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Design of a printed compact UWB antenna

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ABSTRACT
In this paper, a low cost, low profile monopole CPW-fed UWB antenna has been proposed and successfully designed. The proposed antenna has a compact size, which is one of the smallest UWB antenna with a bandwidth of 133.3 % (3 GHz – 15 GHz) at -10dB criteria which has been proved suitable for broadband wireless communication systems.
Keywords–Ultra wideband antennas, Federal Communication Commission and coplanar waveguidefed antenna.

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I. INTRODUCTION

The broadband wireless communication has gained much importance after the early investigation of Ultra wideband (UWB) antennas. UWB wireless technology is being considered as the solution to overcome data rate bottlenecks in the wireless communications and applications. The high data transmission rate is achieved by UWB as it transmits data over a very large spectrum of frequencies from 3.1 GHz to 10.6 GHz (7.5 GHz) as allocated by the Federal Communication Commission (FCC) [1]. Therefore, considerable research efforts have been put into the design of UWB antennas for communication.

Several microstrip antennas for UWB applications have been discussed in literature like the bow tie antenna [2], annual ring [3] , circular disc [4], binomial curved antenna[5] , and double-element ring slot [6]. However, all these antennas have relatively large size and it becomes difficult to integrate with wireless system. Also, most of the antennas do not cover entire UWB frequency band [6, 7] . Although microstrip antennas have many advantages, it is limited by the inherent narrow bandwidth. Hence most of the antenna designers are focusing on various bandwidth enhancement techniques for improving the performance of the UWB system.

Over the past, several antenna designing techniques are available for widening the impedance bandwidth such as using slot [8-10], aperture coupling [11], use of tuning stubs[12, 13], stacking [14] and use of multi feed [15]. But most of these techniques make the antenna structure bulky. Other noted techniques include: use of asymmetrical feed structure[16] , a partial ground [17, 18] , and use of loop structure[19]. Also, it has been noted that the bandwidth performance of the coplanar waveguide (CPW) –fed antenna is better than microstripline fed antenna as CPW feeding has many attractive merits such as larger bandwidth, lesser dispersion,

minimum radiation loss and ease of integration with system circuits[19]. However, several reported CPW – fed antennas are large in size with complex geometry [20-22].

In this paper, we present a simple low cost CPW- fed Compact square shapedUWB monopole antenna is proposed and designed.. It has a very compact size of 26 × 38 mm² which makes it easy to be printed on printed circuit board (PCB) and the design is very simple and straightforward. The prototype is simulated using Ansoft HFSS.

II. UWB ANTENNA DESIGN

The mono-band rejected antenna are obtained from a planar printed CPW-Fed structure, for which we have optimized the design parameters to get the UWB behavior. Fig 3.1 illustrates the geometry of the modified square shapedUWB monopole antenna with small size of 26 × 38 mm². It is printed on FR4 substrate of permittivity εr= 4.4 and thickness h = 0.8 mm, and with the design parameters: Lp = 12.9mm, Wp = 12.9mm, Lf = 22mm,Wf = 1.779mm, gap g = 0.186mm, Lg=21.51mm, Wg=11.8295mm, α=35.6 deg.

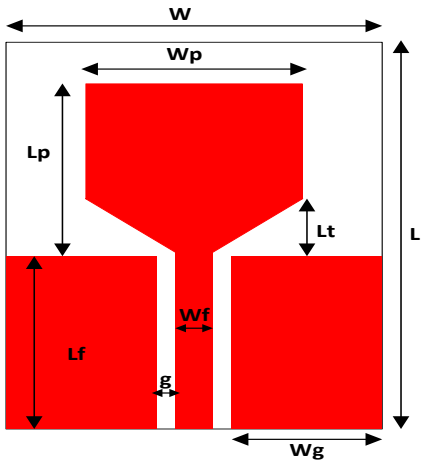

Figure 1: The geometry of the UWB monopole Antenna

In our proposed design, we make use of coplanar waveguide feed rather than microstrip feed line as it gives better bandwidth and minimum radiation loss. The CPW feed widens the bandwidth of the proposed antenna. The single metallic layer and the compact size of the antenna makes it easy to integrate with the system circuits. The designed dimensions of the proposed compact antenna are obtained using the commercially available simulation software Ansoft HFSS.

III. RESULTS AND DISCUSSIONS OF UWB ANTENNA

There are different ways of feeding the antenna structure, but among them most important and commonly used are CPW and microstrip feeding. Firstly, the proposed antenna is fed using CPW feed line. It gives a large bandwidth ranging from 3 to 15 GHz with better impedance matching. Figure 2 shows the return loss curves of the antenna when fed using CPW .

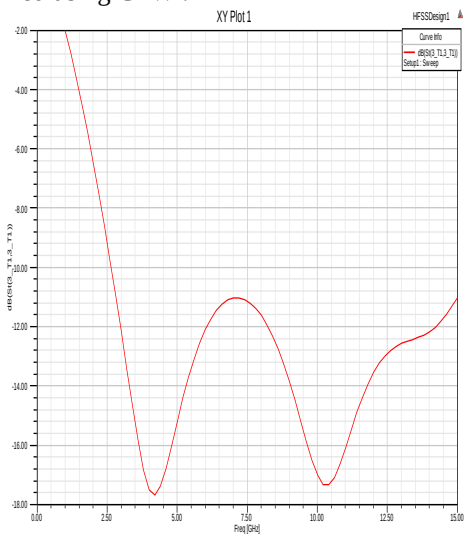

Figure 2: Return loss of the single UWB antenna

Based on several parametric studies, the UWB printed monopole was designed and realized as shown in Figure 1. Simulated values of the antenna return loss over the frequency band 3-15 GHz are given in Figure 2., The effective impedance bandwidth is 3 – 15 GHz for $|S11| < -10$ dB, covering almost the entire band set by the FCC for the UWB telecommunications.

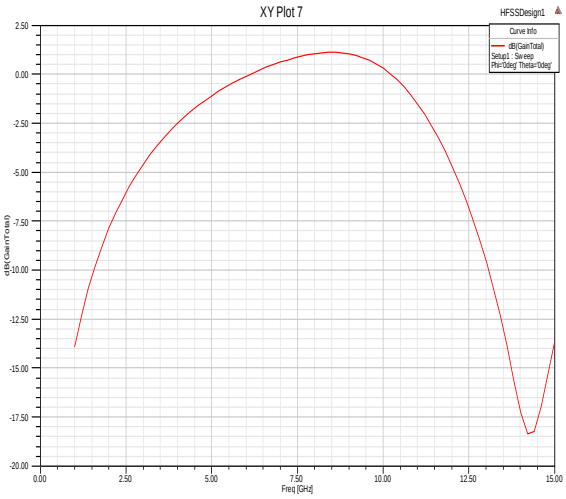

Figure 3: Gain versus Frequency

In Figure 3, the Gain versus frequency plot for the designed antenna is presented and it has a maximum peak gain of 3.1dBi.

IV. COMPARISON OF THE UWB ANTENNA WITH THE EXISTING ANTENNAS

In this section, the performance of the proposed work in terms of size of the antenna and impedance bandwidth is compared with other existing antennas in literature [23-25] as mentioned in Table 1. From the comparison, it can be concluded that the proposed antenna structure gives better performance of impedance bandwidth with relatively very small size and simple structure.

Ref. no.	Dimensions mm²	Impedance Bandwidth (-10dB criteria)
[23]	35.0 × 30.0	117%
[24]	23.0 × 25.5	124%
[25]	25.0 × 25.0	133%
Proposed UWB Antenna	26 × 38	133.3%

Table 1: Comparison of the UWB antenna with the existing antennas.

V. CONCLUSION

In this paper, The proposed antenna has a compact size of 26 × 38 mm² which is one of the smallest UWB antenna. The proposed antenna has gained a bandwidth of 133.3 % (3 GHz – 15 GHz) at -10dB criteria. It is simple with ease of fabrication and integration into system circuits. The antenna has stable radiation pattern over the entire operating bandwidth with a maximum peak gain of 3.1 dBi. The results have proved that the proposed antenna configuration is suitable for broadband wireless communication systems.

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