2012 International Conference on Solid-State and Integrated Circuit (ICSIC 2012)
IPCSIT vol. 32 (2012) © (2012) IACSIT Press, Singapore

A 1.5-V Wideband, Noise-Cancelling LNA in 0.13um CMOS

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Abstract: The first step to implement the software radio is to achieve a linear, wide-band low noise amplifier (LNA). A noise-cancelling wideband LNA in 0.13um CMOS technology is presented in this paper. The LNA consists of a common gate input stage with the broadband input matching network design, and a following common source auxiliary stage for the noise and distortion cancellation. The LNA can achieve a 600MHz-6GHz bandwidth, a nominal gain of 17dB, a minimum noise figure of 2.3dB, a maximum IIP3 of 4dBm using a 130nm RF CMOS process, and consumes 12mW from a 1.5-V supply.

Keywords: noise-cancelling, low-noise amplifier, broadband match, radio frequency integrated circuit.

1. Introduction

Multi-band wireless communication system has been investigated. The software radio [1], a programmable device that severs multiple bands and modes, can cover all major commercial communication bands up to 6GHz. As a result, the RF front-end should cover every communication standard, including providing relatively uniform gain and an input impedance close to 50-Ohm within that frequency range, while handing the full dynamic range of the wideband spectrum incident on the antenna, without significant distortion or noise corrupting desired signals. The first step towards a multi-band front-end is a linear, wide-band low noise amplifier (LNA).

Design of a tuneable or wideband front-end amplifier has many benefits compared to parallel narrowband receiving paths. It can provide better reconfigurations as well as greater area and power efficiency. The distribution approach [2] and resistive feedback method [3][4], transformer-based feedback[5], active feedback[6], and multiple parallel feedback loops [7], have been used to design conventional wideband amplifiers. However, the distributed approach often suffers from high power consumption and low gain, while noise figure of resistive feedback is usually not good enough.

The use of wideband filtering and matching networks [8][9] is a good way to match the input impedance of the inductively degenerated LNA across a wide band. Also, in recently years, a noise-cancelling technique has become a promising technique in realizing wideband LNAs [10][11][12][13][15]. Another benefit of Noise-cancelling LNAs is that in principle it can achieve high linearity because the amplifier topology is capable of cancelling the distortion due to the matching element.

In this paper, a noise-cancelling wideband LNA is designed with a low-Q resonant input-matching network to provide high gain (17 dB), low noise figure (~3dB) and good input impedance match(S11<-10dB) over a wide frequency range (600M~6GHz) in 0.13um CMOS technology.

2. Noise Cancelling LNA

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