Ultra Wide Band Microstrip Patch Antenna Design For Wireless Application

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ABSTRACT
This paper presents a Microstrip planar Antenna for Ultra Wide Band frequency for cover a large bandwidth of 4GHz with the Resonance frequency of 5.8GHz.Here its wide applications like Medical Application, radar imaging technology, WLAN, Wi-MAX, PC Peripherals, Wireless mouse, satellite communications etc. The gain and directivity of the propose antenna is 2.66db and 3db respectively . for this design and simulation of antenna HFSS simulator is used .

Keywords— ***Micro strips Transmission Line, Ultra Wide Band, Planar Antenna.***

INTRODUCTION

Microstrip antennas are used in applications where size, weight, cost and ease of installation are required. These antennas are low-profile and conformable to both planar and non-planar surfaces. Antenna characteristics are also dependent of dielectric parameters.
Antenna arrays are used in order to achieve higher gain. The larger number of antenna elements, the better gain of antenna array is achieved. Antenna arrays are more demanding for EM simulation than single element antennas due to their electrical size.
Application of ultra-wideband (UWB) technology on wireless communication system has increased considerably in last seven years. Because the UWB technology has great potential in the development of various modern wireless communication systems, the U.S Federal Communication Commission (FCC) authorized the unlicensed use of the ultra wideband (3.1-10.6 GHz) frequency spectrum for indoor and hand-held wireless communication since early February 2002[3]. To meet the variety of applications in UWB communication systems, many researchers around the world have been aroused on the design, research and development of UWB filter and antenna [4-5].
We will focus on only one parameter to illustrate the electrical size of the array:

• Length of quarter model of antenna (AntQLen)
The width of entire the array is approximately four times less than length.

The rising importance of wireless communication and multimedia services increasing the efforts to the design and implementation of novel microstrip patch structures from miniaturized electronic circuits to the antenna arrays. The main advantages of microstrip patches are light weight, low cost, planar or conformal and ability of integration with electronic or signal processing circuitry.
Microstrip antenna elements radiate efficiently as devices on microstip printed circuit boards. Microstrip antenna array consists of microstrip antenna elements; feed and phasing networks. Designing microstrip structure requires understanding of both mathematical relatives and applications. The microstrip array is very reliable since the entire array is one continuous piece of copper.
Microstrip patch antenna consists of a radiating patch on one side of a dielectric substrate with a continuous metal layer bonded to the opposite side of the substrate which forms a ground plane.
The patch is generally made of conducting material such as copper or gold and can take any possible shape. A patch antenna is a narrowband, wide-beam antenna fabricated by photo etching the antenna element pattern in metal trace on the dielectric substrate.

UWB ANTENNA

UWB is a Radio Frequency (RF) technology that transmits binary data, using low energy and extremely short duration impulses or bursts (in the order of picoseconds) over a wide spectrum of frequencies. It delivers data over 15 to100 meters and does not require a dedicated radio frequency so is also known as carrier-free, impulse or base-band radio. People commonly refer to UWB as available spectrum rather than as a technology 7500 MHz of unlicensed spectrum, in the 3.1-10.6 GHz band, is currently available in the US for any Communication system that occupies more than 500MHz. fig.1 the data rates of ultra wide antenna is very high but cover distance is less in meter.[6]

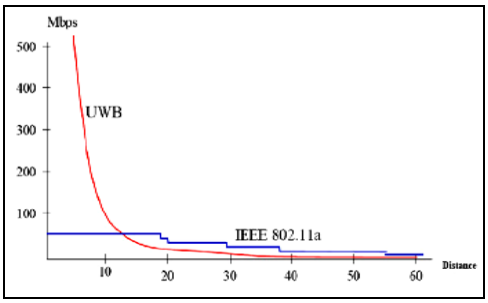


Fig.1 UWB Data Rates

The simulated -10 db at 3GHz to7 GHz with larger bandwidth of 4 GHz. Low dielectric constant substrates is generally preferred for maximum radiation.
Main purpose of this antenna to use one antenna for many application like Medical Application, radar imaging technology, WLAN, Wi-MAX, PC Peripherals, Wireless USB etc.which is the cost effective to deign one antenna for all application.

UWB ANTENNA CONFIGURATION DESIGN

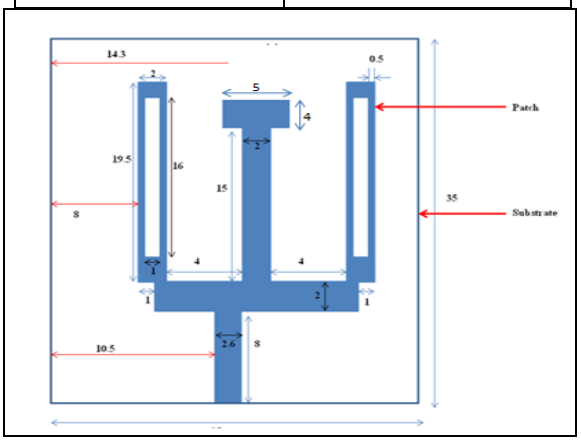
The proposed antenna is formed by a on one side of a PCB and a strip is the connected of the PCB as fig 2. The strip is connected to the front structure with a metal strip on the side or via through the PCB. The antenna has a low profile and can be easily embedded into the display of a laptop computer. This simple structure made from common materials is very cost effective.

In the design of this type of antennas, the width 'W' and Length 'L' plays a crucial role in determining the resonant frequency of the system. The starting values of these parameters are calculated by using the equations given in [9-10] for the substrate height (h), dielectric constant (εr) and for the lower frequency. The designed values of the antenna are optimized with HFSS tool. The optimization was performed for the best impedance bandwidth. Fig 2. shows the structure of the ultra wide band planer antenna. The antenna consists of rectangular aperture with width 'W' and length 'L' and rectangular patch with height 'H'. In this study, a dielectric substance (Teflon) with thickness of 3mm with a relative permittivity of 2.08 is chosen as substrate. The CPW feed is designed for 50 Ω characteristic impedance with fixed 2 mm feed line width and 0.5 mm ground gap.

By properly adjusting the dimension of the antenna and feeding structure the impedance matching of the proposed antenna is improved that produces wider impedance bandwidth with satisfactory radiation pattern. The wide bandwidth and impedance matching with reduced size of the antenna is achieved by the different surface magnetic currents of the structure. [7]- [8]

Fig.2 shows the geometry and configuration of ultra wide-band (UWB) antenna. The design parameters are L=19mm, W=21 mm, H=0.035mm, h=3mm (substrate height).

Design frequency	5.8 GHz
Thickness of substrate	3mm
Height of patch& ground	0.035mm
Width of patch(W)	21 mm
Length of patch(L)	19 mm
Length of feed line	8 mm
Substrate materials	Teflon(Єr=2.08)



25 (All dimensions are in mm)

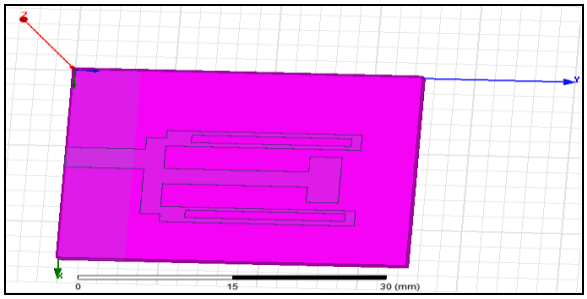


Fig. 2.a Front view of UWB Microstrip antenna.

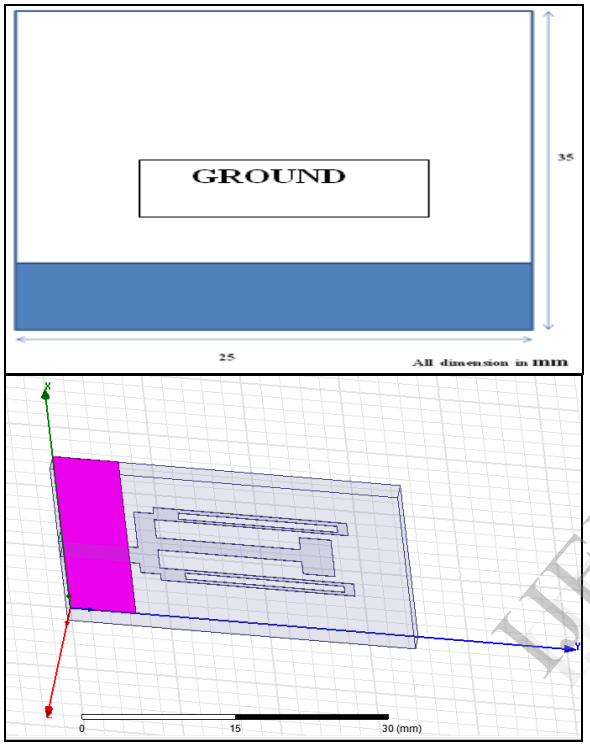


Fig. 2.b back view of UWB Microstrip antenna.

SIMULATION RESULTS

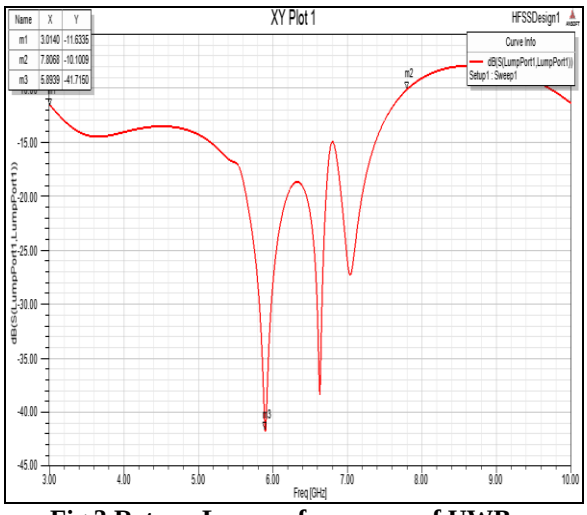


Fig.3 Return Loss vs. frequency of UWB Microstrip antenna.

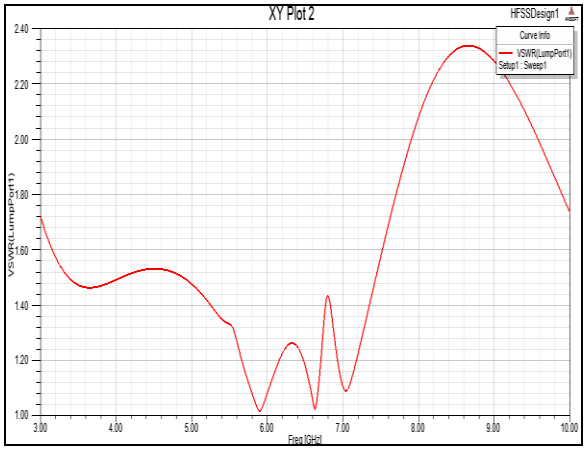


Fig. 4. VSWR vs. frequency of UWB Microstrip antenna.

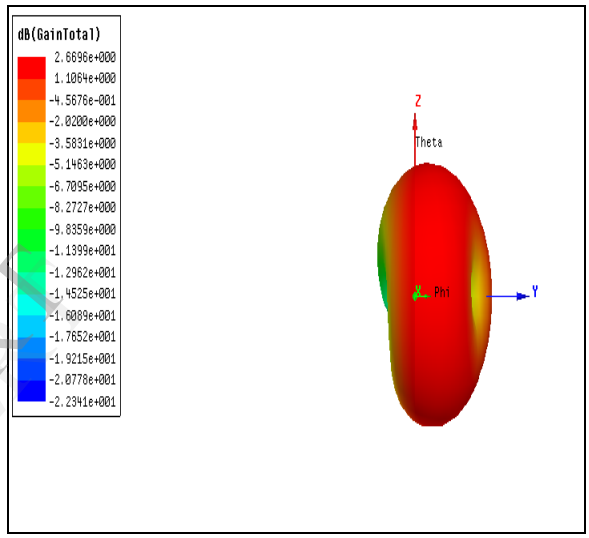


Fig. 5. a .Gain at 5.8 GHz.

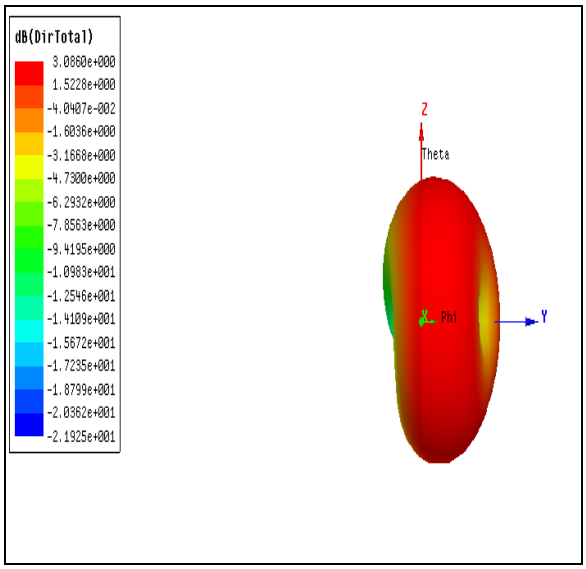


Fig. 5. b .Directivity at 5.8 GHz.

CONCLUSION

This paper investigates a low profile and cheap Microstrip patch antenna that cover 3GHz to 7GHz frequency band which is suitable for, covering S-Band and C-Band for WLAN applications, satellite communication, Wi-Fi for laptop applications. by simulation work using HFSS, we achieved the gain and directivity of the propose antenna is 2.66db and 3db respectively with a good BW of 4GHz.

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