

A Fully Integrated Current Injection Up-conversion Mixer-VCO in InGaP/GaAs Technology

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Abstract

An InGaP/GaAs HBT upconversion Mixer-VCO is designed by current injection and harmonic noise filtering techniques to improve linearity and phase noise performance. The VCO which is combined with mixer, is designed and fabricated with low phase noise of -133.96 dBc/Hz at 1 MHz offset. The measured conversion gain of the upconversion mixer is 0 dB. It shows the effective gain flatness of 1.2 dB from 1.6GHz to 1.8GHz. Also, it has third-order input intercept point (IIP3) of +18 dBm, and a third-order output intercept point (OIP3) of -19.2 dBm. An integrated differential cascode output amplifier generates the input and output-referred 1-dB compression point (P_{1dB}) as 1 dBm and 1.2 dBm. The high linearity Mixer-VCO is fabricated within a total chip area of $2560 \times 900 \mu\text{m}^2$. Since VCO output and mixer input impedances are matched to 50Ω without extra matching circuit.

1. Introduction

Modern communication systems require the devices with high performance and technically integrated. In this reason, fully integrated InGaP/GaAs HBT transceivers are used in many wireless applications, as a cellular phone, GPS (global positioning system), and ICS (interference cancellation system). In other words, an InGaP/GaAs HBT is quite an attractive device for microwave integrated circuits because of its extremely high linearity, low voltage operation, and high efficiency by comparison with a Si BJT, GaAs MESFET, and GaAs HEMT. Also, it is able to obtain a good performance in speed.

This paper presents a high performance upconversion mixer and VCO co-designed integrated circuit using InGaP/GaAs HBT devices. In the building blocks of communication, the mixer and VCO should be considered several parameters such as conversion gain, inter-modulation distortion, operating frequency, frequency bandwidth, noise figure, isolation, phase noise, and output swing [1]. The double-balanced Gilbert-cell mixer topology is suggested in upconversion mixer design since it suppresses the local oscillator(LO) signal

at the output and harmonic noise frequency filtering technique was suggested to design the VCO getting a good result of low phase noise.

2. Design Techniques of Mixer

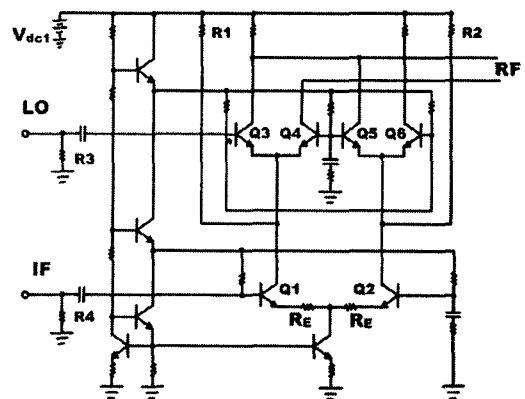


Fig. 1. The schematic of the double balanced mixer

High linearity and superior isolation between LO and IF ports are very important issues in upconversion