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Design of Hexa Band Modified Kotch Antenna for Novel Wireless Applications

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ABSTRACT

Many techniques for multiresonances were formulated by researchers of which kotch fractals are one. Kotch fractal first iteration is attempted in this paper. Further modifications are done by creating certain slots on patch while swastik shaped slots are created on its ground plane. The modified antenna is found to resonate At 6.28, 6.88, 7.6, 11.68, 14.8, 16.96 GHz Frequencies which finds application in satellite communication, radiolocation.

Keywords: Microstrip Patch Antenna, Linear Polarization, Wireless Applications, Swastik, Spiral Slot, Radar, SATCOM Applications

I. INTRODUCTION

Deschamps first proposed the concept of the MPA in 1953. However, practical antennas were developed by Munson and Howell in the year 1970s. The numerous merits of MPA, such as its low weight, small volume and ease of fabrication using printed circuit technology led to the design of several configurations for various applications. With increasing requirements for personal and mobile communications, the demand for smaller and low-profile antennas has brought the MPA to the forefront. [1,2]. Eversince it was proposed it underwent many modifications to overcome its flaws like low gain, Narrow band. The Most recent emerging domain is Fractal antennas. The word fractal was first coined by B. B. Mandelbrot in 1975. It was derived from the Latin word "fractus", defined a broken or shattered glass. Mandelbrot began to study fractals called Julia sets a previous work of Gaston Julia and Pierre Fatou, he used a computer to plot images of the Julia sets. There are many types of Fractal antennas as seen in [3-9]. This paper deals with first iteration of Koch Fractal and introduction of slots on patch and ground to create Hexa band resonances. The paper is organized in to Introductory section followed by Design, Analysis, Conclusion.

DESIGN OF PENTA BAND KOCH ANTENNA

The design starts with the design of a coaxial fed conventional patch using NELTEC NY 9220 substrate with relative permittivity of 2.2 with a thickness of 62 mils. [1,2]. The size of the Patch is 5 X 5 cm. Triangular slots are removed on the four sides of the Square patch. Further circular, Elliptical and a rough triangular slots are etched on the patch (the number details are seen in Table 1). The top view as well as its ground plane, Return loss are seen in Figures 1 and 2. Also Swastik shaped slots are created on ground plane and its details are also shown in Table 1.

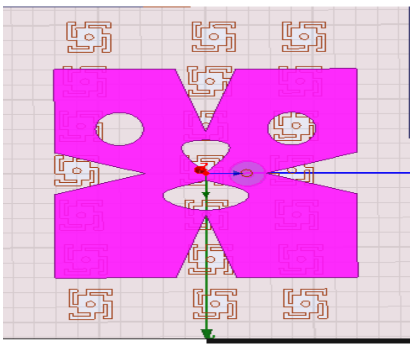

Figure 1. Proposed Antenna

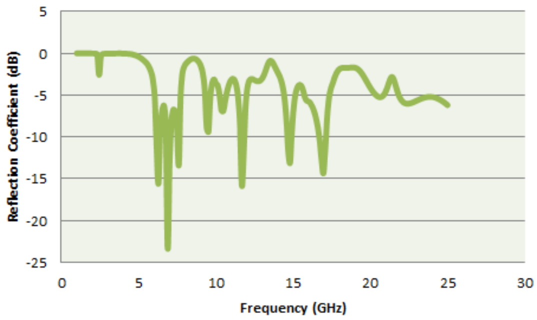

Figure 2. Reflection Coefficient of the Proposed Antenna.

Table 1: Dimension of the Proposed Antenna, Details of Slots on Patch and Ground.

Parameters	Size	Parameters	Total
Substrate	62 mils	Circular slot on patch	Two
Relative permittivity	2.2	Elliptical slot	One
Ground	45 x 38 mm	Triangular slot	1
Patch	50 x 50 mm	Ground with Swastik slots	21

ANALYSIS OF THE PROPOSED ANTENNA

The Coaxial fed antenna is optimized to resonate at 6.28, 6.88, 7.6, 11.68, 14.8, 16.96 GHz and its return loss characteristics are shown in Figure 2. The value of S_{11} is – 15.5, -23.3,-13.37, -15.8, -13.09, -14.36 dB indicating good match.The Polar Plot of rE field at the discrete resonant frequencies are shown in Figs.3-8. The simulated antenna parameters are seen in Tables 2-7. The E Field, Current, Directivity of the antenna could be seen in Figutr . 9-11.

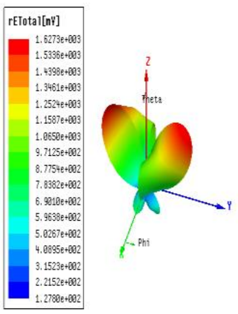

Figure 3. rE total of the Proposed Antenna

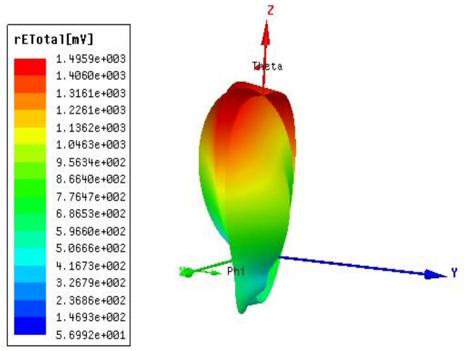

Figure 4, rE total of the Proposed Antenna

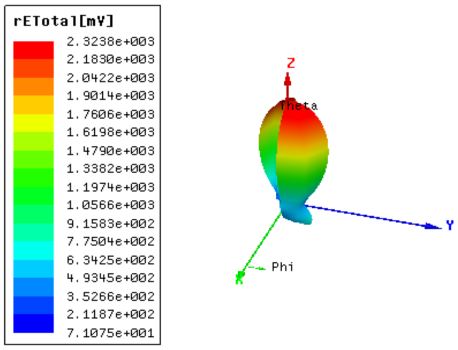

Figure 5. rE total of the Proposed Antenna

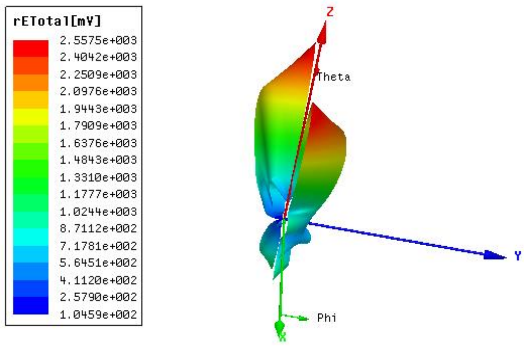

Figure 6. rE total of the Proposed Antenna

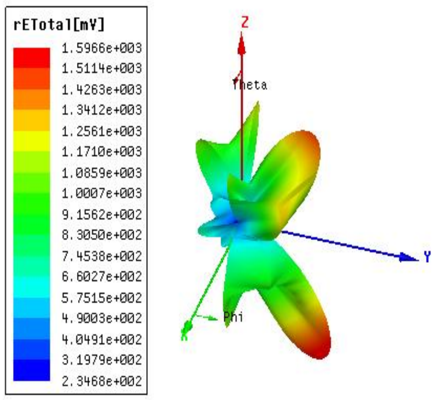

Figure 7. rE total of the Proposed Antenna

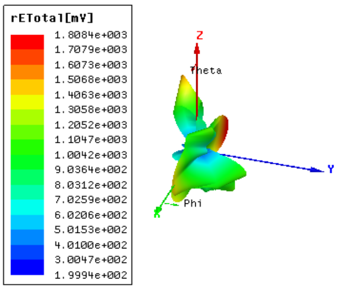

Figure 8. rE total of the Proposed Antenna

Table 2: Parameters of the Proposed Antenna

Antenna Parameters:

Quantity	Value	Units
Max U	0.003512	W/sr
Peak Directivity	4.6631	
Peak Gain	4.593	
Peak Realized Gain	4.4543	
Radiated Power	0.0094644	W
Accepted Power	0.009609	W
Incident Power	0.0099081	W
Radiation Efficiency	0.98496	
Front to Back Ratio	7.0758	
Decay Factor	0	

Table 3: Parameters of the Proposed Antenna

Antenna Parameters:

Quantity	Value	Units
Max U	0.002968	W/sr
Peak Directivity	3.8143	
Peak Gain	3.772	
Peak Realized Gain	3.7644	
Radiated Power	0.0097783	W
Accepted Power	0.009888	W
Incident Power	0.0099078	W
Radiation Efficiency	0.98891	
Front to Back Ratio	17.029	
Decay Factor	0	

Table 4: Parameters of the Proposed Antenna

Antenna Parameters:

Quantity	Value	Units
Max U	0.0071616	W/sr
Peak Directivity	9.8759	
Peak Gain	9.6916	
Peak Realized Gain	9.0838	
Radiated Power	0.0091129	W
Accepted Power	0.0092861	W
Incident Power	0.0099075	W
Radiation Efficiency	0.98134	
Front to Back Ratio	37.392	
Decay Factor	0	

Table 5: Parameters of the Proposed Antenna

Antenna Parameters:

Quantity	Value	Units
Max U	0.0086746	W/sr
Peak Directivity	11.127	
Peak Gain	11.303	
Peak Realized Gain	11.004	
Radiated Power	0.0097973	W
Accepted Power	0.0096442	W
Incident Power	0.0099061	W
Radiation Efficiency	1.0159	
Front to Back Ratio	8.6329	
Decay Factor	0	

Table 6: Parameters of the Proposed Antenna

Antenna Parameters:

Quantity	Value	Units
Max U	0.0033806	W/sr
Peak Directivity	4.4367	
Peak Gain	4.5823	
Peak Realized Gain	4.2889	
Radiated Power	0.0095754	W
Accepted Power	0.0092711	W
Incident Power	0.0099054	W
Radiation Efficiency	1.0328	
Front to Back Ratio	2.7073	
Decay Factor	0	

Table 7: Parameters of the Proposed Antenna

Antenna Parameters:

Quantity	Value	Units
Max U	0.0043373	W/sr
Peak Directivity	5.3388	
Peak Gain	5.6711	
Peak Realized Gain	5.5028	
Radiated Power	0.010209	W
Accepted Power	0.0096111	W
Incident Power	0.009905	W
Radiation Efficiency	1.0622	
Front to Back Ratio	2.2028	

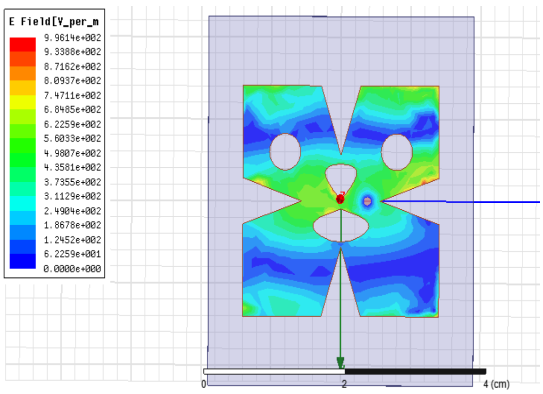

Figure 9. E field distribution of the Proposed Antenna

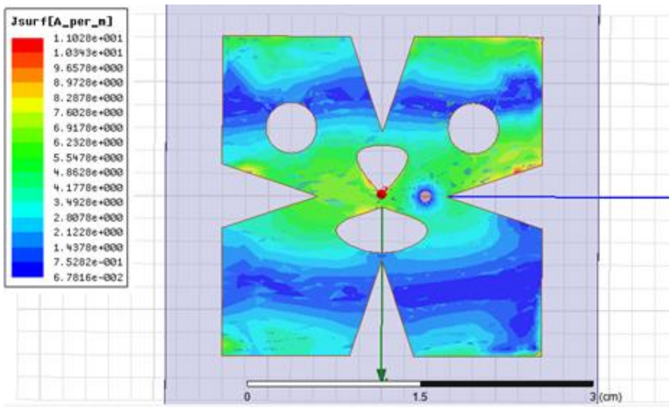

Figure 10. Current distribution of the Proposed Antenna

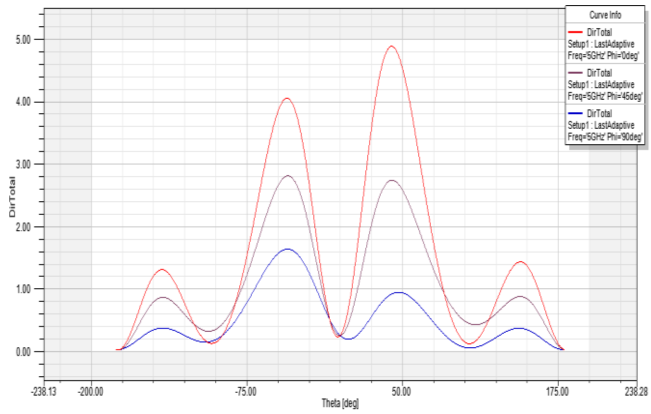

Figure 11. Directivity of the Proposed Antenna

II. CONCLUSION

A Hexa band Antenna Design Suiting the need of Satellites, Radar like novel applications is presented in this paper. The antenna has adequate gain in most of the bands with FBR values increased due to slots in its ground but if this concept is further extended for arrays then this drawback may be overcome making it a viable candidate for SATCOM applications. This antenna is cheap since it may be fabricated using PCB techniques. Further attempt may be for dual polarisation which includes circular polarization

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