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Monopole Fractal Antennas for Wideband Applications

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Abstract: This research Paper outlines printed monopole fractal antennas for wide band applications, having better performance, in terms bandwidth, gain, percentage bandwidth, impedance, band width and size reduction. Our proposed base antenna is a simple monopole antenna which is having a resonating frequency of 6.6GHz with a return loss -25 dB, for same monopole antenna applying first iteration of fractal has resonating frequency of 5.7GHz and 7.5GHz has a return loss of -17dB and second iteration of fractal is applied for same antenna which resonates at a frequency of 6.3 GHz and 8.4 GHz having a return loss of -20 db. Third iteration antenna will have a resonant frequency of 3 GHz with return loss of -17 dB, 6.61GHz with return loss of -23db, 10.72GHz with return loss of -21db. Antenna will have highest gain of 6.9dB. IE3D simulation tool is used to design antenna.
Keywords: Wideband monopole, Fractal antenna, wide band antennas (UWB).

I. INTRODUCTION

Wireless and mobile communication industry made a revolutionary remark in 21st century with the development of modern communication equipment having ultra-compact size with multi features. The main problem of common antennas is that they only operate at multiband frequencies [6], restricting the number of bands equipment is capable of supporting .Another issue is the size of common antenna .Due to the very strict space that a handset has, setting up more than one antenna is very difficult .Therefore many kinds of miniaturization techniques [4,5] ,such as using high dielectric substrate, applying resistive or reactive loading and increasing the electrical length of the antenna by optimizing its shape with slots and meandering have been proposed by many scientists. Similarly another technique is the application of fractal geometry [1] to conventional micro strip antenna structure which optimizes the shape of antenna in order to increases their electrical length and thus reduces the overall size and multiple operating frequencies.Fractal shape antenna elements present various advantages of wide bandwidth, multiband and reduced size among which patch curve is characterized by two factors: iteration factor and iteration number. The iteration factor represents the construction law of fractal geometry [3] generation, and the iteration number depicts how many iterating process are carried out. UWB system requires a compact antenna providing wide band characteristics over the whole operating band. Due to their appealing features of wide bandwidth, simple structures, omnidirectional patterns and ease of construction, planner metal plate monopole antennas [2] have been proposed for such applications.

II. DESIGN OF ANTENNA

The monopole fractal antenna are designed with 3 essential parameters are : Frequency of operation (f0): The resonant frequency of the antenna must be selected appropriately which is able to operate under desired frequency range. The frequency of operation in this design is 3GHz, 6.61GHz, 10.72 GHz.

Dielectric constant of the substrate (εr): The dielectric material selected for the design is glass epoxy which has a dielectric constant 4.4.

Height of dielectric substrate (h) : For the microstrip patch antenna to be used in cellular phones, it is connected that the antenna should not be bulky. Hence, height of the dielectric substrate is selected as 1.6mm.

Radiating patch of monopole fractal antenna is designed using following formula

$$\lambda 0 = \frac{c}{f}$$

where, f is a resonant frequency.
c is a velocity of light.

Width of patch $w = \frac{c}{2f_r}\left(\frac{\varepsilon r+1}{2}\right)^{-1/2}$

Length of patch $L = \frac{c}{2f_r\sqrt{\varepsilon_e}} - 2\Delta L$

Effective length $\Delta L = 0.412h \times \frac{(\varepsilon_e+0.3)(\frac{w}{h}+0.264)}{(\varepsilon_e-0.258)(\frac{w}{h}+0.8)}$

Where $\varepsilon_e = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2}[1+12\frac{h}{w}]^{-1/2}$

The optimized geometry of the proposed antenna is shown in the fig .1. The size of the patch is 40mm x 25mm is printed on a dielectric substrate of thickness 1.6mm. The material used is glass epoxy with dielectric permittivity of εr=4.4 which is designed to operate at 6.5 GHz. This antenna is fed by microstrip line of dimension 40mm x 10mm. It is mounted on a ground plane having the dimension of 50mm x 20mm. The antennas are initially simulated using IE3D software and all parameters optimized.

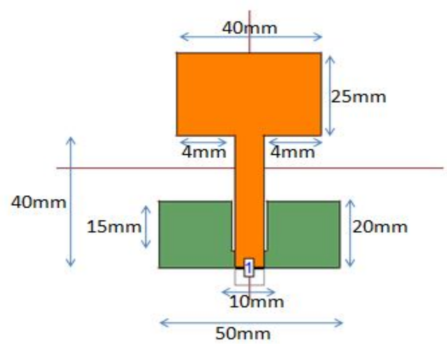

Fig:1. Simple monopole antenna

Return loss and gain of base monopole antenna is shown in fig.2 and fig.3

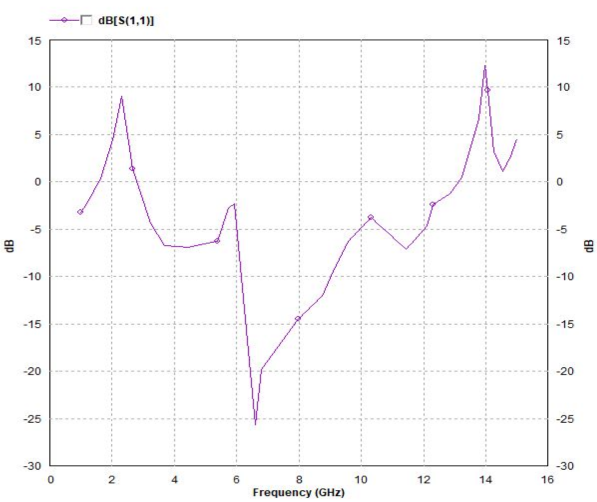

Fig.2 Return loss of simple monopole antenna

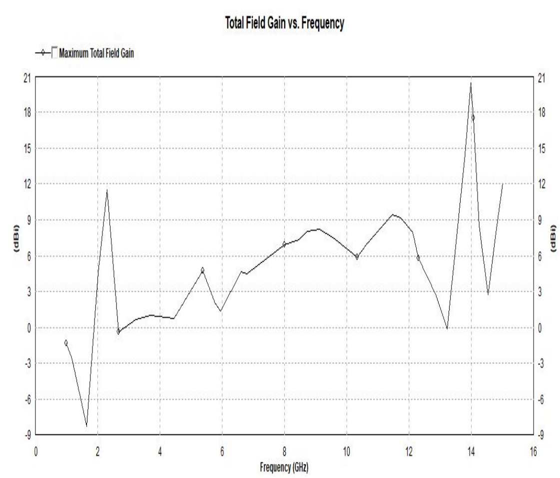

Fig.3. Total field gain VS Frequency

A. *Result And Discussion Of Simple Monopole Antenna*

It is observed that resonating frequency is 6.5 GHz. The return loss of monopole antenna is shown in fig.2. return loss of the designed antenna is -25 db. Bandwidth obtained is 2.94 GHz and the percentage band width is 45%. Total field Gain verses frequency is shown fig 3, gain of the antenna is 5db, and it is observed that impedance matching at a resonating frequency is 50 ohms. Radiation pattern obtained is shown in fig.4, Here radiation pattern obtained is multiple sequence lobbing and can be used for radar tracking.

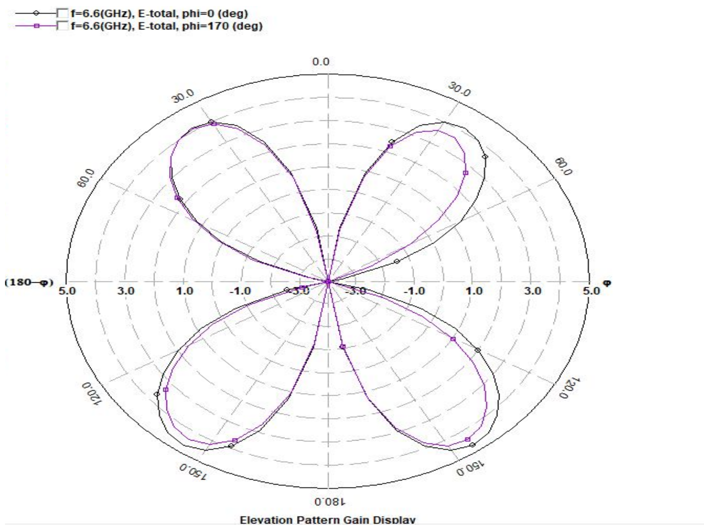

Fig.4: Radiation pattren of simple monopole antenna

By applying the fractal geometry to base antenna, we get plus shaped fractal monopole antenna. Geometry of Monopole fractal antenna with 1st iteration, return loss and radiation pattern shown in fig 5, fig 6 and fig 7.

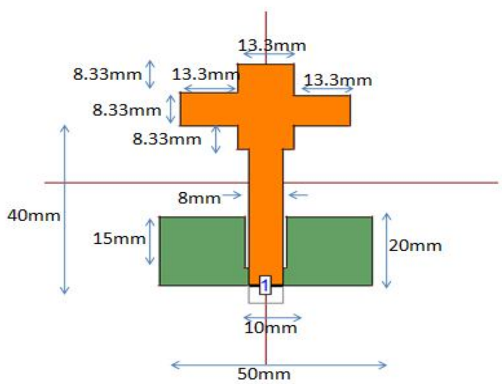

Fig 5: First iteration antenna geometry

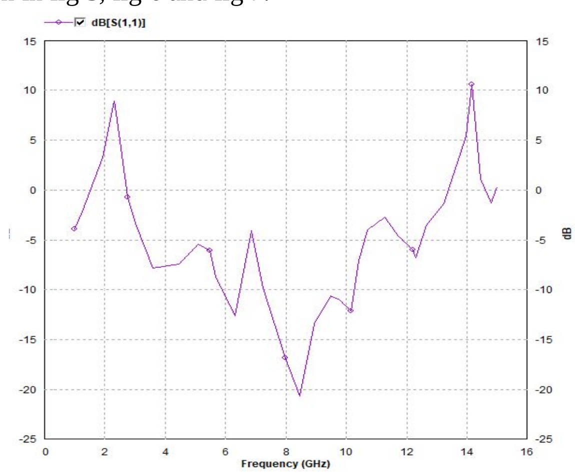

Fig.6: Return loss of plus shaped antenna

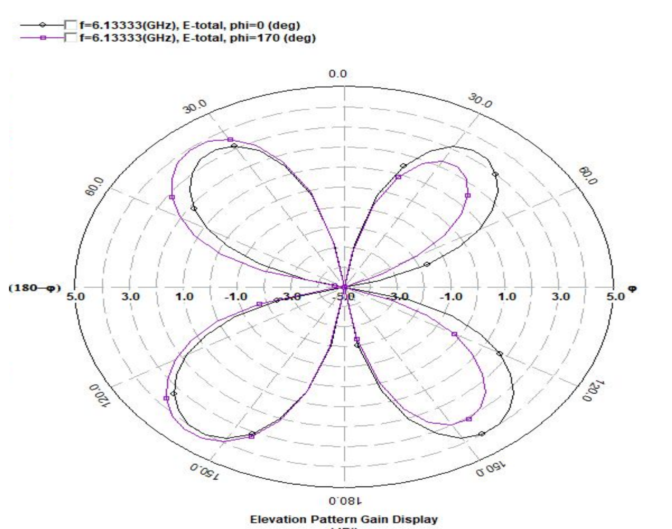

Fig.7.Radiation pattren of plus shape antenna

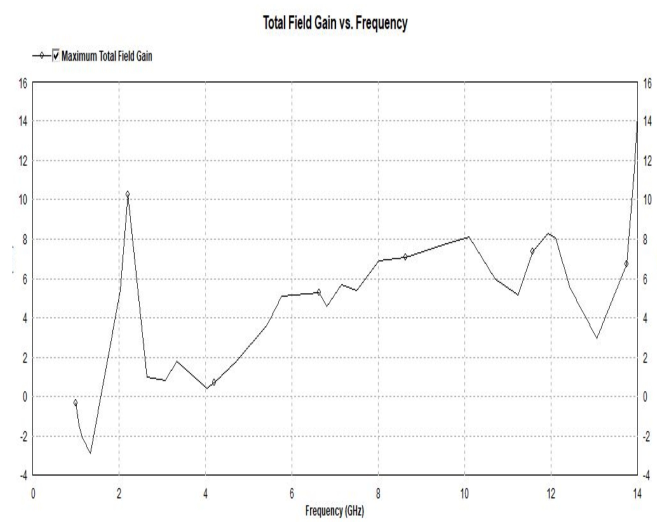

Fig .8. Total gain verses frequency

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B. Result And Discussion Of Simple Monopole Antenna

Designed antenna resonates at a resonating frequency of 6.2 GHz and 8.5 GHz having a return loss of -14 dB and -22 dB. Bandwidth of the plus shaped antenna is 3.601 GHz and percentage band width is 46%. It has been observed that Impedance matching at 6.2 GHz is 50 ohms and at 8.5 GHz is 52 ohms. and gain obtained is 5 dB at 6.017 GHz and 6.9 dB at 8.5 GHz

Geometry of plus shaped monopole antenna with slot is show in figure 9. Dimensions of this antenna remain same as that of first iteration monopole fractal antenna with introduction of slot. Return loss, radiation pattern and gain of antenna are shown in fig 9, fig 10.and fig 11.

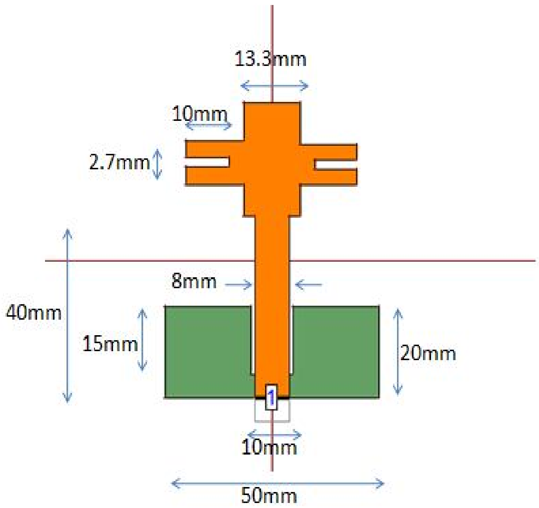

Fig. 9 :Plus shape with slot in monopole antenna

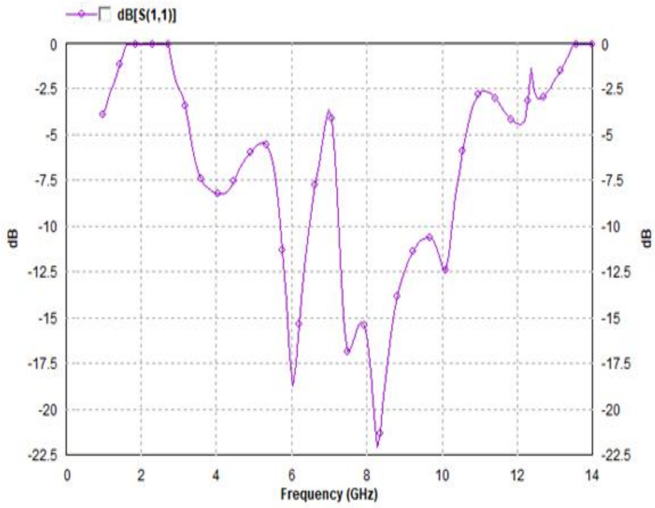

Fig 10: Return loss of plus shape and slot in monopole antenna

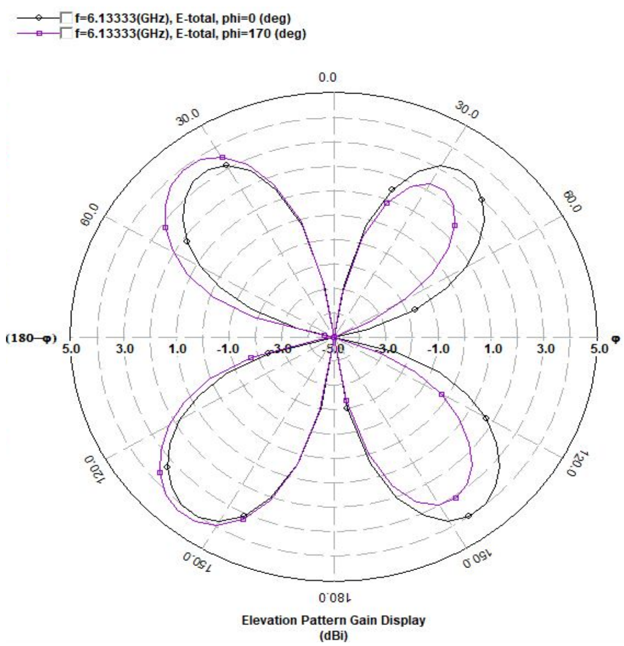

Fig 11. Radiation pattern

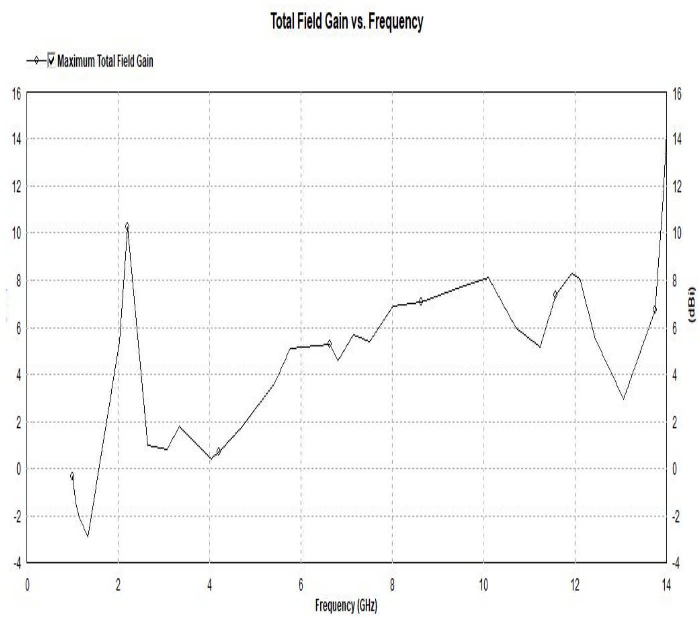

Fig 12 . Total gain verses frequency

C. Second Iteration Of Plus Shaped Monopole Fractal Antenna

Geometry of second iteration of monopole fractal antenna is shown in figure 13. Dimensions of the antenna remained same with respect to first iteration in addition to first iteration of plus shaped antenna four plus shaped patch is introduced to four corners of the plus shaped antenna using fractal geometry

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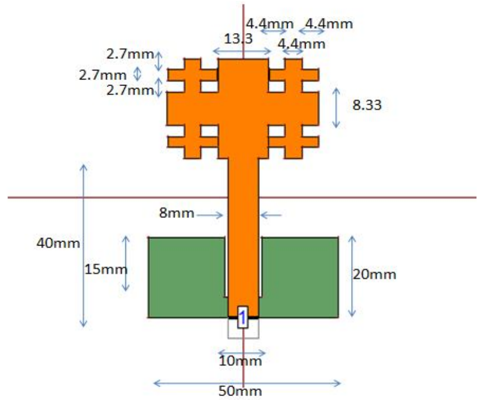
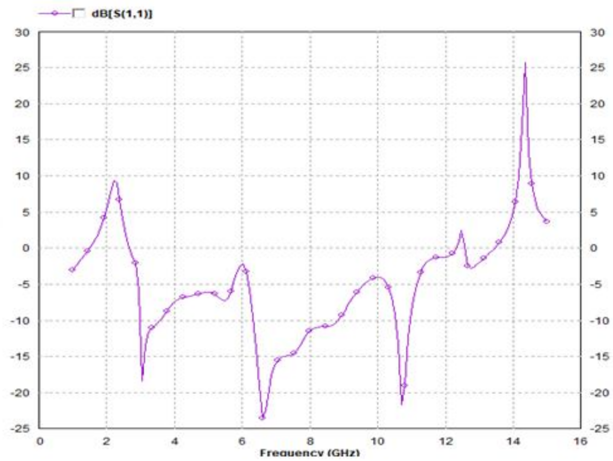


Fig 13.Second iteration monopole antenna

D. Results And Discussions

S11 parameters and return loss is shown in figure 14. It is observed that resonating frequencies for second iteration of the plus shaped monopole antenna are 3.05 GHz ,6.6GHz and 10.7 GHz having a return loss of -10 dB,-18 dB and -11.8 dB respectively. Bandwidth of antenna is 3.5GHz and percentage bandwidth obtained is 61%. Impedance matching observed at 3.05 GHz is 51 ohms, at 6.6 GHz is 50 ohms and at 10.7 GHz is 51 ohms. Total field gain verses frequency is shown in figure 15, gain at 3.05 GHz is 3.1 dB, at 6.6GHz is 4.3dB and at 10.7 GHz is 9.8 dB. Radiation pattern of second iteration of monopole fractal antenna is shown in figure 16. Here radiation pattern obtained is multiple sequence lobbing and can be used for radar tracking.



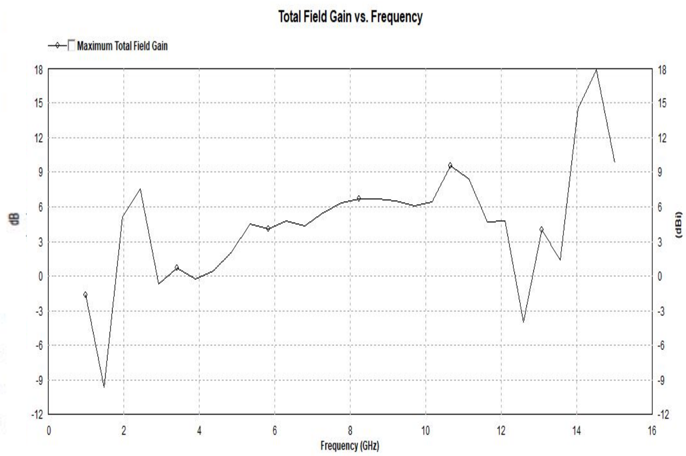


Fig .14: Return loss for second iteration monopole Fig .15:Total field gain vs frequencyfractal antenna

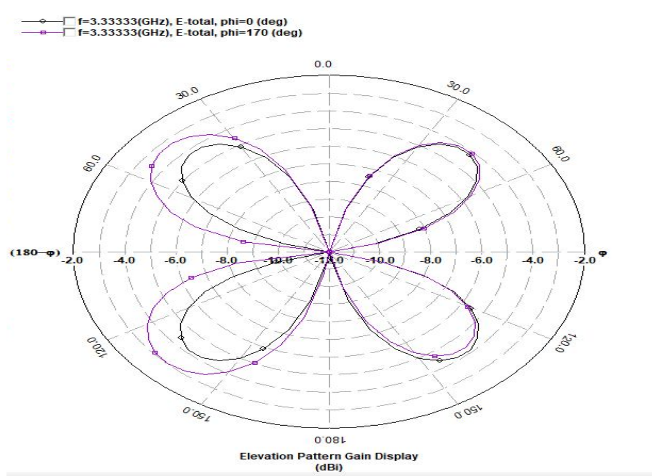


Fig .16 :Radiation pattren of second itteration

Result comparison for base antenna, first iteration plus shaped antenna, plus Shaped with slot antenna, second iteration monopole fractal antenna shown in below table 1.

	Resonating frequency	Retur n loss	Gain	Band width	Percentage bandwidth	Area reducti on in %
Simple monopole antenna	6.5 GHz	-25dB	5dB	2940 MHz	45%	
First iteration	6.2 GHz, 8.5 GHz	-14 dB -16 dB	5 dB 6.9dB	700 MHz 3010 MHz	46%	9%
First iteration with slot	6.01 GHz 8.02GHz	-18dB -22dB	5.1dB 6.9dB	700 MHz 3000 MHz	48%	14.5%
Second iteration	3.01 GHz 6.6 GHz 10.7 GHz	-10dB -18dB -11dB	3.1dB 4.3dB 10.7dB	650 MHz 2470 MHz 400 MHz	61%	79%

Table.1. Comparison of result

III. CONCLUSION

Research paper summarizes monopole antenna which resonates at a frequency of 6.5 GHz with a gain of 5dB having a bandwidth of 2940 MHz, with a percentage band width of 45%. Plus shaped antenna resonates at frequencies of 6.01 GHz and 8.2 GHz frequency with increased bandwidth of 3600 MHz. Introducing of slot to the same antenna resonates at frequencies of 6.01 GHz and 8.2 GHz with increased bandwidth of 3714 MHz and gives improved percentage band width of 48%. By incorporating a second iteration to the same antenna resonates at frequencies of 3.01 GHz, 6.6 GHz, 10.7 GHz with improved percentage bandwidth of 61%.

REFERENCE

[1] Neetu, Savina Banasl, R K Bansal, "Design and Analysis of Fractal Antennas based on Koch and Sierpinski Fractal Geometries" International Journal of Advanced Research in Electrical ,Electronics and Instrumentation Vol,2,Issue 6, June 2013

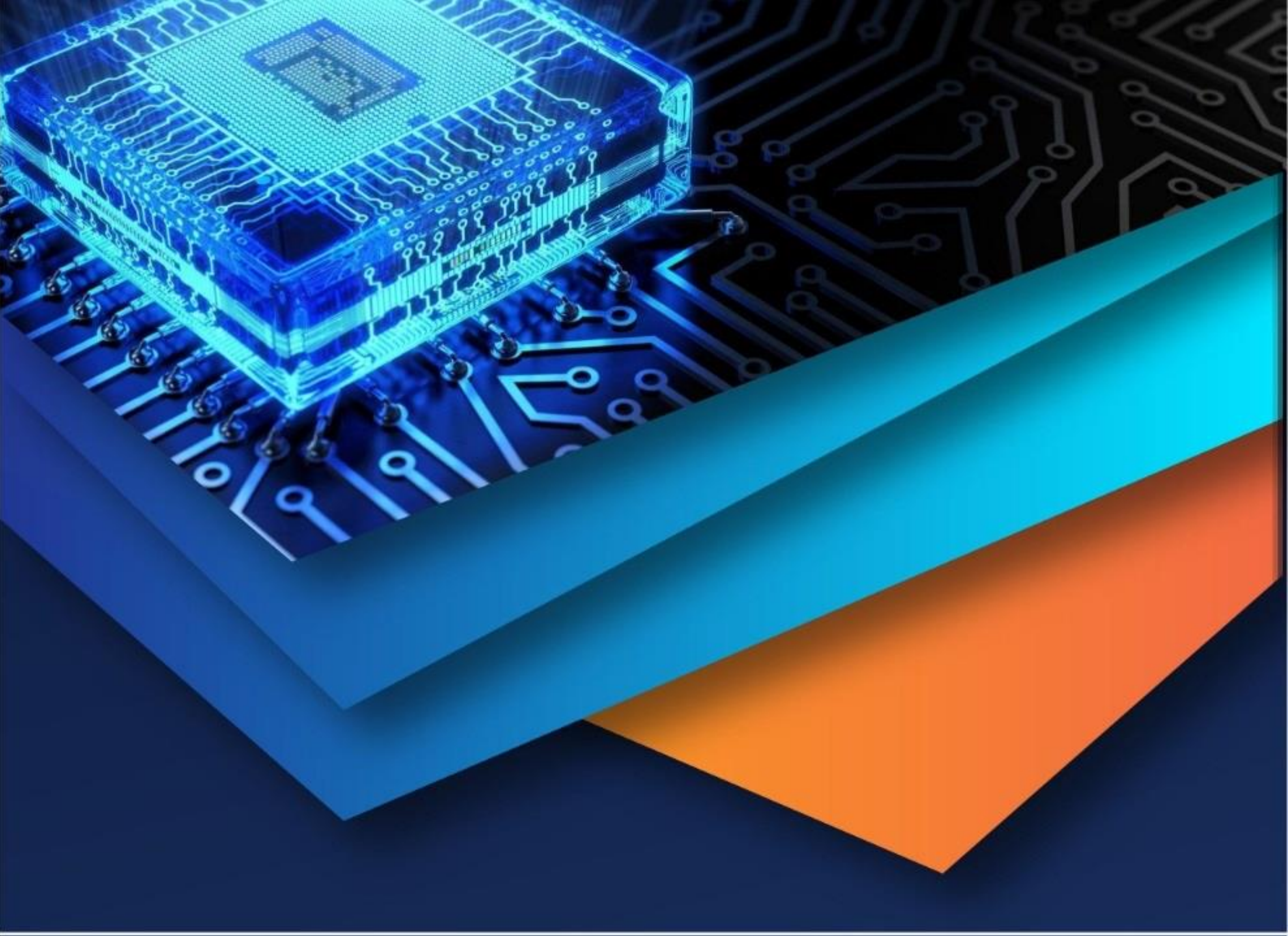
[2] P.Misra, A.Tripathy, N.Singhdeo. "A planar Monopole Antenna for Dual Band Application", International Journal of Scientific & Technology Research Volume 1, Issue 2, March 2012 .

[3] C.Mahattanajatuphat, S.Saleekaw, P.Akkaraekthalin , "A Rhombic Patch Monopole Antenna With Modified Murkowski Fractal Geometry For UMTS,WLAN, and Mobile WIMAX application", Progress In Electromagnetics Research, PIER PP 57-74,2009

[4] A.Kaka, M. Toycan, V.Bashirya,H.Ademgil and S.D Walker, "A Fractal Geometry, Multi-band, Miniaturized Monopole Antenna Design for UWB Wireless Applications" , 978-1-4577-0048-4/11/2011 IEEE

[5] Abdulhadi E. Abdulhadi, Ramesh Abhari, "Design and Experimental Evaluation of Miniaturized Monopole UHF RFID Tag Antennas" IEEE antennas and wireless propagation letters, vol. 11, 2012.

[6] Manish Sharma, Prateek Jindal,Sushila Chahar, "Design of Fractal Antenna for Multiband Application" ,"International Journal of Advanced Research in Computer Science Engineering", Volume 4, Issue 6, June 2014



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