A Very Useful Reference For Power Supply Designers

Switching Power Supply Design, A Concise Practical Handbook, Lazar Rozenblat, ISBN 9798757654942, paperback and Kindle format, 109 pages, 2021, $9.99.

Reviewed by Kevin Parmenter, Contributor, How2Power.com

When I review technical books, I typically ask myself whether the work in question is something I would use routinely as an engineer. *Switching Power Supply Design, A Concise Practical Handbook* is just that. Its everyday usefulness lies as much in what it is not as in what it is: It is neither a cookbook, an instructional text nor an academic work to teach theoretical topics to students. As its title implies, this is a precise and practical handbook.

In a nutshell, *Switching Power Supply Design* is a handy assembly of information that you need to have when working on power supply designs. It brings together formulas, simple schematics, waveforms, graphs, tables and other data used when designing a range of popular power supply topologies. So instead of needing a stack of books 3 feet high to reference all of the key design data, you have it all in one source, making it much easier to access the key pieces of practical information at the time and place you need them. So, if you are working in the field of power electronics, this publication is something you should have at your fingertips.

As the author spells out in the preface, the contents are arranged by "practically used isolated and non-isolated converter topologies, including active PFC; power transformer and inductor design and estimation of the losses; feedback control loop relationships including transfer function with TL431 [shunt regulator]; miscellaneous design and analysis topics, such as MOSFET switching time and losses, capacitance calculation for transient response, PCB trace characteristics, and little-known empirical equations."

The first chapter is an excellent review of SMPS topologies. The list of discussed topologies, which is also outlined in the preface, includes "buck, Fly-Buck, boost, buck-boost (non-isolated flyback), SEPIC, CCM and DCM isolated flyback, forward (including active clamp forward) half-bridge, phase-shifted full bridge with current doubler, LLC, and CCM and DCM PFC boost." Other than exotic approaches, this list would seem to cover most of the topologies that are regularly used in modern power electronics designs.

For each topology, the author provides an overview that goes into its salient properties and theory of operation. Then toward the end of chapter 1, another section provides tables on how to select the correct topology for the application at hand. This includes a table that ranks the different dc-dc topologies according to characteristics such as switching losses, efficiency, transformer size, parts count and switch utilization. It also has a table that identifies the suitable power ranges for each topology across a power spectrum from 0 to 3000 W with the author also providing his recommendation for applications above this limit.

In the chapters that follow, a couple of sections are devoted to power factor and power factor correction (PFC) methodologies including CCM and DCM boost approaches. This is a logical point in the discussion to place this section because many of the preceding topologies described in chapter 1 are dc-dc. So first and foremost, with many of those topologies, we must get the ac line rectified and conditioned into dc with PFC to meet the global mains standards.

Chapter 3 is devoted to control loop design and stability criteria including transient response and its relation to the feedback loop compensation and gain-phase margin, stability criteria. This includes how to increase the gain and phase margin and how to rigorously evaluate it. Many designers simply optimize the control loop for a good transient load-step waveform. However, such results can be deceiving, and such an approach is not good design practice. Instead, one should always measure the control loop with a network analyzer to know for sure what you will be shipping in your product.

This text explains how to measure the control loop properly. As an aside, if you need more information on this subject Ray Ridley of Ridley Engineering offers the most accurate and useful information on measuring control loops as well as the instrumentation to do so. Rozenblat includes Ridley's famous thesis on modeling current-mode control among his references in this area especially in regard to current-mode control.

As part of the discussion on feedback compensation, chapter 3 includes a section on adjusting control loop gain with the popular TL431 shunt regulator. Again, this is an area where Ridley is a source for more information, including complete simulations and modeling in software for TL431 compensation. So, this functionality has been automated with accurate simulation using LTSPICE, and it agrees with Rozenblat's approach in this handbook.

Chapter 4 is devoted to magnetics design and development including calculating copper and core losses. It has been my experience that if you can get the magnetics right and the control loop right, you are well on your way to having a successful power converter design. The magnetics section has all of what you need and none of what you do not need. I found it to be practical, concise, and complete.

The remaining sections of this work (in chapter 5) contain very practical reference material on estimating MOSFET losses, output capacitance versus transient response, ripple and noise calculations, and PCB trace properties. For example, where else can you easily find the self-inductance of a PCB trace for various dimensions? So, these estimations and calculations, as well as the appendix on unit conversions, are super handy.

Anyone working on power electronics designs should be able to benefit from this outstanding work and the author should be commended for putting together this excellent reference and making it available at such a low price. At $9.99, this book is practically a gift. And now a bit about the author.

As his bio at the end notes, "Lazar Rozenblat is a retired electrical engineer with over 30 years of experience in … practical power electronics design." By distilling his practical experience into a highly readable, easy to navigate, practical document, the author has created a real asset for the engineer who's in the lab designing things that have to work and last with high efficiency.

I have read too many texts which are of no practical value other than impressing other professors with how much complicated math they can throw at a theoretical solution considering perfect components that do not exist in the real world. This reference work, on the other hand, can be of use the moment you open it and start reading. Or you can consult a particular section when you reach the corresponding part of your design. In that way, you'll have what you need when you need it. In my case, I used this book to help with a project on the same day I received it.

There are a handful of engineering books I keep on hand all the time, and this is now one of them. ***Switching Power Supply Design*** makes looking up information for your design quick and easy. Ultimately, this will save you both time and money.

About The Author

Kevin Parmenter is an IEEE Senior Member and has over 20 years of experience in the electronics and semiconductor industry. Kevin is currently director of Field Applications Engineering North America for Taiwan Semiconductor. Previously he was vice president of applications engineering in the U.S.A. for Excelsys, an Advanced Energy company; director of Advanced Technical Marketing for Digital Power Products at Exar; and led global product applications engineering and new product definition for Freescale Semiconductors AMPD - Analog, Mixed Signal and Power Division.

Prior to that, Kevin worked for Fairchild Semiconductor in the Americas as senior director of field applications engineering and held various technical and management positions with increasing responsibility at ON Semiconductor and in the Motorola Semiconductor Products Sector. Kevin also led an applications engineering team for the start-up Primarion. Kevin serves on the board of directors of the PSMA (Power Sources Manufacturers Association) and was the general chair of APEC 2009 (the IEEE Applied Power Electronics Conference.) Kevin has also had design engineering experience in the medical electronics and military electronics fields. He holds a BSEE and BS in Business Administration, is a member of the IEEE, and holds an Amateur Extra class FCC license (call sign KG5Q) as well as an FCC Commercial Radiotelephone License.