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# UWB Microstrip Patch Antenna with A Highly Directional CPW-Fed Design

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**Abstract:**

In this section, we will discuss the design and implementation of a new coplanar waveguide (CPW) antenna, which is designed for use in ultra-wideband (UWB) communication. Two carved ground planes distinguish the radiator from the rest of the chassis. It is necessary to dig a hole in the ruined ground. Circular radiators with rectangular cutouts are excellent for superheterodyne receivers because they have wider bandwidths than other types of radiators. This antenna operates at a frequency of 7 GHz and has a return loss of less than -10 dB. Its working frequency is 7 GHz. When utilising HFSS12, it is possible to determine S11 and VSWR.

**Keywords**— Ultra-wideband, waveguide coplanar, antenna slot.

## 1. Introduction

The FCC (Federal Communications Commission) has designated 3.1 GHz to 10.6 GHz for UWB activities [1]. The tiny size of microstrip antennas is useful because they have both low-profile and high-data-rate capabilities (MMICs). UWB CPW slot antennas are one of the most often used UWB planar antennas for UWB applications. A stepped impedance resonator [8] similar to a folded square as well as an eye-shaped radiator [4] and fork-like stub [3] offer an enhanced bandwidth. This article describes a new, 25 x 38 mm2 C-band CPW antenna with a 0.8 mm FR4 substrate thickness.

### 1.1. UWB's Key Characteristics

The following requirements must be met by UWB antennas:

Overall dispersion properties are seldom degraded owing to a lack of mismatches: there must be no mismatches at the antenna and transmission ends.

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If the group delay stays constant, the pulse waveform does not grow in time.

Because there are no waves travelling in either direction, the ultranarrow bandwidth's directivity has constant gain.

Section II is dedicated to additional studies of a similar kind to assist you comprehend the substance of the article. Sections III, IV, and V contain the detailed antenna design details, simulation results, and conclusions.

## 2. Companion Works

The novel small-size antenna developed by S. Y. Sze and colleagues (2001) was designed to improve bandwidth. The tuning stub, which looks like a fork, and a microstrip line feed are both included in the setup. It was possible to calculate in advance the gain and radiation pattern of the UWB disc monopole, and a gain of 2 dB as well as a return loss of less than -10 dB were achieved.

A novel planar eye-shaped UWB antenna design, based on a 50-Ohm microstrip patch eye-shaped patch, is proposed by C. A. Tsai et al. (2012) in [4, and it is described in detail in [5]. The efficiency of this antenna is about 85-90 percent, and the gain is approximately 85 percent. The etched ground plane serves as a reflector, increasing the directional characteristics of the device as a result of its etching.

As a result of this, it is possible to build a planar antenna with low return loss, almost constant group delay, improved directivity, and a visually appealing radiation pattern.

In 2011, Azim R. and colleagues [5] created an antenna with a tapered ground plane slot that has a wider bandwidth of 3 to 11.2 GHz and a greater bandwidth of 3 to 11.2 GHz. The prototype antenna has a surface area of 22 24 mm2. The antenna has a gain of 5.4 dB and radiates in a steady stream. There is no difference in the conclusions reached regardless of the band in which the data is stored. In line with expectations, the VSWR is less than 2.

It was published in [6] that the authors' work, which details a new ultrawideband antenna that combines two components on a single substrate, was first published. The first structure is a gap in the ground plane that has been shaped into a leaf, while the second structure is a piece of substrate that has been shaped into an inverted cone. With the use of the PICA principle, this article will show you how to build a slot antenna on a printed circuit board (PCB) (PCB). In order to control the antenna impedance, it is necessary to make adjustments to the slot and feed area. In the two-metal-plane Slot PICA, a leaf-shaped structure on one plane and a larger leaf-shaped slot on the other plane are combined to form a slot. Changes in the polarisation of an antenna result in an increase in the radiation efficiency and coverage area of the antenna.

S. R. Madian and colleagues (2012) [7] described the antenna they built as having a circle-shaped slot, a trident-shaped feed line, and two stacked C-shaped stubs as its primary characteristics. The use of a trident-shaped feed line in the spectrum results in a substantial increase in the bandwidth available for use. The back surface of the substrate includes two notches for the frequency bands 5.1–6.2 GHz (WLAN) and 3–3.8 GHz (WiMAX), which were created by inserting a pair of nested stubs between the notches. Among its many advantages are its low VSWR, good impedance matching, constant gain throughout the whole frequency range, and an omnidirectional emission pattern, among others.

Sung et al. (2012) demonstrated a microstrip feed line, a circular radiating element with a 50-Ohm impedance, a SIR with two short circuits, and a ground plane that was partially truncated [8]. While the UWB properties of this antenna span a frequency range of 3.07 to 10.61 GHz, its RF characteristics span a frequency range of 5.37 to 6.01 GHz. The SIR design with folded layers is much smaller than the conventional design, making it more suitable for use in high-frequency bands like as WiMAX and WLAN. It may be used to produce slits in frequency bands, for example.

## 4. Antenna Design

Figure 1 depicts the antenna design and exact dimensions of the proposed model, as well as the suggested model's overall size. A 50-ohm microstrip line linked to the microwave substrate via a circular radiator with a rectangular cut provides feed to the tapered slot, which is located in the middle of the taper's length. A prototype with dimensions of 25 mm square, 25 mm deep, and 0.8 mm thick is seen in this photograph. Because of the incision in the patch's top region, the proposed antenna radiator has the benefit of providing impedance matching while also making antenna assembly easier. In addition, these antennas were designed with directional UWB uses in mind when they were constructed. It is possible to enhance the impedance bandwidth and radiation properties of a device by carefully selecting the slot shape and radiating area.

## 5. Criteria for design:

The antennas are made to use FR4 as a material of choice. The dielectric layer is only 0.035mm thick, while each of the dielectric and conducting layers is 0.8mm thick. The relative permittivity was kept at 4.4 throughout the research. The substrate is a FR4 board measuring 25 by 38 mm2, and it is a dielectric. Microstrip feeding line is linked to a modified circular disc on the conducting side. A partially-visible ground plane sits on the top side of the substrate.

To do this, the UWB antenna should have low return loss, high voltage, low standing wave ratio, and strong directivity. The following parameters were selected: The diameter of the circular incision is about 9 mm, and the radius of the circle is around 8 mm. The antenna design depicted in Figure 2 is similar to the one in use.

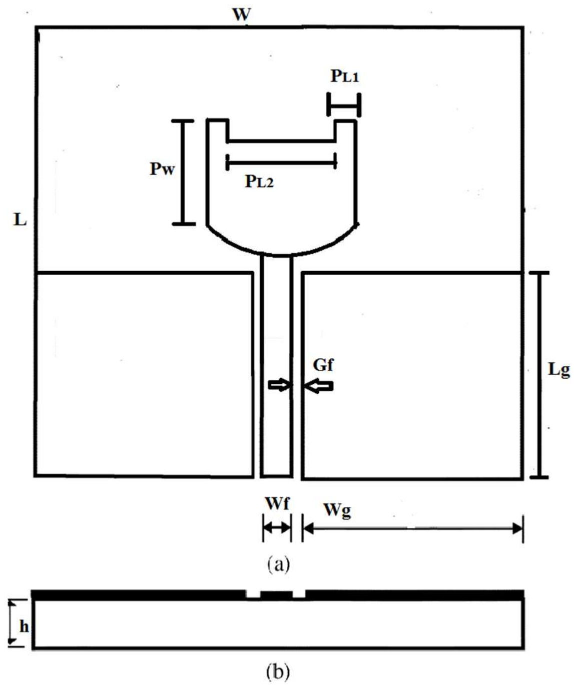


Fig.1The proposed antenna's schematic perspective (a) from the top (b) from the side.

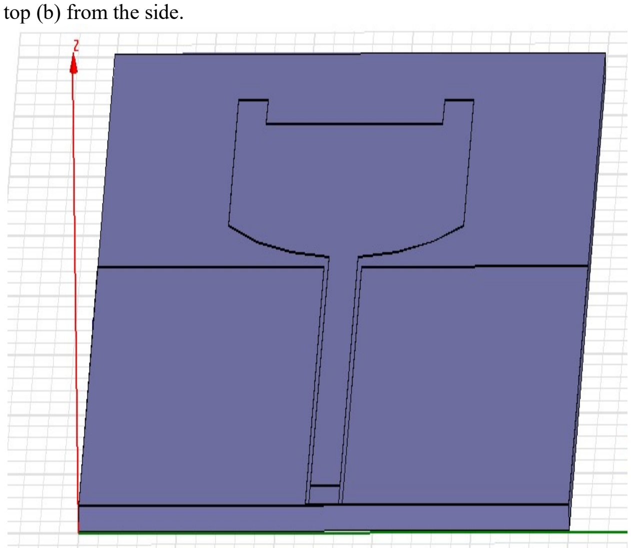

Fig.2 : UWB antenna with HFSS design

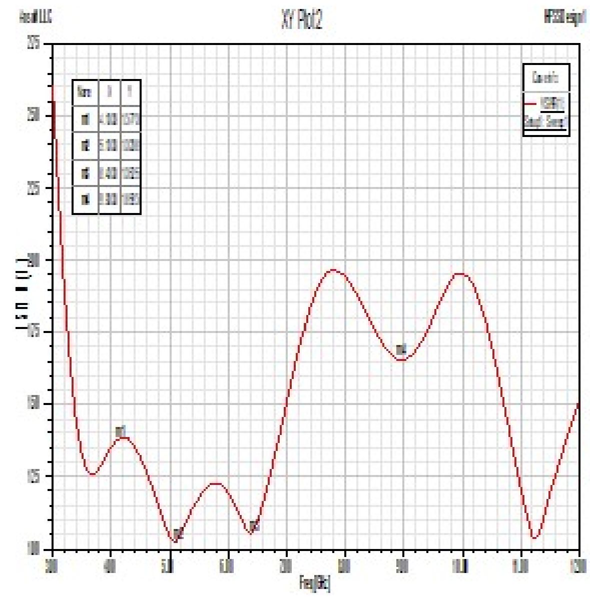


Fig. 3 Return loss simulation results

## 4. Simulation Results

A return loss of between 3.1 and 10.6 GHz places this antenna in the UWB-band, which also describes the whole bandwidth. A UWB application may get a VSWR of less than 2 across the frequency range. This summary table shows how the proposed antenna's modelling results break down, highlighting the different features of UWB and offering optimum directivity across a wide range of angles.

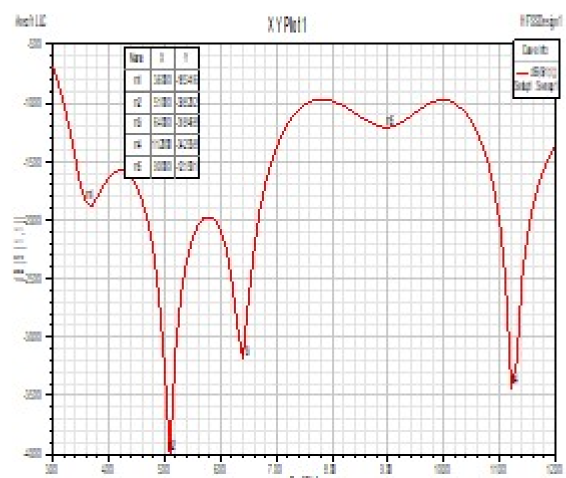


Fig. 4 Simulation results from VSWR

Table 1

## References


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| Parameters(mm) | Wf | Wg | Pw | PL1 | PL2 | Lg | Gf |
|---|---|---|---|---|---|---|---|
| Unit | 1.15 | 11.15 | 9.1 | 1.15 | 9.1 | 20.1 | 0.13 |