APRIL 2011

IN COMPLIANCE™ Magazine

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FEATURE ARTICLES

DEPARTMENTS

Dear Editor,

This is about Mike Violette's Reality Engineering piece in the February 2011 issue of *IN Compliance Magazine,* entitled "What's Luck Got To Do With It?"

The article "What's Luck Got To Do With It?" by Mike Violette is well-written and entertaining, but at least for a landlubber like myself, it leaves one hanging at the end. I think a better title for the article might have been, "What's High Tide Got To Do With It?"

I'm not hard over about seeing this in print – but if you will pass it on to Mr. Violette, I am interested in his response.

Thank you,

Ken Javor
tel: (256) 650-5261

Thanks for the note, Mr. Javor. I like the recast title!

But we puzzled over the effect of high tide and we concluded that any observed connection between tide and interference was speculative: a cause looking for an effect, so to speak. (We didn't actually witness any connection, although Lou insisted "Oh yeah, you'll see, if you hang around here long enough. It definitely gets worse at high tide." I suppose that Lou had a lot of time to speculate in the dead of the South Jersey winter, imagining the ghosts in the machine).

In the end, 'tis the nature of EMI as you know: the 'fix' is often fundamentally simple as sometimes one just needs a little luck...or some copper tape--in just the right spot.

Ahoy,
Mike

Mike Violette
mikev@wll.com
tel: (240) 401-1388

Dear Editor,

The article "A Tall Tale: What's Luck Got To Do With It?" by Mike Violette, *IN Compliance Magazine*, February 2011, page 16, was very illustrative of grounding issues one finds when doing on-site investigations.

However, the calculation of the "pigtail" ground impedance was in error. The expression:

Z=2*31415*88 = 55 ohms, not 28 ohms as stated in the article.

The voltage on the shield is then 1.7 Volts.

This article illustrates the benefit of a peripherally grounded shield as opposed to a pigtail ground.

Ed French, Owner
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OMG, it's even worse than I thought!

Good eye, Ed. Thanks for the correction.

Mike

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We welcome letters to the Editor to share your comments and feedback with our community of readers.

Please direct your letters to editor@incompliancemag.com.

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Ready for the RoHS Recast?

by Krista Crotty

A quick update on the timeline for publication - just the dates

Many companies are patiently waiting for any word on the RoHS Directive Recast, particularly the timeframe in which enforcement is likely to commence. This is the latest information on the timeline and expected dates for the RoHS Recast. It is current as of March 3, 2011.

In March 2011, the European Commission received translations of the RoHS Directive Recast for approval. Once approved translations are available, publication into the European Commission's Official Journal is possible. As of this article, the Parliament is fine-tuning the various language versions of the Recast based on the draft text the European Parliament agreed to in November 2010.

Once published in the EU Official Journal, the new RoHS Directive is to be in force approximately 20 days after publication. As with the original casting of the directive, EU member states will have approximately eighteen (18) months to transpose the directive into national law.

The BIS in the UK speculates the EC to start developing guidance this year, but that process has yet to start. The UK would supplement that if necessary, but we would prefer a Europe wide approach. ■

Action / Event	*Date / Timeline*
Approval by EC of RoHS Recast Directive translated into all languages	March 2011
Publication into EC Official Journal	April/May 2011
Directive Entry into Force	+20 days
Member State deadline for transposition into National Law	+18 months
Estimated enforcement date by Member States	Nov 2012

* Dates may change, dates as of information March 2011

Key Dates Table – RoHS Directive Recast

Commission Issues Citations for Marketing of Cell Phone Jammers

The Federal Communications Commission (FCC) is dramatically increasing its efforts to deter the marketing and sale of cellphone jamming devices, as reflected in a series of recent enforcement efforts against device resellers.

In the space of just two weeks during late January through early February 2011, the FCC issued citations against three online resellers for marketing cellphone jamming devices through their websites. Two of the resellers, DeadlyDeal.com and ContrexCommunications.com, admitted listing such devices for sale, but informed the Commission that they had immediately removed from their website any and all references to cellphone jamming devices. The third reseller, DealExtreme.com, has not yet responded to the FCC.

Separately, the Commission has also issued a citation against a Georgia company for marketing a device named the TxTStopper. According to the company, Share Enterprises, the TxTStopper was specifically designed as a safety device to prevent texting and cellphone communications within a moving vehicle. However, subsequent testing by agents concluded that the TxTStopper was a cellphone jamming device that effectively blocked cellphone communication both inside and outside of the vehicle.

Finally, in perhaps the most egregious case related to the illegal marketing and sale of cellphone jamming devices, the Chinese company that manufacturers the TxTStopper has been ordered to show cause why an FCC-issued equipment authorization should not be revoked, in light of evidence that the company applied a legally obtained FCC ID to the illegal cellphone jamming device. Should the Commission's investigation substantiate the allegations, the company could face a financial penalty in the amount of $112,500.

In the space of just two weeks during late January through early February 2011, the FCC issued citations against three online resellers for marketing cellphone jamming devices through their websites.

More information about the above citations is available at http://www.fcc.gov/Daily_Releases/Daily_Business/2011/db0126/DA-11-125A1.pdf (DeadlyDeal.com), http://www.fcc.gov/Daily_Releases/Daily_Business/2011/db0126/DA-11-135A1.pdf (ContrexCommunications.com), http://www.fcc.gov/Daily_Releases/Daily_Business/2011/db0209/DA-11-248A1.pdf (DealExtreme.Com) and http://www.fcc.gov/Daily_Releases/Daily_Business/2011/db0209/DA-11-247A1.pdf (Share Enterprises). The Order to Show Cause issued to Shenzhen Tangreat Technology, the manufacturer of the TxTStopper, is available at http://www.fcc.gov/Daily_Releases/Daily_Business/2011/db0209/DA-11-246A1.pdf.

Commission Steps Up Education Efforts About Jamming Devices

The Federal Communications Commission (FCC) is stepping up efforts to remind both retailers and consumers that the marketing, sale and/or use of devices designed to interfere with cellphone communication is illegal.

The Commission has issued separate FCC Enforcement Advisories intended to educate both retailers and consumers about its regulations involving the use of cellphone jammers, the potential dangers associated with the use of jamming devices and the potential penalties associated with the marketing, sale or use of such devices.

The Commission has also released a poster that can be displayed by retailers and other public establishments, warning against the use of cellphone jammers.

A copy of the FCC's retail advisory is available at http://www.fcc.gov/Daily_Releases/Daily_Business/2011/db0209/DA-11-249A1.pdf. A copy of the consumer advisory is available at http://www.fcc.gov/Daily_Releases/Daily_Business/2011/db0209/DA-11-250A1.pdf. Finally, the poster issued by the FCC regarding jamming is available at http://www.fcc.gov/Daily_Releases/Daily_Business/2011/db0209/DOC-304575A2.pdf.

Commission Issues Rules for Interoperable Public Safety Network

Continuing its efforts to ensure seamless communications between emergency services personnel, the Federal Communications Commission (FCC) has issued additional rules to advance communications interoperability for first responders throughout the United States.

As a result of its Third Report and Order and Fourth Further Notice of Proposed Rulemaking issued in January 2011, the Commission will now require all 700 MHz public safety mobile broadband networks to use a common air interface (namely, Long-Term Evolution, known as LTE) to support roaming and interoperable communications.

In addition, the Commission is seeking comments on specific additional rules to ensure nationwide interoperability. Comments on the Commission's additional proposed rules are due to the Commission by mid-March, 2011. The Commission's Order is available at http://www.fcc.gov/Daily_Releases/Daily_Business/2011/db0204/FCC-11-6A1.pdf.

In an effort to make its activities more transparent and accessible for all, the FCC has also released a video on YouTube that provides an overview of the Commission's rulemaking in connection with advance interoperability communications. To view the video, go to http://www.youtube.com/watch?v=h50Njf_Ga_A.

Commission Fines Man for Illegal Transmissions on Marine Safety Bands

The Federal Communications Commission (FCC) has proposed a fine of $20,000 for a Florida man who continuously transmitted non-emergency communications over channels reserved for marine safety communications.

According to a Notice of Apparent Liability for Forfeiture issued in February 2011, Vincent Aversa of Indialantic, FL routinely transmitted non-emergency communications over Marine Safety Channel 16 during a three month period from December 2009 and February 2010. Aversa's transmissions were recorded by the United States Coast Guard, who repeatedly warned Aversa that his transmissions were unauthorized and ordered him (unsuccessfully) to cease transmitting.

The Coast Guard notified the FCC's Enforcement Bureau and, in February 2010, FCC agents from the Tampa Office identified Aversa by using direction-finding equipment to locate the source of the illegal transmissions. Despite repeated warnings from the FCC agents over a three day period to cease his transmissions, Aversa reportedly continued to transmit communications on the Marine Safety Channel from his automobile, in plain sight and hearing of the agents.

The standoff ended when Aversa finally admitted to agents that he had been operating a radio to talk on Marine Safety Channels and relinquished his marine radio.

To view the complete Notice of Apparent Liability for Forfeiture, go to http://www.fcc.gov/Daily_Releases/Daily_Business/2011/db0208/DA-11-232A1.pdf.

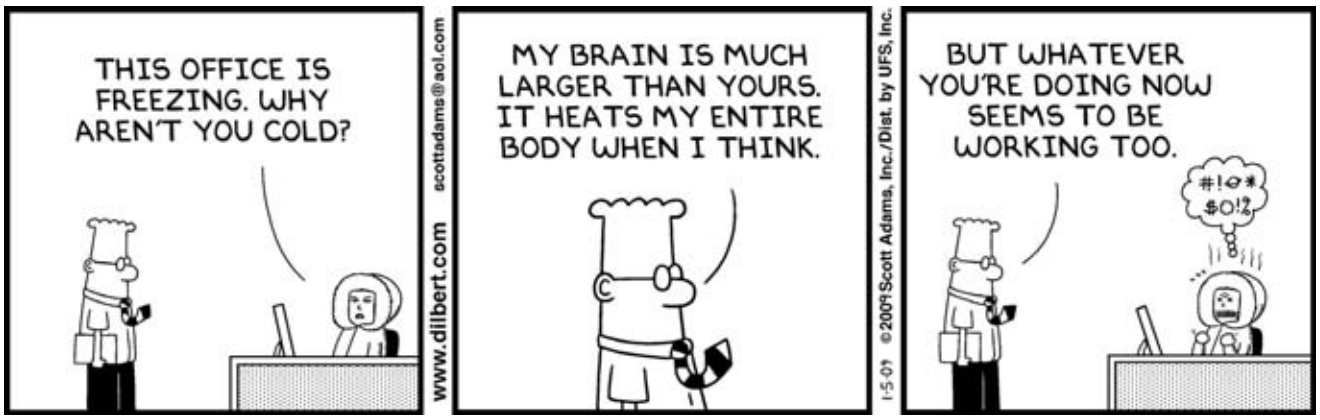
FCC Releases Proposed 2012 Budget

The Federal Communications Commission (FCC) is seeking a 5% increase in its overall spending authority in fiscal year 2012, which begins on October 1, 2011.

In its Fiscal Year 2012 Budget Estimates submitted to Congress in February 2011, the FCC is seeking just over $354 million, an increase of $18.4 million, or 5.47%, over Fiscal Year 2011. Projected staffing of the Commission will remain roughly the same, with just over the equivalent of 1900 full-time employees.

The major increases in the proposed budget include funding for new program initiatives, including Commission-wide information technology programs ($5.7 million), high-speed broadband initiatives ($4.9 million) and public-safety related efforts ($1.85 million). The other significant budget increase proposed is $3.2 million to support 19 full-time employees engaged in audits and other investigative activities on behalf of the Commission.

The complete text of the FCC's budget request for Fiscal Year 2012 is available at http://www.fcc.gov/Daily_Releases/Daily_Business/2011/db0214/DOC-304636A1.pdf.



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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 February 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 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2011:036:0001:0010:EN:PDF.

EU Commission Updates Revised Energy Labeling Requirements for Refrigerators

The Commission of the European Union (EU) has provided additional information on methods of measurement that can be used in connection with its requirements for the energy labeling of refrigerators.

Published in February 2011 in the *Official Journal of the European Communities*, the transitional methods of measurement supplement information originally found in Annex VI of Commission Delegated Regulation 1060/2010, which details specific labeling requirements for refrigerators and which was published in the *Official Journal* in November 2010.

Energy labeling requirements for a variety of home appliances and electronic devices have been promulgated by the Commission in an effort to increase consumer knowledge about the actual energy consumption of comparable household appliances, thereby creating incentives for manufacturers to improve the energy efficiency of their respective products.

The Commission's transitional methods of measurement for the energy labeling of refrigerators is available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2011:049:0006:0011:EN:PDF. The Commission's revised labeling requirements for refrigerators is available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:314:0017:0046:EN:PDF.

EU Commission Releases RAPEX Statistics for December 2010

The Commission of the European Union (EU) has released statistics on notices of unsafe consumer products that have been processed through the EU's rapid information system (RAPEX) during December 2010.

According to the Commission's report, 193 validated notifications of unsafe products (those posing either serious or moderate risk) were processed through the RAPEX system during the month. This compares with just 165 reports of unsafe products processed through the system during the comparable period in 2009.

Of the notifications received during the period, 72 (43%) were related to clothing, textiles and fashion items, with an additional 37 (22%) related to toys and 9 (5%) related to electrical and electronic equipment, including electrical appliances, lighting equipment and communications and media equipment. The risk of electric shock and fire was identified in 10 of the notifications (5%).

Regarding the country of origin identified in connection with products posing a serious safety risk, more than half of all notifications (105, or 63%) were related to products originating from China, including Hong Kong. Another 31 notifications (19%) of unsafe products originated in EU Member States. Fifteen notifications (9%) failed to identify any country of origin.

To view the complete text of the EU Commission's updated report on RAPEX statistics, go to http://ec.europa.eu/consumers/safety/rapex/docs/stats_12-2010.pdf.

EU Commission Publishes Weekly Notifications of Unsafe Products

In an effort to provide more timely information regarding unsafe products within the European Union (EU), the EU Commission is now making public its weekly reports of unsafe products that have been processed through the EU's rapid information system (RAPEX).

Each "Weekly Overview Report of RAPEX Notifications" contains detailed information about each unsafe product reported, the specific danger the unsafe product poses to consumers, the name of the EU member state which submitted the notification to the RAPEX system and the action taken by the notifying member state.

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At present, there is no subscription option available for those who would like to automatically receive copies of the Weekly Overview Reports by e-mail. However, an archive of weekly reports back to 2004 is available at http://ec.europa.eu/consumers/dyna/rapex/rapex_archives_en.cfm.

Company Agrees to $390k Fine for Defective Chairs

The U.S. Consumer Product Safety Commission (CPSC) has announced a settlement of nearly $400,000 with a company who failed to notify the CPSC that its office chairs were unsafe, even after it received reports of consumer injuries.

The company, Raynor Marketing Ltd, has provisionally agreed to pay a civil penalty in the amount of $390,000 in connection with CPSC charges that the company failed to report the product safety defect immediately, as required under federal law.

Raynor announced a recall of 150,000 office chairs in October 2009, following reports that bolts attaching the seatback could loosen and detach. The company received 33 reports of seatback detachments and 14 reports of injuries. The chairs were sold exclusively through Office Depot between May 2006 and August 2009 for between $300 and $350.

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.

In agreeing to the civil penalty, Raynor Marketing has denied CPSC allegations that it knowingly violated the law.

CPSC Extends Stay for Testing of Lead in Certain Children's Products

The U.S. Consumer Product Safety Commission (CPSC) has voted to delay the implementation of lead content testing and certification requirements for certain children's products.

In a 4-1 vote in late January 2011, the Commission agreed to delay until December 31, 2011 the requirement that children's products be tested and certified by a CPSC-approved third-party laboratory for compliance with federal lead content limits. After that date, testing and certification of lead content will be required for children's products sold within the United States.

However, in a press release announcing the stay of enforcement, the Commission notes that manufacturers, importers and retailers must continue to comply with the federal restrictions for total lead content in children's products. Those restrictions limit lead content to not more than 300 parts per million (PPM) and to not more than 90 ppm for lead in paint and surface coatings. That content limit of 300 ppm is scheduled to be reduced to 100 ppm on August 14, 2011, unless the CPSC determines that achieving this lower limit is not technically feasible.

It is also important to note that the CPSC's stay of enforcement regarding testing and certification of lead content in certain children's products does not apply to children's jewelry. Manufacturers and importers of products in this category must continue to verify through third-party testing that the lead content in their products does not exceed the above limits.

Fire Hazards Lead to Recall of Portable Space Heaters

Safety problems associated with electric space heaters are most prevalent during the winter heating season. So, not surprisingly, three separate companies have recently announced the recall of certain models of their electric space heater products due to fire hazards.

In the first recall, Lasko Products Inc. of West Chester, PA is recalling about 107,500 portable electric heaters manufactured in China. The company reports that an electrical connection in the base of the heating unit can overheat, causing it to melt and expose the electrical connection and posing a fire hazard to consumers. Lasko says that it has received 36 reports of the electrical connection overheating and 18 reports of minor burn damage to floors and carpets, but no reports of injuries.

The second recall, by PD Sixty Distributors of Norcross, GA, involves about 3000 of the company's portable space heaters manufactured in China. PD Sixty reports that loose electrical connections can lead to overheating of the space heater, posing a fire hazard to consumers. The company says that it has received one report of the heater overheating, resulting in a fire and minor property damage, but no injuries.

In the third recall, Atico International of Fort Lauderdale, FL has recalled about 92,000 of its TrueLiving-brand heater fans and portable quartz radiant heaters, manufactured in China and sold exclusively through Dollar General Stores. The company says that it has received a total of 29 reports of the recalled fans and heaters overheating and one report of a minor burn injury.

Additional details about these recalls are available at http://www.cpsc.gov/cpscpub/prerel/prhtml11/11121.html (Lasko), http://www.cpsc.gov/cpscpub/prerel/prhtml11/11720.html (PD Sixty) and http://www.cpsc.gov/cpscpub/prerel/prhtml11/11130.html (Atico).

Company Recalls Convertible Irons for Wiring Issues

Sunbeam Products, Inc. of Boca Raton, FL has announced the recall of about 5700 of its convertible clothes irons manufactured in China.

The company reports that the iron can overheat due to a wiring issue within the iron, causing a fire and posing a risk of burn injuries to consumers. Sunbeam says that it has received 17 reports of irons overheating and three reports of irons catching fire. However, no injuries have been reported.

The recalled irons were sold in Bed, Bath & Beyond stores nationwide from June 2010 through November 2010 for about $60.

More information about this recall is available at http://www.cpsc.gov/cpscpub/prerel/prhtml11/11118.html.

Canister Vacuums Recalled Due to Fire and Shock Hazards

Hoover Inc. of Glenwillow, OH has recalled about 142,000 of its Hoover-brand WindTunnel Canister Vacuums manufactured in China.

According to the company, the power cord between the power nozzle and the wand connector can short-circuit, posing a shock and fire hazard to consumers. The short-circuit condition can reportedly occur even when the vacuum has been turned off but left plugged in.

There have been a total of 69 reports of overheating or electrical malfunction, including one report of fire and smoke damage. There has also been one report of a minor injury associated with the recalled vacuums.

The WindTunnel Canister Vacuums were sold through mass merchandisers, department stores and independent vacuum retailers nationwide, as well as online, from March 2003 through December 2008 for between $250 and $280.

Additional details about this product recall are available at http://www.cpsc.gov/cpscpub/prerel/prhtml11/11124.html.

Rechargeable Batteries in Video Baby Monitors Recalled

Summer Infant of Woonsocket, RI is recalling about 58,000 rechargeable batteries manufactured in China that were sold with certain models of the company's Slim and Secure-brand video monitors.

Summer Infant reports that the battery in the handheld video monitor can overheat and rupture, posing a burn hazard to consumers. The company says that it has received five reports of ruptured batteries, including three incidents of minor property damage. However, there have been no reports of injuries.

The recalled batteries were sold with the video monitors exclusively at Babies R Us from September 2009 to May 2010 for about $200.

More information about this recall is available at http://www.cpsc.gov/cpscpub/prerel/prhtml11/11126.html.

Electromagnetic Compatibility Engineering

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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, MAY 25, 2011
Exhibitors:for information contact Sharon Smith - e-mail: sharon.smith@incompliancemag.com or call (978) 873-7722

REGISTRATION

*** **Attendance is limited to 40 - Register by April 15, 2011 and receive a $150 discount off the course fee!** ***

COURSE DATES/TIME: May 24-26, 2011 8:30 a.m. to 4:30 p.m.

COURSE LOCATION: Westford Regency, 219 Littleton Road, Westford, MA 01886

COURSE FEE: $1,395 ($1,245 until 4/15/2011). 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.

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*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.

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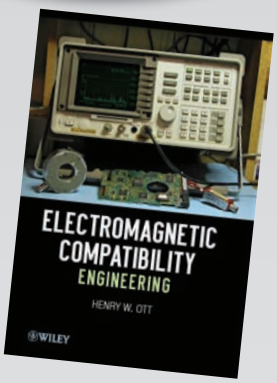

HENRY OTT

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.

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Make checks payable to Henry Ott Consultants.

The iNARTE Informer

Provided by the International Association for Radio, Telecommunications and Electromagnetics

SYMPOSIUM EXAMINATION SCHEDULE FOR 2011

iNARTE has confirmed our attendance at the following key Symposiums during 2011. At each of these events we will be exhibiting, taking certification applications, proctoring examinations and in some cases hosting exam preparation workshops. Although iNARTE examinations are available all year round at our 200 Authorized Test Centers, these events offer candidates a chance to save the Test Center proctor's fee, since all exam rooms are compliments of the event organizers:

- **APEMC 2011** – Jeju, South Korea. iNARTE workshop on May 16, examinations on May 19
- **IEEE EMCS 2011** – Long Beach, CA. iNARTE workshop on August 15, examinations on August 19
- **EOS/ESD 2011** – Anaheim, CA. iNARTE examinations on September 16
- **IEEE PSES 2011** – San Diego, CA. iNARTE examinations on October 13

Remember that any and all of the iNARTE certification examinations will be available at these events by advance registration at http://www.narte.org/h/examregform.asp and clicking on the ***Special Event Location*** menu. In most cases we can accept registration at the event but this is not guaranteed.

We are still on track to introduce our new EMC Design Engineer Certification examination at the EMCS 2011 in August. Watch this publication and the iNARTE web site for updates.

The first iNARTE/ACLASS internal auditor training and credentialing, (iNCLA), workshop for 2011 will be in Alexandria, VA from May 17 to May 19. Registration is now open at http://www.narte.org/h/iNCLAConference.asp. This is an invaluable credential for all who have laboratory auditing and quality system management responsibility in accordance with ANSI/ISO/IEC 17025.

iNARTE QUESTION POOLS

A major challenge for us has always been the maintenance and upgrading of our question pools to incorporate changes to the industry standards and to reflect current measurement techniques and engineering practices. As all of you iNARTE members know, your 10 original questions are intended to keep our pools current. However, for every 100 that we receive only about 15 or so are suitable for use. Some duplication is inevitable, some we find are copied from standard text books, and some are just too simple, (how many ways can Ohm's Law be applied). It is our intention to maintain the value of iNARTE certification so that all our members are recognized as experts in their profession and for this reason we need current and challenging questions. Questions that should be answerable by a competent engineer or technician within about 5 or 6 minutes, given that they have reference books and the internet at their disposal.

COULD YOU WRITE WINNING QUESTIONS?

Now you can help to maintain the value of your certification by writing questions for iNARTE and by doing so be eligible for an award. Each month all questions received will be reviewed by an independent team of experts and the winning question writer can choose from a number of awards: two free years of iNARTE membership, a $200 donation to a charity of choice, a $200 donation to a school or college of choice, or certification application and study guides at no cost if you are not yet an iNARTE member.

RULES OF THE GAME

Questions can be submitted by both members and non-members. There is no limit to the number of questions submitted or the number of months you enter. Questions should be original and in your own words. Questions are to be restricted to the disciplines of EMC, ESD and Product safety. In each discipline the questions categories can be found by accessing the applicable certification application form on the iNARTE web site. The questions are to be emailed to examquestions@inarte.us as Word documents, one question per page(s). Equations and figures are to be saved into the document. Each question should be formatted as follows:

1. The Question
2. Selection of four (4) plausible answers; A, B, C and D, only one of which is correct
3. State the correct answer; A, B, C or D
4. State whether question is intended for; Engineer, Technician or both
5. Estimate how long it should take to answer; (no more than 6 minutes is suggested)
6. Provide a Reference, (publication, standards, web site), where the answer can be verified, or provide calculations leading to the answer.
7. State the Category into which the question best fits, (select from options listed in the applicable iNARTE Application Form; i.e. Filters, Field Theory, Standards, etc.

iNARTE web site pages that contain question categories and examples:

- EMC Certification Application Form http://www.narte.org/d/emcapp.pdf
- ESD Certification Application Form http://www.narte.org/d/esdapp.pdf
- PSE Certification Application Form http://www.narte.org/d/psapp.pdf

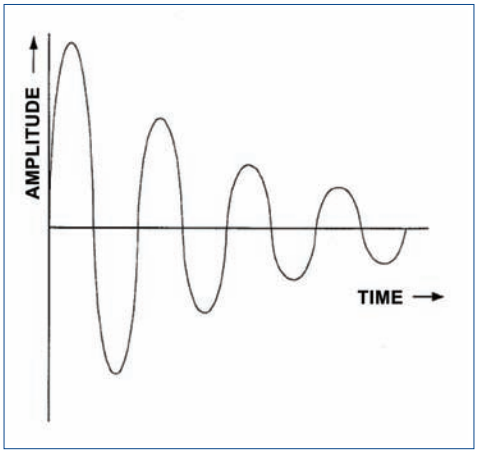
iNARTE shall have the right to use all questions submitted for future examinations.

QUESTION OF THE MONTH

Back in the December issue we asked you:

What is the damping factor of a damped sinusoid with the following parameters?

1. Peak current = 20A
2. Current at 50% decay = 7A
3. Number of cycles at 50% decay = 4



A) 5
B) 9
C) 11
D) 14

The correct answer is B, from $Q = \frac{\pi (4 - 1)}{\log_n (\frac{20}{7})} = 8.976$

This month the question is from our ESD pool:

A large piece of paper is left on top of an ESD control work surface. Someone sets a 15cm X 15cm tote directly on top of the paper. Given the following data, what is the capacitance between the tote and the work surface?

Data: ε of paper = 1.5, paper thickness = 0.05 cm.

A) 29.8 pF
B) 298 pF
C) 59.7 pF
D) 597 pF

Questions such as these could be award winners – why not try for one? ■

Travels with Frosty: Days in Turkiye

by Mike Violette

Frosty and I went to Turkey to do a little shielding work. "Travels with Frosty," coming at you.

We rendez-vous'd at the United Counter, Frosty sporting his signature cowboy boots and white T-shirt, a ponytail-in-progress sprouting from under his hat and a brand-new girlfriend on his arm. We were heading to Eastern Turkey to do some shield tests at a link in the ring of passive listening and defense girding the soon-to-be defunct Soviet Union. But she and he were clearly enamored, having met just two weeks before.

So I walked away and said "See you at the gate?" as they massaged their good-byes.

Frosty got on-board the aircraft at the last minute and settled into his seat, pulling his boots off and flexing his sock-less feet. "Man. I can't wait 'til this gig is over," sighing, "She's a jewel." He leaned back as the engines throttled up and we started rolling. "Maybe I'll bring her back something special," he murmured. The 747 rotated, pitched up and nosed east.

And eighteen hours later, via Paris, we were terra firma on the dividing line between East and West at Esenboğa "Healthy Bull" International Airport, 20 miles north of Ankara, resting on the breast of Turkey (*Turkiye*).

Our host Ibrahim, a tall, laconic lean forty-something mechanical engineer with an alley-wear five o'clock shadow, met us at the airport. We bounced into Ankara (I would go back anytime) in a boxy sedan. Ibrahim, we found, had a rather droll sense of humor. We would appreciate it.

The capital Ankara, née Angora, wears leafy streets and a hilly personality: a city upon a hill steeped richly in history. Not far from the womb of western civilization, one stumbles across the encyclopedia of the Ancients: Greek, Persian, Roman, Byzantine, Persian and Galatian (of St. Paul's Letters fame). We'd spend one night here and the next day head further East to the city of Diyarbakir, in the northern reaches of Kurdistan and not far from Mount Ararat, near the bones of Noah's Ark.

We were grateful to find a quiet bed after a long flight from Washington. Before we turned in, Frosty and I had a few cold ones "just to help us sleep" and went over the test plan for the facility. It was a standard test and was required before the facility was commissioned (and the contractor could get paid). The all-welded room had been designed to protect the listening equipment from outside eavesdropping and from unthinkable EMP. We made a list of test points and test frequencies: magnetic field test from 10kHz and E-field measurements up to 1 GHz.

Frosty jabbered on about his new darling. "We met last weekend. It's been great ever since." He winked at the young waitress. "*Merhaba,"* she said, smiling coyly.

"Yeah, I can see you miss her." I said. Frosty laughed, snorting into his beer.

A few winks later and we were awoken by a call from the front desk from Ibrahim, now joined by his colleague, Mustafa, compact and fierce-looking, foil to the cool Ibrahim. We re-packed quickly and checked out of the fine digs of the Ankara Oğultürk Hotel, the front desk monitored by a prominent portrait of Mr. Atatürk, the founder of modern Turkey.

Atatürk's likeness was everywhere: in government offices, banks, hotels, offices and private residences. His career gained momentum after the British withdrawal from Gallipoli during World War I, when Turkey was known as

The Ottoman Empire and Istanbul was known as Constantinople. (We'd get to spend an eventful night or two in Istanbul at the end of this trip, but we still had our real work to do.) By the early 1920s, Atatürk was re-casting Turkey as a modern, democratic, secular country. Turkey has been a long ally of the US, an important bulwark and interesting mingling of East and West.

The four of us crammed into a taxi and we chatted about the project and engineering business in Turkey as we headed to the domestic airport at Etimesgut—close to the city center. It was a one hour flight to Diyarbakir and the first flight I'd ever been on where absolutely no English was spoken, the safety warnings delivered by a young stewardess with smoky brown eyes. I dozed until we were on final approach into Diyarbakir.

Ibrahim and Mustafa were detailed to this remote city for a year while the project was developed and they were eager to settle back into Ankara with their families. The work was to install new facilities for the Pirinclik Air Station (AS) (now closed) which kept a radar eye on the Soviets to the North and East. This was in the time when Saddam's relationship with the US was less tenuous and the biggest bogeys in the region were the remains of the withering Red Menace and Iran. Tensions inside Turkey, however, were high as the Kurd region was (is) straining to decouple from Western Turkey (and Iraq and Iran). History is still being written in that region. Suffice it to say that, aside from the westerners working at Pirinclik, we were the only Yankees strolling around Diyarbakir that week.

Goats and chickens roam around mud-brick shacks and tin roofs line the road from Diyarbakir airport. Coming into the town, the dry dusty hills rise about the Tigris river—an important source of irrigation for the yearly for *the famous Diyarbakir Watermelon Festival*, among other food crops. At nightfall, young men bring their lean cows into town, coaxing them along with branches of green vegetation.

The pace is slow during the day; it's darn hot and there are few women on the streets and none in the restaurants, even at night, although the daily tabloids are interesting for their, ahem, revealing photos. Men sit on short stools, drinking thick sludgy deliciously-sweetened Turkish coffee, playing backgammon under colored tarps in the many open air cafes around the city. Kids laugh and follow us, yelling "hello-hello!" There's a sign for Kodak film hanging over a small kiosk—the only American brand around (a while before the Starbucks® phenomenon went global).

After settling at the hotel, we headed out in a few mini-vans to the site at Pirinclik for a quick look at the project. A Turkish guard looked at our IDs and we went into the ultra-compact base. It was possible to see the perimeter fence from anywhere on the grounds. I noted that the base hosted a convenience store (thankfully)—a stunted 7-11 of sorts—and a dank lounge. Nights in Pirinclik AS held little enchantment to bored backwater signalmen and contractors, who were boarded in dorms inside the fence.

That night, Ibrahim and Mustafa, now joined by four more of their colleagues, took us to the local *Caravansarai* (caravan-stop), a waypoint on the Silk Trade that connected the Orient to the Mediterranean. The cut-rock structure, four stories high, lay above the river and in the lee of the hill, best to catch the rays of the westering sun and lean a broad shoulder to the northerly winds and occasional snows that blew in from the Black Sea.

The roughly coliseum-shaped edifice featured an interior courtyard that was originally meant for the pack animals: camels and horses primarily. A trader would bed his beasts at night and take one of the "rooms" above, its door open to the courtyard. The Caravanerai offered shelter, protection—and vice.

In recent years, the way-station was rebooted as a restaurant. A corner of the vast courtyard—easily the size of a football field—featured linen-covered tables, a local band playing discordant Turkish music and, of course, a few belly-dancers.

We ate, danced, sang and toasted long-friendships with *raki*—anisette, or ouzo, best described. The liquor turns a milky white with a few drops of cold water are dribbled into the short glasses. We ate. We danced. We sang.

And the alarm jangled a wee bit early the next day.

Heads pounding, we hoped to finish early that first day on the job. The temperatures were in the high 90s and the air as dry as chalk. Passing by the base convenience store, I begged Ibrahim to stop and I bought the only Coke in the cooler; it was warm, but it was golden.

At the front desk was young MP; she was about twenty-two and bored as an old cat. She had not been there when we dropped in briefly the previous day and roused a little when Frosty came around the corner.

"Can I hehhlp yoooou?" She purred.

Frosty poured on the charm, leaning down with his elbows on the desk. "What do you do for fun around here?"

"Oh, you know, it's soooo boring! Can't go out anywhere in Diyarbakir and the lounge is dead."

Mustafa cut in. "We here to test. Let Colonel Brink know." The lady rolled her eyes, picked up the phone and cradled the handset between her head and shoulder.

She looked at her calendar. We all looked at her medals. "They're here." She paused. "OK, I'll let her in." She let the phone drop noisily in its cradle.

"Come in. Watch the gate." The extent of security was a waist-high turnstile that clunked when we passed through. "And maybe I'll see you later." She looked back at Frosty, who returned a slow, interested half-nod.

We hauled our signal generators and receivers inside. A couple of local day laborers, young skinny guys wearing untidy clothes and sandals, helped us out. The heat beat at the black equipment cases and our flush faces. My mouth felt as dry as the surrounding hills.

Inside the was a typical USGOV facility with blank cubicles and a few gypsum-walled offices that lead into the shielded area, where we were to spend a few long and achy daze, er, days. We set up the test: signal generator, transmit and receive antennas, cables, amplifiers and a telephone set-up so we could communicate inside and outside of the shelter, clipping the leads to a pair of low-pass filters installed on the feed-through panel.

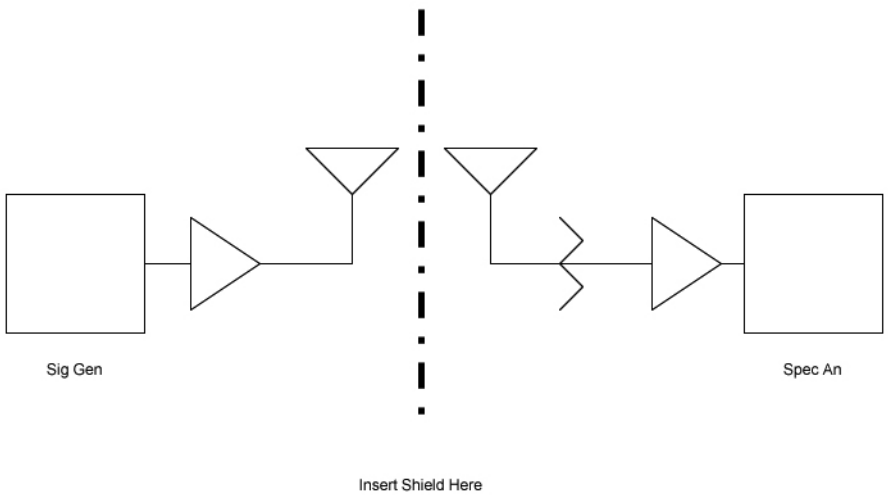
We did a quick visual inspection, yanked some wires that were connected through the shield, unfiltered and looked at the doors. The knife-edges were filthy; bits of fingerstock were broken off.

Frosty brought Ibrahim over and showed him the grime on the door and said, "This is no good. The metal has to be clean and shiny."

Ibrahim walked over and kicked the dusty floor, barking something unintelligible, but completely understandable. Two young Turks scrambled like only the young can and in a few moments, they reappeared, with blue rags and square cans of some clear spirit, probably toluene. Nasty, but effective.

Mustafa motioned with his eyes to the doors. "Clean!" he glowered. The boys soaked their rags and languidly cleaned the bronze fingers on the chamber.

We set up the first measurement. We'd start at 400 MHz to assess the overall shield. It's a quick look; if it passes at 400 MHz, most likely the rest of the frequency range would be OK. Since the enclosure was welded-steel, the magnetic field attenuation should be fine. We were mainly interested in cracks in the shield or cable leakage at the interface and power panels.



To make the measurement, a la MIL-STD-485, the signal generator is set to pump about 0 dBm into the power amplifier that feeds the transmit antenna. Pads (about 80 dB) are on the output of the antennas. Place the transmit and receive antennas one meter apart for a reference measurement. Crank up the power until the spectrum analyzer is maxed out with a healthy amount of attenuation on the front end. The level into the analyzer should be less than 20 dBm or compression could be a problem.

"Signal Generator?" "Check!
"Cables?" Check!
"Attenuators?" Check!
"Bicon, Log, Rod, Loop?" Check!
"Skoal?" Check!
"Water?" Please!

Turn the signal generator on, raise the signal until a decent level is measured on the spectrum analyzer (<20 dBm). The more power one has to transmit and the more sensitivity on the receive side, the better the *dynamic range* of the measurement setup. The dynamic range needs to be higher than the shielding specification to get a valid measurement.

For the baseline, record the drive signal and the input received and move onto the next frequencies and record; then, strip out most of the attenuation and locate the antennas on either side of the enclosure wall. The pad on the receive side can be a combination of fixed and variable attenuators. It (essentially) represents the attenuation that will be measured once the antennas are located on either side of the chamber. It is not really necessary to calibrate all the cables (nor to have calibrated antennas) because this is a measurement of the difference, as long as everything is linear. That means that the input to the power amp, pre-amp and spectrum analyzer have to be below their compression points.

Record. Reduce. Solve for shielding effectiveness.

We did all that and found that the shield leaked at 400 MHz—about 23 dB, about 60 dB above target and certainly not good enough.

I went to find Mustafa, who was wandering around, picking up the coffee cups and joking with some of the laborers, who were rolling dice for a few lira. I brought him back to the room.

"Mustafa! Ibrahim. We have leak!" Frosty said in a mock accent. It was not well-taken.

"Where?" Ibrahim was annoyed.

We pointed along the corner of the wall and corner.

"Sheet! Maybe those guys didn't clean doors good." Mustafa snorted.

Frosty looked over at me and wagged his head; I wonder if it was as soupy as mine? He came over. "It's not the doors. It's a bad seam, under the floor." Ibrahim craned to hear. "We gotta break up this floor, fix the weld and re-shoot."

"No problem!" Ibrahim said. He was as anxious as most of us to go home. He tapped Mustafa on the shoulder and motioned to the boys, who were shining up the metal feedthrough panel and getting high on the toluene.

"Yeri Kir!" Mustafa yelled to the two Turks. "Cimento yeri parcala!" They dropped their rags and ran to get picks and shovels.

Before long, the floor, a four-inch slab was reduced to a pocket of gravely debris that was scooped into wooden wheelbarrows. The suspect seam was laid bare; by eye, it was not apparent where the leak was, but at frequency, she sang.

A few moments, more noise outside, some shouting and curious cheering and the welder came inside, pulling a cart with a huge transformer. He bent over, cleanshaven—unusual—and had big hands that were like gloves. I could not be certain, but his left eye looked sightless.

On his welding rig, which he rolled in behind him on an improvised cart, big fat burned leads were connected under a loose cardboard cover. Some writing or warning, long ignored, was on the cardboard. The red lead connected to a well-used clamp, the black lead to the case of the thing, long encrusted; a postcard of smoked glass. The welder clamped the negative lead to a bolt on the shield, picked up the stick, held the glass to his eyes and the air cracked. A lovely bead of molten metal, right under his practiced hand, flowed in the corner of the shield.

Mustafa hollered as the welder rolled up his cables: "Test again! Is it OK?"

We set up again. It passed.

"Teşekkür ederim! We can go home!"

The engineering part of this trip over, it was on to Istanbul where we meet some of the youth of that huge city and I discover why Frosty had another nickname: *Spiderman.* ■

We want to run your stories - stories of how you overcame compliance engineering challenges that stood in the way of your product passing the hurdles on the road to compliance, stories of how things could have gone terribly wrong but because of your engineering prowess, you saved the day!

Send your stories to reality.engineering@incompliancemag.com.

The Future of Battery Technologies

Testing & Evaluating Lithium Batteries

Rich Byczek, Intertek

In order to ensure that a battery-driven product functions properly, there are different methods of testing and evaluating the battery's functioning and safety. There are four different categories of tests that can be used in order to qualify a battery:

- Electrical performance testing – different types of tests that investigate the battery's electrical functioning, for example, available capacity at different loads and surrounding temperatures, cycle lifetime, calendar lifetime in storage, charging receptivity, impedance as a function of charging state, etc.
- Safety testing in relation to environmental effects – various tests that simulate different kinds of environmental conditions to which the battery could be exposed, for example, vibrations, falls, knocks and blows, dampness, high temperatures or quick temperature changes.
- Safety testing in relation to faults or incorrect usage – various tests that evaluate the battery's ability to deal with different types of stress that can arise intentionally or unintentionally when using the product, for example, overcharging, short circuiting, incorrect installation and similar situations.
- Effect on the environment – chemical analysis of heavy metal content.

Some of these tests have to be carried out because of rules and legal requirements. Amongst these is transport testing in accordance with the UN's transport rules for dangerous goods (UN Manual of Tests and Criteria section 38.3) which is required in order to transport lithium batteries and cells and products that contain lithium batteries, irrespective of the type of transport. Several countries apply limits for certain heavy metals in batteries. The chemical elements that are most commonly regulated are mercury, cadmium and lead. For example, the EU Battery Directive regulates all three of these elements and specifies prohibitive as well as marking requiring heavy metal content.

ELECTRICAL PERFORMANCE TESTING

A battery's technical specifications say a lot, but not everything that an instrument manufacturer needs to know about the battery cell or battery pack that has been chosen to power a certain apparatus. Available battery capacity and the number of discharge cycles are two factors that are strongly affected by actual conditions of use. Similar battery cells from different manufacturers and even different models from the same manufacturer do not need to have the same properties, since the functioning of the battery is governed by those chemical reactions that are possible in each individual case. The balance between different components, additives, pollutant contents, etc. is very important to cell chemistry. Cell design and the manufacturers' recipes for electrode and electrolyte composition are carefully guarded secrets and are important competitive tools among manufacturers. The extent of the testing which is carried out by cell and battery manufacturers can also vary from case to case. Testing represents a cost, and one can therefore assume that low-budget products in many cases have undergone less extensive testing than advanced products from more renowned and experienced manufacturers.

MINIMUM REQUIREMENTS IN STANDARDS

The type tests that are found in IEC standards are basic tools for evaluating lithium cells and batteries' electrical properties. IEC 60086-1 and IEC 60086-2 lay down dimensional requirements for different cell types and sizes of primary batteries. The corresponding standard for rechargeable cells and batteries is IEC 61960. It is generally the case that standard requirements are minimum requirements that all batteries must comply with. Most modern, battery-driven products available on the market impose higher or more extensive requirements on their batteries and so standard tests should be supplemented with application-specific discharge and lifetime tests.

When buying cells and batteries, one should demand that they fulfil the relevant standard requirements. Cell and battery suppliers should be able to provide reports from tests carried out and be able to account for the extent and

frequency of tests, both as part of ongoing production checks and those that are carried out in final checks on the finished cells and batteries. It is not unusual for low-budget cell and battery specifications to state that the product is designed to conform to the requirements of IEC standards without any such testing having been carried out, or that limited testing is carried out covering only parts of the standards. In some cases, testing has been performed in connection with the original product launch, but is not updated in connection with product development or changes in components.

SAFETY TESTING FOR EXTERNAL INFLUENCES

The UN's transport testing is a typical example of safety testing designed to establish the battery's safety properties in the event of external influences. The test program includes a total of eight tests designed to simulate conditions that could occur in a transport situation.

- T1 Simulation of high height (test to recreate low pressure when flying)
- T2 Thermal shock (exposing the battery to alternating high and low temperatures)
- T3 Vibration test
- T4 Fall impact test
- T5 External short-circuiting
- T6 Blow test
- T7 Overcharging test
- T8 Forced discharging

It is important to note that it is not enough to test the individual cells that are included in a battery pack and that the whole battery pack must be tested if it consists of several cells. Re-testing is also required if the product is modified in a way that could affect the results of testing and if the product's weight (primary lithium batteries) or Wh-content or voltage (rechargeable lithium cells and batteries) are changed. As well as special testing, transport rules require that lithium batteries and products that contain lithium batteries are packed, marked and accompanied by safety documentation in accordance with given requirements. Some countries/transport authorities set higher requirements than those that normally apply in UN 38.3. Today, transports in the USA are subject to more extensive requirements.

UL and IEC standards consist of a combination of environmental influence tests and tests that simulate predictable types of incorrect use. The tests focus on evaluating fire-safety and the requirement for approval is generally that the cell or battery does not explode or burn during the course of a test. The tests included in UL or IEC are similar, even though there can be differences in the degree of strictness between the different standards. UL standards are most common in North America, while IEC dominates in the rest of the world.

When buying cells or batteries, you should insist that the cell or battery supplier has carried out tests in accordance with the UN's transport requirements. If these have not been carried out, this can affect the timetable for the product launch and involve considerable costs for the equipment manufacturer, who must then take responsibility for carrying out the tests. Cell and battery suppliers should also be able to provide test reports from completed testing in accordance with UL 1642 (cells) and 2054 (battery packs) or IEC 60086-4 (primary lithium cells and batteries) or IEC 62133 (rechargeable cells and batteries) and to account for the extent and frequency of tests carried out, both as part of ongoing production checks and as final checks on the finished cells and batteries. If, as a buyer, you are unsure whether the battery has been tested or whether the testing has been carried out in the right way, then you should carry out your own verification in accordance with relevant standard methods.

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REGULATED HEAVY METALS ARE UNCOMMON

There is no named method that has to be used for chemical analysis of batteries. None of the listed substances; mercury, cadmium or lead contributes to the electro-chemistry in lithium batteries. There is therefore no reason for manufacturers to add them intentionally. To the extent that they do occur, it's in the form of raw material contamination. It is extremely unusual for lithium-based cells and batteries to contain problematically high levels of these substances.

BATTERY TESTING STANDARDS

Below is a list of the testing standards mentioned earlier. Most national and regional standards, such as SS and EN, are based on the corresponding IEC standard and this is therefore referred to in the current version of IEC. In some cases, national standards are not updated at the same time as IEC and for that reason it is important to be certain that testing has been carried out in accordance with the current guidelines and, where necessary, supplement the tests carried out with further tests.

For transport rules, the method of transport governs which guidelines that apply, i.e. ADR/RID for land transport, the IMDG-code for sea transport and the ICAO-TI and IATA-DGR for air transport. These are updated regularly, but there is sometimes a time delay which leads to transport law guidelines referring to an earlier edition of the UN Manual of Test and Criteria.

UN's transport testing for all batteries that contain lithium

- ST/SG/AC.10/11/Rev.5; UN Manual of Tests and Criteria, Rev.5 (2009)

Primary batteries

- IEC 60086-1: Primary batteries - Part 1: General, Ed 10.0 (2006)
- IEC 60086-2: Primary batteries - Part 2: Physical and electrical specifications, Ed. 11.0 (2006)
- IEC 60086-4: Primary batteries - Part 4: Safety of lithium batteries, Ed. 3.0 (2007)
- UL 1642: Lithium Batteries, Ed. 4, (2005, with revisions 11/2009)
- UL 2054: Household and Commercial batteries (2004, with revisions 11/2009)

Rechargeable batteries

- IEC 62133: Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications, Ed. 1.0 (2002)
- IEC 61960: Secondary cells and batteries containing alkaline or other non-acid electrolytes - Secondary lithium cells and batteries for portable applications, Ed.1.0, (2003)
- UL 1642: Lithium Batteries, Ed. 4, (2005, with revisions 11/2009)
- UL 2054: Household and Commercial batteries (2004, with revisions 11/2009)

Note that several of the above standards are currently in revision.

CONSTRUCTION REQUIREMENTS FOR BATTERY POWERED EQUIPMENT

When applying for product certification for medical-technical equipment, an approved result of the safety test in accordance with IEC or UL standards constitutes a basis for being able to approve the battery as a safe component. This means that if there are several suppliers of cells and/or batteries for a specific item of equipment, then they must be approved individually in order to be used in the equipment.

CB-certification of products containing rechargeable Li-ion batteries requires testing according to IEC 62133 as of May 1, 2012, and that Li cells and batteries certified to UL 1642 and UL 2054, respectively, has to undergo and fulfil additional testing starting from May 1, 2011. Primary lithium batteries must be certified in accordance with IEC 60086-4. The corresponding timetable for products falling under IEC 60065 and IEC 60950-1 remains to be determined.

Product certification requires that the equipment must be safe if a component fails. Fire or dangerous explosions must not occur and a risk analysis is performed based on the test results of the device. For a primary battery or cell of the lithium type, protection is only required against reverse current. It may also be appropriate to specify regular checks on the protective components. For batteries or cells that are tested and certified as short-circuit-proof, no further protection is needed. For other batteries a current-limiting component is also required to limit the

discharge current. The reverse and discharge currents that the battery is certified for must not be exceeded in the case of a fault.

For secondary lithium batteries, i.e. rechargeable batteries and cells, the charging battery protection circuits are investigated. The battery must be protected against excessive discharge current, charging current and charging voltage. Where appropriate, it may also be necessary to monitor the battery's temperature in order to shut down the device and mitigate the effects in ase of over-temperature. If the battery protection is not certified, two independent protective measures are required for each of the three parameters, which is the most commonly occurring scenario.

In addition, a risk analysis based on testing should be carried out to show that it is improbable that faults should occur in both protective circuits simultaneously. ■

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EMC Archaeology

Uncovering a Lost Audio Frequency Injection Technique

Ken Javor, EMC Compliance

Injection of audio frequency ripple on equipment input power conductors has a long history, going back to 1953 (MIL-I-6181B) in the United States military, and at least as far back as 1961 in commercial aviation (RTCA/DO-108). Audio frequency injection has been accomplished by inserting the secondary windings of a coupling (isolation) transformer in series with the power conductor to the test sample. While various transformers had been used prior to the 1960s, one has become standard since 1963. That Model is the Solar Electronics Model 6220, designed in 1962 and accepted by the United States Air Force in 1963 as being superior to previously used injection transformers. [1]

This device, which may be found in every EMI test facility that performs testing for automotive, aviation, or military applications, is admirably suited to the task, with perhaps one minor drawback. That being it inserts about one millihenry of inductance in series with the power line unless the primary side is properly loaded so as to shunt this leakage inductance. Such a large inductance in series with the power source can cause instability and even damage to a switched mode power supply lacking adequate decoupling from the power source.

Unlike the other markets mentioned previously, the space industry often conducts qualification testing on flight equipment, and is thus leery of anything that could have an even remote possibility of damaging flight hardware. The Jet Propulsion Laboratory EMI test facility has gone so far as to develop their own audio frequency injection technique which doesn't require the coupling transformer. [2]

However, such heroic measures are actually unnecessary for space equipment. An alternative injection technique similar to modern bulk current injection technology was developed for the Apollo program Lunar Excursion Module (LEM) in the mid-1960s. It is this forgotten technique that is exhumed and investigated herein.

BACKGROUND

The 1971 Solar Electronics catalog contains the following verbatim text on the reverse side of the ubiquitous Solar Model 6741-1 current probe data sheet:

> **Audio Frequency Induction Probes for LEM Testing**
>
> A clever new idea introduced by Grumman Specification LSP-530-001 for inducing up to one volt of audio on each wire inserted in the window of a split toroid for susceptibility testing. Includes monitoring winding to show how much audio is being induced on the wires being tested. Designed for 4 ohm audio amplifier output. 30 Hz to 15 KHz. Type 6541-1. 1 1/4 " I.D.

References to LSP-530-001 [3] appear in other NASA/Apollo publications as early as 1963. [4] The Solar Model 6541-1 means that the design was done in 1965; the first two digits of a Solar Model number being the last two digits of the year it was designed, in the last century.

The Solar Electronics data sheet for the 6541-1 lists the following pertinent information (verbatim):

> "The Solar Electronics Type 6541-1 Induction Probe has been designed to provide induced signals from a 100 watt audio amplifier with a four ohm output impedance over the range of 20 Hz to 15 kHz. Such a test is required by paragraph 4.5.3 of LEM Specification LSP-530-001.
>
> Using the Type 6541-1 Induction Probe, it is also possible to perform to the specification using the eight ohm output of a 60 watt audio amplifier, with some degradation of waveform at frequencies below 100 Hz. At low frequencies, the wave shape may be improved by lowering the output impedance to less than four ohms by connecting to the four ohm output tap and adding a fixed resistance load."

Other important information is that the Induction Probe saturation current is 35 Amps direct current, and most importantly for our investigation (verbatim), "the probe adds approximately 0.01 ohm in series with each wire passing through the probe." The probe, shown in Figure 1, is physically similar to the well-known Solar Model 6741-1 current probe, using the same enclosure with only a different multi-pin connector instead of a bnc.

It should be understood that the purpose of this new technique in LSP-530-001 was not to replace the coupling transformer injection technique that was included in it and

Figure 1: Solar 6541-1 Audio frequency injection clamp

was substantially the same as that used universally today. Instead, injection using the Solar 6541-1 was aimed at common mode injection on signal cables, similar to how we perform MIL-STD-461D/E/F CS114 and RTCA/DO-160 section 20 rf conducted susceptibility testing today. The limit was much less stringent than the requirement for audio injection on equipment power input. The two LSP-530-001 limits are graphed together for comparison in Figure 2. The two curves are not completely an apples-to-apples comparison, because the "CS01-like" requirement is 3 Vrms open circuit, with no mention of the signal source impedance, whereas the bulk current injection-like limit is measured as induced on the cable-under-test (CUT).

However, a feel for the difference between the open-circuit and cable-induced limits can be obtained by noting that LSP-530-001 specifically references a McIntosh 60 audio

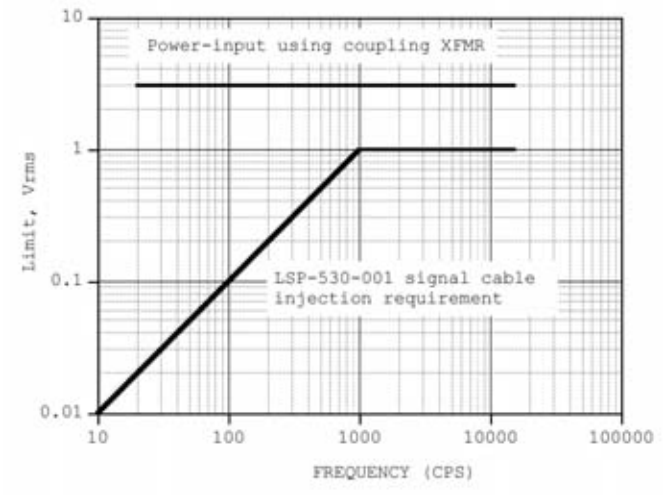

Figure 2: LSP-530-001 power input & signal bundle audio susceptibility limits

Figure 3: McIntosh MC60 amplifier specified for use with Solar 6541-1 in LSP-530-001

power amplifier using the 8 ohm tap for the signal cable test. The McIntosh C60 amplifier shown in Figure 3 was specified to have a damping factor of 12 or better on the 4, 8, and 16 ohm taps so that the source impedance was well under one ohm. And audio frequency conducted susceptibility testing for power inputs was generally specified to have a 0.5 ohm or lower source impedance in the days running up to and including MIL-STD-462. [3] Which means that for most applications, the open-circuit and loaded potentials wouldn't have differed greatly.

RATIONALE FOR USE OF THE ALTERNATE INJECTION TECHNIQUE FOR SPACECRAFT EQUIPMENT

It will be noted that whereas the Model 6220 injection transformer is capable of injecting at least 6.3 Vrms using a 100 watt amplifier, the Model 6541-1 can only inject up to 1 Vrms (see graph, below). Clearly, the Model 6541-1 is not suitable for testing to MIL-STD-461 CS101, or RTCA/DO-160 section 18. However, the ripple levels in these standards derive from electro-mechanical power generation, where an engine of one sort or another turns a shaft that provides motive power to an electrical generator. Such power sources have inherent ripple, viz. MIL-STD-704, all revisions. MIL-STD-461 CS101 in particular is written to provide a margin with respect to MIL-STD-704. [5] RTCA/DO-160 section 18 also refers to harmonics of the power frequency as the source of ripple in all versions since and including RTCA/DO-160B in 1984. Boeing standard D6-16050-2, dated 1977, also refers to power generating equipment as the source of audio frequency ripple requirements.

But most spacecraft are different. Especially those operating in Earth orbit, or within Earth's orbit of the Sun, tend to use solar panel arrays that charge a battery. An electrical power subsystem based on solar charging has no inherent ripple, at least not at audio frequencies. The only source of audio frequency ripple is load-induced effects, and these are minor with a battery-dominated bus. The United States National Space Transportation System (Space Shuttle) quotes 0.8 Volts peak-to-peak in a dc to 50 MHz bandwidth, with no more than 0.4 Volts peak-to peak at any discrete frequency, with the bus resistively loaded (i.e., no load-induced effects). [6] The Space Shuttle uses fuel cells in lieu of batteries and solar arrays. Obsolete MIL-STD-1541A (dated 1987) required time domain ripple to be less than 0.5 Volts peak-peak. The International Space Station Power quality specification [7] required a maximum of 3 Volts peak-peak ripple in the time domain (20 MHz bandwidth), and no more than 0.3 Vrms ripple at any discrete frequency resistively loaded, even though this power was sent through a dc/dc switched mode converter between the solar arrays and the electrical bus. The orbiting x-ray observatory Chandra specified 1.5 Vpeak-peak

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time domain over a 1 Hz to 1 MHz bandwidth. At the current time, the orbiting infrared observatory James Webb Space Telescope is looking at under 1 Volt peak-peak ripple in the time domain and a 1 Vrms CS01 limit.

The graph in Figure 4 shows ripple limits for 28 Vdc power from MIL-STD-704, revisions A-F, vs. the maximum ripple the Solar 6541-1 injection clamp can induce in 0.5 ohms. It will be seen that except for the obsolete A revision, the Solar 6541-1 performance suffices except at the very low end below 100 Hz, and it is precisely that very low end that simply won't be there, meaning the ripple on a battery dominated spacecraft 28 Vdc bus.

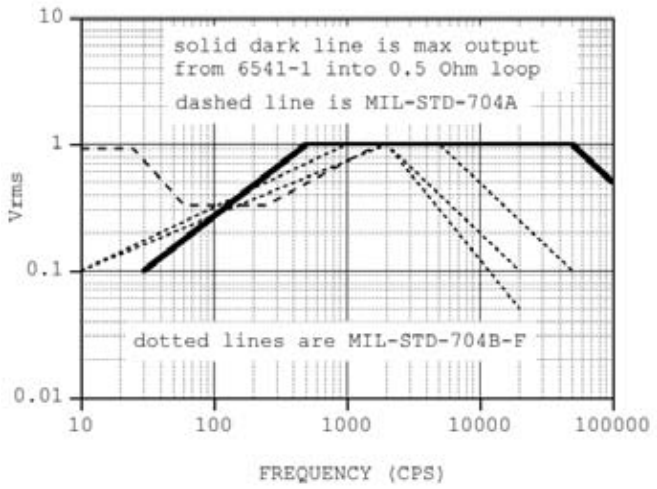

Figure 4: Maximum potential induced on 0.5 ohm load using Solar 6541-1 as intended. Compare to various MIL-STD-704 28 Vdc ripple limits.

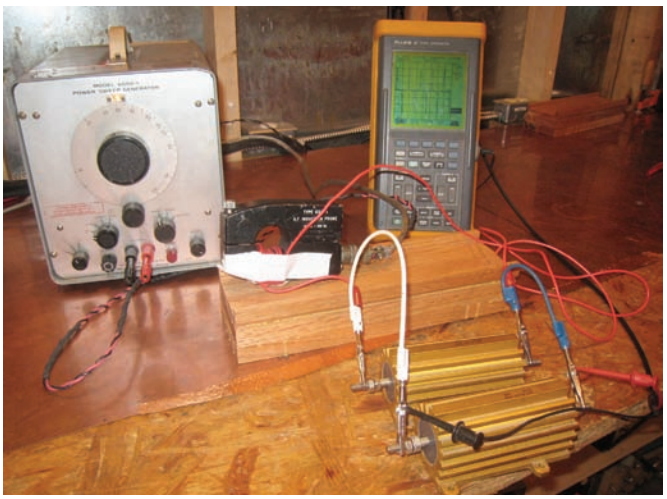

Figure 5: The 6541-1, center, with ten turns through the window is driven from the 100 watt Solar 6550-1 power audio oscillator and induces the oscilloscope-measured potential across the two parallel 1 ohm resistors in the foreground.

MODERNIZING THE TECHNIQUE

While the Solar 6541-1 performs as needed for the LSP-530-001 requirement, it complains loudly (core vibration – "singing") when pushed to the maximum levels in the above graph. And while the author feels the Figure 4 levels available from the 6541-1 should suffice for spacecraft applications with a battery-dominated bus, it is possible to modify the clamp to get 1 Vrms across 0.5 ohms over a wider range. The clamp is a twenty-turn primary, single turn secondary transformer. As such, it is a step-down transformer with a 400:1 impedance transformation. Since the audio amplifier output is no more than 2.4 ohms (Solar audio Amps for conducted susceptibility testing) to well below an ohm (the McIntosh C60), this much step-down is not useful. Pulling ten turns through the clamp window converts the step-down ratio to the same as that for the 6220 coupling transformer, and allows the cited 1 Vrms to be induced across 0.5 ohms from 30 Hz to 80 kHz.

Ten turns, in addition to providing a 2:1 turns ratio, also provides about 100 uH secondary winding inductance, which is 10% that of the 6220. That 10% value was used as a benchmark. More turns give better performance, but at the cost of higher secondary inductance. The whole point of the modernization investigation was to finesse the minimum amount of secondary inductance that would result in the ability to inject the required potential into 0.5 ohm down to 30 Hz. It was felt that keeping that inductance to 100 uH should suffice to allay fears of damage to switching

Figure 6a: 1 Vrms injected across 0.5 ohm at 30 Hz. Note considerable distortion, which can be ameliorated by more turns.

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converters. Note that 100 uH is the power source impedance seen by any test sample undergoing MIL-STD-461D/E/F qualification. In other words, a robust power supply and filter design ought to be able to operate stably from a 100 uH power source impedance.

CONCLUSION

A "space-race" era EMI test technique has been discovered and examined and modified to provide a safer technique to inject audio frequency ripple on dc power lines. The injection clamp is still available from Solar Electronics, and it is the author's hope that the technique described herein is adopted as an alternate audio frequency test technique in such standards as the Goddard Space Flight Center's General Environmental Verification Specification (GEVS), the American Institute of Aeronautics and Astronautics (AIAA) S-121-2009 Electromagnetic Compatibility Requirements for Space Equipment and Systems and other EMI control requirements with a spacecraft focus. ■

ACKNOWLEDGMENT

The author would like to thank EMC engineers at the Marshall Space Flight Center for sifting through old records and finding a copy of LSP-530-001.

REFERENCES

1. ASNPRE-1/34257, June 6, 1963. Subject: Isolation Transformer, Solar Model 6220-1.
2. A. Whittlesey & K. Erickson, "A Stable CS01 Tester for Switch Mode Power Supplies," 2006 IEEE EMC Symposium Record.
3. Grumman Aircraft Engineering Corporation Specification No. LSP-530-001, 24 June 1963, "Electromagnetic Interference Control Requirements, General Specification for."
4. Grumman Aircraft Engineering Corporation Report No. LED-520-1C, 15 May 1963, "Design Criteria and Environments LEM" submitted under NAS Contract 9-1100.
5. See the Rationale Appendix for CS101 in any version of MIL-STD-461 since 1993 (D, E, & F revisions).
6. ICD-2-19001, revision K, "Shuttle Orbiter/Cargo Standard Interfaces," 1 August 1991, Section 7.3.7.1, page 7H-1.
7. SSP 30482 Volume 1: Electrical Power System Electrical Performance Specifications, July 1997.

Ken Javor *has worked in the EMC industry for thirty years. He is a consultant to government and industry, runs a pre-compliance EMI test facility, and curates the Museum of EMC Antiquities, a collection of radios and instruments that were important in the development of the discipline, as well as a library of important documentation. Mr. Javor is an industry representative to the Tri-Service Working Groups that write MIL-STD-464 and MIL-STD-461. He has published numerous papers and is the author of a handbook on EMI requirements and test methods. Mr. Javor can be contacted at ken.javor@emccompliance.com.*

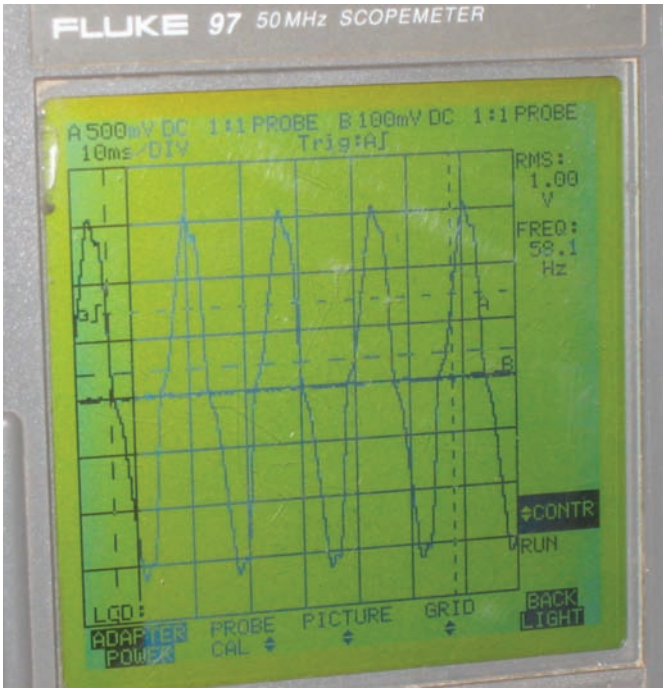

Figure 6b: 1 Vrms injected across 0.5 ohm at 60 Hz. Note distortion, which can be ameliorated by more turns.

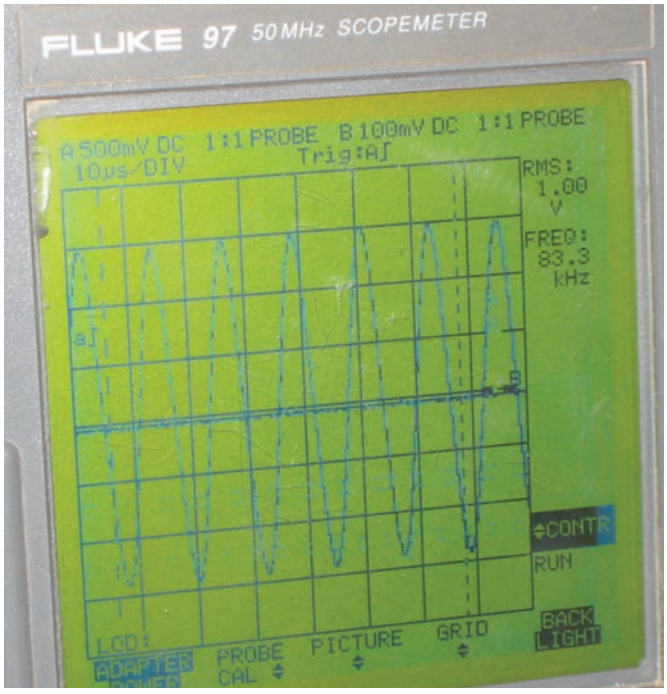

Figure 6c: 1 Vrms injected across 0.5 ohm at 80 kHz.

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IEEE

New Test Methods

to Determine the Shielding Effectiveness of Small Enclosures Defined in IEEE P299.1

Philip F. Keebler
Electric Power Research Institute

Today's end-use electronic equipment has a number of characteristics that require protection from the electromagnetic environment. These characteristics include the growing use of digital electronics (still with a layer of analog electronics); multiple inputs and outputs for power, data, controls and indicators; ventilation for air flow and thermal management; and small openings for accessories. Few pieces of equipment use only one microprocessor. Multiple digital packages (i.e., integrated circuits) are used for small and large amounts of memory, signal processing, and input/output control just to name a few. The days of having just one power cord and a few knobs for control have long since past. A piece of consumer electronic equipment such as a DVD player has an average of 27 penetrations in its case. On the industrial side, a piece of instrumentation and control (I&C) equipment used in a power plant has an average of 38 penetrations. Components used on the surface of a metallic equipment enclosure such as a liquid crystal display (LCD) screen require fairly large penetrations. Universal serial bus (USB) connectors and Ethernet ports are two examples of input/output ports that are being used much more frequently today than just several years ago. While some equipment is getting more efficient and generating less heat, other types of equipment generate significant heat requiring increased air flow across the electronics.

Each of the above surface components requires a penetration, or aperture. The electronics and subcomponents inside equipment generate radiated emissions made up of electric and magnetic fields with not only low, mid, and high frequencies up to 1 GHz, but also frequencies above 1 GHz. From electromagnetic theory, we know that some of these fields will propagate through these apertures. Emissions that escape an enclosure add to the cluttering and

energetic nature of the electromagnetic environment. Some emissions that escape will be the cause of EMI problems. The use of apertures in equipment enclosures degrades the shielding effectiveness that enclosures with no apertures can provide.

Electromagnetic compatibility (EMC) standards in place today specify various levels of emissions control based on product type, application, and frequency among other considerations. To maintain control over the emissions that do escape an equipment enclosure, the equipment designer must be able to determine just how much the shielding effectiveness is degraded by the presence and characteristics of the apertures. Components such as switches and indicators used on the surface of an enclosure can be fitted with EMC gaskets -- a common practice used today. EMC gaskets are specially designed and manufactured materials that can provide some level of shielding. Gaskets essentially 'seal up' the small spaces between a surface component and the plane of the enclosure. If an aperture intended for the flow of heat does not require some type of EMC-grade air filter for dust control, then gaskets are not used. Most standard apertures intended for air flow do not use filters. The sizes of these apertures are bounded by the amount of air flow and heat that must pass through them. Thus, the equipment designer cannot size them small enough to limit the level of emissions escaping from the enclosure and still maintain the required air flow to maintain specific operating temperatures in various ambient environments.

The comprised shielding effectiveness for enclosures larger than two meters when apertures are used can easily be measured using test methods defined in IEEE Standard 299, *Standard Method for Measuring the Effectiveness of Electromagnetic Shielding Enclosures*, first published in 1997 and then revised in 2005. Many enclosures larger than two meters are the large shielded rooms that EMC test houses commonly use. There are some other industry-specific enclosures larger than two meters where the IEEE 299 standard can be applied. Examples of these include medical imaging suites where magnetic resonance imaging (MRI) systems are used. (Patients typically don't see the enclosures as they are behind sheet rock walls to provide a pleasing imaging suite.) Because the definition of shielding effectiveness is straightforward, the application of IEEE 299 is not a problem for these large enclosures. However, when the methods of IEEE 299 are applied to enclosures with dimensions smaller than two meters, problems arise in defining and measuring shielding effectiveness.

For enclosures smaller than 2 meters, applying IEEE 299 test and measurement methods will lead to erroneous shielding effectiveness numbers. Manufacturers of small shields with dimensions less than 2 meters who apply IEEE 299 to determine shielding effectiveness versus frequency will end up with misleading results. Some manufacturers do apply IEEE 299 to small enclosures and publish misleading results. Thus, one can see that there is a need to provide new test methods allowing manufacturers to accurately measure the shielding effectiveness of small enclosures.

The IEEE P299.1 draft standard, *Draft Full-Use Std. Method for Measuring the Shielding Effectiveness of Enclosures and Boxes Having All Dimensions between 0.1 m and 2 m*, addresses the measurement of shielding effectiveness for enclosures between the dimensions of 0.1 to 2 meters. A lower boundary of 0.1 meters was set for this standard as the new test methods are acceptable down to this dimension. In most cases, the test methods presented in this standard will be applied to square or rectangular enclosures. The development of this draft standard is a project within the IEEE Electromagnetic Compatibility Society.

Enclosures used in equipment like computers and other electronic equipment offer a shielding effectiveness ranging from low to medium values. To determine the shielding effectiveness of enclosures with dimensions between 0.1 and 2 meters, one must distinguish between physically small but electrically large enclosures and those that are both physically and electrically small. The former successfully allows a reverberation chamber (RC) method to be applied for SE evaluation by means of the frequency stirring technique. For the latter case, the traditional SE definition is hard to apply because of the undermoded condition, the strong dependence of the internal field on probe positioning and orientation, and the dependence on the incoming field polarization. The frequency stirring technique was pioneered by EMC researchers at the National Institute of Standards and Technology (NIST). Other organizations such as Sapienza Univ. di Roma in Rome, Italy and the University of York in York, United Kingdom were also instrumental in developing the new test methods.

APPLICATION OF THE IEEE P299.1 STANDARD

Figure 1 illustrates a view of an enclosure with overall dimensions between 0.1 and 2 meters. This enclosure is used for a computer power supply on the market today. The actual dimensions of this enclosure are 0.15 meters in width, 0.14 meters in depth, and 0.084 meters in height. These dimensions fit within the requirements of IEEE P299.1. Measuring the shielding effectiveness of computer power supplies is important to the overall EMC performance of the computer. Emissions generated inside the enclosure must be kept under control while emissions generated by the computer hardware must be kept from causing power supply upsets. From the figure, one can see that there are a number of slots in the metal forming the enclosure. In fact, it is possible to notice apertures for the cooling fan, a multiple rectangular aperture for the power plug, a squared hole for switching cables, and a series of slots for heat transfer. These

slots and apertures will degrade the shielding effectiveness of an enclosure of this size with no penetrations. This type of enclosure is exactly the enclosure size that is applicable to the new IEEE P299.1 standard when trying its shielding effectiveness.

There are millions of applications of the new test methods defined in the IEEE P299.1 draft standard. Use of these new test methods will help designers and manufacturers of metallic enclosures with dimension 0.1 to 2 meters better understand the shielding effectiveness of their enclosures and how they perform to provide shielding when used in end-use equipment.

OVERVIEW OF THE IEEE P299.1 STANDARD

The IEEE P299.1 draft standard is divided up into seven chapters and twelve annexes. Listed below are the chapter titles and a brief discussion of their contents:

- Chapter 1: Overview – This chapter presents the scope and purpose of the IEEE P299.1 along with discussion on application of test methods and use of the IEEE P299.1.
- Chapter 2: Definitions – This chapter presents some definitions of particular use and interest to those interested in learning about terminology used in applying the new test methods for determining the shielding effectiveness of enclosures with dimensions between 0.1 and 2 meters.
- Chapter 3: Preparing for shielding effectiveness measurements – preliminary procedures – This chapter is designed to provide technical assistance to the user on various subjects related to shielding effectiveness and the use of the new test methods. Subjects such as the test plan, calibration, reference level, dynamic range, preliminary procedures for checking a shield under measurement, reverberation qualification, pass/fail requirements, and usable frequency ranges and limits are provided. Some of these technical subjects apply to one of the two test methods or both.
- Chapter 4: Measurement instrumentation – This chapter provides guidance on what measurement instruments to consider in using the two new methods.
- Chapter 5: Measurement uncertainty – This chapter provides some guidance on measurement uncertainty when measuring shielding effectiveness. Measurement uncertainty is a parameter that can be associated with the result of a measurement of shielding effectiveness. It characterizes the dispersion of values that could reasonably be attributed to the measurements. There are many aspects of shielding effectiveness where measurement uncertainty can be estimated to gain the overall expanded measurement uncertainty of the shielding effectiveness process contained in the IEEE P299.1.
- Chapter 6 – Test procedures – This chapter presents the two new test methods. Part I deals with enclosures 0.75 to 2 meters. Part II deals with enclosures that are physically small and electrically large. Manufacturers and designers of enclosures that fit these categories will want to purchase the new standard once it is available and review these parts.
- Chapter 7 – Qualify assurance technical report – This chapter presents the format for developing a technical report when using either Part I or Part II (new test methods) of the IEEE P299.1. The investigator has the choice of developing an abbreviated test report or a full test report.

To supplement the two new test methods presented in the main body of the IEEE P299.1, twelve annexes are included. Listed below are the annex titles and a brief discussion of their contents:

- Annex A (informative) – Bibliography – Annex A presents a list of all the technical papers used in developing the IEEE P299.1. Users may desire to refer to them for more detailed information and when interested in applying these new test methods to irregularly-shaped enclosures.
- Annex B (informative) – Rational (for Part I – 0.75 to 2 meter enclosures) – Annex B presents the basis for this new test method, considerations pertinent to the objectives, cavity resonances, measurement locations, and measurement equipment.
- Annex C (informative) – Mathematical formulas (for Part I – 0.75 to 2 meter enclosures) – Annex C presents specific mathematical formulations, low range (50 Hz to 200 MHz) shielding effectiveness, and high range (300 MHz to 100 GHz) shielding effectiveness, non-linear (logarithmic) calculations, and dynamic range considerations.
- Annex D (normative) – Miscellaneous supporting information (for Part I – 0.75 to 2 meter enclosures) – Annex D presents discussion on coplanar versus coaxial loops, non-linearity of high-permeability ferromagnetic enclosures, and selecting measurement frequencies.
- Annex E (informative) – Guidelines for the selection of measurement techniques (for Part I – 0.75 to 2 meter enclosures) – Annex E presents discussion on types of enclosures, performance requirements, equipment requirements, and regulatory agency conflicts.
- Annex F (informative) – Preliminary measurements and repairs (for Part I – 0.75 to 2 meter enclosures) – Annex F presents discussion on background related to this subject, frequencies for preliminary checks, and preliminary check procedures.

- Annex G (informative) – Rationale for wall-mounted monopoles – Annex G presents some technical discussion and understanding of wall-mounted monopoles that are used in carrying out the new test methods.
- Annex H (informative) – Impedance mismatch correction – Annex H presents discussion on impedance mismatch issues that can be encountered when using antennas with the new test methods.
- Annex I (informative) – Using isolated monopoles in outer reverberation chambers – Annex I presents discussion on the use of isolated monopoles when using reverberation chambers to carryout the new test methods.
- Annex J (informative) – Measurement the shielding effectiveness of physically small and electrically small enclosures using magnetic field measurements (≤ 300 MHz) – Annex J presents technical discussion on determining the shielding effectiveness for physically small and electrically small enclosures. This annex is provided should this need arise with shielded enclosures. Test methods for use in determining the shielding effectiveness for enclosures that are physically and electrically small are still under investigation by EMC researchers who study shielding effectiveness and enclosures. This material may spawn the development of further new test methods in future revisions of IEEE 299.1 (when approved).
- Annex K (informative) – Electrically small enclosures in reverberation chambers – Annex K presents technical discussion on the background, measurement procedure, formula to be applied, and internal probe type and positioning when setting out to measure the shielding effectiveness of electrically small enclosures using reverberation chambers.
- Annex L (informative) – Utilization of absorbing (dissipative) materials in equipment enclosures for the measurement of shielding properties – Annex L presents technical discussion on the use of absorbing materials in enclosures when setting out to apply the new test methods to determine shielding effectiveness.

UPCOMING BALLOTING OF THE IEEE P299.1

The IEEE P299.1 document has been completed and is ready for balloting in 2011. Once it has been balloted and approved by IEEE, then it will be available for purchase from the IEEE.

VOLUNTEERING FOR IEEE

IEEE depends upon many volunteers to provide the many services, such as the development of new standards, it offers to its members. Volunteering for work on new standards or the revision of existing standards is just one important role that volunteers may play. Volunteers have the opportunity to meet new people and learn about new developments in the technical community, such as how the shielding effectiveness of small enclosures can be achieved with new test methods. Serving as editor of this new standard has been a challenging but rewarding experience. The author of this paper encourages all IEEE members, especially those of the new generation, to take part in IEEE activities such as standards development. When a project is completed, you'll find out that it was well worth the time spent. ■

Philip F. Keebler
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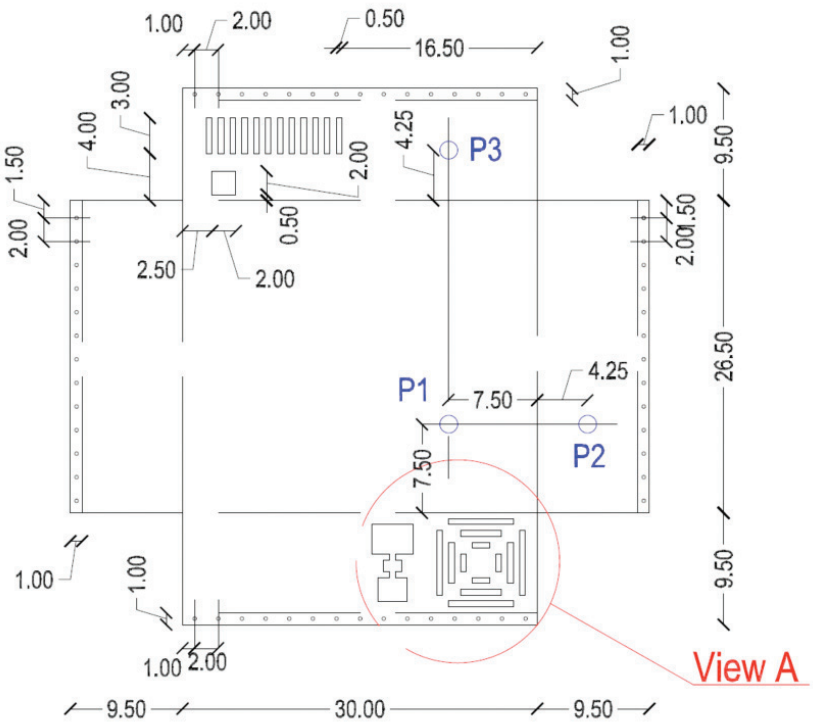

Figure 1: Metallic enclosure for a computer power supply (dimensions are in centimeters).

No Sleeping in Seattle

A Recap of CISPR Projects from the 74th IEC General Meeting

Part 2

Martin Wiles, ETS-Lindgren

In this second installment of a two part article, we continue our review of the recent meeting of IEC-CISPR held in October 2010 in Seattle. In the first part of this article, we have described the current changes affecting the basic standard CISPR 16 and the activities of its experts within CISPR sub-committee (SC) A. We now take a look at the activities of the other CISPR sub-committees responsible for preparing the CISPR product standards. We also describe some of the projects shared by CISPR and IEC TC 77B (High Frequency Phenomena).

PRODUCT STANDARDS

CISPR SC B

Industrial, scientific and medical (ISM) standards

This sub-committee is responsible for the following standard:

- *CISPR 11 - Industrial, scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement, 2009*

Working Groups

- WG 1 - Industrial, scientific and medical (ISM) radio frequency apparatus

  Amendment 1 to CISPR 11 Ed. 5: Selection criteria for the minimum separation distance between EUT and measurement antenna

- Proposal to replace the "Class" criterion currently used in CISPR 11 by a "size-of equipment" criterion. A measuring distance less than 10 m is allowed for "small equipment" either positioned on a table top or standing on the floor which, including its cables, fits into a cylindrical test volume of 1.2 m in diameter and 1.5 m above the ground plane.

  Status: Final Draft International Standard (FDIS)

- WG 2 - Interference from overhead power lines, high-voltage equipment and electric traction

Status: The future CISPR 11, Ed 5.0 is currently under revision with key issues related to harmonizing methods with CISPR 16.

CISPR SC D

Electromagnetic disturbances related to electric/electronic equipment on vehicles and internal combustion engine powered devices

This sub-committee is responsible for the following standards:

- *CISPR 12 Vehicles, boats, and internal combustion engines - Radio disturbance characteristics - Limits and methods of measurement for the protection of off-board receivers, 2009*
- *CISPR 25 Vehicles, boats, and internal combustion engines - Radio disturbance characteristics - Limits and methods of measurement for the protection of on-board receivers, 2008*

Working Groups

- WG 1 - Protection of receivers used in buildings, along the roadside, or in outdoor areas
  - CISPR 12 Ed 6.1 2009-03
  - Status: First Committee Draft (CD) Ed 7.0 under discussion in CISPR D
- WG 2 - Protection of on-board and adjacent vehicle receivers
  - CISPR 25 Ed 3.0 2008-03
  - Status: Ed 4.0 First CD 2010-11; CDV 2012-03; FDIS 2012 -11; Publication 2013-02

    The third edition of CISPR 25 Ed 3.0 announced several items for future work in annex I.

    Some items will be handled within the overall revision work of CISPR 25.

    The chamber validation methods (ALSE) used for the tests defined in CISPR 25 are a more complex issue, which is being addressed separately with the expertise of CISPR/A. The work on the fourth edition is therefore split up into two tasks with separate CDs. Depending on the comments received from the National Committees, the documents will be merged in the enquiry or approval stage.

Image courtesy of ETS-Lindgren

An automotive EMC chamber for whole vehicle testing per CISPR 25.

CISPR SC A – CISPR SC D Joint Task Force (JTF)

Development of appropriate Fast Fourier Transform (FFT) methodology

- Joint Task Force between CISPR/A and CISPR/D - FFT-based emission measurement apparatus - Specification and application

Status: The work is essentially complete.
For details see CISPR A discussion in Part 1 of this article (*IN Compliance Magazine*, February 2011).

CISPR SC D – CISPR SC A JTF

Development of a chamber validation method for CISPR 25

This Joint Task Force of CISPR D and CISPR A experts was assembled to develop a procedure for the validation of chambers used for radiated emission measurements made according to CISPR 25.

- The chamber validation procedure developed by the JTF would then be presented to CISPR/D as a proposed Annex for CISPR 25 4th Edition.
- As a secondary agenda, this JTF would also handle other chamber and site validation proposals for other CISPR/D specifications such as CISPR 12.
- The aim of this work is to
  - Increase the reproducibility of measurements in such anechoic chambers,
  - Be applicable in the frequency range between 150 kHz to 2500 MHz,
  - Include the ground plane bench,
  - Make use of the measurement antennas and their positions during CISPR 25 measurements,
  - Be able to reference to established calibration environments (e.g. TEM cell, OATS),
  - To specify measurement uncertainty for the site,
  - Detect improper connection of the table to the floor or the wall of the ALSE, and,
  - Give guidance on the minimum distances between the EUT and its wiring harness, and the chamber absorber material

The JTF has looked at currently used chamber validation procedures by the industry and also some custom procedures which have been developed for validation of chambers used for 1 meter radiated emissions measurements.

As a result, two chamber validation procedures have shown potential and could provide the CISPR 25 specification users some flexibility. It was thus decided that the proposed annex would contain two chamber validation procedures and the chamber performance can be determined by the use of either method (both methods are not required). The characterisation procedures are as follows:

1. **Reference Site Measurement Method: 150 kHz - 1 GHz**
   This method uses an OATS or Alternate OATS as a reference site. The measurements are made similar to Normalized Site Attenuation (NSA) measurements. The reference site measurements are then repeated in the shielded enclosure. The reference site measurements are then compared to the shielded enclosure measurements in order to determine if the shielded enclosure measurements are within a reasonable tolerance.

2. **Modelled Long Wire Antenna Method: 150 kHz - 1 GHz**
   This method uses a 50 cm "long wire" antenna as the transmitting antenna. This long-wire antenna is then modelled with a ground plane of a standard size (2.5 m x 1 m). Measurements are then made on the long-wire antenna in the shielded enclosure. The shielded enclosure measurements are then compared to the modelled fields in order to determine if the shielded enclosure measurements are within a reasonable tolerance.

   NOTE: The "reasonable tolerance" has been proposed as:
   The ALSE and its installation (physical layout, ground plane size, ground plane grounding, RF absorber, etc.) is suitable for testing, if the Δ = Reference – Enclosure is within ± 6 dB for ≥ 90% of the data points across the entire frequency range of 150 kHz to 1 GHz.

Other Future Work

- Correlation to Japanese JASO –D002 standards: Experts from Japan have proposed a procedure to validate chambers used for radiated emissions measurements on vehicles. This is a proposed Annex for CISPR 12. Since this is a secondary project for this JTF, CISPR/D/WG 1 may decide to have this JTF work on this chamber validation procedure for them.
- Methods > 1 GHz
- Vehicle test chamber

Status: CD out for comment November 2010

CISPR SC F

Household Appliances, electric tools and similar apparatus

This sub-committee is responsible for the following standards:

- *CISPR 14-1 Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 1: Emission.200*
- *CISPR 14-2 Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 2: Immunity - Product family standard.20*
- *CISPR 15 Lighting – SC F working with SC A on use of CDN (coupling-decoupling networks).*

Working Groups

- WG 1 - Household appliances incorporating electric motors and contact devices
- WG 2 - Lighting equipment

Other Joint Task Force

- CISPR/CIS/A/JTF JTFA/F - Joint Task Force between CISPR/A AND CISPR/F – CDN measurement method of radio frequency disturbances for lighting equipment in the frequency range 30 MHz to 300 MHz

Status: CD in preparation

CISPR SC H

Limits for the protection of radio services

This sub-committee is responsible for the following standards:

- *IEC 61000-6-1 (2005-03) Ed. 2.0 Generic standards Immunity for residential, commercial and light-industrial environments.*
  - ***Status Maintenance Result Date: 2011***
- *IEC 61000-6-2 (2005-01) Ed. 2.0 Generic standards Immunity for industrial environments.*
  - ***Status Maintenance Result Date: 2011***
- *IEC 61000-6-3 (2006-07) Ed. 2.0 Generic standards Emission for residential, commercial and light-industrial environments*
  - ***Status Maintenance Result Date: 2010***
- *IEC 61000-6-4 (2006-07) Ed. 2.0 Generic standards Emission for industrial environments*
  - ***Status Maintenance Result Date: 2010***

Working Group

- WG 1

Status: Both generic emission standards are in the FDIS stage and will include emissions from 1 to 6 GHz similar to CISPR 22 but with a difference in the class A and B definitions. They will also include amendments for the use of FARs for floor standing equipment.

CISPR SC I

Information technology, multimedia, and receiver products

This sub-committee is responsible for the following standards:

- *CISPR 13*
  - *"Sound and television broadcast receivers and associated equipment - Radio disturbance characteristics - Limits and methods of measurement", 2009*
- *CISPR 20*
  - *Sound and television broadcast receivers and associated equipment - Immunity characteristics - Limits and methods of measurement, 2006*

- *CISPR 22*
  - *"Information technology equipment – Radio disturbance characteristics- limits and methods of measurement", 2008*
- *CISPR 24*
  - *Information technology equipment - Immunity characteristics - Limits and methods of measurement, 2010*
- *Draft CISPR 32*
  - *CISPR I/333/CDV Electromagnetic Compatibility (EMC) – Multimedia Equipment – Radio disturbance - characteristics - Limits and methods of measurements, 2012*
- *Draft CISPR 35*
  - *CISPR I/330/NP Electromagnetic Compatibility (EMC) – Multimedia Equipment – Radio disturbance - characteristics - Limits and methods of measurement, 2013*

Working Groups

- **WG 1 - Methods of measurement and limits for radiation and immunity of broadcast receivers and associated equipment**
  - Maintenance of CISPR 13 and 20
  - Current activity includes discussions on emissions from plasma TVs below 30 MHz and LTE interference in Europe. When this activity matures, it will be passed on to WG 4 for inclusion in CISPR 35.

    Status: Stability period 2012

Image courtesy of ETS-Lindgren

EMC testing of commercial products, such as televisions, per CISPR 22.

- **WG 2 - Methods of measurements and limits for emissions from multimedia equipment**
  - CISPR 32 will combine and replace CISPR 13 and 22
  - Since TEM Cells, Reverberation Chambers and Fully Anechoic Rooms were removed from the main body of the draft CISPR 32 Ed1.0, a number of separate CDs have been prepared that take them into account. They will be integrated into the main body if they are successful. These include:
    - Proposed amendment of CISPR 32 outdoor units of home satellite receivers' requirements.
      Status: CISPR/I/347/CD for comment
    - Proposed amendment of CISPR 32 to included an informative annex on Gigahertz TEM and reverberation chamber emission test methods and limits
      Status: CISPR/I/346/CD for comment
    - Proposed amendment of CISPR 32 Emission-test arrangement requirements for various types of multimedia equipment
      Status: CISPR/I/348/CD for comment
    - Proposed amendment of CISPR 32 to include the FAR emission test methods and limits
      Status: CISPR/I/345/CD for comment
    - Proposed amendment of CISPR 32 to specify which detectors should be used
      Status: CISPR/I/349/CD for comment

- **WG 3 - Methods of measurements and limits for radiation and immunity of Information Technology Equipment (Maintenance of CISPR 22 and 24)**
  - CISPR 22 Ed 6.0
  - This standard is still within its stabilization period and not due for "maintenance" until 2012, but a few clarifications have been noted recently as below :
    - **Selection of average detector:** CISPR 22 defines limits for radiated emissions at frequencies between 1 GHz and 6 GHz with respect to both average and peak detectors. CISPR 16-1-1 defines two types of Average detector for use above 1 GHz. For the limits given in CISPR 22, the appropriate average detector is the linear average detector defined in CISPR 16-1-1 Edition 2.2, clause 6.4.1.
  - CISPR 24 Ed 2.0
  - This new edition was published in August, 2010

- WG 4 - Methods of measurement and limits for immunity of multimedia equipment
  - (CISPR 35 Ed 1.0)

- This will combine and replace CISPR 20 and 24

Status: Third CD in preparation

Project Team: CISPR-22-PLT

Amendment 1 to CISPR 22 Ed.6.0: Addition of limits and methods of measurement for conformance testing of PLT (power line telecommunication) ports intended for connection to the mains

Despite the efforts of many technical experts over ten years, no proposed change to CISPR 22 for PLT has been able to generate the needed support among the National Committees and this project was reset to a preliminary level. Several national committees have put forward their own versions but the official agreed path is to now wait for the European EMC committee CENELEC to progress this issue. In the meantime PLT products are on the market across the world creating significant interference even though they are regarded as legal by the authorities.

Other activities

Work is starting in WG 3 to create amendments for both CISPR 22 and CISPR 24. They are at the DC (Draft for Comment) stage right now. At the time this article was written in mid-January, one is out for national committee comments for CISPR 22 and the other for CISPR 24 was expected by the end of January.

Other Joint Task Force Activity

- **CISPR/CIS/A/JTF JTF A/I - Joint Task Force between CISPR/A and CISPR/I**
  - This was discussed under CISPR A in Part 1 of this article

Note that CISPR requires technical committees to provide justification for product standards that set different requirements than the generic standards and that use different test methods than those given in CISPR 16. The aim is to determine both differences and places where information contained within the basic standards is repeated in the product standard with the intention of providing an opportunity to justify or re-align and simplify these documents. First up was CISPR 22 largely because some of the work had already been completed in the CISPR/A CISPR/I JTF. CISPR 11 will be the next in line.

Summary of Joint Task Forces

IEC SC 77B / CISPR JTF work

IEC/CISPR has also set up a number joint task forces with IEC SC 77B with responsibility for the publication of the following:

IEC 61000-4-20 Ed.2.0: TEM waveguide test methods

This second edition of the standard has completed its first maintenance cycle and been revised to include field probe calibration as well as harmonized test setups for immunity and emission.
Status: Published

IEC 61000-4-21 Ed.2.0: Reverberation chamber test methods

This second edition of the standard has also completed its first maintenance cycle and is being revised to include, amongst other topics: field probe calibration, immunity and emission methods, and measurement uncertainty.
Status: Approved for Publication October 2010

IEC 61000-4-22 Ed 1.0 Fully Anechoic Rooms (FARs)

The methods described in this document offer an independent and more efficient method of validating a FAR and EUT set up for both radiated immunity and emissions which could exist in parallel to CISPR 16-1-4 and IEC 61000-4-3.
Status: Published

CONCLUSION

In summarizing both articles it is clear that much of the discussion has involved the activities of the CISPR A and CISPR I sub-committees. CISPR A deals with several different technical issues including the use of fast Fourier transforms (FFT), drafting a new antenna calibration standard and the integration of many of the test methods from the product standards as is now required by the CISPR management team. CISPR I is dealing with a number of issues related to real world changes in technology in multimedia and the major effort of bringing together the new standard CISPR 32 and 35, as well as dealing with the contentious subject of PLT. For more information, please consult the IEC website www.iec.ch including the EMC Zone on http://www.iec.ch/zone/emc or contact your national committee. ■

ACKNOWLEDGEMENTS

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Image courtesy of ETS-Lindgren

An example of a GTEM!™ test cell used to perform both radiated emission and immunity tests per IEC 61000-4-3 IEC 61000-4-20.

Image courtesy of ETS-Lindgren

IEC 61000-4-20 Ed 2.0 IEC 61000-4-3 has been revised to include field probe (shown above) calibration as well as harmonized test setups for immunity and emission.

Image courtesy of ETS-Lindgren

IEC/CISPR has set up a number of joint task forces with IEC SC 77B, including test methods using reverberation chambers, such as pictured above.

Image courtesy of ETS-Lindgren

To independently and efficiently validate a Fully Anechoic Room (FAR), IEC 61000-4-22 Ed 1.0 provides a method for both radiated immunity and emission testing.

The Future of EMC Engineering

by Mark I. Montrose, Montrose Compliance Services, Inc.

EMC and Functional Safety

Certain types of electronic products generate electromagnetic interference (EMI). Digital devices may emit EMI that could interfere with the operation of other electrical devices and systems. Newer technologies are in general more likely to cause an EMI disruption or induce an event that could cause functional degradation to another system with low levels of immunity protection. Mixed signal components (digital and analog) are both used on printed circuit boards, yet during the design process hardware engineers are generally more concerned with functionality per a marketing specification and not how it interacts with software or by an end user. In addition, software engineers must be knowledgeable in functional safety. However, this aspect of programming in usually not considered by those involved in code development.

EMC and safety engineers have different skill sets and in some companies may operate largely independent of each other. Years ago, most regulatory compliance engineers wore two hats on a full-time basis; safety and EMC. With advances in technology, safety and EMC engineers now specialize in a small niche without having the time to take on another task or job function, especially if not trained in various high-level aspects of someone else's area of expertise.

Companies without an integrated compliance department, including validation and test engineering, may not be aware of increased risks associated with integration of hardware, software and firmware. For example, a robot manufacturer may use a programmable logic controller (PLC). When the PLC is interfered with by an EM disturbance from a nearby radio or voltage transient on its mains supply, it is possible that the robot could make unintended movements, possibly putting nearby workers at increased risk of injury or even death as it moves in an uncontrolled, hazardous manner. Another example is a hand/cell phone in a hospital causing functional disruption to medical support devices that places the patient in a life-threating situation. Software must be able to detect abnormal operation and put the system into a safe condition with proper notification to the operator.

The EMC Directive does not specifically address electro/mechanical product safety. EMC engineers should be educated in Hazard Based Safety Engineering (HBSE) which addresses functional safety along with hazard and risk assessments. As of today, only a few engineers are aware of a new HSBE standard (IEC 62368-1) that may eventually replace certain UL, CSA, IEC and EN product safety standards. In addition, software engineers must also be trained to recognize foreseeable effects of EMI disturbance that may occur.

EMC, safety, hardware, software and validation engineers must work together to determine the severity of a hazard, magnitude of risk and safety integrity level of products that could cause electrical shock hazard, mechanical injury or other functional harm. Consequently, the compliance team just got larger. ■

Mark I. Montrose is an EMC consultant with Montrose Compliance Services, Inc. having 30 years of applied EMC experience. He currently sits on the Board of Directors of the IEEE (Division VI Director) and is a long term past member of the IEEE EMC Society Board of Directors as well as Champion and first President of the IEEE Product Safety Engineering Society. He provides professional consulting and training seminars worldwide and can be reached at mark@montrosecompliance.com.

Equipment Rental Line Expands

Advanced Test Equipment Rentals has added the Instruments for Industry (IFI) M406 Wideband Power Amplifier to its rental inventory. Ideal for MIL-STD-461/462, RS103 testing, this tetrode tube RF amplifier provides power output of 1000 watts.

Features of the M406 include a flat response broad bandwidth of 10 kHz to 220 MHz. With high power gain and no bandswitching required, all forms of modulation are amplified and faithfully preserved. This fully protected and metered amplifier includes RS232 and Ethernet ports.

Applications include: MIL-STD-461/462, RTCA/DO-160, SAE Specifications, RFI/EMI Susceptibility testing, Bellcore testing, Broadband Communications and more. For further information visit the company's website at www.atecorp.com or call (888) 485-2832 to speak with a rental agent.

New Clare Visor Enclosures Launched for Enhanced Safety Testing

A new range of electrical safety test enclosures incorporates a host of features to optimize safety for the operator and maximize flexibility for the production engineer.

The Clare Visor enclosures from Seaward feature a modern ergonomic design to enable production personnel to carry out the safe and controlled electrical testing of a wide range of products in compliance with EN 50191. Product is supplied fully wired, fully interlocked and can provide an out of the box solution which specifies safe working conditions for electrical testing.

The enclosures can be fully interfaced with electrical testing instrumentation for automated production line routines and can also be incorporated in laboratory-type environments for testing during product design and development stages. The range is available in two standard sizes and full enclosure test systems can also be pre-prepared to suit individual customer requirements. The new range of Seaward enclosures has been introduced to complement the recently extended ClareHAL instrumentation series that includes dedicated ground bond, hipot and insulation testers, alongside a new advanced all in one electrical safety and functional test unit. For additional information visit www.seaward.co.uk.

High Gain Amplifier Uses GaN Technology for Ultra Wideband Operation

Comtech PST has announced the release of a solid state Class "AB" linear amplifier which operates over the full 2500-6000 MHz frequency bandwidth and delivers a minimum of 150 watts into a 2:1 load VSWR. This high gain amplifier uses the latest Gallium Nitride (GaN) technology and is packaged in a standard rack mountable enclosure measuring 19" x 22" x 5.25". The unit has an internal power supply that operates from 100-265 VAC, 47-400 Hz Single Phase making it ideal for both laboratory and airborne applications. The unit is air cooled by an integrated high speed blower. Optional remote control through RS422 is available.

Comtech PST can also add Dual Directional Couplers, Digital Automatic Leveling Loop (ALC), T/R switches, dummy loads or filters to meet your specific requirements. For further information visit www.comtechpst.com.

Wurth Electronics Midcom presents Digi-Key Corporation with Global Presence Award

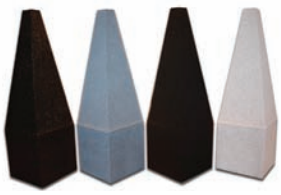
Wurth Electronics Midcom has presented Digi-Key Corporation with the Global Presence Award for 2010. "The Global Presence Award is for the image Digi-Key helped us build as a manufacturer. The partnership we have with their company is indispensable," says Dominik Kern, President at Wurth Electronics Midcom.

In 2010, Digi-Key shipped Wurth Electronics Midcom products to almost 80 countries all over the globe. Digi-Key is carrying over 2000 components in the magnetics and connector lines. "Digi-Key has proven to us their ability to think globally and act locally over the last years, they've become 'glocal' if you will," says Lars Fahrbach, Distribution Manager at Wurth Electronics Midcom. "Their company provides an outstanding service to customers in all local markets from one central organization."

To learn more about Digi-Key and Wurth Electronics Midcom's product offering, visit www.digikey.com/wurth.

New Anechoic Absorber Upgrades EMC Chamber Performance

ETS-Lindgren has announced its new Model EMC-20PCL anechoic absorber, an ultra wideband absorber optimized for EMC applications, including testing per MIL-STD-461D/E/F and RTCA-DO-160. The blunt tip 50.8 cm (20 in) height absorber is ideal for installation in new chambers as well as for retrofits of existing chambers. Its design is an evolution of traditional pyramidal polyurethane absorber that combines carefully balanced dielectric properties with a special reduced profile, blunt-tip geometry that is well suited for EMC testing in a compact space. The blunt tip design feature also reduces possible absorber tip damage. The absorber offers performance from 80 MHz to 40 GHz and 200 V/m continuous wave radiated field strength. Power handling of the absorber has been proven to safely withstand up to 0.5 watt/in² or 775 watt/m².



Model EMC-20PCL meets the fire retardant standards of NRL 8093 Tests 1, 2, and 3; MIT MS-8-21; UL 94; and DIN 4102-B2. In tests for flammability, the absorber has an ASTM E84-84 flame spread index of 35 and a smoke developed index of 450. Maximum service temperature is 90° C (190° F) continuous. Model EMC-20PCL is available in the traditional blue color. Other colors are available upon request.

To view the datasheet on Model EMC-20PCL visit www.ets-lindgren.com/pdf/EMC-20PCL.pdf.

Fairchild Semiconductor Reports Results for the Fourth Quarter and Full Year 2010

Fairchild Semiconductor announced results for the fourth quarter and full year ended December 26, 2010. Fairchild reported fourth quarter sales of $397.7 million, down 4 percent from the prior quarter and 12 percent higher than the fourth quarter of 2009.

The reported highlighted the company's 2010 performance results:

- Increased Sales by 35 Percent in 2010

- Achieved Record Gross Margin Percent for Fourth Quarter
- Generated Record Free Cash Flow of $175 Million in 2010
- Reduced Debt by $152 Million to Record Low $321 Million in 2010

Additional information on Fairchild Semiconductor's 2010 results is available at the Investor Relations section of Fairchild Semiconductor's web site at investor.fairchildsemi.com.

Leader Tech Expands Shielding Lines to Reduce RFI and Weight

Market demand for smaller, lighter and faster electronics has forced many engineers to search for innovative methods to control unwanted RF interference and reduce weight at the same time. One of the easiest ways to achieve these design objectives is to replace existing milled aluminum circuit board covers, also referred to as hogout shields, with a Leader Tech Multi-Cavity CBS or Slot-Lok product.

The company's newly expanded lines of multi-cavity board-level shielding allow engineers to isolate individual components on the same board with minimal weight and footprint allocations. In addition to offering up to 60 dB of shielding effectiveness (SE), the shields are quickly installed using through-hole or surface mount soldering. The 2-piece fence and removable cover construction also facilitates easy rework and inspection processes.

When compared to similar machined aluminum solutions, Leader Tech Multi-Cavity CBS and Slot-Lok shields dramatically reduce space, weight (up to 25%), assembly cost and time-to-market. For additional information visit www.leadertechinc.com.

Razza Joins Mass Design Inc.

James Razza, Jr. recently joined Mass Design Incorporated as quality control manager of this leading producer of high-reliability printed circuit boards for military, medical and commercial applications.

Razza, previously a quality control executive with Circuit Connect, Inc. in Nashua, NH, brings over 25 years of experience as a highly regarded authority on the implementation and maintenance of military, medical and ISO standards. His previous experience includes quality management positions with Time Sensitive Circuits, Inc., Oztek Corp, Advanced Circuit Technology and Flex Technology. He has served as chairman of Technical Review Boards and Material Review Boards as well as serving as an ISO 9001 Auditor in his previous roles. Razza has been responsible for meeting a wide range of standards including MIL-PRF-55110, MIL-PRF-31032 and others.

Razza stated, "I look forward to contributing to Mass Design's unique position in the market as a leader in customer satisfaction and fostering the growth of the more demanding and exacting segments of our business. My goal is to enhance our ability to make the technical collaboration between us and our costumers work and work well."

MET Laboratories Signs MOU

MET Laboratories has announced that it has signed a Memorandum of Understanding with the Korea Institute of Machinery and Materials (KIMM). The MoU allows for a close co-operation supporting the mutual recognition certification marks afforded by KIMM's Reliability Assessment Center (RAC) for the Korean Reliability Mark (RM) and MET Laboratories' Nationally Recognized Testing Laboratory (NRTL) certification marks for North America, as well as MET Laboratories' testing support for European CE Marking

Partnering with MET Laboratories will expand the scope of KIMM's electrical testing and certification services. Key industry sectors benefiting from this partnership include industrial control and process machinery and industrial materials. This partnership will provide Korean manufacturers a cost and time effective way to access North American certifications. For more information visit the company's website www.METLabs.com.

10 Years of Service Celebrated With New Client Discount

In celebration of ten years of operations, The Nebraska Center for Excellence in Electronics (NCEE) has announced an incentive program for new clients. A special rate has been established for first time customers on thermal chamber usage. These price saving opportunities with NCEE will help give manufacturers an opportunity to continue down the path of innovation and further develop their product lines through testing.

New customers looking for environmental testing have the opportunity to utilize one of NCEE's thermal chambers at a low rate for tests of 5 days or more. The company's program provides manufacturers a resource to help get their products to market and continue to move forward. To be eligible for this special, your company must be a new customer of NCEE. Testing for less than five days will be subject to NCEE's standard daily rates. Subsequent testing will be performed at standard rates.

NCEE believes this opportunity to be a solution for manufacturers looking for a quick set of data to verify their products performance. Prescans include radiated and conducted emissions prescreening below 1 GHz only and do not include any mitigation time. For more information about these specials contact NCEE at (402) 472-5880.

Prostat Introduces the Qube

Prostat Corporation has introduced the Qube, a new dual socket grounding plug that provides a convenient ESD ground path to a previously tested receptacle.

Most ESD audit measurements require a connection to AC electrical ground. The company reports that the Q007 ESD Grounding Qube™ replaces expensive electrical ground circuit testers and indicators with a convenient, cost effective means to connect to grounded electrical outlets. In addition to being a vital tool for ESD audit measurements, the Qube can also be used to ground workstations, mats, wrist strap testers, instruments and other ESD products to an approved pre-tested facility electrical ground.

The Qube provides dual banana receptacles, encased in a heavy duty fire retardant ABS with a solid brass grounding pin. The straight line configuration provides the user with two ground connections while occupying just one outlet. For more information visit www.prostatcorp.com/Qube or call (630) 238-8883.

Seminars, Training & Webinars
May 2011

UL University offers a host of training opportunities throughout the year. UL University will offer over 150 courses in 2011, on 50+ subjects throughout the U.S. and Canada. The offerings included in this month's list are new for 2011. Visit their website to view additional topics, dates and locations www.uluniversity.com.

May 2
Circuit-to-Circuit Interference
Associated Research
Chelmsford, MA
www.incompliancemag.com/events/110502_1

May 2 - May 3
EMC/SI Seminar
Kimmel Gerke Associates & Tektronix Inc.
Greece, NY
www.incompliancemag.com/events/110502_2

May 2 - May 5
MIL-STD-810G Testing
Washington Laboratories
Frederick, MD
www.incompliancemag.com/events/110502_3

May 2 - May 6
Photovoltaic (PV) System Installation Training
UL University
Research Triangle Park, NC
www.incompliancemag.com/events/110502_4

May 3
EMC – Printed Circuit Board Design
Silent Solutions
Chelmsford, MA
www.incompliancemag.com/events/110503_1

May 3
Mechanical Design for EMC
Silent Solutions
Chelmsford, MA
www.incompliancemag.com/events/110503_2

May 3 - May 4
Electronic Product Design and Retrofit for EMC
Silent Solutions
Chelmsford, MA
www.incompliancemag.com/events/110503_3

May 3 - May 4
Plastics: Specifying and Evaluating Materials for Electrical, Electronic and Mechanical Applications
UL UniversityToronto, ON
www.incompliancemag.com/events/110503_4

May 9
Drive a Spectrum Analyzer Like an Expert for EMC Test and Troubleshooting
Silent Solutions
Chelmsford, MA
www.incompliancemag.com/events/110509

May 10
Understanding Ground Resistance Testing A One Day Training Seminar
AEMC Instruments
Cincinnati, OH
www.incompliancemag.com/events/110510_1

May 10 - May 11
Test, Measurement and Laboratory Use Equipment: Designing for Compliance to IEC 61010-1: 3rd Edition
UL University
Hartford, CT
www.incompliancemag.com/events/110510_2

May 10 - May 12
EMC for Nuclear Power Facilities
Washington Laboratories
Gaithersburg, MD
www.incompliancemag.com/events/110510_3

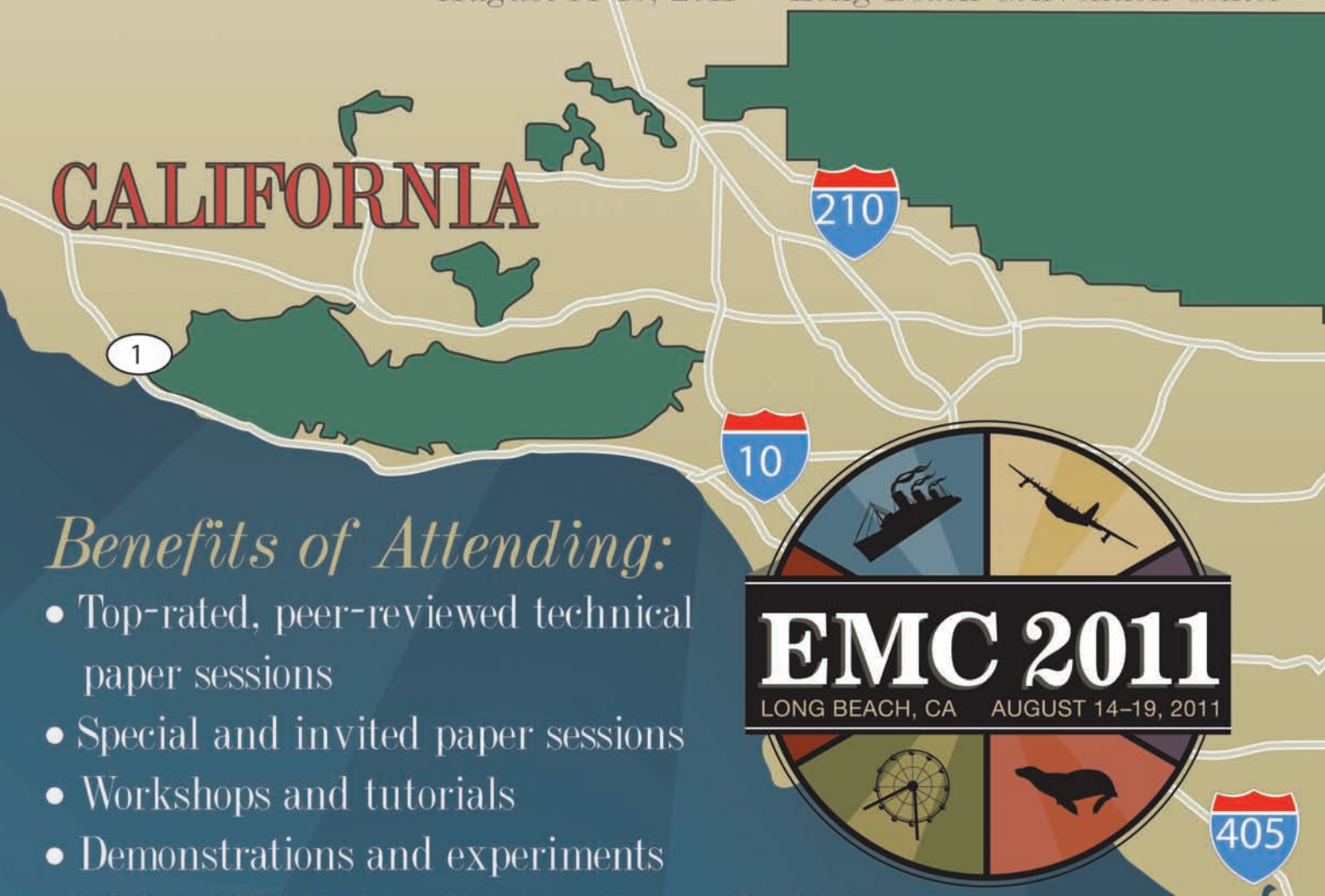
May 11
Solar Panel Testing
Associated Research
Webinar
www.incompliancemag.com/events/110511

May 16 - May 20
Electronics Laboratory Technician Training
UL University
Research Triangle Park, NC
www.incompliancemag.com/events/110516_1

May 16 - May 20
Six Sigma Green Belt Workshop and Certification
UL University
Camas, WA
www.incompliancemag.com/events/110516_2

2011 IEEE International Symposium on Electromagnetic Compatibility

August 14-19, 2011 • Long Beach Convention Center



Benefits of Attending:

- Top-rated, peer-reviewed technical paper sessions
- Special and invited paper sessions
- Workshops and tutorials
- Demonstrations and experiments
- Global EMC University–tutorials with CEUs
- Exhibitors showcasing the latest EMC products and services
- Fun, imaginative, entertaining social events
- Adjacent modern hotel and exhibit facilities - no shuttles, cab rides or long walks
- Close to a wide variety of great tour attractions

EMC SOCIETY® IEEE®

www.emc2011.org

May 18 - May 19
Data Acceptance Program: Requirements for Participation
UL University
Toronto, ON
www.incompliancemag.com/events/110518

May 23 - May 27
Six Sigma Black Belt with Lean Tools Workshop and Certification
UL University
Camas, WA
www.incompliancemag.com/events/110523

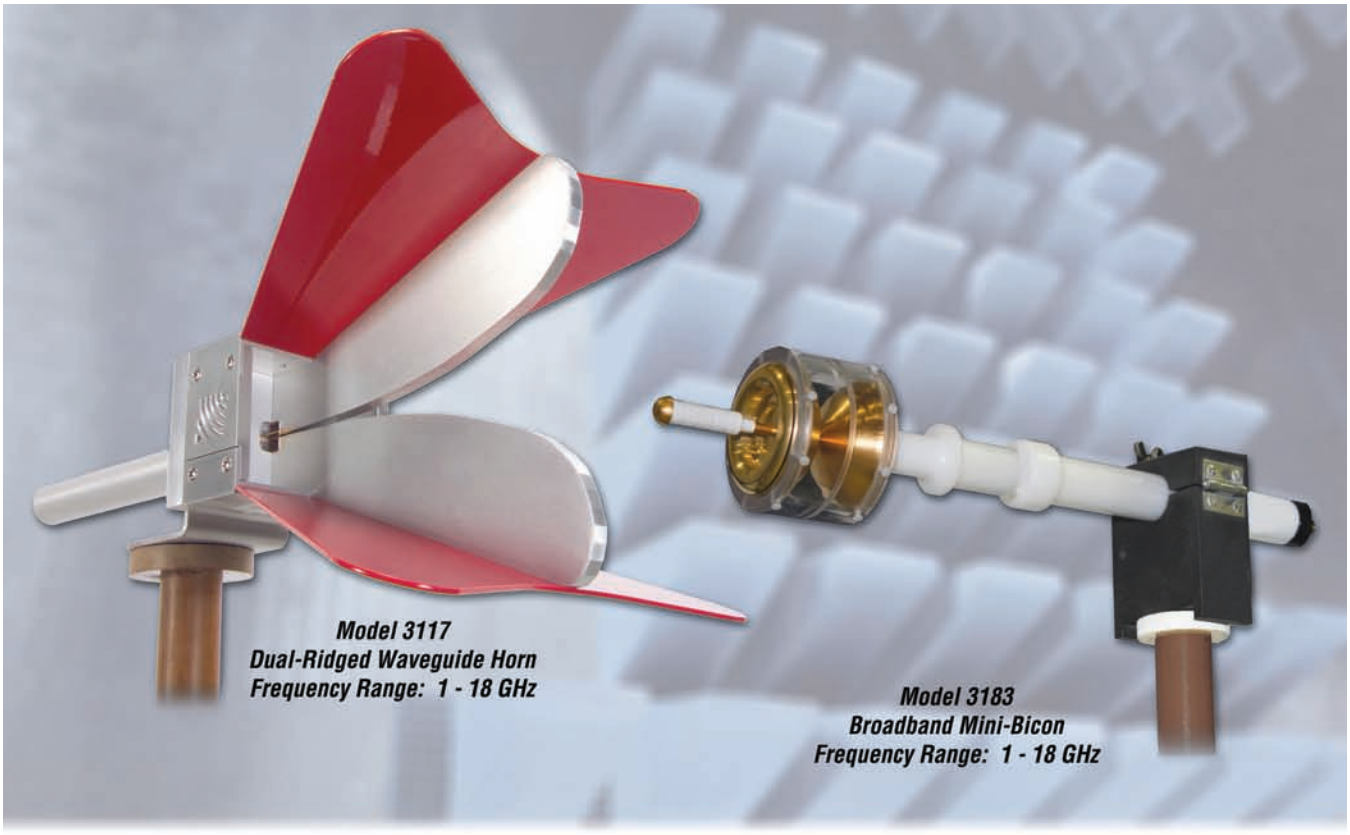
May 24
A/V, Information and Communications Technology Equipment Safety Requirements: Intro to IEC 62368-1
UL University
Brea, CA
www.incompliancemag.com/events/110524_1

May 24 - May 25
High Intensity Radiated Field Effects in Aircraft
EMCC Dr. Rasek
Germany
www.incompliancemag.com/events/110524_2

May 24 - May 26
Electromagnetic Compatibility Engineering
Henry Ott Consultants
Westford, MA
www.incompliancemag.com/events/110524_3

May 26 - May 27
Lightning Electromagnetic Effects on Aircraft
EMCC Dr. Rasek
Germany
www.incompliancemag.com/events/110526

Compliance Marketplace



CISPR 16-1-4 Chamber Characterization:
The Antennas You Need Are Here!

Smart Choices

The new CISPR 16-1-4 standard requires chambers to be characterized above 1 GHz. ETS-Lindgren has a pair of broadband antennas that make the task easier. Both antennas have an operating frequency range of 1-18 GHz, so you don't have to stop for band breaks.

Generating signals of interest with our new mini-bicon is also simplified. With maximum power input levels of 50W at 1 GHz to 25W at 18 GHz, it can generate signals with higher amplitudes that won't get confused with noise floor clutter.

Complete Systems

We make a lot of great antennas, but ETS-Lindgren is also the world's largest manufacturer of EMC components and test systems. So if you don't already have one, we can provide a chamber, or a complete turnkey system, or anything in between. (If you do have a chamber, but it's non-CISPR compliant, we can help with that too.)

Information for the antennas featured here is available at www.ets-lindgren.com/3117 and www.ets-lindgren.com/3183.

Enabling Your Success™

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Offices in the US, Finland, UK, France, India, Singapore, Japan, China, Taiwan

At Braden Shielding Systems, we understand that old habits are hard to break. When it comes to EMC Chambers, Braden actually manufactures our equipment in our 50,000 square foot facility. In fact, Braden Shielding Systems has manufactured and installed over 5,000 chambers worldwide.

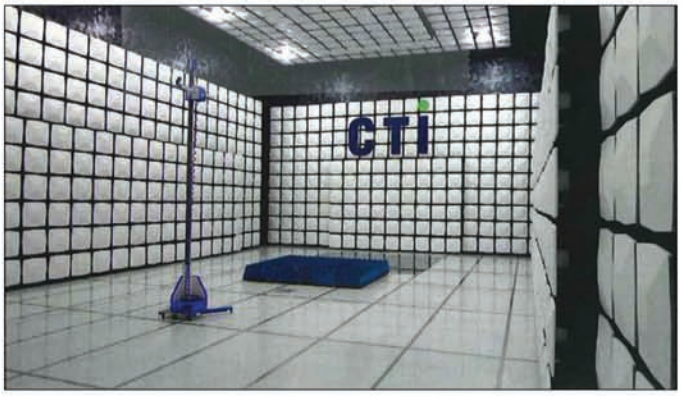
You can be assured that Braden Shielding Systems can install a chamber in your facility. We maintain an extensive list of contractors licenses and state registrations necessary to conduct business. We also keep up to date on laws and regulations in all states.

So the next time you're ready to eat a hamburger or purchase an EMC chamber, remember: ***You don't have to settle for second best just because they sell the most.***

EMC Chambers

Built to Perform!

Built to be the Best!



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