A PPM Higher Order Derivative Gaussian Pulse Transmitter for Ultra-Wideband Communication

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This paper presents a novel new higher order derivative Gaussian pulse transmitter incorporating a pulse position modulator (PPM) for use in an impulse radio ultra-wideband (IR-UWB) system. A fully integrated PPM pulse transmitter is designed using the TSMC 0.18um CMOS technology. Recently, the Gaussian monocycle pulses or the Scholtz's pulses have been adopted for the IR-UWB applications. However, those pulses need filtering in order to satisfy the FCC spectrum mask regulation. Higher order Gaussian pulses, with picoseconds duration, have been found to meet the requirements of the FCC spectrum mask regulation without degrading the system performance. Our proposed single chip UWB transmitter can produce the effective higher order pulse shape whose spectrum is occupied under FCC limitation floor, and this pulse can be transmitted without any extra filtering. Our proposed pulse transmitter has two main function blocks: a PPM modulator and a pulse generator. The modulator consists of delay elements and a 4 to1 multiplexer. The time shifted pulse is then selected according to two bits control data by using the 4 to 1 multiplexer. In the input stage, the oscillator has a 2V and pulse repetition frequency of 100MHz (up to 500MHz) sinusoidal wave. The PPM modulator's output signal drives the pulse generator. Then the signal passing through a simple RC differentiator will produce an approximate Gaussian pulse at rising edge of the square wave. In order to shrink the pulse from nanosecond to picosecond level duration, several inverters are adopted to perform the function of pulse shaping. We employ a PMOS transistor as a common-gate amplifier acting as a differentiator. Then the monocycle pulse can be obtained by taking the derivative of the previous Gaussian pulse. Finally we utilize the third-order RLC differentiator to differentiate the impulse to become a higher order Gaussian pulse in the output stage. The output waveform indeed complies with FCC indoor mask without any filtering and has a bandwidth from 3.1GHz to 10.6GHz. Our proposed pulse transmitter has many advantages such as symmetry, low ringing, and meets with FCC regulation. Moreover all circuits have to be implemented on a single chip for low cost, low power, and system integration with the TSMC 0.18um process. The detail simulation and measurements results will be presented in this talk.