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Triple-Band CMOS Low Noise Amplifier Design Utilizing Transformers

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This paper describes multi-band low noise amplifiers (LNAs) utilizing input matching transformers. We investigate a conventional dual-band LNA circuit utilizing a transformer [1)] , and show its analysis and simulation results. Based on these, we propose a triple band LNA with transformers. We have calculated characteristics of the propsed triple-band LNAs As the results, the LNA shows gain of 20dB maintaining good input matching, in the frequencies at 2.59GHz, 3.50GHz and 5.41 GHz. Then we discuss configuration and coupling coefficients of the transformers, as well as their layout [2)] .

A low noise amplifier (LNA) is used at the front-end of a receiver to amplify a received weak signal with high linearity and noise addition as small as possible[3)]. Recently, the wireless receiver is required to be compatible with several wireless standards, such as Bluetooth, WLAN and WiMAX. As each wireless standard has a different frequency band, one receiver is required to handle multi-band signals. In most cases, multiple LNAs are laid in parallel to realize multi-band receiving ability, however, this method has disadvantages of high power consumption and large chip area. In order to solve these problems, we propose a triple band LNA which integrates multiple bands receiving ability in one LNA, and reduces power consumption and chip area. We have verified the proposed circuit with circuit analysis and Spectre simulations using TSMC 90nm CMOS RF model parameters.

We show our proposed triple-band LNA circuit in Fig.1. This triple-baand LNA has three operation modes and V_{sw1} & V_{sw2} determine its operation mode. Fig.2 represent simulation results of the triple-band LNA. We see in Fig. 2 that impedance matching is obtained at three frequencies, and enough gains are obtained at the matched frequencies by utilizing corresponding load.

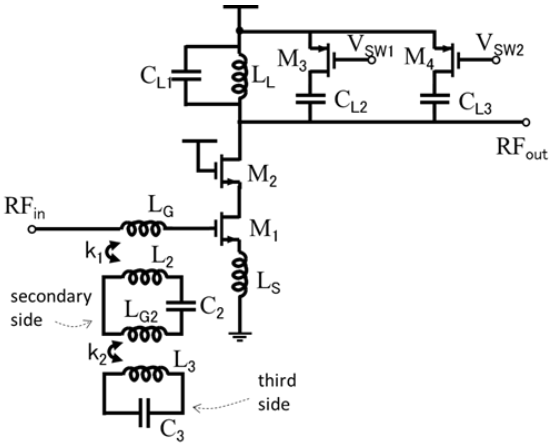

Fig. 1 Proposed triple-band LNA circuit.

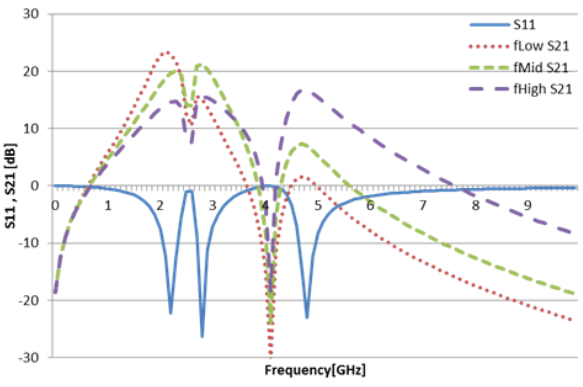

Fig. 2 Simulation results of the proposed triple-band LNA circuit.

[1] Nathan M. Neihart, Jeremy Brown, Xiaohua Yu : "A Dual-Band 2.45/6 GHz CMOS LNA Utilizing a Dual-Resonant Transformer-Based Matching Network," IEEE, Circuits And Systems I, vol.59, no.8, pp1743-1751 (August 2012).
[2] Hideo Yamamura : *Toroidal Core Utilization Encyclopedia*, CQ Publisher, p118-126 (2007).
[3] Kunihiro Asada, Akira Matuzawa : *Analog RF CMOS Integrated-Circuit Design Beyond the Basics* , Baifukan, p166-174 (Feb. 2011)