

**Specification Number:** 26 24 16.12

**Product Name:** I-LINE PANELBOARDS

## **SECTION 26 24 16.12 I-LINE PANELBOARDS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Power Distribution Panelboard - Furnish and install distribution panelboard(s) as specified herein and where shown on the associated [schedules] [drawings].

#### **1.02 REFERENCES**

The panelboard(s) and circuit breaker(s) referenced herein are designed and manufactured according to the latest revision of the following specifications.

- A. NEMA PB 1 - Panelboards
- B. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- C. NEMA AB 1 - Molded Case Circuit Breakers
- D. UL 50 - Enclosures for Electrical Equipment
- E. UL 67 - Panelboards
- F. UL 489 - Molded-Case Circuit Breakers and Circuit Breaker Enclosures
- G. CSA Standard C22.2 No. 29-M1989 - Panelboards and Enclosed Panelboards
- H. CSA Standard C22.2 No. 5-M91 - Molded Case Circuit Breakers
- I. Federal Specification W-P-115C - Type I Class 1
- J. Federal Specification W-C-375B/Gen - Circuit Breakers, Molded Case, Branch Circuit And Service.
- K. Federal Specification W-C-865C - Fusible Switches
- L. NFPA 70 - National Electrical Code (NEC)
- M. ASTM - American Society of Testing Materials
- N. IBC – International Building Code – Seismic compliance requirements
- O. NFPA 5000 – NFPA Building Code – Seismic compliance requirements
- P. ASCE 7 – American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures – Seismic compliance requirements.

#### **1.03 SUBMITTAL AND RECORD DOCUMENTATION**

- A. Approval documents shall include drawings. Drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one line diagrams with applicable voltage systems.

#### **1.04 QUALIFICATIONS**

- A. Company specializing in manufacturing of panelboard products with a minimum of fifty (50) years documented experience.
- B. Panelboards shall be manufactured in accordance with standards listed Article 1.02 - REFERENCES.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Inspect and report concealed damage to carrier within their required time period.
- B. Handle carefully to avoid damage to panelboard internal components, enclosure, and finish.
- C. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.

#### **1.06 OPERATIONS AND MAINTENANCE MATERIALS**

- A. Manufacturer shall provide installation instructions and NEMA Standards Publication PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

#### **1.07 WARRANTY**

- A. Manufacturer shall warrant specified equipment to be free from defects in materials and workmanship for eighteen (18) months from the date of purchase.

#### **1.08 RELATED WORK**

- A. Section 16440-9 - Remote Controlled Lighting Panelboard System

- B. Section 16280-1.2 – Surge Protective Devices (formally Transient Voltage Surge Suppression)
- C. Section 260913.10 – Electrical Power Monitoring & Control

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Shall be Square D Company I-LINE – Class 2110
- B. Substitutions must be submitted in writing three weeks prior to original bid date with supporting documentation demonstrating that the alternate manufacturer meets all aspects of the specification herein.

### **2.02 POWER DISTRIBUTION PANELBOARDS**

- A. I-LINE Circuit Breaker Distribution Panelboard
  - 1. Interior
    - a. Shall be Square D I-LINE type rated 600 Vac or 250 Vdc maximum. Continuous main current ratings as indicated on associated [schedules] [drawings] not to exceed 1200 amperes maximum. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67.
    - b. Provide UL Listed short circuit current ratings (SCCR) as indicated on the associated [schedules] [drawings] not to exceed the lowest interrupting capacity rating of any circuit breaker installed with a maximum of 200,000 RMS symmetrical amperes. Main lug and main breaker panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230.VI and VII.
    - c. The panelboard interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.
    - d. The bussing shall be fully rated with sequentially phased branch distribution. Panelboard bussing rated 100 through 600 amperes shall be plated [copper] [aluminum]. Bussing rated 800 amperes and above shall be plated copper. Bus bar plating shall run the entire length of the bus bar. The entire interleaved assembly shall be contained between two (2) U-shaped steel channels, permanently secured to a galvanized steel-mounting pan by fasteners.
    - e. Interior trim shall be of dead-front construction to shield user from all energized parts. Main circuit breaker and main lug interiors shall be field convertible for top or bottom incoming feed.
    - f. A solidly bonded [aluminum] [copper] equipment ground bar shall be provided. [An additional [aluminum] [copper] isolated/insulated ground bar shall also be provided.]
    - g. Solid neutral shall be equipped with a full capacity bonding strap for service entrance applications. [UL Listed panelboards with 200% rated solid neutrals shall have plated copper neutral bus for non-linear load applications.] Gutter-mounted neutral will not be acceptable.
    - h. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label, and Short Circuit Current Rating shall be displayed on the interior or in a booklet format. Leveling provisions shall be provided for flush mounted applications.
  - 2. Group mounted circuit breakers through 1200A
    - a. Circuit breaker(s) shall be group mounted plug-on with mechanical restraint on a common pan or rail assembly.
    - b. The interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.
    - c. Circuit breakers equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breakers shall be held in mounted position by a

- self-contained bracket secured to the mounting pan by fasteners. Circuit breakers of different frame sizes shall be capable of being mounted across from each other.
- d. Line-side circuit breaker connections are to be jaw type.
  - e. All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.
3. Molded Case Circuit Breaker Characteristics - General
    - a. Circuit breakers shall be constructed using glass reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
    - b. Circuit breakers shall have an over center, trip free, toggle operating mechanism which will provide quick-make, quick-break contact action. The circuit breaker shall have common tripping of all poles.
    - c. The circuit breaker handle shall reside in a tripped position between ON and OFF to provide local trip indication. Circuit breaker escutcheon shall be clearly marked ON and OFF in addition to providing International I/O markings.
    - d. The maximum ampere rating and UL certification standard with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker.
    - e. Each circuit breaker shall be equipped with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit breaker tripping mechanism for maintenance and testing purposes.
    - f. Circuit breakers shall be factory sealed with a hologram quality mark and shall have date code on face of circuit breaker.
    - g. [Circuit breaker/circuit breaker] [Fuse/circuit breaker] combinations for series connected interrupting ratings shall be listed by UL as recognized component combinations. Any series rated combination used shall be marked on the end use equipment along with the statement "Caution - Series Rated System. \_\_\_\_\_ Amps Available. Identical Replacement Component Required".
    - h. Circuit breakers shall be equipped with UL Listed electrical accessories as noted on the associated [schedule], [drawing] or they may be field-installable.
    - i. Circuit breaker handle accessories shall provide provisions for locking handle in the ON and OFF position.
    - j. All circuit breakers with permanent trip units shall be UL Listed for reverse connection without restrictive line and load markings and be suitable for mounting in any position.
    - k. Circuit breakers shall be I-LINE - up to 1200 Amp maximum construction with factory installed mechanical lugs. All circuit breakers shall be UL Listed to accept field installable/removable [mechanical type] lugs (except type QB/QD/QG/QJ). All lugs shall be UL Listed to accept solid (not larger than #8 AWG) and/or stranded [copper and aluminum conductors], [copper conductors only]. Lugs shall be suitable for [60° C rated wire - on 125 A circuit breakers and below], [75° C rated wire] or [90° C rated wire, sized according to the 75° C temperature rating in the National Electrical Code].
  4. Thermal-Magnetic Circuit Breakers
    - a. Shall be Square D type: PowerPact Q-, H- and J-frame (15-250A) [or approved equal].
    - b. Circuit breakers shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole.
    - c. Thermal trip elements shall be factory preset and sealed. Circuit breakers shall be true RMS sensing and thermally responsive to protect circuit conductor(s) in a 40° C ambient temperature.
    - d. Circuit breaker frame sizes above 150 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker (except type QB/QD/QG/QJ).
    - e. Standard two- and three-pole circuit breakers up to 250 amperes at 600 VAC shall be UL Listed as HACR type.
  5. Equipment Ground Fault Protection (Thermal Magnetic Circuit Breakers)

- a. Circuit breakers 250 amperes and less shall be Square D type: PowerPact H-, and J-frame [or approved equal], and shall be equipped with a Ground Fault Module (GFM) with 20-200A sensitivity level or Earth Leakage Module (ELM) with sensitivity ranges between 30mA and 3A [or approved equal].
  - b. Ground fault sensing system shall be modified zero sequence (GFM) or zero sequence (ELM) sensing type.
  - c. The ground fault system shall require no external power to trip the circuit breaker.
  - d. Companion circuit breaker shall be equipped with a ground-fault shunt trip.
  - e. The ground fault sensing system shall be suitable for use on solidly grounded systems. The ground fault sensing system shall be suitable for use on three-phase, three-wire circuits where the system neutral is grounded but not carried through the system or on three-phase, four-wire systems. ELM shall be suitable for use on three-phase, three wire circuits only.
  - f. Ground fault pickup current setting and time delay shall be field adjustable. A switch shall be provided for setting ground fault pickup point. A means to seal the pickup and delay adjustments shall be provided.
  - g. The ground fault sensing system shall include a ground fault memory circuit to sum the time increments of intermittent arcing ground faults above the pickup point.
  - h. A means of testing the ground fault system to meet the on-site testing requirements of NEC Section 230-95(c) shall be provided.
  - i. Local visual ground fault trip indication shall be provided.
  - j. The companion circuit breaker shall be capable of being group mounted.
  - k. The ground fault sensing system shall not affect interrupting rating of the companion circuit breaker.
6. Electronic Trip Circuit Breakers with STR Trip System
- a. Shall be Square D type: PowerPact D-frame (60-600A) [or approved equal].
  - b. The circuit breaker trip system shall be a microprocessor-based true rms sensing design. Sensor ampere ratings shall be as indicated on the associated [schedules], [drawings].
  - c. The integral trip system shall be independent of any external power source and shall contain no less than industrial grade electronic components
  - d. All trip units shall be removable to allow for field upgrades.
  - e. The STR trip unit functions shall consist of adjustable long-time pickup and [adjustable or non-adjustable] delay, short-time pickup and [adjustable or non-adjustable]delay, [optional instantaneous pickup], [optional ground-fault pickup and delay]
  - f. Adjustable rating plug shall allow for six long-time ( $I_o$ ) pickup settings from 0.5 to 1 times the sensor plug ( $I_n$ ) and fine adjustment ( $I_r$ ) with eight settings ranging from 0.8 to 1 times  $I_o$ . [Adjustable long-time delay shall be available in bands from 0.5 to 8 seconds at six times  $I_r$ ].
  - g. Short-time pickup shall allow for seven settings
  - h. From 2 to 9 times  $I_r$ . Short time delay shall be fixed in trip units STR23SP and SR23SP
  - i. From 1.5 to 7 times  $I_r$ . Short –time delay shall be in eight bands from 0 to 0.3  $I_2t$  ON and 0 to 0.3  $I_2t$  OFF in trip units STR53UP.
  - j. [Instantaneous settings on the trip units with LSI protection shall be available in seven bands from 1.5 to 9 times  $I_n$ ]
  - k. [Optional ground-fault settings shall be available to provide residual type ground fault protection. Ground fault pickup shall be in 8 settings from 0.2 to 1 times  $I_n$ . The adjustable delays shall be in 4 settings 0.1 to 0.4  $I_2t$  ON and 0.1 to 0.4  $I_2t$  OFF
  - l. All trip units shall have the capability for the adjustments to be set and read locally by a rotating switch.
  - m. Trip unit shall provide local trip indications
  - n. An ammeter (a digital display) shall be provided to indicate the current of the phase with the greatest load. By pressing a scroll button, it shall also be possible to display

successively the readings of the I1, I2, I3, and I Neutral. LEDs shall indicate the phase for which the current is displayed.

3. Electronic Trip Circuit Breakers with ET 1.0 Trip System
  - a. Shall be Square D type: PowerPact M-frame (300-800A) [or approved equal].
  - b. The circuit breaker trip system shall be a microprocessor-based true rms sensing design. Sensor ampere ratings shall be as indicated on the associated [schedules], [drawings].
  - c. The integral trip system shall be independent of any external power source and shall contain no less than industrial grade electronic components
  - d. Trip Unit shall not be field-replaced.
  - e. ET 1.0 Trip unit functions shall consist of adjustable instantaneous pick-up with no intentional time delay.
  - f. The long time trip point setting shall be fixed and cannot be adjusted.
  - g. The Instantaneous settings on the trip unit shall allow 2 to 10 times the sensor rating (In). The trip unit shall have the capability for the adjustment to be set and read locally by a rotating switch.
  - h. Ground-fault protection shall not be provided.
4. Electronic Trip Circuit Breakers with MICROLOGIC Trip System
  - a. Shall be Square D type: PowerPact P- and R-frame (100-1200A) [or approved equal].
  - b. Circuit breaker trip system shall be a **MICROLOGIC** electronic trip unit.
  - c. All trip units shall be removable to allow for field upgrades.
  - d. Trip Units shall incorporate “True RMS Sensing”, and have LED long-time pickup indications.
  - e. **MICROLOGIC** trip unit functions shall consist of adjustable long-time pickup and delay, [optional short-time pickup and delay], instantaneous [optional neutral protection and optional ground-fault pickup and delay].
  - f. Adjustable long-time pickup (Ir) and delay shall be available in an adjustable rating plug that is UL Listed as field-replaceable. Adjustable rating plug shall allow for nine long-time pickup settings from 0.4 to 1 times the sensor plug (In). Other adjustable rating plugs shall be available for more precise settings to match the application. Long-time delay settings shall be in nine bands from 0.5–24 seconds at six times Ir.
  - g. [Short-time pickup shall allow for nine settings from 1.5 to 10 times Ir. Short-time delay shall be in nine bands from 0.1–0.4 I 2 t ON and 0–0.4 I 2 t OFF.]
  - h. Instantaneous settings on the trip units with LSI protection shall be available in nine bands from 2 to 15 times In. [The Instantaneous setting shall also have an OFF setting when short-time pick-up is provided.]
  - i. All trip units shall have the capability for the adjustments to be set and read locally by rotating a switch. [Optional: trip units shall have the capability to electronically adjust the settings locally and remotely to fine increments below the switch settings. Fine increments for pickup adjustments are to be one ampere. Fine increments for delay adjustments are to be one second.]
  - j. Trip unit shall provide local trip indication [and capability to indicate local and remote reason for trip, i.e., overload, short circuit or ground fault.]
  - k. [Ground-fault protection shall be available for solidly grounded three-phase, three-wire or three-phase, four-wire systems. Trip unit shall be capable of the following types of ground-fault protection: residual, source ground return, and modified differential. Ground-fault sensing systems may be changed in the field.]
  - l. [Ground-fault settings for circuit breaker sensor sizes 1200 A or below shall be in nine bands from 0.2 to 1.0 times In. The ground-fault settings for circuit breakers above 1200 A shall be nine bands from 500 to 1200 A.]
  - m. [Neutral current transformers shall be available for four-wire systems.]
  - n. [Trip units shall be capable of communicating on **MODBUS** ® networks without software interfaces (black boxes).]

- o. [Trip units shall be available to provide additional protection by offering adjustable inverse definite minimum time lag (IDMTL). IDMTL provides optimized coordination by the adjustment of the slope of the long-time delay protection.]
- p. [Trip units shall be available to provide real time metering. Metering functions include current, voltage, power and frequency. Metering accuracy shall be 1.5% current, 0.5% voltage, and 2% power. These accuracy's shall be total system including CT and meter.]
- q. [Trip units shall be available to provide harmonic analysis and waveform capture.]
- r. A means to seal the trip unit adjustments in accordance with NEC Section 240-6(b) shall be provided.
- s. The following table indicates the standard and optional features of the Trip Units. Select the appropriate trip unit (s) for the system performance desired.

Features	Micrologic Trip Unit Series			
	Standard	A	P	H
True RMS Sensing	X	X	X	X
LI	X	X	X	X
LSI	o	o	X	X
LSIG/Ground –Fault Trip		o	o	o
Ground Fault Alarm (no trip)			X	X
Ground Fault Trip and Programming Alarm			o	o
Adjustable Rating Plugs	X	X	X	X
LED - Long-time Pickup	X	X	X	X
LED - Trip indication		X	X	X
Digital Ammeter		X	X	X
Phase loading Bar Graph		X	X	X
Communications		o	X	X
LCD Dot Matrix Display			X	X
Advanced User Interface			X	X
Protective Relay Functions			X	X
Thermal Imaging			X	X
Neutral Protection			X	X
Electronic Contact Wear Indication			X	X
Temperature Indication			X	X
Incremental Fine Tuning of Settings			X	X
Selectable Long-time Delay Bands			X	X
Power Measurement			X	X
Waveform Capture				X
Data Logging				X

**X=Standard o=Option**

- 5. Surge Protective Device  
See: SECTION 16280-1.2 (26 43 00.12) Integrated Surge Protective Device (SPDs) for Panelboards
- 6. Enclosures
  - a. Type 1 Boxes
    - 1) Boxes shall be hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements. Unpainted galvanized steel is not acceptable.
    - 2) Boxes shall have removable blank end walls and interior mounting studs. Interior support bracket shall be provided for ease of interior installation.
  - b. Type 1 Trim Fronts
    - 1) Trim front steel shall meet strength and rigidity requirements per UL 50

- standards. Shall have an ANSI 49 medium gray enamel electrodeposited over cleaned phosphatized steel.
- 2) Trim front shall be [4-piece surface] [4-piece with door] [hinged 1-piece with door] available in [flush] [surface] mount. Trim front door shall have rounded corners and edges free of burrs. A clear plastic directory cardholder shall be mounted on the inside of the door.
  - 3) Locks shall be cylindrical tumbler type with larger enclosures requiring sliding vault locks with 3-point latching. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock.
- c. Type 3R, 5, and 12
- 1) Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be painted with ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
  - 2) All doors shall be gasketed and be equipped with a tumbler type vault lock and two (2) additional quarter turn fasteners. A clear plastic directory cardholder shall be mounted on the inside of door. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install panelboards in accordance with manufacturer's written instructions, NEMA PB 1.1 and NEC standards.

### **3.02 FIELD QUALITY CONTROL**

- A. Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20% of each other. Maintain proper phasing for multi-wire branch circuits.
- C. Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

END OF SECTION