

KIMMEL GERKE



Bullets

Spring, 2003

Welcome to KGB...

And to this issue of our "personal communications" to our friends, clients, and colleagues about EMI issues, problems and solutions.

This KGB discusses "EMC Design Reviews." We last addressed this subject in 1991, so we thought it might be useful to visit this topic again. We've provided this service to dozens of clients over the years with very good success. The goal is to identify and prevent problems early in the design process, while they are easy and inexpensive to fix. Or, as an attorney friend once said, "I'd rather keep you out of jail, than get you out of jail..." EMC design reviews can certainly help keep you out of "EMC jail."

EMC design reviews work at both the circuit board level, and at the systems level (shielding, cabling, grounding, and power.) The best time for a design review is early in the project — that's when you have the most options with the least cost impact. Our experience suggests that \$5K at design time can often save \$50K (or more) in retest and rework at the end of a project.

As always, give us a call if we can help you with any of your EMI problems... designs to disasters... military, commercial, medical, industrial, telecomm, automotive, facilities, and more...

Best Regards... Daryl Gerke, PE, and Bill Kimmel, PE

Get the KGB In Electronic Format

We are in process of converting to an electronic version of the KGB. It saves us money (our list is getting pretty big) and it lets you store them, or forward them to friends and colleagues.

To receive the KGB electronically, simply send your e-mail address to bkimmel@emiguru.com, or register on-line at www.emiguru.com, we will take care of it.

Current and back issues of the KGB are available at www.emiguru.com. *By the way, our KGB list is PRIVATE... it is never used by anyone else!*

Shows and Conferences...

Here are some shows and meetings on EMC that may be of interest. Call us if you'd like more details.

• **IEEE EMC Fest Orange County...** June 12, 2003, at the Irvine Hyatt Regency in Irvine, CA, and sponsored by the Orange County EMC Society chapter. We can't make it to this show, but stop by the ARC Technical Services booth, and pick up an official "EMI-GURU" button. (We are on the ARC line card in California.)

• **IEEE Symposium on EMC...** August 18-22, 2003, at the Hynes Convention Center in Boston, MA, USA. We will be there, of course. Daryl will be doing a technical session Monday titled *EMC Systems Engineering. Hope to see you there.*

• **Power Line Interference Workshop...** September 15-16, 2003, at the Airport Ramada Inn in Spokane, WA. This will include presentations by Marv Loftness, author of the *AC Power Interference Handbook*. (Marv has just updated his book, which we will review in the next KGB.)

Public EMC Courses...

Here are the cities for the Fall 2003 schedule for the EMC seminar series sponsored by Tektronix and Kimmel Gerke Associates, Ltd.

- **Denver, CO - September, 2003**
- **Portland, OR - September, 2003**
- **Lincoln, NE - October 2003**
- **Phoenix, AZ - October 2003**
- **Detroit - October 2003**
- **Minneapolis, MN - October 2003**
- **Chicago, IL - October 2003**
- **San Jose, CA - November 2003**
- **Los Angeles, CA - November 2003**

We don't have firm dates yet, but check our web site at www.emiguru.com for more details.

Our NEW CLASS FORMAT is working out very well — two days on *EMC Grounding & Shielding*, and one day on *EMC & Signal Integrity in PCBs*. All classes are conducted by either Bill or Daryl. *By the way, four or more students from the same company qualify for a 10% discount.* Also, if you have 10 or more students, it often makes sense to hold an in-house class.



Focus on “EMC Design Reviews...”

When we began full time EMC consulting in 1987, most of our clients were already in EMC trouble, due to failed tests or EMC problems in the field. Within a year or two, however, we started doing “EMC Design Reviews” on new projects for many of those same clients. Most had discovered that it was far less painful (and costly) to *design* for EMC than to simply test for EMC.

Since that time, we have done hundreds of design reviews for a wide range of clients with very positive results. We’ve even had design teams “dancing in the lab” when they passed their EMC tests — on the very first try! In our experience, a little effort during design goes a long way towards EMC success.

We first discussed this in a 1991 KGB, so we thought it was a good time to address this again. Here are some general thoughts and comments (both old and new) on EMC design reviews.

So, just what is an EMC design review?... First, it is NOT a full blown review — rather, it focuses on specific EMC issues. Depending on the product, it can address circuit boards issues, systems-level issues, or both. It addresses requirements (regulations and/or threats), constraints (costs, volumes, etc.) and design strategies.

We prefer an interactive approach to EMC design reviews. Rather than dictate directions, we like to get the design team (both electrical and mechanical) actively involved. Together, we identify and assess the risks, and discuss the design options and trade-offs. We understand EMC issues — our clients understand their products and constraints — together, we can come up with sensible EMC solutions.

What is the best time for an EMC design review?...

For most projects, an ideal time is during the initial electrical and mechanical design phases. For circuit boards, an ideal time is when the board layout is complete, and the first set of artwork is available. At this stage, the design is usually solid enough to make good recommendations, but fluid enough to make changes.

In some cases, you may want EMC help in the early concept stages as well. This is particularly helpful when dealing with packaging issues, such as cabling and shielding. This can extend to circuit boards when considering connector placement, or bus or I/O design.

A KGB Bullet...

Here is a link to National Semiconductor for what was section 9 of the FAST logic Applications Handbook. Lot's of good stuff regarding Signal Integrity, complete with scope displays, etc.

<http://www.national.com/an/AN/AN-991.pdf>
(Thank you, Jim Joseph, for this link.)

Four General Tasks... Before jumping into the design, there are four preliminary tasks that must be done.

The first task is to identify and assess the EMC

threats. Typical threats include RF from nearby transmitters, ESD (electrostatic discharge) from humans or other sources, power disturbances, and conducted/radiated emissions. These are often specified as test requirements, but we may need to modify them based on the actual anticipated environment.

The second task is to **identify the key circuits or assemblies** that affect or are affected by these threats. Digital circuits (particularly resets and control circuits) are very vulnerable to spikes and transients, and analog circuits are very vulnerable to RF. Digital clocks (and other highly repetitive sources) are rich sources of radiated emissions. Power circuits are vulnerable to power disturbances, and can also contribute to conducted emissions.

The third task is to **identify other design constraints** that may affect EMC design decisions. These include costs, volumes, weight, space, and “cost of failure.” Incidentally, in very cost sensitive situations, we often advocate designing in “place holders” (such as pads for capacitors) that can be populated later as needed with EMC components.

The fourth and final task is to **identify the appropriate EMC design features.** This is where the design fun begins. The circuit board is an ideal place to start — after all, all EMC problems ultimately begin and end at a circuit. Of course, if you don't design the boards, then we would start at the systems level. Here are some comments on both levels.

Board Level Issues... At this level, we usually like to work from the inside-out.

First, we look at several **critical circuits** — clocks (emissions), reset and interrupt circuits (transients), control lines such as read/write (transients), analog circuits and voltage regulators (RF). Often times, all that are needed are a few well placed 1 000 pF capacitors or ferrite beads.

Next, we look at the **board construction** — trace routing, stackups, and split planes. If critical traces have been autorouted, we examine those. Traces over splits or cuts in the planes can spell big problems.

Finally, we look at the **I/O**, or periphery of the board. Key issues here are filters, transient protection, signal and circuit board grounding.

Systems Level Issues... At this level, we often work from the outside-in, focusing on interfaces, mechanical construction, and grounding.

At the **interface level**, we look at both the signal I/O and power — cables, connectors, filters, and transient protection. We also look at both internal and external cable placement and routing.

At the **mechanical level**, we are usually interested in the shielding characteristics. As such, we look at the materials, and at the mechanical joints (seams or gaskets) and discontinuities (penetrations and openings).

At the **grounding level**, we are interested at various levels — power, digital, analog, and safety. Of course, the safety grounding must always predominate over other EMC issues.

So how much does this cost?... It depends... but the cost is usually pretty low. An in-office review can often be done in a day, including a brief summary. An on-site review may take up to several days, which typically includes travel time and a brief report. Our experience shows that \$5K at design time can easily save \$50K or more at the end of a project. Give us a call if we can help!

It is not that humans have become any more greedy. It's that the avenues to express greed have grown so enormously. —Allan Greenspan, July 2002

Military EMC Support...

Due to heightened military and security concerns, we have seen an increase in our own military business. We certainly welcome that business — in fact, it is how we both got started in EMC over 30 years ago. Here are some ways we have helped past defense clients:

- Proposal support
- EMC Control Plans and EMC Test Plans
- Witness and support EMC tests
- Engineering design reviews (both boards and systems)
- Formal design reviews (PDR, CDR, etc.)
- EMC troubleshooting
- General engineering design support

Please call us at 1-888-EMI-GURU if we can help you with your defense related projects.

Need Technical Writing???

Most of you know us as EMC/Signal Integrity engineers, but we also have experience with technical writing. We've written three books, over 300 technical articles and reports, and over 10 years worth of our own newsletter, the "KGB."

Some of you even had us write applications notes and articles for you, but we've hesitated to pursue these activities due to limited resources. Well, we found a way to overcome this limitation.

We now have an alliance with *eContentWorks*, a firm that specializes in producing technical articles and related collateral. Founded by Jack Shandle, former chief editor of *Electronic Design* and founder of the *Chip-Center* ezine, Jack has a team of experienced tech writers on-call. We are his "EMC/Signal Integrity" specialists.

So, if you need some EMC/SI tech writing, give us a call. (For general tech writing, please contact Jack directly at jshandle@e-contentworks.com.)

Book Reviews...

High-Speed Signal Propagation - Advanced Black Magic, by Howard Johnson and Martin Graham. This is a welcome companion to their earlier book, *High Speed Digital Design*. The new book has new practical examples and never-before-published high speed design techniques. The focus is on Signal Integrity, but the methods apply to EMC as well. If you are doing high speed digital design, you need both of these books. Prentiss Hall, 2003, ISBN 0-13-084408-X. Immediately available at amazon.com.

Application Note...

We've been advised that some of you are still having problems locating the Intel Application Note (*AP711-EMI Design Techniques for Microcontrollers in Automotive Applications*) that we helped write a few years ago. Don't worry — we have a PDF version available. Just e-mail your request to Daryl at dgerke@emiguru.com.

ITEM Changes Name...

After 30+ years in the EMC business, ITEM (Interference Technology Engineers' Master) has changed their name to *Interference Technology*. This FREE publication includes an annual guide, plus quarterly updates. To subscribe, go to their new domain name, InterferenceTechnology.com.

If you already subscribe, be sure to check out the Kimmel Gerke article on page 99 of the 2003 Annual Guide — *Military EMC and the Revival of Systems Engineering*.

EMI-Toolkit® 2.0...

The updated version includes many useful features, plus an improved format. Comes on CD, and runs under Windows 95/98/NT/2000. \$150 single user, \$750 for site license. Discounts apply for V1.0 users.

If you are heavy into the EMC standards, consider *EMI-Toolkit® Plus*. All the features of V2.0, plus additional information on most relevant EMC standards (MIL-STD-461, DO-160, FCC, CISPR, and more...) For more information, e-mail bkimmel@emiguru.com

In-House EMC Courses...

Our on-site classes continue to be popular. Here are some recent classes we have done for clients:

- Design for EMC (2 days)
- Medical Design for EMC (2 days)
- EMC in Telecommunications (2 days)
- EMC in Vehicular Electronics (2 days)
- EMC in Military Systems (2 ½ days)
- EMC in Avionics Systems (2 days)
- Design for ESD (1 day)
- EMC Grounding & Shielding (2 days)
- EMC and Signal Integrity in PCBs (1 day)

We can customize to meet your special needs. Flat rate for up to 30 students, but with even a dozen students, an in-house class often makes sense. Call 1-888-EMI-GURU.



About Kimmel Gerke Associates...

We are often asked to give a quick description of what we do and who we are. If you are asked by someone needing EMI help, here are several key points about KGA...

Point I... We are a two-man **electrical engineering firm that specializes in consulting & training on EMI/EMC (electromagnetic interference and compatibility) issues.** These include five key areas:

- **Regulatory Compliance** (Emissions, immunity, FCC, CISPR, IEC, CE, MIL-STD-461, DO-160, SAE, etc.)
- **Radio Frequency Interference** - (RFI)
- **Electrostatic Discharge** - (ESD)
- **Power Disturbances** - (Transients, magnetic fields, etc.)
- **Self Compatibility** - (Signal Integrity, Analog, etc.)

Point II... We are Registered Professional Engineers (PE) and NARTE Certified EMC and ESD engineers. **Between us, we have over 70 years of industry experience.**

Point III... We are not a test lab - **our emphasis is on EMC design, troubleshooting, and training.** While we are knowledgeable on key EMC tests and regulations, our focus is on design/systems issues, and **how to identify, prevent, and fix EMI problems.**

Point IV... We serve many industries, and **our support ranges from circuit boards to complete systems.**

We've helped clients in the following areas:

- **Military** (MIL-STD-461, TEMPEST, EMP, etc.)
- **Avionics** (DO-160, MIL-STD-461, etc.)
- **Computers** (FCC, EU, PCs to supercomputers)
- **Industrial Controls** (Individual controls to full systems)
- **Vehicular** (SAE, automobiles, farm machinery, etc.)
- **Medical** (FDA, diagnostic, clinical, patient connected)
- **Telecommunications** (BELLCORE 1089, etc.)
- **Architecture** (Shielded rooms, lightning, power)

Point V... We are an independent consulting firm with no outside affiliations. **Our advice and recommendations are free from any bias or other business concerns.**



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