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CPW Fed Rectangular Microstrip Patch Antenna with Upper Pentagonal End Cut

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CPW Fed Rectangular Microstrip Patch Antenna with Upper Pentagonal End Cut

Paresh Jain [α] & Prof. (Dr.) R.K Khola [σ]

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I. Introduction

In the early 1970's the first practical microstrip antenna was fabricated by Howel & Munson and These above said antennas became popular during the 70's period as this antennas had the space borne applications. Antennas play a vital role in communication systems to transmit and receive signals. Microstrip antennas are versatile in geometrical dimensions and can be implemented easily. They are useful as they are of low profile, low power handling, low weight, simple and cheap [1]. Due to their attractive features like high rate of transfer of data and compact size have increased their demand and various applications immensely. The Microstrip antennas are of very high performance, robust in design and easy to fabricate [2].

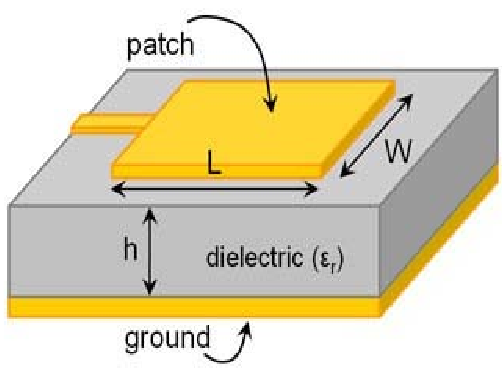

Figure 1 : Block of Schematic of Microstrip Antenna

Many problems such as the surface wave excitation and narrow bandwidth are overcome by various methods such as cutting slot, increasing thickness, etc. CPW is used in designing antenna which has low weight and low transmission losses and this method was introduced by C.P. Wen in 1969 [3]. CPW-Feed method is cheap and the line impedance and phase velocity are less dependent on substrate height then on slot width [4]. The design geometry and the results of the proposed antenna are presented in this paper.

II. Antenna Design

The design is based on transmission line model analysis and it has rectangular patch antenna with upper pentagonal end cut in a circular slot on the ground. The geometry of this antenna is shown in figure 2.In the designing of this antenna three basic parameters are required to be decided, such as thickness of substrate, relative permittivity and dielectric substrate. Thickness of substrate reduces the size of antenna and surface radiations and low dielectric constant is preferred because the antenna gives better efficiency, low losses and higher bandwidth, thus the patch elements are placed on FR-4 epoxy substrate of relative permittivity 4.4 kept at 1.6 mm. height. Feed line width is such that impedance is 50_ [5]. The antenna is designed with a centre frequency of 2.4GHz.The dimensions of the proposed antenna are shown in Table 1.

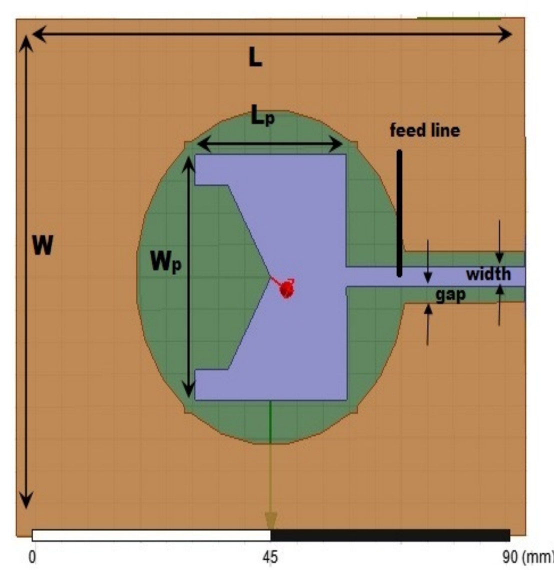

Figure 2 : Geometry of the proposed antenna

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Table 1 : The dimensions of the proposed antenna.

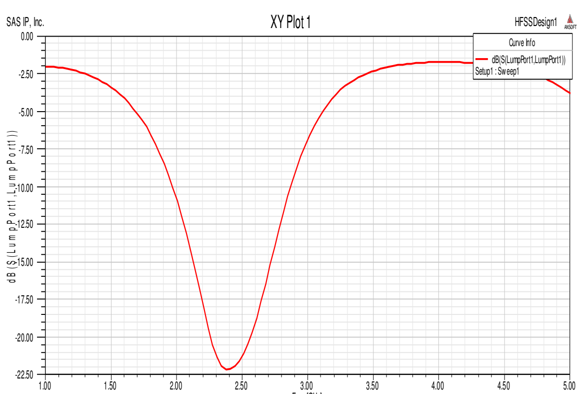
Parameter	Value
Length of patch (L_p)	29mm
Width of patch (W_p)	38mm
Length of substrate (L)	97.48mm
Width of substrate (W)	80mm
Length of feed line	34.24mm
Width of feed line	3.045mm
Height of substrate	1.6mm
Radius of circle	26mm

III. Results

Simulated results are obtained by using Ansoft HFSS 13.0 software. The results are presented and discussed in the following para.

a) Return Loss

The characteristics and measurement of the parameter return loss shows that how the antenna is effective in delivering the power from the source to the antenna. Return loss found is −22.1 *dB*__. The graph of return loss verses frequency is shown in figure 3.



X axis – Frequency in GHz.
Y axis - Return loss in dB.

Figure 3 : Return Loss

b) Bandwidth

Return loss graph can be used in calculating the bandwidth of the antenna. The proposed antenna gives the 10 __ impedance bandwidth of 37%. The antenna can operate in the frequency range from 1.97GHz to 2.87 GHz.

c) Radiation Pattern

The radiation pattern shows the direction in which the power is directed and is also shows the radiation distribution and the power distribution in the particular direction. The figure 4 shows the 3-D radiation pattern of the said antenna at centre frequency 2.4 GHz.

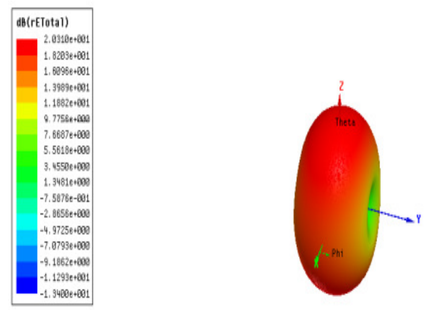
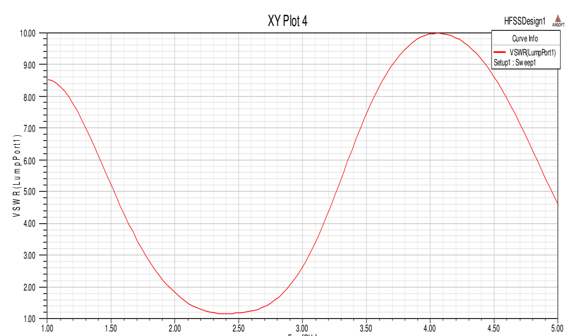


Figure 4 : Radiation Pattern.

d) VSWR

The voltage standing wave ratio is the ratio of the maximum and the minimum voltages at the feed line. The value of the VSWR which is determined for perfect matching of the antenna is such that it should be less than 2. The value should be 1:1 for maximum power transfer and for the antenna to perform efficiently. The plot of VSWR observed at the frequency 2.4 GHz. is 1.15 shown in figure 5.



X axis – Frequency in GHz.
Y axis - VSWR

Figure 5 : VSWR

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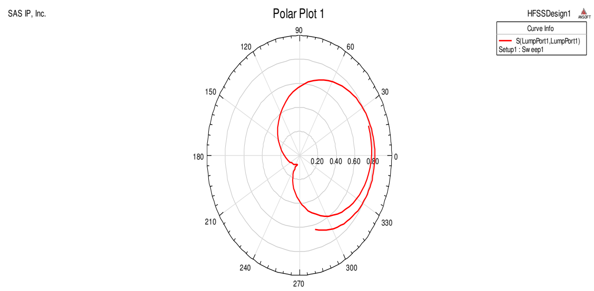

Figure 6 : Smith Chart

The smith chart in figure 6 shows VSWR of 1.15 at an angle of 109.23 and magnitude 0.0702 and impedance is 0.9466-0.1261i which indicates that the antenna is resistive in nature.

e) Gain

The parameter gain shows the amount of the power transmitted in the maximum radiation direction where the isotropic source is taken. The gain should not be less than 0 dB otherwise the antenna is not radiating. The gain of the proposed antenna measured to be 2.55 dB.and shown in figure 7.

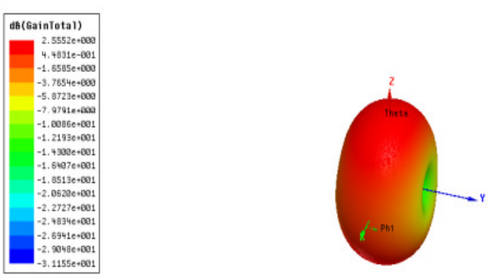

Figure 7 : Gain

IV. Conclusion

The proposed antenna is based on CPW-Fed technique and from the simulated result, gain is observed as 2.55__ and the return loss calculated is -22.1__, The VSWR value calculated is 1.17 and the impedance bandwidth calculated is 37% for the proposed antenna. Simulation and design of the microstrip patch antenna is done on a substrate of dielectric constant 4.4 and at a resonant frequency of 2.4GHz which ranges from 1.97GHz to 2.87GHz and successfully done using HFSS Software. Several other designs can be simulated using different parameters having better results and higher efficiency for applications in the field of wireless communication. Their main applications may be in extended UTMS, Wi-Fi, WiMax, etc.

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