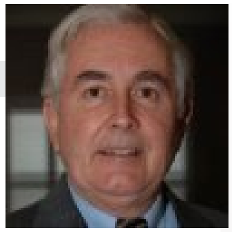
Volume 11, No 1

PRODUCT SAFETY ENGINEERING NEWSLETTER

What's Inside

President's Message



Hello Fellow PSES Members!

It seems like just yesterday that I was writing the last article for 2014! Here we are, already well into 2015!

As we move along through 2015, I hope you are enjoying the new format of the Newsletter. By the time you read this article, you should also be able to view and use our refreshed website as well. I hope you find it easy to use and full of great information. In addition to these, you will be seeing some other new membership/society information and materials that we will be sharing with the Chapters and at the Symposium. You will find a sneak peak on pages 5 and 23 of this newsletter. All intended to enhance communication with our current members, attract new members and make available the many benefits of the IEEE and PSES.

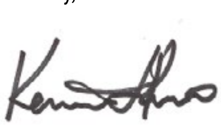
As you know, starting last year we moved our annual Symposium up to the May time-frame. This year will be the same and while we had a great Symposium last year, John Allen (General Chair) and his Symposium Committee are doing the best to deliver an even better Symposium this year. In fact, they are stretching it out to a three full days this year since we had feedback last year that there was just too much in the 2.5 days. If you haven't already registered, I encourage you to do so. Also, if you work for an organization that might benefit by some increased visibility with PSES members and attendees of the Symposium, I encourage you to discuss with them Exhibitor and Patron opportunities. For Registration and additional information about the Symposium go to: http://psessymposium.org/ I hope to see you there!

I would like to conclude, by again thanking all those who support the society – our members and those who volunteer to assume leadership positions at the Chapter level as well as the Board of Directors – you all make it possible for us to keep growing the Society and finding new ways to provide value to our members.

I encourage you all to provide your suggestions on what else we might do and get more members involved in some of the leadership activities – there are even more benefits at that level through training offered by the IEEE as well as additional interaction with others in the organization.

Once again, all the best for 2015!

Sincerely,



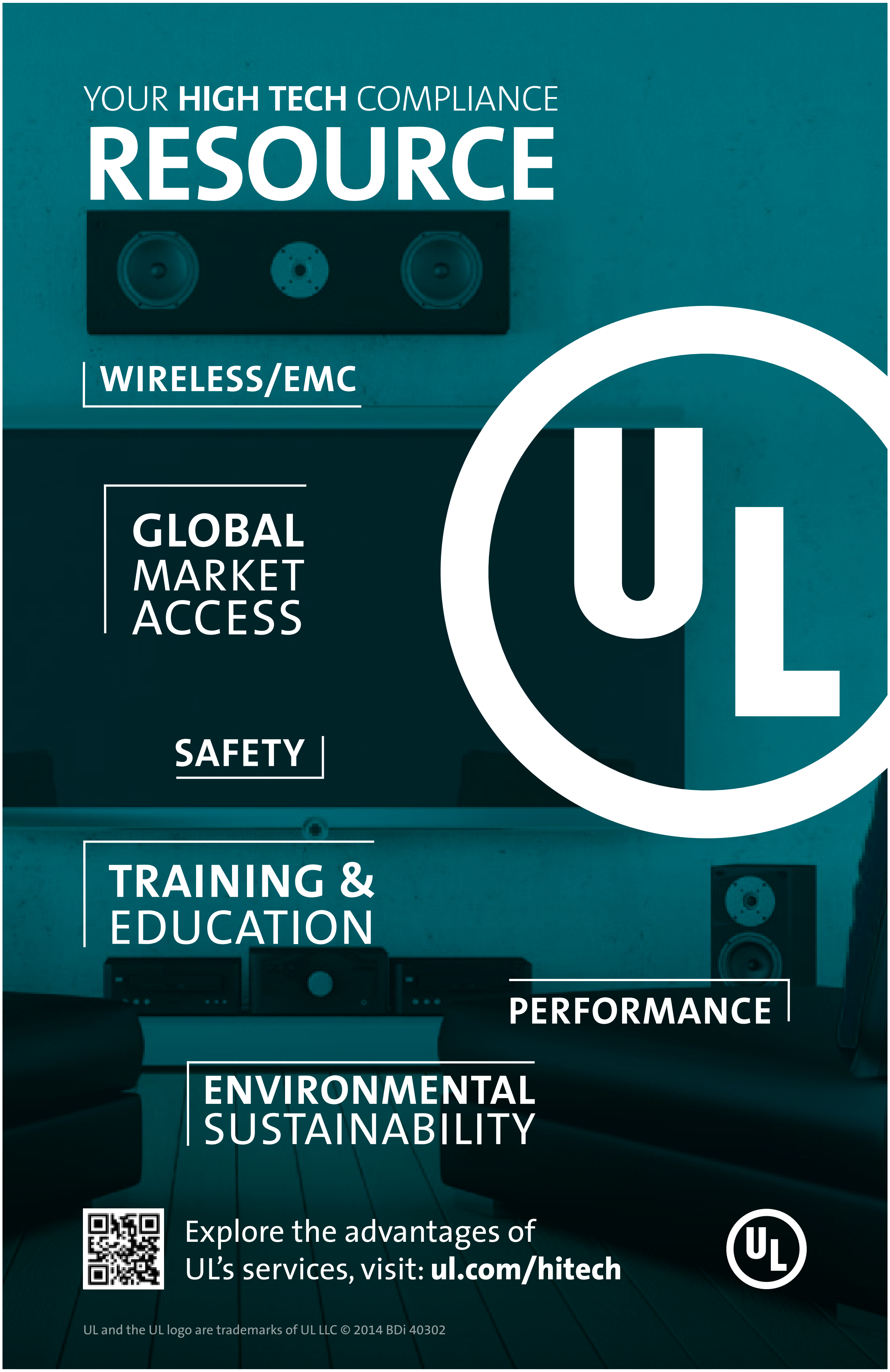
Kevin L. Ravo

Newsletter Committee

The Product Safety Engineering Newsletter is published quarterly during the last month of each calendar quarter. Closing dates for articles, news items, and advertising:

1Q issue: February 15
2Q issue: May 15
3Q issue: August 15
4Q issue: November 15

Volume 11, No. 1 - March 2015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Chapter and TAC Safety Probes

News about Chapters and Technical Activity Committees

To see current chapter information and people looking to start chapters please go to the Chapter page at: http://www.ieee-pses.org/Chapters/index.html

Technical Activity Committee information can be found at: http://www.ieee-pses.org/technical.html

Central Texas and Dallas

The topic on this joint chapter meeting of 2/17/2015 was "The New UL62368 Standard". The speaker was Nate Theilman, Product Safety Engineering from Underwriter's Laboratories.

Meeting opened with general announcements, then an introduction for Nate Theilman and the Dallas PSES group. This was a joint meeting with the Dallas PSES group, made possible by the Dell video link and conference call system. Nate's presentation ran through the historical aspects of the previous standards we have all become very familiar with, and gave a time line for implementation of the 62368 standard. The new standard is replacing UL60950 and UL60065, combining them into one standard using the Hazard based safety scheme. That scheme is becoming more prevalent as old standards are updated or new standards are created. The final date of implementation for the UL62368 standard is June 2019.

There were several questions during and after Nate's presentation. We concluded with a reminder that our next meeting would be on April 21st.

San Diego

The IEEE PSES (Product Safety Engineering Society) San Diego Chapter latest meeting was Mar 10 at 6:00pm, with a guest speaker, Bob LaTouche who currently works for the Irvine Police Department on specialty vehicle technologies. The topic was "Update on the Consumer Product Safety Commission (CPSC) mission".

Northern NJ Section Chapter Forming

A joint PSES/EMCS chapter has formed in northern New Jersey. IEEE HQ and the PSES and EMCS have approved the submittal and the new chapter is official! A survey has been sent out to PSES and EMCS members in the section and an organizational kick off meeting is planned for this Spring. If interested, contact Dan Roman at dan.roman@ieee.org.

Argentina

Silvia Diaz Monnier is looking for members interested in setting up a chapter in Argentina. If interested, contact Silvia at silencasa@yahoo.com.

CHAPTERS - WE NEED YOUR NEWS!

Telecom Safety TAC

The group as of late has been discussing some Telcordia standard releases covering SPDs, Indoor Electronic Equipment Cabinets, Indoor and Outdoor Battery Backup Cabinets, Wireless Transceiver Facilities, and interactions between generic requirements documents.

Don Gies is a member of the committee adapting IEC 60950-21 concerning RFT circuits to IEC 62368 and discussions continue for proposals for this development effort.

The group is also having ongoing discussions on TC 108 US TAG meetings, UL Subject 1081 vs. IEC 61204-7 2nd edition, Telcordia GR-3171-CORE Issue 2 TTF - Wireless Equipment, and protection of DC feeds to radio equipment at the top of towers.

For information about the TSTC contact Don Gies at Don.Gies@ALCATEL-LUCENT.COM. Meetings are generally held on the last Wednesday of the month.

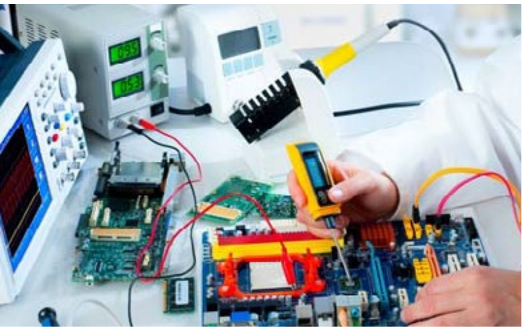
TACS - WE NEED YOUR NEWS!

Product Safety Engineering Society

Be part of a Great Society at the Forefront of Product Safety Innovation!







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News and Notes

Compliance News Shorts

News To Know

REACH News - The European Union Advocate-General to the Court of Justice issued an opinion regarding the concept of an "article" under the Registration, Evaluation and Authorization of Chemicals (REACH) regulation. Seven member states, including France and Germany, had decided to apply the 0.1% threshold to individual components of complex articles such as computers while most member states apply the threshold to the whole article. The Advocate-General's opinion stated that the threshold for registration requirements applies to the whole article, not at the level of each individual component (part). However, for SVHC (substances of very high concern) notification requirements, the Advocate-General's opinion stated that the SVHC notification requirements apply to individual components. If any component within a larger article contains an SVHC above the 0.1% threshold, a company must comply with the notification requirements.

The EU Court of Justice is expected to release its judgment in the coming months, which will be the final ruling on the issue.

Recently Published Standards

CISPR 13 ed5.1 (2015-01) Sound and television broadcast receivers and associated equipment - Radio disturbance characteristics - Limits and methods of measurement

CISPR 13-am1 ed5.0 (2015-01) Amendment 1 - Sound and television broadcast receivers and associated equipment - Radio disturbance characteristics - Limits and methods of measurement

CISPR 14-2 ed2.0 (2015-02) Electro-magnetic compatibility - Requirements for house-hold appliances, electric tools and similar apparatus - Part 2: Immunity - Product family standard

IEC 60335-2-111 ed1.0 (2015-01) Household and similar electrical appliances - Safety - Part 2-111: Particular requirements for electric ondol mattress with a non-flexible heated part

IEC 60335-2-65 ed2.2 (2015-01) Household and similar electrical appliances - Safety - Part 2-65: Particular requirements for air-cleaning appliances

IEC 60335-2-65-am2 ed2.0 (2015-01) Amendment 2 - Household and similar electrical appliances - Safety - Part 2-65: Particular requirements for air-cleaning appliances

IEC 60335-2-82 ed2.2 (2015-01) Household and similar electrical appliances - Safety - Part 2-82: Particular requirements for amusement machines and personal service machines

IEC 60335-2-82-am2 ed2.0 (2015-01) Amendment 2 - Household and similar electrical appliances - Safety - Part 2-82: Particular requirements for amusement machines and personal service machines

IEC 60335-2-95 ed3.1 (2015-01) Household and similar electrical appliances - Safety - Part 2-95: Particular requirements for drives for vertically moving garage doors for residential use

IEC 60335-2-95-am1 ed3.0 (2015-01) Amendment 1 - House-hold and similar electrical appliances - Safety - Part 2-95: Particular requirements for drives for vertically moving gar-age doors for residential use

IEC 60601-1-11 ed2.0 (2015-01) Medical electrical equipment - Part 1-11: General requirements for basic safety and essential performance - Collateral Standard: Requirements for medical electrical equipment and medical electrical systems used in the home healthcare environment

IEC 60601-1-SER ed1.0 (2015-01) Medical electrical equipment - ALL PARTS

IEC 60695-1-12 ed1.0 (2015-01) Fire hazard testing - Part 1-12: Guidance for assessing the fire hazard of electro-technical products - Fire safety engineering

IEC 60968 ed3.0 (2015-02) Self-ballasted fluorescent lamps for general lighting services - Safety requirements

IEC 61010-2-081 ed2.0 (2015-01) Safety requirements for electrical equipment for measurement, control and laboratory use - Part 2-081: Particular requirements for automatic and semi-automatic laboratory equipment for analysis and other purposes

IEC 61010-2-101 ed2.0 (2015-01) Safety requirements for electrical equipment for measurement, control and laboratory use - Part 2-101: Particular requirements for in vitro diagnostic (IVD) medical equipment

IEC 62110 ed1.0 (2015-01) Corrigendum 1 - Electric and magnetic field levels generated by AC power systems - Measurement procedures with regard to public exposure

IEC 62368-1 ed2.0 (2015-02) Corrigendum 1 - Audio/video, information and communication technology equipment - Part 1: Safety requirements

IEC 62485-4 ed1.0 (2015-01) Safety requirements for secondary batteries and battery installations - Part 4: Valve-regulated lead-acid batteries for use in portable appliances

IEC/TR 62471-3 ed1.0 (2015-01) Photo-biological safety of lamps and lamp systems - Part 3: Guidelines for the safe use of in-tense pulsed light source equipment on humans

IEC/TRF 60335-2-100 ed2.0 (2014-12) This Test Report applies to: IEC 60335-2-100:2002 (First Edition) in conjunction with IEC 60335-1:2010 (Fifth Edition) incl. Corr. 1:2010 and Corr. 2:2011 + A1:2013

IEC/TRF 60335-2-102 ed4.0 (2015-02) This Test Re-port applies to: IEC 60335 2-102:2004 (First Edition) +A1:2008 + A2:2012 in con-junction with IEC 60335-1:2010 (Fifth Edition)

IEC/TRF 60335-2-102 ed5.0 (2015-02) This Test Re-port applies to: IEC 60335 2-102:2004 (First Edition) +A1:2008 + A2:2012 in con-junction with IEC 60335-1:2010 (Fifth Edition) incl. Corr. 1:2010 and Corr. 2:2011 + A1:2013

IEC/TRF 60335-2-21,40 ed3.0 (2015-01) This Test Report applies to: IEC 60335-2-21: 2012 (Sixth Edition) & IEC 60335-2-40: 2002 (Fourth edition) + A1:2005 + A2:2005 used in con-junction with IEC 60335-1:2010 (Fifth Edition) (incl. corr. 1:2010, corr. 2:2011) + A1:2013

IEC/TRF 60335-2-24 ed11.0 (2014-12) This Test Report applies to: IEC 60335-2-24:2010 (Seventh Edition) + A1:2012 in conjunction with IEC 60335-1:2010 (Fifth Edition) incl. Corr. 1:2010 and Corr. 2:2011 + A1:2013

IEC/TRF 60335-2-27 ed5.0 (2015-02) This Test Report applies to: IEC 60335-2-27:2009 (Fifth Edition) + A1:2012 in con-junction with IEC 60335-1:2010 (Fifth Edition) incl. Corr. 1:2010 and Corr. 2:2011 + A1:2013

IEC/TRF 60335-2-35 ed5.0 (2015-02) This Test Re-port applies to: IEC 60335-2-35:2012 (Fifth Edition) in con-junction with IEC 60335-1:2010 (Fifth Edition) incl. Corr. 1:2010 and Corr. 2:2011

IEC/TRF 60335-2-9 ed9.0 (2015-01) This Test Report applies to: IEC 60335-2-9:2008 (Sixth edition) +A1: 2012 in conjunction with IEC 60335-1:2010 (Fifth Edition) incl. Corr. 1:2010 and Corr. 2:2011 + A1:2013

IEC/TRF 60601-1-2 ed5.0 (2015-01) This Test Report applies to: IEC 60601-1-2: 2014 (Fourth Edition)

IEC/TRF 60730-2-12 ed2.0 (2015-01) This Test Report applies to: IEC 60730-2-12:2005 (Second Edition) for use with IEC 60730-1:2010 (Fourth Edition)

IEC/TRF 61010-2-10 ed3.0 (2015-01) This Test Report applies to: IEC 61010-2-010: 2014 (Third Edition) for use with IEC 61010-1:2010 (Third Edition)

IEC/TRF 61010-2-10 ed4.0 (2015-02) This Test Re-port applies to: IEC 61010-2-010: 2014 (Third Edition) for use with IEC 61010-1:2010 (Third Edition)

IEC/TRF 61010-2-51 ed3.0 (2015-01) This Test Report applies to: IEC 61010-2-051: 2015 (Third Edition) for use with IEC 61010 1:2012 (Third Edition)

IEC/TRF 61010-2-81 ed3.0 (2015-02) This Test Re-port applies to: IEC 61010-2-051: 2015 (Third Edition) for use with IEC 61010 1:2012 (Third Edition)

IEC/TRF 61558-2-15 ed2.0 (2015-02) This Test Re-port applies to: IEC 61558- 2-15: 2011 (Second Edition) used in con-junction with IEC 61558-1 (Second Edition) + A1:2009

ISO/IEC GUIDE 50 ed3.0 (2014-12) Safety aspects - Guidelines for child safety in standards and other specifications

ISO/IEC GUIDE 71 ed2.0 (2014-12) Guide for addressing accessibility in standards

Project CISPR 24-am1 ed2.0 (2015-01) Amendment 1 - Information technology equipment – Immunity characteristics – Limits and methods of measurement

Project IEC 60335-2-34-am1 ed5.0 (2015-02) Amendment 1 - Household and similar electrical appliances – Safety – Part 2-34: Particular requirements for motor-compressors

Project IEC 60335-2-80 ed3.0 (2015-01) Household and similar electrical appliances – Safety – Part 2-80: Particular requirements for fans

Project IEC 60335-2-89-am2 ed2.0 (2015-02) Amendment 2 - Household and similar electrical appliances – Safety – Part 2-89: Particular requirements for commercial refrigerating appliances with an incorporated or remote refrigerant unit or compressor

Project IEC 60730-2-12 ed3.0 (2015-01) Automatic electrical controls – Part 2-12: Particular requirements for electrically operated door lock

Project IEC 60730-2-6 ed3.0 (2015-01) Automatic electrical controls – Part 2-6: Particular requirements for automatic electrical pressure sensing controls including mechanical requirements

Project IEC 60730-2-9 ed4.0 (2015-02) Automatic electrical controls – Part 2-9: Particular requirements for temperature sensing controls

Project IEC 61010-031 ed2.0 (2015-02) Safety requirements for electrical equipment for measurement, control and laboratory use – Part 031: Safety requirements for hand-held probe assemblies for electrical measurement and test

Project IEC 62321-6 ed1.0 (2015-02) Determination of certain substances in electrotechnical products – Part 6: Polybrominated biphenyls and polybrominated diphenyl ethers in polymers by gas chromatography-mass spectrometry (GC-MS)

Project IEC 62485-1 ed1.0 (2015-01) Safety requirements for secondary batteries and battery installations – Part 1: General safety information

Project IEC 62560-am1 ed1.0 (2015-01) Amendment 1 - Self-ballasted LED-lamps for general lighting services by voltage > 50 V – Safety specifications

EN 60335-2-11:2010/A1:2015 - 2/13/2015 - Household and similar electrical appliances - Safety - Part 2-11: Particular requirements for tumble dryers

EN 60335-2-54:2008/A11:2012/AC:2015 - 1/30/2015 - Household and similar electrical appliances - Safety - Part 2-54: Particular requirements for surface-cleaning appliances for household use employing liquids or steam

CHICAGO

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Legal Column

Dr. Carsten Schucht, Rechtsanwalt

The European Law on Electromagnetic Compatibility – Status Quo and Outlook

PSEN includes a regular column on product compliance from the European perspective. The column is provided by Noerr LLP's Product Compliance Team. This column discusses the Directive on electromagnetic compatibility as it stands and what the changes going into effect in April 2016 will bring.

Since 2004 the European law on electromagnetic compatibility (hereinafter referred to as the "EMC law") has been given in Directive 2004/108/EC on the approximation of the laws of the Member States relating to electromagnetic compatibility. The reason for this directive was, among others, that obligations should be imposed on the various economic operators in order to guarantee protection against electromagnetic disturbance. Moreover, the electromagnetic compatibility of equipment was expected to be regulated with a view to ensuring the functioning of the internal market.

In this context, it is important to mention that Directive 2004/108/EC governs only the phenomenon of electromagnetic compatibility and has no relevance for safety. Against this back-ground, European product safety law consists of further directives which may regulate electromagnetic compatibility with safety relevance. Of high practical relevance are Directive 2006/42/EC on machinery, on the one hand, and Directive 2006/95/EC on electrical equipment designed for use within certain voltage limits, on the other. The Machinery Directive states in the Annex with regard to external radiation that machinery must be designed and constructed in such a way that external radiation does not interfere with its operation. Directive 2006/95/EC contains provisions concerning protection against the hazards arising from electrical equipment. Measures of a technical nature should be prescribed in order to ensure that, among other things, potentially hazardous radiation is not produced.

Because the EMC law was formulated as a Directive, the 28 Member States of the European Union had to transpose the Directive into their national law. In Germany, for example, this is the Electromagnetic Compatibility of Equipment Act (EMVG) of 26 February 2008. Thus, the marketing of products in Germany that are subject to electromagnetic compatibility requirements usually has to comply with the German EMVG.

Scope of Directive 2004/108/EC

European Directive 2004/108/EC applies to equipment, which is a legally defined term. "Equipment" in the meaning of Directive 2004/108/EC means apparatus or fixed installation. An apparatus means any finished appliance or combination thereof made commercially available as a single functional unit, intended for the end user and liable to generate electromagnetic disturbance or the operation of which is liable to be affected by such disturbance. Hence, equipment must meet two important conditions:

- potential emitted interference must exist, and
- the products must potentially be influenced by electromagnetic disturbance.

Essential requirements in EMC law

Of key importance within Directive 2004/108/EC are the essential requirements which also are one of the most important characteristics of the New Approach determining European product safety laws. Instead of prescribing detailed specifications with which products must comply, the European Union has taken a different approach for about 30 years by stating only the essential requirements.

With respect to equipment, the protection requirements in Annex I of Directive 2004/108/EC apply. Accordingly, equipment is to be designed and manufactured, taking into account the state of the art, so as to ensure that

- the electromagnetic disturbance generated does not exceed the level above which radio and telecommunications equipment or other equipment cannot operate as intended and that

- it has a level of immunity to the electromagnetic disturbance to be expected in its intended use which allows it to operate without unacceptable degradation of its intended use.

For fixed installations that means a particular combination of several types of apparatus and, where applicable, other devices, which are assembled, installed and intended to be used permanently at a predefined location, there are further requirements set out in Annex I of Directive 2004/108/EC.

Conformity Assessment

With regard to the conformity assessment procedures it should be noted that the correct application of all relevant harmonised (technical) standards whose references have been published in the Official Journal of the European Union is equivalent to the performance of the electro-magnetic compatibility assessment which otherwise has to be conducted. Therefore, the application of harmonised standards leads to enormous advantages for the products' manufacturers, all the more so, of course, as the presumption of conformity—also characteristic of European product safety law—is effective in the law of the electromagnetic compatibility. Accordingly, compliance with harmonised standards provides a presumption with the essential requirements referred to in Annex I to which such standards relate.

Market surveillance in Germany

As far as market surveillance is concerned, the European law does not determine how the Member States should execute Directive 2004/108/EC or their national laws having been trans-posed the Directive. Thus, in Germany, the EMVG contains a whole section on market surveillance law in the field of electromagnetic compatibility. Notably, the Federal Network Agency—a Federal authority and not an authority of the German states which typically execute product safety law in Germany—is responsible for the implementation of EMVG. The powers of the Federal Network Agency are set out in Section 14 EMVG. Most important in practice is the so called general power. This power enables the Federal Network Agency to take action against all relevant violations of the EMVG. However, in a first step, the authority is only permitted to take such action in order to rectify the shortcoming and prevent further violations. Only when the economic operator fails to correct the defect is the authority allowed to take action to prohibit or restrict the product's availability on the market, to withdraw it from the market or to recall it.

The Federal Network Agency can, additionally, impose a fine for non-compliance with the legal requirements in the amount of up to € 10,000 or € 50,000 depending on the severity of the violation.

Outlook on new Directive 2014/30/EU

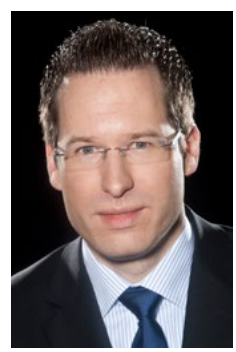
In February 2015, the European Union published the new Directive 2014/30/EU. However, since this Directive also has to be transposed into national law by the EU Member States, it will only apply from 20 April 2016. Therefore, the economic operators as well as the market surveillance authorities will still have sufficient time to adapt to the new legal framework.

In general, the new Directive does not differ a great deal from Directive 2004/108/EC. In particular, the essential requirements are the same as in Directive 2004/108/EC. However, there is a new chapter concerning the obligations of economic operators. Therefore, the Directive sets out in detail the duties of the manufacturer, its authorised representative, the importer, and the distributor. The advantage of these new provisions lies in the fact that every economic operator wishing to do business in the European Union can easily see the obligations that have to be met. Hence, from the perspective of the economic operators the foreseeability of the European law on electromagnetic compatibility will be improved from 2016 on.

There will be, however, some amendments of European EMC law which increase the responsibilities of economic operators, specifically manufacturers: The fulfillment of harmonised standards will no longer be qualified as equivalent to the performance of the electromagnetic compatibility assessment. This means that producers who took advantage of the exemption under Directive 2004/108/EC (as explained above), need to be prepared for carrying out the electromagnetic compatibility assessment from 2016 on.

Additionally, it is important to know that the new Directive 2014/30/EU requests all the economic operators in general and the manufacturer in particular to inform the competent national market surveillance authorities (in all European distribution countries) about risks arising from apparatus. Therefore, there will be a notification duty from 2016 on if products do not fulfill the essential requirements set out in Annex I of Directive 2014/30/EU.

DR. CARSTEN SCHUCHT, RECHTSANWALT



Dr. Carsten Schucht, Rechtsanwalt (e-mail carsten.schucht@noerr.com) is Senior Associate in the Product Safetyand Product Liability Department of Noerr LLP (www.noerr.com). Dr. Schucht specializes in the fields of product safety law (non-food), product liability law and labour protection law. He advises clients in all areas of European and German non-food product safety law and provides legal representation before civil and administrative courts in this fields. He also regularly provides legal support in national and international product recalls. Dr. Schucht has published various articles on product safety law in general and placing electrical equipment on the European market in particular.

Noerr LLP is a European law firm founded in Germany with offices in Brussels, Alicante and various CEE-capitols. Noerr's Product Compliance Team advises its clients on all questions related to placing products onto the European market, defends them against complaints from European market surveillance authorities, and conducts product recalls.

Measurement of Touch Current: RMS vs. Peak - A Standards Discussion

Peter E. Perkins

Why is this topic important?

The human body responds to peak current value, not to rms value.

Electric shock protection is well understood. The IEC 60479 series of standards[1], Effects of current on the human body…, characterizes the three principle effects (see Figure 1):

- Startle-reaction (a-line),
- Let go-immobilization (b-line), and
- Ventricular fibrillation (c1-c3 lines, a statistical distribution)

These effects are summarized in time-current curves of Figure 1. The curves have similar shapes, but the limits are different for ac/bi-polar and dc/mono-polar current. Understand that the c1 to c3 region, a statistical distribution which only includes 95 percent of the population within it, doesn't cover the five percent of the human population which lies to the left of the c1 curve; in today's world more than 300 million people lie within the region designated as the body's built-in safety factor zone between the c1-line and the b-line, and are vulnerable if they are shocked within that region.

From the time that the first touch current measurements were being introduced in the 1930s, electric power was primarily distributed as a sinusoidal waveform which allowed easy delivery over a large area (grid). The development of rms-based limits followed the technology even for electric shock protection.

Some researchers, such as Dalziel, recognized the limitations of these limits and measurements and published proper peak data while allowing rms for practical measurements. Because of the large-scale introduction of mains switching today, evaluation of electric shock protection in products is lagging technology and needs to be updated to provide proper protection.

Touch current measurement history

The early history of touch current measurements goes back at least to 1943, to Charles F Dalziel's papers in which he reported "to make valid comparisons between different physiological response to different waveforms the peak (crest) value must be measured."

In his 1943 paper,[2] Dalziel determined that for various wave shapes the use of peak (crest) values allowed the comparison of let go-immobilization current effects in test subjects for the cases examined. He further claimed that because all of these waveforms gave the same physiological response at the same peak current that other waveforms would behave the same way and their measured peak currents would be the indicator of the body-current effect. In his 1954 paper[3] Dalziel showed that the threshold of perception is related to peak (crest) measurements, again confirming his earlier results.

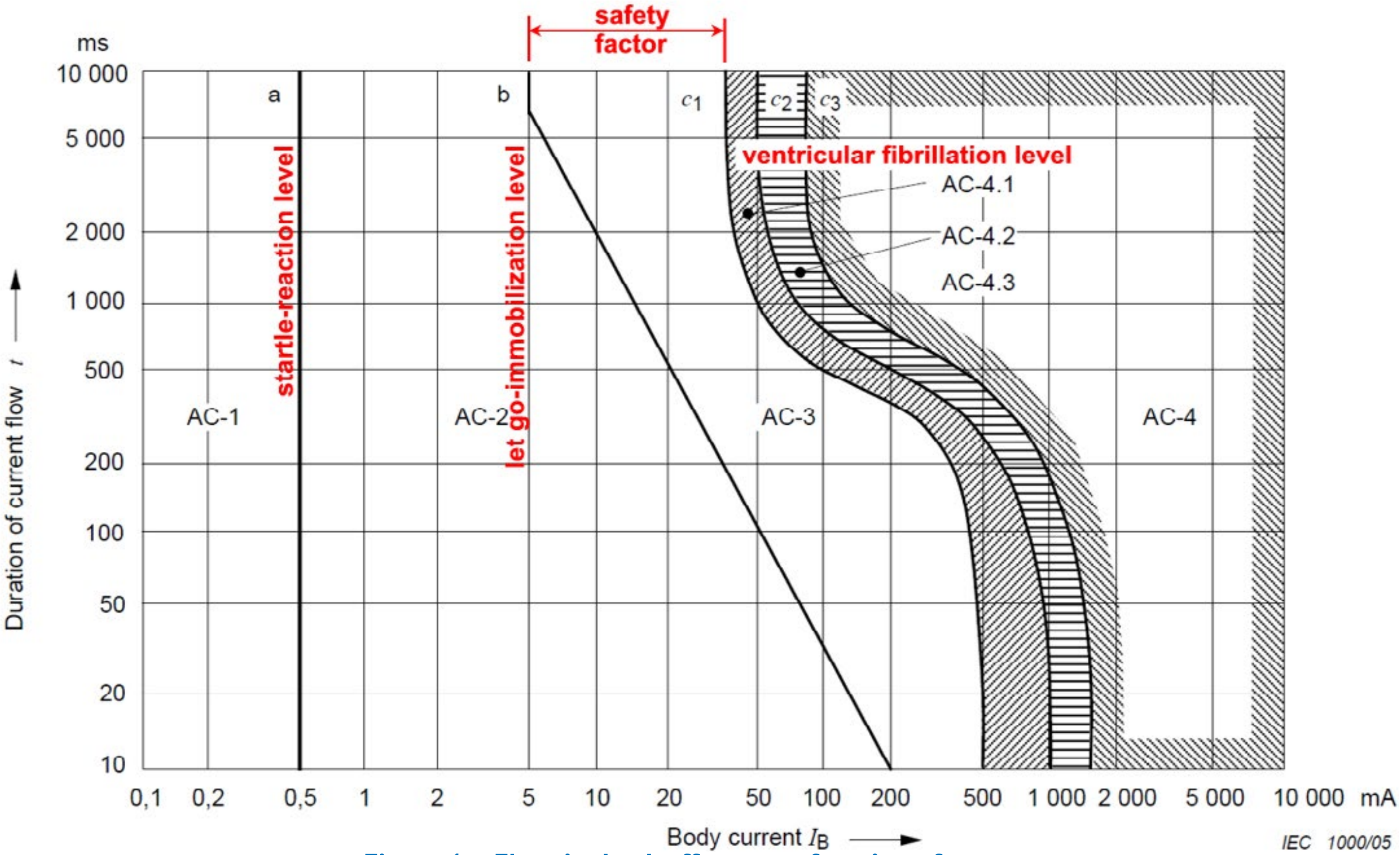


Figure 1 – Electric shock effects as a function of current

The work of Stevenson at UL (1970s) provided ANSI C101, Leakage Current For Appliances (now UL 101) with a statistically defensible data set to justify the 0.5 mA rms touch current limit that has been commonly used.

The work of Hart during the development of IEC 60990 (1980s) reconfirmed the need for peak values; his work was extensively discussed within TC64/WG4 and the 60990 team in TC74/WG5.

The development of SMPS with EMC filtering, which increased current shunted to earth/ground, increased the residual current in the earth/ground and drove the need to increase the limit; 3.5 mA rms was introduced as the touch current in the 1980s. These higher limits were a compromise; enough to seemingly accommodate new designs, but not fully at the 5 mA rms level since not all of the consequences were fully understood. At that time the IEC appointed a new committee to develop proper measurement techniques for these new situations; hence WG5 and IEC 60990.

Since Dalziel made the technical point that peak (crest) values must be measured, how did we get to rms measurements? In spite of the experimental findings, touch current testing has traditionally been done with rms measurement equipment. In my opinion, this is primarily due to the difficulty of making peak measurements in the early days of measurement equipment development. This restriction is no longer true; peak measurements are easily made with modern equipment.

Remember that rms measurements were developed to give an equivalent to the dc measurement of V x I = Power. Even though moving coil instruments provided an average measurement, the instruments were calibrated in rms (approximately10% higher).

Maybe rms measurements are ok?

Figure 2 is shown to illustrate this case.

When IEC 60990 was developed touch currents were starting to look a lot like Figure 2, almost sinusoidal waveforms.[4]

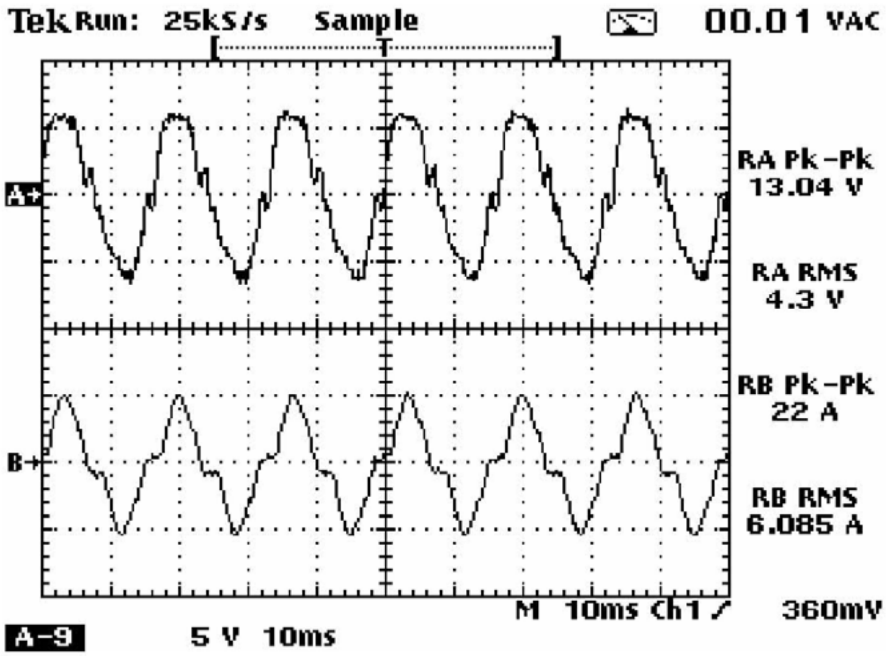


Figure 2 – Touch current (upper trace) from early SMPS input current (lower trace)

These touch current waveforms drove the digital meter manufacturers to develop meters reading "true rms." This was possible because the digitized readings could be manipulated by software and be adjusted for the waveform changes. Everyone thought that this would take care of the problem until PFC (Power Factor Correction) was introduced in response to the triplen harmonic currents that SMPS fed back into the distribution transformers. The harmonic currents could sum to large circulating currents in the primary windings of the transformer, causing transformer damage.

But then the touch current changed

It looked like Figure 3.

The inclusion of Power Factor Correction to equipment drove the touch current to a new level. The touch current waveforms are not sinusoidal in any sense of the term. This has driven further examination of the proper measurement technique for touch current in a series of presentations given to the IEEE PSES over the past few years.[5] Further, complications are being added with the inclusion of Energy Efficiency switching circuits in the supply.[6]

The need for peak measurement is apparent and needs to be established as the proper measurement for these waveforms.

Can't we ignore short spikes?

Figure 4 helps us see how this works. Green et al conducted VF (ventricular fibrillation) tests to 1 ms and saw no physiological reason that the effect of short time spikes would not extend to even shorter times.[7]

The pulse parameter that drives the plotted value higher and, therefore, leads to higher touch current measurements is the rise time (RT) of the pulse. Green's 1 ms lower value is right where the touch current is starting to increase due to RT. Here we see that fast pulse RTs lead to measured peak touch current that is 40–100 percent higher than the slower pulse.

Peak measurements identify these differences and properly take them into account.

Looking at requirements from safety standards for electronic products

IEC 62368-1, Audio/video, information and communication technology equipment – Part 1: Safety requirements,

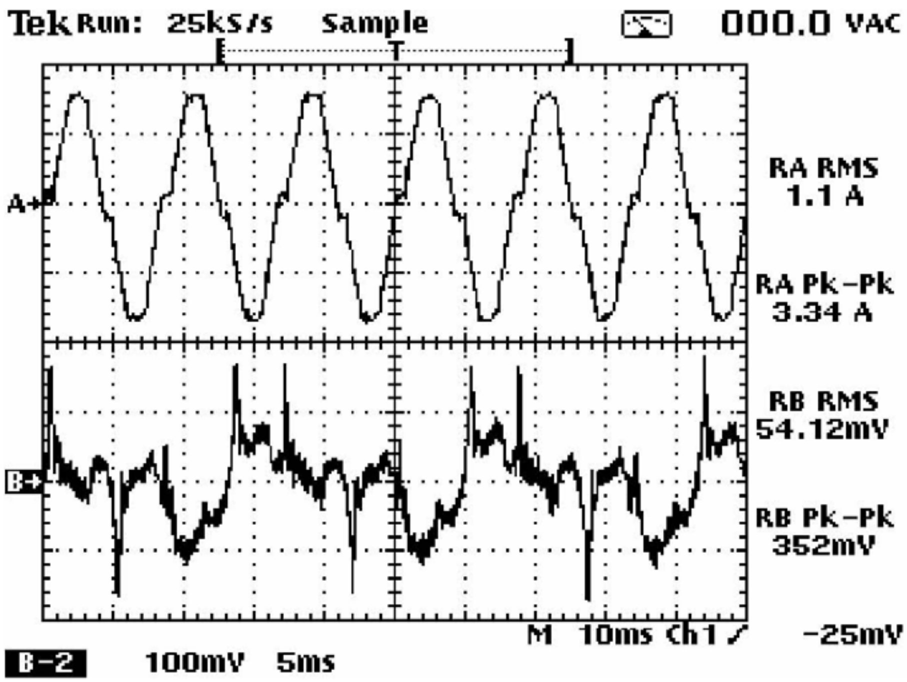


Figure 3 – Touch current (lower trace) from PFC SMPS input current (upper trace)

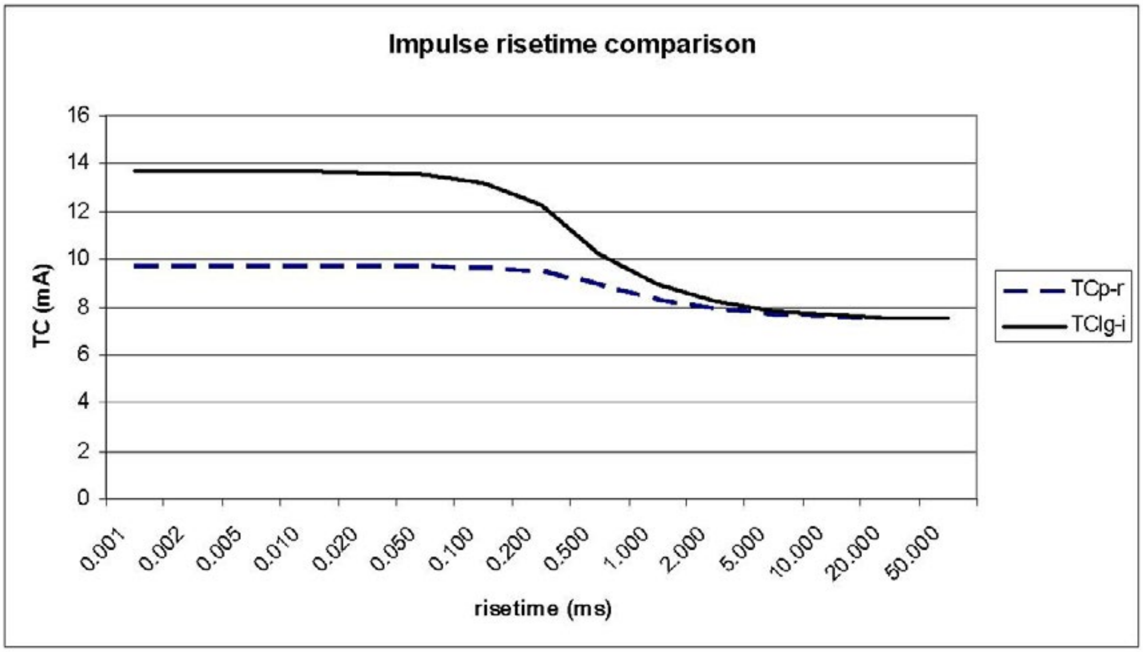


Figure 4 – Impulse rise time comparison

clause 5.7.2.1, Measurement of touch current:

For measurement of TOUCH CURRENT, the instrument for measuring…shall indicate peak voltage. If the TOUCH CURRENT waveform is sinusoidal, an rms indicating instrument may be used.

Note that the waveform must be examined to determine which measurement must be made.

IEC 62368 defines safe levels for operators and then others by defining the voltage and current levels that are safe in each case. This IEC standard measures:

1. the voltage of the exposed part, then
2. the current from the part.

This standard properly differentiates between measurement of low touch current (using the IEC 60990, Figure 4 startle-reaction circuit) and high touch current (using the IEC 60990, Figure 5 let go-immobilization circuit). Peak measurements are specified for non-sinusoidal waveforms.

IEC 61010-1, Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements, clause 6.3, Limit values for ACCESSIBLE parts, clearly defines limits for sinusoidal and non-sinusoidal touch current waveforms for normal and fault conditions. Examining the waveform is critical in determining which limit to apply.

IEC 61010-1 defines an rms limit for sinusoidal waveforms and peak limits for non-sinusoidal waveforms. Because of this clear specification, the waveform needs to be seen on the oscilloscope to determine which limit should be applied.

IEC 60950-1, Information technology equipment – Safety – Part 1: General requirements, was the first IEC standard to adopt the circuit and measuring method of IEC 60990. IEC 60950-1, clause 5.1.6 notes that rms measurements are traditionally used but peak measurements better represent the body response for non-sinusoidal touch current waveforms.

IEC 60065-1, Audio, video and similar electronic apparatus – Safety requirements, clause 5.2.2.2 specifies peak and rms limit values, expecting appropriate measurement methods to be chosen. The waveshape must be examined to know which limit to apply. Peak values of touch current can only be properly measured with an oscilloscope. This standard invokes the use of the IEC 60990 circuits and methodology and this should be fully implemented by moving to peak measurements.

IEC 60065-1 measures the voltage on any exposed part and, if it is above the threshold, measures the touch current. The limits are expressed in voltage values for both low frequency and high frequency waveforms. The measurement method described is more difficult than it needs to be, as the IEC 60990 circuit properly takes into account the frequency factor.

Determination of the wave shape is needed to apply the proper limit

Use of the IEC 60990 circuits and methods was one of the principal driving forces toward development of "true rms" meters. The waveforms were considered "almost sinusoidal" at the time; remember Figure 1. A popular suggested demarcation has been that for a peak/rms ratio of 1.6 or less a waveform is almost sinusoidal. Eighty percent of the waveforms in the sample referred to here (Ref 3) are >1.6 peak/rms ratio.

Unfortunately, this has led to an ongoing error in not continuing to check waveforms to determine whether a full evaluation of the waveform is needed and whether the measurement should be changed to peak. This outdated measurement practice needs to change.

For any product standard or touch current measurement: The IEC 60990 networks specified for the measurement of startle-reaction and let go-immobilization currents are frequency-responsive and are so weighted that single limit power-frequency values can be specified and referenced.

Touch current circuit response as a function of frequency

The performance[8] of IEC 60990 circuits as a function of frequency is shown in Figure 5. For this analysis the input voltage is fixed across the frequency spectrum up to 1 MHz.

The input current rises, in this example, from the initial value of 3.5 mA (such as is allowed in most IEC standards today) to 14 mA at high frequency.

The output is compensated according to the known frequency curve for the human body. This output falls off inversely to the frequency response curve to provide a constant meter reading (at the low frequency specification) which makes for easy determination of compliance—always 3.5 mA for this case.

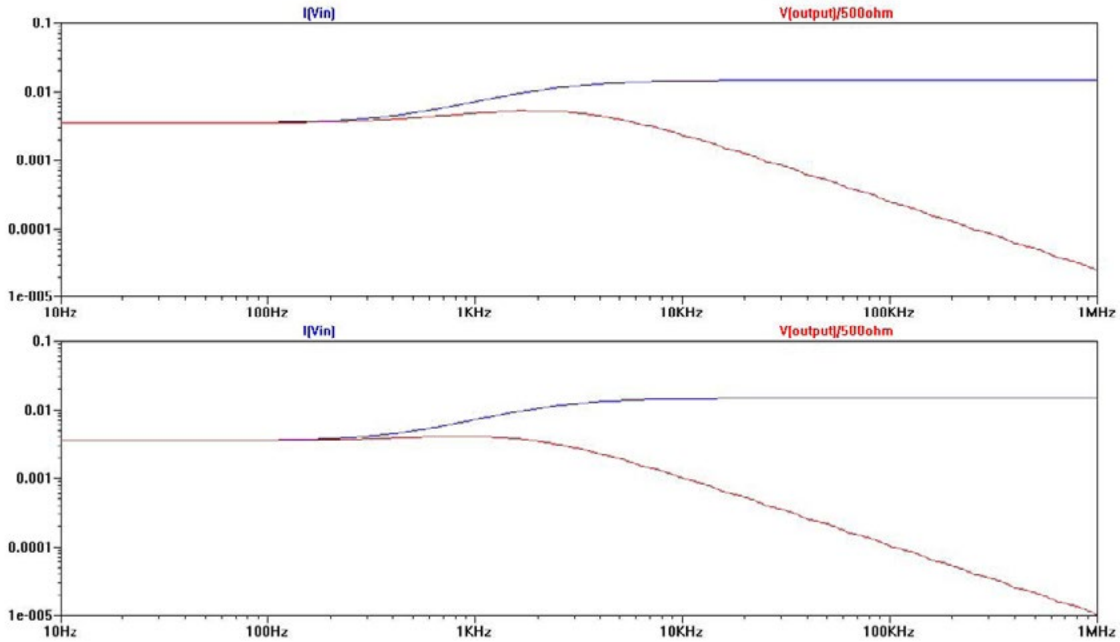


Figure 5 – IEC 60990 measurement circuits current (A) vs. frequency (Hz); upper: lg-i circuit; lower: s-r circuit

The startle-reaction circuit is for cases where the limit is 2 mA rms/2.8 mA peak or less and the let-go-immobilization circuit is for cases above that and is acceptable for measurements to more than tens of mA rms depending upon the robustness of the meter design.

There are special cases to consider

One example is standards such as IEC 60950, allow access to circuits which will not be an electrical shock hazard. These circuits are called Limited Current Circuits (LCC) in the standard.

Figure 6 shows the detailed waveform for the LCC current in this case, a back light for a display.

This evaluation points out a real problem that must be looked at in waveform detail. Using the startle-reaction circuit, the rms touch current value is 3.09 mA which is acceptable in IEC 60950, while the peak touch current value is 5.07 mA which is above the limit. This, of course led to an argument between the manufacturer and the test house; hence the analysis discussed here.

Evaluating this waveform with the let go-immobilization circuit (per IEC 62368), the rms touch current value is 5.9mA and the peak value is 11.5mA. These are both clearly above the 5 mA rms/7.1 mA peak limit. The let go-immobilization peak value is the correct value here and the circuit is not an LCC.

The persistent question remains: Can this be simplified in some way?

RMS measurement of products with low touch current should be acceptable. From limited data, products which measure ~1 mA rms should be acceptable; let's examine that in more detail.

This seems more complicated in the test lab. **Can a simple rule of thumb be developed?**

Based upon the limited data presented, the calculation of a simple measurement using the traditional rms setup seems to be adequate when the touch current is low. For the IEC 60950 ITE product examples we can calculate: 3.5 mA rms limit / 3.25 max peak/rms ratio = 1.08 mA rms or less. Peak/rms ratios of four or more have been reported; perhaps even as much as six.

From this small sample shown earlier: for ~28 percent of the equipment tested a peak measurement should be made. This is a smaller fraction of the examples presented than the 80 percent, which had a peak/rms ratio >1.6; a

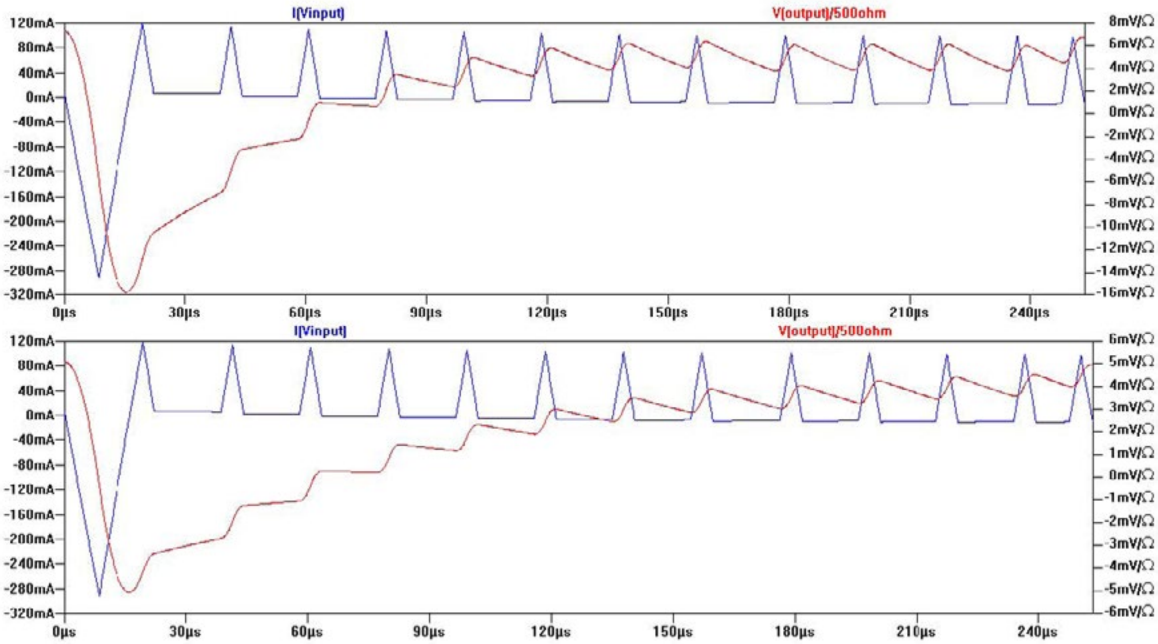


Figure 6 – Limited Current Circuit example; upper: lg-i circuit; lower: s-r circuit

triangular waveform has a peak/rms ratio on the order of 1.75.

This needs to be checked with a larger data set; perhaps with some cooperative effort between test houses. This needs to be reconfirmed as the technology changes (e.g. adding energy efficiency switchers to SMPS) or as other types of equipment start using these techniques.

The acceptability of some simplification needs to be established in the product standards in order to be acceptable in equipment certifications.

Where is all this going?

The issue is growing as mains switching expands to other equipment. Complexity is being added to the present touch current waveforms as energy efficiency requirements are being applied, necessitating the addition of another switching circuit to the product.

Mains switching techniques are being expanded to other classes of equipment to gain efficiency by the use of variable speed drives (VFDs) on household appliances or higher efficiency lighting—LEDs or CFLs that use switch mode power supplies (SMPS), which have been shown to make touch current non-sinusoidal. Solar inverters are using the same techniques. As new standards are being developed (e.g. IEC 62477-1/TC22, IEC 61204-7/TC22e and IEC 61558/TC96) they need to fully implement the IEC 60990 Basic Safety Publication requirements into their standards from the beginning per IEC Guide 1049 which prescribes the incorporation of the BSPs into product standards.

Additionally, since the Frequency Factor curves are a Fourier Transform of the time-current curves (e.g. b-line, the let go-immobilization curve) these circuits could be used to evaluate impulses. The analysis of this is an opportunity for another paper.

Conclusion

What should be done? For touch current measurements, every manufacturer should:

1. Get lab experience in making peak touch current measurements;
2. Collect data on typical touch current waveforms for their product designs;
3. Work with product designers to understand the consequences of design techniques in influencing touch current.

The purpose of this article is to help laboratories and manufacturers see the importance of peak Touch Current measurements specified in product standards. These standards specify peak as well as rms limits. It is technically wrong to make rms measurements of non-sinusoidal waveforms and exposes some users to life threatening electric shock levels.

Additionally, several references have been made to the influence of fast risetime pulses as they affect product touch current.

Designers need to understand the influence of their design choices and not leave touch current as a residual effect to be discovered at the end of the design during testing.

What should be done? For touch current measurements, every test house should:

1. Get lab experience in making peak touch current measurements;
2. Collect data on typical touch current waveforms for products going through their labs;
3. Use peak measurements as specified in technical standards to provide proper protection for users of the products being evaluated.

Test houses need to make the proper interpretation of the measurements so that the desired protection is provided for users. The measurements are straightforward with proper equipment as part of the touch current metering setup.

It is time to move the measurement methods forward to meet the challenge of the application of technology in expanding use today. Investigation of technology changes is needed as progress is made.

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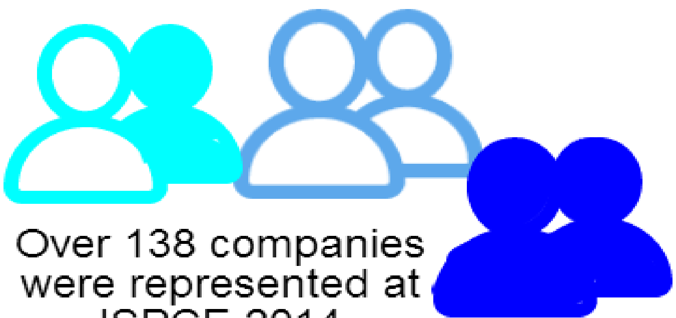

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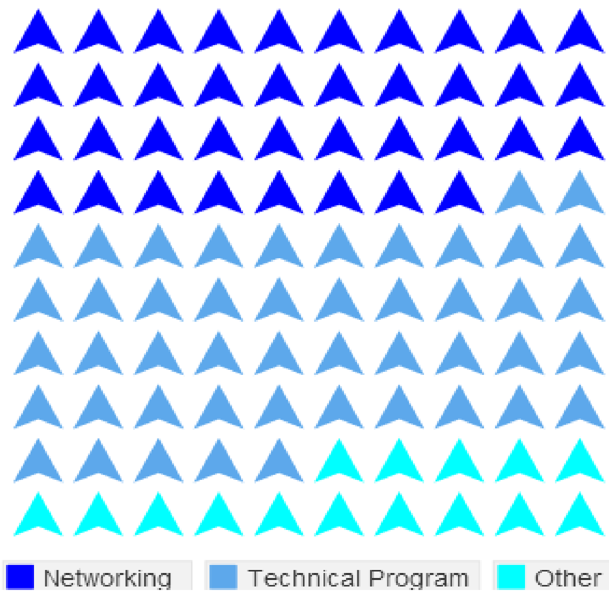

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