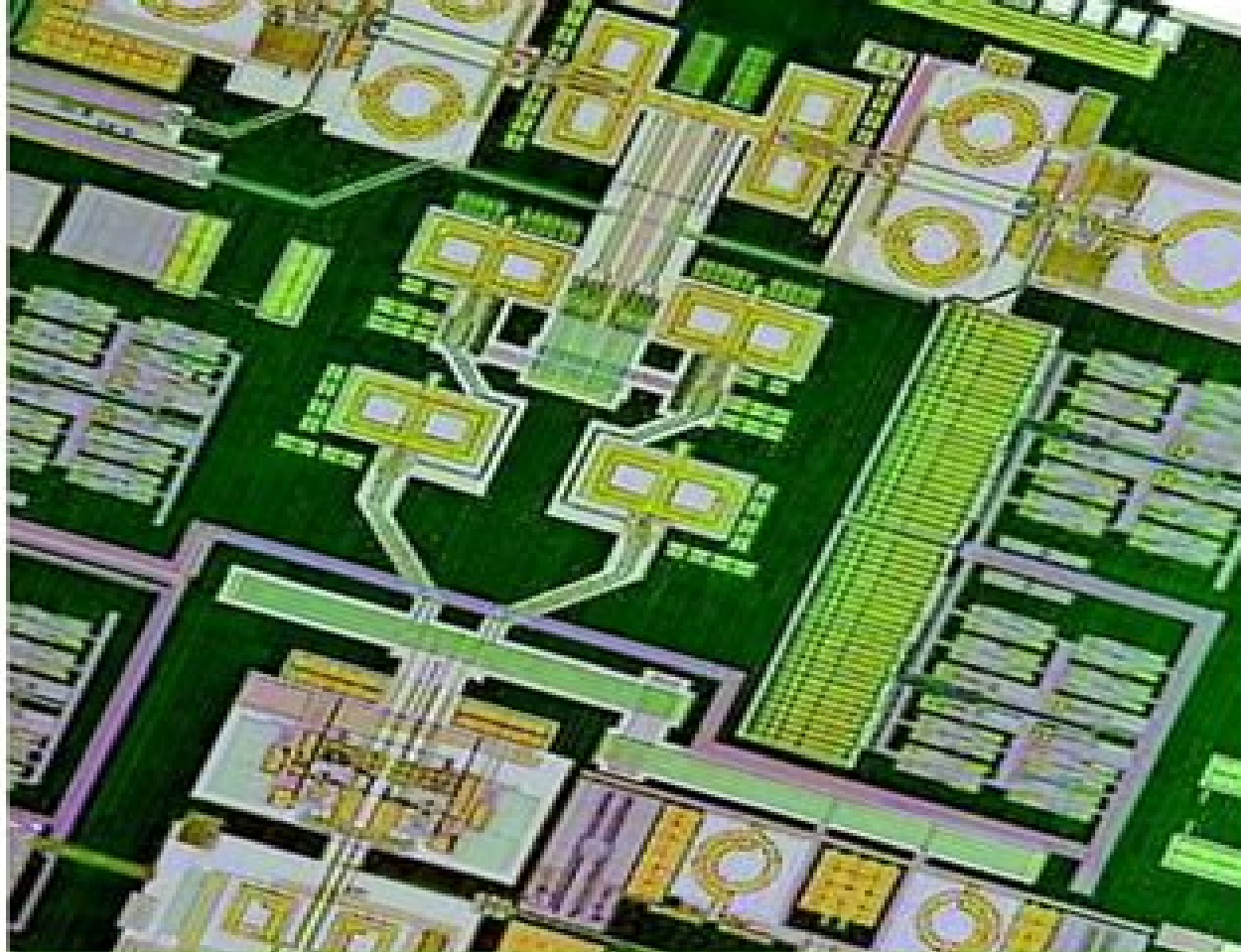




THOMAS H. LEE

The Design of CMOS Radio-Frequency Integrated Circuits

Second Edition

CAMBRIDGE

Design Of Cmos Radio Frequency Integrated Circuits

Inder Bahl



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The Design of CMOS Radio-Frequency Integrated Circuits Thomas H. Lee, 2003-12-22 This book first published in 2004 is an expanded and thoroughly revised edition of Tom Lee's acclaimed guide to the design of gigahertz RF integrated circuits. A new chapter on the principles of wireless systems provides a bridge between system and circuit issues. The chapters on low noise amplifiers, oscillators, and phase noise have been significantly expanded. The chapter on architectures now contains several examples of complete chip designs including a GPS receiver and a wireless LAN transceiver that bring together the theoretical and practical elements involved in producing a prototype chip. Every section has been revised and updated with findings in the field, and the book is packed with physical insights and design tips and includes a historical overview that sets the whole field in context. With hundreds of circuit diagrams and homework problems, this is an ideal textbook for students taking courses on RF design and a valuable reference for practising engineers. *The Design of CMOS Radio-Frequency Integrated Circuits International Student Edition*

Professor Thomas H. Lee, 2004-07-15 An expanded and revised new edition of Tom Lee's acclaimed guide to the design of gigahertz RF integrated circuits. *The Design Of Cmos Radio Frequency Integrated Circuits* LEE, Thomas H. Lee, 2006-08-30 Presenting an expanded and thoroughly revised new edition of Tom Lee's acclaimed guide to the design of gigahertz RF integrated circuits. A new chapter on the principles of wireless systems provides a bridge between system and circuit issues. The chapters on low noise amplifiers, oscillators, and phase noise have been significantly expanded. The chapter on architectures now contains several examples of complete chip designs including a GPS receiver and a wireless LAN transceiver that bring together the theoretical and practical elements involved in producing a prototype chip. Every section has been revised and updated with the latest findings in the field, and the book is packed with physical insights and design tips and includes a historical overview that sets the whole field in context. With hundreds of circuit diagrams and homework problems, this is an ideal textbook for students taking courses on RF design and a valuable reference for practising engineers. **Radio Frequency Integrated Circuit Design**

John W. M. Rogers, Calvin Plett, 2010 This newly revised and expanded edition of the 2003 Artech House classic *Radio Frequency Integrated Circuit Design* serves as an up-to-date practical reference for complete RFIC know-how. The second edition includes numerous updates including greater coverage of CMOS PA design, RFIC design with on-chip components, and more worked examples with simulation results. By emphasizing working designs, this book practically transports you into the authors' own RFIC lab so you can fully understand the function of each design detailed in this book. Among the RFIC designs examined are RF integrated LC-based filters, VCO automatic amplitude control loops, and fully integrated transformer-based circuits, as well as image reject mixers and power amplifiers. If you are new to RFIC design, you can benefit from the introduction to basic theory so you can quickly come up to speed on how RFICs perform and work together in a communications device. A thorough examination of RFIC technology guides you in knowing when RFICs are the right choice for designing a communication

device This leading edge resource is packed with over 1 000 equations and more than 435 illustrations that support key topics

Radio Frequency Integrated Circuit Design John W. M. Rogers, Calvin Plett, 2003 Focuses mainly on bipolar technology to demonstrate circuits but CMOS is included as well

The Design of CMOS Radio-Frequency Integrated Circuits, Second Edition Thomas Lee, 2003 Presenting an expanded and thoroughly revised edition of Tom Lee's acclaimed guide to the design of gigahertz RF integrated circuits A new chapter on the principles of wireless systems provides a bridge between system and circuit issues The chapters on low noise amplifiers oscillators and phase noise have been significantly expanded The chapter on architectures now contains several examples of complete chip designs including a GPS receiver and a wireless LAN transceiver that bring together the theoretical and practical elements involved in producing a prototype chip Every section has been revised and updated with findings in the field and the book is packed with physical insights and design tips and includes a historical overview that sets the whole field in context With hundreds of circuit diagrams and homework problems this is an ideal textbook for students taking courses on RF design and a valuable reference for practising engineers

The Design of CMOS Radio-Frequency Integrated Circuits Thomas H. Lee, 2004 This book first published in 2004 is an expanded and revised edition of Tom Lee's acclaimed RFIC text

High-Linearity CMOS RF Front-End Circuits Yongwang Ding, Ramesh Harjani, 2006-02-08 This book focuses on high performance radio frequency integrated circuits RF IC design in CMOS 1 Development of radio frequency ICs Wireless communications has been advancing rapidly in the past two decades Many high performance systems have been developed such as cellular systems AMPS GSM TDMA CDMA W CDMA etc GPS system global positioning system and WLAN wireless local area network systems The rapid growth of VLSI technology in both digital circuits and analog circuits provides benefits for wireless communication systems Twenty years ago not many people could imagine millions of transistors in a single chip or a complete radio for size of a penny Now not only complete radios have been put in a single chip but also more and more functions have been realized by a single chip and at a much lower price A radio transmits and receives electro magnetic signals through the air The signals are usually transmitted on high frequency carriers For example a typical voice signal requires only 30 Kiloherz bandwidth When it is transmitted by a FM radio station it is often carried by a frequency in the range of tens of megahertz to hundreds of megahertz Usually a radio is categorized by its carrier frequency such as 900 MHz radio or 5 GHz radio In general the higher the carrier frequency the better the directivity but the more difficult the radio design

Design Of Cmos Rf Integrated Circuits And Systems Kiat Seng Yeo, Manh Anh Do, Chirn Chye Boon, 2010-03-24 This book provides the most comprehensive and in depth coverage of the latest circuit design developments in RF CMOS technology It is a practical and cutting edge guide packed with proven circuit techniques and innovative design methodologies for solving challenging problems associated with RF integrated circuits and systems This invaluable resource features a collection of the finest design practices that may soon drive the system on chip revolution Using this book's state of the art design techniques one can

apply existing technologies in novel ways and to create new circuit designs for the future

Radio Frequency Integrated Circuits and Technologies Frank Ellinger, 2008-09-11 In the last decade wireless communications engineering has seen outstanding progress making merged enhanced and novel applications in the area of mobile phones wireless networks sensors and television feasible Technologies have developed from hybrid systems to highly integrated solutions in silicon SiGe GaAs and InP By aggressive scaling of device dimensions below 0.1 μm and employing advanced technologies such as SOI strained silicon and low k circuits with operation frequencies and bandwidths up to approximately 100 GHz can now be fabricated However especially in silicon the restrictions inherent in scaling make circuit engineering a demanding task Examples of these drawbacks are the limited high frequency signal power leakage effects and significant parasitics in passive devices Enhanced circuit topologies and design techniques have to be applied to achieve maximum performance In this context designers must have profound skills in the following areas circuit theory IC technologies communications standards system design measurement techniques etc The aim of this book is to address all these multidisciplinary issues in a compact and comprehensive form and in a single volume Suitable for students engineers and scientists the manuscript provides the necessary theoretical background together with cookbook like optimisation strategies and state of the art design examples Each chapter is accompanied by tutorial questions repeating the key issues of the treated subjects The manuscript is organised as follows Chapter 1 preludes with an introduction concerned with the exciting history of integrated circuits technologies and wireless communications

Designing Bipolar Transistor Radio Frequency Integrated Circuits Allen A. Sweet, 2007-12-01 If you're looking for an in depth and up to date understanding bipolar transistor RFIC design this practical resource is a smart choice Unlike most books on the market that focus on GaAs MESFET or silicon CMOS process technology this unique volume is dedicated exclusively to RFIC designs based on bipolar technology Until now critical GaAs HBT and SiGe HBT process technologies have been largely neglected in reference books This book fills this gap offering you a detailed treatment of this increasingly important topic You discover a wide range of circuit topologies that are optimized for maximum performance with bipolar devices From discussions of key applications Bluetooth UWB GPS WiMax and architectures to in depth coverage of fabrication technologies and amplifier design to a look at performance tradeoffs and production costs this book arms you with complete design know how for your challenging work in the field

Radio-Frequency Integrated-Circuit Engineering Cam Nguyen, 2015-03-04 Radio Frequency Integrated Circuit Engineering addresses the theory analysis and design of passive and active RFICs using Si based CMOS and Bi CMOS technologies and other non silicon based technologies The materials covered are self contained and presented in such detail that allows readers with only undergraduate electrical engineering knowledge in EM RF and circuits to understand and design RFICs Organized into sixteen chapters blending analog and microwave engineering Radio Frequency Integrated Circuit Engineering emphasizes the microwave engineering approach for RFICs Provides essential knowledge in EM and microwave engineering passive and

active RFICs RFIC analysis and design techniques and RF systems vital for RFIC students and engineers Blends analog and microwave engineering approaches for RFIC design at high frequencies Includes problems at the end of each chapter

Low-Voltage CMOS RF Frequency Synthesizers Howard Cam Luong, Gerry Chi Tak Leung, 2004-08-26 A frequency synthesizer is one of the most critical building blocks in any wireless transceiver system Its design is getting more and more challenging as the demand for low voltage low power high frequency wireless systems continuously grows As the supply voltage is decreased many existing design techniques are no longer applicable This book provides the reader with architectures and design techniques to enable CMOS frequency synthesizers to operate at low supply voltage at high frequency with good phase noise and low power consumption In addition to updating the reader on many of these techniques in depth this book will also introduce useful guidelines and step by step procedure on behaviour simulations of frequency synthesizers Finally three successfully demonstrated CMOS synthesizer prototypes with detailed design consideration and description will be elaborated to illustrate potential applications of the architectures and design techniques described For engineers managers and researchers working in radio frequency integrated circuit design for wireless applications

Wireless Radio-Frequency Standards and System Design: Advanced Techniques Cornetta, Gianluca, Santos, David J., Vazquez, Jose Manuel, 2012-01-31 Radio frequency RF integrated circuits in CMOS technology are gaining increasing popularity in the commercial world and CMOS technology has become the dominant technology for applications such as GPS receivers GSM cellular transceivers wireless LAN and wireless short range personal area networks based on IEEE 802 15 1 Bluetooth or IEEE 802 15 4 ZigBee standards Furthermore the increasing interest in wireless technologies and the widespread of wireless communications has prompted an ever increasing demand for radio frequency transceivers Wireless Radio Frequency Standards and System Design Advanced Techniques provides perspectives on radio frequency circuit and systems design covering recent topics and developments in the RF area Exploring topics such as LNA linearization behavioral modeling and co simulation of analog and mixed signal complex blocks for RF applications integrated passive devices for RF ICs and baseband design techniques and wireless standards this is a comprehensive reference for students as well as practicing professionals

Fundamentals of RF and Microwave Transistor Amplifiers Inder Bahl, 2009-06-17 A Comprehensive and Up to Date Treatment of RF and Microwave Transistor Amplifiers This book provides state of the art coverage of RF and microwave transistor amplifiers including low noise narrowband broadband linear high power high efficiency and high voltage Topics covered include modeling analysis design packaging and thermal and fabrication considerations Through a unique integration of theory and practice readers will learn to solve amplifier related design problems ranging from matching networks to biasing and stability More than 240 problems are included to help readers test their basic amplifier and circuit design skills and more than half of the problems feature fully worked out solutions With an emphasis on theory design and everyday applications this book is geared toward students teachers scientists and practicing

engineers who are interested in broadening their knowledge of RF and microwave transistor amplifier circuit design

Ultra Wideband Mohammad Abdul Matin, 2012-10-03 Ultra wideband UWB has advanced and merged as a technology and many more people are aware of the potential for this exciting technology. The current UWB field is changing rapidly with new techniques and ideas where several issues are involved in developing the systems. Among UWB system design, the UWB RF transceiver and UWB antenna are the key components. Recently, a considerable amount of researches has been devoted to the development of the UWB RF transceiver and antenna for its enabling high data transmission rates and low power consumption. Our book attempts to present current and emerging trends in research and development of UWB systems as well as future expectations. *Selected Topics in RF, Analog and Mixed Signal Circuits and Systems* Kiran

Gunnam, Mohammad Vahid Far, 2022-09-01 CMOS process technology progress has led to a revolution towards new and innovative integrated circuits and systems. This trend is still moving forward for applications ranging from high speed wireless and wireline data transfer down to ultra low power mobile applications for more interconnected world. The high performance analog and RF circuits and systems are at the heart of all these developments. *Selected Topics in RF Analog and Mixed Signal Circuits and Systems* provides an overview and the state of the art developments on several selected topics in RF analog and mixed signal circuits and system. The topics include ADC conversion and equalization for high speed links, clock and data recovery for high speed wireline transmission with speeds in several Gb/s, signal generation for terahertz application, oscillator phase noise fundamentals and analog digital PLL overview. Topics covered in the book include Overview of Oscillator Phase Noise, Clock and Data Recovery in High Speed Wireline Communication, Phase Lock Loop Design Techniques, Terahertz and mm Wave Signal Generation Synthesis and Amplification, Reaching the Fundamental Limits, Equalization and A/D conversion for high speed links. *An Introduction to Radio Frequency Engineering* Christopher

Coleman, 2004-05-13 Originally published in 2004, this book provides a detailed introduction to radio frequency RF engineering using a straightforward and easily understood approach combined with numerous worked examples, illustrations and homework problems. The author focuses on minimising the mathematics needed to grasp the subject while providing a solid theoretical foundation for the student. Emphasis is also placed on the practical aspects of radio engineering. The book provides a broad coverage of RF systems, circuit design, antennas, propagation and digital techniques. It will provide an excellent introduction to the subject for graduate students, researchers and practising engineers. *RF Analog Impairments Modeling for Communication Systems Simulation* Lydi Smaini, 2012-10-04

With the growing complexity of personal mobile communication systems demanding higher data rates and high levels of integration using low cost CMOS technology, overall system performance has become more sensitive to RF analog front end impairments. Designing integrated transceivers requires a thorough understanding of the whole transceiver chain including RF analog front end and digital baseband. Communication system engineers have to include RF analog imperfections in their simulation benches in order to study and

quantify their impact on the system performance Here the author explores key RF analog impairments in a transceiver and demonstrates how to model their impact from a communication system design view point He discusses the design aspects of the front end of transceivers both receivers and transmitters and provides the reader with a way to optimize a complex mixed signal platform by taking into account the characteristics of the RF analog front end Key features of this book include Practical examples illustrated by system simulation results based on WiFi and mobile WiMAX OFDM transceivers An overview of the digital estimation and compensation of the RF analog impairments such as power amplifier distortion quadrature imbalance and carrier and sampling frequency offsets An exposition of the challenges involved in the design of both RF analog circuits and DSP communication circuits in deep submicron CMOS technology MATLAB codes for RF analog impairments models hosted on the companion website Uniquely the book bridges the gap between RFIC design specification needs and communication systems simulation offering readers RF analog impairments modeling knowledge and a comprehensive approach to unifying theory and practice in system modelling It is of great value to communication systems and DSP engineers and graduate students who design communication processing engines RF analog systems and IC design engineers involved in the design of communication platforms

Linearization and Efficiency Enhancement Techniques for Silicon Power Amplifiers Eric Kerhervé, Didier Belot, 2015-01-07 This book provides an overview of current efficiency enhancement and linearization techniques for silicon power amplifier designs It examines the latest state of the art technologies and design techniques to address challenges for RF cellular mobile base stations and RF and mmW WLAN applications Coverage includes material on current silicon CMOS SiGe RF and mmW power amplifier designs focusing on advantages and disadvantages compared with traditional GaAs implementations With this book you will learn The principles of linearization and efficiency improvement techniques The architectures allowing the optimum design of multimode Si RF and mmW power amplifiers How to make designs more efficient by employing new design techniques such as linearization and efficiency improvement Layout considerations Examples of schematic layout simulation and measurement results Addresses the problems of high power generation faithful construction of non constant envelope constellations and efficient and well control power radiation from integrated silicon chips Demonstrates how silicon technology can solve problems and trade offs of power amplifier design including price size complexity and efficiency Written and edited by the top contributors to the field

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