A Compact Triangular and Circular Serrated Rectangular Slot Patch Antenna for X-band Applications

Ch. Vijaya Sekhar Babu, K. Nalini, D. Ujwala, R.Rahul, K. Naga Mallik, A. Gowtham

Abstract:- A Rectangular slot patch antenna with triangular and circular serrations is presented in this paper. The proposed design is prototyped on Rogers RT/duroid of dieletric constant 2.2 which has a compact size of 24mm x 24mm x1.5mm. Two identical rectangular slots are on made on patch with double sided triangular and circular serrations. The proposed strucuture operates at dual band which can be used X-band applications. The dependence of impedance matching on feed location is analyzed by varying the feed location horizontally. The simulations are carried out using Finite Element method based Ansoft HFSS version 13.

Keyword:- X-band, Ansoft HFSS version 13.

I. INTRODUCTION

Microstrip antenna is one type of the antennas which can be used for transmitting and receiving signals. Because of their low profile, samll isze, light weight and ease of fabrication, they are widely used in wireless and mobile communications. Microstrip antennas are of basically two types by structure, namely microstrip patch antenna and microstrip slot antenna. Microstrip slot antennas are usually implemented in two forms, namely, wide and narrow slots [1-2]. Wide slot antennas have more bandwidth compared to the narrow slots while they suffer from more x-polar components and larger dimensions. The most important limitation of a narrow microstrip slot antenna is the single frequency and narrow band operation [3-5]. Embedding different types of slots on patch antennas is another method for achieving bandwidth enhancement.

The microstrip slot antenna have low spurious radiations when is is fed by coaxial cable. The inner conductor of the coaxial is attached to the radiation patch of the antenna while the outer conductor is connected to the ground plane. Also coaxial fed antenna is easy to fabricate and easy to match [6]. In this paper, a rectangular slot patch antenna with triangular and circular serrrations is designed and analyzed. It resonates at two frequency bands which can be used for X-band applications. Effect of feed location variations are analyzed in this paper.

II. ANTENNA MODEL

The model of the proposed antenna is as shown in figure 1.

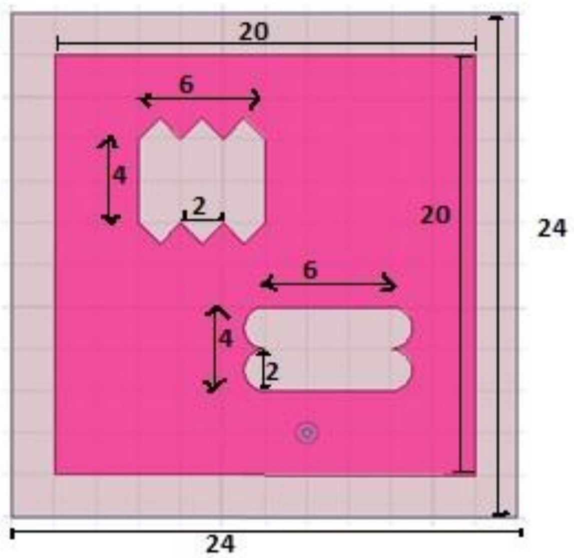

Figure 1: Geometry of proposed antenna

The proposed design is fed by coaxial cable with an input impedance of 50 Ω. The substrate material is Rogers RT/duroid of dielectric constant 2.2 and loss tangent 0.0009 with a thickness of 1.5mm. The size of the proposed antenna is 24mmx 24mm x 1.5mm with a patch size of 20mm x 20mm. Two identical rectangular slots of length 6mm and width 4mm are cut down from the patch. One rectangular slot is serrated with triangles of height 1mm and one rectnagular slot is serrated with circles of radius 1mm. The strucutre is analyzed for different horizontal feed locations and the impedance matching dependance on feed locations is observed. The proposed strucutre is simulated using Ansoft High Frequency Structure Simulator version 13.

III. RESULTS AND DISCUSSIONS

The proposed antenna resonates at dual frequencies 8.65 GHz and 9.25 GHz whose bandwidths are from (8.57 GHZ - 8.76 GHz) and (9.11 GHz – 9.38 GHz) respectively. The corresponding return loss at the two resonanting frequencies are -18.7 dB and -28.8 dB as shown in figure 2.

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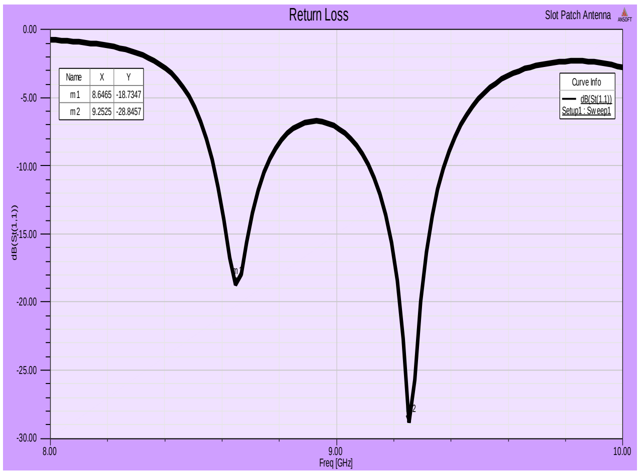

Figure 2: Return Loss versus Frequency

The dependance of impedance matching on feed location is shown in figure 3. The feed location is varied horizontally at different locations feedX= 8mm, 10mm, 12mm, 14mm. It is observed that desirable impedance matching is obtained at feedX=14mm.

The Voltage standing wave ratio (VSWR) at the respective resonant frequencies are 1.26 and 1.07 and the plot is shown in figure 4.

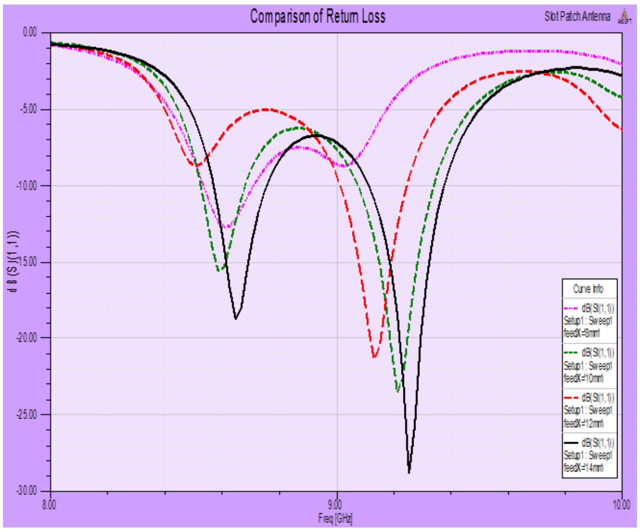

Figure 3: Effect of feed location variations on Return Loss

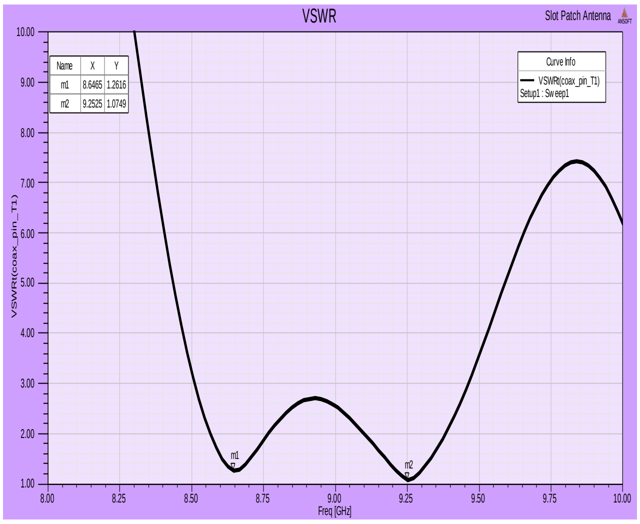

Figure 4: VSWR versus Frequency

The input impedance plot is shown in figure 5.

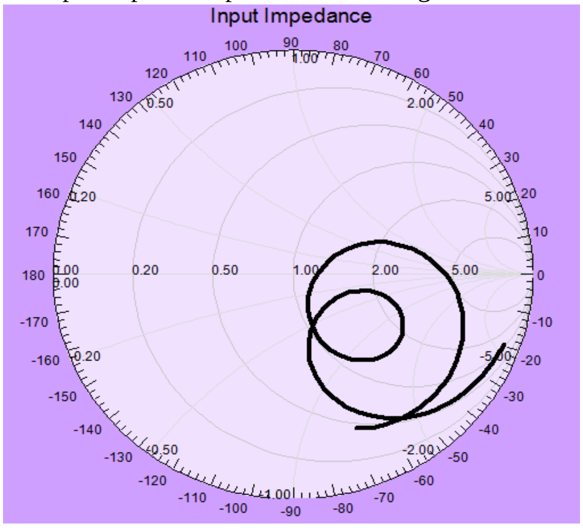

Figure 5: Input Impedance

The gain plot is shown in figure 6. The gain of the proposed antenna is 5.3 dBi.

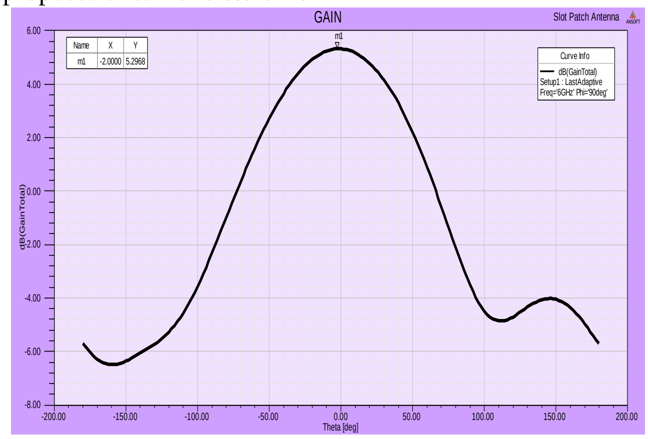

Figure 6: Two dimensional Gain

The radiation patterns in XY-Plane, YZ-Plane and XZ-Plane at the resonant frequencies 8.65 GHz and 9.25 GHz are shown in figures 7 and 8.

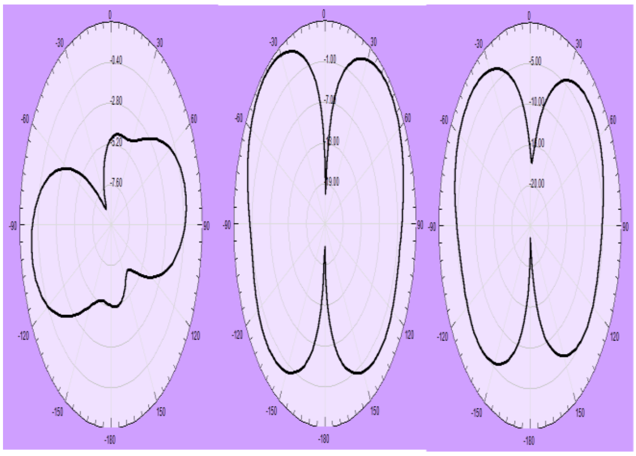

Figure 7: Radiation Patterns at 8.65 GHz in XY, YZ and XZ planes.

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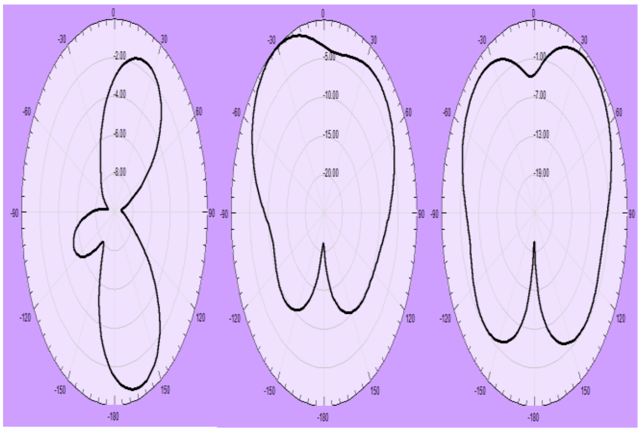

Figure 8: Radiation Patterns at 9.25 GHz in XY, YZ and XZ Planes.

The Electric Field, Magnetic Field and Surface Current distributions at the resonant frequencies 8.65 GHz and 9.25 GHz are shown in figures 9, 10, 11 respectively.

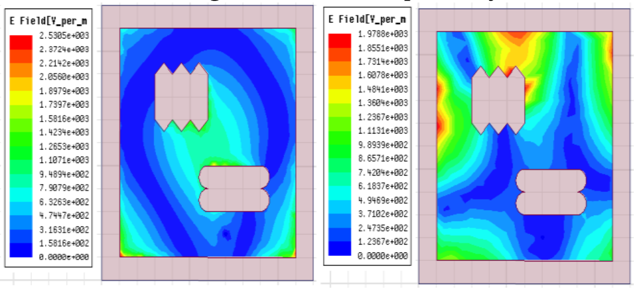

Figure 9: Electric field distributions

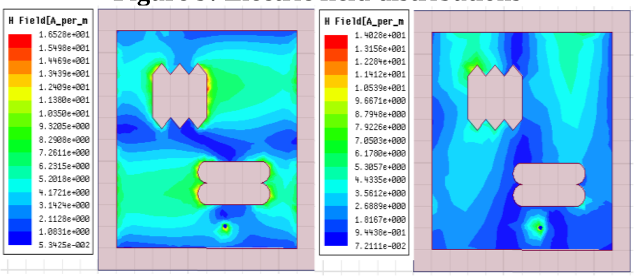

Figure 10: Magnetic field distributions

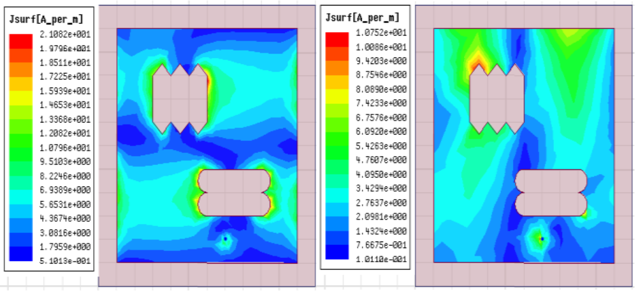

Figure 11: Surface Current distributions

IV. CONCLUSION

A novel rectangular slot patch antenna with triangular and circular serrations is designed, optimized and analyzed for X-band applications. Theoritical investigations have been carried out using Finite Element Method based Ansoft High Frequency Structure Simulator. Good performance characteristics are achieved. After comparing the different feed locations better performance of the proposed antenna is achieved when the feed location is at (14,4).

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