

## TYPICAL ORDERING SPECIFICATION, TYPE 230 INDOOR CONTROLLER

- 1.0 SCOPE This is suggested ordering specification for indoor Class E2 controllers suitable for the automatic control and protection of induction motors or transformers on a 2400-volt (or 4160-volt), 3-phase, 60-hertz, power system.
- 2.0 USE AND GENERAL DESIGN Each controller shall be suitable for full-voltage, non-reversing, magnetic starting and protection of an induction motor (or suitable for switching and protection of a 3-phase transformer). Each controller shall consist of a coordinated combination of vacuum-interrupter contactor, overload relay, current transformers, control transformer, current-limiting fuses, safety-interlocked isolating switch, and main bus, completely assembled and front connected with all parts readily accessible.
- 2.1 FAULT CAPACITY Each controller shall be suitable for use on a power system capable of producing fault currents up to 80,000-amperes RMS asymmetrical (210-MVA at 2400-volts or 360-MVA at 4160-volts for symmetrical calculations).
- 2.2 LOCATION Each controller shall be especially designed for indoor location in a refinery or chemical plant atmosphere, except that the location is not classified as a hazardous location as defined in the National Electrical Code.
- 2.3 STANDARDS Each controller and its components shall be made in the U.S.A. to U.S.A. standards, especially NEMA ICS 3 Part 2 and UL-347 for Class E2 Controllers. In order to comply with OSHA requirements, each controller shall include a UL Label with Listing Mark. If the controller includes optional features that are not included in UL listed products, the manufacturer shall have available test reports on controller design to confirm compliance of basic design.
- 2.4 ENCLOSURE & MOUNTING Each controller shall have its own enclosure, 90-inch nominal height (one-high construction) and shall have a single front door equipped with lockable door handle and 3-point door latching mechanism. The enclosure (exceeding NEMA 12 requirements) shall provide protection for the enclosed equipment against dirt, dust, lint, light splashes, seepage, dripping, nonignitable fibers, noncombustible flyings, internal condensation, and rodents. The controller shall include copper ground bus.
- 2.5 INCOMING LINE BOX Each controller or controller group shall be provided with an attached, incoming line box arranged for either overhead or underground conduit entrance sized and for front or side access, as shown on data sheet or order. When incoming cables are 4/0 or smaller, incoming line connectors shall be located on the controller bus. When incoming line cables are larger than 4/0, the incoming line box shall be sized to include incoming line bus extension, and the line connectors shall be mounted on extended bus in the box. The box shall provide wire-bending space no less than eight times overall diameter of field installed, non-shielded conductors.
- 2.6 LINE & LOAD CONNECTORS Incoming line and load connectors shall be compression crimp-type, sized as shown on data sheet or order.
- 2.7 MATERIAL & FINISH The cabinet, cabinet door, and incoming line box shall be made of 12-gauge or heavier sheet steel, suitably braced and continuously welded. The cabinet, cabinet door, and incoming line box shall be painted for indoor use. All external cabinet hardware, shafts, and pins shall be 18-8 stainless steel or equivalent. Current-carrying parts and connections shall be hermetically sealed and/or tin-plated or silver-plated or nickel-plated.
- 2.8 ASSEMBLY If the controller quantity is two or more, then the controllers shall be grouped into a complete assembly with 600-amp (or 1200-amp) interconnecting bus. For up to four controllers, the assembly shall be shipped as a single piece. For more than four controllers, the assembly may be split for shipment. Each assembly shall have provisions for field handling by either crane or forklift. Each controller shall be an individual unit, capable of being removed from the assembly.
- 2.9 LOAD & CONTROL CONDUIT ENTRANCES The internal arrangement of components shall permit field change from overhead to underground conduit entrances. No knockouts shall be provided for load and control conduit entrances. If specified on data sheet or order, couplings shall be welded in controller roof for overhead conduits.
- 3.0 SAFETY AND OPERATING FEATURES
- 3.1 ISOLATING SWITCH Each controller shall be equipped with a 3-pole, externally-operated, isolating-switch to isolate the controller and the circuit from the power supply. When opened, this switch shall have a substantial, vertical air-gap between its line and load-side contacts. The isolating-switch shall be electrically and mechanically interlocked with a control power switch and the main contactor (a) to prevent accidental operation of the isolating switch under load, (b) to prevent opening the enclosure door before opening the isolating switch, and (c) to prevent closing the isolating switch with the door open.
- 3.2 LIVE PARTS BARRIERS Each controller shall be arranged so that motor cables may be installed, fuses replaced, and all deenergized parts maintained without danger of accidental contact with energized parts, when the isolating-switch is open. A grounded, vertical steel barrier shall be provided in front of the main bus and line contacts of the isolating switch which are still energized when the door is open. A removable maintenance shutter shall be provided in each controller for use by qualified persons when working near the live parts. Each controller shall provide for storing this shutter.



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- 3.3 SWITCH HANDLE AND VIEWING WINDOW The position of the switch handle shall be in plain view when the controller is in operation. A window shall be provided to permit viewing the position of the isolating-switch contacts.
- 3.4 PADLOCKING Provisions shall be made for separate padlocking of the enclosure and of the isolating-switch. The isolating-switch shall be arranged for padlocking either open or closed.
- 3.5 CONTROL TRANSFORMER Each controller shall include a single phase control circuit transformer, 115-volts secondary, oversized to accommodate the control circuit and remote load of 500-VA (or 1000-VA, if specified on data sheet or order). The secondary of the control transformer shall be grounded.
- 3.6 CONTROL TRANSFORMER SWITCHING To increase life of the isolating switch main contacts, a hermetically-sealed auxiliary switch shall be provided on the isolating switch to make and interrupt the primary (magnetizing) current of the control transformer primary.
- 3.7 REMOTE CONTROL A terminal block shall be provided, marked, and wired for external connections of customer's 3-wire control push-button or other master element and of a remote ammeter. These terminals shall be safely accessible when the equipment is in operation. Remote control shall be 115-volts.
- 3.8 MAIN FUSES Motor controllers shall be equipped with General Electric Type EJ-2 fuses, 12-inch clip centers. If specified on data sheet or order, 7-inch clip centers shall be provided for 2400-volts applications. Transformer controllers shall be equipped with General Electric Type EJ-2 or Type EJO-1 fuses, 12-inch clip centers.
- 3.9 CONTACTOR The vacuum-interrupter contactor shall have 360-amp continuous rating and 5-KA load-interrupting rating. The main contacts shall be non-welding under all normal operating and fault conditions. The contactor shall be front accessible, fixed position. The contactor shall have three each n.o. and n.c. auxiliary contacts, all readily accessible and connected to a terminal block.
- 3.10 CONTACTOR POSITION The contactor shall have a mechanical position indicator that is readily visible through a window when the controller door is closed.
- 3.11 UNDERVOLTAGE CHARACTERISTICS The contactor shall have inherent time-delay undervoltage characteristics, so that it remains closed on voltage dips but opens on prolonged loss-of-voltage. For motor control applications, the contactor control shall include a master control relay with dc coil having a lower dropout voltage than the contactor dropout voltage. The contactor shall operate positively on system voltage drop of 25% during motor starting.
- 3.12 CONTACTS & SWITCHES All auxiliary contacts, control switch contacts, and relay contacts, other than overload relay, shall be hermetically-sealed.
- 3.13 CURRENT TRANSFORMERS Each controller shall include three current transformers for connection to overload relay and ammeter. The current transformers shall be sized to accommodate ambient compensated, overload relay and shall not saturate below 600% of load current of that type relay even if used initially only with solid-state relay.
- 3.14 AMMETER A panel-type ammeter, 3-1/2" or larger, visible through a window, shall be provided to show load.
- 3.15 SPACE HEATER The cabinet shall be provided with a 115-volt space heater suitably sized to prevent condensation formation. The space heater shall be energized from the control transformer through a n.c. auxiliary contact or by a temperature control if equivalent heating is not provided by other control devices when the main contactor is closed.
- 4.0 OVERCURRENT PROTECTION Coordinated protection shall be provided for fault currents and operating overload.
- 4.1 FUSES The main-line fuses shall be current-limiting type, non-vented with operation indicator, and shall be selected to withstand locked rotor current for 30-seconds. The control circuit shall be protected by fuses in both the primary and the secondary of the control transformer. A separate secondary fuse shall be provided for heaters.
- 4.2 OVERLOAD RELAY A 3-phase, ambient compensated, Class 20 thermal-overload relay, Westinghouse AA13P, shall be provided for motor running protection. The relay shall be equipped with manual reset, externally operable. Or, if so specified on the data sheet or order, the relay shall be arranged for automatic-reset.



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FOR SOLID-STATE OVERLOAD RELAY, CHANGE 4.2 to read

4.2 OVERLOAD RELAY A 3-phase, self-powered, Class 10 solid-state overload relay, Square D 9065-SSC10, shall be provided for motor running protection and for phase unbalance & single phase protection. The relay shall be equipped, with manual reset, externally operable.

FOR RESISTANCE-GROUNDED SYSTEM, ADD -

4.3 GROUND FAULT An instantaneous-current relay, that is self-reset when isolating switch is opened and/or power is off, shall be provided to open contactor on 10-amp ground fault current. Operation of the relay shall also energize an indicating light mounted on the door.

FOR MULTI-FUNCTION PROTECTIVE RELAY, ADD

4.4 MULTI-FUNCTION PROTECTION Each controller shall include a Multilin 269PLUS (or 239 or 269) microcomputer-based relay that includes protection, monitoring, and diagnostic features. Connections shall be provided for alarm, trip, and other functions, as specified on data sheet or order. To avoid intermediate terminal blocks, any RTDs will be field connected to the relay, however, controller shall include wireties for tiedown of field wiring. For backup protection, each controller shall include 4.2-specified overload relay.

5.4 APPLICATION NAMEPLATE A 3-inch x 8-inch, 1/8-inch thick phenolic nameplate shall be attached to the front of each controller with stainless steel screws. This nameplate shall be engraved with either two lines of 3/4-inch high letters or three lines of 1/2-inch high letters, with lettering as shown on data sheet or order.

6.0 OPTIONAL FEATURES If specified on data sheet or order, each controller shall be equipped with any one or more of these optional features -

- "STOP" &/or "START Control Switch, momentary contact - AC Ammeter Transfer Switch, 4-position

- AC Voltmeter, panel-type, 3-1/2" or larger, connected to control transformer secondary, visible through window

- AC Ammeter, switchboard type, 250-degree scale (instead of panel type)

- Red &/or Green Indicating Light, incandescent lamp (or LED if specified), connected to auxiliary contact(s), marked to indicate "CONTACTOR CLOSED" &/or "CONTACTOR OPEN" (these lights are in addition to mechanical position indicator described in 3.10)

- Amber Indicating Light, incandescent lamp (or LED if specified), to indicate Overload Relay operation

- Hand-Off-Auto Selector Switch, maintained contact

- Foreign Voltage Switch, maintained contact, with Covered Terminal Block

- Time-delay Reclosing Relay, 4-second fixed time, with Auxiliary Relay, to initiate reclose after voltage dip

- Contactor Operations Counter

- Auxiliary Relay, plug-in, (2) SPDT 10-amp contacts, for extra auxiliary contacts

- Mechanically Latched Contactor, electrically closed, with externally operable, manual-trip handle

- Electric-trip Solenoid for Mechanically-latched Contactor

- Main Bus Insulation, 1/16-inch thick, with Multi-Layered Tapes on Joints & Connecting Straps

5.0 MARKINGS All external markings shall be on stainless steel nameplates attached with stainless steel hardware or on nameplate materials that are UL approved. Internal markings shall be on nameplate materials that are UL approved.

5.1 GENERAL Each controller shall include all permanent markings required by the 2.3-referenced NEMA & UL standards including manufacturer's name, type, diagram number, amp rating, HP, fuse size, voltage, bus rating, fault interrupting rating, basic impulse insulation rating, raintight enclosure, and hazardous location classification. When the overload relay has various heater sizes, a heater selection table shall be provided.

5.2 SWITCH POSITION A safety sign or label with message "CAUTION VISUALLY VERIFY ISOLATING SWITCH IS FULLY OPEN BEFORE OPENING CONTROLLER DOOR" shall be mounted on the front door.

5.3 DEVICES & WIRES Each control device shall be identified with its diagram Symbol. Each control wire shall be marked at each end with vinyl-cloth markers, installed on appropriately clean/dry surface.

7.0 TESTS Each controller shall be given dielectric and operational tests, including operating overload and control sequence tests before shipment.

