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A linear Ultra Wide Band Low Noise Amplifier using Pre-distortion Technique

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Abstract This paper presents an Ultra Wide-Band high linear low noise amplifier. The linearity of Common Gate structure is improved based on pre-distortion technique. An auxiliary transistor is used at the input to sink the nonlinear terms of source current, resulting linearity improvement. Furthermore, an inductor is used in the gate of the main amplifying transistor, which efficiently improves gain, input matching and noise performance at higher frequencies. Detailed mathematical analysis show the effectiveness of both linearity improvement and bandwidth extension techniques. Post-layout simulation results of the proposed LNA in TSMC 0.18 µm RF-CMOS show a gain of 13.7dB with –3 dB bandwidth of 0.8-10.4 GHz and minimum noise figure (NF) of 3 dB. Third Input Intercept Point (IIP3) of 10.3-13 dBm is achieved which shows 8 dB improvement compared to conventional common gate structure. The core circuit occupies an area of 0.19 mm^2 including bond pads, while consuming 4 mA from a 1.8-V supply.

Keywords Ultra Wide-Band (UWB); Low Noise Amplifier (LNA); Linearity; Pre-distortion; Bandwidth extension.

1 Introduction

During the last few years, growing demand for high data rate wireless connections and high accuracy locating ability, increases the use of Ultra Wide Band (UWB) transceivers. Low Noise Amplifier (LNA) is a critical and challenging building block of an UWB receiver, since it must provide several requirements such as good input matching and low Noise Figure (NF) over a multi-GHz bandwidth (BW) while consuming little power and die area [1]. Moreover, achieving a flat gain over the whole frequency band of UWB standard, along with low power consumption is a big design challenge. Although CMOS technology is a good choice for system-on- chip solutions, its parasitic degrades the performance of broadband amplifiers and motivates to introduce bandwidth extension techniques [2].

Attaining high linearity over the whole frequency band is another big design challenge for UWB LNAs, as in UWB transceivers hundreds of in-band interferers and intermodulations (IMs) produced by blockers or transmitter leakage enter the receiver without any pre-filtering [3]. A wideband receiver may suffer from second-order intermodulation generated by interferers that have a sum or difference frequency equal to the wanted RF-input signal. Therefore, In broadband applications, both input second-order intercept point (IIP2) and input third-order intercept point (IIP3) are important in order to handle strong interferers like WLAN (IEEE 802.11a/b/g) and GSM standards. On the other hand, linearity performance deteriorates with technology scaling due to high field mobility effect and supply voltage reduction [4]. Thus, ultra wideband linearization in deep sub-micron CMOS process is more challenging and traditional narrowband linearity improvement techniques [5] aren't effective