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DESIGN AND SIMULATION OF WIDE BAND L-SHAPED ANTENNA

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***Abstract*: The Simulated antenna is one of the most excellent antenna structures, due to its low cost and compact design. In the paper, we present a research approach to upgrade the radiation effectiveness and the performance of antennas by miniaturization of the size. We have discussed about the performance of L-shaped mircostrip patch antenna which consists of a rectangular patch. This study was made for the wide frequency ranging from 7.35 GHz to 12.75GHz and the geometry of the antenna and the results are obtained using the simulation software HFSS. The bandwidth obtained is 5.40 GHz The detailed design and the results are shown and discussed in this paper.**

***Keywords:* Broadband , Microstrip , Patch Antenna , Planar, Ultra Wide Band.**

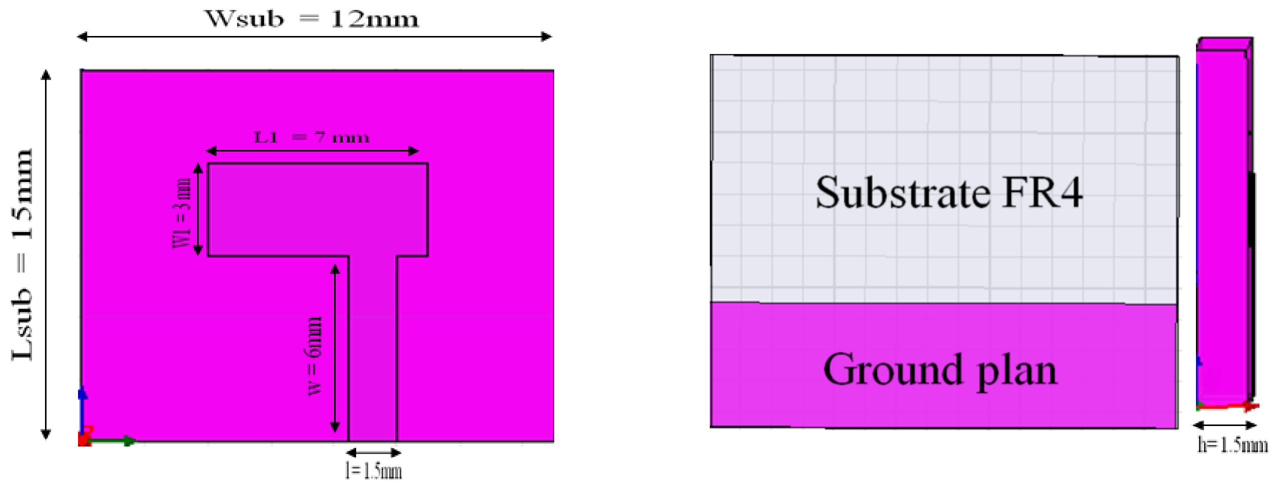
1. INTRODUCTION

Developments in communication systems Ultra Wide Band (UWB) in recent years has harnessed important research activity dedicated to antenna wide bandwidth [1], [2], [3]. Antennas are devices used to radiate electromagnetic energy into space. The characteristics of transmitting and receiving antennas are similar, so a good transmitting antenna is often a good receiving antenna. A single antenna performs both functions in many modern applications. Due to recent developments in high-speed switching technology, UWB is becoming more interesting for low cost patron communications applications. The Federal Communications Commission (FCC) in the U.S.A allocated the UWB frequency spectrum from 3.1 to 10.6 GHz below the transmitter noise threshold of –41.3 dBm/MHz [4], [5]. UWB applications have very good diversity. Microstrip patch antenna is very commonly used in UWB antenna designs due to its various advantages such as it has low weight, ease of integration, small size and compact. With rapid development of broad operating frequency, one serious challenge is the miniaturization of antennas with broad impedance bandwidth and higher radiation efficiency [6]. UWB technology is mainly employed for indoor and portable devices, the size of the UWB antennas is required to be minimally small so that they can be easily integrated into various equipments. Thus, a major challenge for ultra-wideband communications (UWB) terminals for small or very small, for short range radio and in combination with sensors or networks of information transfer in the context domestic, multimedia or professional. The low power consumption (and thus performance), ease of integration, and especially the cost are essential parameters that are incompatible with the performance [7] Maxwell equations [10] are used in analysis of the UWB antenna as well as narrowband antenna but in the case of the UWB antenna it could not be simplified due to wide frequency range. Therefore the simulations are used during design and modeling of the UWB antenna.

Microstrip patch antennas are used in aircraft, spacecraft, satellite and missile applications where small size, low cost, high performance and ease of installation are major limitations. Printed rectangular patch with partial ground technique is fed by a 50Ω impedance feeder presented in this paper. Details of antenna design, software simulation and measured results are also discussed. This paper is organized as follows: in the second chapter the short introduction. . The Third chapter gives design and simulation results. The Fourth chapter concludes the paper.

2. DESIGN AND SIMULATION RESULTS

The antenna proposed is composed of a L-shaped rectangular patch and printed on a substrate (FR4) having a length Lsub = 15mm and Wsub = 12mm width. The relative permittivity of 4.4 and thickness of 1.5 mm. The performance of antenna design is greatly affected by the shape of ground plane in terms of radiation pattern [8, 9], impedance bandwidth and resonating frequency of antenna. Such ground planes cause various design problems and complexities. The antenna is fed by a microstrip line of 50Ω, 1.5mm length and width w=6mm, all placed on a ground plane of 15x4 mm^2 dimension as shown in Fig.1. Rectangular Patch with constitutes the radiating element of the antenna. The microstrip rectangular patch is having the length L1=7mm and width W1=3mm.The design and study of the proposed antenna with a bandwidth of operation below - 10dB, which extends from 7.35 to 12.75 GHz, are presented.



(a) (b) (c)

Fig 1 Proposed Antenna (a) Top View (b) Bottom View (c) Side View

The proposed antenna was analyzed and optimized with the help of High Frequency Structure Simulator software (HFSS). The simulation results of the return loss (in dB) for this proposed antenna are shown. It is indicates that the proposed antenna cover 7.35GHz to 12.75 GHz, that is some portion of UWB. Here the maximum return loss is found -31dB at 9 GHz. The bandwidth obtained from this graph is 5.40 GHz. Here are obtained the lower cutoff frequency 7.35 GHz, upper cutoff frequency 12.35 GHz and the efficiency 33%.
To measure the SWR of the antenna we use S11 parameter.. We found that the antenna had a -10dB or lower response in the bandwidth of 7.35 GHz-12.35 GHz.

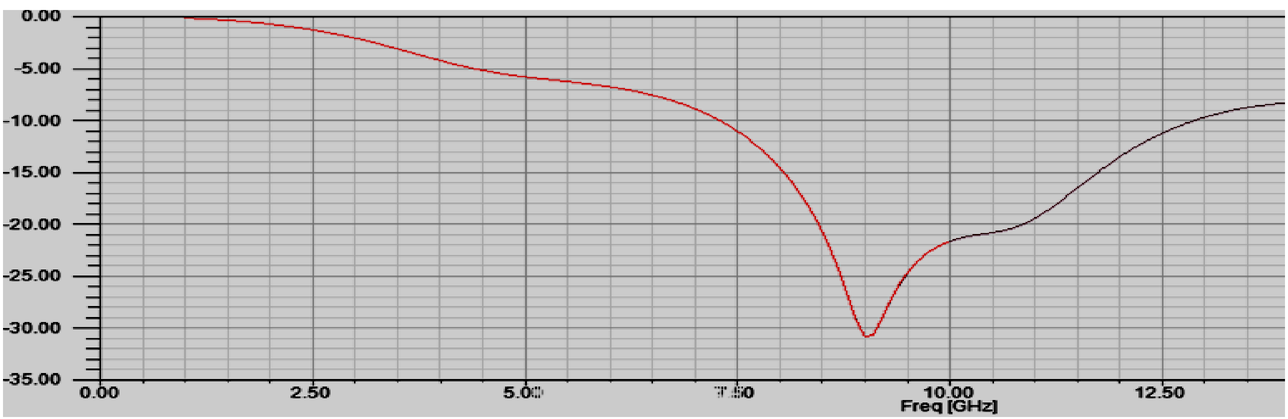


Fig 2 : The return loss S_{11} of the proposed antenna at Lsub=15mm, Wsub= 12mm, Lg= 4mm.

Fig 3 : 3-D Radiation Pattern

The above figure shows the radiation pattern in 3D format which indicate the omnidirectional pattern. The radiation patterns of the proposed antenna are also investigated. The proposed antenna is characterized by a quasi-omnidirectional pattern in the combination of E-plane and H-plane. It can be seen that the excellent wide band radiation pattern are observed.

For the proposed antenna, there are two principle planes selected to present the radiation pattern. These are referred as the *x–y* plane (*E*–plane) and the *y–z* plane (*H*–plane). This shows the plots of the normalized simulated radiation patterns in the *E*-plane and *H*-plane at various frequencies. In the *E*–plane, the value of azimuth angle of 0^0,90^0, $180^0$and 270^0 while for the *H*–plane the value of elevation angle of 0^0, 90^0,$180^0$and 270^0 are taken into consideration.

The below figure 4 shows the radiation pattern of E plane which is known as elevation plane or x-y plne at an elevation angle of 0^0 and it comes to be omnidirectional,at 90^0 it is more wide at this angle. Radiation pattern at 8GHz frequency at angle. At an elevation angle of 180^0 and it is becoming more directive and at at an elevation angle of 270^0 and it is becoming more wide at this angle.

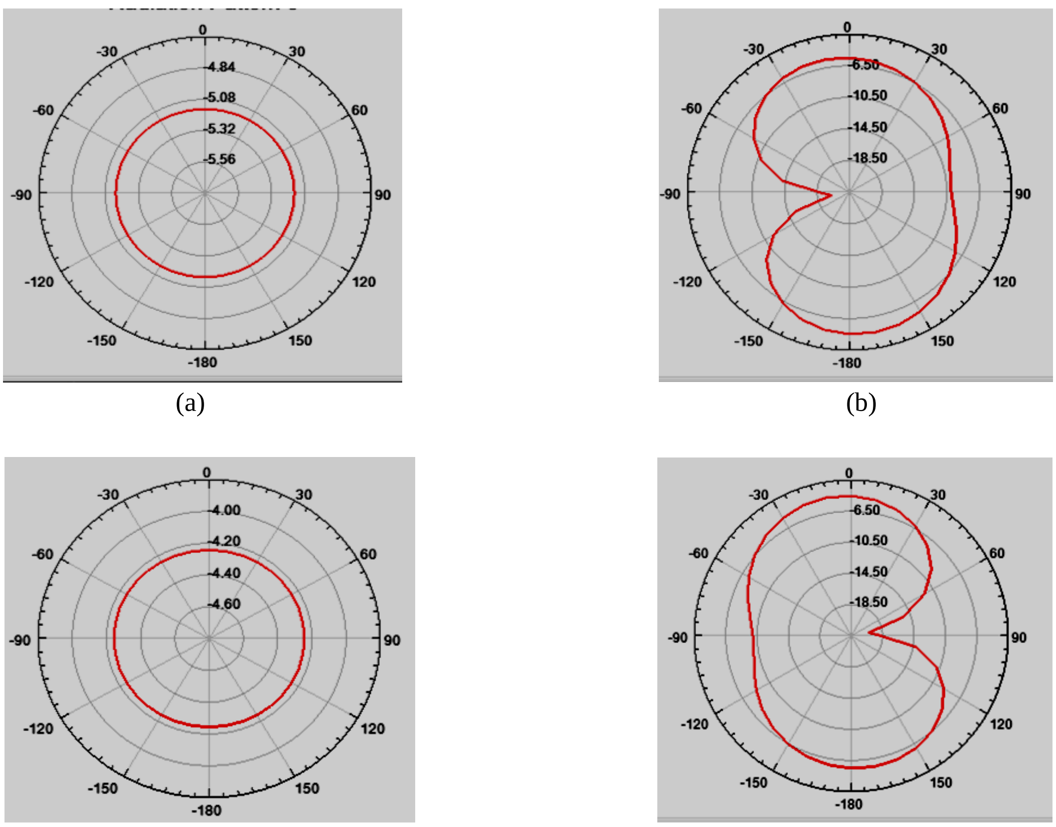


Figure 4:E Plane Radiation pattern at 8 GHz frequency at (a) $\theta = 0^0$ (b) $\theta = 90^0$ (c) $\theta = 180^0$ (d) $\theta = 270^0$

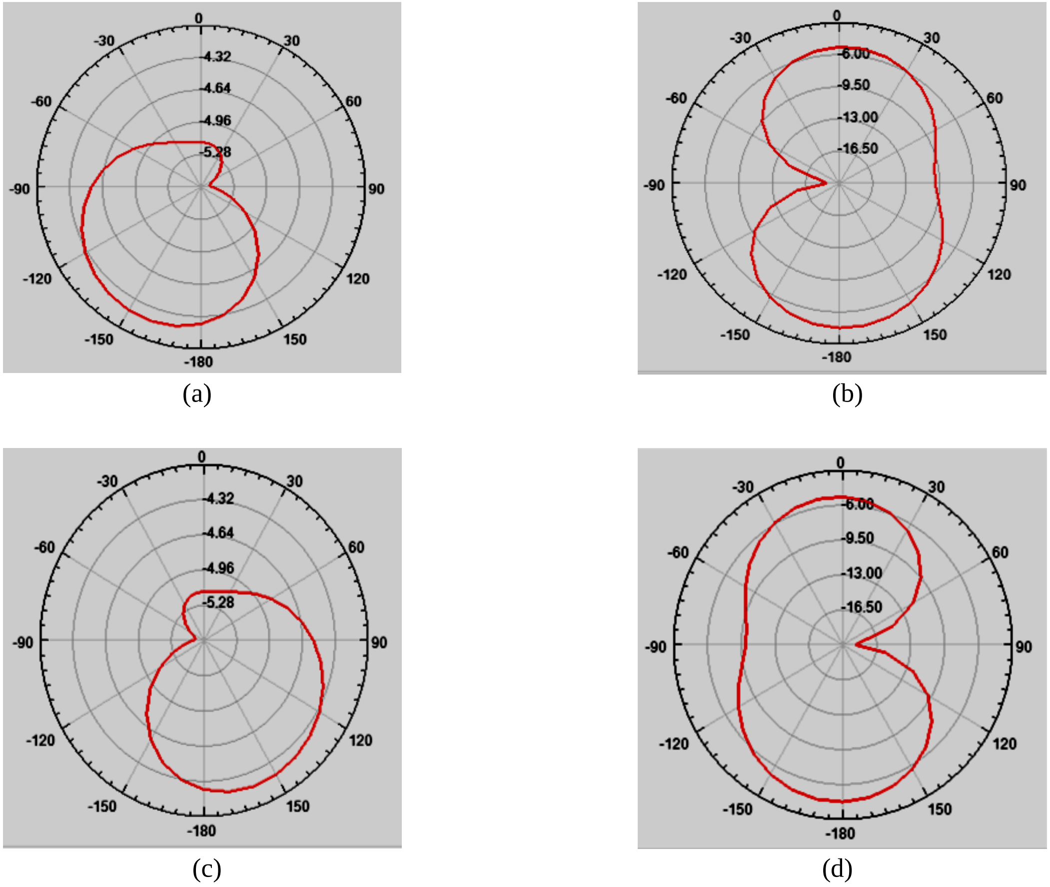


Figure 5: H Plane Radiation pattern at 8 GHz frequency at (a) Ø =0^0 (b) Ø = 90^0 (c) Ø =180^0 (d) Ø =270^0

The above figure 5 shows the radiation pattern of H plane which is known as azimuth plane or y-z plne at an azimuth angle of 0^0 and it comes to be directional. at 90^0 it is directional with side lobes, at 180^0 it is again directional but in other direction and at 270^0 it is directional with side lobes in different direction.

3. CONCLUSION

The above discussion of work finally concludes that the proposed antenna is good in the terms of its structure in providing wide bandwidth. As an antenna plays a very vital role in communication.Due to its compact size and conformability it is convenient to handle in the field of communication. This study was made for the wide frequency ranging from 7.35 GHz to 12.75 GHz.The overall bandwidth of microstip patch antenna is 5.40 GHz which fulfill the system requirements for WiBro, WLAN and mobile phones.

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