



DESIGN OF LOW POWER AND LOW NOISE FIGURE GILBERT MIXER

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ABSTRACT: This paper presents a low power mixer for an RF Receiver front end, which is designed and simulated in 0.18 μ m CMOS technology. Using CMOS process, low power and high integrated RF front end circuits can be designed for high frequency operation. Mixer plays a vital role in the transceiver design for converting LF to RF in transmitter section and RF to IF in receiver section. High gain, low power, better linearity and low noise figure are the designing challenges of mixer. In this paper in order to achieve low output noise and low noise figure current reuse technique are used in Gilbert double balanced mixer. The obtained consumes low power of 0.2W. It also achieve low noise figure of 3dB.

Keywords: Gilbert mixer ,resistive feedback, source degeneration, current reuse.

I. INTRODUCTION

Mixers are crucial parts of any typical front end circuit. The CMOS process, lowers the production cost and allow high level integration [1]. The explosive growth in the wireless communications market, over the past ten years, has led to consumer demand for low-cost, high data rate communications and low-power transceivers [2,3].

Mixer follows LNA should have high linearity and low noise. The gain of the mixer has to be increased suppress the high noise level of the following IF and base band sections [4]. Conversion process in time domain is performed by multiplying the RF signal by a signal named Local (LO). Nonlinearity effect of the mixer is necessary for this frequency translation in order to produce sum and difference frequencies. applications, in the present Nowadays, with the development of the wireless communication technology devices, demand for the wireless service has been constantly increasing. Therefore, 2.4GHz is the frequency band which is set free for the industrial, scientific and medical applications. Due to the importance of these study the RF signal is selected to be in this frequency [5]. Gilbert single balanced mixer have advantages like Differential output gives higher gain and more immunity for RF to IF feed-through but it also have disadvantages like High LO to IF feed-through, Large power consumption compared to previous topology, noise figure increases. So these disadvantages we will remove by using double balanced Gilbert mixer.

It having advantages like higher port isolation among RF, LO &IF and Gives higher conversion gain and disadvantages like large power consumption, large noise figure[1,8]. So this disadvantages we will suppress by using current reuse and current bleeding techniques. Among many proposed mixer active mixers, the Gilbert mixer has been widely used so far, and the double balanced mixer topology has been preferred since it suppress leakage signals at outputs [6]. In RF receiver front end, the low noise amplifier and the down conversion mixer are considered the most important building blocks. Typically, these circuits suffer from significant degradation in the RF properties, especially for gain, noise figure and linearity as the transistor operate in weak inversion. To overcome the limitations on the supply voltage and the transistor overdrive, a complementary current reused topology has been proposed for the RF front end circuits[7]. In the RF transceivers, mixer, which is a nonlinear circuit, is used to perform an important frequency translation from them Radio Frequency (RF) to an Intermediate Frequency (IF) called “down-convert” for the receivers, or from IF to RF called “up-convert” for the transmitters [8]. The key component of any receiver chain is the mixer, coming off the antenna. The block diagram of an RF receiver front end is shown in fig 1 [9].

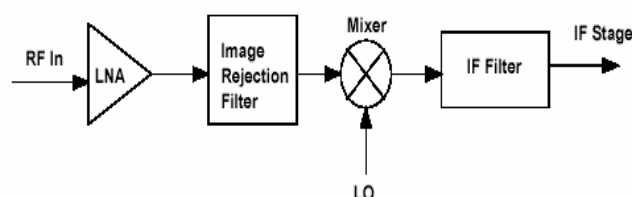


Fig 1 RF receiver front end^[4]



II. IMPLEMENTATION

Proposed mixer with Current reuse technique

A double-balanced Gilbert mixer, comprises a transconductance stage, an LO switch stage, and an output load stage. The RF input signal is amplified in the transconductance stage, down-converted to an IF current signal in the LO switch stage, and then converted to a voltage signal by the output load stage. The dominant noise source of the DCR mixer is flicker noise of the LO switch stage because the IF signal is located at close to dc frequency, which is below the corner frequency of the noise.

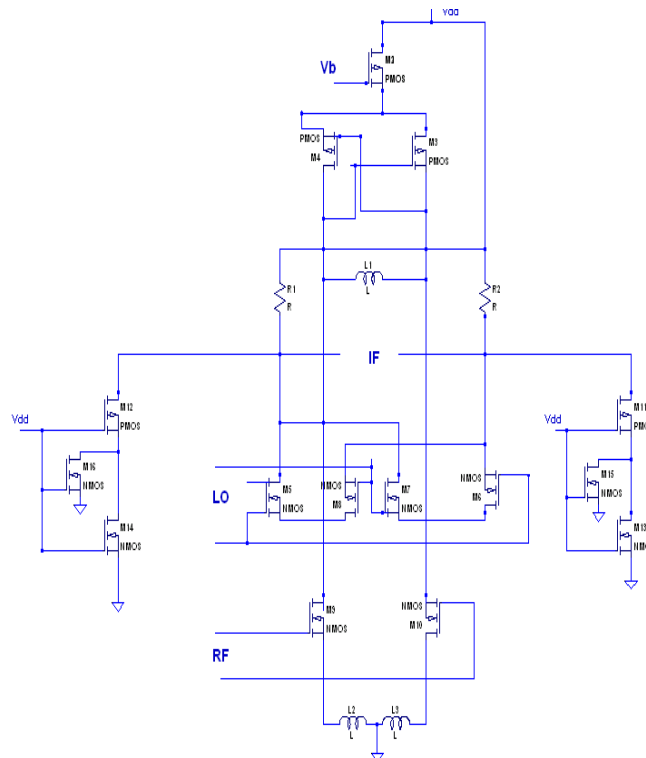


Fig2 Gilbert mixer with current reuse technique

The flicker noise contribution of the conventional Gilbert mixer is reduced by the pMOS switch circuits. The proposed circuit is modified by introducing the current re-use technique in that. The fig 2 shows the modified architecture. In this circuit, current reuse technique is applied in the output stage, to reduce the power consumption. Current reuse technique we applied because to provide same bias current in the circuit. The power consumed by the proposed circuit is 2W, where as the modified circuit with current re-use technique is 0.2W.

III SIMULATION RESULTS

Gilbert mixer with and without current reuse technique

A. Power analysis:

Figure 4 shows the proposed mixer with and without current reuse technique. In this dark line shows the proposed mixer without current reuse technique that power

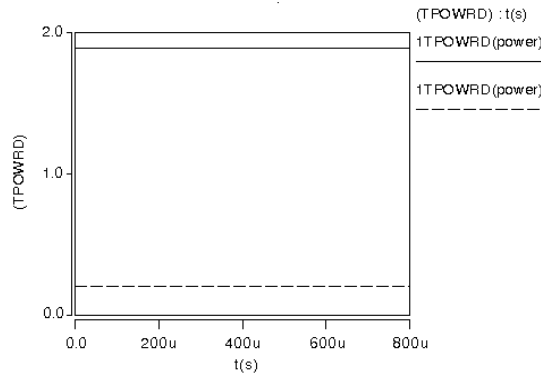


Fig 4 power of Gilbert mixer with and without current reuse technique

is 2 W. And dotted line shows the proposed mixer with current reuse technique that power is 0.2W. So by applying current reuse technique we can see that power reduction is more in the case of proposed mixer with current reuse technique.

B.Noise figure analysis:

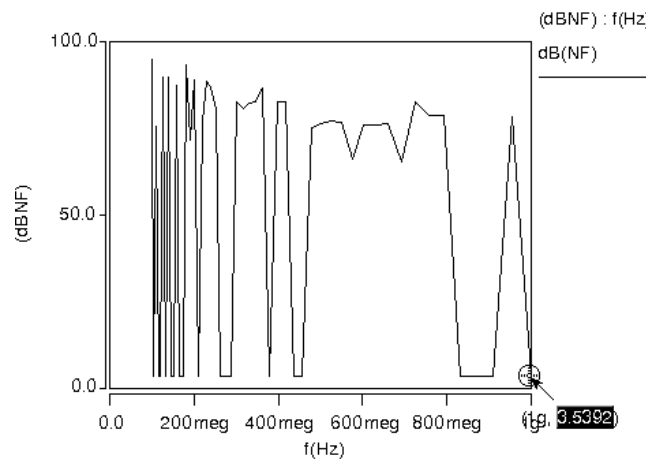


Fig 5 Noise figure of Gilbert mixer with and without current reuse technique

Gilbert mixer also obtain noise figure 3.5392dB as shown in the Noise figure analysis.

IV CONCLUSION

A new circuit to improve power and noise figure of a Gilbert mixer has been proposed. This paper presents a low power and low noise figure in comparison to base paper designed at 1GHz. Proposed mixer with different technique are proposed in this paper, the simulation is done in HSPICERF 0.18um CMOS technology. Current re-use technique is applied to the proposed circuit to obtain low power consumption and low noise figure and the proposed work is compared with the already published works.

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Thank God and His almighty power to finish His research work by using me, my project guide for His ultimate work.

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BIOGRAPHY



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