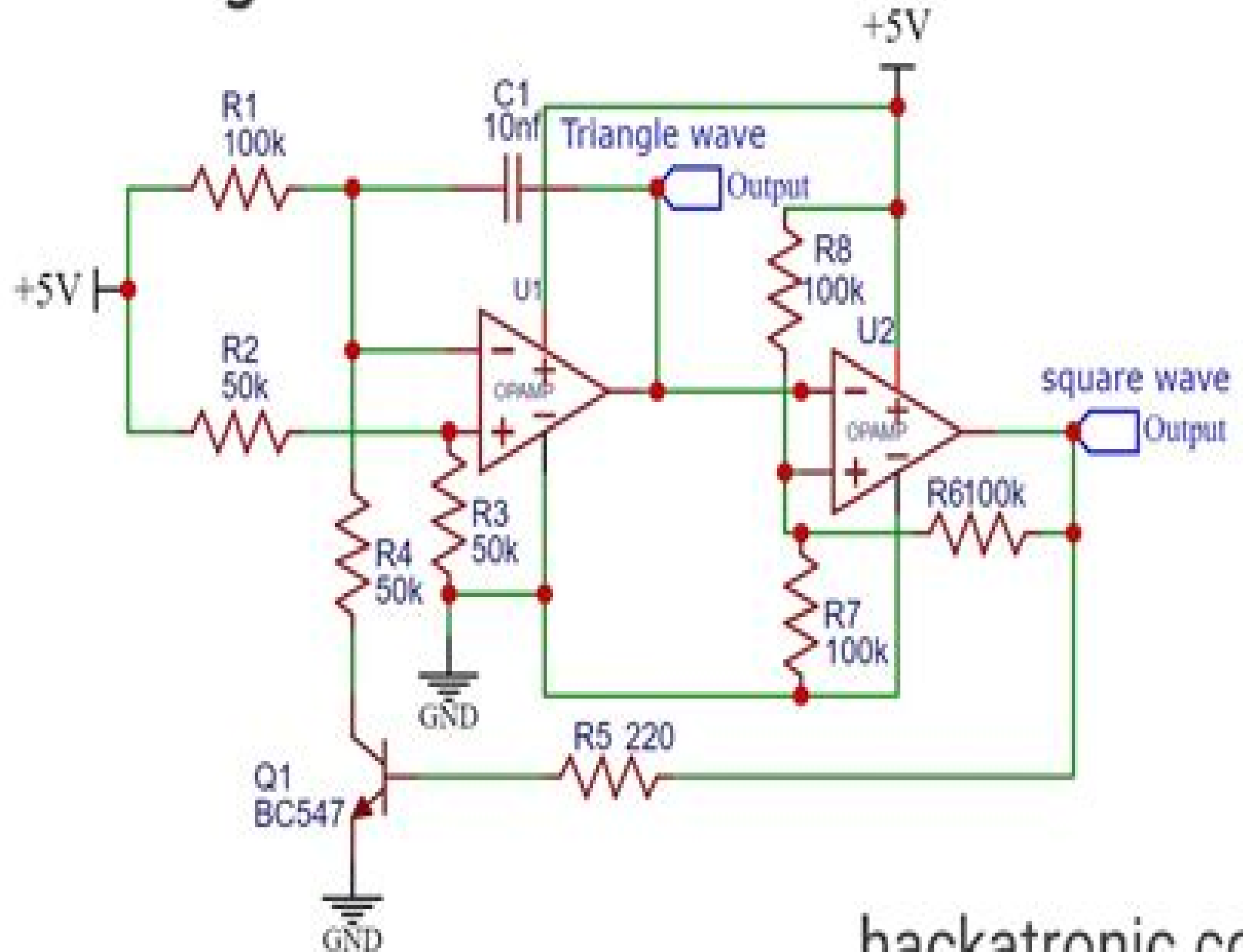


Voltage Controlled Oscillator Circuit



Voltage Controlled Oscillator

Liang Dai, Ramesh Harjani



Voltage Controlled Oscillator:

Voltage Controlled Oscillator (VCO) Asim Mahmood Malik, 2000 **Design of High-Performance CMOS**

Voltage-Controlled Oscillators Liang Dai, Ramesh Harjani, 2012-12-06 Design of High Performance CMOS Voltage Controlled Oscillators presents a phase noise modeling framework for CMOS ring oscillators. The analysis considers both linear and nonlinear operation. It indicates that fast rail to rail switching has to be achieved to minimize phase noise. Additionally, in conventional design, the flicker noise in the bias circuit can potentially dominate the phase noise at low offset frequencies. Therefore, for narrow bandwidth PLLs, noise up conversion for the bias circuits should be minimized. We define the effective Q factor Q_{eff} for ring oscillators and predict its increase for CMOS processes with smaller feature sizes. Our phase noise analysis is validated via simulation and measurement results. The digital switching noise coupled through the power supply and substrate is usually the dominant source of clock jitter. Improving the supply and substrate noise immunity of a PLL is a challenging job in hostile environments such as a microprocessor chip where millions of digital gates are present. *Voltage Controlled Oscillator (VCO) Technology* Charles A. Bissegger, 1980 *A Digital Voltage-controlled Oscillator for Phase Lock Loops* Dominick E. Santarpia, 1968 *Design of VCO-based ADCs* Vishnu Unnikrishnan, 2017-03-28

Today's complex electronic systems with billions of transistors on a single die are enabled by the aggressive scaling down of the device feature size at an exponential rate as predicted by Moore's law. Digital circuits benefit from technology scaling to become faster, more energy efficient, as well as more area efficient as the feature size is scaled down. Moreover, digital design also benefits from mature CAD tools that simplify the design and cross technology porting of complex systems leveraging on a cell-based design methodology. On the other hand, the design of analog circuits is getting increasingly difficult as the feature size scales down into the deep nanometer regime due to a variety of reasons like shrinking voltage headroom, reducing intrinsic gain of the devices, increasing noise coupling between circuit nodes due to shorter distances, etc. Furthermore, analog circuits are still largely designed with a full custom design flow that makes their design and porting tedious, slow, and expensive. In this context, it is attractive to consider realizing analog mixed signal circuits using standard digital components. This leads to scaling friendly mixed signal blocks that can be designed and ported using the existing CAD framework available for digital design. The concept is already being applied to mixed signal components like frequency synthesizers where all digital architectures are synthesized using standard cells as basic components. This can be extended to other mixed signal blocks like digital to analog and analog to digital converters as well, where the latter is of particular interest in this thesis. A voltage controlled oscillator (VCO) based analog to digital converter (ADC) is an attractive architecture to achieve all digital analog to digital conversion due to favorable properties like shaping of the quantization error, inherent anti-alias filtering, etc. Here, a VCO operates as a signal integrator as well as a quantizer. A converter employing a ring oscillator as the VCO lends itself to an all digital implementation. In this dissertation, we explore the design of VCO based

ADCs synthesized using digital standard cells with the long term goal of achieving high performance data converters built from low accuracy switch components In a first step an ADC is designed using vendor supplied standard cells and fabricated in a 65 nm CMOS process The converter delivers an 8 bit ENOB over a 25 MHz bandwidth while consuming 3.3 mW of power resulting in an energy efficiency of 235 fJ/step/Walden FoM Then we utilize standard digital CAD tools to synthesize converter designs that are fully described using a hardware description language A polynomial based digital post processing scheme is proposed to correct for the VCO nonlinearity In addition pulse modulation schemes like delta modulation and asynchronous sigma delta modulation are used as a signal pre coding scheme in an attempt to reduce the impact of VCO nonlinearity on converter performance In order to investigate the scaling benefits of all digital data conversion a VCO based converter is designed in a 28 nm CMOS process The design delivers a 13.4 bit ENOB over a 5 MHz bandwidth achieving an energy efficiency of 4.3 fJ/step according to post synthesis schematic simulation indicating that such converters have the potential of achieving good performance in deeply scaled processes by exploiting scaling benefits Furthermore large conversion errors caused by non ideal sampling of the oscillator phase are studied An encoding scheme employing ones counters is proposed to code the sampled ring oscillator output into a number which is resilient to a class of sampling induced errors modeled by temporal reordering of the transitions in the ring The proposed encoding reduces the largest error caused by random reordering of up to six subsequent bits in the sampled signal from 31 to 2 LSBs Finally the impact of process voltage and temperature PVT variations on the performance while operating the converter from a subthreshold supply is investigated PVT adaptive solutions are suggested as a means to achieve energy efficient operation over a wide range of PVT conditions

Design of High-Performance CMOS Voltage-Controlled Oscillators Liang Dai, Ramesh Harjani, 2012-10-31 Design of High Performance CMOS Voltage Controlled Oscillators presents a phase noise modeling framework for CMOS ring oscillators The analysis considers both linear and nonlinear operation It indicates that fast rail to rail switching has to be achieved to minimize phase noise Additionally in conventional design the flicker noise in the bias circuit can potentially dominate the phase noise at low offset frequencies Therefore for narrow bandwidth PLLs noise up conversion for the bias circuits should be minimized We define the effective Q factor Q_{eff} for ring oscillators and predict its increase for CMOS processes with smaller feature sizes Our phase noise analysis is validated via simulation and measurement results The digital switching noise coupled through the power supply and substrate is usually the dominant source of clock jitter Improving the supply and substrate noise immunity of a PLL is a challenging job in hostile environments such as a microprocessor chip where millions of digital gates are present

RF and Microwave Transistor Oscillator Design Andrei Grebennikov, 2007-04-30 The increase of consumer electronics and communications applications using Radio Frequency RF and microwave circuits has implications for oscillator design Applications working at higher frequencies and using novel technologies have led to a demand for more robust circuits with higher performance and functionality but

decreased costs size and power consumption As a result there is also a need for more efficient oscillators This book presents up to date information on all aspects of oscillator design enabling a selection of the best oscillator topologies with optimized noise reduction and electrical performance RF and Microwave Transistor Oscillator Design covers analyses of non linear circuit design methods including spectral domain analysis time domain analysis and the quasilinear method information on noise in oscillators including chapters on varactor and oscillator frequency tuning CMOS voltage controlled oscillators and wideband voltage controlled oscillators information on the stability of oscillations with discussions on the stability of multi resonant circuits and the phase plane method optimized design and circuit techniques beginning with the empirical and analytic design approaches moving on to the high efficiency design technique general operation and design principles of oscillators including a section on the historical aspects of oscillator configurations A valuable reference for practising RF and Microwave designers and engineers RF and Microwave Transistor Oscillator Design is also useful for lecturers advanced students and research and design R D personnel

Voltage-controlled Oscillator (VCO) Design Used in Phase-locked Loops (PLLs) Based on CMOS Process Chian Hin Teuu,2003

Op Amps: Design, Application, and Troubleshooting David Terrell,1996 Basic concepts of the integrated operational amplifier Amplifiers Voltage comparators Oscillators Active filters Power supply circuits Signal processing circuits Digital to analog and analog to digital conversion Arithmetic function circuits Nondideal op amp characteristics Specialized devices

Distributed Voltage Controlled Oscillator Sunil Modur Nagabhushana,2001

The Voltage-controlled Oscillator Harizah Ismail,1994

Analog CMOS Voltage Controlled Oscillator (VCO) in Phase Locked Loop (PLL) Vern Shyn Khaw,2005

Design of a Voltage Controlled Oscillator John Franklin Alexander,1967

Vco-Based Quantizers Using Frequency-To-Digital and Time-to-Digital Converters ,2011-08-01

Switchable Dual Mode Voltage Controlled Oscillator Dharma Kadam,2004

Design and Analysis 2.4 GHz Voltage-Controlled Oscillator (VCO) for Low-Phase Noise Muhammad Fakhrulrazi Mohamad Fadzil,2024 This project s scope is centred around the meticulous design and optimization of a Voltage Controlled Oscillator VCO with the specific target of achieving a stable oscillation frequency of 2 4 GHz To realize this goal the VCO will be meticulously crafted utilizing 0 35 m CMOS technology which offers a robust foundation for integrated circuit design A key emphasis of this design endeavor is the implementation of advanced filtering techniques to effectively eliminate extraneous noise sources ultimately leading to improved phase noise performance By harnessing the capabilities of CMOS technology and applying precise filtering strategies this project seeks to deliver a 2 4 GHz VCO that not only meets the frequency requirement but also excels in minimizing phase noise thereby enhancing its suitability for demanding wireless communication applications The methodology employed in this study exclusively utilizes simulation techniques without involving any physical fabrication processes Therefore all results and findings herein are derived solely from computational simulations It is essential to emphasize that no physical prototypes or fabricated components were utilized during this research This research

concentrates exclusively on design with simulation as the primary methodological approach The scope of this study imposes constraints on physical fabrication processes Consequently the outcomes are derived solely from simulations conducted within the AWR Cadence software environment While acknowledging the potential variance between simulated results and those obtained through physical implementation it is worth noting that the simulations are expected to closely approximate the performance of the designed system under real world conditions However it is imperative to recognize that the findings are contingent upon the virtual representation within the software thereby

Oscillator Circuits Rudolf F. Graf,1997 The Newnes Circuits Series provides designers with quick reference guides to various types of circuits and is written by a professional technical writer Each book comes with 250 300 ready to use designs with schematics and explanations

A Voltage Controlled Oscillator/Mixer Marion C. Bartlett,Raymond C. Johnson,FLORIDA UNIV GAINESVILLE ENGINEERING AND INDUSTRIAL EXPERIMENT STATION.,1974 A new technique for product mixing of an input signal with a locally generated reference by using a voltage controlled oscillator VCO is described and verified both mathematically and experimentally The technique consists of frequency modulating the oscillator with the signal voltage It is shown that for low index frequency modulation by the signal the sidebands of the oscillator produced by the signal are equivalent to those of a multiplicative mixer with a gain of approximately unity The technique is particularly useful for synchronized IF correlator systems where a function generator can serve to generate the modulation waveform and act as a coherent detector simultaneously Modified author abstract

Automatic Generation of an LC Voltage Controlled Oscillator Donghyeok Kil,2013 A Voltage Controlled Oscillator VCO is used to generate a signal with a frequency that is a function of an input voltage amplitude and is an integral part of circuits such as phase locked loops frequency synthesizers down conversion receivers and clock generators A typical design flow for a VCO involves architecture selection based on specification calculation of circuit parameters simulation and iterations of circuit parameters based on the simulation result In such a design flow changes in specification or process can lead to significant redesign This report focuses on a C based LC VCO generation software that seeks to automate the design process and that includes calculation of circuit parameters creation of Spectre netlist invocation of simulation automated checking of the result and a feedback mechanism to modify circuit parameters until the design can converge to the desired specification Object Oriented Programming principles such as inheritance polymorphism encapsulation class abstraction are exercised to maximize reusability and portability to other projects which may require different foundry device models and supply voltages

A Voltage Controlled Oscillator Circuit Using Single Channel MOS Technology Sumer Can,1977

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Table of Contents Voltage Controlled Oscillator

1. Understanding the eBook Voltage Controlled Oscillator
 - The Rise of Digital Reading Voltage Controlled Oscillator
 - Advantages of eBooks Over Traditional Books
2. Identifying Voltage Controlled Oscillator
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Voltage Controlled Oscillator
 - User-Friendly Interface
4. Exploring eBook Recommendations from Voltage Controlled Oscillator
 - Personalized Recommendations
 - Voltage Controlled Oscillator User Reviews and Ratings
 - Voltage Controlled Oscillator and Bestseller Lists
5. Accessing Voltage Controlled Oscillator Free and Paid eBooks
 - Voltage Controlled Oscillator Public Domain eBooks
 - Voltage Controlled Oscillator eBook Subscription Services
 - Voltage Controlled Oscillator Budget-Friendly Options

6. Navigating Voltage Controlled Oscillator eBook Formats
 - ePub, PDF, MOBI, and More
 - Voltage Controlled Oscillator Compatibility with Devices
 - Voltage Controlled Oscillator Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Voltage Controlled Oscillator
 - Highlighting and Note-Taking Voltage Controlled Oscillator
 - Interactive Elements Voltage Controlled Oscillator
8. Staying Engaged with Voltage Controlled Oscillator
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Voltage Controlled Oscillator
9. Balancing eBooks and Physical Books Voltage Controlled Oscillator
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Voltage Controlled Oscillator
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Voltage Controlled Oscillator
 - Setting Reading Goals Voltage Controlled Oscillator
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Voltage Controlled Oscillator
 - Fact-Checking eBook Content of Voltage Controlled Oscillator
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements

- Interactive and Gamified eBooks

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