Quik-Spec™ Coordination Panelboard

Application Notes

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Introduction

The Cooper Bussmann® Quik-Spec™ Coordination Panelboard is innovative in many ways compared to other commercially available branch circuit panelboards, while providing the benefits of current-limiting fusible overcurrent protection. The Quik-Spec Coordination Panelboard can simplify the effort in ensuring Code compliance for systems where selective coordination is a mandatory NEC® requirement, as well as for other electrical systems. By utilizing the Cooper Bussmann® CUBEFuse® Compact Circuit Protector Base (CCPB) fusible disconnect, the panel is rated 600Vac and capable of providing high short-circuit current ratings (SCCR) up to 200kA. At the same time, it provides many features that increase electrical safety.

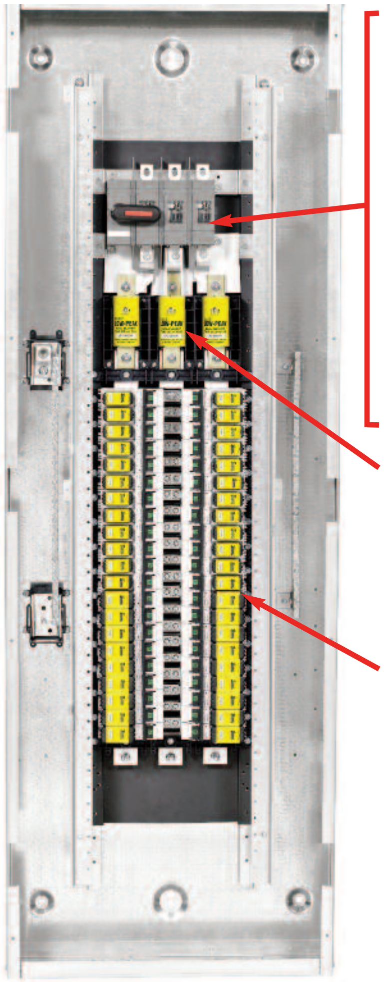
Table 1 – Features and Benefits of the Quik-Spec Coordination Panelboard

Issue	Feature	Benefit
Code Compliance	• Selective coordination between branch and upstream fuses using fuse ratios	• Simplified selective coordination designs for all fault levels up to 200kA, including systems required by NEC® 517.26, 700.27, 701.18 & 708.54
	• UL Listed panel short-circuit current ratings available up to 200kA	• Easier to comply with electrical system protection requirements in NEC® 110.10
	• UL Listed, high interrupting rating Low-Peak® fuses	• Easily complies with the interrupting rating requirements of NEC® 110.9 • No need to be constrained by series ratings
	• CCPB branch circuit fused disconnect	• Current-limiting overcurrent protection integrated with innovative, compact, UL 98, horsepower rated, load-break branch circuit disconnect
	• U.B.C. & C.B.C. Seismic Qualified, I.B.C. Approved (Uniform Building code, California Building Code, International Building code)	• Meets the requirements of installation in areas subject to earthquakes
Safety	• CUBEFuse/CCPB amp rating rejection system	• Ensures continued circuit protection at the specified standard branch circuit amp rating
	• Finger-safe CUBEFuse and disconnect assembly (with dead-front cover installed)	• Enhanced electrical safety
	• Permanent lockout/tagout provisions on main and branch circuit disconnects	• Allows for isolation of individual branch circuit loads or entire panel for safe work practices
	• CUBEFuse and CCPB disconnect interlocked	• Ensures circuit is de-energized before fuse removal
	• Main disconnect interlocked with dead-front cover (100A - 400A versions only)	• Main disconnect must be in the OFF position before dead-front can be removed
	• Main disconnect blades visible without removing dead-front cover (100A - 400A versions only)	• Allows for visual verification of disconnect operation for process of achieving an electrically safe work condition
Ease & Flexibility	• UL Listed 600Vac panel voltage rating	• Suitable for use on most AC systems, 600V or less
	• UL Listed 125Vdc panel voltage rating on MLO with 20kA SCCR with CCPB 40 amps or less.	• Suitable for use on systems, 125Vdc or less and 40A or less branch circuits
	• Standard 20 inch panel width	• Space requirements equivalent to other commercially available circuit breaker branch circuit panelboards
	• Non-fused main disconnect, fused main disconnect or main lug only configurations available up to 400A	• Provides design and overcurrent protection options
	• Local open fuse indication	• Open circuits can be identified quickly and easily
	• CCPB branch circuit fused disconnect	• Panelboard branch circuits configurable up to 100A in 1-, 2- and 3-pole devices with CUBEFuse overcurrent protection (Class J, time-delay performance)
	• Surface & flush mount enclosures • 18, 30 & 42 branch circuit positions • NEMA 1 and 3R enclosures • Door-in-door available • UL service entrance rated panel option • Feed-Through & Sub-Feed lug options	• Installation design options
	• Equipped with six space spare CUBEFuse holder	• Spare CUBEFuse fuses are readily available when in place, speeding maintenance procedures

Overview

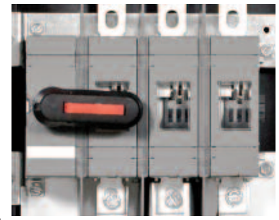
Fused Main Disconnect

- Ease of selective coordination with upstream fuses
- Panel SCCR available up to: 200kA for 600 Vac or less panels, 20kA for 125Vdc or less panels.
- 600Vac rated
- 125Vdc, MLO only, CCPB 40A or less.
- 60A, 100A, 200A or 400A panel rating
- Standard 20" width
- 18, 30 & 42 branch positions available
- Feed-through and sub-feed lug options
- Surface or flush mount
- Equipped with 6 space spare CUBEFuse™ holder
- Door-in-door trim available



100A - 400A Fused Main Disconnect

- Allows for isolation of all branch circuits
- Permanent lockout means
- Contact blades visible without removing dead-front cover
- Interlocked with dead-front cover ensures switch is OFF before removing cover

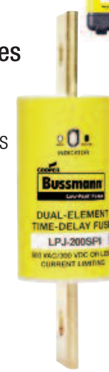


30A - 60A CCP Fused Main Disconnect

- Integrates fuse protection and disconnect into single device
- CUBEFuse Class J current-limiting performance
- Fuse interlocked to prevent removal while energized
- Local open fuse indication

Low-Peak™ LPJ_SP (Class J) Main Fuses

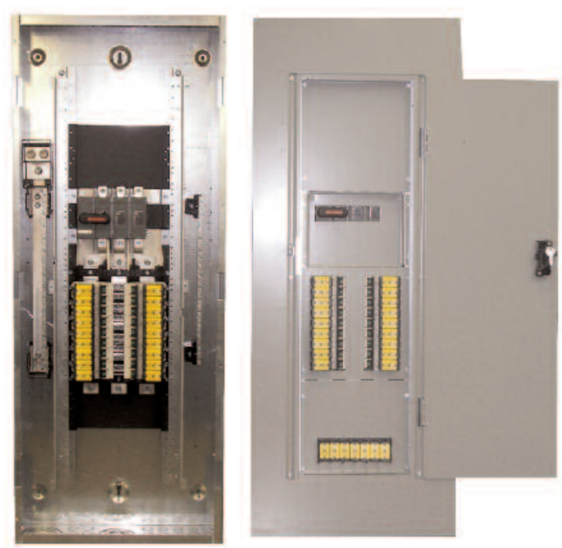
- Time-delay overload performance
- Current-limiting protection
- 300kA interrupting rating (IR) 600Vac or less



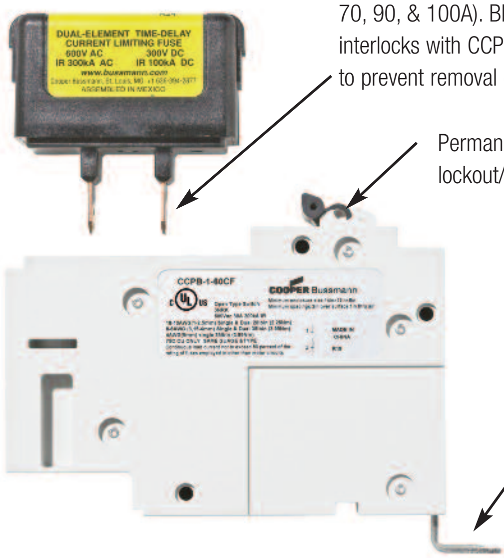
CUBEFuse CCPB Fused Branch Disconnect

- CUBEFuse Class J current-limiting performance
- CCPB SCCR:
  - 200kA/600Vac
  - 20kA/125Vdc, 40A or less
- Hp rated, branch circuit disconnect
- Circuits up through 100A, 1-, 2- and 3-pole
- Permanent lockout provisions
- Local open fuse indication
- Fuse interlocked to prevent removal while energized
- Fuse ampacity rating rejection

Main Lug Only



Non-Fused Main Disconnect



Innovative CUBEFuse® contact blade design in conjunction with CCPB fused disconnect provides amp rating rejection at specified levels (15, 20, 30, 40, 50, 60, 70, 90, & 100A). Blade design also interlocks with CCPB disconnect assembly to prevent removal of fuse while energized

Permanently installed integrated lockout/tagout provisions

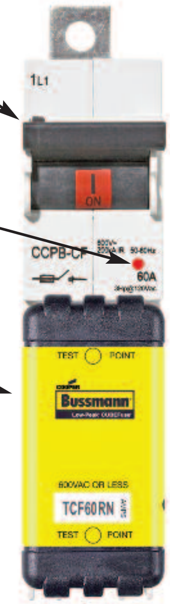
Bolt-on style bus connector

CCPB disconnect handle provides clear circuit status indication with colored and international symbol markings

Local, neon open fuse indication

Illumination requires panelboard bus be energized, circuit closed and minimum 90V.

Cooper Bussmann TCF_RN CUBEFuse provides time-delay Class J, 600V, current limiting overcurrent protection



CUBEFuse indicating version available with permanent on-fuse indication

Branch Circuit Disconnect CCPB Specifications

CCPB Disconnect Catalog Number	Poles	Current Rating	CUBEFuse Catalog Numbers*	Horsepower Rating (Hp)			
				120Vac	240Vac	480Vac	600Vac
CCPB-1-15CF	1	15A	TCF1RN, TCF3RN, TCF6RN, TCF10RN, TCF15RN	0.5Hp	3Hp	5Hp	7.5Hp
CCPB-2-15CF	2						
CCPB-3-15CF	3						
CCPB-1-20CF	1	20A	TCF17-½RN, TCF20RN	0.75Hp	3Hp	7.5Hp	10Hp
CCPB-2-20CF	2						
CCPB-3-20CF	3						
CCPB-1-30CF	1	30A	TCF25RN, TCF30RN	1.5Hp	5Hp	15Hp	10Hp
CCPB-2-30CF	2						
CCPB-3-30CF	3						
CCPB-1-40CF	1	40A	TCF35RN, TCF40RN	2Hp	7.5Hp	20Hp	10Hp
CCPB-2-40CF	2						
CCPB-3-40CF	3						
CCPB-1-50CF	1	50A	TCF45RN, TCF50RN	3Hp	7.5Hp	20Hp	10Hp
CCPB-2-50CF	2						
CCPB-3-50CF	3						
CCPB-1-60CF	1	60A	TCF60RN	3Hp	7.5Hp	20Hp	10Hp
CCPB-2-60CF	2						
CCPB-3-60CF	3						
CCPB-1-70CF	1	70A	TCF70RN	5Hp	10Hp	50Hp	N/A
CCPB-2-70CF	2						
CCPB-3-70CF	3						
CCPB-1-90CF	1	90A	TCF80RN, TCF90RN	5Hp	10Hp	50Hp	N/A
CCPB-2-90CF	2						
CCPB-3-90CF	3						
CCPB-1-100CF	1	100A	TCF100RN	5Hp	10Hp	50Hp	N/A
CCPB-2-1-0CF	2						
CCPB-3-100CF	3						

* CCPB disconnect can accept TCF_RN fuses with amp ratings less than or equal to the amp rating of the CCPB disconnect.

Selective Coordination Made Easy

Quik-Spec™ Coordination Panelboard and Upstream Fuse

The Quik-Spec Coordination Panelboard provides the fusible solution for branch panelboard applications making it simple and cost effective to selectively coordinate the lighting branch circuits with upstream Cooper Bussmann fuses. This innovative branch circuit panelboard uses CUBEFuse™ fuses (1 to 100A) for the branch circuit protective devices and for the main fusible disconnect option either 100A - 400A Low-Peak™ LPJ_SPI fuses or up to 60A CUBEFuse. The CUBEFuse and Low-Peak LPJ_SPI fuses are easy to selectively coordinate with each other and other Cooper Bussmann Low-Peak fuses that are used in upstream power distribution panelboards and switch-boards. Merely maintain at least a 2:1 fuse amp rating ratio between upstream and downstream fuses and selective coordination is ensured up to 200kA.

A circuit with selectively coordinated overcurrent protective devices allows only the nearest upstream overcurrent protective device to open under any overcurrent condition. Selective coordination increases the reliability of a system to deliver power to the loads. Selective coordination is mandatory per the NEC® for the circuit paths of some vital loads on specific systems including:

- Emergency Systems: 700.27
- Legally Required Standby Systems: 701.18
- Critical Operations Power Systems: 708.54
- Essential Electrical Systems: 517.26
- Elevator Circuits: 620.62*

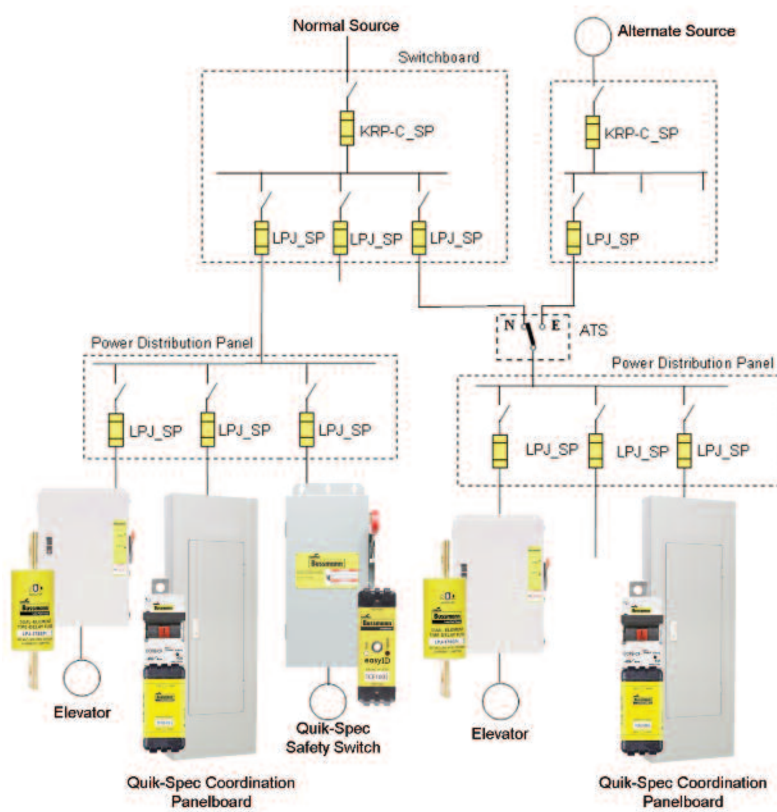
For other systems, selective coordination is a desirable design consideration. It is in the best interest of the building owner or tenants to have selectively coordinated overcurrent protective devices to avoid unnecessary blackouts.

Achieving selective coordination with fusible systems is easy with Cooper Bussmann fuses simply by adhering to minimum fuse amp rating ratios. If the fuses in a circuit path have amp rating ratios which are equal to or greater than these published ratios (see page 15), the fuses in the circuit path are selectively coordinated for overcurrents up to 200kA or the interrupting rating of the fuse, whichever is less. Very few systems will have available short-circuit currents greater than 200kA. This means that for almost all systems, the engineer and installer can just use the published ratios to design and install selectively coordinated systems. This saves money and time since there is no need to do a short-circuit current study nor plot time-current curves to engineer selective coordination between fuses. If the system changes and the available short-circuit current increases (less than 200kA), the fusible solution still provides selective coordination.

In contrast, if a circuit breaker branch circuit panelboard is used, a short-circuit current study and coordination study involving time-current curve analysis is typically necessary. This expends extra time and money. In systems with low available short-circuit currents, commonly used molded case circuit breaker systems may provide selective coordination. However, in many cases, the molded case circuit breakers in the branch panelboard will not selectively coordinate with the commonly used upstream molded case circuit breakers. This necessitates extra engineering time to investigate other upstream circuit breaker alternatives so selective coordination can be achieved. More expensive upstream circuit breakers are typically required to achieve selective coordination. In either case, if the system changes and the available short-circuit current increases, the circuit breaker system may no longer provide selective coordination.

See page 14 for simple application information on applying the Quik-Spec Coordination Panelboard to achieve selective coordination. For in-depth application information on selective coordination visit www.CooperBussmann.com/SelectiveCoordination.

Figure 1 – Selectively Coordinated Fusible System



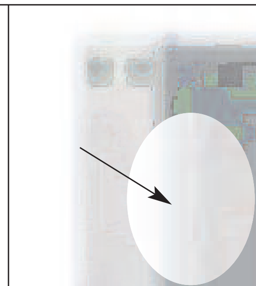
Fuse selective coordination is as simple as maintaining the amp rating ratios of 2:1 (or greater) between all CUBEFuse and Low-Peak fuses in a circuit. For other fuse types see published ratios.

*For elevator fusible disconnects use Cooper Bussmann Quik-Spec™ Power Module™ elevator disconnects (PS) and panelboards (PMP). See Data Sheets 1145 & 1146.

Comparison: *Traditional Fusible Branch Circuit Panelboards*

The Cooper Bussmann Quik-Spec™ Coordination Panelboard provides benefits over existing fusible branch circuit panels including 600Vac rating, high SCCR, high interrupting rated fuses, a broader range of branch circuit amp ratings, branch fuse amp rating rejection feature, safety features including the finger-safe CUBEFuse™ and a unique interlock system which ensures the CUBEFuse is de-energized before removal. Table 2 illustrates several design and safety feature comparisons versus traditional fusible branch circuit panelboards.

Table 2 – Quik-Spec Coordination Panelboard Compared to Traditional Fusible Branch Circuit Panelboards (MLO*)



Typical Class CC fuse holder/circuit breaker branch circuit arrangement

Panel Configuration		Quik-Spec™ Coordination Panelboard		Ferraz Shawmut (SCP) Littelfuse (LCP)	Eaton (PRL4) GE (ADS) Square D (QMB)	Class H or Plug Fuse
	SCCR	50kA	200kA	100kA	200kA	10kA
	Voltage	600V	600V	480V	600V	250V
	Type	MLO	MLO	MLO	MLO	MLO
Branch Fuse Type		CUBEFuse®		Class CC or J**	Class H, J, K, R & T	Class H or Plug Fuse
Size		20" W x 5 ¾" D		28" W x 6" D	36-44" W x 10.4" D	20" W x 6" D
Cost		**$$**	**$$$**	**$$$$**	**$$$$**	**$**
Design Features						
• Branch-circuit amp ratings		Up to 100A (1-, 2- and 3-Pole)		Up to 30A (1-Pole[2])	Up to 1200A	Up to 30A (1-Pole[2])
• Branch amp rating rejection feature		15, 20, 30, 40, 50, 60, 70, 90 & 100 (rejection breaks)		Non-rejection fuse holders (1 to 30 amps)	Rejection by fuse case size only	Class H - no rejection (plug fuse rejection requires adapters)
• Panel voltage rating		Up to 600Vac[3]		277/480V, 120/240V** 120/208V	Up to 600Vac	250Vac and less systems
• Branch circuit disconnect		UL 98 CCPB (innovative disconnect)		Circuit Breaker	UL 98 Fused disconnect	General use snap switch
Safety Features						
• Branch disconnect with integrated lockout means		Yes		No	Yes, but defeatable	No
• Interlock to prevent branch fuse removal while energized		Yes		No	No	No
• Lockable main disconnect (main configuration)		Yes (optional)		No	Yes (optional)	Yes (optional)

* Also available with fused and non-fused main disconnects up to 400A.
** Class J and 120/240V specifications Ferrar Shawmut only

1. Typical panelboard voltage ratings are 208Y/120 3-P, 4W, 120/240 1-P, 3W, & 480Y/277 3-P, 4W.
2. Multi-pole configurations may be available by special order.
3. Suitable for use on most systems up to 600Vac.

Comparison: *Circuit Breaker Branch Circuit Panelboards*

Table 3 contrasts several configurations of commonly available circuit breaker panelboards versus the Quik-Spec™ Coordination Panelboard. This comparison is for fully rated, main lug only panelboards. Series rated panelboards are not included since series combination rated circuit breakers inherently lack the capability to selectively coordinate.

Table 3 – Quik-Spec Coordination Panelboard Compared to Circuit Breaker Branch Circuit Panelboards (MLO)

Panel Configuration	Quik-Spec™ Coordination Panelboard		Circuit Breaker Branch Circuit Panelboards					
SCCR	50kA	200kA	10kA	14kA	25kA	35kA	65kA	100kA
Voltage	600V	600V	240V	480/277V	480/277V	480/277V	480/277V	480/277V
Type	MLO	MLO	MLO	MLO	MLO	MLO	MLO	MLO
Selective Coordination Analysis[1]								
• Short-circuit current study required	No (if fault level below 200kA)		Yes (must calculate available fault current at each point circuit breakers are applied)					
• Ease of achieving selective coordination	Simplest (use fuse ratios)		Requires plotting time-current curves and proper interpretation. Limited to low available fault currents unless more sophisticated upstream circuit breakers are used					
• Study is job specific	Not specific (all systems up to 200kA)		Yes (coordination scheme is typically not transferable)					
• Study applicable if fault currents change	Yes (up to 200kA)		No (must re-verify selective coordination)					
Size	20" W x 5-3/4" D		20" W x 5-3/4" D					
Branch fuse/CB interrupting rating	300kA		10kA	14kA	25kA	35kA	65kA	100kA
Panel SCCR	50kA	200kA	10kA	14kA	25kA	35kA	65kA	100kA
Cost	**$$**	**$$$**	**$**	**$$**	**$$**	**$$$**	**$$$$**	**$$$$$**

1. Selective coordination analysis is based on upstream fuses for the Quik-Spec Coordination Panelboard and based on upstream circuit breakers for circuit breaker branch circuit panelboards.

Explanation of Considerations in Table 3

Selective Coordination Analysis - The effort and cost required for completing selective coordination analysis can differ significantly and may affect equipment selection upstream. Four key considerations include:

Short-Circuit Current Study Required - With fuses, there is no need to complete detailed calculations as long as the available short-circuit current is less than or equal to 200kA or the fuse interrupting rating, whichever is lower. With circuit breakers, it is necessary to calculate the available short-circuit currents at each point a circuit breaker is applied.

Ease of Achieving Selective Coordination - With fuses, just use the selectivity ratio guide which is applicable for the full range of overcurrents up to the fuses' interrupting rating or 200kA, whichever is lower. With circuit breakers, it is necessary to do a detailed analysis including plotting the time-current curves, interpreting selective coordination for the available short-circuit currents and if necessary, investigating other circuit breaker alternatives.

Study is Job Specific - With fuses, the selective coordination scheme determined is not limited just to a specific job since it is a matter of utilizing the selectivity ratios. The same specification of fuse types and amp ratings could be utilized for another project as long as the short-circuit current is not greater than 200kA. With circuit breakers the selective coordination scheme that is used for one project is not generally transferable to another project; each project will have its own specific available short-circuit currents.

Study Applicable if Fault Currents Change - With fuses, even if there is a system change that increases the short-circuit current (such as when the main transformer gets changed), selective coordination is retained up to 200kA. With circuit breakers selective coordination may be negated if the short-circuit current increases due to a system change.

Cost - Cost comparisons are relative and based on equivalent configurations of voltage rating, amp rating and same number of branch circuits.

Size - Standard branch circuit panelboard width and depth are noted. Heights vary by manufacturer.

Circuit Breaker Interrupting Rating (IR) - In accordance with NEC® Section 110.9 overcurrent protective device interrupting ratings must be sufficient for the available fault current at their line terminals. Table 3 contains a sampling of commercially available branch circuit breaker interrupting ratings.

Panel Short-Circuit Current Rating (SCCR) - Panelboard short-circuit current ratings are determined during product testing in accordance with UL 67 test procedures. These ratings must exceed the available fault current at the point of installation to ensure compliance with NEC® 110.10.

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Quick-Spec™ Coordination Panelboard: Short-Circuit Current Rating (SCCR)

For panelboard installations, the National Electrical Code® 110.10 requires that the short-circuit current rating (SCCR) of the panelboard be equal to or exceed the available short-circuit current at the point of installation.

The Quik-Spec Coordination Panelboard is offered in a standard SCCR option or a high SCCR option for each of the three main configurations. Refer to Table 4 and the clarifying figures that follow for examples. The SCCR is marked on the panelboard, as well as provided in the data sheet.

Fuses in the Quik-Spec Coordination Panelboard will selectively coordinate with upstream Cooper Bussmann fuses if upstream fuse type and amp rating meet or exceed the published Selectivity Ratios. No claims are made that the Quik-Spec Coordination Panelboard fuses will selectively coordinate with upstream circuit breakers

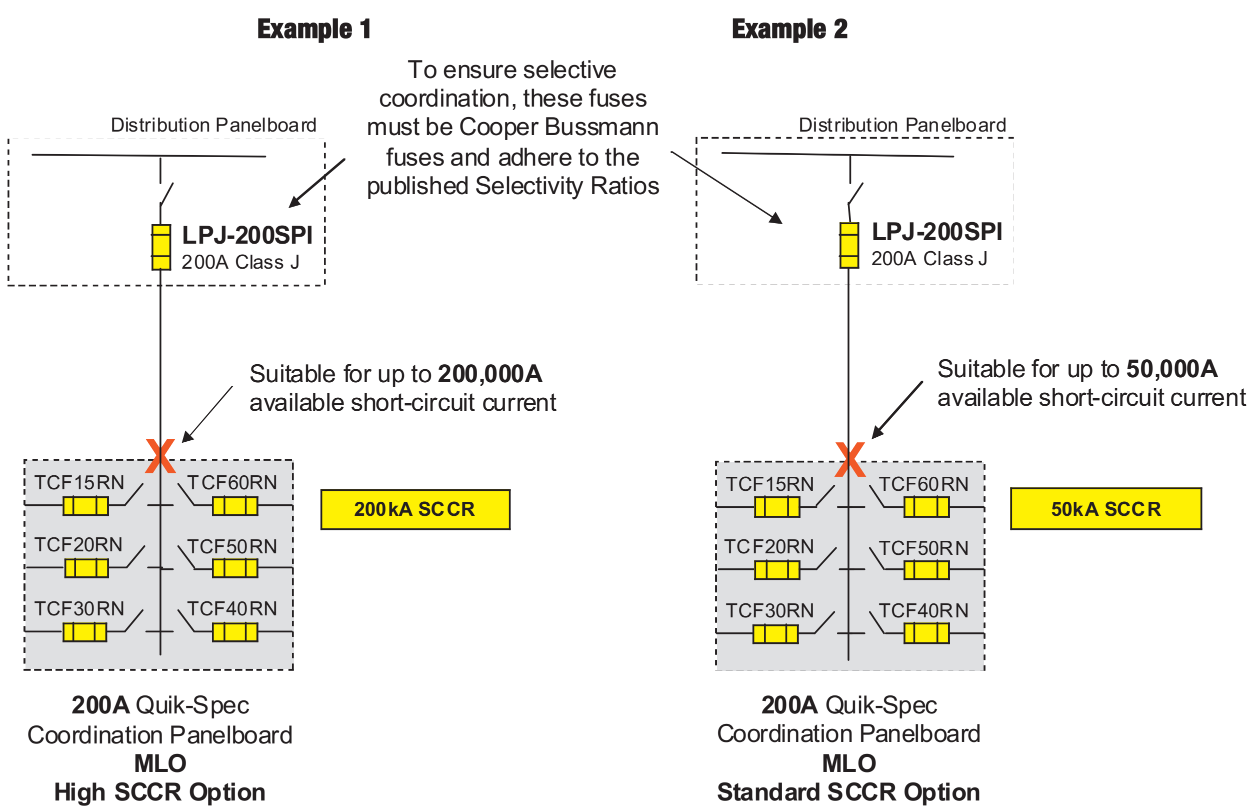
Table 4 - Quik-Spec Coordination Panelboard Short-Circuit Current Ratings

Panelboard Short-Circuit Current Ratings					
	AC Main Options				DC
SCCR	Main Lug Only (MLO)*	70-200A Main Disc. No Fuses* or w/ Class J Fuses	225-400A Main Disc. No Fuses* or w/ Class J Fuses	CCP_CF Main Disc. (60A)**	Main Lug Only (MLO)*
High	200kA	200kA	100kA	200kA	100kA
Std.	50kA	50kA	50kA	50kA	20kA

* For panelboards with subfeed main lugs, or panelboards with optional feed-through lugs, Class J, T, or R fuses are required upstream - max amps = panel amps.

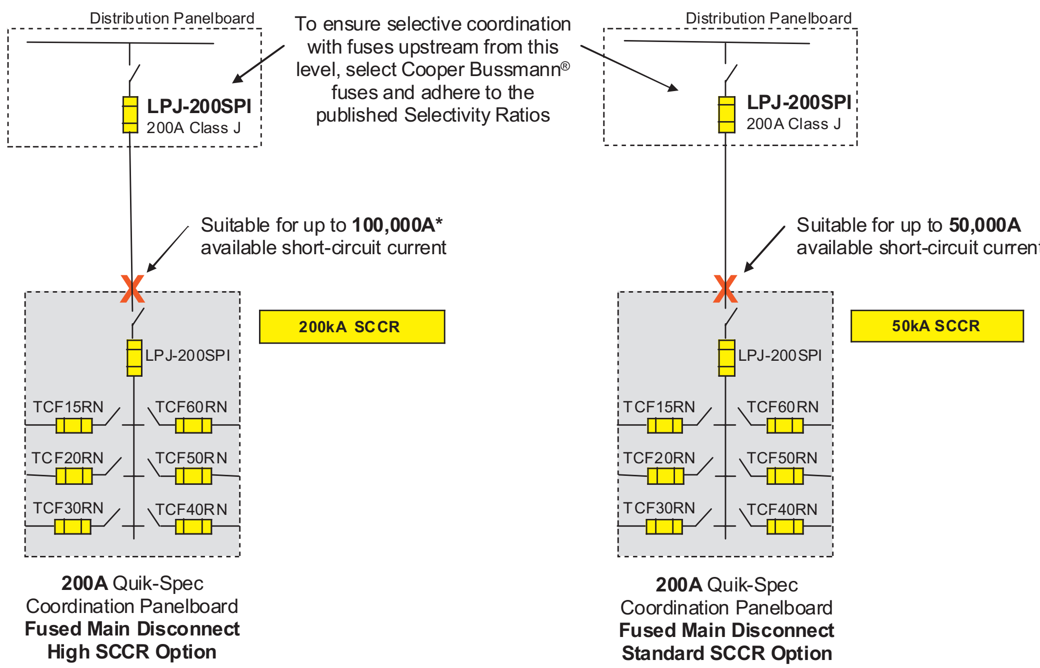
** CUBEFuse Disconnect.

Quik-Spec Coordination Panelboard Short-Circuit Current Ratings with Upstream Fuses (600Vac or less system)



Quik-Spec™ Coordination Panelboard Short-Circuit Current Ratings with Upstream Fuses (600Vac or less system)

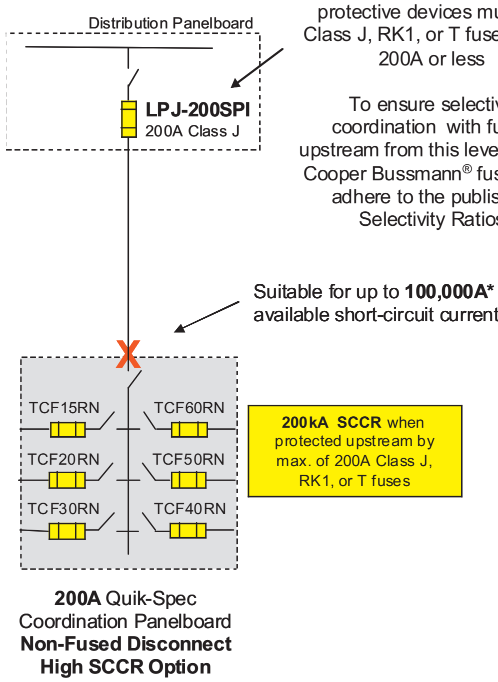
Example 3 / Example 4



Note the upstream 200A fuses do not have to selectively coordinate with the 200A panelboard main fuses because if both open, no additional parts of the electrical system would be shut down unnecessarily. See NEC® 700.27 and 701.18 exceptions.

Quik-Spec™ Coordination Panelboard Short-Circuit Current Ratings with Upstream Fuses (600Vac or less system)

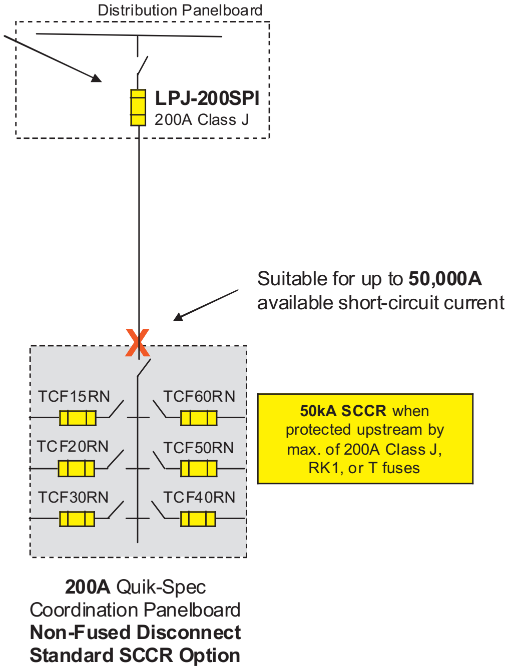
Example 5



These upstream overcurrent protective devices must be Class J, RK1, or T fuses rated 200A or less

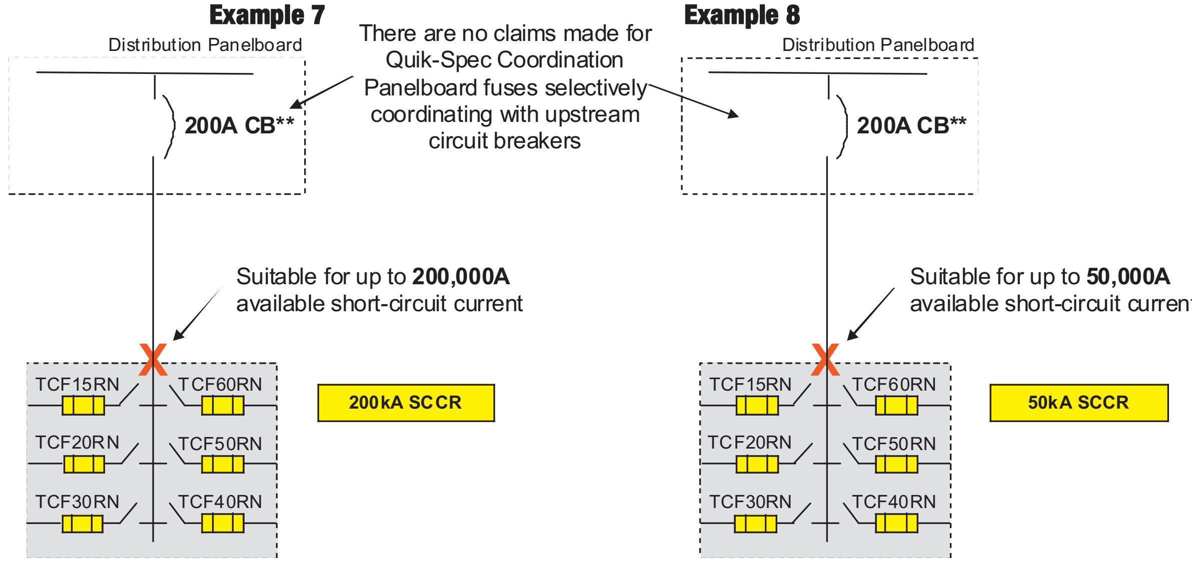
To ensure selective coordination with fuses upstream from this level, select Cooper Bussmann® fuses and adhere to the published Selectivity Ratios

Example 6



Quik-Spec™ Coordination Panelboard Short-Circuit Current Ratings with Upstream Circuit Breakers (600Vac or less system)

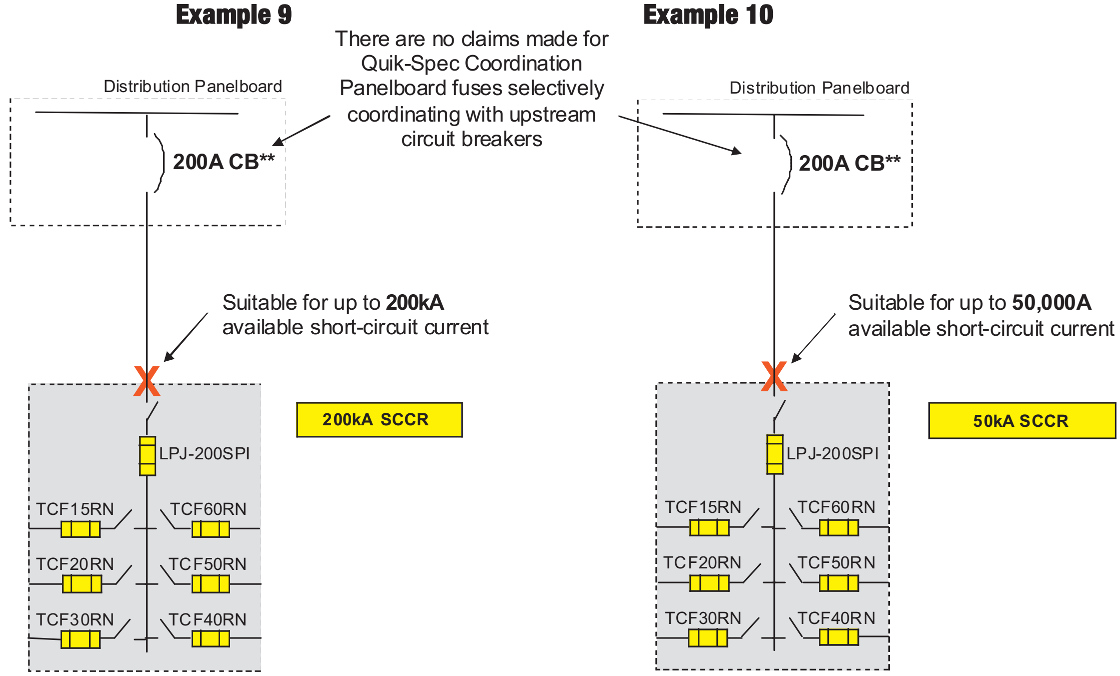
Example 7 / Example 8



200A Quik-Spec
Coordination Panelboard
MLO
High SCCR Option

200A Quik-Spec
Coordination Panelboard
MLO
Standard SCCR Option

Example 9 / Example 10



200A Quik-Spec
Coordination Panelboard
Fused Main Disconnect
High SCCR Option

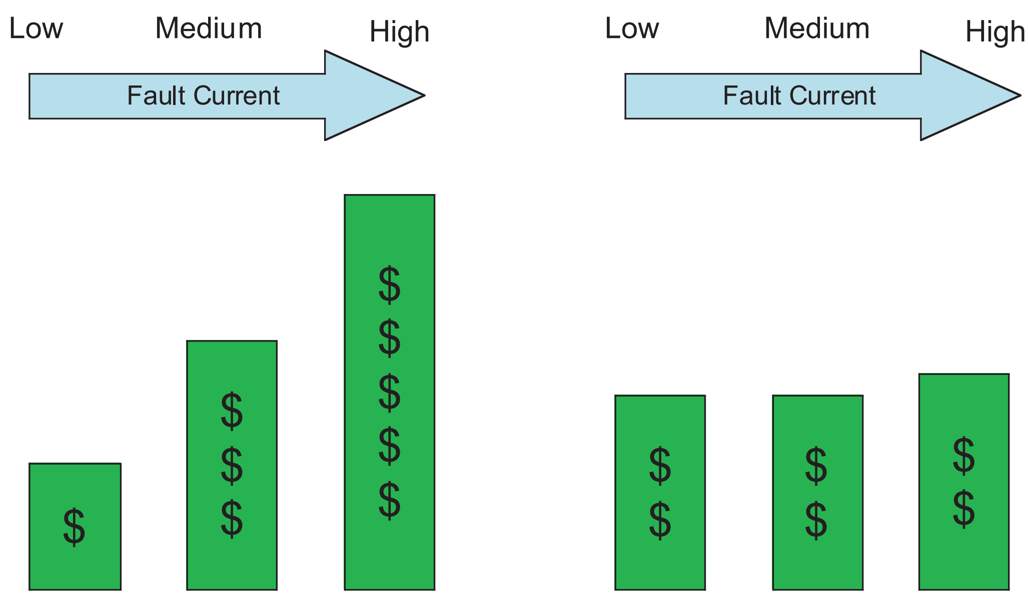
200A Quik-Spec
Coordination Panelboard
Fused Main Disconnect
Standard SCCR Option

** Circuit breaker interrupting ratings must be equal to or greater than available short-circuit current at their line-side per NEC® 110.9.

Comparison: Selectively Coordinated Fuse or Circuit Breaker System Alternatives

If selective coordination is a requirement, Figure 2 illustrates that the costs for fuses and the associated equipment can often be equivalent or substantially less than the cost for circuit breakers and associated equipment (includes service, feeder and branch overcurrent protective equipment). As the system available short-circuit currents increase, the cost advantage of fuse systems is greater. In addition, the time and cost for engineering analysis to achieve selective coordination can be substantially less with fuses.

Figure 2 – Overcurrent Protective Devices & Equipment Costs vs. Available Fault Current



Circuit Breaker System Cost

Costs increase as the available fault current increases due to higher interrupting rating and SCCR requirements, as well as the need for circuit breakers with complex time-current characteristics necessary to achieve selective coordination.

Fusible System Cost

There is no additional cost for 200kA interrupting rating and achieving selective coordination up through 200kA. Costs increase moderately as fault levels increase due to higher SCCR requirements for the Quik-Spec™ Coordination Panelboard.

The time, effort and costs associated with designing and installing a selectively coordinated fuse or circuit breaker distribution system can vary substantially. Table 6 represents a comparison of using fuses or using various circuit breaker alternatives for service, feeder and branch circuits. Table 6 compares important considerations for each alternative.

Fuse or circuit breaker alternatives capable of selectively coordinating only up through lower available short-circuit currents are located to the left of the Table, those capable of selectively coordinating up through high available short-circuit currents are located to the right. Alternatives able to coordinate for a higher range of available fault currents are more flexible and, therefore, are an advantage since they can be applied on more systems. In practice, sometimes an alternative is chosen before available short-circuit current levels are known for the system. Unfortunately, in some cases, device alternatives which are able to selectively coordinate only up through low available short-circuit current levels may be chosen and installed only to determine at a later time that the available fault levels exceed those devices' ability to selectively coordinate. Once installed, modifications to the system design can become very costly.

Table 6 – Selectively Coordinated Fuse or Circuit Breaker System Alternatives

LOW → Fault Current Magnitudes Where Selective Coordination Can Be Achieved → **HIGH**

Distribution Equipment & Protective Device Types  	**Low IR** Instantaneous trip thermal-magnetic molded-case CBs	**Medium IR** Instantaneous trip thermal-magnetic molded-case CBs	**Medium IR** Instantaneous trip electronic or high-magnetic molded-case CBs	**High IR** Instantaneous trip insulated-case & electronic molded-case CBs	**High IR** LV Power CBs	Fusible switchboards, MCCs, and distribution panelboards
Branch Equipment & Protective Device Types 	Low IR MCCB fully rated branch panelboard	Med. IR MCCB fully rated branch panelboard	Med. IR MCCB fully rated branch panelboard	High IR MCCB fully rated branch panelboard	High IR MCCB fully rated branch panelboard	Quik-Spec Coordination Panelboard
Branch Overcurrent Protective Device Type	Low IR MCCB	Medium IR MCCB	Medium IR MCCB	High IR MCCB	High IR MCCB	High IR fuses up through 200kA
Labor Intensive, Selective Coordination Analysis Required[1]	**YES**	**YES**	**YES**	**YES**	**NO** Set time delay bands properly	**NO** Simply use fuse amp rating ratios
Level of Fault Current where Selective Coordination is Achievable	Minimum levels of device coordination limited by instantaneous trip of upstream CBs	Minimum levels of device coordination limited by instantaneous trip of upstream CBs	Moderate levels of device coordination, adjustable trip units provide flexibility, limited by instantaneous trip of upstream CB	Adjustable trip units provide design flexibility, coordination levels limited by CB instantaneous trip	Adjustable time delay settings w/o instantaneous override may coordinate up to CB interrupting rating	Up through 200kA, where fuse amp rating ratios are maintained
Total System Cost[1]	$	$ to $$	$$$	$$$ to $$$$	$$$$$	$$

1. Engineering cost for selective coordination study will vary based on the type of overcurrent protective devices, plus the size and complexity of the electrical system.

How to Achieve Selective Coordination

The Quik-Spec™ Coordination Panelboard saves the designer precious design time and provides an easy means to selectively coordinate lighting and other branch circuits with upstream Cooper Bussmann fuses.

Selective coordination increases the reliability of an electrical system to provide availability of power to vital loads. The NEC® definition in Article 100:

Coordination (Selective). Localization of an overcurrent condition to restrict outages to the circuit or equipment affected, accomplished by the choice of overcurrent protective devices and their ratings or settings.

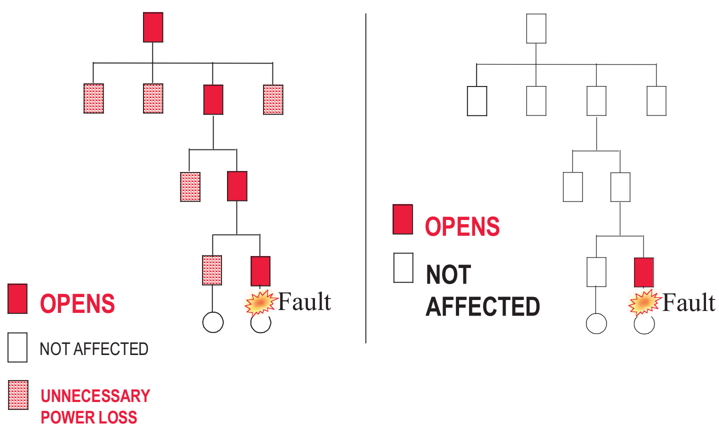
The two one-line diagrams in Figure 3 below demonstrate the concept of selective coordination.

The one-line diagram on the left illustrates a lack of selective coordination; a fault on the load side of one overcurrent protective device unnecessarily opens other upstream overcurrent protective devices. The result is unnecessary power loss to loads that should not be affected by the fault.

The system on the right illustrates selective coordination: for the full range of overcurrents possible for this system, only the nearest upstream overcurrent protective device opens. No other upstream overcurrent protective devices open and interruption of power is minimized to the fewest loads. Similarly, the fault could also occur on a feeder circuit and a selectively coordinated circuit would result in only the nearest upstream feeder overcurrent protective device opening.

Figure 3 – Electrical System Selective Coordination

Without Selective Coordination **With** Selective Coordination



Selective Coordination Using Fuses

Simply adhering to fuse selectivity ratios makes it easy to design and install systems where the fuses are selectively coordinated (see the Cooper Bussmann Selectivity Ratio Guide). The top horizontal axis shows the loadside fuses and the left vertical axis shows the lineside fuses. These selectivity ratios are for all levels of overcurrent up to the fuse interrupting rating or 200,000A, whichever is lower. The ratios are valid even for fuse opening times less than 0.01 seconds. It is not necessary to plot time-current curves or do a short-circuit current analysis (if the available short-circuit current is less than 200kA or the interrupting rating of the fuses, whichever is less). All that is necessary is to ensure that the fuse types and amp rating ratios for the service, feeders, and branch circuits meet or exceed the applicable selectivity ratios. If the ratios are not satisfied, then the designer should investigate other fuse types or design changes.

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Selectivity Ratio Guide (Lineside to Loadside)[1]

Circuit					Loadside Fuse										
Current Rating					601-6000A	601-4000A	0-600A			601-6000A	0-600A	0-1200A	0-600A	0-60A	0-30A
Type					Time-Delay	Time-Delay	Dual-Element Time-Delay			Fast-Acting	Fast-Acting	Fast-Acting	Fast-Acting	Time-Delay	
Trade Name					Low-Peak	Limitron	Low-Peak	Low-Peak	Fusetron	Limitron	Limitron	T-Tron	Limitron	SC	
Class					(L)	(L)	(RK1)	(J)	(RK5)	(L)	(RK1)	(T)	(J)	(G)	(CC)
Cooper Bussmann Symbol					KRP-C_SP	KLU	LPN-RK_SP LPS-RK_SP	LPJ-SP TCF[2]	FRN-R FRS-R	KTU	KTN-R KTS-R	JJN JJS	JKS	SC	LP-CC FNQ-R KTK-R
Lineside Fuse	601 to 6000A	Time-Delay	Low-Peak™ (L)	KRP-C_SP	2:1	2.5:1	2:1	2:1	4:1	2:1	2:1	2:1	2:1	2:1	2:1
	601 to 4000A	Time-Delay	Limitron™ (L)	KLU		2:1									
	0 to 600A	Dual-Element	Low-Peak (RK1) (J)	LPN-RK_SP LPS-RK_SP LPJ-SP TCF[1]	–	–	2:1	2:1	8:1	–	3:1	3:1	3:1	4:1	2:1
			Fusetron™ (RK5)	FRN-R FRS-R	–	–	1.5:1	1.5:1	2:1	–	1.5:1	1.5:1	1.5:1	1.5:1	2:1
	601 to 6000A	Fast-Acting	Limitron (L)	KTU	2:1	2.5:1	2:1	2:1	6:1	2:1	2:1	2:1	2:1	2:1	2:1
	0 to 600A		Limitron (RK1)	KTN-R KTS-R	–	–	3:1	3:1	8:1	–	3:1	3:1	3:1	4:1	
	0 to 1200A		T-Tron™ (T)	JJN JJS	–	–	3:1	3:1	8:1	–	3:1	3:1	3:1	4:1	
	0 to 600A		Limitron (J)	JKS	–	–	2:1	2:1	8:1	–	3:1	3:1	3:1	4:1	
	0 to 60A	Time-Delay	SC (G)	SC	–	–	3:1	3:1	4:1	–	2:1	2:1	2:1	2:1	

1. Where applicable, ratios are valid for indicating and non-indicating versions of the same fuse.
At some values of fault current, specified ratios may be lowered to permit closer fuse sizing. Consult with Cooper Bussmann.
General Notes: Ratios given in this Table apply only to Cooper Bussmann fuses. When fuses are within the same case size, consult Cooper Bussmann.
2. TCF or TCF_RN (CUBEFuse™) is 1 to 100A Class J performance; dimensions and construction are unique, finger-safe design.

Example Analysis

Designers and installers have been selectively coordinating fuses in systems by using the Cooper Bussmann Selectivity Ratio Guide for decades. Now, the Quik-Spec™ Coordination Panelboard permits designers and installers to ensure selective coordination for branch circuits fed from branch circuit panelboards. Below is an example of how simple selective coordination analysis is with Cooper Bussmann fuses. Refer to Figure 4 one-line diagram for this example.

Check the upstream feeder fuse 2 with the largest branch circuit fuse 1:

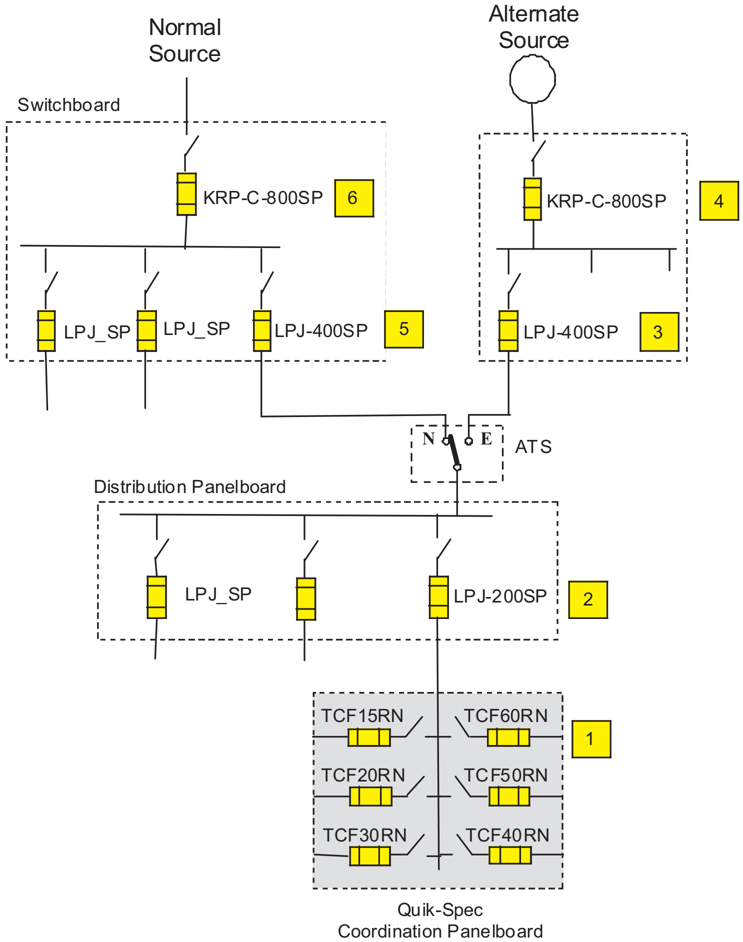
The as-designed amp ratio of feeder LPJ-200SPI to branch TCF60RN (largest branch) is a 3.3:1 ratio and the published ratio to ensure selective coordination from the Selectivity Ratio Guide is 2:1. (Note the TCF60RN is the non-indicating version of the TCF Low-Peak CUBEFuse.) As long as the as-designed ratio is 2:1 or greater, then selective coordination is achieved. Since 3.3:1 is greater than 2:1, the LPJ-200SPI fuses are selectively coordinated with the TCF60RN fuses for any overcurrent up to 200,000A. The other TCF_RN fuses in the panelboard are of a lower amp rating, so they also will selectively coordinate with the LPJ-200SPI fuses.

The analysis should be completed for both the circuit path from the Quik-Spec Coordination Panelboard branch TCF_RN fuses to the service fuses on the normal path as well as the circuit path to the alternate source feeder fuses. The as-designed amp ratios must be equal to or greater than the published ratios in the Selectivity Ratio Guide for the following (the fuses to be analyzed in Figure 4 have been assigned numbers 1 to 6):

- TCF60RN fuses (1) with fuses 2, 3, 4, 5 and 6.
- LPJ-200SPI fuses (2) with fuses 3, 4, 5 and 6
- LPJ-400SPI fuses (3) with fuse 4.
- LPJ-400SPI fuses (5) with fuse 6

The published ratios in the Selectivity Ratio Guide for all the fuse combinations above are 2:1. In all cases, the as-designed ratios, in the example above, are 2:1 or greater, therefore, fuse selective coordination is ensured for the circuit paths from the fuses in the Quik-Spec Coordination Panelboard to the normal service, as well as to the alternate source.

Figure 4 – Selectively Coordinated Quik-Spec™ Coordination Panelboard



Selective coordination is as simple as maintaining amp rating ratios of 2:1 or greater between all CUBEFuse and Low-Peak fuses in a circuit. For other fuse types see published ratios.

Competitive Comparison

To achieve selectively coordinated circuit paths with a molded case circuit breaker branch circuit panelboard requires more time consuming design analysis. In many cases, in order for the upstream circuit breakers to selectively coordinate with a circuit breaker in a branch circuit panelboard, more costly circuit breakers are needed in the feeders and service. This generally results in more design time and higher equipment costs. This application note is not intended to cover this topic in-depth.

To briefly illustrate this point, the time-current curve for a molded case circuit breaker system is shown in Figure 5 along with a simplified one-line diagram. This time-current curve illustrates that this circuit path would only be selectively coordinated for fault values of less than 1600A at the branch circuit breaker panel and 7200A at the 200A circuit breaker point of installation. Any fault currents greater than these values may cause multiple levels of circuit breakers to open under fault conditions, which results in a lack of coordination.

It is apparent that when using circuit breakers, the designer should do a short-circuit current study, plot the time-current curves and interpret the curves as to whether selective coordination is achieved. If standard circuit breakers can not be selectively coordinated, then other circuit breaker alternatives must be investigated.

There are various circuit breaker alternatives when standard molded case circuit breakers lack selective coordination, including different circuit breaker types. Figure 6 is an alternative using molded case circuit breakers in the branch panelboard with upstream low voltage power circuit breakers with short-time delay settings. This solution provides selective coordination for short-circuit currents up to the interrupting rating of the respective circuit breakers. However, the cost and physical foot-print requirements are greater.

Figure 5 – Molded-Case Circuit Breaker System

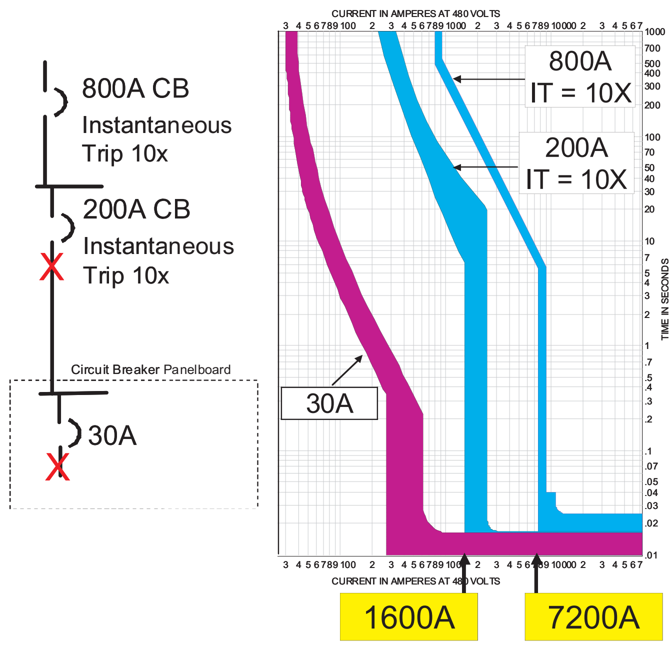
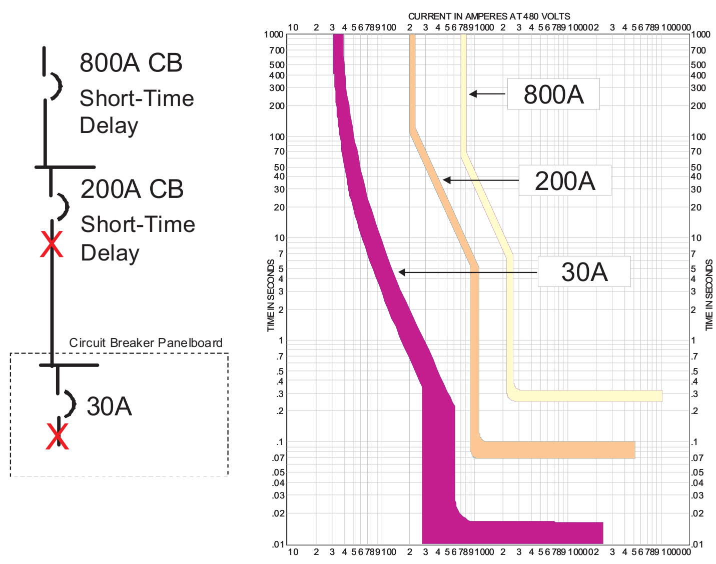


Figure 6 – Molded-Case & Power Circuit Breaker System



More Application Information on Selective Coordination

Cooper Bussmann has more in-depth application materials and article reprints on www.CooperBussmann.com/SelectiveCoordination.

Why Fuses

Overcurrent protection is critical for safety, protection, productivity and Code compliance. The Quik-Spec™ Coordination Panelboard offers many advantages that are covered elsewhere in this publication. In addition to the advantages of the panelboard itself, modern current-limiting fuses, as part of a fusible system, offer a number of superior protection characteristics including the following:

Reliable Overcurrent Protection - If applied properly, modern fuses provide a long, reliable operational lifetime. Overcurrent protection must be reliable and sure. Whether it is the first day of the electrical system or years later, it is important that overcurrent protective devices perform under overload or short-circuit conditions as intended. This is important for arc-flash protection and component protection. Modern current-limiting fuses operate by very simple, reliable principles. Circuit breakers being mechanical devices require periodic maintenance in order to continue to provide their intended level of protection.

Easy to Selectively Coordinate - Simply adhere to the published selectivity ratios to ensure that fuses are selectively coordinated up to 200kA or the fuse interrupting rating, whichever is lower. The analysis is simple and saves the designer time and money. No need to do a time consuming short-circuit current study and plot the time-current curves. Also, even if system changes increase the available fault current, the fuse system remains selectively coordinated.

High Interrupting Rating - The Low-Peak™ family of fuses, which is recommended for new building electrical systems, has interrupting ratings up to 300kA. The designer and installer do not have to be concerned about the available short-circuit currents. No need to do a short-circuit current study to verify proper interrupting ratings (except for an exceptional few installations in the USA).

Current-Limiting - Modern, current-limiting fuses, under short-circuit conditions, can force the current to zero and complete overcurrent interruption within a few thousandths of a second. The UL Standard for current-limiting fuses has uniform industry maximum short-circuit energy limits that fuses are required to meet. No such uniform industry requirements for short-circuit energy limits exist in circuit breaker product standards. Most circuit breakers are not current-limiting. Per the industry product standards, current-limiting fuses or current-limiting circuit breakers are identified by being marked "current-limiting."

Excellent Short-Circuit Current Protection for Components - Current-limiting fuses provide the best short-circuit protection for components. When in their current-limiting range, the short-circuit current energy is limited by the fast fuse operation.

Provide High Short-Circuit Current Ratings (SCCR) - Current-limiting fuses offer superior short-circuit current protection for components and assemblies which facilitates achieving high SCCR markings.

Minimal Maintenance Costs to Retain Overcurrent Protection - Modern fuses are reliable overcurrent protective devices and merely require visual inspection, maintaining fuse clip or mounting integrity, and ensuring proper conductor terminations. In contrast, circuit breakers, which are mechanical devices, require periodic inspections, mechanism exercise and calibration tests in addition to ensuring proper conductor terminations.

Arc-Flash Hazard Mitigation - Current-limiting fuses with their reliability, minimal maintenance requirements and current-limitation provide excellent arc flash mitigation.

Unparalleled Overcurrent Protection Industry Safety System - The modern current-limiting fuse industry has the safest physical mounting installation system. Industry product standards control the current-limiting fuse dimensions and mounting means so that only a fuse of a specific UL Class can be inserted in a specific UL fuse class mounting configuration for Class J, T, R, L, CC and G fuses. For instance, a Class J fuse is the only fuse type that can be installed in a UL Class J fuse mounting. This ensures that only a Class J fuse (which must have a 600V rating, at least 200kA interrupting rating and specific maximum limits for current-limiting short-circuit energy let-through) can be installed in a Class J mounting. The circuit breaker industry does not have such a stringent physical mounting safety system. It is common to be able to interchange circuit breakers of different voltage ratings, different interrupting ratings and different short-circuit energy let-through abilities.

No Worry Design and Installation Preference - Because of the advantages listed above, designers and installers have less work and concern in providing safe protection and Code compliant systems. Fusible designs do not require the costly short-circuit current studies and labor intensive coordination studies. Fusible systems result in reduced engineering time and cost.

Flexibility in the Installation Phase - During the construction phase the final ampacity for some services, feeders and branch circuits are unknown. A fusible solution affords some flexibility. For instance, a contractor orders a 1200A disconnect and then when the proper size of overcurrent device is determined, the proper ampacity fuses can be installed.

Misconceptions about Fuses and Circuit Breakers

Modern fuses are an excellent choice for building system protection and equipment protection. Fuses are widely used in commercial, institutional and industrial applications with satisfied designers, installers, maintenance personnel and owners. However, there are some misconceptions that invariably are mentioned by those within our industry who are unfamiliar with fuses and their application.

Misconception 1:
Circuit Breakers are Resettable and Therefore Preferred

Clarifying Facts:

1. OSHA 1910.334(b)(2) and NFPA 70E-2004 130.6(K) do not permit reclosing circuit breakers or replacing fuses if they opened due to a fault. This is a safety hazard. The fault needs to be located and repaired prior to reclosing.
2. NFPA 70E 225.3 requires that a circuit breaker be inspected and tested after it interrupts a fault approaching its interrupting rating.
3. *After the occurrence of a short-circuit, it is important that the cause be investigated and repaired, and that the condition of the installed equipment be investigated. A circuit breaker may require replacement just as any other switching device, wiring or electrical equipment in the circuit that has been exposed to a short-circuit. Questionable circuit breakers must be replaced for continued, dependable circuit protection.*
   (Quote is by Vince A. Baclawski, Technical Director, Power Distribution Products, NEMA; published in EC&M Magazine, pp. 10, January 1995.)
4. For motor circuits, the starter provides overload protection and a circuit breaker is intended for only short-circuit protection. Therefore when a circuit breaker opens on a motor branch circuit, the convenience of immediately flipping the handle to reclose could be a safety hazard and is a definite violation of OSHA 1910.334(b)(2). At the minimum, the fault must be located and repaired. Then, as stated above, a circuit breaker needs to be inspected, tested and possibly replaced.
5. In addition, since motor branch circuit protection is only short-circuit protection, current-limiting fuses provide superior protection compared to molded case circuit breakers.
6. If a fuse opens, a new factory calibrated fuse is inserted which retains the system protection at the original level. If a circuit breaker is reset without inspection and testing, the circuit breaker may now be out of calibration or non-operative.

Misconception 2:
Fuses Cause Single Phasing and Therefore are Not Preferred

Clarifying Facts:

1. For feeder circuits with single-phase loads it is an advantage to have one fuse open on a line-ground fault or two fuses to open on a line-line fault. It permits the single-phase loads on the other phases to remain in operation. In the 2008 National Electrical Code® cycle, a comment (20-17 Log #2346) was submitted to Code Panel 20 to require all poles of an overcurrent protective device to automatically open for an overcurrent condition. Code Panel 20 unanimously rejected this comment with this Panel Statement (partial quote):
   However, opening all three poles of overcurrent protective devices actually decreases reliability and continuity of power for many vital loads. For example, since most faults are phase-to-ground faults, assume a phase-to-ground fault in an emergency feeder circuit that supplies power for egress lighting and other critical single-phase and phase-to-phase loads. If all three poles of the overcurrent device open because of this phase-to-ground fault, the entire emergency lighting circuit and many other vital loads are without power. This is a blackout condition caused by one phase-to-ground fault. It is much better for only one pole to open in such a situation, which would leave two thirds of these loads energized. Protection for individual branch circuit three-phase motor loads has been addressed since the 1971NEC® began requiring three overcurrent relays and there are other means that can be deployed. Solid state overloads and solid state drives as well as additional phase loss relays are optionally available for branch circuits where enhanced protection is warranted for specific critical motor circuits.
2. There are many causes of single-phasing, besides one fuse opening, such as utility single-phasing, poor terminations, or a switch or circuit breaker not making contact properly. For this reason, individual three-phase motors need to be protected with three overload devices that are properly sized and calibrated. Systems installed prior to the 1971 NEC® incurred a high incident of single-phasing motor damage typically due to primary single-phasing because overload devices were only required in two phases of three-phase motors. The 1971 NEC® rectified this by requiring three overload devices for three-phase motor circuits. Also, if single-phasing for any cause is a serious concern, there are design options that can be utilized such as electronic overload protection that opens for unbalanced conditions, phase loss relays, etc.

Application Information and Fuse Sizing Guidelines

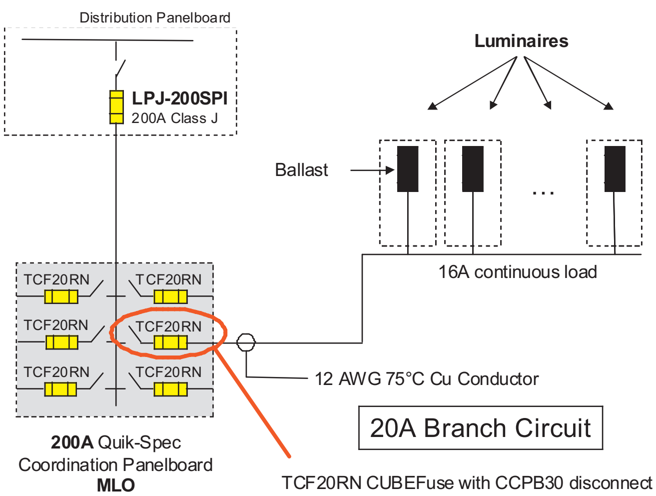
CUBEFuse Sizing Guide

The CUBEFuse is a time-delay fuse. This permits closer fuse sizing than a non-time delay fuse for loads with inrush currents such as transformers or across the line AC motors. The CUBEFuse has excellent current-limiting characteristics (UL Class J) which results in superior short-circuit protection for circuit components and typically outstanding arc flash hazard mitigation. In addition, these fuses are rated 600Vac and have a 300kA interrupting rating.

Branch Circuits: Lighting and/or Appliance Load (No Motor Load)

For lighting branch circuits, the most common application for Quik-Spec™ Coordination Panelboard branch circuits, the CUBEFuse and conductors are sized at the rated circuit ampacity. The branch circuit conductor (per NEC® 210.19(A)(1)) and fuse (per NEC® 210.20(A)) must be sized for the non-continuous load plus 125% of the continuous load. Most lighting branch circuits are continuous loads, so a branch circuit with a 16A lighting load (16A x 125% = 20A) would require a 20A branch circuit rating with 12 AWG 75°C copper conductor and 20A CUBEFuse. (This is before any NEC® adjustment or correction factors that may apply.) See example in Figure 7.

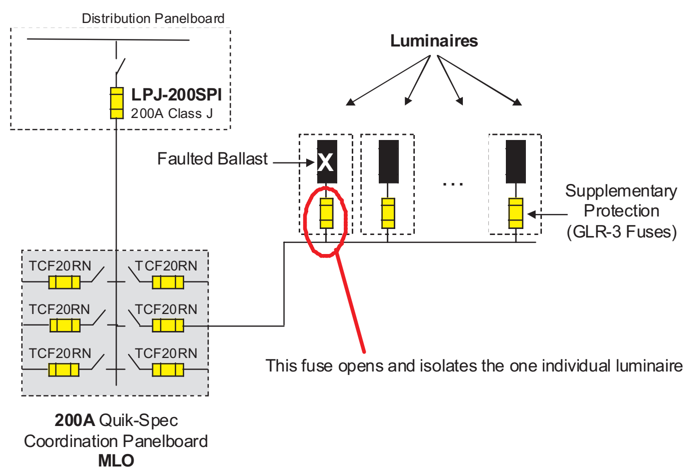
Figure 7 - CCPB Disconnect/CUBEFuse Sized for Lighting Branch Circuit

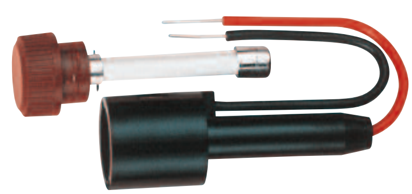


Individual lighting ballast protection recommendation (Figure 8)

Cooper Bussmann provides in-line fuses/holders for the specific purpose of isolating individual luminaires when an internal fault occurs. If a ballast fails, the low amp rated in-line fuse quickly opens without opening the branch circuit fuse or the service ground fault relay, and therefore isolates just the one faulted luminaire. The other luminaires on the lighting branch circuit remain in operation. The GLR/HLR or GLQ/HLQ fuse/holder combination are typically used for this application. See Data Sheets 2032 and 2033. Fuse amp rating should be per luminaire manufacturer's recommendation.

Figure 8 - Example of Fusing Individual Luminaires





GLR fuse and HLR in-line fuse holder.

Branch Circuits: Individual Motor Circuits

The CUBEFuse provides excellent motor branch circuit short-circuit and ground-fault protection per NEC® 430.52 for individual motor on a branch circuit. Based on the motor full load amps from NEC® Tables 430.248 to 430.250, there are three different sizing alternatives to consider. See the CUBEFuse Motor Sizing Table at the end of this section. An example is in Figure 9.

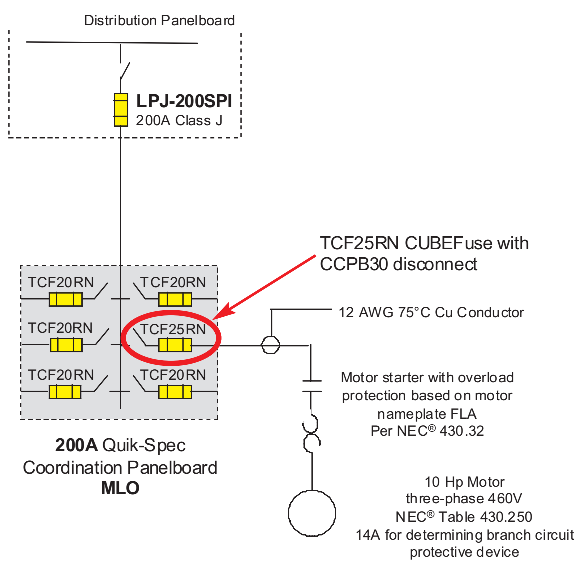
Optimal Branch Circuit Protection - 150% or the next larger CUBEFuse amp rating if 150% does not correspond to a fuse amp rating. This provides the greatest degree of short-circuit and ground-fault protection for motor branch circuits (NEC® 430.52), but typically is not the maximum sizing allowed. If a motor has a long starting time, high starting current profile or is cycled frequently, it may be necessary to use one of the next two sizing guidelines. In some cases for the CUBEFuse Motor Sizing Table at the end of this section, the fuse size is slightly less than 150%. This can provide slightly better protection and in some cases, be less cost.

Maximum Branch Circuit Protection Size, General Applications (Code Max) - 175% or the next larger (NEC® 240.6) standard fuse amp rating if 175% does not correspond to a standard fuse amp rating (NEC® 430.52(C)(1) Exc. 1).

Maximum Branch Circuit Protection Size, Heavy Start - Where sizing at 175% is not sufficient for the starting current of the motor, size at 225% or the next smaller CUBEFuse amp rating if 225% does not correspond to a CUBEFuse fuse amp rating (NEC® 430.52(C)(1) Exc. 2).

For any of the alternatives above, motor running overload protection (NEC® 430.32) needs to be provided by other means such as an overload relay. If the motor controller manufacturer's overload relay tables state a maximum branch circuit protective device of a lower rating, that lower rating must be used in lieu of the sizes determined above. Finally, the Compact Circuit Protector Base (CCPB) disconnect must have a horsepower rating equal to or greater than the motor horsepower rating.

Figure 9 - CUBEFuse/CCPB Disconnect Sized for Optimal Motor Branch Circuit Protection

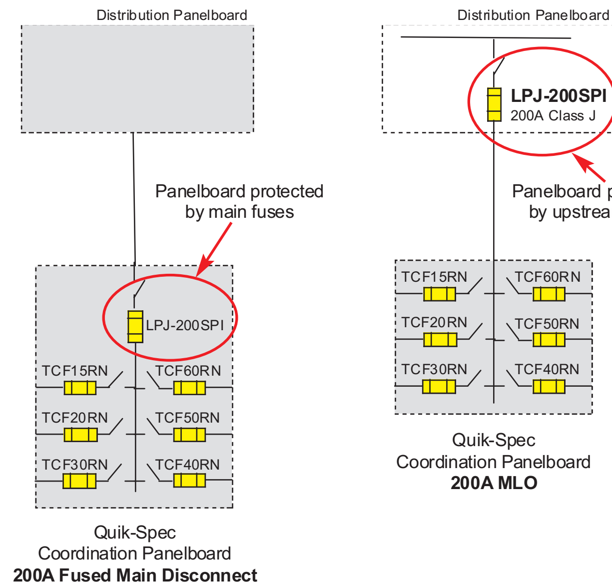


Applying Quik-Spec™ Coordination Panelboards

The panelboard short-circuit current rating (SCCR) must be greater than the available short-circuit current. See the section Quick-Spec Coordination Panelboard: Short-Circuit Current Rating (SCCR) in this publication for more details on this subject.

Each panelboard must be individually protected within the panelboard (fused main disconnect) or on the supply side by a set of fuses or circuit breaker having an amp rating not greater than the panelboard (NEC® 408.36). Exception No. 1: Individual protection is not required when the panelboard is used as service equipment in accordance with NEC® 230.71 See Figure 10.

Figure 10 – Quik-Spec Coordination Panelboard Overcurrent Protection



If the panelboard is supplied through a transformer, the fuses for the protection of the panelboard must be located on the transformer secondary per NEC® 408.36(B). An exception is where a panelboard supplied by a single-phase, two-wire or three-phase, three-wire, delta-delta transformer is permitted to be protected by a set of fuses or a circuit breaker on the primary where the protection complies with NEC® 240.21(C)(1) which requires:

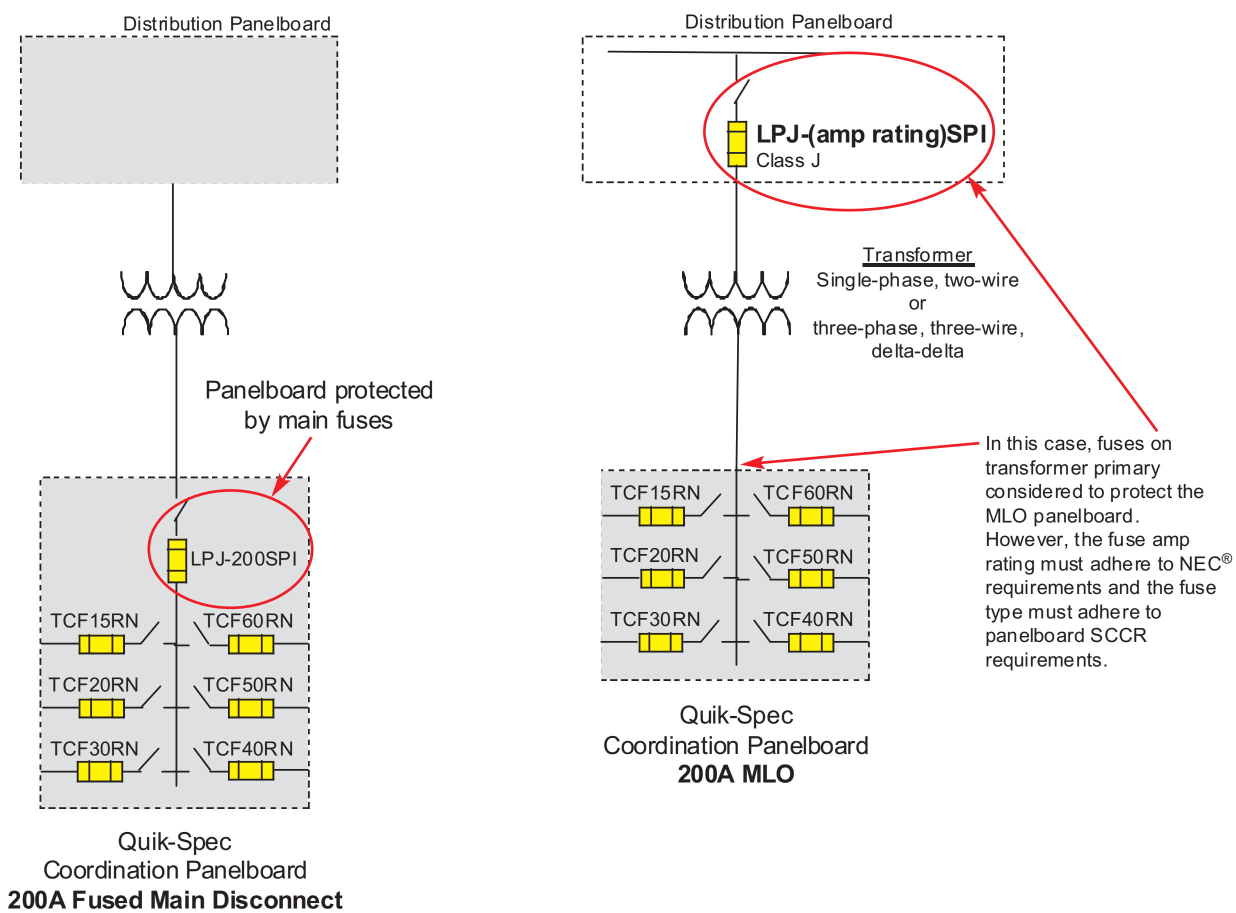
1. The transformer is protected in accordance with 450.3.

   The maximum fuse permitted for 600V or less, transformer primary only protection per NEC® 450.3(B) is 125% of transformer primary rated current or the next standard amp rating in NEC® 240.6 if 125% of this current does not correspond to a standard fuse amp rating.

2. The overcurrent protective device on the primary of the transformer does not exceed the ampacity of the secondary conductor, multiplied by the secondary to primary voltage ratio. Selecting the next higher standard size overcurrent protective device is NOT allowed.

See Figure 11.

Figure 11 – Quik-Spec™ Coordination Panelboard Supplied Through a Transformer



CUBEFuse™ Motor Sizing Table

Voltage	Motor Size (Hp)	Motor[1] FLA (Amps)	Low-Peak™ CUBEFuse™ (Amp Rating) Optimal Protection	Code Max	Heavy Start
115Vac, 1-Phase	0.167	4.4	10	10	10
	0.25	5.8	10	15	15
	0.333	7.2	15	15	15
	0.5	9.8	15	20	20
	0.75	13.8	25	25	30
	1	16	25	30	35
	1.5	20	30	35	45
	2	24	40	45	50
	3[2]	34	50	60	N/A
230Vac, 1-Phase	0.167	2.2	6	6	6
	0.25	2.9	6	6	6
	0.333	3.6	6	10	10
	0.5	4.9	10	10	10
	0.75	6.9	15	15	15
	1	8	15	15	17.5
	1.5	10	15	20	20
	2	12	20	25	25
	3	17	25	30	35
	5	28	45	50	60
	7.5[2]	40	60	N/A	N/A
200Vac, 3-Phase	0.5	2.5	6	6	6
	0.75	3.7	6	10	10
	1	4.8	10	10	10
	1.5	6.9	15	15	15
	2	7.8	15	15	17.5
	3	11	17.5	20	20
	5	17.5	30	35	35
	7.5[2]	25.3	40	45	50
208Vac, 3-Phase	0.5	2.4	6	6	6
	0.75	3.5	6	10	10
	1	4.6	10	10	10
	1.5	6.6	10	15	15
	2	7.5	15	15	15
	3	10.6	17.5	20	20
	5	16.7	25	30	35
	7.5[2]	24.2	40	45	50

Voltage	Motor Size (Hp)	Motor[1] FLA (Amps)	Low-Peak™ CUBEFuse™ (Amp Rating) Optimal Protection	Code Max	Heavy Start
230Vac, 3-Phase	0.5	2.2	6	6	6
	0.75	3.2	6	6	6
	1	4.2	10	10	10
	1.5	6	10	15	15
	2	6.8	15	15	15
	3	9.6	15	20	20
	5	15.2	25	30	30
	7.5[2]	22	35	40	45
460Vac, 3-Phase	0.5	1.1	3	3	3
	0.75	1.6	3	3	3
	1	2.1	6	6	6
	1.5	3	6	6	6
	2	3.4	6	6	6
	3	4.8	10	10	10
	5	7.6	15	15	15
	7.5	11	17.5	20	20
	10	14	25	25	30
	15	21	35	40	45
	20[2]	27	40	50	60
575Vac, 3-Phase	0.5	0.9	3	3	3
	0.75	1.3	3	3	3
	1	1.7	3	3	3
	1.5	2.4	6	6	6
	2	2.7	6	6	6
	3	3.9	6	10	10
	5	6.1	10	15	15
	7.5	9	15	20	20
	10[2]	11	17.5	20	20

Note: Use Code Max column for low to moderate reverse/jog/plug applications. Heavy Start permitted only if Code Max does not allow motor start-up.

1. Based on motor FLA from NEC® tables 430.248 and 430.250.

2. Max. Hp rating for the CCPB 60 Amp device at specified voltage.

CUBEFuse Amp Rating Rejection Table

CCPB[3]	Acceptable Fuse Amp Ratings
CCPB-15	15A & below
CCPB-20	20A & below
CCPB-30	30A & below
CCPB-40	40A & below
CCPB-50	50A & below
CCPB-60	60A & below
CCPB-70	70A & below
CCPB-90	90A & below
CCPB-100	100A & below

3. If using indicating CUBEFuse, install fuse with date code R38 or later.