NOVEMBER 2010

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Magazine

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FROM EARLY HISTORY TO LATEST DEVELOPMENTS

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The Poor Quality of Functional Safety Engineering in the Automobile Industry

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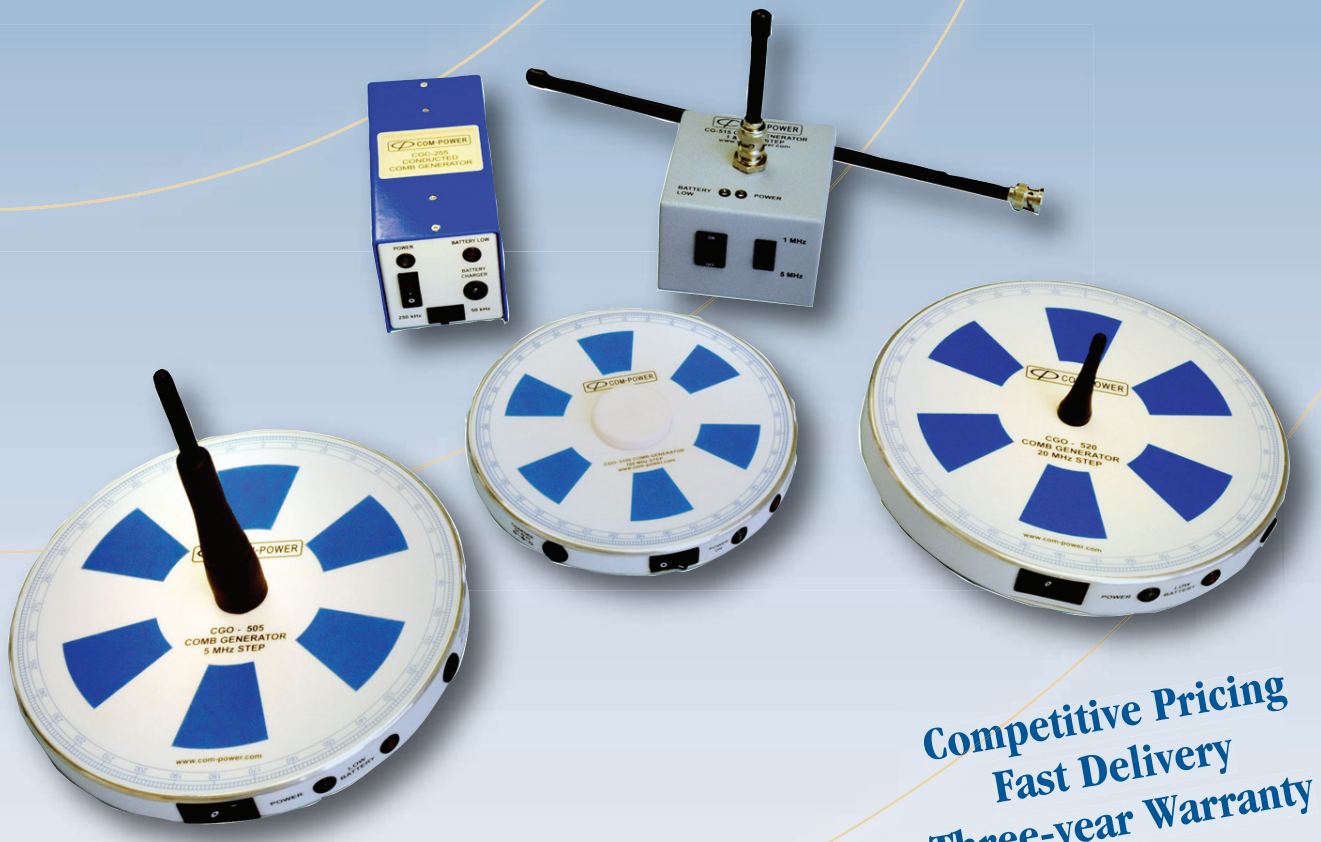

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114 Olinda Drive, Brea, CA 92823 • tel 714.528.8800 • fax 714.528.1992 • sales@com-power.com

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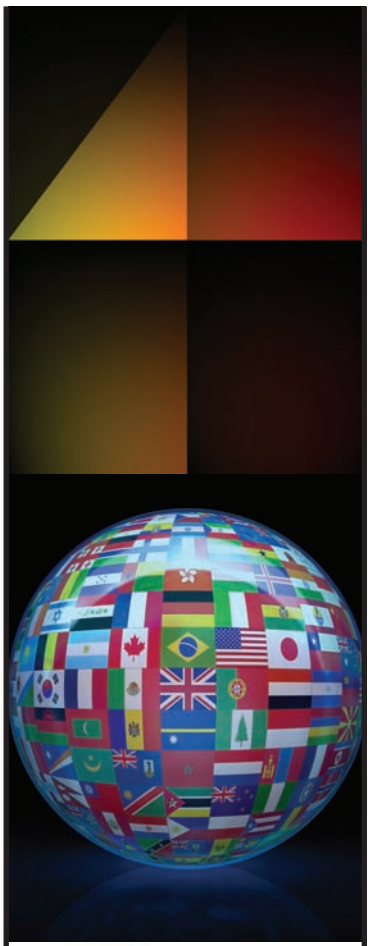

Dear Editor:

The recent article titled "The Truth about ESD Class 0" (September 2010) presents one perspective on the classification of the most ESD-sensitive devices. The authors have presented a good deal of information, but the following issues need to be considered:

1. The term ESD Class 0 is widely used within the electronics industry and has become a ubiquitous term representing ultra-sensitive devices, and their handling in electronics facilities. The term dates back to at least 1982 when Whit Kirk used it in his paper, "Uniform ESD Protection in a Large Multi-Department Assembly Plant (1982 EOS/ESD Symposium Proceedings, page 164)
2. One of the main values of the ESD Class 0 designation is that it functions as a "red flag" for the hand-off from design to manufacturing. We found at AT&T/ Lucent that devices with CDM thresholds below about 200 volts had a detectable increased probability of "ESD busts" due to undetected process incompatibilities. Devices below 50 volts were almost guaranteed to cause some problems when they were first introduced. The term ESD Class 0 was very useful for communicating to designers that these classes of devices had implications for risk in manufacturing. Likewise, it was useful for alerting manufacturing to prepare for these extreme device sensitivities.
3. Standards committees by their nature are followers. Useful concepts must be pushed, sometimes for years, to get what is reasonable and customary encoded into a consensus standard. A relevant example of this was the long effort needed to finally issue the first CDM standard. The CDM model was first proposed by Tom Speakman of AT&T in 1974 and did not become a standard until 1995. Internal CDM testing was done at AT&T, Intel, Sarnoff and other locations by the mid-1980s because it was sorely needed. Creating a consensus standard proved difficult, primarily for technical reasons. Testers used by individual companies in the meantime were providing useful and valid data. It would have been sheer folly to stop using the testers because there was no standard. The same applies here for Class 0.
4. Like CDM, Class 0 qualification of ESD programs is highly complex and it will be many years, if at all, before Standards committees will be able to create a consensus standard for program controls. It would be a mistake to wait. Accordingly, and contrary to the author's assertions, Class 0 qualification is not only possible but has been done successfully.
5. The addition of new ranges 00 and 000 makes classes more useful not less. The Industry Council demonstrated this in their White Paper 2 on CDM by recommending procedures for <250 volts and <125 volts – they just didn't give them names.
6. In my view, the discussion about MM (Machine Model) thresholds contains the following oversights:
   a. The HBM: MM ratio range they quote (between 10 and 30) is not valid below 500 volts (see the 2010 ESDA Technology Roadmap). Below 500, a ratio of 5:1 is a better estimate. It's likely that at 100 volts the ratio is even lower.
   b. The ratios are not relevant because there is no evidence that the Standard MM Test Method is a good representation of conductor-to-device events. In fact, CDM is a better model for this.
   c. The MM test has been downgraded because of b. above and because it is redundant to HBM in testing designs. It has been removed from the JEDEC qualification document and is in the process of being downgraded by the ESDA. JEITA has also downgraded the model.
   d. In the nearly 20 years since the MM was proposed there have been very few, if any, confirmed MM failures that were not also exposed by HBM testing. In the same time period, CDM has been the mechanism associated with machine-related failures and metal-metal discharges.

Going forward, it would benefit the entire electronics industry to establish a definition of Class 0 that is in harmony with the Industry Council's work. To that end, we recommend defining a Class 0 manufacturing program as one dealing with components that have withstand voltages below 250 volts for either HBM or CDM.

Ted Dangelmayer, President & CEO
Dangelmayer Associates, LLC
(978) 282-8888
ted@dangelmayer.com

IN COMPLIANCE Magazine

Lorie Nichols
Publisher & Editor
(978) 873-7777
lorie.nichols@incompliancemag.com

Sharon Smith
Director of Sales
(978) 873-7722
sharon.smith@incompliancemag.com

Barbara Kovalchek
Media Consultant
(978) 846-1656
barbara.kovalchek@incompliancemag.com

Erin C. Feeney
Director of Media Services
(978) 873-7756
erin.feeney@incompliancemag.com

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For information about advertising with IN Compliance, please contact

Sharon Smith at 978-873-7722
sharon.smith@incompliancemag.com

Barbara Kovalchek at (978) 846-1656
barbara.kovalchek@incompliancemag.com

RoHS Update: Exemptions Expiring, Recast Vote Delayed

by Krista Botsford
Botsford EcoTech Partners LLC

For over a year, the EU Commission has been reviewing the exemptions associated in the Restriction on the use of certain Hazardous Substances in electrical and electronic equipment Directive. On 24 September 2010, the European Commission finalized and published in the Official Journal an update of all exemptions within the RoHS Directive. Two highlights of the update are (1) the splitting of exemptions and (2) the association of expiration dates with some exemptions.

There were no new exemptions, but the update did publish several exemption splits.The splitting of the exemptions provides industry with for more clarity on the exemptions; and further allows the Commission to place expiration dates on part(s) of the original exemption.This updated numbering scheme does require companies using exemptions to review their tracking system and determine if the further granularity of the exemptions requires an update to their tracking systems.Fortunately, the Commission is not removing expired exemptions and renumbering all the exemptions. Again, companies need to review their tracking systems and see if adjustments are necessary based on the splitting of exemptions.

In addition to the splitting of exemptions, some exemptions were assigned expiration dates.The exemptions with expiration dates already associated with them did not change.With the publication of expiration dates in the update, only about half have expiration dates (38 of the 77).Many of the expiration dates are associated with exemptions applicable to lighting. Fortunately, the exemption for use of lead solder in specific applications does not have an expiration date at this time.

The update publication of the exemption affects all levels of the supply chain within the electronics industry.It should be of concern for component manufacturers, EMS providers, and product manufacturers – anyone within the electronics industry already affected by the RoHS Directive.

RoHS Recast Vote

The exemption review has been independent of the EU Commission's Recast of the directive.With the exemptions now updated and published, the Commission has shown there is agreement on the existing exemptions; and ultimately shows agreement is possible within the Commission. This is an indication for industry agreement is possible within the Commission.

The vote on the RoHS Recast date did slide from October to November, and may move again, depending on the Commission's view of consensus. If there is no consensus prior to the scheduled vote, postponement until early 2011 is expected.

***Krista Botsford**, Botsford EcoTech Partners LLC can be contacted at kbots@botsfordeco.com or by visiting www.BotsfordEcoTech.com.*

Example: Exemption 7 split with expiration date(s).

Exemption 7 prior to publication:

7. – lead in high melting temperature type solders (i.e. lead-based alloys containing 85% by weight or more lead
– lead in solders for servers, storage and storage array systems, network infrastructure equipment for switching, signaling, transmission as well as network management for telecommunications
– lead in electronic ceramic parts (e.g. piezoelectronic devices)

Published Update to Exemptions:

Exemption		Scope and dates of applicability
7(a)	Lead in high melting temperature type solders (i.e. lead-based alloys containing 85% by weight or more lead)	
7(b)	Lead in solders for servers, storage and storage array systems, network infrastructure equipment for switching, signaling, transmission, and network management for telecommunications	
7(c)-I	Electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezoelectronic devices, or in a glass or ceramic matrix compound	
7(c)-II	Lead in dielectric ceramic in capacitors for a rated voltage of 125 V AC or 250 V DC or higher	
7(c)-III	Lead in dielectric ceramic in capacitors for a tated voltage of less than 125 V AC or 250 V DC	Expires on 1 January 2013 and after that date may be used in spare parts for EEE placed on the market before 1 January 2013

Companies Incur Fines for Failing to Comply with HAC Requirements

The Federal Communications Commission (FCC) has proposed forfeiture penalties against three Tier III wireless carriers in Texas and Oklahoma for failing to offer their customers the required number or percentage of hearing aid compatible (HAC) handsets.

In separate actions, the Commission has proposed forfeitures of $15,000 each against OK-5 Licensee Co. LLC and Oklahoma Independent RSA 5 Partnership, two GSM carriers based in Oklahoma, and TX-10 Licensee, LLC, a GSM carrier based in Texas, for failing to provide customers with a sufficient selection of handsets that meet or exceed the Commission's frequency interference standards for HAC compatibility.

Under the Commission's regulations, non-Tier 1 service providers are required to ensure that at least 50% of the wireless phones offered per digital air interface meet or exceed the minimum rating for hearing aid compatibility.

In its Notices of Apparent Liability for Forfeiture, the Commission cited data submitted by each of the companies in mandatory filings regarding the number of HAC handsets available for sales to consumers.

Commission Proposes Six Figure Fines for Junk Faxes

The Federal Communications Commission (FCC) has issued a Notice of Apparent Liability for Forfeiture for $528,000 against an Oklahoma-based company for willful and repeated violations of the rules against the sending of unsolicited fax advertisements.

The Notice cites Clean Credit, based in Tulsa, OK, for delivering 33 unsolicited fax advertisements for credit services to 15 consumers. The unsolicited faxes were reportedly sent after the company received a Citation from the FCC's Enforcement Bureau, warning them against future violations, as well as two further Notices of Apparent Liability.

Violations of the FCC's regulations regarding junk faxes typically result in proposed monetary fines of up to $11,000 per violation.

The complete text of the Commission's Notice regarding Clean Credit is available at http://www.fcc.gov/Daily_Releases/Daily_Business/2010/db0902/FCC-10-156A1.pdf.

In a separate action, the Commission has also issued a Notice of Apparent Liability for Forfeiture against Presidential Who's Who for $345,000. The New York-based company reportedly sent at least 73 unsolicited fax advertisements for entry in and sale of the publication "Presidential Who's Who," even after receiving a Citation from the Commission's Enforcement Bureau.

Finally, the Commission has issued a Forfeiture Order against Troescher Typing Service for $77,500 for sending at least 16 unsolicited advertisements for commercial and residential loans to at least 14 consumers.

FCC Releases Telephone Subscriber Report

The Federal Communications Commission (FCC) has released its most recent report on telephone subscriber levels in the United States.

The report, which is based on March 2010 statistics from the Census Bureau, provides subscriber penetration statistics by state, income level, race, age, household size and employment status. Among the report's highlights are the following key findings:

- The telephone subscriber penetration rate increased to 96.0% by March 2010, the highest penetration rate reported since the data was first collected in November 1983;
- Penetration rates for households with incomes below $15,000 was at or below 92.8%, while the rate for households in income categories over $50,000 was at least 98.0%;
- Penetration rates by state range from a high of 98.8% in Colorado, to a low of 91.0% in the District of Columbia;
- The penetration rate for employed adults was 96.9%; for unemployed adults, the penetration rate was 95.4%.

The complete text of the Commission's Report on telephone subscribers is available at http://www.fcc.gov/Daily_Releases/Daily_Business/2010/db0831/DOC-301241A1.pdf.

Commission Releases Data on Local Telephone Competition

The Federal Communications Commission (FCC) has also released a report on local telephone competition, reflecting data submitted by incumbent and competitive local exchange carriers through June 30, 2009.

The statistics in the report include the following summary points, which highlight the growing importance of Voice over Internet Protocol (VoIP) service:

- Interconnect VoIP service subscriptions increased by 10% during the first six months of 2009, from 21 million to 23 million subscriptions, while traditional switch access lines decreased by 5%, from 141 million to 133 million lines;
- Of the 157 million total connections in service, 47% were residential switched access lines, 38% were business switched access lines, 13% were residential interconnected VoIP subscriptions, and 2% were business interconnected VoIP subscriptions;
- Of the 93 million wireline residential connections, 73.1% were switched access lines provided by incumbent local exchange carriers (ILECs), 20.7% were non-ILEC interconnected VoIP subscriptions, 5.5% were

non-ILEC switched access lines, and 0.6% were ILEC interconnected VoIP subscriptions;

- Of the 64 million wireline business connections, 68.7% were ILEC switched access lines, 25.6% were non-ILEC switched access lines, 5.1% were non-ILEC interconnected VoIP subscriptions, and 0.6% were ILEC interconnected VoIP subscriptions.

The complete text of the Commission's Report on local telephone competition is available at http://www.fcc.gov/Daily_Releases/Daily_Business/2010/db0903/DOC-301310A1.pdf.

FCC Releases Data on High-Speed Internet Access

The Federal Communications Commission (FCC) has released its most recent report on access in the United States to high-speed Internet connections, documenting for the first time the gap between current service levels and the benchmark Internet connection speeds recommended under the Commission's National Broadband Plan.

According to the Commission's report, titled "Internet Access Services: Status as of June 2009," only 44% of fixed Internet connections to households currently meet or exceed the speed tier that most closely approximates the target set in the National Broadband Plan of 4 megabits per second (Mbps) downstream and 1 Mpbs upstream.

However, the number of mobile wireless service subscribers with data plans for full Internet access increase by 40% over the first six months of 2009, to 35 million.

Regarding fixed location technologies providing high-speed Internet access, cable modem connections increased by 3%, to 41 million, aDSL connections increased by 1%, to 31 million, and fiber connections increased by 23%, to 4 million (the largest rate of increase among fixed-location technologies). Satellite Internet connections increase by 6%, to 1 million.

The complete text of the Commission's report on high-speed Internet access is available at http://www.fcc.gov/Daily_Releases/Daily_Business/2010/db0902/DOC-301294A2.pdf.

FCC Issues Reminder About DSC Radios

The Federal Communications Commission (FCC) is reminding manufacturers and retailers that, beginning March 25, 2011, fixed mounted digital selective calling (DSC) equipment built to RTCM Standard SC-101 may no longer be manufactured, imported, sold or installed.

As of the March 25th deadline, the Commission will also no longer accept applications for the certification of handheld portable DSC equipment that does not meet the requirements of International Telecommunications Union (ITU-R) Recommendation M.493-11 or higher and IEC 62238.

DSC equipment is used primarily in marine and boating applications. Devices meeting the older standard are being phased out in favor of equipment with newer features and functions, including improved detection of stress alerts, a reduced rate of false alarms, and a reduction in incessant alarming.

The FCC notes that DSC equipment installed prior to the March 25th deadline may continue to be used.

A Commission's Notice regarding the DSC radio deadline is available at http://www.fcc.gov/Daily_Releases/Daily_Business/2010/db0913/DA-10-1728A1.pdf.

Commission Frees Spectrum for "Super Wi-Fi" Technologies

Seeking to jumpstart investment in new and innovative technologies, the Federal Communications Commission (FCC) has taken steps to free up vacant airwaves between television channels.

The vacant spectrum available between television channels (also referred to as "white spaces") is reportedly ideal for mobile wireless services as well as newer communications applications, including devices using "super Wi-Fi" technology.

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In a Second Memorandum Opinion and Order issued in September, the Commission moved to eliminate rules requiring TV bands devices to include sensing technology to detect signals of TV stations and low-power auxiliary service stations, such as wireless microphones. In addition, the FCC has reserved two vacant UFH channels for wireless microphones and other low power auxiliary devices to protect incumbent services from interference potentially created by the use of the spectrum white space.

Freeing up unlicensed spectrum is a key component of the Commission's National Broadband Plan announced earlier this year. According to the FCC, the white space affected by its actions represents the first significant block of spectrum made available for unlicensed use in more than 20 years, and its release should fuel new investments in innovative communications technologies.

The full text of the Commission Second Memorandum Opinion and Order releasing spectrum white space is available at http://www.fcc.gov/Daily_Releases/Daily_Business/2010/db0924/FCC-10-174A1.pdf.

Another Updated Standards List Released for the EU's Directive on the Safety of Toys

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 relating to the safety of toys (88/378/EEC), the second such updated list in less than a month.

According to the Directive, a toy is defined as "any product or material designed or clearly intended for use in play by children of less than 14 years of age." The scope of the Directive includes electric toys that are powered by a nominal voltage up to and including 24 V and requires sufficient protections for such devices to prevent the risk of electric shock and/or burns.

The most recently updated list of CEN standards for the EU Directive Relating to the Safety of Toys (88/378/EEC) was published in September (2010) and replaces all previously published standards lists for the Directive, including the list published in August 2010.

The most recently updated list of CEN standards for the Directive was published in September in the *Official Journal of the European Union* and replaces all previously published standards lists for the Directive, including the list published in August 2010.

The revised list of standards can be viewed at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2010:236:0003:0004:EN:PDF.

EU Commission Initiates Anti-Dumping Proceeding Against WWAN Modems

The Commission of the European Union (EU) has initiated an investigation into charges that manufacturers in the People's Republic of China are shipping government subsidized wireless wide area networking (WWAN) modems into the EU, in violation of the EU's anti-dumping laws.

The Commission's investigation, which was announced in the September 16th issue of the *Official Journal of the European Union*, follows a complaint received earlier this year from OPTION NV, an EU-based producer of WWAN modems. In its complaint, OPTION NV alleged that WWAN imports from China have increased overall in absolute terms and in terms of market share and that the prices being charged for the imported WWAN modems have had a negative impact on overall price levels, thereby putting both the company and its employees at risk.

An initial review of the charges by the Commission reportedly determined that there was sufficient evidence to launch a formal investigation into the dumping complaint. The Commission now has 13 months to thoroughly investigate whether government subsidies are being paid to Chinese WWAN manufacturers and to determine what further actions are appropriate.

The complaint from OPTION NV has also resulted in the Commission authorizing EU Customs authorities to begin the registration of all WWAN modems imported into the EU from China. According to a Commission Regulation issued in June 2010, the registration process will provide the documentation necessary to impose anti-dumping financial penalties retroactively, should the investigation support that finding.

The complete text of the Commission's announcement regarding the initiation of its anti-subsidy investigation is available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2010:249:0007:0011:EN:PDF.

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 September 2010 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:2010:251:0001:0010:EN:PDF.

Company Recalls Slow Cookers

Sensio Inc. of Montreal, Quebec (Canada) has recalled about 25,000 slow cooker home kitchen appliances manufactured in China.

According to the company, the slow cooker's control panel can overheat and melt, posing a fire and burn hazard to consumers. Sensio says that it has received 60 separate reports of the slow cookers smoking, melting and sparking, and three reports of the panels catching fire. A total of 14 incidents have resulted in minor property damage to countertops, but there have been no reports of injuries.

The recalled slow cookers were sold in Kohl's Department stores from July 2009 through December 2009 for between $20-40.

Additional information about this recall can be viewed at http://www.cpsc.gov/cpscpub/prerel/prhtml10/10328.html.

Toshiba Recalls Notebook Computers

Toshiba America Information Systems Inc. of Irvine, CA has announced the recall of about 41,000 of its Satellite-brand notebook computers manufactured in China.

Toshiba says that the recalled notebook computers can overheat at the point where the computer plugs into the AC adaptor, posing a burn hazard to consumers. The company has received 129 reports of the notebook computers overheating and deforming the plastic casing area around the AC adaptor plug. There have also been two reports of minor burn injuries, as well as two reports of minor property damage.

The recalled notebook computers were sold through electronic stores and retailers nationwide and online, as well as through Toshibadirect.com and other websites, from August 2009 through August 2010 for between $600-800.

For more information about this recall, go to http://www.cpsc.gov/cpscpub/prerel/prhtml10/10330.html.

Subwoofer Audio Components Recalled

Paradigm Electronics of Ontario, Canada is recalling about 2200 of its Paradigm Cinema-brand subwoofer audio components manufactured in China.

According to Paradigm, the subwoofer can overheat when the speaker system is played at high outputs for an extended period of time. This risk of overheating poses a fire hazard to consumers. The company says that it has received one report of a subwoofer overheating, causing minor property damage, but no reports of injuries.

The recalled subwoofers were sold through small specialty stores and independent audio products dealers nationwide, as well as online through Amazon.com, from July 2009 through August 2010 for about $700.

Additional information about this recall is available at http://www.cpsc.gov/cpscpub/prerel/prhtml10/10333.html.

Burn Hazard Leads to Recall of Rechargeable Spotlights

Innovage LLC of Foothill Ranch, CA is recalling about 1.4 million of its FIXIT-brand rechargeable spotlights manufactured in China.

Innovage reports that the spotlight's charging adaptor can overheat the battery, forcing it to rupture and leak battery acid, and thereby posing a chemical burn hazard to consumers. The company has received 13 reports of incidents involving minor skin chemical burns and battery acid burn holes in upholstery, carpeting and clothing. However, there have been no reports of injuries.

The recalled rechargeable spotlights were sold at Walgreens, Rite-Aid, Bealls, Tuesday Morning, Ace Hardware, Boscov's and Winn-Dixie stores nationwide from October 2003 through October 2009 for about $10.

For additional information about this recall, go to http://www.cpsc.gov/cpscpub/prerel/prhtml10/10337.html.

Defective Model Airplane Receivers Recalled

Horizon Hobby Inc. of Champaign, IL has announced the recall of about 3500 of its Spektrum-brand receivers used with model airplane gliders.

According to Horizon Hobby, the receiver can lose signal contact with the model airplane glider's radio control while within normal radio operating range limits. If this happens, the glider can fall from the sky and potentially hit consumers, posing a risk of injury. The company says that it has not received any reports of incidents or injuries associated with the product, but has initiated the recall to prevent any such future incidents.

The recalled receivers were sold by Horizon Hobby direct sales representatives nationwide from March 2009 through May 2010 for about $105.

More information about this recall can be found at http://www.cpsc.gov/cpscpub/prerel/prhtml10/10342.html.

The iNARTE Informer
Provided by the International Association for Radio, Telecommunications and Electromagnetics

CRITERIA FOR CERTIFICATION

Last month we featured the first two Elements, **Education** and **Experience**, of the four "Es" that are required to achieve iNARTE Certification in any of the following disciplines:

- Electromagnetic Compatibility, EMC
- Electrostatic Discharge Control, ESD
- Product Safety Engineering, PSE

This month we will cover the requirements and makeup of the remaining Elements, **Examination** and **Endorsement**.

ELEMENT 3 – EXAMINATION

The examination consists of two papers, each of which contains 48 multiple choice questions. Candidates are required to answer no more than 40 of the 48 questions, but should answer no less than 40 in order to have the best chance of success. Four hours are allowed for completion of each exam paper and a candidate must attempt both papers on the same day when they first take the examination.

Paper 1 in the morning contains many questions covering the mathematics, physics and fundamentals of the subject. Paper 2 in the afternoon contains many questions about industry standards, metrology practices and principles of mitigating engineering.

To pass the examination, a candidate must achieve an average of 70% correct answers between the two papers. There is no minimum requirement for any one paper, so it is possible to pass the exam with 40 correct answers on one paper, (i.e. 100%), and only 16 correct on the other, (i.e. 40%).

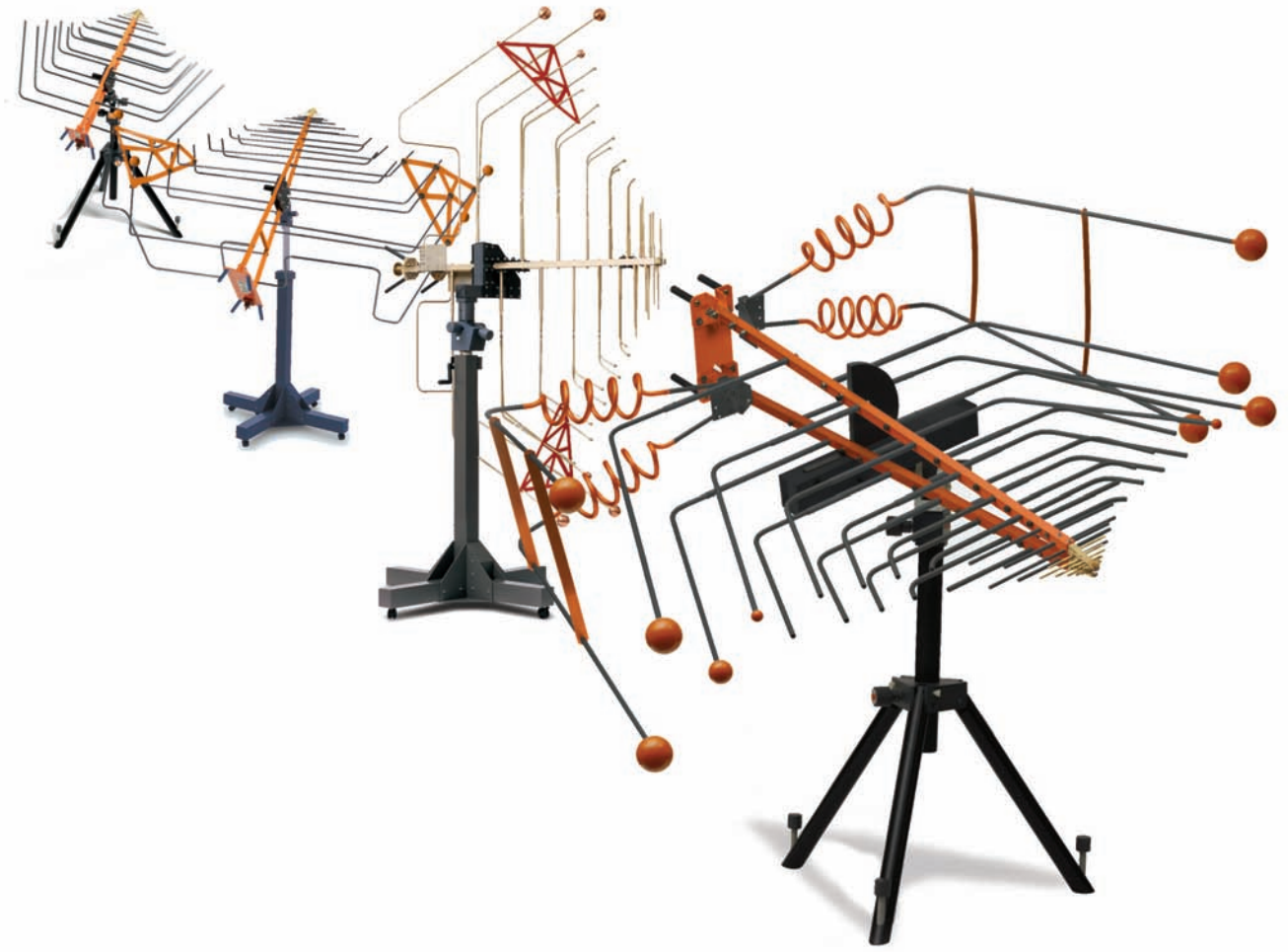
Any candidate who achieves less than a 70% average will be allowed to retake either one or both papers as many times as they wish. The restrictions on retaking exam papers are that there must be a 90 day waiting time between attempts and candidates must take no longer than three years to match their best two scores to achieve the 70% average.

Examination credits are awarded for extra work experience. As discussed in earlier articles, iNARTE requires engineers to demonstrate 9 years of experience, including post secondary education. Technicians must demonstrate at least 6 years of experience. Candidates with more than these minimum requirements will be awarded a 0.5% examination credit for each additional year of experience. In other words, an engineer with 12 years experience will be awarded 1.5% examination credits and can therefore pass the exam with an average score of 68.5%. Experience credits are capped at 10%, so candidates must achieve at least 60% on the examination regardless of their total years of experience.

iNARTE examinations are open book. Notes, reference books, calculators and laptop computers are allowed in the room. We cannot guarantee that all test locations will have power or internet access available, so be sure that batteries are fully charged and wireless communications devices are brought to the exam, if required. Access to the internet, if available, must not be used to communicate with another person. It is recommended to keep reference materials to a minimum; there is not enough time to research any question too extensively. Generally speaking your first choice is the result of your internal search engine giving you the most likelihood of being correct.

There are many different test taking techniques that candidates could employ, but we recommend the following practices as offering a good chance for success:

We've Bent The Rules.



AR's Bent-Element Approach Provides A Size Reduction Of Up To 75%, Along With Great Performance.

Our family of Radiant Arrow bent element antennas – for fields from 26 MHz to 6,000 MHz – up to 75% smaller, lighter, and more compact than standard log periodic antennas. Yet they cover broad frequency ranges, offer up to 6dBi gain, and produce high fields even in the toughest applications. The smaller size not only makes them more portable, it minimizes field loss from "room loading."

With these innovative antennas, AR has advanced the science of log periodic antennas. The design is so revolutionary, we had to patent it to protect it.

Our newest Radiant Arrow antenna pushes the boundaries even farther. The ATR26M6G-1 (26 to 6,000 MHz / 5,000 watts input power) goes beyond existing susceptibility requirements, so it's ready for future developments. And the robust design accommodates the high power levels needed to generate significant E-fields.

All the Radiant Arrow antennas are frequency and power-matched to AR amplifiers. And they can be calibrated for emissions testing. No wonder these little antennas are getting such a big reception!

ISO 9001:2008
Certified

rf/microwave instrumentation

Other ar divisions: modular rf • receiver systems • ar europe

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1. First read through all 48 questions on the paper and check off those that you are least confident to answer. You should try to limit this elimination process to no more than eight questions.
2. Next, go through the paper again and answer those questions that you are most confident about and that can be answered relatively quickly. Circle the correct answer directly on the question paper.
3. Go back through the paper again and answer the questions that require more time to calculate or to look up in reference materials.
4. Check the clock against the number of questions answered. You should be comfortable with having about 30 correct answers within the first 3 hours. You only need 28 correct answers to be on track for a 70% average score.
5. Use the last hour to figure out a few more answers and then to complete a maximum of 40 answers, even if a few are purely guesswork.
6. Leave about 10 minutes at the end to transfer answers from the paper to the Scantron card using a No. 2 pencil. And do not forget to fill in your name date and the exam number on the card.

At the end of each paper, the Scantron card and the exam paper must be returned to the proctor. Candidates will receive a new Scantron card with each paper.

No candidate is allowed to take question papers from the examination room, nor may they copy questions from the papers to be reviewed after the examination.

The examination proctor will not answer any technical questions during the examination. If there are questions that a candidate feels are incorrectly phrased, not representative of current technology, or not able to be answered from the choices given, those question can be challenged by making a notation about the problem on the examination paper itself and writing the question number on the front cover. Challenged questions will be reviewed by an expert committee, and if the challenge is upheld, all candidates for that examination session will be credited with 2.5% points on that paper, (i.e. 1.25% points when averaged between two papers).

10 NEW QUESTIONS

As a second phase of the examination process, candidates are also required to submit ten (10) original multiple choice questions with correct answers and supporting references. It is recommended that candidates complete this phase after attempting the examination so that they have a good understanding of the type and format of the question structure. Questions which relate to real world workplace engineering or technical/testing situations are preferred. Questions must conform to the format outlined on the iNARTE question form, which is part of the Application form document.

All new questions must be presented in electronic format, including all formulae, supporting calculations and explanatory figures. “Word” documents are preferred, but other formats are acceptable if they can be copied and pasted into the iNARTE data pools without transposition errors.

All new questions will be presented to a committee of experts for review. Unsuitable or incorrect questions will be returned to the candidate for correction.

FAQ: Can I take the examination on line?

ANS: Unfortunately the iNARTE examinations are not available on line. All candidates must attend an iNARTE Authorized Test Center.

FAQ: How do I find a Test Center?

ANS: All Authorized Test Centers are listed on the iNARTE web site. There are approximately 200 Centers and individual proctors listed there, and they are situated across the United States and overseas.

FAQ: What if there is no Test Center near me?

ANS: This can sometimes happen and iNARTE will then arrange testing at your place of work, at a local Community College, a library, or a similar facility where a suitable proctor can be found.

FAQ: If I have already passed the Engineer (or Technician) exam and I am interested in getting the other certification, do I have to re-examine?

ANS: Yes you do. We regard these two disciplines as being sufficiently different that they have to be run as completely separate programs. In fact, even if you use the same referees to endorse you, they do need to attest to your skills in each specific area.

FAQ: What if I fail the examination?

ANS: Depending upon your score in each paper, you can retake one or both papers many times over, and we will match your best scores in each paper to get your best average. You have to wait at least 90 days between attempts and your best score has to be achieved within a three year window.

ELEMENT 4 – ENDORSEMENT

We recommend that once a candidate starts the application process, they also initiate action with those individuals who will serve as referees. Candidates can use the reference form provided in the iNARTE application package, or any other reference format that provides a similar endorsement. The selected referees must attest to the applicant's competency at the certification level requested and also serve as character references. One reference must be from a supervisor and two other references should be from peers. Referees should have known the candidate for at least one year during the last two years. Reference forms should be sent directly to iNARTE for inclusion in the applicants file.

FAQ: I am self employed and do not have a supervisor or peer group.

ANS: iNARTE is happy to accept references from clients and customers who are familiar with your work and character.

FAQ: I have just changed jobs and I am not sure if my old supervisor will be responsive to my request.

ANS: You will be surprised. In most cases and regardless of circumstances, your old supervisor will usually come through for you. At least you should give them the chance. Your old peer group should be responsive and by all means send us a reference from your new supervisor, even if you are of brief acquaintance.

Next month the iNARTE Informer will provide details of our new Associate Certification Programs that are designed for engineers and technicians just embarking on a career in one of our supported disciplines.

UPCOMING EVENTS

Below is a table of upcoming iNARTE events.

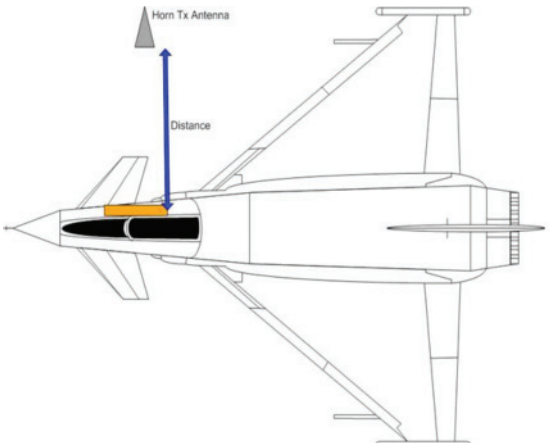
Several other workshops are in the pipeline, so be sure to visit the iNARTE web site regularly to be sure not to miss those in your region or field of interest.

EMC QUESTION OF THE MONTH

The answer to last month's question is: A). 1.0 mH

This month's question is:

You are irradiating an avionic bay using an antenna with its horizontal beam width (for the polarization being irradiated) varying from 45° at 1GHz to 25° at 18GHz. Its vertical beam width is 50° at 1GHz and 35° at 18GHz. The bay is 2 m long by 1 m high.



What should the minimum distance be between the antenna and the bay to make an LLSF measurement over this frequency range to measure both polarizations without changing the position of the antenna (select the nearest):

A) 1m

B) 3m

C) 5m

D) 8.4m

WHEN	WHAT	WHERE	iNARTE/PARTNER/PRESENTER
Nov. 17th-18th	Workshop on High Power Electromagnetic (HPEM) Threats http://www.narte.org/h/HPEM.asp	NASA, Johnson Space Center Clear Lake, Houston, TX	Dr. William Radasky, IEEE Fellow, EMP Fellow, Chairman of IEC SC 77C, and President of Metatech Corporation.

The Poor Quality of Functional Safety Engineering in the Automobile Industry

An Open Letter to the NAS team working on the project:
Electronic Vehicle Controls and Unintended Acceleration (TRB-SASP-10-03)

The professional opinions of
Dr. Antony Anderson BSc(Hons), PhD, CEng, FIEE/IET MIEEE
Dr. Brian Kirk BSc(Hons), PhD, CEng, MBCS, MACM
EurIng Keith Armstrong BSc(Hons), CEng, FIET, SMIEEE, ACGI

SUMMARY

The three decades-old problem of sudden unintended acceleration – that only occurs in cars fitted with automatic gearboxes *and* electronic systems directly controlling their throttles – has led us to write this letter. It explains why we believe that Government Regulators must now mandate the use of functional safety techniques in the automotive industry, based on the approach used in all other safety-related industries, i.e. independent safety assessment to peer reviewed public functional safety standards.

Unlike other industries that use electronics to control safety-critical functions, the automobile industry does not employ peer-reviewed public functional safety standards or independent safety assessors to verify conformance to such standards. Presently we are expected to simply trust whatever automakers assert about the safety of their products!

The auto industry is probably the only industry in the world allowed by Government Regulators (such as NHTSA in the USA) to behave in this way regarding risk to the Public. Certainly, the rail, aviation and medical device industries are not allowed such freedom – despite the fact that, every day, many more people are exposed to lethal hazards from automobiles.

Rather than accept responsibility automakers are content to blame drivers, even when accidents could have been caused by malfunctions of electronics based driver assistance systems. Unfortunately, for well over a decade the Regulators have demonstrably failed to intervene in this area with any effect.

If the problem of the poor quality of functional safety in the design and manufacture of automotive systems is not promptly addressed then we expect the current and next generation of vehicle electronic systems to result in considerably increased carnage on the roads in future.

BACKGROUND

In the early evening of 28th August 2009, an off-duty California Highway Patrolman was driving a hired 2009 Lexus ES 350 saloon (sedan) when it suddenly accelerated to about 120 mph shortly before reaching a T junction. The runaway vehicle hit a Ford Explorer, crashed through a fence, flew into the air, turned over twice and fell into the flood plain of the San Diego River, where it exploded in a ball of fire.

Mark Saylor a skilled police driver with 19 years experience and inspector of heavy vehicles, his wife, 13 year old daughter and brother-in-law were killed instantly. The last 48 seconds before the crash were recorded in a dramatic 911 call which captured the horror of the event.[1]

As one newspaper put it: "Rarely, if ever, has one family's fatal crash had such an impact, forcing the world's largest automaker to admit thousands of sudden-acceleration complaints, recall more than 8 million vehicles worldwide and answer growing questions from Congress and consumers about its safety record."[2]

However, in spite of the recalls to check floor mats and fixings or to insert shims to prevent the possibility of sticky accelerator pedals, sudden unintended acceleration incidents are still occurring in Toyota vehicles that allegedly have been fixed. The fact that a skilled police driver like Mark Saylor would have been perfectly capable of dealing with such problems adds to the strong suggestion that the causes of sudden unintended acceleration have not been sufficiently addressed and probably lie elsewhere.

Toyota categorically denies the possibility of malfunctioning electronic throttle controls. This denial makes it appear, by default, that drivers are to blame and the cause of their own misfortunes: apparently failing to be in control of their vehicles at all times, as the law requires. It is not clear on what factual basis Toyota make their assertions. Thus, in extremis, *because the vehicle electronic systems are given the benefit of the doubt*, the drivers of suddenly accelerating vehicles are punished for allegedly reckless driving. However we assert that in many cases it should be the automobile manufacturers who should be punished for reckless inattention to the requirements of functional safety.

ABSENCE OF PROOF IS NOT PROOF OF ABSENCE OF AN INTERMITTENT ELECTRONIC MALFUNCTION

In mechanical systems, such as the throttle controls in vehicles from before the 1980s, evidence of malfunction is usually present after such an event. However, electronic systems are different. An intermittent electronic error or malfunction may only appear as a result of a rare combination of many factors and may not reappear for years – if ever. Some errors and faults will not trigger fault codes that are recorded in an Electronic Data Recorder (EDR), as Dr David Gilbert demonstrated to Congress in February 2010,[3] and few can be reproduced to order later. Professor Todd Hubing has reported more extensive results along similar lines in July 2010.[4]

This is a situation in which absence of proof is not proof of absence. It is our opinion that "no electronic fault found" *after* a sudden unintended acceleration incident should *never* be taken to mean proof of the absence of an electronic fault *causing* that incident. Particularly when the recorded data concerning the incident can only be accessed by the manufacturer.

Yet again and again in post-incident vehicle examinations the fallacious argument that absence of proof is proof of absence is used to exonerate the vehicle manufacturer and transfer blame to the driver. We believe it is high time that the automobile industry acknowledged the reality of intermittent electronic errors and malfunctions (which has always been a plain and simple fact of life for all other manufacturers of electronics in all other applications) and stopped claiming their non-existence.

Much as they would like us to believe that it is so, the auto industry has no magical "pixie dust" with which to treat its electronics – it is stuck with the same laws of physics as all other industries.

COMPLEXITY OF VEHICLE ELECTRONIC SYSTEMS AND THE IMPOSSIBILITY OF TESTING FOR ALL POSSIBLE FAILURE MODES

Such is the complexity of the electronic systems in modern vehicles that it is totally impossible to completely test to eliminate all possible dangerous failure modes, either of hardware or software, before going into production. See Annex A for the explanations.

The false and unjustified assumption of the supposed near-perfection of safety critical electronics is likely to prevent the inclusion at the design stage of safety measures designed to anticipate and mitigate any possible effects of an electronic error or malfunction. In our opinion, the manufacturer's omission of an independent fail-safe against a stuck-open throttle, i.e. one that would reduce the engine power in an emergency, is the most likely reason that prevented Mark Saylor from bringing the runaway Lexus safely to a halt.[5]

INVESTIGATIVE STUDIES INTO SUDDEN ACCELERATION BY NASA AND NAS

As a direct result of the questioning from Congress, NHTSA have recently commissioned two investigative studies, one by NASA[6] into sudden unintended acceleration in Toyota vehicles and the second by the National Academy of Sciences (NAS)[7] into the possible electronic causes of sudden unintended acceleration in general. It is to this second investigative committee that this memorandum is addressed and in relation to the matter of functional safety.

INDEPENDENT FAIL-SAFES – HOW THE AUTOMOBILE INDUSTRY DIFFERS FROM THE REST OF INDUSTRY

In our opinion, the absence of an independent fail-safe to protect against sudden unintended acceleration is a clear indicator that the automobile industry does not pay sufficient attention to the functional safety of vehicle

electronic control systems. In other words the *quality of the functional safety* incorporated into electronic acceleration and braking control and management is poor at best, i.e. not fit for purpose nor capable of verifiable safety.

Generalizing from the Saylor case and other examples, it seems to us that the necessary attention to functional safety in regard to the design of electronic control systems in automobiles is manifestly lacking. In all other industries an *independent fail-safe* would usually be incorporated.

Even where independent fail-safes *are* used, "means of last resort" protection is usually provided – witness the emergency stop buttons on escalators and factory machinery. Even the domestic water supply has a stopcock and, even though household electrical circuits are very well protected by fuses and circuit-breakers, they still always have a manual ON/OFF switch.

But ignition keys in automobiles are increasingly being replaced, as in the Lexus ES-350, with buttons that require pushing for *several seconds* to switch an engine off – seconds that are almost impossible to find when one needs both hands on the wheel to press down hard on the brake whilst simultaneously steering to avoid hazards caused by high speed or extended stopping distance.

However in the automobile industry it appears to be thought entirely acceptable that – in the event of a sudden unintended acceleration – the driver should, by hard braking action, be able to overcome the engine with the brakes and bring the vehicle safely to a halt.[8] **The driver is unwittingly made the "fail-safe" for the electronic throttle.** Worse still the effectiveness of this fail-safe depends on the reaction time, physical fitness and stamina of the driver!

FUNCTIONAL SAFETY

The term "functional safety" may not be familiar, but it simply concerns the safety risks that could result if a product or system does not perform its activities (its functions) correctly and safely.[9]

Automobiles have a number of interacting safety-critical control functions – engine speed control, gearbox, braking, steering and stability, for example – that must work together. These functions have to be specified, designed and manufactured to be adequately operationally safe both individually and together. Therefore these various control systems must be analyzed individually and together at the design stage from the point of view of their capability to cause functional safety risks.

By the early 1990s the old approach of always fitting a low technology back-up or fail-safe to any safety-related electronics had become inadequate. It had also become well established that it was impossible to do enough testing to prove that electronic devices and systems (and their software programs) were acceptably safe for safety critical applications (see Annex A for details).

Further, there were also many new safety improvements that could be made, provided that the electronics and its software programs could be made much more reliable than normal.

For these reasons, a great deal of work in academia, industry and standards committees was carried out during that decade on how best to make safety-related software and electronic hardware reliable enough for the achievement of acceptable functional safety risks. The resulting standard on how to achieve "functional safety" of electronic (especially computerized) devices and systems was published in 2000 as IEC 61508.[10,11]

Since 2000, many industries (including machinery, rail and aviation) have carried out international peer-reviewed processes lasting several years to interpret the basic functional safety standard IEC 61508 in terms more relevant to their own applications, thereby creating several industry-specific standards on functional safety, for example, EN 50128.[12]

The auto industry has recently started to develop a public standard on Functional Safety, based upon IEC 61508, called ISO 26262.[13] However, ISO 26262 was only at its first draft in 2009, when the machinery, rail and aviation industries had not only already created their standards, but their independent safety assessors had been using them for many years.

The first draft of ISO 26262 is deficient in many ways.[14] Indeed, it is arguable that ISO 26262 is unnecessary, because the existing IEC 61508 standard – combined with a new standard defining the safety considerations specific to the auto domain – would provide a quicker solution which could make use of the widespread safety auditing services already available from other industries.

It remains to be seen whether ISO 26262 will ever become a published standard – let alone an effective one in terms of safety outcomes for consumers. But even if/when it is published as a public standard, the auto industry appears to lack the necessary disciplines of holistic system design and of independent safety assessment that would ever make functional safety a reality within the industry.[15]

Significant cultural and structural changes are required within the industry and its regulatory institutions to be able to develop a functional safety culture appropriate for the modern and future automobile.

INDEPENDENT SAFETY ASSESSMENT AGAINST PEER-REVIEWED PUBLIC SAFETY STANDARDS

Other industries that use electronics to control safety-critical functions – such as nuclear, chemical, machinery, air and rail transport – rely on independent assessment of their product's functional safety against public peer-reviewed safety standards.[16]

If an independent safety assessor (ISA) doesn't agree that the evidence and arguments presented about the specification, design and realization of a product demonstrate that it has acceptable levels of functional safety risks, then design changes have to be made to *assure verifiable safety* and thus demonstrate conformance with the safety standards to the ISA *before* the product can be supplied to customers. ISAs employ a variety of verification and validation methods, including both analysis and testing, but (as noted earlier) testing alone cannot be relied upon because it is incapable of providing enough data to show that a product or system will be safe enough over its anticipated operational lifetime (see Annex A).

The auto industry is the exception to general industrial practice because such functional safety engineering as it does is conducted behind closed doors, using internal specifications that have not been publicly peer-reviewed, and the resulting vehicles are sold to customers without any independent approval of their functional safety. The resulting lack of transparency of the manufacturers evaluating recorded data from vehicles calls in to question its value as evidence. The possibility of undetected tampering with the data by the manufacturers or others also needs to be addressed. These issues do not arise in other industries because data recorders and their contents are evaluated by independent third party assessors.

With the electronic complexities of some modern automobiles – the number of lines of software code (circa 100 million) are now far greater than in an F35 Joint Strike

Aircraft (circa 5.7 million)[17] – there ought to be *at least* as much attention paid to functional safety at the design stage of a new automobile as there is in for a new aircraft.

Also, in other industries, e.g. aviation and avionics, there are schemes whereby safety problems and concerns can be reported to the industry while guaranteeing anonymity to protect the contributor. The automobile industry has no such scheme, and, unlike other industries, not much is publicly known about how automakers control functional safety risks because they will not divulge such information for "reasons of commercial confidentiality".

Any lessons that automakers learn from complaints of vehicle malfunction are kept under lock and key, as are details of any "updating" of software that may be carried out when a vehicle goes in for servicing. Changes in software may in principle completely alter the behavior of the vehicle, for better or for worse, yet the automobile manufacturers keep that information secret.

It is normal in other industries for safety understanding and knowledge to be shared for the good of all, but in the auto industry, vested interests seem to take precedence. In effect, the automobile industry – unlike any other – is allowed to be the judge and jury of the need to ensure the functional safety of electronic control systems.

In all other safety related industries "taking a manufacturers word" that their products are safe enough, is regarded as utterly unacceptable! Yet the auto industry is permitted to operate on this principle!

In other industries, failure investigations – *open to public scrutiny* – recognize uncomfortable facts, endeavor to establish the truth and seek to determine the lessons that should be learnt from the failures. In this way a sound basis for an acceptable level of functional safety risk is established and is *continuously improved*. Not so in the automobile industry where there is a strong culture of denial of the existence of problems relating to functional safety.

When a threshold level of customer complaints is reached, the National Highway Transportation Safety Agency (NHTSA) starts to get involved. All too often the resulting investigation fails to carry out a proper epidemiological analysis of the complaints and gives scant consideration of the possibility of an electronic error or malfunction.

Both NHTSA and automaker's lawyers initial reaction is to presume that drivers are to blame for accidents that could well be caused by errors or malfunctions in electronics or software, possibly instigated or exacerbated by EMC. This is most certainly <u>not</u> the approach taken by every other safety-related industry.

Self-regulation, as demonstrated by Toyota and other automakers in connection with sudden unintended acceleration incidents, evidently does not work.

It is our opinion that such are the potential risks implicit in the growing reliance on safety critical electronic control systems in vehicles that the automobile industry needs to become subject to the same disciplines regarding functional safety as other industries. Otherwise there will be increasing numbers of accidents caused by malfunctioning control systems – to cite a recent example, uncontrolled behavior of electronically assisted steering.[18]

We believe that the well established state of the art regarding functional safety in other industries – peer reviewed public functional safety standards based on IEC 61508, plus independent safety assessment – is what needs to be transferred to the auto industry now and is what the auto industry should be held accountable to in future by Government regulation.

EMI, EMC AND FUNCTIONAL SAFETY ENGINEERING

<u>All</u> electrical and electronic technologies – by their very nature – both cause and suffer from electromagnetic interference (EMI).[19]

Prior to the early 1960s electronics were associated primarily with radio communication, radar and television. Since it proved necessary to have EMC standards to ensure that radio and TV broadcasts could be reliably received without avoidable interference and likewise that multi-channel telephone and telegraph communication could take place with minimal interference between channels.

At that time, as far as the automobile was concerned, it was only necessary to ensure that the ignition system did not interfere with radio and television reception and with the vehicle's radio reception.

The result is that the scientific and engineering communities associated with achieving electromagnetic compatibility (EMC) that have evolved since the 1940, grew up in a world in which there was little or no need to consider safety issues arising with safety-critical electronics because such electronics, especially in automobiles, did not then exist.

Those industries that started to apply electronic devices to the control of electrical machinery in the 1960s came from a

very different background, in which electronics was assumed to be unreliable unless proved otherwise. So the new electronic technology had to be extensively proven against the old – and therefore manufacturers and users alike had to face the evident effects of EMI right from the beginning by adopting well-proven techniques for the minimization of its effects.

Nobody was going to allow the installation of any electronic control system in a power station, chemical plant, ship, aircraft or a train without full consideration being given to the potential consequences of electronic errors or malfunctions, what might happen as a result, and the provision of protective measures including independent fail-safes. From this need for a cautious approach to innovation came the wide scale emphasis on functional safety.

So we now have the situation where the scientific and engineering communities associated with functional safety, and those associated with EMI and EMC, don't share a common background, don't speak the same technical language, and often don't communicate with each other very well at all.

The functional safety experts who wrote IEC 61508 simply assumed that EMC testing was sufficient for safety – because they were told so by EMC experts who didn't (and still don't, in general) understand functional safety engineering. The result is that IEC 61508 and the other public standards derived from it have very few EMC requirements, they simply rely on EMC testing mostly intended to protect radio and TV channels from interference.

However, now that electronic systems are more widespread, and the voltages and currents they use are now much lower (and therefore equipment is much more susceptible to interference) and devices that emit electromagnetic radiation are much more common (e.g. Wi-Fi, Bluetooth, CB Radio, mobile phones, etc.) it is essential that EMC is included as an integral part of design for functional safety.

EMC testing suffers from exactly the same problem as software testing when it comes to functional safety – it is impossible in practice to prove by testing alone that an electronic device or system is acceptably safe (see Annex A).

Some credible reliance on correct design and integral functional safety mechanisms must be an essential part of the overall verification of the design and its manufactured product.

The first public "Technical Specification" (soon to become an approved standard) that attempted to deal with EMC for functional safety reasons was IEC TS 61000-1-2,[20] first published in 2000. Over the next few years, the EMC requirements in IEC 61000-1-2 will be incorporated into the functional safety standards as part of the process of continuing improvement.

CONCLUSIONS

It is our opinion that the automobile industry lacks the necessary framework at present within which to pay proper attention to functional safety of electronic control systems used in the vehicles they specify, design and manufacture. For example, there is no provision for the evaluation of vehicle electronics for sufficient functional safety by independent assessors. It would require significant cultural and structural changes to bring the automobile industry into line with functional safety practice in other industries. However, with the inexorable introduction of more and more interacting, electronic control systems such structural changes will become increasingly necessary.

If no action is taken to improve functional safety within the auto industry then there is no doubt that in future horrific accidents involving single and multiple vehicles will occur, due to their electronic systems being unsafe due to poor quality specification and design. When automated steering, convoy automation and other upcoming plans are implemented, the death toll from electronic system errors and malfunctions is certain to mount to the point where safety regulation will *have to be forced* on the auto industry.

In the long term the automobile industry would benefit enormously from the introduction of independent functional safety assessments because it would provide a greatly increased level of confidence in the integrity of electronic control systems and circuit designs. Because electronic systems would have been subject to independent auditing, they would earn the right to be "trusted". At present, manufacturers' assurances regarding the functional safety of their products are pretty well meaningless. In effect manufacturers are currently asking motorists to put their trust in systems that are intrinsically untrustworthy and potentially dangerous.

Presently if a vehicle electronic system malfunctions, the driver is expected to take the blame for it. This appears to us to represent a complete abdication of responsibility by the automobile industry and its Regulators, *in safety terms this amounts to negligence*. By denying the possibility of electronic malfunctions and treating drivers as blameworthy by default, automobile manufacturers are denying themselves a vital source of feedback from customers in the field that should be leading to improved electronic functional safety to the benefit of all. ■

ANNEX A

Some quotations from world-class industry leaders supporting the fact that it is impossible to verify a modern electronics design (its hardware and/or software) by testing alone

From Alan M Turing, a mathematician and computing pioneer, in 1951

> "It is of course important that some efforts are made to verify the correctness of the assertions that are made about a routine. There are essentially two types of method available, the theoretical and the experimental. In the extreme form of the theoretical method a watertight mathematical proof is provided form the assertion, In the extreme form of the experimental method the routine is tried out on the machine with a variety of initial conditions and is pronounced fit if the assertions hold in each case. Both methods have their weaknesses."
>
> (*Note:* Instead of "routine" we would nowadays use "software," "program" or "firmware".)

From Edsger Dijkstra[21]

> "Testing shows the presence, not the absence of bugs."

From Watts S. Humphrey, often called "The Father of Software Quality," Senior Member of Technical Staff, Software Engineering Institute (SEI), Carnegie Mellon University [22]

> "Our programs are often used in unanticipated ways and it is impossible to test even fairly small programs in every way that they could possibly be used."
>
> "With current practices, large software systems are riddled with defects, and many of these defects cannot be found even by the most extensive testing."
>
> "Unfortunately, it is true that there is no way to prove that a software system is defect free."

From Jiantao Pan of Carnegie Mellon University[23]

> "The difficulty in software testing stems from the complexity of software: we can not completely test a program with moderate complexity."
>
> "Correctness testing and reliability testing are two major areas of testing."
>
> "Software testing is a trade-off between budget, time and quality."

From Ross Anderson,Professor of Security Engineering at the Computer Laboratory, Cambridge University, UK[24]

> "The critical problem with testing is to exercise the conditions under which the system will actually be used."
>
> "Many failures result from unforeseen input/environment conditions (e.g. Patriot)."
>
> "Incentives matter hugely: commercial developers often look for friendly certifiers while military arrange hostile review (ditto manned spaceflight, nuclear)."

From Prof. Nancy Leveson, Professor of Aeronautics and Astronautics and Professor of Engineering Systems, Massachusetts Institute of Technology (MIT)[25]

> "We no longer have the luxury of carefully testing systems and designs to understand all the potential behaviors and risks before commercial or scientific use."

From the Goddard Space Flight Center, NASA[26]

> "Software failures are rarely preceded by warnings while hardware failures are usually preceded by warnings"
>
> "Software essentially requires infinite testing"

From The Institution of Engineering and Technology, the IET (formerly known as the Institution of Electrical Engineering, the IEE), London, UK[27]

> "Computer systems lack continuous behavior so that, in general, a successful set of tests provides little or no information about how the system would behave in circumstances that differ, even slightly, from the test conditions. Systems that contain software will usually be far too complex for it to be practical to test them exhaustively"
>
> "It is generally impractical to rely on test-based evidence in advance of putting a system into widespread service that the overall probability will be less than 10-5 per hour with 99% confidence, equivalent to a mean time between failures of approximately one year."

From Professor Todd Hubing, Michelin Professor of Vehicle Electronic Systems Integration, Clemson University International Center for Automotive Research[28]

> "Unintended automotive system behavior is a problem that will certainly get worse without a major change in automotive standards and design practices."

From Michel Mardiguian, of Paris, France, renowned EMC expert who often works for the auto industry.[29]

> "Electromagnetic interference leaves no trace, it goes away just as it came." "An automaker who declares bluntly that uncontrolled acceleration cannot be caused by electromagnetic interference because they have fully tested their vehicle is a liar, or naive."

From Ron Brewer, NARTE Certified EMC Engineer, IEEE EMC Society Distinguished Lecturer. Ron works on the EMC of the Space Shuttle and other space vehicles.[30]

> "…there is no way by testing to duplicate all the possible combinations of frequencies, amplitudes, modulation waveforms, spatial distributions, and relative timing of the many simultaneous interfering signals that an operating system may encounter. As a result, it's going to fail."

From Alexandre Boyer, *et al*[31]

> "Although electronic components must pass a set of EMC tests to (help) ensure safe operations, the evolution of EMC over time is not characterized and cannot be accurately forecast."

From: Dr I D Flintoff[32]

> "As indicated in [2] narrow-band threat fields with simple modulations are no longer necessarily representative of the EMI which causes the failure in digital systems."

(*Note:* "narrow-band threat fields with simple modulations" is exactly how automotive radiated immunity testing is done.)

From IEC TS 61000-1-2, Ed2, December 2008[33]

> "In most cases there is no simple or practicable way to check and to verify by means of testing or measuring that immunity is achieved for the safety-related system in its entirety with respect to other systems, equipment or the external electromagnetic environment for all operating conditions and operating modes."

> "This is due to the fact that not every combination of operating conditions, of operating modes and of electromagnetic phenomena acting on the system can be achieved in a reasonable way and in a reasonable period."

For a detailed explanation of why EMC testing cannot be sufficient (i.e. on its own) to demonstrate that EMI in the operating environment cannot be a cause of unacceptable functional safety risks, read the first chapter in the IET's 2008 Guide.[34]

NOTES

1. http://www.youtube.com/watch?v=KHGSWs4uJzY
2. *The Norwalk Reflector*, Feb 24, 2010 "Family's fatal outing becomes heart of Toyota controversy"
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5. Regarding further issues of functional safety highlighted by this case: On this particular vehicle the ignition key – a "means of last resort" protection against a runaway vehicle – had been replaced by an ON/OFF push button that required to be continuously pushed for *three seconds* to operate. Further still, there remain questions as to whether or not the electronic transmission control would allow the vehicle to be put into neutral at high speed – another "means of last resort". It can be readily appreciated that had the design been subject to independent assessment at the design stage and a series of "what if?" and "worst case" scenarios had been worked through any functional safety deficiencies would have been identified and any necessary fail-safe measures and means of last resort would have been incorporated into the vehicle's design.

6. http://www.nhtsa.gov/PR/DOT-54-10 U.S. Transportation Secretary Ray LaHood Announces Major Investigations to Resolve Issue of Sudden Acceleration, March 30, 2010
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8. NHTSA's own tests on a Lexus ES-350X (VRTC Memorandum Report EA07-010, VRTC-DCD-7113, 2007 Lexus ES350 Unintended Acceleration, April 30, 2008) show that at 50mph with its throttle jammed open, it took five times the normal maximum foot pressure on the brake to stop the vehicle in more than five times the normal distance. Many people may be unable to exert 130 pounds of pressure on the brake, and even if they could – five times the stopping distance cannot be considered "safely bringing the vehicle to a halt". (Note that pumping the brakes – most drivers' reaction to improve braking effectiveness – only makes things worse when the throttle is wide open, as it depletes the vacuum needed to provide brake power assistance.)
9. If an independent functional safety assessor had reviewed the Titanic, he would firstly have questioned the assertion of its unsinkability, secondly he would have imagined all possible scenarios involving an unsinkable ship sinking and thirdly, he would have made sure that the vessel had sufficient life boats and rafts installed to meet all possible emergencies. Under such a regime of independent assessment, the Titanic would not have been allowed to leave port on its maiden voyage until the assessor's safety requirements had been met.
10. The IEC is the International Electrotechnical Commission, an international standards-creating body based in Switzerland. US experts play a very important part on IEC standards committees to which experts are appointed by all the developed nations. The World Trade Organisation (WTO) recommends that, to encourage trade globalisation, countries should adopt IEC standards as their national standards, as the USA, Canada and Europe mostly do already. http://www.iec.ch/functionalsafety
11. All seven parts of IEC 61508 were issued at Edition 2 in 2010.
12. EN 50128 "Railway Applications - Communications, Signalling and Processing Systems - Software for Railway Control and Protection Systems"
13. ISO is an international standards-creating organization, like the IEC: http://www.iso.org
14. Part of the reason for these deficiencies might be the very different approaches taken by the various national groups. A member of the ISO 26262 committee told one of the authors informally in 2008, that the Japanese appeared most interested in high-performance, the Europeans in safety for drivers and others, and the US in product liability issues. He said that several lists of things that could go wrong and should be taken into account during design had been truncated from 10 or more items to two or less, because US lawyers didn't want to give plaintiff's lawyers any clues as to how auto electronics might malfunction. Of course, this has degraded the effectiveness of the standard in insuring acceptable functional safety risks.
15. So unless there are significant changes we will "just have to take their word for it" that their vehicles actually comply with ISO 26262.
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19. EMC is the scientific and engineering discipline of ensuring that electrical/electronic technologies do not cause electromagnetic interference (EMI) due to their emissions of EM phenomena, and that they are also sufficiently immune to the EM phenomena occurring in their operating environment to function correctly.
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AUTHORS NOTE

All three of us provided the technical expertise for a press conference at the National Press Centre in Washington DC on March 23, 2010, explaining how automobiles may experience a dangerous loss of speed control as a result of EMI or software-related problems affecting their electronic throttle control and engine management systems, and making suggestions as to suitable preventive measures based upon what is already normal practice in other safety-related industries.

We will be pleased to provide more information if requested.

Dr Brian R Kirk BSc (Hons), MSc, PhD, MBCS, Chartered Engineer, MACM

Brian started working with computers in 1966 after gaining a BSc Hons (i.e. Cum Laudes) in Physical Electronics at Salford University followed by an MSc in Device Engineering, Processes and Computing at Imperial College and a PhD in Active Safety Systems in 2008.

His career started in the Microelectronics Industry with Marconi Research (UK) and then General Instrument Corporation (USA) where he was involved in the design and manufacture of microprocessors and custom chips. He was the Development Manager for Microprocessors and Memory Devices in the UK.

He became a founding Director of Robinson Systems Engineering Ltd in 1976 trading as Robinson Associates. The company specializes in designing and building high Integrity and safety critical embedded computing solutions, including safety critical systems for the Transport sector (some using the CAN bus).

Systems experience includes safety critical systems and software for Medical Equipment Automation, Railway Systems and Tools, Juridical Recorders' "Black Box" for Rail Systems, and an Active Safety "Black Box" for Aviation.

Brian is a Member of the British Computer Society (UK) and a life member of the Association of Computing Machinery (USA).

Dr. Brian R Kirk
Director, Robinson Associates
Weavers House, Friday Street Painswick,
Gloucestershire, GL6 6QJ, UK
Tel: +44 1452 813 699 Fax: +44 1452 812912
Cell: +44 7785 354 365
E-mail: b.kirk@robinsons.co.uk
Web: http://www.robinsons.co.uk

Dr Antony Anderson PhD, BSc(Hons), Chartered Engineer, FIEE/FIET, FIDiagE

Since 1997 Dr Anderson has been working as an independent electrical consultant specialising in electrical machine and control system failure investigations and expert witness work. He has investigated a wide range of electrical/electronic related problems on behalf of various UK and US-based

organizations in UK, France, Germany, Belgium, Mexico, Colombia and Canada.

He has investigated many issues, including: high speed stepper motor failures; switching transient problems in motor windings caused by pulse-width modulated inverters; electromagnetic bearing failures; mechanically induced EMI in generator rotors, and generator core failures.

Since 2000 he has also been investigating power electronics-related malfunctions in automobiles, including intermittent malfunctions of an electronic stability system and malfunctions in electronic speed control systems.

He has a BSc (Honours, i.e. Cum Laudes) in Electrical Engineering and a PhD (Electronic Control of Switched Reluctance Motors), both from the University of St Andrews, Queens College Dundee; Scotland, UK.

Previous experience includes: electronic control of rolling mill drives; simulation of variable speed drives; transient performance and stability of electrical machines; organizing superconducting machine design including minimization of effects of high strength rotating magnetic fields, screening etc; investigating transient electromagnetic field effects in large conventional a.c. machines.

He is a Fellow of the Institution of Engineering Technology (FIET) (formerly known as the IEE, Institution of Electrical Engineers, since 1871), a Fellow of the Institution of Diagnostic Engineers and a Member of the IEEE.

Dr Antony Anderson
Electrical Engineering Consultant
26 Westfield Drive, Gosforth,
Newcastle upon Tyne, NE3 4XY, UK
Tel: +44 191 2854577 Fax: +44 191 2854577
E-mail:antony.anderson@onyxnet.co.uk
Web: http://www.antony-anderson.com

EurIng Keith Armstrong BSc(Eng)Hons, Chartered Engineer, FIET, SMIEEE, ACGI

Keith was awarded the BSc (Elec.Eng) with Honours (i.e. Cum Laudes) from Imperial College of Science & Technology, London, UK, in 1972, having specialized in electronic circuit design, control systems, and electromagnetic field theory.

He is a Group 1 European Engineer (EurIng), a Fellow of the Institution of Engineering Technology (FIET) (previously the IEE, since 1871), and a Senior Member of the IEEE.

His IEE/IET Fellowship and IEEE Senior Membership were awarded on the basis of his work since 1997 on the new discipline of "EMC for Functional Safety".

Keith has chaired the IEE/IET's Working Group on "EMC and Functional Safety" since 1997 and is the IET's official spokesperson on that topic.

He is the UK's expert on these International Electrotechnical Committee's teams:

- *IEC 60601-1-2 (EMC for safety of Medical Equipment and Systems)*
- *IEC 61000-1-2 (Basic standard on EMC for Functional Safety)*
- *IEC 61000-6-7 (Generic standard on EMC for Functional Safety*

He has published the following books and is working on two more on EMI/EMC:

- EMC for Printed Circuit Boards, Basic and Advanced Design Techniques, *2007, ISBN: 978-0-9555118-0-6*
- WMC for Systems and Installations (co-authored with Tim Williams), *Newnes 2000, ISBN: 0-7506-4167-3*

Since 1990 he has produced more than 191 papers, articles, guides and workshops in the USA, Europe and China, on EMI/EMC and "EMC for Functional Safety". Many have been translated by volunteers into Spanish, Chinese and Japanese (at their request).

Until 1990, Keith was employed in a number of industries as an electronic designer, later as project leader and design manager. Since 1990 he has been an Independent EMC and Safety consultant since 1990 with his own company, Cherry Clough Consultants, with over 700 customers in the USA, Canada, Europe and Asia.

As an independent he has solved a huge range of EMC problems in a wide range of industries and applications, from tiny products through systems of any complexity to large installations (e.g. synchrotrons) – including electronic modules for rail, aviation and automotive vehicles – and also provided very highly-regarded training courses on EMI/EMC and "EMC for Functional Safety".

EurIng Keith Armstrong
Cherry Clough Consultants
9 Bracken View, Brocton, Stafford, ST17 0TF, UK
Tel: +44 1785 660 247 Fax: +44 1785 660 247
Cell: +44 7785 726 643
E-mail: keith.armstrong@cherryclough.com
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A Brief History of Horns

From Early History to Latest Developments

by Vicente Rodriguez, ETS-Lindgren

Unlike so many technologies in use today, horn antenna history actually started more than a hundred years ago. This short article introduces the reader to the history of horns from the early experiments of radio pioneers to the "horn boom" during the 1940s and 1950s. The article ends with the latest evolution of horn antennas.

An antenna is a device that radiates and receives radio waves. Although most readers are likely familiar with what an antenna is, before we start our discussion on a specific family or type of antenna, it is helpful to start by defining what an antenna is. There are different methods or mechanisms by which an antenna radiates. We all are familiar with resonator antennas. Dipoles are a clear example of this type of antenna. In resonant antennas, there is a movement of charges as the energy changes between the electric field and the magnetic field. This movement of the charges on the antenna causes the field lines to vibrate, generating waves that propagate in free space away from the resonant antenna. Figure 1 shows this type of behaviour. Another mechanism by which antennas radiate is by having an impedance transition that causes the energy being propagated in a transmission line to be launched into free space. Horn antennas are a travelling wave antenna. Their method for radiation is based on a wave impedance transition from the transmission waveguide or line to the impedance of free space. Figure 2 shows this mechanism of radiation on a horn antenna.

EARLY PIONEERS

We tend to think about electromagnetic technology as a new or modern development. The fact is that more than 100 years ago the early pioneers in electromagnetism were experimenting with horn antennas. Sir Oliver Lodge (1851-1940) demonstrated microwave waveguide transmission lines in 1894. From there we just need to go one step further to get a horn antenna. The man that took the step three years later in 1897 was Sir Jagadish Chandra Bose (1858-1937). Bose's horn operated in the millimetre wave range and was able to ring bells and ignite powder at a distance during his experiments in Calcutta. His horn and waveguide were circular. These experiments and use of horn antennas makes Bose the father of this type of antenna and of millimeter wave technology. Incidentally, Bose performed some of his experiments in the 60 GHz range which is becoming popular nowadays with the advent of Wireless HD technologies and industry standards such as IEEE 802.15.3c for Personal Area Networks (PAN) [1].

1930s TO MODERN DAY

As discussed in [1], many of these concepts invented in the 1890s faded away. Ideas such as parabolic reflectors and waveguides faded. Horn antennas were no exception. By 1900, horn antennas faded away. The 1930s saw a return of horn antennas and other discoveries in antenna technology conducted by the 1890s pioneers. Horns were investigated in detail, especially in the decimeter and centimeter range.

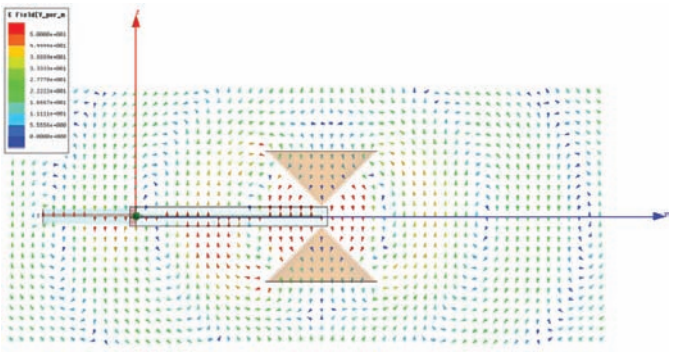

Figure 1: A modified shaped dipole (biconical) radiating; an example of a resonant antenna.

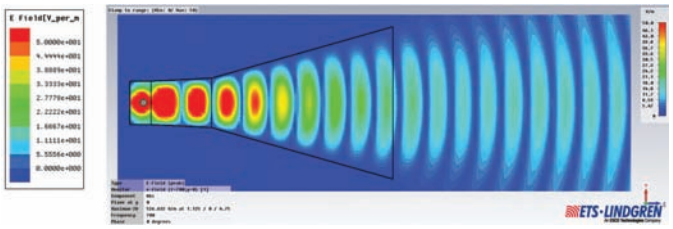

Figure 2: A pyramidal horn radiating; an example of an impedance transition between the transmission line and free space.

The beginning of WWII brought an explosion in microwave antenna development. The horn antenna is an ideal antenna for these frequencies encountered during WWII so we saw more development during this period.

The 2/1 ratio rectangular waveguide became the common transmission line, although other ratios were used (Figure 3) for the centimeter wavelength. The waveguide was then flared creating the popular and common pyramidal horn shape.

To improve the radiation pattern of these pyramidal horns, especially when being used to feed larger reflectors' metallic lenses (Figure 4); in some cases dielectric lenses were used. Like horns, dielectric lenses are not a new development as Bose and other pioneers also conducted experiments on this type of structure.

LATER DEVELOPMENTS

One of the drawbacks of horn antennas is that they are large. As we move to the UHF and VHF ranges, horns become very large. A high gain horn operating in the 150 MHz range can have a size exceeding 200 inches, or in the range of 124 inches, including apertures. Yet horns of this size are sometimes used. The "Big Ear" used in the early days of radioastronomy was a large shaped horn antenna. In high field and pulse immunity testing, sometimes horns of those dimensions are used. But in general, horns are not popular at frequencies in the 100 MHz to 500 MHz range. Their other drawback is their narrow band. The bandwidth of horn antennas was first improved by the use of ridges. The ridges improve the bandwidth in the same manner that they improved it in waveguide technology. Ridges support the required radiating mode for a wider bandwidth.

Broadband antennas became important especially in the test and measurement world. Broadband antennas, such as bi-conical dipoles and log periodic dipole arrays, began to be accepted. The use of broadband antennas reduced test time since the technician did not have to stop the test and adjust or change the dipole antenna for the next short band of frequencies. As the use of broadband antennas expanded, standards were changed to allow for the use of broadband antennas - provided the measurements performed with these antennas could be related to the half wave dipole. One of the antennas required by [2] was a Double-Ridged Guide Horn (DRGH) antenna for the 1 GHz to 18 GHz range. This broadband horn has been an accepted antenna in the EMC industry for over 40 years.

The Double-Ridged Guide Horn antennas and their cousins, the dual polarized quad-ridged horn antennas, remained as originally introduced for about two decades. With the beginning of the new millennium, and the growth in wireless technology, there is an added need for measuring these wireless devices. Directive broadband antennas are now the preferred technology. A series of improvements have been made for these technologies, including the introduction of Open Boundary Horn antennas that increase the wavelength and stabilize the beamwidth of the pattern [2-5]. The development of these open horns has extended into the low frequencies where horns were rarely used previously (Figure 5).

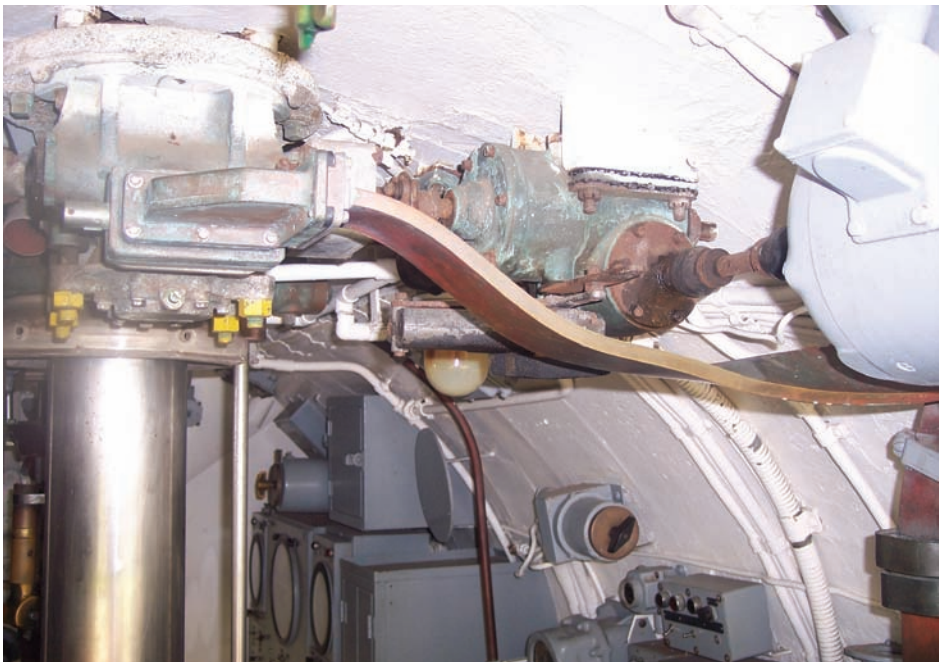

Figure 3: A rectangular waveguide in the conning tower of a WWII U.S. Navy Submarine. (Source: Author's private collection)

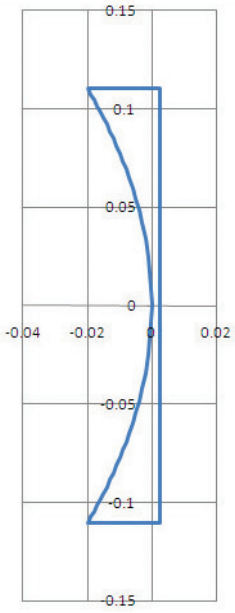

Figure 4: Profile of a typical metallic lens.

What is the next step? Material technology is going to push, in the opinion of the author, the next development in horn antenna technology. Frequency selective materials can be used to create broader band horns as suggested in [6]. Fabrication techniques will also improve; for example, horns can be fabricated of lighter weight dielectrics coated in conductive surfaces. Whatever the direction taken in the future, the concept and the laws describing their behaviour will be the same as those that described the behaviour of Bose's horn antenna more than 100 years ago.

CONCLUSION

This article has provided a brief introduction to the history of horn antennas. It is our goal that this will increase the interest of the reader into the history of technology and electromagnetic theory. The article has also briefly stepped into the dangerous realm of guessing the future developments of this technology. ■

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Vicente Rodriguez *attended Ole Miss, in Oxford, MS, where he obtained his B.S.E.E. M.S. and Ph.D. in 1994, 1996 and 1999 respectively. After a short period as visiting professor at the department of Electrical Engineering and Computer Science at Texas A&M University-Kingsville, Dr. Rodriguez joined EMC Test Systems (now ETS-Lindgren) as an RF and Electromagnetics engineer in June 2000. In September 2004 Dr. Rodriguez took over the position of Senior Principal Antenna Design Engineer, placing him in charge of the development of new antennas for different applications and improving the existing antenna line. In addition, in 2006, Dr. Rodriguez took over the duties of Antenna Product Manager, placing him in charge of development, marketing and maintenance of the antenna product line. Dr. Rodriguez is the author of more than fifty publications, including journal and conference papers as well as book chapters. Dr. Rodriguez holds patents for a hybrid absorber and for a new dual ridge horn antenna. Dr. Rodriguez is a Senior Member of the IEEE and several of its technical societies. He is also a Senior Member of the Antenna Measurements Techniques Association (AMTA), as well as a member of the board of directors of AMTA. Dr. Rodriguez is an active member of the Applied Computational Electromagnetic Society (ACES). He is an Associate Editor of the ACES Journal and has served as a reviewer for the ACES Journal and for the Journal of Electromagnetic Waves and Applications (JEWA). He has served as chair of sessions at several confereces of the IEEE, AMTA and CPEM. Dr. Rodriguez is a Full member of the Sigma Xi Scientific Research Society and of the Eta Kappa Nu Honor Society. Dr. Rodriguez can be reached at Vince.Rodriguez@ets-lindgren.com.*

Photo courtesy of ETS-Lindgren

Figure 5. An Open Boundary Quad-Ridged Horn antenna with an open cavity.

ITE Requirements Around the Globe

Focus on Electromagnetic Compatibility

by John Maas, IBM Corporation

Sellers and importers of Information Technology Equipment (ITE) must comply with a vast array of hardware regulations when marketing their products in today's world. The scope of hardware regulations includes the following basic disciplines:

- Product Safety
- Electromagnetic Compatibility (EMC)
- Homologation of wired and wireless telecommunication devices
- Environmental
- Chemical

Such regulations are established at many levels, including national, regional, state, province and even individual cities or towns. In many cases, hardware regulations carry the force of law. Hence, a complete and in-depth understanding of the regulations applicable to any particular product is needed to avoid running afoul of the law. Being aware of all the regulations that apply to a product can be challenging enough, even before understanding all the details.

REGULATORY FUNDAMENTALS

Regardless the discipline, all hardware regulations encompass a common set of basic elements:

- Technical evaluation (may include testing or engineering analysis)
- Documentation of results (test report)
- Conformity assessment procedures (DOC verification, certification)
- Product marking
- Information to the user
- Market surveillance and on-going compliance

It should be noted that some regulations may not require explicit action on some of these elements. For example, certain regulations do not require a statement of compliance to be included in the documentation provided to the end user of the product.

The technical evaluation typically includes either testing a sample of the product against some defined standard or set of standards or an engineering analysis or assessment. Restrictions or rules on who can perform the testing or evaluation vary. In some cases, the test or assessment may be performed by the product's manufacturer, while other regulations for the same basic discipline may require the use of an independent third party. If testing to standards is required, the lab performing the testing may need to be accredited by the regulatory agency or through a designated lab accrediting agency. With the wide possibility of requirements on who can perform the evaluation and what specifically is required or allowed, it is easy to see why an in-depth knowledge of the applicable regulations is essential for successful compliance.

Once the technical evaluation is completed, the results must be documented. The old adage of the work not being done until the paperwork is completed definitely applies in hardware compliance. Without adequate documentation of the evaluation, one cannot truly demonstrate compliance with the requirements. What product was evaluated? How was the evaluation performed? Who did the work, and were they properly qualified to do it? The list of content that must be included in a test report can be quite extensive. Consider the following example.

1. Test Report Cover Page stating the regulation the report encompasses
2. Classification of the product with respect to the regulation (for example, Class A or Class B for EMC emissions test results)
3. Description of the device being tested for approval, including marketing designation or model number
4. Product specification sheet describing its functions and capabilities
5. Functional block diagram
6. Specific identification of the device that was tested, including serial number and detailed list of all hardware content
7. Description of software used to exercise the unit being tested
8. Measuring equipment, including bandwidth and calibration details
9. Test results
10. Description of any changes required during testing to meet the test limits
11. Photographs of the test setup
12. Photographs of the device being tested
13. Diagram of the physical arrangement and configuration of the unit tested
14. Drawing or photograph of the product label showing required marking(s) and location of label on the device

The conformity assessment procedures define the specific process steps that must be followed to satisfy the regulation and include things such as filing a report with an agency versus keeping it on file to be made available if requested.

Type of Test	Base Standard
Conducted and Radiated Emissions	CISPR 22
	FCC Part 15 Rules
Power Line Harmonic Emissions	IEC 61000-3-2
	IEC 61000-3-12
Voltage Fluctuations and Flicker	IE C 61000-3-3
	IEC 61000-3-11
Immunity	CISPR 24

Table 1: Common standards serve as the basis for global EMC regulations

These procedures can be placed into three basic categories:

- Certification
- Suppliers Declaration of Conformity
- Verification

Certification generally requires filing specific documentation (such as the test report) with the agency and receiving a certificate in return.

In a Suppliers Declaration of Conformity procedure, the supplier (typically the product's manufacturer) completes a form attesting, or declaring, that the device complies with the required regulation. The method used for demonstrating compliance is often listed on the declaration. In some cases, the declaration is distributed with the product to the end user, while in other cases it is kept on file to be made available upon request.

Geography	Test Type	Conformity Assessment Procedure	Submit Test Report	Product Label	User Manual Statement	Lab Accreditation or Approval
Australia	Emission	DoC	No	Yes	No	Recommended
Canada	Emission	Verification	No	Yes	Yes	No
China	Emission	Certification	Yes	Yes	Yes	Yes
European Union	Emission Immunity Harmonics Flicker	DoC	No	Yes	Yes	No
Japan	Emission	DoC	No	Yes	Yes	Yes
South Korea	Emission Immunity	Certification	Yes	Yes	Yes	Yes
New Zealand	Emission	DoC	No	Yes	No	Recommended
Russia	Emission Harmonics Flicker	Certification	Yes	Yes	Yes	Yes
Taiwan	Emission	Certification DoC	Yes	Yes	Yes	Yes
Turkey	Emission Immunity Harmonics Flicker	DoC	No	Yes	Yes	No
USA	Emission	Verification Certification DoC	No Yes No	Yes	Yes	No No Yes
Vietnam	Emission	DoC	Yes	Yes	No	Yes

Table 2: Sampling of compliance details for EMC regulations

Verification is the simplest form of conformity assessment in which the supplier creates documentation to verify that the product meets the requirements. Typically, this documentation would be a test report that is kept on file and made available upon request.

Product marking involves placing a mark or statement on the product. Most often the marking is added to the product's information label. Some regulations allow alternatives of placing the product marking on the packaging (such as the cardboard box) or in the user manual, but most require the marking on the product.

Information to the user is generally a statement that the product complies with the regulation. It may also include caution or warning statements describing types of locations where the device is, or is not, allowed to be used.

Market surveillance includes any activities undertaken by the authorities to verify that the products being sold do, in fact, comply with all applicable regulations. These activities include checking products at retail outlets to ensure proper labeling as well as testing samples acquired from manufacturers, importers or retail outlets.

EMC

Let us now explore EMC regulations around the globe.

A device's ability to exist in its intended operating environment without causing electromagnetic interference with other electronic equipment (emissions) or without suffering undue interference from other equipment (immunity) is regulated in some 50 countries.

Fortunately for manufacturers, importer and other responsible parties, these regulations reference a much smaller set of common standards, as shown in Table 1.

This referencing of common standards substantially reduces the testing burden, although changes and revisions to the reference standards are not always adopted on uniform schedules by the various regulations. A recent example of the variations that can happen in adoption is the roll out of the CISPR 22 limits on radiated emissions between 1 and 6 GHz. These newer limits will need to be met for the Republic of China (Taiwan) starting in October 2010, in March 2011 for the Peoples Republic of China, and October 2011 in Australia, the European Union and Japan.

With the use of these common standards to establish the test conditions and limits that must be met, the primary differences between various global EMC regulations are in the conformity assessment details. A sampling of these details is summarized in Table 2. Note that some regulations include multiple conformity assessment procedures, usually based on the type of product or product classification.

CONCLUSION

Many countries around the world have a variety of hardware regulations that must be met before ITE is marketed, sold or imported into those countries. These regulations exist for valid reasons and generally are intended to protect something: people, other equipment or the environment. For the most part, the technical details of hardware regulations can be met without placing excessive burden on the manufacturer, provided the requirements are understood at the start of a product's design cycle. The most challenging aspect of complying with the regulations is often the conformity assessment process – the administrative details that need to be completed after the technical analysis or testing is finished. ■

John Maas is Corporate Program Manager for EMC for IBM Corporation and has responsibility for IBM's worldwide EMC regulatory compliance program. He has over 25 Years of EMC experience including hardware design and test. He has been involved in international standardization for much of his career and currently is active in IEC SC77B/WG10 and the US advisory groups for IEC TC77, SC77A and SC77B and CISPR/I. Mr. Maas can be reached at johnmaas@us.ibm.com.

Fundamentals of Electrostatic Discharge

Part 4: Training and Auditing

by the ESD Association

Your static control program is up and running. How do you determine whether it is effective? How do you make sure your employees follow it? In Part 3, we suggested that there were at least nine critical elements to successfully developing and implementing an effective ESD control program. In Part 4, we will focus on two more of these elements: training and auditing.

PERSONNEL TRAINING

The procedures are in place. The materials are in use. But your ESD control program just does not seem to yield the expected results. Failures declined initially, but they have begun reversing direction. Or perhaps there was little improvement at all. The solutions might not be apparent in inspection reports of incoming ESD materials, nor in the wrist strap log-in sheets. In large companies or small, it is hard to underestimate the role of training in an ESD control program. ANSI/ESD S20.20 ESD Control Program development standard cites training as a basic administrative requirement within an ESD control program. There is significant evidence to support the contribution of training to the success of the program. [2, 11, 18, 19, 23, 24] We would not send employees to the factory floor without the proper soldering skills or the knowledge to operate the automated insertion equipment. We should provide them with the same skill level regarding ESD control procedures.

ELEMENTS OF EFFECTIVE TRAINING PROGRAMS

Although individual requirements cause training programs to vary from company to company, there are several common threads that run through the successful programs.

1. Successful training programs cover all affected employees.

Obviously we train the line employees who test their wrist straps or place finished products in static protective packaging. But we also include department heads, upper management and executive personnel in the process. Typically, they are responsible for the day-to-day supervision and administration of the program, or they provide leadership and support. Even subcontractors and suppliers should be considered for inclusion in the training program if they are directly involved in handling your products.

Because ESD control programs cover such a variety of job disciplines and educational levels, it may be necessary to develop special training modules for each organizational entity. For example, the modules developed for management, engineering, assembly technicians and field service could differ significantly from one another because their day-to-day concerns and responsibilities are much different.

2. Effective training is comprehensive and consistent.

Training not only covers specific procedures, but also the physics of the problem and the benefits of the program as well. Consistent content across various groups, plants and even countries (adjusted for cultural differences, of course) reduces confusion and helps assure conformance. The training content should include topics such as the fundamentals of static electricity and ESD, the details of the organization's ESD Control Program plan and each person's role in the plan.

3. Use a variety of training tools and techniques.

Choose the methods that will work best for your organization. Combine live instruction with training videos or interactive computer-based programs. You may have in-house instructors available, or you may need to go outside the company to find instructors or training materials. You can also integrate industry symposia, tutorials and workshops into your program.

Effective training involves employees in the process. Reinforce the message with demonstrations of ESD events and their impact. Bulletin boards, newsletters and posters provide additional reminders and reinforcement.

Maintaining a central repository for educational ESD control materials will help your employees keep current or answer questions that may occur outside the formal training sessions. Materials in such a repository might include:

- Material from initial and recurring training sessions
- ESD Association or internal bulletins or newsletters
- Videos or CDs
- Computer based training materials
- Technical papers, studies, ESD Association standards, test methods and specifications
- ESD Control material and equipment product sheets

In addition, a knowledgeable person in the organization should be available to answer trainee questions once they have begun working.

4. Test, certify and retrain

Your training should assure material retention and emphasize the importance of the effort. If properly implemented, testing and certification motivates and builds employee pride. Retraining or refresher training is an ongoing process that reinforces, reminds and provides opportunities for implementing new or improved procedures. Establish a system to highlight when employees are due for retraining, retesting or recertification.

5. Feedback, auditing and measurement

Motivate and provide the mechanism for program improvement. Sharing yield or productivity data with employees demonstrates the effectiveness of the program and of their efforts. Tracking these same numbers can indicate that it's time for retraining or whether modifications are required in the training program.

Design and delivery of an effective ESD training program can be just as important as the procedures and materials used in your ESD control program. A training program that is built on identifiable and measurable performance goals helps assure employee understanding, implementation and success.

AUDITING

Developing and implementing an ESD control program itself is obvious. What might not be so obvious is the need to continually review, verify, analyze, feedback and improve. You will be asked to continually identify the program's return on investment and to justify the savings realized. Technological changes will dictate improvements and modifications. Feedback to employees and top management is essential. Management commitment will need continuous reinforcement.

Like training, regular program verification and auditing becomes a key factor in the successful management of ESD control programs. The mere presence of the auditing process spurs compliance with program procedures. It helps strengthen management's commitment. Program verification and audit reports trigger corrective action and help foster continuous improvement.

The benefits to be gained from regular verification of ESD control procedures are numerous.

- They allow us to prevent problems before they occur rather than always fighting fires.
- They allow us to readily identify problems and take corrective action.
- They identify areas in which our programs may be weak and provide us with information required for continuous improvement.
- They allow us to leverage limited resources effectively.
- They help us determine when our employees need to be retrained.
- They help us improve yields, productivity and capacity.
- They help us bind our ESD program together into a successful effort.

An ESD program verification audit measures performance to the defined ESD Control Program Plan. Typically, we think of the ESD program verification audit as a periodic review and inspection of the ESD work area covering use of the correct packaging materials, wearing of wrist straps, following defined procedures and similar items. Auditing can range from informal surveys of the processes and facilities to the more formal third-party audits for ISO 9000 or ANSI/ESD S20.20 certification.

REQUIREMENTS FOR EFFECTIVE AUDITING

Regardless of the structure, effective ESD auditing revolves around several factors. First, auditing implies the existence of a written and well-defined ESD Control Program Plan. It is difficult to measure performance if you do not have anything to measure against. Yet, you quite frequently hear an auditor ask, "Some people say you should measure less than 500 volts in an ESD protected area, but others say you should measure less than 100 volts. What's acceptable when I audit the factory floor?" Obviously, this question indicates a lack of a formal ESD Control Program Plan and the audit will be relatively ineffective.

Second, most audits require the taking of some measurements – typically measuring resistance and detecting the presence of charge or fields. Therefore, you will need specific instrumentation to conduct work area verification audits. As a minimum, you will need an electrostatic field meter, a wide range resistance meter, a ground/circuit tester and appropriate electrodes and accessories. Although this equipment must be accurate, it need not be as sophisticated as laboratory instruments. The audit is intended to verify basic functions and not as a full qualification of ESD control equipment or materials. You want the right tool for the job. Remember, many of the instruments you might choose for auditing are good indicators, but not suitable for precise evaluation of materials. However, be sure that you can correlate the values obtained on the factory floor with those obtained in the laboratory.

Third, our verification audits need to include all areas in which ESD control is required to protect electrostatic discharge sensitive (ESDS) devices. Typically these areas would include receiving, inspection, stores and warehouses, assembly, test and inspection, research and development, packaging, field service repair, offices and laboratories and cleanrooms. All of the areas listed in the ESD Control Program Plan are subject to verification. Even the areas that are excluded from the Plan need to be reviewed to ensure that unprotected ESDS devices are not handled in those areas. In the event that devices do enter those areas (e.g. Engineering and Design), mechanisms must be put in place to ensure that the devices are handled as non-conforming product. Similarly, we need to audit all of the various processes, materials and procedures that are used in our ESD control programs – personnel, equipment, wrist straps, floors, clothing, worksurfaces, training and grounding.

Fourth, we need to conduct verification audits frequently and regularly. The actual frequency of these audits depends upon your facility and the ESD problems that you have. Following an ESD Control Program initial audit, some experts recommend auditing each department once a month if possible and probably a minimum of six times per year. If this seems like a high frequency level, remember that these regular verification audits are based upon a sampling of work areas in each department, not necessarily every workstation. Once you have gotten your program underway, your frequency of audit will be based on your experience. If your audits regularly show acceptable levels of conformance and performance, you can reduce the frequency of auditing. If, on the other hand, your audits regularly uncover continuing problems, you may need to increase the frequency.

Fifth, we need to maintain trend charts and detailed records and prepare reports. They help assure that specified procedures are followed on a regular basis. The records are essential for quality control purposes, corrective action and compliance with ISO-9000.

Finally, upon completion of the verification audit, it is essential to implement corrective action if deficiencies are discovered. Trends need to be tracked and analyzed to help establish corrective action, which may include retraining of personnel, revision of requirement documents or processes or modification of the existing facility.

TYPES OF AUDITS

There are three types of ESD audits: program management audits, quality process checking and work place audits. Each type is distinctively different and each is vitally important to the success of the ESD program

Program management audits measure how well a program is managed and the strength of the management commitment. The program management audit emphasizes factors such as the existence of an effective implementation plan, realistic program requirements, ESD training programs, regular verification audits and other critical factors of program management. The program management audit typically is conducted by a survey specifically tailored to the factors being reviewed. Because it's a survey, the audit could be conducted without actually visiting the site. The results of this audit indirectly measure work place compliance and are particularly effective as a means of self-assessment for small companies as well as large global corporations.

Quality process checking applies classical statistical quality control procedures to the ESD process and is performed by operations personnel. This is not a periodic verification audit, but rather daily maintenance of the program. Visual and electrical checks of the procedures and materials, wrist strap testing for example, are used to monitor the quality of the ESD control process. Checking is done on a daily, weekly or monthly basis.

Trend charts and detailed records trigger process adjustments and corrective action. They help assure that specified procedures are followed on a regular basis. The records are essential for quality control purposes, corrective action and compliance with ISO-9000.

ESD Control Program Verification audits verify that program procedures are followed and that ESD control materials and equipment are within specification or are functioning properly. Compliance Verification audits are performed on a regular basis, often monthly and utilize sampling techniques and statistical analysis of the results. The use of detailed checklists and a single auditor assures that all items are covered and that the audits are performed consistently over time.

BASIC AUDITING INSTRUMENTATION

Special instrumentation will be required to conduct work area audits. The specific instrumentation will depend on what you are trying to measure, the precision you require and the sophistication of your static control and material evaluation program. However, as a minimum, you will need an electrostatic field meter, a wide range resistance meter, a ground/circuit tester and appropriate electrodes and accessories. Additional instrumentation might include a charged plate monitor, footwear and wrist strap testers, chart recorders/data acquisition systems and timing devices, discharge simulators and ESD event detectors.

Although this equipment must be accurate, it needs not be as sophisticated as laboratory instruments. The audit is intended to verify basic functions and not as a full qualification of ESD control equipment or materials. Remember, you want the right tool for the job. Just as you would not buy a hammer if you are were planning to saw wood, you would not purchase an electrometer to measure static voltages on a production line. If you are making measurements according to specific standards or test methods, be sure the instrumentation meets the requirements of those documents.

With a hand-held electrostatic field meter, you can measure the presence of electrostatic fields in your environment allowing you to identify problem areas and monitor your ESD control program. These instruments measure the electrostatic field associated with a charged object. Many field meters simply measure the gross level of the electrostatic field and should be used as general indicators of the presence of a charge and the approximate level of electrical potential of the charge. Others will provide more precise measurement for material evaluation and comparison.

For greater precision in facility measurements or for laboratory evaluation, a charged plate monitor is a useful instrument that can be used in many different ways; for example to evaluate the performance of flooring materials or balance ionizing equipment.

Receiving
Inspection
Stores and Warehouses
Assembly
Test and Inspection
Research and Development
Packaging
Field Service Repair
Offices and Laboratories
Clean Rooms

Table 1: Typical Facility Areas

Because resistance is one of the key factors in evaluating ESD control materials, a wide range resistance meter becomes a crucial instrument. Most resistance measurements are made at 100 volts and some at 10 volts. The equipment you choose should be capable of applying these voltages to the materials being tested. In addition, the meter should be capable of measuring resistance ranges of 103 to 1012 ohms. With the proper electrodes and cables, you will be able to measure the resistance of flooring materials, worksurfaces, equipment, furniture, garments and some packaging materials.

The final instrument is a ground/circuit tester. With this device you can measure the continuity of your ESD grounds, check the impedance of the equipment grounding conductor (3rd wire AC ground) as well as verify that the wiring of power outlets in the work area is correct.

AREAS, PROCESSES AND MATERIALS TO BE AUDITED

Previously we stated that ESD protection was required "wherever unprotected ESDS devices are handled." Obviously, our audits need to include these same areas. Table 1 indicates some of the physical areas that may be part of the ESD Control Program Plan and therefore will be involved in Compliance Verification Audits. Remember, some areas may be excluded from the Plan depending on the Scope of the Plan.

Personnel
Moving Equipment (Carts, lift trucks)
Wrist Straps
Floors, Floor Mats, Floor Finishes
Shoes, Grounders, Casters
Clothing
Workstations
Worksurfaces
Packaging and Materials Handling
Ionization
Grounding
Production Equipment
Tools and Equipment (Soldering irons, fixtures, etc.)
Labeling and Identification
Purchasing Specifications and Requisitions
ESD Control Program Procedures and Specifications
ESD Measurement and Test Equipment
Personnel Training
Engineering Specifications and Drawings

Table 2: Typical Processes, Materials and Procedures

Similarly, we need to conduct Compliance Verification audits for all of the various processes, materials and procedures that are used in our ESD Control Program Plan. Some of these are shown in Table 2.

CHECK LISTS

Check lists can be helpful tools for conducting Compliance Verification audits. However, it is important that ESD control program requirements are well documented and accessible to avoid a tendency for checklists becoming de facto lists of requirements. Table 3 indicates the type of questions and information that might be included in an auditing check list. Your own check lists, of course, will be based on your specific needs and program requirements. They should conform to your actual ESD control procedures and specifications, and they should be consistent with any ISO 9000 requirements you may have. For ANSI/ESD S20.20 based ESD Control Programs, the recognized Certification Bodies (Registrars) use a formal checklist supplied by the ESD Association to aid in conducting the Certification Audit.

In addition to check lists, you will use various forms for recording the measurements you make: resistance, voltage generation, etc. Part of your audit will also include the daily logs used on the factory floor such as those used for wrist strap checking.

REPORTING AND CORRECTIVE ACTION

Upon completion of the auditing process, Reports should be prepared and distributed in a timely manner. Details of the audits need to be fully documented for ISO 9000 or ANSI/ESD S20.20 certification. As with all audits, it is

Function/Area Audited: Facilities			
Date: Auditor:			
Audit Questions	**Y**	**N**	**Comments**
1. Where ESD protective flooring is used for personnel grounding, are foot grounding devices or conductive footwear worn?			
2. Where conductive floors and footwear are used for personnel grounding, do personnel check continuity to ground upon entering the area?			
3. Are personnel wearing grounded wrist straps at the ESD protective workstations?			
4. Are personnel checking wrist straps for continuity or using a continuous ground monitor?			
5. Where continuous ground monitors are not used, are wrist straps checked and logged routinely and at frequent intervals?			
6. Are wrist strap checkers and continuous ground monitors checked and maintained periodically?			
7. Do wrist straps and foot grounders fit correctly?			
8. Are wrist straps and foot grounders working correctly?			
9. Are wrist strap cords checked, on the person, at the workstation?			
10. Are disposable foot grounders limited to one time use?			
11. Are test records for wrist straps and foot grounders kept and maintained?			
12. When required, are ESD protective garments correctly worn?			
13. Are nonessential personal items kept out of ESD controlled areas?			
14. Are personnel working in the ESD controlled area currently certified or escorted?			
15. Are all personnel with access to the ESD controlled area trained?			
16. Are ESD Control requirements imposed on visitors?			

Table 3: Partial Audit Check List for ESD Control Program

essential to implement corrective action if deficiencies are discovered. Trends need to be tracked and analyzed to help establish corrective action, which may include retraining of personnel, revision of requirement documents or processes or modification of the existing facility.

CONCLUSION

Auditing and training are key elements in maintaining an effective ESD control program. They help assure that procedures are properly implemented and can provide a management tool to gauge program effectiveness and make continuous improvement. ■

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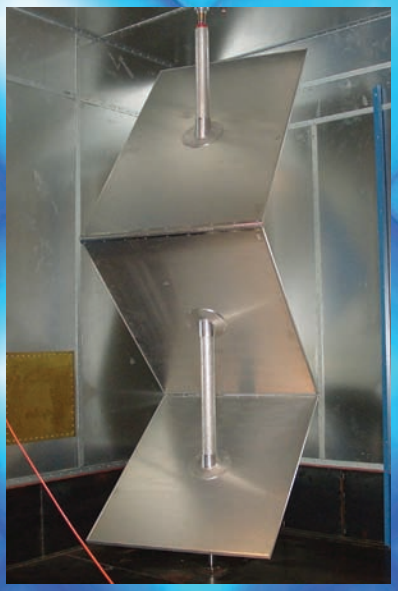
Facility Solutions For Global EMC



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Is Your Wireless Network Slowing Down or Hanging?

Here are the most likely reasons why, along with the forgotten available 5 GHz band

By Dr. Farouk Zanaty, Wi-PerforMax Inc.

Wireless networks offer the convenience of not worrying about being tied to various cables, switches, etc., but they also need to be understood according to their limitations.

The growing demand for using the wireless networks in applications that require high bandwidth points to the need for limiting the demand and checking for performance of the individual devices that form the wireless network.

In simple configurations, an Access Point (AP) is used to connect a number of wireless clients that provide the connectivity between the host computers on which these clients operate and the AP. This is independent of connectivity to the internet, i.e. the number of host computers can communicate together via the wireless clients through the AP independent of the internet. The next step up is to connect to the internet if the AP is fed with a live signal to its WAN port and the clients use the AP IP address as the gateway.

Factors to consider:

- Number of channels and number of APs on each channel
- The forgotten 5 GHz A band
- Number of clients on each channel
- Number of clients the AP can handle
- Signal strengths
- Configuration parameters
- Chipset

NUMBER OF CHANNELS AND NUMBER OF APs ON EACH CHANNEL

The end user is mostly familiar with the band of the operational wireless network. The 802.11 b/g wireless devices operate on 11 channels in North America and on 13 channels in Europe. This is shown in Figure 1. With this limitation, if a corporate wireless network operates in this band with many APs and client cards (for instance 50 APs and 300 clients), the network layout will look like the one shown in Figure 2. That shows an actual scan of the 2.4 GHz band at a Google working facility in Silicon Valley. A close look on the graphs of Figure 2 shows that on every channel (1-11) there are many APs. A possible scenario will be as follows. When a group of users experience difficulty in having smooth connectivity on the wireless network, a new AP is added to resolve the issue. With the limited number of channels and the increasing number of clients, the number of APs per channel will increase. This simply results in performance degradation. One way of enhancing performance in this case will be non-intuitive; that is to reduce the number of APs per channel and redistribute the clients that connect to each AP according to site survey measurements [1].

THE FORGOTTEN 5 GHz A BAND

At the same time the network scan shown in Figure 2 was taken on the 2.4 GHz band, the 5 GHz band scan was also conducted and shown in Figure 3. In North America the channels of this 802.11A band can be designated as 36, 40, 44, 48, 52, etc. all the way up to 164. Clearly the number of channels on this band is significantly higher than the 11 channels of the 2.4 GHz band. But the utilization of this 5 GHz band is not noticeable. This can be explained by one of two possible scenarios. First the network setup takes into account the radar detection scheme that mandates APs to switch from the current operational channel should a radar signal be detected on the channel. This results in forcing the connected clients to switch to the new channel that its AP will choose to switch to after going through an exchange of bidirectional messages according to the wireless protocol. The second is that the network is just setup on the more popular 2.4 GHz which in many cases is the default of the "out of box" configurations of the wireless devices without paying attention to two main important things. One is that most of these wireless devices have the dual band capabilities i.e. they are capable of operating on either 2.4 or 5 GHz and two is that the 5 GHz is widely open and unpopular. So by overlooking the availability of the huge number of channels of this 5 GHz band, a much cleaner (less noisy) spectrum is totally unutilized where it is handily available.

Figures 4 and 5 show two scans of the 2.4 GHz and 5 GHz in a residential area where the first band is also heavily used while the second is not used at all!

NUMBER OF CLIENTS ON EACH CHANNEL

Many clients can be on the same channel with many possible scenarios:

1. Many joining the same AP with the same SSID in infrastructure mode.
2. Many others join different APs on the same channel, each with different SSID in infrastructure mode.
3. Many clients joining a client that created an Ad-Hoc mode.

The occurrence of all these possibilities creates enough busy spectrum to affect the wireless network responsiveness.

SIGNAL STRENGTHS

A direct impact on the wireless network responsiveness is the signal strength that indicates that distance between the communicating nodes. While the absolute value of RSSI is not a reliable indicator (as different devices use inconsistent methods of measuring RSSI), it is an important factor to observe for the same pair of an AP and a client. This points to the need of placing the wireless nodes within close proximity.

CONFIGURATION PARAMETERS

Without digging deeply into the effect of configuration parameters of an AP, the wireless network user may need to observe some of the most intuitive parameters and adjust them to achieve better performing network. Some of these are:

- Channel number; a selection of a less busy channel enhances network performance.
- Fragmentation value; OFF value (mostly 2346) will help
- Power Save; OFF on power-line powered devices will also help as there will be no need to conserve energy on devices that do not use batteries.
- DTIM; an influential parameter that the user may try a few values for (mostly 1, 2, or 3) to gain better responsiveness.

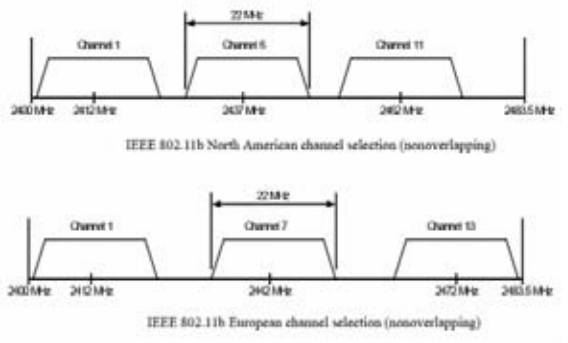


Figure 1: Channels of the 2.4 GHz band

CHIPSET

While the brand name of the wireless device (AP or client) may be an indicator of good behavior based on past experience of using the brand, it should be noted that the same name or model number may utilize different chipsets by different manufacturers.

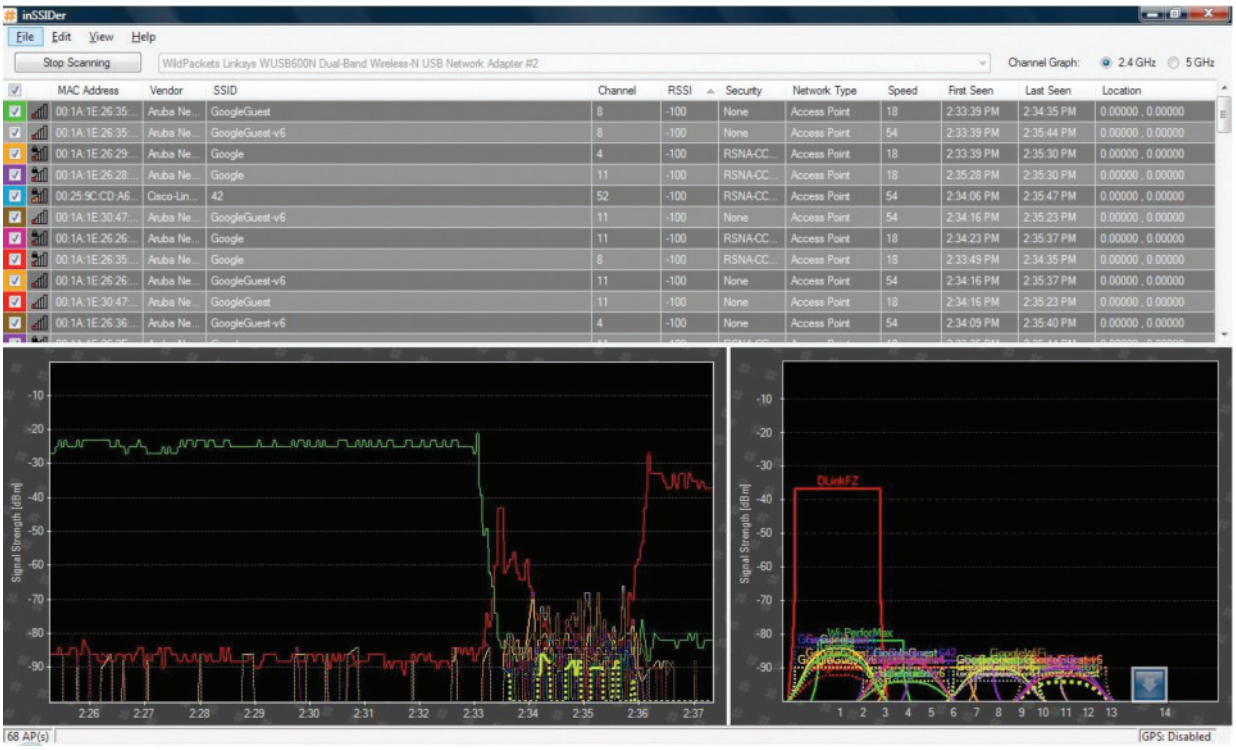


Figure 2: Usage of the 2.4 GHz band in a typical work environment

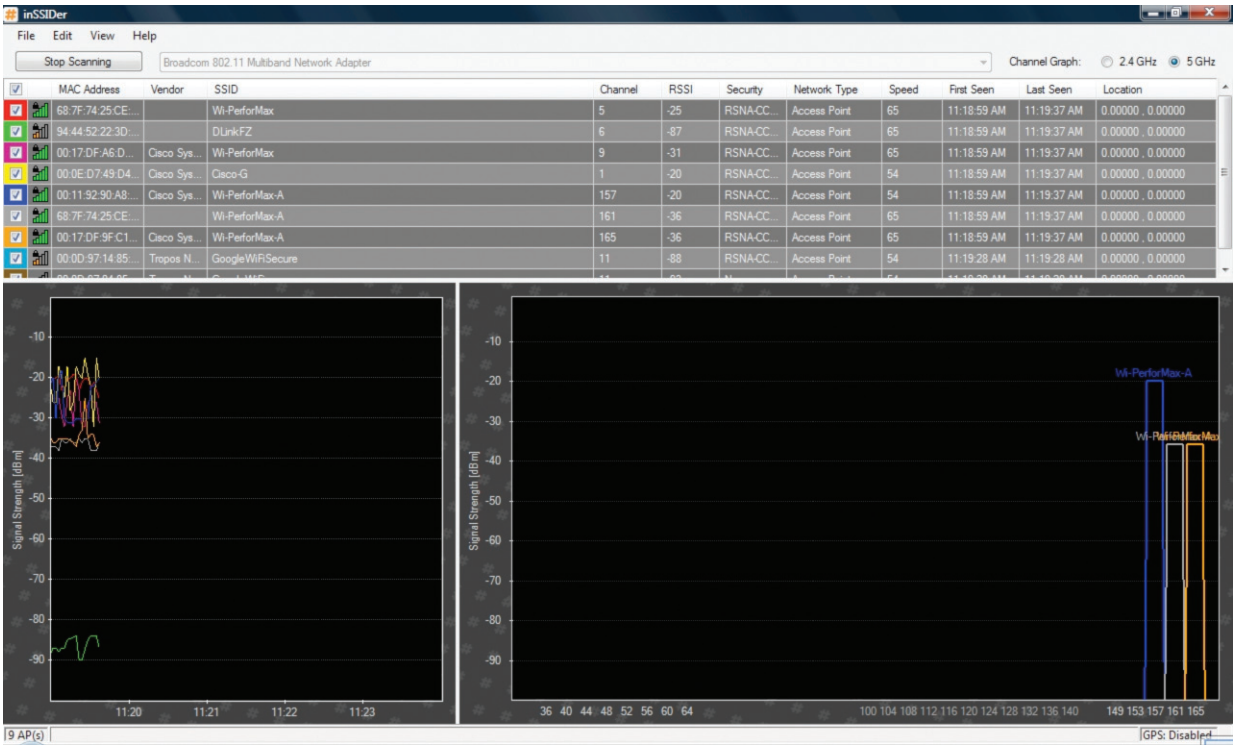


Figure 3: Usage of the 5 GHz band in a typical work environment

Two different chipsets from two different manufacturers may be independently certified for interoperability (under the Wi-Fi program), but both may offer unrelated performance.

While the brand of the chipset will most likely not be indicated on a product, it may be a good idea to find out when deciding to purchase one over the other.

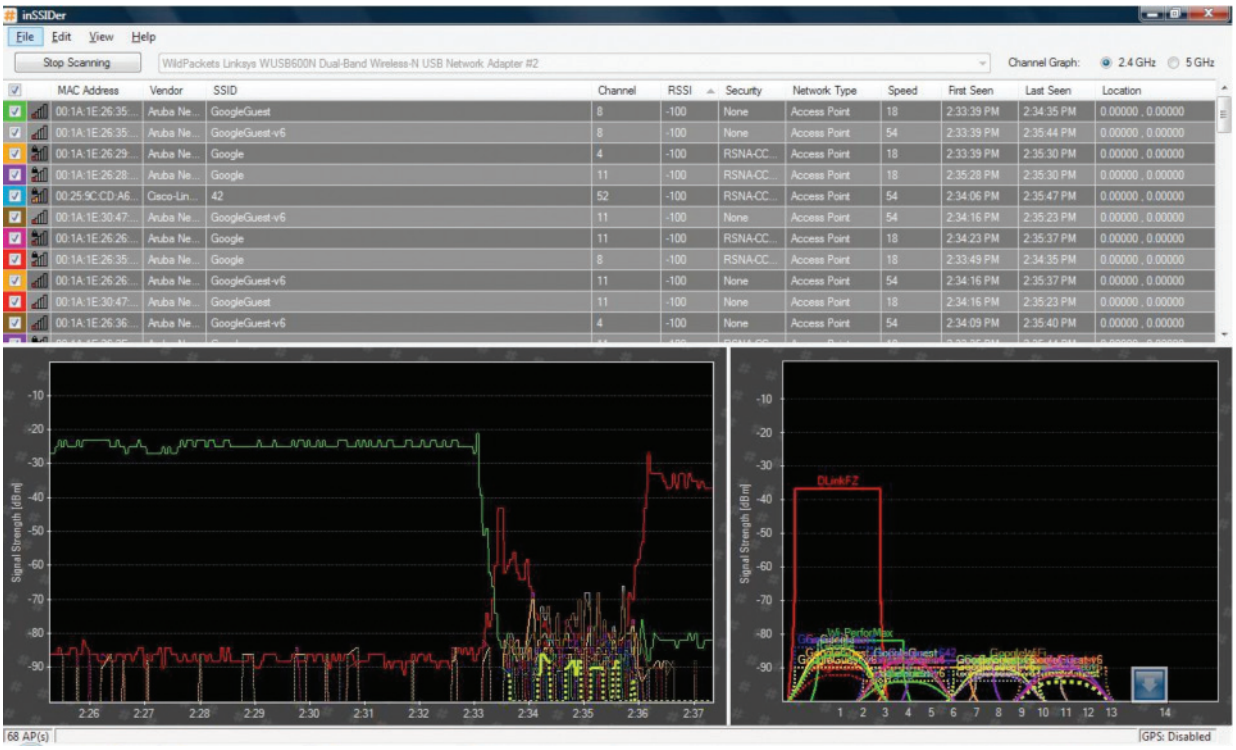


Figure 4: Usage of the 2.4 GHz band in a residential area

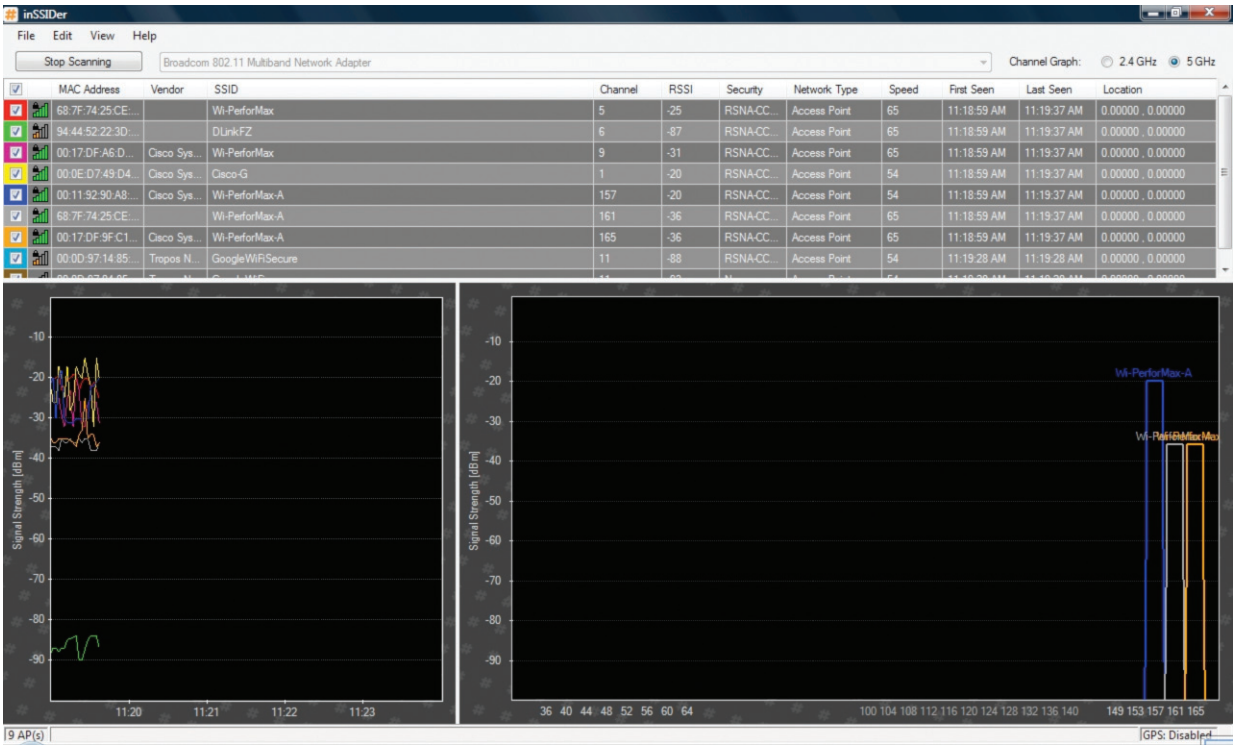


Figure 5: Usage of the 5 GHz band in a residential area

DEALING WITH THE MOST POPULAR

The most popular Wi-Fi 802.11 network so far is the 802.11g. Majority of enterprise and home users use it without paying attention to the performance issues. For instance if there is a need to increase the horse power of the wireless network establishment, the managing authority may just add extra Access Points (APs). This addition of APs will at some point deteriorate the overall performance of the network and cause hang-ups.

A typical example is shown in Figure 2 where a Google wireless LAN shows too many networks active on all channels (1) to (11). The figure shows that on every channel there many networks with different security levels. The scan was taken from a far distance which also indicates that there are even more and more of coexisting networks on every channel should the scan been from a more central location.

The most available Wi-Fi 802.11 network is the 802.11a which is almost not utilized at the large scale of both enterprise and personal levels. The number of channels on 802.11a far exceeds the 11 channels (1-11) of the 802.11g. The typical channels available are 40, 44, 48, 52, etc up to 165.

The chipmakers that test and certify the wireless chips mostly have dual band products, i.e. 802.11a will mostly be available to use. There is however a catch that should not be a reason why this band is not widely used. The radar signals from a nearby airport or similar establishments occur on the 5GHz band where 802.11a operate. The APs are supposed to offer DFS (Dynamic Frequency Selection) that means the AP will switch to another channel should a radar signal be detected on the one it is operating on. Even though this seems to be a good reason why 802.11a may not be widely used but the mainstream end uses most likely are not that sophisticated to notice it and consequently the poor utilization of the 802.11a should be noted as one main highlight of this article.

It is as easy as using 802.11g, the setups are similar in all respects up to the authentication to join the wireless network even through servers that require special accreditation certificates.

Figure 2 shows 3 in-lab 802.11a networks while there is none compared to the heavy usage of the 802.11g at the same scanned location.

CONCLUSION

The wireless networks can slow down or hang due to many reasons. Some due to the surrounding noisy environment, others due to the misuse of channels or bands, or misconfiguartion of influential parameters. In all cases there will be a need to measure and characterize performance of specific wireless devices that to be commissioned in these networks especially with massive number at a work place. The user will experience better performance and avoid possible slowing of the network when proper attention is given to the most obvious like channel and band selection, number of devices on same channel, number of APs and their distribution over the band channels, distances of placing the devices from each other, configuration parameters, and remembering that throwing more APs to operate on the same channel will mostly degrade performance rather than solving a problem of a hanging network. More details to address performance issues in [2]. ■

REFERENCES

1. http://www.wi-performax.com
2. Zanaty, "Necessity but Insufficiency of Interoperability Measures to Assure Smooth Operation of the Wireless Networks" - In Compliance magazine July 2010.

Dr. Farouk Zanaty *has more than 15 years experience in network engineering, protocols, and real time communication systems. Prior to being a cofounder of Wi-PerforMax, Farouk was the leader for Wi-Fi Interoperability Certification programs for all Agilent Labs during a period Agilent was the exclusive test house for Wi-Fi. He joined Conexant systems to automate all the in-house wi-fi testing programs and achieved multiple golden reference certifications for Conexant. He then joined TUV Rheinland of North America as the Wireless Development Manager for the Telecom divisions internationally in 4 countries. He conducted certification tests for all Wi-Fi test plans (802.11a/b/g/n and others) on products from most Wi-Fi member companies while automating Agilent Wi-Fi test beds worldwide. He established the very first Wi-Fi official certification test beds for WPA2 and WMM test plans and exclusively conducted these tests for the first few months. He is the inventor of multiple patents (awarded and pending) in IP Transaction Detail Records, Wireless Networks, C-Chip for cell phone standards, Interlaced Monitors, and SS7 full duplex transmitters. Farouk received his B.Sc. degree in Aeronautical Engineering from Cairo University (Egypt 1974), his first M.Sc. degree in Control Engineering from Hatfield Polytechnic (England 1979), his second M.Sc. degree in Aeronautical Engineering from Cairo University (Egypt 1981) and his Ph.D. in Control Systems of Space Robotics from Oakland University (Michigan USA 1993).*

500 VA Power Converter

Associated Power Technologies, Inc. has announced the release of their model 105 VariPLUS 500 VA Power Converter. The VariPLUS is specifically designed for electrical product manufacturers that need to comply with international safety agency standards. The VariPLUS allows manufacturers to fully comply with these standards without the need to purchase an expensive AC power source. By combining the ease of a variable transformer with the safety and productivity of a more advanced AC power source, the VariPLUS is designed with the operator in mind.

The front panel of the VariPLUS contains two LED displays that provide voltage, current and power measurements. There are five push buttons that allow the operator to edit parameters and change the state of the instrument. A digital rotary encoder replaces the traditional variable transformer twist dial and can be used to change settings and control the output voltage. The universal output receptacle can be used with multiple line cord configurations.

Learn more about the VariPLUS by visiting APT online at http://www.aspowertechnologies.com/products/VariPLUS/VariPLUS105.aspx.

New HAL 104 Passes All the Tests

New advanced technology safety testing instrumentation has been developed for multiple standards, production line and type testing applications in the avionics, appliance, lighting, defense and similar electronics manufacturing sectors. The new Clare HAL 104 from Seaward combines the performance of a multi-function production line safety tester with load and power factor measurement for product energy consumption and ratings assessments.

Part of a new and extended range of specialist HAL electrical safety testing instrumentation, this highly versatile all in one tester has been specially designed for the fast and accurate electrical tests required by modern electronic manufacturing environments.

As well as incorporating key functional checks, the new HAL104 meets the end of line electrical safety compliance tests required by the majority of national and international product safety standards.

As well as load and power functional tests, the new tester incorporates AC/DC Hipot (flash/dielectric strength), insulation, ground/earth bond testing to 40A, load switching to 30A with measurement to 100 millaAmps and leakage to 100 microAmps.

The new tester has widespread applications in the lighting, appliance and electrical/electronics manufacturing sector – and particularly in those production situations where high resolution performance measurements are important, such as LED products in low energy lighting applications and PV solar panels.

The HAL104 can be used as a manual stand alone tester with simple push button test activation or can be fully integrated into automated manufacturing systems with selectable sensors and enclosure interlocks, or by ultimate control using remote PCs and PLCs.

The new HAL104 meets all of the requirements of the various British and European standards in relation to high voltage testing and incorporates fully isolated high voltage outputs to ensure the highest levels of operator safety. More details at http://www.clare.co.uk/hal104.

New Transformer Turns Ratio Measuring Instrument

Hipotronics Inc. has announced a close collaboration with major transformer manufacturers has lead to the new Tettex 2796 Transformer Turns Ratio Meter. The new instrument combines mobility and user friendly handling with accuracy of up to 0.03%.

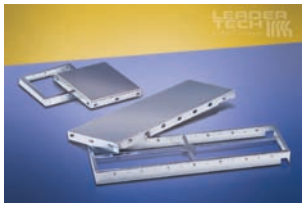
The company reports the higher test voltage of 250 V together with the high precision assures authentic results especially on large power transformers. Advanced analysis features like trending allow the user to detect problems in an early stage. The automatic winding connection identification feature aids to find the correct transformer configuration. With the optional arbitrary phase shift software also special transformers with irregular vector groups can be measured.

During production and in the field the TTR 2796 is a highly valued diagnostic instrument. Within half a minute after connecting the measurement cables to the terminals of the transformer, the voltage ratio, turns ratio, ratio deviation, excitation current and phase deviation are displayed. For more information please contact Matt Lawson, Regional Sales Manager, (845) 230-9216 or e-mail: mlawson@hipotronics.com or visit http://www.hipotronics.com.

Circuit Board Shields Offer Size and Configuration Solutions

A growing trend among many commercial and military electronics manufacturers is to improve the performance of an existing application by integrating wireless communications. As higher power wireless processors are added to existing circuit boards however, engineers have encountered a significant increase in unwanted RF interference and crosstalk.

Leader Tech's Slot-Lok™ circuit board shields offer the perfect solution for manufacturers that need a flexible, low-cost shielding option that can fit seamlessly within an established footprint. The 2-piece Slot-Lok design uses standardized production methods to create a near-custom solution without incurring tooling charges or extended delivery times. Virtually any shape, size or configuration of shield is possible with Slot-Lok; from through-hole



or surface mount installations to automated pick and place or hand assembly operations.

The shields are manufactured from RoHS compliant materials and exhibit exceptional solder characteristics, corrosion resistance and shielding effectiveness. For more information, call (813) 855-6921or visit http://www.leadertechinc.com.

Advanced Digital Receiver

MI Technologies has announced the launch of a new advanced digital receiver at AMTA, the Antenna Measurement & Techniques Associations' 32nd annual conference this month in Atlanta, GA. With the addition of the MI-750 Receiver, MI Technologies has expanded its breadth of measurement instruments by providing its customers more precision instrumentation and innovative solutions to solve their measurement requirements.

"The MI-750 Advanced Digital Receiver is a great addition to MI's arsenal of precision products. Our MI-750 receiver provides an easy upgrade path for those customers with existing MI systems. The receiver operates in a wide variety of operating conditions and easily replaces network analyzers and other receivers," said John Breyer, President and CEO of MI Technologies, "The MI-750 receiver affords the fastest measurement speed in the market today."

For more information contact sales@mi-technologies.com or visit http://www.MI-Technologies.com.

Inductive Components Circuit Simulation Program LT Spice

TDK-EPC now offers via the EPCOS website specifically-adapted simulation models for inductive components for the circuit simulation program LT spice from Linear Technologies. The models can be integrated directly into the current versions of the respective simulation environment and work in both SwCAD III and LTspice IV program versions.

Data for new and improved products has also been entered into the simulation libraries. Customers can find the model libraries on the Internet under http://www.epcos.com/tools .

Laboratory Accredited for NOM Certification In Mexico

TÜV Rheinland has announced that its cTUVus mark has been accepted by the government of Mexico as an equivalent of its NOM standards for product safety. The company's subsidiary TÜV Rheinland de Mexico, S.A. de C.V., located in Mexico City, will handle testing and international approvals under this safety standard locally.

The scope of equivalent standards includes: NOM-001 (Electronic products in general), NOM-016 (Office equipment and devices), NOM-019 (IT products), ANSI/UL 60065 or CAN/CSA-C22.2, ANSI/UL 60335-1 or CAN/CSA-E60335-1/4E-03 (R2007), ANSI/UL 60950-1 or CAN/CSA-C22.2 No. 60950-1-07, and ANSI/UL 60065 (applicable in the U.S. and Canada). Only audio and video products are applicable to ANSI/UL 60065 (NOM-001). Other electronic products under the NOM-001 scope – such as video projectors, battery chargers, and adapters – must obtain the NOM certificate locally.

NOM is a mandatory Mexican standard that regulates the safety of products imported into the country. Electrical, electronic, medical, wireless and telecom products must be tested to the national, mandatory NOM standards by an accredited Mexican laboratory. Products subject to NOM cannot be imported into Mexico unless certified as compliant.

Mexican authorities must receive a copy of the cTUVus certificate with a "Mexico Addendum" to guarantee products clearance through customs and immediate access to the Mexican market. The "Mexico Addendum" can be requested by the TÜV Rheinland de Mexico office. Products imported through the "Standards Equivalent Scheme" are subject to a document follow-up inspections program currently being developed by the Mexican authority. For more information visit http://www.us.tuv.com or call 1-TUV-RHEINLAND (888-743-4652).

Next- Generation Cable Technology for High Data Rate Applications

W. L. Gore & Associates has introduced the next generation in cable technology for high data-rate applications. This technology consists of a new differential cable design with lower SCD21 (differential-to-common-mode conversion) and a very high level of signal fidelity. Additionally, it provides the only cable solution that addresses the degradation in performance caused by SCD21. Engineered for InfiniBand® and other high data-rate applications, this new design has yielded SCD21 values that are typically below -40 dB and consistently well below -25 dB across a 20 GHz bandwidth.

SCD21 is a differential s-parameter matrix element that represents the unwanted conversion between differential mode and common mode in a transmission line. This conversion reduces the signal's energy in differential mode, which causes unpredictable phase delays and skin-effect losses across frequencies. In coupled differential cables, the conversion results in differential-mode jitter. If these effects are not taken into account, the signal may not be recovered. According to Russ Hornung, Gore Cable Product Manager, "In the past year, we have seen more applications employing advanced serializer/deserializer (SERDES) technologies and signal recovery processing that should include a specification for SCD21 performance; however, SCD21 currently is not addressed in most manufacturer or industry specifications. This new technology allows for faster digital data rates that can exceed 20 Gbps without signal integrity being compromised."

Available in cables with smaller gauge sizes (AWG24 to AWG32), Gore's low SCD21 technology allows for very precise cancellation of signals of equal amplitude and differential polarity, with very little phase difference between the differential legs. Using proprietary materials for the cable jacket and dielectric has enabled Gore to engineer the smallest, most flexible cables for high-speed data rate applications. For more information about Gore's full line of products for the electronics industry, visit http://www.gore.com/electronics.

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

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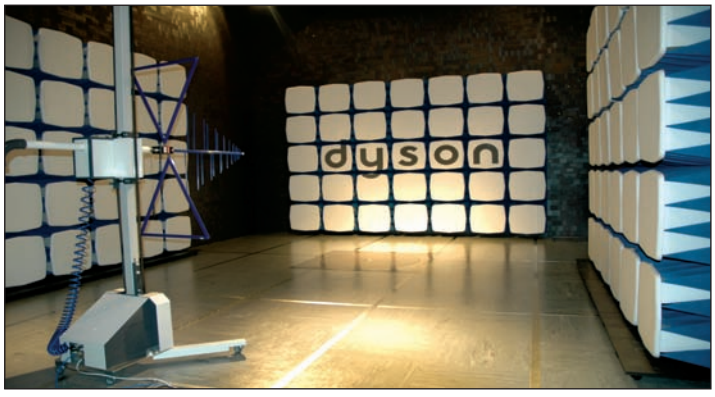

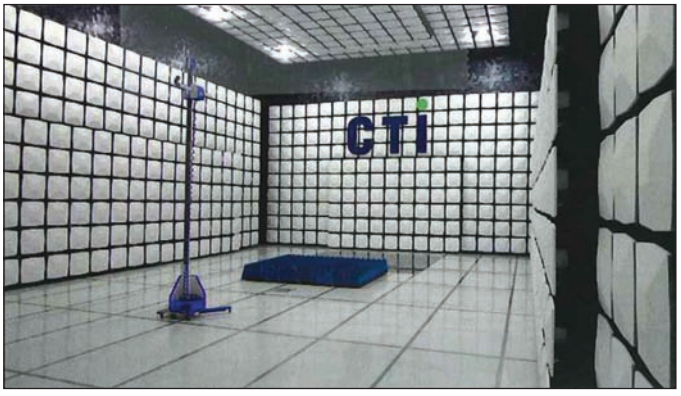

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