Measurement Analysis of Ultra-Wideband Monopole Antenna With Defected Ground Structure

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ABSTRACT

This article describes how a compact, low profile Ultra-wideband (UWB) monopole antenna with a defected ground structure is designed and demonstrated experimentally. The design and experimentation activities have been carried out with the help of a CST Microwave studio tool. The UWB characteristics of the proposed antenna are achieved with a modification of the ground structure of the referenced antenna with novel L shaped defected ground structure (DGS). Both antennas are fabricated on the same substrate with the dimensions of 28.3 x 24 mm². The comparative analysis of the results for both antennas clearly indicate that the proposed UWB monopole antenna enhanced the impedance bandwidth from 3.7 GHz – 14.9 GHz without DGS and to 3.4 GHz – 20 GHz with DGS. The enhanced bandwidth, constant group delay and good radiation characteristics of the proposed antenna have identified it as a good candidate for portable UWB applications.

KEYWORDS
Defected Ground Structure, Group Delay, Radiation Efficiency, Ultra-Wideband

1. INTRODUCTION

In recent times, wireless communication systems shift from low speed data transmission to high speed data transmission applications such as wireless LAN 802.15.3 (Rappaport et al. 2002) and 3G communication technologies (Dahlman et al., 2010). This includes many application domains, for instance: fast internet access, video telephony, enhanced video music download and digital voice services. To full fill the demand of higher data
rate according to Roy et al. (2004), it is desirable to increase the bandwidth allocation for specific application. Although, it cannot be extended without permission of radio frequency regulating bodies throughout worldwide. Thanks for Federal communication commission (FCC) (Porcino & Hirt, 2003) who make possible to free to access of UWB band 3.1 to 10.6 GHz for indoor, short range communication. FCC regulated the UWB unlicensed band in February 2002. UWB system is impulse based transmission system in which extremely short pulses (Kim & Joo, 2005) are used for data transmission over the entire frequency band, without modulation and without need of number of RF stages. Therefore, UWB technology became simple and cost effective in the terms of transmitters and receivers design.

UWB antenna (Schantz, 2004; Klemm & Troester, 2006; Alomainy et al. 2005), is a very essential component of the UWB communication systems and somehow their design techniques affect the overall performance of the communication systems. In the recent time UWB antenna design pay much attention and their performance characteristics, like impedance bandwidth, radiation pattern, directivity, gain, efficiency, and polarization are different from narrowband planer antenna. In this context the physical realization of UWB planer antenna is difficult compared to narrowband and therefore it become an active area of research.

In the case of the narrow band antenna design, antenna has stable impedance matching at a particular resonate frequency, while the UWB antenna has stable impedance matching over the entire 3.1 -10.6 GHz band. The frequency independent techniques (Rumsey, 1966) are better choices for UWB antenna design. Antenna radiation pattern is also come into design consideration, antenna is either directional or Omni-directional, but this is completely application based decision. For mobile and hand held portable devices, they need to be operate with Omni-directional pattern whereas for some application like radar system directional patterns are normally desirable. Radiation efficiency also considered in both cases of narrow band and Ultra-wideband along with the radiation pattern, but radiation efficiency has great significance for the UWB antenna because it’s radiate at low power level with low power emission of -41.3 dBm/MHz. Therefore, it is necessary less amount of power should be lost inside the port of antenna to make it more efficient.

Although we always think for small size, low profile, easy to fabricate and low-cost antenna but UWB applications like wearable devices, mobile and portable devices include especially. Therefore, it is highly desirable that the UWB antenna should be small, low profile and easily mounted in a small integrated wireless equipment without degrade its performance characteristics.

An antenna in UWB system can be treating as a filter (Corral, 2002) by means of magnitude and phase responses. In filter analysis amplitude and phase both are experience their distortion, depending on the characteristics of the filter. In case of UWB-Impulse transmission system, information is time modulated (TM) and these
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