

# A look at a new text on power devices

Review by Phil Hower, Texas Instruments, ATD, 50 Phillippe Cote St, Manchester, NH, United States  
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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 Dannhäuser 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.