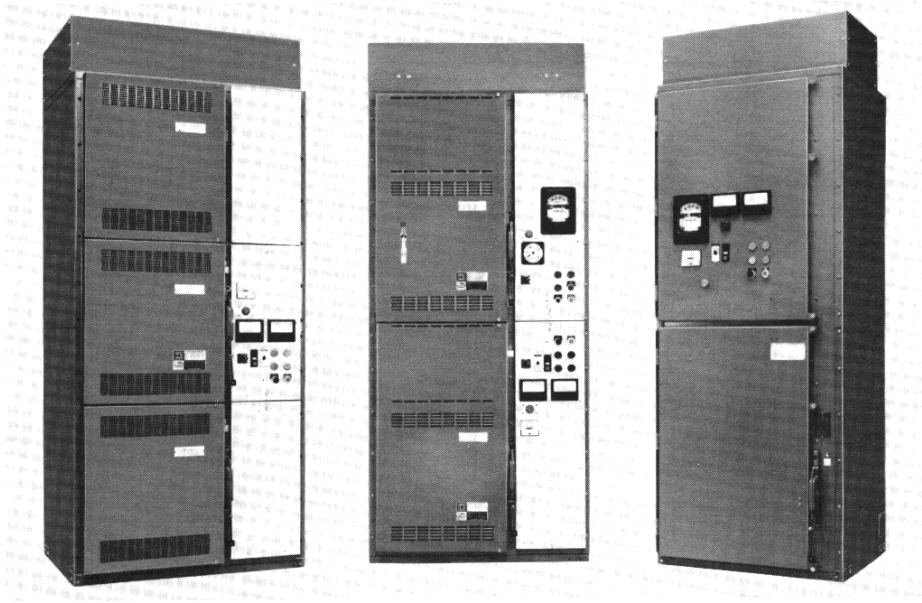
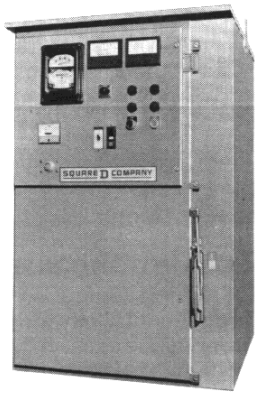
Product Data

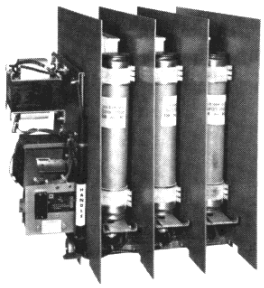
Subject **5000 Volt Class Motor Controller Specifications** *File* 8100



Class 8198 ISO-flex®
Motor Control Center Construction



Class 8196 MINI-flex®
Limited Height Construction



Class 8110 Type E
One Basic Contactor
For all 5KV Applications

Larger motors are frequently applied today to drive various machines and pumps to improve plant efficiency. For horsepower above 200, the overall cost of installation favors 2400, 4160, or 4800 volt motors.

This has created a need for detailed specifications for 5000 volt class motor controllers. The object of this Product Data is to provide specifications to facilitate procurement of medium voltage motor controllers.

It is recognized that the purchaser or consulting engineers may have special requirements and may desire to modify some sections of the specifications. We suggest that such modifications be made by supplementing this specification.

CONTENTS

SPECIFICATION CHECKLIST

CONTROLLERS — GENERAL

- ☐ 5 KV design per NEMA Standard ICS 2-324 and UL Standard 347
- ☐ NEMA Type 1, 3 or 12 enclosures
- ☐ Complete front accessibility to all parts for easy installation and maintenance
- ☐ Mechanical and electrical interlocking system to prevent engaging or disengaging contactor under load and for personnel protection
- ☐ Simple drawout mechanism
- ☐ 600 volt class relays, pilot devices and terminal boards
- ☐ Modifications available to meet special needs
- ☐ Complete line available for squirrel cage, synchronous and wound rotor motors

CONTROLLERS — MOTOR CONTROL CENTER CONSTRUCTION

- ☐ Available in 90″ high, 42″ wide, 35″ deep floor mounted vertical section having three 30″ or two 45″ controller cells. Each controller cell with four distinct and isolated compartments:
  a. Isolated line and vertical bus compartment
  b. Isolated load cable compartment
  c. Isolated medium voltage contactor compartment
  d. Isolated, draw-out , swing-open type low voltage control compartment
- ☐ Available in 90″ high, 34″ wide, 35″ deep floor mounted vertical section for one full voltage non-reversing controller. Each controller shall have two distinct and isolated compartments:
  a. Isolated medium voltage compartment
  b. Isolated low voltage compartment
- ☐ Horizontal bus in isolated 10″ high compartment, mounted on top of 90″ high vertical section.
- ☐ Ground bus — Aluminum or Copper.

CONTACTOR

- ☐ 3 pole, air break, draw-out, NEMA Type H3, heavy duty clapper type, rated 5000 volts, 360A (enclosed), 60kv BIL.
- ☐ Control power transformer and medium voltage fuses integral part of contactor.
- ☐ Power fuses vertically mounted in front. No tool required for removal.
- ☐ Line and load connections completely disconnected when contactor is in withdrawn position.
- ☐ Contactor frame grounded in all positions.
- ☐ Control equipment mounted on side for easy inspection and replacement.
- ☐ Line and load fingers located on contactor for easy access.
- ☐ Identical movable and stationary contact tips.
- ☐ Mechanical latched contactor available with option of electrical solenoid for remote tripping.

CONTROLLERS — LIMITED HEIGHT APPLICATION

- ☐ Available in 54″ high, 34″ wide, 35″ deep floor mounted controller enclosure. Each controller shall have two distinct and isolated compartments:
  a. Isolated medium voltage compartment
  b. Isolated low voltage compartment

SPECIFICATIONS

5000 VOLT CLASS MOTOR CONTROLLERS

I. GENERAL

This specification covers motor controllers for control and protection of 2200-4800 Volts, 3 phase, 50-60 Hertz motors. Controllers shall be designed, manufactured, assembled and tested in accordance with NEMA Standards ICS 2-324 and UL Standard 347.

II. MOTOR CONTROL CENTER CONSTRUCTION

A. Basic structure shall consist of welded framework utilizing minimum 10 gauge steel. Cover plates for sides, top and rear shall be bolted to framework and shall be minimum 12 gauge sheet metal. All doors shall be minimum 12 gauge sheet metal, pan type with flanges formed to provide sturdy, rigid structure. Compartment door latches and hinges shall be capable of holding door closed during maximum fault condition. Ventilation openings shall be provided where required with protective barrier behind them.

B. Enclosures shall be free standing NEMA-1, NEMA-1 gasketed, NEMA-3 or NEMA-12 as specified. All metal parts to be given a thorough rust resistant treatment, then painted with one coat of ANSI-49 medium grey baked enamel. NEMA-3 enclosures shall be supplied with an organic ANSI-49 paint finish.

C. Each indoor type vertical section shall be 90″ high, 42″ wide, and 35″ deep for two and three high, and 90″ high, 34″ wide and 35″ deep for one high construction.

D. Controllers in two and three high construction shall have four distinct, isolated compartments as follows:

1. Line and vertical bus compartment shall extend from top to bottom in left rear portion of each vertical section.
2. Load compartment shall extend from top to bottom in right rear portion of each vertical section.
3. Medium voltage contactor compartment shall be located in left front section of controller cell and shall include mechanical and electrical interlocks to minimize electrical hazards. This compartment shall have hinged door to permit easy access to medium voltage contactor plus line and load connections.
4. Low voltage control compartment shall be located in right front portion of controller cell and shall have drawout, swing open construction to permit easy access to meters, relays, pilot devices and terminal strips for inspection and maintenance. When possible, compartment door and inside panel shall have pre-drilled holes for future addition of meters, pilot devices and relays.

E. Controllers in one high construction shall be limited to full voltage non-reversing applications and shall have two distinct, isolated compartments as follows:

1. Medium voltage contactor compartment shall be located behind low voltage compartment at the top and medium voltage compartment door at the bottom of controller and shall include equipment and provisions described in II.D.3.
2. Low voltage control compartment shall be located in top front portion of controller and shall have swing open construction to permit access to meters, relays, pilot devices and terminal strips for inspection and maintenance. When possible, compartment door and inside panel shall have pre-drilled holes for future addition of meters, pilot devices and relays.

F. Design shall provide complete front accessibility to all electrical parts when installed against walls or for back-to-back arrangements.

III. LIMITED HEIGHT CONSTRUCTION (FULL VOLTAGE NON-REVERSING ONLY)

A. Basic structure shall consist of formed and welded sheet metal utilizing minimum 14 gauge steel. All doors shall be minimum 12 gauge sheet metal, pan type with flanges formed to provide sturdy, rigid structure. Compartment door latches and hinges shall be capable of holding door closed during maximum fault conditions. Ventilation openings shall be provided where required with protective barrier behind them.

B. Enclosures shall be free standing NEMA-1, NEMA-1 gasketed, NEMA-3 or NEMA-12 as specified. Paint finish shall be as described in II.B.

C. Each indoor type enclosure shall be 54″ high, 34″ wide and 35″ deep.

D. Controllers in limited height construction shall have two distinct, isolated compartments as described in II.E.

E. Design shall provide complete front accessibility to all electrical parts when installed against walls.

IV. POWER AND GROUND BUS (MOTOR CONTROL CENTER CONSTRUCTION ONLY)

A. Horizontal bus, when required, shall be in isolated compartment mounted on top of the 90″ high vertical section. Bus shall have minimum continuous current carrying capacity of 1000 amperes, and shall be supported on 5KV fiberglass polyester insulators.

SPECIFICATIONS

B. Vertical bus (for two and three high construction only), when required, shall be located in rear of each vertical section, and shall be securely supported on 5KV fiberglass polyester insulators. When horizontal bus is supplied, vertical bus shall be connected to horizontal bus. For one high construction, where horizontal bus is supplied, cable shall be connected between horizontal bus and controller line connection box.

C. Ground bus, when required, shall be continuous and extended from one end of motor control center to other through each vertical section. Bus shall be located in bottom rear of each vertical section. Minimum continuous rating shall be 375 amperes.

D. All bus ratings shall be in accordance with UL Standard 347.

E. All bus bars shall be tin-plated aluminum or copper.

F. All bus bars and cables shall be braced to withstand, without damage or deformation, maximum let-through current permitted by current limiting fuses.

G. All bolted bus joints shall have minimum of two bolts. To facilitate future extension of motor control center on either side, horizontal bus and ground bus shall be provided with suitable bolt holes.

V. WIRING

A. Controllers shall be complete with all internal power and control wires including terminations for external connections. Phase sequencing shall have proper identification and all wires shall have suitable markings at all terminations.

B. Incoming line may be connected to one of the following:

1. Individual controllers:
   a. For two or three high construction: To incoming line connection boxes in line and vertical bus compartment located at left rear in vertical section. Space shall be provided for terminating a maximum of 2-500 or 1-750 MCM cables per phase for top or bottom entry.
   b. For one high and limited height construction: To incoming line connection box behind lift off cover located in rear of controller section. Space shall be provided for terminating a maximum of 1-500 MCM cable per phase for top or bottom entry.
2. Motor Control Centers:
   a. To horizontal bus located on top of vertical section. Refer to item IV.A. for details of power bus.
   b. To separate incoming line section provided with bus connections to horizontal bus.

C. Motor cables shall be connected to current transformers or stand off insulators. Space shall be provided for terminating a maximum of 3-500 MCM cables per controller for top or bottom entry.

D. Space shall be provided for stress cones for incoming line and load cabling on all types of construction.

VI. CONTACTOR

A. Contactor shall be 3 pole, air break, draw-out, NEMA Type H3, heavy duty, clapper type, designed for long operating life. It shall be rated for 5000 volts, 360 amperes (enclosed), 60kV BIL, with three phase interrupting capacity of 50 MVA, RMS symmetrical. Basic contactor assemblies shall be interchangeable.

B. Power fuses shall be an integral part of contactor and shall be vertically mounted in front for ease of inspection and removal without special tools. Power fuses shall be current limiting type with three phase symmetrical interrupting ratings of 200 MVA at maximum of 2500 volts, and 350 MVA at maximum of 5000 volts, and shall have blown-fuse indication.

C. Control transformer with 120 volt secondary and primary current limiting fuses shall be mounted on contactor, and shall be rated at minimum of 750 VA providing 500 VA capacity for loads above requirement of controller.

D. Draw-out design shall permit removal of contactor from the cell without physically disconnecting any medium voltage cables. Low voltage connections to contactor shall be made with quick disconnect plug.

E. Line and load connection fingers shall be located on contactor for ease of inspection.

F. Movable and stationary contacts shall be identical and shall be of silver tungsten carbide faced copper to prolong operating life. Contactor operation shall provide self-cleaning contact action under mild atmospheric contamination.

G. Contactor shall have a dc operating coil to ensure quiet operation. Control voltage for coil shall be connected through a 12 ampere full wave bridge silicon rectifier and an economizing reactor mounted on contactor. Economizing reactor shall be used to minimize heat losses in coil circuit.

H. Contactor shall include minimum of two single pole, double throw auxiliary contacts rated at 10 amperes continuous for purchaser's use. Maximum of five such contacts shall be provided on contactor when specified.

I. Contactor shall have ground connection in both fully engaged and disengaged (test) positions.

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J. Mechanically latched contactor

1. Mechanically latched contactor shall be provided when specified for transformer feeder circuits, fire pumps, automatic transfer applications, and other uses when it is required to have contactor remain closed, should voltage dip or fail.
2. Mechanically latched contactor shall be closed electrically from local or remote "ON" push button and tripped by mechanical linkage to externally-operated manual trip handle. When specified, an electrically operated solenoid shall be supplied to trip contactor from remote location.

VII. POWER CIRCUIT ISOLATING MEANS

A. Externally operable, gang operating medium voltage isolating means shall be included for each controller and shall be capable of closing and interrupting no load current of control circuit transformer supplied on contactor.

B. Isolating means shall be vertically operated draw-out handle operating through approximately 180° arc to accomplish the following:

1. De-energize medium voltage contactor.
2. Withdraw contactor from line and load connections.
3. Disconnect primary of control transformer.
4. Close shutters over line and load connections.
5. Release door interlock so that medium voltage door can be opened.

C. Draw-out handle shall be rugged, simple and shall have provision for being padlocked in open position.

VIII. INTERLOCKING

A. Mechanical interlocking shall be provided and shall prevent the following:

1. Disengaging contactor from line bus when contactor is closed.
2. Opening medium voltage compartment door with draw-out handle in up position and contactor engaged to line bus.
3. Engaging contactor to line bus with door open.
4. Engaging contactor to line bus with contactor closed in test position.

B. Electrical interlocking shall be provided and shall assure the following:

1. De-energizing contactor before it can be disengaged from line stabs.
2. De-energizing contactor when low voltage door is opened. Defeat system shall be available to keep starter energized.

IX. CONTROL

A. Control power shall be 120 volt ac from a 750 VA control transformer mounted on contactor.

B. Control transformer shall be fused on primary and secondary for proper coordination. Two fuses shall be supplied on primary and one fuse on secondary side with one leg grounded. Primary of control transformer shall be disconnected from power supply with contactor.

C. Control wires shall be minimum 16 gauge stranded, rated for 600 volts.

D. Terminal strips shall be rated for 600 volts and be suitable for terminating maximum 10 gauge wire. Both ends of control wires shall be marked for identification.

E. Push buttons, pilot lights and control relays used shall be heavy duty, rated to 600 volts.

F. Controller shall include circuit to test contactor and control circuit when contactor is in withdrawn or test position. Test circuit shall consist of receptacle and plug mounted in medium voltage contactor compartment and accessible only when medium voltage contactor compartment door is open. In test position, plug may be removed from receptacle and connected to an external 120 volt source of power. This shall isolate control transformer and prevent energizing control transformer secondary from test voltage source.

G. All devices mounted in low voltage compartment shall be suitably identified.

X. PROTECTION AND METERING EQUIPMENT

A. Overload protection shall be provided by means of three phase thermal overload relay, either melting alloy or bimetallic type, and shall be operated through current transformers mounted in load compartment. Relays shall be mounted on low voltage panel with external reset on compartment door. Pressing overload reset button shall not open control circuit or stop motor if it is running.

B. Current transformers used for overload protection shall be of linear response through six times full load motor current and shall have adequate burden capacity for devices they supply. Linear response shall be per ANSI accuracy classification.

C. Ammeters and voltmeters shall be rectangular, 4½" wide, 90° scale, and of 2% accuracy class.

D. Preferably, all control, protection and metering equipment shall be mounted in separate isolated low voltage compartment as described under paragraph II.D.4 and/or II.E.2.

SPECIFICATIONS

XI. MISCELLANEOUS

A. Servicing

Provisions shall be made for removal of contactor from controller to facilitate servicing of controller, contactor and associated equipment.

B. Nameplates

1. Suitable nameplates shall be included on contactor and starter door identify manufacturer's factory order, and wiring diagram numbers.
2. Drive identification plates shall be 5½" x 1½" with ⅜" black letters on white background.

XII. REDUCED VOLTAGE CONTROLLERS

A. Reduced voltage controllers shall be closed transition, adjustable time limit acceleration type. When specified:

1. Primary reactor type controllers shall consist of start contactor, run contactor without power fuses and control transformer, and 3 phase primary reactor with 50, 65 and 80% voltage taps.
2. Autotransformer type controllers shall consist of main contactor, start contactor and run contactor mechanically interlocked without power fuses and control transformer, and two-winding autotransformer connected in open delta with 50, 65 and 80% voltage taps.
3. Wound rotor motor controllers shall consist of primary controls which include main contactor with controls and protective relays, and secondary controls that include secondary acceleration contactors, set of relays for time limit acceleration and set of NEMA Class 135 starting duty resistors. Primary controls and secondary controls except accelerating resistors shall be mounted in top 30" cell or in separate 90" high vertical section for maximum heat dissipation. Resistors shall be heavy duty pressed stainless steel type with welded end connections.

XIII. SYNCHRONOUS MOTOR CONTROLLERS

A. Synchronous motor controllers shall be suitable for conventional or brushless synchronous motors where constant speed and plant power factor correction are desired. Controllers shall be full voltage or reduced voltage type depending upon the specific requirement.

B. Synchronous motor controllers shall have field control panel mounted for ease of inspection. Field panel for conventional synchronous motor shall consist of:

1. Solid-state module for automatic synchronization and motor protection from:
   a. Stalled rotor condition
   b. Failure to accelerate to synchronizing speed
   c. Loss of excitation
   d. Pull-out under excessive load
2. Field application contactor
3. Field discharge resistor
4. DC field ammeter

C. When specified, three phase, full wave bridge static exciter shall be furnished as part of conventional synchronous motor controller. The static exciter package shall provide ac to dc power conversion required for individual synchronous motor field excitation. No field rheostat or resistors shall be required since voltage adjustment shall be made on static exciter transformer by changing taps. Static exciter shall consist of:

1. Three phase fused transformer with four 5% primary taps, two above and two below nominal voltage and seven 2½% secondary taps below nominal voltage.
2. Silicon rectifier and surge protective devices

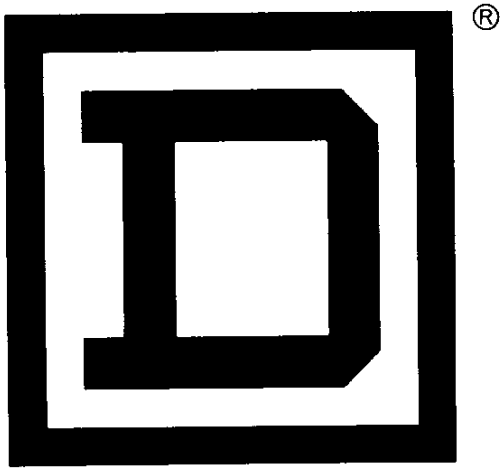
Exciter shall be connected to load side of medium voltage contactor. Exciter shall have:

1. Input: 2300, 4160 or 4800 volts, 3 phase, 60 Hz.
2. Output: 125 or 250V dc as specified. KW rating of exciter shall be based on actual motor data to be supplied by purchaser.

D. Field panel for brushless synchronous motor shall consist of:

1. Exciter field contactor
2. Incomplete sequence relay
3. DC power supply for exciter field with thyrite protector
4. Powerstat for exciter field adjustment
5. Exciter field loss relay
6. Pull out relay
7. DC field ammeter

Control equipment for synchronization shall be part of brushless synchronous motor.



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