ISSUE: March 2014

Manufacturer's Magnetics Design Guide Is Würth Reading

***Trilogy of Magnetics: Design Guide for EMI Filter Design, SMPS, & RF Circuits**, 4th extended and revised edition*, Bernhard Rall, Heinz Zenkner, Alexander Gerfer, Thomas Brander, Würth Elektronik (www.we-online.com), ISBN 978-3-89929-157-5, glossy hardback, 725 pages + CD, 2010, 49 Euros.

Reviewed by Dennis Feucht, Innovatia Laboratories, Cayo, Belize

This book is published by Würth Elektronik (WE), a German electronics company that sells magnetic components. It is mostly an applications handbook for users of WE or other parts, somewhat in the tradition of the semiconductor application-note compendia of National Semiconductor or Analog Devices, where not only are the parts described, but the underlying theory required to understand and use them is explained. Design software is appended on a CD for a WE inductor selector, WE-Flex Designer for winding-configurable transformers, and also Linear Technology's LTSpice/SwitcherCAD III.

The book decomposes into three (the "Trilogy") main sections: Basic Principles, Components, and Applications. With good European rigor, the Basics begin at rock-bottom with an industrial-grade presentation of Maxwell's equations, having only a token contour integral or two to threaten the mathematically adverse reader. The emphasis is on qualitative understanding and approximate quantitative formulas of the kind most useful to the circuit designer. Some emphasis is placed on simulation (hence the CD) of magnetics. The equivalent circuits are not oriented so much for power conversion as for EMI filtering and radio communications circuit magnetics.

The latter half of the first section diverges from magnetics into a rather good, though completely off-track, technical explanation of the Ethernet (LAN) and how it works, with ISO 7-layer communications, encodings, and physical layer schemes for terminations. Finally, s-parameters and the Smith chart appear—obviously more for radio designers than SMPS engineers.

One might expect in the Components section a sales pitch for WE parts, and though the parts appear, they are presented more in the context of typical components, with a rather thorough coverage of what magnetics parts are, how they are characterized, measured, and pictured, including packaging considerations. This section was written by hands-on authors. One is unobtrusively left with the impression that WE has a good selection of magnetics parts.

The Applications section emphasizes filter circuits, audio switching amplifiers, video circuits, EMI suppression for digital communications interfaces, and RF circuits, emphasizing a Bluetooth front end and transceiver, an 868-MHz ISM transceiver, and a VHF/UHF broadband amplifier. Power converters are presented: buck, SEPIC, and phase-interleaved, followed by magnetics for flyback, forward, and push-pull power-switch circuits. Powerline ("mains") filters have their section. After this is a long list of converter applications involving Linear Technology's and ON Semiconductor's controllers, some with parts layout illustrations. The design calculations are rather basic, and readers over a wide range of competencies should be able to follow the design procedures.

The appendices include a "Technical Dictionary," a good resource especially for those not yet familiar with magnetics-related terminology. The keyword index is substantial, and a collection of formulas for flyback converters and winding connection configurations using WE flexible-use multi-winding transformers ends the paper book.

As for stylistic features, the page formatting leaves wide outer margins containing quick phrases summarizing the subject-matter on the page. The formatting does not attempt to fill all pages, and many are partially full. Boxes in red ink appear to alert the reader to what the authors thought was more important. The circuit diagrams use those awful, machine-like European symbols instead of the more artistically-pleasing and readable North American schematic symbols. European math symbols (*U* instead of *V* for voltage) also appear. Those of us who dream in English, however, can be appreciative of engineers who grew up speaking other languages to be writing in ours, and the English grammar and erudition in this book *sind ausgezeichnet* (excellent)! I noticed no subtle hints of meine Grosseltern's (grandparents) native language showing through anywhere.

It is hard for me to cast a simple thumbs up-down judgement on this book. For readers of How2Power Today, the applicable parts are the SMPS and EMI filters for power electronics. Many power electronics and magnetics books do not emphasize filtering details as this book does. It is also (in industry style) a *visual* book, with many

charts, tables, graphs, photographs, and drawings. Many practical engineering details are also illustrated. For these strengths I recommend it.

Yet it is not really very comprehensive in covering power magnetics theory in any depth. Readers seeking a deeper understanding of magnetics theory might need to look elsewhere. Nevertheless, it is certainly not devoid of useful magnetics information for engineers doing circuit design, and it is apparent that the authors have spent much time at the bench. Don't expect an academic treatise. But for many engineers, this book is bound to be quite useful.

About The Author

Dennis Feucht has been involved in power electronics for 25 years, designing motor-drives and power converters. He has an instrument background from Tektronix, where he designed test and measurement equipment and did research in Tek Labs. He has lately been doing current-loop converter modeling and converter optimization.

To read Dennis' reviews of other texts on power supply design, magnetics design and related topics, see How2Power's Power Electronics Book Reviews.