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PERFORMANCE ANALYSIS OF MICROSTRIP CIRCULAR PATCH ANTENNA FOR MULTIBAND APPLICATIONS

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ABSTRACT

In this paper, a design of Microstrip circular Patch Antenna for multiband applications is proposed. This single design of Microstrip antenna operates at different frequencies like 3 GHz[S-band], 5.6 and 6.7 GHz[C-band], 8 GHz, 9.4GHz[X-band], 12.1 GHz [Ku-band] and serves many applications like satellite communication, air traffic control, and radar communications. The substrate used is Rogers RT/Duroid 5880(tm) which has relative permittivity of 2.2. A co-axial feed is used to feed the antenna with input impedance of 50Ω.Introduction of slots increases resonant frequencies which make antenna serves multiple applications. The design is simulated using Ansoft HFSS software and Return loss, VSWR and Radiation Pattern are studied.

Keywords: Co-axial feed, Circular patch, Microstrip, Multiband, Slots

I. INTRODUCTION

Antenna is an electrical device that transmits the electromagnetic waves into the space by converting the electric power given at the input into the radio waves at the transmitter side and at the receiver side the antenna intercepts these radio waves and converts them back into the electrical power [1].

There are so many systems that uses antenna such as cellular phones, satellite communications, spacecraft, radars, wireless phones and wireless computer networks[2]. The antennas required for the various applications should be of small size, lightweight, low profile, broad bandwidth, low cost and integrable with MIC/MMIC circuits. Common Microstrip antenna shapes are square, rectangular, circular and elliptical [3].

The proposed design uses a circular patch which gives better results as compared to rectangular patch. An advantage of patch antenna is the ability to have polarization diversity [4]. Patch antennas can easily be designed to have vertical, horizontal, right hand circular(RHCP) or left hand circular(LHCP),using multiple feed points or a single feed point with asymmetric patch structures[5]. This unique property allows patch antennas to be used in many types of communication links that may have varied requirements [6].

The proposed antenna resonates at multiple frequencies in different frequency bands and fulfills almost all the applications.

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II. DESIGN CONSIDERATIONS

1.1 Antenna Design

In the proposed design of Microstrip patch antenna, substrate used is Rogers RT/ Duroid 5880 (tm) whose relative permittivity is 2.2[7].The patch is taken in circular shape of radius 39. Co-axial feeding technique is used to feed the antenna with input impedance of 50 Ω with inner and outer radius as 0.7 mm and 1.6 mm. The top and side view of proposed multiband Microstrip antenna is shown in Fig 1 and Fig 2.

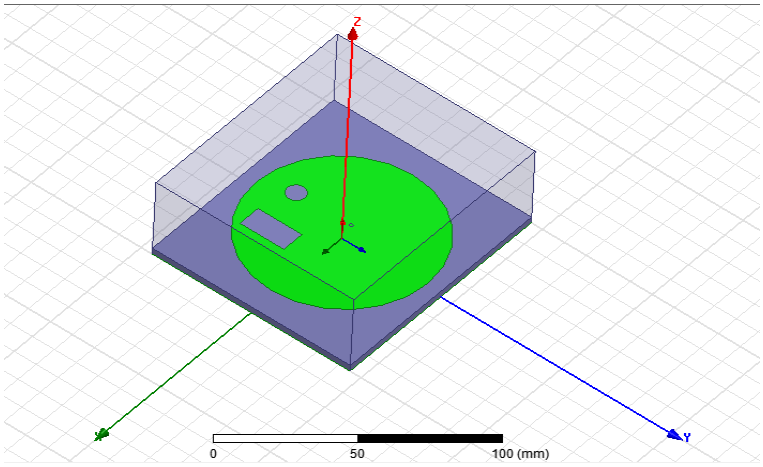

Fig 1. top view of design

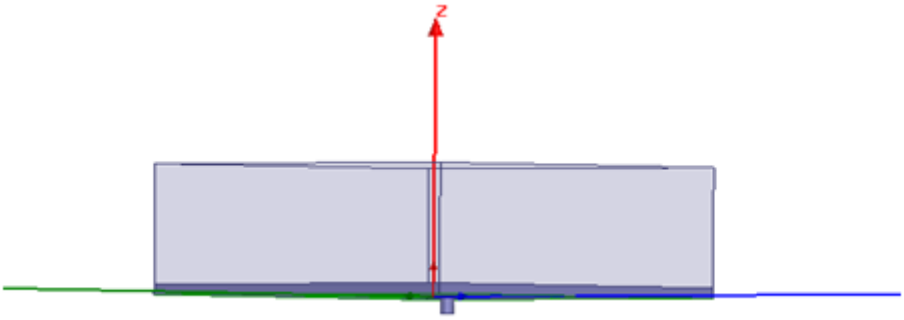

Fig 2. side view of proposed design

1.2 Parameters considerations

Relative permittivity of substrate= 2.2

Resonant frequencies=3 GHz, 5.6 and 6.7 GHz, 8 GHz, 9.4 GHz, 12.1 GHz

Table 1 shows the design specifications of the proposed antenna.

PARAMETERS	DIMENSIONS
Patch(circular)	Radius=39 mm
Ground	100mm × 90mm
Substrate	40mm × 30mm × 3.2mm
Feed Pin Radius	0.7mm and 1.6 mm
Slots	Rectangle-10 X 20mm Circle-Radius=4 mm

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III. SIMULATION RESULTS

The proposed antenna design was stimulated using Ansoft HFSS 14 and plots for return loss, VSWR, etc were studied.

3.1Return loss

Return loss is the loss of power in the signal returned by discontinuity in transmission line. Thus, the return loss of an antenna can be calculated from return loss versus frequency plot[8].

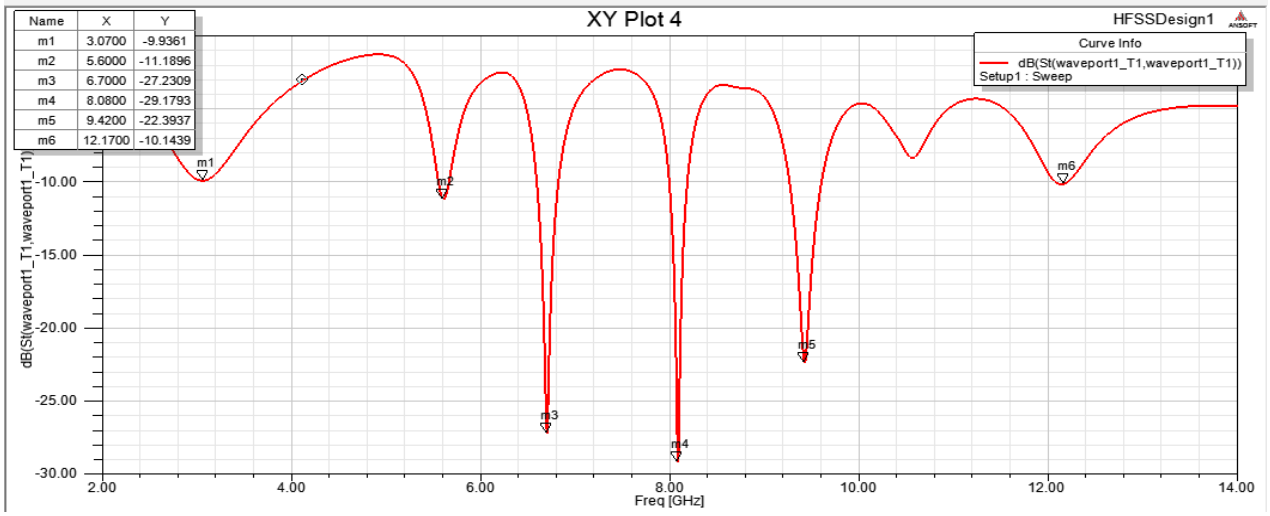

Fig 3. Return loss (in dB) plot of proposed antenna

3.2 VSWR plot

VSWR is a measure that describes how well the antenna is impedance matched to the transmission line connected to it[9].

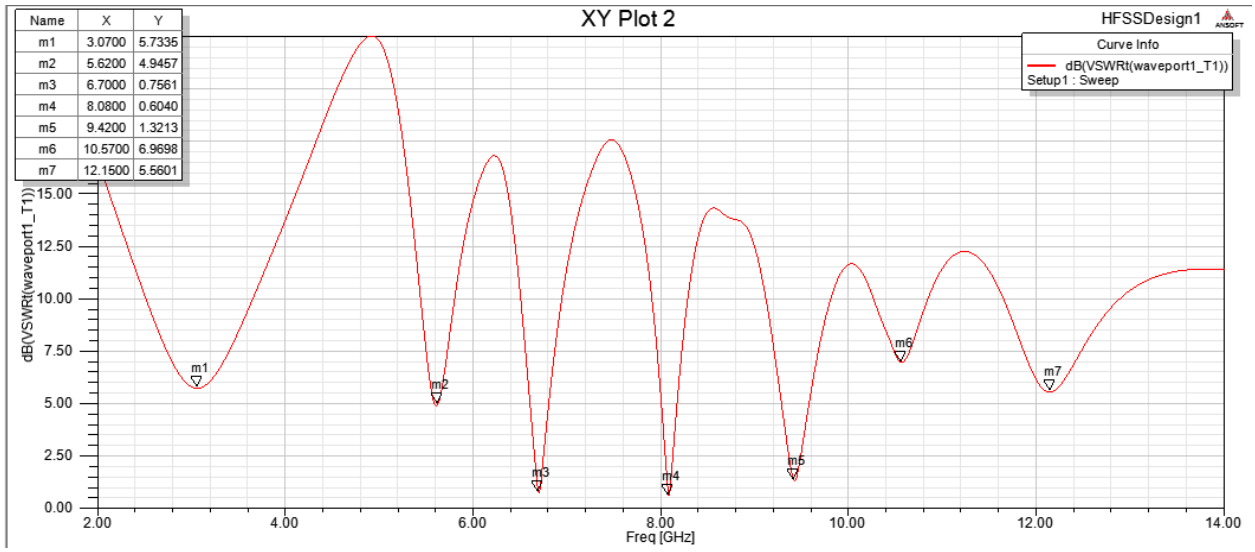

Fig 4. VSWR plot of proposed design

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3.3 Smith Chart

The Smith Chart plot represents that how the antenna impedance varies with frequency. Multiple circles describes that the proposed antenna is a multi-band antenna[10].

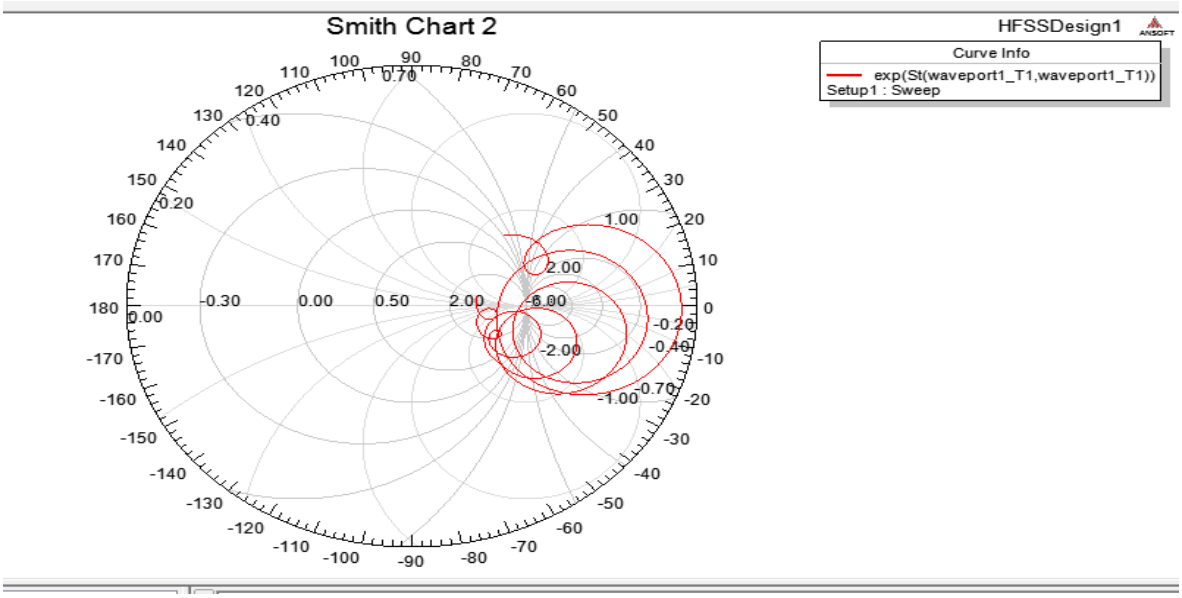

Fig 5. Simulated Smith chart plot

3.4 Gain

Gain measures the degree of directivity of the antenna's radiation pattern. Gain is defined as ratio of maximum radiation intensity in a given direction to the maximum intensity from a reference antenna [11].

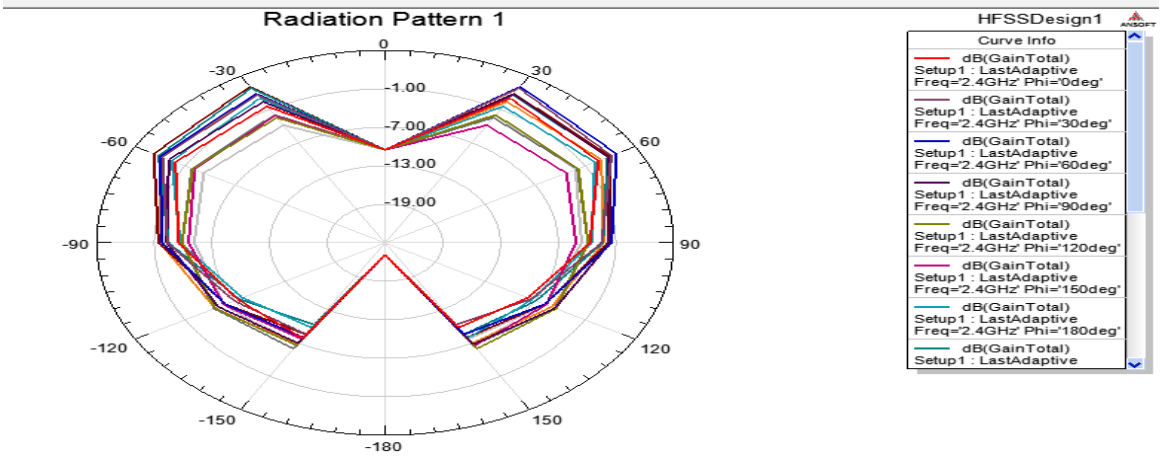

Fig 6.Gain plot of proposed design

IV. CONCLUSION

Microstrip patch antennas are being used in several applications since last few decades and they have been very popular due to their features like low profile, less weight, conformal design, low cost, ease of fabrication and ease of integration into communication systems [12]. The proposed antenna is designed to work on multiband frequencies(S, C, X and Ku band). The design of the antenna is properly analyzed and its different parameters like VSWR and return loss are studied. However, further modifications for enhancing the bandwidth and

decreasing the antenna size are possible [13].

V. FREQUENCY APPLICATIONS OF PROPOSED ANTENNA

S Band:

- Weather radar,
- Surface ship radar and some common satellites.

C Band:

- Satellite TV Networks
- In areas that are subject to tropical rainfall since it is less susceptible to rainfall [14].

X Band:

- Military applications
- Radar communication
- Weather monitoring
- Air traffic control
- Defense Tracking

Ku Band:

- Satellite communication[15]

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