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A 56GHz LC-tank VCO with 17% tuning range in 65nm bulk CMOS for wireless HDMI applications

Publisher: IEEE Cite This PDF

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Abstract

Document Sections

I. Introduction

II. Circuit Description

III. LC Tank Components

IV. Experimental Results

V. Conclusions

Authors

Figures

References

Citations

Keywords

Metrics

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Abstract:
A voltage controlled oscillator (VCO) with 56GHz central frequency and 17% tuning range is presented. The oscillation frequency is tuned both by an analog input and a three-bit digital control bus using the same type of differential varactors. It achieves a record FOM T (considering tuning range) of 186.8 dBc/Hz and it is able to address the full wireless HDMI band. The VCO is implemented in a 65nm bulk CMOS process and dissipates 15 mW from a 1.2 V supply.

Published in: 2009 IEEE Radio Frequency Integrated Circuits Symposium

Date of Conference: 07-09 June 2009 **INSPEC Accession Number:** 10748528

Date Added to IEEE Xplore: 26 June 2009 **DOI:** 10.1109/RFIC.2009.5135585

► ISBN Information: **Publisher:** IEEE

► ISSN Information: **Conference Location:** Boston, MA, USA

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Contents

I. Introduction
This paper presents a digital and voltage controlled oscillator which covers 60 GHz Wireless HDMI requirements including Process, Voltage, and Temperature variations. For such application low phase-noise (PN), low-power, low-cost VCOs with large frequency tuning range (FTR) are required. The trade-off between power consumption, PN and FTR can be addressed using LCtank VCOS implemented in CMOS technologies [1]–[6]. Ultra low-power and low phase-noise have been reported by engineering the tank inductor using slow-wave propagation mode, but at the expenses of the FTR [1]. A FTR of 20% is obtained in [2] by using distributed VCOs, at the expenses of a large power consumption and area. The best compromise for FTR, PN and power consumption can be obtained using LC tank VCOs by optimally sizing the VCO transistors in order to minimize the parasitic capacitances and by maximizing the varactor capacitance range [5]–[6]. Our work demonstrates that very large tuning ranges (17%) can be achieved at mmW frequencies in bulk CMOS advanced processes using a LC tank VCO with differential accumulation type varactors and a combination of continuous tuning and digital switching of varactor banks, resulting in state-of-the-art phase-noise and figure-of-merit performances. Indeed, to the best of the authors' knowledge, it is the first LC tank VCO able to address the full bandwidth of wireless HDMI including an extra frequency range for PVT compensation.

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