KIMMEL GERKE Bullets

MEMBER AMERICAN CONSULTING ENGINEERS COUNCIL

Winter, 1995

Welcome to KGB...

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

This issue focuses on "pre-compliance testing," an area of increasing interest by many of our clients. By performing some simple tests during the design phase, you can greatly increase your probability of EMC success during the product compliance phase.

In the long run, you save both money and time. The latter is particularly critical this year, as test lab time becomes more and more scarce due to the impending European Union EMC deadline of January 1996.

We'll take a quick look at what it takes to set up your own in-house capability for the most common tests. It's not that difficult, nor is it expensive when one realizes that failing just one test often means another $20,000+ in engineering costs for lab fees, rework time, and lost engineering time.

As always, give us a call if we can help. From *designs to disasters*, we're in business to help you with all your EMI problems.

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

PLEASE REQUALIFY...

Please return the enclosed card if you wish to continue to receive *Kimmel Gerke Bullets*. If you joined us or updated in the last few months, you can disregard this request. *If in doubt, send in the card and we'll keep you on our list.*

Since many businesses no longer deliver bulk mail, feel free to use your home address. Besides, if you change companies, you'll still get the KGB. *By the way... our mail list is PRIVATE, and is never used by anyone else.*

Shows and Conferences..

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

Electromagnetic Compatibility and Medical Devices: Issues and Solutions... May 24-25, at the Disneyland Hotel in Anaheim, CA, in conjunction with the AAMI (Association for Advancement of Medical Instrumentation) Annual Meeting and Exposition. Both of us will be participating in special discussion sessions on EMC in medical devices. See inside for more details.

Medical Design & Manufacturing East 95 Conference... June 8-12, 1995, at the Jacob Javits Convention Center in New York, and sponsored by *Medical Devices and Diagnostics Industry* magazine.

Daryl will present a tutorial on *"Designing for EMI/EMC in Medical Devices"*, and Bill will present a paper on *"Leakage Currents vs. EMI - A Juggling Act."* This special full day session on medical EMC issues repeats the popular session at MD&M West in January of this year.

IEEE 1995 EMC Symposium... August 15-20, 1995, in Atlanta, GA. Technical sessions, plus three days of exhibits. Sponsored by the IEEE EMC Society, it's always a good show to attend.

Tenth Annual Minnesota EMC EVENT... Tuesday, October 19, 1995, at the Thunderbird Hotel in Bloomington, MN. Cosponsored by us with TUV Product Service and the Paul Bunyan Chapter of the Electronic Representative Association. Half day seminars on selected EMC/ESD topics will be offered before and after the show (Monday & Wednesday.)

Reprints... EDN Magazine's *Designer's Guide to Electromagnetic Compatibilty*... now available... Due to its popularity, this EMC guide (written entirely by us) is now available as a reprint. *Call Kirsten Dumas at EDN Reprints (1-800-523-9654).* Cost is $19.95 + shipping. Quantity discounts.

Kimmel Gerke Bullets is a newsletter on electromagnetic interference/compatibility (EMI/EMC).
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Focus on Pre-Compliance Testing...

Waiting until the end of a project to discover EMI problems can be expensive, time-consuming, and downright frustrating. As a result, many of our clients now incorporate EMI "pre-compliance" testing as part of their design strategies.

The objective of pre-compliance testing is to find the potential problems early, when you have the most design options and time to make changes. You're also trying to maximize the odds of passing your full compliance tests. We advocate doing as much pre-compliance testing as you can in your engineering lab, and then doing your final compliance tests at a certified EMI test laboratory.

Unlike full compliance testing, you don't need expensive equipment and high precision to get good results. You can do many tests right in your own engineering lab. Here are some suggestions and comments on these tests.

Radiated & Conducted Emissions

If your equipment must meet commercial emission limits, these tests make a lot of sense. For less than $20,000, you can equip yourself well enough to almost guarantee that you'll pass your next FCC or CISPR test. With tests costing thousands of dollars a day, you can pay for this equipment in a short time.

There are two types of commercial emission tests - *radiated* and *conducted*. The *radiated* emissions measure electric field intensities from 30 MHz to 1000 GHz, and the *conducted* emissions measure voltages on the power lines from 10/150/450 kHz (depending on the test) to 30 MHz. Both tests are aimed at preventing unwanted interference with commercial radio and television reception.

Here is the equipment you'll need:

- *Spectrum analyzer* - A small portable unit works well, as long as it covers 10 kHz to 1 GHz. Most vendors offer "EMC" options for their portable units.

- *Antennas* - Two calibrated antennas are needed - a "biconnical" for 30-200 MHz, and a "log periodic" for 200 MHz-1 GHz. Several vendors now offer a combination of these two that eliminate the need to switch antennas. You'll also need a non-conductive tripod to hold the antennas.

- *LISN* - Needed to perform the conducted power line emission measurements. The type you get will depend on the tests (FCC, VDE, CISPR).

- *Miscellaneous* - Cables, connectors, and a clamp on current probe and sniffer probes to troubleshoot.

The test site can be simple, too. If you have some open space, you can do the tests at 3 meters, but if you are confined or in a "noisy" environment, you can run these tests at 1 meter (simply increase the limit by 10 dB to account for the closer distance.) Be sure to use a ground screen under the test area, and stay at least 3 meters from any reflecting surface.

Ambient signals can cause problems. While we've done these tests right in the engineering lab, you may be jammed by other similar equipment. For that reason, we usually try to find a "quiet" spot, such as a parking lot or even a conference room. Of course, you still need to contend with the local radio and TV stations, but these can often be subtracted with a "B-Save A" display on the spectrum analyzer.

Electrostatic Discharge Testing

This is another good candidate for pre-compliance testing. For under $10,000, you can purchase a small ESD tester that will let you duplicate all but the most severe ESD tests.

We recommend using IEC 801.2, the test method specified by the European Union. This document describes the test procedures and recommends test levels. Unless otherwise specified, we recommend testing to 8 KV "contact" and 15 KV "air discharge", using both the "direct" and "indirect" modes.

Two caveats about ESD testing. First, this can be destructive to the equipment under test, and second, this can upset other equipment in the vicinity.

RF Immunity Testing

Unless your equipment is small, you may want to leave RF pre-screening for the test lab. It can easily cost $50,000 to $100,000 for the shielded room, signal generators, and power amplifiers needed for most tests. One exception is small devices (typically under 25 cm in the longest dimension) which can be tested in a transverse electromagnetic (TEM) cell. TEM cells are shielded, and can provide very uniform fields at relatively low power levels. We recommend using IEC 801.3 as a guideline.

A KGB BULLET...

"A typical ringing frequency for a 0.6 mm trace over a ground plane on a 1.6 mm epoxy glass board is 35 MHz divided by the length in meters."

– From the *Circuit Designer's Companion* by Tim Williams (page 34). See our Book Review.

Power Disturbance Testing

In the past, these tests were usually left to the test lab. Thanks to new integrated power disturbance testers, however, many or our clients are now doing these tests in their own engineering labs as well. As a minimum, we recommend performing the EFT (electrically fast transient) tests of IEC 801.4, and the surge (lightning) tests of IEC 801.5 and IEEE C62.41.

Additional sag/swell/dropout tests should also be considered. We recommend the limits specified in IEEE STD1100-1992, "Power and Grounding for Sensitive Electronic Equipment."

For Further Information

Here are two magazine articles that provide more details on "pre-compliance" EMI testing. Both appeared in *Test & Measurement World* magazine.

-The Stakes are High with EMI Tests, Martin Rowe (Technical Editor), February 1995, pp 30-36

-Head Off Problems with Quick EMI Emissions Tests, Kimmel & Gerke, March 1994, pp 71-74

One of the greatest blessings about living in a democracy is that we have complete control over how we pay our taxes... cash, check, or money order.

– From the St. Paul Radio Club "Ground Wave" –

AAMI Conference on Medical EMC...

AAMI, the American Association of Medical Instrumentation, is sponsoring a technical conference on EMC in the medical environment. This special session will be held in Anaheim, CA, on May 24-25, 1995, directly after the regular AAMI Annual Meeting and Exhibition.

We'll be participating as co-chairmen in two sessions:
-Designing for EMC in Medical Devices
-Failure Investigation and Remediation Techniques

These are "break out sessions," not tutorials or presented papers. As such, they are intended to be working sessions, aimed at exchanging ideas about medical EMC problems and solutions. If you are interested, give us a call for more details.

FCC Proposes Rule Changes...

In a recent Notice of Proposed Rule Making dated February 7, 1995, the FCC proposes to relax the authorization process for personal computers. Instead of being certified, PCs would only need to be verified, which would speed up the authorization process. Test facilities would need to be NVLAP approved. Comments are solicited by the FCC.
(Thanks, Dan Hoolihan of TUV Product Service).

Dr. Tom Chesworth, PE...

We're pleased to announce an agreement with Tom Chesworth of Seven Mountains Scientific, to help us (and our clients) with EMC and ESD problems.

As our workload increases, we've found it necessary to call on professional colleagues from time to time for additional help. Some of you have already worked with Tom, and know and appreciate his strong EMC capabilities. For those of you who don't know Tom, he is a "practical Ph.D." with many years of EMC experience. He is also very proficient in detailed EMC analysis.

In addition to EMC consulting, Tom and his wife, Jo, publish *Electromagnetic News Report*, a specialty newsletter for the EMC community. Tom resides near State College, PA, the home of Penn State. Tom is a registered Professional Engineer (PE), and a NARTE Certified EMC Engineer.

In Memory of Ed Finegan, PE...

It is with regret we report the passing of our friend and associate Ed Finegan. He died suddenly in October, just after completing a project for Kimmel Gerke Associates. Those of us who worked with Ed will miss his strong EMC capabilities, and his ever pleasant professional demeanor.

Book Review...

The Circuit Designer's Companion, Tim Williams, published by Reed-Butterworth. This book is full of practical tidbits, suggestions, and "rules of thumb," from the author of "EMC In Product Design." A good addition to any designer's technical library.

E-Mail Address...

You can reach us via Internet E-Mail through America On-Line at **dgerke@aol.com.** (Back issues of the KGB will soon be available on the Internet, too. Details in the next KGB.)

A KGB Bullet...

Here are two application notes of EMC interest from the folks at Motorola:

-Designing for EMC with HCMOS Microcontrollers (AN 1050)

-Transmission Line Effects in PCB Applications. (AN 1051)

Call Motorola Literature Distribution in Phoenix at 1-800-441-2447. Other app notes in future KGBs. *Thanks, Dr. Bob Nelson of North Dakota State University.*

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For more details, or to place an order, call 612/330-3728. We accept MasterCard, VISA, purchase orders, or checks. Minnesota residents, please add 6.5% sales tax.

Design Reviews

An increasing number of our clients now include ***EMC Design Reviews*** as part of their design process. They know that the earlier you address EMC issues, the more options you have, and the lower the costs.

A typical design review examines the *printed circuit board layout, interconnect schemes, power supplies, I/O cables & connectors, and mechanical packaging.* We can also advise on regulations and test strategies. Remember, test failures can cost you $20K+ in retest and rework at the end of a project.

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