

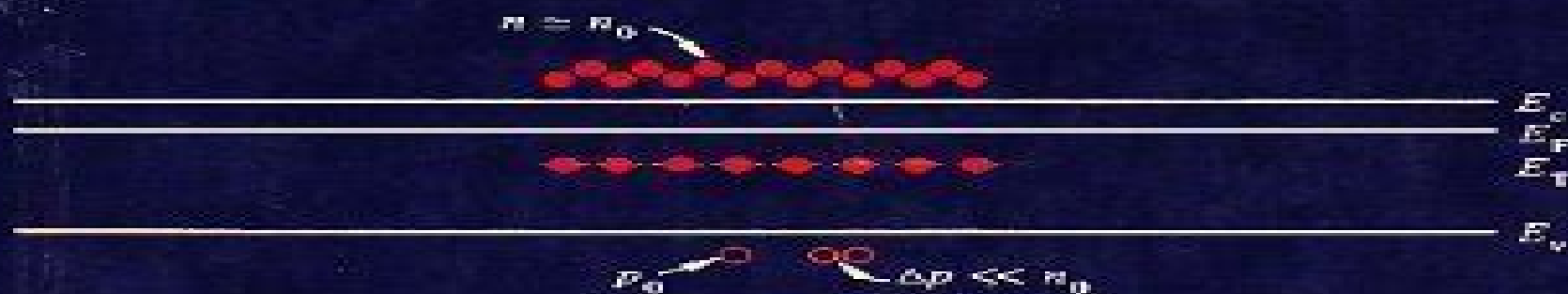
VOLUME I

# MODULAR SERIES ON SOLID STATE DEVICES

Robert F. Pierret • Gerald W. Neudeck, Editors

## Semiconductor Fundamentals

Robert F. Pierret



# Semiconductor Fundamentals Volume Modular Modular Series On Solid State Devices

**John G. Kassakian, David J.  
Perreault, George C. Verghese, Martin  
F. Schlecht**

## **Semiconductor Fundamentals Volume Modular Modular Series On Solid State Devices:**

Modular Series on Solid State Devices: Semiconductor fundamentals Robert F. Pierret, 1983      *Modular Series on Solid State Devices: Advanced semiconductor fundamentals* Robert F. Pierret, 1983      **Advanced Semiconductor Fundamentals** Robert F. Pierret, 2003 Advanced Semiconductor Fundamentals Second Edition by Robert F Pierret is an advanced level presentation of the underlying functional formalism routinely used in describing the operational behavior of solid state devices The second edition provides an update of the topic presentation semiconductor parametric information and relevant references throughout the volume There is also a 50% increase in the end of chapter problems Given the success of the first edition the second edition retains the same overall material coverage and a pedagogical approach in introducing necessary concepts models and formalism      Principles of Power Electronics John G. Kassakian, David J. Perreault, George C. Verghese, Martin F. Schlecht, 2023-08-03 Substantially expanded and updated the new edition of this classic textbook provides unrivalled coverage of the fundamentals of power electronics Comprehensive coverage of foundational concepts in circuits magnetics devices dynamic models and control establishes a strong conceptual framework for further study Extensive discussion of contemporary practical considerations enhanced by real world examples prepares readers for design scenarios ranging from low power dc dc converters to multi megawatt ac machine drives New topics include SiC and GaN wide bandgap materials superjunction MOSFET and IGBT devices advanced magnetics design multi level and switched capacitor converters RF converter circuits and EMI Over 300 new and revised end of chapter problems enhance and expand understanding of the material with solutions for instructors Unique in its breadth and depth and providing a range of flexible teaching pathways at multiple levels this is the definitive guide to power electronics for graduate and senior undergraduate students in electrical engineering and practicing electrical engineers      *Physics of Semiconductor Devices* J.-P. Colinge, C.A. Colinge, 2007-05-08 Physics of Semiconductor Devices covers both basic classic topics such as energy band theory and the gradual channel model of the MOSFET as well as advanced concepts and devices such as MOSFET short channel effects low dimensional devices and single electron transistors Concepts are introduced to the reader in a simple way often using comparisons to everyday life experiences such as simple fluid mechanics They are then explained in depth and mathematical developments are fully described Physics of Semiconductor Devices contains a list of problems that can be used as homework assignments or can be solved in class to exemplify the theory Many of these problems make use of Matlab and are aimed at illustrating theoretical concepts in a graphical manner      Introductory Quantum Mechanics for Semiconductor Nanotechnology Dae Mann Kim, 2010-04-26 Dieses von der Korean Nanotechnology Research Society als Lehrbuch empfohlene Werk hebt sich von anderen Einf hrungen in die Quantenmechanik ab Stark anwendungsbezogen bespricht der lehrerfahrene Autor quantenmechanische Aspekte der Halbleiter Nanotechnologie die er durch viele Mainstream Applikationen illustriert Unter anderem erl utert er Photodetektoren Laserdioden Solarzellen Transistoren und

Schottky Kontakte Die mathematischen Herleitungen sind auf ein Minimum beschränkt dafür legt der Autor besonderen Wert auf den technischen Background und nicht zuletzt auf eine ständige Motivation seiner Leser Mit zahlreichen Übungsaufgaben Lösungen Lesungsheft für Dozenten und Präsentationsmaterial *MOSFET Models for VLSI Circuit Simulation* Narain D. Arora, 2012-12-06 Metal Oxide Semiconductor MOS transistors are the basic building block of MOS integrated circuits I C Very Large Scale Integrated VLSI circuits using MOS technology have emerged as the dominant technology in the semiconductor industry Over the past decade the complexity of MOS ICs has increased at an astonishing rate This is realized mainly through the reduction of MOS transistor dimensions in addition to the improvements in processing Today VLSI circuits with over 3 million transistors on a chip with effective or electrical channel lengths of 0.5 microns are in volume production Designing such complex chips is virtually impossible without simulation tools which help to predict circuit behavior before actual circuits are fabricated However the utility of simulators as a tool for the design and analysis of circuits depends on the adequacy of the device models used in the simulator This problem is further aggravated by the technology trend towards smaller and smaller device dimensions which increases the complexity of the models There is extensive literature available on modeling these short channel devices However there is a lot of confusion too Often it is not clear what model to use and which model parameter values are important and how to determine them After working over 15 years in the field of semiconductor device modeling I have felt the need for a book which can fill the gap between the theory and the practice of MOS transistor modeling This book is an attempt in that direction *The Physics of Semiconductors* Kevin F. Brennan, 1999-02-13 Modern fabrication techniques have made it possible to produce semiconductor devices whose dimensions are so small that quantum mechanical effects dominate their behavior This book describes the key elements of quantum mechanics statistical mechanics and solid state physics that are necessary in understanding these modern semiconductor devices The author begins with a review of elementary quantum mechanics and then describes more advanced topics such as multiple quantum wells He then discusses equilibrium and nonequilibrium statistical mechanics Following this introduction he provides a thorough treatment of solid state physics covering electron motion in periodic potentials electron phonon interaction and recombination processes The final four chapters deal exclusively with real devices such as semiconductor lasers photodiodes flat panel displays and MOSFETs The book contains many homework exercises and is suitable as a textbook for electrical engineering materials science or physics students taking courses in solid state device physics It will also be a valuable reference for practising engineers in optoelectronics and related areas *The VLSI Handbook* Wai-Kai Chen, 2019-07-17 Over the years the fundamentals of VLSI technology have evolved to include a wide range of topics and a broad range of practices To encompass such a vast amount of knowledge The VLSI Handbook focuses on the key concepts models and equations that enable the electrical engineer to analyze design and predict the behavior of very large scale integrated circuits It provides the most up to date information on IC technology you can find Using frequent

examples the Handbook stresses the fundamental theory behind professional applications Focusing not only on the traditional design methods it contains all relevant sources of information and tools to assist you in performing your job This includes software databases standards seminars conferences and more The VLSI Handbook answers all your needs in one comprehensive volume at a level that will enlighten and refresh the knowledge of experienced engineers and educate the novice This one source reference keeps you current on new techniques and procedures and serves as a review for standard practice It will be your first choice when looking for a solution

*Progress in Inorganic Chemistry, Volume 41* Kenneth D. Karlin, 2009-09-17 This comprehensive series of volumes on inorganic chemistry provides inorganic chemists with a forum for critical authoritative evaluations of advances in every area of the discipline Every volume reports recent progress with a significant up to date selection of papers by internationally recognized researchers complemented by detailed discussions and complete documentation Each volume features a complete subject index and the series includes a cumulative index as well

**Solid State and Quantum Theory for Optoelectronics** Michael A. Parker, 2009-12-16 While applications rapidly change one to the next in our commercialized world fundamental principles behind those applications remain constant So if one understands those principles well enough and has ample experience in applying them he or she will be able to develop a capacity for reaching results via conceptual thinking rather than having to

**Influence of Temperature on Microelectronics and System Reliability** Pradeep Lall, Michael G. Pecht, Edward B. Hakim, 2020-07-09 This book raises the level of understanding of thermal design criteria It provides the design team with sufficient knowledge to help them evaluate device architecture trade offs and the effects of operating temperatures The author provides readers a sound scientific basis for system operation at realistic steady state temperatures without reliability penalties Higher temperature performance than is commonly recommended is shown to be cost effective in production for life cycle costs The microelectronic package considered in the book is assumed to consist of a semiconductor device with first level interconnects that may be wirebonds flip chip or tape automated bonds die attach substrate attach case lid lid seal and lead seal The temperature effects on electrical parameters of both bipolar and MOSFET devices are discussed and models quantifying the temperature effects on package elements are identified Temperature related models have been used to derive derating criteria for determining the maximum and minimum allowable temperature stresses for a given microelectronic package architecture The first chapter outlines problems with some of the current modeling strategies The next two chapters present microelectronic device failure mechanisms in terms of their dependence on steady state temperature temperature cycle temperature gradient and rate of change of temperature at the chip and package level Physics of failure based models used to characterize these failure mechanisms are identified and the variabilities in temperature dependence of each of the failure mechanisms are characterized Chapters 4 and 5 describe the effects of temperature on the performance characteristics of MOS and bipolar devices Chapter 6 discusses using high temperature stress screens including burn in for high reliability applications The burn

in conditions used by some manufacturers are examined and a physics of failure approach is described

**The Introduction to Spintronics** Supriyo Bandyopadhyay, Marc Cahay, 2008-03-20 Using spin to replace or augment the role of charge in signal processing devices computing systems and circuits may improve speed power consumption and device density in some cases making the study of spin one of the fastest growing areas in micro and nanoelectronics With most of the literature on the subject still highly advanced and heavily theoretical the demand for a practical introduction to the concepts relating to spin has only now been filled Explains effects such as giant magnetoresistance the subject of the 2007 Nobel Prize in physics Introduction to Spintronics is an accessible organized and progressive presentation of the quantum mechanical concept of spin The authors build a foundation of principles and equations underlying the physics transport and dynamics of spin in solid state systems They explain the use of spin for encoding qubits in quantum logic processors clarify how spin orbit interaction forms the basis for certain spin based devices such as spintronic field effect transistors and discuss the effects of magnetic fields on spin based device performance Covers active hybrid spintronic devices monolithic spintronic devices passive spintronic devices and devices based on the giant magnetoresistance effect The final chapters introduce the burgeoning field of spin based reversible logic gates spintronic embodiments of quantum computers and other topics in quantum mechanics that have applications in spintronics An Introduction to Spintronics provides the knowledge and understanding of the field needed to conduct independent research in spintronics *Simulations for Solid State Physics Paperback Without CD-ROM* Robert H. Silsbee, Joerg Draeger, Jörg Dräger, 1997-06-28 Interactive resource centering around fourteen high quality computer simulations covering essential topics in solid state physics Copyright Libri GmbH All rights reserved *Thermal Design* H. S. Lee, 2010-11-23 Thermal Design Heat Sinks Thermoelectrics Heat Pipes Compact Heat Exchangers and Solar Cells Second Edition is a significantly updated new edition which now includes a chapter on thermoelectrics It covers thermal devices such as heat sinks thermoelectric generators and coolers heat pipes and heat exchangers as design components in larger systems These devices are becoming increasingly important and fundamental in thermal design across such diverse areas as microelectronic cooling green or thermal energy conversion and thermal control and management in space The underlying concepts in this book cover the understanding of the physical mechanisms of the thermal devices with the essential formulas and detailed derivations and also the design of the thermal devices in conjunction with mathematical modeling graphical optimization and occasionally computational fluid dynamic CFD simulation This new edition includes more examples problems and tutorials and a solutions manual is available on a companion website

**Challenges and Opportunities of Distributed Renewable Power** Sudipta De, Avinash Kumar Agarwal, Pankaj Kalita, 2024-04-29 Due to limited non renewable resources and climate change problems the global energy sector must be transformed from fossil fuel dominated to renewable energy based However due to constraints of resources technology locked capital in existing energy systems limited financial support and associated risks in investment etc this transformation is not expected to occur rapidly

Rather there should be an energy transition path with planned replacement of fossil fuel based systems to renewable based ones Large scale renewable power is yet to be dominant globally Distributed renewable power is appearing to be more common as its implementation requires smaller investments with lesser financial risks There are several options of such distributed renewable power with great prospects at different locations Simultaneously there are many challenges to overcome for successful implementation of such projects These challenges are also multi dimensional In this book several chapters address bright prospects of several options of distributed renewable power Simultaneously other chapters address challenges of implementation of such technologies The chapters together cover a wide perspective of both prospects and associated challenges to be addressed for it Chapters include technological issues optimization of energy systems logistics and policies case studies etc Researchers industry professionals and students can benefit from this book

*Field Effect Transistors, A Comprehensive Overview* Pouya Valizadeh, 2016-02-23 This book discusses modern day Metal Oxide Semiconductor Field Effect Transistors MOSFETs and future trends of transistor devices This book provides an overview of Field Effect Transistors FETs by discussing the basic principles of FETs and exploring the latest technological developments in the field It covers and connects a wide spectrum of topics related to semiconductor device physics physics of transistors and advanced transistor concepts This book contains six chapters Chapter 1 discusses electronic materials and charge Chapter 2 examines junctions discusses contacts under thermal equilibrium metal semiconductor contacts and metal insulator semiconductor systems Chapter 3 covers traditional planar Metal Oxide Semiconductor Field Effect Transistors MOSFETs Chapter 4 describes scaling driving technological variations and novel dimensions of MOSFETs Chapter 5 analyzes Heterojunction Field Effect Transistors FETs and also discusses the challenges and rewards of heteroepitaxy Finally Chapter 6 examines FETs at molecular scales Links the discussion of contemporary transistor devices to physical processes Material has been class tested in undergraduate and graduate courses on the design of integrated circuit components taught by the author Contains examples and end of chapter problems

*Field Effect Transistors A Comprehensive Overview From Basic Concepts to Novel Technologies* is a reference for senior undergraduate graduate students and professional engineers needing insight into physics of operation of modern FETs Pouya Valizadeh is Associate Professor in the Department of Electrical and Computer Engineering at Concordia University in Quebec Canada He received B S and M S degrees with honors from the University of Tehran and Ph D degree from The University of Michigan Ann Arbor all in Electrical Engineering in 1997 1999 and 2005 respectively Over the past decade Dr Valizadeh has taught numerous sections of five different courses covering topics such as semiconductor process technology semiconductor materials and their properties advanced solid state devices transistor design for modern CMOS technology and high speed transistors

**Crystalline Defects and Contamination** Bernd O. Kolbesen, Electrochemical Society. Electronics Division, 2001

*Reliability of High Temperature Electronics* A. Christou, 1996

*Thermal Design* HoSung Lee, 2022-05-20 Thermal Design Discover a new

window to thermal engineering and thermodynamics through the study of thermal design Thermal engineering is a specialized sub discipline of mechanical engineering that focuses on the movement and transfer of heat energy between two mediums or altered into other forms of energy Thermal engineers must have a strong knowledge of thermodynamics and the processes that convert generated energy from thermal sources into chemical mechanical or electrical energy as such thermal engineers can be employed in many industries particularly in automotive manufacturing commercial construction and the HVAC industry As part of their job thermal engineers often have to improve a current system to make it more efficient and so must be aware of a wide array of variables and familiar with a broad sweep of systems to ensure the work they do is economically viable In this significantly updated new edition Thermal Design details the physical mechanisms of standard thermal devices while integrating essential formulas and detailed derivations to give a practical understanding of the field to students The textbook examines the design of thermal devices through mathematical modeling graphical optimization and occasionally computational fluid dynamic CFD simulation Moreover it presents information on significant thermal devices such as heat sinks thermoelectric generators and coolers heat pipes and heat exchangers as design components in larger systems all of which are increasingly important and fundamental to numerous fields such as microelectronic cooling green or thermal energy conversion and thermal control and management in space Readers of the Second Edition of Thermal Design will also find A new chapter on thermoelectrics that reflects the latest modern technology that has recently been developed More problems and examples to help clarify points throughout the book A range of appendices including new additions that include more specifics on topics covered in the book tutorials for applications and computational work A solutions manual provided on a companion website Thermal Design is a useful reference for engineers and researchers in mechanical engineering as well as senior undergraduate and graduate students in mechanical engineering



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