Design and Fabrication of Microstrip Antenna for UWB Applications

D.Punitharaj and S.Kalaimani

Abstract – In this paper, a new technique has been proposed for proving the performance of the micro strip antenna for enhancement of the bandwidth is obtained .the operating frequency proposed in this project is 3.1-10.6 GHz for UWB applications. The simulation is done by using HFSS software. The simulated results are compared using VSNA analyser. The simulated results in return loss, efficiency are compared with the ideal one. The main objective of the proposed work is to fabricate a micro strip antenna for ultra-wide band applications. The specifications of the designed antenna are 25 x 29 mm. It allows the frequency band of 3.1-10.6 GHz. The substrate used in this design is FR4.The thickness of the substrate is 1.6 mm. The efficiency of the antenna is increased by increasing the thickness. FR4 is mainly used because it has high amount of thickness compared to the other substrate. The main objective of the paper is to notch the narrow band applications which are interrupting in the ultra-wide band spectrum.

Index terms-Ultra wide band (UWB); micro strip patch antenna; radiation pattern; HFSS; VSNA analyser.

I INTRODUCTION

Ultra-Wideband (UWB) is a technology for transmitting information spread over a large bandwidth (>500 MHz)[1] that should, in theory and under the right circumstances, be able to share spectrum with other users. Regulatory settings of Federal Communications Commission (FCC) in United States are intended to provide an efficient use of scarce radio bandwidth while enabling both high data rate "personal area network" (PAN) wireless connectivity[2] and longer-range, low data rate applications as well as radar and imaging systems. Ultra Wideband was traditionally accepted as pulse radio[3], but the FCC and ITU-R now define UWB in terms of a transmission from an antenna for which the emitted signal bandwidth exceeds the lesser of 500 MHz or 20% of the centre frequency. Thus, pulse-based systems where in each transmitted pulse instantaneously occupies the UWB bandwidth, or an aggregation of at least 500 MHz worth of narrow band carriers, for example in orthogonal frequency-division multiplexing(OFDM)[4] fashion can gain access to the UWB spectrum under the rules. Pulse repetition rates may be either low or very high. Pulse-based UWB radars and imaging systems tend to use low repetition rates, typically in the range of 1 to 100 mega pulses per second. On the other hand, communications systems favour high repetition rates, typically in the range of 1 to 2 giga-pulses per second, thus enabling short-range gigabit-per-second communications systems [5].

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Each pulse in a pulse-based UWB system occupies the entire UWB bandwidth, thus reaping the benefits of relative immunity to multipath fading (but not to inter symbol interference) [6], unlike carrier-based systems that are subject to both deep fades and inter symbol interference. The UWB characteristics are very well suited to short distance applications.A representative case is for PC peripherals; see wireless USB (implemented on top of UWB).

The outline of this paper is Section I. Introduction, Section II. Description about the antenna geometry, Section III. Results obtained from the antenna, Section IV. Conclusion

II ANTENNA GEOMETRY

The proposed work is a compact printed micro strip-fed monopole ultra wide band antenna with triple notched bands is presented and analyzed in detail. A straight, open-ended quarter-wavelength slot is etched in the radiating patch to create the first notched band in 3.3–3.7 GHz for the Wi-MAX system. In addition, three semicircular half-wavelength slots are cut in the radiating patch to generate the second and third notched bands in 5.15–5.825 GHz for WLAN and 7.25–7.75 GHz for downlink of X -band satellite communication. Surface current distributions and transmission line models are used to analyze the effect of these slots. The antenna is successfully fabricated and measured, showing broadband matched impedance and good omnidirectional radiation pattern. The designed antenna has a compact size of 25 x 29 mm**.** There is an issue of a possible electromagnetic interference, as over the allocated wide bandwidth of the UWB system, some narrow bands for other communication systems exist, such as Wi-MAX operating in 3.3–3.7 GHz, WLAN operating in 5.15–5.825 GHz, and downlink of X –band satellite communication systems in 7.25–7.75 GHz.Three band stop filters connected to a UWB antenna can be used to reject these bands. However, this increases the complexity of the system. A simpler way to solve this problem is to design the UWB antenna with band-notched characteristics.UWB antennas with band-notched function have been reported, mostly with one notched band for WLAN in 5.15–5.825 GHz. Recently, several antennas with dual notched bands or triple notched bands were presented. In this letter, the detailed analysis and the operational principles of the embedded slots in getting the notched band function, both half-wavelength and quarter-wavelength types. A new term, an effective length of a slot, and use this concept along with the surface current distributions and transmission line models to analyze the physical effects of those slots.

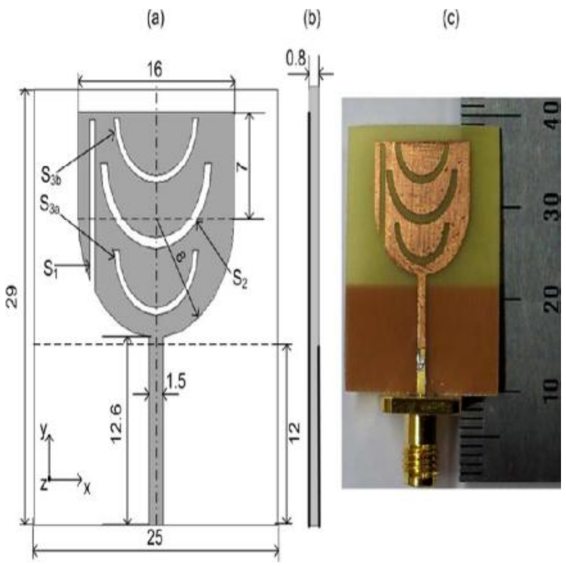

Fig 2.1 Dimensions of the antenna

III RESULTS AND DISCUSSIONS

In this research, a novel U-shaped antenna has been designed which provide an end fire radiation pattern when laid down in an array configuration. It has been observed that arrays consisting of 4 and eight elements produce an end fire radiation pattern when their current distribution is changed. The analysis procedure adopted for observing the change in radiation pattern is that initially the effect of change in current distribution on radiation pattern is analyzed for single U-shaped micro strip antenna. Afterwards, a two, four and eight element array have been designed, and the same analysis of change in radiation pattern with change in current distribution is observed. The critical aspect of designing an array is designing the array feeder. In the arrays designed, corporate feed networks with quarter wave transformers for impedance matching are used. SMA connector of 50Ω and FR-4 substrate is used. The extensive, rapid and explosive growth in wireless communication technology and communication systems is prompting the extensive use of low profile, low cost and easy to manufacture antennas. All these requirements are efficiently realized by micro strip antennas. Micro strip antennas grant RF engineers with innumerable advantages as compared to conventional antennas; such as small size, low profile, low cost, light weight, mechanically robust, easy integration in electronic and communication systems and bulk production

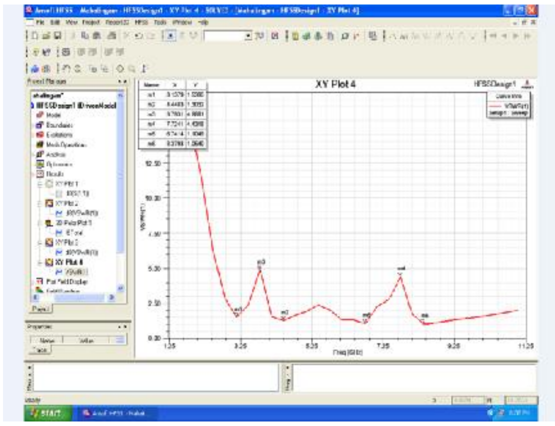

Fig 3.1 VSWR plot

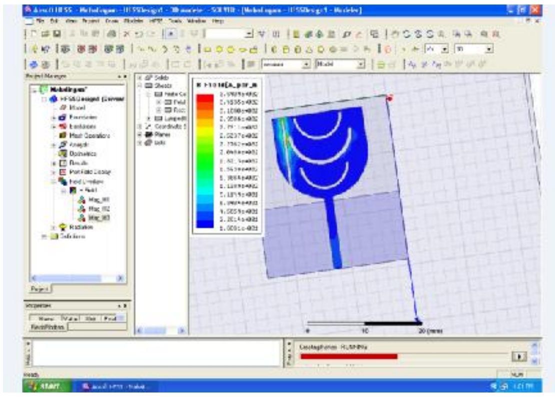

Fig 3.2 Current distribution at 3.5GHz

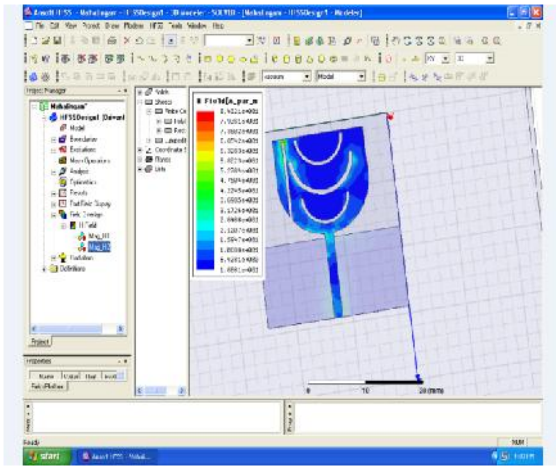

Fig 3.3 Current distribution at 4.5GHz

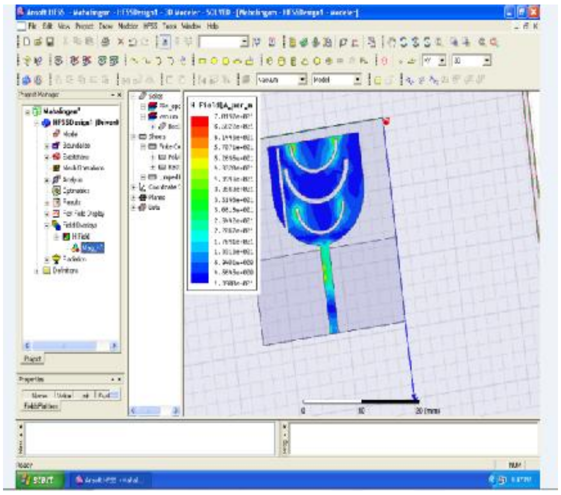

Fig 3.4 Current distribution at 7.5GHz

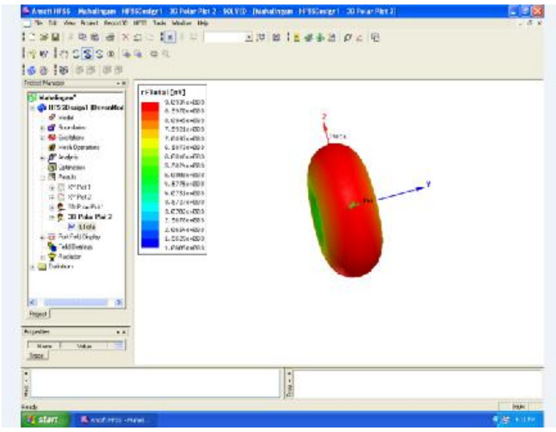

Fig 3.5 Radiation efficiency

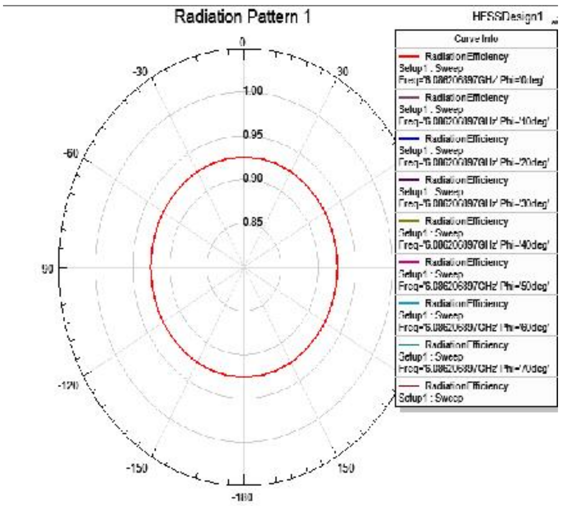

Fig 3.6 Radiation plot

IV CONCLUSION

The foremost objective of the proposed work is to design an antenna for UWB applications. The proposed antenna is designed to overcome the drawbacks of the existing antennas and to overcome the interference of narrow band in the ultra-wide band spectrum. The proposed antenna is used to notch the narrow band entering into the UWB. It can be used for short distance applications efficiently. The antenna has been highly reliable, good gain and has high percentage of accuracy. In this letter; a compact printed micro strip-fed triple band notched UWB antenna has been presented and analysed in detail. To obtain three notched bands, two types of slots a straight open-ended quarter-wavelength type and a semi-circular half wave length type were etched in the radiating patch. We introduced new term, an effective length of a slot, and used this concept along with the surface current distributions and transmission line models to analyse the physical effects of these slots generating the band-notched characteristics. The antenna was fabricated and measured, showing broad bandwidth, three designed notched bands, and good unidirectional radiation patterns. The substrate used in the proposed antenna is FR4.FR-4 (or FR4) is a grade designation assigned to glass-reinforced epoxy laminate sheets, tubes, rods and printed circuit boards (PCB). FR-4 is a composite material composed of woven fiber glass cloth with an epoxy resin binder that is flame resistant (self-extinguishing).

V FUTURE WORK

The proposed technique is designed mainly to overcome the interruption of narrow band in ultra-wide band spectrum. The proposed scheme is implemented using HFSS simulation software. The real time implementation of the project is majorly used in the short distances applications. The efficiency obtained from the proposed scheme is nearly 90%. The efficiency can be increased by changing the fractal cuts over the patch. By increasing the efficiency we can radiate the signal effectively.

VI REFERENCES

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