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Design of U Slot Patch Antenna for Wi-max and Radar Applications

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Abstract: ***A compact U shaped slot patch antenna is proposed and designed in this paper for Wi-max and radar applications. This antenna is designed on a Rogers RT-Duroid substrate of dielectric constant 2.2 with thickness of 0.16cm. The dimensions of the proposed antenna are 3cm X 3cm X 0.16cm. The proposed antenna resonates at three frequencies 6.05 GHz, 9.87 GHz and 10.47 GHz. The gain of the proposed model is 8.47 dBi. The proposed model is simulated using commercial antenna design software High frequency Structure Simulator(HFSS).***

Keywords: ***Microstrip patch antenna, Return Loss, Radar, Slot, Wi-Max.***

1.INTRODUCTION

The need for a low profile and compact antennas is on rise with the rapid development of the wireless communication devices. Due to low fabrication cost and compactness of the patch antennas many researchers are working in this area.Also these antennas are light weight and easy to instal[1-4]. To maintain compactness and multiple bands yet to remain high gain of the antenna is still a challenge to the antenna designers.Typically dual frequency operations can be obtained by using multilayer stack patches[5] and little attension has been paid to single layer microstrip antennas[6].Several techniques of microstrip antennas are known, prominent among them are the use of stacked patches. The stacked patch antenna has multi layer structure consisiting of several parasatic radiating elements placed one above the other and above the driven element[7].However this approach has the inherent disadvantage of increased overall thickness and issues related to alligning various layers precisely.But slot antennas are ahead of this.The proposed antenna is of small size having the dimensions 3cmx3cmx0.16cm. The operating frequencies of the proposed model are 6.05 GHz, 9.87GHz and 10.47GHz.The 6.05 GHz frequency can be used for wireless applications.The 9.87 GHz and 10.47 GHz band can be used for RADAR applications(I/J band).This I/J band is relatively popular RADAR band for military applications like airborne RADARs for performing the roles of interceptor,fighter and attack of enemy fighters and of ground targets.This frequency band is widely used for maritime civil and military navigation RADARs.This freequency band is also popular for space borne or airborne imaging RADARs based on Synthetic Aperture Radar(SAR) both for military electronic intelligence and civil geographic mapping.

2. ANTENNA DESIGN

The design of theproposed antenna is as shown in figure 1. The antenna is realized on Rogers RT/duroid substrate with dieelectric constant 2.2 and a loss tangent of 0.0009. The thickness of the antenna

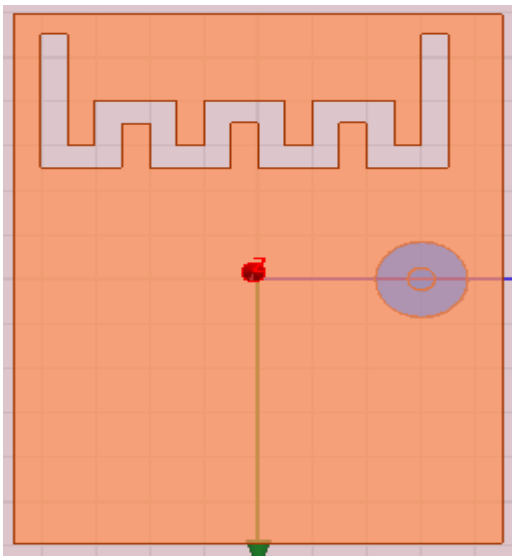

Fig 1: Proposed Model

antenna is 0.16mm. It is fed by a coaxial cable with 50Ω impedance matching.The dimensions of the substrate are 3cmx3cmx0.16cm.The dimensions of the patch are 1.2cmx1cm with slots of two different sizes. The length and width of the longer slot are 0.3cm and 0.05cm respectively. The length and width of the shorter slot are 0.1 and 0.05 respectively. The diameter of the feed is 0.05cm and the hieght is 0.16cm.The proposed antenna has three resonant modes and having a maximum gain of 8.4 Dbi.

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3. RESULTS AND DISCUSSIONS

The proposed antenna resonates at three frequencies 6.05 GHz, 9.87 GHz and 10.47 GHz. The First Resonant Frequency has a bandwidth from 6.01 GHz to 6.09 GHz. The other two Resonant Frequencies create a wide bandwidth ranging from 9.57 GHz to 10.77 GHz.

The return loss of the proposed antenna at the three Resonanat Frequencies is shown in figure 2.The return loss values are -20.5 dB, -14.42 dB and 13 dB for the frequencies 6.05 GHz, 9.87 GHz and 10.47 GHz respectively.

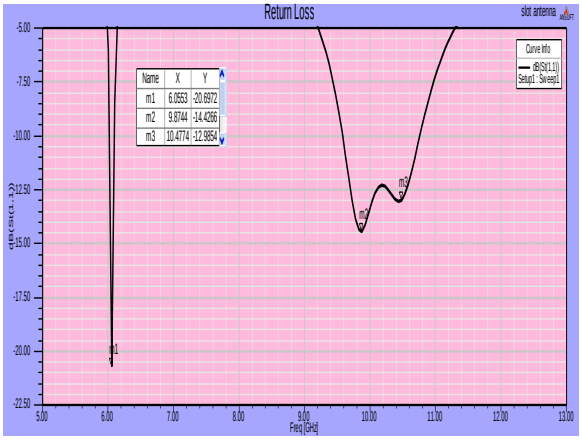

Fig 2: Return Loss vs Frequency

The Voltage Standing Wave Ratio (VSWR) describes the amount of power reflected by an antenna. In Practical, the VSWR should be between 1 and 2 for less reflection losses. The VSWR plot of the proposed antenna is shown in figure 3. The VSWR is 1.2, 1.47 and 1.57 at the three Resonating Frequencies 6.05 GHz, 9.87 GHz and 10.47 GHz respectively.

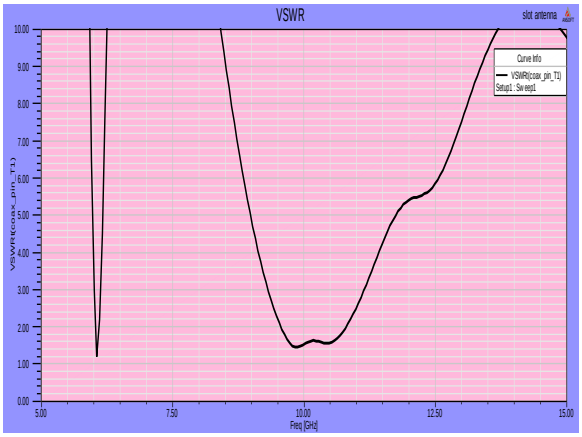

Fig 3: VSWR vs Frequency

The E-plane radiation pattern at the Resonant Frequencies is shown in figure 6. The E-plane radiation pattern is directional from the figure.

The 2-D Gain of the proposed model is shown in the figure 4. The maximum gain of the proposed antenna is 8.47dBi.

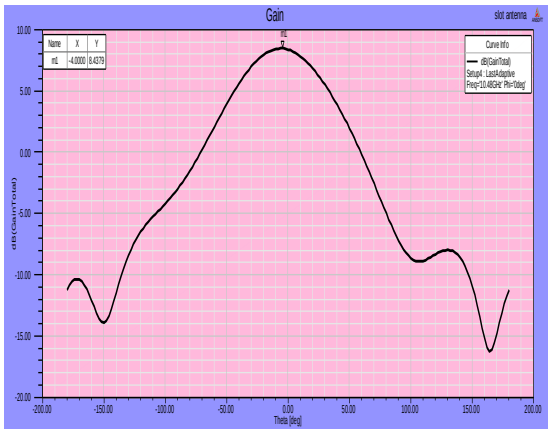

Fig 4: 2D Gain

The 3-D Gain of the proposed antenna is shown in figure 5.

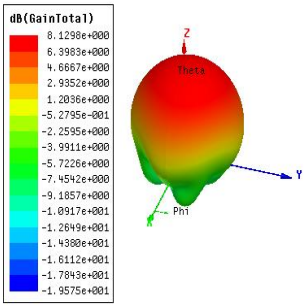

Fig 5: 3D Gain

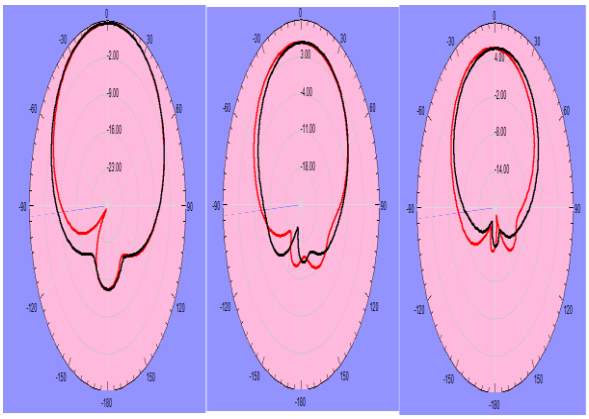

Fig 6: E-plane Radiation pattern at phi=0, 90deg.

The H-plane radiation patterns at the Resonant Frequencies are shown in figure 7.

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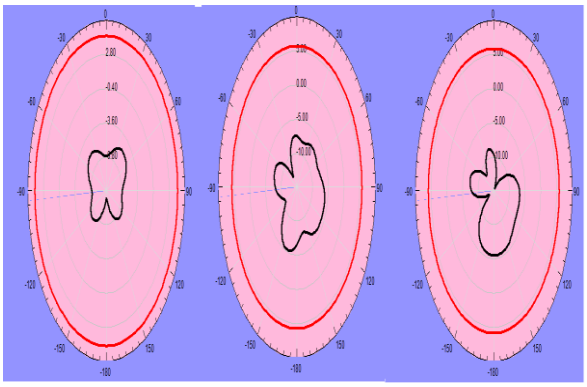

Fig 7: H-plane Radiation pattern at theta=0, 90deg

The H-plane radiation pattern is Omni directional from the figure.
The orientation of an electric field vector is known as the polarization of an electro magnetic wave of an antenna.

The E-field distribution at the three resonant Frequencies is shown in the figure 8.

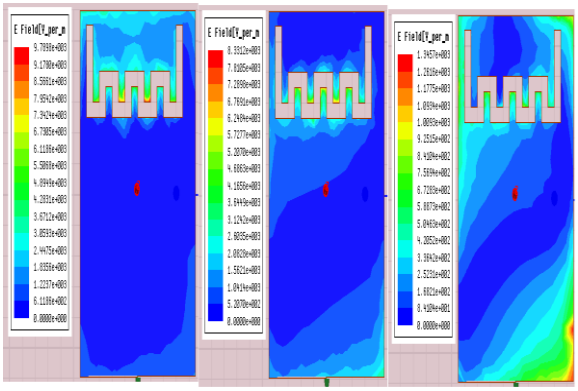

Fig 8: E-field distribution.

The H-field distribution is shown in the figure 9.

4. CONCLUSION

A novel compact slot antenna design and the simulations are presented in this paper. The proposed antenna has three resonant frequencies of 6.05 GHz, 9.87 GHz and 10.47 GHz. The first resonant frequency can be used for wireless applications and the remaining two frequencies can be used for Radar applications. The gain of the proposed antenna is 8.47dBi at the solution frequency. The radiation patterns are directional in E-Plane and Omni directional in H-Plane.

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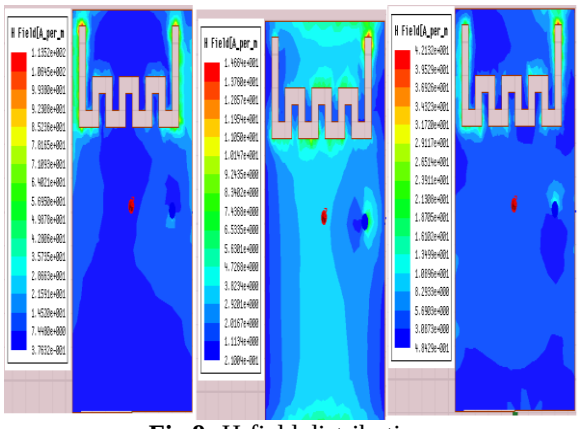

Fig 9: H-field distribution.

The mesh generation plot of the proposed antenna at the three Resonant Frequencies is shown in the figure 10.

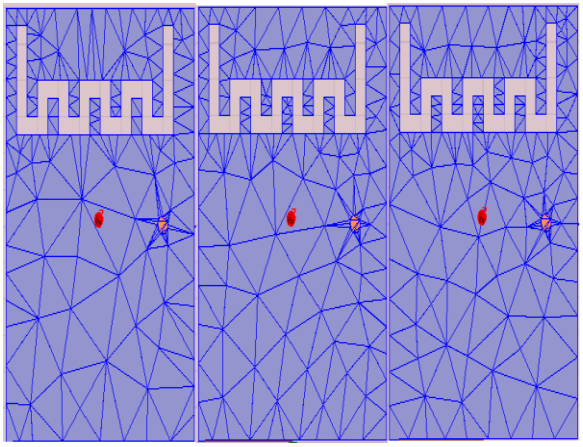

Fig 10: Mesh Plot generation

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