Safety Design and Certification For Test and Measurement Products

Part 1

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Have you ever designed a product that you thought was ready to ship only to have it fail testing by not meeting safety requirements? Months can be lost and mistakes repeated if a company doesn't have a first-class safety design philosophy and certification process in place.

Before embarking down the safety design and certification path, an understanding of the important role standards and certification play is essential. When designers become familiar with safety design issues and institute a safety certification process, delays in the shipment of products can be avoided.

Safety certification marks are commonplace in the United States and Europe for household appliances (HHA) and information technology (IT) equipment (computers) due to long-time consumer awareness of potential hazards from electronic products. Safety marks include UL and CSA for North America and VDE, TUV, and Demko for Europe.

Safety awareness among test and measurement product users is increasing because of new high-voltage measurement categories and extra precautions required for safe operation. For example, test and measurement products may see voltages of 1,000 V or higher, which can be accessible during measurement operations via test probes.

In addition to high-voltage potentials, test and measurement products are used in commercial establishments, laboratories, industrial areas, or hazardous locations that require extended operating conditions such as higher temperatures, pollution, or potentially explosive atmospheres. Test and measurement products generally need special installation procedures, labeling requirements, and operating instructions.

With today's higher voltage applications and expanding markets, product design and certification to ensure safety are more important than ever.

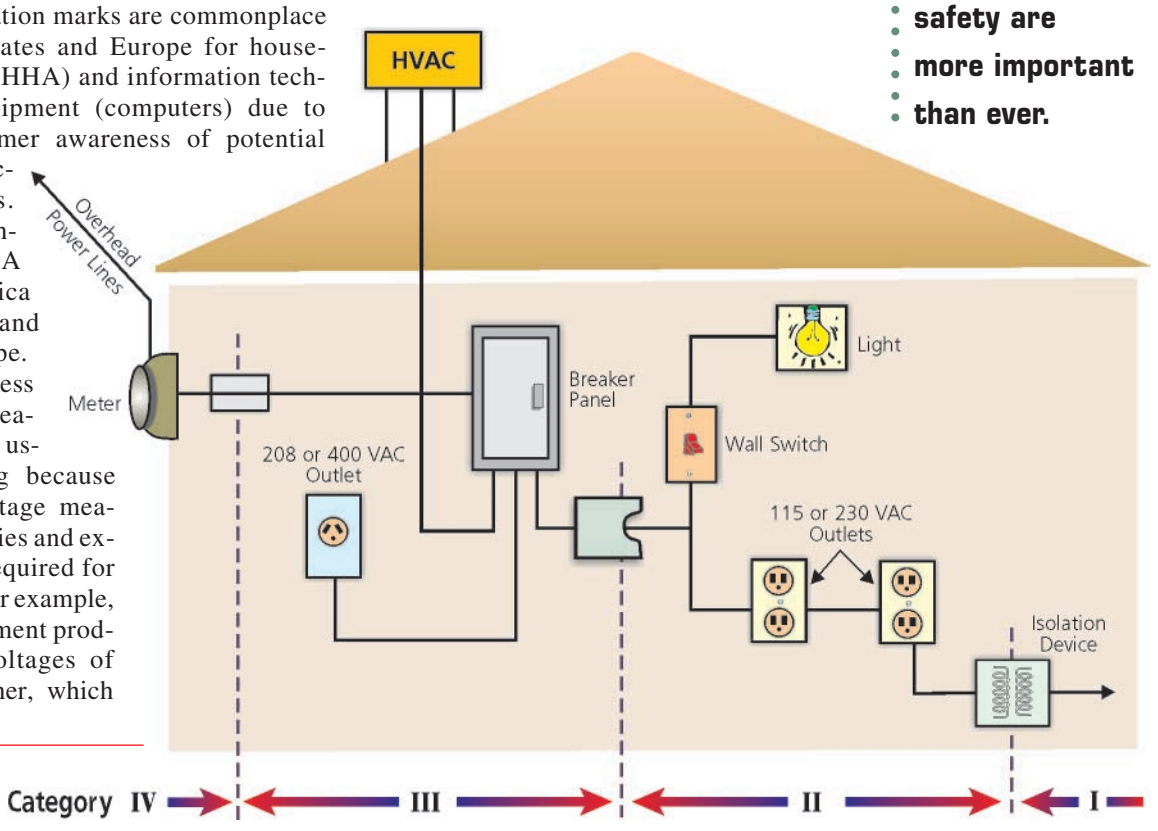

Figure 1. Measurement Categories

	**North American Product Safety Certification** Underwriters Laboratories (UL) and CSA International (CSA) are independent product safety testing and certification organizations. The UL or CSA mark on a product means that it has been tested and determined to meet UL/CSA requirements. Products also are periodically checked at the manufacturer's facility. The combined cULus or cCSAus mark indicates compliance with U.S. and Canadian safety standards such as, UL 3111-1 (UL 61010B-1), UL 3121-1 (UL 61010C-1), and CAN/CSA C22.2 No. 1010.1.
	**European Union Product Safety Certification** Notified Bodies are accredited in Europe for product safety testing and certification according to European norms such as EN 61010-1. The primary goal of the Notified Body is to protect the health of the consumer and provide independent third-party support for the suppliers' CE Marking. Notified Bodies are listed in the *Official Journal of the European Communities (OJ)*. Examples of Notified Bodies are VDE, TUV, and Demko.
	**North American Hazardous Locations Certification** UL, CSA, and FM certify products for use in hazardous locations where explosive atmospheres may be present. Certification covers division and zone area classification systems for the United States and/or Canada according to UL 1604, IEC/UL 60079-15, and CSA C22.2 No.142-M1987. Classification examples include Class I, Division 2, Groups A,B,C,D T4, and Class I, Zone 2, AEx nC IIC T4, and Ex nC IIC T4.
	**European Union Hazardous Locations Certification** The Ex Type Examination Certificate is a statement from an independent Notified Body verifying compliance with the essential requirements of EU Directive 94/9/EC. An example of an explosive atmosphere standard for test and measurement products is EN 50021, Protective System Classification: EEx nC IIC T4.
	**European Union EMC and Safety Declaration** The European Conformity (CE) Marking is affixed to products with input of 50 to 1,000 VAC or 75 to 1,500 VDC and/or for products which may cause or be affected by electromagnetic disturbance. The CE Marking symbolizes conformity of the product with the applicable community requirements such as Directives 89/336/EEC (EMC) and 73/23/EEC (product safety). CE is the manufacturer's or supplier's self-declaration on conformity. Standards for test and measurement products include EN 55011 (EMC emissions), EN 61326 (EMC immunity), and EN 61010-1 (product safety).
	**North American EMI Declaration** The U.S. Federal Communications Commission (FCC) enacted electromagnetic-interference regulations for various products such as transmitters, receivers, information technology, and similar microprocessor-based equipment. To streamline authorization procedures for computers and similar devices and align FCC requirements with those of world markets, the FCC amended Parts 2 and 15 allowing manufacturers self-authorization. U.S. FCC and Industry Canada EMI Verification requirements for a Class A digital device include FCC Part 15 and ICES-003.
	**Australian EMC Declaration** To limit potential problems of electromagnetic interference, the Australian Communications Authority (ACA) introduced an EMC protection framework requiring EMC compliance for electronic products. The C-Tick Mark along with the supplier's registration number indicates that the product complies with Australian EMI Standard AUS/NZ 2064 and establishes a traceable link between the product and the manufacturer.

Table 1. Marks, Certifications, and Declarations Examples

Compliance Standards

Standards are the cornerstone of compliance and the technical rules for product safety design and testing. Areas covered by safety standards include components, enclosures, grounding, insulation, classification, temperature limits, labels and markings, documentation, flammability, and testing.

International technical committees (TC) such as TC66 for test and measurement products develop International Electrotechnical Commission (IEC) standards with inputs from industry, test bodies, and other interested parties. IEC standards are the basis for most standards including UL/CSA and European Norms (ENs).

Standards are considered the minimum acceptable crite-

ria. When a product conforms to the relevant standards, a presumption of conformity exists for the CE Marking. There is no presumption of conformity when standards are not used.

The IEC 61010-1 standard for test and measurement equipment specifies safety requirements for electrical products and associated accessories intended for professional, industrial-process, and educational use when used for test and measurement, control, and in laboratories.

Certification Bodies and Marks

Many countries require proof of safety conformity for electrical products either by a manufacturer's self-verification or a third-party certification mark. Some laws make safety conformity a legal requirement. And with U.S. building codes (NEC), state safety laws, and so many product liability suits, safety conformity is a must for manufacturers in North America.

Certification is an attestation from an accredited third-party verifying that a product or component complies with the relevant standards. Certification allows marks to be affixed to products as visual evidence of conformity. European testing laboratories and certification organizations, known as Notified Bodies for safety, are third parties for product certification in the EU. VDE, TUV, and Demko are examples of EU Notified Bodies. Nationally Recognized Testing Laboratories (NRTLs) are sanctioned by the Occupational Safety and Health Administration (OSHA) for certification of products in North America. UL and CSA are NRTLs. **Table 1** shows examples of safety conformity marks.

The product manufacturer/supplier ultimately is liable for product safety. But a safety mark can enhance a company's sales and limit the manufacturer's risks should the product's compliance come into question.

At first, certification may seem complicated. But once you establish a working relationship with a test and certification body, the rewards of certification marks are seen through increased customer confidence in your products.

CE Marking

Since the introduction of the CE Marking as a mandatory requirement in Europe, past barriers to trade have been lowered, but the public's confusion surrounding the meaning of the mark persists. In addition, market-surveillance audits show that many products bearing only the CE Marking often do not meet the directives. Consumers are beginning to question the CE Marking, especially as it relates to product safety and due diligence.

The European Conformity (CE) Marking is the manufacturer's or importer's self-declaration (self-test) symbol signifying that a product meets applicable EU directives and standards. The CE Marking is for customs authority control, allowing products to circulate freely within Europe.

The CE Marking is the supplier's self-declaration marking for EMC and safety. It allows products to be placed on the market and ensures the free movement of goods, and it encourages authorities to audit and withdraw nonconforming products. It is not a third-party approval, certification, safety mark, or quality mark; it is not appropriate for most components; and it is not intended for sales or marketing purposes.

Due diligence means taking all reasonable steps to ensure conformity. Proving due diligence is difficult under the CE Marking approach. Even though it's the manufacturer's or importer's responsibility, customers have the right to ask if safety conformity was verified by a certification body. Safety marks on products are the manufacturer's best defense of due diligence should a product's conformity come into question.

Product Classifications

Several safety classes relate to test and measurement products depending on the product's working voltage or rating and the operating environment. The classifications that follow apply internationally.

Measurement Category

The measurement category, also referred to as the installation category, establishes standardized impulse-withstand voltage levels that may occur in an electrical distribution system. **Figure 1** depicts the correlation of parts of a building to measurement category. Higher measurement categories mean larger spacing distances on PCBs and, often, larger components. The following definitions are based on IEC 61010-1:

- Measurement Category I—The most benign category with less severe transients. CAT I is for measurements on circuits not directly connected to the AC supply wall outlet such as protected secondaries, signal level, and limited energy circuits.
- Measurement Category II—For measurements performed on circuits directly connected to the electrical distribution system such as provided by a wall outlet (115/230 VAC). Examples are measurements on household appliances or portable tools.
- Measurement Category III—For measurements performed in the building installation at the distribution level such as on hardwired equipment in fixed installation and circuit breakers.
- Measurement Category IV—For measurements performed at the primary electrical supply (<1,000 V) such as on primary overcurrent protection devices, ripple control units, or meters.

Pollution Degree

Conductive dust or moisture can reduce the surface resistivity and voltage-withstand capability of materials, increasing the potential for voltage arc-over. Pollution degrees measure the insulation capability of plastic materials or insulators based on the amount of conductive dust, ionized gas, and moisture. A higher pollution

degree translates into larger PCB spacing distances and components. Offices generally are a degree 2 environment. Some industrial areas are degree 3.

- Pollution Degree 1—No pollution or only dry, nonconductive pollution which has no influence.
- Pollution Degree 2—Normally only nonconductive pollution or temporary conductivity caused by condensation.
- Pollution Degree 3—Conductive pollution or dry, nonconductive pollution which becomes conductive due to condensation.

Part 2

Part 2 of this article focuses on the underlying safety principles needed to design products that are not hazardous to the user. It includes a handy design checklist that outlines important safety considerations for enclosures; grounding, wiring, and connections; labels and markings; and flammability of materials. Part 2 will appear in EE's December issue.

About the Author

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