

Charles Chiang  
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# Design for Manufacturability and Yield for Nano-Scale CMOS



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# Design For Manufacturability And Yield For Nano Scale Cmos

**Victor Champac, Jose Garcia Gervacio**



## **Design For Manufacturability And Yield For Nano Scale Cmos:**

**Design for Manufacturability and Yield for Nano-Scale CMOS** Charles Chiang,Jamil Kawa,2007-06-15 This book walks the reader through all the aspects of manufacturability and yield in a nano CMOS process It covers all CAD CAE aspects of a SOC design flow and addresses a new topic DFM DFY critical at 90 nm and beyond This book is a must read book the serious practicing IC designer and an excellent primer for any graduate student intent on having a career in IC design or in EDA tool development *Design for Manufacturability and Yield for Nano-Scale CMOS* Charles Chiang,Jamil Kawa,2009-09-03 This book walks the reader through all the aspects of manufacturability and yield in a nano CMOS process It covers all CAD CAE aspects of a SOC design flow and addresses a new topic DFM DFY critical at 90 nm and beyond This book is a must read book the serious practicing IC designer and an excellent primer for any graduate student intent on having a career in IC design or in EDA tool development **Design For Manufacturability And Yield For Nano-Scale Cmos** Chiang,2009-06-01 Nanoscale CMOS VLSI Circuits: Design for Manufacturability Sandip Kundu,Aswin Sreedhar,2010-06-22 Cutting Edge CMOS VLSI Design for Manufacturability Techniques This detailed guide offers proven methods for optimizing circuit designs to increase the yield reliability and manufacturability of products and mitigate defects and failure Covering the latest devices technologies and processes Nanoscale CMOS VLSI Circuits Design for Manufacturability focuses on delivering higher performance and lower power consumption Costs constraints and computational efficiencies are also discussed in the practical resource Nanoscale CMOS VLSI Circuits covers Current trends in CMOS VLSI design Semiconductor manufacturing technologies Photolithography Process and device variability analyses and modeling Manufacturing Aware Physical Design Closure Metrology manufacturing defects and defect extraction Defect impact modeling and yield improvement techniques Physical design and reliability DFM tools and methodologies

**Yield-Aware Analog IC Design and Optimization in Nanometer-scale Technologies** António Manuel Lourenço Canelas,Jorge Manuel Correia Guilherme,Nuno Cavaco Gomes Horta,2020-03-20 This book presents a new methodology with reduced time impact to address the problem of analog integrated circuit IC yield estimation by means of Monte Carlo MC analysis inside an optimization loop of a population based algorithm The low time impact on the overall optimization processes enables IC designers to perform yield optimization with the most accurate yield estimation method MC simulations using foundry statistical device models considering local and global variations The methodology described by the authors delivers on average a reduction of 89% in the total number of MC simulations when compared to the exhaustive MC analysis over the full population In addition to describing a newly developed yield estimation technique the authors also provide detailed background on automatic analog IC sizing and optimization **Nano-scale CMOS Analog Circuits** Soumya Pandit,Chittaranjan Mandal,Amit Patra,2018-09-03 Reliability concerns and the limitations of process technology can sometimes restrict the innovation process involved in designing nano scale analog circuits The success of nano scale analog

circuit design requires repeat experimentation correct analysis of the device physics process technology and adequate use of the knowledge database Starting with the basics Nano Scale CMOS Analog Circuits Models and CAD Techniques for High Level Design introduces the essential fundamental concepts for designing analog circuits with optimal performances This book explains the links between the physics and technology of scaled MOS transistors and the design and simulation of nano scale analog circuits It also explores the development of structured computer aided design CAD techniques for architecture level and circuit level design of analog circuits The book outlines the general trends of technology scaling with respect to device geometry process parameters and supply voltage It describes models and optimization techniques as well as the compact modeling of scaled MOS transistors for VLSI circuit simulation Includes two learning based methods the artificial neural network ANN and the least squares support vector machine LS SVM method Provides case studies demonstrating the practical use of these two methods Explores circuit sizing and specification translation tasks Introduces the particle swarm optimization technique and provides examples of sizing analog circuits Discusses the advanced effects of scaled MOS transistors like narrow width effects and vertical and lateral channel engineering Nano Scale CMOS Analog Circuits Models and CAD Techniques for High Level Design describes the models and CAD techniques explores the physics of MOS transistors and considers the design challenges involving statistical variations of process technology parameters and reliability constraints related to circuit design

**Design for Manufacturability** Artur Balasinski, 2013-10-05 This book explains integrated circuit design for manufacturability DfM at the product level packaging applications and applies engineering DfM principles to the latest standards of product development at 22 nm technology nodes It is a valuable guide for layout designers packaging engineers and quality engineers covering DfM development from 1D to 4D involving IC design flow setup best practices links to manufacturing and product definition for process technologies down to 22 nm node and product families including memories logic system on chip and system in package

*Reliability of Nanoscale Circuits and Systems* Miloš Stanisavljević, Alexandre Schmid, Yusuf Leblebici, 2010-10-20 This book is intended to give a general overview of reliability faults fault models nanotechnology nanodevices fault tolerant architectures and reliability evaluation techniques Additionally the book provides an in depth state of the art research results and methods for fault tolerance as well as the methodology for designing fault tolerant systems out of highly unreliable components

*CMOS Nanoelectronics* Nadine Collaert, 2012-09-19 This book covers one of the most important device architectures that have been widely researched to extend the transistor scaling FinFET Starting with theory the book discusses the advantages and the integration challenges of this device architecture It addresses in detail the topics such as high density fin patterning gate stack design and s

**Process Variations and Probabilistic Integrated Circuit Design** Manfred Dietrich, Joachim Haase, 2011-11-20 Uncertainty in key parameters within a chip and between different chips in the deep sub micron area plays a more and more important role As a result manufacturing process spreads need to be considered during the design process Quantitative

methodology is needed to ensure faultless functionality despite existing process variations within given bounds during product development This book presents the technological physical and mathematical fundamentals for a design paradigm shift from a deterministic process to a probability orientated design process for microelectronic circuits Readers will learn to evaluate the different sources of variations in the design flow in order to establish different design variants while applying appropriate methods and tools to evaluate and optimize their design **Semiconductors** Artur Balasinski,2018-09-03

Because of the continuous evolution of integrated circuit manufacturing ICM and design for manufacturability DfM most books on the subject are obsolete before they even go to press That s why the field requires a reference that takes the focus off of numbers and concentrates more on larger economic concepts than on technical details Semiconductors Integrated Circuit Design for Manufacturability covers the gradual evolution of integrated circuit design ICD as a basis to propose strategies for improving return on investment ROI for ICD in manufacturing Where most books put the spotlight on detailed engineering enhancements and their implications for device functionality in contrast this one offers among other things crucial valuable historical background and roadmapping all illustrated with examples Presents actual test cases that illustrate product challenges examine possible solution strategies and demonstrate how to select and implement the right one This book shows that DfM is a powerful generic engineering concept with potential extending beyond its usual application in automated layout enhancements centered on proximity correction and pattern density This material explores the concept of ICD for production by breaking down its major steps product definition design layout and manufacturing Averting extended discussion of technology techniques or specific device dimensions the author also avoids the clumsy chapter architecture that can hinder other books on this subject The result is an extremely functional systematic presentation that simplifies existing approaches to DfM outlining a clear set of criteria to help readers assess reliability functionality and yield With careful consideration of the economic and technical trade offs involved in ICD for manufacturing this reference addresses techniques for physical electrical and logical design keeping coverage fresh and concise for the designers manufacturers and researchers defining product architecture and research programs **Design Rules in a**

**Semiconductor Foundry** Eitan N. Shauly,2022-11-30 Nowadays over 50% of integrated circuits are fabricated at wafer foundries This book presents a foundry integrated perspective of the field and is a comprehensive and up to date manual designed to serve process device layout and design engineers It comprises chapters carefully selected to cover topics relevant for them to deal with their work The book provides an insight into the different types of design rules DRs and considerations for setting new DRs It discusses isolation gate patterning S D contacts metal lines MOL air gaps and so on It explains in detail the layout rules needed to support advanced planarization processes different types of dummies and related utilities as well as presents a large set of guidelines and layout aware modeling for RF CMOS and analog modules It also discusses the layout DRs for different mobility enhancement techniques and their related modeling listing many of the

dedicated rules for static random access memory SRAM embedded polyfuse ePF and LogicNVM The book also provides the setting and calibration of the process parameters set and describes the 28 20 nm planar MOSFET process flow for low power and high performance mobile applications in a step by step manner It includes FEOL and BEOL physical and environmental tests for qualifications together with automotive qualification and design for automotive DfA Written for the professionals the book belongs to the bookshelf of microelectronic discipline experts      Analog Circuit Design for Process Variation-Resilient Systems-on-a-Chip Marvin Onabajo,Jose Silva-Martinez,2012-03-08 This book describes several techniques to address variation related design challenges for analog blocks in mixed signal systems on chip The methods presented are results from recent research works involving receiver front end circuits baseband filter linearization and data conversion These circuit level techniques are described with their relationships to emerging system level calibration approaches to tune the performances of analog circuits with digital assistance or control Coverage also includes a strategy to utilize on chip temperature sensors to measure the signal power and linearity characteristics of analog RF circuits as demonstrated by test chip measurements Describes a variety of variation tolerant analog circuit design examples including from RF front ends high performance ADCs and baseband filters Includes built in testing techniques linked to current industrial trends Balances digitally assisted performance tuning with analog performance tuning and mismatch reduction approaches Describes theoretical concepts as well as experimental results for test chips designed with variation aware techniques      *Timing Performance of Nanometer Digital Circuits Under Process Variations* Victor Champac,Jose Garcia Gervacio,2018-04-18 This book discusses the digital design of integrated circuits under process variations with a focus on design time solutions The authors describe a step by step methodology going from logic gates to logic paths to the circuit level Topics are presented in comprehensively without overwhelming use of analytical formulations Emphasis is placed on providing digital designers with understanding of the sources of process variations their impact on circuit performance and tools for improving their designs to comply with product specifications Various circuit level design hints are highlighted so that readers can use then to improve their designs A special treatment is devoted to unique design issues and the impact of process variations on the performance of FinFET based circuits This book enables readers to make optimal decisions at design time toward more efficient circuits with better yield and higher reliability      *Computational Intelligence in Analog and Mixed-Signal (AMS) and Radio-Frequency (RF) Circuit Design* Mourad Fakhfakh,Esteban Tlelo-Cuautle,Patrick Siarry,2015-07-14 This book explains the application of recent advances in computational intelligence algorithms design methodologies and synthesis techniques to the design of integrated circuits and systems It highlights new biasing and sizing approaches and optimization techniques and their application to the design of high performance digital VLSI radio frequency and mixed signal circuits and systems This first of two related volumes addresses the design of analog and mixed signal AMS and radio frequency RF circuits with 17 chapters grouped into parts on analog and mixed signal applications and radio frequency design It will be of

interest to practitioners and researchers in computer science and electronics engineering engaged with the design of electronic circuits

**Circuit Design for Reliability** Ricardo Reis, Yu Cao, Gilson Wirth, 2014-11-08 This book presents physical understanding modeling and simulation on chip characterization layout solutions and design techniques that are effective to enhance the reliability of various circuit units The authors provide readers with techniques for state of the art and future technologies ranging from technology modeling fault detection and analysis circuit hardening and reliability management

Introduction to Microfabrication Sami Franssila, 2010-10-29 This accessible text is now fully revised and updated providing an overview of fabrication technologies and materials needed to realize modern microdevices It demonstrates how common microfabrication principles can be applied in different applications to create devices ranging from nanometer probe tips to meter scale solar cells and a host of microelectronic mechanical optical and fluidic devices in between Latest developments in wafer engineering patterning thin films surface preparation and bonding are covered This second edition includes expanded sections on MEMS and microfluidics related fabrication issues new chapters on polymer and glass microprocessing as well as serial processing techniques 200 completely new and 200 modified figures more coverage of imprinting techniques process integration and economics of microfabrication 300 homework exercises including conceptual thinking assignments order of magnitude estimates standard calculations and device design and process analysis problems solutions to homework problems on the complementary website as well as PDF slides of the figures and tables within the book With clear sections separating basic principles from more advanced material this is a valuable textbook for senior undergraduate and beginning graduate students wanting to understand the fundamentals of microfabrication The book also serves as a handy desk reference for practicing electrical engineers materials scientists chemists and physicists alike [www.wiley.com/go/Franssila\\_Micro2e](http://www.wiley.com/go/Franssila_Micro2e)

*Built-in-Self-Test and Digital Self-Calibration for RF SoCs* Sleiman Bou-Sleiman, Mohammed Ismail, 2011-09-23 This book will introduce design methodologies known as Built in Self Test BiST and Built in Self Calibration BiSC which enhance the robustness of radio frequency RF and millimeter wave mmWave integrated circuits ICs These circuits are used in current and emerging communication computing multimedia and biomedical products and microchips The design methodologies presented will result in enhancing the yield percentage of working chips in a high volume run of RF and mmWave ICs which will enable successful manufacturing of such microchips in high volume

**Strain-Engineered MOSFETs** C.K. Maiti, T.K. Maiti, 2018-10-03 Currently strain engineering is the main technique used to enhance the performance of advanced silicon based metal oxide semiconductor field effect transistors MOSFETs Written from an engineering application standpoint Strain Engineered MOSFETs introduces promising strain techniques to fabricate strain engineered MOSFETs and to methods to assess the applications of these techniques The book provides the background and physical insight needed to understand new and future developments in the modeling and design of n and p MOSFETs at nanoscale This book focuses on recent developments in strain engineered MOSFETs implemented in

high mobility substrates such as Ge SiGe strained Si ultrathin germanium on insulator platforms combined with high k insulators and metal gate It covers the materials aspects principles and design of advanced devices fabrication and applications It also presents a full technology computer aided design TCAD methodology for strain engineering in Si CMOS technology involving data flow from process simulation to process variability simulation via device simulation and generation of SPICE process compact models for manufacturing for yield optimization Microelectronics fabrication is facing serious challenges due to the introduction of new materials in manufacturing and fundamental limitations of nanoscale devices that result in increasing unpredictability in the characteristics of the devices The down scaling of CMOS technologies has brought about the increased variability of key parameters affecting the performance of integrated circuits This book provides a single text that combines coverage of the strain engineered MOSFETS and their modeling using TCAD making it a tool for process technology development and the design of strain engineered MOSFETS      *Microelectronics Technology and Devices - SBMicro 2009* Davies William de Lima Monteiro,Olivier Bonnaud,Nilton Itiro Morimoto,2009-08 This issue of ECS Transactions features eight invited and sixty seven regular papers on technology devices systems optoelectronics modeling and characterization all either directly or indirectly related to microelectronics The topics presented herein reveal the multidisciplinary character of this field which definitely incites the highly cooperative trace of human nature



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