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A Low Power 2.4 GHz Low Noise Amplifier Bypass Switch With Current Reuse Technique

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Abstract :- Low Noise Amplifier (LNA) is an electronic amplifier used to amplify possibly very weak signals. An LNA is a key component which is placed at the front end of the radio receiver circuit.The growing demand for low cost and low power CMOS radio frequency(RF) transceivers in the application of wireless body sensor networks and RF identification encourages research on low power and ultra low power RF circuit design technique such as current reusing. In this paper a low power 2.4GHz low noise amplifier bypass switch is proposed to reduce power consumption and linearity.This is single ended input and differential output low noise amplifier used inWLAN RF front end.

Keywords :- Complementary metal- oxide semiconductor(CMOS), current reusing, low power consumption, radio frequeny front end(RF), receiver

I. INTRODUCTION

Low noise amplifiers (LNAs) play a key role in radio receiver performance. The success of a receiver's design is measured inmultiple dimensions: receiver sensitivity, selectivity, and proclivity to reception errors. The RF design engineer works to optimize receiver front−end performance with a special focus on the first active device.All receivers require an LNA with sufficient sensitivity to discern the residual signal from the surrounding noise and interference in order to reliably extract the embedded information. Five characteristics of LNA design are under the designer's control and directly affect receiver sensitivity: noise figure, gain, bandwidth, linearity, and dynamic range. Controlling these characteristics, however, requires an understanding of the active device, impedance matching, and details of fabrication and assembly to create an amplifier that achieves optimal performance with the fewest trade−offs.

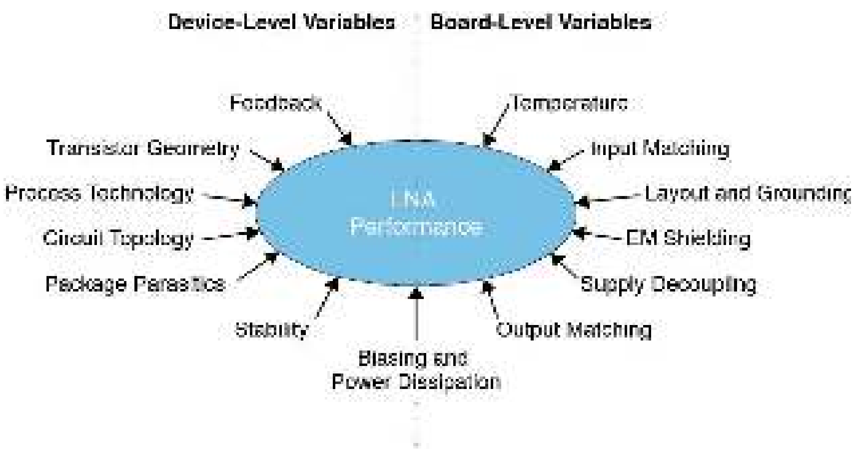

Fig. 1 LNA performance variables

Figure shows the set of variables that affect LNA performance at the device and board design levels. It is up to the designer to mitigate the impact of environmental variables, while finding the most appropriate trade−off between competing characteristics to optimize receiver sensitivity and selectivity, and maintaining information integrity.

II. RELATED WORK

Chao Chen, Jianhui Wu designs a 2.4-GHz current-reused receiver front end is presented in this brief. Instead of using the traditional stack-on current-reusing scheme that compresses the voltage headroom, the proposed front end employs a lateral current-shunt branch to share most of the dc bias current of the transconductance transistors in an LNA and a mixer.

To prevent the signal interaction between the two modules, an *LC* tank is inserted into the current-reusing path to cut off the radio-frequency signal path between the LNA and the mixer.[1]

Meng-Ting Hsu, Jhih-Huei Du designs of a low power LNA with second stage that uses a notch filter for DS-UWB application. The LNA employs a current reuse structure to reduce the power consumption and an active second order notch filter to produce band rejection in the 5 - 6 GHz frequency band.[2]

Wang Chunhua. and Wan Qiuzhen designs a two-stage broadband LNA for ultrawideband applications in 0.18 _m RFCMOS technology is proposed. In the proposed ultra-wideband LNA, a resistive current reuse and dual inductive degeneration techniques are adopted in the first stage for broadband simultaneous noise and input impedance matching. Meanwhile, an inductive peaking technique is adopted in the second stage for bandwidth enhancement.

With these techniques, the ultra-wideband LNA demonstrates an excellent noise performance as low as 2.8–4.7 dB in the required band with a maximum power gain of 15.6dB while consuming only 14.1 mW under a supply voltage of 1.5V.[3]

Jelena Radić1, Alena Djugova designs a 2.4 GHz low noise amplifier (LNA) with a bias current reuse technique is proposed in this work. To obtain the optimum noise figure (*NF*) value, dependence of *NF* on its most influential LNA parameters has been analysed. Taking into account the LNA design requirements for other figures of merit, values of the circuit parameters are given for the optimum noise figure.[4]

Pou-Tou Sun, Shry-Sann Liao, a 3.1 to 10.6 GHz ultra-dwideband (UWB) low noise amplifier (LNA) using a current-reused technique and wideband input matching network is proposed. The implemented LNA presents a maximum power gain of 12.8 dB, and a good input matching in the required band.

An excellent noise figure (NF) of 2.97 to 6.04 dB was obtained in the frequency range of 3.1 to 10.6 GHz with a power dissipation of 10.13mW under a 1.8-V DC power supply. The finished chip size is 1.26 * 1.05mm2. The proposed UWB LNA is implemented by TSMC 0:18 µm CMOS technology.[5]

In this paper a low power 2.4 GHz Low-noise amplifier bypass switch is proposed to reduce the power consumption and improving linearity. This is single ended input and differential output low noise amplifier used in WLAN RF front end.

III. DESIGN

3.1 Block Diagram:

The system basically consists of input matching network, bias network, Differential amplifier and Balun.

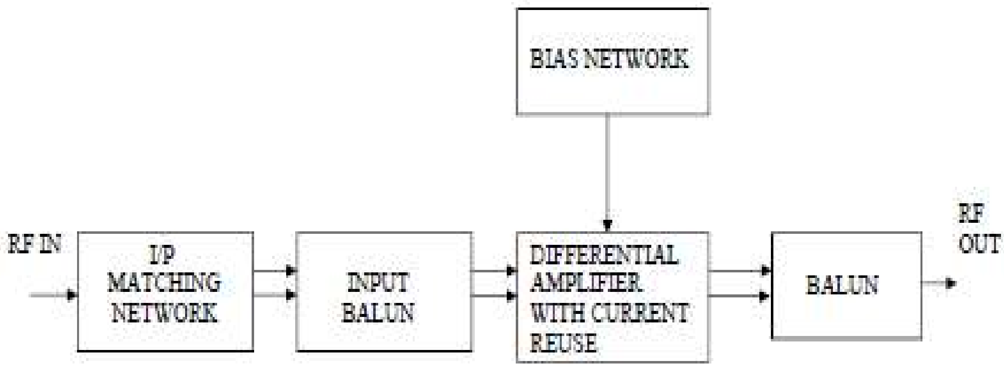

Fig 1. Block Diagram

I/P MATCHING NETWORK:

There are several important considerations when approaching the task of input matching. Noise figure degradation can be mitigated by limiting the number of elements between the antenna and LNA input. A high−Q input matching network provides an optimal noise figure and gain performance because of the minimal loss, but these networks are often quite sensitive to variations in process, voltage, temperature, and component value.

BALUN:

A Balun is an electrical device that converts between a balanced signal (two signals working against each other where ground is irrelevant) and an unbalanced signal (a single signal working against ground or pseudo-ground). A balun can take many forms and may include devices that also transform impedances but need not do so. Transformer baluns can also be used to connect lines of differing impedance. The origin of the word balun is “balanced to unbalanced”.

Baluns can take many forms and their presence is not always obvious. Sometimes, in the case of transformer baluns, they use magnetic coupling but need not do so. Common-mode chokes are also used as baluns and work by eliminating, rather than ignoring, common mode signals.

DIFFERENTIAL AMPLIFIER:

A differential amplifier is a type of electronic amplifier that amplifies the difference between two voltages but does not amplify the particular voltages.

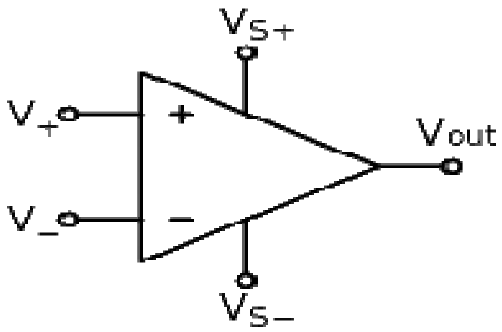

Fig 2:- Differential Amplifier

Many electronic devices use differential amplifiers internally. The output of an ideal differential amplifier is given by:

$$V_{\mathrm{out}} = A_{\mathrm{d}}(V_{\mathrm{in}}^{+} - V_{\mathrm{in}}^{-}) \quad (1)$$

Where V_{in}^{+} and V_{in}^{-} are the input voltages and A_{d} is the differential gain.

BIASING NETWORKS:

RF and microwave bias networks are used in a wide variety of biasing applications for test and measurement requirements in laboratory and production environments. Bias networks provide the means of supplying DC bias to the center conductor of the coax connector for your device while blocking the DC to the RF ports.

IV. CONCLUSION

This brief has presented a 2.4-GHz current-reused LNA. In the proposed structure, the dc of the transconductance stage of the LNA are reused without using the traditional stack-on current-reusing scheme.
The power consumption of the LNA is dramatically reduced while maintaining decent performance. The LNA measurement at 2.4 GHz exhibits the minimum noise figure of 2.76 dB, maximum gain of 15.63 dB, input return loss is < -10 dB at 2.4 GHz and output return loss is < -9:3 dB at 2.4 GHz with the stability factor of 1.709.

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