

KIMMEL GERKE



Bullets

Summer
2010

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

This KGB focuses on software as a component. While most EMC problems are addressed at the hardware level (grounding, shielding, filters, board layout, etc.), software can be quite effective, particularly when dealing with immunity issues (ESD, RFI, transients, etc.)

It is not unusual for a few lines of the right code to greatly reduce EMI vulnerabilities, at virtually no recurring cost. (Yes, you still have the one-time design costs.)

Some people feel that software fixes are "cheating" or are a "band-aid", but we see software as just another tool in the battle against EMI. It is all part of a systems approach -- making the tradeoffs and blending the electrical, mechanical, and software components to achieve EMC.

We hope you enjoy this issue of the KGB. As always, give us a call if we can help you out with any of your EMI problems or concerns.

Best Regards

Daryl Gerke, PE, and Bill Kimmel, PE

Please Requalify...

It is that time of year again, when we ask you to requalify. You can do so on line at www.emiguru.com/register.html, or you can send in the enclosed card if you received this by snail mail. (Not necessary if you have signed up recently, or attended a seminar in the past year.)

Please include your E-MAIL address, plus your current SNAIL-MAIL address. Since many company firewalls block outside messages, your HOME e-mail is a good idea. Your HOME snail-mail address is OK, too.

Well over half of our subscribers now receive the electronic version of the KGB. We thank you... it saves us money on postage and printing, and it lets you store them or forward them to your friends and colleagues. Thus, e-mail will be the preferred medium.

Our Privacy Policy — Our list is PRIVATE. In addition to the KGB notices about twice a year, we will also let you know when we are holding a class in your vicinity.

Shows and Conferences...

—IEEE Symposium on EMC - July 25-31, 2010, at the Convention Center, Ft. Lauderdale, FL. Lots of good stuff for both EMC newcomers and old-timers - demos, tutorials, research papers, and numerous EMC vendors. For more info, go to www.emcs.org.

—Minnesota EMC-Event - September 17, 2010, at the Ramada Mall of America (formerly the Thunderbird) in Bloomington, MN. Three technical tracks, EMC vendors, and a delicious lunch. Bill Kimmel will be a presenter. For more information, go to www.mnemcevent.com.

Public EMC Courses...

Here are the cities we have selected for the Fall 2010 EMC seminar series co-hosted by Tektronix and Kimmel Gerke Associates, Ltd. We've been doing these popular seminars since 1992, and have provided practical EMC training to thousands of your colleagues.

— Lincoln, NE - September 8-9-10, 2010

NCEE Labs - Lincoln, NE

This class includes optional Troubleshooting Workshop.

— Denver, CO - September 13-14, 2010

Courtyard by Marriott - Louisville, CO

— Seattle, WA - September 27-28, 2010

Carlton Inn at Totem Lake - Kirkland, WA

— Chicago, IL - October 4-5, 2010

Holiday Inn Express, Downers Grove, IL

— Minneapolis, MN - October 7-8, 2010

Courtyard by Marriott - Roseville, MN

— Los Angeles, CA - November 8-9, 2010

Hacienda at LAX - El Segundo, CA

— San Jose, CA - November 15-16, 2010

Courtyard by Marriott - San Jose Airport

— Phoenix, AZ - November 18-19, 2010

Windmill Suites - Chandler, AZ

For more information, please visit our web site, www.emiguru.com, or call 1-888-EMI-GURU. Please note you can also register on-line. Payment by Paypal, credit card, or check. Sorry, due to past bankruptcies and nonpayment, we can no longer accept purchase orders.

FREE Copy of Useful Bits of Info...

Want your own copy of UBI, the little shirt pocket "cheat sheet" for EMI? Just e-mail dgerke@emiguru.com with your snail mail address, and we'll send you one.

Focus on Software as a Component...

We first used a "software fix" for one of our EMC clients back in 1987. A Z80 (remember those?) based control system was randomly locking up in a factory environment. Since it worked fine in the lab, "noise" was suspected.

Upon examining the system, we noted an unused interrupt that was connected directly to a three foot ribbon cable. It turned out the interrupt vector location was not protected with either software or hardware. Thus, when the line was asserted, the system would hang. It was an unintended and unwanted "noise detector" circuit.

By simply adding a "NOP" to the interrupt vector location, the system worked fine. The customer was ecstatic, as this meant no hardware changes were needed. We did advise them if they ever wanted to use that interrupt vector, the input would need a hardware filter.

Based on this case, we wrote a technical paper and a magazine article. The goal was to encourage software solutions to EMI problems, not just hardware solutions. The paper ultimately won an award from the SAE, which was kind of neat. (SAE 870787 - *Designing Microcomputer Systems to Tolerate Noise* - April 1987.)

Since then, we've used software fixes many times. No, we're not programmers, but the concepts are simple and easy to implement in software. Sometimes only a line or two of code are needed (such as adding the NOP)

Failure Modes - The primary problem is susceptibility to spikes, such as ESD, EFT, or other transients. A bit gets flipped, and either memory or I/O are corrupted, or the machine ends up in an unintended state.

RF is a secondary problem, since RF usually first affects analog circuits. At high enough levels, however, the digital circuits may also be affected. High level pulsed RF, such as RADAR, can certainly be problematic. In that case, the rectified pulses look a lot like other transients. Thus, the same software fixes work well.

Emissions are usually not a problem, either. We once had a case, however, where the software affected emissions. Changing the idle loop from a branch on itself to a "wait" condition dropped the emissions, as the address and memory busses were no longer being toggled. Some devices (such as clock drivers) have programmable output levels. Choosing a lower drive level might reduce the radiated emissions from the clock -- always worth a try.

Some Kimmel Gerke Bullets...

Here are some rather hard to find conversion factors:

- 10 rations = 1 decoration
- 8 nickels = 2 paradigms
- 100 rations = 1 C-ration
- 2 monograms = 1 diagram
- 10 monologs = 5 dialog
- 10 cards = 1 decacards
- 5 dialogs = 1 decalog
- 2 wharves = 1 paradox

Hope these facilitate your EMI/EMC calculations!

Noise Tolerant Design - We often refer to this as "Noise Tolerant" software. Based on fault tolerant concepts, the goals are to detect errors, and then gracefully recover (or at least go into a safe mode.) Automatic resets are often employed, particularly if the data is intact. The system may hiccup, but then just keeps going. Here are some simple techniques to consider:

Software Tokens - Structured programming design typically uses modules with single entry/single exit points. A token is saved on entry, and then checked on exit. If they don't agree, a program flow error has occurred. The added advantage of this is that the error can often be trapped before it causes bigger problems.

Checksums - These are widely used in I/O, but can also be applied to data tables in memory. In both cases, a checksum is calculated for the stream of data, and then checked again prior to using the data. If the two checksums do not agree, data has been corrupted.

Parity - This is also applied to I/O data., and also individual memory cells. With enough redundancy, you can not only detect errors, but you can correct them as well. For memory, this is often employed with hardware. For I/O, these are known as "Error Correcting Codes."

Type and Range Checking - This is primarily an I/O technique. Basic checks are applied to all external data as they are supplied to see if they are reasonable. For example, if a sensor is supposed to be between 1 and 4 volts, and you measure 6 volts, you have a problem.

Software Filtering - A very simple technique is to read an input multiple times to determine if the input is the same, or if the input was the result of a noise transient. By ignoring the short pulses, the software acts as a crude but effective low pass filter. Of course, one can get much more sophisticated by using DSP techniques. But even the simple rereading of inputs can be quite effective.

Echoing - This allows one to check system outputs. The sent signal is "echoed" to see if what was received on the other end matches what was sent in the first place. This method is very common with displays and keyboards. Saving the echoed data can also facilitate error recovery.

Protocols - Very common in communications channels. These can range from simple "ACK/NAK" handshaking to sophisticated packet handling. Fortunately, much of this is readily handled today in dedicated hardware. But don't overlook even the simple approaches in software for simple embedded control systems.

Diagnostics - These should be run at power-on to assure a known startup configuration. For example, a quick read/write of memory followed by I/O loop-back- tests can give a high degree of confidence of reliability. Additional diagnostics can be run in a background mode.

Interrupts - As shown in the initial example, interrupts deserve attention. Unused interrupts should be masked to prevent unwanted operations. Non-maskable interrupts deserve special attention.

Watchdog timers -- A combination of hardware and software, this prevents runaway programs. If the software has not reset the watchdog in a predetermined time, the systems is forced into a reset or known state.

Circumvention -- Another combination of hardware and software, this is often used in extremely harsh environments as protection against overwhelming threats. If external sensors can react fast enough, the system can be put into an idle state until the threat is past. This is often used in military and space-based systems for protection against ionizing radiation.

Don't overlook using software as an "EMI component." We've had clients ponder whether this was cheating. Our response was "All is fair in love, war, and EMC..."

We hope this has provoked some thought. In the meantime, give us a call if we can help with any of your EMC problems - from microchips to full systems.

Experience is something you don't get until just after you need it. -- Author Unknown

A Bit of Engineering Humor...

This is a true story. Several months ago Daryl's wife (Mary) was at the beauty shop, getting her hair done. She couldn't help hearing the conversation in the next chair. The discussion centered around the new boy friend of the customer's niece. Here is a summary of the exchanges:

Hairdresser - "So, it sounds pretty serious with your niece and her young man."

Customer - "Yes, he seems really nice. The only problem is that he is studying engineering. You know, engineers can be kind of strange..."

Mary - (Interrupting) "Tell me about it, I'm married to one!"

Customer - (Embarrassed) "Oh, I didn't mean..."

Mary -- "Don't worry, it's true - they are different." But then she added, "Its OK, though. We've been married over 40 years..."

I guess we engineers do have a reputation to uphold. Without us, there would be no Dilbert, right?

EDN Designer's Guide to EMC...

Written entirely by Kimmel Gerke Associates. First published in 1994, and updated in 2001 (three new chapters). Still very relevant. Now available directly from Kimmel Gerke Associates.

Order on-line at www.emiguru.com, for \$29 (includes US shipping). Call for special pricing on multiple copies. Attend a class and get a FREE copy of this book.

Some Thoughts on EMC Training...

As the electronics business starts to pick up, we're seeing an increased interest in EMC training. The payback is certainly there -- even one extra trip back to the test lab can cost you \$10-20K in test and engineering time. Not to mention the additional cost of being late to market!

EMC training has been an integral part of our business, right from the start in 1987. We began with in-house classes, and in 1992, we began our public classes in partnership with Tektronix. Over the years, we've trained over 10,000 engineers and technicians on the "tools, tips, and techniques" to prevent and solve EMI problems.

This has been immensely satisfying. Nothing pleases us more than hearing from a past student, touting a success thanks to our classes. Yes, this stuff really works!

If you haven't done so, we invite you to join us in a public class. If it has been a few years, you might want to attend again as a refresher (*call us for the special rate for "repeat students".*) The fall schedule is on page 1. The spring schedule will be posted on our website, www.emiguru.com.

By the way, if you need a break from the cold weather, think about our annual WINTER GETAWAYS in ORLANDO and SAN DIEGO in February. These also include the optional *EMC Troubleshooting Workshop*.

If you have 10 or more people, you may want to consider an in-house class. To keep things simple, we do these on a fixed-price basis, and can accommodate up to 30 students. There are NO PER SEAT FEES -- just send who you want. (For reference, most in-house classes run from 10-20.)

Here are some examples of in-house classes we have done for clients. The first one is still the most popular, and is essentially the same as our popular public class.

- Design for EMC (2 days)
- EMC Design, Systems, & Troubleshooting (3 days)
- EMC in Medical Devices (2 days)
- EMC in Vehicular Electronics (2 days)
- EMC in Military Systems (2 ½ days)
- EMC in Avionics Systems (2 days)
- EMC Grounding & Shielding (2 days)
- EMC and Signal Integrity in PCBs (1 day)

We can customize to meet your special needs. You supply the meeting space and refreshments -- we supply the materials and the instructor (either Bill or Daryl.) *For more information, call us at 1-888-EMI-GURU.*

Book Review...

Linchpin, by Seth Godin, 2010. Although not a technical book, the author is an entrepreneur with several Silicon Valley successes. The book is a blend of philosophy, business, and career advice. A "Linchpin" is a critical player who helps hold things together. We think many EMC engineers fall into that category. Daryl found it a quick and interesting read. (ISBN 978-1-59184-316-0)

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**FIRST CLASS
MAIL**



Kimmel Gerke Associates, Ltd.

Summer 2010

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 80 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 EMC tests and regulations (and regularly witness EMC testing for our clients), our primary 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.**

- **Military/Aero** (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** (GR-1089, etc.)
- **Facilities** (Shielded rooms, lightning, power)
- **Site Surveys** (RF, magnetic fields, mitigation help)

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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