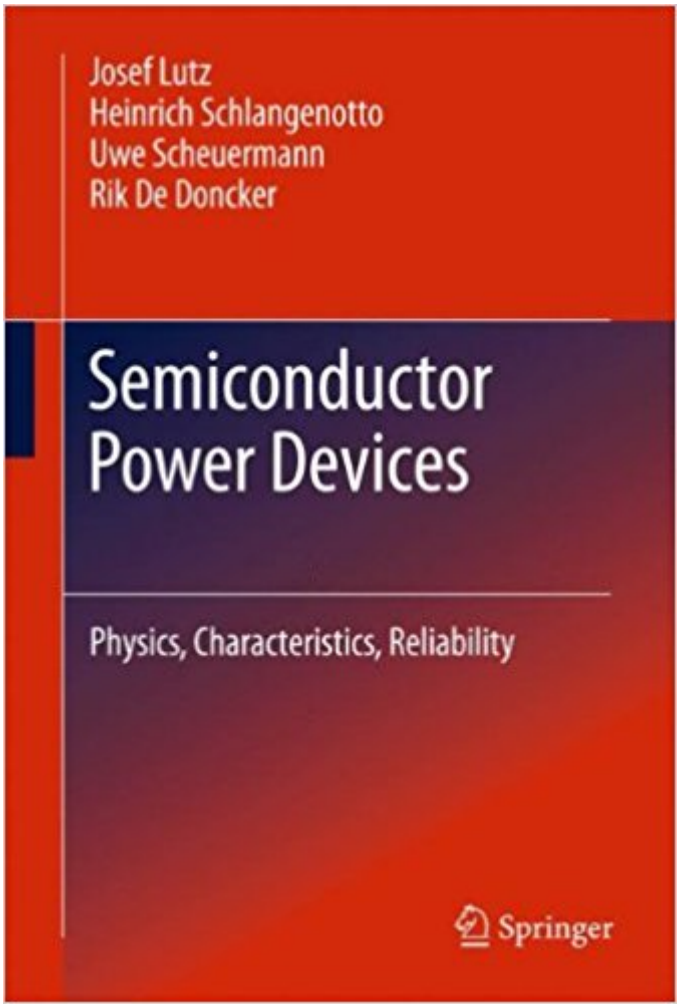
Semiconductor Power Devices: Physics, Characteristics, Reliability



Synopsis

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.

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Customer Reviews

Aus den Rezensionen:Ã¢â ¬Å“... Das Buch ist eine erweiterte, aktualisierte englische Version des deutschen Buchs der Autoren. Es prÃƒÂ¤sentiert Leistungshalbleiter auf umfassender Weise ... Das Buch prasentiert auch diverse StÃƒÂ¶rungen und Schwingungen, die durch SchaltvorgÃƒÂ¤nge bei Leistungskomponenten verursacht werden. ... Die LektÃƒÂ re schafft es,

fundierte Theorie praxisnah und verstÃƒÂ¤ndlich zu vermitteln. Ein grÃƒÂ ndliches, ausgewogenes Buch, das sowohl Energietechnik-Studierenden als auch Leistungselektronik-Entwicklungsingenieuren eine FÃƒÂ lle an wertvollen Informationen und Einsichten bietet.Ã¢â ¬Å“ (in: Bulletin SEV/VSE, 7/October/2011, Issue 10, S. 68)

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Semiconductor Power Devices, Physics, Characteristics, Reliability, by Josef Lutz, Heinrich Schlangenotto, Uwe Scheuermann, and Rik De Doncker, Springer-Verlag, Berlin Heidelberg, 2011.This is truly an excellent book. There is much here for those interested in power devices in general. Those with specific interests in power modules will find it even more rewarding. Written by four acknowledged experts, they have given us a text with fourteen chapters, and three appendices comprising 536 pages. As one might expect, silicon devices and technology dominate, but SiC devices are frequently mentioned and well described. Sentences are simple and direct to the point. Solid-state physics is available but not intimidating. TCAD is there, but also in non-overwhelming fashion. Relatively simple analytic equations are present throughout the book. The authors make good use of previously published papers, giving brief expositions of the important results for each paper. This is preferred, rather than just a reference citation. As the authors mention, much of the material was previously presented in classroom lectures. My view is that this "vetting" is beneficial and helps to improve overall understandability.The introduction to each chapter typically has a brief historical description that is interwoven with an overview of the chapter’s subject matter. An "Outlook" section concludes most chapters and gives possibilities for future development. These are

welcome features not normally present in engineering texts.There is also an especially well done chapter on packaging and reliability that answers many of the frequent questions that tend to arise on the packaging side. Many power packages are described. Transient thermal behavior of devices and packages is covered. The section on reliability is particularly helpful.Perhaps the book's strongest chapters deal with diodes. There are four, counting an important chapter on destructive mechanisms. What might be called the German method of taking into account emitter recombination and behavior of the middle region is employed in the analysis of diode forward I-V characteristics. I've used most of the methods described in the pin diode chapter and found them to work well. Diode static and transient behavior is extensively covered. Diode failure modes are treated in detail. The reverse-recovery failure description provides a useful extension to the classic paper by Benda and Spenke.Operation of the main component of the power module, the IGBT, is covered and its SOA and short circuit behavior discussed extensively in the chapter on device destruction. A major problem in the application of motor drives and power modules, power device induced oscillations, is given an entire chapter and discussed in detail.What's not to like? Color would have been nice, but it's probably not quite ready for texts, maybe a future edition? Power integrated circuits are only briefly described. The one-dimensional thyristor turn-on model, for example from DannhÃƒÂ¤user and Voss, is not here. These are only quibbles. This is truly a great text and will be welcomed by the power device and power electronics communities.

This book has been written by highly recognized experts in device development, device theory, device integration methods, and application aspects for power electronics. It covers all important types of semiconductor power devices, and it treats important aspects of reliability, robustness and EMI problems. For device specialists, it presents a really useful theoretical base, and for power electronics specialists, it contains the essential informations on device structures and properties.Therefore I definitely recommend this book for all students and engineers involved in power electronics.Prof. Dieter SilberInstitute for Electrical Drives, Power Electronics and DevicesUniversity of BremenGermany

I have been working in the high power semiconductor field for 15 years.Now I want to encourage young engineers study high power semiconductor engineering.This book covers all the topics from the traditional to the new ones.I strongly recommend young engineers to buy a copy.

Engineering, Reliability and Diagnostics: A Practical Approach to High Power and Single Mode Devices Semiconductor Physics and Applications (Series on Semiconductor Science and Technology) Semiconductor Physics And Devices: Basic Principles Semiconductor Physics And Devices Semiconductor Physics and Devices International Edition Semiconductor Devices: Physics and Technology Physics of Semiconductor Devices Semiconductor Process Reliability in Practice Understanding Semiconductor Devices (The Oxford Series in Electrical and Computer Engineering) Semiconductor Devices for High-Speed Optoelectronics An Introduction to Semiconductor Devices Principles of Semiconductor Devices (The Oxford Series in Electrical and Computer Engineering) Microwave Noise in Semiconductor Devices Semiconductor Devices Silicon Carbide Biotechnology, Second Edition: A Biocompatible Semiconductor for Advanced Biomedical Devices and Applications Solar Power: The Ultimate Guide to Solar Power Energy and Lower Bills: (Off Grid Solar Power Systems, Home Solar Power System) (Living Off Grid, Wind And Solar Power Systems) Power Training: For Combat, MMA, Boxing, Wrestling, Martial Arts, and Self-Defense: How to Develop Knockout Punching Power, Kicking Power, Grappling Power, and Ground Fighting Power Power Pivot and Power BI: The Excel User's Guide to DAX, Power Query, Power BI & Power Pivot in Excel 2010-2016 Airplane Design Part VI : Preliminary Calculation of Aerodynamic Thrust and Power Characteristics