

Low-Power CMOS Circuits

Technology, Logic Design
and CAD Tools

Christian Piguet



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Low Power Cmos Circuits Technology Logic

**Anantha P. Chandrakasan, Robert W.
Brodersen**



Low Power Cmos Circuits Technology Logic:

Low-Power CMOS Circuits Christian Piguet, 2005-11-01 The power consumption of microprocessors is one of the most important challenges of high performance chips and portable devices In chapters drawn from Piguet s recently published Low Power Electronics Design Low Power CMOS Circuits Technology Logic Design and CAD Tools addresses the design of low power circuitry in deep submicron technologies It provides a focused reference for specialists involved in designing low power circuitry from transistors to logic gates The book is organized into three broad sections for convenient access The first examines the history of low power electronics along with a look at emerging and possible future technologies It also considers other technologies such as nanotechnologies and optical chips that may be useful in designing integrated circuits The second part explains the techniques used to reduce power consumption at low levels These include clock gating leakage reduction interconnecting and communication on chips and adiabatic circuits The final section discusses various CAD tools for designing low power circuits This section includes three chapters that demonstrate the tools and low power design issues at three major companies that produce logic synthesizers Providing detailed examinations contributed by leading experts Low Power CMOS Circuits Technology Logic Design and CAD Tools supplies authoritative information on how to design and model for high performance with low power consumption in modern integrated circuits It is a must read for anyone designing modern computers or embedded systems [MOS Devices for Low-Voltage and Low-Energy Applications](#) Yasuhisa

Omura, Abhijit Mallik, Naoto Matsuo, 2017-02-28 Helps readers understand the physics behind MOS devices for low voltage and low energy applications Based on timely published and unpublished work written by expert authors Discusses various promising MOS devices applicable to low energy environmental and biomedical uses Describes the physical effects quantum tunneling of MOS devices Demonstrates the performance of devices helping readers to choose right devices applicable to an industrial or consumer environment Addresses some Ge based devices and other compound material based devices for high frequency applications and future development of high performance devices Seemingly innocuous everyday devices such as smartphones tablets and services such as on line gaming or internet keyword searches consume vast amounts of energy Even when in standby mode all these devices consume energy The upcoming Internet of Things IoT is expected to deploy 60 billion electronic devices spread out in our homes cars and cities Britain is already consuming up to 16 per cent of all its power through internet use and this rate is doubling every four years According to The UK s Daily Mail May 2015 if usage rates continue all of Britain s power supply could be consumed by internet use in just 20 years In 2013 U S data centers consumed an estimated 91 billion kilowatt hours of electricity corresponding to the power generated by seventeen 1000 megawatt nuclear power plants Data center electricity consumption is projected to increase to roughly 140 billion kilowatt hours annually by 2020 the equivalent annual output of 50 nuclear power plants Natural Resources Defense Council USA Feb 2015 All these examples stress the urgent need for developing electronic devices that consume as little energy as possible The

book MOS Devices for Low Voltage and Low Energy Applications explores the different transistor options that can be utilized to achieve that goal. It describes in detail the physics and performance of transistors that can be operated at low voltage and consume little power such as subthreshold operation in bulk transistors, fully depleted SOI devices, tunnel FETs, multigate and gate all around MOSFETs. Examples of low energy circuits making use of these devices are given as well. The book MOS Devices for Low Voltage and Low Energy Applications is a good reference for graduate students, researchers, semiconductor and electrical engineers who will design the electronic systems of tomorrow. Dr. Jean Pierre Colinge, Taiwan Semiconductor Manufacturing Company, TSMC. The authors present a creative way to show how different MOS devices can be used for low voltage and low power applications. They start with Bulk MOSFET, following with SOI MOSFET, FinFET, gate all around MOSFET, Tunnel FET and others. It is presented the physics behind the devices, models, simulations, experimental results and applications. This book is interesting for researchers, graduate and undergraduate students. The low energy field is an important topic for integrated circuits in the future and none can stay out of this. Prof. Joao A. Martino, University of Sao Paulo, Brazil.

Integrated Circuit and System Design. Power and Timing Modeling, Optimization and Simulation José L. Ayala, Delong Shang, Alex Yakovlev, 2013-01-03. This book constitutes the refereed proceedings of the 22nd International Conference on Integrated Circuit and System Design, PATMOS 2012, held in Newcastle, UK, Spain, in September 2012. The 25 revised full papers presented were carefully reviewed and selected from numerous submissions. The paper features emerging challenges in methodologies and tools for the design of upcoming generations of integrated circuits and systems, including reconfigurable hardware such as FPGAs. The technical program focuses on timing performance and power consumption as well as architectural aspects with particular emphasis on modeling, design, characterization, analysis and optimization.

Low Power Vlsi Design And Technology Farid N. Najm, Garey K-h. Yeap, 1996-08-30. Low power and low energy VLSI has become an important issue in today's consumer electronics. This book is a collection of pioneering applied research papers in low power VLSI design and technology. A comprehensive introductory chapter presents the current status of the industry and academic research in the area of low power VLSI design and technology. Other topics cover logic synthesis, floorplanning, circuit design and analysis from the perspective of low power requirements. The readers will have a sampling of some key problems in this area as the low power solutions span the entire spectrum of the design process. The book also provides excellent references on up to date research and development issues with practical solution techniques.

Low-Power Digital VLSI Design Abdellatif Bellaouar, Mohamed Elmasry, 2012-12-06. Low Power Digital VLSI Design: Circuits and Systems addresses both process technologies and device modeling. Power dissipation in CMOS circuits, several practical circuit examples and low power techniques are discussed. Low voltage issues for digital CMOS and BiCMOS circuits are emphasized. The book also provides an extensive study of advanced CMOS subsystem design. A low power design methodology is presented with various power minimization techniques at the circuit, logic architecture and algorithm levels. Features: Low

voltage CMOS device modeling technology files design rules Switching activity concept low power guidelines to engineering practice Pass transistor logic families Power dissipation of I/O circuits Multi and low VT CMOS logic static power reduction circuit techniques State of the art design of low voltage BiCMOS and CMOS circuits Low power techniques in CMOS SRAMS and DRAMS Low power on chip voltage down converter design Numerous advanced CMOS subsystems e.g. adders multipliers data path memories regular structures phase locked loops with several design options trading power delay and area Low power design methodology power estimation techniques Power reduction techniques at the logic architecture and algorithm levels More than 190 circuits explained at the transistor level

Integrated Circuit and System Design. Power and Timing Modeling, Optimization and Simulation

Jose L. Ayala, Braulio Garcia-Camara, Manuel Prieto, Martino Ruggiero, Gilles Sicard, 2011-09-25 This book constitutes the refereed proceedings of the 21st International Conference on Integrated Circuit and System Design PATMOS 2011 held in Madrid Spain in September 2011 The 34 revised full papers presented were carefully reviewed and selected from numerous submissions The paper feature emerging challenges in methodologies and tools for the design of upcoming generations of integrated circuits and systems and focus especially on timing performance and power consumption as well as architectural aspects with particular emphasis on modeling design characterization analysis and optimization

Ulsi Front-end Technology: Covering From The First Semiconductor Paper To Cmos Finfet Technology Wai Shing Lau, 2017-08-23 The main focus of this book is ULSI front end technology It covers from the early history of semiconductor science technology from 1874 to state of the art FINFET technology in 2016 Some ULSI back end technology is also covered for example the science and technology of MIM capacitors for analog CMOS has been included in this book

Low Power Digital CMOS Design Anantha P. Chandrakasan, Robert W. Brodersen, 1995-06-30 Power consumption has become a major design consideration for battery operated portable systems as well as high performance desktop systems Strict limitations on power dissipation must be met by the designer while still meeting ever higher computational requirements A comprehensive approach is thus required at all levels of system design ranging from algorithms and architectures to the logic styles and the underlying technology Potentially one of the most important techniques involves combining architecture optimization with voltage scaling allowing a trade off between silicon area and low power operation Architectural optimization enables supply voltages of the order of 1 V using standard CMOS technology Several techniques can also be used to minimize the switched capacitance including representation optimizing signal correlations minimizing spurious transitions optimizing sequencing of operations activity driven power down etc The high efficiency of DC/DC converter circuitry required for efficient low voltage and low current level operation is described by Stratakos Sullivan and Sanders The application of various low power techniques to a chip set for multimedia applications shows that orders of magnitude reduction in power consumption is possible The book also features an analysis by Professor Meindl of the fundamental limits of power consumption achievable at all levels of the design hierarchy Svensson of ISI

describes emerging adiabatic switching techniques that can break the CV²f barrier and reduce the energy per computation at a fixed voltage Srivastava of AT T presents the application of aggressive shut down techniques to microprocessor applications **Electronic Design Automation for IC Implementation, Circuit Design, and Process Technology**

Luciano Lavagno,Igor L. Markov,Grant Martin,Louis K. Scheffer,2017-02-03 The second of two volumes in the Electronic Design Automation for Integrated Circuits Handbook Second Edition Electronic Design Automation for IC Implementation Circuit Design and Process Technology thoroughly examines real time logic RTL to GDSII a file format used to transfer data of semiconductor physical layout design flow analog mixed signal design physical verification and technology computer aided design TCAD Chapters contributed by leading experts authoritatively discuss design for manufacturability DFM at the nanoscale power supply network design and analysis design modeling and much more New to This Edition Major updates appearing in the initial phases of the design flow where the level of abstraction keeps rising to support more functionality with lower non recurring engineering NRE costs Significant revisions reflected in the final phases of the design flow where the complexity due to smaller and smaller geometries is compounded by the slow progress of shorter wavelength lithography New coverage of cutting edge applications and approaches realized in the decade since publication of the previous edition these are illustrated by new chapters on 3D circuit integration and clock design Offering improved depth and modernity Electronic Design Automation for IC Implementation Circuit Design and Process Technology provides a valuable state of the art reference for electronic design automation EDA students researchers and professionals *Low Power VLSI Design and Technology* Gary K. Yeap,Farid N. Najm,1996 Low power and low energy VLSI has become an important issue in today s consumer electronics This book is a collection of pioneering applied research papers in low power VLSI design and technology A comprehensive introductory chapter presents the current status of the industry and academic research in the area of low power VLSI design and technology Other topics cover logic synthesis floorplanning circuit design and analysis from the perspective of low power requirements The readers will have a sampling of some key problems in this area as the low power solutions span the entire spectrum of the design process The book also provides excellent references on up to date research and development issues with practical solution techniques *BiCMOS Technology and Applications* Antonio R. Alvarez,2012-12-06 BiCMOS Technology and Applications Second Edition provides a synthesis of available knowledge about the combination of bipolar and MOS transistors in a common integrated circuit BiCMOS In this new edition all chapters have been updated and completely new chapters on emerging topics have been added In addition BiCMOS Technology and Applications Second Edition provides the reader with a knowledge of either CMOS or Bipolar technology design a reference with which they can make educated decisions regarding the viability of BiCMOS in their own application BiCMOS Technology and Applications Second Edition is vital reading for practicing integrated circuit engineers as well as technical managers trying to evaluate business issues related to BiCMOS As a textbook this book is also appropriate at the graduate level for a

special topics course in BiCMOS A general knowledge in device physics processing and circuit design is assumed Given the division of the book it lends itself well to a two part course one on technology and one on design This will provide advanced students with a good understanding of tradeoffs between bipolar and MOS devices and circuits *Green Mobile Devices and Networks* Hrishikesh Venkataraman,Gabriel-Miro Muntean,2016-04-19 While battery capacity is often insufficient to keep up with the power demanding features of the latest mobile devices powering the functional advancement of wireless devices requires a revolution in the concept of battery life and recharge capability Future handheld devices and wireless networks should be able to recharge themselves automaticall

Basics of Electrical Engineering Pavel Bartoš,Václav Fiala,Radek Mařík,2025-05-01 In this book we will cover the fundamental principles of electrical engineering The field that is fundamental to understanding the operation and design of electrical and electronic devices Electrical engineering is a field that is constantly evolving and has a huge impact on all aspects of modern life from basic domestic wiring to complex industrial systems and telecommunications One of the critical concepts to understand is electric charge It is a fundamental property of particles such as electrons and protons and it is electric charge that allows electric current to flow through a conductor

Digital Signal Processing for Multimedia Systems Keshab K. Parhi,Takao Nishitami,1999-03-11 Addresses a wide selection of multimedia applications programmable and custom architectures for the implementations of multimedia systems and arithmetic architectures and design methodologies The book covers recent applications of digital signal processing algorithms in multimedia presents high speed and low priority binary and finite field arithmetic architectures details VHDL based implementation approaches and more

Scientific and Technical Aerospace Reports ,1994

Advances in Signal Processing, Embedded Systems and IoT V.V.S.S.S. Chakravarthy,Vikrant Bhateja,Wendy Flores Fuentes,Jaume Anguera,K. Padma Vasavi,2023-05-23 The book discusses the latest developments and outlines future trends in the fields of microelectronics electromagnetics and telecommunication It contains original research works presented at the International Conference on Microelectronics Electromagnetics and Telecommunication ICMEET 2022 held in Bheemavaram West Godavari Dist Andhra Pradesh India during 22 23 July 2022 The papers were written by scientists research scholars and practitioners from leading universities engineering colleges and R D institutes from all over the world and share the latest breakthroughs in and promising solutions to the most important issues facing today s society

Innovations in Electrical and Electronic Engineering Saad Mekhilef,Rabindra Nath Shaw,Pierluigi Siano,2022-04-26 This book features selected high quality papers presented at International Conference on Electrical and Electronics Engineering ICEEE 2022 jointly organized by University of Malaya and Bharath Institute of Higher Education and Research India during January 8 9 2022 at NCR New Delhi India The book focuses on current development in the fields of electrical and electronics engineering The book one covers electrical engineering topics power and energy including renewable energy power electronics and applications control and automation and instrumentation and book two covers the areas of robotics artificial intelligence and

IoT electronics devices circuits and systems wireless and optical communication RF and microwaves VLSI and signal processing The book is beneficial for readers from both academia and industry *Progress in VLSI Design and Test* Hafizur Rahaman, Sanatan Chattopadhyay, Santanu Chattopadhyay, 2012-06-26 This book constitutes the refereed proceedings of the 16th International Symposium on VLSI Design and Test VDAT 2012 held in Shibpur India in July 2012 The 30 revised regular papers presented together with 10 short papers and 13 poster sessions were carefully selected from 135 submissions The papers are organized in topical sections on VLSI design design and modeling of digital circuits and systems testing and verification design for testability testing memories and regular logic arrays embedded systems hardware software co design and verification emerging technology nanoscale computing and nanotechnology *Futuristic Sustainable Energy & Technology* Rajesh Singh, Anita Gehlot, P.S. Ranjit, Dolly Sharma, 2022-06-07 *Futuristic Sustainable Energy and Technology* provides a structured overview of the concept of Futuristic Sustainable Energy and Technology It also explores the promotion of the sustainable development of renewable energy from the perspectives of technology modelling application sustainability and policy This book is dedicated to the advancement of energy efficiency to mitigate consumption ensure and replenish expand and reuse elective energy supplies and to replicate the damage caused by previous energy initiatives This book has offered a large stage of experimentation for practitioners experts researchers and teachers to incorporate and analyze their latest developments as well as the trends and difficulties encountered and the ongoing evolution of the stage in these areas

High Performance Embedded Computing Handbook David R. Martinez, Robert A. Bond, M. Michael Vai, 2018-10-03 Over the past several decades applications permeated by advances in digital signal processing have undergone unprecedented growth in capabilities The editors and authors of *High Performance Embedded Computing Handbook A Systems Perspective* have been significant contributors to this field and the principles and techniques presented in the handbook are reinforced by examples drawn from their work The chapters cover system components found in today's HPEC systems by addressing design trade offs implementation options and techniques of the trade then solidifying the concepts with specific HPEC system examples This approach provides a more valuable learning tool Because readers learn about these subject areas through factual implementation cases drawn from the contributing authors own experiences Discussions include Key subsystems and components Computational characteristics of high performance embedded algorithms and applications Front end real time processor technologies such as analog to digital conversion application specific integrated circuits field programmable gate arrays and intellectual property based design Programmable HPEC systems technology including interconnection fabrics parallel and distributed processing performance metrics and software architecture and automatic code parallelization and optimization Examples of complex HPEC systems representative of actual prototype developments Application examples including radar communications electro optical and sonar applications The handbook is organized around a canonical framework that helps readers navigate through the chapters and it concludes with a discussion

of future trends in HPEC systems The material is covered at a level suitable for practicing engineers and HPEC computational practitioners and is easily adaptable to their own implementation requirements

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