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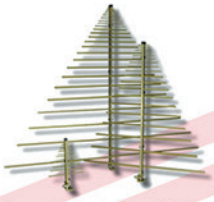
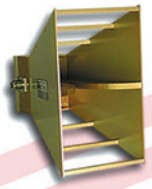


Log Periodics
80 MHz - 7 GHz
13 Models



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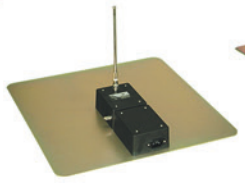

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clas·sic (klăs ĭk)
adj.
1.
a. Belonging to the highest rank or class.
b. Serving as the established model or standard: a classic example of colonial architecture.
c. Having lasting significance or worth; enduring.

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Failing Product Safety Testing in the 21st Century

Even though safety is second nature to electrical product designers, testing laboratories still see their share of products failing safety testing. This is often due to circumstances that could have been prevented through simple yet effective safety measures. This article will provide a technical overview of areas of concern in regards to product design, testing and documentation.

Steve Williams and Uwe Meyer

DEPARTMENTS

FEATURES

News in Compliance

Radio Operator Fined $3k for Refusing Inspection

The U.S. Federal Communications Commission (FCC) has ordered the operator of a Citizen Band (CB) radio station to pay a penalty of $3,000 for his refusal to allow an inspection of his installation.

According to a Forfeiture Order issued by the Commission in February 2015, the operator, Tommie Salter of Jacksonville, FL, refused to allow agents from the FCC Enforcement Bureau's Tampa (FL) office to inspect his CB station. Salter continued to refuse the agents' request to inspect his equipment even after being informed by the agents that his refusal to allow an inspection constituted a violation of FCC rules.

In his response to a Notice of Apparent Liability issued by the Commission, Salter did not deny that he refused access to his equipment, but claimed that he was not able to permit the inspection since he had to leave for a doctor's appointment. However, neither of the Enforcement Bureau agents who visited Salter recalled his having mentioned the appointment, and Salter was unable to produce any tangible evidence of having such an appointment.

The Commission did reduce the amount of the proposed penalty from $14,000 to $3,000 in light of tax returns submitted by Salter that supported his claim of financial hardship.

The complete text of the Commission's Forfeiture Order is available at incompliancemag.com/news/1504_1.

Commission Seeks Comment on Robotic Lawn Mowers

The U.S. Federal Communications Commission (FCC) is seeking comment on its decision to waive a portion of its Part 15 rules to accommodate a wirelessly operated robotic lawn mower (RLM) system.

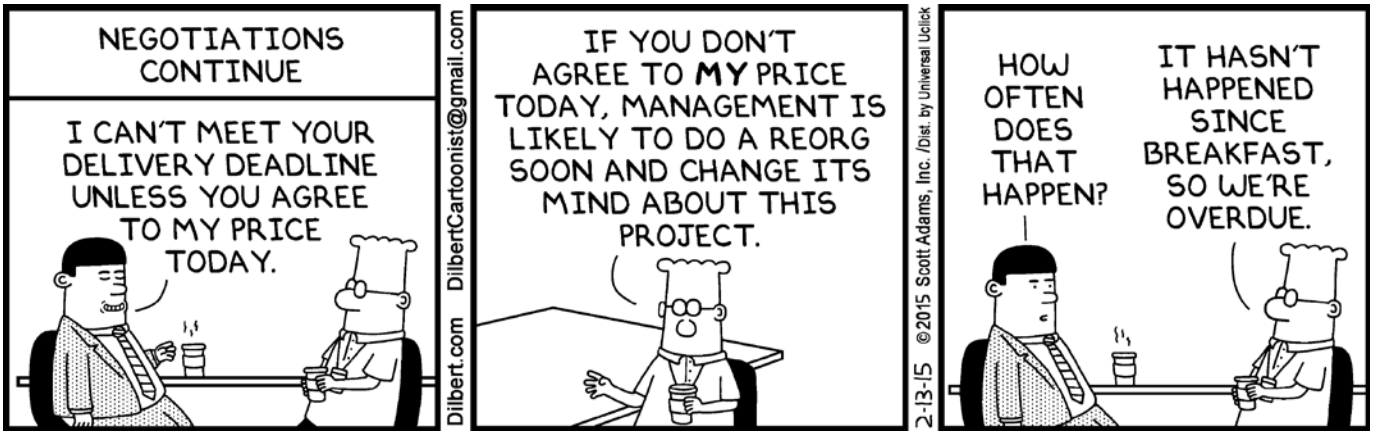
As reported in a press release issued by the Commission in February 2015, iRobot Corporation had filed a request for a waiver from the Commission rules applicable to the unlicensed operation of a wideband system to accommodate its RLM system. According to the company, the RLM system consists of battery operated self-propelling lawn mowers that utilize portable beacons placed in multiple locations on a lawn. The beacons reportedly transmit information to the RLM that enables it to map a designated mowing area and operate within those boundaries. The iRobot RLM system is designed to operate in the frequency range of 6240-6740 MHz, which is within the bands allocated for unlicensed wideband systems.

Comments on the waiver decision were due to the Commission on March 9, 2015. The Commission's press release, which includes information on filing comments, is available at incompliancemag.com/news/1504_2.

FCC Appoints Frequency Coordinator for Medical Body Area Networks

The U.S. Federal Communications Commission (FCC) has appointed an independent industry association to coordinate the use of frequencies assigned to medical body area networks (MBANs).

In an Order released in February 2015, the Commission designated



the American Society for Health Care Engineering of the American Hospital Association (ASHE/AHS) as the MBAN frequency coordinator. As a result of this designation, the ASHE/AHS will be required to sign a Memorandum of Understanding that sets forth its responsibilities as MBAN frequency coordinator as well as the limits on its authority.

MBANs are low-powered networks that transmit a range of patient data from multiple body-worn sensors to a control device. MBANs can be used to monitor patient vital health signs in real time, thereby providing advanced notice of potential problems. And, because they are wireless, MBANs make it easier to move patients to different areas of a healthcare facility for specialized treatment.

The FCC originally allocated 40 MHz of spectrum in the 2360-2400 MHz band for MBAN use on a secondary basis in 2012. The Commission also modified the provisions of its rules governing medical device radio communications so that users do not have to apply for individual operating licenses.

In an Order on Reconsideration and Second Report and Order issued in August 2014, the Commission modified its rules to facilitate the coordination, deployment and use of MBAN systems, as well as to facilitate the development and implementation of technical standards applicable to MBAN devices. The Commission also defined the process for selecting a MBAN frequency coordinator responsible for facilitating the use of MBAN frequencies. This recent action addresses that issue.

The complete text of the FCC's latest Order regarding MBANs is available at incompliancemag.com/news/1504_3.

FCC Plans $9 Million Forfeiture for Fabricated Switching Authorizations

In one of the most egregious cases in memory, the U.S. Federal Communications Commission (FCC)

News in Compliance

The General Electric Company of Fairfield, CT has agreed to pay a monetary forfeiture of $3.5 million to settle charges that it failed to properly notify the U.S. Consumer Product Safety Commission (CPSC) of product defects that could lead to consumer injuries.

has proposed that an Atlanta, GA telephone company pay a penalty of more than $9 million for illegally switching consumers' long distance telephone services ("slamming") and billing them for unauthorized charges ("cramming").

According to a Notice of Apparent Liability issued by the Commission in February, 2014, telecom company GPSPS, Inc. not only slammed and crammed customers, but also created fake audio recordings of conversations in which consumers allegedly authorized a change of service. When responding to inquiries regarding the more than 150 complaints that had been filed with the Commission, GPSPS brazenly submitted the fake "verification" recordings as evidence. However, this strategy quickly unraveled when multiple consumers who listened to the recordings denounced them as fabrications.

The complete text of the Commission's Notice of Apparent Liability is available at incompliancemag.com/news/1504_4.

New List of Standards Issued for EU's Machinery Directive

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

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

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

The extensive list of CEN and Cenelec standards for the Machinery Directive was published in February 2015 in the *Official Journal of the European Union*, and replaces all previously published standards lists for the Directive.

The revised list of standards can be viewed at incompliancemag.com/news/1504_5.

EU Commission Amends REACH Regulations

The Commission of the European Union (EU) has amended its regulations on the registration, evaluation, authorization and restriction of chemicals (REACH) to adopt a new protocol for mandated toxicity studies.

Published in the Official Journal of the European Union in February 2015, Commission Regulation (EU) 2015/282 amends key Annexes of the original REACH Regulation (EC No 1907/2006) to permit the use of so-called extended one-generation reproductive toxicity studies (EOGRTS) in assessing the reproductive toxicity of chemical substances. EOGRTS are reported to have a number of advantages over two-generational reproductive toxicity studies, including a reduction in the number of test animals used and an improvement in the sensitivity and level of information obtained from testing.

The complete text of the Regulation is available at incompliancemag.com/news/1504_6.

GE to Pay $3.5 Million for Failing to Report Defective Products

The General Electric Company of Fairfield, CT has agreed to pay a monetary forfeiture of $3.5 million to settle charges that it failed to properly notify the U.S. Consumer Product Safety Commission (CPSC)

of product defects that could lead to consumer injuries.

According the CPSC, GE failed to report on a timely basis defects with two models of the company's Profile-brand freestanding dual-fuel ranges. The company sold the ranges for $1,300 to $2,000 between June 2002 and December 2005, but began receiving reports in 2004 of overheating and fires attributable to a defect in the ranges' wiring harness. Ultimately, GE reported the hazards to the CPSC in February 2009 after receiving 13 separate reports of overheating, including 5 separate reports of fires. The company announced a recall of about 28,000 ranges in April 2009.

In a separate instance, GE failed to report a defect involving overheated control panels on Profile and Monogram-brand dishwashers sold between July 2003 and October 2010. The company began receiving reports from consumers regarding the defect as early as 2007, and even paid out settlements to consumers in connection with the defect. But it failed to report the problem to the CPSC until October 2010, when GE and the CPSC announced a recall of about 174,000 dishwashers.

Federal law requires that manufacturers, distributors and retailers immediately (i.e., within 24 hours) report to the CPSC information that a product contains a defect which could create a substantial product hazard, or pose a risk of injury or death to consumers.

As part of its settlement with the CPSC, GE also agreed to maintain an internal compliance program to ensure the timely reporting of defective products. However, the company neither admitted nor denied CPSC allegations that its appliances posed an unreasonable risk of injury or death, or that the company violated the reporting requirement of the U.S. Consumer Product Safety Act.

Portable Space Heaters Pose Shock Hazard

Source Network Sales and Marketing of Plano, TX (dba Lifesmart) has recalled about 17,000 portable space heaters manufactured in Canada.

According to a press release issued by the U.S. Consumer Product Safety Commission (CPSC), the recalled portable space heaters utilize screws to attach the back plate of the heater unit that are too short, allowing the back plate to detach when removing the heater from an outlet, thereby exposing users to the risk of an electrical shock. To date, there have been no reports of injuries or other incidents related to space heaters.

The recalled units were sold through a number of retail and online stores nationwide from January 2014 through December 2014 for between $40 and $50.

For additional information about this recall, go to incompliancemag.com/news/1504_7.

Fire Hazard Leads to Battery Packs Recalled

Jackco Transnational, Inc. of Azusa, CA is recalling about 5000 ZETA by Jackco-brand product jump starter battery packs manufactured in China. According to Jackco, the battery packs can overheat, split apart and melt the battery pack's enclosure, posing a fire hazard. The company reports that it has received nearly 500 reports of battery failure and two reports of a fire resulting in property damage. However, there have been no reports of injuries.

The recalled battery packs were sold at retailers nationwide and at Amazon.com from July 2014 through January 2015 for between $110 and $140.

Further details about this recall are available at incompliancemag.com/news/1504_8.

Electric Ranges Recalled Due to Shock Hazards

Electrolux of Canada and Electrolux Home Products of Charlotte, NC have announced the recall of about 3,000 Kenmore-brand electric cooking ranges manufactured in Canada.

According to the companies, the heating element in the range can fail to properly adhere to the cooktop, posing an electric shock hazard to consumers. Electrolux has not received any reports of incidents or injuries related to the recalled ranges, but has initiated the recall to prevent future such incidents.

The recalled electric ranges were sold at Sears and Kenmore stores nationwide from April 2014 through October 2014 for between $650 and $860.

More information about this recall is available at incompliancemag.com/news/1504_9.

REALITY Engineering

The Effect of the FCC's New Rules on Testing Laboratories

A Sea Change for Testing Laboratories?

BY MIKE VIOLETTE

The Federal Communication Commission (FCC) ended 2014 with an overhaul of its Rules for device testing and certification. While everyone was getting ready to pop the champagne, the Commission released its long-anticipated "Rule Making 11652" on December 30, 2014. It was an uncorking that echoed around the world, most notably in the ears of our testing laboratory friends overseas.

In short, it may spell the end of testing for FCC compliance for hundreds of laboratories.

The stated reason for the new Rules is to update certain procedures for device certification and to "facilitate the continued rapid introduction of new and innovative products to the market while ensuring that these products do not cause harmful interference to each other or to other communications devices and services."[1] However, these changes will potentially affect billions of dollars of global trade in electronics in a very big way.

By implementing certain specific goals outlined in the preceding Notice of Proposed Rulemaking (NPRM) issued in 2013, the Rule changes that have been enacted jeopardize the recognition of testing laboratories in countries that do not have a mutual recognition arrangement (MRA) with the U.S., notably China, Malaysia, Brazil, India, Mexico and Thailand. Beginning sometime in 2016, data submitted by testing laboratories based in those countries will no longer be recognized by the FCC. As it now stands, electronic device manufacturers in those countries may have to find other ways to obtain the testing required for FCC approval.

BACKGROUND

The FCC partly privatized its Certification process in the year 2000 at the dawn of what would be an explosion of wireless device innovation and development. As of the writing of this piece, approximately 233,000 entries[2] have been made in the past 15 years or so in the FCC's Certification database, reflecting an astonishing array and diversity of products used for communications, entertainment, health, safety, energy and other critical areas of our modern lives. The pace is accelerating.

The globalization of research and development as well as manufacturing occurred during this same period. Taiwan, Korea and Japan were already largely invested in electronics development at the time of the FCC's original action. But, in the year 2000, China was just getting started on its high-technology race to the top.

Since the inception of its Equipment Authorization program, the FCC has historically accepted test data from any laboratory that complied with the minimum facility reporting requirements under Part 2.948 of the FCC's Rules. Reporting requirements included a description of the laboratory, information on its site attenuation characteristics, photos and a list of equipment. Testing laboratories from all over the globe that submit this information to the FCC are referred to as "Listed" laboratories, and their names are published on the FCC's website. This was a practical approach before the days of accreditation when the industry was evolving, and quite liberal when compared to some other regulatory regimens. However, several forces have changed the Commission's view of this process, making the Listing of testing laboratories become a thing of the past.

GLOBALIZATION

MRAs allow the free exchange of test data between countries ("economies" in MRA parlance). MRAs also form as a basis for Certification Bodies to be designated outside the U.S. They are also a key element in the acceptance of a Declaration of Conformity under

Along with the FCC, various U.S. government agencies have actively worked to establish working MRAs with numerous economies, some with great success and progress and, in other cases, not so much. Frankly, this has been the source of some frustration in and around the industry and with regulatory bodies as well.

Part 15 of the FCC's Rules. For the most part, the MRA process has worked well and allows product developers to test locally and sell internationally.

However, because the FCC's process allows acceptance of test data from anywhere, the benefits of this liberal system can be enjoyed even by testing laboratories based in countries that do not have an MRA with the U.S. As a result, it has created an uneven playing field for testing laboratories and, by extension, their customers.

Along with the FCC, various U.S. government agencies have actively worked to establish working MRAs with numerous economies, some with great success and progress and, in other cases, not so much. Frankly, this has been the source of some frustration in and around the industry and with regulatory bodies as well.

So the changes promulgated in the FCC's new Rules will affect several hundred testing laboratories based outside the U.S. in non-MRA partner economies. The specifics are embodied in the summary of the Commission's Report and Order implementing the new Rules, wherein the FCC will "… require accreditation of all laboratories that test equipment subject to any of the certification procedures under Part 2 of the Commission's rules…"

The real issue is what accreditations will the FCC accept. This is a crucial issue for those testing laboratories that will lose their status as FCC Listed laboratories. The answer to this question is found in Section 48 of the Report and Order, which states that "the current rules allow for the recognition of accredited testing laboratories in countries with which there is no operational MRA with the United States," but (and it's a big "but"), "the Rules do not provide a process for such recognition." And there are no current plans to address this issue.

A couple of other nuances are also being massaged in the FCC's Report and Order. Notably, accreditation is being applied very broadly, not just on testing laboratories directly, but for subcontracted testing as well. That is, if a laboratory subcontracts testing work to another laboratory, the subcontracting laboratory needs to be accredited for the work. Further, FCC-authorized telecommunication certification bodies (TCBs) will be obligated to accept work only from accredited and recognized testing laboratories.

TICK-TOCK

The FCC's rulemaking raises several time-critical issues. At present, the new rules have not yet been published in the *Federal Register*, which is the first step in the implementation of the new requirements. Once the rules are published, a one-year countdown begins on the dissolution of the Listing program. This short timeframe could leave many busy testing laboratories high and dry. The way around this issue would be for the FCC to develop a formal process for officially recognizing testing laboratories, but the Commission has indicated that they are not currently working to develop such a recognition program.

So, how will this coil unwind? Well, for starters, non-MRA countries could get back to serious negotiations and execute MRAs with the U.S. This is a good idea, but probably not realistic given the limited amount of time. Another scenario is that the FCC allows existing testing laboratory listings to expire without further action, resulting in testing being redirected to countries with an MRA. This would this be a windfall for testing laboratories in those countries but devastating for incumbent testing laboratories in non-MRA economies. A more likely scenario is that the electronics industry will apply political pressure to exact a more reasonable solution, one that doesn't increase the time and cost for product testing and approval.

So stay tuned. Something has to give. IN

ENDNOTES

1. ET Docket 13-44 RM 11652. Report and order Adopted: December 17, 2014 Released: December 30, 2014
2. This number reflects database entries, not the sum of all the devices. Many devices have several line entries. If one were to "de-rate" this number by 75%, it is still amazing.

(the author)

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is President of Washington Laboratories and Director of American Certification Body. He can be reached at mikev@wll.com.

ON Your Mark

Understanding Symbols

Static Electricity Hazards

BY GEOFFREY PECKHAM

One of the critical building blocks for your product safety labels is symbols. This month, we'll explore ESD symbols and their application.

Today's equipment contains many complex and highly sensitive electronic devices for control. Providing notice to workers is critical for protecting electrostatic discharge (ESD) sensitive devices from damage. Your safety labels related to ESD help remind workers to use proper grounding equipment, wear appropriate attire and use compatible handling methods, as well as to indicate the location of the best grounding points; this is all so that equipment is not damaged. While in the U.S., adherence to ESD labeling standards is voluntary, choosing to use the right international symbols on your labels will help to assure consistency among products, promote a quick understanding of the label's meaning and reduce unnecessary confusion in the marketplace. In this article, we'll look at the standards, symbols and label formats involved in ESD. The goal is to help you, as a product engineer, better choose label and symbol designs to fit your applications.

ESD SYMBOL STANDARDS

For the U.S. domestic market, the best practice standard is currently ANSI S8.1:2012 for symbol design and ANSI/ESD S20.20:2007 for ESD control program development. These two standards have incorporated – and in most situations replaced – the JESD471:2009 (EIA-471) symbol standard and the MIL-STD-1686 standard for ESD control programs. Some military contracts and suppliers still reference the older MIL-STD even though ANSI S20.20-2007 was designed to replace it.[1] Internationally, IEC 61340-5-1 covers ESD control programs and it was recently updated and is now virtually equivalent to ANSI S20.20:2007.

1. If you're making products for the military, we suggest you continue to use MIL-STD-1686.

ESD "SENSITIVITY" SYMBOL

Many ESD symbols have been developed over the years. **Figure 1** shows the two most current symbols as defined by ANSI/ESD S8.1 – ESD Awareness Symbols and IEC 60417 – Graphical symbols for use on equipment (at left and at middle). The IEC design is preferred for the international market, and is easier to reproduce in small sizes.

The ESD sensitivity/susceptibility symbol is to be used on ESD sensitive components, assemblies, packaging containing ESD devices or the access panel to ESD sensitive devices. Black on a yellow background is the preferred

Figure 1: The ESD susceptibility symbol from ANSI/ESD S8.1 (at left), the simplified electrostatic sensitivity symbol from IEC 60417 (at middle) and the JESD471 symbol for electrostatic sensitive devices (at right).

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ON Your Mark

In addition to identifying protective packaging, the ESD protective symbol is also used on signage, tapes, physical barriers and markings for ESD protective areas (EPA), protective garments, shoes and equipment. Guidelines suggest having a sign at the entrance to an EPA and at the workstation.

color scheme. The ANSI standard gives you the option to include a sensitivity-based alphanumeric code to tell people the proper level of precautions necessary to avoid damage to the equipment. For military standards, there are specific word messages to be paired with the JESD471 symbol (see **Figure 1**, at right). The standards suggest that the symbol be black on a yellow background, but monochromatic reproduction in any color that contrasts with the background may be used.

ESD "PROTECTIVE" SYMBOL

The ANSI S8.1 standard and IEC 61340-5-3 both prescribe symbols to be used to either 1) identify protective packaging materials or 2) identify an electrostatic protective area (EPA) where ESD precautions are in place (see **Figure 2**). The ESD protective symbol differs from the ESD sensitivity symbol by removing the slash and adding a 'bold arc' around the triangle to suggest the idea of protection. In Europe, a letter is added to identify the type of protection provided by a package. As described in IEC 61340-5-3, the four letter codes for IEC 60417 6202 are:

S for electrostatic discharge shielding

F for electrostatic field shielding

C for electrostatic conductive

D for electrostatic dissipative

In addition to identifying protective packaging, the ESD protective symbol is also used on signage, tapes, physical barriers and markings for ESD protective areas (EPA), protective garments, shoes and equipment. Guidelines suggest having a sign at the entrance to an EPA and at the workstation. ANSI/ESD S8.1 states that the word message, "May include manufacturer's name, date of manufacture, or lot code where applicable." The preferred color is yellow on a black background.

Figure 2: The ESD protective symbol from ANSI S8.1 (at left) and the IEC packaging version of the symbol from IEC 60417 (at right). The '*' in the IEC symbol is for the letter code to be added.

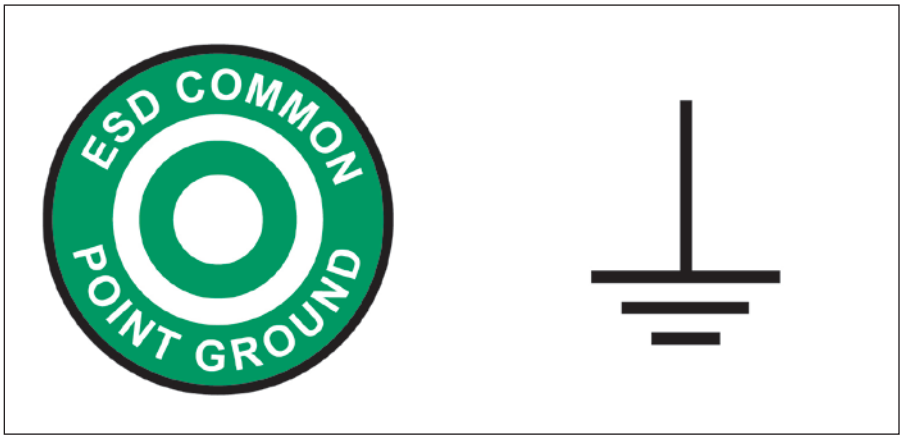

Figure 3: The common ground point symbol from ANSI S8.1 (at left) and the general earth (ground) terminal identification symbol from IEC 60417 (at right).

ESD "COMMON GROUND POINT" SYMBOL

ANSI S8.1 also has a symbol for "common ground point." IEC 60417 has a similar wordless symbol meaning "earth; ground." See **Figure 3.**

This ESD-related symbol is used to indicate the location of an acceptable

The common ground point symbol is used in an EPA for identifying where to attach ground wires when servicing equipment in the field or in your facility. If possible, the inner circle of this label should be the location of the ground post or socket.

common ground point as described in ANSI/ESD S6.1. The colors are optional per the standard, but it suggests either using black or using white on green.

The common ground point symbol is used in an EPA for identifying where to attach ground wires when servicing equipment in the field or in your facility. If possible, the inner circle of this label should be the location of the ground post or socket.

HARMONIZATION WITH ANSI Z535

When it comes to your ESD label's content, some of the older standards refer to "CAUTION" as the signal word to use when warning about part and assembly damage from ESD. Other standards specify the use of "ATTENTION". Per ANSI Z535 (the standard in the U.S. which sets the overall benchmark for product safety labeling), "NOTICE" is the more appropriate choice for an ESD label's signal word. "NOTICE" is used to indicate information to avoid equipment damage (in contrast to using the signal words DANGER, WARNING or CAUTION which are used to indicate potential personal injury hazards). The ANSI Z535.4 Standard for Product Safety Signs and Labels can be used for ESD labels – harmonizing with IEC standards by incorporating one of the three internationally recognized ESD symbols discussed above into the symbol panel of an ANSI Z535.4 label (see **Figure 4**). Taking this extra step towards harmonization will help to ensure consistency with the latest best practice standards in the U.S., and will help to maintain consistency within your product's overall system of safety labels.

Stay tuned for the next article in this year's *On Your Mark* series which will explore the history and progress in standardized symbols related to laser labeling. IN

(the author)

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Figure 4: Examples of ANSI Z535-style ESD labels. (Designs ©2015 Clarion Safety Systems. All rights reserved.)

Failing Product Safety Testing in the 21st Century

BY STEVE WILLIAMS AND UWE MEYER

Even though safety is second nature to electrical product designers, testing laboratories still see their share of products failing safety testing. This is often due to circumstances that could have been prevented through simple yet effective safety measures. This article will provide a technical overview of areas of concern in regards to product design, testing and documentation.

OFF TO A GREAT START… OR IS IT?

After the product design is complete and the entire organization is in anticipation of a new, hot product hitting the market, there remains a question of product safety approval process. Naturally, the designers considered safety features so the laboratory can run the sample through and issue the certificate in time for the official product launch. In the ideal world, that is.

First, the laboratory might have other products in queue, so waiting till the product is complete before contacting a test lab is not a good idea. The equipment needed for testing might not be available right away. Second, even if technicians begin testing right away, it is possible that they find non-conformances that could delay the product from getting to market on time.

THE DEVIL IS IN THE DESIGN DETAILS

It is always a good idea to review basic safety requirements applicable to the product in the works. This reduces the chance of overlooking a minor technical detail that may turn into a costly mistake if the design team needs to make physical changes to the product during the safety approval process. While the safety standards will have many different features, the tricky ones are listed below.

Ground Is King

The laboratory will examine the ground path according to the applicable standard and look at such factors as the capacity of current-carrying parts in the ground path, reliability and prevention against accidental loosening. Remember to use the wire of the correct color. Ground is sacred in many standards as it will shunt the fault current away from a user in the event of a fault.

Watch Your Spacings

Spacings are the separations between circuits at different voltage levels and different circuits and user-accessible parts. The laboratory will check the creepage and clearance as required by the standard (refer to the Reference Guide to Terms and Basic Requirements at the end of the article).

Proper layout of the printed circuit board (PCB) is critical. Today, automated programs allow a PCB designer to input design rules. A good practice is to define all nodes on the schematic by the circuit type (primary, Safety Extra Low Voltage (SELV), ground, etc.) and then set design rules based on the standard used to evaluate the product. Designers must be careful on the tolerance. A well-designed PCB will often fail because the design allowed for under etching, which can cause a failure by as small a distance as one micron. A tight tolerance on the low dimension is recommended.

Regarding spacings, the other area to watch is next to the enclosure. Engineers need to ensure that component devices, such as a switch mode power supply, are mounted on standoffs tall enough to ensure proper clearance. They need to watch for sneak paths from the PCB in contact with a plastic enclosure through a seam. This is a valid creepage path and products often fail because many designers ignore the seam. The last thing an engineer wants to do is reduce a PCB size.

Enclosures Keep Fires In and Fingers Out

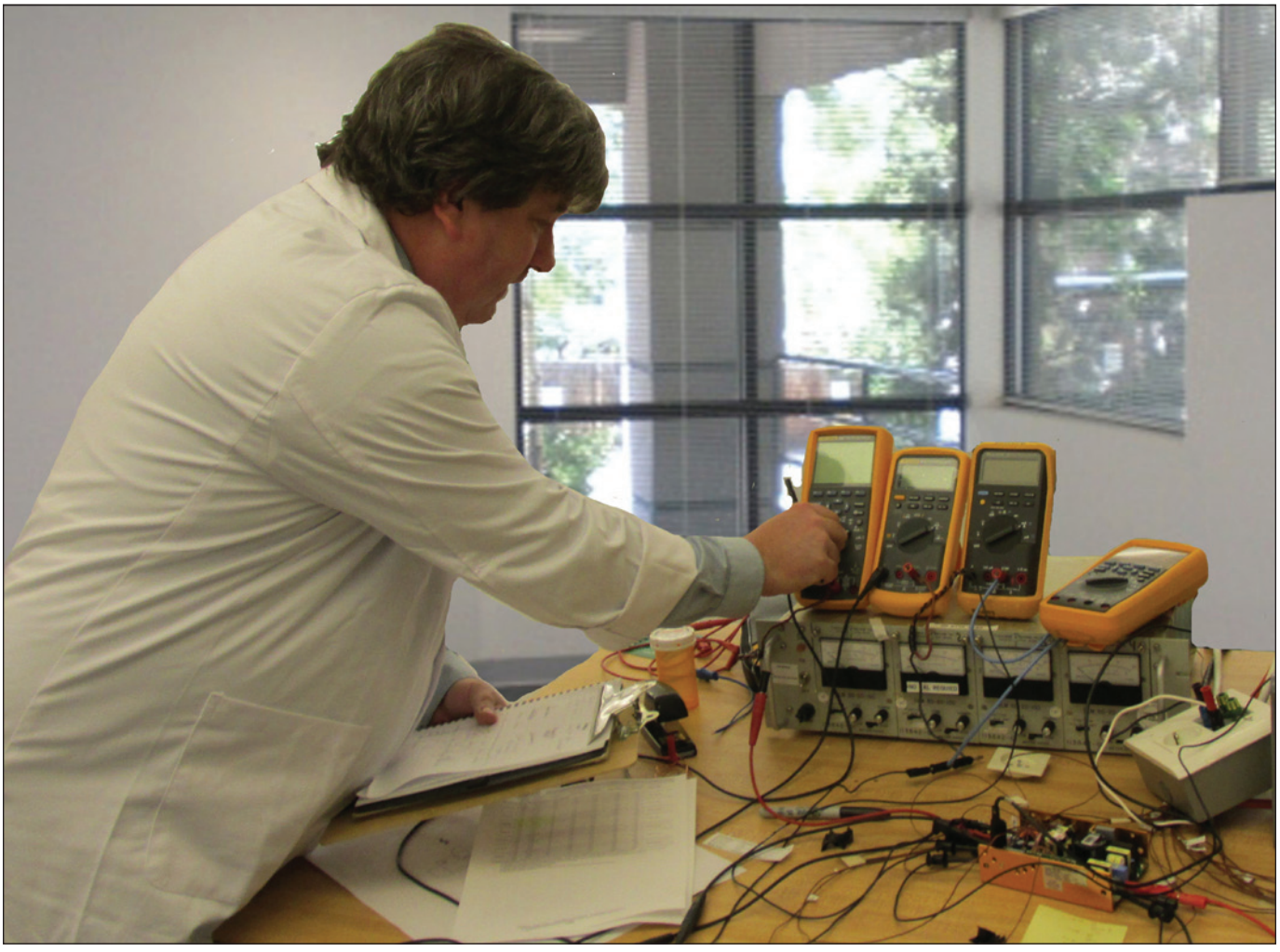
The enclosure prevents users from coming into contact with hazardous electrical or mechanical parts. It also prevents an internal product fire from spreading to the surrounding environment. That is why enclosures are evaluated for proper materials, openings and strength and suitability for the purpose. The openings in an enclosure must be examined for both accessibility and their ability to contain fire, and polymeric materials of construction must be of the type with a suitable flame retardancy rating.

There are a few major traps to watch out for. Plastic has flame ratings according to its thickness. If the enclosure for the product is thinner than the approved thickness for a flame rating, this presents a problem. Also, plastics are approved in various colors. Make sure the color of the enclosure, as selected typically by the marketing department, is covered under the plastics' approvals.

Additionally, the lab will put the enclosure through a series of abuse tests to make sure it can withstand long-term usage. Engineers are well advised to review the standard against which the product will be evaluated for details on these mechanical tests.

The Fine Art of Specmanship

Specmanship is the practice of assigning ratings, not tolerances, to a product based on the worst-case tolerances of parts inside the end product. Following are a few examples.



Meters testing: **The lab staff are determining the energy levels available from a standard switch mode power supply with the goal of ensuring that the power available is limited to safe levels in accordance with the standard.**

Where Safety Matters, Use The Latest Technology

Electromagnetic radiation is becoming more of a safety concern to individuals as well as workers. Dedicated RF safety meters and sensor heads are becoming vital for measuring these fields, but the measurements you obtain are only as good as the instruments you use. AR's family of safety products includes important features and benefits, and provide essential items in their standard configuration that others don't. AR sets a new standard with the following features and benefits:

- Perform time domain, frequency domain and broadband measurements using one meter
- Frequency coverage from DC to 40 GHz and measure electric field strengths from 0.2–20,000 V/m & magnetic field strengths from 20nT to 15T
- Internal GPS module – identifies the site where the measurements were registered for accurate and fast analysis
- User friendly remote control interface

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Designers must pay attention to safety-critical components. It is always better to choose pre-approved components. They will still need to be tested in the end product but the safety mark on them goes a long way.

- The power supply is rated 100-240VAC but its specs say 86 to 264V. Often, a manufacturer will rate the product 86-264V. For the heating test, this means the laboratory will test at 90% of 86V (77.4V) and 106% of 264 (280V) There will most likely be failures. Additionally, many components in the device are rated only 250V and, strictly speaking, cannot be used in a product rated as high a 264V.
- A component inside is good to a 5,000-meter altitude so the manufacturer rates the product as suitable for use at 5,000 meters. In the laboratory, the assumption is that the product is good to 2,000 meters. If the product is rated higher than 2,000 meters, the spacings values change dramatically, a consideration sometimes missed by designers.

Shopping for the Right Components

Designers must pay attention to safety-critical components. It is always better to choose pre-approved components. They will still need to be tested in the end product but the safety mark on them goes a long way. Custom made parts without approval could add weeks and extra cost to the safety approval process. The laboratory will have to evaluate the component and will need information that a designer may not have and a vendor may not want to provide. While a custom part allows engineers to add some great features, they need to check early in the design stage if its use will have an impact on the safety process.

Blender testing: **Even today, testing laboratories still see their share of electric products failing safety testing. Pictured is a simple test that often leads to failures as the lab staff are running the product through normal use and then check if they can access the moving blades with the test finger. Simple yet effective safety measures help ensure the product's compliance and timely release to market.**

AVOID THE TEST TRAPS

Below is a set of traps that manufacturers can fall into and end up with test failures.

- **Hipot:** Engineers need to check the trimming of through hole components on the power supply. They also must make sure the standoffs for the power supply are tall enough. It is a good idea to check any possible arc paths and be prepared to add insulators.
- **Leakage current caused by EMI fixes** (see hipot as well): Designers must be careful about adding too many capacitors to pass EMC tests. They are the reason they have a leakage current. A proper balance is always required.
- **Ground continuity:** There are two main traps. The first happens when carrying product ground through a PCB. If this is done, a 1000A test is conducted and most traces are not designed for this test. The other trap is painted metal surfaces. Designers need to either employ masking techniques or utilize paint biting washers for any screws.
- **Heating:** A lack of airflow is always the culprit in heating test failures. Ensuring there is enough airflow will keep the components from exceeding the allowable temperature limits.

- **Batteries:** Lithium batteries will need approval to IEC 62133. Even user-replaceable AA batteries will need this approval, so it pays off to select approved batteries.

NO REQUIREMENT IS TOO MINOR

One of the most common issues that delays any laboratory from completing a product safety review is the lack of labels and a manual. Documentation and labeling are an integral part of the safety standards but they are often overlooked, with the design getting all the attention. Typical labeling and manual requirements for generic electronic equipment are listed below.

Safety-related documentation accompanying an electric product must contain the following items:

- Technical specifications, instructions for use, name and address of the manufacturer or supplier for technical assistance and an explanation of warning symbols;
- Equipment ratings such as supply voltage, frequency, power, current and environmental conditions under which the equipment can operate;
- Equipment installation instructions, including those required for assembly, mounting, protective earthing, ventilation and similar actions;
- Equipment operation instructions, such as use of operating controls, interconnection to accessories, replacement of consumables and cleaning;
- Equipment maintenance instructions, including identification of a specific battery type, fuse types and parts that need to be supplied by the manufacturer or his agent.

The equipment must feature the following markings:

- Manufacturer's name, trademark and model number
- Equipment ratings (supply voltage, frequency, power/current and IP)
- Fuse marking (current rating and type) according to IEC 60127 (e.g., 250 V F 2.0 A)
- Equipment protected throughout by double or reinforced insulation must be marked as such.
- Warning markings
- Safety instructions must be available in the language of the country of installation.
- Other markings, which may include:

Protection against electric shock relies on three measures: a connection to protective earth; double insulation between hazardous parts and the operator; and supply by SELV. However, this last measure is not defined in EN 61010-x.

- Short duty cycles and mains voltage adjustment
- Power outlets in the operator accessible area must be marked with the maximum load allowed, voltage and current
- Fusing, if operator replaceable, must be marked with the rated current, voltage and characteristic. If it is in the service area, then a cross reference is acceptable: F1, F2, etc., with a replacement information in the service instructions; e.g., = 250V 3A. The following fuse characteristic markings should be used:
  - FF = very fast acting
  - F = fast acting (fast blow)
  - M = medium acting
  - TT = time lag
  - T = time lag (slow blow)

REFERENCE GUIDE TO TERMS AND BASIC REQUIREMENTS

This section contains the most commonly used terms and basic requirements for product safety as well as guidance to help designers implement them.

Hazardous Voltages

When it comes to hazardous voltages, follow these ranges: >30 V r.m.s. or >42.2 V peak or >60 V d.c., according to IEC 60950-1, and >33 V r.m.s. or >46.7 V peak or 70 V d.c. respectively, per IEC 61010-1.

Enclosure flame ratings

When selecting materials for enclosures, remember the following requirements:

- For movable equipment having a mass of < 18 kg, use 94V-1 or the test of clause A2;
- For movable equipment having a mass of > 18 kg and all stationary equipment, use 94-5V or the test of clause A1;
- For decorative parts outside the fire enclosure, 94-HB is acceptable.

Electric Shock Protection

Protection against electric shock relies on three measures: a connection to protective earth; double insulation between hazardous parts and the operator; and supply by SELV. However, this last measure is not defined in EN 61010-x.

Insulation Types

An electric device can incorporate one or more of the following five insulation types:

1. While insufficient for safe electrical separation, operational insulation is nevertheless needed for the correct operation of equipment and is applied between line and neutral and in SELV circuits. There is no thickness specified for operational insulation. Dielectric is dependent on the working voltage and spacings are the same as for basic insulation. Abnormal short circuits or dielectric testing is allowed to show compliance.

2. Applied between primary circuits and earthed parts, basic insulation supplies a basic level of insulation against shock. There is no thickness specified for basic insulation. Dielectric between primary and earth is 1500Vrms or 2121dc for compliance with EN 60950. Dielectric between primary and earth is 1350Vrms or 1900Vdc for compliance with EN 61010.

3. When combined with basic insulation, supplementary insulation creates a double insulation for protection against electric shock. Independent insulation is applied to basic insulation to ensure protection against electric shock if basic insulation fails. The specified thickness is 0.4 mm when it is combined with basic insulation. Transformers must have two thin layers where one layer passes dielectric for supplemental insulation, or three thin layers where any two pass the required dielectric.

   Supplementary insulation is applied between primary circuits and SELV. Dielectric is 1500Vrms or 2121Vdc for a working voltage of 250Vrms for compliance with EN60950. Dielectric is 1350Vrms or 1900Vdc for a working voltage of 300Vrms or dc for compliance with EN61010.

4. Double insulation is comprised of basic and supplementary insulation. Its main application is between primary hazardous voltage and SELV circuits. Dielectric for 250Vrms working voltage between primary and SELV

is 1500Vrms (basic) + 1500Vrms (supp.) = 3000Vrms or 4242Vdc for compliance with EN60950. Dielectric for 300Vrms or dc working voltage between primary and SELV is 2300Vrms or 3250V dc for compliance with EN 61010.

5. Reinforced insulation is a single insulation that provides protection against electric shock equal to that of double insulation. It is usually a thin sheet material used in transformers and comprised of at least two layers, where either layer passes the dielectric for reinforced insulation. Its minimum thickness must be 0.4 mm and its main application is between hazardous voltage circuits and SELV circuits. Dielectric between primary hazardous voltages and SELV for a working voltage of 250Vrms is 3000Vrms or 4242Vdc. Dielectric for 300Vrms or dc working voltage between primary and SELV is 2300V rms or 3250 dc for compliance with EN61010.

Understanding the Insulation System

Keeping in mind that, for various types of insulation, designers need to build an insulation system in an electric device. Any insulation system must include the elements described below:

1. Creepage distance over solid insulation. It is the shortest distance between two conductive parts, measured through air.

2. Clearance through air. It is the shortest path between two conductive parts measured along the surface of the equipment.

3. Solid insulation material. There are no requirements for the thickness of material but it has to undergo a dielectric strength test.

Varying Electrical Protection Based on Equipment Class

The type of insulation used to protect a device will depend on its classification. Protection against electric shock in Class I equipment is achieved with both the basic insulation and a reliable earth connection to the metal parts that may assume hazardous voltage if the basic insulation fails.

To render Class II equipment safe, designers do not need to have a connection to the earth, but the unearthed metal parts are isolated by reinforced insulation from hazardous voltages. Class II equipment must be marked with symbol 5172 from IEC Publication 417, and the mark must be visible on the outside of the product in the operator accessible area.

Class III equipment is the type of equipment where protection against electric shock relies upon a supply from SELV circuits and in which hazardous voltages are not generated.

PLAYING IT SAFE

When it comes to safety of electric devices, it pays to spend extra time on shock and burn protection. Consideration of the technical factors discussed above will ensure a great degree of confidence in the outcome of the regulatory compliance process, and significantly increase the odds of the product passing the tests and getting to market on time and on budget. IN

(the authors)

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BRAZIL

RUSSIA

INDIA

CHINA

Compliance in Brazil, Russia, India, and China for Information Technology Equipment

An Overview of ITE Compliance Requirements for BRIC Market Countries

BY MARK MAYNARD

"Exploration is the engine that drives innovation. Innovation drives economic growth. So let's all go exploring." – Edith Widder

Brazil, Russia, India, and China have over 40% of the world's population, making this large pool of potential customers a key target for companies eager to enter these potential high-growth markets, which are commonly referred to by the acronym "BRIC." With close to three billion inhabitants, and their growing middle classes eager to have the same popular electronic products as their US and European global neighbors, these nations have demonstrated healthy economic growth rates for the most part, even with the ongoing global recession. These four countries have been recently ranked in the top seven global economies, based on gross domestic product at purchasing power parity (GDP PPP) per capita, and it has been estimated that the BRIC economies could overtake the block of G7 economies in the next ten to fifteen years. Gaining access to these customers with rising wages has become a priority for increasing global market share.

What these countries share in common are having recently arrived at similar advanced stages of economic development, with a desire to be in the leading economic powers of the twenty-first century, but being held back by old government bureaucracies and weak infrastructures that hinder progress. It has only been in the last fifteen years or so that they have begun to attain accelerated economic growth and rising wages, which have resulted

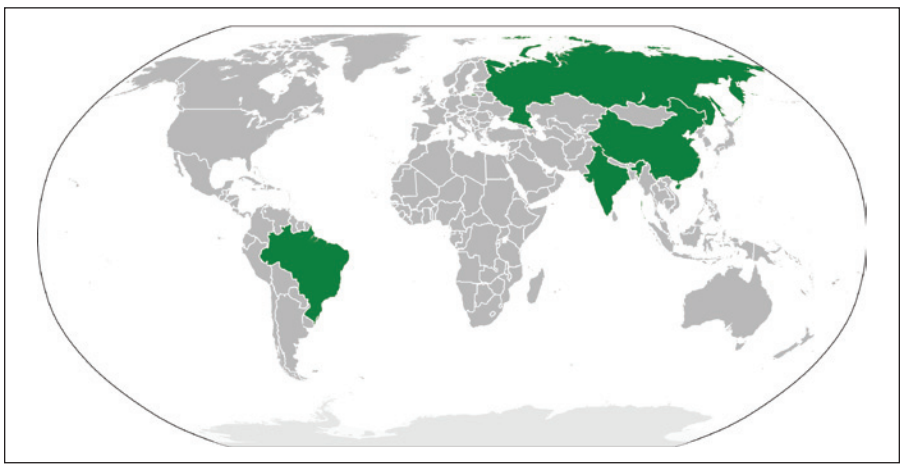


Figure 1: BRIC Countries (image by Felipe Menegaz)

in mass consumerism of high-tech products. Companies importing electronic products can find a maze of confusing and changing requirements, as well as unfamiliar and inefficient methods of conducting business.

To successfully enter the BRIC markets with information technology equipment (ITE) products, it is necessary to understand the legislated compliance requirements, as well as the application of the regulations and test criteria for compliance, including identifying the regulatory bodies, the certification approaches, and the means and effectiveness of enforcement activities. Additionally, information regarding the efficiency and norms of the systems in each country and recommendations for accessing each market are also needed. Let's get started by taking a look at our first country in the list, Brazil.

BRAZIL COMPLIANCE

There are two main regulatory bodies in Brazil for electronic and electrical product certification, INMETRO and ANATEL. Each has their own specific focus, but they coordinate their activities to ensure compliance in this South American country, where the official language is Portuguese.

INMETRO is the National Institute of Metrology, Standardization and Industrial Quality, which develops and implements the certification systems in Brazil. Tasked with maintaining the national standards, INMETRO is also the national developer of conformity assessment programs as well as the main accrediting authority for certification bodies and laboratories.

ANATEL is Brazil's national telecommunications agency, responsible for the establishment of authorized bodies for certification and testing activities for EMC compliance. ANATEL is the more dynamic of the two regulatory bodies in Brazil, requiring more activities to keep up with the rapid pace of technological developments.

Established in 1998, ANATEL promotes the development of Brazil's telecommunication industry by exercising standardization, homologation, and market surveillance for compliance. Legislated regulatory compliance requirements are disseminated through several types of legal documents:

- Resolution 242 is the general regulation for the certification of telecommunication products. This resolution established the current certification and homologation schemes, authorizing the creation of the certification bodies designated by ANATEL, as well as authorized test laboratories.
- Resolution 323 represents improvements made to the original Resolution 242. Both Resolutions give the legislated regulatory compliance requirements in Brazil, along with the Instrumentos de Gestão and Oficios Circulares issued by ANATEL.
- *Instrumento de Gestão*, or "Management Tools", are also called IGs. These publications give additional details on processes and providers for Brazil approvals. These are published on ANATEL's web site.
- *Oficios Circulares* are offical letters from ANATEL, with the purpose of clarifying and giving information on Resolutions and official rules concerning the certification processes. These are used to quickly publish updates when ANATEL deems it urgent.

ANATEL has regulations for the various categories of regulatory compliance, issued as ANATEL Regulations and technical bulletins. Resolution 442 contains Brazil's EMC compliance regulations, and is based on the international CISPR 22 and CISPR 24 standards, with EMC requirements similar to the CE Mark in the European Union (EU) for radiated emissions and immunity. These test requirements should be followed closely to successfully obtain certification.

Special attention should also be paid to labeling requirements, including warning statements in Portuguese either on the label or in the user instructions. For ANATEL product certification labels, bar codes are assigned, which are known as GS1 or EAN codes. ANATEL uses the database of GS1/EAN Brazil to identify the organization obtaining ANATEL approval, for purposes of market surveillance audits and tracking reported issues.

Figure 2: Brazil INMETRO and ANATEL logos

In Brazil certification and testing must be performed by authorized organizations. The homologation certificate will be issued by ANATEL, and have no expiration date. In addition, the product must be certified by a Designated Certification Body.

The certification process follows this progression:

- Application and product sample submittals
- Required tests and report production
- Issuance of official test reports
- Issuance of product certificates
- Registration of the certificate in the Federal Register
- Periodic inspections to ensure continued compliance

Organismo de Certificacao Designado, or "Designated Certification Body," is referenced by the acronym "OCD." These are companies authorized by ANATEL to perform product evaluations, in order to certify the product according to ANATEL rules. To obtain ANATEL product certification, it is necessary to interface with one of the authorized Brazilian OCDs. During certification, testing must be performed by a test lab that has been accredited either by INMETRO, an OCD, or a foreign laboratory member of the International Laboratories Accreditation Cooperation.

Manufacturers and importers are responsible for continued compliance of their products in Brazil. They must comply with all regulations and any special stipulations given in the approved reports and certifications, or they can face legal repercussions. Any changes to the product as approved is in violation and subject to penalties. Resolution 242, Title VI, Article 54, gives the sanctions which can be levied against violators. These may be applied separately or in combination. Article 61 of Resolution 242 gives the limits on fines that can be assessed for non-fulfillment of any ANATEL provision.

There are several "unwritten rules" for successful product certifications in Brazil. These key items concern the local representative, labeling, and language issues. First, ANATEL certification requires that companies placing their products on the market in Brazil have an authorized local representative. For companies that do not, there are agents available. It is highly advised to acquire the services of one experienced with the ANATEL requirements and processes. Second, the ANATEL agency is very strict on product labeling requirements. It is recommended that you ask for a review of your label design if you have any doubts about the label regulations, and also that you use black and white labels, as color labels must pass a very strict review on matching the mandated color scheme. And third, the technical sections of the ANATEL and OCD websites are in Portuguese, without an option for English-language versions. This is an area where your local representative can be extremely helpful in ensuring that the translated requirements are accurate.

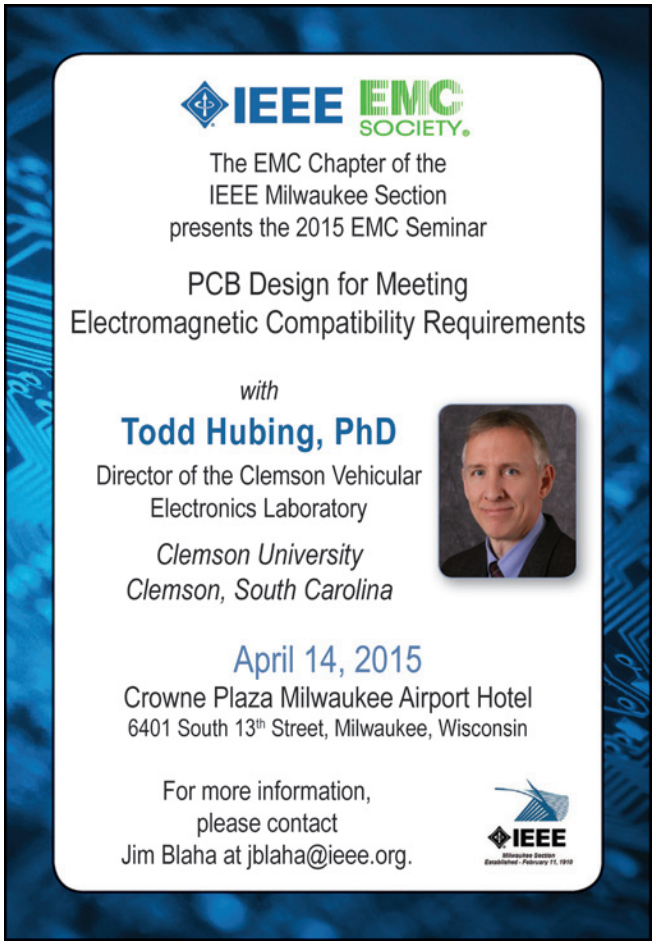
RUSSIA COMPLIANCE

In Russia, navigating the compliance agencies, local requirements, and compliance programs can present numerous challenges. This makes understanding the legislation, regulation, certification, and enforcement activities critical for successfully obtaining product certifications.

A new regulatory compliance process was initiated in 2013, called the "Technical Regulations – Customs Union" (TR-CU) program, and it replaced the previous GOST product approval scheme utilized in Russia. As part of the Eurasian Economic Commission (EEC), a trade agreement was established that allows one set of approvals to cover the compliance requirements for selling ITE products not only in Russia, but also in the former Soviet-bloc countries of Armenia, Belarus and Kazakhstan. The intent of the EEC is for more neighboring countries to be added to this Customs Union over time, creating a system of economic cooperation between member states similar to the EU.

To enter Russia, electronic products must be in compliance with Federal Law. These laws are developed and enacted by the three branches of their federal system, the executive, legislative, and judicial branches. However, these laws are introduced as a series of serial laws, making it very important for companies to have an in-country expert. The current laws for regulatory compliance are given in the Russian Federal Law "On Technical Regulating," which are incorporated into the TR-CU approval program. This legislation provides for the establishment of the agencies which establish the EMC, product safety, and hygienic regulations in Russia.

The new EMC compliance certification program in Russia has introduced its own system of regulations and bureaucracy. All ITE products approved after February 15, 2013 must follow the new TR-CU program and requirements. The new TR



Regulation applicable for EMC compliance of ITE products is TR CU № 879, entitled "Electromagnetic compatibility of hardware." Careful study of the new TR-CU requirements is advised as there are some major differences from the old GOST approval scheme.

The typical approval process for TR-CU certification follows the same progression:

- Application and product sample submittals
- Required tests and report production
- Issuance of official test reports
- Factory audits, if required
- Issuance of product and/or factory certificates
- Registration of the certificate in the Federal Register
- Periodic inspections to ensure continued compliance

A major difference from the old GOST system is that the TR-CU scheme requires a local representative in Russia to hold the certification. This person must be authorized to act as an official company representative by the importing organization, and will be legally liable in the event of any non-compliance. Another difference is that a TR-CU factory inspection is mandatory for product certifications, inspections which must be performed by auditors authorized by TR-CU.

The following documents are required for TR-CU certifications:

- The CB certificate and CB test report
- EMC test report
- User manual and instructions in Russian language
- Label drawing with certification body code
- Factory ISO certificates
- TR-CU authorized factory inspection report
- Ergonomics test report/certification (for displays)

Once the TR-CU certificate is issued, it is valid for one to five years, with the term chosen by the manufacturer. After the initial term, it must be renewed annually for as long as the product is offered for sale in Russia. If the product is modified during the validity period, it must be resubmitted for approval by the agency.

Figure 3: The TR-CU EAC Compliance Mark

All products imported to Russia must carry the new EAC mark of conformity, shown in Figure 3. The EAC logo is required on the product.

Russia Compliance Enforcement

The manufacturers and importers are responsible for continued compliance while their products are placed on the market in Russia. This means that they must comply will all regulations and any special stipulations given in the approved reports and certification documents. Any changes to the product as approved is considered a non-compliance, unless it has been resubmitted for approval and granted certification.

In Russia, special attention must be given to the laws and regulations in place, as penalties for non-compliance can be very harsh. In addition to civil penalties, such as fines, there are also criminal charges that can be filed in cases of human health and safety, or for defrauding customers. Since these regulations are based on federal laws, enforcement is by federal police. In addition to charges against the local company representatives, company officers can be held liable, and company assets can be seized and forfeited to pay off civil penalties. It is vital to thoroughly understand customs.

Russia also has some "unwritten rules" that must be followed to ensure imported products will successfully pass through customs, which is the top complication for companies. Failure to master the customs process often means cost overruns beyond the cost of the duties and taxes. In addition, the new TR-CU regulations and certification programs mean that close attention must also be paid to the new customs requirements and criteria for the three additional EEU countries. For these reasons, it is highly recommended that companies procure the services of a customs agent experienced with Russian requirements as well as the importation requirements of Armenia, Belarus and Kazakhstan prior to entering the EEU market.

INDIA EMC COMPLIANCE

India has made great strides in aligning their compliance standards and processes with those of more established markets. Their regulatory organizations are government departments, seeking to coordinate their activities as they modernize and help promote the development of industry in India. One indication of this effort is the wealth of information freely available online at these agencies, translated in English.

India has a parliamentary form of government, based on the British system. Two ministries have been authorized by Parliament to be responsible for the generation of rules and requirements covering electronic products manufactured and sold in India, the Ministry of Consumer Affairs, Food,

and Public Distribution (MCAFPD) and the Ministry of Communications and Information Technology (MCIT).

The MCAFPD oversees the Bureau of Indian Standards (BIS). The Bureau of Indian Standards Act of 1986 gave BIS statutory authority in creating national standards. With the mandate to develop standards, regulatory markings, and certification programs, this agency seeks to create a culture of quality, and encourage consumer participation in creating and implementing these product requirements.

The MCIT is the government ministry over the Department of Electronics and Information Technology (DeitY), which oversees the Department of Telecommunications (DOT). DOT in turn is the department in charge of the Telecommunications Engineering Center (TEC).

TEC is the designated subject-matter expert group that is authorized to prepare and publish the standards and regulations for the EMC aspects of wired telecom equipment, in cooperation with BIS. The EMC regulations for wired telecom equipment can be found in TEC/EMI/TEL-001/01/FEB-09, "Electromagnetic Compatibility Standard for Telecommunication Equipment," which can be downloaded from the TEC website. In addition, new specific absorption rate (SAR) requirements came into effect in India in 2012, and TEC is the SAR regulations-making body for this country.

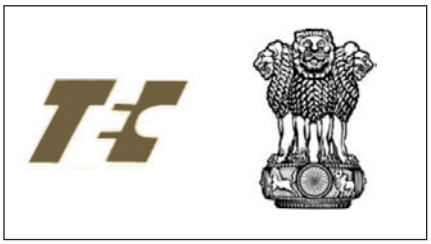


Figure 4: TEC and DeitY logos

The TEC branch under MCIT is the authorized agency for issuing EMC certifications for telecom equipment. The "IR" certification is the most common type of approval, and all certified equipment must be labeled per the TEC requirements.

The submittal package for certification should contain the following:

- TEC Form A application sheet
- EMC report per TEC/EMI/TEL-001/01/FEB-09 criteria
- Product safety report
- Schematics, bill of materials, and user manual
- Local representative authorization letter
- Technical specification/datasheet
- TEC Form B with two samples of the equipment

India performs market surveillance enforcement activities to ensure that products are certified and manufactured as originally approved. Penalties for non-compliance can range from fines to civil and criminal penalties. Non-approved and non-compliant imported products are frequently seized by customs agents, who are diligent in their review of product documentation and labeling. All aspects of EMC enforcement are directed by TEC, performing market surveillance and reviewing renewal applications to ensure compliance.

Difficulties in clearing customs is one of the most common issues encountered in India. Without the proper importation paperwork and certifications, significant delays can keep products from reaching consumers. Understanding this critical process and the specific requirements will definitely pay off. Hiring an experienced customs agent is recommended, who can ensure proper documentation for customs, and expedite customs clearance. A local agent can also provide schedules for customs clearance, as lead times can fluctuate during the year.

CHINA COMPLIANCE

China has a culture and a market shrouded in mystery for many companies entering this large and growing consumer market. If you want approvals for electronic products, then you will face some unique obstacles in this country. There are several barriers to imported products, including distance, language, unfamiliar culture and unsophisticated commercial market condition.

The authority of all laws in China lies with the central ruling body, responsible for establishing the authorized government agencies. After entry to the World Trade Organization (WTO), the Chinese government has undertaken a massive effort to revise its laws and regulations in accordance with WTO rules.

The China Certification and Accreditation Administration (CNCA) was established in 2002, with responsibility for developing the legal regulatory compliance requirements for electronic products. The CNCA was given the authority to govern all aspects of the China Compulsory Certification (CCC) program, the certification program for EMC and product safety for these regulated devices. CNCA publishes a catalog for 22 types of products, covering a total of 159 categories. All products in the CCC product catalog, whether manufactured by a foreign or a Chinese company, must comply with the same CNCA regulations for the specific CCC product program to enter the Chinese market.

Standards are published in Mandarin Chinese language, and official English translations are not always readily available. In addition, changes are frequent as technology changes and

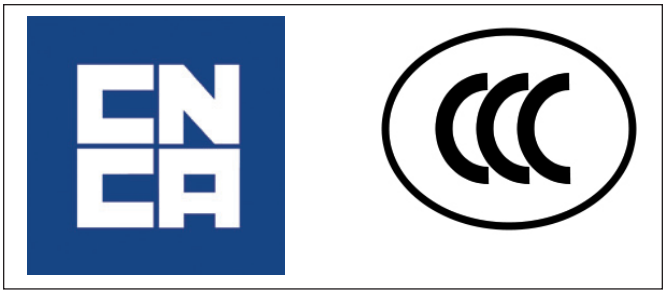


Figure 5: CNCA and CCC logos

China attempts to align more with WTO standards. The standards are referred to as "Harmonized Standards," but it should be noted that there are some major differences from the international code system for harmonized standards used by such international standards bodies as the IEC. The current Chinese EMC Standard is GB 9254:2008, implemented in 2009 and entitled "Test Method and Limits for Radio frequency disturbance from ITE." This standard includes requirements for testing at the highest frequency above 108 MHz, and the testing of telecom ports.

The China Compulsory Certification (CCC Mark) under the CNCA is the EMC and product safety compliance program. CNCA accredits CCC certification bodies, who are then authorized to issue CCC certificates. Under CNCA, there are three separate certification organizations, as follows: China National Accreditation Board for Certifiers (CNAB), China National Accreditation Board for Laboratories (CNAL), and China National Auditor and Training Accreditation Board (CNAT). CNAB has accredited nine certification bodies, all of which are in China. Each is accredited and authorized to certify particular types of products and issue the CCC Mark.

A CCC certification body is not allowed to perform CCC testing. All CCC testing must be performed at CNAL-accredited test laboratories. CNAL has accredited over 800 testing laboratories in China, each of which is accredited for CCC testing on certain types of products. Because CNCA has not achieved any mutual recognition agreements (MRA) with any other accreditation body, CCC testing must be performed at CNCA-accredited laboratories in China.

The CCC Mark requires the following steps to be taken to accomplish the whole process:

- Application to a CNCA-accredited certification body
- Sample testing at a CNCA-accredited test laboratories
- Factory inspection by certification body engineers
- Verification of remittance of CCC certification fees, including fees for application, testing, and inspections
- Granting of CCC certification by the certification body
- Purchasing the CCC Mark product label (CCC stickers) or applying for permission to print CCC labels

All applications must be made using the standard form or electronically with a Declaration of Conformity to Chinese standards. The application must be in Chinese. Applications must be accompanied by product samples for EMC testing. A CNCA-accredited lab will be assigned by the certification body to perform EMC tests according to Chinese standards.

One key note about manufacturing. If a factory has never been inspected under either the CCIB or CCEE systems, factory inspection is mandatory before a CCC Mark is granted. The certification body assigns a technical engineer and a quality assurance engineer to inspect the facility. Details of factory inspection criteria are defined in the official publication of CCC Implementation Rules for each category of products.

In general, the items included in an application package will include the following:

- TAB NAL application form
- Business license of applicant
- Power of attorney for local representative
- Description of manufacturer and local representative
- Manufacturer/factory quality system documents
- Equipment specifications
- Block diagrams, circuit diagrams, and assembly diagrams
- User manual and installation instructions
- Details of post-sales support program and commitment
- Photos of interior and exterior (minimum of 5 photos)

The CNCA has its own enforcement agency, and criminal findings will be turned over to law-enforcement agencies. Market surveillance and auditing is performed to ensure continued compliance, and customs, retail outlets, and manufacturers in China are all subject to this oversight, and can be required to provide test samples.

The laws and regulations in China must be absolutely followed, as penalties for non-compliance can be very harsh. In addition to monetary penalties, criminal charges can be filed in cases of human health or safety, up to and including the death penalty. The court system is China is very different from most western countries, and the right to appeal is not always allowed. Since these regulations are based on federal laws, enforcement is by federal authorities. In addition to charges against the local company representative in China,

company officers can be held liable, and company assets can be seized and forfeited to pay off civil penalties.

Navigating the regulatory landscape can be very difficult, unless you obtain the services of a knowledgeable regulatory consultant in China. Who you hire is critical, because they will be operating as an authorized representative of your company in China, with the power of attorney that is provided for the application process. Spending the time to find a reputable agent with experience in your company's product categories will be well worth the investment.

Replacement part regulations are another confusing area. Generally, separate certifications are required if a part also falls into a certification category, such as replacement power supplies for ITE. Also, additional help can be obtained by procuring the services of an experienced customs expert is highly recommended. Clearing customs in China can create customer fulfillment and supply management issues, an important area for global firms, and should be included in the planning for any project launch in this country.

NEXT STEPS

Although the regulatory schemes in these countries can seem excessively bureaucratic, over time the processes have become more streamlined, and international standards continue to be the models these countries are following and adopting. Be sure to keep in mind the specific recommendations that have been provided for each country, to help expedite the approvals processes for electronic product certification.

Please note that the content in this article should not be the sole source of information when submitting for certification. The official standards should be obtained for the authorized agencies, and an experienced regulatory agent should be utilized if in-house expertise is not available. Also remember customs facilitators can be a valuable source of information on the importation of products.

Finally, engineering and regulatory compliance affinity groups are an invaluable resource in staying current on the latest changes to the regulatory compliance requirements and processes. The local chapters of the Institute of Electrical and Electronics Engineers (IEEE), such as the IEEE EMC Society and the IEEE Product Safety Engineering Society, provide presentations and opportunities for networking with regulatory compliance engineers on the changing certification requirements. In addition, social media site Linked In has a wealth of different regulatory compliance-related groups that can be joined at no cost, such as the "International Approvals/Certifications" group, where the latest news on BRIC and other countries regulatory criteria is shared with other group members. IN

INTERNET RESOURCES

- Brazil INMETRO website: www.inmetro.gov.br/english
- Brazil ANATEL website: www.anatel.gov.br
- Eurasian Economic Commission website: http://eurasiancommission.org/en
- India DeitY website: www.deity.gov.in
- India TEC website: www.tec.gov.in
- China CNCA website: www.cnca.gov.cn
- IEEE website: www.ieee.org
- Linked In: www.linkedin.com

(the author)

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ESD Standards: An Annual Progress Report

BY THE ESD ASSOCIATION

Industry standards play a major role in providing meaningful metrics and common procedures that allow various manufacturers, customers, and suppliers to communicate from facility to facility around the world. Standards are increasingly important in our global economy. In manufacturing, uniform quality requirements and testing procedures are necessary to make sure that all involved parties are speaking the same language.

In electrostatic discharge (ESD) device protection, standard methods have been developed for component ESD stress models to measure a component's sensitivity to electrostatic discharge from various sources. In ESD control programs, standard test methods for product qualification and periodic evaluation of wrist straps, garments, ionizers, worksurfaces, grounding, flooring, shoes, static dissipative planar materials, shielding bags, packaging, electrical soldering/desoldering hand tools, and flooring/footwear systems have been developed to ensure uniformity around the world.
The EOS/ESD Association, Inc. (ESDA) is dedicated to advancing the theory and practice of ESD protection and avoidance. The ESDA is an American National Standards Institute (ANSI) accredited standards developer. The Association's consensus body is called the standards committee (STDCOM), which has responsibility for the overall development of documents. Volunteers from the industry participate in working groups to develop new and to update current ESDA documents.

The ESDA's standards business unit is charged with keeping pace with the industry demands for increased device and product performance and more effective control programs. The existing standards, standard test methods, standard practices, and technical reports assist in the design and monitoring of the electrostatic protected area (EPA), and also assist in the stress testing of ESD sensitive electronic components. Many of the existing documents relate to controlling electrostatic charge on personnel and stationary work areas. However, with the ever increasing emphasis on automated handling, the need to evaluate and monitor what is occurring inside of process equipment is growing daily. Since automation has become more dominant, the charged device model (CDM) has become the primary cause of ESD failures and, thus, the more urgent concern. Together, the human body model (HBM) and CDM cover the vast majority of ESD events that might occur in a typical factory.

ESD Association Document Categories

- **Standard (S):** A precise statement of a set of requirements to be satisfied by a material, product, system or process that also specifies the procedures for determining whether each of the requirements is satisfied.
- **Standard Test Method (STM):** A definitive procedure for the identification, measurement and evaluation of one or more qualities, characteristics or properties of a material, product, system or process that yield a reproducible test result.
- **Standard Practice (SP):** A procedure for performing one or more operations or functions that may or may not yield a test result. Note, if a test result is obtained it may not be reproducible.
- **Technical Report (TR):** A collection of technical data or test results published as an informational reference on a specific material, product, system or process.

The ESD Association document categories are:

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- **Standard Test Method (STM):** A definitive procedure for the identification, measurement and evaluation of one or more qualities, characteristics or properties of a material, product, system or process that yield a reproducible test result.
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- **Technical Report (TR):** A collection of technical data or test results published as an informational reference on a specific material, product, system or process.

The ESDA's technology roadmap is compiled by industry experts in IC protection design and test to provide a look into future ESD design and manufacturing challenges. The roadmap previously pointed out that numerous mainstream electronic parts and components would reach assembly factories with a lower level of ESD protection than could have been expected just a few years earlier. This prediction has proven to be rather accurate. As with any roadmap, the view of the future is constantly changing and requires updating on the basis of technology trend updates, market forces, supply chain evolution, and field return data. An updated roadmap was published in March 2013 and industry experts extended the horizon beyond the 2013 predictions to 2015. The Association is working on a revision to the technology roadmap that will extend the predictions out another 5 years.

EOS is an area that has long been overlooked by the industry, not because of any limited importance but rather because of its complex definition and multiple root causes. Recently, two working groups have been focusing on this area and both expect to publish TRs in 2015. One TR is expected to help establish some fundamental definitions and distinctions between various EOS threats and provide direction for further work. The second TR is focused on "best practices" that will outline ways to mitigate EOS threats in manufacturing.

Another area of development has been a request by the aerospace industry for an ESD control document that defines more definitively what ESD controls need to be in place in factories that are in the aerospace industry. The WG is working on a technical report that will provide some additional quality management specifications to the ESD control plan definition in ANSI/ESD S20.20.

The ESDA standards committee is continuing several joint document development activities with the JEDEC Solid State Technology Association. Under the memorandum of understanding agreement, the ESDA and JEDEC formed a joint working group for the standardization work in which volunteers from the ESDA and JEDEC member companies can participate. This collaboration between the two organizations has paved the way for the development of harmonized device test methods for ESD, which will ultimately reduce uncertainty about test standards among manufacturers and suppliers in the solid state industry. ANSI/ESDA/JEDEC JS-001-2014, a fourth revision of the joint HBM document, was published in September 2014.

A second joint working group is currently working on a joint charged device model (CDM) document. At the time of this publication, ESDA/JEDEC JS-002, the first revision of the joint CDM document, was in the final stages of the approval process with an expected publication date in early-2015. These efforts will assist manufacturers of devices by providing one test method and specification for each model instead of multiple, almost but not quite identical, versions of device testing methods.

The ESDA is also working in the area of process assessment. At the time of this publication, ESD TR17.0-01-14 was in the final stages of approval with an expected publication date of

early-2015. The first TR published by the WG is a compilation of recent publications by members of the WG. The goal of the TR is to give the reader examples of "best practices" of process assessment methodologies and test methods. The WG is also working on a second TR with a goal of describing a set of methodologies, techniques, and tools that can be used to characterize the ability of a process to safely handle ESD sensitive items. It is expected that following the release of the second technical report, more work will be done to provide a more detailed and complete description of process assessment methods with a possible standard practice being published.

The ESDA standard covering the requirements for creating and managing an ESD control program is ANSI/ESD S20.20 "ESD Association Standard for the Development of an Electrostatic Discharge Control Program for – Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)." ANSI/ESD S20.20-2007 is a commercial update of and replacement for MIL-STD-1686 and has been adopted by the United States Department of Defense. In addition, the 2007-2008 update of IEC 61340-5-1 edition 1.0 "Electrostatics - Part 5-1: Protection of Electronic Devices from Electrostatic Phenomena General Requirements" is technically equivalent to ANSI/ESD S20.20-2007.

ANSI/ESD S20.20 was revised during the five-year review and a 2014 version was published in August. The IEC document 61340-5-1 is currently being updated with a technically equivalent document targeted to be published mid-2015. Updates to ANSI/ESD S20.20 include changes in scope to address CDM and isolated conductors, changes to the qualification of footwear/flooring systems, process required insulators within 1 in of ESD sensitive devices and requirements on isolated conductors. A section was added on product qualification for clarification. In table 3, there were updates to ionization and the inclusion of wrist strap ground connection requirements and the addition of soldering irons. Formatting of table 3 was updated for clarity. For more information, please go to http://esda.org/Documents.html#s2020.

In order to meet the global need in the electronics industry for technically sound ESD control programs, the ESDA has established an independent third party certification program. The program is administered by EOS/ESD Association, Inc. through country-accredited ISO 9000 certification bodies that have met the requirements of this program. The facility certification program evaluates a facility's ESD program to ensure that the basic requirements from industry standards ANSI/ESD S20.20 or IEC 61340-5-1 are being followed. More than 673 facilities have been certified worldwide since inception of the program. The factory certification bodies report strong interest in certification to ANSI/ESD S20.20, and consultants in this area report that inquiries for assistance remain at a very high level.

Individual education also seems of interest once again as 58 professionals have obtained certified ESD program manager status and many more are attempting to qualify for this certification. A large percentage of the certification program requirements are based on standards and the other related documents produced by the ESD Association standards committee.

CURRENT ESD ASSOCIATION STANDARDS COMMITTEE DOCUMENTS

Charged Device Model (CDM)

ANSI/ESDA/JEDEC JS-001 Electrostatic Discharge Sensitivity Testing - Charged Device Model (CDM) - Component Level
Establishes the procedure for testing, evaluating, and classifying the ESD sensitivity of components to the defined CDM.

Cleanrooms

ESD TR55.0-01-04 Electrostatic Guidelines and Considerations for Cleanrooms and Clean Manufacturing
Identifies considerations and provides guidelines for the selection and implementation of materials and processes for electrostatic control in cleanroom and clean manufacturing environments.

Compliance Verification

ESD TR53-01-06 Compliance Verification of ESD Protective Equipment and Materials
Describes the test methods and instrumentation that can be used to periodically verify the performance of ESD protective equipment and materials.

Electronic Design Automation (EDA)

ESD TR18.0.01-14 – ESD Electronic Design Automation Checks
Provides guidance for both the EDA industry and the ESD design community for establishing a comprehensive ESD electronic design automation (EDA) verification flow satisfying the ESD design challenges of modern ICs.

ESD Control Program

ANSI/ESD S20.20 Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)
This standard provides administrative and technical requirements for establishing, implementing, and maintaining an ESD Control Program to protect electrical or electronic parts, assemblies, and equipment susceptible to damage by electrostatic discharges greater than or equal to 100 volts HBM, 200 volts CDM, and 35 volts on isolated conductors.

ESD TR20.20-2008—ESD Handbook (Companion to ANSI/ESD S20.20)
Produced specifically to support ANSI/ESD S20.20 ESD Control Program standard, this 132-page document is a major rewrite of the previous handbook. It focuses on providing guidance that can be used for developing, implementing, and monitoring an ESD control program in accordance with the S20.20 standard.

ESD Foundry Parameters

ESD TR22.0.01-14 – Relevant ESD Foundry Parameters for Seamless ESD Design and Verification Flow
In this report the essential requirements on ESD-related technology data will be described which need to be delivered to design customers by a foundry vendor. Design customers can be design houses, IDMs following a foundry strategy or IP vendors. The purpose is to ensure seamless design integration and ESD EDA verification of IC level ESD concepts.

Flooring

ANSI/ESD STM7.1 Resistive Characterization of Materials – Floor Materials
Covers measurement of the electrical resistance of various floor materials, such as floor coverings, mats, and floor finishes. It provides test methods for qualifying floor materials before installation or application, and for evaluating and monitoring materials after installation or application.

ESD TR7.0-01-11 Static Protective Floor Materials
This technical report reviews the use of floor materials to dissipate electrostatic charge. It provides an overview on floor coverings, floor finishes, topical antistats, floor mats, paints and coatings. It also covers a variety of other issues related to floor material selection, installation and maintenance.

Flooring and Footwear Systems

ANSI/ESD STM97.1 Floor Materials and Footwear – Resistance Measurement in Combination with a Person
Provides test methods for measuring the electrical system resistance of floor materials in combination with person wearing static control footwear.

ANSI/ESD STM97.2 Floor Materials and Footwear – Voltage Measurement in Combination with a Person
Provides for measuring the electrostatic voltage on a person in combination with floor materials and footwear, as a system.

Footwear

ANSI/ESD STM9.1 Footwear – Resistive Characterization
Defines a test method for measuring the electrical resistance of shoes used

for ESD control in the electronics environment (not to include heel straps and toe grounders).

ESD SP9.2 Footwear – Foot Grounders Resistive Characterization
Provides test methods for evaluating foot grounders and foot grounder systems used to electrically bond or ground personnel as part of an ESD Control Program. Static Control Shoes are tested using ANSI/ESD STM9.1.

Garments

ANSI/ESD STM2.1 Garments - Resistive Characterization
Provides test methods for measuring the electrical resistance of garments. It covers procedures for measuring sleeve-to-sleeve resistance and point-to-point resistance.

ESD TR2.0-01-00 Consideration for Developing ESD Garment Specifications
Addresses concerns about effective ESD garments by starting with an understanding of electrostatic measurements and how they relate to ESD protection.

ESD TR2.0-02-00 Static Electricity Hazards of Triboelectrically Charged Garments
Intended to provide some insight to the electrostatic hazards present when a garment is worn in a flammable or explosive environment.

Glossary

ESD ADV1.0 Glossary of Terms
Definitions and explanations of various terms used in Association Standards and documents are covered in this advisory. It also includes other terms commonly used in the electronics industry.

Gloves and Finger Cots

ANSI/ESD SP15.1 In-Use Resistance Testing of Gloves and Finger Cots
Provides test procedures for measuring the intrinsic electrical resistance of gloves and finger cots.

ESD TR15.0-01-99 ESD Glove and Finger Cots
Reviews the existing known industry test methods for the qualification of ESD protective gloves and finger cots. (Formerly TR03-99)

Grounding

ANSI/ESD S6.1 Grounding
Specifies the parameters, materials, equipment, and test procedures necessary to choose, establish, vary, and maintain an Electrostatic Discharge Control grounding system for use within an ESD Protected Area for protection of ESD susceptible items, and specifies the criteria for establishing ESD Bonding.

Handlers

ANSI/ESD SP10.1 Automated Handling Equipment (AHE)
Provides procedures for evaluating the electrostatic environment associated with automated handling equipment.

ESD TR10.0-01-02 Measurement and ESD Control Issues for Automated Equipment Handling of ESD Sensitive Devices below 100 Volts
Provides guidance and considerations that an equipment manufacturer should use when designing automated handling equipment for these low voltage sensitive devices. (Formerly TR14-02)

Hand Tools

ESD STM13.1 Electrical Soldering/ Desoldering Hand Tools
Provides electric soldering/desoldering hand tool test methods for measuring the electrical leakage and tip to ground reference point resistance, and provides parameters for EOS safe soldering operation.

ESD TR13.0-01-99 EOS Safe Soldering Iron Requirements
Discusses soldering iron requirements that must be based on the sensitivity of the most susceptible devices that are to be soldered. (Formerly TR04-99)

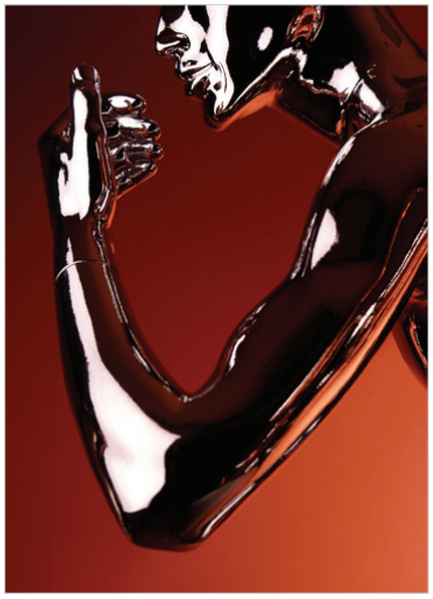
Human Body Model (HBM)

ANSI/ESDA/JEDEC JS-001 ESDA/JEDEC Joint Standard for Electrostatic Discharge Sensitivity Testing – Human Body Model (HBM) – Component Level
Establishes the procedure for testing, evaluating, and classifying the electrostatic discharge sensitivity of components to the defined human body model (HBM).

ESD JTR001-01-12, ESD Association Technical Report User Guide of ANSI/ESDA/JEDEC JS-001 Human Body Model Testing of Integrated Circuits
Describes the technical changes made in ANSI/ESDA/JEDEC JS-001 and explains how to use those changes apply human body model tests to IC components.

Human Metal Model (HMM)

ANSI/ESD SP5.6 Electrostatic Discharge Sensitivity Testing - Human Metal Model (HMM) - Component Level
Establishes the procedure for testing, evaluating, and classifying the ESD sensitivity of components to the defined HMM.



ESD TR5.6-01-09 Human Metal Model (HMM)
Addresses the need for a standard method of applying the IEC contact discharge waveform to devices and components.

Ionization

ANSI/ESD STM3.1 Ionization
Test methods and procedures for evaluating and selecting air ionization equipment and systems are covered in this standard test method. The document establishes measurement techniques to determine ion balance and charge neutralization time for ionizers.

ANSI/ESD SP3.3 Periodic Verification of Air Ionizers
Provides test methods and procedures for periodic verification of the performance of air ionization equipment and systems (ionizers).

ANSI/ESD SP3.4 Periodic Verification of Air Ionizer Performance Using a Small Test Fixture
Provides a test fixture example and procedures for performance verification of air ionization used in confined spaces where it may not be possible to use the test fixtures defined in ANSI/ESD STM3.1 or ANSI/ESD SP3.3.

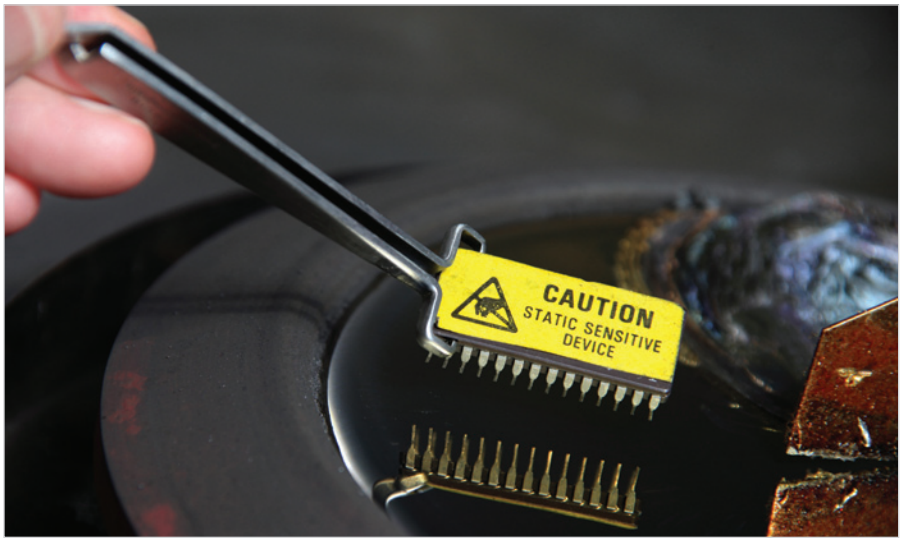
ESD TR3.0-01-02 Alternate Techniques for Measuring Ionizer Offset Voltage and Discharge Time
Investigates measurement techniques to determine ion balance and charge neutralization time for ionizers.

ESD TR3.0-02-05 Selection and Acceptance of Air Ionizers
Reviews and provides a guideline for creating a performance specification for the four ionizer types contained in ANSI/ESD STM3.1: room (systems), laminar flow hood, worksurface (e.g., blowers), and compressed gas (nozzles & guns).

Machine Model (MM)

ANSI/ESD STM5.2 Electrostatic Discharge Sensitivity Testing - Machine Model (MM) - Component Level
Establishes the procedure for testing and evaluating the ESD sensitivity of components to the defined machine model.

ANSI/ESD SP5.2.1 Machine Model (MM) Alternative Test Method: Supply Pin Ganging – Component Level
Defines an alternative test method to perform Machine Model component level ESD tests when the component or device pin count exceeds the number of ESD simulator tester channels.



ANSI/ESD SP5.2.2 Machine Model (MM) Alternative Test Method: Split Signal Pin - Component Level
Defines an alternative test method to perform Machine Model component level ESD tests when the component or device pin count exceeds the number of ESD simulator tester channels.

ESD TR5.2-01-01 Machine Model (MM) Electrostatic Discharge (ESD) Investigation - Reduction in Pulse Number and Delay Time
Provides the procedures, results, and conclusions of evaluating a proposed change from 3 pulses (present requirement) to 1 pulse while using a delay time of both 1 second (present requirement) and 0.5 second.

Ohmmeters

ESD TR50.0-02-99 High Resistance Ohmmeters--Voltage Measurements
Discusses a number of parameters that can cause different readings from high resistance meters when improper instrumentation and techniques are used and the techniques and precautions to be used in order to ensure the measurement will be as accurate and repeatable as possible for high resistance measurement of materials.

Packaging

ANSI/ESD STM11.11 Surface Resistance Measurement of Static Dissipative Planar Materials
Defines a direct current test method for measuring electrical resistance, replacing ASTM D257-78. This test method is designed specifically for static dissipative planar materials used in packaging of ESD sensitive devices and components.

ANSI/ESD STM11.12 Volume Resistance Measurement of Static Dissipative Planar Materials
Provides test methods for measuring the volume resistance of static dissipative planar materials used in the packaging of ESD sensitive devices and components.

ANSI/ESD STM11.13 Two-Point Resistance Measurement
Measures the resistance between two points on a material's surface without consideration of the material's means of achieving conductivity. This test method was established for measuring resistance where the concentric ring electrodes of ANSI/ESD STM11.11 cannot be used.

ANSI/ESD STM11.31 Bags
Provides a method for testing and determining the shielding capabilities of electrostatic shielding bags.

ANSI/ESD S11.4 Static Control Bags
Establishes performance limits for bags that are intended to protect electronic parts and products from damage due to static electricity and moisture during common electronic manufacturing industry transport and storage applications.

ANSI/ESD S541 Packaging Materials for ESD Sensitive Items
Describes the packaging material properties needed to protect electrostatic discharge (ESD) sensitive electronic items, and references the testing methods for evaluating packaging and packaging materials for those properties. Where possible, performance limits are provided. Guidance for selecting the types of packaging with protective properties appropriate for specific applications is provided. Other considerations for protective packaging are also provided.

ESD ADV11.2 Triboelectric Charge Accumulation Testing
Provides guidance in understanding the triboelectric phenomenon and relates current information and experience regarding tribocharge testing as used in static control for electronics.

Seating

ANSI/ESD STM12.1 Seating – Resistive Measurement
Provides test methods for measuring the electrical resistance of seating used for the control of electrostatic charge or discharge. It contains test methods for the qualification of seating prior to installation or application, as well as test methods for evaluating and monitoring seating after installation or application.

Socketed Device Model (SDM)

ANSI/ESD SP5.3.2 Electrostatic Discharge Sensitivity Testing – Socketed Device (SDM) – Component Level
Provides a test method for generating a Socketed Device Model (SDM) test on a component integrated circuit (IC) device.

ESD TR5.3.2-01-00 Socket Device Model (SDM) Tester
Helps the user understand how existing SDM testers function, offers help with the interpretation of ESD data generated by SDM test systems, and defines the important properties of an "ideal" socketed-CDM test system.

Static Electricity

ESD TR50.0-01-99 Can Static Electricity Be Measured?
Gives an overview of fundamental electrostatic concepts, electrostatic effects, and most importantly of electrostatic metrology, especially what can and what cannot be measured.

Susceptible Device Concepts

ESD TR50.0-03-03 Voltage and Energy Susceptible Device Concepts, Including Latency Considerations
Contains information to promote an understanding of the differences between energy and voltage susceptible types of devices and their sensitivity levels.

Symbols

ANSI/ESD S8.1 Symbols – ESD Awareness
Three types of ESD awareness symbols are established by this document. The first one is to be used on a device or assembly to indicate that it is susceptible to electrostatic charge. The second is to be used on items and materials intended to provide electrostatic protection. The third symbol indicates the common point ground.

System Level ESD

ESD TR14.0-01-00 Calculation of Uncertainty Associated with Measurement of Electrostatic Discharge (ESD) Current
Provides guidance on measuring uncertainty based on an uncertainty budget.

ESD TR14.0-02-13 System Level Electrostatic Discharge (ESD) Simulator Verification
Developed to provide guidance to designers, manufacturers, and calibration facilities for verification and specification of the systems and fixtures used to measure simulator discharge currents.

Transient Latch-up

ESD TR5.4-01-00 Transient Induced Latch-Up (TLU)
Provides a brief background on early latch-up work, reviews the issues surrounding the power supply response requirements, and discusses the efforts on RLC TLU testing, transmission line pulse (TLP) stressing, and the bi-polar stress TLU methodology.

ESD TR5.4-02-08 Determination of CMOS Latch-up Susceptibility - Transient Latch-up
Intended to provide background information pertaining to the development of the transient latch-up standard practice originally published in 2004 and additional data presented to the group since publication.

ESD TR5.4-03-11 Latch-up Sensitivity Testing of CMOS/Bi CMOS Integrated Circuits – Transient Latch-up Testing – Component Level Supply Transient Stimulation
Developed to instruct the reader on the methods and materials needed to perform transient latch-up Testing.

ESD TR5.4-04-13 Transient Latch-up Testing
Defines transient latch-up (TLU) as a state in which a low-impedance path, resulting from a transient overstress that triggers a parasitic thyristor structure or bipolar structure or combinations of both, persists at least temporarily after removal or cessation of the triggering condition. The rise time of the transient overstress causing TLU is shorter than five µs. TLU as defined in this document does not cover changes of functional states, even if those changes would result in a low-impedance path and increased power supply consumption.

Transmission Line Pulse

ANSI/ESD STM5.5.1 Electrostatic Discharge Sensitivity Testing – Transmission Line Pulse (TLP) – Component Level
Pertains to Transmission Line Pulse (TLP) testing techniques of semiconductor components. The purpose of this document is to establish a methodology for both testing and reporting information associated with TLP testing.

ANSI/ESD SP5.5.2 Electrostatic Discharge Sensitivity Testing - Very Fast Transmission Line Pulse (VF-TLP) - Component Level
Pertains to very fast transmission line pulse (VF-TLP) testing techniques of semiconductor components. It establishes guidelines and standard practices presently used by development, research, and reliability engineers in both universities and industry for VF-TLP testing. This document explains a methodology for both testing and reporting information associated with VF-TLP testing.

ESD TR5.5-01-08 Transmission Line Pulse (TLP)
A compilation of the information gathered during the writing of ANSI/ESD SP5.5.1 and the information gathered in support of moving the standard practice toward re-designation as a standard test method.

ESD TR5.5-02-08 Transmission Line Pulse Round Robin
Intended to provide data on the repeatability and reproducibility limits of the methods of ANSI/ESD STM5.5.1.

ESD TR5.5-03-14 Very-Fast Transmission Line Pulse Round Robin
Reviews the RR measurements and analysis used to support the re-designation of the VF-TLP document from SP to STM. It also discusses some of the lessons learned about VF-TLP and the performing of a RR experiment.

Workstations

ESD ADV53.1 ESD Protective Workstations
Defines the minimum requirements for a basic ESD protective workstation used in ESD sensitive areas. It provides a test method for evaluating and monitoring workstations. It defines workstations as having the following components: support structure, static dissipative worksurface, a means of grounding personnel, and any attached shelving or drawers.

Worksurfaces

ANSI/ESD S4.1 Worksurface - Resistance Measurements
Provides test methods for evaluating and selecting worksurface materials, testing of new worksurface installations, and the testing of previously installed worksurfaces.

ANSI/ESD STM4.2 ESD Protective Worksurfaces - Charge Dissipation Characteristics
Aids in determining the ability of ESD protective worksurfaces to dissipate charge from a conductive test object placed on them.

ESD TR4.0-01-02 Survey of Worksurfaces and Grounding Mechanisms
Provides guidance for understanding the attributes of worksurface materials and their grounding mechanisms.

Wrist Straps

ANSI/ESD S1.1 Wrist Straps
Establishes test methods for evaluating the electrical and mechanical characteristics of wrist straps. It includes improved test methods and performance limits for evaluation, acceptance, and functional testing of wrist straps.

ESD TR1.0-01-01 Survey of Constant (Continuous) Monitors for Wrist Straps
Provides guidance to ensure that wrist straps are functional and are connected to people and ground. IN

About the EOS/ESD Association, Inc. Founded in 1982, the EOS/ESD Association, Inc. is a professional voluntary association dedicated to advancing the theory and practice of electrostatic discharge (ESD) avoidance. From fewer than 100 members, the Association has grown to more than 2,000 throughout the world. From an initial emphasis on the effects of ESD on electronic components, the Association has broadened its horizons to include areas such as textiles, plastics, web processing, cleanrooms, and graphic arts. To meet the needs of a continually changing environment, the Association is chartered to expand ESD awareness through standards development, educational programs, local chapters, publications, tutorials, certification, and symposia.

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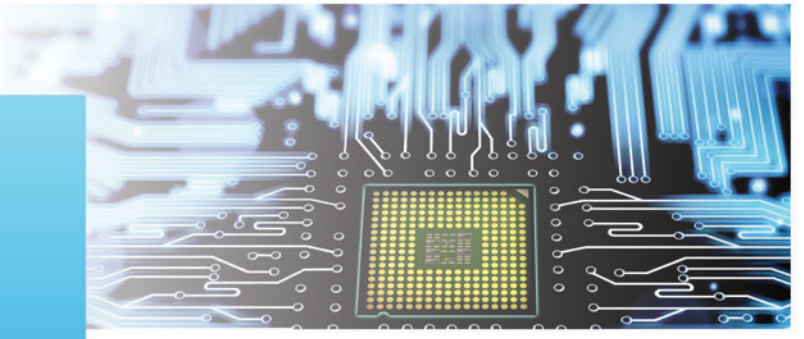

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- Signal Integrity Tools

Meet Dr. Bruce

Dr. Bruce Archambeault is an IEEE Fellow, an IBM Distinguished Engineer Emeritus and an Adjunct Professor at Missouri University of Science and Technology. He received his B.S.E.E degree from the University of New Hampshire in 1977 and his M.S.E.E degree from Northeastern University in 1981. He received his Ph. D. from the University of New Hampshire in 1997. His doctoral research was in the area of computational electromagnetics applied to real-world EMC problems. He has taught numerous seminars on EMC and Signal Integrity across the USA and the world, including the past 12 years at Oxford University.

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The Turtle Method of Selecting EMC Commercial Test Software

A Systematic Approach to Choosing the Right Product for Your Requirements

BY JACK McFADDEN

Over the last few years it has become evident to me that there is a clear need for a vetting process that allows EMC professionals to select test software based on their needs. In this article, I will begin by describing the software types and software characteristics that need to be quantified, and then present a scoring method to compare various products. Software selection is a process and, since it is a process, a visual tool can be used to aid the reader. The process tool I will use is called a Turtle Diagram.

In case you are unaware of the Turtle Diagram process, the body of the turtle presents the process name. The mouth of the turtle is used to identify inputs. The legs are used to show the methods/documentation, measurements, resources, and personnel. The output is the um... let's call it the tail. It is shown in Figure 1.

For the purposes of this article, I have relabeled the parts of the basic Turtle Diagram. Inputs will be the type of software, Measurements will be the cost of the product. Methods/documentation will be standards, Resources will be the instrument drivers the software supports, and personnel will be the software support.

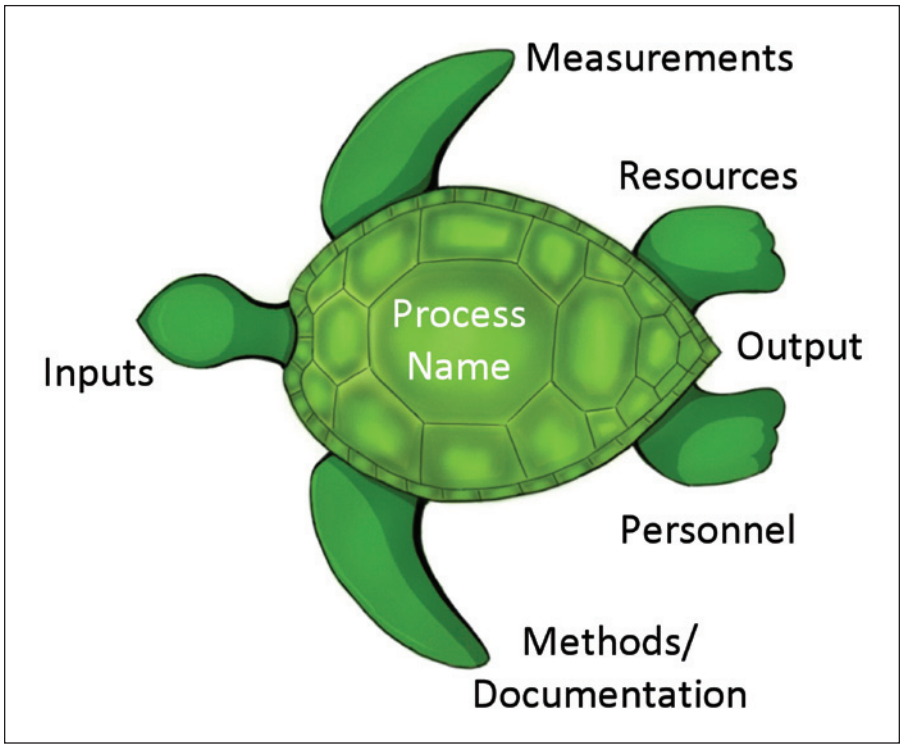


Figure 1: Basic Turtle Process

The output will be the results of the process displayed in table form. The modified Turtle Diagram is shown in Figure 2.

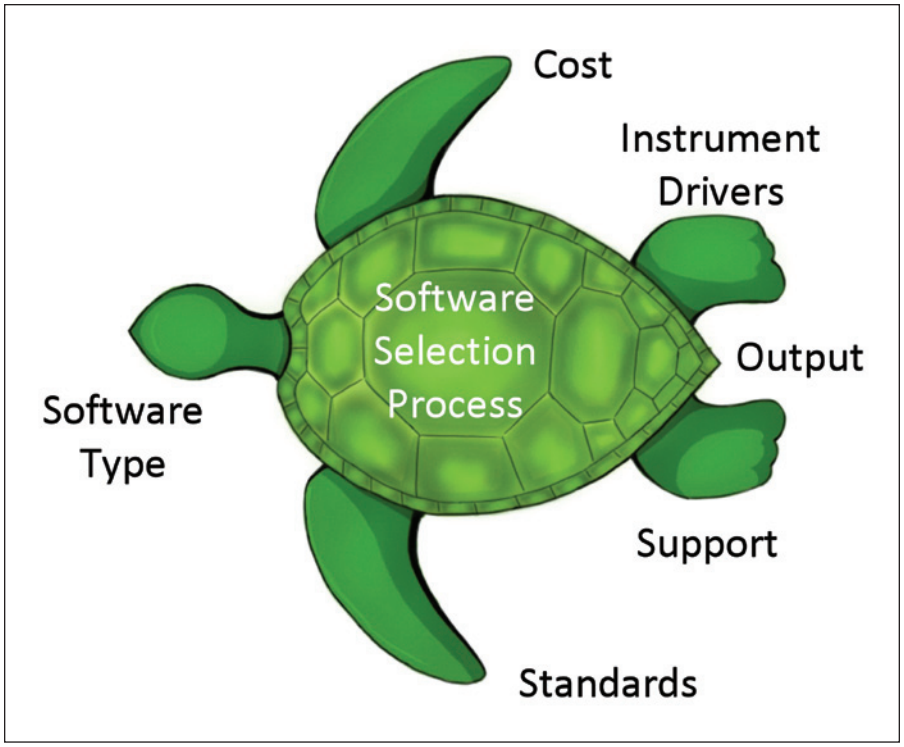
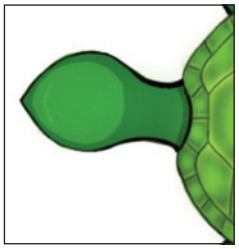


Figure 2: Software Selection Process

SOFTWARE TYPES

Let's begin by describing the two types of commercially available test software. They are commercial off-the-shelf (COTS) software, and modified off-the-shelf (MOTS) software. These terms are in accordance with standards of the American Association for Laboratory Accreditation (A2LA)[1]. However, I prefer to think of these products as "black box" and "white box" software.

Black box (i.e., COTS) software products perform a specific test usually for a dedicated test standard. They are an excellent choice if you are regularly performing the same standardized testing with little or variation. Black box software products are also relatively easy to use. Black box measurement processes are typically invisible to the operator, who can see the instrument settings and review measurement results but cannot directly control the measurement process itself.



Software Type

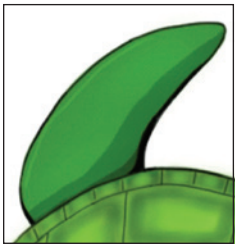
Black box software products are also difficult to modify. Requests for modification are typically sent directly to the original equipment manufacturer (OEM), who then constructs (or reconstructs) the software instrument drivers and measurement capabilities to meet the operator's specific requirements.

White box (i.e., MOTS) software, on the other hand, is the polar opposite of black box software. It is easy to modify but tends to be complex to operate. Test processes are entirely controlled by the operator, who can create, observe and even modify specific measurements. However, the operator must have a greater level of measurement process knowledge to run white box software accurately and effectively.

In the end, black box and white box software products each have their own unique benefits, and you will need to determine which software type represents the best fit with your specific testing and measurement requirements.

COST

Now we'll move into the right front leg of our Turtle Diagram to evaluate costs, one of the primary concerns for any purchase. Here, we need to evaluate exactly what our cash will purchase for us. It sometimes comes as a surprise that what we thought was included in the purchase price is actually an "extra" that's only available for an additional charge. If we want to avoid these surprises we need the answers a few questions. For example, what is the cost per license? What options are included, and not included, in the published cost? What start up support and initial training is included within the purchase? What are the maintenance fees? Answering these questions in advance of the final purchase decision should help to reduce your sticker shock.



Cost

STANDARDS AND DOCUMENTATION

The left front leg of our Turtle Diagram is devoted to product documentation and standards. Of course, we want to know the regulatory compliance or standards issues that the software is designed to help us assess. But we're not just talking about the international standards that the software is designed to test to. We're also enquiring about the standard software development practices that were used to develop the

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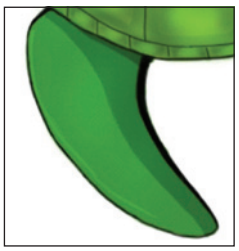
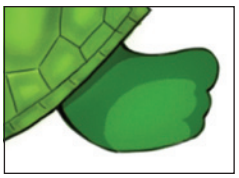
software product. Specifically, has the software been developed using proven quality methods,[2] and has a proven process been used to verify and validate the final product? Or, is the OEM familiar with the Software Engineering Body of Knowledge (SWEBOK)?[3] The extent to which a developer follows industry-standard software development practices is a good indicator of how good the final product will be. If the software manufacturer does not know the standards or cannot describe the process used to develop their product, you can expect a higher probability of software errors.



Standards and Documentation

SUPPORT

Next, let's take a look at support considerations. The first question to ask is whether there is local support. Issues can usually be resolved more quickly if technical support is available from within the same hemisphere as your location. Also, you'll also want to enquire about global support, since many companies have test laboratories around the world. Next, you'll want to know what type of support is available. A good software engineer may know how to write code, but may be less knowledgeable about EMC issues, and that could result in the need for additional time (and patience!) in resolving issues. The best technical support is most likely to come from a software development firm that has a



Support

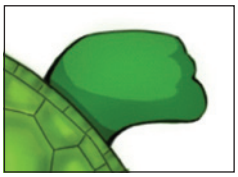
Turtle Diagram Component	Input	Considerations	Company Requirements	Software "X"	Software "Y"
Mouth	Software Type	Black box			
		White box			
Right Front Leg	Cost	Number of License(s)			
		Start up Support			
		Initial Training			
		Maintenance Fees			
		Included Options			
		Options not included			
Left Front Leg	Standards and Documentation	Compliance Standards			
		Development Standards			
Left Rear Leg	Support	Local Support			
		Global Support			
		Software Developers			
		EMC Engineers			
		Maintenance			
		New Development			
Right Rear Leg	Instrument Drivers	Quantity			
		Communication Protocol(s)			
		Dedicated Equipment Manufacturers			
		Diverse Equipment Manufacturers			
		New Instrument Development			
Tail	Output	**Winner is**			

Table 1: Turtle Diagram Software Comparison Table

mixture of both software developers and EMC engineers on their support staff or, even better, support engineers who have been trained in both software development and EMC-related issues.

Another support item that should be considered is software system maintenance. One of the benefits of so-called black box software is that it reduces the maintenance burden. However, maintenance is a requirement for every type of test software product. Those software development companies that allocate resources for product maintenance are likely to provide better, more advanced technology over the long term.

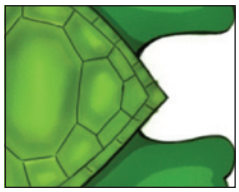
INSTRUMENT DRIVERS



Instrument Drivers

Test software is designed to communicate and control test equipment to perform a specific operations, conduct the necessary calculations and generate an output. The number of instruments with which a specific test software product can communicate needs to be considered. In addition, it is important to know what type of instrument communication protocols the software can support, and whether your test software only supports legacy protocols that are likely to be obsolete in the near future. In this same vein, does the test software include instrument drivers dedicated to just one instrument manufacturer or for multiple instrument manufacturers? If your testing laboratory is equipped with various instruments from different manufacturers, your test software product must be able to handle them. Finally, how are new instrument drivers planned and created, and does the software development firm have access to or partnerships with those instrument companies designing new or advanced equipment?

OUTPUT



Output

It is time to take a breath and wrap up everything into a nice small tight package, so that we can make a purchasing decision based on the data we've collected. The competing test software products need to be compared, and each product's characteristics need to be assessed in the context of your laboratory's unique requirements. In the end, you should select the test software product that best meets those requirements.

Table 1 illustrates a software comparison table based on the Turtle Diagram evaluation that we've presented here.

CONCLUSION

All business decisions should be knowledge based, and based on the available data. The data itself should be collected using proven methods and tools. As an engineer colleague of mine always said, "Conclusions without data are opinions. Conclusions drawn from data are facts." Decisions are based on knowledge, and knowledge should be derived from data. The requirement to make data-driven decisions is even more important when a financial investment is involved, since capital is always a finite resource. Hopefully, this article has provided a method that will help to ensure that your test software purchases represent the best fit with your company's needs. IN

REFERENCES

The references, standards and helpful documents mentioned in this article include:

1. "R214—Specific Requirements: Informaton Technology Testing Laboratory Accreditation Program," the American Association for Laboratory Accreditation, July 13, 2010. http://www.a2la.org/requirements/17025_IT_req.pdf.
2. Software Quality Engineering, http://www.sqe.com.
3. "Description of the SWEBOK Knowledge Area Software Engineering Process (Version 0.9)," Khaled El-Emam. 2001, National Research Council of Canada, Institute for Information Technology NRC, Canada. Available at http://nparc.cisti-icist.nrc-cnrc.gc.ca/npsi/ctrl?action=shwart&index=an&req=8914095&lang=en.
4. "Software Validation in Accredited Laboratories: A Practical Guide," Gregory D. Gogates, June 7, 2010. ftp://ftp.fasor.com/pub/iso25/validation/adequate_for_use.pdf.
5. "Software Training and Consulting (SQE Training: Testing

More information on software quality engineering can be found at the American Society for Quality (www.asq.org); the American Software Test Qualification Board, Inc. (www.astqb.org); the Society for Quality Engineering (www.sqe.org), and at ETS-Lindgren, TILE Support (https://support.ets-lindgren.com/TILE/).

(the author)

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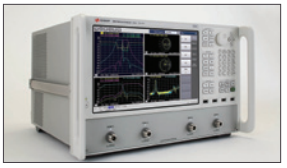
BUSINESS News

Keysight Technologies' New ENA Vector Network Analyzer

Keysight Technologies, Inc. announced the E5080A ENA vector network analyzer (VNA), which offers an ideal combination of RF measurement performance and speed, enabling a tenfold improvement in test time. The new ENA uses the Keysight PNA- and PXI-Series software architecture, making it easier for engineers to take measurements across multiple Keysight VNAs. It also offers a large color touchscreen display with fast access to basic measurements. Additional information is available at www.keysight.com.



MVG Successful Installation of StarLab at Antenna Company

MVG (Microwave Vision Group) announces the successful installation of StarLab at Antenna Company's design center in Eindhoven, Netherlands. StarLab will provide Antenna Company with an in-house testing resource for the rapid measurement of antennas during the design, prototyping and final manufacturing phase. For more information, visit www.microwavevision.com.

NTS Acquires Trace Laboratories

National Technical Systems, Inc. (NTS) announced that it has acquired Trace Laboratories, an internationally accredited, full-service testing laboratory with 45,000 square feet of industry-respected facilities. The Palatine, IL, facility, which will become NTS Chicago, further strengthens NTS' network of environmental simulation testing capabilities, including dynamics, climatic, EMI/EMC, lightning, product safety, mechanical, and fluids testing. The Hunt Valley, MD, facility, which will become NTS Baltimore, offers expertise in failure analysis and materials testing, printed circuit board and printed circuit assembly failure analysis and testing. For additional information, visit www.nts.com.

Convenient Current Measurements with the New R&S RT ZC20B Current Probe

The Rohde & Schwarz oscilloscope accessories portfolio now includes the new R&S RT-ZC20B current probe with the Rohde & Schwarz probe interface. Via this interface, oscilloscopes automatically detect up to four current probes connected in parallel. At 100 MHz bandwidth, the R&S RT-ZC20B can measure AC and DC of a maximum 30 A (RMS)/50 A (peak) current with a resolution of 10 mA and low noise. Combined with the R&S RTO/R&S RTE 16 bit high definition option, currents less than 1 mA can also be measured. For more information, visit www.rohde-schwarz.com.

SGS Expands LTE/4G Testing Capabilities

SGS has selected Rohde & Schwarz to strengthen its industry conformance and carrier acceptance testing capabilities for key LTE/4G technologies. Expanding on existing R&S TS8980FTA-2 and R&S CMW500 wireless test platforms, SGS enhances its LBS, eMBMS, carrier aggregation, IMS, and Wi-Fi calling / Wi-Fi offloading solutions to cover the next wave of LTE devices and wireless connectivity. For more details, visit www.sgs.com.

Patented Technology Offers Design Upgrade, Licensing Opportunity for RF and EMI Shielded Door Industry

The basic closing mechanism of RF and EMI shielded doors has been largely unchanged since the 1970s. Now, Steven Rust patented a new design that makes these bulky, difficult doors easy to open and close by implementing a constant force flat torsion spring that gently coils and uncoils when the shielded door is open and closed. Rust is now providing licensing opportunities for the "Constant Force Spring Perimeter Seal for an Electromagnetic Shielded Door" patent. Interested parties should contact svrust@optonline.net.

TIA Launches Online CLE Program

The Telecommunications Industry Association (TIA) announced the launch of its online Continuing Legal Education (CLE) program. The new program offers a range of video webinars which are approved for CLE credit in all major legal jurisdictions. Each webinar provides professional education for anyone seeking to keep up with the latest developments in telecommunications law. For more information, visit tiaonline.org.

TÜV SÜD Japan Authorized to Conduct Marketing Certification for Designated Class III Medical Devices

TÜV SÜD Japan Ltd. is now authorized to provide marketing certification services for designated Specially Controlled Medical Devices (Class III medical devices). The company is one of the only two Registered Certification Bodies (RCB) in the market authorized to conduct marketing certification for Class III Medical Devices designated by the Minister of Health, Labor and Welfare (MHLW). The certification criteria have been specified along with the implementation of the Act on Securing Quality, Efficacy and Safety of Pharmaceuticals, Medical Devices, Regenerative and Cellular Therapy Products, Gene Therapy Products, and Cosmetics (PMD Act). Visit www.tuv-sud.jp for more information.

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