Programmable Logic Controllers and IEC/EN 61010-2-201

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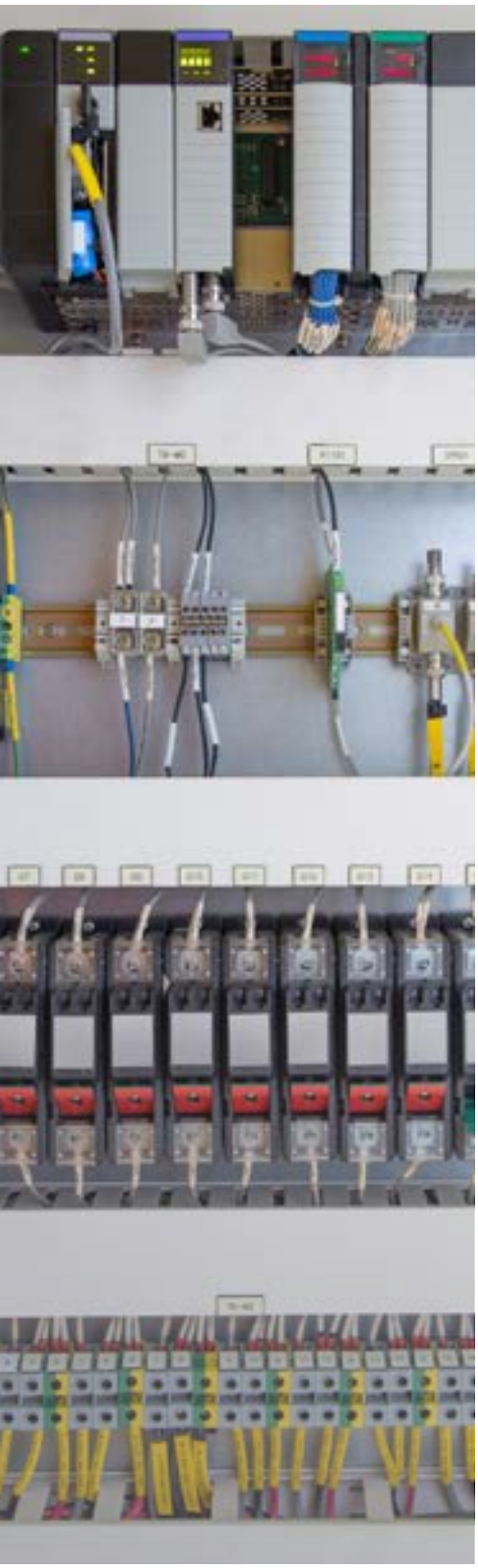

From their initial introduction in the late 1960s, programmable logic controllers have revolutionized the operation of electromechanical machinery and equipment.

The widespread use of programmable logic controllers (PLCs) today supports the operation of all types of production equipment, especially equipment used in modern industrial facilities. Easily adaptable to automating a wide range of tasks, PLCs make it possible to achieve increased production efficiencies in a safe and cost-effective manner.

Numerous efforts have been undertaken over the past few years to harmonize global PLC requirements to reduce the regulatory compliance challenges that manufacturers face when seeking worldwide market access. The 2017 publication of IEC 61010-2-201 represents the most recent effort to harmonize technical requirements. When used in conjunction with IEC 61010-1, this standard addresses the specific safety requirements of PLCs and other devices used in industrial automation and serves as the basis for the certification of PLCs beginning in April 2016.

This UL white paper provides an overview of PLC requirements as presented in IEC 61010-2-201 and the technical changes that PLC manufacturers must address in the certification of new and modified PLC designs. Beginning with a brief history of standards applicable to industrial control equipment, the paper discusses the background and structure of the IEC 61010 series of standards and their national equivalents. The white paper then takes a detailed look at the new and revised technical requirements of IEC 61010-2-201.

The need for standards to keep pace with advanced industrial automation technologies around the world.

Today, manufacturers increasingly rely on automation to reduce production costs and increase efficiencies. Automated industrial processes have also helped manufacturers achieve more consistent product quality, resulting in more reliable products in the marketplace. In many cases, industrial automation has contributed to a reduction in workplace deaths and injuries by minimizing worker exposure to potentially dangerous conditions. In recent years, the combination of new and advanced industrial automation technologies with complex control systems has facilitated the further integration of formerly separate and distinct aspects of the production process. From the receipt of raw materials, through the material handling, production and packaging processes, and ending with the shipment of final products, a fully integrated factory can achieve even greater efficiencies and cost savings than a comparably advanced facility just 15 years ago.

At the same time, the integration of numerous and diverse technologies relying on a high degree of interconnectivity has significantly complicated the design and development of new industrial automation systems and equipment. One factor contributing to these complications has been the slower pace at which applicable standards have changed to address new technologies and performance expectations for industrial automation equipment. In many cases, these delays have resulted in overlapping or conflicting technical requirements, as well as inadequate attention to larger safety and security concerns attributable to entire systems and the environment in which they operate.

In response to requests from manufacturers of industrial automation technologies, the International Electrotechnical Commission (IEC) began a major initiative in 2011 to address these concerns. Following an extensive internal review process, the IEC determined the need to revamp its approach to standards intended for use with industrial automation systems and equipment under the scope of its international safety certification scheme, the IEC System for Conformity Assessment Schemes for Electrotechnical Equipment (IECEE) CB Scheme. Specifically, the IEC created a new product standards category, industrial automation technology (INDAT), intended to include all standards directly related to products used in industrial automation applications.

The IEC also formed a new joint working group (JWG) as a mechanism to support the development of more in-depth technical expertise in the application of technology to industrial automation processes. The JWG included participants from IEC technical committee (TC) 65 and TC 66, and the formation of JWG 13 also helped to centralize the IEC's oversight of applicable industrial automation equipment standards. JWG 13 now evaluates existing industrial automation equipment standards and addresses gaps in safety coverage either by modifying existing requirements or developing new standards.

These and other efforts by the IEC, as well as national standards bodies and certification organizations, are expected to result in more globally consistent technical requirements for all types of industrial automation equipment and systems. A consistent standardization approach will help to streamline the testing and certification process for new industrial automation technologies. Further, an internationally recognized group of standards for industrial automation equipment is an essential requirement for the application of the IECEE's CB Scheme to this important product group, and it will strongly support product acceptance by regulators around the world.

PLCs and IEC 61010-2-201

An essential element of nearly every type of industrial automation technology, PLCs have previously been subject to different standards with divergent technical requirements. IEC 61131-2 has provided the primary technical requirements for PLCs in the European Union (EU) and many other countries around the world. However, the U.S. and Canada have employed different standards to evaluate PLCs, with UL 508, the Standard for Safety of Industrial Control Equipment, applicable in the U.S. and CAN/CSA-C22.2 No. 142 applicable in Canada.

While the technical requirements of these U.S. and Canadian PLC standards were generally consistent with each other, they differed in significant ways from IEC 61131-2. The key differences could be found in creepage and clearance distances, required protection types, and the classification of loads, e.g., HP rating versus AC-3, or pilot duty rating versus AC-1. These and other technical differences resulted in conflicting

testing requirements for PLC manufacturers seeking to achieve compliance with regulations in major global markets. As part of its revamped approach to industrial automation standards, the IEC published in February 2013 a new technical standard for PLCs, IEC 61010-2-201.

Developed for use in conjunction with IEC 61010-1 for the evaluation and certification of PLCs, the new standard incorporates electrical safety requirements previously found in IEC 61131-2. Concurrent with the publication of IEC 61010-2-201, the European Committee for Electrotechnical Standardization (CENELEC) released EN 61010-2-201, a harmonized version of the standard applicable to PLCs sold or imported into the EU.

The move toward globally harmonized requirements for PLCs continued in January 2014, when UL published UL 61010-2-201, the Standard for Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 2-201: Particular Requirements for Control Equipment, to be used in conjunction with UL 61010-1, the Standard for the Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements, for U.S. certification of PLCs. A short time later in April 2014, CAN/CSA-C22.2 No. 61010-2-201, a harmonized version of IEC 61010-2-201 for the certification of PLCs in Canada, was published. Both the UL and Canadian Standards Association (CSA) harmonized standards have been directly adopted from IEC 61010-2-201 and include no national deviations.

The publication of IEC 61010-2-201 and equivalent versions of the standard in the EU, the U.S. and Canada have now resulted in a single set of harmonized technical requirements that are broadly applicable to PLCs regardless of where they are manufactured or sold. This change will significantly reduce design challenges for PLC manufacturers and eliminate the need for duplicate testing to meet regulatory requirements in key target markets.

Scope and new requirements of IEC 61010-2-201 for PLCs

IEC 61010-2-201 is a particular standard under the IEC 61010 series of industrial automation standards that specifically addresses safety requirements and related verification tests for PLCs and a variety of other types of industrial control equipment. Specific types of control equipment covered under the scope of the standard include:

- Programmable logic controllers (PLCs)
- Programmable automation controllers (PACs)
- Distributed control systems (DCSs)
- Remote input/output (I/O)
- Industrial and panel PCs, as well as programming and debugging tools (PADTs)
- Displays and human-machine interfaces (HMIs)
- Positioners

The specific technical requirements for PLCs detailed in IEC 61010-2-201 differ from those in IEC 61131-2, UL 508, the Standard for Industrial Control Equipment, and CAN/CSA-22.2 No. 142 in a number of key aspects. Some of the most notable new and revised technical requirements include:

- **Durability of marking** — PLCs are now tested for the durability of markings when exposed to cleaning materials or isopropyl alcohol. This is a new requirement.
- **Double insulation** — Under IEC 61010-2-201, all accessible parts must be separated from any hazardous part by two levels of protection. Current PLC standards in the U.S. and Canada require only a single level of protection.
- **Protection against mechanical hazards** — IEC 61010-2-201 requires evaluation for specific mechanical hazards, including sharp edges and moving or removable parts, as well as the risk of equipment instability or fall. In current PLC standards, protection against mechanical hazards associated with enclosures is generally addressed with specific construction requirements and by references to other standards.
- **Risk assessment for mechanical hazards** — In certain circumstances, IEC 61010-2-201 requires a risk assessment procedure to evaluate each hazard for severity, probability of exposure and possibility of avoidance. The outcome of this assessment determines the appropriate protective measures that must be applied to mitigate identified hazards. This is a new requirement.
- **Production line testing** — Additional testing of production line product samples is required. New required tests include protective earth, voltage testing and floating circuits testing. For voltage testing, IEC 61010-2-201 uses different values than those found in UL 508 and CAN/CSA-22.2 No. 142. The floating circuits test is a new requirement under the standard, should a PLC have a floating circuit.
- **Single fault testing** — A number of specified components are subject to testing under single fault conditions, including motors, capacitors, mains transformers, interlocks and other components. UL 508 and CAN/CSA-22.2 No. 142 did not call out specific components for testing under single fault conditions.
- **Enclosures** — IEC 61010-2-201 incorporates specific requirements for enclosures and materials within the standard. In addition, fire enclosures and materials involving a fire hazard must have a minimum V-1 flame rating. For PLCs that form a part of an end product enclosure, such as a panel-mounted PLC, it may be necessary to apply the environmental ratings specified in UL 50E, the Standard for Safety of Enclosures for Electrical Equipment, Environmental Considerations.

In addition to demonstrating compliance with the technical requirements specified in IEC 61010-2-201, manufacturers seeking PLC certification will also be expected to meet the general safety requirements detailed in IEC 61010-1.

Transition timelines and other considerations

In most jurisdictions, April 1, 2016, was the target date for transitioning to the requirements of IEC 61010-1 and IEC 61010-2-201. In the EU, presumption of conformity with the essential requirements of the EU's Low Voltage Directive (2006/95/EC) mandates that PLCs comply with the technical requirements of EN 61010-1 and EN 61010-2-201 (the EU's harmonized versions of IEC 61010-1 and IEC 61010-2-201) beginning on that date. April 1, 2016, corresponds with the published date of withdrawal of EN 61131-2, the EU's harmonized equivalent of IEC 61131-2 and the current PLC safety standard in the EU.

In the U.S., UL had established a transition plan to the new PLC standards that aligns with that of the EU. As of April 1, 2016, UL no longer accepts new submittals for evaluation of PLCs to either UL 508 or UL 61131-2. Instead, new applications for Recognition or Listing to UL Standards will be evaluated according to the requirements of UL 61010-1 and UL 61010-2-201.

PLC certifications issued in accordance with the requirements of UL 508 or UL 61131-2 prior to April 1, 2016, remain in effect. UL also allows testing of alternate constructions of currently UL Recognized or UL Listed products to the requirements of UL 508 or UL 61131-2.

Canada has not announced a date for the transition to CAN/CSA 22.2 No. 61010-1 and CAN/CSA 22.2 No. 61010-2-201, and their position on certification of PLCs remains unclear. However, this situation is subject to change, and it is recommended that manufacturers investigate possible changes in advance of scheduled testing.

Presently, JWG13 is working on IEC 61010-2-201 third edition, which is presently in draft form and is anticipated to be completed in late 2021. Details of the changes and effective dates will be established upon publication.

Summary and conclusion

The adoption of IEC 61010-1 and IEC 61010-2-201 as the basis for the evaluation of PLCs and other types of industrial control equipment has created some challenges. Manufacturers need to adapt existing and planned PLC designs to the new requirements and prepare for more thorough and rigorous testing of their products. At the same time, the acceptance by regulators of globally harmonized requirements for PLCs will significantly ease testing and certification, reduce compliance-related costs and allow PLC manufacturers to more quickly gain legal access to important markets without the need for additional testing.

UL has extensive experience in industrial control systems and equipment, as well as most industrial automation technologies, and offers a complete suite of safety testing and certification services for PLCs. In addition to testing PLCs for compliance with U.S., Canadian and EU harmonized equivalents of IEC 61010-1 and IEC 61010-2-201, UL is a national certification body with worldwide CB testing laboratories (CBTL) under the IECEE's CB Scheme, offering a single source for testing and evaluation required by more than 50 additional countries around the world.

For more information about UL's services for PLCs, visit UL.com/PLCs or contact us at UL.com/contact-plcs.

UL has also published a helpful guide called, "Frequently Asked Questions for the Transition from UL 508 to UL 61010-1 and UL 61010-2-201," which addresses a number of additional issues of interest to manufacturers whose products are currently UL Listed or UL Recognized.

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IEC 61010-2-201 is primarily a safety standard and does not address reliability, functionality or performance requirements, nor any other properties not directly related to the safety of the equipment. The standard also does not include any mechanical or environmental requirements related to operation, transport or storage of equipment. It does not cover electromagnetic compatibility (EMC) requirements, which continue to be addressed in the IEC 61326 or IEC 61131 series of standards. Finally, IEC 61010-2-201 does not directly address requirements that may be applicable regarding functional safety, which are covered by IEC 61508 or IEC 61131-6, or protective measures applicable to equipment used in explosive atmospheres, which is covered by IEC 60079 series of standards.

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