International Journal of Current Engineering and Technology
E-ISSN 2277 – 4106, P-ISSN 2347 – 5161
Available at http://inpressco.com/category/ijcet

Research Article

Design & Simulation of 8–Shaped Coaxial Feed Patch Antenna

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Accepted 09 June 2016, Available online 11 June 2016, **Vol.6, No.3 (June 2016)**

Abstract

This paper describes the design and simulation of 8-shaped patch antenna *using Hfss11.1 electromagnetic simulation software* with coaxial feeding technique used. *The* 8-shaped patch antenna is being designed for amateur radio and satellite applications and thus resonates in X-band. *8 shape microstrip antenna gives better performance in return loss, efficiency and directivity.This paper proposes the design and simulation of different stages of antenna with DGS and the performance characteristics of this antenna reported in this paper.DGS and slot cutting technique being used in this paper to enhance band width.*

Keywords: *Multiband, microstrip, Simulation, Return loss.Dgs.*

1. Introduction

An antenna is a transducer which converts the electrical power into the electromagnetic waves and vice versa. The concept of Microstrip antenna was first proposed by Georges Deschamps in 1953 in USA. In 1955, Gutton and Baissinot patented a flat aerial that can be used in the UHF region in France. The fast development of microstrip antenna technology began in the late 1970s. By the early 1980s basic microstrip antenna was well established in terms of modelling design and the workers were involve in turning their attentions for improving antenna performance features (such as bandwidth), and to enhance applications in various fields by cutting one or multiple slots.

The microstrip patch antennas possess characteristics such as low profile, low weight and low manufacturing cost. So, the microstrip patch antenna can be used in Radars, missiles, spacecrafts, robots and mobiles, where size, weight and cost are constraints. DGS worked in order to enhance Bandwidth.

Conventional microstrip patch antennas have a conducting patch printed on a substrate. The shape of patch of the antenna may be square, rectangular, circular, triangular, elliptical or of other specific configurations.

2. Antenna Design

In this model, a coaxial fed 8–shaped microstrip patch antenna is presented. The FR4 epoxy dielectric material of relative permittivity 4.4 and loss tangent of 0.019. With the thickness of 1.6mm is used as a substrate of the antenna. The proposed antenna is excited by coaxial probe feeding technique and probe is located at (-2.9 mm, 0 mm,-3 mm). Dimension of patch of length 6.4 mm and width 9 mm as shown in figure 1.

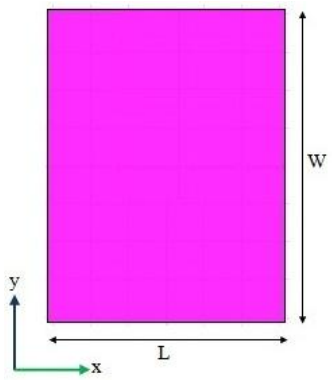

Fig.1 Simple rectangular patch

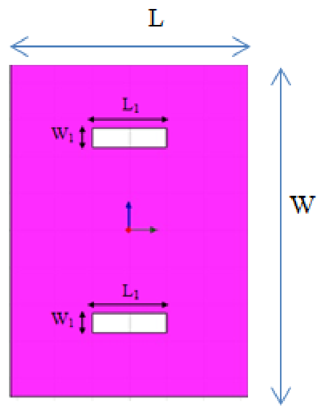

Fig.2 8-shaped patch

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For the first iteration rectangular (2*0.5) shape slot is cut inside the geometry in order to shape 8 shaped as shown in figure 2.

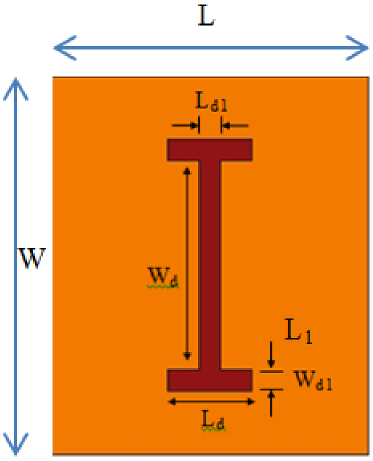

Fig.3 DGS

Parameters	Dimensions (mm)
L_d	4
W_d	10
L_{d1}, W_{d1}	0.5
$L_g x W_g$	15 x 18

Here we get better return loss than base shape and after application of DGS we further improved the return loss.

3. Result Analysis of Proposed Work

Antenna Design	f_l (GHz)	f_h (GHz)	f_r (GHz)	Return Loss (dB)	Bandwidth Percentage
Base Shape	8.3093	8.6996	8.5044	-16.0499	4.58 %
8-Shape	9.9876	10.6757	10.3316	-27.4451	6.66 %
DGS Optimized	10.0004	10.6926	10.3600	-44.1210	6.68 %

4. Computer Simulation and Results

For the simulation of RF component design, there exist many types of software, such as HFSS, CST, Fidelity, Super NEC etc. The structure is designed and simulated using HFSS simulation software. There resonant frequency for which minimum return loss occurs for various bands with increase in number of fractal since successive iterations. Figure 4 shows the Return loss versus frequency for base shape. Figure 5 shows the variation of VSWR versus frequency for base shape. Similar results for successive iterations are shown in figure 6 to figure 9. It its observed that as the number of iterations are increased; number frequency bands also increase. (.O.Peitgen, H. Jurgens, and D. Saupe, Chaos,1992)

For the base shape, resonant frequency occur at 1.700GHz and return loss is-17.88 and bandwidth percentage is 5.586 .For first iteration also resonate frequency occurs at 1.700GHz but their bandwidth percentage and return loss increases to 7.83% and -25.9257 respectively.. Similarly for second iteration resonant frequency occurs at 1.700GHz . But return loss increases to ,-35.07db and band width increases to 9.01825.

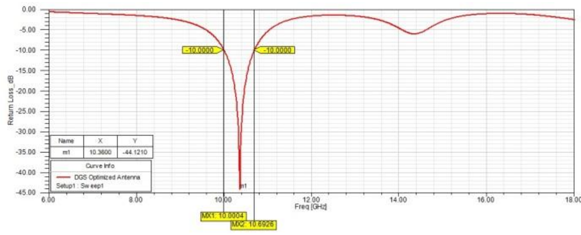

Fig.4 Return loss and bandwidth plot

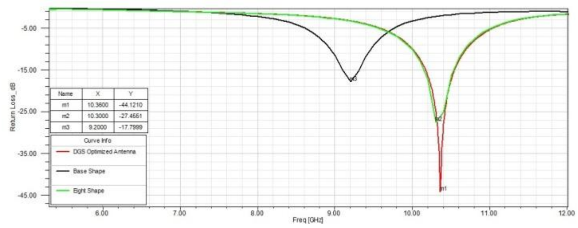

Fig.5 Return loss plot for base shape, 8–shaped and DGS optimized antenna

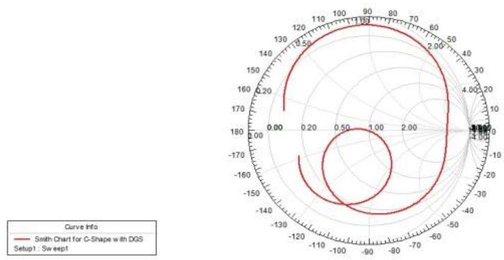

Fig.6 Smith chart of 8–shapedpatch antenna

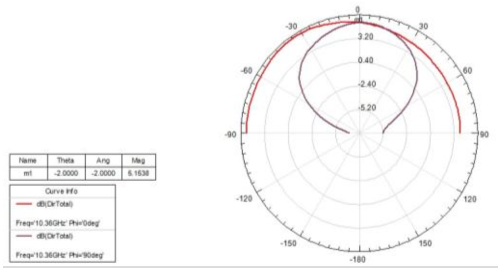

Fig.7 Radiation pattern of 8-shaped patch antenna at 10.36 GHz

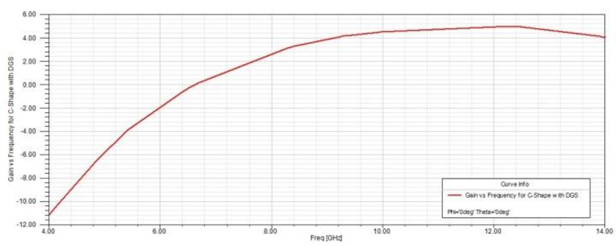

Fig.8 Gain V/s Frequency of 8–shaped patch antenna

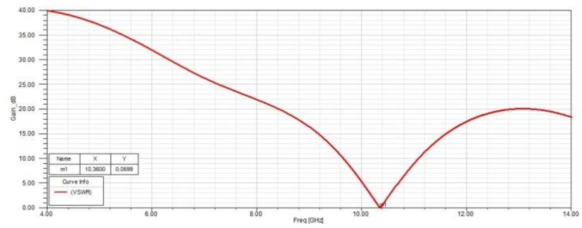

Fig.9 VSWR of 8–shaped patch antenna

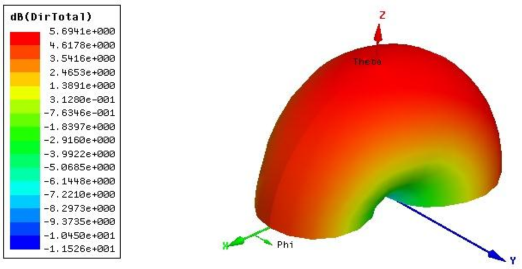

Fig.10 3D Polar plot of 8–shaped patch antenna at 10.36 GHz

Conclusion

In this paper, an 8-shaped patch antenna has been designed with coaxial feeding technique used. Initially rectangular shape patch is simulated and return loss curve is traced, then a rectangular shape of particular dimension is removed from the base shape such a way that base shape converted into 8-shape then a defected ground structure is created. After completion of the design it is kept under simulation to get desired result. Here we get better return loss than base shape and after application of DGS we further improved the return loss, then parametric study of various parameters of the proposed antenna has also been presented. We concluded that return loss increases to some value. The return loss plot of the proposed antenna has been shown that the antenna is resonated from 10.0002 GHz to 10.6926 GHz with the return loss of -44.12 dB. So, the proposed antenna can be used for amateur radio and satellite communications.

The proposed antenna shows the satisfactory gain in the desired frequency range. In this shape we improved BW% up to 6.68 % from 4.48 %. i.e. (4.48 % BW was at base shape antenna and after optimization it increases to 6.68 %).

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