SECTION 26 28 20.9

LOW VOLTAGE POWER CIRCUIT BREAKER

Schneider Electric Editor's Note:

This guide specification is written in accordance with the Construction Specifications Institute (CSI) Master Format. This section must be carefully reviewed and edited by the architect or the engineer to meet the requirements of the project. Coordinate this section with other specification sections within the Contract Documents and Drawings.

In order to properly use / edit this document, show formatting and hidden text by selecting ¶ on the menu or by typing (Ctrl+*) simultaneously. Except for these introductory paragraphs, green hidden text will not print. Text in red is optional. Red text in [brackets] denotes multiple options where one or more should be chosen. All red text should be edited and changed to black for final project conformation. In addition, these introductory paragraphs should be deleted or changed to hidden text.

PART 1 - GENERAL

1.1 SUMMARY

Circuit breakers shall be fixed or drawout type MASTERPACT® NW or NT with MICROLOGIC® electronic trip units as specified on the associated drawings. Circuit breakers shall have interrupting, close and latch, and 30-cycle withstand ratings that meet the application requirements. Interrupting rating shall be available up to 200 kAIR RMS without fuses. Close and latch ratings up to 170kA peak current for NW and 90kA peak current on NT frame sizes Thirty-cycle withstand rating available up to 100 kA to provide maximum coordination with downstream circuit breakers. Circuit breakers shall be available in (800), (1200), (1600), (2000), (3200), (4000), (5000) and (6000) A NW frame sizes and (800) A NT frame sizes. An adjustable rating plug (range of 0.4-1 times the sensor plug value) and a field-replaceable sensor plug (available in standard amperage steps from 50% to 100% of the frame size) shall determine the ampere rating of the circuit breaker.

1.2 REFERENCES

A. Circuit breakers shall be constructed in accordance with the following: Standards: The standards listed below form a part of this Specification to the extent referenced. The standards are referred to in the text by the basic designation only. The edition/revision of the referenced standards shall be the latest date as of the date of the Contract Documents, unless otherwise specified.

1. Standards:
   a. ANSI® C37.13-Low-voltage AC Power Circuit Breakers Used in Enclosures
   b. ANSI C37.50-Test Procedures for Low-voltage AC Power Circuit Breakers
   c. NEMA® SG-3-Low-voltage Power Circuit Breakers
   d. UL® 1066-Low-voltage AC and DC Power Circuit Breakers Used in Enclosures
   e. cULus – for Canadian standards
   f. CSA???

1.3 DELIVERY, STORAGE AND HANDLING

A. Prior to delivery to the Project site, ensure that suitable storage space is available to store circuit breakers in a well ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres. Circuit breakers shall be protected during delivery and storage and shall not exceed the manufacturer stated storage requirements.

B. Deliver materials to the Project site in manufacturer's original wrappings and containers, labeled with suppliers or manufacturer's name, material or product brand name, and lot number, if any.

C. Inspect and report any concealed damage or violation of delivery storage, and handling requirements to the [Engineer] [Contract Manager].

PART 2 - PRODUCTS

2.1 EQUIPMENT, COMPONENTS AND ACCESSORIES

A. Circuit Breaker:

1. Circuit breaker shall be [drawout] [fixed] type MASTERPACT [manually] [electrically] operated.
2. All circuit breaker operating mechanisms are to be two-step, fully- stored energy devices for quick-make, quick-break operation with a maximum of a five-cycle closing time. Open-close-open (O-C-O) cycle shall be possible without recharging. Motor operator shall automatically charge when circuit breaker is closed. Actuation of the operating handle or an operation cycle of the circuit breaker motor is to charge the closing springs (step one) and operation of a local "close" button is to close the circuit breaker contact (step two). Closing the circuit breaker contacts shall automatically charge the opening springs.
3. The case of the circuit breaker shall be a polyester thermoset material providing high dielectric strength.
4. Current-carrying components shall be completely isolated from the accessory mounting area and double insulated from the operator with accessory cover in place.
5. Each phase inside the circuit breaker shall be completely isolated from other phases and ground by polyester thermoset material.
6. Padlocking provisions shall be furnished to receive up to three padlocks when circuit breaker is in the disconnected position, positively preventing unauthorized closing of the circuit breaker contacts.
7. Provisions for up to two key locks shall be furnished allowing locking in the disconnected position. Provisions for locking in the connected, test and disconnected positions by padlock or key lock shall be available as an option.
8. Located on the face of the circuit breaker shall be buttons, with optional lockable clear cover, to open and close the circuit breaker and indicators to show the position of the circuit breaker contacts, status of the closing springs, and circuit breaker position in the cell. An indicator shall show "charged-not OK to close" if closing springs are charged but circuit breaker is not ready to close. Circuit breaker racking system must have positive stops at the connected, test, disconnected and withdrawn positions.
9. Circuit breaker must be equipped with an interlock to discharge the stored energy spring before the circuit breaker can be withdrawn from its cell. Circuit breaker must provide a positive ground contact check between the circuit breaker and cell when the accessory cover is removed while

the circuit breaker is in the connected, test or disconnected positions.

10. Primary connectors that can be rotated to provide flexible vertical or horizontal connections shall be available as an option. Front connections shall also be available for shallow depth equipment designs.
11. Ready-to-close contact must be available to indicate remotely that the circuit breaker is "ready to close." The circuit breaker is ready to close when it is open, spring mechanism is charged, a maintained closing order is not present, a maintained opening order is not present, and the circuit breaker is in an operational position.
12. The closing time shall be less than or equal to 70 milliseconds for rating <4000A.
13. Secondary wiring shall be front accessible and available in cage clamp or ring terminal connections. Secondary wiring must not be accessible when switchgear door is closed.
14. Circuit breakers shall be equipped with metal filters to reduce effects of an interruption outside the circuit breaker.
15. The circuit breaker shall be equipped with a safety interlock which keeps the circuit breaker open if the trip unit is not installed.
16. Circuit breaker shall provide long service life. The 3200 A circuit breaker frame and those of lower ratings must be certified to perform a minimum of 10,000 operations without maintenance. The 4000 A, 5000 A and 6000 A frames must be certified to 5,000 operations without maintenance.
17. Circuit breaker shall be equipped with a visual contact wear indicator.
18. Circuit breaker shall be equipped with anti pumping function: If opening and closing orders occur simultaneously, the circuit breaker shall remain in the open position. After fault tripping or intentional opening using the manual or electrical controls, the closing order must first be discontinued, then reactivated to close the circuit breaker.
19. Circuit breaker arc chutes containing asbestos will NOT be accepted.
20. Shunt trip and shunt close coils shall be designed for continuous-duty.
21. The drawout mechanism shall be part of the circuit breaker cell to reduce the weight of withdrawable circuit breaker part.
22. Each rack-in and rack-out position shall be acknowledged before moving to a new position.

B. Trip Unit

1. Circuit breaker trip system shall be a **MICROLOGIC** electronic trip unit.
2. In electronic trip units, protection functions shall be electronically managed independently of measurement function by a dedicated ASIC (application specific integrated circuit).
3. All trip units shall be removable to allow for field upgrades.
4. Trip Units shall incorporate “True RMS Sensing”, and have LED long-time pickup indications.
5. **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].
6. It shall be possible to adjust protections with a knob without any power supply or when the main is off

7. 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.
8. [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.]
9. 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.]
10. 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.]
11. 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.]
12. [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.]
13. [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.]
14. [Neutral current transformers shall be available for four-wire systems.]
15. [Trip units shall be capable of communicating on four wire or two wire **MODBUS** ® networks or TCP/IP Ethernet networks without software interfaces.]
16. [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.]
17. [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 and shall be of reading not full scale in a range of 5 – 500%.]
18. [Trip units shall be available to provide harmonic analysis and waveform capture.]
19. If required by the application, the trip unit shall offer measurement including energy without additional module whatever the protection type (LSI, LSIG).
20. The measurements shall be displayed on the breaker itself and on a remote system via Modbus TCP/IP or RS485 serial line communication. In addition to these solutions it shall be possible to connect a remote display.

21. Select the appropriate trip unit (s) for the system performance desired.

C. Communicating Circuit Breaker Interface to Monitor, Control, and Maintain Electrical Equipment

1. General
   a. The circuit breaker shall therefore be equipped with a communicating interface that makes it possible to monitor and control protection units with information on their status, to deliver maintenance equipment information using an open protocol such as Modbus TCP/IP or Modbus RS485 serial line :
      1) Energy cost management : energy saving and optimization
      2) Electrical Distribution network management : protection, monitoring & control
      3) Asset management: use optimization, predictive maintenance, equipment alarming.
      4) Transmit data to the BMS or FTP Server
   b. Communicating circuit breaker interface shall offer Ethernet TCP/IP 10/100 Mbps ports to be connected on the building Local Area Network (LAN) and shall offer a real time access to device data by using a standard internet web browser.

2. Characteristics, operating principle and indications
   a. The following information shall be accessible for circuit breakers at all the layers of electrical distribution architecture (modular feeders up to incomer circuit breakers)
      1) ON/OFF position (O/F) / trip indication (SD) / fault-trip indication (SDE).
      2) Cradle management : Draw out position
   b. The following commands shall be possible
      1) open / close / reset.
   c. When advanced trip units are used, the following information shall be accessible
      1) Instantaneous and demand values, maximeters/minimeters, energy metering, demand current and power, power quality.
      2) protection and alarm settings
      3) time-stamped trip and alarm histories and event tables
      4) Maintenance indicators.
      5) Energy meter

3. Communicating Circuit breaker Interfaces functions
   a. Energy management system shall offer main interface and secondary interfaces for energy management issue. Data shall be collected via Ethernet TCP/IP and ModBus networks which communicating circuit breakers, I/O digital and analog input modules, pulse counter, power meter and energy meter will be connected to interface.
   b. A switchboard display shall be connected via Ethernet TCP/IP network to switchboard interface and shall offer a real time direct data access to monitor and control devices and load.
   c. Ethernet Communication interfaces will be compliant to Device Profile Web Service (DPWS) for discovery on the local area network (LAN).
   d. Energy management interface shall offer direct access to data collection to monitor and control devices and load.
   e. Energy management interface shall collect :
      1) Data from communicating circuit breaker with embedded measurement capability
      2) Pulse from metering pulse electrical, gas, water counters
      3) Data from communicating energy meters or power meters
      4) Logic state of technical devices or equipment
      5) Device alarms with time logs
      6) Temperature analog sensor value.
   f. Energy management interface shall display via web pages :
      1) Energy consumption
      2) Electrical data network monitoring
      3) Alarms and events
      4) Energy quality monitoring
      5) Equipment or devices status (open, close, tripped, NA) and indication of fault types (LT, ST, instantaneous, ground fault) faulty phases, Interrupted current.
      6) Operation and predictive maintenance monitoring.

g. Energy management interface shall integrate simple control functions via web pages :
   1) Load and devices via digital output
   2) Orders of actuator

4. Communicating Circuit breaker Interface features
   a. The main interface enables an intelligent modular unit (IMU), for Air or Molded Case circuit breakers to be connected to an Ethernet network and enables gateway to Modbus serial line connection.
   b. An intelligent modular unit is a mechanical and electrical assembly containing one or more products to perform a function in a switchboard (incoming protection, motor command, and control). The modular units are easily installed in the switchboard.
   c. The features of the main interface are:
      1) Dual Ethernet port for simple daisy chain connection
      2) Device Profile Web Service (DPWS) for discovery on the local area network (LAN)
      3) Dual Universal Logic Plug (ULP) compliant for advanced connection with Air or Molded Case circuit breaker
      4) Gateway for Modbus-SL connected devices
      5) Embedded set-up web pages
      6) Embedded monitoring web pages
      7) Embedded control web pages
      8) Built-in e-mail alarm notification
      9) The interface mounts on a DIN rail
      10) A stacking accessory enables the user to connect several Modbus interface for Air or Molded Case circuit breaker without additional wiring.
      11) The interface must be always supplied with 24 Vdc using an UL listed and recognized limited voltage/limited current or a class 2 power supply with 3 A maximum.
      12) The interface provides DC supply to the modbus interfaces for Air or Molded Case circuit breaker and it is not necessary to supply them separately.
      13) The interface indicates the status of the interface, the Ethernet communication dual color ports, ULP and modbus connections by using LED on the front panel.
      14) A locking pad on the front panel of the interface enables or disables to send the remote control commands over the Ethernet network to the interface, and to the other modules of the connected IMU.
      15) Pre-defined application adds new functions to the IMU in a simple way:
         a) selection by the application rotary switch on the I/O application module, defining the application with pre-defined input/output assignment and wiring diagram
         b) no additional setting with the customer engineering tool required. The resources not assigned to the pre-defined application are free for additional user-defined applications: cradle management, breaker operation, cradle management and Energy Reduction Maintenance Setting (ERMS) light and load control and other custom for protection / control / energy management / monitoring.
      16) The firmware can be updated using:FTP connection or customer engineering tool.

5. Switchboard display
   a. Energy management system shall integrate a switchboard display. Switchboard display will be connected to switchboard interface via Ethernet TCP/IP network to offer:
      1) Real time display monitoring of devices
      2) Simple control of devices and load.
      3) Switchboard display shall integrate functions to monitor:
         a) Energy consumption
         b) Electrical network data
         c) Alarms and events
         d) Energy quality
         e) Equipment or devices status (open, close, tripped, NA) and indication of fault types (LT, ST, instantaneous, ground fault) faulty phases, Interrupted current.

f) Predictive maintenance monitoring contact wear rate, load profile, and the circuit breaker counter values

D. Operating and installation principles

1. Positioning, installation and connection of communicating interface
   a. When the application requires the usage of several communicating interfaces :
      1) The interface enabling communication with the monitoring system (outside the switchboard) could be using a Modbus TCP/IP
      2) The other device interfaces inside the switchboard shall be using Modbus RS485 SL
      3) The different device interface shall be interconnected by Modbus RS485 SL daisy chaining, inside the switchboard, using stackable connectors
      4) The device interfaces shall be positioned on DIN rail for quick viewing of the network set up and status
      5) The communicating interface shall be equipped with plug-in type input/output application module
      6) The interfaces / devices links shall preferably be of the prefabricated type with RJ45 connectors that allow the device to be connected to the interface in a single operation and with no risk of error

2. Operation of the communicating interface
   a. The communicating interface shall be capable of being easily integrated into the installation's communication network with automatic adaptation of their communication parameters to match those of the network
   b. They shall provide data to the supervisor in Modbus tables, at fixed addresses that require no configuration
   c. The data shall be of the type described in chapter 3.2
   d. The concentrators shall be capable of receiving from the supervisor, by writing in the Modbus table at fixed addresses
   e. They shall be capable of having the orders executed by the control devices, after having taken into account the devices' current positions
   f. The communicating interface should be able to monitor and control auxiliaries and devices using integrated web page
   g. The communicating interface should be able to monitor analog temperature sensors

3. Testing of the system in the switchboard
   a. The manufacturer shall supply a (software) tool for overall testing of the system, within the limits of the switchboard: the entire data transmission and control chain between the modular devices and all of the concentrators, including communication.
   b. The test tool shall supply a report that includes the list of all the devices connected to each channel of the data concentrators as well as a diagram describing the configuration of the system with indication of the associated Modbus addresses.

4. Operation and maintenance
   a. Product measurement and communication capability shall offer operating assistance function:
      1) Status of circuit breaker operations: Open/Close/Tripped/NA
      2) Indication of fault types (LT, ST, instantaneous, ground fault) faulty phases, Interrupted current.
      3) trips history
      4) alarms history
      5) events history (setting changes, test…)
      6) These functions and indicators shall be available by remote display, communication or Engineering tool
   b. The main interface web pages and switchboard display allow the authorized group to :
      1) execute one or more reset commands per device type
      2) control the following applications remotely:
         a) circuit breaker operations: Open/Close
         b) Reset input counters, Reset output counters, Light control, Load control, User-defined output control

3) To provide maintenance log information
   a) the date and time the entry was made, and the name of the user who made it.
   b) the maintenance counter information for the selected device : circuit breaker operation counters, trip and alarm counters, load profile, contact wear counters, and the cradle counters.
4) To send and display alarms
   a) User shall be able to activate alarms based on measurement (I, V, F, P, Q, S, THD, CosPhi, FP, Idemand, Pdemand,) or counters
   b) Alarms shall be time stamped
   c) Alarms could activate a digital output for local indication
   d) These functions and indicators shall be available by remote display, communication or Engineering tool.

Micrologic Trip Unit Table

MICROLOGIC Trip Units									
Yes-- Standard Feature O -- Available Option									
	Standard		**Ammeter**			**Power**		**Harmonic**	
Features	**3.0**	**5.0**	**3.0A**	**5.0A**	**6.0A**	**5.0P**	**6.0P**	**5.0H**	**6.0H**
True RMS Sensing	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LI	Yes		Yes						
LSI		Yes		Yes	Yes	Yes	Yes	Yes	Yes
Instantaneous OFF		Yes		Yes	Yes	Yes	Yes	Yes	Yes
LSIG / Ground-Fault Trip					Yes		Yes		Yes
Ground-Fault Alarm (No Trip)						Yes		Yes	
Ground-Fault Trip and Programmable Alarm							Yes		Yes
Adjustable Rating Plugs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LED - Long-time Pickup	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LED Trip Indication			Yes	Yes	Yes	Yes	Yes	Yes	Yes
Digital Ammeter			Yes	Yes	Yes	Yes	Yes	Yes	Yes
Phase Loading Bar Graph			Yes	Yes	Yes	Yes	Yes	Yes	Yes
Zone Selective Interlocking (ZSI)			Yes	Yes	Yes	Yes	Yes	Yes	Yes
Communications			O	O	O	Yes	Yes	Yes	Yes
LCD Dot Matrix Display						Yes	Yes	Yes	Yes
Advanced User Interface						Yes	Yes	Yes	Yes
Protective Relay Functions						Yes	Yes	Yes	Yes
Thermal Imaging	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Neutral Protection [1]						Yes	Yes	Yes	Yes
Electronic Contact Wear Indication						Yes	Yes	Yes	Yes
Incremental Fine Tuning of Settings						Yes	Yes	Yes	Yes
Selectable Long-time Delay Bands						Yes	Yes	Yes	Yes
Power Measurement						Yes	Yes	Yes	Yes
Power Quality Measurement								Yes	Yes
Waveform Capture								Yes	Yes
Data Logging								Yes	Yes

[1] Requires neutral current transformer

END OF SECTION 26 28 20.6