

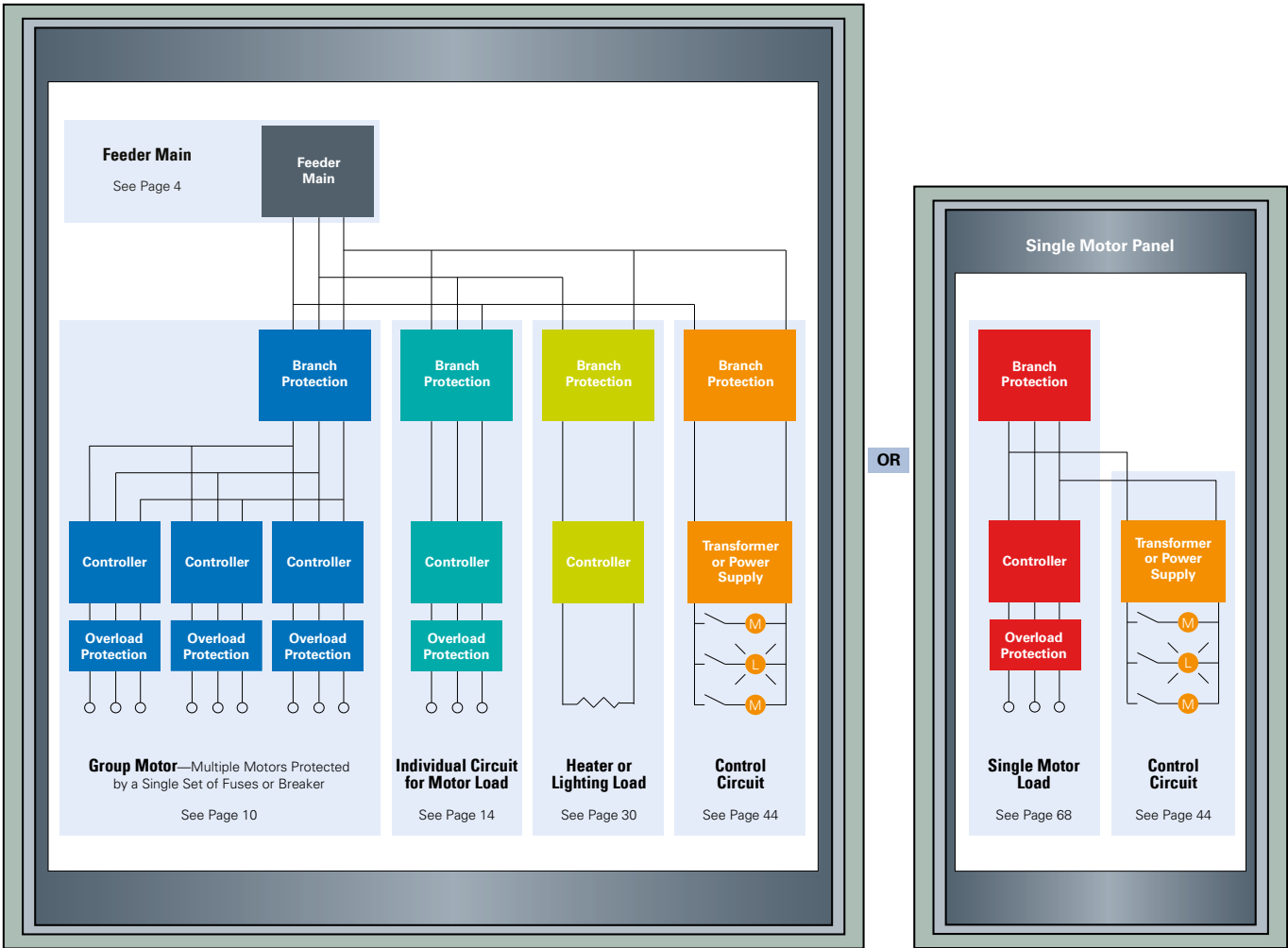
Control panel design guide according UL 508A



EAT•N

Powering Business Worldwide

Designing the panel

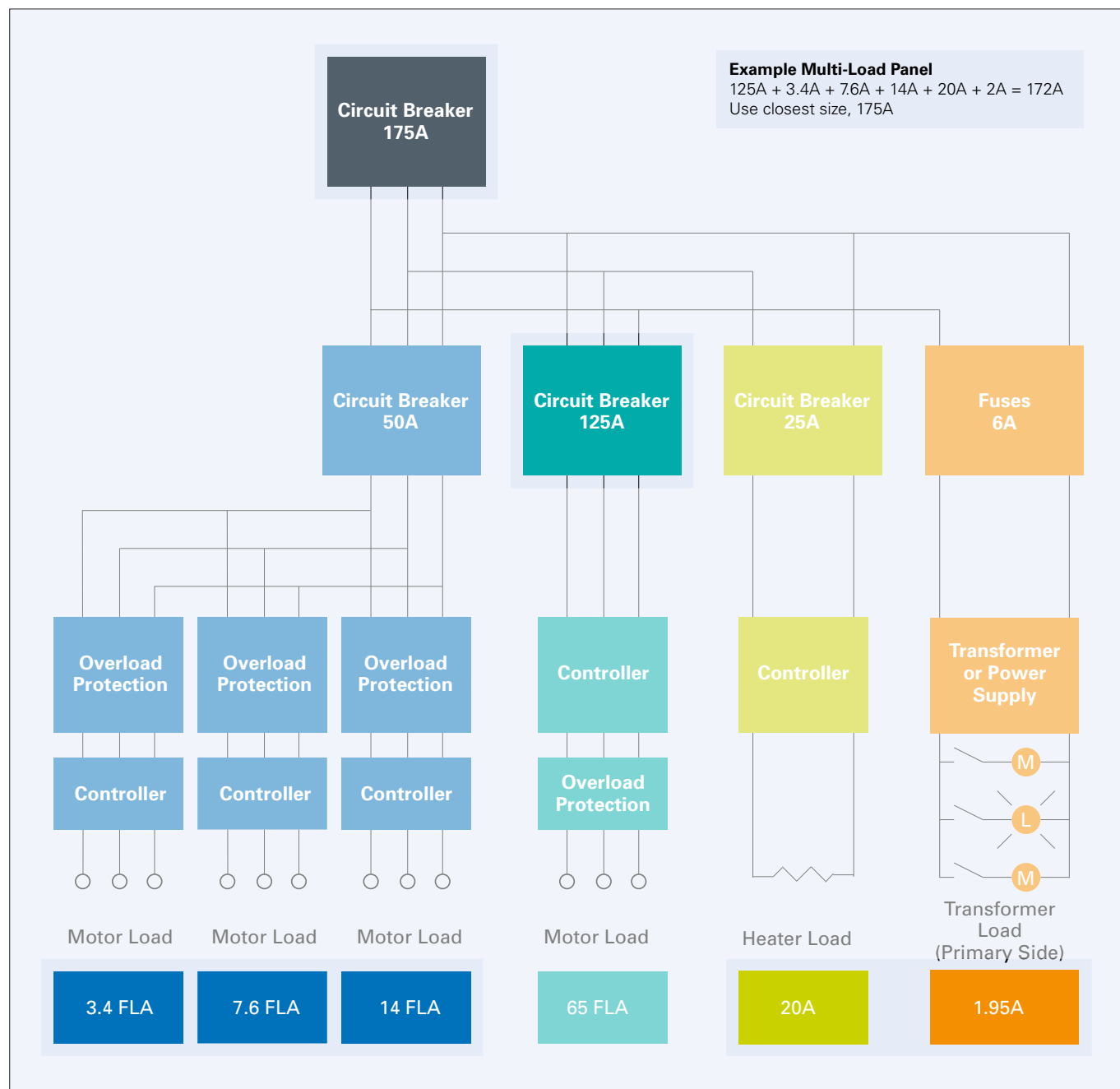


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Sizing the feeder

Reference to UL 508A Section 32.3.1a

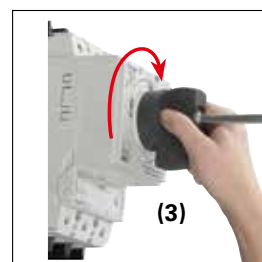
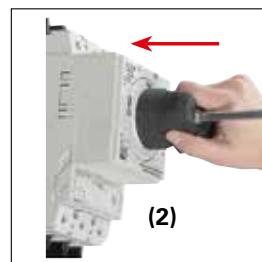
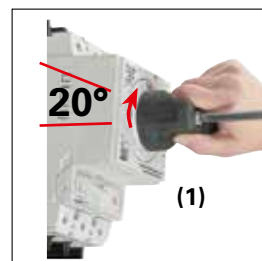


The feeder amp rating is sized based on the sum of the amp rating of the largest branch protective device plus the full-load currents of the other loads.

In this example, the 125A circuit breaker is the largest short-circuit protective device. This value is added to the full load

currents of the other loads in the circuit (motors, heater, and the primary of the transformer).

The overcurrent feeder amp rating should not exceed the conductor ampacity rating on the loadside. For conductor ampacity ratings, see UL508 A Table 28.1.



Fulfilling key requirements of relevant North American standards



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Main disconnect switches (Circuit Breakers and Molded Case Switches) equipped with door mounted rotary handles, and installed in industrial control panels for industrial machinery applications, essentially require the use of an additional internally mounted supplementary handle in order to meet all of the requirements found in the relevant North American standards dealing with this application. Eaton's assortment of new supplementary handles meet these stricter requirements in both the UL 508A and NFPA 79 standards.

UL 489 Circuit Breaker and Molded Case Switch Selection

rated current A	circuit breaker				fuse acc. NEC/CEC A	Molded Case Switch					main switch assembly kit with additional rotary handle	
	Part no.	SCCR 480Y/ 277V kA	SCCR 480V 600Y/ 347V	SCCR 600Y/ 347V			SCCR 480Y/ 277V kA	SCCR 480V 600Y/ 347V	SCCR 600Y/ 347V	black	red-yellow	
												
15	NZMB2-AF15(-BT)-NA	25	25	18	15	NS2-160(-BT)-NA		100	100	50	NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMN2-AF15(-BT)-NA	35	35	35							NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMH2-AF15(-BT)-NA	150	150	65							NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
					15		P3-30...-MCS	10				
20	NZMB1-AF20-NA	25			20	NS1-63-NA		35			NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMN1-AF20-NA	35									NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMB2-AF20(-BT)-NA	25	25	18	20	NS2-160(-BT)-NA		100	100	50	NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMN2-AF20(-BT)-NA	35	35	35							NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMH2-AF20(-BT)-NA	150	150	65							NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
					20		P3-30...-MCS	10				
25	NZMB1-AF25-NA	25			25	NS1-63-NA		35			NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMN1-AF25-NA	35									NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMB2-AF25(-BT)-NA	25	25	18	25	NS2-160(-BT)-NA		100	100	50	NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMN2-AF25(-BT)-NA	35	35	35							NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMH2-AF25(-BT)-NA	150	150	65							NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
					25		P3-30...-MCS	10				
30	NZMB1-AF30-NA	25			30	NS1-63-NA		35			NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMN1-AF30-NA	35									NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMB2-AF30(-BT)-NA	25	25	18	30	NS2-160(-BT)-NA		100	100	50	NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMN2-AF30(-BT)-NA	35	35	35							NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMH2-AF30(-BT)-NA	150	150	65							NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
					30		P3-30...-MCS	10				
35	NZMB1-AF35-NA	25			35	NS1-63-NA		35			NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMN1-AF35-NA	35									NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMB2-AF35(-BT)-NA	25	25	18	35	NS2-160(-BT)-NA		100	100	50	NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMN2-AF35(-BT)-NA	35	35	35							NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMH2-AF35(-BT)-NA	150	150	65							NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
40	NZMB1-AF40-NA	25			40	NS1-63-NA		35			NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMN1-AF40-NA	35									NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMB2-AF40(-BT)-NA	25	25	18	40	NS2-160(-BT)-NA		100	100	50	NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMN2-AF40(-BT)-NA	35	35	35							NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMH2-AF40(-BT)-NA	150	150	65							NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
45	NZMB1-AF45-NA	25			45	NS1-63-NA		35			NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMN1-AF45-NA	35									NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMB2-AF45(-BT)-NA	25	25	18	45	NS2-160(-BT)-NA		100	100	50	NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMN2-AF45(-BT)-NA	35	35	35							NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMH2-AF45(-BT)-NA	150	150	65							NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
50	NZMB1-AF50-NA	25			50	NS1-63-NA		35			NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMN1-AF50-NA	35									NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMB2-AF50(-BT)-NA	25	25	18	50	NS2-160(-BT)-NA		100	100	50	NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMN2-AF50(-BT)-NA	35	35	35							NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMH2-AF50(-BT)-NA	150	150	65							NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA

UL 489 Circuit Breaker and Molded Case Switch Selection

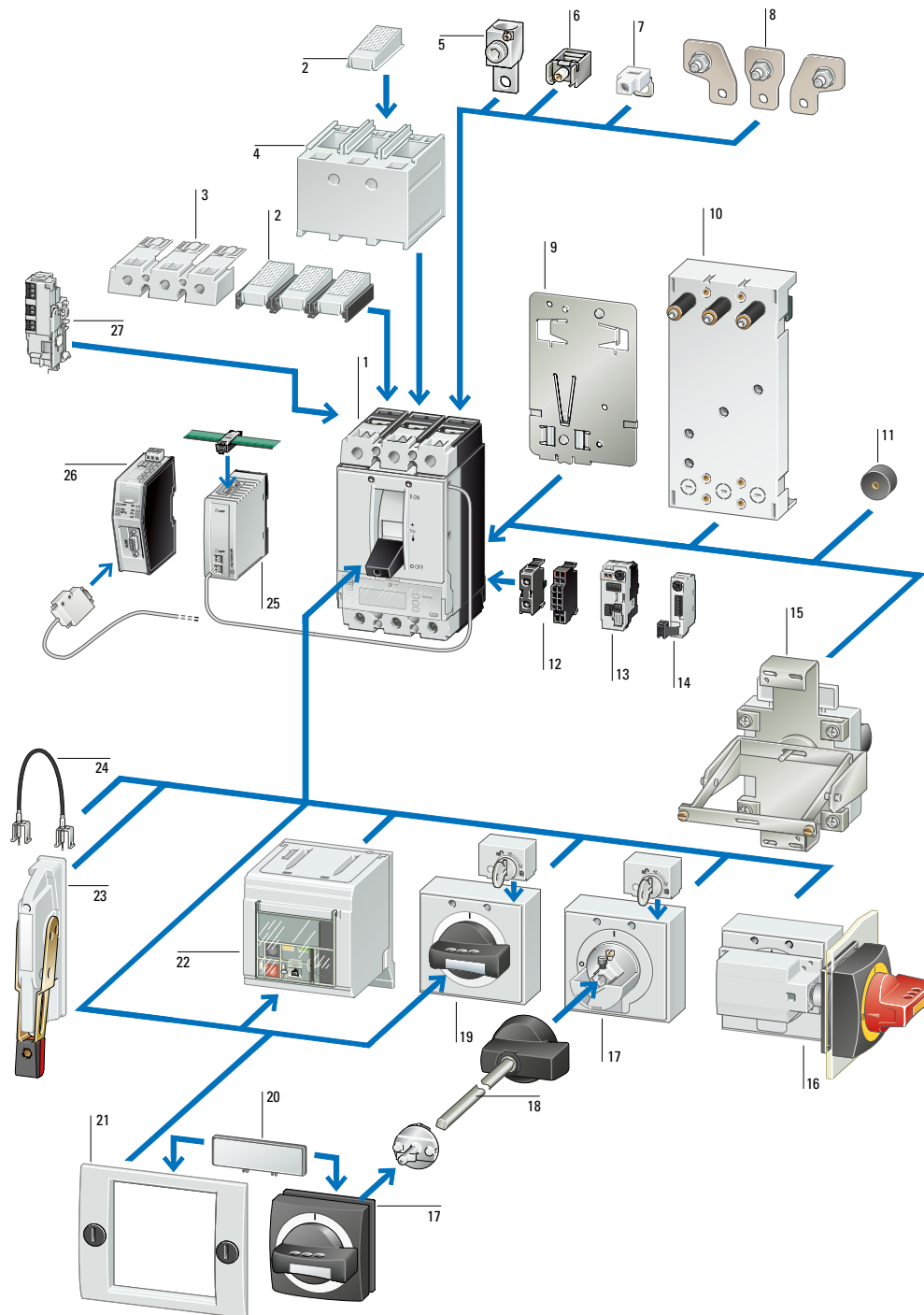
rated current A	circuit breaker				fuse acc. NEC/CEC A	Molded Case Switch			main switch assembly kit with additional rotary handle		
	Part no.	SCCR 480Y/ 277V kA	SCCR 480V	SCCR 600Y/ 347V		SCCR 480Y/ 277V kA	SCCR 480V	SCCR 600Y/ 347V	black	red-yellow	
											
60	NZMB1-AF60-NA	25			50	NS1-63-NA	35			NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMN1-AF60-NA	35								NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMB2-AF60(-BT)-NA	25	25	18	60	NS2-160(-BT)-NA	100	100	50	NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMN2-AF60(-BT)-NA	35	35	35						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMH2-AF60(-BT)-NA	150	150	65						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
70	NZMB1-AF70-NA	25			70	NS1-100-NA	35			NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMN1-AF70-NA	35								NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMB2-AF70(-BT)-NA	25	25	18	70	NS2-160(-BT)-NA	100	100	50	NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMN2-AF70(-BT)-NA	35	35	35						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMH2-AF70(-BT)-NA	150	150	65						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
80	NZMB1-AF80-NA	25			80	NS1-100-NA	35			NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMN1-AF80-NA	35								NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMB2-AF80(-BT)-NA	25	25	18	80	NS2-160(-BT)-NA	100	100	50	NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMN2-AF80(-BT)-NA	35	35	35						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMH2-AF80(-BT)-NA	150	150	65						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
90	NZMB1-AF90-NA	25			90	NS1-100-NA	35			NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMN1-AF90-NA	35								NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMB2-AF90(-BT)-NA	25	25	18	90	NS2-160(-BT)-NA	100	100	50	NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMN2-AF90(-BT)-NA	35	35	35						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMH2-AF90(-BT)-NA	150	150	65						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
100	NZMB1-AF100-NA	25			100	NS1-100-NA	35			NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMN1-AF100-NA	35								NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMB2-AF100(-BT)-NA	25	25	18	100	NS2-160(-BT)-NA	100	100	50	NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMN2-AF100(-BT)-NA	35	35	35						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMH2-AF100(-BT)-NA	150	150	65						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
110	NZMB1-AF110-NA	25			110	NS1-125-NA	35			NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMN1-AF110-NA	35								NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMB2-AF110(-BT)-NA	25	25	18	110	NS2-160(-BT)-NA	100	100	50	NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMN2-AF110(-BT)-NA	35	35	35						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMH2-AF110(-BT)-NA	150	150	65						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
125	NZMB1-AF125-NA	25			125	NS1-125-NA	35			NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMN1-AF125-NA	35								NZM1-XHB-DA-NA	NZM1-XHB-DAR-NA
	NZMB2-AF125(-BT)-NA	25	25	18	125	NS2-160(-BT)-NA	100	100	50	NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMN2-AF125(-BT)-NA	35	35	35						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMH2-AF125(-BT)-NA	150	150	65						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
150	NZMB2-AF150(-BT)-NA	25	25	18	150	NS2-160(-BT)-NA	100	100	50	NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMN2-AF150(-BT)-NA	35	35	35						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMH2-AF150(-BT)-NA	100	100	50						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
175	NZMB2-AF175(-BT)-NA	25	25	18	175	NS2-200(-BT)-NA	100	100	50	NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMN2-AF175(-BT)-NA	35	35	35						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMH2-AF175(-BT)-NA	100	100	50						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
200	NZMB2-AF200(-BT)-NA	25	25	18	200	NS2-200(-BT)-NA	100	100	50	NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMN2-AF200(-BT)-NA	35	35	35						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMH2-AF200(-BT)-NA	100	100	50						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA

UL 489 Circuit Breaker and Molded Case Switch Selection

rated current A	circuit breaker				fuse acc. NEC/CEC A	Molded Case Switch				main switch assembly kit with additional rotary handle	
	Part no.	SCCR 480Y/ 277V kA	SCCR 480V	SCCR 600Y/ 347V			SCCR 480Y/ 277V kA	SCCR 480V	SCCR 600Y/ 347V	black	red-yellow
											
225	NZMB2-AF225(-BT)-NA	25	25	18	225	NS2-250(-BT)-NA	100	100	50	NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMN2-AF225(-BT)-NA	35	35	35						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMH2-AF225(-BT)-NA	100	100	50						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
250	NZMB2-AF250(-BT)-NA	25	25	18	250	NS2-250(-BT)-NA	100	100	50	NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMN2-AF250(-BT)-NA	35	35	35						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
	NZMH2-AF250(-BT)-NA	100	100	50						NZM2-XHB-DA-NA	NZM2-XHB-DAR-NA
300	NZMN3-AX300-NA	42	42	35	300	NS3-400-NA	100	100	50	NZM3-XHB-DA-NA	NZM3-XHB-DAR-NA
	NZMH3-AX300-NA	100	100	50						NZM3-XHB-DA-NA	NZM3-XHB-DAR-NA
350	NZMN3-AX350-NA	42	42	35	350	NS3-400-NA	100	100	50	NZM3-XHB-DA-NA	NZM3-XHB-DAR-NA
	NZMH3-AX350-NA	100	100	50						NZM3-XHB-DA-NA	NZM3-XHB-DAR-NA
400	NZMN3-AX400-NA	42	42	35	400	NS3-400-NA	100	100	50	NZM3-XHB-DA-NA	NZM3-XHB-DAR-NA
	NZMH3-AX400-NA	100	100	50						NZM3-XHB-DA-NA	NZM3-XHB-DAR-NA
450	NZMN3-AX450-NA	42	42	35	450	NS3-600-NA	100	100	50	NZM3-XHB-DA-NA	NZM3-XHB-DAR-NA
	NZMH3-AX450-NA	100	100	50						NZM3-XHB-DA-NA	NZM3-XHB-DAR-NA
500	NZMN3-AX500-NA	42	42	35	500	NS3-600-NA	100	100	50	NZM3-XHB-DA-NA	NZM3-XHB-DAR-NA
	NZMH3-AX500-NA	100	100	50						NZM3-XHB-DA-NA	NZM3-XHB-DAR-NA
600	NZMN3-AX600-NA	42	42	35	600	NS3-600-NA	100	100	50	NZM3-XHB-DA-NA	NZM3-XHB-DAR-NA
	NZMH3-AX600-NA	100	100	50						NZM3-XHB-DA-NA	NZM3-XHB-DAR-NA
700	NZMN4-AX700-NA	42	42	35	700	NS4-800-NA	65	65	42	NZM4-XHB-DA-NA	NZM4-XHB-DAR-NA
	NZMH4-AX700-NA	85	85	50						NZM4-XHB-DA-NA	NZM4-XHB-DAR-NA
800	NZMN4-AX800-NA	42	42	35	800	NS4-800-NA	65	65	42	NZM4-XHB-DA-NA	NZM4-XHB-DAR-NA
	NZMH4-AX800-NA	85	85	50						NZM4-XHB-DA-NA	NZM4-XHB-DAR-NA
900	NZMN4-AX900-NA	42	42	35	900	NS4-1000-NA	65	65	42	NZM4-XHB-DA-NA	NZM4-XHB-DAR-NA
	NZMH4-AX900-NA	85	85	50						NZM4-XHB-DA-NA	NZM4-XHB-DAR-NA
1000	NZMN4-AX1000-NA	42	42	35	1000	NS4-1000-NA	65	65	42	NZM4-XHB-DA-NA	NZM4-XHB-DAR-NA
	NZMH4-AX1000-NA	85	85	50						NZM4-XHB-DA-NA	NZM4-XHB-DAR-NA
1200	NZMN4-AX1200-NA	42	42	35	1200	NS4-1200-NA	65	65	42	NZM4-XHB-DA-NA	NZM4-XHB-DAR-NA
	NZMH4-AX1200-NA	85	85	50						NZM4-XHB-DA-NA	NZM4-XHB-DAR-NA

UL 489 Circuit Breaker and Molded Case Switch

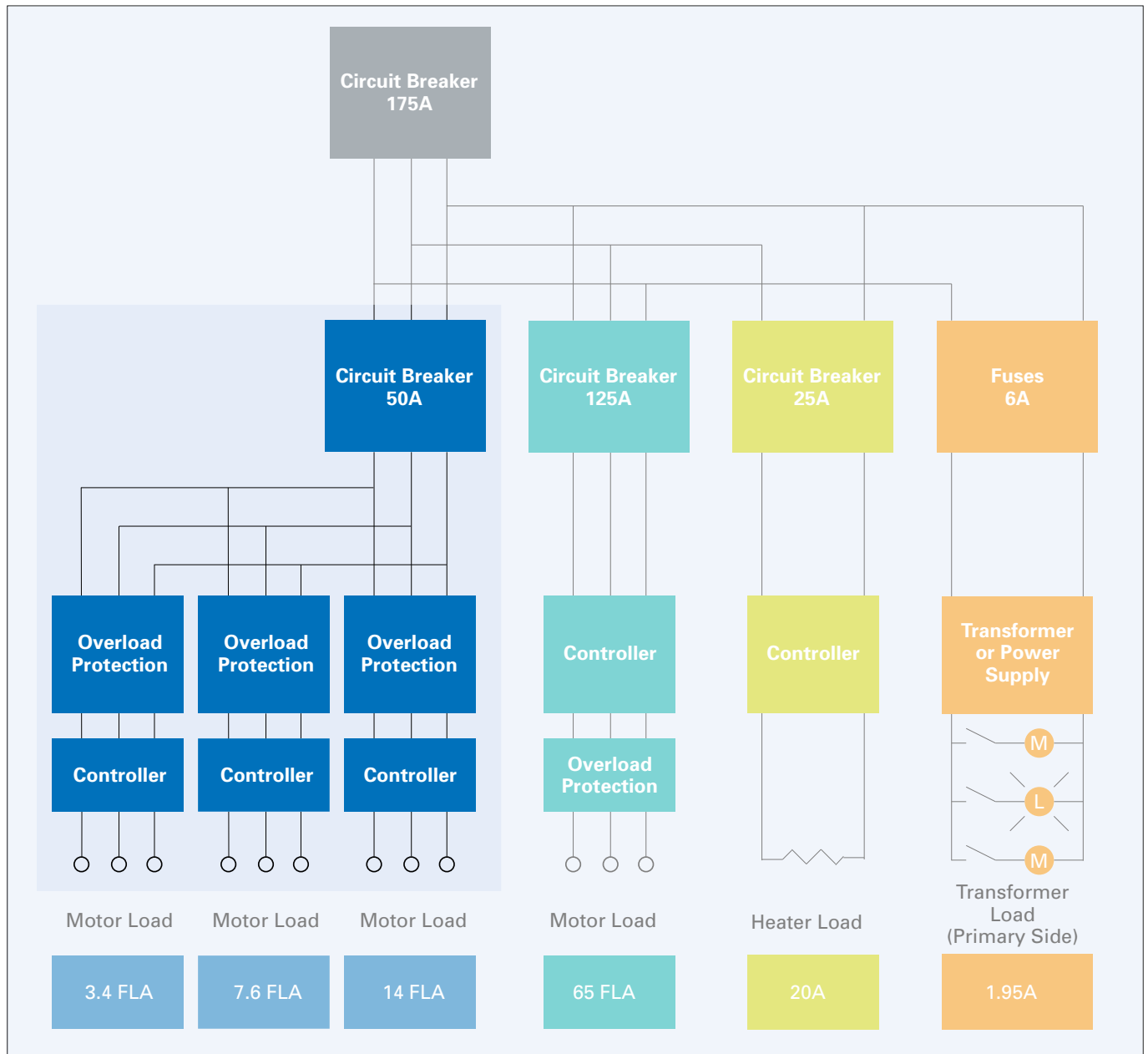
System overview



- | | | | |
|---|--|--|--|
| 1 Switch-disconnector; circuit breaker; circuit breaker for North America; molded case switches for North America | 9 Link kit | 18 Residual-current protection device | 27 Toggle lever interlock device |
| 2 IP2X protection against finger-contact | 10 Plug-in and withdrawable unit | 19 Rear operator | 28 Side operator handle |
| 3 Terminal cover, knockout | 11 Adapter plate | 20 Main switch rotary handle for side panel mounting | 29 Mechanical interlock |
| 4 Terminal cover | 12 Busbar adapter | 21 Door coupling rotary handle | 30 Communication module for SmartWire-DT |
| 5 Tunnel terminals | 13 Spacer | 22 Extension shaft | 31 Communication module Ethercat, Ethernet/IP and Profinet |
| 6 Box terminals | 14 Connection on rear | 23 Rotary handle | 32 Voltage release/early-make auxiliary contact |
| 7 Control circuit terminal | 15 Standard auxiliary contacts, trip-indicating auxiliary switches | 24 External warning plate/marketing plate | 33 Delay unit for undervoltage releases |
| 8 Connection width extension | 16 BSM interface module | 25 Insulating surround | |
| | 17 Interface communication module for Modbus RTU | 26 Remote operator | |

Group motor design

Reference to UL 508A Section 31.4.1.c



Group Motor – Multiple Motors Protected by a Single Set of Fuses or Breaker

The following rules apply to manual motor controllers for motor loads only:

A single set of fuses or breaker can be used if the following conditions are met:

- All power circuit devices are rated for group motor use as indicated on the component, heater tables or instruction publication.
- The following tap rule (31.4.3) is met:
 - The conductors to the individual loads are not less than 1/10 the ampacity of the branch circuit protection for each circuit provided with a manual motor controller (MMC) marked "Suitable as tap conductor protection in group installations." Also, the conductors on the load side of the MMC shall not have an ampacity less than 125% of the motor FLA.
- The branch circuit protection is sized by the sum of the following:
 - If the branch protection is a breaker, 250% of the largest motor FLA, plus the sum of the remaining motor loads,
 - If the branch protection is a time delay fuse, 175% of the largest motor FLA, plus the sum of the remaining motor loads, or
 - If the branch protection is a CC fuse, 300% of the largest motor FLA, plus the sum of the remaining motor loads.
- The branch circuit protection must not exceed the amp rating as specified in the group installation marking of the power circuit components and the type specified.



PKE Manuel Motor Protector



MSC Manuel Motor Controller



Special considerations for Manual Motor Controllers and Motor Starters in North America



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The motor protection is described in detail in NEC Article 430.

Basically for all motor circuits the 4 functions are required:

- Disconnect (main switch)
- Short-circuit protection
- Operational switching (contactor)
- Overload protection.

This functions can separately incorporate equipment or might be combined in one device.

Short Circuit Current Ratings for single protection, group protection, tap conductor protectors

	Overload trip (A)	Accessories	SCCR		Fuse max.		Circuit breaker max.		Part no.
			(kA)	(kA)	(A)	(A)	(A)	(A)	
	1. Manual motor controller in group installations with upstream back-up protective device		480 V	600 V	480 V	600 V	480 V	600 V	
	0,1 - 6,3	-	50	50	600	600	600	600	PKZM0-... (-S)PI
	9 - 12		65	18	600	600	600	600	PKZM0-... (-S)PI
	10 - 16	-	10	10	150	150	125	125	PKZM0-... (-S)PI
	10 - 16	with CL-PKZ0	50	50	600	600	600	600	PKZM0-... (-S)PI
	16 - 25	-	10	10	150	150	125	125	PKZM0-... (-S)PI
	16 - 25	with CL-PKZ0	18	18	600	600	600	600	PKZM0-... (-S)PI
	24 - 32	-	18	10	600	600	125	125	PKZM0-... (-S)PI
	24 - 32	with CL-PKZ0	18	18	600	600	600	600	PKZM0-... (-S)PI
	up to 50	-	65	42	600	600	600	600	PKZM4-50
	up to 56	-	65	42	600	600	600	600	PKZM4-58
	up to 58	-	65	42	600	600	600	600	PKZM4-63
	2. Tap Conductor Protectors suitable for use in group installations		480 Y/277 V*	600 Y/347 V*	The maximum rating of the branch circuit protective fuse or circuit breaker is determined per the 1/10th rule.				
	up to 11		50	50					PKZM0-... (-S)PI
	up to 16		42	18					PKZM0-... (-S)PI
	up to 32		18	-					PKZM0-... (-S)PI
	up to 40	-	65	25					PKZM4-...
	up to 58	-	65	-					PKZM4-...

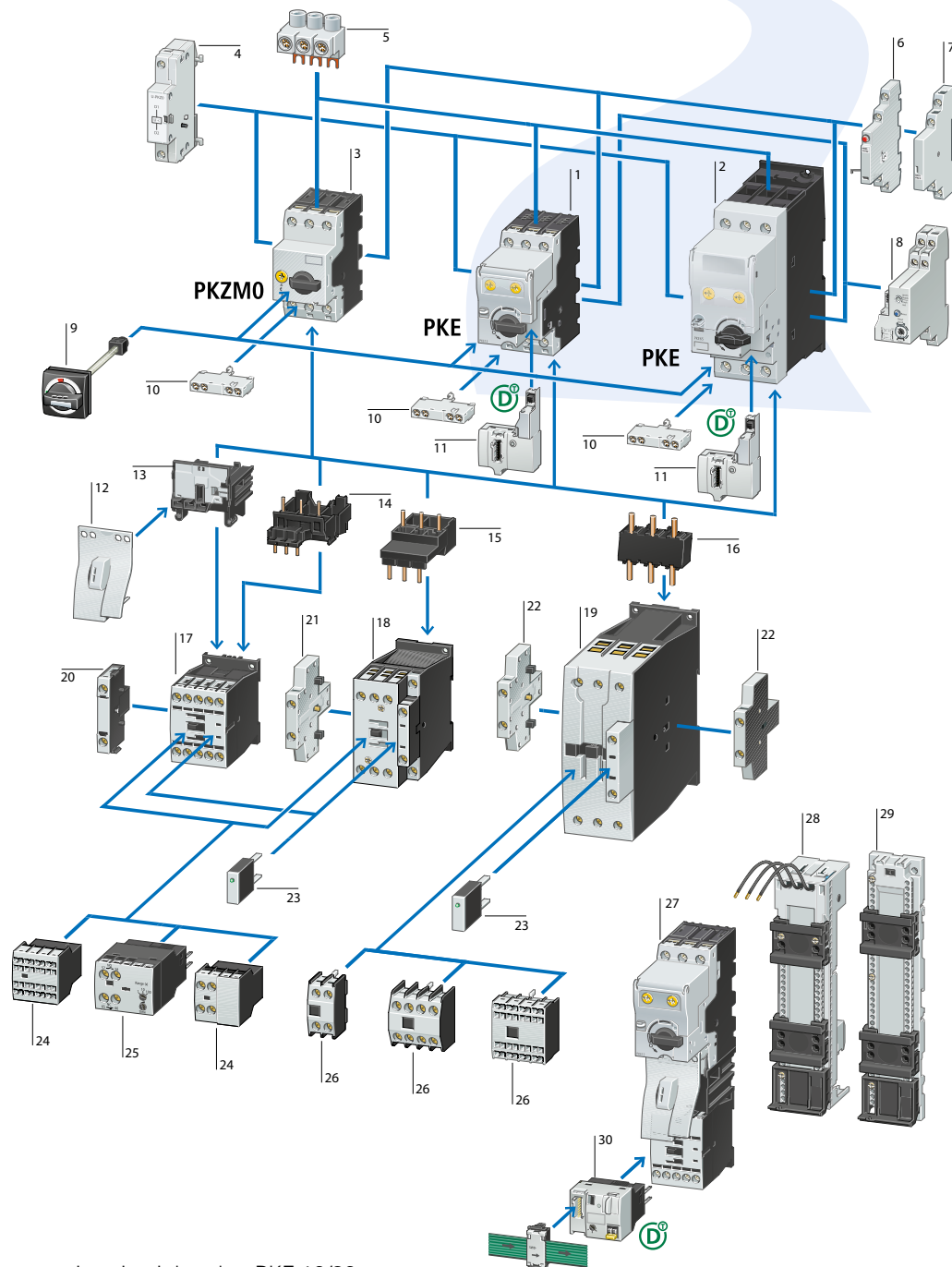
* solidly grounded system Status: April 2016

UL 508 Type E and UL 508 Type F controllers see on page 16 and 17.

Maximum short circuit current rating and sizing of back-up overcurrent protective fuses and circuit breakers in group installations per NEC, Article 430-53 and CEC Part 1, Rule 28-206. PKZM0 with and without CL-PKZM0 current limiter.

Group Protection and Tap Conductor Protection Ratings PKE

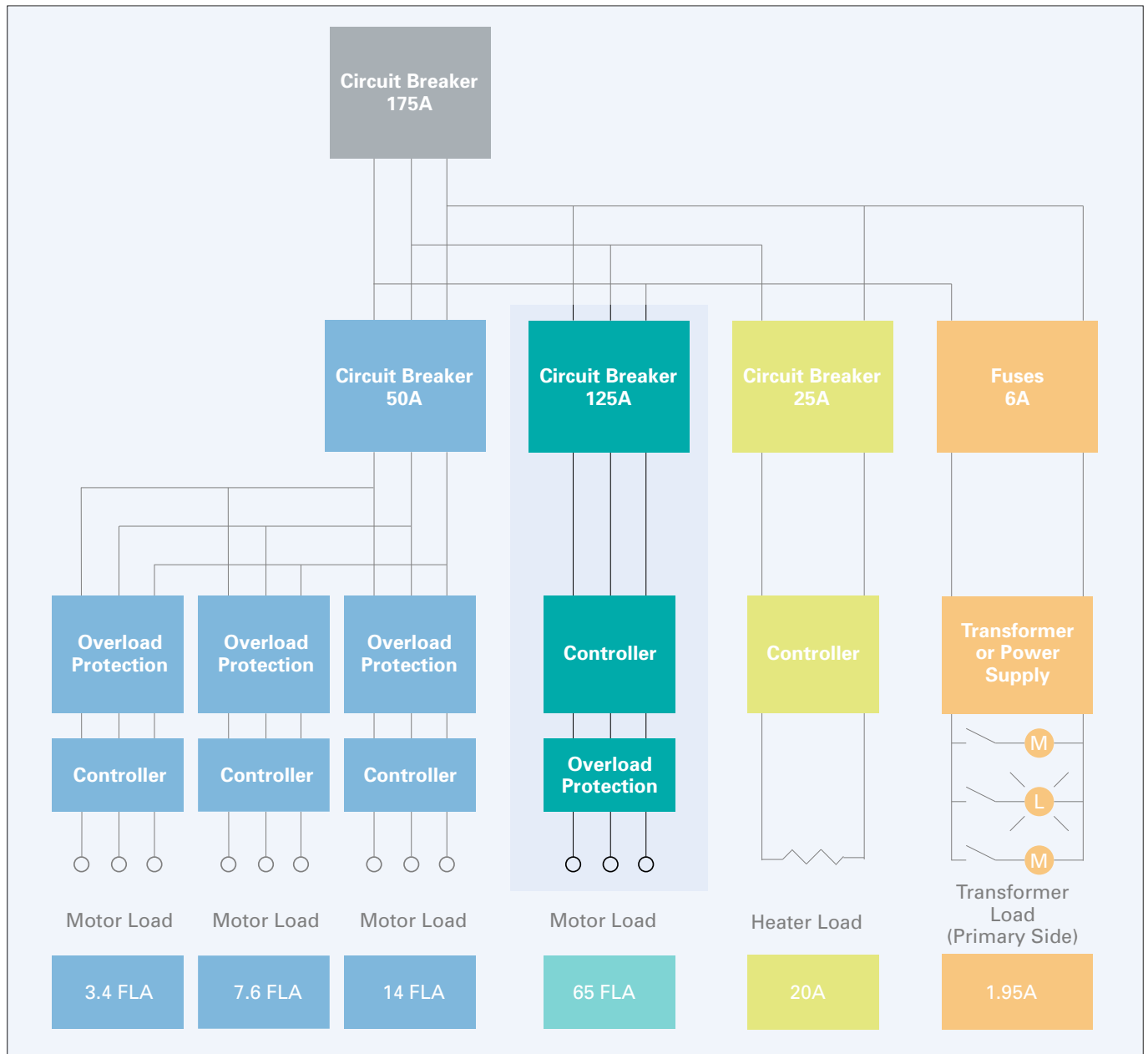
	Maximum motor rating Three-phase current				Setting Ranges overload release	Short-Circuit Current Rating (SCCR)			Group Protection and Tap Conductor Protection Fuse	Manual Motor Protector Part no.
	200V HP	230V HP	460V HP	575V HP		240V kA	480V kA	600V kA		
			½	½	0.3 – 1.2	100	100	100	100A Class J	PKE12/XTU(A)-1,2
	¾	¾	2	3	1 – 4	100	100	100	100A Class J	PKE12/XTU(A)-4
	3	3	7½	10	3 – 12	100	100	100	100A Class J	PKE12/XTU(A)-12
	5	7½	15	20	8 – 32	100	100	100	100A Class J	PKE32/XTU(A)-32
	7½	7½	20	25	8 – 32	100	100	100	200A Class J	PKE65/XTU(A)W-32
	15	15	40	40	16 – 65	100	100	100	200A Class J	PKE65/XTU(A)-65



- | | | | |
|----|---|----|---|
| 1 | Motor-protective circuit breaker PKE 12/32 | 17 | Contactor up to 15 A |
| 2 | Motor-protective circuit breaker PKE 65 | 18 | Contactor up to 38 A |
| 3 | Motor-protective circuit breaker PKZM01 | 19 | Contactor up to 65 A |
| 4 | Undervoltage release/shunt release | 20 | Side mounted auxiliary contact |
| 5 | Feeder terminal block | 21 | Side mounted auxiliary contact |
| 6 | Trip-indicating auxiliary contact | 22 | Side mounted auxiliary contact |
| 7 | Side mounted auxiliary contact | 23 | Suppressor |
| 8 | PKE-XZMR electronic overload relay module | 24 | Surface mounted auxiliary contact |
| 9 | Door-coupling rotary handle and shaft extension | 25 | Electronic timer |
| 10 | Front mounted auxiliary contact | 26 | Surface mounted auxiliary contact |
| 11 | SmartWire-DT communication interface for PKE | 27 | DOL starter MSC-DEA up to 5.5 kW with PKE |
| 12 | Combination plug-in connector | 28 | Busbar adapter |
| 13 | Mechanical plug-in connector | 29 | DIN rail adapter plate |
| 14 | Motor starter link | 30 | SmartWire-DT PKE module |
| 15 | Electrical plug-in connector | | |
| 16 | Electrical plug-in connector | | |

Individual circuit for motor load

Reference to UL 508A Section 31.3, 33.2, 34.2, 66.8



Individual Circuit for Motor Load

There are several ways to build a branch circuit for a motor load. Each method provides short-circuit protection, motor overload protection, and the ability to start and stop the motor. Some additionally provide a means to disconnect the branch circuit for maintenance and safety purposes.

UL 508 Type F Combination Motor Controllers (CMCs) (manual motor protector + contactor + line-side adapter) provide the most efficient means to build a branch circuit for a motor. CMCs are designed for motor loads such that they do not need to be oversized (as breakers and fuses are) to prevent tripping during motor startup. CMCs not only take up less space, but also install more quickly.



UL 508

Individual Circuit for
Motor Load

2-Component Combination Motor Controller Solutions for North America



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Motors are by far the most important pieces of equipment in the machine tool and panel building industry. There are essentially 2 traditional approaches involved in switching and protecting such motors. One uses fuses as the primary overcurrent protective device. The other is fuseless, and relies on motor protective switches or circuit breakers as the core protective element.

In the IEC world, the choice between a motor protective switch or a circuit breaker can often be made simply on the basis of a motor's nominal current rating. In North America, both types of components fall under markedly different product standards (UL 508 resp. UL 489, or CSA-C22.2 No.14 resp. CSA-C22.2 No. 5-09), which ultimately also impacts the application range of both components when they are used as protective devices in branch circuits.

Branch Circuit Protection: PKZM0(4), UL 508 Type E “Manual self-protected combination motor controllers”

Maximum Motor HP Rating 3 Phase, 60Hz				Trip settings		Short Circuit Current Rating (SCCR)			Components	
200 V 208 V (HP)	230 V 240 V (HP)	460V 480 V (HP)	575 V 600 V (HP)	Adjustable thermal (A)	Instantaneous Trip, Fixed (A)	240 V (kA)	480Y/277 V ²⁾ (kA)	600Y/347V ²⁾ (kA)	Motor Protector Part no.	Accessories Part no.
1)				0.1 - 0.16	2.5	65	65	50	PKZM0-0,16 (-SPI...)	BK25/3-PKZ0-E
				0.16 - 0.25	3.9	65	65	50	PKZM0-0,25 (-SPI...)	BK25/3-PKZ0-E
				0.25 - 0.4	6.2	65	65	50	PKZM0-0,4 (-SPI...)	BK25/3-PKZ0-E
				0.4 - 0.63	9.8	65	65	50	PKZM0-0,63 (-SPI...)	BK25/3-PKZ0-E
				0.63 - 1	16	65	65	50	PKZM0-1 (-SPI...)	BK25/3-PKZ0-E
				1 - 1.6	25	65	65	50	PKZM0-1,6 (-SPI...)	BK25/3-PKZ0-E
½	½	1	1 ½	1.6 - 2.5	39	65	65	50	PKZM0-2,5 (-SPI...)	BK25/3-PKZ0-E
¾	¾	2	3	2.5 - 4	62	65	65	50	PKZM0-4 (-SPI...)	BK25/3-PKZ0-E
1 ½	1 ½	3	5	4 - 6.3	98	65	65	50	PKZM0-6,3 (-SPI...)	BK25/3-PKZ0-E
2	3	5	7 ½	6.3 - 11	155	65	65	50	PKZM0-10 (-SPI...)	BK25/3-PKZ0-E
3	3	7 ½	10	9 - 12	186	65	65	-	PKZM0-12 (-SPI...)	BK25/3-PKZ0-E
3	5	10	10	10 - 16	248	65	65	25	PKZM4-16	BK50/3-PKZ4-E
5	7 ½	15	20	16 - 27	388	65	65	25	PKZM4-25	BK50/3-PKZ4-E
7 ½	10	20	30	24 - 34	496	65	65	25	PKZM4-32	BK50/3-PKZ4-E
10	-	30	30	32 - 40	620	65	65	25	PKZM4-40	BK50/3-PKZ4-E
-	15	30	-	40 - 52	775	65	65	-	PKZM4-50	BK50/3-PKZ4-E
-	-	40	-	50 - 56	899	65	65	-	PKZM4-58	BK50/3-PKZ4-E
-	-	40	-	52 - 58	977	65	65	-	PKZM4-63	BK50/3-PKZ4-E
1)				0.1 - 0.16	2.5	65	65	50	PKZM0-0,16-PI...	LSA-PKZ0-E-PI
				0.16 - 0.25	3.9	65	65	50	PKZM0-0,25-PI...	LSA-PKZ0-E-PI
				0.25 - 0.4	6.2	65	65	50	PKZM0-0,4-PI...	LSA-PKZ0-E-PI
				0.4 - 0.63	9.8	65	65	50	PKZM0-0,63-PI...	LSA-PKZ0-E-PI
				0.63 - 1	16	65	65	50	PKZM0-1-PI...	LSA-PKZ0-E-PI
				1 - 1.6	25	65	65	50	PKZM0-1,6-PI...	LSA-PKZ0-E-PI
½	½	1	1 ½	1.6 - 2.5	39	65	65	50	PKZM0-2,5-PI...	LSA-PKZ0-E-PI
¾	¾	2	3	2.5 - 4	62	65	65	50	PKZM0-4-PI...	LSA-PKZ0-E-PI
1 ½	1 ½	3	5	4 - 6.3	98	65	65	50	PKZM0-6,3-PI...	LSA-PKZ0-E-PI
2	3	5	7 ½	6.3 - 11	155	65	65	50	PKZM0-10-PI...	LSA-PKZ0-E-PI
3	3	7 ½	10	9 - 12	186	65	65	-	PKZM0-12-PI...	LSA-PKZ0-E-PI

1) In this range, select devices per motor full load current. Refer to NEC Table 430-250.

2) Solidly grounded power distribution system.

Status: May 2023

UL 508 Type E “Manual self-protected combination motor controllers”



Branch Circuit Protection: PKZM0(4), “UL 508 Type F Combination Motor Controllers”

Maximum Motor HP Rating 3 Phase, 60Hz				Trip settings		Short Circuit Current Rating (SCCR)			Components		
200 V 208 V (HP)	230 V 240 V (HP)	460 V 480 V (HP)	575 HP 600 V (HP)	Adjustable thermal (A)	Instantaneous trip, fixed (A)	240 V (kA)	480 V/ 277 V ²⁾ (kA)	600 V/ 347 V ²⁾ (kA)	Motor Protector Part no.	Supply Terminal ³⁾ Part no.	Contactor Part no.
1)				0.1 - 0.16	2.5	65	65	50	PKZM0-0,16 (-SPI(16 / 32))	BK25/3-PKZ0-E	DILEM
				0.16-0.25	3.9	65	65	50	PKZM0-0,25 (-SPI(16 / 32))	BK25/3-PKZ0-E	DILEM
				0.25 - 0.4	6.2	65	65	50	PKZM0-0,4 (-SPI(16 / 32))	BK25/3-PKZ0-E	DILEM
				0.4 - 0.63	9.8	65	65	50	PKZM0-0,63 (-SPI(16 / 32))	BK25/3-PKZ0-E	DILEM
				0.63 - 1	16	65	65	50	PKZM0-1 (-SPI(16 / 32))	BK25/3-PKZ0-E	DILEM
				1 - 1.6	25	65	65	50	PKZM0-1,6 (-SPI(16 / 32))	BK25/3-PKZ0-E	DILEM
½	½	1	1 ½	1.6 - 2.5	39	65	65	50	PKZM0-2,5 (-SPI(16 / 32))	BK25/3-PKZ0-E	DILEM
¾	¾	2	3	2.5 - 4	62	65	65	50	PKZM0-4 (-SPI(16 / 32))	BK25/3-PKZ0-E	DILEM
1	1 ½	3	5	4 - 6.3	98	65	65	50	PKZM0-6,3 (-SPI(16 / 32))	BK25/3-PKZ0-E	DILEM
2	3	5	7 ½	6.3 - 11	155	65	65	50	PKZM0-10 (-SPI(16 / 32))	BK25/3-PKZ0-E	DILEM
1)				-	0.1 - 0.16	65	65	18	PKZM0-0,16 (-SPI(16 / 32))	BK25/3-PKZ0-E	DILM7
				-	0.16 - 0.25	65	65	18	PKZM0-0,25 (-SPI(16 / 32))	BK25/3-PKZ0-E	DILM7
				-	0.25 - 0.4	65	65	18	PKZM0-0,4 (-SPI(16 / 32))	BK25/3-PKZ0-E	DILM7
				-	0.4 - 0.63	65	65	18	PKZM0-0,63 (-SPI(16 / 32))	BK25/3-PKZ0-E	DILM7
				-	0.63 - 1	65	65	18	PKZM0-1 (-SPI(16 / 32))	BK25/3-PKZ0-E	DILM7
				1 - 1.6	25	65	65	18	PKZM0-1,6 (-SPI(16 / 32))	BK25/3-PKZ0-E	DILM7
½	½	1	1 ½	1.6 - 2.5	39	65	65	18	PKZM0-2,5 (-SPI(16 / 32))	BK25/3-PKZ0-E	DILM7
¾	¾	2	3	2.5 - 4	62	65	65	18	PKZM0-4 (-SPI(16 / 32))	BK25/3-PKZ0-E	DILM7
1	1 ½	3	5	4 - 6.3	98	65	65	18	PKZM0-6,3 (-SPI(16 / 32))	BK25/3-PKZ0-E	DILM7
2	3	5	7 ½	6.3 - 11	155	65	65	18	PKZM0-10 (-SPI(16 / 32))	BK25/3-PKZ0-E	DILM12
3	3	7 ½	10	9 - 12	186	50	50	-	PKZM0-12 (-SPI(16 / 32))	BK25/3-PKZ0-E	DILM12
3	5	10	10	10 - 16	248	65	65	30	PKZM4-16	BK50/3-PKZ4-E	DILM17
5	7 ½	15	20	16 - 25	388	65	65	30	PKZM4-25	BK50/3-PKZ4-E	DILM25
7 ½	10	20	30	25 - 32	496	65	65	50	PKZM4-32	BK50/3-PKZ4-E	DILM32
10	-	30	30	32 - 40	620	65	65	50	PKZM4-40	BK50/3-PKZ4-E	DILM40
-	15	30	-	40 - 52	775	65	65	-	PKZM4-50	BK50/3-PKZ4-E	DILM50
-	-	40	-	50 - 56	899	65	65	-	PKZM4-58	BK50/3-PKZ4-E	DILM65
-	-	40	-	52 - 58	977	65	65	-	PKZM4-63	BK50/3-PKZ4-E	DILM65
1)				-	0.1 - 0.16	65	65	18	PKZM0-0,16-PI	LSA-PKZ0-E-PI	DILM7
				-	0.16-0.25	65	65	18	PKZM0-0,25-PI	LSA-PKZ0-E-PI	DILM7
				-	0.25 - 0.4	65	65	18	PKZM0-0,4-PI	LSA-PKZ0-E-PI	DILM7
				-	0.4 - 0.63	65	65	18	PKZM0-0,63-PI	LSA-PKZ0-E-PI	DILM7
				-	0.63 - 1	65	65	18	PKZM0-1-PI	LSA-PKZ0-E-PI	DILM7
				1 - 1.6	25	65	65	18	PKZM0-1,6-PI	LSA-PKZ0-E-PI	DILM7
½	½	1	1 ½	1.6 - 2.5	39	65	65	18	PKZM0-2,5-PI	LSA-PKZ0-E-PI	DILM7
¾	¾	2	3	2.5 - 4	62	65	65	18	PKZM0-4-PI	LSA-PKZ0-E-PI	DILM7
1 ½	1 ½	3	5	4 - 6.3	98	65	65	18	PKZM0-6,3-PI	LSA-PKZ0-E-PI	DILM7
2	3	5	7 ½	6.3 - 11	155	65	65	18	PKZM0-10-PI	LSA-PKZ0-E-PI	DILM12
3	3	7 ½	10	9 - 12	186	65	65	-	PKZM0-12-PI	LSA-PKZ0-E-PI	DILM12

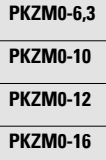
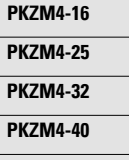
1) In this range, select devices per motor full load current. Refer to NEC Table 430-250.

2) Solidly grounded power distribution system.

3) Alternative use of LSA-PKZ0-E instead of BK25/3-PKZ0-E for PKZM0 device without -PI / -SPI(16/32), alternative use of HB-PKZ4-CB instead of BK50/3-PKZ4-E for PKZM4 devices

Status: May 2023

Branch Circuit Protection “Type E Combination Motor Controller”

				Short Circuit Current Rating (SCCR) 480Y/277V kA			Part no. for Field Assembly			
460V HP	460V FLA	Motor Current Adjust Range (A)			MMP		Contactor			
										
---	0.16	0.1 ... 0.16	65					PKZM0-0,16	---	DILM7..15-..
---	0.25	0.16 ... 0.25						PKZM0-0,25	---	DILM7..15-..
---	0.40	0.25 ... 0.40						PKZM0-0,4	---	DILM7..15-..
---	0.63	0.40 ... 0.63						PKZM0-0,63	---	DILM7..15-..
---	1.0	0.63 ... 1.0						PKZM0-1	---	DILM7..15-..
3/4	1.6	1.0 ... 1.6						PKZM0-1,6	---	DILM7..15-..
1	2.5	1.6 ... 2.5						PKZM0-2,5	---	DILM7..15-..
2	3.4	2.5 ... 4.0						PKZM0-4	---	DILM7..15-..
										
3	4.8	4.0 ... 6.3	65					PKZM0-6,3	---	---
7 1/2	11	6.3 ... 10						PKZM0-10	---	---
7 1/2	11	9.0 ... 12						PKZM0-12	---	---
10	14	10 ... 16						PKZM0-16	---	---
15	21.0	20 ... 25						PKZM0-25	---	---
										
10	14	10 ... 16	65					---	PKZM4-16	---
15	21	16 ... 25						---	PKZM4-25	---
20	27	25 ... 32						---	PKZM4-32	---
30	40	32 ... 40						---	PKZM4-40	---
30	40	40 ... 50						---	PKZM4-50	---
40	52	50 ... 58						---	PKZM4-58	---

Branch Circuit Protection; MSC-DE-...-M...-SP, “Type E Combination Motor Controller”

Maximum motor rating Three-phase current				Setting Ranges overload release A	Rated short-circuit breaking capacity			Combination Motor Starter
200V HP	230V HP	460V HP	575V HP		240V kA	480Y/277V kA	600Y/347V kA	
		1/2	1/2	0.3–1.2	14	14	14	MSC-DE-1,2-M17-SP(...)
3/4	3/4	2	-	1–4	18	18	-	MSC-DE-4-M17-SP(...)
3	3	7 1/2	-	3–12	18	18	-	MSC-DE-12-M17-SP(...)
5	7 1/2	15	-	8–32	18	18	-	MSC-DE-32-M32-SP(...)

MSC-DE-...-M...-SP, Type E Combination Motor Controller with PKE

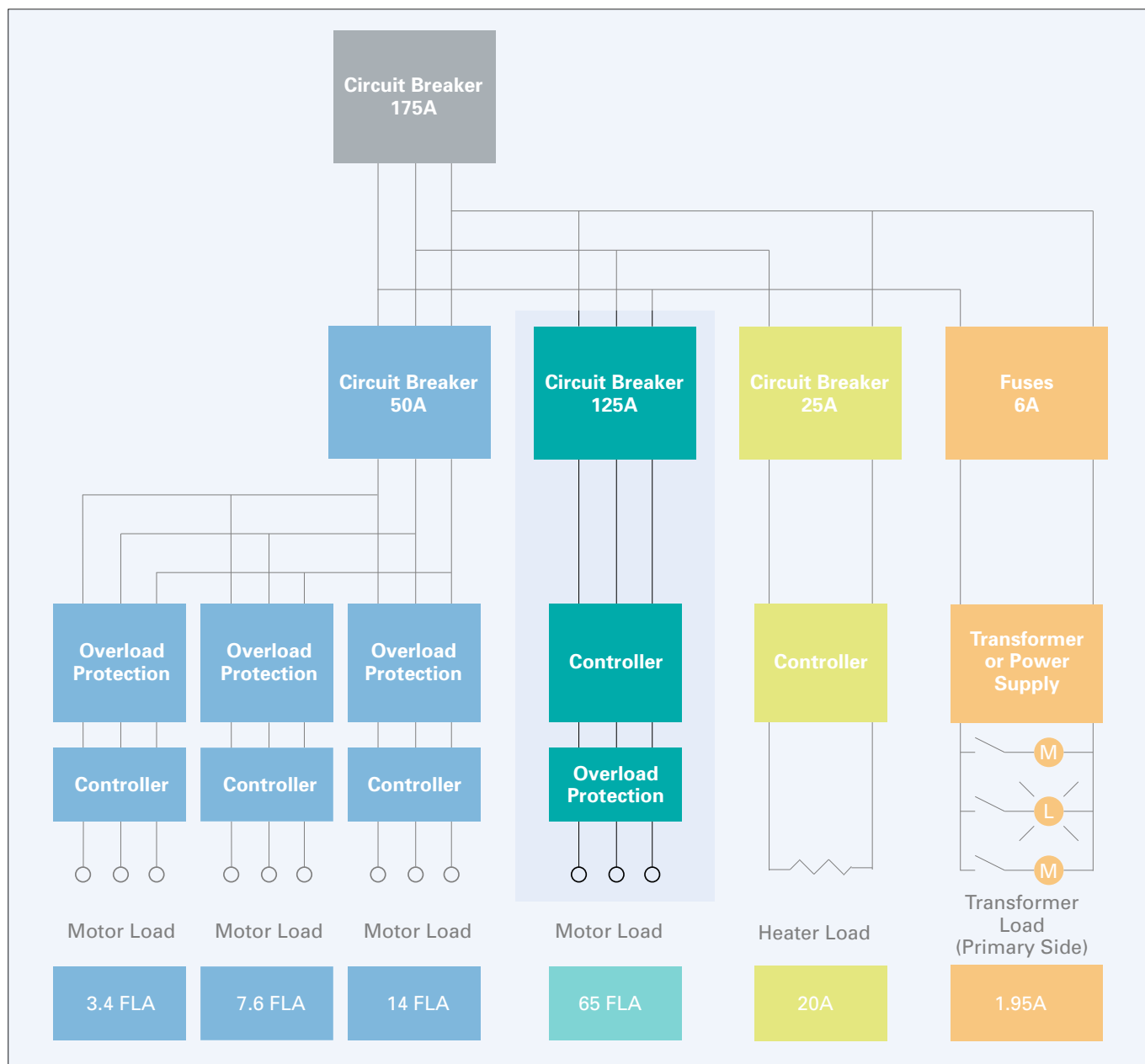
		Terminal Adapter	Terminal Adapter	Connection Module (optional)	Connection Module (optional)	Lockable handle (optional)
						
---	---	BK25/3-PKZ0-E	LSA-PKZ0-E	PKZM0-XDM15ME	PKZM0-XDM12	AK-PKZ0
---	---	BK25/3-PKZ0-E	LSA-PKZ0-E	PKZM0-XDM15ME	PKZM0-XDM12	AK-PKZ0
---	---	BK25/3-PKZ0-E	LSA-PKZ0-E	PKZM0-XDM15ME	PKZM0-XDM12	AK-PKZ0
---	---	BK25/3-PKZ0-E	LSA-PKZ0-E	PKZM0-XDM15ME	PKZM0-XDM12	AK-PKZ0
---	---	BK25/3-PKZ0-E	LSA-PKZ0-E	PKZM0-XDM15ME	PKZM0-XDM12	AK-PKZ0
---	---	BK25/3-PKZ0-E	LSA-PKZ0-E	PKZM0-XDM15ME	PKZM0-XDM12	AK-PKZ0
---	---	BK25/3-PKZ0-E	LSA-PKZ0-E	PKZM0-XDM15ME	PKZM0-XDM12	AK-PKZ0
---	---	BK25/3-PKZ0-E	LSA-PKZ0-E	PKZM0-XDM15ME	PKZM0-XDM12	AK-PKZ0
DILM17..32-..	---	BK25/3-PKZ0-E	LSA-PKZ0-E	PKZM0-XDM32ME	---	AK-PKZ0
DILM17..32-..	---	BK25/3-PKZ0-E	LSA-PKZ0-E	PKZM0-XDM32ME	---	AK-PKZ0
DILM17..32-..	---	BK25/3-PKZ0-E	LSA-PKZ0-E	PKZM0-XDM32ME	---	AK-PKZ0
DILM17..32-..	---	BK25/3-PKZ0-E	LSA-PKZ0-E	PKZM0-XDM32ME	---	AK-PKZ0
DILM17..32-..	---	BK25/3-PKZ0-E	LSA-PKZ0-E	PKZM0-XDM32ME	---	AK-PKZ0
---	DILM40..65-..	BK50/3-PKZ4-E	HB-PKZ4	PKZM4-XM65	---	AK-PKZ0
---	DILM40..65-..	BK50/3-PKZ4-E	HB-PKZ4	PKZM4-XDM65	---	AK-PKZ0
---	DILM40..65-..	BK50/3-PKZ4-E	HB-PKZ4	PKZM4-XDM65	---	AK-PKZ0
---	DILM40..65-..	BK50/3-PKZ4-E	HB-PKZ4	PKZM4-XDM65	---	AK-PKZ0
---	DILM40..65-..	BK50/3-PKZ4-E	HB-PKZ4	PKZM4-XDM65	---	AK-PKZ0
---	DILM40..65-..	BK50/3-PKZ4-E	HB-PKZ4	PKZM4-XM65	---	AK-PKZ0

Branch Circuit Protection: UL 489 Circuit Breaker with UL 508 Motor Protection Calibration

$I_n = I_u$ (A)	Setting Range		Projected Max. HP Ratings		Breaker with Normal Interrupting rating Part no.	Breaker with High Interrupting rating Part no.	Suitable magnetic contactors Part no.
	Overload Trip* I_r (A)	Instantaneous short circuit trip I_i (A)	I_i	460 V 480 V HP	SCCR	SCCR	
90	45-90	90-1260	$2 \dots 14 \times I_n$	60	85 kA 240 V 35 kA 480 V	150 kA 240 V 100 kA 480 V	DILM80 DILM95
140	70-140	140-1960	$2 \dots 14 \times I_n$	100	NZMN2-ME140-NA	NZMH2-ME140-NA	DILM115 DILM150
200	100-200	200-2800	$2 \dots 14 \times I_n$	150	NZMN2-ME200-NA	NZMH2-ME200-NA	DILM185A DILM225A

Individual circuit for motor load

Reference to UL 508A Section 31.3.2, 33.1.2, 34.1.2



Individual Circuit for Motor Load

A variable speed drive must meet the requirements of the standard for power conversion equipment. Branch circuit protection for a single-motor circuit equipped with a variable-speed drive shall be of the type and size specified in the

manufacturer's instructions supplied with the drive. Power conversion devices that have a solid-state motor overload protection function shall comply with the requirements of the Standard for Power Conversion Devices.



SCCR values of controllers and switchgear with variable frequency drives



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The Eaton variable frequency drives DE1, DC1, DA1, DM1 and DG1 are UL certified. They meet all international requirements and standards of the IEC. For a UL-compliant machine control, not only UL-approved products have to be used, the interaction of the devices according to the respective standards in the actual application is decisive.

In North America, an "Industrial Control Panel" must be marked with the short circuit current rating (SCCR). The lowest SCCR value of the installed components determines the value of the entire control panel. For assigned motor powers up to 50 HP (37.3 kW), this standard SCCR value of variable frequency drives is only 5 kA, and thus they can reduce the short-circuit level of the entire control system to 5 kA. By using a current-limiting fuse or by using so-called "High Fault Short Circuit Values" with tested Branch Circuit Protective Devices, the SCCR of the inverter in the branch circuit can be increased.

Branch circuit protection for variable speed starter

 DE1/DE11	Nominal input current A	Part no.	Branch Circuit Protection AWG wiring required Molded Case Circuit Breaker				
			1 pole: 277 V AC	2 poles: 480 Y/277 V AC	SCCR	Fuse	SCCR
					kA		kA
	3.6	DE1-121D4...	FAZ-B10/1-NA	FAZ-B10/2-NA	10	LPJ-10SP	100
	6.2	DE1-122D3...	FAZ-B10/1-NA	FAZ-B10/2-NA	10	LPJ-10SP	100
	7.3	DE1-122D7...	FAZ-B10/1-NA	FAZ-B10/2-NA	10	LPJ-10SP	100
	11.3	DE1-124D3...	FAZ-B15/1-NA	FAZ-B15/2-NA	14	LPJ-15SP	100
	17.4	DE1-127D0...	FAZ-B20/1-NA	FAZ-B20/2-NA	14	LPJ-20SP	100
	23.2	DE1-129D6...	FAZ-B30/1-NA	FAZ-B30/2-NA	10	LPJ-30SP	100
	3.6	DE11-121D4...	FAZ-B10/1-NA	FAZ-B10/2-NA	10	LPJ-10SP	100
	6.2	DE11-122D3...	FAZ-B10/1-NA	FAZ-B10/2-NA	10	LPJ-10SP	100
	7.3	DE11-122D7...	FAZ-B10/1-NA	FAZ-B10/2-NA	10	LPJ-10SP	100
	11.3	DE11-124D3...	FAZ-B15/1-NA	FAZ-B15/2-NA	14	LPJ-15SP	100
	17.4	DE11-127D0...	FAZ-B20/1-NA	FAZ-B20/2-NA	14	LPJ-20SP	100
	23.2	DE11-129D6...	FAZ-B30/1-NA	FAZ-B30/2-NA	10	LPJ-30SP	100

 DE1/DE11	A	Part no.	Branch Circuit Protection	SCCR	Branch- and Group-Protection	SCCR	Fuse	SCCR
			Combination Motor Controller Type E		Molded Case Circuit Breaker			
			3 poles: 480 Y/277 V AC		3 poles: 480 Y/277 V AC			
				kA		kA		kA
	1.7	DE1-341D3...	PKZM0-6,3+BK25/3-PKZ0-E+AK-PKZ0	65	FAZ-B6/3-NA	10	LPJ-6SP	100
	3.1	DE1-342D1...	PKZM0-6,3+BK25/3-PKZ0-E+AK-PKZ0	65	FAZ-B6/3-NA	10	LPJ-6SP	100
	4.9	DE1-343D6...	PKZM0-6,3+BK25/3-PKZ0-E+AK-PKZ0	65	FAZ-B6/3-NA	10	LPJ-6SP	100
	7	DE1-345D0...	PKZM0-10+BK25/3-PKZ0-E+AK-PKZ0	65	FAZ-B10/3-NA	10	LPJ-10SP	100
	8.5	DE1-346D6...		42	FAZ-B15/3-NA	14	LPJ-15SP	100
	10	DE1-348D5...		42	FAZ-B15/3-NA	14	LPJ-15SP	100
	12	DE1-34011...		42	FAZ-B15/3-NA	14	LPJ-15SP	100
	16.5	DE1-34016...		18	FAZ-B25/3-NA	14	LPJ-25SP	100
	1.7	DE11-341D3...	PKZM0-6,3+BK25/3-PKZ0-E+AK-PKZ0	65	FAZ-B6/3-NA	10	LPJ-6SP	100
	3.1	DE11-342D1...	PKZM0-6,3+BK25/3-PKZ0-E+AK-PKZ0	65	FAZ-B6/3-NA	10	LPJ-6SP	100
	4.9	DE11-343D6...	PKZM0-6,3+BK25/3-PKZ0-E+AK-PKZ0	65	FAZ-B6/3-NA	10	LPJ-6SP	100
	7	DE11-345D0...	PKZM0-10+BK25/3-PKZ0-E+AK-PKZ0	65	FAZ-B10/3-NA	10	LPJ-10SP	100
	8.5	DE11-346D6...		42	FAZ-B15/3-NA	14	LPJ-15SP	100
	10	DE11-348D5...		42	FAZ-B15/3-NA	14	LPJ-15SP	100
	12	DE11-34011...		42	FAZ-B15/3-NA	14	LPJ-15SP	100
	16.5	DE11-34016...		18	FAZ-B25/3-NA	14	LPJ-25SP	100

Branch Circuit Protection for drive circuits

Nominal Input Current	Part no.	FS	Supply Voltage	Nominal Supply Voltage	Branch Circuit Protection fuses	Fuse (Type J)	Fuse holders for LPJ fuse
(without Main choke, CT, 50 °C)			(50 (-5 %) - 60 (+5 %) Hz)		UL	(UL: SCCR: 100 kA)	
A			V	V	A	A	
Input Phase 1							
7.8	DC1-1D2D3...	1	110 (-10 %) - 115 (+10 %)	110	10	LPJ-10SP	CH30J...
15.8	DC1-1D4D3...	1			25	LPJ-25SP	CH30J...
21.9	DC1-1D5D8...	2			30	LPJ-30SP	CH30J...
3.7	DC1-122D3...	1	200 (-10 %) - 240 (+10 %)	230	6	LPJ-6SP	CH30J...
7.5	DC1-124D3...	1			10	LPJ-10SP	CH30J...
12.9	DC1-127D0...	1			17.5	LPJ-17-1-2SP	CH30J...
12.9	DC1-127D0...	2			17.5	LPJ-17-1-2SP	CH30J...
19.2	DC1-12011...	2			25	LPJ-25SP	CH30J...
29.2	DC1-12015...	3			40	LPJ-40SP	CH60J...
Input Phase 3							
3.4	DC1-322D3...	1	200 (-10 %) - 240 (+10 %)	230	6	LPJ-6SP	CH30J...
5.6	DC1-324D3...	1			10	LPJ-10SP	CH30J...
9.5	DC1-327D0...	1			15	LPJ-15SP	CH30J...
9.5	DC1-327D0...	2			15	LPJ-15SP	CH30J...
12.1	DC1-32011...	2			17.5	LPJ-17-1-2SP	CH30J...
20.9	DC1-32018...	3			30	LPJ-30SP	CH30J...
26.4	DC1-32024...	3			35	LPJ-35SP	CH60J...
33.3	DC1-32030...	4			45	LPJ-45SP	CH60J...
50.1	DC1-32046...	4			70	LPJ-70SP	JM60100-...
3.5	DC1-342D2...	1	380 (-10 %) - 480 (+10 %)	400/460	6	LPJ-6SP	CH30J...
5.6	DC1-344D1...	1			10	LPJ-10SP	CH30J...
5.6	DC1-344D1...	2			10	LPJ-10SP	CH30J...
7.5	DC1-345D8...	2			10	LPJ-10SP	CH30J...
11.2	DC1-349D5...	2			15	LPJ-15SP	CH30J...
17.2	DC1-34014...	2			25	LPJ-25SP	CH30J...
21.2	DC1-34018...	3			30	LPJ-30SP	CH30J...
27.5	DC1-34024...	3			35	LPJ-35SP	CH60J...
34.2	DC1-34030...	4			45	LPJ-45SP	CH60J...
44.1	DC1-34039...	4			60	LPJ-60SP	CH60J...
51.9	DC1-34046...	4			70	LPJ-70SP	JM60100-...
Input Phase 1							
8.6	DA1-124D3...	2	200 (-10 %) - 240 (+10 %)	230	15	LPJ-15SP	CH30J...
12.9	DA1-127D0...	2			20	LPJ-20SP	CH30J...
19.2	DA1-12011...	2			25	LPJ-25SP	CH30J...
Input Phase 3							
5.7	DA1-324D3...	2	200 (-10 %) - 240 (+10 %)	230	10	LPJ-10SP	CH30J...
10.5	DA1-327D0...	2			15	LPJ-15SP	CH30J...
13.2	DA1-32011...	2			17.5	LPJ-17-1-2SP	CH30J...
20.9	DA1-32018...	3			30	LPJ-30SP	CH30J...
26.4	DA1-32024...	3			40	LPJ-40SP	CH60J...
26.9	DA1-32024...	4			40	LPJ-40SP	CH60J...
33.3	DA1-32030...	4			50	LPJ-50SP	CH60J...
50.1	DA1-32046...	4			70	LPJ-70SP	JM60100-...
63.9	DA1-32061...	5			90	LPJ-90SP	JM60100-...
74	DA1-32072...	5			110	LPJ-110SP	JM60200-...
99.1	DA1-32090...	6			150	LPJ-150SP	JM60200-...
121	DA1-32110...	6			175	LPJ-175SP	JM60200-...
159.7	DA1-32150...	6			225	LPJ-225SP	JM60400-...
187.5	DA1-32180...	6			250	LPJ-250SP	JM60400-...
206.5	DA1-32202...	7			300	LPJ-300SP	JM60400-...
255.5	DA1-32248...	7			350	LPJ-350SP	JM60400-...



DC1



DA1

Branch Circuit Protection for drive circuits

Nominal Input Current	Part no.	FS	Supply Voltage	Nominal Supply Voltage	Branch Circuit Protection fuses	Fuse (Type J)	Fuse holders for LPJ fuse
(without Main choke, CT, 50 °C)			(50 (-5 %) - 60 (+5 %) Hz)		UL	(UL: SCCR: 100 kA)	
A			V	V	A	A	
Input Phase 3							
3.5	DA1-342D2....	2	380 (-10 %) - 480 (+10 %)	400/460	6	LPJ-6SP	CH30J...
5.6	DA1-344D1...	2			10	LPJ-10SP	CH30J...
7.5	DA1-345D8...	2			10	LPJ-10SP	CH30J...
11.5	DA1-349D5...	2			15	LPJ-15SP	CH30J...
17.2	DA1-34014...	3			25	LPJ-25SP	CH30J...
21.8	DA1-34018...	3			30	LPJ-30SP	CH30J...
28	DA1-34024...	3			40	LPJ-40SP	CH60J...
28	DA1-34024...	4			40	LPJ-40SP	CH60J...
34.2	DA1-34030...	4			50	LPJ-50SP	CH60J...
44.1	DA1-34039...	4			60	LPJ-60SP	CH60J...
51.9	DA1-34046...	4			70	LPJ-70SP	JM60100-...
66.1	DA1-34061...	5			80	LPJ-80SP	JM60100-...
77.3	DA1-34072...	5			100	LPJ-100SP	JM60100-...
102.7	DA1-34090...	6			125	LPJ-125SP	JM60200-...
126.4	DA1-34110...	6			150	LPJ-150SP	JM60200-...
164.7	DA1-34150...	6			200	LPJ-200SP	JM60200-...
192.1	DA1-34180...	6			250	LPJ-250SP	JM60400-...
210.8	DA1-34202...	7			300	LPJ-300SP	JM60400-...
244.5	DA1-34240...	7			350	LPJ-350SP	JM60400-...
307.8	DA1-34302...	7			400	LPJ-400SP	JM60400-...
377.2	DA1-34370...	8			500	LPJ-500SP	JM60600-...
458.7	DA1-34450...	8			600	LPJ-600SP	JM60600-...
3.4	DA1-352D1...	2	500 (-10 %) - 600 (+10 %)	500/575	6	LPJ-6SP	CH30J...
4.2	DA1-353D1...	2			6	LPJ-6SP	CH30J...
4.9	DA1-354D1...	2			10	LPJ-10SP	CH30J...
8.6	DA1-356D5...	2			10	LPJ-10SP	CH30J...
12.2	DA1-359D0...	2			15	LPJ-15SP	CH30J...
15.1	DA1-35012...	3			20	LPJ-20SP	CH30J...
20.9	DA1-35017...	3			30	LPJ-30SP	CH30J...
26	DA1-35022...	3			35	LPJ-35SP	CH60J...
26	DA1-35022...	4			35	LPJ-35SP	CH60J...
34	DA1-35028...	4			45	LPJ-45SP	CH60J...
41.2	DA1-35034...	4			60	LPJ-60SP	CH60J...
48.9	DA1-35043...	4			70	LPJ-70SP	JM60100-...
62.2	DA1-35054...	5			80	LPJ-80SP	JM60100-...
75.8	DA1-35065...	5			100	LPJ-100SP	JM60100-...
90.6	DA1-35078...	6			125	LPJ-125SP	JM60200-...
121.1	DA1-35105...	6			150	LPJ-150SP	JM60200-...
143.2	DA1-35130...	6			175	LPJ-175SP	JM60200-...
158.4	DA1-35150...	6			200	LPJ-200SP	JM60200-...



DA1

Nominal Input Current	Part no.	Frame Size	Nominal Supply Voltage (UL)	Branch Circuit Protection Sicherungen (RK5, J, T)		Fuse (Type J)	Fuse holders for LPJ fuse
(without Main choke, CT, 50 °C)						(UL: SCCR: 100 kA)	
A			V	Quantity	A	A	

U₀ 230 V AC, 3-phase / U₂ 230 V AC, 3-phase

Mains voltage (50/60Hz) U_{LN}: 200 (-15%) - 240 (+10%) V

4.8	DG1-323D7...	0	230	3	10	LPJ-10SP	CH30J3
4.8	DG1-323D7...	1	230	3	10	LPJ-10SP	CH30J3
6.6	DG1-324D8...	0	230	3	10	LPJ-10SP	CH30J3
6.6	DG1-324D8...	1	230	3	10	LPJ-10SP	CH30J3
7.8	DG1-326D6...	0	230	3	16	LPJ-20SP	CH30J3
7.8	DG1-326D6...	1	230	3	10	LPJ-10SP	CH30J3
11	DG1-327D8...	1	230	3	15	LPJ-15SP	CH30J3
12.5	DG1-32011...	1	230	3	15	LPJ-15SP	CH30J3
17.5	DG1-32012...	2	230	3	20	LPJ-20SP	CH30J3
25	DG1-32017...	2	230	3	30	LPJ-30SP	CH30J3
31	DG1-32025...	2	230	3	35	LPJ-35SP	CH60J3
48	DG1-32031...	3	230	3	60	LPJ-60SP	CH60J3
61	DG1-32048...	3	230	3	80	LPJ-80SP	JM60100-3CR
75	DG1-32061...	4	230	3	100	LPJ-100SP	JM60200-3CR
88	DG1-32075...	4	230	3	110	LPJ-110SP	JM60200-3CR
114	DG1-32088...	4	230	3	125	LPJ-125SP	JM60200-3CR
143	DG1-32114...	5	230	3	175	LPJ-175SP	JM60200-3CR
170	DG1-32143...	5	230	3	200	LPJ-200SP	JM60200-3CR
211	DG1-32170...	5	230	3	250	LPJ-250SP	JM60400-3CR
261	DG1-32211...	6	230	3	400	LPJ-400SP	JM60400-3CR
312	DG1-32248...	6	230	3	400	LPJ-400SP	JM60400-3CR

U₀ 480 V AC, 3-phase / U₂ 480 V AC, 3-phase

Mains voltage (50/60Hz) U_{LN}: 380 (-15%) - 500 (+10%) V

3.3	DG1-342D2...	0	480	3	6	LPJ-6SP	CH30J3
3.3	DG1-342D2...	1	480	3	10	LPJ-10SP	CH30J3
4.3	DG1-343D3...	0	480	3	10	LPJ-10SP	CH30J3
4.3	DG1-343D3...	1	480	3	10	LPJ-10SP	CH30J3
5.6	DG1-344D3...	0	480	3	10	LPJ-10SP	CH30J3
5.6	DG1-344D3...	1	480	3	10	LPJ-10SP	CH30J3
7.6	DG1-345D6...	0	480	3	16	LPJ-20SP	CH30J3
7.6	DG1-345D6...	1	480	3	10	LPJ-10SP	CH30J3
9	DG1-347D6...	1	480	3	15	LPJ-15SP	CH30J3
12	DG1-349D0...	1	480	3	15	LPJ-15SP	CH30J3
16	DG1-34012...	2	480	3	20	LPJ-20SP	CH30J3
23	DG1-34016...	2	480	3	30	LPJ-30SP	CH30J3
31	DG1-34023...	2	480	3	35	LPJ-35SP	CH60J3
38	DG1-34031...	3	480	3	50	LPJ-50SP	CH60J3
46	DG1-34038...	3	480	3	60	LPJ-60SP	CH60J3
61	DG1-34046...	3	480	3	80	LPJ-80SP	JM60100-3CR
72	DG1-34061...	4	480	3	100	LPJ-100SP	JM60200-3CR
87	DG1-34072...	4	480	3	110	LPJ-110SP	JM60200-3CR
105	DG1-34087...	4	480	3	125	LPJ-125SP	JM60200-3CR
140	DG1-34105...	5	480	3	175	LPJ-175SP	JM60200-3CR
170	DG1-34140...	5	480	3	200	LPJ-200SP	JM60200-3CR
205	DG1-34170...	5	480	3	250	LPJ-250SP	JM60400-3CR
261	DG1-34205...	6	480	3	400	LPJ-400SP	JM60400-3CR
310	DG1-34245...	6	480	3	400	LPJ-400SP	JM60400-3CR
385	DG1-34310...	7	480	3	500	LPJ-500SP	JM60600-3CR
460	DG1-34385...	7	480	3	600	LPJ-600SP	JM60600-3CR
520	DG1-34460...	7	480	3	700	KRP-C-700SP	51235
590	DG1-34520...	7	480	3	800	KRP-C-800SP	51235
650	DG1-34590...	8	480	6	400	LPJ-400SP	JM60400-3CR
730	DG1-34650...	8	480	6	500	LPJ-500SP	JM60600-3CR
820	DG1-34730...	8	480	6	600	LPJ-600SP	JM60600-3CR



Branch Circuit Protection for drive circuits

Nominal Input Current (without Main choke, CT, 50 °C)	Part no.	Frame Size	Nominal Supply Voltage (UL)	Branch Circuit Protection Sicherungen (RK5, J, T)		Fuse (Type J) (UL: SCCR: 100 kA)	Fuse holders for LPJ fuse
A			V	Quantity	A	A	
920	DG1-34820...	8	480	6	600	LPJ-600SP	JM60600-3CR
1010	DG1-34920...	8	480	6	600	LPJ-600SP	JM60600-3CR
1180	DG1-341K0...	8	480	6	700	KRP-C-700SP	51235

U₀ 575 V AC, 3-phase / U₂ 575 V AC, 3-phase

Mains voltage (50/60Hz) U_{LN}: 380 (-15%) - 500 (+10%) V

4.5	DG1-353D3...	1	575	3	10	LPJ-10SP	CH30J3
7.5	DG1-354D5...	1	575	3	10	LPJ-10SP	CH30J3
10	DG1-357D5...	1	575	3	15	LPJ-15SP	CH30J3
13.5	DG1-35010...	2	575	3	20	LPJ-20SP	CH30J3
18	DG1-35013...	2	575	3	30	LPJ-30SP	CH30J3
22	DG1-35018...	2	575	3	35	LPJ-35SP	CH60J3
27	DG1-35022...	3	575	3	40	LPJ-40SP	CH60J3
34	DG1-35027...	3	575	3	45	LPJ-45SP	CH60J3
41	DG1-35034...	3	575	3	50	LPJ-50SP	CH60J3
52	DG1-35041...	4	575	3	70	LPJ-70SP	JM60100-3CR
62	DG1-35052...	4	575	3	80	LPJ-80SP	JM60100-3CR
80	DG1-35062...	4	575	3	125	LPJ-125SP	JM60200-3CR
100	DG1-35080...	5	575	3	150	LPJ-150SP	JM60200-3CR
125	DG1-35100...	5	575	3	175	LPJ-175SP	JM60200-3CR
144	DG1-35125...	5	575	3	200	LPJ-200SP	JM60200-3CR
208	DG1-35144...	6	575	3	400	LPJ-400SP	JM60400-3CR
250	DG1-35208...	6	575	3	400	LPJ-400SP	JM60400-3CR
325	DG1-35261...	7	575	3	500	LPJ-500SP	JM60600-3CR
385	DG1-35325...	7	575	3	600	LPJ-600SP	JM60600-3CR
416	DG1-35385...	7	575	3	700	KRP-C-700SP	51235
460	DG1-35416...	8	575	3	800	KRP-C-800SP	51235
520	DG1-35460...	8	575	6	400	LPJ-400SP	JM60400-3CR
590	DG1-35520...	8	575	6	500	LPJ-500SP	JM60600-3CR



Nominal Input Current	Part no.	Frame Size	Nominal Supply Voltage	Branch Circuit Protection Sicherungen (RK5, J, T)		Fuse (Type J)	Fuse holders for LPJ fuse
(VT, 50 °C)			(UL)			(UL: SCCR: 100 kA)	
A			V	Anzahl	A	A	

U_e 115 V AC, 1-phase / U₂ 230 V AC, 3-phase

Mains voltage (50/60Hz) U_{LN}: 100 (-15%) - 120 (+10%) V

3	DM1-111D6...	1	115	1	10	LPJ-10SP	CH30J1
4.8	DM1-113D0...	1	115	1	25	LPJ-20SP	CH30J1
6.9	DM1-114D8...	2	115	1	32	LPJ-32SP	CH30J1
7.8	DM1-116D9...	2	115	1	40	LPJ-40SP	CH30J1

U_e 230 V AC, 1-phase / U₂ 230 V AC, 3-phase

Mains voltage (50/60Hz) U_{LN}: 200 (-15%) - 240 (+10%) V

3	DM1-121D6...	1	230	1	4	LPJ-4SP	CH30J1
4.8	DM1-123D0...	1	230	1	6	LPJ-6SP	CH30J1
7.8	DM1-124D8...	1	230	1	10	LPJ-10SP	CH30J1
11	DM1-127D8...	2	230	1	16	LPJ-16SP	CH30J1
17.5	DM1-12011...	2	230	1	25	LPJ-25SP	CH30J1
25	DM1-12017...	3	230	1	32	LPJ-32SP	CH30J1

U_e 230 V AC, 3-phase / U₂ 230 V AC, 3-phase

Mains voltage (50/60Hz) U_{LN}: 200 (-15%) - 240 (+10%) V

3	DM1-321D6...	1	230	3	4	LPJ-4SP	CH30J3
4.8	DM1-323D0...	1	230	3	6	LPJ-6SP	CH30J3
7.8	DM1-324D8...	1	230	3	10	LPJ-10SP	CH30J3
11	DM1-327D8...	1	230	3	16	LPJ-16SP	CH30J3
17.5	DM1-32011...	2	230	3	29	LPJ-30SP	CH30J3
25	DM1-32017...	2	230	3	32	LPJ-35SP	CH30J3
32	DM1-32025...	3	230	3	40	LPJ-40SP	CH30J3
48	DM1-32032...	4	230	3	61	LPJ-70SP	CH30J3
61	DM1-32048...	4	230	3	80	LPJ-80SP	CH30J3

U_e 480 V AC, 3-phase / U₂ 480 V AC, 3-phase

Mains voltage (50/60Hz) U_{LN}: 380 (-15%) - 500 (+10%) V

2.2	DM1-341D5...	1	480	3	4	LPJ-4SP	CH30J3
4.3	DM1-342D2...	1	480	3	6	LPJ-6SP	CH30J3
5.6	DM1-344D3...	1	480	3	10	LPJ-10SP	CH30J3
7.6	DM1-345D6...	1	480	3	10	LPJ-10SP	CH30J3
12	DM1-347D6...	2	480	3	16	LPJ-16SP	CH30J3
16	DM1-34012...	2	480	3	20	LPJ-35SP	CH30J3
23	DM1-34016...	2	480	3	32	LPJ-35SP	CH30J3
31	DM1-34023...	3	480	3	40	LPJ-40SP	CH30J3
38	DM1-34031...	4	480	3	50	LPJ-50SP	CH30J3
46	DM1-34038...	4	480	3	63	LPJ-70SP	CH30J3

U_e 575 V AC, 3-phase / U₂ 575 V AC, 3-phase

Mains voltage (50/60Hz) U_{LN}: 525 (-15%) - 600 (+10%) V

7.5	DM1-354D5...	2	575	3	10	LPJ-10SP	CH30J3
10	DM1-357D5...	2	575	3	10	LPJ-10SP	CH30J3
13.5	DM1-35010...	2	575	3	16	LPJ-16SP	CH30J3
18	DM1-35013...	3	575	3	20	LPJ-20SP	CH30J3
22	DM1-35018...	4	575	3	25	LPJ-25SP	CH30J3
27	DM1-35022...	4	575	3	40	LPJ-40SP	CH30J3



Branch Circuit Protection for drive circuits

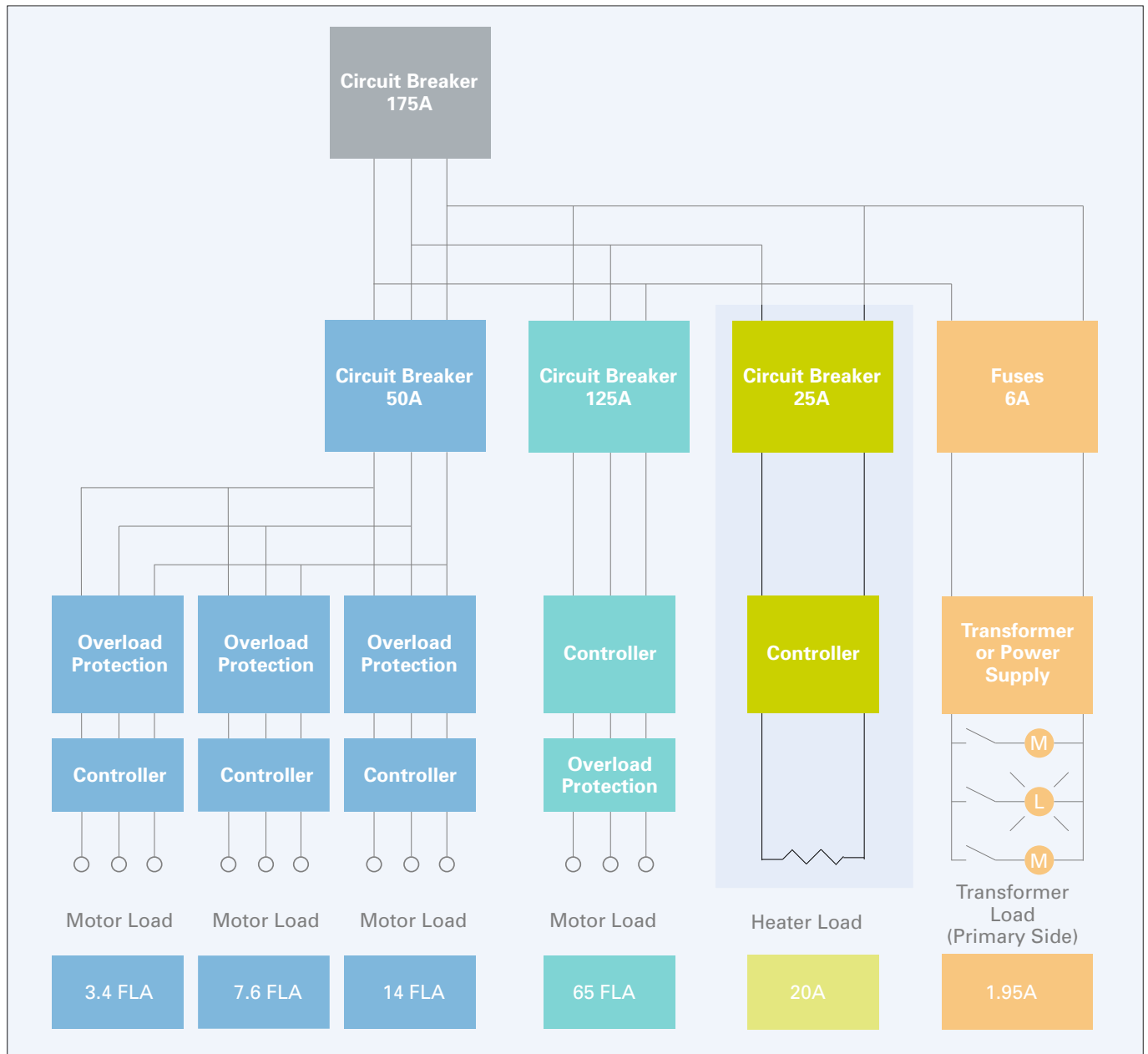
Nominal Input Current (without Main choke, CT, 50 °C)	Part no.	Frame Size	Nominal Supply Voltage (UL)	Branch Circuit Protection Sicherungen (RK5, J, T)		Fuse (Type J) (UL: SCCR: 100 kA)	Fuse holders for LPJ fuse
A			V	Quantity	A	A	
650	DG1-35590...	8	575	6	600	LPJ-600SP	JM60600-3CR
750	DG1-35650...	8	575	6	600	LPJ-600SP	JM60600-3CR
820	DG1-35820...	8	575	6	700	KRP-C-700SP	51235
			Input Phase 3				
	001A1-4...	4	380 (-15 %) - 500 (+10 %)	400/460	10	LPJ-10SP	CH30J...
	F15A1-4...	4			10	LPJ-10SP	CH30J...
	002A1-4...	4			10	LPJ-10SP	CH30J...
	003A1-4...	4			10	LPJ-10SP	CH30J...
	005A1-4...	4			10	LPJ-10SP	CH30J...
	006A1-4...	4			15	LPJ-15SP	CH30J...
	007A1-4...	5			20	LPJ-20SP	CH30J...
	010A1-4...	5			30	LPJ-30SP	CH30J...
	015A1-4...	5			35	LPJ-35SP	CH60J...
	020A1-4...	6			50	LPJ-50SP	CH60J...
	025A1-4...	6			50	LPJ-50SP	CH60J...
	030A1-4...	6			70	LPJ-70SP	JM60100-...
	040A1-4...	7			80	LPJ-80SP	JM60100-...
	050A1-4...	7			100	LPJ-100SP	JM60100-...
	060A1-4...	7			125	LPJ-125SP	JM60200-...
	075A1-4...	7			175	LPJ-175SP	JM60200-...
	100A1-4...	8			200	LPJ-200SP	JM60200-...
	125A1-4...	8			250	LPJ-250SP	JM60400-...
	150A1-4...	9			300	LPJ-300SP	JM60400-...
	200A1-4...	9			400	LPJ-400SP	JM60400-...



9000X

Heater and lighting load circuits

Reference to UL 508A Sections 31.6, 31.8, 66.7.6



Heater loads:

The branch circuit protection is sized (see Section 31.6.1 exceptions for larger heater loads):

1. Not less than 125 % of the heater load,
2. Not more than 60 A, and
3. Not larger than the ampacity of the field wiring to the heater load.

Controllers are sized to the heater full-load rating using the controller's general-purpose amp rating or resistive load rating.

Lighting loads:

The branch circuit protection for standard-duty incandescent lampholders or fluorescent ballasts (see Section 31.8.2 for larger lighting loads):

1. Shall not exceed 20 A, and
2. Shall not exceed the ampacity of the anticipated field wiring

The controllers are sized to the specific lighting ratings.

Branch Circuit Protection

Controller



Molded Case Circuit Breaker
PKEM4-...-CB



Circuit Breaker FAZ...-NA



Fuse



Contactor DILM

Problem solver for the North American market: PKZM4-...-CB



[Click here for whitepaper download](#)

Whereas electrical assemblies in the majority of countries around the world are primarily governed by IEC standards, the North American market is still largely the domain of local codes and standards (NEC, CEC, UL 508A, NFPA 79), which still markedly differ from the IEC standards in many aspects. Market conventions and customer sensibilities in North America also remain distinct and divergent in many ways from those encountered in the IEC world.

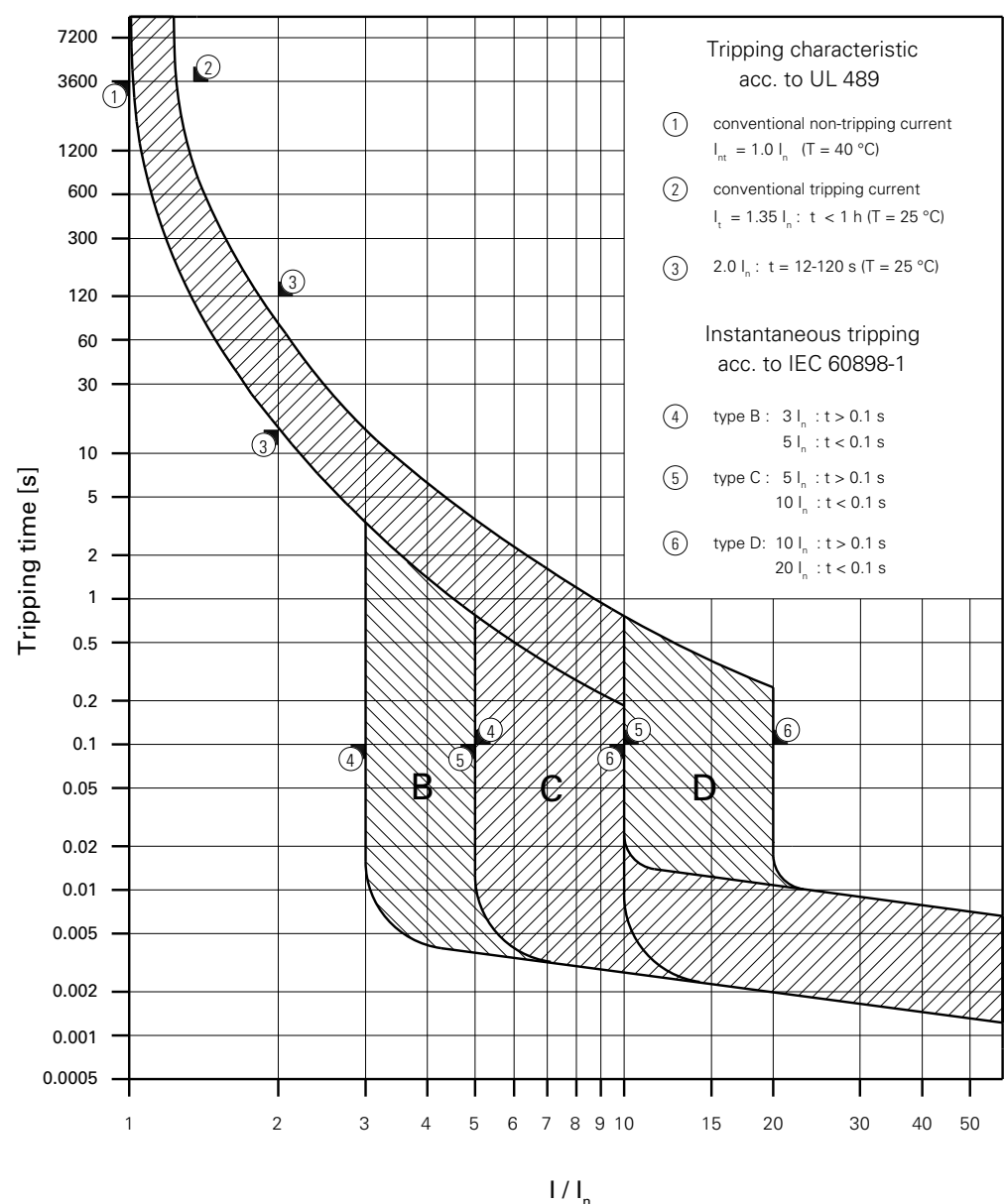
The most important load category involved in the design of electrical equipment for industrial machinery, both in the IEC world and in North America, are motors. Motors are switched and protected in various ways and the rules which outline the requirements in North America are well established and defined. The UL 508 standard recognizes various construction types of combination motor controllers for this purpose. Types E and F are especially relevant in the IEC world, since they legitimize the use of IEC style motor protective switches to a much greater extent.

Branch circuit protection: PKZM4-CB

A	poles	Voltage (VAC)	Short Circuit Current in kA	Part no.
10...16	3	240	65	PKZM4-16-CB
16..25	3	240	65	PKZM4-25-CB
25...32	3	240	65	PKZM4-32-CB
10...16	3	480Y/277	65	PKZM4-16-CB
16..25	3	480Y/277	65	PKZM4-25-CB
25...32	3	480Y/277	65	PKZM4-32-CB
10...16	3	600Y/347	22	PKZM4-16-CB
16..25	3	600Y/347	22	PKZM4-25-CB
25...32	3	600Y/347	22	PKZM4-32-CB



Characteristics of miniature circuit breakers



Features:

- Current limiting design provides fast short-circuit interruption that reduces the let-through energy that can damage the circuit
- Thermal-magnetic overcurrent protection
- Three levels of short-circuit protection, Categorized by B, C and D curves
- Trip-free design. Breaker can not be defeated by holding the handle in the ON position
- A color-coded red/green indicator provides immediate visual indication of device status (green for OFF, red for ON) and isolation function.
- Power to the circuit breakers can be fed from the line or load side
- Separate version for ring-tongue connection (Type FAZ-RT), terminal screws can be removed (on both sides). Captive screws cannot be lost
- Fulfill UL 489, CSA C22.2 No.5 and also IEC 60947-2 Standard. For use in applications for which UL 1077 or CSA C22.2 No.235 are also allowed
- Easy installation on DIN rail. Module width of only 17.7 mm (per pole)
- To save installation time, bus connectors and feeder terminal facilitate mounting and wiring of multiple miniature circuit breaker arrays in control panel assemblies

Eaton offers a full range of DIN-Rail miniature circuit breakers up to 63A current rating for feeder and branch circuit protection. Breakers comply with the latest national and international standards including UL 489. Two levels of circuit

protection available, one for medium inrush startup currents to provide protection for small transformers, pilot devices, etc., and one with a magnetic range to allow for higher inrush levels during startup usually seen with motors.

Branch circuit protection: circuit breaker xEffect FAZ-NA

		Voltage (VAC)	Short circuit current in kA	Part no.	Part no.	Part no.	Part no.
A							
Trip curve B, Lift terminal				1 pole*	2 poles	3 poles	4 poles
							
1	480Y/277	10	FAZ-B1/1-NA	FAZ-B1/2-NA	FAZ-B1/3-NA	FAZ-B1/4-NA	
1.5		10	FAZ-B1,5/1-NA	FAZ-B1,5/2-NA	FAZ-B1,5/3-NA	FAZ-B1,5/4-NA	
2		10	FAZ-B2/1-NA	FAZ-B2/2-NA	FAZ-B2/3-NA	FAZ-B2/4-NA	
3		10	FAZ-B3/1-NA	FAZ-B3/2-NA	FAZ-B3/3-NA	FAZ-B3/4-NA	
4		10	FAZ-B4/1-NA	FAZ-B4/2-NA	FAZ-B4/3-NA	FAZ-B4/4-NA	
5		10	FAZ-B5/1-NA	FAZ-B5/2-NA	FAZ-B5/3-NA	FAZ-B5/4-NA	
6		10	FAZ-B6/1-NA	FAZ-B6/2-NA	FAZ-B6/3-NA	FAZ-B6/4-NA	
7		10	FAZ-B7/1-NA	FAZ-B7/2-NA	FAZ-B7/3-NA	FAZ-B7/4-NA	
8		10	FAZ-B8/1-NA	FAZ-B8/2-NA	FAZ-B8/3-NA	FAZ-B8/4-NA	
10		10	FAZ-B10/1-NA	FAZ-B10/2-NA	FAZ-B10/3-NA	FAZ-B10/4-NA	
13		10	FAZ-B13/1-NA	FAZ-B13/2-NA	FAZ-B13/3-NA	FAZ-B13/4-NA	
15		14	FAZ-B15/1-NA	FAZ-B15/2-NA	FAZ-B15/3-NA	FAZ-B15/4-NA	
16		14	FAZ-B16/1-NA	FAZ-B16/2-NA	FAZ-B16/3-NA	FAZ-B16/4-NA	
20		14	FAZ-B20/1-NA	FAZ-B20/2-NA	FAZ-B20/3-NA	FAZ-B20/4-NA	
25		14	FAZ-B25/1-NA	FAZ-B25/2-NA	FAZ-B25/3-NA	FAZ-B25/4-NA	
30		10	FAZ-B30/1-NA	FAZ-B30/2-NA	FAZ-B30/3-NA	FAZ-B30/4-NA	
32	10	FAZ-B32/1-NA	FAZ-B32/2-NA	FAZ-B32/3-NA	FAZ-B32/4-NA		
35	240	10	FAZ-B35/1-NA	FAZ-B35/2-NA	FAZ-B35/3-NA	FAZ-B35/4-NA	
40		10	FAZ-B40/1-NA	FAZ-B40/2-NA	FAZ-B40/3-NA	FAZ-B40/4-NA	
50		10	FAZ-B50/1-NA	FAZ-B50/2-NA	FAZ-B50/3-NA	FAZ-B50/4-NA	
63		10	FAZ-B63/1-NA	FAZ-B63/2-NA	FAZ-B63/3-NA	FAZ-B63/4-NA	
Trip curve B, Ringe Tongue Terminal							
1	480Y/277	10	FAZ-B1/1-RT	FAZ-B1/2-RT	FAZ-B1/3-RT	FAZ-B1/4-RT	
1.5		10	FAZ-B1,5/1-RT	FAZ-B1,5/2-RT	FAZ-B1,5/3-RT	FAZ-B1,5/4-RT	
2		10	FAZ-B2/1-RT	FAZ-B2/2-RT	FAZ-B2/3-RT	FAZ-B2/4-RT	
3		10	FAZ-B3/1-RT	FAZ-B3/2-RT	FAZ-B3/3-RT	FAZ-B3/4-RT	
4		10	FAZ-B4/1-RT	FAZ-B4/2-RT	FAZ-B4/3-RT	FAZ-B4/4-RT	
5		10	FAZ-B5/1-RT	FAZ-B5/2-RT	FAZ-B5/3-RT	FAZ-B5/4-RT	
6		10	FAZ-B6/1-RT	FAZ-B6/2-RT	FAZ-B6/3-RT	FAZ-B6/4-RT	
7		10	FAZ-B7/1-RT	FAZ-B7/2-RT	FAZ-B7/3-RT	FAZ-B7/4-RT	
8		10	FAZ-B8/1-RT	FAZ-B8/2-RT	FAZ-B8/3-RT	FAZ-B8/4-RT	
10		10	FAZ-B10/1-RT	FAZ-B10/2-RT	FAZ-B10/3-RT	FAZ-B10/4-RT	
13		10	FAZ-B13/1-RT	FAZ-B13/2-RT	FAZ-B13/3-RT	FAZ-B13/4-RT	
15		14	FAZ-B15/1-RT	FAZ-B15/2-RT	FAZ-B15/3-RT	FAZ-B15/4-RT	
16		14	FAZ-B16/1-RT	FAZ-B16/2-RT	FAZ-B16/3-RT	FAZ-B16/4-RT	
20		14	FAZ-B20/1-RT	FAZ-B20/2-RT	FAZ-B20/3-RT	FAZ-B20/4-RT	
25		14	FAZ-B25/1-RT	FAZ-B25/2-RT	FAZ-B25/3-RT	FAZ-B25/4-RT	
30		10	FAZ-B30/1-RT	FAZ-B30/2-RT	FAZ-B30/3-RT	FAZ-B30/4-RT	
32	10	FAZ-B32/1-RT	FAZ-B32/2-RT	FAZ-B32/3-RT	FAZ-B32/4-RT		
35	240	10	FAZ-B35/1-RT	FAZ-B35/2-RT	FAZ-B35/3-RT	FAZ-B35/4-RT	
40		10	FAZ-B40/1-RT	FAZ-B40/2-RT	FAZ-B40/3-RT	FAZ-B40/4-RT	
50		10	FAZ-B50/1-RT	FAZ-B50/2-RT	FAZ-B50/3-RT	FAZ-B50/4-RT	
63		10	FAZ-B63/1-RT	FAZ-B63/2-RT	FAZ-B63/3-RT	FAZ-B63/4-RT	

Note: * UL rated voltage: 277 V AC for all single-pole circuit breakers

Branch circuit protection: circuit breaker xEffect FAZ-NA

A	Voltage (VAC)	Short circuit current (SCCR) in kA	Part no.	Part no.	Part no.	Part no.
Trip curve C, Lift terminal			1 pole*	2 poles	3 poles	4 poles
						
0.5	480Y/277	10	FAZ-C0,5/1-NA	FAZ-C0,5/2-NA	FAZ-C0,5/3-NA	FAZ-C0,5/4-NA
1		10	FAZ-C1/1-NA	FAZ-C1/2-NA	FAZ-C1/3-NA	FAZ-C1/4-NA
1.5		10	FAZ-C1,5/1-NA	FAZ-C1,5/2-NA	FAZ-C1,5/3-NA	FAZ-C1,5/4-NA
2		10	FAZ-C2/1-NA	FAZ-C2/2-NA	FAZ-C2/3-NA	FAZ-C2/4-NA
3		10	FAZ-C3/1-NA	FAZ-C3/2-NA	FAZ-C3/3-NA	FAZ-C3/4-NA
4		10	FAZ-C4/1-NA	FAZ-C4/2-NA	FAZ-C4/3-NA	FAZ-C4/4-NA
5		10	FAZ-C5/1-NA	FAZ-C5/2-NA	FAZ-C5/3-NA	FAZ-C5/4-NA
6		10	FAZ-C6/1-NA	FAZ-C6/2-NA	FAZ-C6/3-NA	FAZ-C6/4-NA
7		10	FAZ-C7/1-NA	FAZ-C7/2-NA	FAZ-C7/3-NA	FAZ-C7/4-NA
8		10	FAZ-C8/1-NA	FAZ-C8/2-NA	FAZ-C8/3-NA	FAZ-C8/4-NA
10		10	FAZ-C10/1-NA	FAZ-C10/2-NA	FAZ-C10/3-NA	FAZ-C10/4-NA
13		10	FAZ-C13/1-NA	FAZ-C13/2-NA	FAZ-C13/3-NA	FAZ-C13/4-NA
15		14	FAZ-C15/1-NA	FAZ-C15/2-NA	FAZ-C15/3-NA	FAZ-C15/4-NA
16		14	FAZ-C16/1-NA	FAZ-C16/2-NA	FAZ-C16/3-NA	FAZ-C16/4-NA
20		14	FAZ-C20/1-NA	FAZ-C20/2-NA	FAZ-C20/3-NA	FAZ-C20/4-NA
25		14	FAZ-C25/1-NA	FAZ-C25/2-NA	FAZ-C25/3-NA	FAZ-C25/4-NA
30	240	10	FAZ-C30/1-NA	FAZ-C30/2-NA	FAZ-C30/3-NA	FAZ-C30/4-NA
32		10	FAZ-C32/1-NA	FAZ-C32/2-NA	FAZ-C32/3-NA	FAZ-C32/4-NA
35		10	FAZ-C35/1-NA	FAZ-C35/2-NA	FAZ-C35/3-NA	FAZ-C35/4-NA
40		10	FAZ-C40/1-NA	FAZ-C40/2-NA	FAZ-C40/3-NA	FAZ-C40/4-NA
50		10	FAZ-C50/1-NA	FAZ-C50/2-NA	FAZ-C50/3-NA	FAZ-C50/4-NA
63		10	FAZ-C63/1-NA	FAZ-C63/2-NA	FAZ-C63/3-NA	FAZ-C63/4-NA
Trip curve C, Ringe Tongue Terminal						
0.5	480Y/277	10	FAZ-C0,5/1-RT	FAZ-C0,5/2-RT	FAZ-C0,5/3-RT	FAZ-C0,5/4-RT
1		10	FAZ-C1/1-RT	FAZ-C1/2-RT	FAZ-C1/3-RT	FAZ-C1/4-RT
1.5		10	FAZ-C1,5/1-RT	FAZ-C1,5/2-RT	FAZ-C1,5/3-RT	FAZ-C1,5/4-RT
2		10	FAZ-C2/1-RT	FAZ-C2/2-RT	FAZ-C2/3-RT	FAZ-C2/4-RT
3		10	FAZ-C3/1-RT	FAZ-C3/2-RT	FAZ-C3/3-RT	FAZ-C3/4-RT
4		10	FAZ-C4/1-RT	FAZ-C4/2-RT	FAZ-C4/3-RT	FAZ-C4/4-RT
5		10	FAZ-C5/1-RT	FAZ-C5/2-RT	FAZ-C5/3-RT	FAZ-C5/4-RT
6		10	FAZ-C6/1-RT	FAZ-C6/2-RT	FAZ-C6/3-RT	FAZ-C6/4-RT
7		10	FAZ-C7/1-RT	FAZ-C7/2-RT	FAZ-C7/3-RT	FAZ-C7/4-RT
8		10	FAZ-C8/1-RT	FAZ-C8/2-RT	FAZ-C8/3-RT	FAZ-C8/4-RT
10		10	FAZ-C10/1-RT	FAZ-C10/2-RT	FAZ-C10/3-RT	FAZ-C10/4-RT
13		10	FAZ-C13/1-RT	FAZ-C13/2-RT	FAZ-C13/3-RT	FAZ-C13/4-RT
15		14	FAZ-C15/1-RT	FAZ-C15/2-RT	FAZ-C15/3-RT	FAZ-C15/4-RT
16		14	FAZ-C16/1-RT	FAZ-C16/2-RT	FAZ-C16/3-RT	FAZ-C16/4-RT
20		14	FAZ-C20/1-RT	FAZ-C20/2-RT	FAZ-C20/3-RT	FAZ-C20/4-RT
25		14	FAZ-C25/1-RT	FAZ-C25/2-RT	FAZ-C25/3-RT	FAZ-C25/4-RT
30	240	10	FAZ-C30/1-RT	FAZ-C30/2-RT	FAZ-C30/3-RT	FAZ-C30/4-RT
32		10	FAZ-C32/1-RT	FAZ-C32/2-RT	FAZ-C32/3-RT	FAZ-C32/4-RT
35		10	FAZ-C35/1-RT	FAZ-C35/2-RT	FAZ-C35/3-RT	FAZ-C35/4-RT
40		10	FAZ-C40/1-RT	FAZ-C40/2-RT	FAZ-C40/3-RT	FAZ-C40/4-RT
50		10	FAZ-C50/1-RT	FAZ-C50/2-RT	FAZ-C50/3-RT	FAZ-C50/4-RT
63		10	FAZ-C63/1-RT	FAZ-C63/2-RT	FAZ-C63/3-RT	FAZ-C63/4-RT

Note: * UL rated voltage: 277 V AC for all single-pole circuit breakers

Branch circuit protection: circuit breaker xEffect FAZ-NA

A	Voltage (VAC)	Short circuit current (SCCR) in kA	Part no.	Part no.	Part no.	Part no.
---	---------------	------------------------------------	----------	----------	----------	----------

Trip curve D, Lift terminal

1 pole*



2 poles



3 poles



3 poles



0.5	480Y/277	10	FAZ-D0,5/1-NA	FAZ-D0,5/2-NA	FAZ-D0,5/3-NA	FAZ-D0,5/4-NA
1		10	FAZ-D1/1-NA	FAZ-D1/2-NA	FAZ-D1/3-NA	FAZ-D1/4-NA
1.5		10	FAZ-D1,5/1-NA	FAZ-D1,5/2-NA	FAZ-D1,5/3-NA	FAZ-D1,5/4-NA
2		10	FAZ-D2/1-NA	FAZ-D2/2-NA	FAZ-D2/3-NA	FAZ-D2/4-NA
3		10	FAZ-D3/1-NA	FAZ-D3/2-NA	FAZ-D3/3-NA	FAZ-D3/4-NA
4		10	FAZ-D4/1-NA	FAZ-D4/2-NA	FAZ-D4/3-NA	FAZ-D4/4-NA
5		10	FAZ-D5/1-NA	FAZ-D5/2-NA	FAZ-D5/3-NA	FAZ-D5/4-NA
6		10	FAZ-D6/1-NA	FAZ-D6/2-NA	FAZ-D6/3-NA	FAZ-D6/4-NA
7		10	FAZ-D7/1-NA	FAZ-D7/2-NA	FAZ-D7/3-NA	FAZ-D7/4-NA
8		10	FAZ-D8/1-NA	FAZ-D8/2-NA	FAZ-D8/3-NA	FAZ-D8/4-NA
10		10	FAZ-D10/1-NA	FAZ-D10/2-NA	FAZ-D10/3-NA	FAZ-D10/4-NA
13		14	FAZ-D13/1-NA	FAZ-D13/2-NA	FAZ-D13/3-NA	FAZ-D13/4-NA
15		14	FAZ-D15/1-NA	FAZ-D15/2-NA	FAZ-D15/3-NA	FAZ-D15/4-NA
16		14	FAZ-D16/1-NA	FAZ-D16/2-NA	FAZ-D16/3-NA	FAZ-D16/4-NA
20		14	FAZ-D20/1-NA	FAZ-D20/2-NA	FAZ-D20/3-NA	FAZ-D20/4-NA
25		10	FAZ-D25/1-NA	FAZ-D25/2-NA	FAZ-D25/3-NA	FAZ-D25/4-NA
30		10	FAZ-D30/1-NA	FAZ-D30/2-NA	FAZ-D30/3-NA	FAZ-D30/4-NA
32		10	FAZ-D32/1-NA	FAZ-D32/2-NA	FAZ-D32/3-NA	FAZ-D32/4-NA
35	240	10	FAZ-D35/1-NA	FAZ-D35/2-NA	FAZ-D35/3-NA	FAZ-D35/4-NA
40		10	FAZ-D40/1-NA	FAZ-D40/2-NA	FAZ-D40/3-NA	FAZ-D40/4-NA

Trip curve D, Ring Tongue Terminal

0.5	480Y/277	10	FAZ-D0,5/1-RT	FAZ-D0,5/2-RT	FAZ-D0,5/3-RT	FAZ-D0,5/4-RT
1		10	FAZ-D1/1-RT	FAZ-D1/2-RT	FAZ-D1/3-RT	FAZ-D1/4-RT
1.5		10	FAZ-D1,5/1-RT	FAZ-D1,5/2-RT	FAZ-D1,5/3-RT	FAZ-D1,5/4-RT
2		10	FAZ-D2/1-RT	FAZ-D2/2-RT	FAZ-D2/3-RT	FAZ-D2/4-RT
3		10	FAZ-D3/1-RT	FAZ-D3/2-RT	FAZ-D3/3-RT	FAZ-D3/4-RT
4		10	FAZ-D4/1-RT	FAZ-D4/2-RT	FAZ-D4/3-RT	FAZ-D4/4-RT
5		10	FAZ-D5/1-RT	FAZ-D5/2-RT	FAZ-D5/3-RT	FAZ-D5/4-RT
6		10	FAZ-D6/1-RT	FAZ-D6/2-RT	FAZ-D6/3-RT	FAZ-D6/4-RT
7		10	FAZ-D7/1-RT	FAZ-D7/2-RT	FAZ-D7/3-RT	FAZ-D7/4-RT
8		10	FAZ-D8/1-RT	FAZ-D8/2-RT	FAZ-D8/3-RT	FAZ-D8/4-RT
10		10	FAZ-D10/1-RT	FAZ-D10/2-RT	FAZ-D10/3-RT	FAZ-D10/4-RT
13		14	FAZ-D13/1-RT	FAZ-D13/2-RT	FAZ-D13/3-RT	FAZ-D13/4-RT
15		14	FAZ-D15/1-RT	FAZ-D15/2-RT	FAZ-D15/3-RT	FAZ-D15/4-RT
16		14	FAZ-D16/1-RT	FAZ-D16/2-RT	FAZ-D16/3-RT	FAZ-D16/4-RT
20		14	FAZ-D20/1-RT	FAZ-D20/2-RT	FAZ-D20/3-RT	FAZ-D20/4-RT
25		10	FAZ-D25/1-RT	FAZ-D25/2-RT	FAZ-D25/3-RT	FAZ-D25/4-RT
30		10	FAZ-D30/1-RT	FAZ-D30/2-RT	FAZ-D30/3-RT	FAZ-D30/4-RT
32		10	FAZ-D32/1-RT	FAZ-D32/2-RT	FAZ-D32/3-RT	FAZ-D32/4-RT
35	240	10	FAZ-D35/1-RT	FAZ-D35/2-RT	FAZ-D35/3-RT	FAZ-D35/4-RT
40		10	FAZ-D40/1-RT	FAZ-D40/2-RT	FAZ-D40/3-RT	FAZ-D40/4-RT

Note: * UL rated voltage: 277 V AC for all single-pole circuit breakers

UL1053 Ground Fault Detection: residual-current circuit breakers FRCmM-NA

	A	Voltage (VAC)	Rated fault current A	Type A	Type G/A, short time delayed
	25	120	0.03	-	FRCMM-25/2/003-G/A-NA-110
	40		0.03	-	FRCMM-40/2/003-G/A-NA-110
	63		0.03	-	FRCMM-63/2/003-G/A-NA-110
	25		0.3	-	FRCMM-25/2/03-G/A-NA-110
	40		0.3	-	FRCMM-40/2/03-G/A-NA-110
	63		0.3	-	FRCMM-63/2/03-G/A-NA-110
	25	277	0.03	FRCMM-25/2/003-A-NA	FRCMM-25/2/003-G/A-NA
	40		0.03	FRCMM-40/2/003-A-NA	FRCMM-40/2/003-G/A-NA
	63		0.03	FRCMM-63/2/003-A-NA	FRCMM-63/2/003-G/A-NA
	25		0.3	FRCMM-25/2/03-A-NA	FRCMM-25/2/03-G/A-NA
	40		0.3	FRCMM-40/2/03-A-NA	FRCMM-40/2/03-G/A-NA
	63		0.3	FRCMM-63/2/03-A-NA	FRCMM-63/2/03-G/A-NA
	25	480Y/277	0.03	FRCMM-25/4/003-A-NA	FRCMM-25/4/003-G/A-NA
	40		0.03	FRCMM-40/4/003-A-NA	FRCMM-40/4/003-G/A-NA
	63		0.03	FRCMM-63/4/003-A-NA	FRCMM-63/4/003-G/A-NA
	25		0.3	FRCMM-25/4/03-A-NA	FRCMM-25/4/03-G/A-NA
	40		0.3	FRCMM-40/4/03-A-NA	FRCMM-40/4/03-G/A-NA
	63		0.3	FRCMM-63/4/03-A-NA	FRCMM-63/4/03-G/A-NA
	25	208/120	0.03	FRCMM-25/4/003-A-NA-110	FRCMM-25/4/003-G/A-NA-110
	40		0.03	FRCMM-40/4/003-A-NA-110	FRCMM-40/4/003-G/A-NA-110
	63		0.03	FRCMM-63/4/003-A-NA-110	FRCMM-63/4/003-G/A-NA-110
	25		0.3	FRCMM-25/4/03-A-NA-110	FRCMM-25/4/03-G/A-NA-110
	40		0.3	FRCMM-40/4/03-A-NA-110	FRCMM-40/4/03-G/A-NA-110
	63		0.3	FRCMM-63/4/03-A-NA-110	FRCMM-63/4/03-G/A-NA-110

Special Purpose Ratings according to UL/CSA test conditions

Type DILM..	7	9	12	15	17	25	32	40	50	65 72	80	95	115	150 170
AC Elevator Control	HP	HP	HP	HP	HP	HP	HP	HP	HP	HP	HP	HP	HP	HP
480 V 60 Hz, 3-pole	2	3	7 ½	7 ½	7 ½	10	20	25	30	30	50	60	75	75
600 V 60 Hz, 3-pole	3	5	7 ½	7 ½	10	15	20	30	40	40	60	75	100	100
AC Refrigeration Control	A	A	A	A	A	A	A	A	A	A	A	A	A	A
480 V 60 Hz, 3-pole	6	7,5	10	10	23	32	40	26	36	45	63	70	84	90
600 V 60 Hz, 3-pole	6	7,5	10	10	17	24	30	26	36	45	63	70	84	90
AC Resistance Air Heating	A	A	A	A	A	A	A	A	A	A	A	A	A	A
480 V 60 Hz, 3-pole	12	18	20	20	27	35	40	63	79	90	94	110	136	160
600 V 60 Hz, 3-pole	12	18	20	20	27	35	40	63	79	90	94	110	136	160
AC Incandescent Lamps (Tungsten)	A	A	A	A	A	A	A	A	A	A	A	A	A	A
480 V 60 Hz, 3-pole	8	11	14	14	23	32	40	55	74	90	85	100	136	160
600 V 60 Hz, 3-pole	8	11	14	14	23	32	40	55	74	90	85	100	136	160
AC Electrical Discharge Lamps (Ballast)	A	A	A	A	A	A	A	A	A	A	A	A	A	A
480 V 60 Hz, 3-pole	12	18	20	20	27	35	40	63	79	90	85	100	136	160
600 V 60 Hz, 3-pole	12	18	20	20	27	35	40	63	79	90	85	100	136	160

Type DILK..	12	20	25	33	50
Capacitive Switching					
480 V 60 Hz, 3-pole, A	18	28	36	48	72.1
kVAr	15	20	30	40	60
600 V 60 Hz, 3-pole, A	14.4	28	38.4	48	72.1
kVAr	15	30	40	50	75

Selection table for contactors DILM and DILK for special Applications (Special Purpose Ratings) for the North America Market



Contactors Frame size 1 - 4

Short Circuit Current Rating SCCR

Contactor	Basic Rating			480V High Fault				600V High Fault			
	kA	max. Fuse	max. CB	kA	max. Fuse	kA	max. CB	kA	max. Fuse	kA	max. CB
DILM7-...(…)	5	45A	60A	30 / 100	25A / 20A Class J	65	16	30 / 100	25A / 20A Class J	-	Fuse Only
DILM9-...(…)						-	Fuse Only				
DILM12-...(…)											
DILM15-...(…)											
DILMP20(…)											
DILM17-...(…)		125A	125A	10 / 100	125A / 70A Class J	10 / 65	50A / 32A	10 / 100	125A / 70A Class J	10 / 22	50A / 32A
DILM25-...(…)									125A / 100A Class J		
DILM32-...(…)									125A / 125A Class J		
DILM38-...(…)											
DILMP32-...(…)											
DILMP45-...(…)											
DILM40(…)	10	250A	250A	30 / 100	250A / 150A Class J	65	100A	30 / 100	125A / 125A Class J	30	250A
DILM50(…)									250A / 150A Class J		
DILM65(…)											
DILM72(…)											
DILMP63(…)											
DILMP80(…)											
DILM80(…)		600A	600A		300A / 300A Class J		250A		300A / 300A Class J	350A	
DILM95(…)											
DILM115(…)											
DILM150(…)											300A / 600A Class J
DILM170(…)											
DILMP125(…)											
DILMP160(…)											
DILMP200(…)											
DILM185A(…)	18	700A	800A	100	600A Class J		350A	100	600A Class J	50	
DILM225A(…)											
DILM250(…)											
DILM300A(…)											
DILM400(…)		800A		30 / 100	800A / 600A Class J	100	600A	30	800A	30	
DILM500(…)											
DILM570(…)											
DILM580(…)											
DILM650(…)		2000A	1200A	85	2000A	85	1200A	85	2000A	85	1200A
DILM750(…)											
DILM820(…)											
DILM1000(…)											
DILM1600(…)	85		-			-	-			-	-

Circuit Breaker



Fuse



Contactor DILM

Power circuit wiring

This section refers to the wiring in the feeder and branch circuits. For information on wiring in the control circuit, see page 48.

Internal wiring (Reference UL 508A Section 29, 66.5):

- All internal wiring conductors shall be copper.
- All conductors in the power circuit should be labeled at the termination point with letters or numbers corresponding with the wiring diagram provided in the industrial control panel.
- Power circuit conductors should not be smaller than 14 AWG.
- For single loads, power circuit conductors for motors or heater loads should be sized for an ampacity not less than 125% of the full-load current.
- For multiple loads, such as multiple motors or a motor with other loads, power circuit conductors shall be sized for an ampacity not less than 125% of all heater loads plus 125% of the largest motor load plus the full-load ampere ratings of all remaining motors and other loads that are simultaneously operable.
- The wire size is selected from the table on page 33 based on the calculated wire ampacity. Conductors used in group motor applications should also comply with Table 66.2 (Reference Section 66.7.5).

Field wiring (Reference to UL 508A Section 28.3, 66.4):

- Not smaller than 14 AWG.
- For single loads, the field wiring conductors should be sized for an ampacity of 125% of the full-load current.
- For multiple loads, such as multiple motors or a motor with other loads, the field wiring is sized based on the sum of 125% of the largest motor FLA, plus the sum of the other full-load currents of the remaining loads.
- The wire size is selected from the table on page 42 based on the calculated wire ampacity.

Wire color designation (internal power circuit wiring)



Black:

All ungrounded power circuit conductors regardless of voltage



White or gray or three continuous white stripes on other than green, blue, orange or white:



Grounded AC current-carrying power circuit conductor regardless of voltage

Exception: Insulated conductors sized 4 AWG (21.2 mm²) or larger and having insulation colored other than as in Section 17.4 shall be identified at each termination point by a white marking, such as tape wrapped around the conductor.

Ampacity of insulated conductors according NEC table 310.15(B)

Circuit Size Copper Conductor	Ampacity 60°C	Ampacity 75°C	Ampacity 90°C
AWG 14	15	20	25
AWG 12	20	25	30
AWG 10	30	35	40
AWG 8	40	50	55
AWG 6	55	65	75
AWG 4	70	85	95
AWG 3	85	100	115
AWG 2	95	115	130
AWG 1	110	130	145
AWG 1/0	125	150	170
AWG 2/0	145	175	195
AWG 3/0	165	200	225
AWG 4/0	195	230	260
250 kcmil	215	255	290
300 kcmil	240	285	320
350 kcmil	260	310	350
400 kcmil	280	335	380
500 kcmil	320	380	430
600 kcmil	350	420	475
700 kcmil	385	460	520
750 kcmil	400	475	535
800 kcmil	410	490	555
900 kcmil	435	520	585
1000 kcmil	455	545	615
1250 kcmil	495	590	665
1500 kcmil	525	625	705
1750 kcmil	545	650	735
2000 kcmil	555	665	750

For group motor applications where two or more motors are protected by a single device, wire sizes should comply with the fuse/breaker size in UL 508A Table 66.3 at right.

Ampacities of insulated conductors – Reference to UL 508A table 28.1

Wire Size AWG	mm ²	Copper 75°C (167°F)
14	2.1	15
12	3.3	20
10	5.3	30
8	8.4	50
6	13.3	65
4	21.2	85
3	26.7	100
2	33.6	115
1	42.4	130
1/0	53.5	150
2/0	67.4	175
3/0	85.0	200
4/0	107.2	230
250 kcmil	127	255
300	152	285
350	177	310
400	203	335
500	253	380
600	304	420
700	355	460
750	380	475
800	405	490
900	456	520
1000	506	545
1250	633	590
1500	760	625
1750	887	650
2000	1013	665

For multiple conductors of the same size (1/0 AWG or larger) at a terminal, the ampacity is equal to the value in this table for that conductor multiplied by the number of conductors that the terminal is able to accommodate.

Relationship between conductor size and overcurrent protection rating for power circuits – Reference to UL 508A table 66.3

Conductor Size AWG	mm ²	Maximum Rating of Non- Time Delay Fuse or Inverse Time Circuit Breaker (Amps)	Time Delay or Dual Element Fuse (Amps)
14	2.1	60	30
12	3.3	80	40
10	5.3	100	50
8	8.4	150	80
6	13.3	200	100
4	21.2	250	125
3	26.7	300	150
2	33.6	350	175
1	42.4	400	200
1/0	53.6	500	250
2/0	67.4	600	300
3/0	85.0	700	350
4/0	107.2	800	400

To determine the wire size for motor loads, add the full-load current ratings found in UL 508A Table 50.1 for all external loads being carried by the conductor. Then use UL 508A Table 28.1 on the following page to determine the wire size for the calculated ampacity.

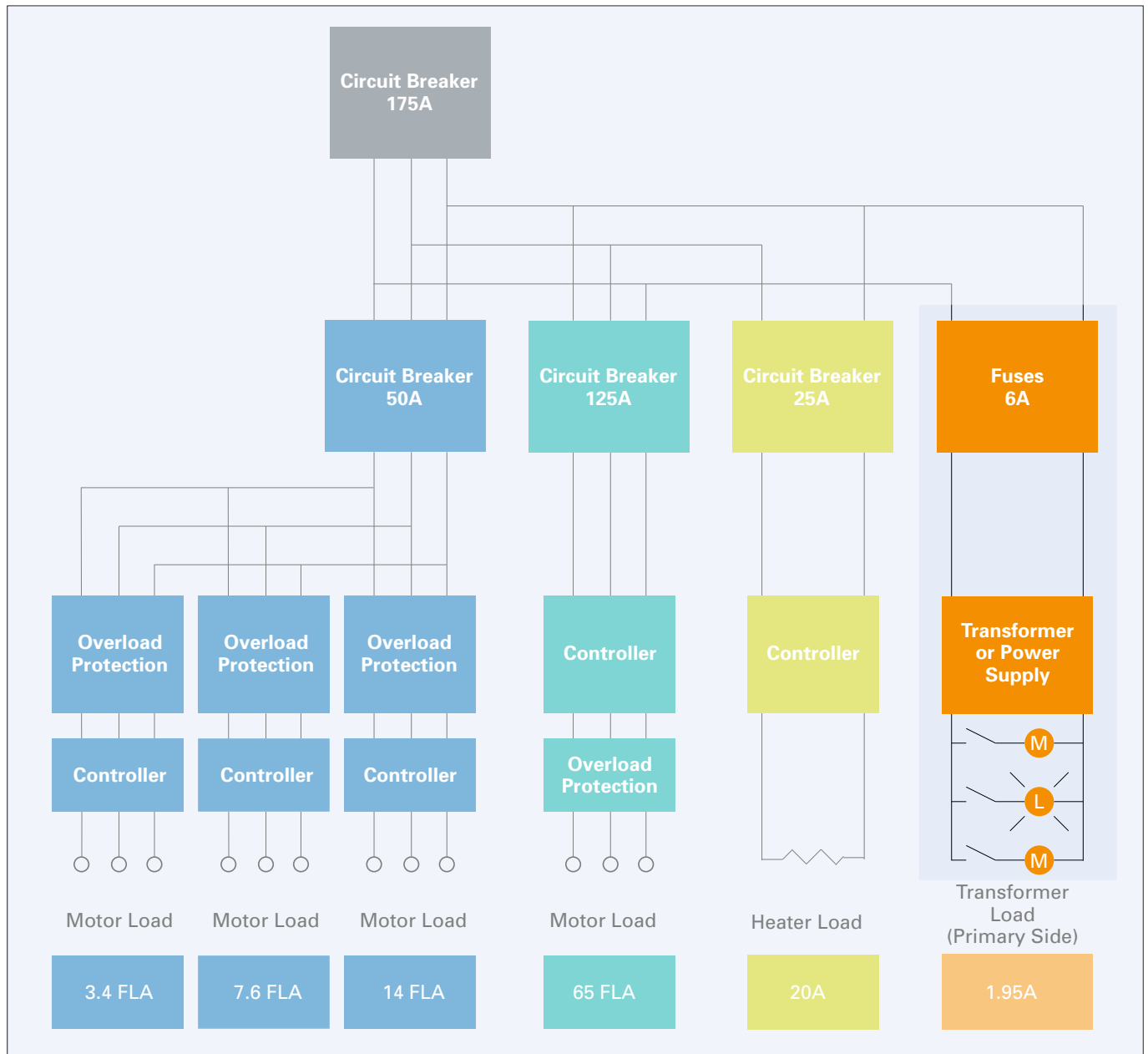
Full-load motor-running currents in amperes corresponding to various AC horsepower ratings – Reference to UL 508A table 50.1

HP	110–120V	200V		208V		220–240V A ¹⁾		380–415V		440–480V		550–600V	
	Single-Phase	Single-Phase	Three-Phase	Single-Phase	Three-Phase	Single-Phase	Three-Phase	Single-Phase	Three-Phase	Single-Phase	Three-Phase	Single-Phase	Three-Phase
1/10	3.0	–	–	–	–	1.5	–	1.0	–	–	–	–	–
1/8	3.8	–	–	–	–	1.9	–	1.2	–	–	–	–	–
1/6	4.4	2.5	–	2.4	–	2.2	–	1.4	–	–	–	–	–
1/4	5.8	3.3	–	3.2	–	2.9	–	1.8	–	–	–	–	–
1/3	7.2	4.1	–	4.0	–	3.6	–	2.3	–	–	–	–	–
1/2	9.8	5.6	2.5	5.4	2.4	4.9	2.2	3.2	1.3	2.5	1.1	2.0	0.9
3/4	13.8	7.9	3.7	7.6	3.5	6.9	3.2	4.5	1.8	3.5	1.6	2.8	1.3
1	16.0	9.2	4.8	8.8	4.6	8.0	4.2	5.1	2.3	4.0	2.1	3.2	1.7
1 1/2	20.0	11.5	6.9	11.0	6.6	10.0	6.0	6.4	3.3	5.0	3.0	4.0	2.4
2	24.0	13.8	7.8	13.2	7.5	12.0	6.8	7.7	4.3	6.0	3.4	4.8	2.7
3	34.0	19.6	11.0	18.7	10.6	17.0	9.6	10.9	6.1	8.5	4.8	6.8	3.9
5	56.0	32.2	17.5	30.8	16.7	28.0	15.2	17.9	9.7	14.0	7.6	11.2	6.1
7 1/2	80.0	46.0	25.3	44.0	24.2	40.0	22.0	27.0	14.0	21.0	11.0	16.0	9.0
10	100.0	57.5	32.2	55.0	30.8	50.0	28.0	33.0	18.0	26.0	14.0	20.0	11.0
15	135.0	–	48.3	–	46.2	68.0	42.0	44.0	27.0	34.0	21.0	27.0	17.0
20	–	–	62.1	–	59.4	88.0	54.0	56.0	34.0	44.0	27.0	35.0	22.0
25	–	–	78.2	–	74.8	110.0	68.0	70.0	44.0	55.0	34.0	44.0	27.0
30	–	–	92.0	–	88.0	136.0	80.0	87.0	51.0	68.0	40.0	54.0	32.0
40	–	–	120.0	–	114.0	176.0	104.0	112.0	66.0	88.0	52.0	70.0	41.0
50	–	–	150.0	–	143.0	216.0	130.0	139.0	83.0	108.0	65.0	86.0	52.0
60	–	–	177.0	–	169.0	–	154.0	–	103.0	–	77.0	–	62.0
75	–	–	221.0	–	211.0	–	192.0	–	128.0	–	96.0	–	77.0
100	–	–	285.0	–	273.0	–	248.0	–	165.0	–	124.0	–	99.0
125	–	–	359.0	–	343.0	–	312.0	–	208.0	–	156.0	–	125.0
150	–	–	414.0	–	396.0	–	360.0	–	240.0	–	180.0	–	144.0
200	–	–	552.0	–	528.0	–	480.0	–	320.0	–	240.0	–	192.0
250	–	–	–	–	–	–	604.0	–	403.0	–	302.0	–	242.0
300	–	–	–	–	–	–	722.0	–	482.0	–	361.0	–	289.0
350	–	–	–	–	–	–	828.0	–	560.0	–	414.0	–	336.0
400	–	–	–	–	–	–	954.0	–	636.0	–	477.0	–	382.0
450	–	–	–	–	–	–	1030.0	–	–	–	515.0	–	412.0
500	–	–	–	–	–	–	1180.0	–	786.0	–	590.0	–	472.0

1) To obtain full-load currents for 265 and 277 volt motors, decrease corresponding 220–240 volt ratings by 13 and 17 percent respectively.

Designing the control circuit

Reference to UL 508A



Control circuits provide the logic for the operation of the components in the power circuit. Control circuits are typically a lower, safer voltage, such as 120 Vac or 24 Vdc. Control power transformers (CPTs) and power supplies are used to transform or convert the power circuit voltage to the control circuit voltage.

Refer to page 47 for selection of the CPT and protective devices.

Eaton also offers a variety of control devices commonly used in control circuits.



A complete line of circuit protection solutions for UL 508A



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Control transformer

Rated output	Part no.	Short-time rating	primary current	Secondary current	primary protection, max. fuse acc. UL248 or max. circuit breaker acc. UL489	secondary protection, max. fuse acc. UL248 or max. circuit breaker acc. UL489, max. supplementary protector acc. UL1077
kVA	480/120V	kVA	A	A	A	A
						
0.06	STN0,06(480/120)	0.095	0.13	0.50	0.60	-
0.1	STN0,1(480/120)	0.16	0.21	0.83	1.00	-
0.16	STN0,16(480/120)	0.32	0.33	1.33	1.50	-
0.2	STN0,2(480/120)	0.38	0.42	1.67	2.00	-
0.25	STN0,25(480/120)	0.44	0.52	2.08	2.50	3.50
0.315	STN0,315(480/120)	0.6	0.66	2.63	3.00	4.00
0.4	STN0,4(480/120)	0.62	0.83	3.33	4.00	6.00
0.5	STN0,5(480/120)	0.88	1.04	4.17	5.00	6.00
0.63	STN0,63(480/120)	1.51	1.31	5.25	6.00	8.00
0.8	STN0,8(480/120)	2.25	1.67	6.67	8.00	10.00
1	STN1,0(480/120)	3.28	2.08	8.33	5.00	13.00
1.3	STN1,3(480/120)	4.8	2.71	10.83	6.00	13.00
1.6	STN1,6(480/120)	3.98	3.33	13.33	8.00	16.00
2	STN2,0(480/120)	5.75	4.17	16.67	10.00	20.00
2.5	STN2,5(480/120)	7.24	5.21	20.83	13.00	25.00
3	STN3,0(480/120)	8.36	6.25	25.00	15.00	30.00
4	STN4,0(480/120)	12.2	8.33	33.33	20.00	40.00
0.06	STZ0,06(480/120)	0.13	0.13	0.50	0.60	-
0.1	STZ0,1(480/120)	0.24	0.21	0.83	1.00	-
0.16	STZ0,16(480/120)	0.36	0.33	1.33	1.60	-
0.2	STZ0,2(480/120)	0.44	0.42	1.67	2.00	-
0.25	STZ0,25(480/120)	0.6	0.52	2.08	1.30	3.00
0.315	STZ0,315(480/120)	0.75	0.66	2.63	1.60	4.00
0.4	STZ0,4(480/120)	1.1	0.83	3.33	2.00	5.00
0.5	STZ0,5(480/120)	1.6	1.04	4.17	2.50	6.00
0.63	STZ0,63(480/120)	1.7	1.31	5.25	3.00	8.00
0.8	STZ0,8(480/120)	2	1.67	6.67	4.00	10.00
1	STZ1,0(480/120)	2.8	2.08	8.33	5.00	13.00
1.3	STZ1,3(480/120)	3.7	2.71	10.83	6.00	17.50
1.6	STZ1,6(480/120)	5.5	3.33	13.33	8.00	20.00
2	STZ2,0(480/120)	7	4.17	16.67	10.00	20.00
2.5	STZ2,5(480/120)	9	5.21	20.83	13.00	25.00
3	STZ3,0(480/120)	11.5	6.25	25.00	15.00	30.00
4	STZ4,0(480/120)	15	8.33	33.33	20.00	40.00

Electronic protection device PXS24

	Rated current A	Rated voltage V	Conductor cross-section AWG	with feed-in terminal	without feed-in terminal
PXS24S...F/ORT-IT and PXS24S...F/ORT					
 Standard (with communication plug)	2	24	20	PXS24S-e2/F/ORT-IT	PXS24S-e2/F/ORT
	4		20	PXS24S-e4/F/ORT-IT	PXS24S-e4/F/ORT
	6		18	PXS24S-e6/F/ORT-IT	PXS24S-e6/F/ORT
	8		16	PXS24S-e8/F/ORT-IT	PXS24S-e8/F/ORT
	10		16	PXS24S-e10/F/ORT-IT	PXS24S-e10/F/ORT
	13		14	PXS24S-e13/F/ORT-IT	PXS24S-e13/F/ORT
	16		14	PXS24S-e16/F/ORT-IT	PXS24S-e16/F/ORT
PXS24E...-IT and PXS24E...F					
 Economy (without communication plug)	2	24	20	PXS24E-e2/F-IT	PXS24E-e2/F
	4		20	PXS24E-e4/F-IT	PXS24E-e4/F
	6		18	PXS24E-e6/F-IT	PXS24E-e6/F
	8		16	PXS24E-e8/F-IT	PXS24E-e8/F
	10		16	PXS24E-e10/F-IT	PXS24E-e10/F

PXS24E...-IT and PXS24E...F

Connection terminals	PXS24-IT
Connection terminals, insulated	AKI16/10
Busbar, 1m	PXS24-BB/80A/1m
Busbar, 4 HP (approx. 70 mm)	PXS24-BB/80A/4TE
Busbar, 8 HP (approx. 140 mm)	PXS24-BB/80A/8TE
Busbar, 12 HP (approx. 210 mm)	PXS24-BB/80A/12TE
Busbar cover	PXS24-BBC

24 V DC PSG and PSL power supplies

Rated output Power W	Part no.		Rated output current A	Branch Circuit Protection UL248 Fuse or UL489 Circuit Breaker
				
	Single phase power supplies	3-phase power supplies		max. A
10	PSL10E24RP	-	2.5	20
30	PSL30E24RP	-	2.5	20
60	PSL60E24RP	-	5	20
75	PSG75E24SRP	-	10	20
100	PSL100E24RP	-	20	20
120	PSG120E24SRM	PSG120F24SRM	40	20
240	PSG240E24SRM	PSG240F24SRM		
480	PSG480E24SRM	PSG480F24SRM		
960	-	PSG960F24SRM		

Common control circuit wiring

Connections for Control Stations

Local Control

Figure A

START/STOP Pushbuttons

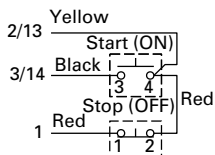


Figure D

2-Position Selector Switch

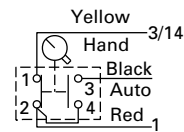


Figure B

START/STOP Selector Switch

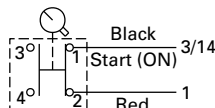


Figure E

Pilot Light (Motor RUN)

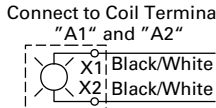


Figure C

3-Position Selector Switch

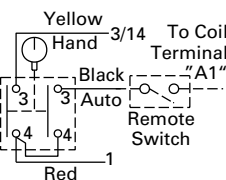
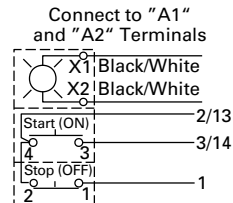
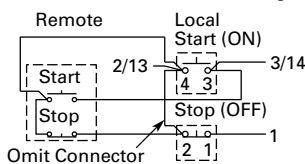


Figure F

START/STOP with Pilot Light



Combined Remote and Local for Figures 1 and 2

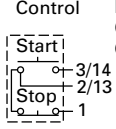


Remote Control

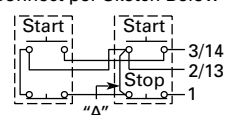
2-Wire Control



3-Wire Control



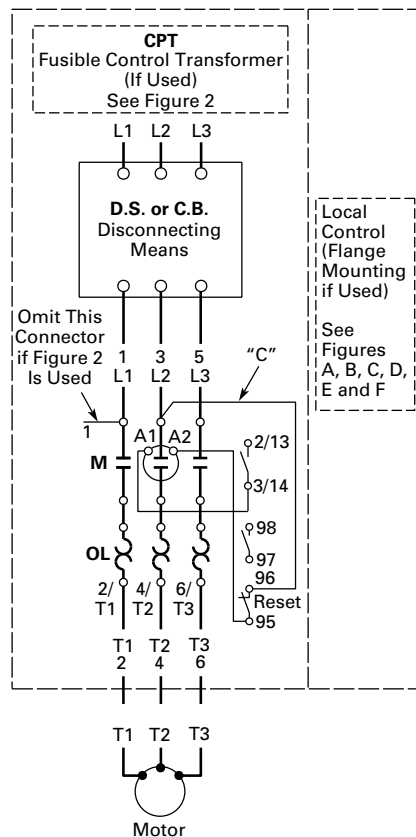
When More Than One Pushbutton Station Is Used, Omit Connector "A" and Connect per Sketch Below



Connections for Starters

Figure 1

Front View Diagram



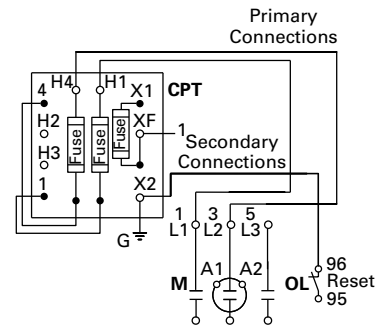
Separate Control

Remove Wire "C" if Supplied and Connect Separate Control Lines to the Number 1 Terminal on the Remote Pilot Device and to the Number 96 Terminal on the Overload Relay

Figure 2

Fusible Control Transformer

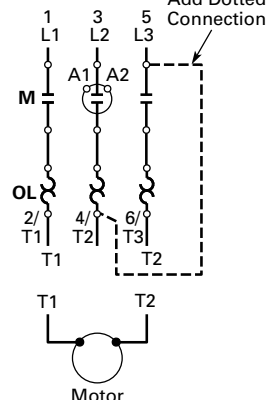
Remove Wire "C" (Figure 1) if Used and Connect as Shown Below. (All Other Starter Wires Remain as Shown in Figure 1)



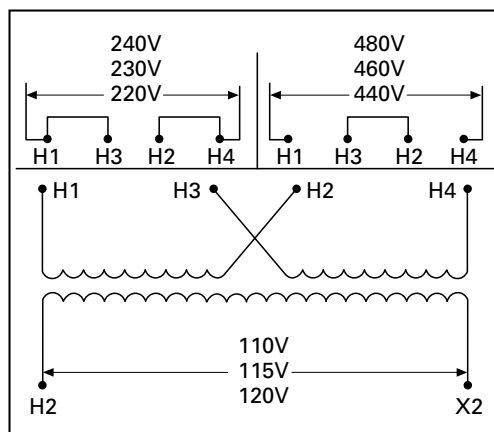
Connections for Dual Voltage Rated Transformer – See Transformer Nameplate

Field Conversion to 1-Phase

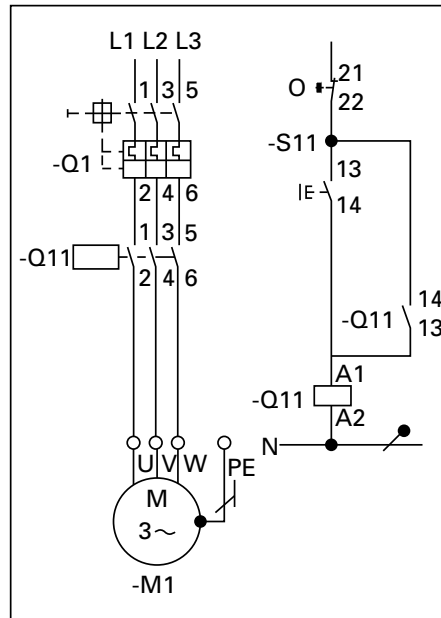
Add Dotted Connection



260878 D4



240V x 480V Primary, 120V Secondary CPT Wiring Diagram



Manual Motor Controller and Combination Motor Controller Wiring Diagram

Wire selection according UL508A

**Black:**

All ungrounded AC or DC conductors

**Red:**

Ungrounded AC control circuits

**Blue:** Ungrounded DC control circuits**Orange:**

Ungrounded AC or DC conductors, such as for cabinet lighting, that remain energized when the main disconnect is in the OFF position ("excepted circuits")

**White or gray or three white stripes on other than green, blue, orange, or yellow:**

Grounded AC or DC current-carrying control circuit conductor regardless of voltage

**White with blue stripe:**

Grounded DC current-carrying control circuit conductor

**White with orange stripe:**

Grounded AC or DC conductors that remains energized when main disconnect switch is in the OFF position ("excepted circuits")

**Green or Green/Yellow:**

Protective conductor



Wire size for control circuits must be no smaller than 18 AWG, with exception of control circuits for PLC input/outputs. Wire size is determined from Table 38.1 based on the amp rating of the overcurrent protective device for the control circuit or the amp rating of the secondary of the CPT or power supply.

Ampacity of control circuit conductors – Reference to UL 508A table 38.1

Ampacity, Amperes	Conductor Size	
	AWG	mm ²
10	16	1.3
7	18	0.82
5	20 ²⁾	0.52
3	22 ²⁾	0.32
2	24 ²⁾	0.20
1	26 ²⁾	0.13
0.8	28 ^{1) 2)}	0.08
0.5	30 ^{1) 2)}	0.05

1) Where these conductors are contained in a jacketed multi-conductor cable assembly.

2) These sizes of conductors are only for connection of control circuits for electronics programmable input/output and static control (having no moving parts).

UL Low voltage – branch circuit fuse links overview

Class CC		Class J		Class T	
					
Catalog numbers		LP-CC, FNQ-R, KTK-R		LPJ-SP(I), JKS	
Rated voltage	V AC	600		600	
	V DC	300		160/170	
Rated current		Up to 30 A		Up to 600 A	
Breaking capacity	RMS Sym	200 kA		200/300 kA	
	DC	20 kA		100 kA	
Operating class		Time delay, fast acting		Fast acting	
Fuse holders		Optima, CHCC, HPF, HPS		CUBEFuse, CH Class J modular holders, Safety J™	
Fuse blocks		BCM		N/A	
Standards		CE, UL Listed and CSA Certified		BH Modular style, T300 and T600 panel mount	
Applications		Specialised circuits, industrial control, isolated in-line fuse holder, line protection small control transformers		Power panelboards, branch circuit breaker panelboard mains, machinery disconnects, industrial control	

UL Low voltage – supplementary fuse links overview

Fast acting		Time delay	
			
Catalogue numbers		KTK, KLM, FNM, FNQ	
Rated voltage	V AC	600	
	V DC	-	
Rated current		Up to 30 A	
Breaking capacity	RMS Sym	100 kA	
	DC	N/A	
Operating class		Fast acting fuse links	
Fuse holders		Optima, CH, HPG, HPC, HPS, HPM, HPF, HEB, HEX, HEY, NDNF1-WH, CCP	
Fuse blocks		BCM, 4421 and 4515	
Standards		CE, UL Listed and CSA Certified	
Applications		Control circuits, lightning circuit protection, meter circuits	

Branch circuit fuses - Class CC Low peak™ time delay, rejection-type fuses

Rated current A	Rated voltage V	Breaking capacity kA	Operating class	Part no.
0.5	600 V a.c. / 300 V d.c.	200 kA RMS Sym. / 20 kA d.c.	Time delay	LP-CC-1-2
0.6				LP-CC-6-10
0.8				LP-CC-8-10
1				LP-CC-1
1.125				LP-CC-1-1-8
1.25				LP-CC-1-1-4
1.4				LP-CC-1-4-10
1.5				LP-CC-1-1-2
1.6				LP-CC-1-6-10
1.8				LP-CC-1-8-10
2				LP-CC-2
2.25				LP-CC-2-1-4
2.5				LP-CC-2-1-2
2.8				LP-CC-2-8-10
3	LP-CC-3			
3.2	LP-CC-3-2-10			
3.5	LP-CC-3-5-10			
4	LP-CC-4			
4.5	LP-CC-4-1-2			
5	LP-CC-5			
5.6	LPC-CC-5-6-10			
6	LP-CC-6			
6.25	LP-CC-6-1-4			
7	LP-CC-7			
7.5	LP-CC-7-5-10			
8	LP-CC-8			
9	LP-CC-9			
10	LP-CC-10			
12	LP-CC-12			
15	LP-CC-15			
20	LP-CC-20			
25	LP-CC-25			
30	LP-CC-30			
	600 V a.c. / 150 V d.c.			
	600 V a.c. / 300 V d.c.			



Branch circuit fuses – Class J Limitron™ fast-acting fuses

Rated current A	Rated voltage V	Breaking capacity kA	Operating class	Part no.
1	600 V a.c.	200 kA RMS Sym.	Fast-acting	JKS-1
2				JKS-2
3				JKS-3
4				JKS-4
5				JKS-5
6				JKS-6
8				JKS-8
10				JKS-10
12				JKS-12
15				JKS-15
20				JKS-20
25				JKS-25
30				JKS-30
40				JKS-40
45				JKS-45
50				JKS-50
60				JKS-60
70				JKS-70
80				JKS-80
90				JKS-90
100				JKS-100
110				JKS-110
125				JKS-125
150				JKS-150
175				JKS-175
200				JKS-200
225				JKS-225
250				JKS-250
300				JKS-300
350				JKS-350
400				JKS-400
450				JKS-450
500				JKS-500
600				JKS-600



Branch circuit fuses – Class CC Limitron™, rejection-type fuses

	Rated current A	Rated voltage V	Breaking capacity kA	Operating class	Part no.	
	0.25	600 V a.c.	200 kA RMS Sym.	Time-delay	FNO-R-1-4	
	0.3				FNO-R-3-10	
	0.4				FNO-R-4-10	
	0.5				FNO-R-5-10	
	0.6				FNO-R-6-10	
	0.75				FNO-R-3-4	
	0.8				FNO-R-8-10	
	1				FNO-R-1	
	1.125				FNO-R-1-1-8	
	1.25				FNO-R-1-1-4	
	1.3				FNO-R-1-3-10	
	1.4				FNO-R-1-4-10	
	1.5				FNO-R-1-1-2	
	1.6				FNO-R-1-6-10	
	1.8				FNO-R-1-8-10	
	2				FNO-R-2	
	2.25				FNO-R-2-1-4	
	2.5				FNO-R-2-1-2	
	2.8				FNO-R-2-8-10	
	3				FNO-R-3	
	3.2				FNO-R-3-2-10	
	4				FNO-R-4	
	4.5				FNO-R-4-1-2	
	5				FNO-R-5-10	
	5.6				FNO-R-5-6-10	
	6				FNO-R-6	
	6.25				FNO-R-6-1-4	
	7				FNO-R-7	
	7.5				FNO-R-7-1-2	
	8				FNO-R-8	
	9				FNO-R-9	
	10				FNO-R-10	
	12				FNO-R-12	
	15	600 V a.c. / 300 V d.c.	200 kA RMS Sym. / 20 Ka d.c.		FNO-R-15	
	17.5				FNO-R-17-1-2	
	20				FNO-R-20	
	25	600 V a.c.	200 kA RMS Sym.		FNO-R-25	
	30				FNO-R-30	

Branch circuit fuses – Class CC Limitron™, rejection-type fuses

	Rated current A	Rated voltage V	Breaking capacity kA	Operating class	Part no.
	0.1	600 V a.c.	200 kA RMS Sym.	Fast-acting	KTK-R-1-10
	0.125				KTK-R-1-8
	0.2				KTK-R-2-10
	0.25				KTK-R-1-4
	0.3				KTK-R-3-10
	0.4				KTK-R-4-10
	0.5				KTK-R-5-10
	0.6				KTK-R-6-10
	0.75				KTK-R-3-4
	1				KTK-R-1
	1.5				KTK-R-1-1-2
	2				KTK-R-2
	2.5				KTK-R-2-1-2
	3				KTK-R-3
	3.5				KTK-R-3-1-2
	4				KTK-R-4
	5				KTK-R-5
	6				KTK-6
	7				KTK-7
	8				KTK-8
	9				KTK-9
	10				KTK-10
	12				KTK-12
	15				KTK-15
	20				KTK-20
	25				KTK-25
	30				KTK-30

Supplementary fuses – Time-delay fuses

	Rated current A	Rated voltage V	Breaking capacity kA	Operating class	Part no.
	0.1	500 V a.c.	10 kA	Time-delay	FNQ-1-10
	0.125				FNQ-1-8
	0.15				FNQ-15-100
	0.188				FNQ-3-16
	0.2				FNQ-2-10
	0.25				FNQ-1-4
	0.3				FNQ-3-10
	0.4				FNQ-4-10
	0.5				FNQ-5-10
	0.6				FNQ-6-10
	0.8				FNQ-8-10
	1				FNQ-1
	1.125				FNQ-1-1-8
	1.25				FNQ-1-1-4
	1.5				FNQ-1-1-2
	1.6				FNQ-1-6-10
	2				FNQ-2
	2.25				FNQ-2-1-4
	2.5				FNQ-2-1-2
	3				FNQ-3
	3.2				FNQ-3-2-10
	4				FNQ-4
	4.5				FNQ-4-1-2
	5				FNQ-5
	5.6				FNQ-5-6-10
	6				FNQ-6
	6.25				FNQ-6-1-4
	7				FNQ-7
	8				FNQ-8
	9				FNQ-9
	10				FNQ-10
	12				FNQ-12
	14				FNQ-14
	15				FNQ-15
	20				FNQ-20
	25				FNQ-25
	30				FNQ-30

Supplementary fuses – Fast-acting fuses

	Rated current A	Rated voltage V	Breaking capacity kA	Operating class	Part no.
	0.1	600 V a.c.	100 kA	Fast acting	KTK-1-10
	0.125				KTK-1-8
	0.2				KTK-2-10
	0.25				KTK-1-4
	0.3				KTK-3-10
	0.4				KTK-4-10
	0.5				KTK-1-2
	0.6				KTK-6-10
	0.75				KTK-3-4
	1				KTK-1
	1.25				KTK-1-1-4
	1.5				KTK-1-1-2
	2				KTK-2
	2.5				KTK-2-1-2
	3				KTK-3
	3.5				KTK-3-1-2
	4				KTK-4
	5				KTK-5
	6				KTK-6
	7				KTK-7
	7.5				KTK-7-1-2
	8				KTK-8
	9				KTK-9
	10				KTK-10
	12				KTK-12
	15				KTK-15
	20				KTK-20
	25				KTK-25
	30				KTK-30

Branch circuit fuses – Class J Low peakTM dual-element, time delay fuses

Rated current A	Rated voltage V	Breaking capacity kA	Operating class	Part no.
Low peak dual element, time delay fuse links				
1	600 V a.c./ 300 V d.c.	300 Ka RMS Sym. / 100 kA d.c.	Time delay	LPJ-1SP
1.25				LPJ-1-1-4SP
1.6				LPJ-1-6-10SP
1.8				LPJ-1-8-10SP
2				LPJ-2SP
2.25				LPJ-2-1-4SP
2.5				LPJ-2-1-2SP
2.8				LPJ-2-8-10SP
3				LPJ-3SP
3.2				LPJ-3-2-10SP
3.5				LPJ-3-1-2SP
4				LPJ-4SP
4.5				LPJ-4-1-2SP
5				LPJ-5SP
5.6				LPJ-5-6-10SP
6				LPJ-6SP
7				LPJ-7SP
8				LPJ-8SP
9				LPJ-9SP
10				LPJ-10SP
12				LPJ-12SP
15				LPJ-15SP
17.5				LPJ-17-1-2SP
20				LPJ-20SP
25				LPJ-25SP
30				LPJ-30SP
35				LPJ-35SP
40				LPJ-40SP
45				LPJ-45SP
50				LPJ-50SP
60				LPJ-60SP
70				LPJ-70SP
80				LPJ-80SP
90				LPJ-90SP
100				LPJ-100SP
110				LPJ-110SP
125				LPJ-125SP
150				LPJ-150SP
175				LPJ-175SP
200				LPJ-200SP
225				LPJ-225SP
250				LPJ-250SP
300				LPJ-300SP
350				LPJ-350SP
400				LPJ-400SP
450				LPJ-450SP
500				LPJ-500SP
600				LPJ-600SP





The power of space

Next generation Compact Circuit Protector for use with Class CC and supplemental fuses requires up to 38% less space



Powering Business Worldwide

CCP2 UL 98 Class CF Disconnect switches

Rated current	Rated voltage	Description/switch operation	Number of poles	Compatible CUBEFuse**	Part no.
30 A CCP2 Disconnect switches					
30 A	347 V AC/125 V DC	CCP2 Class CF switch only	1	TCF and FCH up tp 30 A	CCP2-1-30CF
	600 V AC/125 V DC		2	TCF and FCH up tp 30 A	CCP2-2-30CF
	600 V AC		3	TCF and FCH up tp 30 A	CCP2-3-30CF
	600 V AC/125 V DC	CCP2 Class CF right front rotary, clockwise	2	TCF and FCH up tp 30 A	CCP2R-2-30CF
	600 V AC		3	TCF and FCH up tp 30 A	CCP2R-3-30CF
	600 V AC/125 V DC	CCP2 Class CF left front rotary, clockwise	2	TCF and FCH up tp 30 A	CCP2RL-2-30CF
	600 V AC		3	TCF and FCH up tp 30 A	CCP2RL-3-30CF
	600 V AC/125 V DC	CCP2 Class CF right side rotary, clockwise	2	TCF and FCH up tp 30 A	CCP2S-2-30CF
	600 V AC		3	TCF and FCH up tp 30 A	CCP2S-3-30CF
	600 V AC/125 V DC	CCP2 Class CF left side rotary, counterclockwise	2	TCF and FCH up tp 30 A	CCP2SL-2-30CF
	600 V AC		3	TCF and FCH up tp 30 A	CCP2SL-3-30CF
60 A CCP2 Disconnect switches					
60 A	347 V AC/125 V DC	CCP2 Class CF switch only	1	TCF and FCH up tp 60 A	CCP2-1-60CF
	600 V AC/125 V DC		2	TCF and FCH up tp 60 A	CCP2-2-60CF
	600 V AC		3	TCF and FCH up tp 60 A	CCP2-3-60CF
	600 V AC/125 V DC	CCP2 Class CF right front rotary, clockwise	2	TCF and FCH up tp 60 A	CCP2R-2-60CF
	600 V AC		3	TCF and FCH up tp 60 A	CCP2R-3-60CF
	600 V AC/125 V DC	CCP2 Class CF left front rotary, clockwise	2	TCF and FCH up tp 60 A	CCP2RL-2-60CF
	600 V AC		3	TCF and FCH up tp 60 A	CCP2RL-3-60CF
	600 V AC/125 V DC	CCP2 Class CF right side rotary, clockwise	2	TCF and FCH up tp 60 A	CCP2S-2-60CF
	600 V AC		3	TCF and FCH up tp 60 A	CCP2S-3-60CF
	600 V AC/125 V DC	CCP2 Class CF left side rotary, counterclockwise	2	TCF and FCH up tp 60 A	CCP2SL-2-60CF
	600 V AC		3	TCF and FCH up tp 60 A	CCP2SL-3-60CF
100 A CCP2 disconnect switches					
100 A	347 V AC/125 V DC	CCP2 Class CF switch only	1	TCF and FCH up tp 100 A	CCP2-1-100CF
	600 V AC/125 V DC		2	TCF and FCH up tp 100 A	CCP2-2-100CF
	600 V AC		3	TCF and FCH up tp 100 A	CCP2-3-100CF
	600 V AC/125 V DC	CCP2 Class CF right front rotary, clockwise	2	TCF and FCH up tp 100 A	CCP2R-2-100CF
	600 V AC		3	TCF and FCH up tp 100 A	CCP2R-3-100CF
	600 V AC/125 V DC	CCP2 Class CF left front rotary, clockwise	2	TCF and FCH up tp 100 A	CCP2RL-2-100CF
	600 V AC		3	TCF and FCH up tp 100 A	CCP2RL-3-100CF
	600 V AC/125 V DC	CCP2 Class CF right side rotary, clockwise	2	TCF and FCH up tp 100 A	CCP2S-2-100CF
	600 V AC		3	TCF and FCH up tp 100 A	CCP2S-3-100CF
	600 V AC/125 V DC	CCP2 Class CF left side rotary, counter-clockwise	2	TCF and FCH up tp 100 A	CCP2SL-2-100CF
	600 V AC		3	TCF and FCH up tp 100 A	CCP2SL-3-100CF
200 A CCP2 disconnect switches					
200 A	347 V a.c.	CCP2 Class CF switch only	1	N/A	CCP2-1-200CF
	600 V a.c.		2	N/A	CCP2-2-200CF
	600 V a.c.		3	N/A	CCP2-3-200CF

Space optimized variable switching and protection



The Bussmann series CCP is a fused UL 98 Listed branch circuit disconnect switch utilizing Bussmann series Class CF CUBEFuse with Class J performance.

The CCP is available in 30, 60, 100, 200 and 400 A versions (30 and 60 A versions have the same footprint) and is panel mountable and DIN Rail mountable (up to 100 A). The CCP is available as a switch only, or with front or side rotary mechanisms.

All CCPs are available with a variety of accessories, including lug kits with terminal shrouds, pistol handles, NFPA 79 compliant handles and auxiliary contacts.

Accessories - Handles

Handle type	Color	Suitable for switches	Part no.
Selector handle	Black/grey	Clockwise rotating - For use with: Right and left front clockwise rotating 30, 60 and 100 A disconnect switch CF. Clockwise rotating right front 30, 60 and 100 A	CCP2-H4X-B1
Selector	Rot/gelb		CCP2-H4X-R1
Pistolengriff	Schwarz/grau		CCP2-H4X-B2
Pistolengriff	Rot/gelb		CCP2-H4X-R2
Selector	Schwarz/grau	Counterclockwise - For use with counterclockwise 30, 60 and 100 switch disconnectors CF	CCP2-H4X-B1L
Selector	Rot/gelb		CCP2-H4X-R1L
Pistolengriff, kurz	Schwarz/grau		CCP2-H4X-B2L
Pistolengriff, kurz	Rot/gelb		CCP2-H4X-R2L
Pistolengriff, kurz	Schwarz/grau	Clockwise - For use with front rotary mechanism or side rotary mechanism CCP2-SM on the switch's right side	CCP2-H4X-B3
Pistolengriff, kurz	Rot/gelb		CCP2-H4X-R3
Pistolengriff, kurz	Schwarz/grau		CCP2-H4X-B4
Pistolengriff, kurz	Rot/gelb		CCP2-H4X-R4
Pistolengriff, lang	Schwarz/grau	Counterclockwise - Use only if installing side rotary mechanism CCP2-SM on the switch's left side	CCP2-H4X-B3L
Pistolengriff, lang	Rot/gelb		CCP2-H4X-R3L
Pistolengriff, lang	Schwarz/grau		CCP2-H4X-B4L
Pistolengriff, lang	Rot/gelb		CCP2-H4X-R4L
NFPA 79	Schwarz/grau	CF 30, 60, 100 A disconnect switches	CCP2-NFPA-1
NFPA 79	Rot/gelb	CF 200 A disconnect switches	CCP2-NFPA-2



Selector handle
black/grey
red/yellow



Short pistol
black/grey
red/yellow



Long pistol
black/grey
red/yellow



CCP2-NFPA-1
CCP2-NFPA-2



Disconnecter with variable actuation



Shown with left through the
side rotary



30 and 60 A CCP
Shown with right through
the side rotary



Shown with right through
the side rotary



100 A CCP
Shown with right
through the front rotary



Shown with left through
the front rotary



200 A CCP
Shown with right
through the side rotary



Shown with through the
front rotary



400 A CCP
Shown with through the
front rotary

CUBEFUSE™ - TCF Class CF Low peak time-delay CUBEFuse™

	A	Rated current	Breaking capacity	Recommended CUBEFuse™ finger-safe fuse holder
Indicating CUBEFuse				
TCF6	6	600 V AC./ 300 V DC.	300 kA (UL) / 200 kA (CSA) / 100 kA DC UL und CSA	TCFH30N/TCFH60N/TCFH100N
TCF10	10			TCFH30N/TCFH60N/TCFH100N
TCF15	15			TCFH30N/TCFH60N/TCFH100N
TCF17-1/2	17.5			TCFH30N/TCFH60N/TCFH100N
TCF20	20			TCFH30N/TCFH60N/TCFH100N
TCF25	25			TCFH30N/TCFH60N/TCFH100N
TCF30	30			TCFH30N/TCFH60N/TCFH100N
TCF35	35			TCFH60N/TCFH100N
TCF40	40			TCFH60N/TCFH100N
TCF45	45			TCFH60N/TCFH100N
TCF50	50			TCFH60N/TCFH100N
TCF60	60			TCFH60N/TCFH100N
TCF70	70			TCFH100N
TCF80	80			TCFH100N
TCF90	90			TCFH100N
TCF100	100			TCFH100N
TCF110	110		200 kA (UL) / 100 kA DC UL	TCFH200N/TCFH225N/TCFH400N
TCF125	125			TCFH200N/TCFH225N/TCFH400N
TCF150	150			TCFH200N/TCFH225N/TCFH400N
TCF175	175			TCFH200N/TCFH225N/TCFH400N
TCF200	200			TCFH200N/TCFH225N/TCFH400N
TCF225	225			TCFH225N/TCFH400N
TCF250	250			TCFH400N
TCF300	300			TCFH400N
TCF350	350			TCFH400N
TCF400	400			TCFH400N



CUBEFUSE™ - TCF Class CF Low peak time-delay CUBEFuse™

	A	Rated current	Breaking capacity	Recommended CUBEFuse™ finger-safe fuse holder
Indicating CUBEFuse				
TCF1RN	1	600 V AC./ 300 V DC.	300 kA (UL) / 200 kA (CSA) / 100 kA DC UL und CSA	TCFH30N/TCFH60N/TCFH100N
TCF3RN	3			TCFH30N/TCFH60N/TCFH100N
TCF6RN	6			TCFH30N/TCFH60N/TCFH100N
TCF10RN	10			TCFH30N/TCFH60N/TCFH100N
TCF15RN	15			TCFH30N/TCFH60N/TCFH100N
TCF17-1/2RN	17.5			TCFH30N/TCFH60N/TCFH100N
TCF20RN	20			TCFH30N/TCFH60N/TCFH100N
TCF25RN	25			TCFH30N/TCFH60N/TCFH100N
TCF30RN	30			TCFH30N/TCFH60N/TCFH100N
TCF35RN	35			TCFH60N/TCFH100N
TCF40RN	40			TCFH60N/TCFH100N
TCF45RN	45			TCFH60N/TCFH100N
TCF50RN	50			TCFH60N/TCFH100N
TCF60RN	60			TCFH60N/TCFH100N
TCF70RN	70			TCFH100N
TCF80RN	80			TCFH100N
TCF90RN	90			TCFH100N
TCF100RN	100			TCFH100N
TCF110RN	110		200 kA (UL) / 100 kA DC UL	TCFH200N/TCFH225N/TCFH400N
TCF125RN	125			TCFH200N/TCFH225N/TCFH400N
TCF150RN	150			TCFH200N/TCFH225N/TCFH400N
TCF175RN	175			TCFH200N/TCFH225N/TCFH400N
TCF200RN	200			TCFH200N/TCFH225N/TCFH400N
TCF225RN	225			TCFH225N/TCFH400N
TCF250RN	250			TCFH400N
TCF300RN	300			TCFH400N
TCF350RN	350			TCFH400N
TCF400RN	400			TCFH400N

CUBEFUSE™ - FCF Class CF Fast acting CUBEFuse™

	A	Rated voltage	Breaking capacity	Recommended CUBEFuse™ Finger- safe fuse holder
Indicating CUBEFuse 	FCF1RN	1	600 V AC/ V DC	TCFH30N/TCFH60N/TCFH100N
	FCF3RN	3		TCFH30N/TCFH60N/TCFH100N
	FCF6RN	6		TCFH30N/TCFH60N/TCFH100N
	FCF10RN	10		TCFH30N/TCFH60N/TCFH100N
	FCF15RN	15		TCFH30N/TCFH60N/TCFH100N
	FCF20RN	20		TCFH30N/TCFH60N/TCFH100N
	FCF25RN	25		TCFH30N/TCFH60N/TCFH100N
	FCF30RN	30		TCFH30N/TCFH60N/TCFH100N
	FCF35RN	35		TCFH30N/TCFH60N/TCFH100N
	FCF40RN	40		TCFH60N/TCFH100N
	FCF45RN	45		TCFH60N/TCFH100N
	FCF50RN	50		TCFH60N/TCFH100N
	FCF60RN	60		TCFH60N/TCFH100N
	FCF70RN	70		TCFH100N
	FCF80RN	80		TCFH100N
	FCF90RN	90		TCFH100N
	FCF100RN	100		TCFH100N
			200 kA (CSA und UL) / 50 kA DC	TCFH100N
				TCFH100N
				TCFH100N
				TCFH100N

CHCC Class CC Modular fuse holders

	Number of poles	A	Rated voltage	Breaking capacity	Recommended fuse links
Without indicator					
CHCC1DU	1	30	600 V AC/ V DC	200 kA	LP-CC, FNQ-RL KTK-R
CHCC2DU	2	30	600 V AC/ V DC	200 kA	LP-CC, FNQ-RL KTK-R
CHCC3DU	3	30	600 V AC/ V DC	200 kA	LP-CC, FNQ-RL KTK-R
With indicator					
CHCC1DIU	1	30	600 V AC/ V DC	200 kA	LP-CC, FNQ-RL KTK-R
CHCC2DIU	2	30	600 V AC/ V DC	200 kA	LP-CC, FNQ-RL KTK-R
CHCC3DIU	3	30	600 V AC/ V DC	200 kA	LP-CC, FNQ-RL KTK-R
CHCC1DI-48U	1	30	48 V DC	200 kA	LP-CC, FNQ-RL KTK-R



CHCC1DU



CHCC2DU



CHCC3DU

UL 98 R9 Switch-disconnectors

Description		Ampere rating	Part no.	Part no.	Short Circuit Current Rating		
3 Pole switch + direct handle					max. Fuse Class J	480 V	600 V
	3 pole switch-disconnector with knob	30	R9C3030U-DH	191859	30 A	100 kA	100 kA
		60	R9C3060U-DH	191860	60 A	100 kA	100 kA
		100	R9C3100U-DH	191861	100 A	100 kA	25 kA
3 Pole switch body		Ampere rating					
	Switch-disconnector UL98 basic	30	R9C3030U	191853	30 A	100 kA	100 kA
		60	R9C3060U	191854	60 A	100 kA	100 kA
		100	R9C3100U	191855	100 A	100 kA	25 kA

Zubehör

Direct handle

	Thumb-grip, black	DHR9	191845
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External operating handle

	Size 0 handle, Nema 4X	Colour		
		Black	SHB0N4X	191849
		Red	SHR0N4X	191850

Shaft extensions for external handle

	Shafts are for external front and right side handles	Length mm (inch)		
		90 (3.50)	SF90SH5X5	191846
		200 (7.87)	SF200SH5X5	191847
		320 (12.60)	SF320SH5X5	191862

Guide cone

	Guide cone is recommended for use with 320 mm shaft Allows up to 10mm of vertical offset of the shaft	SFGAB	191848
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Switched 4-pole module

	Transforms a three-pole switch into a four pole	Ampere rating		
		30	S4PR930	191856
		60	S4PR960	191857
		100	S4PR9100	191858

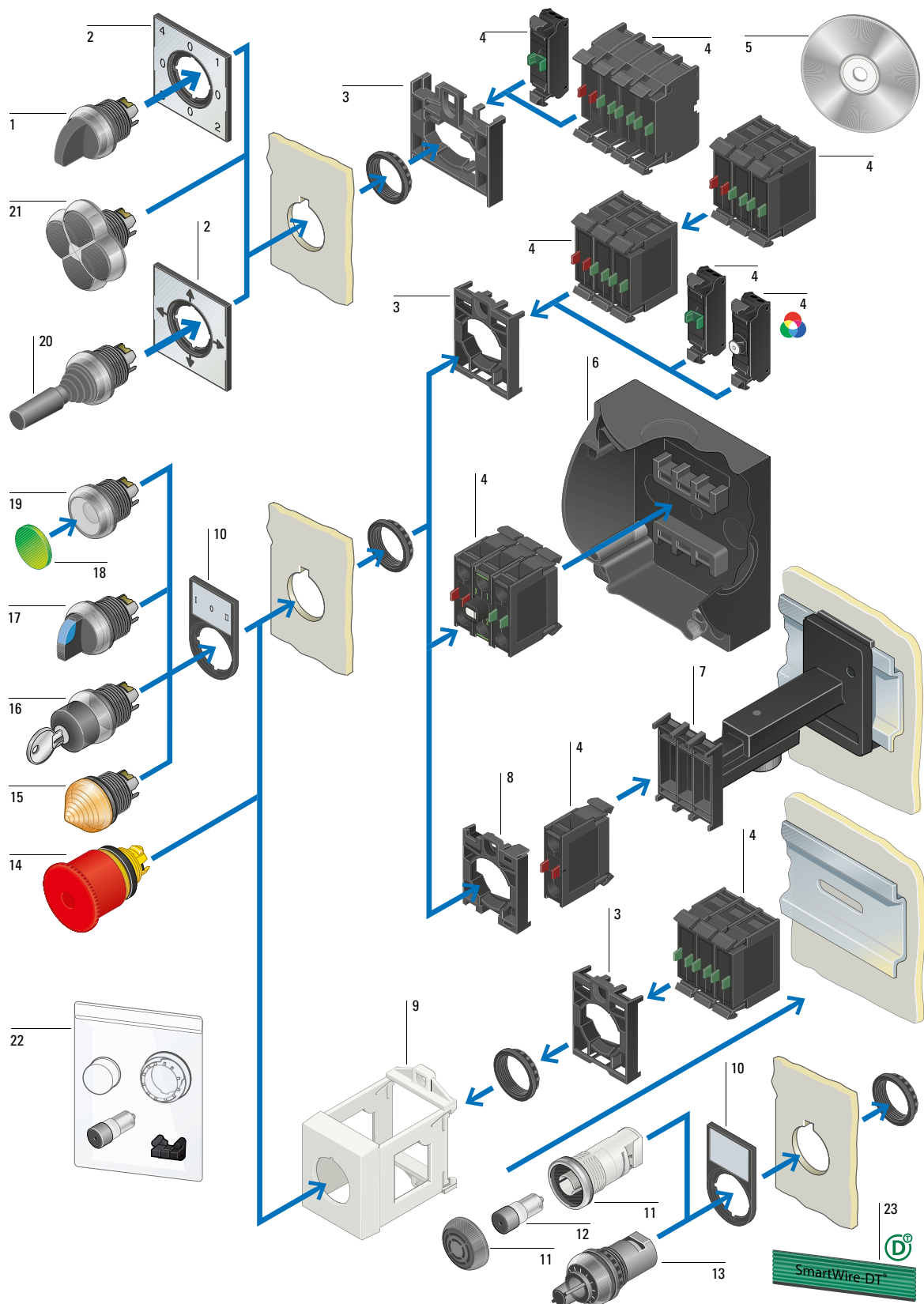
Auxiliary contacts

	Early-break/same-make and signalization of positions 0 and I. 1NO + 1NC or 2NO auxiliary contacts. Can be mounted on the left or right side of the device. Maximum four auxiliary contacts (two modules)	Type		
		1 NO + 1 NC	AC1NONC	191843
		2 NO	AC2NO	191844

Terminal shrouds

	"Protection against direct contact with the terminals. Contains 2 pcs to protect line and load side. Single or three-pole versions."	Number of poles		
		1	TS1R9	191851
		3	TS3R9CV	191852

Logic control – pilot devices selection



- | | | | |
|-----------------------------------|----------------------------|---|------------------------------|
| 1 4-way selector switch actuators | 8 Centring adapter | 14 Controlled stop pushbuttons/
emergency-stop buttons | 20 Joystick |
| 2 Labels with label mounts | 9 IVS top-hat rail adapter | 15 Indicator light | 21 4-way pushbutton |
| 3 Mounting clamp | 10 Label mounts | 16 Key-operated actuators | 22 Accessories |
| 4 Contact/LED elements | 11 Acoustic device | 17 Changeover switches | 23 SmartWire-DT ribbon cable |
| 5 Individual inscription | 12 Buzzer | 18 Button plates/lenses | |
| 6 Surface mounting enclosure | 13 Potentiometer | 19 Pushbutton actuators | |
| 7 Telescopic clip | | | |



In great shape: The world market control circuit devices RMQ Titan



Catalog download:

The RMQ-Titan devices have been granted numerous national approvals and ship classifications, meaning they are ready for use anywhere in the world. Especially the RMQ-Titan units with a flush design and a frame size of 30mm meets the requirements of the US market. The flush pushbuttons features a modular design and are the perfect match for the RMQTitan series, flush contacts, and LED elements.

Modern styling has been combined with an optimum range of functions. The perfect outfit for use at machines and on panels around the world. The ergonomically shaped button elements are matched to the shape of a fingertip for even more comfortable operations.

Rules for Operator Controls

1. Start buttons and switches should be located either above or to the left of the associated stop button.



2. Every control panel that includes operator controls should include an emergency stop. This emergency stop should be a mushroom or palm type that is self-latching.





SmartWire-DT: The communication and wiring system for more profitability



[Click here for catalog download](#)

Customer expectations today are focused on increased performance in a more compact design, shorter delivery times, and the right price. To meet these requirements, machines need to be built in shorter time frames, using smaller control cabinets with intelligent, energy-saving devices that allow a smaller footprint compared with existing components.

For plants and systems the availability is the key to higher profitability. SmartWire-DT is a unique wiring solution that streamlines connection and communications inside and outside control panels.

Machine and system builders globally are finding that SmartWire-DT can be integrated easily into machines in a smaller control cabinet, reducing the time and effort for wiring their machines and systems by up to 85 %. In operation the profitability of the machines and system can be raised. Digital and analog data help to improve the performance and to avoid downtimes.



Cleaner wiring solution

Background

US-based Renegade Parts Washers manufactures heavy-duty parts washing machines for numerous applications. Founded in 1996, the company has grown from offering a single solution to now having the capability to manufacture customized solutions built to their customers' specifications.

Challenge

Customers depend on a solution that will quickly and efficiently clean a high volume of parts and demand the shortest lead time between production and final end-user installation. With the increasing complexity of its machines, Renegade was looking for ways to optimize its production processes.

Solution

A machine control system based on the SmartWire-DT communication system cut wiring time, improved flexibility, and supported the implementation of advanced diagnostic features. This meant simpler machines at a lower cost and with added functionality. Extension up to 600m outside the control panel also allowed the connection of sensors and other machine-mounted devices.

Results

"SmartWire-DT has transformed our control systems," says Dave Barney, owner of Renegade Parts Washers. "It has allowed us to cut our wiring times while improving the flexibility of our systems and adding advanced diagnostic facilities that are a big selling point when we talk to our customers. We'll certainly be using SmartWire-DT on all of the automated machines we build in the future."



Streamlining processes for reliable production

Background

Grossi Electric Inc. is a full service electrical company, based in Escalon (CA), that specializes in industrial and commercial construction and automation services. Mike Grossi, founder and principal, was interested in expanding its services into lean agricultural automation systems. The opportunity arose when a nearby walnut processing plant contacted Grossi Electric to help facilitate some of its processes.

Challenge

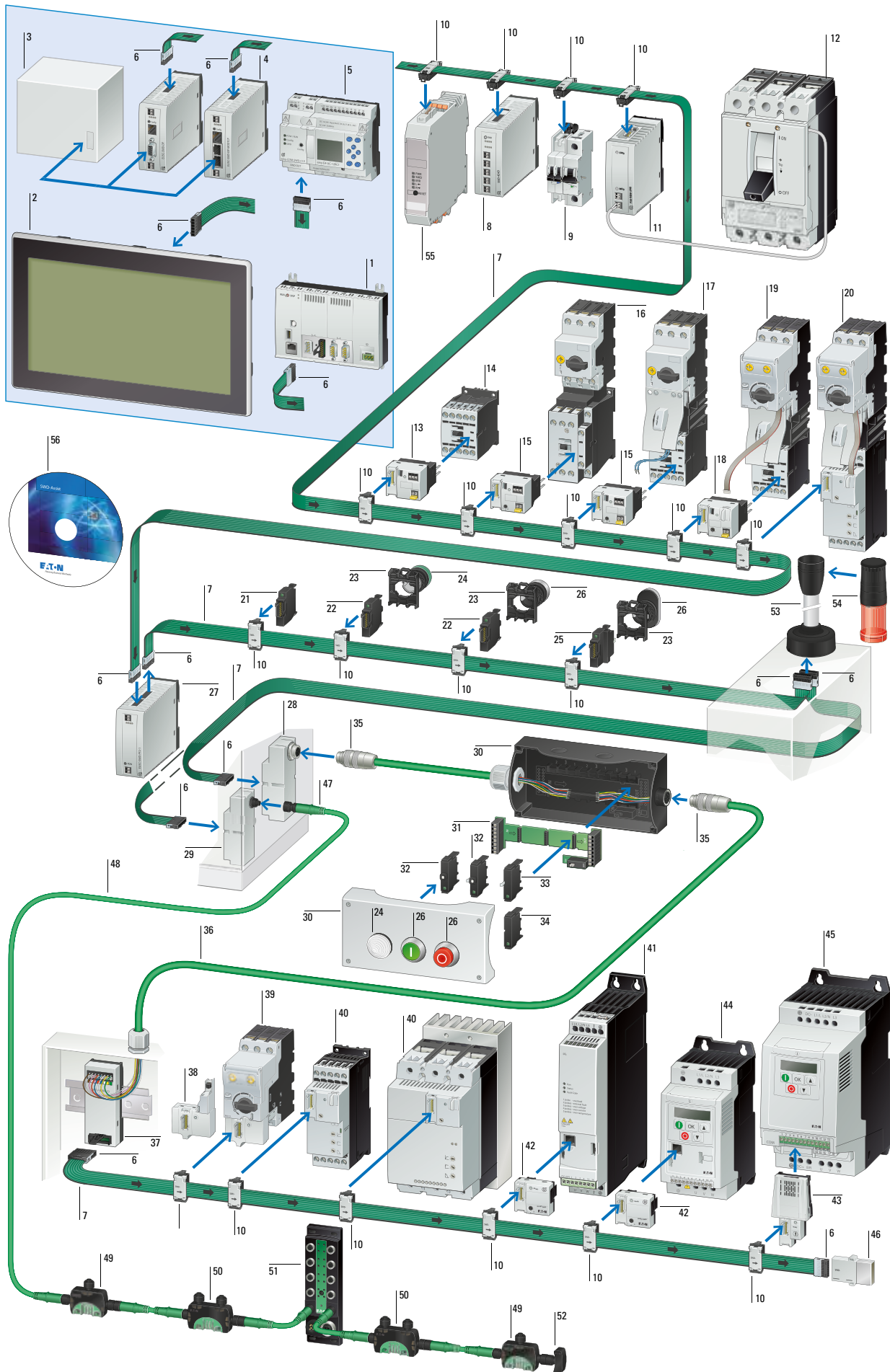
On the motor control side, the walnut plant project seemed fairly straightforward, though Grossi saw there was great potential to develop a more elegant solution. The vision was to make the harvesting process smarter, simpler and more effective.

Solution

By combining Eaton products into a total package solution, Grossi designed a very affordable and cost-effective control system for the walnut processing plant. SmartWire-DT enabled the control panels to be built and wired more quickly, with greater reliability. The result was a completely intelligent communication and control system for the panel, while keeping to a very simple design.

Results

In collaboration with Eaton, Grossi Electric designed and implemented a smarter and leaner automation control system for the walnut hulling and dehydration machine. The overall look and feel of the control panel was clean and simple to the end user, while the customer loved the small footprint, which was a quarter of the original design. Grossi noted benefits of the Eaton system solution in terms of improved reliability, ease of maintenance and comprehensive cost savings for his company and his customer.



1 Compact PLC	17 MSC motor starters	31 SWD card for function elements, base fixing	45 DA1 variable frequency drives
2 Touch panel	18 SWD PKE module (motor starter)	32 SWD LED elements for base fixing	46 SWD bus termination resistor for 8 pole flat band conductor
3 PLC with field bus interface	19 Motor starters with PKE electronic motor protection	33 SWD function elements for base fixing	47 M12 plug connector, 5 pole
4 Gateways	20 DS7 soft starters with PKE electronic motor protection	34 SWD universal modules, base fixing	48 Round cable, 5-pole
5 Control relays easyE4	21 SWD universal module, front mount	35 SWD plug-in connector, 8 pole	49 SWD I/O module IP67, 2 I/O
6 SWD blade terminal, 8 pole	22 SWD LED element, front mount	36 SWD round cable, 8 pole	50 SWD I/O module IP67, 4 I/O
7 SWD ribbon cable, 8 pole	23 RMQ-Titan mounting clamps for flush mounting plates	37 SWD adapter for flat/round cable for top-hat rail mounting	51 SWD I/O module IP67, max. 16 I/O
8 SWD I/O module	24 RMQ-Titan indicator lights	38 SWD PKE module (motor-protective circuit-breaker)	52 SWD bus termination resistor IP67 for 5 pole round cable, M12
9 SWD module for circuitbreakers and residual current circuit-breakers	25 SWD function elements for front mount	39 PKE motor-protective circuit-breakers	53 Base module signal tower SL4/SL7
10 SWD external device plug, 8 pole	26 SWD operating elements	40 Soft Starter DS7	54 Signal towers SL4 /SL7
11 SWD interface for NZM	27 SWD power feeder module	41 DE1 Variable speed starter	55 Electronic Motor Starter EMS
12 NZM circuitbreakers	28 SWD control panel bushing ribbon cable to 8 pole round cable, M20	42 SWD function element for DC1 variable frequency drive, DE1 variable speed starter	56 SmartWire-DT planning and ordering aid (SWD-Assist)
13 SWD contactor module	29 SWD control panel bushing ribbon cable to 5 pole round cable, M12	43 SWD function element for DA1 variable frequency drive	
14 DILM contactor	30 Surface mounting enclosure RMQ-Titan	44 DC1 variable frequency drives	
15 SWD contactor module with manual 0 automatic switch			
16 Motor-protective circuitbreakers			

Features

SmartWire-DT coordinators

Touch panel

With SWD master switch and PLC function
3.5", 5.7", 7", 10" and 15" TFT-LCD screen, additional
field bus interfaces, Ethernet, WEB server

Compact controller

With SWD master switch
Additional fieldbus interfaces, Ethernet, WEB server

Control relay

With SWD master switch

Gateways

Connection of SmartWire-DT to fieldbus (e.g. CANopen, Profibus, Profinet ...)

Supply voltage for the SmartWire-DT modules

Feeder unit for the control voltage for the motor starter or contactor

Support of up to 99 SmartWire-DT modules

SmartWire-DT module

I/O modules to connect digital and analog input/output signals in IP20, IP67 degree of protection

DS7 Soft starter with integrated connection

Function element to connect to:

- Pilot devices RMQ-Titan
- SL4/7 signal tower
- Contactor DILM
- Motor-protective circuitbreaker PKZ/PKE
- PKE32, 65 circuitbreaker
- NZM2, 3, 4 circuitbreakers
- Miniature circuit breaker (MCB)
- DE1 Variable speed starter
- DC1, DA1 variable frequency drives
- XNH fuse-switch disconnectors

SmartWire-DT-Assist (SWD-Assist)

Easily create SmartWire-DT networks integrated validity check

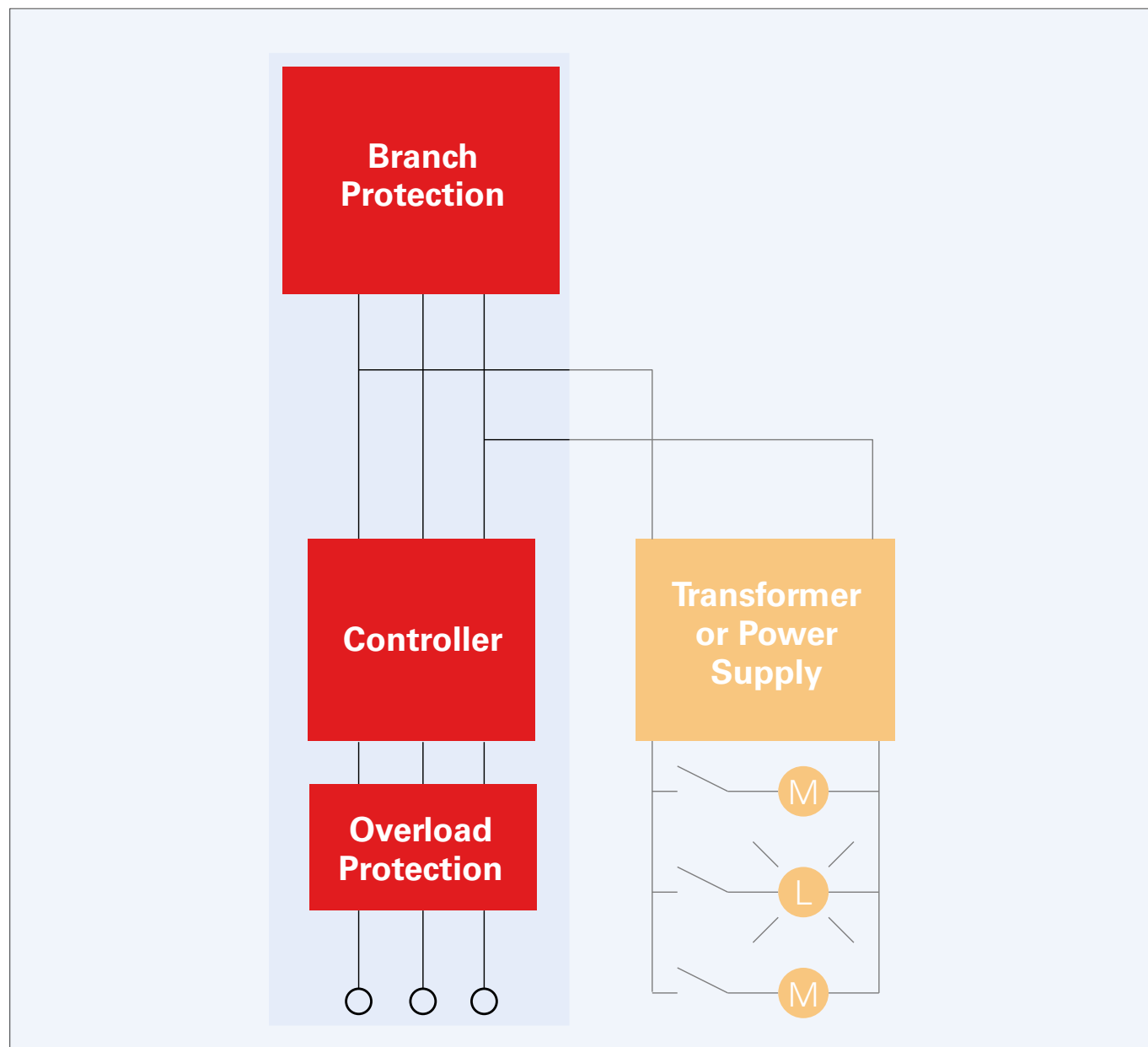
Generate order lists.

Online functions:

- Configuration check and comparison
- Display of all input/output data, setting outputs
- Display of parameters and diagnostics

Free download at Eaton.com/software

Sizing the branch protection for a single motor and a control circuit



Single Motor Load and Control Circuit with Shared Branch Protection

For single motor load control panel where the branch protective device acts as the main for the panel and the control circuit is tapped off the load side of the device, the branch protective device is sized by the following:

1. Multiply the motor FLA (from Table 50.1 on page 35) with the following percentage based on the type of protective device from the table at right:
2. Add the full-load current on the primary of the CPT from the table below.
3. Select the closest standard protective device rating.

See page 8 for selection of the controller and overload protection.

Conductors of a control circuit that are tapped from the load side of a branch circuit device (and where the power voltage is the same as the control voltage – no CPT) shall be protected by overcurrent devices rated not more than as specified in the table at the right.

Branch Circuit Protection

Type	Percent of FLA
Non-time delay fuse and Class CC fuse	Up to 300%
Dual element fuse (time delay) except Class CC	Up to 175%
Inverse-time circuit breaker	Up to 250%
Self-protected combination motor controller	100%
Manual self-protected combination motor controller	100%

Circuit protective device – Reference to table UL 508a table 66.5

Conductor Size		Control Circuit Overcurrent Device (Amps)	Branch Circuit Overcurrent Device (Amps)	
AWG	mm ²		Control in Wire Panel	Remote Control
Larger than 14	Larger than 2.1	Equal to wire capacity	400% of wire ampacity	300% of wire ampacity
14	2.1	20	80	60
16	1.3	20	40	20
18	0.82	20	25	20

See table on page 6 for breaker and fused disconnect part numbers, and page 50 for fuses.

Common formulas and conversions

	Direct Current	Single-Phase (AC)	Three-Phase (AC)
Current (I) from HP	$I = \frac{HP \times 746}{V \times \%EFF}$	$I = \frac{HP \times 746}{V \times \%EFF \times PF}$	$I = \frac{HP \times 746}{V \times \%EFF \times PF \times 1.73}$
Current (I) from kW	$I = \frac{kW \times 1000}{V}$	$I = \frac{kW \times 1000}{V \times PF}$	$I = \frac{kW \times 1000}{V \times PF \times 1.73}$
Current (I) from kVA		$I = \frac{kVA \times 1000}{V}$	$I = \frac{kVA \times 1000}{V \times 1.73}$
Horsepower (HP)	$HP = \frac{V \times I \times \%EFF}{746}$	$HP = \frac{V \times I \times \%EFF \times PF}{746}$	$HP = \frac{V \times I \times \%EFF \times PF \times 1.73}{746}$

Voltage Drop Calculations	
V	Voltage drop
I	Current
L	Length of cable/wire (ft)
D	Conductor cross section (circular mile)
K	Resistivity of conductor • K = 12 for circuits loaded more than 50% of rating (copper) • K = 11 for circuits loaded less than 50% of rating (copper)
Two-wire, single-phase	$V = \frac{2K \times L \times I}{D}$
Three-wire, three-phase	$V = \frac{2K \times L \times I \times 0.866}{D}$

Conversions	
1 inch	2.54 cm
3.28 feet	1 meter
1 yard	0.91 meters
1 mile	5,280 feet
1 mile	1.609 kilometers
144 square inches	1 square foot
9 square feet	1 square yard
640 acres	1 square mile
1 cubic foot	7.48 gallons

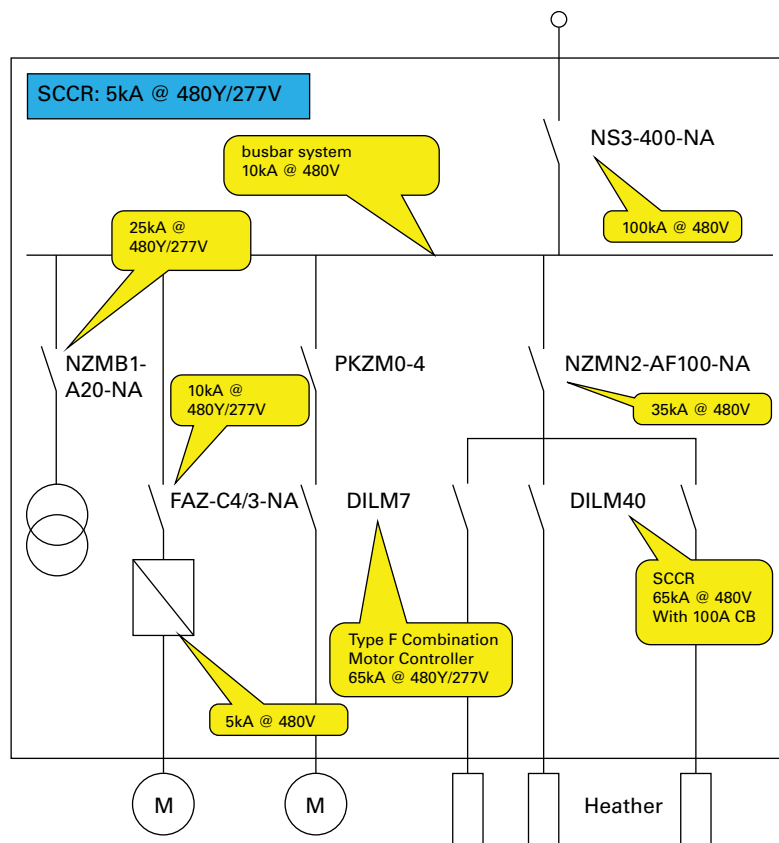
Determination of the Overall Panel Short Circuit Current Rating (SCCR) according to UL508A Supplement SB

General Procedure / Weakest Link Method:

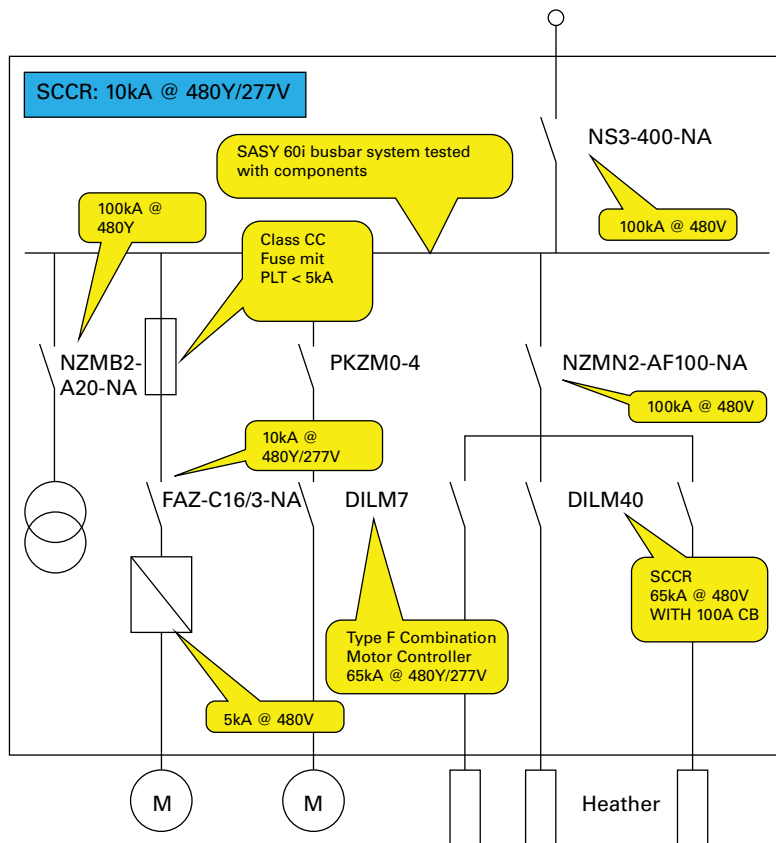
1. compilation of the component short circuit current ratings of all components in the main circuit
2. identify the weakest link
3. increasing the short circuit value of components with low short circuit levels in the branch circuit by using current limiting measures in the feeder circuit
4. possibly replacing branch circuit protective devices with low short-circuit small short-circuit breaking capacity by BCPDs with higher short-circuit breaking capacity

All protective devices in the feeder circuit must have at least a short-circuit breaking capacity equal to the panel SCCR must have. Serial Ratings (in terms of back-up protection) of protection devices is not provided according to UL508A.

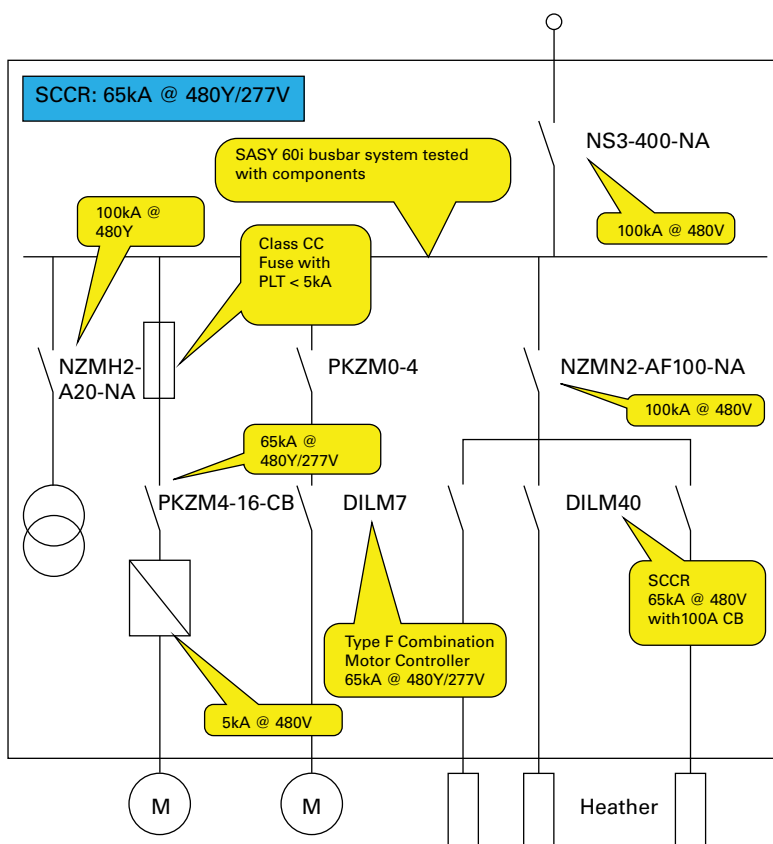
Current-limiting elements - such as fuses or circuit breakers - must be installed in the feeder circuit and must not must not be the branch circuit protective device of the branch to be branch to be strengthened.



The smallest short-circuit value of all components in the main current determines the SCCR of the entire plant.



The use of a current-limiting fuse can compensate for the low component Short Circuit Rating of the inverter in the Branch Circuit can be increased.



If you now replace the BCPD upstream of the frequency drive for a higher-quality one, the SCCR is increased even further.



[Click here and download the whitepaper](#)

North American environmental type ratings for electrical equipment

Comparison of North American and IEC/EN environmental ratings for electrical equipment

IP ratings per IEC/EN standards cannot be used as a substitute for North American Type ratings. **The IP ratings shown represent a rough comparison only.** A precise conversion is not possible since tests and evaluation criteria in the relevant standards differ greatly from one another. UL/CSA and NEMA type ratings are often used interchangeably. The significant difference between the two is that a UL/CSA type rating represents third party certification by an approved testing agency, which is the preferred manner in which ratings are verified in North America.

North American environmental type ratings are referenced in the following standards:

- NFPA 70 (National Electrical Code),
- CEC (Canadian Electrical Code),
- UL 50E, UL 508A,
- CSA-C22.2 No. 94-M91 (2006),
- NEMA 250-2008
(National Electrical Manufacturers Association).

North American environmental Type ratings	Application	Rough equivalency to IP ratings per IEC/EN 60529, DIN 40050
UL/CSA Type 1 Incidental contact with enclosed equipment; falling dirt	Indoor use	IP20
UL/CSA Type 2 Driptight	Indoor use	IP22
UL/CSA Type 3 Dusttight, raintight, degree of protection against rain, snow and sleet	Outdoor use	IP55
UL/CSA Type 3 R Rainproof, degree of protection against rain, snow and sleet	Outdoor use	IP24
UL/CSA Type 3 S Dust-tight, rain-tight, protection against sleet and ice	Outdoor use	IP55
UL/CSA Type 3 X, 3 RX, 3 SX same as 3, 3 R and 3 S, but with corrosion resistance	Outdoor use	IP55
UL/CSA Type 4 Watertight, raintight, dusttight	Indoor or Outdoor use ¹⁾	IP66
UL/CSA Type 4 X Watertight, raintight, dusttight, corrosion resistant	Indoor or Outdoor use ¹⁾	IP66
UL/CSA Type 5 Driptight, dusttight	Indoor use	IP53
UL/CSA Type 6 Raintight, watertight, temporarily submersible	Indoor or Outdoor use ¹⁾	IP67
UL/CSA Type 12 Common industrial rating, driptight, dusttight	Indoor use	IP54
UL/CSA Type 13 driptight, dusttight, oiltight	Indoor use	IP54

1) Take note of manufacturer instructions!



A complex job made simple – Successful export to North America

Machinery from Germany, Europe, and the rest of the world that follows IEC standards is frequently exported to North America (the United States and Canada). However, the codes and standards that need to be complied with there are significantly different from those used in other parts of the globe.

One thing that is certain is that the percentage of technologically sophisticated and innovative German machines that are being exported is growing considerably. This is why it is important for you to be absolutely ready for the UL market and the specifics it entails. After all, providing electrical and electronic equipment that meets all of your North American customers' expectations is a perfect way to stand out among the competition.

The EMEA Eaton Experience Center offers custom-tailored training courses focusing on UL 508A and NFPA 79-compliant panel building. These courses are a great way to learn exactly what it takes to successfully export electrical equipment to North America.

<https://www.eaton.com/gb/en-gb/support/education-training.html>

During the training course, you will learn:

- The basics behind the relevant codes and standards
- Device types and main applications in North America
- Mains / power supply
- Short Circuit Current Rating
- and much more!



Eaton is an intelligent power management company dedicated to improving the quality of life and protecting the environment for people everywhere. We are guided by our commitment to do business right, to operate sustainably and to help our customers manage power – today and well into the future. By capitalizing on the global growth trends of electrification and digitalization, we're accelerating the planet's transition to renewable energy, helping to solve the world's most urgent power management challenges, and doing what's best for our stakeholders and all of society.

Founded in 1911, Eaton is marking its 100th anniversary of being listed on the New York Stock Exchange. We reported revenues of \$20.8 billion in 2022 and serve customers in more than 170 countries. For more information, **visit www.eaton.com**. Follow us on **Twitter** and **LinkedIn**.

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Eaton Industries GmbH
Hein-Moeller-Str. 7–11
D-53115 Bonn/Germany

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