Industrial Solutions

INSTALLATION, OPERATIONS AND MAINTENANCE MANUAL

Evolution series E9000

Motor control center

by ABB

Table of contents

Warnings, cautions and notes
As used in this publication

Warning notices are used in this publication to emphasize that hazardous voltages, currents, or other conditions that could cause personal injury are present in this equipment or may be associated with its use.

Warning notices are also used for situations in which in attention or lack of equipment knowledge could cause either personal injury or damage to equipment.

Caution notices are used for situations in which equipment might be damaged if care is not taken.

Notes call attention to information that is especially significant to understanding and operating the equipment.

Introduction

—
01
Evolution Series
three-section lineup

This publication provides guidelines for installation and maintenance of Evolution Motor Control Centers, as shown in Figure 1. The information provided does not cover all details or variations in this product offering, nor does it address all possible contingencies to be met in connection with installation, operation, or maintenance. Should further information be desired, contact Post Sales Support: **1-888-437-3765**

Refer to the requisition number found on the front of the equipment when calling for assistance.

Disconnect equipment from all electrical services before performing any installation or maintenance work.

For additional information, including safety considerations for personnel working on this product, see NEMA Standard Publication No. ICS 2.3, Instructions on the Handling, Installation, Operation, and Maintenance of Motor Control Centers.

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01

General description – vertical section enclosures
Each Evolution MCC vertical section is assembled with two full-side sheets having openings near the top and bottom for lateral busing and wiring between sections. Multiple sections are joined together at the factory in three-section (maximum) shipping splits. Each shipping split is provided with continuous floor sills and a lifting angle. Floor sills and lifting angles are field removable. Each shipping split includes a continuous non-removable main horizontal bus. Main bus splice bars are provided within each shipping split for field connecting main busses. Refer to motor control center outline drawings furnished by ABB for location of shipping splits within each motor control center lineup. Hinged doors are provided over horizontal and vertical wireways. (These doors can be removed by extracting the hinge pins inside the doors.)

Vertical sections are normally provided with a top (12-inch high) horizontal wireway and a bottom (6-inch high) horizontal wireway. Non-arc resistant vertical section is provided with a vertical (4-inch wide) wireway. Each arc-resistant vertical section is provided with a vertical (3.85-inch wide) wireway.

To open unit doors, rotate the latches 90' counter-clockwise until the screwdriver slots or knobs are vertical.

To open wireway doors, rotate the latches 90' clockwise until the screwdriver slots or knobs are vertical.

Secure

Open

Unit Door Latch shown in secure position

Because of the great variety of motor controller assemblies and components provided within industrial motor control centers and to satisfy floor-space limitations at installation sites, a large variety of vertical section dimensions are provided, as follows:

- Section Height: 90-inch[2], 78-inch[1], 66-inch[1] etc.
- Section Width: 20-inch, 24-inch, 30-inch etc.
- Section Depth: 13-inch[1], 20-inch, 22-inch or deeper for large assemblies.

1. Not available in arc-resistant.
2. Sections with top fans and top vents will add 5" Sections with pull box and plenum will add 12".

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02A
Horizontal bus with Lexan barrier

—
02B
2500A without fans, 3000/3200 A main horizontal bus

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03
Metallic horizontal bus barrier for arc-resistant design

General description – arc-resistant
The arc-resistant sections are built with increased structural capacity. The main enhancements are thicker gage of steel, latches, hinges, and metallic PD brackets. In addition, there are two versions available with and without a plenum. The plenum option adds 12-inches to the top of the 90-inch section. The plenumless option should have a 4' clearance on top of the MCC. The top (12-inch high) horizontal wireway door and the bottom (6-inch high) wireway door utilize multi-turn latches to secure the doors. The remaining latches are ¼ turn (with options for closed status indication). There is no variation in the units between arc-resistant and standard E9000 other than the unit door. Additionally, the Arc Flash Mitigation units are compatible in arc-resistant design with arc-resistant/Arc flash Mitigation door.

General description – motor control center buses
The main horizontal power bus is located at the top of the vertical section. The bus bolted joints are accessible from the front by loosening the barrier mounting screws and sliding the Lexan® bus barrier up and forward from the main bus. Figure 2A shows a horizontal power bus with its Lexan barrier. For arc-resistant design, uses this same Lexan barrier with additional Metallic dead front barrier. Figure 2B shows the 2500 A without fans and the 3000/3200 A main horizontal bus configuration.

The vertical bus, either 300 A or 600/850 A, is connected with two bolts per phase to the main bus. The phase relationship is A–B–C from top to bottom and left to right, as viewed from the front. 2500 A Type 12 construction without fans will be limited to 700A vertical bus.

A continuous horizontal ground bus, sized in accordance with the National Electrical Code, is provided near the bottom of all motor control centers.

An optional vertical ground bus can be provided in each section providing additional grounding. A neutral bus is provided, when specified, in the bottom of the incoming section or in the bottom of all enclosure(s) as specified.

As shown in Figure 3, the arc-resistant MCC will include a metallic main bus barrier in addition to the standard Lexan barrier.

General description – motor control center units
Consult Publication DET-291 for detailed listings of Evolution MCC units.

Plug-in units are supplied with stabs rated at either 250 A or 600 A. Arc Flash Mitigation (AFM) units are supplied with retractable stabs, mechanical interlocks, racking screw, and visual stab and shutter indicators. AFM units are available in plug-in or stab-bolt configuration.

Installation and operation of units, both standard and AFM, are described on page 18 of this guide.

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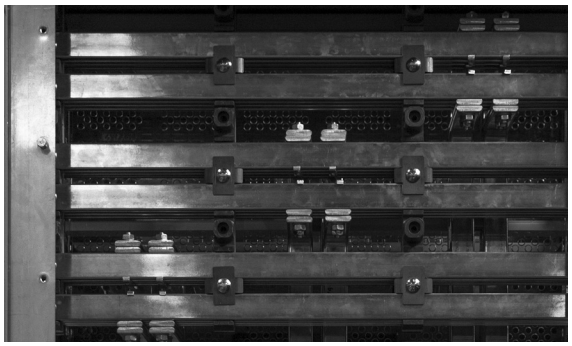
02A



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02B

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03

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04
Horizontal bus barrier mounting slot and screw

Bus splicing

Main, neutral and ground bus splice bars (with all associated hardware) are furnished, as necessary, to join sections together. They are located in the first section to the right of the joint.

Remove the top Lexan barrier, as shown in Figure 2A and Figure 04, to access the main bus. Refer to instruction drawings in splice kit. See Table 2.

Arc-resistant design has metallic barrier in addition to the Lexan barrier which also must be removed to access the main bus. Arc-resistant shipping splits will arrive with end caps. When bus splicing, please remove these end caps to make connection, only the furthest most left and right end caps shall remain.

—
04

Table 1:
Torque values for various bolt sizes and joint types.

Bolt Size	Copper Joints		Aluminum Joints	
	lb-ft	N-m	lb-ft	N-m
5/16-18	5–9	7–12	6.5–9	9–12
3/8-16	12–16	16–22	10–15	14–20
1/2-13	30–39	41–53	25–35	34–47
5/8-11	65–80	88–108	35–45	47–61
3/4-10	125–150	169–203	50–75	68–102

Note: When assembling or connecting to aluminum bus, apply a suitable joint compound between the contacting surfaces.

Bus splice kits

Table 2: Bus splice kits splicing from / to E9000/E9000

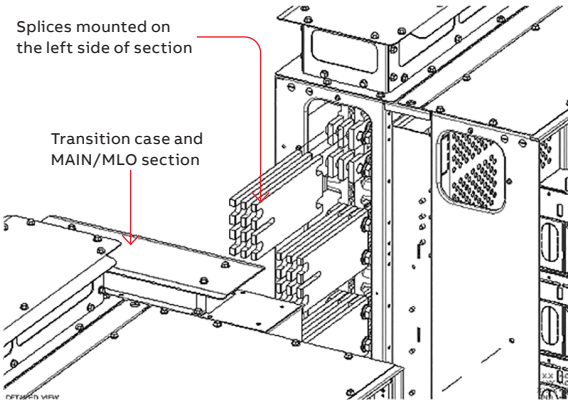
Amps	Main Bus Splice Assembly Kit	Bars/ Phase Copper	Size (in.) (thick x width)	SC Rating 600V Max (sym.amps)	Splice Instruction Drawing*
Standard Splicing					
600	110C1735G1SM	1	1/4 x 2	65K	110C1258
800	110C1735G4SM	1	3/8 x 2	65K	110C1256
1200	110C1735G7SM	1	1/2 x 2	100K	110C1253
1600/ 2000	110C1735G12SM	2	1/2 x 2	100K	110C1263
2500	110C1735G13SM	2	1/2 x 2	100K	110C1785
2500/ 3200	110C1735G38SM	3	2/5 x 4	100K	110C2357
N3R and Spacer Shells					
600	110C1735G14SM	1	1/4 x 2	65K	110C1258
800	110C1735G15SM	1	3/8 x 2	65K	110C1256
1200	110C1735G16SM	1	1/2 x 2	100K	110C1253
1600/ 2000	110C1735G17SM	2	1/2 x 2	100K	110C1263
2500	110C1735G13SM	2	1/2 x 2	100K	110C1263
2500/ 3200	110C1735G39SM	3	2/5 x 4	100K	110C2357

*Included in kits

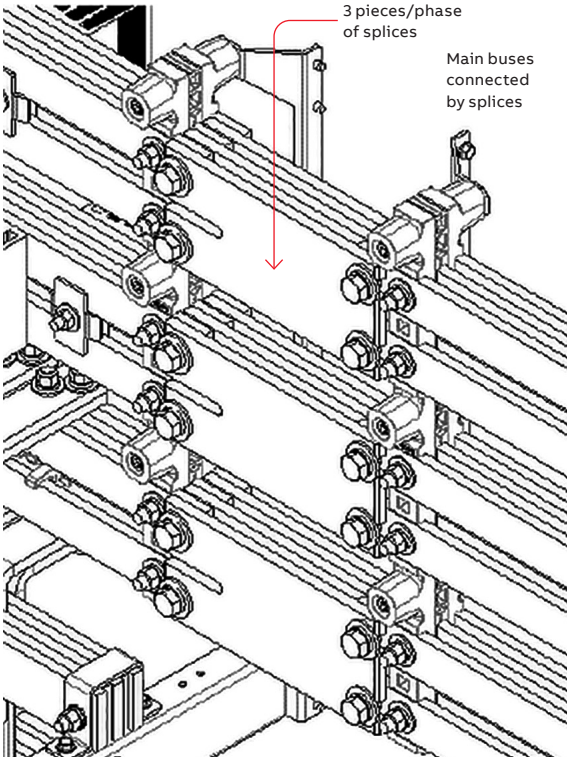
Note: Standard plating is tin. Refer to factory for alternate plating.

Bus splicing steps for 2500A without fans, 3000A, and 3200A main bus

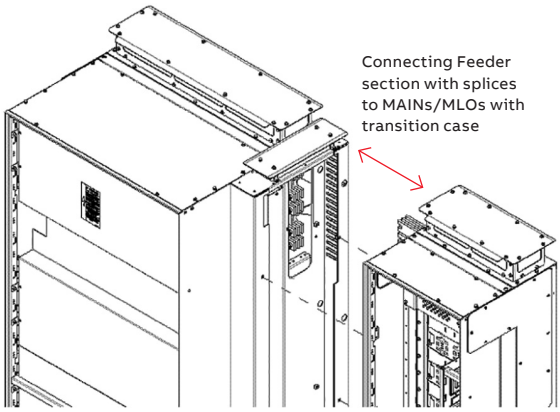
For 2500 A without fans, 3000 A, and 3200 A main bus, it is recommended to pre-mount the align and torque all splices in all phases before you join the section if possible. If splicing from the left, pre-mount the splices and pre-torque bolts from right case side opening. If splicing from the right, slide in bus bars through left case side opening and access the bolts for torquing through the vertical wireway.



Step 1: Mount on left side of section



Step 3: Connect main buses with splices



Step 2: Connect feeder section with splices

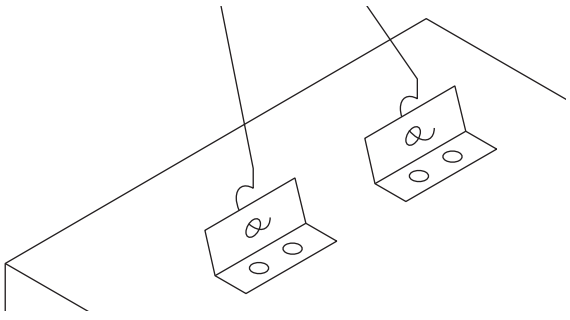
Receiving, handling and storage

Receiving
Before leaving the factory, the motor control center is given a final mechanical and electrical inspection and is packed in accordance with the best practices for electrical equipment.

On receipt of any apparatus, make an immediate inspection for any damage or loss of equipment in transit. Should damage or missing material be noted, file a claim immediately with the carrier and notify the nearest office of ABB. Information such as a description of the damage, the shipping crate numbers, the requisition numbers and the panel catalog number should accompany the claim.

Handling
Motor control center sections are always shipped in an upright position, in single or group sections. Sections must be maintained in an upright position during all handling.

Never attempt to jack, lift, or move the equipment at points other than the lifting angle or floor sills. Use two or more chains or cables to distribute the weight evenly. Pinch bars, pipe rollers or slings are useful implements for handling equipment; but be careful to maintain distributed loading and to always apply leverage at the floor sills and/or lifting eyes. Figures 05A and 05B illustrate typical handling techniques.



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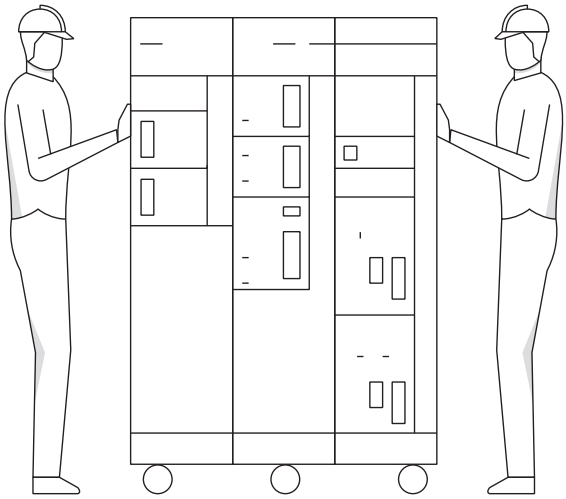
05A
Using standard lifting angles or lifting eyes to hoist the MCC

Storage
If it is necessary to store the equipment for any length of time, be sure to observe the following precautions:

- Uncrate the equipment.
- Store the equipment in a clean, dry, humidity-controlled area at moderate temperature. Cover with a suitable canvas or heavy-duty plastic cover to prevent entrance of foreign material.
- If equipment must be stored in cool or high humidity areas, in addition to completely covering the equipment, provide a heat source to prevent condensation of moisture in the equipment. Energize space heaters (if furnished in the equipment) or place a standard 120-volt lamp rated at 75 watts inside the bottom of each vertical section.



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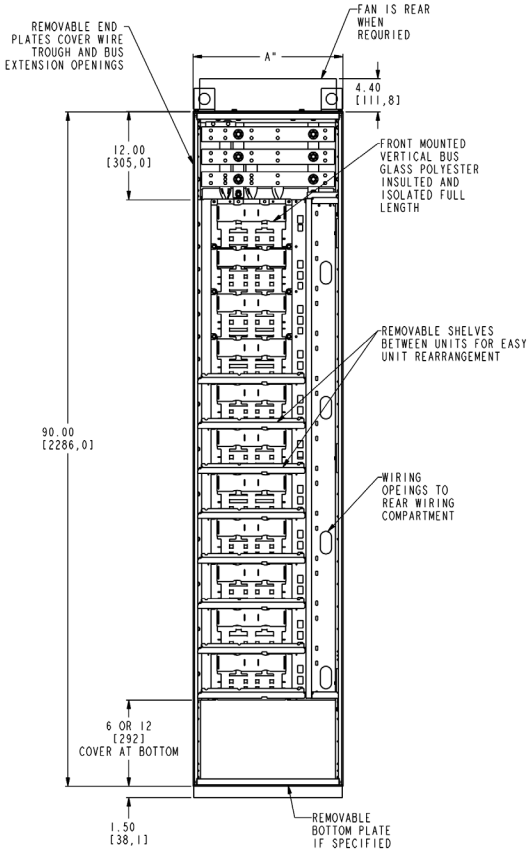
05B
Positioning the MCC with rollers

Installation

Before any installation work is begun, consult all drawings, as well as all applicable contract drawings, for the particular installation. Pay particular attention to the location of units in the motor control center and their relations to existing or planned conduits and busways.

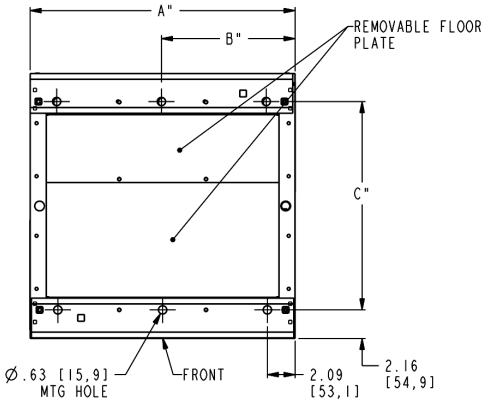
Indoor enclosures

Front elevation and mounting locations (13-inch, 20-inch, 22-inch and 25-inch Deep sections)



Note:

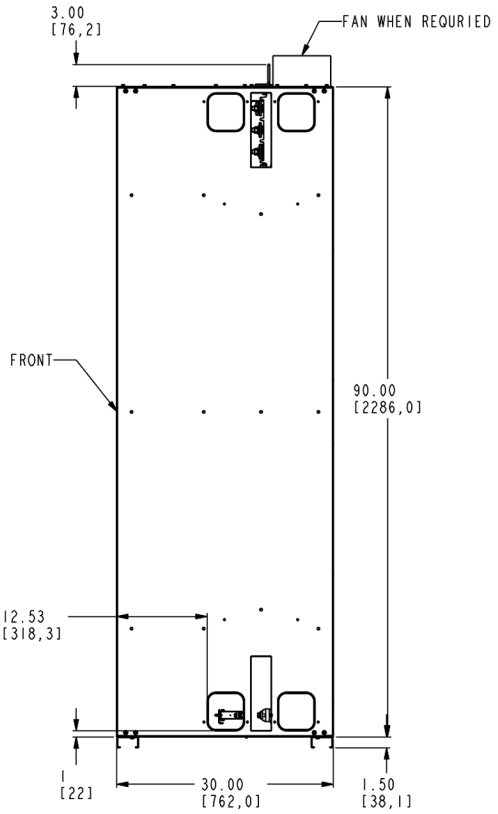
1. If anchor bolts are to be inbedded in the foundation, they must be Equipment. Locate one in the center front and one in the center back. Anchor bolts should be 1/2 inch diameter, of Grade 2 steel (minimum) In non-Seismic Zone 4 Locations. Bolts must extend a minimum of 2 11/32 inch above grade to 3/4 inch above the channel sill. If 13 (330.2mm) deep verical sections are used, anchor bolts or some form of external bracing is required.
2. Seismic Zone 4 IBC testing was performed use 1/2 " - 13 Grade 5 bolts torqued to 50 foot-pounds, located in each of the four corners in each section.



Bottom view: Location of mounting holes

Ref. Dim.	Section Depth							
	13° Deep		20° Deep		22° Deep		25° Deep	
Width "A"	B	C	B	C	B	C	B	C
20°	10.00°	8.73°	10.00°	15.73°	10.00°	17.73°	10.00°	20.68°
508.8 mm	254.4 mm	221.7 mm	254.4 mm	399.5 mm	254.4 mm	450.3 mm	254.4 mm	525.3 mm
24°	12.00°	8.73°	12.00°	15.73	12.00°	17.73°	12.00°	20.68°
609.6 mm	304.8 mm	221.1 mm	304.8 mm	399.5 mm	304.8 mm	450.3 mm	304.8 mm	525.3 mm
30°	15.00°	8.73°	15.00°	15.73°	15.00°	17.73°	15.00°	20.68°
762.0 mm	381.0 mm	221.7 mm	381.0 mm	399.5 mm	381.0 mm	450.3 mm	381.0 mm	525.3 mm

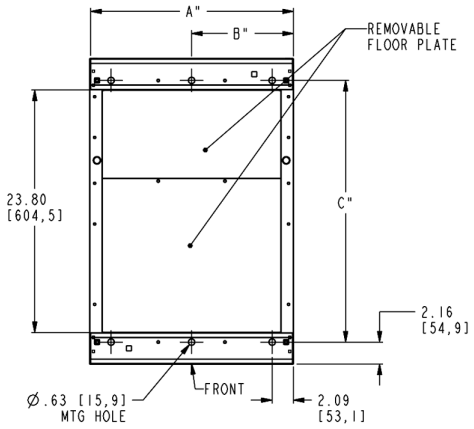
Indoor enclosures
Elevation and Mounting
30-inch Deep Sections 600 A to 1200 A Main Bus



End view: Standard 30-inch deep

Note:

1. If anchor bolts are to be inbedded in the foundation, they must be located according to the drawing for the specific equipment. Locate one in the center front and one in the center back. Anchor bolts should be 1/2 inch diameter, of Grade 2 steel (minimum) In non-Seismic Zone 4 Locations. Bolts must extend a minimum of 2 11/32 inch above grade to 3/4 inch above the channel sill. If 13 (330.2mm) deep verical sections are used, anchor bolts or some form of external bracing is required.
2. Seismic IBC testing was performed use 1/2' - 13 Grade 5 bolts, torqued to 50 foot-pounds, located in each of the four corners in each section.



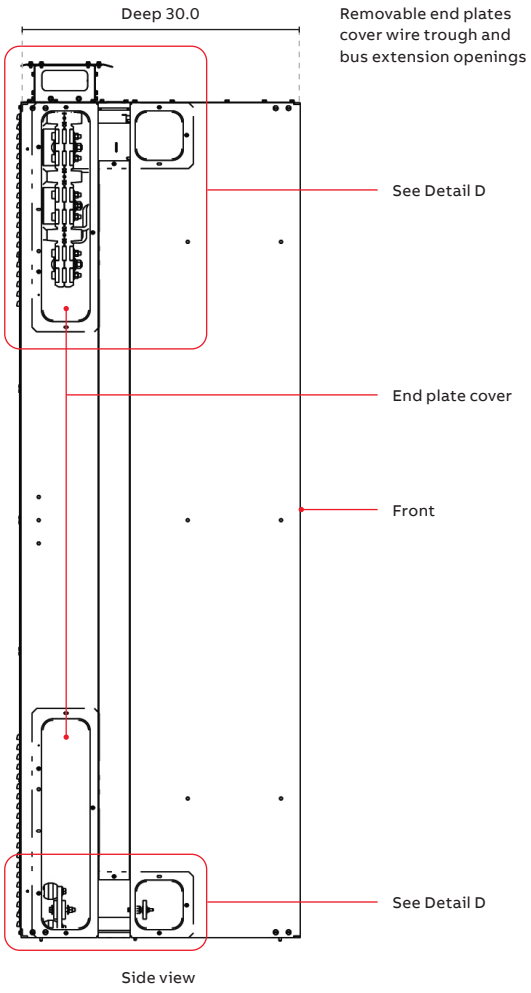
Bottom view: Location of mounting holes

REF. DIM.	Section Depth									
	13° Deep		20° Deep		22° Deep		25° Deep		30° Deep	
Width "A"	B	C	B	C	B	C	B	C	B	C
20°	10.00°	8.73°	10.00°	15.73°	10.00°	17.73°	10.00°	20.68°	10.00°	25.69°
508.8 mm	254.4 mm	221.7 mm	254.4 mm	399.5 mm	254.4 mm	450.3 mm	254.4 mm	525.3 mm	254.4 mm	653.5 mm
24°	12.00°	8.73°	12.00°	15.73	12.00°	17.73°	12.00°	20.68°	12.00°	25.69°
609.6 mm	304.8 mm	221.1 mm	304.8 mm	399.5 mm	304.8 mm	450.3 mm	304.8 mm	525.3 mm	304.8 mm	653.5 mm
30°	15.00°	8.73°	15.00°	15.73°	15.00°	17.73°	15.00°	20.68°	15.00°	25.69°
762.0 mm	381.0 mm	221.7 mm	381.0 mm	399.5 mm	381.0 mm	450.3 mm	381.0 mm	525.3 mm	381.0 mm	653.5 mm

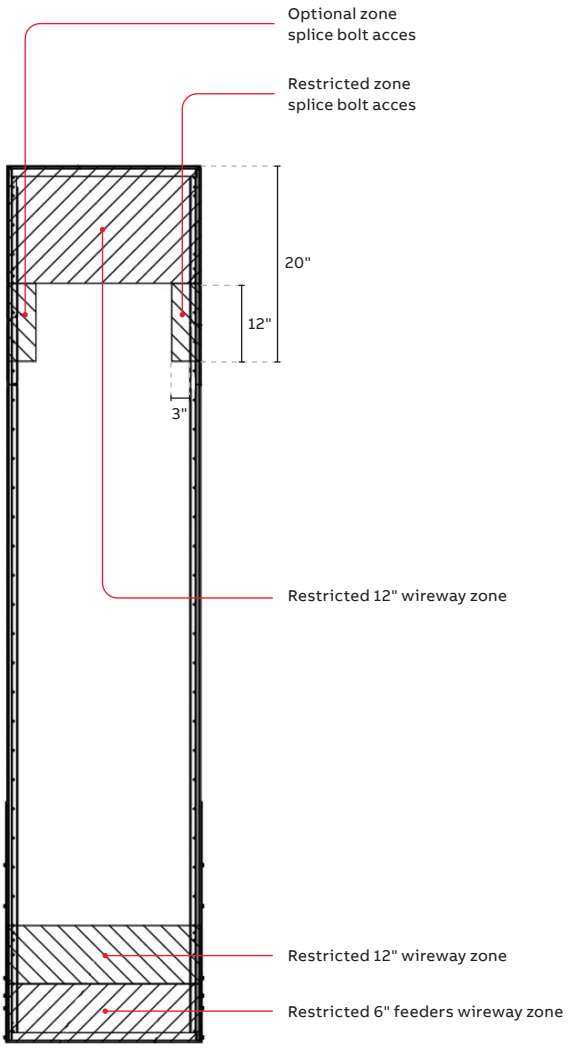
Indoor enclosures

Elevation and mounting

30-inch deep sections 2500A without fans, 3000A, and 3200A main bus configurations.



End view: Standard 30-inch deep section for 2500A without fans, 3000A, and 3200A main bus configurations



Restricted zones - No component can be placed in restricted zones as shown in figure.

Note:

1. If anchor bolts are to be inbedded in the foundation, they must be located according to the drawing for the specific equipment. Locate one in the center front and one in the center back. Anchor bolts should be 1/2 inch diameter, of Grade 2 steel (minimum) In non-Seismic Zone 4 Locations. Bolts must extend a minimum of 2 11/32 inch above grade to 3/4 inch above the channel sill. If 13 (330.2mm) deep verical sections are used, anchor bolts or some form of external bracing is required.
2. Seismic IBC testing was performed use 1/2' - 13 Grade 5 bolts, torqued to 50 foot-pounds, located in each

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6A
Bottom conduit entrance details for standard 13-inch deep section, low bus position.

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6B:
Bottom conduit entrance details for standard 13- nch deep section, bus upper position.

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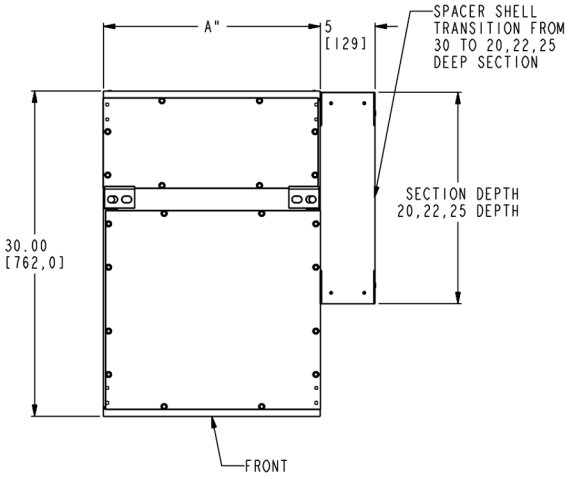
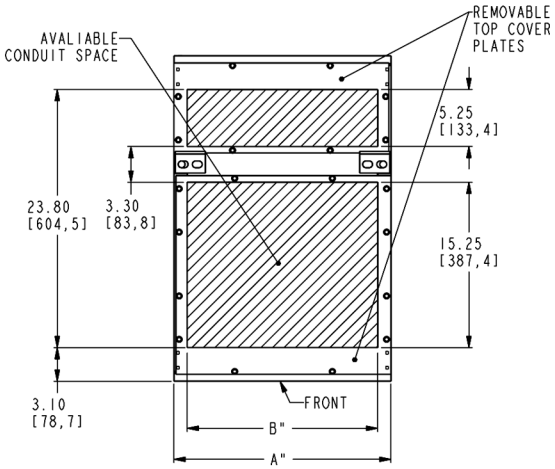
6C
(arc-resistant). Bottom conduit entrance for standard 20-inch deep section, low bus position, 6-inch bottom cover.

Top conduit entry 30-inch deep section



Note: Spacer shell allows unit doors, in spliced section on the right, to open fully.



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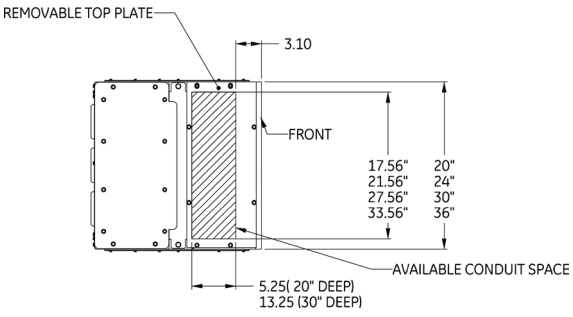
Top conduit entrance details for std. 20" x 30' 3" channel



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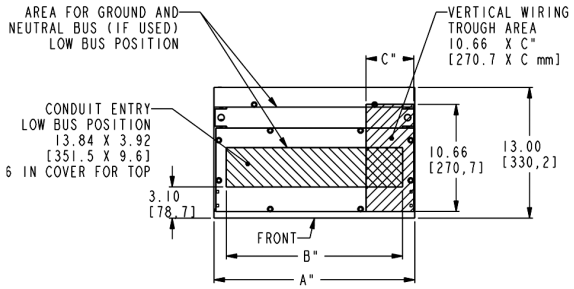
Top conduit entry for all 2500A without fans, 3000A, and 3200A configurations

Installation of bottom entry conduits

Conduits can be stubbed in after the location of the motor control center lineup has been established. Conduit should be stubbed approximately 2 inches (51mm) above the finished floor line. Figure 6 and Figure 7 show the conduit entrance space available at the bottom of standard sections. Exceptions to this available space rule are indicated on drawings for specific installations. Center the conduit beneath the section vertical wireway to facilitate direct cable entry.

Note: Bottom rear entrance should only be used with full rear accessibility.



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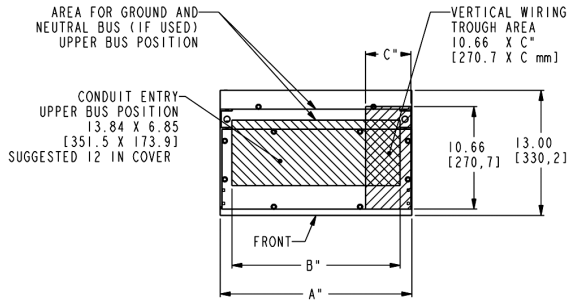
6A



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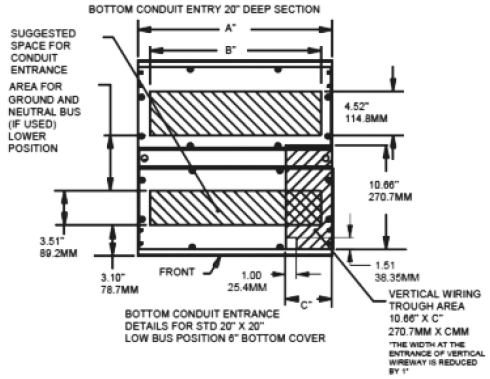
6B



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6C

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6D
(arc-resistant). bottom conduit entrance details for standard 20-inch deep section, bus upper position.

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7A
Low bus position of ground and neutral bus (minimum available space for conduit entry) in 13-inch deep section, 6-inch cover.

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7B
Standard position of ground and neutral bus with 12-inch cover compartment at the bottom of MCC

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7C
Low bus position of ground and neutral bus (minimum available space for conduit entry) in 13-inch deep section, 6-inch cover

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7D
Upper position of ground and neutral bus (maximum space available for conduit entry), 6-inch bottom cover

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7E
Available conduit space for 2500A without fans, 3000A, and 3200A main bus configurations

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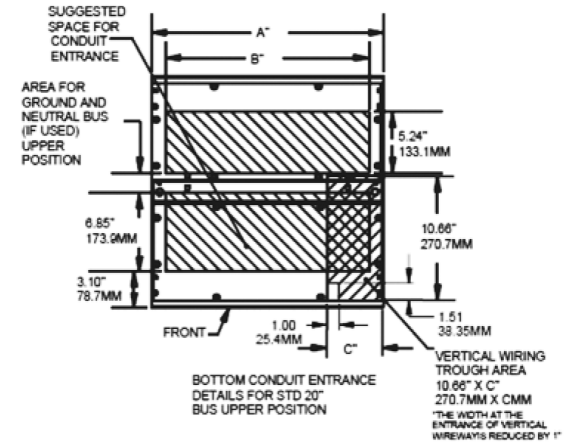
7F
Neutral & Ground bus positions for 2500A without fans, 3000A, and 3200A main bus configurations



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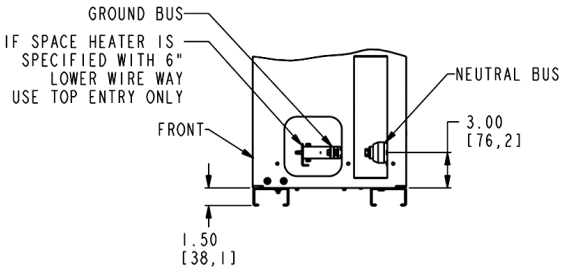
6D



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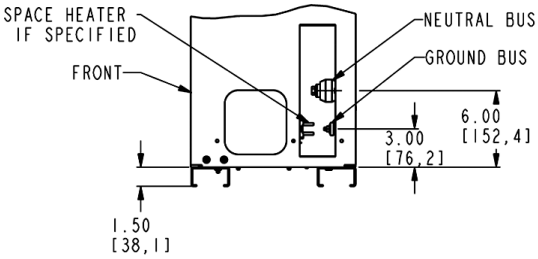
7A



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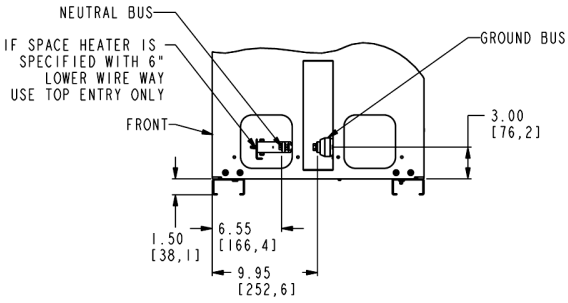
7B



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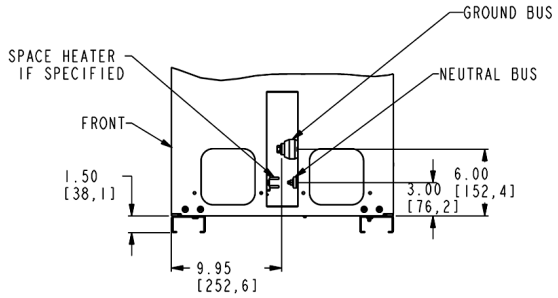
7C



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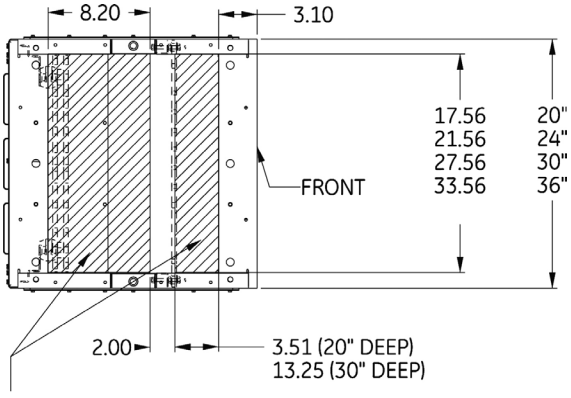
7D



AVAILABLE CONDUIT SPACE

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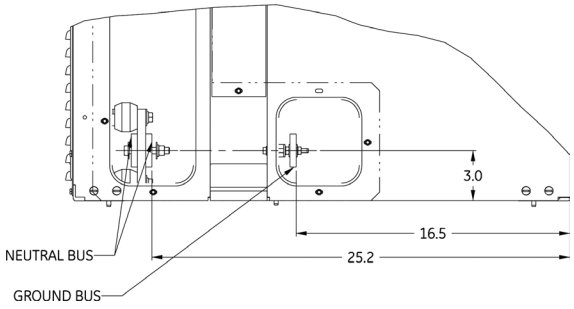
7E



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7F

—
08
Control center floor sills grouted to the floor before installation to provide a level foundation

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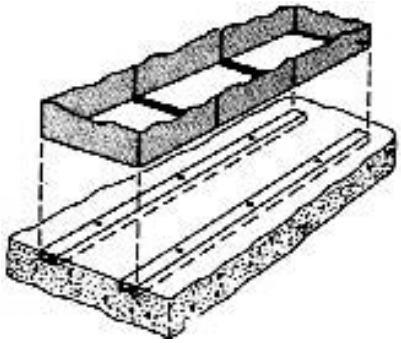
09
Installing steel floor members

Installation of flooring
For most installations, the MCC floor sills can rest on the finished floor. The foundation for the equipment should be level and even. Although not normally required, the purchaser may elect to install, level and grout the steel members or MCC floor sills in the floor, as illustrated in Figure 8 and Figure 9. If the floor sills are removed, lifting and moving the shipping sections must be done carefully.



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08

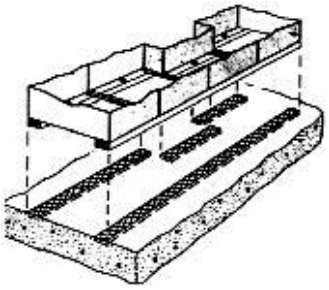
Note: Cannot be rolled (as in Figure 20) without floor sills.

Surface under motor control center base must be of non-combustible material unless bottom covers are installed in each vertical section.

The overall height of the equipment should be considered with respect to headroom, top conduit entry space and alignment with other equipment.

Note:
- If anchor bolts are to be imbedded in the foundation, they must be located according to the drawing for the specific equipment. Locate one in the center front and one in the center back. Anchor bolts should be 1/2" in diameter, of Grade 2 steel (minimum) in non-seismic locations. Bolts must extend a minimum of 2 11/32" above grade to 3/4" above the channel sill. If 13" (330.2mm) deep sections are used, anchor bolts or some form of external bracing is required.
- Seismic Zone 4/IBC testing was performed using 1/2" – 13 Grade 5 bolts, torqued to 50 foot-pounds, located in each of the four corners in each section.

If there are vertical sections of varying depths (such as 13, 20, or 22 inches) in a single lineup, the fronts of the sections must be lined up for proper alignment of the main bus bars. Figure 9 illustrates this point.



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09

Note the front alignment of the 13-inch-deep section.

—
10A
Side view of a 20-inch-deep section showing the cover plates, plug bottoms and joining points

—
10B
Type 12 and arc-resistant gasket material between section splits

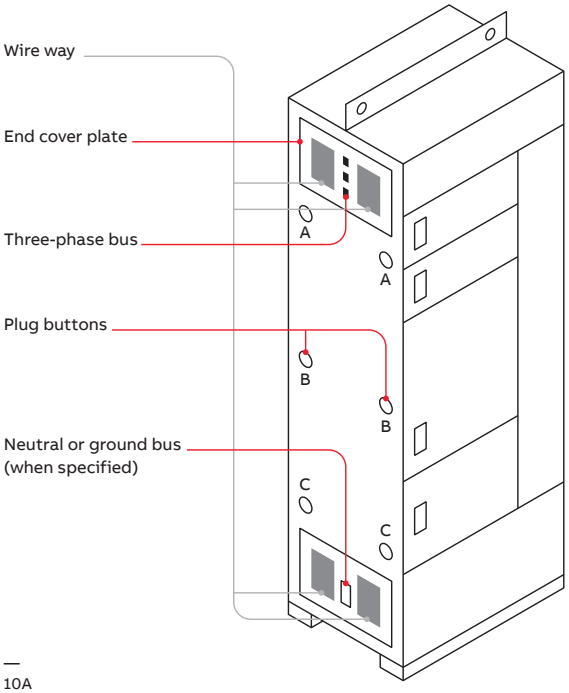
Positioning and joining sections
If groups of sections are to be joined together in a final lineup, remove the end cover plates and the plug buttons, from the sides of the sections to be joined. Figure 10A shows the side views, with the end cover plates removed, for 20-inch-deep sections with 2-inch (50.8 mm) and 4-inch (101.6 mm) bus bars.

Carefully check and remove dirt, dust or bits of packing material from the interior of all sections. Use a brush, soft cloth or vacuum cleaner.

Do not use compressed air to clean the equipment if it contains moisture. Remove all hardware packages, drawings and other items shipped with the equipment. Check all nuts, bolts, and electrical joints for tightness.

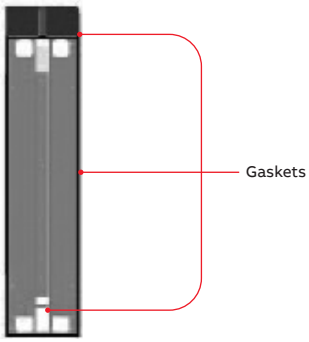
All cables entering the bottoms of sections should be pulled through conduits to a point where they will be accessible after the equipment is in place. Sections can be moved to their final position and properly leveled.

For arc-resistant plenum-less design, the cables should enter through the front aluminum flap on top of the section.



—
10A

For Type 12 and arc-resistant enclosure, see Figure 10B for proper gasket in between the section splits. For additional gasket material order part number 245A1888P5.



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10B

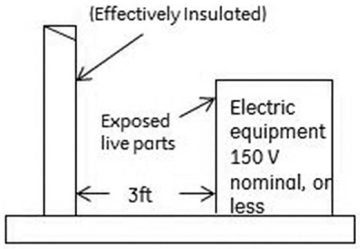
NEC work space
NEC Work Space is defined in Table 110.26(a) Working Spaces. Included in these clearance requirements is the step-back distance from the face of the equipment. Table 110.26(a) provides requirements for clearances away from the equipment, based on the circuit voltage to ground, and whether there are grounded or ungrounded objects in the step-back space, or if there are exposed live parts across from each other. The voltages to ground consist of two groups: 0 to 150 and 151 to 600, inclusive. Remember, where an ungrounded system is utilized, the voltage to ground will be the greatest voltage between the given conductor and any other conductor of the circuit. For example, the voltage to ground for a 480-volt ungrounded delta system is 480 volts.

See Figure 11 for general working clearance requirements. Distances are measured from the live parts if the live parts are exposed, or from the enclosure front if live parts are enclosed. If any assemblies, such as switchboards or motor control centers, are accessible from the back and expose live parts, the working clearance dimensions would be required at the rear of the equipment, as illustrated. Note that for Condition 3, where there is an enclosure on opposite sides of the working space, the clearance for only one working space is required.

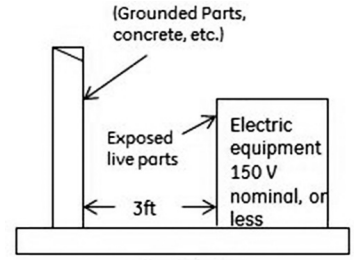
—
11
General Working Clearance Requirements

—
12A
Top conduit entry space for 13-inch sections

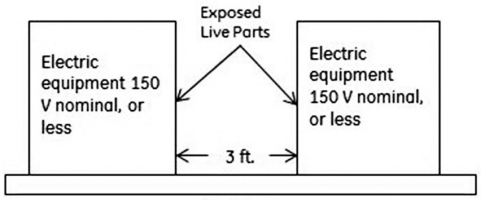
—
12B
Top conduit entry space for 20-inch and 22-inch sections



Condition 1
Minimum 3 ft. for 151-600V



Condition 2
Space would increase to 3 ft. 6 in for 151-600V



Condition 3
Space would increase to 4 ft. for 151 – 600V

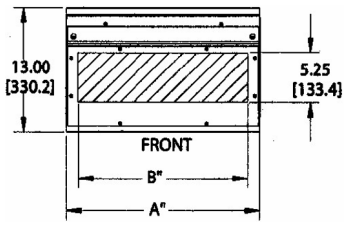
—
11

Installation of top entry conduits
After the motor control center is in place and leveled, and the sections are joined together, conduits can be brought into the tops of sections as required. Figure 12 and Figure 13 show the conduit entry space available at the tops of standard sections. Refer to drawings for deviations on specific installations.

Note: Top rear entrance should only be used with full rear accessibility.

For plenum-less arc-resistant design, the conduits can be brought into the tops of the sections through front or rear flaps as required. For arc-resistant sections with plenum the conduit can be assembled on top of the plenum. ABB offers an additional pull box for higher conduit space requirement. The Pull box can be assembled on top of the incoming section.

Always remove top cover plates when drilling holes. This prevents small metal chips from falling into the panel and cause serious damage.



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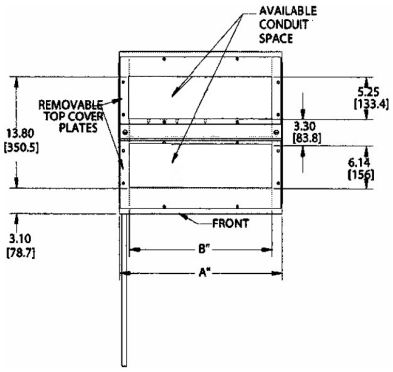
12A



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12B

Table 3: Dimensions for figures 12 and 13

Width	Dimension A	Dimension B
20"	20"	17.56"
24"	24"	21.56"
30"	30"	27.56"

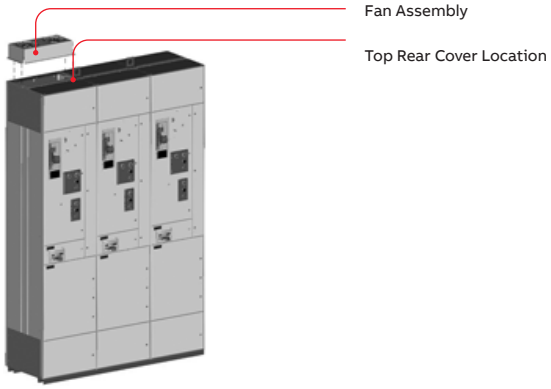
Equipment wiring
When pulling, bending, and terminating field wiring, avoid scraping, cutting or otherwise damaging cable insulation or strands.

—
13A
Exhaust fan for NEMA 1 enclosure

—
13B
Elevated roof for 3000/3200 A main bus

—
13C
Exhaust fan for UL Type 12 enclosure

Exhaust fan installation for NEMA 1 enclosure



—
13A

High heat loss main bus splice joints and/or components, including certain solid state power devices, may require removal of excess heat to the MCC exterior environment. This is accomplished by the utilization of exhaust fans.

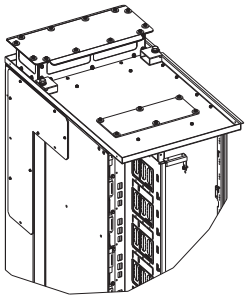
Exhaust fans, if required, are delivered to the installation site as a separate shipping item. Fans must be unpacked, checked for collateral damage, and installed over the top rear conduit entry space of the appropriate MCC section.

Installation involves connecting two mated control power harness ends for each fan assembly. One harness is located within the fan assembly. The corresponding mated harness end is coiled and secured inside the top rear of the section being ventilated.

If, upon delivery, it is found that standard rear top section covers are in place on the section requiring ventilation, the covers must be removed and discarded. The exhaust fan assembly can then be installed as shown in Figure 13B.

Note: For details on inlet filter maintenance, see Filter Maintenance on page 33.

For 3000/3200 A main bus, an elevated roof for ventilation is required. This elevated roof is located on the rear half of the top cover and is 5-inch tall as shown in Figure 16B.



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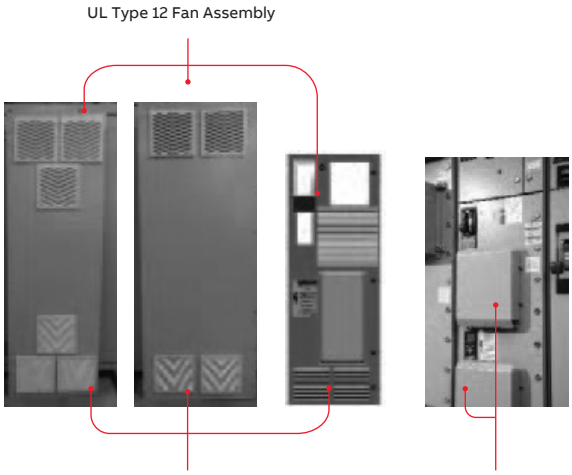
13B

Exhaust fan installation for UL type 12 enclosure and arc-resistant vented fan shields



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13C

—
14
Typical top entry of main cables to the incoming-line lug compartment (600A shown)

—
15A
Typical bottom entry or main cables to the incoming-line lug compartment (600A shown)

—
15B
Cables secured at each support (600A example), will adequately brace cables for faults of 100K RMS symmetrical amperes, based on horizontal bus bracing

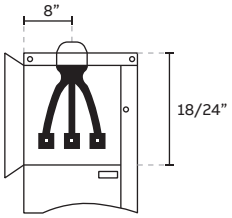
High heat loss components, including certain solid state power devices, may require removal of excess heat to the MCC exterior environment. This is accomplished by the utilization of exhaust fans mounted on unit doors along with filters. These fans and filters are factory installed.

Note: In addition to using Type 12 exhaust fans and filters, arc-resistant design will also have a vented fan shield on the exterior of the door (Figure 13C). For details on inlet filter maintenance, see Filter Maintenance on page 33.

Main incoming power cables

Refer to the motor control center drawings for the location of the main disconnect or incoming line terminals and the direction (top or bottom) of cable entry. Cable-bending room provided within the vertical section will meet or exceed National Electrical Code requirements.Incoming line sections are provided with cable supports. Incoming cables must be firmly secured to withstand the significant forces that may be generated during a short circuit.

Cables secured at each support, as illustrated in Figure 15B (600A example), will adequately brace cables for faults of 100K RMS symmetrical amperes, based on horizontal bus bracing. However, cables should always be secured at the first support inside the enclosure and at the support nearest to the incoming terminals. Insulated bushings are also recommended at conduit terminations.



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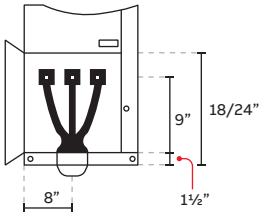

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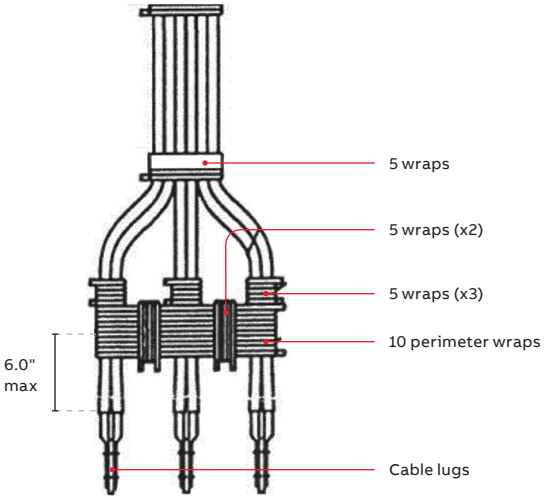
15A



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15B

Lashing scheme for connecting cables in 2500A, 3000A, and 3200A main bus configurations. Add 5 wraps for every additional 12" of incremental unit height.

Align the conduit linearly directly over or as close as possible to the supports. Run the cable in a convenient orientation, making sure the cable is located against the supports before it connects to the cable terminals. Lash the cable using the following procedure:

Wrap the line cables together and, if provided, tie cables together with nominal 3/8-inch (9.5 mm) nylon rope or rope having a minimum tensile strength of 2000 pounds (8896 N), at 6 inches (152 mm) and 12 inches (305 mm) from the line terminals. Use five wraps and complete every additional 6 inches with five wraps or every 1 inch (25 mm) with one wrap. Use supplied cable supports as desired. Refer to UL 891.

Individual unit wiring

Open the vertical wireway door(s) and the top and/or bottom horizontal wireway hinged covers. All doors can be removed, if desired, by extracting hinge pins or removing the hinge.

When installing cables, be sure to not damage the cable insulation on any sharp edges, such as steel work or screws.

Where access to the rear of the section is available, cables can be brought into the space behind the vertical bus and brought forward into the front wire trough area through any of the modular openings in the right-hand steel support plate.

Wiring NEMA type A motor control centers

Use the following procedure to wire NEMA Type A MCCs:

1. Remove black plastic barrier closest to unit connection points and remove knockouts as required.
2. Pull load cables near the unit to be wired. Measure (allowing for cable bends), cut and strip the cables, and feed them carefully through barrier knockout into the unit. Terminate the cables on the feeder or starter lugs provided in the unit. If aluminum wire is used, coat the wire strands with an oxide-inhibiting grease specifically designated for use with aluminum cable. Install plastic side barrier.
3. Pull the control wiring, then measure, cut, strip, and terminate it on individual device terminals in the unit.
4. When specified, an optional ground lug is provided in each draw-out combination starter unit for terminating a motor-frame grounding wire. (For larger starters, the lug is mounted on the horizontal ground bus.)
5. Use cord or plastic ties to secure all wiring. Route the wiring to avoid interference with moving parts and to keep it away from heat-producing components, such as resistors and fuses.
6. Verify that the connections on all devices and terminal blocks are tightened to their proper torque values, as listed on the label on the vertical wireway door.

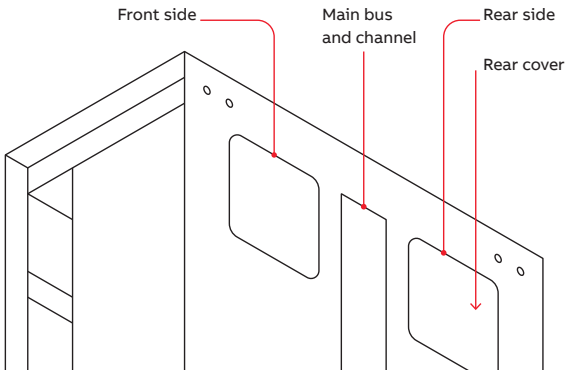
—
16
Standard section with main bus

—
17
Plenum arc-resistant top view

—
18
Top view of Plenum design for arc-resistant

Cable entry for arc-resistant motor control center
After a motor control center is in place and the sections are joined together, conduits for cable entry can be brought into the top of sections as required. Note: Only the front side of the top section can be used for cable entry.

For arc-resistant design, the Equipment is guaranteed to maximize protection to surrounding if an arc instance occurred inside the equipment except for designated gas release locations. Customers need to identify the front side of the section using the help of the main bus channel. Figure 16 show a section with a top main bus.



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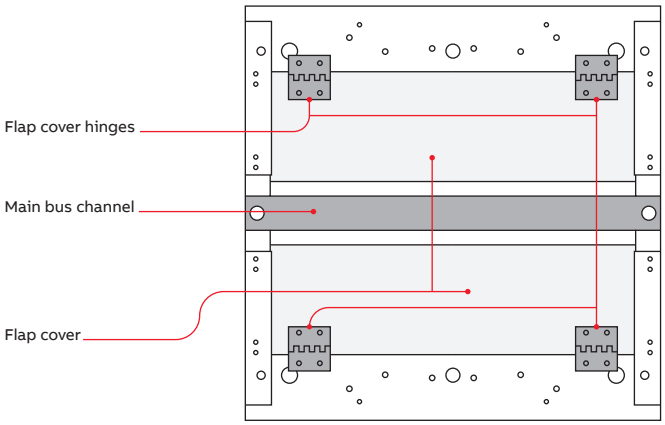
16

To release the exhaust gases of the arc-resistant equipment the sections are sold in two different types with and without a plenum.

Arc-resistant plenum equipment
Plenum equipment that is ventilated with ducts can be identified for the hinges that are on the top of the section. See Figure 17 for a top view of an arc-resistant plenum equipment, only the flap cover from the top side can be removed for conduit hub areas.



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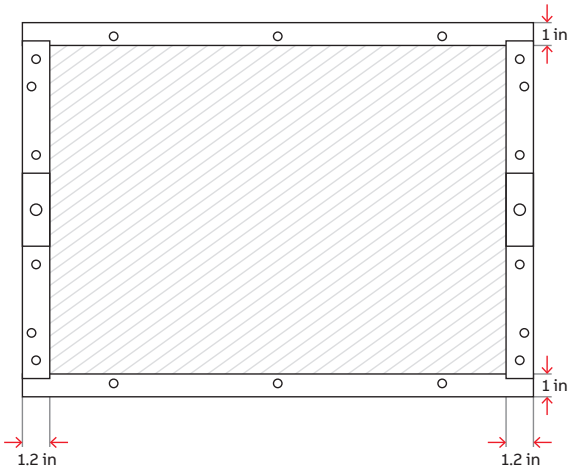
17

For a plenum arc-resistant design there is no restriction on using a certain brand for hubs, however it is recommended to use water-gas tight.

The end piece of the plenum should be routed to proper gas relief environments due to the toxicity of the gases. Also 48 inches of space at the end piece is needed as a safe zone.

The plenum design can vary in height, depth and width, see table 1. It is used on the flap covers on the top of the section. The frontal fap cover of the section is the only one to be removed.

When the plenum is installed users can cut anywhere in the top of the plenum for incoming cables with the exception for the outside of the frame perimeter. Figure 18 shows the perimeter of the frame for the top plenum for the section.



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18

Table 1: Plenum sizes for arc-resistant design

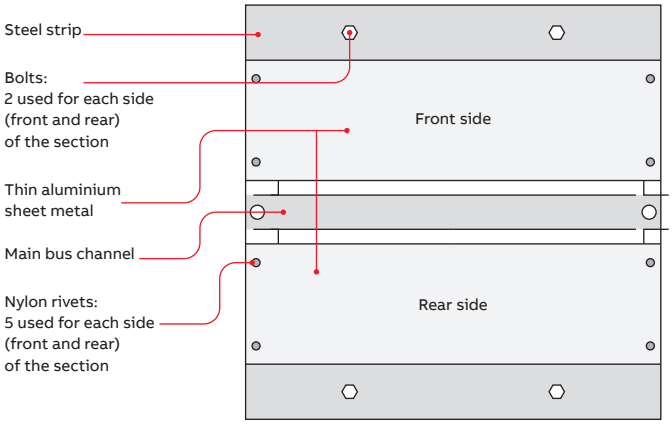
Height	Width	Depth
6 in	20 in	20 in
12 in	24 in	30 in
-	30 in	-
-	36 in	-

—
19
Plenum-less arc-resistant equipment.

—
20
Cable entry cut out area.

Shown in Figure 18 there is no restrictions in this setup as the customer can use the hatched area of the top from the plenum for cable entry. The available space varies per the depth and width of the section. Do not make any cuts on top of sections that don't have incoming cables, to reduce the chance of arc propagation.

Arc-resistant plenum-less equipment
Plenum-less equipment design uses thin aluminum sheet metal attached to the top of the section with nylon rivet, when an arc instance occurs the top side of the section is the only one to deform releasing any gas.



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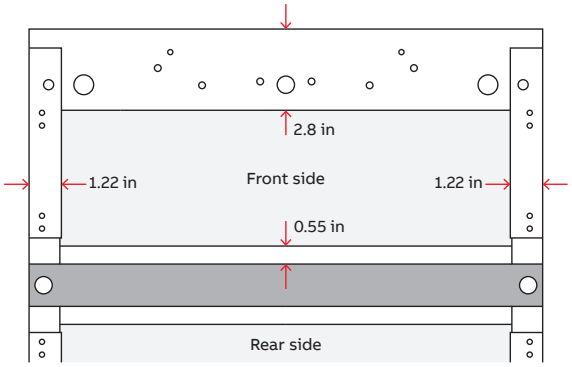
19

In Figure 19 shows the top view of a plenum-less equipment, for a plenum-less equipment the thin aluminum sheet metal is attached to the section with nylon rivet, when an arc flash occurs the top side of the section is the only one to deform releasing any gas.

For the cable entry on a plenum-less equipment it is only allowed to do cuts on the front side of the top section. Figure 20 shows the allowed area to do a cut for incoming cable outside the perimeter frame area and the steel strips that holds together the aluminum sheet metal to the section.



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20

Wiring NEMA type B motor control centers
Use the following procedure to wire NEMA Type B MCCs:

1. Remove black plastic barrier closest to unit connection points and remove knockouts as required.
2. Pull load cables near the unit to be wired. Measure (allowing for cable bends), cut and strip the cables, and feed them carefully through barrier knockout into the unit. Terminate feeder cables directly on the lugs on the disconnect. Connect the motor leads at the starter terminals if either of these conditions is met:
   a. The motor control center is furnished as "NEMA B-D wiring" (where D=Device) or;
   b. The starter is NEMA size 6 or smaller. Connect the motor leads to the starter at the T1, T2, and T3 terminals if these conditions are met:
   a. The equipment is furnished as "NEMA B-T" wiring and;
   b. The starter is NEMA size 2 or smaller.

Install plastic side barrier after power and control wiring in Step 4 is complete. Aluminum wire is not recommended for this product.

3. Pull the control wiring, then measure, cut, strip and terminate it at the terminal blocks provided within the unit. Optionally, control terminal blocks may be pulled apart and the plastic knock-outs removed to allow wiring outside the bucket. The terminal blocks can then be placed back through the plastic knockout openings and reinstalled. This method allows wiring to terminal blocks outside the confines of the starter unit.
4. When specified, an optional ground lug is provided in each draw-out combination starter unit for terminating a motor frame grounding wire. (For larger starters, the lug is mounted on the horizontal ground bus.)
5. Use cord or plastic ties to secure all wiring. Route the wiring to avoid interference with moving parts and to keep it away from heat-producing components, such as resistors and fuses.
6. Verify that the connections on all devices and terminal blocks are tightened to their proper torque values, as listed on the label on the vertical wireway door.

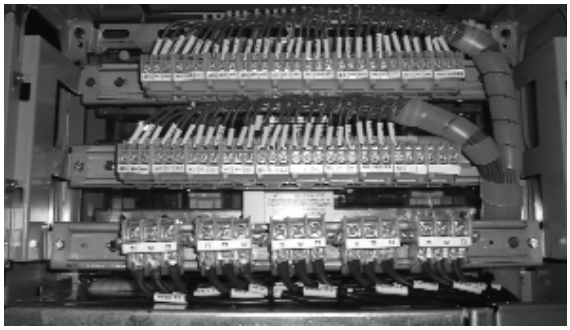
Wiring NEMA type C motor control centers

Master terminal boards in NEMA Type C motor control centers are provided in the larger top or bottom horizontal wireway of each vertical section. (Refer to the drawings for the locations of master terminal boards.) Figure 21 and Figure 22 show typical Type C terminal board arrangements.

These terminal boards are connected at the factory to control terminal blocks of plug-in units in each vertical section.

Wiring diagrams show these terminal points. These terminal blocks are also factory wired to the T1, T2 and T3 motor-lead terminals for each NEMA size 1–2 starter unit in each vertical section. Field connections to these control and load terminals should be made at the master terminal boards.

Make field connections to all feeders and motor loads for starters larger than NEMA size 2 as described for NEMA Type B motor control centers. Optional grounding lug can be provided in each Plug-in unit if vertical ground bus is specified.



—
21
Typical Type C terminal board at the top of a section

—
22
Typical Type C terminal boards in multiple sections

—
23A
Side cutout dimensions on 13-inch, 20-inch, 22-inch and 25-inch

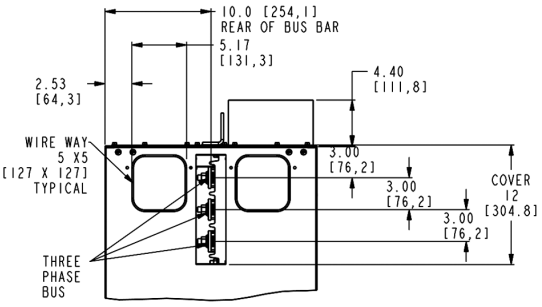
—
23B
Side cutout dimensions on 30-inch

—
24
Mounting the terminal block

—
25
Type 12 and arc-resistant gasket material installed in a MCC section

Wiring between sections

Figure 23A shows the dimensions of side cutouts in each vertical section for wiring between sections. Cross-wiring can be accomplished at both the top and bottom of sections. 20-inch or 22-inch deep vertical sections accessible from the rear can be cross-wired in the open rear area, with the wiring brought forward through oval openings in the rear of the vertical wireway.



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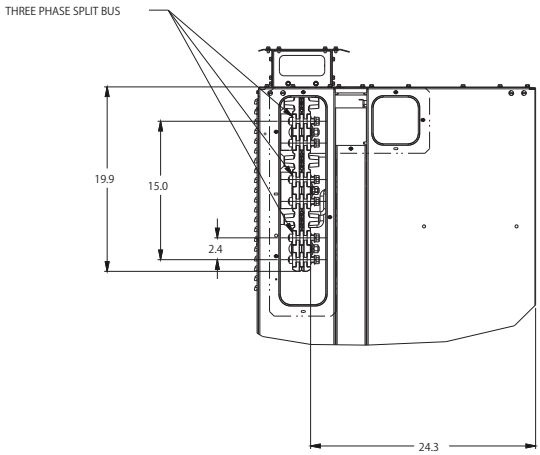
23A



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23B

If rear access is used, a rear main bus barrier is a required option.

If 2500A without fans, 2500A Type 12, 3000A, or 3200A main bus configurations are used, 3" of clearance between back of MCC and wall is required.

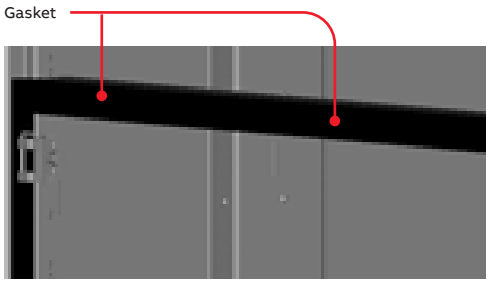
Terminal blocks

The terminal blocks are mounted on a metal rail located at the bottom of the unit, as shown in Figure 24. The terminal block easily slides into position from either side of the mounting rail.

—
24

Installation of standard motor control center units

Any unit ordered separately is shipped complete with the door and associated hardware. If the space available in the vertical section is greater than the new unit height, order a blank filler door with hinge hardware and a snap shelf. See the renewal parts bulletin for ordering blank doors and gasket materials. The gasket material lines the inner perimeter of the section. Figure 25 shows the gasket material mounted to the outside of the door.



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25

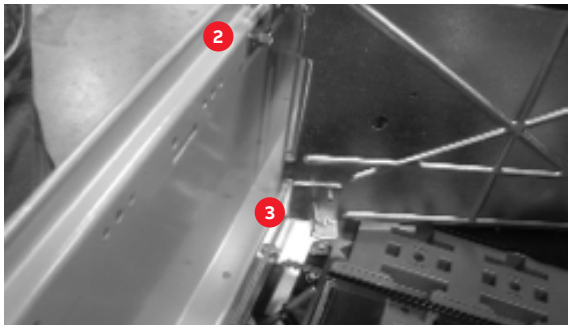
—
26
View of the snap-in shelf as installed

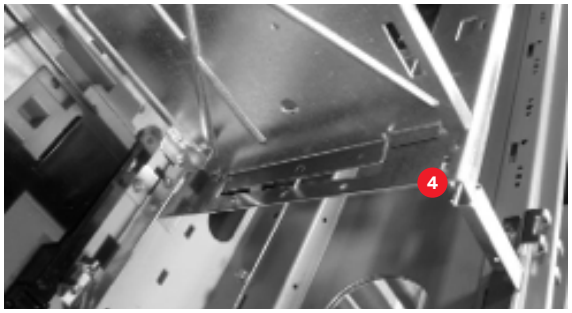
—
27
Unit disconnect in the OFF position. Two quarter-turn door latches are located at the top.

—
28
Quarter-turn latch located at the bottom of the unit

Use the following procedure to install a motor control center unit:

1. Attach the door hinges to the left side of the section, line up the door with the hinges, then insert the hinge pins to secure the door. (For Type 12 enclosures, mount the gasket on hinge side. See Figure 25.)
2. Start 1/4-20 thread rolling screw in left hinge rail just below the location for the shelf shown in Figure 26.
3. At the same time, hook the shelf into the rear wing plate and onto the started 1/4-20 screw from step 2.
4. Snap the shelf into the shelf support on the vertical wireway side of the case and tighten the 1/4-20 screw from step 2.
5. Lower the right side of the shelf and snap the two detents in the right-side flange into the two holes in the side of the vertical wiring trough barrier, as shown in Figure 26. Swivel the shelf hold-down bracket and grounding spring into place and tighten the lower case hinge.
6. Examine the new unit carefully, front and rear, to ensure that all screw terminals are tight, all foreign material and packing are removed, and the insulating barriers are secure.
7. The unit disconnect must be in the OFF position before the unit can be inserted into the vertical section.
8. If necessary, rotate the latches at the top and bottom of the unit so that they are horizontal.
9. Remove the snap-in cover over the vertical bus stab-in openings at the appropriate installation location for the unit to be installed.
10. Lift the unit and place its base on the front horizontal surface of the snap-in shelf.
11. Slide the unit into the vertical section, then push at the top and bottom until the stabs are fully engaged with the vertical bus.
12. Rotate the latches at the top and bottom of the unit clockwise to engage the latches with the horizontal shelves above and below the unit. See Figures 27 and 28.
13. Verify the operation of the disconnect handle and safety interlocks, as described later in this manual.





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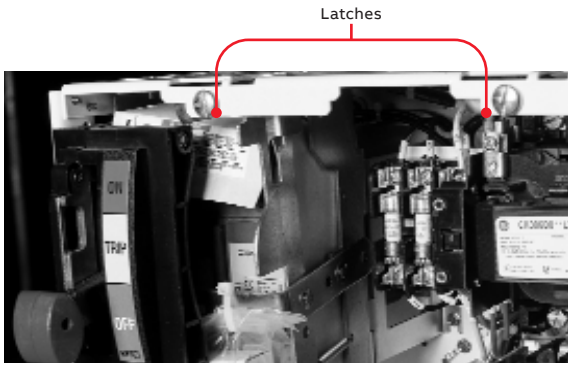

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27

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28

Removal of draw-out motor control center unit

Some units may still have control power applied from an external source after the unit disconnect has been switched to the OFF position. Be extremely careful when removing units from any motor control center. Failure to observe this precaution can result in serious injury or death.

The procedure for removing a motor control center unit is generally the reverse of the procedure for installing a unit:

1. Ensure that the unit disconnect is in the OFF position, as shown in Figure 27. For AFM units, ensure that the stabs are in the “DISENGAGED” position with indicators showing green.
2. Turn the door latches a quarter turn, open the unit door and the vertical wiring trough door.
3. Disconnect all field-connected wiring by separating the pull-apart terminal blocks in the unit. Pass the terminal blocks and wires into the vertical wiring trough. Note that the plastic knock-outs in the vertical wireway barrier can be removed and left within the vertical wireway, with the field wiring, rather than threading the wiring and terminals back through the knock-out.
4. Disconnect any other field-installed wires that are terminated in the unit. Remove these wires from the unit, tag them (if desired), and leave them in the vertical wireway adjacent to the unit.

Be careful with any field wiring removed from a unit that may become energized. Such wiring must be adequately insulated to avoid inadvertent contact. Failure to observe this precaution can result in serious injury or death.

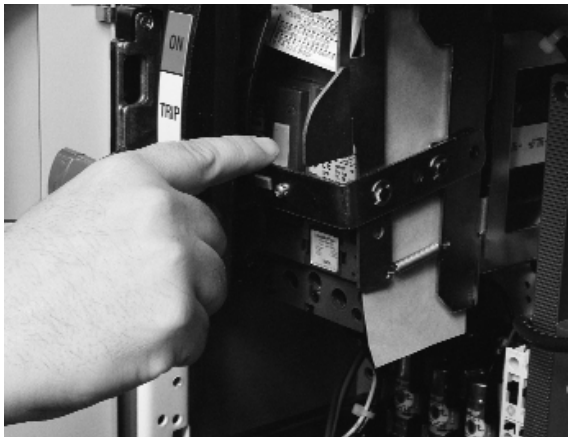
5. Turn the latches at the top and bottom of the unit a quarter turn counterclockwise to release the unit. These latches are shown in Figure 27 and Figure 28.
6. Pull unit out to remove it, being extremely careful to support its weight as it is fully withdrawn.
7. The door over the withdrawn unit can be latched closed.
8. If desired, a blank door can be ordered to cover the unused opening. (For large unit spaces, two blank doors and a horizontal unit shelf may be required.)

Operating handles, door interlocks and padlocking provisions

All Evolution motor control center units are furnished with disconnect operating handles that are integral to the unit structure. The position of the disconnect (ON–OFF for switches or ON–TRIP–OFF for circuit breakers) is indicated by the position of the operating handle. The operating handle is interlocked with a catch on the inside of the unit door to prevent inadvertent opening of the door when the disconnect is in the ON position, as shown in Figure 29. Switching the handle to OFF allows access to the i nterior of the unit.

Each disconnect operating handle is equipped with an interlock that prevents opening the door when the disconnect is ON Shown in Figure 31.

A concealed screw can be turned counterclockwise with a 5/32” Allen wrench to defeat the door interlock and access the breaker disconnect when ON, as shown in Figure 30. Only qualified personnel should be allowed to defeat the interlock.



—
29
Door-interlock feature that prevents access to the disconnect when the power is ON

—
30
Concealed screw used to defeat the door interlock

—
31
The door cannot be opened when the disconnect is ON

—
32
Removing the operating handle mounting screw

—
33
Rotating the operating handle to access the breaker

—
31

The disconnect is also equipped with a padlocking provision, so that the operating handle can be locked in the OFF position. The handle can also be drilled to accommodate one padlock to secure it in the ON position. In either case, the unit cannot be withdrawn because of interference between the padlock(s) and door.

Final commissioning: Verify that all doors are properly latched and interlocked prior to energizing.

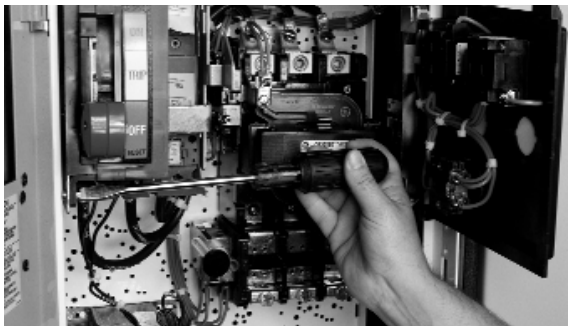
Plug-in units, no door	Estimated weight (lbs)	Minimum height (Inches)
NEMA Size 1 FVNR	35	12
NEMA Size 2 FVNR	37	12
NEMA Size 3 FVNR	53	18
NEMA Size 4 FVNR	62	24
NEMA Size 5 FVNR	125	36

Caution: should be used when removing or installing units consider the weight in table above. Two persons may be required or the assistance of a lifting devices. See page 28 for suggested lifts.

Caution: The friction of Type 12 gasketing can prevent the breaker disconnect operating handle from returning to the full ON position. Prior to servicing, confirm breaker disconnect is in the OFF position.

Operating handle

The operating handle must be moved out of the way to access the breaker disconnect. Make sure that the disconnect operating handle is in the OFF position. Open the door, then remove the mounting screw securing the base of the handle to the side of the unit, as shown in Figure 32. The handle can then be rotated up and out of the way, as shown in Figure 33, allowing access to the breaker.



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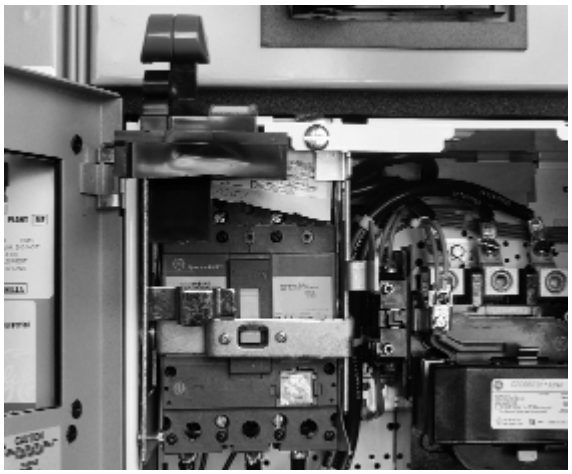

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33

—
34A
Grasp the center of the door

—
34B
Arc-resistant metallic pilot device bracket

—
34C
Pilot device bracket locking bracket in door

Pilot bracket and door

The pilot device door can be removed by lifting straight off per Figure 34. Also, the metal bracket can be removed by loosening mounting screws and removing bracket.

—
34A

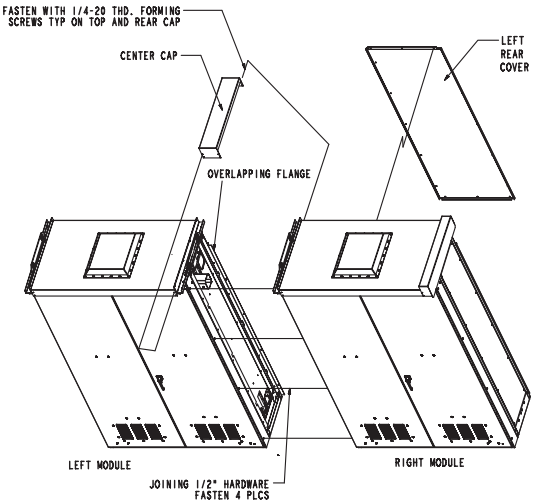
—
34B

—
34C

The pilot device bracket in is locked in place using the door mounted locking bracket shown in Figure 35A.

All pilot device brackets for arc-resistant MCCs are metallic (both standard and AFM units). Standard E9000 MCCs utilize a plastic pilot device bracket (Figure 34B).

NEMA 3R outdoor enclosure installation



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35A

—
35A
NEMA 3R Outdoor Enclosure Installation

—
35B
Assembly module line-up

—
35C
Wireway transition channel barrier installation

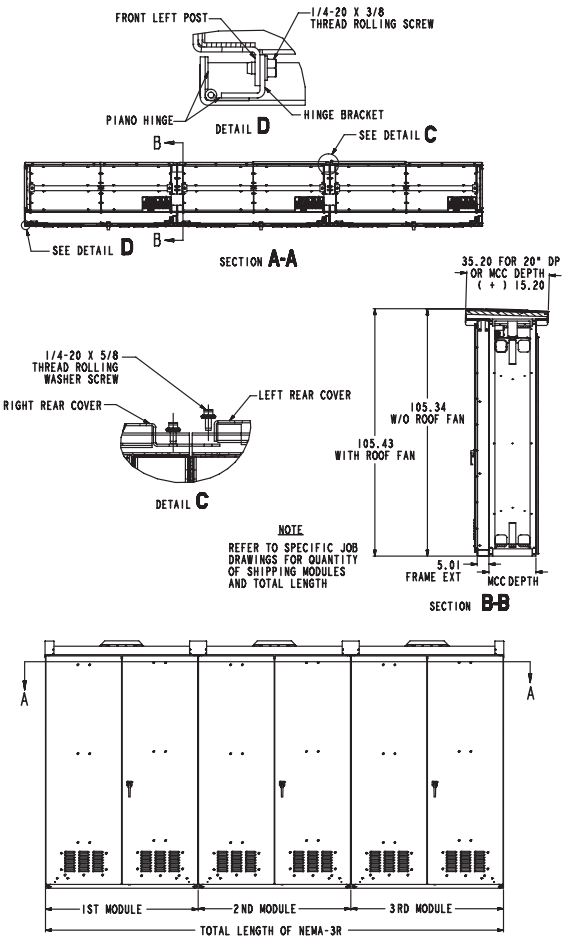
—
35D
Floor plate member installatio

NEMA 3R Installation Instructions

1. Remove left rear cover on right shipping module (Figure 35A, previous page.) Save the screws for later reassembly of the cover. Note that the left module right rear cover has a flange that will be underneath the removed covered with it is replaced. This provides an overlapping connection in the rear of the two spliced modules (Detail C in Figure 35B).
2. Slide adjoining shipping modules as close together as possible while carefully aligning the modules front-to-back.
3. Join shipping modules together using (4 sets) 1/2 hardware (front only). Hardware kits shipping with modules.
4. Assemble bus splices per splice instructions (included in splice kit).
5. Install wireway transition channel barrier by sliding it though the 5 x 5 wireway cutout and attaching it using (1) 1/4-28 x 3/8 thread rolling (Figure 35C).
6. Re-attach right, rear cover by re-attaching 1/4-20 x 5/8 sealing screw (Figure 35B, Detail C).
7. Attached center cap using (8) 1/4-20 x 5/8 thread rolling screws (Figure 35A).

Notes:

1. 3-inch floor members can be installed similarly to standard MCC floor members (Figure 35D).
2. Module doors can be removed by removing 1/4-20 x 3/8 thread rolling screws from door hinge bracket (Detail D in Figure 35B).



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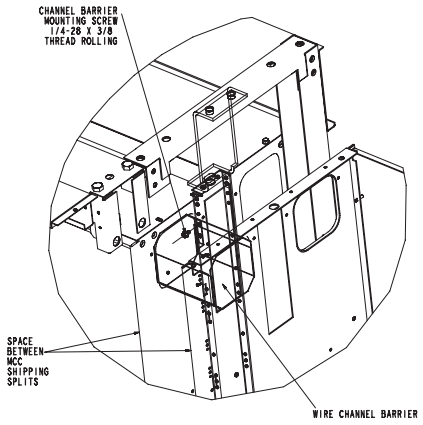
35B



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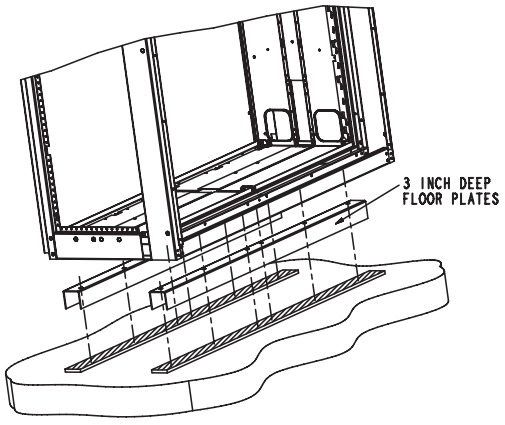
35C



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35D

Operation

Preparing for initial operation
In addition to the normal circuit checking after wiring is completed, the following specific actions should be taken before energizing the equipment:

1. Check and tighten any electrical connections, such as lugs and bus splices that may have loosened during shipment, handling and installation. Torque values are provided on or adjacent to components or lugs. See torque labels in MCC vertical wireway door. Visually check that all latches on arc-resistant enclosures are engaged.
2. Operate each magnetic device by hand to verify that all moving parts operate freely. Check all electrical contacts for proper operation.
3. Current transformers are shipped with a shunt across the secondary if the circuit is not complete. Remove the shunt after completing the connections to the transformer secondary.
4. Verify that the horsepower and voltage rating of the motor agree with the rating stamped on the starter unit to which it is connected.
5. Check each overload heater or electronic overload relay setting against the motor full-load current.

Check current transformer-operated overload relays to be certain that overload heaters are in place. Do not operate starters without overload protection.

6. Check all circuit breaker trip settings and fuse ratings against the drawings supplied with the equipment.
   a. If trip settings must be changed, use the rating plug extractor tool (catalog number TRTOOL) to remove rating plugs from Spectra circuit breakers.
   b. See the startup procedure following information regarding instantaneous trip settings on magneticonly circuit breakers.

Do not exceed the long-time and/or instantaneous trip settings stipulated in the National Electrical Code and as identified in the overload heater selection tables in this manual.

7. Check all pneumatic or motor-driven timers for proper time-interval settings.
8. Manually operate all branch-circuit disconnects and verify proper operation of disconnects and door interlocks.
9. Where applicable, manually trip all circuit breakers to verify that operating handles move freely to the TRIP indicating position. With the door closed and latched, reset each tripped circuit breaker by pushing the operating handle down beyond the OFF position. The operating handle should move upward to the OFF position after the breaker has been reset. After the reset, turn the circuit breaker ON and then OFF to confirm proper operation.
10. Visually check all units and enclosures to ensure that electrical spacings have not been reduced because of shipping and handling actions.
11. Verify that the motor control center enclosure and units are grounded.
12. Replace all protection barriers and panels that have been removed during installation.
13. Carefully clean the equipment interior with a clean cloth, soft brush or vacuum cleaner to remove all metal chips, dust, wire and other debris.
14. After taking precautions to prevent accidental contact with the motor control center buswork, conduct the following insulation-resistance test with a 1000 Vdc (Megger) tester. With all disconnects in the OFF position,
    • Apply voltage between all phase pairs.
    • Apply voltage between each phase and ground.
    All readings should be 1 megohm minimum; typical values will be 50–100 megohm but may vary based on humidity.
    Similarly, test individual feeder and motor circuit wiring (field wiring) as each set of conductors is pulled into the motor control center, before terminating the conductors at either end.

15. With all disconnects OFF, close and latch all doors and secure all external covers.
16. For AFM Units, ensure that all visual indicators are showing “RED” to indicate “ENGAGED” stab position and “OPEN” shutter position.

Initial operation of the motor control center

Because of problems that may occur during the initial energizing of the motor control equipment, only qualified personnel should carry out this startup procedure.

Use the following procedure for initial startup of the motor control equipment. Be sure that the steps in the previous section, Preparing for Initial Operation, have been completed.

1. Ensure that all doors are closed and latched and all external covers on the motor control center are secured. Visually check that all latches on arc-resistant enclosures are engaged.
2. Verify that all main and branch disconnects within the motor control center are OFF.
3. Verify (with an insulation-resistance tester) that all main incoming feeders to the motor control center are adequately insulated.
4. Close the upstream feeder to energize the motor control center.
5. Close the main disconnects, if any, at the motor control center.
6. Close each branch-circuit disconnect or feeder at the motor control center. For AFM Units, ensure that all visual indicators are showing “RED” to indicate “ENGAGED” stab position and “OPEN” shutter position.
7. Operate each motor starter individually to verify satisfactory operation, including the following parameters:
   - Motor rotation
   - Pilot light indication
   - Electrical interlocking
   - Acceleration and sequence timing
8. Adjust instantaneous settings on magnetic-only circuit breakers and/or fuse sizes and overload heater selections to achieve proper motor and branch circuit protection. (See NEC Article 430.52.) Since the adjustable trip setting on magnetic-only circuit breakers is factory set at the minimum trip position, nuisance tripping may occur on initial motor starting.

   Increase the trip setting in increments until tripping no longer occurs during motor starting. Do not exceed the maximum trip settings given in overload relay tables in this publication. All adjustable overloads are also factory set at minimum. Check motor name-plate data and set overloads accordingly.

Because of problems that may occur during the initial energizing of the motor control equipment, only qualified personnel should carry out this startup procedure.

Door closing procedure of pilot device bracket, extension bubble door for some GP/FP drives E9000 MCC units

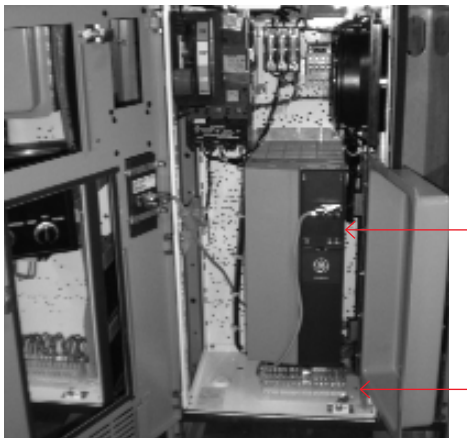
— 36
Door, pilot device bracket and extension bubble in open position

— 37
Partially close the pilot device bracket and extension bubble as shown

— 38
Partially close the door as shown

— 39
Adjust the pilot device bracket and extension bubble lip so it enters in between the keeper bracket and inside of the door

— 40
Close the door completely and turn the 1/4-turn latches



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37

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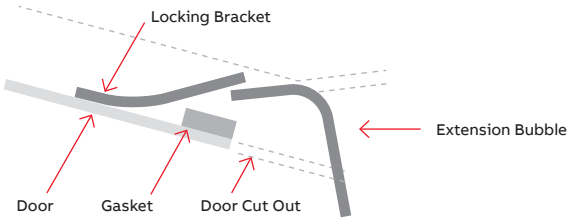
38



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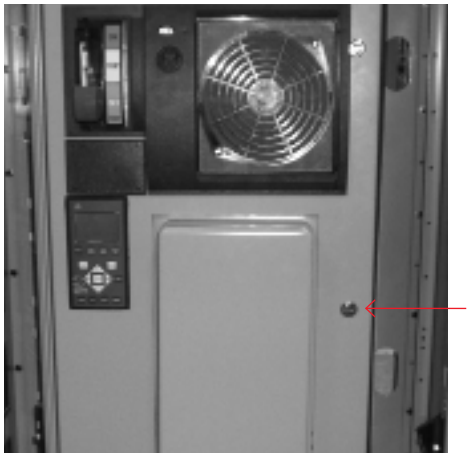

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Maintenance

Equipment maintenance

De-energize all equipment before performing any maintenance operation. There may be voltage present within the equipment from remote sources, even though all main- and branch-circuit disconnects have been opened at the equipment. Failure to observe this precaution can result in serious injury or death.

The customer should prepare a maintenance program consisting of a schedule and checklist matrix listing items to be periodically examined on the installed equipment. The frequency and extent of the maintenance activities will vary depending on such factors as equipment usage and environmental conditions. In any maintenance program the following actions should be included:

1. Remove accumulated dust and dirt with a soft cloth, brush or vacuum cleaner.
2. Wipe clean all main bus insulators and vertical bus barriers.
3. Inspect main and vertical bus joints and main bus supports and tighten, if necessary. Refer to Table 1 for torque specifications.
4. Inspect all wiring from units for deterioration of insulation.
5. Remove draw-out units and check stabs and all unit wiring. Remove accumulated dust from horizontal shelves and the areas around stabs.
6. Check all starter contacts. They need only be replaced when nearly all the silver tip is gone and the contact tip support is exposed. Do not file the contacts. Filing or otherwise dressing the contacts only results in lost tip material and reduces starter life. See publication GET-6915A for questionable contact appearance.
7. Check all unit wiring for deterioration of insulation and tighten all connections.
8. Visually check meters and instruments. Check critical instrument calibrations.
9. Check all unit door interlocks for proper operation.
10. Check all indicating lights and replace, as required.
11. If fuse replacement is necessary, always install the same type and rating as the fuses furnished with the motor control center. Fuse designs may be mechanically equivalent but not electrically equivalent. They may not have the same short-circuit withstand and current-limiting ability.

Inlet filter maintenance

Filter inspection and cleaning must be carried out every six months or more frequently as per your established maintenance plan. The frequency of filter maintenance or replacements should be determined individually, depending on dust accumulation and operating period.

Note: A soiled filter mat will cause the temperature to rise inside the enclosure. The filter mat can be regenerated by washing or blowing out.

Arc-resistant maintenance

If a unit is removed from an arc-resistant section for maintenance, a solid blank door should be used to cover the opening in order to maintain arc resistance.

Control power

The option to have control power or test power during service is a functionality that has been provided with the arc-resistant introduction of the LV MCC. This is a necessary requirement in order to check functions during service such as pilot lights and devices. This is intended to standardize the offerings when a customer orders common control power on the MCC. The two options we provide allow for 1) customer supplied 120VAC power or 2) self-contained control power within the MCC.

The key switch is utilized to operate the control power when the stabs are disengaged. The key switch is turned “On” allowing the secondary control power to be utilized. The key switch should be “Off” during normal operation of the MCC.

—
41
Fuse location

—
42
Rating plug removal tool, catalog number TRTOOL

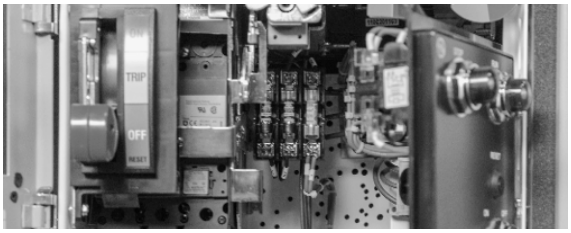
—
43
Pilot light and pushbutton removal tool, catalog number GEN-1684A

—
44
EntelliGuard Trip Unit Digital Test Kit, catalog number GTUTK20

—
45
Manual racking handle, catalog number 110C2073G1

—
46
Remote racking device, catalog number 190B3523G1

Control power fusing
Control fuses are front accessible except in the 6-inch compact starter. Remove 6-inch FVNR starter for maintenance. Fuses are located on the side, as shown in Figure 41.



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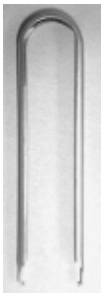
Suggested maintenance tools
The following tools are recommended for performing maintenance operations:
- Spectra circuit breaker rating plug removal tool, catalog number TRTOOL (see Figure 42).
- Pilot light and push button removal tool, catalog number GEN-1684A (see Figure 43).
- EntelliGuard TU Digital Test Kit, catalog number GTUTK20 (see Figure 44). The Test Kit may also be used to temporarily defeat the ground-fault function during primary injection (high-current test set).
- Manual racking handle, catalog number 110C2073G1 (see Figure 45).
- Remote racking device, catalog number 190B3523G1 (see Figure 46).
- Allen wrench in size 5/32 inch or #4 metric for defeating the door interlock.



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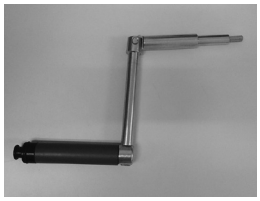

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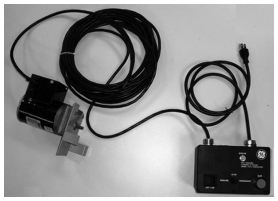

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Rearrangement of units must follow the following loading rules: 80% of the feeder trip or fuse clip rating, plus 100% of the starters full load current, plus 25% of the largest motor full load current. Do not exceed the vertical bus rating label on each section.

Replacing or adding breaker accessories to plug-in E or F frame circuit breaker
Use the following procedure to replace a circuit breaker in a motor control center.
1. Turn the power off.
2. Remove the unit from the motor control center.
3. Remove line and load cables (not required for accessories only)
4. Remove the toggle holding plate (toggle needs to be in the ON position, UP)
5. Remove the top four screws in top plate holding the breaker assembly (not required for accessories only).
6. Remove three front breaker screws from assembly.
7. Slide the breaker down and out.
8. Install the new breaker by following this procedure in the reverse order. Torque all electrical connections.

Replacing a control power transformer mounted under disconnect

Use the following procedure to replace a control power transformer mounted under a disconnect.

1. Turn the power off.
2. Remove the saddle unit from the motor control center.
3. Remove the top plate from the saddle unit.
4. Remove the handle assembly, as described on page 15.
5. Remove line and load cables.
6. Loosen the screws securing the disconnect assembly to the back plate and slide the assembly out.
7. Disconnect the transformer power and control leads.
8. Remove the transformer mounting screws and lift out the transformer.
9. Install the new transformer by following this procedure in the reverse order. Torque all electrical connections.

Replacing a compact starter (1/2X)

Use the following procedure to replace the starter.

1. Turn the power off.
2. Remove the saddle unit for the motor control center.
3. Remove the pilot device bracket (it is not required to remove control wiring)
4. Remove overload relay.
5. Use DIN rail release to gain access to line side wiring of contactor, remove line wires.
6. Reverse to install new starter.

Suggested lifts

Example: Model No. 55B534913P1

- All welded construction;
- Positive lock winch system;
- 500 lb. capacity;
- Raised height 58";
- Lowered height 3-1/8Æ;
- 20" X 20" deck size;
- 10" load center;
- 2" X 6" molded-on-rubber casters.

The following instructions are available.

300 Line starter

GEH-5190 – NEMA Size 1 FVNR
GEH-4774 – NEMA Size 2 FVNR
GEH-4806 – NEMA Size 3 FVNR
GEH-4807 – NEMA Size 4 FVNR
GEH-4839 – NEMA Size 5 FVNR
GEH-5198 – NEMA Size 6 FVNR
GEH-5190 – NEMA Size 1 FVR and 2 Speed
GEH-4775 – NEMA Size 2 FVR and 2 Speed
GEH-4806 – NEMA Size 3 FVR and 2 Speed
GEH-4807 – NEMA Size 4 FVR and 2 Speed
GEH-4839 – NEMA Size 5 FVR and 2 Speed
GET-6915A - Tech Info.- Contact Appearance

Arc flash mitigation units

DEI-007 – Remote Racking System Instructions
DEI-009 – AFM Retrofit Assembly Instructions
DEI-010 – Manual Racking Handle Instructions

C-2000 contactors

GEH-6263 – CL02, CL025
GEH-6264 – CL045
GEH-6265 – CL08
GEH-6266 – CL10
GEH-6350 – CK08
GEH-6227 – CK095
GEH-6228 – CK10B, CK11B, CK12B

Solid state starters

DET-787 – ASTAT-BP
DEH-40397 – ASTAT-CD Plus

Relays
GEH-4115 – CR120B
GEH-6435 – ECM

AF600 Drives
DET-609 – AF-600FP Operating/Installation
DET-620 – AF-600FP Programming Guide
DET-623 – AF-600 FP/AF-650 GP
DET-624 – AF-600FP / AF-650 GP Profibus DP
DET-633 – AF-600 FP Analog I/O Instructions
DET-635 – AF-600 FP / AF-650 GP External DC Supply
DET-607 – AF-650 GP Operating/Installation
DET-618 – AF-650 GP Programming Guide

Smart relays

MM300
GEK-113022 – Instruction Manual
GEK-113336 – Quick Start Guide
GEK-113392 – Communication Guide MM200
GEK-113400 – Instruction Manual
GEK-113401 – Quick Start Guide
GEK-113402 – Communication Guide

Spectra circuit breakers
DET-244 – Special Lugs
GET-7002 – Application and Selection
GEZ-7754 – Spectra Time-Current Curves

Power break II insulated-case circuit breakers
DEH-4568 – GTU Test Kit
GEH-6270 – PBII Instruction Manual
DEH-4567 – EntelliGuard Instruction Manual
DES-096, 097, 098, 099, 100 – EntelliGuard TU Trip Curves

Renewal parts
Because of the variety of components furnished in the E9000 motor control center, the suggested spare parts will vary. You should consider maintaining an adequate supply of the following components as spares:
- Overload heaters;
- Power and control circuit fuses;
- Replacement starter contact kits;
- Starter coils;
- Pilot lights;
- Push buttons;
- Circuit breakers and fusible switches;
- Extra draw-out terminal blocks;
- Complete starters and/or spare units as warranted by installation needs.

Your account manager will be glad to assist you in preparing a recommended parts list for your installation.

Ordering additional or replacement parts
The following information is needed for supplying the proper equipment:
1. All data on the motor control center master nameplate.
2. If the unit is to be a duplicate of an existing unit, all data on that unit's nameplate, located on the right side of the unit.
3. NEMA control center class: I or II.
4. NEMA wiring type: A, B or C.
5. NEMA enclosure type: 1, 1 Gasketed, 1-HG (heavy gasketed) 2, 3R or 12.
6. Power supply characteristics:
   - Voltage
   - Number of phases
   - Frequency in Hz
7. Control power voltage and frequency in Hz.
8. Nameplate designation and title.
9. Motor characteristics:
   - Horsepower rating;
   - Speed in RPM;
   - Temperature rise in °C;
   - Full-load current in amperes;
   - Accelerating time in seconds;
   - Service factor.
10. Disconnect characteristics:
    - Fusible switch rating (A), fuse type, and clips;
    - Circuit breaker frame size and current rating (A).
11. NEMA starter size: 1, 2, 3, 4, 5, 6 or 7.
12. Starter type: FVNR, FVR, RVNR, 2-speed winding and accessories:
    - Push buttons: start-stop, forward, reverse, up, down;
    - Transfer switch: H-O-A;
    - Pilot lights: quantity, color and type;
    - Interlocks: quantity of NO and NC;
    - Control power transformer.
13. Unit X height or space available.
14. Are horizontal shelves or other parts required?
15. Circuitry.
16. All other modifications.

Other information
For other information, refer to the nearest ABB sales office and give full details, including equipment nameplate data.

Nameplates are prominently displayed on the motor control center lineup and contain such details as service, voltage, frequency, factory order number. Similar nameplates are mounted on each motor control center unit.

Overload heaters

Heaters for ther-mag circuit breaker controllers
For continuous-rated motors with a service factor of 1.15 to 1.25, select the appropriate heaters for the motor full-load current. For continuous-rated motors with a service factor of 1.0, multiply the motor full-load current by 0.9 and use this value to select heaters.

Overload relay tripping current in 40°C ambient is the minimum value of full-load current multiplied by 1.25.

Provide short-circuit protection in accordance with the National Electrical Code.

Overload relays with automatic reset may automatically start a motor connected to a two-wire control circuit. When automatic restarting is not desired, use a three-wire control circuit.

Circuit breaker tripping may be an indication that a fault current has been interrupted. To provide continued protection against fire or shock hazard, examine all current-carrying parts and other components of the motor controller and replace any damaged components. If heater burnout occurs, the complete overload relay must be replaced.

Size 0 and 1 (Standard and Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123
.41-.45	C054A	4.96-549	C592A
.46-.49	C060A	5.50-5.91	C630A
.50-.53	C066A	5.92-6.47	C695A
.54-.59	C071A	6.48-7.20	C778A
.60-.65	C078A	7.21-8.22	C867A
.66-.76	C087A	8.23-8.72	C955A
.77-.84	C097A	8.73-9.67	C104B
.85-.93	C109A	9.68-10.4	C113B
.94-1.04	C118A	10.5-11.0	C125B
1.05-1.15	C131A	11.1-12.4	C137B
1.16-1.27	C148A	12.5-13.2	C151B
1.28-1.39	C163A	13.3-15.4	C163B
1.40-1.55	C184A	15.5-17.1	C180B
1.56-1.73	C196A	17.2-18.0	C198B
1.74-1.89	C220A		**Size 1**
1.90-2.05	C239A		
2.06-2.28	C268A	17.2-18.1	C198B
2.29-2.47	C301A	18.2-20.0	C214B
2.48-2.79	C326A	20.1-21.5	C228B
2.80-3.31	C356A	21.6-22.5	C250B
3.32-3.70	C379A	22.6-23.9	C273B
3.71-4.06	C419A	24.0-26.3	C303B
4.07-4.47	C466A	26.4-27.0	C330B
4.48-4.95	C526A		

Size 2 (Standard and Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123
5.48-5.85	C630A	16.8-17.9	C180B
5.85-6.47	C695A	18.0-18.7	C198B
6.48-7.35	C778A	18.8-20.4	C214B
7.36-8.06	C867A	20.5-22.7	C228B
8.07-9.03	C955A	22.8-24.7	C250B
9.04-9.61	C104B	24.8-26.3	C273B
9.62-10.5	C113B	26.4-29.5	C303B
10.6-11.6	C125B	29.6-32.5	C330B
11.7-12.5	C137B	32.6-36.7	C366B
12.6-13.6	C151B	36.8-41.9	C400B
13.7-16.7	C163B	42.0-43.2	C440B
		43.3-45.0	C460B

Size 3 (Standard and Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123
19.0-19.3	F233B	17.8-18.4	F233B
19.4-22.1	F243B	18.5-21.1	F243B
22.2-23.4	F270B	21.2-22.1	F270B
23.5-27.0	F300B	22.2-26.1	F300B
27.1-29.1	F327B	26.2-28.0	F327B
29.2-31.8	F357B	28.1-31.3	F357B
31.9-33.9	F395B	31.4-33.3	F395B
34.0-37.6	F430B	33.4-34.3	F430B
37.7-41.9	F487B	34.4-40.9	F487B
42.0-47.7	F567B	41.0-44.7	F567B
47.8-52.1	F614B	44.8-51.0	F614B
52.2-55.8	F658B	51.1-52.0	F658B
55.9-59.7	F719B	52.1-55.4	F719B
59.8-68.1	F772B	55.5-63.3	F772B
68.2-71.5	F848B	63.4-66.1	F848B
71.6-78.2	F914B	66.2-73.5	F914B
78.3-87.5	F104C	73.6-82.2	F104C
87.6-90.0	F114C	82.3-90.0	F114C

Size 4 (Standard and Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123
27.1-32.2	F357B	28.8-32.0	F357B
32.3-34.0	F395B	32.1-34.2	F395B
34.1-36.8	F430B	34.3-36.7	F430B
36.9-44.6	F487B	36.8-43.9	F487B
44.7-48.4	F567B	44.0-46.6	F567B
48.5-53.9	F614B	46.7-52.6	F614B
54.0-57.4	F658B	52.7-55.6	F658B
57.5-60.0	F719B	55.7-58.7	F719B
60.1-69.5	F772B	58.8-67.1	F772B
69.6-71.7	F848B	67.2-70.6	F848B
71.8-79.9	F914B	70.7-76.3	F914B
80.0-92.3	F104C	76.4-88.7	F104C
92.4-97.0	F114C	88.8-93.4	F114C
97.1-108	F118C	93.5-105	F118C
109-118	F133C	106-114	F133C
119-131	F149C	115-128	F149C
132-135	F161C	129-131	F161C
		132-135	F174C

Size 5 (Standard and Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123
109-118	C592A	185-200	C104B
119-128	C630A	201-221	C113B
129-138	C695A	222-237	C125B
139-155	C778A	238-262	C137B
156-168	C867A	263-270	C151B
169-184	C955A		

Heaters for mag-break® controllers

The Mag-Break protector is factory adjusted to the minimum trip setting

To maintain overload, short-circuit, and groundfault protection, use the following instructions to select heaters and to adjust the Mag-Break trip setting.

For continuous-rated motors with a service factor of 1.15 to 1.25, select the appropriate heaters for the motor full-load current. For continuous-rated motors with a service factor of 1.0, multiply the motor full-load current by 0.9 and use this value to select heaters.

Use the heater table to verify that the Mag-Break and current limiter rating is correct for the motor full-load current. Then set the Mag-Break trip setting to the recommended value.

If the Mag-Break trips during motor startup, increase the trip setting by one step at a time until the motor can be consistently started. Do not exceed the maximum trip setting shown in the heater table.

Overload relay tripping current in 40° C ambient is the minimum value of heater full-load current multiplied by 1.25.

Circuit breaker tripping may be an indication that a fault current has been interrupted. To provide continued protection against fire or shock hazard, examine all current-carrying parts and other components of the motor controller and replace any damaged components. If heater burnout occurs, the complete overload relay must be replaced.

Size 0 and 1 (Standard)

Motor Full- Load Amps 3-Ph, 3 Heater	Heater Number CR123	Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123
.65-.74	C087A	3	LO
.75-.84	C097A	3	LO
.85-.92	C109A	3	1
.93-1.02	C118A	3	1
1.03-1.10	C131A	3	2
1.11-1.23	C148A	3	2
1.24-1.38	C163A	3	3
1.39-1.49	C184A	3	4
1.50-1.67	C196A	3	4
1.68-1.79	C220A	3	5
1.80-1.98	C239A	3	6
1.99-2.24	C268A	3	7
2.25-2.43	C301A	3	8
2.25-2.43	C301A	7	1
2.44-2.75	C326A	7	2
2.76-3.25	C356A	7	3
3.26-3.43	C379A	7	4
3.44-4.03	C419A	7	4
4.04-4.43	C466A	7	5
4.44-4.94	C526A	7	6
4.95-5.36	C592A	7	7
5.37-5.77	C630A	7	6
5.37-5.77	C630A	15	2
5.78-6.35	C695A	15	2
6.36-6.92	C778A	15	3
6.93-7.99	C867A	15	3
8.00-8.47	C955A	15	4
8.48-9.19	C104B	15	5
9.20-10.0	C113B	15	6
10.1-10.7	C125B	15	6
10.8-12.0	C137B	15	7
10.8-12.0	C137B	30	2
12.1-12.9	C151B	15	8
12.1-12.9	C151B	30	2
13.0-15.1	C163B	30	3
15.2-16.3	C180B	30	4
16.4-17.9	C198B	30	4
Size 1			
18.0-19.7	C214B	1	5
19.8-21.2	C228B	1	6
21.3-22.3	C250B	2	7
22.4-23.5	C273B	2	8
23.6-25.5	C303B	3	8
23.6-25.5	C303B	LO	3
25.6-27.0	C330B	LO	3

Size 0 and 1 (Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	TEC and TECL Rating	Mag-Break Trip Setting	
			Rec.	Max.
66-.76	C087A	3	LO	LO
.77-.84	C097A	3	LO	LO
.85-.93	C109A	3	LO	1
.94-1.04	C118A	3	LO	1
1.05-1.15	C131A	3	LO	2
1.16-1.27	C148A	3	LO	2
1.28-1.39	C163A	3	LO	3
1.40-1.55	C184A	3	LO	4
1.56-1.73	C196A	3	1	4
1.74-1.89	C220A	3	1	5
1.90-2.05	C239A	3	2	6
2.06-2.28	C268A	3	2	7
2.29-2.47	C301A	3	3	8
2.29-2.47	C301A	7	LO	1
2.48-2.79	C326A	7	LO	2
2.80-3.31	C356A	7	LO	3
3.32-3.70	C379A	7	LO	4
3.71-4.06	C419A	7	1	5
4.07-4.47	C466A	7	1	5
4.48-4.95	C526A	7	2	6
4.96-5.49	C592A	7	2	7
4.96-5.49	C592A	15	LO	1
5.50-5.91	C630A	7	3	8
5.50-5.91	C630A	15	LO	2
5.92-6.47	C695A	15	LO	2
6.48-7.20	C778A	15	LO	3
7.21-8.22	C867A	15	LO	3
8.23-8.72	C955A	15	1	4
8.73-9.67	C104B	15	1	5
9.68-10.4	C113B	15	1	6
10.5-11.0	C125B	15	2	7
11.1-12.4	C137B	15	2	7
11.1-12.4	C137B	30	LO	2
12.5-13.2	C151B	30	LO	2
13.3-15.4	C163B	30	LO	3
15.5-17.1	C180B	30	LO	4
Size 1				
17.2-18.1	C198B	30	1	5
18.2-20.0	C214B	30	1	5
20.1-21.5	C228B	30	2	6
21.6-22.5	C250B	30	2	7
22.6-23.9	C273B	30	2	8
22.6-23.9	C273B	50	LO	2
24.0-26.0	C303B	30	3	8
24.0-26.0	C303B	50	LO	3
26.1-27.0	C330B	50	LO	4

Size 2 (Standard)

Motor Full- Load Amps 3-Ph, 3 Heater	Heater Number CR123	TEC and TECL Rating	Mag-Break Trip Setting	
			Rec.	Max.
8.81-9.27	C104B	15	2	5
9.28-9.99	C113B	15	2	6
10.0-11.1	C125B	15	3	6
11.2-12.1	C137B	15	3	7
11.2-12.1	C137B	30	LO	2
12.2-13.0	C151B	15	4	8
12.2-13.0	C151B	30	LO	2
13.1-15.5	C163B	30	1	3
15.6-16.8	C180B	30	1	4
16.9-18.0	C198B	30	2	5
18.1-19.7	C214B	30	2	5
19.8-21.6	C228B	30	2	6
21.7-23.9	C250B	30	3	7
21.7-23.9	C250B	50	LO	2
24.0-25.5	C273B	30	3	8
24.0-25.5	C273B	50	LO	3
25.6-26.0	C303B	30	3	9
25.6-28.2	C303B	50	LO	3
28.3-31.6	C330B	50	1	4
31.7-34.7	C366B	50	2	5
34.8-37.8	C400B	50	2	6
37.9-40.6	C440B	50	3	7
40.7-43.4	C460B	50	3	8

Size 2 (Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	TEC and TECL Rating	Mag-Break Trip Setting	
			Rec.	Max.
9.04-9.61	C104B	15	2	5
9.62-10.5	C113B	15	2	6
10.6-11.6	C125B	15	3	7
11.7-12.5	C137B	15	3	8
11.7-12.5	C137B	30	LO	2
12.6-13.0	C151B	15	4	9
12.6-13.6	C151B	30	LO	3
13.7-16.7	C163B	30	1	3
16.8-17.9	C180B	30	1	5
18.0-18.7	C198B	30	2	5
18.8-20.4	C214B	30	2	6
20.5-22.7	C228B	30	2	7
22.8-24.7	C250B	30	3	8
22.8-24.7	C250B	50	LO	2
24.8-26.0	C273B	30	4	9
24.8-26.3	C273B	50	LO	4
26.4-29.5	C303B	50	LO	4
29.6-32.5	C330B	50	1	4
32.6-36.7	C366B	50	2	6
36.8-41.9	C400B	50	2	7
42.0-43.2	C440B	50	3	9
43.3-43.4	C460B	50	3	9

Size 3 (Standard and Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	TEC and TECL Rating	Mag-Break Trip Setting	
			Rec.	Max.
17.8-18.4	F233B	30	1	5
18.5-21.1	F243B	30	1	6
21.2-22.1	F270B	30	2	7
22.2-26.0	F300B	30	3	7
26.1-28.0	F327B	50	LO	4
28.1-31.3	F357B	50	LO	4
31.4-33.3	F395B	50	1	5
33.4-34.3	F430B	50	1	6
34.4-40.9	F487B	50	1	6
41.0-43.4	F567B	50	2	8
43.5-44.7	F567B	100	LO	3
44.8-51.0	F614B	100	LO	3
51.1-52.0	F658B	100	1	4
52.1-55.4	F719B	100	1	4
55.5-63.3	F772B	100	1	5
63.4-66.1	F848B	100	2	6
66.2-73.5	F914B	100	2	6
73.6-82.2	F104C	100	2	7
82.3-86.9	F114C	100	3	9

Size 4 (Standard)

Motor Full- Load Amps 3-Ph, 3 Heater	Heater Number CR123	TEC and TECL Rating	Mag-Break Trip Setting	
			Rec.	Max.
28.8-32.0	F357B	50	1	4
32.1-34.2	F395B	50	2	5
34.3-36.7	F430B	50	2	6
36.8-43.4	F487B	50	3	7
43.5-43.9	F487B	100	1	3
44.0-46.6	F567B	100	1	3
46.7-52.6	F614B	100	1	3
52.7-55.6	F658B	100	1	4
55.7-58.7	F719B	100	2	5
58.8-67.1	F772B	100	2	5
67.2-70.6	F848B	100	3	6
70.7-76.3	F914B	100	3	7
70.7-76.3	F914B	150	LO	1
76.4-86.9	F104C	100	4	8
76.4-88.7	F104C	150	LO	2
88.8-93.4	F114C	150	1	3
93.5-102	F118C	150	1	3
103-110	F133C	150	1	4
111-122	F149C	150	1	4
123-131	F161C	150	2	5

Size 4 (Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	TEC and TECL Rating	Mag-Break Trip Setting	
			Rec.	Max.
28.8-32.0	F357B	50	2	4
32.1-34.2	F395B	50	2	5
34.3-36.7	F430B	50	2	6
36.8-43.4	F487B	50	3	7
36.8-43.8	F487B	100	LO	2
43.9-46.6	F567B	100	2	3
46.7-52.6	F614B	100	1	3
52.7-55.6	F658B	100	1	4
55.7-58.7	F719B	100	2	5
58.8-67.1	F772B	100	2	5
67.2-70.6	F848B	100	3	6
70.7-76.3	F914B	100	3	7
76.4-86.9	F104C	100	4	8
76.4-88.7	F104C	150	LO	2
88.8-93.4	F114C	150	1	3
93.5-105	F118C	150	1	3
106-114	F133C	150	1	4
115-128	F149C	150	2	5
129-130	F161C	150	2	6

Size 5 (Standard and Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	TEC and TECL Rating	Mag-Break Trip Setting	
			Rec.	Max.
106-115	C592A	550-1670	2	6
116-125	C630A	550-1670	3	7
126-135	C695A	550-1670	3	7
126-135	C695A	1000-3300	LO	3
136-151	C778A	1000-3300	LO	3
152-164	C867A	1000-3300	LO	4
165-179	C955A	1000-3300	1	5
180-195	C104B	1000-3300	2	5
196-215	C113B	1000-3300	2	6
216-231	C125B	1000-3300	3	6
232-255	C137B	1000-3300	4	7
256-270	C151B	1000-3300	4	HI

Size 0 and 1 (Standard)

Motor Full- Load Amps 3-Ph, 3 Heater	Heater Number CR123	SE Rating Plug	Mag-Break Trip Setting	
			Rec.	Max.
65-.74	C087A	3	LO	LO
.75-.84	C097A	3	LO	LO
.85-.92	C109A	3	LO	LO
.93-1.02	C118A	3	LO	2
1.03-1.10	C131A	3	LO	2
1.11-1.23	C148A	3	LO	2
1.24-1.38	C163A	3	LO	3
1.39-1.49	C184A	3	LO	4
1.50-1.67	C196A	3	LO	4
1.68-1.79	C220A	3	LO	5
1.80-1.98	C239A	3	2	5
1.99-2.24	C268A	3	3	5
2.25-2.43	C301A	3	3	6
2.44-2.75	C326A	7	LO	3
2.76-3.25	C356A	7	LO	4
3.26-3.43	C379A	7	LO	4
3.44-4.03	C419A	7	2	4
4.04-4.43	C466A	7	2	5
4.44-4.94	C526A	7	3	5
4.95-5.36	C592A	7	3	6
5.37-5.77	C630A	7	4	6
5.37-5.77	C630A	15	LO	3
5.78-6.35	C695A	15	LO	3
6.36-6.92	C778A	15	LO	4
6.93-7.99	C867A	15	2	4
8.00-8.47	C955A	15	2	5
8.48-9.19	C104B	15	3	5
9.20-10.0	C113B	20	2	4
10.1-10.7	C125B	20	2	5
10.8-12.0	C137B	20	2	5
12.1-12.9	C151B	20	3	5
13.0-15.1	C163B	20	4	6
15.2-16.3	C180B	25	3	5
16.4-17.9	C198B	25	3	6

Size 1 (Standard)

Motor Full- Load Amps 3-Ph, 3 Heater	Heater Number CR123	SE Rating Plug	Mag-Break Trip Setting	
			Rec.	Max.
18.0-19.7	C214B	30	3	5
19.8-21.2	C228B	30	3	5
21.3-22.3	C250B	30	3	6
22.4-23.5	C273B	40	2	5
23.6-25.5	C303B	40	3	5
25.6-27.0	C330B	40	3	5

Size 0 and 1 (Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	SE Rating Plug	Mag-Break Trip Setting	
			Rec.	Max.
.66-.76	C087A	3	LO	LO
.77-.84	C097A	3	LO	LO
.85-.93	C109A	3	LO	LO
.94-1.04	C118A	3	LO	2
1.05-1.15	C131A	3	LO	2
1.16-1.27	C148A	3	LO	3
1.28-1.39	C163A	3	LO	3
1.40-1.55	C184A	3	LO	4
1.56-1.73	C196A	3	2	4
1.74-1.89	C220A	3	2	5
1.90-2.05	C239A	3	2	5
2.06-2.28	C268A	3	3	5
2.29-2.47	C301A	3	3	6
2.48-2.79	C326A	7	LO	3
2.80-3.31	C356A	7	LO	4
3.32-3.70	C379A	7	2	4
3.71-4.06	C419A	7	2	4
4.07-4.47	C466A	7	2	5
4.48-4.95	C526A	7	3	5
4.96-5.49	C592A	7	3	6
5.50-5.91	C630A	7	4	6
5.50-5.91	C630A	15	LO	3
5.92-6.47	C695A	15	LO	3
6.48-7.20	C778A	15	2	4
7.21-8.22	C867A	15	2	4
8.23-8.72	C955A	15	2	5
8.73-9.67	C104B	15	3	5
9.68-10.4	C113B	20	2	4
10.5-11.0	C125B	20	2	4
11.1-12.4	C137B	20	2	5
12.5-13.2	C151B	20	3	5
13.3-15.4	C163B	20	4	6
15.5-17.1	C180B	25	3	5

Size 0 and 1 (Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	SE Rating Plug	Mag-Break Trip Setting	
			Rec.	Max.
17.2-18.1	C198B	25	3	6
18.2-20.0	C214B	30	3	5
20.1-21.5	C228B	30	3	5
21.6-22.5	C250B	30	3	6
22.6-23.9	C273B	40	2	5
24.0-26.0	C303B	40	3	5
26.1-27.0	C330B	40	3	5

Size 2 (Standard)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	SE Rating Plug	Mag-Break Trip Setting	
			Rec.	Max.
8.81-9.27	C104B	15	3	5
9.28-9.99	C113B	20	2	4
10.0-11.1	C125B	20	2	5
11.2-12.1	C137B	20	3	5
12.2-13.0	C151B	20	3	5
13.1-15.5	C163B	20	4	6
15.6-16.8	C180B	25	3	5
16.9-18.0	C198B	25	3	6
18.1-19.7	C214B	30	3	5
19.8-21.6	C228B	30	3	5
21.7-23.9	C250B	40	2	5
24.0-25.5	C273B	40	2	5
25.6-28.2	C303B	50	2	5
28.3-31.6	C330B	50	3	5
31.7-34.7	C366B	50	3	6
34.8-37.8	C400B	50	3	6
37.9-40.6	C440B	60	3	5
40.7-43.4	C460B	60	3	6

Size 2 (Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	SE Rating Plug	Mag-Break Trip Setting	
			Rec.	Max.
28.8-32.0	F357B	50	3	5
32.1-34.2	F395B	50	3	5
34.3-36.7	F430B	70	2	5
36.8-43.8	F487B	70	3	5
43.9-46.6	F567B	70	3	5
46.7-52.6	F614B	100	2	4
52.7-55.6	F658B	100	2	5
55.7-58.7	F719B	100	2	5
58.8-67.1	F772B	100	3	5
67.2-70.6	F848B	100	3	6
70.7-76.3	F914B	150	2	4
76.4-88.7	F104C	150	2	5
88.8-93.4	F114C	150	3	5
93.5-105.0	F118C	150	3	5
106.0-114.0	F133C	150	3	5
115.0-128.0	F149C	150	4	6
129.0-130.0	F161C	150	4	6

Size 3 (Standard and Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	SE Rating Plug	Mag-Break Trip Setting	
			Rec.	Max.
17.8-18.4	F233B	30	2	5
18.5-21.1	F243B	30	3	5
21.2-22.1	F207B	30	3	5
22.2-26.0	F300B	40	3	5
26.1-28.0	F327B	40	3	5
28.1-31.3	F357B	50	3	5
31.4-33.3	F395B	50	3	5
33.4-34.3	F430B	50	3	5
34.4-40.9	F487B	70	2	5
41.0-44.7	F567B	70	3	5
44.8-51.0	F614B	100	LO	4
51.1-52.0	F658B	100	LO	4
52.1-55.4	F719B	100	2	5
55.5-63.3	F772B	100	3	5
63.4-66.1	F848B	100	3	5
66.2-73.5	F914B	100	3	6
73.6-82.2	F104C	150	2	4
82.3-86.9	F114C	150	2	5

Size 4 (Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	SE Rating Plug	Mag-Break Trip Setting	
			Rec.	Max.
28.8-32.0	F357B	50	3	5
32.1-34.2	F395B	50	3	5
34.3-36.7	F430B	70	2	5
36.8-43.8	F487B	70	3	5
43.9-46.6	F567B	70	3	5
46.7-52.6	F614B	100	2	4
52.7-55.6	F658B	100	2	5
55.7-58.7	F719B	100	2	5
58.8-67.1	F772B	100	3	5
67.2-70.6	F848B	100	3	6
70.7-76.3	F914B	150	2	4
76.4-88.7	F104C	150	2	5
88.8-93.4	F114C	150	3	5
93.5-105.0	F118C	150	3	5
106.0-114.0	F133C	150	3	5
115.0-128.0	F149C	150	4	6
129.0-130.0	F161C	150	4	6

Size 4 (Standard)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	SE Rating Plug	Mag-Break Trip Setting	
			Rec.	Max.
28.8-32.0	F357B	50	3	5
32.1-34.2	F395B	50	3	5
34.3-36.7	F430B	70	2	5
36.8-43.9	F487B	70	3	5
44.0-46.6	F567B	70	3	5
46.7-52.6	F614B	100	2	4
52.7-55.6	F658B	100	2	5
55.7-58.7	F719B	100	2	5
58.8-67.1	F772B	100	3	5
67.2-70.6	F848B	100	3	6
70.7-76.3	F914B	150	2	4
76.4-88.7	F104C	150	2	5
88.8-93.4	F114C	150	3	5
93.5-102.0	F118C	150	3	5
103.0-110.0	F133C	150	3	5
111.0-122.0	F149C	150	4	6
123.0-131.0	F161C	150	4	6

Size 4 (Standard)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	SE Rating Plug	Mag-Break Trip Setting	
			Rec.	Max.
28.8-32.0	F357B	70	2	4
32.1-34.2	F395B	70	2	4
34.3-36.7	F430B	70	2	5
36.8-43.9	F487B	70	2	5
44.0-46.6	F567B	70	3	5
46.7-52.6	F614B	100	2	4
52.7-55.6	F658B	100	2	4
55.7-58.7	F719B	100	2	5
58.8-67.1	F772B	150	LO	4
67.2-70.6	F848B	150	LO	4
70.7-76.3	F914B	150	2	4
76.4-88.7	F104C	200	LO	4
88.8-93.4	F114C	200	LO	4
93.5-102.0	F118C	200	LO	5
103.0-110.0	F133C	200	2	6
111.0-122.0	F149C	200	2	6
123.0-131.0	F161C	200	2	6

Size 4 (Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	SE Rating Plug	Mag-Break Trip Setting Rec.	Mag-Break Trip Setting Max.
28.8-32.0	F357B	70	2	4
32.1-34.2	F395B	70	3	4
34.3-36.7	F430B	70	3	5
36.8-43.8	F487B	70	3	5
43.9-46.6	F567B	70	3	5
46.7-52.6	F614B	100	2	4
52.7-55.6	F658B	100	2	4
55.7-58.7	F719B	100	2	5
58.8-67.1	F772B	150	LO	4
67.2-70.6	F848B	150	LO	4
70.7-76.3	F914B	150	2	4
76.4-88.7	F104C	200	LO	4
88.8-93.4	F114C	200	LO	4
93.5-105.0	F118C	200	LO	5
106.0-114.0	F133C	200	2	6
115.0-128.0	F149C	200	2	6
129.0-130.0	F161C	200	2	6

Size 5 – 300:15 CT (Standard and Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	SG Rating Plug	Instantaneous Trip Setting Rec.	Instantaneous Trip Setting Max.
106-115	C592A	250	LO	3
116-125	C630A	250	LO	4
126-135	C695A	250	2	4
136-151	C778A	250	2	5
152-164	C867A	300	2	4
165-179	C955A	300	2	5
180-195	C104B	350	2	4
196-215	C113B	350	2	5
216-231	C125B	400	2	4
232-255	C137B	400	2	5
256-270	C151B	400	3	5

Size 6 – 600:5 CT (Standard and Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	SG Rating Plug	Instantaneous Trip Setting Rec.	Instantaneous Trip Setting Max.
181-197	C220A	400	MIN	4
198-214	C239A	400	2	5
215-238	C268A	500	MIN	4
239-258	C301A	500	MIN	4
259-290	C326A	500	2	5
291-346	C356A	600	MIN	5
347-387	C379A	600	2	5
388-424	C419A	600	3	MAX

Size 6 – 600:5 CT (Standard and Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	SK Rating Plug	Instantaneous Trip Setting Rec.	Instantaneous Trip Setting Max.
181-197	C220A	400	LO	4
198-214	C239A	400	2	4
215-238	C268A	400	3	5
239-258	C301A	500	LO	4
259-290	C326A	500	2	5
291-346	C356A	800	LO	4
347-387	C379A	800	LO	5
388-423	C419A	800	2	5
424-467	C466A	1000	LO	4
468-516	C526A	1000	2	4
517-540	C592A	1000	2	5

Heaters for fused controllers

For continuous-rated motors with a service factor of 1.15 to 1.25, select the appropriate heaters for the motor full-load current. For continuous-rated motors with a service factor of 1.0, multiply the motor full-load current by 0.9 and use this value to select heaters.

Overload relay tripping current in 40° C ambient is the minimum value of full-load current multiplied by 1.25.

Overload relays with automatic reset may automatically start a motor connected to a two-wire control circuit. When automatic restarting is not desired, use a three-wire control circuit.

Provide short-circuit protection in accordance with the National Electrical Code, except that fuses are not to exceed the value shown in the table.

Suitable for use in a circuit capable of delivering not more than the maximum RMS symmetrical amperes indicated in the Maximum Fuse and Short-Circuit Rating table below, 600 V maximum, when protected by an appropriate fuse having an interrupting rating not less than the available short-circuit current.

Opening of the fuse(s) may be an indication that a fault current has been interrupted. To provide continued protection against fire or shock hazard, examine all current-carrying parts and other components of the motor controller and replace any damaged components. If heater burnout occurs, the complete overload relay must be replaced.

Maximum Fuse and Short-Circuit Rating

	Class RK Fuse		Class J Fuse		Class K-1, K-5 Fuse	
NEMA Size	Max. Clip	Max. RMS Sym. Amps	Max. Clip	Max. RMS Sym. Amps	Max. Clip	Max. RMS Sym. Amps
1	30A	100,000	60A	100,000	Fuse per Overload Heater Table	5,000
2	60	100,000	100	100,000		5,000
3	100	100,000	200	100,000		5,000
4	200	100,000	400	100,000		10,000
5	400	100,000	600	100,000		10,000

Size 5 – 300:15 CT (Standard and Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	Maximum Fuse Rating
.41-.45	C054A	3
.46-.49	C060A	3
.50-.53	C066A	3
.54-.59	C071A	3
.60-.65	C078A	3
.66-.76	C087A	3
.77-.84	C097A	3
.85-.93	C109A	3
.94-1.04	C118A	3
1.05-1.15	C131A	3
1.16-1.27	C148A	3
1.28-1.39	C163A	3
1.40-1.55	C184A	6
1.56-1.73	C196A	6
1.74-1.89	C220A	6
1.90-2.05	C239A	6
2.06-2.28	C268A	6
2.29-2.47	C301A	6
2.48-2.79	C326A	10
2.80-3.31	C356A	10
3.32-3.70	C379A	12
3.71-4.06	C419A	15
4.07-4.47	C466A	15
4.48-4.95	C526A	15
4.96-5.49	C592A	20
5.50-5.91	C630A	20
5.92-6.47	C695A	25
6.48-7.20	C778A	25
7.21-8.22	C867A	30
8.23-8.72	C955A	30
8.73-9.67	C104B	35[1]
9.68-10.4	C113B	35[1]
10.5-11.0	C125B	40[1]
11.1-12.4	C137B	45[1]
12.5-13.2	C151B	50[1]
13.3-15.4	C163B	60[1]
15.5-17.1	C180B	60[1]
17.2-18.0	C198B	60[1]

Size 1 (Standard and Ambient Comp.)

Motor Full- Load Amps 3-Ph, 3 Heater	Heater Number CR123	Maximum Fuse Rating
17.2-18.1	C198B	60[1]
18.2-20.0	C214B	60[1]
20.1-21.5	C228B	60[1]
21.6-22.5	C250B	60[1]
22.6-23.9	C273B	60[1]
24.0-26.3	C303B	60[1]
26.4-27.0	C330B	60[1]

Size 2 (Standard and Ambient Comp.)

Motor Full- Load Amps 3-Ph, 3 Heater	Heater Number CR123	Maximum Fuse Rating
5.48-5.85	C630A	20
5.86-6.47	C695A	20
6.48-7.35	C778A	25
7.36-8.06	C867A	30
8.07-9.03	C955A	30
9.04-9.61	C104B	35
9.62-10.5	C113B	35
10.6-11.6	C125B	40
11.7-12.5	C137B	45
12.6-13.6	C151B	50
13.7-16.7	C163B	60
16.8-17.9	C180B	60
18.0-18.7	C198B	70[1]
18.8-20.4	C214B	80[1]
20.5-22.7	C228B	80[1]
22.8-24.7	C250B	90[1]
24.8-26.3	C273B	90[1]
26.4-29.5	C303B	100[1]
29.6-32.5	C330B	100[1]
32.6-36.7	C366B	100[1]
36.8-41.9	C400B	100[1]
42.0-43.2	C440B	100[1]
43.3-45.0	C460B	100[1]

Size 3 (Standard)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	Maximum Fuse Rating
19.0-19.3	F233B	70
19.4-22.1	F243B	80
22.2-23.4	F270B	80
23.5-27.0	F300B	90
27.1-29.1	F327B	100
29.2-31.8	F357B	110[1]
31.9-33.9	F395B	125[1]
34.0-37.6	F430B	125[1]
37.7-41.9	F487B	150[1]
42.0-47.7	F567B	175[1]
47.8-52.1	F614B	175[1]
52.2-55.8	F658B	200[1]
55.9-59.7	F719B	200[1]
59.8-68.1	F772B	200[1]
68.2-71.5	F848B	200[1]
71.6-78.2	F914B	200[1]
78.3-87.5	F104C	200[1]
87.6-90.0	F114C	200[1]

Size 1 (Standard and Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	Maximum Fuse Rating
27.1-32.2	F357B	110
32.3-34.0	F395B	125
34.1-36.8	F430B	125
36.9-44.6	F487B	150
44.7-48.4	F567B	175
48.5-53.9	F614B	175
54.0-57.4	F658B	200
57.5-60.0	F719B	225[1]
60.1-69.5	F772B	225[1]
69.6-71.7	F848B	250[1]
71.8-79.9	F914B	275[1]
80.0-92.3	F104C	300[1]
92.4-97.0	F114C	350[1]
97.1-108	F118C	400[1]
109-118	F133C	400[1]
119-131	F149C	400[1]
132-135	F161C	400[1]

Size 3 (Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	Maximum Fuse Rating
17.8-18.4	F233B	70
18.5-21.1	F243B	80
21.2-22.1	F270B	80
22.2-26.1	F300B	90
26.2-28.0	F327B	100
28.1-31.3	F357B	110[1]
31.4-33.3	F395B	125[1]
33.4-34.3	F430B	125[1]
34.4-40.9	F487B	150[1]
41.0-44.7	F567B	150[1]
44.8-51.0	F614B	175[1]
51.1-52.0	F658B	200[1]
52.1-55.4	F719B	200[1]
55.5-63.3	F772B	200[1]
63.4-66.1	F848B	200[1]
66.2-73.5	F914B	200[1]
73.6-82.2	F104C	200[1]
82.3-90.0	F114C	200[1]

Size 3 (Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	Maximum Fuse Rating
28.8-32.0	F357B	110
32.1-34.2	F395B	125
34.3-36.7	F430B	125
36.8-43.9	F487B	150
44.0-46.6	F567B	175
46.7-52.6	F614B	175
52.7-55.6	F658B	200
55.7-58.7	F719B	225[1]
58.8-67.1	F772B	225[1]
67.2-70.6	F848B	250[1]
70.7-76.3	F914B	275[1]
76.4-88.7	F104C	300[1]
88.8-93.4	F114C	350[1]
93.5-105	F118C	350[1]
106-114	F133C	400[1]
115-128	F149C	400[1]
129-131	F161C	400[1]
132-135	F174C	400[1]

Size 5 – 300:15CT (Standard and Ambient Comp.)

Motor Full-Load Amps 3-Ph, 3 Heater	Heater Number CR123	Maximum Fuse Rating
109-118	C592A	600
119-128	C630A	600
129-138	C695A	600
139-155	C778A	600
156-168	C867A	600
169-184	C955A	600
185-200	C104B	600
201-221	C113B	600
222-237	C125B	600
238-262	C137B	600
263-270	C151B	600

Electronic overload table for fusible controllers
Tripping current is 120% of Dial setting. Motors with 1.15-1.25 service factor, set dial to motor FLA Motors with 1.0 service factor, set dial to 0.9 motor FLA.

NEMA Size	FLA Range in Amps	Catalog Number	Max. Fuse in Amps	
1	0.8 to 1.59	CR324CXD	Class R 30	Class J 60
1	1.6 to 3.19	CR324CXE		
1	3.2 to 6.49	CR324CXF		
1	6.5 to 12.8	CR324CXG		
1	13 to 27	CR324CXH		
2	13 to 25.6	CR324DXG	60	100
2	26 to 49.9	CR324DXH		
2	50 to 100	CR324DXJ		
3	17 to 34.9	CR324FXK	100	200
3	35 to 64.9	CR324FXL		
3	65 to 90	CR324FXM		
4	17 to 34.9	CR324FXK	200	400
4	35 to 64.9	CR324FXL		
4	65 to 135	CR324FXM		
5[1]	32 to 64.0	CR324GXN	400	600
5[1]	65 to 129.9	CR324GXP		
5[1]	130 to 270	CR324GXQ		
6[2]	130 to 259.9	CR324HXS	600	Class L 1200
6[2]	260 to 540	CR324HXT		

Additional motor overload protection required for MM200 abd MM300 relay applications with FLA less than 6A.

Heaters for NEMA size 6 and 7 fused controllers
For continuous-rated motors with a service factor of 1.15 to 1.25, select the appropriate heaters for the motor full-load current. For continuous-rated motors with a service factor of 1.0, multiply the motor full-load current by 0.9 and use this value to select heaters.

Overload relay tripping current in 40° C ambient is the minimum value of full-load current multiplied by 1.25. Provide short-circuit protection in accordance with the National Electrical Code

Opening of the circuit breaker or power fuse may be an indication that a fault current has been interrupted. To provide continued protection against fire or shock hazard, examine all current-carrying parts and other components of the motor controller and replace any damaged components. If heater burnout occurs, the complete overload relay must be replaced.

Overload heaters for controllers with NEMA Size 6 starters for standard and ambient-compensated ratings, CT ratio 600:5.

Maximum Motor Full-Load Current	Current Transformer Secondary Amps	Heater Number CR 123
181-197	1.51-1.64	C220A
198-214	1.65-1.78	C239A
215-238	1.79-1.98	C268A
239-258	1.99-2.15	C301A
259-290	2.16-2.42	C326A
291-346	2.43-2.88	C356A
347-387	2.89-3.22	C379A
388-423	3.23-3.53	C419A
424-467	3.54-3.89	C466A
468-516	3.90-4.30	C526A
517-540	4.31-4.50	C592A

Overload heaters for controllers with NEMA Size 7 starters for standard and ambient-compensated ratings, CT ratio 800:5.

Maximum Motor Full-Load Current	Current Transformer Secondary Amps	Heater Number CR 123
346-387	2.16-2.42	C326A
388-461	2.43-2.88	C356A
462-515	2.89-3.22	C379A
516-565	3.23-3.53	C419A
566-622	3.54-3.89	C466A
623-688	3.90-4.30	C526A
689-763	4.31-4.77	C592A
764-810	4.78-5.06	C630A

Electronic overload for circuit breaker and fused controllers

The tripping current is 120% of the dial setting. For continuous-rated motors with a service factor of 1.15 to 1.25, set the dial to the motor full-load current. For continuous-rated motors with a service factor of 1.0, set the dial to 0.9 of the motor full-load current. Refer to GEH-6430 or 6431 before energizing.

Opening of the branch-circuit protective device may be an indication that a fault current has been interrupted. To provide continued protection against £re or shock hazard, examine all current-carrying parts and other components of the motor controller and replace any damaged components. If heater burnout occurs, the complete overload relay must be replaced.

Provide short-circuit protection in accordance with NEC Article 430 or CE Code Part 1.

Tripping current is 120% of Dial setting. Motors with 1.15-1.25 service factor, set dial to motor FLA Motors with 1.0 service factor, set dial to 0.9 motor FLA.

Catalog numbers of electronic overloads for various sizes of NEMA starters and current ranges.

NEMA Size	FLA Range in Amps	Catalog Number	Breaker Frame and Type
1	0.8 to 1.59	CR324CXD	E Mag. and Thermal Mag.
1	1.6 to 3.19	CR324CXE	E Mag. and Thermal Mag.
1	3.2 to 6.49	CR324CXF	E Mag. and Thermal Mag.
1	6.5 to 12.8	CR324CXG	E Mag. and Thermal Mag.
1	13 to 27	CR324CXH	E Mag. and Thermal Mag.
2	13 to 25.6	CR324DXG	E Mag. and Thermal Mag.
2	26 to 49.9	CR324DXH	E Mag. and Thermal Mag.
2	50 to 100	CR324DXJ	E Mag. and Thermal Mag.
3	17 to 34.9	CR324FXK	E Mag. and Thermal Mag.
3	35 to 64.9	CR324FXL	E Mag. and Thermal Mag.
3	65 to 90	CR324FXM	E Mag. and Thermal Mag.
4	17 to 34.9	CR324FXK	E,F and G Mag. and Thermal Mag.
4	35 to 64.9	CR324FXL	E,F and G Mag. and Thermal Mag.
4	65 to 135	CR324FXM	E,F and G Mag. and Thermal Mag.
5[1]	32 to 64.0	CR324GXN	G Mag. and Thermal Mag.
5[1]	65 to 129.9	CR324GXP	G Mag. and Thermal Mag.
5[1]	130 to 270	CR324GXQ	G Mag. and Thermal Mag.
6[2]	130 to 259.9	CR324HXS	E,F and G Mag. and Thermal Mag.
6[2]	260 to 540	CR324HXT	K Mag. and Thermal Mag

Catalog numbers of electronic overloads for various sizes of NEMA starters and current ranges

NEMA Size	FLA Range in Amps	Catalog Number	Max. Fuse in Amps	
1	0.8 to 1.59	CR324CXD	Time-Delay Class RandJ 30	Time-Delay Class J 60
1	1.6 to 3.19	CR324CXE		
1	3.2 to 6.49	CR324CXF		
1	6.5 to 12.8	CR324CXG		
1	13 to 27	CR324CXH		
2	13 to 25.6	CR324DXG	60	100
2	26 to 49.9	CR324DXH		
2	50 to 100	CR324DXJ		
3	17 to 34.9	CR324FXK	100	200
3	35 to 64.9	CR324FXL		
3	65 to 90	CR324FXM		
4	17 to 34.9	CR324FXK	200	400
4	35 to 64.9	CR324FXL		
4	65 to 135	CR324FXM		
5[1]	32 to 64.0	CR324GXN	400	600
5[1]	65 to 129.9	CR324GXP		
5[1]	130 to 270	CR324GXQ		
6[2]	130 to 259.9	CR324HXS	600	Class L 1200

IEC style overload relays
C2000 contactor CLNCJ type RT overload relay for 1/2X starter

Current Range	Max CB	Cat. No.	Class	Cat. No.	Class	Lug/ Wire Size	Torque (in-lbs)
0.4-.65	15	RTN1D	10	RT12D	20	#14-8	14-20
0.65-1.1	15	RTN1F	10	RT12F	20	#14-8	14-20
1-1.5	15	RTN1G	10	RT12G	20	#14-8	14-20
1.3-1.9	15	RTN1H	10	RT12H	20	#14-8	14-20
1.8-2.7	15	RTN1J	10	RT12J	20	#14-8	14-20
2.5-4.1	15	RTNIK	10	RT12K	20	#14-8	14-20
4.0-6.3	15	RTNIL	10	RT12L	20	#14-8	14-20
5.5-8.5	15	RTNIM	10	RT12M	20	#14-8	14-20
8.0-12	30	RTNIN	10	RT12N	20	#14-8	14-20
10.0-16	35	RTNIP	10	RT12P	20	#14-8	14-20
14.5-18	40	RTNIS	10	RT12S	20	#14-8	14-20
17.5-22	50	RTNIT	10	RT12T	20	#14-8	14-20

AF-600 FP / AF-650 GP Drives E9000 Panel mount use with RTXP base adapter

Contactor	Cat. No. Class 10	Cat. No. Class 20	FLA Range	Lug/ Wire Size	Torque (in-lbs)
LAR02AJ	RTN1B	NA	0.16-0.26	#14-8 AWG	14-20
LAR25AJ	RTN1C	NA	0.27-0.41	#14-8 AWG	14-20
LAR45AJ	RTN1D	RT12D	0.42-0.65	#14-8 AWG	14-20
	RTN1F	RT12F	0.66-1.10	#14-8 AWG	14-20
	RTN1G	RT12G	1.11-1.50	#14-8 AWG	14-20
	RTN1H	RT12H	1.51-1.90	#14-8 AWG	14-20
	RTN1J	RT12J	1.91-2.5	#14-8 AWG	14-20
	RTN1K	RT12K	2.51-4.10	#14-8 AWG	14-20
	RTN1L	RT12L	4.11-6.3	#14-8 AWG	14-20
	RTN1M	RT12M	6.31-8.5	#14-8 AWG	14-20
	RTN1N	RT12N	8.51-12.0	#14-8 AWG	14-20
	RTN1P	RT12P	12.1-16	#14-8 AWG	14-20
	RTN1S	RT12S	16.1-18	#14-8 AWG	14-20
	RTN1T	RT12T	18.1-22	#14-8 AWG	14-20
	RTN1U	RT12U	22.1-26	#14-8 AWG	14-20
	RTN1V	RT12V	26.1-32	#14-8 AWG	14-20
	RTN1W	RT12W	32.1-40	#14-8 AWG	14-20
LAR08AJ	RTN2A	NA	11.5-15	#10-3 AWG	50

Mount direct to contactor

Contactor	Cat. No. Class 10	Cat. No. Class 20	FLA Range	Lug/ Wire Size	Torque (in-lbs)
LAR08AJ	RTN2B	NA	15.1-19	#10-3 AWG	50
LAR10AJ	RTN2C	NA	19.1-25	#10-3 AWG	50
	RTN2D	RT22D	25.1-32	#10-3 AWG	50
	RTN2E	RT22E	32.1-43	#10-3 AWG	50
	RTN2G	RT22G	43.1-55	#10-3 AWG	50
	RTN2H	RT22H	55.1-65	#10-3 AWG	50
	RTN2J	RT22H	65.1-82	#10-3 AWG	50
	RTN2L	RT22L	82.1-97	#10-1 AWG	50
	RTN2M	RT22M	97.1-110	#10-1 AWG	50
KAR08CJ	RTN3B	NA	55-80	#6-250 MCM	275
	RTN3C	RT32C	80.1-90	#6-250 MCM	275
	RTN3D	RT32D	90.1-120	#6-250 MCM	275
	RTN3E	RT32E	120.1-140	#6-250 MCM	275
	RTN3F	RT32F	140.1-190	#6-250 MCM	275
KAR95BYWZ	RTN4N	NA*	120-190	#6-350MCM	200
	RTN4P	NA*	190.1-280	#6-350MCM	200
	RTN4R	NA*	280.1-310	#6-350MCM	200
KAR95BJWZ	RTN4N	NA*	120-190	#6-350MCM	200
	RTN4P	NA*	190.1-280	#6-350MCM	200
	RTN4R	NA*	280.1-310	#6-350MCM	200
KAR10BYWZ	RTN5A	NA*	120-190	#6-350MCM	375
KAR11BYWZ	RTN5B	NA*	190.1-280	#6-350MCM	375
KAR11BJWZ	RTN5B	NA*	190.1-280	#6-350MCM	375
KAR12BJWZ	RTN5C	NA*	280.1-400	#6-350MCM	375
KAR12BYWZ	RTN5C	NA*	280.1-400	#8-500 MCM	375
	RTN5D	NA*	400.1-500	#8-500 MCM	375
	RTN5E	NA*	500.1-650	#8-500 MCM	375

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DEH-40472 Rev 9 August 2020