Navigating the Regulatory Maze with Optocouplers

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To apply optocouplers effectively in power designs, designers must become familiar with the various equipment-level and component-level standards that govern their use.

Galvanic isolation means that no direct electrical connection exists between two circuits or between circuits and accessible parts. Its purpose is to limit transient overvoltages and to electrically segregate circuits that, if connected directly, could allow the flow of harmful voltage, current, energy or charge while allowing the isolated circuits to communicate.

There are two basic types of galvanic isolation: functional and reinforced. Functional isolation only provides for the correct functioning of a piece of equipment, but does not necessarily protect a user from electrical shock. Reinforced isolation is a single isolation system that provides protection equivalent to double insulation.

Although functional isolation can be achieved by various technologies, such as high-voltage integrated circuits (HVICs), reinforced isolation—considered to be failsafe within the maximum specifications—is provided only by qualified pulse transformers and optocouplers. Emerging technologies such as magnetic isolators or magnetic couplers currently can only be considered to provide functional isolation because there is no accepted final worldwide standard that covers them. Designers need to be aware of what isolation quality is required for their end product and choose the right technology to meet those requirements.

Organization Name	Charter
European Committee for Electrotechnical Standardization (CENELEC)	Harmonizing of European standards
Underwriters Laboratories (UL)	U.S. standards
International Electrotechnical Commission (IEC)	International electronic standards
Canadian Standards Association (CSA)	Canadian standards
Deutscher Elektrotechnische Kommission (DKE)	German DIN/VDE standards

Table 1. *Some of the most frequently encountered standards bodies.*

Regulatory Aspects Are Critical

Applications calling for galvanic isolation often take place in environments where high voltages are present. Equipment operators and circuits within equipment may need safe isolation and protection from high voltages. Because of the potential dangers of high voltages, both galvanic isolators and the equipment in which they are used are usually subject to safety standard regulations. Given the large assortment of regulating organizations and associated standards and specifications, regulatory compliance for both optocoupler and equipment manufacturers can be confusing.

Various regions of the world determine their individual standards, and an organization in that country issues approvals or certificates for equipment and products. Since standards bodies have often begun as national organizations, many countries have their own regulatory environment. As international commerce grows, there is a trend toward international safety regulations and standards. **Table 1** shows several of the standards bodies involved with electrical/electronic systems in general and isolation components specifically.

The Underwriters Laboratories (UL), Canadian Standards Association (CSA) and Deutscher Elektrotechnische Kommission (DKE) have similar charters as national standards organizations. In general, each body has its own standards and little overlap is visible between related specifications. DKE authors DIN specifications;

Region	International	Europe	United States	Canada	Germany
Organization	**IEC**	**CENELEC (EN)**	**UL**	**CSA**	**DIN/VDE**
Industrial	204 604	50178	508	14-M91	160
Information Technology Equipment	950	60950	1950	950	60950
Medical	601	60601	2601-1	601	750
Household	65	60065	8730-1	--	860
Measurement and Control	1010-1	61010-1	1262	1010	0410 0411
Telecom	950	60950 41003	1459	225	804

Table 2. *Application categories versus global/regional safety standards.*

for historical reasons, these specifications are often described as VDE (Verband Deutscher Electrotechniker) standards. The VDE Testing and Certification Institute is a neutral and independent body that carries out tests and issues certificates according to either VDE specifications or other acknowledged standards. TÜV (Technischer Uberwachungs-Verein) is another organization that offers test certification to German and international standards.

UL and CSA can be described as standards-writing bodies and third-party certifiers but not as regulatory bodies. The International Electrotechnical Commission (IEC) develops standards and supports the IEC Competent Bodies (CB) program. This program allows the exchange of test data and certifications from third-party certification organizations participating in the CB program. IEC is an international organization comprising of 50 national organzations; it is the only truly global electronics standards organization.

The European Committee for Electrotechnical Standardization (CENELEC) was created to minimize or eliminate regulatory complexities associated with the pan-European Union. The "CE" stamp is granted by CENELEC. The CENELEC specifications, which are European Norm (EN) documents, are often based on existing documents from organizations such as IEC.

Table 2 shows equipment-level specifications from

Region	International	Europe	United States	Canada	Germany
Organization	IEC	CENELEC (EN)	UL	CSA	DIN/VDE
	IEC 60747-5-2	EN 60747-5-2	1577	Component Acceptance Notice #5	DIN EN 60747-5-2

Table 3. *Opto-isolator component-level specifications.*

regulatory organizations for major categories of applications. Each equipment specification is a master document with many subordinate specifications referenced to complete the total regulatory requirements.

Table 3 lists the most significant specifications for opto-isolator components. Equipment-level specifications can reference the component-level specification as a subordinate document, or there may be no direct connection between equipment-level and component-level specifications.

For optocouplers, the most relevant component-level standard today is IEC/EN/DIN EN 60747-5-2. VDE 0884 was the dominant worldwide standard for optocouplers until it was supplanted by IEC/EN/DIN EN 60747-5-2 in January 2004. IEC/EN/DIN EN 60747-5-2 defines safety-related parameters, such as isolation voltages (maximum and working), clearance and creepage distances, and other critical optocoupler-related parameters. The EN and related national authorities, such as German DKE/VDE, follow the IEC for new standards.

Any optocoupler that passes IEC/EN/DIN EN 60747-5-2 testing is certified for reinforced isolation and, therefore, is qualified as an isolator for safety critical applications. The maximum isolation voltages relate to package dimensions (internal and external clearance, creepage), the ability of their dielectric isolation to withstand high voltage, and the mold compound characteristics (comparative tracking index or CTI). In addition, the optocoupler component standards are recognized by various equipment-level standards, which is helpful for the equipment qualification as well.

An increasing amount of safety standards-related information is available on the Internet:

- IEC: www.iec.ch/
- VDE: www.vde-institut.com/vde_pi_en/
- CSA: www.csa.ca/
- CENELEC: www.cenelec.org/
- UL: www.ul.com/
- ANSI: www.ansi.org

A consolidated list of agencies and information is available at the International Product Safety News website, www.safetylink.com. **PETech**