# Design of Microstrip Rectangular Patch Antenna for Wireless Application

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**Abstract**

*This paper demonstrates the design of a rectangular probe feed microstrip patch antenna for frequency specific wireless applications operating in the frequency range of 4.2Ghz to 5Ghz.Use of higher bandwidth in microstrip has been possible by using different methods of patch construction but this antenna aims at specific short band of 0.7Ghz to be used only at desired centre frequency of 4.85Ghz. The antenna has a good gain of 7.9209db and directivity of 8.0019db.It has Voltage standing wave ratio less than 2 and is very easy to be constructed.*

**Keywords:** microstrippatch; wirelesslan; HFSS; low profile

## Introduction:

The huge demand of wireless communication system and their miniaturization has made antenna design more challenging. Recently microstrip patch antennas have been widely used in satellite communications, aerospace, radars, biomedical applications and reflector feeds because of its inherent characteristics such as light weight, low profile, low cost, mechanically robust, compatibility with integrated circuits and very versatile in terms of resonant frequency. The patch antenna model used for the numerical simulation in Ansoft HFSS is shown below. In this paper the patch antenna is designed for 5GHz operation on a substrate with 2.2permittivity and 0.32mm thickness.The patch with the coaxial feeding was simulated in AnsoftHFSS.It has a bandwidth of 4.5Ghz to 5.2Ghz. Further the percentage bandwidth is increased by increasing substrate thickness and by increasing patch height.The use of wide band has been modern trend in microstrip profile design but it causes band pollution in crowded areas. Because these bands are "free" and not sanctioned by FCC license, signals may be heavily polluted by other unlicensed systems. These other competing signals appear as noise to the desired signal and may degrade signal integrity and range.So a short band specific antenna is designed to support different wireless application.

## Geometrical parmeters:

Antenna can be best model as a transmission line for fast and easy design but is less accurate.

Width: The width of the patch controls the bandwidth and is given by

$$w = C0/2fr\sqrt{2/Er+1}$$

Length: patch length is calculated by

$$L=C0/2fr((Ereff)^{1/2})-2\triangle L$$

whereEreff is calculated as

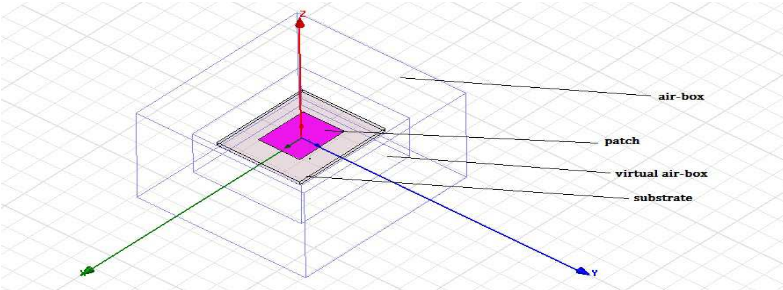
$$Ereff = \frac{Er+1}{2} + \frac{Er-1}{2}\left([1+H*12/w]\right)^{-1/2}$$

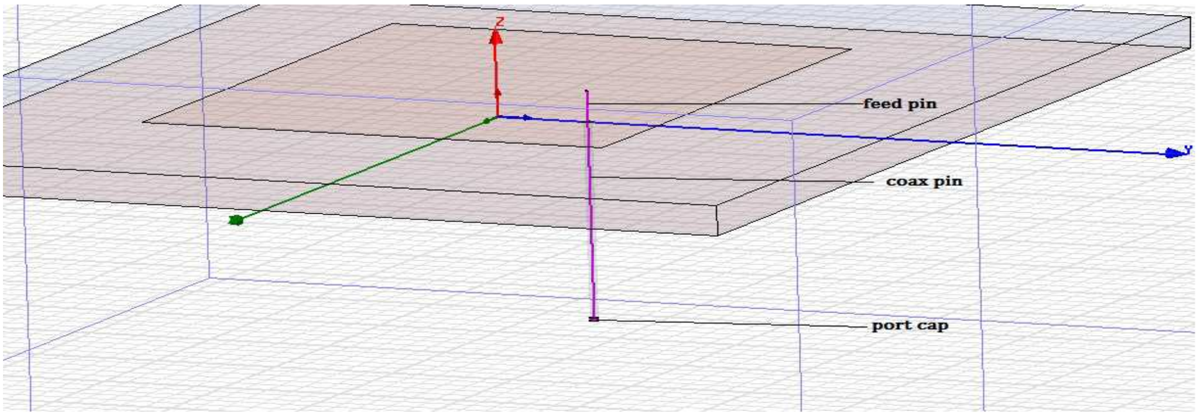
Length and width of patch antenna and its thickness controls the directivity and bandwidth of an antenna

| | |
|---|---|
| Substrate | Roger RT /duroid 5880™ with |

| | |
|---|---|
| | Er=2.2 |
| Substrate length and width | 45mm, 38.2mm |
| Patch length and | 23.72mm, |

| | |
|---|---|
| width | 19.32mm |
| Feeding method | Coaxial feed |
| Gain | 5db-8db |
| Polarization | linear |




**Return loss curve:** This Return Loss is determined in dB as follows:

RL = -20log |Γ| (dB)

Where |Γ| is = vo-/vo+ =zl-zo/zl+zo

|Γ| is the reflection coefficient

V0+ is the incident voltage

V0- is the reflected voltage

Zl and Zo are the load and characteristics impedances

**Gain and directivity:** The expression for the maximum gain of an antenna is as follows:

*G* = η x D

η – The efficiency of the antenna

D – Directivity

**Voltage standing wave ratio** : is given as

V.S.W.R=Vmax/Vmin=1+|Γ|/1-|Γ|

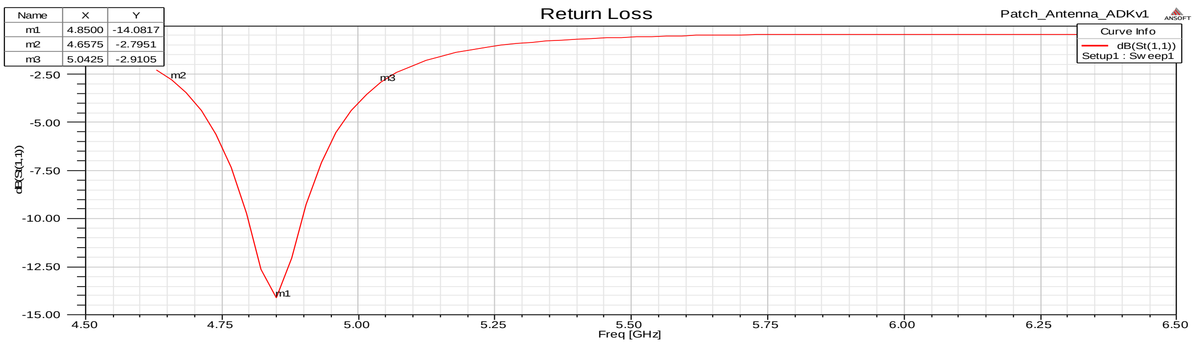
As the reflection coefficient ranges from 0 to 1, the *VSWR* ranges from 1 to ∞.

**Bandwidth**:The bandwidth is the ratio of the upper and lower frequencies of an operation. According to the bandwidth can be obtained as:

$$B \propto \frac{\varepsilon_r - 1}{\varepsilon_r^2} \frac{W}{L} h$$

**Simulation results:**

## Return loss:




As we can see from simulated graph that the return loss is -14.0817db which gives a VSWR of 1.083 <2 so it has desired performance.

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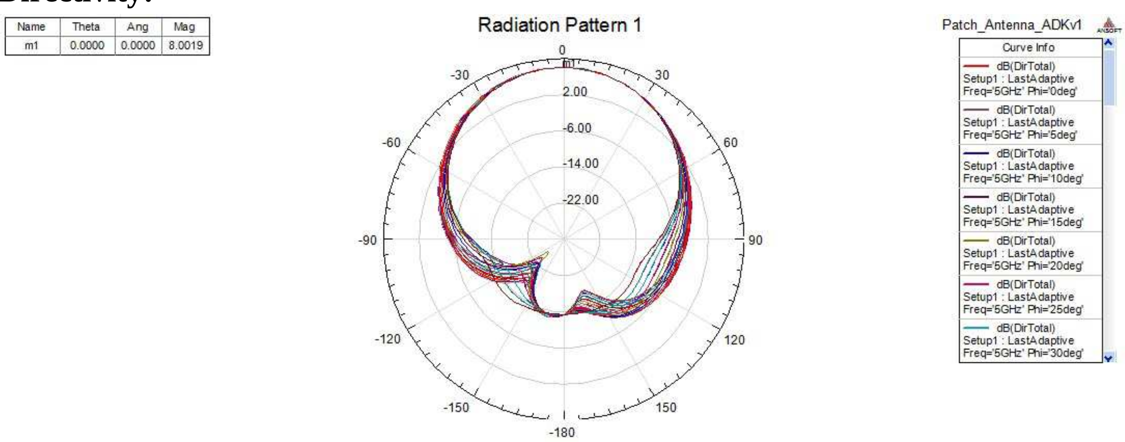
## Gain:



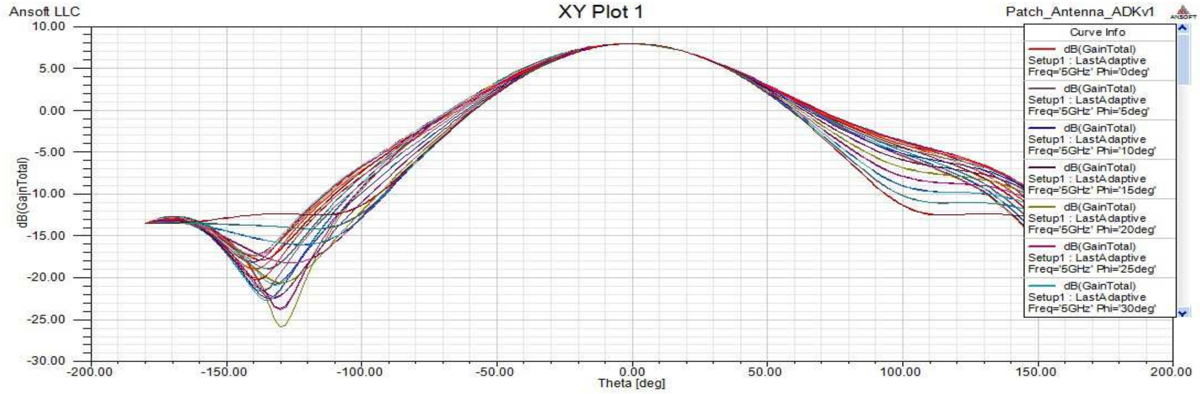
from the gain graph it is seen that the highest gain is found to be 7.9209 db

## Directivity:

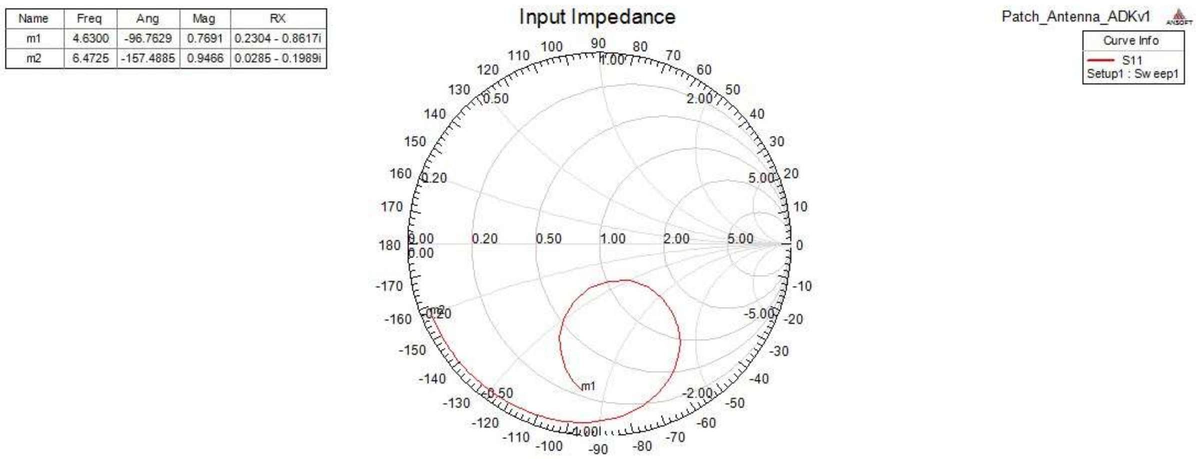



directivity is maximum at 0degree and is 8.0019db in magnitude

**XY plot of gain graph:**




**Input impedance plot:**




**Conclusion:** the centre frequency is found to be 4.85Ghz and it is clear that the bandwidth is narrow and is of only 0.7Ghz so it can be typically used for only some specific wireless applications and can serve its motive with good accuracy.

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