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DESIGN OF C-SLOT ANTENNA FOR WIDE BAND APPLICATIONS WITH STOP BAND OPEARTION

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ABSTRACT

Antenna is a vital component in wireless application systems. Antenna is important for establishing effective communication between places at different location. The microstrip antenna can be used for wireless applications as it has features such as light weight, easily mounted and it is easy to mass produce. The antenna has been characterized experimentally in terms of impedance bandwidth and radiation pattern. This C-slot antenna deals with design and fabrication of Microstrip antenna for the Ultra Wide Band frequency operation which cover the wide band from 3.10 GHz to 10.60 GHz. The substrate material used is FR4 with thickness 1.6 mm having the dielectric constant ( ) of 4.4. The patch material is copper having thickness of 0.1mm.

The different patch designs are considered for observation purpose majorly derived from the basic Monopole patch structure and the detail study of the antenna parameter such as Return Loss (S11), Radiation pattern, Bandwidth, Radiation efficiency, Gain etc. is done for each of the antenna design. Simulated and measured results are presents to validate the usefulness of proposed antenna stricture for UWB applications..

INTRODUCTION

RF and Microwave Technologies are rapidly finding their way into commercial applications. Industrial applications such as satellite data transfer, vehicle tracking and paging systems have been among the first to be developed. Other applications include mobile telephony, Radio Frequency Identification systems (RFIDs), Direct Broadcast Television (DBS), Wireless Local Area Networks (LANs) and Personal Communications Systems (PCS). The intelligent vehicle highway of the future will guide us through traffic jams and systems using Global Positioning System (GPS) will tell us about our location. From being a technology that had its utilization mainly in Telecommunications and Radar applications, it is today the forefront technology for a myriad of wireless applications.[1]

In this article, we present a new design of compact wideband slot antenna with band rejection characteristics for UWB applications. In this antenna C-slot with defective ground structure plane was used for enhance of bandwidth and to generate a band notch performance. The fabricated antenna has the frequency band of 3.1 to more than 10.6 GHz with a rejection band around 3.2-4.15 GHz. The size of the designed antenna is smaller than the slot antennas reported recently [2-5]. Good return loss and radiation pattern characteristics are obtained in the frequency band of interest.

The performance of antenna depends upon the characteristics of feed-line. The feed-line characteristics shown in following table.

Table 1: Comparison of different feed techniques.

Characteristics	**Microstrip Line Feed**	**Coaxial feed**	**Aperture coupled feed**	**Proximity coupled feed**
Spurious feed radiation	More	More	Less	Minimum
Reliability	Better	Poor due to soldering	Good	Good
Ease of fabrication	Easy	Soldering and drilling needed	Alignment required	Alignment required
Impedance matching	Easy	Easy	Easy	Easy

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Bandwidth	2-5%	2-5%	2-5%	13%

Antenna Design

The proposed C-slot antenna fed by a 50-Ω microstrip line is shown in Figure I. which is printed on a FR4 substrate of thickness 1.6 mm and permittivity 4.4.[6] The width of the microstrip feedline is fixed at 3 mm. The basic antenna structure is in rectangular shape have 28 mm length & 30 mm width. The antenna feed is provided and optimization is done for input impedance matching. The width of the feed is 3mm and the gap between feed and ground plane is 1.5 mm.

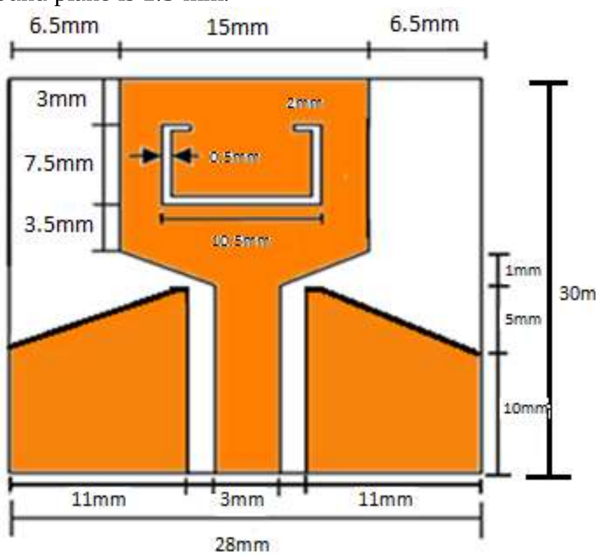

Figure 1: Geometry of C-slot UWB antenna

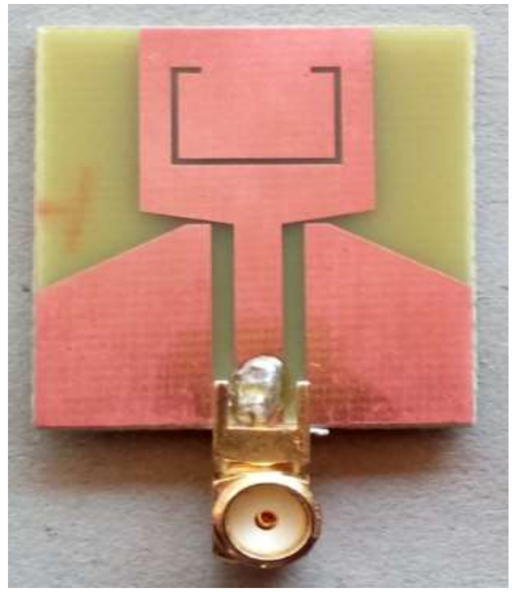

Figure 2: Hardware of C-slot UWB antenna

The basic antenna structure consists of a square radiating stub, a feedline, and a ground plane. The proposed antenna is connected to a 50-Ω SMA connector for signal transmission.[3]

Since Federal Communication Commission of USA allowed 3.1 GHz to 10.6 GHz unlicensed band for low power ultra wideband (UWB) technologies have drawn more and more attention due to their merits such as high data rate, small emission power and low cost. Between this bands of UWB some other narrow band are existing for WLAN at 5.5GHz (5.150GHz-5.8525GHz) and Wi-MAX at3.5GHz (3.31GHz-3.78GHz). The UWB antennas with the band notch characteristics have great demand in today's communication system. The WLAN signal is assigned at 5.5 GHz as centre frequency. To avoid the interference from this signal the notch band is created at that frequency to stop the interference. For creating the notch at that frequency the quarter wavelength of that frequency is calculated and the symmetrical shape is created. The relation between the length of slot and the centre frequency is shown in equations.[4-7]

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$$\lambda_g = \lambda\sqrt{\frac{2}{\mathcal{E}r + 1}}$$

The length of slots for the quarter wavelength slot is $L = \lambda_g/4$ and $L = \lambda_g/2$ for half wavelength slot. Slot resonant frequency which is same as the notch frequency may be given by the equation,

$$f_{ro} = \frac{c}{2L}\sqrt{\frac{2}{\mathcal{E}r+1}}$$

RESULTS

Return loss

As we know for proper transmission of signal by antenna the S_{11} parameter of antenna should be less then -10dB, so for the proposed antenna the return loss below -10dB has started from 2.79GHz and the same characteristics has been shown till 10GHz and one stop band which is shown in Figure 7.2 and as we know from the defination of UWB if the bandwidth of system is 1/4 of the centre frequency of operating band then it is considered as a UWB system so this antenna is showing the UWB characteristic.

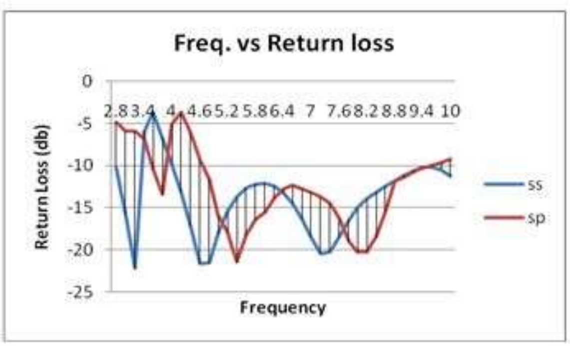

Figure 2: Return loss vs. Frequency.

Figure 2 shows the comparison between simulated result and practical measured result. The simulate result shows the stop band starts from 3.2 GHz - 4.15 GHz, where practical measured result shows 3.8 GHz - 4.65 GHz. So from graph both results are approximately same.

VEWR

Figure 3 shows the VSWR of the antenna. For good working of the antenna the VSWR < 2, from Figure 3 antenna has good VSWR.

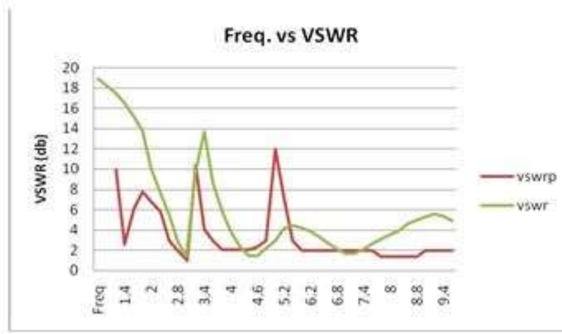

Figure 3: VSWR response

Radiation patterns

Figure 4 shows the simulated radiation pattern for the antenna at 5.5 GHz frequency.

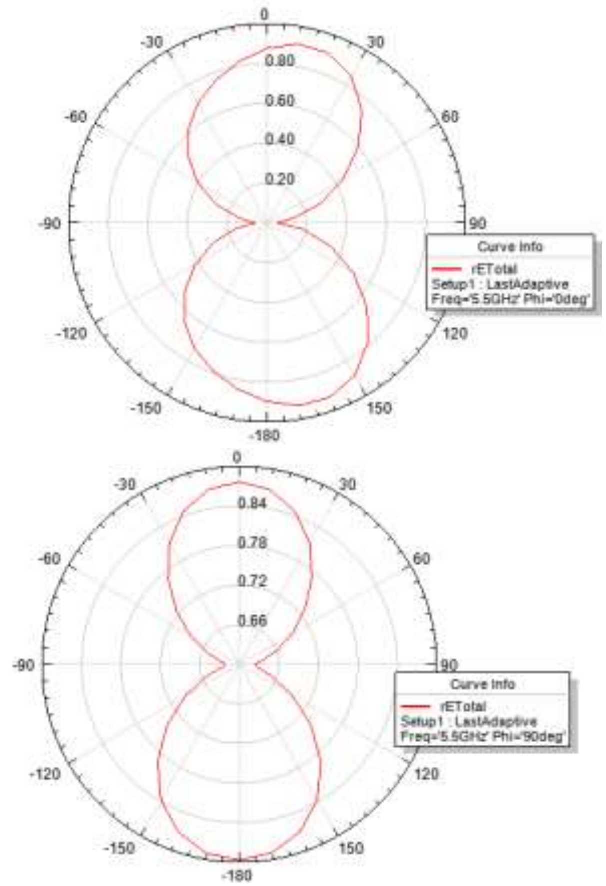

Figure 4: Rediation pattern at XZ & XY planes

Figure 5 shows the measured radiation pattern for the antenna at 5.5 GHz frequency.

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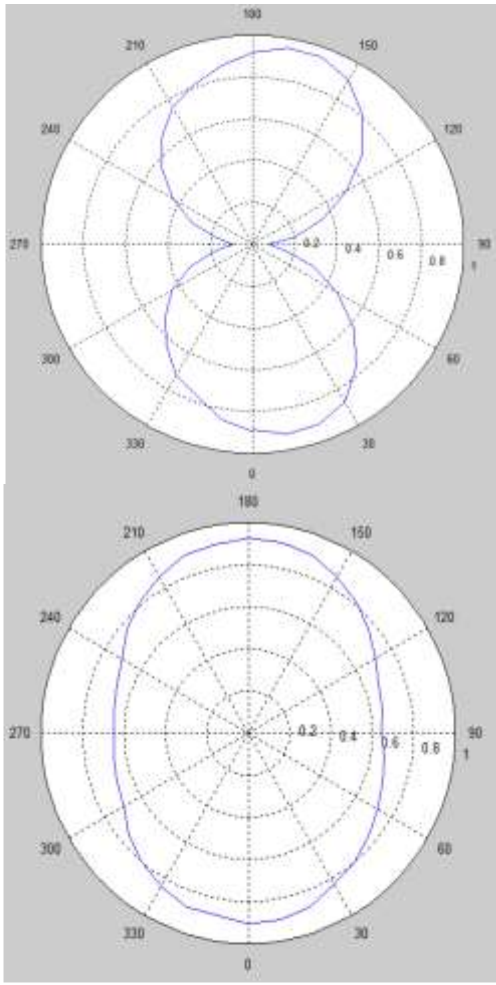

Figure 5: Measured Rediation pattern at XZ & XY planes

Smith chart

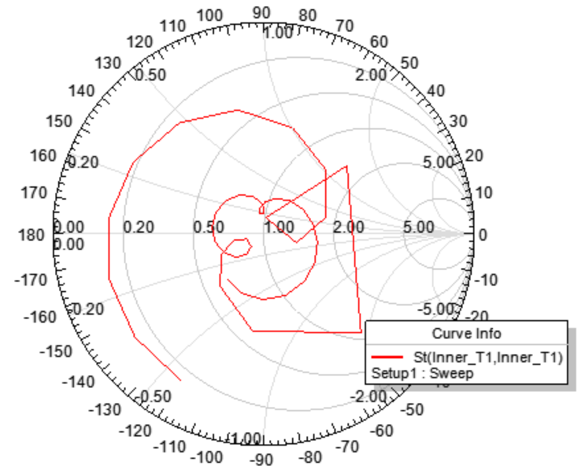

Figure 6: Smith chart

Input Impdance

Input impedance of an antenna is defined as the impedance presented by an antenna at it's terminals or the ratio of the voltage to the current at the pair of terminals or the ratio of appropriate component of the electric to magnetic field at a point. Hence the impedance of antenna can be written as,

Zin= Rin + jXin

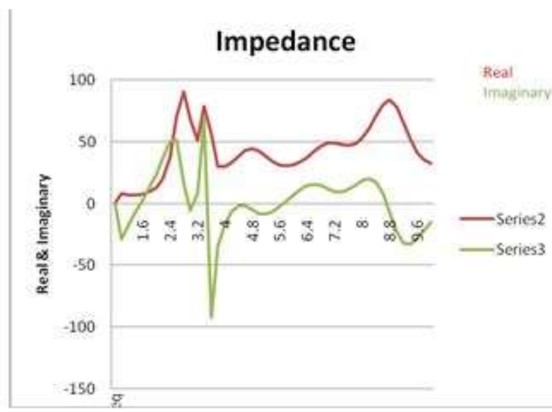

Figure 6: Input Impedance

CONCLUSION

Operation of UWB antenna for different applications is observed in this report. Substrate material used is FR4 material with dielectric constant 4.4 and thickness 0.8mm. The operating band is depends on the patch size and also on the overall size of the antenna and is inversely proportional to it. Coaxial feed-line is used for power input mainly affects the

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return loss of the antenna thus on total working of the antenna. Gap between patch and ground also between ground and feed plays important role in matching input impedance of antenna. Stable radiation pattern and consistent gain in UWB were obtained. Notch band antennas are very useful for the band rejection or filter applications. Size of the UWB antennas is very small and can be effectively used in the wireless applications such as WLAN, Radar communication or Satellite communication, etc. Fabrication costs of the antennas are also less. These antennas suffer from the drawbacks as low gain. Radiation patterns become highly directive at high frequencies. The antennas are useful for UWB system, Cellular, GSM, LAN, WAN and Radar applications.

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