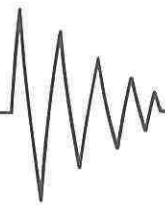


# KIMMEL GERKE



## Bullets



Winter, 1992  
Vol. 3, No. 2

### Welcome to KGB. . .

And to this issue of our "personal communications" to our friends, clients, and colleagues. We hope you find an idea or two that helps you **identify, prevent, or fix EMC problems.**

**This issue focuses on medical devices,** and the special EMC issues faced by the designers of this lifesaving technology. Medical devices are gaining increased EMC attention, both in Europe with the new European Community regulations, and in the United States from the Food and Drug Administration.

We've worked on quite a number of medical products, so we appreciate special design constraints such as isolating a patient from 60 Hz leakage currents. We also appreciate non-EMC concerns, such as liability and confidentiality.

Give us call if you need help. Our "country doctor" design approach works with both medical and non-medical products. And we even make "house calls."

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

#### SEMINAR ON HIGH PERFORMANCE DESIGN

Not just another EMC seminar, but rather **TWO DAYS FOCUSED ON DESIGN ISSUES** facing designers of high performance electronics.

Sponsored by Tektronix, and presented by Bill Kimmel of Kimmel Gerke Associates, Ltd.

**What:** High Performance Design Seminar

**When:** March 9-10 (Dallas)  
March 11-12 (Houston)

**Where:** Local Tektronix office

**Cost:** \$750 per person

**How to Register:** Call 1-800-426-2200 Ext 181

**Questions:** Call Bill Kimmel at 612-330-3728

*This is a "nuts and bolts" seminar complete with demonstrations. If you've ever heard Bill speak, you know this will be filled with design-oriented tips and techniques.*

### Shows and Conferences. . .

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

**EMC Test and Design Show. . .** April 21-24, in Denver, Colorado. A new show sponsored by *EMC Test and Design Magazine*. Tutorial sessions on Tuesday, followed by technical sessions and exhibits Wednesday-Friday. We're hosting two sessions, "*EMC Design for Compliance*" (Tuesday) and "*EMC in Harsh Environments*" (Wednesday.) Don't miss this show. . . it really looks good to us.

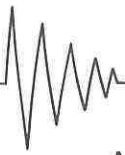
**EMC Expo 1992. . .** May 18-20, in Washington, DC. Sponsored by EMC Technology Magazine. Three days of technical sessions and exhibits. We're planning a session titled "*T2 Offbeat EMI Problems. . . And Solutions.*" Sort of our own "Tales from the Dark Side of EMI." Should be fun.

**IEEE 1992 EMC Symposium. . .** August 17-21, in Anaheim, California. Three days of technical sessions and exhibits. Daryl will present a paper entitled "*Electric Field Levels Around a Typical Amateur Radio System.*" Hope to see you there.

**Seventh Annual Minnesota EMC Event. . .** October 22, at the Thunderbird Hotel in Bloomington, MN. Co-sponsored by Amador and Kimmel Gerke Associates. Part of EMC WEEK in Minnesota. Mark your calendars to attend.

### Magazine Recommendation. . .

If you are not receiving **ITEM (Interference Technology Engineer's Master)**, you should be. For over 20 years, this annual "reference magazine" has been published by R&B Enterprises. It typically runs over 400 pages, and is filled with articles and advertisements that focus on current EMC issues. We contributed an article in 1990 (*Power Disturbances and Computerized Equipment*), and have another article planned for 1992. Best of all . . . **it's FREE to qualified readers.** For more information, call R&B Enterprises in West Conshohocken, Pennsylvania, at 215-825-1960.



## Focus on Medical Devices. . .

Here are some observations and comments on common EMC concerns with electronic medical devices. While this lifesaving technology often performs miracles, it is still subject to EMC and the "laws of physics".

Medical device EMC is affected by several factors. These include **patient isolation, mixed technologies, an increasingly "harsh" environment, and a lack of uniform EMC regulations.** These are compounded by the need for very high reliability, and the constant threat of litigation.

**Patient isolation** is mandatory in any device connected to a patient. The primary threat is 50/60 Hz leakage currents that can result in "microshocks." Due to low impedance connections such as EKG or intravenous devices, even very small currents can be hazardous. Thus, all "patient connected" medical devices must provide both power and ground isolation. This can have significant EMC impact, particularly if input filtering or shielding is needed. Fortunately, there are solutions.

**Mixed technologies** compound the problems. Many medical devices combine very sensitive analog circuits (such as EKG) with high speed digital controllers. In addition, many incorporate noisy electromechanical devices, such as relays and actuators. Self compatibility can be a serious problem.

**Lack of uniform guidelines** is another contributing factor. Without a set of acceptable EMC goals, many designers are left to fend for themselves. This situation is now changing, with the emerging European Community rules plus increased interest from the U.S. Food and Drug Administration.

Now let's look at some of the key threats to medical devices in more detail.

**Radio Frequency Interference.** . . This is a serious threat to all modern electronic systems, due to the proliferation of radio transmitters such as handheld VHF/UHF radios and cellular telephones. The problems is particularly acute with medical devices that monitor low level signals. A nearby source of RF can simply overwhelm such a system.

As a rule of thumb, a 1 watt radio at 1 meter has an electric field of over 5 volts/meter. This is about the same as a 10,000 watt commercial FM station at 100 meters. Thus, the typical specification levels of 1-10 volts/meter are very realistic. They are rough to meet, however, and require strict attention to EMC design details. Simple "FCC/VDE" fixes are often woefully inadequate.

**Electrostatic Discharge.** . . This is also a serious, but realistic, problem area. And it no longer takes a "direct hit" to cause problems. . . the intense

electromagnetic field from a nearby hit can easily upset a system. We've seen this effect up to 20 feet away.

An ESD event is very rapid, often 1-3 nanoseconds. At 1 nanosecond, the equivalent "EMC Bandwidth" is over 300 MHz. This means that many of the design techniques needed to harden against VHF/UHF radio transmitters also work here. Tough problems, but solvable.

Typically, the "indirect hit" causes upset, while the "direct hit" can cause both upset and damage. The damage may be immediate, or it may be latent. . . waiting to get you later. We feel that ESD should be addressed on every electronic system, medical or not. These problems can be controlled, but it won't happen by accident.

**Power Disturbances.** . . This is becoming a serious EMC problem for all electronic systems. It's not that the threat is getting worse. . . rather, modern electronic systems are becoming much more vulnerable to power line disturbances. Digital circuits are easily fooled by spikes, while analog circuits can be misled by slow power sags and surges.

Power guidelines range from simple "high/low" voltage limits to more sophisticated requirements such as EFT, or the "electrically fast transient". EFT simulates arcing and other high speed noise that plays havoc with microprocessors and computers. Finally, there are the "lightning" based transients tests that can cause equipment damage.

**Power Line Fields.** . . Power lines are everywhere, and so are their electric and magnetic fields. With all the controversy about power line magnetic fields, the question often arises about the effects of these fields on medical devices.

Actually, the "magnetic" fields are usually not a concern. About the only electronic equipment adversely affected by power line magnetic fields are video display terminals. (We've written several articles and papers on this subject. . . call if you want more details.)

Low frequency "electric" fields, however, can upset low level signals such as EKG inputs. Careful analog  
*continued. . .*

### A KGB Bullet. . .

#### Bill's Rule of Three

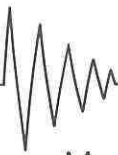
*For low impedance connections at high frequencies, use a bond strap. For the best results, keep the ratio of the length-to-width less than 3:1.*

*1 inch long × 1/2 inch wide*

*3 inches long × 1 inch wide*

*6 inches long × 2 inches wide*

*Remember, keep it short, keep it fat, and keep it flat.*



### Focus on Medical Devices. . .continued

design techniques (shielding and transformer isolation) are necessary. Remember there is a vast world of difference between low frequency and high frequency grounding and shielding, so compromises and "hybrid" approaches are often needed.

**Emissions. . .** No EMC discussion would be complete without a word about emissions. At this time, medical devices are exempt from FCC regulations in the US. By the way, this exemption applies only to devices under the supervision of a medical professional. . . devices like home blood pressure monitors are not exempt.

The situation is more stringent in Europe. At this time, both the EC and the VDE require that medical products meet the same emission levels as other consumer products. A bit of good news though. . . usually the fixes for the immunity areas (RFI, ESD, power) are more than adequate for meeting emission requirements.

### 60 Hz Magnetic Fields Not a Danger to Health. . .

So says the British Institute of Electrical Engineers (IEE), according to a recent article in *EE Times Magazine* (November 4, 1991). The IEE says that fears of possible health risks due to magnetic field exposure have been greatly exaggerated. This conclusion was based on a year long study of laboratory tests and medical investigations from around the world. The IEEE "Committee of Man and Radiation" has reached similar conclusions.

However, some researchers theorize that low frequency magnetic fields *might* provide a subtle promoting factor to certain cancers. Although not a direct cause, magnetic fields may act like a "fertilizer". It will likely be years before the actual effects, if any, are known.

### WANTED. . . Dead or Alive. . .

A reward is being offered for information leading to the arrest of Eddy Current, charged with the induction of an 18 year old coil called Milli Henry. Found half choked with the theft of her valuable Joules.

This unrectified criminal escaped from a primary cell where he was clamped in ions. The escape was planned in three phases. First he fused the electrolytes, then he climbed through a grid, and then he finally ran to ground in a nearby magnetic field.

He has been missing since last Faraday. Watt seems most likely is that he stole an AC motor of low capacity, which he is expected to exchange it for a Megacycle and return Ohm by a short circuit. He may offer series resistance.

(A little humor from the St. Paul Radio Club *Ground Wave*.)

### Confidential Information. . .

Sometimes we hear concerns about confidential information that may be necessary to help solve an EMC problem. This can range from new product plans to simply the fact that your company or product "may have an EMI problem."

This is not at issue with Kimmel Gerke Associates. First, we routinely sign standard non-disclosure agreements. Second, we treat all client information (regardless of non-disclosures) as though it were *Company Confidential*. Third, we won't even divulge client names without permission. (*See our brochure. . . while other consulting firms give a list of clients, we give a list of projects.*) Your secrets are safe with us.

*Start every day with a smile, and get it over with.*  
—W.C. Fields

### Shielding Reports Available. . .

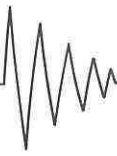
Two of our clients have elected to make our reports available to the public. These reports describe the results of research projects funded by these clients. *The reports are FREE, but must be requested from our clients:*

- **"Vacuum Deposition Shielding Effectiveness Tests"**  
Electric field shielding from 30 MHz-3000 MHz on silver paint vs. silver/aluminum/copper vacuum deposition. **Vacuum Platers Inc., Mauston, WI 608-847-5644**
- **"Optical Filter Shielding Effectiveness Tests"** (3 reports) Magnetic and electric field shielding on several computer terminal "glare shields" in the VLF/ELF range (30 Hz-400 kHz.) **Optical Coating Laboratory, Inc. Santa Rosa, CA 1-800-221-6091 (California Only 1-800-654-1881)**

Thanks to both VPI and OCLI for sharing this information. Need similar research for your products or applications? Give us a call. . . we do EMI research and development, as well as EMI design and troubleshooting.

**A KGB Bullet. . .**  
**Daryl's Rule of Three**  
*Holes or slots can provide additional shielding, if the ratio of the depth-to-width exceeds 3:1. This is known as a "waveguide beyond cutoff." (For a slot the width is the longest dimension, not the spacing.) Also, the highest frequency needs to be less than 1/20 wavelength.*  
*For example:*  
    1/4 inch hole needs 3/4 inch depth (good to 2.4 GHz)  
    1 inch slot needs 3 inches of depth (good to 600 MHz)  
*Remember, keep it short and make it deep.*





## About Kimmel Gerke Associates, Ltd.



DARYL GERKE, PE

We're a professional engineering consulting firm that specializes in ELECTROMAGNETIC COMPATIBILITY, a broad area of electrical engineering that deals with electronic interference, or noise. We share almost fifty years of experience in the electronics industry. We're both degreed Electrical Engineers, and we are both Registered Professional Engineers.



WILLIAM KIMMEL, PE

We both have experience with the design, applications, and installation of electronic systems subject to government EMC (FCC, VDE, MIL-STD-461) and TEMPEST requirements. We both have experience solving operational EMC problems with a wide range of equipment. We'd be glad to help you with your EMC problems, fixes, design support, test support, or training needs.

## 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.

### **KIMMEL GERKE ASSOCIATES, LTD.**

*Electrical Engineering Consultants*

#### **SPECIALISTS IN ELECTRONIC INTERFERENCE CONTROL**

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New designs and retrofits

Experienced in power, communications,  
and computers

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