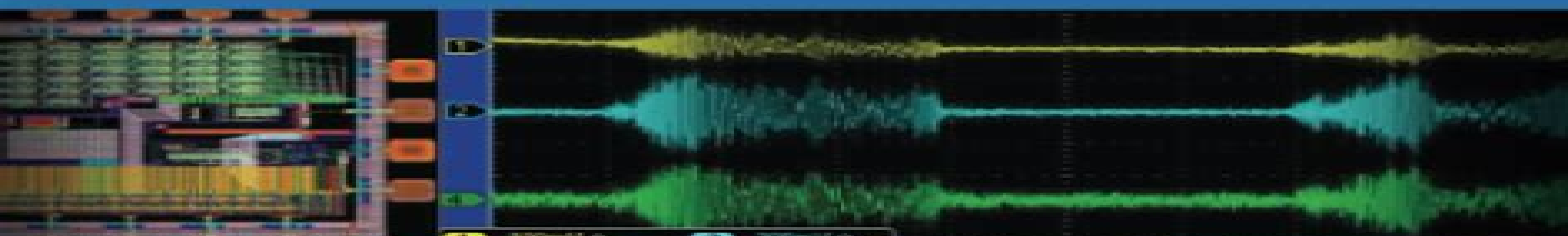




# VLSI

Circuits for  
Emerging  
Applications

EDITED BY TOMASZ WOJCICKI



CRC Press  
Taylor & Francis Group

# Vlsi Circuits For Emerging Applications Devices Circuits And Systems

**Shilpi Birla, Shashi Kant Dargar, Neha  
Singh, P. Sivakumar**



## **Vlsi Circuits For Emerging Applications Devices Circuits And Systems:**

Micro and Nanoelectronics Devices, Circuits and Systems Trupti Ranjan Lenka,Durgamadhab Misra,Lan Fu,2022-09-12

This book presents select proceedings of the International Conference on Micro and Nanoelectronics Devices Circuits and Systems MNDCS 2022 The book includes cutting edge research papers in the emerging fields of micro and nanoelectronics devices circuits and systems from experts working in these fields over the last decade The book is a unique collection of chapters from different areas with a common theme and is immensely useful to academic researchers and practitioners in the industry who work in this field

**VLSI** Tomasz Wojcicki,2015 Preface Only recently the world celebrated the 60th anniversary of the invention of the first transistor The first integrated circuit was built a decade later with the first microprocessor designed in the early 1970s Today integrated circuits are part of almost every aspect of our daily life They help us to live longer and more comfortably and to do more and do it faster And all that is possible because of the relentless search for new materials new circuit designs and new ideas happening on a daily basis at universities and within the industry around the globe Proliferation of integrated circuits in our daily lives does not mean making more of the same It is actually the opposite It is about making more of something completely different and customized for a particular application And today s circuit designers cannot complain about the shortage of things to work with All leading semiconductor foundries are offering now at least six different process nodes from 180 nm down to 16 nm with each node having two three or even more flavors There are at least three different IO voltage standards 3.3 V 2.5 V and 1.8 V And apart from the mainstream CMOS process each foundry offers more options such as GaAs SOI and GaN new even more exotic materials are not far behind It all gives engineers an almost unlimited number of options and choices to make to achieve their objectives or their application

**Low Power Designs in Nanodevices and Circuits for Emerging Applications** Shilpi Birla,Shashi Kant Dargar,Neha Singh,P. Sivakumar,2023-11-14 This reference textbook discusses low power designs for emerging applications This book focuses on the research challenges associated with theory design and applications towards emerging Microelectronics and VLSI device design and developments about low power consumptions The advancements in large scale integration technologies are principally responsible for the growth of the electronics industry This book is focused on senior undergraduates graduate students and professionals in the field of electrical and electronics engineering nanotechnology This book Discusses various low power techniques and applications for designing efficient circuits Covers advance nanodevices such as FinFETs TFETs CNTFETs Covers various emerging areas like Quantum Dot Cellular Automata Circuits and FPGAs and sensors Discusses applications like memory design for low power applications using nanodevices The number of options for ICs in control applications telecommunications high performance computing and consumer electronics continues to grow with the emergence of VLSI designs Nanodevices have revolutionized the electronics market and human life it has impacted individual life to make it more convenient They are ruling every sector such as electronics energy

biomedicine food environment and communication This book discusses various emerging low power applications using CMOS and other emerging nanodevices      *Circuits and Systems for Security and Privacy* Farhana Sheikh, Leonel Sousa, 2017-12-19

*Circuits and Systems for Security and Privacy* begins by introducing the basic theoretical concepts and arithmetic used in algorithms for security and cryptography and by reviewing the fundamental building blocks of cryptographic systems It then analyzes the advantages and disadvantages of real world implementations that not only optimize power area and throughput but also resist side channel attacks Merging the perspectives of experts from industry and academia the book provides valuable insight and necessary background for the design of security aware circuits and systems as well as efficient accelerators used in security applications      *Circuits and Systems for Biomedical Applications* Hadi Heidari, Sara Ghoreishizadeh, 2022-09-01

*Circuits and Systems for Biomedical Applications* UKCAS 2018 covers several advanced topics in the area of Devices Analog and Mixed Signal Circuits and Systems for Biomedical Applications The fundamental aspects of these topics are discussed and state of the art developments are presented The book proceeds the 1st United Kingdom Circuits and Systems UKCAS 2018 Workshop It addresses multidisciplinary theme areas such as Biosensing Memristors next generation medical diagnostics neural inspired circuits neural implants neuro prostheses prosthetic hand and neuro rehabilitation Having perceived the device and circuit assets for such technologies and knowing what challenges these present for the biomedical scientists and engineers integrated circuits for addressable biosensing are reviewed in the first chapter The Second Chapter is harnessing the power of the brain using metal oxide Memristors The third chapter contains construction of an endoscopic capsule for the diagnostics of dysmotilities in the gastro intestinal track The next three chapters are on neural interfaces analogue building blocks of neural inspired circuits are described in the fourth chapter while chapter five focuses on circuits for bio potential recording from the brain Networked Integrated circuits and their use in creating advanced implantable stimulation systems will be discussed in chapter six This topic will be completed by circuits and systems for control of Prosthetic Hands in seventh chapter and genetically enhanced brain implants for neuro rehabilitation in chapter eight      *Nanomaterials* Sivashankar Krishnamoorthy, 2017-12-19

*Nanomaterials* are being incorporated into products all around us having an incredible impact on durability strength functionality and other material properties There are a vast number of nanomaterials presently available and new formulations and chemistries are being announced daily *Nanomaterials A Guide to Fabrication and Applications* provides product developers researchers and materials scientists with a handy resource for understanding the range of options and materials currently available Covering a variety of nanomaterials and their applications this practical reference Discusses the scale of nanomaterials and nanomachines focusing on integrated circuits ICs and microelectromechanical systems MEMS Offers insight into different nanomaterials interactions with chemical reactions biological processes and the environment Examines the mechanical properties of nanomaterials and potential treatments to enhance the nanomaterials performance Details recent

accomplishments in the use of nanomaterials to create new forms of electronic devices Explores the optical properties of certain nanomaterials and the nanomaterials use in optimizing lasers and optical absorbers Describes an energy storage application as well as how nanomaterials from waste products may be used to improve capacitors Featuring contributions from experts around the globe Nanomaterials A Guide to Fabrication and Applications serves as a springboard for the discovery of new applications of nanomaterials      Labs on Chip Eugenio Iannone,2018-09-03 Labs on Chip Principles Design and Technology provides a complete reference for the complex field of labs on chip in biotechnology Merging three main areas fluid dynamics monolithic micro and nanotechnology and out of equilibrium biochemistry this text integrates coverage of technology issues with strong theoretical explanations of design techniques Analyzing each subject from basic principles to relevant applications this book Describes the biochemical elements required to work on labs on chip Discusses fabrication microfluidic and electronic and optical detection techniques Addresses planar technologies polymer microfabrication and process scalability to huge volumes Presents a global view of current lab on chip research and development Devotes an entire chapter to labs on chip for genetics Summarizing in one source the different technical competencies required Labs on Chip Principles Design and Technology offers valuable guidance for the lab on chip design decision making process while exploring essential elements of labs on chip useful both to the professional who wants to approach a new field and to the specialist who wants to gain a broader perspective      Nature-Inspired VLSI Circuits - From Concept to Implementation Hongjiang Song,2018-05-30 Nature inspired VLSI circuit technology offers unique approach for studying analyzing designing and implementing VLSI circuits through perception reasoning and action mimicking the nature Such circuit technology covers various aspects of nature inspired VLSI circuit design techniques such as the design rule bases design principles computing and information processing algorithms sensing and interfacing techniques energy harvesting and power management      CMOS Angelo Rivetti,2018-09-03 CMOS Front End Electronics for Radiation Sensors offers a comprehensive introduction to integrated front end electronics for radiation detectors focusing on devices that capture individual particles or photons and are used in nuclear and high energy physics space instrumentation medical physics homeland security and related fields Emphasizing practical design and implementation this book Covers the fundamental principles of signal processing for radiation detectors Discusses the relevant analog building blocks used in the front end electronics Employs systematically weak and moderate inversion regimes in circuit analysis Makes complex topics such as noise and circuit weighting functions more accessible Includes numerical examples where appropriate CMOS Front End Electronics for Radiation Sensors provides specialized knowledge previously obtained only through the study of multiple technical and scientific papers It is an ideal text for students of physics and electronics engineering as well as a useful reference for experienced practitioners      *Nanoelectronics for Next-Generation Integrated Circuits* Rohit Dhiman,2022-11-23 The incessant scaling of complementary metal oxide semiconductor CMOS technology has resulted in

significant performance improvements in very large scale integration VLSI design techniques and system architectures This trend is expected to continue in the future but this requires breakthroughs in the design of nano CMOS and post CMOS technologies Nanoelectronics refers to the possible future technologies beyond conventional CMOS scaling limits This volume addresses the current state of the art nanoelectronic technologies and presents potential options for next generation integrated circuits Nanoelectronics for Next generation Integrated Circuits is a useful reference guide for researchers engineers and advanced students working on the frontier of the design and modeling of nanoelectronic devices and their integration aspects with future CMOS circuits This comprehensive volume eloquently presents the design methodologies for spintronics memories quantum dot cellular automata and post CMOS FETs including applications in emerging integrated circuit technologies

Nanoscale Field Effect Transistors: Emerging Applications Ekta Goel, Archana Pandey, 2023-12-20

Nanoscale Field Effect Transistors Emerging Applications is a comprehensive guide to understanding simulating and applying nanotechnology for design and development of specialized transistors This book provides in depth information on the modeling simulation characterization and fabrication of semiconductor FET transistors The book contents are structured into chapters that explain concepts with simple language and scientific references The core of the book revolves around the fundamental physics that underlie the design of solid state nanostructures and the optimization of these nanoscale devices for real time applications Readers will learn how to achieve superior performance in terms of reduced size and weight enhanced subthreshold characteristics improved switching efficiency and minimal power consumption Key Features Quick summaries Each chapter provides an introduction and summary to explain concepts in a concise manner In Depth Analysis This book provides an extensive exploration of the theory and practice of nanoscale materials and devices offering a detailed understanding of the technical aspects of Nano electronic FET transistors Multidisciplinary Approach It discusses various aspects of nanoscale materials and devices for applications such as quantum computation biomedical applications energy generation and storage environmental protection and more It showcases how nanoscale FET devices are reshaping multiple industries References Chapters include references that encourage advanced readers to further explore key topics Designed for a diverse audience this book caters to students academics and advanced readers interested in learning about Nano FET devices Readership Students academics and advanced readers

*Microfluidics and Nanotechnology* Eric Lagally, 2017-12-19

An increasing number of technologies are being used to detect minute quantities of biomolecules and cells However it can be difficult to determine which technologies show the most promise for high sensitivity and low limit detection in different applications Microfluidics and Nanotechnology Biosensing to the Single Molecule Limit details proven approaches for the detection of single cells and even single molecules approaches employed by the world's foremost microfluidics and nanotechnology laboratories While similar books concentrate only on microfluidics or nanotechnology this book focuses on the combination of soft materials elastomers and other polymers with hard materials semiconductors metals

and glass to form integrated detection systems for biological and chemical targets It explores physical and chemical as well as contact and noncontact detection methods using case studies to demonstrate system capabilities Presenting a snapshot of the current state of the art the text Explains the theory behind different detection techniques from mechanical resonators for detecting cell density to fiber optic methods for detecting DNA hybridization and beyond Examines microfluidic advances including droplet microfluidics digital microfluidics for manipulating droplets on the microscale and more Highlights an array of technologies to allow for a comparison of the fundamental advantages and challenges of each as well as an appreciation of the power of leveraging scalability and integration to achieve sensitivity at low cost Microfluidics and Nanotechnology Biosensing to the Single Molecule Limit not only serves as a quick reference for the latest achievements in biochemical detection at the single cell and single molecule levels but also provides researchers with inspiration for further innovation and expansion of the field

**High Frequency Communication and Sensing** Ahmet Tekin,Ahmed Emira,2018-09-03 High Frequency Communication and Sensing Traveling Wave Techniques introduces novel traveling wave circuit techniques to boost the performance of high speed circuits in standard low cost production technologies like complementary metal oxide semiconductor CMOS A valuable resource for experienced analog radio frequency RF circuit designers as well as undergraduate level microelectronics researchers this book Explains the basics of high speed signaling such as transmission lines distributed signaling impedance matching and other common practical RF background material Promotes a dual loop coupled traveling wave oscillator topology the trigger mode distributed wave oscillator as a high frequency multiphase signal source Introduces a force based starter mechanism for dual loop even symmetry multiphase traveling wave oscillators presenting a single loop version as a force mode distributed wave antenna FMDWA Describes higher frequency passive inductive and quarter wave length based pumped distributed wave oscillators PDWOs Examines phased array transceiver architectures and front end circuits in detail along with distributed oscillator topologies Devotes a chapter to THz sensing illustrating a unique method of traveling wave frequency multiplication and power combining Discusses various data converter topologies such as digital to analog converters DACs analog to digital converters ADCs and GHz bandwidth sigma delta modulators Covers critical circuits including phase rotators and interpolators phase shifters phase locked loops PLLs delay locked loops DLLs and more It is a significantly challenging task to generate and distribute high speed clocks Multiphase low speed clocks with sharp transition are proposed to be a better option to accommodate the desired timing resolution High Frequency Communication and Sensing Traveling Wave Techniques provides new horizons in the quest for greater speed and performance

**Testing for Small-Delay Defects in Nanoscale CMOS Integrated Circuits** Sandeep K. Goel,Krishnendu Chakrabarty,2017-12-19 Advances in design methods and process technologies have resulted in a continuous increase in the complexity of integrated circuits ICs However the increased complexity and nanometer size features of modern ICs make them susceptible to manufacturing defects as well as performance and quality issues Testing

for Small Delay Defects in Nanoscale CMOS Integrated Circuits covers common problems in areas such as process variations power supply noise crosstalk resistive opens bridges and design for manufacturing DfM related rule violations The book also addresses testing for small delay defects SDDs which can cause immediate timing failures on both critical and non critical paths in the circuit Overviews semiconductor industry test challenges and the need for SDD testing including basic concepts and introductory material Describes algorithmic solutions incorporated in commercial tools from Mentor Graphics Reviews SDD testing based on alternative methods that explores new metrics top off ATPG and circuit topology based solutions Highlights the advantages and disadvantages of a diverse set of metrics and identifies scope for improvement Written from the triple viewpoint of university researchers EDA tool developers and chip designers and tool users this book is the first of its kind to address all aspects of SDD testing from such a diverse perspective The book is designed as a one stop reference for current industrial practices research challenges in the domain of SDD testing and recent developments in SDD solutions

**Device Circuit Co-Design Issues in FETs** Shubham Tayal,Billel Smaani,Shiromani Balmukund Rahi,Samir Labiod,Zeinab Ramezani,2023-08-22 This book provides an overview of emerging semiconductor devices and their applications in electronic circuits which form the foundation of electronic devices Device Circuit Co Design Issues in FETs provides readers with a better understanding of the ever growing field of low power electronic devices and their applications in the wireless biosensing and circuit domains The book brings researchers and engineers from various disciplines of the VLSI domain together to tackle the emerging challenges in the field of engineering and applications of advanced low power devices in an effort to improve the performance of these technologies The chapters examine the challenges and scope of FinFET device circuits 3D FETs and advanced FET for circuit applications The book also discusses low power memory design neuromorphic computing and issues related to thermal reliability The authors provide a good understanding of device physics and circuits and discuss transistors based on the new channel dielectric materials and device architectures to achieve low power dissipation and ultra high switching speeds to fulfill the requirements of the semiconductor industry This book is intended for students researchers and professionals in the field of semiconductor devices and nanodevices as well as those working on device circuit co design issues

**3D Integration in VLSI Circuits** Katsuyuki Sakuma,2018-04-17

Currently the term 3D integration includes a wide variety of different integration methods such as 2.5 dimensional 2.5D interposer based integration 3D integrated circuits 3D ICs 3D systems in package SiP 3D heterogeneous integration and monolithic 3D ICs The goal of this book is to provide readers with an understanding of the latest challenges and issues in 3D integration TSVs are not the only technology element needed for 3D integration There are numerous other key enabling technologies required for 3D integration and the speed of the development in this emerging field is very rapid To provide readers with state of the art information on 3D integration research and technology developments each chapter has been contributed by some of the world's leading scientists and experts from academia research institutes and industry from



around the globe Covers chip wafer level 3D integration technology memory stacking reconfigurable 3D and monolithic 3D IC Discusses the use of silicon interposer and organic interposer Presents architecture design and technology implementations for 3D FPGA integration Describes oxide bonding Cu SiO<sub>2</sub> hybrid bonding adhesive bonding and solder bonding Addresses the issue of thermal dissipation in 3D integration      **High Performance CMOS Range Imaging** Andreas Süss,2016-03-24 This work is dedicated to CMOS based imaging with the emphasis on the noise modeling characterization and optimization in order to contribute to the design of high performance imagers in general and range imagers in particular CMOS is known to be superior to CCD due to its flexibility in terms of integration capabilities but typically has to be enhanced to compete at parameters as for instance noise dynamic range or spectral response This work gathers the widespread theory on noise and extends the theory by a non rigorous but potentially computing efficient algorithm to estimate noise in time sampled systems      *Noise Coupling in System-on-Chip* Thomas Noulis,2018-01-09 Noise Coupling is the root cause of the majority of Systems on Chip SoC product fails The book discusses a breakthrough substrate coupling analysis flow and modelling toolset addressing the needs of the design community The flow provides capability to analyze noise components propagating through the substrate the parasitic interconnects and the package Using this book the reader can analyze and avoid complex noise coupling that degrades RF and mixed signal design performance while reducing the need for conservative design practices With chapters written by leading international experts in the field novel methodologies are provided to identify noise coupling in silicon It additionally features case studies that can be found in any modern CMOS SoC product for mobile communications automotive applications and readout front ends      **Analog Electronics for Radiation Detection** Renato Turchetta,2017-12-19 Analog Electronics for Radiation Detection showcases the latest advances in readout electronics for particle or radiation detectors Featuring chapters written by international experts in their respective fields this authoritative text Defines the main design parameters of front end circuitry developed in microelectronics technologies Explains the basis for the use of complementary metal oxide semiconductor CMOS image sensors for the detection of charged particles and other non consumer applications Delivers an in depth review of analog to digital converters ADCs evaluating the pros and cons of ADCs integrated at the pixel column and per chip levels Describes incremental sigma delta ADCs time to digital converter TDC architectures and digital pulse processing techniques complementary to analog processing Examines the fundamental parameters and front end types associated with silicon photomultipliers used for single visible light photon detection Discusses pixel sensors with per pixel TDCs channel density challenges and emerging 3D technologies interconnecting detectors and electronics Thus Analog Electronics for Radiation Detection provides a single source for state of the art information on analog electronics for the readout of radiation detectors

**VLSI-SoC: System-on-Chip in the Nanoscale Era - Design, Verification and Reliability** Thomas Hollstein,Jaen Raik,Sergei Kostin,Anton Tšertov,Ian O'Connor,Ricardo Reis,2017-08-31 This book contains extended and revised versions of the best

papers presented at the 24th IFIP WG 10.5 IEEE International Conference on Very Large Scale Integration VLSI SoC 2016 held in Tallinn Estonia in September 2016. The 11 papers included in the book were carefully reviewed and selected from the 36 full papers presented at the conference. The papers cover a wide range of topics in VLSI technology and advanced research. They address the latest scientific and industrial results and developments as well as future trends in the field of System on Chip SoC Design.

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