WHITE PAPER

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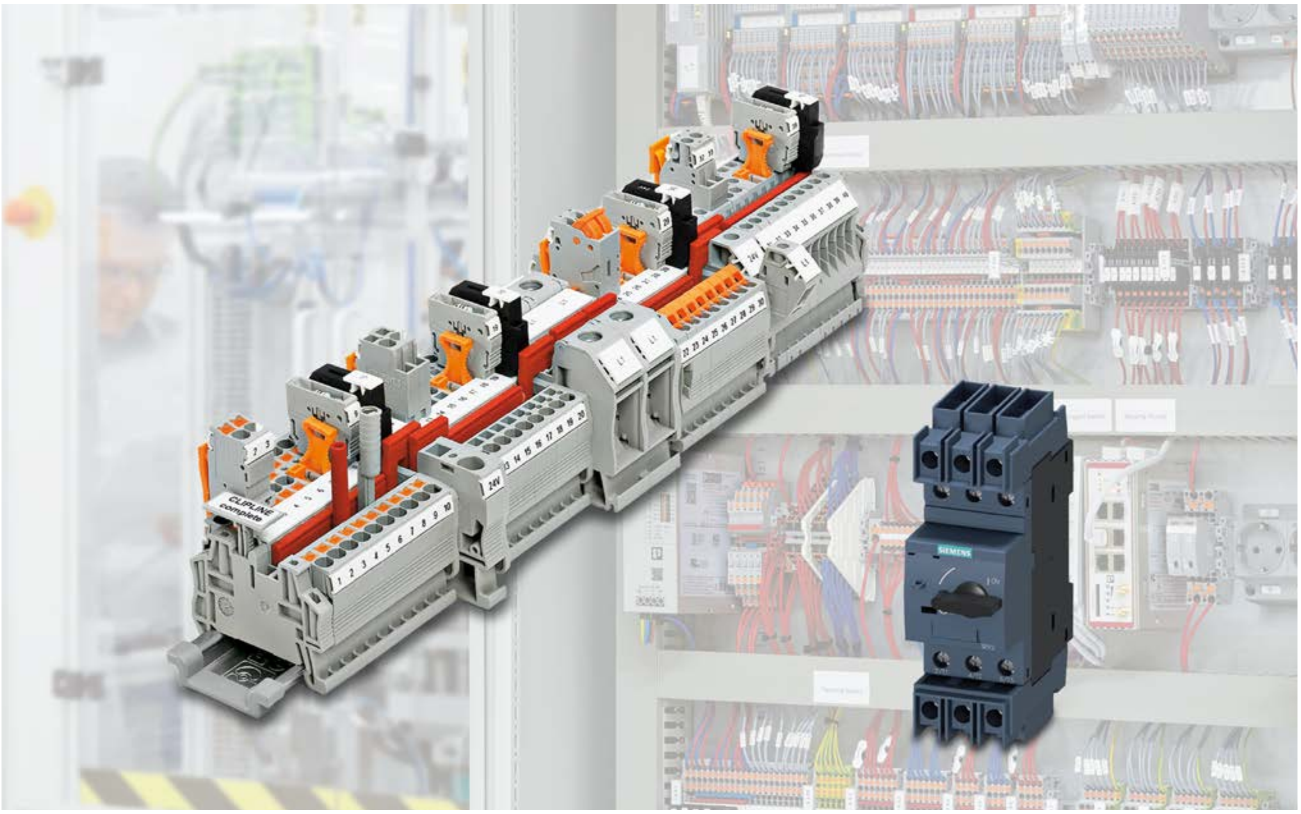

Figure 1: Combinations made up of Phoenix Contact terminal blocks and Siemens circuit breakers can withstand maximum short-circuit currents in accordance with the NEC® directive. ***Image source:*** Phoenix Contact/Siemens AG 2022, all rights reserved.

High-fault short-circuit current ratings (SCCR) for Phoenix Contact terminal blocks combined with Siemens circuit breakers

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INSIDE

Introduction

Since 2005, the National Electrical Code (NEC) has required documentation of a short-circuit current rating for switching devices. As of 2017, it also requires documentation of potential short-circuit current at the point of installation. These rules also affect process engineering systems. Tested combinations of terminal blocks and circuit breakers make it easier to use modern protective devices and avoid expensive conversions.

NEC requirements

The requirement to document the short-circuit current rating was enacted in 2005. Since then, the SCCR rating of a switching device must be shown on its rating plate. In section 409.110, the NEC states that the SCCR value of a switching device must either be based on a listed and labeled design or calculated based on a recognized and proven method.

All switching devices in the U.S. need approval per UL, including process engineering equipment. Here, the NEC refers to UL 508A, which cites a recognized method to calculate a switching device's SCCR in Supplement SB. Because many switching devices are not typically manufactured as a series product, this method is used in numerous cases. In particular, this applies

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to exporters who distribute their devices on the North American market and may have to convert them.

Engineers can use Table SB 4.1 in UL 508A as a guide for any components that do not have their own tested SCCR value. An SCCR value indicated there can be assumed for the components listed. Generally, though, these values are too low because, in practice, the short-circuit current that is expected at the installation location is usually higher. For example, an SCCR of 10 kA can be assumed for terminal blocks and 5 kA for circuit breakers. In the past, systems were often commissioned anyway, because the potential short-circuit current did not need to be documented and was often not available. With the change in the 2017 NEC, this is no longer an option, because the potential short-circuit current at the installation site must now be known and documented. During commissioning, the SCCR value of the system is now compared with the available short-circuit current. If the value of the system is lower, it does not comply with the directive and must not be commissioned. Costly reworking is the result.

Tested components and combinations

The recommended approach is, therefore, to consider the highest possible SCCR value when planning the switching device or to use the available short-circuit current as the basis for planning.

Tested components and devices from the manufacturer are helpful for the design. They make it easier to fill the weakest link in the chain with a component that has been tested with a "high-fault SCCR." This is because the component with the lowest SCCR in the load circuits also represents the SCCR of the entire system.

For years, tested combinations of terminal blocks and fuses have been available for the Clipline complete system. With an SCCR of 100 kA, they generally exceed the usual maximum possible fault currents at the installation site.

SCCR tests are now also firmly anchored in UL 1059, the specification for terminal blocks. They require that the combination of terminal block and circuit breaker be subjected to the targeted short-circuit current. Even though the guard trips, the momentary current flow and phase shift create magnetic fields, causing the connecting cables to reciprocally repel each other. The forces will stress the terminal block, particularly at the connection point. The test is passed if the condition of the terminal block afterward corresponds to its condition before the test.

Given that not every lab has a test current of 100 kA or greater, manufacturers usually have to commission external labs to conduct the tests. This causes the expended effort and the costs to skyrocket. At the same time, the testing effort for the terminal block and fuse combination is still manageable. In accordance with UL 248, the fuses are standardized in the relevant throughput and maximum values I^2t and Ipeak. As a result, the tested combinations apply regardless of the manufacturer of the fuses.

The standardization does not provide any default values for Ipeak and I^2t for circuit breakers. Ultimately, the breaking capacity and the characteristics are also distinctive features of each manufacturer. So, there is no test combination possible that would cover all devices on the market, and manufacturers need to look at each combination separately. Consequently, the high-fault SCCR values for the terminal block/circuit breaker combination have only been available to a very limited extent so far (Figure 2).

Fuse or circuit breaker?

There is no right or wrong answer to this question. In comparison, fuses are less expensive and depend less on ambient temperature.

Figure 2: Components and devices from manufacturers being tested in the high-voltage lab

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In turn, circuit breakers offer much more in terms of functions. They have short-circuit and overload protection, high switching capacities, the capability to be used multiple times, an included status indicator, the ability to be used as ON/OFF switches, and a long-term stable characteristic curve, just to name a few of the differences. They are used in applications requiring motorized and non-motorized loads and applied in switching devices in load circuits relevant to the SCCR. This is why they are also usually tested and documented with a high-fault SCCR.

Some circuit breakers have connection block accessories because of the different air clearance and creepage distance requirements between IEC and UL. They create the distances required by UL. Usually, the circuit breakers are wired to terminal blocks in the switching devices, meaning the connecting cables only have to be connected to the terminal blocks on site.

Siemens and Phoenix Contact have compiled a test portfolio of combinations of circuit breakers and modular terminal blocks in a joint project. It encompasses a total of more than 150 tested combinations covering the majority of applications. Here, terminal blocks were tested in combination with circuit breakers and combination motor controllers.

Circuit breakers are used with non-motor loads such as heaters and busbars. Combination motor controllers, on the other hand, have built-in overload protection and are used exclusively for motor loads as defined by UL.

The portfolio extends from small circuit breakers with a maximum of 15 A to devices with a maximum current of 250 A.

The terminal blocks tested in combination with the circuit breakers comply with this output data. To meet the globally different requirements relating to wiring, terminal blocks with push-in and screw connection technology have been taken into account.

These tested components and devices can also be used in combination following UL 508A. Switching devices that were not originally designed by manufacturers for the U.S. market no longer require costly conversion that involves wiring the circuit breakers directly or even replacing them with fuses.

Conclusion

Using Phoenix Contact modular terminal blocks increases the reliability of planning switching devices for the American market. The terminal blocks have been tested in combination with fuses per UL 248 with an SCCR of 100 kA. New additions are the tested combinations with circuit breakers with a high-fault SCCR of 50-65 kA.

Documentation of the SCCR values in the UL Product IQ: (see Figure 3 on page 4).

- The tested combinations of Phoenix Contact modular terminal blocks and guards (fuses and circuit breakers) are listed in UL product IQ in file E60425
- The corresponding applicable output data of the terminal blocks and circuit breakers are listed here as well

Cat. No.	Line	Load	Mfr	Type	Max Amp	SCCR, RMS Sym, Ka	Volts Max
PT 2.5, PT 2.5-TWIN, PT 2.5-QUATTRO, PT 2.5-PE, PT 2.5-TWIN-PE, PT 2.5-QUATTRO-PE	14-12 Str	14-12 Str	Siemens	3RV2721.., 3RV2821..	22	50	480
PT 2.5, PT 2.5-TWIN, PT 2.5-QUATTRO, PT 2.5-PE, PT 2.5-TWIN-PE, PT 2.5-QUATTRO-PE	14-12 Str	14-12 Str	Siemens	3RV2711.., 3RV2811..	15	65	480
PT 2.5, PT 2.5-TWIN, PT 2.5-QUATTRO, PT 2.5-PE, PT 2.5-TWIN-PE, PT 2.5-QUATTRO-PE	14-12 Str	14-12 Str	Siemens	3RV2011.., 3RV2021..	25	65	480
PT 4, PT 4-TWIN, PT 4-QUATTRO, PT 4-PE, PT 4-TWIN-PE, PT 4-QUATTRO-PE	14-10 Str	14-10 Str	Siemens	3RV2721.. 3RV2821..	22	50	480
PT 4, PT 4-TWIN, PT 4-QUATTRO, PT 4-PE, PT 4-TWIN-PE, PT 4-QUATTRO-PE	14-10 Str	14-10 Str	Siemens	3RV2711.. 3RV2811..	15	65	480
PT 4, PT 4-TWIN, PT 4-QUATTRO, PT 4-PE, PT 4-TWIN-PE, PT 4-QUATTRO-PE	14-10 Str	14-10 Str	Siemens	3RV2011.. 3RV2021..	25	65	480
PT 6, PT 6-TWIN, PT 6-QUATTRO, PT 6-PE, PT 6-TWIN-PE, PT 6-QUATTRO-PE	14-8 Str	14-8 Str	Siemens	3RV2721.. 3RV2821..	22	50	480
PT 6, PT 6-TWIN, PT 6-QUATTRO, PT 6-PE, PT 6-TWIN-PE, PT 6-QUATTRO-PE	14-8 Str	14-8 Str	Siemens	3RV2021..	32	50	480
PT 6, PT 6-TWIN, PT 6-QUATTRO, PT 6-PE, PT 6-TWIN-PE, PT 6-QUATTRO-PE	14-8 Str	14-8 Str	Siemens	3RV2011.. 3RV2021..	25	65	480
PT 10, PT 10-TWIN, PT 10-PE, PT 10-TWIN-PE	14-6 Str	14-6 Str	Siemens	3RV2721.., 3RV2821..	22	50	480
	14-6 Str	14-6 Str	Siemens	3VA51..	60	65	480
PT 10, PT 10-TWIN, PT 10-PE, PT 10-TWIN-PE	14-6 Str	14-6 Str	Siemens	3RV2031.. 3RV2032..	52	65	480
PT 16 N, PT 16-TWIN N, PT 16 N-PE, PT 16-TWIN N-PE	14-4 Str	14-4 Str	Siemens	3RV2742..	70	65	480
PT 16 N, PT 16-TWIN N, PT 16 N-PE, PT 16-TWIN N-PE	14-4 Str	14-4 Str	Siemens	3VA51..	125	65	480
PT 16 N, PT 16-TWIN N, PT 16 N-PE, PT 16-TWIN N-PE	14-4 Str	14-4 Str	Siemens	3RV2041.., 3RV2042..	100	65	480
PTPOWER 35, PTPOWER 35-F, PTPOWER 35-PE	14-2 Str	14-2 Str	Siemens	3VA51..	125	65	480
PTPOWER 50, PTPOWER 50P, PTPOWER 50-F, PTPOWER 50-PE PTPOWER 50P-F	8-1/0 Str	8-1/0 Str	Siemens	3VA51..	125	65	480
PTPOWER 35, PTPOWER 35-F, PTPOWER 35-PE	14-2 Str	14-2 Str	Siemens	3RV2041.., 3RV2042..	100	65	480
PTPOWER 50, PTPOWER 50P, PTPOWER 50-F, PTPOWER 50-PE PTPOWER 50P-F	8-1/0 Str	8-1/0 Str	Siemens	3RV2041.., 3RV2042..	100	65	480
PTPOWER 95, PTPOWER 95-F, PTPOWER 95-F-P, PTPOWER 95 P, PTPOWER 95-PE	4-4/0 Str	4-4/0 Str	Siemens	3VA52..	250	65	480

Figure 3: Excerpt from the UL Product IQ with tested combinations made up of Phoenix Contact push-in terminal blocks and Siemens circuit breakers
Image source: UL product IQ, https://iq.ulprospector.com/en/profile?e=167499

ABOUT PHOENIX CONTACT

Phoenix Contact is a global market leader based in Germany. Phoenix Contact produces future-oriented components, systems, and solutions for electrical controls, networking, and automation. With a worldwide network reaching across more than 100 countries, and with over 20,300 employees, Phoenix Contact maintains close relationships with its customers, which is essential for shared success. The company's wide variety of products makes it easy for engineers to implement the latest technology in various applications and industries. Phoenix Contact focuses on the fields of energy, infrastructure, process, and factory automation.

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