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Short Circuit Current Ratings & Solid-State Relays

By Dr. Oscar Montero, Crydom, Inc.
Global Technical Center



New Challenges for Industrial Panel Builders

The 2005 National Electrical Code ([more information](#)) now requires most control panels to be marked with their short-circuit current rating (SCCR). This change affects all industrial control panels (409.110), industrial machinery panels (670.3(A)), and non-residential HVAC equipment rated greater than 60A (440.4(B)). Furthermore, all industrial control panels listed to UL508A must be marked with their SCCR. Supplement SB in UL508A, which became effective on April 1, 2006, is referenced by the NEC as an approved method for establishing the SCCR of a panel.

As with most every change to the NEC, safety is the primary concern of this new requirement. Under abnormal operating conditions, such as an electrical fault, a control panel may be subjected to thousands of amperes of let-through current before any protective device(s) inside the panel clears the fault. Such an event may cause severe damage to power components and electrical wiring, which can compromise the integrity of the Panel and result in injury to nearby personnel.

Proper matching between the maximum available current from the power supply and the SCCR for the panel is fundamental to ensure safety. From the Panel users point of view, Panels with a higher SCCR allows them the flexibility to connect their Panel to electrical systems with different available currents. From the Panel builder's point of view, establishing this higher SCCR may represent significant challenges and additional costs.

Establishing the SCCR for Control Panels

Even though supplement SB from UL508A defines how the SCCR for an Industrial Panel is established, determining the Panel's actual SCCR may not be so straightforward. The simplest method to obtain the Panel's rating is by analyzing the individual power components in each branch of the circuit. The component with the lowest rating determines the SCCR for the entire branch. Subsequently, the branch with the lowest rating determines the SCCR for the entire panel.

Typical Components found in a branch circuit of an industrial control panel:

Circuit Breakers	SSRs
Contactors	Drives
Motor Controllers	Fuses
NEMA Contactors	Transformers
Terminal Blocks	Receptacles
Meter Sockets	Switch Units

Despite the fact that the SCCR rating for SSRs was not available in the past (nor was such a rating required) it is obvious from the above example that this is a critical part of



Crydom
Custom Sensors & Technologies
2320 Paseo de las Americas, Suite 201
San Diego, CA 92154
Tel: (877) 502-5500
Fax: (619) 710-8540
www.crydom.com
sales@crydom.com



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determining the rating for the entire panel. Per UL508A supplement SB, components that do not have such a rating are given one based upon their specific category. SSRs, which do not have a specific category, are considered to fall under “Switches”, “Switch Units”, or “Motor Controller, 0-50HP”. The rating for unmarked components in these categories is 5kA, and the use of such component in a branch circuit effectively reduces the entire panel to the same rating.

Extract of Data from UL 508A Table SB4.1
Assumed maximum short circuit current rating for unmarked components
(Eff. April 25, 2006)

Component	SCCR, kA
Bus bars	10
Circuit breakers (including GFCI type)	5
Current meters	*
Fuseholder	10
Industrial control equipment	
a. Auxiliary devices (overload relay)	5
b. Switches (other than mercury tube type)	5
c. Mercury tube switches	
- Rated over 60 amperes or over 250V	5
- Rated 250 volts or less, 60 amperes or less, and over 2 kVA	3.5
- Rated 250 volts or less and 2 kVA or less	1
Motor controller, rated in horsepower (kW)***	
a. 0-50 (0-37.3)	5***
b. 51-200 (38-149)	10***
c. 201-400 (150-298)	18***
d. 401-600 (299-447)	30***
e. 601-900 (448-671)	42***
f. 901-1500 (672-1193)	85***
Meter socket base	10
Miniature or miscellaneous fuse	10**
Receptacle (GFCI type)	2
Receptacle (other than GFCI type)	10
Supplementary protector	0.2
Switch unit	5
Terminal block or power distribution block	10

It must be realized that any rating from this table is subject to meeting what UL defines as conditions of acceptability. It is strongly recommended to check with UL about those conditions for any unmarked component that may be included in the Panel. Moreover, it should be noticed that the rating assigned to the SSR may have an impact on determining the rating for the whole Panel, as will any other power component inside the Panel.

Establishing the SCCR for Solid-State Relays

Per UL508A, short-circuit current ratings can be conveniently established for individual power components, or for combination of power components, or for the Control Panel as a whole. Crydom has elected to test a combination of SSRs with protective devices (fuses initially) in order to meet the conditions of acceptability necessary to assign the standard 5kA rating to the combination. However, most Crydom customers desire a SCCR rating higher than 5kA for their panel in order to be more competitive in the market. For this reason, Crydom is undertaking a series of tests in order to significantly increase the UL approved SCCR ratings for their relays.

The tricky part is selecting the right fuse for not only the application, but also for the desired SCCR rating for the combination. It is understood that under sizing the fuse may compromise performance, while over sizing the fuse may impact the safety of the Panel. Not to mention add unnecessary cost. To further complicate the issue, fuses of the same physical size may have different current ratings (i.e. a 60A fuse is the same physical size as a 45A fuse). This is a significant UL concern, as field service technicians could easily replace a fuse with one of identical size but having a higher current rating. Such an error could potentially result in damage to the relay, the load, or nearby personnel.

Therefore, UL requires that the relay-fuse combination be tested with an “umbrella fuse”. That is, the fuse used in the combination must have the highest possible current rating available for that particular fuse package. Since UL approval with a rated fuse covers all fuse ratings up to that value, the “umbrella fuse” method



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adequately addresses this concern. Crydom's test plan involves multiple relays of different load-current ratings in combination with the highest possible "umbrella fuse" combination. This not only meets UL's safety requirements, but also provides panel builders with flexibility in selecting the right relay for their application and their specific SCCR requirements.



Similar to fuses, solid-state relay manufacturers tend to follow a typical industry-standard footprint. However, unlike fuses, each manufacturer's relays may have significant design differences that affect thermal performance, power dissipation, mechanical stress/fatigue, etc. Therefore, the "umbrella" concept does not apply in the same manner as it does for fuses. So simply substituting one relay with an "equivalent" relay from another manufacturer will not likely result in an equivalent short-circuit current rating.

It should be remembered that SCCR is strongly related to safety, and therefore great caution must be used when changing solid-state relays in control panel.

Who Should be Concerned Over SCCR?

While the new NEC code focuses primarily on the North American market, Panel Builders selling outside of the US may also be affected by the change. Any panel requiring UL Listing, regardless of its final destination, must be marked with a SCCR. In addition, some regions outside of the US may enforce NEC 2005 as an additional safety measure for local installations. Panels in such locations must also have their SCCR clearly marked.

To add to the confusion, some states in the US have not yet adopted NEC 2005. Therefore, they do not yet require the SCCR marking on panels. However, as stated above, a UL Listed panel installed in that particular state must have an approved SCCR, regardless of the state's regional requirements.

SCCR for Crydom Solid-State Relays

To date, testing for selected combinations of solid-state relays and fuses performed in an UL approved Schneider Electric Laboratory and witnessed by an UL representative has yielded the results shown in the table(s) below. Current and potential customers of Crydom solid-state relays should note the following:

- Equivalent relays from different manufacturers may not have similar SCCR. Caution is advised when relays are rated in combination with protective devices.
- The following table(s) contains both UL approved and manufacturer approved relay/fuse combinations. The manufacturer approved combinations are highlighted / italicized. The table(s) also contains generic and specific fuse information. Panel builders can use the



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generic information in their manufacturing procedure. For example, generic information is when protected by a 30Amp Class J Fuse. In these cases, it is allowed to use fuses of the same class with lower ratings.



- Data for a specific manufacturers fuse (i.e. “when protected by a AJT80 Class J Fuse”) was obtained in a manner identical to the procedure for generic information (i.e. “when protected by a $\leq 30A$ Class J Fuse”). As with the generic evaluation, the specific testing was also witnessed by a UL representative. However, UL does not allow for a SSR to be marked with a specific manufacturers fuse. Regardless, the information remains valuable, as it may be used only as a reference to help panel builders better understand the limits of the branch where the specific relay-fuse combination is located. This information will help in determining the panels overall SCCR in cases where the panel is tested as a complete system.
- Crydom relays are able to operate safely at ratings higher than 5kA. Crydom is currently working on meeting all UL conditions of acceptability to achieve higher SCCR for various relay-fuse combinations. Please check the Crydom

website for regular updates or contact support@crydom.com for assistance on any issue related to our product’s SCCR.

- Additional helpful information can be found at [Schneider Electric NEC409/UL508 Support Website](#) and [Crydom Technical Support](#).
- Please contact your Crydom sales representative if you require official information regarding a SSR’s rating.



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Crydom Solid-State Relay Short-Circuit Current Ratings (SCCR)*

Product Family		Suitable for use in a circuit capable of delivering not more than:					
		5kA @ 600Vrms (symmetrical)	22kA @ 600Vrms (symmetrical)	50kA @ 600Vrms (symmetrical)			
H12 Series 25A Solid-State Relays, followed by D/CD/WD, followed by 4825 Additional Products Covered: Series 1 (240/480Vac), H10, and HA/HD relays of the same ratings and construction are represented by Series H12	When protected by; 10Amp Class J fuse OR 10Amp Class CC fuse UL - E116949, Vol. 1	When protected by; 30Amp Class J fuse OR 30Amp Class CC fuse UL - E116949, Vol. 1	When protected by; 30Amp Class J fuse OR 30Amp Class CC fuse UL - E116949, Vol. 1	When protected by; AJT40 Class J fuse AJT40 Class J fuse	Pending	Pending	200kA @ 600Vrms (symmetrical)
	H12 Series 50A Solid-State Relays, followed by D/CD/WD, followed by 4850 Additional Products Covered: Series 1 (240/480Vac), H10, and HA/HD relays of the same ratings and construction are represented by Series H12	When protected by; 30Amp Class J fuse OR 30Amp Class CC fuse UL - E116949, Vol. 1	When protected by; 60Amp Class J fuse OR 30Amp Class CC fuse UL - E116949, Vol. 1	When protected by; 60Amp Class J fuse OR 30Amp Class CC fuse UL - E116949, Vol. 1	Pending	Pending	Pending
CWD4850 / CWA4850	When protected by; 30Amp Class J fuse OR 30Amp Class CC fuse UL - E116949, Vol. 1	When protected by; 60Amp Class J fuse OR 30Amp Class CC fuse UL - E116949, Vol. 1	Pending	Pending	Pending	Pending	Pending
H12 Series 90A Solid-State Relays, followed by D/CD/WD, followed by 4890 Additional Products Covered: Series 1 (240/480Vac), H10, and HA/HD relays of the same ratings and construction are represented by Series H12. H12WD4875 also represented in this category	When protected by; 45Amp Class J fuse OR 30Amp Class CC fuse UL - E116949, Vol. 1	Pending	When protected by; AJT150 Class J fuse AJT150 Class J fuse ATDR30 Class CC fuse HSJ60 Class J fuse	Pending	Pending	Pending	Pending
H12WD48125 Additional Products Covered: H12D48125, H12CD48125, and CWA24125	When protected by; 50Amp Class J fuse OR 30Amp Class CC fuse UL - E116949, Vol. 1	When protected by; 100Amp Class J fuse OR 30Amp Class CC fuse UL - E116949, Vol. 1	Pending	When protected by; AJT200 Class J fuse	Pending	Pending	Pending
CKRD6030 Additional Products Covered: CKRD4830 and CKRD2430	When protected by; AJT40 Class J fuse LPJ40 Class J fuse	When protected by; AJT80 Class J fuse	Pending	Pending	Pending	Pending	Pending
CMRD6045 Additional Products Covered: CMRD4845 and CMRD2445	When protected by; AJT80 Class J fuse LPJ80 Class J fuse	When protected by; AJT80 Class J fuse	Pending	Pending	Pending	Pending	Pending
CMRD6065 Additional Products Covered: CMRD4865 and CMRD2465	When protected by; AJT80 Class J fuse LPJ80 Class J fuse	When protected by; AJT175 Class J fuse	Pending	Pending	Pending	Pending	Pending
H12D4840D Additional Products Covered: D2440D	When protected by; ATDR30 Class CC fuse	When protected by; ATDR30 Class CC fuse	When protected by; ATDR30 Class CC fuse	When protected by; ATDR30 Class CC fuse	Pending	Pending	Pending

*Notes regarding listed SCCR

Updated as of March 27, 2007

Non italicized / non highlighted cells are UL Approved ratings

Models with lower voltage ratings are also represented

Models using suffixes are also represented

Class CC fuses are commercially available up to 30A only