

# Model 6 Motor Control Centers

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by Schneider Electric



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## Product Description

### Introduction



Motor control centers (MCCs) provide the most suitable method for grouping electrical motor control, automation, and power distribution in a compact and economical package. Motor control centers consist of totally enclosed, dead front, free-standing structures bolted together. These sections support and house control units, a common bus bar for distributing power to the control units, and a network of wire trough and conductor entrance areas for accommodating incoming and outgoing load and control wires.

The control units consist of components such as combination motor starters, branch feeder devices, AC drives, soft starts, or lighting panelboards. Each unit is mounted in an individual, isolated compartment having its own door. Standard MCC dimensions are 20 in. wide (including a 4 in. vertical wireway trough) by 90 in. high (add 1.5 in. base channel and a 3 in. removable top lifting channel) by 15 or 20 in. deep. Larger sections are often required for mounting larger equipment or for providing space for customer-mounted devices.

Two package styles are available: standard and industrial. These Model 6 feature packages allow you to custom design the MCC to fit your specific requirements. The standard package lets you tailor the MCC by selecting only those options that you need for an individual project, guaranteeing the optimal cost/value balance. The industrial package includes options most often requested and specified by industrial customers. Offering the options as part of a package reduces the possibility of leaving out common industrial features. See the following table for a comparison of the two packages.

Option	Standard Package	Industrial Package
<b>Structure Features</b>		
Vertical ground bus material	Steel	Copper
Horizontal bus material	Tin-plated aluminum <sup>1</sup>	Tin-plated copper
Fishtape barriers	Optional	Included
<b>Unit Features</b>		
Interior color	Gray	White
Nameplates	Optional	Included
X1 and X2 wired to terminal blocks	Optional	Included

<sup>1</sup> Exceptions: 1600–2500 A are tin plated copper.

All features of the industrial package can be added individually to the standard version.

**Features**



**Sliding Bus Barriers**

- Horizontal power bus is located at the top of the structure for easy installation, inspection, and maintenance without the need to remove units.
- Non-conductive, two-piece, sliding, horizontal bus barrier provides convenient access for splicing and maintenance without the need to remove the panels.
- Captive, four-bolt, horizontal splice bars with self-contained nuts and hardware make installation easy and reduce the possibility of splice bar loss.



**Full Depth Vertical Wireway (Right-Side View)**

- A full-depth vertical wireway maximizes the wire pulling area. The Model 6 MCC has the largest vertical wireway in the industry.
- Vertical bus barriers and wireway openings, when supplied, are built in 3 in. increments. This feature allows more mounting flexibility for the units and reduces wasted space in the enclosure.
- Vertical ground bus is located in each section. This bus mates with ground stabs on the rear of each plug-on unit to create a positive ground connection, with first make/last break operation.



**Structural Integrity**

- Frame is constructed with 12-gauge steel, and features welded corner channels for exceptional structural rigidity.
- Leveling notches in the base channel provide a means of aligning the section during installation.



**Innovative**

- Cast metal handle, an industry-exclusive feature, is more rugged than composites, and clearly indicates disconnect status, including a 'tripped' circuit breaker, for added safety.
- Quarter-turn fasteners on unit and wireway doors expedite closing and opening.
- L-shaped unit door hinge pins are easily removed with a screwdriver for general maintenance.



**Shrouded Power Stabs**

- Each unit is fully compartmentalized, with solid side, back, and bottom plates. This feature allows more mounting space for components and confines any potential faults within the individual unit.
- A hinged, or fold-down, unit bottom plate allows additional space for wiring and maintenance.
- Shrouded power stabs protect stabs against damage during unit maintenance, and provide a self-aligning system for installation of units and connection to the vertical bus.



**Codes and Standards**



Model 6 Motor Control Centers are manufactured to National Electrical Manufacturers Association (NEMA) Standard ICS 18-2001 and Electrical Equipment Manufacturers Association of Canada (EEMAC) standards. Model 6 MCCs are also manufactured to Underwriters Laboratories (UL) Standard 845 and bear the “UL Listed” label, where applicable. The “UL Listed” mark is applied to vertical sections and units that are installed within those sections. It should be noted that sections and installed units are independently listed devices. Thus, it is possible to have non-UL Listed units installed in UL Listed vertical sections.

All sections and units listed in this catalog are UL Listed, unless otherwise noted. The Model 6 MCC meets Canadian Standards Association (CSA) specification standards and can carry the CSA label.

**Certification**



Model 6 Motor Control Centers are certified by the American Bureau of Shipping (ABS) for use in power distribution, control, and protection of motor and non-motor loads for multiple applications on board ABS Classed Vessels, Offshore Rigs and Platforms, and Marine applications. ABS develops and verifies conformance with standards for design, construction, and operational maintenance of marine-related facilities. Many customers require ABS certification for products used by and for marine facilities. The certification granted by ABS includes classification of use of the motor control center for both Essential and/or Non-Essential Services.

**NEMA/EEMAC Wiring Classes and Enclosure Types**

**Wiring Classes**

Class 1—Independent Units

Class 1 motor control centers consist of mechanical groupings of combination motor control units, branch feeders, other units, and electrical devices arranged in a convenient assembly. The manufacturer completes wiring between components within each unit. Wiring between units is not required.

Class 2—Interconnected Units

Class 2 MCCs are the same as Class 1 MCCs with the addition of manufacturer-furnished electrical interlocking and wiring between units as specifically described in the overall control system diagrams supplied by the purchaser.

Type A

User (field) wiring connects directly to device terminals internal to the unit. Type A wiring is provided only on Class 1 MCCs.

Type B

User (field) control wiring connects to unit terminal block(s) in or adjacent to each motor control unit. User load (power) wiring for Size 3 or smaller combination motor control units connects as follows:

Type B-D

User load (power) wiring connects directly to the device terminals, which are located immediately adjacent to, and are readily accessible from, the vertical wireway.

Type B-T

User load (power) wiring connects to factory-wired power terminal blocks located in or adjacent to each unit.

User load (power) wiring for Size 4 or larger combination motor control units and branch feeder units connects directly to the unit device terminals.



**Control Terminal Block**

Type C

User (field) control wiring and load wiring on Size 3 or smaller motor control units connects to master terminal blocks mounted at the top or bottom of those vertical sections containing control units. Unit control wiring and load wiring on Size 3 or smaller units are factory-wired from unit-located terminal blocks to the master terminal blocks.

User load (power) wiring for Size 4 or larger units connects directly to the device terminals. As an option, user load (power) wiring for all sizes of motor control units may connect directly to the device terminals within the MCC units. See page 85 for load wiring options.

**Enclosure Types**

Type 1

Intended for indoor use only. Type 1 enclosures are designed primarily to provide protection against contact with energized equipment inside. They are to be used in locations where normal service conditions exist.

Type 1A (Gasketed)

Intended to restrict the entrance of dust and falling dirt into Type 1 enclosures. Type 1A enclosures are **not** dust-tight. Neoprene gasketing is the standard material used.

Type 3R

Intended for outdoor use only. Type 3R enclosures are designed primarily to provide protection against falling rain and sleet and remain undamaged by the formation of ice on the enclosure. They are **not** intended to provide protection against conditions such as dust, internal condensation, internal icing, or extreme heat or cold. The Model 6 Type 3R enclosure is built with galvanized steel, which provides a high level of resistance to corrosion when compared to standard hot or cold rolled steel with the same paint finish.

Type 12

Intended for indoor use only. Type 12 enclosures are designed primarily to protect against dust, falling dirt, light splashing, and dripping of non-corrosive liquid. They are not intended to provide protection against conditions such as internal condensation.

**Shipping Weights**

One, two, or three vertical sections can be shipped together on a pallet. Larger MCCs are split into shipping blocks of three sections maximum. The following table lists typical approximate shipping weights for a normal mix of MCC equipment. Some sections, based on installed devices and width of the section, may vary from values shown in the table.

**Approximate MCC Shipping Weights**

NEMA/EEMAC Enclosure Type	Depth (inches)	1 Section (lbs)	2 Sections (lbs)	3 Sections (lbs)
1, 1A, 12	15	600	1200	1800
3R Non-Walk-In	15 <sup>1</sup> (27.2 in. overall)	900	1800	2700
1, 1A, 12	20	750	1500	2250
3R Non-Walk-In	20 <sup>1</sup> (32.2 in. overall)	1050	2100	3150

<sup>1</sup> See the NEMA/EEMAC 3R dimensions drawing on page 108.

**Altitude Ratings / Heat Dissipation**

**Altitude Ratings**

The following table lists the MCC derating factors necessary at altitudes of 6,600 ft (2,000 m) and higher.

Altitude	Altitude Rating Correction Factors <sup>1</sup>		
	Full Load Current	System Voltage	Ambient Temperature
6,600 ft (2,000 m)	1.0	1.0	1.0
8,500 ft (2,600 m)	0.99	0.95	1.0
13,000 ft (3,900 m)	0.96	0.80	0.95
14,000 ft (4,300 m)	0.95	0.80	0.90
15,000 ft (4,600 m)	0.93	0.80	0.85

<sup>1</sup> For variable frequency drives above 3,300 ft (1,000 m), derate the output current rating by 1% for each additional 330 ft (100 m) up to a maximum of 9,900 ft (3000 m).

For solid state reduced voltage starters above 3,300 ft (1,000 m), derate the nominal output current by 2.2% for each additional 330 ft (100 m) up to a maximum of 6,600 ft (2,000 m).

**Motor Control Center Heat Dissipation**

The following table lists the approximate heat dissipation of various MCC units. This information is often requested by engineers who are sizing HVAC equipment to cool and ventilate equipment rooms. Values include an estimate of heat dissipated by the MCC Power Bus. To use, add the values for each of the units in the MCC. Values are given in BTUs per hour and watts.

The values given are for "typical" applications, and include an adjustment for power bus contribution. Make the following adjustments for special situations:

- Add 10–20 percent to the total heat dissipation for MCCs that make extensive use of relays, timers, and other control devices.
- Add 10 percent to the total heat dissipation for MCCs with 1200–1600 A main bus.
- Add 20 percent to the total heat dissipation for MCCs with 2000–2500 A main bus.

**Typical Heat Dissipation Values<sup>1</sup>**

Description	Size/Rating	Heat Dissipation	
		BTUs/hr	Watts
Combination Starters (Circuit Breaker or Fusible Disconnect)	1	270	79
	2	360	106
	3	720	210
	4	1440	420
	5	2400	700
Main and Branch Feeder Breakers	15–150 A	270	79
	175–250 A	720	210
	300–400 A	780	230
	500–600 A	1320	390
	700–800 A	2220	650
	900–1200	5802	1700
	1600 A	8020	2350
	2000 A	12,628	3700
	2500 A	27,815	8150
Main and Branch Feeder Switches	30 A	126	37
	60 A	156	46
	100 A	282	85
	200 A	780	230
	400 A	1020	300
	600 A	2047	600
	800 A	3242	950
	1200 A	8874	2600
	1600 A	15,529	4550
	2000 A	24,232	7100

<sup>1</sup> For programmable logic controllers, unit heat dissipation can be significant. Contact the MCC Technical Assistance Group (TAG) for the heat dissipation of these devices.

**Typical Heat Dissipation Values (Continued)**

Description	Motor Rated HP @ 480V	Heat Dissipation					
		BTUs/hr			Watts		
		Drive	Line Reactor 3% / 5%	Load Reactor or Filter	Drive	Line Reactor 3% / 5%	Load Reactor or Filter
Combination Altivar 61 AC drives (variable torque rated)	1	150	27 / 41	255	44	8 / 12	75
	2	150	48 / 48	255	45	14 / 14	75
	3	218	68 / 68	273	64	20 / 20	80
	5	389	99 / 89	307	119	29 / 26	90
	7.5	491	106 / 140	324	144	31 / 41	95
	10	608	147 / 147	324	178	43 / 43	95
	15	741	177 / 208	375	217	52 / 61	110
	20	1092	180 / 180	444	320	53 / 53	130
	25	1338	184 / 184	444	392	54 / 54	130
	30	1662	212 / 222	461	487	62 / 65	135
	40	2447	229 / 242	495	717	67 / 71	145
	50	3331	246 / 276	870	976	72 / 81	255
	60	4301 <sup>1</sup>	— / 328	870	1260 <sup>1</sup>	— / 96	255
	75	4928 <sup>1</sup>	— / 369	836	1444 <sup>1</sup>	— / 108	245
	100	5690 <sup>1</sup>	— / 614	921	1667 <sup>1</sup>	— / 180	270
	125	8447 <sup>1</sup>	— / 470	887	2475 <sup>1</sup>	— / 138	260
	150	11002 <sup>1</sup>	— / 498	904	3224 <sup>1</sup>	— / 146	265
	200	13016 <sup>1</sup>	— / 747	990	3814 <sup>1</sup>	— / 219	290
	250	14676 <sup>1</sup>	— / 1197	1109	4300 <sup>1</sup>	— / 351	325
	300	17450 <sup>1</sup>	— / 2682	1024	5113 <sup>1</sup>	— / 786	300
	350	19717 <sup>1</sup>	— / 2560	1535	5777 <sup>1</sup>	— / 750	450
	400	22931 <sup>1</sup>	— / 2491	1621	6719 <sup>1</sup>	— / 730	475
	450	24665 <sup>1</sup>	— / 2642	—	7227 <sup>1</sup>	— / 774	—
	500	52927 <sup>1</sup>	— / 2379	—	8281 <sup>1</sup>	— / 697	—
Combination Altivar 71 AC drives (constant torque rated)	1	150	27 / 41	255	44	8 / 12	75
	2	218	48 / 48	255	64	14 / 14	75
	3	297	68 / 68	273	87	20 / 20	80
	5	492	99 / 89	307	144	29 / 26	90
	7.5	608	106 / 140	324	178	31 / 41	95
	10	741	147 / 147	324	217	43 / 43	95
	15	1092	177 / 208	375	320	52 / 61	110
	20	1338	180 / 180	444	392	53 / 53	130
	25	1659	184 / 184	444	486	54 / 54	130
	30	2447	212 / 222	461	717	62 / 65	135
	40	3331	229 / 242	495	976	67 / 71	145
	50	4253 <sup>1</sup>	— / 276	870	1246 <sup>1</sup>	— / 81	255
	60	4936 <sup>1</sup>	— / 328	870	1446 <sup>1</sup>	— / 96	255
	75	5607 <sup>1</sup>	— / 369	836	1643 <sup>1</sup>	— / 108	245
	100	5446 <sup>1</sup>	— / 470	921	2475 <sup>1</sup>	— / 138	270
	125	8774 <sup>1</sup>	— / 498	887	2571 <sup>1</sup>	— / 146	260
	150	9638 <sup>1</sup>	— / 747	904	2824 <sup>1</sup>	— / 219	265
	200	10205 <sup>1</sup>	— / 1197	990	2990 <sup>1</sup>	— / 351	290
	250	14146 <sup>1</sup>	— / 2242	1109	4145 <sup>1</sup>	— / 657	325
	300	17877 <sup>1</sup>	— / 2229	1024	5238 <sup>1</sup>	— / 653	300
	350	18556 <sup>1</sup>	— / 2160	1535	5437 <sup>1</sup>	— / 633	450
	400	21279 <sup>1</sup>	— / 2449	1621	6235 <sup>1</sup>	— / 716	475
	450	24719 <sup>1</sup>	— / 2058	—	7243 <sup>1</sup>	— / 603	—
	Description	Soft Start Frame	Heat Dissipation				
BTUs/hr			Watts				
Combination Altistart 48 Soft Start (includes shorting contactor as standard)	10	51		15			
	15	51		15			
	20	85		25			
	25	85		25			
	30	85		25			
	40	85		25			
	50	85		25			
	60	85		25			
	75	85		25			
	100	85		25			
	125	85		25			
	150	171		50			
	200	171		50			
	250	171		50			
	300	273		80			
	350	273		80			
400	273		80				
500	273		80				

<sup>1</sup> A 3% line reactor is standard in these drive sizes.

**Structure Steel Gauge Information**

Model 6 MCCs are totally enclosed, dead front, free standing assemblies. All steel is in compliance with UL 845/CSA requirements:

<b>Part Description</b>	<b>Thickness (Gauge)</b>
Corner Channels	12
Back Plates: 20–30 in. wide	16
35 in. wide	14
End Closing Plates	16 (NEMA/EEMAC Type 3R: 12 gauge)
Unit Doors	14 and 16 (NEMA/EEMAC Type 3R: 12 gauge on outer door)
Side Channels	11
Top and Bottom Frame	12
Top and Bottom Plates	14
Base Channels	10
Lifting Angle	7

## Application and General Information

### Structures and Bussing



#### Structure

Each section provides 72 in. of vertical mounting space for MCC units. Special sections are required for selected units such as autotransformer starters and some main breakers, drives, and soft starters.

NEMA/EEMAC Enclosure Type	Depth
General Purpose Type 1	15 in. - Standard 20 in. - Optional
General Purpose Type 1 Gasketed (often referred to as Type 1A)	
Industrial Duty Type 12	
Outdoor Duty Type 3R Non-Walk-In	
Outdoor Duty Type 3R Walk-In (Contact the Project Support and Engineering Center in Nashville.)	

#### Main Bus Amps and Material <sup>1</sup>

600 A tin-plated aluminum	1200 A silver-plated copper
600 A tin-plated copper	1600 A tin-plated copper (20 in. deep only)
600 A silver-plated copper	1600 A silver-plated copper (20 in. deep only)
800 A tin-plated aluminum	2000 A tin-plated copper (20 in. deep only)
800 A tin-plated copper	2000 A silver-plated copper (20 in. deep only)
800 A silver-plated copper	2500 A tin-plated copper <sup>2</sup>
1200 A tin-plated aluminum	2500 A silver-plated copper <sup>2</sup>
1200 A tin-plated copper	

**NOTE:** For 3-phase, 4-wire systems, see page 26.

- Ratings shown based on 149 ° F (65 ° C) max. temperature rise per UL 845. Consult the MCC Technical Assistance Group (TAG) for current density ratings.
- Not available in NEMA/EEMAC Type 12 or 3R enclosures.



Horizontal Bus Splice

### Bussing Options and Modifications

#### Description

Bus bar surge protection. Requires 6 in. mounting space near the incoming feeder. Not UL Listed. Not for use on ungrounded systems.	
300 A vertical bus – tin-plated copper (Standard)	
Substitute 600 A vertical bus – tin-plated copper	
Substitute 600 A vertical bus – silver-plated copper	
4 bolt splice (captive) on main/horizontal bus (Standard)	
Bus Withstand Rating	42,000 A rms (Standard)
Modifications to increase the bus system withstand rating to meet available fault current requirements. <b>Does not increase individual unit ratings.</b>	65,000 A rms
	85,000 A rms
	100,000 A rms <sup>1</sup>
Tin-plated copper vertical ground bus	
Tin-plated copper horizontal ground bus - 1/4 in. x 1 in., rated 300 A (Standard)	
Tin-plated copper horizontal ground bus - 1/4 in. x 2 in., rated 600 A <sup>2</sup>	
Silver-plated copper horizontal ground—1/4 in. x 1 in. (rated 300 A)	
Silver-plated copper horizontal ground—1/4 in. x 2 in. (rated 600 A)	
Optional 2 in. main/horizontal bus – tin-plated copper <sup>2</sup>	
Optional 2 in. main/horizontal bus – silver-plated copper	
Insulated horizontal bus (Non-UL Listed)	Standard section (600–1600 A)
	Main lug section (600–1600 A)
	Main circuit breaker/fusible switch section (600–1600 A)

<sup>1</sup> 480 V maximum

<sup>2</sup> Standard on 2500 A horizontal bus

Structure Options and Modifications

Description			
12 in. high pull box			
18 in. high pull box			
Two-piece top plate			
Bottom plate for NEMA/EEMAC Type 1 Gasketed			
Drip hood (Not available with 2500A horizontal bus)			
Strip heater (200 Watts at 120 V) (Not available in sections with Size 6 RVAT, bottom feed main lugs, bottom feed mains and branches over 600 A, or distribution transformers)			
Thermostat for control of strip heater (6 heaters maximum)			
Seismic certification			
Reduced height construction:			
Structure height including base channels (without lifting angles):	79.5 in.	73.5 in.	67.5 in.
Available unit mounting space:	60 in.	54 in.	48 in.
Amount section shortened:	12 in.	18 in.	24 in.
Application: Not available on back-to-back, corner, NEMA/EEMAC Type 3R, or sections with neutral bussing. Reduced height construction reduces the section's unit mounting space and does not reduce either the top or bottom horizontal wireway.			
Wire tie retainers in vertical wireway			
Manual vertical bus barrier closing shutters (Standard)			
Automatic vertical bus shutters			
Non-standard exterior color (includes one coat of Schneider Electric selected paint.) <b>Consult factory for specifications detailing primers, paint, thickness, and application process.</b>			
Fishtape barrier (Prevents rising of bottom-entering fishtapes into wireway. Standard on Industrial.)			
Rodent barriers (Standard)			
GFI receptacle (NEMA/EEMAC Type 3R Non-Walk-In)			
Fluorescent light (NEMA/EEMAC Type 3R Non-Walk-In)			



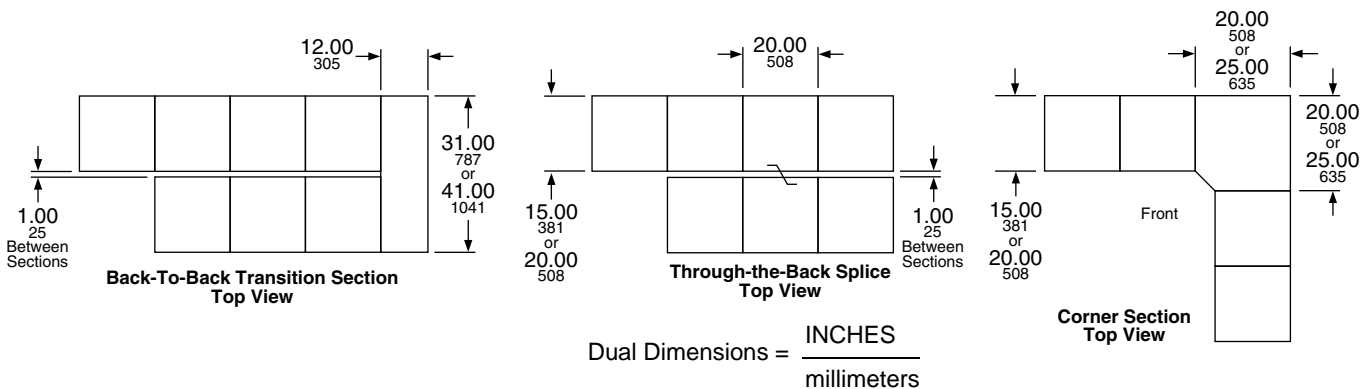
Automatic Vertical Bus Shutter

Special Structures

Not available in NEMA/EEMAC Type 3R construction or reduced height sections.

Description	Application
Back-to-back splice transition section	2500 A Max.
Through-the-back splice <sup>1</sup>	1200 A Max.
Corner Sections	2500 A Max.

<sup>1</sup> Tin plated copper splice standard. Not available with neutral bus or relay sections.



**Model 6 to Model 5 Transition Section**

Model 6 MCCs will splice directly to a Model 5 MCC, provided the Model 5 structure was built after May 1992.

If the Model 5 MCC was built prior to May of 1992, contact the MCC Technical Assistance Group (TAG). Custom splice plates will be required and supplied with the first section in the Model 6 line-up depending on which side of the existing Model 5 line-up the Model 6 is installed.

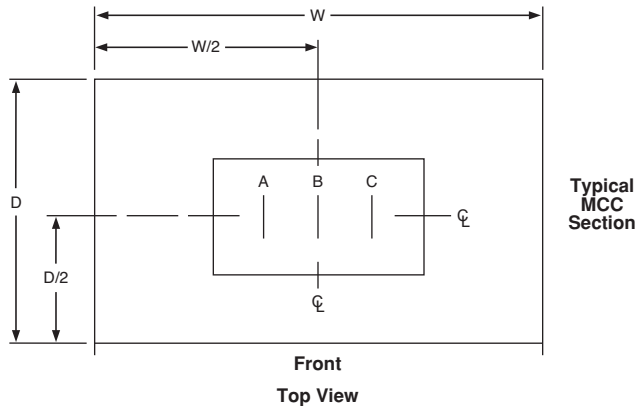
**Switchboard to Model 6 Transition Section**

Square D® brand Switchboards can be provided with bussed transitions to Model 6 Motor Control Center line-ups. Contact the MCC TAG for details.

**Bus Duct Connection**

I-Line® II feeder busway compartments must always be located at the top of the section. A 12 in. high pull box is required. I-Line II Busway should be positioned edgewise A, B, C, left-to-right as shown in the figure below. To facilitate installation, both front and side accessibility is recommended. **No additional mounting space is required.**

**NOTE:** Must be “I-Line II Feeder End” Style; Qwik Flange is **not** available. NEMA/EEMAC Type 3R is **not** available. Bus duct connections are **not** UL Listed in MCCs.



No Main Disconnect <sup>1</sup>				C/B Disconnect <sup>2</sup>				Fusible Main Disconnect <sup>2</sup>			
MCC Bus Ampacity	Width (In.)	Depth (In.)	Conn	MCC Mains Ampacity	Width (In.)	Depth (In.)	Conn	MCC Mains Ampacity	Width (In.)	Depth (In.)	Conn
600 A 800 A 1200 A	20	15 or 20	Bus	110–600 A	20	15 or 20	Cable	200–600 A	20	15 or 20	Cable
1600 A 2000 A	25 <sup>3</sup>	20	Bus	800–1200 A	20	20	Bus	800–1200 A	20	20	Bus
—	—	—	—	1600–2500 A	25	20	Bus	1600–2000 A	30	20	Bus

<sup>1</sup> With no main disconnect, the connection from busway to horizontal bus is made with main bus. A main lug compartment is not required.

<sup>2</sup> With a main disconnect, the connection from busway to disconnect is made with either cable or bus, depending on ampacity.

<sup>3</sup> A 25 in. wide section is a standard section with a 9 in. wireway and will accept plug-on units. A 72 in. unit mounting space is available. For 3P4W (left to right orientation), a 30 in. wide section is required. For 3P4W (front to rear orientation), a 25 in. wide section is required.



**Model 4 to Model 6 Transition Section**

**NOTE:** Not Available In NEMA/EEMAC Type 3R Construction

Provides transition from existing Model 4 to a new Model 6 MCC. The transition requires a 12 in. extension on the first section of the Model 6 lineup. A transition section does not affect the space calculation when estimating the number of sections. **The transition section must be ordered with at least one Model 6 section and cannot ship separately. The Model 6 ampacity must be equal to or less than the ampacity of the Model 4 bus. Neutral bus is not supported.**

**NOTE:** Splice bars are included with the transition section.

The transition section will match the depth of the Model 6 MCC, and can be used to splice a front-of-board Model 6 to an existing back-to-back Model 4 MCC (20 in. deep). The transition section will be rear aligned with both the Model 4 and the Model 6 sections. On 3-phase, 4-wire systems, the 3-phase bus bars will splice together, but the Model 4 neutral bus bar will not be carried through in the Model 6.

**NOTE:** When ordering a Model 4 to Model 6 transition section, you must provide the original Model 4 factory order number.

**Basic Transition <sup>1</sup>**


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Model 4 on left and Model 6 on right

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Model 6 on left and Model 4 on right

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<sup>1</sup> Includes 12 in. wide structure with 800 A bus as standard.

**Transition Bussing Modifications**

Model 4 Bus	Model 6 Bus
600 A Aluminum or Copper	600 A Copper
800 A Aluminum	800 A Copper
1000 A Aluminum (2) 2 in.	1200 A Copper
1200 A Aluminum (2) 3 in.	1200 A Copper
1000 A Aluminum (1) 4 in.	1200 A Copper
1200 A Copper (2) 2 in.	1200 A Copper
1000 A Copper (1) 3 in.	1200 A Copper
1200 A Copper (1) 4 in.	1200 A Copper
1400 A Aluminum (2) 4 in.	1600 A Copper
1600 A Copper (2) 3 in.	1600 A Copper
1800 A Copper (2) 4 in.	2000 A Copper
2000 A Copper (2) 4 in.	2000 A Copper

**Incoming Devices**



Incoming or main devices are used to connect power to the motor control center. In the majority of MCC applications, the system is rated as 480 V, 3-phase, 3-wire. If a neutral wire connection is required, a neutral kit can be supplied (see “3-Phase, 4-Wire Systems” on page 26).

Typically, one of three devices is used to connect power to the MCC: main lugs, main circuit breaker, or main fusible switch. One of these devices is connected to the horizontal main bus with cable or hard bus. Cabled or bussed branch devices or cabled starter units (those with an L, M, or P frame circuit breaker disconnect, or 600 A or larger fusible switch disconnect) cannot be installed in the same section as a main device.

As with all electrical equipment rated 600 V or less, incoming cables must be rated using the 75 °C temperature ratings tables in the National Electrical Code® (NEC®). The incoming lugs are 194° F (90 °C) lugs, and 194 °F (90 °C) cable can be used. However, the cable must be applied to the 75 °C ratings.

All main devices must be top- or bottom-located.

**Main Lug Compartments**

Main lug compartments must be specified in the absence of other incoming line provisions.

3-phase, 3-wire main lugs include neutral assembly for cable connection to other units with solid neutrals.

Main lug units short circuit current ratings to 100,000 A are available.

**Top Located Main Lug Compartments**

System	Amps	Space (Inches)	Horizontal Bus Connection	
3-phase, 3-wire	600 <sup>1</sup>	6	Bussed	
	800			
	1200	12		
	1600 <sup>2</sup>			
	2000 <sup>2</sup>			
2500 <sup>2</sup>	72			
3-phase, 4-wire		600 <sup>1</sup>		9
		800		
		1200 <sup>3</sup>		12
		1600 <sup>2</sup>		
	2000 <sup>2</sup>			
2500 <sup>2</sup>	72			

<sup>1</sup> Not available @ 100,000 A.

<sup>2</sup> 30 in. wide by 20 in. deep section

<sup>3</sup> 25 in. wide section with 9 in. wireway

**Bottom Located Main Lug Compartments**

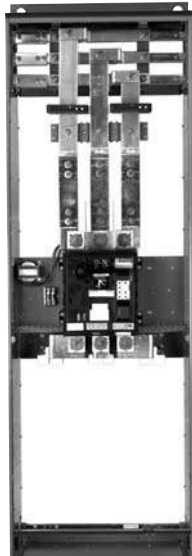
System	Amps	Space (Inches)	Horizontal Bus Connection
3-phase, 3-wire	600	18	Bussed
	1200 <sup>1</sup>	36	
	1600 <sup>2</sup>	72	
	2000 <sup>2</sup>		
	2500 <sup>2</sup>		
3-phase, 4-wire	600	18	
	1200 <sup>1</sup>	36	
	1600 <sup>2</sup>	72	
	2000 <sup>2</sup>		
	2500 <sup>2</sup>		

<sup>1</sup> 25 in. wide section with 9 in. wireway

<sup>2</sup> 30 in. wide by 20 in. deep section

**Main Circuit Breakers**

- Main circuit breaker units are located in 20 in. wide by 15 in. or 20 in. deep sections, except where noted. Mains must be mounted at the top or bottom of the MCC section.
- Thermal-magnetic, molded case circuit breakers are standard. Optional electronic trip circuit breakers are available as shown in the tables below.
- All units are for 3-phase, 3-wire systems. 3-phase, 4-wire applications may require additional space (see “3-Phase, 4-Wire Systems” on page 26).



Main Circuit Breaker

**Thermal-Magnetic, Molded Case Circuit Breakers**

Breaker Trip Ratings (Amps)	Breaker Frame (Amps)	Breaker Type	Unit Interrupting Rating (kA)			Space (Inches)
			208/240 V	480 V	600 V	
<b>Standard (80%) Rated</b>						
15-150	150	HG/HJ/HL	65	35	18	12 (Plug On)
			100	65	25	
			100	100	50	
175-250	250	JG/JJ/JL	65	35	18	18 (Plug On)
			100	65	25	
			100	100	50	
300-400	400	LH	65	35	25	21 (Top Entry)
	600	LI	100	100	100	27 (Bottom Entry)
450-600	600	LI	100	100	100	24 (Top Entry)
						36 <sup>1</sup> (Bottom Entry)
800	800	MJ	65	65	25	18 (Top Entry)
	1200	PL/PK	100	100	50	36 <sup>1</sup> (Bottom Entry)
1200	1200	PL/PK	100	100	50	21 (Top Entry) 36 <sup>1</sup> (Bottom Entry)
1600 <sup>2</sup>	3000	RL/RK	100	100	65	72 <sup>1</sup> (20 W X 20 D)
2000 <sup>2</sup>	3000	RL/RK	100	100	65	72 <sup>1</sup> (20 W x 20 D)
2500 <sup>2</sup>	3000	RL/RK	100	100	65	72 <sup>1</sup> (25 W x 20 D) NEMA/EEMAC Type 1/1A only
<b>Optional 100% Rated<sup>3</sup></b>						
300-400	400	LE	100	65	35	24 (Top Entry) 36 (Bottom Entry)
600	1200	PL/PK	100	100	50	18 (Top Entry) 36 <sup>1</sup> (Bottom Entry)
800	1200	PL/PK	100	100	50	21 (Top Entry) 36 <sup>1</sup> (Bottom Entry)
1200 <sup>2</sup>	1200	PL/PK	100	100	50	72 <sup>1</sup> (20 W x 20 D) NEMA/EEMAC Type 1/1A only
1600 <sup>2</sup>	3000	RL/RK	100	100	65	72 <sup>1</sup> (20 W x 20 D)
2000 <sup>2</sup>	3000	RL/RK	100	100	65	72 <sup>1</sup> (25 W x 20 D) NEMA/EEMAC Type 1/1A only

<sup>1</sup> Requires single shipping split.

<sup>2</sup> Specify top or bottom entry.

<sup>3</sup> All 100% rated circuit breakers are molded case with Micrologic electronic trip. LE electronic trip circuit breakers include Full Function Trip Unit with LSI tripping functions. P- and R-frame electronic trip circuit breakers include Basic 3.0 Trip Unit with LI tripping functions.

**Optional Masterpact Power Circuit Breaker Main Units—Stored Energy/Drawout Style/Insulated Case**

Masterpact NT and NW power circuit breakers are available in Model 6 Motor Control Centers as an incoming main device. The Masterpact NT/NW circuit breaker offered in the Model 6 MCC is a UL489 Listed insulated case circuit breaker with drawout style mounting. These circuit breakers contain a two-step stored energy mechanism which provides 5-cycle maximum closing in both manually and electrically operated types.

**NOTE:** Masterpact circuit breakers are rated at 80% of their capacity in MCC construction.

MCC drawout main circuit breaker include the following features:

- UL 845/CSA listed with UL 489 version
- Stored energy breaker mechanism
- Internal barriers for separating line, load, and control areas
- Micrologic trip units (Standard 5.0 included, 6.0P with Ground Fault optional).
- Modbus communications for Web-enabled power and control compatibility is optional
- Fully bussed power circuit
- Control compartment including trip unit power supply and additional panel space
- Optional Arc Flash version tested to show the arc flash hazard risk category referenced by NFPA 70E

All offered Masterpact circuit breakers are equipped with the Micrologic Electronic Trip System. In Model 6, two trip unit models are available: 5.0 Basic and 6.0 Power. The MCC Masterpact NT/NW main circuit breaker comes with Basic 5.0 trip units as standard, with LSI tripping functions: long-time trip, long-time trip delay adjustments, short-time trip, short-time trip delay adjustment, and instantaneous trip. The optional 6.0P Micrologic trip unit offers LSIG tripping functions: long-time trip, long-time trip delay adjustments, short-time trip, short-time trip delay adjustments, instantaneous trip, ground fault trip, and ground fault trip delay adjustment.

**Main Circuit Breaker Unit Interrupting Ratings per UL 845/CSA**

<b>Circuit Breaker Type (Interrupting Rating Code)</b>	<b>240 V Delta</b>	<b>480 V Delta or Wye</b>	<b>600 V Delta or Wye</b>
800-1200 A NT (H)	65	50	50
800-1200 A NT (L1)	100	65 <sup>1</sup>	—
800-2500 A NW (N)	65	65	50
800-2500 A NW (H)	100	100	65
800-2500 A NW (L)	100	100	65

<sup>1</sup> 100 kA interrupting rating is available by ordering optional Arc Flash (LF) version.

Masterpact Main Circuit Breakers

Breaker Frame	Unit Type and Amps	MCC Unit Short Circuit Rating (kA)			Circuit Breaker Model No.	Space (Inches)
		240 V	480 V	600 V		
<b>Top Entry</b>						
NT	M6MDT800H	65	50	50	NT08H	72 (25 W x 20 D)
	M6MDT800L1	100	65	—	NT08L1	
	M6MDT1200H	65	50	50	NT12H	
	M6MDT1200L1	100	65	—	NT12L1	
NW	M6MDT1200NWN <sup>1</sup>	65	65	50	NW12N	3W Two full sections required 1 @ (30 W x 20 D) 1 @ (20 W x 20 D)
	M6MDT1200NWL <sup>1</sup>	100	100	65	NW12L	
	M6MDT1600N <sup>1</sup>	65	65	50	NW16N	4W Two full sections required 1 @ (30 W x 20 D) 1 @ (25 W x 20 D)
	M6MDT1600L <sup>1</sup>	100	100	65	NW16L	
	M6MDT2000N <sup>1</sup>	65	65	50	NW20N	
	M6MDT2000L <sup>1</sup>	100	100	65	NW20L	
M6MDT2500H <sup>1,2</sup>	100	100	65	NW25H		
<b>Bottom Entry</b>						
NT	M6MDB800H	65	50	50	NT08H	72 (25 W x 20 D)
	M6MDB800L1	100	65	—	NT08L1	
	M6MDB1200H	65	50	50	NT12H	
	M6MDB1200L1	100	65	—	NT12L1	
NW	M6MDB1200NWN	65	65	50	NW12N	3W or 4 W 72 H x 30 W (20 D)
	M6MDB1200NWL	100	100	65	NW12L	
	M6MDB1600N	65	65	50	NW16N	
	M6MDB1600L	100	100	65	NW16L	
	M6MDB2000N	65	65	50	NW20N	
	M6MDB2000L	100	100	65	NW20L	
M6MDB2500H <sup>2</sup>	100	100	65	NW25H		

<sup>1</sup> Top entry mains must be at the end of the MCC lineup. Top entry mains ship as two shipping splits: one 30 in. wide section for the breaker and one 20 in. wide section (25 in. wide for 4W) as an incoming cable section. No through bus is included in the incoming cable section. **NOTE:** Bottom entry can be at the end or middle of the MCC lineup.

<sup>2</sup> Available as NEMA/EEMAC Type 1/1A only.

**MCC Masterpact Main Accessory Groups**

The MCC Masterpact drawout breaker package is offered in two accessory groups—Limited and Enhanced—to help in selecting and pricing the most popular options. See the Accessory Group descriptions below for the Masterpact options included in each accessory group. Refer to the Masterpact NT/NW Universal Power Circuit Breaker catalog #0613CT0001 for a full description of the trip units and the accessories.

**Limited Accessory Group includes:**

- 5.0 trip unit (LSI)
- Sensor Plug = Unit Amp Rating
- Rating plug “A”
- No communications
- 4 Form C auxiliary switches
- 1 Form C overcurrent trip switch
- Padlockable push button cover
- Transparent cover over front of circuit breaker (NEMA/EEMAC Type 12) only)
- Automatic cradle shutters with padlocking provisions

**Enhanced Accessory Group includes:**

- 6.0 P trip unit (LSIG)
- Sensor Plug = Unit Amp Rating
- Rating plug “A”
- Modbus breaker communications module and 24 Vdc communications power supply, unwired to MCC network
- 4 Form C auxiliary switches
- 1 Form C overcurrent trip switch
- Padlockable push button cover
- Transparent cover over front of circuit breaker (NEMA/EEMAC Type 12) only)
- Schneider key interlock for circuit breaker
- Spring charging motor (120 Vac)
- Shunt trip without communications (120 Vac)
- Shunt close without communications (120 Vac)
- Electric reset (120 Vac)
- Ground fault
- Neutral CT (4-wire model only)
- Automatic cradle shutters with padlocking provisions

**Tie Breakers**

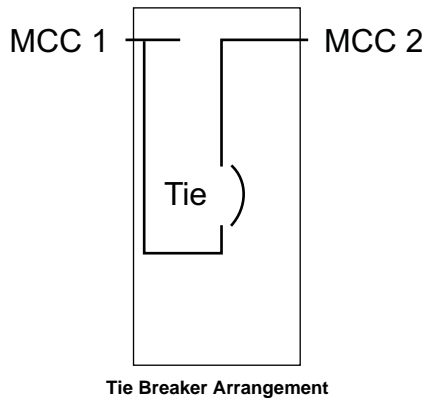
Tie Breakers are used to connect two MCCs together to allow either MCC Main to feed both MCCs as required. The tie breaker consists of a PowerPact® or Masterpact circuit breaker and hard bus transition network to complete the connection between the power buses from each MCC. The mains of the two MCCs may be on the outside ends or in the middle of the lineup with a tie breaker. The Trip Rating, Frame (Amps), and Breaker Frame of the tie breaker should match those of the main.

Neutral bus is not available in the tie breaker, therefore the neutral is not continuous nor switched through the tie. Contact factory for applications requiring continuous or switched neutral.

The standard configuration includes a manual throwover of the tie breaker. Automatic throwover systems controlled by a programmable logic controller can be provided for PowerPact P-frame or Masterpact NW circuit breakers in the MCC.



Description	Trip Rating (Amps)	Frame (Amps)	Breaker Frame	Tie Breaker Total Space (Inches) <sup>1</sup>
<b>Standard 80% Rated</b>				
800	800	800	MJ	72 (20 W x 20 D)
	1200	1200	PL/PK	
1200	1200	1200	PL/PK	72 (20 W x 20 D)
	3000	3000	Masterpact Drawout NW	72 Two full sections required 1 @ (30 W x 20 D) 1 @ (20 W x 20 D)
1600–2000	3000	3000	RL/RK	72 Two full sections required 2 @ (20 W x 20 D)
		3000	Masterpact Drawout NW	72 Two full sections required 1 @ (30 W x 20 D) 1 @ (20 W x 20 D)
2500	3000	3000	RL/RK	72 Two full sections required 2 @ (20 W x 20 D) NEMA/EEMAC Type 1/1A only
		3000	Masterpact Drawout NW	72 Two full sections required 1 @ (30 W x 20 D) 1 @ (20 W x 20 D) NEMA/EEMAC Type 1/1A only
<b>Optional 100% Rated</b>				
800	800	1200	PL/PK	72 (20 W x 20 D)
1200	1200	1200	PL/PK	72 (20 W x 20 D) NEMA/EEMAC Type 1/1A only
1600–2000	1600–2000	3000	RL/RK	72 Two full sections required 2 @ (20 W x 20 D) NEMA/EEMAC Type 1/1A only



<sup>1</sup> Tie breaker total space will be as shown, and includes a bus transition between two MCCs and the tie breaker. Each MCC Main must also include the key interlock option.

**Main Fusible Switches**

Main fusible switch units are located in 20 in. wide by 15 in. or 20 in. deep sections, except where noted. Mains must be mounted at the top or the bottom of the MCC section.

All main switches use automatic molded case switches in series with Class R fuse clips (up to 600 A) or L fuse clips (above 600 A).

All fusible units have a short circuit rating of 100,000 A.

All main switches listed are for 3-phase, 3-wire systems. 3-phase, 4-wire applications may require additional space (see “3-Phase, 4-Wire Systems” on page 26).

**Main Fusible Switches**

<b>Maximum Fuse Size (Amps) 600 V Max.</b>	<b>Space (Inches)</b>
200	24 (plug-on)
400	45 (Top Entry) 54 (Bottom Entry)
600	60
800	60 (Top Entry) 60 <sup>1</sup> (Bottom Entry)
1000 <sup>2</sup>	72 <sup>1</sup> (20 W X 20 D, Top Entry) 60 <sup>1</sup> (Bottom Entry)
1200	72 <sup>1</sup> (20 W X 20 D, Top Entry) 60 <sup>1</sup> (Bottom Entry)
1600	72 <sup>1</sup> (30 W X 20 D)
2000	72 <sup>1</sup> (30 W X 20 D)

<sup>1</sup> Requires a single shipping split.

<sup>2</sup> Specify top or bottom entry.

**Special Note for All Main Devices**

Branches 450 A or larger cannot be installed in the same vertical section as the main device.

**Standard Wire Lug Ranges (Mechanical)**

Mechanical set-screw type lugs are supplied as standard for Model 6 MCC main, branch, and neutral line and/or load connection. Compression crimp type lugs are available (see “Wiring Options” on page 85).

**Main Lugs**

<b>Main Lug Amps</b>	<b>Lug Wire Range</b>	<b>Lugs Per Phase/Neutral</b>
600	3/0–500 kcmil	2
800		3
1200	3/0–600 kcmil	4 <sup>1</sup>
1600	3/0–750 kcmil	6
2000, 2500		6

<sup>1</sup> Up to 750 kcmil wire size can be used if a 12 in. high pull box is ordered.



Main and Branch Circuit Breaker Lug Ranges

Circuit Breaker Frame	Amps	Standard Lug Wire Range	Lugs Per Phase
H	150	14-3/0	1
J	175	4-4/0	1
J	250	3/0-350 kcmil <sup>1</sup>	1
LA/LH	125-400	(2) 1-250 kcmil or (1) 1-600 kcmil	1
LI/LX/LE/LXI	300-600	(2) 4/0-500 kcmil	1
M/P	700-800	3/0-500 kcmil (standard) 3/0-600 kcmil Cu or Al; 750 kcmil compacted aluminum only (optional)	3 2
P	1000-1200	3/0-500 kcmil (standard)	4
		350-600 kcmil Cu or Al (optional)	3
		3/0-600 kcmil Cu or Al; 750 kcmil compacted aluminum only (optional)	3
R	1600-2500	1/0-750 kcmil	6
NT Drawout	800-1200	3/0-500 kcmil	4
NW Drawout	800-2500	3/0-750 kcmil (top entry) 3/0-500 kcmil (bottom entry)	8

<sup>1</sup> Wire size is limited to 250 kcmil on Compact™ 6 units.

Main and Branch Fusible Switch Lug Ranges

Main Switch Amps	Standard Lug Wire Range	Lugs Per Phase
30	#12-4	1
60	#8-1	1
100	#14-2	1
200	#1-300 kcmil (branches) or #4-4/0 <sup>1</sup> (mains)	1
400	(2) #1-250 kcmil or (1) #1-600 kcmil	1
600	3/0-500 kcmil	3
800	3/0-600 kcmil Cu or Al; 750 kcmil compacted aluminum only (optional)	2
1000 1200	3/0-500 kcmil (standard)	4
	350-600 kcmil (standard)	3
	3/0-600 kcmil Cu or Al; 750 kcmil compacted aluminum only (optional)	3
1600 2000	1/0-750 kcmil	6

<sup>1</sup> Lugs for up to 250 kcmil wire are available. Contact factory for AL250JD lug kit if larger lugs are needed.

Neutral Lug Ranges

Application	Lug Wire Range
100 A Main or Branch	(2) #14-1/0
200-250 A Main or Branch	(2) #4-300 kcmil
400-600 A Main or Branch	(2) 3/0-500 kcmil
800 A Main or Branch	(3) 3/0-500 kcmil
1000 A Main or Branch	
1200 A Main or Branch	(4) 3/0-750 kcmil
1600-2500 A Main or Branch	
800-1200 A NT Drawout	(4) 3/0-500 kcmil
1200-2500 A NW Drawout	(8) 3/0-750 kcmil (Top Entry) (8) 3/0-500 kcmil (Bottom Entry)
600-2500 A Main Lugs	See Main Lugs Table on page 24
Neutral Rating 1250 A Max.	(4) 3/0-750 kcmil (14) #6-300 kcmil
600-800 A (1) 1.5 in. x 1/4 in. Cu 1200-2000 A (2) 1.5 in. x 1/4 in. Cu Max. 100% Rating is 1250 A	Holes drilled for customer variations

**3-Phase, 4-Wire Systems**

If the motor control center contains only motor loads, and no future 4-wire loads are anticipated, it is not necessary to bring the neutral conductor into the MCC. As an option, a neutral lug assembly (Figure 1 in “4-Wire Examples” on page 27) can be provided in the incoming main section to terminate a neutral conductor. Additional lugs can be added for connections to the neutral.

When 4-wire loads are present in the MCC, solid neutral bussing (Figure 2 in “4-Wire Examples” on page 27) can be provided in individual sections and connected to provide a continuous neutral bar. A neutral lug termination option must be selected for the incoming main section when selecting solid neutral bus in the MCC. Lugs are not provided when selecting solid neutral bus, but holes are pre-drilled to accommodate user-mounted lugs. As an option, neutral conductors for loads can be connected to the MCC neutral bus via a neutral bus drop located in each vertical wireway for easy access (Figure 2 in “4-Wire Examples” on page 27).

A special 12 in. neutral distribution unit (Figure 3 in “4-Wire Examples” on page 27) can be provided to terminate branch device neutral connections in 15 in. deep sections. Such branches should be located close to the main for easier interconnections. A neutral lug termination option must be selected when selecting a neutral distribution unit.

Description	Application	Space (Inches)
Neutral lug termination <sup>1</sup> (Provides termination for fourth wire on 3-phase, 4-wire systems)	110–150 A main or branch <sup>2</sup>	0
	175–250 A main or branch	0
	300–400 A main or branch <sup>3</sup>	0
	450–600 A top located main breaker	18
	450–600 A	6
	600–800 A main switch or top located branch switch	5 in. added to width
	600–800 A bottom located branch switch	0
	1000–2000 A main or branch switch	5 in. added to width
	800–2500 A main or branch breaker	
		600–2500 A main lugs
Neutral distribution unit <sup>4</sup>	Neutral rating 1250 A max.	12
Solid neutral bus <sup>5</sup> (20 in. deep sections required)	600–800 A (1) 1.5 in. x 0.25 in. cu	0
	1200–2500 A (2) 1.5 in. x 0.25 in. cu max. 100% rating is 1200 A	
Neutral bus drop <sup>6, 7</sup> (Provides vertical extension of solid neutral bus into vertical wireway to facilitate neutral connections from units)	Provides vertical extension of solid neutral bus into vertical wireway to facilitate neutral connections from units.	0

<sup>1</sup> Neutrals in units are factory-connected when the neutral distribution option or neutral bus drop option are chosen.

<sup>2</sup> Except for Compac 6 units.

<sup>3</sup> When >35 kA SCCR or electronic trip, an additional 6 in. of space is required on top located mains and an additional 3 in. for bottom located mains and branches.

<sup>4</sup> Neutral distribution units must go in the next adjacent section on bottom feed full section mains. 12 in. of additional space is not required on top-feed, full section (72 in.) mains.

<sup>5</sup> Not available with through-the-back splice.

<sup>6</sup> 25 in. wide section required when used with a cabled main or branch breaker devices (450–600 A branches and 400–600 A mains). Neutral bus drop is not available in sections with 800 A or larger top main or any branch breakers, or 600 A or larger top main or any branch switches. However, the 4-wire Neutral Lug Termination will be factory-connected to the MCC neutral and additional holes are drilled for unit load neutrals on the main/branch neutral termination.

<sup>7</sup> 600–1200 A bottom entry, fusible switch main will add 12 in. to unit height.

4-Wire Examples

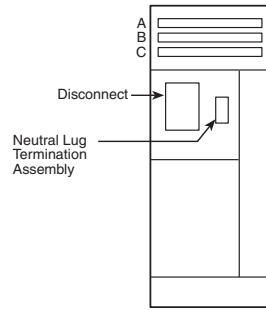


Figure 1

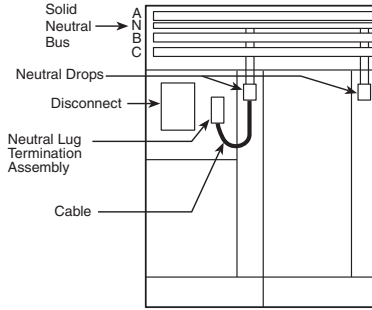


Figure 2

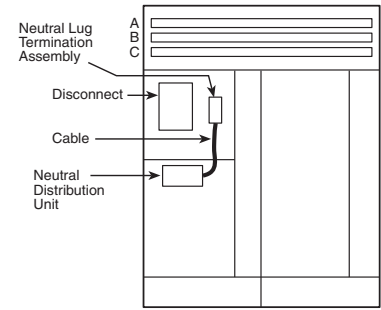


Figure 3

Service Entrance Label (not available on Main Lug Systems)

Description	Application	Space (Inches)
3-phase, 3-wire system with a main breaker/switch	15–2500 A <sup>1</sup>	0
	110–150 A without GFI	3
	110–150 A with GFI	3
	175–250 A without GFI	0
	175–250 A with GFI	0
	300–400 A without GFI <sup>2</sup>	0
	300–400 A with GFI <sup>3</sup>	12
3-phase, 4-wire system with a main breaker/switch <b>NOTE:</b> A neutral lug termination option and/or solid neutral bus option is required on 4-wire systems.	450–600 A without GFI	6
	450–600 A with GFI	12 <sup>4</sup>
	800–2500 A circuit breaker with GFI	0
	600–2000 A switch with GFI	
	800 A circuit breaker without GFI	15
	1200 A circuit breaker (80% rated) without GFI	
	600–800 A switch without GFI	12
	1000–1200 A bottom incoming switch without GFI	
	Any other main without GFI (except as shown above)	0

- <sup>1</sup> Ground fault protection is added to all 1000 A and larger mains when a service entrance is specified and the system voltage is 480 V.
- <sup>2</sup> When SCCR is >35 kA on 300–400 A applications, an additional 15 in. of space is required for top feed installations and an additional 9 in. for bottom feed.
- <sup>3</sup> Requires an additional 15 in. of space for top feed applications.
- <sup>4</sup> Requires an additional 6 in. of space when the metering option is selected.

**PowerLogic® Circuit Monitor**

PowerLogic series 3000 and 4000 circuit monitors are multifunction digital metering and monitoring devices capable of replacing a variety of meters, relays, transducers, and other components. Data available for local viewing includes metered values plus extensive min/max, alarm, and analog/digital input data. Circuit monitor data is available for viewing and recording via standard RS-485, RS-232 (series 4000 only) or optional Ethernet communications. A 4-line x 20-character LCD type display with customizable displays is provided as standard. An optional vacuum fluorescent display with backlighting is also available. The circuit monitors offer waveform capture, event/alarm logging and custom alarms. Included with the circuit monitor are a current transformer, current transformer shorting terminal block, current/voltage module, voltage connections, and power supply.



**PowerLogic CM4000**

Description	Application
<b>Monitors</b>	
CM3250 with LCD Display	Circuit Monitor, data logging, waveform capture, 8MB memory, LCD Display
CM3350 with LCD Display	Circuit Monitor, same features as CM3250 with Disturbance Monitoring
CM4250 with LCD Display	Instrumentation, data logging, waveform and disturbance capture, programmable logic, 2 option card slots
CM4000T with LCD Display	CM4000 features plus high-speed voltage transient detection and capture.
CMDLC	4-line x 20 character Liquid Crystal Display with backlighting
CMDVF	4-line x 20 character Vacuum Fluorescent Display with I/R port and proximity sensor substituted for standard LCD display
<b>I/O Modules</b>	
IOC 44 <sup>1, 2</sup>	Field Installable I/O card with 4 status inputs, 3 relay (10 A) outputs, and 1 pulse output (KYZ)
IOX0404 <sup>3</sup>	I/O Extender module with 4 status inputs and 4 analog inputs (4 to 20 mA)
IOX2411 <sup>3</sup>	I/O Extender module with 4 inputs (32 Vdc), 2 outputs (60 Vdc), 1 analog input (0-5 Vdc), 1 analog output (4-20 mA)
IOX08 <sup>3</sup>	I/O Extender module with 8 status inputs (120 Vac)
IOX <sup>3</sup>	I/O Extender module only, no installed I/O, accepts up to 8 I/O modules with maximum of 4 analog I/O
<b>Accessories</b>	
ECC21 <sup>1, 2</sup>	Ethernet communications card, 100 Mbps fiber and 10/100 Mbps UTP Ethernet port and 1 RS-485 master port

- <sup>1</sup> Only one slot is available for I/O Modules or the Ethernet ECC21 card on CM3000.
- <sup>2</sup> Two slots are available for two IOC44 I/O Modules or one IOC44 I/O Module and one Ethernet ECC21 card on CM4250/4000T.
- <sup>3</sup> Available on CM4250/4000T only. Choose only one module per circuit monitor.

**Circuit Monitor Space Requirements**

Device Type	Additional Space Requirements (Inches)		
	Main Unit	Monitor Unit <sup>1</sup>	Total
<b>Main Lugs</b>			
600–1200 A	0	12	12
1600–2500 A	0		12 <sup>2</sup>
<b>Main Circuit Breaker</b>			
110–250 A	6	12	18
300–400 A	9		21
450–600 A	6		18
800 A	15		27
1200 A 80% rated	15		27
1200 A 100% rated; 1600–2500 A	0		12
<b>Main Fusible Switch</b>			
200 A	6	12	18
Top Located, 400 A	3		15
Bottom Located, 400 A	6		18
600–800 A	12		24
Top Located, 1000–2000 A	0		12
Bottom Located, 1000–2000 A	12		24
1600–2000 A	0		12

- <sup>1</sup> The circuit monitor unit must be placed adjacent to (below, above, or next to) the main unit.
- <sup>2</sup> If space is not available for the circuit monitor, an option is available to integrate the metering equipment on the door of main. This option requires no additional space for the circuit monitor module. On bottom located mains, this option protrudes 6.2 in. out from the door and reduces customer aisleway by the same dimension.

**PowerLogic Power Meter**

The PowerLogic Series 800 Power Meter is a high-performance power monitoring component able to provide advanced power measurement capabilities in a compact MCC plug-in unit. It is designed for use in basic power metering applications and can replace conventional metering devices such as ammeters, voltmeters, and watt-hour meters while providing powerful capabilities not offered by analog metering. This option can offer an economical advantage in MCCs requiring multiple analog meters for voltage, current, and watt-hours. With its easy to use intuitive interface and self guiding menus, the large antiglare and back lit display makes this meter the easiest to navigate and use.

- Monitor current, voltage, power, and energy simultaneously
- Individual harmonic measurements on current and voltage
- THD measurement
- Modbus® RS-485 Communications and compatible with Transparent Ready® Equipment

The Power Meter offering below is for MCC incoming main devices only. The MCC power meter option includes the power meter module, front mounted display for easy viewing, main and control voltage fusing, and necessary current transformers with shorting terminal blocks in the main device. Optional modules can be added to the power meter to increase type and number of inputs and outputs. For other power meter applications, contact the MCC Technical Assistance Group (TAG).

Description	Application	System	Space (Inches)
<b>Meters</b>			
PM820	Power Meter door mounted display + module with instrumentation functions, THD measurement, alarming, and 80 kb logging.	3-phase, 3-wire	See "Power Meter Space Requirements" on page 30
		3-phase, 4-wire	
PM850	Power Meter door mounted display + module with instrumentation functions, THD measurement, alarming, 800 kb logging, and waveform capture.	3-phase, 3-wire	
		3-phase, 4-wire	
PM870	Power Meter door mounted display + module with instrumentation functions, THD measurement, alarming, 800 kb logging, configurable waveform capture, and sag/swell detection.	3-phase, 3-wire	
		3-phase, 4-wire	
<b>I/O Modules</b>			
Up to 2 modules of the same or different types can be mounted on the meter to expand the I/O.			
PM8M26	I/O module with 2 digital outputs (relays), 6 digital inputs	—	0
PM8M2222	I/O module with 2 digital outputs, 2 digital inputs, 2 analog outputs and 2 analog inputs		
<b>Accessories</b>			
PM8ECC	Ethernet Communications Card includes: instantaneous readings, advance security, TRE Level 1, Web browser based Diagnostics and Register Reader, 10/100BaseTx Ethernet, RS-485, and support for 2-wire and 4-wire daisy-chains. Supported protocols: ModbusTCP/IP, FTP, SNMP MIB2, ARP, UDP, and HTTP.  Available on all Power Meter 800 Series meters.	—	0

**Power Meter Space Requirements**

Device Type	Additional Space Requirements (Inches)		
	Main Unit	Meter Unit <sup>1</sup>	Total
<b>Main Lugs</b>			
600–1200 A	0	6	6
1600–2500 A	0		6
<b>Main Circuit Breaker</b>			
110–250 A	6	6	12
300–400 A	9		15
450–600 A	6		12
800 A	15		21
1200 A 80% rated	15		21
1200 A 100% rated; 1600–2500 A	0		6
<b>Main Fusible Switch</b>			
200 A	6	6	12
Top-located, 400 A	3		9
Bottom-located, 400 A	6		12
600–800 A	12		18
Top-located, 1000–1200 A	0		6
Bottom-located, 1000–1200 A	12		18
1600–2000 A	0		6

<sup>1</sup> The power meter unit must be placed adjacent to (below, above, or next to) the main unit.

**PowerLogic Power Meter and Circuit Monitor Comparison**

Feature	Model PM820	Model PM850	Model PM870	Model CM3250	Model CM3350	Model CM4250	Model CM4000T
Amps, volts, power, energy, PF	X	X	X	X	X	X	X
Communications: RS485 Modbus	X	X	X	X	X	X	X
Communications: optional Ethernet	X	X	X	X	X	X	X
Demand readings, THD	X	X	X	X	X	X	X
Trending and forecasting				X	X	X	X
ITIC/SEMI F47/NEMA MG-1-1998				Optional	Optional	Optional	Optional
Extended memory						X	X
Alarm event log	X	X	X	X	X	X	X
High speed (100ms) alarms		X	X	X	X	X	X
Disturbance (10ms) alarms					X	X	X
Transient (1 microsec) alarms							X
Interval min./max./avg. log				X	X	X	X
Billing log	X	X	X				
Waveform capture		X	X	X	X	X	X
Disturbance waveform capture			X		X	X	X
100ms event recordings					X	X	X
Infrared port				Optional	Optional	Optional	Optional
Analog inputs/outputs (maximum)	(4)	(4)	(4)	(0)	(0)	(4)	(4)
Digital inputs/outputs (maximum)	(17)	(17)	(17)	(8)	(8)	(24)	(24)
Programmable math and LOGIC functions						X	X
Downloadable firmware	X	X	X	X	X	X	X



Analog Meter

Metering Options<sup>1</sup>

Description	Application	Metering Sequence	Space (Inches)
AC ammeter with transfer switch and two current transformers and shorting terminal blocks (Three CTs provided on 4-wire systems)	110–250 A main circuit breakers	Hot	15
	When used with voltmeter		0
	15–250 A branch circuit breaker	Cold	15
	When used with voltmeter		0
	300–600 A main/branch circuit breakers	Cold	9
	When used with voltmeter		0
	800–2500 A main/branch circuit breakers		Not available <sup>2</sup>
	30–200 A main/branch fusible switches	Cold	15
	When used with voltmeter		0
	400 A and above main/branch fusible switches	Cold	9
	When used with voltmeter		0
	600–2000 A main/branch fusible switches		Not available <sup>2</sup>
	600–1200 A top located main lugs	Hot	9
	When used with voltmeter		0
AC voltmeter with VM transfer switch and two potential transformers (Three PTs provided on 4-wire systems)	600–1200 A bottom main lugs	Hot	0
	1600–2500 A main lugs	Hot	0
Elapsed time meter <sup>3</sup>	Main and branch feeders <sup>2</sup>	Cold	9
	Main lugs	Hot	0
AC ammeter with current transformer	Starter unit		3
1% meters (switchboard type)			6
Ground detection lights	Main breaker/switch only		12
	Main lugs		12
Fuse for metering circuit	For special applications only		0
Current transformer (CT)	For special applications only		3
Potential transformer (PT)	For special applications only		6
Shorting terminal blocks for metering CTs	Option for starters, branch feeders (standard on PowerLogic devices)		0

<sup>1</sup> Total space of unit and meter options shall not exceed 72 in.

<sup>2</sup> Analog metering is not available on PowerPact M-, P-, and R-frame units. Use an optional Micrologic ammeter, power, or harmonic trip unit on the circuit breaker, or a PowerLogic circuit monitor/power meter for switch applications.

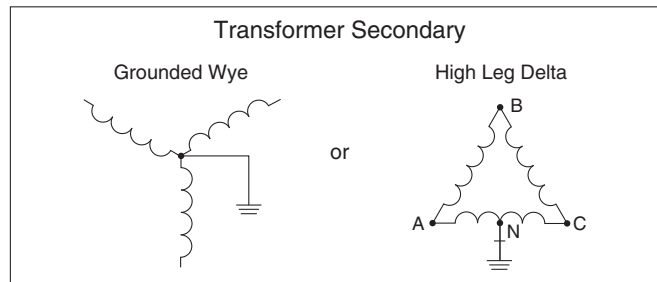
<sup>3</sup> Not available on Compac 6 starters.

**Transient Voltage Surge Suppressor (TVSS) Units for MCC Incoming Mains**

**General Information**

**NOTE:** TVSS units must be installed on grounded power distribution systems. Installation on an ungrounded power distribution system is not recommended. See the figure below for proper transformer feed to the MCC where TVSS units can be applied.

- Must be located as close as possible to the incoming main provision.
- TVSS units for 4-wire systems must include a solid neutral bus and/or neutral lug termination assembly in the MCC.
- TVSS components for installation in MCC-mounted panelboards or on distribution transformer secondaries should use a panel-mounted TVSS component.



All MCC TVSS units for MCC incoming mains include as standard:

- Flange-mounted disconnect
- Door-mounted diagnostic lights for each phase
- Audible alarm with Test/Disable/Enable switch
- TVSS with EMI/RFI filter
- UL 1449 Standard, Second Edition, Tested and Recognized Component
- UL 1283 Recognized Component
- cUL Certified Component
- Motor Control Center certifications per UL 845, CSA (Canada) and NOM (Mexico)
- Individually fused suppression modules utilizing surge-rated fuses
- Each suppression MOV is thermally protected for low current faults
- High energy parallel MOV design for Category A, B, C3 exposure levels per IEEE C62.41 criteria
- Can be applied to MCCs with 100 kAIC short circuit withstand rating
- Designed as standard MCC unit construction to enable new or retrofit applications
- One Form C alarm contact

**Selection**

1. Select the TVSS Model based on:
  - a. System voltage (480 Vac, 240 Vac, 208 Vac, or 600 Vac).
  - b. Desired surge current capacity (120 kA, 160 kA, or 240 kA). If a surge current capacity higher than 240 kA is required, more than one TVSS unit can be added to the MCC to bring it to the desired surge current capacity. When adding more than one TVSS unit to an MCC, all units should be mounted in the same section, if possible, and as close as possible to the MCC incoming main unit.
  - c. Type of loads to be protected (branch loads, service entrance applications, or large individual loads).
  - d. If backup redundancy is a requirement, two TVSS units should be added in the same MCC section and in adjacent mounting spaces.
2. Select the TVSS model based on the main power transformer connection (see figure above), desired surge current capacity, and type of loads to be protected.



**Model IMA TVSS (120 kA Surge Rating)**

- For protection of small MCC lineups and non-critical loads
- 120,000 A per phase surge current capacity

Customer Incoming Power Connection to MCC	System Voltage	Space (Inches)
Three phases with or without neutral connected to MCC (3- or 4-wire MCC). Wye secondary transformer with grounded neutral.	208 Vac	6
	480 Vac	
	600 Vac	
Transformer with high-leg delta secondary. Three phases with or without neutral connected to MCC (3- or 4-wire MCC). <b>NOTE:</b> B-phase is configured as the high leg.	240 Vac	

**Model IMA TVSS (160kA Surge Rating)**

- For protection of branch loads/electronics, large individual loads, and drives/soft starts
- 160,000 A per phase surge current capacity

Customer Incoming Power Connection to MCC	System Voltage	Space (Inches)
Three phases with or without neutral connected to MCC (3- or 4-wire MCC). Wye secondary transformer with grounded neutral.	208 Vac	6
	480 Vac	
	600 Vac	
Transformer with high-leg delta secondary. Three phases with or without neutral connected to MCC (3- or 4-wire MCC). <b>NOTE:</b> B-phase is configured as the high leg.	240 Vac	

**Model IMA TVSS (240 kA Surge Rating)**

- For application on high exposure systems for service entrance protection with large power electronic loads (drives/soft starts)
- 240,000 A per phase surge current capacity

Customer Incoming Power Connection to MCC	System Voltage	Space (Inches)
Three phases with or without neutral connected to MCC (3- or 4-wire MCC). Wye secondary transformer with grounded neutral.	208 Vac	6
	480 Vac	
	600 Vac	
Transformer with high-leg delta secondary. Three phases with or without neutral connected to MCC (3- or 4-wire MCC). <b>NOTE:</b> B-phase is configured as the high leg.	240 Vac	

**Additional Options**

Description	Space (Inches)
Surge Counter—Door mounted display that counts the number of transients entering the facility through the suppressor.	0

**Branch Feeder Units**

**Circuit Breaker Branch Feeder Units**



- Branch feeder units may be located in 20 in. wide by 15 in. or 20 in. deep sections, except where noted.
- Select trip rating and desired unit interrupting rating. (The unit interrupting rating is equal to the breaker rating.)
- Units listed are for 3-phase, 3-wire systems. 3-phase, 4-wire applications may require additional space (see “3-Phase, 4-Wire Systems” on page 26). Four-wire applications are not available on Compac™ 6 units.

**Thermal-Magnetic Molded Case Circuit Breakers**

Breaker Trip Rating (Amps)	Breaker Frame (Amps)	Breaker Type	Unit Interrupting Rating (kA)			Space (Inches)
			208/240 V	480 V	600 V	
<b>Standard (80%) Rated</b>						
15–150	150	HG	65	35	18	6 (Compac 6, Plug-on)
		HJ	100	65	25	
		HL	100	100	50	
175–250	250	JG	65	35	18	
		JJ	100	65	25	
		JL	100	100	50	
15–150	150	HG	65	35	18	12 (Plug On)
		HJ	100	65	25	
		HL	100	100	50	
175–250	250	JG	65	35	18	18 (Plug On)
		JJ	100	65	25	
		JL	100	100	50	
300–400	400	LA	42	30	22	27 (Plug On)
		LH	65	35	25	
	600	LI	100	100	100	
450–600	600	LI	100	100	100	36 <sup>1</sup>
800	800	MJ	65	65	25	18 (Top Entry) 18 <sup>2</sup> (25 W, Bottom Entry)
	1200	PL/PK	100	100	50	
1200	1200	PL/PK	100	100	50	21 (Top Entry) 21 <sup>2</sup> (25 W, Bottom Entry)
<b>Optional 100% Rated<sup>3</sup></b>						
300–400	400	LE	100	65	35	36 <sup>1</sup>
600	1200	PL/PK	100	100	50	18 (Top Entry) 18 <sup>2</sup> (25 W, Bottom Entry)
800	1200	PL/PK	100	100	50	21 (Top Entry) 21 <sup>2</sup> (25 W, Bottom Entry)
1200	1200	PL/PK	100	100	50	72 <sup>4</sup> (20 W x 20 D) NEMA/EEMAC Type 1/1A only

<sup>1</sup> Specify top or bottom entry.

<sup>2</sup> Top located in section with 9 in. vertical wireway for bottom cable entry.

<sup>3</sup> All 100% rated circuit breakers are molded case with Micrologic electronic trip. LE electronic trip circuit breakers include Full Function Trip Unit with LSIG tripping functions. P and R-frame electronic trip circuit breakers include Basic 3.0 Trip Unit with LI tripping functions.

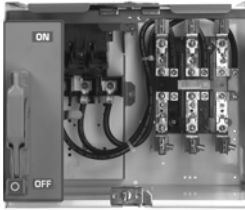
<sup>4</sup> Requires single shipping split.



**Compac 6, H-frame, 150A, Circuit Breaker Branch Feeder Unit**

**Branch Feeder Units**

**Fusible Switch Branch Feeder Units**



**Fusible Switch Branch  
Feeder Unit**

Branch feeder units may be located in 20 in. wide by 15 in. or 20 in. deep sections, except where noted.

Branch feeder units up to 100 A use a bladed switch disconnect. Above 100 A, the disconnect is an automatic molded case switch.

Class H (0–600 A) and Class L (800–1200 A) fuse clips are provided as standard, except Compac 6, six inch units, which use Class J fuse clips. Class R fuse clips can be provided for 30–600 A switches.

All fusible switch units have a short circuit rating of 100,000 A.

Fuses are not included as standard.

Units listed are for 3-phase, 3-wire systems. 3-phase, 4-wire applications may require additional space (see “3-Phase, 4-Wire Systems” on page 26). Four-wire applications are not available on Compac 6 units.

**Main Fusible Switches—600 V Max.**

Maximum Fuse Size (Amps)	Space (Inches)
30	6 <sup>1</sup> (Plug-on)
60	
100	
30	12 (Plug On)
60	
100	
200	24 (Plug On)
400	51
600 <sup>2</sup>	60 (top exit) 60 <sup>3</sup> (25 W, bottom exit)
800 <sup>2</sup>	60 (top exit) 60 <sup>2</sup> (25 W, bottom exit)
1000 <sup>2</sup>	72 <sup>4</sup> (25 W x 20 D)
1200 <sup>2</sup>	72 <sup>4</sup> (30 W x 20 D)

- <sup>1</sup> Compac 6 units.
- <sup>2</sup> Specify top or bottom exit.
- <sup>3</sup> Top located in section with 9 in. vertical wireway for bottom cable entry.
- <sup>4</sup> Requires single shipping split.

**NOTE:** Only one 400 A or larger main disconnect, top located main lug, or starter unit can be installed per section. Only one 450 A or larger cabled/bussed branch can be installed per section.

**Combination Starter Units**

Combination starter units combine the requirements of motor overload and short circuit protection into one convenient package. Starter units are provided with Schneider Electric Type S or TeSys® D-Line contactors, thermal or solid-state overloads, and fusible switch or circuit breaker disconnects.



**Full Voltage Non-Reversing (FVNR) Starters with Circuit Breakers**

FVNR combination starters will mount in standard 20 in. wide by 15 in. or 20 in. deep sections, except where noted.

All Compac™ 6, NEMA-rated, six-inch starters use GJL frame Mag-Gard® motor circuit protectors (MCPs). All standard height starters with MCP frames through 250 A use PowerPact® electronic motor circuit protectors. All starters with MCP frames above 250A use L- and P-frame Mag-Gard motor circuit protectors. Thermal-magnetic circuit breakers may be substituted for motor circuit protectors on starter units. All units are UL Listed.

Motor Control Center units are available with short circuit ratings up to 100,000 A.



**Combination Starter Unit  
with Circuit Breaker  
Disconnect**

Starter Horsepower				NEMA Size	MCP Frame (Amps)	Space (Inches)
208 V	240 V	480 V	600 V			
0.33	0.5	1	—	1	3	6 <sup>1</sup>
1	1	3				
3	5	7.5				
5	7.5	10				
5	5	10	10	1	30	12
	7.5	—	—		50	
10	—	25	15	2	30	12
	10		25		50	
	15		—		100	
—	—	50	30	3	50	18
20	25		50		100	
25	30		—		150	
40	—	—	60	4	100	21
	40	75	100		150	
	50	100	—		250	
50	60	125	150	5	250	42 <sup>2</sup>
75	100	200	200		400	48
100	—	250	300	6	400	72 (20 W x 20 D)
150	200	400	400		600	

<sup>1</sup> Compac 6 units.

<sup>2</sup> When the thermal-magnetic circuit breaker option is chosen, the space requirement is 48 in.

**Full Voltage Non-Reversing Vacuum Starters with Circuit Breakers**

Vacuum contactor combination starters will mount in standard 20 in. wide by 15 in. or 20 in. deep sections, except where noted.

All vacuum starter units with circuit breaker disconnects use PowerPact electronic motor circuit protectors (MCPs) or L-frame or PowerPact M- or P-frame thermal magnetic (TM) circuit breakers. All units are UL Listed.

Motor Control Center units are available with short circuit ratings up to 100,000 A.

Starter Horsepower				NEMA Size	MCP Frame or TM Trip/Frame (Amps)	Space (Inches)
208 V	240 V	480 V	600 V			
—	—	—	60	4	100 MCP	21
40	40	75	100		150 MCP	
—	50	100	—		250A MCP	
50	—	—	150	5	200/400 TM	48
—	60	125	—		225/400 TM	
60	75	150	200		250/400 TM	
75	—	—	—		300/400 TM	
—	100	200	—		350/400 TM	
—	—	—	250	6	600/800 TM	72 (20 W x 20 D)
100	125	250	300			
125	150	300	400			
150	—	350	—			
—	200	400	—			

**Application-Rated Compac 6 Starters—Full Voltage Non-Reversing with Circuit Breakers**

All Compac 6 application-rated, six-inch starters use TeSys® D-Line contactors and GJ frame Mag-Gard adjustable instantaneous trip breakers (UL Listed for 100,000 A at 480 V short circuit rating). Compac 6 application-rated six-inch starters will mount in 20 in. wide by 15 in. or 20 in. deep sections. Select application rated units based on system voltage and motor full load amps.



**Compac 6 Units**

**Application-Rated FVNR Combination Starters—With Mag-Gard Circuit Breaker (480 V Max.)**

Starter Ampacity			Overload Relay Ampacity Range <sup>1</sup>	Circuit Breaker (Amps)	Space (Inches)
208 V	240 V	480 V			
1	1	1	0.63 to 1.0	3	6
1.6	1.6	1.6	1.0 to 1.6		
2.1	2.1	2.1	1.6 to 2.1		
2.5	2.5	2.5	2.1 to 2.5	7	
4	4	4	2.5 to 4.0		
4.8	4.8	4.8	4.0 to 4.8	15	
5.5	5.5	5.5	4.8 to 5.5		
7	7	7	5.5 to 7.0		
9	9	—	7.0 to 9.0		
—	—	7.6	7.0 to 7.6		
—	9.6	—	9.0 to 9.6		
11	—	—	9.0 to 11		
—	—	9	7.6 to 9.0		
—	—	11	9.0 to 11.0		
—	11	—	9.6 to 11.0		
12	12	12	11 to 12.0	30	
—	—	14	12.0 to 14.0		
17	17	—	12.0 to 17.5		
22	22	—	17.5 to 22.0		
—	—	17	14 to 17		
—	—	21	17 to 21	50	
23	23	—	22 to 23		
—	—	23	21 to 23		
30	30	30	23 to 30		
34	34	34	30 to 34	75	
37	37	—	34 to 37		
42	42	—	37 to 42		

<sup>1</sup> Maximum overload relay ampacity when used on Compac 6 units.

**Full Voltage Reversing (FVR) Starters with Circuit Breakers**

FVR combination starters will mount in standard 20 in. wide by 15 in. or 20 in. deep sections, except where noted. All starters with motor circuit protector (MCP) frames through 250 A use PowerPact electronic motor circuit protectors. All starters with MCP frames above 250 A use L-frame Mag-Gard motor circuit protectors. All units are UL Listed.

Motor Control Center units are available with short circuit ratings up to 100,000 A.

Starter Horsepower				NEMA Size	MCP Frame (Amps)	Space (Inches)
208 V	240 V	480 V	600 V			
5	5	10	10	1	30	18
—	7.5	—	—		50	
—	—	—	15	2	30	18
10	10	25	25		50	
—	15	—	—		100	
—	—	—	30	3	50	27
20	25	50	50		100	
25	30	—	—		150	
—	—	—	60	4	100	33
40	40	75	100		150	
—	50	100	—		250	
75	100	200	200	5	400	72 (25 W)

**Full Voltage Reversing Vacuum Starters with Circuit Breakers**

Vacuum contactor combination starters will mount in standard 20 in. wide by 15 in. or 20 in. deep sections, except where noted. All vacuum starter units with circuit breaker disconnects use PowerPact electronic motor circuit protectors (MCP) or L-frame thermal magnetic (TM) circuit breakers as indicated. All units are UL Listed.

Motor Control Center units are available with short circuit ratings up to 100,000 A.

Starter Horsepower				NEMA Size	MCP Frame or TM Trip/Frame (Amps)	Space (Inches)
208 V	240 V	480 V	600 V			
40	—	—	100	4	100 MCP	21
	40	75			150 MCP	
	50	100			250 MCP	
50	—	—	150	5	200/400 TM	48
—	60	125	—		225/400 TM	
60	75	150	200		250/400 TM	
75	—	—	—		300/400 TM	
—	100	200	—		350/400 TM	

**Application-Rated Compac 6 Starters—Full Voltage Reversing with Circuit Breakers**

All Compac 6 application-rated, six-inch starters use TeSys D-Line contactors and GJ frame Mag-Gard adjustable instantaneous trip breakers (UL Listed for 100,000 A at 480 V short circuit rating).  
Compac 6 application-rated six-inch starters will mount in 20 in. wide by 15 in. or 20 in. deep sections. Select application rated units based on system voltage and motor full load amps.

**Application-Rated FVR Combination Starters – With Mag-Gard® Circuit Breaker (480 V Max.)**

Starter Ampacity			Overload Relay Ampacity Range <sup>1</sup>	Circuit Breaker (Amps)	Space (Inches)
208 V	240 V	480 V			
1	1	1	0.63 to 1.0	3	6
1.6	1.6	1.6	1.0 to 1.6		
2.1	2.1	2.1	1.6 to 2.1		
2.5	2.5	2.5	2.5 to 4.0	7	
4	4	4	2.5 to 4.0		
4.8	4.8	4.8	4.0 to 4.8		
5.5	5.5	5.5	4.8 to 5.5	15	
7	7	7	5.5 to 7.0		
—	—	7.6	7.0 to 7.6		
9	9	—	7.0 to 9.0		
—	9.6	—	9.0 to 9.6		
11	—	—	9.0 to 11		
—	—	9	7.6 to 9.0		
—	—	11	9.0 to 11.0		
—	11	—	9.6 to 11		
12	12	12	11.0 to 12.0	30	
—	—	14	12.0 to 14.0		
17	17	—	12.0 to 17.5		
22	22	—	17.5 to 22.0		
—	—	—	—		

<sup>1</sup> Maximum overload relay ampacity when used on Compac 6 units.



**Reduced Voltage Autotransformer (RVAT) Starters with Circuit Breakers**

RVAT combination starters mount in standard 20 in. wide by 20 in. deep sections. Sections with RVAT starters require single shipping splits. All RVAT starter units with circuit breaker disconnects use thermal-magnetic (TM) circuit breakers. All units are UL Listed.

Motor Control Center units are available with short circuit ratings up to 100,000 A.

Starter Horsepower				NEMA Size	TM Trip/Frame (Amps)	Space (Inches)
208 V	240 V	480 V	600 V			
—	—	—	30	3	80/150	48 (20 D)
—	—	30	—		100/150	
—	—	—	40		110/150	
15	—	—	—		125/150	
20	25	50	50		150/150	
—	—	—	60	4	175/250	60 (20 D)
25	30	60	75		200/250	
40	50	100	100		250/250	
50	—	—	150		200/400	
—	60	125	—	5	225/400	72 (25 W X 20 D)
60	75	150	200		250/400	
75	—	—	—		300/400	
—	100	200	—		350/400	
—	—	—	250	6	600/800	72 (30 W x 20 D)
100	125	250	300			
—	—	—	350			
125	150	300	400			
150	—	350	—			
—	200	400	—		800/800	

**Reduced Voltage Autotransformer (RVAT) Vacuum Starters with Circuit Breakers**

RVAT vacuum contactor combination starters mount in standard 20 in. wide by 20 in. deep sections. Sections with RVAT starters require single shipping splits. All RVAT starter units with circuit breaker disconnects use thermal magnetic (TM) circuit breakers. All units are UL Listed.

Motor Control Center units are available with short circuit ratings up to 100,000 A.

Starter Horsepower				NEMA Size	TM Trip/Frame (Amps)	Space (Inches)
208 V	240 V	480 V	600 V			
—	—	—	60	4	175/250	60 (20 D)
25	30	60	75		200/250	
40	50	100	100		250/250	
50	—	—	150	5	200/400	72 (25 W x 20 D)
—	60	125	—		225/400	
60	75	150	200		250/400	
75	—	—	—		300/400	
—	100	200	—		350/400	
—	—	—	250	6	600/800	72 (30 W x 20 D)
100	125	250	300			
—	—	—	350			
125	150	300	400			
150	—	350	—			
—	200	400	—		800/800	

**Full Voltage 2-Step Part-Winding (FVPW) Starters with Circuit Breakers**

Part-winding combination starters will mount in standard 20 in. wide by 15 in. or 20 in. deep sections, except where noted. Part-winding starters use a separate motor circuit protector (MCP) for each of the two motor windings. All starters with MCP frames through 250 A use PowerPact electronic motor circuit protectors. All starters with MCP frames above 250 A use L-frame Mag-Gard motor circuit protectors. All units are UL Listed.

Each MCP has an external operating mechanism. Part-winding starters require six thermal units.

Motor Control Center units are available with short circuit ratings up to 100,000 A.

Starter Horsepower				NEMA Size	MCP Frame (Amps)	Space (Inches)
208 V	240 V	480 V	600 V			
5	5	10	15	1	30	30
10	10	15	—		50	
—	—	25	25	2	50	30
20	25	40	40		100	
—	—	50	60	3	100	36
40	50	75	75		150	
—	—	—	100	4	150	54
75	75	150	150		250	
150	150	350	350	5	400	72 (25 W x 20 D)

**Full Voltage 2-Speed 1-Winding Starters (Consequent Pole) with Circuit Breakers**

Two-speed combination starters will mount in standard 20 in. wide by 15 in. or 20 in. deep sections, except where noted. All starters with motor circuit protector (MCP) frames through 250 A use PowerPact electronic motor circuit protectors. All starters with MCP frames above 250 A use L-frame Mag-Gard motor circuit protectors. All units are UL Listed.

Motor windings are Wye connected as standard. Open Delta connection is available.

Motor Control Center units are available with short circuit ratings up to 100,000 A.

Starter Horsepower								NEMA Size	MCP Frame (Amps)	Space (Inches)
Constant Horsepower				Constant Or Variable Torque						
208 V	240 V	480 V	600 V	208 V	240 V	480 V	600 V			
5	5	7.5	7.5	5	7.5	10	10	1	30	21
—	—	10	15	—	—	—	15	2	30	24
7.5	10	20	20	10	10	25	25		50	
—	—	—	—	—	15	—	—	3	100	51 <sup>1</sup>
10	—	25	30	—	—	—	30		50	
20	25	40	40	20	25	50	50	4	100	60
—	—	—	—	25	30	—	—		150	
—	—	50	60	—	—	—	60	4	100	60
30	40	75	75	40	40	75	100		150	
—	—	—	—	—	50	100	—	5	250	72 (25 W)
60	75	150	150	75	100	200	200		400	

<sup>1</sup> When using an ambient compensated, bimetal overload, 60 in. of mounting space is required.

**Full Voltage 2-Speed 2-Winding Starters (Separate Winding) with Circuit Breakers**

Two-speed combination starters will mount in standard 20 in. wide by 15 in. or 20 in. deep sections, except where noted. All starters with MCP frames through 250 A use PowerPact electronic motor circuit protectors. All starters with MCP frames above 250 A use L-frame Mag-Gard motor circuit protectors. All units are UL Listed.

Motor Control Center units are available with short circuit ratings up to 100,000 A.

Starter Horsepower								NEMA Size	MCP Frame (Amps)	Space (Inches)
Constant Horsepower				Constant Or Variable Torque						
208 V	240 V	480 V	600 V	208 V	240 V	480 V	600 V			
5	5	7.5	7.5	5	7.5	10	10	1	30	21
—	—	10	5	—	—	—	15	2	30	24
7.5	10	20	20	10	10	25	25		50	
—	—	—	—	—	15	—	—		100	
10	—	25	30	—	—	—	30	3	50	30
20	25	40	40	20	25	50	50		100	
—	—	—	—	25	30	—	—		150	
—	—	50	60	—	—	—	60	4	100	33
30	40	75	75	40	40	75	100		150	
—	—	—	—	—	50	100	—		250	
60	75	150	150	75	100	200	200	5	400	72 (25 W)

**Full Voltage 2-Speed Reversing Starters with Circuit Breakers**

This table lists the option to provide reversing contactors and control to a standard 2-speed starter. The reversing contactors will be the same NEMA size as the 2-speed starter contactor. The control circuit/control circuit transformer should be sized for the additional contactor load.

**Add Reversing to 2-Speed Starter**

Application	2-Speed Starter Size	Space (Inches)
Reversing in both speeds Reversing in low speed only Reversing in high speed only	1	12
	2	12
	3	18
	4 <sup>1</sup>	24

<sup>1</sup> 25 in. wide section required when a circuit breaker disconnect is used.

**Wye-Delta Closed Transition Starters with Circuit Breakers (Non-UL Listed)**

Wye-Delta Closed Transition combination starters will mount in standard 20 in. wide by 15 in. or 20 in. deep sections, except where noted. All Wye-Delta starter units with circuit breaker disconnects use thermal magnetic (TM) circuit breakers.

Motor Control Center units are available with short circuit ratings up to 100,000 A.

Starter Horsepower <sup>1</sup>				NEMA Size	TM Trip/Frame (Amps)	Space (Inches) <sup>2</sup>
208 V	240 V	480 V	600 V			
1.5	2	5	5	1	15/150	60
2	3	7.5	7.5		20/150	
3	5	10	10		30/150	
5	—	15	15		40/150	
—	7.5	—	—		50/150	
7.5	10	—	—		60/150	
10	—	—	—		70/150	
—	—	—	20	2	40/150	66
—	—	20	30		60/150	
—	—	25	—		70/150	
15	15	30	40		90/150	
20	25	40	—		100/150	
—	—	50	50	3	100/150	72 (30 W)
25	—	—	—		110/150	
—	30	75	75		125/150	
30	40	—	—		150/150	
40	—	—	—		175/250	
—	50	—	—	4	200/250	Two full sections required 2 @ (20 W x 20D)
—	—	—	100		150/150	
—	—	100	—		175/250	
50	—	—	150		225/250	
—	75	150	—		250/250	
60	—	—	—	5	300/400	Two full sections required 1 @ (20 W x 20 D) 1 @ (30 W x 20 D)
—	—	—	250		300/400	
75	100	250	300		350/400	
—	125	—	—		400/400	
125	150	300	—		—	
150	—	—	—	6	—	Three full sections required 2 @ (20 W x 20 D) 1 @ (30 W x 20 D)
—	—	350	400		—	
—	200	400	500		—	
200	250	500	600	6	—	Three full sections required 1 @ (20 W x 20 D) 1 @ (25 W x 20 D) 1 @ (30 W x 20 D)
250	300	—	700		—	
300	350	600	—		—	

<sup>1</sup> Wye-Delta starter motor information sheet is required with each Wye-Delta starter.

<sup>2</sup> Space requirements listed are for resistor banks that meet standard Wye-Delta starting characteristics. Additional space may be required for other Wye-Delta applications. Contact the MCC TAG for layout information.

**Wye-Delta Open Transition Starters with Circuit Breakers (Non-UL Listed)**

Wye-Delta Open Transition combination starters will mount in standard 20 in. wide by 15 in. or 20 in. deep sections, except where noted. All Wye-Delta starter units with circuit breaker disconnects use PowerPact thermal magnetic (TM) circuit breakers.

Motor Control Center units are available with short circuit ratings up to 100,000 A.

Starter Horsepower <sup>1</sup>				NEMA Size	TM Trip/Frame (Amps)	Space (Inches) <sup>2</sup>
208 V	240 V	480 V	600 V			
1.5	2	5	5	1	15/150	24
2	3	7.5	7.5		20/150	
3	5	10	10		30/150	
5	—	15	15		40/150	
—	7.5	—	—		50/150	
7.5	10	—	—		60/150	
10	—	—	—		70/150	
—	—	—	20	2	40/150	30
—	—	20	30		60/150	
—	—	25	—		70/150	
15	15	30	40		90/150	
20	25	40	—		100/150	
—	—	50	50	3	100/150	42
25	—	—	—		110/150	
—	30	75	75		125/150	
30	40	—	—		150/150	
40	—	—	—		175/250	
—	50	—	—		200/250	
—	—	—	100	4	150/150	72 (20 W)
—	—	100	—		175/250	
50	—	—	150		225/250	
—	75	150	—		250/250	
60	—	—	—		300/400	
—	—	—	250	5	300/400	72 (30 W)
75	100	250	300		350/400	
—	125	—	—		400/400	
125	150	300	—			
150	—	—	—			
—	—	—	350	6		Two full sections required 1 @ (20 W x 20 D) 1 @ (30 W x 20 D)
—	—	350	400			
—	200	400	500	6		Two full sections required 1 @ (25 W x 20 D) 1 @ (30 W x 20 D)
200	250	500	600			
250	300	—	700			
300	350	600	—			

<sup>1</sup> Wye-Delta starter motor information sheet is required with each Wye-Delta starter.

<sup>2</sup> Space requirements listed are for resistor banks that meet standard Wye-Delta starting characteristics. Additional space may be required for other Wye-Delta applications. Contact the MCC TAG for layout information.

**Full Voltage Non-Reversing (FVNR) Starters with Fusible Switch Disconnects**

FVNR combination starters will mount in 20 in. wide by 15 in. or 20 in. deep sections, except where noted. All FVNR starter units with fusible switch disconnects are provided with Class H fuse clips. Class R fuse clips can be provided at no additional charge. Fusible disconnect combination starters Sizes 5 and 6 use molded case automatic circuit interrupters in series with fuse clips.

**NOTE:** Do not use renewable link fuses in fused switches.

All Compac 6, NEMA-rated, six-inch units use Class J fuses (rated for 100,000 AIR at 600 V). Compac 6 units mount in 20 in. wide by 15 in. or 20 in. deep sections. Up to twelve Compac 6 units can be installed in a Model 6 vertical section.

Motor Control Center unit short circuit current ratings to 100,000 A are available.

Starter Type and Horsepower				NEMA Size	Fusible Switch (Amps)	Space (Inches)
208 V	240 V	480 V	600 V			
5	5	10	10	1	30	6 <sup>1</sup>
7.5 <sup>2</sup>	7.5	—	—		60	
5	5	10	10	1	30	12
7.5 <sup>2</sup>	7.5	—	—		60	
10	15	25	25	2	100	
20	25	50	50	3	200	
25	30	—	—		18	
40	50	100	100	4	400	30
75	100	200	200	5	600	72
150	200	400	400	6	600	72 (30 W x 20 D)

<sup>1</sup> Compac 6 starters.

<sup>2</sup> 5 hp maximum with solid state overload relays.

**Full Voltage Non-Reversing Vacuum Starters with Fusible Switch Disconnects**

FVNR vacuum combination starters will mount in 20 in. wide by 15 in. or 20 in. deep sections, except where noted. All FVNR vacuum starters with fusible disconnects are provided with Class J fuse clips. Fusible disconnect combination starters Sizes 5 and 6 use molded case automatic circuit interrupters in series with fuse clips.

Motor Control Center unit short circuit current ratings to 100,000 A are available.

Starter Horsepower				NEMA Size	Fusible Switch (Amps)	Space (Inches)
208 V	240 V	480 V	600 V			
40	50	100	100	4	200	30
75	100	200	200	5	400	72
150	200	400	400	6	600	72 (30 W x 20 D)

**Application-Rated Compac 6 Starters—Full Voltage Non-Reversing with Fusible Disconnects**

All Compac 6 application-rated, six-inch starters use TeSys D-Line contactors and Class J fuses (rated for 100,000 AIR at 600 V). Compac 6 application-rated six-inch starters will mount in 20 in. wide by 15 in. or 20 in. deep sections. Select application rated starters based on system voltage and motor full load amps.

Starter Ampacity				Overload Relay Ampacity Range <sup>1</sup>	Fusible Switch (Amps)	Space (Inches)	
208 V	240 V	480 V	600 V				
1	1	1	1	0.63 to 1.0	30	6	
1.6	1.6	1.6	1.6	1.0 to 1.6			
2.5	2.5	2.5	2.5	1.6 to 2.5			
4	4	4	4	2.5 to 4.0			
5.5	5.5	5.5	5.5	4.0 to 5.5			
7	7	7	6.1	5.5 to 7.0			
—	—	7.6	—	7.0 to 7.6			
9	9	—	—	7.0 to 9.0			
—	9.6	—	—	9.0 to 9.6			
11	—	—	—	9.0 to 11			
—	—	—	7	6.1 to 7.0			
—	—	—	9	7.0 to 9.0			
—	—	9	—	7.6 to 9.0			
—	—	—	11	9.0 to 11			
—	—	12	—	9.0 to 12			
—	12	—	—	9.6 to 12			
12	—	—	—	11 to 12			
—	—	14	—	12 to 14			
17	17	—	—	12 to 17.5			
22	22	—	—	17.5 to 22			
—	—	—	12	11 to 12			
—	—	—	17	12 to 17			
—	—	17	—	14 to 17			
—	—	23	23	17 to 23			
23	23	—	—	22 to 23			
—	—	—	27	23 to 27			
30	30	30	—	23 to 30			
—	—	34	—	30 to 34			
37	37	—	—	30 to 37			
42	42	—	—	37 to 42			
—	—	—	—	—	60		6
—	—	—	12	11 to 12			
—	—	—	17	12 to 17			
—	—	17	—	14 to 17			
—	—	23	23	17 to 23			
23	23	—	—	22 to 23			
—	—	—	27	23 to 27			
30	30	30	—	23 to 30			
—	—	34	—	30 to 34			
37	37	—	—	30 to 37			

<sup>1</sup> Maximum overload relay ampacity range when used in Compac 6 starters.

**Full Voltage Reversing (FVR) Starters with Fusible Switch Disconnects**

FVR combination starters will mount in 20 in. wide by 15 in. or 20 in. deep sections, except where noted. All FVR starter units with fusible switch disconnects are provided with Class H fuse clips as standard. Class R fuse clips are available. Size 5 fusible disconnect combination starters use a molded case automatic circuit interrupter in series with fuse clips. All units are UL Listed.

Motor Control Center units are available with short circuit ratings up to 100,000 A.

Starter Horsepower				NEMA Size	Fusible Switch (Amps)	Space (Inches)
208 V	240 V	480 V	600 V			
5	5	10	10	1	30	18
7.5	7.5	—	—		60	
10	15	25	25	2	60	
20	25	50	50	3	100	27
40	50	100	100	4	200	39
75	100	200	200	5	400	72 (25 W)

**Full Voltage Reversing Vacuum Starters with Fusible Switch Disconnects**

Vacuum combination starters will mount in 20 in. wide by 15 in. or 20 in. deep sections, except where noted. All vacuum starter units with fusible disconnects are provided with Class J fuse clips. These starters use molded case automatic circuit interrupters in series with fuse clips.

Motor Control Center units are available with short circuit ratings up to 100,000 A.

Starter Type and Horsepower				NEMA Size	F/S Amps	Space (Inches)
208 V	240 V	480 V	600 V			
40	50	100	100	4	200	39
75	100	200	200	5	400	72 (25 W)



**Application-Rated Compac 6 Starters—Full Voltage Reversing with Fusible Disconnects**

All Compac 6 application-rated, six-inch starters with fusible switch disconnects use TeSys D-Line contactors and Class J fuses (rated for 100,000 AIR at 600 V). Compac 6 application-rated, six-inch starters will mount in 20 in. wide by 15 in. or 20 in. deep sections. Select application rated units based on system voltage and motor full load amps.

Starter Ampacity				Overload Relay Ampacity Range <sup>1</sup>	Fusible Switch (Amps)	Space (Inches)
208 V	240 V	480 V	600 V			
1	1	1	1	0.63 to 1.0	30	6
1.6	1.6	1.6	1.6	1.0 to 1.6		
2.5	2.5	2.5	2.5	1.6 to 2.5		
4	4	4	4	2.5 to 4.0		
5.5	5.5	5.5	5.5	4.0 to 5.5		
—	—	—	6.1	5.5 to 6.1		
7	7	7	—	5.5 to 7.0		
—	—	7.6	—	7.0 to 7.6		
9	9	—	—	7.0 to 9.0		
—	9.6	—	—	9.0 to 9.6		
11	—	—	—	9.0 to 11		
—	—	—	7	6.1 to 7.0		
—	—	—	9	7.0 to 9.0		
—	—	9	—	7.6 to 9.0		
—	—	—	11	9.0 to 11		
—	—	12	—	9.0 to 12		
—	12	—	—	9.6 to 12		
12	—	—	—	11 to 12		
—	—	14	—	12 to 14		
17	17	—	—	12 to 17.5		
22	22	—	—	17.5 to 22		
					60	

<sup>1</sup> Maximum overload relay ampacity range when used in Compac 6 starters.

**Reduced Voltage Autotransformer (RVAT) Starters with Fusible Switch Disconnects**

RVAT combination starters will mount in 20 in. wide by 15 in. or 20 in. deep sections, except where noted. Sections with RVAT starters require single shipping splits. All RVAT starter units with fusible disconnects are provided with Class H fuse clips as standard. Class R fuse clips are available. Fusible disconnect combination starters Sizes 5 and 6 use molded case automatic circuit interrupters in series with fuse clips.

Motor Control Center units are available with short circuit ratings up to 100,000 A.

Starter Type and Horsepower				NEMA Size	Fusible Switch (Amps)	Space (Inches)
208 V	240 V	480 V	600 V			
20	25	50	50	3	100	54 (20 D)
40	50	100	100	4	200	72 (20 D)
75	100	200	200	5	400	72 (25 W x 20 D)
150	200	400	400	6	600	72 (50 W x 20 D)

**Reduced Voltage Autotransformer Vacuum Starters with Fusible Switch Disconnects**

Sections with RVAT starters require single shipping splits. Provided with Class J fuse clips. Fusible disconnect combination starters Sizes 5 and 6 use molded case automatic circuit interrupters in series with fuse clips. All units are UL Listed.

Motor Control Center units are available with short circuit ratings up to 100,000 A.

Starter Type and Horsepower				NEMA Size	Fusible Switch (Amps)	Space (Inches)
208 V	240 V	480 V	600 V			
40	50	100	100	4	200	72 (20 D)
75	100	200	200	5	400	72 (25 W x 20 D)
150	200	400	400	6	600	72 (50 W x 20 D)

**Full Voltage 2-Step Part-Winding (FVPW) Starters with Fusible Switch Disconnects**

Part-winding starters use a fusible disconnect with separate fuse clips for each of the two motor windings. Each switch has an external operating mechanism. Part-winding starters require six thermal units. All units are UL Listed.

Motor Control Center units are available with short circuit ratings up to 100,000 A.

Starter Horsepower				NEMA Size	MCP Frame (Amps)	Space (Inches)
208 V	240 V	480 V	600 V			
5	5	10	15	1	30	30
—	—	25	25	2	60	30
—	—	50	60	3	100	42
—	—	—	100	4	200	66
150	150	350	350	5	400	72 (25 W)

**Full Voltage 2-Speed, 1-Winding Starters (Consequent Pole) with Fusible Switch Disconnects**

Two-speed combination starters will mount in standard 20 in. wide by 15 in. or 20 in. deep sections, except where noted. Motor windings are Wye connected as standard. Available as Open Delta connected. All units are UL Listed.

Motor Control Center units are available with short circuit ratings up to 100,000 A.

Starter Type and Horsepower								NEMA Size	Fusible Switch (Amps)	Space (Inches)
Constant Horsepower				Constant or Variable Torque						
208 V	240 V	480 V	600 V	208 V	240 V	480 V	600 V			
5	5	7.5	7.5	5	5	10	10	1	30	21
—	—	—	—	7.5	7.5	—	—		60	
7.5	10	20	20	10	15	25	25	2	60	24
20	25	40	40	25	30	50	50	3	100	51 <sup>1</sup>
30	40	75	75	40	50	100	100	4	200	66
60	75	150	150	75	100	200	200	5	400	72 (25 W)

<sup>1</sup> When using an ambient compensated, bimetallic overload relay, 60 in. of mounting space is required.

**Full Voltage 2-Speed, 2-Winding Starters (Separate Winding) with Fusible Switch Disconnects**

Two-speed combination starters will mount in standard 20 in. wide by 15 in. or 20 in. deep sections, except where noted. All units are UL Listed.

Motor Control Center units are available with short circuit ratings up to 100,000 A.

Starter Type and Horsepower								NEMA Size	Fusible Switch (Amps)	Space (Inches)
Constant Horsepower				Constant or Variable Torque						
208 V	240 V	480 V	600 V	208 V	240 V	480 V	600 V			
5	5	7.5	7.5	5	5	10	10	1	30	21
—	—	—	—	7.5	7.5	—	—		60	
7.5	10	20	20	10	15	25	25	2	60	24
20	25	40	40	25	30	50	50	3	100	30
30	40	75	75	40	50	100	100	4	200	39
60	75	150	150	75	100	200	200	5	400	72 (25 W)

**Full Voltage 2-Speed Reversing Starters with Fusible Switch Disconnects**

The table below lists the option to provide reversing contactors and control to a standard 2-speed starter. The reversing contactors will be the same NEMA size as the 2-speed starter contactor. The control circuit/control circuit transformer should be sized for the additional contactor load.

**Add Reversing to 2-Speed Starter**

Application	2-Speed Starter Size	Space (Inches)
Reversing in both speeds Reversing in low speed only Reversing in high speed only	1	12
	2	12
	3	18
	4	24

**Wye-Delta Closed Transition Starters with Fusible Switch Disconnects (Non-UL Listed)**

Wye-Delta Closed Transition combination starters will mount in standard 20 in. wide by 15 in. or 20 in. deep sections, except where noted.

Motor Control Center units are available with short circuit ratings up to 100,000 A.

Starter Horsepower <sup>1</sup>				NEMA Size	Fusible Switch (Amps)	Space (Inches) <sup>2</sup>
208 V	240 V	480 V	600 V			
10	10	15	15	1	60	60
20	25	40	40	2	100	66
40	50	75	75	3	200	72 (30 W)
60	75	150	150	4	400	Two full sections required 1 @ (25 W x 20 D) 1 @ (30 W x 20 D)
150	150	300	300	5	600	Three full sections required 2 @ (25 W x 20 D) 1 @ (30 W x 20 D)
300	350	600	700	6	800	Three full sections required 2 @ (25 W x 20 D) 1 @ (35 W x 20 D)

<sup>1</sup> Wye-Delta starter motor information sheet is required with each Wye-Delta starter.

<sup>2</sup> Space requirements listed are for resistor banks that meet standard Wye-Delta starting characteristics. Additional space may be required for other Wye-Delta applications. Contact the MCC TAG for layout information.

**Wye-Delta Open Transition Starters with Fusible Switch Disconnects (Non-UL Listed)**

Wye-Delta Open Transition combination starters will mount in standard 20 in. wide by 15 in. or 20 in. deep sections, except where noted.

Motor Control Center units are available with short circuit ratings up to 100,000 A.

Starter Horsepower <sup>1</sup>				NEMA Size	Fusible Switch (Amps)	Space (Inches) <sup>2</sup>
208 V	240 V	480 V	600 V			
10	10	15	15	1	60	30
20	25	40	40	2	100	42
40	50	75	75	3	200	72 (20 W)
60	75	150	150	4	400	
150	150	300	300	5	600	72 (30 W)
300	350	600	700	6	800	Two full sections required: 1 @ (25 W x 20 D) 1 @ (30 W x 20 D)

<sup>1</sup> Wye-Delta starter motor information sheet is required with each Wye-Delta starter.

<sup>2</sup> Space requirements listed are for resistor banks that meet standard Wye-Delta starting characteristics. Additional space may be required for other Wye-Delta applications. Contact the MCC TAG for layout information.

**Altivar® 61 and 71 AC Drives**

Altivar 61 and 71 AC drives in MCCs offer economical, general purpose drives in a high density, space-saving package. Units are available in NEMA/EEMAC Type 1, Type 1 Gasketed (Type 1A), Type 3R Outdoor-Rated, and Type 12 MCC enclosures in the following ranges.



Motor Ratings	Altivar 61 Variable Torque Rated	Altivar 71 Constant Torque Rated
<b>NEMA/EEMAC Type 1 and Type 1A (Gasketed) Enclosures</b>		
460 Vac, 3-phase, 60 Hz	1–500 hp	1–450 hp
230 Vac, 3-phase, 60 Hz	1–50 hp	1–40 hp
200 Vac, 3-phase, 60 Hz	1–40 hp	1–40 hp
<b>NEMA/EEMAC Type 3R Enclosures</b>		
460 Vac, 3-phase, 60 Hz	Use constant torque	1–40 hp
230 Vac, 3-phase, 60 Hz		1–20 hp
200 Vac, 3-phase, 60 Hz		1–20 hp
<b>NEMA/EEMAC Type 12 Enclosures</b>		
460 Vac, 3-phase, 60 Hz	1–100 hp	1–75 hp
230 Vac, 3-phase, 60 Hz	1–50 hp	1–40 hp
200 Vac, 3-phase, 60 Hz	1–40 hp	1–40 hp

**NOTE:** Determine the type of application the drive will be applied to: variable torque or constant torque. Variable torque ratings are to be used on centrifugal pumps and fan loads which are considered light duty with maximum 110% current overload. The Altivar 61 AC Drive is used for variable torque applications and has many specific features dedicated for pump and fan applications. Constant torque ratings are to be used on all other types of loads to provide normal duty and maximum overload capacity of 170%. The Altivar 71 AC Drive is used for constant torque application and has increased rating and performance for demanding loads.

**MCC Package Features**

As standard, basic MCC Altivar 61 and 71 AC drive units include:

- Altivar 61 or 71 AC Drive
- Operator keypad display mounted on the front of the unit
- Disconnect circuit breaker or fusible switch
- 3% line reactors above 50 hp Variable Torque (VT) or 40 hp Constant Torque (CT) @ 480 V, above 25 hp VT or 20 hp CT @ 240 V, and above 20 hp VT/CT @ 208 V
- Cooling fans
- UL 845 listed for 100,000 AIC short circuit withstand at 480 V
- Control station plate with space for five 22 mm operators or three 30 mm (9001 Type K) operators

MCC Altivar AC Drive units are plug-on style saddles (up to 50 hp VT) or full sections which can be factory/field-installed in Model 6 MCCs or field-installed in Model 5 MCCs. There are no preferred or restricted locations for mounting any Altivar AC Drive in Square D® brand MCC sections.

Circuit breakers used on the MCC Altivar AC Drive basic units are thermal-magnetic type. As an option, PowerPact electronic motor circuit protectors can be substituted for the thermal-magnetic circuit breakers up to 250 A. Fusible switches used on the MCC Altivar AC Drive units are bladed switches (molded case switches above 100 A) with Class J fuse clips installed between the drive and the switch.

**NOTE:** Fusible disconnect drives do not include the power fuses installed at the factory.

**Factory Options:**

- Bypass contactors available as either integrated in the drive or barred from the drive unit (<250 hp)
- Line or load contactor: <125 hp Variable Torque (VT) or 100 hp Constant Torque (CT)
- Line reactors (3 or 5%)
- NOTE:** 3% line reactors are standard above 50 hp VT or 40 hp CT @ 480V, above 25 hp VT or 20 hp CT @ 240V, and above 20 hp CT/VT @ 208V
- Motor protecting filters or output reactors
- Pilot devices 22 mm or 30 mm
- Unit extensions to provide additional panel space
- Wired and unwired control relays

## **Altivar AC Drive Features**

### **Performance**

Torque: sensorless flux vector control (ATV71 can include sensor for tighter control)

Frequency range: 0.1 to 500Hz

Speed range: 1 to 100 open loop

Overtorque = 170% of nominal torque for 60 seconds (220% for 2 seconds) for ATV71 Constant Torque rated drives and 110% of nominal torque for 60 seconds for ATV61 Variable Torque rated drives

Auto-tuning

Dynamic speed regulation

### **Protective Features**

Motor and inverter thermal protection

Short-circuit between phases and between phase and ground

Main supply and motor phase loss

Mains undervoltage and overvoltage

Degraded operation on voltage dip

Auto restart

Catch on the fly with speed search

### **Monitoring and Indication**

Door-mounted, LCD type operator keypad displays setup parameters and the last fault occurrence with plain text display. Factory preset for the most common adjustments and the control schemes ordered with the unit. Security to prevent accidental adjustments is provided by a password. Programs are saved in the keypad, allowing storage and retrieval of four different programs between multiple drive units.

Other features include:

Real time display of:

- Drive state (running, ready, accelerating, decelerating, etc.)
- Reference frequency (in Hz)
- Output frequency (in Hz)
- Motor speed (in RPM)
- Motor current (in amps)
- Mains voltage (in volts)
- Motor voltage (in volts)
- Output power (in watts)
- Motor thermal state (in %)
- Drive thermal state (in %)
- Energy consumed (Wh)
- Last fault
- Run time (hrs)

One normally open contact indication of drive running (closes on run)

One normally closed contact indication of drive fault (opens on fault)

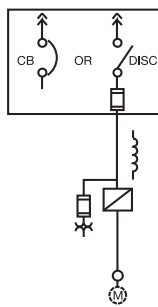
Standard Analog output for motor current, motor frequency, ramp output, motor power and motor torque.

Standard Modbus or CANopen serial communication port

**Options**

- Commissioning software for personal computers
- I/O extension cards
- 120 Vac interface card
- Controller Inside option card
- Modbus® plus communication card
- Uni-Telway/Modbus communication card
- Ethernet communication card
- DeviceNet™ communication card
- PROFIBUS communication card

**“Basic” Drive Power Circuit**



- Consist of disconnect switch and drive pre-programmed for selected options if applicable.
- Unit is UL 845 Listed for 100,000 A short circuit current.
- Includes operator LCD keypad/display mounted on front of the unit.
- Pilot Devices are optional and are available as 22 mm XB4 or XB5 type pilot devices, or 30 mm 9001 Type K pilot devices.
- Control power transformer (480 V/120 V), if necessary, for enclosure ventilation fans is included.

**Variable Torque Rated 480 V Drives with Circuit Breaker Disconnects**

Motor Rated Horsepower @ 460 V	Maximum Continuous Output Amps	Space (Inches)	
		NEMA/EEMAC Type 1 and 1A (Gasketed)	NEMA/EEMAC Type 12
1	2.1	12	24
2	3.4		
3	4.8		
5	7.6	15	30
7.5	11		
10	14	24	36
15	21		
20	27	27	
25	34		
30	40	45	
40	52		
50	65		
60	77		
75	96	72 (20 W)	72 (20 W)
100	124		
125	156	72 (25 W x 20 D)	Not available in NEMA/EEMAC Type 12
150	180	72 (30 W x 20 D)	
200	240		
250	302		
300	361	72 (35 W x 20 D)	
350	414		
400	477		
450	515		
500	590		

**Variable Torque Rated 480 V Drives with Fusible Switch Disconnects**

Motor Rated Horsepower @ 460 V	Maximum Continuous Output Amps	Space (Inches)	
		NEMA/EEMAC Type 1 and 1A (Gasketed)	NEMA/EEMAC Type 12
1	2.1	12	24
2	3.4		
3	4.8		
5	7.6	15	30
7.5	11		
10	14	24	36
15	21		
20	27	27	
25	34		
30	40	45	
40	52		
50	65		
60	77		
75	96	72 (20 W)	72 (20 W)
100	124		



### Variable Torque Rated 240 V Drives with Circuit Breaker Disconnects

Motor Rated Horsepower @ 230 V	Maximum Continuous Output Amps	Space (Inches)	
		NEMA/EEMAC Type 1 and 1A (Gasketed)	NEMA/EEMAC Type 12
1	4.2	12	24
2	6.8		
3	11		
5	15.2	15	30
7.5	22	24	36
10	28		
15	42	45	45
20	54		
25	68		
30	80		
40	104	72 (20 W)	72 (20 W)
50	130		

### Variable Torque Rated 240 V Drives with Fusible Switch Disconnects

Motor Rated Horsepower @ 230 V	Maximum Continuous Output Amps	Space (Inches)	
		NEMA/EEMAC Type 1 and 1A (Gasketed)	NEMA/EEMAC Type 12
1	4.2	12	24
2	6.8		
3	11		
5	15.2	15	30
7.5	22	24	36
10	28		
15	42	45	48
20	54		
25	68		
30	80		
40	104	72 (20 W)	72 (20 W)
50	130		

### Variable Torque Rated 208 V Drives with Circuit Breaker Disconnects

Motor Rated Horsepower @ 200 V	Maximum Continuous Output Amps	Space (Inches)	
		NEMA/EEMAC Type 1 and 1A (Gasketed)	NEMA/EEMAC Type 12
1	4.6	12	24
2	7.5	15	30
3	11		
5	16.7		
7.5	24	24	36
10	31		
15	46	45	45
20	59		
25	75		
30	88		
40	114	72 (20 W)	72 (20 W)

**Variable Torque Rated 208 V Drives with Fusible Switch Disconnects**

Motor Rated Horsepower @ 200 V	Maximum Continuous Output Amps	Space (Inches)	
		NEMA/EEMAC Type 1 and 1A (Gasketed)	NEMA/EEMAC Type 12
1	4.6	12	24
2	7.5	15	30
3	11		
5	16.7		
7.5	24	24	36
10	31	45	48
15	46		
20	59		
25	75	72 (20 W)	72 (20 W)
30	88		
40	114		

**Constant Torque Rated 480 V Drives with Circuit Breaker Disconnects**

Motor Rated Horsepower @ 460 V	Maximum Continuous Output Amps	Space (Inches)	
		NEMA/EEMAC Type 1 and 1A (Gasketed)	NEMA/EEMAC Type 12
1	2.1	12	24
2	3.4		
3	4.8		
5	7.6	15	30
7.5	11	24	36
10	14		
15	21		
20	27	27	45
25	34		
30	40		
40	52	45	45
50	65		
60	77		
75	96	72 (20 W)	72 (20 W)
100	124		
125	156		
150	180	72 (30 W x 20 D)	Not available in NEMA/EEMAC Type 1
200	240	72 (35 W x 20 D)	
250	302		
300	361		
350	414		
400	477		
450	515		

Constant Torque Rated 480 V Drives with Fusible Switch Disconnects

Motor Rated Horsepower @ 460 V	Maximum Continuous Output Amps	Space (Inches)	
		NEMA/EEMAC Type 1 and 1A (Gasketed)	NEMA/EEMAC Type 12
1	2.1	12	24
2	3.4		
3	4.8		
5	7.6	15	30
7.5	11		
10	14	24	36
15	21		
20	27		
25	34	45	48
30	40		
40	52		
50	65	72 (20 W)	72 (20 W)
60	77		
75	96		

Constant Torque Rated 208/240 V Drives with Circuit Breaker Disconnects

Motor Rated Horsepower		Maximum Continuous Output Amps	Space (Inches)	
@ 200 V	@230 V		NEMA/EEMAC Type 1 and 1A (Gasketed)	NEMA/EEMAC Type 12
—	1	4.6/4.2	12	24
—	2	7.5/6.8		
3	3	11/9.6		
5	5	16.7/15.2	15	30
7.5	7.5	24/22		
10	10	31/28	24	36
15	15	46/42		
20	20	59/54		
25	25	75/68	45	45
30	30	88/80		
40	40	114/104		
			72 (20 W)	72 (20 W)

Constant Torque Rated 208/240 V Drives with Fusible Switch Disconnects

Motor Rated Horsepower		Maximum Continuous Output Amps	Space (Inches)	
@ 200 V	@230 V		NEMA/EEMAC Type 1 and 1A (Gasketed)	NEMA/EEMAC Type 12
—	1	4.6/4.2	12	24
—	2	7.5/6.8		
3	3	11/9.6		
5	5	16.7/15.2	15	30
7.5	7.5	24/22		
10	10	31/28	24	36
15	15	46/42		
20	20	59/54		
25	25	75/68	45	48
30	30	88/80		
40	40	114/104		
			72 (20 W)	72 (20 W)

## Combination Altistart® 48 Soft Start Units



Altistart 48 (ATS48) MCC soft start units are available from 11–604 A in NEMA/EEMAC Type 1, Type 1A (Gasketed), Type 12, and Type 3R MCC enclosures. Units are available for three phase, 60 Hz, 208 V, 240 V, 480 V, or 600 V, 3- or 4-wire power systems. The Altistart 48 soft start in MCCs can provide soft starting (reduced voltage) and deceleration along with machine and motor protection of standard NEMA B-Design three-phase squirrel cage asynchronous motors in the following power ranges:

- 3–200 hp @ 208 V
- 5–250 hp @ 230 V
- 10–500 hp @ 460 V
- 15–600 hp @ 575 V

The MCC soft start units integrate the latest technology Altistart 48 soft start from Schneider Electric into a combination starter package for MCCs. MCC soft start units include a shorting contactor, shunt trip input power disconnect, door-mounted keypad, and 120 Vac control circuitry. TeSys® D- and F-Line contactors are standard (NEMA-type contactors are optional). All packages and options are UL 845 Listed for a minimum 65,000 Amp short circuit rating up to 600V (ratings of 100,000 A @ 600 V are available with fuses).

All soft starter units with circuit breaker disconnects through 250 A and 800–1200 A frames use PowerPact® thermal magnetic (TM) circuit breakers. All soft starter units with 400–600 A frame disconnects use L-frame thermal-magnetic (TM) circuit breakers. The fusible switch disconnects used on MCC soft start units are automatic molded case switches. Provisions for Class J or L fuses are provided. Fuses are not installed at the factory. All units are UL Listed.

## Selection

The ATS48 controller must be selected on the basis of 3 main criteria:

- Main voltage supply: Three-phase AC voltage: 208, 240, 480, or 600 V
- The power and the nominal current (motor FLA) indicated on the motor nameplate
- The type of application and the operating cycle. The application types are:
  - Standard duty
  - Severe duty

**NOTE:** Standard or severe duty applications define the limiting values of the current and the duty cycle ratings.

### Standard Duty Applications

In standard duty applications, the ATS48 controller is designed to provide:

- Starting at 400% nominal motor current ( $I_n$ ) for 23 seconds or at 300% nominal motor current ( $I_n$ ) for 46 seconds from a cold state
- Starting at 300% nominal motor current ( $I_n$ ) for 23 seconds or at 400% nominal motor current ( $I_n$ ) for 12 seconds with a load factor of 50% and 10 starts per hour or an equivalent thermal cycling

The motor thermal protection conforms to Class 10 overload protection.

### Severe Duty Applications

In severe duty applications, the ATS48 controller is designed to provide:

- Starting at 400% nominal motor current ( $I_n$ ) for 48 seconds or at 300% nominal motor current ( $I_n$ ) for 90 seconds from a cold state
- Starting at 400% nominal motor current ( $I_n$ ) for 25 seconds with a load factor of 50% and 5 starts per hour or an equivalent thermal cycling

The motor thermal protection conforms to Class 20 overload protection.

Contact the MCC TAG for additional application information for those applications requiring:

2-speed or delta-wye motors

The ATS48 can operate with a 2-speed motor. A motor demagnetizing period must elapse before changing from low speed to high speed in order to avoid antiphase between the line supply and the motor, which would generate very high currents.

Motors other than NEMA Design B

High efficiency motors

Low slip motors

Power factor correction capacitors

Do not connect power factor correction capacitors to the terminals of a motor controlled by an ATS48 soft start. The power factor capacitors must be controlled and connected to a line side contactor sequenced by the ATS48 at end of starting.

Controller oversizing of more than 50%

Multi-motor applications

Motors may be connected in parallel provided that the power limit of the starter is not exceeded (the sum of the motor currents must not exceed the nominal current of the starter selected, depending on the type of application). Individual thermal protection and local disconnect is required for each motor.

Non-standard trip characteristics

Modifications not listed in this catalog

Horsepower greater than those listed in this catalog

Long motor cable lengths

Very long motor cables cause voltage drops due to the resistance of the cable. If the voltage drop is significant, it could affect the current consumption and the torque available. This criteria must be taken into account when selecting the motor and the starter.

**NOTE:** Do not use the ATS48 controller upstream of loads other than motors (for example transformers and resistance type loads).

See the Altistart 48 catalog #8636CT0201 and data bulletin #8600PD9201 for additional information.

## **Features**

### **Shorting Contactor**

A shorting contactor is supplied on all units. This allows the motor current to bypass the soft start's thyristors once the soft start has ramped up to full voltage/full speed. The use of a shorting contactor reduces temperature rise within the enclosure during steady state operation and requires less current carrying duty on the thyristors.

### **Torque Control System (TCS)**

The Altistart 48 uses TCS ramping to accelerate the motor to full voltage. Basing the acceleration ramp on the motor torque rather than current or voltage, as used in traditional soft starts, provides a linear speed ramp independent of the motor loading without tachometer feedback. The TCS ramp is also used for improved control of deceleration and eliminates the need for a special controller to handle water hammer problems.

### **Starting and Stopping**

Four types of starting are available:

- TCS soft start—adjustable from 1 to 60 seconds
- TCS with “boost”—adjustable from 50 to 100% of mains voltage
- Current limit—adjustable from 150 to 500% of controller rating
- Voltage ramping

Three types of stopping are available:

- Freewheel or coast to stop
- TCS soft stop—adjustable from 1 to 60 seconds
- InTele braking—adjustable from 50 to 100%

### **Protective Features**

- Solid state motor thermal overload protection—programmable from Class 10 through 30
- Soft start thermal protection
- Motor phase loss protection
- Line supply failure
- Overcurrent fault
- Locked rotor fault
- Line frequency outside limits +/-5% or +/-20%
- Selectable protection, including:
  - Phase reversal
  - Stall and jam
  - Thermal overload pre-alarm
  - Current threshold alarm
  - Underload fault
- Transient suppression modules on all contactors

### Monitoring and Indication

#### Door mounted keypad:

- Displays setup parameters and fault codes.

- Factory preset for most common adjustments.

- Security to avoid accidental controller modifications is provided by dip switches on the back of the keypad, which must be adjusted to provide access to 3 programming levels.

#### Real time indication via the digital keypad of:

- Motor current

- Load torque

- Motor thermal state

- Power factor

- Fault status

#### Two logic outputs:

- Motor thermal overload or indication of motor current present

- Current threshold alarm

- Motor underload alarm

One analog output for 4 to 20 or 0 to 20 mA indication of motor current, torque, thermal state, active power, or power factor.

Two logic inputs, which are configurable for force to freewheel, thermal overload reset, or indication of external fault.

#### Options:

- Input isolation contactor

- Full voltage bypass

- NEMA hp-rated contactors substituted for Telemecanique D or F line contactors

- Reversing

- 120 Vac control power transformer

- 120 Vac customer VA capacity added to control power transformer

- Push-To-Test pilot lights

- LED pilot lights

- Auxiliary interlocks

- Network Communications: Modbus®, DeviceNet™, PROFIBUS, and Ethernet

# Model 6 Motor Control Centers Application and General Information

## Soft Start Units

### Standard Duty Altistart 48 Soft Starts with Circuit Breaker Disconnects <sup>1</sup> (Pumps, Fans, Lightly Loaded, or Unloaded Starting Applications)

Starter Type and Horsepower			Soft Start Frame	Max. Unit Amps	TM Trip/Frame (Amps)	Space (Inches) <sup>2</sup>	
200 V	230 V	460 V				IEC Contactors	NEMA Contactors
3	—	—	D17	10	20/150	30	42
—	—	10		14	25/150		
—	5	—		15	30/150		
5	—	—	D22	16	30/150		
—	—	15		21	40/150		
—	7.5	—		24	45/150		
7.5	—	—	D32	24	45/150		
—	—	20		27	50/150		
—	10	—		28	50/150		
10	—	—	D38	30	60/150		
—	—	25		34			
—	—	30	D47	40	80/150		
—	15	—		42			
15	—	—	D62	46	110/150		
—	—	40		52			
—	20	—		54			
20	—	—	D75	59	110/150		
—	—	50		65			
—	25	—	D88	68	110/150		
25	—	—		74			
—	—	60		77			
—	30	—	C11	80	125/150		
30	—	—		88			
—	—	75		96			
—	40	—	C14	104	125/150		
40	—	—		114			
—	—	100		124			
—	50	—	C17	130	200/250		
50	—	—		143			
—	60	—	C21	154	200/250		
—	—	125		156			
60	—	—		169			
—	—	150	C25	180	250/600		
—	75	—		192			
75	—	—	C32	211	450/600		
—	—	200		240			
—	100	—		248			
100	—	—	C41	273	450/600		
—	—	250		302			
—	125	—	C48	312	600/800		
125	—	—		343			
—	150	—		360			
—	—	300	C59	361	800/800		
150	—	—		396			
—	—	350	C66	414	800/800		
—	—	400		477			
—	200	—		480			
200	—	—	C66	528	800/800		
—	—	500		590			
—	250	—		604			

<sup>1</sup> Motor rated horsepower shown for convenience only. Size per actual motor full load amps. For severe duty applications, choose the next larger horsepower size.

<sup>2</sup> Space shown is applicable to NEMA/EEMAC Type 1, 1A, 12, and 3R enclosures. Options may require additional space.



# Model 6 Motor Control Centers Application and General Information

## Soft Start Units

### Standard Duty Altistart 48 Soft Starts With Fusible Switch Disconnects <sup>1</sup> (Pumps, Fans, Lightly Loaded or Unloaded Starting Applications)

Starter Type and Horsepower				Soft Start Frame	Max. Unit Amps	F/S Amps (Fuse Class)	Space (Inches) <sup>2</sup>	
200 V	230 V	460 V	575 V				IEC Contactors	NEMA Contactors
3	—	—	—	D17	10	30 (J)	30	42
—	—	10	—		14			
—	5	—	—		15			
—	—	—	15		17			
5	—	—	—	D22	16	30 (J)		
—	—	15	—		21	30 (J)		
—	—	—	20		22	60 (J)		
—	7.5	—	—		24	60 (J)		
7.5	—	—	—	D32	24	60 (J)		
—	—	20	25		27			
—	10	—	—		28			
10	—	—	—	D38	30	60 (J)		
—	—	—	30		32			
—	—	25	—		34			
—	—	30	—	D47	40	100 (J)		
—	—	—	40		41			
—	15	—	—		42			
15	—	—	—	D62	46	100 (J)		
—	—	40	50		52			
—	20	—	—		54			
20	—	—	—	D75	59	200 (J)		
—	—	—	60		62			
—	—	50	—		65			
—	25	—	—	D88	68	200 (J)		
25	—	—	—		74			
—	—	60	75		77			
—	30	—	—	C11	80	200 (J)		
30	—	—	—		88			
—	—	75	—		96			
—	—	—	100	C14	99	200 (J)		
—	40	—	—		104			
40	—	—	—		114		200 (J)	
—	—	100	—	C17	124	400 (J)		
—	—	—	125		125	400 (J)		
—	50	—	—		130	400 (J)		
50	—	—	—	C21	143	400 (J)		
—	—	—	150		144			
—	60	—	—		154			
—	—	125	—	C25	156	400 (J)		
60	—	—	—		169			
—	—	150	—		180		400 (J)	
—	75	—	200	C32	192	400 (J)		
75	—	—	—		211		400 (J)	
—	—	200	—		240		600 (J)	
—	—	—	250	C41	242	600 (J)		
—	100	—	—		248	600 (J)		
100	—	—	—		273	600 (J)		
—	—	—	300	289				
—	—	250	—	302				
—	125	—	—	C48	312	800 (L)		
—	—	—	350		343		600 (J)	
125	—	—	—		343		600 (J)	
—	150	—	—	C59	360	800 (L)		
—	—	300	—		361	800 (L)		
—	—	—	400		382	800 (L)		
150	—	—	—	396				
—	—	350	—	414				
—	—	—	500	C66	472	1000 (L)		
—	—	400	—		477			
—	200	—	—		480			
200	—	—	—	C66	528	1000 (L)		
—	—	—	600		580	1000 (L)		
—	—	500	—		590	1200 (L)		
—	250	—	—		604	1200 (L)		

<sup>1</sup> Motor rated horsepower shown for convenience only. Size per actual motor full load amps. For severe duty applications, choose the next larger horsepower size. Power fuses are not included.  
<sup>2</sup> Space shown is applicable to NEMA/EEMAC Type 1, 1A, 12, and 3R enclosures. Options may require additional space.

# Model 6 Motor Control Centers

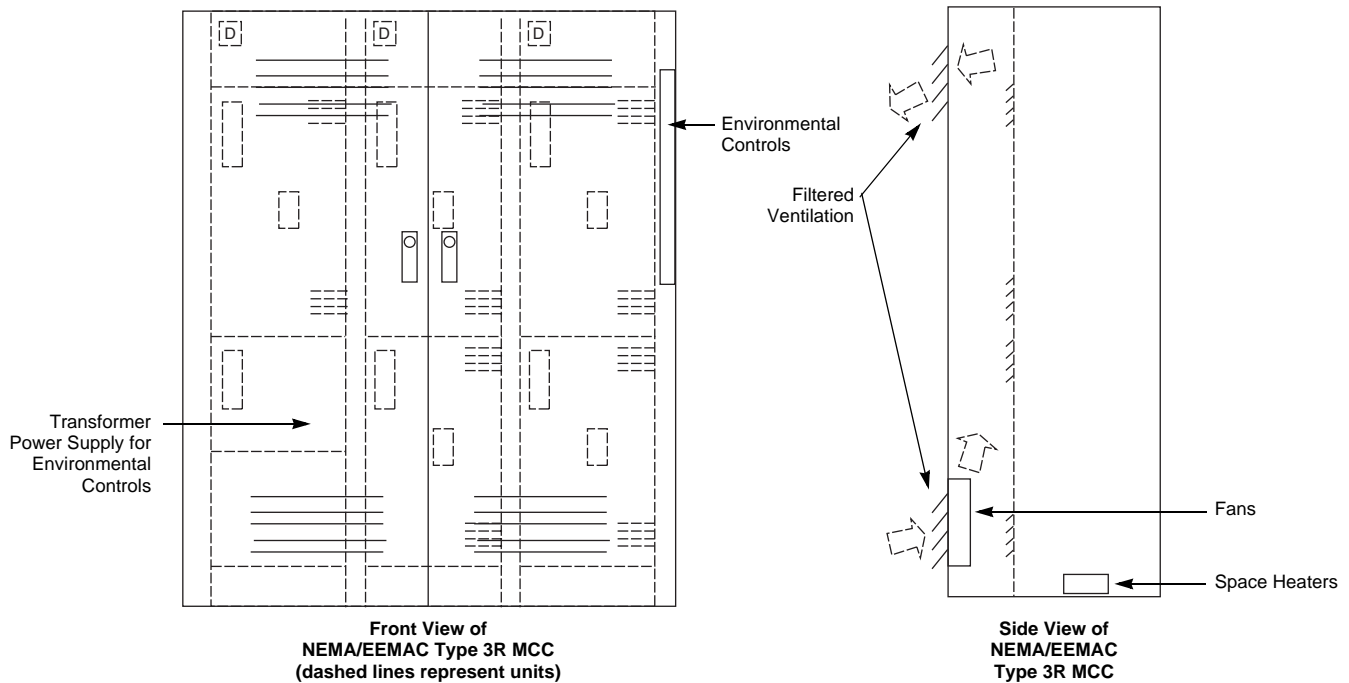
## Application and General Information

## NEMA Type 3R Enclosures for AC Drives and Soft Starts

### NEMA/EEMAC Type 3R Enclosure Applications for AC Drives and Soft Starts

NEMA/EEMAC Type 3R MCCs manufactured by Schneider Electric are non-walk-in enclosures with a design based on the standard Type 1 MCC. Additional housing and gasketing provide protection from rain, sleet, and ice. The Type 3R MCC for AC drives and soft starts features louvered and filtered openings on the front doors, along with humidity controls inside the enclosure (see Figure 1). The MCC enclosure is further modified to include fan-forced ventilation while continuing to meet NEMA/EEMAC Type 3R enclosure requirements and the UL 845 MCC standard.

### Center Ventilated NEMA/EEMAC Type 3R Enclosure



### Environmental Control

The ventilated NEMA/EEMAC Type 3R MCC manages the internal MCC environment to maintain the required temperature and humidity levels for the drive and soft start controls in outside environments from 14 to 104 °F (-10 to 40 °C). The following features are included:

**Dual Door Fans**—Dual door fans force fresh air into the enclosure and move air out of the enclosure. The centrifugal impeller fans use highly reliable ball bearing rotors. A factory-preset thermostat controls the fans, based on the MCC's internal temperature. Door interlock switches turn the fans off when the outer NEMA/EEMAC Type 3R door is opened.

**Positive Pressure Ventilation**—The intake fans, mounted at the lower vents, blow air into the cabinet. This air increases the cabinet's internal air pressure relative to the air pressure outside the cabinet. The "positive" air pressure created inside the cabinet helps force out dirt and contaminants. This positive pressure ventilation method is common practice for industrial atmospheres: it provides a cleaner environment for drive and soft start electronics than one that would be created by exhaust fans mounted at the upper vents.

**Space Heaters**—Space heaters add heat to prevent condensation during cooler periods, overnight, and in winter weather.

**NOTE:** Space heaters do not permit use of the MCC in temperatures below 14 °F (-10 °C).

**Humidity Controls** —It is crucial to maintain a level of dryness in or around the electronic controls for drives and soft starts. Condensation must be avoided. The space heaters will supply the MCC with heat when necessary to reduce condensate formation. A factory-preset thermostat and humidistat monitor humidity levels and turn on the space heaters to dry the internal MCC ambient air.

**Self-Contained Power Supply**—The fused control transformer(s) supplied in each MCC line-up provide power for space heaters and fans. There is no need for external power once the main 3-phase power is connected. The power supply is pre-wired at the factory to fans, space heaters, and environmental controls through protected wiring provisions. Each transformer is able to supply power to three sections and should be mounted at the bottom of the MCC section.

**Filtered Louvers**—Each NEMA/EEMAC Type 3R MCC door contains top and bottom louvers for ventilation. Behind each louver is a coarse rubber filter that helps keep debris from entering the MCC.

**NOTE:** All drives and soft starts include internal thermal protection switches to shut down the drive or soft start unit before damage occurs.

**Ratings**

Altivar 71: 1–40 hp, 480 V, or 1–15 hp, 208/230 V

**NOTE:** A maximum of four ATV71 drives are allowed in a single section. Mount drive units starting at the top of the section.

Altistart 48 Soft Start: 10–500 hp, 480 V  
                                   15–600 hp, 600 V  
                                   5–250 hp, 240 V  
                                   3–200 hp, 208 V

**NOTE:** In hotter climates, Schneider Electric suggests installing a shed for shading the MCC as a best practice, since high temperatures are not always consistent.

Altivar 71—Use constant torque ratings for variable torque applications  
 14 to 104 °F (-10 to 40 °C)  
 Up to 2000 A horizontal bus  
 Outdoor, Rainproof, Sleet Resistant Enclosure (NEMA/EEMAC Type 3R)  
 UL 845 Listed  
 0–480 Vac, 3Ph, 3W or 4W  
 Non-walk-in

**Unit Options**

**Options And Modifications**



Various options can be provided on Model 6 units to meet specific customer requirements. Many options require additional mounting space as indicated in the following tables. It is not necessary to add a unit extender modification to accommodate the additional space listed below. The space requirements listed are for typical unit arrangements. Unusual combinations or variations may require additional space.

The total space added to any one unit should total 3, 6, 9, 12, or 24 in. to avoid multiple unit extenders. Unit extenders may be specified to allow additional unit space for customer requirements (see page 81). Some units (primarily full section 72 in. units) contain room for limited options without the need for the additional space listed. Contact MCC TAG for additional information or layout assistance.

**NOTE:** Unit options listed are based on factory-selected components. Other devices are available. Contact MCC TAG for further information.

**Control And Timing Relays**

Description	Application	Space
5-pole Control Relay D-Line (wired or unwired), (3 NO + 2 NC)	Starter or MT unit	3
4-pole Control Relay Type X (wired or unwired), (2 NO + 2 NC)	Starter or MT unit	
9-pole Control Relay D-Line (wired or unwired), (5 NO + 4 NC)	Starter or MT unit	
8-pole Control Relay Type X (wired or unwired), (4 NO + 4 NC)	Starter or MT unit	
5-pole Latching Relay D-Line (wired or unwired), (3 NO + 2 NC)	4-pole relay with mechanical latch	
4-pole Latching Relay Type X (wired or unwired), (2 NO + 2 NC)	4-pole relay with mechanical latch	
Pneumatic Timer D-Line (wired or unwired), (3 NO + 2 NC) Instantaneous and (1 NO + 1 NC) Timed Contacts	On Delay	
Pneumatic Timer D-Line (wired or unwired), (3 NO + 2 NC) Instantaneous and (1 NO + 1 NC) Timed Contacts	Off Delay	
Pneumatic Timer Type X (wired or unwired), (2 NO + 2 NC) Instantaneous and (1 NO + 1 NC) Timed Contacts	On Delay	
Pneumatic Timer Type X (wired or unwired), (2 NO + 2 NC) Instantaneous and (1 NO + 1 NC) Timed Contacts	Off Delay	
Motor Operated Timing Relay, (Single Timing Step)	(1) Timed Circuit	6
	(2) Timed Circuit	
	Each Instantaneous Contact	
Multifunction Timing Relay Type RE7 (wired or unwired) <sup>1, 2</sup> 2PDT (form C)	Multifunction	3
2-pole Control Relay SK-Line (wired or unwired), (1 NO + 1 NC)	Starter or MT unit	0
3-pole Control Relay Type K (wired or unwired) , 3PDT (form C)	General Purpose	
4-pole Control Relay Type R (wired or unwired) 4PDT (form C)	General Purpose	
Phase Failure Relay Type MP (wired or unwired) , SPDT (form C)	Phase Failure	

<sup>1</sup> Fusible FVNR units Size 1 and 2 require 3 in. of space, max. (1). Not available in Compac starters with CPT.

<sup>2</sup> Instantaneous contacts not available.

**Special Function Relays**

Description	Application	Space (Inches)
Duplex Alternator	Used with (2) Combination Starters	0 <sup>1</sup>
Compelling Relay	2-Speed Starters	
Accelerating Relay	2-Speed Starters	
Decelerating Relay	2-Speed Starters	
Over/Undervoltage Relay	Starter Units (Single Phase – 120 V)	3

<sup>1</sup> Compelling, accelerating, and decelerating relays used with Size 3 and 4, 2-speed 2-winding starters require 6 in. of mounting space.

**Motor Winding Heaters**

Description	Application	Space (Inches)
Motor Winding Heater	3–100 hp @ 480 V	0
	101–300 hp @ 480 V	

**Unit Nameplates**

Description	Application	Space (Inches)
Unit nameplate engraved (1.5 in. x 6.5 in.)	White letters on gray (standard)	0
	Black letters on white	
	White letters on black	
	White letters on red	



Standard Unit Nameplate

Unit nameplate other than standard size	All	0
Stainless steel mounting hardware		—
Master nameplate engraved (8 in. x 10 in.)	White letters on gray	0
	Black letters on white	
	White letters on black	
	White letters on red	

**Control Circuit Variations**

Description	Application	Description	Space (Inches)
Unfused Separate 120V Control Circuit with Control Power Disconnect	Standard on all starters unless control power transformer is chosen. (All Size 6 starters have control power transformer as standard)	SPDT	0
		DPDT	
Fused Separate 120V Control Circuit with Control Power Disconnect	Includes one fuse and control circuit interlock.	SPDT	0
		DPDT	
Fused Line Voltage Control Circuit (two primary fuses)	Control power taken between phases		0
	Control power taken from phase and neutral		
Operating Mechanism Interlock 1 (Not suitable for use as loss source indication)	SPDT		0
	DPDT		
Fused Control Power Transformer (two primary fuses and one secondary fuse as standard)	Size 1 FVNR	50VA (23)	0
		100VA (73)	
		150VA (123)	
		300VA (273)	
	Size 1 FVR and 2-Speed; All Size 2	100VA (62)	0
		150VA (112)	
		300VA (262) <sup>2</sup>	
	All Size 3, except 2-Speed 1-Winding	150VA (104)	9
		300VA (253)	
		500VA (453)	
	All Size 4 and Size 3 2-Speed 1-Winding	300VA (211)	0
		500VA (411)	
		750VA (661)	
	All Size 5 and All RVAT (Use Line Voltage Coil with Interposing Relay)	50VA (25)	0
100VA (75)			
150VA (125)			
300VA (275) <sup>3</sup>			
500VA (475) <sup>4</sup>			
All Size 6	150VA (15) STD	0	
	300VA (165)		
	450VA (315)		
Transient Suppression Module	Size 1-5 Starters (Maximum coil voltage = 120 V)		0

- 1 Not suitable for use as loss source indication.  
2 6 in. required on Size 1 2-Speed and all Size 2 starters.  
3 6 in. required on Size 1-3 RVAT and RVPW.  
4 9 in. required on Size 1-3 RVAT and RVPW.

**Pilot Devices**

Model 6 Motor Control Centers use Class 9001 Type XB5 22 mm pilot devices as standard. Starters are provided with a removable hinged station plate that has five knockouts for XB5 (maximum of three Type K 30 mm devices). Compac 6 starters are provided with a control station plate that has knockouts for four Class 9001 Type XB5 22 mm pilot devices. Type K devices cannot be substituted on Compac 6 starters.

**NOTE:** When more pilot devices are specified than will fit in the station plate, the additional devices will be mounted directly in the unit door. Not applicable to Compac 6.



Control Station Plate

Description	Application	Space (Inches)
Start-Stop push button	Any starter	0
Forward-Reverse-Stop push button	FVR	
High-Low-Stop push button	2-speed	
Fast-Off-Slow push button	2-speed	
High-Low push button	2-speed	
Fast-Slow push button	2-speed	
On-Off push button	Any starter	
Single Function push button	Any starter	
Illuminated push button	Any starter	
Maintain Contact push button	Any starter	
Hand-Off-Auto selector switch	Any starter	
Hand-Off-Auto selector switch with manual speed potentiometer	AC Drives	
Start-Stop selector switch	Any starter	
On-Auto selector switch	Any starter	
On-Off selector switch	Any starter	
High-Off-Low selector switch	2-speed	
Hand-Auto selector switch	Any starter	
Test-Auto selector switch	Any starter	
Forward-Off-Reverse selector switch	FVR	
Forward-Off-Reverse selector switch with manual speed potentiometer	AC Drives	
High-Low selector switch	2-speed	
Slow-Off-Fast selector switch	2-speed	
Slow-Fast selector switch	2-speed	
Forward-Reverse selector switch	FVR	
High-Low-Off selector switch	2-Speed	
4-position selector switch	Any starter—Type K operators	
Switchboard type rotary cam selector switch	Any circuit	
Substitute Type K pilot devices (XB5 STD.) (N/A on Compac 6)	Any starter (max. 3 Type K devices)	
Substitute Type XB4 pilot devices (XB5 STD.)	Any starter	
Addition of dust boots to above pilot devices	Any pilot device	
Omit control station plate (solid steel unit door)	Units without pilot devices	
	Units with pilot devices (door mounted)	

**Pilot Lights**

Model 6 Motor Control Centers use Class 9001 Type XB5 22 mm pilot devices as standard. Starters are provided with a removable hinged station plate that has five knockouts for XB5 (maximum of three Type K 30 mm devices). Compac 6 starters are provided with a control station plate that has knockouts for four class 9001 Type XB5 22 mm pilot devices. Type K and push-to-test devices cannot be substituted on Compac 6 starters.

**NOTE:** When more pilot devices are specified than will fit in the station plate, the additional devices will be mounted directly in the unit door. Not applicable to Compac 6.

Description		Application	Space (Inches)	
Pilot lights	"On" (Red, Green)	Any starter, AC Drive <sup>1</sup>	0	
	"Off" (Red, Green)	Any starter		
	Special configuration <sup>2</sup>	Red		Any starter
		Green		
		Yellow		
Blue				
White				
Push-To-Test pilot lights (not available on Compac 6)	"On" (Red, Green)	Any starter		
	"Off" (Red, Green)	Any starter		
	Special configuration <sup>2</sup>	Red		Any starter
		Green		
		Yellow		
		Blue		
	White			
	"RUN"	Red	AC Drives	
		Green		
	"STOPPED"	Red		
Green				
"FAULT"	Yellow			
"HAND" and "AUTO"				
Substitute Type K pilot light (not available on Compac 6)		Any starter		
Substitute Type XB4 pilot light				

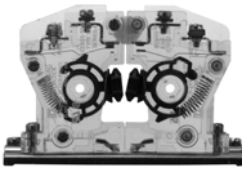
<sup>1</sup> LED-type direct supply.

<sup>2</sup> Any starter application requires a diagram with order entry.



## Unit Options

# Model 6 Motor Control Centers Application and General Information



Auxiliary Electrical Interlocks

### Auxiliary Electrical Interlocks <sup>1</sup>

Max. Aux. Interlocks Per Contactor			Description	
Type	Size	Qty.		
FVNR	1-2	4	When the starter has more than one contactor (FVR, RVAT, 2-speed), indicate which contactor receives the interlock.	
	3-6	4		
FVR <sup>2</sup>	1-2	4		
	3-5	2		
2-speed 1-winding	CHP: Low	1-4		2
	CHP: High	1-2		4
		3-4		2
	CVT: Low	1-2		4
3-4		2		
2-speed 2-winding	CVT: High	1-4		2
		1-2		4
		3		3
RVAT	4	2		
	3-6	5		

<sup>1</sup> Elapsed time meters, transient suppression module, and Off pilot light use one auxiliary interlock each. Size 1 starters with three auxiliary interlocks require a minimum 100 VA control power transformer.

<sup>2</sup> Maximum of 2 interlocks per contactor for Compac 6 starters.

### Overload Relays

Model 6 motor control center units with Type S starters are available in NEMA/EEMAC Sizes 1 through 6. Type S starters are provided with melting alloy overload relay blocks as standard. Their trip-free construction allows the overload relay to trip even if the reset lever is blocked or held in the reset position. Features such as the trip-to-test and the visible trip indicator minimizes troubleshooting time. With these features and state-of-the-art design, the Model 6 starter unit has earned a solid reputation that no other NEMA/EEMAC starter can equal.

Schneider Electric has added the solid state motor overload protection to its existing family of overload relay protection equipment, including melting alloy and bi-metallic devices. Technological migration allows Schneider Electric customers the ability to make the same space “smarter,” while preserving backward compatibility.

Description	Application	Space (Inches)
Melting alloy overload relay	Any starter	0 <sup>1</sup>
Ambient compensated bi-metallic overload relay	Any starter	
TeSys® T Motor Management Controller	Any starter	See following tables.
Motor Logic Solid State Overload Relay (SSOLR)	Any starter	
Motor Logic Plus/Motor Logic Plus II SSOLR	Any starter	
Isolated alarm contact – N.O.	Melting alloy only	0
Overload alarm light (Amber) <sup>2</sup>	Melting alloy, bimetal	0
Overload alarm light – LED (Amber)	Melting alloy, bimetal	
Omit overload relay	Converts combination starter to combination contactor	0
Omit external overload reset button	—	0
Additional overload relay (See NEC 430-53 for proper application)	Size 1 starters	6
	Size 2 starters	6
	Size 3 starters	9
	Size 4 starters	12
Factory-installed thermal units <sup>3</sup> (Will be sized per NEC 430-150, unless full load current provided with order)	All standard melting alloy and bimetal thermal units (set of 3)	0
	Type FB Quick Trip (set of 3)	
	Type SB Slow Trip (set of 3)	

<sup>1</sup> Size 3 2-speed 1-winding requires 9 in. space adder.

<sup>2</sup> Not available on Size 3 and 4 starters with bimetal overload.

<sup>3</sup> Order must include thermal unit selection or motor full load current ratings. 2-speed and part-winding starters require six thermal units.



**TeSys® T Motor Management Controller**

The TeSys T Motor Management controller connects directly to the communication network offering data monitoring and control. Communication users gain access to motor data variables and system process control through “onboard” I/O. The TeSys T controller includes thermal overload, over/under current, long start/jam, ground fault, and phase failure/unbalance protection. In addition, when combined with a PLC, the TeSys T controller provides an independent data monitoring and control system.

The TeSys T controller is available in five different native, open communication protocols: CANopen, DeviceNet™, Ethernet TCP/IP, Modbus®, and PROFIBUS.

Voltage and load monitoring is available by selecting the optional Expansion Module. The additional motor monitoring includes over/under voltage, phase reversal, over/under power factor, and load shedding. In addition, the optional HMI may be supplied on each unit to provide local monitoring, configuration, and control functions.

The TeSys T Motor Management Controller includes:

- Native open communication protocol
- Six discrete inputs and three relay outputs
- RJ-45 port for connection to expansion module, HMI display, or PC
- 24 Vdc or 120 Vac, 50/60 Hz control power
- Status indicating LEDs
  - HMI communication—Communication between controller and HMI device
  - Power—Controller state
  - Alarm—Warning or fault condition
  - Fallback—Communication loss on active control source
  - PLC communication—Network status
- Fault relay—1 N.O. and 1 N.C.
- Ground Fault CT input
- Thermistor/PTC input

**NOTE:** The TeSys T Motor Management Controller is not available with vacuum starters, Altivar® drives, or Compac 6 starters.

**TeSys T and Motor Logic Plus™ Family Solid-State Overload Relay (SSOLR) Space Addition Requirements—Circuit Breaker Type Disconnects**

Size	FVNR	FVR	2S2W	2S1W	RVAT	PW
1	0 in.	3 in.	3 in.	3 in.	—	0 in.
2	0 in.	3 in.	3 in.	3 in.	—	0 in.
3	0 in.	0 in.	0 in.	0 in.	3 in.	0 in.
4	3 in.	15 in.	27 in.	27 in.	6 in.	—
5	0 in.	25 in.	0 in.	0 in.	0 in.	—
6	0 in.	—	—	—	0 in.	—

**TeSys T and Motor Logic Plus Family SSOLR Space Addition Requirements—Fusible Switch Type Disconnects**

Size	FVNR	FVR	2S2W	2S1W	RVAT	PW
1	0 in.	3 in.	3 in.	3 in.	—	0 in.
2	0 in.	3 in.	3 in.	3 in.	—	0 in.
3 (100 A)	3 in.	0 in.	0 in.	0 in.	3 in.	0 in.
3 (200 A)	0 in.	—	—	—	—	—
4	9 in.	15 in.	27 in.	0 in.	0 in.	—
5	0 in.	25 in.	0 in.	0 in.	0 in.	—
6	0 in.	—	—	—	—	—

TeSys T Options

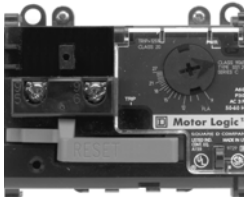
Option	Description
Expansion Module	Voltage and Load monitoring. Four additional logic inputs. Powered through the controller. RJ-45 port.
RJ-45 Port	Programming port. Mounted in 22mm control station plate. Door mounted if more than five 22mm pilot devices.
HMI	Door mounted operator interface. LCD display—4 lines, 20 characters. RJ-45 port.
Programmer	Hand held HMI. Enables configuring and commissioning of the controller.
Ground Fault CT	Measures ground faults at levels significantly lower than the ground fault detection based on the internal summation of the 3-phase currents.
Reset Push Button	Mounted in 22 mm control station plate. Local Operator reset.
PowerSuite™ Software	Enables configuring and commissioning of the controller. Default logic can be modified or new logic can be created with this software.
Warning Pilot Light	CSP-mounted; provides visibility of TeSys T Warning.
Fault Pilot Light	CSP-mounted; provides visibility of TeSys T Fault.

Motor Logic® Solid-State Overload Relays

The Motor Logic SSOLR family of products offers a degree of flexibility for selecting the amount of motor protection or control you require. Coupled with the Square D® brand Type S contactor, the Motor Logic SSOLRs form the benchmark for NEMA/EEMAC-style motor starters. They are available fully integrated in the Model 6 MCC, forming a complete power and control system.



Unit with Motor Logic Solid State Overload Relay



Motor Logic Solid State Overload Relay "Base Unit"

Application	Space (Inches)	Application	Space (Inches)
<b>Motor Logic Base Unit</b>		<b>Motor Logic Feature Base Unit</b>	
Size 1–2 FVNR and FVR	0	Size 1–2 FVNR and FVR	0
Size 1–2 2SPD 1,2		Size 1–2 2SPD	
Size 3–4 FVNR, FVR and RVAT		Size 3–4 FVNR, FVR and RVAT	
Size 3–4 2SPD and PW		Size 3–4 2SPD and PW	
Size 5 2SPD and PW		Size 5 2SPD and PW	
Size 5–6 FVNR, FVR and RVAT		Size 5–6 FVNR, FVR and RVAT	

- 1 Specify Full Load Current for both speeds.
- 2 Not all configurations are available.

Motor Logic Options

Description	Application	Space (Inches)
Isolated Auxiliary Contact (required for fault pilot light)	All Starters with Motor Logic	0
Auto Reset and Isolated Auxiliary contact	All Starters with Motor Logic	
Remote Reset and Isolated Auxiliary Contact	All Starters with Motor Logic	
Overload Light	Requires Isolated Contact	
MCC Looping Terminal Kit	Size 1 Starters	

**Motor Logic Plus Solid State Overload Relays**

The Motor Logic Plus family of solid state overload relays are programmable electronic overloads with motor protective features and communications capabilities.

The Motor Logic Plus provides voltage and current monitoring with an integral LED display. The communication port allows for connectivity to an upstream network.

The Motor Logic Plus II provides protective and control functions. The Motor Logic Plus II integrates I/O with four digital inputs and two relay outputs for network control functions.

**Motor Logic Plus Family SSOLR Communications Adaptors**

Overload Relay Type	Description	Space (Inches)
Motor Logic Plus	Modbus® 2-wire communications adapter, part #9999MB22	0
	Modbus 4-wire communications adapter, part #9999MB11	
	DeviceNet™ communications adapter, part #9999DN	
	PROFIBUS communications adapter, part #CIO-MLP-PR-IO	
Motor Logic Plus II	DeviceNet communications adapter, part #9999DN2	
	PROFIBUS communications adapter, part #CIO-MLPII-PR	

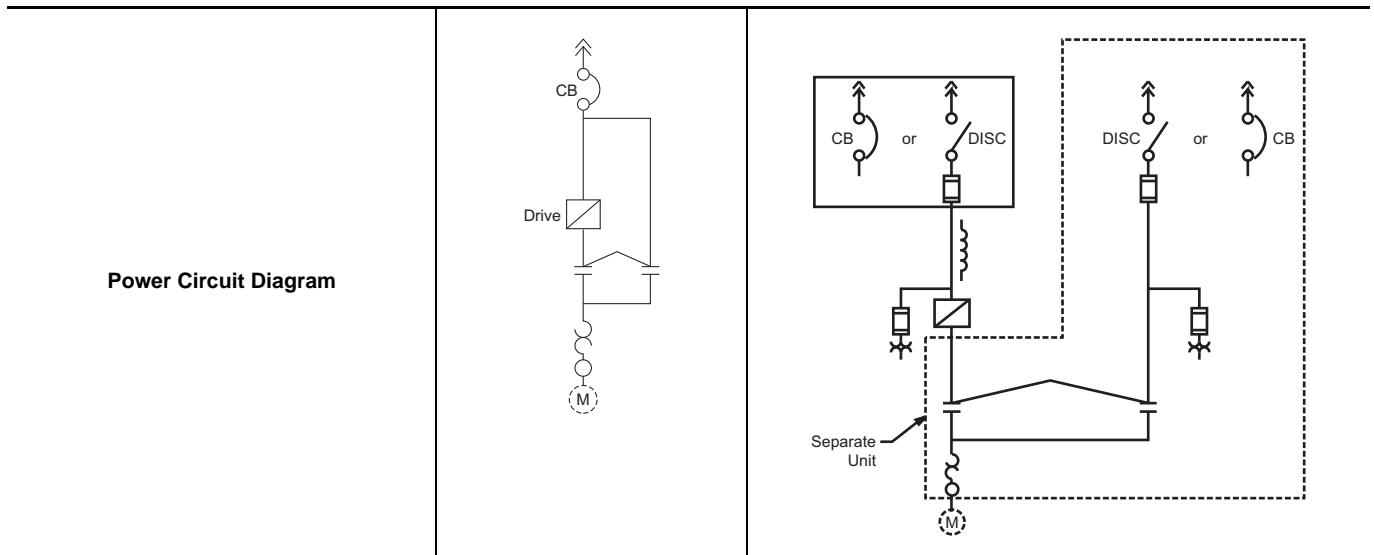
**Motor Logic Plus Family SSOLR Application Notes:**

- Not available with vacuum starters, Altivar drives, or with Compac 6 starters.
- 120 Vac control power available with individual control power transformers or separate source.
- The Motor Logic Plus SSOLR is provided with a communications module as standard. Part #9999MB22.

# Unit Options: AC Drives

# Model 6 Motor Control Centers Application and General Information

## AC Drive Power Contactor Options <sup>1</sup>

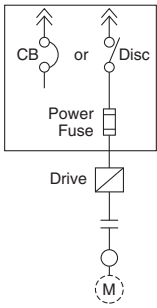
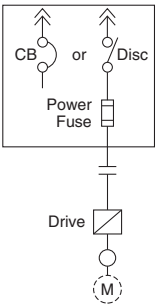


Description			Integrated Bypass <sup>2</sup> Available with circuit breaker disconnect only. Uses TeSys contactors.	Barrired Bypass (Uses NEMA contactors)	Barrired Application Rated Compac 6 Bypass (14 A maximum)
<b>208 V</b>	<b>240 V</b>	<b>480 V</b>	<b>Space (Inches)</b>		
1–5 hp	1–5 hp	1–10 hp	12	18	6
7.5–10 hp	7.5–10 hp	15–20 hp	12	18	N/A
—	—	25 hp VT	12	18	
—	15 hp	25 hp CT	9	18	
15–20 hp	20 hp	30–40 hp	9	27	
—	25 hp VT	50 hp VT	9	27	
25 hp	25 hp CT 30 hp All	50 hp CT	5 added to width	27 in adjacent section	
30–40 hp VT	40–50 hp VT	60–100 hp VT	5 added to width	33 in adjacent section for CB 39 in adjacent section for FS	
30–40 hp CT	40 hp CT	60–75 hp CT	20 added to width	33 in adjacent section for CB 39 in adjacent section for FS	
—	—	100 hp CT	20 added to width	25 added to width	
—	—	125–150 hp All	20 added to width	25 added to width	
—	—	200 hp All	20 added to width	25 added to width	
			<ul style="list-style-type: none"> <li>Basic Drive features with isolation and bypass contactors for emergency full speed operation in same compartment.</li> <li>TeSys D- or F-Line contactors are used.</li> <li>Only available as circuit breaker disconnect common to drive and bypass.</li> <li>Drive and bypass are UL 845 Listed for 100,000 A SCCR and coordinated for Type 1 protection.</li> <li>Includes AFC-Off-Bypass selector switch, Red Push-To-Test "AFC" Pilot Light and Yellow Push-To-Test "Bypass" Pilot Light on bypass control island.</li> </ul>	<ul style="list-style-type: none"> <li>Basic drive features with isolation and bypass contactors for emergency full speed operation.</li> <li>Barrired application-rated Compac 6 bypass uses TeSys contactors. NEMA contactors are used on barrired NEMA bypass.</li> <li>Separate disconnect for drive and bypass can be operated independently.</li> <li>Drive and bypass starter are enclosed in separate barrired compartments.</li> <li>Drive and bypass are UL 845 Listed for 100,000 A SCCR and coordinated for Type 1 protection.</li> <li>Includes AFC-Off-Bypass selector switch, Red Push-To-Test "AFC" Pilot Light and Yellow Push-To-Test "Bypass" Pilot Light on bypass control island. (Non-Push-To-Test used on Compac 6)</li> </ul>	

<sup>1</sup> Only one allowed.

<sup>2</sup> Bypass is not isolated from the drive compartment. Both drive and bypass must be removed at the same time.

**AC Drive Power Contactor Options (Continued)**

Power Circuit Diagram			Load Contactor	Line Contactor
				
Description			Load Contactor	Line Contactor
208 V	240 V	480 V	Space (Inches)	
1–3 hp All	1–3 hp All	1–10 hp All	12	12
5 hp All	5 hp All	15 hp All	12	12
7.5–10 hp All	7.5–10 hp All	20 hp All	12	12
—	—	25 hp VT		
15–20 hp VT	15–25 hp VT	30–50 hp VT	9	9
15–20 hp CT	15–20 hp CT	25–40 hp CT		
25–50 hp VT	30–50 hp VT	60–100 hp VT	5 added to width	5 added to width
25–40 hp CT	25–40 hp CT	50–75 hp CT		
			<ul style="list-style-type: none"> <li>Basic Drive features with load contactor for motor isolation. Contactor is open when drive is not running.</li> <li>TeSys D- or F-Line contactors are used.</li> <li>Drive and load are UL 845 Listed for 100,000 A SCCR.</li> </ul>	<ul style="list-style-type: none"> <li>Basic Drive features with line contactor for isolating drive from input line.</li> <li>TeSys D- or F-Line contactors are used.</li> <li>Drive and line contactor are UL 845 Listed for 100,000 A SCCR.</li> </ul>

**AC Drive Miscellaneous Options**

Option	Space (Inches)
<b>Line Reactors (3% or 5%)</b>	
Each line reactor is mounted in the MCC cabinet as a separate unit above the drive unit and is factory wired to the line side of the drive	
1–5 hp, 208/240 V or 1–10 hp, 480 V (3 or 5% Impedance) <sup>1</sup>	6
7.5–20 hp, 208/240 V or 15–40 hp, 480 V (3 or 5% Impedance)	9
25 hp VT, 240 V or 50 hp VT, 480 V (3 or 5% Impedance)	12
25–40 hp CT, 208/240 V or 25–40 hp VT, 208 V or 30–50 hp VT, 240 V or 50–100 hp CT, 480 V or 60–125 hp VT, 480 V	0
125–200 hp CT or 150–250 hp VT, 480 V	
250–450 hp CT or 300–500 hp VT, 480 V	
<b>Motor Protecting Filters or 5% Output Reactors</b>	
Each load filter/reactor is mounted in the MCC cabinet as a separate unit adjacent to the drive unit and is factory wired to the load side of the drive. Not available on NEMA/EEMAC Type 12 MCCs.	
1–10 hp, 480 V	6
15–40 hp, 480 V	9
50–75 hp, 480 V	12
100–125 hp, 480 V	21 (bottom mounted only in adjacent section)
150–200 hp, 480 V	
250–300 hp, 480 V	24 (bottom mounted only in adjacent section)
350–400 hp, 480 V	

<sup>1</sup> Space is applicable to NEMA/EEMAC Type 1, 1A, or 3R. Contact MCC TAG for line reactors in NEMA/EEMAC Type 12 MCCs for these sizes.

**AC Drive Miscellaneous Options (continued)**

Option	Space (Inches)
<b>100 VA customer capacity on drive's 120 V control transformer</b>	
1–3 hp, 208/240 V or 1–3 hp, 480 V with basic power option	3
5–100 hp, 480 V or 5–50 hp, 208/240 V	0
<b>300 VA customer capacity on drive's 120 V control transformer</b>	
125–500 hp VT or 100–450 hp CT, 480 V with basic power option	0
<b>Extended I/O Cards <sup>1</sup></b>	
Each option board is pre-installed onto drive inside unit with all customer terminations left unwired (Type 1A wiring).	
Basic I/O card (VW3A3201)	0
Extended I/O card (VW3A3202)	
Controller inside card (VW3A3501)—mounting only, no programming. Contact MCC TAG for applications requiring programming.	
115 Vac Logic Input adapter (VW3A3101). Adapts seven logic inputs for use with user supplied 115 Vac signals	3 on Basic Power Option for 1–15 hp 480 V or 1–10 hp, 208/240 V 0 for all others
<b>Communications Cards (choose only one)</b>	
Each option board is pre-installed and does not include network wiring. Network interwiring within the MCC must be purchased separately.	
Modbus®/Uni-Telway (VW3A3303)	0
Modbus Plus (VW3A3302)	
PROFIBUS DP (VW3A3307)	
DeviceNet™ (VW3A3309)	
Ethernet TCP/IP (VW3A3310D)	
Ethernet IP (VW3A3316)	
FIPIO® (VW3A3311)	
INTERBUS® (VW3A3304)	
LonWorks® (VW3A3312)	
Metasys N2 (VW3A3313)	
BACnet® (VW3A3315)	
Apogee® FLNPI (VW3A3314)	
<b>Dynamic Braking Resistors</b>	
The use of braking resistors dissipates excess energy generated by the motor whenever the motor functions in the generator mode as on high inertia loads or machines with a driving load. Resistors are mounted in the MCC cabinet as a separate unit above the drive unit and is factory wired to the DC bus of the drive. Not available in NEMA/EEMAC Type 12 MCCs.	
1–2 hp, 208/240 V or 1–10 hp, 480 V	6
3–10 hp, 208/240 V or 15–20 hp, 480 V	9
15–20 hp, 208/240 V or 25–40 hp, 480 V	9
<b>Drive Unit Extenders</b>	
1–25 hp VT or 1–20 hp CT, 480 V or 1–10 hp, 208/240 V Provides space added below drive unit for added devices with single door to cover the drive and added space. Available for Basic and Barriered Bypass Power Options only.	3, 6, or 12
30–50 hp VT or 25–40 hp CT, 480 V or 15–25 hp VT or 15–20 hp CT, 208/240 V Provides space added below drive unit for added devices with single door to cover the drive and added space. Available for Basic and Barriered Bypass Power Options only.	3, 6, or 9
<b>Control and Timing Relays:</b>	
Auto Start Relay without Delay Provides interposing relay for starting drive in auto mode via customer supplied 120 Vac. Requires Hand-Off-Auto Selector Switch	For Basic and Barriered Bypass units, add 3 for 1–25 hp VT @ 480 V, or 1–20 hp CT @ 480 V, or 1–10 hp @ 208/240 V. Add 0 for all others.
Auto Start Relay with Delay Provides interposing relay for starting drive in auto mode via customer supplied 120 Vac or dry contact. Adjustable time delay for delaying drive start from 1.5-30 seconds is included. Requires Hand-Off-Auto Selector Switch	

<sup>1</sup> A maximum of two extended I/O cards can be installed. If a comm. card is present, only one extended I/O card can be installed.

**Soft Start Unit Power Options**

Description	Soft Start Frame	Space (Inches)	
		IEC Contactors	NEMA Contactors
<p><b>Input Isolation Contactor</b>                      (Replaces the standard shunt trip disconnect. Standard feature if reversing or full voltage bypass is chosen.)</p> <p>As an option, MCC soft start units can include an input contactor instead of a shunt trip disconnect to isolate the soft start in case of a fault condition. The input contactor also opens when the motor is not in use. This provides protection from voltage transients when the electronics are most susceptible to damage. Control power is maintained after the input contactor is opened so fault diagnostics are available.</p>	D17 – D47	15	15
	D62-C11	18	15
	C14-C17	18	12 (5 added to width)
	C21-C32	10 added to width for CB version only	20 added to width
	C41-C66 (IEC) or C41-C59 (NEMA)	0	20 added to width
<p><b>Integrated Full Voltage Bypass Starter</b>                      (requires input isolation contactor)</p> <p>As an option, MCC soft start units can include a full voltage bypass to allow emergency full voltage starting of the motor in case the soft start is unable to be used. This feature includes necessary control and power circuitry to start the motor with full voltage using a bypass enable/disable selector switch. A Class 20 overload relay is provided to protect the motor in the bypass mode. The bypass contactor also acts as a shorting contactor in the soft start mode. Not available with Reversing Capability.</p>	D17 - D47	15	27
	D62-C11	18	27
	C14-C17	18	12 (5 added to width)
	C21-C32	10 added to width for CB version only	20 added to width
	C41-C66 (IEC) or C41-C59 (NEMA)	0	20 added to width
<p><b>Reversing Capability</b>                      (includes input isolation contactor)</p> <p>Not available with NEMA contactors or full voltage bypass.</p>	D17 - D47	15	Consult Factory
	D62-C11	18	
	C14-C17	18	
	C21-C32	10 added to width for CB version only	
	C41-C66	20 added to width	

**Soft Start Unit Control Options**

Description	Space (Inches)
1.5-30 sec. start delay	0
Emergency Off push button, maintained contact. Requires Shunt Trip option on disconnect.	
Current meter—analogue, 2.5 in. panel type, 0-200% of nominal motor current	
Elapsed time meter	
<b>Auxiliary Electrical Interlocks</b>	
Run contacts, 1 NO, 5A @ 120 Vac (8501 Type R relay)	0
Bypass run contacts, 1 NO, 5A @ 120 Vac (8501 Type R relay). Requires integrated full voltage bypass.	
Auto mode contacts, 1 NO, 5A @ 120 Vac (8501 Type R relay). Requires Hand-Off-Auto switch.	
Fault contacts, 1 NO, 5A @ 120 Vac (8501 Type R relay)	



**Unit Extenders**

Unit extenders are used to provide additional component mounting space within a unit. Only one unit extension is recommended per unit. **Total unit size cannot be increased beyond 72 in.** Space requirements shown for the modifications in this catalog already include the unit extension.

Description	Application	Space (Inches)
3 in. unit extender	All plug-in units	3
6 in. unit extender		6
9 in. unit extender		9
12 in. unit extender		12
15 in. unit extender		15
18 in. unit extender		18
21 in. unit extender		21
24 in. unit extender		24
30 in. unit extender		30
36 in. unit extender		36

**Fusible Switch Options**

Description	Application	Space (Inches)
Class R fuse clips <sup>1</sup>	30–600 A fusible switches; Size 1-6 fusible starters	
Class J fuse spacing (standard with Compac™ 6 fusible starters and branches)	30–400 A fusible switches	
	600 A fusible switches	
Next larger size Class J fuse clips	Size 1, 5, 6 fusible starters	
	Size 2, 3 fusible starters	
	Size 4 starters	
Next smaller size fuse clips	Size 1–6 fusible starters	
Key interlock (single cylinder)	Per lock/ per switch	

<sup>1</sup> Not available on Compac 6 starters.

**Factory Installed Fuses**

Type Class Max. Fuse Size	FRN/RK5	KTN/RK1	LPN/RK5	FRS/RK5	KTS/RK1	LPJ/J	LPS/RK5	KRP/L
30 60 100 200 400 600	250 V			600 V				—
1200 1600 2000	—			—				600 V

**Circuit Breaker Options**

Description	Application	Space (Inches)
Substitute L-interrupting circuit breaker for J-interrupting circuit breaker. (Part-winding starters require two circuit breakers.)	H-frame units	0
	J-frame units	
Substitute thermal-magnetic circuit breaker for motor circuit protector.	All starters (Include actual hp information)	
122 °F (50 °C) rise breaker	All (non-UL)	
Key interlock (Schneider Electric brand) <sup>1</sup>	Per lock on any device	
Operating mechanism interlock <sup>2</sup>	SPDT	0
	DPDT <sup>1</sup>	
Shunt trip (120 Vac)	Any unit with a circuit breaker	
Shunt trip (24 Vdc)	Any unit with a circuit breaker	
Undervoltage trip	Any unit with a circuit breaker	
Phase failure relay, Type MP SPDT (Form C) for main circuit breaker or switch	15–600 A main circuit breaker	9
	200–400 A main switch	
	800 A main circuit breaker	15
	1200 A (80%) main circuit breaker	
	600–800 A main switch	12
	1000–1200 A bottom incoming main switch	
Auxiliary switch <sup>3</sup>	All other mains	0
	Any unit with a circuit breaker	
	1 Form C contact	
	2 Form C contacts (PowerPact only)	
3 Form C contacts (PowerPact M-, P-, and R-frame only)		
Alarm switch <sup>3</sup>	Any unit with a circuit breaker (1A or 1B switch)	
Overcurrent trip switch (SDE) <sup>3</sup>	PowerPact circuit breaker (1 Form C contact)	
Electrical operator (two-step, stored energy). Includes spring-charging motor and terminals for remote contact control of open/close operation	Mains/branches with PowerPact P-frame circuit breaker	
Electrical operator with Modbus communications (two-step, stored energy). Includes spring-charging motor and actuators for serial communication control of open/close operation		

<sup>1</sup> Not available on Compac 6.

<sup>2</sup> Not available in 600–2500 A mains/branches that do not have handle operators.

<sup>3</sup> Low level switches for switching very low loads are available on PowerPact H/J/M/P or R-frame breakers.

**Circuit Breaker Micrologic® Electronic Trip Unit Options**

Description	Application	Space (Inches)	
<b>350–600A Breakers (L-frame)</b>			
Standard function LX substituted for LA/LH/LI	LSI <sup>1</sup>	0	
Full function LE substituted for LA/LH	LSI		
<b>700–2500A Circuit Breakers (PowerPact M-, P-, and R-frame)</b>			
Standard			
5.0	LSI		
Ammeter			
5.0A	LSI		
6.0A	LSIG		
Trip unit power supply (recommended for ammeter trip unit)			
Power			
5.0P	LSI		
6.0P	LSIG		
Trip unit power supply (provided standard for power trip unit)			
Harmonic			
5.0H	LSI		
6.0H	LSIG		
Trip unit power supply (provided standard for harmonic trip unit)			
Modbus Breaker Communications Module (BCM) installed and unwired (Includes 24 Vdc communications power supply)	A trip unit only		
Modbus BCM unwired (Includes 24 Vdc communications power supply)	P or H trip unit		
Wiring to MCC Modbus network (adds network cable to main/branch unit)	Intelligent MCC or Transparent Ready MCC		
Communications for shunt trip	A, P, or H trip unit		

<sup>1</sup> Ground fault tripping functions can be added to these trip units. See the Ground Fault Options table on page 84.

**Ground Fault Options**

Description	Application	Ground Fault Type	Space (Inches)
Ground fault protection (zero sequence)	Size 1–2 starter	GA	6
	Size 3 starter		9
	Size 4–5 starter		12
	Size 6 starter		0
	Size 6 autotransformer	Order appropriate Micrologic electronic trip unit option (6.0A, P or H)	0
	15–250 A branch circuit breaker <sup>1</sup>	GFM	6
	110–250 A main circuit breaker		
	200 A main/branch fusible switch	GA	0
	300–600 A main or branch circuit breakers	LX MX C/B <sup>2</sup>	
	300–600 A main or branch circuit breakers	LE ME C/B	
	600–800 A main or branch switch	Order appropriate Micrologic electronic trip unit option (6.0A, P or H)	0 (3 W) 12 (4 W)
	1000-1200 A branch switch or top incoming main switch		0
	1000-1200 A bottom incoming main switch		0 (3 W) 12 (4 W)
	800-1200 A main or branch circuit breaker (80%) 800 A main or branch circuit breaker (100%)		0 (3 W) 15 (4 W)
	1200 A main or branch circuit breaker (100%) 1600-2500 A main circuit breaker or switch		0

<sup>1</sup> Not available on Compac 6.

<sup>2</sup> 12 in. of additional space required for 3-phase, 4-wire systems with neutral lug option.

## Unit Options

## Model 6 Motor Control Centers Application and General Information



Control Terminal Block

### Wiring Options

Description	Application	Space (Inches)
Additional terminal blocks	All starters—unwired (per terminal point)	0
<b>NOTE:</b> Max. 20 control terminals per unit; 12 max. with power terminals	All starters—wired (per terminal point)	0
Control power transformer leads X1 and X2 wired to the control terminal block (standard on industrial package)	All starters	0
Power terminal blocks (will reduce max. control from 20 to 12)	Size 1–2 starters	0
	Size 3 starters	
Starter control wiring; size, and type	#16 AWG Type MTW (standard)	0
	#14 AWG Type MTW <sup>1</sup>	
	#16 AWG Type SIS	
	#14 AWG Type SIS	
Standard wire labels—plastic sleeve	All starter control wiring—Schneider Electric numbering	0
Custom wire labels—plastic sleeve	All starter control wiring—User-defined (13 characters max.)	0
Ring tongue terminals <sup>2</sup>	All starter control wiring	
Copper crimp lugs (For customer connections only; cable sizes must be provided)	Main lug compartments	0
	Size 1-4 starters <sup>3</sup>	0
	15–150 A main/branch circuit breaker	3
	175–250 A main/branch circuit breaker	0
	15–100 branch fusible switch	3
	110–225 A main/branch fusible switch	6
	600-800 A Main Switch	12
	800 A Main or Branch Circuit Breaker	15
	All other units	6
	Main/branch mechanical lug alternatives	<b>Aluminum Lug for 600 kcmil Cu or Al cable or 750 kcmil compacted Al cable (2/phase, AL800P7K kit)</b>
700–800 A Circuit Breaker		15
600–800 A Main Switch		12
<b>Aluminum Lug for 600 kcmil Cu or Al cable (3/phase, AL1200P6KU kit)</b>		
1000–1200 A Circuit Breaker (80% rated)		15
1000–1200 A Circuit Breaker (100% rated)		0
1000–1200 A Top Incoming Main Switch		
1000–1200 A Bottom Incoming Main Switch		
<b>Aluminum Lug for 750 kcmil compacted AL cable (3/phase, AL1200P7KU kit)</b>		
1000–1200 A Circuit Breaker (80% rated)		15
1000–1200 A Circuit Breaker (100% rated)		0
1000–1200 A Top Incoming Main Switch		
1000–1200 A Bottom Incoming Main Switch		
Special wire colors—3 max.	All starter control wiring	0

<sup>1</sup> Not applicable to Compac 6, Altivar®, or Altistart® units.

<sup>2</sup> Provided where possible and allowed by UL procedure.

<sup>3</sup> Not UL Listed.

### Optional Burndy Type Copper Crimp Lugs

Circuit Breaker Frame	Maximum Amps	Burndy Crimp Lug Lug Wire Range	Lugs Per Phase
H	60	#6–1/0 Cu	1
	150	#4–2/0 Cu	1
J	150	#4–2/0 Cu	1
	250	2/0–300kcmil Cu	1
P (molded case switch)	600	4/0–500 kcmil Cu	2
M and P (circuit breakers/switches)	800	500–750 kcmil Cu	

**AccuSine® Power Correction System**

**General Information**

The AccuSine Power Correction System (PCS) is an active harmonic filter (AHF) which actively injects opposite harmonics current on the source side of the load and it:

Decreases harmonic related overheating of cables, switchgear, and transformers.

Reduces downtime caused by nuisance thermal tripping of protective devices.

Increases electrical network reliability and reduces operating costs.

Corrects to the 50th harmonic; reduces harmonics level to meet IEEE 519 at the MCC main incoming power connection.

Cost effective approach to groups of harmonic loads and as an alternative to multi-pulse drives.

When installed in the MCC, the AccuSine PCS will compensate for harmonic loads within and fed by the MCC. This is an essential function as MCCs continually incorporate more and more solid state components such as AC drives, soft starts, and PLCs, which increase the potential for power quality issues.

The Model 6 MCC AccuSine package includes:

50 A or 100 A rated model Accusine PCS for 208–480 V

Door-interlocked disconnect and fusing

Door-mounted display (HMI) for programming and monitoring

Suitable for use in 100 kAIC rated MCCs

UL/cUL Listed

Rated for NEMA/EEMAC Type 1 or Type 1A (Gasketed) enclosures.

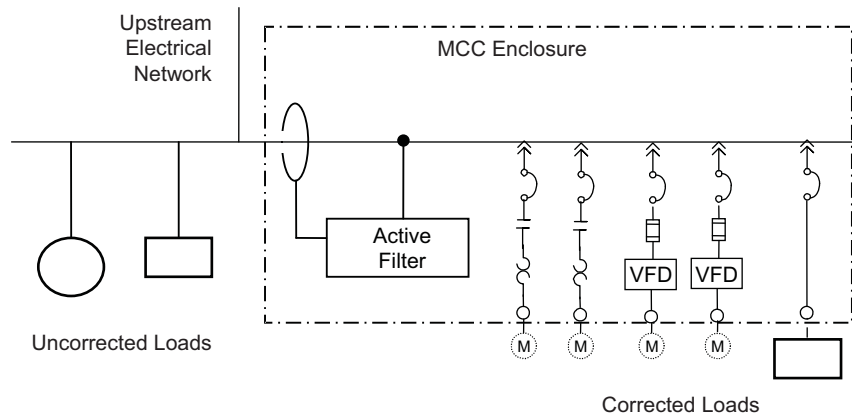
Not available for Type 12 or Type 3R enclosures.

Two current transformers for installation by contractor at the MCC main incoming cables. Three CTs are supplied when single-phase loads are present.

Up to five multiple units can be connected in parallel to increase compensation up to 500 A of harmonic current compensation.

Standard MCC bus and enclosure depth allow the active filtering to be retrofitted onto the MCC for future expansion of harmonic compensation.

**Typical MCC AccuSine Installation**



**Accusine PCS Sizing**

A harmonic study is not required to select the size of the AccuSine PCS installation, because when AccuSine PCS is installed it becomes a lower impedance for harmonics than the existing power supply. Unlike passive devices, AccuSine PCS is easy to apply and cannot be overloaded. For proper sizing, contact your local Schneider Electric representative, or visit the Schneider Electric website ([www.schneider-electric.us](http://www.schneider-electric.us)) for downloadable sizing software. To expedite the product selection process, have a single line diagram and/or details of the application including sizes of transformers, non-linear and linear loads, and any existing filters and capacitors.

**AccuSine Power Correction System for Model 6 MCC**

Total Current (RMS Amps)	Disconnect Switch (Amps)	Voltage Rating (Volts)	Space (Inches)
50	100	208/240/480	72 (20 W x 20 D)
100	150		

**Single-Phase Distribution Transformers 120/240V Secondary**

Distribution transformers are provided with a primary circuit breaker or fusible switch.

5 kVA and 10 kVA transformers may be mounted in a standard 20 in. W x 15 or 20 in. D section. 15 kVA and 25 kVA transformers must be mounted in a 20 in. W x 20 in. D section.

302 °F (150 °C) temperature rise transformers are supplied as standard.

**NOTE:** 5 kVA and 10 kVA transformers are available in multiple section shipping splits. All other transformers listed are bottom mounted in a single shipping split. Shielded isolation transformers are available, and other primary voltages can be supplied.



**Distribution Transformer**

Disconnect	kVA Rating	Disconnect Amps	Space (Inches)
480 V Primary Circuit Breaker	0.5 kVA	15	6
	1 kVA	15	12
	1.5 kVA	15	15
	5 kVA	15	21 <sup>1</sup>
	10 kVA	30	21 <sup>1</sup>
	15 kVA	40	36
240 V Primary Circuit Breaker	0.5 kVA	15	6
	1 kVA	15	12
	1.5 kVA	15	15
	5 kVA	30	21 <sup>1</sup>
	10 kVA	50	21 <sup>1</sup>
	15 kVA	70	36
600 V Primary Circuit Breaker	0.5 kVA	15	6
	1 kVA	15	12
	1.5 kVA	15	15
	5 kVA	15	21 <sup>1</sup>
	10 kVA	20	21 <sup>1</sup>
	15 kVA	30	36
480 V Primary Fusible Switch	0.5 kVA	15	6
	1 kVA	15	12
	1.5 kVA	15	15
	5 kVA	15	21 <sup>1</sup>
	10 kVA	25	21 <sup>1</sup>
	15 kVA	35	36
240 V Primary Fusible Switch	0.5 kVA	15	6
	1 kVA	15	12
	1.5 kVA	15	15
	5 kVA	25	21 <sup>1</sup>
	10 kVA	45	21 <sup>1</sup>
	15 kVA	70	36
600 V Primary Fusible Switch	0.5 kVA	15	6
	1 kVA	15	12
	1.5 kVA	15	15
	5 kVA	10	21 <sup>1</sup>
	10 kVA	20	21 <sup>1</sup>
	15 kVA	30	36
25 kVA	25 kVA	50	36

<sup>1</sup> Unit mounted transformers are available in 5 kVA and 10 kVA ratings. Requires a 30 in. space.



### Three-Phase Distribution Transformers 208Y/120 V Secondary

Distribution transformers are provided with primary circuit breaker or fusible switch. 302 °F (150 °C) temperature rise transformers are supplied as standard. Three-phase distribution transformers must be located in 20 in. deep sections.

**NOTE:** All transformers listed must be bottom mounted in a single shipping split. Shielded isolation transformers are available and other primary voltages can be supplied.

Disconnect	kVA Rating	Disconnect Amps	Space (Inches)
480 V Primary Circuit Breaker	9 kVA	15	30
	15 kVA	20	30
	30 kVA	40	36
	45 kVA	60	36 <sup>1</sup>
240 V Primary Circuit Breaker	9 kVA	30	30
	15 kVA	40	30
	30 kVA	90	36
	45 kVA	125	36
600 V Primary Circuit Breaker	9 kVA	15	30
	15 kVA	20	30
	30 kVA	40	36
	45 kVA	50	36
480 V Primary Fusible Switch	9 kVA	15	30
	15 kVA	20	30
	30 kVA	40	36
	45 kVA	60	36
240 V Primary Fusible Switch	9 kVA	25	30
	15 kVA	40	30
	30 kVA	80	36
	45 kVA	125	48
600 V Primary Fusible Switch	9 kVA	10	30
	15 kVA	20	30
	30 kVA	35	36
	45 kVA	50	36

<sup>1</sup> Requires a 25 in. wide structure.

**Distribution Panelboards**

Panelboards are provided with space for branch circuit breakers. All panelboards are provided with a main circuit breaker. Copper bus is standard. The 3-phase Type NQ 30 circuit is also available with a main lug.

**NOTE:** NQ 18- and 30-circuit panelboards utilize back-fed main units, thus reducing the available pole spaces for circuit feeds. NF panelboards must be located in the top of the section.

Ratings: 1-Phase NQ = 120/240 V  
 3-Phase NQ = 240 V  
 3-Phase NF = 277/480 V



Distribution Panelboard  
 in an MCC

Unit Type	1-Pole Spaces	Main Amperes	Interrupting Rating	Space (Inches)
1-Phase Type NQ	18	100	—	27
	42	225	—	51
3-Phase Type NQ	18	100	—	27
	30	100	—	33
	42	225	—	51
Main Lug	30	100	—	33 <sup>1</sup>
3-Phase Type NF	30	—	65 kAIC	45 <sup>2</sup>
	30	—	100 kAIC	45
	42	—	65 kAIC	57
	42	—	100 kAIC	57

<sup>1</sup> Main Lug.

<sup>2</sup> 25 in. wide structure.

**Factory Installed Panelboard Branch Circuit Breakers**

The branch circuit breakers below are rated for 10,000 AIR at the voltage listed. Higher interrupt ratings are available.

Panelboard Type	Branch Circuit Breaker Type	Poles	Amps
NQ QOB branch circuit breakers are standard, unless otherwise noted.	QO/QOB 120/240V	1	10–70
		2	10–125
		3	10–100
	QO/QOB – GFI 120/240V	1	15–30
		2	15–60
	QO/QOB 240V	2	15–100
NF EDB branch circuit breakers are standard, unless otherwise noted.	EDB (bolt-on only)	1	15–70
		2	15–125
		3	15–125
	EGB (bolt-on only)	1	15–70
		2	15–125
		3	15–125
	EJB (bolt-on only)	1	15–70
		2	15–100
		3	15–100

**Miscellaneous Units**

**Empty Mounting Units**



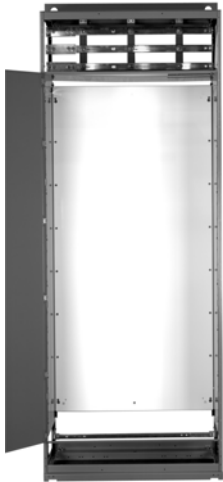
Empty Mounting Unit

Empty mounting units are available in 3-inch increments from 6 in. through 48 in. high.

Includes a removable undrilled unit and a hinged door to provide space for customer mounted devices. Unit dimensions are 13.85 in. wide by 9.5 in. deep. Height is dependent on unit selected.

Empty mounting units may be used in 20 in. wide by 15 in. or 20 in. deep sections.

**Full Section Empty Mounting Units (Relay Section)**



Relay Section

Consists of a removable undrilled mounting pan and a full height door on structure for customer mounted devices. The section does not contain vertical bus or a vertical wireway. The section cannot be modified to accept plug-on units. Horizontal bus is supplied to allow feed through to additional MCC sections.

Panel height: 68 in.

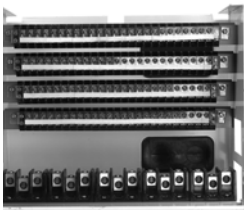
Panel depth (clearance from panel to door):

11.7 in. (15 in. deep section)

16.7 in. (20 in. deep section)

Section Width	Panel Width	Space (Inches)
20 in.	18.13 in.	72
25 in.	23.13 in.	
30 in.	28.13 in.	
35 in.	33.13 in.	
<b>Omit horizontal bus for listed sections</b>		
—	—	0
<b>3-point door latch</b>		
—	—	0

**Unwired Master Terminal Compartment**



Master Terminal Compartment  
(Unit Shown Unwired)

Includes a removable 12 in. unit, hinged door, unwired control and power terminal blocks, and mounting provisions. Compartment may be located anywhere in a 20 in. wide by 15 in. or 20 in. deep section.

Terminal Provisions	Space (Inches)
100 control points	12
100 control points and 15 power points	
70 control points and 30 power points	

**Blank Doors**

Blank covers are available in 3-inch increments from 3 in. through 36 in. high. Factory-assembled MCC orders are automatically provided with the proper number of blank covers to fill any unused space in each section.

Future prepared space may be provided if desired; to provide future prepared space, add the desired number and size required.

Blank doors are required to fill prepared space when rearranging plug-in units in an existing motor control center.

**Power Factor Correction Capacitors**

Power Factor Correction Capacitors listed are environmentally safe and include fuses for protection of the capacitor. These capacitors include discharge resistors as required by the NEC. **Capacitors are mounted directly below the corresponding starter and are connected between the starter contactor and overload relay.** Installation of capacitors does not affect normal selection of overload thermal units, starters, or disconnects.

Do not use capacitors on controllers subject to plugging or jogging. It is recommended that only Full Voltage Non-Reversing (FVNR) starters be provided with power factor correction capacitors. Capacitors can be applied to other types of starters, but auxiliary contactors are often required. Some types of starters are not compatible with individual motor correction. Contact the MCC TAG for details or application assistance.

**Selection**

To select unit type, determine kvar rating from table below. Match kvar rating to last digits listed on unit type.

kvar Rating				Space (inches)
208 V	240 V	480 V	600 V	
1	1	1	1	6
1.5	1.5	1.5	1.5	
2	2	2	2	
2.5	2.5	2.5	2.5	
3	3	3	3	
4	4	4	4	
5	5	5	5	
6	6	6	6	
7	7	7	7.5	
7.5	7.5	7.5	10	
9	8	8	11	
10	9	9	12	
	10	10	12.5	
	11	11	15	
	12	12	16	
	12.5	12.5	17.5	
	15	13.5	18	
	17.5	15	20	
		16	22.5	
		17.5	25	
		18	27.5	
		22.5	30	
		25		
		27.5		
		30		
11	20	32.5	32.5	12
12.5	22.5	35	35	
15	25	37.5	37.5	
17.5	27.5	40	40	
20	30	42.5	45	
		45	50	
		50	60	
		60		
22.5	32.5	70		18
25	35	80		
27.5	37.5		—	
	40			
	42.5			
	45			

**Capacitor Sizing Table—480 V**

Size capacitors (in kvar) to the particular motor loads to be corrected. If motor characteristics are not available, the values in the last column provide approximate sizing.

hp	RPM – NEMA/EEMAC Design										Approx. Value When Motor Data Is Not Available
	3600	1800		1200			900		720	600	
	B	B	C	B	C	D	B	C	B	B	
3	1.5	1.5	1	2	1	1	3	2	3	4	1.5
5	2	2.5	2	3	2	2	4	2	4	5	2
7.5	2.5	3	3	4	3	2	5	4	5	6	2.5
10	4	4	4	5	4	3	6	4	7.5	8	3
15	5	5	5	6	5	5	7.5	5	8	10	4
20	6	6	5	7.5	5	6	9	6	10	12.5	5
25	7.5	7.5	6	8	6	6	10	6	12.5	17.5	7
30	8	8	7.5	10	7.5	10	15	9	15	20	9
40	12.5	15	10	15	10	12	17.5	12	20	25	10
50	15	17.5	12	20	12	15	22.5	15	22.5	30	12
60	17.5	20	17.5	22.5	17.5	18	25	18	30	35	15
75	20	25	20	25	20	22.5	30	22.5	35	40	18
100	22.5	30	27.5	30	27.5	30	35	27.5	40	45	22.5
125	25	35	35	35	35	37.5	40	37.5	45	50	27.5
150	30	40	37.5	40	37.5	45	50	45	50	60	32.5
200	35	50	45	50	45	60	70	60	70	90	40
250	40	60	55	60	55	70	80	70	90	100	50
300	45	70	65	75	65	75	100	90	100	120	55
350	50	75	—	90	—	—	120	—	120	135	65
400	75	80	—	100	—	—	130	—	140	150	70

**PowerLogic® Ethernet Gateways**

The PowerLogic devices listed below provide an interface between Ethernet and Modbus® devices. In addition to the high-speed communications, the Ethernet connectivity opens up information access via standard web browsers. The gateway can connect with up to 64 Modbus or PowerLogic devices. Each unit includes the gateway, control power disconnect, fused control power transformer, and DC power supply. Connection cables to the Modbus or Ethernet network are not included.

Description	Application	Space (Inches)
EGX100	PowerLogic Ethernet Gateway with one UTP Ethernet Port (10/100 Mbps), one RS-485 serial port, and one RS-232 serial port.	9
EGX300	PowerLogic integrated gateway-server provides serial support for Modbus RTU, Modbus ASCII, JBus and PowerLogic protocols to support a wide range of devices. Includes one 10/100BaseTx Ethernet port and one serial port configurable for RS485 (2/4-wire) or RS232 (RJ45). Connects up to 64 network devices. Includes 512MB webserver memory.	

**Transparent Ready® Equipment Configurations**

MCC Transparent Ready options provide the ability to access pre-programmed/pre-linked web pages in the MCC equipment. This allows the customer to quickly commission and view a wide range of process data using web browser software. The MCC can be pre-tested and pre-wired at the factory with the Ethernet connection ready for the customer's network.

The Transparent Ready levels below offer web page choices for real time data, enhanced graphics, and reporting capability.

Description	Application
<b>TR1—Essential</b>	
Web enabled and factory configured for Ethernet	Mains monitoring only <sup>1</sup>
Five web pages of real time data using Web-Generator 1 (WG-1) <sup>2</sup>	Main + downstream devices monitoring <sup>3</sup>
<b>TR2—Deluxe</b>	
Features of TR1 Plus graphical pages for use on EGX system supported software: Web-Generator 2 (WG2) <sup>4</sup>	Main + downstream devices <sup>5</sup>

- <sup>1</sup> Requires one of the following: PowerLogic power meter with an ECC card, PowerLogic circuit monitor with an ECC card, or an EGX gateway with Ethernet switches.
- <sup>2</sup> Web-Generator (WG-1) software provides basic informational pages for use with the PowerLogic ECC or EGX Ethernet Gateway.
- <sup>3</sup> Requires at least one Modbus compatible device (TeSys T Motor Management Controller, PowerLogic Meter, Altivar 61/71 AC drive, or Altistart Soft Start). Requires one of the following: PowerLogic power meter with an ECC card, PowerLogic circuit monitor with an ECC card, or an EGX gateway with Ethernet switches.
- <sup>4</sup> Web-Generator (WG-2) software provides advanced informational pages for use with the PowerLogic EGX Ethernet Gateway.
- <sup>5</sup> Requires at least one Modbus compatible device (TeSys T Motor Management Controller, PowerLogic Meter, Altivar 61/71 AC drive, or Altistart Soft Start). Requires an EGX300 gateway with Ethernet switches.

**Gateway Ethernet Switches**

A gateway Ethernet switch serves as a hardware interface between an EGX Ethernet gateway and other Ethernet connections such as the customer's Ethernet network outside the MCC, and the programming port on the outside of the MCC door. A choice of switch types is available, depending on the hardware (copper wire or fiber optic) the customer would prefer. For Transparent Ready MCCs, the default selection is 10/100 Mbps if no other choice is made.

**NOTE:** The Ethernet switches and bulkhead port connector are not provided unless a Transparent Ready level is requested. For customers requesting network provisions only, the gateway is provided with no switches.

Description	Space Adder
<b>10/100 Mbps Ethernet RS485 Switches</b> (Available with EGX Gateways only)	
Provides five 10/100 Mbps twisted pair (RJ-45 connectors) ports for connecting an Ethernet factory network and mounted programming port to the EGX Gateway(s)	
<b>Fiber Optic Interface Switches</b> (Available with EGX Gateways only)	
Provides four 10/100Mbps twisted pair (RJ-45 connectors) ports and one 100Mbps fiber optic port (100 Base-hFX, Duplex SC connector) for connecting an Ethernet factory network and mounted programming port to the EGX Gateway(s).	

**High Resistance Ground Unit**

The High Resistance Ground Unit offers ground fault control and monitoring for power systems using ungrounded delta or wye transformer secondaries. The Model 6 Motor Control Center high resistance ground unit can be applied to 480 V and 600 V ungrounded delta and wye, 50/60Hz systems. The high resistance ground unit is available for both 3-phase, 3-wire wye and delta power systems. The Model 6 high resistance ground unit facilitates a controlled, sequential process shutdown, thereby reducing the adverse affects resulting from an uncontrolled shutdown.

Standard Package Features:

- Resistor bank limits overvoltages by grounding the system neutral through impedance
- High resistance ground indication/control panel

The high resistance neutral grounding equipment will contain the following equipment on an operator's panel on the front of the unit as standard:

- Line Disconnect
- Test Push-button

A digital display unit containing the following functions:

- Green Light to Indicate “Normal” Operating Status
- Flashing red Light to Indicate “Fault” Status
- Red Light to Indicate “Harmonic” Status
- Fault reset
- Alarm silence
- Pulse on/off
- Amber light to indicate “pulse” status
- Indication of Under-Voltage condition
- Indication of Under-Current condition
- Ethernet/Modbus port for Communications
- Single setpoint Meter Relay

The relay to monitor fundamental voltage and current will incorporate an adjustable time delay function to avoid spurious alarms.

The relay to monitor harmonic voltage and current will incorporate an adjustable time delay function to avoid spurious alarms.

**High Resistance Ground Unit for Model 6 MCC**

System Voltage Configuration	Current Range (Ground Current Amps)	Space (Inches)
480 V, 3-phase, Wye or Delta	1–10	72 (20 W X 20 D)
600 V, 3-phase, Wye or Delta	2–7	
<b>Additional Options</b>		
Portable hook-on ammeter with carrying case		0

**ASCO 7000 Series Automatic Transfer Switches With  
Microprocessor Control Panel (Non-UL Listed)**

The standard automatic transfer switch is the ASCO 7000 Series switch. High speed transfer of loads between alternate sources of power, regardless of ampacity size, is achieved by a reliable, field proven solenoid operating mechanism. When combined with a programmable microprocessor controller with keypad and LCD display, the automatic transfer switch offers the most advanced method of transferring all types of loads, such as, motors, electronic drives, UPS's, and microprocessor-based systems. 7000 Series automatic transfer switches are open transfer in ampacity sizes from 30 through 1200 A. If you have any questions, contact MCC TAG.

- Conventional two-position transfer configuration with automatic control
- UL Listed to 1008 Transfer Switch Equipment and CSA certified to CSA 22.2 No. 178-1978 Automatic Transfer Switches
- Independently qualified and certified listed to IEC 60947-6-1, CE marked (optional; limited to certain accessories)
- Rated up to 600 Vac, 30–1200 A
- Reliable and field proven solenoid operating mechanism
- High withstand and close-on ratings including 30 cycle withstand current rating for optimum flexibility in circuit breaker coordination (600–1200 A)
- Solid, switched, or overlapping neutral conductor options
- Front replaceable main and arcing contacts (800–1200 A)
- Programmable microprocessor controller with keypad and LCD display
- Centrally located terminal block for customer control connections (260–1200 A)
- 16 mm, industrial grade control switches and indicating lights
- Switch position indicators and true source acceptability lights
- Standard ground conductor connections
- Four auxiliary contacts—two contacts closed when switch is in normal position and two contacts closed when switch is in emergency position

**ASCO 7000 Series Automatic Transfer Switches With Microprocessor Control Panel**

Rating	Lug Range	Space (Inches)
<b>3Ø3W (can be used with solid neutral through 800 A; ASCO accessory 22)</b>		
30 A	(1) #14–#4/0	36 <sup>1</sup>
70 A	(1) #14–4/0	36
100 A	(1) #14–4/0	36
150 A	(2) 1/0–250 kcmil or (1) #4–600 kcmil	72 (25 W) <sup>2</sup>
260 A	(2) #1/0–250 kcmil or (1) #4–600 kcmil	72 (25 W)
400 A	(1) #4–600 kcmil or (1) #4–600 kcmil	72 (25 W)
600 A	(3) #2–600 kcmil	72 (25 W x 20 D)
800 A	(4) 1/0–750 kcmil	72 (30 W x 20 D)
1200 A	(4) 1/0–750 kcmil	Two full sections required: 1 @ (30 W x 20 D) 1 @ (20 W x 20 D)
<b>3Ø4W with switched neutral (ASCO accessory 28)</b>		
30 A	(1) #14–4/0	36
70 A	(1) #14–4/0	36
100 A	(1) #14–4/0	36
150 A	(2) 1/0–250 kcmil or (1) #4–600 kcmil	72 (25 W)
260 A	(2) 1/0–250 kcmil or (1) #4–600 kcmil	72 (25 W)
400 A	(2) 1/0–250 kcmil or (2) 1/0–250 kcmil	72 (25 W)
600 A	(2) #2–600 kcmil	72 (25 W x 20 D)
800 A	(4) 1/0–750 kcmil	72 (30 W x 20 D)
1200 A	(4) 1/0–750 kcmil	Two full sections required: 1 @ (30 W x 20 D) 1 @ (20 W x 20 D)

<sup>1</sup> Must be top or bottom located.

<sup>2</sup> No vertical bus or vertical wireway.



### Standard Features and Optional Accessories

Description	ASCO Accessory Code	
Accessory panel required for some ASCO accessories. <sup>1</sup>	AP	
Extended time delay on engine start. <sup>2</sup>	2C	
3-phase differential voltage sensing of alternate source. <sup>2</sup>	4E	
3-phase overvoltage sensing of normal source. <sup>2</sup>	4H	
Reset switch to manually bypass time delay on retransfer to normal.	6B	
Reset switch to manually retransfer to normal source after time delay.	6C	
Toggle and selector switches to permit manual or automatic reset to normal.	6D	
Normal/alternate source available pilot lights.	9C/9D	
Push-to-test pilot lights for connected-to-normal and connected-to-emergency source.	9E/9F	
Engine generator exercise timer with switch to select with load or without load.	11C	
Three position engine control switch: Stop/Auto/Engine Test.	12	
(2) auxiliary contacts that close when switch is connected to normal source	14A	
(2) auxiliary contacts that close when switch is connected to emergency source	14B	
Two-pole, double throw contacts operate when emergency source voltage is present at transfer switch terminals.	18B	
Two-pole, double throw contacts operate when normal source voltage is present at transfer switch terminals.	18G	
Solid neutral for 3-wire switch. (Cannot be used if either source has ground fault protection.)	30–150 A switch	22
	260 A switch	
	400 A switch	
	600 A switch	
	800 A switch	
	1200 A switch	
In-phase monitor for motor loads; monitors sources and retransfers to normal when both sources are phase; prevents excess transients on transfer.	27	
Equipment ground lug	33	
Selective load disconnect control contacts that operate with time delay prior to and/or after load transfer and retransfer.	31Z	
Serial communication module for remote communication	72A	
Connectivity module for remote communications using Ethernet TCP/IP networks.	72E	

<sup>1</sup> 18 in. additional space required for 30–100 A switches; no additional space required on larger switches.

<sup>2</sup> Requires accessory panel option AP.

### Model 6 iMCCs

Model 6 iMCCs feature the same overall structure and unit features as Model 6 motor control centers with additional “intelligent” capabilities. Schneider Electric supports two popular methods for configuring Model 6 iMCCs to customize your application:

- iMCC-Hardwired I/O: PLC Interwiring
- iMCC-Network: Network Cabling

**iMCC- Hardwired I/O:** PLC Interwiring offers a hardwired I/O system in the Model 6 MCC that provides basic information and control capabilities. With the I/O mounted in the MCC, the starters are wired to the I/O at the Schneider Electric manufacturing plant and the system is tested prior to shipment. This pre-wired MCC is more cost effective than separately mounting and wiring the automation hardware outside of the MCC. This option can also include an independent network.

**iMCC Network:** A key feature of our iMCC-Network solution is the integration of intelligent devices and device level networks for control and automation that delivers improved performance. Popular network protocols such as CANopen, DeviceNet™, Ethernet, Modbus®, and PROFIBUS communicate directly to every unit of the iMCC for an effective method of connecting centralized control to widely distributed I/O. The network of your choice creates a common thread for a variety of motor control equipment that not only improves control, but also allows for simple and easy installation and operation.

Networking allows for easy monitoring of critical data of each motor or load connected to the iMCC, enabling precise process control at all times. With this information, your staff can respond to potential problems proactively. Real-time access to information and records of last faults allows for simplified diagnostics and reduced downtime.

Using network control to consolidate all I/O communications significantly reduces the amount of tedious wiring that would normally be required for a hardwired I/O MCC with similar functionality. We design a network cabling solution that is appropriate for your selected communication network. Our industry-leading full-depth wireway effectively separates network cabling from high voltage cabling. Additionally, our standard wireway barrier isolates the communication cabling from the load cabling routed in the vertical wireway.

#### Experience the benefits of an iMCC network:

- Remote monitoring capability
- Reduced downtime and system interwiring
- Control to every bucket
- Lower commissioning costs
- Flexible configuration
- Cabling system compliant to applicable standards.
- DeviceNet solution is Open DeviceNet Vendor Association (ODVA) certified.

Intelligent Motor Control Centers

Common Mounting Configurations for Automation Components

PLC components are packaged in Schneider Electric MCCs in two distinct configurations: a unit-mount configuration and a full-section configuration. The unit-mount configuration supports plug-on installation and location flexibility in the MCC. The full-section configuration provides increased space for mounting PLCs and associated equipment. Two full sections can be joined to provide maximum mounting space. For additional automation component mounting information, consult the Model 6 MCC catalog.

**NOTE:** The configurations shown below represent the maximum PLC component densities available. Power distribution, power supplies, component selection, communication protocol, fusing, interposing relays, and CableFast modules affect the actual component densities. The configurations shown are standard configurations. Schneider Electric can also provide custom configurations to meet your specific requirements.

PLC Type	Unit Mounts		Special Units (no wireway) <sup>1</sup>		Full Sections			
	12 in. (13.5 x 11 in.)	18 in. (13.5 x 17 in.)	18 in. Height	24 in. Height	20 in. wide (16.4 x 63.4 in.)	25 in. wide (21.4 x 63.4 in.)	30 in. wide (26.4 x 63.4 in.)	35 in. wide (31.4 x 63.4 in.)
Momentum™	2 modules	4 modules	6 modules	8 modules	12 modules	18 modules	24 modules	30 modules
Micro™	1 PLC (fixed I/O) and power supply	2 PLC (fixed I/O)	1 PLC and 1 Expansion	1 PLC and 2 Expansion	up to 5 interconnected PLCs	up to 5 interconnected PLCs	up to 5 interconnected PLCs	up to 5 interconnected PLCs
Compact™	up to one 5-slot rack plus one 2-slot rack	up to two 5-slot racks	up to two 5-slot racks	up to three 5-slot racks	up to two 5-slot racks	up to four 5-slot racks	up to four 5-slot racks	up to four 5-slot racks
Quantum™	N/A	up to one 6-slot backplane	up to one 10-slot backplane	up to one 10-slot backplane	up to four 6-slot backplanes	up to four 10-slot backplanes	up to four 10-slot backplanes	up to four 16-slot backplanes
Premium™	N/A	up to one 8-slot backplane	up to one 8-slot backplane	up to two 6-slot backplanes	up to four 8-slot backplanes	up to four 12-slot backplanes	up to four 12-slot backplanes	up to four 12-slot backplanes

<sup>1</sup> Special units include 18, 24, 30, and 36 in. high configurations. These units are not plug-in and take up the vertical wireway. They must be mounted at the bottom of a 20 in. wide section.

PLC Foldout Rack

Description	Application
6 in. foldout rack	12 in. unit or larger
12 in. foldout rack	18 in. unit or larger
18 in. foldout rack	24 in. unit or larger

Options for Automation Components in MCCs

Description of Charge	Application	Space (inches)
24 Vdc Control power supply rated 8 A	—	6
Power supply unit 500 VA/115 Vac	—	
120 Vac starter interposing relay	Size 3–5 starters	0
24 Vdc starter interposing relay	—	
Telemecanique relay module	Size 3–5 starters	
Surge suppressor	All starters	

**iMCC-Network Cabling**

Class 1 cabling is 600 V, 8 A rated, 15 AWG power pair, 18 AWG data pair with a braided shield and drain. This cable solution provides current protection, eliminating the need for a vertical wireway communication barrier. (The communication barrier option is still available.)

Class 2/CM cabling is 600 V, 22 AWG, 4-conductor with a foil shield and drain.

Class 2/CM and CAT5E rated cable solutions require a mechanical communication barrier for standard sections.

**iMCC Network Cabling**

Network	Class/Rating
CANopen <sup>1</sup>	Class 1
DeviceNet <sup>1</sup>	Class 1 <sup>2</sup>
Ethernet TCP/IP	CAT5E <sup>3</sup>
Modbus	Class 2/CM
PROFIBUS	Class 2/CM

Option	Description
Communication barrier <sup>4</sup>	Mounted in vertical wireway. Adds additional mechanical protection for network cable.

- <sup>1</sup> Optional Class 2/CM cabling available for DeviceNet and CANopen applications. Consult the MCC TAG for pricing and Quote-To-Cash selector assistance.
- <sup>2</sup> Open DeviceNet Vendor Association (ODVA) approved.
- <sup>3</sup> CAT5E cables connect devices to centralized switch. See the "Ethernet Switch Options" table below.
- <sup>4</sup> Optional for Class 1 cabling only. Communication barrier mounted in vertical wireway of Standard Section supplied as standard with Ethernet, Modbus, and PROFIBUS Class 2/CM applications.



Network Cabling

**Ethernet Switches**

There are two primary ways to configure your Ethernet communications network:

- Distributed switch(es) per shipping split
- Centralized switch(es) per MCC

Application Notes:

- 48 ports maximum per unit
- Recommend using only 80% of ports for I/O, interconnectivity expansion, etc.
- 8 port switch unit can be mounted anywhere
- Switch units with more than 8 ports must be bottom located
- Switch units require a separate 6 in. unit, 8 A power supply; see the table below.

**Ethernet Switch Options**

Switch Ports	Space
8	12
16	18
24	
48	
24 Vdc power supply, rated 8 A	6



Intelligent Motor Control Centers

Repeaters/Bridges/Gateways

Repeaters, bridges, and gateways are recommended for the following applications/reasons:

- Provide a convenient termination point for network cabling.
- Allow the iMCC to be isolated and tested as a subsystem for ease of troubleshooting.
- iMCC is located in the middle of a network. (Two repeaters are used in this configuration.)
- Ground levels can vary from enclosure to enclosure, thus the possibility exists of introducing noise into a system if a repeater is not implemented.

**NOTE:** Repeaters are typically not required for short cable runs routed in the same area.

Model 6 iMCC Bridges/Repeaters

Network	Description	Space (Inches)	Notes
Modbus®	RS-485 repeater	9	Manufactured by B&B Electronics
	PowerLogic® RS-232/RS-485 converter, with 120 Vac Power Supply		
PROFIBUS	24 Vdc/8 A Power Supply	6	Default with iMCC-Network with PROFIBUS
	PROFIBUS Cable Terminations	9	Default with iMCC-Network with PROFIBUS. Required with MLPPI starters.
	PROFIBUS Cable Terminations with RS-485 Repeater		Manufactured by Siemens
	PROFIBUS Cable Terminations with PROFIBUS Active Terminations		
	PROFIBUS Cable Terminations with RS-485 Repeater and PROFIBUS Active Terminator		
DeviceNet™	24 Vdc/10 A Power Supply	6	
	Repeater	9	

## Technical Overview

### Short Circuit Current Ratings



Motor control centers are being applied to electrical systems with increasingly high available fault currents. Because of ever increasing short circuit requirements, Schneider Electric continually pursues higher ratings through new design and testing.

Many “buzz” words and terms are used to describe short circuit ratings and how they relate to motor control centers. Here are a few with a description of what they actually mean:

#### Bus Bracing or Withstand Rating

This term describes the capacity of the bus network to withstand the mechanical forces generated during a short circuit (fault).

#### Integrated Equipment Rating

This term is not clearly defined, especially when applied to motor control centers. While it is often assumed that this term means series connected short circuit ratings or short circuit current ratings, this term can also have other interpretations. Integrated equipment ratings are generally not provided for MCCs.

#### Interrupt Rating

This term describes the maximum fault current level that a particular device can interrupt. This type of rating applies only to devices that operate to interrupt a short circuit when it occurs. This term does not apply to power bus or components of the electrical system that do not interrupt current. Different units within the same motor control center may have different interrupt ratings. Further, the interrupt rating does not take into consideration the effect of a main device or the bus withstand rating.

#### Series Connected Short Circuit Current Ratings

This term describes short circuit ratings that take into consideration the effect of a main overcurrent protective device located in the motor control center or in upstream equipment. It does not necessarily mean that the main has to open whenever a fault occurs. Many engineers feel that series connected short circuit ratings mean that a system cannot be “coordinated” (coordination refers to a system’s capability of interrupting a fault at the lowest level thereby limiting the amount of equipment shut down as a result of that fault). System coordination should be considered when designing any electrical distribution system and the level of coordination will often dictate the type of equipment used. It is possible to maintain acceptable levels of system coordination while utilizing series short circuit ratings and alternately, avoidance of series connected short circuit ratings will not automatically mean that the system will be fully coordinated. Fault coordination should not be confused with series connected short circuit current ratings.

#### Short Circuit Current Rating

This term is Schneider Electric’s “bottom line” in describing the overall short circuit rating of a motor control center. It means that the motor control center will withstand and/or interrupt a fault on an electrical system capable of supplying the specified fault current.

To be properly applied, a motor control center must have a short circuit current rating equal to or greater than the specified available fault current. In order to obtain this rating, a motor control center must contain:

1. A main device capable of interrupting the specified fault current, located in the motor control center or in upstream equipment. A short circuit current rating of a motor control center cannot be greater than the interrupt rating of the main device feeding it.

or:

2. A bus bracing or withstand rating equal to or greater than the specified fault current.

**Short Circuit Current Ratings**

and:

- Units with short circuit current ratings equal to or greater than the specified fault current. All units must either have an interrupt rating greater than or equal to the specified fault current or carry a series connected short circuit rating greater than or equal to this level.

**UL Listed Short Circuit Current Ratings**

Underwriters' Laboratories (UL) has defined test criteria for motor control center short circuit ratings. In general, UL witnesses the testing of "worst case" configurations of motor control center units, structures, and bussing at the short circuit current levels for which the equipment is being rated. In many cases, such as units with circuit breaker disconnects, the same unit must be subjected to those fault levels more than once. To pass, equipment must withstand and/or interrupt the fault in accordance with UL criteria. UL Listed short circuit ratings ensure that different manufacturers are "comparing apples to apples" when describing short circuit current ratings.

**"Self-Certified" Short Circuit Current Ratings**

Short circuit current ratings that are obtained through first-party testing and/or engineering evaluation, are certified by the manufacturer, and are not UL Listed are known as "self-certified" ratings.

Self-certified short circuit ratings should not necessarily be considered unacceptable. However, caution should be used because the basis for the short circuit ratings may differ from one manufacturer to another.

**Main and Branch Feeder Circuit Breakers—Short Circuit Ratings**

Breaker Trip Rating (Amps)	Breaker Frame	Unit Interrupting Rating (kA)		
		208/240V	480V	600V
150	HG	65	35	18
	HJ	100	65	25
	HL	100	100	50
250	JG	65	35	18
	JJ	100	65	25
	JL	100	100	50
400	LA	42	30	22
	LH	65	35	25
	LE	100	65	35
600	LI	100	100	100
	LX	100	65	35
	LXI	100	100	100
800	MJ	65	65	25
1200	PK	65	50	50
	PL	100	100	—
3000	RK	65	65	65
	RL	100	100	50

**Main and Branch Feeder Fusible Switch—Short Circuit Ratings**

Maximum Fuse Size (Amps)	Short Circuit Rating			
	Class H	Class J	Class R	Class L
30	5 kA	100 kA	100 kA	—
60	5 kA	100 kA	100 kA	—
100	10 kA	100 kA	100 kA	—
200	10 kA	100 kA	100 kA	—
400	10 kA	100 kA	100 kA	—
600	10 kA	100 kA	100 kA	—
2000	—	—	—	100 kA

**Circuit Breaker Combination Starter with Melting Alloy, Bimetallic, or Solid State Overloads—Short Circuit Ratings**

NEMA Size	Breaker Frame	Unit Interrupting Rating (kA)		
		208/240 V	480 V	600 V
1, 2, 3, and 4	HG	65	35	18
	HJ	100	65	25
	HL	100	100	50
4 and 5	JG	65	35	18
	JJ	100	65	25
	JL	100	100	50
5	LA	100	100	50
	LH	100	100	50
	LC	65	65	50
	LE	100	100	50
	LI	100	100	100
	LX	100	100	50
	LXI	100	100	100
6	LA	100	100	50 <sup>1</sup>
	LH	100	100	50 <sup>1</sup>
	LC	65	65	35
	LE	100	100	50
	LI	100	100	100
	LX	100	100	50
	LXI	100	100	100
	MJ	65	65	25
	PK	—	—	50
PL	100	100	—	

<sup>1</sup> Denotes Thermal-Magnetic rating; Magnetic-only is 22 kA.

**Fusible Switch Combination Starter Units (NEMA/EEMAC) with Melting Alloy, Bimetallic Thermal, or Solid State Overloads—Short Circuit Ratings**

Ratings for all voltages through 600 V.

NEMA Size	Short Circuit Rating		
	Class H	Class J	Class R
1	10 kA	100 kA	100 kA
2	10 kA	100 kA	100 kA
3	10 kA	100 kA	100 kA
4	10 kA	100 kA	100 kA
5	10 kA	100 kA	100 kA
6	10 kA	100 kA	100 kA

**Circuit Breaker or Fusible Switch Compac 6 Application Rated Combination Starter Units and Bimetallic Thermal Overloads—Short Circuit Ratings**

Only use GJL Magnetic Only or Thermal-Mag breakers and Class J fuses

Disconnect	Short Circuit Rating	
	480 V Maximum	600 V Maximum
Circuit breaker	100 kA	NA
Fusible switch	100 kA	100 kA



Layout Instructions

Selection Guide

Layout Instructions

The lines between letters represent 3 in. increments.



When planning your MCC line-up, use this form. Start at the top of the leftmost column, drawing a line across the column at the increment mark where the unit stops, e.g., a Compac 6, 6 in. unit would take up spaces A and B. A line would be drawn across the column from B and that unit designation would be "A." The next unit designation would be "C," and so on.)

Example:

	MCC Section 1	MCC Section 2
A	A 6 in. (COMPAC 6)	
B		
C	C 6 in. (COMPAC 6)	
D		
E	E 12 in. (Standard Unit)	
F		
G		
H		
I	I 12 in. (Standard Unit)	
J		
K		
L		
M		

Use page 106 to detail which components you'll need to build your MCC.

Indicate shipping splits here by filling in the appropriate triangle(s). (Maximum of three sections.)

	MCC Section ____	MCC Section ____	MCC Section ____	MCC Section ____	MCC Section ____
A					
B					
C					
D					
E					
F					
G					
H					
I					
J					
K					
L					
M					
N					
O					
P					
Q					
R					
S					
T					
U					
V					
W					
X					

	MCC Section ____	MCC Section ____	MCC Section ____	MCC Section ____	MCC Section ____
A					
B					
C					
D					
E					
F					
G					
H					
I					
J					
K					
L					
M					
N					
O					
P					
Q					
R					
S					
T					
U					
V					
W					
X					

**Unit Designation Chart for Planning**

Section/ Unit Location	Starter Class or Description	Size	CB Trip/ Fuse Clips (A)	hp Rating	Aux. Intlks.		Control Devices							Other			Nameplate Identifications	
					NO	NC	Push Button		Selector Switches			Indicating Lights						
							Start-Stop	Fwd-Rev-Stop	Fast-Slow-Stop	Hand-Off-Auto	On-Off	Fwd-Off-Rev	Fast-Off-Slow					Green (Stopped)

**General**

**Dimensions**

**General**

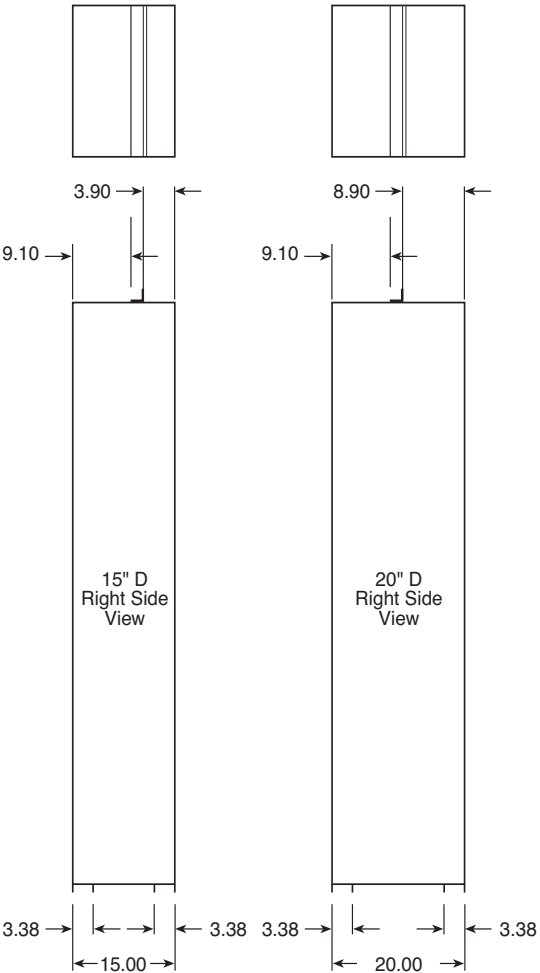
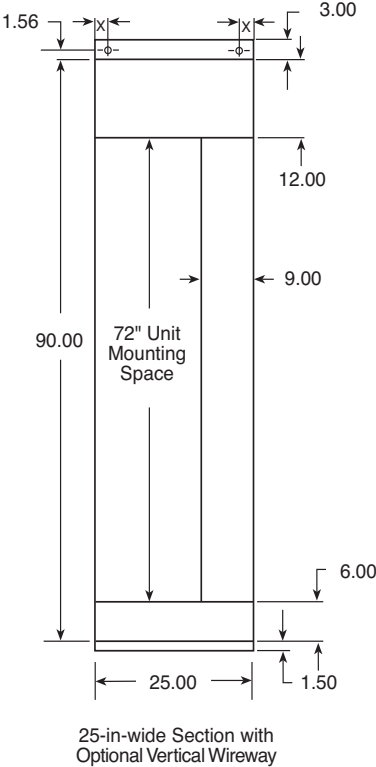
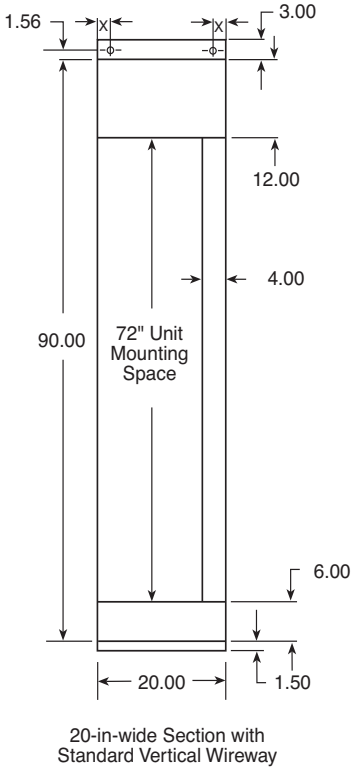


Standard sections contain both a vertical bus system and a vertical wireway. A relay section contains neither, but does have horizontal power and ground bus for splicing to other sections. A relay section can be equipped with a relay pan for customer-mounted equipment and devices. Starter units and main or branch devices that require 72 inches of space are mounted in a relay section.

A transition section is used to splice two different models of Square D® brand MCCs together (see page 16), turn a corner, or create a back-to-back arrangement (see page 15). **Conduit entry is not recommended in transition sections.**

**NEMA/EEMAC Type 1, Type 1A (Gasketed), or Type 12 Enclosures**

Number of Sections Per Shipping Assembly	Dimension "X"
1	1.90
2	5.00
3	10.00



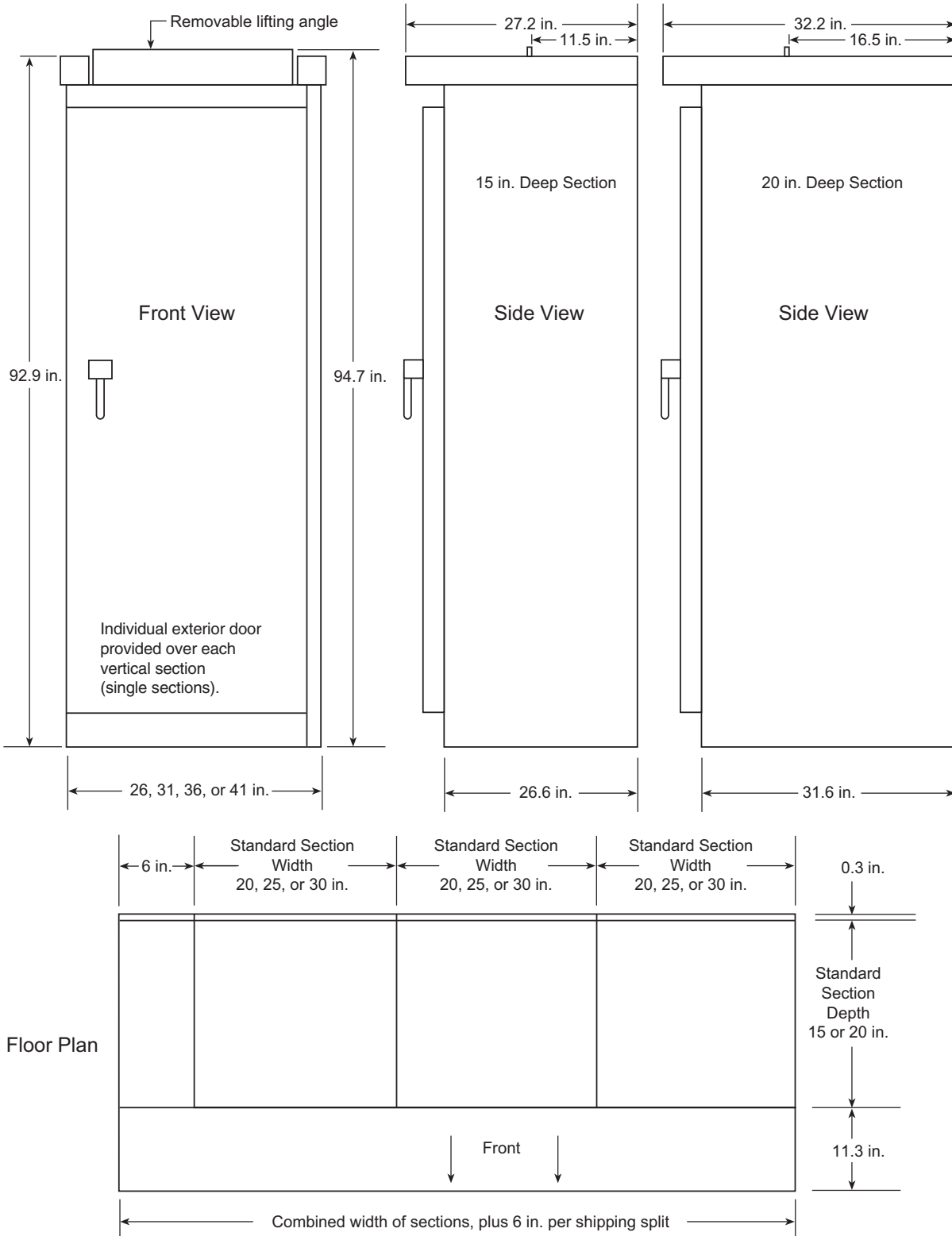
**Notes:**

- All dimensions are shown in inches.
- Depths shown indicate actual depth of the structure. Doors and cover plates extend forward 0.06 inches.
- Handles and door mounted devices extend forward 2.45 inches or less.
- Standard door swing extends forward 15.38 inches for unit doors. On full-section units, 20, 25, or 30 inches is required for doors.

# Model 6 Motor Control Centers Dimensions

## NEMA/EEMAC Enclosures

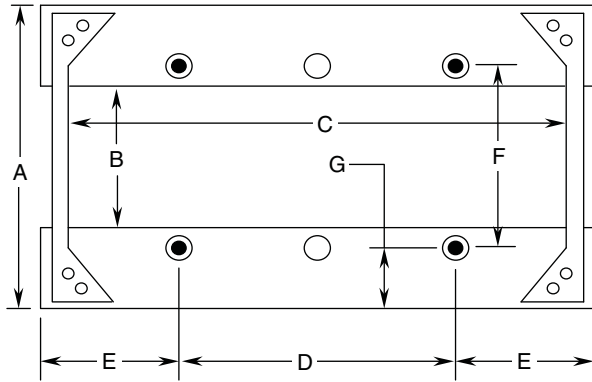
### NEMA/EEMAC Type 3R Non-Walk-In Basic Enclosures



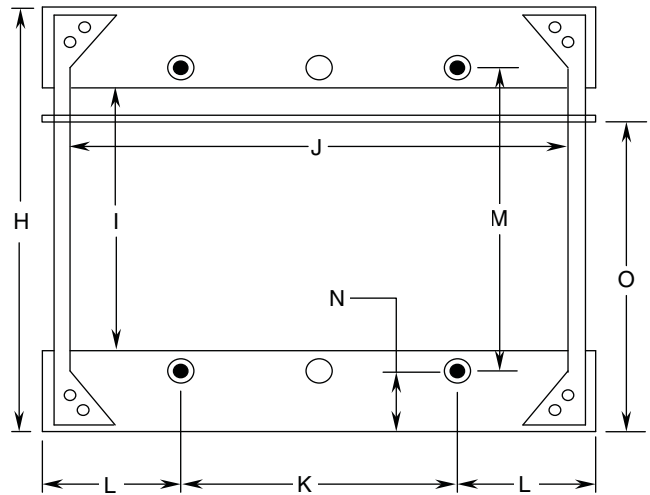
**NEMA/EEMAC Enclosures**

**Bottom Conduit Entry**

**NEMA/EEMAC Type 1, Type 1A (Gasketed), and Type 12 Enclosures—Anchor Locations**



- Standard Anchor Locations
- Seismic Anchor Locations



**NEMA/EEMAC Type 1, Type 1A (Gasketed), and Type 12 Enclosures—Bottom Conduit Entry and Structure Anchoring Information for Standard and Seismic Installation**

Dimension	Size (In.)	
Section Depth		
A	15	
Available Conduit Entry		
B	8.24	
C	17.22	
Section Width Anchor		
D	20	10
	25	15
	30	20
	35	25
Anchors		
E	5.00	
F	9.98	
G	2.50	

Dimension	Size (In.)	
Section Depth		
H	20	
Available Conduit Entry		
I	13.24	
J	17.22	
Section Width Anchor		
K	20	10
	25	15
	30	20
	35	25
Anchors		
L	5.00	
M	14.98	
N	2.50	
Ground Bus		
O	12.85	

**NOTES:**

The dimensions shown are tie-down locations within individual MCC sections. Refer to factory supplied drawings to determine appropriate anchor locations for the equipment pad.

Depths shown indicate actual depth of the structure. Doors and cover plates extend forward 0.06 in.

Handles and door mounted devices extend forward 2.45 in. or less.

Standard door swing extends forward 15.38 in. for unit doors. On full-section units, 20, 25, or 30 in. is required for doors.

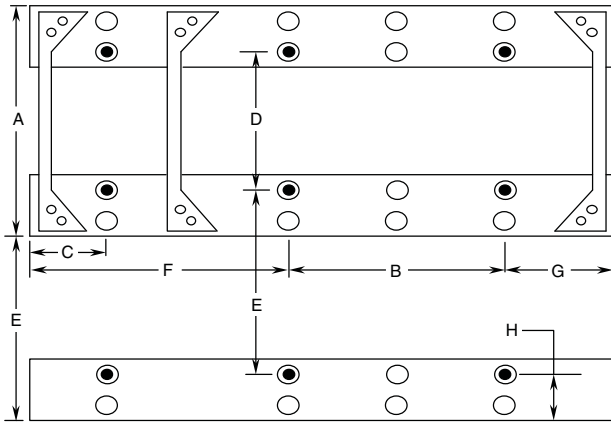
NEMA/EEMAC Type 12 section width is extended to account for gasketing between sections.

Vertical clearance for conduit entry to nearest obstruction is 7 in. minimum, except 20 in. deep sections where ground bus obstruction is 5 in.

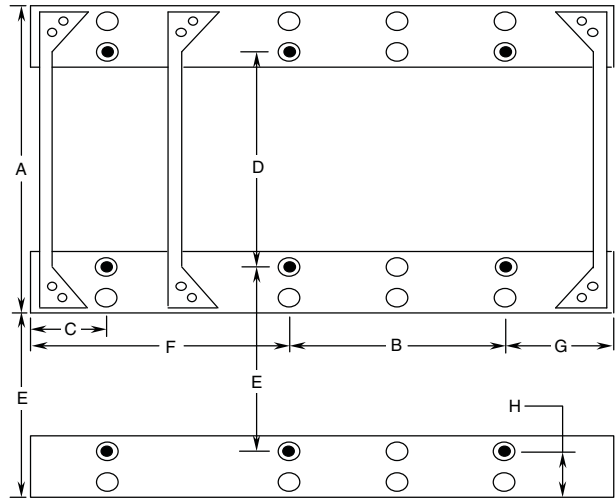
# Model 6 Motor Control Centers Dimensions

## NEMA/EEMAC Enclosures

### NEMA/EEMAC Type 3R (Non Walk-in) Enclosure—Anchor Locations



- Standard Anchor Locations
- Seismic Anchor Locations



### NEMA/EEMAC Type 3R (Non Walk-in) Enclosure—Structure Anchoring Information for Standard and Seismic Installation

Dimension	Size (In.)	
Section Depth		
A	15	
Section Width Anchor		
B	20	10
	25	15
	30	20
	35	25
Anchors		
C	5.00	
D	9.98	
E	11.60	
F	12.50	
G	5.00	
H	3.60	

Enclosure depth is dimension A (15 in.) + E (11.6 in.) = 26.6 in.

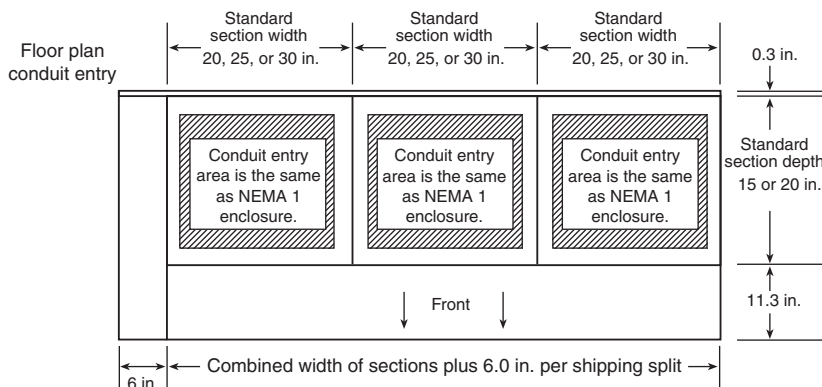
Dimension	Size (In.)	
Section Depth		
A	20	
Section Width Anchor		
B	20	10
	25	15
	30	20
	35	25
Anchors		
C	5.00	
D	14.98	
E	11.60	
F	12.50	
G	5.00	
H	3.60	

Enclosure depth is dimension A (20 in.) + E (11.6 in.) = 31.6 in.

#### NOTES:

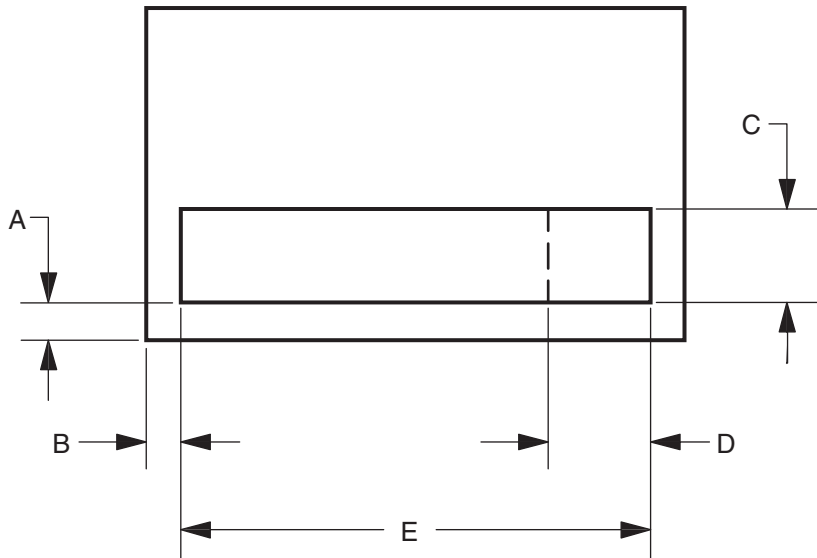
- The dimensions shown are tie-down locations within individual MCC sections. Refer to factory supplied drawings to determine appropriate anchor locations for the equipment pad.

### Additional Conduit Entry Information for NEMA/EEMAC Type 3R Enclosures



Top Conduit Entry

NEMA/EEMAC Type 1, Type 1A (Gasketed), and Type 12 Enclosures—Top Conduit Entry Information for Standard and Seismic Installation



Dimension		Size (In.)
Available Conduit Entry		
A		1.62
B		1.39
C		4.14
Control Only Width		
D	20	3.26
	25	8.26
Section Width		
E	20	17.22
	25	22.22
	30	27.22
	35	32.22

NOTES:

- NEMA/EEMAC Type 12 section width is extended to account for gasketing between sections.
- Vertical clearance for conduit entry to nearest obstruction is 12 in. minimum.
- Control is limited to area within C x D for all top-located mains in standard structure.

# Model 6 Motor Control Centers

## Typical Specifications

### Typical Specifications

**NOTE:** Optional items are shown in bold text enclosed in square brackets. For example, **[600 A]** **[800 A]** **[1200 A]**.



#### Part 1 General

##### 1.01 Description

This section includes requirements for a motor control center (MCC) and all required control devices as shown on the drawing and specified to be part of the MCC equipment. The MCC shall be 480 V, 3-Phase, 3-Wire, 60 Hz unless otherwise indicated (600 V in Canada).

##### 1.02 Submittals

Submit with the delivery of the MCC an Installation and Maintenance Manual and one (1) copy of the manufacturer's drawings per shipping block.

##### 1.03 Regulatory Requirements

The MCC must conform to Underwriters Laboratories (UL) 845, current revision, CSA, EEMAC, NEMA ICS-18, the latest version of the National Electrical Code, and the Canadian Electrical Code. The MCC must be manufactured in an ISO 9001 certified facility.

##### 1.04 Packing/Shipping

The MCC shall be separated into shipping blocks no more than three vertical sections each. Shipping blocks shall be shipped on their sides to permit easier handling at the job site. Each shipping block shall include a removable lifting angle, which will allow an easy means of attaching an overhead crane or other suitable lifting equipment.

##### 1.05 Storage

If the MCC cannot be placed into service reasonably soon after its receipt, store it in a clean, dry, and ventilated building free from temperature extremes. Acceptable storage temperatures are from 32 °F (0 °C) to 104 °F (40 °C).

##### 1.06 Warranty

The MCC shall be warranted to be free from defects in materials and workmanship for a period of eighteen (18) months from date of invoice from manufacturer or authorized sales channel.

#### Part 2 Product

##### 2.01 Manufacturers

- A. Shall be Square D® brand or equal.
- B. Additions to existing MCCs shall be the same as the original manufacturer.



### 2.02 Materials

- A. Steel material shall comply with UL 845 and CSA requirements.
- B. Each MCC shall consist of one or more vertical sections of heavy gauge steel bolted together to form a rigid, free-standing assembly. A removable 7 gauge structural steel lifting angle shall be mounted full width of the MCC shipping block at the top. Removable 7 gauge bottom channel sills shall be mounted underneath front and rear of the vertical sections and shall extend the full width of the shipping block. Vertical sections shall be made of welded side-frame assembly formed from a minimum of 12 gauge steel. Internal reinforcement structural parts shall be of 12 and 14 gauge steel to provide a strong, rigid assembly. The entire assembly shall be constructed and packaged to withstand normal stresses in transit and during installation.

### 2.03 MCC Finish

- A. All steel parts shall be provided with UL and CSA listed acrylic/alkyd baked enamel paint finish or TGIC Powder Coat, except plated parts used for ground connections. All painted parts shall undergo a multi-stage treatment process, followed by the finishing paint coat.
- B. Pre-treatment shall include:
  - 1. Hot alkaline cleaner to remove grease, oil, and other contaminants.
  - 2. Iron phosphate or other approved pretreatment technology to improve adhesion and corrosion resistance.
- C. The paint shall be applied using an electro-deposition process to ensure a uniform paint coat with high adhesion.
- D. The standard paint finish shall be tested to UL 50 per ASTM B117 (5% ASTM salt spray) with no greater than 0.125 in. (3 mm) loss of paint from a scribed line along with minimal field blisters.
- E. Paint color shall be #49 medium light gray per ANSI standard Z55.1-967 (55-65 gloss) on all surfaces unless specified otherwise. Control station plates and escutcheon plates shall be a contrasting gray. Unit interior saddles may be painted white for better visibility inside the unit.

### 2.04 Structures

- A. Structures shall be totally enclosed, dead-front, free-standing assemblies. Structures shall be capable of being bolted together to form a single assembly.
- B. The overall height of the MCC shall not exceed 90 in. (2286 mm) (not including base channel or lifting angle). Base channels of 1.5 in. (38 mm) in height and lifting angles of 3 in. (76 mm) in height shall be removable. The total width of one section shall be 20 in. (508 mm). (Widths of 25 in. (630 mm), 30 in. (760 mm), and 35 in. (890 mm) can be used for larger devices.)
- C. Structures shall be NEMA/EEMAC Type **[1 (general purpose)] [1A (gasketed general purpose)] [12 (industrial duty)] [3R non-walk-in (rainproof)]**.
- D. Each 20 in. (508 mm) wide standard section shall have all the necessary hardware and bussing for modular plug-on units to be added and moved around. All unused space shall be covered by hinged blank doors or appropriate cover plate and equipped to accept future units. Vertical bus openings shall be covered by manual bus shutters.
- E. Each section shall include a top plate (single piece or two-piece). NEMA/EEMAC Type 12 enclosures shall also include a bottom plate. Top and bottom plates shall be removable for ease in cutting conduit entry openings.

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## Typical Specifications

### 2.05 Wireways

- A. Structures shall contain a minimum 12 in. (305 mm) high horizontal wireway at the top of each section and a minimum 6 in. (152 mm) high horizontal wireway at the bottom of each section. These wireways shall run the full length of the MCC to allow room for power and control cable to connect between units in different sections.
- B. A full-depth vertical wireway shall be provided in each MCC section that accepts modular plug-on units. The vertical wireway shall connect with both the top and bottom horizontal wireway. The vertical wireway shall be 4 in. (102 mm) wide minimum with a separate hinged door. There should be a minimum of 60 in.<sup>2</sup> (387 cm<sup>2</sup>) of cabling space available for 15-inch-deep sections and 80 in.<sup>2</sup> (516 cm<sup>2</sup>) of cabling space available for 20-inch-deep sections. Access to the wireways shall not require opening control unit doors. Structures that house a single, full section control unit are not required to have vertical wireways. Those control units must open directly into the MCC horizontal wireways.

### 2.06 Barriers

- A. All power bussing and splice connections shall be isolated from the unit compartments and the wireways. The horizontal bus shall be mounted onto a glass-filled polyester support assembly that braces the bus against the forces generated during a short circuit. The horizontal bus shall be isolated from the top horizontal wireway by a two-piece, rigid, non-conductive barrier. The barrier design shall allow qualified personnel to slide the barriers both left and right, to allow access to the bus and connections for maintenance without having to remove the barrier. Barrier sliding shall occur via an upper and lower track system.
- B. The vertical bus shall be housed in a molded glass-filled polyester support that provides bus insulation and braces the bus against the forces generated during a short circuit. These supports shall have openings every 3 in. (75 mm) for unit stab-on connections. Each opening shall be provided with a manual shutter to close off the stab opening. These shutters shall be attached to the structure so that when they are removed (to allow a stab connection), they are retained in the structure and are readily accessible for use should a plug-on unit be removed from the MCC.
- C. **[Barriers shall be provided in the vertical structure and unit designs to prevent the contact of any energized bus or terminal by a fishtape inserted through the conduit or wireway areas.]**

### 2.07 Bussing

- A. All bussing and connectors shall be **[tin-plated aluminum] [tin-plated copper] [silver-plated copper]**.
- B. The main horizontal bus shall be rated at **[600 A] [800 A] [1200 A] [1600 A] [2000 A] [2500 A (NEMA/EEMAC Type 1 enclosure only)]** continuous, and shall extend the full length of the MCC. Bus ratings shall be based on 149 °F (65 °C) maximum temperature rise in a 104 °F (40 °C) ambient. Provisions shall be provided for splicing additional sections onto either end of the MCC.
- C. The horizontal bus splice bars shall be pre-assembled into a captive bus stack. This bus stack is installed into the end of the MCC power bus to allow the installation of additional sections. The main bus splice shall use four bolts, two on each side of the bus split, for each phase. Additional bolts must not be required when splicing higher amperage bus. The splice bolts shall secure to self-clenching nuts installed in the bus assembly. It shall be possible to maintain any bus connection with a single tool.
- D. Each section that accepts plug-on units shall be provided with a vertical bus for distributing power from the main bus to the individual plug-on starter units. This bus shall be copper and plated the same as the main bus, and shall be rated at **[300 A] [600 A]** continuous. The vertical bus shall be connected directly to the horizontal bus stack without the use of risers or other intervening connectors. It shall be possible to maintain the vertical to horizontal bus connection with a single tool. "Nut and bolt" bus connections to the power bus shall not be permitted. When a back-to-back unit arrangement is used, separate vertical bus shall be provided for both the front and rear units.

## Model 6 Motor Control Centers Typical Specifications

- E. A **[tin-plated copper] [silver-plated copper]** ground bus shall be provided that runs the entire length of the MCC. The ground bus shall be rated for **[300 A] [600 A]**. A compression lug shall be provided in the MCC for a 4/0-250 kcmil ground cable. The ground bus shall be provided with (6) 0.38 in. (10 mm) holes for each vertical section to accept customer-supplied ground lugs for any loads requiring a ground conductor.
- F. Each vertical section shall have a **[steel] [copper]** vertical ground bus that is connected to the horizontal ground bus. This vertical ground bus shall be installed so that the plug-on units engage the ground bus prior to engagement of the power stabs and shall disengage only after the power stabs are disconnected upon removal of the plug-on unit.
- G. The system shall be rated for an available short circuit capacity of **[42,000] [65,000] [85,000] [100,000]** rms amperes.

### 2.08 Typical Unit Construction

- A. Units with circuit breaker disconnects through the 400 A frame size, and fusible switch disconnects through 400 A, shall connect to the vertical bus through a spring-reinforced, stab-on connector. Units with larger disconnects shall be connected directly to the main horizontal bus with appropriately sized cable or riser bus.
- B. All conducting parts on the line side of the unit disconnect shall be shrouded by a suitable insulating material to prevent accidental contact with those parts.
- C. Unit mounting shelves shall include hanger brackets to support the unit weight during installation and removal. All plug-on units shall use a twin-handle camming lever located at the top of the bucket to rack in and rack out the plug-on unit. The cam lever shall work in conjunction with the hanger brackets to ensure positive stab alignment.
- D. A lever handle operating mechanism must be provided on each disconnect. With the unit stabs engaged onto the vertical phase bus and the unit door closed, the handle mechanism shall allow complete ON/OFF control of the unit. All circuit breaker operators shall include a separate TRIPPED position to clearly indicate a circuit breaker trip condition. It shall be possible to reset a tripped circuit breaker without opening the control unit door. Clear indication of disconnect status shall be provided by adhering to the following operator handle positions:
  - 1. Handle "ON" position must be up and within 45 degrees of being parallel to the face of the equipment.
  - 2. Handle "OFF" position must be down and within 45 degrees of being parallel to the face of the equipment.
  - 3. The minimum separation between the "ON" and "OFF" positions shall be 90 degrees.
  - 4. On circuit breaker disconnects, the "TRIPPED" position of the handle must be perpendicular to the face of the equipment +/- 30 degrees. Minimum separation between "ON" and "TRIPPED" shall be 30 degrees. Minimum separation between "TRIPPED" and "OFF" shall be 45 degrees.
- E. A mechanical interlock shall prevent the operator from opening the unit door when the disconnect is in the ON position. Another mechanical interlock shall prevent the operator from placing the disconnect in the ON position while the unit door is open. It shall be possible for authorized personnel to defeat these interlocks.
- F. A non-defeatable interlock shall be provided to prevent installing or removing a plug-on unit unless the disconnect is in the OFF position.
- G. The plug-on unit shall have a grounded, stab-on connector that engages the vertical ground bus prior to, and releases after, the power bus stab-on connectors engage/release.
- H. Provisions shall be provided for locking all disconnects in the OFF position with up to three padlocks.
- I. Handle mechanisms shall be located on the left side to encourage operators to stand to the left of the unit being switched.
- J. Unit construction shall combine with the vertical wireway isolation barrier to provide a fully compartmentalized design.
- K. **[Surfaces (back, side, and bottom plates) of the unit shall be painted white.]**

# Model 6 Motor Control Centers

## Typical Specifications

### 2.09 Components for Typical Units

#### A. Combination Starters

1. All combination starters shall use a unit disconnect as described in specification 2.08. Magnetic starters shall be furnished in all combination starter units. All starters shall use NEMA/EEMAC rated contactors. Starters shall be provided with a three-pole, external manual reset, overload relay for **[eutectic melting alloy] [ambient compensated bimetallic] [solid state]** thermal overload units.
2. When provided, control circuit transformers shall include two primary protection fuses and one secondary fuse (in the non-ground secondary conductor). The transformer shall be sized to accommodate the contactor(s) and all connected control circuit loads. The transformer rating shall be fully visible from the front when the unit door is opened.
3. When a unit control circuit transformer is not provided, the disconnect shall include an electrical interlock for disconnection of externally powered control circuits.
4. Auxiliary control circuit interlocks shall be provided where indicated. Auxiliary interlocks shall be field convertible to normally open or normally closed operation.
5. NEMA/EEMAC Size 1–4 starters shall be mounted directly adjacent to the vertical wireway so that power wiring (motor leads) shall connect directly to the starter terminals without the use of interposing terminals. Larger starters shall be arranged so that power wiring may exit through the bottom of the starter cubicle without entering the vertical wireway.

#### B. Terminal Blocks

1. When Type B wiring is specified, all starter units shall be provided with unit control terminal blocks.
2. Terminal blocks shall be pull-apart type, 250 V, and rated for 10 A. All current carrying parts shall be tin-plated. Terminals shall be accessible from inside the unit when the unit door is opened. Terminal blocks shall be DIN rail-mounted with the stationary portion of the block secured to the unit bottom plate. The stationary portion shall be used for factory connections and shall remain attached to the unit when removed. The terminals used for field connections shall face forward so they can be wired without removing the unit or any of its components.
3. When Type C wiring is specified, all starter units shall be provided with unit control terminal blocks as described for Type B wiring, along with power terminal blocks for NEMA/EEMAC Size 1–3 units. An additional set of terminal blocks shall be provided in a terminal compartment located in each section. These terminal blocks shall be pre-wired to the unit terminals so that all field control connections can be made at the terminal compartments.

#### C. Nameplates

When provided, nameplates shall be engraved phenolic with a gray background and white letters. Total outside dimensions shall be a minimum of 1.5 in. (38 mm) H x 6.25 in. (159 mm) W.

#### D. Pilot Device Panel

Each combination starter unit shall be provided with a hinged/removable control station plate that can accommodate up to five 22 mm pilot devices or three 30 mm pilot devices. **[The control station plate can be deleted if no local unit pilot devices are required.]**

### 2.10 Six-Inch Unit Construction

- A. Units with circuit breaker disconnects through 250 A frame and fusible switch disconnects through 100 A shall connect to the vertical bus through a spring-reinforced, stab-on connector. Stabs on all plug-on units shall be cable connected to the unit disconnect. Six-inch fusible units shall accept Class J fuses only.
- B. All conducting parts on the line side of the unit disconnect shall be shrouded by a suitable insulating material.

## Model 6 Motor Control Centers Typical Specifications

- C. Unit mounting shelves shall include hanger brackets to support the unit weight during installation and removal. All six-inch plug-on units shall be installable without the assistance of a camming device so as to allow maximum accessibility with the unit installed.
- D. A lever handle operating mechanism must be provided on each disconnect. With the unit stabs engaged into the vertical phase bus and the unit door closed, the handle mechanism shall allow complete ON/OFF control of the unit disconnect with clear indication of the disconnects status. All circuit breaker operators shall include a separate TRIPPED position to clearly indicate a circuit breaker trip condition. It shall be possible to reset a tripped circuit breaker without opening the control unit door.
  - 1. A mechanical interlock shall prevent an operator from opening the unit door when the disconnect is in the ON position. Another mechanical interlock shall prevent an operator from placing the disconnect in the ON position while the door is open. It shall be possible for authorized personnel to defeat these interlocks.
  - 2. A non-defeatable interlock shall be provided between the lever handle and the structure to prevent installing or removing a plug-on unit unless the disconnect is in the OFF position. The plug-on unit shall have a grounded stab-on connector which engages the vertical ground bus prior to, and releases after, the power bus stab-on connectors engage/release.
- E. Provisions shall be made for locking all disconnects in the OFF position with up to three padlocks.
- F. Handle mechanisms shall be located on the bottom left side of the unit and operate horizontally to encourage operators to stand to the left of the unit being switched.
- G. Unit construction shall combine with the vertical wireway isolation barrier to provide a fully compartmentalized design.
- H. A maximum of twelve six-inch units can be installed per vertical section without placement restrictions in new or existing applications.

### 2.11 Components for Six-Inch Units

- A. Six-Inch Combination Starters
  - 1. All six-inch combination starters shall use a unit disconnect as described in specification 2.10. All starters shall use **[NEMA/EEMAC] [IEC]-rated** contactors. Starter units shall be provided with a 3-pole, external manual reset, overload relay for **[eutectic melting alloy (NEMA rated units only)] [solid state (NEMA rated units only)] [ambient compensated bi-metallic (application-rated units)]** motor overload protection.
  - 2. When provided, control circuit transformers shall include two primary protection fuses and one secondary fuse (in the non-ground secondary conductor). The transformer shall be sized to accommodate the contactor(s) and all connected control circuit loads.
  - 3. When a unit control circuit transformer is not provided, the disconnect shall include an electrical interlock for disconnection of externally powered control circuits.
  - 4. Auxiliary control circuit interlocks shall be provided where indicated. For NEMA rated starters, auxiliary interlocks shall be field convertible to normally open or normally closed operation.
  - 5. NEMA/EEMAC Size 1 starters shall be mounted directly adjacent to the vertical wireway so that power wiring (motor leads) will connect directly to the starter terminals.
- B. Terminal Blocks for Six-Inch Units
  - 1. All starter units shall be provided with unit control terminal blocks.
  - 2. Terminal blocks shall be pull-apart type, 250 V, and rated for 10 A. All current-carrying parts shall be tin-plated. Terminals shall be accessible from inside the unit when the unit door is opened. The stationary portion of the terminal block shall be used for factory connections and will remain attached to the unit when the portion used for field connections is removed. The terminals used for field connections shall be accessible so they can be wired without removing the unit or any of its components.

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### C. Nameplates

Nameplates shall be provided for each MCC and unit compartment. They shall be engraved phenolic with a gray background and white letters. Total outside dimensions shall be a minimum of 1.5 in. (38 mm) H x 6.25 in. (159 mm) W.

### D. Pilot Device Control Panel

Each unit to be provided with a control panel for a maximum of four pilot devices. **[Pilot device control panel can be deleted if no local unit pilot devices are required.]** Control panel to be removable by loosening two semi-captive fasteners for customer access.

## 2.12 Adjustable Frequency AC Drive Unit Construction

- A. The AC drive controller unit shall be a combination disconnect-drive MCC style unit. The input **[circuit breaker] [fusible switch]** shall provide NEC required branch circuit protection. The branch circuit protection shall have an external operator. The adjustable frequency drives shall be **[variable torque] [constant torque]** AC drives. Wiring between the AC drive and the disconnect shall not be disturbed when removing or installing the AC drive controller unit from the MCC.
- B. Units should be of modular construction so that it is possible to readily interchange units of the same size without modifications to the MCC structure.
- C. All conducting parts on the line side of the unit disconnect shall be isolated to prevent accidental contact with those parts.
- D. AC drive controller units up to 50 hp variable torque shall be plug-on units which connect to the vertical bus through a spring-reinforced, stab-on connector. Units larger than 50 hp variable torque shall be connected directly to the main horizontal bus with appropriately sized cable or riser bus.
- E. All AC drive controller unit interior mounting panels shall be white for better visibility.
- F. A disconnect operator shall be provided per specification 2.08 D.
- G. All plug-on AC drive controller units shall have a grounded stab-on connector which engages the vertical ground bus prior to, and releases after, the power bus stab-on connectors engage/release.
- H. All AC drive controller units shall be provided with unit control terminal blocks for use in terminating field wiring. Terminal blocks shall be pull-apart type, 250 V, and rated for 10 A. All current-carrying parts shall be tin-plated. Terminals shall be accessible from inside the unit when the unit door is opened. The stationary portion of the terminal block shall be used for factory connections and will remain attached to the unit when the portion used for field connections is removed. The terminals used for field connections shall be accessible so they can be wired without removing the unit or any of its components.
- I. The AC drive controller unit shall incorporate a self-contained, air-based cooling system. Any air exhaust vents shall be louvered to help direct air flow away from personnel operating the AC drive controller unit. Any fans, ductwork, or filters shall be easily accessible for maintenance.
- J. The AC drive controller unit cooling system shall be sized to cool the drive regardless of mounting location within the MCC. The AC drive controller unit shall not be restricted to a specific location in the MCC.
- K. An internal overtemperature trip shall be provided to detect cooling system failure or blockage. Upon occurrence of an overtemperature trip, the cooling system fans shall continue running to provide a rapid cool down.
- L. Power for the cooling system shall be provided internal to the AC drive controller unit by use of a control power transformer that includes two primary fuses and one secondary fuse (in the non-ground secondary conductor).
- M. Electrical Ratings
  - 1. The AC drive controller unit shall be designed to operate from an input voltage of **[208] [240] [480] [600]** Vac, + or -10%.
  - 2. The AC drive controller unit shall operate from an input voltage frequency range of 57–63 Hz.

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3. The displacement power factor shall not be less than 0.95 lagging under any speed or load condition.
4. The efficiency of the AC drive at 100% speed and load shall not be less than 96%.
5. The variable torque overtorque capacity shall be 130% for 1 minute. **[The constant torque overtorque capacity shall be 170% for 1 minute.]**
6. The output carrier frequency of the AC drive shall be selectable between 1 kHz and 16 kHz, depending on inverter rating for low noise operation. The output carrier frequency of the AC drive shall be randomly modulated to avoid resonance.
7. All AC drive controller unit feeder equipment, including conductors, lugs, disconnects, contactors, etc., shall be sized per NEC Article 430 for the AC drive input current rating. An impedance range corresponding to a 22,000 to 100,000 A fault availability level shall be assumed for the input current rating.

### N. Protection

1. The AC drive controller unit shall be protected against fault currents up to and including 100,000 A rms symmetrical at 480 Vac and shall be UL 845 listed as verification.
2. Upon power-up, the AC drive shall automatically test for valid operation of memory, option module, loss of analog reference input, loss of communication, dynamic brake failure, DC to DC power supply, control power, and the pre-charge circuit.
3. The AC drive controller unit shall be protected against short circuits between output phases, between output phases and ground, on the internal power supplies, and on the logic and analog outputs.
4. The AC drive controller unit shall have a minimum AC undervoltage power loss ride-through of 200 milliseconds (12 cycles). The AC drive shall have the user-defined option of frequency fold-back to increase the duration of the power-loss ride-through.
5. The AC drive will have a selectable ride-through function which will allow the logic to maintain control for a minimum of one second (60 cycles) without faulting.
6. For a fault condition other than a ground fault, short circuit, or internal fault, an auto restart function shall provide restart attempts for a period of 5 minutes and up to an unlimited amount time depending on setting. The restart attempts shall be separated by increasingly longer waiting periods to allow the condition to be cleared.
7. The deceleration mode of the AC drive shall be programmable. The stop modes shall include free-wheel stop, ramp stop, fast stop, and DC injection braking.
8. Upon loss of the analog process follower reference signal, the AC drive shall be programmable to fault and freewheel stop, ramp stop, fast stop, stop without trip, automatically restart, run at last speed, or maintain a user-defined low speed setting.
9. The AC drive shall have solid-state I<sup>2</sup>t protection that is UL Listed, meets UL 508C as a Class 10 overload protection, and meets IEC 60947. The minimum adjustment range shall be from 25 to 150% of the nominal current rating of the AC drive controller unit.
10. The AC drive shall have three skip frequency ranges with hysteresis adjustment that can each be programmed independently, back-to-back, or overlapping.
11. The AC drive shall include an adjustable thermal alarm which can be assigned to a relay or logic output to indicate the drive temperature has reached the thermal alarm setting.

### O. Adjustment and Configuration

1. The AC drive shall have a user selectable Auto Tune feature. The Auto Tune will automatically send motor-rated current to the connected motor and store the resulting resistance data into memory. The AC drive will automatically optimize the operating characteristics according to the stored data.
2. The AC drive motor and control parameters will be factory preset to operate most common applications. Necessary adjustments for factory supplied unit operator controls and sequencing shall be pre-programmed and tested by the manufacturer.
3. A choice of three types of acceleration and deceleration ramps will be available in the AC drive software—linear, S curve, and U curve—as well as custom.

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### Typical Specifications

4. The acceleration and deceleration ramp times shall be adjustable from 0.01 to 6000 seconds.
  5. The volts per frequency ratios shall be user selectable to meet variable torque loads, normal, and high torque machine applications.
  6. The memory shall retain and record run status and fault type of the past eight faults for operator review.
  7. The software shall have an energy saving function that will optimize the energy consumed. A constant volts/Hz ratio will be maintained during acceleration. The output voltage will then automatically adjust to meet the torque requirement of the load.
  8. Slip compensations shall be a software-enabled function.
  9. The AC drive shall offer programmable DC injection braking that will brake the AC motor by injecting DC current and creating a stationary magnetic pole in the stator. The level of current will be adjustable between 10–110% of rated current and available from 0.1–30 seconds continuously. For continuous operation after 30 seconds, the current shall be automatically reduced to 50% of the nameplate current of the motor.
  10. Sequencing logic will coordinate the engage and release thresholds and time delays for the sequencing of the AC drive output, mechanical actuation, and DC injection braking in order to accomplish smooth starting and stopping of a mechanical process.
- P. Graphic Display Terminal Interface
1. The graphic display terminal shall provide 8 lines of 240 by 160 pixels in plain English to control, adjust, and configure the AC drive including all electrical values, bar charts, configuration parameters, I/O assignment, application and activity function access, faults, local control, adjustment storage, self-test, and diagnostics. There will be a standard selection of six additional languages built in to the operating software as standard.
  2. The AC drive model number, torque type, software revision number, horsepower, output current, motor frequency, and motor voltage shall all be listed on the drive identification display as viewed on the graphic display terminal.
  3. The graphic display shall be able to indicate one, two, or five digital values, or up to two values by bar graph. As a minimum, the selectable display values shall consist of speed reference, output frequency, output current, motor torque, output power, output voltage, line voltage, DC voltage, motor thermal state, drive thermal state, elapsed time, motor speed, machine speed reference, and machine speed.
  4. The graphic display terminal will consist of programmable function keys. The functions will allow both operating commands and programming options to be preset by the operator.
  5. The graphic display terminal shall offer levels of settings from simple start-up to advanced user menus consisting of parameter setting, I/O map, fault history, and drive configuration. Password protection shall be available to limit unauthorized access to various levels of the menus.
  6. The navigation wheel shall provide the ability to scroll through menus and screens, select or activate functions, or increase the value of a selected parameter.
  7. An escape key shall allow a parameter to return the existing value if adjustment is not required and the value is displayed. The escape function will also return to a previous menu display.
  8. A RUN key and a STOP key shall command normal starting and stopping as programmed when the AC drive is in keypad control mode. The STOP key shall be active in all control modes.
  9. A **[Windows® based personal computer] [serial communication link] [detachable graphic terminal display]** user interface shall be available.
  10. The keypad shall store up to four user configuration programs in nonvolatile memory. An operator shall have the ability to download a stored configuration to multiple AC drives.
  11. The operator interface shall be MCC door-mounted on the AC drive controller unit for ease of access and increased visibility.
  12. All door-mounted controls shall be NEMA/EEMAC Type 12 rated.



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### Q. Control

1. Pilot devices shall be industrial rated **[22mm] [30mm]** type control operators and used independently of the keypad display. Software assignments for control inputs and outputs to operate factory-supplied controls shall be pre-configured from the factory. The following basic controls shall be provided:

**[HAND-OFF-AUTO selector switch - The HAND mode shall allow manual operation of start, stop, and speed control. The AC drive shall start when the control operation is in the HAND mode. A door-mounted, manual-speed potentiometer shall be used to control speed in the HAND mode. The AC drive shall run at the low speed setting or higher as required by the position of the manual-speed potentiometer. This mode shall function as 2-wire control and automatically restart after a power outage or auto restart after a fault. The OFF position of the control operation shall stop the AC drive and prevent it from restarting. The AUTO (automatic) mode shall receive an [auto start contact] [serial link command] to control starting and stopping of the AC drive. This contact shall also start and stop bypass (if used) when both the automatic and bypass modes of operation are selected. Speed control shall be from a customer supplied [4–20 mAdc] [serial link communication] signal.]**

**[START-STOP pushbuttons—START/STOP pushbuttons shall provide 3-wire start/stop control.]**

**[POWER On pilot light, red]**

**[FAULT pilot light, yellow, push-to-test]**

**[RUN pilot light, green, push-to-test]**

**[STOPPED pilot light, red, push-to-test]**

**[HAND/AUTO pilot lights, yellow, push-to-test]**

**NOTE:** Additional controls can be found on the equipment electrical diagrams.

2. 2-wire or 3-wire control strategy shall be defined within the software.
3. The control power for the digital inputs and outputs shall be 24 Vdc.
4. The internal power supply incorporates an automatic current fold-back that protects the internal power supply if incorrectly connected or shorted. The transistor logic outputs shall be current limited and not be damaged if shorted or if excess current is pulled.
5. All logic connections shall be furnished on pull-apart terminal strips.
6. There will be (2) two software assignable analog inputs with interference filtering. The analog inputs will be software selectable and consisting of user defined configurations: x-y mA or x-y V.
7. There will be five software assignable logic inputs that will be selected and assigned in the software. The selection of assignments shall consist of forward, reverse, jog, plus/minus speed (2 inputs required), setpoint memory, preset speeds (up to 8 inputs), auto/manual control, controlled stop, terminal or keypad control, output contactor (2 inputs required), motor switching, and fault reset.
8. There will be two software assignable analog outputs with interference filtering. The analog outputs can be selected and assigned in the software. The analog output assignments shall be proportional to the following motor characteristics: frequency, current, power, torque, voltage, and thermal state. The output signal will be user-defined configurations: x-y mA or x-y V.
9. Two voltage-free Form C relay output contacts shall be provided. One of the contacts will indicate AC drive fault status. The other contact will be user assignable.

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**Note to Specification Writer:** Items 10 and 11 are optional network communications specifications.

10. [Drives shall include network communication interface for data acquisition only over [Modbus] [Modbus Plus] [Ethernet (Modbus TCP)] [DeviceNet] [PROFIBUS DP]. Drive control and speed control via PLC hardwired I/O shall include:]

[PLC Analog output (4–20 mA) speed reference signal]

[PLC Analog input (4–20 mA) speed feedback signal]

[PLC digital output drive start control] [PLC digital outputs for drive preset speed control]

[PLC digital input drive run (Run =1)]

[PLC digital input drive fault (Fault = 1)]

11. [Drives shall include network communication interface for control and data acquisition over [Modbus] [Modbus Plus] [Ethernet (Modbus TCP)] [DeviceNet] [PROFIBUS DP] [Ethernet IP].

[At a minimum, drive units shall allow configuration of these parameters:]

— [Motor Frequency]

— [Motor Voltage]

— [Ramp Profiles]

— [I/O Assignments]

— [Current Limitation]

[Drive units shall be capable of making these adjustments:]

— [Speed Range]

— [Ramp Time]

— [Thermal Protection]

[Drive units shall allow control of these parameters:]

— [Start/Stop]

— [Braking]

— [Frequency Reference]

— [Fault Resets]

### R. Optional Isolation/Bypass Contactors

1. As a UL Listed option, the AC drive controller unit shall include **[NEMA rated isolation and bypass contactors packaged as a separate MCC unit with steel barriers segregating the AC drive from the bypass starter][IEC rated isolation and bypass contactors integrated with the AC drive as one MCC unit to reduce space]**.
2. The isolation and bypass contactors shall be mechanically and electrically interlocked complete with a Class 10 thermal overload relay, disconnect interlocked with the door, control circuit transformer, AFC/OFF/BYPASS switch, and BYPASS RUN and AFC RUN lights.
3. The operator shall have full control of the bypass starter by operation of the door-mounted selector switch.
4. When the drive is supplied with a HAND-OFF-AUTO selector switch, the AUTO mode shall also control the run/stop of the bypass operation.

### S. Optional Harmonic Provisions

1. A harmonic distortion analysis shall be performed and priced as a separate line item by the AC drive manufacturer based upon system documentation supplied by the contractor. The documentation shall consist of one-line diagrams, distribution transformer information (kVA, %Z, and X/R ratio), and emergency standby generator performance specifications. The harmonic distortion analysis report shall be part of the approval drawing process, submitted to the engineer for approval. If the calculations determine that harmonic distortion values are higher than the voltage and current values specified in IEEE 519-1992, the drive

## Model 6 Motor Control Centers Typical Specifications

manufacturer shall provide line reactors of sufficient percent impedance to meet the IEEE specified values. The line reactor shall be ventilated in the MCC and shall be completely factory wired and tested with the AC drive controller unit.

2. A **[3% impedance] [5% impedance]** line reactor shall be provided that is completely factory wired and tested with the AC drive controller unit.
  3. An active harmonic filter shall be provided to perform electronic cancellation of load produced harmonic currents such that the upstream power harmonic current and voltage are reduced below the IEEE 519-1992 guidelines for load demand and voltage distortion limits. Filter shall be Square D® brand Accusine or equivalent. Performance of the filter shall be independent of the impedance of the power source: AC lines or back-up generator. All necessary current transducers, reactors, and operator interfaces shall be supplied with the MCC. A factory certified start-up technician shall be used to start up each harmonic filter to achieve optimum system performance.
- T. Optional Load Filters

As a UL Listed option, the AC drive controller unit shall include a motor protection filter unit designed to limit peak voltages and reduce electrical stress on the motor insulation. This option shall be required for motor lead lengths above 150 ft. (50 m). The filter unit shall be ventilated to limit heat build up within the MCC.

### 2.13 Solid-State Reduced-Voltage Starter Unit Construction

- A. The soft start controller unit shall be a combination disconnect/soft starter, MCC-style unit. The input **[circuit breaker][fusible switch]** shall provide NEC required branch circuit protection. The branch circuit protection shall have an external operator. Wiring between the soft starter and the disconnect shall not be disturbed when removing or installing the soft start controller unit from the MCC. Units shall be of modular construction so that units of the same size can be interchanged without modifications to the MCC structure.
- B. All conducting parts on the line side of the unit disconnect shall be isolated to prevent accidental contact with those parts.
- C. Soft start controller units rated for standard duty (up to 156 A) shall be plug-on units which connect to the vertical bus through a spring-reinforced stab-on connector. Units rated higher than 156 A shall be connected directly to the main horizontal bus with appropriately sized cable or riser bus.
- D. All soft start controller unit interior mounting panels shall be white for better interior visibility.
- E. A disconnect operator shall be provided per specification 2.08 D.
- F. All plug-on soft start controller units shall have a grounded stab-on connector which engages the vertical ground bus prior to, and releases after, the power bus stab-on connectors engage/release.
- G. Handle mechanisms shall be located on the left side to encourage operators to stand to the left of the unit being switched.
- H. All soft start controller units shall be provided with unit control terminal blocks for use in terminating field wiring. Terminal blocks shall be pull-apart type, 250 V, and rated for 10 A. All current-carrying parts shall be tin-plated. Terminals shall be accessible from inside the unit when the unit door is opened. The stationary portion of the terminal block shall be used for factory connections and will remain attached to the unit when the portion used for field connections is removed. The terminals used for field connections shall be accessible so they can be wired without removing the unit or any of its components.
- I. The enclosure shall include a door-mounted digital keypad for adjusting the soft start parameters and viewing the motor, soft start, and fault status without opening the enclosure door.
- J. A shorting contactor shall be supplied in each soft start controller unit to reduce temperature rise within the unit and MCC enclosure. The shorting contactor shall be rated to carry the motor full load current during steady state after full voltage has been applied to the motor by the soft starter.

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### K. Electrical Ratings

1. The soft start controller unit shall be designed to operate from an input voltage between -10% and +10% of nominal voltage rating.
2. The soft start controller unit shall operate from an input voltage frequency range of +/-5%. By configuration, it shall be capable of operation at a supply line frequency that can vary by +/- 20% during steady state operation.
3. The soft starter shall be capable of supplying 400% of rated full load current for 23 seconds at the maximum ambient temperature.
4. All soft start controller unit power and control devices shall be rated for:

**[Standard Duty capable of 10 evenly spaced starts per hour at 400% of full rated current for 12 seconds per start without tripping.]**

**[Severe Duty capable of 5 evenly spaced starts per hour at 400% of full rated current for 25 seconds per start without tripping.]**

5. The silicon-controlled rectifiers (SCRs) shall have a minimum peak inverse voltage (PIV) rating of 1800 Vac. Lower rated SCRs with protection by metal oxide varistors (MOVs) are not acceptable.

### L. Protection

1. A microprocessor-based thermal protection system shall be included that continuously calculates the temperature rise of the motor and soft starter and provides:

A motor overload pre-alarm that indicates by relay contact or logic output that the motor windings have exceeded 130% of their rated temperature rise. This function shall be for alarm only.

A motor overload fault will stop the motor if the windings have exceeded 140% of their rated temperature rise.

An electronic circuit with a time-constant adjustable to the motor's thermal cooling time-constant that ensures memorization of the thermal state even if power is removed from the soft starter.

2. The soft starter shall provide line and motor phase loss, phase reversal, underload, stall, and jam protection.
3. The soft start controller unit shall include a shorting contactor which closes after full voltage has been applied to the motor by the soft starter to reduce the current carrying duty on the SCRs. The integral protective features shall be active even when the shorting contactor is used to bypass the SCRs during steady state operation.
4. All units and options shall be constructed with protection provisions to pass UL 845 short circuit testing criteria at a minimum of 65,000 A short circuit current.
5. Diagnostic faults and soft start status shall be displayed on the door-mounted keypad after a fault condition.
6. The motor must be automatically protected from solid state component failure by one of the following means:

**[Shunt trip coil to trip disconnect in the event of a soft start fault condition, including a shorted SCR.]**

**[Isolation contactor that opens when the motor is stopped or when the controller detects a fault condition including a shorted SCR.]**

### M. Adjustments and Configurations

1. All programming/configuration devices, display units, and field control wiring terminals shall be accessible on the front of the control module. Exposure to control circuit boards or electrical power devices during routine adjustments is prohibited.
2. Digital indication shall provide, as a minimum, the following conditions:

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Soft starter status—ready, starting/stopping, run

Motor status—current, torque, thermal state, power factor, operating time, power in kW

Fault status—motor thermal overload, soft starter thermal fault, loss of line or motor phase, line frequency fault, low line voltage fault, locked rotor fault, motor underload, maximum start time exceeded, external fault, serial communication fault, line phase reversal fault, motor overcurrent fault

3. The starter shall be preset to the following for operation without adjustment in most applications:
  - Linear (torque-controlled) acceleration ramp of 15 seconds
  - Current limitation to 400% of the motor full load current rating
  - Class 10 overload protection
  - Motor current preset per NEC / NFPA 70 table 430.150 for standard hp motors
4. A digital keypad shall be used to configure the following operating parameters as required:
  - Motor full load amps adjustable from 40 to 130% of the controller's rating
  - Current limitation on starting adjustable from 150 to 700% of the motor current rating, not to exceed 500% of the soft start rating
  - Torque ramp adjustable from 1 to 60 seconds
  - Initial torque adjustable from 10 to 100% of nominal motor torque
  - Torque limit adjustable from 10 to 200% of nominal motor torque
  - Maximum start time adjustable from 10 to 999 seconds
  - Voltage boost adjustable from 50 to 100% of the nominal supply voltage
  - Selection of freewheel, soft stop, or braking
  - Linear (torque-controlled) deceleration ramp time adjustable from 1 to 60 seconds
  - Threshold to change to freewheel following a soft stop from 0 to 100% of the nominal motor torque
  - Braking torque level adjustable from 0 to 100% effectiveness
  - Selection of Class 2, 10, 10A, 15, 20, 25, or 30 motor thermal overload protection
5. A digital keypad shall be used to configure the following controller parameters as required:
  - Selectable automatic reset operation
  - Cancellation of the torque control loop for multi motor installations
  - Adjustment of the stator loss estimation for specialty motors
  - Assignment of soft start inputs and outputs
  - Activation of phase reversal protection
  - Reset of motor thermal state
  - Return to factory parameter settings
  - Activation of test mode for use with low power motors
  - Indication of elapsed time in hours of starting, running and stopping
6. Output relays shall provide the following status indications:
  - One Form A (N.O.) minimum for indication of fault
  - One Form A (N.O.) for indication that acceleration ramp is complete and current is below 130% motor FLA (end of start)
  - One Form A (N.O.) assignable to one of the following functions: motor thermal alarm, motor current level alarm, and motor underload alarm

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7. Additional inputs and outputs shall be available to provide the following status indications:

Two assignable control inputs for the following functions: force to freewheel stop, external fault input, disable serial link control, external motor overload reset, or general fault reset

Two assignable logic-level signal outputs for the following functions: motor thermal overload alarm, "motor powered" signal, motor overcurrent alarm, or motor underload alarm

One analog output shall be available for 4 to 20 mA indication of motor current, motor torque, motor power, motor thermal state, or power factor

8. Relay and I/O functions listed above must be isolated with respect to common.

### N. Control Options

1. The soft starter's control circuit shall be fed from the line supply and be completely independent of the power circuit and separate from relay control logic.
2. The peripheral soft starter control circuitry shall be operated from a control power transformer included within the enclosure.
3. Operator devices shall be door-mounted and shall be (choose all that apply):

Black START and red STOP push buttons

Three position H-O-A switch which provides for manual (HAND) start or remote signal (AUTO) start from user-supplied relay contacts

Three position FORWARD/OFF/REVERSE selector switch mounted on the door control island (available with reversing starter only)

Red RUN pilot light illuminated whenever the soft starter is provided a run command and no fault condition is present

Green OFF pilot light illuminated whenever the soft starter is supplied with control power and no run command is present

### O. Shorting Contactor (Standard On All Units)

1. A microprocessor shall control the operation of the shorting contactor via an output relay.
2. The shorting contactor shall close, shorting the SCRs after the acceleration ramp is complete and motor current is below 130% of motor FLA, and open on a stop command to allow a deceleration ramp.
3. Overload protection integral to the soft starter shall continue to protect the motor when shorting is engaged.

**Note to Specification Writer:** Item P is optional; delete if not needed.

### P. [Full Voltage Emergency Starter]

1. [The soft start controller unit shall include full voltage starting capability to start and control the motor instead of the reduced voltage soft start method of starting the motor.]
2. [The full voltage emergency starter shall be UL Listed and shall include [an IEC rated] [a NEMA Rated] contactor capable of carrying the motor inrush and motor full load current.]
3. [A door-mounted BYPASS/NORMAL selector switch shall be provided to enable the user to manually select the motor starting method. NORMAL mode provides a reduced voltage start using the soft starter. In BYPASS mode, the soft starter will be left inactive and the motor will be started using an across-the-line full voltage starting method.]
4. [An overload provision independent of the soft starter shall be provided to protect the motor in the BYPASS mode.]
5. [The full voltage emergency starter components shall be integrated inside the soft start controller unit and shall be fully tested by the MCC manufacturer.]

### **2.14 General Communication Cabling**

- A. The MCC shall employ a pre-engineered communication cabling system to interconnect units within the MCC.
- B. Network cabling shall be routed through the lower horizontal wireway to isolate the network from the horizontal bussing routed through the top.
- C. The full-depth vertical wireway serves to separate communications from power cabling to prevent noise interference on the network cable.
- D. The communication cabling installation shall meet Class 2 wiring practices under the provisions of NEC articles 725 and 800.
- E. Provisions for appropriate terminators and grounding shall be provided.
- F. Addition, removal, or rearrangement of units shall not interrupt the trunk line and shall not affect the cabling of other units attached to the trunk line.
- G. Cable assemblies will use 5-pole Micro-style connectors with a single keyway and will comply with SAE-H1738-2 specifications.
- H. Connectors are to be epoxy-coated for a 500-hour salt-spray test per Mil-Std 202F.
- I. Cable coupler design shall include a vibration-resistant ratchet to prevent loosening.
- J. The system will be constructed of molded PVC material.

### **2.15 Modbus® Communication Cabling**

- A. The Modbus cabling system will be UL 498 Listed.
- B. An extended ground pin shall ensure first make/last break ground connections.
- C. The cabling system shall consist of individual trunk line segments in each MCC section. A trunk/drop topology will be used. Trunk line segments will be routed from the lower wireway into each vertical section. The trunkline for sections containing plug-on vertical bus shall have six taps spaced 12 in. apart. Unused tee connectors will be capped at the factory.
- D. A 36-in. (915 mm) "pigtail" cable shall connect the communication device in each MCC unit to the trunk cable via a pre-engineered tap. One end of the pigtail cable will terminate in a Micro-style connector and will be attached to the trunk. The other end will terminate at the communication device in the MCC unit.

### **2.16 Ethernet (Modbus TCP) Communication Cabling**

- A. The Modbus TCP/IP (Ethernet) communications network shall be configured in a star topology.
- B. The cabling system shall consist of multiple, custom-length Ethernet patch cables that each connect a single network device to a central Ethernet switch unit located in the MCC.
- C. Ethernet switches located in the MCC shall be Connexium, Hirschmann, or approved equal.

### **2.17 DeviceNet™ Communication Cabling**

- A. The DeviceNet cabling system will be ODVA rated with a trunkline-dropline topology.
- B. Control power shall be provided through individual unit transformers that are separate from the network to reduce network power demand. This will allow devices to operate independently of the network power supply.
- C. Sectioned cabinets shall have six pre-molded trunklines with tees. Full length cabinets shall have one trunkline with a tee. A tee at the bottom of each section shall provide the means of connection to the next section with a pre-molded section of cable.
- D. A 36-in. (915 mm) "pigtail" cable shall connect the tee in the dropline to the DeviceNet device located in the MCC unit.

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### 2.18 CANopen Communication Cabling

- A. The CANopen cabling system will be configured in a trunkline-dropline topology.
- B. Control power shall be provided through individual unit transformers that are separate from the network to reduce network power demand. This will allow devices to operate independently of the network power supply.
- C. Sectioned cabinets shall have six pre-molded trunklines with tees. Full length cabinets shall have one trunkline with a tee. A tee at the bottom of each section shall provide the means of connection to the next section with a pre-molded section of cable.
- D. A 36-in. (915 mm) "pigtail" cable shall connect the tee in the dropline to the CANopen device located in the MCC unit.

### 2.19 PROFIBUS DP Communication Cabling

- A. The PROFIBUS DP cabling system shall consist of individual trunk line segments in each MCC section. A trunkline-dropline topology will be used. Trunk line segments will be routed from the lower wireway into each vertical section. The trunkline for sections containing plug-on vertical bus shall have six taps spaced 12 in. apart. Unused tee connectors will be capped at the factory.
- B. Sectioned cabinets shall have six pre-molded trunklines with tees. Full length cabinets shall have one trunkline with a tee. A tee at the bottom of each section shall provide the means of connection to the next section with a pre-molded section of cable.
- C. A 36-in. (915 mm) "pigtail" cable shall connect the tee in the dropline to the PROFIBUS DP device located in the MCC unit.

### 2.20 Quality Control

- A. The entire MCC shall go through a quality inspection before shipment. This inspection will include:
  - 1. Physical Inspection of:
    - Structure
    - Electrical conductors, including:
      - Bussing
      - General Wiring
      - Units
  - 2. Electrical Tests
    - General electrical tests include:
      - Power Circuit Phasing
      - Control Circuit Wiring
      - Instrument Transformers
      - Meters
      - Ground Fault System
      - Device Electrical Operation
    - AC dielectric tests shall be performed on the power circuit.
  - 3. Each device shall be configured and addressed to correspond with software settings.
  - 4. A Read/Write test shall be performed prior to shipment on all network devices including, but not limited to, Overloads, Drives, and Soft Starters.



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5. Testing shall be designed to verify system operation and shall include these verifications as a minimum:
  - Drawings and Bill of Materials
  - I/O addressing
  - Correct device operation by I/O address
  - Host Communications
  - Control Network Interface
6. Markings/Labels include:
  - Instructional type
  - Underwriters Laboratory (UL)/Canadian Standards Association (CSA)
  - Inspector's stamps
7. The manufacturer shall use integral quality control checks throughout the manufacturing process to ensure that the MCC meets operating specifications.

### Part 3 Execution

#### 3.01 Location

- A. Motor control centers are not to be placed in hazardous locations. The area chosen shall be well ventilated and totally free from humidity, dust, and dirt. The temperature of the area shall be no less than 32 °F (0 °C) and no greater than 104 °F (40 °C). For indoor locations, protection must be provided to prevent moisture entering the enclosure.
- B. Motor control centers shall be located in an area with a minimum of 3 ft. (915 mm) of free space in front for front-of-board construction. An additional 3 ft. (915 mm) should be allowed in the rear for back-to-back construction. This free space will give adequate room to remove and install units. A minimum of 0.5 in. (13 mm) space should be provided between the back of front-of-board MCCs and a wall. 6 in. (152 mm) is required for damp locations.
- C. The MCCs shall be assembled in the factory on a smooth level surface so that all sections are properly aligned. A similar smooth and level surface shall be provided for installation. An uneven foundation will cause misalignment of shipping blocks, units, and doors. The surface under a MCC shall be of a non-combustible material unless bottom plates are installed in each vertical section.

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