# A Design of Rectangular Linear Polarized Microstrip Patch Antenna at 1 GHZ

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**Abstract:** ***This paper presents the basic design of a rectangular linear polarized microstrip patch antenna. The proposed design was simulated using Ansoft HFSS 12 software based on operating frequency of 1 GHz. The objective of this paper is to analyze, design and validate rectangular ushape microstrip patch antenna. The substrate material Rogers RT/duroid 5880 with permittivity of 2.2. Our results showed very low return loss and VSWR which are typical parameters used to study the behavior of antennas.***

**Keywords:** Linear Polarized Microstrip, Patch Antenna, Ansoft HFSS 12, Rogers RT/duroid 5880, VSWR

## 1. Introduction

Microstrip antenna technology began its rapid development in the late 1970s [1]. By the early 1980s basic microstrip antenna elements and arrays were fairly well establish in term of design and modeling. In the last decades printed antennas have been largely studied due to their advantages over other radiating systems, which include light weightiness, reduced size, low cost, conformability and the ease of integration with active device. A Microstrip Patch antenna consists of a radiating patch on one side of a dielectric substrate which has a ground plane on the other side as shown in Figure1. The patch is generally made of conducting material such as copper or gold. The radiating patch and the feed lines are usually photo etched on the dielectric substrate [2]. Microstrip patch antennas radiate primarily because of the fringing fields between the patch edge and the ground plane.

In its most fundamental form, a Microstrip Patch antenna consists of a radiating patch on one side of a dielectric substrate which has a ground plane on the other side as shown in Figure 1. The patch is generally made of conducting material such as copper or gold and can take any possible shape. The radiating patch and the feed lines are usually photo etched on the dielectric substrate. The patch acts approximately as a resonant cavity (short circuit walls on top and bottom, open-circuit walls on the sides). In a cavity, only certain modes are allowed to exist, at different resonant frequencies. If the antenna is excited at a resonant frequency, a strong field is set up inside the cavity, and a strong current on the (bottom) surface of the patch. This produces significant radiation (a good antenna) [3].

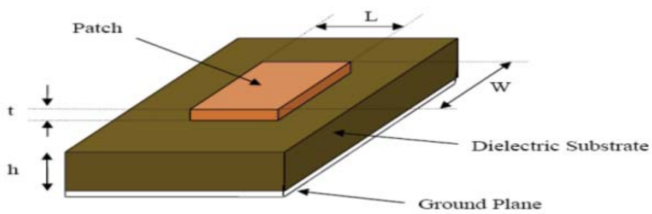



**Figure 1:** Basic structure of Rectangular Micro strip Antenna.

In this paper, the design of u-shape microstrip patch antenna is proposed with dielectric substrate Rogers RT/duroid5880 with εr=2.2 and dimensions are based on resonant frequency 1GHz.

## 2. The Microstrip Patch Antenna Design

The proposed antenna consists of a ground plane, Rogers RT/duroid 5880 substrate material, rectangular patch and a microstrip co-axial feeding line. The basic geometry of the antenna is shown in Figure 2.

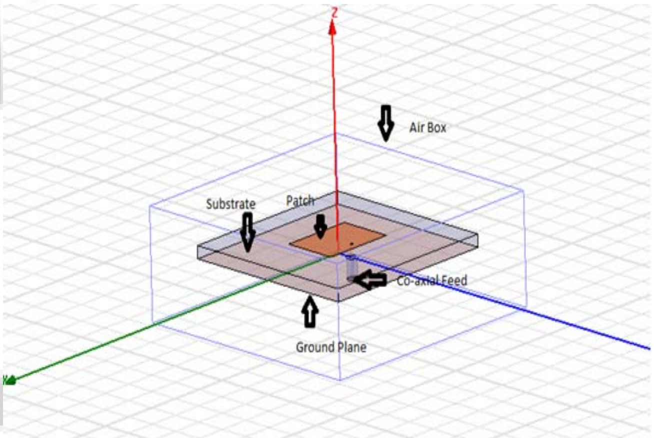



**Figure 2:** The microstrip patch antenna design in HFSS

**Table 1:** Specifications of the proposed Microstrip patches antenna show in table

| | |
|---|---|
| *Operating frequency* | 1GHz |
| *Substrate* | RT/duroid5880 |
| *Dielectric constant of substrate* | 2.2 |
| *Height of substrate* | 16mm |
| *Patch width* | 90mm |
| *Patch length* | 119mm |

In general, the resonance frequency of the Antenna excited at any TMmn mode is obtained using the following expression:

$$f_0 = \frac{c}{2\sqrt{\epsilon_e}}\left[\left(\frac{m}{L}\right)^2 + \left(\frac{n}{W}\right)^2\right]^{1/2}$$

For design of microstrip patch antenna, the stander formula to calculate width and length of antenna at particular operating frequency as given bellow:

$$W = \frac{c}{2f_0\sqrt{\frac{(\epsilon_r + 1)}{2}}}$$

$$L = \frac{V_o}{2f_r\sqrt{\varepsilon_{ef}}} - 2\Delta L$$

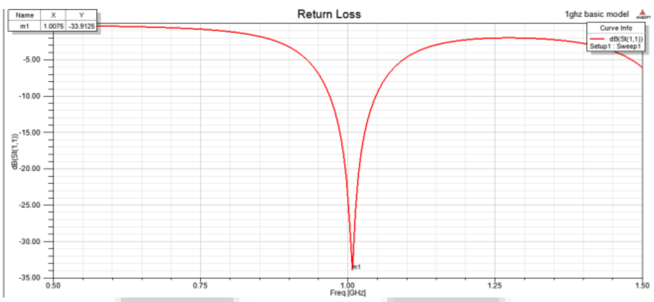
$$\Delta L = h \times o.421\left[\frac{(\varepsilon_{ef} + 0.3)(\frac{W}{h} + 0.264)}{(\varepsilon_{ef} - 0.258)(\frac{W}{h} + 0.8)}\right]$$

## 3. Simulation Result and Discussion

Ansoft HFSS is a high performance full wave electromagnetic (EM) field simulator [6]. It integrates simulator, visualization, solid modeling and Automation in an easy-to-learn environment where solution of 3D EM problem is quickly and accurately obtained. Ansoft HFSS can be used to calculate parameters such as return loss, gain, band width and VSWR etc.

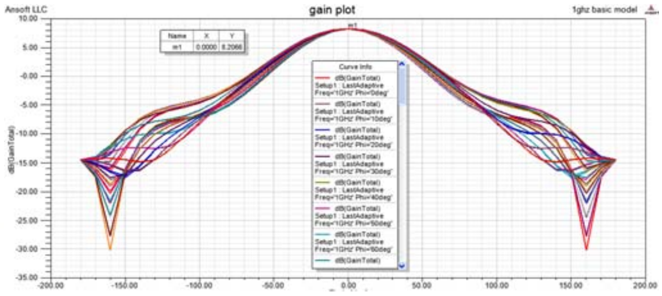
### 3.1 Return Loss

Power will not deliver to the load and is a return of the power, that is called loss, and this loss that is returned is called the return loss. Larger return loss indicates higher power being radiated by the antenna which eventually increases the gain [4]. In this Figure it show that the u-shape microstrip patch antenna resonating at 1GHz having a maximum return loss of -34db.



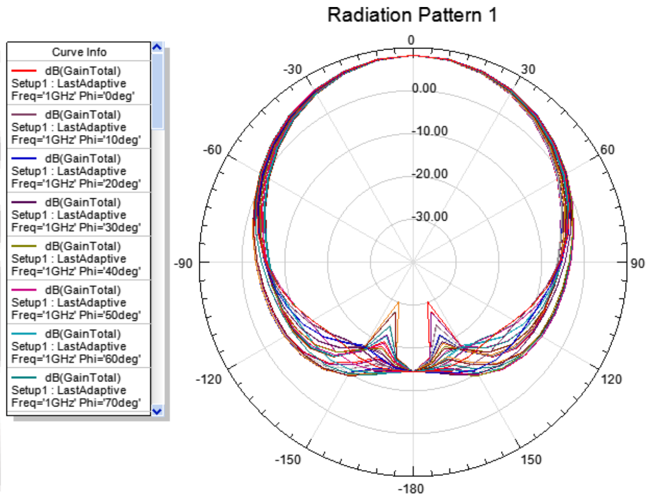

### 3.2 Gain

The gain of the antenna is the quantity which describes the performance of the antenna or the capability to concentrate energy through a direction to give a better picture of the radiation performance [5]. This is expressed in dB, in a simple way we can say that this refers to the direction of the maximum radiation. Figure shows the simulated result of gain of the proposed antenna. The maximum achievable gain is 8.2dB.




### 3.3 Radiation Pattern

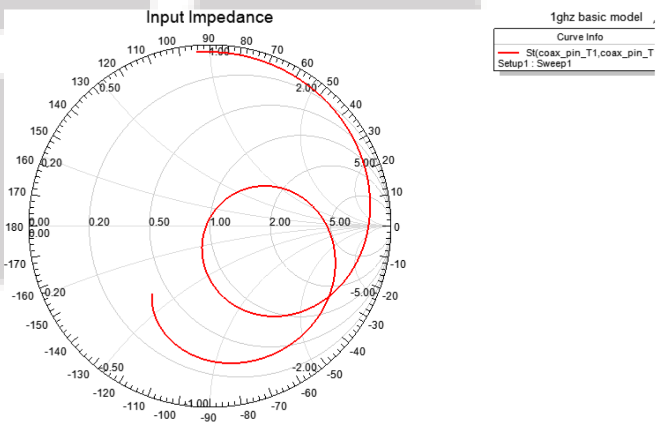
The radiation pattern of microstrip Patch Antenna is the power radiated or received by the antenna [7]. It is the function of angular position and radial distribution from the antenna. The radiation pattern for the proposed microstrip patch antenna is show in Figure.




### 3.4 Input Impedance

The input impedance of this circuit is approximately described by:

$$Z_{in} \approx jX_f + \frac{R}{1 + j2Q(f/f_o - 1)}$$

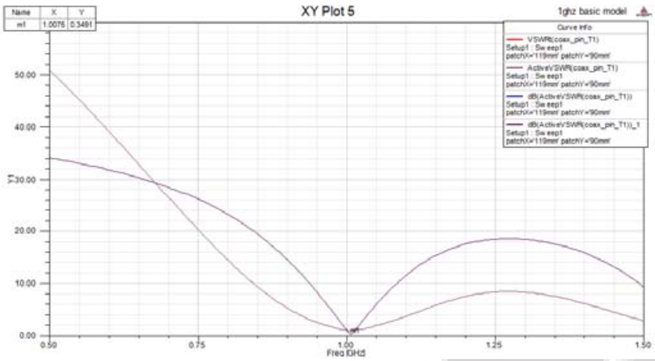



### 3.5 Voltage Standing Wave Ratio (VSWR)

The VSWR is an important specification for all communication devices. It measures how well an antenna is matched to the cable impedance where the reflection, |Γ|

= 0. This means that all power is transmitted to the antenna and there is no reflection.

The simulation result of Voltage Standing Wave Ratio, (VSWR) is shown in Fig-. Below. By referring to Fig-, at operating frequency 1GHz, the VSWR value obtained is 0.3.




## 4. Conclusion

A single microstrip patch antenna has been successfully designed according to its design specifications, simulated and analyzed. The design of this work gives the following results; the return loss in the operating frequency of 1GHz is equal to –34dB and antenna gain is 8.026dB. The performance of the designed antenna was analyzed in term of bandwidth, return loss, Input Impedance and radiation pattern. The design was optimized to meet the best possible result. Substrate used is RT/Duroid 5880. The results show this antenna is able to operate from 1 GHz frequency if it is made with this perfect dimension 119mm x 90mm.

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