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Semiconductor Drives By P V

Rao

*Power*

*Semiconductor*

*Drives By P V Rao*

Electrostatic discharge (ESD) failure mechanisms continue to impact semiconductor components and systems as technologies scale from micro- to nano-electronics. This book studies electrical overstress, ESD, and latchup from a failure analysis and case-study approach. It provides a clear insight into the physics of failure from a generalist perspective, followed by investigation of failure mechanisms in specific technologies, circuits, and systems. The book is unique in covering both the failure mechanism and the practical solutions to fix the problem from either a technology or circuit methodology. Look inside for

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extensive coverage on: failure analysis tools, EOS and ESD failure sources and failure models of semiconductor technology, and how to use failure analysis to design more robust semiconductor components and systems; electro-thermal models and technologies; the state-of-the-art technologies discussed include CMOS, BiCMOS, silicon on insulator (SOI), bipolar technology, high voltage CMOS (HVCMOS), RF CMOS, smart power, gallium arsenide (GaAs), gallium nitride (GaN), magneto-resistive (MR) , giant magneto-resistors (GMR), tunneling magneto-resistor (TMR), devices; micro electro-mechanical (MEM) systems, and photo-masks and reticles; practical methods to use failure analysis for the understanding of ESD circuit operation, temperature analysis, power distribution, ground rule development, internal bus distribution, current path

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analysis, quality metrics, (connecting the theoretical to the practical analysis); the failure of each key element of a technology from passives, active elements to the circuit, sub-system to package, highlighted by case studies of the elements, circuits and system-on-chip (SOC) in today's products. ESD: Failure Mechanisms and Models is a continuation of the author's series of books on ESD protection. It is an essential reference and a useful insight into the issues that confront modern technology as we enter the Nano-electronic era.

Power Electronics Handbook, Fourth Edition, brings together over 100 years of combined experience in the specialist areas of power engineering to offer a fully revised and updated expert guide to total power solutions. Designed to provide the best technical and most commercially viable solutions available, this handbook

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undertakes any or all aspects of a project requiring specialist design, installation, commissioning and maintenance services. Comprising a complete revision throughout and enhanced chapters on semiconductor diodes and transistors and thyristors, this volume includes renewable resource content useful for the new generation of engineering professionals. This market leading reference has new chapters covering electric traction theory and motors and wide band gap (WBG) materials and devices. With this book in hand, engineers will be able to execute design, analysis and evaluation of assigned projects using sound engineering principles and adhering to the business policies and product/program requirements. Includes a list of leading international academic and professional contributors Offers practical concepts and developments for laboratory test plans

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Includes new technical chapters on electric vehicle charging and traction theory and motors Includes renewable resource content useful for the new generation of engineering professionals

Concern for reliable power supply and energy-efficient system design has led to usage of power electronics-based systems, including efficient electric power conversion and power semiconductor devices. This book provides integration of complete fundamental theory, design, simulation and application of power electronics, and drives covering up-to-date subject components. It contains twenty-one chapters arranged in four sections on power semiconductor devices, basic power electronic converters, advanced power electronics converters, power supplies, electrical drives and advanced applications. Aimed at senior undergraduate and graduate students in

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electrical engineering and power electronics including related professionals, this book

- Includes electrical drives such as DC motor, AC motor, special motor, high performance motor drives, solar, electrical/hybrid vehicle and fuel cell drives
- Reviews advances in renewable energy technologies (wind, PV, hybrid power systems) and their integration
- Explores topics like distributed generation, microgrid, and wireless power transfer system
- Includes simulation examples using MATLAB®/Simulink and over four hundred solved, unsolved and review problems

This book covers the fundamentals and significance of 2-D materials and related semiconductor transistor technologies for the next-generation ultra low power applications. It provides comprehensive coverage on advanced low power transistors such as NCFETs, FinFETs,

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TFETs, and flexible transistors for future ultra low power applications owing to their better subthreshold swing and scalability. In addition, the text examines the use of field-effect transistors for biosensing applications and covers design considerations and compact modeling of advanced low power transistors such as NCFETs, FinFETs, and TFETs. TCAD simulation examples are also provided.

**FEATURES** Discusses the latest updates in the field of ultra low power semiconductor transistors Provides both experimental and analytical solutions for TFETs and NCFETs Presents synthesis and fabrication processes for FinFETs Reviews details on 2-D materials and 2-D transistors Explores the application of FETs for biosensing in the healthcare field

This book is aimed at researchers, professionals, and graduate students in electrical engineering, electronics and

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communication engineering, electron devices, nanoelectronics and nanotechnology, microelectronics, and solid-state circuits.

Proceedings of the ... International Symposium on Power Semiconductor Devices and ICs

Physics, Design and Applications of the Insulated Gate Bipolar Transistor Multiphysics Simulation by Design for Electrical Machines, Power Electronics and Drives

Power Electronics and Motor Drives Proceedings of the 2006 Lester Eastman Conference, Cornell, Ithaca, NY, USA, 26 August 2006

This book addresses material growth, device fabrication, device application, and commercialization of energy-efficient white light-emitting diodes (LEDs),



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laser diodes, and power electronics devices. It begins with an overview on basics of semiconductor materials, physics, growth and characterization techniques, followed by detailed discussion of advantages, drawbacks, design issues, processing, applications, and key challenges for state of the art GaN-based devices. It includes state of the art material synthesis techniques with an overview on growth technologies for emerging bulk or free standing GaN and AlN substrates and their applications in electronics, detection, sensing,

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optoelectronics and photonics. Wengang (Wayne) Bi is Distinguished Chair Professor and Associate Dean in the College of Information and Electrical Engineering at Hebei University of Technology in Tianjin, China. Hao-chung (Henry) Kuo is Distinguished Professor and Associate Director of the Photonics Center at National Chiao-Tung University, Hsin-Tsu, Taiwan, China. Pei-Cheng Ku is an associate professor in the Department of Electrical Engineering & Computer Science at the University of Michigan, Ann Arbor, USA. Bo Shen is the Cheung Kong Professor at Peking

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University in China.

For some time there has been a need for a semiconductor device book that carries diode and transistor theory beyond an introductory level and yet has space to touch on a wider range of semiconductor device principles and applications. Such topics are covered in specialized monographs numbering many hundreds, but the voluminous nature of this literature limits access for students. This book is the outcome of attempts to develop a broad course on devices and integrated electronics for university students at about senior-

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year level. The educational prerequisites are an introductory course in semiconductor junction and transistor concepts, and a course on analog and digital circuits that has introduced the concepts of rectification, amplification, oscillators, modulation and logic and SWitching circuits. The book should also be of value to professional engineers and physicists because of both, the information included and the detailed guide to the literature given by the references. The aim has been to bring some measure of order into the subject area examined and to provide a

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basic structure from which teachers may develop themes that are of most interest to students and themselves. Semiconductor devices and integrated circuits are reviewed and fundamental factors that control power levels, frequency, speed, size and cost are discussed. The text also briefly mentions how devices are used and presents circuits and comments on representative applications. Thus, the book seeks a balance between the extremes of device physics and circuit design. Power Semiconductor devices play a vital role in electrical power systems and

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are used widely in transmission, distribution and control of electric power. It deals with the fundamentals of machines, converters and control of machines with solid state devices. It is divided into eight chapters covering d.c. motor, single and three phases controlled rectifiers, d.c. motor driver by dual converter, four quadrant drive, d.c. choppers, induction motor with VSI, CSI and cycloconverters, control of induction motors and control of synchronous motors. Features \* Each topic is explained lucidly so that the student can understand

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every aspect of the drive system easily. \* Number of worked-out examples are given at the end of each chapter. \* A number of quiz type questions are also given with answers after each chapter.

The Brown Boveri Symposia are by now part of firmly established tradition. This is the seventh event in a series which was initiated shortly after Corporate Research was established as a separate entity within our Company; the Symposia are held every other year. The themes to date have been 1969 Flow Research on Blading 1971 Real-Time Control of Electric Power

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Systems 1973 High-Temperature Materials in Gas Turbines 1975 Nonemissive Electrooptic Displays 1977 Current Interruption in High-Voltage Networks 1979 Surges in High-Voltage Networks 1981 Semiconductor Devices for Power Conditioning Why have we chosen these titles? At the outset we established certain selection criteria; we felt that a subject for a Symposium should fulfill the following requirements: It should characterize a part of a thoroughly scientific discipline; in other words, it should describe an area of scholarly study and research. It should be of current interest in the



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sense that important results have recently been obtained and considerable research effort is underway in the international scientific community. It should bear some relation to the scientific and technological activity of our Company. Let us look at the requirement "current interest": Some of the topics on the list have been the subject of research for several decades, some even from the beginning of the century. One might wonder, then, why such fields could be regarded as particularly timely in the 1960s and 1970s. A few remarks on this subject therefore are in

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Power Electronics and Motor  
Control

Power Semiconductor Devices  
and Circuits

Handbook of Automotive Power  
Electronics and Motor Drives  
Advances and Trends

Smart Power ICs

This book provides a survey of  
the state of the art of technology  
and future trends in the new  
family of Smart Power ICs and  
describes design and applications  
in a variety of fields ranging from  
automotive to  
telecommunications, reliability  
evaluation and qualification  
procedures. The book is a  
valuable source of information  
and reference for both power IC  
design specialists and to all those

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concerned with applications, the development of digital circuits and with system architecture. This book provides readers with a variety of tools to address the challenges posed by hot carrier degradation, one of today's most complicated reliability issues in semiconductor devices. Coverage includes an explanation of carrier transport within devices and book-keeping of how they acquire energy ("become hot"), interaction of an ensemble of colder and hotter carriers with defect precursors, which eventually leads to the creation of a defect, and a description of how these defects interact with the device, degrading its performance.

The IGBT device has proved to be

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a highly important Power Semiconductor, providing the basis for adjustable speed motor drives (used in air conditioning and refrigeration and railway locomotives), electronic ignition systems for gasolinepowered motor vehicles and energy-saving compact fluorescent light bulbs. Recent applications include plasma displays (flat-screen TVs) and electric power transmission systems, alternative energy systems and energy storage. This book is the first available to cover the applications of the IGBT, and provide the essential information needed by applications engineers to design new products using the device, in sectors including consumer, industrial, lighting, transportation, medical and

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renewable energy. The author, B. Jayant Baliga, invented the IGBT in 1980 while working for GE. His book will unlock IGBT for a new generation of engineering applications, making it essential reading for a wide audience of electrical engineers and design engineers, as well as an important publication for semiconductor specialists.

Essential design information for applications engineers utilizing IGBTs in the consumer, industrial, lighting, transportation, medical and renewable energy sectors.

Readers will learn the methodology for the design of IGBT chips including edge terminations, cell topologies, gate layouts, and integrated current sensors. The first book to cover

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applications of the IGBT, a device manufactured around the world by more than a dozen companies with sales exceeding \$5 Billion; written by the inventor of the device.

This clear and concise advanced textbook is a comprehensive introduction to power electronics.

Power Semiconductor Devices  
Proceedings of the 6th  
International Conference on  
Industrial Engineering (ICIE 2020)  
Sliding Mode Control for  
Synchronous Electric Drives  
Hot Carrier Degradation in  
Semiconductor Devices  
Science, Technology, and  
Applications

***This volume covers five  
emerging areas of advanced***

***device technology: wide band gap devices, terahertz and millimeter waves, nanometer silicon and silicon-germanium devices, nanoelectronics and ballistic devices, and the characterization of advanced photonic and electronic devices. The papers by leading researchers in high speed and advanced electronic and photonic technology presented many firsts and breakthrough results, as has become a tradition with the Lester Eastman Conference, and will allow readers to obtain up-to-date information about***

***emerging trends and future directions of these technologies. Key papers in each section present snapshot and mini reviews of state-of-the-art and hot off the press results making the book required reading for engineers, scientists, and students working on advanced and high speed device technology.***

***Presents state-of-the-art GaN and SiC electronic devices, as well as detailed applications of these devices to power conditioning, r. f. base station infrastructure and high temperature electronics.***



***During the last decade many new concepts have been proposed for improving the performance of power MOSFETs. The results of this research are dispersed in the technical literature among journal articles and abstracts of conferences. Consequently, the information is not readily available to researchers and practicing engineers in the power device community. There is no cohesive treatment of the ideas to provide an assessment of the relative merits of the ideas. "Advanced Power MOSFET Concepts" provides an in-depth treatment***

***of the physics of operation of advanced power MOSFETs. Analytical models for explaining the operation of all the advanced power MOSFETs will be developed. The results of numerical simulations will be provided to give additional insight into the device physics and validate the analytical models. The results of two-dimensional simulations will be provided to corroborate the analytical models and give greater insight into the device operation. This book covers power electronics, in depth, by presenting the basic principles***

***and application details, which can be used both as a textbook and reference book. Introduces a new method to present power electronics converters called Power Blocks Geometry (PBG) Applicable for courses focusing on power electronics, power electronics converters, and advanced power converters Offers a comprehensive set of simulation results to help understand the circuits presented throughout the book***

***Power Electronics, Drives, and Advanced Applications***

***Fundamentals of Power  
Semiconductor Devices  
Advanced Power Electronics  
Converters  
Materials, Physics, Design,  
and Applications  
Integrated Power Devices and  
TCAD Simulation***

Initially, the only electric loads encountered in an automobile were for lighting and the starter motor. Today, demands on performance, safety, emissions, comfort, convenience, entertainment, and communications have seen the working-in of seemingly innumerable advanced electronic devices. Consequently, vehicle electric systems require larger

**capacities and more complex configurations to deal with these demands. Covering applications in conventional, hybrid-electric, and electric vehicles, the Handbook of Automotive Power Electronics and Motor Drives provides a comprehensive reference for automotive electrical systems. This authoritative handbook features contributions from an outstanding international panel of experts from industry and academia, highlighting existing and emerging technologies. Divided into five parts, the Handbook of Automotive Power Electronics and Motor Drives offers an overview of automotive power systems, discusses semiconductor devices, sensors, and other**

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**components, explains different power electronic converters, examines electric machines and associated drives, and details various advanced electrical loads as well as battery technology for automobile applications. As we seek to answer the call for safer, more efficient, and lower-emission vehicles from regulators and consumer insistence on better performance, comfort, and entertainment, the technologies outlined in this book are vital for engineering advanced vehicles that will satisfy these criteria.**

**This book relates the recent developments in several key electrical engineering R&D labs, concentrating on power electronics switches and their use. The first**

**sections deal with key power electronics technologies, MOSFETs and IGBTs, including series and parallel associations. The next section examines silicon carbide and its potentiality for power electronics applications and its present limitations. Then, a dedicated section presents the capacitors, key passive components in power electronics, followed by a modeling method allowing the stray inductances computation, necessary for the precise simulation of switching waveforms. Thermal behavior associated with power switches follows, and the last part proposes some interesting prospectives associated to Power Electronics integration.**

**This book highlights recent findings in industrial, manufacturing and mechanical engineering, and provides an overview of the state of the art in these fields, mainly in Russia and Eastern Europe. A broad range of topics and issues in modern engineering are discussed, including the dynamics of machines and working processes, friction, wear and lubrication in machines, surface transport and technological machines, manufacturing engineering of industrial facilities, materials engineering, metallurgy, control systems and their industrial applications, industrial mechatronics, automation and robotics. The book gathers selected papers presented at the 6th**



**International Conference on Industrial Engineering (ICIE), held in Sochi, Russia in May 2020. The authors are experts in various fields of engineering, and all papers have been carefully reviewed. Given its scope, the book will be of interest to a wide readership, including mechanical and production engineers, lecturers in engineering disciplines, and engineering graduates.**

**This volume presents the theory of control systems with sliding mode applied to electrical motors and power converters. It demonstrates the methodology of control design and the original algorithms of control and observation. Practically all semiconductor devices are used in**

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**power converters, that feed electrical  
motors, as power switches. A switch  
Failure Mechanisms and Models  
ESD**

**The IGBT Device**

**Proceedings of the ... International  
Symposium on Semiconductor  
Wafer Bonding**

**Advanced Power MOSFET Concepts**

From power electronics to  
power integrated circuits  
(PICs), smart power  
technologies, devices, and  
beyond, Integrated Power  
Devices and TCAD Simulation  
provides a complete picture  
of the power management and  
semiconductor industry. An  
essential reference for  
power device engineering  
students and professionals,

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the book not only describes the physics inside integrated power semiconductor devices such lateral double-diffused metal oxide semiconductor field-effect transistors (LDMOSFETs), lateral insulated-gate bipolar transistors (LIGBTs), and super junction LDMOSFETs but also delivers a simple introduction to power management systems. Instead of abstract theoretical treatments and daunting equations, the text uses technology computer-aided design (TCAD) simulation examples to explain the design of integrated power semiconductor devices. It

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also explores next generation power devices such as gallium nitride power high electron mobility transistors (GaN power HEMTs). Including a virtual process flow for smart PIC technology as well as a hard-to-find technology development organization chart, Integrated Power Devices and TCAD Simulation gives students and junior engineers a head start in the field of power semiconductor devices while helping to fill the gap between power device engineering and power management systems. This book presents physics-

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power semiconductor devices and their implementation in MATLAB and Simulink. The devices are subdivided into different regions, and the operation in each region, along with the interactions at the interfaces, are analyzed using basic semiconductor physics equations that govern their behavior. The Fourier series solution is used to solve the ambipolar diffusion equation in the lightly doped drift region of the devices. In addition to the external electrical characteristics, internal physical and electrical information, such as the junction voltages and the

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carrier distribution in different regions of the device, can be obtained using the models. Key words: power semiconductor devices; physics-based model; Fourier series solution; drift region, carrier diffusion, transient switching behavior

Wide Bandgap Semiconductor Power Devices: Materials, Physics, Design and Applications provides readers with a single resource on why these devices are superior to existing silicon devices. The book lays the groundwork for an understanding of an array of applications and anticipated benefits in energy savings. Authored by

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the Founder of the Power Semiconductor Research Center at North Carolina State University (and creator of the IGBT device), Dr. B. Jayant Baliga is one of the highest regarded experts in the field. He thus leads this team who comprehensively review the materials, device physics, design considerations and relevant applications discussed. Comprehensively covers power electronic devices, including materials (both gallium nitride and silicon carbide), physics, design considerations, and the most promising applications Addresses the key challenges towards the

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realization of wide bandgap power electronic devices, including materials defects, performance and reliability Provides the benefits of wide bandgap semiconductors, including opportunities for cost reduction and social impact

The book addresses the need to investigate new approaches to lower energy requirement in multiple application areas and serves as a guide into emerging circuit technologies. It explores revolutionary device concepts, sensors, and associated circuits and architectures that will greatly extend the practical engineering limits of energy-



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efficient computation. The book responds to the need to develop disruptive new system architectures and semiconductor processes aimed at achieving the highest level of computational energy efficiency for general purpose computing systems. Discusses unique technologies and material only available in specialized journal and conferences. Covers emerging materials and device structures, such as ultra-low power technologies, nanoelectronics, and microsystem manufacturing. Explores semiconductor processing and

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manufacturing, device design, and performance.

Contains practical applications in the engineering field, as well as graduate studies. Written by international experts from both academia and industry.

Low Power Semiconductor Devices and Processes for Emerging Applications in Communications, Computing, and Sensing

Semiconductor Devices and Technologies for Future

Ultra Low Power Electronics

Power Semiconductor Drives

Modeling Bipolar Power

Semiconductor Devices

Wide Bandgap Semiconductor

Power Devices

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*Power Electronics and Motor Drive Systems* is designed to aid electrical engineers, researchers, and students to analyze and address common problems in state-of-the-art power electronics technologies. Author Stefanos Manias supplies a detailed discussion of the theory of power electronics circuits and electronic power conversion technology systems, with common problems and methods of analysis to critically evaluate results. These theories are reinforced by

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*simulation examples using well-known and widely available software programs, including SPICE, PSIM, and MATLAB/SIMULINK. Manias expertly analyzes power electronic circuits with basic power semiconductor devices, as well as the new power electronic converters. He also clearly and comprehensively provides an analysis of modulation and output voltage, current control techniques, passive and active filtering, and the characteristics and gating circuits of different*

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*power semiconductor  
switches, such as BJTs,  
IGBTs, MOSFETs, IGCTs,  
MCTs and GTOs. Includes  
step-by-step analysis of  
power electronic systems  
Reinforced by simulation  
examples using SPICE,  
PSIM, and MATLAB/SIMULINK  
Provides 110 common  
problems and solutions in  
power electronics  
technologies  
Entrepreneurship in Power  
Semiconductor Devices,  
Power Electronics, and  
Electric Machines and  
Drive Systems introduces  
the basics of  
entrepreneurship and a*

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*methodology for the study of entrepreneurship in electrical engineering and other engineering fields. Entrepreneurship is considered here in three fields of electrical engineering, viz. power semiconductor devices, power electronics and electric machines and drive systems, and their current practice. It prepares the reader by providing a review of the subject matter in the three fields, their current status in research and development with analysis aspect as needed,*

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*thus allowing readers to gain self-sufficiency while reading the book. Each field's emerging applications, current market and future market forecasts are introduced to understand the basis and need for emerging startups. Practical learning is introduced in:*

*(i) power semiconductor devices entrepreneurship through the prism of 20 startups in detail, (ii) power electronics entrepreneurship through 28 startup companies arranged under various application fields and*

*(iii) electric machines and drive systems entrepreneurship through 15 startups in electromagnetic and 1 in electrostatic machines and drive systems. The book:*

*(i) demystifies entrepreneurship in a practical way to equip engineers and students with entrepreneurship as an option for their professional growth, pursuit and success; (ii) provides engineering managers and corporate-level executives a detailed view of entrepreneurship*



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*activities in the considered three fields that may potentially impact their businesses, (iii) provides entrepreneurship education in an electrical engineering environment and with direct connection and correlation to their fields of study and (iv) endows a methodology that can be effectively employed not only in the three illustrated fields of electrical engineering but in other fields as well. This book is for electrical engineering students and*

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*professionals. For use in undergraduate and graduate courses in electrical engineering, the book contains discussion questions, exercise problems, team and class projects, all from a practical point of view, to train students and assist professionals for future entrepreneurship endeavors.*

*Fundamentals of Power Semiconductor Devices provides an in-depth treatment of the physics of operation of power semiconductor devices that are commonly used by the*

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*power electronics industry. Analytical models for explaining the operation of all power semiconductor devices are shown. The treatment here focuses on silicon devices but includes the unique attributes and design requirements for emerging silicon carbide devices. The book will appeal to practicing engineers in the power semiconductor device community. Presents applied theory and advanced simulation techniques for electric machines and drives This book combines the*

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*knowledge of experts from both academia and the software industry to present theories of multiphysics simulation by design for electrical machines, power electronics, and drives. The comprehensive design approach described within supports new applications required by technologies sustaining high drive efficiency. The highlighted framework considers the electric machine at the heart of the entire electric drive. The book also emphasizes the simulation by design*

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*concept—a concept that frames the entire highlighted design methodology, which is described and illustrated by various advanced simulation technologies. Multiphysics Simulation by Design for Electrical Machines, Power Electronics and Drives begins with the basics of electrical machine design and manufacturing tolerances. It also discusses fundamental aspects of the state of the art design process and includes examples from industrial practice. It*

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*explains FEM-based analysis techniques for electrical machine design—providing details on how it can be employed in ANSYS Maxwell software. In addition, the book covers advanced magnetic material modeling capabilities employed in numerical computation; thermal analysis; automated optimization for electric machines; and power electronics and drive systems. This valuable resource: Delivers the multi-physics know-how based on practical electric machine*

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*design methodologies  
Provides an extensive  
overview of electric  
machine design  
optimization and its  
integration with power  
electronics and drives  
Incorporates case studies  
from industrial practice  
and research and  
development projects  
Multiphysics Simulation by  
Design for Electrical  
Machines, Power  
Electronics and Drives is  
an incredibly helpful book  
for design engineers,  
application and system  
engineers, and technical  
professionals. It will*

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*also benefit graduate engineering students with a strong interest in electric machines and drives.*

*Power Electronics Handbook  
Advanced Semiconductor  
Devices*

*Handbook of GaN*

*Semiconductor Materials  
and Devices*

*Semiconductor Devices and  
Integrated Electronics*

*Power Electronics*

*Semiconductor Devices*

Power electronics is an area of extremely important and rapidly changing technology. Technological advancements in the area contribute to performance improvement and



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cost reduction, with applications proliferating in industrial, commercial, residential, military and aerospace environments. This book is meant to help engineers operating in all these areas to stay up-to-date on the most recent advances in the field, as well as to be a vehicle for clarifying increasingly complex theories and mathematics. This book will be a cost-effective and convenient way for engineers to get up-to-speed on the latest trends in power electronics. The reader will obtain the same level of informative instruction as they would if attending an

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IEEE course or a training session, but without ever leaving the office or living room! The author is in an excellent position to offer this instruction as he teaches many such courses. Self-learning advanced tutorial, falling between a traditional textbook and a professional reference. Almost every page features either a detailed figure or a bulleted chart, accompanied by clear descriptive explanatory text.

Power Electronics and Motor Drives: Advances and Trends, Second Edition is the perfect resource to keep the electrical engineer up-to-

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speed on the latest advancements in technologies, equipment and applications. Carefully structured to include both traditional topics for entry-level and more advanced applications for the experienced engineer, this reference sheds light on the rapidly growing field of power electronic operations. New content covers converters, machine models and new control methods such as fuzzy logic and neural network control. This reference will help engineers further understand recent technologies and gain practical understanding with its inclusion of many

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industrial applications.  
Further supported by a  
glossary per chapter, this  
book gives engineers and  
researchers a critical  
reference to learn from real-  
world examples and make  
future decisions on power  
electronic technology and  
applications. Provides many  
practical examples of  
industrial applications  
Updates on the newest  
electronic topics with  
content added on fuzzy logic  
and neural networks Presents  
information from an expert  
with decades of research and  
industrial experience  
This symposium was the  
scientific-technical event  
of the centennial

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celebration of the Asea Brown Boveri Switzerland. The purpose was to assess the present state of the art as well as shaping the basis for future progress in the area of power devices and related power circuits. The merger of Brown Boveri (BBC) with Asea to Asea Brown Boveri (ABB) three years ago gave new stimulus and enriched the technical substance of the symposium. By 1991, 100 years after the formation of BBC in Switzerland as a single company, this organization has been decentralized, forming 35 independent ABB companies. One of them - ABB Semiconductors Ltd. -

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directly deals with the power semiconductor business. These significant changes reflect the changes in the market place: increased competition and higher customer expectations have to be fulfilled. In line with the core business activities of ABB and with the concept of sustainable development, it is natural for ABB to be active in the area of power devices and circuits. Increased awareness towards energy conservation is one of the main drives for these activities. User friendliness is another drive: integration of intelligent functions, e.g.

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protection and/or increased direct computer interfacing of the power circuits.

Therefore, also the R&D activities related to the subject of this symposium will in the future be characterized by an even stronger coupling with the market needs. For the members of the R&D Laboratories this means improved customer partnership beyond operational excellence.

This book presents physics-based models of bipolar power semiconductor devices and their implementation in MATLAB and Simulink. The devices are subdivided into different regions, and the

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operation in each region, along with the interactions at the interfaces which are analyzed using basic semiconductor physics equations that govern their behavior. The Fourier series solution is used to solve the ambipolar diffusion equation in the lightly doped drift region of the devices. In addition to the external electrical characteristics, internal physical and electrical information, such as the junction voltages and the carrier distribution in different regions of the device, can be obtained using the models.

Volume II



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