

What About Electrons, Holes and Reliability of Your Circuit?

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Design of power electronic circuits sometimes seems straightforward — but designers know, it often isn't: What e. g. happens if a device is not used under the conditions given in the data sheet — for example, which switching losses occur in an IGBT undergoing zero voltage switching, but being only specified for hard switching? Experienced designers know that this depends on the design of the device — there e. g. is a difference between NPT and PT devices. Or what about reliability of power electronics for a vehicle drive being exposed to driving cycles? Experienced designers know that this strongly depends on the package of the device. Last but not least — how to identify the root cause of failures before more of them might occur in the field? Obviously in many cases additional background information is needed which gives a deeper understanding of the physical effects and their consequences for power electronics designs.

Exactly this background information can be found in the new textbook

Semiconductor Power Devices—Physics, Characteristics, Reliability

**by Josef Lutz, Heinrich Schlangenotto,
Uwe Scheuermann and Rik De Doncker
published at Springer
Heidelberg/Dordrecht/London/New York,
2011, hardcover ISBN 978-3-642-
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which is available as a print or online version with more than 500 pages: In the first chapter, IEEE PELS past president Rik De Doncker builds a bridge from circuit design to device physics.

In the following chapters Josef Lutz and Heinrich Schlangenotto introduce physics of semiconductors and pn-junctions, the following explanations of power semiconductor devices are based on: Diodes, briefly bipolar transistors, thyristors, MOSFETs and other unipolar field effect transistors and IGBTs are considered; in each case, their basic structure and main electric properties are explained first, followed by in depth physical considerations. A power semiconductor component is not only made from silicon — consequently renowned expert Uwe Scheuermann explains

packages in the following, outlining types of package, their thermal and electrical behaviour, which is mostly considered to be parasitic, and related reliability issues. In the following, several destructive mechanisms are described as a result of recent comprehensive investigations. Further considerations refer to oscillations in and between devices which are important for electromagnetic emissions, and the prospect of system integration.

A predecessor of this work had already been published in German language. The English version referenced here takes additionally into account what has been learned and researched in the meantime — it is a mature and comprehensive work. Its interdisciplinary approach with a focus on device physics, but also considering surrounding packaging, circuit design and related problems, makes it unique — and sometimes in a way a demanding reading matter. It is however surely worth to work through the chapters in the reader's field of interest — there is no substitute for a deep understanding of physical background for an engineer in power electronics research and development, and this new book significantly can help us to achieve this.