JANUARY 2012

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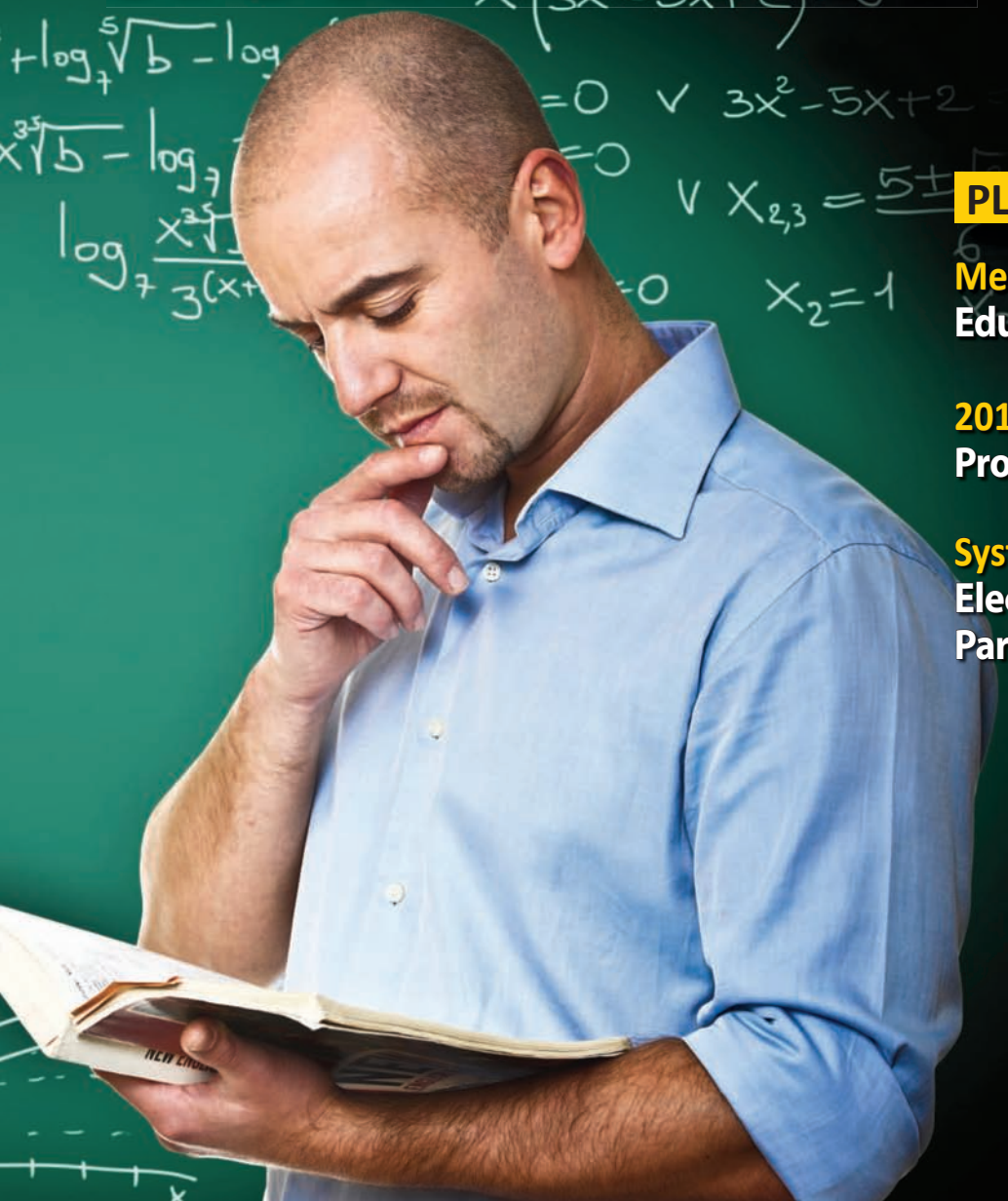

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Letter from the editor

Investing in the Future

Dear Readers,

This issue of *In Compliance* focuses on professional development opportunities available to you throughout 2012. Now, more than ever, it is vital that compliance engineers make an investment in the future of their careers through continued learning and career growth opportunities.

In our cover story "So You're a New EMC Engineer, Now What?" (page 24) authors Daryl Gerke and Bill Kimmel give their tried and true recommendations for getting up to speed in the position of a new EMC Engineer. Some of you not-so-new to EMC engineering are going to read through the article and find yourselves saying – "Oh, that is so true!" There's some great advice, recommendations and resources in the article. Thank you, Daryl and Bill for your contribution.

In the article "Meet the Educators" (page 32) ICM interviews nine industry educators and gives a behind-the-scenes opportunity for you to learn more about this great group of professionals who have found their life's work in teaching others. This is a new type of article for *In Compliance* and we hope that it proves valuable as well as enjoyable as you get to know them and learn their stories.

As the compliance community continues to grow, many learning opportunities become available for both new and seasoned engineers. If you have any recommendations about classes, workshops, and seminars not listed in this issue, please drop us a note so we can add it to our events calendar.

In Compliance is committed to serving the industry in providing current, relevant and useful educational information. We encourage you to hang on to this issue and refer to it as you plan your educational goals for 2012.

We wish you a bright, prosperous New Year!

Until next time.

Lorie Nichols
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Volume 4 ● Number 1

24 So You Are A New EMC Engineer

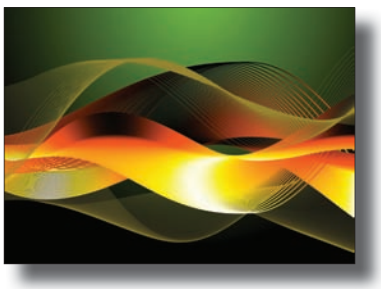
Now What?

It's been said that nobody grows up wanting to be an EMC engineer. Rather, it usually just happens. Maybe you showed a knack for EMC troubleshooting, and suddenly you're now the company expert - whether you want to be or not.

Daryl Gerke, PE, and Bill Kimmel, PE

DEPARTMENTS

FEATURES



News in Compliance

FCC News

FCC Launches Small Business Cyber Planner

In an effort to help small businesses develop security plans to protect against threats from online sources, the Federal Communications Commission (FCC) has announced the launch of an online planning resource.

The FCC's *Small Biz Cyber Planner* is an interactive tool that will allow a business to create a customized cyber security guide by answering a series of basic questions. Then, by implementing the plan recommended by the guide, a business can better protect themselves, their information and their customers from cyber threats.

FCC Chairman Julius Genachowski noted that "with larger companies increasing their online defenses, small businesses are now the low hanging fruit for cyber criminals." "Even a business with one computer can benefit from this important guidance," said Genachowski.

The *Small Biz Cyber Planner* was created through a partnership between the FCC, industry groups, and some of the leading technology companies, including Microsoft, HP, Symantec and McAfee. The *Planner* is available at www.fcc.gov/cyberplanner.

Florida Travel Company Subject to $3 Million Fine for Junk Phone Calls

The Federal Communications Commission (FCC) has proposed forfeiture penalties in the amount of $2,960,000 against a Florida travel company for delivering unsolicited, pre-recorded phone messages.

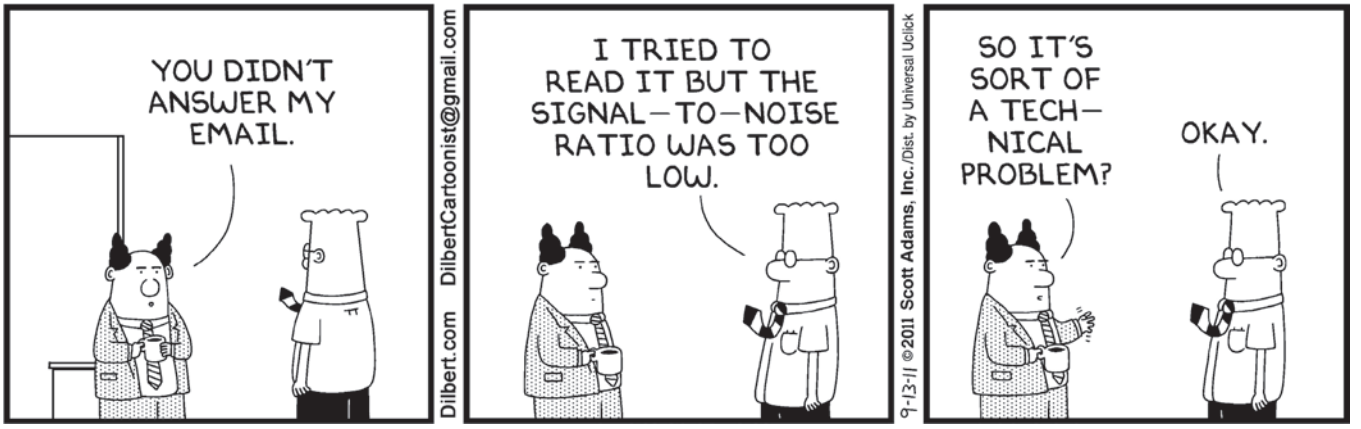
Issued in October 2011, the Notice of Apparent Liability cites Tampa-based Travel Club Marketing, Inc. for delivering 185 unsolicited phone messages to 142 separate telephone numbers. In at least one instance, the company also reportedly failed to transmit caller identification information required of telemarketers.

The Commission's Notice follows the issuance of two separate Citations against the company in July and September 2010. In response to the first Citation, the company informed the Commission that Travel Club Marketing was "deceased" and "no longer functioning" (the company did not respond to the second Citation). However, despite the company's reported demise, the Commission received an additional 142 complaints from consumers from November 2010 through October 2011.

The Telephone Consumer Protection Act of 1991 makes it "unlawful for any person within the United States… to initiate calls using an automatic telephone dialing system or an artificial or prerecorded voice to…any cellular telephone number" without the prior consent of the called party, except for emergency purposes. In addition, FCC rules require telemarketers to transmit "caller ID information that permits consumers to make a do-not-call request."

In this case, the Commission cited Travel Club Marketing for willful and repeated violations of its regulations, levying $16,000 in fines for each of the 185 apparent violations, for a total of $2,960,000. The Commission noted that the proposed penalty was based on the number of apparent, willful, repeat violations involved, as well as the company's "apparent deceptive and evasive conduct."

The complete text of the Commission's Forfeiture Order against Travel Club is available at www.incompliancemag.com/news/1201_01.



FCC News

FCC Announces Funding for Expanding Broadband Services

The Federal Communications Commission (FCC) has released details of its plan to provide increased funding for the wider deployment of broadband Internet and communications services to millions of Americans.

In a Report and Order and Further Notice of Proposed Rulemaking issued in November, 2011, the Commission laid out the structure of its new Connect America Fund. The Fund, which has the stated goal of bringing broadband services to 18 million people, mostly in rural and otherwise underserved areas, is based on the Commission's overhaul of its universal service and intercarrier compensation schemes. It also represents an important milestone, enlarging the scope of the Commission's universal service mission to include access to mobile broadband Internet services.

The Fund's annual budget, which will not exceed $4.5 million, is the same size of the current universal services funding level. Further, the Commission believes that expanded broadband access can serve as an important engine for economic growth. It estimates that the new Fund will generate approximately 500,000 new jobs and $50 billion in economic growth over the next six years.

The complete text of the Commission's Order on the formation of the Connect America Fund is available at www.incompliancemag.com/news/1201_02.

News in Compliance

European Union News

Updated List of Standards Released for EU's Directive on General Product Safety

The Commission of the European Union (EU) has published an updated list of standards that can be used to demonstrate compliance with the essential requirements of its Directive 2001/95/EC, related to general product safety.

The EU's General Product Safety Directive covers "any product… which is intended for consumers or likely, under reasonably foreseeable conditions, to be used by consumers even if not intended for them, and is supplied or made available, whether for consideration or not, in the course of a commercial activity, and whether new, used or reconditioned." The Directive is intended to ensure the general safety of products beyond those specific safety issues addressed in other product directives, such as the Machinery Directive, the EMC Directive or the R&TTE Directive.

The list of CEN standards was published in November 2011 in the *Official Journal of the European Union*, and replaces all previously published standards lists for the Directive.

The revised list of standards is available at www.incompliancemag.com/news/1201_03.

New List of Standards for EU's Machinery Directive

The Commission of the European Union (EU) has issued an updated list of standards that can be used to demonstrate compliance with the essential requirements of its Directive 2006/42/EC, also known as the Machinery Directive.

The EU's Machinery Directive defines the essential health and safety requirements for a wide range of products, including: machinery and partly completed machinery; lifting accessories; chains, ropes and webbing; interchangeable equipment; removable mechanical transmission devices; and safety components.

The Directive's scope specifically excludes electrical and electronic products covered under Directive 2006/95/EC (the so-called Low Voltage Directive), including household appliances, audio and video equipment, informational technology equipment and ordinary office machinery.

The extensive list of CEN and Cenelec standards for the Machinery Directive was published in November 2011in the *Official Journal of the European Union*, and replaces all previously published standards lists for the Directive.

The revised list of standards can be viewed at www.incompliancemag.com/news/1201_04.

Updated Standards List Published for EU's ATEX Directive

The Commission of the European Union (EU) has published an updated list of standards that can be used to demonstrate conformity with the essential requirements of its directive concerning equipment and protective systems intended for use in potentially explosive atmospheres.

The directive, 94/9/EC, which is also known as the ATEX Directive, applies to "machines, apparatus, fixed or mobile devices, control components and instrumentation…and detection or prevention systems which…are intended for the generation, transfer, storage, measurement, control and conversion of energy and/or the processing of material," and "which are capable of causing an explosion through their own potential sources of ignition."

The updated list of standards was published in November 2011 in the *Official Journal of the European Union*, and replaces all previously published standards lists for the ATEX Directive.

The complete list of standards can be viewed at www.incompliancemag.com/news/1201_05.

The Commission of the European Union New has released new standards lists for the General Product Safety Directive, the Machinery Directive, and the ATEX Directive.

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News in Compliance

CPSC News

CPSC Launches Online Reporting Tool for Business

The U.S. Consumer Product Safety Commission (CPSC) has introduced new features to its SaferProducts.gov web site launched in March 2011 that will make it easier and more efficient for businesses to report defective products to the Commission.

The most important new feature is a comprehensive, online form that allows manufacturers and importers to quickly submit reports to the CPSC of potentially hazardous or defective products. Federal law requires that manufacturers, distributors and retailers immediately (i.e., within 24 hours) report to the CPSC information that a product contains a defect which could create a substantial product hazard, or pose a risk of injury or death to consumers.

A separate improvement to the business portal of SafeProducts.gov expands the Commission's ability to communicate electronically with all businesses registered on the website. Now, the Commission can forward product notices and consumer incident reports electronically to the affected companies, rather than having to rely on postal mail.

The SaferProducts.gov website allows consumers to file a report directly with the CPSC about an incident with an unsafe or potentially hazardous consumer product. The manufacturer then has 10 days to respond to the CPSC and provide any comments or claims regarding the report. At that point, the consumer's report and the manufacturer's response are posted to the SaferProducts.gov website.

The CPSC reports that the website contains more than 4100 consumer product-related reports as of the end of October 2011.

The business portal for the CPSC's website can be reached at www.incompliancemag.com/news/1201_06. The online reporting form is available at www.incompliancemag.com/news/1201_07.

The SaferProducts.gov website allows consumers to file a report directly with the CPSC about an incident with an unsafe or potentially hazardous consumer product.

Company Recalls Motion Sensing Wall Switches

HeathCo, LLC of Bowling Green, KY has announced the recall of about 75,000 of its Heath®/Zenith and WirelessCommand®-brand motion-sensing wall switches, manufactured in China.

The company reports that, when the switches are in the auto mode and the light is off, a small amount of leakage current passes through the electric circuit, including the socket. If consumers fail to disconnect the power at the circuit breaker and make contact with both terminals inside the socket while replacing a bulb, there is a risk of electric shock.

HeathCo says that it has not received any reports of injuries to consumers or other incidents related to the recalled wall switches, but is taking action now to prevent any future incidents.

The motion-sensing wall switches were sold through mass merchants, electrical distributors, hardware stores and online

retailers from August 2007 through August 2011 for between $20 and $25. Additional information about this recall is available at www.incompliancemag.com/news/1201_08.

Best Buy Recalls iPhone Battery Cases

Best Buy Co, Inc. of Richfield, MN is recalling about 31,000 Rocketfish model mobile battery cases manufactured in China for Apple's 3G and 3Gs model iPhones.

According to Best Buy, the battery case can overheat while charging, thereby posing a fire hazard to consumers. The company has received 14 reports of the battery cases overheating, including three reports of minor burns to consumers and four reports of minor property damage.

The recalled battery cases were sold at Best Buy stores nationwide, at Future Shop and Best Buy stores in Canada, and online from April 2010 through September 2011 for between $10 and $60.

Additional details about this recall are available at www.incompliancemag.com/news/1201_09.

Company Recalls iPod Touch Battery Cases

Mophie, LLC of Paw Paw, MI has announced the recall of about 6100 rechargeable external battery cases manufactured in China.

The company says that the integrated circuit switch in the battery case can overheat and pose a burn hazard to consumers. Mophie has received 110 reports of battery cases becoming warm to the touch, 44 reports of cases deforming, and nine reports of minor burns.

The recalled battery cases were sold at B&H Photo, Barnes & Noble Bookstores, InMotion Entertainment, J&R Music World, Marine Corps Exchanges, Amazon.com, and mophie.com since April 2011 for about $50.

More information about this recall is available at www.incompliancemag.com/news/1201_10.

Do you have news that you'd like to share with your colleagues in the compliance industry? We welcome your suggestions and contributions.

Send news items to the editor:

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Hopedale, MA
(508) 488-6274
editor@incompliancemag.com

News in Compliance

UL Standards Updates

Underwriters Laboratories has announced the availability of these standards and revisions. For additional information, please visit their website at www.ul.com.

STANDARDS

UL 427: Standard for Refrigerating Units
New Edition dated November 11, 2011

UL 561: Standard for Floor-Finishing Machines
New Edition dated October 31, 2011

UL 880: Standard for Sustainability for Manufacturing Organizations
New Edition dated November 2, 2011

Subject 1294: COMPOSITE PANELS
Outline dated November 29, 2011

UL 1773: Standard for Termination Boxes
New Edition dated October 31, 2011

UL 2089: Standard for Vehicle Battery Adapters
New Edition dated November 22, 2011

UL 2515A: Standard for Supplemental Requirements for Extra Heavy Wall Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
New Edition dated November 21, 2011

UL 2766: Standard for Sustainability for Energy Efficient Heating/Cooling Systems for Building
New Edition dated October 17, 2011

UL 2768: Standard for Sustainability for Architectural Surface Coatings
New Edition dated November 9, 2011

UL 2774: Standard for Sustainability for Events
New Edition dated October 12, 2011

UL 2776: Laundry Detergents and Fabric Softeners
New Edition dated November 9, 2011

UL 2777: Hard Floor Care Products
New Edition dated November 9, 2011

UL 2782: Standard for Sustainability for Solid Biofuels
New Edition dated October 7, 2011

UL 2784: Standard for Sustainability for Hand Cleaners
New Edition dated October 3, 2011

UL 2785: Standard for Sustainability for Printing Cartridges
New Edition dated November 3, 2011

REVISIONS

UL 66: Fixture Wire
Revision dated November 21, 2011

UL 125: Standard for Flow Control Valves for Anhydrous Ammonia and LP-Gas
Revision dated November 10, 2011

UL 353: Standard for Limit Controls
Revision dated November 8, 2011

UL 514C: Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
Revision dated November 9, 2011

UL 746B: Standard for Polymeric Materials - Long Term Property Evaluations
Revision dated November 3, 2011

UL 817: Standard for Cord Sets and Power-Supply Cords
Revision dated November 2, 2011

UL 875: Standard for Electric Dry-Bath Heaters
Revision dated November 16, 2011

UL 935: Standard for Fluorescent-Lamp Ballasts
Revision dated November 7, 2011

UL 1004-3: Standard for Thermally Protected Motors
Revision dated November 16, 2011

UL 1004-2: Standard for Impedance Protected Motors
Revision dated November 10, 2011

UL 1081: Standard for Swimming Pool Pumps, Filters, and Chlorinators
Revision dated November 29, 2011

UL 1602: Standard for Gasoline-Engine-Powered, Rigid-Cutting-Member Edgers and Edger-Trimmers
Revision dated November 16, 2011

UL 1996: Standard for Electric Duct Heaters
Revision dated November 4, 2011

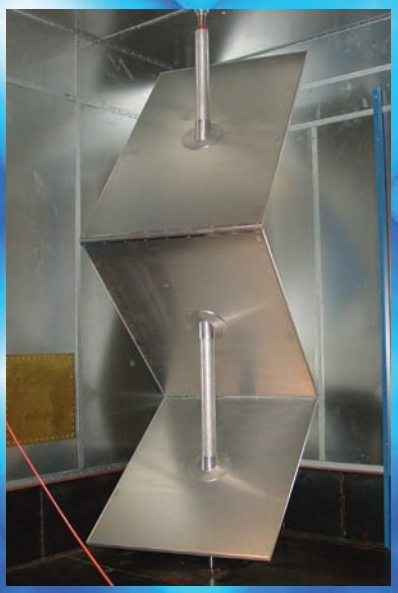
UL 2040: Standard for Folding Rollaway Tables
Revision dated November 16, 2011

UL 2167: Standard for Water Mist Nozzles for Fire Protection Service
Revision dated November 29, 2011

UL 2200: Standard for Stationary Engine Generator Assemblies
Revision dated November 01, 2011

UL 8750: Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products
Revision dated November 1, 2011

Facility Solutions For Global EMC



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iNARTE Informer

The Year Ahead

The staff and directors of iNARTE extend our best wishes for the 2012 New Year to all our friends, volunteers, members, partners, associates and affiliates. Without all of your help and support our programs would not be possible, and the true expertise of our certificate holders would remain un-validated.

NEW YEAR RESOLUTIONS

How many of you made a resolution this year? And will you keep them? It is difficult to lose weight, save money, take more exercise or stop smoking. These things require constant attention and are so easy to let slip. But what about getting your **iNARTE Certification**, that would be a resolution of lasting value, and what's more you have probably already accomplished most of the work to get there:

- Post secondary education qualifications in a suitable discipline.
- Work experience.
- Referees that will attest to your work ethic and professionalism

All of our programs have these elements in common, so all that remains is for you to pass our exam and send us a few question of your own that we can use in future exams. Just a day or two out of your schedule and this resolution can be achieved.

WHAT CAN WE EXPECT IN 2012

There seems to be a rally at the stock market. Europe may be getting its bail out programs in order. Holiday spending was up. US Automakers are forecasting profits. Maybe we will see some economic improvement this year, and maybe companies will be looking to expand once again. But there have been important lessons over the last five years that will not be soon forgotten. Money will be tight and cash will be closely guarded. Companies have figured out how to do more with less, either by better use of IT or by stretching and challenging a smaller staff to still get the jobs done.

There may very well be some new opportunities created in 2012, but it will still be a case of, "survival of the fittest". Getting involved in a program of continuing professional development and validating your credentials through an independent and well established certification program may very well be the key to success in 2012. iNARTE has a wide variety of certification programs to offer and there will be some new ones to look forward to in 2012.

CERTIFICATION PROGRAMS

Here is a list of what we have to offer today:

- FCC Commercial License Examinations, RRP, MROP, GROL and GMDSS
- Telecommunications Technician – Junior, Senior or Master
- Telecommunications Engineer – Junior, Senior or Master
- EMC Technician
- EMC Engineer
- ESD Technician
- ESD Engineer
- ESD Engineer endorsement for ESDA Certificate holders
- Product Safety Engineering, PSE, Technician
- Product Safety Engineering, PSE, Engineer

Young Engineers in Japan eager to get their EMC Design credentials

- Internal Laboratory Auditor, iNCLA
- EMC Design Engineer
- Senior EMC Design Engineer
- MIL-STD EMC Specialist

Most of the above have a minimum experience requirement, but for applicants who can demonstrate knowledge but have not yet achieved the minimum years of work experience, we do offer Associate certification levels. We also have some new programs under development that should be ready in 2012:

- Spectrum Management Engineering
- Wireless Regulatory Test Engineering

The most significant new program that we introduced in 2011 was the **EMC Design Engineer**. This credential is intended for the EMC Engineer whose responsibility is the application of EMC principles in electronic design for compliance, rather than in EMC testing and mitigating engineering. It has been developed in cooperation with major corporations in both the USA and Japan.

The first phase of this program, launched at EMCS 2011, targets recent graduates and younger engineers about to begin their careers in EMC Design. The next phase, intended for Senior EMC Design Engineers with more than four years of related work experience, has now been completed and examinations will be available in January 2012. iNARTE's partner in Japan, KEC Electronic Industry Development Center, attracted more than 40 applicants at their first examination session. We think this new program will be of great interest in 2012 and subsequent years.

REGISTER FOR CERTIFICATION EXAMS

A visit to the iNARTE web site at www.narte.org will enable you to get all the details of these current programs. If you have any questions about your qualifications for a particular program, or to find which program may best suit your career goals, please call or email us directly.

iNARTE does not offer training in any of these disciplines in order that we can maintain our independent status according to ISO 17024. However, we can offer advice on training options and we do maintain a listing of Approved Training Centers that can be found on our web site.

When you are ready for the iNARTE examination phase of your program, visit our web site at www.narte.org/h/testcenters.asp to find a convenient iNARTE Authorized Test Center. If none of our centers are suitably located, we can make alternative arrangements for you.

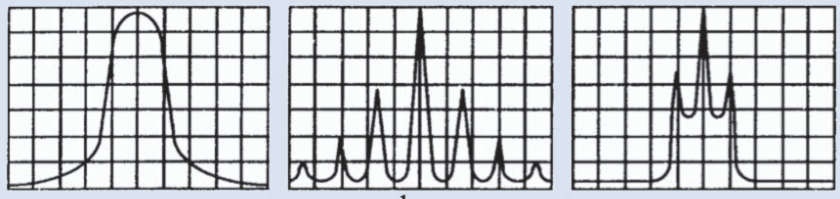
QUESTION OF THE MONTH

Last month we asked:

Which of the spectrum analyzer CRT displays of the same signal (below) shows the narrowest resolution bandwidth?

A. a
B. b
C. c

The answer is A. a.



This month's question is:

A product being evaluated for product safety is provided with an interface port that has plain old telephone set (POTS) features and connects directly to a network interface unit (NIU). What is the acceptable working voltage for the TNV circuit that can be used for evaluating creepage and clearance distances required for separation within the product?

A. 90 V ac
B. 60 V dc
C. 127 V dc
D. 120 V dc

(the author)

BRIAN LAWRENCE began his career in electromagnetics at Plessey Research Labs, designing "Stealth" materials for the British armed services. In 1973 he moved to the USA and established a new manufacturing plant for Plessey to provide these materials to the US Navy. In 1980 he joined the "Rayproof" organization to develop an RF Anechoic Test Chamber product line. As a result of acquisitions, Rayproof merged into Lindgren RF Enclosures, and later into ETS-Lindgren. Following a career spanning more than 40 years in the electromagnetic compatibility field, Brian retired as Managing Director of ETS-Lindgren UK in 2006. Later that year he assumed the position of Executive Director for the National Association of Radio and Telecommunications Engineers, NARTE. Now renamed iNARTE, the Association has expanded its operations and is today an affiliate of RABQSA under the overall banner of the American Society for Quality, ASQ.

REALITY Engineering

Keep Looking

BY MIKE VIOLETTE

Rufus set up the stepladder outside the trauma room so I could climb up and take a look above the panels in the drop ceiling. For the past few days we'd been looking for the source of interference to the electronic sensor panels on an imaging X-Ray system in this urban hospital. The "noise" was causing dark horizontal lines on the images, which were, at a minimum, distracting and more importantly affecting image clarity and potentially affecting patient diagnoses.

Figure 1: Trauma room

Working in and around the trauma room, for me, was a bit unnerving, what with the gunshot wounds, traffic accidents, mauled limbs and various crises played out in a steady but random order. The trauma room was a critical part of the emergency room function, where triage was performed on the most-acutely injured or suffering. This particular operation featured three beds for quick-action.

An overhead gantry affair allowed the technician to swing the X-Ray source from bed to bed. The key was a quick diagnosis of internal injuries. As the patient may or may not be able to cooperate with the ER team, flexibility in the X-Ray system was of paramount importance. The electronic sensor used a transistor imaging technology in an array-format. When the X-Rays were collected and scanned, the cassette-like sensor (a bit larger than a traditional X-Ray film) wirelessly transmitted the image to the control station and the image could be viewed nearly-instantaneously—no chemicals or delays—pretty cool.

Figure 2 shows a "clean" image versus a "noisy" image (Figure 3) with the horizontal lines appearing as artifacts. The horizontal lines appear at regular intervals and the (my) initial thought was that the 58kHz was somehow interfering with the rastering of the pixel elements during the imaging process.

The going-in supposition was that this was an "EMF" or low frequency coupling problem, so the initial efforts focused on measurements starting from 60 hertz to a few hundred kilohertz. This initial diagnosis seemed to be confirmed by the observation that the noise artifacts were strongest on the right hand side of the room, indicating a near-field coupling issue. Focusing on the 60 Hz to 5 MHz area, the tallest pole

The strong periodicity of the artifacts led me to suspect (falsely, it turned out) that the 58 kHz was somehow coupling in the sensor and corrupting the raster scan frequency.

in the proverbial tent was a signal at 58 kHz which had all the hallmarks of a dirty, nasty source (Figure 4, page 18).

The signal had very strong 3rd and higher harmonic energies, indicating a fast-switching quasi-square wave behavior. The noise source appeared to be strongly associated with the wiring, cabling, bus duct and even building steel that was on the far-right side of the trauma room.

The strong periodicity of the artifacts led me to suspect (falsely, it turned out) that the 58 kHz was somehow coupling in the sensor and corrupting the raster scan frequency. Not having any technical details on the sensor, it was a decent guess: the frequencies seemed about right for a horizontal scan rate in imaging equipment. We'd seen image noise in the good old days of CRTs, before the widespread deployment of flat panel screens, which are inherently immune to magnetic field interference (of the "usual" variety). The CRT interference was usually due to 60 Hz magnetic field coupling into the vertical refresh; computer displays used non-60 Hz vertical refresh and the power line frequency would create a "beat" frequency, wiggling the screen at a few hertz.

In this case we searched for the source of the 58kHxz. After eliminating various sources in and around the room (fluorescent lights, nearby elevator drive, equipment in the trauma room and an RFID access-system in the hall) the first day had passed and a certain level of frustration was rising with the client and the client's client (the Emergency Room team).

Some additional survey equipment was needed to pinpoint the offending conductor(s), so a return visit was arranged. In addition, we widened the frequency range of our search up to 10 GHz, just to ascertain whether something was interfering with the data transfer over the WiFi connection between the sensors and the access point connected to the PC station.

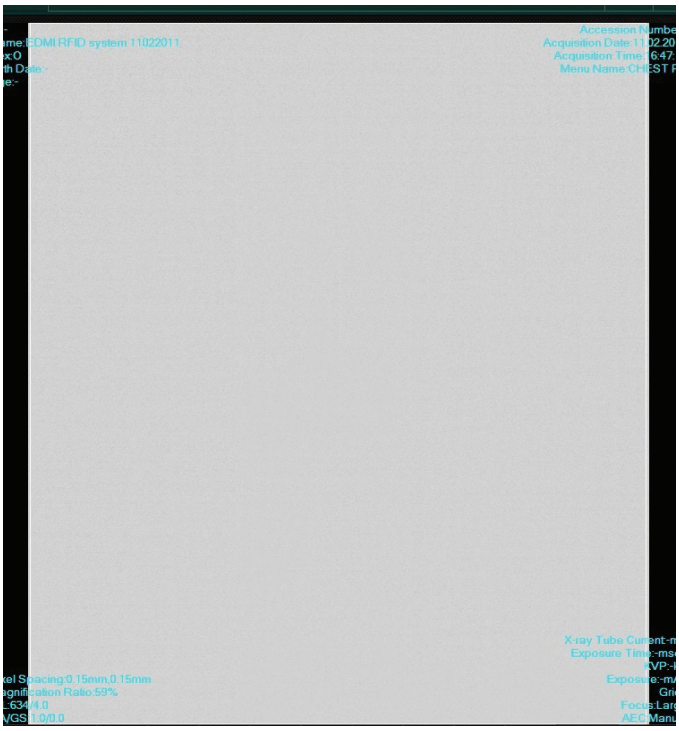


Figure 2: Clean image

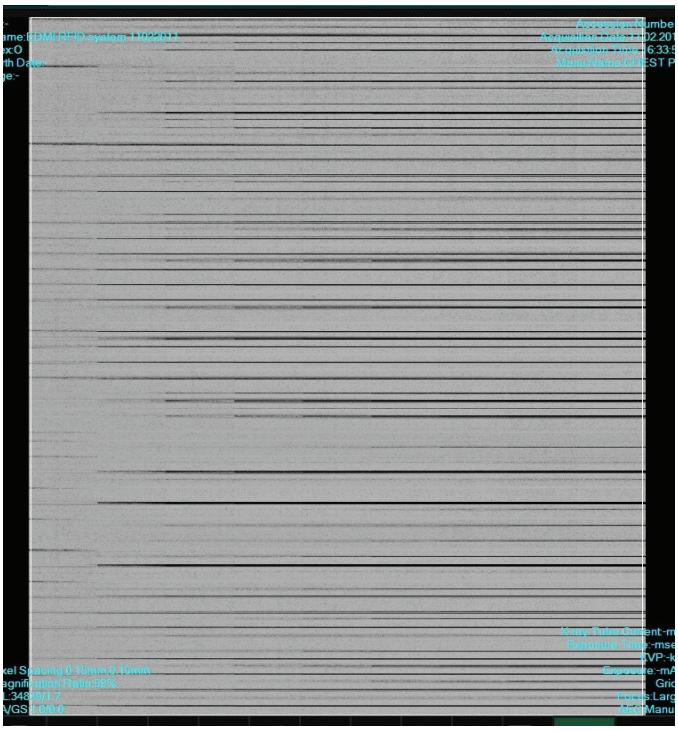


Figure 3: Image with noise artifacts

REALITY Engineering

Using more localized magnetic field sensors (small loops) we attempted to map out the origin of the source emanating, it seemed, from everywhere (ceiling, floor and walls on the far end of the trauma room). The vexing problem was that it appeared that the current was present on every piece of metal in the building—and there was a lot of metal. I supposed that there was a grounding problem of some kind associated with a fairly high powered pump or motor of some kind. How else could one get a wide-spread current flowing "everywhere"?

I passed along the unpleasant diagnosis that some kind of shielding would likely have to be installed. The trauma room, not yet fully commissioned and fitted with all manner of fixtures, wiring, appliances and other equipment, would have to be "un-done" to some degree to install the shielding. Groan. I passed along this diagnosis during the three p.m. conference call between the X-Ray manufacturer and the hospital leadership.

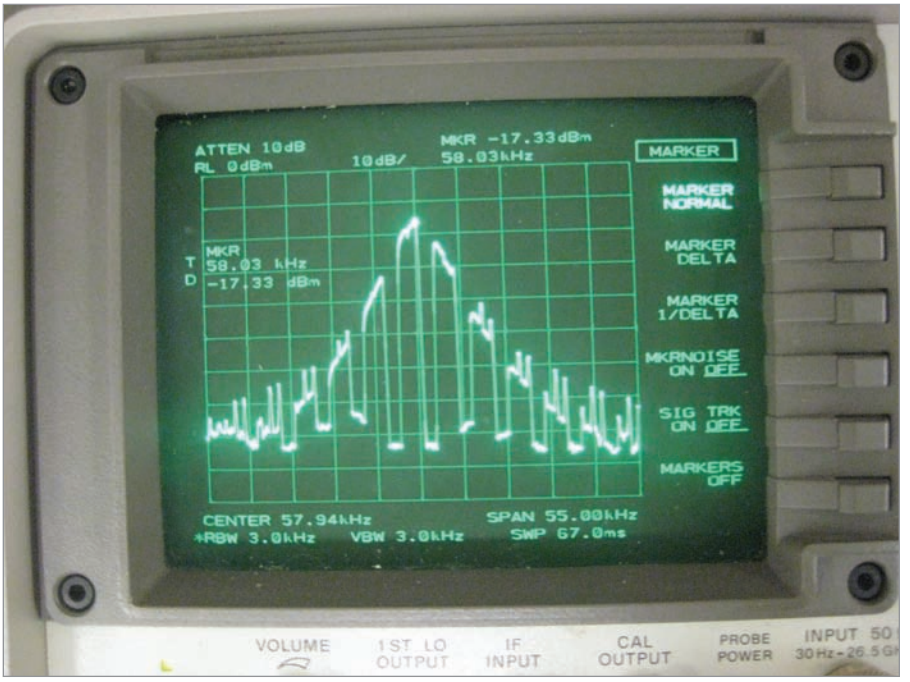


Figure 4: Spectrum of suspected noise

Figure 5: Entrance to ER with RFID pedestal

The news was met with negative joy.

It was at this point that one looks for some other kind of support and I beseeched Norm. "Please give me a hand." The message came back, clear-as-a-bell: "Keep Looking." OK, I'll keep looking and we redoubled our efforts to track down the source: upstairs, downstairs, in the elevator equipment room, above the ceiling, in electrical closets. Nothing was obvious. I went downstairs past the ER entrance (for the twentieth time, at least) and noticed, amongst some supply carts, a pedestal at the doorway. Hmm, a theft-detection system common in retail outlet chains: RFID. When I rejoined the team I suggested to Rufus that we power the thing down and see what happens; I continued to perform my survey measurements on the second floor without any brilliant success and rejoined the team in the trauma room.

In the EMC business one always hopes to load and fire that silver bullet that will slay the EMI beast, but after a while, one doesn't elevate hope till the thing is confirmed DOA. This time, however, I walked up to Rufus; he had a bemused look on his face.

"Well?" I asked.

Rufus replied "Looks interesting."

Sure enough, we shot a half-dozen RFID "on" and RFID "off" trials . The appearance of the artifacts were

The appearance of the artifacts were definitely correlated to the operation of the RFID. I confirmed the frequency: 13.56 MHz, a standard frequency band.

definitely correlated to the operation of the RFID. I confirmed the frequency: 13.56 MHz[1], a standard frequency band. The funny thing was, it was not the highest signal level in the general spectrum of noise in the ER. Go figure. We stopped chasing the red herring and gave the more palatable news to the client.

In this business, it is not always obvious; sometimes you just have to "keep looking".

NOTE

1. This RFID frequency (13.56 MHz) is in very common use and it would not have been evaluated during 60601-1-2 immunity testing for medical equipment as radiated immunity testing is performed from 26 MHz up. In addition, the RFID transmitters use a magnetic field and traditional radiated immunity simulate Electric field sources; the coupling is inherently different. Perhaps the standards community needs to look at doing a "spot frequency" test at the 13.56 MHz frequency?

Post script: The FDA is, apparently, looking into this as part of their ongoing work at the Center for Devices and Radiological Health, looking at magnetic field immunity at 13.56 MHz and at 125 kHz, another widely-used RFID transmit frequency.

(the author)

MIKE VIOLETTE
is President of Washington Labs and Director of American Certification Body (mikev@wll.com) and is no stranger to chasing Red Herrings.

On Your Mark

BY GEOFFREY PECKHAM

With the various markings available to identify ground terminals, how do you know which specific symbol should be used? The international standards are the right place to go for guidance, and this column will outline these best practices for use of earthing (grounding) symbols and markings.

THE GROUNDING SYMBOLS

Identifying the ground terminal is critical to ensuring the products you design can be properly used and serviced in a safe manner. The actual symbols used to indicate ground terminals are found in IEC 60417 *Graphical symbols for use on equipment*, (Figure 1).

Here are the precise IEC definitions for each symbol:

No. 5017 Earth (ground): To identify an earth (ground) terminal in cases where neither the symbol 5018 nor 5019 is explicitly stated.

No. 5018 Noiseless (clean) earth (ground): To identify a noiseless (clean) earth (ground) terminal, e.g. of a specially designed earthing (grounding) system to avoid causing malfunction of the equipment.

No. 5019 Protective earth (ground): To identify any terminal which is intended for connection to an external conductor for protection against electrical shock in case of a fault, or the terminal of a protective earth (ground) electrode.

No. 5020 Frame or chassis: To identify a frame or chassis terminal.

APPLYING THE SYMBOLS

When it comes to knowing where to apply these ground symbols, you'll want to reference *IEC 60204 Safety of machinery - Electrical equipment of machines – Part 1, 2005*.[1] This standard says the following about ground symbols (excerpts from Sections 4.4.2 and 8.2.6). (Shown at right, in Table 1.)

Notice the preference for the use of the 5019 symbol in the last quotation over the use of the letters "PE". I believe this was done so a completely symbolic language for identifying components is maintained in preference to using letters that don't translate well in other languages. ISO and IEC are creating a global language for safety and identification, and the use of words or letters as symbols can serve to undermine this goal.

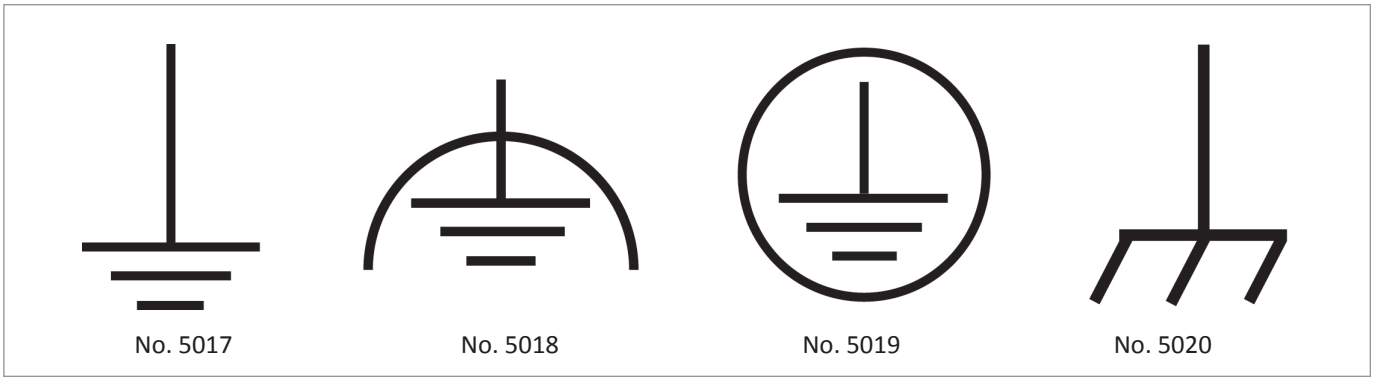
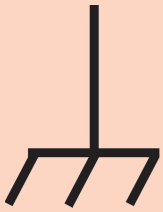


Figure 1: IEC 60417 ground symbols.

4.4.2 Electromagnetic compatibility (EMC)

To enhance the immunity of the equipment against conducted and radiated RF disturbance, measures include:

– connection of sensitive electrical circuits to the chassis. Such terminations should be marked or labeled with the symbol IEC 60417-5020:



– connection of sensitive electrical equipment or circuits directly to the PE circuit or to a functional earthing conductor (FE) (see Figure 2), to minimize common mode disturbance. This latter terminal should be marked or labeled with the symbol IEC 60417-5018:

8.2.6 Protective conductor connecting points

The protective conductor connecting points shall have no other function and are not intended, for example, to attach or connect appliances or parts. Each protective conductor connecting point shall be marked or labeled as such using the symbol IEC 60417-5019 or with the letters PE, the graphical symbol being preferred, or by use of the bicolour combination GREEN-AND-YELLOW, or by any combination of these.

Table 1

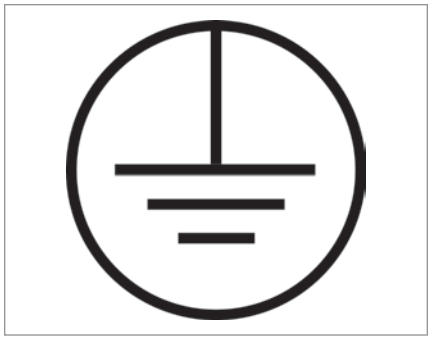


Figure 2: The incorrect drawing of IEC 5019 as shown in the *NFPA 70-2011 National Electrical Code*.

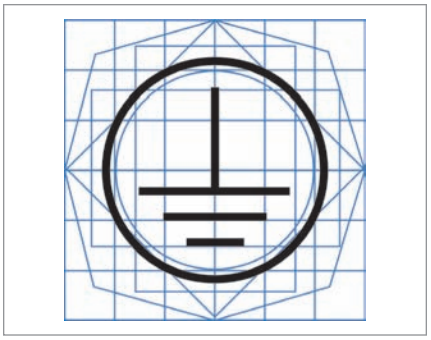


Figure 3: IEC 5019 drawn on the ISO/IEC function/control symbol drawing template.

From a U.S. perspective, you might think to look at the *NFPA 70-2011 National Electrical Code* for guidance on this subject. Don't. This code's advice on using ground symbols is useless because they show an illustration of a symbol drawn incorrectly (see Figure 2 - note how the vertical bar touches the circle). The NFPA 70 code indicates that this is an "informational note figure" and that it is "one example of a symbol used to identify the termination point for an equipment grounding conductor". These words leave you to wonder about the other symbols that might exist and where and how you might best use them. Clearly, IEC 60204 is more useful on this topic.

THE SCIENCE BEHIND DESIGN AND LEGIBILITY

One last point should be made here. Whether it's a safety symbol or a function/control symbol, there's a science to creating icons that communicate. ISO and IEC have developed a carefully defined set of rules for drawing various types of symbols. The ISO and IEC committees in charge of function/control symbols use a carefully constructed template (Figure 3) and line width guidelines to ensure that their standardized symbols are drawn with common design principles and consistent visual weight to ensure legibility and readability.

Next issue's topic will focus on the use of safety symbols to communicate how users must read and understand your product's manuals before using or servicing your product.

For more information about safety signs and symbols, visit www.clarionsafety.com.

NOTE

1. The IEC version of this standard is nearly identical to the European version, EN 60204. For those engineers that build machinery, note that in November 2011 the European Commission acknowledged that 60204 is "harmonised" with Machinery Directive 2006/42/EC. This means that you can use 60204 to fulfill the requirements for electrical safety to meet the intent of the Machinery Directive, an important aspect for obtaining the CE mark.

(the author)

GEOFFREY PECKHAM is president of Clarion Safety Systems and chair of both the ANSI Z535.2 Standard for Environmental and Facility Safety Signs and the U.S. Technical Advisory Group to ISO Technical Committee 145- Graphical Symbols. Over the past two decades he has played a pivotal role in the harmonization of U.S. and international safety standards dealing with safety signs, colors, formats and symbols.

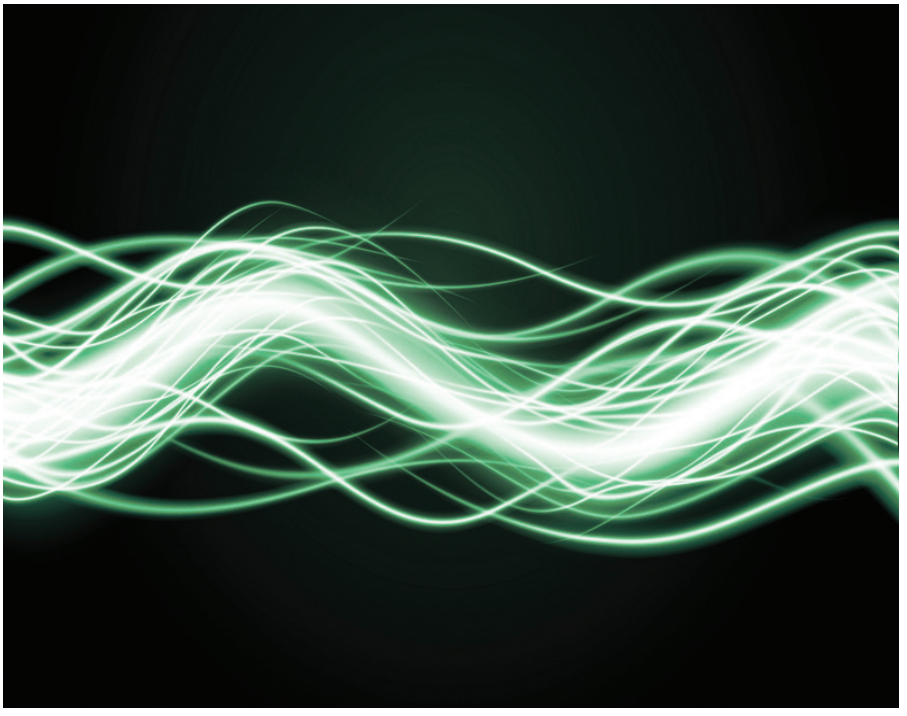
MYTH vs. Reality

System-product Response to Electrostatic Discharge Events

BY W. MICHAEL KING

The myth: A system-product that successfully complies with the criteria of ESD (IEC-based) Standards will not exhibit personnel ESD susceptibility when used in actual installations.

The reality: The ESD "simulation" of typical "standards" only represents a portion of the ESD continuum that can be exhibited in nature.



Electrostatic Discharge (ESD) events from personnel in nature (as opposed to simulations stipulated in "standards") exhibit a great variety of waveforms and peak amplitudes of current that are far broader in spectral impact than those required in "standards". For example, at initialization ESD voltages (the static level prior to displacement through discharge) below approximately 5kV, research has shown that rise times can often be found in the 200 to 500 picosecond range, with peak currents in the tens of amperes. As initialization voltages increase, the ionization path at the discharge point increases and the rise times can slow down into the range of approximately 1 to 20 nanoseconds. However, peak currents at these slower rise times can still be found in the range of tens of amperes for conditions where the ESD comes from a metal object (e.g. a key). (In nature, currents from fingertips are much less by an approximate factor of 5.)

Extending the continuum of ESD events to other conditions, such as ESD from mobile-furnishings (e.g. desk chair structures that can impact "horizontal" planes), brings an even greater increase in peak currents (approaching 100 amperes from source impedance of approximately 75 ohms) and increased radiated field intensities (from the displacement of current in the structure). The extraordinary current peaks from mobile furnishings pose an increased threat to system performance due simply to current stress. The high current from ESD at, for example, 15 kV from a metal push-cart can produce time-domain radiated field intensities from the cart (which will

become a transmitting antenna with the ESD current displacement) in the range of approximately 1,600 Volts/meter!

In practice, ESD impulses are spectral excitations across a broad frequency span. The efficiency of spectral excitation is established by the rise time, while the intensity is established by the current delivered to the system-product. At low ESD voltages where the rise times tend to exhibit a spectral distribution well over 1 GHz, system-products may be more responsive (susceptible) due to the "match" of the ESD spectra to fast circuit devices. At higher ESD voltages where the rise times are much slower, the system-products are less susceptible. Spectra from longer ESD rise times can influence responses in interface cables (which can support the lower-spectra of current) where the spectra from faster rise times can couple through local apertures in shields or circuit devices to cause system response. Considered in combination, it is possible for a system to exhibit ESD responses to lower ESD voltages (e.g. 2 to 4 kV) and not higher voltages, mid-ESD range voltages (e.g. 5 to 8 kV) and not lower or higher levels (sometimes called "the response window effect"), or only higher (> 10 kV) levels. This assumes that, in performing such evaluations on products, the ESD Test Generator used is capable of producing ESD waveforms that are variable at different voltages as they are found in nature. For reporting, the effect noted here can be termed the "spectral-bandwidth-dependency", where the spectral bandwidth is defined by the ESD amplitude in nature. The description also exposes another "myth"; that testing a system-product at high ESD amplitudes will assure immunity at lower amplitudes.

Given these realities, combined with the limitations of "standard" test methods, the typical immunity tests may be viewed only as "tentative" in describing the ESD performance of system-products.

ICM wishes to acknowledge the first appearance of W. Michael King's "Myth vs. Reality" series with NTS - Silicon Valley.

(the author)

W. MICHAEL KING
is a systems design advisor who has been active in the development of over 1,000 system-product designs in a 50 year career. He serves an international client base as an independent design advisor. Many terms used for PC Board Layout, such as the "3-W Rule", the "V-plane Undercut Rule", and "ground stitching nulls", were all originated by himself. His full biography may be seen through his web site: www.SystemsEMC.com.

Significantly, he is the author of EMCT: High Speed Design Tutorial (ISBN 0-7381-3340-X) which is the source of some of the graphics used in this presentation. EMCT is available through Elliott Laboratories/NTS, co-branded with the IEEE Standards Information Network.

So you are a new EMC Engineer... Now what?

BY DARYL GERKE, PE, AND BILL KIMMEL, PE

It's been said that nobody grows up wanting to be an EMC engineer. Rather, it usually just happens. Maybe you had incriminating information on your resume, such as being a radio ham. "You've created interference, so you must know how to stop it, right?" Maybe you showed a knack for EMC troubleshooting, and suddenly you're now the company expert - whether you want to be or not.

Or maybe you just zigged when you should have zagged. In any event, you're now in the EMC trenches. In this article, we'll discuss what to do next. It won't happen overnight, but with a plan (and some work), you can move from EMI-novice to EMI-expert.

FIRST, FIND A MENTOR...

If you are in a big company with an established EMC group, this may be your boss or a colleague. You need someone who has experience and who is willing and able to share it. Fortunately, most EMC engineers are happy to help - particularly the older guys, so don't be afraid to approach the more senior members of your engineering staff.

If you are in a smaller company, identifying a mentor may be more difficult, particularly if you are the sole EMC practitioner. In this case, you may need to look outside the company. Good candidates for mentors are your local EMC test lab, or perhaps an EMC consultant. Since both sell their time, fees may or may not be involved, but your company should be willing to invest in your education. After all, they put you in this position, and they want you to do well.

If you are responsible for the front end design work, get to know the design teams. Participate in design reviews even if you don't feel you know a lot about EMC. Trust us, this is a quick way to accelerate learning, particularly if you are a young engineer.

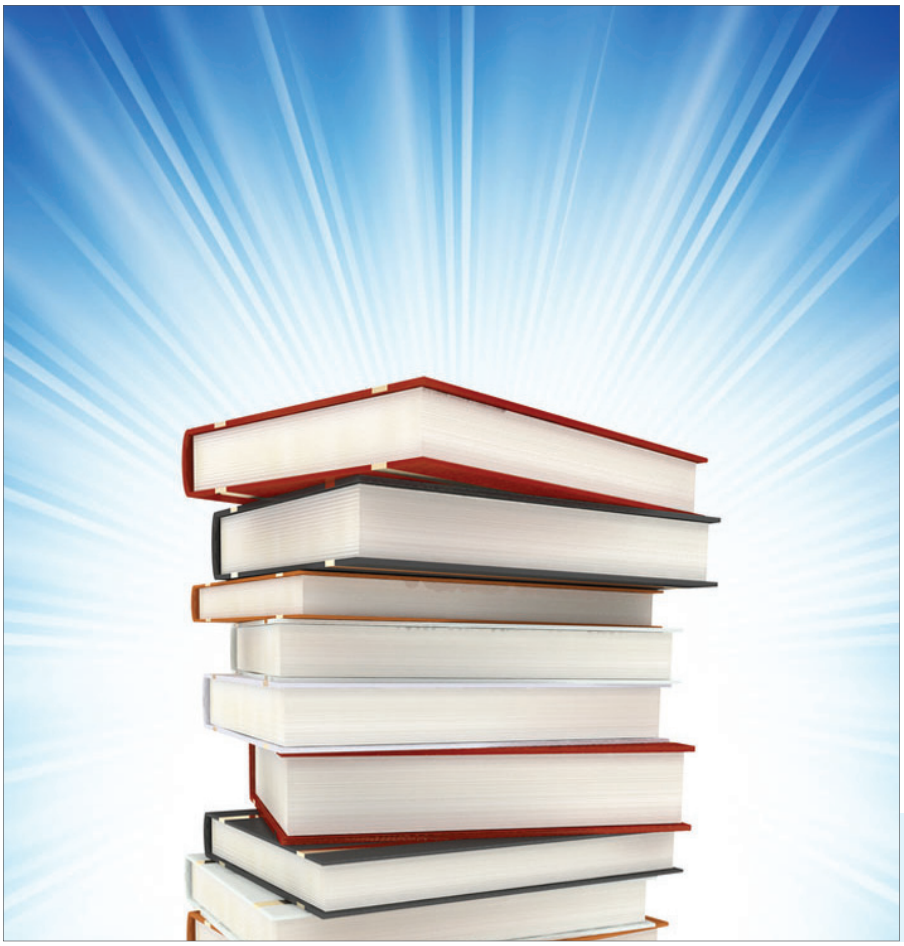
GET SOME EXPERIENCE - FAST...

If you are responsible for the front end design work, get to know the design teams. Participate in design reviews even if you don't feel you know a lot about EMC. Trust us, this is a quick way to accelerate learning, particularly if you are a young engineer.

Be curious, and ask questions. Don't worry that you don't know the answers - you are in learning mode. And don't limit yourself to EMC engineers.

Designers in specialized areas like power electronics, RF or analog circuits often have valuable insights applicable to EMC issues.

Witness EMC tests. If you are hired into an EMC lab, you'll be doing this anyway under the supervision of an experienced EMC test engineer. If you're doing design work, get in as much test time as you reasonably can. It is amazing how much you can learn by just watching an EMC test. An added advantage - you'll also get to know the good folks at the test lab.



START ON YOUR SELF-EDUCATION...

Unfortunately, undergraduate engineering classes on EMC are few and far between. Graduate programs are even more rare, and those that do exist usually focus on specific research. As a result, you may need to set up your own self-training program. Here are some ideas.

Books

While we have over a hundred EMC books on our bookshelves, there are four we regularly recommend for newcomers to EMC.

EDN Magazine Designer's Guide to EMC written by us as a beginner's guide for non-EMC engineers. Simple explanations and recommendations, with no equations or complex math. A good place to start if you are new to EMC. Published by Kimmel Gerke Associates.

Electromagnetic Compatibility Engineering - written by Henry Ott as a major update to his previous book (*Noise Reduction Techniques in Electronics Systems*). Well written, with all the equations you need without field theory or complex calculus. Published by Wiley & Sons.

Introduction to Electromagnetic Compatibility, 2nd Edition - written by Clayton Paul, primarily as a college text, so it has lots of technical depth with all the field theory details. At the same time, very readable and practical. Published by Wiley Interscience.

While we have over a hundred EMC books on our bookshelves, there are four we regularly recommend for newcomers to EMC.

Courses are an excellent way to gain focused practical information in a short time. They typically run from 2-5 days in duration and are offered throughout the US. In house classes are another option.

High Speed Digital Design - A Handbook of Black Magic - written by Howard Johnson as the definitive guide on Signal Integrity. Easy to read, with all the great design advice applies to EMC too. Published by Prentice Hall.

Magazines

There are several publications serving the EMC community. The good news is that two are free, and both are filled with practical articles. We've also included a third publication, a specialty newsletter that is not free but quite useful for industry events and insights.

In Compliance (you are reading it now) - monthly, with an annual buyers guide. Design, test and regulatory issues. Focus on commercial electronics, blanketing compliance related topics. Free on-line, free hard copy in North America. Same Page Publishing Co.

Interference Technology (formerly ITEM) - annual buyers guide with two additional guides throughout the year. Primarily test and regulatory issues, with an emphasis on EMC. Free. ITEM Publications.

Electromagnetic News Report (*ENR*) - bi-monthly publication on EMC issues. Good coverage of EMC community news, products, and events. Paid Subscription. Seven Mountains Scientific.

Courses

These are an excellent way to gain focused practical information in a short time. They typically run from 2-5 days in duration and are offered throughout the US. In house classes are another option. Here are three major providers of EMC training.

You will want to get copies of the EMC regulations applicable to your industry. Most are copyrighted and have a fee, but government regulations such as MIL-STD-461 and MIL-STD-464 are in the public domain and are free.

Kimmel Gerke Associates (us) - EMC Design classes (2-day), plus an optional EMC Troubleshooting class (1-day). Typically, 15-20 public classes are offered per year throughout the US in selected cities. Also provides in-house training classes. Has offered training for 20+ years.

Henry Ott Consultants - EMC Design classes (2-day). Typically, several public classes offered per year. Also provides in-house training classes. Has offered training for 30+ years.

WL Academy - various EMC issues (length varies), with an emphasis on regulatory topics. Classes throughout the year at Washington Labs in Maryland. Offers a unique and very popular class on MIL-STD-461F testing.

REGULATIONS

Last, but not least, you will want to get copies of the EMC regulations applicable to your industry. Most are copyrighted and have a fee, but government regulations such as MIL-STD-461 and MIL-STD-464 are in the public domain and are free. The latter also have detailed appendices that are great tutorials on the "why" along with the "how" of the various tests. (Recommended reading.)

Here are the main EMC requirement by industry (with web sites.) Many of these are tailored by individual companies as internal EMC requirements.

- *Military* - MIL-STD-461F & MIL-STD-464 (www.assist.daps.dla.mil)
- *Avionics* - RTCA DO-160F (www.rtca.org)
- *Automotive* - SAE J551 & SAE J1113 (www.sae.org)
- *Commercial/Industrial* - FCC Part 15, EN55022/55011, EN61000-4-x (www.fcc.gov, www.ansi.org)
- *Telecommunications* - Telecordia (formerly Bellcore) GR-1089 (www.telecorida.com)
- *Medical* - EN60601-1-2, FDA "Reviewer Guidance" (www.ansi.org, www.fda.gov)

PARTICIPATE IN THE EMC COMMUNITY...

The community is small, but tight. Don't worry - fresh recruits are always welcome. Maybe it is a case of "misery likes company", but you will find most EMC folks are friendly to newcomers.

This is especially true of many EMC old-timers. Most of us have enjoyed the journey and are happy to share what we have learned. Since little of this is taught in schools, most of us learned (and continue to learn) directly from colleagues and those before us. So if you are a new EMC engineer, don't hesitate to ask for help.

The IEEE EMC Society is probably the biggest community resource. Among the smallest of the IEEE professional societies, the EMC Society is very active. It hosts chapters throughout the world, along with annual symposiums. Both provide excellent opportunities for ongoing education and professional networking.

The community is small, but tight. Don't worry - fresh recruits are always welcome. Maybe it is a case of "misery likes company", but you will find most EMC folks are friendly to newcomers.

SAVE THE DATE for the 2012 IEEE

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Our first recommendation is to join your local IEEE EMC chapter.
Go to www.emcs.org for a list of chapters, many with links to their local pages.

Join an EMC Chapter

Our first recommendation is to join your local IEEE EMC chapter. Go to www.emcs.org for a list of chapters, many with links to their local pages. Most chapters host at least four meetings a year, and usually include a speaker discussing a technical topic. Finally, you don't need to be an IEEE member to attend - if you are interested in EMC, you are always welcome.

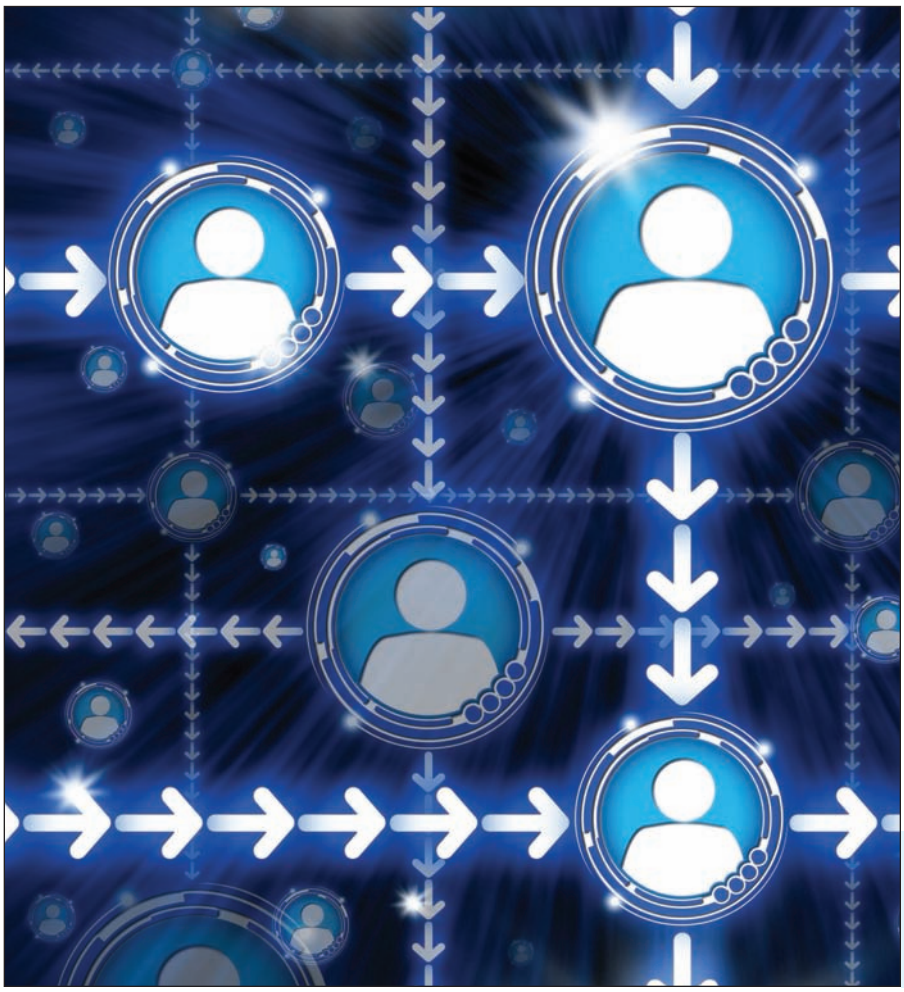
If you don't have a local chapter, consider forming your own. When Daryl moved to Phoenix fifteen years ago, he missed the camaraderie of the Minnesota chapter. He and two other EMC engineers reactivated the local chapter, which had been defunct for years. It is still active fifteen years later. And, again, you are not alone. The EMC Society will help with its *Angel* and *Distinguished Lecturer* programs.

Attend EMC Symposiums

Our next recommendation is to attend an IEEE EMC Symposium. These are held annually around the US, with additional international symposiums around the world. A word of caution - you may need to convince your management of the value of attending. Trade shows are often seen as a boondoggle, but this can be an excellent educational opportunity. Even after 40+ years in this business, we both learn something new from every show.

Here are some suggestions for attending the symposium:

- Attend all five days. While the main technical sessions are Tuesday through Thursday, tutorial sessions are held on Monday and Friday. These tutorials sessions are often aimed at the new EMC engineer, but we find them useful too.
- The Tuesday through Thursday technical sessions are usually heavy on analysis and modeling, so make these a lower priority. Now this may irk the academics, but you can always read the papers later. If a particular paper interests you, by all means attend. Sometimes there are special sessions, and we've found those to be very useful. The point is - don't spend all your time in the meeting rooms.
- Spend time on the show floor. Talk with the vendors to find out about new products, and attend the special tutorial demos. Both can be particularly beneficial to the new EMC engineer.



Use your on-line resources. At this time, LinkedIn is the preferred venue for professional activities. There are several EMC special interest groups which you can join.

Don't stop learning. Even after 40+ years each, we are still learning about EMC. Actually, this keeps us in the game. What weird problem will we see next?

- Attend the social events. Remember, "All work and no play..." Besides, this is a chance to rub shoulders with those in the business. Although many engineers are introverts, try to mingle, meet and ask questions. Most of those you meet will be fellow engineers.

Use LinkedIn

Finally, use your on-line resources. At this time, LinkedIn is the preferred venue for professional activities. There are several EMC special interest groups which you can join. Your participation can be as much or as little as you prefer. These are also great places to post those perplexing EMC questions.

MAKE A PLAN, AND THEN WORK IT...

First, be patient. It may take a couple of years until you feel like you have really mastered the craft. If you are new, there is a lot to learn. Often this learning is piecemeal, like working a puzzle. But if you study, learn and participate, one day in the not too distant future the overall picture will make sense. At that point, you'll realize you are finally there - you're no longer an EMC-novice, but have become an EMC-expert.

A final piece of advice. When you reach that point, don't stop learning. Even after 40+ years each, we are still learning about EMC. Actually, this keeps us in the game. What weird problem will we see next? Welcome to the wild and wacky world of EMC!

(the authors)

DARYL GERKE, PE AND BILL KIMMEL, PE

are the founding partners of Kimmel Gerke Associates, Ltd. The firm specializes in EMC consulting and training, and has offices in Minnesota and Arizona. The firm was founded in 1978 and has been in full time EMC practice since 1987.

Daryl and Bill have solved or prevented hundreds of EMC problems in a wide range of industries - computers, medical, military, avionics, industrial controls, vehicular electronics and more. They have also trained over 10,000 designers through their public and in-house EMC seminars.

Daryl and Bill are both degreed Electrical Engineers, registered Professional Engineers, and NARTE Certified EMC Engineers. Between them, they share over 80 years of industry experience. For more information and resources, visit their web site at www.emiguru.com.

Meet the Educators in Compliance

In this article we feature nine industry educators committed to passing on the knowledge and experience they've gained through years of experience in their fields.

We've interviewed each to get a more in-depth picture of their stories so we could pass them on to you. We encourage you to meet our educators and hope that you connect with a few to take advantage of their vast wealth of knowledge over the year ahead.

Meet Educators

Bill Kimmel, PE and Daryl Gerke, PE

Kimmel Gerke Associates, Ltd.

Bill Kimmel, PE
Forty-nine years as an electrical engineer. Past employers include Sperry Univac and Control Data Corporation. Co-founder of Kimmel Gerke Associates - part time in 1978, full time since 1987. Professionally involved with EMI/EMC since 1965.

BSEE, University of Minnesota. Registered Professional Engineer (PE). NARTE Certified EMC Engineer.

Daryl Gerke, PE
Forty-three years as an electrical engineer. Past employers include Collins Radio, Sperry Univac, Tektronix, and Intel. Co-founder of Kimmel Gerke Associates - part time in 1978, full time since 1987. Professionally involved with EMI/EMC since 1970.

BSEE, University of Nebraska. Registered Professional Engineer (PE). NARTE Certified EMC Engineer. FCC licenses (Commercial and Amateur Radio.)

ICM: *What led to your commitment to becoming educators in your field?*

Kimmel Gerke: We began moonlighting as technical instructors for a vocational school in 1975. Working together soon led to founding our consulting firm. In addition to teaching, we developed the curriculum for an adult evening electronics program. Later, under a state grant, we developed a one year certificate program for printed circuit board designers.

After going into full time EMC consulting, we decided to offer training classes to help our clients prevent problems at the design stage. At first, classes were only offered in-house, but since 1992 we have partnered with Tektronix on our public EMC design classes.

Almost 20 years later, we have trained over 10,000 engineers and technicians in EMC design methods through our public and in-house classes.

We have found the educational aspects of our consulting practice to be very gratifying. Not only have we helped our fellow engineers do a better job, but we've helped improve products as well.

ICM: *What do you hope attendees will leave your class having learned?*

Kimmel Gerke: Our emphasis is on design and troubleshooting EMI/EMC issues, NOT on testing and regulations. We hope our students leave our classes with two things:

- A general understanding of EMI/EMC and how to design to prevent problems.
- A specific set of design guidelines that can be immediately applied (rules of thumb, checklists.)

Kimmel Gerke plans to offer the following classes and workshops in 2012. To learn more about their classes, visit their website at www.emiguru.com.

Design For EMC: Two days focused on how to "identify, prevent, and fix" common EMI/EMC problems. Includes over 40 "fixes". Very practical with minimal math.

EMC Troubleshooting: One day workshop covering troubleshooting methods. Includes several interactive case studies. Only offered in February in two locations - Orlando and San Diego.

2012 Class Schedule
(Subject to change)

Current plans include six classes, which may expand if business conditions warrant.

February 2012: Orlando, FL and San Diego, CA (Includes optional troubleshooting workshop)

March 2012: Dallas, TX and Washington DC/Baltimore, MD

April 2012: Boston, MA and Syracuse, NY

"We have found the educational aspects of our consulting practice to be very gratifying. Not only have we helped our fellow engineers do a better job, but we've helped improve products as well."

Meet Educator

Lee Hill

Founding Partner, Silent Solutions LLC

"My commitment to becoming an educator certainly originated from a family and cultural emphasis on education that was groomed by a few standout professors, most notably Dr. Paul Wilson at RIT, and of course my thesis advisor at the Missouri University of Science and Technology (MS&T), Dr. Tom Van Doren."

ICM: *Lee, Tell us your story:- What is your professional background?*

Lee: My first and only "real" job - I worked as a Principal EMC and Systems Engineer at Digital Equipment Corporation's Workstation Systems Engineering Group (WSE) in Palo Alto, California. I was hired by the design team to assist with the design of new high speed desktop RISC (Reduced Instruction Set Computers) workstations that at the time were used mostly by scientists and engineers. WSE was a very small, independent design organization composed of some of the best and brightest from Stanford University and the University of California- Berkeley.

Prior to California, I worked for Digital's Low End Product Regulatory group in Massachusetts, where the company developed many different high volume, lower cost products like video displays, network adapters, small desktop and floor-standing computers, and almost every kind of peripheral, cable, and I/O you can imagine. The EMC engineering group trained us to be EMC consultants, who in order to be successful had to develop interpersonal skills and form effective business relationships with many, many different people and design groups within the company. At the time I was there, Digital had over 125,000 employees, which gave me additional opportunities to work with gifted engineers within many different product design and research groups around the world. Even back in the '80s I was able to correspond with technical colleagues via a mature intercompany email network, which today is taken for granted, but back then was a rarity except for the companies including Digital that developed the original Ethernet standard.

Both jobs gave me a terrific background in the design, troubleshooting, and retrofit of high speed electronic products. Today it would be difficult to duplicate even a fraction of this experience since the design process for many types of high volume consumer products is now conducted and managed offshore.

Lee earned his MSEE in Electromagnetics from Missouri University of Science and Technology (MS&T)

ICM: *What led to your commitment to becoming an educator in your field?*

Lee: While I was an EE undergraduate student at the Rochester Institute of Technology (RIT), I worked as an academic tutor in math and science for the Office of Special Services. I also worked as a tutor/counselor for an inner-city Federal program (Upward Bound) that promoted tutoring and on-campus activities with the goal of getting more inner-city youth interested in and successfully enrolled in higher education. Along with my childhood home near the city of Hartford, CT, this experience helped me develop skills and enjoy success in teaching a very diverse population, from the most privileged to the most needy.

My commitment to becoming an educator certainly originated from a family and cultural emphasis on education that was groomed by a few standout professors, most notably Dr. Paul Wilson at RIT, and of course my thesis advisor at the Missouri University of Science and Technology (MS&T), Dr. Tom Van Doren. I earned my MSEE at MS&T under Tom's guidance. He is the epitome of an ideal educator, he is kind, extremely competent, economical in his use of language, and is able to bridge academic concepts with real life education and technical demonstrations. His instructional materials reflect his ability to condense complex material into elegant, incredibly simple concepts and illustrations. Watching Tom teach has inspired me to never stop learning and developing new ways to teach and delight our class attendees. My commitment to education was also inspired by the excellent instruction I received from Dr. James Drewniak and Dr. Todd Hubing at MS&T. The 1990s were a very exciting time in EMC research and teaching, and MS&T was absolutely the best place on the planet to learn. Being surrounded by teaching excellence at MS&T cultivated my natural curiosity to learn and share that knowledge with others around the world.

Lee earned his MSEE in Electromagnetics from Missouri University of Science and Technology (MS&T).

ICM: *What do you hope attendees will leave your class having learned?*

Lee: I'd quibble and say that we don't "hope" they learn, we want to be certain that students leave with a mastery of key concepts. We constantly change our material to find ways to elicit as many "ah hah!" moments as possible during a class. Then we survey every single student to find out what they loved about the class and also to get ideas about what we could improve or change.

What do we strive to have them learn – that's easy – we have identified the most important EMC concepts that are left out of most undergraduate programs, specifically a) the noise model and how to use it for design and troubleshooting, b) physical self and mutual inductance, c) common-mode current d) Ground versus Return, e) antennas.

We expose our students to a strong base of equal amounts of theory, application, and examples so that they leave the class able to think for themselves and apply the information to new, future design and troubleshooting projects.

The best compliment that we often receive from past students is "Lee, we are already using your class information to solve noise problems, and now we don't have to hire your company (SILENT), sorry about that!".

Silent Solutions LLC will be offering the following classes in May and October 2012. Check www.silent-solutions.com for actual dates and registration information:

- Circuit to Circuit
- Design & Retrofit
- PCB Design
- Mechanical Design
- Spectrum Analyzer

Meet Educator

Daniel D. Hoolihan

President, Hoolihan EMC Consulting

"I like to have the students leave with advanced knowledge of EMC engineering, an appreciation for the history of EMC engineering, and a burning desire to know more about EMC."

ICM: *Dan, would you share with us a bit about your professional background?*

Dan: I have 42-years of experience in EMC Engineering. Two degrees in Physics – Bachelors and Masters. Work experience with Control Data Corporation, AMADOR Corporation, TUV SUD America, and Hoolihan EMC Consulting. Long-time IEEE member with Past-President credentials in the EMC Society. Chair of ANSI-ASC C63 (2012-2014).

ICM: *What led to your commitment to becoming an educator in your field?*

Dan: I have been teaching industrial seminars in EMC Engineering since 1970; I like to teach mature students who are interested in developing their capabilities in electrical engineering especially in the specialized area of "electromagnetic interference."

Dan has 42-years of experience in EMC Engineering. Two degrees in Physics – Bachelors and Masters. He is a long-time IEEE member and is a Past President.

ICM: *What do you hope attendees will leave your class having learned?*

Dan: I like to have the students leave with advanced knowledge of EMC engineering, an appreciation for the history of EMC engineering, and a burning desire to know more about EMC.

Dan currently has plans to offer the following classes in 2012:

I will be giving classes in conjunction with ETS-Lindgren (in the Austin, Texas area) in 2012:

February 14 -16, 2012: Fundamentals of EMC Compliance Testing (includes "hands-on" laboratory testing as part of the course).

March 20-22, 2012: MIL-STD 461F (includes "hands-on" laboratory testing as part of the course).

May 22-24, 2012: Fundamentals of EMC Compliance Testing (includes "hands-on" laboratory testing as part of the course).

October 16-18, 2012: MIL-STD 461F (includes "hands-on" laboratory testing as part of the course).

The courses include short "guest" lectures on specialized topics by world-renowned engineers from ETS-Lindgren.

Meet Educator

Henry W. Ott

President/Principal Consultant Henry Ott Consultants

"I discovered that there was very little information available on dealing with noise and interference in electronics... As a result I began to educate myself on the subject, which led to me teaching a course on the subject within Bell Labs. The course notes eventually led to the Noise Reduction Techniques book."

***ICM:** Mr. Ott, would you share with us a bit about your professional background?*

Henry: After undergraduate school I went into the Air Force for four years, and was assigned to the Air Research and Development Command at Eglin AFB, Florida, where I was involved in flight-testing of armament systems on new aircraft. After the Air Force, I worked at Bell Labs in Whippany, NJ as a product design engineer. In 1963, I obtained my Masters Degree in Electrical Engineering. At Bell Labs I was a Distinguished Member of the Technical Staff and a consultant on EMC. In 1988, after 30 years at Bell Labs, I left to start Henry Ott Consultants, an EMC training and consulting organization.

While at Bell Labs, I wrote my first book "Noise Reduction Techniques in Electronic Systems," which was published by John Wiley & Sons in 1976. A second edition of the book was published in 1988, just after I left Bell Labs, and remained in print until 2009. In 2009, my second book "Electromagnetic Compatibility Engineering" was published also by John Wiley.

At Bell Labs, I was involved in designing sensitive low-level analog electronics that had to work in an electrically noisy environment. At this time, this was the mid 60s, I discovered that there was very little information available on dealing with noise and interference in electronics. The universities taught nothing about the subject, and there was very little literature available pertaining to the subject.

As a result I began to educate myself on the subject, which led to me teaching a course on the subject within Bell Labs. The course notes eventually led to the Noise Reduction Techniques book. The book got me known outside of Bell Labs and I began teaching continuing-education courses on the subject, on my own time, for various companies and organizations outside of Bell Labs. This eventually lead to my leaving Bell Labs and doing full-time EMC consulting and training.

My success has come from my ability to take a complex subject, such as EMC, and explain in it a simple understandable way both in person and in print. "Noise Reduction Techniques in Electronics Systems" has been referred to, by many as the "Bible on EMC." My new book "Electromagnetic Compatibility Engineering" received the "2009 PROSE Award," from the Association of American Publishers for the most professional and scholarly book published that year in the category of Engineering and Technology.

The majority of the EMC training classes presented by Henry Ott Consultants are done in-plant for specific clients. However, I do try to offer at least two public EMC seminars each year. This allows engineers at companies that do not have enough people interested in EMC to justify an in-plant seminar to receive EMC training. These public seminars are usually offered in the spring and the fall, one in the eastern US, and one in the western US.

The 2012 spring public seminar will be held in Atlanta, GA area April 17-19. The fall 2012 public seminar is not yet finalized, but Denver, CO area is being considered.

More information is available on the Henry Ott Consultants website (www.hottconsultants.com), both on the public and in-plant EMC courses.

These public offerings are 3-day EMC seminars directed towards electrical engineers. However, mechanical engineers, systems engineers, regulatory compliance engineers, technicians, and others who need a working knowledge of EMC principles will also benefit from these seminars. The participants obtain the knowledge necessary to design electronic equipment that is compatible with the electromagnetic environment, and in compliance with national and international EMC.

The majority of the EMC training classes presented by Henry Ott Consultants are done in-plant for specific clients. Mr. Ott also offers at least two public EMC seminars each year, in the spring and fall.

Meet Educator

Donald L. Sweeney

President and Senior EMC Engineer
D.L.S. Electronic Systems, Inc.

Don has been teaching EMC and electronics for over 30 years, first at Oakton College, then at the University of Wisconsin, and currently as an independent EMC design seminar/workshop. He is a graduate of the Department of Electrical Engineering at the University of Illinois at Urbana and has over 45 years experience in the EMC and electrical engineering fields. He is a senior EMC Engineer, an iNARTE certified EMC Engineer and President of D.L.S. Electronic Systems, Inc. Don specializes in EMC, RFI and EMI consulting and testing and is known worldwide for his problem solving abilities. He has served as a special consultant to the Lawrence Livermore National Laboratory and the Nuclear Regulatory Commission. He is past chairman of the Chicago area IEEE EMC Society, founding chairman of U.S. Council of EMC Laboratories (USCEL) and has served on the board of directors of the IEEE EMC Society for more than 13 years.

ICM: *What led to your commitment to becoming an educator in your field?*

Don: As an engineer doing EMI/EMC testing for my employer, I was able to attend the IEEE EMC Symposiums. I felt a need to share what I was learning with other design engineers in my department, so I presented to them the information I had learned from the papers I had attended at the Symposium. When a fellow engineer would have a specific EMC problem, I would put together a few slides to show them how to design in a way that would avoid their problem.

I was pleasantly surprised when the University of Wisconsin asked me to present a night school class for engineers in the Milwaukie area. They had been contacted by a company who had heard about me and had suggested I teach a class there. I put together 10 weeks of lessons and we met every other Wednesday from 5:30 - 9:30 pm. We had 65 engineers and technicians attend the first semester, including 2 or 3 who drove up from the west side of the Chicago (about 100 miles each way), after they had all worked an 8 hour day. The average attendance was 62. It was such a pleasure to teach as everyone was so interested and wanted to learn about EMI/EMC. Shortly thereafter the university asked me to offer my class as a 3-day seminar.

A while later, I was asked to do an in-house series of classes for a large company that were held one Friday a month (payday so everyone was at work and in town) that lasted for two years. I eventually covered all the material I had, but since they wanted more, I kept generating new material.

I then began offering the classes locally in the Chicago area as a four-day seminar and students began attending from all over the world. The longer I taught, the more I had a growing need to help my students learn how to apply the EMC concepts to real life products, so in 2004 we began offering a hands-on workshop as part of the class to help tie together the concepts and practical applications.

The icing on the cake was added when we introduced the Product Reviews as an additional part of the class. The instructor(s), or one of their associates, discuss one-on-one with each student their own personal company project and how EMC can be improved. During the 45 minute review we are able to explain how EMC has been compromised using the terms and concepts we covered during the past three days. Even if the student does not have a product to discuss, we will talk about ideas they are considering and help in the planning stage. One student commented during his product review. "I would not understand what you are talking about had I not just taken your class. Now I see what we have been doing wrong."

That sums up why I enjoy teaching others what I have learned over my more than 45 years in the electrical engineering and EMC design field. I personally believe by taking our current three-day seminar/workshop and taking advantage of the product review, a company has the potential of saving tens or even hundreds of thousands of dollars by designing a product correctly from the beginning. For example, I once had a client at my test lab that would have saved $10,000 on the year's production if they saved

"I strongly encourage all design engineers to take an EMC seminar/workshop so they can learn to evaluate their own products to avoid potential pitfalls."

Don shares teaching with Roger Swanberg. Here is a brief summary of Roger's background:

Roger Swanberg is a Senior EMC Engineer at D.L.S. and teaches circuit board design. He is a graduate of the Illinois Institute of Technology in Chicago, with over 35 years in the electrical engineering field. He has worked for Motorola and Zenith in color TV design, Nuvatec Design Consulting as a consultant and EMC testing manager, US Robotics as an EMC designer and regulatory compliance manager, plus Motorola Lighting and Motorola Cellular as an EMC and electronics designer. He is Vice-Chairman for the Chicago Section IEEE EMC Society.

just "one penny" on each product they manufactured. Unfortunately very few "fixes" for a badly designed product can be added for a penny. Sometimes we can save a client (or potentially save a student) $10, $50 or even 100's of dollars per product manufactured. Imagine what their savings would be over a year, or over several years of production, had they learned how to design their product with EMC in mind.

ICM: *What do you hope attendees will leave your class having learned?*

Don: When students leave this seminar/workshop, they should be ready to lead a design team with a high degree of confidence that their products will meet the EMC requirements.

The class is designed to teach concepts first, followed by the application of these concepts in a product. We begin by giving numerous examples of EMC problems that I'm familiar with, from the shutting down of nuclear power plants to a company designing a product using the wrong technology, requiring the power supply to be totally redesigned at a cost of about $500,000. We next discuss the various world regulations which must be met in order to market a product.

Once students know why they need to understand EMC, they are next taught the very basics such as: Typical noise paths, Wave lengths, Grounding, Cabling and how shielding works, Passive components - how capacitors, inductors and even wires do not behave as ideal components.

We then discuss how electromagnetic fields radiate from wires and traces, and develop a strategy for designing our product to be a low emission system. We then go through each of the ways of minimizing emissions in our design, from the basic integrated circuit and how it influences emission, to the cabinet and how by using the correct material and the bonding of the joints, we create an RF tight system. We next cover filtering leads which might leave a system unshielded; then we troubleshoot a product which does not quite meet our EMC/ESD goal and see how to bring it into compliance.

During the last day we apply the concepts and equations by using a take-home software program developed by the instructors that will allow students to predict emissions based on quickly using a computer. Previously we'd been manually predicting emissions by using the equations developed in the textbook. We finally put this all together by meeting one-on-one with the student, applying the concepts just learned to their own product.

I strongly encourage all design engineers to take an EMC seminar/workshop so they can learn to evaluate their own products to avoid potential pitfalls.

Planned class schedule for 2012:

EMC By Your Design: A Practical Applications Seminar and Workshop

April 17-19, 2012 and
October 23-25, 2012
Northbrook, IL
847-537-6400
www.dlsemc.com/1101

As the compliance community continues to grow, many learning opportunities become available for both new and seasoned engineers. If you have any recommendations about classes, workshops, and seminars not listed in this issue, please drop us a note so we can add it to our events calendar.

events@incompliancemag.com

Meet Educator

Dr. Tom Van Doren

President, Van Doren Company

Professor Emeritus of Electrical and Computer Engineering at Missouri University of Science & Technology (formerly University of Missouri-Rolla)

President = "chief lackey", Van Doren Company, my wife Lana is the real boss of the company. I have been happily married to my 'angel' for over 51 years!

ICM: *What is your professional background?*

Tom: I received BS, MS and PhD degrees in Electrical Engineering from the University of Missouri-Rolla in 1962, 1963, and 1969 respectively. The main thing that I learned while obtaining the PhD degree was persistence will beat intelligence nearly every time. I served two years as a young second lieutenant with the US Army Security Agency from 1963-1965. While in the Army I realized how little I knew compared to the gray-haired senior sergeants. I worked for Collins Radio Company as a microwave engineer in Dallas, TX from 1965-1967.

During that time I was taught by some patient, experienced microwave engineers what inductance was and I discovered from some electrical safety engineers what electrical grounding was all about. I have been teaching the concepts of inductance and grounding in my short courses for the past 28 years. I never suspected then that I would become a multi-millionaire by teaching what I learned about those two concepts. I began my college teaching career with the University of Missouri-Rolla in 1969. During my first decade of teaching, I spent 9 summers in the 1970s working for the Naval Weapons Center in China Lake, CA on advanced missile radar designs. There, I learned to combine my theoretical PhD education with the practical experience needed to make electronics work reliably over wide temperature and pressure ranges. On many occasions the experienced senior technicians gently "put me in my place" by showing me that I really didn't know as much about engineering as I thought I did.

I am one of the founding members of the Missouri S&T EMC Laboratory. Currently, 8 US and 9 foreign corporations are sponsoring 23 different EMC related research projects at the EMC Laboratory. We have 26 graduate students, 5 research faculty, 5 tenured faculty and about $1.5M annual budget.

I have received two outstanding teacher awards from Missouri S&T, the Richard R. Stoddard award from the IEEE EMC Society for contributions to EMC technology and education, and I am a Life Fellow of the IEEE and Honored Life member of the EMC Society.

ICM: *Why do you teach electromagnetic compatibility short courses?*

Tom: In the early 1980s, I recognized that working engineers and technicians needed some help to diagnose and reduce their electrical interference problems. I developed a 2-day short course titled "Grounding and Shielding of Electronic Systems". This course explained and demonstrated the key concepts involved with making equipment electromagnetically compatible. Even though I was a university faculty member who was familiar with complicated electromagnetic theory, in my short course I tried to explain the key concepts in a way that would be understood by and useful to design engineers and technicians. I must have succeeded because over the past 28 years more than 18,000 people from 110 companies and 15 countries have attended my short course presentations.

ICM: *What do you hope attendees will leave your class having learned?*

Tom:

1. Treat an electrical signal as a current that requires careful routing of the outgoing and returning paths.
2. Route a current such that the 'geometrical' centroid of its outgoing path is coincident with

"In the early 1980s, I recognized that working engineers and technicians needed some help to diagnose and reduce their electrical interference problems. I developed a 2-day short course titled "Grounding and Shielding of Electronic Systems". This course explained and demonstrated the key concepts involved with making equipment electromagnetically compatible."

the 'geometrical' centroid of its return path.

3. Every current, signal or noise, eventually returns to its source, not to ground.
4. Sinusoidal steady-state currents take the path of least impedance, not least resistance.
5. Self-inductance is a property of a complete current path, not a property of a single wire.
6. The reasons for grounding are to reduce voltage differences that might cause an electrical safety problem or an electrical interference problem.
7. A signal routing connection is intended to carry current, but a signal grounding connection should carry negligible signal current.
8. Electrical noise problems can be predicted, diagnosed, and reduced by understanding the four electrical energy coupling mechanisms—conducted current coupling; magnetic field coupling; electric field coupling; and, electromagnetic wave coupling.

Open enrollment classes scheduled for 2012:

"Grounding & Shielding of Electronic Systems"
(How to Diagnose and Solve Electromagnetic Interference and Signal Integrity Problems)

March 1-2 at Oklahoma State University (OSU) in Stillwater, OK. Details about the course in Stillwater, OK can be found at http://gs-course.okstate.edu

March 28-29 at University of Missouri-St. Louis (UMSL). Details about the course in St. Louis, MO can be found at http://dce.mst.edu/noncredit/facetoface/Grounding_and_Shielding_St_Louis.html

Meet Educator

Dr. Steven H Voldman

CEO/President
Dr. Steven H. Voldman LLC

Dr. Voldman has provided tutorials at the ESD Symposium for many years including ESD circuits and ESD physics. I initiated the "ESD on Campus" program to bring lectures to universities students globally.

ICM: *Tell us your story - what is your professional background?*

Steven: My background is 25 years in semiconductor development at IBM, and also worked at Qimonda, TSMC, and Intersil. This includes 25 years of work in latchup development, and 20 years in the electrostatic discharge (ESD) field . I have been a member of the ESD Association for 20 years, where I have provided ESD tutorials in various fields. I have been a member of ESD Association workgroups for development of ESD standards. I am presently providing ESD consulting, latchup consulting, patent support, expert witness support, and teaching a variety of short courses.

ICM: *What led to your commitment to becoming an educator in your field?*

Steven: I am the first IEEE Fellow in the field of electrostatic discharge. I have provided tutorials at the ESD Symposium for many years including ESD circuits, ESD physics, I initiated the "ESD on Campus" program to bring lectures to universities students globally. I also teach short courses presently in many subjects in the United States, Singapore, Malaysia, China, Taiwan, Israel, and Sri Lanka.

"I am presently providing ESD consulting, latchup consulting, patent support, expert witness support, and teaching a variety of short courses."

ICM: *What do you hope attendees will leave your class having learned?*

Steven: The attendees will learn many subjects from design and layout, circuits, design integration, failure mechanisms, to innovation.

Course Titles and Offerings for 2012:

- ESD physics
- ESD physics and devices
- ESD circuits
- ESD in radio frequency technologies
- ESD in Gallium Arsenide
- ESD Failure Mechanisms
- Latchup
- ESD design and synthesis
- ESD and latchup computer aided design
- Innovation, inventing and patenting

Meet Educator

Kenneth Wyatt

Sr. EMC Engineer

Wyatt Technical Services, LLC

Kenneth Wyatt, holds degrees in biology and electronic engineering and has worked as a product development engineer for 10 years at various aerospace firms on projects ranging from DC-DC power converters to RF and microwave systems for shipboard and space systems. For over 20 years, he worked as an EMC engineer for Hewlett-Packard and Agilent Technologies in Colorado Springs, eventually advancing to a leadership position within both companies.

A prolific author and presenter, Ken has written or presented topics including RF amplifier design, RF network analysis software, EMC design of products and use of simple tools for EMC troubleshooting. He has been published in magazines such as, , *Electronic Design*, *HP Journal*, *Safety & EMC* (China), *In Compliance*, *Interference Technology* (ITEM), *Microwave Journal*, *RF Design*, *Test & Measurement World* and several others. Kenneth is a senior member of the IEEE and a long time member of the EMC Society where he serves as their official photographer. He is also a member of the dB Society and is a licensed amateur radio operator.

ICM: *What led to your commitment to becoming an educator in your field?*

Ken: I've always had a passion for teaching technical subjects to my peers and others in the field. I started writing for hobby and technical magazines while still in college (mid-1970s) and am convinced those published articles got my foot in the door for my first engineering job once I graduated. After I joined Hewlett-Packard, I took an EMC engineering course through a local university, based on Clayton Paul's book, "*Introduction to Electromagnetic Compatibility*". I was really fired up afterward and taught an internal course based on what I had learned. After Agilent Technologies spun-off from HP, I taught a weekly web-based course over a period of nine months to Agilent engineers worldwide. This eventually became a two-day Practical EMC Design seminar I taught throughout Agilent Technologies worldwide. Because I had developed this course on my own time, Agilent management supported my taking the course public. After I retired in 2008, I've had the opportunity to teach the course all around the country and really get a kick out of helping so many other companies with this "niche" subject.

ICM: *What do you hope attendees will leave your class having learned?*

Ken: My target audience - Analog, RF, Mechanical and Digital hardware design engineers will benefit from this course. A basic engineering background (BSEE or equivalent) is generally suggested. One thing that differentiates my seminars with others is that I try hard to teach the theory on a practical level, so that the essential basics are understood. I also include many interesting demonstrations of the concepts taught. The learning objectives for the participants include the ability to:

- Analyze, measure, troubleshoot and solve an EMC problem in more detail
- Understand theory from a more in-depth view and understand causes of the top EMC issues: radiated emissions and electrostatic discharge
- Make or purchase simple low-cost bench top troubleshooting tools
- Perform simple evaluation and pre-qualification tests to ensure likeliness of compliance

Class Schedule for 2012:

While I'm still developing my training schedule for 2012, the following course is available:

March 20-21, 2012

"EMC Essentials" - Design, Trouble-shooting & Pre-Compliance Testing
EMC Integrity, Longmont, CO
(www.emcintegrity.com).

To register, call Vince at (303) 776-7249 or email: vinceg@emcintegrity.com

I'm still looking for host test labs on the east and west coasts, so check my web site early in January for the latest news (www.emc-seminars.com).

Additional comment from Ken

Because all electronic products are required to meet strict limits and standards for EMC, it is vital for those assigned to EMC or product regulations to continue learning EMC theory and be able to build compliance into the product designs early. They also need to be able to troubleshoot issues quickly. Since most colleges and universities do not teach Electromagnetic Compatibility, I recommend a regular program of education in this field (and I'm speaking from experience here). Try to find at least one good seminar per year. I also highly recommend attending the annual IEEE EMC Symposium. While many of the papers presented are way theoretical, there are always a great number of basic theory and practical measurement and troubleshooting techniques offered, as well. It is also quite valuable to speak to the many EMC vendors present.

PRODUCT Showcase

Your Source for Product and Service Solutions

Electromagnetic Compatibility Engineering

Training for Noise and Interference Control in Electronic Systems
presented by EMC expert

Henry Ott

April 17-19, 2012
Wyndham Peachtree Conference Center
Peachtree City, GA

Presented by Henry Ott Consultants
in partnership with
IN COMPLIANCE Magazine

In this 3-day intensive course we'll cover practical aspects of noise and interference control in electronic systems and provide a working knowledge of EMC principles. Ideas are illustrated with examples of actual case histories and mathematic complexity is kept to a minimum. Participants will gain knowledge needed to design electronic equipment compatible with the electromagnetic environment and in compliance with national and international EMC regulations.

COURSE CONTENT

CABLING
Electric and magnetic field coupling, crosstalk. Cable types: coax, twisted pair and ribbon cables. Cable shielding and terminations.

GROUNDING PRINCIPLES
Why do we ground? Ground systems: single point, multipoint, hybrid. Ground loops. Return current paths, split reference planes. EMC grounding philosophy. AC power grounds.

DIGITAL LAYOUT & GROUNDING
Noise sources, PCB layout, power distribution, ground grids, characteristics of ground planes. Decoupling capacitors: value, placement, resonance and limitations.

HIGH SPEED DIGITAL DECOUPING
Alternative decoupling methods, use of distributed decoupling capacitance, power supply isolation, effect of paralleling capacitors. Embedded PCB capacitance.

DIFFERENTIAL-MODE EMISSION
Radiated emission mechanisms. Fourier spectrum. Methods of controlling differential-mode emission. Clock dithering. Cancellation techniques.

COMMON-MODE FILTERING
Basic C-M filter theory. Filter source and load impedances. Single and multi-stage filters. Ferrite chokes versus shunt capacitors. Effectiveness of various filter configurations. Filter mounting and layout.

TRANSMISSION LINES
What is a transmission line? Transmission-line effects, transmission-line radiation, and matching. How currents flow on transmission lines. Series, shunt and AC terminations. Simulation.

MIXED SIGNAL PCBs
Defining the problem, A/D converter requirements, return current paths, split ground planes, PCB partitioning, bridges & moats, routing discipline.

RF & TRANSIENT IMMUNITY
RF immunity: circuits affected, PCB layout, audio rectification, RFI filters. Transient immunity: circuits affected, the three-prong approach, keeping transient energy out, protecting the sensitive devices, designing software/firmware for transient immunity.

CONDUCTED EMISSION
AC power line conducted emission models, switching power supplies, parasitic capacitance, layout. Common-mode and differential-mode conducted emission, common-mode chokes, saturation. Power line filters.

SHIELDING
Absorption and reflection loss. Seams, joints, gaskets, slot antennas, and multiple apertures. Waveguides below cutoff, conductive coatings. Cabinet and enclosure design.

EMC EXHIBITS AND EVENING RECEPTION: WEDNESDAY, APRIL 18, 2012
Exhibitors:for information contact Sharon Smith - e-mail: sharon.smith@incompliancemag.com or call (978) 873-7722

REGISTRATION

COURSE DATES/TIME: April 17-19, 2012
Tuesday and Thursday 8:30 a.m. to 4:30 p.m.
Wednesday 8:30 a.m. to 5:00 p.m.

COURSE LOCATION: Wyndham Peachtree Conference Center, 2443 Highway 54 West, Peachtree City, GA 30269

COURSE FEE: $1,495 ($1,295 until 3/2/2012). Fee includes notes, textbook*, breakfast, luncheon and beverage breaks. Payment required prior to course. Hotel accommodations are NOT included.

CANCELLATION POLICY: You may cancel your registration up to two weeks prior to the course and receive a full refund. For cancellations received after this time there will be a $100 cancellation fee, or you can send a substitute, or use the registration for a future course. No-shows will not receive a refund; however the seminar fee may be applied to a future course.

TO REGISTER: Call 973-992-1793, fax 973-533-1442 or mail the registration form.

HOTEL RESERVATIONS: Call the Wyndham Peachtree Conference Center toll free at 877-999-3223 or 770-487-2000. Special room rates will be available soon.

*Electromagnetic Compatibility Engineering, by Henry W. Ott

Who Should Attend

This course is directed toward electrical engineers. However, mechanical engineers, reliability and standards engineers, technical managers, systems engineers, regulatory compliance engineers, technicians and others who need a working knowledge of electromagnetic compatibility engineering principles will also benefit from the course.

Feedback from recent participants

"This is really a fantastic course. Everything is very practical, and I have a much more intuitive feel for what is important in EMC and why."

"Very enjoyable presentation; passionate about subject, used good practical examples."

"Henry is the best in EMC."

"Probably the most useful technical seminar I have ever attended. Should have learned this 20 years ago."

"Thank You. Your work is very valuable and your presentation style is refreshing!!"

"Really happy I flew all the way here."

"Excellent course! Presented in a very understandable way, even for a mechanical engineer."

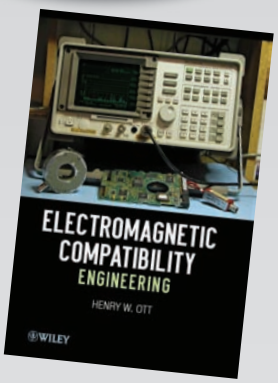
"Should be required training for all engineers."

"This is the best practical course available."

"An excellent seminar presented by a pragmatic, knowledgeable and entertaining teacher."

"This seminar exceeded by far my expectations, and my expectations were high already."

Includes Henry Ott's latest book!



HENRY OTT

Henry W. Ott is President and Principal Consultant of Henry Ott Consultants (www.hottconsultants.com), an EMC training and consulting organization. He has literally "written the book" on the subject of EMC and is considered by many to be the nation's leading EMC educator. He is the author of the popular EMC book Noise Reduction Techniques in Electronic Systems (1976, 1988). The book has sold over 65,000 copies and has been translated into six other languages. In addition to knowing his subject, Mr. Ott has the rare ability to communicate that knowledge to others.

Mr. Ott's newly published (Aug. 2009) 872-page book, Electromagnetic Compatibility Engineering, is the most comprehensive book available on EMC. While still retaining the core information that made Noise Reduction Techniques an international success, this new book contains over 600 pages of new and revised material.

Prior to starting his own consulting company, Mr. Ott was with AT&T Bell Laboratories, Whippany, NJ for 30 years, where he was a Distinguished Member of the Technical Staff and a consultant on EMC.

Mr. Ott is a Life Fellow of the IEEE and has served the EMC Society in various capacities including: membership on the Board of Directors, Education Committee Chairman, Symposium Committee Chairman and Vice President of Conferences. He is also a member of the ESD Association and a NARTE certified ESD engineer. He is a past Distinguished Lecturer of the EMC Society, and lectures extensively on the subject of EMC.

REGISTRATION FORM

Register by 3/2/12 and save $200!

ELECTROMAGNETIC COMPATIBILITY ENGINEERING
April 17-19, 2012 Wyndham Peachtree Conference Center, Peachtree City, GA
Fee: $1,495
Payment required prior to start of course.

Name: _____

Title: _____

Company: _____

Address: _____

City: _____ **State:** _____ **Zip:** _____

PAYMENT METHOD

❍ Check ❍ P.O. ❍ AMEX
❍ Discover ❍ Visa ❍ MC

Card # _____

Exp date: _____ **Security Code:** _____

Signature: _____

Office Phone: _____ **Fax:** _____ **E-Mail:** _____

Call 973-992-1793, fax to 973-533-1442 or mail registration form to: Henry Ott Consultants, 48 Baker Road, Livingston, NJ 07039-2502.
Make checks payable to Henry Ott Consultants.

Furthering Your Professional Development in 2012

The start of a new year is a time when, traditionally, we reflect on the progress we made during the year passed and set our goals for the new year. More often than not your professional development goals include training or some form of higher education to expand or refresh your technical knowledge. We've queried training resources in our niche industry to provide you with an overview of affordable solutions to meet your training goals in 2012. You'll find here sources of compliance related seminars and workshops offered online and on location, public and private.

We invite you to submit your own suggestions for additional listings as we continue to update our events section online at www.incompliancemag.com. Send your comments to us at editor@incompliancemag.com.

EMC CLASSES AND WORKSHOPS

EMC By Your Design: A Practical Applications Seminar and Workshop - D.L.S. Electronic Systems, Inc. (www.dlsemc.com/1101) - Learn to design products to avoid EMC problems by gaining an understanding of EMC design principles through three days of lecture multiple video clips and hands on workshops. Included are the basics from passive components, such as inductors, capacitors, grounding and cabling, to the shielding characteristics of the housing, circuit board design, ESD troubleshooting, controlling signal return currents of PCBs, how EMC and signal integrity are interrelated and how all this relates to the regulatory standards. Participants will apply these EMC principles through hands-on calculations for actual products. For further information please visit www.dlsemc.com/1101.

The current schedule for 2012:

- April 17-19, 2012 - Northbrook, IL
- October 23-25, 2012 - Northbrook, IL

EMC Tests according to ED-14F/ DO-160F, MIL-STD-461F & Previous Issues - EMCC Dr. Rasek (www.emcc.de) offers a seminar at the EMCC Seminar Centre in Unterleinleiter, Germany. A new measurement seminar in English. For further information visit www.emcc.de. This public seminar is currently scheduled for May 7, 2012.

HIRF - High Intensity Radiated Field Effects in Aircraft - EMCC Dr. Rasek (www.emcc.de) offers a two day seminar at the EMCC Seminar Centre in Unterleinleiter, Germany. For further information visit www.emcc.de. This public seminar is currently scheduled for May 8-9, 2012.

LEMP - Lightning Electromagnetic Pulse Effects onto Aircraft - EMCC Dr. Rasek (www.emcc.de) offers a two day seminar at the EMCC Seminar Centre in Unterleinleiter, Germany. For further information visit www.emcc.de. This public seminar is currently scheduled for May 10-11, 2012

Hands-on Fundamentals of EMC Testing Course - ETS-Lindgren offers a three-day hands-on course designed for engineers or lab technicians who want to expand their knowledge of EMC compliance testing, or are new to the subject and want to "learn-how" quickly.

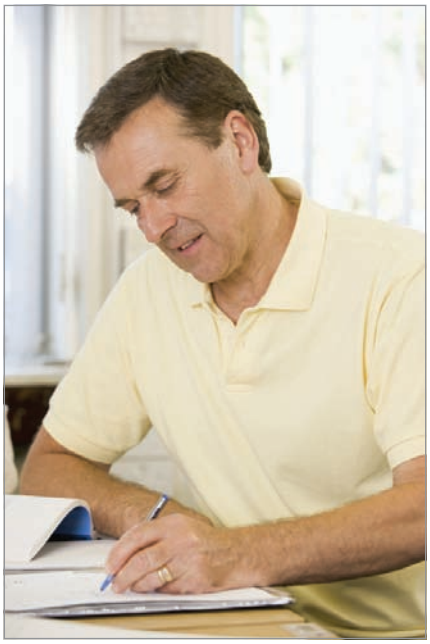
Instruction is divided between class lectures and hands-on lab experience. Students are taught how to perform actual tests in a fully instrumented lab that includes a 3 meter anechoic chamber, GTEM, and a demonstration reverberation chamber. Tests are made according to published standards for radiated and conducted emissions and immunity measurements. Students receive an illustrated, bound textbook written specifically for the *Fundamentals of EMC Testing* course, with many of the test setups illustrated. Class size is limited to twelve students.

- February 14 -16, 2012 - Fundamentals of EMC Compliance Testing
- March 20-22, 2012 - MIL-STD 461F
- May 22-24, 2012 - Fundamentals of EMC Compliance Testing
- October 16-18, 2012 - MIL-STD 461F

Classes are scheduled several times a year and new classes specializing in MIL-STD and wireless OTA testing are being added.
For more information please visit www.ets-lindgren.com/learning

Electromagnetic Compatibility Engineering - Henry Ott Consultants offers this three-day course covering the practical aspects of noise and interference control in electronic systems. The course will provide the participants with a working knowledge of electromagnetic compatibility principles. Emphasis is on cost effective EMC design for digital systems. The commercial and industrial aspects of EMC Engineering are emphasized. The amount and complexity of mathematics will be kept to a minimum, and ideas will be illustrated with examples of actual case histories.

This course is directed towards electrical engineers. However, mechanical engineers, reliability and standards engineers, technical managers, systems engineers,



regulatory compliance engineers, technicians, and others who need a working knowledge of electromagnetic compatibility engineering principles will also benefit from the course.

The participants should receive from this course knowledge necessary to design electronic equipment which is compatible with the electromagnetic environment, and is in compliance with national and international EMC regulations.

The 2012 spring public seminar will be held in Atlanta, GA area April 17-19.

The fall 2012 public seminar is not yet finalized, but Denver, CO area is being considered.

More information is available on the Henry Ott Consultants website (www.hottconsultants.com), both on the public and in-plant EMC courses.

Design For EMC - Kimmel Gerke Associates - EMI Guru (www.emiguru.com) - Two days focused on how to "identify, prevent, and fix" common EMI/EMC problems. Includes over 40 "fixes". Very practical with minimal math.

EMC Troubleshooting - Kimmel Gerke Associates - EMI Guru (www.emiguru.com) - One day workshop covering troubleshooting methods. Includes several interactive case studies. Only offered in February in two locations - Orlando and San Diego.

EMI Guru 2012 Class Schedule (subject to change) - Current plans include six classes, which may expand.

- February 7-9, 2012 -San Diego, CA - Arrow Electronics Training Center, San Diego, CA
- February 13-15, 2012 - Orlando, FL - Maingate Lakeside Resort, Kissimmee, FL (near Disney World)
- March 2012 - Dallas TX and Washington DC/Baltimore MD
- April 2012 - Boston MA and Syracuse NY

Electronic Product Design and Retrofit for EMC - This two-day class gives engineering professionals the ability to successfully recognize, solve and avoid common EMI problems. Demonstrations using working hardware illustrate concepts such as radiated emissions, high frequency antennas, radiated and conducted immunity, and crosstalk in connectors, cables and IC packages. This class is appropriate for experienced circuit and system design engineers, EMC

engineers, as well as those who are new to EMI problem solving. Engineers with time-to-market projects will find this workshop extremely useful. For more information please visit http://silent-solutions.com/education.htm.

EMC - Printed Circuit Board Design This two-day class provides technical training intended for electrical and EMC engineers interested only in PC board design. It is an excellent follow-up class for students who have recently completed our two or three-day EMC class. Course topics include component placement, signal routing and stackup, power bus decoupling, signal theory and signal integrity, "ground" splits, and a critique of bad applications notes from IC vendors. Students will examine good and bad design techniques using hardware demonstrations, schematic reviews, and sample PCB layouts. For more information please visit http://silent-solutions.com/education.htm.

Circuit-to-Circuit Interference - This unique one-day class is for electrical design engineers at all levels challenged by electrical noise problems in products containing RF (wireless), analog, switching power supply and digital electronics. Through a unique combination of lecture and hands-on experiments, class participants will master the ability to anticipate, solve and avoid electrical noise problems that can inhibit functionality in new product designs. By participating in this class, design engineers will be able to accelerate time-to-market design. For more information please visit http://silent-solutions.com/education.htm.

Mechanical Design for EMC - Unique to the industry, this two-day class provides clear applications, theory and demonstrations for the successful design of mechanical enclosures for good system emissions and immunity performance. Key topics include grounding at the PCB and enclosure, system ground maps, PCB component placement and control drawings, enclosure and cable shielding, PCB device "cans", resonant slots and enclosures, heatsinks, unintentional antennas, as well as connector, screw, and conductive gasket spacing. For more information please visit http://silent-solutions.com/education.htm.

Grounding for EMC, Signal Integrity and Instrumentation - Theory, applications and hardware demonstrations in this one-day class describe effective design and troubleshooting techniques. The real-time demonstrations use a spectrum analyzer, oscilloscope and signal generators to illustrate inductance, common-impedance coupling, and ground loops. Specific examples of single-point, multi-point, "good" and "bad" grounds will be discussed. For more information please visit http://silent-solutions.com/education.htm.

Mastering the Spectrum Analyzer for Electrical Noise Measurement - SILENT's newest one-day class is packed with practical tips, applications, and demonstrations to help make it easy for you to pick up a spectrum analyzer and start measuring and troubleshooting electrical noise and EMC problems. We will have a minimum of 3 different spectrum analyzers in class to help explain and demonstrate operating techniques that we have honed over the last twenty years, including:

- near field probing
- distinguishing narrowband and broadband signals
- finding the optimum resolution bandwidth
- settings to achieve maximum dynamic range
- conducted & radiated emissions testing
- parasitic resonance identification
- real time quasi-peak measurements
- quirks, strengths, and weaknesses of specific spectrum analyzers
- how to get the most repeatable, accurate measurements
- "must have" accessories and options for specific instruments

Our unique combinations of digital, RF and EMC design troubleshooting, and training experience combined with our graduate education from the Missouri University of Science and Technology (MS&T) ensures that our classes have the right balance of technical rigor, instruction. For more information please visit http://silent-solutions.com/education.htm.

Doug Smith offers the following classes in 2012. For additional information visit his website www.dsmith.org or email Doug for details: doug@emcesd.com.

EMC Lab for Designers - Practical Methods to Find EMC Problems in the Development Lab

- Newport Beach, CA week of April 4, 2012
- Oxford University in Oxford, England, June 2012

Failure Analysis and Prevention in Electronic Circuits - Design Troubleshooting for the Lab and Field

- Newport Beach, CA week of April 4, 2012
- Oxford University in Oxford, England, June 2012

High Frequency Measurements and Troubleshooting

- Newport Beach, CA week of April 4, 2012
- Oxford University in Oxford, England, June 2012

Grounding & Shielding of Electronic Systems - Dr. Tom Van Doren teaches participants how to diagnose and solve Electromagnetic Interference and Signal Integrity problems

March 1-2 at Oklahoma State University (OSU) in Stillwater, OK. Details about the course in Stillwater, OK can be found at http://gs-course.okstate.edu

March 28-29 at University of Missouri-St. Louis (UMSL). Details about the course in St. Louis, MO can be found at http://dce.mst.edu/noncredit/facetoface/Grounding_and_Shielding_St_Louis.html

Washington Laboratories Academy will be offering a range of training opportunities in 2012, ranging from the very popular and often sold-out MIL-STD-461 training. As always, the engineering community can take advantage of its core training offerings in EMC Design and Mitigation. Other offerings will focus on Wireless Regulatory topics, including International Approvals for RF devices, Simulation, Nuclear EMC, Shielding Design, Environmental Testing and Design and breaking topics in Engineering Reliability and Maintainability. Served up in-house, on the road and on the web and teaming with its slate of expert instructors, WLA delivers the best selection and options for engineering development. In the coming twelve months, the Academy will expand its partner opportunities to support the engineering community with the finest in professional development. Contact Mike Violette (mikev@wll.com) for more information, or visit the Washington Laboratories Academy at http://wll.com/academy.

PRODUCT SAFETY SEMINARS

Understanding Ground Resistance Testing - A One Day Training Seminar - AEMC Instruments (www.aemc.com) This one day course offers the information needed to understand testing of grounding systems. Through a combination of classroom instruction and hands-on demonstrations attendees learn the various types of ground resistance test, proper application and how to operate equipment used in conducting these tests.

2012 Schedule

- February 7, 2012 - Miami, FL
- March 6, 2012 - Arizona
- April 3, 2012 - Kansas City, Kansas
- May 1, 2012 - Baltimore, MD
- June 5, 2012 - Cleveland, OH
- July 10, 2012 - Spokane, WA
- September 11, 2012 - Burlington, VT
- October 4, 2012 - San Antonio, TX
- November 6, 2012 - Palm Springs, CA

For more information please visit www.aemc.com/techinfo/Seminars/Ground_Resistance_Testers/ground-seminar-listings.html.

Compliance Tech University, founded by ED&D (www.ProductSafeT.com), offers the following seminars in electrical product safety covering topics:

Laboratory, Measurement, & Control Equipment - a three-day course designed to help participants understand UL/CSA/EN/IEC61010-1 requirements. Hands-on training to perform the tests. Designing for Compliance: May 15-17, 2012 and October 9-10, 2012

Ingress Protection - a two-day course designed to help participants understand EN/IEC60529 & UL/CSA/EN/IEC60950-22 requirements. . Hands-on training to perform the tests. Designing for Compliance: June 12-13, 2012 and October 24-25, 2012

Information Technology Equipment - a three-day course designed to help participants understand UL/CSA/EN/IEC60950-1 requirements. Hands-on training to perform the tests. Designing for Compliance: July 17-19, 2012

Electrical Medical Equipment - a four-day course designed to help participants understand UL/CSA/EN/IEC60601-1 requirements. Combined 2nd and 3rd Edition based course. Hands-on training to perform the tests. Designing for Compliance: August 21-24, 2012

Hazardous Location Equipment - a three-day course designed to help participants understand UL/CSA/EN/IEC60079-0 + particulars, CE-ATEX, IECEx standards & code requirements, UL/CSA standard transition to IEC harmonized, Methods to design for compliance including intrinsically safe, purged/pressurized, & explosion proof. September 18-20, 2012

Please visit ED&D's website for dates, locations or to register.

MET Laboratories - (www.metlabs.com) offers seminars at different locations throughout the year. Visit their website for additional details. Here is a list of the currently planned seminars, dates and locations: **NEBS Testing Seminar** - Santa Clara, CA: April 26, 2012 and Austin, TX: October 30, 2012

Medical Device Product Safety Testing Seminar - Austin, TX: May 17, 2012

MIL-STD Testing Seminar - Baltimore, MD: May 31, 2012 and Santa Clara, CA: June 14, 2012

Hazardous Location Product Safety Testing Seminar - Houston, TX: June 12, 2012

Annual Global Product Compliance Seminar - Crab Feast - Baltimore, MD**:** September 13, 2012

Wireless Testing Seminar - Santa Clara, CA: September 20, 2012 and Baltimore, MD: September 27, 2012

TÜV SÜD Academy (www.tuvamerica.com) offers one, two, three and five day training sessions on a variety of topics throughout the year. Please visit the company's website for further information.

UL University is UL's training and advisory services business unit, providing safety and compliance-related knowledge solutions that facilitate product development and create safer working environments for people. UL University's comprehensive service offerings are designed to help customers access first-hand, real-time, industry-critical information. In addition to comprehensive coverage of UL standards, UL University addresses specific topics intended to help customers and constituents design and/or install safer products, increase efficiency and realize improved speed to market.

Following are some of UL University's featured offerings:

- Standards Training and Product Safety
- Electromagnetic Compatibility (EMC) Engineering
- Audio/Video, Information Technology and Communications Technology Equipment
- Global Market Access
- Hazard Based Safety Engineering

For more details about UL University's extensive training offerings, advisory services and more, please visit www.uluniversity.us.

Washington Laboratories offers Product Safety Seminars through their Washington Labs Academy. Visit them online for topics, locations and dates (http://wll.com/academy.html).

ESD SEMINARS

The ESD Association holds educational opportunities throughout the year. For full details visit the ESD Association website at www.esda.org .

The current schedule:

ESD Standards Basics for EPA, Ionization Issues and Answers for the Program Manager - March 13, 2012 - Austin, TX

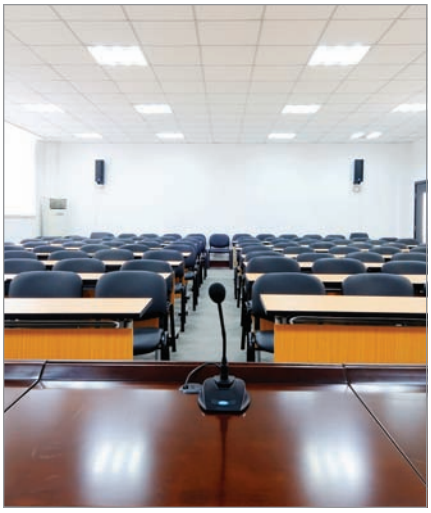
Packaging Principles for the Program Manager, Cleanroom Considerations for the Program Manager: March 14, 2012 - Austin, TX

Essentials for ESD Programs Factory: Technologies, Controls, Procedures: May 8-9, 2012

ESD Training for Internal Quality Auditors and Supplier Quality Engineers: May 10, 2012

ESD Basics for the Program Manager: May 16, 2012 - Bloomington, MN

How Tos of In-Plant ESD Auditing and Evaluation Measurements: May 17, 2012 - Bloomington, MN



Stephen Halperin & Associates (www.halperinassoc.com) - offers training courses throughout the year. Check their website for 2012 training information.

Doug Smith offers the following ESD class in 2012. For additional information visit his website www.dsmith.org or email Doug for details: doug@emcesd.com.

ESD: Design and Troubleshooting at the System and PWB Level Newport Beach, CA week of April 4, 2012

Dr. Steven Voldman offers the following courses throughout 2012. Visit his website www.voldmanllc.com for more information.

Course Titles and Offerings for 2012

- ESD physics
- ESD physics and devices
- ESD circuits
- ESD in radio frequency technologies
- ESD in Gallium Arsenide
- ESD Failure Mechanisms
- Latchup
- ESD design and synthesis
- ESD and latchup computer aided design
- Innovation, inventing and patenting

OTHER PROFESSIONAL DEVELOPMENT SEMINARS

iNARTE Certified Laboratory Auditor, (iNCLA) Training and Credentialing Program - iNARTE (www.narte.org) For more information and to register visit: www.narte.org/h/iNCLAConference.asp.

iNARTE also offers the following workshops throughout the year. Please visit their website for additional details www.narte.org: HPEM/HEMP/IEMI Workshop, Personal Development through Engineering Excellence, Workshop on ANSI C63.10 - 2009: Testing Unlicensed Wireless Devices .

PRIVATE/CUSTOM SEMINARS

Many experts offer private seminars designed to train select personnel at your location. These seminars offer companies an opportunity to train multiple compliance personnel with a customized approach designed for their needs. Following is a list of experts who offer private seminars.

Best ESD Technical Services (www.bestesd.com) - Classes and seminars can be arranged on different topics - from basic introduction to highly-specialized classes on a particular subject of ESD or EMC/EMI relevant to your applications.

Cherry Clough Consultants (www.cherryclough.com) - Seminars allow for a customized approach to training in basic and advanced EMC design, the EMC Directive and EMC engineering practices for EMC testing techniques and EMC functional safety.

DLS Electronics Systems (www.dlsemc.com/1101) - DLS experts offer practice oriented seminars and workshops on EMC design and regulatory compliance issues.

Kimmel Gerke Associates, Ltd. (www.emiguru.com) - offers seminars on EMC design fundamentals and techniques for ensuring EMC Compliance.

Montrose Compliance Services (www.montrosecompliance.com) - offers worldwide customized training programs on achieving EMC compliance, EMC design fundamentals and techniques.

Henry Ott Consultants offers one to three day EMC seminars (in plant and public) on over 25 different topics, including "Partitioning and Layout of Mixed-Signal PCBs" and EMC Considerations in Switching Power Supply Designs". Please visit Mr. Ott's website for additional information www.hottconsultants.com/seminar.html.

Wyatt Technical Services, LLC. - An independent consulting firm that specializes in EMC design, troubleshooting and training services to commercial and industrial manufacturers with global distribution in the consumer, computer, network & telecommunications, industrial and scientific industries. Visit www.emc-seminars.com for further information.

ON-LINE TRAINING

If webinars are your preferred style of learning, many companies sponsor on demand style webinars for viewing at your convenience. Please visit the following sites to view topics and make your selection.

Associated Research (www.asresearch.com) - offers webinar programs providing detailed information on many aspects of electrical safety testing. They are a valuable resource that can be used to learn more about common electrical safety tests.

Hipot Testing Basics - January 18, 2012: 1-2 PM CST

Electrical Safety Testing Your Product - A Complete Overview - February 15, 2012: 1-2 PM CST

Ground Bond and Ground Continuity Testing - March 7, 2012: 1-2 PM CST

Solar Panel Testing - March 21, 2012: 1-2 PM CST

Earth and Enclosure Leakage Testing - April 18, 2012: 1-2 PM CST

Hipot Testing Your Product - May 16, 2012: 1-2 PM CST

A Crash Course in Safety and Circuit Theory - June 13, 2012: 1-2 PM CST

Understanding the Features (settings) of your Hipot Tester - July 25, 2012: 1-2 PM CST

Hipot Testing in a Production Environment - August 15, 2012: 1-2 PM CST

Medical Device Testing - September 12, 2012: 1 -2 PM CST

Succeeding in Advanced Hipot Test Applications - October 17, 2012: 1-2 PM CST

Is Repeated Hipot Testing Destructive? - November 14, 2012: 1-2 PM CST.

Intertek Academy (www.intertek.com/training) - offers educational opportunities in quality, safety and Energy Efficiency. Intertek's 2012 line-up of technical seminars, webinars, workshops, training events, conferences and White Papers provide in-depth guidance for understanding new standards and specs, innovative techniques and compliance. Visit their website for dates and details.

Kimmel Gerke (EMI Guru) is offers webinars throughout the year. Please visit their website for details: www.emiguru.com.

MET Laboratories offers this free webinar - **Laser Product Safety Compliance Webinar -** This free webinar will cover the specific standards and regulations in effect as they apply to photonics, and touch on related applicability with respect to product design, risk, and management. January 24, 2012, 1:00 p.m. -2:00 p.m.

MET Laboratories also offers on-demand viewing of past webinars at: www.metlabs.com/News-and-Events/Seminars-and-Webinars.aspx

TUV SUD America (www.tuvamerica.com/tuvnews/webinars.cfm) - TUV offers webinars and online seminars in the areas of Safety, EMC, Management Systems and Competency Assessments.

UL University (www.uluniversity.com) - offers a selection of online courses including self-paced eLearning and live and pre-recorded webinars. UL's professional design staff can also create custom eLearning solutions to meet your specific needs. In addition to an extensive portfolio of online training courses. Visit their website for full details.

INDUSTRY SYMPOSIA AND TABLE TOP PROGRAMS

These annual symposia, sponsored by the IEEE's EMC and Product Safety Engineering Societies, and the ESD Association, are an excellent resource for extensive technical training, and exchange of new ideas and technical concepts. The benefit of attending these events is that attendees can sample a vast array of workshops quickly and efficiently while networking with colleagues and professionals with the same interests.

EMV 2012 - Dusseldorf , Germany - February 7-9, 2012. Visit their website for additional details (www.mesago.de/en/EMV/The_Conference/Welcome/index.htm).

28th International Review of Progress in Applied Computational Electromagnetics (http://aces.ee.olemiss.edu/conference/2012/conference.php) - Columbus, OH, April 10-14, 2012

IEEE EMC Society - International Symposium on Electromagnetic Compatibility (http://2012emc.org/) Pittsburgh, PA, August 5-10, 2012.

34th Annual Electrical Overstress/Electrostatic Discharge Symposium (http://esda.org/symposia.html) - Westin La Paloma, Tucson, AZ, September 9-14, 2012.

34th Annual Symposium of the Antenna Measurement Techniques Association (AMTA) (www.amta.org) - Bellevue, WA, October 21-26, 2012.

EMCUK - Newbury, UK - October 9-10, now in the 9th year, EMCUK can contribute its success to being an event dedicated to industry by industry. It has firmly established the position of the "must be at EMC show" a true high profile Networking event the Exhibition being supported by top flight hands on interactive Training and Technical Forums. Visit www.emcuk.co.uk/ for additional details.

IEEE Symposium on Product Compliance Engineering (www.psessymposium.org) Portland, OR, November 5-7, 2012.

EMC China 2012 - Shanghai Everbright Convention & Exhibition Center, Shanghai, China, November 5-7, 2012 (www.emcexpo.com)

Sixth Asia-Pacific conference on Environmental Electromagnetics (CEEM'2012/Shanghai) to be held in Shanghai ,China at Nov 6-9, 2012 (http://emc2012beijing.com).

IEEE EMC SOCIETY REGIONAL EVENTS 2012

AMTA Regional Event - Williamsburg, VA: March 5, 2012 - Erik Vedeler, Head of Electromagnetics and Sensor Branch at NASA Langley Research Center will be speaking. Colonial Williambsburg Lodge. Contact Janet O'Neil, ETS Lindgren phone: (425) 868-2558 or email: j.n.oneil@ieee.org.

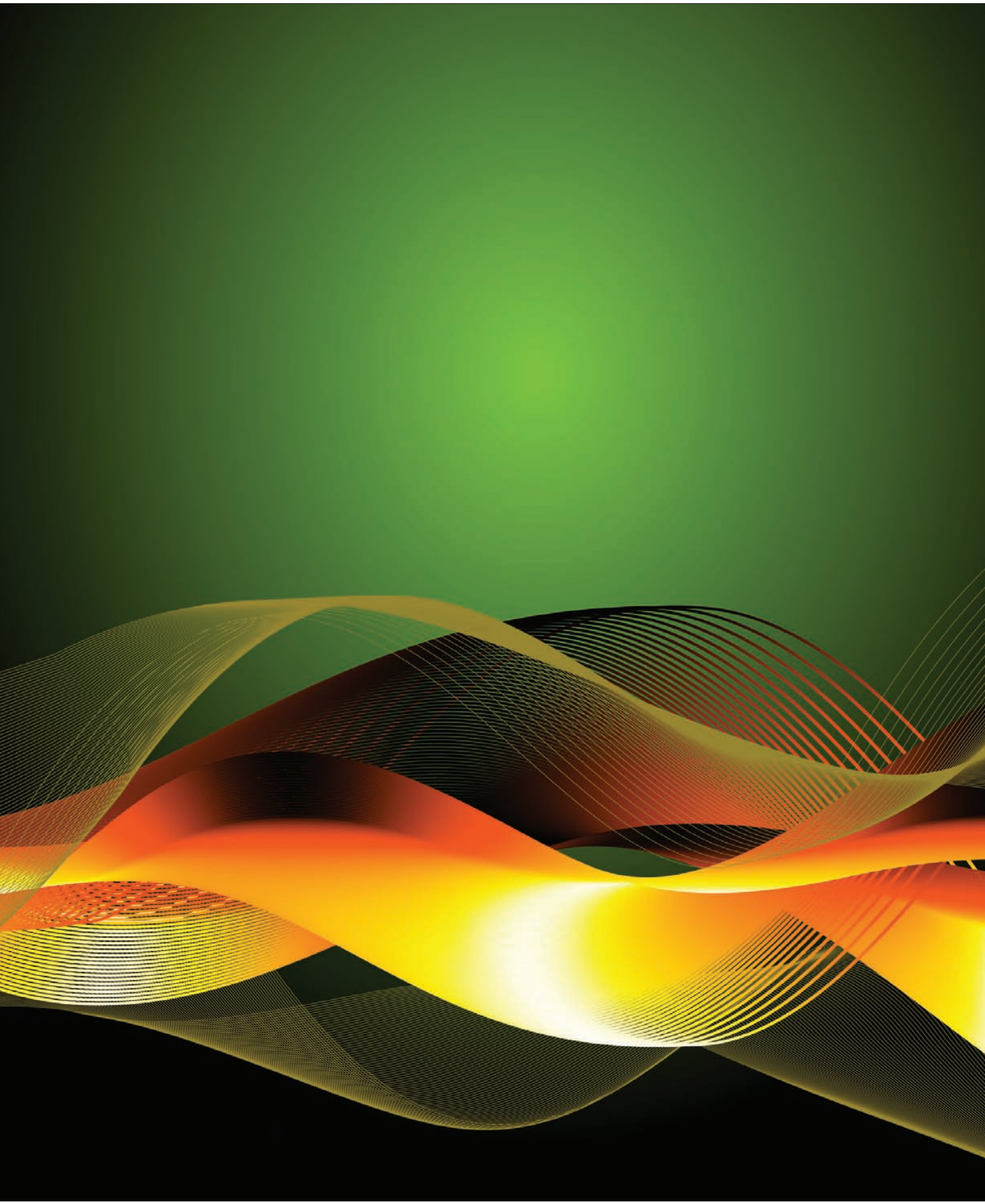
Milwaukee, WI: March 27, 2012 - Jeremy Campbell, PE will be speaking on Designing a Product to Meet Today's Emission and Immunity Requirements. Crown Plaza Hotel - Milwaukee Airport. Contact Jim Blaha at GE Healthcare, Phone: (262) 548-2978 or e-mail: jblaha@ieee.org or James.Blaha@GE.com.

Chicago, IL: May 8, 2012 - Multiple speakers on various topics. Itasca Country Club, Itasca, IL. Contact Frank Krozel, Electronic Instrument (630) 924-1600 or frank@electronicinstrument.com.

Detroit, MI: May 16, 2012 - Todd Hubing will be speaking on Automotive EMC topics. Canton Summit on the Park. Contact Scott Lytle at Yazaki North America, (734) 983-6012 or scott@emcsociety.org.

Minneapolis, MN: September 2012 - Ramada Mall of America, Bloomington, MN. Contact Dan Hoolihan Phone: (651) -213-0966 or email: danhoolihanemc@aol.com

Santa Clara, CA: October 11, 2012 - Doug Smith on ESD and Dr. Ege Engin on Power Integrity. Biltmore Hotel & Suites. Contact Eriko Yamoto, TechDream, Inc. Phone: (408) 483-5413 or email: eriko@tech-dream.com.



Systems Response to Electrostatic Discharge
Part 2

Applications of impulse waveform research toward evaluation of product performance

BY W. MICHAEL KING

A NOTE FROM THE AUTHOR

The research references provided in this article occurred between 1978 and 1987, and are as applicable today as they were then, when they advanced understanding of ESD phenomena and through that, the ESD state of the art of knowledge.

These were the first reports to display that: ESD currents to a system do not increase in direct proportion to the initial electrostatic charge amplitude produced before the ESD event (e.g. low ESD voltages produce higher current than higher voltages); ESD spectra is greater than 1GHz with rise-times much faster than 1.0 nanosecond (e.g. 50 pSec to 200 pSec); the ESD "equivalent network" is not a single R-C network as previously thought, but rather a complex cascade of several networks, each with a different time constant; a "single ESD event" may be comprised of many events, even showing the approximate periodicity between each sub-event; suggested the initial impact of ESD was from boundary charge displacements of electric fields; detailed the ESD impulse waveforms and currents related to many common conditions (finger-tip direct, humans discharging through metal objects, humans discharging through furnishings); described how systems produce ESD amplitude-response dependencies owing to the different spectra of ESD events at different amplitudes; and, that compliance with a higher amplitude of ESD (e.g. 15kV) does not assure that adequate immunity will be exhibited at lower (e.g. 2kV) levels. During these research efforts the "human body concept", the "human with metal object" concept; the "furnishings impact" equivalent values; the vertical and horizontal coupling planes for "radiated ESD equivalents" were all devised. The impact on the international community was sufficiently extensive starting circa 1979 that approximately five years of confirming work were required for the reports to achieve broad acceptance.

Since that time this work has been thoroughly disseminated and various standards and standard practices for ESD have been published, many (if not most) of which extend from these early research efforts. In the process of standardization some of the baseline foundational information delineating ESD mechanisms have been diffused. It didn't help that when the IEEE converted published symposia archives to microfiche some years ago, much of the original photographic data for ESD event waveforms was lost as the contrast of the original printed publications became often degraded to black rectangles. Thanks to the invitation of The Editor of this magazine, you have the opportunity to travel with me, back to history, and back to this future to gather a broad understanding of the underlying boundary charge displacements that establish ESD, catch a glimpse of the propagational spectral mechanisms that impact systems-product performance, and to review foundational information that extends to this day.

W. Michael King

(For further reading, I suggest the book "Electrostatic Discharge" Third Edition by Michel Mardiguian, Wiley/IEEE Press, ISBN: 978-0470-39704-6, and ANSI, C-63.16-1994 "Guide for Electrostatic Discharge Test Methodologies and Criteria for Electronic Equipment.")

It has been recognized that the spectral bandwidth of the ESD event, considered as a continuum, is highly dependent on the electrostatic initialization amplitudes that are evident immediately prior to the displacement of the stored energy through the ESD event.

ESD AMPLITUDE DEPENDENCIES

Through the referenced research efforts, it has been recognized that the spectral bandwidth of the ESD event, considered as a continuum, is highly dependent on the electrostatic initialization amplitudes that are evident immediately prior to the displacement of the stored energy through the ESD event.

In general:

a. High ESD initialization amplitudes produce relatively lower frequency spectral bandwidth distributions.

b. Lower ESD initialization levels produce extremely high frequency (extending into microwave) spectral bandwidth distributions.

c. Mid-range ESD levels (5 to 10 kV) develop spectral bandwidth distributions that appear to center in the general area of 100 MHz (which is approximately midrange in the spectral bandwidth envelope of the available ESD spectral probabilities).

The ESD susceptibility dependencies intrinsic to system response are obviously influenced by the conditional mechanisms described above since these factors impact various ESD response excitations of related components of the product or system (e.g. cables or casework). In and of themselves, these conditional factors can alter the susceptibility performance of system products in terms of ESD response amplitude, response mechanism, and response characteristics with a causal relationship to the conditional basis.

Suppose, for example, that the interface circuit of a desktop product has a design weakness to common-mode currents with risetimes (spectra) in the area of approximately 5 nanoseconds, but not too common-mode current components with risetimes (spectra) at 1 nanosecond (or faster) or 20 nanoseconds (or slower). According to the referenced ESD research information, ESD impulse waveforms with risetimes in the 5 nanosecond range are exhibited in the area of approximately 7 to 10 kV of ESD initialization amplitudes. When the product is placed on a metal-top desk, a distributive transfer impedance is established that will effectively bypass a significant portion of the 5 nanosecond ESD component energy through the case or cabinet structure (through the desk-to-ground), circumventing significantly the excitation of the weakness of the common-mode design in the interface.

Should the same unit described above be placed on any non-conductive tabletop, however, a larger portion of the ESD levels with the 5 nanosecond component will be available to excite the weakness in the interface design. Assuming no other product susceptibility effects, the ESD responses exhibited will be a "window response" effect where the product responds in the area of 7 to 10 kV, but only when the product is positioned on a desk or table top that is non-conductive.

Due to these fundamental propagational responses in common-mode product/system design mechanisms, so-called "mystery" ESD responses that can be encountered in various products may be understood. These responses are identified in the paragraphs that follow.

OVERVIEW OF ESD PROPAGATIONAL PATHS

Consider the ESD propagational paths that are represented in Figure 1, where:

Z_s = source impedance of ESD event;

Z_t = distributed transfer impedance of product case-to-ground;

Z_p = impedance of external power to ground (including ground);

Z_{ct} = distributive transfer impedance of cables to ground;

Z_d = directly conducted connection impedance of interconnected product to ground;

I_c = case incident impulse current;

I_{if} = interface cable exit current;

E_a = aperture-produced fields;

E_i = impulsive field gradient.

ESD PROPAGATIONAL DESCRIPTION

The diagram in Figure 1 generally describes the fundamental propagational ESD paths (including interface) that have been described in overview in the preceding paragraphs. The description that follows delineates the interaction and significance of various spectral ESD components that are associated with these paths.

Initial Impulse Effect

On application of the initial excitation ESD impulse, through its intrinsic source impedance Z_s and an impulsive field displacement E_i, is instantaneously produced in the region of the charged structure that is causing the discharge. The specific size of this field displacement has a causal relationship

The displacement of the localized field can result in aperture currents that develop as a result of propagation of the field and incident currents across apertures (slots or holes) in the product's case structures.

to the size and shape of the structure causing the discharge, as well as the "load plane" (product surface) that is being subjected to the discharge as it opposes the structure being discharged.

The propagational activity of this initial impulse field displacement is very significant in the area of low ESD initialization levels, particularly below 5 kV. In that range, a surface-to-surface distribution of transfer impedance is established between the charged structure and the load plane, which results in intense impulse currents (which can range to approximately 100 amperes) and results from very severe field intensities (approximating 3 megavolts per meter). [2, 3 and 5] Further explanations are provided in Figure 2 (page 58).

System Response Significance: Initial Field Spatial Displacement

The significance of the initial ESD impulse field displacement on a systems product is found in two immediate paths.

First, the displacement of the localized field can result in aperture currents that develop as a result of propagation of the field and incident currents across apertures (slots or holes) in the product's case structures. These apertures, given these excitations, function as slot antennas that produce field radials inside the product under evaluation. The effect on the product of these immediate fields, that are typically very intense in the close proximity of the slot-apertures, is dependent on the location of circuitry with respect to the slot-aperture, and the coincident match of the bandwidth of the circuitry with the effective propagational (transmitting) bandwidth of the slot-aperture incident field.

In the example above, the first interrelationship between ESD initialization amplitude and system-product response is encountered. Since it has been well established that ESD impulse bandwidths exhibit spectra well above 1 GHz at lower initialization amplitudes (in the references listed) it is to be anticipated that the size of many slots-apertures in typical products are efficient as antennas at lower initialization levels and much

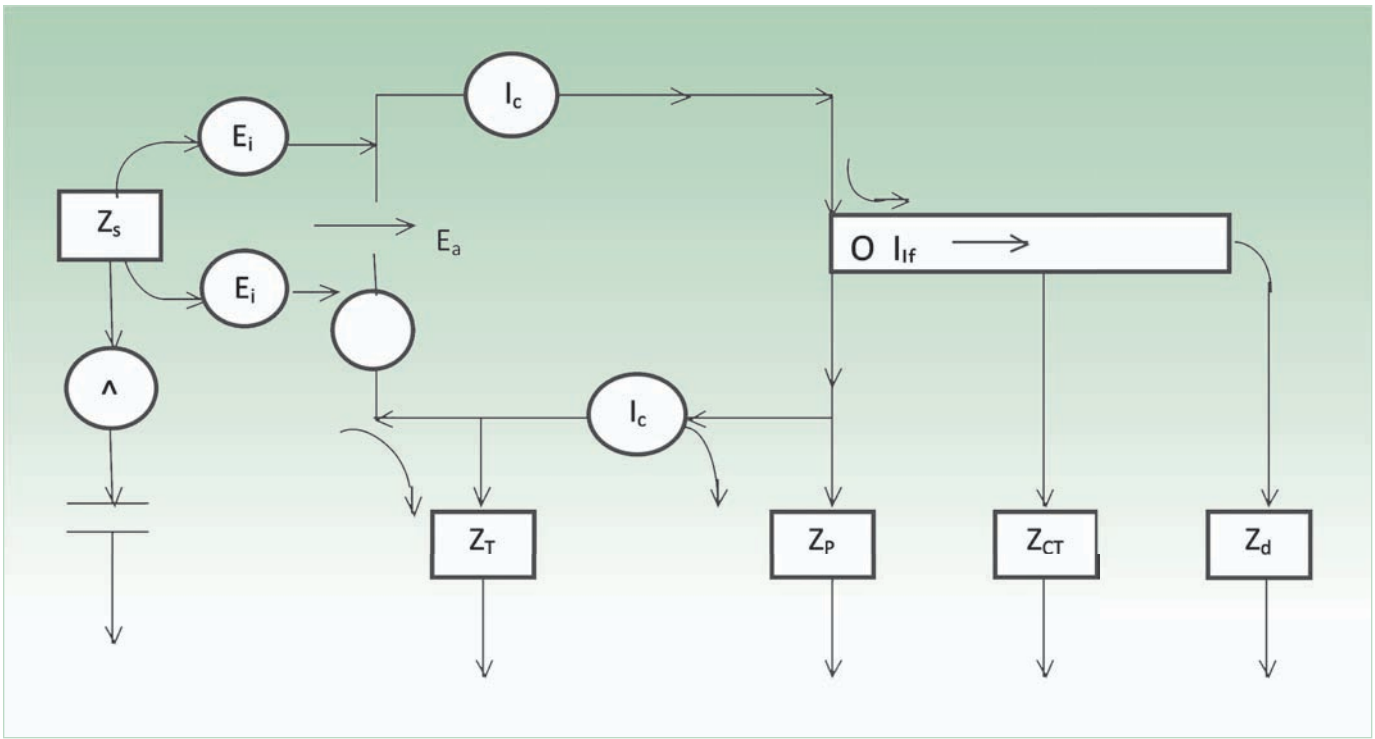
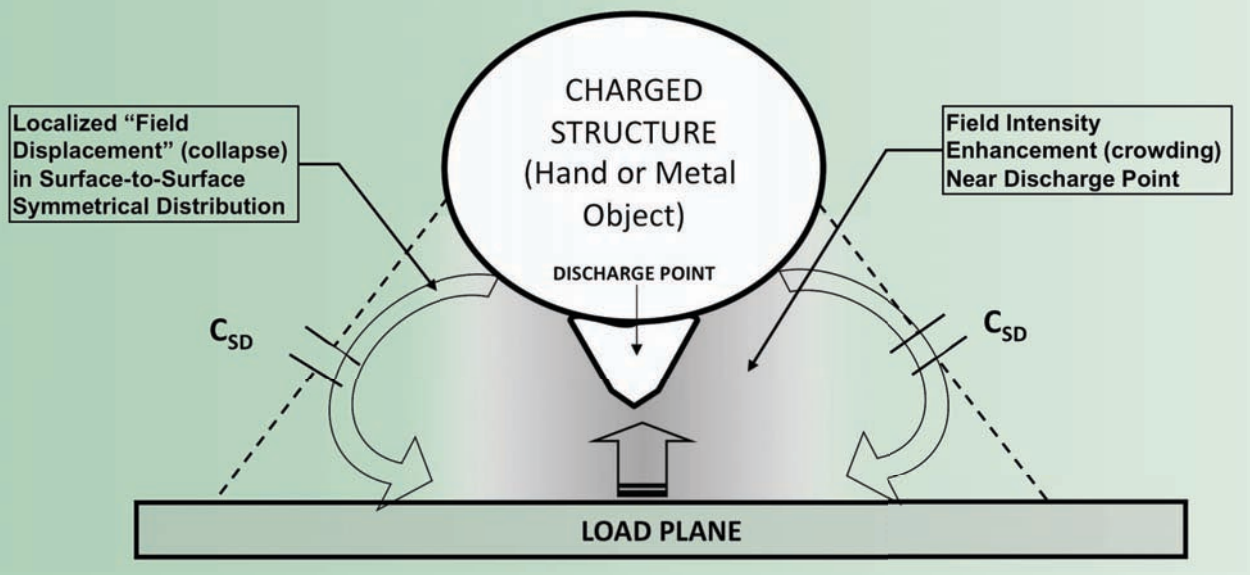


Figure 1: Propagational Overview



The initial ESD "circuit equivalent" is a spatial electric field displacement (collapse) between the charged structure (e.g. a hand) and a load plane, with the field intensity collecting at the discharge point. This displacement is between two structures, and is not dependent upon earth ground. This can be represented by distributed capacitance as a "surface distribution" that exhibits a "very low" transfer impedance function.

Figure 2a: Approximation: Initial impact of spatial field distribution yielded by review of ESD waveform characteristics exhibited in nature

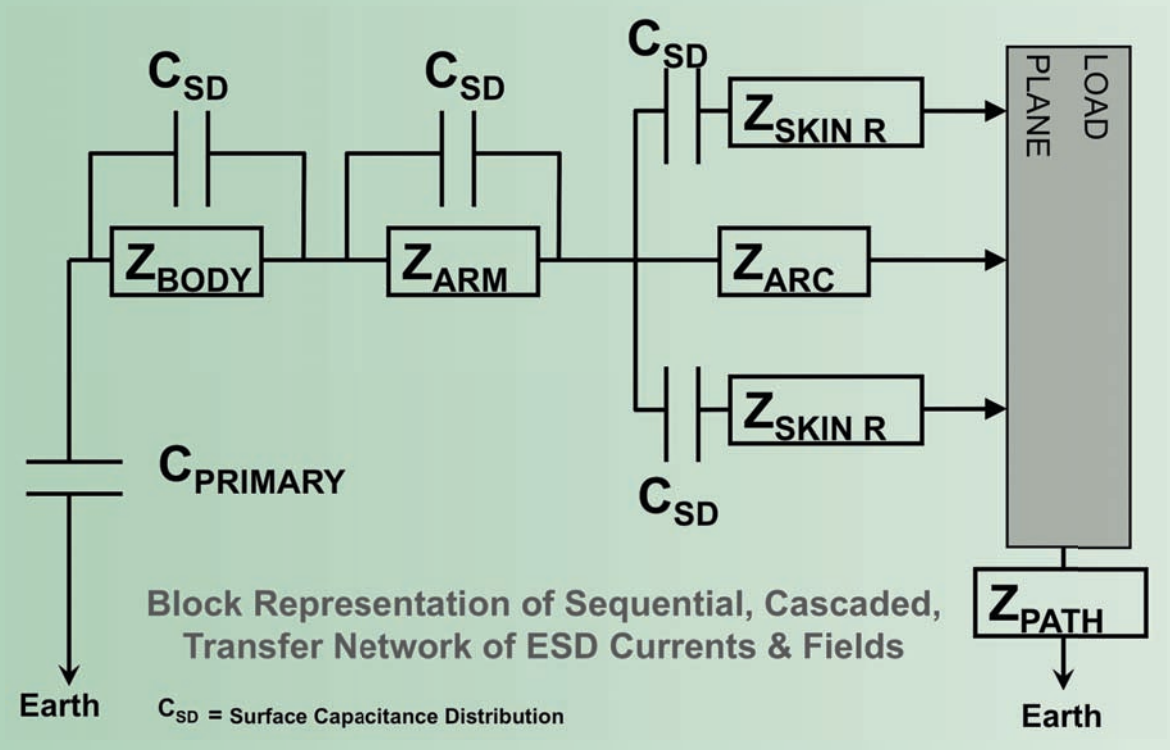


Figure 2b: Block diagram overview of ESD equivalent network

COMMENTS

Equivalent network implications for human finger-tip direct ESD and with small-metal objects intervening in the ESD path:

- → **The Capacitance of "surface distribution" will, in probability, vary between equivalent values of approximately 1 pfd and 20 pfd for the "finger-tip" and "small metal object" conditions, depending on the angularity of the hand with respect to the load plane as a localized field displacement.**
- → **The "primary" Capacitance will, in probability, vary between equivalent values of approximately 100 pfd and 200 pfd for the "finger-tip" and "small metal object" conditions, since this value is presented to Earth (and space) from the human body.**
- → **For "finger-tip" conditions the "equivalent impedance" of "skin resistance" and "arc impedance" for the "first effect" of surface-field displacement, appears to approximate 200 Ohms. In this same "finger-tip" condition, the higher-voltage "second effect" impedance appears to approximate 1,000 Ohms.**
- → **For "small metal object" conditions, the "equivalent impedance" of "skin resistance" and "arc impedance" for the "first effect" of surface-field displacement, appears to approximate 20 Ohms. In "metal-object" conditions, the higher-voltage "second effect" impedance appears to approximate 150 to 200 Ohms.**

less efficient at higher levels due to the reduced spectral bandwidth of the higher level ESD impulse continuum. (Apart from slot apertures and owing to the limitations of various impedances in the casework at EHF, the same conclusion may be advanced when relating the general shielding effectiveness of case structures at these bandwidths.)

Assuming that in the immediate proximity of the excited aperture "antenna" there is an active circuit that has an intrinsic admittance (susceptibility-sensitivity) bandwidth complementing (coinciding with) the efficiency bandwidth produced by the ESD impulse propagating across the aperture, then a product susceptibility response is probable. In recent years, this response is typically *more probable* than in the past since many circuit and logic families are capable of exhibiting very high admittance bandwidths compared to older logic devices.

This affect is far less likely with the ESD initialization levels set at high levels. The simple basis for this statement is that the spectral bandwidth developed by the higher ESD initialization amplitudes are far less likely to produce efficient/coincident matches between the emission spectral capabilities of the product apertures and the spectral level distribution of the ESD impulse. Without such a match, aperture propagational efficiency is not developed, and consequently the probability of product susceptibility response becomes far less.

Second, the localized field displacement results in a case current that is propagated to ground (rather than surface-to-surface as in the previous example) through the distributive transfer impedance Z_t. Here, the second interrelationship between ESD initialization amplitude and system-product response is encountered. The Z_t case in impedance of the product will probably exhibit a broader bandwidth effect of response than the previously described localized service-to-surface distributions. This is because the Z_t case impedance operate throughout a (probably) larger structure: the case itself! The comparatively large surface area of the case is excited not only by radiated field displacements, but by the direct conduction of current I_c. The transfer of energy across the distributive case impedance (Z_t) results in the enhancement of the case-to-ground field gradient (E_i) that is driven across the case as a result of the conducted current.

Case-conducted Current Effect

The next effect in the propagational path of ESD in a product is touched on in the above paragraph. This is the development of a case-conducted current (I_c) from the product surfaces to ground. The energy of this path flows through the distributive transfer impedance (Z_t) to ground, and additionally through the conduction impedances of the power lines (Z_p) and the interface cables (I_{if}).

System Response Significance: Distribution to Earth and Cables

The propagation of the impulse case current into the distributed transfer impedance of the case to ground is paralleled by the conductive path of the power cable and the signal/data interface cable(s). These cables will exhibit "antenna efficiency" that is a development of the common-mode impedances of the cables and their respective termination points. These cables (which typically exhibit far greater inductance than the casework) will interact with the distributive transfer impedance of the case (usually capacitance-based) to result in an L-C resonance.

The inductive and resonance effects noted above suggest that another value of spectral bandwidth dependency will be produced. It is entirely reasonable that these values will be encountered

Generally, data and signal interface cables are capable of propagating faster risetime impulse currents than are power cables, since many interface cables are shielded and consist of many parallel wires which mutually combine to reduce common-mode inductance and impedance.

at ESD amplitudes that are much higher than the lower-initialization level effects first described above. This concept is advanced due to the fact that the inductive properties of cables typically limit the efficiency of energy transfer at very high frequency spectral distributions, which is the occupancy domain of lower-initialization levels of ESD.

The probability is that the interaction of the cases and cables, as they propagate the spectral components of the ESD continuum that is efficient for them, will be responsible for susceptibility effects with varying probability above 5 kV due solely to these factors of energy transfer efficiency.

Interface Impulse Effects

The final propagational effects of system-product ESD are found as conducted currents in interface cables, including power line cables. Generally, data and signal interface cables are capable of propagating faster risetime impulse currents than are power cables, since many interface cables are shielded (resulting in lower inductance) and consist of many parallel wires which mutually combine to reduce common-mode inductance and impedance. (This is an effect that functions in the same manner as litz wire.) Power cables frequently are not shielded and do not consist of many parallel separate conductors (unlike interface cables), and accordingly tend not to support the faster impulse risetimes of ESD due to their increased inductive properties.

System Response Significance: Interface Effects

Although exceptions may be found to any rule, the probability (considering cable-conducted ESD impulse currents) is that well-shielded interface cables (with well-terminated shields) will either not contribute to significant ESD product susceptibility or, if they do, it is more likely that susceptibility will be exhibited at higher ESD initialization amplitudes, where the risetimes produce lower frequency spectra and the conducted efficiency of the cables is greater. Unshielded (poorly shielded or well-shielded but poorly terminated) data and signal cables can result in higher-frequency (i.e., lower ESD amplitude) responses because localized fields around the cables or localized high frequency transfer impedances can effectively bypass the normally-anticipated conducted energy effects that are associated with the direct cable inductance. (However, it is possible to design a common-mode loop flow architecture in a product that is sufficiently inadequate for susceptibility considerations, to the point where it may become economically or technically difficult to provide enough cable shielding without resorting to additional means, such as the utilization of lumped common-mode inductance in the interface *ahead* of the interface cables shields.)

Under these conditions, the cables in effect become receiving (or localized loading) antennas with effective areas (efficiencies) that will *vary importantly with cable position* consequently resulting in instability of the ESD performance since antenna area and efficiency is related to the bandwidth of efficiency which, of course, is related to the ESD amplitude/waveform continuum.

ESD RESPONSE INSTABILITY IN NATURE MAY BE USEFUL TOWARD PRODUCTION COST EFFECTIVENESS

Descriptions of the dynamic interactions between the ESD impulse continuum (with its related initialization amplitude-dependent spectral energy shape migrations) and various systems/products response mechanisms (operating in conjunction with product/system physical arrangement conditions) all combine to develop significant variations in the observed ESD performance of the system. These variations may be encountered both in the measured ESD threshold-amplitude of response, as well as the exhibited operational response characteristics. These variations in response and performance may be recognized as anticipatable and "normal" to the nature of the spectra of the ESD continuum.

Although absolutely normal to the physics of ESD, these variations can result in confusion and consternation in personnel who may be attempting to evaluate the performance of a system or product during ESD impulse exposure. This is particularly true because the nature of ESD dynamic physics defies the common wisdom that views the ESD phenomenon simply as an effect that proportionally ascends in difficulty with ascending ESD amplitude. The problem with this approach is that it incorrectly assumes that the higher the ESD initialization amplitude, the worse the systems response will be. Since the inverse is frequently true based on understanding the spectral and

The conclusions yielded and supported through research of ESD dynamics directly contradict the traditional viewpoint both theoretically and empirically that higher amplitudes will be the worst for product/systems performance.

propagational influences, it is of little wonder that confusion results.

The conclusions yielded and supported through research of ESD dynamics directly contradict the traditional viewpoint both theoretically and empirically that higher amplitudes will be the worst for product/systems performance. These relatively recent research efforts affirm that the study of ESD dynamics (and the related systems/product response) is actually a study of dynamic impulsive spectral distributions wherein the excitation amplitudes have significantly large field intensities that accompany the field displacements (megavolts per meter), large impulse currents (to over 100 amperes peak) and extraordinarily fast and variable risetimes (tens of picoseconds to tens of nanoseconds). All of these components propagationally interact in various ways with specific response mechanisms of a product/system design and the installation conditions of the product or system. Understanding of the systems and product responses, along with their associated variabilities, may be gained only through understanding the dynamic interactions between the ESD continuum and the system's spectral propagational mechanisms.

The variabilities that are natural to the physics of ESD and the propagational mechanisms of products may be viewed as instabilities by test personnel. The natural (human) reaction derived from the viewpoint of instability is to seek means of achieving stability, particularly during product validation tests. Toward this end, many attempts have been made at stabilizing the ESD test. Potentially, however, there are two major drawbacks to stabilizing the ESD test methodology (and consequently the ESD test results), especially if the means chosen to achieve the stabilization fixes the ESD pulse waveshape to the point that it cannot vary as it does in the "real world". Drawn from conclusions based on the research, these potential drawbacks are:

a. exaggerating the ESD susceptibility of the product under evaluation, resulting in exacerbated production costs to "fix" the overstated problem; and,

b. understating the ESD susceptibility of the product under evaluation, resulting in inadequate performance margins in the installed base.

Exaggerated ESD Responses

Having established the importance of the ESD amplitude-waveform dependencies toward system/product performance, it may be recognized (by studying the research noted in the reference list) that if a simulated test method were to produce ESD waveforms which happened to coincide with the worst-case spectral response windows from a product, the ESD responses from the product would be exaggerated in potentially two ways.

First, the constant (probably repetitive) simulated waveshape would over-emphasize the probabilities of the response since "natural" ESD impulse shapes are highly variable at any given initialization amplitude, as shown in the listed references. Second, the characteristic severity of the response may be magnified because more impulses of a possibly worst-case nature impact the probability timeframe of a systems logic sequence. Third, many standards dramatically over-test systems for the most probable ESD condition: humans direct through fingertips.

Understated ESD Responses

In the same manner that a stabilized ESD test approach might happen to unrealistically coincide with the worst-case response window of a system, it is also possible that the stabilized waveform might not match the susceptibility admittance characteristics of a product. This raises the possibility that the "stabilized" test would not produce the excitations that would be found in the natural environment and otherwise cause the system to be susceptible. Although the initial production costs might be lower for the product, the eventual costs could be unacceptably high in terms of both finance and customer goodwill due to the potential of product/system field performance problems and the attendant retrofit need.

CONCLUSION

Given the evidence based on accepted research results, it is reasonable to suggest that the historical concept of learning the characteristics of the ESD waveform continuum as it actually exists and replicating that continuum both in waveshape and waveshape-probability during simulation tests during product evaluation may actually be the best approach, both in terms of product costs and accuracy of the simulation performance result from products/systems. This is despite the fact that it characteristically may cause a certain amount of test instability which in turn causes a certain amount of confusion and consternation among test personnel. It is possible that other simulation techniques that have been developed

It is possible that the current trend observed in efforts to "stabilize" the ESD dynamic waveform continuum in the interest of product-evaluation test efficiencies will eventually become recognized as a misplaced, simplistic approach to a complicated and dynamic physics problem.

with a view toward simplifying and "stabilizing" the ESD test method may, in fact, be substituting test-lab efficiency for accurate and required ESD performance-measurement information that would serve as a vital predictor of product performance in the field. [8]. Further, it is possible that the current trend observed in efforts to "stabilize" (as opposed to "standardize") the ESD dynamic waveform continuum in the interest of product-evaluation test efficiencies will eventually become recognized as a misplaced, simplistic approach to a complicated and dynamic physics problem.

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(*) The Vertical Coupling Plane (VCP), Horizontal Coupling Plane (HCP), Incremental Level Test Requirements and incremental probability criteria were first devised and presented in these (and similar) documents.

(**) Note: This article is based on, and is an expansion of, the above published paper.

(the author)

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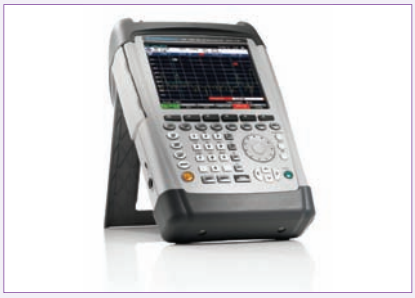
is a systems design advisor who has been active in the development of over 1,000 system-product designs in a 50 year career. He serves an international client base as an independent design advisor. Many terms used for PC Board Layout, such as the "3-W Rule", the "V-plane Undercut Rule", and "ground stitching nulls", were all originated by himself. His full biography may be seen through his web site: www.SystemsEMC.com.

Significantly, he is the author of EMCT: High Speed Design Tutorial (ISBN 0-7381-3340-X) which is the source of some of the graphics used in this presentation. EMCT is available through Elliott Laboratories/NTS, co-branded with the IEEE Standards Information Network.

New Analyzer Eases Installation, Maintenance and Analysis of Cable and Antenna Systems

Rohde & Schwarz, a leading manufacturer of test and measurement, communications and broadcasting equipment, has developed a handheld cable and antenna analyzer that features an advanced set-up measurement "wizard" to simplify the user interface. Optimized for cable and antenna measurements, the handheld ZVH Series analyzer's measurement wizard enables users to easily set up test parameters and execute all measurements. All analyzers in the ZVH Series allow technicians to set up, test and download files to their PC in three steps. The series is available in 3.6 and 8 GHz versions and has easy to update software options to add vector voltmeter and spectrum analysis measurement capabilities.



Capable of multiple measurements, including reflection, cable loss, distance-to-fault and transmission measurements, the ZVH Series analyzer provides a high dynamic range of up to 100 dB for transmission measurements. The product is lightweight and has a longer than average battery life. Contact Rohde & Schwarz through their website at www.rohde-schwarz.com.

TDK-EPC Publishes New Product Portfolio for 2011

TDK-EPC has just published a new product portfolio that includes ceramic, aluminum electrolytic and film capacitors, ferrites and inductors, high-frequency components such as surface acoustic wave (SAW) filter products and modules, piezo and protection

components, and sensors. Contents of the portfolio include:

- PFC power capacitors in the PhaseCap® Premium, =haseCap® Compact, PhaseCap® HD, PhiCapTM and MKV series
- power factor controllers in the BR604, BR6000 and BR70000 series
- multi-measuring interfaces in the MM160000/MM17000 series
- grid analysis tool MC7000-3
- capacitor contactors
- thyristor modules of the TSM-series for dynamic PFC
- harmonic filter reactors and discharge reactors
- accessories such as protective covers and casings, discharge devices

TDK-EPC Corporation's product spectrum offers customers a broad range of solutions from a single source, with a focus on power factor correction and power quality solutions for demanding markets in the areas of information and communication technology, as well as automotive, industrial and consumer electronics. The new publication can be downloaded at www.epcos.com/publications.

Compliance West, USA Builds the HTT-1R Tester to Meet Enhanced Safety Agency Requirements

Any EMI engineer working today knows that safety agencies are demanding more specific function test requirements. Compliance West, USA has introduced a new tester to meet this demand. The HTT-1R verifies proper operation of Dielectric Withstand (hipot) and Ground Bond Testers between calibration cycles. According to Jeff Lind, Compliance West president, these enhanced procedures use actual component values which mimic the product being tested. HTT-1R tester capabilities include:

- verifying three failure modes; open ground, high leakage current and dielectric breakdown.
- simulating a passing test.
- analyzing up to 30A ground bond testers using values which simulate actual operations.
- using one of four standard values to test the leakage current trip function of the hipot tester up to 3000V.
- checking the Arc Detection circuit of the hipot tester.

The HTT-1R provides test leads, which allow connection to any brand hipot tester that uses a standard NEMA 15A receptacle, and banana plug return leads, which connect to the equipment being tested. In addition, the HTT-1R manual contains anticipated results and suggests testing procedures.

Compliance West USA, Inc. specializes in the manufacture of custom and standard Impulse and Surge Test equipment for laboratory and production verification testing. The company provides safe and reliable testing solutions for a wide range of industries, including medical device manufacturers, telecom, computer technology, solar energy and agencies such as UL, TUV, CSA and NEMKO. For more information about Compliance West and the HTT-1R, call 619-917-6810 or go to www.compwest.com. A demonstration video of the HTT-1R can be viewed at www.compwest.com/HTT-1R.html.

SPEAKING Out

Quality and Safety for Everyone

BY HERMES MAGNUS

We are living in the century of quality. Hand-in-hand with quality, for society as well as sound business practice, goes safety. Born from the need to address these concerns, the field of compliance engineering is at a crucial moment in its development. What happens next will have a deep impact on the larger world of technology.

The main challenge in this moment is twofold. Of primary importance is the lack of capacity at the university level to educate young engineers versed in the intertwining, interdisciplinary problems surrounding compliance. The discipline of electrical compliance in engineering is integral to the reliable functioning of our world. As such, a curriculum of advanced study with defined levels of mastery needs to be established with the input and agreement of various involved branches of engineering. This course of study should be jointly developed with the private sector as well as disciplinary chairs of representative universities, since the field of compliance usually covers a broad range of the engineering disciplines. Furthermore, the study of compliance engineering should be available as both a major course of study and as an elective to broaden the understanding of students of other engineering disciplines.

The second challenge to our industry is that, though standards themselves continue to be refined, testing equipment is not universally regulated. One problem is that China's continued growth as a global industrial power now includes the production and distribution of test equipment to the international market. This low cost equipment is sometimes of low quality that does not necessarily meet mandatory requirements. It is paramount that all test equipment in the certification market be approved by qualified auditors to meet global standards. We cannot accept a distortion of the standards that results in validation of low quality and safety levels.

Over the course of compliance engineering history, a false sense of security has arisen from the belief that the larger portion of the products offered to the market are compliant

As has happened before during remarkable moments in history, the present international compliance crises can become the opportunity to bring forth a reinvention the engineering landscape.

with accepted standards. If these standards are compromised, we will all suffer. A remedy to this situation is that small manufacturers around the globe must have access to testing equipment with the highest technical excellence for evaluating compliance. Slowed by the current economic climate but regardless of this global pressure, big corporations continue to furnish their test laboratories with the latest European test equipment. They consider this an investment in their ability to remain market leaders. On the other side, small businesses, particularly in developing countries, continue to struggle to buy the tools needed for testing their products. Whether it is because they are forced to use less reliable testing equipment mass produced in China or refurbished European test apparatus that does not conform to current standards, any "approved" products put into the marketplace by companies without fair access to reliable test equipment undermines consumer confidence in the entire industry.

As has happened before during remarkable moments in history, the present international compliance crises can become the opportunity to bring forth a reinvention the engineering landscape. In this case, the revolution in thinking will be not only in the technological process, but primarily in newly created and refined mechanisms that provide the field with improved and more accessible tools. Even if these developments seem to temporarily work against the interests of larger members of the compliance community, the end result will be the trust of the consumer, greater confidence in our own products, and a better environment for us all. In another context and another time Charles B. Dudley, the driving force behind the creation of the American Society of Testing Material (ASTM) was considered an outsider by the steel manufacturers. However, his chemical studies, by improving steel quality and ending the frequent breakdown of rail line materials, led to standards that changed the face of the American railroad industry and made the fortune of more than one railroad tycoon.

Worldwide, we have the best institutions for standardization and the continued industry commitment for voluntary standards improvement, established norms as well as the creation of new ones. But, in my opinion, we need more than that. We must foster the conditions that allow small companies to be viable members of the compliance world. We must provide universities with test equipment and protocols so that students are equipped to meet the challenges they will face in the compliance environment. And, as the human resource in this equation, we must truly prepare ourselves and generations to come to instill our continued commitment to quality and safety of products worldwide.

(the author)

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We wish to thank our community of knowledgeable authors, indeed, experts in their field - who come together to bring you each issue of *In Compliance*. Their contributions of informative articles continue to move technology forward.

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