



Spectra Series™ and 8000-Line Motor Control Centers

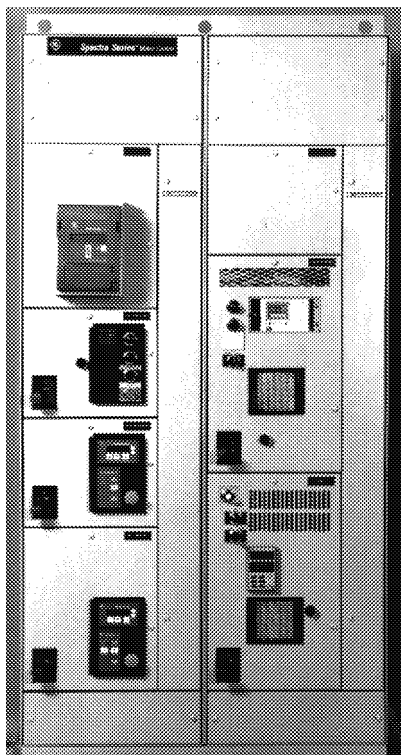
General

The General Electric Spectra Series™ and 8000-Line motor control centers provide an economical means of centralizing motor starters and related control equipment. It permits combination motor control units, feeder tap units, distribution transformers, lighting panels, interlocking relays, programmable control, metering and other miscellaneous devices to be contained in a single floor-mounted structural assembly fed from a common enclosed main bus.

GE motor control centers are constructed of standardized heavy gauge vertical sections housing vertical and horizontal buses, wiring channels and compartmented control units. Shipping splits are bolted together to form a single line-up assembly. Units are mounted and wired in accordance with the level of factory wiring purchased. The entire center may be powered by incoming line connection at a single point. Where possible, motor control centers bear UL section and unit labels.

The purpose of this publication is to simplify the selection of GE motor control centers. The following logic flow chart lists basic items which must be considered for each application.

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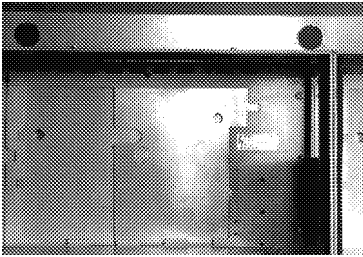
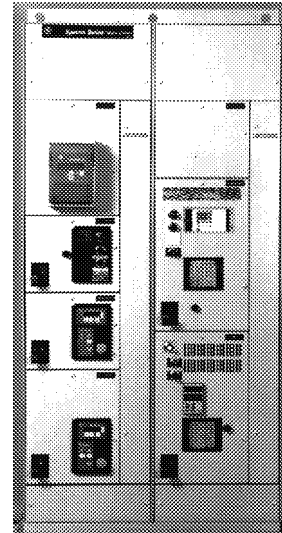
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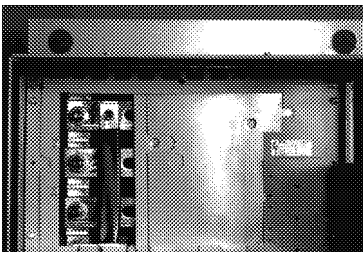
PRODUCT FEATURES STANDARD DESIGN FEATURES

Design flexibility, performance, personnel and equipment protection, ease of maintenance and installation are all contained in the Spectra Series™. Spectra Series™ features, such as separate wiring troughs, split-type terminal boards, isolated bus, drawout starter units, operating mechanisms, and provisions for starter interchangeability, are designed for a high level of reliability and convenience.

These steel-enclosed control centers can be joined together to centralize and protect the most complex systems of industrial auxiliary drives, or the simplest of fan- or pump-motor controls. As the need arises, additional sections can be added to an existing lineup.



Barriers located in front of the main horizontal bus isolate the bus from the top horizontal wireway. Maintenance personnel can easily gain entrance to the top horizontal wireway of the control center without danger of contact with a live bus.



Barriers furnished with 2-inch main bus systems use a sliding panel. After de-energizing the bus, maintenance personnel may slide back the panels to give ready access to the main bus for inspection of bolted connections. Main bus splicing is accomplished in this area with the hardware already in place. 4-inch main bus systems have stationary removable barriers



An incoming-line terminal compartment can be located at the top or bottom of a vertical section to allow cable termination with minimum bending. The standard 600-ampere incoming line terminal compartment shown is furnished with 2 mechanical type lugs per phase. Other incoming line terminal compartments are available for main bus ampacities up to 2500 amperes.



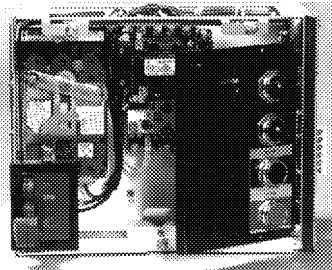
Spectra Series™ and 8000-Line Motor Control Centers

General

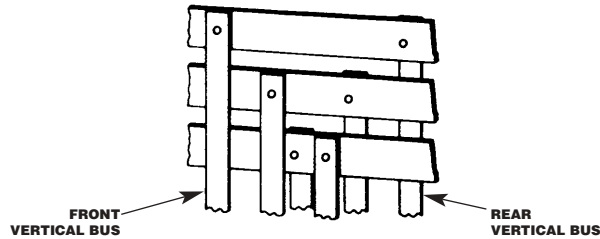
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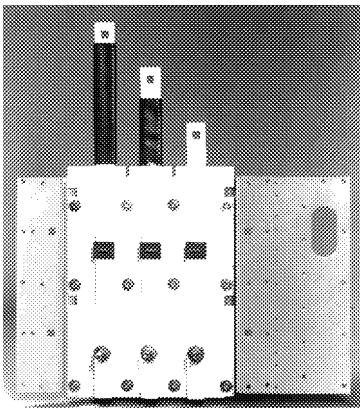
New doors mounted on the case feature a removable hinge pin providing easy door removal and accurate alignment, in Spectra Series™.



High density door bracket mounts up to 8 NEMA pilot devices in Spectra Series™. Bracket swings open to allow easy access to unit components, wiring and terminal blocks.



In back-to-back single section construction, two independent vertical bus assemblies eliminate the need for reversing the phase sequence of front and rear mounted units.



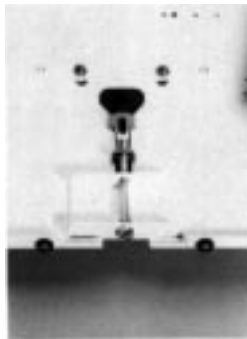
A polyester-reinforced “sandwich” insulates and isolates the vertical bus and helps prevent the spread of faults from starter and feeder units to vertical or horizontal bus. Small stab openings provide effective isolation. 65 kA short circuit bracing is standard for Spectra Series™ MCC.



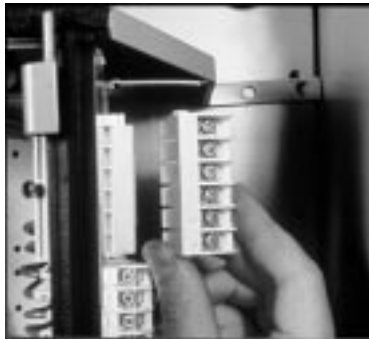
PRODUCT FEATURES



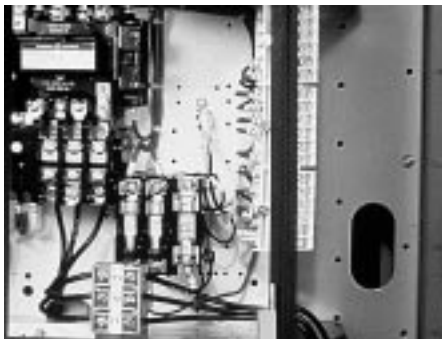
Stab connections are made with wedge-shaped silver-plated copper unit power stabs which are under double spring pressure and engage the vertical bus to provide positive contact and expand under short-circuit stress to increase contact pressure. Design maintains common unit interface between 7700 Line, 8000 Line, and Spectra Series™ MCCS.



All combination starters and feeder units of plug-in construction utilize a positive guidance system combined with a mechanical insertion means. This unique GE design grounds the unit to the structure and provides positive electrical connection between the unit stabs and the vertical bus.



High density two-piece cam-operated pull-apart control terminal boards feature up to 18 points in 12" high units. External and internal unit connections are made on opposite sides, allowing the unit to be withdrawn without disconnecting control wiring. Accommodates up to (2) #12 AWG wires with ring, fork or bare terminations. Rated 25 Amps, 600 Vac. Meets NEC Article 430-74.



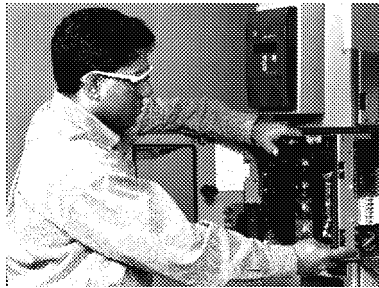
Large isolated wire trough provides a 4⁵/₈-inch x 8¹/₈-inch area to "lay in" wire and make control and load connections. A separate removable door, adjacent to drawout units, makes wiring installation and inspection easy. The door can be opened without disturbing adjacent unit doors. 8⁵/₈-inch x 8¹/₈-inch wire troughs are available with 24-inch wide enclosures.



Spectra Series™ and 8000-Line Motor Control Centers

General

A



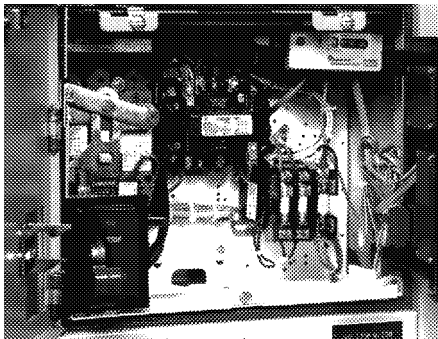
Units can be withdrawn to a disconnected position and padlocked for maintenance. Old style "B Block" terminal boards are still available as an option. All Spectra Series™ units and sections are fully compatible with 7700 and 8000 Line units.



An interlock release system is provided so that – if it becomes necessary for maintenance purposes – the disconnect may be closed with the door open. A by-pass is provided to allow opening the door with the disconnect closed. **Only qualified personnel familiar with the equipment should use the interlock release and by-pass features.**



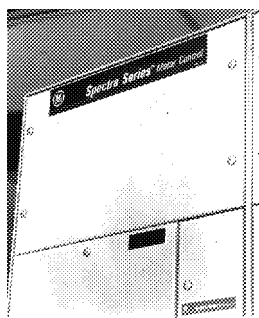
The vertically mounted integral handle can be locked in the OFF position with up to three padlocks. A drilling pattern is furnished, allowing the handle to be modified for locking in the ON position with a single padlock. This modification should only be made after the user determines it is desirable to lock the disconnect in the ON position. Padlock to have maximum $\frac{3}{8}$ -inch shackle.



For flexibility, standard Size 1 and Size 2 FVNR starters are interchangeable in the same 12-inch high space unit. This design allows quick, easy field changes when modifications are desired after installation.



New front $\frac{1}{4}$ -turn latches for secure installation and visual engagement



A new paint finish is applied to all un-plated steel parts. The powder coating process withstands 1000 Hr. salt spray tests and provides lasting beauty and protection.



PRODUCT FEATURES

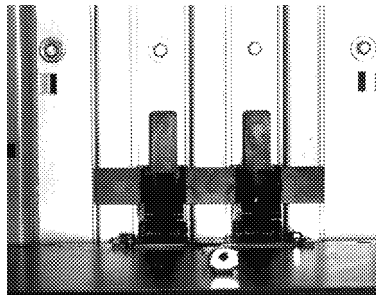
OPTIONAL CUSTOMIZING FEATURES



Vertical Ground Bus and Unit Stab

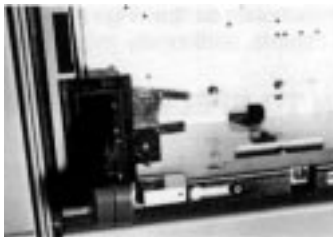
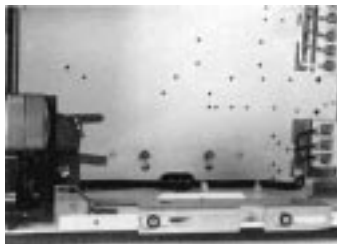
Vertical copper ground bus allows direct grounding of unit saddles to the equipment ground bus. A unit ground bus stab engages the vertical ground bus before the unit power stabs engage the vertical bus.

A load vertical ground bus is available for customer cable grounding. Termination points are located at the rear of the vertical wireway, next to starter/feeder lugs.



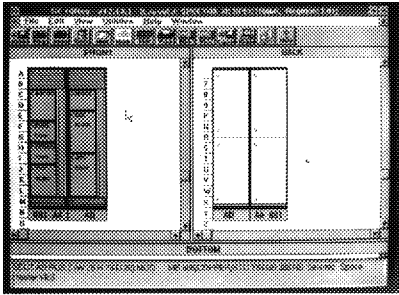
Vertical Bus Shutter Mechanism

A vertical bus shutter mechanism can be supplied which covers the vertical bus stab area when a plug-in starter or feeder is withdrawn. This feature may also be added to existing 7700-Line, 8000-Line and Spectra Series™ motor control centers. Cap plugs are available to close unused stab openings.



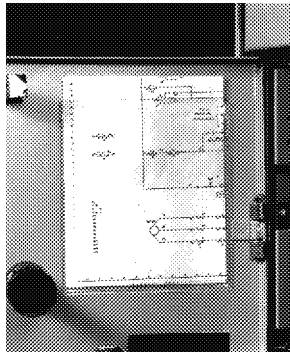
Power-Off Insertion or Withdrawal Feature

Provides power-OFF insertion or withdrawal for plug-in combination starter or feeder units. A slide, mounted to the starter frame, coupled with the operating handle, inhibits access to the driving screw until the primary disconnect is open or OFF.



New Drawing Software

Windows™-based Engineering Drawing System creates high-quality detailed front, top, bottom, and side views as well as specific device information.



Drawing Holder

An optional drawing holder allows you to mount complete wiring diagrams inside doors.

Nameplates

Unit service designation nameplates are furnished when specified. Nameplates can be supplied as blanks suitable for field engraving, or engraved at the factory.

The standard unit service designation nameplate is of 2-ply thermoplastic material, black face with white core, 1-inch x 3-inch, fastened with non-corrosive nylon clips. Plated steel screws are available as an option. One to three lines of white letters on a black background can be engraved with 0.18-inch high characters. Lines 1 and 3 can have a maximum of 19 characters and line 2, 15 characters.

A 2-inch x 6-inch master nameplate mounted on the top left wireway cover of each motor control center lineup can be supplied if requested. One line of 6 characters is possible with 1-inch high letters; with 1/2-inch high letters, two lines of 12 characters each are possible. The standard is white letters on a black background.

Refer to the factory for special nameplates.

Wire and Cable

Standard control and power wire includes flame-retardant, (VW-1) moisture-heat-and oil-resistant thermoplastic insulation rated 600 volts, with stranded copper conductors, types MTW and THW.

Standard Colors are:

Red	-AC Control
Blue	-DC Control
Black	-AC/DC Power
Green	-Ground
White	-Neutral

Optional wiring available includes SIS heat-resistant synthetic rubber-covered switchboard wire and XHHW flame-retardant cross-linked synthetic polymer, both rated 600 volts with stranded copper conductors, and a VW-1 flame rating (no PVC).

Note:

- Not all colors are available with optional wiring.



NEMA CLASS OF DIAGRAMS AND WIRING

Motor control centers are classified by NEMA as follows:

NEMA CLASS I DEFINITION^①

Class I motor control centers consist essentially of a mechanical grouping of combination motor control, feeder tap and/or other units arranged in a convenient assembly. They include connections from the common horizontal power bus to the units.

They do not include interwiring or interlocking between units or to remotely mounted devices, nor do they include control system engineering.

Diagrams of the individual units only are supplied.

NEMA CLASS II DEFINITION^①

Class II motor control centers consist of a grouping of combination motor control, feeder tap and/or other units designed to form a COMPLETE CONTROL SYSTEM. They include the necessary electrical interlocking and interwiring between units and interlocking provisions to remotely mounted devices in addition to the connections from the horizontal common power bus to the units.

The control manufacturer shall provide a suitable diagram to illustrate operation of the control associated with the motor control center.

NEMA CLASS IS AND IIS DEFINITION^①

Class IS and IIS motor control centers shall be the same as Class I and II motor control centers except custom drawings shall be provided in lieu of standard drawings.

^① From NEMA Standard ICS-2-322.08.

Examples of custom drawings are:

- Special identifications for electrical devices
- Special terminal numbering designations
- Special sizes of drawings

The drawings supplied by the manufacturer shall convey the same information as drawing provided with Class I and II motor control centers, additionally modified as specified by the user.

WHEN TO SPECIFY CLASS I

Specify NEMA Class I control centers for independently operated motors requiring no interlocking or other interconnection between units.

WHEN TO SPECIFY CLASS II

When factory interconnections are desired to provide such functions as sequencing and other interlocking or interconnection, the control centers required are NEMA Class II.

WHEN TO SPECIFY CLASS IS AND IIS

When custom drawings are desired to show special device identification, special terminal numbering, or special diagram size, etc. the control centers required are Class IS or IIS.

The NEMA classes are sub-divided into A, B and C depending on the type wiring furnished, with type B further having type B-D for customer load wiring direct to the device and B-T for customer wiring to a load TB (size 1, 2 or 3 starters). NOTE: For feeders and large starters, customer must wire direct to unit device terminals.

WIRING FEATURES BY NEMA CLASSIFICATION

Type of Power or Control Termination Furnished	Class I			Class IS			Class II		Class IIS	
	A	B	C	A	B	C	B	C	B	C
Pull-apart and numbered control terminal boards on unit starter—Sizes 1, 2, 3 and 4	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Stationary and numbered control terminal boards on unit starter – Sizes 5, 6 and 7	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Pull-apart and numbered power terminal boards on unit starter –Sizes 1 and 2. Stationary terminal boards on Size 3 (On Type A wiring: Same type of numbered terminals on starter itself for Sizes 1, 2, 3 and 4)	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Numbered terminals on starter itself for power connection with no power terminal boards – Sizes, 5, 6 and 7	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stationary master terminal boards (Top, bottom or rear of section) For control – Sizes 1 thru 5 For power – Sizes 1 thru 3	No	No	Yes	No	No	Yes	No	Yes	No	Yes
Unit terminal boards for feeder tap units and distribution panels	No	No	No	No	No	No	No	No	No	No
Starter-unit-mounted pilot devices internally wired to starter – Sizes 1 thru 7	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Terminal board points for remote devices (Excluding extra tie points)	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Master Terminal-board wiring connections	No	No	Yes	No	No	Yes	No	Yes	No	Yes
Factory-wired interconnections between units in the same motor control center	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Type of Drawings Furnished										
Outline and summary sheet (Schedule of units)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Unit elementary wiring diagrams showing numbered terminal points (Terminal boards not furnished on Type A)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Unit elementary wiring diagrams showing numbered terminal points and interconnections to other units and/or to the first level of remote devices.	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Schedule of wires to master terminal blocks	No	No	Yes	No	No	Yes	No	Yes	No	Yes
Custom drawings as specified by user	No	No	No	Yes	Yes	Yes	No	No	Yes	Yes

A computerized manufacturing process necessitates that the CR8000-Line motor control center standard unit numbering system be followed to identify the section and location of each unit. This is explained in detail in application data (Section J). It greatly simplifies wire tracing of interconnection wires, and is

beneficial to the application of programmable control. The Outline and Summary drawing furnished with the equipment cross references the unit numbers and customer unit designations when specified.



CODES AND STANDARDS

Motor control centers are manufactured to NEMA standard ICS 2-322 and are eligible to receive the Underwriters Laboratories listing mark under standard UL 845. Vertical sections and units which have been listed with UL will bear the listing mark. Since vertical sections and units are listed independently, it is possible to have combinations of listed and non-listed sections and units within the same control center. Sections and units which will be shipped with the UL listing mark are identified in the appropriate sections of this publication.

The National Electrical code covers installation of electric conductors and equipment for installations identified in the NEC Article 90. The NEC is not intended as a design specification and acceptance of an installed motor control center by a local code authority is dependent on factors independent of the equipment as shipped from the factory. In general, equipment which bears the UL listing mark can be installed to meet the NEC. Where 100 percent UL listed equipment is mandatory or there are other special code requirements refer to the factory for verification.

The NEC defines several types of control circuits and the over-current protection required for each type. The following paragraphs

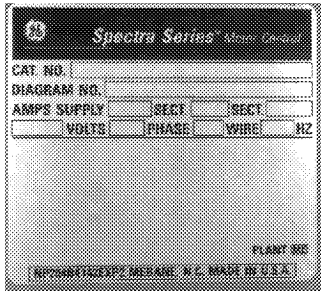
provide a general reference to the NEC Article applicable for the more common control circuits.

NEC Articles 430-72(a) and (b) cover motor control circuits tapped from the load side of a motor branch-circuit short-circuit protective device (unit disconnect). Control circuit conductors from such a tapped control circuit shall be protected in accordance with NEC Table 430-72(b), which lists the maximum fuse or circuit breaker rating vs. conductor size.

Motor control circuits other than such tapped control circuits (common control transformers or external power source) shall be protected against overcurrent in accordance with Section 725-12 or 725-35, as applicable, for the type power source and field wiring conductor sizes.

Where a motor control circuit transformer is provided, the transformer should be protected in accordance with NEC Article 430-72(c). Transformers other than motor control circuit transformers should be protected in accordance with NEC Article 450-3(b).

A



Section Label



Unit Label

In addition, CSA labeling per CSA 22.2-14 Industrial Equipment is also available when all devices are CSA approved - refer to factory.



SHORT CIRCUIT CONSIDERATIONS

ALL RATINGS IN THIS PUBLICATION ARE RMS SYMMETRICAL AMPERES

SHORT-CIRCUIT CURRENT RATINGS

The NEMA Motor Control Center Standard ICS-2-322 defines the short-circuit rating of a motor control center as follows:

“The motor control center short-circuit rating shall be the maximum available rms symmetrical current in amperes permissible at its line terminals. It shall be computed as the sum of the short-circuit current contributions of the motors connected to the motor control center and the maximum available current, including all other short-circuit current contributions of the supply system at the point of connection to the motor control center.”

MOTOR CONTROL CENTER BUS

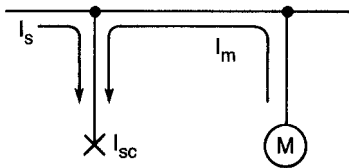


Fig. 1

Figure 1 illustrates simply the basis of determining the available short-circuit current. The individual short-circuit current ratings of the main bus extensions, combination-controller units, and feeder-tap units must equal or exceed available short-circuit current.

I_s is the short-circuit current available from the system at the point where the motor control center is connected. I_m is the short-circuit current contribution of the motors connected to the motor control center. If exact information is lacking, the motor contribution can be estimated at four times (4X) the continuous-current rating of the main horizontal bus. I_{sc} is the available short-circuit current to be used as the basis for selection. Thus: $I_{sc} = I_s + I_m$.

High available short-circuit currents of modern distribution systems require special consideration so that equipment may be operated within its rating. The cost and operational acceptability of the following should be carefully considered:

1. Use load-center distribution systems with smaller transformers which limit the available short-circuit current.
2. Use a current-limiting busway, reactors, or higher-impedance transformers to reduce the available short-circuit current.
3. Use current-limiting fuses, current-limiting breakers, or breakers with limiters, in all combination starters and feeders in the control centers.

MAIN PROTECTIVE DEVICES

A motor control center requires adequate overcurrent and short-circuit protection. This is the function of the main protective device. It may be located in or remote from the control center. Wherever located, it must have an interrupting rating equal to greater than the available short-circuit current at the point of its connection to the system. If located at the control center, this value would be the system available short-circuit current, I_s (Fig. 1).

A motor control center should be protected for all types of faults from low-level arcing ground faults to bolted three-phase faults which can develop the full available short-circuit current. Line-to-line and line-to-ground arcing faults (often produced by contaminated atmospheres, foreign materials, etc.) can be appreciably

lower in magnitude than the available short-circuit current and must be assumed not to be self-extinguishing. Even low-level arcing faults are capable of releasing tremendous energy at the point of fault and can be highly destructive.

A NON-AUTOMATIC CIRCUIT BREAKER (MOLDED CASE SWITCH) OR A NON-FUSED SWITCH MUST BE PROPERLY COORDINATED WITH UP STREAM PROTECTIVE DEVICES.

For full protection against all levels of arcing faults on grounded systems, a ground-fault relay is recommended. The ground-fault system is a protective means that responds to phase-to-ground current, but is not affected by phase-to-phase current. It is used to protect motor control centers from extensive damage, which can be caused by phase-to-ground arcing faults.

Fuses are single-pole interrupters. An arcing fault may not necessarily be cleared by a single-pole interruption, as the fault can be back-fed from the other energized phases. This reduces the fault current, increasing the blowing time of the energized fuses. Because of this delay, severe equipment damage may occur. Single-phasing is eliminated with fast-acting three-pole fused interrupter switches which open when a single fuse blows.

An electrically operated HPC switch with single-phase detector will meet the three-phase disconnection (single-phase protection) recommendations for a main protective device.

When switches without a three-phase trip are used, a GSR ground-fault protection scheme is particularly recommended since damaging arcing faults almost always involve ground. It should operate the trip device on the closest line-side three-phase disconnect.

MAIN HORIZONTAL BUS AND VERTICAL BUS EXTENSIONS

The standard bus short-circuit withstand rating is 42,000 rms symmetrical amperes. Also available optionally are ratings of 50,000, 65,000 and 100,000 rms symmetrical amperes. The bus rating must equal or exceed the available short-circuit current. Refer to Structure (Section B) for ratings.

COMBINATION MOTOR CONTROL UNITS

The short-circuit rating of a combination controller is based on tests with rated short-circuit current available at the line terminal of the control center and at rated voltage.

The short-circuit rating must equal or exceed the available short-circuit current. Refer to Starters (Section D) for ratings.

FEEDER TAP UNITS

All feeder tap units must have a short-circuit rating which equals or exceeds the available short-circuit current. Refer to Feeders (Section C) for ratings.



FUSE CLASSIFICATION

UL classifications are the most definitive method of determining fuse characteristics, and are used in this publication. Use UL fuse “Class” when specifying type of fuse.

UL classifications used in motor control centers are:

- A. Class H—defines dimensions for 600 amperes maximum, 250 volts or 600 volts, with non-reject type mounting. Fuse characteristics may vary.
- B. Class K—have Class H mounting dimensions and limit peak let-through currents, though not classified as “Current Limiting.” Class K fuses are sub-divided into Classes K-1, K-5 and K-9, depending on peak let-through current, with K-1 having the lowest peak let-through currents. K-9 fuses are not recommended because their peak let-through currents are too great to be considered safe for controllers. Class K fuses are rated 600 amperes maximum, 250 volts or 600 volts.
- C. Class R—current-limiting type fuses with reject mounting features. Class R fuses are sub-divided into Classes RK-1 and RK-5, depending on maximum peak let-through currents. RK fuses are rated 600 amperes maximum and 250 volts or 600 volts.

- D. Class J — are more current limiting than RKs and due to their unique dimensions have an inherent rejection feature. Ratings are 600 amperes maximum, 600 volts.
- E. Class L — are current limiting and due to their unique mounting dimensions have an inherent rejection feature. Ratings are 601 amperes minimum, 600 volts.

Fuses marked with “D,” “Time-Delay,” “Dual-Element” or similar designations are time-delay type fuses and will generally carry 500 percent rated amperes for 10 seconds, thus allowing a smaller rated fuse to be used in most starter applications.

UL listed combination motor starter units furnished with non-rejection Class H, K-1 or K-5 fuses are short-circuit rated 5kA for NEMA size 1, 2 and 3 starters, and 10kA for larger starters. Higher short-circuit ratings require rejection type fuses. See Fuse Classifications table below for short-circuit ratings.

Fuses that are mechanically interchangeable may not be electrically equivalent. Refer to the fuse manufacturer for interrupting rating and current-limiting characteristics.

FUSE CLASSIFICATIONS

Characteristic ^①	UL Standard				
	Class J	Class R	Class L	Class H	Class K-1, K-5
Ampere Range	0-600	0-600	601-6000	0-600	0-600
Voltage Ratings	600	250 600	600	250 600	250 600
Interrupting Rating RMS Symmetrical Amperes	200K	200K	200K	10K	50K 100K 200K
Current-Limiting	Yes	Yes	Yes	No	No
Rejection Type	Yes	Yes	Yes	No	No

^① Check fuse manufacturers for specific fuse characteristics

ENVIRONMENTAL CONSIDERATIONS

The standard 8000-Line motor control center is designed for operation in a clean, indoor environment having a 40°C maximum ambient temperature.

The nominal minimum temperature for storage is -40°C and for operation, -20°C. Motor control center space heaters are recommended whenever temperature conditions below 0°C will exist. Where extreme cold temperatures are to be encountered for long periods of time. It is recommended that the motor control center be installed in heated rooms or enclosures.

For ambient temperatures above 40°C, special consideration must be given to the need for ventilation, ambient-compensated breakers and overload relays, special wire insulation, and oversized control transformers. Ambient compensated overloads provide essentially constant trip setting as the control ambient varies.

For indoor environments subject to falling liquids, NEMA 2 drip-proof enclosures are recommended. If water spray and splashing are to be encountered, NEMA 2 construction should also be used. Space heaters may be desirable to prevent condensation on internal parts.

For outdoor installations, NEMA 3R weatherproof enclosures are required. These can be non-walk-in, walk-in, non-walk-in back-to-back, and walk-through with common aisle. Thermostatically controlled space heaters and ambient-compensated breakers and overload relays should be considered for these applications. Provisions for heating and cooling the entire outdoor enclosure are also available. Standard NEMA 3R construction is suitable for wind

velocities up to 75 mph. Beyond this, up to 130 mph, specially reinforced enclosures are available. This special design is also necessary if the NEMA 3R enclosure has to withstand seismic conditions, including seismic Zone 4 applications.

A modification of the 20- and 22-inch deep 8000-Line motor control center is available for earthquake conditions. It can satisfactorily withstand a force of 5 g's, 1 to 100 Hz, input at its floor sills simultaneously in all three orthogonal axes, and is suitable for Seismic Zone 4 installation.

For dusty atmospheres, semi-dust-tight NEMA 1 gasketed or NEMA 12 construction are recommended.

The altitude limit for the standard electro-mechanical motor control center design is 6000 feet. Applications above this should be referred to the Company for recommendations. Some solid-state components are only rated to 3300 feet and may reduce the altitude limit of the motor control center.

Fungus-Proofing of organic materials in a motor control center can be provided. It should be noted that the best available treatment has a very limited effective life of only a few months. Keeping equipment dry and above the dew-point is a much better way of avoiding fungus-growth, and the use of space heaters is recommended for this purpose. Heaters should be energized if the motor control center is to be stored for any length of time. Where export crating is involved, terminals for connection of an external source of space heater power can be provided on the outside of the crate.