Power Xpert C445 Motor Management Relay

Product Description

The Power Xpert® C445 global motor management relay is Eaton’s newest addition to the C400 series of advanced motor protection. The Power Xpert C445 is fully configurable, providing the highest level of monitoring accuracy and protection for the entire power system—from the incoming power source feeding the motor all the way to the individual pump or load. By utilizing integrated power quality and energy usage analytics along with built-in efficiency algorithms, users can save significant energy costs through increased awareness of energy usage at the individual load level.

Due to its unrivaled compact size and modular format, the Power Xpert C445 allows for simple integration into NEMA and IEC Motor Control Center platforms as well as OEM control panels. Based on this smaller size, users can reduce costs and improve system flexibility through simplified wiring, smaller enclosure footprint and seamless field modifications as systems evolve over time. By separating the monitoring and control functionality into separate modules, users can easily customize the Power Xpert C445 mounting configuration to match their individual applications.

C445 was designed with ease of use and user safety in mind. Users can monitor and configure data parameters without opening the door by using a variety of communication network options, web pages, a free software tool or the easy user interface. C445 can be integrated into almost any PLC and DCS system through integrated EtherNet/IP, ModbusTCP, PROFIBUS and Modbus Serial. Free tools like Add On Instructions and EIP-Assist make adding C445 to EtherNet/IP networks fast and error free. For non-fieldbus users, C445’s intelligence is still easy to leverage with the user interface or free Power Xpert inControl software.

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5.4 Motor Protection and Monitoring
Overload Relays

Features and Benefits

Features
Product Range
- 0.3–800 A
- Up to 690 Vac
- 4160 Vac with PT ratios
- 20–80 Hz operation
- Selectable trip class (5–40)

Product Hardware
- Modular design with multiple options:
  - Base control module: protections, monitoring, communications, I/O
  - Measurement module: sensing capability
  - User interface options (2)
    - Monitoring and programming LCD display with optional control
    - Control only display with diagnostic LEDs
  - AC (120/240) or DC (24) control-power options
  - 2% monitoring accuracy on current and voltage values
  - Standard on-board I/O
    - (4) DI (AC or DC options)
    - (3) Relay out
      - 2 Form A (NO)
      - 1 Form C (NO/NC) latching or non-latching
  - Superior motor protection solutions, including:
    - Motor (current)
    - Line (voltage)
    - Load (power)
  - Advanced monitoring algorithms
- Pre-configured operation modes
  - Overload only
  - Direct (FVNR)
  - Reverser (FVR)
  - Star/delta
  - Two speed pole changing
  - Two speed Dahlander
  - Auto transformer
  - Solenoid valve
  - HMCP/MCCB actuation
  - Contactor feeder
  - General purpose input/output
- Compact footprint
- Pass-through modular design
- Flexible communication options
  - Modbus Serial
  - Modbus TCP
  - EtherNet/IP
  - PROFIBUS
  - Web pages
- Real-time clock and memory backup module
- Integrated USB communication port
- Power Xpert inControl software tool
- Configuration
- Monitoring
- Diagnostics

Benefits
Intelligence Made Easy
- Advanced diagnostics provide quick and accurate identification of the root cause of a fault
- Greater system coverage through line-, load- and motor-based protections
- User interface provides easy motor monitoring and immediate delivery of fault diagnostics
- Voltage loss restart functionality allows for automatic revival after outages from voltage loss without the need for user intervention
- On-board I/O meets needs of most communication requirements without the need for additional modules
- Seamless integration into EtherNet/IP networks via EIP-Assist tool
- Pre-programmed operation modes support fast, easy installation for most applications
- MTBF 20 years at 50 °C

Flexibility
- Modular format with scalable options allows for customization to exact needs of application
- Widest range of communication options for easy integration into majority of PLC/DCS systems
- Fully programmable output relays
- Fully programmable trip and alarm thresholds and time delays

Standards and Certifications
- CE, UL, CSA
- IEC EN 60947-4-1
- ATEX 95
Motor Protection and Monitoring

5.4 Overload Relays

System Overview
The Power Xpert C445 Motor Management Relay is a solid-state motor management relay designed to protect single- or three-phase AC electric induction motors from 0.3 to 800 A. C445 provides intelligent monitoring, protection and efficiency calculations for motor, load and line conditions. It’s ideal for oil and gas, water treatment, mining, utility and industrial motor control applications. C445 offers a modular pass-through design, breaking the sensing, protection, and control into separate modules. This allows the user to select the appropriate options for each module and combine them to meet the exact needs of their application. Together, these modules provide a fully configurable and industry-leading intelligent motor protection solution for the entire system.

Base Control Module
The base control module is the core of the C445 system, providing the various monitoring, protection and control algorithms. Equipped with native I/O connections, communication card options and USB connectivity, the base control module provides users with real-time data on the health and status of their application. Various pre-configured operation modes are available that simplify the wiring and logic requirements for the user.

Measurement Module
The measurement module is a pass-through device that samples current and voltage data consumed by the system. This data is continuously transmitted back to the base control module for analysis. Various frame sizes are available for applications up to 800 A, with voltage measurement and positive temperature coefficient (PTC) protection options.

User Interface
C445 offers two user interface types.

- Monitoring user interface: Unlocks advanced functionality but in an intuitive format. It provides a quick start wizard, local monitoring, parameter editing, complete fault data and optional control. Ideal for users who want easy-to-access local information with or without use of a network.

- Control user interface: A family of control and diagnostic user interface customized for common starter applications. Designed for users who prefer system monitoring to be done only by higher level fieldbus systems.

Both displays offer micro-USB ports for connection to the free software tool (Power Xpert i/Controll) as well as bright fault, warning and control status LEDs.
### 5.4 Motor Protection and Monitoring

**Overload Relays**

#### Protection Summary

**Current-Based Protection Summary**

<table>
<thead>
<tr>
<th>Trip</th>
<th>Alarm</th>
<th>Level Range</th>
<th>Default Level</th>
<th>Delay Range (Seconds)</th>
<th>Alarm Level Range</th>
<th>Default Level</th>
<th>Delay Range (Seconds)</th>
<th>Default Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal overload</td>
<td>X</td>
<td>0.3–800 A</td>
<td>Low end of FLA range</td>
<td>Trip Class 5–40</td>
<td>Trip Class 5</td>
<td>1–100%</td>
<td>90%</td>
<td>Instantaneous</td>
</tr>
<tr>
<td>Instantaneous overcurrent</td>
<td>X</td>
<td>50–400% FLA</td>
<td>400%</td>
<td>0.001–2.000</td>
<td>2</td>
<td>50–400% FLA</td>
<td>400%</td>
<td>0.2–5.0</td>
</tr>
<tr>
<td>Jam</td>
<td>X</td>
<td>50–400% FLA</td>
<td>400%</td>
<td>1–60</td>
<td>10</td>
<td>50–400% FLA</td>
<td>400%</td>
<td>0.2–5.0</td>
</tr>
<tr>
<td>Stall</td>
<td>X</td>
<td>50–400% FLA</td>
<td>200%</td>
<td>Instantaneous</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Undercurrent</td>
<td>X</td>
<td>10–90% FLA</td>
<td>50%</td>
<td>1–60</td>
<td>20</td>
<td>10–90% FLA</td>
<td>50%</td>
<td>0.2–5.0</td>
</tr>
<tr>
<td>Current unbalance</td>
<td>X</td>
<td>1–60%</td>
<td>15%</td>
<td>1–60</td>
<td>15</td>
<td>1–60%</td>
<td>15%</td>
<td>0.2–5.0</td>
</tr>
<tr>
<td>Current phase loss</td>
<td>X</td>
<td>60%</td>
<td>60%</td>
<td>2</td>
<td>2</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Ground fault</td>
<td>X</td>
<td>—</td>
<td>1–60</td>
<td>5</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>PTC (requires option)</td>
<td>X</td>
<td>Overtemperature</td>
<td>Off</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

**Voltage-Based Protection Summary**

<table>
<thead>
<tr>
<th>Trip</th>
<th>Alarm</th>
<th>Level Range</th>
<th>Default Level</th>
<th>Delay Range (Seconds)</th>
<th>Alarm Level Range</th>
<th>Default Level</th>
<th>Delay Range (Seconds)</th>
<th>Default Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase rotation</td>
<td>X</td>
<td>ABC, ACB</td>
<td>ABC</td>
<td>Instantaneous</td>
<td>Instantaneous</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Voltage phase loss</td>
<td>X</td>
<td>70%</td>
<td>70%</td>
<td>2</td>
<td>2</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Overvoltage</td>
<td>X</td>
<td>90–150%</td>
<td>110%</td>
<td>1–60</td>
<td>20</td>
<td>90–150%</td>
<td>110%</td>
<td>0.2–5.0</td>
</tr>
<tr>
<td>Undervoltage</td>
<td>X</td>
<td>10–100%</td>
<td>90%</td>
<td>1–60</td>
<td>20</td>
<td>10–100%</td>
<td>90%</td>
<td>0.2–5.0</td>
</tr>
<tr>
<td>Voltage unbalance</td>
<td>X</td>
<td>2–20%</td>
<td>6%</td>
<td>1–20</td>
<td>20</td>
<td>2–20%</td>
<td>6%</td>
<td>0.2–5.0</td>
</tr>
<tr>
<td>Frequency deviation (slow)</td>
<td>X</td>
<td>0.1–5 Hz</td>
<td>0.1 Hz</td>
<td>1–60</td>
<td>20</td>
<td>0.1–5 Hz</td>
<td>0.1 Hz</td>
<td>0.2–5.0</td>
</tr>
<tr>
<td>Frequency deviation (fast)</td>
<td>X</td>
<td>0.02–2 Hz</td>
<td>0.1 Hz</td>
<td>0.02–60</td>
<td>1</td>
<td>0.02–2 Hz</td>
<td>0.1 Hz</td>
<td>0.2–5.0</td>
</tr>
</tbody>
</table>

**Power-Based Protection Summary**

<table>
<thead>
<tr>
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<th>Alarm</th>
<th>Level Range</th>
<th>Default Level</th>
<th>Delay Range (Seconds)</th>
<th>Alarm Level Range</th>
<th>Default Level</th>
<th>Delay Range (Seconds)</th>
<th>Default Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low power</td>
<td>X</td>
<td>–200 to 200%</td>
<td>50%</td>
<td>1–60</td>
<td>20</td>
<td>–200 to 200%</td>
<td>50%</td>
<td>1–60</td>
</tr>
<tr>
<td>High power</td>
<td>X</td>
<td>–200 to 200%</td>
<td>110%</td>
<td>1–60</td>
<td>20</td>
<td>–200 to 200%</td>
<td>110%</td>
<td>1–60</td>
</tr>
<tr>
<td>Power factor deviation (low)</td>
<td>X</td>
<td>–100 to 100%</td>
<td>6%</td>
<td>1–60</td>
<td>20</td>
<td>–100 to 100%</td>
<td>6%</td>
<td>1–60</td>
</tr>
<tr>
<td>Power factor deviation (high)</td>
<td>X</td>
<td>–100 to 100%</td>
<td>100%</td>
<td>1–60</td>
<td>20</td>
<td>–100 to 100%</td>
<td>100%</td>
<td>1–60</td>
</tr>
</tbody>
</table>

**Advanced Protection Summary**

<table>
<thead>
<tr>
<th>Trip</th>
<th>Alarm</th>
<th>Level Range</th>
<th>Default Level</th>
<th>Delay Range (Seconds)</th>
<th>Alarm Level Range</th>
<th>Default Level</th>
<th>Delay Range (Seconds)</th>
<th>Default Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage loss restart</td>
<td>X</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Peak demand alarm</td>
<td>X</td>
<td>User settable</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

**Notes**

1. Not all trips/alarms are enabled by default. Consult C445 user manual for further information.
3. Voltage, Power and Advanced Protections require voltage option on the measurement module.
4. Voltage loss restart is a control functionality used for reacceleration schemes after power loss. Consult C445 user manual for further information.
### Motor Protection and Monitoring

**Overload Relays**

### Monitoring Summary

#### Current-Based Monitoring

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Range / Units</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA (L1) float</td>
<td>Depends on frame size (amps)</td>
<td>Phase A (L1) motor current, 2% accuracy within 30–125% of FLA</td>
</tr>
<tr>
<td>IB (L2) float</td>
<td>Depends on frame size (amps)</td>
<td>Phase B (L2) motor current, 2% accuracy within 30–125% of FLA</td>
</tr>
<tr>
<td>IC (L3) float</td>
<td>Depends on frame size (amps)</td>
<td>Phase C (L3) motor current, 2% accuracy within 30–125% of FLA</td>
</tr>
<tr>
<td>I Average float</td>
<td>Depends on frame size (amps)</td>
<td>Average motor current, 2% accuracy within 30–125% of FLA</td>
</tr>
<tr>
<td>I Unbalance percent</td>
<td>0–100%</td>
<td>Motor current unbalance percent</td>
</tr>
<tr>
<td>I Average % of FLA (nominal current)</td>
<td>0–725% of FLA (amps)</td>
<td>Average motor current as a percentage of FLA</td>
</tr>
<tr>
<td>Maximum start current floating point</td>
<td>Depends on frame size (amps)</td>
<td>Maximum motor starting current</td>
</tr>
<tr>
<td>Motor residual GF RMS</td>
<td>Depends on frame size (amps), scaled via fieldbus</td>
<td>Motor residual ground fault current RMS; Accuracy meets UL 1053 / IEC Class II-B</td>
</tr>
</tbody>
</table>

#### Voltage-Based Monitoring

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Range / Units</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage AB (L1-L2)</td>
<td>0–690 V; max. 4,160 V with PT ratios</td>
<td>Supply line-to-line voltage AB (L1-L2), 2% accuracy up to 690 Vac</td>
</tr>
<tr>
<td>Voltage BC (L2-L3)</td>
<td>0–690 V; max. 4,160 V with PT ratios</td>
<td>Supply line-to-line voltage BC (L2-L3), 2% accuracy up to 690 Vac</td>
</tr>
<tr>
<td>Voltage CA (L3-L1)</td>
<td>0–690 V; max. 4,160 V with PT ratios</td>
<td>Supply line-to-line voltage CA (L3-L1), 2% accuracy up to 690 Vac</td>
</tr>
<tr>
<td>Average line-to-line voltage</td>
<td>0–690 V; max. 4,160 V with PT ratios</td>
<td>Supply line-to-line voltage average; 2% accuracy up to 690 Vac</td>
</tr>
<tr>
<td>Line frequency x 100</td>
<td>20–80 Hz (Centi-Hz)</td>
<td>Supply Frequency in centi-Hz</td>
</tr>
<tr>
<td>Voltage phase order</td>
<td>0: unknown; 1: ABC (L1-L2-L3); 2: ACB (L1-L3-L2)</td>
<td>Reports phase sequence of the line voltage</td>
</tr>
<tr>
<td>Voltage unbalance percent</td>
<td>0–100%</td>
<td>Supply voltage unbalance percentage</td>
</tr>
</tbody>
</table>

#### Power-Based Monitoring

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Range / Units</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total watts</td>
<td>Depends on frame size (Watts)</td>
<td>Total Real Power; 5% accuracy</td>
</tr>
<tr>
<td>Total VA</td>
<td>Depends on frame size (Volt-Amps)</td>
<td>Total Apparent Power; 5% accuracy</td>
</tr>
<tr>
<td>Total VARs</td>
<td>Depends on frame size (VARs)</td>
<td>Total Reactive Power; 5% accuracy</td>
</tr>
<tr>
<td>Power factor</td>
<td>0–100%, Scaled by 0.01% via Fieldbus</td>
<td>Apparent power factor in percentage; 1% accuracy</td>
</tr>
<tr>
<td>Motor speed RPM</td>
<td>Depends on motor (RPM)</td>
<td>Motor speed in RPM</td>
</tr>
<tr>
<td>Motor torque</td>
<td>Depends on motor (Nm)</td>
<td>Motor torque</td>
</tr>
<tr>
<td>Motor efficiency percent</td>
<td>PC Tool in %, Scaled by 0.01% via Fieldbus</td>
<td>Motor efficiency in percentage</td>
</tr>
<tr>
<td>Real energy</td>
<td>Depends on frame size (0.1 kVAh)</td>
<td>Real energy; 5% accuracy</td>
</tr>
<tr>
<td>Real energy (resettable)</td>
<td>Depends on frame size (0.1 kVAh)</td>
<td>Real energy (resettable) scaled; 5% accuracy</td>
</tr>
<tr>
<td>Apparent energy</td>
<td>Depends on frame size (0.1 kVAh)</td>
<td>Apparent energy; 5% accuracy</td>
</tr>
<tr>
<td>Apparent energy (resettable)</td>
<td>Depends on frame size (0.1 kVAh)</td>
<td>Apparent energy (resettable) scaled; 5% accuracy</td>
</tr>
<tr>
<td>Reactive energy</td>
<td>Depends on frame size (0.1 kVARh)</td>
<td>Reactive energy; 5% accuracy</td>
</tr>
<tr>
<td>Reactive energy (resettable)</td>
<td>Depends on frame size (0.1 kVARh)</td>
<td>Reactive energy (resettable) scaled; 5% accuracy</td>
</tr>
<tr>
<td>Current demand value</td>
<td>Depends on frame size (Watts)</td>
<td>Latest estimate of the demand; 5% accuracy</td>
</tr>
<tr>
<td>Demand (resettable)</td>
<td>Depends on frame size (Watts)</td>
<td>Peak demand, user resettable; 5% accuracy</td>
</tr>
<tr>
<td>Peak demand time stamp</td>
<td>Time in seconds</td>
<td>Peak demand time stamp (in Unix time)</td>
</tr>
<tr>
<td>Demand window duration</td>
<td>Time in minutes</td>
<td>Demand window duration</td>
</tr>
</tbody>
</table>

**Note**

Voltage option must be selected for the measurement module.
### System Monitoring

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Range / Units</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor state (current based)</td>
<td>0: Stopped; 1: Accelerating; 2: Running</td>
<td>Current Based motor state (independent of command)</td>
</tr>
<tr>
<td>Motor control status</td>
<td>Various</td>
<td>Present motor control status bits</td>
</tr>
<tr>
<td>Number of operating seconds</td>
<td>Time in seconds</td>
<td>Number of operating seconds</td>
</tr>
<tr>
<td>Operating seconds (resettable)</td>
<td>Time in seconds</td>
<td>Number of operating seconds (resettable)</td>
</tr>
<tr>
<td>Time to trip overload</td>
<td>Time in seconds</td>
<td>Time for overload to reach trip threshold (100%)</td>
</tr>
<tr>
<td>Time to reset overload</td>
<td>Time in seconds</td>
<td>Time for overload to reach reset threshold (thermal memory must drop below 75%)</td>
</tr>
<tr>
<td>PTC status</td>
<td>Various</td>
<td>PTC status</td>
</tr>
<tr>
<td>Digital input status</td>
<td>0/1</td>
<td>ON/OFF status of digital inputs</td>
</tr>
<tr>
<td>Base control module relay status</td>
<td>0/1</td>
<td>Base control module relay status (output status)</td>
</tr>
<tr>
<td>Total motor run time</td>
<td>Time in seconds</td>
<td>Total motor run time in seconds</td>
</tr>
<tr>
<td>Total motor run time (resettable)</td>
<td>Time in seconds</td>
<td>Total run time user (resettable)</td>
</tr>
<tr>
<td>Last measured starting time</td>
<td>Time in seconds</td>
<td>The amount of time the motor took to reach up to speed on the last start.</td>
</tr>
<tr>
<td>Number of starts</td>
<td>Number</td>
<td>Total number of motor starts</td>
</tr>
<tr>
<td>Number of starts (resettable)</td>
<td>Number</td>
<td>Number of starts (resettable)</td>
</tr>
<tr>
<td>Number of contactor operations last hour</td>
<td>Number</td>
<td>Number of contactor operations during the last hour</td>
</tr>
<tr>
<td>Latest run time</td>
<td>Time in seconds</td>
<td>Duration in seconds of the last start-to-stop motor run time</td>
</tr>
<tr>
<td>Thermal memory percent</td>
<td>0–250%</td>
<td>Thermal memory in percent—overload trip occurs at 100%</td>
</tr>
</tbody>
</table>

### Faults and Events

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Range / Units</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active fault</td>
<td>Various</td>
<td>Provides reason for trip</td>
</tr>
<tr>
<td>Active warning</td>
<td>Various</td>
<td>Provides reason for warning</td>
</tr>
<tr>
<td>Active inhibit</td>
<td>Various</td>
<td>Provides reason for inhibit</td>
</tr>
<tr>
<td>Fault queue—event order</td>
<td>Various</td>
<td>A list of the last 10 faults shown in the order they occurred. Most recent at top</td>
</tr>
<tr>
<td>Trip snapshot</td>
<td>Various</td>
<td>Time-stamp log of (12) parameters at time of trip</td>
</tr>
</tbody>
</table>
Catalog Number Selection

**Power Xpert C445 Global Motor Management Relay**

**Required System Components**
Order these catalog numbers for a complete C445 system.
- 1 Base Control Module (C445B...)
- 1 Measurement Module (C445M...)
- 1–2 Connection cables (D77E...), required to connect the Base Control Module to the Measurement Module and the User Interface (if used). Order separately in the length desired.
- 1 programming cable (C445XS-USBMICRO) to configure the device using Power Xpert inControl. Cable is not needed if users are programming the device only with user interface C445UM, or connecting to inControl using Modbus TCP using the C445XC-E card.

**Optional Accessories**
These system accessories are compatible with any C445 system but are not required.
- Communication Modules (C445XC...)
- Real-time Clock and Memory Backup Module (C445XO-RTC)
- User Interfaces (C445UM or C445UC...)
- User Interface Digital Input Wiring Harnesses (C445XU...), required only if utilizing optional digital inputs on User Interfaces

### Relay

<table>
<thead>
<tr>
<th>Family</th>
<th>Module</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>C445B</td>
<td>Base control module</td>
<td>Options depend on module selected</td>
</tr>
<tr>
<td>C445M</td>
<td>Measurement module</td>
<td></td>
</tr>
<tr>
<td>C445U</td>
<td>User interface</td>
<td></td>
</tr>
<tr>
<td>C445X</td>
<td>Accessory</td>
<td></td>
</tr>
</tbody>
</table>

**Base Control Module**

<table>
<thead>
<tr>
<th>Family</th>
<th>Module</th>
<th>Supply Voltage</th>
<th>Version</th>
<th>Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>C445B</td>
<td>Base control module</td>
<td>A = 120–240 Vac</td>
<td>S = Standard</td>
<td>A = 120 Vac</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D = 24 Vdc</td>
<td>X = ATEX</td>
<td>D = 24 Vdc</td>
</tr>
</tbody>
</table>

**Measurement Module**

<table>
<thead>
<tr>
<th>Family</th>
<th>Module</th>
<th>Frame Size</th>
<th>Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>C445M</td>
<td>Measurement module</td>
<td>A = 45 mm (0.3–45 A)</td>
<td>2P4 = 0.3–2.4 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B = 55 mm (9–72 A)</td>
<td>005 = 1–5 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C = 90 mm (17–136 A)</td>
<td>032 = 4–32 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>045 = 6–45 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>55 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>90 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>136 mm</td>
</tr>
</tbody>
</table>

**Sensing Capability**
- I = Current only
- V = Current and voltage
- P = Current and PTC
- A = Current, voltage and PTC

### Notes
- For other communication protocol options, see Accessories chart on Page V5-T5-114.
- If a real-time clock and memory backup module are required, see Accessories chart on Page V5-T5-114.
- For applications above 136 A, see Accessories chart on Page V5-T5-114.
5.4 Motor Protection and Monitoring

Overload Relays

User Interface

C445 U M

Family
C445 = Power Xpert C445 global motor management relay

Module
U = User interface

Type
C = Control
M = Monitoring

Application
0-9
Note: See selection on Page V5-T5-118

Color Scheme
N = NEMA
I = IEC
Note: See images on Page V5-T5-118

Power Xpert C445 Global Motor Management Relay

Accessories

C445 X C E

Family
C445 = Power Xpert C445 global motor management relay

Module
X = Accessory

Type
C = Communication card
O = Option module
S = Spare parts and accessory kits
U = User interface input cable harness
X = ATEX accessory

Options
Communication Module Options
E = EtherNet/IP and Modbus TCP
P = PROFIBUS

Option Modules
RTC = Real-time clock and memory backup module

Spare Parts and Cables
TERM = Spare terminal connectors kit
USBMICRO = Standard USB male to micro USB male
USBRJ12 = Standard USB male to RJ12
USBLEADS = Standard USB male to loose leads

Control User Interface Input Cables
050 = 0.50 m length
100 = 1 m length
200 = 2 m length
300 = 3 m length

Notes
1. Applies to control version only, leave blank for monitoring version (C445UM).
2. This cable harness is to utilize optional inputs on the back of C445UC Control User Interfaces. For other C445 connector cables, see Accessories on Page V5-T5-120.
3. Applies to communication card accessories only.
Product Selection

Power Xpert C445 Global Motor Management Relay

**Base Control Module**

<table>
<thead>
<tr>
<th>Power Source</th>
<th>Voltage Range</th>
<th>Digital Inputs</th>
<th>Relay Outputs</th>
<th>On-board Communications</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>120/240 Vac</td>
<td>0–690 Vac</td>
<td>(4) 120 Vac</td>
<td>(2) Form A, (1) Form C (non-latching)</td>
<td>—</td>
<td>C445BA-SANN</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2) Form A, (1) Form C (latching)</td>
<td>Modbus Serial</td>
<td>C445BA-SANM</td>
</tr>
<tr>
<td></td>
<td>24 Vdc</td>
<td>(4) 24 Vdc</td>
<td>(2) Form A, (1) Form C (non-latching)</td>
<td>—</td>
<td>C445BA-SDNN</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2) Form A, (1) Form C (latching)</td>
<td>Modbus Serial</td>
<td>C445BA-SDLN</td>
</tr>
<tr>
<td>24 Vdc</td>
<td>0–690 Vac</td>
<td>(4) 120 Vac</td>
<td>(2) Form A, (1) Form C (non-latching)</td>
<td>—</td>
<td>C445BD-SANN</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2) Form A, (1) Form C (latching)</td>
<td>Modbus Serial</td>
<td>C445BD-SALN</td>
</tr>
<tr>
<td></td>
<td>24 Vdc</td>
<td>(4) 24 Vdc</td>
<td>(2) Form A, (1) Form C (non-latching)</td>
<td>—</td>
<td>C445BD-SDNN</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2) Form A, (1) Form C (latching)</td>
<td>Modbus Serial</td>
<td>C445BD-SDLN</td>
</tr>
</tbody>
</table>

*Note*

† Can be used for 4160 Vac applications with PT ratios.
## Measurement Module

<table>
<thead>
<tr>
<th>Frame Size</th>
<th>Current Range (A)</th>
<th>Current (I) Sensing</th>
<th>Voltage (V) Sensing</th>
<th>PTC Sensing</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 mm</td>
<td>0.3–2.4</td>
<td>Yes</td>
<td>—</td>
<td>—</td>
<td>C445MA-2P4I</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>—</td>
<td>C445MA-2P4P</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>—</td>
<td>Yes</td>
<td>C445MA-2P4V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>—</td>
<td>C445MA-2P4A</td>
</tr>
<tr>
<td>1–5</td>
<td></td>
<td>Yes</td>
<td>—</td>
<td>—</td>
<td>C445MA-655I</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>—</td>
<td>C445MA-655P</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>—</td>
<td>Yes</td>
<td>C445MA-655V</td>
</tr>
<tr>
<td>4–32</td>
<td></td>
<td>Yes</td>
<td>—</td>
<td>—</td>
<td>C445MA-632I</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>—</td>
<td>C445MA-632P</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>C445MA-632V</td>
</tr>
<tr>
<td>6–45①</td>
<td></td>
<td>Yes</td>
<td>—</td>
<td>—</td>
<td>C445MA-045I</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>—</td>
<td>C445MA-045P</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>—</td>
<td>Yes</td>
<td>C445MA-045V</td>
</tr>
<tr>
<td>95 mm</td>
<td>9–72</td>
<td>Yes</td>
<td>—</td>
<td>—</td>
<td>C445MB-072I</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>—</td>
<td>C445MB-072P</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>C445MB-072V</td>
</tr>
<tr>
<td>90 mm</td>
<td>11–90</td>
<td>Yes</td>
<td>—</td>
<td>—</td>
<td>C445MC-090I</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>—</td>
<td>C445MC-090P</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>—</td>
<td>Yes</td>
<td>C445MC-090V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>—</td>
<td>C445MC-090A</td>
</tr>
<tr>
<td>17–136</td>
<td></td>
<td>Yes</td>
<td>—</td>
<td>—</td>
<td>C445MC-136I</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>—</td>
<td>C445MC-136P</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>—</td>
<td>Yes</td>
<td>C445MC-136V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>—</td>
<td>C445MC-136A</td>
</tr>
</tbody>
</table>

**Note**

① The 45 mm frame is capable of 6 AWG wire maximum with the exception of insulation types RHH, RHW and RHW-2. If these insulation types are being used, use the 55 mm frame.
Motor Protection and Monitoring

Overload Relays

5.4

Monitoring User Interface

Catalog Number: C445UM

Features—powerful but simple

- Intuitive navigation
- Safe, remote mounting on panel door
- Large font current, voltage, power, thermal and system monitoring
- Simple Setup Wizard
- Easy parameter setting
- Fault/event notification with full description and diagnostics
- Bright fault and warning LEDs
- Control status LEDs indicate starting, running, stopped, inhibited, auto
- Password protection option
- LED color, control button and screen idle behavior customization
- USB-Micro connects to free Power Xpert inControl software

Monitoring Menus: Press <MODE/BACK> to toggle through

<table>
<thead>
<tr>
<th>Data in menu</th>
<th>Use ▲ to scroll</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (Current)</td>
<td>Avg Current (Iavg)</td>
</tr>
<tr>
<td>V (Voltage)</td>
<td>Watts Total (P Watts)</td>
</tr>
<tr>
<td>P (Power)</td>
<td>Thermal Memory % (TIM%)</td>
</tr>
<tr>
<td>T (Thermal)</td>
<td>Run Time (Run Time)</td>
</tr>
<tr>
<td>O (Other)</td>
<td># Motor starts (#Starts)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control</th>
<th>Wiring Config</th>
<th>Protections</th>
<th>User Interface Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>See active control source</td>
<td>Set single phase/3-phase</td>
<td>Enable/disable trips/warnings</td>
<td>Set screen idle behavior</td>
</tr>
<tr>
<td>Control relay outputs</td>
<td>Set PT ratios</td>
<td>Customize protection thresholds and delays</td>
<td>Contrast/brightness</td>
</tr>
<tr>
<td>View digital input status</td>
<td></td>
<td></td>
<td>Set control button delays</td>
</tr>
<tr>
<td>View relay output status</td>
<td></td>
<td></td>
<td>Change LED colors</td>
</tr>
</tbody>
</table>

Go here to …

Monitor voltage, current, power, system data
(alternating monitoring values, not just favorites)
Clear resettable monitor values

Select operation mode, local/remote control sources
Set comm loss/idle behavior
Select output functions

Configure Ethernet and Modbus settings
(addresses, baud rate, advanced, etc.)
Factory Reset
Soft Reset
Re-pair modules
Launch Setup Wizard

Notes

Available Q4 2016.
Resettable parameter—users can reset to zero in PRG menu.
## Options

### Control User Interface Family—NEMA Color Scheme

<table>
<thead>
<tr>
<th>Operation Mode</th>
<th>Control Type (Local = UI)</th>
<th>Control Button(s)</th>
<th>LED Indicator Labels</th>
<th>Diagnostic LED Label(s)</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVNR Starter</td>
<td>Local Only</td>
<td>START</td>
<td>OFF</td>
<td>RUN</td>
<td>FAULT, WARNING, OVERLOAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FVNR Starter</td>
<td>Remote Only</td>
<td></td>
<td></td>
<td></td>
<td>FAULT, WARNING, OVERLOAD</td>
</tr>
<tr>
<td>FVR Starter</td>
<td>Remote Only</td>
<td></td>
<td></td>
<td></td>
<td>FAULT, WARNING, OVERLOAD</td>
</tr>
<tr>
<td>2-Speed Starter</td>
<td>Remote Only</td>
<td></td>
<td></td>
<td></td>
<td>FAULT, WARNING, OVERLOAD</td>
</tr>
<tr>
<td>FVNR Starter</td>
<td>Local/Remote</td>
<td></td>
<td></td>
<td></td>
<td>FAULT, WARNING, OVERLOAD</td>
</tr>
<tr>
<td>FVR Starter</td>
<td>Local/Remote</td>
<td></td>
<td></td>
<td></td>
<td>FAULT, WARNING, OVERLOAD</td>
</tr>
<tr>
<td>2-Speed Starter</td>
<td>Local/Remote</td>
<td></td>
<td></td>
<td></td>
<td>FAULT, WARNING, OVERLOAD</td>
</tr>
<tr>
<td>MCCB Actuation</td>
<td>Local/Remote</td>
<td></td>
<td></td>
<td></td>
<td>FAULT, WARNING, TRIPPED</td>
</tr>
<tr>
<td>MCCB Actuation</td>
<td>Local Only</td>
<td></td>
<td></td>
<td></td>
<td>FAULT, WARNING, TRIPPED</td>
</tr>
<tr>
<td>Overload</td>
<td>Local/Remote</td>
<td></td>
<td></td>
<td></td>
<td>FAULT, WARNING, OVERLOAD</td>
</tr>
</tbody>
</table>

### NEMA User Interface Example

![](image)

**Notes**

1. All options include a reset button, micro USB port, and four self-powered 24 Vdc digital inputs. Please see Accessories on Page V5-T5-120 for digital inputs wiring harness options.
2. Not all operation modes are stock items. Check with EatonCare for availability.
3. F1 function key is reserved for future use.
**5.4 Motor Protection and Monitoring**

**Overload Relays**

### Control User Interface Family — IEC Color Scheme

<table>
<thead>
<tr>
<th>Operation Mode</th>
<th>Control Type (Local = UI)</th>
<th>Control Button(s)</th>
<th>LED Indicator Labels</th>
<th>Diagnostic LED Label(s)</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVNR Starter Local Only</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>FAULT, WARNING, EARTH FAULT</td>
<td>C445UC-10</td>
</tr>
<tr>
<td>FVNR Starter Remote Only</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>FAULT, WARNING, EARTH FAULT</td>
<td>C445UC-11</td>
</tr>
<tr>
<td>2-Speed Starter Local Only</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>FAULT, WARNING, EARTH FAULT</td>
<td>C445UC-12</td>
</tr>
<tr>
<td>FVR Starter Local Only</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>FAULT, WARNING, EARTH FAULT</td>
<td>C445UC-13</td>
</tr>
<tr>
<td>FVR Starter Local/Remote</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>FAULT, WARNING, EARTH FAULT</td>
<td>C445UC-14</td>
</tr>
<tr>
<td>FVR Starter Local/Remote</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>FAULT, WARNING, EARTH FAULT</td>
<td>C445UC-15</td>
</tr>
<tr>
<td>2-Speed Starter Local/Remote</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>FAULT, WARNING, EARTH FAULT</td>
<td>C445UC-16</td>
</tr>
<tr>
<td>MCCB Actuation Local/Remote</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>FAULT, WARNING, TRIPPED</td>
<td>C445UC-17</td>
</tr>
<tr>
<td>MCCB Actuation Local Only</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>FAULT, WARNING, TRIPPED</td>
<td>C445UC-18</td>
</tr>
<tr>
<td>Overload Local/Remote</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>FAULT, WARNING, EARTH FAULT</td>
<td>C445UC-19</td>
</tr>
</tbody>
</table>

### IEC User Interface Example

![IEC User Interface Example](C445UC-16.png)

**Notes**

1. All options include a reset button, micro USB port, and four self-powered 24 Vdc digital inputs. Please see Accessories on Page V5-T5-120 for digital inputs wiring harness options.
2. Not all operation modes are stock items. Check with EatonCare for availability.
3. F1 function key is reserved for future use.
5.4 Motor Protection and Monitoring

Overload Relays

Accessories

External Current Transformers
Use external CTs on systems greater than 136A with the 1–5 Amp Measurement Module (Part Numbers C445MA-005_). Catalog numbers are for one single-phase CT.
Order three CTs for a three-phase system.

<table>
<thead>
<tr>
<th>CT Range (A)</th>
<th>Description</th>
<th>Terminal Size</th>
<th>Measurement Module</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>17–300</td>
<td>300:5 single-phase CT, 1.25 inch dia hole, UL and CSA ANSI/IEEE C57.13, 50–400 Hz, 600 Vac, 10 kV, relay class C50, accuracy 0.3% B0.1</td>
<td>(2) 8–32 brass terminals, comes with mounting bracket kit</td>
<td>C445MA-005_</td>
<td>XCT300-5</td>
</tr>
<tr>
<td>75–600</td>
<td>600:5 single-phase CT, 2.00 inch dia hole, UL and CSA ANSI/IEEE C57.13, 50–400 Hz, 600 Vac, 10 kV, relay class C50, accuracy 0.3% B0.1</td>
<td>(2) 8–32 brass terminals, comes with mounting bracket kit</td>
<td>C445MA-005_</td>
<td>XCT600-5</td>
</tr>
<tr>
<td>100–800</td>
<td>800:5 single-phase CT, 2.50 inch dia hole, UL and CSA ANSI/IEEE C57.13, 50–400 Hz, 600 Vac, 10 kV, relay class C50, accuracy 0.3% B0.1</td>
<td>(2) 8–32 brass terminals, comes with mounting bracket kit</td>
<td>C445MA-005_</td>
<td>XCT800-5</td>
</tr>
</tbody>
</table>

Communication and Option Modules

Cables, Wiring Harnesses and Spare Parts

Connection Cables and Accessories
D77E connection cables are required to connect the base control module to the measurement module and to the user interface. Order the appropriate lengths for each connection.

C445XS-USBMICRO and C445XS-USBLEADS are used to connect the Power Xpert inControl tool (see next page for details). C445XS-USBRJ12 and C445XS-USBLEADS are used for firmware updates.

<table>
<thead>
<tr>
<th>Description</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>EtherNet/IP and Modbus TCP card with 2-port switch</td>
<td>C445XC-E</td>
</tr>
<tr>
<td>PROFINET DPV0 and DVP1 card</td>
<td>C445XC-P</td>
</tr>
<tr>
<td>Real-time clock and memory backup module</td>
<td>C445XO-RTC</td>
</tr>
<tr>
<td>Connection cable (base control module to measurement module or user interface), 13 cm length</td>
<td>D77E-QPIP13</td>
</tr>
<tr>
<td>Connection cable (base control module to measurement module or user interface), 25 cm length</td>
<td>D77E-QPIP25</td>
</tr>
<tr>
<td>Connection cable (base control module to measurement module or user interface), 100 cm length</td>
<td>D77E-QPIP100</td>
</tr>
<tr>
<td>Connection cable (base control module to measurement module or user interface), 200 cm length</td>
<td>D77E-QPIP200</td>
</tr>
<tr>
<td>Connection cable (base control module to measurement module or user interface), 300 cm length</td>
<td>D77E-QPIP300</td>
</tr>
<tr>
<td>Control user interface digital inputs wiring harness, 50 cm, 16 AWG wires</td>
<td>C445XU-050</td>
</tr>
<tr>
<td>Control user interface digital inputs wiring harness, 100 cm, 16 AWG wires</td>
<td>C445XU-100</td>
</tr>
<tr>
<td>Control user interface digital inputs wiring harness, 200 cm, 16 AWG wires</td>
<td>C445XU-200</td>
</tr>
<tr>
<td>Control user interface digital inputs wiring harness, 300 cm, 16 AWG wires</td>
<td>C445XU-300</td>
</tr>
<tr>
<td>Spare parts kit—terminal connectors, mounting feet</td>
<td>C445XS-TERM</td>
</tr>
<tr>
<td>Standard USB A male to micro USB male cable</td>
<td>C445XS-USBMICRO</td>
</tr>
<tr>
<td>Standard USB A male to loose ends cable (for use with Modbus Serial terminals)</td>
<td>C445XS-USBLEADS</td>
</tr>
<tr>
<td>Standard USB A male to RJ-12 cable (for firmware upgrades)</td>
<td>C445XS-USBRJ12</td>
</tr>
</tbody>
</table>
Motor Protection and Monitoring

Overload Relays

5.4

Power Xpert inControl Software
The Power Xpert inControl software tool is designed for programming, controlling and monitoring the Power Xpert C445 motor management relay. Features include loading parameters that can be saved to a file or printed, setting references, starting and stopping the motor, monitoring signals in graphical or text form and real-time display.


Power Xpert inControl Connection Cables
The following connection methods are possible between the PC running the inControl software and C445:
1. USB/Micro USB cable (C445XS-USBMICRO) connected to the Micro USB port on the User Interface.
3. USB/RS-485 cable (C445XS-USBLEADS) connected to the RS-485 Modbus port on the Base Control Module (if ordered with the Modbus option).

![Image: Power Xpert inControl software interface]

![Image: Power Xpert inControl connection cables]
5.4 Motor Protection and Monitoring

Overload Relays

Technical Data and Specifications

Power Xpert C445 Motor Management Relay Short Circuit Ratings (North American CSA and UL) ✪

<table>
<thead>
<tr>
<th>Measurement Module Frame</th>
<th>Overload FLA Range</th>
<th>480 V (kA)</th>
<th>600 V (kA)</th>
<th>Max. Fuse Size (A) (RK5)</th>
<th>Max. Breaker Size (A)</th>
<th>Fuses (RK5)</th>
<th>480 V (kA)</th>
<th>600 V (kA)</th>
<th>Max. Fuse Size (A) (RK5)</th>
<th>Max. Breaker Size (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 mm</td>
<td>0.3–2.4 A</td>
<td>5</td>
<td>5</td>
<td>6 A</td>
<td>15 A</td>
<td>100</td>
<td>100</td>
<td>8 A</td>
<td>100</td>
<td>15 A</td>
</tr>
<tr>
<td>45 mm</td>
<td>1–5 A</td>
<td>5</td>
<td>5</td>
<td>20 A</td>
<td>20 A</td>
<td>100</td>
<td>100</td>
<td>20 A</td>
<td>100</td>
<td>20 A</td>
</tr>
<tr>
<td>45 mm</td>
<td>4–32 A</td>
<td>5</td>
<td>5</td>
<td>125 A</td>
<td>125 A</td>
<td>100</td>
<td>100</td>
<td>125 A</td>
<td>100</td>
<td>125 A</td>
</tr>
<tr>
<td>45 mm</td>
<td>6–45 A</td>
<td>5</td>
<td>5</td>
<td>175 A</td>
<td>175 A</td>
<td>100</td>
<td>100</td>
<td>175 A</td>
<td>100</td>
<td>175 A</td>
</tr>
<tr>
<td>55 mm</td>
<td>9–72 A</td>
<td>10</td>
<td>10</td>
<td>250 A</td>
<td>250 A</td>
<td>100</td>
<td>100</td>
<td>250 A</td>
<td>100</td>
<td>250 A</td>
</tr>
<tr>
<td>90 mm</td>
<td>11–90 A</td>
<td>10</td>
<td>10</td>
<td>360 A</td>
<td>360 A</td>
<td>100</td>
<td>100</td>
<td>360 A</td>
<td>100</td>
<td>360 A</td>
</tr>
<tr>
<td>90 mm</td>
<td>17–136 A</td>
<td>10</td>
<td>10</td>
<td>400 A</td>
<td>400 A</td>
<td>100</td>
<td>100</td>
<td>400 A</td>
<td>100</td>
<td>400 A</td>
</tr>
</tbody>
</table>

Power Xpert C445 Motor Management Relay Short Circuit Ratings (IEC) ✪

<table>
<thead>
<tr>
<th>Measurement Module Frame</th>
<th>Overload FLA Range</th>
<th>480 V (kA)</th>
<th>690 V (kA)</th>
<th>Max. Fuse Size (A) (gG)</th>
<th>Max. Breaker Size (A)</th>
<th>Fuses (gG)</th>
<th>480 V (kA)</th>
<th>690 V (kA)</th>
<th>Max. Fuse Size (A) (gG)</th>
<th>Max. Breaker Size (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 mm</td>
<td>0.3–2.4 A</td>
<td>1</td>
<td>1</td>
<td>16 A</td>
<td>15 A</td>
<td>N/A</td>
<td>100</td>
<td>100</td>
<td>10 A</td>
<td>N/A</td>
</tr>
<tr>
<td>45 mm</td>
<td>1–5 A</td>
<td>1</td>
<td>1</td>
<td>20 A</td>
<td>20 A</td>
<td>100</td>
<td>100</td>
<td>20 A</td>
<td>100</td>
<td>20 A</td>
</tr>
<tr>
<td>45 mm</td>
<td>4–32 A</td>
<td>3</td>
<td>3</td>
<td>125 A</td>
<td>125 A</td>
<td>100</td>
<td>100</td>
<td>125 A</td>
<td>100</td>
<td>125 A</td>
</tr>
<tr>
<td>45 mm</td>
<td>6–45 A</td>
<td>3</td>
<td>3</td>
<td>200 A</td>
<td>175 A</td>
<td>100</td>
<td>100</td>
<td>175 A</td>
<td>100</td>
<td>175 A</td>
</tr>
<tr>
<td>55 mm</td>
<td>9–72 A</td>
<td>5</td>
<td>5</td>
<td>250 A</td>
<td>250 A</td>
<td>100</td>
<td>100</td>
<td>250 A</td>
<td>100</td>
<td>250 A</td>
</tr>
<tr>
<td>90 mm</td>
<td>11–90 A</td>
<td>5</td>
<td>5</td>
<td>360 A</td>
<td>360 A</td>
<td>100</td>
<td>100</td>
<td>360 A</td>
<td>100</td>
<td>360 A</td>
</tr>
<tr>
<td>90 mm</td>
<td>17–136 A</td>
<td>10</td>
<td>10</td>
<td>400 A</td>
<td>400 A</td>
<td>100</td>
<td>100</td>
<td>400 A</td>
<td>100</td>
<td>400 A</td>
</tr>
</tbody>
</table>

Power Xpert C445 Technical Data and Specifications

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical, Motor/Load Ratings</td>
<td>Operating voltage: 110–690 Vac. 4160 Vac with Potential Transformer (PT) ratios between: 35:1 and 6:1 (PT) ✪</td>
</tr>
<tr>
<td></td>
<td>Trip class: 5–40, selectable in 5 step increments</td>
</tr>
<tr>
<td></td>
<td>Operating current (FLA) range: Varies by measurement module frame. See below.</td>
</tr>
<tr>
<td>45 mm measurement module</td>
<td>0.3–2.4 A; 1.0–5.0 A; 4.0–32.0 A; 6–45 A</td>
</tr>
<tr>
<td>55 mm measurement module</td>
<td>9.0–72.0 A</td>
</tr>
<tr>
<td>90 mm measurement module</td>
<td>11.0–90.0 A; 17.0–136.0 A</td>
</tr>
<tr>
<td>Rated frequency</td>
<td>20–80 Hz ✪</td>
</tr>
<tr>
<td>Application(s)</td>
<td>Single-phase, three-phase</td>
</tr>
<tr>
<td>Accuracy</td>
<td>Current: 2% within 30–125% of FLA; 3% of 500% of FLA</td>
</tr>
<tr>
<td></td>
<td>Voltage: 2% within 110 Vac, 690 Vac. Power: 5%</td>
</tr>
<tr>
<td>Rated supply voltage</td>
<td>120/240 Vac (or) 24 Vdc</td>
</tr>
<tr>
<td>Operating supply voltage range</td>
<td>94–254 Vac (or) 18–30 Vdc</td>
</tr>
<tr>
<td>Overvoltage category</td>
<td>24 Vac = III 120/240 = II</td>
</tr>
<tr>
<td>Maximum power consumption</td>
<td>Less than 8 W—varies by module, see below</td>
</tr>
<tr>
<td>Base control module + measurement module</td>
<td>Less than 5 W</td>
</tr>
<tr>
<td>User interface</td>
<td>Less than 1.5 W</td>
</tr>
<tr>
<td>Communication card</td>
<td>Less than 2 W</td>
</tr>
</tbody>
</table>

Notes

✪ Short circuit protective device (SCP D) sizing per NEC: Max = 400% of FLA under 100 A, 300% of FLA over 100 A.

✪ Published monitoring accuracies are across the frequency range of 47–60 Hz.
### Environmental Ratings

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature (operating)</td>
<td>–40 to 60 °C</td>
</tr>
<tr>
<td>Ambient temperature (storage)</td>
<td>–40 to 85 °C</td>
</tr>
<tr>
<td>Operating humidity (UL991 [HI])</td>
<td>5–95% noncondensing</td>
</tr>
<tr>
<td>Altitude NEMA ICS1</td>
<td>2000 meters (6600 feet)</td>
</tr>
<tr>
<td>Shock IEC 60068-2-27</td>
<td>15 g in any direction for 11 milliseconds, non-operating</td>
</tr>
<tr>
<td>Vibration IEC 60068-2-6</td>
<td>5 g non-operating and 3 g operating in any direction</td>
</tr>
<tr>
<td>Pollution degree per IEC 60947-4-1</td>
<td>3</td>
</tr>
<tr>
<td>Ingress protection</td>
<td>IP20 (Non-operating) / Measurement Module / IP64 (User Interface)</td>
</tr>
<tr>
<td>Mean time between failures (MTBF)</td>
<td>20 years at 50 °C</td>
</tr>
</tbody>
</table>

### Safety

- Thermal overload protection: Per UL 60947-4-1, IEC 60947-4-1
- Binary PTC protection: IEC 60947-8
- Safety integrity level: SIL 1 (reference 50495)

### Electrical / EMC

- Radiated emissions IEC/EN 60947-4-1, Table 15 EN 55011 (CISPR 11) Group 1, Class A: 30–1000 MHz
- Conducted emissions IEC/EN 60947-4-1, Table 14 EN 55011 (CISPR 11) Group 1, Class A: 0.15–30 MHz
- ESD immunity per IEC 61000-4-2: ± 8 kV air, ± 4 kV contact
- Radiated immunity per IEC 61000-4-3: 10 V/m 80–1000 MHz
- Fast transient per IEC 61000-4-4: ± 2 kV power
- Surge per IEC 61000-4-5: ± 1 kV line-to-line, ± 2 kV line-to-ground
- Conducted immunity per IEC 61000-4-6: 10 V, 0.15–80 MHz
- Magnetic field per IEC 61000-4-8: 30 A 50/60 Hz
- Voltage dips per IEC 61000-4-11: Class 2, 110 Vac 60 Hz, 230 Vac 50 Hz
  - 0% during 1/2 cycle
  - 0% during 1 cycle
  - 70% during 25/30 cycles
  - Note: 70% refers to 70% of nominal operating voltage, 0% refers to 0% of operating voltage, 25/30 cycles correlates to 50/60 Hz.

### Output Relay Ratings (Base Control Module)

- Three mono-stable output relays:
  - One Form C (NO/NC): B300 pilot duty on all relays
  - Two Form A (NO): R300 pilot duty on NO relays only
- Rated operating current:
  - 3 A at 120 Vac, 1.5 A at 240 Vac
  - 1.5 A at 24 Vdc, 0.22 A at 125 Vdc, 0.1 A at 250 Vdc
- Utilization category: AC-15, DC-13
5.4 Motor Protection and Monitoring

Overload Relays

Power Xpert C445 Technical Data and Specifications, continued

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input Ratings (Base Control Module)</strong></td>
<td></td>
</tr>
<tr>
<td>Supply voltage</td>
<td>24 Vdc, 120 Vac</td>
</tr>
<tr>
<td>Number of inputs</td>
<td>4</td>
</tr>
<tr>
<td>Type of inputs</td>
<td>Digital</td>
</tr>
<tr>
<td>On-state voltage</td>
<td>15–20 Vdc, 79–132 Vac</td>
</tr>
<tr>
<td>Off-state voltage</td>
<td>0–5 Vdc, 0–30 Vac</td>
</tr>
<tr>
<td>Overvoltage category</td>
<td>III</td>
</tr>
</tbody>
</table>

**Input/Output Terminal Blocks**

Wire capacity: 30–12 AWG (0.4–0.5 Nm)

**Measurement Module Current Pass Through**

<table>
<thead>
<tr>
<th>Measurement module size (current range)</th>
<th>45 mm (0.3–2.4 A)</th>
<th>45 mm (1–5 A)</th>
<th>45 mm (4–32 A)</th>
<th>45 mm (8–45 A)</th>
<th>55 mm (9–72 A)</th>
<th>90 mm (11–90 A)</th>
<th>90 mm (17–136 A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supported conductor</td>
<td>6 AWG</td>
<td>6 AWG</td>
<td>6 AWG</td>
<td>6 AWG</td>
<td>3 AWG</td>
<td>2/0 AWG</td>
<td>2/0 AWG</td>
</tr>
<tr>
<td>EMEA 600 V (mm²)</td>
<td>20 mm²</td>
<td>16 mm²</td>
<td>16 mm²</td>
<td>16 mm²</td>
<td>16 mm²</td>
<td>25 mm²</td>
<td>70 mm²</td>
</tr>
<tr>
<td>Supported conductor</td>
<td>6 AWG</td>
<td>6 AWG</td>
<td>6 AWG</td>
<td>3 AWG</td>
<td>2/0 AWG</td>
<td>2/0 AWG</td>
<td></td>
</tr>
<tr>
<td>EMGA 800 V (mm²)</td>
<td>20 mm²</td>
<td>16 mm²</td>
<td>16 mm²</td>
<td>25 mm²</td>
<td>70 mm²</td>
<td>70 mm²</td>
<td></td>
</tr>
</tbody>
</table>

**Voltage Terminals**

<table>
<thead>
<tr>
<th>Maximum wire capacity (for voltage input terminals)</th>
<th>12–26 AWG solid, 0.13 to 3.31 mm²</th>
</tr>
</thead>
</table>

**PTC Specifications**

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>EN 60947-8/A1:2006 “Mark A Control Unit”</td>
</tr>
<tr>
<td>Compatible thermal detectors</td>
<td>Mark A type (abrupt characteristic change) as described in EN 60947-8/A1:2006 Annex A wired in series</td>
</tr>
<tr>
<td>Terminals</td>
<td>Marked T1 and T2</td>
</tr>
<tr>
<td>Cold resistance</td>
<td>≤1500 ohms</td>
</tr>
<tr>
<td>Measuring voltage</td>
<td>≤2.5 V for resistance ≤1330 ohms, ≤7.5 V for resistance ≤4 kohms, ≤9.0 V open circuit</td>
</tr>
<tr>
<td>Temperature rise response</td>
<td>3800 ohms ±10%</td>
</tr>
<tr>
<td>Over temperature reset</td>
<td>1500 ohms ±10%</td>
</tr>
<tr>
<td>Short-circuit response</td>
<td>Between 10 and 28 ohms</td>
</tr>
<tr>
<td>Short-circuit reset</td>
<td>Between 20 and 40 ohms</td>
</tr>
<tr>
<td>Wire break response</td>
<td>20 k to 40 kohms</td>
</tr>
<tr>
<td>Isolation</td>
<td>$U_{imp} = 4$ kV</td>
</tr>
</tbody>
</table>

**Note**

1. Use only UL Listed or recognized conductors. Copper wire rated 75C for all field wiring terminals and main conductor wiring.
Dimensions

**Power Xpert C445 Motor Management Relay**
Approximate Dimensions in Inches (mm)

**Base Control Module**

Panel Mount Option 1

Panel Mount Option 2

Panel Mount Option 3
5.4 Motor Protection and Monitoring

Overload Relays

Approximate Dimensions in Inches (mm)

**Measurement Module — 45 mm Frame**

Panel Mount Option 1

Panel Mount Option 2

Panel Mount Option 3

Panel Mount Option 4

**Note:** Measurement Module part shown has factory-installed terminals for all measurement options (current, voltage and PTC).
Approximate Dimensions in Inches (mm)

**Measurement Module—55 mm Frame**

**5.4 Motor Protection and Monitoring**

**Overload Relays**

**Note:** Measurement Module part shown has factory-installed terminals for all measurement options (current, voltage and PTC).
5.4 Motor Protection and Monitoring

Overload Relays

Approximate Dimensions in Inches (mm)

Measurement Module—90 mm Frame

**Note:** Measurement Module part shown has factory-installed terminals for all measurement options (current, voltage and PTC).
Approximate Dimensions in Inches (mm)

User Interface—Monitoring Version

Note: Backwards compatible with C4411
Motor Insight display cutout.
5.4 Motor Protection and Monitoring

Overload Relays

Approximate Dimensions in Inches (mm)

User Interface—Control Version

- Width: 3.62 (92.0) inches
- Height: 1.77 (45.0) inches

User Interface Module Cutout

- Width: 3.91 (99.0) inches
- Height: 2.05 (52.0) inches

- User Label 1
- User Label 2
- User Label 3

- Run 1
- Run 2
- Stop
- Status 1
- Status 2
- Status 3

- USB
- Reset
- Auto
- Run 1 Ind
- Run 2 Ind

- Dimensions: 1.24 (32.0) inches x 1.47 (37.0) inches