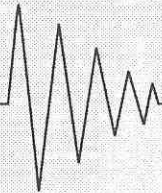


KIMMEL GERKE



Bullets



Winter, 1996

Welcome to KGB...

And to the first issue in 1996 of our "personal communications" to our friends, clients, and colleagues about EMI issues, problems and solutions.

This issue focuses on Industrial Electronics, and the EMI problems associated with process control systems, manufacturing and production lines, semiconductor tools, robots, electric power controls, oil refineries, etc. We've worked on problems in each of these areas this past year, so we've seen some interesting EMI situations. In fact, the majority of our consulting clients this past year were in the ISM (Industrial Scientific & Medical) areas.

The key with ISM equipment is to both "design it right" and to "install it right". The European Union EMC directives have helped focus engineering efforts on ISM problems, but they still persist. As always, give us a call if we can help you out.

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

1996 MINNESOTA EMC EVENT

Plan now to attend the **Eleventh Annual Minnesota EMC EVENT...** held at the Thunderbird Hotel in Bloomington, MN... April 16-17, 1996. (Tue-Wed)

Please note we moved to the spring, as several large shows (including Midwest Expo) moved to the fall this year. With all the interest in the 1996 European EMC rules, we did not want to skip 1996.

The Exhibits on Wednesday (April 17) are **FREE...** Trade Show Exhibits, **FREE LUNCH**, and several Technical Talks by Industry Experts. Join us Tuesday some in-depth half day seminars on European EMC Directives, ESD Design, and more.

Sponsored by Kimmel Gerke Associates, TUV Product Service, and the Paul Bunyan Chapter of the Electronics Representatives Association.

Shows and Conferences...

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

Medical Design & Manufacturing West 95 Conference... February 6-8, 1996, at the Anaheim Convention Center in Anaheim, California, and sponsored by *Medical Device and Diagnostic Industry* magazine.

Daryl will present a tutorial paper on "RFI and Circuit Boards: Assessing the Threat", and Bill will present a tutorial paper on "ESD and Edge Triggered Circuits: Asking for Trouble." This is part of a special half day session on medical EMC issues.

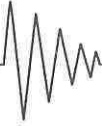
Portable By Design... March 25-29, 1996, in Santa Clara, California. Bill will be doing a one day tutorial on "ESD Design in Portable Electronics." Sponsored by *Electronic Design* magazine.

Eleventh Annual Minnesota EMC Event... Wednesday April 17, 1996, at the Thunderbird Hotel in Bloomington, Minnesota. *The Wednesday show... and the lunch... are free.* Half day seminars on Tuesday for a nominal fee.

Medical Design & Manufacturing East 95 Conference... June 4-6, 1996, in New York City, sponsored by *Medical Device and Diagnostic Industry* magazine. We'll be chairing a session, presenting papers, and participating in the "Ask an Expert" sessions at this show.

IEEE EMC Symposium... August 19-23, 1996, at the Santa Clara Convention Center in Santa Clara, CA. We'll be there, of course!

Reprints... EDN Magazine's Designer's Guide to Electromagnetic Compatibility... We're told this EMC design guide (written entirely by us) is still a popular item. For your copy, call Cahners Reprint Services at 1-800-523-9654. Only \$19.95+ shipping.



Focus on Industrial Electronics...

We last looked at industrial controls in early 1991, so we felt it was time to discuss this topic again. Much of our business is industrial — in fact, a majority of our consulting projects are ISM (industrial, scientific, and medical). While many of our colleagues focus on ITE (information technology equipment) or military systems, we enjoy the variety and “EMI challenges” of ISM equipment and systems.

The “guts and glory” may be in high performance computers, but for every high end 64 bit computer design, there are probably a thousand 4/8/16/32 bit designs. Here are some comments and observations on dealing with EMI in industrial electronics.

First, the industrial environment is harsh. The primary EMI threats are ESD, RFI, and power disturbances. Analog circuits are plagued by 50/60 Hz “ground loop” problems. Emissions are usually not a functional problem, but the European Union rules are forcing compliance in this area, too.

Second, electronics often play a secondary role. Unlike a computer system, where the electronics are the “core technology”, industrial electronics are often used to support another technology, such as chemical, mechanical, or process functions. Often the biggest challenge is integrating electronics with other non-electronic technologies.

Third, the EMI rules and regulations are finally catching up to industrial electronics. For years, many of these systems were exempt from mandatory rules, so unless there was an actual problem, EMI was often ignored. With the European EMC Directives now in force, industrial electronics are included. In fact, “heavy industrial” electronics are subject to tougher European immunity standards than are “light industrial” or “residential” electronics.

The bottom line... EMI problems in industrial electronics are often tougher and more complex than in their “business/home” computer cousins. They can even be tougher than many military EMI problems, where EMI has usually been considered during design. Here are some comments on several specific EMI threats.

Electrostatic Discharge (ESD)... This is a big threat to industrial electronics, both from humans (controls and keyboards) and from internal arcing (due to the movement of plastic, paper, etc.) And it doesn't take a “direct hit” to cause a problem — we've seen upsets at 20 or 30 feet due to the intense electromagnetic fields associated with “indirect” ESD.

An ESD event is very fast, with 1 nanosecond or less rise and fall times. At 1 nanosecond, the equivalent “bandwidth” is over 300 MHz, so VHF/UHF design or troubleshooting techniques are often needed. Don't assume low humidity or lack of shocks means no ESD problems. We've seen several cases where we were told “ESD can't be a problem”... yet it was.

Normal fixes for these problems are improved high frequency grounding, I/O filtering or shielding, and special attention to internal reset and control circuits.

Radio Frequency Interference... This is a serious problem with industrial electronics, and will likely get worse with the increased proliferation of hand held radios and cellular telephones. We expect the wireless LANs to provide some interesting EMI challenges.

As a rule of thumb, a 1 watt hand held radio at 1 meter has an electric field of 3-5 volts/meter, so the “heavy industrial” limits of 10 volts meter are very realistic. Incidentally, we have some clients (industrial and medical) who are actually banning hand held radios close to their electronic equipment.

Normal fixes for these problems are high frequency filtering and shielding. Low level analog circuits are particularly vulnerable to RF interference.

Power Disturbances... This has long been known as a serious EMI threat to industrial electronics. As a result, most industrial systems are pretty robust, at least at low frequencies. The Europeans simulate some “high frequency” power threats with the EFT (electrical fast transient) and injected RF tests. “Surge” test requirements are used to simulate power line transients due to lightning.

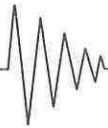
Incidentally, we consider all of these tests as realistic for the industrial environment.

A KGB BULLET...

Here is a *Rule of Thumb* we use for simple L or T filters on signal lines and in circuits:

Try to provide at least 100 ohms of impedance (inductive or resistive) in series, and 0.1-1 ohms of shunt impedance (typically capacitive). This will provide 40-60 dB of attenuation through the filter.

For example, at 300 MHz (ESD) use a 100 ohm ferrite and a 0.001 uf cap ($X_c = 0.5$ ohms)



Normal fixes for these problems are filters, transient suppressers, and grounding. Of course, with analog circuits, we also worry about 60 Hz "ground loops."

Emissions... In the US, industrial electronics still remain exempt from the FCC requirements. Not so in Europe, but the "heavy industrial" systems only need to meet the easier Class A limits of CISPR 11. "Light industrial" equipment, however, still needs to meet the more stringent Class B limits.

One word of caution, here. We've seen several problems where the industrial systems were jamming nearby VHF radios. Unfortunately, even the CISPR limits are not adequate, since they only protect nearby television receivers. In those cases, extra shielding and filtering may be necessary.

What Does EMC Stand For?

Thanks to all of you who responded to our "call" for more definitions in the last KGB. Here are some of the new ones we received — we'll include more in a future KGB. One person asked for anonymity, since he was worried about repercussions (his management lacks a sense of humor). We also noticed that several of these were picking on us poor consultants. Hmmm. In any event, we hope you enjoy this round:

- Easy Money for Consultants
- Employ More Consultants
- Even More Consulting
- Even More Confusion
- $E=MC^2$
- Electronic Mortal Combat
- Easy Means Complicated
- Eats Management Capital
- Expensive Mating Connectors
- Enlist Meticulous Consultants
- Employ Maxwell's Conclusions
- Expect Mangled Connections
- Evoke Magical Cures

Thanks to David Badtorff, Al Einstein (guess which one he did), Diethard Hansen, and one anonymous engineer. If you have more ideas, drop us an E-Mail.

World Wide Web...

Come visit our "home page", which we should have ready in the next few weeks. Bill's son Eric (author of the **EMI-Toolkit**® software) is busy working on this project. We plan to include the past issues of the KGB as well. The address will be **emiguru.com**.

In the meantime, you can reach both of us via Internet E-Mail at:

dgerke@aol.com
bkimmel@primenet.com

Extra EMC help available...

In response to increased workloads, we've made arrangements with two professional colleagues for additional EMC support. Our goal is to provide you with highly skilled help in a timely fashion.

Dr. Tom Chesworth, PE, has already worked with a number of our clients. Tom is a "practical PhD" with many years of EMC experience. He is very proficient in detailed EMC analysis as well. Tom and his wife Jo reside near State College, PA.

Bill Ritenour has recently gone "independent", and has 30+ years of industry EMC experience. Bill is also practical, well published, and highly knowledgeable about ESD, EMI, and European EMC Regulations. Bill and his wife Roma reside in Boulder, CO.

We are extremely pleased to have both Tom and Bill helping us and our clients solve EMC problems.

If ignorance is bliss, why aren't more people happy?

—Author Unknown

New Book on Medical EMC...

We're pleased to announce the publication of our new book, **Electromagnetic Compatibility in Medical Equipment**, published jointly by IEEE Press and Interpharm Press Inc. Twelve chapters plus several Appendices of reference material.

While it has a medical focus, we think the book will be of interest to all electronic device designers, engineers, technicians, and technical managers.

Medical equipment installers and facility engineers may also find this book useful. See the insert for more details.

To order, contact Interpharm Press at 708- 459-8480, or IEEE Press at 800-678-IEEE. (Note - Discount prices available for IEEE members through IEEE.)

A KGB Bullet...

Here is a good source of RF and EMC oriented books and videos:

Crestone Engineering
5910 South University Blvd.
Bldg C-18 #360
Littleton, CO 80121
Tel: (303)-770-4709
Fax: (303)-721-1021

Call or write for catalog. Lot's of good stuff. from a friend and colleague in the RF/EMC business.

