

Design of a Differential Colpitts Voltage Controlled Oscillator using InGaP/GaAs HBT Technology for an ICS Application

Bhanu Shrestha, Jae-Ho Yoon, *Sang-Hoon Cheon, and Nam-Young Kim

RFIC Research and Education Center, Department of Electronic Engineering, Kwangwoon University, Seoul, 139-701, Korea

*Knowledge*on Inc.

E-mail : bnu@kw.ac.kr

513-37 Euyang-dong, Iesan 570-210, Korea

Abstract

The proposed differential Colpitts VCO is implemented in InGaP/GaAs HBT process for an adaptive feedback interference cancellation system (AF-ICS) application. Two switching transistors are introduced to steer the core bias current and voltage to save power. The VCO produced a phase noise of -126.14 dBc/Hz at 1 MHz offset frequency from the carrier frequency of 1.542 GHz and the second harmonic suppression is significantly suppressed as -54.805 dBc/Hz in simulation result. The three pairs of BC diodes are integrated in the tank circuit to increase the VCO tuning range.

1. Introduction

Monolithic microwave integrated circuit (MMIC) voltage controlled oscillators (VCOs) are important building blocks in wireless communication systems. They generate a high quality LO signal. Hence, the current trend in oscillator design is to produce an exact specification [1].

Many technologies and topologies have been implemented in the designing of VCOs for superior phase noise performance. For example, VCOs have been designed using CMOS, BiCMOS, SiGe, Si-BJT, InP HBT and InGaP/GaAs HBT devices. Also, cross coupled and balanced topologies combined with LC resonators (frequency selective network) have been used. This work utilizes a differential colpitts topology with an LC resonator using InGaP/GaAs technology for an adaptive feedback interference cancellation system (AF-ICS). The AF-ICS system cancels the feedback signal from the transmitting antenna in a transmit and receive system [2]. Single ended Colpitts oscillators are commonly used for their superior phase noise characteristics. Hajimiri and Lee [3] developed a theoretical model to describe phase noise in the

oscillator. This model uses the impulse sensitivity function (ISF) to describe how a noise source affects the oscillator phase noise across an oscillation period.

In this newly proposed differential Colpitts VCO, the phase noise characteristic can be significantly enhanced by comparison with other differential VCOs. Moreover, the InGaP/GaAs HBT process produces further phase noise suppression. This is achieved using a ledge located between the base metal and emitter to reduce intrinsic semiconductor noise. In this design, high linearity transistors (HL_F2x2x20) and base-collector (BC) diodes (BC_35x40) provided by Knowledge*on semiconductor company [4] were used.

Section II describes the choice of topology and design strategy. Section III illustrates the proposed circuit design and simulation results plus a comparison with other recently published papers using InGaP/GaAs HBT process. And, finally, conclusions and future work are specified in section IV.

2. Topology Choice and Design Strategy

The reason for selecting the differential Colpitts topology is that it produces superior phase noise with