

KIMMEL GERKE



Bullets

Winter, 1997

Welcome to KGB...

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

This issue discusses EMI gaskets. With high speed microprocessors and an increasingly harsh electro-magnetic environment, shielding is often a necessity. Seams and other openings can be a "weak link" in shielding.

These often must be filled with conductive gasketing. In this issue, we'll take a quick look at different EMI gaskets, and how they can help prevent and fix EMI problems.

We've seen several recent problems caused by poor shielding and gasketing. Many might be tempted to leave gasket problems to the mechanical engineers, but EMI solutions often require concerns for both electrical and mechanical issues. Like most EMI problems, the issues may be subtle, but they are usually simple once you understand some basic principles.

As always, give us a call if we can help you out with any of your EMI problems — from simple gaskets to full systems.

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

P.S. Seasons Greeting to all of you, and Best Wishes for a Happy & Prosperous 1998.

EMC Winter Workshops

Need a winter break, and some fun in the sun? Want to learn more about EMC design, regulations, or troubleshooting? Then join us in **Orlando or Phoenix in January/February** for our expanded EMC seminar series, sponsored by Tektronix.

This year we've added a fourth day on regulations, in addition to the two days on design, and one day on troubleshooting. Take only what you need (1,2,3 or 4 days) to get up to speed on critical EMC issues.

See the insert for more details, or call us (toll free) at 1-888-EMI-GURU. (We even have special hotel rates in Orlando, located just outside Disney World.)

Shows and Conferences...

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

Orlando EMC Winter Workshop...January 26-29, 1998, at the Sheraton Lakeside in Kissimmee, FL. Bill Kimmel will conduct the "Design for EMC" and the "EMC Troubleshooting" sessions, and Bill Ritenour will conduct the "Understanding EMC Regulations" session. (Hotel is one mile from the entrance to Disney World.)

Phoenix EMC Winter Workshop...February 2-5, 1998, at the Embassy Suites in Tempe, AZ. Daryl Gerke will conduct the "Design for EMC" and the "EMC Troubleshooting" sessions, and Bill Ritenour will conduct the "Understanding EMC Regulations" session. (Great time to visit Phoenix, particularly if you like golf.)

Thirteenth Annual Minnesota EMC Event...April 29-30, 1998, at the Thunderbird Hotel in Bloomington, MN. One day of tutorials (April 29) and one day FREE exhibition (April 30) with vendor presentations. Hard to believe we've been involved with this show for 13 years.

IEEE EMC Symposium...August 23-28, 1998, at the Colorado Convention Center in Denver, CO. For more information, their Web site is http://ball.com/aero_space/ieee_html. For those of you new to EMC, don't miss the very popular tutorial sessions on Monday, August 23.

Thanks for requalifying...

Thanks for sending in those postcards (or Emails) to requalify for the KGB. And thanks to all of you for your kind notes when you requalified — its nice to know so many of you enjoy receiving the KGB. If you haven't requalified, please do so by regular "snail mail", or by Email at bkimmel@emiguru.com.

Ten Year Anniversary...

As we mentioned in the last KGB, in 1997 we are celebrating 10 years as full-time EMC consulting engineers. Just for the record, the first "official" full time day in business was the day the stock market crashed... how about that timing? Thanks to all of you for your support over the years. (By the way, our EMC experience goes back about 30 years... each...)



Gasket Specs and Testing - This has caused a lot of controversy within the EMI community in recent years, and its still not fully resolved.

One long accepted test method harkens back to World War II, when gaskets were first widely used. Since gaskets were used in shielded rooms, and since MIL-STD-285 was the test method to assure room integrity, this method has evolved into a test method for gaskets. In this case, electromagnetic fields are measured through a "window" in a shielded room, and then remeasured when a gasketed panel replaces the window. The improvement is said to be the shielding effectiveness of the gasket. Unfortunately, this method can result in some high errors.

More recently, gasket manufacturers are using conducted, rather than radiated methods to assess gaskets. The measured parameter is "transfer impedance" which can be used to predict shielding effectiveness.

A key point is not to rely on absolute numbers, but rather comparative results among gaskets you are considering. The ultimate test will be whether they solve your EMI problems at the equipment/systems level.

Correction...

The correct URL Martin Rowe's compliance FAQ page is world.std.com/~techbook/compliance_faq.html. It does NOT begin with "www" as we reported in the last KGB. Our apologies to Martin Rowe Test & Measurement World magazine. (m.rowe@ieee.org)

Attention Hams...

The American Radio Relay League (ARRL) is writing a book on how to evaluate RF exposure levels. This will expand on the FCC Office of Engineering and Technology "Bulletin 65" that will soon apply to many amateur radio stations. For more information, contact Ed Hare, W1RFI, at ehare@arrl.org.

This book may be of interest to EMC personnel who are not hams as well. (Note Ed's new amateur call — W1RFI — very appropriate, wouldn't you agree?)

SOME KGB BULLETS...

Here are some more EMC "info-bullets" on the Internet:

www.ball.com/aerospace/ieee_emc.html — Information on the 1998 IEEE EMC Symposium in Denver.

www.umd.umsl.edu/ — University of Missouri at Rolla - Lots of good info on EMC vendors, books, and more.

www.sigcon.com/ — Dr. Howard Johnson, author of "High Speed Digital Design". Good signal integrity info.

www.emiguru.com — Our site. Good info, of course.

Congratulations...

Our congratulations to Dan Hoolihan, who was recently elected to a two year term as President of the IEEE EMC Society. Dan is with TUV Product Service in Minnesota, and has served in a number of positions within the society, including Vice-President and on the Board of Directors.

EU EMC Update Services...

If you need the very latest word on EMC regulations, this German based service may be just for you. Get the latest in EMC documents (including draft standards) as soon as they are available, plus an answering service for specific questions. For information, call:

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011-49-9131-604752 (Facsimile)

"If the automobile had followed the same development as the computer, a Rolls-Royce would today cost \$100, get a million miles per gallon, and explode once a year killing everyone inside." Robert Cringley, Info-World

New Test Lab in Minnesota...

International Certification Services, founded by Duane Bagdons, has opened a new EMC test lab in Glencoe, MN (just west of Minneapolis). Duane has extensive experience in international compliance issues (CE Mark) and other EMC testing. Phone 320-364-4444 or 1-888-286-6888 (toll free). Our congratulations and best wishes to Duane on his new venture.

Book Review...

The EMC Desk Reference Encyclopedia, by Don White. This is a first of its kind, and contains over 3000 entries. In addition to terms, it also contains some detailed explanations of EMC phenomena complete with formulas. We even learned some new EMC acronyms as well. ISBN 0-932263-49-6. Published by *emf-emi control® Inc.*, Gainesville, VA. (Note - We're told a second, expanded version will be released in early 1998, complete with CD.)

In-House EMC Seminars...

Our in-house EMC seminars have been very popular this past year. We have several standard seminars, including Design for EMC, Grounding & Shielding, Medical Design for EMC, EMC in Telecommunications, EMC Troubleshooting, and Understanding EMC Regulations. We can also custom tailor classes to your needs as well. If you have 12 or more, our classes become quite cost effective. For more information, call 1-888-EMI-GURU.



Focus on EMI Gaskets...

Years ago, EMI gaskets were rarely seen in commercial computer equipment, although they were widely used in military systems and radio communications equipment. Today, thanks to increasing processor speeds and increasing EMI threats, gaskets are quite common in a wide range of electronic equipment. Although gaskets are relatively simple, they are often misapplied. In this article, we'll look at how to get the best "bang for the buck" when using EMI gaskets.

How Gaskets Work - EMI gaskets perform their magic by providing a conductive path across seams and other discontinuities in an electronic enclosure. This "shorts out" any potential difference across the shield surface.

In a perfect EMI shield (a "Faraday cage") EMI currents induced on the shield remain inside (or outside) the shield. In the real world, seams or other joints can result in a relatively high impedance. Ohm's law prevails — a current flowing across a high impedance results in a voltage potential across the seam or joint.

This voltage potential can "launch" an electromagnetic wave, just like a wire antenna. In fact, seams in shields are often modeled as "slot antennas." The only difference between a wire antenna and a slot antenna is that a wire antenna is metal surrounded by space, and a slot antenna is space surrounded by metal.

That means even a "thin" slot (such as two metal surfaces separated by paint) can radiate if it is long enough. The critical parameter is length, not thickness. Most of us in the EMI business worry when slots are longer than 1/20 wavelength (e.g. two inches at 300 MHz...see the KGB Bullets below.)

The secret to success is to minimize impedance across the joint with clean, metal-to-metal contact. An alternate would be to reduce the current flowing in the shield, but this usually isn't practical. Don't overlook this, however—we had a recent case where hundreds of amps of high frequency currents could be flowing in the cabinet, and reducing those currents were possible. That case gave us two options to explore — either improve the gaskets, or reduce the currents.

A KGB Bullet...

Here are some *rules of thumb* we use when trouble-shooting radiated emissions problems:

- For frequencies < 300 MHz, assume the cables are the primary "antennas."
- For frequencies >300 MHz, assume cables, boards, and enclosure seams (slots) can all act as antennas.
- Anything over 1/20 wavelength is a suspect antenna.

(100 MHz - 6 in. 300 MHz - 2 in. 1GHz - 3/4 in.)

Types of Gaskets - There are several types of popular EMI gaskets. All will work well when properly installed, so the decision is usually based on mechanical issues. Here are some pros and cons on different EMI gaskets.

Beryllium-Copper - These gaskets provide very high EMI performance. The material has high conductivity, and is very "springy" which makes it ideal for doors and panels. The material can be formed into many shapes, such as fingerstock, serrations, and spirals. It can be plated for corrosion protection. The drawbacks are cost, mechanical vulnerability (such as snagging of fingerstock), and the lack of an environmental seal.

Conductive Elastomers - These gaskets provide good performance. They often have metallic particles or wires embedded in them, so they do require pressure to assure an EMI seal. A big advantage is that they can also provide an environmental seal as well as an RF seal. The main drawback is the compression force, but hollow elastomer gaskets often overcome this issue.

Wire Mesh - These gaskets can provide very high levels of EMI performance, often similar fingerstock. A drawback to many mesh gaskets is that they take a set, and thus can not be reused. They are fine for permanent seals, but are usually not suitable for doors or access panels. They also lack an environmental seal.

Conductive cloth over foam - These gaskets are becoming very popular in commercial applications, and are quite cost effective. Most use a silver-plated cloth over foam to create a soft gasket that can take up a lot of slack. The major drawback is a lack of an environmental seal.

Conductive epoxies - These are permanent gaskets, formed from a metal impregnated caulk. Silver loading is very common, and the seal is usually also water tight. The major drawback is that any repaired joint must be cleaned and recaulked to maintain a seal.

Form-in-place gaskets - These gaskets often make sense for small, high volume applications that can "auto-mate" making a gasket right on a specific enclosure. These are similar to conductive elastomers. When cured, these gaskets are resilient and thus reusable. The major drawback is that they are not practical for low volumes.

Corrosion - This can be a key concern for equipment used in harsh environments, such as medical, military, vehicular, or even industrial. (Fortunately, corrosion is not usually a concern for commercial products.) To fight corrosion, plated gaskets can be used to minimize the effects of dissimilar metals. "Hybrid" gaskets are also available that incorporate both an environmental seal and an EMI seal. In those cases, be sure to install the environmental seal to the "outside" to protect the EMI gasket from external moisture.

Electronic Communications... Here are several ways of contacting us or getting information:

World Wide Web— Visit our "home page" at <http://www.emiguru.com>. You'll find back issues of the KGB (*Kimmel Gerke Bullets*), plus other information.

Toll Free "888" Number... Please feel free to call us on our toll free number **1-888-EMI-GURU**. This reaches our answering service in Minnesota, so please leave a message and we'll get back to you. For calls from outside the US, you should continue to use 612-330-3728.

E-Mail... A preferred way of reaching us if you don't need a "real-time" answer. We both check our mail boxes regularly, and it works out well. Addresses are:

Bill Kimmel - bkimmel@emiguru.com

Daryl Gerke - dgerke@emiguru.com

Reprints... EDN Magazine's Designer's Guide to Electromagnetic Compatibility...

This popular EMC design guide (written entirely by us) is still available. For your copy, call Cahners Reprint Services at 1-800-523-9654. Only \$19.95+ shipping.

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