DESIGN AND PERFORMANCE EVALUATION OF SLOTTED MICROSTRIP PATCH ANTENNA FOR C- BAND APPLICATIONS

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Abstract:In this paper, a slotted microstrip patch antenna for C Band applications is presented. The proposed antenna resonates at a frequency of 4.39 GHz having a return loss values of -33.8 dB, with a peak gain of 4.33 dB and have a bidirectional radiation pattern. The bandwidth of the proposed design is 2.68 GHz. A polygon slot is cut in the radiating patch for size reduction as well as making the antenna to have multidimensional characteristics with improvement in antenna parameters like gain etc. The FR4 epoxy with permittivity of 4.4 is used as a substrate with dimensions of 30mm x 30mm in X and Y directions and having a thickness of 1mm. The microstrip feed of size 10mm x 2mm is used in the proposed design. The proposed antenna is simulated using Ansoft HFSS software and results obtained for the proposed design are optimized, and they exhibit better radiation characteristics within the C-Band frequency range.

Index Terms: **C- Band, Microstrip, Slots, Bandwidth, Gain.**

I. INTRODUCTION

An antenna is an essential part of modern wireless communication systems. The success of communication systems is based on the characteristics of an antenna that it should be of low profile, compact size, and have excellent radiation properties. The first frequency band that was allocated for commercial telecommunications via satellites was C- band. Most of the commercial satellites use C- band for communication [1-4]. The bandwidth assigned is limited to 500 MHz. According to the IEEE, the C-band used for Radar communication is from 4 to 8 GHz. The C- Band frequency ranges have a wide range of applications such as satellite communications, weather forecasting, radar systems, Wi-Fi & ISM Band applications. C- Band is the original frequency allocation for communications satellites. C band uses 3.7-4.5 GHz for downlink, 5.925 to 6.425 for uplink direction and uplink means that ground station to satellite and downlink means that satellite to ground station. For this, offering a microstrip patch antenna with innovative design which allows it to function in a C Band Frequency with its range from 4 to 8 GHz with a better gain.The antenna should be compact, low profile, economic and have wide bandwidth so that it can be used efficiently for C-Band applications. In this paper, a slotted microstrip patch antenna for C- Band applications is presented [5-10].

II. ANTENNA DESIGN

In this paper, a slotted microstrip patch antenna is proposed. The FR4 having the permittivity of 4.4 with a size of 30 x 30 x 1 mm^3 is used as a substrate in the proposed design. The radiating patch has 18 x 18 mm^2 along with X and Y directions. In the radiating patch, a regular polygon of 8 segments is cut at the top surface to make the proposed antenna small in size also to increase the antenna parameters like gain, bandwidth, etc. A rectangular microstrip feed of length 10mm and width 2mm is used in this proposed design.The proposed design is simulated using HFSS software and further optimization is done so that the radiation properties of the proposed antenna falls under C- band. Table-1 presents the detailed dimensions of the proposed antenna.

Table 1:- Proposed Antenna Dimensions

Parameter(s)	Proposed Dimensions (mm)
Length of Substrate	30
Width of Substrate	30
Length of Ground Plane	8.5
Width of Ground Plane	30
Thickness of Substrate	1
Length of Microstrip Line	10
Width of Microstrip Line	2

Figure1. (a) and (b) represents the structure of the top view and side view of the proposed antenna.

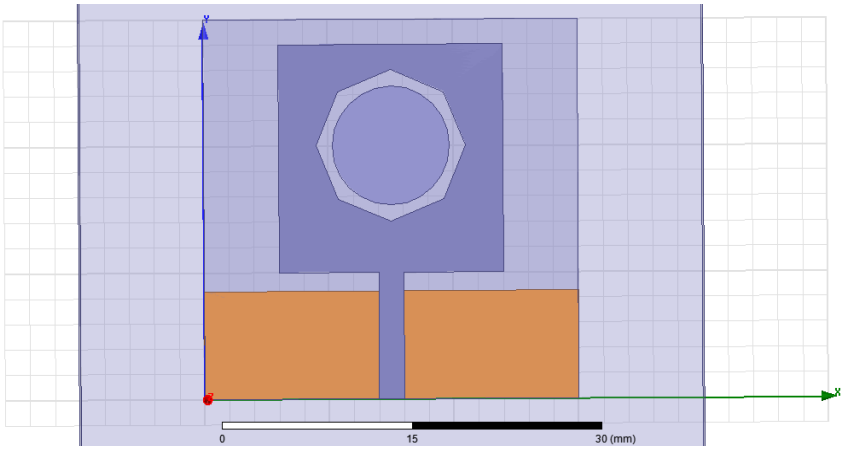

Figure-1(a) Top view of proposed antenna

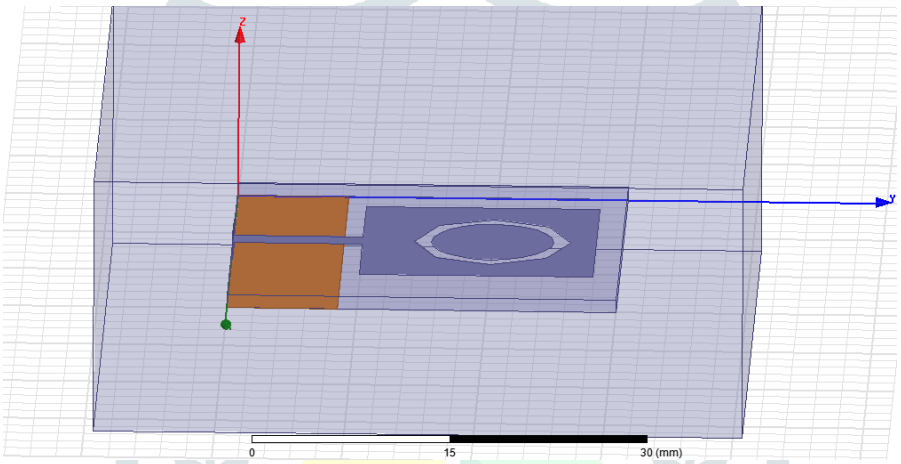

Figure-1(b) Side view of proposed antenna

III. RESULTS AND DISCUSSION

The proposed antenna is simulated using HFSS software, and simulation results show that the proposed antenna can be used for C Band antenna applications. The proposed antenna resonates at frequency 4.39 GHz. The simulated results of the proposed antenna are presented as follows:

1. Return Loss and Bandwidth

Figure-2 shows the return loss (S_{11}) values at resonating frequency 4.39 GHz is -33.8 dB. The bandwidth as calculated from return loss versus frequency plot, for the proposed slotted patch antenna is 2.68 GHz.

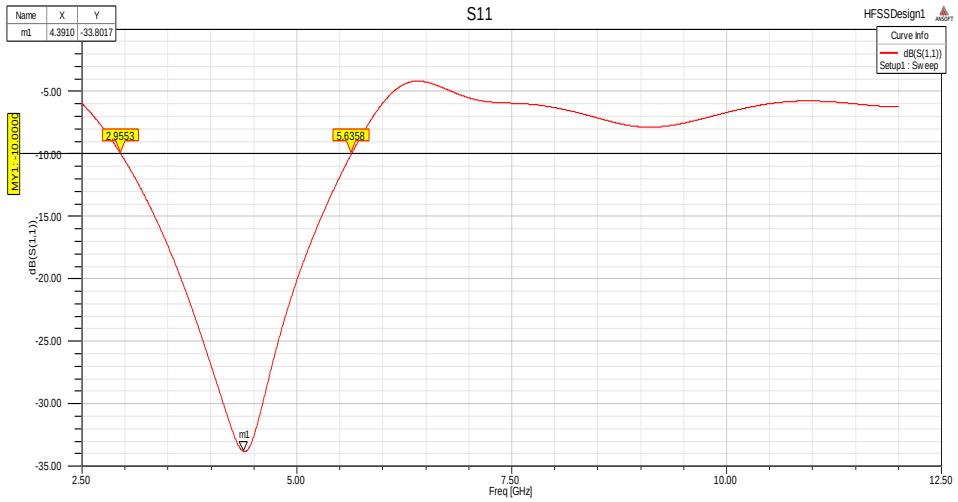

Figure-2: Return Loss (S_{11} parameters)Plot

2. Voltage Standing Wave Ratio (VSWR)

Figure-3 represents the VSWR plot of the proposed design. The VSWR values at the resonating frequency is0.3 dB.

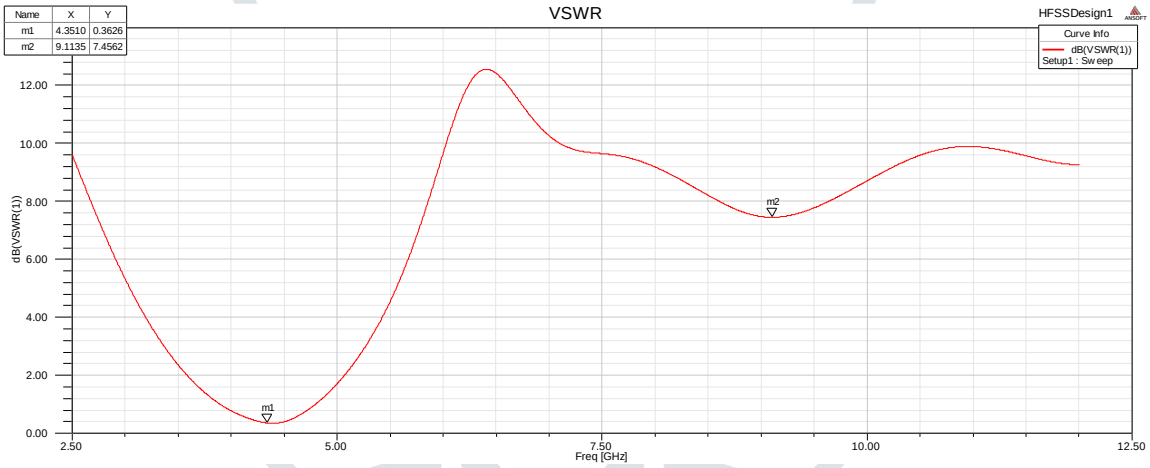

Figure-3: VSWR Plot

3. Gain

Figure-4 represents the 3D Gain plot of the proposed design. From the plot, it can be observed that the peak gain of the presented antenna is 4.33 dB. The gain of the antenna in a particular direction is more as compared to the isotropic antenna radiating in all direction is more as compared which is very useful for various applications in C Band providing better performance.

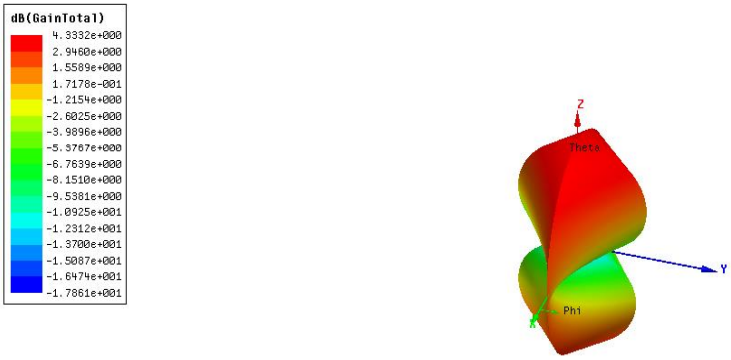

Figure-4: 3D Gain Plot

4. Radiation Pattern

From polar plot view of the pattern, as shown in figure-5, it can be seen that at resonant frequencies radiation pattern obtained is bidirectional which is required for different C Band applications.

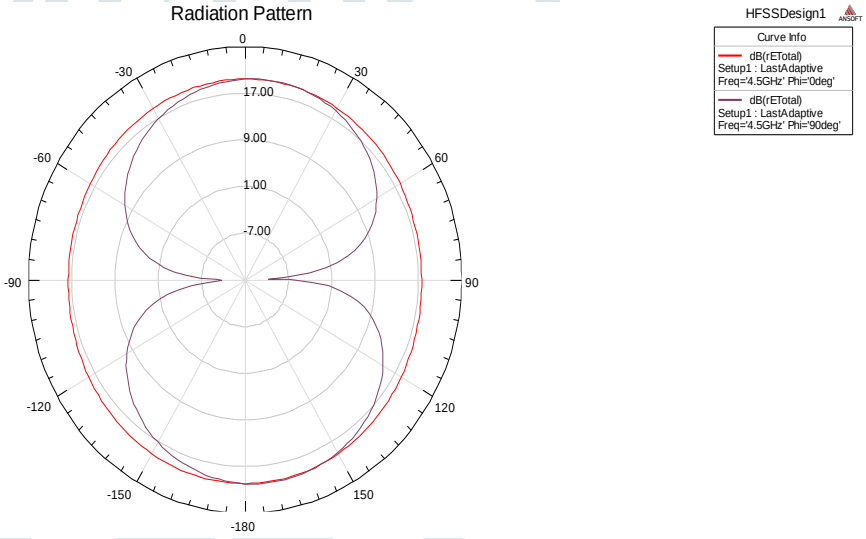

Figure-5: 2D Radiation Pattern

Table-2 Represents the complete results obtained after simulation of the proposed design.

Table-2: Simulation Results

Parameters	Results
Resonating frequency	4.39 GHz
Bandwidth	2.68 GHz
Return loss	-33.8 dB
Peak Gain	4.33 dB
VSWR	0.3 dB

IV. CONCLUSION AND FUTURE SCOPE

Microstrip patch antennas are preferred for various wireless communication applications as it has multiple advantages like the low power, good noise immunity, signals can penetrate variety of materials easily, high immunity to multipath fading, potentially very high data rates, etc. In this paper, a slotted microstrip patch antenna is designed for C- Band applications. The design of the antenna is analysed and its different parameters like gain, radiation pattern, VSWR and return loss are studied, the number of frequency bands can be further increased by proper slotting and adjusting the design parameters. Also, the use of Metamaterials in antenna designing can be done for further improvement in antenna parameters. Changes and modifications in the design can make the antenna resonate at dual or more frequency range. By improving the shape of patch and ground, we can obtain an antenna with enhanced characteristics.

V. REFERENCES

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