

## Control panel design guide

# UL 508A control panel design guide

The easy-to-design guide for selection of electrical control components in control panels used in industrial machinery applications

This guide is provided to assist with the design of control panels per UL® 508A, specifically for use in industrial machinery applications. This guide is designed to cover the most common applications of electrical control products per UL 508A, but is by no means an exhaustive guide, and does not cover all uses and applications associated with UL 508A regulations. This guide is not intended to be used in lieu of UL 508A or other regulatory standards. Always consult all pertinent actual regulatory standards and local standard representatives to ensure full compliance.



element14

## A long history of innovation in control and protection

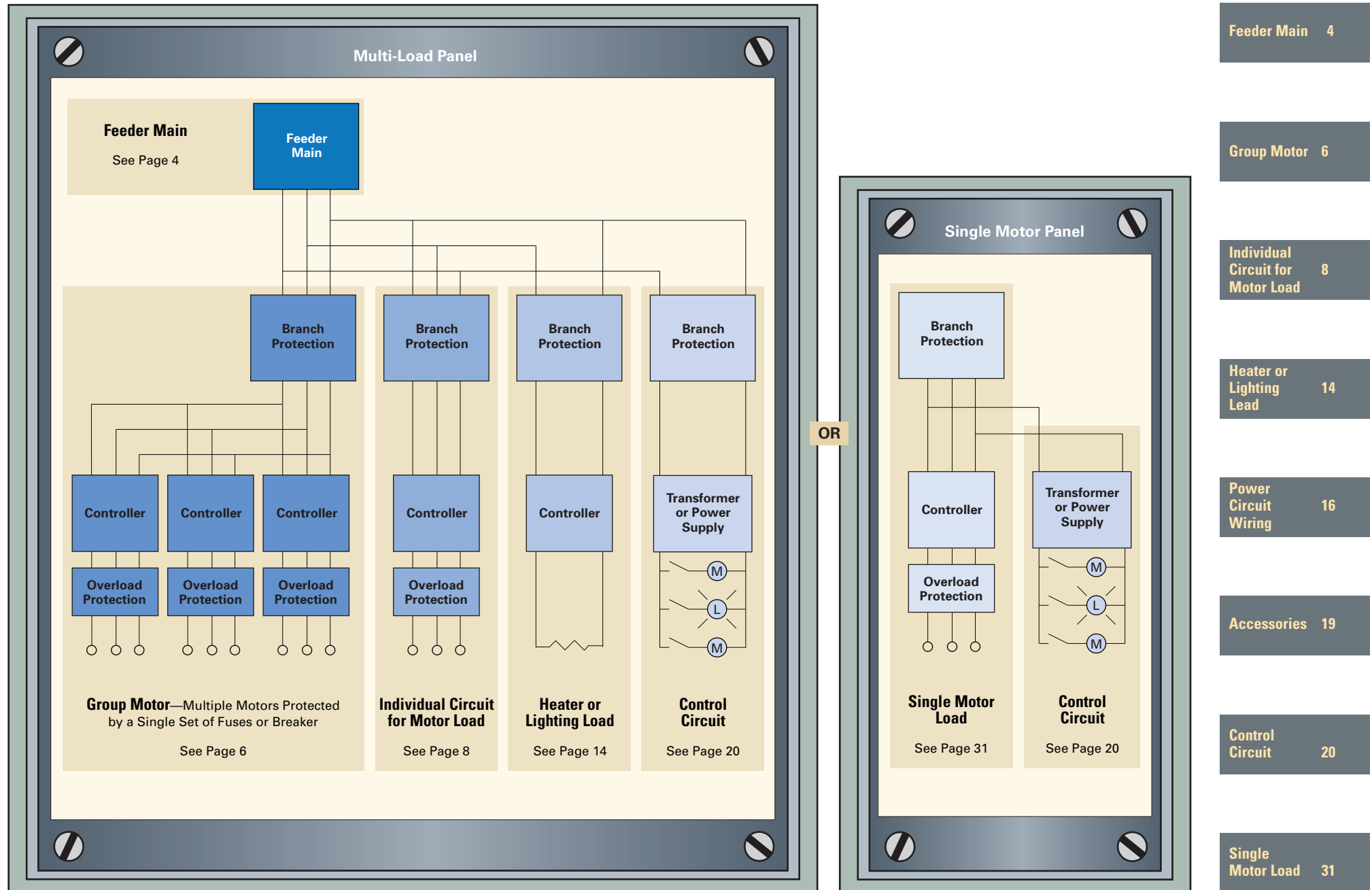
Through continuing investments, Eaton's Electrical Sector has grown into a world-class provider of power protection and control products. Meeting your specific needs means offering a complete line of motor protection, control and logic devices—all the latest in technology.

From contactors, starters and drives to pushbuttons, relays and programmable controllers, you'll have the edge when it comes to application-specific solutions. Trust Eaton to deliver the products and solutions that will make your process more efficient and effective.



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## Designing the panel

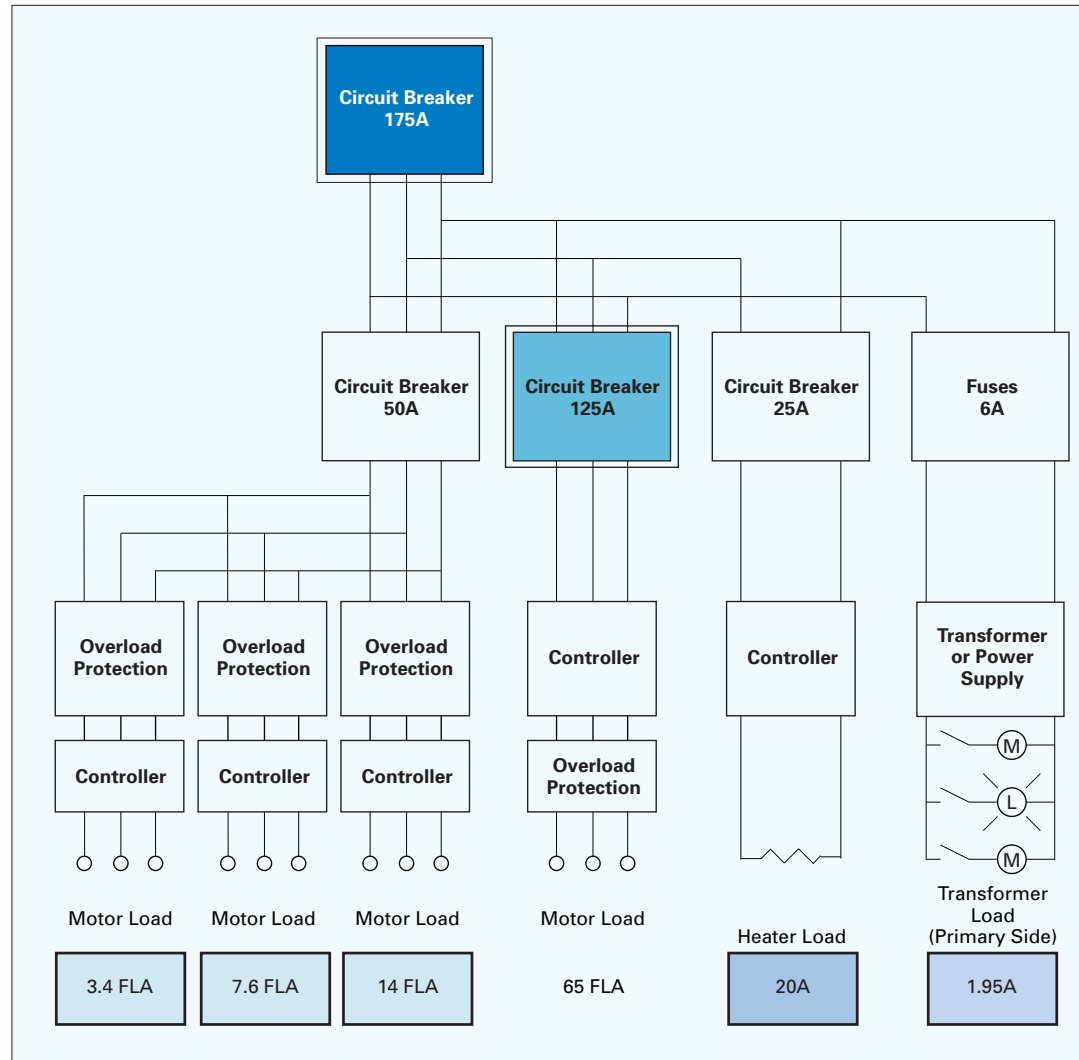


## Sizing the feeder

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 Table 28.1 on Page 18.



**Example Multi-Load Panel**

$$125A + 3.4A + 7.6A + 14A + 20A + 2A = 172A$$

Use closest size, 175A



### Molded Case Circuit Breaker



NEMA 1/12/3R  
Rotary Handle  
Mechanism,  
12" Shaft for EG  
**EGHMVD12B**

EG Frame



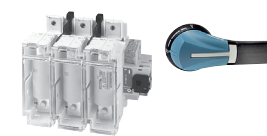
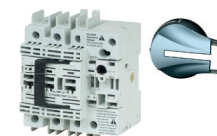
NEMA 1/12/3R  
Rotary Handle  
Mechanism,  
12" Shaft for JG  
**JGHMVD12B**

JG Frame



NEMA 1/12/3R  
Rotary Handle  
Mechanism,  
12" Shaft for LG  
**LGHMVD12B**

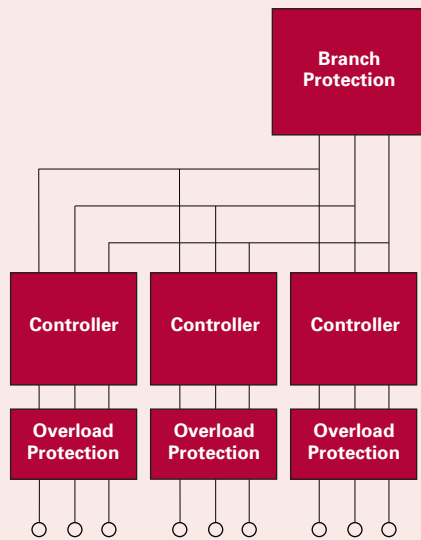
LG Frame



Rotary Fusible Disconnect (Fuses not Included)



## Group motor design



**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:

1. All power circuit devices are rated for group motor use as indicated on the component, heater tables or instruction publication.
2. The following tap rule (31.4.3) is met:
  - a. 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.
3. The branch circuit protection is sized by the sum of the following:
  - a. If the branch protection is a breaker, 250% of the largest motor FLA, plus the sum of the remaining motor loads,
  - b. If the branch protection is a time delay fuse, 175% of the largest motor FLA, plus the sum of the remaining motor loads, or
  - c. If the branch protection is a CC fuse, 300% of the largest motor FLA, plus the sum of the remaining motor loads.
4. 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.



**XT Manual Motor Controller (XTSC)**



**Note:** UL 508 Type F combination motor controllers (XTFC) are self-protected and do not limit the upstream protective devices.

## Manual Motor Controllers Short-Circuit Ratings for UL/CSA® Group Installations

### XTSC and XTSR Manual Motor Controllers (MMC) / Starter Combinations

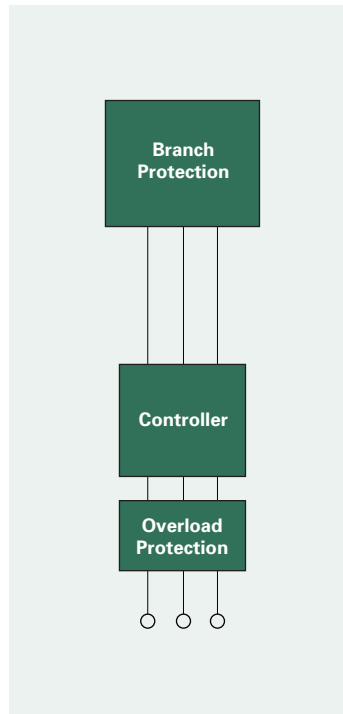
| Assembled Controller                                 |            |                                                               | Group Installation, UL/CSA                         |      |      |                                           |                              |
|------------------------------------------------------|------------|---------------------------------------------------------------|----------------------------------------------------|------|------|-------------------------------------------|------------------------------|
|                                                      |            |                                                               | Maximum rms Symmetrical Short-Circuit Ratings (kA) |      |      | Maximum Upstream Protective Device (Amps) |                              |
| Non-Reversing                                        | Reversing  | FLA Adjustment Range/Overload Release — I <sub>L</sub> (Amps) | 240V                                               | 480V | 600V | Maximum Fuse 600V                         | Maximum Circuit Breaker 600V |
| <b>XTSC and XTSR Frame B MMP + Frame B Contactor</b> |            |                                                               |                                                    |      |      |                                           |                              |
| XTSCP16BBA                                           | XTSRP16BBA | 0.1–0.16                                                      | 50                                                 | 50   | 50   | 600                                       | 600                          |
| XTSCP25BBA                                           | XTSRP16BBA | 0.16–0.25                                                     | 50                                                 | 50   | 50   | 600                                       | 600                          |
| XTSCP40BBA                                           | XTSRP40BBA | 0.25–0.4                                                      | 50                                                 | 50   | 50   | 600                                       | 600                          |
| XTSCP63BBA                                           | XTSRP63BBA | 0.4–0.63                                                      | 50                                                 | 50   | 50   | 600                                       | 600                          |
| XTSC001BBA                                           | XTSR001BBA | 0.63–1                                                        | 50                                                 | 50   | 50   | 600                                       | 600                          |
| XTSC1P6BBA                                           | XTSR1P6BBA | 1–1.6                                                         | 50                                                 | 50   | 50   | 600                                       | 600                          |
| XTSCAP5BBA                                           | XTSR2P5BBA | 1.6–2.5                                                       | 50                                                 | 50   | 50   | 600                                       | 600                          |
| XTSC004BBA                                           | XTSR004BBA | 2.5–4                                                         | 50                                                 | 50   | 50   | 600                                       | 600                          |
| XTSC6P3BBA                                           | XTSR6P3BBA | 4–6.3                                                         | 50                                                 | 50   | 50   | 600                                       | 600                          |
| XTSC010BBA                                           | XTSR010BBA | 6.3–10                                                        | 22                                                 | 22   | 22   | 150                                       | 125                          |
| XTSC012BBA                                           | XTSR012BBA | 8–12                                                          | 10                                                 | 10   | 10   | 150                                       | 125                          |
| XTSC016BBA                                           | —          | 10–16                                                         | 10                                                 | 10   | 10   | 150                                       | 125                          |
| <b>XTSC and XTSR Frame B MMP + Frame C Contactor</b> |            |                                                               |                                                    |      |      |                                           |                              |
| XTSC016BCA                                           | XTSR016BCA | 10–16                                                         | 10                                                 | 10   | 10   | 150                                       | 125                          |
| XTSC020BCA                                           | XTSR020BCA | 16–20                                                         | 10                                                 | 10   | 10   | 150                                       | 125                          |
| XTSC025BCA                                           | XTSR025BCA | 20–25                                                         | 10                                                 | 10   | 10   | 150                                       | 125                          |
| XTSC032BCA                                           | XTSR032BCA | 25–32                                                         | 5                                                  | 5    | 5    | 150                                       | 125                          |
| <b>XTSC and XTSR Frame D MMP + Frame C Contactor</b> |            |                                                               |                                                    |      |      |                                           |                              |
| XTSC016DCA                                           | XTSR016DCA | 10–16                                                         | 50                                                 | 50   | 10   | 600                                       | 600                          |
| XTSC025DCA                                           | XTSR025DCA | 16–25                                                         | 50                                                 | 50   | 10   | 600                                       | 600                          |
| XTSC032DCA                                           | XTSR032DCA | 25–32                                                         | 50                                                 | 50   | 10   | 600                                       | 600                          |
| <b>XTSC and XTSR Frame D MMP + Frame D Contactor</b> |            |                                                               |                                                    |      |      |                                           |                              |
| XTSC040DDA                                           | XTSR040DDA | 32–40                                                         | 50                                                 | 50   | 10   | 600                                       | 600                          |
| XTSC050DDA                                           | XTSR050DDA | 40–50                                                         | 50                                                 | 50   | 10   | 600                                       | 600                          |
| XTSC058DDA                                           | XTSR058DDA | 50–58                                                         | 50                                                 | 50   | —    | —                                         | —                            |
| XTSC063DDA                                           | XTSR063DDA | 55–63                                                         | 50                                                 | 50   | —    | —                                         | —                            |

**Note:** Products are shown with a 120 Vac coil. For other coil voltages, replace the "A" suffix with the corresponding letter from the following table.

| Coil Voltage | Suffix |
|--------------|--------|
| 120 Vac      | A      |
| 24 Vdc       | TD     |
| 24 Vac       | T      |
| 240 Vac      | B      |

Refer to Page 5 for breaker part numbers and to Page 19 for fuse base part numbers.

## Individual circuit for motor load



**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.

For selection of motor branch circuits for 240V, refer to Pages 10 and 11.

For selection of motor branch circuits for 480V, refer to Pages 12 and 13.



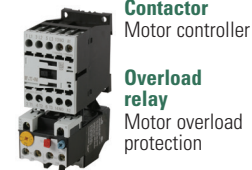
## Motor Branch Circuit Types

### Motor Branch Devices

#### Fuse and Starter



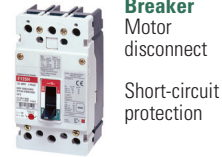
**Fuses**  
Short-circuit protection



**Contactor**  
Motor controller

**Overload relay**  
Motor overload protection

#### Breaker and Starter



**Breaker**  
Motor disconnect

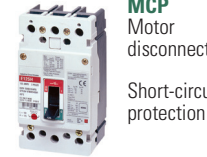
Short-circuit protection



**Contactor**  
Motor controller

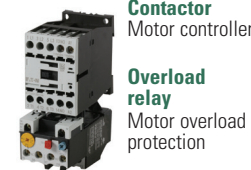
**Overload relay**  
Motor overload protection

#### Motor Circuit Protector and Starter



**MCP**  
Motor disconnect

Short-circuit protection



**Contactor**  
Motor controller

**Overload relay**  
Motor overload protection

#### Combination Motor Controller (Type F)



**CMC**  
Motor disconnect

Short-circuit and motor overload protection

Motor controller

### Branch circuit functions

|                           |                       |                |                         |                        |
|---------------------------|-----------------------|----------------|-------------------------|------------------------|
| Disconnect function       | Disconnect (separate) | Breaker        | Motor circuit protector | Manual motor protector |
| Short-circuit protection  | Fuse block/fuses      | Breaker        | Motor circuit protector | Manual motor protector |
| Motor controller          | Contactor             | Contactor      | Contactor               | Contactor              |
| Motor overload protection | Overload relay        | Overload relay | Overload relay          | Manual motor protector |

### Installation

|                           |               |               |               |     |
|---------------------------|---------------|---------------|---------------|-----|
| Installation effort       | High          | Moderate      | Moderate      | Low |
| Line-side commoning links | Not available | Not available | Not available | Yes |

### Usability

|                                  |                             |                      |                  |                  |
|----------------------------------|-----------------------------|----------------------|------------------|------------------|
| Controller options               | Remote                      | Remote               | Remote           | Manual or remote |
| Resetability after short circuit | Replacement fuses necessary | Reset breaker switch | Reset MCP switch | Reset CMC switch |

### Protection

|                           |                                                                                                                                                                         |                                                                                                                                                                             |                                                                                                                                                                        |                                                                                                                                                                     |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sizing protective devices | Fuses are sized up to 300% of the FLA to prevent nuisance tripping during startup. Because the fuses are oversized for the motor FLA, an overload relay is also needed. | Breakers are sized up to 250% of the FLA to prevent nuisance tripping during startup. Because the breaker is oversized for the motor FLA, an overload relay is also needed. | MCPs are sized up to 800 to 1100% of the FLA to prevent nuisance tripping during startup. Because the MCP provides no thermal protection, an overload relay is needed. | CMCs are sized according to the motor FLA to provide overload protection. The CMC includes short circuit that is designed to mimic the motor inrush (14 times FLA). |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### Safety

|                       |                                              |                             |                         |                 |
|-----------------------|----------------------------------------------|-----------------------------|-------------------------|-----------------|
| Padlockable provision | No, unless provided in a separate disconnect | Yes, with breaker accessory | Yes, with MCP accessory | Included in MMP |
|-----------------------|----------------------------------------------|-----------------------------|-------------------------|-----------------|

### Cost

|                        |          |          |          |     |
|------------------------|----------|----------|----------|-----|
| Component price        | Low      | Moderate | Moderate | Low |
| Panel space (and cost) | Moderate | Moderate | Moderate | Low |

## Components used to build a reversing contactor

For reversing applications, the contactors should have mechanical and electrical interlocks. For Frame B, use contactors with a built-in NC auxiliary (ending in “B01A” instead of “B10A”).

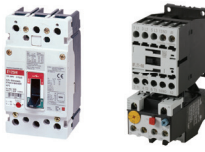
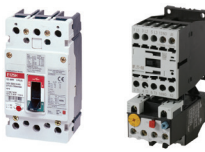
| Quantity | Frame                     | B          | C          | D          | F          | G          |
|----------|---------------------------|------------|------------|------------|------------|------------|
| 2        | Contactor                 | XTCE...B01 | XTCE...C01 | XTCE...D00 | XTCE...F00 | XTCE...G00 |
| 2        | Auxiliary contact (front) | XTCEXFAC20 | XTCEXFAC20 | XTCEXFBG11 | XTCEXFBG11 | XTCEXFBG11 |
| 1        | Mechanical interlock      | XTCEXMLB   | XTCEXMLC   | XTCEXMLD   | XTCEXMLG   | XTCEXMLG   |
| 1        | Reversing link kit        | XTCEXRLB   | XTCEXRLC   | XTCEXRLD   | XTCEXRLG   | XTCEXRLG   |

Branch Motor Selection for 230 Vac

|                                                                                     | HP (230V)                    | 1/2              | 3/4              | 1                | 1-1/2            | 2                | 3                | 5                | 7-1/2            |
|-------------------------------------------------------------------------------------|------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                                                                                     | FLA                          | 2.2              | 3.2              | 4.2              | 6                | 6.8              | 9.6              | 15.2             | 22               |
|                                                                                     | Minimum Wire Size (AWG)      | 14               | 14               | 14               | 14               | 14               | 14               | 12               | 10               |
|    | Fuse amperage                | 3                | 6                | 10               | 15               | 15               | 15               | 30               | 40               |
|                                                                                     | Fuse type                    | CC               | CC               | CC               | CC               | CC               | CC               | J                | J                |
|                                                                                     | Contactor                    | XTCE007B10A      | XTCE007B10A      | XTCE007B10A      | XTCE007B10A      | XTCE007B10A      | XTCE009B10A      | XTCE015B10A      | XTCE025C10A      |
|                                                                                     | Auxiliary contact            | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in |
|                                                                                     | Thermal overload relay       | XTOB2P4BC1       | XTOB004BC1       | XTOB006BC1       | XTOB010BC1       | XTOB010BC1       | XTOB010BC1       | XTOB016BC1       | XTOB024CC1       |
|                                                                                     | Overload range (A)           | 1.6 to 2.4       | 2.4 to 4.0       | 4 to 6           | 6 to 10          | 6 to 10          | 6 to 10          | 12 to 16         | 16 to 24         |
|                                                                                     | SCCR (kA)                    | 100              | 100              | 100              | 100              | 100              | 100              | 100              | 100              |
|    | Breaker                      | EGH015FFG        | EGH015FFG        | EGH015FFG        | EGH015FFG        | EGH015FFG        | EGH020FFG        | EGH030FFG        | EGH040FFG        |
|                                                                                     | Breaker size (A)             | 15               | 15               | 15               | 15               | 15               | 20               | 30               | 40               |
|                                                                                     | Contactor                    | XTCE007B10A      | XTCE007B10A      | XTCE007B10A      | XTCE007B10A      | XTCE007B10A      | XTCE009B10A      | XTCE015B10A      | XTCE025C10A      |
|                                                                                     | Auxiliary contact            | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in |
|                                                                                     | Thermal overload relay       | XTOB2P4BC1       | XTOB004BC1       | XTOB006BC1       | XTOB010BC1       | XTOB010BC1       | XTOB010BC1       | XTOB016BC1       | XTOB024CC1       |
|                                                                                     | Overload range (A)           | 1.6 to 2.4       | 2.4 to 4.0       | 4 to 6           | 6 to 10          | 6 to 10          | 6 to 10          | 12 to 16         | 16 to 24         |
|                                                                                     | SCCR (kA)                    | —                | —                | —                | —                | —                | —                | —                | 50 kA ①          |
|   | Motor circuit protector      | HMCP003A0C       | HMCP007C0C       | HMCP007C0C       | HMCPE015E0C      | HMCPE015E0C      | HMCPE015E0C      | HMCPE030H1C      | HMCPE030H1C      |
|                                                                                     | Contactor                    | XTCE007B10A      | XTCE007B10A      | XTCE007B10A      | XTCE007B10A      | XTCE007B10A      | XTCE009B10A      | XTCE015B10A      | XTCE025C10A      |
|                                                                                     | Auxiliary contact            | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in |
|                                                                                     | Thermal overload relay       | XTOB2P4BC1       | XTOB004BC1       | XTOB006BC1       | XTOB010BC1       | XTOB010BC1       | XTOB010BC1       | XTOB016BC1       | XTOB024CC1       |
|                                                                                     | Overload range               | 1.6 to 2.4       | 2.4 to 4.0       | 4 to 6           | 6 to 10          | 6 to 10          | 6 to 10          | 12 to 16         | 16 to 24         |
|                                                                                     | SCCR (kA)                    | 35               | 35               | 15               | 65               | 65               | 65               | 65               | 65               |
|                                                                                     | Combination motor controller | XTFC2P5BBA       | XTFC004BBA       | XTFC6P3BBA       | XTFC6P3BBA       | XTFC010BBA       | XTFC010BBA       | XTFC016BBA       | XTFC025BCA       |
|  | Overload range (A)           | 1.6 to 2.5       | 2.5 to 4.0       | 4 to 6.3         | 4 to 6.3         | 6.3 to 10        | 6.3 to 10        | 10 to 16         | 20 to 25         |
|                                                                                     | SCCR (kA)                    | 65               | 65               | 65               | 65               | 65               | 65               | 50               | 18               |
|                                                                                     |                              |                  |                  |                  |                  |                  |                  |                  |                  |

① UL Pending.

Branch Motor Selection for 230 Vac, continued

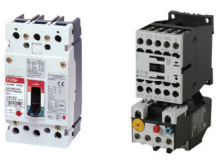
|                                                                                     | HP (230V)                                        | 10               | 15                             | 20                             | 25                             | 30                             | 40                             | 50                             | 60                             |
|-------------------------------------------------------------------------------------|--------------------------------------------------|------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
|                                                                                     | FLA                                              | 28               | 42                             | 54                             | 68                             | 80                             | 104                            | 130                            | 154                            |
|                                                                                     | Minimum Wire Size (AWG)                          | 8                | 6                              | 4                              | 4                              | 3                              | 1                              | 2/0                            | 3/0                            |
|    | Fuse amperage                                    | 50               | 80                             | 100                            | 125                            | 150                            | 200                            | 225                            | 300                            |
|                                                                                     | Fuse type                                        | J                | J                              | J                              | J                              | J                              | J                              | J                              | J                              |
|                                                                                     | Contactor                                        | XTCE032C10A      | XTCE050D00A                    | XTCE065D00A                    | XTCE065D00A                    | XTCE080F00A                    | XTCE150G00A                    | XTCE150G00A                    | XTCE150G00A                    |
|                                                                                     | Auxiliary contact                                | 1NO aux built-in | 1NO/1NC side aux<br>XTCEXSBN11 | 1NO/1NC side aux<br>XTCEXSBN11 | 1NO/1NC side aux<br>XTCEXSBN11 | 1NO/1NC side aux<br>XTCEXSBN11 | 1NO/1NC side aux<br>XTCEXSBN11 | 1NO/1NC side aux<br>XTCEXSBN11 | 1NO/1NC side aux<br>XTCEXSBN11 |
|                                                                                     | Thermal overload relay                           | XTOB032CC1       | XTOB057DC1                     | XTOB065DC1                     | XTOB075DC1                     | XTOB100GC1                     | XTOB125GC1                     | XTOB150GC1                     | XTOB175GC1                     |
|                                                                                     | Overload range (A)                               | 24 to 32         | 40 to 57                       | 50 to 65                       | 65 to 75                       | 70 to 100                      | 95 to 125                      | 120 to 150                     | 145 to 175                     |
|                                                                                     | SCCR (kA)                                        | 100              | 100                            | 100                            | —                              | 100                            | 100                            | 100                            | 100                            |
|    | Breaker                                          | EGH050FFG        | EGH080FFG                      | EGH100FFG                      | EGH125FFG                      | JGE150FAG                      | JGE200FAG                      | JGE250FAG                      | LGE3300FAG                     |
|                                                                                     | Breaker size (A)                                 | 50               | 80                             | 100                            | 125                            | 150                            | 200                            | 250                            | —                              |
|                                                                                     | Contactor                                        | XTCE025C10A      | XTCE040D00A                    | XTCE050D00A                    | XTCE065D00A                    | XTCE080F00A                    | XTCE095F00A                    | XTCE115G00A                    | XTCE150G00A                    |
|                                                                                     | Auxiliary contact                                | 1NO aux built-in | 1NO/1NC side aux<br>XTCEXSBN11 | 1NO/1NC side aux<br>XTCEXSBN11 | 1NO/1NC side aux<br>XTCEXSBN11 | 1NO/1NC side aux<br>XTCEXSBN11 | 1NO/1NC side aux<br>XTCEXSBN11 | 1NO/1NC side aux<br>XTCEXSBN11 | 1NO/1NC side aux<br>XTCEXSBN11 |
|                                                                                     | Thermal overload relay                           | XTOB032CC1       | XTOB057DC1                     | XTOB065DC1                     | XTOB075DC1                     | XTOB100GC1                     | XTOB125GC1                     | XTOB150GC1                     | XTOB175GC1                     |
|                                                                                     | Overload range (A)                               | 24 to 32         | 40 to 57                       | 50 to 65                       | 65 to 75                       | 70 to 100                      | 95 to 125                      | 120 to 150                     | 145 to 175                     |
|                                                                                     | SCCR (kA)                                        | 50 kA ①          | 50 kA ①                        | 50 kA ①                        | 50 kA ①                        | 65 kA ①                        | 65 kA ①                        | 65 kA ①                        | 42 kA ①                        |
|   | Motor circuit protector                          | HMCPE050K2C      | HMCPE100R3C                    | HMCPE100T3C                    | —                              | —                              | —                              | —                              | —                              |
|                                                                                     | Contactor                                        | XTCE032C10A      | XTCE040D00A                    | XTCE050D00A                    | —                              | —                              | —                              | —                              | —                              |
|                                                                                     | Auxiliary contact                                | 1NO aux built-in | 1NO/1NC side aux<br>XTCEXSBN11 | 1NO/1NC side aux<br>XTCEXSBN11 | 1NO/1NC side aux<br>XTCEXSBN11 | 1NO/1NC side aux<br>XTCEXSBN11 | 1NO/1NC side aux<br>XTCEXSBN11 | 1NO/1NC side aux<br>XTCEXSBN11 | 1NO/1NC side aux<br>XTCEXSBN11 |
|                                                                                     | Thermal overload relay                           | XTOB032CC1       | XTOB057DC1                     | XTOB057DC1                     | —                              | —                              | —                              | —                              | —                              |
|                                                                                     | Overload range (A)                               | 24 to 32         | 40 to 57                       | 40 to 57                       | —                              | —                              | —                              | —                              | —                              |
|                                                                                     | SCCR (kA)                                        | 65               | 65                             | 65                             | —                              | —                              | —                              | —                              | —                              |
|                                                                                     | Combination motor controller or MPCB + contactor | XTFC032BCA       | XTFC050DDA                     | XTFC058DDA                     | FDMP 3080L + XTCE080F00A       | FDMP 3100L + XTCE080F00A       | FDMP 3160L + XTCE085F00A       | FDMP 3160L + XTCE115G00A       | FDMP 3160L + XTCE150G00A       |
|  | Overload range (A)                               | 25 to 32         | 40 to 50                       | 50 to 58                       | 40 to 80                       | 80 to 100                      | 100 to 160                     | 100 to 160                     | 100 to 160                     |
|                                                                                     | SCCR (kA)                                        | 18               | 65                             | 65                             | 65                             | 65                             | 65                             | 65                             | 65                             |

① UL Pending.

**Note:** Contactors are shown with a 120 Vac coil. For other coil voltages, replace the "A" suffix with the corresponding letter from the following table.

| Coil Voltage | Suffix |
|--------------|--------|
| 120 Vac      | A      |
| 24 Vdc       | TD     |
| 24 Vac       | T      |
| 240 Vac      | B      |

Branch Motor Selection for 460 Vac

|                                                                                     | HP (480V)                    | 1/2              | 3/4              | 1                | 1-1/2            | 2                | 3                | 5                | 7-1/2            |
|-------------------------------------------------------------------------------------|------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                                                                                     | FLA                          | 1.1              | 1.6              | 2.1              | 3.0              | 3.4              | 4.8              | 7.6              | 11               |
|                                                                                     | Minimum Wire Size (AWG)      | 14               | 14               | 14               | 14               | 14               | 14               | 14               | 14               |
|    | Fuse amperage                | 3                | 3                | 3                | 6                | 6                | 10               | 15               | 30               |
|                                                                                     | Fuse type                    | CC               | CC               | CC               | CC               | CC               | CC               | CC               | CC               |
|                                                                                     | Contactor                    | XTCE007B10A      | XTCE007B10A      | XTCE007B10A      | XTCE007B10A      | XTCE007B10A      | XTCE007B10A      | XTCE009B10A      | XTCE012B10A      |
|                                                                                     | Auxiliary contact            | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in |
|                                                                                     | Thermal overload relay       | XTOB1P6BC1       | XTOB2P4BC1       | XTOB2P4BC1       | XTOB004BC1       | XTOB004BC1       | XTOB006BC1       | XTOB010BC1       | XTOB012BC1       |
|                                                                                     | Overload range (A)           | 1.0 to 1.6       | 1.6 to 2.4       | 1.6 to 2.4       | 2.4 to 4         | 2.4 to 4         | 4 to 6           | 6 to 10          | 9 to 12          |
|    | High fault rating (kA)       | 100              | 100              | 100              | 100              | 100              | 100              | 100              | 100              |
|                                                                                     | Breaker                      | EGE3015FFG       | EGE3015FFG       | EGE3015FFG       | EGE3015FFG       | EGE3015FFG       | EGE3015FFG       | EGE3015FFG       | EGE3025FFG       |
|                                                                                     | Breaker size (A)             | 15A EG frame     | 15A EG frame     | 15A EG frame     | 15A EG frame     | 15A EG frame     | 15A EG frame     | 15A EG frame     | 25A EG frame     |
|                                                                                     | Contactor                    | XTCE007B10A      | XTCE007B10A      | XTCE007B10A      | XTCE007B10A      | XTCE007B10A      | XTCE007B10A      | XTCE009B10A      | XTCE012B10A      |
|                                                                                     | Auxiliary contact            | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in |
|                                                                                     | Thermal overload relay       | XTOB1P6BC1       | XTOB2P4BC1       | XTOB2P4BC1       | XTOB004BC1       | XTOB004BC1       | XTOB006BC1       | XTOB010BC1       | XTOB012BC1       |
|   | Overload range (A)           | 1.0 to 1.6       | 1.6 to 2.4       | 1.6 to 2.4       | 2.4 to 4         | 2.4 to 4         | 4 to 6           | 6 to 10          | 9 to 12          |
|                                                                                     | High fault rating            | —                | —                | —                | —                | —                | —                | —                | —                |
|                                                                                     | Motor circuit protector      | HMCPE015E0C      | HMCPE015E0C      | HMCPE015E0C      | HMCPE015E0C      | HMCPE015E0C      | HMCPE015E0C      | HMCPE015E0C      | HMCPE015E0C      |
|                                                                                     | Contactor                    | XTCE007B10A      | XTCE007B10A      | XTCE007B10A      | XTCE007B10A      | XTCE007B10A      | XTCE007B10A      | XTCE009B10A      | XTCE012B10A      |
|                                                                                     | Auxiliary contact            | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in |
|                                                                                     | Thermal overload relay       | XTOB1P6BC1       | XTOB2P4BC1       | XTOB2P4BC1       | XTOB004BC1       | XTOB004BC1       | XTOB006BC1       | XTOB010BC1       | XTOB012BC1       |
|  | Overload range (A)           | 1.0 to 1.6       | 1.6 to 2.4       | 1.6 to 2.4       | 2.4 to 4         | 2.4 to 4         | 4 to 6           | 6 to 10          | 9 to 12          |
|                                                                                     | High fault rating (kA)       | 35               | 35               | 35               | 35               | 35               | 65               | 65               | 65               |
|                                                                                     | Combination motor controller | XTFC1P6BBA       | XTFC2P5BBA       | XTFC2P5BBA       | XTFC004BBA       | XTFC004BBA       | XTFC6P3BBA       | XTFC010BBA       | XTFC012BBA       |
|  | Overload range (A)           | 1.0 to 1.6       | 1.6 to 2.5       | 1.6 to 2.5       | 2.5 to 4.0       | 2.5 to 4.0       | 4 to 6.3         | 6 to 10          | 8 to 12          |
|                                                                                     | SCCR (kA) (480/277V)         | 65               | 65               | 65               | 65               | 65               | 65               | 65               | 65               |
|                                                                                     | CMC                          |                  |                  |                  |                  |                  |                  |                  |                  |

Branch Motor Selection for 460 Vac, continued

|                                                                                     | HP (480V)                                        | 10               | 15               | 20               | 25                          | 30                          | 40                          | 50                          | 60                          |
|-------------------------------------------------------------------------------------|--------------------------------------------------|------------------|------------------|------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
|                                                                                     | FLA                                              | 14               | 21               | 27               | 34                          | 40                          | 52                          | 65                          | 77                          |
|                                                                                     | Minimum Wire Size (AWG)                          | 12               | 10               | 8                | 8                           | 8                           | 6                           | 4                           | 3                           |
|    | Fuse amperage                                    | 25               | 35               | 50               | 60                          | 70                          | 90                          | 125                         | 150                         |
|                                                                                     | Fuse type                                        | J                | J                | J                | J                           | J                           | J                           | J                           | J                           |
|                                                                                     | Contactor                                        | XTCE015B10A      | XTCE025C10A      | XTCE032C10A      | XTCE040D00A                 | XTCE040D00A                 | XTCE050D00A                 | XTCE065D00A                 | XTE080F00A                  |
|                                                                                     | Auxiliary contact                                | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO-1NC side aux XTCEXSBN11 | 1NO-1NC side aux XTCEXSBN11 | 1NO-1NC side aux XTCEXSBN11 | 1NO-1NC side aux XTCEXSBN11 | 1NO-1NC side aux XTCEXSBN11 |
|                                                                                     | Thermal overload relay                           | XTOB016BC1       | XTOB024CC1       | XTOB032CC1       | XTOB040DC1                  | XTOB057DC1                  | XTOB057DC1                  | XTOB065DC1                  | XTOB100GC1                  |
|    | Overload range (A)                               | 12 to 16         | 16 to 24         | 24 to 32         | 24 to 40                    | 40 to 57                    | 40 to 57                    | 50 to 65                    | 70 to 100                   |
|                                                                                     | High fault rating (kA)                           | 100              | 100              | 100              | 100                         | 100                         | 100                         | 100                         | 100                         |
|                                                                                     | Breaker                                          | EGH3035FFG       | EGH3040FFG       | EGH3050FFG       | EGH3070FFG                  | EGH3080FFG                  | EGH3100FFG                  | EGH3125FFG                  | JGH3150FAG                  |
|                                                                                     | Breaker size (A)                                 | 35A EG frame     | 40A EG frame     | 50A EG frame     | 70A EG frame                | 80A EG frame                | 100A EG frame               | 125A EG frame               | 150A JG frame               |
|                                                                                     | Contactor                                        | XTCE015B10A      | XTCE025C10A      | XTCE032C10A      | XTCE040D00A                 | XTCE040D00A                 | XTCE050D00A                 | XTCE065D00A                 | XTE080F00A                  |
|   | Auxiliary contact                                | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO-1NC side aux XTCEXSBN11 | 1NO-1NC side aux XTCEXSBN11 | 1NO-1NC side aux XTCEXSBN11 | 1NO-1NC side aux XTCEXSBN11 | 1NO-1NC side aux XTCEXSBN11 |
|                                                                                     | Thermal overload relay                           | XTOB016BC1       | XTOB024CC1       | XTOB032CC1       | XTOB040DC1                  | XTOB057DC1                  | XTOB057DC1                  | XTOB075DC1                  | XTOB100GC1                  |
|                                                                                     | Overload range (A)                               | 12 to 16         | 16 to 24         | 24 to 32         | 24 to 40                    | 40 to 57                    | 40 to 57                    | 65 to 75                    | 70 to 100                   |
|                                                                                     | High fault rating                                | —                | 65 kA ①          | 65 kA ①          | 65 kA ①                     | 65 kA ①                     | 65 kA ①                     | 65 kA ①                     | 65 kA ①                     |
|                                                                                     | Motor circuit protector                          | HMCPE030H1C      | HMCPE030H1C      | HMCPE050K2C      | HMCPE050K2C                 | HMCPE100R3C                 | HMCPE100R3C                 | HMCPE100R3C                 | HMCPE100T3C                 |
|  | Contactor                                        | XTCE015B10A      | XTCE025C10A      | XTCE032C10A      | XTCE040D00A                 | XTCE040D00A                 | XTCE050D00A                 | XTCE065D00A                 | XTE080F00A                  |
|                                                                                     | Auxiliary contact                                | 1NO aux built-in | 1NO aux built-in | 1NO aux built-in | 1NO-1NC side aux XTCEXSBN11 | 1NO-1NC side aux XTCEXSBN11 | 1NO-1NC side aux XTCEXSBN11 | 1NO-1NC side aux XTCEXSBN11 | 1NO-1NC side aux XTCEXSBN11 |
|                                                                                     | Thermal overload relay                           | XTOB016BC1       | XTOB024CC1       | XTOB032CC1       | XTOB040DC1                  | XTOB057DC1                  | XTOB057DC1                  | XTOB065DC1                  | XTOB100GC1                  |
|                                                                                     | Overload range (A)                               | 12 to 16         | 16 to 24         | 24 to 32         | 24 to 40                    | 40 to 57                    | 40 to 57                    | 50 to 65                    | 70 to 100                   |
|                                                                                     | High fault rating (kA)                           | 65               | 65               | 65               | 65                          | 65                          | 65                          | 65                          | 65                          |
|  | Combination motor controller or MPCB + contactor | XTFC016BBA       | XTFC025BCA       | XTFC032BCA       | XTFC040DDA                  | XTFC050DDA                  | XTFC058DDA                  | XTFC063DDA                  | FDMP 3080L + XTCE080F00A    |
|                                                                                     | Overload range (A)                               | 10 to 16         | 20 to 25         | 25 to 32         | 32 to 40                    | 40 to 50                    | 50 to 58                    | 55 to 65                    | 40 to 80                    |
|                                                                                     | SCCR (kA) (480/277V)                             | 50               | 18               | 18               | 65                          | 65                          | 65                          | 65                          | 65                          |

① UL Pending.

**Note:** Contactors are shown with a 120 Vac coil. For other coil voltages, replace the "A" suffix with the corresponding letter from the following table.

| Coil Voltage | Suffix |
|--------------|--------|
| 120 Vac      | A      |
| 24 Vdc       | TD     |
| 24 Vac       | T      |
| 240 Vac      | B      |

## Heater and lighting load circuits

### 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 60A, and
3. Not larger than the ampacity of the field wiring to the heater load.

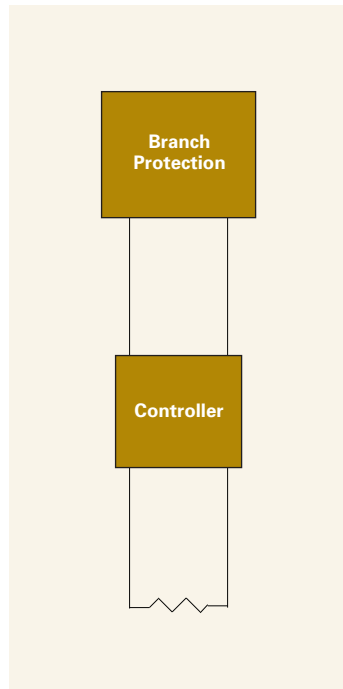
Controllers are sized to the heater full-load rating using the controller's general-purpose amp rating or resistive load rating.

### 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 15A, and
2. Shall not exceed the ampacity of the anticipated field wiring

The controllers are sized to the specific lighting ratings.



Heater or Lighting Load



## Contactors



### Definite Purpose Contactor

| Resistive Load (A) | Two-Pole   | Three-Pole |
|--------------------|------------|------------|
| 20                 | C25DRF215A | C25DRF315A |
| 35                 | C25DRF225A | C25DRF325A |
| 40                 | C25DRF230A | C25DRF330A |
| 50                 | C25DRF240A | C25DRF340A |
| 65                 | C25DRJ250A | C25DRJ350A |



### Electrically Held Lighting Contactor

| Ballast or Mercury Vapor Load (at 600V) | Tungsten Load (at 480V) | 2NO       | 3NO       | 4NO       |
|-----------------------------------------|-------------------------|-----------|-----------|-----------|
| 10                                      | 10                      | CN35AN2AB | CN35AN3AB | CN35AN4AB |
| 20                                      | 20                      | CN35BN2AB | CN35BN3AB | CN35BN4AB |



### IEC Contactor

| General Purpose Amps | Three-Pole  | Four-Pole   |
|----------------------|-------------|-------------|
| 20                   | XTCE015B10A | XTCF020B00A |
| 40                   | XTCE032C10A | XTCF045C10A |
| 63                   | XTCE040D00A | XTCF063D00A |



|                               |         |         | Single-Pole              | Two-Pole                 | Two-Pole                    |                          | Three-Pole               |                             |                          |                          |
|-------------------------------|---------|---------|--------------------------|--------------------------|-----------------------------|--------------------------|--------------------------|-----------------------------|--------------------------|--------------------------|
| Heater application between... |         |         | Miniature Breaker        | Miniature Breaker        | Molded Case Circuit Breaker |                          | Miniature Breaker        | Molded Case Circuit Breaker |                          |                          |
| Breaker Rating (A)            | Minimum | Maximum | 10 kA 277V<br>10 kA 120V | 10 kA 480V<br>10 kA 240V | 18 kA 480V<br>25 kA 240V    | 65 kA 480V<br>50 kA 240V | 10 kA 480Y<br>10 kA 240V | 18 kA 480V<br>25 kA 240V    | 35 kA 480V<br>43 kA 240V | 65 kA 480V<br>50 kA 240V |
| 0.5                           | -       | 0.4     | WMZT1CX0                 | WMZT2CX0                 | EGB2015FFG                  | EGH2015FFG               | WMZT3CX0                 | EGB3015FFG                  | EGE3015FFG               | EGH3015FFG               |
| 1                             | 0.4     | 0.8     | WMZT1C01                 | WMZT2C01                 | —                           | —                        | WMZT3C01                 | —                           | —                        | —                        |
| 1.5                           | 0.8     | 1.2     | WMZT1CX1                 | WMZT2CX1                 | —                           | —                        | WMZT3CX1                 | —                           | —                        | —                        |
| 2                             | 1.2     | 1.6     | WMZT1C02                 | WMZT2C02                 | —                           | —                        | WMZT3C02                 | —                           | —                        | —                        |
| 3                             | 1.6     | 2.4     | WMZT1C03                 | WMZT2C03                 | —                           | —                        | WMZT3C03                 | —                           | —                        | —                        |
| 4                             | 2.4     | 3.2     | WMZT1C04                 | WMZT2C04                 | —                           | —                        | WMZT3C04                 | —                           | —                        | —                        |
| 5                             | 3.2     | 4       | WMZT1C05                 | WMZT2C05                 | —                           | —                        | WMZT3C05                 | —                           | —                        | —                        |
| 6                             | 4.0     | 4.8     | WMZT1C06                 | WMZT2C06                 | —                           | —                        | WMZT3C06                 | —                           | —                        | —                        |
| 7                             | 4.8     | 5.6     | WMZT1C07                 | WMZT2C07                 | —                           | —                        | WMZT3C07                 | —                           | —                        | —                        |
| 8                             | 5.6     | 6.4     | WMZT1C08                 | WMZT2C08                 | —                           | —                        | WMZT3C08                 | —                           | —                        | —                        |
| 10                            | 6.4     | 8       | WMZT1C10                 | WMZT2C10                 | —                           | —                        | WMZT3C10                 | —                           | —                        | —                        |
| 13                            | 8.0     | 10.4    | WMZT1C13                 | WMZT2C13                 | —                           | —                        | WMZT3C13                 | —                           | —                        | —                        |
| 15                            | 10.4    | 12      | WMZT1C15                 | WMZT2C15                 | —                           | —                        | WMZT3C15                 | —                           | —                        | —                        |
| 20                            | 12.0    | 16      | WMZT1C20                 | WMZT2C20                 | EGB2020FFG                  | EGH2020FFG               | WMZT3C20                 | EGB3020FFG                  | EGE3020FFG               | EGH3020FFG               |
| 25                            | 16.0    | 20      | WMZT1C25                 | WMZT2C25                 | EGB2025FFG                  | EGH2025FFG               | WMZT3C25                 | EGB3025FFG                  | EGE3025FFG               | EGH3025FFG               |
| 30                            | 20.0    | 24      | WMZT1C30                 | WMZT2C30                 | EGB2020FFG                  | EGH2020FFG               | WMZT3C30                 | EGB3030FFG                  | EGE3030FFG               | EGH3030FFG               |
| 35                            | 24.0    | 28      | WMZT1C35                 | WMZT2C35                 | EGB2035FFG                  | EGH2035FFG               | WMZT3C35                 | EGB3035FFG                  | EGE3035FFG               | EGH3035FFG               |
| 40                            | 28.0    | 32      | WMZT1C40                 | WMZT2C40                 | EGB2040FFG                  | EGH2040FFG               | WMZT3C40                 | EGB3040FFG                  | EGE3040FFG               | EGH3040FFG               |
| 45                            | 32.0    | 36      | —                        | —                        | EGB2045FFG                  | EGH2045FFG               | —                        | EGB3045FFG                  | EGE3045FFG               | EGH3045FFG               |
| 50                            | 36.0    | 40      | —                        | —                        | EGB2050FFG                  | EGH2050FFG               | —                        | EGB3050FFG                  | EGE3050FFG               | EGH3050FFG               |
| 60                            | 40.0    | 48      | —                        | —                        | EGB2060FFG                  | EGH2060FFG               | —                        | EGB3060FFG                  | EGE3060FFG               | EGH3060FFG               |

## 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 26.

### Internal wiring (Reference 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 17 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 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 17 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 yellow:

Grounded AC current-carrying power circuit conductor regardless of voltage



**Exception:** Insulated conductors sized 4 AWG (21.2 mm<sup>2</sup>) 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.

To determine the wire size for motor loads, add the full-load current ratings found in Table 50.1 for all external loads being carried by the conductor. Then use 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 Table 50.1**

| HP    | 110–120V     |              |             | 200V         |             | 208V         |             | 220–240V ❶   |             | 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 | 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          | —           | 2.2          | —           | 1.4          | —           | —            | —           | —            | —           |
| 1/4   | 5.8          | 3.3          | —           | 3.2          | —           | 2.9          | —           | 2.9          | —           | 1.8          | —           | —            | —           | —            | —           |
| 1/3   | 7.2          | 4.1          | —           | 4.0          | —           | 3.6          | —           | 3.6          | —           | 2.3          | —           | —            | —           | —            | —           |
| 1/2   | 9.8          | 5.6          | 2.5         | 5.4          | 2.4         | 4.9          | 2.2         | 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         | 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         | 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         | 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         | 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         | 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        | 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        | 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        | 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        | 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        | 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        | 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        | 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       | 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       | 216.0        | 130.0       | 139.0        | 83.0        | 108.0        | 65.0        | 86.0         | 52.0        |
| 60    | —            | —            | 177.0       | —            | 169.0       | —            | 154.0       | —            | 154.0       | —            | 103.0       | —            | 77.0        | —            | 62.0        |
| 75    | —            | —            | 221.0       | —            | 211.0       | —            | 192.0       | —            | 192.0       | —            | 128.0       | —            | 96.0        | —            | 77.0        |
| 100   | —            | —            | 285.0       | —            | 273.0       | —            | 248.0       | —            | 248.0       | —            | 165.0       | —            | 124.0       | —            | 99.0        |
| 125   | —            | —            | 359.0       | —            | 343.0       | —            | 312.0       | —            | 312.0       | —            | 208.0       | —            | 156.0       | —            | 125.0       |
| 150   | —            | —            | 414.0       | —            | 396.0       | —            | 360.0       | —            | 360.0       | —            | 240.0       | —            | 180.0       | —            | 144.0       |
| 200   | —            | —            | 552.0       | —            | 528.0       | —            | 480.0       | —            | 480.0       | —            | 320.0       | —            | 240.0       | —            | 192.0       |
| 250   | —            | —            | —           | —            | —           | —            | 604.0       | —            | 604.0       | —            | 403.0       | —            | 302.0       | —            | 242.0       |
| 300   | —            | —            | —           | —            | —           | —            | 722.0       | —            | 722.0       | —            | 482.0       | —            | 361.0       | —            | 289.0       |
| 350   | —            | —            | —           | —            | —           | —            | 828.0       | —            | 828.0       | —            | 560.0       | —            | 414.0       | —            | 336.0       |
| 400   | —            | —            | —           | —            | —           | —            | 954.0       | —            | 954.0       | —            | 636.0       | —            | 477.0       | —            | 382.0       |
| 450   | —            | —            | —           | —            | —           | —            | 1030.0      | —            | 1030.0      | —            | —           | —            | 515.0       | —            | 412.0       |
| 500   | —            | —            | —           | —            | —           | —            | 1180.0      | —            | 1180.0      | —            | 786.0       | —            | 590.0       | —            | 472.0       |

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

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 Table 66.2 at right.

Ampacities of Insulated Conductors—Reference Table 28.1

| Wire Size |                 |                        |
|-----------|-----------------|------------------------|
| AWG       | mm <sup>2</sup> | Copper<br>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                    |

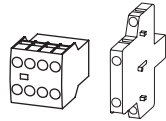
**Note:** For multiple conductors of the same size (1/0 AWG or larger) at a terminal, the ampacity is equal to the value in this table for that conductor multiplied by the number of conductors that the terminal is able to accommodate.

Relationship Between Conductor Size and Overcurrent Protection Rating for Power Circuits—Reference Table 66.2

| Conductor Size |                 | Maximum Rating of Non-Time Delay Fuse or Inverse Time Circuit Breaker (Amps) | Time Delay or Dual Element Fuse (Amps) |
|----------------|-----------------|------------------------------------------------------------------------------|----------------------------------------|
| AWG            | mm <sup>2</sup> |                                                                              |                                        |
| 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                                    |

## Accessories

### Contactor Auxiliary Contacts



|                                                     | Conventional Thermal Current, Open at 60°C<br>$I_{th}=I_{br}$ , AC-1 in Amps | Contact Configuration | Circuit Symbol | Package Quantity | Screw Terminals<br>Catalog Number |
|-----------------------------------------------------|------------------------------------------------------------------------------|-----------------------|----------------|------------------|-----------------------------------|
| <b>Frame B–C<br/>Front (Top) Mount</b>              |                                                                              |                       |                |                  |                                   |
| For use with<br>XTCE... B<br>XTCE... C              | 16                                                                           | 4NO                   |                | 5                | <b>XTCEXFAC40</b>                 |
|                                                     | 16                                                                           | 3NO-1NC               |                | 5                | <b>XTCEXFAC31</b>                 |
|                                                     | 16                                                                           | 2NO-2NC               |                | 5                | <b>XTCEXFAC22</b>                 |
| <b>Frame C<br/>Side Mount</b>                       |                                                                              |                       |                |                  |                                   |
| For use with<br>XTCE... C                           | 10                                                                           | 1NO-1NC               |                | 1                | <b>XTCEXSCC11</b>                 |
| <b>Frame D–G</b>                                    |                                                                              |                       |                |                  |                                   |
| For use with<br>XTCE... D<br>XTCE... F<br>XTCE... G | 16                                                                           | 4NO-0NC               |                | 5                | <b>XTCEXFBG40</b>                 |
|                                                     | 16                                                                           | 3NO-1NC               |                | 5                | <b>XTCEXFBG31</b>                 |
|                                                     | 16                                                                           | 2NO-2NC               |                | 5                | <b>XTCEXFBG22</b>                 |
| <b>Frame D–R</b>                                    |                                                                              |                       |                |                  |                                   |
| For use with<br>XTCE... D<br>XTCE... F<br>XTCE... G | 10                                                                           | 1NO-1NC               |                | 1                | <b>XTCEXSBN11</b>                 |

### EG Frame Multiwire Connectors Ordering Information

|  | Maximum Amps | Wires per Terminal | Wire Size Range AWG Cu | Kit Catalog Number |
|--|--------------|--------------------|------------------------|--------------------|
|  | 125          | 3                  | 14–2                   | <b>3TA125E3K</b>   |
|  | 125          | 6                  | 14–6                   | <b>3TA125E6K</b>   |

### JG Frame Multiwire Connectors Ordering Information

|  | Maximum Amps | Wires per Terminal | Wire Size Range AWG Cu | Kit Catalog Number |
|--|--------------|--------------------|------------------------|--------------------|
|  | 250          | 3                  | 14–2                   | <b>3TA250FJ3</b>   |
|  | 250          | 6                  | 14–6                   | <b>3TA250FJ6</b>   |

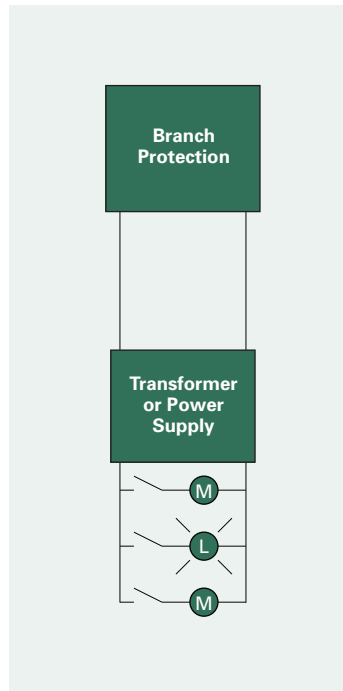
### Disconnect Fuse Holders Product Selection

| Description              | Standard Pack | Catalog Number  |
|--------------------------|---------------|-----------------|
| <b>For Class CC Fuse</b> |               |                 |
| Single-pole fuse holder  | 12            | <b>C383FHCC</b> |

### MMP Accessories

| Description                                                      | Catalog Number    |
|------------------------------------------------------------------|-------------------|
| Line-side adapter<br>For use with XTPR... BC1                    | <b>XTPAXLSA</b>   |
| Tool-less connector kit<br>For use with XTPR... BC1<br>XTCE... B | <b>XTPAXTPCB</b>  |
| 1NO-1NC<br>Front mount auxiliary                                 | <b>XTPAXFA11</b>  |
| Commoning link<br>For use with XTPR... BC1                       | <b>XTPAXCLKA2</b> |
| Commoning link<br>For use with XTPR... BC1                       | <b>XTPAXCLKA3</b> |
| Commoning link<br>For use with XTPR... BC1                       | <b>XTPAXCLKA4</b> |
| Commoning link<br>For use with XTPR... BC1                       | <b>XTPAXCLKA5</b> |
| Handle mechanism                                                 | <b>XTPAXRHMRY</b> |

## Designing the control circuit



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 22 for selection of the CPT and protective devices.

Refer to Page 24 for selection of the power supply and protective devices.

Refer to Page 26 for control circuit wiring.

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

Refer to Page 27 for pushbutton and pilot devices.

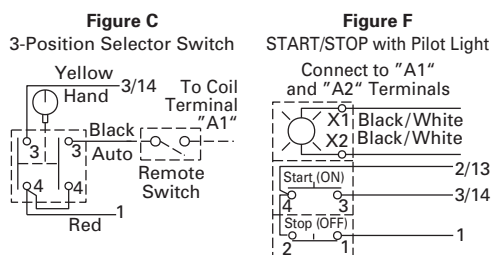
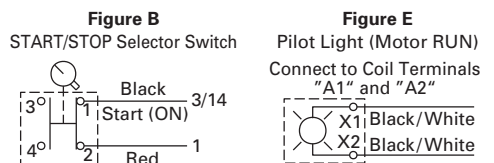
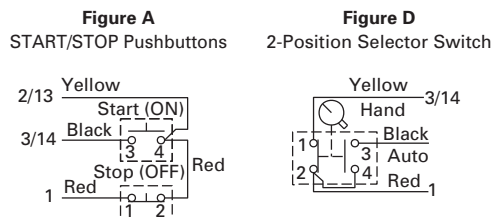
Refer to Page 28 for relays, timers, and terminal blocks.

Refer to Page 29 for programmable logic controllers and relays.

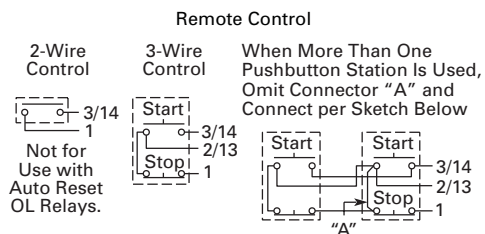
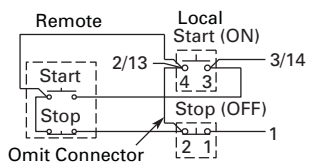
## Common control circuit wiring

### Connections for Control Stations

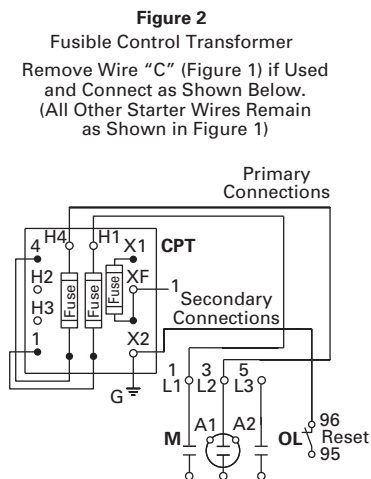
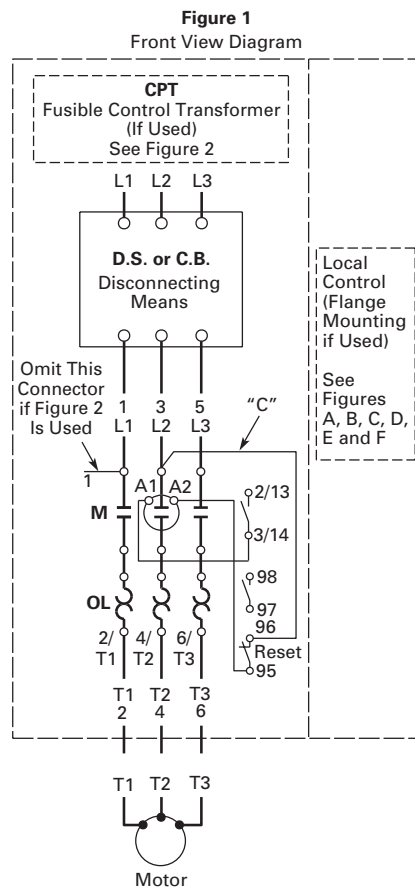
#### Local Control



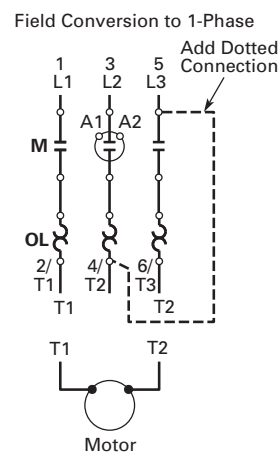
#### Combined Remote and Local for Figures 1 and 2



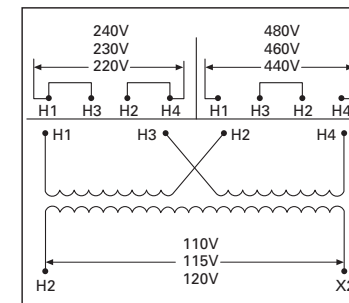
### Connections for Starters



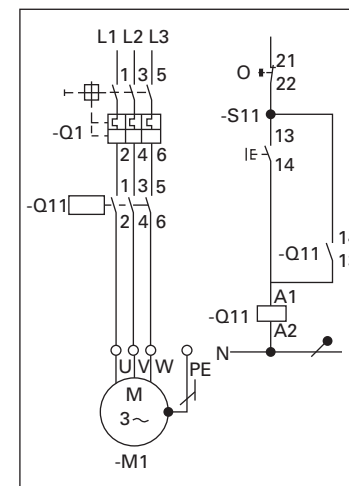
Connections for Dual Voltage Rated Transformer – See Transformer Nameplate



260878 D4



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



**Manual Motor Controller and Combination Motor Controller Wiring Diagram**

## Sizing the control power transformer



- Use the following formula to determine the inrush power of the control power transformer (CPT) needed to support the components used in the application.

$$\text{CPT INRUSH VA} = \sqrt{(\text{INRUSH VA})^2 + (\text{SEALED VA})^2}$$

### Example

| Qty   | Description       | Inrush VA | Sealed VA | Total Inrush | Total Sealed |
|-------|-------------------|-----------|-----------|--------------|--------------|
| 1     | XTCE007B10A coil  | 25        | 3.3       | 25           | 3.3          |
| 2     | XTCE018C10A coil  | 58        | 6.5       | 116          | 13.0         |
| 2     | Relays            | 29        | 3.3       | 58           | 6.6          |
| 6     | Indicating lights | 7.0       | 7.0       | 42           | 42.0         |
| Total |                   |           |           | 241          | 65.0         |

$$\text{CPT INRUSH VA} = \sqrt{(241)^2 + (65)^2} = 250 \text{ VA}$$

- Select the CPT size based on the CPT inrush VA needed.

### Selection Using Data from Previous Example

| Part Number | Primary Voltage | Secondary Voltage | Transformer VA | Inrush VA (90% Sec. Inrush Voltage) |
|-------------|-----------------|-------------------|----------------|-------------------------------------|
| C0050E2A    | 240 x 480       | 120               | 50             | 200                                 |
| → C0075E2A  | 240 x 480       | 120               | 75             | 410                                 |
| C0100E2A    | 240 x 480       | 120               | 100            | 540                                 |

C0075E2AFB has enough inrush VA capacity to handle the 250 VA inrush of the components.

### CPT Selection Chart

| CPT Part Number ① | Primary Voltage (AC) | Secondary Voltage (AC) | CPT VA | Inrush VA at 20% Power Factor |                       |
|-------------------|----------------------|------------------------|--------|-------------------------------|-----------------------|
|                   |                      |                        |        | 90% Secondary Voltage         | 95% Secondary Voltage |
| C0025E2A          | 240 x 480            | 120                    | 25     | 130                           | 100                   |
| C0050E2A          | 240 x 480            | 120                    | 50     | 200                           | 170                   |
| C0075E2A          | 240 x 480            | 120                    | 75     | 410                           | 310                   |
| C0100E2A          | 240 x 480            | 120                    | 100    | 540                           | 370                   |
| C0150E2A          | 240 x 480            | 120                    | 150    | 930                           | 780                   |
| C0200E2A          | 240 x 480            | 120                    | 200    | 1150                          | 810                   |
| C0250E2A          | 240 x 480            | 120                    | 250    | 1900                          | 1400                  |
| C0300E2A          | 240 x 480            | 120                    | 300    | 2700                          | 1900                  |
| C0350E2A          | 240 x 480            | 120                    | 350    | 3650                          | 3100                  |
| C0500E2A          | 240 x 480            | 120                    | 500    | 5300                          | 4000                  |
| C0750E2A          | 240 x 480            | 120                    | 750    | 11000                         | 8300                  |
| C1000E2A          | 240 x 480            | 120                    | 1000   | 21000                         | 15000                 |

① Add "FB" to the end of the part number to include a double-pole primary fuse block for rejection type fuses. Not available for 25 VA.

### Common Control Loads

| Description                          | Part Number | Inrush VA | Sealed VA |
|--------------------------------------|-------------|-----------|-----------|
| 7 to 15A <b>XT</b> Contactor Coil    | XTCE...B... | 25        | 3.3       |
| 18 to 32A <b>XT</b> Contactor Coil   | XTCE...C... | 58        | 6.5       |
| 40 to 72A <b>XT</b> Contactor Coil   | XTCE...D... | 154       | 14        |
| 80 to 95A <b>XT</b> Contactor Coil   | XTCE...F... | 372       | 37.1      |
| 115 to 170A <b>XT</b> Contactor Coil | XTCE...G... | 170       | 3.1       |
| Definite Purpose Contactor Coil      | C25DRF...   | 75        | 5.8       |
| Definite Purpose Contactor Coil      | C25DRJ...   | 111       | 7.6       |
| Lighting Contactor Coil              | C35A...     | 80        | 7.5       |
| Lighting Contactor Coil              | C35B...     | 100       | 10        |
| Mini <b>XT</b> Relay                 | XTRM...     | 29        | 3.9       |
| LED M22 Indicating Light             | M22-L...    | 0.4       | 0.4       |
| Intelligent Relay                    | EZ512...    | 5         | 5         |
| Intelligent Relay                    | EZ719...    | 10        | 10        |
| EZ Expansion Module                  | EZ618...    | 10        | 10        |

## Sizing protection for CPTs



Reference Accessories Section  
on Page 19 for Fuse Holders.

### Primary and Secondary Protection



C383FHCC  
Single-Pole  
Fuse Holder  
(Type CC)

| CPT Part Number ❶                   | CPT VA | Primary<br>Two-Pole Breaker | Secondary<br>Two-Pole Breaker | Primary<br>Fuse Size | Secondary<br>Fuse Size |
|-------------------------------------|--------|-----------------------------|-------------------------------|----------------------|------------------------|
| <b>240V Primary: 120V Secondary</b> |        |                             |                               |                      |                        |
| C0025E2A                            | 25     | WMZT2CX0                    | WMZT2CX0                      | 1                    | 1                      |
| C0050E2A                            | 50     | WMZT2C01                    | WMZT2C01                      | 1                    | 1                      |
| C0075E2A                            | 75     | WMZT2CX1                    | WMZT2C01                      | 3                    | 1                      |
| C0100E2A                            | 100    | WMZT2C02                    | WMZT2CX1                      | 3                    | 1                      |
| C0150E2A                            | 150    | WMZT2C03                    | WMZT2C02                      | 3                    | 3                      |
| C0200E2A                            | 200    | WMZT2C04                    | WMZT2C03                      | 6                    | 3                      |
| C0250E2A                            | 250    | WMZT2C05                    | WMZT2C04                      | 6                    | 3                      |
| C0300E2A                            | 300    | WMZT2C06                    | WMZT2C04                      | 6                    | 3                      |
| C0350E2A                            | 350    | WMZT2C07                    | WMZT2C05                      | 10                   | 3                      |
| C0500E2A                            | 500    | WMZT2C05                    | WMZT2C07                      | 6                    | 6                      |
| C0750E2A                            | 750    | WMZT2C08                    | WMZT2C10                      | 10                   | 6                      |
| C1000E2A                            | 1000   | WMZT2C10                    | WMZT2C15                      | 10                   | 10                     |
| <b>480V Primary: 120V Secondary</b> |        |                             |                               |                      |                        |
| C0025E2A                            | 25     | WMZT2CX0                    | WMZT2CX0                      | 1                    | 1                      |
| C0050E2A                            | 50     | WMZT2CX0                    | WMZT2C01                      | 1                    | 1                      |
| C0075E2A                            | 75     | WMZT2C01                    | WMZT2C01                      | 1                    | 1                      |
| C0100E2A                            | 100    | WMZT2C01                    | WMZT2CX1                      | 1                    | 1                      |
| C0150E2A                            | 150    | WMZT2CX1                    | WMZT2C02                      | 1                    | 3                      |
| C0200E2A                            | 200    | WMZT2C02                    | WMZT2C03                      | 1                    | 3                      |
| C0250E2A                            | 250    | WMZT2C03                    | WMZT2C04                      | 1                    | 3                      |
| C0300E2A                            | 300    | WMZT2C03                    | WMZT2C04                      | 1                    | 3                      |
| C0350E2A                            | 350    | WMZT2C04                    | WMZT2C05                      | 1                    | 3                      |
| C0500E2A                            | 500    | WMZT2C05                    | WMZT2C07                      | 1                    | 6                      |
| C0750E2A                            | 750    | WMZT2C08                    | WMZT2C10                      | 3                    | 6                      |
| C1000E2A                            | 1000   | WMZT2C05                    | WMZT2C15                      | 3                    | 10                     |

❶ Add "FB" to the end of the CPT part number to include a two-pole primary fuse block for rejection type fuses.

## Control power selection

1. Determine the output capacity needed to support the components used in the application. First, calculate the total load at steady state (nominal load after inrush). This is done by summing the sealed-in or nominal loads.

$$\text{Nominal Load} = \text{Sealed Load}_1 + \text{Sealed Load}_2 + \dots + \text{Sealed Load}_n$$

For extended operational life of the power supply, increase the calculated nominal load by 20%.

2. Next, calculate the total inrush or surge loads of the components supported by the power supply.

$$\text{Inrush Load} = \text{Inrush Load}_1 + \text{Inrush Load}_2 + \dots + \text{Inrush Load}_n$$

3. Select the power supply based on the available input voltage, nominal load and inrush (surge) load requirements.
4. Verify that the application of the components on the load does not exceed the surge capacity and other specifications of the selected power supply.

### Example: Select a 24 Vdc Power Supply with the Following Loads and a 240 Vac Input

| Qty   | Description       | Inrush W | Sealed W | Surge Current | Nominal Current | Total Surge Current | Total Nominal Current |
|-------|-------------------|----------|----------|---------------|-----------------|---------------------|-----------------------|
| 8     | XTCE007B10TD Coil | 3        | 3        | 0.13          | 0.13            | 1.00                | 1.00                  |
| 4     | XTCE018C10TD Coil | 12       | 0.5      | 0.50          | 0.02            | 2.00                | 0.08                  |
| 2     | Relay             | 2.6      | 2.6      | 0.11          | 0.11            | 0.22                | 0.22                  |
| 5     | Indicating light  | 1.2      | 1.2      | 0.05          | 0.05            | 0.25                | 0.25                  |
| Total |                   |          |          |               |                 | 3.47                | 1.55                  |

Derating for Extended Operation: Total Nominal Current = 1.55 x 120% = 1.86

Selection using data from previous table.

| Part Number     | Capacity W | Input Voltage   | Output Voltage | Nominal Current | Surge Current | Surge Capacity                  |
|-----------------|------------|-----------------|----------------|-----------------|---------------|---------------------------------|
| → <b>PSG60E</b> | 60         | 100–240 Vac 1-P | 24 Vdc         | 2.5A            | 3.75A         | 1 second at 10 second intervals |
| <b>PSG120E</b>  | 120        | 100–240 Vac 1-P | 24 Vdc         | 5A              | 7.5A          | 1 second at 10 second intervals |
| <b>PSG240E</b>  | 240        | 100–240 Vac 1-P | 24 Vdc         | 10A             | 15A           | 1 second at 10 second intervals |

**PSG60E** has enough nominal and surge current capacity for these components.



### Selection Chart

| Part Number    | Capacity | Input                    |                     | Output          |               |                                 |
|----------------|----------|--------------------------|---------------------|-----------------|---------------|---------------------------------|
|                |          | Voltage                  | Voltage             | Nominal Current | Surge Current | Surge Capacity                  |
| <b>PSG60E</b>  | 60W      | 100–240 Vac single-phase | 24 Vdc single-phase | 2.5A            | 3.75A         | 1 second at 10 second intervals |
| <b>PSG120E</b> | 120W     |                          |                     | 5A              | 7.5A          |                                 |
| <b>PSG240E</b> | 240W     |                          |                     | 10A             | 15A           |                                 |
| <b>PSG480E</b> | 480W     |                          |                     | 20A             | 30A           |                                 |
| <b>PSG60F</b>  | 60W      | 400–500 Vac three-phase  | 24 Vdc single-phase | 2.5A            | 3.75A         |                                 |
| <b>PSG120F</b> | 120W     |                          |                     | 5A              | 7.5A          |                                 |
| <b>PSG240F</b> | 240W     |                          |                     | 10A             | 15A           |                                 |
| <b>PSG480F</b> | 480W     |                          |                     | 20A             | 30A           |                                 |

**Note:** Above 55 degrees C, the PSG should be derated. See catalog CA08102001E for additional information and other specifications.

### Common Control Loads

| Description                          | Part Number               | Inrush W | Sealed W |
|--------------------------------------|---------------------------|----------|----------|
| 7 to 9A <b>XT</b> Contactor Coil     | XTCE...B...               | 3        | 3        |
| 12 to 15A <b>XT</b> Contactor Coil   | XTCE...B...               | 4.5      | 4.5      |
| 18 to 32A <b>XT</b> Contactor Coil   | XTCE...C...               | 12       | 0.5      |
| 40 to 72A <b>XT</b> Contactor Coil   | XTCE...D...               | 24       | 0.5      |
| 80 to 95A <b>XT</b> Contactor Coil   | XTCE...F...               | 90       | 1.3      |
| 115 to 170A <b>XT</b> Contactor Coil | XTCE...G...               | 149      | 2.1      |
| Definite Purpose Contactor Coil      | C25D...                   | 69       | 3.1      |
| Lighting Contactor (10 and 20A) Coil | C35...                    | 77       | 3.4      |
| Mini <b>XT</b> Relay                 | XTRM...                   | 2.6      | 2.6      |
| LED M22 Indicating Light             | M22-L...                  | 0.4      | 0.4      |
| Intelligent Relay                    | EZ512...                  | 2        | 2        |
| Intelligent Relay                    | EZ719...                  | 3.5      | 3.5      |
| EZ Display                           | EZD-80...                 | 3        | 3        |
| EZ Expansion Modules                 | EZ618...                  | 4        | 4        |
| ELC Programmable Logic Controller    | ELC-PV...                 | 5.3      | 5.3      |
| ELC Expansion Modules                | ELC-EX..., -AN..., -TC... | 2.2      | 2.2      |

## Sizing protection for power supplies

### Power Supplies



| Part Number | Capacity | Input Voltage            | Primary Fusing | Class CC Fuse Holder (Qty) | Suggested Power Supply Primary Wire Size |
|-------------|----------|--------------------------|----------------|----------------------------|------------------------------------------|
| PSG60E      | 60W      | 100–240 Vac single-phase | 6A or 10A      | <b>C383FHCC</b> (2)        | 14 AWG                                   |
| PSG120E     | 120W     |                          | 6A or 10A      | <b>C383FHCC</b> (2)        | 14 AWG                                   |
| PSG240E     | 240W     |                          | 10A or 16A     | <b>C383FHCC</b> (2)        | 14 AWG                                   |
| PSG480E     | 480W     |                          | 10A or 16A     | <b>C383FHCC</b> (2)        | 14 AWG                                   |
| PSG60F      | 60W      | 400–500 Vac three-phase  | 6A or 10A      | <b>C383FHCC</b> (3)        | 14 AWG                                   |
| PSG120F     | 120W     |                          | 6A or 10A      | <b>C383FHCC</b> (3)        | 14 AWG                                   |
| PSG240F     | 240W     |                          | 6A or 10A      | <b>C383FHCC</b> (3)        | 14 AWG                                   |
| PSG480F     | 480W     |                          | 6A or 10A      | <b>C383FHCC</b> (3)        | 14 AWG                                   |

**Note:** If the sum of the loads on the secondary of the power supply exceeds the output ratings of the power supply, then secondary overload protection is required.

## Wire selection for control circuits

### Wire color designation (internal power circuit wiring)

|                                                                                                                                                                            |                                                                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                           | <b>Black:</b><br>All ungrounded control circuit conductors operating at the supply voltage                                                                                                       |
|                                                                                           | <b>Red:</b><br>Ungrounded AC control circuits operating at a voltage less than the supply voltage                                                                                                |
|                                                                                           | <b>Blue:</b> Ungrounded DC control circuits                                                                                                                                                      |
| <br>     | <b>Yellow or orange:</b><br>Ungrounded control circuits or other wiring, such as for cabinet lighting, that remain energized when the main disconnect is in the OFF position                     |
| <br>    | <b>White or gray or three white stripes on other than green, blue, orange, or yellow:</b><br>Grounded AC current-carrying control circuit conductor regardless of voltage                        |
|                                                                                         | <b>White with blue stripe:</b><br>Grounded DC current-carrying control circuit conductor                                                                                                         |
| <br> | <b>White with yellow stripe or white with orange stripe:</b><br>Grounded AC control circuit current-carrying conductor that remains energized when main disconnect switch is in the OFF position |

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 Table 38.1

| Ampacity, Amperes | Conductor Size    |                 |
|-------------------|-------------------|-----------------|
|                   | AWG               | mm <sup>2</sup> |
| 10                | 16                | 1.3             |
| 7                 | 18                | 0.82            |
| 5                 | 20 <sup>2</sup>   | 0.52            |
| 3                 | 22 <sup>2</sup>   | 0.32            |
| 2                 | 24 <sup>2</sup>   | 0.20            |
| 1                 | 26 <sup>2</sup>   | 0.13            |
| 0.8               | 28 <sup>1 2</sup> | 0.08            |
| 0.5               | 30 <sup>1 2</sup> | 0.05            |

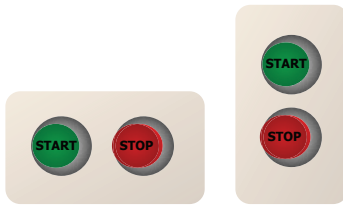
<sup>1</sup> Where these conductors are contained in a jacketed multi-conductor cable assembly.

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

## Logic control—pilot devices selection

### 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.



### Choosing Operators and Lights

| Type                                            | Catalog Number |
|-------------------------------------------------|----------------|
| Flush green momentary button                    | M22-D-G        |
| Extended red momentary button                   | M22-DP-R       |
| Blue RESET with push rod                        | M22-DZ-B-GB14  |
| Twist-to-release E-Stop with 1NO/2NC            | M22-PVT-K12    |
| Two-position maintained selector switch         | M22-WKV        |
| Two-position maintained keyed selector switch   | M22-WRS        |
| Three-position maintained selector switch       | M22-WRK3       |
| Three-position maintained keyed selector switch | M22-WRS3       |

| Type                 | Description    | Catalog Number |
|----------------------|----------------|----------------|
| NO contact block     |                | M22-K10        |
| NC contact block     |                | M22-K01        |
| LED indicating light | 12–30 Vac/Vdc  |                |
|                      | Yellow         | M22-L-Y-W      |
|                      | Green          | M22-L-G-G      |
|                      | Red            | M22-L-R-R      |
|                      | Blue           | M22-L-B-B      |
|                      | 85–264 Vac/Vdc |                |
|                      | Yellow         | M22-L-Y-230W   |
|                      | Green          | M22-L-G-230G   |
|                      | Red            | M22-L-R-230R   |
|                      | Blue           | M22-L-B-230B   |
| Legend plates        | "START"        | M22S-ST-GB1    |
|                      | "STOP"         | M22S-ST-GB0    |
|                      | "OFF ON"       | M22S-ST-GB10   |
|                      | "MAN. AUTO"    | M22S-ST-GB11   |
|                      | "HAND O AUTO"  | M22-ST-D12     |
|                      | "MAN. O AUTO"  | M22-ST-GB12    |

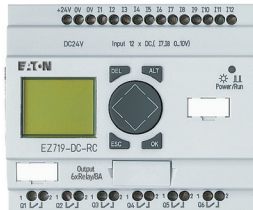
## Logic control—relays, timers, and terminal block selection

| Image                                                                               | Type                                 | Catalog Number                                       | Image                                                                                | Type                                          | Catalog Number                                                                                                           |
|-------------------------------------------------------------------------------------|--------------------------------------|------------------------------------------------------|--------------------------------------------------------------------------------------|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
|    | 2NO-2NC 10A relay 120 Vac            | <b>XTRM10A22A</b>                                    |   | 30A terminal blocks 6.2 mm wide               | <b>XBUT4 (Grey)</b><br><b>XBUT4BU (Blue)</b><br><b>XBUT4BK (Black)</b><br><b>XBUT4WH (White)</b><br><b>XBUT4RD (Red)</b> |
|    | 2NO-2NC 10A relay 24 Vdc             | <b>XTRM10A22TD</b>                                   |   | Ground terminal block                         | <b>XBUT4PE</b>                                                                                                           |
|    | On-delay timer 0.05s to 60h          | <b>XTMT6A60H11B</b>                                  |    | DIN rail end stop                             | <b>XBAES35C</b>                                                                                                          |
|    | Single-pole terminal block relays    | <b>XRU1D120U</b><br><b>XRU1D24U</b>                  |   | Terminal block jumpers                        | <b>XBAFBS26—2 pos.</b><br><b>XBAFBS36—3 pos.</b><br><b>XBAFBS56—5 pos.</b><br><b>XBAFBS106—10 pos.</b>                   |
|  | Four-pole, 15A control relays        | <b>D7PF4AA (120 Vac)</b><br><b>D7PF4AT1 (24 Vdc)</b> |  | Terminal block end cover                      | <b>XBACUT10</b>                                                                                                          |
|  | Four-pole control relay socket       | <b>D7PAD</b>                                         |  | Blank marker strip (strip of 10)              | <b>XBMBZB6</b>                                                                                                           |
|  | Multifunction universal timing relay | <b>TRL07</b>                                         |  | Open three-pole power distribution block 175A | <b>CHDB3213</b>                                                                                                          |
|  | DIN rail                             | <b>XBANS3575P</b>                                    |  | Finger-safe power distribution block 380A     | <b>CHDB330F</b>                                                                                                          |

## Logic control—logic controllers and relays



**EZ500 with Display**



**EZ700 with Display**



**ELC Logic Controller**



**ELC Power Supply**

### PLCs and Intelligent Relays

|                          | Controller     |                                                                                |               |              |               | Expansion Module Options                    |               |           |               |                |                | Power Supply Options             |                      |
|--------------------------|----------------|--------------------------------------------------------------------------------|---------------|--------------|---------------|---------------------------------------------|---------------|-----------|---------------|----------------|----------------|----------------------------------|----------------------|
|                          | Catalog Number | Description                                                                    | Digital Input | Analog Input | Relay Outputs | Catalog Number                              | Description   |           |               |                |                | 100–240 Vac Input Catalog Number | 24 Vdc Output (Amps) |
| Basic (120 Vac Input)    |                |                                                                                |               |              |               |                                             |               |           |               |                |                |                                  |                      |
|                          | EZ512-AC-RC    | Intelligent relay with clock and display                                       | 8             | —            | 4             | —                                           | —             |           |               |                |                | EZ400-POW                        | 1.25                 |
| Basic (24 Vdc Input)     |                |                                                                                |               |              |               |                                             |               |           |               |                |                |                                  |                      |
|                          | EZ512-DC-RC    | Intelligent relay with clock and display                                       | 8             | 2            | 4             | —                                           | —             |           |               |                |                | EZ400-POW                        | 1.25                 |
| Expanded (120 Vac Input) |                |                                                                                |               |              |               |                                             |               |           |               |                |                |                                  |                      |
|                          |                |                                                                                |               |              |               | 110–240 Vac Inputs                          |               |           | Relay Outputs |                |                |                                  |                      |
|                          | EZ719-AC-RC    | Intelligent relay with clock and display                                       | 12            | —            | 6             | EZ618-AC-RE                                 | 12            | 6         |               | EZ400-POW 1.25 |                |                                  |                      |
| Expanded (24 Vdc Input)  |                |                                                                                |               |              |               |                                             |               |           |               |                |                |                                  |                      |
|                          |                |                                                                                |               |              |               | 24 Vdc Inputs                               |               |           | Relay Outputs |                |                |                                  |                      |
|                          | EZ719-DC-RC    | Intelligent relay with clock and display                                       | 12            | 4            | 6             | EZ618-DC-RE                                 | 12            | 6         |               | EZ400-POW 1.25 |                |                                  |                      |
| Advanced (24 Vdc Input)  |                |                                                                                |               |              |               |                                             |               |           |               |                |                |                                  |                      |
|                          | ELC-PV28NNDR   | Programmable logic controller that has expandable features with add-on modules | 16            | —            | 12            | Right Side Module                           | 24 Vdc Inputs | Analog In | Relay Outputs | Analog Out     | Transistor Out |                                  |                      |
| ELC-EX16NNDR             |                |                                                                                |               |              |               | 8                                           | —             | 8         | —             | —              | ELC-PS01       | 1                                |                      |
| ELC-EX16NNDT             |                |                                                                                |               |              |               | 8                                           | —             | —         | —             | 8              | ELC-PS02       | 2                                |                      |
| ELC-AN06AANN             |                |                                                                                |               |              |               | —                                           | 4             | —         | 2             | —              |                |                                  |                      |
| ELC-TC04ANNN             |                |                                                                                |               |              |               | Thermocouple J, K, R, S, T plus 4 analog in |               |           |               |                |                |                                  |                      |
| ELC-MC01                 |                |                                                                                |               |              |               | Motion control, 1 axis module               |               |           |               |                |                |                                  |                      |
| Left Side Module         |                |                                                                                |               |              |               |                                             |               |           |               |                |                |                                  |                      |
|                          | ELC-COENETM    | Ethernet Modbus TCP (master/slave)                                             |               |              |               |                                             |               |           |               |                |                |                                  |                      |

#### EZ Accessories

- EZSOFT**—Programming software
- EZ-PC-CAB**—PC programming cable
- EZD-80-B**—External display
- EZD-CP4-500**—Display communication module with cable



**EZ80-B**

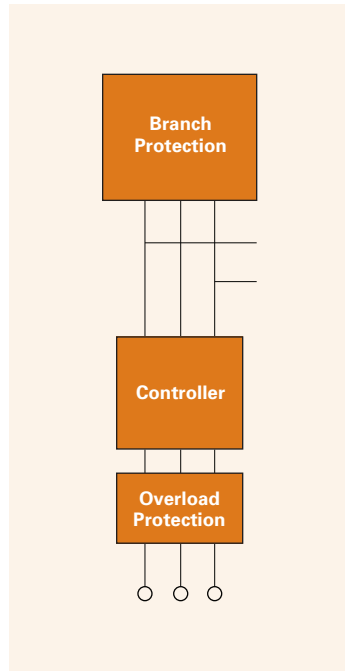
#### ELC Accessories

- ELCSOFT**—ELC programming software
- ELC-GP04**—External graphic panel display
- ELC-CBPCELC1**—PC/graphic panel cable
- ELCSOFTGP**—ELC-GP programming software



**ELC-GP04**

## 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 32) 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%           |

### Overcurrent Device Ratings for Control Circuit Conductors Tapped from Load Side of Branch Circuit Protective Device—Reference Table 66.4

| Conductor Size |                 | Control Circuit Overcurrent Device (Amps) | Branch Circuit Overcurrent Device (Amps) |                       |
|----------------|-----------------|-------------------------------------------|------------------------------------------|-----------------------|
| AWG            | mm <sup>2</sup> |                                           | 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                    |

**Note:** See table on Page 6 for breaker and fused disconnect part numbers, and Page 19 for fuse holders.

## Common Formulas and Conversions

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

### Voltage Drop Calculations

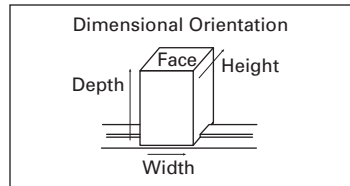
|                                |                                                                                                                                                            |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------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

### 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     |

### NEMA/UL/IEC Enclosure Type Cross-Reference—Approximate

| NEMA<br>Enclosure<br>Rating | IP10 | IP20 | IP21 | IP22 | IP23 | IP30 | IP31 | IP32 | IP33 | IP40 | IP41 | IP42 | IP43 | IP50 | IP51 | IP52 | IP53 | IP54 | IP55 | IP56 | IP60 | IP61 | IP62 | IP63 | IP64 | IP65 | IP66 | IP67 | IP68 |
|-----------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 1                           | X    | X    | X    | X    | X    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 2                           | X    | X    | X    | X    | X    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 3                           | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |      |
| 3R                          | X    | X    | X    | X    | X    | X    | X    | X    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 3S                          | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |      |
| 4                           | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |      |
| 4X                          | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |      |
| 6                           | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |      |
| 6P                          | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |      |
| 12                          | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |      |
| 13                          | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |      |



## Product Specifications

| Protective Devices               | Part Number             | Tightening Torque (in-lb)                                          |                                                                    | Mounting | Approximate Dimensions (mm) |       |       | Type        | Installation Pub Number |
|----------------------------------|-------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------|----------|-----------------------------|-------|-------|-------------|-------------------------|
|                                  |                         | Lineside                                                           | Loadside                                                           |          | Height                      | Width | Depth |             |                         |
| Molded case circuit breakers ①   | EGB...                  | 14–10 AWG... 35                                                    | 14–10 AWG... 35                                                    | 10       | 139.7                       | 76.2  | 75.9  | Three-pole  | I.L. 29C515C            |
|                                  | EGE...                  | 8 AWG... 40                                                        | 8 AWG... 40                                                        |          | 139.7                       | 76.2  | 75.9  | Three-pole  | I.L. 29C515C            |
|                                  | EGH...                  | 6–4 AWG... 45                                                      | 6–4 AWG... 45                                                      |          | 139.7                       | 76.2  | 75.9  | Three-pole  | I.L. 29C515C            |
|                                  | EGC...                  | 3–3/0 AWG... 50                                                    | 3–3/0 AWG... 50                                                    |          | 139.7                       | 76.2  | 75.9  | Three-pole  | I.L. 29C515C            |
|                                  | JGE...                  | 4–350 kcmil... 180                                                 | 4–350 kcmil... 180                                                 | 10       | 177.8                       | 104.9 | 90.7  | Three-pole  | IL01204006E             |
|                                  | JGS...                  |                                                                    |                                                                    |          | 177.8                       | 104.9 | 90.7  | Three-pole  | IL01204006E             |
|                                  | JGH...                  |                                                                    |                                                                    |          | 177.8                       | 104.9 | 90.7  | Three-pole  | IL01204006E             |
|                                  | JGC...                  |                                                                    |                                                                    |          | 177.8                       | 104.9 | 90.7  | Three-pole  | IL01204006E             |
|                                  | LGE...                  | 2–500 kcmil (2)... 375                                             | 2–500 kcmil (2)... 375                                             | 25       | 257.3                       | 139.2 | 103.9 | Three-pole  | IL01207006E             |
|                                  | LGH...                  |                                                                    |                                                                    |          | 257.3                       | 139.2 | 103.9 | Three-pole  | IL01207006E             |
|                                  | LGU...                  |                                                                    |                                                                    |          | 257.3                       | 139.2 | 103.9 | Three-pole  | IL01207006E             |
| Multiwire terminals              | 3TA125E3K               | 70 in-lb                                                           | 70 in-lb                                                           | 35       | 48.0 Incremental            |       |       |             | IL01202001E             |
|                                  | 3TA125E6K               | 25 in-lb                                                           | 25 in-lb                                                           | 35       | 48.0 Incremental            |       |       |             | IL01202002E             |
|                                  | 3TA250FJ3               | 70 in-lb                                                           | 70 in-lb                                                           | 96       | 81.0 Incremental            |       |       |             | IC01204001E             |
|                                  | 3TA250FJ6               | 25 in-lb                                                           | 25 in-lb                                                           | 96       | 81.0 Incremental            |       |       |             | IC01204002E             |
| Miniature circuit breakers       | WMZT...                 |                                                                    |                                                                    |          |                             |       |       |             |                         |
| Motor circuit protectors         | HMCP...                 | 14–10 AWG... 35<br>8 AWG... 40<br>6–4 AWG... 45<br>3–3/0 AWG... 50 | 14–10 AWG... 35<br>8 AWG... 40<br>6–4 AWG... 45<br>3–3/0 AWG... 50 | 28       | 152.4                       | 105.0 | 86    | Three-pole  | IL01211006E             |
|                                  | HMCPE...                | 14–10 AWG... 35<br>8 AWG... 40<br>6–4 AWG... 45<br>3–3/0 AWG... 50 | 14–10 AWG... 35<br>8 AWG... 40<br>6–4 AWG... 45<br>3–3/0 AWG... 50 | 10       | 139.7                       | 76.2  | 75.9  | Three-pole  | IL29C130D               |
| Motor protective circuit breaker | FDMP...                 | 14–10 AWG... 35<br>8 AWG... 40<br>6–4 AWG... 45<br>3–4/0 AWG... 50 | 14–10 AWG... 35<br>8 AWG... 40<br>6–4 AWG... 45<br>3–4/0 AWG... 50 | 35       | 152.4                       | 105.0 | 86.0  | Three-pole  | IL29C115C               |
| Fusible disconnects              | R4H3030FJ               | 27 in-lb                                                           | 27 in-lb                                                           | 20       | 116.0                       | 105.0 | 99.0  |             | N/A                     |
|                                  | R4H3030FCC              | 27 in-lb                                                           | 27 in-lb                                                           | 20       | 116.0                       | 96.0  | 83.5  |             | N/A                     |
|                                  | R9J3030FJ and R9J3060FJ | 31 in-lb                                                           | 31 in-lb                                                           | 20       | 136.0                       | 149.5 | 123.0 |             | N/A                     |
|                                  | R9K3100FJ               | 35.4 in-lb                                                         | 35.4 in-lb                                                         | 20       | 186.0                       | 149.5 | 123.0 |             | N/A                     |
|                                  | R9L3200FJ               | 200 in-lb                                                          | 200 in-lb                                                          | 20       | 291.0                       | 195.0 | 130.0 |             | N/A                     |
|                                  | R9M3400FJ               | 500 in-lb                                                          | 500 in-lb                                                          | 20       | 390.0                       | 276.0 | 141.5 |             | N/A                     |
|                                  | R9N3600FJ               | 500 in-lb                                                          | 500 in-lb                                                          | 20       | 471.0                       | 364.0 | 250.0 |             | N/A                     |
| Fuse holders                     | C383FHCC                | 18–12 AWG... 20<br>10–8 AWG... 25<br>18–10 AWG (2)... 25           | 18–12 AWG... 20<br>10–8 AWG... 25<br>18–10 AWG (2)... 25           |          | 81.2                        | 17.8  | 61.0  | Single-pole |                         |

① Tightening torques are for standard terminal provided with breaker. For alternative lugs, see the installation publication.

**Product Specifications (continued)**

| Controllers      | Part Number  | Tightening Torque (in-lb)                                                   |       |      | Approximate Dimensions (mm) |                  |                  |                  | Type | Installation<br>Pub Number |
|------------------|--------------|-----------------------------------------------------------------------------|-------|------|-----------------------------|------------------|------------------|------------------|------|----------------------------|
|                  |              | Line                                                                        | Load  | Coil | Auxiliary<br>Contacts       | Height           | Width            | Depth            |      |                            |
| Motor control    | XTSC...BB... | 15.0                                                                        | 10.6  | 10.6 | 10.6                        | 178.5            | 45.0             | 95.7             |      | Pub51176                   |
|                  | XTSC...BC... | 15.0                                                                        | 26.6  | 10.6 | 10.6                        | 228.8            | 45.0             | 124.3            |      | Pub51228                   |
|                  | XTSC...DD... | 26.6                                                                        | 29.2  | 10.6 | 10.6                        | 284.0            | 55.0             | 196.0            |      | Pub51190                   |
|                  | XTFC...BB... | 36                                                                          | 10.6  | 10.6 | 10.6                        | 209.0            | 45.0             | 95.7             |      | Pub51176                   |
|                  | XTFC...BC... | 36                                                                          | 26.6  | 10.6 | 10.6                        | 266.7            | 45.0             | 124.3            |      | Pub51228                   |
|                  | XTFC...DD... | 36                                                                          | 29.2  | 10.6 | 10.6                        | 312.1            | 55.0             | 196.0            |      | Pub51190                   |
|                  | XTCE...B...  | 10.6                                                                        | 10.6  | 10.6 | 10.6                        | 68.0             | 45.0             | 75.0             |      | Pub51210                   |
|                  | XTCE...C...  | 26.6                                                                        | 26.6  | 10.6 | 10.6                        | 85.0             | 45.0             | 97.4             |      | Pub51211                   |
|                  | XTCE...D...  | 29.2                                                                        | 29.2  | 10.6 | 10.6                        | 104.0            | 55.0             | 132.1            |      | Pub51216                   |
|                  | XTCE...F...  | 123.9                                                                       | 123.9 | 10.6 | 10.6                        | 170.0            | 90.0             | 160.0            |      | Pub51188                   |
|                  | XTCE...G...  | 123.9                                                                       | 123.9 | 10.6 | 10.6                        | 170.0            | 90.0             | 160.0            |      | Pub51188                   |
|                  | XTOB...BC1   | —                                                                           | 16.0  | —    | 7–10.6                      | 49.8 incremental | 45.0             | 88.4             |      | Pub51210                   |
|                  | XTOB...CC1   | —                                                                           | 16.0  | —    | 7–10.6                      | 51.4 incremental | 45.0             | 105.3            |      | Pub51211                   |
|                  | XTOB...DC1   | —                                                                           | 31.0  | —    | 7–10.6                      | 70 incremental   | 60.0             | 93.6             |      | Pub51216                   |
|                  | XTOB...GC1   | —                                                                           | 88.5  | —    | 7–10.6                      | 107 incremental  | 118.0            | 134              |      | Pub51188                   |
|                  | XTCEXF...    | —                                                                           | —     | —    | 10.6                        | —                | —                | 41.2 incremental |      | Pub51211 or Pub51216       |
|                  | XTCEXS...    | —                                                                           | —     | —    | 10.6                        | —                | 10.5 incremental | —                |      | Pub51216 or Pub51188       |
|                  | XTPAXF...    | —                                                                           | —     | —    | 10.6                        | —                | —                | —                |      | Pub51198                   |
|                  | XTPAXTPCB    | Not required                                                                | —     | —    | —                           | —                | —                | —                |      | Pub51176                   |
|                  | XTPAXLSA     | 36                                                                          | —     | —    | —                           | 30.5 incremental | —                | —                |      | —                          |
| Definite purpose | C25DR...     | 12–14 AWG 15 in-lb<br>10 AWG 25 in-lb<br>8 AWG 40 in-lb<br>4–6 AWG 45 in-lb |       |      |                             |                  |                  |                  |      |                            |

**Product Specifications (continued)**

| Power Conversion           | Part Number | Tightening Torque (in-lb) |             | Approximate Dimensions (mm) |       |       | Type | Installation Pub Number |
|----------------------------|-------------|---------------------------|-------------|-----------------------------|-------|-------|------|-------------------------|
|                            |             | Primary                   | Secondary   | Height                      | Width | Depth |      |                         |
| Control power transformers | C0025E2A    | 16                        | 16          | 65.0                        | 76.0  | 64.0  | —    |                         |
|                            | C0050E2A    | 16                        | 16          | 65.0                        | 76.0  | 76.0  | —    |                         |
|                            | C0075E2A    | 16                        | 16          | 65.0                        | 76.0  | 89.0  | —    |                         |
|                            | C0100E2A    | 16                        | 16          | 73.0                        | 86.0  | 86.0  | —    |                         |
|                            | C0150E2A    | 16                        | 16          | 81.0                        | 95.0  | 102.0 | —    |                         |
|                            | C0200E2A    | 16                        | 16          | 97.0                        | 114.0 | 102.0 | —    |                         |
|                            | C0250E2A    | 16                        | 16          | 97.0                        | 114.0 | 111.0 | —    |                         |
|                            | C0300E2A    | 16                        | 16          | 97.0                        | 114.0 | 121.0 | —    |                         |
|                            | C0350E2A    | 16                        | 16          | 97.0                        | 114.0 | 133.0 | —    |                         |
|                            | C0500E2A    | 30                        | 30          | 121.0                       | 133.0 | 140.0 | —    |                         |
|                            | C0750E2A    | 30                        | 30          | 121.0                       | 133.0 | 178.0 | —    |                         |
|                            | C1000E2A    | 30                        | 30          | 144.0                       | 171.0 | 164.0 | —    |                         |
| Power supplies             | PSG60E      | 6.94–8.68                 | 6.94–8.68   | 125.0                       | 32.0  | 120.5 | —    | IL00912001E             |
|                            | PSG60F      | 10.41–13.89               | 10.41–13.89 | 126.5                       | 70.0  | 111.4 | —    | IL00912005E             |
|                            | PSG120E     | 6.94–8.68                 | 6.94–8.68   | 126.5                       | 50.0  | 115.0 | —    | IL00912002E             |
|                            | PSG120F     | 10.41–13.89               | 10.41–13.89 | 126.5                       | 70.0  | 111.3 | —    | IL00912006E             |
|                            | PSG240E     | 6.94–8.68                 | 6.94–8.68   | 126.5                       | 85.0  | 118.5 | —    | IL00912003E             |
|                            | PSG240F     | 10.41–13.89               | 10.41–13.89 | 126.5                       | 85.0  | 120.5 | —    | IL00912007E             |
|                            | PSG480E     | 10.41–13.89               | 10.41–13.89 | 126.5                       | 160.0 | 111.4 | —    | IL00912004E             |
|                            | PSG480F     | 10.41–13.89               | 10.41–13.89 | 126.5                       | 160.0 | 111.4 | —    | IL00912008E             |

| Type              | Part Number  | Tightening Torque (in-lb) |                  | Mounting | Approximate Dimensions (mm) |       |       | Type | Installation Pub Number |
|-------------------|--------------|---------------------------|------------------|----------|-----------------------------|-------|-------|------|-------------------------|
|                   |              | Lineside                  | Loadside         |          | Height                      | Width | Depth |      |                         |
| Logic controllers | EZ512...     | 5.3                       | 5.3              | —        | 110.0                       | 71.5  | 58.0  | —    | MN05013003E             |
|                   | EZ719...     | 5.3                       | 5.3              | —        | 110.0                       | 107.5 | 58.0  | —    | MN05013003E             |
|                   | EZ618...     | 5–7                       | 5–7              | —        | 110.0                       | 107.5 | 58.0  | —    | IL05013009E             |
|                   | EZ400...     | 5–7                       | 5–7              | —        | 110.0                       | 71.5  | 56.5  | —    | IL05013008E             |
|                   | ELC-PV...    | 22–16 AWG... 1.7          | 22–16 AWG... 1.7 | —        | 96.0                        | 70.0  | 60.0  | —    | IL05001004E             |
|                   | ELC-EX16NNDR | 22–16 AWG... 1.7          | 22–16 AWG... 1.7 | —        | 96.0                        | 25.2  | 60.0  | —    | IL05003004E             |
|                   | ELC-EX16NNDT | 22–16 AWG... 1.7          | 22–16 AWG... 1.7 | —        | 96.0                        | 25.2  | 60.0  | —    | IL05003004E             |
|                   | ELC-AN06AANN | 22–16 AWG... 1.7          | 22–16 AWG... 1.7 | —        | 96.0                        | 25.2  | 60.0  | —    | IL05003003E             |
|                   | ELC-TC04ANNN | 1.7                       | 1.7              | —        | 96.0                        | 25.2  | 60.0  | —    | IL05003009E             |
|                   | ELC-MC01     | 22–16 AWG... 1.7          | 22–16 AWG... 1.7 | —        | 96.0                        | 25.2  | 60.0  | —    | IL05003023E             |
|                   | ELC-COENETM  | —                         | —                | —        | 96.0                        | 33.0  | 60.0  | —    | MN05006001E             |
|                   | ELC-PS01     | 4.3–6.9                   | 4.3–6.9          | —        | 96.0                        | 36.5  | 60.0  | —    | IL05003007E             |
|                   | ELC-PS02     | 4.3–6.9                   | 4.3–6.9          | —        | 96.0                        | 55.0  | 60.0  | —    | IL05003007E             |

Product Specifications (continued)

| Logic Circuit Components              | Part Number | Tightening Torque (in-lb) |                                                                  | Approximate Dimensions (mm) |      |        |       |       |      | Installation Pub Number |
|---------------------------------------|-------------|---------------------------|------------------------------------------------------------------|-----------------------------|------|--------|-------|-------|------|-------------------------|
|                                       |             | Line                      | Load                                                             | Mounting                    | Coil | Height | Width | Depth | Type |                         |
| Pushbuttons, switches<br>pilot lights | M22...      | 7.1                       | —                                                                | 17.7                        | —    | —      | —     | —     | —    | IL04716001E             |
|                                       | M22...      | 7.1                       | —                                                                | 17.7                        | —    | —      | —     | —     | —    | —                       |
| Relays                                | XTRM...     | 10.6                      | —                                                                | —                           | 10.6 | 58.0   | 45.0  | 54.0  | —    | Pub51219                |
|                                       | XTMT...     | 10.6                      | —                                                                | —                           | 10.6 | 58.0   | 45.0  | 54.0  | —    | Pub51245                |
|                                       | TRL07       | 8.8                       | —                                                                | —                           | 8.8  | 87.0   | 17.5  | 60.0  | —    | IL04910002E             |
|                                       | D7...       | 7–8                       | —                                                                | —                           | 7–8  | 79.7   | 49.9  | 70.0  | —    | —                       |
| Terminal blocks                       | XBUT4...    | 5.3–7.1                   | —                                                                | —                           | —    | 47.5   | 6.2   | 46.9  | —    | Pub51473                |
|                                       | XBAE...     | 5.3–7.1                   | —                                                                | —                           | —    | 47.5   | 6.2   | 46.9  | —    | Pub51473                |
|                                       | XBAF...     | Not required              | —                                                                | —                           | —    | —      | —     | —     | —    | Pub51473                |
|                                       | CHDB3213    | 2/0–8 AWG... 120          | 4–6 AWG... 35<br>8 AWG... 25<br>10–14... 20                      | —                           | —    | 101.6  | 131.8 | 84.3  | —    | —                       |
|                                       | CHDB330F    | 500–6 AWG... 500          | 2–3 AWG... 50<br>4–6 AWG... 45<br>8 AWG... 40<br>10–14 AWG... 35 | —                           | —    | 118.4  | 39.1  | 72.9  | —    | —                       |

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