

UL 508A

Industrial Control Panels



Objectives

- ☐ Who is UL?
- ☐ UL508A Origin
- ☐ Current emphasis on UL508A
- ☐ What is the UL 508A Standard?
- ☐ Implementation of the Standard
 - ☐ Component Selection
 - ☐ Short Circuit Current Ratings
- ☐ Q & A



Underwriters Laboratories (UL)

On January 1, 2012, Underwriters Laboratories transformed from a non-profit organization to a for-profit company in the U.S.

A new subsidiary named simply UL LLC, a limited liability corporation, took over Underwriters Laboratories' product testing and certification business.

UL Standards-Setting

Safety standards are written documents that outline the process in which a product is tested to help mitigate risk, injury or danger. UL is a standard-setting organization.

UL Standards development covers more than just products; it also includes testing of systems and services.

UL Standards-Setting

A standard is developed in cooperation with a Standards Technical (STP).

An STP is a group of individuals, representing a variety of interests, formed to review proposals related to UL Standards for Safety. Members are manufacturers, product representatives, consulting engineers, and others who are interested in the standard; UL has one member. Each member has one vote.

Standards are developed by consensus.

UL Testing

OSHA created and administers the NRTL program. UL is a Nationally Recognized Testing Laboratory (NRTL), recognized under OSHA's NRTL program.

UL tests products and methods to assure safety and compatibility with a standard. Testing may be for UL standards and for others, e.g., IEC.

UL508A Standard

- ❑ UL508A Origin, Title: *Industrial Control Panels*
First edition 2001
Latest: Second Edition, December 2013
- ❑ Current emphasis
NFPA 70, *The National Electrical Code* (NEC), made reference to the UL508A standard in the 2005 edition. The new Article 409, titled “Industrial Control Panels”, was introduced.
- ❑ UL508A definition:
“2.27 INDUSTRIAL CONTROL PANEL FOR GENERAL USE – A control panel intended to be installed in accordance with the general use requirements in Chapter 4 of the National Electrical Code, ANSI/NFPA 70.”



NEC 2017 Definition

Industrial Control Panel. An assembly of two or more components consisting of one of the following:

- (1) power circuit components only, such as motor controllers, overload relays, fused disconnect switches, and circuit breakers;
- (2) control circuit components only, such as push buttons, pilot lights, selector switches, timers, switches, and control relays;
- (3) a combination of power and control circuit components.

These components, with associated wiring and terminals, are mounted on, or contained within, an enclosure or mounted on a subpanel.

Source: NEC 2017

NEC 409.110 Marking

An industrial control panel shall be marked with the following information that is plainly visible after installation:

- (1) Manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product can be identified.
- (2) Supply voltage, number of phases, frequency, and full-load current for each incoming supply circuit.

Source: NEC 2017

NEC 409.110 Marking (contd.)

- (4) 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

Informational Note: ANSI/UL 508A, *Standard for Industrial Control Panels*, Supplement SB, is an example of an approved method.

Exception to (4): Short-circuit current rating markings are not required for industrial control panels containing only control circuit components.

Source: NEC 2017

UL 508A

Industrial Control Panels

□ Industrial Control Panels are rated:

- ❖ 1000V or less

- ❖ 40°C ambient

□ UL 508A Standard does not include:

- ❖ Panels for Hazardous Locations “NRBX” which are covered under UL698A

- ❖ Panels Containing Intrinsic Safety Barriers and Intended for Circuits in Hazardous Areas

UL 508A – The Standard

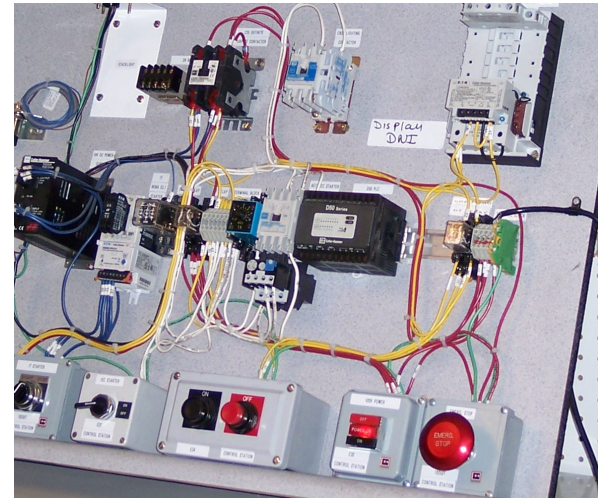
❑ The Standard Covers...

❖ Industrial Control Panel Assemblies which may contain:

- Motor controllers
- Overload relays
- Fused Disconnects / Circuit Breakers
- Buttons, Switches, Timers & Controllers
- Wiring
- Terminals
- Enclosures

❑ Four Parts

- ❖ Part 1 – General Use
- ❖ Part 2 – Specific Use
- ❖ Part 3 – Specific Component Requirements
- ❖ Part 4 – Short Circuit Current Ratings



How is equipment SCCR determined?

1. Short-circuit testing in high power laboratory
 - ❑ Tested and listed to UL product standard

2. Analysis methods (for device or apparatus)
 - ❑ Example: *UL 508A Industrial Control Panel* product standard, *Supplement SB*

Industrial Control Panels

UL 508A – Circuit Type Definitions

PART 1 – GENERAL USE INDUSTRIAL CONTROL PANELS

- 2.38 POWER CIRCUIT –
Conductors and components of
branch and **feeder** circuits.
 - Supply LOADS - Motor, Lighting, Heating, Appliances, etc.

- 2.11 CONTROL CIRCUIT – A
circuit that carries the electric
signals directing the performance
of a controller, and which does not
carry the main power circuit. A
control circuit is, in most cases,
limited to 15 amperes.

*SCCR applies to POWER
CIRCUIT devices, not
CONTROL CIRCUIT
devices.*

*Exception: SCCR also
applies to the overcurrent
protective device
protecting the primary
side of the control
transformer or power
supply.*

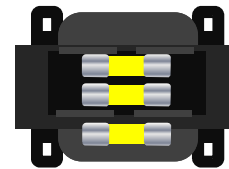
See SB3.2.1

Industrial Control Panels

UL 508A – Transformer Type Definitions

PART 1 – GENERAL USE INDUSTRIAL CONTROL PANELS

- 2.39 POWER TRANSFORMER –
A transformer whose secondary winding supplies power to loads or a combination of loads and control circuit devices operating at the secondary voltage.
- 2.12 CONTROL TRANSFORMER –
A transformer whose secondary supplies power to control circuit devices only (excluding loads).



KEY QUESTION:

Does the transformer feed a load outside the panel?

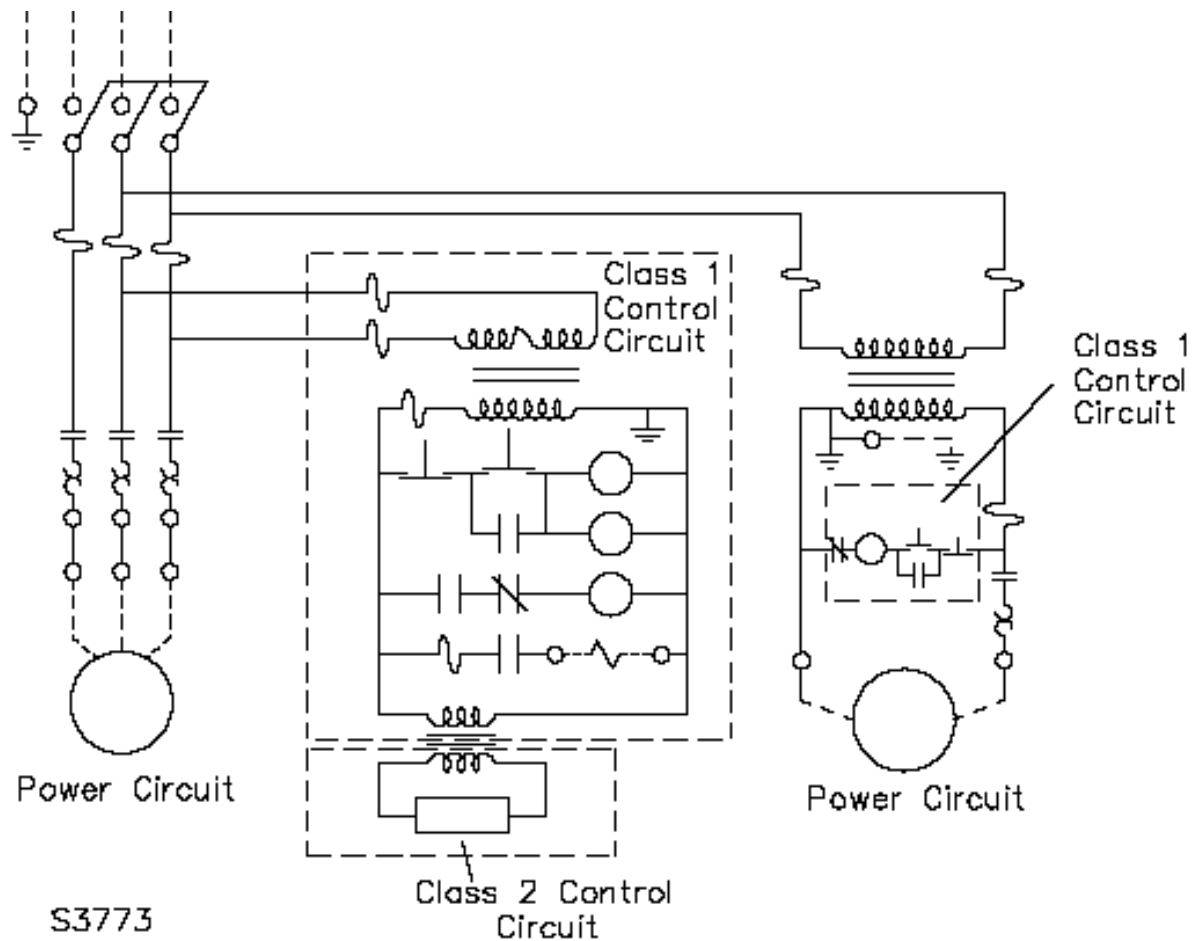
If YES - Power Transformer, considered in Panel SCCR

If NO - Control Transformer, not considered in Panel SCCR

Industrial Control Panels

UL 508A – Transformer Type Definitions

❑ Control Circuit vs. Power Circuit

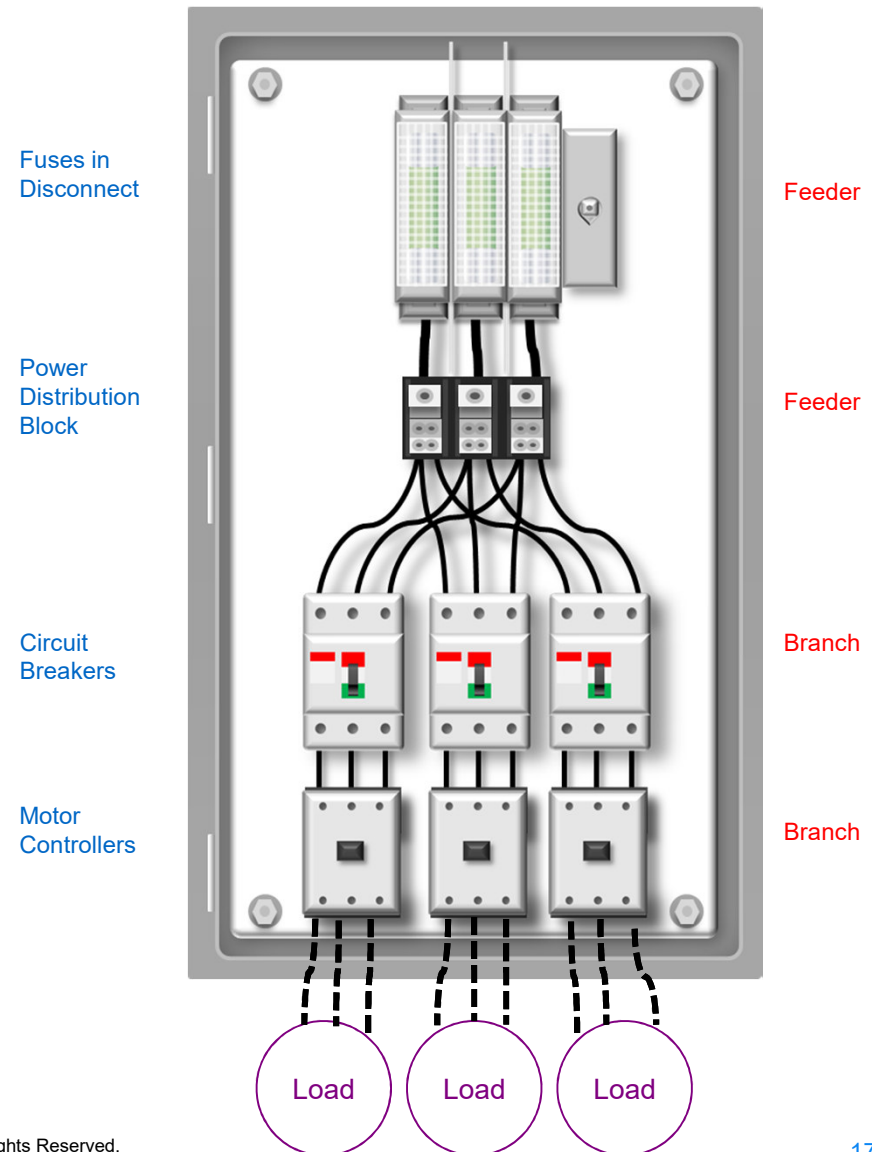


Industrial Control Panels

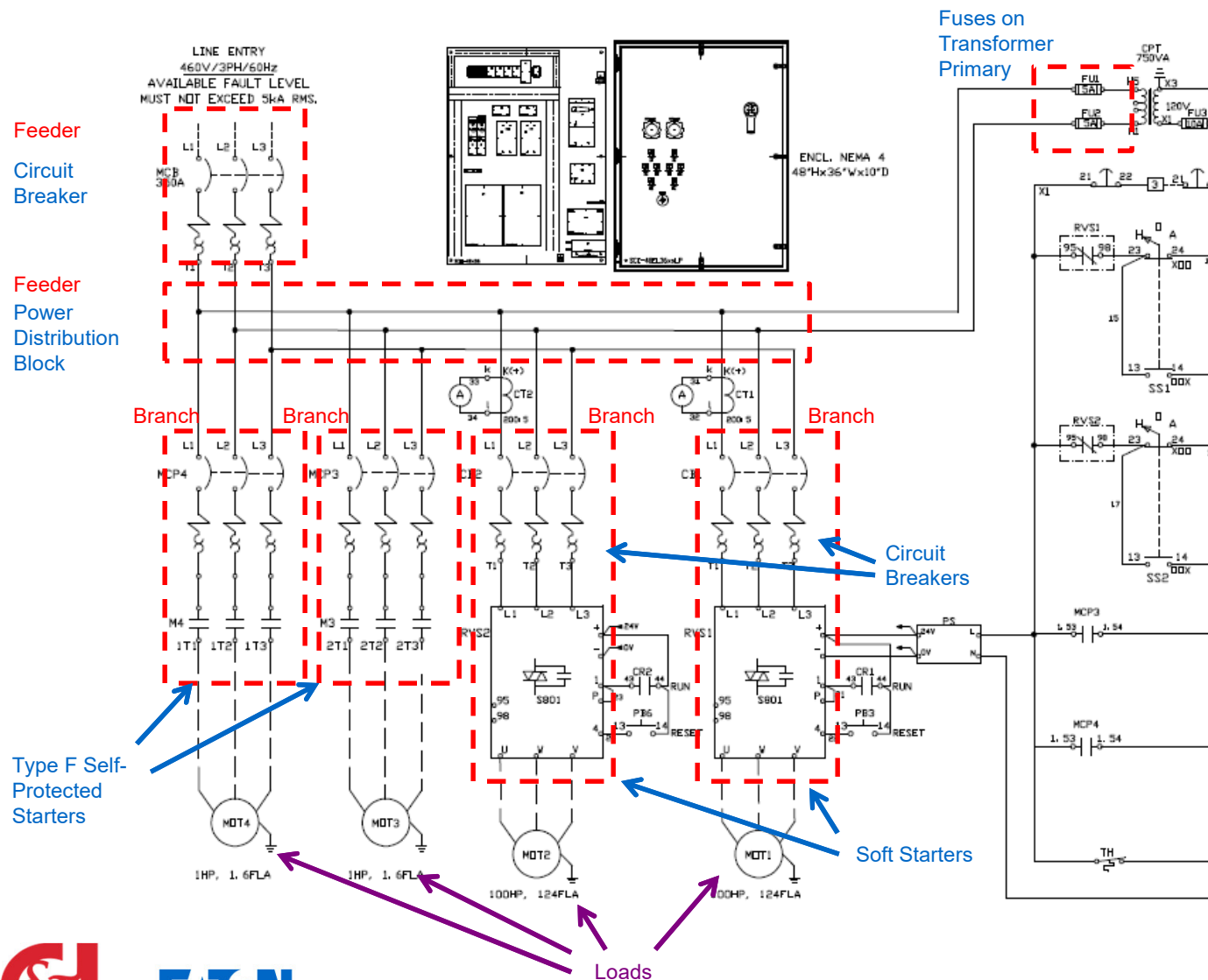
UL 508A – Circuit Location Definitions

PART 1 – GENERAL USE INDUSTRIAL CONTROL PANELS

- 2.18 FEEDER CIRCUIT – The conductors and circuitry on the supply side of the branch circuit overcurrent protective device.
- 2.3 BRANCH CIRCUIT – The conductors and components following the last overcurrent protective device protecting a load.



Example Panel



SCCR also applies to the overcurrent protective device protecting the primary side of the control transformer or power supply.

Exception: Secondary circuits operating at 24 vdc maximum and supplied from a source with a maximum output power of 100 VA, shall be considered control circuits.

See SB3.2.1

Summary

Power circuit components are evaluated when determining SCCR for an industrial control panel:

Any device in the panel that is either

- in a circuit path that leads to an external load, or
- any overcurrent protective device on the transformer/power supply primary

Component Ratings

Remember, the panel SCCR is determined based on the rating of the components inside or on the panel.

Which component ratings are used?

- For overcurrent protective devices: **Interrupting rating**
- For other devices: **Component SCCR**

Component SCCRs – Standard Fault

Component Standard Fault

- This is the *minimum* rating that electrical components are required to have attained when tested with an OCPD.
- If standard fault ratings are unknown, UL allows a *default* rating to be used.
- Standard fault ratings can be used when rating panels, but are often too low for those who want to achieve an adequate panel SCCR.
- Standard fault ratings are usually found on the product label.

Table SB4.1
Assumed maximum short circuit current rating for unmarked components
Table SB4.1 effective April 25, 2006

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

^a 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.

^b The use of a miniature fuse is limited to 125-volt circuits.

^c Standard fault current rating for motor controller rated within specified horsepower range.

Component SCCRs – High Fault

SB2.2 HIGH FAULT SHORT CIRCUIT CURRENT RATING – Marked short circuit current rating of a motor controller that is greater than the standard fault short circuit current rating.

- High fault ratings will include a maximum ampacity and may include a specific type of OCPD for the short circuit protective device.
- High fault ratings can be found either on the product or in instructions (not on UL's website).
- Procedures may have to be modified to include the reference high fault info.

EAT•N

012B

U_e	220	240	380	415	440	500	660	V~
U_e	230		400				690	V~
AC-3	12	12	12	12	12	10	7	A
AC-3	3.5	4	5.5	7	7.5	7	6.5	kW
AC-4	7	7	7	7	7	6	5	A
AC-1	$I_e = I_{th}$ 20 A			U_{imp} 8000 V		IEC/EN 60947		

A039962

N4246 GB 14048.4

AUX. CONT A600 P300

3 POLE BREAK 250 VDC
MAX A OPEN

3 PH 600V AC MAX 20 A OPEN

120	240	VDC
125	250	VDC
0.75	2	HP

AC	115	200	230	460	575	V
	120	208	240	480	600	V
3 PH		3	3	10	10	HP
1 PH	1	2	2	-	-	HP

SUITABLE FOR RMS
SYM MAX AT 600 VAC

SCCR	Fuse	CB
5 kA	45 A	60 A
30 kA	25 A	Fuses only

Elevator Duty

3 PH	-	2	2	7.5	7.5	HP
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CU 75°C WIRE TIGHTENING TORQUE 1.2 Nm / 10.6 lb.in.

FOR SINGLE AWG 18 AWG 14 FOR DOUBLE
TIGHTENING TORQUE 1.2 Nm / 10.6 lb.in.
FOR SINGLE AWG 18 AWG 14 FOR DOUBLE

UL LISTED

3408 LISTED



Product Rating Label of XTCE012B Contactor

Combination Ratings – Motor Starter & Contactor

Component High Fault



Contactor Catalog Number	Overload Relay Catalog Number	High Fault Current		
		kA (600 Vac)	Class J Fuse Size	Class CC Fuse Size
XTCE007B	XT0BP40BC1	100	1	1
XTCE007B	XT0BP60BC1	100	1	1
XTCE007B	XT0B001BC1	100	1	1
XTCE007B	XT0B001BC1	100	1	1
XTCE007B	XT0B1P6BC1	100	3	3
XTCE007B	XT0B2P4BC1	100	3	3
XTCE007B	XT0B004BC1	100	3	3

XT Part Number	kA (600 Vac)	Class	Max. Upstream Fuse Ampere Rating
XTCE007B	100	J	20
XTCE009B	100	J	20
XTCE012B	100	J	45
XTCE015B	100	J	60

Component SCCR - PDBs





Component High Fault

PDBFS220 (4 – 14 Load Side Conductors) – 100kA with 175A Class J fuse or less



Series PDBFS

Series PDBFS

		Terminal Copper Conductor Capability			Short-Circuit Current Rating							
		Line	Load	Configuration	Conductors		Max Fuse Class & /					
Catalog Number	Amps	Wire Range	Wire Range	Openings per Pole		Line AWG or kcmil	Load AWG or kcmil	J	T	RK1		
(All Single Pole)				Line	Load			LPJ	JJS JJN	LPS-RK LPN-RK		
PDBFS204	175A	2/0 - 8 AWG 70 - 10 mm ²	2/0 - 8 AWG 70 - 10 mm ²			2/0 - 8	2/0 - 8	200	200	100		
PDBFS220	175A	2/0 - 8 AWG 70 - 10 mm ²	4 - 14 AWG 25 - 2.5 mm ²			2/0 - 8	4 - 12	200	200	100 [†]		
									4 - 14	175 [†]	175 [†]	100 [†]
										200 [†]	200 [†]	100 [†]

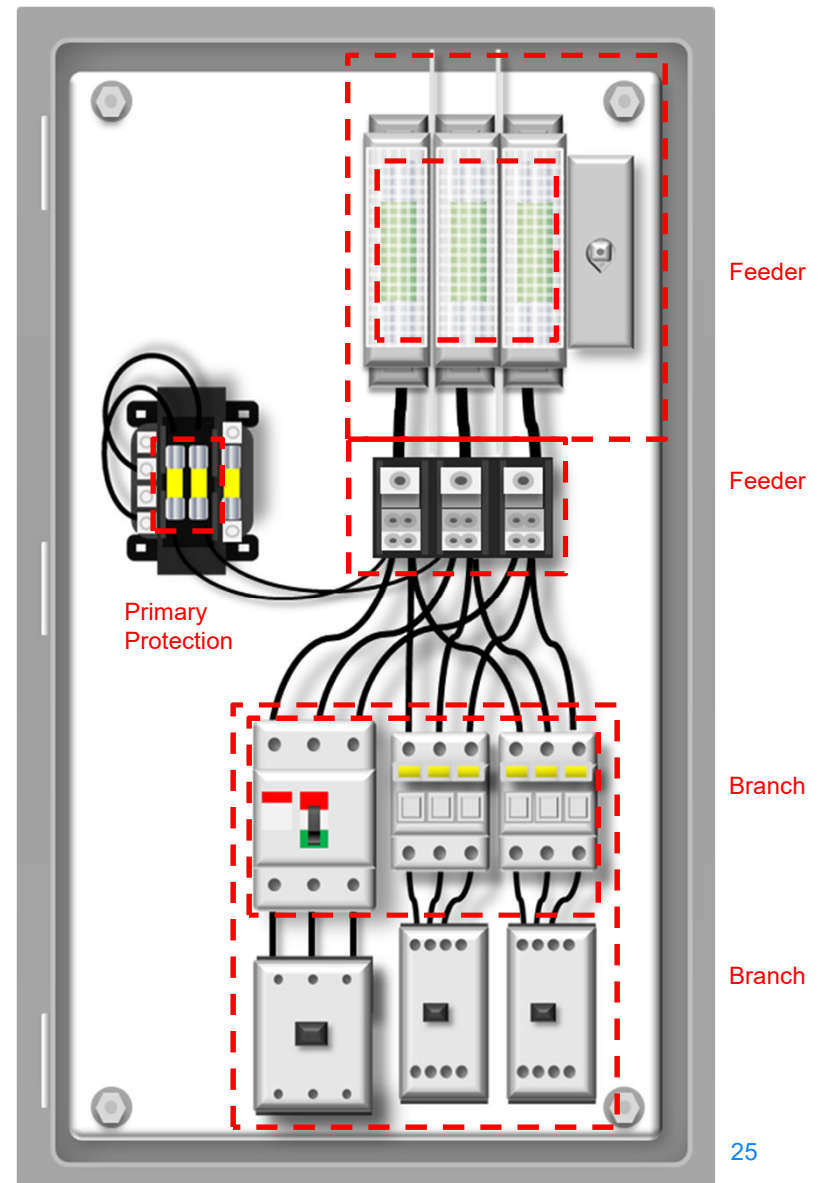
Note: If used in feeder circuits, power distribution blocks must have feeder circuit spacing - typically a Listed (not Recognized) power distribution block is required.

UL 508A SB Method for Determining Panel SCCR

SB4.4

1. Determine the SCCR of each branch circuit.
2. Determine the SCCR for each feeder component.
3. Identify the interrupting rating for each overcurrent protective device.
4. The panel SCCR is the lowest value from steps 1-3.

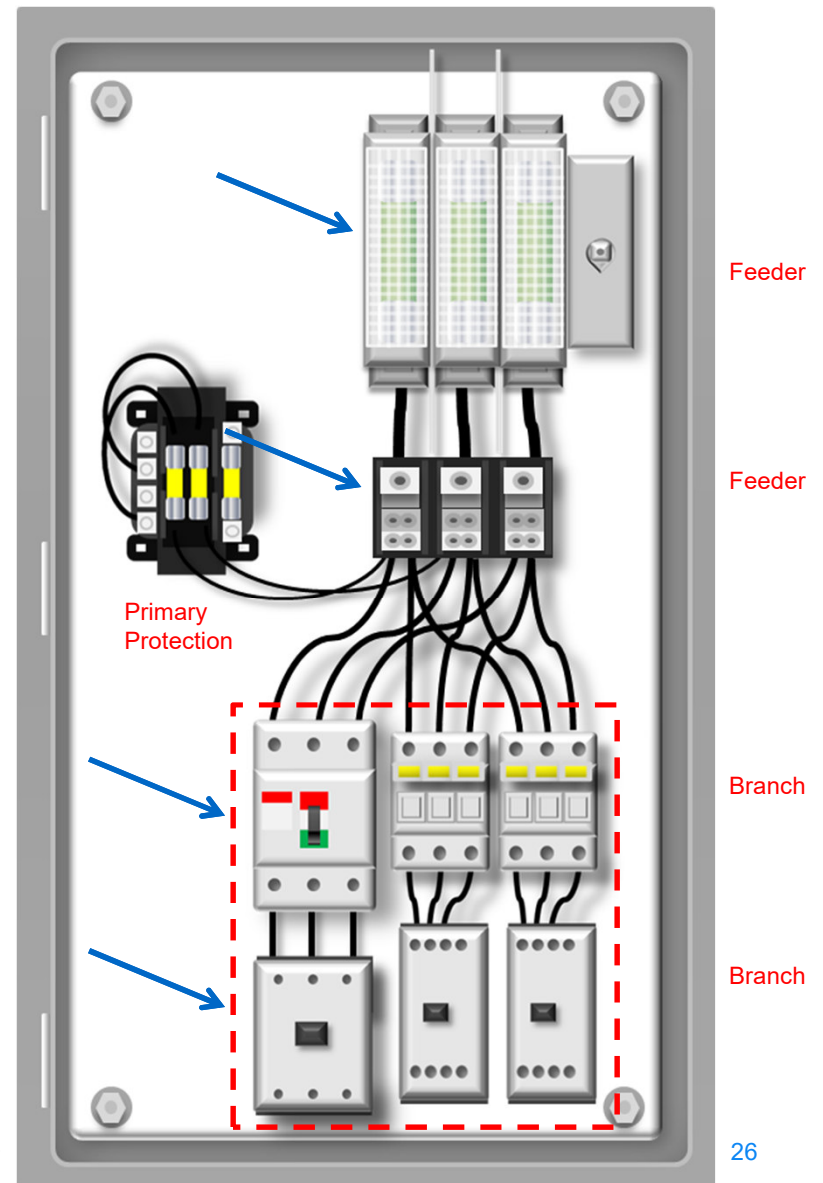
Let's take a closer look at step 1....



UL 508A SB Method for Determining Panel SCCR

1. Determine the SCCR for each branch circuit:
 - a) Identify the component SCCR of each device in the branch circuit (SB4.2)
 - b) Determine if branch component SCCR can be effectively raised using feeder components (SB4.3)
2. Determine the SCCR for each feeder component.
3. Identify the interrupting rating for each overcurrent protective device.
4. The panel SCCR is the lowest value from steps 1-3

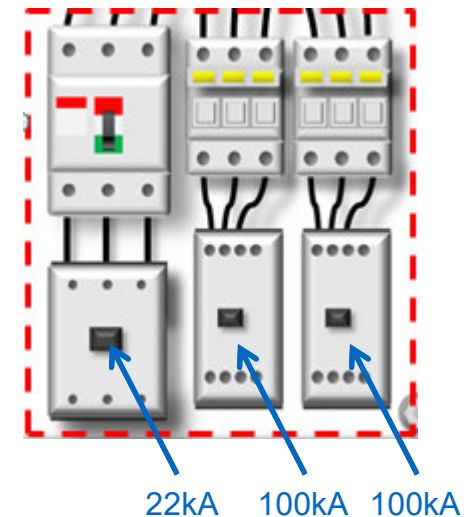
Let's take a closer look at step 1 a)....



SCCR of Individual Power Circuit Components

Short Circuit Current Ratings of Individual Power Circuit (Feeder or Branch) Components (SB4.2)

- The SCCR marked on the component or on instructions.
 - The SCCR determined by the voltage rating of the component and the assumed short circuit current from Table SB4.1.
- or
- The short circuit current rating for a component 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 associated product standard, and described in the manufacturer's Procedure.



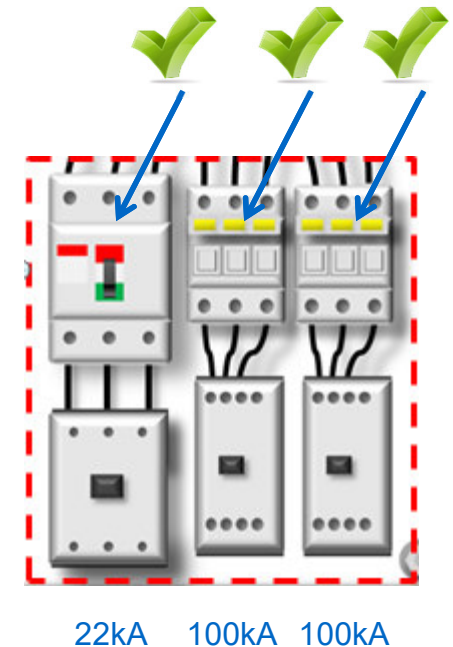
Previously only indicated high fault ratings for motor controllers (UL 508) applied, now can be any feeder or branch component.

SCCR of Individual Power Circuit Components

Short Circuit Current Ratings of Individual Power Circuit Components (SB4.2)

SB4.2.3

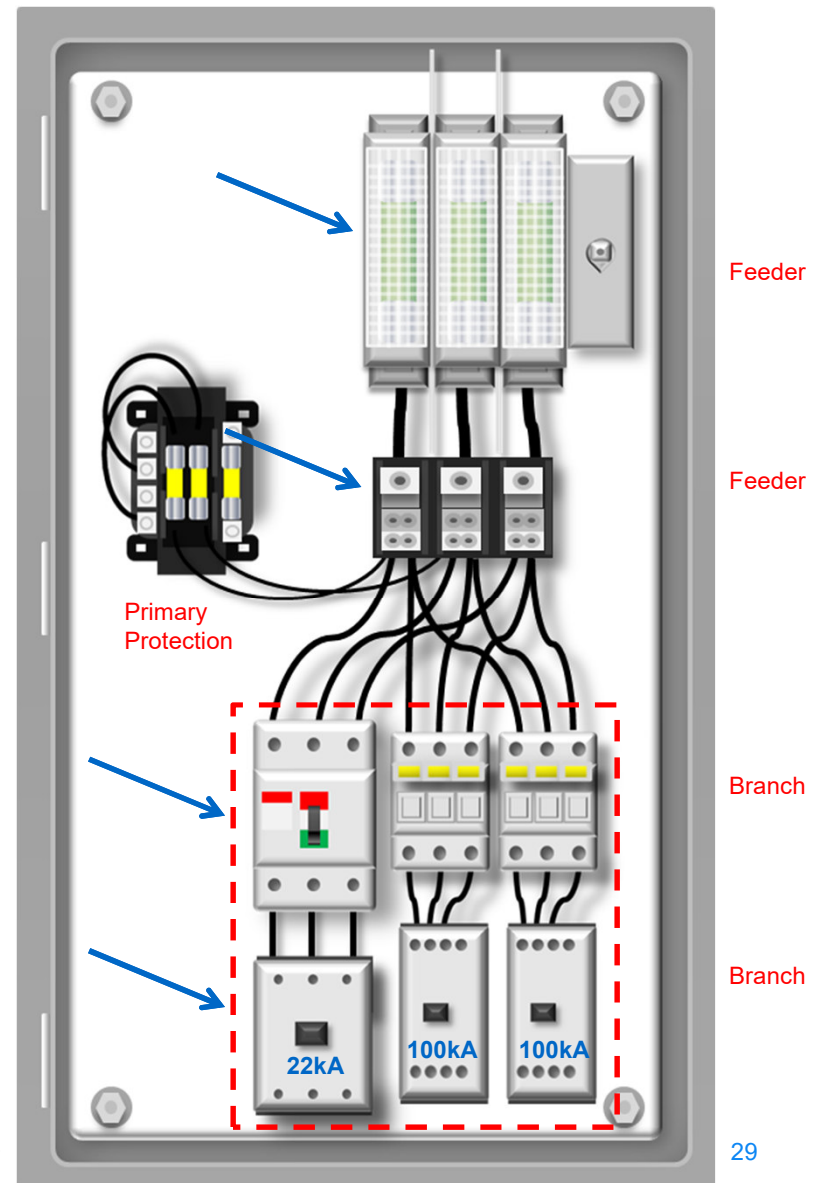
- A high fault short circuit current rating for a motor controller, an overload relay, or a combination motor controller, as specified in SB4.2.2 (a) or (c), shall only be used as the short circuit current rating of the component **when the specified branch circuit protective device is provided.**



UL 508A SB Method for Determining Panel SCCR

1. Determine the SCCR for each branch circuit:
 - a) Identify the component SCCR's of each device in the branch circuit (SB4.2)
 - b) Determine if branch component SCCR can be effectively raised using feeder components (SB4.3)
2. Determine the SCCR for each feeder component.
3. Identify the interrupting rating for each overcurrent protective device.
4. The panel SCCR is the lowest value from steps 1-3

Let's take a closer look at step 1 b)....

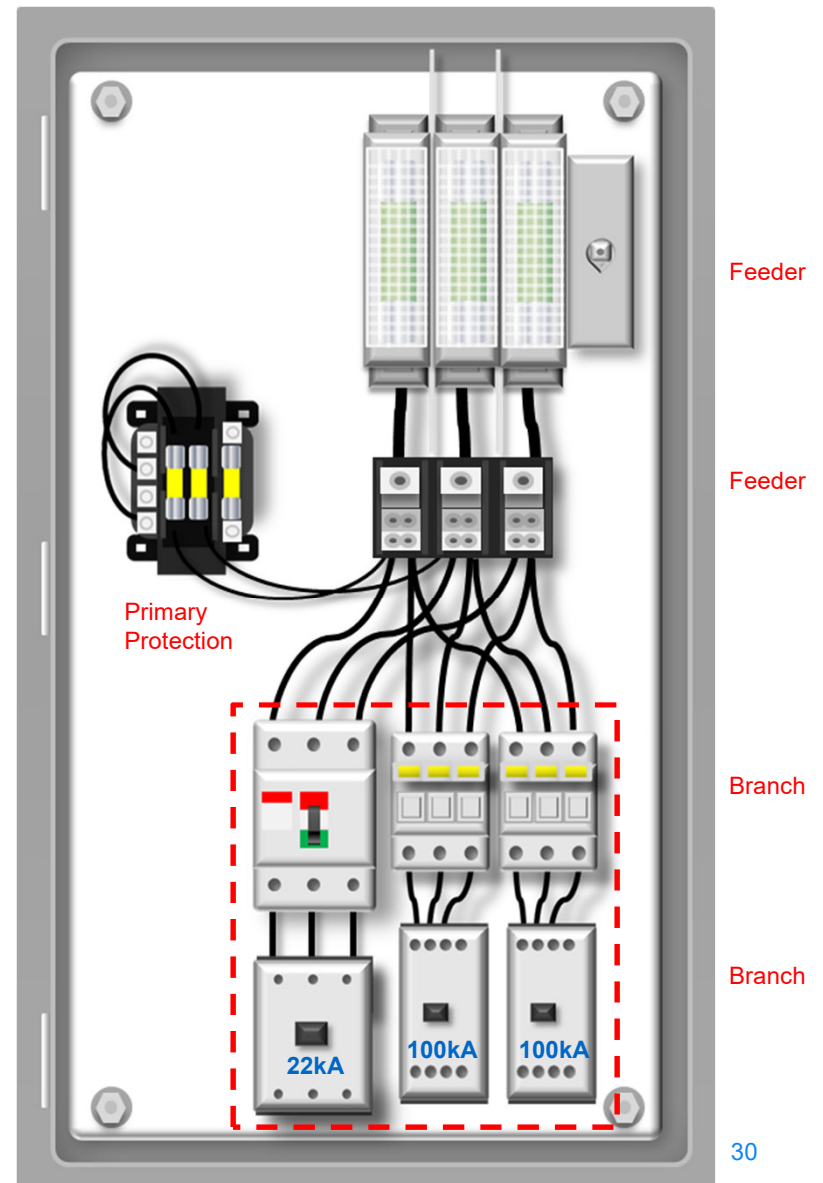


UL 508A SB Method for Determining Panel SCCR

Branch component SCCR can be effectively raised by components in the feeder by the following four methods (SB4.3)

- SB4.3.1 Use of an upstream **power transformer** in the feeder circuit.
- SB4.3.2 Use of an upstream **current limiting circuit breaker** in the feeder circuit.
- SB4.3.3 Use of an upstream **current limiting fuse** in the feeder circuit.
- SB4.3.4 Use of an upstream current limiting breaker or fuse **supplied in the field** when the panel is marked per SB5.1.3.

Let's take a closer look at each...

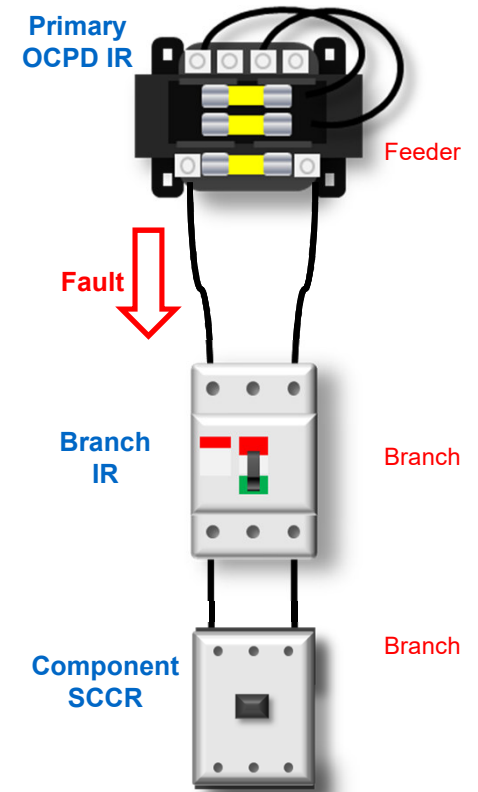


SCCR of Individual Power Circuit Components

SB4.3.1

- For **feeder and branch components and overcurrent devices** supplied by a **power transformer** with an isolated secondary winding, the short circuit current rating on the line side of the transformer shall be one of the following:

Fault Current (Calculated or from Table SB4.3 or 4.4)	Branch OCPD Interrupting Rating	Branch Component SCCR	RESULTING SCCR
Is the fault current less than or equal to...	YES	YES	Resulting SCCR equals the interrupting rating of the <u>primary</u> OCPD
Is the fault current less than or equal to...	NO	YES	Resulting SCCR equals the interrupting rating of the <u>branch</u> OCPD
Is the fault current less than or equal to...	NO	NO	Resulting SCCR equals the lower branch OCPD or component IR/SCCR



Let's look at an illustrated example on the next page...

SCCR of Individual Power Circuit Components

Example...

- Downstream component SCCR = 5kA
- Primary side overcurrent protective device has an interrupt rating of 200kA
- Single phase 3000VA transformer with 120V secondary
- $5\text{kA} > 1.2\text{kA}$, thus this circuit is considered 200kA.

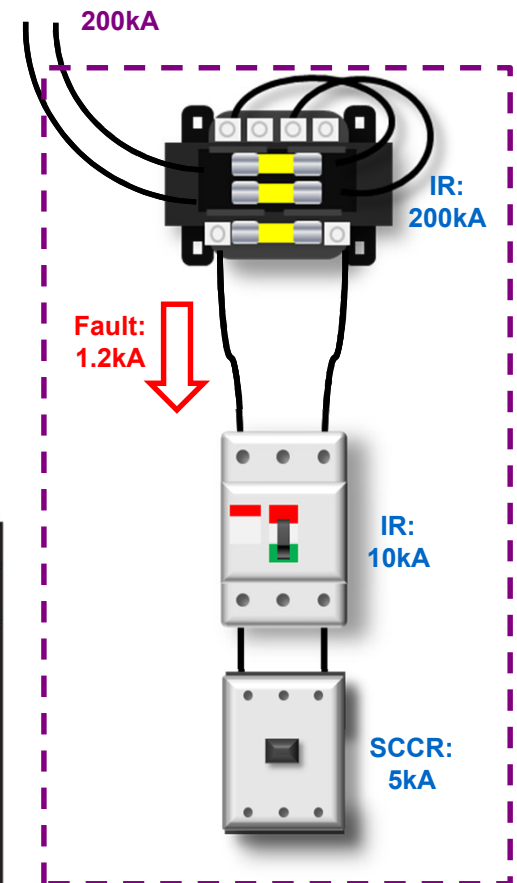
Table SB4.3

Single phase transformer secondary available short circuit currents (Amps)^a

Column 1	Column 2							
Transformer Max kVA	Minimum Transformer Secondary Voltage (V)							
	120	120/240 ^b	208	240	277	347	480	600
1	400 A	300 A	230 A	200 A	180 A	140 A	100 A	80 A
3	1,200 A	900 A	690 A	600 A	520 A	420 A	300 A	240 A
5	1,990 A	1,490 A	1,150 A	1,000 A	860 A	690 A	500 A	400 A
10	3,970 A	2,980 A	2,290 A	1,990 A	1,720 A	1,380 A	1,000 A	800 A
15	5,960 A	4,470 A	3,440 A	2,980 A	2,580 A	2,060 A	1,490 A	1,200 A
25	9,930 A	7,450 A	5,730 A	4,970 A	4,300 A	3,440 A	2,490 A	1,990 A
37.5	14,890 A	11,170 A	8,590 A	7,450 A	6,450 A	5,150 A	3,730 A	2,980 A
50	19,850 A	14,890 A	11,450 A	9,930 A	8,600 A	6,870 A	4,970 A	3,970 A
75	29,770 A	22,330 A	17,180 A	14,890 A	12,900 A	10,300 A	7,450 A	5,960 A

^a Z assumed to be 2.1%.

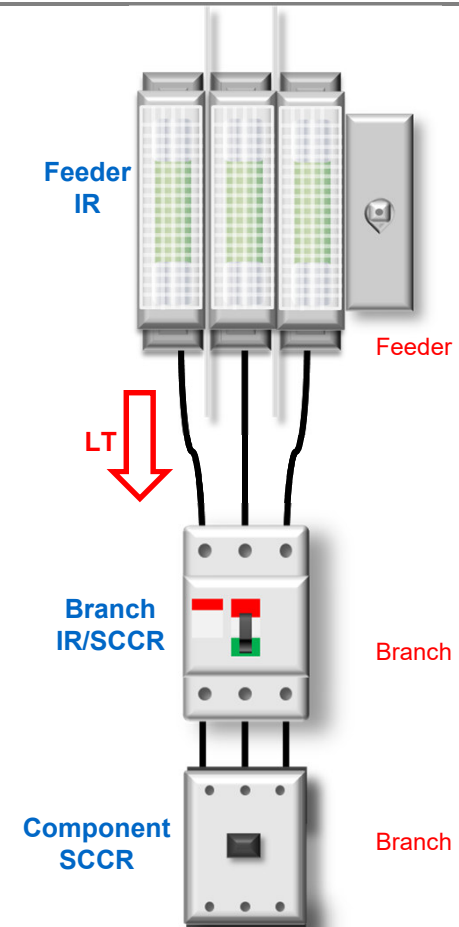
^b Short-circuit current shown is line-to-neutral.



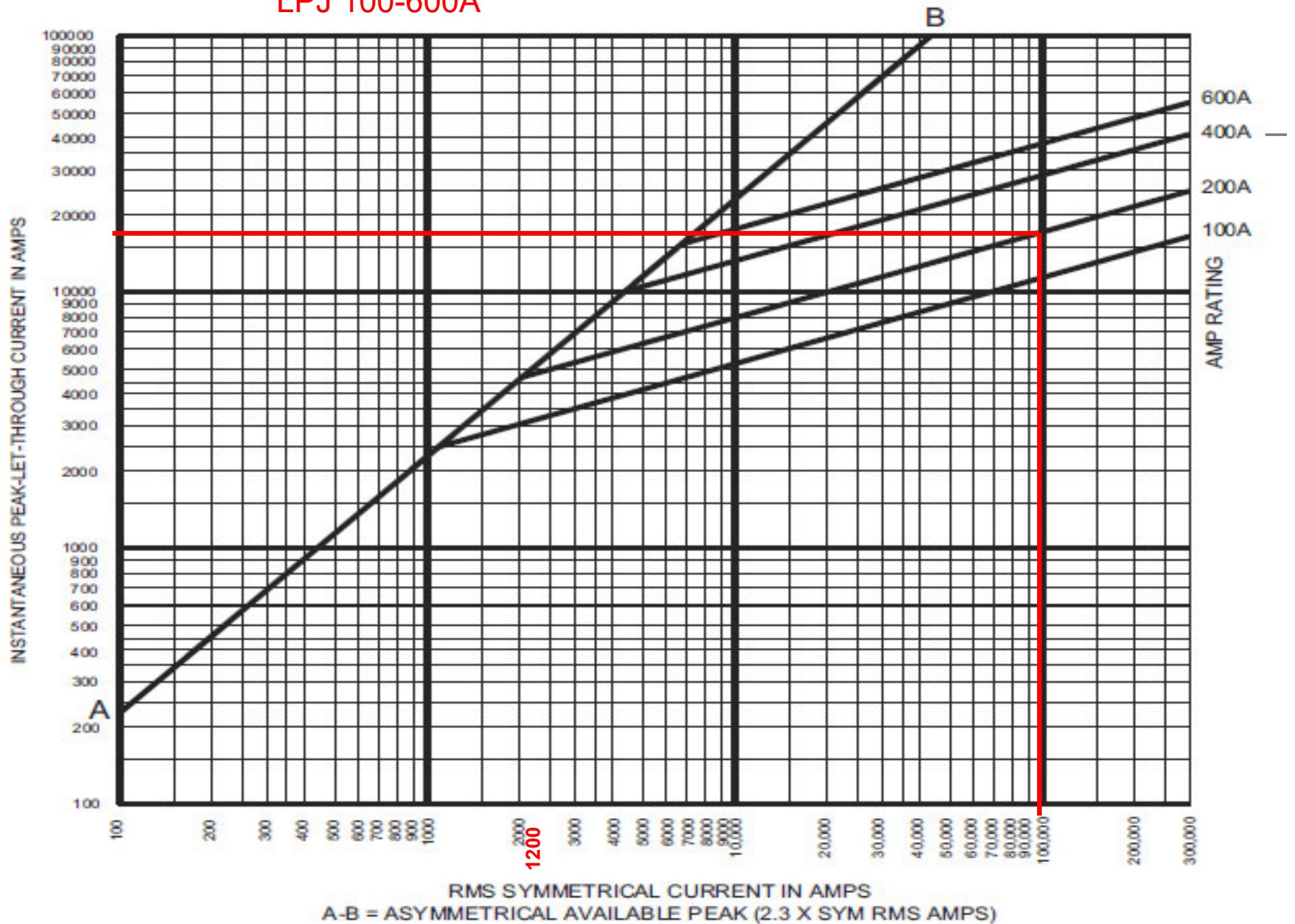
SCCR of Individual Power Circuit Components

SB4.3.3

- For branch circuits supplied by a **Class CC, G, J, L, RK1, RK5, or T** in the feeder circuit:
 - Determine the “peak let-through current” at a given **prospective fault current** from **Table SB4.2**
 - Compare the **peak let-through** to the **component SCCR**, if the peak let-through is **less than** the component SCCR, adjust to the component SCCR to the **prospective fault current**.
 - Compare adjusted **component SCCR** to **Branch IR/SCCR** – **lower** of the two is the **branch circuit SCCR**.

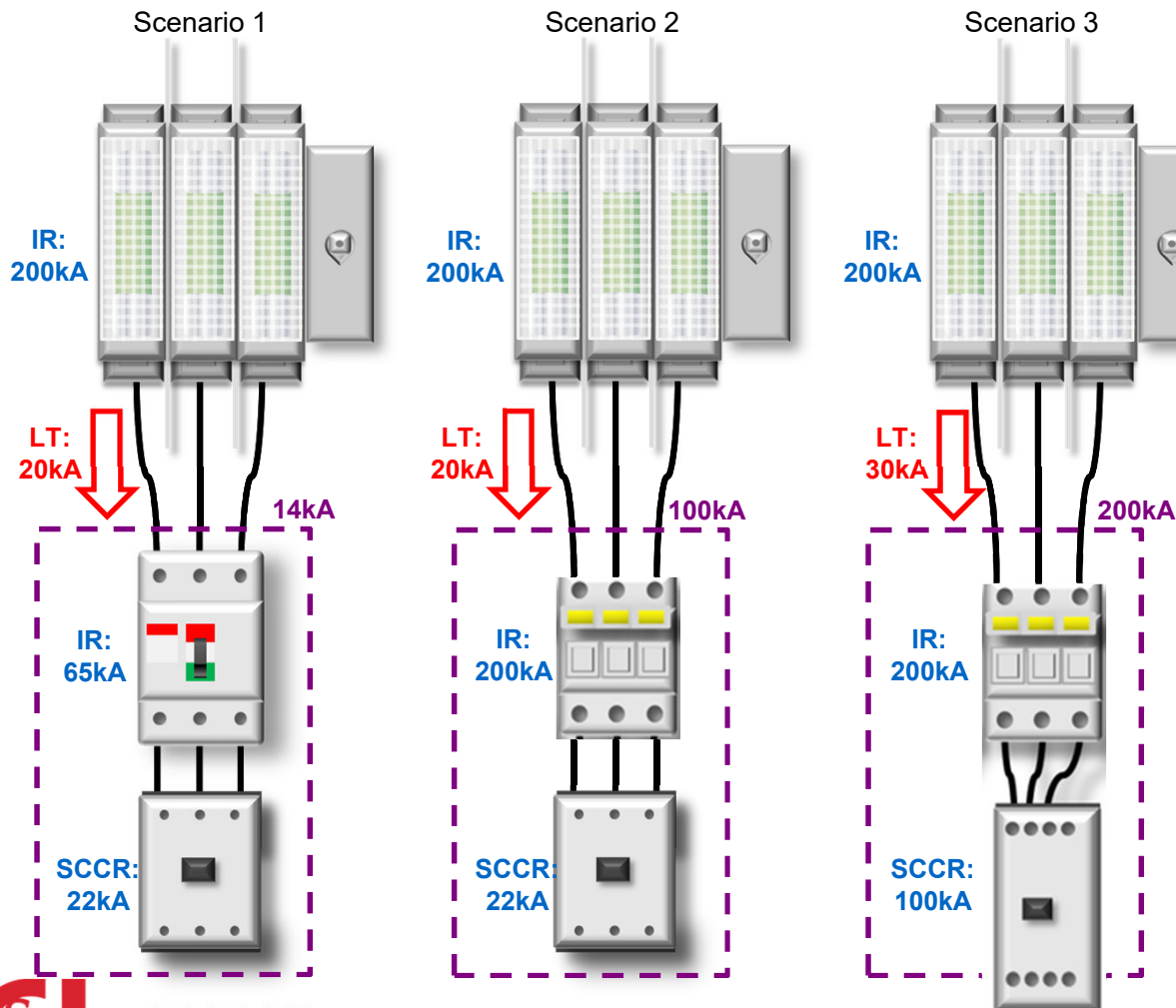


LPJ 100-600A



SCCR of Individual Power Circuit Components

Example: 100kA fault current, 200A class J feeder



Excerpt from Table SB4.2

Fuse types	Fuse rating amperes	100 kA	
		$I^2t \times 10^3$	$I_p \times 10^3$
Class CF (up to 100 A)	1	0.8	1
Class J and 600 volt Class T ^b	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	7.5
	35	12	7.5
	40	17	8
	45	18	8.5
	50	22	9
	60	30	10
	70	50	11.5
	80	60	12.5
	90	75	13.5
	100	80	14
	110	100	14.5
	125	150	15.5
	150	175	17
	175	225	18.5
	200	300	20
	225	350	22.5
	250	450	24

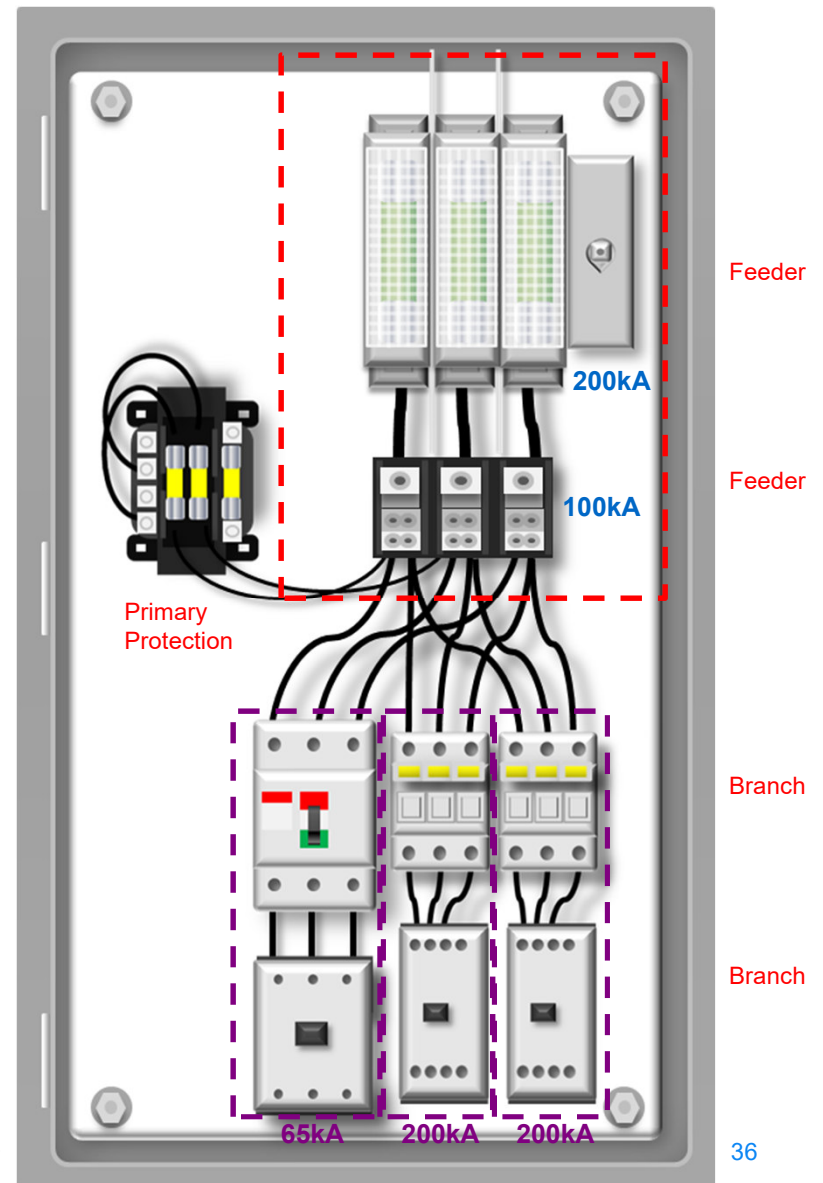
I_p at 200kA = 30kA

We will use Scenario 2 for our panel example...

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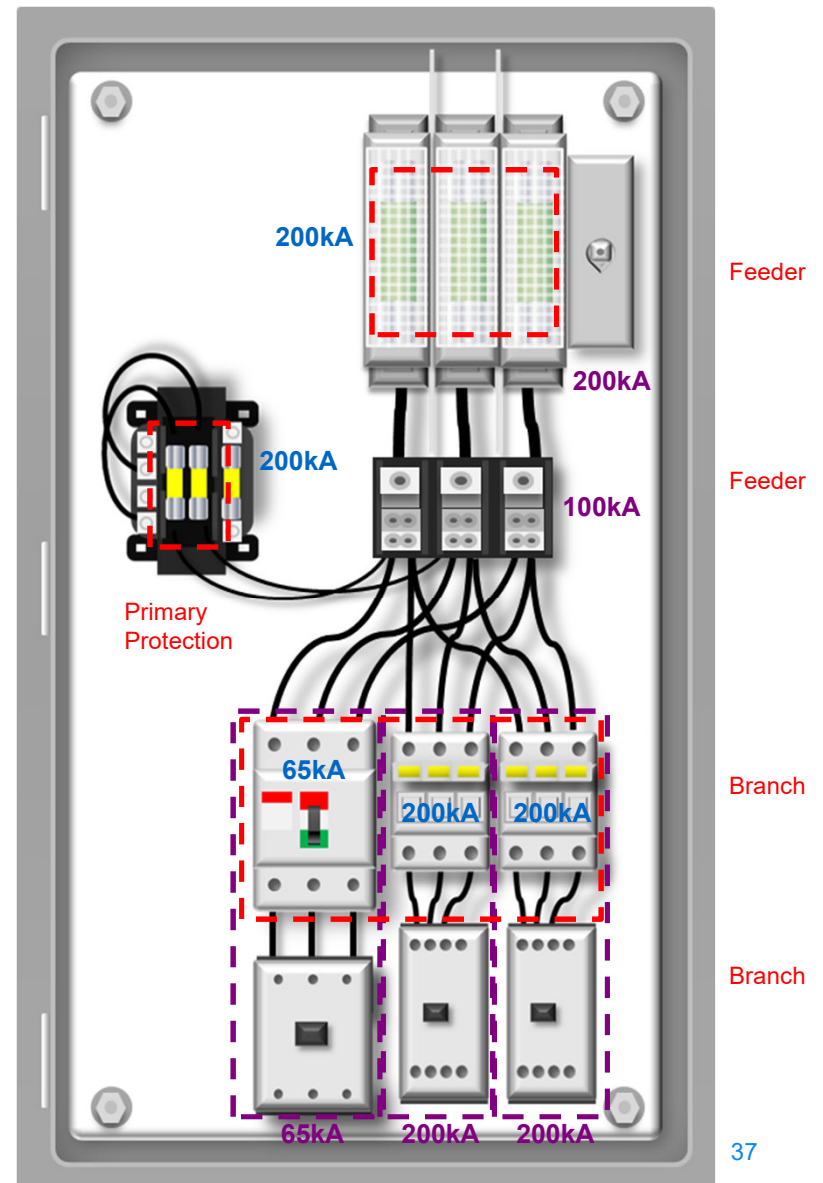
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2. Determine the SCCR for each feeder component.
3. Identify the interrupting rating for each overcurrent protective device.
4. The panel SCCR is the lowest value from steps 1-3



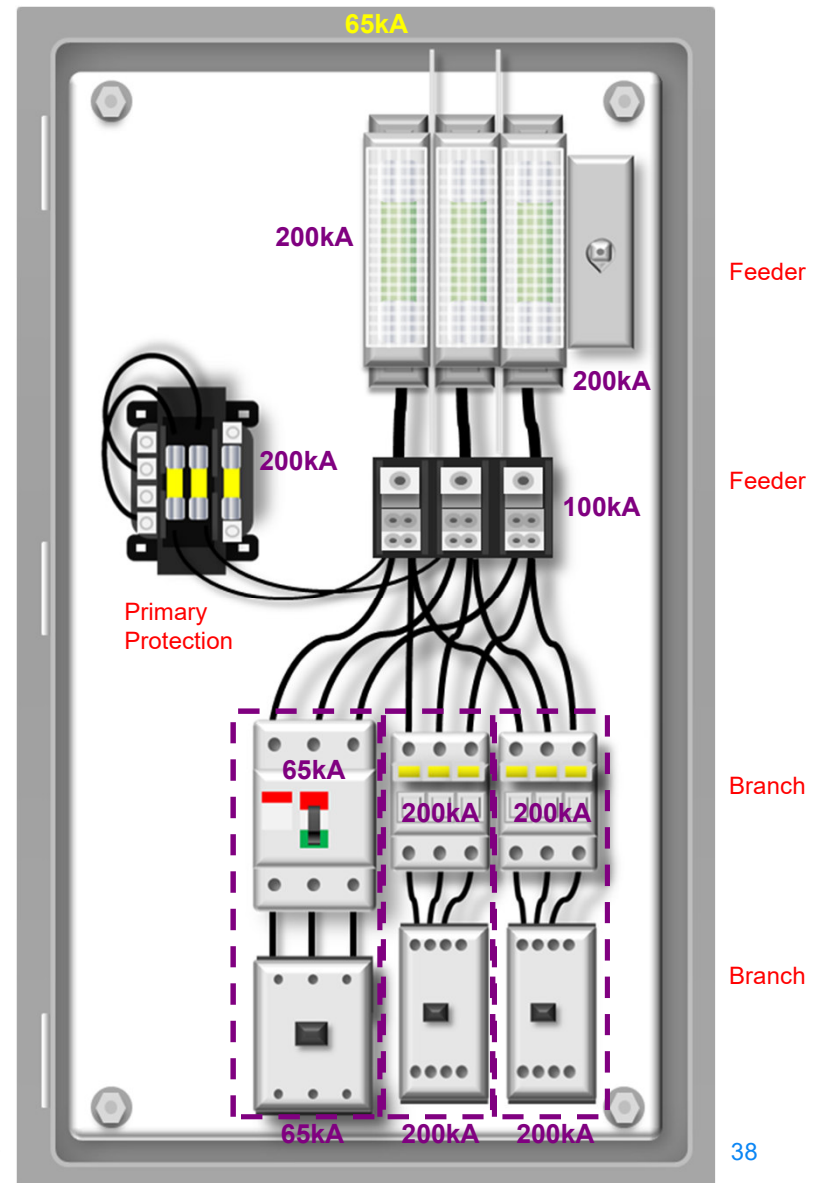
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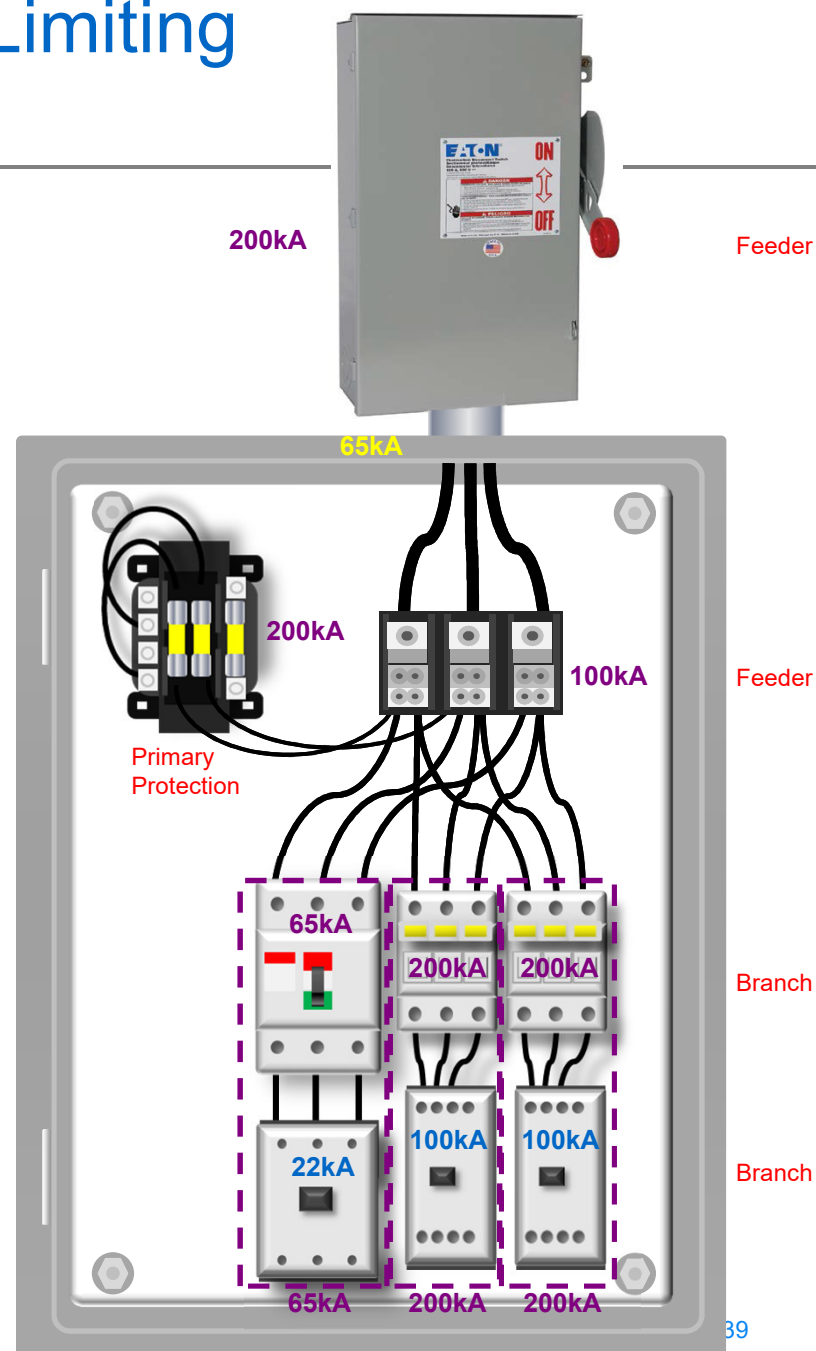
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Applying External Current Limiting Feeder

ABC Company		Machine XYZ	
123 Main St, City, ST 01234		Serial No: 1234567	
Model: XZY123			
Volts 480/277	Phase 3	Frequency 60Hz	
Max HP 50	FLA	124	
SCCR SYM: 65kA WHEN FED BY 200 AMP CLASS J FUSE.		UL	



UL Link For Short-Circuit Ratings

<https://industries.ul.com/industrial-systems-and-components/industrial-control-products-and-systems/short-circuit-current-ratings-for-combination-motor-controller-components>

Or

<https://UL.com>

Search: Short circuit ratings of industrial control panels

Database Identification Number	Construction Type	Component Description								Combination Motor Controller Ratings					Enclosure Volume, cubic inches
		Component Type Abbreviation	Manufacturer Name	Complete Part Number	Voltage, V	Number of Phases	SCCR, kA	Full Load Current, A	Hp Rating	Voltage, V	Number of Phases	SCCR, kA	Current Rating, FLA or FLA/LRA	Hp Rating	
XTITF1	F	MSP	Eaton	XTPR1P6BC1	600Y347	3	50	1.3	3/4	600Y347	3	35	1.3	3/4	257
		MC	Eaton	E111A06X3N	600	3	5	3.9	3						
		ACC(ADAPTOR)	Eaton	XTPAXLSA	600	3	--	--	--						
XTITF2	F	MSP	Eaton	XTPR1P6BC1	480Y277	3	50	1.6	3/4	480Y277	3	35	1.6	3/4	257
		MC	Eaton	E111A06X3N	480	3	5	4.8	3						
		ACC(ADAPTOR)	Eaton	XTPAXLSA	480	3	--	--	--						
XTITF3	F	MSP	Eaton	XTPR2P5BC1	600Y347	3	50	2.4	1 1/2	600Y347	3	35	2.4	1 1/2	257
		MC	Eaton	E111A06X3N	600	3	5	3.9	3						
		ACC(ADAPTOR)	Eaton	XTPAXLSA	600	3	--	--	--						
XTITF4	F	MSP	Eaton	XTPR2P5BC1	480Y277	3	50	2.1	1	480Y277	3	35	2.1	1	257
		MC	Eaton	E111A06X3N	480	3	5	4.8	3						
		ACC(ADAPTOR)	Eaton	XTPAXLSA	480	3	--	--	--						
XTITF5	F	MSP	Eaton	XTPR2P5BC1	240	3	50	2.2	1/2	240	3	35	2.2	1/2	257
		MC	Eaton	E111A06X3N	240	3	5	6	1 1/2						
		ACC(ADAPTOR)	Eaton	XTPAXLSA	240	3	--	--	--						
XTITF6	F	MSP	Eaton	XTPR2P5BC1	200	3	50	2.5	1/2						257
		MC	Eaton	E111A06X3N	200	3	5	4.8							
		ACC(ADAPTOR)	Eaton	XTPAXLSA	200	3	--	--	--						
XTITF7	F	MSP	Eaton	XTPR004BC1	600Y347	3	50	3.9		ACC				3	257
		MC	Eaton	E111A06X3N	600	3	5	3.9							
		ACC(ADAPTOR)	Eaton	XTPAXLSA	600	3	--	--	--						
XTITF8	F	MSP	Eaton	XTPR004BC1	480Y277	3	50	3.4		MSP				2	257
		MC	Eaton	E111A06X3N	480	3	5	4.8							
		ACC(ADAPTOR)	Eaton	XTPAXLSA	480	3	--	--	--						
XTITF9	F	MSP	Eaton	XTPR004BC1	240	3	50	3.2	3/4	MC					257
		MC	Eaton	E111A06X3N	240	3	5	6	1 1/2						
		ACC(ADAPTOR)	Eaton	XTPAXLSA	240	3	--	--	--						
XTITF10	F	MSP	Eaton	XTPR004BC1	200	3	50	3.7	3/4						257
		MC	Eaton	E111A06X3N	200	3	5	4.8							
		ACC(ADAPTOR)	Eaton	XTPAXLSA	200	3	--	--	--						

ACC

MSP

MC



Questions?



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