Design of CMOS Power Amplifier with Resistive Feedback and Notch Filter for UWB Systems

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***Abstract*—A CMOS power amplifier (PA) with the implementation of the notch filter designed for ultra-wideband (UWB) systems is presented in this paper. The design is consisted of two stages of amplifier involving source follower and common source topologies with a notch filter and an output matching network. Such design is meant for full band UWB applications that utilize the frequency range within 3.1 GHz to 10.6 GHz with the elimination at 5-6 GHz using 0.18 µm CMOS process. The simulation shows that the proposed PA design achieved 19.25 dB maximum gain with 1.8 V power supply. In this work, the achieved input and output return loss ranging from -8.13 dB to -19.19 dB, and -1.68 dB to -16.03 dB, respectively, through full band frequency.**

***Index Terms*—Notch Filter; Power Amplifier (PA); Radio Frequency (RF); Ultra-wideband (UWB)**

I. INTRODUCTION

Ultra-wideband (UWB) is commonly used in wireless communications, with most of its applications are utilized in advanced radar and imaging systems. As stated by the Federal Communication Commission (FCC), the UWB is defined as a signal within 3.1 GHz to 10.6 GHz with a bandwidth of more than 500 Mhz or a fractional bandwidth that is larger than 20% of the operating bandwidth. In UWB transmissions, there are two technologies that have been introduced, which are direct-sequence ultra-wideband (DS-UWB) and multi-band orthogonal frequency division multiplexing (MB-OFDM), as shown in Figure 1. For DS-UWB, the signal travels in a series of impulses that will cause the spectrum to be in very wide bandwidth. On the other hand, the MB-OFDM uses a wideband or multiband signal operating at 500 MHz bandwidth. The signal then bounces in frequency to achieve high bandwidth. The DS-UWB is usually used in high data rate transmissions such as for short-range transmission while MB-OFDM is used in wireless communications.

Even though the UWB frequency range lies within 3.1 to 10.6 GHz, there are other bands at frequency of 5 GHz to 6 GHz, reserved for HiperLAN and UNII communication systems. The existence of these networks might cause interference to UWB signals. To overcome this problem, the amplifier used in UWB application must be equipped with a filter to eliminate these frequencies.

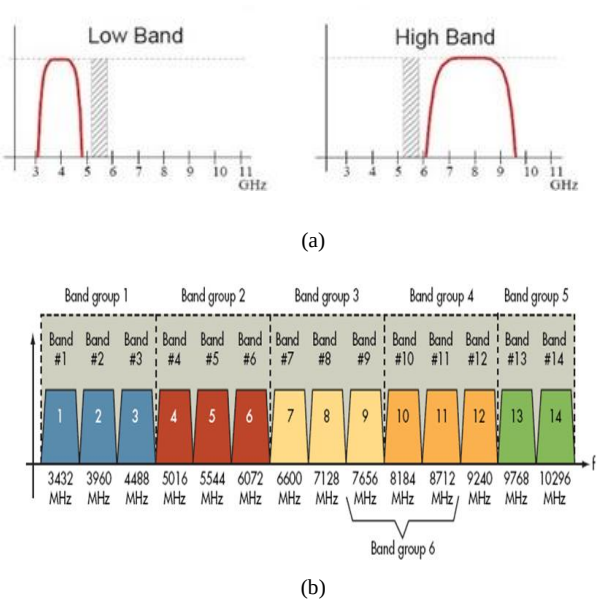

Figure 1: Spectrum allocated for UWB communication; (a) DS-UWB, (b) MB-OFDM.

There are various researches have been done in power amplifier designed for UWB applications available in the literature. Different topologies were used according to UWB applications which depends on the operating frequency. Each topology will produce different result of PA's parameters. In [1], all designs for UWB PA have been reviewed. The most popular topology for PA UWB is current reuse topology [2]-[6], because of its ability to improve gain flatness and achieve low power. However, none of the design is able to perform in a full band UWB operation. For full band applications, the commonly used topologies are distributed amplifier, resistive shunt feedback and stagger tuning. Distributed amplifier [7]-[8] and stagger tuning [9]-[10] topologies achieve a good gain and wideband matching but have a major drawback in which they consume high power. In UWB systems, it is very important for power amplifier to operate at a very low voltage and consume low power because to achieve an energy-efficient communication.

Up to date, there is no existing power amplifier design that includes a filter to eliminate a certain range of frequency. Therefore, this paper focuses on designing a power amplifier with high gain, better stability and low voltage with the implementation of the notch filter to eliminate 5-6 GHz.