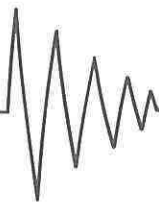


# KIMMEL GERKE



## Bullets



Fall, 1991  
Vol. 3, No. 1

### Welcome to KGB...

And to the third year of our "personal communications" to our friends, clients, and colleagues. Time flies when you're having fun...and it has been fun working with so many of you these past several years.

**This issue focuses on architectural shielding**, with some ideas and recommendations on shielding buildings and facilities. In the past, this was typically done only for military or test facilities. Thanks to new low cost materials, shielded rooms are now practical for a much wider range of applications.

These breakthroughs come not a moment too soon. In today's hostile electromagnetic environment, a wide range of electronic systems can benefit from facility shielding. Add in the concerns about "industrial espionage", and a shielded room can become a necessity.

We've worked on several such projects. If you are concerned about these issues, give us a call. Remember, we never charge for "quick questions"... and we're always here to help you **identify, prevent, and fix your EMI/EMC problems.**

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

### Minnesota EMC Event

If you haven't signed up for the **Sixth Annual Minnesota EMC EVENT**, do so right now! Remember, it's **FREE if you are preregistered.**

**Don't miss this FREE ONE DAY SHOW...**  
October 24 at the Thunderbird Hotel in Bloomington...Over 30 vendors, with 18 technical talks...Many **new vendors and new topics** this year...**Come learn how to solve your EMC design and test problems.**

There are also two days of in-depth seminars, for a nominal fee. More details on Page 4, or **CALL 612-465-3911 NOW.**

### Shows and Conferences...

Here are some shows and conferences in which we'll be participating. Give us a call if you'd like more information on any of these events.

**Sixth Annual Minnesota EMC EVENT.**...The local (Twin Cities) EMC show of the year, co-sponsored by Amador and Kimmel Gerke Associates, held Thursday, October 24, at the Thunderbird Hotel in Bloomington, Minnesota. Bill will be doing his ever-popular talk on "*EMI Design Tips*", and Daryl will present a paper on "*Magnetic Fields and CRTs*", originally given at EMC-EXPO-91 in Orlando.

**EMC Test and Design Show**...We'll be participating in this new show, sponsored by *EMC Test and Design Magazine*. The show will be held April 21-24, 1992, in Denver, Colorado. Early indications suggest that this will be a good show to attend. We'll be participating in two sessions: "*EMC Design For Compliance*" and "*EMC In Harsh Environments*". More details in the next issue.

**Midwest Expo 1992**...The largest electronics show in Minnesota, aimed at the general technical community. Held May 19-21 at the Minneapolis Convention Center. We're planning a session on "*Common EMI Mistakes...and How to Avoid Them.*" This talk has been very popular at other shows, and this is the first time in the Twin Cities.

**EMC Expo 1992**...Current plans call for this show to be held in Washington DC in May 1992. This is a change from earlier plans to hold this show in Orlando in July. We plan to be there, hosting a session. Should be a good show.

### IEEE EMC Show A Winner...

It was a pleasure seeing many of you at this international EMC show in Philadelphia last August. Good technical sessions, many vendors, plus a good crowd. We particularly enjoyed the pre-conference session on "*EMC-92*", and hope to see similar focused sessions in the future. Next year the IEEE EMC show is in Los Angeles...hope to see you there.

## Focus on Architectural Shielding . . .

In the past, "shield rooms" were typically found only in military or test facilities. Thanks to new low cost materials, shield rooms are now practical for a much wider range of applications. Due to an increasingly hostile electromagnetic environment, shield rooms often become a necessity.

Even inexpensive rooms can represent a significant investment, both in money and in engineering time. And even the best shield room can be rendered totally useless if not properly installed and maintained. It's a bit like building a water tank — one little leak can ruin everything. Here are some ideas and recommendations based on our experiences with shield rooms.

**Determine needs** — In the beginning, ask a lot of questions. *What is the threat?* (Nearby radio transmitters? Radar? NMR machines? "Industrial espionage" or "electronic terrorism"?) *What is the cost of a "failure"?* (What happens if the computer crashes?) *Do I need magnetic field shielding?* (It can be a lot more expensive.) *How big is the facility?* (Can I do it better/cheaper at the equipment level?) *How much shielding do I really need, anyway?*

In addition to questions, you may need tests, such as a "site survey" to measure the local electromagnetic environment. Be a "snoop" as well — in one case, we discovered that a commercial AM radio station was planning to add an FM radio transmitter about 1/2 mile from a client computer facility. That crucial piece of information completely changed the shield room strategy.

**Develop solutions** — After the needs are determined, the next step is to develop some solutions. You first need a *preliminary specification* that defines *shielding levels, frequency range, and type* (electric, magnetic, plane wave). Be careful not to overspecify here — costs can go up almost exponentially. On the other hand, don't underspecify — it can be very expensive to retrofit. The real key is to understand your overall objectives.

There are *two areas of concern*. The first is the *shielding effectiveness (SE) of the shield material*, and the second is the *degradation due to openings and penetrations*. The proper material must be selected, since this sets an upper limit; then it must be properly installed, or you can lose everything you paid for.

Shielding effectiveness can be divided into several practical levels. The most *extreme levels (120 dB typical)* require welded steel rooms with expensive gasketed doors, massive filters, and waveguide materials for ventilation. These levels are often needed for military and classified applications. *At high levels (100 dB typical)*, modular steel rooms or copper screen rooms may replace the welded enclosure. These levels are typical for test facilities and for housing very sensitive electronic systems in severe environments. *At moderate levels (60 dB typical)*, metal foils, screens, paints, and conductive wallpaper may be used,

combined with less expensive doors, filters, and ventilation. This level is often more than adequate for protecting commercial/industrial computer facilities. *At low levels (30-40 dB typical)* the conductive wall coverings are very cost effective, and can often be combined with inexpensive doors, filters, and ventilation screens. This level can be quite adequate for protecting electronics against a wide range of moderate threats.

*A key issue is magnetic field shielding.* At low frequencies, this can be both difficult and expensive. If required, it dictates permeable material (steel or mu-metals), and very careful installation. It's often cheaper and simpler to solve these problems at the equipment level. Many commercial and industrial users don't need low frequency magnetic field shield rooms, but they do need high frequency shield rooms.

**Select vendors** — The first two steps usually result in a shield room specification. At this point, cost comparisons and tradeoffs can be made. By the way, you'll probably be talking to vendors prior to this stage anyway. We certainly recommend that, since most shielding vendors are very knowledgeable about their products and how to apply them. You should do your homework first, however, to determine what you really need.

At this point, you also need to talk to your architect and electrical/mechanical engineers. You'll likely need an EMI engineer as part of this team, too. The EMI engineer should be a licensed Professional Engineer (PE), an important credential when working with architects and construction engineering firms.

**Installation** — At this point, you are ready to install the room. Three key pieces of advice here are *check-it-out, check-it-out, and check-it-out!* No matter how thorough you are, someone will try a shortcut. (You mean one little tiny wire through the wall will cause problems? What to you mean we can't do this — we've always done it that way!)

*continued . . .*

### A KGB Bullet . . . Bill's Rule of One

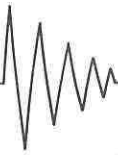
Choosing the right size of decoupling capacitor is a common EMC concern. If too small, the impedance is too high. If too big, resonance problems can occur due to internal inductance. Bill uses this rule: **FC=1, where F=Frequency in MHz, and C=Capacitance in uf.**

1 MHz = 1 uf

10 MHz = 0.1 uf

100 MHz = 0.01 uf (works good for ESD too)

This guarantees that the impedance will be about 0.15 ohms. *(In a pinch, you can go one order of magnitude less.)*



## Focus on Architectural Shielding . . . *continued*

We recommend regular inspections (every day or two) on the progress. It also helps to get the construction supervisor on your side. In one case, the supervisor was invaluable in catching and preventing problems. (He had our home phone numbers, with instructions to call with *any* questions, which he did.) *Keep your eye on things at this stage.*

**Testing** — The final stage is testing the shield room. We suggest two types of tests — *engineering*, and *acceptance*.

The *engineering* tests are done during the installation, and are aimed at catching any mistakes as early as possible. These can be done with a spectrum analyzer and some simple RF sources, such as hand-held radios. These tests should be done as soon as the shield material is installed, and again after filters, doors, and wiring are installed.

The *acceptance* tests are done after all crafts are finished, and are aimed at assuring the shielding objectives are met. We recommend these tests be done a qualified and experienced EMC test laboratory. This is mandatory if the room is to be certified to a government specification. In addition, the room should be retested for acceptance on a regular basis (at least every 2-3 years) or whenever changes are made.

**Summary** — Shield rooms can provide practical solutions to EMI problems. Modern electronic systems are often sensitive, and the environment is often hostile. If you are planning a new computer room or other electronic facility, you should consider shielding it from the start. As we say, *"An ounce of prevention is worth a pound of shielding. . ."*

## Book Review . . .

To learn more about architectural shielding, we recommend a brand new book from the IEEE Press, *Architectural Electromagnetic Shielding Handbook*, by Leland Hemming. This is a well written, pragmatic book that covers the important issues, and illustrates them with many real-world examples. The IEEE Order Number is PC0282-4.

## EMI/EMC Articles . . .

Several EMI/EMC related articles have appeared in the popular trade journals recently. Here are two that caught our attention:

**Guide to Designing With High Speed CMOS ICs**, by Rudy Sterner of Advanced Micro Devices. This article appeared in the September 12, 1992, issue of *Electronic Design*. It's easy to read, and filled with practical ideas and advice on high speed design. It includes many design practices that we advocate for

good EMI/EMC design. Mr. Sterner can be reached at 408-732-2400.

**Europe Lays Down EMC Law**, by Brian Kerridge, European Editor of *EDN Magazine*. This article appeared in the September 16, 1992 issue of *EDN*, and gives a good overview of the current European EMC regulations. If you plan to sell your products in Europe, you cannot ignore these requirements. And since they are generally more stringent than the US requirements, it's often better to design for these European limits in the first place.

## Cable Shielding Info . . .

Bill Moncrief of Georgia Power sent us some comments regarding our Bullet on cable shielding in the last KGB. It seems that our guideline of grounding one end of a "short" cable (less than 1/20 wavelength) doesn't work too well in 500 kilovolt substations.

After a recent tour of one of Bill's facilities, we now appreciate his special problems. For example, we were able to light fluorescent bulbs simply by walking under the 500 KV lines. It's safe to say that his field levels are a bit on the high side of what most of us will see.

Nevertheless, Bill did advise that tri-ax cables work well for them. For their control cables, they ground the inside shield at both ends, and the outside shield is grounded at the indoor (amplifier) end only. This gives them both electric field and magnetic field protection. They also pay special attention to grounding.

## FCC Information . . .

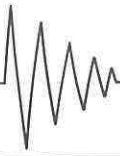
While at the IEEE EMC show in Philadelphia, we picked up a copy of the *FCC Interference Handbook—1990 Edition*. This 64 page paperback contains a wealth of information on EMI problems and solutions. It not only addresses RFI (amateur, CB, commercial transmitters) but also power line noise and grounding. Best of all, it's free.

The FCC also has a computer line (Public Access Link) at 301-725-1072 for compliance information. Use 300-1200 baud, no parity, 8 data bits, no stop bits. Hit one or more carriage returns upon connect.

### A KGB Bullet . . . Daryl's Rule of Two

When using decoupling capacitors over a broad frequency range, adding parallel devices can extend the frequency range. Daryl uses this rule: **Add a parallel capacitor two orders of magnitude lower to extend the range.** For example, if you are using 1 uf capacitor, add a 0.01 uf in parallel. *And remember, keep those capacitor leads short!*





## Minnesota EMC Week

October 21-25, 1991

Mark your calendars to join us this fall for these EMC activities. Learn new techniques, see new products, meet new people, and have a good time during **Minnesota EMC Week**.

- Tues., Oct. 22    **Special IEEE EMC Meeting**  
Dinner and social hour
- Tues., Oct. 22    **Full Day Seminar**  
"Design for EMC"
- Wed., Oct. 23    **Half Day Seminars**  
"EC-92 EMC Update"  
"MIL-STD-461/462 Testing"  
"EMC For Medical Devices"  
"Electrostatic Discharge Design"
- Thurs., Oct. 24    **SIXTH ANNUAL MINNESOTA EMC EVENT.** Over 30 vendors plus half-hour tutorial sessions on design, test, and products. (FREE to Preregistered Attendees)

All events held at the Thunderbird Hotel, Highway 494 and Cedar in Bloomington, Minnesota. New things to see and do.

## Design Reviews . . .

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

We'd like to help you prevent EMI/EMC problems in your projects. The best time for a design review is right at the start, when you have the most flexibility. And remember, \$5K at design time can easily save \$50K in retest and rework at the end of a project. Call us for more details.

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