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Research Article

Design and Simulation of a Microstrip Antenna for Ultra-Wideband (UWB) Application

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ABSTRACT

In the present study, a compact microstrip antenna was designed for the applications of Ultra-Wideband (UWB). The proposed antenna was fabricated on an FR4 substrate of thickness 1.6 mm. It used a 50 Ω microstrip line with the relative permittivity of 4.4. Ansys High Frequency Structure Simulator (HFSS) was employed to perform the design and simulation. The return-loss at, 10 dB was measured by a vector network analyzer for result validation purpose. It was found that the measured data agreed well with the simulated result.

Keywords: Microstrip Antenna, Return Loss, Radiation Pattern, UWB

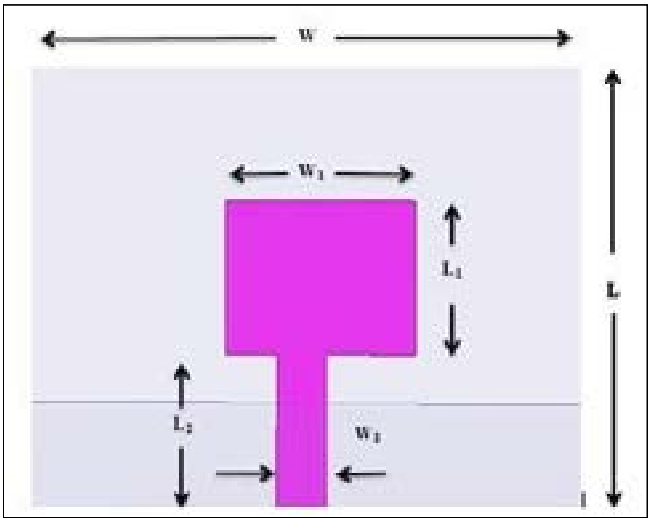
Introduction

In the world of wireless communication, one of the most critical components is antenna. A good design of antenna can improve the overall system performance. One of the most typical examples is TV which the antenna is utilized to improve the broadcast reception. To guide the waves in the transmission line, it requires the waveguide whereby the free space wave can be guided in the received mode.[1,2] In the year of 1950s the first microstrip antenna was introduced. However, it only became popular after the mature development of the printed circuit board technology. Nowadays, microstrip antenna is the most common types of antenna owing to its light weight, low cost, low profile, superior portability, easy of conformal, planar configuration and ease of fabrication. It has been widely used in various microstrip circuit applications.[3-12] On the other hand, Ultra Wideband (UWB) is one of the technologies of radio transmission. It was firstly defined as a pulse-based Spark Gap radio. After several decades, the Federal Communication Commission (FCC) allocated 7.5 GHz of bandwidth, from 3.1 GHz to 10.6 GHz, to the UWB applications. UWB can approach high bandwidth wireless communication in a short range of the revolution. It is much different from the traditional narrow band radio system, since it transmits the signal by modulating phase, amplitude, sinusoidal waveform of the frequency. Besides, UWB radio provides high data rate in hundred Megabytes per second. It can be applied to protect the data in security since the transmitting data is difficult to be tracked. Owing to the impressive advantages, the UWB technology was widely employed in several fields such as radar or radio related uses, medical imaging, indoor/ outdoor positioning.[13,22]

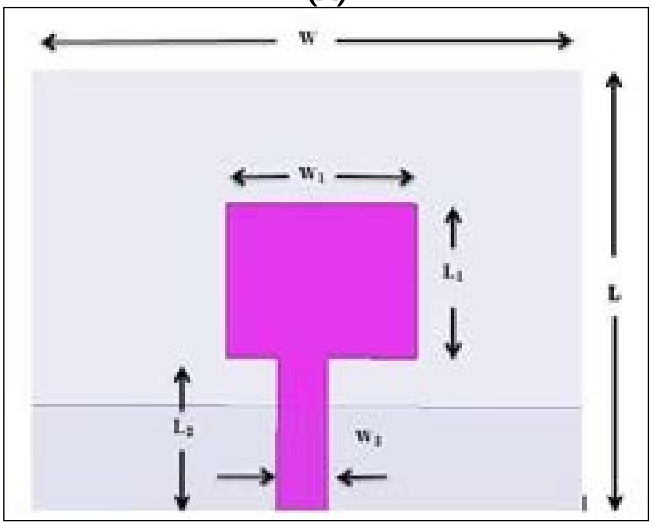
The UWB spectrum allows the transmission of material at very high data rates that expands the amount of info to be transmitted within a second. However, the implementation is very complex and it involves the antenna to be designed in a small size. In this paper, a compact antenna was proposed and fabricated for the applications of UWB.

Antenna Design

The front and back sides of the proposed antenna are shown in Figure 1 (a) and (b), respectively.



(A)



(B)

Figure 1.Final Design of the UWB Antenna

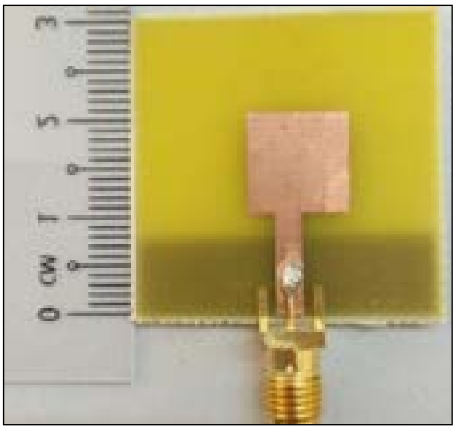
The dimensions of the design are tabulated in Table 1. The simulation work was performed using ansys High Frequency Structure Simulator (HFSS).[23]

Table 1.Parameters of the Antenna

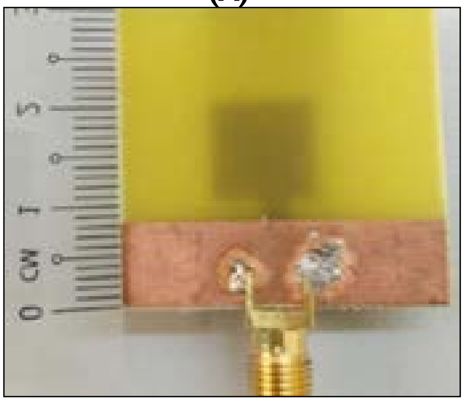
Parameter	Size	Parameter	Size
L	30 mm	W	30 mm
L_1	10 mm	W_1	10 mm
L_2	10 mm	W_2	26 mm
L_3	8 mm		

Result and Discussion

The proposed structure of antenna includes a radiating patch, a ground plane and a 50 W SMA connector as shown in Figure 2. The antenna was fabricated on an FR4 substrate with thickness 1.6 mm, loss tangent 0.022 and permittivity 4.4.[24]



(A)



(B)

Figure 2.Photograph of the UWB Antenna: (A) Front and (B) Back

Return loss measures the effectiveness of power delivery from a transmission line.[25] It is apparent in Figure 3, that both the calculated and simulated results agreed well with each other. Note that the measured result was cut off after 8.5 GHz due to the hardware constraint of the vector network analyzer.

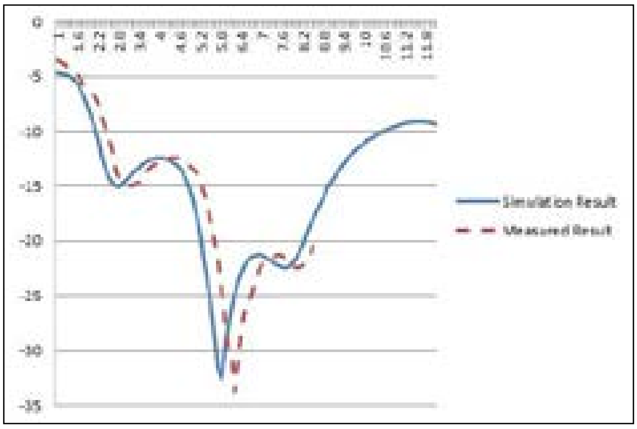
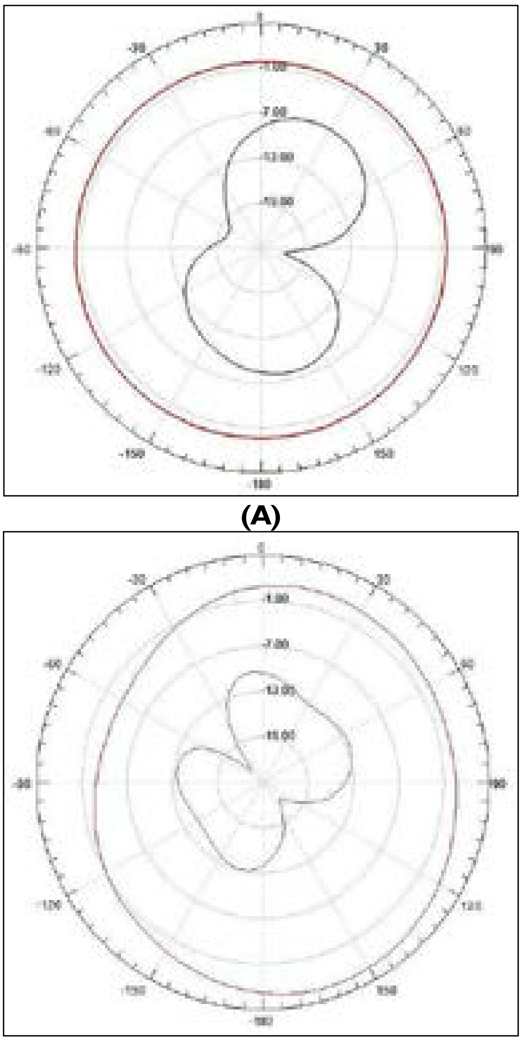


Figure 3.Simulated and Measured Return Loss

The simulated radiation patterns at 2 GHz and 6 GHz along the E- and H-planes are displayed in Figure 4. It was found that the radiation patterns are almost omnidirectional at both resonant frequencies.



(A)

(B)

Figure 4.Simulated Radiation Patterns At (A) 2 GHz and (B) 6 GHz

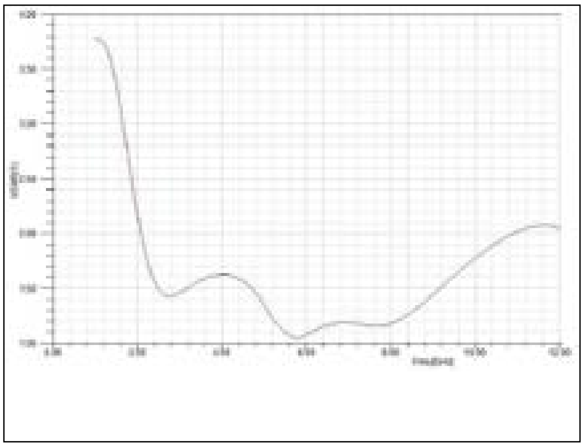


Figure 5.Result of VSWR

Figure 5, shows the result of VSWR (Voltage Standing Wave Ratio) for the proposed design. It is a reflection of coefficient that determines the reflected power from the antenna. In general, the VSWR value should be less than 2 so as to ensure a good impedance matching of loads to the characteristic impedance of a transmission line or waveguide.

Conclusion

A simple design of microstrip UWB antenna was proposed in this study. It could be seen from the simulated results that the return loss ranges from 2 GHz to 10 GHz and it agrees well with the quantified consequence. The VSWR is less than 2. Besides, the proposed UWB antenna has a wide impedance bandwidth as evidenced by the omni-directional radiation patterns.

Acknowledgment

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