InGaP/GaAs HBT Based MMIC VCO for X-Band Satellite Communications

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1. Introduction

This design is essentially focused on InGaP/GaAs HBT technology based VCO operating at X-band frequency spectrum. The VCO with tuning range of about 140 MHz that consisted the capacitive cross-coupled differential topology. The core VCO achieves the oscillation frequency of 3.58 GHz with the output power of 3.65 dBm then using tripler circuitry(Fig.2) so that the output frequency becomes 10.75 GHz.

2. Circuit Design

The designed MMIC VCO based on differential type shown in Fig.1. The cross coupled capacitive feedback between the HBTs (Q_2, Q_3) is used to generate negative resistance which compensates the loss of LC resonator. The inductors L_1 and L_2 are used to control the phase of active block to satisfy Barkhausen criterion. If these values are decreased, voltage signal swing at collector of Q_2 and Q_3 is increased consequently. Q_2 and Q_3 are identical to generate balanced signal.

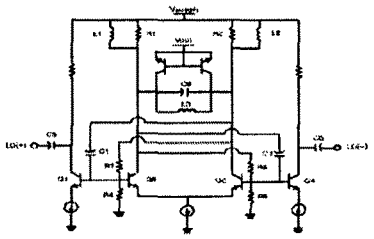

Fig. 1. Schematic of the MMIC VCO.

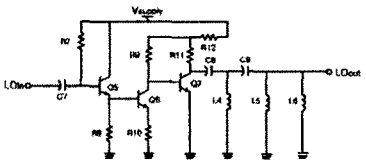

Fig. 2. Schematic of the tripler circuit.

3. Measurement Results

Microphotograph of the fabricated MMIC VCO is shown in Fig. 3. Three stage test balun is used for measuring differential output signal (Fig.4). The phase noise -108.45 dBc/Hz at 1 MHz and -89.35 dBc/Hz at 100 KHz offset frequency. The rest of other measurement results are given in Table 1.

Table 1. Simulation and Measurement Results.

Items		Unit	Simulation Results	Measurement Results
Tripler VCO Frequency		GHz	10.95	10.75
Output Power		dBm	0 ~ 5	3.65
Tuning Range (0 ~ 3.5 V)		MHz	150	143
Supply Voltage		V	3	2.9
Current Consumption		mA	35	30
Phase Noise	@ 100 kHz	dBc/Hz	·	-89.35
	@ 1 MHz		·	-108.45
Frequency Drift as Supply Voltage		MHz	·	55
Chip Size		μm^2	995 × 850	995 × 850

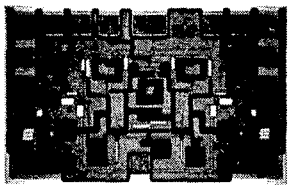

Fig. 3. Microphotograph of MMIC VCO

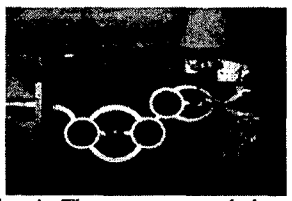

Fig. 4. Three stage test balun.

Acknowledgement

This research work is supported by Nano IP/SoC & Promotion Group of Seoul R&BD Program (10560) in 2009 and MKE Korea under the ITRC supervised by IITA-2009-C1090-0902-0018.

Reference

[1] J. H. Yoon, A. R. Koh, and N. Y. Kim, "Optimized Phase Noise of LC VCO using Asymmetric Inductance Tank in InGaP/GaAs HBT Technology", Microwave and Optical Technology Letters, vol. 48, no. 6, pp. 1035-1040, Jun. 2006.