CT432
Short Circuit Current Ratings
Calculation and Tools
Overview

Evaluating Panel SCCR

Additional Design Tools

Summary
Overview

Why Understanding SCCR is Important
Importance of Short-Circuit Current Ratings

- **Short-Circuit:**
  - An overcurrent fault that exceeds normal full load currents... 10x, 100x, 1,000x of FLC
  - Catastrophic results if SC Faults are not cleared properly

- **SC Faults are critical to:**
  - Worker safety
  - Customer applications (critical care, continuous process)
  - Circuit components, assemblies and system installations
  - Productivity and downtime ($100k’s per hour)

- **We forget how much “power” we are really discussing:**
  - “65kA @ 400V”
  - “100kA @ 480V”
  - “80kA @ 690V”

- Recent changes to NEC and UL have mandated for a wider range of electrical panels to be marked with the Short Circuit Current Rating (SCCR) of the panel.
- Local inspectors are having to more strictly enforce that the SCCR rating of a panel Meets or Exceeds the available fault current where it is connected.
Evaluating Panel SCCR

The Steps
What is a Short-Circuit Current Rating?

- **Short-Circuit “Interrupting Rating” (Breaking Capacity):**
  - The maximum short circuit current at rated voltage that an overcurrent protective device can safely interrupt and clear (fuses and circuit breakers)

- **Short-Circuit Current Rating – SCCR:**
  - The maximum available short-circuit current an electrical component can sustain without the occurrence of excessive damage *when protected with* an overcurrent protective device

- **“Motor Protection Circuit Breaker”**
  - Protective Device
  - Icu/Ics = 65kA @ 400V

- **“Combination Motor Controllers”**
  - Icu/Ics = 65kA @ 400V
  - IEC Type “2” Coordination
Building a Short-Circuit Current Rating

- Protection Levels:
  - Component
  - Combinations
  - Branch circuit
  - Panel Assembly

- Motor Protection Circuit Breaker
  - Icu/Ics = 65kA @ 400V

- Combination Motor Controllers
  - Icu/Ics = 65kA @ 400V
  - IEC Type “2” Coordination

- Panel SCCR
  - 65kA @ 400V

- Branch Circuit SCCR
  - 65kA @ 400V

Manufacturer Name: ABC Company
Voltage: 480V
Phase: 3 Phase
Frequency: 60 Hz

Full Load Current: 300 Amperes
Short Circuit Current Rating: 65,000A

Maximum Circuit Breaker Rating: 400A

* Suitable for use on a circuit capable of delivering not more than 65,000 symmetrical amperes of short-circuit current.
Common Global SCCR Requirements

- Determine system voltage and frequency
- Determine Available Fault Currents (AFC)
- Ensure control panel SCCR covers the AFC
- Mark the panels accordingly

SCCR “Evaluation Process” varies greatly

- 480V, 60 Hz
UL 508A Supplement SB

- Short-Circuit Current Ratings for Industrial Control Panels shall be determined by the following evaluation procedure:

SB4.1: Short-Circuit Current Rating (SCCR)

a) First, establish the short circuit current ratings of individual power circuit components as specified in SB4.2

b) Second, modify (limit) the available short-circuit current within a portion of a circuit in the panel due to the presence of current limiting components as specified in SB4.3

c) Third, determine the overall panel short-circuit current rating as specified in SB4.4
SB4.2.1 All power circuit components, including disconnect switches, branch circuit protective devices, branch circuit fuse holders, load controllers, motor overload relays, terminal blocks, and bus bars, shall have a short-circuit current rating expressed in amperes or kilo-amperes and voltage.

- **Exception No. 1:** Power transformers, reactors, current transformers, dry-type capacitors, resistors, varistors, and voltmeters are not required to have a short circuit current rating.
- **Exception No. 2:** The “S” contactor of a wye-delta motor controller is not required to have a short-circuit current rating.
Motor Starter Coordination

Type 1 Coordination

Under short circuit conditions, the contactor or starter shall cause no danger to persons or installation and may not be suitable for further service without repair and replacement of parts.

Type 2 Coordination

Under short circuit conditions, the contactor or starter shall cause no danger to persons or installation and shall be suitable for further use. The risk of contact welding is recognized, in which case the manufacturer shall indicate the measures to be taken in regards to equipment maintenance.

Type F Coordination

Under short circuit conditions, no damage to the motor protection circuit breaker is permissible. The contactor may be inoperative and require replacement.

Self-Protected Coordination

Under short circuit conditions, no damage to the contactor, overload relay, or other parts is permissible.
SB4.2.2 – The short circuit current rating of a component shall be established by one of the following methods:

- **A)** – The short circuit current rating marked on the component or instructions provided with the component.

- **B)** – The short circuit current rating determined by the voltage rating of the component and the assumed short circuit current from Table SB4.1; or

- **C)** – The short circuit current rating for a load controller, motor overload relay, or combination motor controller that has been investigated in accordance with the performance requirements, including short circuit test requirements for standard fault currents or high fault currents specified in the Standard for Industrial Control Equipment, UL 508, and described in the manufacturer’s Procedure.

### Table SB4.1

<table>
<thead>
<tr>
<th>Component</th>
<th>Short circuit current rating, kA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus bars</td>
<td>10</td>
</tr>
<tr>
<td>Circuit breaker (including GFCI type)</td>
<td>5</td>
</tr>
<tr>
<td>Current meters</td>
<td>10</td>
</tr>
<tr>
<td>Current shunt</td>
<td>10</td>
</tr>
<tr>
<td>Fusenholder</td>
<td>10</td>
</tr>
<tr>
<td>Industrial control equipment:</td>
<td></td>
</tr>
<tr>
<td>a. Auxiliary devices (overload relay)</td>
<td>5</td>
</tr>
<tr>
<td>b. Switches (other than mercury tube type)</td>
<td>5</td>
</tr>
<tr>
<td>c. Mercury tube switches</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Rated over 60 amperes or over 250 volts</td>
</tr>
<tr>
<td></td>
<td>Rated 250 volts or less, 60 amperes or less, and over 2 kVA</td>
</tr>
<tr>
<td>Motor controller, rated in horsepower (kW)</td>
<td></td>
</tr>
<tr>
<td>a. 0 – 50 (0 – 37.3)</td>
<td>5°</td>
</tr>
<tr>
<td>b. 51 – 200 (38 – 149)</td>
<td>10°</td>
</tr>
<tr>
<td>c. 201 – 400 (150 – 298)</td>
<td>18°</td>
</tr>
<tr>
<td>d. 401 – 600 (200 – 447)</td>
<td>30°</td>
</tr>
<tr>
<td>e. 601 – 900 (446 – 671)</td>
<td>42°</td>
</tr>
<tr>
<td>f. 901 – 1500 (672 – 1193)</td>
<td>85°</td>
</tr>
<tr>
<td>Meter socket base</td>
<td>10</td>
</tr>
<tr>
<td>Miniature or miscellaneous fuse</td>
<td>10°</td>
</tr>
<tr>
<td>Receptacle (GFCI type)</td>
<td>2°</td>
</tr>
<tr>
<td>Receptacle (other than GFCI type)</td>
<td>10°</td>
</tr>
<tr>
<td>Supplementary protector</td>
<td>0.2°</td>
</tr>
<tr>
<td>Switch unit</td>
<td>5°</td>
</tr>
<tr>
<td>Terminal block or power distribution block</td>
<td>10°</td>
</tr>
</tbody>
</table>

* A short circuit current rating is not required when connected via a current transformer or current shunt. A directly connected current meter shall have a marked short circuit current rating.

* A short circuit current rating for motor controller rated within specified horsepower range.
UL 508A SB4.2.2

Determining the SC Circuit Rating of Components


Our Global Short-circuit Current Ratings (SCCR) Tool provides coordinated high-fault branch circuit solutions for motor starters, soft-starters, and component drives.

DOWNLOAD THE GLOBAL SCCR TOOL

The one-line bill of materials provides coordinated high fault SCCR ratings for all power devices used in the circuit, which saves customers time and effort to find and determine these ratings. The data provided by the Global SCCR Tool is based in compliance to IEC and UL standards.

Please complete the form to download the Global SCCR Selection Tool.
UL 508A SB4.2.2

Determining the SC Circuit Rating of Components

UL 508A SB4.2.2
Determining the SC Circuit Rating of Components

UL 508A SB4.2.2

Determining the SC Circuit Rating of Components

UL 508A SB4.2.2

Determining the SC Circuit Rating of Components

UL 508A SB4.2.2

Determining the SC Circuit Rating of Components

### Determining the SC Circuit Rating of Components

**UL 508A SB4.2.2**

#### Short-circuit Coordination

**Shunt Type:**
- AC Inductive - Non-Resonant
- DC Inductive - Resonant

**Data Sheet****
- UL 508A SB4.2.2
- Determining the SC Circuit Rating of Components

http://www.rockwellautomation.com/global/support/globalsccr.page

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<table>
<thead>
<tr>
<th>Breaker Type</th>
<th>AC Inductive Frequency Band</th>
<th>DC Inductive Frequency Band</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
</tr>
</tbody>
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**Table 1:**

<table>
<thead>
<tr>
<th>Breaker Type</th>
<th>AC Inductive Frequency Band</th>
<th>DC Inductive Frequency Band</th>
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</thead>
<tbody>
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</tbody>
</table>

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**Table 2:**

<table>
<thead>
<tr>
<th>Breaker Type</th>
<th>AC Inductive Frequency Band</th>
<th>DC Inductive Frequency Band</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Notes:**

- [Note](#)
- [Note](#)
- [Note](#)
- [Note](#)
- [Note](#)

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**Diagram:**

- Rockwell Automation

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**UL 508A SB4.2.2**

Determining the SC Circuit Rating of Components

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### Short-circuit Coordination

**Starter Type:** AC Variable Frequency Drive

**S.C. Protective Device:** PowerFlex 525

**Input/Output Contactors:**
- UL/CSA Class J or T Fuses, Current Limiting
- Optimized Fuse Selection for Component Sizing
- 100-C, 1005-C
- 100-C to 100S-C and 193-E1 Plus, E3 & E3 Plus
- 460V 60Hz (480V Line)
- 480V 60Hz

**Rated Operating Voltage:**
- 100kA (rms sym.)
- Type "Y" or "g" per IEC 60947-4

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#### Motor Ratings

<table>
<thead>
<tr>
<th>HP</th>
<th>Input [A]</th>
<th>Output [A]</th>
<th>w/o EMC (Cat. No.)</th>
<th>w/ EMC (Cat. No.)</th>
<th>Max Fuse Size</th>
<th>Disconnect Switch Cat. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>1.1</td>
<td>1.7</td>
<td>325-D1P4N104</td>
<td>25B-D1P4N114</td>
<td>J, T 6</td>
<td>194R-J30-1753</td>
</tr>
<tr>
<td>3/4</td>
<td>1.6</td>
<td>2.9</td>
<td>325-D2P3N104</td>
<td>25B-D2P3N114</td>
<td>J, T 6</td>
<td>194R-J30-1753</td>
</tr>
<tr>
<td>1</td>
<td>2.1</td>
<td>2.9</td>
<td>325-D2P3N104</td>
<td>25B-D2P3N114</td>
<td>J, T 6</td>
<td>194R-J30-1753</td>
</tr>
<tr>
<td>1</td>
<td>2.1</td>
<td>2.9</td>
<td>325-D2P3N104</td>
<td>25B-D2P3N114</td>
<td>J, T 6</td>
<td>194R-J30-1753</td>
</tr>
<tr>
<td>2</td>
<td>3.0</td>
<td>5.2</td>
<td>325-D4P0N104</td>
<td>25B-D4P0N114</td>
<td>J, T 10</td>
<td>194R-J30-1753</td>
</tr>
<tr>
<td>3</td>
<td>3.4</td>
<td>6.2</td>
<td>325-D4P0N104</td>
<td>25B-D4P0N114</td>
<td>J, T 15</td>
<td>194R-J30-1753</td>
</tr>
<tr>
<td>4</td>
<td>4.6</td>
<td>6.9</td>
<td>325-D6P0N104</td>
<td>25B-D6P0N114</td>
<td>J, T 15</td>
<td>194R-J30-1753</td>
</tr>
<tr>
<td>5</td>
<td>7.6</td>
<td>12.6</td>
<td>325-D10N104</td>
<td>25B-D10N114</td>
<td>J, T 20</td>
<td>194R-J30-1753</td>
</tr>
<tr>
<td>7</td>
<td>11.1</td>
<td>14.5</td>
<td>325-D10N104</td>
<td>25B-D10N114</td>
<td>J, T 30</td>
<td>194R-J30-1753</td>
</tr>
<tr>
<td>10</td>
<td>14.0</td>
<td>18.4</td>
<td>325-D10N104</td>
<td>25B-D10N114</td>
<td>J, T 40</td>
<td>194R-J30-1753</td>
</tr>
<tr>
<td>15</td>
<td>21.0</td>
<td>26.4</td>
<td>325-D20N104</td>
<td>25B-D20N114</td>
<td>J, T 50</td>
<td>194R-J30-1753</td>
</tr>
<tr>
<td>20</td>
<td>27.0</td>
<td>33.0</td>
<td>325-D30N104</td>
<td>25B-D30N114</td>
<td>J, T 50</td>
<td>194R-J30-1753</td>
</tr>
<tr>
<td>25</td>
<td>34.0</td>
<td>38.0</td>
<td>325-D30N104</td>
<td>25B-D30N114</td>
<td>J, T 50</td>
<td>194R-J30-1753</td>
</tr>
<tr>
<td>30</td>
<td>40.0</td>
<td>38.0</td>
<td>325-D30N104</td>
<td>25B-D30N114</td>
<td>J, T 70</td>
<td>194R-J100-1753</td>
</tr>
</tbody>
</table>

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#### Line Reactor

- Input/Output
- Input Cat. No
- Output Cat. No
- SCOPD
- Disconnect Switch Cat. No

#### Contactor

- Input/Output
- Input Cat. No
- Output Cat. No
- Contactor Cat. No

#### Bypass Starter

- OLR
- Adj range

#### IEC Coordination

- Coordination Type
- Remark

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**Type 2**

- 3.2 - 16

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**Type 3**

- 1.0 - 5.0

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**Type 4**

- 1.0 - 5.0
SB4.3 – Feeder components that limit the short-circuit current available:

- **SB4.3.1** – For branch circuits supplied by a **power transformer with an isolated secondary winding**…

- **SB4.3.2** – For branch circuits supplied by a **Listed circuit breaker marked “current limiting”** in the feeder circuit…

- **SB4.3.3** – For branch circuits supplied by a **Class CC, G, J, L, RK1, RK5, or T fuse** in the feeder circuit…
SB4.3.1 A) – For a power transformer with a **Marked or Known impedance**...the Secondary Short Circuit Current (I_{sc}) is calculated using the formulas below...

- **Single Phase Transformers**
  - Transformer FLC (I_{FL}) = Transformer VA / Voltage*
  - Short Circuit Current (I_{sc} line-to-line) = (Transformer FLC (I_{FL}))/Transformer Impedance (Z)
  - *Line-to-line secondary voltage

- **Three Phase Transformers**
  - Transformer FLC (I_{FL}) = Transformer VA / (Voltage** x 1.732)
  - Short Circuit Current (I_{sc} line-to-line-to-line) = (Transformer FLC (I_{FL}))/Transformer Impedance (Z)
  - **Line-to-line-to-line secondary voltage
SB4.3.1 B) – For a power transformer with an *Unmarked impedance*, or with a Marked or Known *impedance not less than 2.1%*, the Secondary Short Circuit Current ($I_{sc}$) can be calculated using the formula method or Tables SB4.3 or SB4.4

<table>
<thead>
<tr>
<th>Transformer Max kVA</th>
<th>Column 1</th>
<th>Column 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>120</td>
<td>120/240b</td>
</tr>
<tr>
<td>1</td>
<td>400 A</td>
<td>300 A</td>
</tr>
<tr>
<td>3</td>
<td>1,200 A</td>
<td>900 A</td>
</tr>
<tr>
<td>5</td>
<td>1,990 A</td>
<td>1,490 A</td>
</tr>
<tr>
<td>10</td>
<td>3,970 A</td>
<td>2,980 A</td>
</tr>
<tr>
<td>15</td>
<td>5,960 A</td>
<td>4,470 A</td>
</tr>
<tr>
<td>25</td>
<td>9,930 A</td>
<td>7,450 A</td>
</tr>
<tr>
<td>37.5</td>
<td>14,890 A</td>
<td>11,170 A</td>
</tr>
<tr>
<td>50</td>
<td>19,850 A</td>
<td>14,890 A</td>
</tr>
<tr>
<td>75</td>
<td>29,770 A</td>
<td>22,330 A</td>
</tr>
</tbody>
</table>

*Z assumed to be 2.1%.

*Short circuit current shown is line-to-neutral.*
SB4.3.1 B) – For a power transformer with an *Unmarked impedance*, or with a Marked or Known *impedance not less than 2.1%*, the Secondary Short Circuit Current ($I_{sc}$) can be calculated using the formula method or Tables SB4.3 or SB4.4.
SB4.3.2 For branch circuits supplied by a *Listed circuit breaker marked “current-limiting”* in the feeder circuit, the short-circuit current rating on the line side of the circuit breaker shall be one of the following:

a) The short-circuit current rating of the *feeder circuit breaker* when all components in the branch circuit have a short-circuit current rating not less than the published peak let-through current of the circuit breaker, see Figure SB4.1, and the short-circuit current rating of all branch circuit protective devices on the load side are not less than the short-circuit current rating of the feeder circuit breaker;

b) The smallest short-circuit current rating of any branch circuit protective device on the load side of the feeder circuit breaker, when the conditions of SB4.3.2(a) exist except the short-circuit current rating of the branch circuit protective devices on the load side are less than the short-circuit current rating of the feeder circuit breaker.
SB4.4.1 For each branch circuit provided with branch circuit protection within the industrial control panel, the smallest short-circuit current rating of all power circuit components on the load side of a branch circuit protective device and the control circuit overcurrent protection in SB3.2.1 shall be determined and compared with the short-circuit current rating of the branch circuit protective device. The smaller of the two ratings shall be assigned to the line side of the branch circuit protective device.

In other words, use the lowest rating of a component or branch protective device to determine branch rating.
1. Panel SCCR will be determined by the **smallest SCCR** of any **feeder or branch overcurrent protective device or component**

2. Branch Circuit Protection Devices, **BCPDs** **must cover panel available fault level**

3. All components and controllers with SCCR’s based on **high-fault ratings must be used with the specified branch circuit protective device**

4. And finally, **the panel SCCR must cover the available fault current supplying the panel!**
Disconnecting Means

Connection Systems

Branch Circuits “Power”

Branch Circuits “Control”

Manufacturer Name: ABC Company
Voltage: 480V, Phase: 3 Phase, Frequency: 60 Hz
Full Load Current: 300 Amperes
Short Circuit Current Rating: 65,000A

* Suitable for use on a circuit capable of delivering not more than 65,000 symmetrical amperes of short-circuit current.
Resources

Additional Design Tools
Additional Design Tools

- MCS Star
  - 141A busbar systems
- Industrial Automation Builder (IAB)
  - Communication layout and design software
- Safety Automation Builder
  - Safety system layout and design software
- Eplan
  - Panel layout and design software
Summary

The Key Concepts
Summary

- Understanding SCCR can save lives and equipment
- Knowing available fault current can make design easier and more cost effective
- Based on customer’s aversion to machine downtime, starter coordination can be used to better sell to their needs
- Rockwell provides multiple tools and resources to help you provide the right product to your customers to achieve their safety and productivity goals
Thank You!