Technical Note 023

UL 508C transition to UL 61800-5-1
Impact on Short Circuit Current Rating

The following technical note reviews the recent withdrawal of the UL 508C standard and the implementation of the UL 61800-5-1 standard as its replacement. It will cover why the new standard was developed, the transition from UL 508C to UL 61800-5-1 and the changes impacting the investigation and testing requirements for Power Conversion Equipment (VFDs). Specifically, the Short Circuit test and the Breakdown of Components test as the drive products are tested and certified for their assigned levels of SCCR.

Harmonization of the UL, CSA and IEC standards

Beginning in 2013 the UL standard, UL 508C was harmonized with the European standard IEC 61800-5-1 and the Canadian standard CSA 22.2 No 240. The result is the UL 61800-5-1, STANDARD FOR SAFETY Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal and Energy standard adopted in 2016.

The goal of the harmonization process was to combine the multiple standards and achieve "common investigation requirements" that are acceptable to Europe, United States, and Canada. The new, harmonized UL 61800-5-1 replaces the former UL 508C standard in the United States and, with a few exceptions, meets the requirements of Canada's CSA C22.2 No 274 standard. As a result, Power Conversion Equipment products investigated to the UL 61800-5-1 standard would gain UL and CSA approval and labels.

All the words used to define requirements in the new UL standard are adopted from the IEC 61800-5-1 standard. Not all UL requirements are covered by the IEC standard thus, additions or deletions to those words are used to reflect "national differences" specific to North America. As an example, NEMA and UL environmental type ratings for enclosures are not the same as the IP ratings used in the IEC standard.

UL 508C to UL61800-5-1 transition

The UL 61800-5-1, Part 5-1: Safety Requirements apply to all new drive designs, as well as modifications of existing VFD product designs. As of February of 2020, UL508C is withdrawn and only UL 61800-5-1 is being used to investigate new products or changes to existing product lines.

Using a continuing certification approach, the products that are certified to UL 508C will remain certified after the 508C standard is withdrawn. Changes made to exiting drive products will require that the products be transitioned to the UL 61800-5-1 and be investigated for the new requirements that are significantly different from the UL508C.

Significant differences between UL 508C and UL 61800-5-1

For the IEC requirements that were in effect 'equivalent' to the UL 508C standard, the IEC standard wording was adopted into the UL 61800-5-1. For the most part the IEC requirements were similar, or the differences easily adopted. In these cases, the changes have minimal impact, such as the adoption of enclosure mechanical requirements or the testing for temperature or abnormal operation.

There are, however, new adopted requirements that represent significant differences to the UL 508C or CSA C22.2 No 274 standards. The most impactful differences are the: Short Circuit test and the Breakdown of Components test which will require changes to how drive circuits are designed and protected.

Short Circuit test

UL 508C has been evolving over the years with the latest version 4 released in May of 2016. The later versions offered voluntary testing requirements similar to those that are now adopted in UL 61800-5-1. Originally, the UL 508C only required the drive's output connections to the motor be tested to meet UL 508C requirements for short circuit current ratings. UL 61800-5-1 now requires that the internal components must be tested for both standard fault current and high fault current levels based on the manufacturer's short circuit current rating being assigned. ABB drives in North America are typically tested to an assigned level of 100 kA, SCCR.

This represents a significant change when combined with changes to what parts of the drive circuit must now be tested to withstand these fault currents. This makes the Breakdown of Component testing a more important part of the overall VFD investigation and certification process.

Breakdown of Components test

All power outputs including the DC bus power section will need to be tested under UL61800-5-1. And they will need to be tested in a test circuit with a source fault current the same as the drive's rated fault current withstand rating being assigned. The assigned level of SCCR for ABB drives products in North America will typically be 100 kA SCCR.

The Breakdown of Components test for internal components is now to be performed at all the main power output components within the drive. This includes the diode bridge, the DC bus capacitors/power section and at the IGBTs. These components are upstream of the drive's solid-state protection which means the drive's overcurrent protection is not engaged and would not be able to stop a fault current event that occurs at these components.

In most cases, an upstream current interrupting device is now needed to protect the input feeder and the power conversion equipment from fault current events occurring at components within the drive circuit. The current interrupting device whether it is a circuit breaker, drive input fuses, or a combination of both will need to be selected to provide the required level of ampere interrupting capacity (AIC) and support the assigned SCCR (kA).

This is key since the fault current event can be considered to occur at any point in the drive circuit. The VFDs investigated to UL 61800-5-1, in most cases, will now require drive input fusing to create the withstand protection of the short circuit fault current levels being tested and assigned.

Impact on drive designs

Drive products investigated to the later versions of UL 508C and to the new UL 61800-5-1 will have to meet the Breakdown of Components test requirements. The most likely way to provide for the often-specified 100 kA short circuit current rating (SCCR) will be to place overcurrent protection, in most cases in-line fuses, upstream of the drive input terminals. For 'drive only' products sold without an overcurrent protection device upstream of the drive input, the statement of SCCR would have to be changed to the conditional statement of… '100 kA SCCR with proper upstream fusing'.

It is important to note that the ABB low voltage drives offered in North America meet the appropriate UL safety requirements for Adjustable Speed Electrical Power Drive Systems. Whether they were investigated under UL 508C and carry that certification or investigated to the newly adopted UL 61800-5-1, Part 5-1: Safety Requirements, ABB drive products will continue to be evaluated against the most current UL safety standards.

Summary

The main impact of the UL 61800-5-1 adoption and transition from UL 508C is that the variable frequency drives will now be tested at all critical components within the drive circuit. Evaluating the circuit for fault current events occurring at these component locations will require, in most cases, that drive input fuses are used to insure the proper levels of AIC and SCCR.

You are seeing that drive packages now have drive input fusing in series with the drive's main power disconnect means and protection. For the bypass designs the drive path will have input fusing in series with the drive and the drive package's main disconnect and protection.

With the expanded testing required by UL 61800-5-1 a wider selection of manufactures' fuses are now available to be used with our drives. Most of our drives can now be protected with class T, J, CC, and CF fuses. This provides the end

user more flexibility and options to maintain drive system protection. In addition, circuit breakers and manual motor protectors (MMPs) are now available protection with most of the drive module applications.

ABB has worked closely with UL to ensure compliance with the 61800-5-1 requirements. This is very important moving forward as new and existing UL requirements will reference the 61800-5-1 standard and build on its protections.

- The upcoming (June 2024) transition of UL 1995 to UL 60335-2-40 will rely on 61800-5-1.
- UL 508A which relied on UL 508C will now rely on UL 61800-5-1.

With respect to the transition from UL 508C to UL 61800-5-1 we know that:

- the transition from UL 508C to UL 61800-5-1 was done with the intent of creating a standard that, while being based upon and adopting IEC requirements, would incorporate national differences that would address U.S. installation requirements (NFPA 70, US National Electrical Code).
- UL is using a Continuing Certification approach for the implementation of the new UL 61800-5-1. Products that are certified to UL 508C may remain certified after the withdrawal of UL 508C without an investigation to UL 61800-5-1 (assuming significant modifications are not made).
- the new UL 61800-5-1 standard will replace UL 508C. The harmonization committee chose to adopt IEC requirements which make the requirements of UL 61800-5-1 and UL 508C not equivalent. There are also modifications made to requirements through national differences that make the requirements of UL 61800-5-1 and UL 508C not equivalent.

References

The overview of changes and some of the summary statements in this Technical Note are derived in part from the UL presentation, *UL 508C for Motor Drives Has Been Withdrawn - Learn About its Replacement UL 61800-5-1*; presented by Seth Carlton. The recorded presentation is available for viewing from the UL.com website. Another reference to consider on this subject is the FAQs document available on the www.UL.com site.