RESEARCH ARTICLE OPEN ACCESS

Design Of Micro-Strip with Circular, Step shape Slot Antenna for S Band Applications

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Abstract
In this paper a novel design of small sized, rectangular patch antenna with coaxial fed low profile antenna with step type slots at the four sides, circular slot at the center is proposed for the frequency of C Band application with the substrate RT duroid 5880(™) whose relative permeability and a loss tangent are 2.2, 0.0009respectively.Withthe above specifications Designed antenna parameters like return loss which is -38.4225dB at 3.7374GHz with elliptical polarization, along θ, Ø directions, radiation pattern in 2D & 3D where the 2-D gain is 7.598dB, along with gain and radiation pattern E&H field and current distributions are simulated using HFSS 11.0. The measured parameters satisfy required limits hence making the proposed antenna suitable for s-band weather radar applications.
Keywords Micro strip slot antennas, Wireless communication, Microstrip patch antenna.

I. Introduction

The **S band** is part of the microwaveband of the electromagnetic spectrum. With frequencies that range from 2 to 4 GHz. The S band is used for radar applications like weather, surface ship radarand also for satellite communication.Theradar with 10cm are short-band range are roughly from 1.55 to 5.2 GHz.
The 2.6 GHz range is used for China Multimedia Mobile Broadcastinga radio(satellite) andm TV(mobile). In some countries, S band is used for Direct-to-Home satellite television. The frequency typically allocated for this service is 2.5 to 2.7 GHz (LOF 1.570 GHz). Amateur radio and amateur satellite operators have two S-band allocations,13cm(2.4 GHz)and9 cm (3.4 GHz).Radar applications use relatively high power pulse transmitters and sensitive receivers. So radar is operated in bands not used for other purposes. Most radar bands are part of the microwavespectrum, although certain important applications for meteorology make use of powerful transmitters in the UHF band.

Micro strip patch antennas are widely used because of its lightweight, compact size, they are easy to integrate and finally cost effective.

However, Major Diminishing factor of patch antennas is their narrow bandwidth due to surface wave losses andfor better performance size of patch must be large. As a result various techniques to enhance the bandwidth are proposed. Techniques to reduce size include different structural techniques, shorting pin or plate techniques, where a micro strip line or patch is shorted with the ground plane of the antenna. Different loading techniques can be used; such as using external lumped components to reduce the size of the antenna, which result in reduced overall performance and gain, while increasing the cost of the antenna.

Keeping in view of inserting slots in patch antenna for greater band of operationwithout increasing its size.Coaxial fed Rectangular patch antenna with step slots at the foursides, center with circular slot wasproposed keeping in view of weather radar applications.

The proposed antenna parameters like return loss with elliptical polarization, gain along θ, Ø directions, radiation pattern in 2D & 3D, E & H field and current distributions are simulated using HFSS 11.0 which is a high-performance full-wave electromagnetic(EM) field simulator for arbitrary 3D volumetric passive device modeling that takes advantage of the familiar Microsoft Windows graphical user interface. Ansoft HFSS can be used to calculate parameters such as S-Parameters, Resonant Frequency, and Fields.

II. Antenna Model

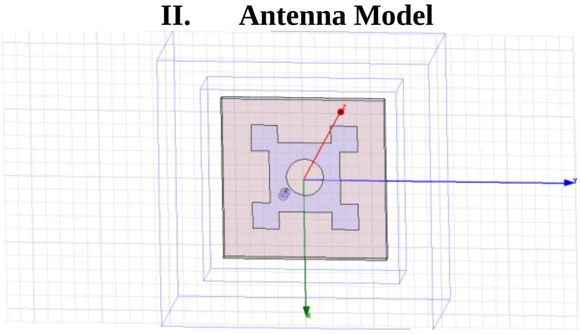

Figure1 proposed Antenna Model.

III. Antenna Design considerations

The proposed structure of the antenna is shown in Figure. (1). The antenna is simulated using RT duroid substrate with a dielectric constant and loss tangent are 2.2, 0.0009. The thickness of the substrate is 0.32cm. The size of the antenna is 0.2mm, which is suitable for most Radar applications. Patch with step slots on four sides, center with circularslot is proposed for the frequency of S Band application.

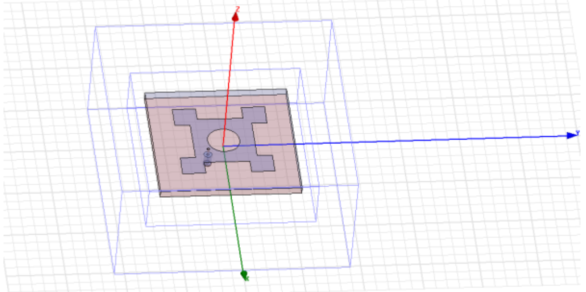

Figure. 2. Generated antenna model

The patch can also be fed with a probe through ground plane. The probe position can be inset for matching the patch impedance with the input impedance. This insetting minimizes probe radiation. The ease of insetting and low radiations is advantages of probe feeding as compared to micro strip line feeding. The dimensions of shaped patch shown in Fig. (1) are these are designed at operating frequency 7.1GHz

IV. Simulation &Analysis

Return loss

It is a deciding parameter for the measure of Antenna performance is defined as the reflected energy from a transmitted signal. It is commonly expressed in positive dB's.The larger the value the less energy that is reflected.

The designed antenna is simulated using HFSS software. The results obtained are mentioned below,

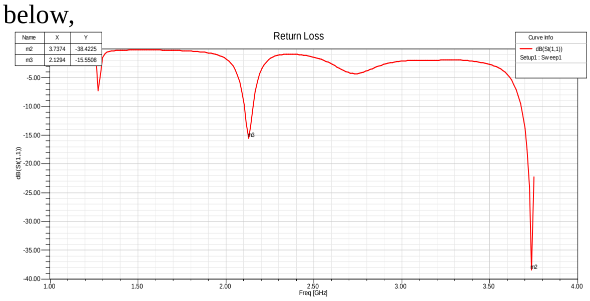

Fig3 Return loss.

A return loss of -38.4225dB, -15.0558 are obtained at 3.7374GHz and 2.1294GHz respectively.

Gain The ratio of the intensity, in a given direction, to the radiation intensity that would be obtained if the power accepted by the antenna were radiated isotropically.

2-D Gain

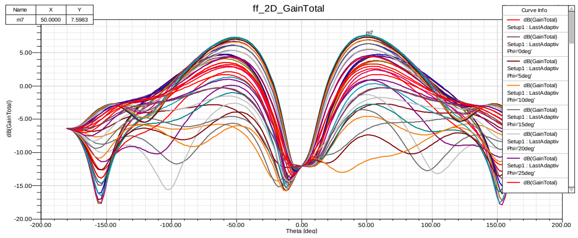

Fig4 2-D Gain.

3-D Gain

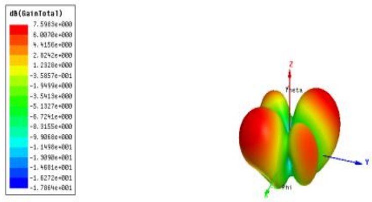

Fig5 3-D Gain

For the antenna model a 2D Gain of 7.598dB and a 3D Gain of 7.598dB is obtained

E-field pattern

An electric field can be visualized by drawing field lines, which indicate both magnitude and direction of the field. Field lines start on positive charge and end on negative charge. The direction of the field line at a point is the direction of the field at that point. The relative magnitude of the electric field is proportional to the density of the field lines.

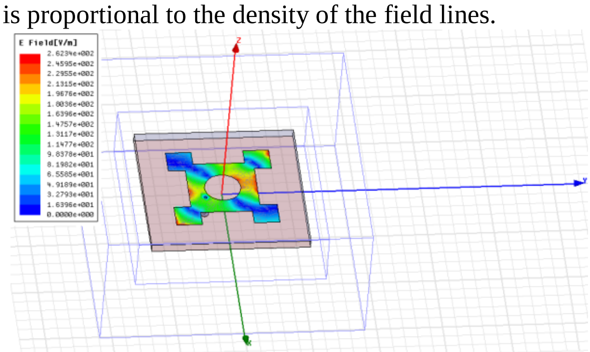

Fig6 E-Field pattern.

H-field Pattern

In the case of the same linearly polarized antenna, this is the plane containing the magnetic field vector and the direction of maximum radiation. The magnetic field or "H" plane lies at a right angle to the "E" plane. For a vertically-polarized antenna, the H-plane usually coincides with the horizontal/azimuth plane. For a horizontally-polarized antenna, the H-plane usually coincides with the vertical/elevation plane.

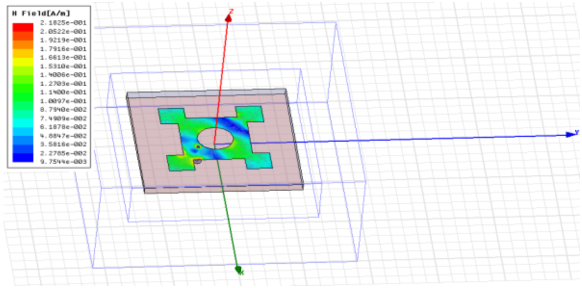

Fig7 H-Field pattern.

Vector E- Field

The field equations of Einstein Cartan Evans (ECE) are used to develop the concept of the static electric field as a vector boson with spin indices −1, 0, +1, which occur in addition to the vector character of the electric field. The existence of the electric vector boson in physics is inferred directly from Cartan geometry, using the concept of a spinning space-time that defines the electromagnetic field. When the electromagnetic field is independent of the gravitational field the spin connection is dual to the tetrad, producing a set of equations with which to define the electric vector boson. Angular momentum theory is used to develop the basic concept.

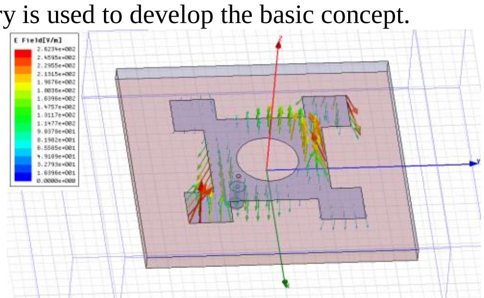

Fig8 Vector E-Field pattern.

Vector H- Field

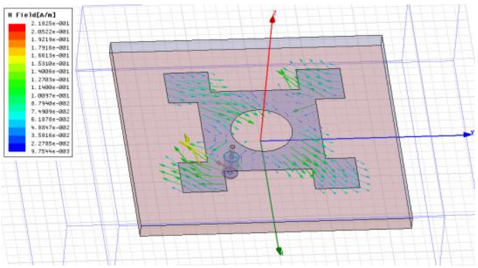

Fig9 Vector H-Field pattern.

V. Current Distrubution

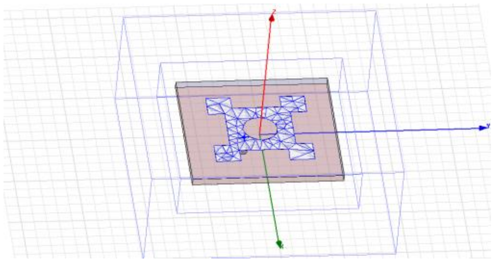

Fig10Mesh Pattern.

The triangles show the current distribution. Here the number of triangles inside the patch is more than those on the substrate i.e.the current distribution in the patch are more when compared to that inside the substrate as in Fig10.

Radiation pattern

The radiation pattern or antenna pattern describes the relative strength of the radiated field in various directions from the antenna, at a constant distance.

Radiation pattern of Gain total

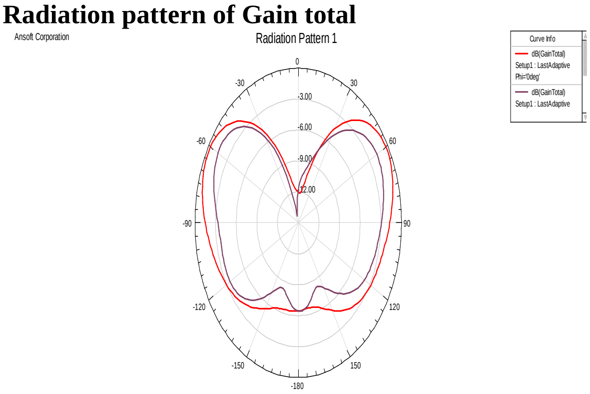

Fig11 Radiation pattern of Gain total.

Radiation pattern of Gain in Theta direction

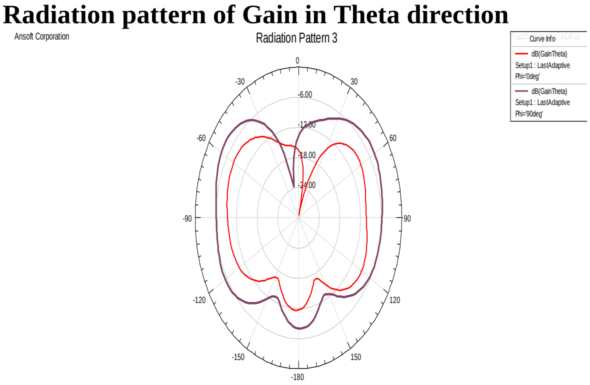

Fig12 Radiation pattern of Gain in Theta direction.

Radiation pattern of Gain in Phi direction

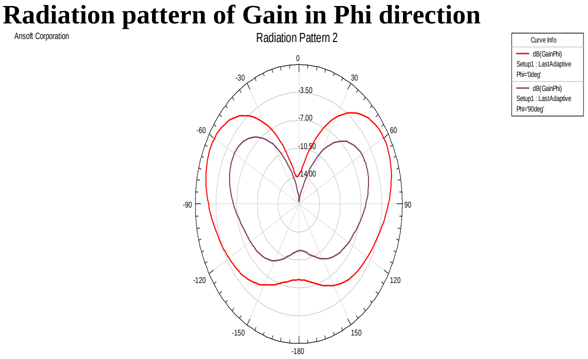

Fig13 Radiation pattern of Gain in Phi direction.

Axial Ratio

Axial Ratio is the ratio of peak value in the major lobe direction to peak value in the minor Lobe direction.

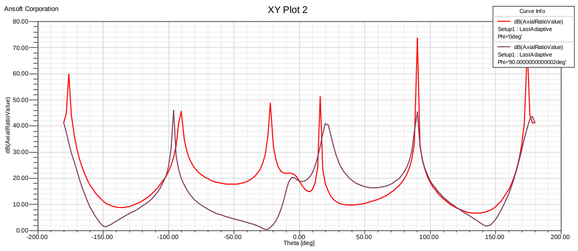

Fig14 Axial Ratio.

VI. Conclusion

Finally, the optimum dimension of elliptically polarized patch antenna on RT duroid substrate for C-band Radar applications has been investigated. The performance properties are analyzed for the optimized dimensions and the proposed antenna works well at the required 2.1294GHz and 3.7374GHz frequency bands.

VII. Acknowledgement

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