



# **MODERN POWER DEVICES**

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**B. Jayant Baliga**

# Modern Power Devices

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## **Modern Power Devices:**

Modern Power Electronic Devices Francesco Iannuzzo, 2020-10 Power devices are key to modern power systems performing functions such as inverting and changing voltages buffering and switching Following a device centric approach this book covers power electronic applications semiconductor physics materials science application engineering and key technologies such as MOSFET IGBT and WBG

**Modern Power Devices** B. Jayant Baliga, 1987-03-10 Written in a tutorial form the text supplies in depth the physics design and fabrication technology for power devices Each chapter includes a discussion of the basic concepts of device operation and their electrical characteristics a detailed analysis of the device physics and the technology of fabrication Extensive analytical solutions are used to enable the reader to obtain an understanding of the physics

**Fundamentals of Power Semiconductor Devices** B. Jayant Baliga, 2010-04-02 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 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

**Semiconductor Power Devices** Josef Lutz, Heinrich Schlangenotto, Uwe Scheuermann, Rik De Doncker, 2011-01-15 Semiconductor power devices are the heart of power electronics They determine the performance of power converters and allow topologies with high efficiency Semiconductor properties pn junctions and the physical phenomena for understanding power devices are discussed in depth Working principles of state of the art power diodes thyristors MOSFETs and IGBTs are explained in detail as well as key aspects of semiconductor device production technology In practice not only the semiconductor but also the thermal and mechanical properties of packaging and interconnection technologies are essential to predict device behavior in circuits Wear and aging mechanisms are identified and reliability analyses principles are developed Unique information on destructive mechanisms including typical failure pictures allows assessment of the ruggedness of power devices Also parasitic effects such as device induced electromagnetic interference problems are addressed The book concludes with modern power electronic system integration techniques and trends

**Modern Silicon Carbide Power Devices** B Jayant Baliga, 2023-09-18 Silicon Carbide power devices are being increasingly adopted for many applications such as electric vehicles and charging stations There is a large demand for a resource to learn and understand the basic physics of operation of these devices to create engineers with in depth knowledge about them This unique compendium provides a comprehensive design guide for Silicon Carbide power devices It systematically describes the device structures and analytical models for computing their characteristics The device structures included are the Schottky diode JBS rectifier power MOSFET JBSFET IGBT and BiDFET Unique structures that address achieving excellent voltage blocking and on resistance are emphasized This useful textbook and reference

innovations for achieving superior high frequency operation and highlights manufacturing technology for the devices The book will benefit professionals academics researchers and graduate students in the fields of electrical and electronic engineering circuits and systems semiconductors and energy studies      **Modern Power Electronics** Bimal K. Bose,1992 Provides the latest techniques and energy saving applications for working with power semiconductor devices ac dc converters ac ac converters dc dc converters dc ac converters PWM methods and converter applications This book starts with a very comprehensive tutorial section which reviews state of the art power electronics technology integrating power semiconductor devices different classes of converter topologies PWM techniques and key power electronics applications

Advanced High Voltage Power Device Concepts B. Jayant Baliga,2011-09-21 The devices described in Advanced MOS Gated Thyristor Concepts are utilized in microelectronics production equipment in power transmission equipment and for very high power motor control in electric trains steel mills etc Advanced concepts that enable improving the performance of power thyristors are discussed here along with devices with blocking voltage capabilities of 5 000 V 10 000 V and 15 000 V Throughout the book analytical models are generated to allow a simple analysis of the structures and to obtain insight into the underlying physics The results of two dimensional simulations are provided to corroborate the analytical models and give greater insight into the device operation      *The IGBT Device* B. Jayant Baliga,2022-11-25 The IGBT Device Physics Design and Applications of the Insulated Gate Bipolar Transistor Second Edition provides the essential information needed by applications engineers to design new products using the device in sectors including consumer industrial lighting transportation medical and renewable energy The IGBT device has proven to be 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 gasoline powered motor vehicles and energy saving compact fluorescent light bulbs The book presents recent applications in plasma displays flat screen TVs and electric power transmission systems alternative energy systems and energy storage but it is also used in all renewable energy generation systems including solar and wind power This book is the first available on the applications of the IGBT It will unlock IGBT for a new generation of engineering applications making it essential reading for a wide audience of electrical and design engineers as well as an important publication for semiconductor specialists Presents essential design information for applications engineers utilizing IGBTs in the consumer industrial lighting transportation medical and renewable energy sectors Teaches the methodology for the design of IGBT chips including edge terminations cell topologies gate layouts and integrated current sensors Covers 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 is the first book to highlight the key role of the IGBT in enabling electric vehicles and renewable energy systems with global impacts on climate change      *Latest Advances in Electrothermal Models* Krzysztof Górecki,Paweł Górecki,2021-03-17 This book is devoted to the latest advances in the area of electrothermal

modelling of electronic components and networks It contains eight sections by different teams of authors These sections contain the results of a electro thermal simulations of SiC power MOSFETs using a SPICE like simulation program b modelling thermal properties of inductors taking into account the influence of the core volume on the efficiency of heat removal c investigations into the problem of inserting a temperature sensor in the neighbourhood of a chip to monitor its junction temperature d computations of the internal temperature of power LEDs situated in modules containing multiple power LEDs taking into account both self heating in each power LED and mutual thermal couplings between each diode e analyses of DC DC converters using the electrothermal averaged model of the diode transistor switch including an IGBT and a rapid switching diode f electrothermal modelling of SiC power BJTs g analysis of the efficiency of selected algorithms used for solving heat transfer problems at nanoscale h analysis related to thermal simulation of the test structure dedicated to heat diffusion investigation at the nanoscale

**Flexible AC Transmission Systems: Modelling and Control** Xiao-Ping Zhang,Christian Rehtanz,Bikash Pal,2012-02-24 The extended and revised second edition of this successful monograph presents advanced modeling analysis and control techniques of Flexible AC Transmission Systems FACTS The book covers comprehensively a range of power system control problems from steady state voltage and power flow control to voltage and reactive power control to voltage stability control to small signal stability control using FACTS controllers In the six years since the first edition of the book has been published research on the FACTS has continued to flourish while renewable energy has developed into a mature and booming global green business The second edition reflects the new developments in converter configuration smart grid technologies super power grid developments worldwide new approaches for FACTS control design new controllers for distribution system control and power electronic controllers in wind generation operation and control The latest trends of VSC HVDC with multilevel architecture have been included and four completely new chapters have been added devoted to Multi Agent Systems for Coordinated Control of FACTS devices Power System Stability Control using FACTS with Multiple Operating Points Control of a Looping Device in a Distribution System and Power Electronic Control for Wind Generation

**Springer Handbook of Semiconductor Devices** Massimo Rudan,Rossella Brunetti,Susanna Reggiani,2022-11-10 This Springer Handbook comprehensively covers the topic of semiconductor devices embracing all aspects from theoretical background to fabrication modeling and applications Nearly 100 leading scientists from industry and academia were selected to write the handbook s chapters which were conceived for professionals and practitioners material scientists physicists and electrical engineers working at universities industrial R D and manufacturers Starting from the description of the relevant technological aspects and fabrication steps the handbook proceeds with a section fully devoted to the main conventional semiconductor devices like e g bipolar transistors and MOS capacitors and transistors used in the production of the standard integrated circuits and the corresponding physical models In the subsequent chapters the scaling issues of the semiconductor device technology are addressed followed by the description of

novel concept based semiconductor devices The last section illustrates the numerical simulation methods ranging from the fabrication processes to the device performances Each chapter is self contained and refers to related topics treated in other chapters when necessary so that the reader interested in a specific subject can easily identify a personal reading path through the vast contents of the handbook

**Silicon Compatible Materials, Processes, and Technologies for Advanced Integrated Circuits and Emerging Applications** 7 F. Roozeboom, H. Jagannathan, K. Kakushima, P. J. Timans, E. P. Gusev, Z. Karim, S. De Gendt, 2017

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

**Proceedings of the Symposia on Reliability of Semiconductor Devices and Interconnection and Multilevel Metallization, Interconnection, and Contact Technologies** Harzara S. Rathore, G. C. Schwartz, Robin A. Susko, 1989

**Micro and Nanoelectronics Devices, Circuits and Systems** Koushik Guha, Samar Kanti Saha, Jacopo Iannacci, 2025-07-23 This book presents select proceedings of the International Conference on Micro and Nanoelectronics Devices Circuits and Systems MNDCS 2024 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 It is beneficial to academic researchers and practitioners in the industry who work in this field

High Voltage Devices and Circuits in Standard CMOS Technologies Hussein Ballan, Michel Declercq, 2013-03-14 Standard voltages used in today's ICs may vary from about 1.3V to more than 100V depending on the technology and the application High voltage is therefore a relative notion High Voltage Devices and Circuits in Standard CMOS Technologies is mainly focused on standard CMOS technologies where high voltage HV is defined as any voltage higher than the nominal low voltage i.e. 5V, 3V or even lower In this standard CMOS environment IC designers are more and more frequently confronted with HV problems particularly at the I/O level of the circuit In the first group of applications a large range of industrial or consumer circuits either require HV driving capabilities or are supposed to work in a high voltage environment This includes ultrasonic drivers flat panel displays robotics automotive etc On the

other hand in the emerging field of integrated microsystems MEMS actuators mainly make use of electrostatic forces involving voltages in the typical range of 30 to 60V Last but not least with the advent of deep sub micron and or low power technologies the operating voltage tends towards levels ranging from 1V to 2.5V while the interface needs to be compatible with higher voltages such as 5V For all these categories of applications it is usually preferable to perform most of the signal processing at low voltage while the resulting output rises to a higher voltage level Solving this problem requires some special actions at three levels technology circuit design and layout High Voltage Devices and Circuits in Standard CMOS

Technologies addresses these topics in a clear and organized way The theoretical background is supported by practical information and design examples It is an invaluable reference for researchers and professionals in both the design and device communities

*Handbook of Microwave and Radar Engineering* Anatoly Belous, 2021-01-04 This comprehensive handbook provides readers with a single source reference to the theoretical fundamentals physical mechanisms and principles of operation of all known microwave devices and various radars The author discusses proven methods of computation and design development process schematic schematic technical and construction peculiarities of each breed of the microwave devices as well as the most popular and original technical solutions for radars Coverage also includes the history of creation of the most widely used radars as well as guidelines for their potential upgrading Offers readers a comprehensive systematized view of all contemporary knowledge acquired during the last 20 years on radars and related disciplines Provides a single source reference on the physical mechanisms and principles of operation of the basic components of radio location devices including theoretical aspects of designing the necessary high efficiency electronic devices and systems as well as key practical methods of computation and design Presents complex topics using simple language minimizing mathematics

**Ion Implantation: Basics to Device Fabrication** Emanuele Rimini, 2013-11-27 Ion implantation offers one of the best examples of a topic that starting from the basic research level has reached the high technology level within the framework of microelectronics As the major or the unique procedure to selectively dope semiconductor materials for device fabrication ion implantation takes advantage of the tremendous development of microelectronics and it evolves in a multidisciplinary frame Physicists chemists materials scientists processing device production device design and ion beam engineers are all involved in this subject The present monography deals with several aspects of ion implantation The first chapter covers basic information on the physics of devices together with a brief description of the main trends in the field The second chapter is devoted to ion implanters including also high energy apparatus and a description of wafer charging and contaminants Yield is a quite relevant issue in the industrial surrounding and must be also discussed in the academic ambient The slowing down of ions is treated in the third chapter both analytically and by numerical simulation methods Channeling implants are described in some details in view of their relevance at the zero degree implants and of the available industrial parallel beam systems Damage and its annealing are the key processes in ion implantation Chapter four and five

are dedicated to this extremely important subject      **Actuators** Hartmut Janocha,2013-03-09 Authored by a team of acknowledged experts this book presents a multidisciplinary view of the state of the art in the field of actuators The goal of the book is to provide a comprehensive overview of the properties applications and potential applications of traditional and unconventional actuators together with their corresponding power electronics Special attention is paid to the objective assessment of competing actuator principles The book is written primarily for designers and engineers in research and development but will also be valuable as a textbook for students of automation engineering mechatronics and adaptronics

Integrated Silicon Optoelectronics Horst Zimmermann,2013-11-11 The book covers the entire topic from the basics of optoelectronics device physics of photodetectors and light emitters simulation of photodetectors and technological aspects of optoelectronic integration in microelectronics to circuit aspects and practical applications It summarizes the state of the art in integrated silicon optoelectronics and reviews recent publications on this topic Results of basic research on silicon light emitters are included as well while published results are compared with each other and with the work of the author



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