

# Welcome!

## Overview of UL's 2006 Changes to UL508A for Short Circuit Current Ratings

*Presented by*

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*President*

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*Vice President*



# Absolute

## Automation Systems, Inc.

INDUSTRIAL CONTROL ENGINEERING • SYSTEMS  
INTEGRATION • FABRICATION (CUSTOM & LONG RUN)

toll-free 877-820-9900

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# Who is Absolute Automation Systems, Inc.

- Formed in 1999 from a merger of Tenric, Inc. and L-A-S Automation Systems, Inc.
- Mission: produce top quality panels on time and at a fair price.
- Employ approx. 18 assemblers and wiremen, 8 engineers and techs and several office/support people.
- Facility is 15,000 ft<sup>2</sup> and shop is 10,000 ft<sup>2</sup> with the room to expand the building another 10,000 ft<sup>2</sup>.
- Employs lean manufacturing principles and practices.
  - Manufacture between 6,000 and 7,000 control panels per year, of which over 5,000 are UL approved.
  - Nominated for WI Manufacturer of the Year.
  - Listed on the 2007 INC 5000 list of fastest-growing private companies.
  - Control Engineering “System Integrator of the Year” Finalist 2008



# Services provided by Absolute Automation

1. Design, manufacture, test and provide UL/CUL and CSA agency approval of custom control panels for all industries, including hazardous locations.
2. High volume production runs of control panels or assemblies.
3. Engineering services including applications consulting, systems design and programming of PLC, interface, motion control and data acquisition systems.
4. Laser and rotary engraving of legend plates, lamacoids, name plates, awards, plaques and signage on many different materials.
5. Sublimation printing of signage, nameplates, displays, etc.



6. Wire Prepping and Harnessing

## LOOK FOR THESE SPECIALLY MARKED BOXES

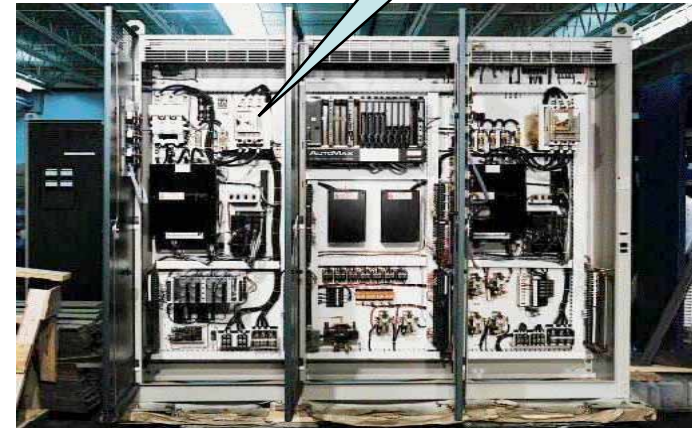


We also have the ability to build UL/CUL approved hazardous location controls

# NEC Article 409 Code Change

- **New** Article 409 covers “Control Panels”
- “Industrial Control Panel” Definition
  - Industrial Control Panels, intended for general use, ordinary locations, 600V or less.
- Subsection 409.110 (3) “Markings” Industrial Control Panels **must** be evaluated & marked for their Short-Circuit Current Rating (SCCR)

Panel SCCR  
50kA RMS Symmetrical  
480V Maximum



- (3) Short-circuit current rating of the industrial control panel based on one of the following:
- a. Short-circuit current rating of a listed and labeled assembly
  - b. Short-circuit current rating established utilizing an approved method

FPN: UL 508A-2001, Supplement SB, is an example of an approved method.

## ARTICLE 409 Industrial Control Panels

### I. General

**409.1 Scope.** This article covers industrial control panels intended for general use and operating at 600 volts or less.

FPN: UL 508A is a safety standard for industrial control panels.

### 409.2 Definitions.

**Industrial Control Panel.** An assembly of a systematic and standard arrangement of two or more components such as motor controllers, overload relays, fused disconnect switches, and circuit breakers and related control devices such as pushbutton stations, selector switches, timers, switches, control relays, and the like with associated wiring, terminal blocks, pilot lights, and similar components. The industrial control panel does not include the controlled equipment.



# Definition of Short Circuit Current Rating

- Short-Circuit Current Rating – SC CR:
  - The perspective or maximum symmetrical fault current at a nominal voltage to which an apparatus or system is able to be connected without sustaining damage exceeding the defined acceptance criteria.



# How to determine SCCR of a panel?

- Short circuit current rating of an industrial control panel is based on one of the following:
  - a) Short circuit current rating of a listed and labeled assembly
  - b) Short circuit current rating established utilizing an approved method

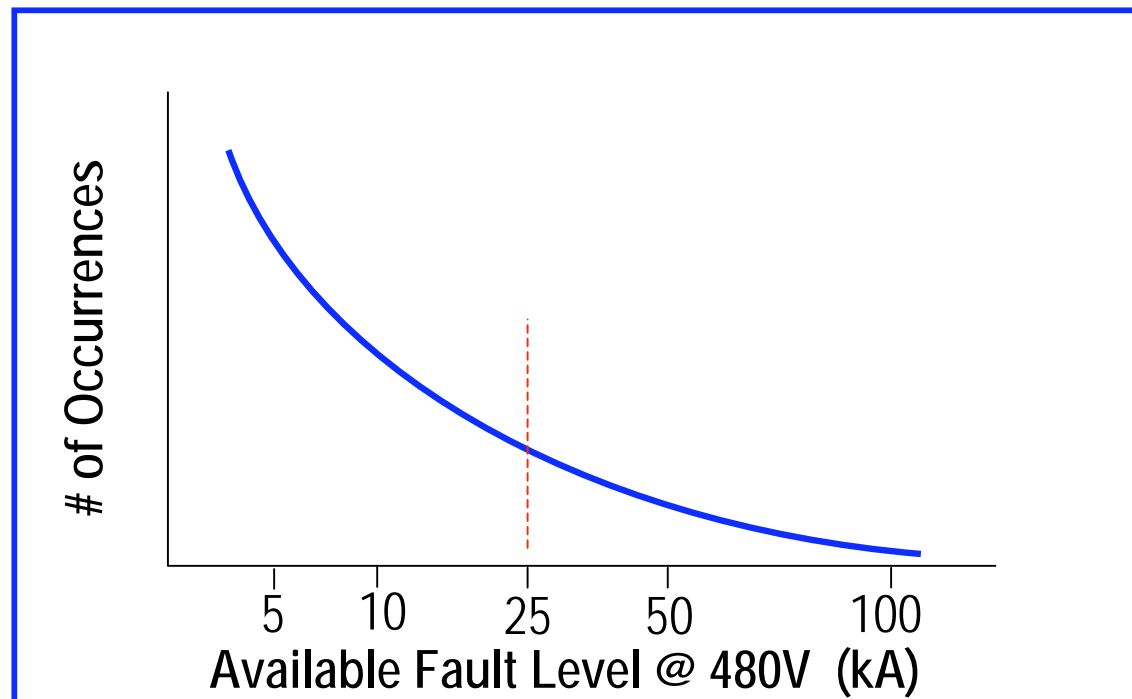
FPN: UL508A-2001, Supplement SB is an example of an approved method.



## Panel Short Circuit Rating Requirements

- Majority of installations have available fault levels under 25kA @ 480V!
- Determine panel short circuit current rating requirements at the start of a project.

### Survey of 300 Industrial Installations



*Installation Fault Levels*

# UL508A SCCR of Components or Combinations

*In UL 508A, the term short circuit current rating, refers to either:*

- *Overcurrent Protective Devices (Interrupting Ratings)*
- *Power components short circuit current ratings*

*or*

- *Combinations of the two*



Overcurrent  
Protective  
Device

Power  
components



# 3 ways to determine the short circuit current rating of a component

- Markings on the component itself.
- Table SB4.1, which is the default UL values for components. This is used if there are no markings on the component.
- A combination that has been approved by UL that will be referenced on the component itself or on the component spec. sheet.



# Individual Power Circuit Components

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*.



# Establish SCCR of Components

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 on instructions provided with the component;



# Establish SCCR of Components

- b) The short-circuit current rating determined by the voltage rating of the component and *the assumed (assigned) short-circuit current* from Table SB4.1;



# Establish SCCR of Components

- c) The short-circuit current rating for a load controller, motor overload relay, or combination motor controller that has been investigated (tested) 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 (panel builder's) procedure.



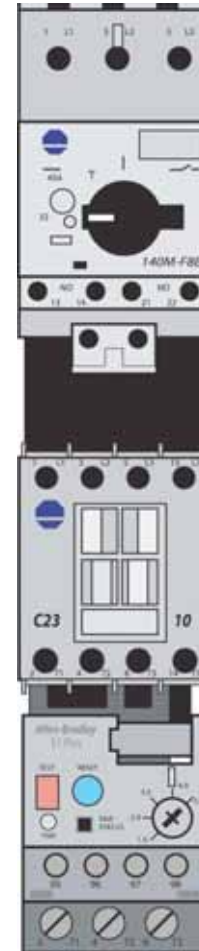
# Individual Power Circuit Components

- **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.



# High Fault Ratings of Components

- High fault ratings are achieved through testing of combinations of components with specific protective devices
- Using components that have been tested for high fault SCCRs:
  - Eliminates the need to apply complicated feeder current limiting provisions.
  - Allows a significantly higher panel SCCR rating than can be achieved using standard or assumed component ratings.



# High Fault SCCR of Components

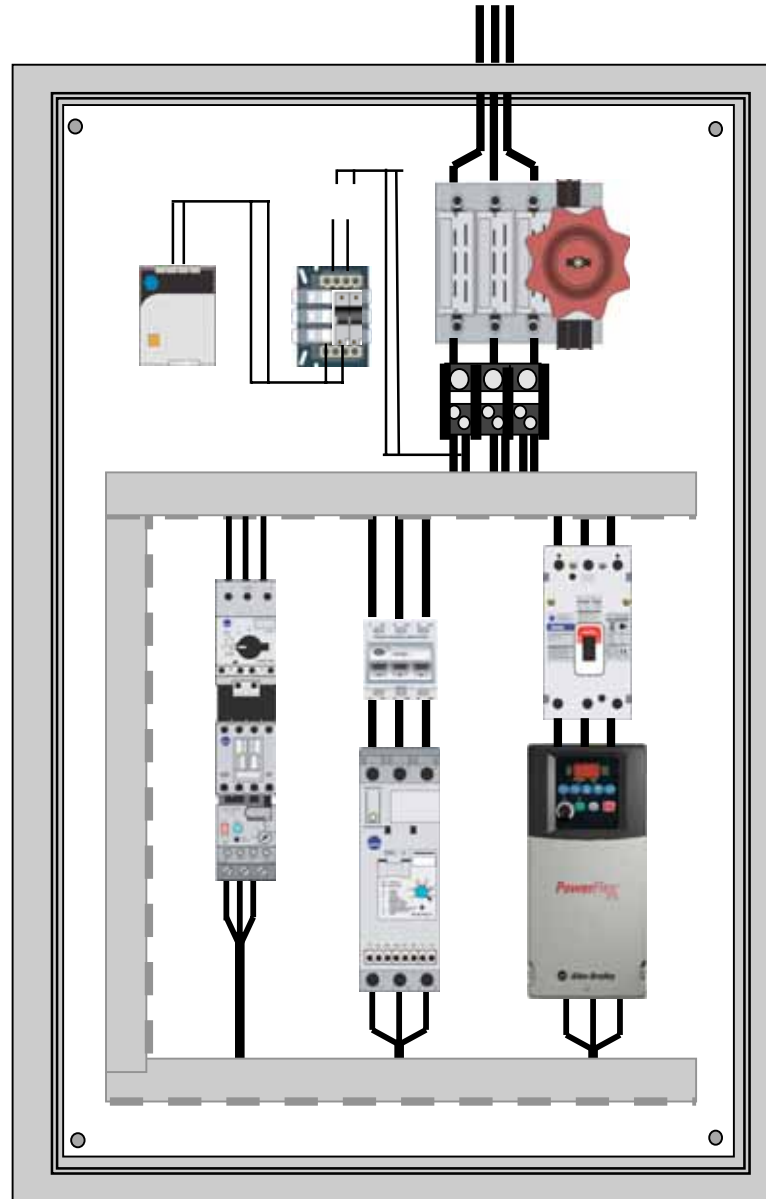
- **Exception 1:**
  - When the specified BCPD related to the high fault SCCR is a Class CC, G, J, L, RK1, RK5 or T fuse, a fuse of different class is able to be used at the same high fault rating where the  $I_p$  let-through current and  $I^2t$  of the new fuse is not greater than that of the specified fuse. See Table SB4.2 for maximum let-through currents ( $I_p$ ) and  $I^2t$
- **Exception 2:**
  - The specified branch circuit protective device is able to be provided in the field when the panel is marked in accordance to SB5.1.2.
- **Exception 3:**
  - When the specified BCPD related to the high fault SCCR is a listed circuit breaker marked “current limiting”, a different current-limiting circuit breakers is able to be used at the same high fault rating.....



SCCR: 100kA,  
600V with UL  
Class J or CC  
Fuses



# Overall SCCR of the Panel



# 3 steps to determine the short circuit rating of a control panel

- Establish the short circuit ratings of the individual components.
- Modify those component values based on the presence of current limiting components and high fault combinations
- Determine the overall panel rating based on the “weakest link”.

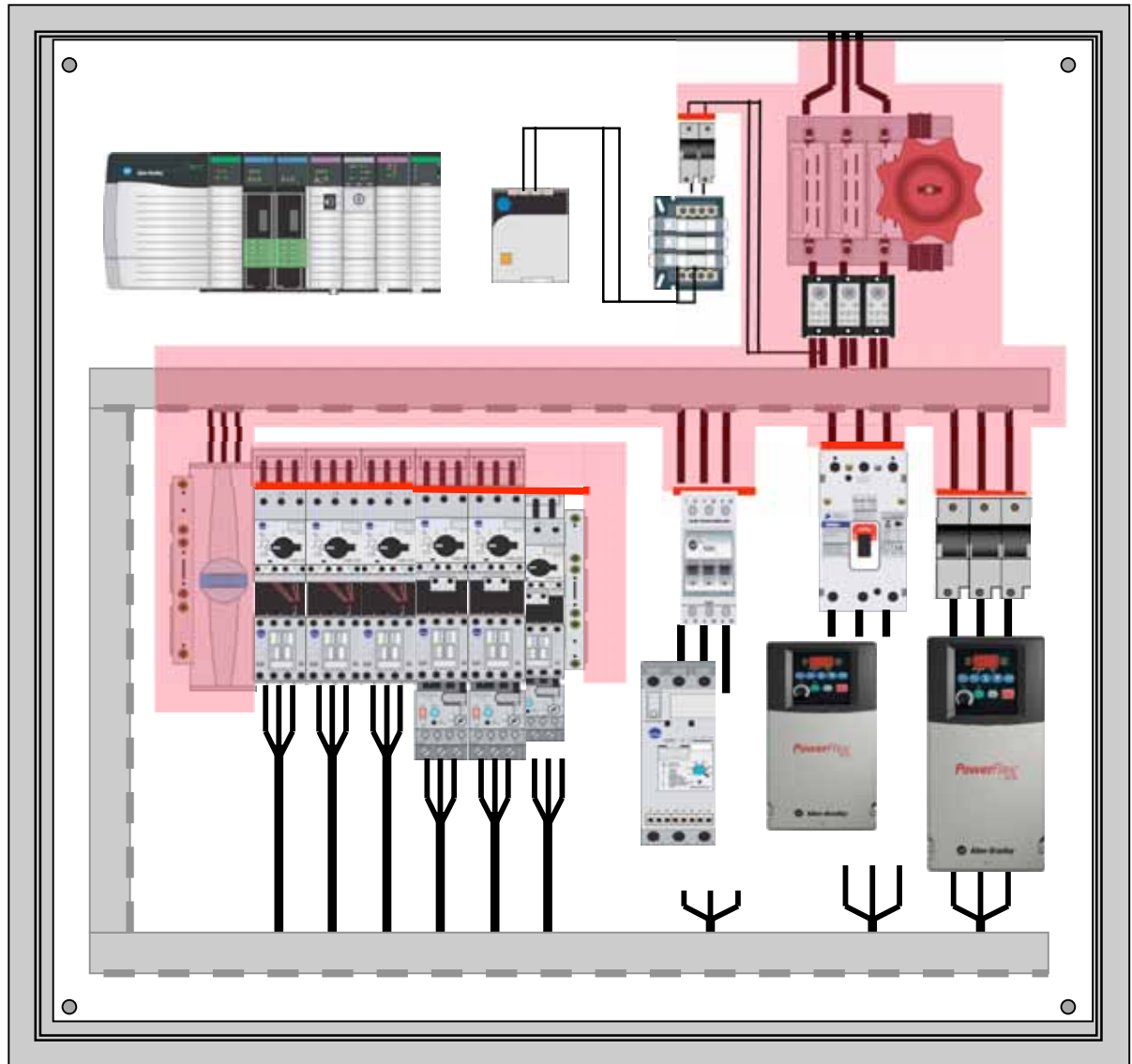


# “Feeder Circuit” Definition

- “Feeder Circuit” covers all power conductors and components from incoming feeder disconnect, .... to the line side of the last branch circuit protective device (BCPD).

“Feeder Circuit” 

“Branch” CPD 



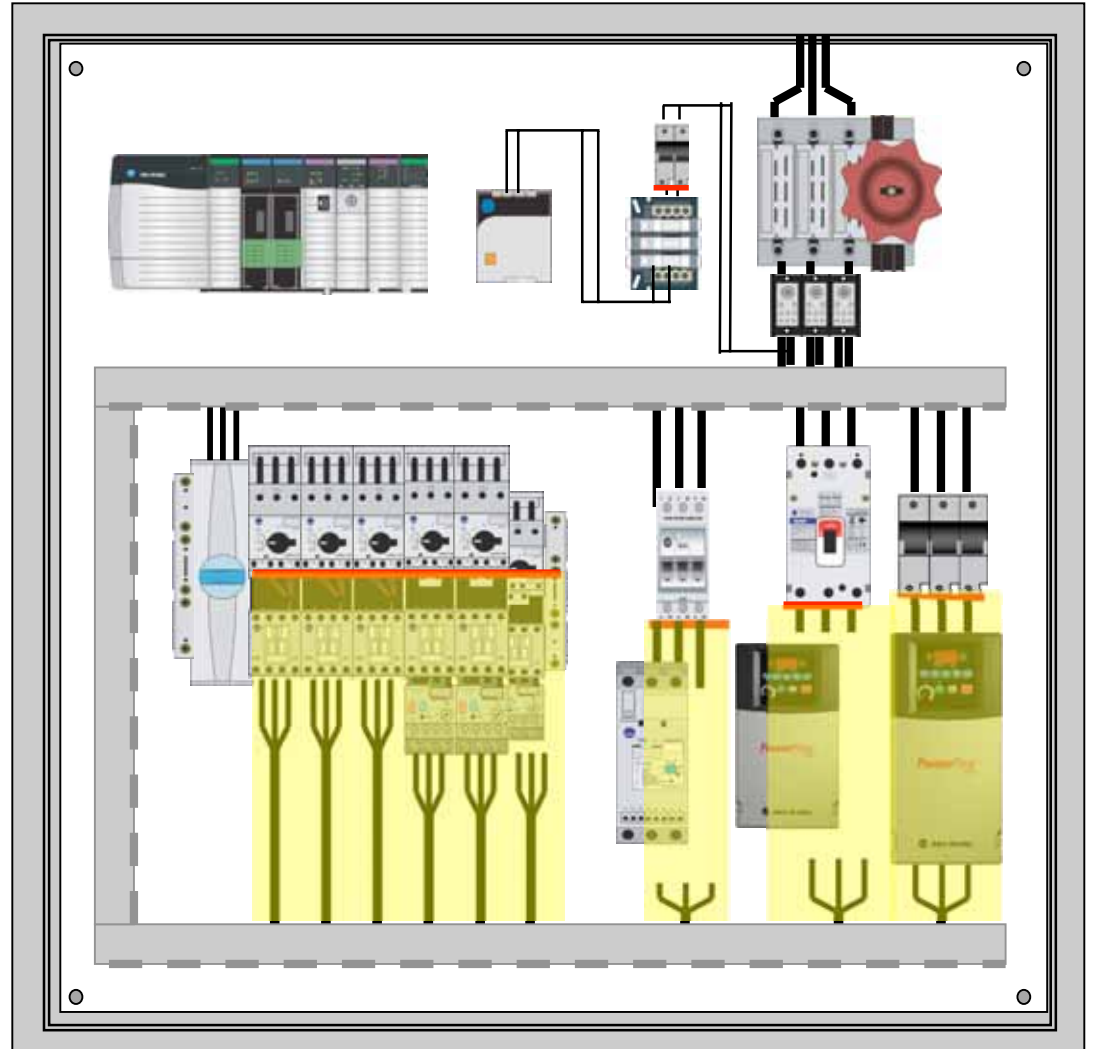
# “Branch Circuit” Definition

- “Branch Circuit” covers all power conductors and components from the load-side of the branch circuit, .... to the controller load-side connections.

“Branch Circuit” 

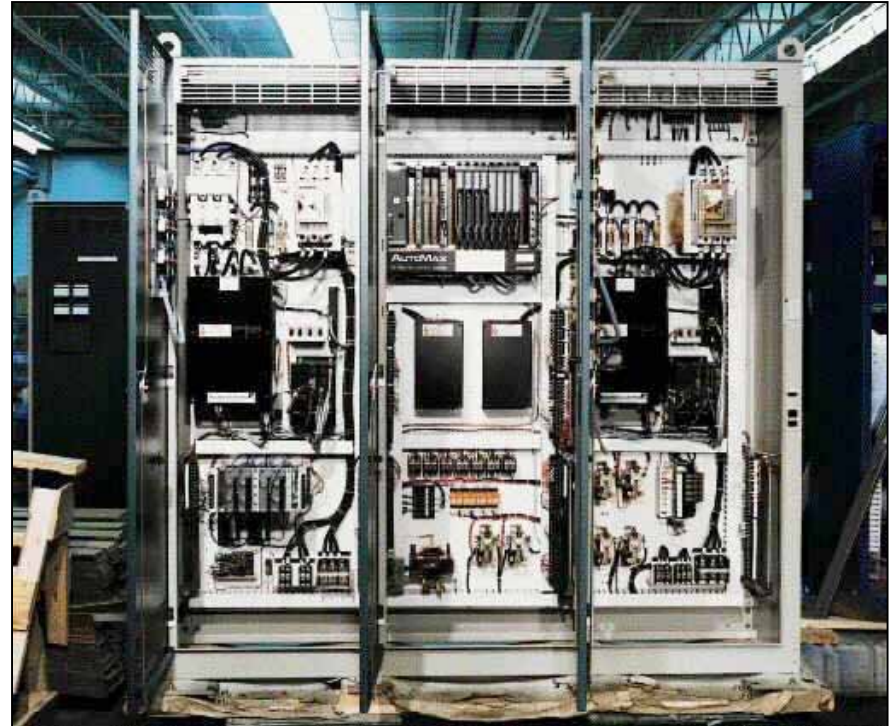
“Branch” CPD 

- Terms used for protection devices:
  - Over-current Protection Device (OPD)
  - Branch Circuit Protection Device (BCPD)



# NEC Marking Requirements

NEC Article  
409.110 now  
requires Industrial  
Control Panels to  
be marked with  
Short Circuit  
Current Ratings



# UL508A Marking Requirements

- **SB5.1 General**

- SB5.1.1 The nameplate rating of an industrial control panel shall include:

**“Short circuit current: \_\_\_kA rms symmetrical, \_\_\_V maximum”**  
or the equivalent.

- This is required for each incoming circuit

- **SB5.2 Cautionary Markings**

- If the branch circuit protective device is not provided, the panel should be marked with the "type and size" of branch circuit protective device that shall be installed in the field.
- If an industrial control panel has a rating based on the high fault short circuit current rating, then additional markings of "Warning" shall be added with the following statement: "Risk of Fire or Electric Shock"



# Spec. Label Requirements

## Prior to April 2006

\_\_\_ Volts  
\_\_\_ Hertz  
\_\_\_ Phase  
\_\_\_ FLA (Total)  
\_\_\_ FLA of Largest Motor  
\_\_\_ Drawing Number

## After April 25, 2006

\_\_\_ Volts  
\_\_\_ Hertz  
\_\_\_ Phase  
\_\_\_ FLA (Total)  
\_\_\_ FLA of Largest Motor  
\_\_\_ Drawing Number  
Short Circuit Current: \_\_\_ kA rms Symmetrical at \_\_\_ V Maximum  
\_\_\_ A Max Feeder Circuit Protection Size  
Feeder Circuit Protection \_\_\_ Class



# Additional Markings

- High Fault Combination Marking

## **Warning**

### Risk of Fire or Electrical Shock Label

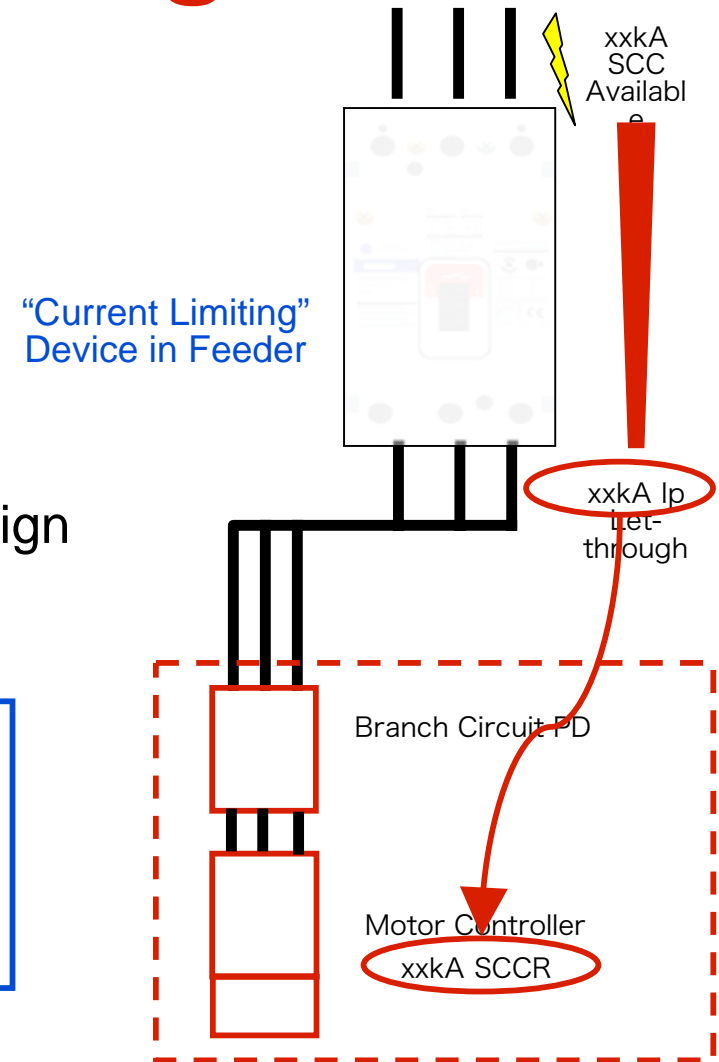
THE OPENING OF THE BRANCH-CIRCUIT PROTECTIVE DEVICE MAY BE AN INDICATION THAT A FAULT CURRENT HAS BEEN INTERRUPTED. EXAMINE ALL CURRENT-CARRYING PARTS PROTECTED BY THIS DEVICE FOR DAMAGE. IN ORDER TO MAINTAIN THE LISTED CURRENT RATING OF THE CONTROL PANEL. DAMAGED PARTS MAY ONLY BE REPLACED WITH THE ORIGINAL MANUFACTURER'S PART NUMBER.



# Current-Limiting

- SB4.3 provides current limiting provisions
  - Current limiting device(s) must be in feeder
  - Standard fault rated components restrict applicability
  - Often difficult to achieve desired design
- More on current limiting later..

Use of high fault rated components virtually eliminates the need to apply the current limiting provisions!



# What is Current Limiting?

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- **Current limiting:** The ability of a protective device to clear a short circuit fault in less than one half cycle and typically within one quarter cycle. Current limiting devices will reduce the levels of  $i$ -peak magnetic and  $I^2t$  heat energies.
- Circuit breakers have the ability to open high fault currents in just a few milliseconds, very comparable to fuses.



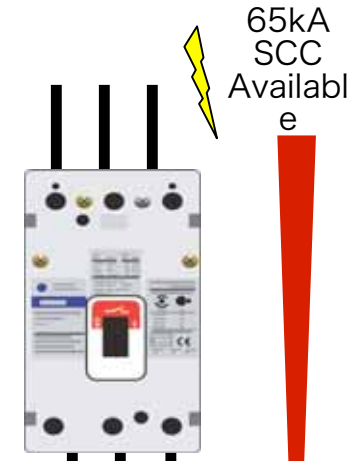
# Current-Limiting w/ Circuit Breakers

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:

This is what we are evaluating



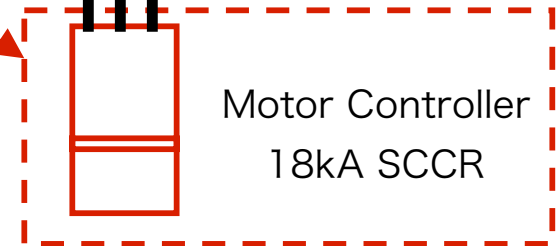
Feeder CB  
“Current Limiting”  
65kA SCCR



??kA I<sub>p</sub> Let-through

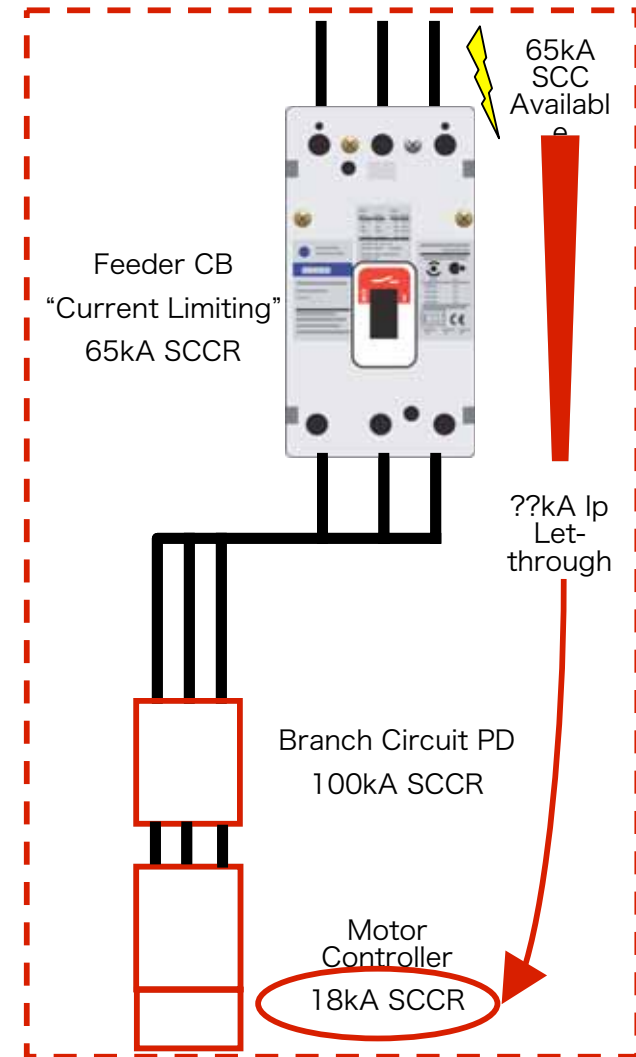
Branch Circuit PD  
65kA SCCR

Motor Controller  
18kA SCCR



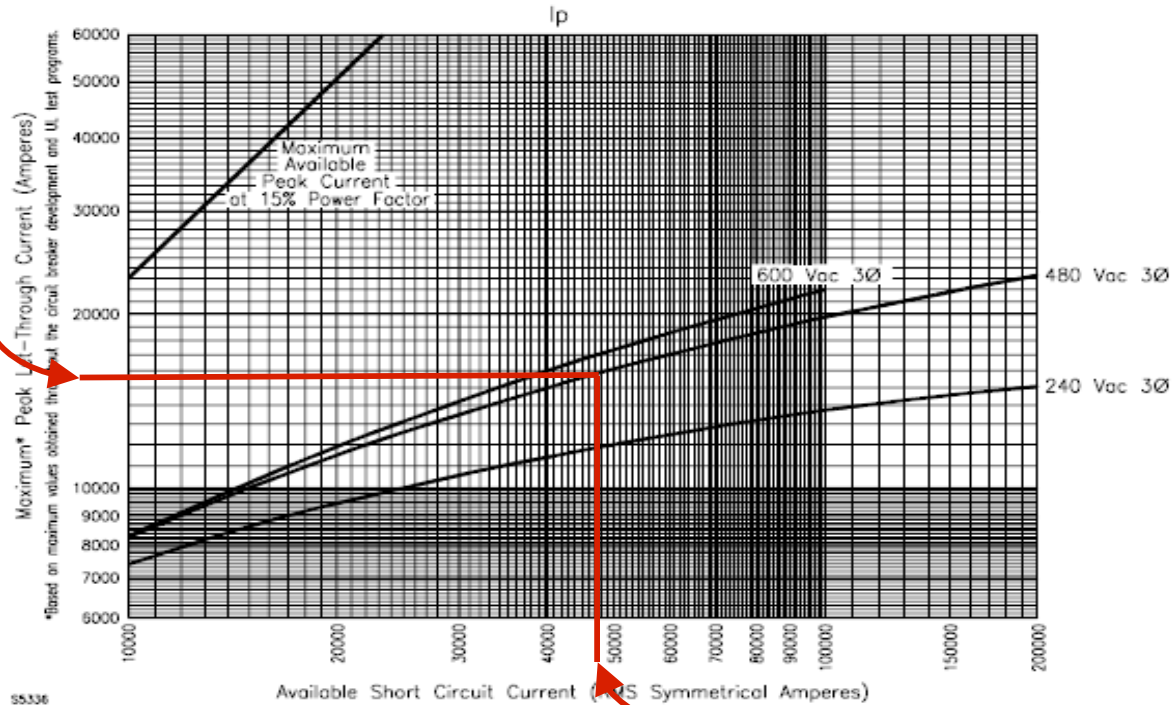
# Current-Limiting w/ Circuit Breakers

- a) The short-circuit current rating of the feeder circuit breaker when all of the 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;



# Current Limitation – UL Listed Circuit Breakers

**Figure SB4.1**  
**Sample plots of current limiting circuit breakers let-through values**  
 Added Figure SB4.1 effective April 25, 2006



17kA Let Through

65kA Available

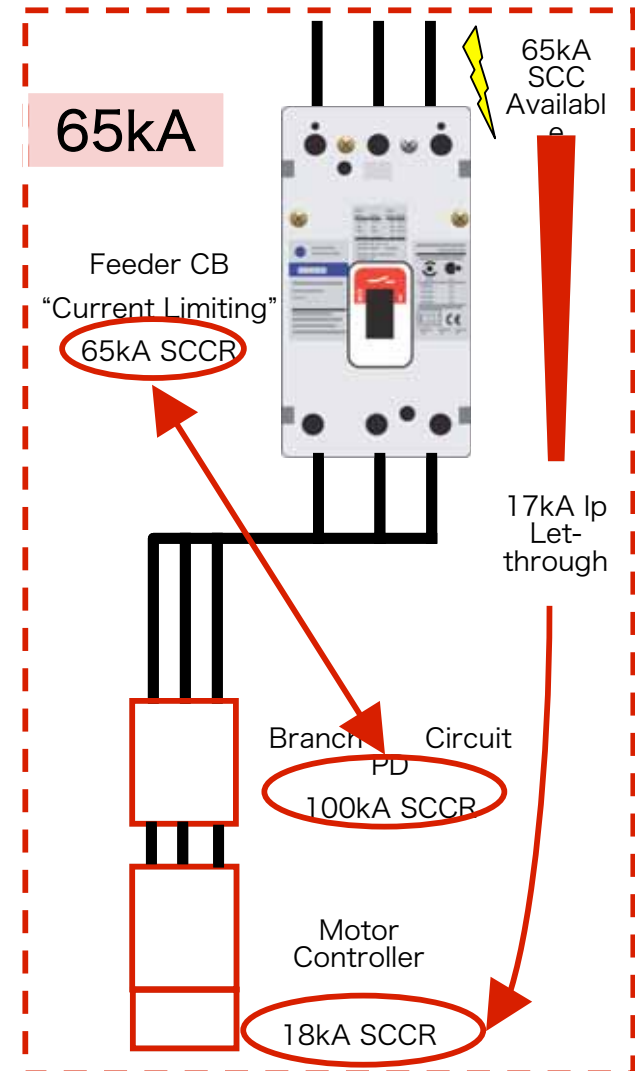
*"Current Limiting Circuit Breakers"*



# Current-Limiting w/ Circuit Breakers

- a) The short-circuit current rating of the feeder circuit breaker when all of the 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;

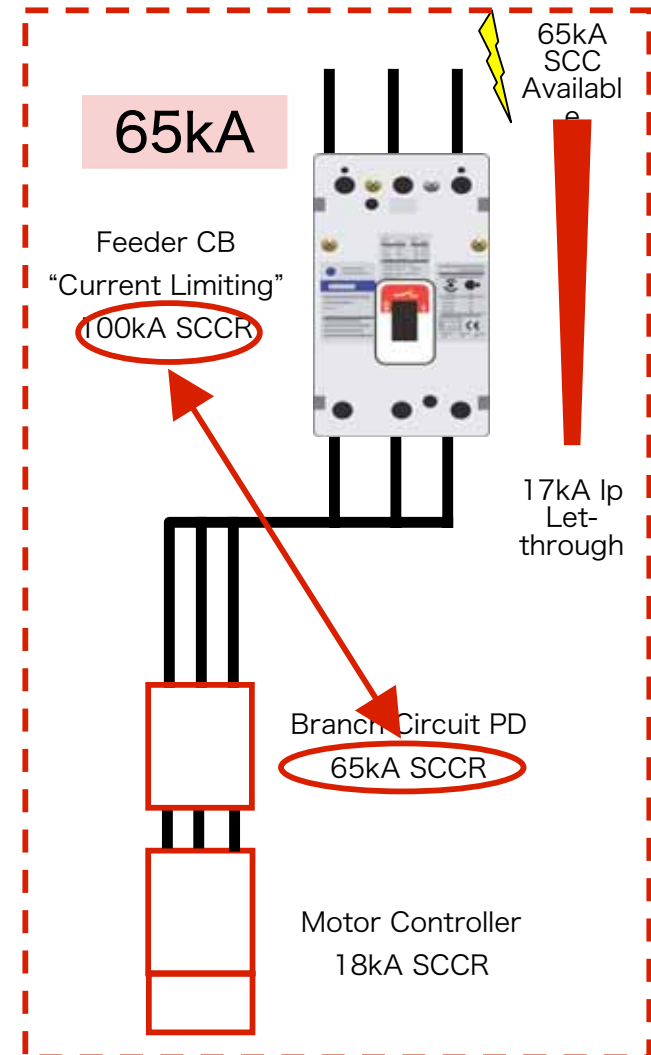
Feeder Circuit Protective Device limits branch SCCR to 65kA.



# Current-Limiting w/ Circuit Breakers

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.

Branch Circuit Protective Device limits Branch SCCR to 65kA

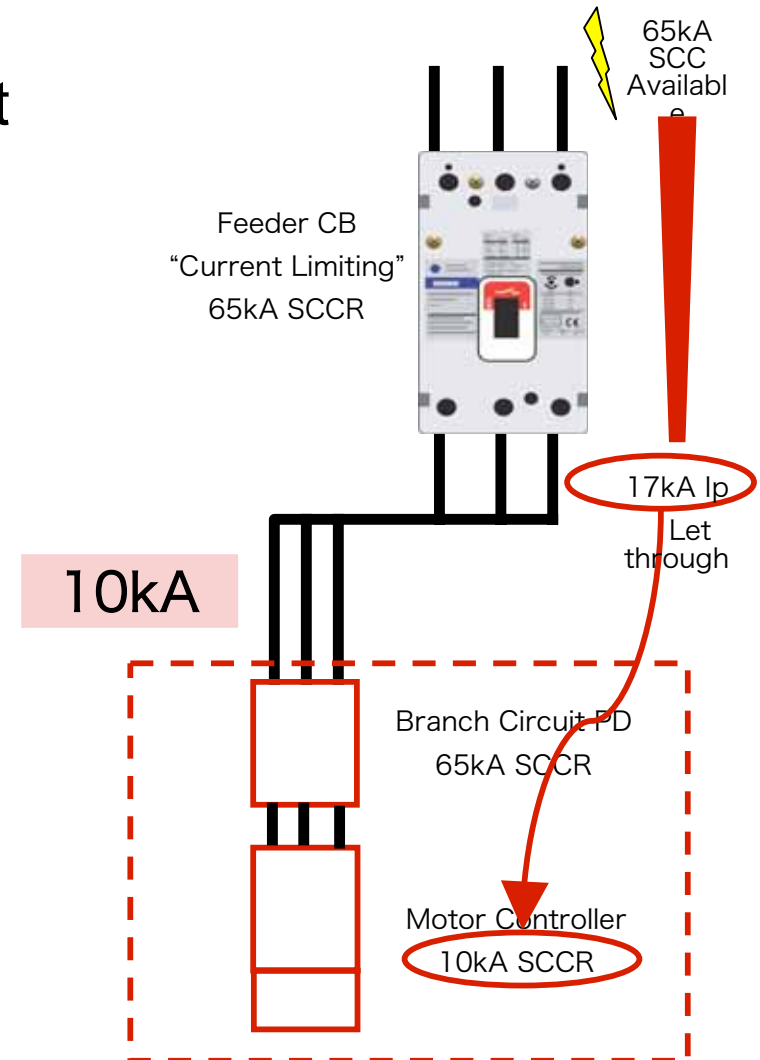


# Current-Limiting w/ Circuit Breakers

- c) The smallest short-circuit current rating of any branch circuit on the load side of the feeder circuit breaker, when the conditions of SB4.3.2(a) or SB4.3.2(b) are not met.

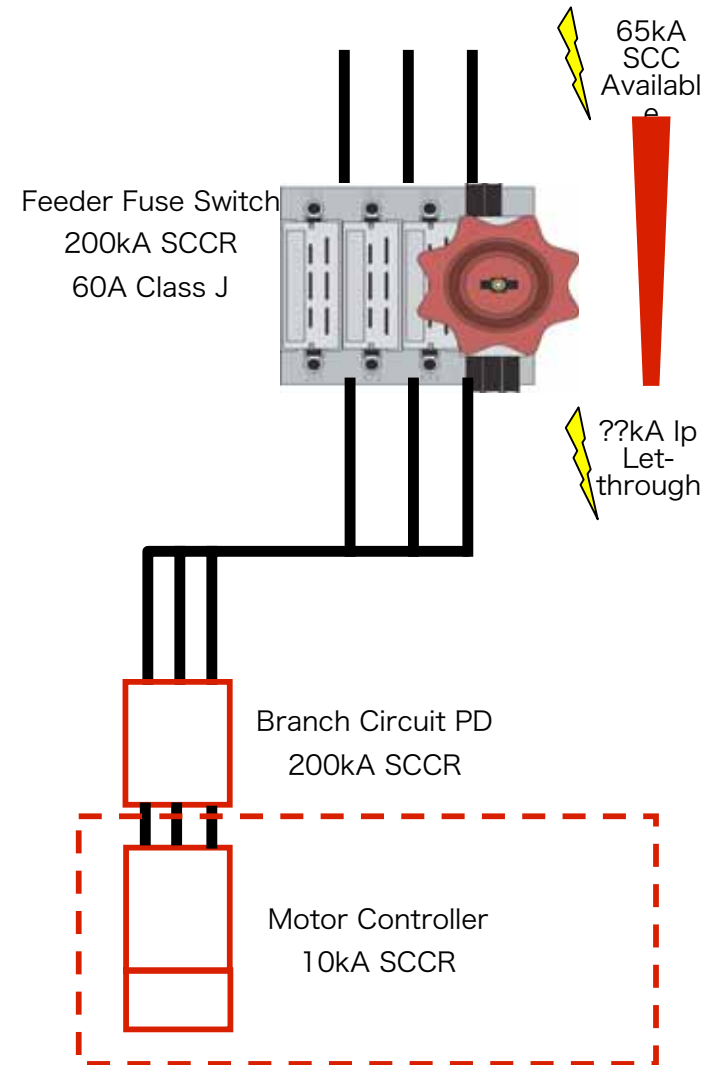
Motor Controller limits branch SCCR to 10kA.

Note: Branch does not meet available fault current.



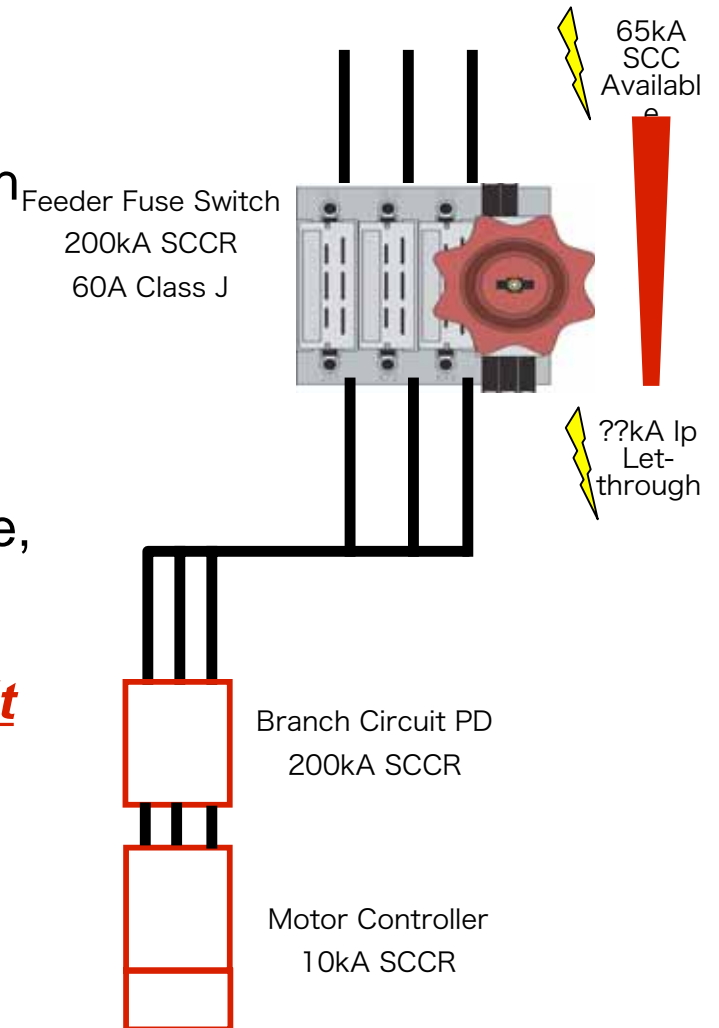
# Current Limiting w/ Fuses

For branch circuits supplied by a **Class CC, G, J, L, RK1, RK5, or T fuse in the feeder circuit,** the short-circuit current rating on the line side of the fuse shall be one of the following:



# Current Limiting w/ Fuses

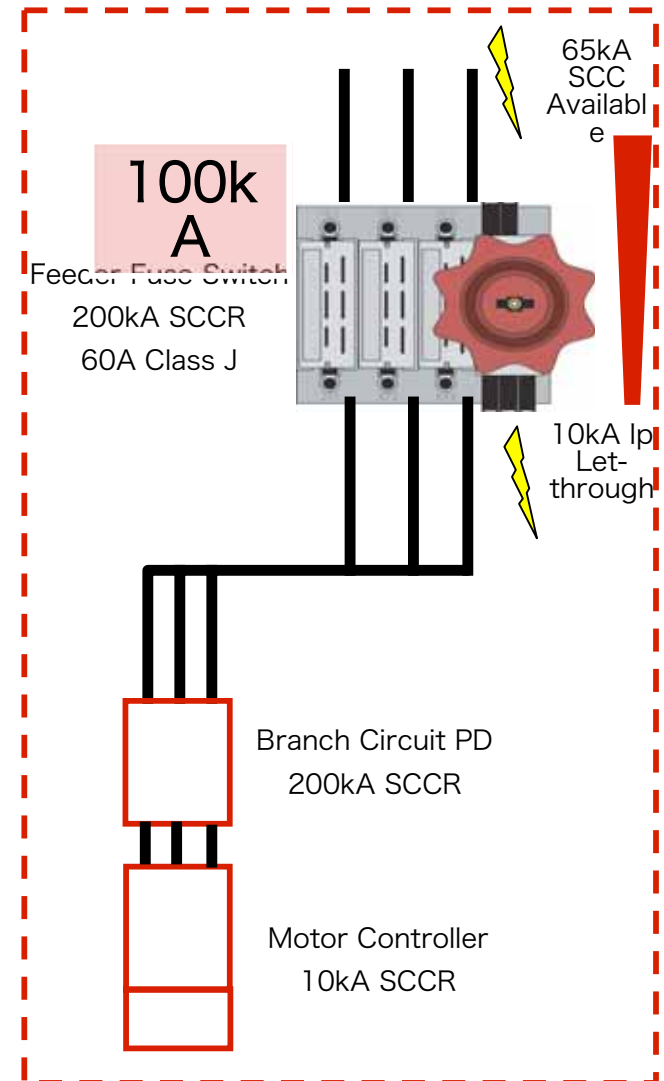
- a) The short-circuit current rating of the **feeder fuse** when all of the components in the branch circuit have a short circuit current rating not less than the **peak let-through** current corresponding to the specific fuse class employed from Table SB4.2 based on the current rating of the fuse and the available short-circuit current on the line side of the fuse, 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 fuse**;



# Current Limiting w/ Fuses

- a) The short-circuit current rating of the feeder fuse when all of the components in the branch circuit have a short circuit current rating not less than the peak let-through current corresponding to the specific fuse class employed from Table SB4.2 based on the current rating of the fuse and the available short-circuit current on the line side of the fuse, 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 fuse;

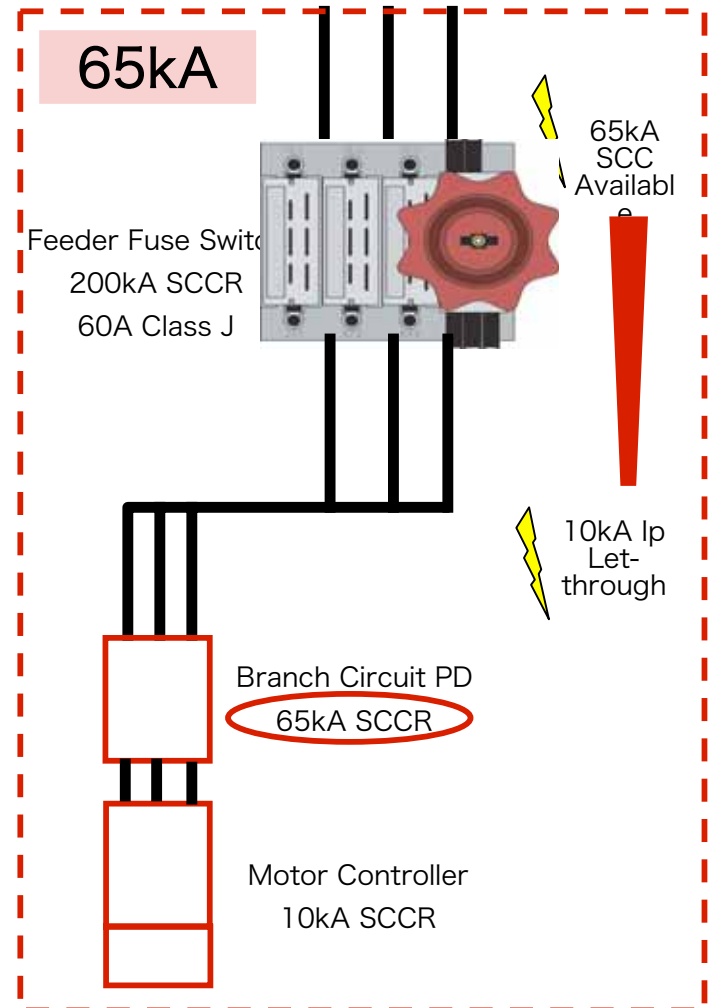
SCCR of the feeder fuse rating per Table SB4.2 is 100kA to limit the feeder let through below the motor controller SCCR. Branch SCCR is 100kA.



# Current Limiting w/ Fuses

- b) The smallest short-circuit current rating of any branch circuit protective device on the load side of the feeder fuse, when the conditions of SB4.3.3(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 fuse.

As in previous example the feeder fuse has a SCCR rating of 100kA. The branch circuit protective device limits rating. Branch SCCR is 65kA

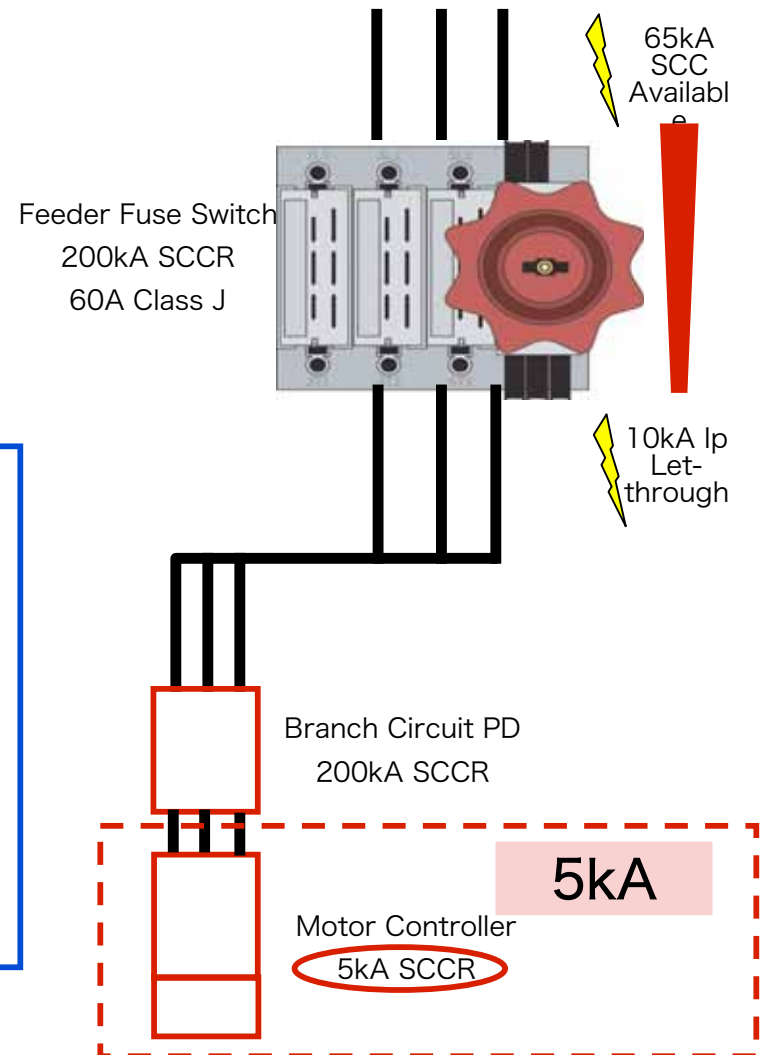


# Current Limiting w/ Fuses

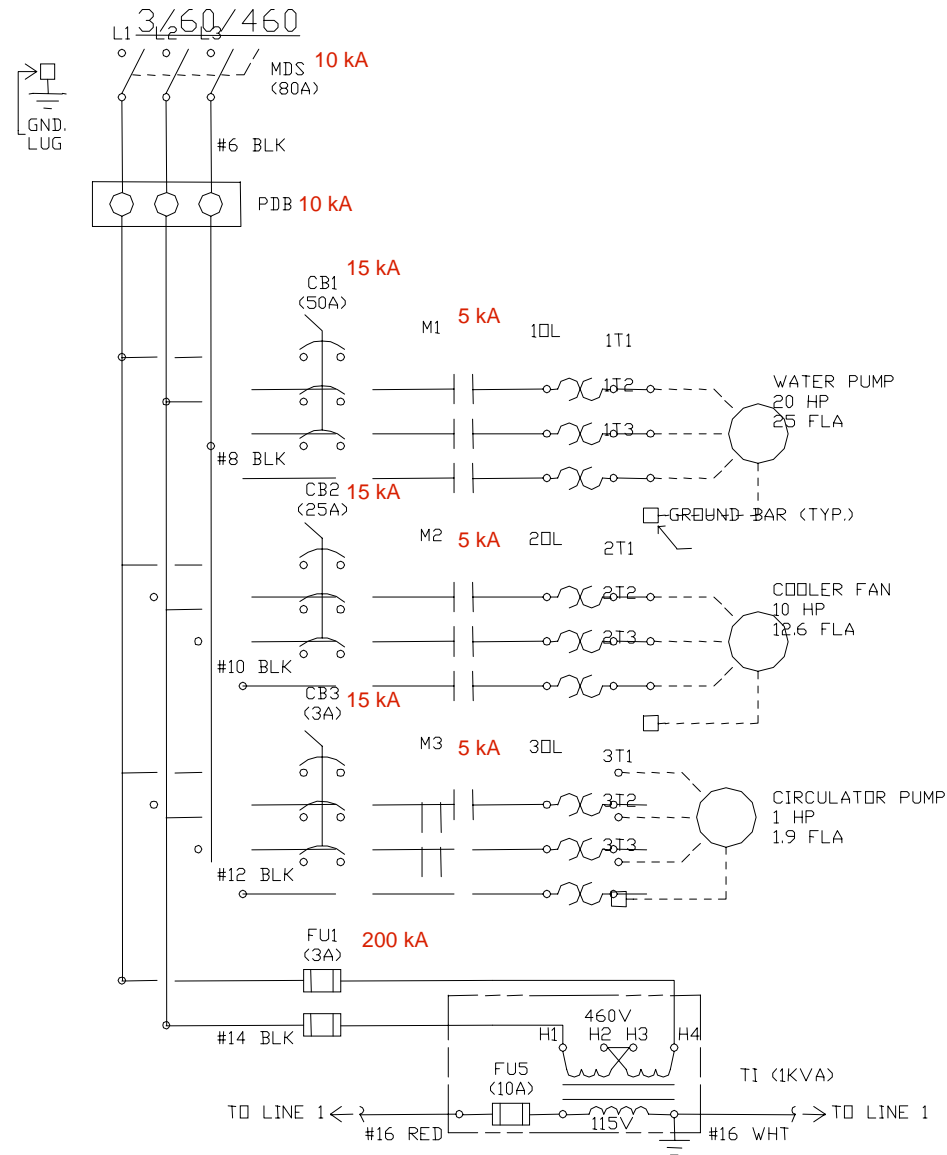
- c) The smallest short-circuit current rating of any branch circuit on the load side of the feeder fuse, when the conditions of SB4.3.3(a) or SB4.3.3(b) are not met.

Feeder let through current exceeds motor controller SCCR. Current limiting does not apply. Branch SCCR remains at 5kA.

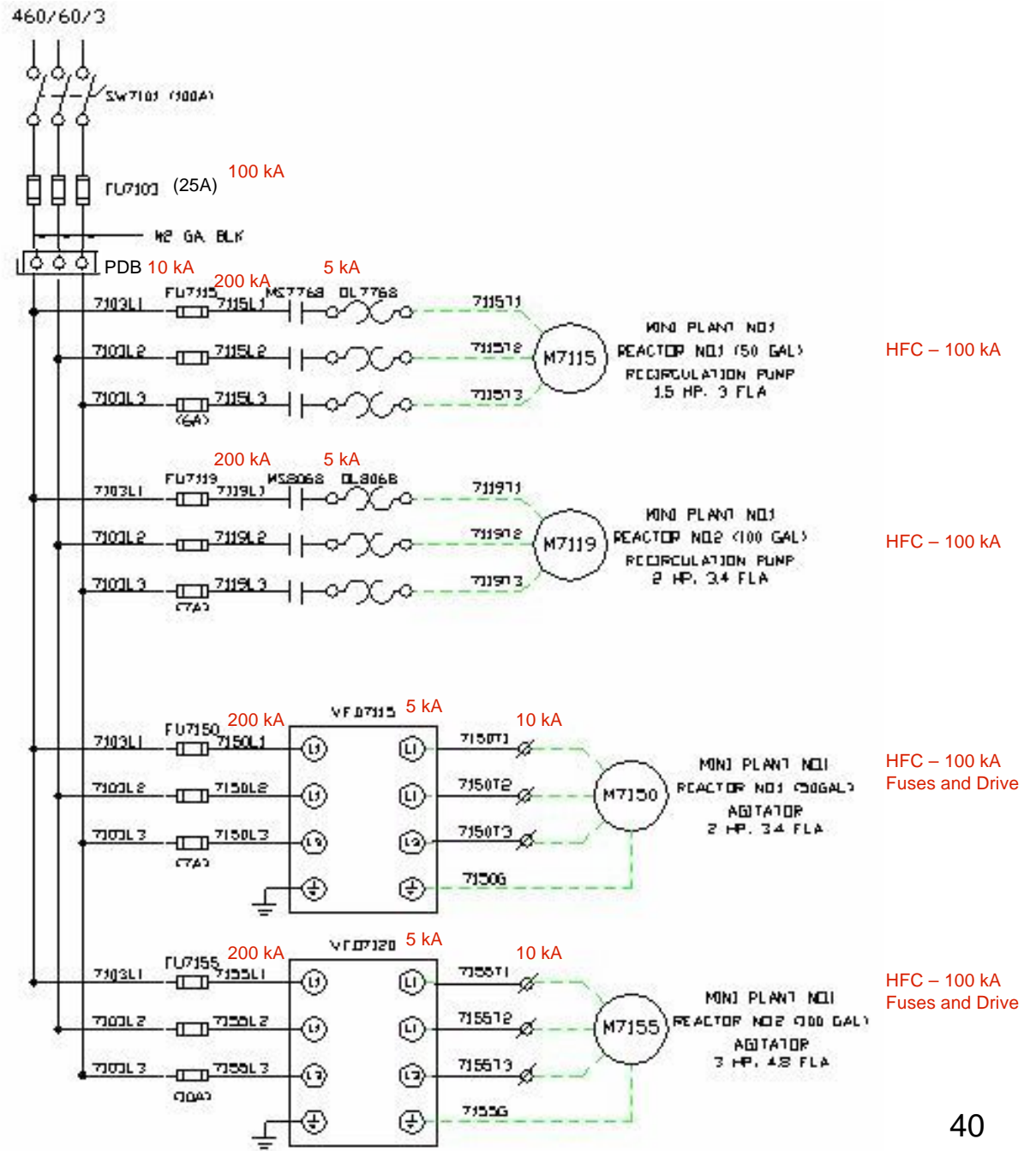
Note: Branch does not meet available fault current.



# Circuit Breaker Example



# Fuse Example



# Resources

UL Standards available for purchase at Comm 2000:

- <http://www.comm-2000.com>
- UL508A Standard: [http://www.comm-2000.com/productdetails.aspx?sendingPageType=BigBrowser&CatalogID=Standards&ProductID=UL508A\\_1\\_S\\_20010425\(ULStandards2\)](http://www.comm-2000.com/productdetails.aspx?sendingPageType=BigBrowser&CatalogID=Standards&ProductID=UL508A_1_S_20010425(ULStandards2))

To Purchase the 2008 NEC Handbook:

- [http://www.nfpa.org/catalog/product.asp?pid=70HB08&order\\_src=A208](http://www.nfpa.org/catalog/product.asp?pid=70HB08&order_src=A208)

Free Arc Flash Safety Resources:

- <http://www.easypower.com/support.php>



# QUESTIONS???



Email them to:

[Don Lavrenz](#)

Vice President

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