CHAPTER 1

INTRODUCTION

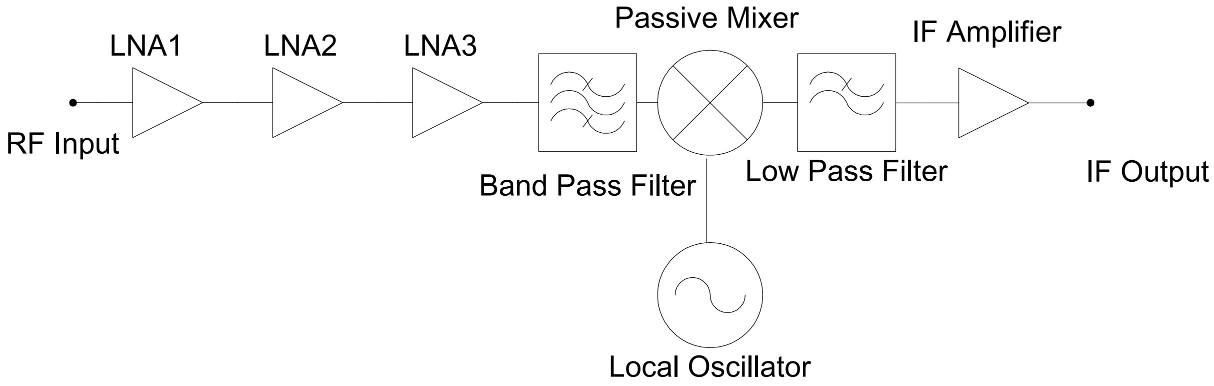

Figure 1.1 3-Stage LNA satellite downlink front-end system block diagram

The structure of modern satellite downlink front-end system could be best described by using the block diagram as shown in Figure 1.1. Suppose that for each stage in the block diagram the impedance were conjugate matched, then a typical cascaded conversion gain and noise figure linking budget of a satellite downlink front-end system could be calculated and estimated. The downlink front-end as shown in Figure 1.1 could be divided into seven stages as: RF LNAs (3 stages), image-rejection filters, passive mixers, low pass filters and amplifiers for intermediate (IF) frequency bands. The overall conversion gain of a downlink front-end system is 50 to 60dB, and the noise figure is about 0.5 to 1dB.

Another approach that could be used to reduce the total stages of the front-end, as shown in Figure 1.2, was also widely adopted for use today. This approach could be divided into six stages that include RF LNA (2 stages), Image rejection filter, Active mixer, IF Low Pass filter and IF Amplifier. This approach has an advantage in that it provides higher conversion gain, better stability, smaller size and lower cost while the noise figure would get degraded due to the reduced gain in the RF stage.

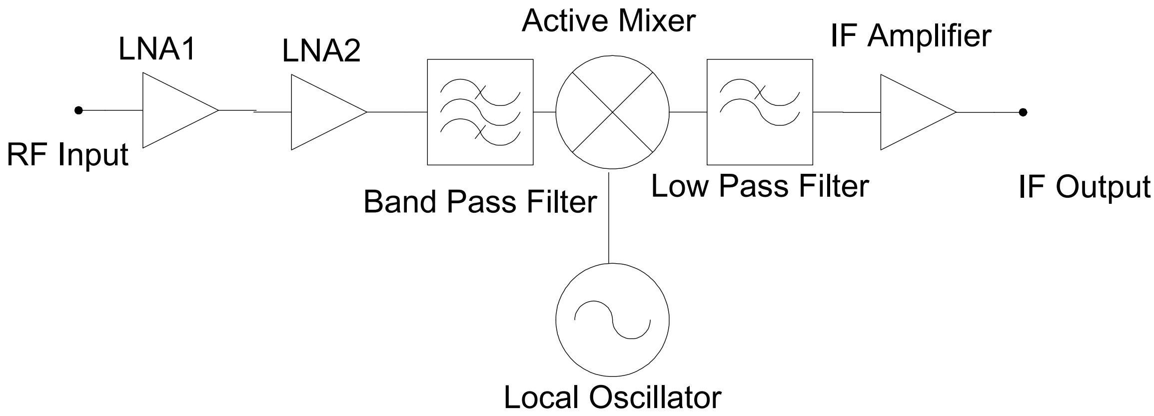

Figure 1.2 2-Stage LNA satellite downlink front-end system block diagram

For this approach; we need a mixer that could provide low noise figure, high conversion gain and low input return loss as well as low cost and small size.

As we known that:

---for low cost → discrete component should be used.

---for high conversion gain→ Active mixer should be used.[8][5][7]

---for low noise figure→Gate bias-Drain drive Active Mixer should be used.[8],

---for low input return loss → Balance mixer should be used[6], but a “hybrid” should be used to separate RF input signals and would lead to an increase of 3dB loss, which would increases the noise figure by 3dB as well.

So, in this thesis, we proposed a new type of “Active balanced switching mixer” and adopted ”switching method” to improve the RF input return loss of an active mixer. The concept of this novel mixer type could be diagramed as shown in Figure 1.3. The design trend of low noise figure, low input return loss, high conversion gain, low cost and small size could be fully attained by using non-hybrid active balance switching mixers.

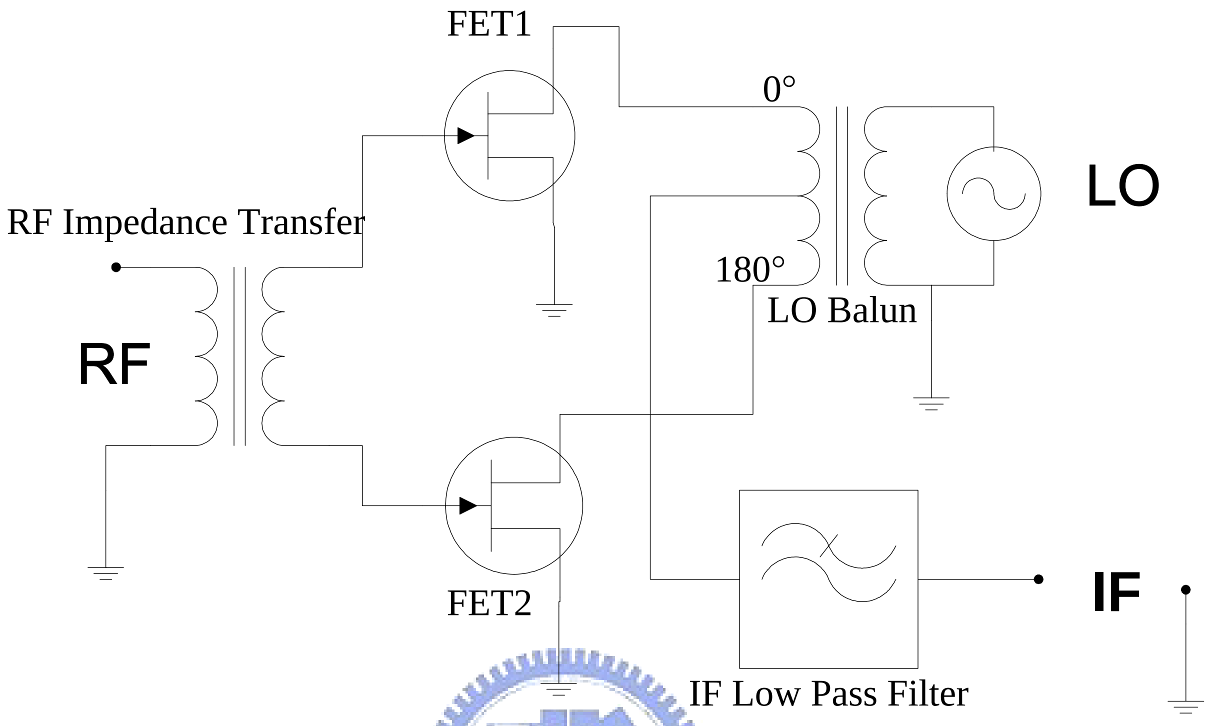

Figure 1.3 Concept diagram of Active balanced switching mixer

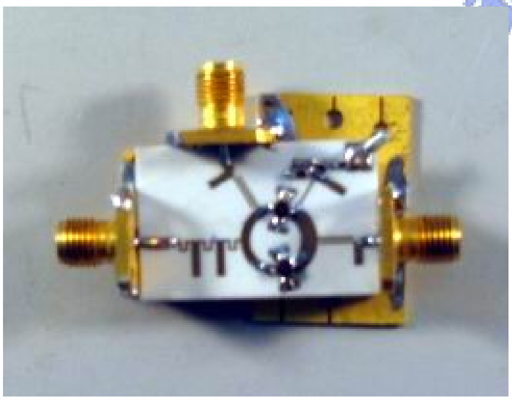

Figure 1.4 Prototype Photo of Active balanced switching mixer