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Dual Band Edge Serrated Microstrip Antenna on FR4 Substrate for L & S Band Applications

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Abstract- With the advancements in optical and satellite communications for high speed long range data transmissions, serrated antennas plays a vital role. In this work we have designed a Edge Serrated Microstrip Patch antenna used for these applications has been modeled on FR4 substrate as a dielectric medium which has a relative permittivity value of 4.4. The proposed antenna was resonating at two different frequencies in L & S band Microwave frequency ranges. This antenna was fed with coaxial feeding and was designed in a software HFSS.

Index Terms- Rectangular Microstrip, Serrated Antennas, Dual Band, Gain.

I. INTRODUCTION

A micro strip antenna is basically designed in such a way that an integration of two parallel conducting layers which is separated by a dielectric material is printed on to a single board. The lower layer and upper layers act as a ground plane and radiator respectively [1]. A simple patch antenna uses a patch of half wavelength long and having a larger ground plane which may increase the antenna size on the contrary gives better performance. We can design different shapes of micro strip patch elements such as dipole, triangular, rectangular, elliptical, circular and square [3]. But we use rectangular microstrip for better radiation characteristics. Micro-strip antennas are the successors of the printed antennas which are the present inventory for any type of wireless application with its frequency components sparing to different applications in defense, GPS, missile systems and satellite communications [2, 4].

Micro strip antennas have good performance in antenna technologies when compared to other metallic antennas at low cost. We can implement different techniques and technologies to attain antenna integration within a unique chip using this type of antenna. In reference to this in our paper we have designed a serrated rectangular microstrip patch antenna on FR4 substrate. The basic idea behind designing a serrated patch antenna is that it has multiband characteristics, since we have obtained dual band in this case, it will be effective that it will have high bandwidth and high gain with only a single radiating element and Omni directional radiation pattern like those of general printed antennas, but these are more advantageous due to its applications [2].

In serrated antenna design we have used FR4 substrate since all the printed circuited boards are mostly made of this material it is easy to make serrated apertures with this material [5]. Serrated antennas have multiband characteristics since serrated apertures are used for optical communication where high speed is necessary, this would be helpful for high speed long range data transmission to satellite in microwave frequency range. And multiband frequencies are really necessary in military applications integrated with satellite ranges, we can have connection with high secure, high speed and low cost using the proposed the antenna specifications.

II. DESIGN MODEL

The proposed Edge Serrated Microstrip Patch Antenna shown in the figure 1 & 2 was fabricated using a software HFSS.Here coaxial feed was given because of low spurious radiations and ease of fabrication. HFSS is a commercially available finite element method solver for electromagnetic structures.

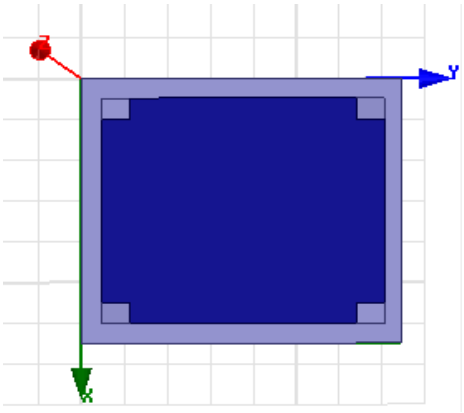

Figure 1. Edge Serrated Antenna

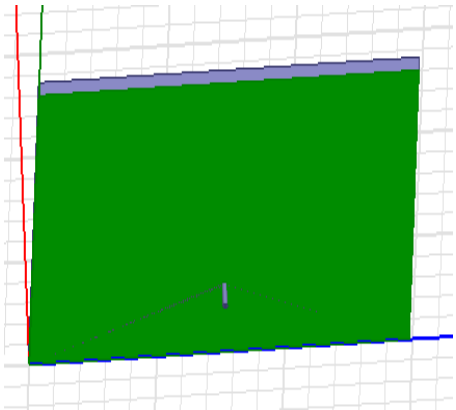

Figure 2. Antenna with coaxial feed

Specification	Measurement
Length of Patch	65.80 mm
Width of Patch	55.41 mm
Length of Substrate	74.40 mm
Width of Substrate	65.01 mm
Height of Substrate	1.60 mm
Feed Inner & Outer radius	0.13,0.47 mm
Feed Position	16.446,37.7,0
Serrated length	6.6 mm
Serrated width	5.2 mm

Table 1. Design Specifications

III. RESULTS AND DISCUSSIONS

Return Loss:

Return loss indicates at what frequencies the designed antenna was operating with minimum loss of signal. A minimum of 10dB is required compulsory but for the better signal strength the return loss should be as higher as possible than that.

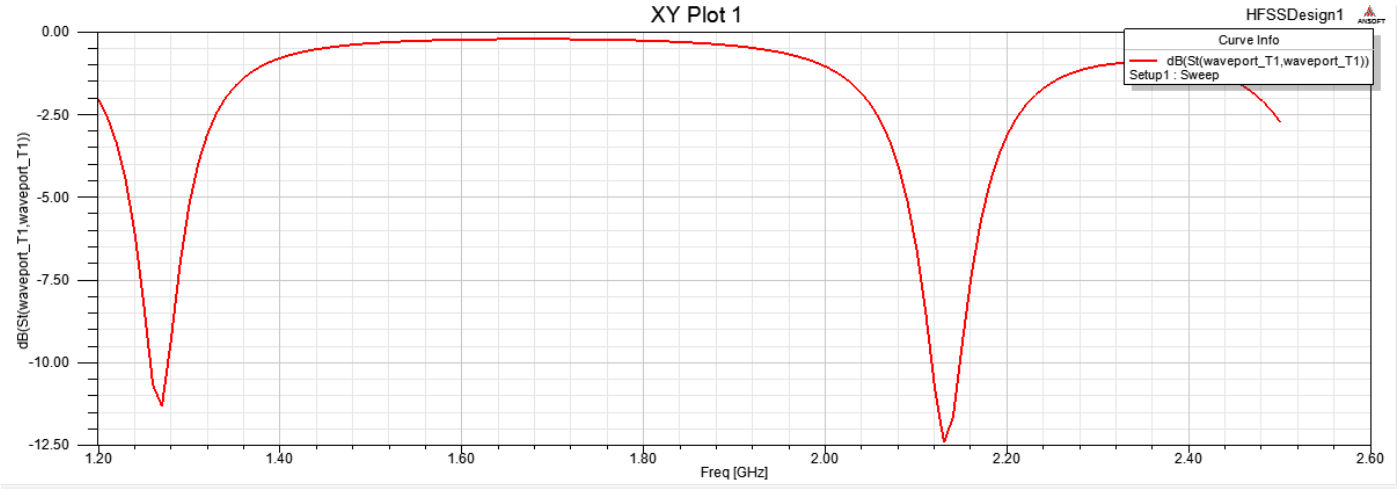

Figure 3. Return loss with FR4 as substrate

Dual-band serrated antenna means it radiates power at two different frequencies. As shown in the figure 3 the antenna was resonating at 1.24 & 2.15 GHz. Since these frequencies belong to L and S band frequency range this antenna can be used for application which in turn uses these frequencies.

The operational disadvantage with these microstrip antennas is having low gain. So gain is the major constraint to be take care as it depends on shape, size and dielectric material used. As shown in the figure 5 the designed serrated antenna has a gain of 7.9 dB which is best suitable for real time applications.

Radiation Characteristics:

Radiation Characteristics defines the relative field strength of the antenna from different directions. 2d-radiation pattern is nothing but the graphical representation of antenna pattern in two dimensions, whereas 3d-radiation pattern is the graphical representation of antenna pattern in three dimensions.

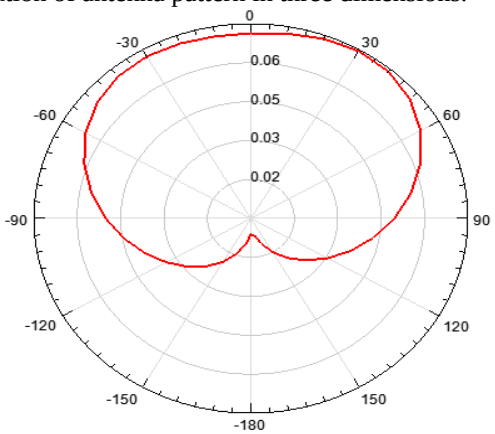

Figure 4. 2d- pattern

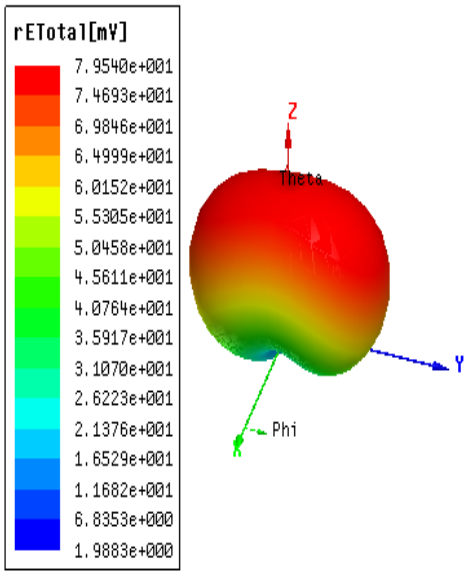

Figure 5. 3d- pattern

Directivity:

Directivity is also a one of the important parameter that should be take care while designing microstrip patch antennas because directivity defines how the radiations are forwarding in the desired directions. Since directivity purely depends on the dielectric material but not on the ground plane, selecting a proper substrate increases the directivity of the antenna. As shown in the figure 7 the directivity of the serrated antenna has 6.23 dB which is better suitable for satellite applications.

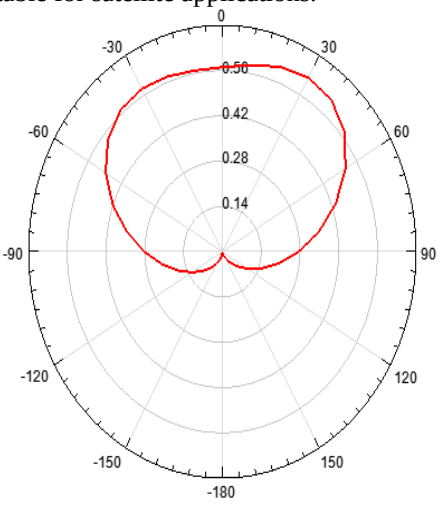

Figure 6. 2d-Directivity Pattern

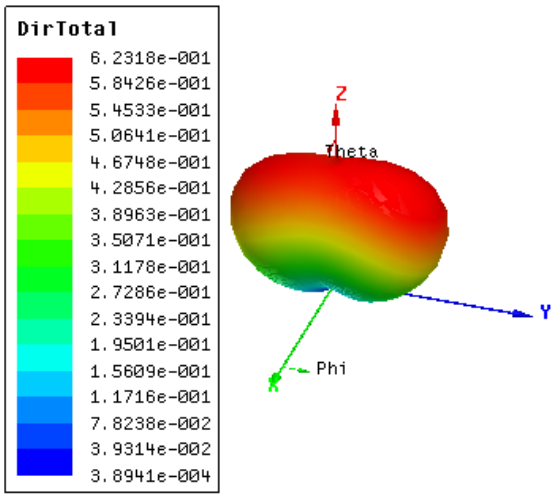

Figure 7. 3d- Directivity Pattern

Field Characteristics:

The E-Field and H-Field characteristics of the proposed Edge Serrated Microstrip Patch Antenna are shown in the figures 8 & 9.

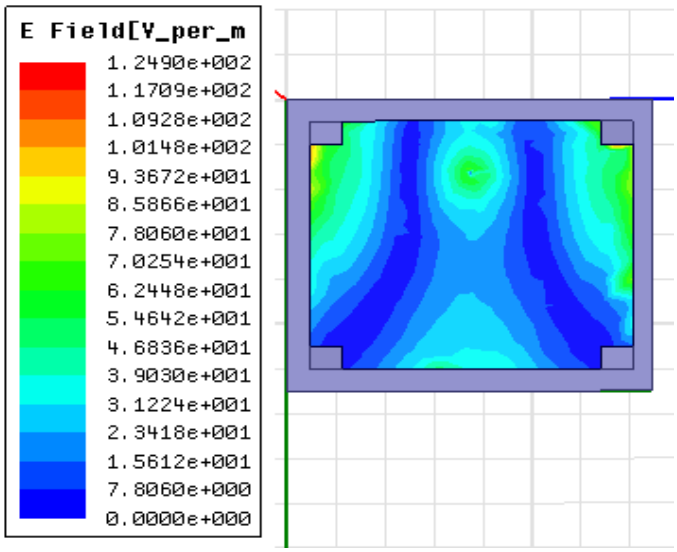

Figure 8E-Field Pattern

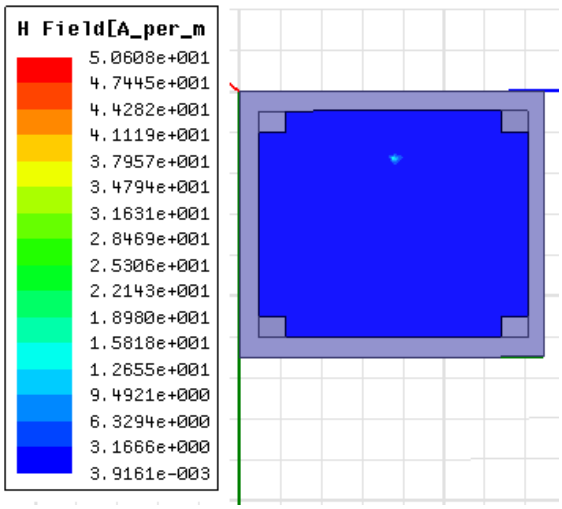

Figure 9. H-Field Pattern

IV. CONCLUSION

Performance of serrated antenna with FR4 as substrate has been investigated in this work. Since this serrated antenna was resonating at two frequencies in L and S band range we can use this antenna in a application where these frequencies are used. We observed that the gain of this antenna is 7.9dB and directivity of 6.2dB has been achieved.

V. FUTURE WORK

This work can be further extended to operate this antenna at multiple frequencies with wide band range of operation and to improve gain and directivity for satellite applications.

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