Planar Microstrip Slotted Patch Antenna For Ultra Wideband Applications

Divya Bharathi R, Dr C.R. Byrareddy
Dept. of electronics and communication Engg.
Bangalore Institute of Technology
Bengaluru, India

Abstract **- A compact Ultra wide band planar rectangular Micro-strip antenna (RMSA) antenna for a Ultra Wide Band frequency Range (3.1GHz to 10.6GHz)applications is presented. The antenna is simulated using Ansoft HFSS and area of the antenna is 32mm x28mm.This is a very compact, high efficiency and simple microstrip patch antenna. In this proposed design, defective or partial ground plane is used to enhance the bandwidth of the microstrip patch antenna . The results show a large bandwidth, high gain and minimum return loss. The proposed antenna has return loss of less than -16dB in multiple frequency ranges in UWB and is suitable for wireless communication applications in ultra wide band Range.**

Keywords **- Rectangular Microstrip Slotted Antenna (RMSA), Ultra Wide Band UWB, monopole dual band.**

I. INTRODUCTION

Rapid progress in wireless communication services have led to an enormous challenge in antenna design. Patch antennas for dual and multi frequency band operation & Ultra wide band has increasingly become common, mainly because of many advantages such as low profile, light weight, reduced volume and compatibility with microwave integrated circuits(MIC) and monolithic microwave integrated circuit (MMIC).WLAN is one of the most important applications of the wireless communication technology that takes advantage of licence free frequency bands[ISM] due to high speed connectivity between PCs, laptops, cell phones and other equipments in environments.

In the near future WiMAX technology with different standards is going to occupy the market. Wireless data services are evolving and continuously growing using various technologies, such as 2G/3G. The impact of such diverse technologies is on the use of frequency band in different technologies will need to occupy different frequency allocations, Such as WLAN/WiMAX. Therefore there is a need to develop a Ultra wide band antenna for Applications for various bands occupying 3.1 to 10.06 GHz frequency bands. Several papers on Ultra wide band antennas for IEEE standards have been reported.

The proposed planar Slotted monopole antenna is capable of generating good Omni directional monopole with radiation in all the frequency bands. Proposed antenna with Omni-directional planar antenna for WiMAX applications, can operate in Ultra wide band which cover 3.25-3.85,3.3-3.8 and 5.15-5.85 GHz with return loss of less than -16dB.

In this paper a compact Ultra wide band antenna structure for Ultra wide band WLAN and WiMAX applications is proposed. The proposed antenna is simple to design and offer an effective control over operating bands by controlling the dimensions of rectangular vertical slots. The antenna can easily be fed using a 50Ω probe feed with Micro-strip line feeding technique for impedance matching. Also the Slotted Micro-strip Patch antenna structure is attractive from the package point of view. The advantage of Micro-strip Line feed technique feeding method is to match the transmission line characteristics impedance to the input impedance.

II. ANTENNA GEOMETRY AND DESIGN

The geometry of the proposed antenna structure is shown in figure 1. It is etched on a substrate of dielectric constant ε_r=4.4 and thickness h=1.6mm with tangent loss 0.09. The Basic structure of the antenna is Rectangular patch with substrate of dimension 32x28 mm.

The Patch is fed by a Micro-strip line of width 2 mm & length 16mm to achieve impedance of 50ohm.The antenna has ground plane dimension of length L_g= 15mm and width W_g= 28mm printed on other side of the substrate. The height of feed gap between feed point & ground plane is 1.6mm.The resulting antenna resonates at 3.2 GHz to 10.2 GHz in Ultra wide band region. From simulation and experimental studies, it is found that the dimensions of the gap between patch & ground plane is optimized to resonate at Ultra wideband.

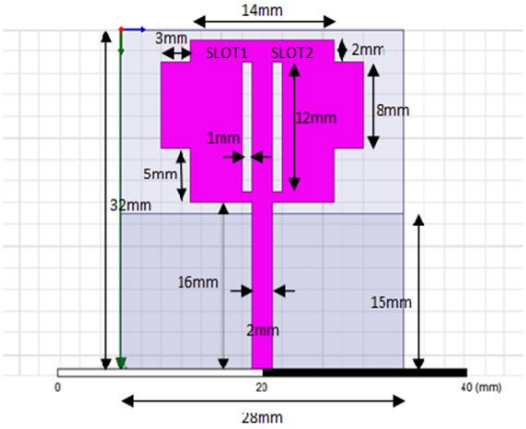


Figure 1. Geometry of the proposed Slotted UWB Patch Antenna.

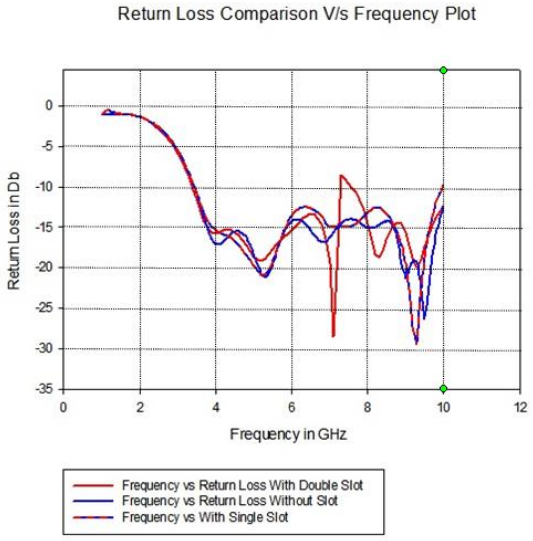
III.RESULTS AND DISCUSSION

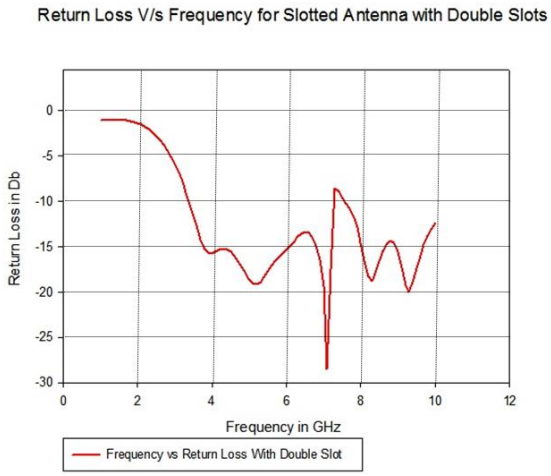
Ansoft HFFSv15 is used for simulation and analysis of the structure. Simulation process involves setting up of the optimum geometric dimension to satisfy the desired centre frequency, as well as the bandwidth requirement for specified return loss requirements in each band. The simulation was iteratively conducted until the desired results were found. Radiation patterns, E-field &H-field, S-parameters and gain were measured.

The following sections describe the details of and simulated results. Measurement of return loss is most important because our main interest in this research is to produce dual band characteristics within the specified centre frequency with sufficient impedance bandwidth requirement.

Return loss and VSWR

The following figure 2 show the simulated return loss and VSWR plots of the proposed Slotted Ultra wide band antenna with and without slots on the patch. From the simulation, the impedance bandwidth of the lower frequency band determined by -10dB return loss approximately 6GHz of bandwidth (3.2-10.2 GHz). To achieve the maximum results the gap distance between the Patch & the ground plane are adjusted and length of the micro-strip feed line 50 ohm need to be controlled.





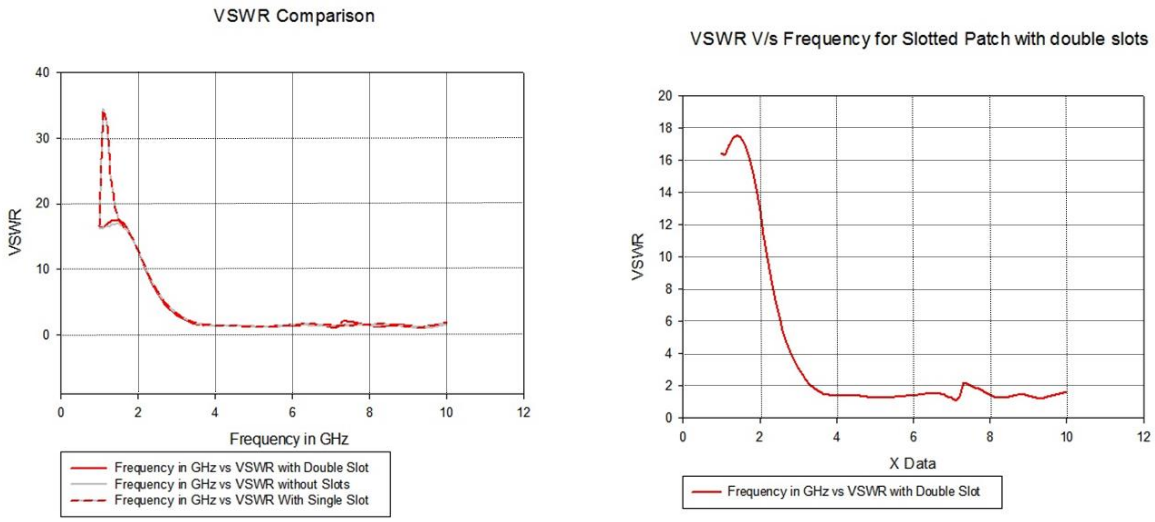


Figure 2. Simulated return loss and VSWR plots

Radiation Patterns

The simulated radiation patterns of the proposed antenna operating at Ultra wide band region for various frequencies are shown in figures 3 and 4. It is found that the antenna has relatively stable radiation patterns over its operating band, a near Omni directional pattern is obtained in the most of bands. Because of symmetry in the antenna structure the radiation patterns are as good as those of a conventional monopole. In the elevation plane (azimuth angle)as shown in the plots, asymmetrical radiation patterns are seen in the x-y and x-z planes. The measured radiation patterns are stable and quasi –Omni directional in the entire operational band which is highly suitable for the proposed modern wireless communication bands.

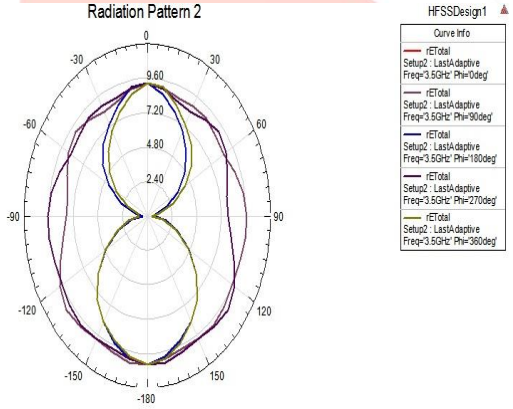


Figure 3. Simulated radiation patterns at 3.5GHz.

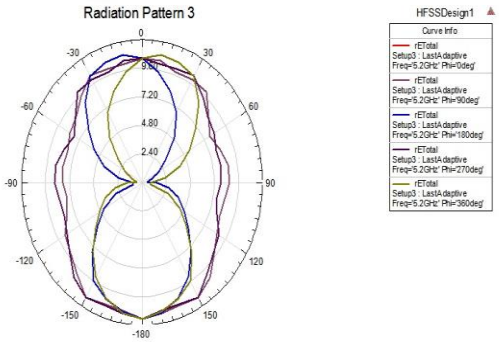


Figure 4. Simulated radiation patterns at 5.2GHz.

Current Distribution Characteristics and 3-D plot

A better understanding of the antenna behaviour can be obtained by analyzing the current distributions at Selected peak resonant frequency as shown in following figure.

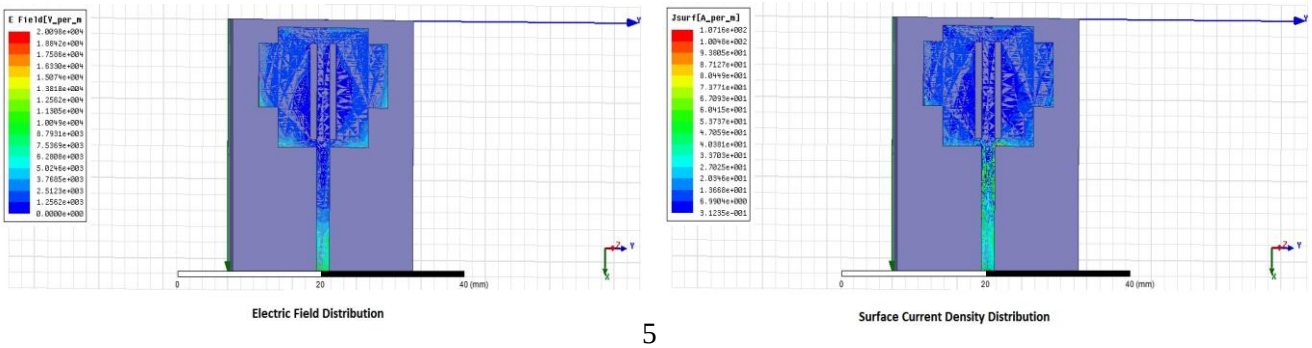


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Figure 5. Current distribution and e-field distribution of the Slotted Patch Antenna.

The figure 6 shows the 3D simulated radiation pattern . It is found that the planar antenna provides almost Omni directional radiation coverage and can be used for WLAN applications.

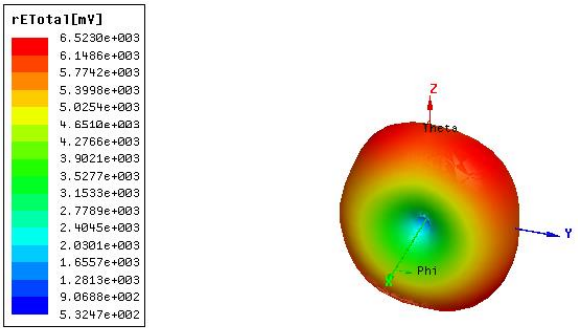

Figure 6. Simulated 3D radiation pattern of the Slotted Patch Antenna

Gain characteristics

The peak gain of the antenna measured at each frequency points by comparison method. Figure7 shows the measured antenna gain versus frequency. Average gain at different frequencies for Ultra wide bands are shown where as at 3.5GHz frequency band is approximately 1.5dBi.

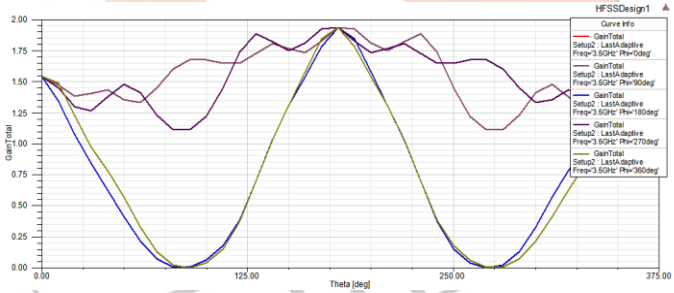

Figure 7. Peak gain of antenna at different frequencies

IV CONCLUSION

A study of construction and experimental verification of Rectangular Micro-strip Slotted Patch Antenna structure for the operation in the Ultra Wide bands is presented. Patch antennas being used in many applications like WLAN, GPS, WIMAX, HYPERLAN, and many other narrow band frequencies, which had applications only for one frequency band . Here we designed Slotted Patch antenna for Ultra Wide band which has applications in various fields. Designed patch has less return losses and large band width which are required for the applications designed. The Designed Antenna resonates at 3.2 Ghz to 10 Ghz with return loss of less than -16db all over the UWB band region .The Antenna has a Bandwidth of 6.6Ghz it's an Ultra Wide Band Antenna. As discussed this Antenna has Applications in WLAN and UWB ranges.

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