EMC Wisdom Has A Long Shelf Life

EDN Designers Guide to Electromagnetic Compatibility, Daryl Gerke, PE, and William Kimmel, PE, 98 pages, available in PDF or hardcopy reprint from Kimmel Gerke Associates.

Reviewed by Kevin Parmenter, Chair, and James Spangler, Co-chair, PSMA Safety and Compliance Committee

I (Kevin) was recently reviewing several textbooks on EMI/EMC and related topics and was looking for some guides I could recommend to system designers to get them through safety and EMC testing and on to volume production. In reviewing several works, I was struck by how much they focused on EMI theory. Of the ten or so books I researched, they were all very impressive with mathematical simulation and modeling. But they didn't offer much information that would help someone get a product through EMC testing.

Back in the '90s when I was working at Motorola we often provided in-house training for our customers to help them get their systems working and into production. I ran across a document in my library which I used back then to teach onsite courses. The work, *EDN Designers Guide to Electromagnetic Compatibility*, (we'll also refer to it as the *Guide* or the book for short) was authored by a couple of the legends of EMC—Daryl Gerke PE and William Kimmel, PE of Kimmel Gerke Associates. William has passed, however, Daryl still is actively running the operation.[1] Fortunately, since this publication has been out of print for several years the Kimmel and Gerke team purchased the rights to publish and distribute the work as a service to the electronics industry.

Why am I recommending a book that was released in 1994 and has subsequently been updated a few times with new materials? Quite simply, the same issues are still with us today and new engineers are coming into the industry who need to learn how to design for EMC. Not only was none of this information taught in our universities in the past, it's still not being taught. Almost nothing you learned in engineering school will teach you how to design and qualify a system that can pass EMC standards.

On top of this, some of the EMC requirements faced today are tougher than those of the past. For example IEC 60601 4th edition contains more-stringent EMC test limits than the earlier versions and CISPR has new requirements. In general, the regulatory landscape continues to become more stringent. Meanwhile, everybody and his sister has a 3D printer today. So while almost everyone used a metal chassis for their products, it's now popular to make the chassis out of plastic. A plastic enclosure looks nice but does not help the thermal conductivity of your power electronics, and it sure does not help your grounding and shielding. This means you need the information in the *Guide* even more than you would if you transported back to 1994 and worked on a design project then.

As the authors say, there are two kinds of engineers—those that have had EMI problems to solve and those who will have them. Yet the good news is that there are logical causes and effects which underly EMI problems. Consequently, there are rules, strategies and techniques that can be applied to systems to solve your EMC challenges.

One of the models I always recommend to engineers is the Kimmel–Gerke "Source-Path-Receptor model". All three of these elements must be present for an EMC issue to occur. First of all, this model says there must be a source. Usually in power electronics it's the switching power supply, which will be blamed even if it's not the culprit.

Just as an example, I was once helping a customer who was trying to get their new instrument design to pass EMC testing. The instrument was failing in the EMC lab because of an out-of-tolerance signal at 100 MHz. The customer insisted it was coming from the power supply. Yet, it turned out to be their LCD display. The customer had selected the unshielded version of the display so they could to save four dollars per unit, even though it was part of an instrument that would retail for $300,000—go team! We dropped in the shielded display unit and the EMC disappeared.

So, as we see in that example, we have to consider the source. Then, as the next part in the model, we have a path that can transmit radiated EM fields or produce crosstalk via inductive coupling, capacitive coupling, or conducted coupling through signal, power or ground lines. Finally, we must have a receptor that is interfered with. This could be digital logic being re-set, or noise affecting low-level analog signals, RF sections, receivers (including the EMC test receiver) and displays, audio sections and so forth.

Since you have to have a source of energy, a receptor that is upset or interfered with by the energy, and a method of coupling from source to receptor, the *Guide* basically outlines how to reduce or eliminate the interference by one of the following methods:

- mitigating energy at the source
- interrupting the coupling from the source to the receptor or
- hardening the receptor such that it does not suffer interference.

The Kimmel–Gerke "Source-Path-Receptor model" is introduced in an early chapter with subsequent chapters building on this discussion. Another great chapter covers how to treat ESD as an EMI problem. That chapter alone is worth the price of this book.[2]

Similarly, the discussions on clearing up common-mode and differential-mode power line interference are of great value. Also, not to be missed are the recommendations on cabling and designing PCB layouts for EMC.

It's hard to find a single document which encapsulates so many of the discussions I have with designers on a weekly basis and which contains the solutions I routinely recommend. The *Guide* is a reference that can be used throughout your whole design process and also, when the design is done, to help you fix problems that were missed so that you can pass your EMC testing.

This book is a time-tested work. There is no telling how many successful products were taken to market using this document, but I am sure there were many. If you are looking for a practical reference work of great use to power electronics designers as well as other system and circuit designers, you will find the *Guide* is packed with more information in less space than most works.

In the *Guide*, you will find information you can put to work in the lab right away. This is a treasure trove of practical, time-tested advice and application tips distilled into less than 100 pages. For anyone tasked with designing systems and getting them to pass compliance testing, this book is a must have. I simply can't recommend this outstanding publication enough.

Reference

1. Kimmel Gerke Associates website.
2. *EDN Designers Guide to Electromagnetic Compatibility* is available for download in PDF form through Paypal for $29, see the EDN Designers Guide (Paypal) page. Or a hard copy may be ordered for $39 by calling 888-EMI-GURU.

About The Authors

Kevin Parmenter is an IEEE Senior Member and has over 20 years of experience in the electronics and semiconductor industry. Kevin was recently vice president of applications engineering in the U.S.A. for Excelsys, an Advanced Energy company. Previously, Kevin has served as 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 based in Tempe, Arizona.

Prior to that, he 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 where he worked on high-speed electro-optical communications and digital power supply semiconductors.

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.

Jim Spangler is a Life Member of the IEEE with over 40 years of electronics design experience and is president of Spangler Prototype Inc. (SPI). His power electronics engineering consulting firm's priority is helping

companies to place products into production, assisting them to pass government regulations and agency standards such as UL, FCC, ANSI, IES, and the IEC.

For many years, he worked as a field applications engineer (FAE) for Motorola Semiconductor, On Semiconductor, Cirrus Logic, and Active Semiconductor, assisting customers in using semiconductors. He published numerous application notes and conference papers at a variety of conferences: APEC, ECCE, IAS, and PCIM. Topics included power factor correction, lighting, and automotive applications. As an FAE, he traveled internationally giving switch-mode power supply seminars in Australia, Hong Kong, Taiwan, Korea, Japan, Mexico, and Canada.

Jim has a Master's Degree from Northern Illinois University (NIU), and was a PhD candidate at Illinois Institute of Technology (IIT). He taught senior and first-level graduate student classes: Survey of Power Electronics, Fields and Waves, and Electronic Engineering at IIT and Midwest College of Engineering.

Jim is a member of the IEEE: IAS, PELS, PES; the Illuminating Engineering Society (IES), and the Power Sources Manufacturers Association (PSMA) where he is co-chair of the Safety and Compliance Committee.

For further reading on power supply-related safety and compliance issues, see How2Power's special section on Power Supply Safety and Compliance.