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Millimeter-Wave Circuits for 5G and Radar
Analysis and Design of Analog Integrated Circuits
The Design of CMOS Radio-Frequency Integrated Circuits
Chaos and Organization in Health Care
The Design and Implementation of Low-Power CMOS Radio Receivers
Low Power VCO Design in CMOS
Conference Proceedings
Microelectronics Data Network Engineering
The Design of CMOS Radio-Frequency Integrated Circuits
Planar Microwave Engineering
Multi-GHz Frequency Synthesis & Division
CMOS RFIC Design Principles
Proceedings
Integration of 2D Materials for Electronics Applications
Transmission Lines, Matching, and Crosstalk
Three-dimensional Integrated Circuit Design
RFID Systems
MOSFET Technologies for Double-Pole Four-Throw Radio-Frequency Switch
Design of CMOS Phase-Locked Loops
Proceedings of the IEEE 2000 Custom Integrated Circuits Conference
All-Digital Frequency Synthesizer in Deep-Submicron CMOS
Software-Defined Radio for Engineers
Microwave Journal
Analog Circuit Design
RF Circuit Design
The VLSI Handbook
Semiconductor Detector Systems
The Electronics of Radio
Crystal Fire
Radio Frequency Integrated Circuits and Systems
IEEE Circuits & Devices
Millimeter Wave Wireless Communications
Analog/RF and Mixed-Signal Circuit Systematic Design
The Design of Low Noise Oscillators
Design of Analog CMOS Integrated Circuits
Feedback Linearization of RF Power Amplifiers
Current Sources and Voltage References
Modern RF and Microwave Measurement Techniques
High-Frequency Integrated Circuits

Millimeter-Wave Circuits for 5G and Radar

With vastly increased complexity and functionality in the "nanometer era" (i.e. hundreds of millions of transistors on one chip), increasing the performance of integrated circuits has become a challenging task. Connecting effectively (interconnect design) all of these chip elements has become the greatest determining factor in overall performance. 3-D integrated circuit design may offer the best solutions in the near future. This is the first book on 3-D integrated circuit design, covering all of the technological and design aspects of this emerging design paradigm, while proposing effective solutions to specific challenging problems concerning the design of 3-D integrated circuits. A handy, comprehensive reference or a practical design guide, this book provides a sound foundation for the design of 3-D integrated circuits. * Demonstrates how to overcome "interconnect bottleneck" with 3-D integrated circuit design leading edge design techniques offer solutions to problems (performance/power consumption/price) faced by all circuit designers * The FIRST book on 3-D integrated circuit design provides up-to-date information that is otherwise difficult to find * Focuses on design issues key to the product development cycle good design plays a major role in exploiting the implementation flexibilities offered in the 3-D * Provides broad coverage of 3-D integrated circuit design, including

interconnect prediction models, thermal management techniques, and timing optimization offers practical view of designing 3-D circuits

Analysis and Design of Analog Integrated Circuits

The Design of CMOS Radio-Frequency Integrated Circuits

This book provides analysis and discusses the design of various MOSFET technologies which are used for the design of Double-Pole Four-Throw (DP4T) RF switches for next generation communication systems. The authors discuss the design of the (DP4T) RF switch by using the Double-Gate (DG) MOSFET, as well as the Cylindrical Surrounding double-gate (CSDG) MOSFET. The effect of HFO₂ (high dielectric material) in the design of DG MOSFET and CSDG MOSFET is also explored. Coverage includes comparison of Single-gate MOSFET and Double-gate MOSFET switching parameters, as well as testing of MOSFETs parameters using image acquisition.

Chaos and Organization in Health Care

This book is a printed edition of the Special Issue "Integration of 2D Materials for

Electronics Applications" that was published in Crystals

The Design and Implementation of Low-Power CMOS Radio Receivers

This book, first published in 2004, is an expanded and revised edition of Tom Lee's acclaimed RFIC text.

Low Power VCO Design in CMOS

It is hardly a revelation to note that wireless and mobile communications have grown tremendously during the last few years. This growth has placed stringent requirements on channel spacing and, by implication, on the phase noise of oscillators. Compounding the challenge has been a recent drive toward implementations of transceivers in CMOS, whose inferior $1/f$ noise performance has usually been thought to disqualify it from use in all but the lowest-performance oscillators. Low noise oscillators are also highly desired in the digital world, of course. The continued drive toward higher clock frequencies translates into a demand for ever-decreasing jitter. Clearly, there is a need for a deep understanding of the fundamental mechanisms governing the process by which device, substrate, and supply noise turn into jitter and phase noise. Existing models generally offer

only qualitative insights, however, and it has not always been clear why they are not quantitatively correct.

Conference Proceedings

It is certain that, over the next few years, data traffic will dwarf voice traffic on telecommunications networks. Growth in data-traffic volumes far exceeds that for voice, and is driven by increased use of applications such as e-mail attachments, remote printing and fileserver access, and the now omnipresent World Wide Web. The growth of data networking to connect computers with each other and with their peripheral devices began in earnest in the 1970s, took off in the 1980s and exploded in the 1990s. The early 21st century will see ever faster, more cost effective networks providing flexible data access into ever more businesses and homes. Since the 1970s there have been great advances in technology. For the past twenty years the processing power of computers has continued to grow with no hint of slowing - recall the oft-cited Moore's Law claiming that this power doubles every 18 months. Advances in the data networking equipment required to support the data traffic generated have been enormous. The pace of development from early X. 25 and modem technology through to some of the advanced equipment functionality now available is breathtaking - it is sometimes hard to believe that the practical router is barely ten years old! This book provides an overview of the advanced data networking field by bringing together chapters on

local area networks, wide area networks and their application.

Microelectronics

This modern, pedagogic textbook from leading author Behzad Razavi provides a comprehensive and rigorous introduction to CMOS PLL design, featuring intuitive presentation of theoretical concepts, extensive circuit simulations, over 200 worked examples, and 250 end-of-chapter problems. The perfect text for senior undergraduate and graduate students.

Data Network Engineering

CMOS (complementary metal oxide semiconductor) is a key digital integrated circuit technology that is widely used throughout the wireless communications industry. This resource offers guidance on designing CMOS RF integrated circuits. It provides design details on elemental and advanced CMOS RF circuits.

The Design of CMOS Radio-Frequency Integrated Circuits

Summarizes the schemes and technologies in RF circuit design, describes the basic parameters of an RF system and the fundamentals of RF system design, and

presents an introduction of the individual RF circuit block design. Forming the backbone of today's mobile and satellite communications networks, radio frequency (RF) components and circuits are incorporated into everything that transmits or receives a radio wave, such as mobile phones, radio, WiFi, and walkie talkies. RF Circuit Design, Second Edition immerses practicing and aspiring industry professionals in the complex world of RF design. Completely restructured and reorganized with new content, end-of-chapter exercises, illustrations, and an appendix, the book presents integral information in three complete sections: Part One explains the different methodologies between RF and digital circuit design and covers voltage and power transportation, impedance matching in narrow-band case and wide-band case, gain of a raw device, measurement, and grounding. It also goes over equipotentiality and current coupling on ground surface, as well as layout and packaging, manufacturability of product design, and radio frequency integrated circuit (RFIC). Part Two includes content on the main parameters and system analysis in RF circuit design, the fundamentals of differential pair and common-mode rejection ratio (CMRR), Balun, and system-on-a-chip (SOC). Part Three covers low-noise amplifier (LNA), power amplifier (PA), voltage-controlled oscillator (VCO), mixers, and tunable filters. RF Circuit Design, Second Edition is an ideal book for engineers and managers who work in RF circuit design and for courses in electrical or electronic engineering.

Planar Microwave Engineering

Multi-GHz Frequency Synthesis & Division

Discover the concepts, architectures, components, tools, and techniques needed to design millimeter-wave circuits for current and emerging wireless system applications. Focusing on applications in 5G, connectivity, radar, and more, leading experts in radio frequency integrated circuit (RFIC) design provide a comprehensive treatment of cutting-edge physical-layer technologies for radio frequency (RF) transceivers - specifically RF, analog, mixed-signal, and digital circuits and architectures. The full design chain is covered, from system design requirements through to building blocks, transceivers, and process technology. Gain insight into the key novelties of 5G through authoritative chapters on massive MIMO and phased arrays, and learn about the very latest technology developments, such as FinFET logic process technology for RF and millimeter-wave applications. This is an essential reading and an excellent reference for high-frequency circuit designers in both academia and industry.

CMOS RFIC Design Principles

A comprehensive, hands-on review of the most up-to-date techniques in RF and microwave measurement, including practical advice on deployment challenges.

Proceedings

This book, first published in 2004, is an expanded and revised edition of Tom Lee's acclaimed RFIC text.

Integration of 2D Materials for Electronics Applications

Based on the popular Artech House classic, Digital Communication Systems Engineering with Software-Defined Radio, this book provides a practical approach to quickly learning the software-defined radio (SDR) concepts needed for work in the field. This up-to-date volume guides readers on how to quickly prototype wireless designs using SDR for real-world testing and experimentation. This book explores advanced wireless communication techniques such as OFDM, LTE, WLA, and hardware targeting. Readers will gain an understanding of the core concepts behind wireless hardware, such as the radio frequency front-end, analog-to-digital and digital-to-analog converters, as well as various processing technologies. Moreover, this volume includes chapters on timing estimation, matched filtering, frame synchronization message decoding, and source coding. The orthogonal frequency division multiplexing is explained and details about HDL code generation and deployment are provided. The book concludes with coverage of the WLAN toolbox with OFDM beacon reception and the LTE toolbox with downlink reception.

Multiple case studies are provided throughout the book. Both MATLAB and Simulink source code are included to assist readers with their projects in the field.

Transmission Lines, Matching, and Crosstalk

Three-dimensional Integrated Circuit Design

A stimulating introduction to radio electronics and wireless communications.

RFID Systems

This volume of Analog Circuit Design concentrates on three topics: Volt Electronics; Design and Implementation of Mixed-Mode Systems; Low-Noise and RF Power Amplifiers for Telecommunication. The book comprises six papers on each topic written by internationally recognised experts. These papers are tutorial in nature and together make a substantial contribution to improving the design of analog circuits. The book is divided into three parts: Part I, Volt Electronics, presents some of the circuit design challenges which are having to be met as the need for more electronics on a chip forces smaller transistor dimensions, and thus lower breakdown voltages. The papers cover techniques for 1-Volt electronics. Part II,

Design and Implementation of Mixed-Mode Systems, deals with the various problems that are encountered in mixed analog-digital design. In the future, all integrated circuits are bound to contain both digital and analog sub-blocks. Problems such as substrate bounce and other substrate coupling effects cause deterioration in signal integrity. Both aspects of mixed-signal design have been addressed in this section and it illustrates that careful layout techniques embedded in a hierarchical design methodology can allow us to cope with most of the challenges presented by mixed analog-digital design. Part III, Low-noise and RF Power Amplifiers for Telecommunication, focuses on telecommunications systems. In these systems low-noise amplifiers are front-ends of receiver designs. At the transmitter part a high-performance, high-efficiency power amplifier is a critical design. Examples of both system parts are described in this section. Analog Circuit Design is an essential reference source for analog design engineers and researchers wishing to keep abreast with the latest developments in the field. The tutorial nature of the contributions also makes it suitable for use in an advanced course.

MOSFET Technologies for Double-Pole Four-Throw Radio-Frequency Switch

In chapters culled from the popular and critically acclaimed Electromagnetic

Compatibility Handbook, Transmission Lines, Matching, and Crosstalk provides a tightly focused, convenient, and affordable reference for those interested primarily in this subset of topics. Author Kenneth L. Kaiser demystifies transmission lines, matching, and crosstalk and explains the source and limitations of the approximations, guidelines, models, and rules-of-thumb used in this field. The material is presented in a unique question-and-answer format that gets straight to the heart of each topic. The book includes numerous examples and uses Mathcad to generate all of the figures and many solutions to equations. In many cases, the entire Mathcad program is provided.

Design of CMOS Phase-Locked Loops

It is hardly a profound observation to note that we remain in the midst of a wireless revolution. In 1998 alone, over 150 million cell phones were sold worldwide, representing an astonishing 50% increase over the previous year. Maintaining such a remarkable growth rate requires constant innovation to decrease cost while increasing performance and functionality. Traditionally, wireless products have depended on a mixture of semiconductor technologies, spanning GaAs, bipolar and BiCMOS, just to name a few. A question that has been hotly debated is whether CMOS could ever be suitable for RF applications. However, given the acknowledged inferiority of CMOS transistors relative to those in other candidate technologies, it has been argued by many that “CMOS RF” is an oxymoron, an endeavor best left

cloistered in the ivory towers of academia. In rebuttal, there are several compelling reasons to consider CMOS for wireless applications. Aside from the exponential device and density improvements delivered regularly by Moore's law, only CMOS offers a technology path for integrating RF and digital elements, potentially leading to exceptionally compact and low-cost devices. To enable this achievement, several thorny issues need to be resolved. Among these are the problem of poor passive components, broadband noise in MOSFETs, and phase noise in oscillators made with CMOS. Beyond the component level, there is also the important question of whether there are different architectural choices that one would make if CMOS were used, given the different constraints.

Proceedings of the IEEE 2000 Custom Integrated Circuits Conference

All-Digital Frequency Synthesizer in Deep-Submicron CMOS

This text constitutes the proceedings from the Custom Integrated Circuits Conference that took place in 2000. Topics covered include key methods for successful SOCs, high speed data conversion, embedded memory and architecture components and technology.

Software-Defined Radio for Engineers

Microwave Journal

This work covers the design of CMOS fully integrated low power low phase noise voltage controlled oscillators for telecommunication or datacommunication systems. The need for low power is obvious, as mobile wireless telecommunications are battery operated. As wireless telecommunication systems use oscillators in frequency synthesizers for frequency translation, the selectivity and signal to noise ratio of receivers and transmitters depend heavily on the low phase noise performance of the implemented oscillators. Datacommunication systems need low jitter, the time-domain equivalent of low phase noise, clocks for data detection and recovery. The power consumption is less critical. The need for multi-band and multi-mode systems pushes the high-integration of telecommunication systems. This is offered by sub-micron CMOS featuring digital flexibility. The recent crisis in telecommunication clearly shows that mobile hand-sets became mass-market high-volume consumer products, where low-cost is of prime importance. This need for low-cost products - livens tremendously research towards CMOS alternatives for the bipolar or BiCMOS solutions in use today.

Analog Circuit Design

Modern wireless communications hardware is underpinned by RF and microwave design techniques. This insightful book contains a wealth of circuit layouts, design tips, and practical measurement techniques for building and testing practical gigahertz systems. The book covers everything you need to know to design, build, and test a high-frequency circuit. Microstrip components are discussed, including tricks for extracting good performance from cheap materials. Connectors and cables are also described, as are discrete passive components, antennas, low-noise amplifiers, oscillators, and frequency synthesizers. Practical measurement techniques are presented in detail, including the use of network analyzers, sampling oscilloscopes, spectrum analyzers, and noise figure meters. Throughout the focus is practical, and many worked examples and design projects are included. There is also a CD-ROM that contains a variety of design and analysis programs. The book is packed with indispensable information for students taking courses on RF or microwave circuits and for practising engineers.

RF Circuit Design

The Definitive, Comprehensive Guide to Cutting-Edge Millimeter Wave Wireless Design “This is a great book on mmWave systems that covers many aspects of the

technology targeted for beginners all the way to the advanced users. The authors are some of the most credible scholars I know of who are well respected by the industry. I highly recommend studying this book in detail.” —Ali Sadri, Ph.D., Sr. Director, Intel Corporation, MCG mmWave Standards and Advanced Technologies

Millimeter wave (mmWave) is today's breakthrough frontier for emerging wireless mobile cellular networks, wireless local area networks, personal area networks, and vehicular communications. In the near future, mmWave products, systems, theories, and devices will come together to deliver mobile data rates thousands of times faster than today's existing cellular and WiFi networks. In Millimeter Wave Wireless Communications, four of the field's pioneers draw on their immense experience as researchers, entrepreneurs, inventors, and consultants, empowering engineers at all levels to succeed with mmWave. They deliver exceptionally clear and useful guidance for newcomers, as well as the first complete desk reference for design experts. The authors explain mmWave signal propagation, mmWave circuit design, antenna designs, communication theory, and current standards (including IEEE 802.15.3c, Wireless HD, and ECMA/WiMedia). They cover comprehensive mmWave wireless design issues, for 60 GHz and other mmWave bands, from channel to antenna to receiver, introducing emerging design techniques that will be invaluable for research engineers in both industry and academia. Topics include Fundamentals: communication theory, channel propagation, circuits, antennas, architectures, capabilities, and applications Digital communication: baseband signal/channel models, modulation, equalization, error

control coding, multiple input multiple output (MIMO) principles, and hardware architectures Radio wave propagation characteristics: indoor and outdoor applications Antennas/antenna arrays, including on-chip and in-package antennas, fabrication, and packaging Analog circuit design: mmWave transistors, fabrication, and transceiver design approaches Baseband circuit design: multi-gigabit-per-second, high-fidelity DAC and ADC converters Physical layer: algorithmic choices, design considerations, and impairment solutions; and how to overcome clipping, quantization, and nonlinearity Higher-layer design: beam adaptation protocols, relaying, multimedia transmission, and multiband considerations 60 GHz standardization: IEEE 802.15.3c for WPAN, Wireless HD, ECMA-387, IEEE 802.11ad, Wireless Gigabit Alliance (WiGig)

The VLSI Handbook

In the past 10 years extensive effort has been dedicated to commercial wireless local area network (WLAN) systems. Despite all these efforts, however, none of the existing systems has been successful, mainly due to their low data rates. The increasing demand for WLAN systems that can support data rates in excess of 20 Mb/s enticed the FCC to create an unlicensed national information infrastructure (U-NII) band at 5 GHz. This frequency band provides 300 MHz of spectrum in two segments: a 200 MHz(5.15–5.35 GHz) and a 100 MHz (5.725–5.825 GHz) frequency band. This newly released spectrum, and the fast trend of CMOS scaling, provide

an opportunity to design WLAN systems with high data rate and low cost. One of the existing standards at 5 GHz is the European high performance radio LAN (HIPERLAN) standard that supports data rates as high as 20 Mb/s. One of the main building blocks of each wireless system is the frequency synthesizer. Phase-locked loops (PLLs) are universally used to design radio frequency synthesizers. Reducing the power consumption of the frequency dividers of a PLL has always been a challenge. In this book, we introduce an alternative solution for conventional flipflop based MULTI-GHZ FREQUENCY SYNTHESIS & DIVISION frequency dividers. An injection-locked frequency divider (ILFD) takes advantage of the narrowband nature of the wireless systems and employs resonators to trade off bandwidth for power.

Semiconductor Detector Systems

Current Sources and Voltage References provides fixed, well-regulated levels of current or voltage within a circuit. These are two of the most important “building blocks” of analog circuits, and are typically used in creating most analog IC designs. Part 1 shows the reader how current sources are created, how they can be optimized, and how they can be utilized by the OEM circuit designer. The book serves as a “must-have reference for the successful development of precision circuit applications. It shows practical examples using either BJTs, FETs, precision op amps, or even matched CMOS arrays being used to create highly accurate

current source designs, ranging from nanoAmps to Amps. In each chapter the most important characteristics of the particular semiconductor type being studied are carefully reviewed. This not only serves as a helpful refresher for experienced engineers, but also as a good foundation for all EE student coursework, and includes device models and relevant equations. Part 2 focuses on semiconductor voltage references, from their design to their various practical enhancements. It ranges from the simple Zener diode to today's most advanced topologies, including Analog Devices' XFET® and Intersil's FGATM (invented while this book was being written). Over 300 applications and circuit diagrams are shown throughout this easy-to-read, practical reference book. * Discusses how to design low-noise, precision current sources using matched transistor pairs. * Explains the design of high power current sources with power MOSFETs * Gives proven techniques to reduce drift and improve accuracy in voltage references.

The Electronics of Radio

For the new millenium, Wai-Kai Chen introduced a monumental reference for the design, analysis, and prediction of VLSI circuits: The VLSI Handbook. Still a valuable tool for dealing with the most dynamic field in engineering, this second edition includes 13 sections comprising nearly 100 chapters focused on the key concepts, models, and equations. Written by a stellar international panel of expert contributors, this handbook is a reliable, comprehensive resource for real answers

to practical problems. It emphasizes fundamental theory underlying professional applications and also reflects key areas of industrial and research focus. WHAT'S IN THE SECOND EDITION? Sections on Low-power electronics and design VLSI signal processing Chapters on CMOS fabrication Content-addressable memory Compound semiconductor RF circuits High-speed circuit design principles SiGe HBT technology Bipolar junction transistor amplifiers Performance modeling and analysis using SystemC Design languages, expanded from two chapters to twelve Testing of digital systems Structured for convenient navigation and loaded with practical solutions, The VLSI Handbook, Second Edition remains the first choice for answers to the problems and challenges faced daily in engineering practice.

Crystal Fire

Semiconductor sensors patterned at the micron scale combined with custom-designed integrated circuits have revolutionized semiconductor radiation detector systems. Designs covering many square meters with millions of signal channels are now commonplace in high-energy physics and the technology is finding its way into many other fields, ranging from astrophysics to experiments at synchrotron light sources and medical imaging. This book is the first to present a comprehensive discussion of the many facets of highly integrated semiconductor detector systems, covering sensors, signal processing, transistors and circuits, low-noise electronics, and radiation effects. The diversity of design approaches is

illustrated in a chapter describing systems in high-energy physics, astronomy, and astrophysics. Finally a chapter "Why things don't work" discusses common pitfalls. Profusely illustrated, this book provides a unique reference in a key area of modern science.

Radio Frequency Integrated Circuits and Systems

Two leading physicians' prescription for solving our health care problems: organizing the fragmented system that delivers care. One of the most daunting challenges facing the new U.S. administration is health care reform. The size of the system, the number of stakeholders, and ever-rising costs make the problem seem almost intractable. But in *Chaos and Organization in Health Care*, two leading physicians offer an optimistic prognosis. In their frontline work as providers, Thomas Lee and James Mongan see the inefficiency, the missed opportunities, and the occasional harm that can result from the current system. The root cause of these problems, they argue, is chaos in the delivery of care. If the problem is chaos, the solution is organization, and in this timely and outspoken book, they offer a plan. In many ways, this chaos is caused by something good: the dramatic progress in medical science—the explosion of medical knowledge and the exponential increase in treatment options. Imposed on a fragmented system of small practices and individual patients with multiple providers, progress results in chaos. Lee and Mongan argue that attacking this chaos is even more important

than whether health care is managed by government or controlled by market forces. Some providers are already tightly organized, adapting management principles from business and offering care that is by many measures safer, better, and less costly. Lee and Mongan propose multiple strategies that can be adopted nationwide, including electronic medical records and information systems for sharing knowledge; team-based care, with doctors and other providers working together; and disease management programs to coordinate care for the sickest patients.

IEEE Circuits & Devices

Improving the performance of the power amplifier is the most pressing problem facing designers of modern radio-frequency (RF) transceivers. Linearity and power efficiency of the transmit path are of utmost importance, and the power amplifier has proven to be the bottleneck for both. High linearity enables transmission at the highest data rates for a given channel bandwidth, and power efficiency prolongs battery lifetime in portable units and reduces heat dissipation in high-power transmitters. Cartesian feedback is a power amplifier linearization technique that acts to soften the tradeoff between power efficiency and linearity in power amplifiers. Despite its compelling, fundamental advantages, the technique has not enjoyed widespread acceptance because of certain implementation difficulties. Feedback Linearization of RF Power Amplifiers introduces new techniques for

overcoming the challenges faced by the designer of a Cartesian feedback system. The theory of the new techniques are described and analyzed in detail. The book culminates with the results of the first known fully integrated Cartesian feedback power amplifier system, whose design was enabled by the techniques described. Feedback Linearization of RF Power Amplifiers is a valuable reference work for engineers in the telecommunications industry, industry researchers, academic researchers.

Millimeter Wave Wireless Communications

Equips students with essential industry-relevant knowledge through in-depth explanations, practical applications, examples, and exercises.

Analog/RF and Mixed-Signal Circuit Systematic Design

Despite the fact that in the digital domain, designers can take full benefits of IPs and design automation tools to synthesize and design very complex systems, the analog designers' task is still considered as a 'handcraft', cumbersome and very time consuming process. Thus, tremendous efforts are being deployed to develop new design methodologies in the analog/RF and mixed-signal domains. This book collects 16 state-of-the-art contributions devoted to the topic of systematic design

of analog, RF and mixed signal circuits. Divided in the two parts Methodologies and Techniques recent theories, synthesis techniques and design methodologies, as well as new sizing approaches in the field of robust analog and mixed signal design automation are presented for researchers and R/D engineers.

The Design of Low Noise Oscillators

Focuses on the human factors behind the invention of the twentieth century's defining artifact, the transistor, highlighting the pride, jealousy, and scientific ambitions of the Bell Labs team who spawned the epoch-making technology.

Design of Analog CMOS Integrated Circuits

A new and innovative paradigm for RF frequency synthesis and wireless transmitter design Learn the techniques for designing and implementing an all-digital RF frequency synthesizer. In contrast to traditional RF techniques, this innovative book sets forth digitally intensive design techniques that lead the way to the development of low-cost, low-power, and highly integrated circuits for RF functions in deep submicron CMOS processes. Furthermore, the authors demonstrate how the architecture enables readers to integrate an RF front-end with the digital back-end onto a single silicon die using standard ASIC design flow.

Taking a bottom-up approach that progressively builds skills and knowledge, the book begins with an introduction to basic concepts of frequency synthesis and then guides the reader through an all-digital RF frequency synthesizer design: Chapter 2 presents a digitally controlled oscillator (DCO), which is the foundation of a novel architecture, and introduces a time-domain model used for analysis and VHDL simulation Chapter 3 adds a hierarchical layer of arithmetic abstraction to the DCO that makes it easier to operate algorithmically Chapter 4 builds a phase correction mechanism around the DCO such that the system's frequency drift or wander performance matches that of the stable external frequency reference Chapter 5 presents an application of the all-digital RF synthesizer Chapter 6 describes the behavioral modeling and simulation methodology used in design The final chapter presents the implementation of a full transmitter and experimental results. The novel ideas presented here have been implemented and proven in two high-volume, commercial single-chip radios developed at Texas Instruments: Bluetooth and GSM. While the focus of the book is on RF frequency synthesizer design, the techniques can be applied to the design of other digitally assisted analog circuits as well. This book is a must-read for students and engineers who want to learn a new paradigm for RF frequency synthesis and wireless transmitter design using digitally intensive design techniques.

Feedback Linearization of RF Power Amplifiers

Current Sources and Voltage References

This book provides an insight into the 'hot' field of Radio Frequency Identification (RFID) Systems In this book, the authors provide an insight into the field of RFID systems with an emphasis on networking aspects and research challenges related to passive Ultra High Frequency (UHF) RFID systems. The book reviews various algorithms, protocols and design solutions that have been developed within the area, including most recent advances. In addition, authors cover a wide range of recognized problems in RFID industry, striking a balance between theoretical and practical coverage. Limitations of the technology and state-of-the-art solutions are identified and new research opportunities are addressed. Finally, the book is authored by experts and respected researchers in the field and every chapter is peer reviewed. Key Features: Provides the most comprehensive analysis of networking aspects of RFID systems, including tag identification protocols and reader anti-collision algorithms Covers in detail major research problems of passive UHF systems such as improving reading accuracy, reading range and throughput Analyzes other "hot topics" including localization of passive RFID tags, energy harvesting, simulator and emulator design, security and privacy Discusses design of tag antennas, tag and reader circuits for passive UHF RFID systems Presents EPCGlobal architecture framework, middleware and protocols Includes an accompanying website with PowerPoint slides and solutions to the problems <http://www.site.uottawa.ca/~mbolic/RFIDBook/> This book will be an invaluable

guide for researchers and graduate students in electrical engineering and computer science, and researchers and developers in telecommunication industry.

Modern RF and Microwave Measurement Techniques

A transistor-level, design-intensive overview of high speed and high frequency monolithic integrated circuits for wireless and broadband systems from 2 GHz to 200 GHz, this comprehensive text covers high-speed, RF, mm-wave, and optical fibre circuits using nanoscale CMOS, SiGe BiCMOS, and III-V technologies. Step-by-step design methodologies, end-of chapter problems, and practical simulation and design projects are provided, making this an ideal resource for senior undergraduate and graduate courses in circuit design. With an emphasis on device-circuit topology interaction and optimization, it gives circuit designers and students alike an in-depth understanding of device structures and process limitations affecting circuit performance.

High-Frequency Integrated Circuits

By helping students develop an intuitive understanding of the subject, Microelectronics teaches them to think like engineers. The second edition of Razavi's Microelectronics retains its hallmark emphasis on analysis by inspection

and building students' design intuition, and it incorporates a host of new pedagogical features that make it easier to teach and learn from, including: application sidebars, self-check problems with answers, simulation problems with SPICE and MULTISIM, and an expanded problem set that is organized by degree of difficulty and more clearly associated with specific chapter sections.

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