frequencies merge each other and give the overall ultra wide bandwidth. The behavior of ultra wideband justified from the current distribution shown below. Slots produce a destructive interference for the excited surface currents, causing the antenna not to be responsive at frequencies which depend on the slots dimensions and positions.

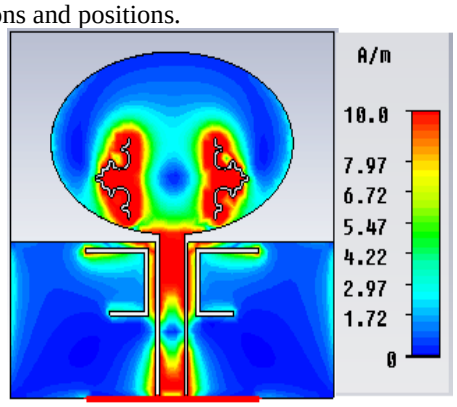


Fig. 4: Surface current distribution

To study the time domain characteristics of the antenna, its group delay is studied as shown in figure 5. The antenna is non dispersive in nature as its group delay is lies within 1ns.

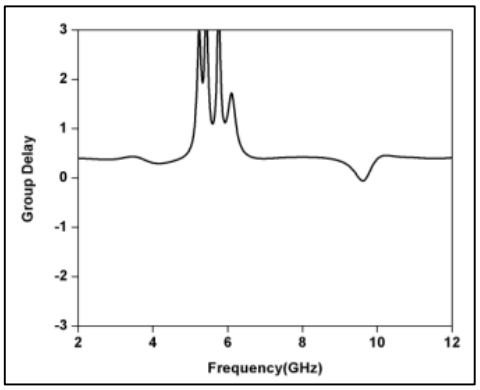
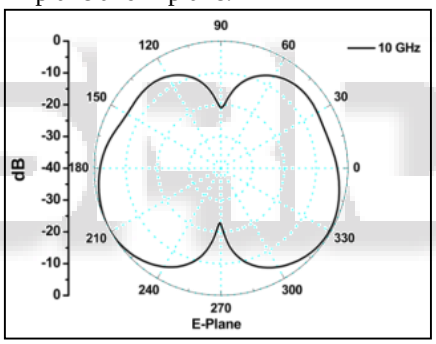
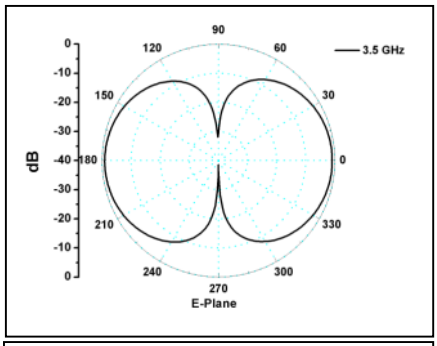
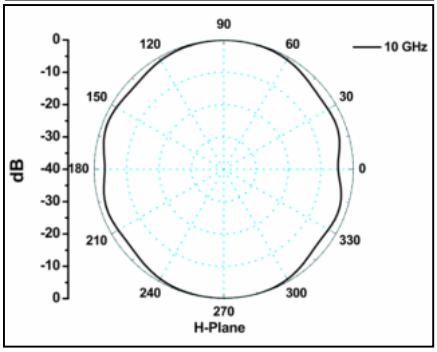


Fig. 5: Simulated Group delay

One of the challenges of the UWE antenna is to obtain Omni directional radiation pattern. The simulated radiation patter show fig.6 omnidirectional radiation pattern in H-plane.and the dipole like pattern in E- plane At higher frequencies, the pattern is distorted due to the undulation in the pattern caused by the propagation of higher order modes.. Figure7. shows the omnidirectional radiation pattern of proposed antenna in H plane and E plane.







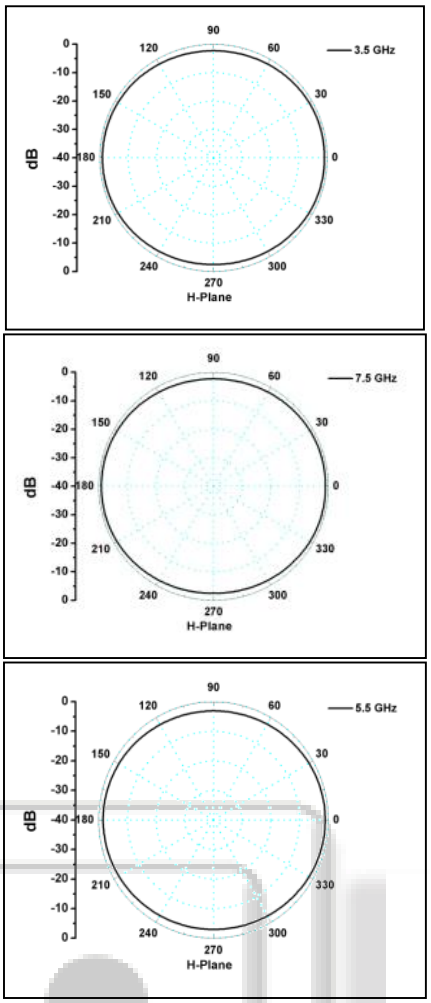


Fig. 6: Simulated radiation pattern in E- planes

IV. CONCLUSION

An elliptical shaped UWB antenna with dual band notch and minkowski fractal slot is designed in this paper. The impedance bandwidth of proposed antenna is lies between 2.45 GHz to 13.89 GHz The group delay lies within 1 ns. The rejection band centered at 5.5 GHz is obtained by etching out incomplete inverted C type slots coplanar waveguide (CPW) with band notch

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