International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 03 | March - 2023 Impact Factor: 7.185 ISSN: 2582-3930

DESIGN OF DUAL BAND ASYMMETRIC CPW-FED D SHAPED PATCH ANTENNA FOR RADAR APPLICATIONS

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ABSTRACT-In this paper a D shaped substrate conformal patch antenna by coplanar waveguide(CPW)-FED is proposed for Radar applications. As it is a asymmetrical CPW fed antenna the design consists of D-shaped patch and ground plane of different lengths separated by a feedline on the same side of substrate .The antenna is designed with the material FR4_Epoxy substrate with dielectric constant 4.4 and thickness 1.59mm. As per the simulation results, the proposed antenna can resonate at frequencies 7.77GHz and 12.6GHz which are used for satellite communications. This antenna is simulated using HFSS (High Frequency Structure Simulation)software and the basic parameters of antenna such as return loss, radiation pattern, bandwidth are analysed.

Keywords-CPW-Fed, Antenna, Radar, polarization, impedance.

INTRODUCTION:

Modern day communication devices are designed in such a way that it should have a small size and able to perform multiple functionalities. The antenna used in these devices should be capable of operating at multifrequency, but should be light weight and less voluminous. The most widely used antenna for this purpose is microstrip patch antenna because of their less bulkiness, low cost and easy to fabricate.

Antennas plays a major role in the field of radio communication system. Antenna acts as a transceiver device which can transmit and receive the microwave signals, radio signals and satellite signals. An antenna increases the signal strength due to its high gain capability. The low gain antennas are used in a large number for receiving and transmitting. Now a days, the usage of antennas has been increased due to its miniature size and low manufacturing cost. Here the antenna we preferred in this design is semi-circular antenna with coplanar waveguide (CPW) Fed. A circularly polarized (CP) antenna has given more priority than linearly polarized antennas. A CP antenna performs better than LP antennas because it prevents the mismatch between impedance, polarization, and loss of multipaths, etc. CPW-Fed antennas have many desirable features

like low radiation loss, low dispersion, simple integration for integrated circuits, so the usage of these antennas have been increasing day by day. Coplanar waveguide (CPW) has many advantages over microstrip antennas such as low radiation loss, dispersion and easy integration with microwave devices, so it is a popular choice than microstrip feed. The shape inside the aperture looks like a semi-circular patch shaped.

RADAR is an electrical device used to track, detect and locate objects in the atmosphere. RADAR system can be used to obtain much more data from the filtered refl signal and have broader applications, but range detecti on is still one of its important functions.Through observing atmospheric conditions, RADAR increases the abi lity of sense of vision.It can detect the conditions of the atmosphere that are unaffected by human vision. It can be designed for the human eyes as an extra sensory organ that can identify and locate the target beyond the range of human eyes. This feature can be seen in wind, snow, dark, fog, smoke, etc. data collection. It is also used to measure any object approaching or going away from the observer's instantaneous velocity.

High-tech RADAR nowadays has broader fields of applications, i.e. Anti-collision aircraft systems, air and ground traffic control systems, surveillance systems, air defense systems, meteorological tracking, antimissile systems, RADAR astronomy, ships marine RADARs, remote sensing, geological surveys, height and depth estimation, etc. In RADAR the frequency band 4-8GHz is used for Long range tracking air borne weather condition and the band 8-12GHz is used for short range tracking missile guidance mapping, marine RADAR airborne intercept.

General applications of RADAR are:

(a) Air Traffic control: RADAR is used in the vicinity of airports to direct aircraft in adverse weather conditions for proper landing. RADARs are used for secure aircraft landing with a ground control approach (GCA) system.

(b) Aircraft Navigation: The weather avoidance RADAR and ground RADARs are used in aircrafts to guide it properly under all conditions.

(c) Ship Navigation and safety: High resolution RADARs mounted on shore are used for navigation and beaconing. The RADAR ensures safe travel by warning potential threats during poor visibility due to bad weather conditions.

(d) Space: RADARs are used to dock and land spacecrafts safely.Satellite born RADARs are used for remote sensing. Ground-based RADARs are used for satellite and spacecraft monitoring and detection

(e) Remote sensing and environment: RADARS are used in remote sensing to detect (meteorological) atmospheric conditions and to monitor planetary conditions.

A semi-circular patch antenna was designed to enhance the gain and impedance bandwidth. The bandwidth of antenna is improved by considering the Asymmetric CPW-Fed. The proposed antenna resonates at 7.7GHz and 12.6GHz frequency. A 7.7GHz and 12.6GHz dual band antenna was proposed for Radar applications.

ANTENNA STRUCTURE AND DESIGN:

While designing the patch antennas the important parameters to be considered are dielectric constant, thickness of substrate, resonating frequency and shape of the radiating patch .The layout of the proposed antenna is shown in fig1.To achieve good return loss maximum gain and for desired band the antenna incorporates semicircular patch with rectangular ground plane and 50 ohm Coplanar waveguide feedline.

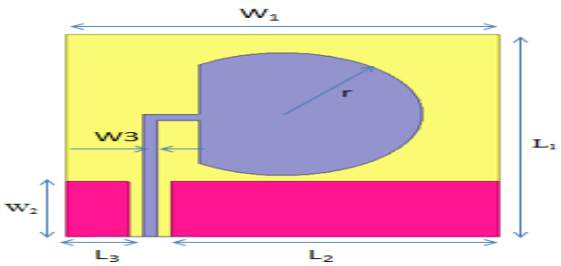

fig1. Geometric dimensions of proposed antenna

Table 1: Parameters

PARAMETER	VALUES
L1	65
W1	62
L2	46
L3	9
W2	18
W3	2
r	20

The antenna is printed on Fr4 epoxy substrate which has low dielectric constant of 4.4 and thickness h=1. 59mm.The structure of the antenna is very simple as ground plane and patch are etched on the same side of substrate. The optimized length and width of substrate are 66mm x62 mm. The section of the ground plane is separated by a feed line by 2mm. As it is asymmetric CPW fed the dimensions of the ground plane on both sides of the feedline are different. One has dimension 18mmx9mm and the other has 18mmx47mm.The design

consists of semicircular radiating patch is made up of copper and radius is 20mm.The length and width of CPW fed line is 10mmx2mm.

SIMULATION RESULTS AND DISCUSSION:

The proposed semicircular patch antenna is analyzed using HFSS software. The parametric analysis is carried out step by step and Return loss, Radiation pattern, 3d polar plot ,surface current distribution at two operating frequencies are presented. The proposed antenna is used for Radar applications. In Europe, Ku-band downlink is used from 10.7 GHz to 12.75 GHz for direct broadcast satellite services, such as Astra.

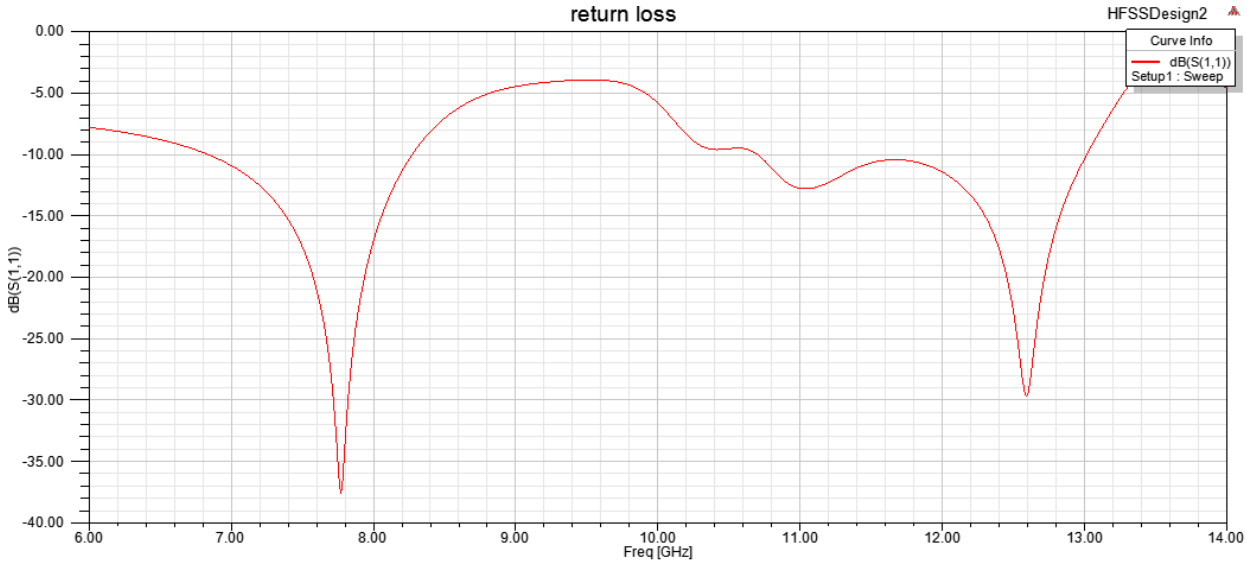

fig 2 . Return loss of the antenna

The frequency band covers the range from 6.8GHz -8.27GHz and 10.7GHz-13GHz centered at 7.77 GHz and 12.6GHz with impedance bandwidth of 18.4% and 18.25%. It is observed that it has a good return loss of at both operating frequencies.

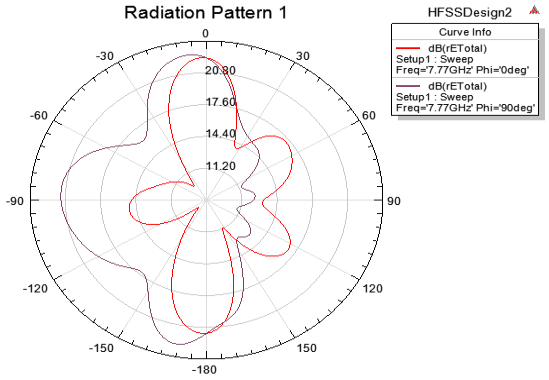

Fig 3 . E plane and H plane Radiation pattern at operating frequency 7.77GHz

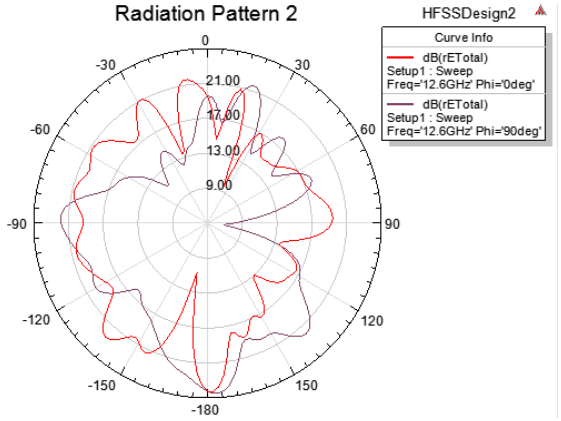

Fig 4 . E plane and H plane Radiation pattern at operating frequency 12.56GHz

The Antenna's radiation pattern is the energy that the antenna radiates and receives. It is the angular position f unction and the antenna's radial distribution. The E and H-

planes radiation patterns of the given antenna are simulated and then measured at 7.77 and 12.6GHz respectively at the different resonant frequencies. The patterns are shown in the below figures.

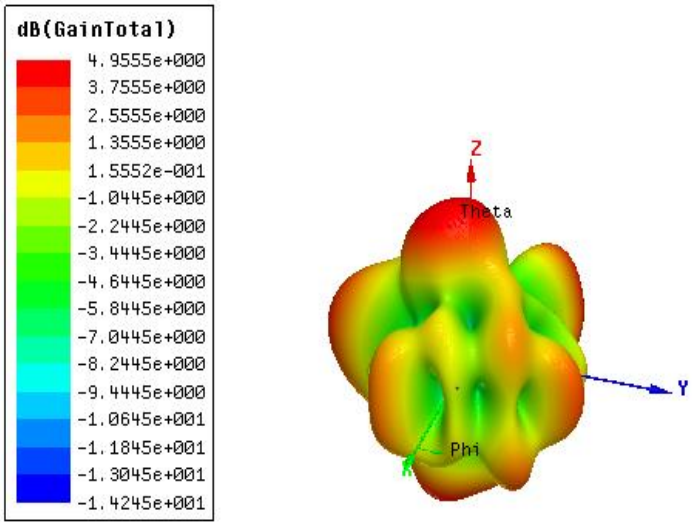

Fig 5 .Simulation results for gain at operating frequency 7.77GHz

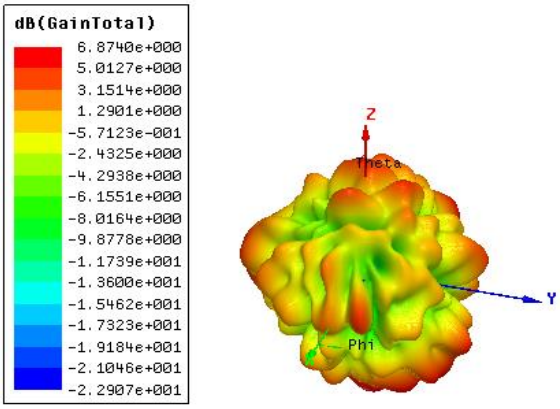

Fig 6 .Simulation results for gain at operating frequency 12.6GHz

The 3d polar plot of the antenna simulated at 7.77 GHz gives a gain of 4.95dB and 12.6 GHz gives a gain of 6.87dB shown in the fig.

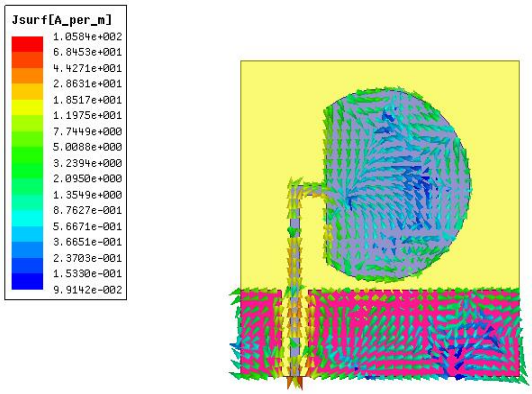

Fig 7 . Surface Current Distribution at operating frequency 7.77GHz

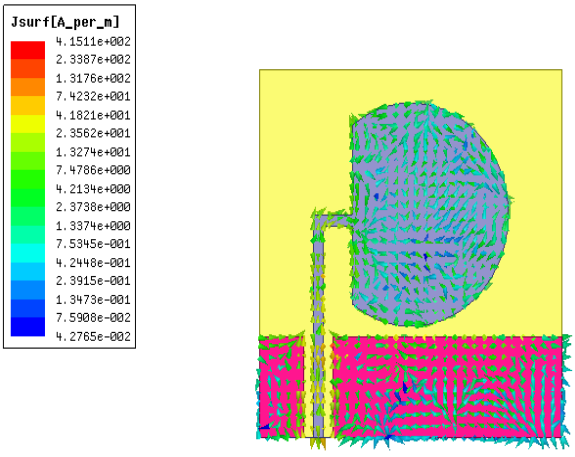

Fig 8 . Surface Current Distribution at operating frequency 12.56GHz

Current distributions on the ground plane on the left and right sides of the feedline rotate over time, but the direction of rotation of the current distributions on the left and right planes is opposite to each other.

CONCLUSION

In this paper, a compact dual band CPW fed D shaped patch antenna is proposed and simulated successfully. The radiation pattern, current distribution and gain plots at two operating frequencies is obtained and results shows it has a circular polarization with return loss -37.5db and -29.38db.This semicircular patch antenna is used for radar applications and satellite downlink frequency for wireless communication systems.

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