

# Transistor Level Modeling for Analog/RF IC Design

*Edited by*  
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 Springer

# Transistor Level Modeling For Analogrf Ic Design

**Chao Zhang**



## **Transistor Level Modeling For Analogrf Ic Design:**

**Transistor Level Modeling for Analog/RF IC Design** Wladyslaw Grabinski, Bart Nauwelaers, Dominique Schreurs, 2006-07-01 Among many great inventions made in the 20th century electronic circuits which later evolved into integrated circuits are probably the biggest when considering their contribution to human society Entering the 21st century the importance of integrated circuits has increased even more In fact without the help of integrated circuits recent high technology society with the internet cellular phone car navigation digital camera and robot would never have been realized Nowadays integrated circuits are indispensable for almost every activity of our society One of the critical issues for the fabrication of integrated circuits has been the precise design of the high speed or high frequency operation of circuits with huge number of components It is quite natural to predict the circuit operation by computer calculation and there have been three waves for this at 15 year intervals The rst wave came at the beginning of the 1970s when LSIs Large Scale Integrated circuits with more than 1000 components had just been introduced into the market A mainframe computer was used for the simulation and each semiconductor company used its own proprietary simulators and device models However the capability of the computer and accuracy of the model were far from satisfactory and there are many cases of the necessity of circuit redesign after evaluation of the rst chip The second wave hit us in the middle of 1980s when the EWS Engineering Work Station was introduced for use by designers

*Organic and Inorganic Light Emitting Diodes* T.D. Subash, J. Ajayan, Wladek Grabinski, 2023-06-19 This book covers a comprehensive range of topics on the physical mechanisms of LEDs light emitting diodes scattering effects challenges in fabrication and efficient enhancement techniques in organic and inorganic LEDs It deals with various reliability issues in organic inorganic LEDs like trapping and scattering effects packaging failures efficiency droops irradiation effects thermal degradation mechanisms and thermal degradation processes Features Provides insights into the improvement of performance and reliability of LEDs Highlights the optical power improvement mechanisms in LEDs Covers the challenges in fabrication and packaging of LEDs Discusses pertinent failures and degradation mechanisms Includes droop minimization techniques This book is aimed at researchers and graduate students in LEDs illumination engineering optoelectronics and polymer organic materials

*Circuits and Systems Advances in Near Threshold Computing* Sanghamitra Roy, 2021-05-11 Modern society is witnessing a sea change in ubiquitous computing in which people have embraced computing systems as an indispensable part of day to day existence Computation storage and communication abilities of smartphones for example have undergone monumental changes over the past decade However global emphasis on creating and sustaining green environments is leading to a rapid and ongoing proliferation of edge computing systems and applications As a broad spectrum of healthcare home and transport applications shift to the edge of the network near threshold computing NTC is emerging as one of the promising low power computing platforms An NTC device sets its supply voltage close to its threshold voltage dramatically reducing the energy consumption Despite showing

substantial promise in terms of energy efficiency NTC is yet to see widescale commercial adoption This is because circuits and systems operating with NTC suffer from several problems including increased sensitivity to process variation reliability problems performance degradation and security vulnerabilities to name a few To realize its potential we need designs techniques and solutions to overcome these challenges associated with NTC circuits and systems The readers of this book will be able to familiarize themselves with recent advances in electronics systems focusing on near threshold computing

*The gm/ID Methodology, a sizing tool for low-voltage analog CMOS Circuits* Paul Jespers, 2009-12-01 IC designers appraise currently MOS transistor geometries and currents to compromise objectives like gain bandwidth slew rate dynamic range noise non linear distortion etc Making optimal choices is a difficult task How to minimize for instance the power consumption of an operational amplifier without too much penalty regarding area while keeping the gain bandwidth unaffected in the same time Moderate inversion yields high gains but the concomitant area increase adds parasitics that restrict bandwidth Which methodology to use in order to come across the best compromise s Is synthesis a mixture of design experience combined with cut and tries or is it a constrained multivariate optimization problem or a mixture Optimization algorithms are attractive from a system perspective of course but what about low voltage low power circuits requiring a more physical approach The connections amid transistor physics and circuits are intricate and their interactions not always easy to describe in terms of existing software packages The gm ID synthesis methodology is adapted to CMOS analog circuits for the transconductance over drain current ratio combines most of the ingredients needed in order to determine transistors sizes and DC currents

**Load-Pull Techniques with Applications to Power Amplifier Design** Fadhel M. Ghannouchi, Mohammad S. Hashmi, 2012-06-06 This first book on load pull systems is intended for readers with a broad knowledge of high frequency transistor device characterization nonlinear and linear microwave measurements RF power amplifiers and transmitters Load Pull Techniques with Applications to Power Amplifier Design fulfills the demands of users designers and researchers both from industry and academia who have felt the need of a book on this topic It presents a comprehensive reference spanning different load pull measurement systems waveform measurement and engineering systems and associated calibration procedures for accurate large signal characterization Besides this book also provides in depth practical considerations required in the realization and usage of load pull and waveform engineering systems In addition it also provides procedure to design application specific load pull setup and includes several case studies where the user can customize architecture of load pull setups to meet any specific measurement requirements Furthermore the materials covered in this book can be part of a full semester graduate course on microwave device characterization and power amplifier design

**Microwave and Millimetre-Wave Design for Wireless Communications** Ian Robertson, Nutapong Somjit, Mitchai Chongcheawchamnan, 2016-06-29 This book describes a full range of contemporary techniques for the design of transmitters and receivers for communications systems operating in the range from 1 through to

300 GHz In this frequency range there is a wide range of technologies that need to be employed with silicon ICs at the core but compared with other electronics systems a much greater use of more specialist devices and components for high performance for example high Q factor low loss and good power efficiency Many text books do of course cover these topics but what makes this book timely is the rapid adoption of millimetre waves frequencies from 30 to 300 GHz for a wide range of consumer applications such as wireless high definition TV 5G Gigabit mobile internet systems and automotive radars It has taken many years to develop low cost technologies for suitable transmitters and receivers so previously these frequencies have been employed only in expensive military and space applications The book will cover these modern technologies with the follow topics covered transmitters and receivers lumped element filters transmission lines and S parameters RF MEMS RFICs and MMICs and many others In addition the book includes extensive line diagrams to illustrate circuit diagrams and block diagrams of systems including diagrams and photographs showing how circuits are implemented practically Furthermore case studies are also included to explain the salient features of a range of important wireless communications systems The book is accompanied with suitable design examples and exercises based on the Advanced Design System the industry leading CAD tool for wireless design More importantly the authors have been working with Keysight Technologies on a learning teaching initiative which is designed to promote access to industry standard EDA tools such as ADS Through its University Educational Support Program Keysight offers students the opportunity to request a student license backed up with extensive classroom materials and support resources This culminates with students having the chance to demonstrate their RF MW design and measurement expertise through the Keysight RF Microwave Industry Ready Student Certification Program [www.keysight.com](http://www.keysight.com) find eesof university [www.keysight.com](http://www.keysight.com) find eesof student certification

**Springer Handbook of Semiconductor Devices** Massimo Rudan, Rossella Brunetti, Susanna Reggiani, 2022-11-10 This Springer Handbook comprehensively covers the topic of semiconductor devices embracing all aspects from theoretical background to fabrication modeling and applications Nearly 100 leading scientists from industry and academia were selected to write the handbook s chapters which were conceived for professionals and practitioners material scientists physicists and electrical engineers working at universities industrial R D and manufacturers Starting from the description of the relevant technological aspects and fabrication steps the handbook proceeds with a section fully devoted to the main conventional semiconductor devices like e g bipolar transistors and MOS capacitors and transistors used in the production of the standard integrated circuits and the corresponding physical models In the subsequent chapters the scaling issues of the semiconductor device technology are addressed followed by the description of novel concept based semiconductor devices The last section illustrates the numerical simulation methods ranging from the fabrication processes to the device performances Each chapter is self contained and refers to related topics treated in other chapters when necessary so that the reader interested in a specific subject can easily identify a personal reading path through the vast contents of the handbook

*Structured Analog CMOS*

*Design* Danica Stefanovic, Maher Kayal, 2008-10-20 Structured Analog CMOS Design describes a structured analog design approach that makes it possible to simplify complex analog design problems and develop a design strategy that can be used for the design of large number of analog cells. It intentionally avoids treating the analog design as a mathematical problem, developing a design procedure based on the understanding of device physics and approximations that give insight into parameter interdependences. The basic design concept consists in analog cell partitioning into the basic analog structures and sizing of these basic analog structures in a predefined procedural design sequence. The procedural design sequence ensures the correct propagation of design specifications, the verification of parameter limits and the local optimization loops. The proposed design procedure is also implemented as a CAD tool that follows this book. *Tradeoffs and Optimization in Analog CMOS Design* David Binkley, 2008-09-15 Analog CMOS integrated circuits are in widespread use for communications, entertainment, multimedia, biomedical and many other applications that interface with the physical world. Although analog CMOS design is greatly complicated by the design choices of drain current, channel width and channel length present for every MOS device in a circuit, these design choices afford significant opportunities for optimizing circuit performance. This book addresses tradeoffs and optimization of device and circuit performance for selections of the drain current, inversion coefficient and channel length, where channel width is implicitly considered. The inversion coefficient is used as a technology independent measure of MOS inversion that permits design freely in weak, moderate and strong inversion. This book details the significant performance tradeoffs available in analog CMOS design and guides the designer towards optimum design by describing an interpretation of MOS modeling for the analog designer motivated by the EKV MOS model using tabulated hand expressions and figures that give performance and tradeoffs for the design choices of drain current, inversion coefficient and channel length. Performance includes effective gate source bias and drain source saturation voltages, transconductance efficiency, transconductance distortion, normalized drain source conductance, capacitances, gain and bandwidth measures, thermal and flicker noise mismatch and gate and drain leakage current. Measured data that validates the inclusion of important small geometry effects like velocity saturation, vertical field mobility reduction, drain induced barrier lowering and inversion level increases in gate referred flicker noise voltage. In depth treatment of moderate inversion which offers low bias compliance voltages, high transconductance efficiency and good immunity to velocity saturation effects for circuits designed in modern low voltage processes. Fabricated design examples that include operational transconductance amplifiers optimized for various tradeoffs in DC and AC performance and micropower low noise preamplifiers optimized for minimum thermal and flicker noise. A design spreadsheet available at the book web site that facilitates rapid optimum design of MOS devices and circuits. *Tradeoffs and Optimization in Analog CMOS Design* is the first book dedicated to this important topic. It will help practicing analog circuit designers and advanced students of electrical engineering build design intuition, rapidly optimize circuit performance during initial design and minimize trial and error circuit simulations. *Radio Frequency System*

*Architecture and Design* John W. M. Rogers, Calvin Plett, Ian Marsland, 2013-10-01 Communication devices such as smart phones GPS systems and Bluetooth are now part of our daily lives more than ever before As our communication equipment becomes more sophisticated so do the radios and other hardware required to enable that technology Common radio architectures are required to make this technology work seamlessly This resource describes practical aspects of radio frequency communications systems design bridging the gap between system level design considerations and circuit level design specifications Industry experts not only provide detailed calculations and theory to determine block level specifications but also discuss basic theory and operational concepts This resource also includes extensive up to date application examples

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