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Short-Circuit Current Rating (SCCR)

The 2008 NEC® has a new definition of "Short-Circuit Current Rating" (SCCR). Previously there was no definition of short-circuit current rating (sometimes referred to as "withstand rating"), although it was referenced in several sections on the marking and proper application of various types of equipment. Because the term is referenced in multiple locations of the Code, it was necessary to add a definition to Article 100 of the NEC®.

Article 100 Definitions

Short-Circuit Current Rating. *The prospective symmetrical fault current at a nominal voltage to which an apparatus or system is able to be connected without sustaining damage exceeding defined acceptance criteria.*

What is Short-Circuit Current Rating?

Short-Circuit Current Rating (SCCR) is the maximum short-circuit current a component or assembly can safely withstand when protected by a specific overcurrent protective device(s) or for a specified time. Adequate short-circuit current rating is required per NEC® 110.10.

AWG Wire Range	Class J Fuse Max. Amp	Resulting SCCR
2-6	400A	200kA
2-14	200A	50kA
2-14	175A	100kA

This power distribution block, protected with Class J fuses, is rated for use on a circuit capable of delivering no more than the SCCR kA shown (kA rms sym. or DC amps 600V maximum).

Figure 1

Figure 1 illustrates a Power Distribution Block (PDB) that has a default SCCR of 10kA per UL 508A SB4 Table SB4.1. However, this PDB has been combination tested and UL Listed with higher SCCRs when in combination with specific types and maximum amp rating current-limiting fuses. The label is marked with a 200kA SCCR when protected by 400A or less Class J fuses and the conductors on the lineside and loadside are in the range of 2 to 6AWG.

"Short-circuit current rating" is not the same as "interrupting rating" and the two must not be confused. Interrupting rating is the maximum short-circuit current an overcurrent protective device can safely interrupt under standard test conditions; it does not ensure protection of the circuit components or equipment. Adequate interrupting rating is required per NEC® 110.9. The fuse in Figure 2 has a UL Listed interrupting rating of 300kA @ 600Vac or less.

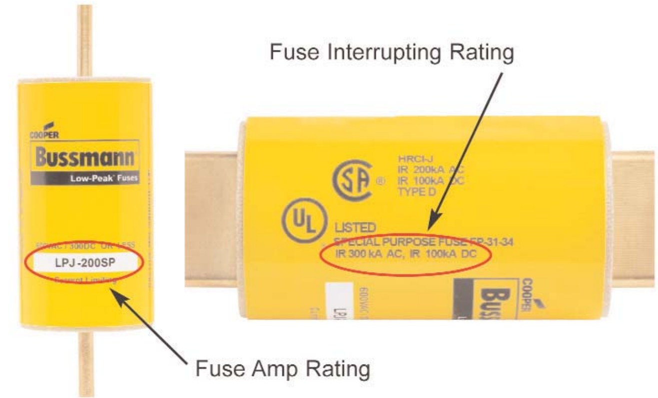


Figure 2

When analyzing assemblies for short-circuit current rating, the interrupting rating of overcurrent protective devices and the short-circuit current rating of all other components affect the overall equipment/assembly short-circuit current rating. For instance, the short-circuit current rating of an industrial control panel typically can not be greater than the lowest interrupting rating of any fuse or circuit breaker, or the lowest short-circuit current rating of all other components in the enclosure.

Why is Short-Circuit Current Rating Important?

Short-circuit current ratings provide the level of fault current that a component or piece of equipment can safely withstand (based on a shock hazard or a fire hazard external to the enclosure). Without knowing the available fault current and short-circuit current rating, it is impossible to determine if components or equipment can be safely installed.

Specification and installation of new equipment with higher short-circuit current ratings, such as 200,000 amps, makes it easy to meet the requirements of the NEC®. In addition, when equipment is later moved within a facility or from plant to plant, equipment with the highest ratings can be moved without worrying about unsafe situations that might arise from placing the equipment in a new location where the available short-circuit current is higher than the old location and now above the rating of the equipment.

SCCR Marking Requirements & Compliance

What are the Short-Circuit Current Rating Marking Requirements?

The NEC® has requirements for certain components and equipment to be marked with their short-circuit current rating. The important sections of the Code that require the marking of the short-circuit current rating include the following areas.

Industrial Control Panels: 409.110 requires that an industrial control panel be marked with its short-circuit current rating (see Figure 3).

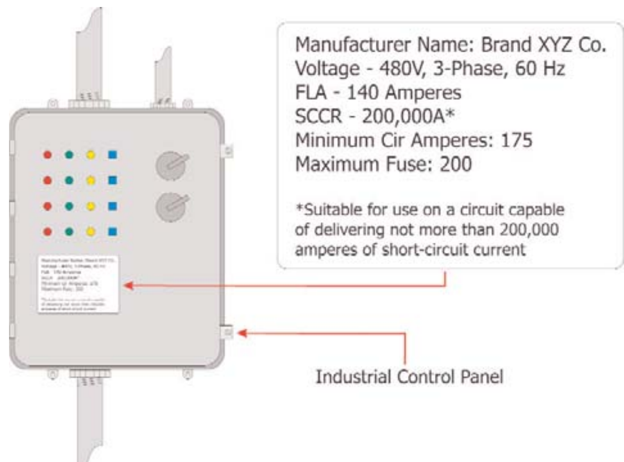
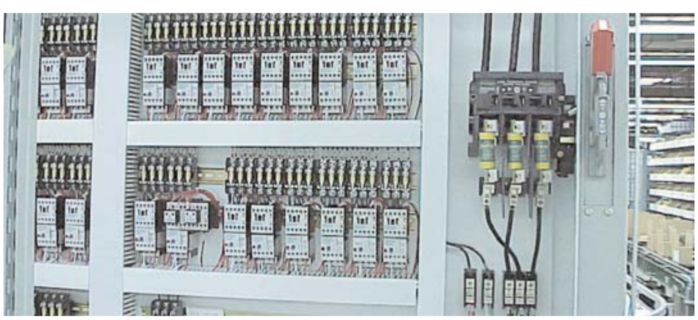


Figure 3 *(Courtesy IAEI)*

Industrial Machinery Electrical Panel: 670.3(A) requires the nameplate on industrial machinery to include the short-circuit current rating of the machine industrial control panel. In previous editions of the NEC® (2002 Edition) and NFPA 79 (2002 Edition), the industrial machine nameplate was required to include only the interrupting rating of the machine overcurrent protective device, if furnished. This marking was misleading as it did not represent the short-circuit current rating of the machine industrial control panel, but could be misinterpreted as such.



Interior of modern industrial machinery panel.

Air Conditioning and Refrigeration Equipment with Multimotor and Combination Loads: 440.4(B) requires the nameplate of this equipment to be marked with its short-circuit current rating. There are three exceptions for which this requirement does not apply:

- One and two family dwellings
- Cord and attachment-plug connected equipment, or
- Equipment on a 60A or less branch circuit

So for most commercial and industrial applications, air conditioning and refrigeration equipment with multimotor and combination loads must have the short-circuit current rating marked on the nameplate.

Meter Disconnect Switches: 230.82(3) permits a meter disconnect switch (rated up to 600V) ahead of the service disconnecting means, provided the meter disconnect switch has a short-circuit current rating adequate for the available short-circuit current.

Motor Controllers: 430.8 requires that motor controllers be marked with their short-circuit current rating. There are three exceptions:

- For fractional horsepower motor controllers
- Two horsepower or less general-purpose motor controllers, and
- Where the short-circuit current rating is marked on the assembly

How to Assure Compliance?

To assure proper application, the designer, installer and inspector must assure that the marked short-circuit current rating of a component or equipment is not exceeded by the calculated available fault current.

In order to assure compliance it is necessary to:

1. Determine the available short-circuit current or fault current at the point of installation of the component or equipment.
2. Assure the component or equipment marked short-circuit current rating (see Figure 3 for example) is equal to or greater than the available fault current.

Figure 4 illustrates compliance of short-circuit ratings from a system perspective. Any installation where the component or equipment marked short-circuit current rating is less than the available fault current is a lack of compliance, a safety hazard, and violation of 110.10. In these cases, the equipment cannot be installed until the component or equipment short-circuit current rating is sufficient or the fault current is reduced to an acceptable level.

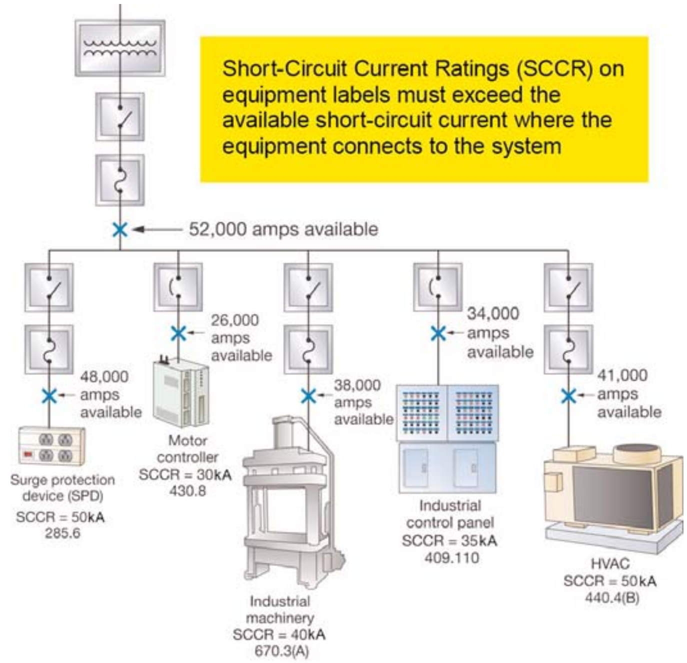


Figure 4 *(Courtesy NJATC)*

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Determining Assembly SCCR: "Two Sweep" Method & Procedures

How to Determine Assembly SCCR

For ***components***, the Short-Circuit Current Rating (SCCR) is typically determined by product testing. For ***assemblies***, the marking can be determined through the equipment product listing standard or by an approved method. With the release of the UL 508A, *UL Standard for Safety for Industrial Control Panels*, an industry-approved method is now available. **UL 508A, Supplement SB**, provides an analytical method to determine the short-circuit current rating of an industrial control panel. This method is based upon the "weakest link" approach. In other words, the assembly marked short-circuit current rating is limited to the lowest rated component short-circuit current rating or the lowest rated overcurrent protective device interrupting rating. Since testing is not required with this method, it is typically the preferred method to use in determining the assembly SCCR.

There are two basic concepts that must be understood and identified *before* analyzing the assembly SCCR per UL 508A, Supplement SB. The first is power circuit vs. control circuit. The second is branch circuit vs. feeder circuit. The differences and importance of these concepts are detailed below:

- **Per UL 508A:** a ***power circuit*** is defined as the conductors and components of branch and feeder circuits. A branch and feeder circuit carries main line power current to loads such as motors, lighting, heating, appliances and general use receptacles. A ***control circuit*** is a circuit that carries the electric signals directing the performance of a controller, and which does not carry the main power current. **Only devices in power circuits and overcurrent devices protecting control circuits affect the assembly SCCR**.
- **Per UL 508A:** a ***branch circuit*** is defined as the conductors and components following the final branch circuit overcurrent protective device protecting a load. A ***feeder circuit*** is the conductors and circuitry on the supply side of the branch circuit overcurrent protective device(s). **In some cases, as will be discussed later; current-limiting devices in the feeder circuit can be used to increase the SCCR of branch circuit components**. In addition, larger spacings are required for components used in feeder circuits versus when used in branch circuits. This is especially important for power distribution and terminal blocks, if used in feeder circuits.

Using the "Two Sweep" Method Based on UL 508A

After all the power circuit components and overcurrent devices protecting control circuits have been identified, the "Two Sweep" method based on UL 508A can be used to determine the assembly Short-Circuit Current Rating (SCCR). The purpose of performing two sweeps in this method is to assure that the overcurrent protective device interrupting rating (or SCCR for some devices) are never increased by an upstream overcurrent protective device. UL 508A requirements strictly prohibit any overcurrent protective device interrupting rating (or SCCR for some devices) from being raised beyond the marked interrupting rating by an upstream overcurrent protective device. Hence series rating of overcurrent devices is prohibited.

Sweep 1: The Component Protection Sweep

The first sweep reviews all components in the branch, feeder, sub-feeder and supply circuits, and determines the component with the lowest SCCR.

Sweep 2: The Overcurrent Protection Sweep

The second sweep reviews all overcurrent protection devices in the branch, feeder and supply circuits, and determines the lowest interrupting rating (or short-circuit current rating for some devices).

The lowest rating from Sweep 1 and Sweep 2 identifies the assembly SCCR. Because this method determines the assembly SCCR, it may be referred to as the "**FIND IT**."

***Note**: It is necessary to complete **both** Sweeps and **all** Steps to determine an assembly's SCCR marking. If an assembly SCCR marking is inadequate, then see the "FIX IT" portion at the end of this section for suggestions on how to increase an assembly's marked SCCR.*

Procedures for the "Two Sweep" Method

Each sweep of this method is broken down into steps. Sweep 1 has five steps and Sweep 2 has three steps. The following shows the procedure for completing the steps of both sweeps.

Sweep 1: Verifying assembly ***component*** SCCRs

Step 1: Determine the **component** SCCR for each **branch circuit**:

- Identify all component short-circuit current ratings and any special conditions that exist to utilize the ratings by one of the following methods:
  1. The SCCR based on the default ratings per UL 508A Table SB4.1 (see Table SCCR1 - Default SCCR Ratings).
  2. The SCCR marked on the component or instruction sheet provided with the component.
  3. The SCCR based on testing with a specific overcurrent protective device and/or combination of components in accordance with product standards and documented by the manufacturer. Example: a motor controller may have an SCCR of 100kA with a 30A Class J fuse, but only 5kA with a 30A circuit breaker.
- Take and apply the lowest SCCR of any component used in a branch circuit as the SCCR for that branch circuit. Repeat this for each branch circuit in the assembly.
- Note the lowest branch circuit SCCR for every branch circuit in the assembly or panel.

Step 2: Determine the **component** SCCR for each **feeder circuit** (includes supply, feeders and sub-feeders):

- Identify all component SCCRs and any special conditions that exist to utilize the ratings by one of the following methods:
  1. The SCCR based on the default ratings per UL 508A Table SB4.1 (see Table SCCR1 - Default SCCR Ratings).
  2. The SCCR marked on the component or instruction sheet provided with the component.
  3. The SCCR based on testing with a specific overcurrent protective device and/or combination of components in accordance with product standards and documented by the manufacturer. Example: a power distribution block may have an SCCR of 100kA with a 200A Class J fuse, but only 10kA with a 200A circuit breaker.
- Take and apply the lowest SCCR of any component used in the feeder circuit as the SCCR of the feeder circuit.
- Note the lowest feeder circuit SCCR.

Determining Assembly SCCR "Two Sweep" Method Procedures

Step 3: If using a **10kVA or less power transformer** in a **feeder circuit**, modify the transformer circuit SCCR, if possible, as follows:

- For **10kVA or less** power transformers that are in a feeder circuit, determine if the SCCR of the downstream circuits can be increased by applying the following procedure:
  1. On the transformer secondary, verify the SCCR of each component and the interrupting ratings of all overcurrent protective devices.
  2. Identify the lowest component SCCR or overcurrent protective device interrupting rating.
  3. If the lowest component SCCR or overcurrent protective device interrupting rating is 5kA or greater, apply the transformer's primary overcurrent protective device interrupting rating to the entire transformer circuit. Otherwise apply the lowest downstream component SCCR or overcurrent protective device interrupting rating to the transformer circuit.
- For **5kVA or less** power transformers **with 120V secondary** in the feeder circuit, determine if the SCCR of the downstream circuits can be increased by applying the following:
  1. On the transformer secondary, verify the SCCR of each component and the interrupting ratings of all overcurrent protective devices.
  2. Identify the lowest component SCCR or overcurrent protective device interrupting rating.
  3. If the lowest component SCCR or overcurrent protective device interrupting rating is 2kA or greater, apply the transformer's primary overcurrent protective device interrupting rating to the entire transformer circuit. Otherwise apply the lowest downstream component SCCR or overcurrent protective device interrupting rating to the transformer circuit.

Step 4: If using a ***current-limiting overcurrent protective device*** in the **feeder circuit**, modify **branch circuit component** SCCRs (other than branch circuit overcurrent protection devices such as fuses, circuit breakers, instantaneous trip circuit breakers or motor circuit protectors - *MCPs* - and self-protected combination starters), if possible, as follows:

- If current-limiting overcurrent protective devices are used in the feeder circuit use the following procedure:
  1. Determine the ***peak let-through value*** of the current-limiting overcurrent protective devices.
     a) If the overcurrent protective device is a **current-limiting fuse**, determine the peak let-through umbrella value dictated by the product standard for the fuse class and amp rating utilized at the level of fault current desired (50, 100, 200kA). **See *Table SCCR2 - UL Umbrella Limits at Rated Voltage*** (based on UL 508A Table SB4.2).
     b) If the overcurrent protective device is a **current-limiting circuit breaker**, **manufacturer's let-through curves** can be used to determine the peak let-through value. A current-limiting circuit breaker must be listed and marked as current-limiting. It is important to note, that unlike the fuse industry, UL 489 for molded case circuit breakers does not have specific industry maximum short-circuit let-through limits established for each circuit breaker frame size and amp rating. So the degree of current limitation for the same frame size and amp rating circuit breaker can vary from one manufacturer to another.
  2. Ensure that the peak let-through value is less than any of the SCCRs determined in Step 1.
  3. If condition "2" above is met, apply a short-circuit current rating to branch circuits fed by the feeder based upon the value of fault current used to determine the peak let-through value of the current-limiting overcurrent protective device.

Step 5: Determine the assembly SCCR for Sweep 1

- Determine the Sweep 1 assembly SCCR by utilizing the lowest rated branch or feeder circuit SCCR.

End of Sweep 1

Sweep 2: Verify assembly overcurrent protective device interrupting rating (or SCCR for some devices).

Step 1: Determine the interrupting ratings (or SCCR) of all the overcurrent protective devices used in feeder (includes supply, feeders and sub-feeders) and branch circuits, as well as those devices protecting control circuits.

Step 2: Determine the lowest overcurrent protective device interrupting rating or SCCR.

Step 3: Compare the lowest **overcurrent protective device** interrupting rating or SCCR with the ***component*** SCCRs from Sweep 1, Step 5. The lowest rating encountered is the ***assembly*** SCCR.

This SCCR is then marked on the assembly. If this SCCR is not sufficiently high enough, there are "FIX IT" solutions at the end of this section that can be investigated to achieve a higher SCCR marking.

End of Sweep 2

Table: SCCR1 - Default SCCR Ratings (UL 508A Table SB4.1)

Component	Default SCCR (kA)
Bus bars	10
Circuit breaker (including GFCI type)	5
Current meters	*
Current shunt	10
Fuse holder	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 amps or over 250 volts	5
• 25 volts or less, 60 amps or less and over 5kVA	3.5
• 250 volts or less and 2kVA or less	1
Motor controller, rated in horsepower (kW)	
a. 0-50 (0-37.5)	5**
b. 51-200 (38-149)	10**
c. 201-400 (150-298)	18**
d. 401-600 (299-447)	20**
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)	10
Supplementary protector	0.2
Switch unit	5
Terminal block or power distribution block	10

* A SCCR is not required when connected via a current transformer or current shunt. A directly connected current meter shall have a marked SCCR.
** Standard fault current rating for motor controller rated within specified horsepower range.
*** The use of a miniature fuse is limited to 125 volt circuits.

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Verify Assembly Assembly Overcurrent Protective Devices

Table: SCCR2 - UL Umbrella Limits at Rated Voltage (UL 508A Table SB4.2)

Fuse Type	Fuse Amp Rating	Between threshold & 50kA		100kA		200kA	
		$I^2t \times 10^3$	$I_p \times 10^3$ (kA)	$I^2t \times 10^3$	$I_p \times 10^3$ (kA)	$I^2t \times 10^3$	$I_p \times 10^3$ (kA)
Class CC	15	2	3	2	3	3	4
	20	2	3	3	4	3	5
	30	7	6	7	7.5	7	12
Class G	15	—	—	3.8	4	—	—
	20	—	—	5	5	—	—
	30	—	—	7	7	—	—
	60	—	—	25	10.5	—	—
Class RK1	30	10	6	10	10	11	12
	60	40	10	40	12	50	16
	100	100	14	100	16	100	20
	200	400	18	400	22	400	30
	400	1200	33	1200	35	1600	50
	600	3000	45	3000	50	4000	70
Class RK5	30	50	11	50	11	50	14
	60	200	20	200	21	200	26
	100	500	22	500	25	500	32
	200	1600	32	1600	40	2000	50
	400	5200	50	5000	60	6000	75
	600	10000	65	10000	80	12000	100
Class T 300V	1	–	–	0.4	0.8	–	–
	3	–	–	0.6	1.3	–	–
	6	–	–	1	2	–	–
	10	–	–	1.5	3	–	–
	15	–	–	2	4	–	–
	20	–	–	2.5	4.5	–	–
	25	–	–	2.7	5.5	–	–
	30	3.5	5.0	3.5	7	3.5	9
	35	–	–	6	7	–	–
	40	–	–	8.5	7.2	–	–
	45	–	–	9	7.6	–	–
	50	–	–	11	8	–	–
	60	15	7	15	9	15	12
	70	–	–	25	10	–	–
	80	–	–	30	11	–	–
	90	–	–	38	12	–	–
	100	40	9	40	12	40	15
	110	–	–	50	12	–	–
	125	–	–	75	13	–	–
	150	–	–	88	14	–	–
	175	–	–	115	15	–	–
	200	150	13	150	16	150	20
	225	–	–	175	21	–	–
	250	–	–	225	22	–	–
	300	–	–	300	24	–	–
	350	–	–	400	27	–	–
	400	550	22	550	28	550	35
	450	–	–	600	32	–	–
	500	–	–	800	37	–	–
	600	1,000	29	1,000	37	1,000	46
	700	–	–	1,200	45	–	–
	800	1,500	37	1,500	50	1,500	65
	1000	–	–	3,500	65	–	–
	1200	3,500	50	3,500	65	4,000	80

Note: These values are UL umbrella limits. Intermediate values shown in the 100kA column for Class J and T fuses are included per UL 248, but have not yet been added to UL 508A Supplement SB.

Verify Assembly Assembly Overcurrent Protective Devices

Table: SCCR2 - UL Umbrella Limits at Rated Voltage (UL 508A Table SB4.2) **(continued)**

Fuse Type	Fuse Amp Rating	Between threshold & 50kA		100kA		200kA	
		$I^2t \times 10^3$	$I_p \times 10^3$ (kA)	$I^2t \times 10^3$	$I_p \times 10^3$ (kA)	$I^2t \times 10^3$	$I_p \times 10^3$ (kA)
Class T & J 600V	1	–	–	0.8	1	–	–
	3	–	–	1.2	1.5	–	–
	6	–	–	2	2.3	–	–
	10	–	–	3	3.3	–	–
	15	–	–	4	4	–	–
	20	–	–	5	5	–	–
	25	–	–	5.5	6	–	–
	30	7	6	7	7.5	7	12
	35	–	–	12	7.5	–	–
	40	–	–	17	8	–	–
	45	–	–	18	8.5	–	–
	50	–	–	22	9	–	–
	60	30	8	30	10	30	16
	70	–	–	50	12	–	–
	80	–	–	60	13	–	–
	90	–	–	75	14	–	–
	100	60	12	80	14	80	20
	110	–	–	100	15	–	–
	125	–	–	150	16	–	–
	150	–	–	175	17	–	–
	175	–	–	225	19	–	–
	200	200	16	300	20	300	30
	225	–	–	350	23	–	–
	250	–	–	450	24	–	–
	300	–	–	600	26	–	–
	350	–	–	800	29	–	–
	400	1,000	25	1,100	30	1,100	45
	450	–	–	1,500	36	–	–
	500	–	–	2,000	42	–	–
	600	2,500	35	2,500	45	2,500	70
	700*	–	–	3,500*	50*	–	–
	800*	4,000*	50*	4,000*	55*	4,000*	75*
Class L	800	10000	80	10000	80	10000	80
	1200	12000	80	12000	80	15000	120
	1600	22000	100	22000	100	30000	150
	2000	35000	110	35000	120	40000	165
	2500	—	—	75000	165	75000	180
	3000	—	—	100000	175	100000	200
	4000	—	—	150000	220	150000	250
	5000	—	—	350000	—	350000	300
	6000	—	—	350000	—	500000	350

*Value applies to Class T fuses
Note: These values are UL umbrella limits. Intermediate values shown in the 100kA column for Class J and T fuses are included per UL 248, but have not yet been added to UL 508A Supplement SB.

About Umbrella Limits

What is a Fuse Umbrella Limit?

UL / CSA / ANCE Fuse Standards set maximum I_p and I^2t let-through limits for short-circuit current performance of current-limiting fuses. The limits vary by fuse class, amp rating and available short-circuit current. To receive a listing, a commercially available current-limiting fuse must be tested and evaluated under short-circuit current tests per the applicable standard and witnessed by a National Recognized Testing Laboratory (NRTL). One evaluation criteria of the testing is that the fuse's I_p and I^2t let-through measured during the short-circuit tests can not exceed the Standard's "umbrella limits" for I_p and I^2t let-through established for that fuse class, amp rating, and available short-circuit current*. See *Table: SCCR2 - UL Umbrella Limits at Rated Voltage* on the preceding pages for the umbrella limits applicable to most of the current-limiting fuses.

***NOTE:** These tests are done at the fuse's rated voltage, with only one fuse in the circuit and by controlled closing of the test circuit so that the fuse "starts to arc" between 60 and 90 degrees on the voltage wave. These test conditions are the most severe for fuse interruption. In addition, current-limiting fuses are required to have periodic NRTL witnessed follow-up testing in the same manner. The fuses for NRTL witnessed follow-up testing are pulled from inventory.*

What is an umbrella fuse?

An umbrella fuse is a special fuse that is designed to have short-circuit current I_p and I^2t let-through that are at least equal to or greater than the UL / CSA / ANCE Fuse Standard limit. Umbrella fuses are not intended as commercially available fuses.

UL has a specific standard for these devices, which is UL248-16 Test Limiters. UL uses the term "test limiters" for what we refer to as umbrella fuses.
UL 248-16 states:

"...test limiters are calibrated to specific limits of peak let-through current and clearing I^2t at 250, 300, 480, or 600Vac. Test limiters are non-renewable and current-limiting, with test current ratings up to 200,000 A. They are calibrated to maximum peak let-through current and clearing I^2t limits for the fuses specified in this Standard and are used for withstand testing of equipment designed to accept those fuses."

Umbrella fuses are used for test purposes in qualifying a combination short-circuit current rating with a specific component. For instance, a controller manufacturer wants the controller to be marked with a 100,000A SCCR at 600V when protected by 60A Class J fuses. The NRTL witnessed tests would be with 60A Class J umbrella fuses in combination with the controller on a test circuit of 100,000A at 600V. If the results satisfy the UL 508 Industrial Control Standard evaluation criteria, the controller can be labeled with a 100,000A, 600V SCCR when protected by Class J fuses 60A (or less). Another use of umbrella fuses is for series rated fuse/circuit breaker panelboard and switchboard combinations. For more information on series ratings see the section on Series Rating: Protecting Circuit Breakers. However, UL 508A Supplement SB4 does not permit series rated combinations for use in establishing the SCCR for industrial control panels. Therefore, the interrupting rating of overcurrent devices cannot be raised by another upstream overcurrent device.

Calculate Assembly SCCR with Ease & Confidence

Enhanced Cooper Bussmann® OSCAR™ Software Speeds Code & Standards Compliance

The new Cooper Bussmann® OSCAR™ Version 2.0 SCCR (Short-Circuit Current Rating) compliance software easily guides you through entering your electrical panel's components and calculates an assembly SCCR. This award winning, online, essential design tool allows you to comply quickly and accurately with 2008 NEC® and UL 508A Supplement SB for assembly SCCR marking requirements:

- Industrial Control Panels [409.110]
- Industrial Machinery Electrical Panels [670.3(A)]
- HVAC Equipment [440.4(B)]

New Project Management Features:

- Simplify your panel design and project organization
- Save and edit existing panel designs
- Save multiple panels under a single project
- Copy existing panels to new projects

New Intuitive Navigation:

- Display your one-line diagram
- Select from pre-loaded circuit templates
- Identify the "weakest link" component automatically
- Print reports and one-line diagrams for required SCCR documentation
- Utilize mouse-over tips to enhance your design

Design with Confidence:

- Logic updated to current UL requirements
- Extensive 55,000+ component database
- Search by partial part number or device rating
- Custom device option allows for entering specialized component rating information

For more information, visit: www.cooperbussmann.com/OSCAR.

Example Using the "Two Sweep" Method: "FIND IT"

"FIND IT"

The following example will illustrate the procedures previously outlined for the two sweep method to determine the assembly SCCR. It may be helpful to periodically refer back to the procedures for the two sweep method while going through this example. The example is based on the industrial control panel shown in Figure 5 and 6. Figure 5 shows the graphical representation of the industrial control panel while Figure 6 is the one-line diagram for the industrial control panel. The ratings for each power circuit component are detailed in Figure 6. This example illustrates how each sweep and their steps are performed and documented in the tables. After both sweeps and all steps have been completed, the result identifies the assembly SCCR ("FIND IT"). Later, methods are outlined to increase the assembly SCCR ("FIX IT").

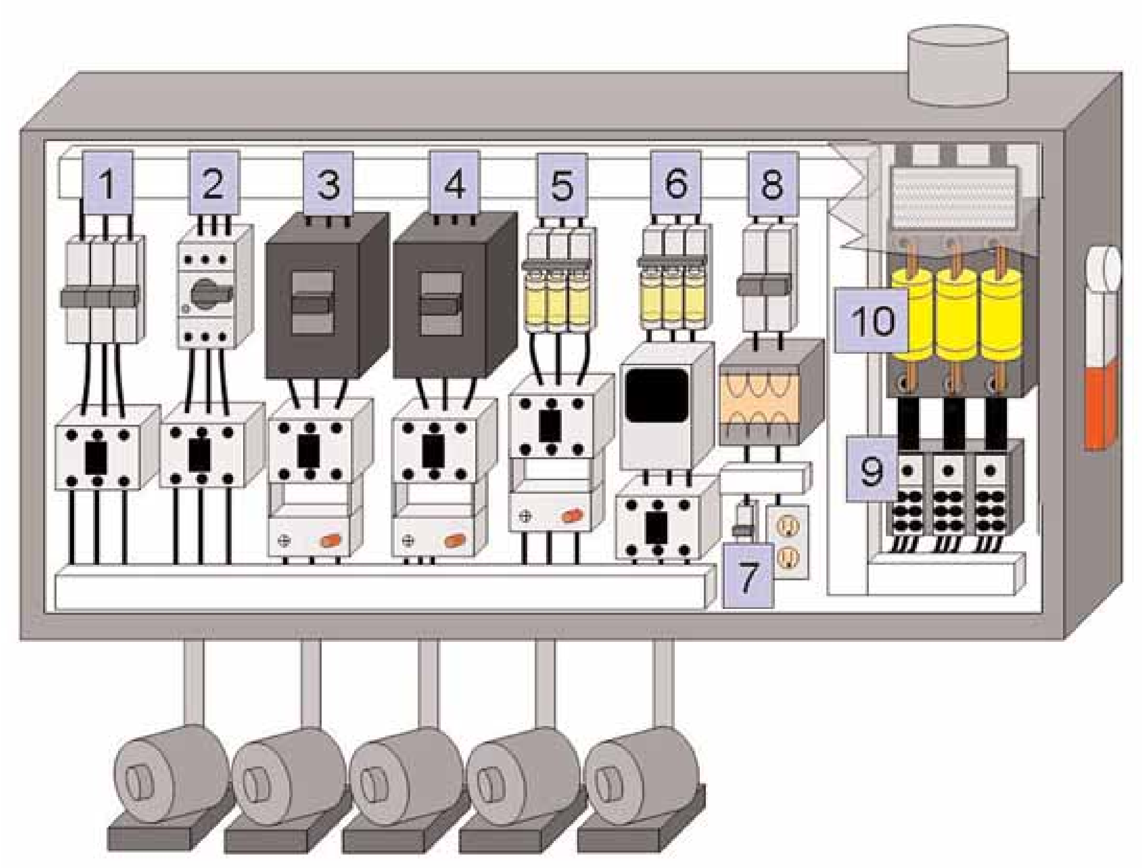


Figure 5

Industrial Control Panel Circuit and Device Descriptions

Circuit Number	Device Descriptions
1	Molded case circuit breaker protecting an IEC contactor
2	Self-protected starter protecting an IEC contactor (additional components may be required)
3	Instantaneous trip circuit breaker (MCP) protecting an IEC starter (special assembly conditions required)
4	Molded case circuit breaker protecting an IEC starter
5	Class CC fused switch protecting an IEC starter
6	Class CC fused switch protecting variable frequency drive and contactor
7	Molded case circuit breaker and GFCI receptacle
8	Molded case circuit breaker protecting power transformer
9	Power distribution block
10	Class J fused switch

Example Using the "Two Sweep" Method: "FIND IT"

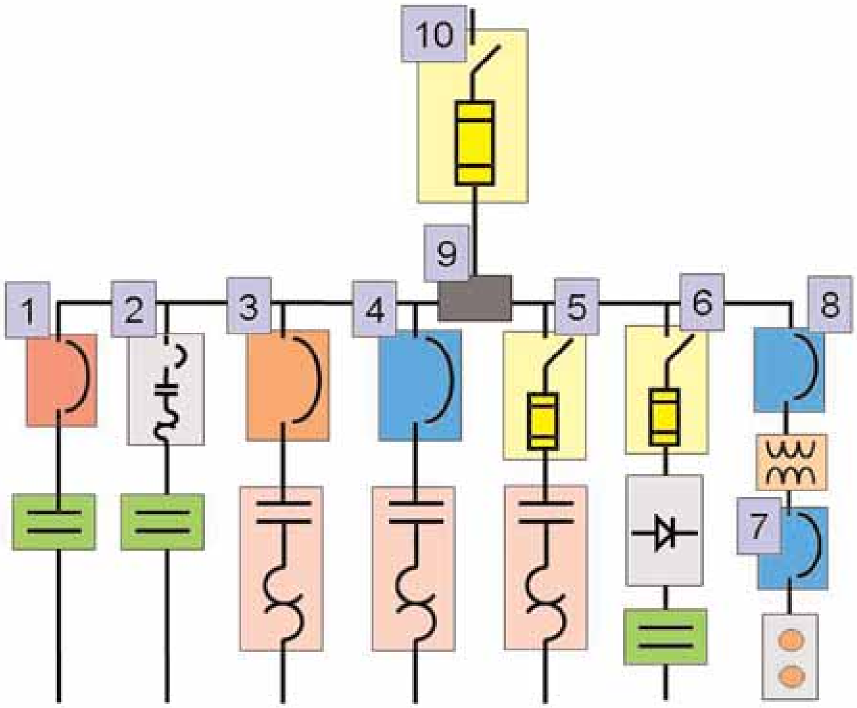


Figure 6 – One-line Diagram of Industrial Control Panel

Note: *It is important to record the voltage ratings for all components and overcurrent protective devices. The assembly is marked based upon the lowest or most restrictive device voltage rating. If there are devices with slash voltage ratings (such as 480/277V), these are more limiting than straight or full voltage ratings (such as 480V). Assemblies with 480/277V devices are suitable for only 480/277V solidly grounded wye systems. These assemblies cannot be applied on 480V ungrounded, resistance grounded or corner grounded systems. (See the section on Slash Voltage Ratings for more information.)*

Industrial Control Panel Circuit Descriptions and Ratings

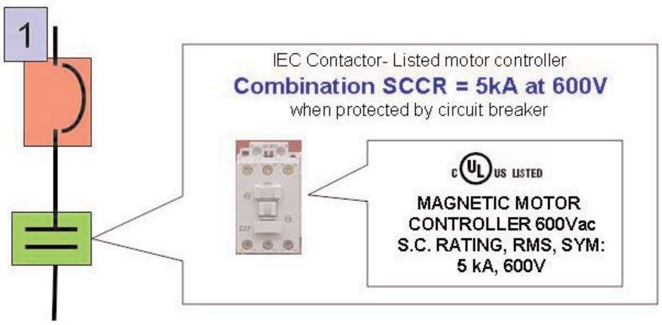
Circuit Number	Circuit Type	Device Descriptions
1	Branch	• Molded case circuit breaker: IR = 14kA @ 480/277V • IEC contactor: SCCR = 5kA @ 600V
2	Branch	• Self-protected starter with lineside terminal kit: SCCR = 65kA @ 480/277V • IEC contactor: SCCR = 5kA @ 600V
3	Branch	• Instantaneous trip circuit breaker (MCP): unmarked IR • IEC Starter: SCCR = 5kA @ 600V
4	Branch	• Molded case circuit breaker: IR = 14kA @ 480V • IEC starter: SCCR = 5kA @ 600V
5	Branch	• Cooper Bussmann® Class CC Compact Circuit Protector (CCP): SCCR = 200kA @ 600V • Cooper Bussmann® LP-CC Fuses: IR = 200kA @ 600V • IEC starter: SCCR = 5kA @ 600V
6	Branch	• Cooper Bussmann Class CC Compact Circuit Protector (CCP): SCCR = 200kA @ 600V • Cooper Bussmann LP-CC Fuses: IR = 200kA @ 600V • Variable Frequency Drive: SCCR = 5kA @ 480V • IEC contactor: SCCR = 5kA @ 600V
7	Branch	• Molded case circuit breaker: IR = 10kA @ 120V • GFCI Receptacle: unmarked SCCR
8	Sub-Feeder	• Molded case circuit breaker: IR = 14kA @ 480/277V • 3kVA 480V-120V secondary power transformer (does not affect SCCR)
9	Feeder	• Power distribution block: unmarked SCCR
10	Supply	• Cooper Bussmann® 100A Class J fused switch: SCCR = 200kA @ 600V • Cooper Bussmann® 100A LPJ fuses: IR = 300kA @ 600V

"Two Sweep" Method: Sweep 1, Step 1 - Branch Circuit Components

Sweep 1: Verifying assembly ***component*** SCCRs

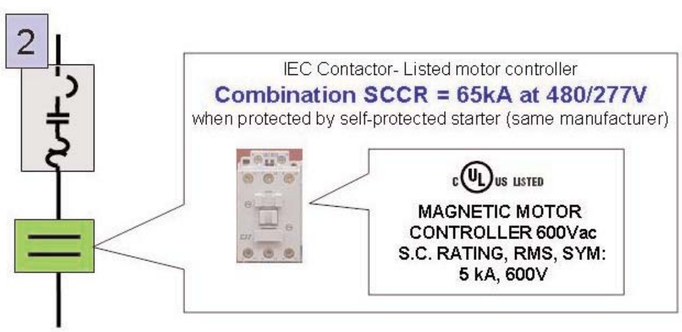
Step1: Determine lowest rated ***component*** in each **branch circuit**.

> ***Note:*** *Determine SCCRs for components only.*
>
> *Interrupting rating or SCCR of overcurrent protective devices is ignored in this step.*



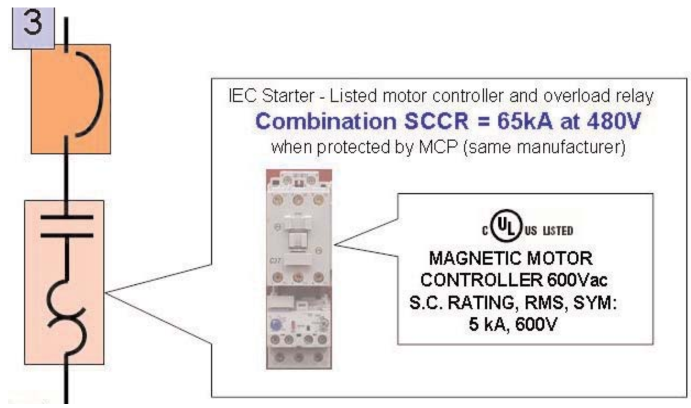
Branch Circuit 1

- IEC contactor: SCCR = 5kA @ 600V
- Higher combination rating with a circuit breaker does not exist
- **SCCR = 5kA @ 600V**



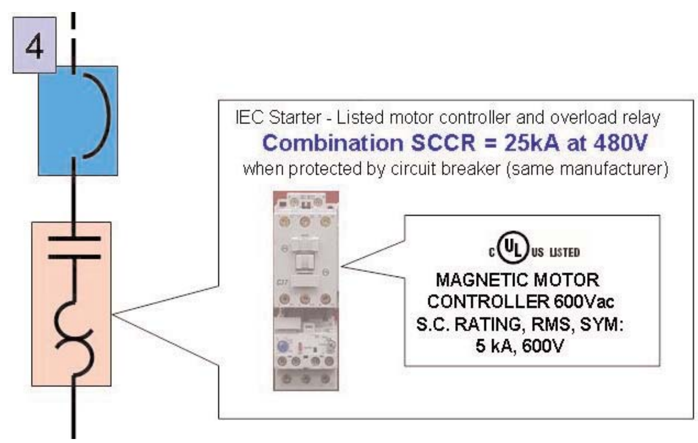
Branch Circuit 2

- IEC contactor: SCCR = 5kA @ 600V
- Combination rating with self-protected starter (only with same manufacturer) = 65kA @ 480/277V
- **SCCR = 65kA @ 480/277V**



Branch Circuit 3

- IEC Starter: SCCR = 5kA @ 600V
- Combination rating with MCP (only with same manufacturer) = 65kA @ 480V
- **SCCR = 65kA @ 480V**



Branch Circuit 4

- IEC starter: SCCR = 5kA @ 600V
- Combination rating with circuit breaker (only with same manufacturer) = 25kA @ 480V
- **SCCR = 25kA @ 480V**

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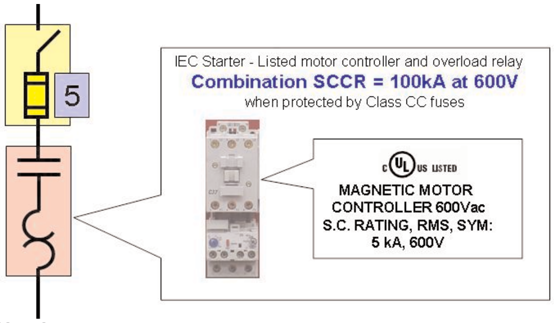
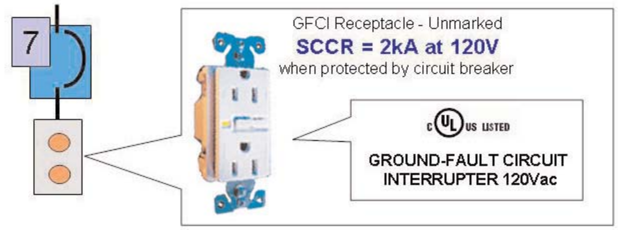
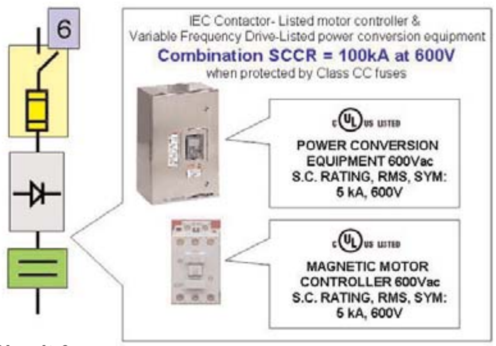
"Two Sweep" Method: Sweep 1, Step 1 - Branch Circuit Components



Branch Circuit 5
- IEC starter: SCCR = 5kA @ 600V
- Combination rating with Class CC fuses = 100kA @ 600V
- **SCCR = 100kA @ 600V**



Branch Circuit 7
- GFCI Receptacle: unmarked SCCR
  (2kA per *Table SCCR1-Default SCCR Ratings*)
- Higher combination rating with circuit breaker does not exist
- **SCCR = 2kA @ 120V** (does not affect panel voltage rating)



Branch Circuit 6
- Variable Frequency Drive: SCCR = 5kA @ 480V
- IEC contactor: SCCR = 5kA @ 600V
- Combination rating with Class CC fuses:
  - 200kA @ 600V for variable frequency drive
  - 100kA @ 600V for IEC contactor
- **SCCR = 100kA @ 600V**

Sweep 1 - Step 1 Summary
- Lowest SCCR of Step 1 is 2kA @ 480/277V

Results of Sweep 1, Step 1: SCCR = 2kA @ 480/277V

	Assessment				SCCR Revisions		Sweep 1 Results			
	Sweep 1-Step 1 (Branch)		Sweep 1-Step 2 (Feeder)		Sweep 1-Step 3 (Trans)	Sweep 1-Step 4 (C-L OCPDs)	Sweep 1-Step 5		Sweep 2-Steps 1& 2 (Overcurrent Device)	
	SCCR	Voltage	SCCR	Voltage	SCCR	SCCR	SCCR	Voltage	IR/SCCR	Voltage
Branch Circuit 1	5kA	600V								
Branch Circuit 2	65kA	480/277V								
Branch Circuit 3	65kA	480V								
Branch Circuit 4	25kA	480V								
Branch Circuit 5	100kA	600V								
Branch Circuit 6	100kA	600V								
Branch Circuit 7	2kA	–								
Sub-Feeder Circuit 8	–	–								
Feeder Circuit 9	–	–								
Supply Circuit 10	–	–								

Note: *Red cells in table denote limiting components and voltages for each step.*

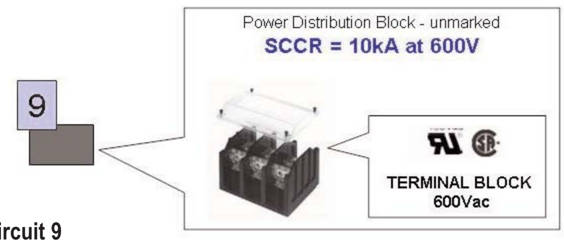
"Two Sweep" Method: Sweep 1, Step 2 - Feeder Circuit Components

Sweep 1: Verifying assembly ***component*** SCCRs

Step 2: Determine the ***component*** SCCR for each **feeder**, **sub-feeder** and **supply circuit**.

Sub-Feeder Circuit 8

• This is a transformer circuit and is covered by Sweep 1, Step 3



Feeder Circuit 9

- Power distribution block (PDB): unmarked SCCR (10kA per Table SCCR1 - Default SCCR Ratings)
- **SCCR = 10kA @ 600V**

Note: *PDB must have proper spacings for feeder application per UL 508A.*

Supply Circuit 10

- Cooper Bussmann® 100A Class J fused switch: SCCR = 200kA @ 600V
- **SCCR = 200kA @ 600V**

Sweep 1 - Step 2 Summary

- Lowest SCCR of Step 2 is 10kA @ 600V
- Lowest SCCR of Step 1 or Step 2 is 2kA @ 480/277V

Results of Sweep 1, Step 2: SCCR = 2kA @ 480/277V

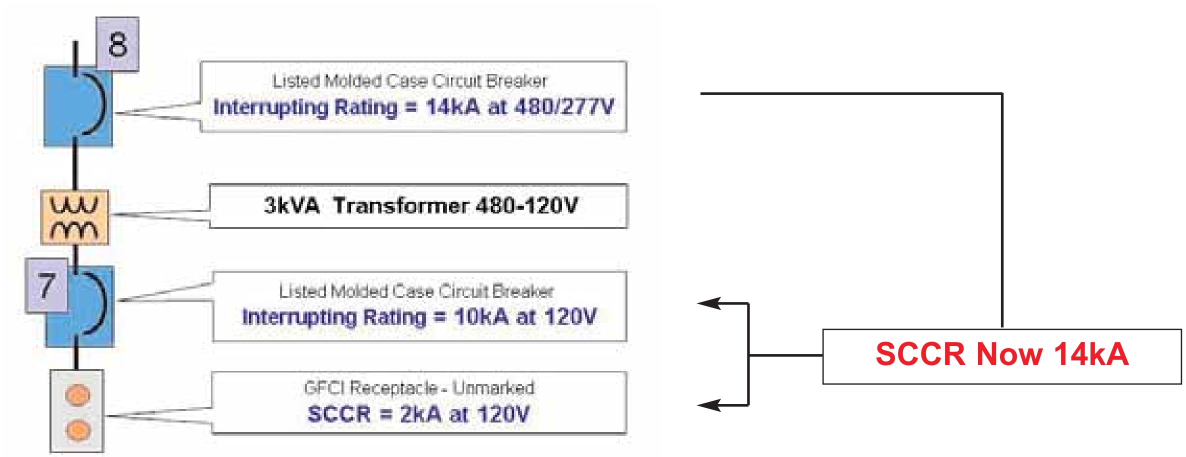
	Assessment				SCCR Revisions		Sweep 1 Results			
	Sweep 1-Step 1 (Branch)		Sweep 1-Step 2 (Feeder)		Sweep 1-Step 3 (Trans)	Sweep 1-Step 4 (C-L OCPDs)	Sweep 1-Step 5		Sweep 2-Steps 1& 2 (Overcurrent Device)	
	SCCR	Voltage	SCCR	Voltage	SCCR	SCCR	SCCR	Voltage	IR/SCCR	Voltage
Branch Circuit 1	5kA	600V	–	–						
Branch Circuit 2	65kA	**480/277V**	–	–						
Branch Circuit 3	65kA	480V	–	–						
Branch Circuit 4	25kA	480V	–	–						
Branch Circuit 5	100kA	600V	–	–						
Branch Circuit 6	100kA	600V	–	–						
Branch Circuit 7	**2kA**	–	–	–						
Sub-Feeder Circuit 8	–	–	–	–						
Feeder Circuit 9	–	–	10kA	600V						
Supply Circuit 10	–	–	200kA	600V						

Note: *Red cells in table denote limiting components and voltages for each step.*

"Two Sweep" Method: Sweep 1, Step 3 - Components/Transformers

Sweep 1: Verifying assembly ***component*** SCCRs

Step 3: Determine if **10kVA or smaller power transformers** in the feeder, sub-feeder or supply circuit are able to raise branch circuit component SCCRs (circuit breaker and GFCI receptacle):



Sub-Feeder Circuit 8

- Sub-feeder transformer is 3kVA with 120V secondary and can be used to raise the secondary components. Follow procedure for 5kVA or smaller transformers.
- Since all secondary components have an interrupting rating/SCCR (circuit breaker IR = 10kA) or SCCR (GFCI receptacle SCCR = 2kA) of 2kA or higher, the interrupting rating rating of the transformer primary overcurrent protective device (Sub-Feeder Circuit 8) can be assigned to the entire Branch Circuit 7 (circuit breaker and GFCI receptacle).
- Revised Branch Circuit 7 **SCCR = 14kA**

Sweep 1 - Step 3 Summary

- Branch Circuit 7 was raised to 14kA
- However, Branch Circuit 1 is still the limiting SCCR factor

Results of Sweep 1, Step 3: SCCR = 5kA @ 480/277V

	Assessment				SCCR Revisions		Sweep 1 Results			
	Sweep 1-Step 1 (Branch)		Sweep 1-Step 2 (Feeder)		Sweep 1-Step 3 (Trans)	Sweep 1-Step 4 (C-L OCPDs)	Sweep 1-Step 5		Sweep 2-Steps 1& 2 (Overcurrent Device)	
	SCCR	Voltage	SCCR	Voltage	SCCR	SCCR	SCCR	Voltage	IR/SCCR	Voltage
Branch Circuit 1	5kA	600V	–	–	–					
Branch Circuit 2	65kA	480/277V	–	–	–					
Branch Circuit 3	65kA	480V	–	–	–					
Branch Circuit 4	25kA	480V	–	–	–					
Branch Circuit 5	100kA	600V	–	–	–					
Branch Circuit 6	100kA	600V	–	–	–					
Branch Circuit 7	2kA	–	–	–	14kA					
Sub-Feeder Circuit 8	–	–	–	–	–					
Feeder Circuit 9	–	–	10kA	600V	–					
Supply Circuit 10	–	–	200kA	600V	–					

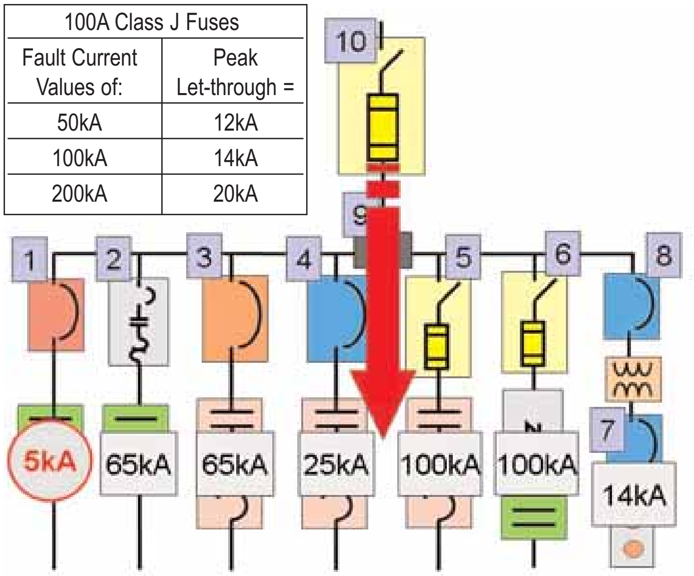
Note: *Red cells in table denote limiting components and voltages for each step.*

"Two Sweep" Method: Sweep 1, Step 4 - Current-Limiting Overcurrent Devices

Sweep 1: Verifying assembly ***component*** SCCRs

Step 4: Determine if **current-limiting *overcurrent protective devices*** (C-L OCPDs) are used in the **feeder**, **sub-feeder** or **supply** circuit that can raise **branch circuit component ratings** (other than devices that provide branch circuit overcurrent protection).

100A Class J Fuses	
Fault Current Values of:	Peak Let-through =
50kA	12kA
100kA	14kA
200kA	20kA



Supply Circuit 10

The 100A Class J fuse in Supply Circuit 10 is a current-limiting device. Use *Table SCCR2 - UL Umbrella Limits at Rated Voltage* to identify the peak let-through values:

- Compare the peak let-through values with result of Step 1 and increase branch circuit component ratings where possible.

Note: *Since the 100A Class J fuse peak let-through of 20kA at a fault current of 200kA is less than the SCCR of Step 1 for Branch Circuits 2 through 6, the SCCR is raised to 200kA. The SCCR of components in Feeder Circuit 9, Sub-Feeder Circuit 8 or Supply Circuit 10 cannot be raised per UL 508A.*

Sweep 1 - Step 4 Summary

- Branch Circuit 1 SCCR cannot be raised
- Increased SCCR of Branch Circuits 2 through 6 to 200kA
- Branch Circuit 7 SCCR cannot be raised in this step because it was raised by Step 3

Results of Sweep 1, Step 4: SCCR = 5kA @ 480/277V

	Assessment				SCCR Revisions		Sweep 1 Results			
	Sweep 1-Step 1 (Branch)		Sweep 1-Step 2 (Feeder)		Sweep 1-Step 3 (Trans)	Sweep 1-Step 4 (C-L OCPDs)	Sweep 1-Step 5		Sweep 2-Steps 1& 2 (Overcurrent Device)	
	SCCR	Voltage	SCCR	Voltage	SCCR	SCCR	SCCR	Voltage	IR/SCCR	Voltage
Branch Circuit 1	5kA	600V	–	–	–	–				
Branch Circuit 2	65kA	480/277V	–	–	–	200kA				
Branch Circuit 3	65kA	480V	–	–	–	200kA				
Branch Circuit 4	25kA	480V	–	–	–	200kA				
Branch Circuit 5	100kA	600V	–	–	–	200kA				
Branch Circuit 6	100kA	600V	–	–	–	200kA				
Branch Circuit 7	2kA	–	–	–	14kA	–				
Sub-Feeder Circuit 8	–	–	–	–	–	–				
Feeder Circuit 9	–	–	10kA	600V	–	–				
Supply Circuit 10	–	–	200kA	600V	–	–				

Note: *Red cells in table denote limiting components and voltages for each step.*

"Two Sweep" Method: Sweep 1, Step 5 - Results of Entire Sweep 1

Sweep 1: Verifying assembly ***component*** SCCRs

Step 5: Determine the lowest branch or feeder circuit component SCCR based on all steps in Sweep 1 and retain for Sweep 2.

- Lowest SCCR resulted from Branch Circuit 1 in Step 1
- Branch Circuit 2 limited voltage in Step 1
- **Sweep 1 Lowest SCCR = 5kA @ 480/277V**

Note: Sweep 2 must still be completed to determine SCCR marking.

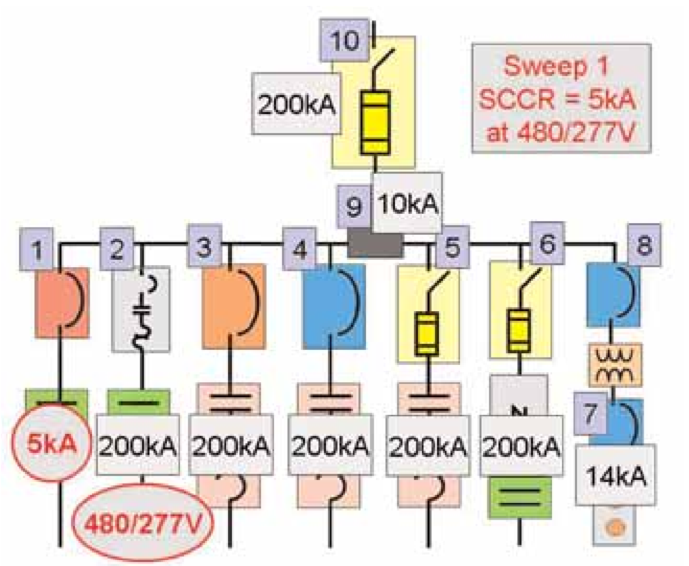


Figure 7 – Results of Sweep 1, Steps 1 through 5

Sweep 1 - Step 5 Summary

After completing all five steps in Sweep 1, the resulting SCCR based upon the components, remains at a low 5kA @ 480/277V because of the 5kA rated contactor in Branch Circuit 1 and the slash voltage rating of the contactor in Branch Circuit 2 (when protected by a slash voltage rated self protected motor starter). See figure 7.

Results of Sweep 1, Step 5: SCCR = 5kA @ 480/277V

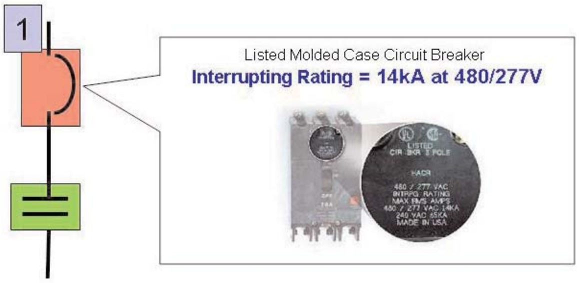
	Assessment				SCCR Revisions		Sweep 1 Results		Sweep 2-Steps 1& 2 (Overcurrent Device)	
	Sweep 1-Step 1 (Branch)		Sweep 1-Step 2 (Feeder)		Sweep 1-Step 3 (Trans)	Sweep 1-Step 4 (C-L OCPDs)	Sweep 1-Step 5			
	SCCR	Voltage	SCCR	Voltage	SCCR	SCCR	SCCR	Voltage	IR/SCCR	Voltage
Branch Circuit 1	5kA	600V	–	–	–	–	**5kA**	600V		
Branch Circuit 2	65kA	480/277V	–	–	–	200kA	200kA	**480/277V**		
Branch Circuit 3	65kA	480V	–	–	–	200kA	200kA	480V		
Branch Circuit 4	25kA	480V	–	–	–	200kA	200kA	480V		
Branch Circuit 5	100kA	600V	–	–	–	200kA	200kA	600V		
Branch Circuit 6	100kA	600V	–	–	–	200kA	200kA	600V		
Branch Circuit 7	2kA	–	–	–	14kA	–	14kA	–		
Sub-Feeder Circuit 8	–	–	–	–	–	–	–	–		
Feeder Circuit 9	–	–	10kA	600V	–	–	10kA	600V		
Supply Circuit 10	–	–	200kA	600V	–	–	200kA	600V		

***Note:** Red cells in table denote limiting components and voltages for each step*

"Two Sweep" Method: Sweep 2, Step 1 - Overcurrent Protective Device IR or SCCR

Sweep 2: Verifying assembly SCCR based upon overcurrent protective device interrupting rating (or SCCR for some devices).

Step 1: Determine overcurrent protective device interrupting rating or SCCR*:



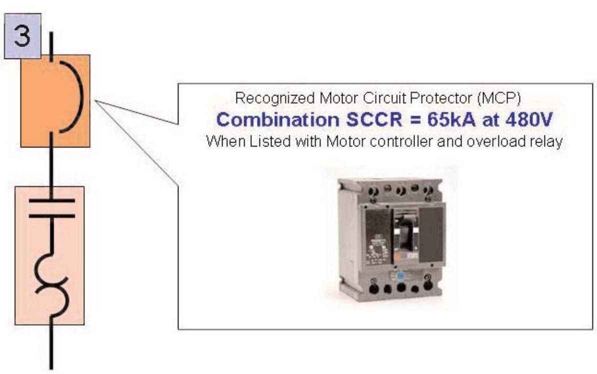
Branch Circuit 1

- Molded case circuit breaker
- **IR = 14kA @ 480/277V**

Branch Circuit 2

- Self-protected starter
- **SCCR = 65kA @ 480/277V**

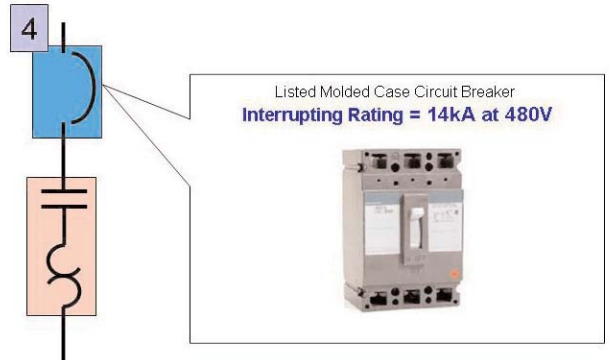
***Note:** Self-protected starters are not rated with an interrupting rating. So for this Step 1, its SCCR is used.*



Branch Circuit 3

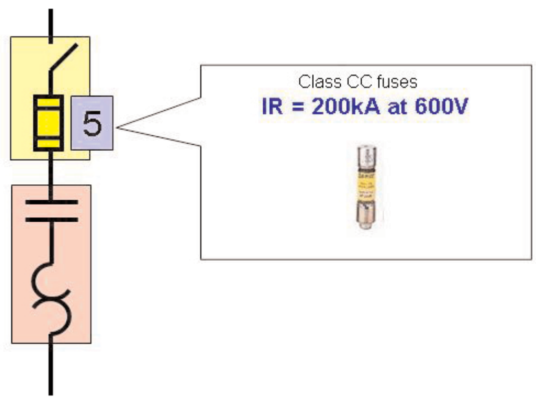
- MCP – Combination rating with IEC Starter (same manufacturer)
- **SCCR = 65kA @ 480V**

***Note:** Per UL 508A, in order to assure proper application in industrial control panels, the MCP must be procedure described to verify use as part of a listed combination motor controller and the corresponding SCCR.*



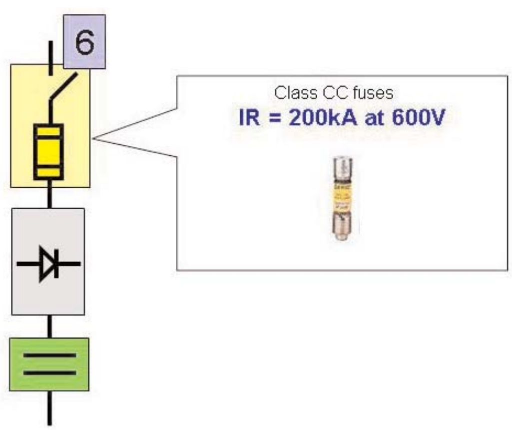
Branch Circuit 4

- Molded case circuit breaker
- **IR = 14kA @ 480V**



Branch Circuit 5

- Cooper Bussmann® LP-CC fuses
- **IR = 200kA @ 600V**



Branch Circuit 6

- Cooper Bussmann® LP-CC fuses
- **IR = 200kA @ 600V**

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"Two Sweep" Method: Sweep 2, Step 2 - Lowest IR or SCCR

Sweep 2: Verifying assembly overcurrent protective device interrupting rating or SCCR.

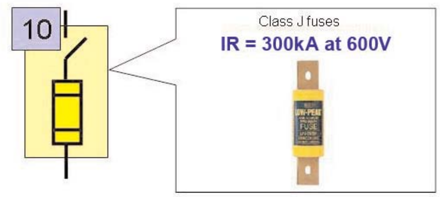
Step 2: Determine lowest overcurrent protective device interrupting rating or SCCR.

Branch Circuit 7
- Molded case circuit breaker analyzed in Sweep1, Step 3
- **IR = 10kA, but raised to 14kA** due to **transformer** and interrupting rating of Sub-Feeder Circuit 8 molded case circuit breaker

Sub-Feeder Circuit 8
- Molded case circuit breaker
- **IR = 14kA @ 480/277V**

Sweep 2 - Step 1 & Step 2 Summary
- The lowest interrupting rating or SCCR of this Step is 14kA @ 480/277V

Feeder Circuit 9
- No overcurrent protective device in this circuit



Supply Circuit 10
- Cooper Bussmann® 100A LPJ fuses
- **IR = 300kA @ 600V**

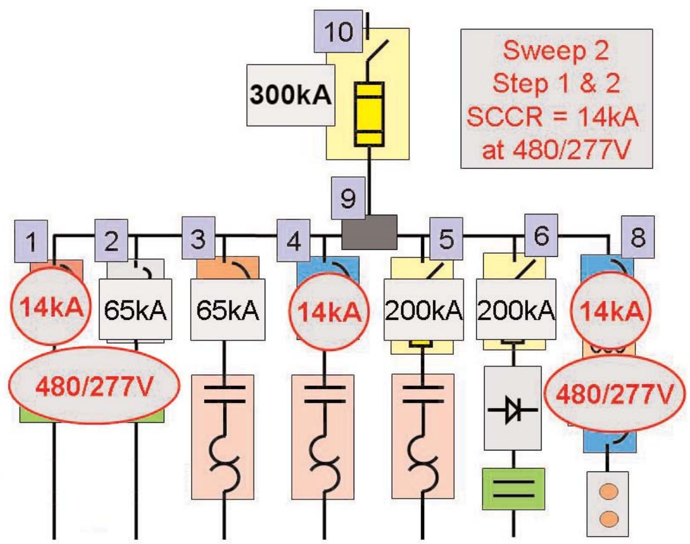


Figure 8 – Results of Sweep 2 – Steps 1 & 2

Results of Sweep 2, Steps 1 & 2: SCCR = 14kA @ 480/277V (Sweep 2, Step 2 Only)

	Assessment				SCCR Revisions		Sweep 1 Results			
	Sweep 1-Step 1 (Branch)		Sweep 1-Step 2 (Feeder)		Sweep 1-Step 3 (Trans)	Sweep 1-Step 4 (C-L OCPDs)	Sweep 1-Step 5		Sweep 2-Steps 1& 2 (Overcurrent Device)	
	SCCR	Voltage	SCCR	Voltage	SCCR	SCCR	SCCR	Voltage	IR/SCCR	Voltage
Branch Circuit 1	5kA	600V	–	–	–	–	5kA	600V	14kA	480/277V
Branch Circuit 2	65kA	480/277V	–	–	–	200kA	200kA	480/277V	65kA	480/277V
Branch Circuit 3	65kA	480V	–	–	–	200kA	200kA	480V	65kA	480V
Branch Circuit 4	25kA	480V	–	–	–	200kA	200kA	480V	14kA	480V
Branch Circuit 5	100kA	600V	–	–	–	200kA	200kA	600V	200kA	600V
Branch Circuit 6	100kA	600V	–	–	_	200kA	200kA	600V	200kA	600V
Branch Circuit 7	2kA	–	–	–	14kA	–	14kA	–	–	–
Sub-Feeder Circuit 8	–	–	–	–	–	–	–	–	14kA	480/277V
Feeder Circuit 9	–	–	10kA	600V	–	_	10kA	600V	–	–
Supply Circuit 10	–	–	200kA	600V	–	–	200kA	600V	300kA	600V

Note: *Red cells in table denote limiting components and voltages for each step.*

"Two Sweep" Method: Sweep 2, Step 3 - Final Assembly SCCR

Sweep 2: Verifying assembly SCCRs based upon overcurrent protective device interrupting rating or SCCR.

Step 3: Determine final assembly SCCR based upon results of Sweep 1 (component SCCR) and Sweep 2 (overcurrent protective device interrupting rating or SCCR).

- Sweep 1 lowest SCCR = 5kA @ 480/277V
- Sweep 2 lowest IR or SCCR = 14kA @ 480/277V
- Resulting **assembly SCCR = 5kA @ 480/277** (see Figure 9)

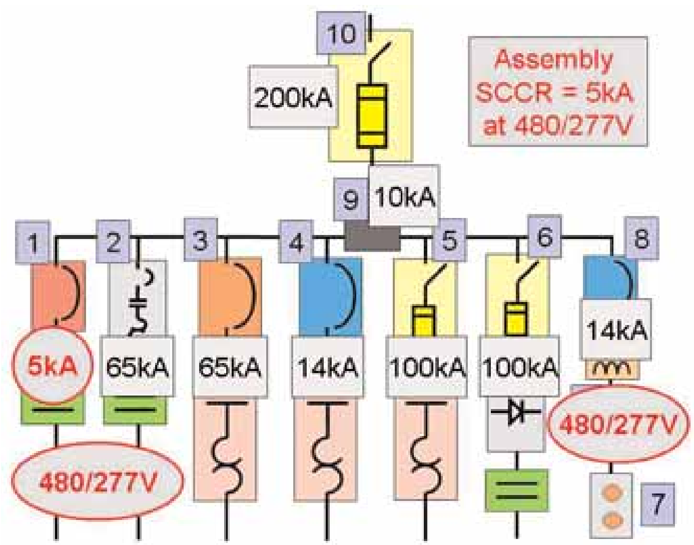
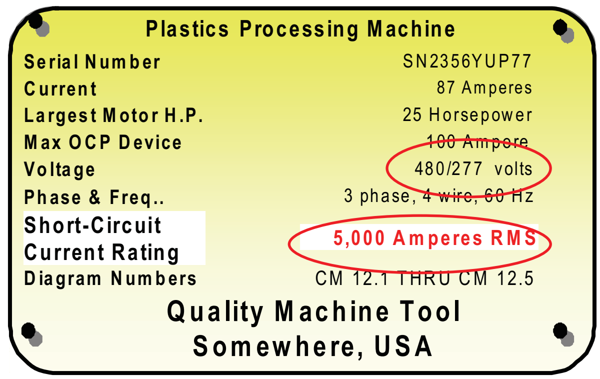


Figure 9 – Results of Sweep 2 – Step 3



Example of assembly SCCR label marking based on the "2 Sweep" method.

Sweep 2 - Step 3 Summary

- The lowest SCCR of both Sweep 1 and Sweep 2 is 5kA @ 480/277V
- The 5kA SCCR is based on the contactor in Branch Circuit 1, analyzed in Sweep 1 - Step 1
- The 480/277 slash voltage rating is from multiple components in Sweep 1 - Steps 1 and 5, and Sweep 2, Steps 1, 2 and 3
- The **Assembly SCCR is 5kA @ 480/277V**

Note*: The assembly would have to be marked with 5kA SCCR and 480/277V. Assemblies with 480/277V devices are suitable for only 480/277V solidly grounded wye systems. These assemblies cannot be applied on 480V ungrounded, resistance grounded or corner grounded systems. See the section on Slash Voltage Ratings for more information.)*

Results of Sweep 2, Step 3: Assembly SCCR = 5kA, Voltage = 480/277V

	Assessment				SCCR Revisions		Sweep 1 Results		**Sweep 2 Final**	
	Sweep 1-Step 1 (Branch)		Sweep 1-Step 2 (Feeder)		Sweep 1-Step 3 (Trans)	Sweep 1-Step 4 (C-L OCPDs)	Sweep 1-Step 5		Sweep 2-Steps 1, 2 & 3 (Overcurrent Device)	
	SCCR	Voltage	SCCR	Voltage	SCCR	SCCR	SCCR	Voltage	IR/SCCR	Voltage
Branch Circuit 1	5kA	600V	–	–	–	–	**5kA**	600V	14kA	**480/277V**
Branch Circuit 2	65kA	480/277V	–	–	–	200kA	200kA	**480/277V**	65kA	**480/277V**
Branch Circuit 3	65kA	480V	–	–	–	200kA	200kA	480V	65kA	480V
Branch Circuit 4	25kA	480V	–	–	–	200kA	200kA	480V	14kA	480V
Branch Circuit 5	100kA	600V	–	–	–	200kA	200kA	600V	200kA	600V
Branch Circuit 6	100kA	600V	–	–	_	200kA	200kA	600V	200kA	600V
Branch Circuit 7	2kA	–	–	–	14kA	–	14kA	–	–	–
Sub-Feeder Circuit 8	–	–	–	–	–	–	–	–	14kA	**480/277V**
Feeder Circuit 9	–	–	10kA	600V	–	_	10kA	600V	–	–
Supply Circuit 10	–	–	200kA	600V	–	–	200kA	600V	300kA	600V

Note: *Red cells in table denote limiting components and voltages for each step.*

Example: Increasing Assembly SCCR - "FIX IT"

"FIX IT"

What follows are methods to increase, or "FIX," a low assembly SCCR using the appropriate overcurrent protective devices with higher interrupting ratings and components with higher SCCRs.

To increase the assembly SCCR, identify the "weak links" and determine alternatives that can be used to increase the SCCR. While industrial control panels are only required to be marked with an SCCR, many OEMs and Industrials are finding that SCCR ratings of 65kA, 100kA, or higher with full voltage ratings (480V in lieu of 480/277V) are often needed to assure safety for the initial installation and flexibility for future changes to the system or moving the assembly to another location. The process to "FIX" these "weak links" is detailed below in order to meet the installation needs of OEMs and Industrials.

"Weak Link" 1

Branch Circuit 1: SCCR = 5kA and Slash Voltage Rating

The first "weak link" from the previous "Two Sweep" example is the IEC contactor (5kA SCCR) and the slash rated circuit breaker (480/277V) from Branch Circuit 1. This can be a common issue where circuit breakers are used in branch circuits. As shown in Figure 10, not only does the circuit breaker have a low interrupting rating (14kA) and slash voltage rating (480/277V), but the other circuit components, such as the IEC contactor (5kA), can additionally limit the SCCR since higher combination ratings are not available.

The "FIX IT" is to find a fully rated overcurrent device with a high interrupting rating and a high SCCR combination rating with the IEC contactor. A solution is to change the circuit breaker to the Cooper Bussmann® Compact Circuit Protector (CCP) with Class CC fuses. The Class CC CCP is rated 600V and 200kA. Since the Class CC CCP utilizes Class CC fuses, and since the IEC contactor in this example had a combination rating of 100kA with Class CC fuses, the SCCR is now 100kA. An additional benefit of the CCP can be space savings when compared to typical lighting and industrial style circuit breakers.

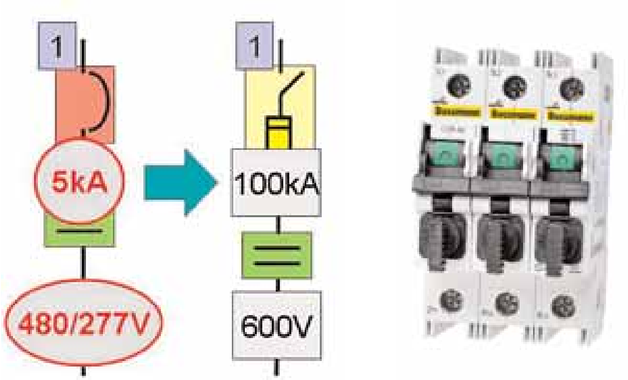


Figure 10

The Cooper Bussmann® CCP with Class CC fuses can easily increase SCCR by replacing low IR and slash rated molded case circuit breakers.

"Weak Link" 2

Feeder Circuit 9: SCCR = 10kA

The next "weak link" is the unmarked power distribution block. The easy solution to this is to find a power distribution block that has a high SCCR when protected by a specific overcurrent device upstream. Since the overcurrent device upstream is a Class J fuse, the solution would be to use a Cooper Bussmann® high SCCR power distribution block or terminal block. This is important to note, as most power distribution blocks and terminal blocks require a current-limiting fuse to achieve a SCCR higher than 10kA. In addition, since the power distribution block is in the feeder circuit, feeder circuit spacings are also required per UL 508A. The Cooper Bussmann PDB (open style) or PDBFS (enclosed style) Series of power distribution blocks are Listed to UL 1953 assuring compliance with feeder circuit spacing requirements in UL 508A and are UL Listed with high SCCR ratings with Class J fuses as shown in Figure 11.

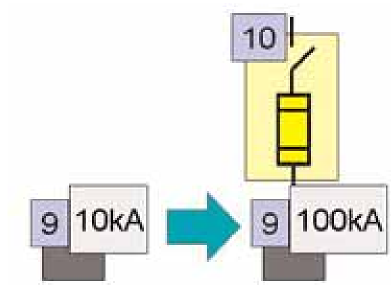


Figure 11

High SCCR PDBs

Often the power distribution block is the"weak link" holding assembly SCCR low. Using high SCCR PDBs protected with Class J fuses can deliver a higher combination SCCR. The following table shows the possible SCCRs.

This power distribution block is rated for use on a circuit capable of delivering no more than the SCCR kA shown (kA rms sym. or DC amps 600V maximum). For other SCCR options, see Data Sheet 1049.

Figure 12

AWG Wire Range	Class J Fuse Max. Amp	Resulting SCCR
2-6	400A	200kA
2-14	200A	50kA
2-14	175A	100kA

***Note**: SCCR of the Cooper Bussmann® PDBFS is only 10kA with a circuit breaker.*

Example: Increasing Assembly SCCR - "FIX IT"

"Weak Link" 3
Branch Circuit 4: SCCR = 14kA and Sub-Feeder Circuit 8 – SCCR = 14kA and Slash Voltage Rating

The next "weak link" is the 14kA circuit breaker in Branch Circuit 4 and the 14kA slash rated (480/277V) circuit breaker in Sub-Feeder Circuit 8. There are two possible solutions for this, either increase the interrupting rating of both circuit breakers and change to a full or straight voltage rated circuit breaker in Sub-Feeder Circuit 8 (this will increase the cost and may require changing to a larger industrial style circuit breaker) or change to the Cooper Bussmann® CCP as shown in "Weak Link 1." The most economical solution is to change the circuit breaker to the Cooper Bussmann CCP with Class CC fuses. In Branch Circuit 4, this change increases the interrupting rating to 200kA as well as increasing the rating of the IEC starter to 100kA through the use of Class CC fuses so that Branch Circuit 4 is now rated 100kA. The change to Sub-Feeder Circuit 8 not only increased the interrupting rating to 200kA, but also improved the voltage rating from 480/277V (limits the assembly) to 600V (not limited).

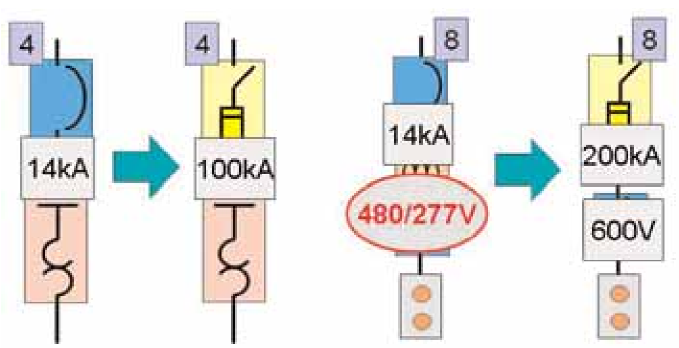


Figure 13

"Weak Link" 4
Branch Circuit 2: Slash Voltage Ratings

The next "weak link" is the slash voltage rating in Branch Circuit 2. While the self-protected starter is compact in size and has a relatively high SCCR (65kA), it typically comes with a slash voltage rating. The solution is to either add an overcurrent device with a high interrupting rating ahead of the self-protected starter or change to the CCP with Class CC fuses and a magnetic starter. The most economical solution to achieve a high SCCR and full voltage rating is to change to the CCP with Class CC fuses and a magnetic starter. With this change the circuit is rated 100kA @ 600V.

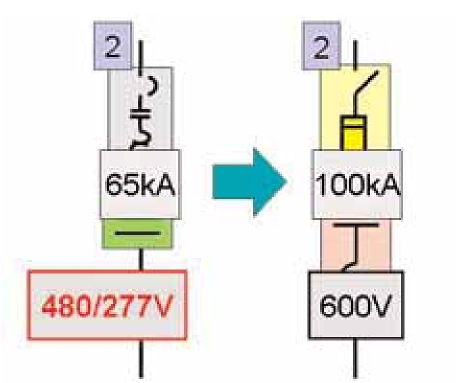


Figure 14

"Weak Link" 5
Branch Circuit 2, 3 & 4: Manufacturer Limitation

In motor circuits, when mechanical overcurrent protective devices are selected the assembly typically has SCCR or voltage rating limitations as shown previously. These devices can additionally lock the user into a single manufacturer. For instance, the self-protected starter and contactor in Branch Circuit 2 requires the same manufacturer to be selected if higher combination short-circuit current ratings are desired. The MCP and magnetic starter in Branch Circuit 3 must be from the same manufacturer to be a listed combination as required by the NEC®. The circuit breaker and magnetic starter in Branch Circuit 4 must be from the same manufacturer and a high interrupting rated circuit breaker must be selected to achieve a high combination short-circuit current rating. This greatly decreases flexibility for the user and can adversely increase component cost. In contrast, where fusible devices are used in motor circuits, high combination ratings with multiple manufacturers are possible increasing flexibility and reducing cost.

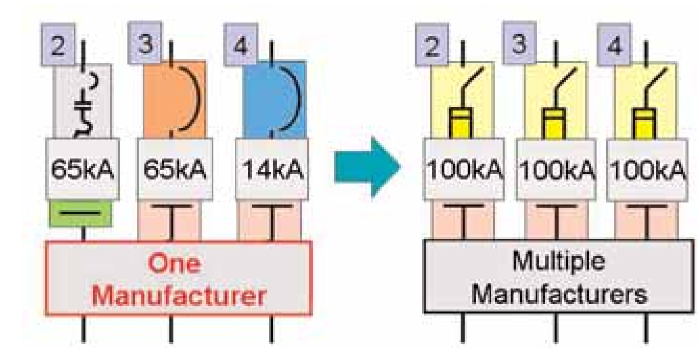
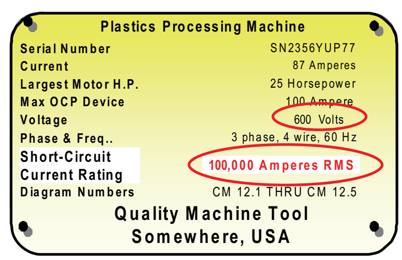


Figure 15

"FIX IT" Summary

The Figure 16 shows how all the "weak links" have been changed and now the panel has a high assembly SCCR with a full voltage rating.



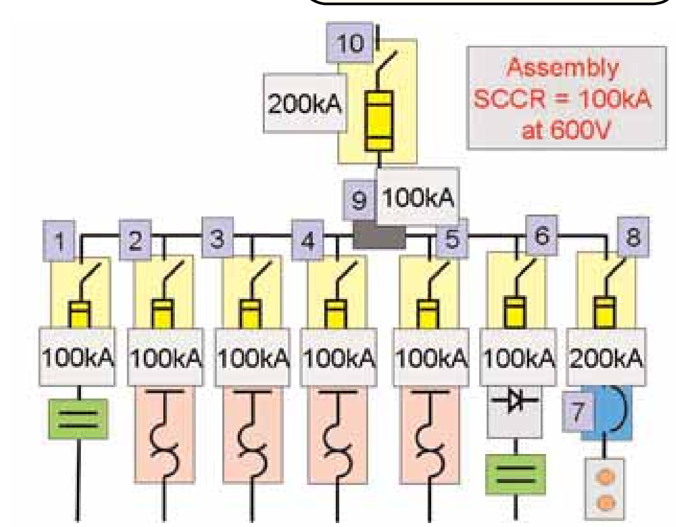


Figure 16

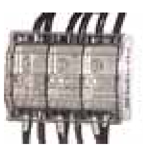
COOPER Bussmann

Increasing Assembly SCCR: "FIX IT" - Typical "Weak Links"

Typical "Weak Links" and Improving SCCR

The following table highlights the typical "weak links" in industrial control panels and provides Cooper Bussmann solutions, along with the added benefits that these solutions can provide for a design.

This is an example of how Cooper Bussmann can help "FIND" the "weakest link" and "FIX" the "weakest link." Cooper Bussmann will provide the most versatile and reliable design for any overcurrent protection need.

"Weak Link"		"FIX IT"	
	**UL 1077 Supplementary Protectors** **Assembly Limiting Factor:** • Some may have an interrupting rating of 5kA to 10kA. Default rating is 200A if unmarked. • Not permitted for feeder or branch circuit protection.		**Increase the Interrupting Rating:** • Use Cooper Bussmann® current-limiting fuses and the CCP (Class CC or CUBEFuse®) or fuse holder to achieve higher SCCRs by replacing the low interrupting rated UL 1077 supplementary protector with modern current-limiting fuses with high IRs of up to 300kA.
	**UL 489 Instantaneous Trip Circuit Breaker** **Assembly Limiting Factor:** • SCCR is dependent upon combination rating when used with a listed combination motor controller. Default rating can be as low as 5kA. Varies by manufacturer.		**Increase the Interrupting Rating:** • Use Cooper Bussmann current-limiting fuses and the CCP (Class CC or CUBEFuse) or fuse holder to achieve higher short-circuit current ratings by replacing the low SCCR combination rated instantaneous trip circuit breaker with modern current-limiting fuses with high interrupting ratings of up to 300kA.
	**Power Distribution Block in Feeder Circuit** **Assembly Limiting Factor:** • If the power distribution block is not marked with a combination SCCR the default rating of 10kA must be used. • For feeder circuit applications, power distribution blocks must have feeder spacings per UL 508A.		**Use PDB and PDBFS Series of Power Distribution Blocks with High SCCR:** • Cooper Bussmann has introduced a line of power distribution blocks Listed to UL 1953 with high SCCRs up to 200kA when protected by Class J fuses. By replacing a low rated power distribution block with the Cooper Bussmann® PDBs or PDBFS, a panel can achieve the high ratings and proper spacings needed.
	**Molded Case Circuit Breakers with Low Interrupting Ratings** **Assembly Limiting Factor:** • Typically have interrupting ratings of 10kA to 14kA. • Higher interrupting ratings are available at increased cost.		**Increase the Interrupting Rating:** • Use Cooper Bussmann current-limiting fuses and the CCP (Class CC or CUBEFuse) or fuse holder to achieve higher short-circuit current ratings by replacing the low interrupting rated circuit breaker with modern current-limiting fuses with high interrupting ratings of up to 300kA.
	**Type E Self Protected Combination Starter** **Assembly Limiting Factor:** • Slash voltage rating limits the application options for the assembly to only a solidly grounded wye system. • Line-to-ground interrupting capability is limited. • SCCR at 600/347V is typically limited.		**Use Device With Straight Voltage Rating:** • Use Cooper Bussmann current-limiting fuses and the CCP (Class CC or CUBEFuse) or fuse holder with high SCCR combination and straight voltage rated motor starter to allow for installation on any type of system grounding.

Additional Resources on SCCR

Cooper Bussmann offers tools to assist with the proper application of short-circuit current ratings including:

Simplified Guide to SCCR: basic understanding of short-circuit current ratings and tools to determine the "weakest link" for industrial control panels.

OSCAR™: Online Short-Circuit Current per UL 508A Rating Compliance Software. Used to determine and document the short-circuit current ratings of industrial control panels. Go online to www.cooperbussmann.com/oscar for more information.

Short-Circuit Calculator Program: free software download to calculate the available fault current at different points within the electrical distribution system.

For more information on the above, go to: www.cooperbussmann.com.