

PROGRAMMABLE LOGIC CONTROLLERS AND IEC 61010-2-201



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

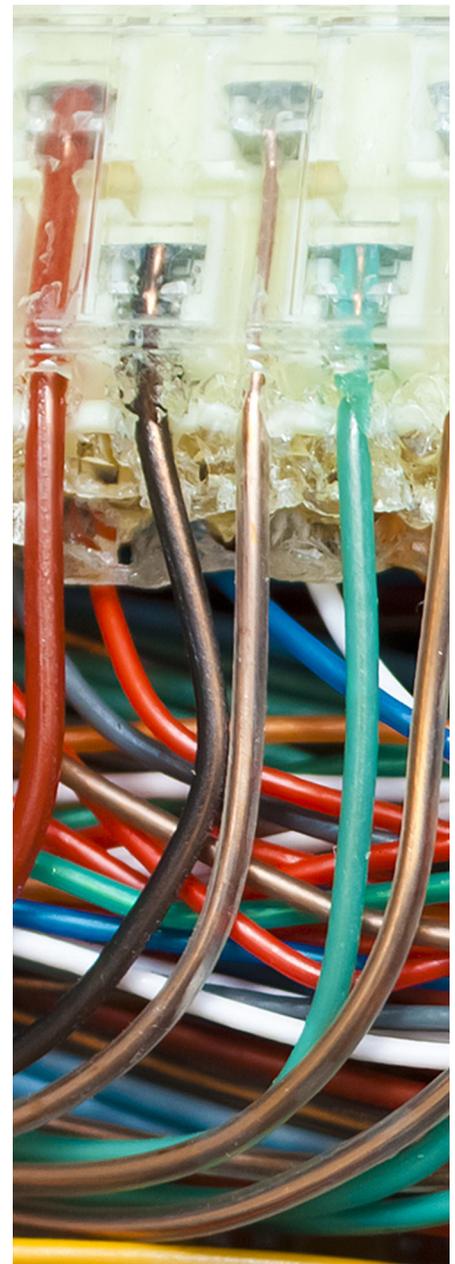
The widespread use of PLCs today is essential to the operation of all types of production equipment, especially equipment used in modern industrial facilities. Easily adaptable to automating a wide range of tasks, PLCs make it possible to achieve increased production efficiencies in a safe and cost-effective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

Numerous efforts have been undertaken over the past few years to harmonize global PLC requirements to reduce the regulatory compliance burden on manufacturers seeking worldwide market access. The most recent effort to harmonize technical requirements is represented by the 2013 publication of IEC 61010-2-201, Safety requirements for electrical equipment for measurement, control and laboratory use – Part 2-201: Particular requirements for control equipment. When used in conjunction with IEC 61010-1, Safety requirements for electrical equipment for measurement control and laboratory use – Part 1: General requirements, this standard addresses the specific safety requirements of PLCs and other devices used in industrial automation, and will serve 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, and concludes with information about timelines for transitioning to the new standard.

Industrial Automation and the Standards Shortfall

Industrial automation technologies have dramatically transformed the business of manufacturing around the world. Today, manufacturers increasingly rely on automation to reduce production costs and increase production efficiencies. Automated industrial processes have also helped manufacturers achieve more consistent product quality, resulting in more reliable products in the marketplace. And, 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 10 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 relatively slow 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 CB Scheme. Specifically, it created a new product standards category, INDAT (industrial automation technology), 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. Comprised of participants from IEC Technical Committee (TC) 65 and TC 66, the formation of JWG 13 also helped to centralize the IEC's oversight of applicable industrial automation equipment standards. JWG 13 is now responsible for evaluating existing industrial automation equipment standards, and addressing 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 IEC's CB Scheme to this important

product group, and 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, Programmable controllers—Part 2: Equipment requirements and tests, has provided the primary technical requirements for PLCs in the European Union (EU) and in 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, Process Control Equipment, 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 vs. AC-3, or pilot duty rating vs. 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, to be used in conjunction with UL 61010-1 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 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 as well as 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 as well as a variety of other types of industrial control equipment. Specific types of control equipment covered under the scope of the standard include:

- Programmable controllers (PLCs and programmable automation controllers, PACs)
- Components of distributed control systems (DCSs)
- Components of remote input/output (I/O) systems
- Industrial computers, as well as programming and debugging tools (PADTs)
- Human-machine interfaces (HMIs)
- Stand-alone power supplies
- Any other type of product that performs the function of control equipment and/or its associated peripheral devices

The specific technical requirements for PLCs detailed in IEC 61010-2-201 differ from those in IEC 61131-2, UL 508 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.

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, issues which continue to be addressed in the IEC 61131 series. Finally, IEC 61010-2-201 does not directly address requirements that may be applicable regarding functional safety, electromagnetic compatibility or protective measures applicable to equipment used in explosive atmospheres.



- 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 the current standards. 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. Current PLC standards in the U.S. and Canada do not call out specific components for testing under single fault conditions.

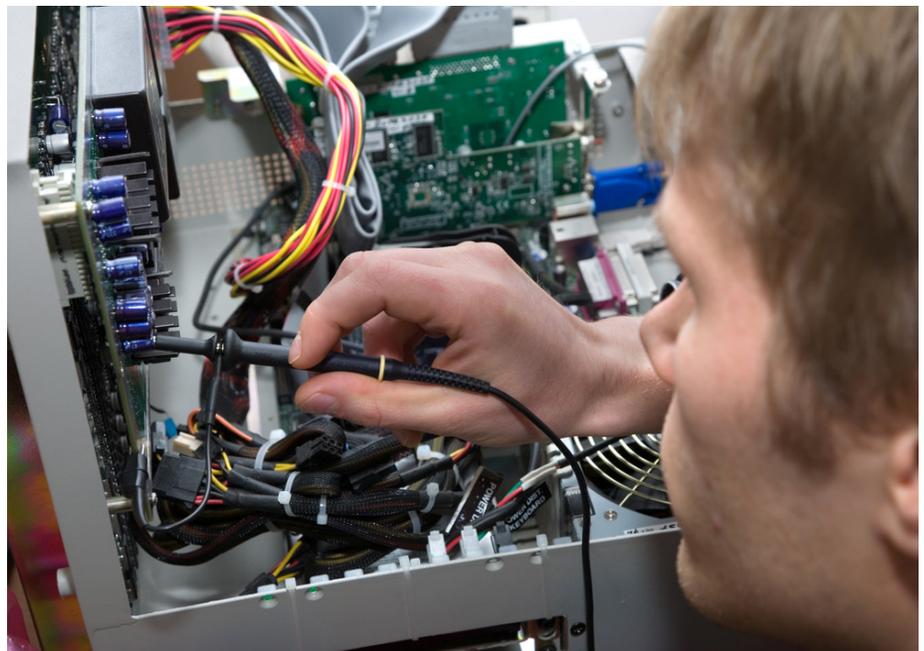
- Enclosures—UL 61010-2-201 incorporates specific requirements for enclosures and materials within the standard. In addition, fire enclosures and materials involving a fire hazard must have a minimum V-1 flame rating. For PLCs that form a part of an end-product enclosure, such as a panel-mounted PLC, 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 Time Lines and Other Considerations

In most jurisdictions, April 1, 2016, is 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 has established a transition plan to the new PLC standards that aligns with that of the EU. As of April 1, 2016, UL will no longer accept new submittals for approval of PLCs to either UL 508 or UL 61131-2. Instead, new applications for Recognition or Listing to UL standards will be reviewed 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 will remain in effect after that date. UL will also allow testing of alternate constructions of currently Recognized or Listed products to the requirements of UL 508 or UL 61131-2 after April 1, 2016.

As of this writing (August 2015), 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. Instead, it is expected that Canada will continue to permit the use of PLCs certified to CAN/CSA 22.2 No. 142 and CAN/CSA-E61131-2 (the harmonized equivalent of IEC 61131-2), as well as PLCs certified to the new standards. However, this situation is subject to change, and it is recommended that manufacturers investigate possible changes in advance of scheduled testing.

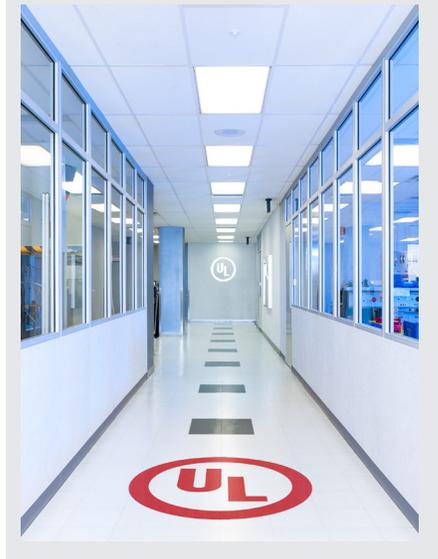
Summary and Conclusion

The pending adoption of IEC 61010-1 and IEC 61010-2-201 as the basis for the approval of PLCs and other types of industrial control equipment is likely to create some challenges in the short term. Manufacturers will 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 the testing and certification burden, 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 also a recognized CB testing laboratory (CBTL) under the IECCE's CB Scheme, offering a single source for testing and approval required by more than 50 additional countries around the world.

For more information about UL's services for PLCs, contact Steven Brown at Steven.A.Brown@UL.com, or John Kovacik at John.R.Kovacik@UL.com.

UL has also published "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 508 listed or recognized. This helpful guide is available at <http://industries.ul.com/blog/uls-standard-transition-from-ul-508ul508c-to-iec-based-standards?>



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