

# Evaluation of Circular Pin Fed Linearly Polarized Patch Antenna Using Different Substrates

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**Abstract:** In this paper, a circular pin fed linearly polarized patch antenna is designed, which can be used in radio & Television, Wimax, GSM, Bluetooth, and WLAN communication systems. The main focus of this paper is to optimize the performance of micro strip patch antenna. In recent times, Wimax based communication applications are widely using circular pin fed linearly polarized patch antenna and it is very familiarized. The proposed antenna design uses 0.5 GHz frequency band and it is working at narrowband within this band. RT/DUROID 606 material is used for creating the substrate of the micro strip antenna. This new design of the micro strip patch antenna gives high performance in terms of gain and gain bandwidth product.

**Keywords:** Patch Antenna, RT/Duroid, Narrow Band, Pin Fed

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## 1. Introduction

At micro wave frequencies physically small sized antenna is well enough to generate desired directivity. Latest communication systems are very small in size, hence antenna size should be very small and can be easily mounted on the system. One such design is micro strip patch antenna, they are highly reliable and robust in nature. Recently, the need for the design of a micro strip patch antenna has increased due to its properties such as, high performance, high gain, low cost. In addition to these properties, it provides an easy user interface and is simple to understand. The topology used for making micro strip patch antenna is pin fed linearly polarized antenna, which is single narrowband patch antenna. The E-shaped micro strip patch antenna is used for WLAN applications. While, Dual wideband Stacked patch antenna is used for both WLAN and WIMAX applications. Due to these properties, the micro strip patch antenna has become very popular in many applications such as in Wimax communication system and mobile applications. The micro strip antenna is bonded to an insulated dielectric substrate. Rectangular patch is most commonly used by the micro strip antenna. The material, which is used for the patch is copper.

The proposed antenna is designed by using substrate material RT/DUROID 606 /Arlan 25N/ Nelco N900 BRF

with permittivity 3 and dielectric tangent loss=0.0004. The micro strip antenna has a narrowband property, which is a disadvantage of Micro strip patch antenna and shows electromagnetic nature, in some cases. There may be many shapes possible for making micro strip patch antenna such as, rectangular, circular, elliptical, square etc. In this paper, we are designing a circular shaped patch antenna. The circular pin fed linearly polarized micro strip patch antenna is working at a frequency band of 2.5 to 3 GHz. The height of the substrate is calculated as  $635\mu\text{m}$  and 1.524 mm, which returns maximum return loss greater than -42dB that improves the gain of the antenna and results high performance. The far-field pattern of micro strip patch antenna also has very good characteristics.

## 2. Circular Pin Fed Linearly Polarized Antenna

Circular pin fed linearly polarized antenna was designed for Wimax communication system with different substrate materials. The conclusion comes out that the antenna gives a maximum gain 5.704dBi and bandwidth of 1.55% with height of 1.524 mm. The structural design of the circular pin fed linearly polarized antenna is shown in the figure 1.design

frequencies are  $f_0 = 2.74\text{GHz}$ ,  $f_{\min} = 2.5\text{GHz}$ ,  $f_{\max} = 3\text{GHz}$  and operating frequency is  $f = 2.85\text{GHz}$ .

In this paper, the aim is to increase the gain of an antenna for using in Wimax communication application system. The proposed patch antenna has maximum gain is about 5.704

dBi when Nelco N900 BRF is used as substrate. The same gain can be achieved with Arlan 25N. But with N900 BRF better gain bandwidth product can be achieved than Arlan 25N, as shown in the table 4.

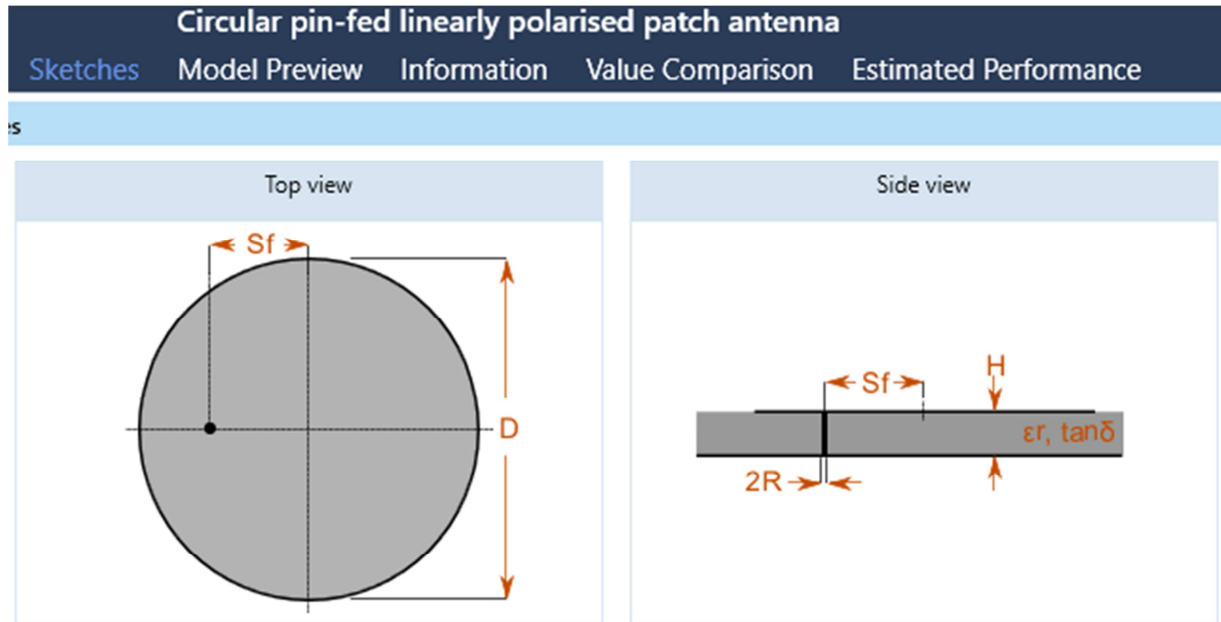


Figure 1. The circular pin fed linearly polarized patch antenna.

### 3. Parameter Specification and Values Used in the Design of Antenna

Table 1. Height of Different substrates.

	$\epsilon_r$	$\tan\delta$	H
Arlan 25N	3.58	$2.5e^{-3}$	1.524mm
Duroid RT 606	6.15	$2.7e^{-3}$	635 $\mu\text{m}$
Nelco N900 BRF	3	$4e^{-3}$	1.524mm

In this paper, our aim is to increase the performance of an antenna. In table 2, we will compare features of different substrates. Design characteristics for different substrates are

shown in table 3

Table 2. Diameter and radius of Different substrates.

	D (mm)	SF	R
Arlan 25N	35.69	6.078	190.5 $\mu\text{m}$
Duroid RT 606	25.79	3.926	79.38 $\mu\text{m}$
Nelco N900 BRF	35.69	6.078	190.5 $\mu\text{m}$

Table 3. Specifications of Antenna.

	x dimension	y dimension	z dimension
Arlan 25N	35.69mm	35.69mm	1.524mm
Duroid RT 606	25.79mm	25.79mm	635 $\mu\text{m}$
Nelco N900 BRF	35.69mm	35.69mm	1.524mm

Table 4. Result analysis.

	Gain	Band width	Gain band width product
Arlan 25N	5.704dBi	1.460%	8.327dBi
Duroid RT 606	3.702dBi	536.4e-3	0.00198dBi
Nelco N900 BRF	5.704dBi	1.55%	8.8412dBi

The performance of the antenna designed for Wimax applications depends on certain parameters such as gain, radiation pattern, and gain band width product. These parameters are determined by the simulation method, design techniques and substrates of the micro strip patch antenna. The gain is one of the most important property of the micro strip patch antenna. In the proposed antenna, the received gain is about 5.704 dBi with Arlan 25N and Nelco N900 BRF, which is far better than the simple micro strip patch antenna. Therefore the patch antenna with Nelco N900 BRF substrate gives us better results and performance for use in

the Wimax applications.

### 4. Conclusion

The micro strip patch antenna is most widely used antenna design in the Wimax communication system. In this paper, the performance of the antenna is increased by using different substrate materials such as Arlan 25N, RT/ Duroid 606 and Nelco N900 BRF. The proposed antenna with Nelco N900 BRF substrate gives a better gain of 5.704 dBi with a maximum gain band width product 8.8412dBi, which greatly

helps to enhance the performance of the antenna. So that it can be efficiently used in the WiMAX communication system and other applications.

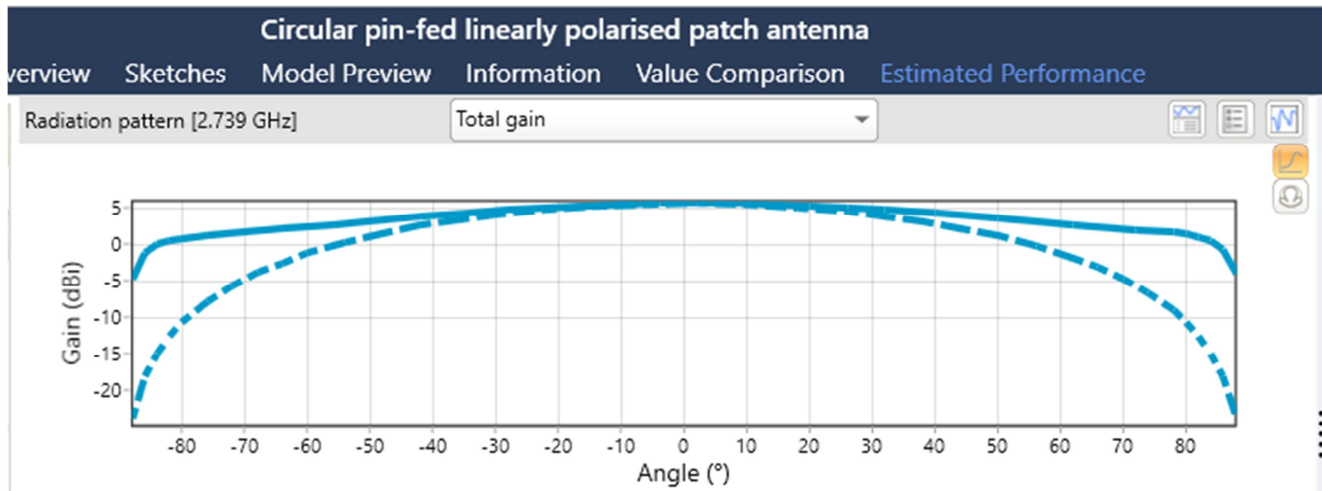


Figure 2. Gain of circular pin fed antenna.

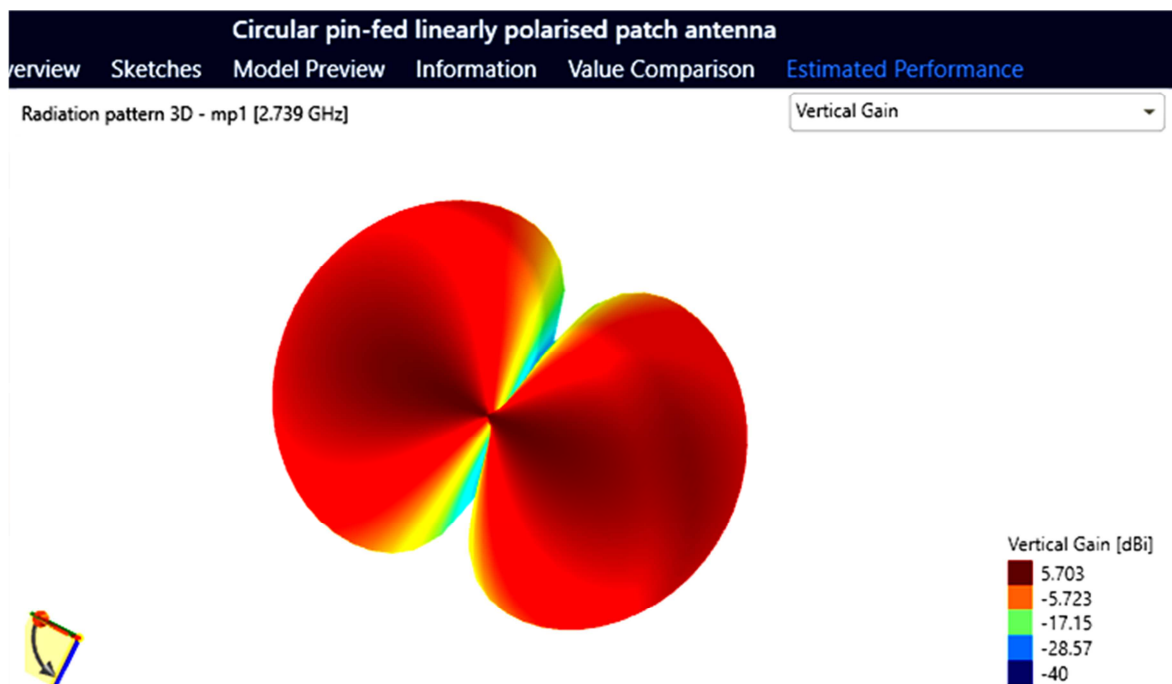


Figure 3. Radiation pattern of circular pin fed linearly polarized patch antenna.

1. Same gain can be achieved with both the substrates Arlan 25N and Nelco N900 BRF
2. N900 BRF has better bandwidth over Arlan 25N
3. N900 BRF has better gain bandwidth product over Arlan 25N

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